https://truckmanualshub.com/

SB4391E00
Aug. 2012

DL06 Diesel Engine (interim Tier Ⅳ)

Specification
System Operation
Testing & Adjusting
Disassembly & Assembly

D110S-5, D130S-5, D160S-5

Downloaded from www.Manualslib.com manuals search engine

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

FOREWORD

This Operation & Maintenance Manual is designed to provide the information on engine operation and maintenance manual to customers and service technicians of the **DL06K** industrial electronic control diesel engine provided by DOOSAN.

The **DL06K** industrial electronic control diesel engine is designed and manufactured to satisfy all requirements, such as low noise, economical power consumption, high-speed, and durability by applying DOOSAN's latest technologies in order to provide the best engine to its customers, and meet interim Tier-4 emission regulation.
It is important to use precise operation and maintenance procedures to keep the engine in the best possible condition and ensure the best possible long term performance. This Operation & Maintenance Manual provides the specification, defined values, fault diagnosis, parts configuration diagrams, and figures, that allow users to understand, manage, and take actions conveniently and accurately.

Please read this Operation & Maintenance Manual carefully before handling the engine, to ensure that the highest quality maintenance procedures can be applied and the technician's safety can be protected through the use of proper work methods and operating procedures as recommended by DOOSAN and compiled here within.

We are continually developing and investing in creating products with the best performance and quality, as well as the improvement of maintenance procedures. We are not obliged to reflect all design changes for product improvement in this Operation & Maintenance Manual, and this manual is subject to change without prior notice.

We are always working to satisfy customer requirements and provide more convenient and safe maintenance procedures to its customers.

If you find any incorrect information in this manual or have any inquiry, please contact our head office, dealers or authorized service shops near by your location for any services.

Doosan industrial vehicle Co., Ltd.

* All contents in this Operation & Maintenance Manual are the property of DOOSAN.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

Important Safety Information

Most accidents involving product operation, maintenance and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. A person must be alert to potential hazards. This person should also have the necessary training, skills and tools to perform these functions properly.

Read and understand all safety precautions and warnings before operating or performing lubrication, maintenance and repair on this product.

Basic safety precautions are listed in the “Safety” section of the Service or Technical Manual. Additional safety precautions are listed in the: Safety” section of the owner/operation/maintenance publication. Specific safety warnings for all these publications are provided in the description of operations where hazards exist. WARNING labels have also been put on the product to provide instructions and to identify specific hazards. If these hazard warnings are not heeded, bodily injury or death could occur to you or other persons. Warnings in this publication and on the product labels are identified by the following symbol.

⚠ WARNING

Improper operation, lubrication, maintenance or repair of this product can be dangerous and could result in injury or death.
Do not operate or perform any lubrication, maintenance or repair on this product, until you have read and understood the operation, lubrication, maintenance and repair information.

Operations that may cause product damage are identified by NOTICE labels on the product and in this publication.

DOOSAN cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are therefore not all inclusive. If a tool, procedure, work method or operating technique not specifically recommended by DOOSAN is used, you must satisfy yourself that it is safe for you and others. You should also ensure that the product will not be damaged or made unsafe by the operation, lubrication, maintenance or repair procedures you choose.

The information, specifications, and illustrations in this publication are on the basis of information available at the time it was written. The specifications, torques, pressures, measurements, adjustments, illustrations, and other items can change at any time. These changes can affect the service given to the product. Obtain the complete and most current information before starting any job. DOOSAN dealers have the most current information available.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

INDEX

1. Safety Regulations & Specifications.....8

1.1. Safety Regulations.....8
1.2. Engine Specifications.....13
1.3. Engine Power.....14
1.4. Engine Performance Curve.....15
1.5. Engine Assembly.....17

2. Technical Information.....20

2.1. Engine Model and Serial Number.....20
2.2. Diagnostic tool.....21
2.3. Engine character.....21
2.4. Diagnosis and Remedy.....42
2.5. Engine Inspection.....53

3. Disassembly and Reassembly of Major Components.....54

3.1. Engine Disassembly.....54
3.2. Inspection and Measurement on Major Parts.....69
3.3. Engine Reassembly.....90
3.4. Fuel Injection System.....114
3.5. Electrical System.....126
3.6. Exhaust Gas Reduction System.....133
3.7. Engine Diagnostic.....149
3.8. Operating Condition of the ECU.....161

4. Commissioning and Operation....163

4.1. Preparations.....163
4.2. Breaking-In.....163
4.3. Inspections after Starting.....165
4.4. Operation in Winter Time.....166
4.5. Engine Components Check after Long Time Running.....167
4.6. Maintenance and Care.....168
4.7. Cooling System.....170
4.8. Adjustment of Valve Clearance.....171

5. Maintenance of Major Components 174

5.1. Cooling System.....174
5.2. Lubrication system.....178
5.3. Turbo Charger.....181
5.4. Air cleaner.....193
5.5. Belt.....195

6. Special Tool List.....197

- **Appendix**

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

0. General Instructions

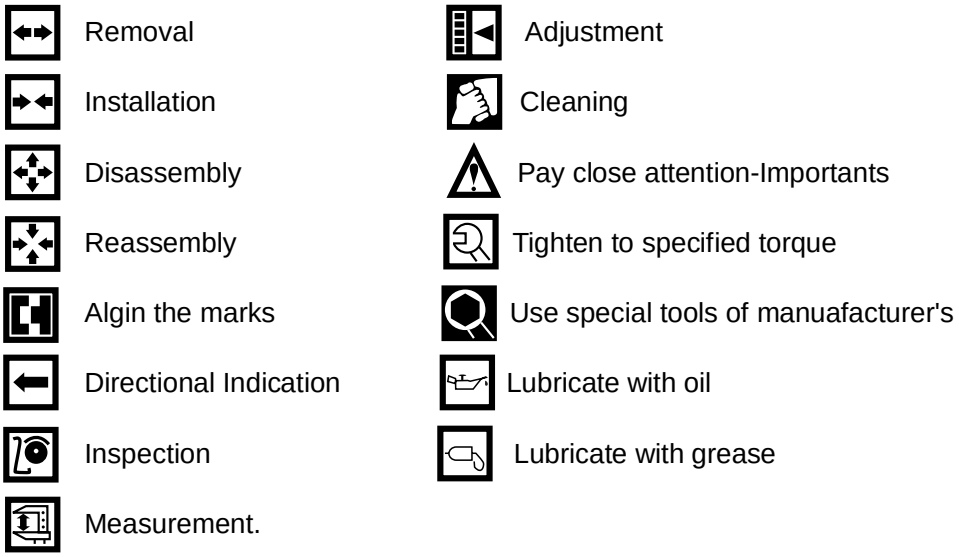
This Operation & Maintenance Manual is a manual designed for officially qualified professional service technicians. If maintenance procedures is performed by unqualified personnel, or without the specified tools and facilities, workers or others may be injured or their life can be threatened, or an error may occur that could fatally affect engine performance.

Regular checkups and management are required to keep the engine in optimal condition and performing at its best. If any part needs to be replaced, the genuine part supplied by DOOSAN and specified in the Parts Book should be used. Use of uncertified, similar parts, or recycled parts may cause serious damage to the engine. If such a part is used, DOOSAN will bear no responsibility.

Please note that the work procedures described in this Operation & Maintenance Manual are the safest and most efficient work procedures, and you may be required to use special tools for some work items.

Please contact us for genuine parts and special tools.

This Operation & Maintenance Manual uses the following symbols to explain maintenance procedures, so that workers can make preparations and understand work items in advance.



Please follow the instructions listed below to prevent environmental pollution during engine maintenance.

- Take old oil to an old oil disposal point only.
- Ensure without fail that oil and diesel fuel will not get into the sea or rivers and canals or the ground.
- Treat undiluted anti-corrosion agents, antifreeze agents, filter element and cartridges as special waste.
- The regulations of the relevant local authorities are to be observed for the disposal of spent coolants and special waste.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

1. Safety Regulations & Specifications.

1.1. Safety Regulations

1.1.1. General notes

- You should read this manual carefully and follow routine and regular check methods to use the engine as safely as possible and minimize problems.
- Safety rules can be divided into three parts - injury to people, damage to property, and pollution. In addition, users must comply with the regulations which apply to each particular engine model, and the regulations regarding its place of use.

IMPORTANT:

If despite all precautions, an accident occurs, in particular through contact with caustic acids, fuel penetrating the skin, scalding from oil, antifreeze being splashed in the eyes etc, consult a doctor immediately.

1.1.2. To prevent accidents with injury to persons

(1) Engine starting and operation

- Please read "Caution" in the manual carefully before starting an engine. If you don't understand anything, please contact Doosan.
- Please attach the "Authorized personnel only" warning sign on the engine for safety, and remind the engine driver that the driver is responsible for safety in the engine room.
- Only authorized personnel should start and run the engine. Unauthorized personnel should not start the engine.
- Do not access the engine parts when the engine is running.
- Do not touch the engine with bare hands while the engine is running, because the engine is hot and dangerous.
- Exhaust fumes are toxic. Check ventilation when the engine is running in an enclosed space.

(2) Maintenance and care

- The engine must be stopped before performing maintenance procedures. If the engine should be maintained during operation, please take additional caution as to the danger of burns or accidents. Refrain from doing maintenance when the engine is running as much as possible. Do not get too close to rotating parts, if maintenance works are inevitable during operation.
- Replace engine oil when it is hot after operation, when the engine is stopped.

Downloaded from www.Manualslib.com manuals search engine

CAUTION:

Do not replace or disassemble pipes or hoses (engine fuel circuit, engine oil circuit, coolant circuit, and compressed air circuit) while the engine is running. Fluid spattering may cause injury.

- Check the amount of oil in the oil pan, and use a container large enough to hold engine oil when replacing it.
- When replacing or replenishing engine coolant, cool down the engine and disassemble the drain plug. The heated coolant may cause burns and safety accident.
- Do not fasten or open pipes or hoses (engine oil circuit, coolant circuit, and compressed air circuit) while the engine is running. Fluid spattering may cause injury.
- Fuel is a highly combustible substance. Do not smoke or use fire around the engine. Refuel the engine only when the engine is stopped.
- Do not mix engine maintenance materials (coolant, engine oil, fuel, battery fluid, etc.) with drinking water containers.
- Follow the instructions of the manufacturer when checking or handling the battery.

CAUTION:

Battery fluid is toxic, corrosive, and explosive. Therefore, the battery should be handled by a specialized technician only.

(3) When carrying out checking, setting and repair work

- Engine maintenance should be performed by authorized personnel only.
- Only tools suitable for the purpose should be used. If a wrench with a worn-out edge is used, safety accidents may occur due to sliding.

- When an engine is lifted by a crane, nobody should stand below it, or pass by it. Please check the safety conditions of the crane first.
- For electric welding, turn off the engine, block the power supply, and remove the vehicle side wire harness connector that is connected to the ECU (electronic control unit).
- Never weld the electric device or ECU, or apply electric or mechanical shock.
- Disconnect the battery ground wire first when working with electric devices. Connect the ground wire again when other work is completed, in order to prevent a short circuit.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

1.1.3. To prevent damage to engine and premature wear

(1) Do not use the engine any purpose other than original design.
For more details, please refer to reference data from sales. Never calibrate the ECU without the approval of DOOSAN.

(2) If any fault is found in the engine, the cause should be found and fixed immediately to prevent serious damages to the engine.

(3) Please use genuine spare and maintenance parts recommended by DOOSAN. DOOSAN will bear no responsibility for damage due to the use of unauthorized parts.

(4) Keep the following points in mind, in addition to the above instructions.

- Use normal and clean diesel fuel only. Do not use bio-diesel. Please refer to the recommendations on fuel. Diesel fuel should not contain any moisture.
- Do not run the engine without lubricant and coolant. Use the service products (engine oil, coolant, and anticorrosion agent) recommended by DOOSAN only.
- Keep the surroundings of the engine clean
- Refer to the recommendations about fuel in the handling manual.
- Maintain the engine at a regular interval, using the engine checklist.
- Do not stop the engine abruptly if the engine is hot. Instead, run the engine in the idle state for 5 minutes without load to reduce engine temperature.
- Do not refill the coolant if the engine is overheated.
- Do not refill engine oil to a level higher than those marked on the level gauge. Keep the maximum allowable slant of the engine during maintenance works.
- Check whether equipment gauges (battery, oil pressure, coolant temperature) work properly (normally).
- Do not run the engine without coolant. If coolant freezing is expected in winter, drain off coolant.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

1.1.4. To prevent pollution

(1) Engine oil filter elements, fuel filters

- Pour used oil into the oil collection drum.
- Pay special attention not to spill oil on the ground or into the ocean. Leaked oil can pollute sources of drinking water.
- Separate oil and oil filter cartridge as wastes of environmental pollution, and dispose them according to the prescribed regulations.

(2) Coolant

- Treat non-diluted anticorrosive agents and coolants as dangerous waste.
- Comply with the relevant regulations of the related government office, when disposing used coolant.

1.1.5. Notes on safety in handling used engine oil

If the skin is in contact with engine oil repetitively or for a long period of time, the skin can contract or gets dry, and become inflamed.

As used engine oil contains hazardous substances, follow basic safety rules at the work site when handling engine oil.

< Cautions for your health >



- Do not touch used engine oil repetitively or for a long time.
- Apply skin protection cream or wear gloves.
- Clean the skin if contacted with engine oil.
- Use soap and water when washing your skin.
- Do not use gasoline, diesel fuel, thinner, or solvent as an abstergent.
- Apply an oily cream to your skin after washing your skin.
- Replace your clothes or shoes if they have been soaked with oil.
- Do not put oil-stained rags into your pocket.

Downloaded from www.Manualslib.com manuals search engine

CAUTION:

Please check whether used engine oil is processed properly.
Wrongly processed engine oil can contaminate drinking water.

Therefore, do not pour out engine oil on the ground, waterway, drain, or sewer. You may be punished if you don't obey these handling regulations. Be careful when disposing engine oil. Please contact the seller, supplier, or related agency, regarding engine oil collection methods.

1.1.6. General repair instructions



1. Disconnect the battery ground wire first for maintenance, in order to prevent wire damage due to a short circuit.
2. Use the cover not to damage or pollute disassembled parts.
3. Handle engine oil and coolant with care, as they can do damage to paintings.
4. It is recommended to use the proper tools and special tools for maintenance of the specified parts, considering efficiency and reliability of the maintenance work.
5. Make sure to use the genuine Doosan replacement parts.
6. Use the new cotter pin, gasket, O-ring, sealing, oil seal, lock washer, and self lock nut when maintaining these parts. If you use the existing parts without change, normal function cannot be maintained.
7. Keep disassembled parts by group for smooth reassembly. In particular, bolts and nuts with different strength and shape are used, depending on the assembly position. Therefore, you should separate bolts and nuts clearly.
8. Clean all parts before inspection or re-assembly. In addition, clean the oil hole using compressed air to prevent the presence of foreign objects.
9. Spray oil or grease on the rotation or sliding part thinly before assembly.
10. If necessary, apply adhesives to the gasket to prevent an oil or water leak.
11. Assemble parts, using pre-defined bolts and net fastening torque.
12. Please check the engine again, when maintenance is completed.
13. Check common rail pressures and engine temperature using the laptop diagnosis device before working with fuel lines, and start work 5 minutes after the engine has stopped.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

1.2. Engine Specifications

Items \ Engine model		DL06K
		LDF00/LDF01
Engine type		Water-cooled, 4 cycle, In-line, Turbo charged & inter-cooled
Combustion chamber type		Direct injection type
Cylinder liner type		Replaceable dry liner
Timing gear system		Gear driven type
No. of piston ring		2 compression ring, 1 oil ring
No. of cylinder-bore x stroke (mm)		6 – 100 ×125
Total piston displacement (cc)		5,890
Compression ratio		17.4 : 1
Engine dimension (length x width x height) (mm)		1,264 x 848 x 1,124
weight (kg)		644
Rotating direction (from flywheel)		Counter clockwise
Firing order		1 – 5 – 3 – 6 – 2 - 4
Fuel high pressure pump type		Bosch CP3.3 fuel high pressure pump type
Engine control type		Electric control type (ECU)
Injector type		Multiple hole type
Fuel injection operating pressure (bar)		1,800
Valve clearance (cold) (mm)	Intake valve	0.3
	Exhaust valve	0.4
Intake valve	Open at	21° (B.T.D.C)
	Close at	33° (A.B.D.C)
Exhaust valve	Open at	56.2° (B.B.D.C)
	Close at	22.2° (A.T.D.C)
Fuel filter type		Current type (cartridge type)
Oil pressure (kg/cm^2)	At idle speed	1.5 or more
	At rated speed	3.0 ~ 6.0
Using lubrication oil		SAE 15W40 (over API CJ-4 or ACEA-E9 class)
Lubrication method		Full forced pressure feed type
Oil pump type		Gear type driven by crankshaft
Oil filter type		Cartridge type
Lubricating oil capacity (max./min.) [1](lit)		27 / 17
Oil cooler type		Water cooled
Oil pressure indicator		Hydraulic indicator
Water pump		Belt-driven centrifugal type
Cooling method		Pressurized circulation
Oil separator		OCV
Cooling water capacity (engine only) (lit)		13

[1] With 2.0 liters in the engine

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

Items \ Engine model		DL06K
		LDF00/LDF01
Thermostat	Type	Wax pallet type
	Open at (°C)	75
	Open wide at (°C)	90
	Valve lift (mm)	9.5
Water temperature indicator		Water temperature sensor mounted
Turbo charger		Exhaust gas driven type
Engine stop system		Fuel feeding shut-off by ECU
Alternator (voltage – capacity) (V–A)		24 - 50
Starting motor(voltage–output) (V–kW)		24 – 4.5
Air heater (V–A)		24 – 2.1

1.3. Engine Power

tolerance : ±5%

Engine model		Performance[1)]			
Model	Suffix	Power (PS / rpm)	Torque (kg.m / rpm)	Low idle (rpm)	High idle (rpm)
DL06K	LDF00	140/2,100	65/1,400	850±10	2,400±25
	LDF01	160/2,100	74/1,400	850±10	2,400±25

* Note1) : All data are based on operation without cooling fan.

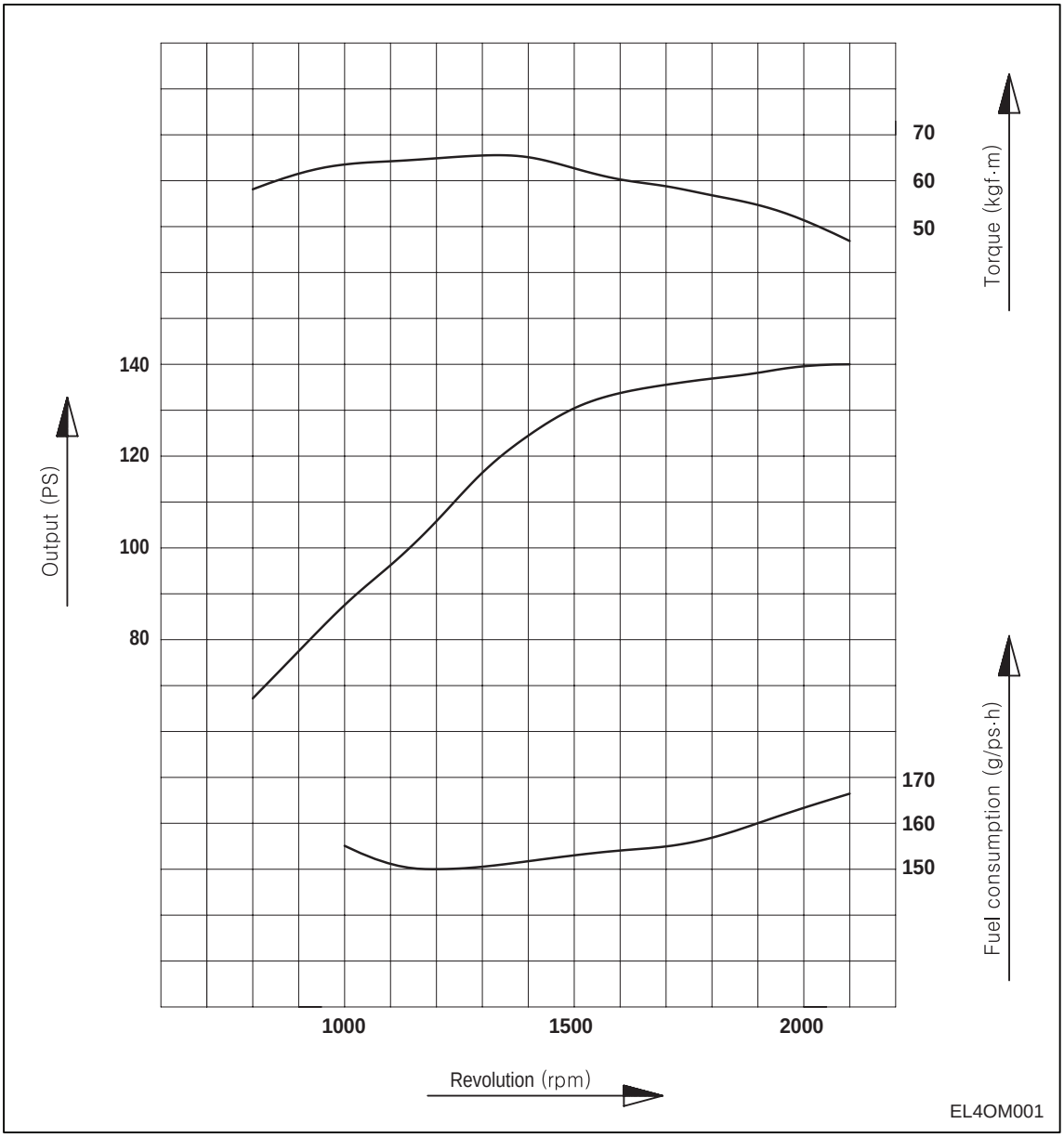
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

1.4. Engine Performance Curve

1.4.1. Performance curve

DL06 – LDF00

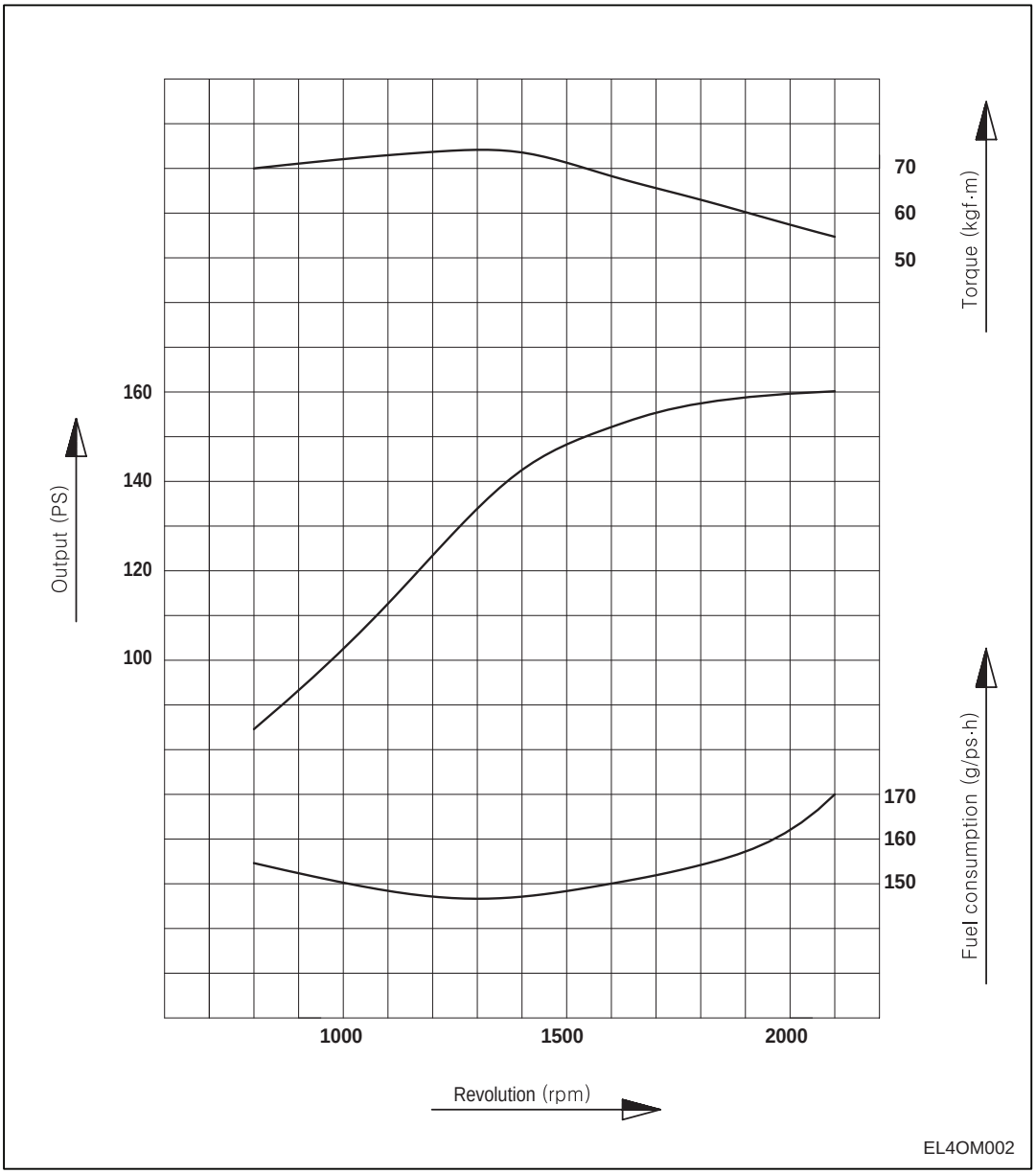


Performance		KS-R 1004
Output	(rating)	140 PS / 2,100 rpm
Torque	(max)	65 kgf·m / 1,400 rpm

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

DL06 – LDF01



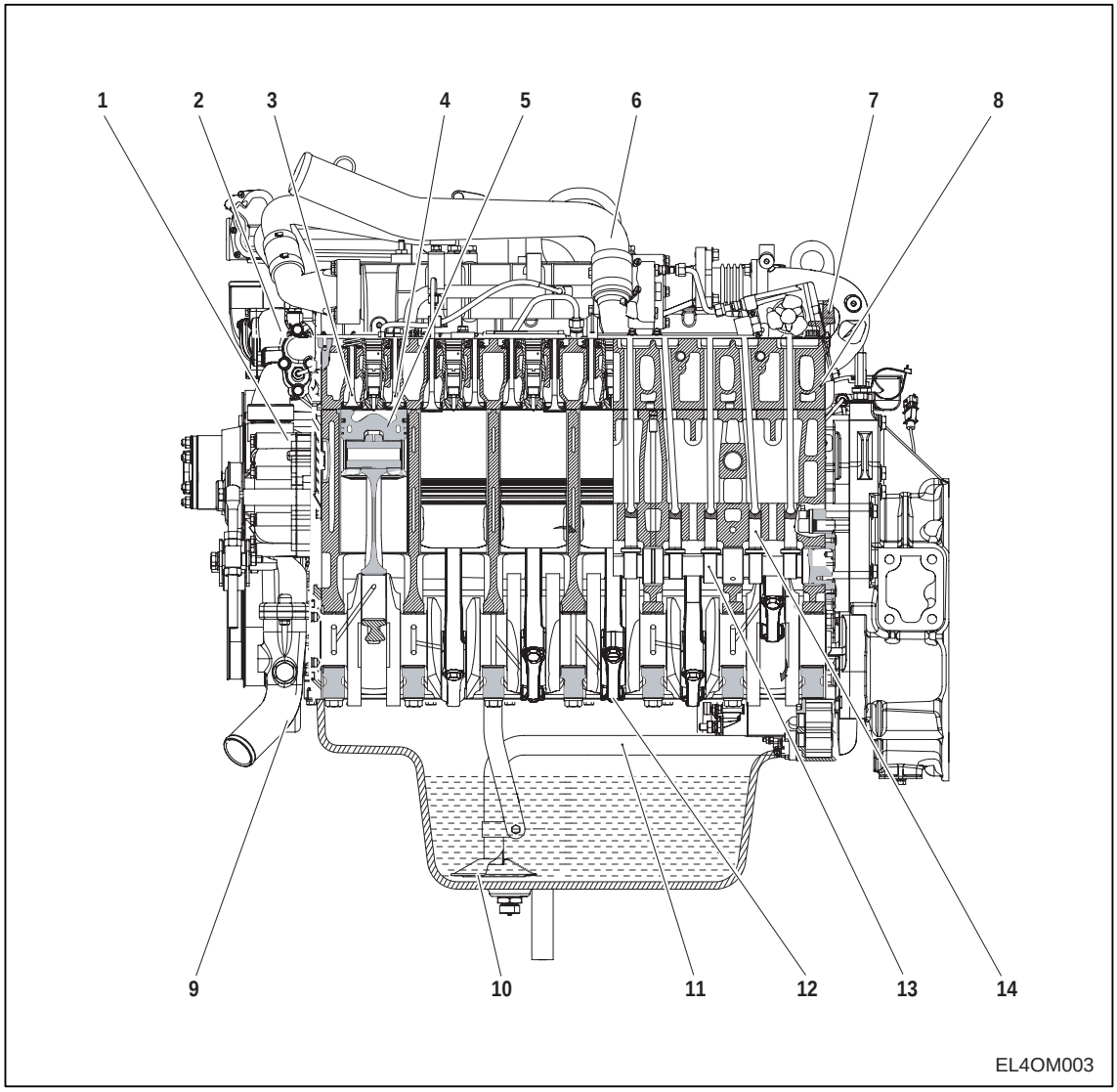
Performance		KS-R 1004
Output	(rating)	160PS / 2,100 rpm
Torque	(max)	74 kgf·m / 1,400 rpm

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

1.5. Engine Assembly

1.5.1. Sectional drawing

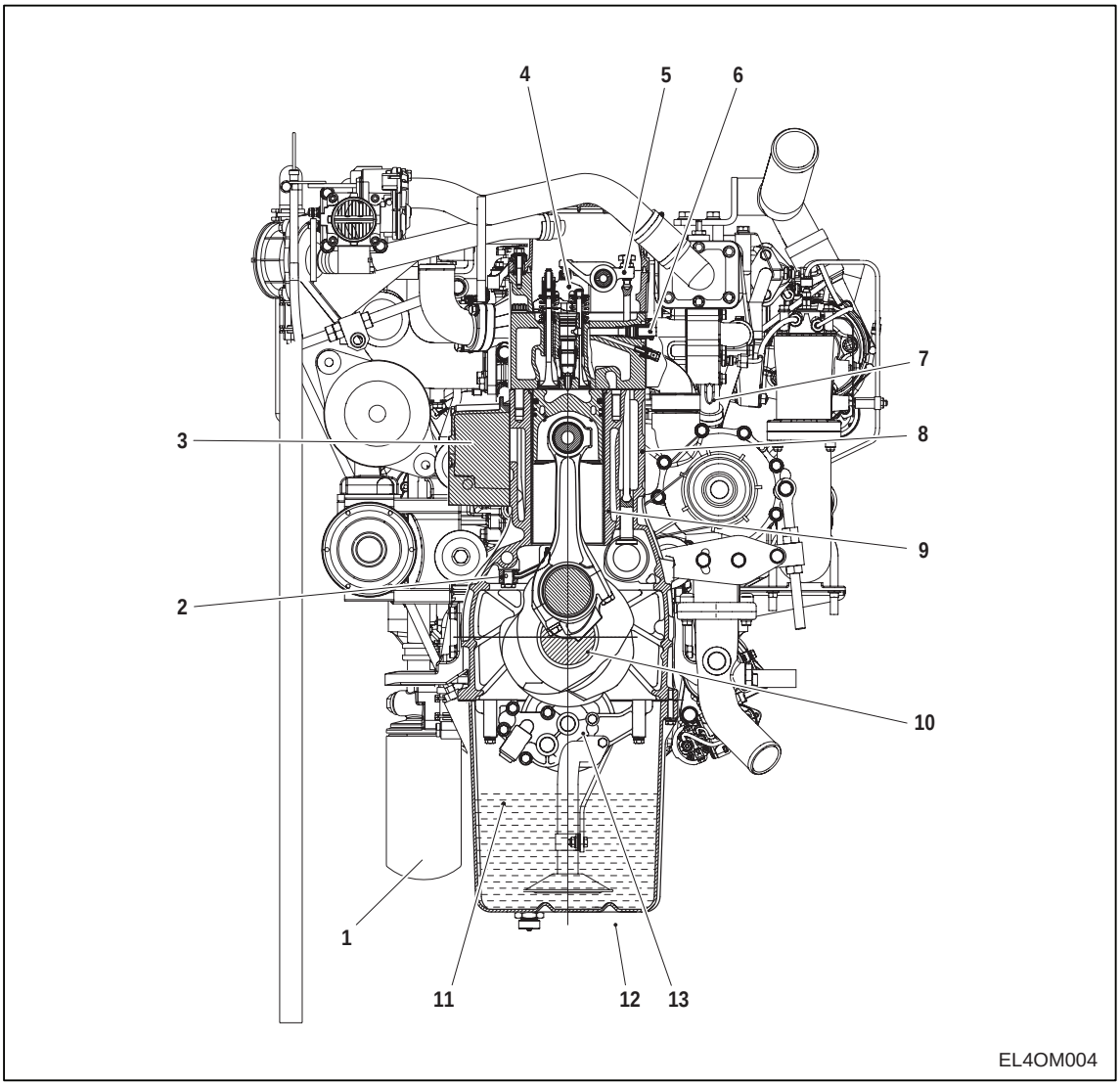


1	Cooling water pump	8	Cylinder head
2	Thermostat	9	Vibration damper
3	Exhaust valve	10	Oil pan
4	Intake valve	11	Oil suction pipe
5	Piston	12	Connecting rod
6	Cylinder head cover	13	Camshaft
7	Intermediate cover	14	Tappet

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

1.5.2. Sectional drawing



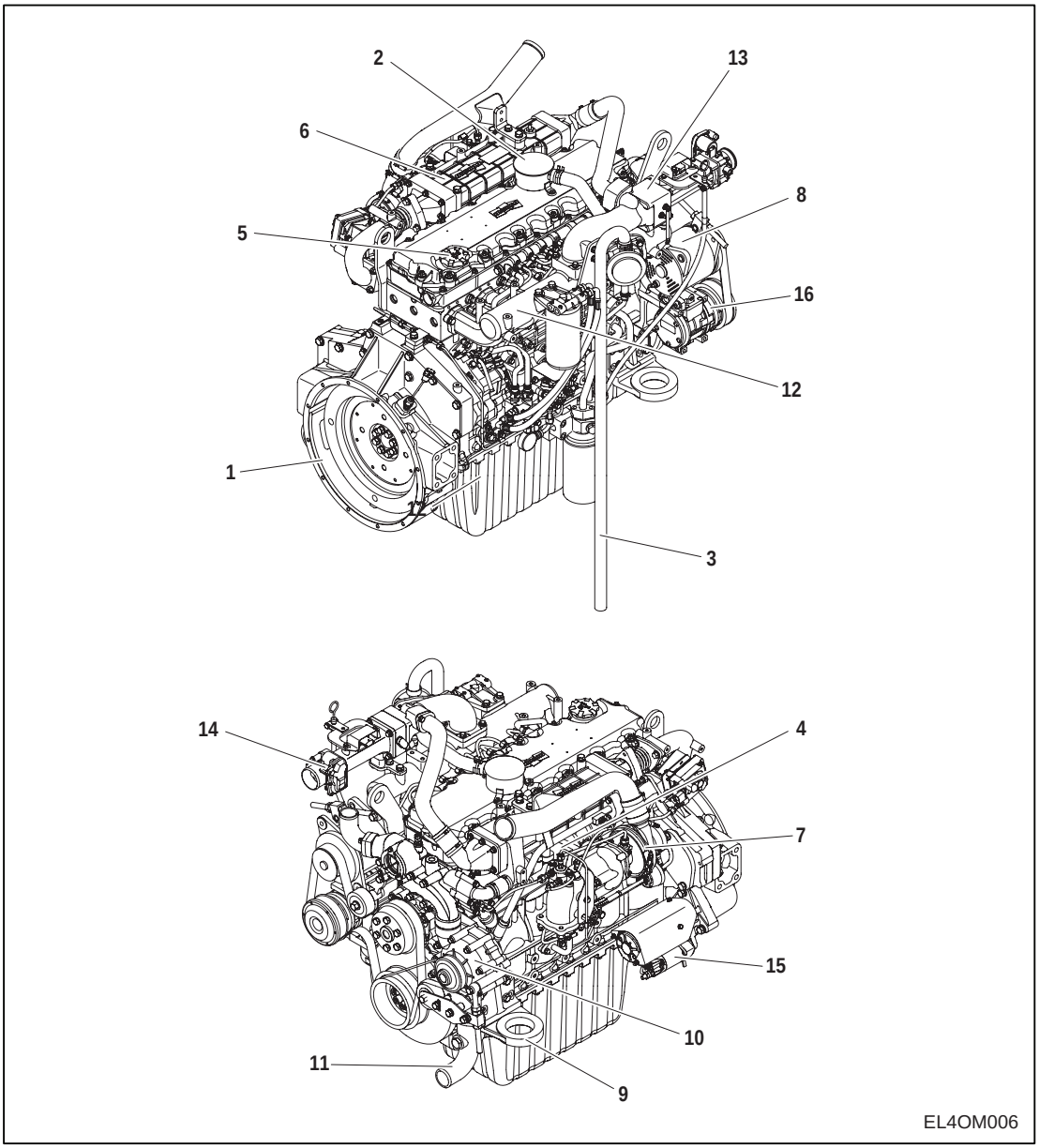
1	Fuel filter	8	Cylinder block
2	Oil spray nozzle	9	Cylinder liner
3	Oil cooler	10	Crankshaft
4	Caliper	11	Oil level gauge
5	Rocker arm	12	Oil drain valve
6	Fuel high pressure connector	13	Oil pump
7	Fuel high pressure pipe		

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

1.5.3. Engine assembly

(1) DL06K



1	Flywheel housing	9	Mounting bracket
2	Breather	10	Cooling water pump
3	Breather pipe	11	Water outlet pipe
4	Exhaust manifold	12	Intake manifold
5	Oil filter cap	13	Air heater
6	EGR cooler	14	Throttle valve
7	Turbo charger	15	Starting motor
8	Alternator	16	Air compressor

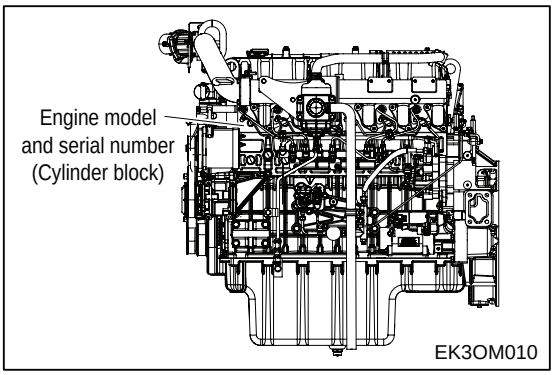
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

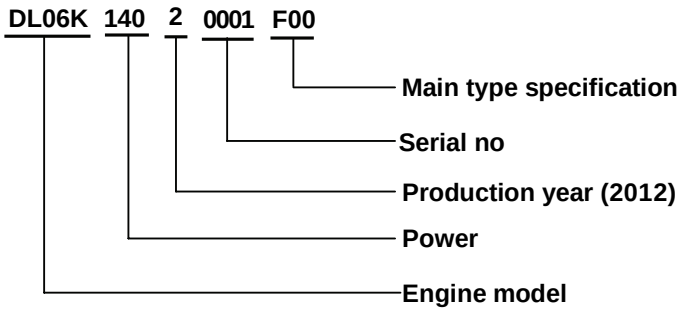
2. Technical Information

2.1. Engine Model and Serial Number

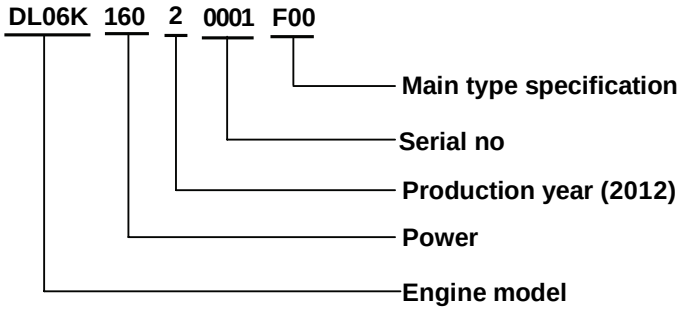
- You can find the engine model and serial number at the market position in the figure.
  The serial number is required for the warranty or parts ordering.



- **Engine serial No. (Example 1 : DL06-LDF00)**



- **Engine serial No. (Example 2 : DL06-LDF01)**

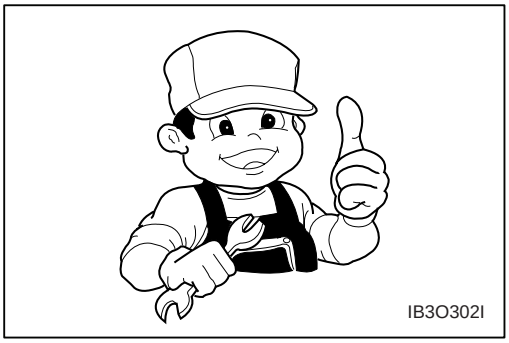


Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

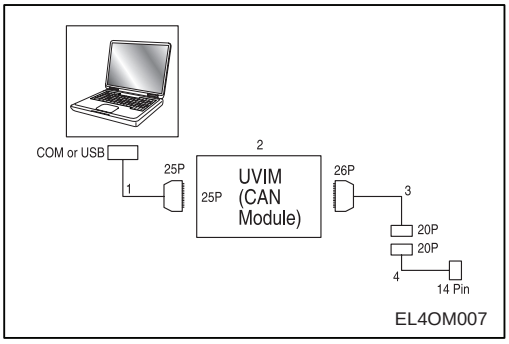
2.2. Diagnostic tool

- Electrical problems in vehicles mounted with the DL06K engine can be checked conveniently, using a laptop computer.



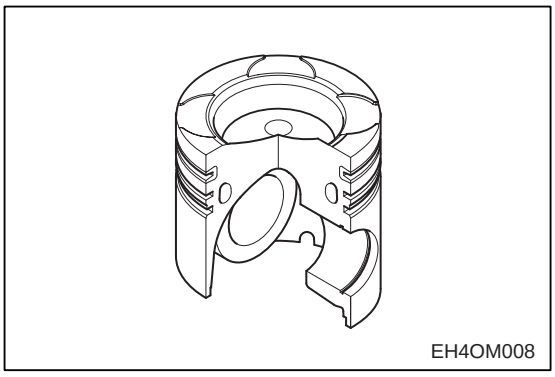
1) Diagnostic by laptop computer

- Please see the Fault Diagnosis Device Manual for more details on how to use a fault diagnosis device.



2.3. Engine character

- DL06K diesel engine adopts the overhead valve and turbo charger. DL06K is an air cooling ECU engine.
- High pressure fuel processed by the high pressure fuel pump is saved in the common rail. When the driver operates the vehicle, the optimal fuel amount and fuel spray timings are determined, based on the data set in the ECU, according to the vehicle speed and operating conditions. Then, the solenoid valve of the injector, which is installed for each engine cylinder, is activated and fuel is sprayed into the cylinder.
- The oil gallery cooling method is used to cool down the engine piston. For piston gallery cooling, the gallery shape, nozzle shape, and nozzle position and oil flow amount are important in reducing the temperature. The sectional shape of the piston gallery is designed to obtain maximum cooling efficiency by making the oil flow effective.



Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

2.3.1. Cylinder block

- The cylinder block is made of single alloy cast iron, and put under the crankshaft axis line to increase strength. In addition, the cylinder liner can be replaced with a dry one. The cylinder head is built-in.

2.3.2. Piston, connecting rod, crankshaft

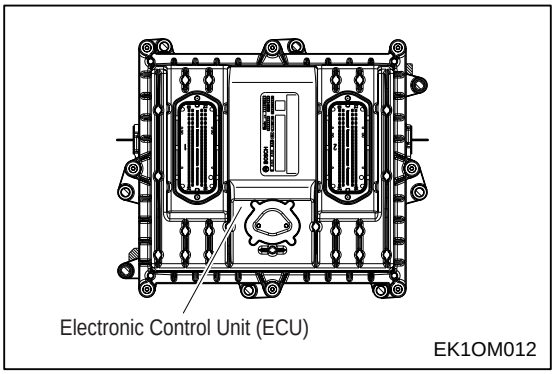
- The cylinder block is made of single alloy cast iron, and put under the crankshaft axis line to increase strength. In addition, the cylinder liner can be replaced with a dry one. The cylinder head is built-in.
- The connecting rod is a forging product, and the big end is separated diagonally, and can be disassembled through the upper side of the cylinder like a piston. The assembly type alloy bearing is used for the operating part of the crankshaft and connecting rod.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

2.3.3. Electric control unit : ECU

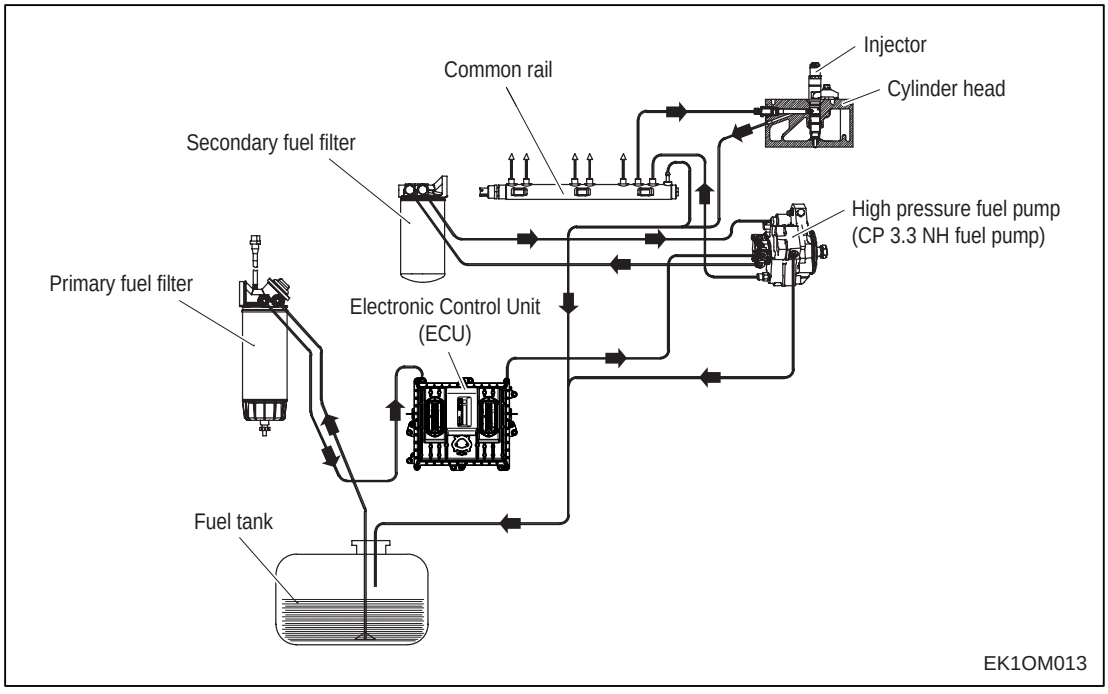
- The ECU is used to supply fuel.
- The ECU is connected to various types of sensors, and controls the engine with the value set in these sensors for optimal operation.



CAUTION:
Make sure to disconnect the ground wire of the battery cable before removing the connector of the ECU. Never disassemble the ECU.

2.3.4. Fuel injection system

- High pressure fuel processed by the high pressure fuel pump is saved in the common rail, and spraying and fuel amount are calculated, based on the data programmed in the ECU. At this time, the ECU activates the solenoid valve of the injector, which is installed for each engine cylinder, to spray fuel into the cylinder.



2.3.5. Bleeding the fuel system

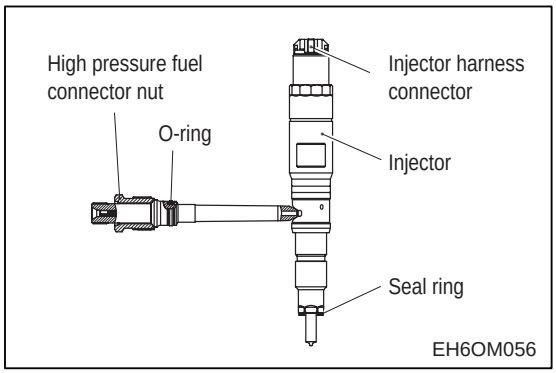
- To expel air from the fuel line, loosen the fuel supply pipe from the secondary fuel filter to the fuel high pressure pump, and activate the priming pump manually of the primary fuel filter until no bubble is found.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

2.3.6. Injector and high pressure connector

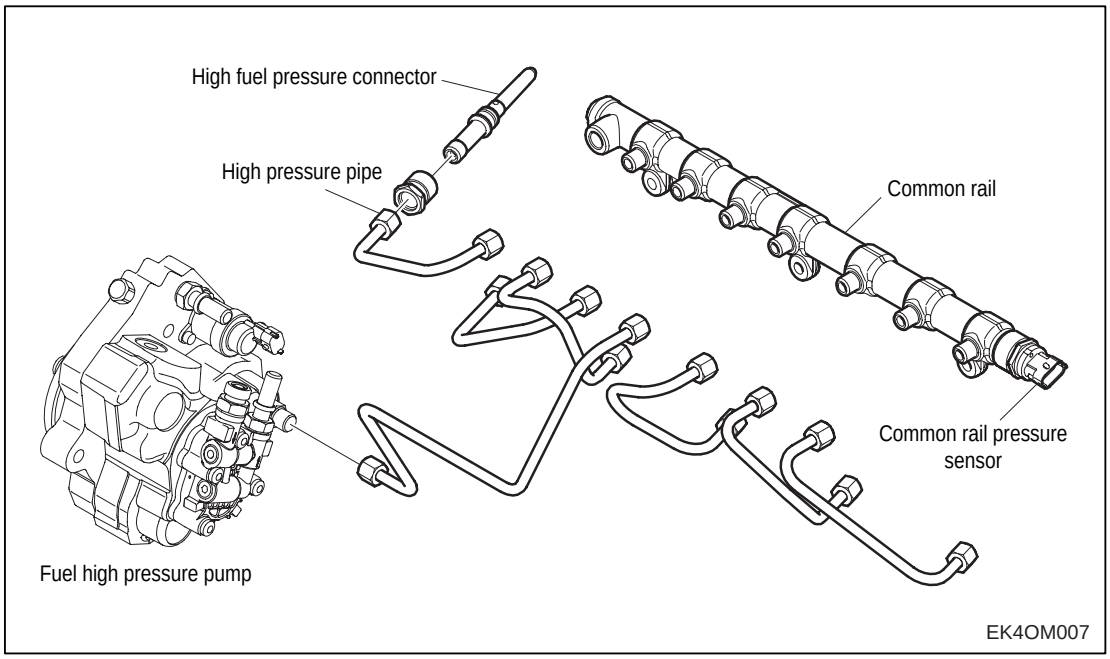
- Be careful not to put any foreign objects inside the injector and high pressure connector when performing disassembly maintenance.
- O-rings and cooper washers should be replaced with new one, when reassembling the engine.
- Spray oil before assembling O-Ring parts.



- Check the model number of the replacing part first before assembly.

2.3.7. Common rail system

- Pressure generation and fuel injection are completely decoupled from each other in the “Common Rail” fuel injection system. The injection pressure is generated independent of engine speed and injected fuel quantity stored in the ECU.

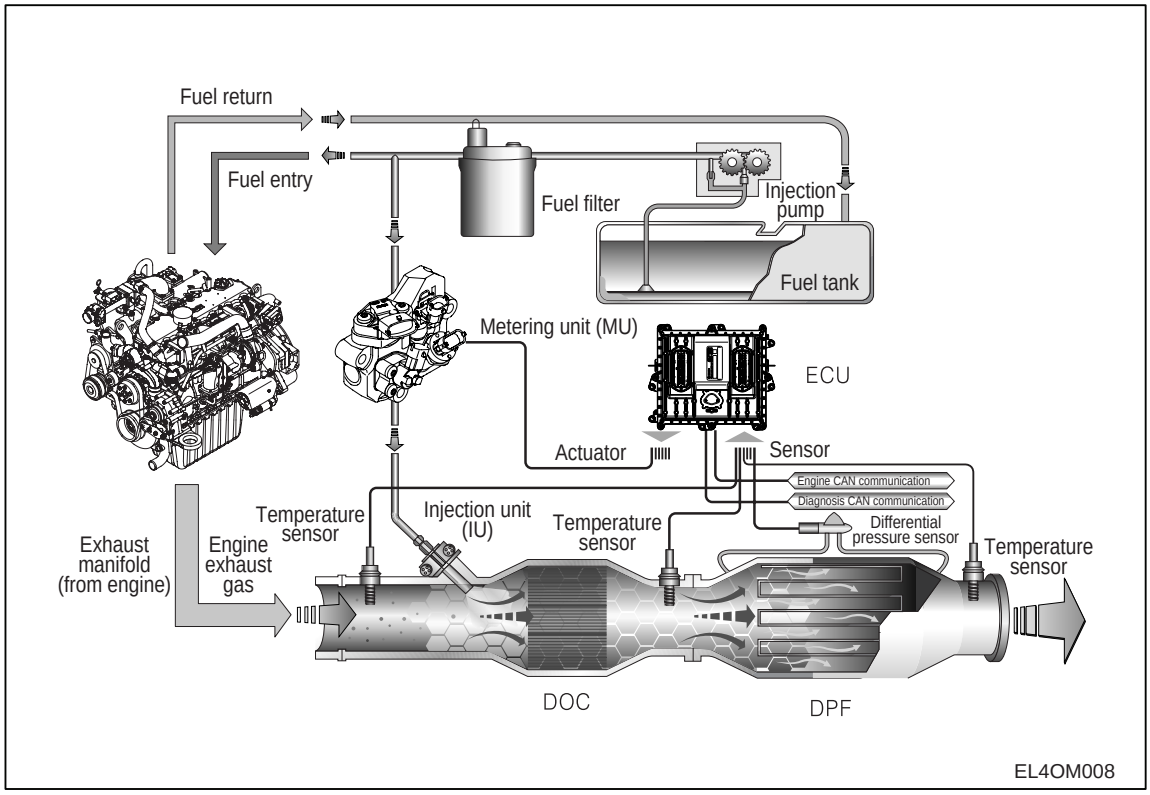


Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

2.3.8. Emission reduction system

- Tier4 Interim DL06K engine has both oxidation catalyst system and exhaust reduction system as an emission reduction system.
- Operating principle : The oxidation catalyst system reduces HC and CO in exhaust gas and induces DBF temperature increase during HC injection to regenerate exhaust particles in DPF and reduce exhaust. DPF (Diesel Particulate Filter) collects harmful particles in diesel exhaust to prevent emission to the air, and regenerate the collected particles by burning them to reuse the filter.

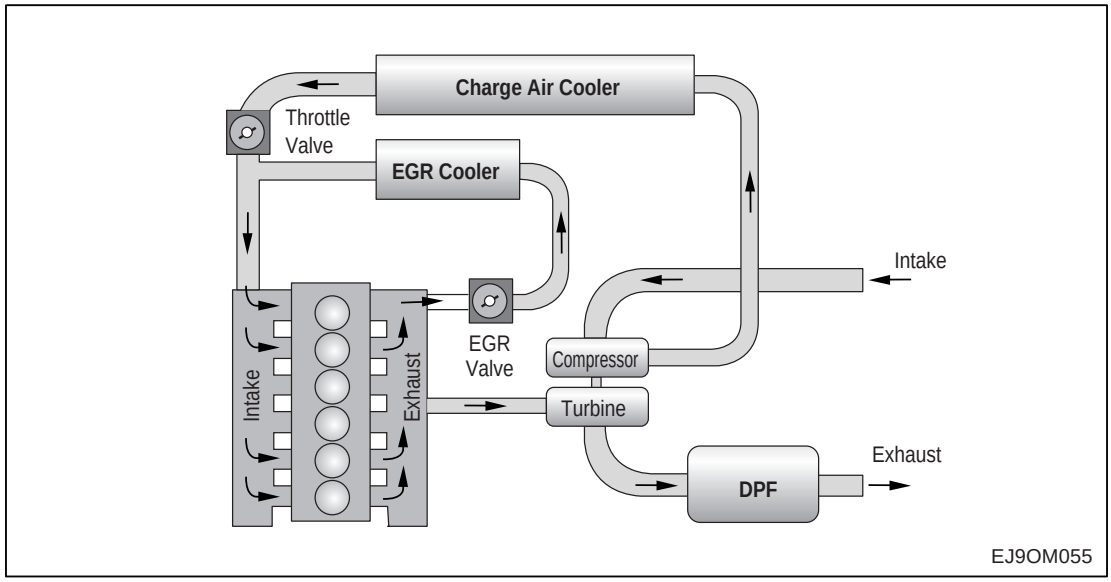


Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

2.3.9. Exhaust gas recirculation (EGR)

- To reduce exhaust gas, the EGR (Exhaust Gas Recirculation) circulates some of exhaust gas combusted in the engine to the intake side, and supplies it to the engine after cooling for re-combustion to reduce NOx emission amount.
- Operating principle : To reduce NOx exhaust gas amount emitted from the engine, the exhaust gas that contains almost no oxygen is circulated to the intake side, so that concentration of oxygen supplied to the engine can be reduced for the reduction of NOx emission by inducing low-temperature combustion.
  When EGR is applied, combustion is normal because of its characteristics. Therefore, the NOx and PM generation amount increases during combustion. To resolve this problem, both DPF and EGR are applied, and the EGR cooler is used to reduce NOx generation (by reducing the temperature of high-pressure exhaust gas) and improve engine combustion efficiency.

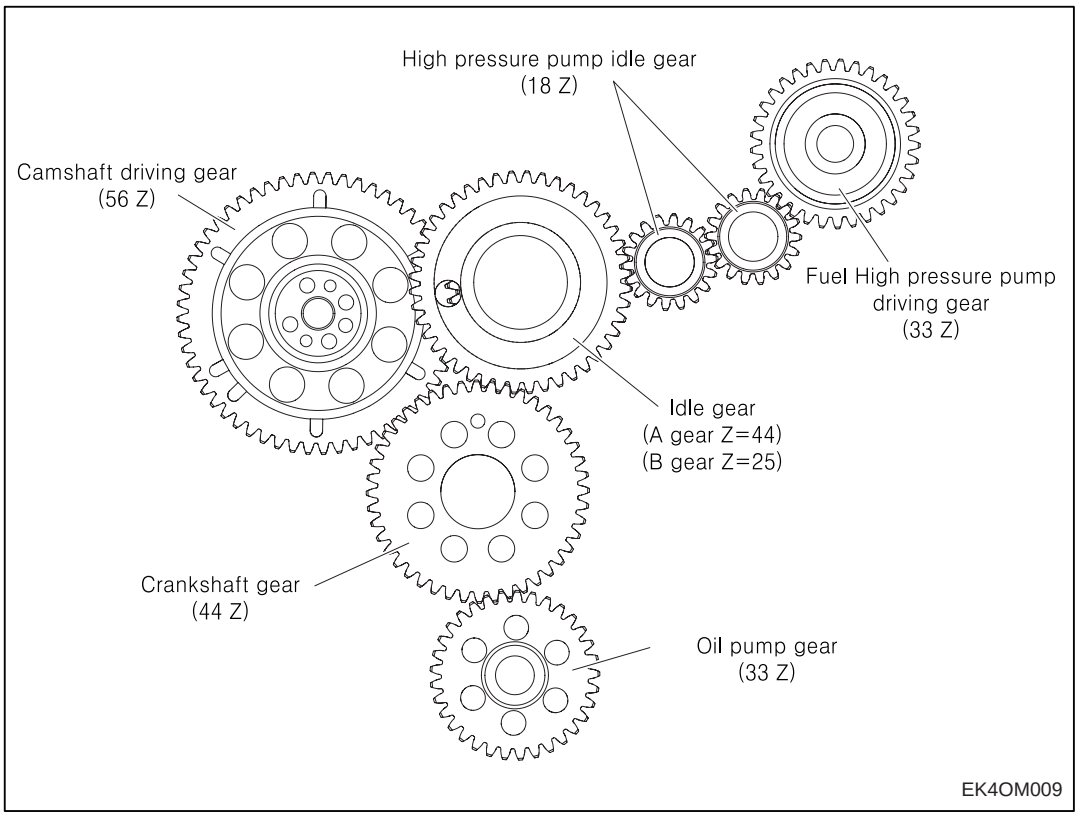


Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

2.3.10. Engine timing

- Camshaft, oil pump, fuel high pressure pump are driven by gear connection inside the engine flywheel housing.



2.3.11. Valve

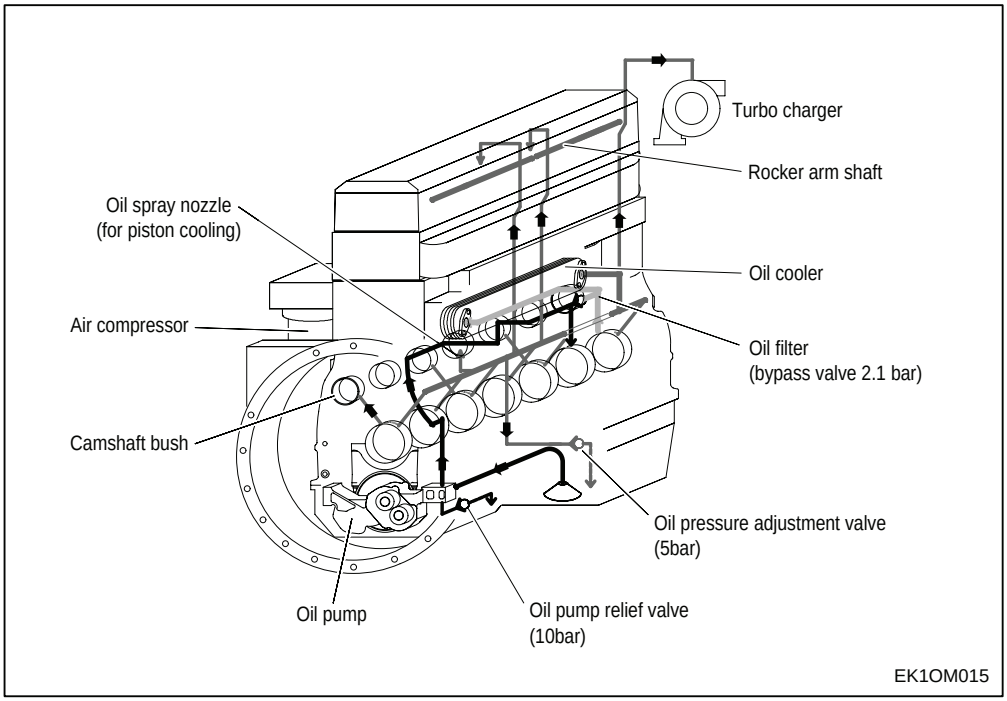
- The overhead valve is operated by the valve tappet, push rod, and rocker arm on the camshaft.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

2.3.12. Lubrication system

- The engine runs with the forced lubrication system. Oil pressure is generated and supplied by gear revolution of the oil pump, which is meshed directly with the crankshaft located at the rear side of the cylinder block.
- The oil pump sends oil sucked by the oil pan with the intake pipe via the oil filter and oil cooler. Then, oil is supplied to the crankshaft bearing, camshaft bearing, and rocker arm for lubrication. In addition, the turbo charger is also connected to the engine lubricant circuit, and supplies oil for engine break operation.
- Lubricant is sprayed around cylinder blocks and timing gears. Each cylinder has the oil injection nozzle to cool down the inside of the piston. Engine oil is cleaned by passing through the oil filter.



2.3.13. Engine oil

- Check the oil amount with an oil level gauge, and refill oil, if necessary. Check the oil level after stopping the engine. If the engine was running, measure the oil level after 5 ~ 10 minutes, so that oil is returned to the crank case. The oil level should be between upper and lower limit of the gauge.
- Engine oil should be replaced regularly, and the oil filter cartridge should be replaced at the same time.

- First oil change

First oil change	After 50 Hr operating
Excavator, fork lift	Every 500Hours

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

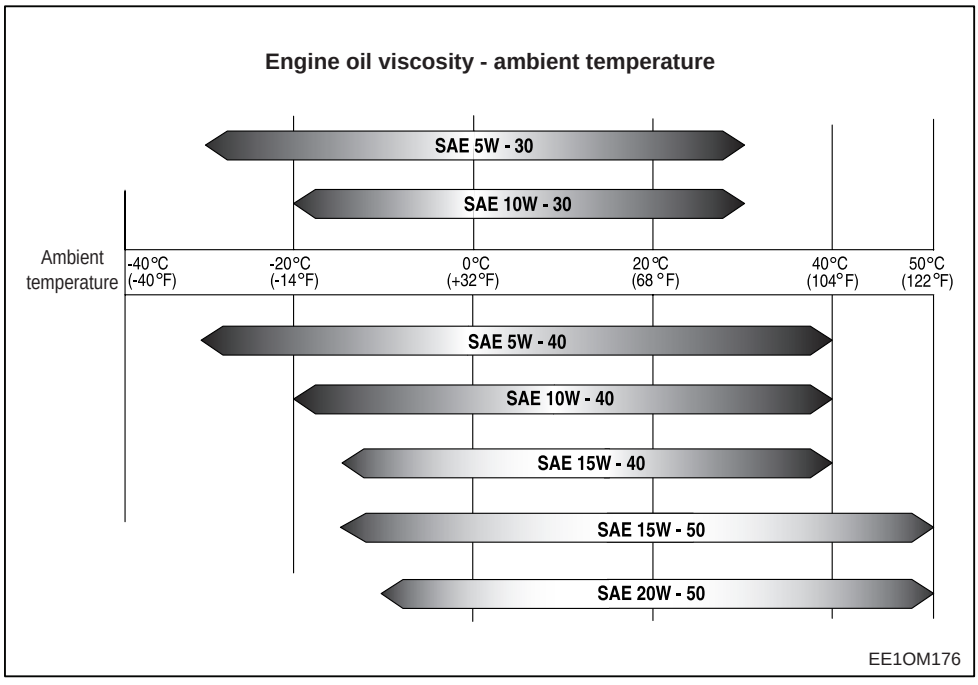
- The following oils are also recommended.

Engine oil		SAE No.	API No.	Manufacture Enterprise
DL06K	Genuine oil	SAE 15W40	ACEA-E5 (API CI-4)	Kixx DX Euro
	Recommended oil	SAE 15W40	ACEA-E5 (API CI-4)	SK : ZIC XQ5000 Shell : Rimula R4L 15W40

- Engine oil capacity

Engine oil capacity				
Engine model	Product Code	Oil pan inside		Total[1] (lit)
		Max (lit)	Min (lit)	
Fork lift	LDF00/01	27	17	29

[1] Including 2.0 liter in the engine

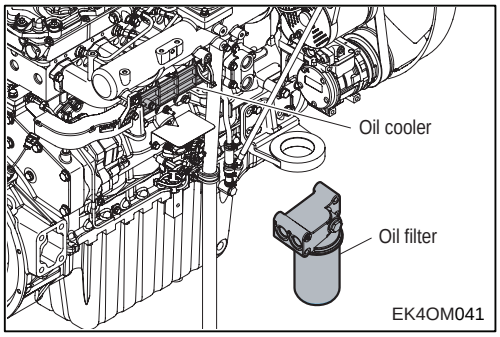


Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

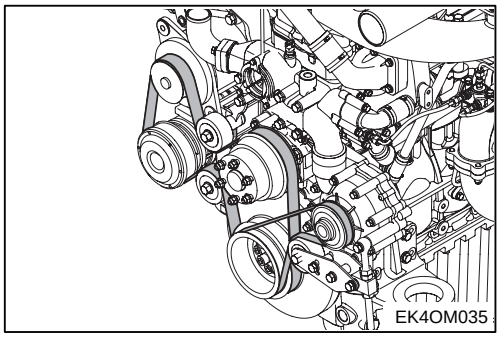
2.3.14. Oil filter & cooler

- The oil cooler is composed of flat tubes and cooled down by cooling water.
- Check oil pressure and oil leak, and repair or replace the oil filter, if necessary.
- Replace the oil filter cartridge each time you replace engine oil.



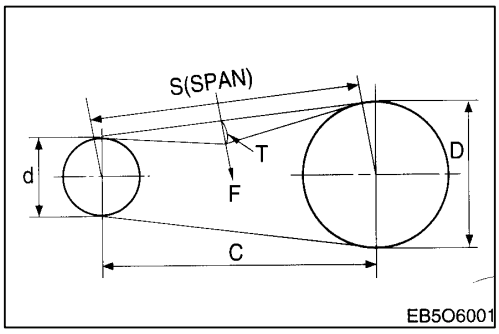
2.3.15. Fan belt

- Use the best quality fan belt. Replace with new one if the fan belt is damaged or worn-out.
- Check belt tension to see if the tension value is appropriate.



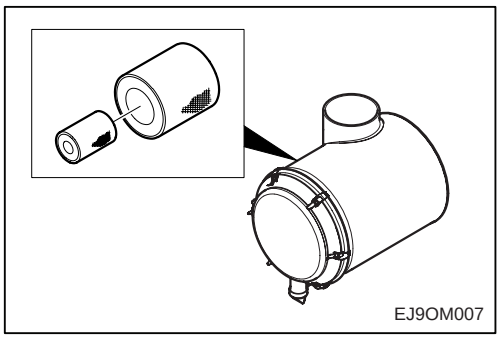
- Adjust the tension of poly belt when pressed down with specified force (F kg@picture) :

  (T) = 0.015 x S
  (Deflection : 1.5 mm per 100 mm)



2.3.16. Air cleaner

- Replace the air filter element, if it is deformed, damaged, or cracked. (Use the best quality element.)
- The element should be cleaned and replaced at regular intervals.

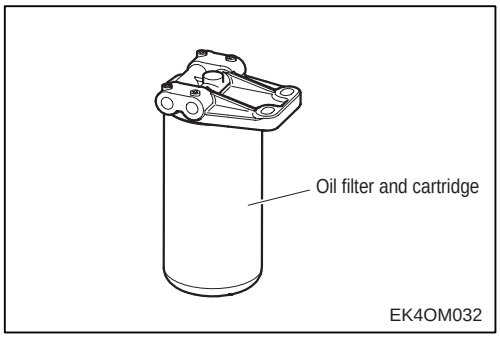


Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

2.3.17. Fuel filter

- Replace the oil filter cartridge every 500 hours.



2.3.18. Recommended fuel

The fuel quality is very important for satisfactory engine performance, engine life extension, and complying with the allowable exhaust gas level. Doosan engines are designed to use diesel fuel sold in the market.

Please use proper fuel by referring to the following fuel selection table, in order to obtain the optimal engine performance.

- Ultra low sulfur diesel

Fuel components		Standard value
Specific gravity (kg/lit)		0.820 ~ 0.845
Ignition point (°C)		40 or more
Kinematic viscosity (40 °C) (cSt)		1.9 ~ 5.5
Sulfur content (wt ppm)		Under 15
Cloud point (°C)		-
Pour point (°C)		Under -17.5
Low temperature filter blocking temperature (°C)		Under -16
Color (ASTM)		Under 2.5
Carbon residue (10%) distillation residue (wt) (%)		Under 0.15
Total acid number (mg KOH/g)		Under 0.40
Plate corrosion rate (100 °C, 3 hours)		Under 1
Ash content (mass %)		Under 0.01
Moisture and precipitate (vol. %)		Under 0.02
Cetane index		45 or more
Distillation experiment temperature (°C)	50% distillation point	-
	90% distillation point	Under 360

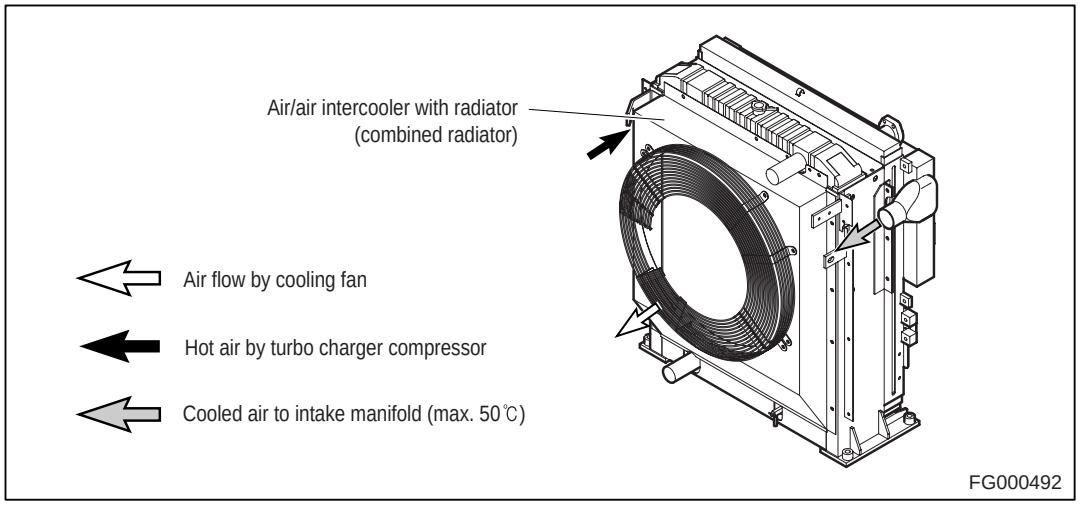
Note) The fuel specification is based on ultra low sulfur diesel provide by SK.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

2.3.19. Inter cooler

- The air cooling method is used for the inter cooler, and the sufficient cooling capacity is provided.
  The life and performance of the inter cooler heavily depends on the intake air conditions.
- Dirty air pollutes and blocks inter cooler fins. As a result, it drops the engine output and cause engine failure.
  Therefore, you should always check whether the air filter in the intake system is damaged or polluted.

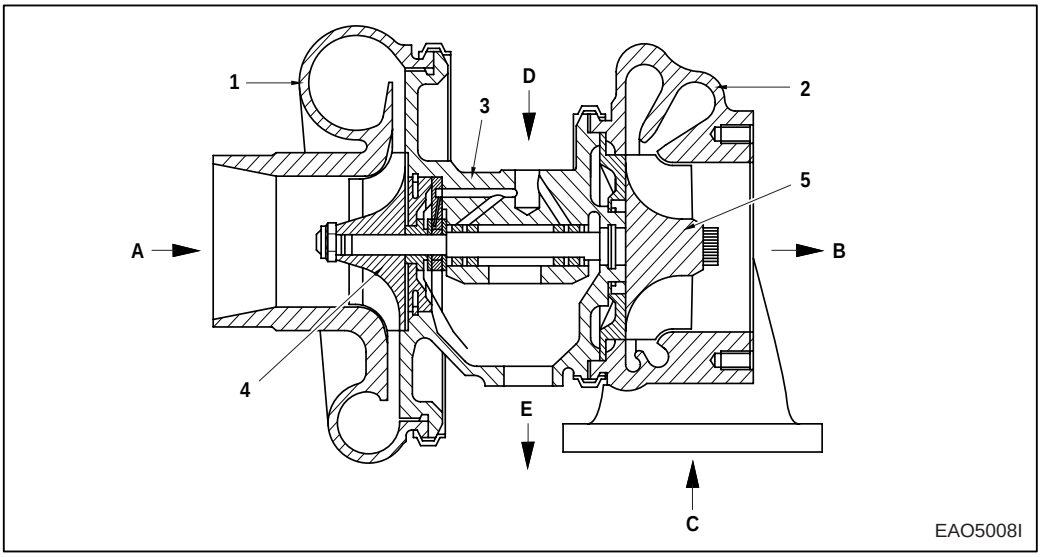


Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

2.3.20. Turbo charger

- No special maintenance is required for the turbo charger.
- Each time you replace engine oil, you should also check the leak or blocking of the oil pipe.
- The air filter should be managed carefully, so that no foreign object goes into the filter. The charged compressed air and exhaust pipe should be checked periodically. The exhaust leak should be fixed immediately, because it causes engine overheating.
- You should clean impeller frequently, while working at the site with much dust and oil. Disassemble impeller casing (caution: Do not bend!) and clean with non-acid solvent. Use the plastic scraper, if necessary.
- If the impeller is polluted seriously, soak into solvent and clean with stiff brushes. At this time, soak the impeller only, and support the turbo charger with the bearing housing, instead of the impeller.



Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

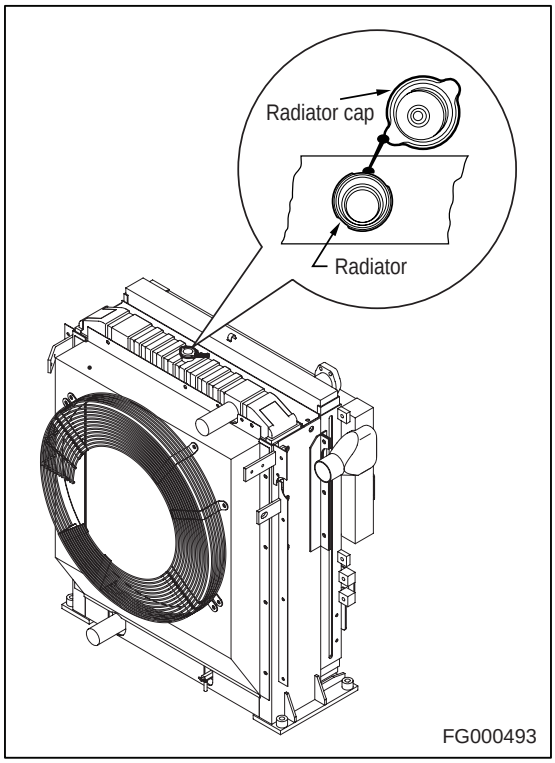
2.3.21. Cooling system

Cooling water is used to cool down the engine. The cooling water pump is driven by the belt. The impeller type pump is used that doesn't require maintenance.

- Check the cooling water level by opening the cooling water cap of the expansion tank, and refill cooling water, if necessary.
- Before pouring antifreeze, drain used cooling water from cylinder blocks and radiator and clean neatly.
- Mix antifreeze with tap water.
- The EGR cooler and turbo charge cooling are added.

2.3.22. Coolant pressure cap

- Check opening pressure of the pressure value, using a radiator cap tester.
- Replace the cooling water cap, if the measurement value doesn't satisfy the standard value.



NOTICE :
Do not open the pressure cap if cooling water is hot.
Wait until the engine cools down. Otherwise, you can be burned due to hot steam and cooling water.
If you have to open a pressure cap inevitably, wrap the pressure cap with cloth or protection glove and open the pressure cap slowly to reduce internal pressure of the tank.
Then, open the cap completely.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

2.2.23. Cooling water

- The clean tap water should be used as engine cooling water.
- Mix 40% of antifreeze with engine cooling water, and use 3 ~ 5% additive (DCA4) for corrosion prevention.
- To keep proper viscosity of antifreeze and additive, check cooling water every 500 hours.

CAUTION :

If you keep antifreeze and anticorrosive agent properly, you can prevent engine corrosion effectively and keep the engine quality stably. On the contrary, if you manage them inappropriately, the cooling water pump and cylinder liner can be damaged fatally.

- DL06K engine's cylinder liner is a dry type. In particular, cooling water flow should be good.
- Viscosity of antifreeze and anticorrosive agent can be check with cooling water check paper. (Fleet card number: CC2602M or Doosan number: 60.99901-0038)
- Cooling water concentration measurement method

(1) When cooling water temperature is between 10 and 55 °C, drain cooling water and fill the plastic cup by half.

CAUTION :

If you collect test cooling water from the auxiliary fuel tank, you cannot measure viscosity accurately. Makes sure to collect test cooling water by opening the cooling water drainage plug.

(2) Soak the test paper into the collected cooling water and take out after 3 - 5 seconds. Then, shake the test paper to shake out the water.

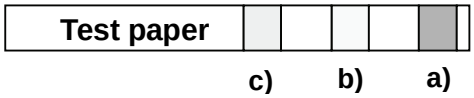
(3) Wait 45 seconds until the color of the test paper changes.

Downloaded from www.Manualslib.com manuals search engine

CAUTION :

Do not measure longer than 75 seconds. If the test takes longer, the color will be changed.

- **Test paper discriminance**



a) Compare glycol/freeze point (end pad) in the table with the test paper color.

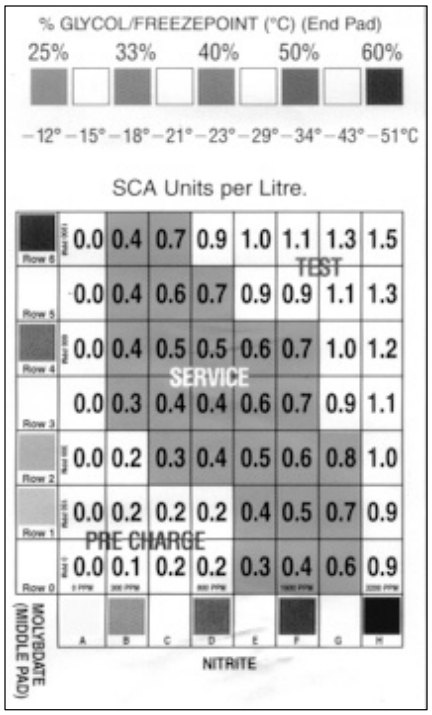
b) Compare molybdate (middle pad) in the table with the test paper color.

c) Lastly, compare nitrite in the table with the test paper color.

(4) Compare the changed color of the pink "a)" at the edge of the test paper with glycol/freeze point on the top of the container to check viscosity. (The viscosity indication should be between 33% and 50% color scope.)

(5) The point that "b)" vertical direction molybdate at the center of the test paper crosses with the color of "c)" horizontal direction nitrite on the test paper indicates the status of additive for corrosion prevention. The indication mark should be between 0.3 and 0.8 green sector.

(6) If the measurement result is under 0.3, refill the anticorrosive agent (DCA4). Or, if it is over 0.8, drain some cooling water and inject tap water to adjust concentration



Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

CAUTION:

If the color is different when compared, find the lower number column. (e.g. If the color of "c" section in the test paper is between D and F of the standard color table (nitrite), select the position E.)

CAUTION :

To prevent internal corrosion of the engine cooling system, drain cooling water every year and replace with new cooling water.

- **Antifreeze amount in winter**

Ambient Temperature (°C)	Cooling water (%)	Anti-freeze (%)
Over –10	85	15
-10	80	20
-15	73	27
-20	67	33
-25	60	40
-30	56	44
-40	50	50

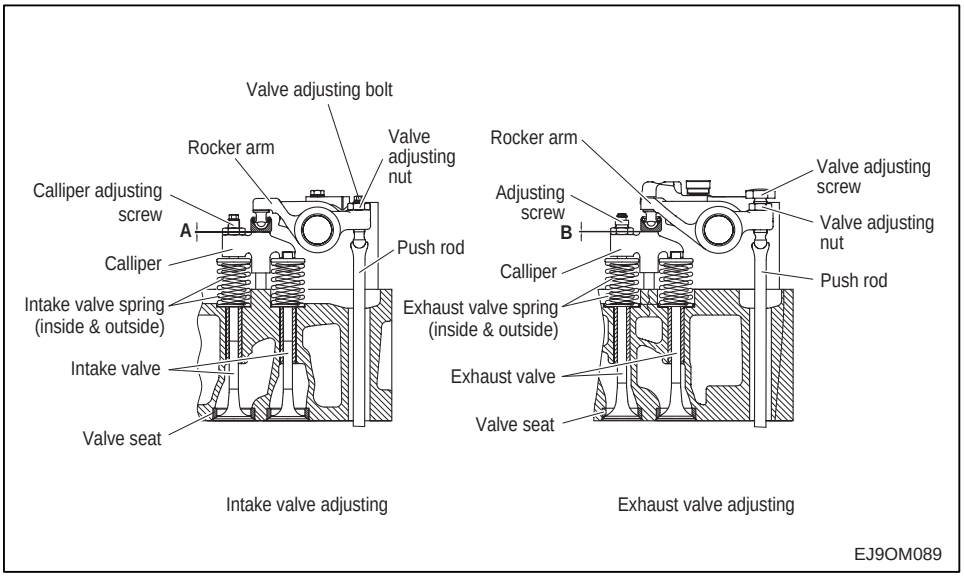
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

2.3.24. Valve clearance adjust procedure

- Rotate the crankshaft to make #1 cylinder piston to reach the compression TDC (top dead center) and then, adjust the valve clearance.
- Unfasten the rocker arm fixing nut and insert the clearance gauge between rocker arm and valve and then, adjust each clearance with adjusting screw and fasten the fixing nut.
- Adjust the valve clearance as follows, when the engine cools down.

Engine model	Intake valve (A)	Exhaust valve (B)
DL06K	0.3 mm	0.4 mm

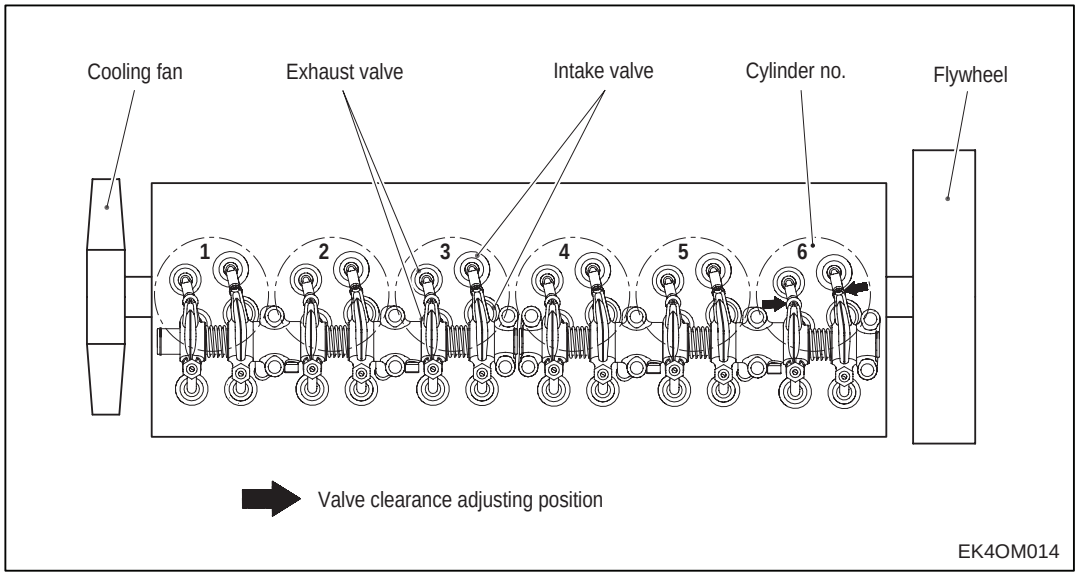


< Adjust the valve clearance by the following sequence.>

- Rotate the engine so that #6 cylinder valve is overlapped.
- Adjust the clearance of the valve corresponding to "A," when #1 cylinder reaches TDC.
- Adjust the "B" marking part, when #5 cylinder reaches TDC (180 °C rotation).
- Rotate the crankshaft one time (360 °C rotation) so that #1 cylinder valve is overlapped.
- Adjust the clearance of the valve corresponding to "C" in the following table, when #6 cylinder reaches TDC.
- Adjust the "D" marking part, when #2 cylinder reaches TDC (540 °C rotation).
- Check the valve clearance again, and adjust it again, if necessary.

Downloaded from www.Manualslib.com manuals search engine

- The cylinder that the cooling fan is assembled is the cylinder number 1.



- **Adjusting of valves** (**Type 1**)

Cylinder no. / Valve adjusting	1		2		3		4		5		6	
	Exhaust	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust	Intake
#1 cylinder top dead center (#6 cylinder valve overlap)	**A**	**A**			**A**			**A**	**A**			
180° rotation (#5 cylinder top dead center)										**B**		
360° rotation #5 cylinder top dead center (#1 cylinder valve overlap)			**C**			**C**	**C**				**C**	**C**
540° rotation (#2 cylinder top dead center)				**D**								

- **Adjusting of valves** (**Type 2**)

Adjusting of the valve overlapping on cylinder is done as follow.

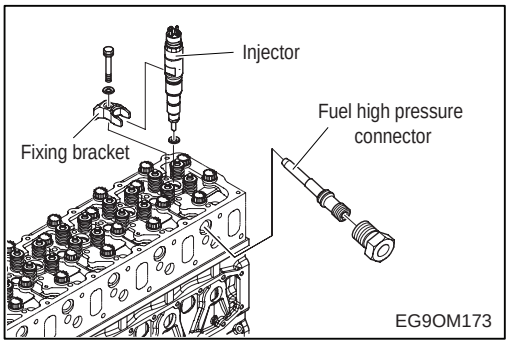
When each cylinder is valve overlap (Firing cylinder no. order)	**1**	**5**	**3**	**6**	**2**	**4**
Valve adjusting cylinder No	**6**	**2**	**4**	**1**	**5**	**3**

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

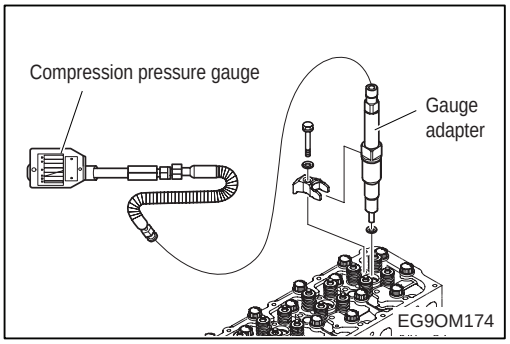
2.3.25. Cylinder compression pressure

- Warm up and stop the engine.
- Remove the injector fixing bracket and fuel high pressure connector, and injector.
- Install the special tool (compression pressure gauge) at the injector installation hole, and insert the compression pressure gauge to the hole.



- Compression pressure gauge adapter : EF.110-119
- Measure the compression pressure by the starting motor.

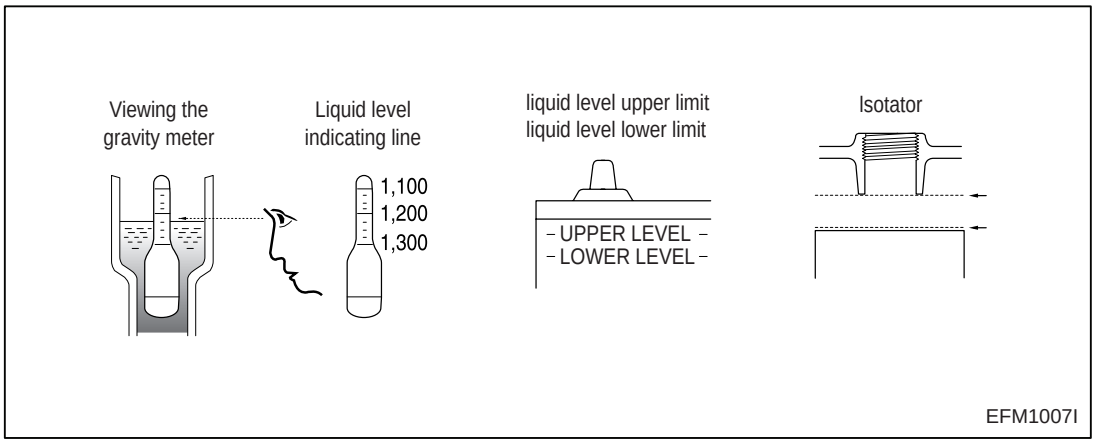
Standard value	Over 28 kg/cm2
Limit value	24 kg/cm2
Difference between each cylinder	Within ± 10 %



- Condition : Coolant temperature 20 °C and engine speed 200 rpm.

2.3.26. Battery

- Check the electrolyte leak caused by battery crack. If the battery is defective, replace the battery.
- Check the electrolyte amount, and refill distilled water.
- Measure electrolyte concentration and refill electrolyte, if it is under the standard value (1.12 ~ 1.28).



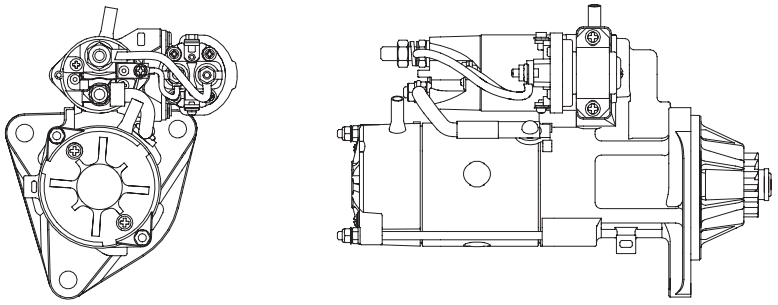
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

2.3.27. Starting motor

- The starter motor is installed at the rear side of the left flywheel housing (seen from the flywheel side). When disassembling the engine, soak the starter motor pinion gear and ring gear into fuel and clear with brushes. Then, apply grease to prevent corrosion.

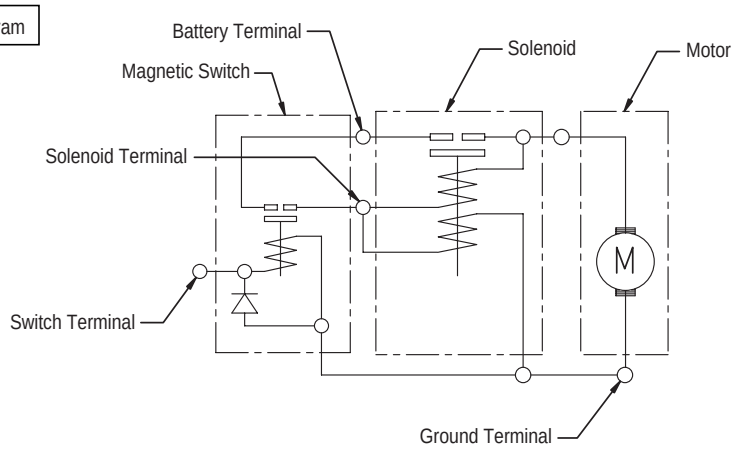
24V X 6.0kW



EK4OM010

The starter motor should be always protected from humidity.

Circuit diagram



EJ9OM010

WARNING :

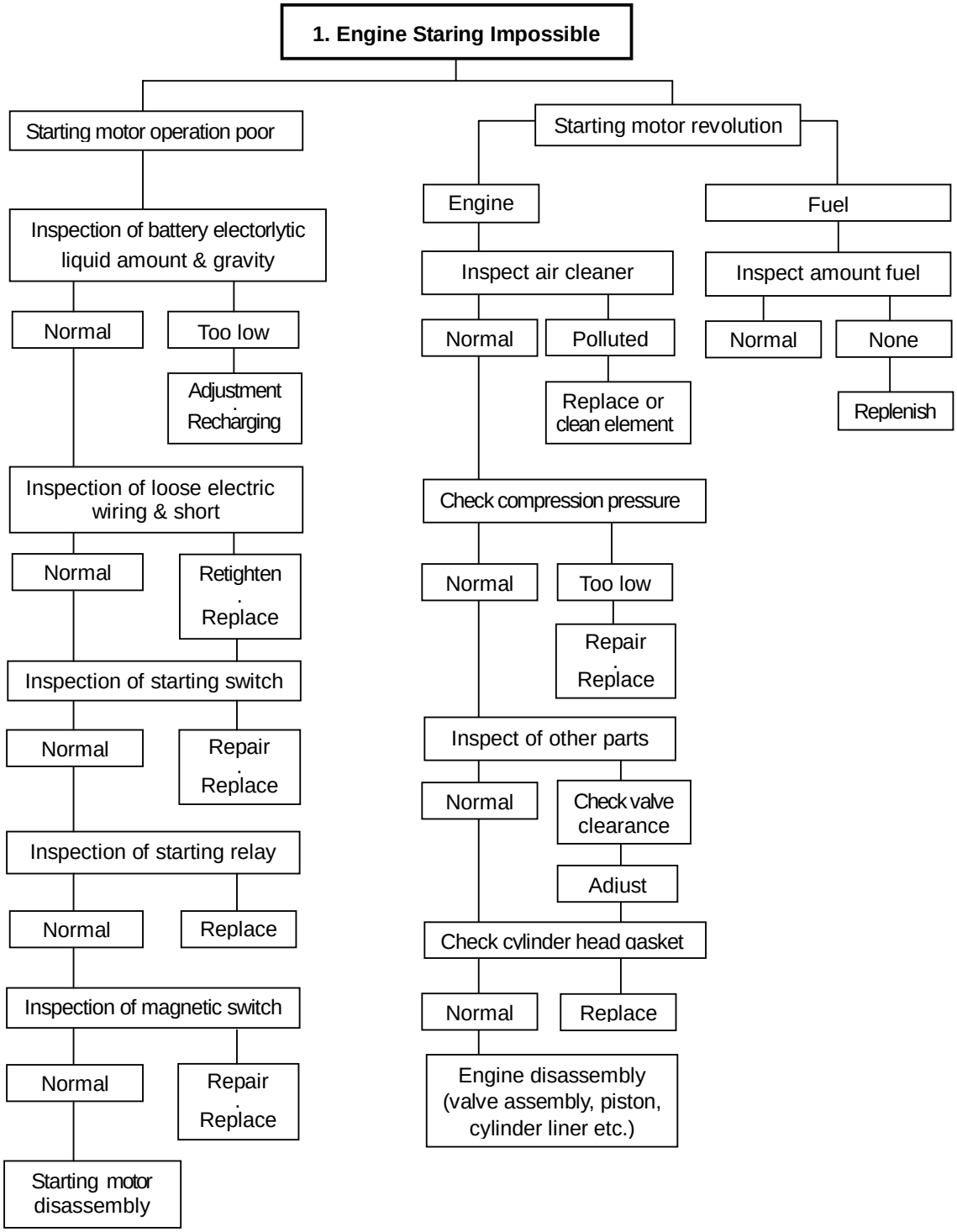
Make sure to disconnect the battery ground line ("-" minus line) before working with the electrical system. Connect the ground line again when the work is completed, because there is a risk of a short circuit during the work.

Downloaded from www.Manualslib.com manuals search engine

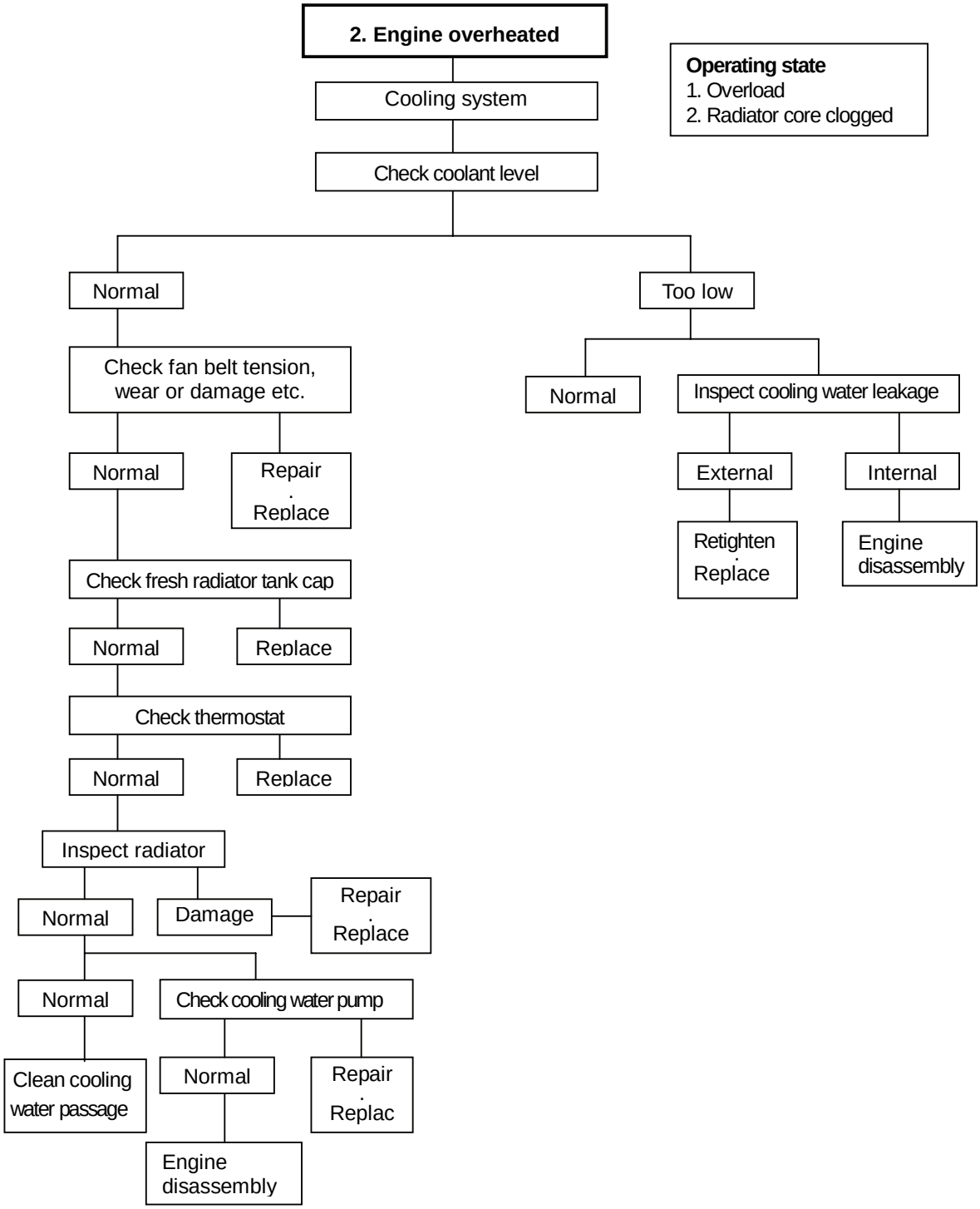
https://truckmanualshub.com/

2.4. Diagnosis and Remedy

- The following description summarizes the probable cause of and remedy for general failure by item.
- Inspect the electrical parts problem with diagnostic tools and refer diagnostic manual.
- Immediate countermeasures should be taken before a failure is inflamed if any symptom is detected.

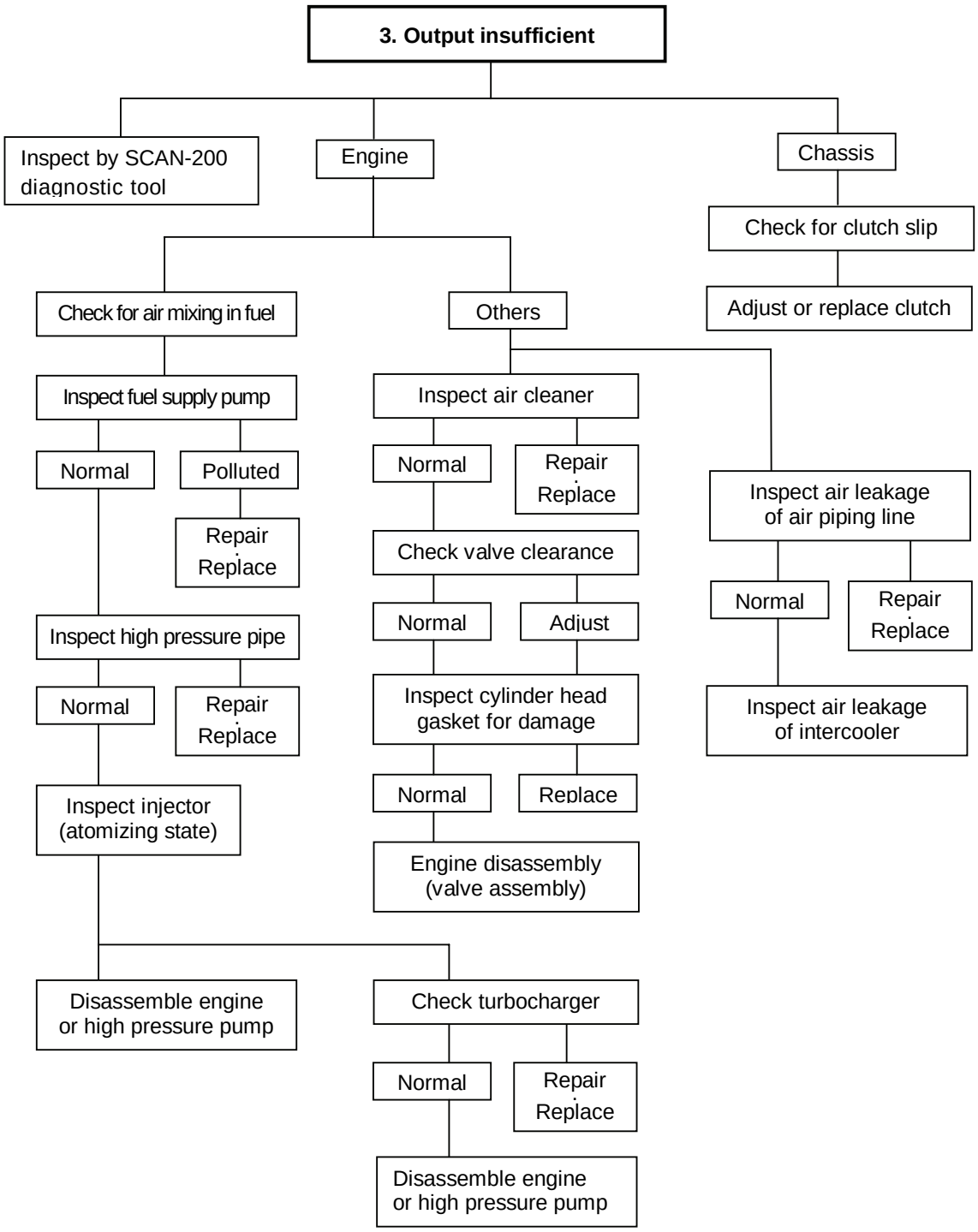


Downloaded from www.Manualslib.com manuals search engine



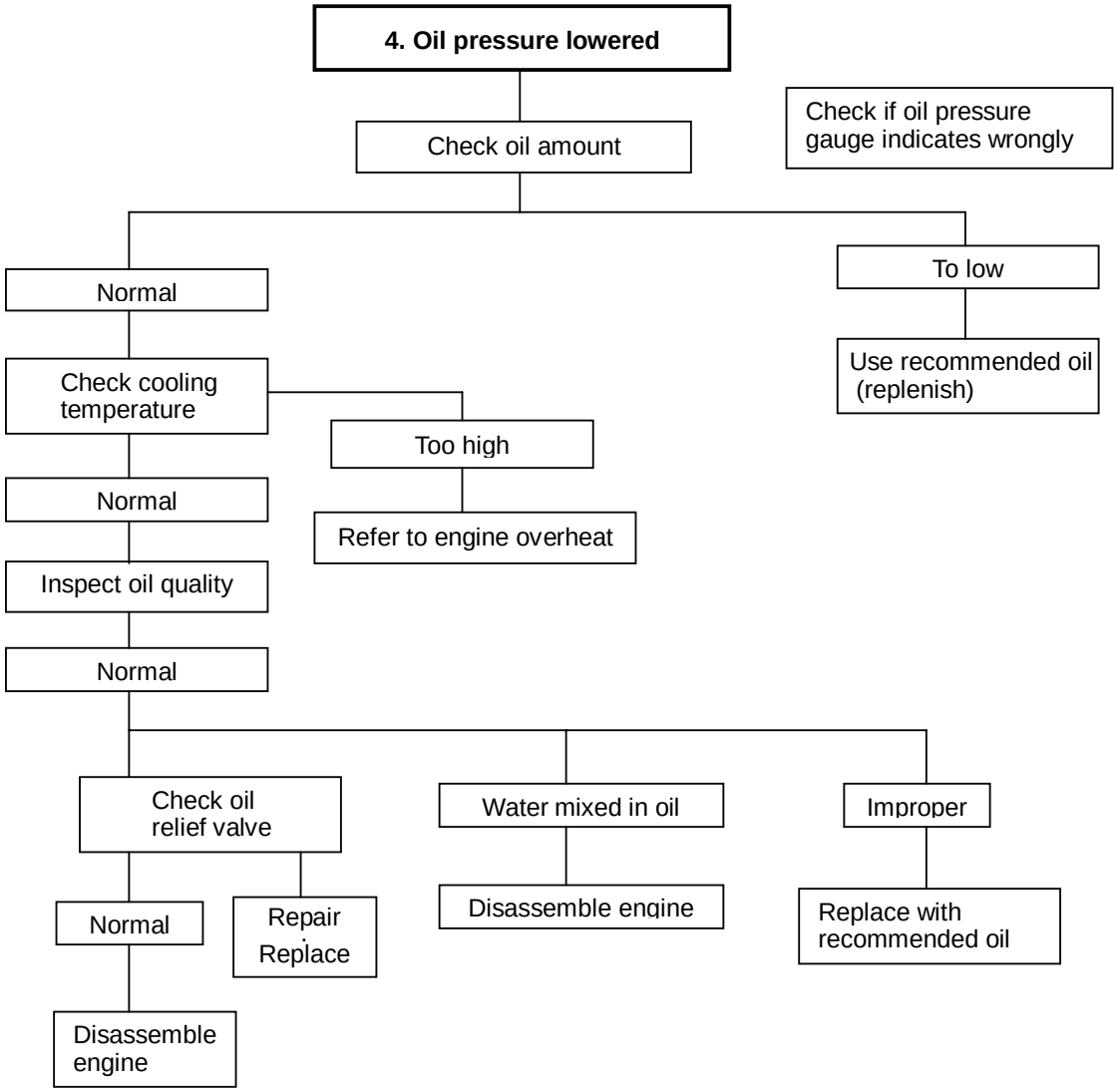
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/



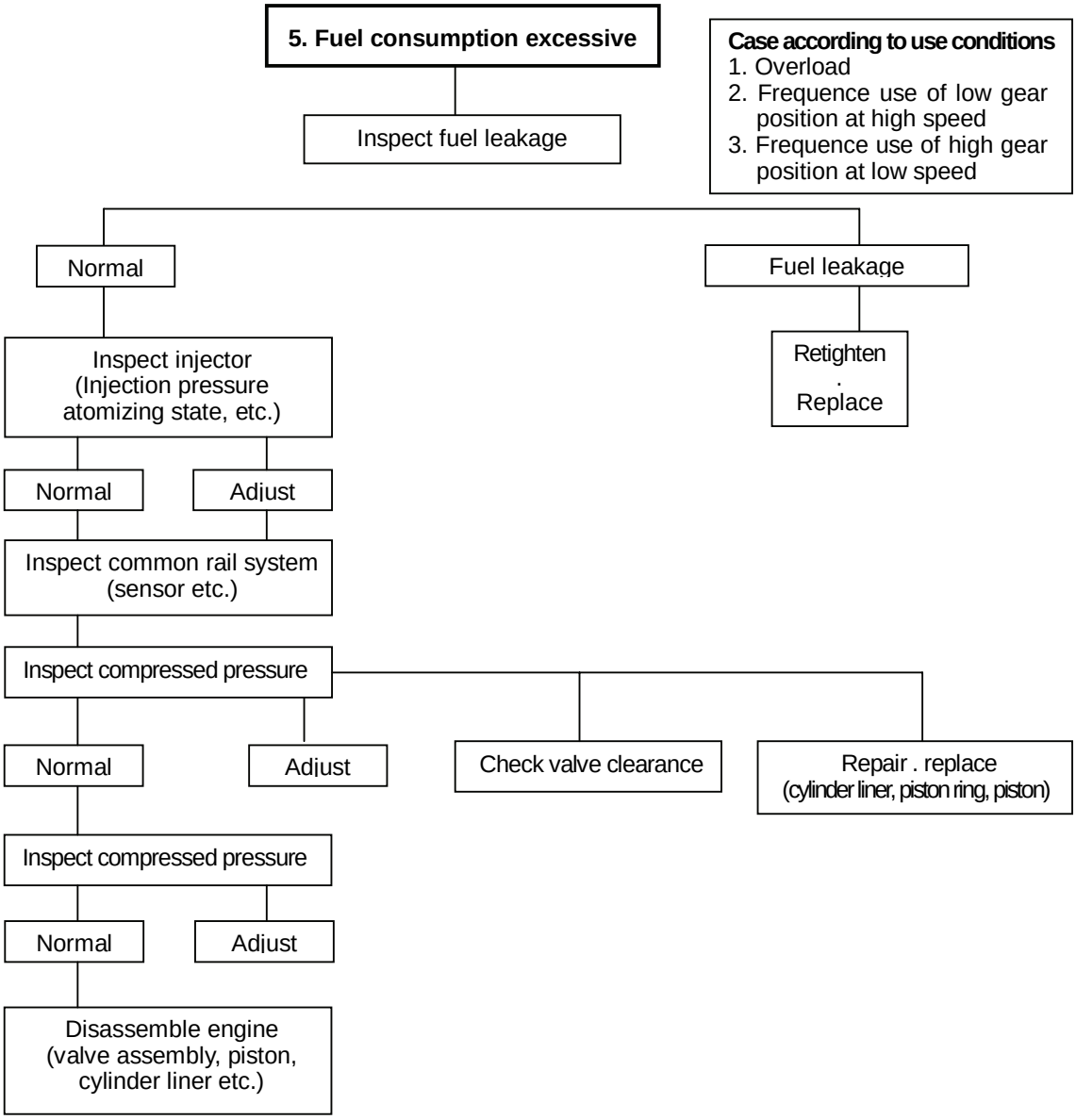
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/



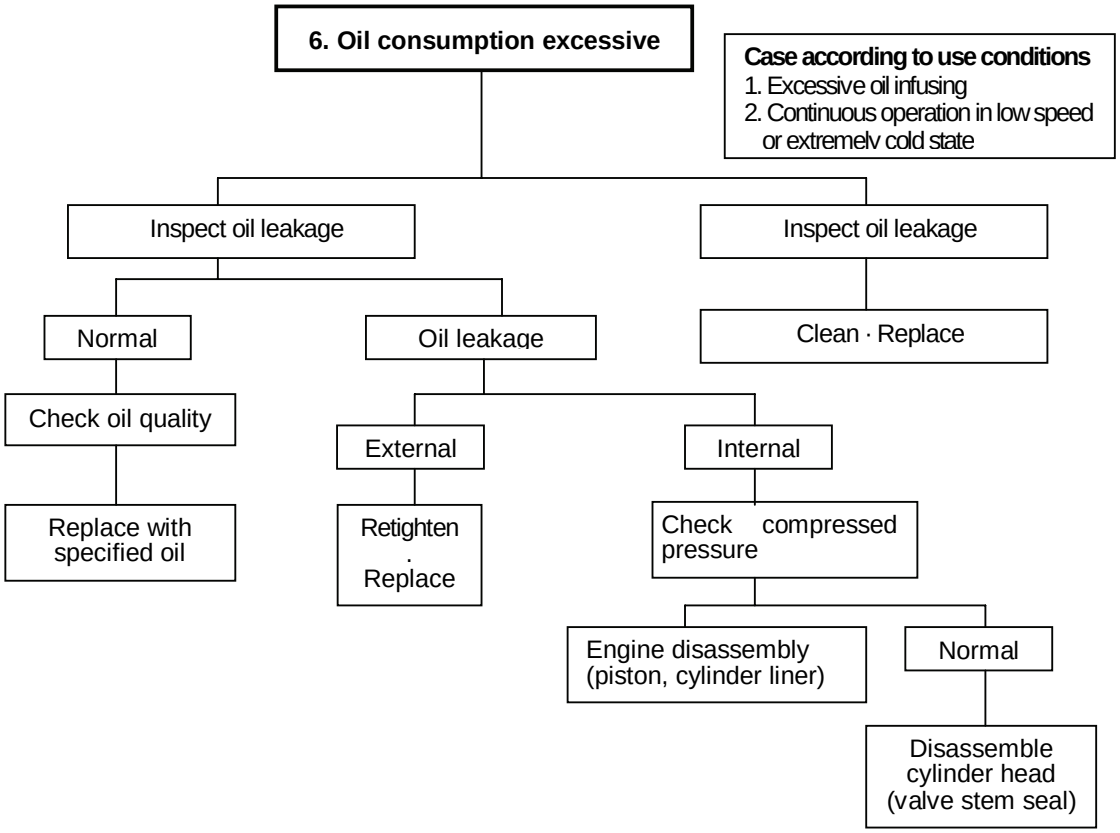
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/



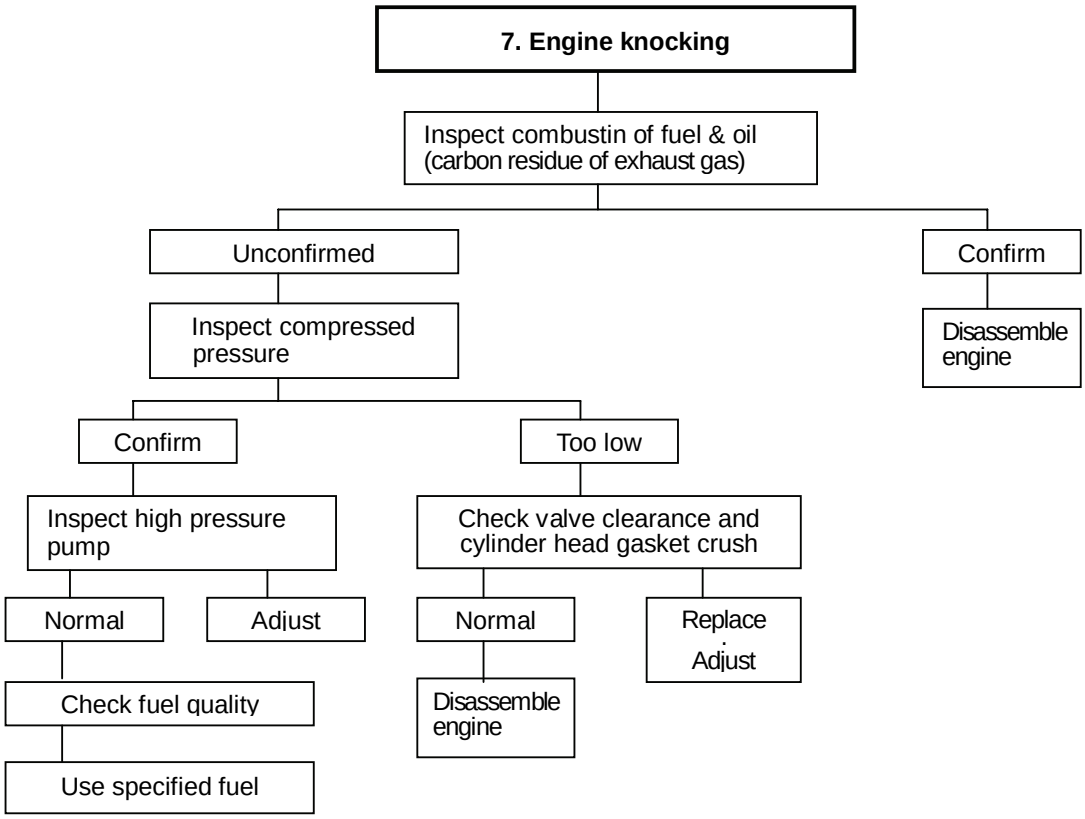
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/



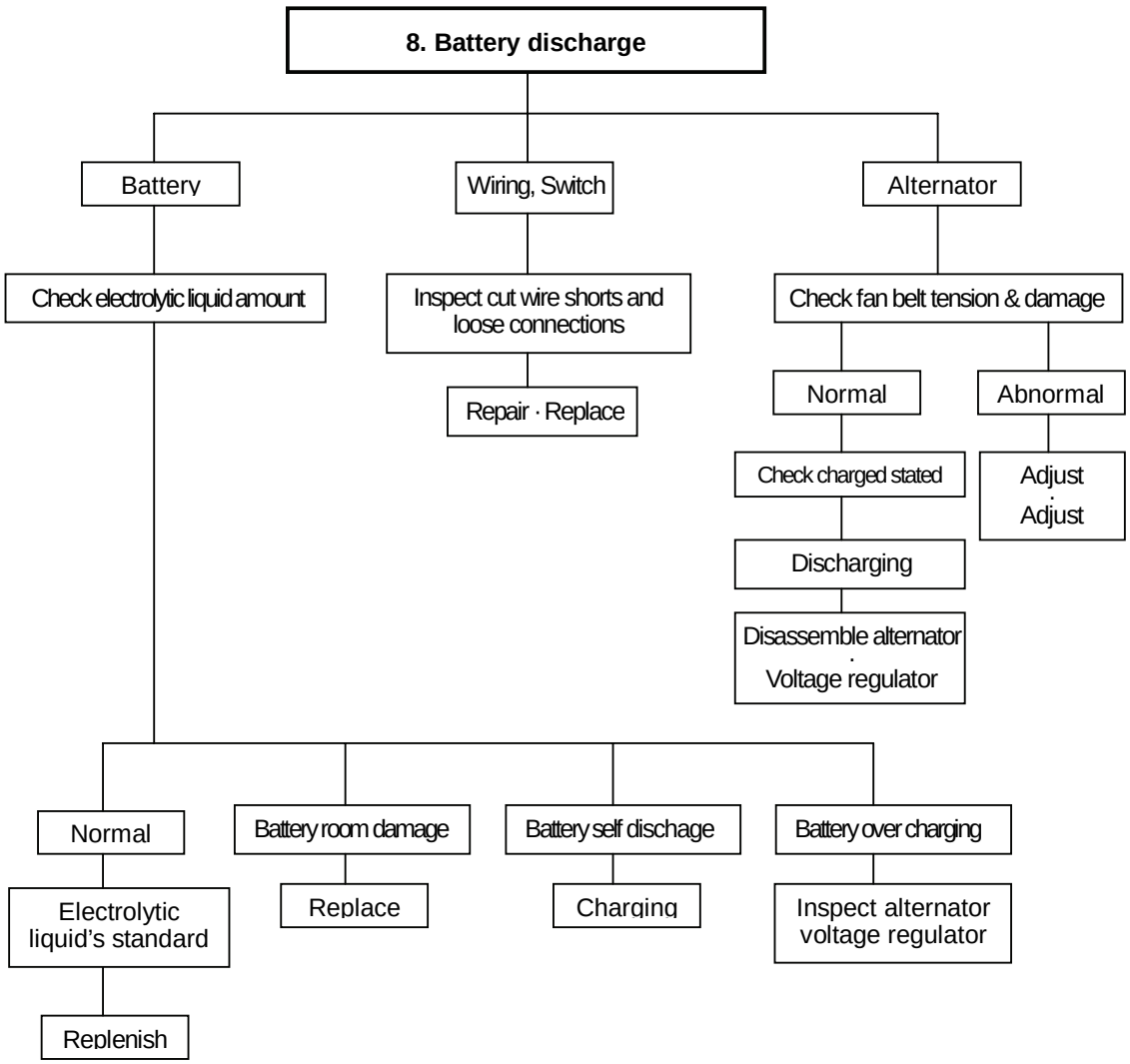
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/



Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/



Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

Condition	Causes	Remedies
1) Starting difficult		
(1) Starting motor trouble (2) Fuel system trouble (3) Compression pressure lack	Refer to diagnostics	
	Refer to diagnostics	
	● Valve's poor shut, stem distortion	Repair or replace
	● Valve spring damage	Replace valve spring
	● Cylinder head gasket's leak	Replace gasket
	● Wear of piston, piston ring or liner	Adjust
2) Idle operation abnormal	● Injection timing incorrect	Check by EDIA
	● Air mixing at high pressure pump	Remove air
3) Engine output insufficient (1) Continuous output insufficient.	● Valve clearance incorrect	Adjust
	● Valve tightness poor	Repair
	● Cylinder head gasket's leak	Replace gasket
	● Wear, stick, damage of piston ring	Replace piston ring
	● Injection timing incorrect	Check
	● Fuel injection amount insufficient	Check
	● Injector injection pressure improper or stuck	Adjust or replace Repair or replace
	● Supply pump's function lowered	Repair
	● Fuel pipe system clogged	Clean or replace air cleaner
	● Air suction amount insufficient	Repair or replace
	● Turbocharger poor	Hose clamp adjust
	● Intercooler pipe air leak	
(2) Output insufficient when in acceleration	● Compression pressure insufficient	Disassemble engine
	● Injection timing incorrect	Check
	● Fuel injection amount insufficient	Check
	● Injector infection pressure, infection angle improper	Repair, replace
	● Supply pump's function lowered	Repair or replace
	● Air intake amount insufficient	Clean or replace air cleaner
4) Overheating	● Engine oil insufficient or poor	Replenish or replace
	● Cooling water insufficient	Replenish or replace
	● Fan belt loosened, worn, damaged	Adjust or replace
	● Cooling water pump's function	Repair or replace
	● Water temperature regulator's operation poor	Replace
	● Valve clearance incorrect	Adjust
	● Exhaust system's resistance increased	Clean or replace

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

Condition	Causes	Remedies
5) Engine noisy	For noises arise compositely such as rotating parts, lapping parts etc., there is necessity to search the cause of noises accurately.	
(1) Crankshaft	● As the wear of bearing or crankshaft progress, the oil clearances increase	Replace bearing & grind crankshaft
	● Lopsided wear of crankshaft	Grind or replace
	● Oil supply insufficient due to oil passage clogging	Clean oil passage
	● Stuck bearing	Replace bearing & grind
(2) Connecting-rod and connecting-rod bearing	● Lopsided wear of con rod bearing	Replace bearing
	● Lopsided wear of crank pin	Grind crankshaft
	● Connecting rod distortion	Repair or replace
	● Stuck bearing	Replace & grind crankshaft
	● Oil supply insufficiency as clogging at oil passage progresses	Clean oil passage
(3) Piston, piston pin & piston ring	● Piston clearance increase as the wear of piston and piston ring progresses	Replace piston & piston ring
	● Wear of piston or piston pin	Replace
	● Piston stuck	Replace piston
	● Piston insertion poor	Replace piston
	● Piston ring damaged	Replace piston
(4) Others	● Wear of crankshaft, thrust bearing	Replace thrust bearing
	● Camshaft end play increased	Replace thrust plate
	● Idle gear end play increased	Replace thrust washer
	● Timing gear backlash excessive	Repair or replace
	● Valve clearance excessive	Adjust valve clearance
	● Abnormal wear of tappet, cam	Replace tappet, cam
	● Turbocharger inner part damaged	Repair or replace
6) Fuel consumption excessive	● Injection timing incorrect	Check
	● Fuel injection amount excessive	Adjust

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

Condition	Causes	Remedies
7) Oil Consumption Excessive (1) Oil level elevated	● Clearance between cylinder liner & piston.	Replace
	● Wear of piston ring, ring groove	Replace piston, piston ring
	● Piston ring's damage, stick, wear	Replace piston ring
	● Piston ring opening's disposition improper	Correct position
	● Piston skirt part damaged or abnormal wear	Replace piston
	● Oil ring's oil return hole clogged	Replace piston ring
	● Oil ring's contact poor	Replace piston ring
(2) Oil level lowered	● Looseness of valve stem & guide	Replace in set
	● Wear of valve stem seal	Replace seal
	● Cylinder head gasket's leak	Replace gasket
(3) Oil leak	● Looseness of connection parts	Replace gasket, repair
	● Various parts' packing poor	Replace packing
	● Oil seal poor	Replace oil seal

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

2.5. Engine Inspection

2.5.1. Regular check and maintenance

Regular check and maintenance are required to keep the best engine performance and prevent malfunction.

– The following items should be checked everyday.

– The following items should be maintained regularly and thoroughly.

– This checklist is subject to the operation conditions of the vehicle.

O : Check & adjust ● : Replace

Inspection		Daily	Inspection time (Hr)		Remark
			50	500	
Cooling system	Check for leakage (hoses, clamp)	O			
	Check the water level	O			
	Check the V-belt tension	O			
	Change the coolant water			O	
Lubrication system	Check for leakage	O			
	Check the oil level gauge	O			
	Change the lubricating oil		● 1st	● (Note1)	After the first 50 hours, replace every 500 hours
	Replace the oil filter cartridge		● 1st	● (Note1)	After the first 50 hours, replace every 500 hours
Intake System	Inter cooler connection part (hose, clamp)	O			
	Air filter pressure indicator	O			
Exhaust system	DPF cleaning (Ash cleaning)		After the first 4,500 hours, clean every 3,000 hours (Note2)		
Fuel system	Extract moisture from oil/water separator	O			
	Oil leak from the fuel line	O			
	Fuel injection timing				When necessary
	Oil filter cartridge replacement			●	
	Check the injector				When necessary
Engine adjust	Check the exhaust gas state	O			
	Check the battery charging	O			
	Check the compression pressure				When necessary
	Adjust intake/exhaust valve clearance				When necessary

* Note1 : Oil and cartridge replacement is subject to the use conditions.
* Note2 : Subject to the operating conditions, surroundings, or engine oil.

2.5.2. Use of original parts for repair and replacement

The engine is assembled by numerous parts and those parts are harmonized mechanically. Therefore, engine failure can be prevented and the best performance can be maintained only when the standard part recommended by the engine manufacturer is used for replacement or repair during regular maintenance.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3. Disassembly and Reassembly of Major Components

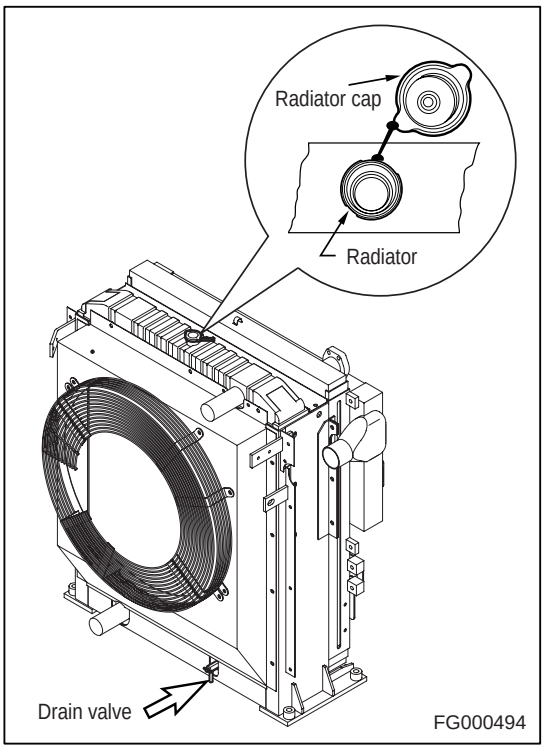
3.1. Engine Disassembly

3.1.1. General precautions

- Prepare the shelf to keep various tools, repair parts, and parts after disassembly.
- Perform the maintenance work in bright and clean place. Wash your hands when assembling the engine.
- Keep the disassembled parts by order of disassembly. Keep the parts safely and separately.

3.1.2. Cooling water

- Open the radiator cap and drain cooling water by opening the drain valve located under the radiator, as shown in the right side figure.



CAUTION :

When opening a radiator cap while the engine is hot, wrap the cap with cloths and open the valve slowly, so that internal steam pressure goes down.

Then, the incident by hot steam from the cap can be prevented.

- Disassemble the cooling water drain plug of the cylinder block and oil cooler, and drain cooling water to the prepared container.

3.1.3. Oil level gauge

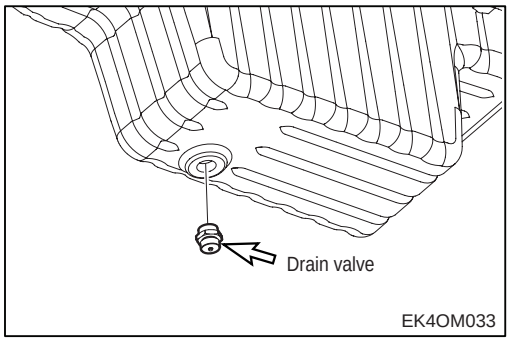
- Take out the oil level gauge.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

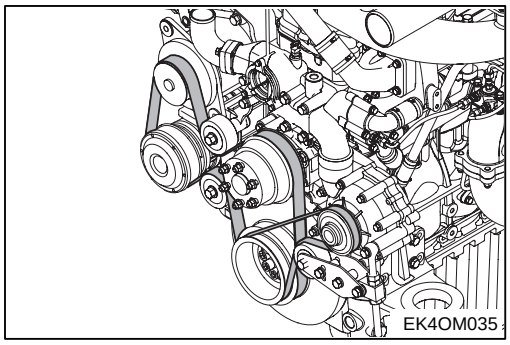
3.1.4. Engine oil

- Open the drain plug of the oil pan and drain engine oil to the prepared container.



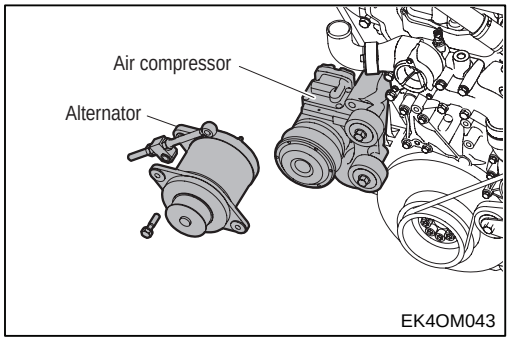
3.1.5. Belt

- Unfasten the tension adjustment bolts and fixing bolts of the air conditioner compressor, air compressor, and alternator, and disassemble the belt.



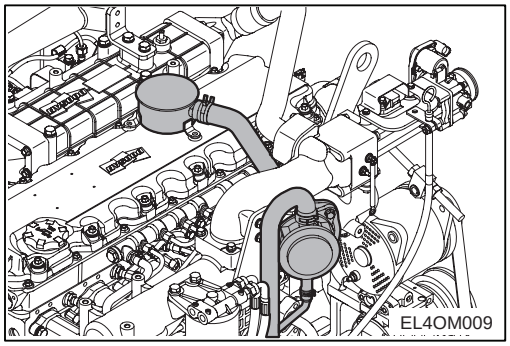
3.1.6. Alternator and air conditioner compressor

- Unfasten fixing bolts and disassemble the alternator.
- Unfasten the idle pulley fixing bolts and disassemble the air compressor.



3.1.7. Breather

- Loosen the clamp screw to remove the rubber hose.
- Remove the breather valve assembly.

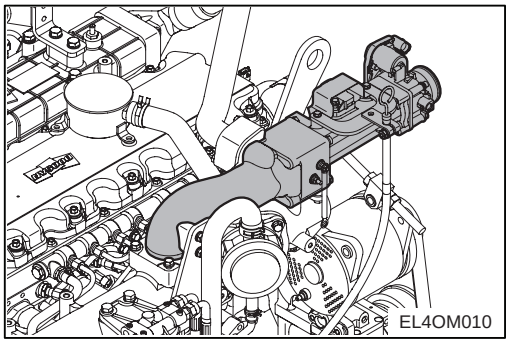


Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

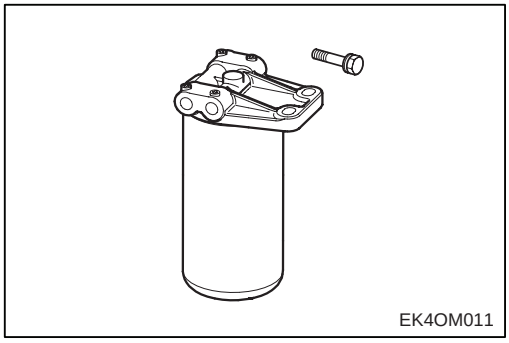
3.1.8. Air pipe and air heater

- Loosen and remove fixing bolts of the air pipe and air heater.
- Be careful not to input any foreign object into the turbo charger.



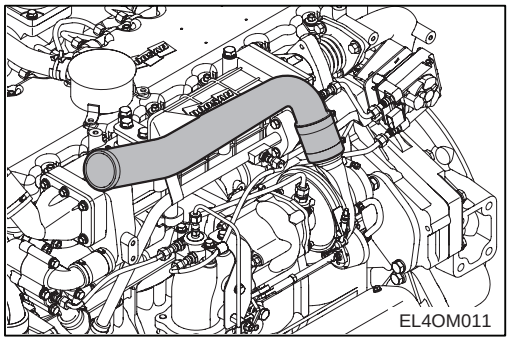
3.1.9. Fuel filter

- Loosen the hollow screws of the fuel filter and disassemble the fuel hose.
- Loosen the fixing bolts of the fuel filter and disassemble the fuel filter.



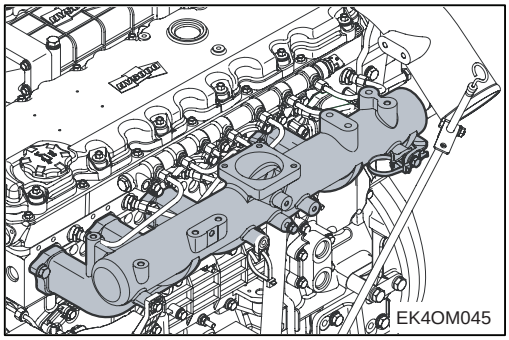
3.1.10. Intake stake

- Loosen the fixing bolts and remove the air hose.



3.1.11. Intake manifold

- Disassemble the bolts for intake manifold assembly and detach the cylinder block from the intake manifold.
- Detach the gasket and clean the gasket mounting surface with a scraper.

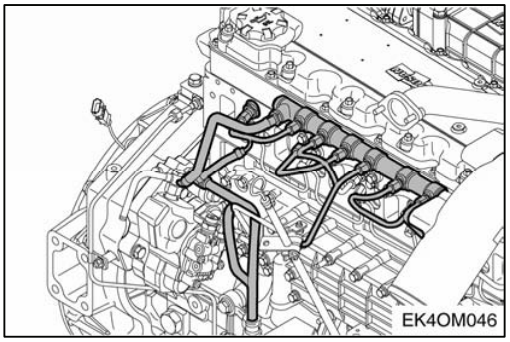


Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.1.12. Common rail and high pressure pipe

- Disassemble the high pressure pipe between fuel high pressure connector and common rail.
- Loosen the fixing bolts of the common rail and disassemble the common rail.



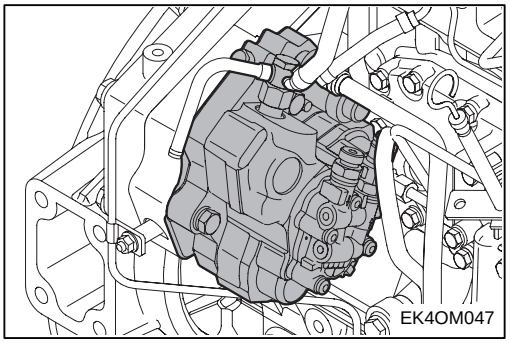
CAUTION :

1) Seal the common rail after disassembly, so that no foreign object is inserted.

2) The fuel high pressure pipe cannot be used again after removal .

3.1.13. Fuel high pressure pump

- Loosen the fixing bolts of the fuel high pressure pump and remove the fuel high pressure pump.

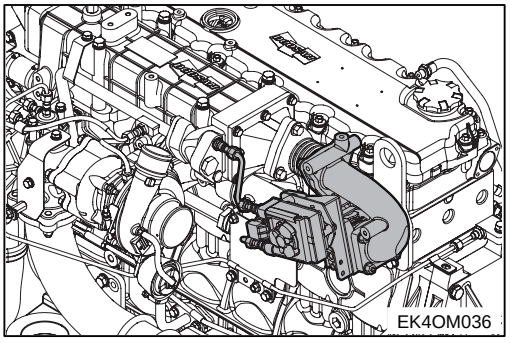


CAUTION :

1) Seal the fuel high pressure pump after disassembly, so that no foreign object is inserted.

3.1.14. EGR valve

- Loosen the fixing bolts of the EGR valve and remove the EGR valve and Exhaust manifold.
- Loosen the fixing bolts connected to the EGR cooler and exhaust pipe, and remove the exhaust pipe
- Remove the cooling water pipe connected to the EGR valve.

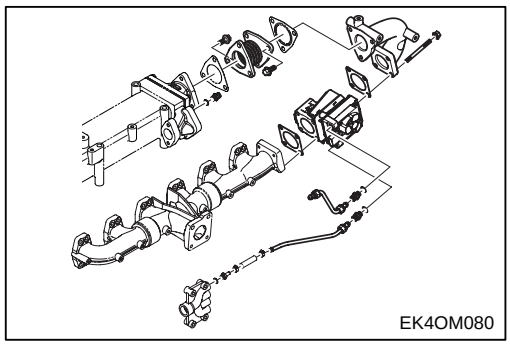


Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

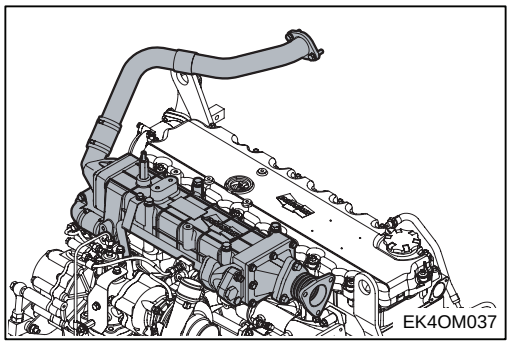
CAUTION :

1) Seal the EGR valve and exhaust pipe after disassembly, so that no foreign object is inserted.



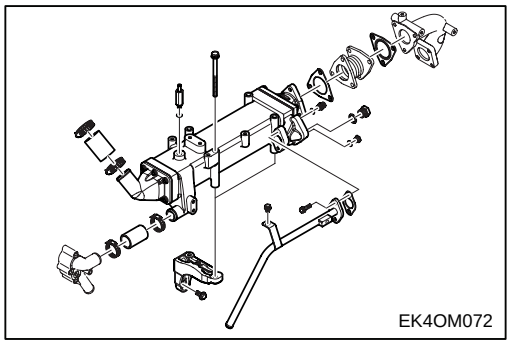
3.1.15. EGR cooler

- Loosen the fixing bolts that connect the EGR cooler and bracket, and remove the EGR cooler.
- Detach the pipe and hose connected to the EGR cooler.



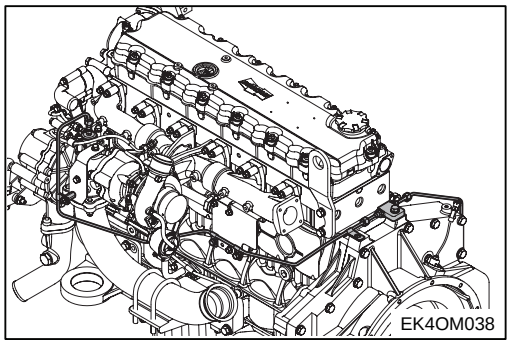
CAUTION :

Seal the EGR cooler after disassembly, so that no foreign object is inserted.



3.1.16. HC hydro-carbon

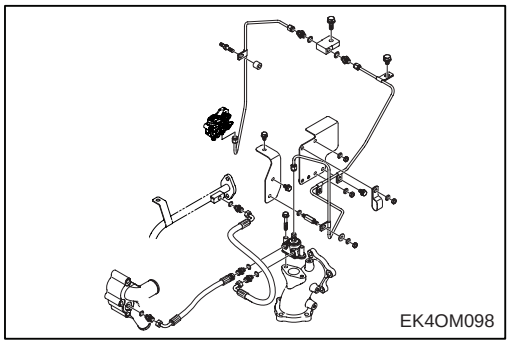
- Remove the HC injection pipe.
- Remove the cooling hose connected to the HC injection device.
- Loosen the fixing bolts of the HC injection device and remove the exhaust pipe.



Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

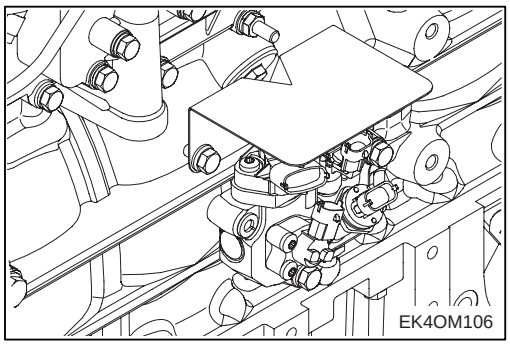
CATION :
Seal the HC injection device, exhaust pipe, and hose after disassembly, so that no foreign object is inserted.



3.1.17. HC dosing metering unit

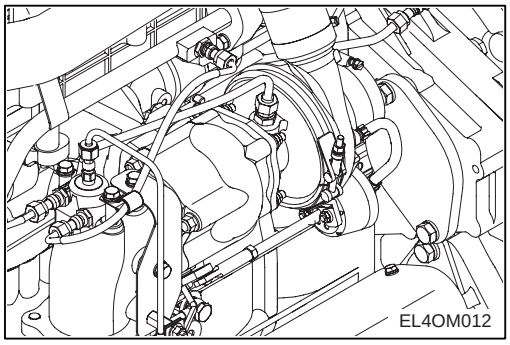
- Loosen the fixing bolts of the HC dosing metering unit and remove from the bracket.

CAUTION :
Seal the HC dosing metering unit after disassembly, so that no foreign object is inserted.



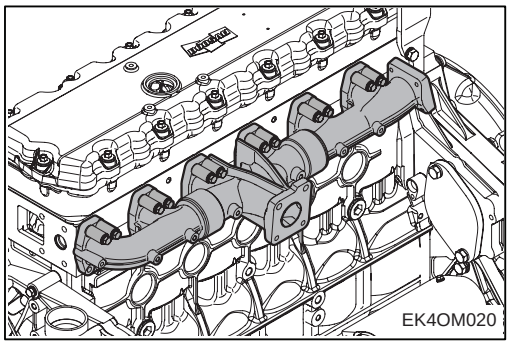
3.1.18. Turbo charger

- Remove the air pipe connected to the turbo charger.
- Remove the cooling water pipe connected to the turbo charger. Disassemble the oil supply pipe connected from the cylinder block to the turbo charger, and the oil pipe connected from the turbo charger to the cylinder block.
- Loosen the fixing bolts of the turbo charger, and detach the turbo charger from the exhaust manifold.



3.1.19. Exhaust manifold

- Loosen the fixing bolts of the exhaust manifold and disassemble the exhaust main fold.
- Do not reuse the used gasket.

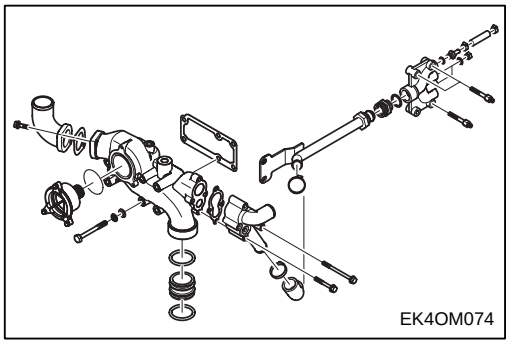


Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.1.20. Cooling water pipe & thermostat

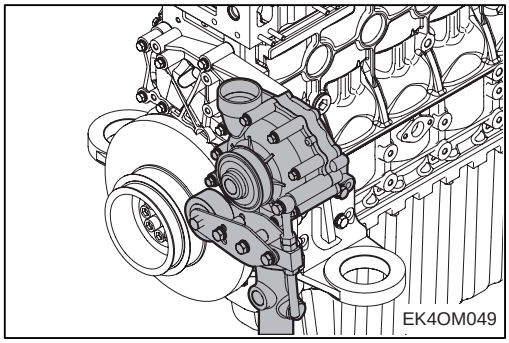
- Loosen the fixing bolts of the cooling water pipe, and disassemble the cooling water pipe assemble dot the thermostat housing.
- Remove the cooling water thermostat and O-ring.
- Clean the gasket mounting surface of the cooling water pipe with a scraper.


EK4OM074

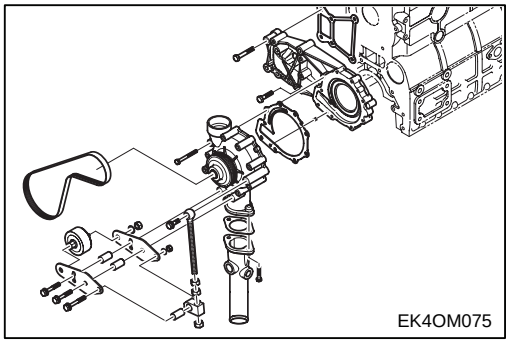
CAUTION :
Be careful that the gasket piece is not dropped into the cooling water path.

3.1.21. Cooling water pump

- Disassemble the bracket fixing bolts that fix the cooling water pump and oil cooler.


EK4OM049

- Loosen one bolt for oil cooler assembly, and assembly blots of the cooling water pump, to remove the cooling water pump.
- Disassemble the O-ring for the cooling water pump.
- Do you reuse the O-ring.

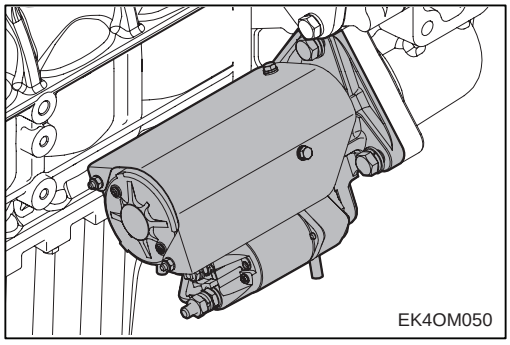

EK4OM075

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

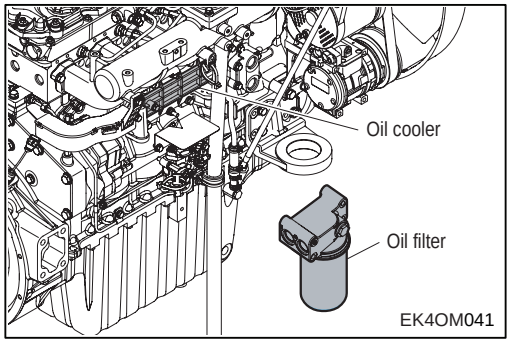
3.1.22. Starting motor

- Loosen assembly nuts of the starter motor, and disassemble the starter motor while paying attention not to damage the starter motor gear.



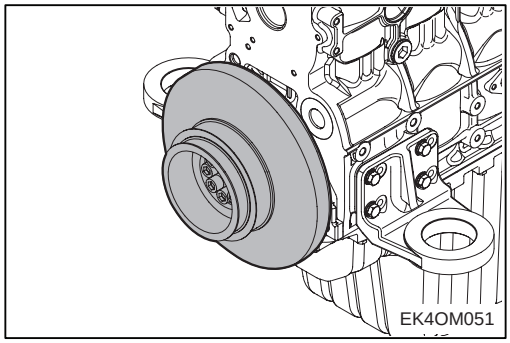
3.1.23. Oil filter

- Remove the oil filter cartridge using special tools.



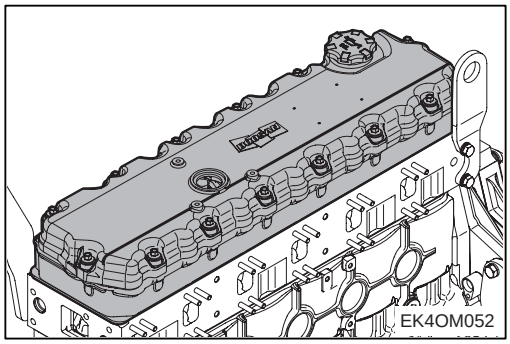
3.1.24. Vibration damper

- Loosen the fixing bolts of the vibration damper and crank pulley in reverse order of assembly, and disassemble the vibration damper components.



3.1.25. Cylinder head cover

- Loosen the bolts for cylinder head cove assembly, and remove the cover.
- Loosen the bolts for intermediate cove assembly, and remove the cover.

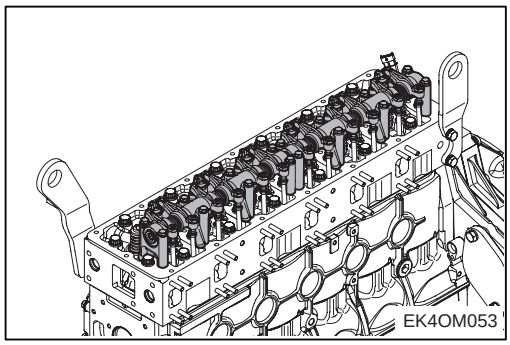


Downloaded from www.Manualslib.com manuals search engine

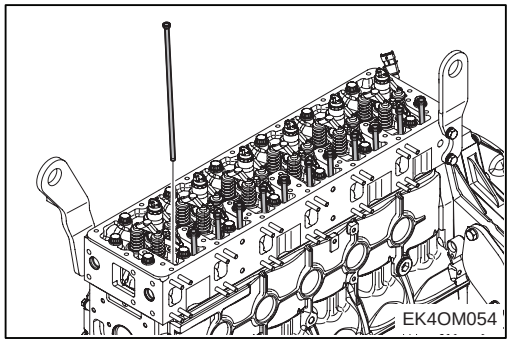
https://truckmanualshub.com/

3.1.26. Rocker arm

- Loosen the bolts for rocker arm bracket assembly in reverse order of assembly, and detach rocker arm components.

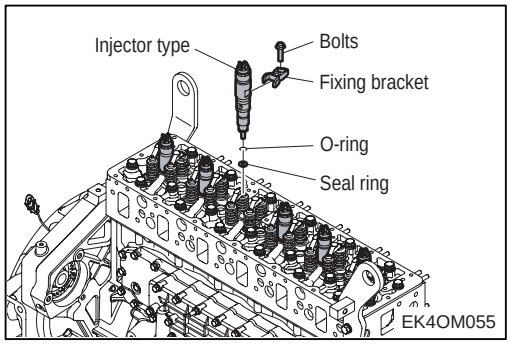


- Disassemble the push rod.



3.1.27. Injector

- Loosen the fixing bolts of the fuel high pressure connector, and detach the fuel high pressure connector.
- Remove the harness connected to the injector, and loosen the bracket bolts for fixing on the injector and then, disassemble the fuel injector.
- Be careful not to damage the nozzle when disassembling the fuel injector.
- Take out the seal ring from the nozzle hole of the cylinder head.



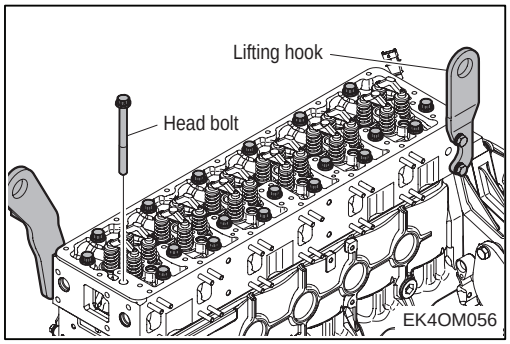
CAUTION :
To disassemble the fuel injector, loosen the fixing nuts of the fuel high pressure connector to remove the fuel high pressure connector completely and then, loosen the caliper fixing bolt of the fuel injector and detach the fuel injector.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

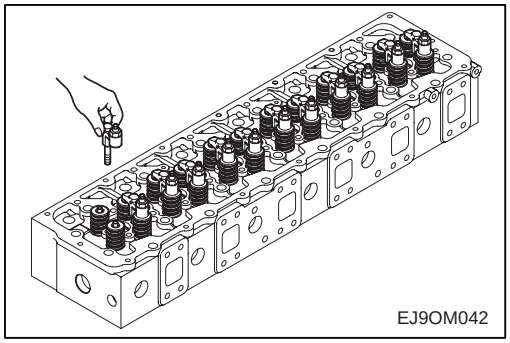
3.1.28. Cylinder head

- Loosen and disassemble the cylinder head bolts in reverse order of assembly.
  - Phase 1 : Loosen by one or two cogs.
  - Phase 2 : Loosen the entire bolt and disassemble.
- Disassemble the cylinder head bolts by phase 1 and 2.
- Keep the disassembled bolts in order, so that the thread of a screw is not damaged. Keep each bolt separately.
- Remove and dispose the cylinder head gasket.
- Remove the foreign object from the cylinder head and block surface. Be careful not to damage the contact surface.
- Loosen the assembly bolts of the assembled lifting hook from the cylinder head, and separate the lifting hook.

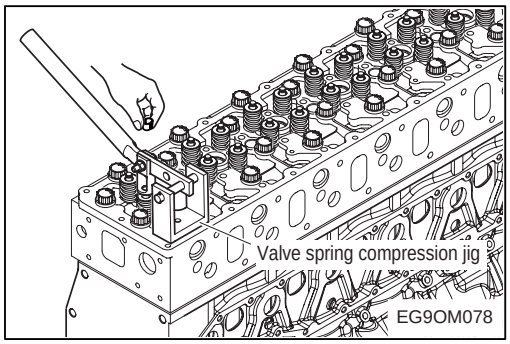


3.1.29. Valve and valve stem seal

- Press the valve spring and retainer with the valve spring compression tool, and disassemble the valve cotter.
- Valve spring compression tool number : EF.123-065
- Remove the valve spring and retainer.
- Remove the caliper.



- Remove the valve stem seal using the general tool. Do not reuse the valve steam seal.
- Remove the valve.
- Loosen the assembly bolts of the assembled lifting hook from three cylinder blocks, and separate the lifting hook.

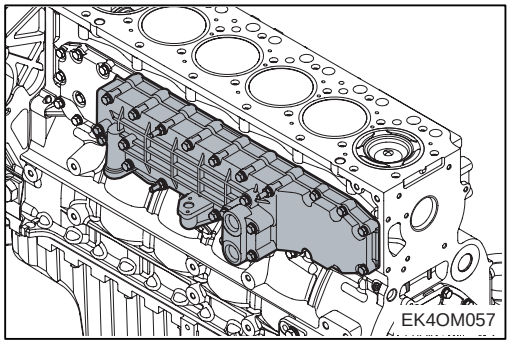


Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

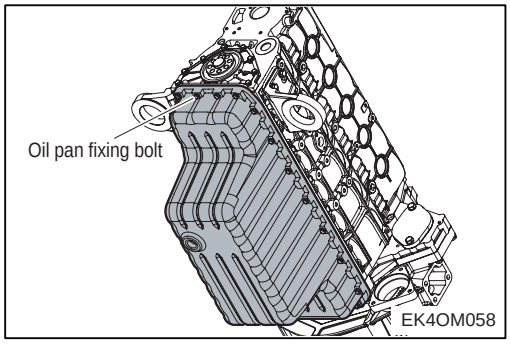
3.1.30. Oil cooler

- Loosen the fixing bolts of the oil cooler and disassemble the oil cooler.



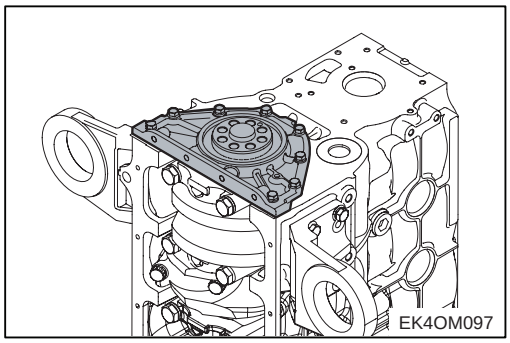
3.1.31. Oil pan

- Disassemble the oil fan fixing bolts, and detach the oil pan.
- Remove the oil pan gasket.



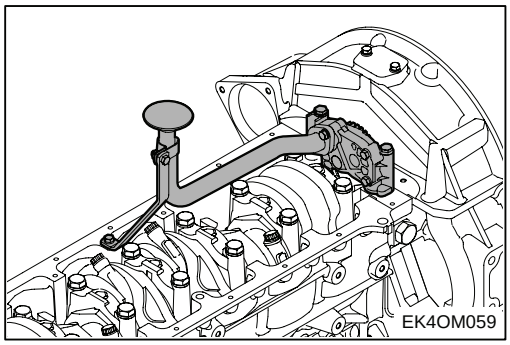
3.1.32. Front oil seal cover

- Disassemble the oil seal, using the oil seal disassembly tool.
- Loosen the fixing bolts of the gear case cover, and disassemble the oil seal cover.



3.1.33. Oil pump & pipe

- Loosen the fixing bolts of the oil intake pipe and disassemble the bracket.
- Disassemble the bolts for oil pump pipe assembly, and detach the intake pipe and supply pipe.
- Disassemble the bolts for oil pump assembly, and detach the oil pump.

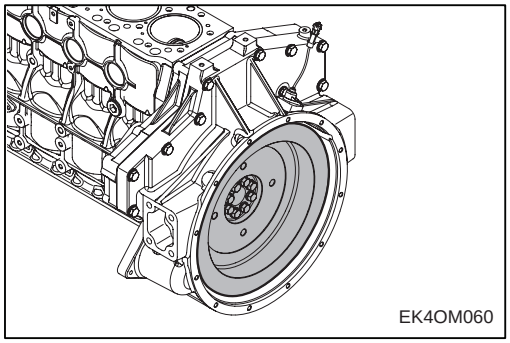


Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

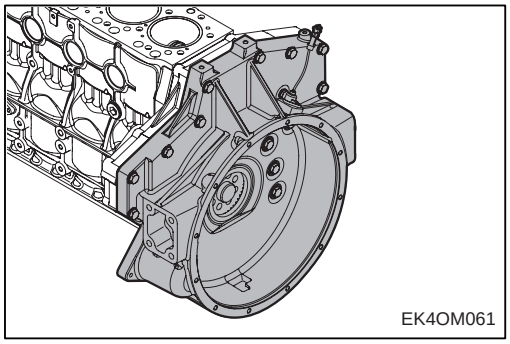
3.1.34. Fly wheel

- Disassemble the flywheel fixing bolts, and install the guide bolts, and detach the flywheel.
- Loosen the bolts in reverse order of assembly and in phases.


EK4OM060

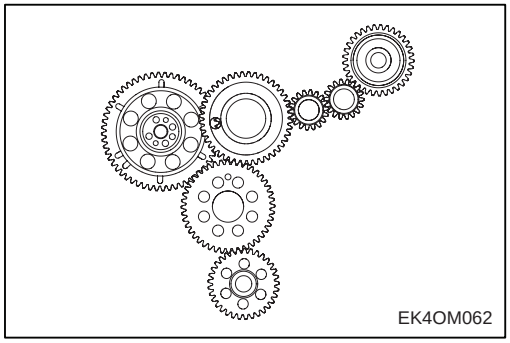
3.1.35. Flywheel housing

- Remove the bolts for flywheel housing assembly, and disassemble the flywheel housing.
- Disassemble the flywheel housing oil seal.


EK4OM061

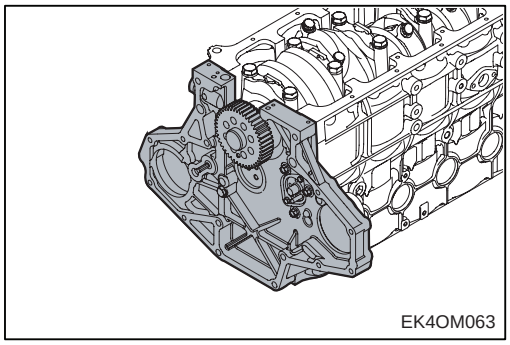
3.1.36. Cam gear and idle gear

- Disassemble the fixing bolts of the camshaft gear, and remove the camshaft gear.
- Disassemble the fixing bolts of the idle gear, and detach the idle gear pin.


EK4OM062

3.1.37. Timing gear case

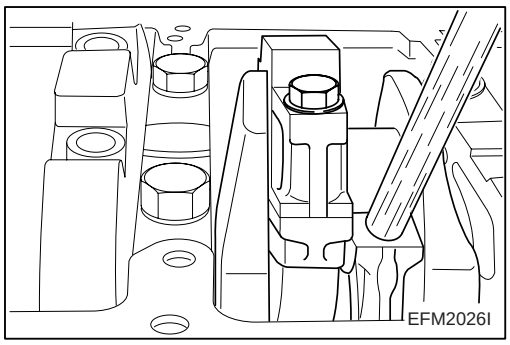
- Remove the bolts for timing gear case assembly.
- Beat the left and right rear side of timing gear case contact with urethane hammer slight to disassemble the timing gear case.


EK4OM063

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.1.38. Piston & connecting-rod

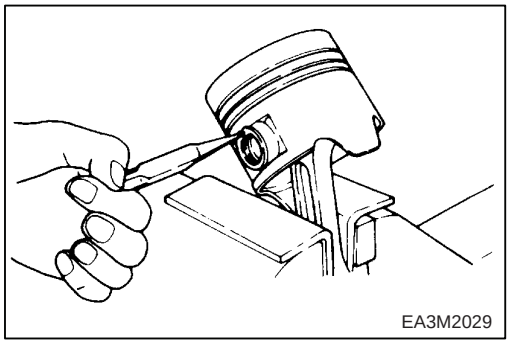


- Disassemble the connection rod cap bolts in reverse of assembly. Disassemble the bolts by phase 1 and 2, using the same method of the cylinder head bolts.
- Beat the top and bottom of the connecting rod cap softly with urethane hammer, and disassemble the bearing cap and bearing.
- Push the connecting rod with a wooden rod from oil pan to cylinder heat, and disassemble the piston assembly.
- Keep the disassembled pistons in order of the cylinder number, so that they don't touch each other.
- Assemble the connecting rod cap with the matching connecting rod temporarily, so that the caps are not changed.

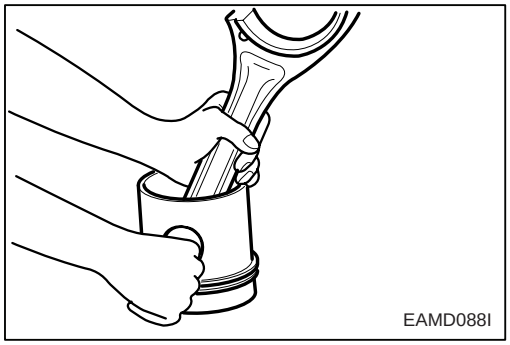
<Disassembly of piston >

(1) Remove the snap rings by means of a pliers.

- Disassemble jig no.
- : T7610001E.



(2) Heat the piston with a electric heater, then take out the piston pin from the piston as tapping it with a round wooden bar.

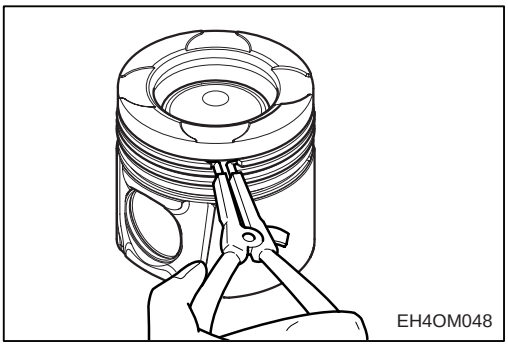


Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

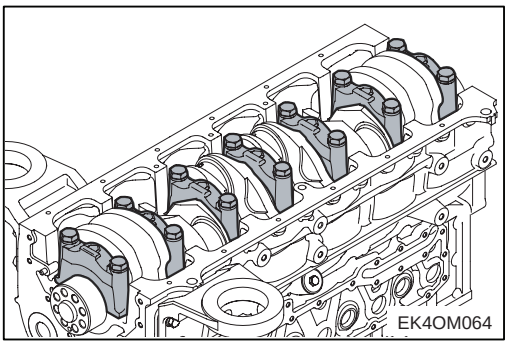
(3) Remove the piston ring with a pliers.
Disassemble jig no.
: T7621010E.

(4) Clean the piston thoroughly.



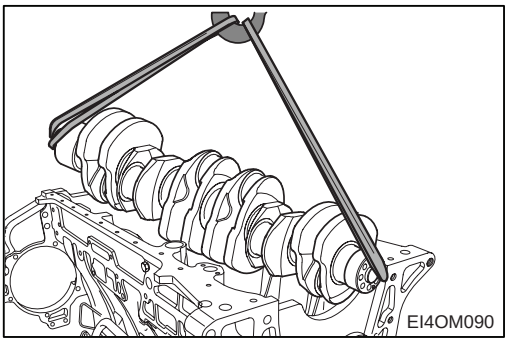
3.1.39. Bearing cap

- Remove the bearing cap fixing bolts in reverse order of assembly and in phase, and disassemble the bearing cap. (Remove the bearing cap with the same method for cylinder head bolt disassembly.)
- Keep bearing caps in order.



3.1.40. Crankshaft

- Assemble bolts to both side of the crankshaft temporarily.
- Life the crankshaft with a crane by connecting the rope to the bolt, while paying attention not to damage the crankshaft.
- Keep the disassembled crankshaft on the special shelf, so that it is not bent or damaged.
- Disassemble main bearings in order, and keep them.



CAUTION :

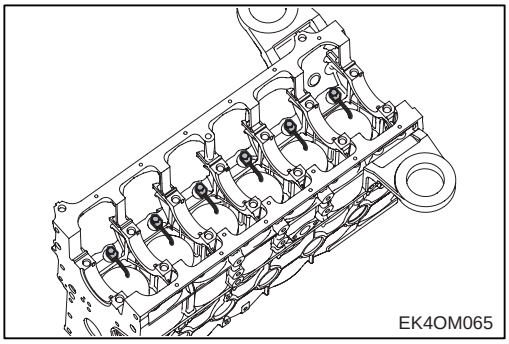
Do not mix main bearings and bearing caps. To prevent mixing, assemble main bearings with bearing caps temporarily in order.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

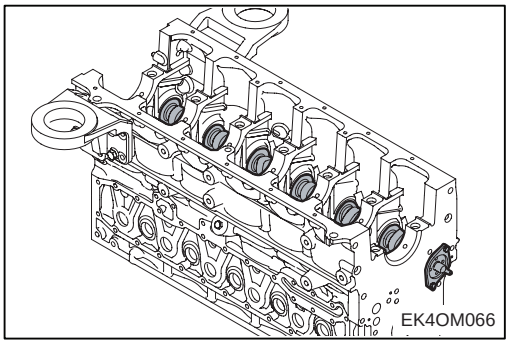
3.1.41. Oil spray nozzle

- Unscrew the crankshaft pulley fixing bolts in reverse sequence of installing sequence and remove the vibration damper assembly.



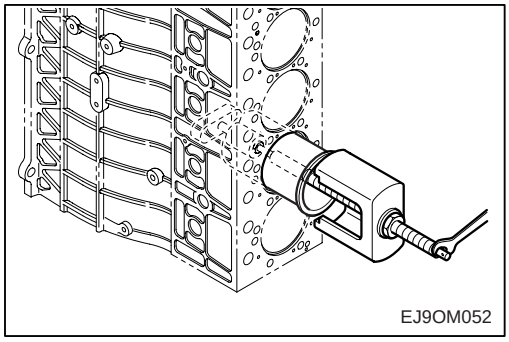
3.1.42. Camshaft and tappet

- Disassemble the camshaft by rotating it, in order to prevent the damage.
- Keep the disassembled crankshaft on the special shelf, so that it is not bent or damaged.
- Take out the tappet.
- Check the damage, scratch, and abrasion. If any abnormal item is found, replace it.



3.1.43. Cylinder liner

- Be careful not to generate any damage at cylinder block.
- Disassemble the cylinder liner with a special tool or hands.
- Disassemble jig no.
  : EF.121-222



Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

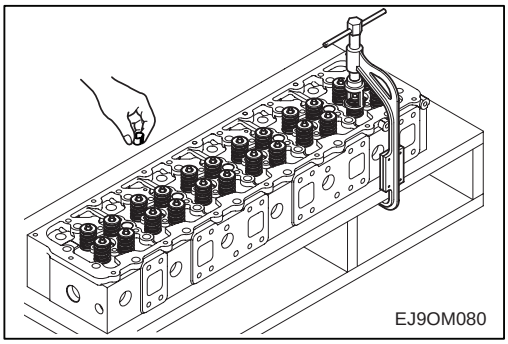
3.2. Inspection and Measurement on Major Parts

3.2.1. Cylinder block

- Clean the cylinder block thoroughly, and check for any crack or damage.
- If there is any crack or severe damage, replace it and if there is minor one, correct it.
- Check for any clogging or corrosion in the oil passage and water passage.
- Carry out a leakage test for any crack or air leaking. (Hydraulic test)
- Plug each cylinder block's water and oil discharge ports, and apply the air pressure of about 4 kg/cm2 to intake port and soak it in water for about 1 minute to check if there is any leakage. (Water temperature : 70 °C)

3.2.2. Cylinder head

1) Disassembly



- Disassemble the cylinder assembly, and put it on the shelf for assembly or clean lathe.
- Prevent any damage to gasket's contact surface of the cylinder head.
- Disassemble the cotter pin, spring, spring seat pushing valve spring by a special tool.
  Assembly tool item number :
  EF.123-065A
- Pull out the intake and exhaust valves.
- The disassembled parts are kept laid in turn.
- Disassemble the valve stem seal.

2) Inspection of cylinder head

a) Check for the cylinder head.

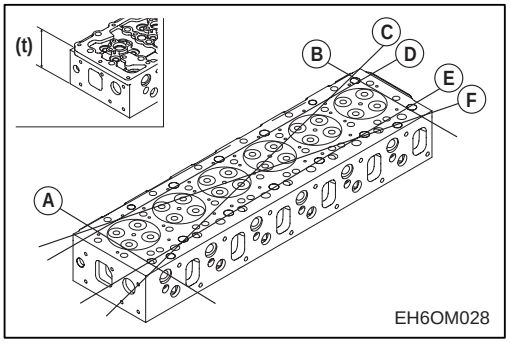
- Remove carbon from the cylinder head lower surface, and then should be careful not to scratch the surface.
- Check any crack or damage that can not found by naked eyes through the hydraulic or magnetic particle test.

Downloaded from www.Manualslib.com manuals search engine

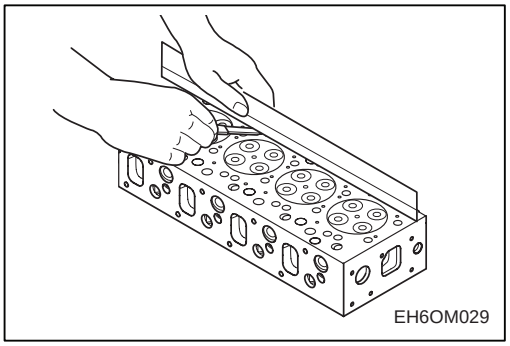
https://truckmanualshub.com/

b) Distortion of lower surface

- As shown in figure, measure the cylinder head's distortion at 6 directions with horizontal ruler and clearance gauge.
- If the measured value is beyond the limit value, correct it by means of the fine grinding paper or grinding machine.



- If it is beyond the max. allowable value, replace the cylinder head.



< Lower face warpage and height >

(mm)

Dimension / Description	Standard	Limit
Warpage	0.08 or less	0.15
Thickness : t (reference)	104.9 ~ 105.1	104.4

c) Flatness

- Check the flatness of the installing surface of cylinder head's intake and exhaust manifolds with horizontal ruler and clearance gauge.

(mm)

Standard	Limit
0.15	0.3

d) The hydraulic test

- The hydraulic test of cylinder head is same as the cylinder block test.

Downloaded from www.Manualslib.com manuals search engine

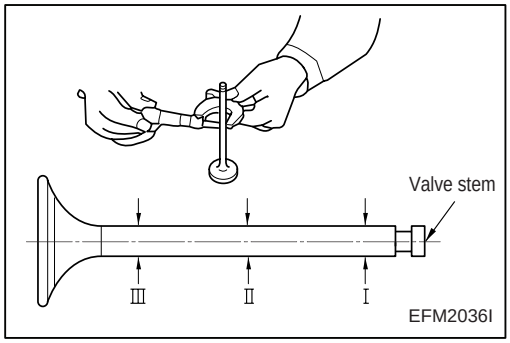
https://truckmanualshub.com/

3.2.3. Inspection of valve and valve guide

1) Valve

- After cleaning valve with fuel, check it.

- Valve stem outer diameter
  Measure the valve stem outer diameter at 3 positions (top, middle, and bottom), and check for any wear and if beyond the limit value, replace the valve.

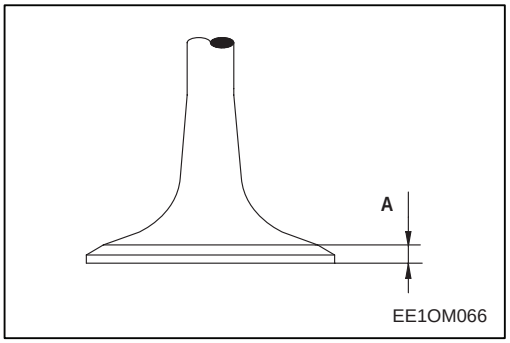


(mm)

Dimension / Description	Standard	Limit
Intake valve stem	ø6.963 ~ ø6.977	ø6.93
Exhaust valve stem	6.950 ~ 6.964	ø6.91

- Valve seat contacting faces
  Check the valve seat contact surface for any crack and wear, and if necessary, correct with grinding paper, and if excessive, replace it.

- Valve head thickness
  Measure the thickness of valve head and if beyond the limit value, replace the valve.



(mm)

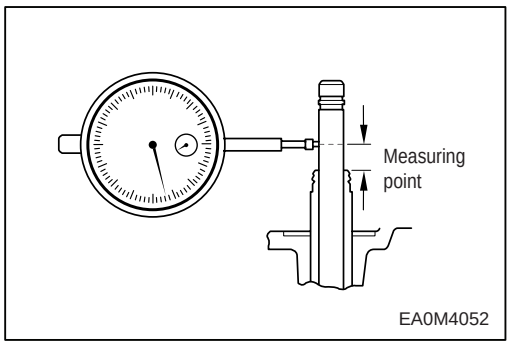
Dimension / Description	standard	Limit
Intake valve (A)	3.3 ~ 3.7	2.8 or less
Exhaust valve (A)	3.3 ~ 3.7	2.8 or less

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

2) Valve guide

- Put the valve in the cylinder head, and measure the valve guide and valve clearance with valve movement. If the clearance is big, measure the valve, and replace the valve or valve guide, which is more worn-out.



< Valve stem clearance >

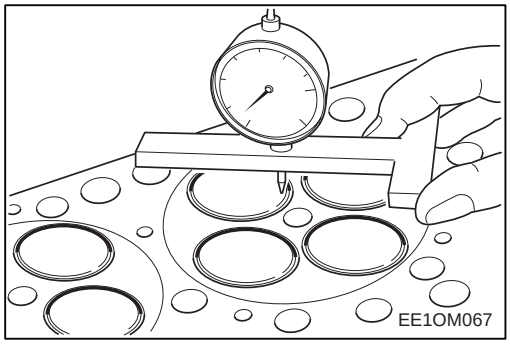
(mm)

Description \ Dimension	Standard	Limit
Intake valve	0.023 ~ 0.052	0.1
Exhaust valve	0.036 ~ 0.065	0.15

- Assemble the valve to cylinder head's valve guide and see if it is centered with the valve seat using a special tool.

3) Valve seat

- Contact frequency of the contact surface. Measure height of the contact surface with the intake and exhaust valve to check abrasion of the valve seat. If the measurement value is over the limit of tolerance, replace the valve seat.
- Put the valve into the valve seat of the cylinder head, and measure the distance of valve insertion into the cylinder head bottom, using the dial gauge.



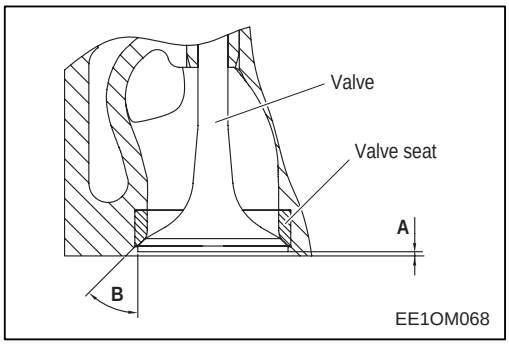
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

< Valve depression >

(mm)

Dimension / Description	standard	Limit
Intake valve (A)	0.35 ~ 0.65	0.85
Exhaust valve (A)	0.35 ~ 0.65	0.85

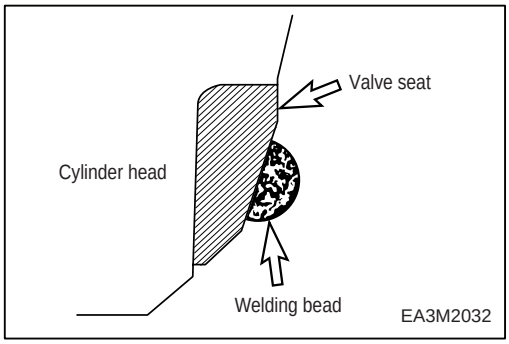


< Valve angle >

(mm)

Intake valve (B)	Exhaust valve (B)
60°	45°

- Replace the valve seat, if the valve insertion distance exceeds the limit of tolerance.
- To disassemble the valve seat, perform arc welding at two spots on the valve seat, and take out the valve seat using the special tool.
  (Boring of the bore is needed, when the valve seat is replaced.)



- To assemble the valve seat, put the valve seat in dry ice for 2 hours for freezing. Then, push the valve seat into the cylinder heat using the bench press.
- Apply abrasive material on the valve heat contact of the valve seat, and turn the valve. Then, grind the valve seating surface until the valve is fixed firmly, and wipe out the abrasive material.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

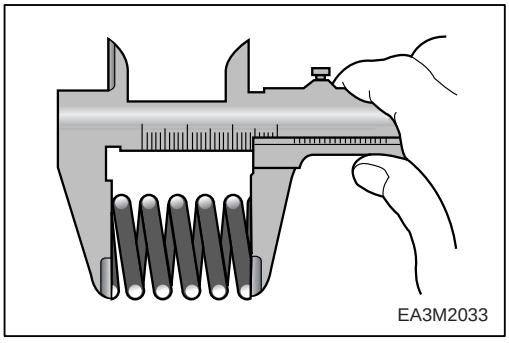
4) Valve spring

- Visual check

  Check the appearance of valve spring and if necessary replace the spring.

- Valve spring free length

  Use a vernier caliper to measure the valve spring free length. If the measured value is less than the specified limit, the valve spring must be replaced.

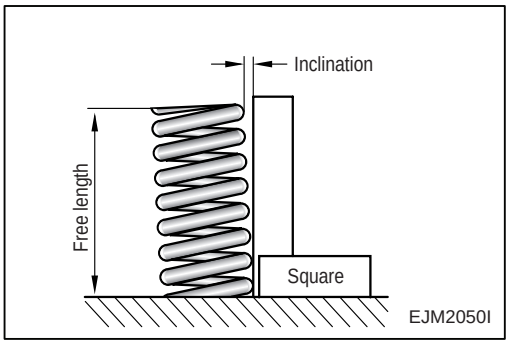


(mm)

Spring free length	Standard
Intake valve Exhaust valve	53.5

- Valve spring inclination

  Measure orthogonality of the valve spring using the surface plate and square measure. If the measurement exceeds the limit of tolerance, replace the valve spring.

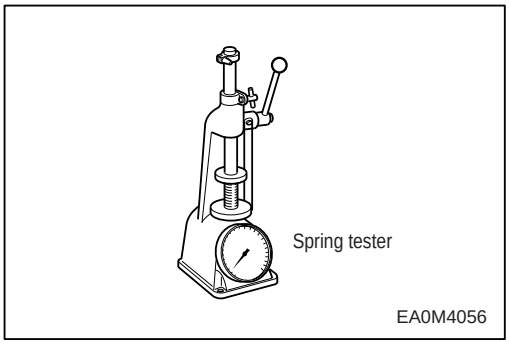


(mm)

Dimension / Description	standard	Limit
Valve spring inclination	Under 1.4	2.0

- Valve spring tension

  Use a spring tester to measure the valve spring tension if the measured value is less than the specified limit, the valve spring must be replaced.



(mm)

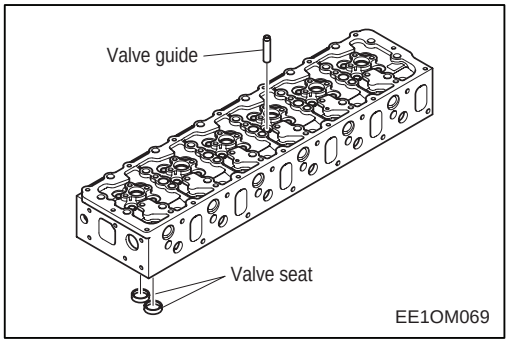
Item	Setting length	Spring tension	Limit
Intake and exhaust valve	39.4 mm	28.8 kg	±2 kg
	29.67 mm	50 kg	±2 kg

Downloaded from www.Manualslib.com manuals search engine

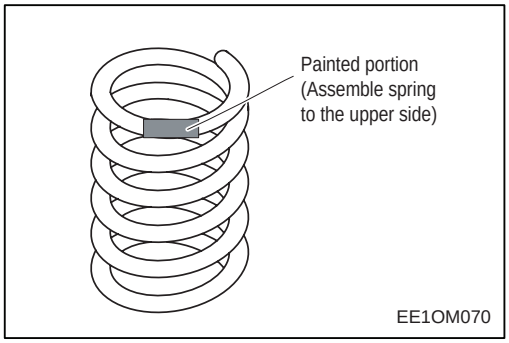
https://truckmanualshub.com/

5) Assembling cylinder head

- Clean the cylinder head, and replace the valve steam seal with new one.
- Put the steam seal in the cylinder head valve guide, using the special tool.
  - Assembly tool item number : EF.121-253
- Spray engine oil on the valve stem and valve guide, and assemble the valves. Be careful not to damage the valve stem seal.
- Mount the valve spring seat on the valve guide on the upper side of the cylinder head.



- Assemble the internal and external valve spring, and put the spring seat on it.
- Press the valve spring using the valve spring pressing tool, and insert the valve cotter to assemble the valve.
  - Assembly tool item number : EF.123-065

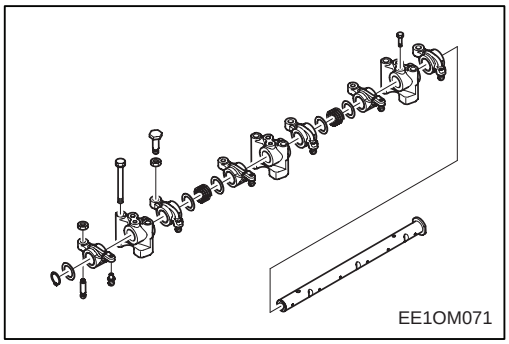


- Beat the valve softly with a urethane hammer to see if the valve is assembled correctly.

3.2.4. Rocker arm

1) Disassembly

- Disassemble the snap rings that are located at one end of rocker arm shaft by a plier.
- Disassemble in the order of washer, rocker arm, rocker arm bracket, rocker arm spring.



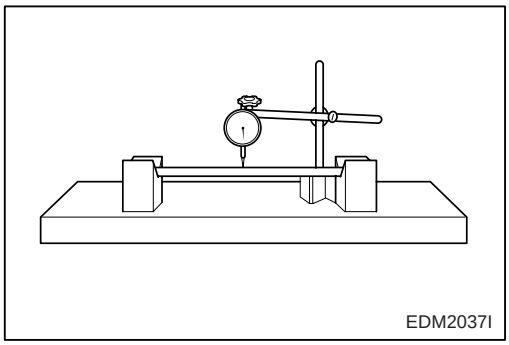
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

2) Inspection of rocker arm assembly

- Rocker arm shaft

Rocker arm shaft run-out Place the rocker arm shaft on two V-blocks and inspect the shaft for bend using a dial gauge. If the amount of this run-out is small, press the shaft with a bench press to correct the run-out. Replace the shaft if the measured value exceeds the limit.



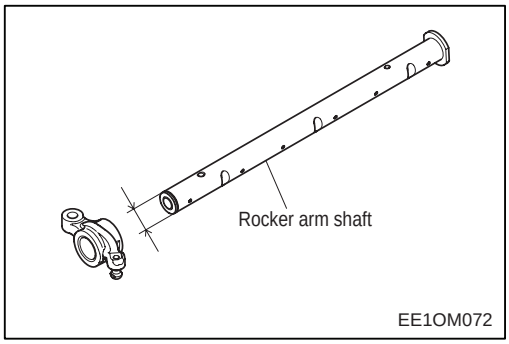
(mm)

Limit	0.1

- Rocker arm shaft diameter

With an outside micrometer, measure the rocker arm shaft diameter at the point where the rocker arms have been installed.

Replace the rocker arm if the amount of wear is beyond the specified limit.



(mm)

Standard	Limit
ø24.939 ~ 24.960	ø24.90

3) Rocker arm

- Visual check

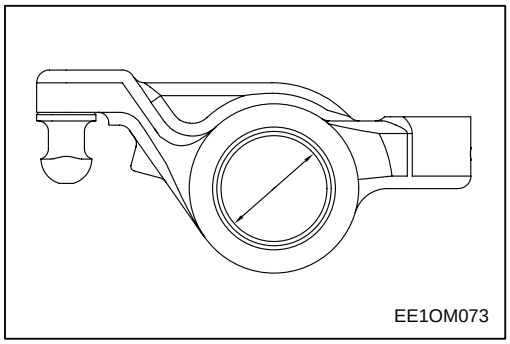
Visually check the face of the rocker arm in contact with the valve stem end for scores and step wear. If the wear is small, correct it with an oil stone or grinding paper of fine grain size. Rocker arm with a considerable amount of step wear should be replaced.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

- Rocker arm bushing diameter

Measure the inside diameter of the rocker arm bushing with an inside micrometer or vernier calipers, and compare the measured values with the rocker arm shaft diameter. If the clearance exceeds the limit, replace either bushing or shaft, whichever worn more.



(mm)

Standard	Limit
ø24.991 ~ 25.012	ø25.04

(mm)

	Standard	Limit
Rocker arm and shaft clearance	0.031~ 0.073	Under 0.14

4) Tappet and push rod

- Clearance

Measure the clearance of the tappet and tappet holes of the cylinder block. If the value is beyond the specified limit, replace tappets.

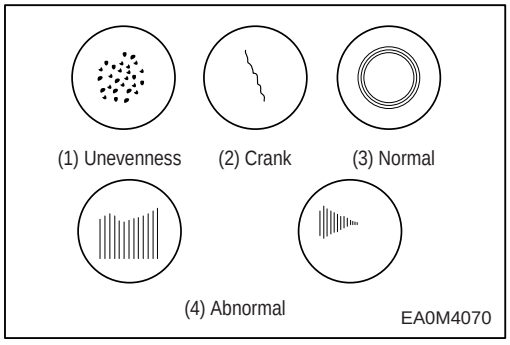
(mm)

Standard	Limit
0.028 ~ 0.069	0.13

- Visual check of tappet

Visually check the face of the tappets in contact with the cam for pitting, scores or cracks, and replace if severely damaged.

If the amount of cracks or pitting is small, correct with an oil stone or grinding paper.



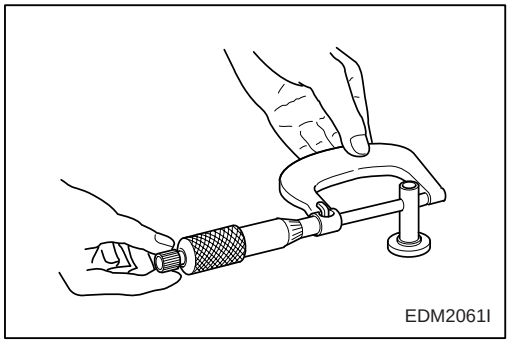
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

- Outside diameter of tappet
  With an outside micrometer, measure the tappet outside diameter if the measured value is beyond the limit, replace tappets.

(mm)

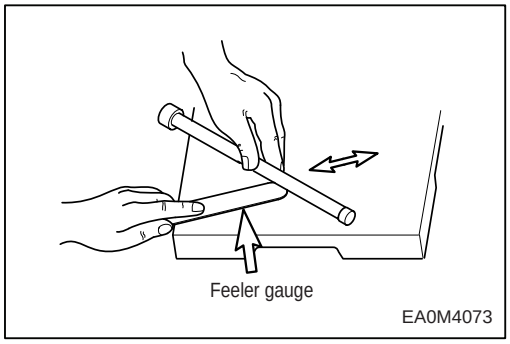
Standard	ø24.90 ~ ø27.982



- Push rod run-out
  Use a feeler gauge to measure the push rod run-out.
  Roll the push rod along a smooth flat surface as shown in the figure.

(mm)

Limit	0.25 or less
Push rod length	344



5) Rocker arm assembly

- Reassembling can be done in the reverse order of disassembling and following things should be heeded.
- Check the oil supply hole of rocker arm shaft for any clog and clean thoroughly.
- Be careful, not to occur any swap of position and reverse assembly.

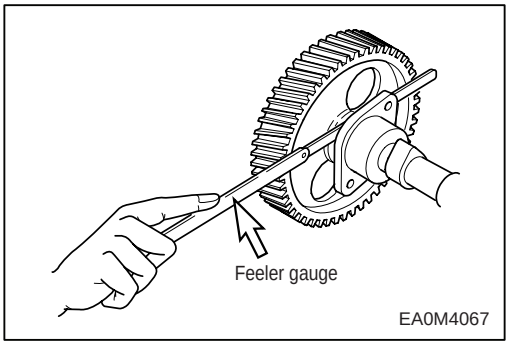
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.2.5. Camshaft

1) Camshaft end play

- Push the camshaft gear toward the opposite cylinder block.
- With a feeler gauge, measure the clearance between the thrust plate and camshaft gear.
- If the end play is excessive, replace the thrust plate.

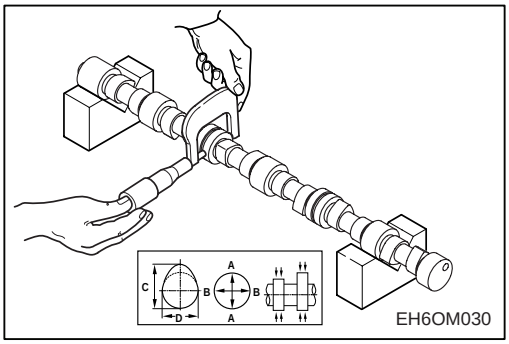


(mm)

Standard	Limit
0.028 ~ 0.069	0.13

2) Cam

- Use a micrometer to measure the cam lobe height and journal diameter.
- If the measured number is less than the specified limit, the camshaft must be replaced.



(mm)

		Standard	Limit
Cam lobe height (C)	Intake	46.025	45.73
	Exhaust	49.170	47.48
Cam journal diameter (A, B)		ø55.92 ~ ø55.95	ø57.65

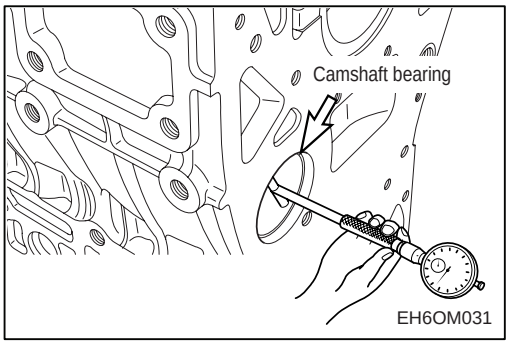
- Inspect the cam face for scratch or damage.
- Slight step wear or damage on the cam face may be corrected with oil stone or oiled grinding paper. But, replace if severely damaged.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3) Between camshaft journal and camshaft bush

- With an outside micrometer, measure the camshaft journal diameter.
- Measure the inside diameter of the camshaft bushing on the cylinder block using a cylinder bore indicator, and compare the measured value with the camshaft outside diameter to determine the clearance.



<Clearance>

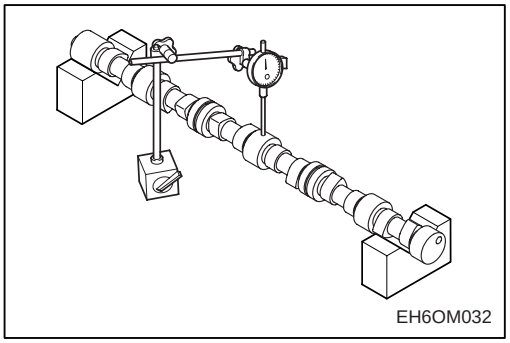
(mm)

Standard	Limit
0.03 ~ 0.09	0.18

- Replace the bushing if the measured value is beyond the specified limit.

4) Camshaft run-out

- Support the camshaft on two V-blocks and check for run-out using a dial indicator. Correct or replace the camshaft if the amount of run-out is beyond the value indicating need for servicing.



(mm)

Standard	Limit
0.05	0.15

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.2.6. Crankshaft .

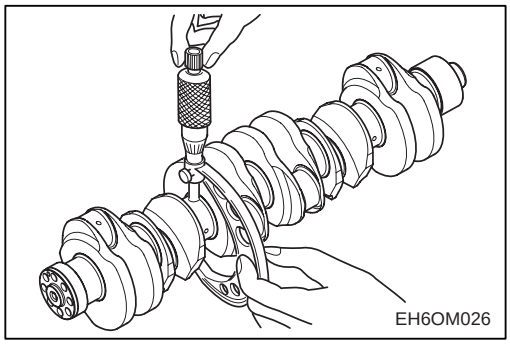
1) Inspection of crankshaft

a) Defect check

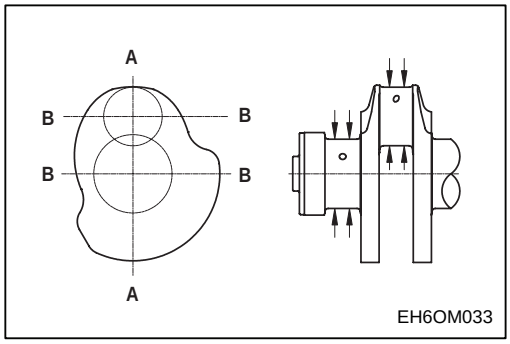
- Check the scratch or crack of the crankshaft journal and crank pin with naked eyes.
- Check crack of the crankshaft through the magnetic particle inspection test and crack detection by penetration of penetrant (color check). If any crack is found, replace the crankshaft.

b) Wear measuring

- With an outside micrometer measure the diameter of the crankshaft journals and pins in the directions as shown, and compare the measured values to determine the amount of wear.
- If the amount of wear is beyond the limit, have the crankshaft ground and install undersize bearings.



- However, if the amount of wear is within the limit, you can correct the wear using an oil stone or oiled grinding paper of fine grain size. (Be sure to use grinding paper which has been immersed in oil.)

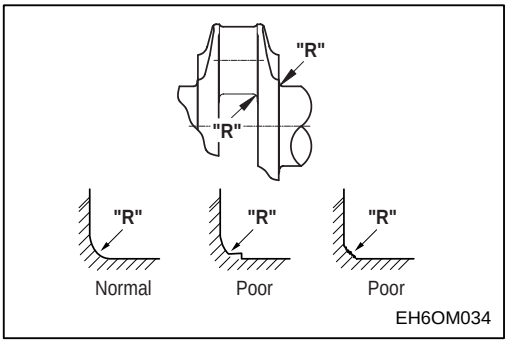


(mm)

	Standard	Limit
Journal diameter	ø79.905 ~ ø79.925	ø78.905
Pin diameter	ø68.924 ~ ø68.944	ø67.924

Downloaded from www.Manualslib.com manuals search engine

- In case that pin's wear is more than the limit value, grind the crankshaft journal and crank pin, and use the undersized bearings.
- Be sure to use grinding paper which has been immersed in oil.



< Undersize bearings available >

(a) Standard

(b) 0.25 (Inside diameter is 0.25 mm lesser than the standard size)

(c) 0.50 (Inside diameter is 0.50 mm lesser than the standard size)

(d) 0.75 (Inside diameter is 0.75 mm lesser than the standard size)

(e) 1.00 (Inside diameter is 1.00 mm lesser than the standard size)

- Undersize bearings are available in 2 different sizes as indicated above, and the crankshaft can be reused through the regrinding as described above.

<"R part" standard value>

(a) Crank pin 'R' : 3.3 ~3.7

(b) Crank journal 'R' : 3.3 ~3.7

CAUTION :

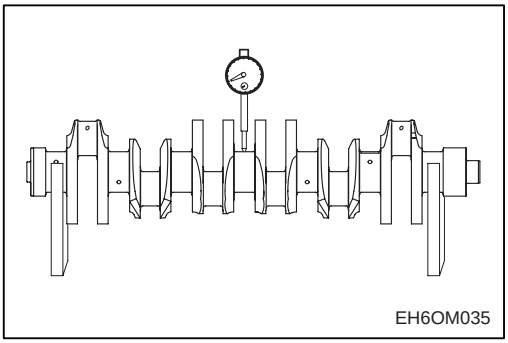
In case of regrinding, the grinding the "R" part of bearing end should be correctly done and avoid sharp corners or insufficient fillet.

c) Crankshaft run-out

- Support the crankshaft on V blocks.
- Turn the crankshaft with a dial indicator placed on the surface plate and take the amount of crankshaft run-out.

(mm)

Standard	Limit
0.06	0.15 or less



2) Crankshaft bearing and connecting rod

a) Visual check

- Visually check the crankshaft bearing and connecting rod bearing for scratch, uneven wear or damage.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

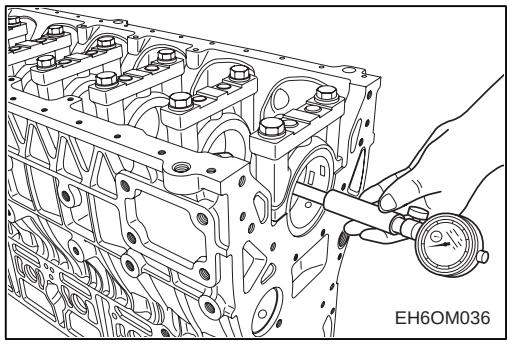
b) Oil clearance between crankshaft and bearing

(Method 1 : dial gauge)

- Main bearing clearance

Install the main bearing in the cylinder block, tighten the bearing cap to specified torque, then measure the inside diameter.

Torque	30 kg•m



Compare the two values obtained through measurement of main bearing inside diameter with the outside diameters of crankshaft journals to determine the oil clearance.

<Main bearing oil clearance>

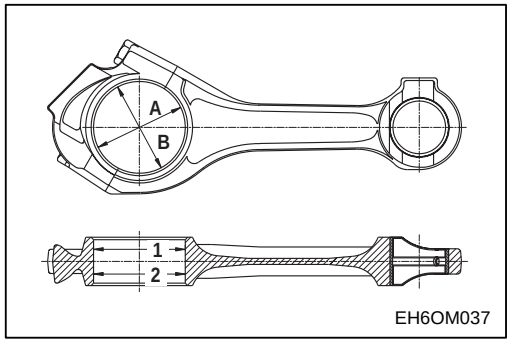
(mm)

Standard	Limit
0.052 ~ 0.122	0.15

- Connecting rod bearing clearance

Install the connecting rod bearing in the connecting rod bearing cap, tighten the connecting rod cap bolts to the specified torque, then measure the inside diameter.

Torque	9.75 kg•m



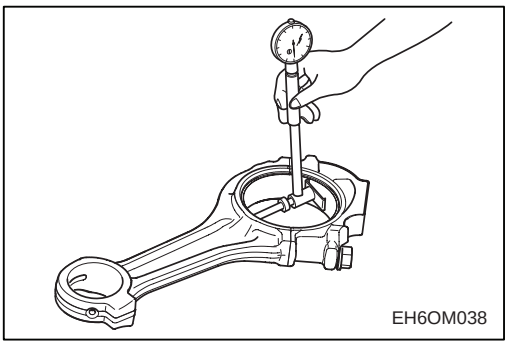
CAUTION :

For the assembly of the connecting rod bolt, assemble with your hand until the head of the bolt contacts both sides of the bolt surface of the connecting rod, and then use the torque wrench to tighten the bolts.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

- Compare the two values obtained through measurement of connecting rod bearing inside diameter with the outside diameters of crankshaft pins to determine the oil clearance.



(mm)

Standard	Limit
0.030 ~ 0.081	0.15

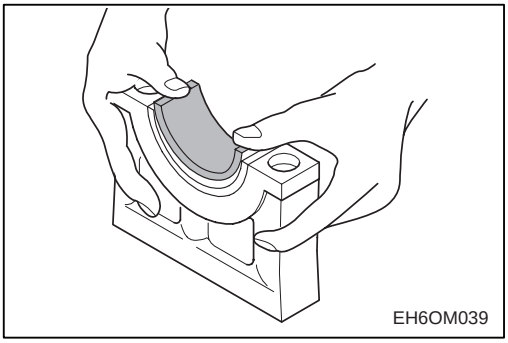
- If the clearance deviates from the specified range, have the crankshaft journals and pins ground and install undersize bearings.

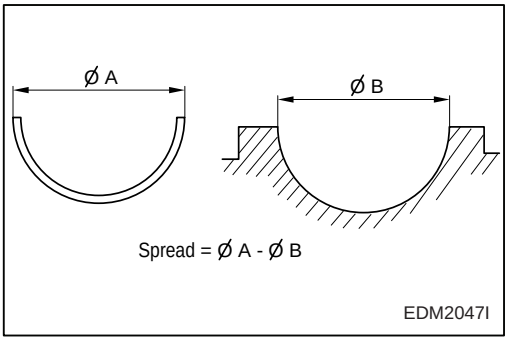
c) Oil clearance between crankshaft and bearing (Method 2 : plastic gauge)

- Assemble the crankshaft on the cylinder block and put plastic gauge on the journal and pin of crankshaft and then after assembling bearing cap, tighten the bolts at the specific torque.
- Again after disassembling the bearing cap by removing the bolts, take out the flatted plastic gauge and measure the width of plastic gauge by means of plastic gauge measuring scale. This is the oil clearance.

d) Bearing spread and crush

- Inspection
  Check to see that the bearing requires a considerable amount of finger pressure at reassembly operation.



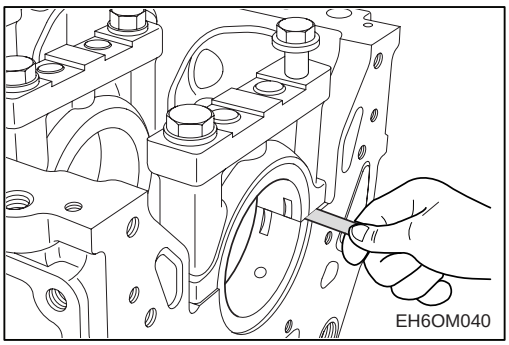


Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

- Crankshaft bearing crush

Install the bearing and cap in the cylinder block, retighten the bolts to specified torque, unscrew out one bolt completely, then measure the clearance between the bearing cap and cylinder block using a feeler gauge.

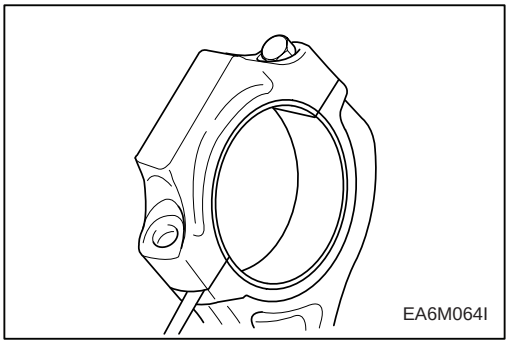


(mm)

Standard	0.065 ~ 0.105

- Connecting rod bearing crush

Install the bearing and cap in the connecting rod big end, retighten the bolts to specified torque, unscrew out one bolt completely, then measure the clearance between the bearing cap and connecting rod big end using a feeler gauge.

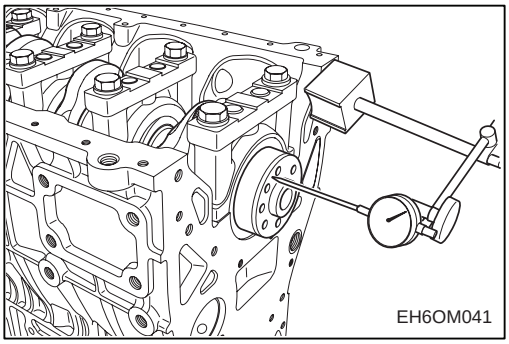


(mm)

Standard	0.065 ~ 0.105

e) Crankshaft end play

- Assemble the crankshaft to the cylinder block.
- With a dial gauge, measure crankshaft end play.



(mm)

Standard	Limit
0.052 ~ 0.122	0.15

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.2.7. Piston assembly

- Disassembly of piston assembly
  Disassemble piston according to the disassembly process.

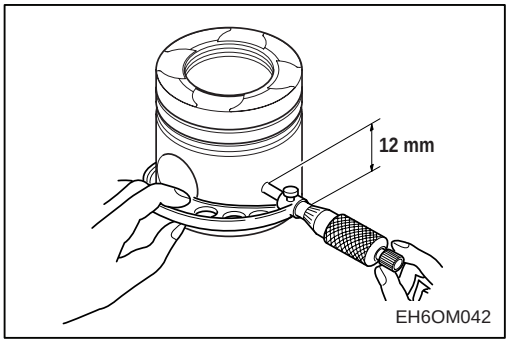
1) Piston inspection

a) Visual check

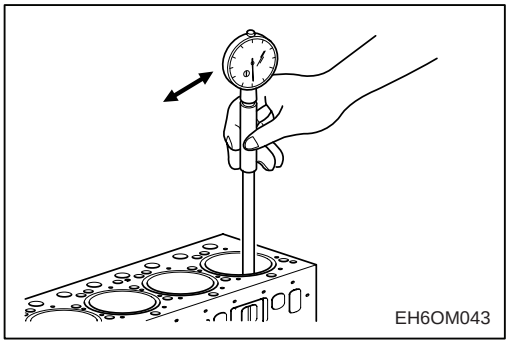
- Visually check the pistons for cracks, scuff or wear, paying particular attention to the ring groove.

b) Clearance between the piston and cylinder liner

- With an outside micrometer, measure the piston outside diameter at a point 12 mm away from the lower end of piston skirt in a direction at a right angle to the piston pin hole.



- Measure the internal diameter of the cylinder liner, using the cylinder internal diameter gauge.
- Measure three spots (top ring contact part of the cylinder liner, middle part, and oil ring contact part near the bottom dead center) to the 45 degree direction. Then, calculate the average value, excluding the maximum and minimum value.



- The clearance value can be obtained by detecting the external diameter measurement value of the piston from the internal diameter measurement value of the cylinder liner. If this value exceeds the limit of tolerance, replace the piston or cylinder liner, which is more worn-out.

<Clearance between piston and liner>

(mm)

Standard	0.065 ~ 0.105

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

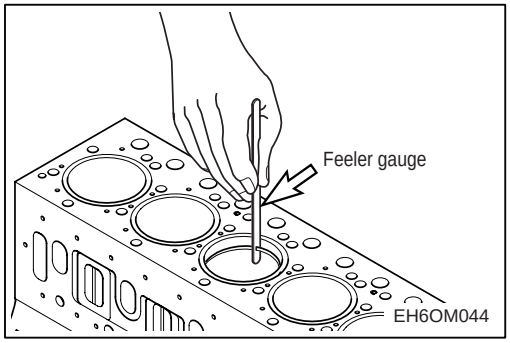
2) Piston rings

a) Visual check

- Replace the piston rings with new ones if detected worn or broken when the engine is overhauled.

b) Piston ring gap

- Insert the piston ring into the upper portion of the cylinder liner bore so that it is held at a right angle to the cylinder liner wall.
- Measure the piston ring gap with a feeler gauge.

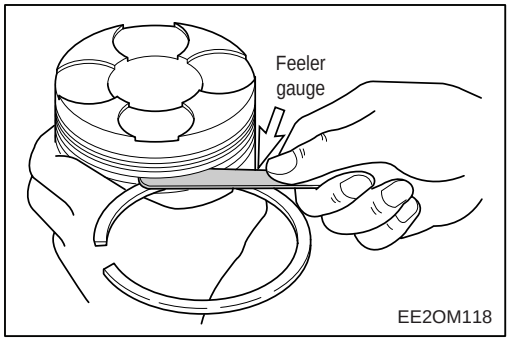


(mm)

	Standard	Limit
1st ring	0.30 ~ 0.45	1.5
2nd ring	0.60 ~ 1.80	1.5
Oil ring	0.25 ~ 0.45	1.5

c) Piston ring side clearance

- Fit the compression ring and oil ring in the piston ring groove.
- With a feeler gauge, measure side clearance of each ring, and replace either the ring or piston if the measured value is beyond the specified limit.



(mm)

	Standard	Limit
1st ring	-	-
2nd ring	0.05 ~ 0.09	0.15
Oil ring	0.03 ~ 0.07	0.15

d) Piston ring tension

- With a tension tester, measure piston ring tension. Replace the piston ring if the measured value is beyond the limit.

	Standard
1st ring	1.47 ~ 2.21 kg
2nd ring	1.49 ~ 2.23 kg
Oil ring	4.08 ~ 5.52 kg

Downloaded from www.Manualslib.com manuals search engine

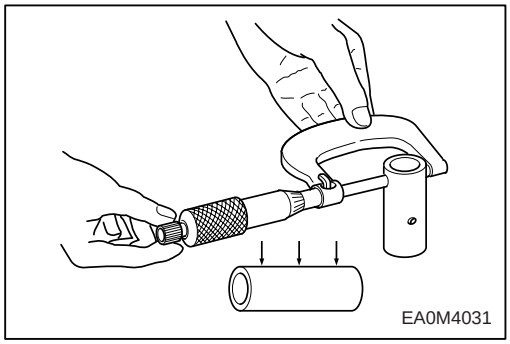
https://truckmanualshub.com/

3) Piston pin inspection

- The measured values are beyond the limit (0.08 mm or greater), replace the piston pin.

(mm)

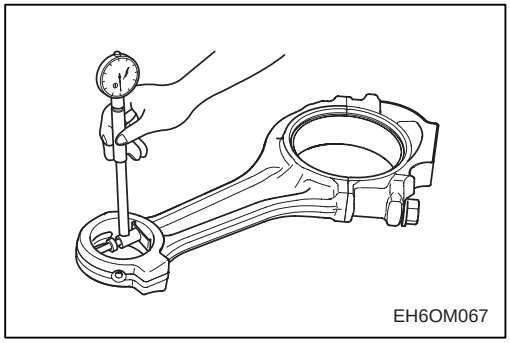
Piston pin Standard	Limit
∅39.994 ~ ∅40.000	∅39.94



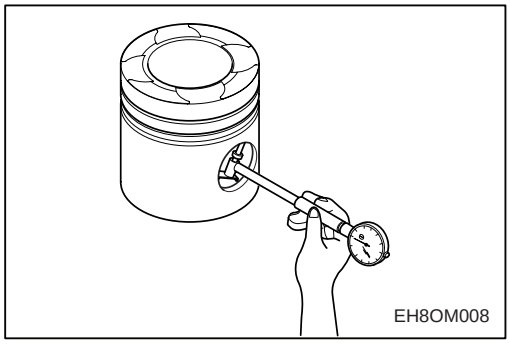
- Measure the clearance between the piston pin and connecting rod bushing, and replace either of them, whichever damaged more, if the measured value is beyond the limit.

(mm)

Standard	Limit
0.008 ~ 0.020	0.08



- When replacing the piston, be sure to replace the piston pin together.



Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

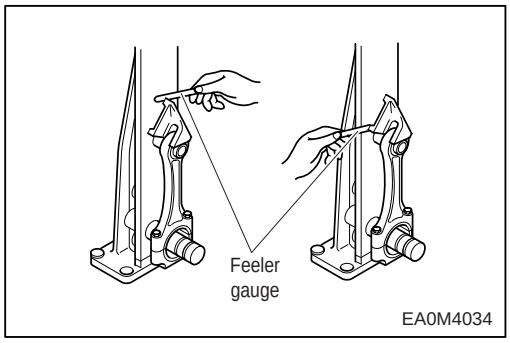
4) Connecting rod inspection

a) Distortion

- Check the connecting rod for distortion. As shown in the figure below, install the connecting rod to the connecting rod tester, and check for distortion using a feeler gauge.
- If the connecting rod is found distorted, never re-use it but replace with a new one.

b) Holes alignment (parallelism)

- Measure the alignment of the connecting rod piston pin bushing holes with connecting rod big end holes.
- At this time also, use both connecting rod tester and feeler gauge.



(mm)

Standard	Limit
0.02	Under 0.1

c) Wear

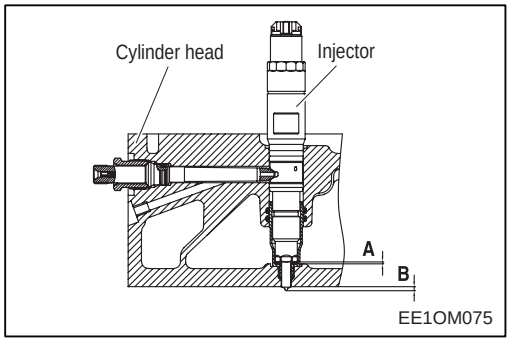
- Assemble the connecting rod to the crankshaft and measure connecting rod big end side clearance using a feeler gauge.
- Assemble the connecting rod to the piston and measure connecting rod small end side clearance.
- If the measured values are beyond the limit, replace the connecting rod.

(mm)

Standard	Limit
0.17 ~ 0.30	0.50

3.2.8. Injector projection

- Insert a seal ring on the cylinder head and assemble the injector. (Refer to 3.3 chapter for assembly order)
- Measure the clearance between the cylinder head bottom and injector tip. If the measured valves are beyond the limit, replace the seal ring.



(mm)

A (Thickness of seal ring)	2.0
B (Projection of nozzle)	3.0

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.3. Engine Reassembly

3.3.1. General precautions

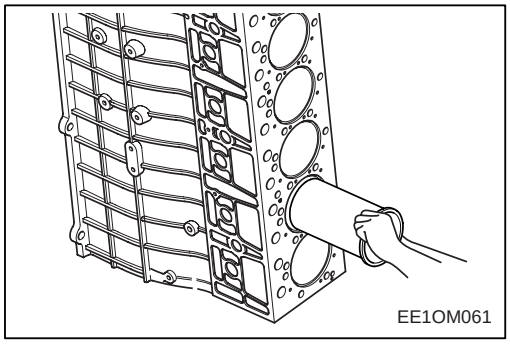
- Clean all the disassembled parts, particularly oil and water ports, using compressed air, then check that they are free from restrictions.
- Arrange the general and special tools in order for engine assembly operation.
- To wet each sliding part, prepare the clean engine oil.
- Prepare service materials such as sealant, gaskets, etc.
- Discard used gaskets, seal rings, and consumable parts, and replace with new ones.
- Apply only the specified torque for bolts in the specified tightening order and avoid over-tightening.
- Be sure to check that all the engine parts operate smoothly after being reassembled.
- Check the bolts for looseness after reassembly.
- After completing the engine reassembly operation, check if there is missing parts or shortage of parts.
- Keep your hands clean during the working.

3.3.2. Cylinder block

- Put wood or thick paper on the workplace floor and face the head assembly surface downward, so that the cylinder head assembly surface is not damaged.

3.3.3. Cylinder liner

- Stand the cylinder block so that the flywheel faces downward.
- Thoroughly clean the liner flange fitting surface and bore inside with compressed air to prevent the entry of foreign substances.
- After the cleaning operation, make the cylinder liner dried up and push it into the cylinder block by hand.

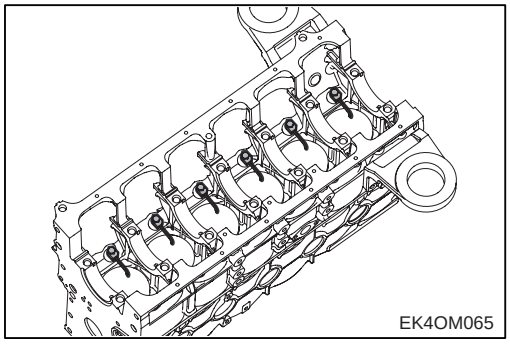

EE1OM061

- Wet the liner inside diameter with engine oil.

3.3.4. Oil spray nozzle

- Adjust the oil injection nozzle to the cylinder block groove, using the oil injection nozzle assembly jig, and assemble them with relief valve fixing bolts.

Torque	2.1 kgf•m

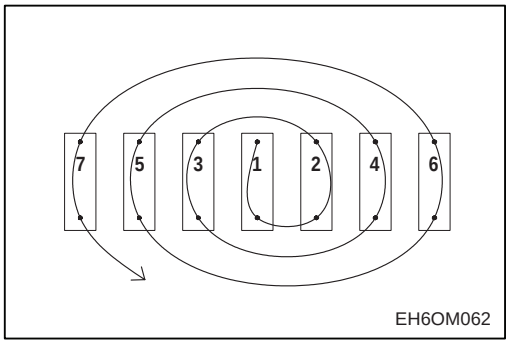

EK4OM065

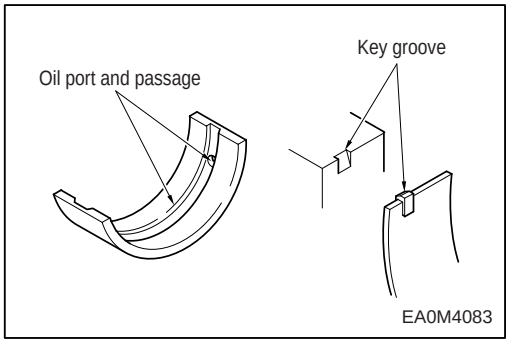
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

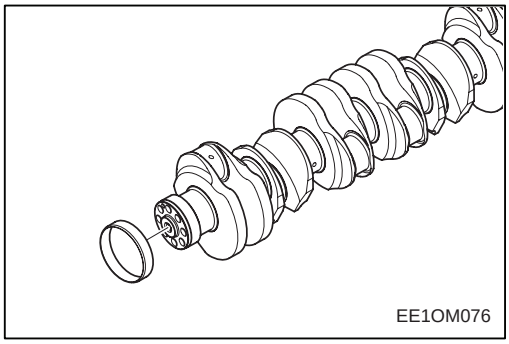
3.3.5. Crankshaft

- Install the main bearing (refer to assemble sequence : right figure) machined with two holes in the cylinder block so that the key is aligned with the key groove, then apply oil to the bearing surface.

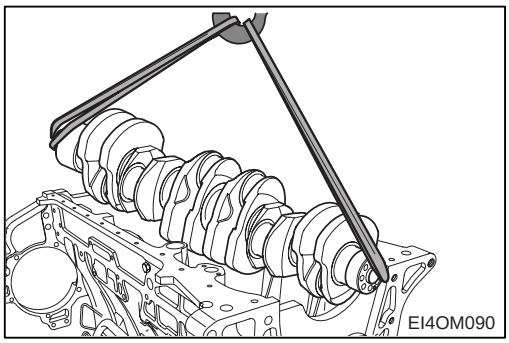




- Put the wear ring into the heater to heat it up to 150 °C level for 10 minutes, push it over the crankshaft by means of a jig.



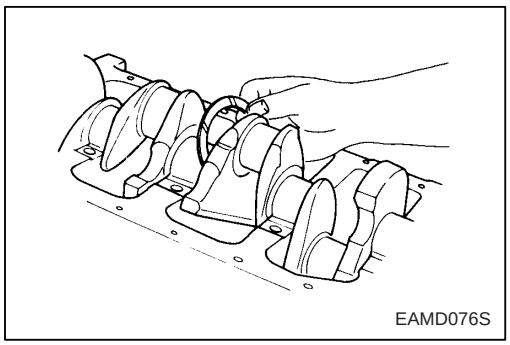
- Semi-tighten bolts at both sides of the crankshaft, apply engine oil to journals and pins, then assemble the crankshaft with the cylinder block by tightening the fixing bolts.
- Coat engine oil to the pin and journal of crankshaft.



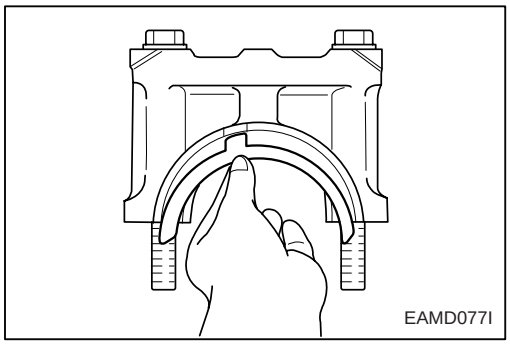
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

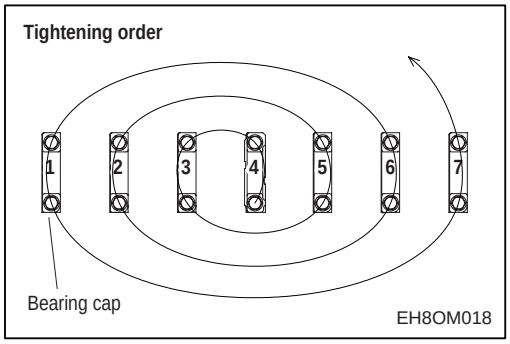
- Install the oiled thrust washers with the oil groove facing outward.



- Install the bearing and thrust washers to the bearing cap and apply oil to the bearing and thrust washers.



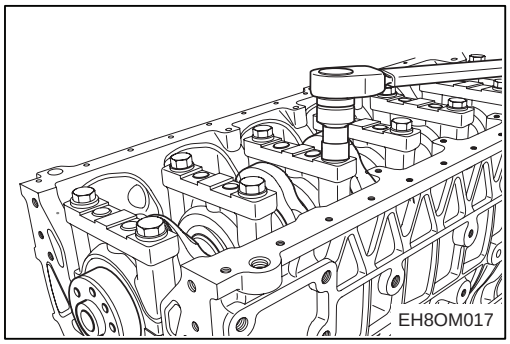
- Install the bearing cap by matching the cylinder block No. with the bearing cap No.



- Apply oil to the entire part of the bearing cap bolts, then tighten in tightening sequence to specified torque.

Torque	30 kgf•m

- After semi-tightening both bolts evenly, tighten them diagonally to the specified torque using a torque wrench as follows.



Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

<Tightening Order>

(1) First stage : Spray engine oil on bolts.

(2) Second stage : Fasten with 5 kgf•m torque until bolts are tightened.

(3) Third stage : Fasten up to 15 kgf•m with a torque wrench.

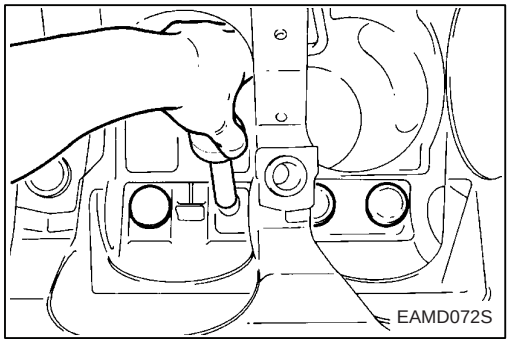
(4) Fourth stage : Fasten up to 25 kgf•m with a torque wrench.

(5) Fifth stage : Fasten up to 30 kgf•m with a torque wrench.

- Tighten the bearing cap in the sequence of 4 – 3 – 5 – 2 – 6 – 1 – 7.
- Rotate the assemble crankshaft 2 ~ 3 times to see if it rotates smoothly.

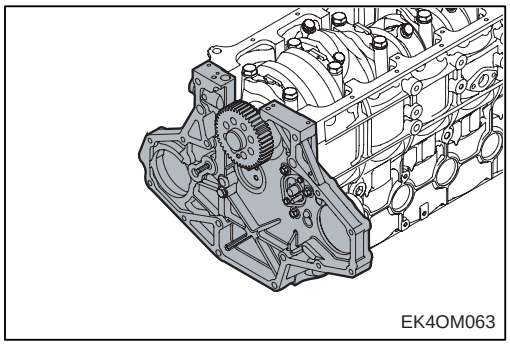
3.3.6. Tappet and camshaft

- Freeze the new bush by putting it in dry ice for 2 hours, and press it into the cam bush position of the cylinder block, using a bench press. Measure the internal diameter of the cam bush after pushing-in, and check deformation.
- Spray engine oil on the front side the tappet, and insert into tappet hole of the cylinder block.
- Spray engine oil on the camshaft hole and camshaft journal of the cylinder block, and insert the camshaft into the camshaft hole of the cylinder block.


EAMD072S

3.3.7. Timing gear case

- Install the gasket on the cylinder block, using the standard pin.
- Install the timing gear case on the cylinder block by adjusting the pin hole of the timing gear case to the pin hole, and beat the left and right side of the timing gear case softly with a urethane hammer, so that it is pressed to the cylinder block.


EK4OM063

- Tighten the bolt with the pre-defined torque.
- Tighten the bolts at the edge of both ends first, and others subsequently.

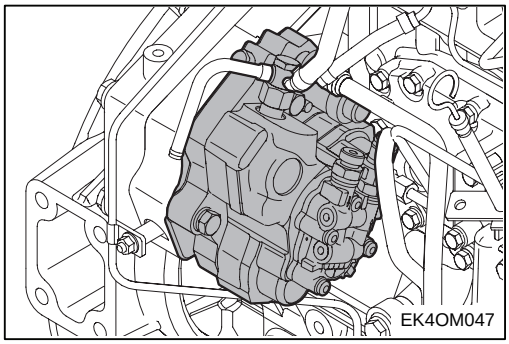
Relief valve	2.6 kgf•m
Timing gear case fixing bolt	4.4 kgf•m

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.3.8. Fuel high pressure pump

- Assemble the fuel high pressure pump, using the dedicated jig.


EK4OM047

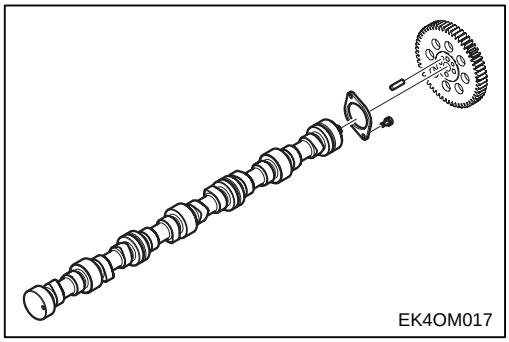
Gear nut torque	11 kgf•m
Fixing bolt torque	4.4 kgf•m

- When assembling a new fuel high pressure pump, open the plug screw and refill 60 m ℓ fuel.
- Install the fuel high pressure pump n the timing gear case located at the rear side of the flywheel housing.
- Tighten the fixing blots in order of assembly, using the pre-defined torque.

Flow screw torque	3.0 kgf•m
Nipple torque	4.4 kgf•m

3.3.9. Gear system

- Install the thrust washer on the camshaft, and assemble the cam gear to fit into the camshaft pin hole.
- Tighten the bolt for cam gear assembly with the pre-defined torque.


EK4OM017

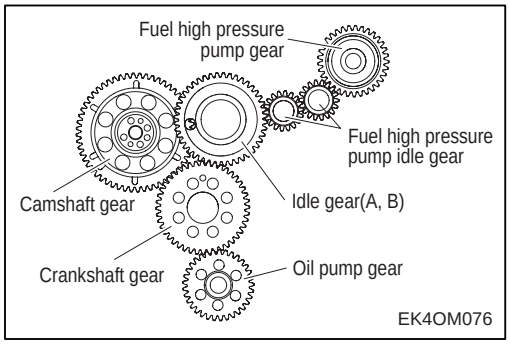
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

- Install the idle gear by adjusting it to the crankshaft gear, camshaft gear, and idle gear mark.

< Gear mark >

Crankshaft gear and idle gear (A)	"0" and "0"
Camshaft gear and idle gear (B)	"1" and "1"



Stem idle gear	6.2 kgf•m
Fuel high pressure pump idle gear	6.2 kgf•m

- Check backlash and end play amount of the gear, using the clearance gauge.

< Backlash > (mm)

Measurement position	Standard
Camshaft gear and idle gear	0.074 ~ 0.163
Fuel high pressure pump gear and idle gear	0.103 ~ 0.182
Crankshaft gear and oil pump driving gear	0.073 ~ 0.239

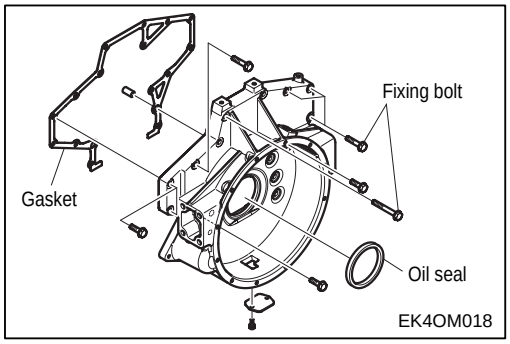
< End play > (mm)

Measurement position	Standard
Camshaft gear	0.280 ~ 0.430
Stem idle gear	0.107 ~ 0.183
Fuel high pressure pump idle gear	0.078 ~ 0.140

3.3.10. Flywheel housing

- Install a guide bar on the cylinder block temporarily.
- Attach the gasket to the cylinder block.
- Assemble the flywheel housing using dowel pins and guide bar, and tighten fixing bolts in tightening order with the pre-defined torque.

Torque	11.2 kgf•m



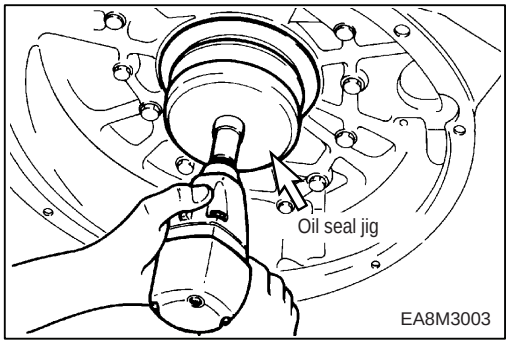
- Remove the guide bar after tightening the bolt.
- Apply engine oil on the outside surface of the oil seal thinly, and push the press into the housing.
- Assembly tool item number : EF.121-300

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

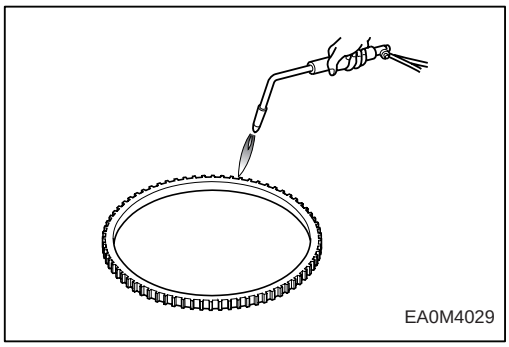
3.3.11. Rear oil seal

- Install the oil seal on the crankshaft, and assemble the oil seal, using the oil seal jig.

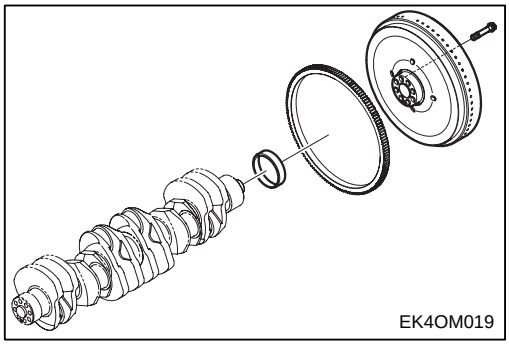


3.3.12. Flywheel

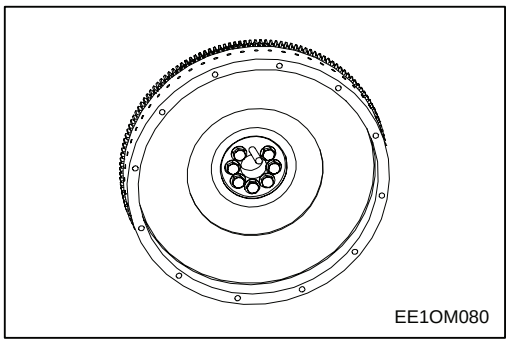
- Heat the ring gear with a gas burner evenly to inflate the ring gear, and assemble it, using the hammer.
- Make sure that the ring gear temperature doesn't go up over 200 °C.
- To assemble the ring wear front, heat the ring wear front at 150 °C and apply rock tight #262, and assemble using the assembling jig.



- When assembling the ring wear front, the side with the chamfered portion on outer periphery is the front side.



- Install a guide bar on the crankshaft bolt hole, and lift the flywheel and adjust it to the standard pin and then, assemble them temporarily.
- Apply the additive to the assembly bolts (rock tight #587), and assemble the bolts of which guide pin is not installed. Lastly, disassemble the guide pin, and assemble remaining bolts.

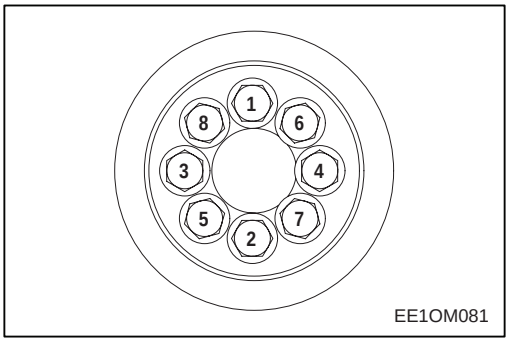


Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

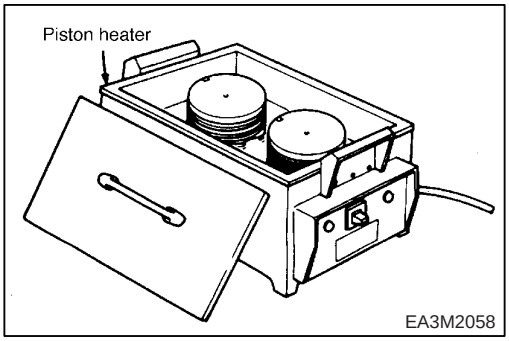
- Tighten fixing bolts in fastening order with the pre-defined torque, using a torque wrench.

Bolt specification	M14 × 1.5
Torque	20 kgf•m

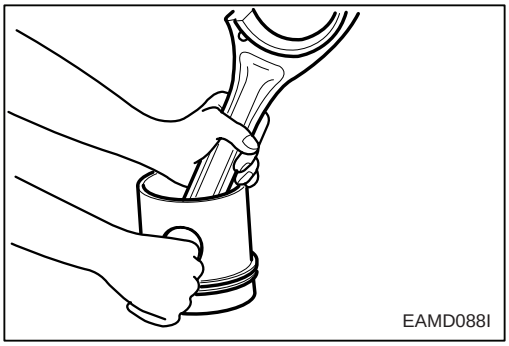


3.3.13. Piston and connecting rod

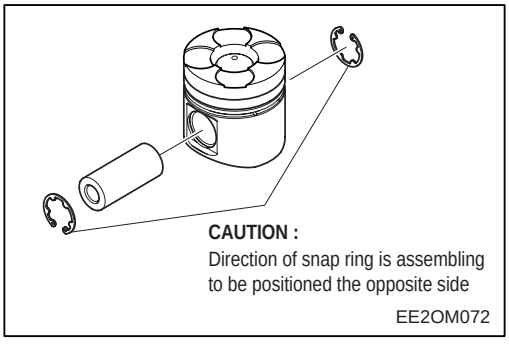
- Heat the piston at 100 °C at 5 minutes, using the piston heater.



- When assembling the piston and connecting rod, the weight adjustment part of the small end of the connecting rod should be on the opposite side of the oil gallery entry (large hole side) of the piston.
- Apply oil to the piston pin hole adjust it to the small end of the connecting rod. Then, beat the piston pin with a rubber hammer, and assemble the connecting rod and piston.



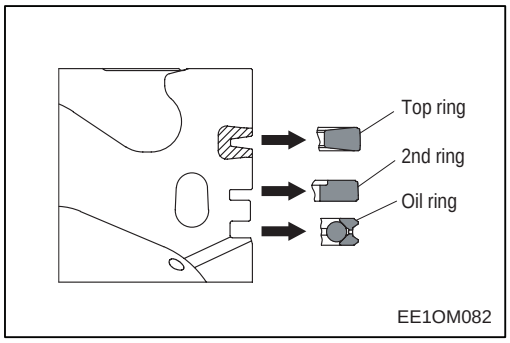
- Assemble the opening part of snap ring assembly in such way that it faces to the opposite side.
- Assemble the snap ring and check the assembly status.



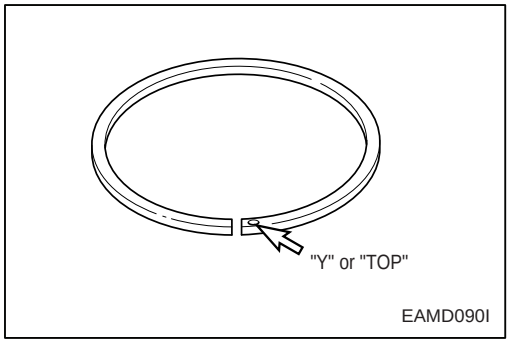
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

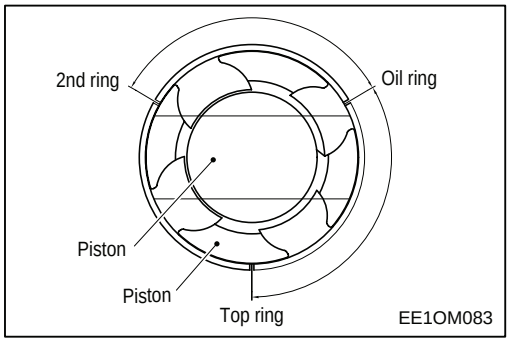
- Assemble the piston ring to the piston, using the piston ring flier.



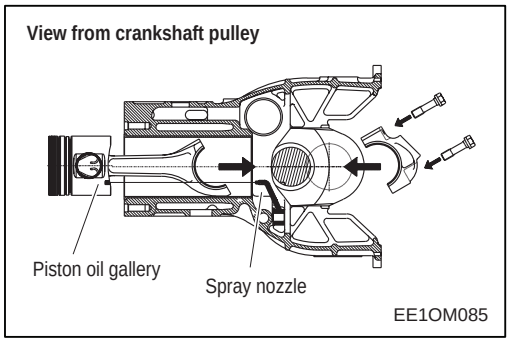
- To prevent that piston rings are upside down, make the section marked with "Y' or "TOP" on the upper side of the ring connection part face upward.



- Adjust the angle of the piston ring connection part to 120° and insert the piston insertion jig to the piston. Be careful that the piston ring connection part should not match the pin direction.
- Assemble the connecting rod bearing to the key groove, and spray oil on the bearing and piston.



- Insert the piston in such way that the entry of the piston oil gallery matches the direction of the spray nozzle.
- Be careful not to damage the cylinder liner and piston, and insert the ring into the cylinder line, using the piston insertion tool, so that the ring is not damaged by the end of the liner.
- Assembly tool item number : EF.120-208

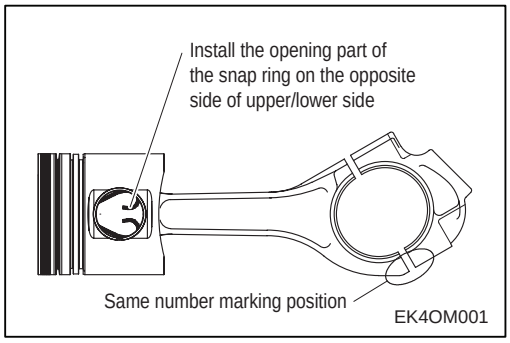


- Insert a bearing to the connecting rod cap and spray oil.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

- Make sure that the manufacture serial numbers impressed on the connecting rod cap and connecting rod big end are identical, and install the connecting rod cap by aligning it with dowel pin.

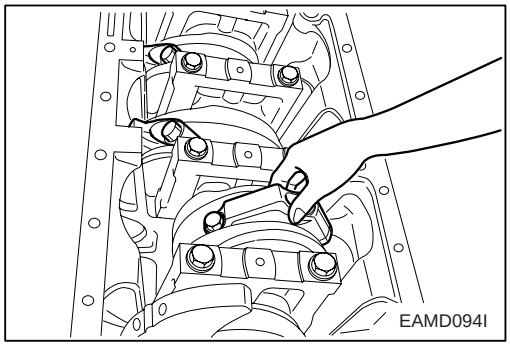


- Wet the fixing bolts with engine oil, semi-tighten them with hand, tighten them to the specified torque using a torque wrench as follows.

< Tightening order >
First stage : Spray oil on the bolts.
Second stage : Assemble the connecting rod bolts with hands, until the bolt head fixing part touches the bolt seating surface of both sides with bare hands.
Third stage : Fasten to 4 ~ 6 kgf•m with a torque wrench.
Fourth stage : Fasten to 9.75 kgf•m finally with a torque wrench.

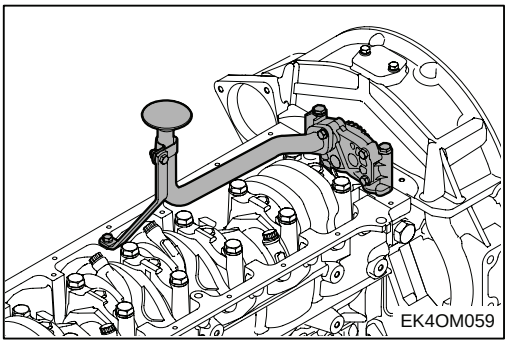
Torque	9.75 kgf•m

- Shake the bearing cap with hands. If the bearing cap doesn't move, loosen and assemble again.



3.3.14. Oil pump and oil pipe

- Assemble the standard pint to the bearing cap number 7, and beat the oil lamp softly with a urethane hammer to assemble.
- Assemble the washer, and fasten the bolt for assembly with the pre-defined torque.



Torque	M8	2.2 kgf•m
	M10	4.4 kgf•m

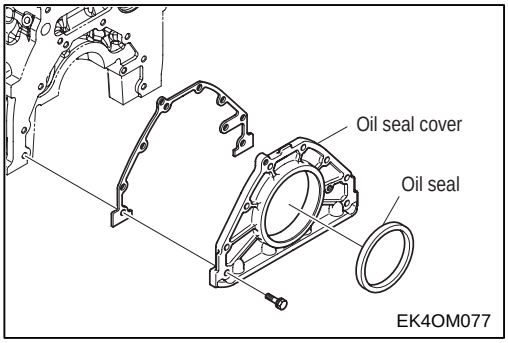
- Assemble the oil supply pipe to the oil pump, using bolts.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.3.15. Oil seal

- Apply engine pile on the inner side of the oil seal, and install the oil seal on the cover.
- Adjust the new oil seal to the center of the oil seal cover hole, and assemble the oil seal using the assembly jig.



Torque	2.2 kgf•m

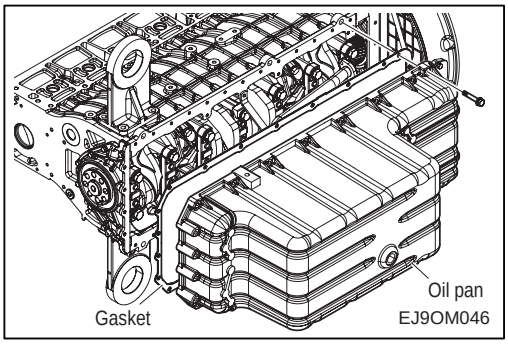
- Item number of the oil seal assembly jig
  : EF.121-299

3.3.16. Oil pan

- Remove the projected gasket with scrapper completely from the timing gear case, cover, cylinder block, and flywheel housing contact surface.

CAUTION :
Be careful not to drop a gasket into the engine during maintenance works.

- Apply silicon to the place where the gasket was removed, and attach the new oil pan gasket.
- Fasten the bolts for oil pan assembly to assemble the oil pan.
- Fasten four bolts at both ends first and fasten remaining bolts with the predefined torque at the time of assembly.



Torque	Oil pan	2.2 kgf•m
	Drain plug	10 kgf•m

- Adjust the bolt hole to the gasket hole to prevent the damage to the gasket, and fasten the bolt.

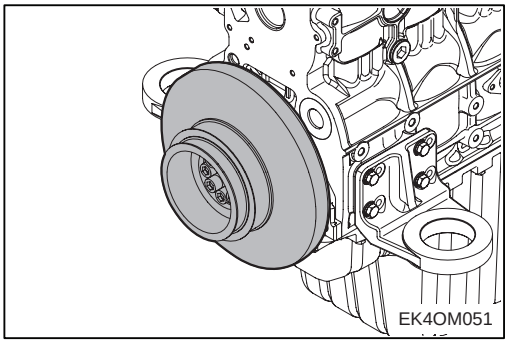
Downloaded from www.Manualslib.com manuals search engine

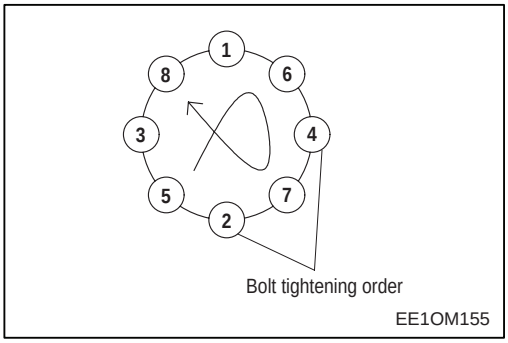
https://truckmanualshub.com/

3.3.17. Crankshaft pulley and vibration damper

- Mount the vibration damper on the crankshaft pulley, and fasten fixing bolts in fastening order with the predefined torque.

Torque	Vibration damper	6.2 kgf•m
	Crankshaft pulley	20 kgf•m

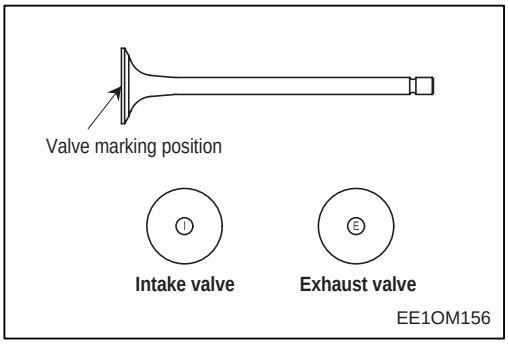

EK4OM051



EE1OM155

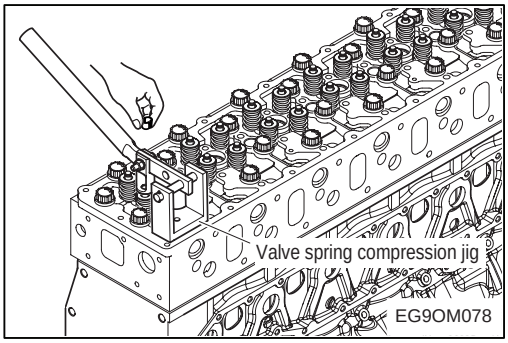
3.3.18. Intake and exhaust valve

- Check the "I" and "E" mark on the valve head, before assembling the valve to the cylinder head.
- Assemble the valve stem seal to the valve guide, using the valve stem seal assembly jig.
- Item number of the valve stem seal assembly jig : EF.121-253



EE1OM156

- Assemble the valve cotter by pressing the retainer, using the valve spring compression jig, after installing the valve spring and retainer.
- Item number of the valve spring compression tool : EF.123-065
- Check whether the valve is assembled correctly, by beating the valve stem softly, using the rubber hammer.



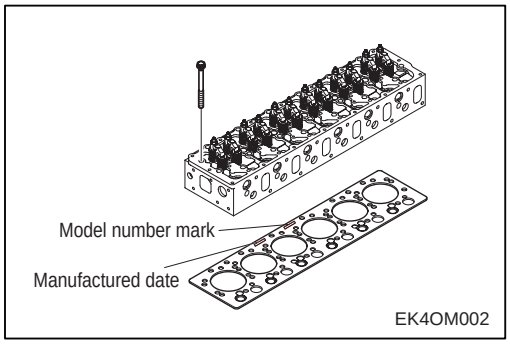
EG9OM078

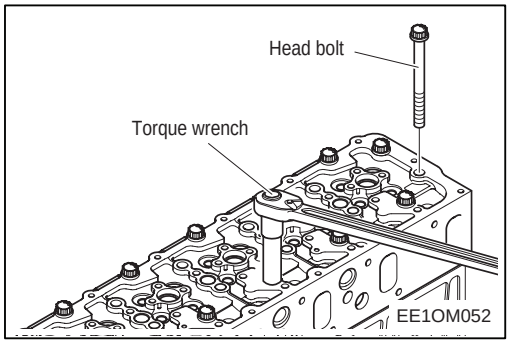
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.3.19. Cylinder head

- Blow out the bolt hole of the cylinder head with compressed air to remove foreign object.
- Clean the contact surface of the cylinder head gasket.
- At this time, be careful not to put any foreign object into the combustion chamber.
- Adjust the bolt hole of the new gasket to the standard pin of the cylinder block, and make the right side mark face upward and assemble the cylinder head.
- Check the foreign object inside the combustion chamber, and put the cylinder head on the fixing pin.
- Be careful not to damage the gasket. If the pin hole doesn't fit, lift again.
- Replace the gasket with new one, when assembling cylinder head bolts after disassembly.

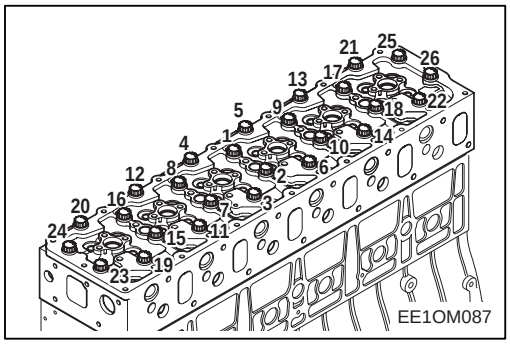




- Spray engine oil on cylinder head bolts, and fasten the fixing blots in order of assembly, using the pre-defined torque.

< Cylinder head bolt >

Specification	 M13 × 1.5 × 140
Torque	1st Tightening : Under 4 kgf•m 2nd Tightening : 5 kgf•m 3rd Tightening : 90° 4th Tightening : 90° Final tightening : 90°



Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

< Tightening order of bolts by steps >

(1) First stage : Coat the bolts with engine oil.

(2) Second stage: Fasten the screw by one or two cogs with hands, and fasten under 4 kgf•m temporary fastening torque.

(3) Third stage : Tighten at about 6 kgf•m with a wrench.

(4) Fourth stage : Tighten at rotating angle method 90° with a wrench.

(5) Fifth stage : Tighten at rotating angle method 90° with a wrench.

(6) Sixth stage : Finally, tighten at rotating angle method 90° with a torque wrench.

- All bolts should be fastened by the above sequence.



- Spray engine oil on the push rod, and insert into the push rod hole of the cylinder head.

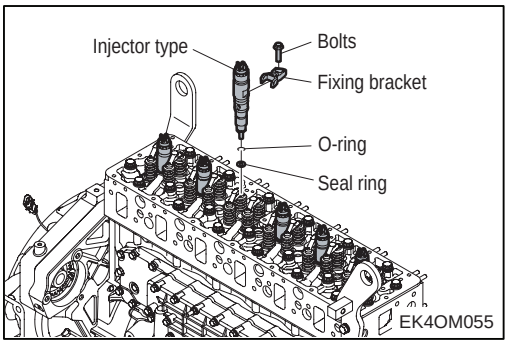
3.3.20. Injector



- Clean all the parts thoroughly and be careful not to fall into the foreign material.
- Especially take deeper care on fuel line from common rail up to injector because this area has no filtering function.



- Clean the holes which an injector and a high pressure connector will be put into before they are assembled.



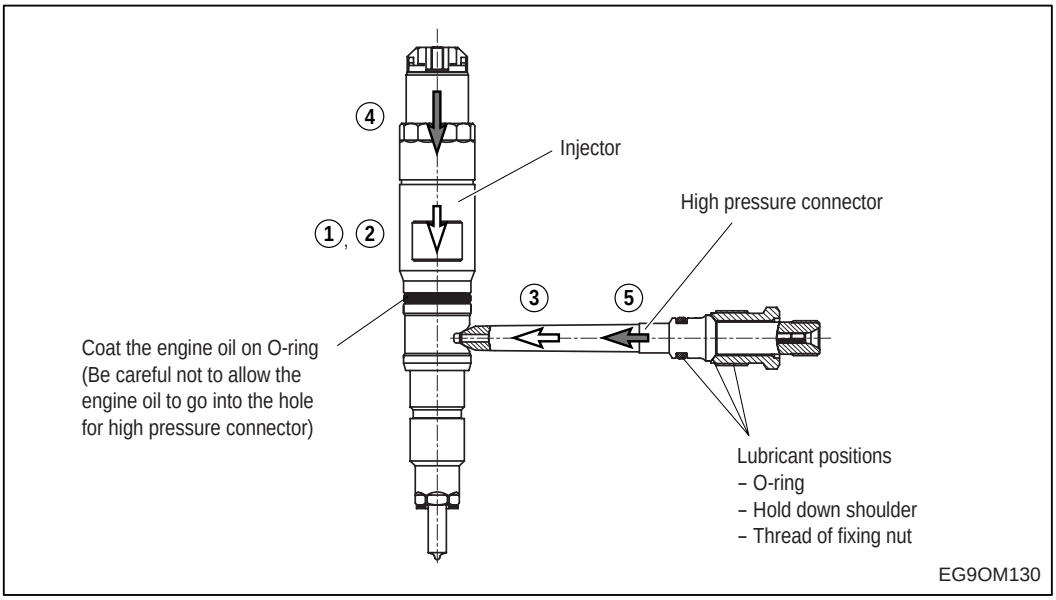
- Whenever disassembling the injector, fuel high pressure connector must be replaced with a new one.
- If fuel goes in the combustion chamber during disassembling the injectors from the fuel return line and/or gap around the injector and high pressure connector, please remove the fuel by sucking with hand pump or short cranking with fuel stop.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

< Injector and high pressure connector assembly procedure >

1) The injector should be assembled correctly on the following procedure.



2) Coat the fresh engine oil on the O-ring of the injector. At the same time, be careful not to allow the engine oil or foreign material to go into the holes for a fuel high pressure connector.

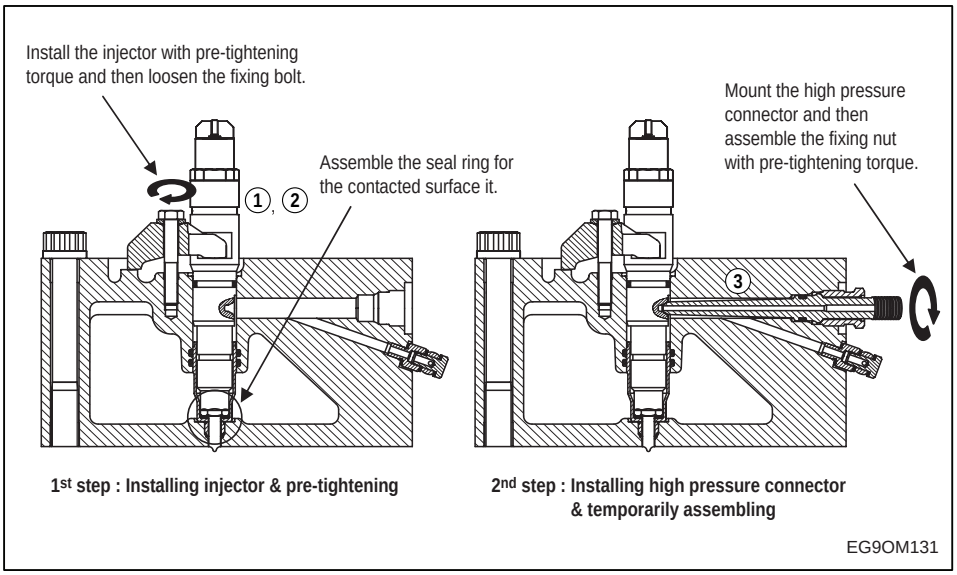
3) First, set the position between the hole of fixing bracket and the tap hole of the bolt for injector fixing bracket. Second, insert the injector vertically to the hole. Put the bolt of the injector fixing bracket into a thread on the head and tighten about 2 ~ 3 turns with hands.

4) (1), (2) Temporarily mount the fixing bolt assemble with pre-tightening torque while aligning an injector and a fuel high pressure connector. Through this step, the sealing and O-ring is placed correctly on the cylinder head and fuel lines are to be fit together. Afterwards release the injector by loosening the fixing bolt and then injector pre-load leads to 0 (zero) kg•m.

Downloaded from www.Manualslib.com manuals search engine

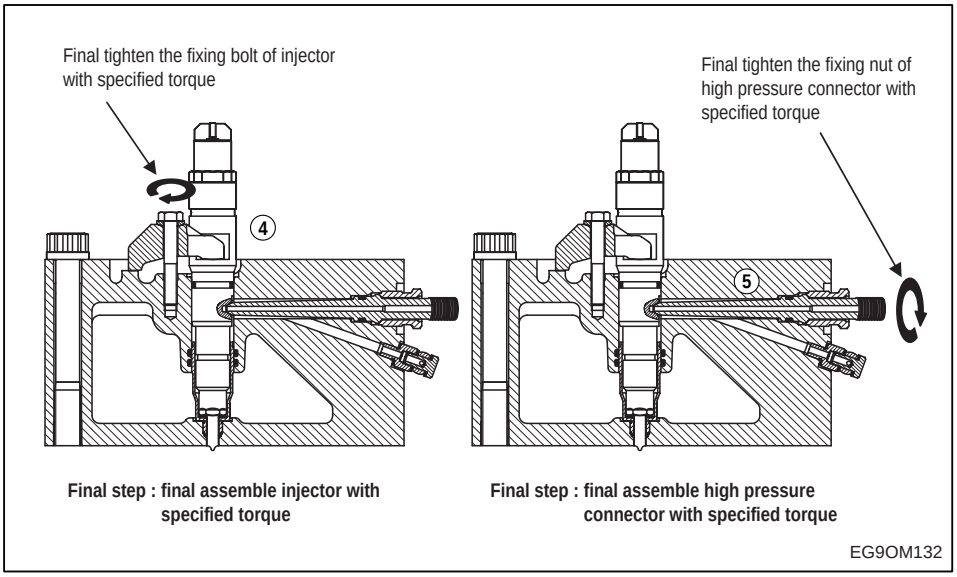
https://truckmanualshub.com/

5) (3) Coat the fresh and clean engine oil on O-ring, Hold down shoulder and Thread of fixing nut. Grasp high pressure connector with balls vertical and insert it into the hole on while aligning the balls of connector and slot of the head. Push the connector into the hole until feeling it contacted.



	Injector fixing bracket bolt	Fuel high pressure connector fixing nut
Temporarily torque	0.3 kgf•m	1.5 + 0.5 kgf•m

6) The injector and high pressure connector should be assembled correctly by the following order. (4) Finally tighten the fixing bolt of injector up to the specified torque while the high pressure connector is still pre-tightened.



	Injector fixing bracket bolt	Fuel high pressure connector fixing nut
Temporarily torque	3.1 ~ 3.5 kgf•m	5 ~5.5 kgf•m

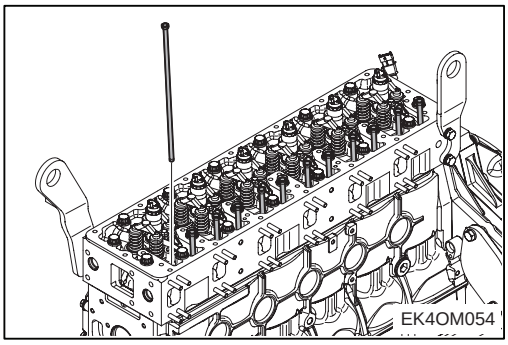
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

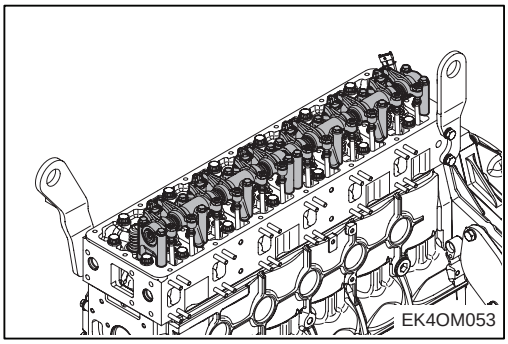
3.3.21. Rocker arm

- Apply oil to the rocker arm bush and axis, and assemble the bracket to the rocker arm on the cylinder head, using the fixing bolts.
- Fasten the bolts with the zigzag fastening method, using the pre-defined torque.

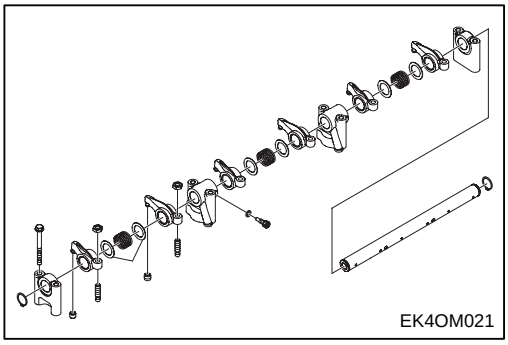
Torque	3.75 kgf•m



- Assemble the valve clearance adjustment screw to the rocker arm temporarily.



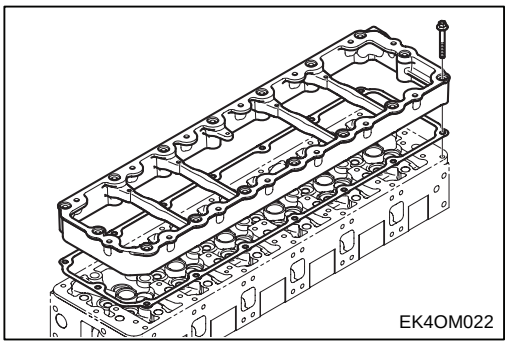
- Assemble the rocker arm assembly in order of the spring, rocker arm, bracket, rocker arm, spring, washer, and snap ring.
- Assemble the rocker arm and bracket to the same direction.



3.3.22. Intermediate cover

- Assemble the new gasket to the intermediate cover, and fasten the fixing bolts with the pre-defined torque.

Torque	3.1 kgf•m



Downloaded from www.Manualslib.com manuals search engine

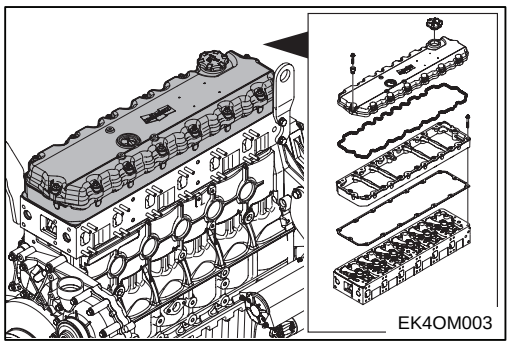
https://truckmanualshub.com/

3.3.23. Cylinder head cover

- Assemble the new rubber gasket to the cylinder head cover and install it on the cylinder head, and fasten the fixing bolts with pre-defined torque.

Torque	2.2 kgf•m

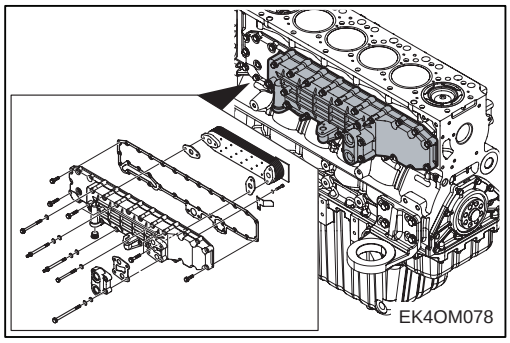
- Assemble the oil injection hole cap to the cylinder head cover.



3.3.24. Oil Cooler

- Install the oil cooler and gasket on the cylinder block and fasten the bolts.
- Be careful not to change the gasket assembly direction.

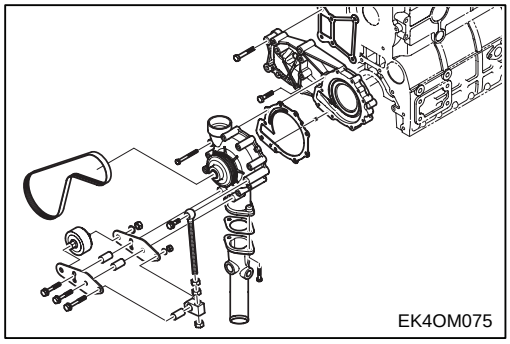
Torque	2.2 kgf•m



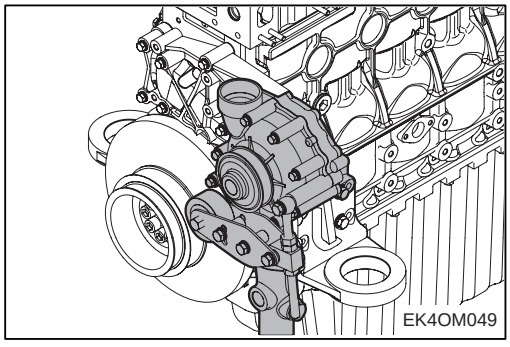
3.3.25. Cooling water pump

- Install the cooling water pump cover and cooling water pump gasket.
- Install the cooling water pump on the cylinder block, and fasten the assembly bolt with the pre-defined torque.

Torque	2.2 kgf•m



- Assemble the idle pulley bracket.



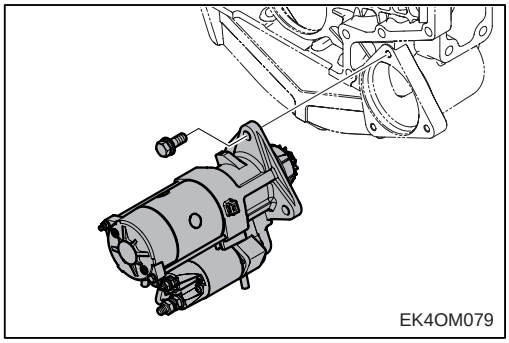
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.3.26. Starting motor

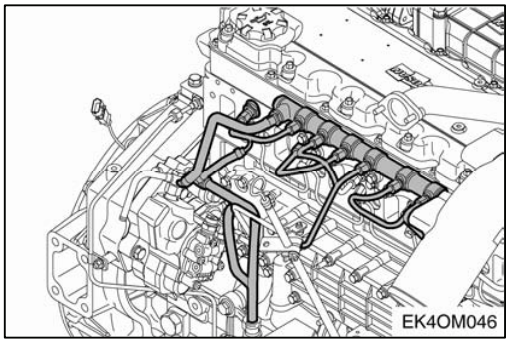
- Insert the starter into the flywheel housing and tighten the fixing nuts.

Torque	8.0 kgf•m



3.3.27. Common rail and high pressure pipe

- Install the common rail on the cylinder block.
- Install the fuel supply pipe between the common rail and fuel high pressure connector, and fasten cylinders one be one with the pre-defined torque.
- Do not reuse the used fuel high pressure pipe.

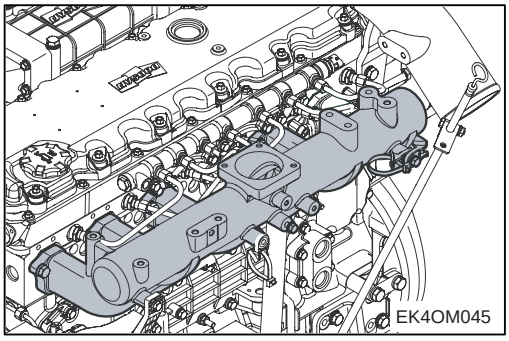


Torque	Fuel high pressure pipe	Side of common rail	2.5 kgf•m
		Side of fuel high pressure connector	2.8 kgf•m
		Common rail from fuel high pressure pump	2.1 kgf•m
	Common rail fixing bolt		2.2 kgf•m

3.3.28. Intake manifold

- Put in the new gasket between the cylinder head and manifold, and assemble the intake manifold by tightening the fixing bolts.

Torque	4.4 kgf•m

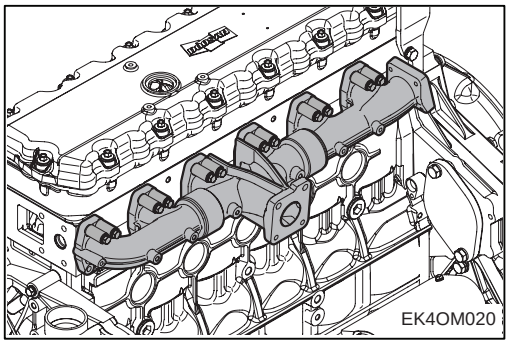


Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

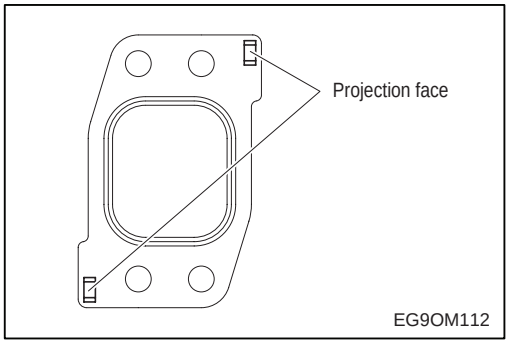
3.3.29. Exhaust manifold

- Install the exhaust manifold gasket on the stud bolt of the cylinder head, and adjust the gas outlet of the cylinder head to the gasket hole.



- Be careful not to change the gasket front and rear side.

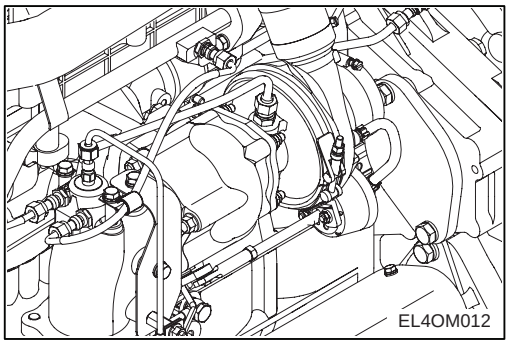
Torque	5.0 kgf•m



3.3.30. Turbo charger

- Fit a new gasket over the stud bolts of the exhaust manifold before tightening those turbo charger fixing nuts.
- Install the oil supply pipe and return pipe.
- Tighten the clamps of rubber hose that is connected air pipe to the turbo charger.

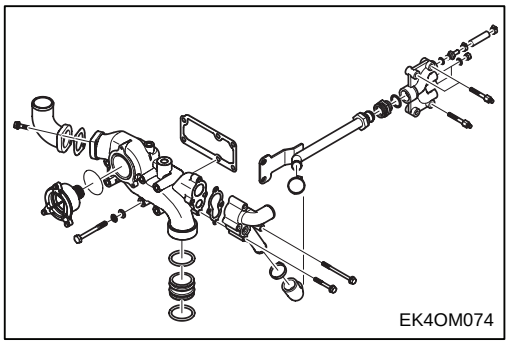
Torque	8.0 kgf•m



3.3.31. Cooling water pipe & thermostat

- Attach the gasket to the cylinder head, and assemble the thermostat housing.
- Install the O-ring to the thermostat, and assemble the cooling water pipe by fastening it with bolts.

Torque	2.2 kgf•m

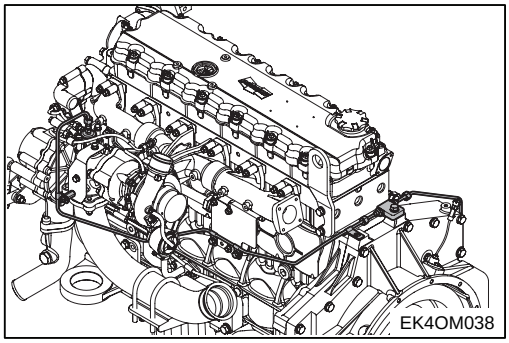


Downloaded from www.Manualslib.com manuals search engine

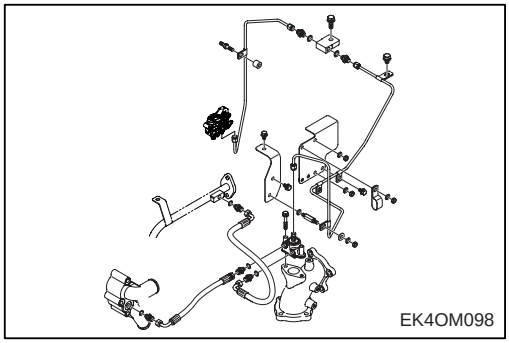
https://truckmanualshub.com/

3.3.32. HC dosing injection (HC hydro-carbon)

- Assemble the HC injection device to the exhaust pipe, using the fixing bolts.

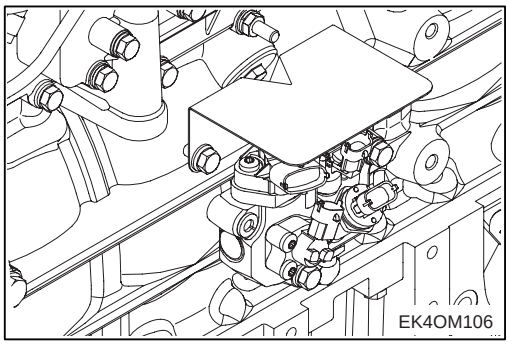


- Assemble the cooling water hose to the HC injection device.
- Assemble the HC injection device.



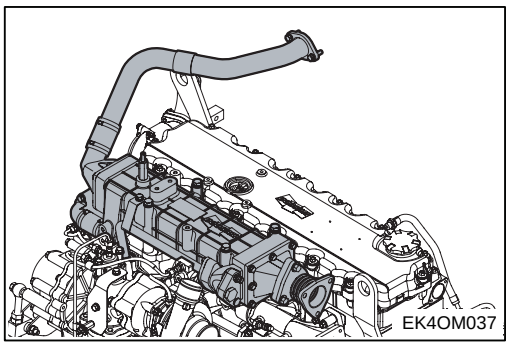
3.3.33. HC dosing metering unit

- Assemble the HC dosing metering unit to the bracket, using assembly bolts.
- Assemble the cover for the HC dosing metering unit, using assembly bolts.
- Assemble the HC dosing pipe.



3.3.34. EGR cooler

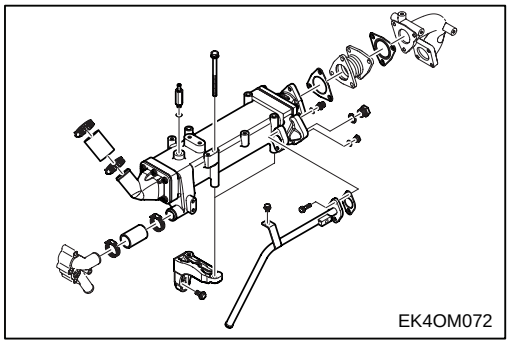
- Assemble the bracket for EGR cooler assembly to the cylinder head, using the fixing bolts.
- Assemble the EGR cooler to the bracket, using the fixing bolts.



Downloaded from www.Manualslib.com manuals search engine

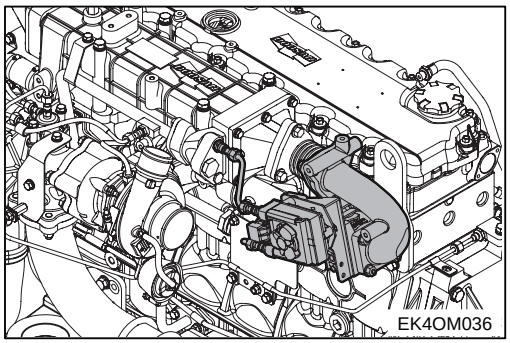
https://truckmanualshub.com/

- Assemble the pipe and hose to the EGR cooler.
- Do not reuse the gasket.
- See Chapter 3.6.9 for more details on disassembly and assembly.

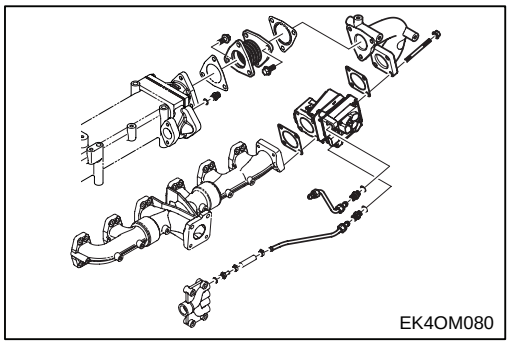

EK4OM072

3.3.35. EGR valve

- Assemble the exhaust pipe to the EGR cooler together with the gasket, using the fixing bolts.
- Assemble the EGR valve with gasket to the exhaust pipe, using the fixing bolts.

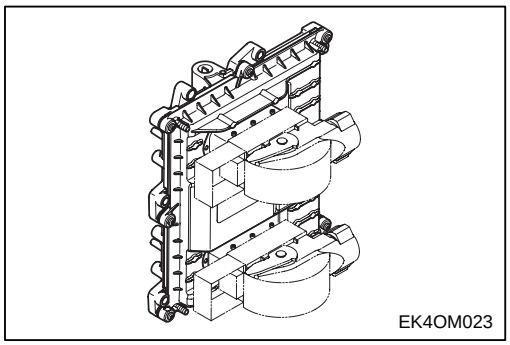

EK4OM036

- Do not reuse the gasket.
- See Chapter 3.6.9 for more details on disassembly and assembly.


EK4OM080

3.3.36. Electrical control unit (ECU)

- Fix the ECU mounting plate.
- Assemble the ECU.
- See Chapter 3.4 for more details on the common rail system and ECU.


EK4OM023

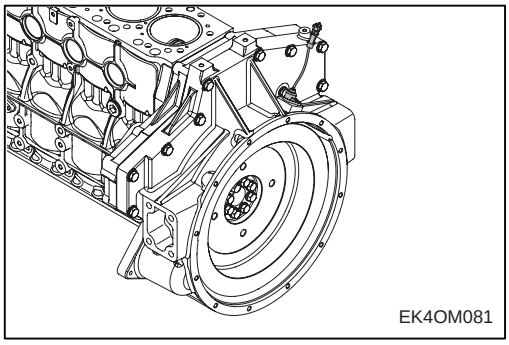
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.3.37. Crankshaft speed sensor and Camshaft speed sensor

- Measure the clearance between the assembly part of the crankshaft RPM sensor and flywheel, and adjust the clearance using the shim.

Assembly clearance	1.0 mm
Torque	1.0 kgf•m

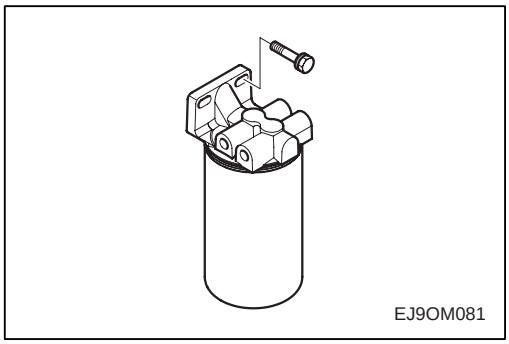

EK4OM081

- Measure the clearance between the assembly part of the crankshaft RPM detection sensor and the timing gear, and adjust the clearance using the shim.

Assembly clearance	1.0 mm
Torque	1.0 kgf•m

3.3.38. Fuel filter

- When replacing the fuel filter with new one, fill up fuel inside the cartridge.
- Assemble the fuel supply pipe according to the arrow direction marked on the head of the fuel filter, so that fuel can be supplied in order of the fuel supply pump → fuel filter → fuel high pressure pump → common rail.

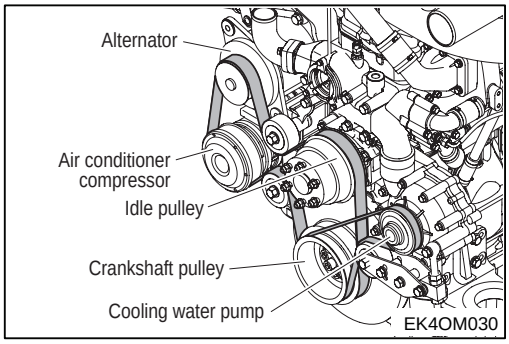

EJ9OM081

Torque	Fuel pipe	3.0 kgf•m
	Fuel temperature sensor	2.2 kgf•m
	Fixing bracket	4.4 kgf•m

3.3.39. Alternator and belt

- Install the alternator and air conditioner bracket, using the fixing bolts.
- Assemble the alternator, air conditioner compressor, and idle pulley.

Torque	Alternator fixing bolts	7.7 kgf•m
	Alternator support fixing bolts	5.0 kgf•m



EK4OM030

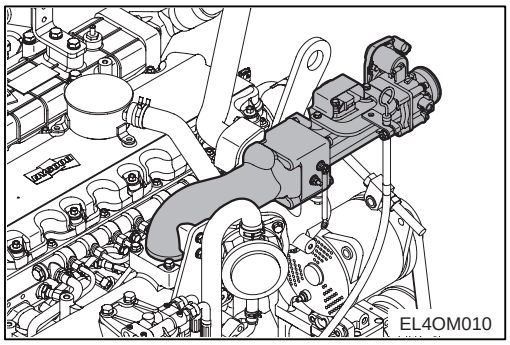
- Install the belt, and adjust tension using the adjustment bolt.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

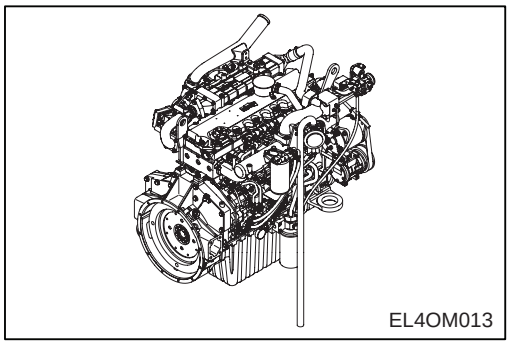
3.3.40. Air pipe and air heater

- Assemble the air pipe and air heater using the fixing bolts of the throttle bolts.
- Be careful not to input any foreign object into the turbo charger.



3.3.41. Oil level gauge

- Apply the adhesive (Loctite #262) to the guide tub.
- Assemble the guide tube and oil level gauge to the oil pan.



3.3.42. Others

- Connect other sensors, harnesses, and fuel and oil line breather.

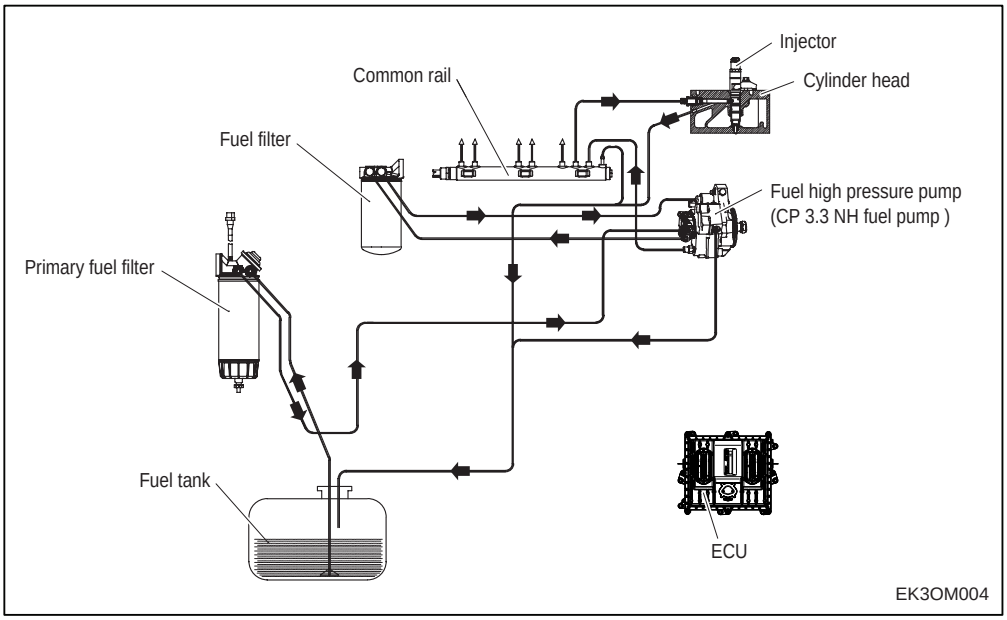
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.4. Fuel Injection System

3.4.1. Common rail fuel-injection system

- Pressure generation and fuel injection are completely decoupled from each other in the common rail injection system. The electric control unit(ECU) determine the fuel quantity, injection timing, and injection pressure in order to show the optimum performance on the condition for operation of the engine, then inject the fuel in the cylinder.
- The fuel is stored under pressure in the common rail ready for injection. The injected fuel quantity is defined by the driver, and the start of injection and injection pressure are calculated by the ECU on the basis of the stored map. The ECU then triggers the solenoid valves that the injector at each engine cylinder injects accordingly.



3.4.2. Major components of the common rail system

1) Electric control unit(ECU)
2) Crankshaft speed sensor
3) Camshaft speed sensor
4) Accelerator pedal sensor
5) Fuel temperature sensor
6) Boost pressure and temperature sensor
7) Common rail pressure sensor
8) Coolant temperature sensor

- Using the input signals from the above sensors, the ECU registers the driver's requirements(accelerator pedal setting) and defines the instantaneous operating performance of the engine and the vehicle as a whole. On the basis of this information, it can then intervene with open and closed-loop controlling action at the vehicle and particularly at the engine.

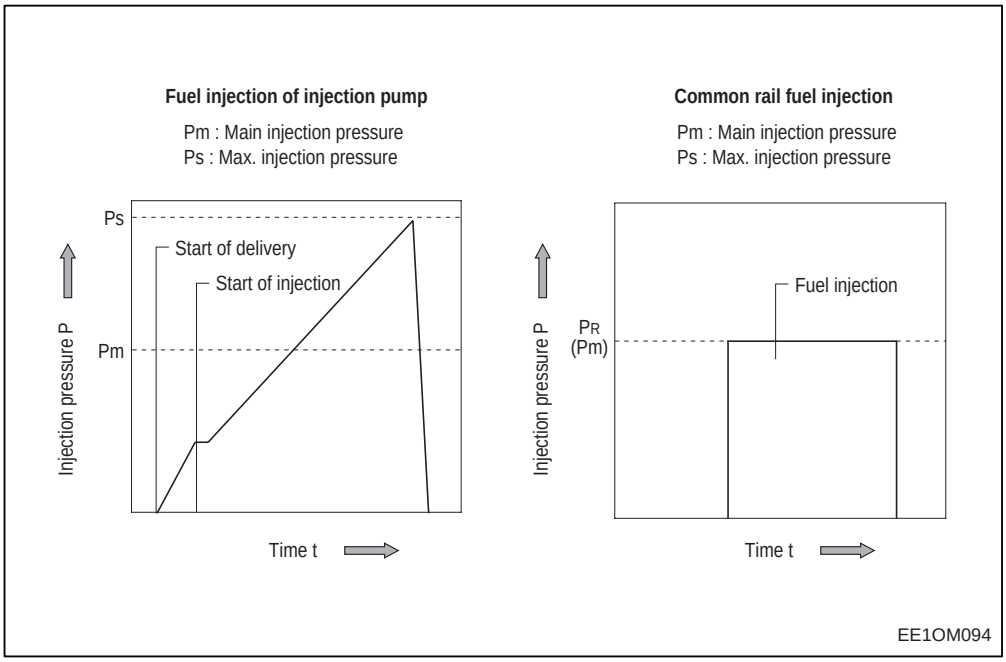
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

- The engine speed is measured by the crankshaft speed sensor, and the camshaft speed sensor determines the firing sequence (phase length). The electrical signal generated across a potentiometer in the accelerator pedal module informs the ECU about how far the driver has depressed the pedal, the engine is equipped with a turbo charger and boost pressure control, the boost pressure sensor also measures boost pressure.
- At low outside temperatures and with the engine cold, the ECU applies the data from the coolant temperature and air temperature sensors to adapt the set point values for start of the particular operating conditions.

3.4.3. Injection characteristics with common rail

- Injection characteristics with common rail, compared to conventional injection characteristics, the following demands are made up on an ideal injection characteristic, Independently of each other, injected fuel quantity and injection pressure should be definable for each and every engine operating condition.



- At the beginning of the injection process, the injected fuel quantity should be as low as possible (that is, during the ignition lag between the start of injection and the start of combustion)
- The common rail system is a modular system, and essentially the following components are responsible for the injection characteristic.
  - Solenoid valve controlled injectors which are screwed into the cylinder head
  - Common rail
  - Fuel high pressure pump
  - Electric control unit(ECU)
  - Crankshaft speed sensor
  - Camshaft speed sensor

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.4.4. Fuel high pressure pump

- A radial-piston pump is used as the high pressure pump for pressure generation. Pressure is generated independently of the injection process. The speed of the high pressure pump is coupled directly to the engine speed with a non-variable transmission ratio. In comparison with conventional injection systems, the fact that delivery is practically uniform.
- The injectors are connected to the common rail by high pressure pipe, comprise a nozzle, and a solenoid valve which is energized by the ECU to switch it on (start of injection), When the solenoid valve is switched off injection ceases.
- The required high-speed solenoid switching is achieved by using high voltages and currents. This means that the solenoid valve triggering stage in the ECU must be designed accordingly. The start of injection is controlled by the angle-time control system of the EDC(Electronic Diesel Control).This uses a sensor on the crankshaft to register engine speed, and a sensor on the camshaft for phase detection(working cycle).

3.4.5. Fuel system

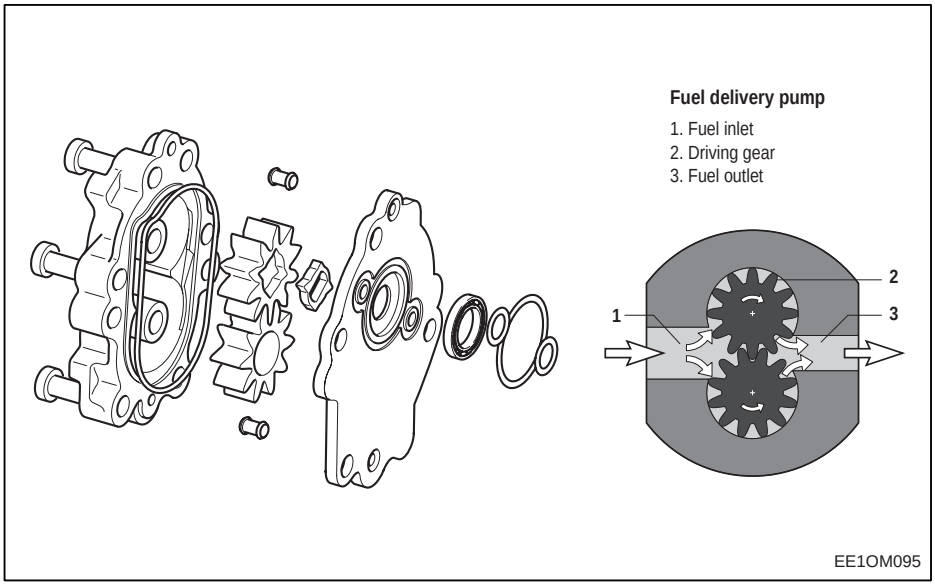
- The common rail fuel injection system comprises a low pressure stage for the low pressure delivery of fuel, a high pressure stage for the high pressure delivery, and the ECU.

3.4.6. Fuel tank

- The fuel tank must be of non-corroding material, and must remain free from leaks at double the operating pressure, and in any case at 0.3 bar.

3.4.7. Fuel delivery pump

- The fuel delivery pump is installed on back side of the fuel high pressure pump, is a gear type fuel pump. The pump draws the fuel from the fuel tank and continually delivers the required quantity of fuel in the direction of the high pressure pump.



Downloaded from www.Manualslib.com manuals search engine

3.4.8. Fuel filter

- Fuel filter inadequate filtering can lead to damage at the pump components, delivery valves, and injector nozzles. The fuel filter cleans the fuel before it reaches the high pressure pump, and thereby prevents premature wear at the pump's sensitive components.

3.4.9. High pressure fuel delivery

- The high pressure stage of the fuel system in a common rail installation comprises.
  - High pressure pump with pressure control valve
  - High pressure fuel lines
  - The common rail as the high pressure accumulator
  - Rail pressure sensor.
  - Pressure limiting valve.
  - Injectors
  - Fuel return lines

3.4.10. High pressure system components

- Fuel high pressure pump
  The high-pressure pump pressurizes the fuel to a system pressure of up to 1,800 bar. This pressurized fuel then passes through a high-pressure line and into the tubular high pressure fuel accumulator (common rail).
- Common rail
  Even after an injector has taken fuel from the common rail in order to inject it, the fuel pressure inside the rail remains practically constant. Fuel pressure is measured by the rail pressure sensor and maintained at the desired level by the pressure control valve. It is the job of the pressure limiter valve to limit the fuel pressure in the rail to maximum 1,800 bar.
- Injector
  The nozzles of these injectors open when the solenoid valve is triggered and permit the flow of fuel. They inject the fuel directly into the engine's combustion chamber, The excess fuel which was needed for opening the injector nozzles flows back to the tank through a collector line. The return fuel from the pressure control valve and from the low pressure stage is also led into this collector line together with the fuel used to lubricate the high pressure pump.
- Fuel high pressure pipe
  These fuel high pressure pipes carry the high pressure fuel of up to 1,800 bar. They must therefore be able to permanently withstand the maximum system pressure and, during the pauses in injection, the sometimes high frequency pressure fluctuations which occur. They are therefore manufactured from the high pressure pipe. They have an outside diameter of 8.0 mm and an internal diameter of 3.5 mm. The fuel high pressure pipe lines between the common rail and the injectors must all be of the same length, should be kept as short as possible.

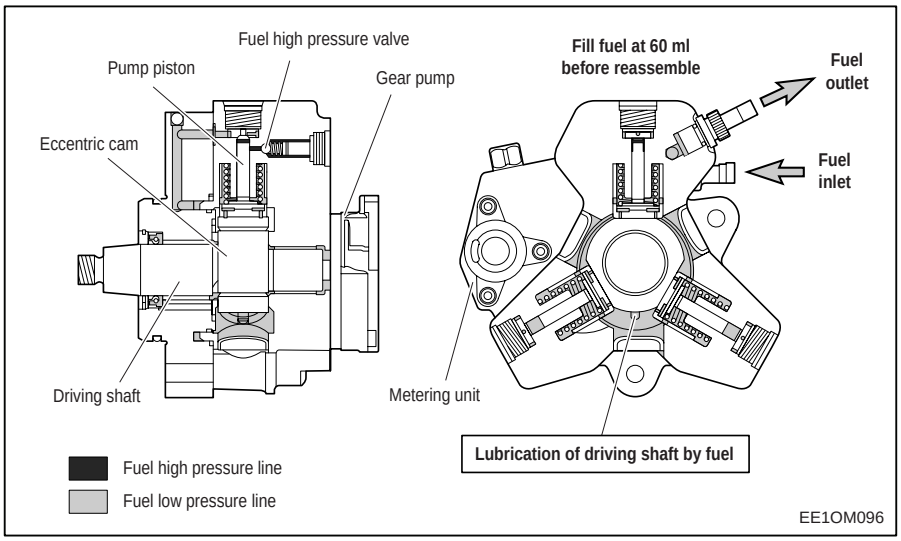
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.4.11. Construction of the fuel high pressure pump

1) Function

The fuel high pressure pump has the lower pressure and high pressure phase. The pump transfers high pressure fuel during perfect service life of the vehicle under all operating conditions. In addition, the pump supplies fuel needed for a quick start or abrupt pressure change inside the common rail. The fuel high pressure pump builds up system pressure for the common rail continuously.



2) Construction of the fuel high pressure pump

Three pump pistons inside the fuel high pressure pump, which are installed at 120 degrees to each other, compress fuel to the circumference direction. Tension in the pump driving device is maintained regularly, because three compression strokes are made for every rotation. And, weak driving power is needed. About one ninth of the exiting pump driving force is required for the common rail pump.

3) Method of operation

The fuel supply pump supplies fuel from the tank to the high pressure pump via the fuel entry and safety valve. The pump forces transfer of fuel to the lubrication and cooling unit of the high pressure pump via the safety valve. The driving axle with eccentric cam moves the pump piston up and down, depending on the cam shape. If transfer pressure of the fuel supply pump exceeds expansion pressure of the safety valve (0.5 ~ 1.5 bar), fuel is transferred to the pumping chamber where the pump piston is moving down via the intake valve of the fuel high pressure pump (intake stroke). If the pump piston passes the bottom dead center, the valve entry is closed, and fuel cannot exist from the pumping chamber. Therefore, fuel is compressed more than supplied pressure. The exit valve is opened as soon as fuel pressure reaches common rail pressure. Then, compressed fuel enters into the high-pressure circuit. The pump piston continues to force fuel transfer until the top dead center is reached. Afterwards, the exit valve is closed when pressure drops. Fuel remained in the pumping chamber is loosened, and the pump piston moves downward again. If pressure in the pumping chamber drops under fuel supply pump pressure, the entry valve is opened and the above process is started again.

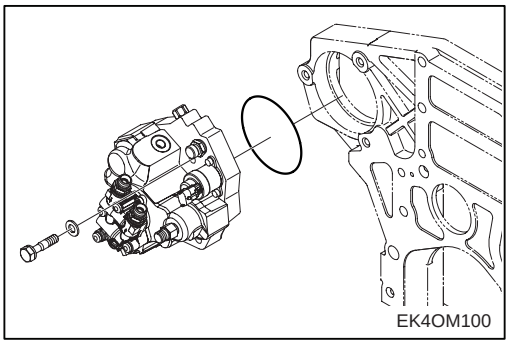
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

4) Fuel delivery rate

Since the high-pressure pump is designed for large delivery quantities, excess high-pressure fuel is delivered during idle and part load operation. This excess fuel is returned to the tank via the pressure control valve.

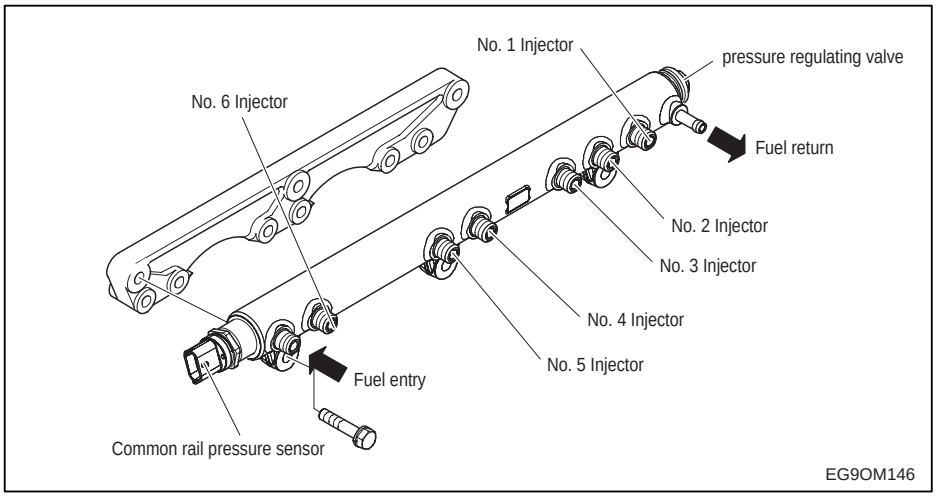
5) Fuel metering shut off valve



If the switch of the fuel high pressure pumping blocking valve is turned off, the fuel quantity supplied to the common rail is increased. If the switch is turned off, the intake valve is opened, and fuel pumping solenoid valve is pulled, and the pin attached to the electric magnet continues to open the valve entry. Therefore, fuel taken to this pumping valve cannot be compressed during the transfer stroke. Fuel returns to the low pressure passage, and no pressure is built up. As the pumping blocking valve is running with small driving power, fuel supply and blocking are perform at a short interval.

6) Common rail

The common rail stores the fuel at high pressure. At the same time, the pressure oscillations which are generated due to the high pressure pump delivery and the injection of fuel are damped by the rail volume. After the injector use the fuel from the common rail for fuel injection, the pressure oscillation of the common rail is maintained constantly by the common rail volume. The fuel pressure is calculated by the pressure sensor of the common rail, is maintained with required value by the pressure control valve. The fuel pressure is controlled at max. 1,800 bar in the common rail.

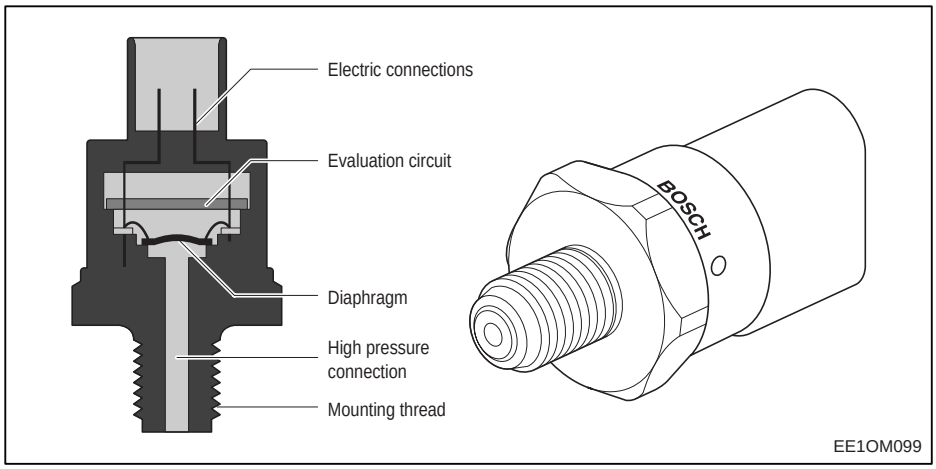


Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

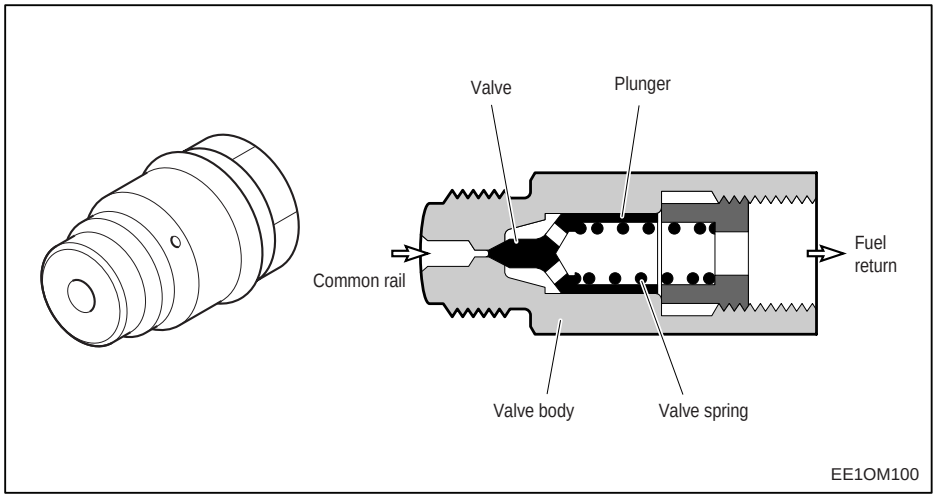
7) Common rail pressure sensor

The fuel flows to the rail pressure sensor through an opening in the common rail, the end of which is sealed off by the sensor diaphragm. Pressurized fuel reaches the sensor's diaphragm through a blind hole. The sensor element for converting the pressure to an electric signal is mounted on this diaphragm. The signal generated by the sensor is inputted to an evaluation circuit which amplifies the measuring signal and sends it to the ECU.



3.4.12. Pressure limiter valve

- The pressure limiter valve is at the connection end to the common rail, is closed by the cone shaped end of the plunger valve against inside of the valve body. At normal operating pressures (1,800 bar), a spring forces the plunger against the seat and the common rail remains closed.
- As soon as the operating pressure is exceeded, the plunger is forced by the rail pressure against the force of the spring, the fuel pressure is maintained with the normal pressure, and the escape fuel return to the fuel tank through the return pipe.

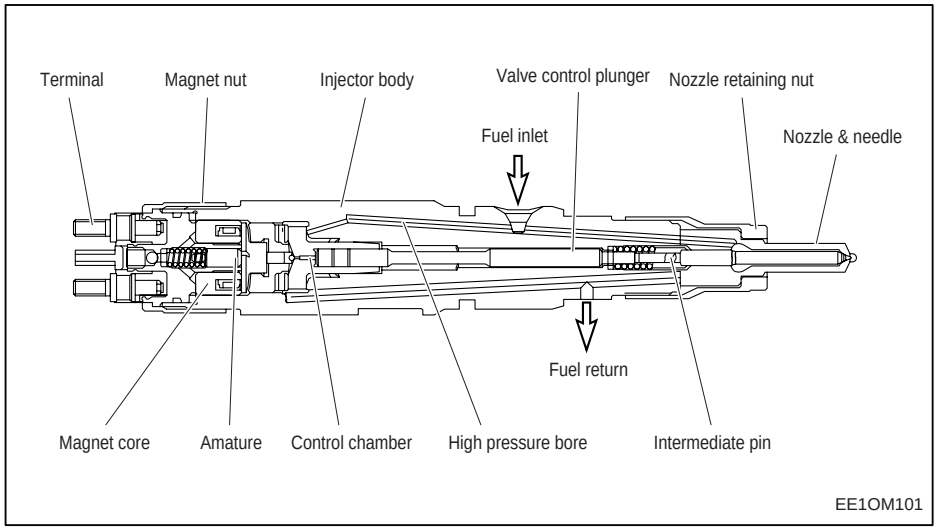


Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.4.13. Injector

- The solenoid valve installed on the fuel injector adjusts the beginning of fuel injection and injection quantity, and the fuel injector replaces the function of existing engine's nozzle and nozzle holder. Fuel is supplied to the injector via the high pressure connection connector installed on the cylinder head, and supplied to the valve control chamber via the supply hole.
- The valve control chamber is opened by the solenoid valve, and connected to the fuel return line via the outlet hole. Oil pressure force applied to the valve control plunger while the outlet hole is closed exceeds pressure of the nozzle needle. As a result, fuel supply to the combustion chamber is blocked by the force applied to the contact surface of the nozzle needle.
- The outlet hole is opened when the injector solenoid valve is pulled. It drops pressure of the control chamber, as well as oil pressure applied to the plunger. If oil pressure becomes weaker than nozzle needle pressure, the nozzle needle will be opened. And, fuel is injected into the combustion chamber via the injection nozzle hole.



- When controlling the nozzle needle using oil pressure, the force needed to open the needle quickly is not directly generated by the solenoid valve. The fuel control quantity needed to open the nozzle needle is added to the fuel amount that is actually injected. And, used fuel exhausted trough the fuel return line via the hole of the valve control chamber. Fuel loss occurs during control, and at the nozzle needle and valve plunger guide. Fuel leaked during control, and fuel collected from the line that is connected to the overflow valve, high pressure pump, and pressure control valve return to the fuel tank via the fuel return line.

Downloaded from www.Manualslib.com manuals search engine

(1) Method of operation

The injector’s operation can be subdivided into four operating states with the engine running and the high pressure pump generating pressure.

a) Injector closed (with high pressure applied)

b) Injector opens (start of injection)

c) Injector opened fully

d) Injector closes (end of injection)

These operating states result from the distribution of the forces applied to the injector’s components. With the engine at standstill and no pressure in the rail, the nozzle spring closes the injector.

(2) Injector closed (at rest status)

In the at rest state, the solenoid valve is not energized and is therefore closed. With the bleed orifice closed, the valves spring forces the armature's ball onto the bleed-orifice seat. The rail's high pressure builds up in the control valve, and the same pressure is also present in the nozzle's chamber volume. The rail pressure applied at the control plunger's end face, together with the force of the nozzle spring, maintain the nozzle in the closed position against the opening forces applied to its pressure stage.

(3) Injector opens (start of injection)

The injector is in its at-rest position. The solenoid valve is energized with the pick-up current which serves to ensure that it opens quickly. The force exerted by the triggered solenoid now exceeds that of the valve spring and the armature opens the bleed orifice. Almost immediately, the high-level pick-up current is reduced to the lower holding current required for the electromagnet. This is possible due to the magnetic circuit's air gap now being smaller. When the bleed orifice opens, fuel can flow from the valve-control chamber into the cavity situated above it, and from there via the fuel return to the fuel tank. The bleed orifice prevents complete pressure balance, and the pressure in the valve control chamber sinks as a result. This leads to the pressure in the valve-control chamber being lower than that in the nozzle's chamber volume which is still at the same pressure level as the rail. The reduced pressure in the valve-control chamber causes a reduction in the force exerted on the control plunger, the nozzle needle opens as a result, and injection starts. The nozzle needle's opening speed is determined by the difference in the flow rate through the bleed and feed orifices. The control plunger reaches its upper stop where it remains supported by a cushion of fuel which is generated by the flow of fuel between the bleed and feed orifices. The injector

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

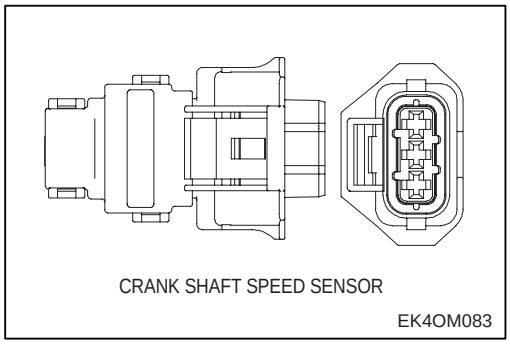
nozzle has now opened fully, and fuel is injected into the combustion chamber at a pressure almost equal to that in the fuel rail. Force distribution in the injector is similar to that during the opening phase.

(4) Injector closes (end of injection)

As soon as the solenoid valve is no longer triggered, the valve spring forces the armature downwards and the ball closes the bleed orifice. The armature is a 2-piece design. Here, although the armature plate is guided by a driver shoulder in its downward movement, it can "over spring" with the return spring so that it exerts no downwards-acting forces on the armature and the ball. The closing of the bleed orifice leads to pressure buildup in the control chamber via the input from the feed orifice. This pressure is the same as that in the rail and exerts an increased force on the control plunger through its end face. This force, together with that of the spring, now exceeds the force exerted by the chamber volume and the nozzle needle closes. The nozzle needle's closing speed is determined by the flow through the feed orifice. Injection ceases as soon as the nozzle needle comes up against its bottom stop again.

3.4.14. Crankshaft speed sensor

- The piston position in the combustion chamber is decisive in defining the start of injection. All the engine's pistons are connected to the crankshaft by connecting rods. A sensor on the crankshaft can therefore provide information on the position of all the pistons. The rotational speed defines the number of crankshaft rotations per minute. This important input variable is calculated in the ECU using the signal from the inductive crankshaft speed sensor.

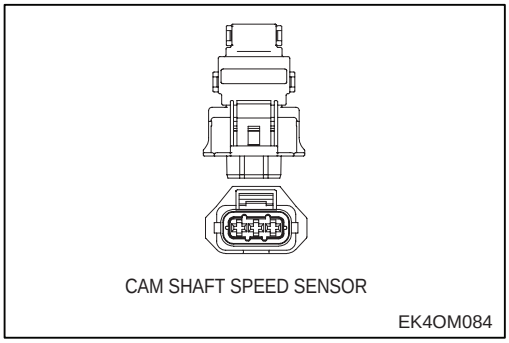

CRANK SHAFT SPEED SENSOR
EK4OM083

No.	ECU PIN	Description
1	2.66	CRS POS
2	2.65	CRS NEG
3	2.69	Shield

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.4.15. Camshaft speed sensor


CAM SHAFT SPEED SENSOR
EK4OM084

- The camshaft controls the engine's intake and exhaust valves. It turns at half the speed of the crankshaft. When a piston travels in the direction of TDC, the camshaft position determines whether it is in the compression phase with subsequent ignition, or in the exhaust phase. This information cannot be generated from the crankshaft position during the starting phase. During normal engine operation on the other hand, the information generated by the crankshaft sensor suffices to define the engine status. In other words, this means that if the camshaft sensor should fail while the vehicle is being driven, the ECU still receives information on the engine status from the crankshaft sensor.

No.	ECU PIN	Description
1	2.68	CAS POS
2	2.67	CAS NEG
3	2.69	Shield

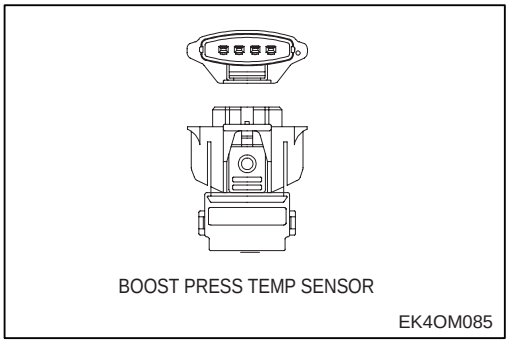
3.4.16. Accelerator pedal sensor

- The accelerator pedal sensor transmitted the driver’s acceleration input to the ECU. A voltage is generated across the potentiometer in the accelerator-pedal sensor as a function of the accelerator-pedal setting. Using a programmed characteristic curve, the pedal's position is then calculated from this voltage.

Downloaded from www.Manualslib.com manuals search engine

3.4.17. Boost pressure and temperature sensor

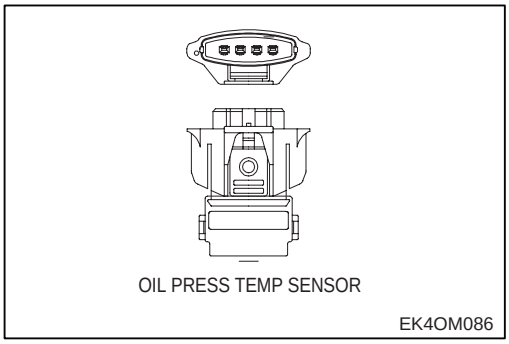
- The boost pressure & temperature sensor are connected to the intake manifold by the O-ring and measures the intake manifold's absolute pressure and temperature.
- The output signal is inputted to the ECU where, with the help of a programmed characteristic curve, it is used for calculating the boost pressure.



No.	ECU PIN	Description
1	2.90	Ground
2	2.37	Boost temperature Signal
3	2.07	+5V Supply
4	2.86	Boost Pressure Signal

3.4.18. Engine oil pressure and temperature sensor

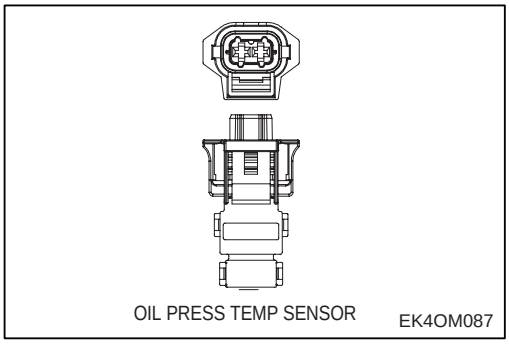
- The engine oil and temperature sensor detects pressure and temperature and sends them to the ECU.



No.	ECU PIN	Description
1	2.90	Ground
2	2.37	Boost temperature Signal
3	2.07	+5V Supply
4	2.86	Boost Pressure Signal

3.4.19. Engine coolant temperature sensor

- The engine coolant temperature sensor detects the engine coolant.



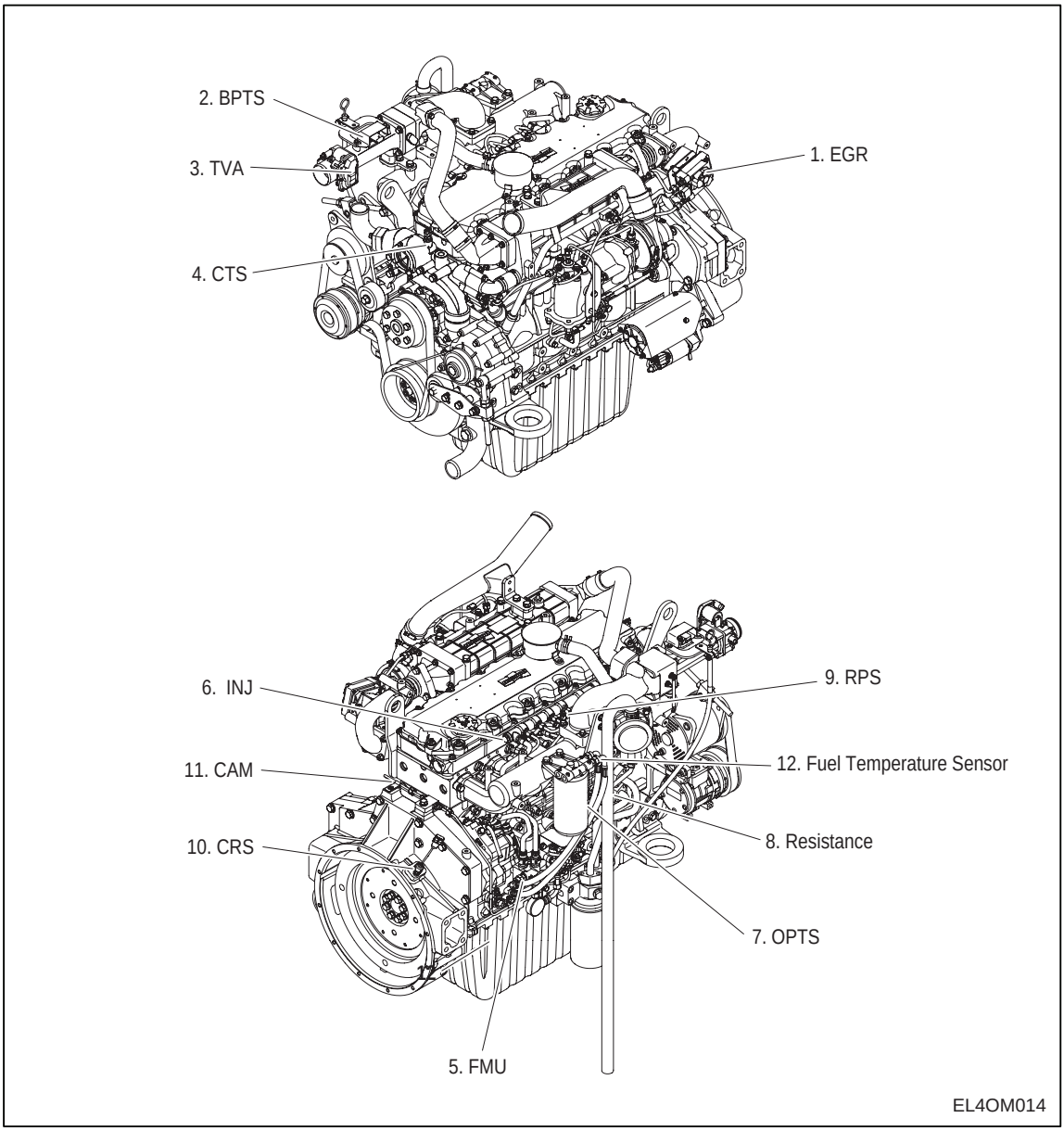
No.	ECU PIN	Description
1	2.39	Coolant temperature Signal
2	2.59	Ground

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.5. Electrical System

3.5.1. Electrical parts

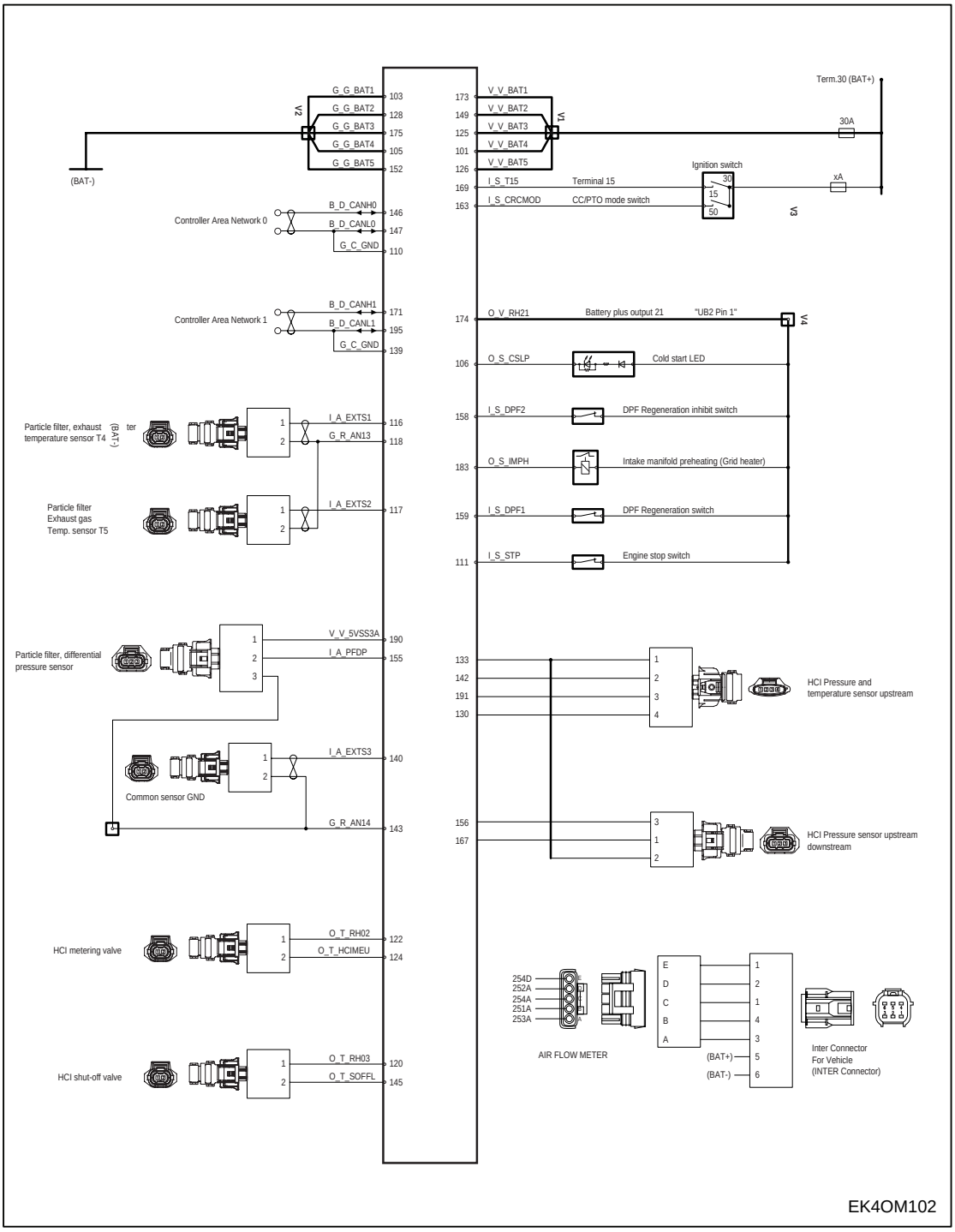


1. Exhaust gas recirculation actuator sensor (EGR)
2. Boost pressure temperature sensor (BPTS)
3. Throttle valve actuator/position sensor (TVA)
4. Cooling water temperature sensor (CTS)
5. Fuel pressure sensor (FMU)
6. Injector sensor (INJ)
7. Oil pressure temperature sensor (OPTS)
8. Resistance connector (Resistance)
9. Commonrail pressure sensor (RPS)
10. Crankshaft speed sensor (CRS)
11. Camshaft speed sensor (CAM)
12. Fuel temperature sensor (FTS)

Downloaded from www.Manualslib.com manuals search engine

3.5.2. Harness of electric control unit

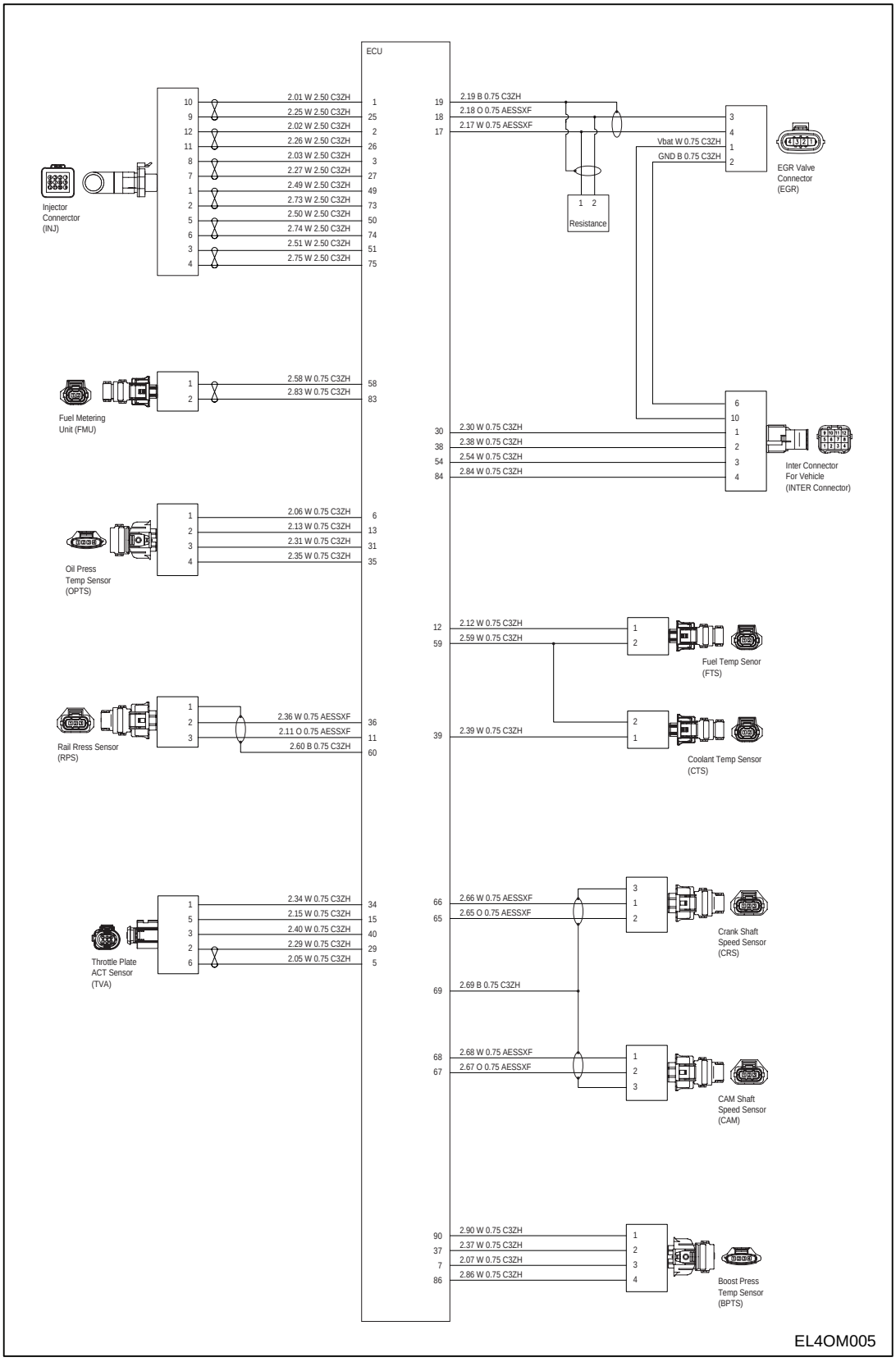
1) Vehicle connector



Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

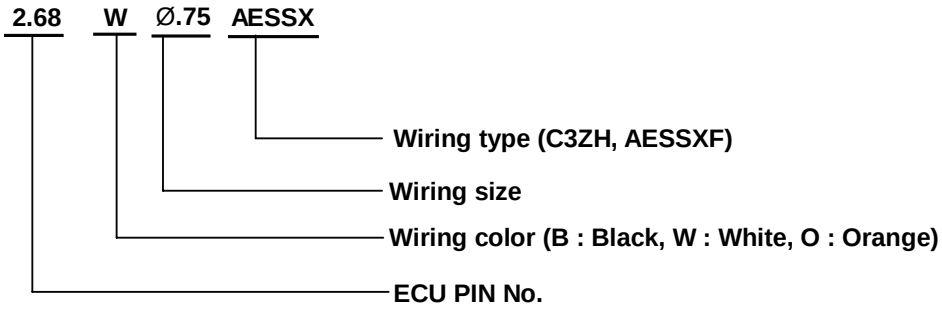
2) Engine connector



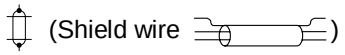
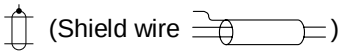
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

- The wiring number can be checked by marking on the wire.



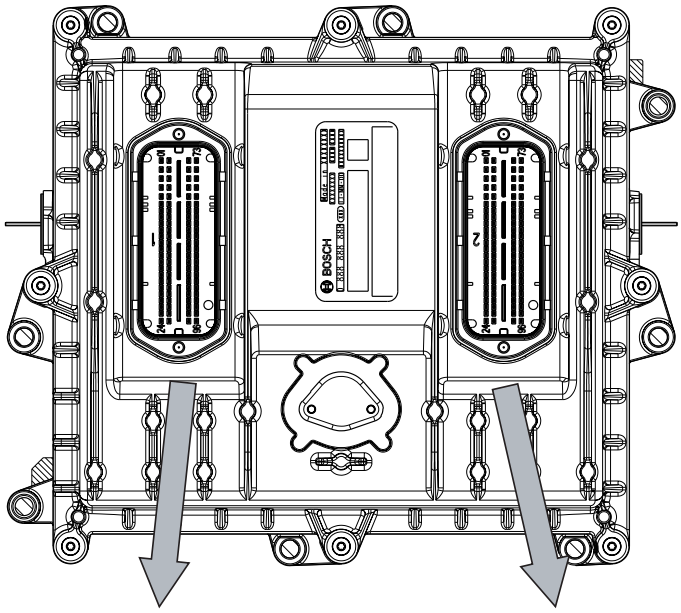
- Symbols on the circuit diagram have the following meaning.

1	 (Twist wire)	Two wires are twisted together.
2	 (Shield wire)	Refers to two phase blocking. The line is grounded to prevent electric noise like static electricity. Two phase blocking means that wires are connected and grounded from both sides.
3	 (Shield wire)	Refers to one phase blocking. The line is grounded to prevent electric noise like static electricity. One phase blocking means that wires are connected and grounded from one side.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.5.3. Connector of electric control unit (ECU)



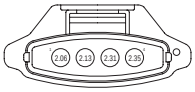
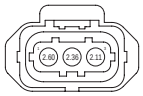
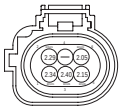
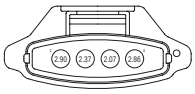
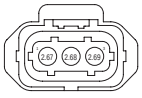
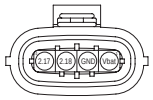
Vehicle side connector

Engine side connector

EJ9OM058

Downloaded from www.Manualslib.com manuals search engine

3.5.4. Electric control unit

Figure	Signs	Pin No.	Circuit name
Fuel Metering Unit 	FMU	2.58	Fuel metering unit (O_V_MEU)
		2..83	Fuel metering unit (O_T_MEU)
Oil Press Temp Sensor 	OPTS	2.06	Oil Press/Temp Sensor GND (G_R_OPS)
		2.13	Oil Temp Sensor Signal (I_A_OTS)
		2.31	Oil Press/Temp Sensor PWR (V_V_5VSS1F)
		2.35	Oil Press Sensor Signal (I_A_OPS)
Rail Press Sensor 	RPS	2.60	Rail Press Sensor GND (G_R_RAILPS)
		2.36	Rail Press Sensor Signal (I_A_RAILPS)
		2.11	Rail Press Sensor PWR (V_V_5VSS3B)
Throttle Plate Actuator/Position Sensor 	TVA	2.34	Throttle Valve PWR (V_V_5VSS3C)
		2.29	Throttle Valve Motor - (O_T_DCNEG1)
		2.40	Throttle Valve GND (G_R_TVA)
		2.15	Throttle Valve Signal (I_A_TVA)
		2.05	Throttle Valve Motor + (O_T_DCPOS1)
Boost Press Temp Sensor 	BPTS	2.90	Boost Press/Temp Sensor GND (G_R_BPS)
		2.37	Boost Temp Sensor Signal (I_A_BTS)
		2.07	Boost Press/Temp Sensor PWR (V_V_5VSS1A)
		2.86	Boost Press Sensor Signal (I_A_BPS)
Coolant Temp Sensor 	CTS	2.39	Coolant Temp Sensor Signal (I_A_CTS)
		2.59	Fuel Temp/Coolant Temp Sensor GND (G_R_AN18)
Crank Shaft Speed Sensor 	CRS	2.66	Crankshaft Speed Sensor POS (I_F_CRSPOS)
		2.65	Crankshaft Speed Sensor NEG (I_F_CRSNEG)
		2.69	Crankshaft/Camshaft Speed Sensor GND (G_C_GND)
Cam Shaft Speed Sensor 	CAM	2.68	Camshaft Speed Sensor POS (I_F_CASPOS)
		2.67	Camshaft Speed Sensor NEG (I_F_CASNEG)
		2.69	Crankshaft/Camshaft Speed Sensor GND (G_C_GND)
EGR Valve 	EGR	Vbat	24V(bat) (O_V_RH32)
		GND	Ground (Body GND)
		2.18	CAN2_Low (B_D_CAN2L)
		2.17	CAN2_High (B_D_CAN2H)

Downloaded from www.Manualslib.com manuals search engine

Figure	Signs	Pin No.	Pin No.
Injector Connector 	INJ	2.49	Injector #1 High (O_P_SVH11)
		2.73	Injector #1 Low (O_P_SVL11)
		2.51	Injector #3 High (O_P_SVH13)
		2.75	Injector #3 Low (O_P_SVL13)
		2.50	Injector #2 High (O_P_SVH12)
		2.74	Injector #2 Low (O_P_SVL12)
		2.27	Injector #3 High (O_P_SVH23)
		2.03	Injector #3 Low (O_P_SVL23)
		2.25	Injector #1 High (O_P_SVH21)
		2.01	Injector #1 Low (O_P_SVL21)
		2.26	Injector #2 High (O_P_SVH22)
		2.02	Injector #2 Low (O_P_SVL22)
Rail Press Sensor 	FTS	2.12	Fuel Temp Sensor Signal (I_A_FTS)
		2.59	Fuel Temp/Coolant Temp Sensor GND (G_R_AN18)
Inter Connector for Vehicle 	Inter Connector (HFM)	2.30	HFM Sensor GND (G_R_AMS)
		2.38	HFM Sensor Signal (I_A_IATS)
		2.54	HFM Sensor Frequency Output (I_F_AMS)
		2.84	HFM Sensor PWR (O_V_VDD12)
		Vbat	24V (bat) (O_V_RH32)
		GND	GND Ground (Body GND)
Resistance 	Resistance	2.17	CAN2_High (B_D_CAN2H)
		2.18	CAN2_Low (B_D_CAN2L)

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

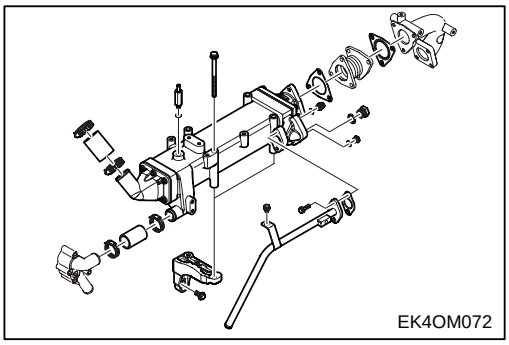
3.6. Exhaust Gas Reduction System

Doosan EPA Tier4 interim compliant engine satisfies industrial exhaust gas related regulations all over the world by utilizing Doosan core technologies.

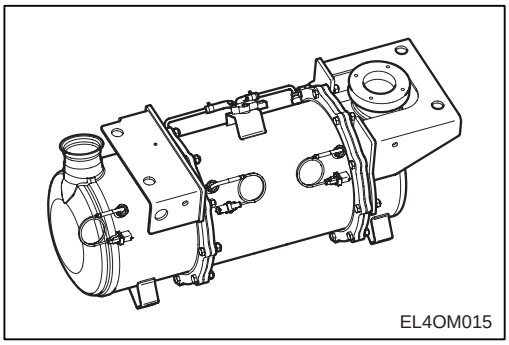
3.6.1. Tier 4 interim exhaust gas reduction device

The exhaust gas reduction device is enhanced with the aid of DPF where DOC is applied and EGR to reduce NOx in the exhaust gas.

- EGR (Exhaust Gas Recirculation System) : exhaust gas circulating mechanism to reduce the formation of NOx.



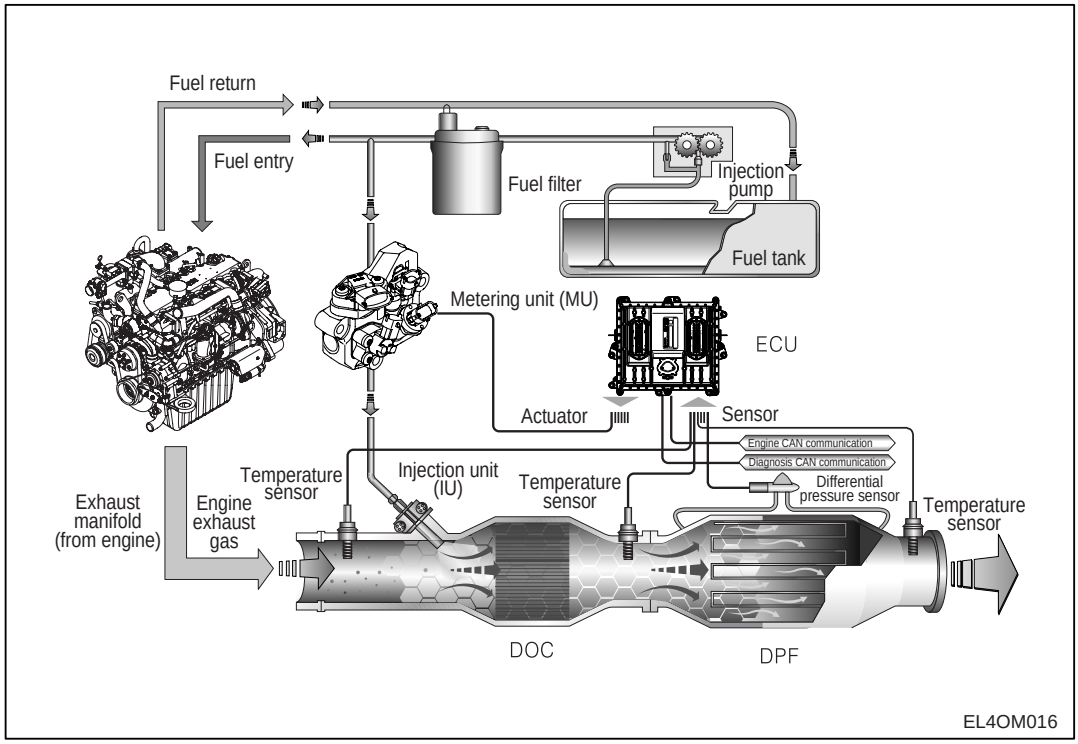
- DPF (Diesel Particulate Filter) : consist of Diesel Oxidation Catalyst (DOC) and DPF itself DOC reduces the amount of HC and CO through chemical reaction caused by catalyst when DPF captures particles in the filter and burn them again to passively-regenerate energy and reduce the amount of harmful exhaust gas.



Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.6.2. Exhaust gas reduction system circuit diagram



Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.6.3. Diesel oxidation catalyst : DOC

- Introduction

  DOC is a device where HC and CO are oxidized. DOC also raises the temperature of DPF by helping oxidization of HC (diesel) sprayed during the active regeneration mode while transforming NO into NO2 to cause the passive regeneration of soot inside DPF.

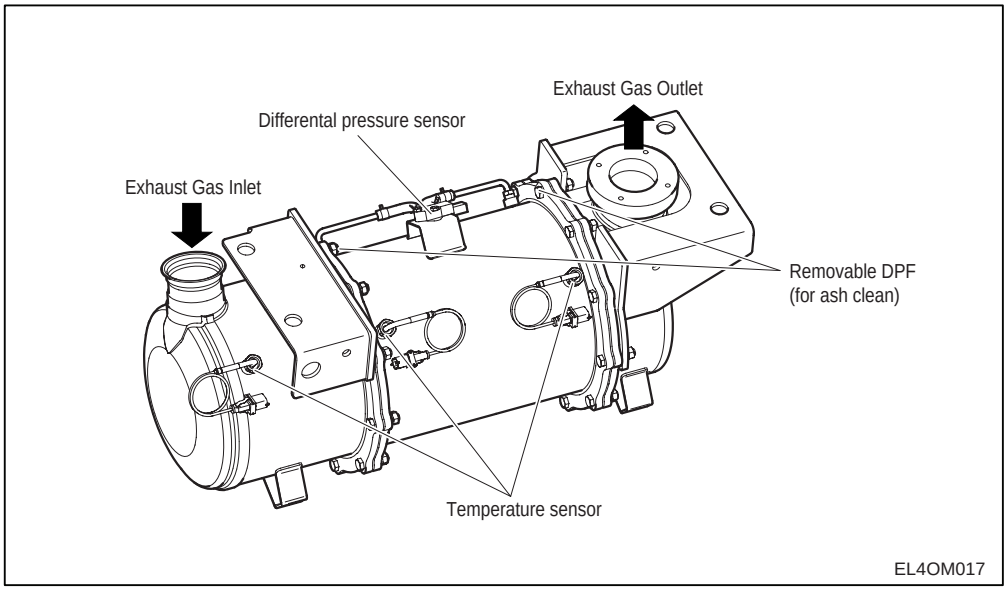
  A few temperature sensors are attached on the front side of DPF system to be able to control the temperature of DOC during the generation mode.

- Removal

  Temperature sensor on DOC should be removed first and checked for damage and rust. DOC must be handled with care to avoid damage.

  (Installation and replacement, assemble and disassemble refer to chapter 3.6.5.)

- Installation and replacement



Downloaded from www.Manualslib.com manuals search engine

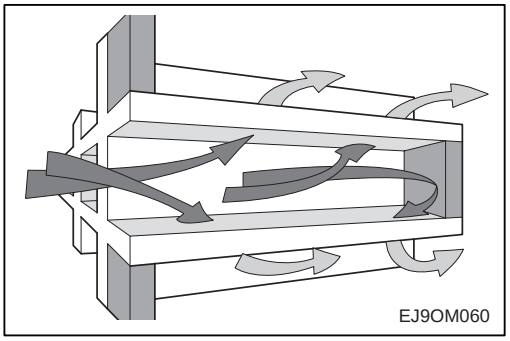
https://truckmanualshub.com/

3.6.4. Diesel particulate filter : DPF

- Introduction

  DPF (Diesel Particulate Filter) prevents PM (Particulate Matter) from contaminating the air when exhausted without proper treatment. DPF consists of DPF itself, 3 units of exhaust gas temperature sensor and differential pressure sensor. DPF has a structure that is similar to honeycomb. When exhaust gas reaches the DPF, PM piles up inside DPF while the rest goes through the DPF. The PM piled inside DPF is defined as Soot, and the PM will be burned again or eliminated by one of the two generation method.

- DPF regeneration

  DPF regeneration is a process of eliminating soot, the contaminant in the exhaust gas generated after fuel burning that is filtered and piled inside DPF. ECU (Engine Control Unit) calculates the amount of soot by analyzing the data collected from DPF Differential Pres signal, vehicle operating hours, fuel consumption and simulation data and starts DPF regeneration when the amount of soot reaches certain level. Regeneration is a process of burning collected soot in DPF by raising temperature above 580 °C in DOC as controlling engine throttle and post fuel injection and spraying HC (diesel) through exhaust. After the regeneration process, ash remains inside DPF. DPF Regeneration has 2 different modes
  ; active and forced regeneration.

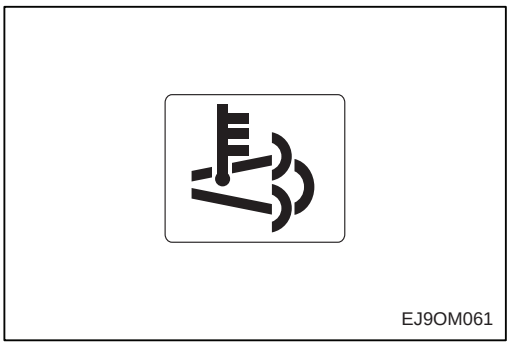
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

- DPF regeneration lamp and switch

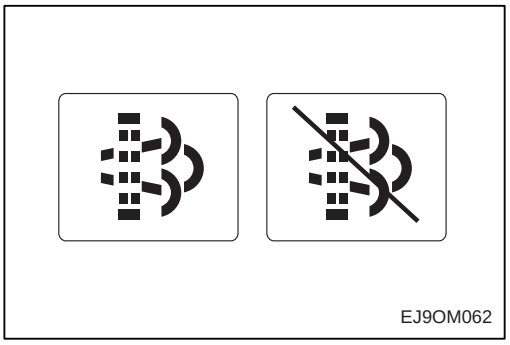
  1) High temperature caution lamp :

  DPF Regeneration process release extreme amount of heat, therefore, flammable objects near the pipe must be removed.



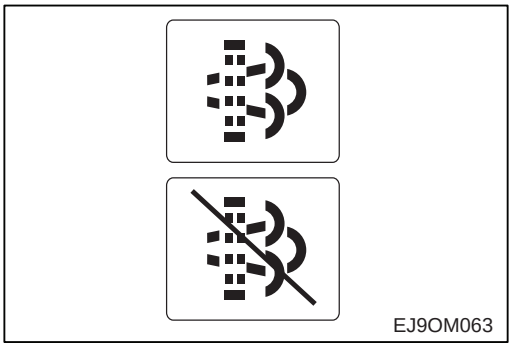
  2) Regeneration lamp :

  Regeneration lamp turns on during the regeneration or when the regeneration is necessary. If driver stops or does not initiate regeneration, It shows the right signal.



  3) Forced regeneration switch and stop switch :

  The above switch is compulsory regeneration switch and the below one is stop switch which prevents the machine or automobile from initiating regeneration.

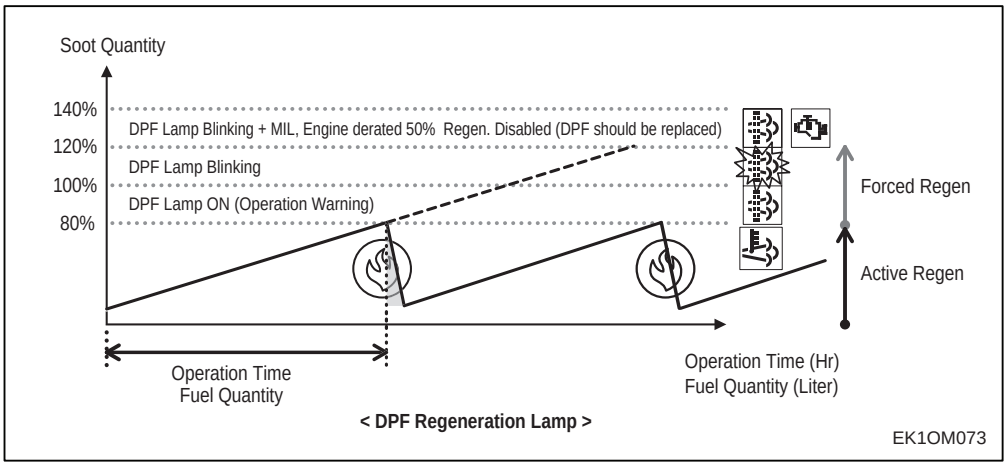


NOTE :

If regeneration is needed after setting the regeneration prohibition switch, press the regeneration prohibition switch again to release the regeneration prohibition warning lamp. Then, press the regeneration switch again.

Downloaded from www.Manualslib.com manuals search engine

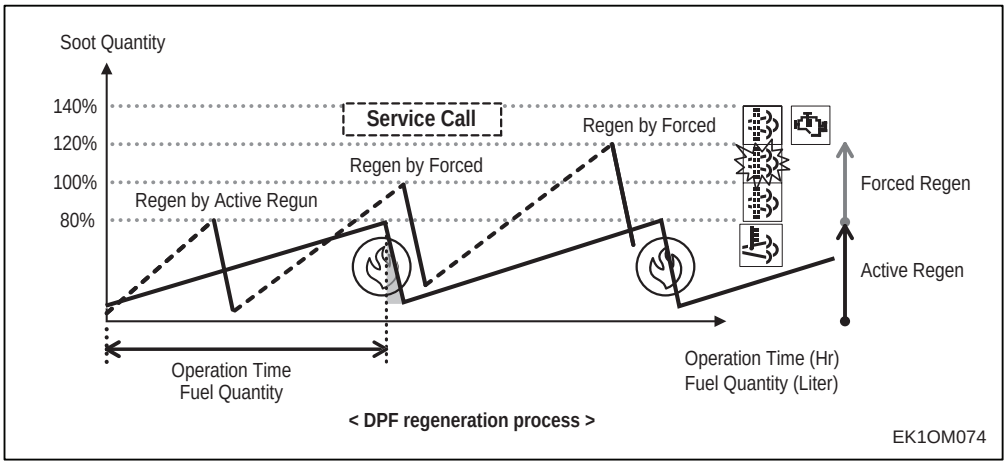
https://truckmanualshub.com/



- Lamp on when the amount of soot in DPF reaches 80% of its capacity.
- Lamp blinks when the amount of soot in DPF reaches 100% of its capacity.
- Lamp blink + MIL+ output decrease (50%) when the amount of soot in DPF reaches 120% of its capacity.

- DPF regeneration process

  There are 2 kinds of regeneration ; active regeneration and forced regeneration.
  Active regeneration initiates when the amount of soot in DPF is below 80% of its capacity ; however, when the amount of soot exceeds 80%, driver has to start the forced regeneration process by himself.
  If the amount of soot exceeds 120%, the caution lamp turns on and the engine power output falls below 50%. Driver then needs to call for service.



- Soot in DPF below 80% : active regeneration
- Soot in DPF below 100% : forced regeneration
- Soot in DPF below 120% : forced regeneration
- Soot in DPF above 120% : unable to initiate regeneration, need to call service agents.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

1) Active regeneration

ECU initiates active regeneration under below conditions. Regeneration generates heated exhaust gas, and the regeneration caution lamp and temperature caution lamp turn on to notify the driver. Driver can still maneuver the machinery or automobile but need caution. The regeneration process takes 20 to 30 minutes, and the lamps turn off when the process is over.

WARNING :

Turning off the engine when the regeneration is still in process and the lamp is on can affect DPF critically.

Therefore, the engine is not supposed to be turned off until the process is completed unless the driver is in immediate danger or emergency happens.

1. Vehicle operating hours : less than 10 hours.

2. Fuel consumption amount : less than 120 liters.

3. The amount of soot collected calculated by ECU simulation reaches certain level.

2) Forced regeneration

Forced regeneration is a process of regeneration started by the driver when DPF is not performing regeneration automatically during maneuvering, and the process is supposed to be started when the vehicle is parked. Forced regeneration should be initiated by the driver when active regeneration might not occur under the condition below.

- Repeated operation with light load or low speed driving within a short distance.
- Frequent idle operation

The timing of driver's initiative to start forced regeneration

1. Coolant (engine oil) temperature: more than 55 °C
2. Revolution : idle
3. Gear stick : neutral (Wheel loader)

Forced regeneration procedure

1. Park the vehicle. (Due to the raise of the exhaust gas temperature, the vehicle should be parked in a safe place.)
2. Set the engine revolution at idle.
3. Pull down the safety lever
4. Turn on the forced regeneration switch.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

5. The engine revolution will increase up to 1,400 rpm (depends on the model and type of vehicle operating) and starts the regeneration process.
6. The regeneration lamp and HEST lamp turn on as the process begins, and the process takes approximately 20 minutes.
7. The engine revolution drops to idle.
8. The regeneration lamp and HEST lamp turn off.
9. Turn off the regeneration switch.
   * If the driver has to stop the regeneration process due to emergency, the safety lever should be pulled up.
     However, stopping regeneration in the middle of its operation can affect DPF regeneration negatively. Please, choose a safe place and finish the 20 minute process.

- Removal

  Temperature sensor and differential pressure sensor on DPF should be removed and checked for damage and rust. DPF must be handled with care to avoid damage.

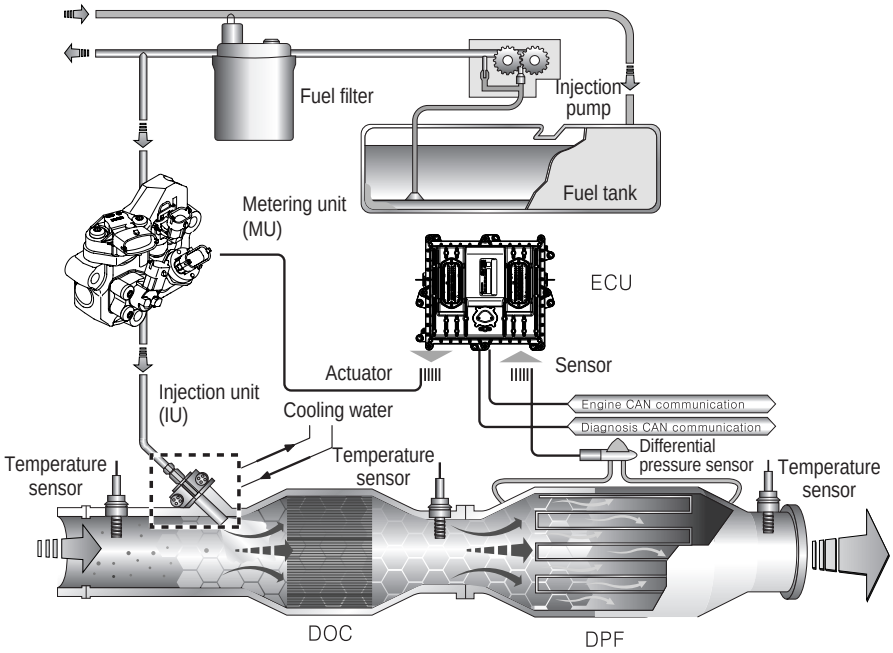
  1) Check for damage and rust on DPF's front and back.
  2) Check for soot on the back side of DPF. If black material or soot is seen or found when wiping it with cotton or a piece of paper, the DPF should be checked by service personnel for further diagnosis.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

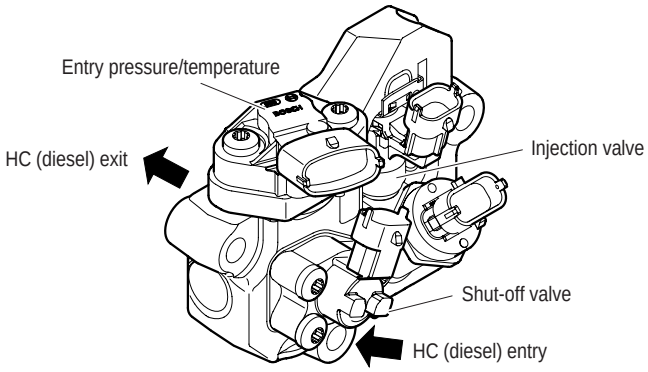
3.6.5. HC dosing metering unit, MU

HC supply device is supplying HC fuel to exhaust pipe to initiate DPF regeneration. It's consists of fuel pressure sensor, shut off valve which controls the amount of fuel spayed and fuel spraying valve.



< HC (diesel) injection system overview diagram >

EK4OM027



< HC (diesel) supply unit >

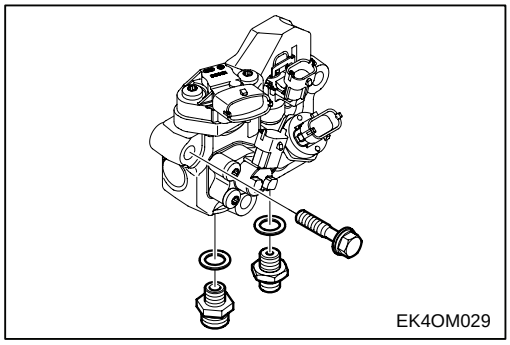
EK4OM028

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

- Removal

  1) Fuel supply pipe and injection unit pipe attached to metering unit should be removed before removing 3 pieces of M8 bolt.


EK4OM029

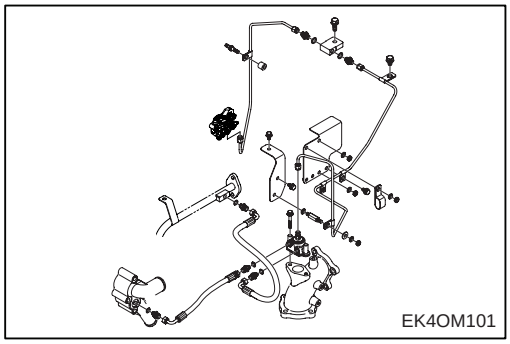
- Installation

  1) Place metering unit on the bracket and fix it together by screwing 3 pieces of M8 bolt.
     - M8 bolt assembling torque = 2.2 kgf•m
     - Fuel pipe union nut torque = 2 kgf•m

WARNING : When Working on the "Air Extraction"
The air in the fuel supply line should be removed by activating forced regeneration after installing HC (diesel) supply device.

3.6.6. HC dosing injection unit, IU

HC dosing injection unit injects HC that is supplied by HC supply device to initiate DPF regeneration, and the unit is placed on the exhaust pipe.


EK4OM101

- Removal

  1) Remove Injection unit pipe union nut before removing the bracket attached on the exhaust pipe.

  2) Remove cooling hose connected to injection unit.

- Installation and replacement

  Assemble the injection unit to the exhaust pipe, suing M8 bolts, and assemble the fuel pipe unit nuts. Assemble the cooling pipe connection parts by identifying the in/out direction of the injection unit.

WARNING : Air deflation
After replacing the HC (diesel) supply unit, air in the fuel line should be expelled through forced regeneration.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.6.7. EGR system

1) Introduction

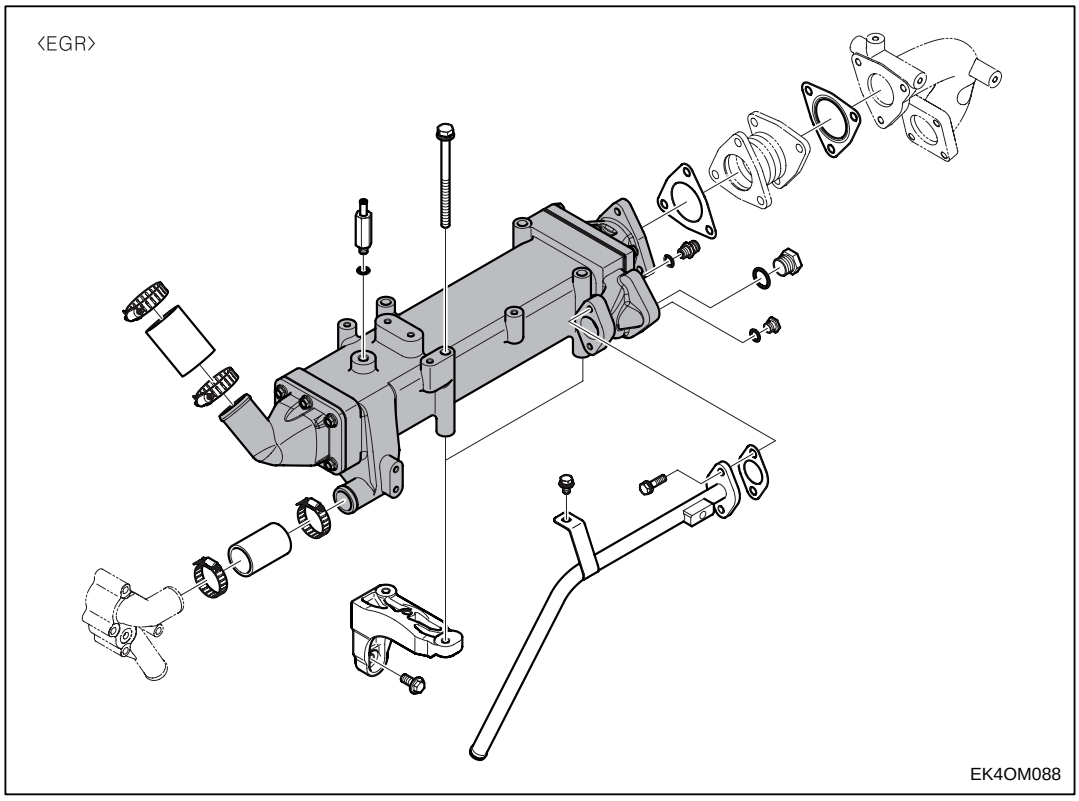
- EGR performs recirculation of a portion of exhaust gas to reduce the generation of NOx.
- Exhaust gas released from the back of exhaust manifold and flows back into the engine with cooled air intake from the inter cooler.

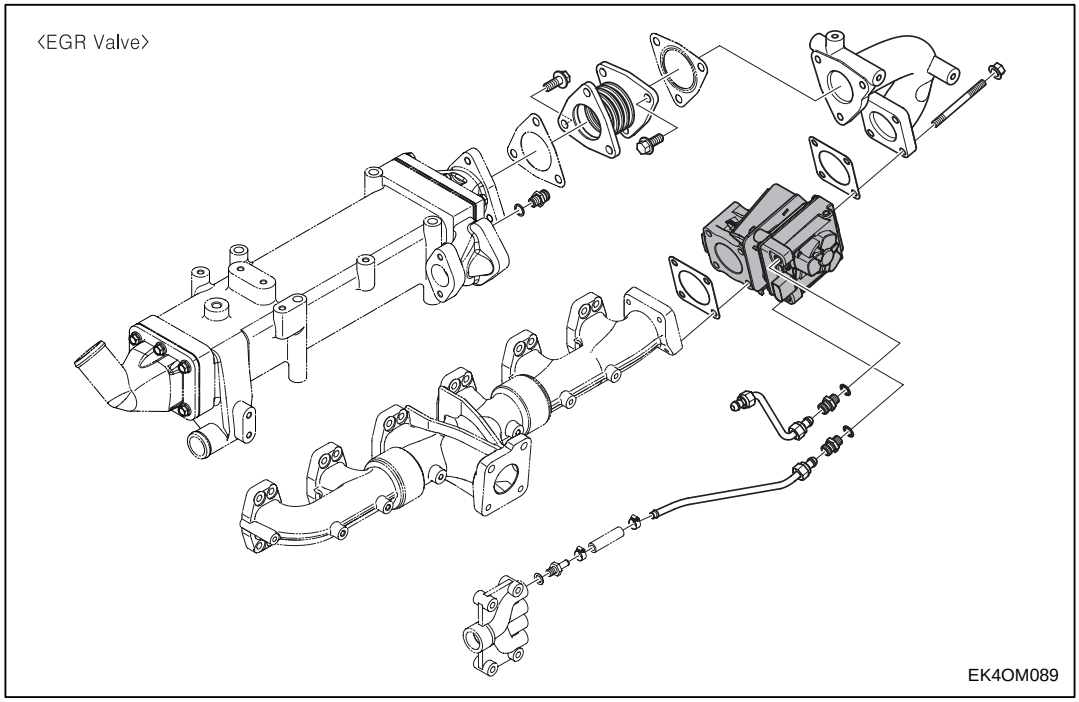
2) Feature

- EGR cooler is installed to lower exhaust gas temperature. (Cooled EGR System)
- Electric EGR valve with motor is installed to control EGR rate.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/





Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.6.8. EGR cooler

1) Introduction

- EGR cooler is heat exchanging device that reduces the temperature of recirculating exhaust gas.
- EGR cooler enhances fuel efficiency while reducing the amount of NOx generation.

2) Feature

- High efficient tube & fin type applied.

3.6.9. EGR system installation and disassembly

1) Disassembly

(1) Disassemble the EGR valve (K) and elbow pipe (L)

(The above should be performed when heat screen (O) and bellows pipe (N) are previously disassembled.)

: EGR system should be cooled after long hours of operation before initiating disassembly.

- Disassemble nut (P) from stud bolt (M).
- Cooling pipe should be disassembled when disassembling EGR valve.

(2) Disassembling EGR Bracket should be performed after disassembling exhaust manifold (A)Part.

2) Installation

Installation process should be preformed in reverse order of disassembly.

3.6.10. EGR cooler installation and disassembly

1) Disassembly

EGR system should be cooled after long hours of operation before initiating disassembly.

(1) Please take apart water inlet, outlet pipe and hose.

(2) Please take apart gas outlet pipe and hose.

(3) Please take apart heat screen.

(4) Please disassemble (N) part

(5) Please disassemble EGR cooler assembly bolt.

(6) Please EGR cooler from EGR bracket.

2) Installation

Installation process should be preformed in reverse order of disassembly.

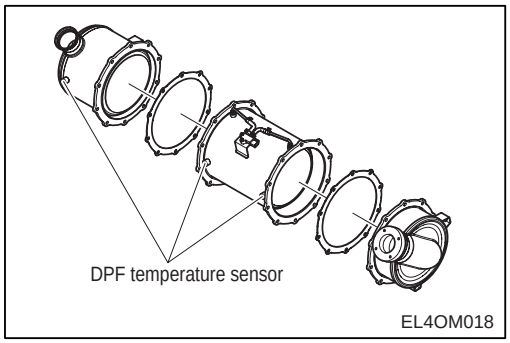
* Replace the used gasket with new one.

Downloaded from www.Manualslib.com manuals search engine

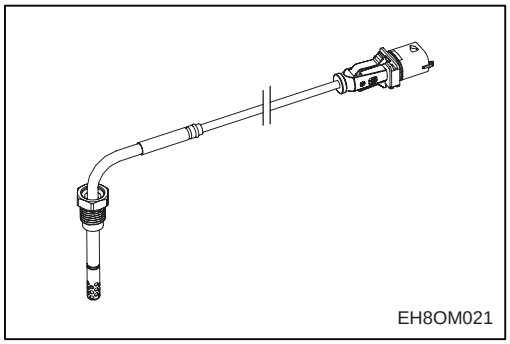
https://truckmanualshub.com/

3.6.11. Exhaust gas temperature sensor

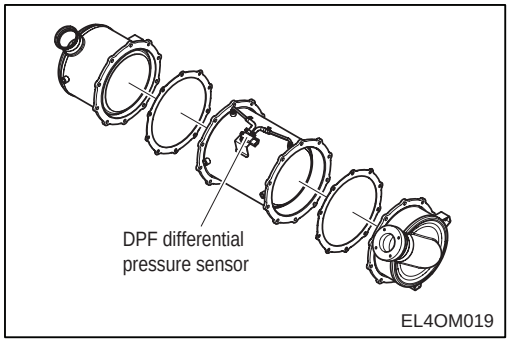
- DPF temperature sensor



- The following temperature sensors were applied at the DOC upstream, DPF upstream, and DPF downstream position, in order to measure temperature of the DOC and DPF, which is the post processing unit.

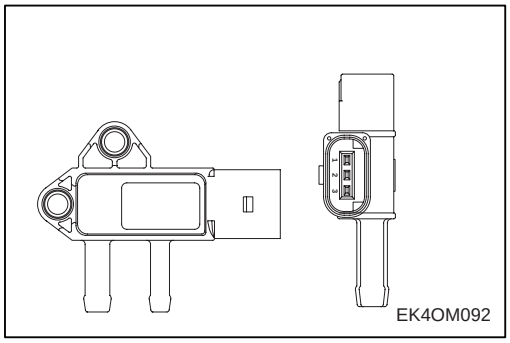


- DPF differential pressure sensor.



- The differential pressure sensor is applied by measuring the pressure difference between the front and rear side of the DPF.

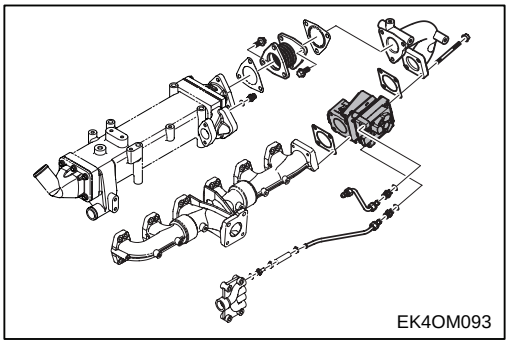
No.	Description
1	Supply Voltage (VCC)
2	Ground
3	Output Signal



Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

- EGR valve
  The EGR valve is applied to main the optimal EGR.



Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

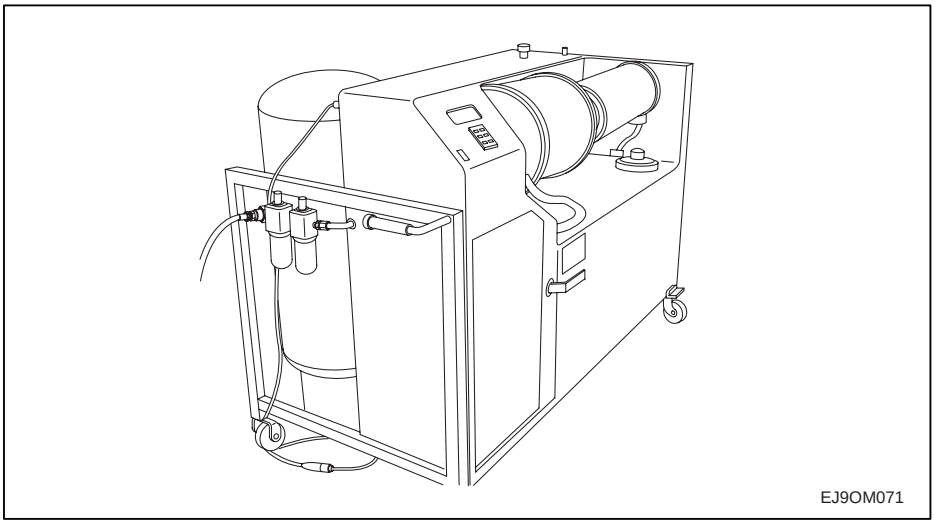
3.6.12. Caution while working at DPF assembly

Be cautious of below when handling and assembling DPF.

1) DOC and DPF must be protected from shock that can be caused by dropping and hitting when being removed.
2) Technical failure can be occurred when substance from outside infiltrates into the differential pressure sensor pipe during replacement.
3) The infiltration of exterior substance during the removal process can cause defect in DOC and DPF.
4) Differential pressure sensor and temperature sensor should be protected from being damaged during the process of removal since they are placed outside of DPF.
5) A new set of gaskets should be placed to prevent leakage instead of placing the used ones.
6) Leakage from exhaust system can cause failure meeting regulations, raise in the noise level and increase in harmful exhaust, and observance of proper torque is crucial when assembling.

- Ash removal in DPF, DPF cleaning

  Regeneration of soot in DPF forms ash, and the increases in the amount of ash cause the increase of exhaust pressure which negatively affects engine performance and the fuel efficiency. To prevent the above disadvantage happening, ash cleaning should be done regularly. DPF system can be disassembled into different parts for the convenience in cleaning. The ash cleaning is recommended every 4,500 hours ; however, the period of cleaning is depending widely on the operating condition, surroundings and engine oil.



WARNING :

1. ULSD should be used to obtain the normal DPF effect.

2. To secure proper DPF cleaning interval, the low ash engine lubricant oil (CJ4 grade) should be used.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.7. Engine Diagnostic

3.7.1. Method of confirmation for the fault code

Doosan specified the occurrence conditions for the following fault codes, as the fault diagnosis unit can handle the fault fast and accurately. Please check the fault code using the fault diagnosis device (laptop).

3.7.2. Engine fault code and occurring condition

Fault code	Fault content	Occurrence conditions
1. Air mass flow sensor		
P0100	DFC_AFSBattErr	Battery voltage error of HFM sensor
P0101	DFC_AFSSetyDrftMax	Sensitivity drift high error for HFM sensor
P0101	DFC_AFSSetyDrftMin	Sensitivity drift error low for HFM sensor
P0103	DFC_AFSSigErr	SCB of hardware signal of HFM sensor
P0103	DFC_AFSSRCRawMax	SRC high error for raw value in HFM sensor
P0102	DFC_AFSSRCRawMin	SRC low error for raw value in HFM sensor
2. Air control governor deviation error.		
P0402	DFC_AFSSRCRawMin	Air control positive governor deviation above limit
P0401	DFC_AFSSRCRawMin	Air control negative governor deviation below limit
3. Engine temperature sensor plausibility		
P1000	DFC_AirTMonPlaus_0S	Air temperature monitoring plausibility check array 0
P1001	DFC_AirTMonPlaus_1	Air temperature monitoring plausibility check array 1
P1002	DFC_AirTMonPlaus_2	Air temperature monitoring plausibility check array 2
P1003	DFC_AirTMonPlaus_3	Air temperature monitoring plausibility check array 3
P1004	DFC_AirTMonPlaus_4	Air temperature monitoring plausibility check array 4
P1005	DFC_AirTMonPlausTot	Air temperature monitoring plausibility check
4. Actuator relay0 error		
P0659	DFC_ARlySCB_0	Short circuit to battery error at acuator relay 0
P0658	DFC_ARlySCG_0	Short circuit to ground error at actuator relay 0
5. Actuator relay1 error		
P2671	DFC_ARlySCB_1	Short circuit to battery error at acuator relay 1
P2670	DFC_ARlySCG_1	Short circuit to ground error at actuator relay 1
6. Actuator relay2 error		
P2686	DFC_ARlySCB_2	Short circuit to battery error at acuator relay 2
P2685	DFC_ARlySCG_2	Short circuit to ground error at actuator relay 2
7. Actuator relay3 error		
P1045	DFC_ARlySCB_3	Short circuit to battery error at acuator relay 3
8. Battery		
P0563	DFC_BattUH	High Battery Voltage indication

Downloaded from www.Manualslib.com manuals search engine

Fault code	Fault content	Occurrence conditions
P0562	DFC_BattULo	Low Battery voltage indication
P0563	DFC_BattUSRCMax	SRC high for battery voltage sensor
P0562	DFC_BattUSRCMin	SRC low for battery voltage sensor
9. Timeout error of CAN Module A		
C028	DFC_BusDiagBusOffNodeA	BusOff error CAN A
10. Timeout error of CAN Module C		
C046	DFC_BusDiagBusOffNodeC	BusOff error CAN C
11. Coolant temperature		
P1116	DFC_CEngDsTAbsTst	Coolant temperature : defect fault check for Absolute plausibility test
P1116	DFC_CEngDsTDynTst	Coolant temperature : defect fault check for dynamic plausibility test
P1116	DFC_CEngDsTPhysRngHi	Physical range check high for coolant temperature
P1116	DFC_CEngDsTPhysRngLo	Physical range check low for coolant temperature
P1118	DFC_CEngDsTSRCMax	SRC High for Engine coolant temperature
P1117	DFC_CEngDsTSRCMin	SRC low for Engine coolant temperature
12. Hydraulic oil temperature CAN time out		
C141	DFC_ComAAI2EDCTO	Timeout Error of CAN-Receive-Frame Hydraulic oil temperature
13. Timeout error of CAN receive frame DEC1V		
C122	DFC_ComDEC1VTO	Timeout Error of CAN-Receive-Frame DEC1V
14. Timeout error of CAN receive frame EGR valve		
C10A	DFC_ComEGRErrStTO	Timeout error of CAN receive frame EGR valve
C10A	DFC_ComEGRVlv2EDCTO	Timeout error of CAN receive frame EGR valve
15. Engine shut off request from EPOS		
D100	DFC_ComEngShOffEBC1	Engine shut off request from EPOS
16. Timeout error of CAN receive frame Vehicle cut off switch		
C124	DFC_ComRxAUXIO1TO	Timeout error of CAN receive frame Vehicle cutt off switch
17. Accel pedal CAN max error		
C123	DFC_ComRxDEC1V	Accel pedal CAN max error
18. EGR valve actuator error		
C10A	DFC_ComRxEGRComLos	EGR valve actuator communication loss error
C40B	DFC_ComRxEGRIniErr	EGR valve actuator error
C10A	DFC_ComRxEGRLosCom	EGR valve actuator communication loss error
C40B	DFC_ComRxEGROvrLd	EGR valve actuator error
C40B	DFC_ComRxEGRPosDvt	EGR valve actuator error
C40B	DFC_ComRxEGRPosEst	EGR valve actuator error
C40B	DFC_ComRxEGRShrtDetc	EGR valve actuator error
C40B	DFC_ComRxEGRTempAlrt	EGR valve actuator error
C40B	DFC_ComRxEGRTempErr	EGR valve actuator error
C40B	DFC_ComRxEGRTempWar	EGR valve actuator error
C40B	DFC_ComRxEGRTrqLim	EGR valve actuator error

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

Fault code	Fault content	Occurrence conditions
19. Vehicle cutoff switch error		
C125	DFC_ComRxVehCutOffSwtErr	Vehicle cutoff switch error
20. Error message from VGT actuator		
C40D	DFC_ComRxVGTB2EDC	VGT actuator error
21. Timeout error of CAN receive frame TCU		
C121	DFC_ComTSC1TETO	Timeout error of CAN receive frame TCU
22. Timeout error of CAN receive frame VGT		
C10C	DFC_ComVGTB2EDCTO	Timeout error of CAN receive frame VGT
23. Performance limit activation		
P1007	DFC_CoVehPrfmLimAct	Performance limit activation
24. ECU hardware chip CY146 error		
P0607	DFC_Cy146SpiCom1	Reported SPI and COM-Errors of a Cy146
P0607	DFC_Cy146SpiCom2	Reported SPI and COM-Errors of a Cy146
P0607	DFC_Cy146SpiCom3	Reported SPI and COM-Errors of a Cy146
P0607	DFC_Cy146SpiCom4	Reported SPI and COM-Errors of a Cy146
P0607	DFC_Cy146SpiCom5	Reported SPI and COM-Errors of a Cy146
25. ECU hardware chip CY320 error		
P0607	DFC_Cy320SpiCom	ECU hardware chip CY320 error
26. ECU power stage test		
P0563	DFC_Dev Lib BattUHi	ECU power stage test (high battery voltage)
P0562	DFC_DevLibBattULo	ECU power stage test (low battery voltage)
27. Metering Unit supply voltage		
P025D	DFC_DPMOvrVltg	DPM System Overvoltage Error
P025C	DFC_DPMUndrVltg	DPM System Under voltage Error
28. Metering Unit differential pressure MIN		
P025B	DFC_DPMPresDiffUndrMin	Differential pressure of the dosing system lower than the hysteresis threshold
29. EEPROM error		
P062F	DFC_EEPEraseErr	EEP Read Error based on the error for more blocks
P062F	DFC_EEPRdErr	EEP Read Error based on the error for more blocks
P062F	DFC_EEPWrErr	EEP Write Error based on the error for one block
P062F	DFC_GptaEEPData1BlkErr	Error in EEPROM block EEPData1. SD correction can not be calculated
30. Overspeed detection in component engine protection		
P0219	DFC_EngPrtOvrSpd	Over speed detection in component engine protection
31. Barometric pressure sensor in ECU		
P2227	DFC_EnvPPhysRngHi	Physical Range Check high for Environment Pressure
P2227	DFC_EnvPPhysRngLo	Physical Range Check low for Environment Pressure
P2229	DFC_EnvPSRCMax	SRC High for Environment Pressure
P2228	DFC_EnvPSRCMin	SRC low for Environment Pressure

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

32. Camshaft sensor		
P0341	DFC_EpmCaSI1ErrSig	camshaft signal diagnose - disturbed signal
P0340	DFC_EpmCaSI1NoSig	camshaft signal diagnose - no signal
P0340	DFC_EpmCaSI1OfsErr	camshaft offset angle exceeded
33. Crankshaft sensor		
P0336	DFC_EpmCrSErrSig	crankshaft signal diagnose - disturbed signal
P0335	DFC_EpmCrSNoSig	crankshaft signal diagnose - no signal
34. Auto fan clutch PWM out		
P0480	DFC_FanDIOOL	Fan : Open Load error on the output power stage.
P0484	DFC_FanDIOOvrTemp	Fan : Over Temperature error on the output power stage
P0484	DFC_FanDIOSCB	Fan : Short Circuit to battery error on the output power stage
P0485	DFC_FanDIOSCG	Fan : Short Circuit to Ground error on the output power stage
P0481	DFC_FanPWMOL	Fan : Open Load error on the output power stage
P0481	DFC_FanPWMOvrTemp	Fan : Over Temperature error on the output power stage
P0694	DFC_FanPWMSCB	Fan : Short Circuit to battery error on the output power stage
P0693	DFC_FanPWMSCG	Fan : Short Circuit to Ground error on the output power stage
35. Auto fan clutch speed		
P0526	DFC_FanSpdLonPer	Fan speed signal long period fault path
P0527	DFC_FanSpdSRCHigh	Fan speed signal range check high fault path
P0528	DFC_FanSpdSRCLow	Fan speed signal range check low fault path
36. Fuel temperature sensor		
P0181	DFC_FuelTPhysRngHi	Physical Range Check high for fuel temperature
P0180	DFC_FuelTPhysRngLo	Physical Range Check low for fuel temperature
P0183	DFC_FuelTSRCMax	SRC high for fuel temperature sensor
P0182	DFC_FuelTSRCMin	SRC low for fuel temperature sensor
37. Metering Unit Hydrocarbon dosing valve.		
P1080	DFC_HCDosVlvEPHi	The current at the end of the injection phase exceeds the maximum threshold (HCDosVlv_iEIPMax_C)
P1081	DFC_HCDosVlvOvrTemp	Over temperature error on power stage of Hydrocarbon dosing valve actuator
P1082	DFC_HCDosVlvSCBLS	Short circuit to battery error in power stage of Hydrocarbon dosing valve actuator
P1083	DFC_HCDosVlvSCBOLHS	short circuit to ground or open load on the High side switch.
P1084	DFC_HCDosVlvSCGOLLS	short circuit to ground or open load on the low side switch.
P1085	DFC_HCDosVlvSCHS	Short circuit error in high side power stage of Hydrocarbon dosing valve actuator
38. DPM system error		
P1060	DFC_HCIMonAddPresIncTstDs	Additional Pressure Increase Test Downstream Error = FCT_ERROR in Pressure Increase Test-Upstream state
P1061	DFC_HCIMonPresDecTstUsErr	Pressure Decrease Test Upstream Error = FCT_ERROR in Pressure Decrease Test Upstream

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

P1062	DFC_HCIMonPresDsMax	Dynamic Pressure Monitoring -pressure downstream in excess of maximum threshold
P1063	DFC_HCIMonPresDsMin	Dynamic Pressure Monitoring -pressure downstream below minimum threshold
P1064	DFC_HCIMonPresEqlTstErr	Pressure Equalization Test Error = FCT_ERROR in Pressure Equalization state
P1065	DFC_HCIMonPresIncDsMaxTstErr	Pressure Increase Downstream Maximum Test Error = FCT_ERROR in Pressure Increase-
P1066	DFC_HCIMonPresIncTstDsErr	Pressure Increase Test Downstream Error = FCT_ERROR in Pressure Increase Test Downstream
P1067	DFC_HCIMonPresIncTstUsErr	Pressure Increase Test Upstream Error = FCT_ERROR in Pressure Increase Test Upstream stat
P1068	DFC_HCIMonPresIncUsMaxTstErr	Pressure Increase Test Upstream Maximum Test Error = FCT_ERROR in Pressure Increase-
P1069	DFC_HCIMonPresIncUsMinTstErr	Pressure Increase Upstream Minimum Test Error = FCT_ERROR in Pressure Increase Test-Upstream
P106A	DFC_HCIMonPresUsMax	Dynamic Pressure Monitoring -pressure upstream in excess of maximum threshold
P106B	DFC_HCIMonPresUsMin	Dynamic Pressure Monitoring -pressure upstream below minimum threshold
P106C	DFC_HCIMonStatLkgTstDsErr	Static Leakage Test Downstream Error = FCT_ERROR in Static Leakage Test Upstream Error state
P106D	DFC_HCIMonStatLkgTstUsErr	Static Leakage Test Upstream Error = FCT_ERROR in Static Leakage Test Upstream Error state
P106E	DFC_HCIMonSysErr	System Test Error
P106F	DFC_HCIMonSysTstPresMonDs	Pressure monitoring downstream
P1070	DFC_HCIMonSysTstPresMonUs	Pressure monitoring upstream error
P1071	DFC_HCIMonVtlnErr	Ventilation error = FCT_ERROR in Ventilation state
P1072	DFC_HCIPODDVBlkOpn	Hydrocarbon dosing valve blocked open
P1073	DFC_HCIPODDVPlausBIP	Hydrocarbon dosing valve BIP plausibility
P1074	DFC_HCIPODHDVDsPPlaus	Hydrocarbon dosing valve downstream pressure sensor plausibility
P1075	DFC_HCIPODHDVUsPPlaus	Hydrocarbon dosing valve up stream pressure sensor plausibility
P1076	DFC_HCIPODIVBlkOpn	Hydrocarbon injection valve blocked open
P1077	DFC_HCIPODSVBlkOpn	Hydrocarbon shutoff valve blocked open
39. Metering Unit downstream pressure sensor		
P1086	DFC_HDVDsPSRCMax	SRC high for Hydrocarbon Dosing Valve Downstream Pressure Sensor
P1087	DFC_HDVDsPSRCMin	SRC low for Hydrocarbon Dosing Valve Downstream Pressure Sensor

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

Fault code	Fault content	Occurrence conditions
40. Metering Unit upstream pressure sensor		
P1088	DFC_HDVUsPSRCMax	SRC high for Hydrocarbon Dosing Valve Upstream Pressure Sensor
P1089	DFC_HDVUsPSRCMin	SRC low for Hydrocarbon Dosing Valve Upstream Pressure Sensor
41. Metering Unit Hyrocarbon doser intake fuel temperature		
P108A	DFC_HDVUsTSRCMax	SRC high in Hydrocarbon Dosing valve upstream temperature sensor
P108B	DFC_HDVUsTSRCMin	Diagnostic fault check for SRC low in Hydrocarbon Dosing valve upstream temperature sensor
42. Power stage for intake air heater		
P0543	DFC_IAirHtOL_0	Intake air heater : No load error for power stage on CJ945.
P0540	DFC_IAirHtOvrTemp_0	Intake air heater : Over temperature error on CJ945.
P0542	DFC_IAirHtSCB_0	Intake air heater : Short circuit to battery error for power stage on CJ945.
P0541	DFC_IAirHtSCG_0	Intake air heater : Short circuit to ground error for power stage on CJ945
43. Monitoring of injection		
P1315	DFC_InjCrvInjLimChrgBal	Number of injections is limited by charge balance of booster capacity
P1316	DFC_InjCrvInjLimQntBal	Number of injections is limited by quantity balance of high pressure pump
P1317	DFC_InjCrvInjLimSys	Number of injections is limited by system
P1318	DFC_InjCrvNumInjRtmLim	Number of injections is limited by runtime
44. Detection of failed engine start		
P0A0F	DFC_InjUnStrtTst	Detection of Failed Engine Start
45. Injection bank		
P062D	DFC_IVDiaBnkShCir_0	Short circuit to battery error at injection bank 1
P0206	DFC_IVDiaBnkShCir_1	Short circuit to battery error at injection bank 2
P0206	DFC_IVDiaBnkShCir_2	Short circuit to battery error at injection bank 3
P062B	DFC_IVDiaChp_0_C	Injection chip error (CY33X)
P062D	DFC_IVDiaShCirGndToutBnk_0	Injection bank1 Time out of SCG measurement
P0206	DFC_IVDiaShCirGndToutBnk_1	Injection bank2 Time out of SCG measurement
P0206	DFC_IVDiaShCirGndToutBnk_2	Injection bank3 Time out of SCG measurement
P062D	DFC_IVDiaShCirGndTstBnk_0	Short Circuit to Ground Monitoring Test in Bank1
P0206	DFC_IVDiaShCirGndTstBnk_1	Short Circuit to Ground Monitoring Test in Bank2
P0206	DFC_IVDiaShCirGndTstBnk_2	Short Circuit to Ground Monitoring Test in Bank3
46. Solenoid power stage 1 (Cylinder 1)		
P0201	DFC_IVDiaCylNoLd_0	Cylinder 1 injection open load
P0263	DFC_IVDiaCylPttDet_0	Cylinder 1 injection special pattern for special cases
P0262	DFC_IVDiaCylShCir_0	Cylinder 1 injection general short circuit

Downloaded from www.Manualslib.com manuals search engine

Fault code	Fault content	Occurrence conditions
47. Solenoid power stage 2 (Cylinder 5)		
P0202	DFC_IVDiaCylNoLd_1	Cylinder 5 injection open load
P0266	DFC_IVDiaCylPttDet_1	Cylinder 5 injection special pattern for special cases
P0265	DFC_IVDiaCylShCir_1	Cylinder 5 injection general short circuit
48. Solenoid power stage 3 (Cylinder 3)		
P0203	DFC_IVDiaCylNoLd_2	Cylinder 3 injection open load
P0269	DFC_IVDiaCylPttDet_2	Cylinder 3 injection special pattern for special cases
P0268	DFC_IVDiaCylShCir_2	Cylinder 3 injection general short circuit
49. Solenoid power stage 4 (Cylinder 6)		
P0204	DFC_IVDiaCylNoLd_3	Cylinder 6 injection open load
P0272	DFC_IVDiaCylPttDet_3	Cylinder 6 injection special pattern for special cases
P0271	DFC_IVDiaCylShCir_3	Cylinder 6 injection general short circuit
50. Solenoid power stage 5 (Cylinder 2)		
P0205	DFC_IVDiaCylNoLd_4	Cylinder 2 injection open load
P0275	DFC_IVDiaCylPttDet_4	Cylinder 2 injection special pattern for special cases
P0274	DFC_IVDiaCylShCir_4	Cylinder 2 injection general short circuit
51. Solenoid power stage 6 (Cylinder 4)		
P0206	DFC_IVDiaCylNoLd_5	Cylinder 4 injection open load
P0278	DFC_IVDiaCylPttDet_5	Cylinder 4 injection special pattern for special cases
P0277	DFC_IVDiaCylShCir_5	Cylinder 4 injection general short circuit
52. CP metering unit		
P025A	DFC_MeUnIntCtct	Fuel pump module control circuit/open
P025A	DFC_MeUnOL	Fuel pump module control circuit/open
P0252	DFC_MeUnOT	over temperature of device driver of metering unit
P0254	DFC_MeUnShCirHSBatt	short circuit to battery in the high side of the MeUn
P0253	DFC_MeUnShCirHSGnd	short circuit to ground in the high side of the MeUn
P0254	DFC_MeUnShCirLSBatt	short circuit to battery of metering unit output
P0253	DFC_MeUnShCirLSGnd	short circuit to ground of metering unit output
P0254	P0254 DFC_MeUnSRCMax	signal range check high error of metering unit AD-channel
P0253	DFC_MeUnSRCMin	signal range check low error of metering unit AD-channel
53. Injection Misfire detection cylinder 1		
P0301	DFC_MisfDetMisfireCyl_0_C	injection Misfire detection cylinder 1
54. Injection Misfire detection cylinder 5		
P0302	DFC_MisfDetMisfireCyl_1_C	Injection Misfire detection cylinder 5
55. Injection Misfire detection cylinder 3		
P0303	DFC_MisfDetMisfireCyl_2_C	Injection Misfire detection cylinder 3
56. Injection Misfire detection cylinder 6		
P0304	DFC_MisfDetMisfireCyl_3_C	Injection Misfire detection cylinder 6

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

Fault code	Fault content	Occurrence conditions
57. Injection Misfire detection cylinder 2		
P0305	DFC_MisfDetMisfireCyl_4_C	Injection Misfire detection cylinder 2
58. Injection Misfire detection cylinder 4		
P0306	DFC_MisfDetMisfireCyl_5_C	Injection Misfire detection cylinder 4
59. Monitoring Misfire detection multiple cylinder		
P0300	DFC_MisfDetMisfireMul_C	Monitoring Misfire detection multiple cylinder
60. Monitoring of ADC		
P060B	DFC_MoCADCNTP	NTP error in ADC monitoring
P060B	DFC_MoCADCTst	ADC test error
P060B	DFC_MoCADCVltgRatio	error in Voltage ratio in ADC monitoring
61. Monitoring of communication module		
P060C	DFC_MoCComErrCnt	errors in query-/response communication
P060C	DFC_MoCComSPI	errors in SPI-communication
62. Monitoring of complete ROM test		
P060C	DFC_MoCROMErrXPg	multiple error while checking the complete ROM-memory
63. ECU shut off path error		
P060C	DFC_MoCSOPErrMMRespByte	Too less bytes received by MM from CPU as response
P060C	DFC_MoCSOPErrNoChk	Error during SOP test
P060C	DFC_MoCSOPErrRespTime	Error trying to set MM Response time
P060C	DFC_MoCSOPErrSPI	Error detected in the SPI communication
P060C	DFC_MoCSOPLoLi	Error in the check of the shut-off path test of the under voltage detection
P060C	DFC_MoCSOPMM	Error in the check of the shut-off path of the monitoring module
P060C	DFC_MoCSOPOSTimeOut	Time out error trying to set or cancelling the alarm task
P060C	DFC_MoCSOPPsvTstErr	Error during positive test
P060C	DFC_MoCSOPTimeOut	Error in time monitoring of the shut-off path test
P060C	DFC_MoCSOPUpLi	Error in the check of the shut-off path test of the over voltage detection
P1008	DFC_EngICO	Shut-off request of the injection cut-off for the shut-off coordinator in case of a standard ICO
64. Monitoring of overrun		
P101A	DFC_MoFOvR	Monitoring of overrun error
65. Monitoring of voltage supply		
P1600	DFC_MonUMaxSupply1	Reported Over Voltage of Supply
P1601	DFC_MonUMinSupply1	Reported Under Voltage of Supply
66. ECU main relay		
P068A	DFC_MRlyErlyOpng	Early opening defect of main relay
P068B	DFC_MRlyStk	stuck main relay error
67. DPF Pressure sensor hose line check		
P2453	DFC_NplHsChngPPFltDiff	the monitoring for incorrectly connected hose lines of the differential pressure sensor

Downloaded from www.Manualslib.com manuals search engine

Fault code	Fault content	Occurrence conditions
68. DPF Pressure sensor offset diagnostic		
P2453	DFC_NplPresSensPPFltDiff	the monitoring of the offset of the differential pressure sensor have been concluded and that no errors have occurred in the process
69. ECU power stage module		
P060C	DFC_OCWDACom	Error report "WDA active" due to a defect query/ response communication
P060C	DFC_OCWDALowVltg	Error report "ABE active" due to over voltage detection
P060C	DFC_OCWDAOvrVltg	Error report "ABE active" due to under voltage detection
P060C	DFC_OCWDAReasUnkwn	Error report "ABE/WDA active" due to an unknown reason
70. Oil pressure sensor		
P0521	DFC_OilPSwmpPhysRngHi	Maximum oil pressure error in plausibility check
P0520	DFC_OilPSwmpPhysRngLo	Minimum oil pressure error in plausibility check
P0523	DFC_OilPSwmpSRCMax	SRC high for oil pressure sensor
P0522	DFC_OilPSwmpSRCMin	SRC high for oil pressure sensor
71. Oil temperature sensor		
P0196	DFC_OilTPhysRngHi	Physical Range Check high for Oil Temperature
P1095	DFC_OilTPhysRngLo	Physical Range Check low for Oil Temperature
P1098	DFC_OilTSRCMax	SRC High for Oil Temperature
P1097	DFC_OilTSRCMin	SRC low for Oil Temperature
72. Pressure control regulator		
P2263	DFC_PCRGovDvtMax	Pressure control regulator positive governor deviation above limit
P2263	DFC_PCRGovDvtMin	Pressure control regulator negative governor deviation below limit
73. Monitoring for maximum ash mass in DPF		
P242F	DFC_PFltAshLdMax	maximum ash load in the particulate filter
74. Mon pressure differential characterstics		
P2453	DFC_PFltCharPDiffMax	the characteristic pressure reduction of the particulate filter -max
P2453	DFC_PFltCharPDiffMin	the characteristic pressure reduction of the particulate filter -min
75. Completely damaged particulate filter		
P2002	DFC_PFltDstrMin	completely damaged particulate filter
76. Monitoring of the engine protection		
P1049	DFC_PFltEngPrt	Engine protection monitoring of the particulate filter
77. Monitoring of incomplete regeneration		
P1078	DFC_PFltRgnNoCompl	Incomplete regeneration of the DPF
78. Regeneration locked		
P1079	DFC_PFltRgnPerm	permanent regeneration of the particulate filter
79. Maximum soot mass in particulate filter		
P2463	DFC_PFltSotMsMax	maximum soot mass in the particulate filter

Downloaded from www.Manualslib.com manuals search engine

Fault code	Fault content	Occurrence conditions
80. Forced regeneration switch		
P107A	DFC_PFltSwtSCBDem	short circuit to battery of regeneration demand switch
P107C	DFC_PFltSwtExtDemPlaus	DPF(Diesel Particulate Filter) Regeneration inhibition switch and Forced regeneration switch plausibility test
81. Forced regeneration inhibit switch		
P107B	DFC_PFltSwtSCBInh	regeneration inhibition switch short circuit to battery is detected
82. Boost pressure sensor		
P0238	DFC_PIntkVUsSRCMax	SRC high in air pressure upstream of intake valve sensor
P0237	DFC_PIntkVUsSRCMin	SRC low in air pressure upstream of intake valve sensor
83. DPF pressure sensor physical range check		
P244B	DFC_PPFltDiffEnhSRCMax	Diagnostic Fault Check for Signal value above maximum limit --Enhanced check
P244A	DFC_PPFltDiffEnhSRCMin	Diagnostic Fault Check for Signal value below minimum limit --Enhanced check
84. Disconnected DPF pressure sensor hose line		
P2453	DFC_PPFltDiffNplHsLn	Fault check of Disconnected DPF pressure sensor hose line
P2453	DFC_PPFltDiffSot	Fault check of Disconnected DPF pressure sensor hose line
85. Diesel oxidation catalyst differential pressure		
P2465	DFC_PPFltDiffSRCMax	SRC High for DPF differential pressure sensor
P2464	DFC_PPFltDiffSRCMin	SRC low for DPF differential pressure sensor
86. Monitoring of PRV		
P0089	DFC_PRVctOpnMax	pressure relief valve reached maximum allowed opening count
P0089	DFC_PRVFrOpnPresInc	pressure relief valve is forced to open; perform pressure increase
P0089	DFC_PRVFrOpnPresShck	pressure relief valve is forced to open; perform pressure shock
P0089	DFC_PRVOpn	pressure relief valve is open
P1036	DFC_PRVQBalChk	Quantity balance check if a success full PRV opening is ensured
P0137	DFC_PRVRPOutOfRng	Averaged rail pressure is outside the expected tolerance range
P0089	DFC_PRVtiOpnMax	pressure relief valve reached maximum allowed open time
87. MSC Errors of R2S2		
P060C	DFC_R2S2_MscComm1	MSC Errors of R2S2
88. Rail pressure monitoring		
P0251	DFC_RailMeUn0	Positive governor deviation of rail pressure exceeded
P0251	DFC_RailMeUn10	Check of the volume flow balance
P0251	DFC_RailMeUn2	Negative governor deviation at zero delivery
P0087	DFC_RailMeUn3	Monitoring for minimum rail pressure
P0088	DFC_RailMeUn4	Monitoring for maximum rail pressure

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

Fault code	Fault content	Occurrence conditions
P0088	DFC_RailMeUn42	Maximum rail pressure (second stage)
P1050	DFC_RailMeUn7	Error detection by metering unit set value in overrun
P0251	DFC_RailMeUn8	Plausibility check of the volume flow of the metering unit at low idle
89. Rail pressure sensor		
P0193	DFC_RailPSRCMax	Rail pressure sensor voltage above upper limit
P0192	DFC_RailPSRCMin	Rail pressure sensor voltage below lower limit
P0088	DFC_RailPRV4	Monitoring for maximum rail pressure in limp home mode with PRV
P1320	DFC_InjVlvPresMin	Shut-off request due to minimum rail pressure
90. Accelerator pedal position		
P0123	DFC_SRCHighAPP1	Signal Range Check High for Accel pedal
P0122	DFC_SRCLowAPP1	Signal Range Check Low for Accel pedal
91. Monitoring of 12V sensor supply voltage in ECU		
P0643	DFC_SSpMon1	Sensor Supply Monitor 1 error
P0653	DFC_SSpMon2	Sensor Supply Monitor 2 error
P0699	DFC_SSpMon3	Sensor Supply Monitor 3 error
P1602	DFC_SSpMonSply1Max	Monitoring of 12V sensor supply 1 SRC_HIGH Error
P1603	DFC_SSpMonSply1Min	Monitoring of 12V sensor supply 1 SRC_LOW Error
P1602	DFC_SSpMonSplyMax	Monitoring of internal 12V supply SRC_HIGH Error
P1603	DFC_SSpMonSplyMin	Monitoring of internal 12V supply SRC_LOW Error
92. Metering Unit Shut off valve		
P1090	DFC_SVSCBHS	short circuit to battery error on high side power stage of the SV actuator
P1091	DFC_SVSCBLS	short circuit to battery error on the low side power stage of the SV actuator
P1092	DFC_SVSCGOL	short circuit to ground or open load error on the high side or low side power stage of the SV actuator
93. Engine error lamp		
P1604	DFC_SVSOL	Open load error on the output power stage for SVS lamp
P1605	DFC_SVSOvrTemp	Over Temperature error on the output power stage for SVS lamp
P1606	DFC_SVSSCB	Short circuit to battery error on the output power stage for SVS lamp
P1607	DFC_SVSSCG	Short circuit to ground error on the output power stage for SVS lamp
94. ECU reset		
P1608	DFC_SWReset_0	Visibility of Software Resets in DSM
P1609	DFC_SWReset_1	Visibility of Software Resets in DSM
P160A	DFC_SWReset_2	Visibility of Software Resets in DSM
95. Air mass flow sensor temperature		
P0096	DFC_TAFSPhysRngHi	Physical Signal Range high on the air mass flow sensor temperature
P0098	DFC_TAFSSRCMax	Signal range check high on the raw voltage value of the air mass flow sensor temperature signal
P0097	DFC_TAFSSRCMin	Signal range check low on the raw voltage value of the air mass flow sensor temperature signal

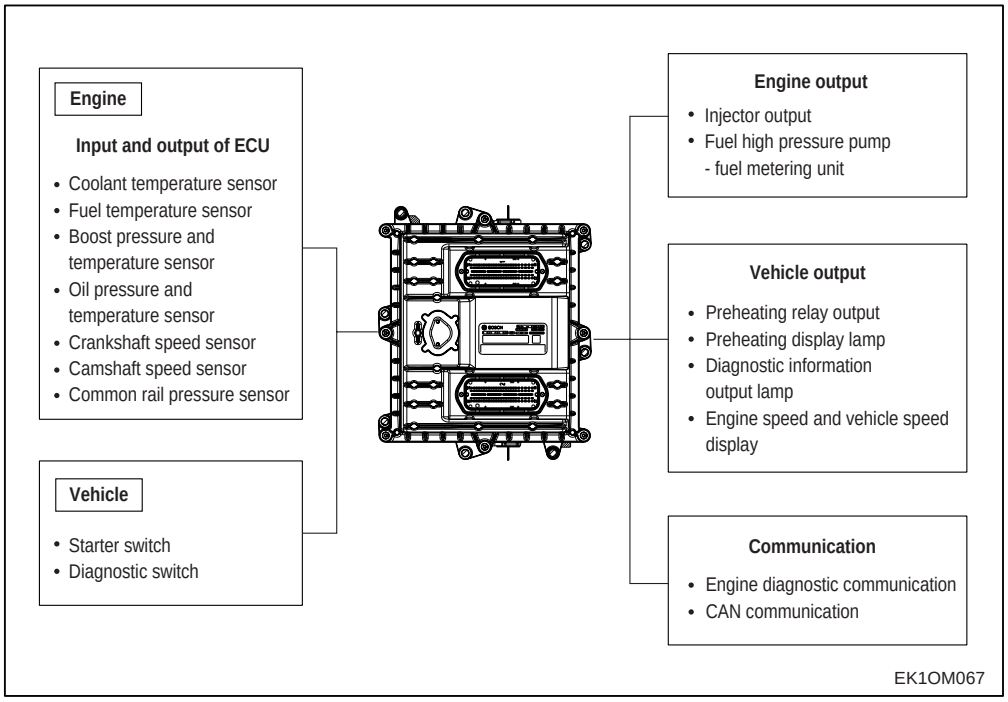
Downloaded from www.Manualslib.com manuals search engine

Fault code	Fault content	Occurrence conditions
96. Air Inlet temperature		
P0113	DFC_TCACDsSRCMax	SRC High for boost temperature
P0112	DFC_TCACDsSRCMin	SRC Low for boost temperature
P0113	DFC_TIntkVUsSRCMax	SRC High for boost temperature
P0112	DFC_TIntkVUsSRCMin	SRC Low for boost temperature
97. Engine ECU temperature		
P0669	DFC_TECUPhysRngHi_0	Physical Range Check high for ECU temperature sensor
P0668	DFC_TECUPhysRngLo_0	Physical Range Check low for ECU temperature sensor
P0669	DFC_TECUSRCMax	SRC high for ECU temperature sensor
P0668	DFC_TECUSRCMin	SRC low for ECU temperature sensor
98. Throttle valve control.		
P02E1	DFC_ThrVlvDrftOpn	Throttle valve drift at open position
P02E1	DFC_ThrVlvGovDvtMax	Positive governor deviation for throttle valve
P02E1	DFC_ThrVlvGovDvtMin	Negative governor deviation for throttle valve
P02E0	DFC_ThrVlvHBrgOpnLd	Open load error for throttle valve powerstage (H-bridge)
P02EB	DFC_ThrVlvHBrgOvrTemp	Over temperature error for throttle valve powerstage (H-bridge)
P02E3	DFC_ThrVlvHBrgShCirBatt1	Short circuit to battery on Out1 error for H-bridge
P02E3	DFC_ThrVlvHBrgShCirBatt2	Short circuit to battery on Out2 error for H-bridge
P02E2	DFC_ThrVlvHBrgShCirGnd1	Short circuit to ground on Out1 error for H-bridge
P02E2	DFC_ThrVlvHBrgShCirGnd2	Short circuit to ground on Out2 error for H-bridge
P02E5	DFC_ThrVlvJamVlvClsd	Jammed valve of throttle valve
P02E4	DFC_ThrVlvJamVlvOpn	Jammed valve of throttle valve
99. Throttle valve position sensor		
P02E9	DFC_ThrVlvSRCMax	Throttle valve position sensor voltage SRC high
P02E8	DFC_ThrVlvSRCMin	Throttle valve position sensor voltage SRC low
100. DOC upstream temperature		
P2080	DFC_TOxiCatUsPhysRngHi	Diagnostic Fault Check of DOC upstream temperature for Physical Signal below minimum limit
P0546	DFC_TOxiCatUsSRCMax	SRC high in Oxidation Catalyst upstream temperature
P0545	DFC_TOxiCatUsSRCMin	SRC low in Oxidation Catalyst upstream temperature
101. DPF downstream temperature		
P2033	DFC_TPFltDsSRCMax	SRC high in Particle filter downstream temperature
P2032	DFC_TPFltDsSRCMin	SRC low in Particle filter downstream temperature
102. DPF upstream temperature		
P2084	DFC_TPFltUsPhysRngHi	Diagnostic Fault Check of DPF upstream temperature for Physical Signal below minimum limit
P242D	DFC_TPFltUsSRCMax	SRC high in Particle filter upstream temperature
P242C	DFC_TPFltUsSRCMin	SRC low in Particle filter upstream temperature

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.7.3. Input and output of the ECU



3.8. Operating Condition of the ECU

3.8.1. Engine starting

- Set the standard temperature to determine pre-heating.
  Set the smallest value among cooling water temperature, fuel temperature, intake air temperature, and oil temperature.
- Set the standard temperature to determine the fuel quantity.
  Set the engine cooling water temperature as the standard temperature.
- Measure the engine RPM signal.
  - Use the crankshaft rotation sensor.
  - Determine the fuel amount appropriate for start-up, and supply it to the engine.

3.8.2. Vehicle running

- Indispensable data for vehicle driving.
  - Acceleration dial position signal (CAN information received from the vehicle control unit)
  - Engine RPM

3.8.3. Engine idle adjusting

- Adjusting the engine RPM according to the driver's needs.
  - Adjust the engine RPM according to the driver's request, and control the engine at the ECU, according to the required RPM.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3.8.4. Limp home function

- The limp home is a function which the vehicle can be operated to the maintenance shop with minimum condition for traveling on the condition of taking safety when the defect code is occurred.
- Application condition
  - Accelerator pedal is trouble : The vehicle is operated by constant engine speed no relation to depressing of the accelerator pedal.
  - Sensor is trouble : The vehicle is operated with constant transfer value when the trouble of all kinds sensors is occurred.
  - Fuel quantity is limited : The fuel quantity supplied into the engine is limited according to kind of the defect. (is applied by division into 4 stages)
  - Diagnostic information output lamp : The safety driving is leaded to the driver by proposal of information about status of occurred faults.

3.8.5. Diagnostic

- When the fault occurs, the fault diagnosis information display lamp is activated on the instrument panel.
- Checking the fault code using the fault diagnosis information display lamp.
  - The fault code can be checked, using the fault diagnosis information on the instrument panel.
- Diagnosis by CAN equipment
  - Connect the diagnosis unit to the check connector located at the rear side of the driver's seat, and diagnose the fault.

3.8.6. Vehicle operating record

- The ECU records the travel information.
- Contents recorded in the ECU.
  - Rate of fuel consumption
  - Engine use period, ECU use period
- The travel record can be monitored, using the ECU diagnosis device.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

4. Commissioning and Operation

4.1. Preparations

At the time of initial commissioning of a new or overhauled engine make sure to have observed the “Technical information for the installation DOOSAN’s vehicle engines”.

- Oil filler neck on cylinder head cover
  Before daily starting of the engine, check the fuel, coolant and oil level, replenish if necessary.
- The oil level must be between Max. and Min. lines on the gauge. The notches in the oil level gauge indicate the highest and lowest permissible oil levels.



CAUTION :
Do not fill above the top of the mark by over lifting. Over lifting will result in damage to the engine.

- Cleanliness
  Fuel, lubrication oil, and coolant should be kept clean, and special attention should be paid to preventing the introduction of foreign materials when filling the engine.
  The quality warranty may get void for any trouble caused by using fuel, lubrication oil or coolant not recommended by the company

4.2. Breaking-In

Each engine is operated for a short period before the final approval test of the engine at the factory before delivery. Users should perform proper processes to break in the engine for 50-hour's operation or longer to exert the maximum capability of the engine, and to keep the life span of the engine intact.

4.2.1. Operation of a new engine (Break-in)

Because the sliding surfaces of a new engine are not lapped enough, the oil film can be destroyed easily by overload or over speed and the engine life-time may be shortened. Therefore the following things must be obeyed by all means.

Up to the first 50 Hr

- Engine should be run at fast idling until the temperature of the engine becomes normal operating condition.
- Overload or continuous high speed operation should be avoided.
- High speed operation with no load should be prevented.
- Abrupt start and stop of the engine should be avoided.
- Engine speed must be under 70 % of its maximum speed.
- Maintenance and inspection must be accomplished thoroughly.

Downloaded from www.Manualslib.com manuals search engine

4.2.2. Check points for break-in

During the break-in (the initial running of the engine) period, be particularly observant as follows :

- Check engine oil level frequently. Maintain oil level in the safe range, between the “min.” and “max.” marks on dipstick.

IMPORTANT :
If you have a problem getting a good oil level reading on the oil level gauge, rotate the oil level gauge 180° and re-insert for check.

- Watch the oil pressure warning lamp. If the lamp blinks, it may be the oil pick-up screen is not covered with oil. Check oil level gauge. Add oil to the oil pan, if required. Do not overfill.
- If level is correct and the status still exists, see your DEALER for possible switch or oil pump and line malfunction.

IMPORTANT :
Oil pressure will rise as RPM increases, and fall as RPM decreases. In addition, cold oil will generally show higher oil pressure for any specific RPM than hot oil. Both of these conditions reflect normal engine operation.

- Monitor the coolant temperature gauge. Make sure that the circulation of coolant is adequate. When the level of coolant in the reservoir tank is excessively low, the needle of the coolant temperature gauge waves.
- Once the breaking in operation is complete, replace the cartridges of the engine oil and the oil filter with new ones.
- Use an engine oil that satisfies the specifications recommended below.

Engine oil		SAE No.	API No.	Manufacture Enterprise
DL06K	Genuine oil	SAE 15W40	ACEA-E9 (API CJ-4)	Kixx DX Euro
	Recommended oil	SAE 15W40	ACEA-E9 (API CJ-4)	SK : ZIC XQ5000 Shell : Rimula super

- Engine oil capacity

Engine oil capacity				
Engine model	Product Code	Oil pan inside		Total [1] (lit)
		Max (lit)	Min (lit)	
DL06K	LDF00/01	27	17	29

* 1) Including 2.0 liters in the engine

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

4.2.3. Operating after break-In

When starting a cold engine, always allow the engine to warm up gradually. Never run the engine at full throttle until the engine is thoroughly warmed up. Be sure to check the oil level frequently during the first 50 Hr of operation, since the oil consumption will be high until the piston rings are properly seated.

4.3. Inspections after Starting

During operation the oil pressure in the engine lubrication system must be monitored. If the monitoring devices register a drop in the lube oil pressure, switch off the engine immediately. And the charge warning lamp of the alternator should go out when the engine is running.

- Do not disconnect the battery or pole terminals or the cables.
- If, during operation, the battery charge lamp suddenly lights up, stop the engine immediately and remedy the fault in the electrical system.
- Engine should be stopped if the color, the noise or the odor of exhaust gas is not normal.
- Confirm the following things through warning lamps and gauge panel.

4.3.1. Pressure of lubricating oil

The normal pressure comes up to 1.0 ~ 3.0 kg/cm2 (1.0 ~ 3.0 bar) at idling and 3.0 ~ 6.0 kg/cm2 at maximum speed. If the pressure fluctuates at idling or does not reach up to the expected level at high speed, shut down the engine immediately and check the oil level and the oil line leakage.

4.3.2. Temperature of cooling water

The cooling water temperature should be 75 ~ 90 °C in normal operating conditions. Abnormally high cooling water temperature could cause the overheating of engine and the sticking of cylinder components. And excessively low cooling water temperature increases the fuel consumption, accelerates the wears of cylinder liners and shortens the engine life-time.

4.3.3. Over-speed control

The electric control unit (ECU) have a system of preventing the engine over-speed among many system. This system involve many function of fuel flow control, ignition time delay, fuel shut off, and ignition shut off etc.

These values are set up in advance in the memory of the ECU, and should not be revised by user.

This engine with ECU should not be run at the over-speed rating speed for a regular time, if the vehicle is speeded, the fuel and ignition is shut off until the engine speed is up to the proper level.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

4.4. Operation in Winter Time

Pay special attention to the freezing of cooling water and the viscosity of lubricating oil.

4.4.1. Operation in winter time

CAUTION :
1. **Preheating devices are attached to the engine for improving the starting abilities at extremely low temperature.**
2. **Do not actuate the starter for longer than 10 seconds. If starting fails regardless of the preheating, start the preheating again after 30 seconds.**

Operation 1 : Turn the key switch to the HEAT position, then the pilot lamp lights up for about 20 seconds When the pilot lamp is extinguished, do operation 2.

Behavior – When the coolant temperature is below 10 °C in cold weather, you'd better operate the pre-heating system (Air heater).

– If the pre-heating is not necessary, the pre-heating system is not operated with the pilot lamp.

Operation 2 : After checking the pilot lamp, turn the key switch to the START position to crank the engine, at once.

Behavior – When the key switch is placed in the START position, air heater is continuously heated to facilitate starting operation and to reduce white smoke automatically.

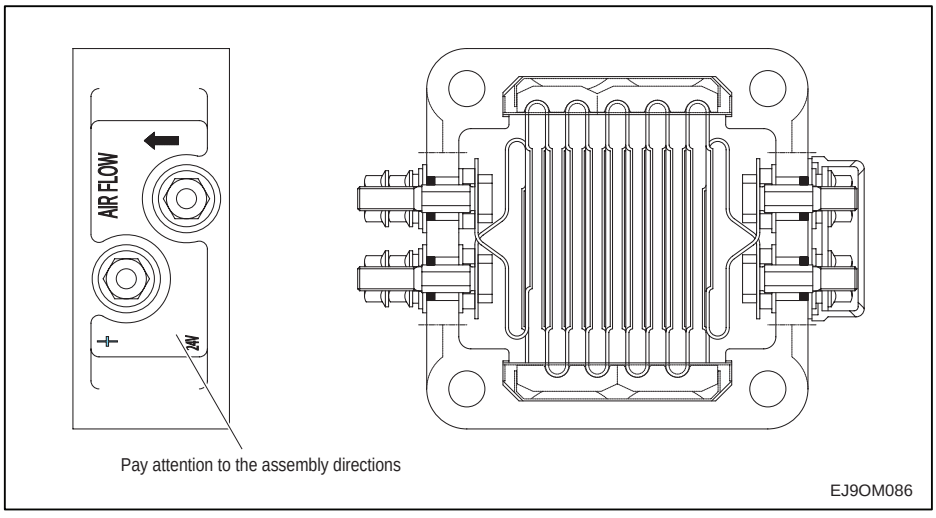
- If the coolant temperature is above 10 °C, air eater needs not be heated.

Operation 3 : After the engine is cranked, convert the key switch to the ON position.

Behavior – As the engine is cranked, air heater is heated for 120 seconds (2 minute after-heating) to reduce and to element quickly white smoke.

* Major specifications of the air heater

Rated	DC22V (95 A ± 10 %)
Capacity	2.1 kW



Downloaded from www.Manualslib.com manuals search engine

4.4.2. Prevention against freezing of cooling water

When not using anti-freeze, cause the diffusion of corrosion in inner part of the engine, cause drop the cooling efficiency, cause being frozen to burst in winter, therefore the whole cooling water should be completely discharged after engine running.

The freezing of cooling water is the reason of fatal damage on the engine, always use by mixing the anti-freeze. (anti-freeze quantity filled : 40 ~ 50 % of the cooling water) the anti-freeze is used to prevent cooling water from freeze.

4.4.3. Prevention against excessive cooling

Drop of thermal efficiency caused by excessive cooling increases fuel consumption, therefore prevent the engine from excessive cooling. If the temperature of coolant does not reach to normal condition (71 ~ 85 °C) after continuous operation, examine the thermostat or the other cooling lines.

4.4.4. Lubricating oil

As cold weather leads to the rise of oil viscosity, engine speed becomes unstable after starting.

Therefore the lubricating oil for winter should be used to prevent this unstability. Refer to lubricating system section.

4.5. Engine Components Check after Long Time Running

Abrasion, corrosion and degradation of components or assemblies may take place after operating the engine for an extended period of time. The purpose of checking the engine after operation is to recover lost capabilities and increase the durability of the engine. Unpredicted failure may take place at certain weak points after extended operation time, even under normal engine operation. It is hard to improve the engine capabilities by correcting one or two parts. It is desirable to correctly and precisely analyze the cause, and to replace or correct parts that may affect the power and capabilities.

Performing preventive maintenance on the engine ensures safe operation of the engine, and provides safer operation of the engine.

It is desirable to perform preventive maintenance on the engine parts in the spring, not in the winter.

Performing engine alignment in the spring season ensures cost effective and fault-free operation.

The parts listed below affect the power and the capabilities of the machine, and should be subject to the preventive maintenance.

- Parts affecting intake and exhaust
  The air cleaner, the air cooler, the turbocharger, the silencer, the EGR cooler and band, and the DPF muffler
- Parts affecting lubrication and cooling
  The air cleaner, the oil filter, and antifreeze solution.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

4.6. Maintenance and Care

4.6.1. Periodical Inspection and Maintenance

Regular inspection and maintenance are essential for preventing failure of the engine, and keeping the capabilities of the engine at the maximum level.

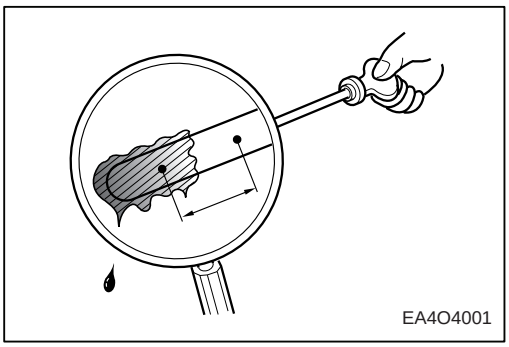
4.6.2. Exchanging of lubrication oil

Engine oil and the oil filter are important factors affecting engine life. They affect ease of starting, fuel economy, combustion chamber deposits and engine wear.
At the end of the break-in period , change the oil sump oil and replace the oil filter cartridge.

4.6.3. Oil level gauge

Check the oil level with the oil level gauge on a daily basis.

- The maximum and the minimum scales are indicated on the oil level gauge.
- Check the oil level after the engine is kept horizontal 15 to 20 minutes after stopping the engine.
- Check viscosity and contamination of the oil on the oil level gauge, and replace the engine oil, if required.

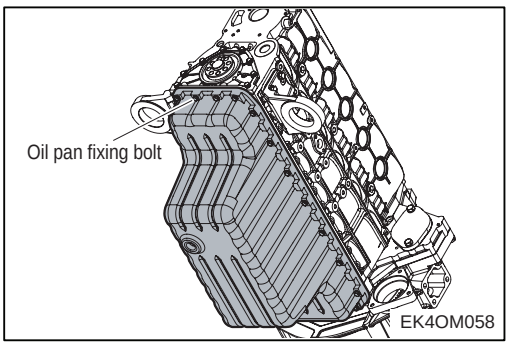

EA4O4001

CAUTION :
Do not add so much engine oil that the oil level rises above the max. marking on the oil level gauge. Over lifting will result in damage to the engine.

4.6.4. Oil exchange procedure

Run the engine, and replace the oil with the engine kept warm as follows.

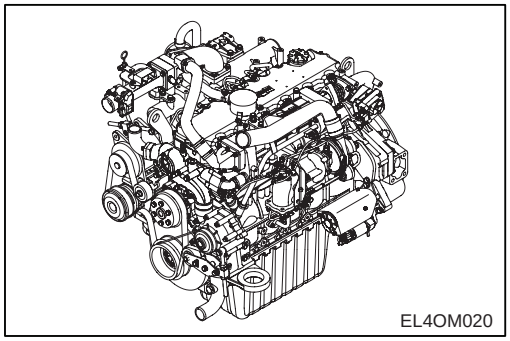
- Remove the oil level gauge.
- Open the drain plug of the oil pan, and drain the engine oil into a container.



Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

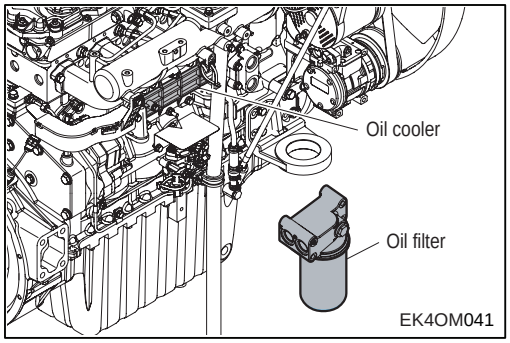
- Refill with new engine oil at the oil filler neck on the head cover and the lubricating oil in accordance with the oil capacity of the engine through oil filler.
- Be careful about the mixing of dust or contaminator during the supplement of oil. Then confirm that oil level gauge indicates the vicinity of its maximum level.


EL4OM020

- For a few minutes, operate the engine at idling in order to circulate oil through lubrication system.
- Thereafter shut down the engine. After waiting for about 10 minutes measure the quantity of oil and refill the additional oil if necessary.

4.6.5. Replacement of oil filter cartridge

- At the same times of oil exchanges, replace the oil filter cartridge.



EK4OM041

CAUTION :
Don't forget tightening the drain plug after having drained engine oil.

- Loosen the oil filter by turning it counterclockwise with a filter wrench.
- With a rag wipe clean the fitting face of the filter head and the oil filter cartridge so that new oil filter cartridge can be seated properly.
- Lightly apply oil the O-ring and turn the oil filter until sealing face is fitted against the O-ring. Turn 1 ~ 1 1/2 turns further with the filter wrench.

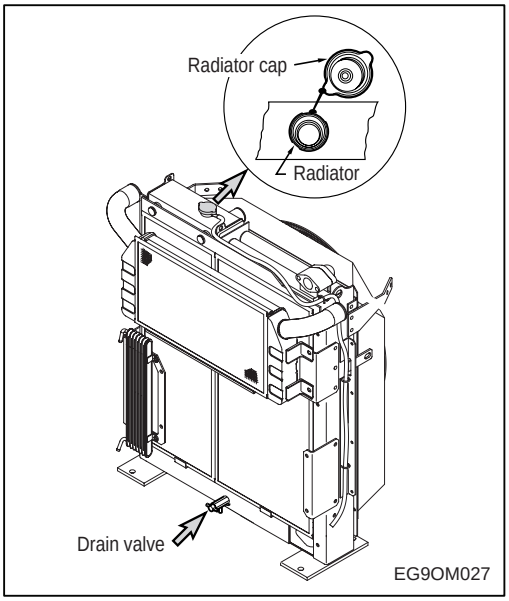
CAUTION :
Use the company's standard parts when replacing the oil filter cartridge.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

4.7. Cooling System

- The coolant must be changed at intervals of 1,200 Hr operation or 1 year whichever comes first. If the coolant is being fouled greatly, it will lead an engine overheat or coolant blow off from the expansion tank.



4.7.1. Coolant draining

- Remove the pressure cap.
- Open the drain valve at the radiator lower part to drain the coolant as the right figure.
- Loosen the coolant drain plug of the cylinder block.

CAUTION :
When removing the pressure filler cap while the engine is still hot, cover the cap with a rag, then turn it slowly to release the internal steam pressure. This will prevent a person from scalding with hot steam spouted out from the filler port.

4.7.2. Cleaning of the cooling inside system circuit

When the cooling system circuits are fouled with water scales or sludge particles, the cooling efficiency will be lowered. When the cooling system circuits are clogged, the water pump mechanical seal is damaged.
The poor condition of the cooling system is normally due to use of unsuitable or no anti-freezing agents and corrosion inhibitor or defect.
If twice in a short time (within 6 months) the water pump of an engine develops leases or the coolant is heavily contaminated (dull, brown, mechanically contaminated, gray or black sings of a leakage on the water pump casing) clean the cooling system prior to removing that water pump as follows.

1) Drain coolant.
2) Remove thermostats, so that the whole cooling system is immediately flown through when cleaned.
3) Fill the cooling system with a mixture of potable water and 1.5% by volume of cleaner. (Henkel P3T5175)
4) Warm up engine under load. After a temperature of 60 °C is reached, run engine for a further 15 minutes.
5) Drain cleaning fluid.
6) Repeat steps 3) and 4).

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

7) Fill cooling system with hot water.
8) Run engine at idle for 30 minutes. At the same time continuously replenish the water leaking from the bore in drain plug by adding fresh water.

CAUTION :
Periodically clean the circuit interior with a cleaner.

4.8. Adjustment of Valve Clearance

4.8.1. General information

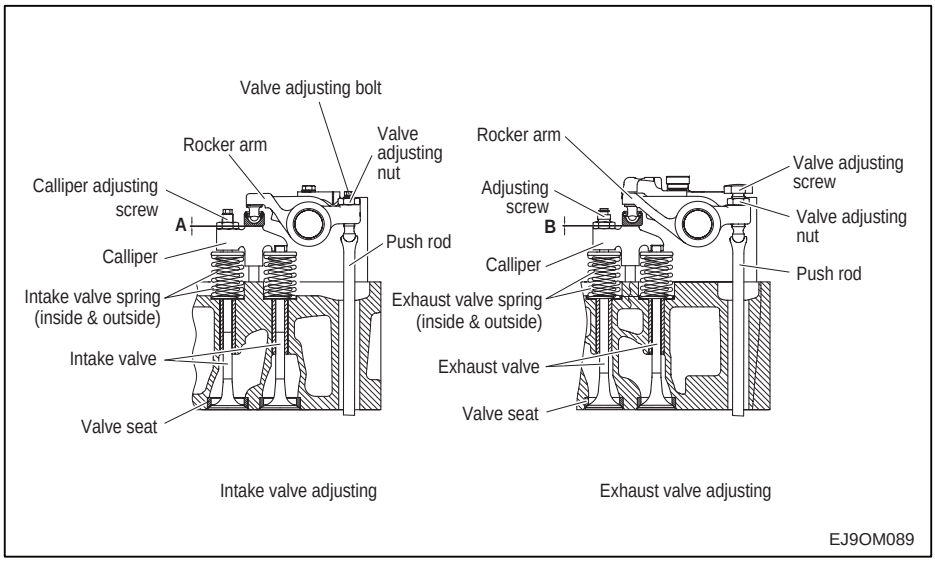
The valve clearances are to be adjusted at the times of the following situations.

- When the engine is overhauled and the cylinder heads are disassembled.
- When severe noise comes from valve train.
- When the engine is not normally operated, even though there is no trouble in the fuel system.

4.8.2. Valve clearance adjust procedure

- After letting the #1 cylinder's piston come at the compression top dead center by turning the crankshaft, adjust the valve clearances.
- Loosen the lock nuts of rocker arm adjusting screws and push the feeler gauge of specified value between a rocker arm and a valve stem and adjust the clearance with adjusting screw respectively and then tighten with the lock nut.
- As for the valve clearance, adjust it when in cold, as follows.

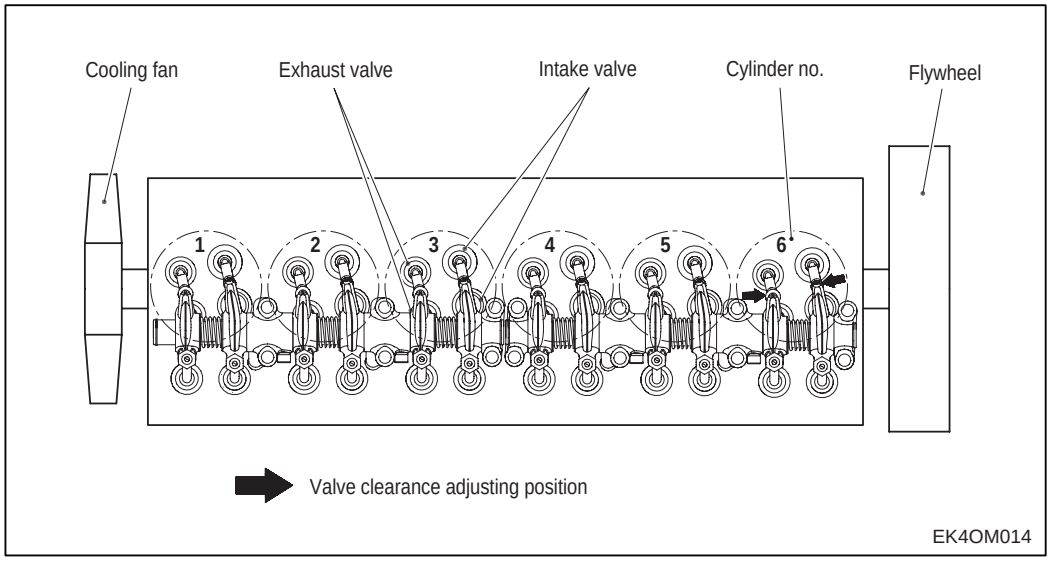
Engine model	Intake valve (A)	Exhaust valve (B)
DL06K	0.3 mm	0.4 mm



Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

- No. 1 cylinder is assembled with the flywheel.



- Adjusting of valves (Type 1)

Cylinder no. / Valve adjusting	1		2		3		4		5		6	
	Exhaust	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust	Intake
#1 cylinder top dead center (#6 cylinder valve overlap)	A	A			A			A	A			
180° rotation (#5 cylinder top dead center)										B		
360° rotation #5 cylinder top dead center (#1 cylinder valve overlap)			C			C	C				C	C
540° rotation (#2 cylinder top dead center)				D								

- Adjusting of valves (Type 2)
  Adjusting of the valve overlapping on cylinder is done as follow.

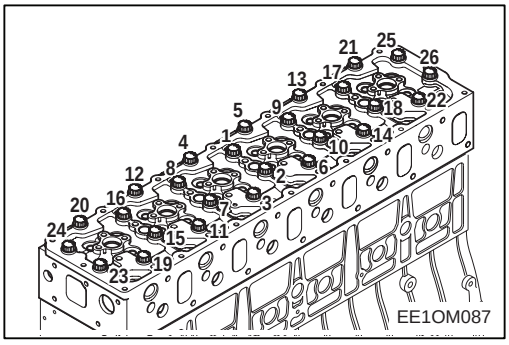
When each cylinder is valve overlap (Firing cylinder no. order)	1	5	3	6	2	4
Valve adjusting cylinder No.	6	2	4	1	5	3

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

4.9. Tightening the Cylinder Head Bolts.

- Coat the engine oil on the cylinder head bolt, assemble with specified torque according to the order of the assembling.



< Cylinder head bolts >

Specification	 M13 × 1.5 × 140
Torque	1st : 5 kg•m 2nd : 90° 3rd : 90° 4th : 90°

< Cylinder head bolt's tightening order >

(1) First step : Coat the bolts with engine oil.

(2) Second step : Screw down 1 ~ 2 threads by hands.

(3) Third step : Tighten with about 5 kg•m by wrench.

(4) Fourth step : Tighten with rotating 90° by torque wrench.

(5) Fifth step : Tighten with rotating 90° by torque wrench.

(6) Sixth step : Finally, tighten with rotating angle method 90° by torque wrench.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

5. Maintenance of Major Components

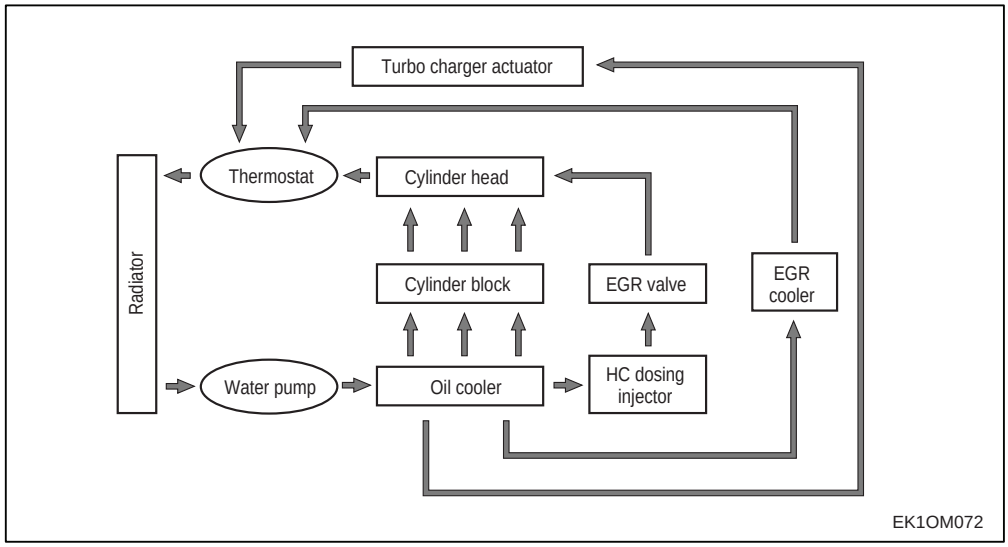
5.1. Cooling System

5.1.1. General descriptions and main data

This engine is a water cooling engine. Combustion heat from the combustion chamber and heat of the engine oil are absorbed by coolant and released outside the engine for normal operation of the engine.

Coolant supplied by the coolant pump is circulated in the oil cooler through the coolant pipe to absorb heat from the oil, and flows into the coolant jacket and the cooling route of the cylinder head of the cylinder block to absorb combustion heat.

Coolant that is absorbing heat from oil and combustion flows into the thermostat through the coolant pipe. If the temperature of coolant is lower than the valve opening temperature of the thermostat, coolant flows into the coolant pump. Otherwise, coolant flows to the radiator. The radiator emits absorbed heat from coolant to cool the water, and supplies the water to the coolant pump.



5.1.2. Specification

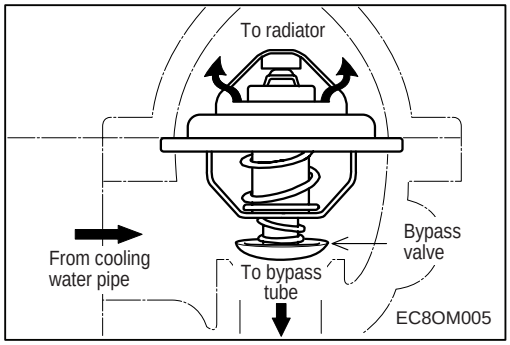
Item		Specification
1. Water pump	Type	Centrifugal type
	Pumping speed	3,750 rpm
	Supply volume	Approx. 280 liters/min or higher
	Pump head	18 m
	Pump backpressure	1.79 bar or lower
2. Thermostat	Operating temperature	75 °C
	Valve lift	9.5 mm
	Operating temperature	75 ~ 90 °C

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

5.1.3. Thermostat

- **General descriptions and main data**



The thermostat maintains a constant temperature of coolant (90 ~ 95 °C) and improves thermal efficiency of the engine by preventing heat loss.
Namely, when the temperature of coolant is low, the thermostat valve is closed to make the coolant bypass to directly enter the water pump ; when the coolant temperature rises to open wide the thermostat valve, the bypass circuit is closed and the water passage to the radiator is opened so that the coolant is forced to flow into the radiator.

Item	Idle pulley
Type	Wax pallet type
Open at	75 °C
Open wide at	90 °C
Valve lift	9.5 mm or longer

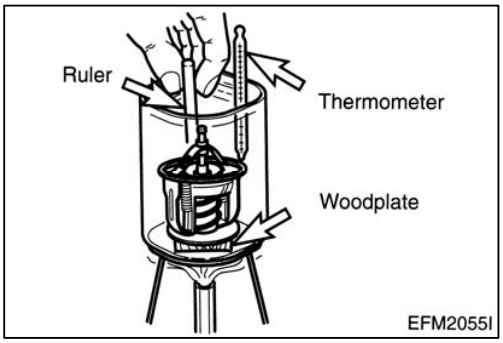
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

- **Inspecting**

  1) Check the wax pallet and spring for damage.

  2) Put the thermostat in a container of water, then heat the water slowly and check temperature with a thermometer. If the valve lift is 0.1 mm (starting to open) at temperature of 75 °C and 9.5 mm or more (opening wide) at temperature of 90°C, the thermostat is normal.



- **Replacing thermostat and precautions for handling**

  1) Precautions for handling

  The wax pallet type thermostat does not react as quickly as bellows type one to a variation of temperature of coolant. Such relatively slow reaction is mainly due to the large heat capacity of the wax pellet type thermostat. Therefore, to avoid a sharp rise of coolant temperature, it is essential to idle the engine sufficiently before running it. In cold weather, do not run the engine at overload or over-speed it immediately after engine starting.

  2) When draining out or replenishing coolant, do it slowly so that air is bled sufficiently from the entire cooling system.

  3) Replacing thermostat

  If the thermostat is detected defective, retrace with a new one.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

5.1.4 Diagnostics and troubleshooting

Complaints	Possible causes	Corrections
1. Engine overheating	● Lack of coolant ● Radiator cap pressure valve spring weakened ● Fan belt loosened or broken ● Fan belt fouled with oil ● Thermostat inoperative ● Water pump defective ● Restrictions in water passages due to deposit of scales ● Injection timing incorrect ● Restriction in radiator core ● Gases leaking into water jacket due to broken cylinder head gasket	● Replenish coolant ● Replace cap ● Adjust or replace fan belt ● Replace fan belt ● Replace thermostat ● Repair or replace ● Clean radiator and water passages ● Check injection timing by EDIA ● Clean exterior of radiator ● Replace cylinder head gasket
2. Engine overcooling	● Thermostat inoperative ● Ambient temperature too low	● Replace thermostat ● Install radiator curtain
3. Lack of coolant	● Leakage of coolant from the radiator ● Loosened or damaged coolant connection on the radiator ● Loosened radiator cap valve spring ● Leakage from the coolant pump ● Leakage from the cylinder head gasket ● Crack in the cylinder head or the block	● Repair or replacement ● Fasten the hose clamp or replace the hose ● Replace the cap ● Repair or replacement ● Replace the cylinder head gasket ● Replace the cylinder head or the block
4. Cooling system noisy	● Water pump bearing defective ● Fan loosely fitted or bent ● Fan out of balance ● Fan belt defective	● Replace bearing ● Retighten or replace fan ● Replace fan ● Replace fan belt

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

5.2. Lubrication system

5.2.1. General descriptions and main data

- **General descriptions**

All the engine oil pumped up from the oil pan by the gear type oil pump is filtrated through the oil cooler and oil filter, and this filtrated oil is forced through the main oil gallery in the cylinder block from where it is distributed to lubricate the various sliding parts, and fuel injection pump in order to ensure normal engine performance.

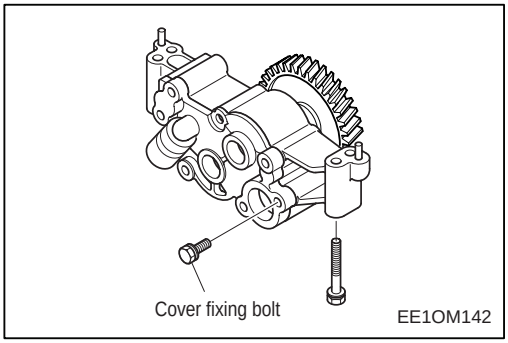
- **Specifications**

Item	Specifications	Item	Specifications
Lubricating system	Forced pressure circulation	Oil filter type	Full flow type
Oil pump type	Gear type	Cartridge by pass	
Relief valve opening pressure	9 ~10.5 kg/cm^2	Valve varying pressure	1.9~2.3 kg/cm^2
Oil spray nozzle adjusting		Oil pre-filter bypass	
Valve varying pressure	2 ~2.4 kg/cm^2	Valve varying pressure	5.3~5.7 kg/cm^2

5.2.2. Oil pump

- **Disassembly**

1) Disassembly of oil pump drive gear
   a. Unscrew the screw and disassemble the oil relief valve.
   b. Unfold the washer for the oil pump drive gear fixing nut and remove the nut.
   c. Disassemble the drive gear.



2) Loosing the fixing nut of the oil pump lid, and disassemble the lid.
3) The oil pump lid is fixed on the body by two of the position fixing pins.
4) Disassemble the drive gear and the passive gear.

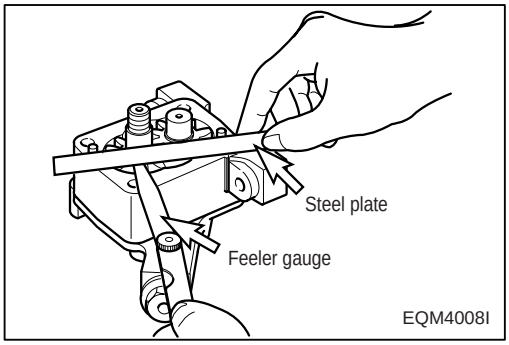
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

- **Inspection and correction**

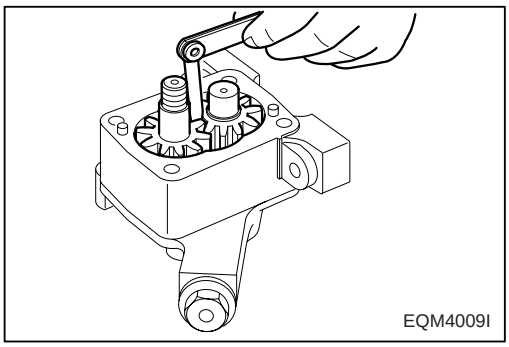
1) With steel rule and feeler gauge, measure the axial end play of the oil pump gear. Replace if the measured value is beyond the limit.

End play limit	0.03 ~ 0.136 mm



2) With a feeler gauge, measure the amount of backlash between the oil pump drive gear and driven gear. Replace if the measured value is beyond the limit.

Standard	0.312 ~ 0.476 mm
Limit	0.64 mm



3) Measuring clearance between drive shaft and bushing

a. Measure the outside diameters of the drive shaft and driven shaft, and replace if the measured values are less than the limit.

Standard	ϕ21.936 ~ ϕ21.95
Limit	ϕ21.90 mm

b. Measure the inside diameter of the pump body bushing to determine the clearance between the bushing and shaft, and compare the measured value with the standard value to determine whether to replace or no.

Oil clearance	0.050 ~ 0.085 mm

- **Reassembly**

(1) For reassembly, reverse the disassembly sequence.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

5.2.3. Diagnosis and troubleshooting of cause of failure

Complaints	Possible causes	Corrections
1. Oil consumption excessive	● Poor oil	● Use suggested oil
	● Oil seal or packing leaky	● Replace
	● Pistons or piston rings worn	● Replace pistons and/or piston rings
	● Cylinder liner worn	● Replace cylinder liner
	● Piston rings sticking	● Replace pistons and/or piston rings
	● Valve guide oil seals or valve guides, or valve stem worn	● Replace
2. Oil pressure too low	● Poor oil	● Use suggested oil
	● Relief valve sticking	● Replace
	● Restrictions in oil pump strainer	● Clean strainer
	● Oil pump gear worn	● Replace
	● Oil pump feed pipe cracked	● Replace
	● Oil pump defective	● Correct or replace
	● Oil pressure gauge defective	● Correct or replace
	● Various bearings worn	● Replace
3. Oil deteriorates quickly	● Restriction in oil filter	● Replace filter element
	● Gases leaking	● Replace piston rings and cylinder liner

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

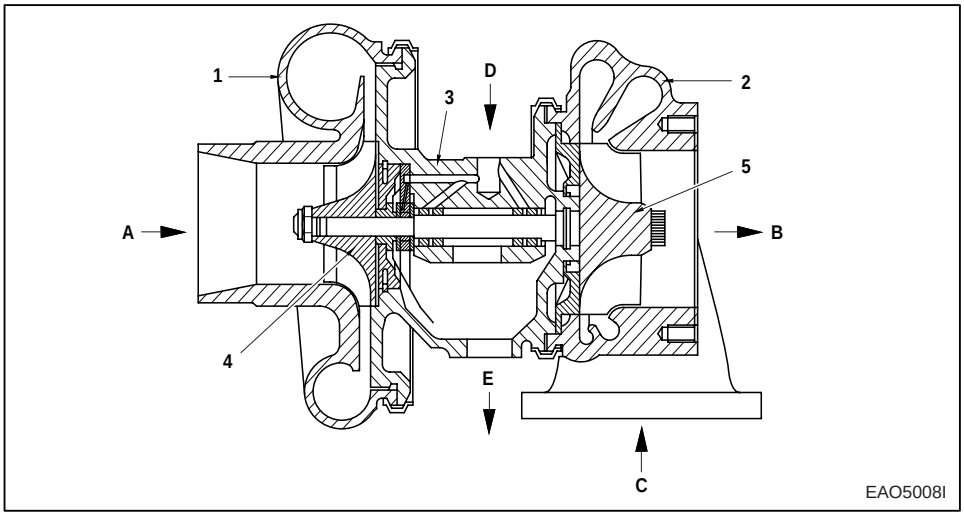
5.3. Turbo Charger

5.3.1. Specification and construction

1) Main data and specification

Specification		DL06K
Model		BorgWarner WGT
At maximum output	Air pressure at compressor outlet	2.86 kgr/cm^2
	Air suction of turbine revolution	180 g/s
	Speed of turbine revolution	148 krpm
Maximum allowable speed		183 krpm
Maximum allowable temperature of exhaust gas at turbine inlet		700 °C
Lubricating system		Outside oiling
Weight		Approx 9.0 kg

2) Construction

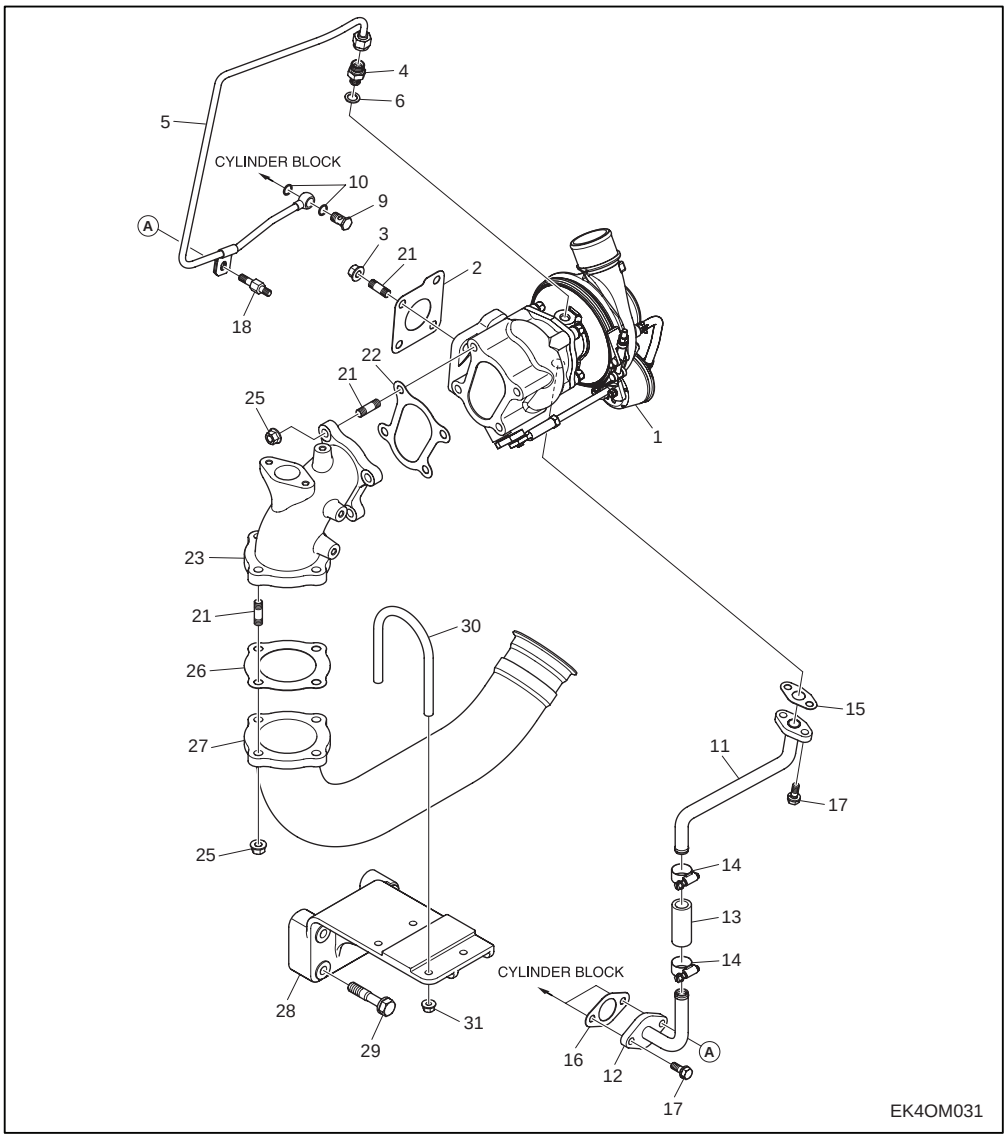


1	Impeller casing	A	Air inlet
2	Turbine casing	B	Gas outlet
3	Bearing casing	C	Gas inlet
4	Impeller	D	Oil supply
5	Turbine	E	Oil return

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3) Components of turbocharger

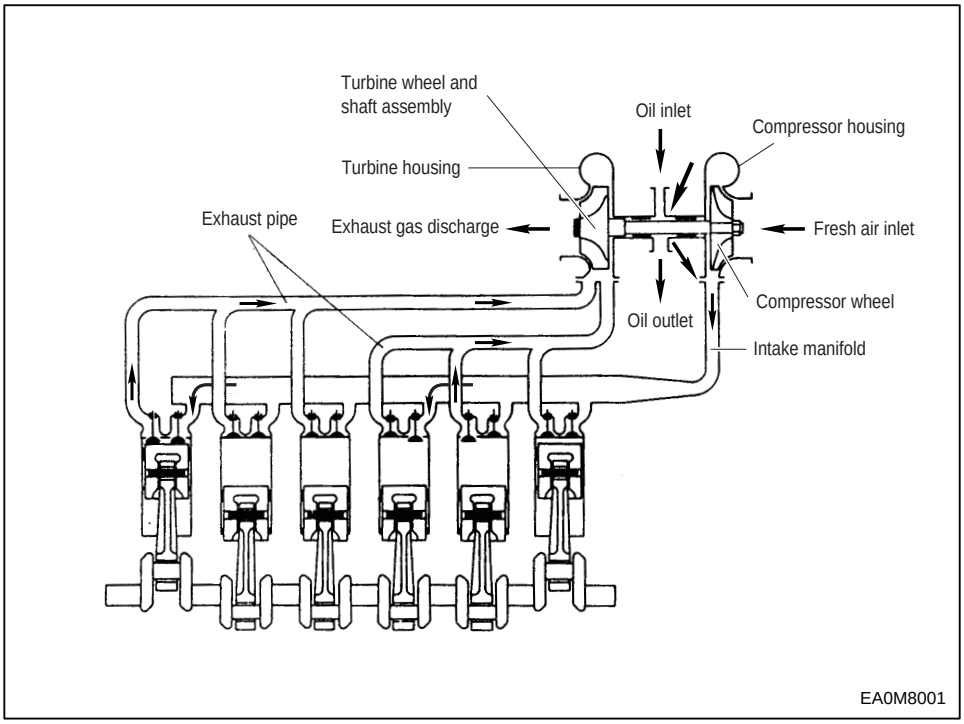


4	Bearing housing	32	O - ring	67	Hex bolt
5	Turbine housing	33	Oil baffle	74	Actuator ass'y
6	Turbine wheel ass'y	34	Inlet baffle	75	Hose clamp
7	Compressor wheel	36	Thrust collar	77	Actuator clip
8	Compressor housing	38	Heat protector cover	80	Cover plate
11	Journal bearing	43	Oil seal plate	81	Hose
12	Thrust bearing	46	Gasket	82	Elbow
13	Piston ring seal (turbine)	57	Hex bolt	83	Hex nut
16	Piston ring seal	61	Lock nut	88	Clamp plate
22	Retaining ring	64	Snap ring	91	Retaining ring
31	Oil stopper				

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

4) Operating principle



The turbocharger is an piece of equipment which increases the engine's power by sucking air at a high density into the cylinder of the engine by making use of the exhaust heat energy of the engine.

5.3.2. General information

The engine output depends upon the supplied fuel quantity and the engine efficiency. In order to transform into the effective work of engine by burning the supplied fuel fully, the sufficient air to burn the fuel should be supplied to the cylinder. Therefore, the engine output is essentially determined by the size of the cylinder, and for if the air is supplied to the given volume of cylinder with the air being compressed, the air quantity in the cylinder will Increase as much to result in that it may burn more fuel. the output will also be able to increase, Supplying the air by compressing like this into the engine cylinder is called as super charging, and super charging by means of exhaust gas energy that discharges to the atmosphere is called as the turbo charging.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

5.3.3. Function

1) Turbine

The exhaust gas that is discharged from combustion chamber passes through turbine housing conveying an energy to turbine wings to give the rotating power, This is called as the turbine and in order not to influence a bad effect at bearing part, there are the seal ring and heat protector.

2) Compressor

It is connected to the same shaft with the turbine to make a revolving assembly, and receive the revolving force of turbine, and sends air to the suction manifold by suctioning and compressing it. This is called as the compressor.

3) Bearing

(1) Thrust bearing

Thrust bearing force is applied to the turbine wheel and an arrangement is made for the shaft not to shift.

(2) Journal bearing

Journal bearing (floating bearing) is adopted and it forms the double oil films at the inner and outer surfaces in comparison to the general stationary type so that the bearing may be able to rotate independently and consequently the double layers of films act as the damper to make the slipping speed on the bearing surface less than the rotating speed of shaft so that the dynamic stability may be obtained.

4) Sealing at compressor shaft

In order for the compressed intake air and lubricating oil not to leak, a seal plate and a seal ring are made to the double structures.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

5.3.4. How to handle the engine

1) Precautions for operation of the engine

Operation following items must be observed at the starting, operation and stop of engine.

Operation	Caution	Reason
At starting	1) Inspect oil quantity 2) After confirming that oil pressure rises by starting engine with starter (until the pointer of oil pressure gauge moves or pressure indicating lamp operates), the starting must be done. 3) In case that oil, oil filter and lubricating system's part are replaced or engine was stalled for long time (more than a week), and in case of operation under cold weather, loosen the oil pipe connecting parts of turbocharger inlet, and operate the starting motor until oil comes out the connecting parts. Care must be paid that after the confirming above, retighten the pipe connecting parts without fail, and proceed with the normal starting.	2) If engine is started quickly, of course beginning with every parts of engine, for it revolves without oil that is to reach to the turbocharger, the bearing's abnormal wear or stuck may be caused. 3) In case that engine stalled for long time and of cold weather, the fluidity of oil may be get worse.
Immediately After starting	1) Perform idling operation for about 5 min. immediately after engine starting. 2) Various inspections must insure that there are no leakage of oil, gas and air.	1) Sudden load at time soon after engine starting and at the state when turbocharger did not yet reach to smooth revolution, if abrupt load is applied to engine, some parts where oil did still not reach may cause a burn to be stuck. 2) If there are the leakage of oil, gas, air, particularly oil, for the oil pressure lowers, it causes a burn of bearing to be stuck.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

Operation	Caution	Reason
During operation	Following items must be confirmed. 1) Oil pressure At idling : 1.5 ~ 3.0 kg/cm^2 At full load : 3.0 ~ 5.5 kg/cm^2 2) When abnormal noises and vibration are generated, slow down the revolution and must stop it to investigate the causes.	1) If the pressure is too low, abnormal wear or stuck may be caused. Or if too high, the oil leak may be generated. 2) If the engine operation were continued with abnormal noises and vibration, it causes the engine trouble that can not be repaired or some other troubles.
At stop	1) At stopping the engine, perform the idling operation for 5 min. and then stop it.	1) After heavy load operation, if the engine were stopped suddenly, the heat would be conducted to bearing parts from red hot turbine wings that would result in burning the oil to cause the stuck bearing metal and revolving shaft.

5.3.5. Routine inspection and maintenance

Since the state of turbocharger depends largely on the state of engine maintenance, to perform the specified up keep thoroughly is needed.

1) Air intake system

System the intake air system, care must be taken to the air cleaner. In case of oil passing type air cleaner, if the oil level is lower than the specified value, the cleaning efficiency get worse, if higher, the sucked oil pollutes a case. Particularly, for if the rotor were polluted, the balance adjusted precisely would be deviated to cause a vibration that may cause the stuck or abnormal wear by loading large force to the bearing, the perfect air cleaner must always be used. In case of dry type filter, according to the indication of a dust indicator, cleaning must be done to make the intake air resistance as small as possible.

2) Exhaust system

In exhaust system, a care must be taken to the gas leak and the stuck prevention if exhaust gas leaks from the exhaust pipe and turbocharger etc., for the super charging effect will be lowered, the installed states of various parts must be paid with careful attention. Since the parts that reach to high temperature during operation such as the turbine room use the anti- heat nuts, a care must be paid not to mix with the general nuts and at the same time, bolt stuck preventing paint should be coated on the nut for the designated places.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

3) Lubricating system

Care should be taken in dealing with oil quality and replacement timing of the oil filter cartridge of the lubrication system.

Degradation of engine oil can have significantly adverse effects on the engine body as well as the turbocharger.

The oils recommended for the engine mounted with the turbocharger are as follows :

Engine oil		SAE no.	API no.	Manufacture Enterprise
DL06K	Genuine oil	SAE 15W40	ACEA-E9 (API CJ-4)	Kixx DX Euro
	Recommended oil	SAE 15W40	ACEA-E9 (API CJ-4)	SK : ZIC XQ5000 Shell : Rimula super

***** Recommended oil (Use the standard Doosan oil, if possible.)

5.3.6. Periodical servicing

Make it a rule to check the turbocharger assembly for condition and contamination periodically.

1) Guide for checking the rotor for rotating condition

The inspection of the rotor assembly for rotating condition should be performed by the degree of unusual sound. If a sound detecting bar is used, install its tip on the turbocharger housing and increase the engine revolutions slowly. If a high-pitch sound is heard continuously, it means that the rotor assembly is not normal. In this case, as the metal bearing and rotor are likely to be in abnormal conditions, the turbocharger should be replaced or repaired.

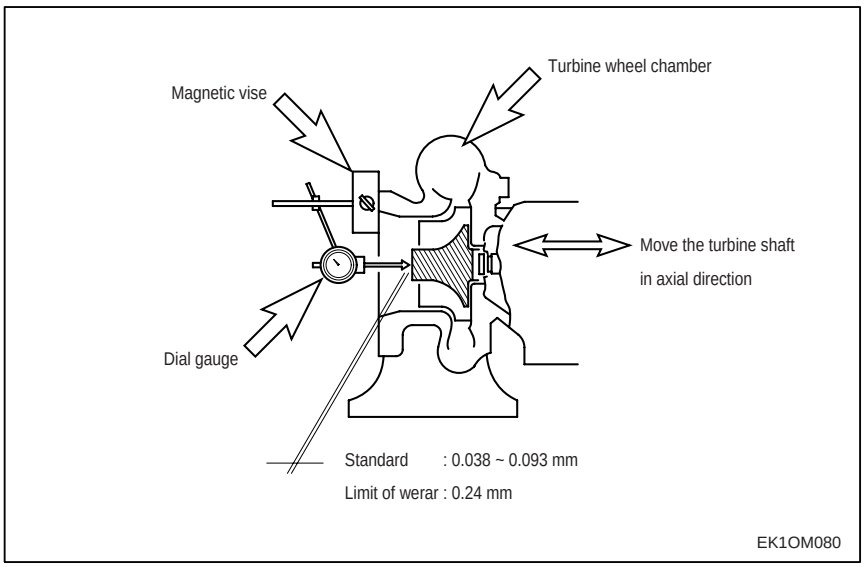
2) Guide for checking rotor end play

Disassemble the turbocharger from the engine, then check the rotor axial play and radial play. When disassembling the turbocharger, be sure to plug the oil inlet and outlet ports with taps, etc

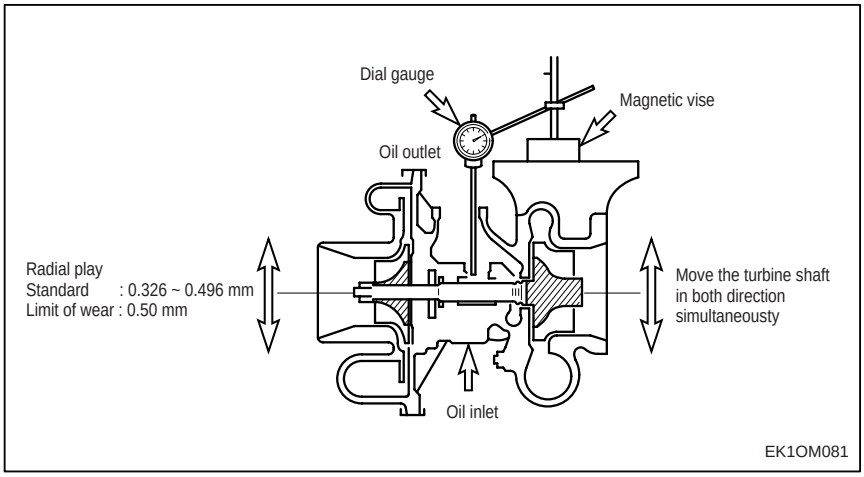
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

(1) Rotor axial direction end play



(2) Rotor radial direction end play



(3) If the measured axial and radial end plays are beyond the limit of wear, replace or repair the turbocharger.

3) Guide for disassembling/cleaning and checking the turbocharger

First, disassemble the turbocharger from the engine and clean/check it with the oil inlet and outlet plugged with tape and so on

4) Precautions for reassembling the turbocharger onto the engine

For reassembly of the turbocharger or handling it after reassembly operation, be sure to observe the following precautions.

Especially, exercise extreme care to prevent foreign matters from entering the inside of the turbo charger.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

(1) Lubricating system

- Before reassembling the turbocharger onto the engine, inject new oil in the oil inlet port and lubricate the journal and thrust bearings by rotating them with hand.
- Clean not only the pipes installed between the engine and oil inlet port but also the oil outlet pipe and check them for damage or foreign matters.
- Assemble each joint on oil pipes securely to prevent oil leaks.

(2) Air intake system

- Check the inside of the intake system for foreign matters.
- Assemble each joint on the intake duct and air cleaner securely to prevent air leaks.

(3) Exhaust system

- Check the inside of the exhaust system for foreign matters.
- Be sure to use heat resisting steel bolts and nuts. Do not interchange them with ordinary steel bolts and nuts when performing reassembly operation. Apply anti-seizure coating to the bolts and nuts.
- Assemble each joint on the exhaust pipes securely to prevent gas leaks.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

5.3.7. Diagnostics and troubleshooting

1) When abruptly increasing the engine rpm after starting the engine, the crank shaft rotates at an excessive speed before the journal bearing of the crank shaft is not lubricated due to an insufficient supply of lubrication oil. When the turbocharger rotates under these conditions, cooling and lubrication are not smoothly executed causing burnt adhesion of the bearing and damage to parts.
2) Perform idling operation of the engine for two minutes or longer before operating the engine to ensure that sufficient lubrication oil is circulated in the turbocharger after replacing the engine oil or the oil filter.
3) When the engine is run at a high speed for an extended period of time, sufficiently perform idling operation and then stop the engine. Otherwise, the turbine wheel continuously operates without oil pressure on the turbocharger. In this case, an oil film is not formed on the center bearing and the journal bearing of the turbocharger causes abrasion and reduces the life span of the turbocharger.
4) When operating the engine in extremely cold temperatures or if the engine has been shut down for an extended period of time, perform the idling operation after starting the engine until the oil pressure of the engine reaches normal conditions.
5) The turbocharger turbine rotates at the super high speed of 50,000 - 200,000 rpm. Oil supply to the bearings may have significant effects on the life span of the turbocharger. Use only the standard engine oil that is recommended by the company, and regularly check and replace the engine oil.
6) Using contaminated air cleaner for an extended period may cause critical damage to the Turbo charger. Regularly check and replace the air cleaner.
7) The turbocharger is a very complicated and precise part. Only authorized mechanics should service the turbocharger.
8) Operating the turbocharger with no intake and exhaust pipes mounted may cause serious damage to the engine or physical injury of workers. The turbocharger should be operated with all the parts correctly mounted on the correct positions.
9) Do not lift the turbocharger by the actuator of the turbocharger. The turbocharger may be damaged by its own weight.
10) The weight of the turbocharger is approx. 9.0 kg. When lifting the turbocharger for removing or mounting, the worker should lower their center of gravity, or lift the turbocharger with the body of worker closely in contact with the turbocharger. Otherwise, the turbocharger may be dropped, causing damage to the parts or physical injury of the worker.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

5.3.8. Diagnostics and troubleshooting

Complaints	Possible causes	Corrections
1. Excessive black smoke	1) Air cleaner element clogged	Replace or clean
	2) Restrictions in air duct	Check and correct
	3) Leakage at intake manifold	Check and correct
	4) Turbo charger seized up and not rotating	Disassemble/repair or replace
	5) Turbine blades and compressor blades coming in contact with each other or damaged	Disassemble/repair or replace
	6) Exhaust piping deformed or clogged	Check and correct
2. Excessive white smoke	1) Oil leak into turbine and compressor	Disassemble/repair or replace
	2) Worn or damaged seal ring due to excessive wear of bearing	Disassemble/repair or replace
3. Low engine output	1) Gas leak at each part of exhaust system	Check and correct
	2) Air cleaner element restricted	Replace or clean
	3) Turbo charger fouled or damaged	Disassemble/repair or replace
	4) Leakage at discharge port on compressor side	Check and correct
4. Unusual sound or vibration	1) Rotor assembly coming in contact	Disassemble/repair or replace
	2) Unbalanced rotation of rotor	Disassemble/repair or replace
	3) Seized up	Disassemble/repair or replace
	4) Each joint loosened	Check and correct

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

Checking items before and after removing the turbocharger

	No	Items to check	Expected problem						Troubleshooting
			Noise	Power reduction	Oil leakage.	Oil con-sumption.	Black smoke	Blue smoke	
Before removal	1	Is there a torn or deformed intake system hose?	O	O	O		O		Replace the hose
	2	Is the clamp properly connected?	O	O	O	O			Re-tighten the bolts and he nuts
	3	Is the air filter in good condition?	O	O	O		O		Replace the air filter, and checking the turbocharger and impeller for damage
	4	Is there leakage of TC coolant or oil from the oil hose?	O		O	O	O		Replace the hose and the gasket
	5	Is there gas leakage from the exhaust manifold gasket?	O						Replace the nuts and the gasket
	6	Are the solenoid valve and the EGR system in good condition?	O	O			O		Replace the solenoid and the ERG valve
	7	Is operation of the turbo actuator normal?	O	O	O		O		Replace the turbo
During removal	1	Is there any trace of leakage between the engine block and the exhaust manifold?	O	O	O	O		O	Replace the turbo
	2	Is the volume of foreign material and oil supplied through the blow-by gas normal?	O	O	O	O	O		Check the turbo impeller and the turbo intake outlet
	3	Is there trace of contact with the wall due to large clearance of the wheel?	O	O	O	O			Check foreign materials (sand and metal materials)
	4	Is the wheel damaged?	O	O	O	O			Check foreign materials (sand and metal materials)
After removal	1	Is the wheel damaged and the shaft clipped?	O	O	O	O			Check foreign materials (sand and metal materials)
	2	Is the wheel rotation normal?	O	O	O	O			

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

5.4. Air cleaner

5.4.1. Maintenance of air cleaner

(Only when engine is switched off)

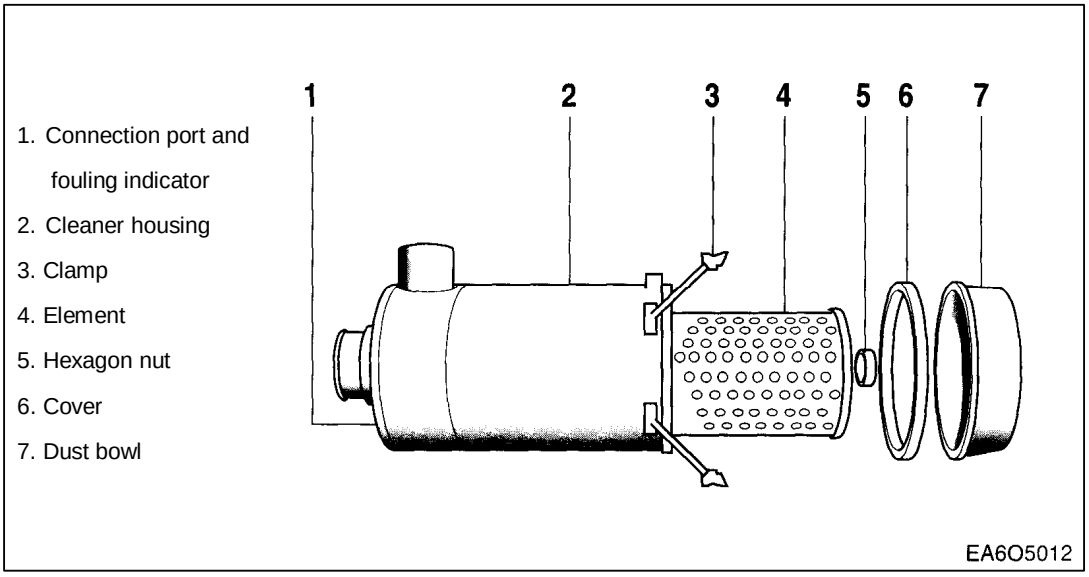
Empty the dust bowl (7) regularly. The bowl should never be filled more than halfway with dust.

On slipping off the two clamps (3), the dust bowl can be removed. Take off the cover (6) of the dust bowl and empty.

Be careful to assemble cover and bowl correctly.

There is a recess in the cover rim and a lug on the collector which should register.

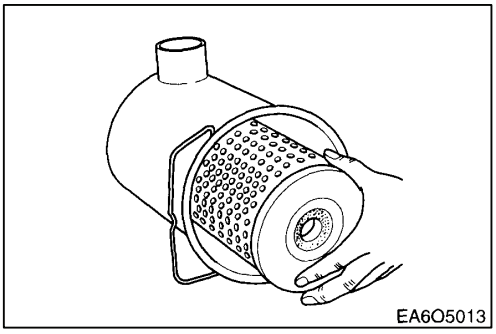
Where the filter is installed horizontally, watch for “top” mark on cleaner bowl.



1. Connection port and fouling indicator
2. Cleaner housing
3. Clamp
4. Element
5. Hexagon nut
6. Cover
7. Dust bowl

5.4.2. Changing air cleaner element

CAUTION:
Do not allow dirt to get into the clean air end.



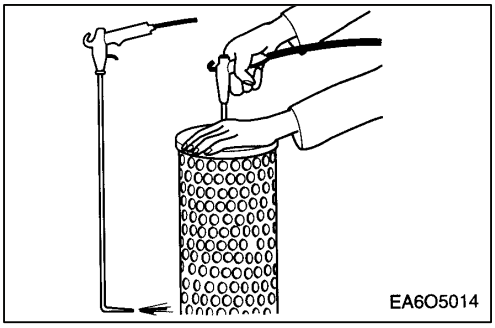
- On removing the hexagon nut, take out the dirty cartridge and renew or clean.
- Wipe the cleaner housing with a damp cloth, in particular the sealing surface for the element.

Downloaded from www.Manualslib.com manuals search engine

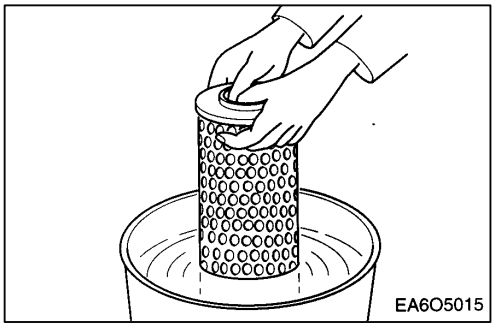
https://truckmanualshub.com/

5.4.3. Cleaning air cleaner elements

- **By compressed air (wear goggles)**
  - Use the air gun to clean the element down to the inside of the bottom of the element by spraying compressed air in 90 degree direction..
  - Move the air gun up and down along the element, and blow the air from inside to outside until no dust is blown out of the element.
  - The compressed air pressure should not exceed 5 bars.



- **By washing**
  - Before washing, the element should be precleaned by means of compressed air, as described above.
  - Then allow the element to soak in lukewarm washing solvent for 10 minutes, and then move it to and fro in the solvent for about 5 minutes.
  - Rinse thoroughly in clean water, shake out and allow drying at room temperature. The cartridge must be dry before it is reinstalled.
  - Never use steam sprayers, petrol (gasoline), alkalis or hot liquids etc. to clean the air cleaner elements.

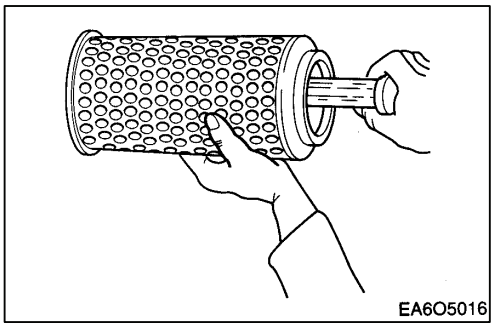


- **Knocking out dirt by hand**
  - In emergencies, when no compressed air or cleaning agent is available, it is possible to clean the filter cartridge provisionally by hitting the end disk of the cartridge with the ball of one's thumb.
  - Under no circumstances should the element be hit with a hard object or knocked against a hard surface to loosen dirt deposits.

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

- **Checking the air cleaner cartridge**
  - Before reinstalling the cartridge, it must be checked for damage e.g. to the paper pleats and rubber gaskets, or for bulges and dents etc. in the metal jacket.
  - Damaged cartridges should not be reused under any circumstances. In cases of doubt, discard the cartridge and install a new one.



5.5. Belt

The tension of the belts should be checked after every 2,000 hours of operation.

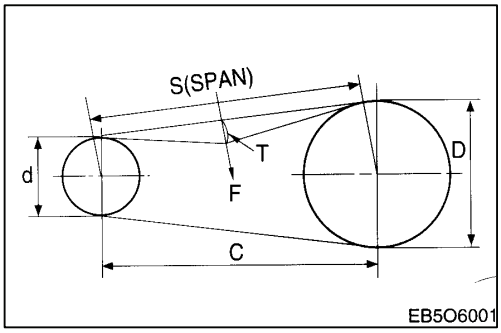
(1) Change the belts if necessary

If in the case of a multiple belt drive, wear or differing tensions are found, always replace the complete set of belts.

(2) Testing by hand

- **Poly belt**

  Poly belt will be properly tensioned if the deflection force “F” is applied mid-way between the belt’s tangent points with the pulley.



(T) = 0.015 x S (about 1.5mm per 100mm).

T = 0.015 x *S (mm)

(T : Deflection, S : Span)

$$^{*}S = \sqrt{C^2 - \frac{(D-d)^2}{2}} \quad \text{(mm)}$$

C : Distance of pulleys (mm)

D : Large pulley diameter (mm)

d : Small pulley diameter (mm)

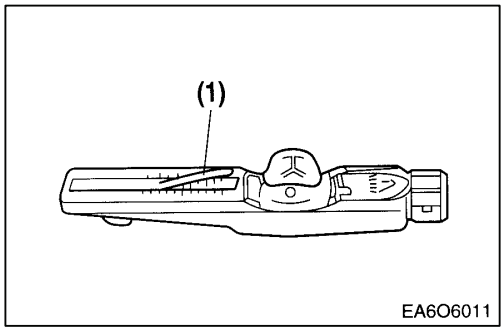
Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

(3) Measuring tension

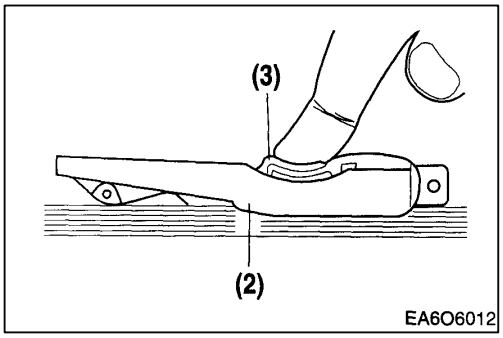
① Lower indicator arm (1) into the scale

- Apply tester to belt at a point midway between two pulleys so that edge of contact surface (2) is flush with the V- belt.
- Slowly depress pad (3) until the spring can be heard to disengage. This will cause the indicator to move upwards.
- If pressure is maintained after the spring has disengaged a false reading will be obtained.



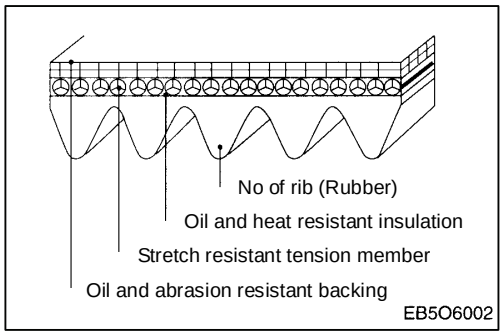
② Reading of tension

- Read of the tensioning force of the belt at the point where the top surface of the indicator arm (1) intersects with the scale.
- Before taking readings make ensure that the indicator arm remains in its position.



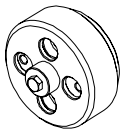
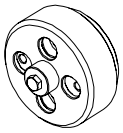
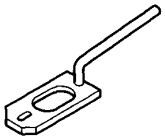
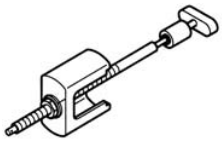
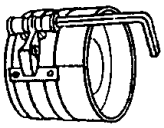
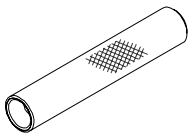
- **Poly belt tension**

No of rib (PK type)	Force (kgf)
3	20 - 27
4	27 - 36
5	34 – 45
6	41 – 57
7	48 – 66
8	59 - 73

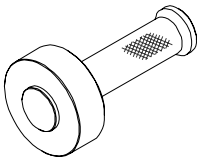
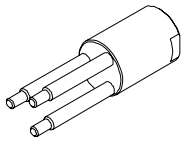
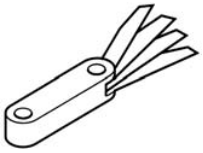
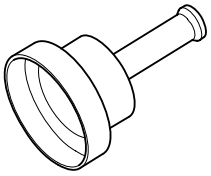
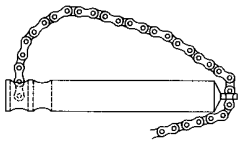
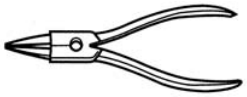
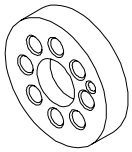
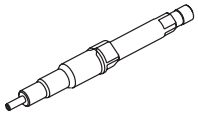


Downloaded from www.Manualslib.com manuals search engine

6. Special Tool List

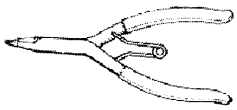
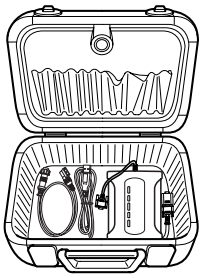
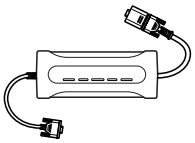
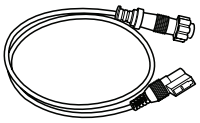
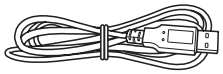
No	Part no.	Figure	Tool name	Remark
1	EF.121-299		Oil seal insert assembly (Front)	
2	EF.121-300		Oil seal assembly jig (Rear)	
3	EF.123-065		Valve spring compression tool	
4	EF.123-365A		Cylinder liner disassembly tool	
5	EF.121-250		Piston insertion tool	DL06K Dedicated tool
	EF.120-208			Common for engine
6	EF.121-253		Valve stem seal punch tool	

Downloaded from www.Manualslib.com manuals search engine

No	Part no.	Figure	Tool name	Remark
7	EF.121-181		Cam shaft hole cover punch	
8	EF.121-252		Step idle gear pin assembly jig	
9	60.99901-0027		Gap gauge	
10	EF.121-260		Abrasion ring punch (rear)	
11	65.98801-0001		Filter wrench	
12	T7610001E		Snap ring plier	
13	EF.121-259		Crankshaft gear insert jig	
14	EF.110-120		Compression pressure gauge adaptor	

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

No	Part no.	Figure	Tool name	Remark
15	T7621010E		Piston ring pliers	
16	860104-01045		Failure diagnosis unit Included below 17, 18, 19 items.	
17	860104-01046		UVIM (CAN module)	Failure diagnosis unit part
18	860104-01047		14-pin connector	Failure diagnosis unit part
19	860104-01048		USB	Failure diagnosis unit part

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

Appendix

● Tightening torque for major parts

Major parts	Screw (Diameter x pitch)	Tightening torque
Cylinder block bearing cap	M16 x 2.0	30±2 kg.m
Oil spray nozzle	M10 x 1.25	2.1+0.5 kg.m
Flywheel housing	M12 x 1.5	11.2 +1.0 kg.m
Crank pulley fixing bolt	M14 x 1.5	20+0.2 kg.m
Vibration absorber	M10 x 1.5	6.2+0.5 kg.m
Flywheel wheel fixing bolt	M14 x 1.5	20 +2.0 kg.m
Connecting rod cap bolt	M12 x 1.5	9.75+0.25 kg.m
Cylinder head bolt	M13 x 1.5	5kg.m + 90°+ 90°+ 90°
Cylinder head lid bolt	M8	2.2 +0.5 kg.m
Injector cable fixing nut	M4	0.15+0.01 kg.m
Rocker arm bracket fixing bolt	M8 x 1.25	3.7+0.5 kg.m
Rocker arm adjustment nut	M10 x 1.0	3.0 +0.5 kg.m
Oil pump cover	M8	2.2+0.5 kg.m
Oil pump fixing bolt	M10 x 1.5	4.4+0.5 kg.m
Oil cooler fixing bolt	M8	2.2+0.5 kg.m
Oil fan fixing bolt	M8	2.2+0.5 kg.m
Oil drain plug	M30 x 1.5	10+1.0 kg.m
Exhaust pipe fixing bolt	M8	5.0 +0.5 kg.m
Intake pipe fixing bolt	M10 x 1.5	4.4 +0.5 kg.m
Start motor	M12 x 1.5	8.0+1.0 kg.m
Alternator bracket fixing bolt	M12 x 1.5	7.7+0.5 kg.m
Cooling water temperature sensor	M12 x 1.5	2.2 kg.m (max. 2.5 kg.m)
Engine mounting bracket	M10 x 1.5	6.2+0.5 kg.m

● Tightening torque for fuel injection system

Fuel high pressure pump gear nut (CP pump)	M18 x 1.5	11 kg.m ± 0.5 kg.m
Fuel injector fixing bracket bolt	M8	3.1 kg.m
Fuel high pressure pump fixing bolt (cylinder block)	M8	4.4+0.5 kg.m
Fuel high pressure connector nut	M22 x 1.5	5+0.5 kg.m
Common rail fixing bolt	M8	2.2+0.5 kg.m
Fuel high pressure pipe - High pressure fuel connector	M14 x 1.5	2.8+0.5 kg.m
Fuel high pressure pipe - Common rail	M14 x 1.5	2.5+0.5 kg.m
Fuel high pressure pipe - Fuel high pressure pump	M14 x 1.5	2.1+0.5 kg.m
Fuel filter fixing bolt	M10	4.4+0.5 kg.m

Downloaded from www.Manualslib.com manuals search engine

Standard bolt tightening torque table

Refer to the following table for bolts other then described above

Diameter x pitch (mm)	Degree of strength										
	3.6	4.6	4.8	5.6	5.8	6.6	6.8	6.9	8.8	10.9	12.9
	(4A)	(4D)	(4S)	(5D)	(5S)	(6D)	(6S)	(6G)	(8G)	(10K)	(12K)
	Limit value for elasticity (kg/mm^2)										
	20	24	32	30	40	36	48	54	64	90	108
	Tightening torque (kg.m)										
M5	0.15	0.16	0.25	0.22	0.31	0.28	0.43	0.48	0.5	0.75	0.9
M6	0.28	0.30	0.45	0.4	0.55	0.47	0.77	0.85	0.9	1.25	0.5
M7	0.43	0.46	0.7	0.63	0.83	0.78	1.2	1.3	1.4	1.95	2.35
M8	0.7	0.75	1.1	1	1.4	1.25	1.9	2.1	2.2	3.1	3.8
M8x1	0.73	0.8	1.2	1.1	1.5	1.34	2.1	2.3	2.4	3.35	4.1
M10	1.35	1.4	2.2	1.9	2.7	2.35	3.7	4.2	4.4	6.2	7.4
M10x1	1.5	1.6	2.5	2.1	3.1	2.8	4.3	4.9	5	7	8.4
M12	2.4	2.5	3.7	3.3	4.7	4.2	6.3	7.2	7.5	10.5	12.5
M12x1.5	2.55	2.7	4	3.5	5	4.6	6.8	7.7	8	11.2	13.4
M14	3.7	3.9	6	5.2	7.5	7	10	11.5	12	17	20
M14x1.5	4.1	4.3	6.6	5.7	8.3	7.5	11.1	12.5	13	18.5	22
M16	5.6	6	9	8	11.5	10.5	17.9	18.5	18	26	31
M16x1.5	6.2	6.5	9.7	8.6	12.5	11.3	17	19.5	20	28	33
M18	7.8	8.3	12.5	11	16	14.5	21	24.2	25	36	43
M18x1.5	9.1	9.5	14.5	12.5	18.5	16.7	24.5	27.5	28	41	49
M20	11.5	12	18	16	22	19	31.5	35	36	51	60
M20x1.5	12.8	13.5	20.5	18	25	22.5	35	39.5	41	58	68
M22	15.5	16	24.5	21	30	26	42	46	49	67	75
M22x1.5	17	18.5	28	24	34	29	47	52	56	75	85
M24	20.5	21.5	33	27	40	34	55	58	63	82	92
M24x1.5	23	25	37	31	45	38	61	67	74	93	103

Others:

1. The above torque rating have been determined to 70% or so of the limit value for bolt elasticity.
2. Tension is calculated by multiplying tensile strength by cross section of thread.
3. Special screws should be tightened to 85% or so of the standard value.
   For example, a screw coated with MoS_2 should be tightened to 60% or so of the standard value.

Tightening torque for plug screw

M10	M12	M14	M16	M18	M22	M24	M26	M30
5.0	5.0	8.0	8.0	10.0	10.0	12.0	12.0	15.0

Tightening torque for hollow screw(4-hole)

	M8	M10	M12	M14	M16	M18	M22	M26	M30	M38
SM25C	-	1.6	2.5	3.5	4.5	5.5	9.0	13.0	18.0	30.0
* SUM22L	0.8	1.8	3.0	4.0	5.5	6.5	11.0	16.0	20.0	35.0
STS304	0.8	1.8	3.0	4.0	5.5	6.5	11.0	16.0	20.0	35.0

* : Adopted in DOOSAN engine

Downloaded from www.Manualslib.com manuals search engine

● Engine assembly tolerance

(unit : mm)

Group	Part	Inspection item		Stand value for assembly	Limit for use	Correction	Remark
Cylinder block	Cylinder block & liner	Inside diameter of cylinder liner		ϕ104.9~ϕ105.1	ϕ104.4	Replace liner	Measure unworn portion beneath the rim of the upper side
		Amount of liner projection		0.03 ~ 0.08	-		From top of cylinder
		The flatness of upper surface of cylinder block		0.08	-	Correct with a surface grinder	Referenced length 200mm
		Hydraulic test for 1 Minute (kg/cm^2)		4	-	Replace if leaky	
	Cylinder head & valve	Valve seat depression	Intake	0.35 ~ 0.65	0.85	Replace valve seat	Depression of valve from lower face of cylinder head
			Exhaust	0.35 ~ 0.65	0.85		
		Cylinder head height		104.9~105.1	104.4	Replace cylinder head	
		The flatness of lower surface of cylinder head		0.15	0.3	Replace cylinder head	
		Thick of cylinder head gasket(at assembly status)		1.215~1.285	-		
		Hydraulic test for 1 minute (bar)		4	-	Replace if leaky	Water temperature 70°C
Major moving parts	Piston	Outer diameter of piston		ϕ99.93~ ϕ99.952	-	Replace liner	Measure at 8 mm away from piston head(long diameter)
		Clearance between piston and liner		0.079~0.101	0.3	Replace one worn more	
		Inner diameter of piston pin		ϕ40.008~ ϕ40.014	-		
		Width of piston ring grooves	Top ring	-	-	Replace piston if groove width is beyond specified	Measure at ϕ100 mm of top ring groove
			2nd ring	2.54~2.56	-		
			Oil ring	4.02~4.04	-		
		Piston projection from cylinder block upper surface		0.206~0.558	-		Measure unworn portion beneath the rim of the upper side
		Permissible weight difference of each piston		30g	30g↓	Replace piston	
	Piston ring	Width of piston ring	Top ring	-	-	Replace ring	
			2nd ring	2.47~2.49	-		
			Oil ring	3.97~3.99	-		
		Piston ring gap	Top ring	3.97~3.99	1.5	Replace ring	Standard gauge inside diameter: ϕ100
			2nd ring	0.60~0.80	1.5		
			Oil ring	0.25~0.45	1.5		

Downloaded from www.Manualslib.com manuals search engine

Group	Part	Inspection item		Stand value for assembly	Limit for use	Correction	Remark
		Piston ring side clearance	Top ring	-	-	Replace ring or piston	Limit for use is if for standard clearance.
			2nd ring	0.05~0.09	0.15		
			Oil ring	0.03~0.07	0.15		
		Direction of ring gap		-	-	Cross Install by 120°	
	Piston pin	Outer diameter of piston pin		ϕ39.994~ ϕ40.000	ϕ39.94	Replace piston pin	
		Clearance between piston pin and its bush		0.008~0.020	0.08	Replace one worn more	

Downloaded from www.Manualslib.com manuals search engine

(Unit : mm)

Group	Part	Inspection item	Stand value for assembly	Limit for use	Correction	Remark
Major moving parts	Crank shaft	Radial run-out of journal and pin	-	0.01	Correct with a grinder	Horizontal and vertical directions
		Outside diameter of journal	ϕ79.905~ ϕ79.925	ϕ78.905	Use under sized bearings respectively (0.25, 0.5, 0.75, 1.0)	
		Outside diameter of pin	ϕ68.924~ ϕ68.944	ϕ67.924		
		With of thrust journal	33.99 ~ 34.03	33.94		
		Ellipticity of journal and pin	0.007	0.025		
		Concentricity of journal and pin	0.01	0.03		
		Taper of journal and pin	0.02	0.03		
		Run-out of crankshaft	0.06↓	0.15↓	Adjust by a press	Measure #4 journal (journal #1, #7 support)
		Clearance between crankshaft and bearing	0.045~0.110	0.15	Replace bearings	Measure at crown part
		End play of crankshaft	0.14~0.33	0.4	Replace thrust bearing	Measure at crown part
		Balance of Crankshaft (g.cm)	60 ↓	Under 60	Check dynamic balance	Measure at 400 rpm
		Torque of Journal bearing cap bolt (kg.m)	30±2	-	Coat the bolt with engine oil	Clean out foreign objects on joining surface
		Crush of journal diameter	0.065~0.105	-		Measure after tightening metal cap and releasing one bolt
		Oil seal for wear (crank shaft rear)	-	-	Replace oil seal if oil leaking	
	Connecting rod	Inner diameter of small-end	ϕ40.03~ ϕ40.04	-		
		Inner diameter of big-end	ϕ73.000~ ϕ73.015	-		
		End play of con-rod	0.170~0.30	0.50		
		Clearance between con-rod bearing and crank pin	0.03~0.081	0.15	Replace bearing	
		Clearance between small end bush & piston pin	0.04~0.056	0.08	Replace con-rod	
		Crush height of con-rod bearing	0.085~0.125	-		Measure after installing the bearing and releasing one bolt
		Perpendicularity of big-end inner diameter	0.05	0.1		
		Roundness of big-end inner diameter	0.007	0.25		
		Parallelness of small end side and big end	0.2	0.50	Replace con-rod.	
		Allowable weight difference per con-rods	10g ↓	-	Replace same degree	Management of con-rod's grade (A ~I)
		Con-rod bearing cap bolt (kg.m)	9.75+0.25	-	Coat the bolt with engine oil	Clean out foreign objects on joining surface.
	Cam shaft	Inner diameter of hall of cylinder block camshaft	ϕ56.000~ ϕ56.030	-		

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

Group	Part	Inspection item		Stand value for assembly	Limit for use	Correction	Remark
		Diameter of camshaft journal		ϕ55.92~ ϕ55.95	ϕ55.65		
		Clearance between cam shaft and cam bush		0.03 ~ 0.09	0.18	Replace cam bush	
		End play of camshaft		0.280 ~ 0.430	0.5	Replace thrust washer	
		Run-out of camshaft		0.05	0.15	Correct or replace the cam shaft	
	Timing gear	Clearance between idle shaft bush and idle shaft		0.025~0.066	0.1		
		End play of idle gear shaft		0.107~0.183	0.3	Correct or replace gear	
	Fly wheel	Ring gear assembly part's outer diameter		ϕ361.5~ ϕ361.6	-		Heating temperature at ring gear assembly (200~230 °C)
		Ring gear inner diameter		ϕ361~ ϕ361.2	-		
		Overlap		0.3 ~ 0.6	-		
		Heating temperature at time of assembly (°C)		200	-		
		Allowable shaking amount after assembly		0.5	-		
		Outer diameter after reassembly wear ring		ϕ99.86 ~ ϕ100.0	-		
Valve system	Valve and valve guide	Diameter of intake valve stem		ϕ6.963~ϕ6.977	ϕ6.93	Replace Valve & valve guide	When replacing valve guide & seat work simultaneously by special tools.
		Diameter of exhaust valve stem		ϕ6.950~ϕ6.964	ϕ6.91		
		Clearance between valve stem and valve guide	Intake	0.023~0.052	0.1		
			Exhaust	0.036~0.065	0.15		
		Degree of valve seat	Intake	60°	-		
			Exhaust	45°	-		
		Diameter of valve head	Intake	ϕ34.9~ϕ35.1	-		
			Exhaust	ϕ30.9~ϕ31.1	-		
		Thickness of valve head	Intake	3.3~3.7	2.8 or more		
			Exhaust	3.3~3.7			
		Projection amount of valve guide and valve spring seat	Intake	12.8 ~13.2	-	Use with assembly jig	To upper side of valve guide from spring seat side of cylinder head
			Exhaust	12.8 ~13.2	-		
		Valve seat assembly part's inner diameter of cylinder head	Intake	ϕ35.800~ ϕ35.825	-		
			Exhaust	ϕ32.000~ ϕ32.025			
		Outer diameter of valve seat	Intake	ϕ35.848~ ϕ35.864	-		
			Exhaust	ϕ32.048~ ϕ32.064			
		Valve seat assembly part's depth of cylinder head		7.9~8.1	-		

Downloaded from www.Manualslib.com manuals search engine

Group	Part	Inspection item		Stand value for assembly	Limit for use	Correction	Remark
		Inner diameter of valve guide		ϕ7.000~ϕ7.015	-		When replacing valve guide & seat work simultaneously by special tools
		Valve guide assembly part's inner diameter of cylinder head		ϕ13.000~ ϕ13.018	-		
		Diameter of valve guide		ϕ13.028~ ϕ13.039	-		
		Clearance between valve guide and cylinder head installing hole		-0.01 ~ -0.039	-		Spread oil over valve guide and press it into the hole
		Concentricity between valve seat and valve guide		0.05	-		Without spring seat
		Intake and exhaust valve spring	Free length	53.4 mm	-	Replace valve spring	
			Tension force (kg) 39.4mm	28.8 kg	±2 kg		
			Tension force (kg) 29.67mm	50 kg	±2 kg		
			Squareness (along free length direction)	1.4 mm	2.0		
	Rocker arm and push rod	Valve clearance (at cold)	Intake	0.3	-	Adjust	
			Exhaust	0.4	-		
		Clearance of engine brake		1.5	-	Grind or replace if severely pitted on tip of rocker arm and stem	
		Joining surface of valve stem and rocker arm bush		-	-	–	–
		Inner diameter of rocker arm bush		ϕ24.991~ ϕ25.012			
		Diameter of rocker arm shaft		ϕ24.939~ ϕ24.960	ϕ24.90		
		Clearance between rocker arm shaft & rocker arm bush		0.031~0.073	0.14	Replace bush or shaft	
		Run-out of push rod		0.25	0.25↓	Replace or correct	
	Tappet	Tappet assembly part's inner diameter of cylinder block		ϕ28.010~ ϕ28.031	-		
		Diameter of tappet		ϕ27.962~ ϕ27.982	-	Replace tappet	
		Clearance between tappet & tappet hole of cylinder block		0.028~0.069	0.13	Replace if severely worn or deformed	
		Tappet face in contact with cam		-	-	Replace if severely worn or deformed	
Lubricating system	Engine oil	Oil pressure (at normal speed) kg/cm^2		3.0~5.5	-	Check oil leakage and clearance between each part	-
		Oil pressure (idling) kg/cm^2		1.5~3.0	-	Use recommended oil	
		Oil temperature (°C)		-	105		Must not exceed

Downloaded from www.Manualslib.com manuals search engine

Group	Part	Inspection item		Stand value for assembly	Limit for use	Correction	Remark
		Permissible oil temperature in short time (°C)		-	120		this value
		By-pass valve for oil filter (kg/cm^2)		1.9~2.3	-		
		Spray nozzle	Operating pressure	2.0~2.2		Replace valve	
			Nozzle diameter	ϕ1.6			
	Oil pump	Delivery volume l/min - Pump speed: 3,333rpm - Oil temperature: 80°C - pressure: 4.0 kg/cm^2		75 or more	-	Replace gear or cover	
		With gear assembly part's of oil pump housing		18.000~18.027	-		
		Width of oil pump gear		17.941~17.968	-		
		oil pump relief valve (kg/cm^2)		9.0~10.5	-	Replace valve	
		Clearance between drive gear shaft and cover hole		0.050~0.085	-	Replace bush or cover	
		Diameter of gear shaft		ϕ21.936~ ϕ21.95	-	Replace gear shaft	
		Diameter of driving gear bush		ϕ22.000~ ϕ22.021	-	Replace bush	
	Oil filter	Damage of oil filter cartridge		-	-	Clean or replace	
		oil filter bypass (kg/cm^2)		1.9~2.3	-	Replace valve	
Cooling system	Radiator	Radiator & water pump for corrosion, damage & improper connecting		-	-	Correct or replace	
		Test for leakage (air pressure) (kg/cm^2)		1.2~1.3	-	Submerge in water and replace if air bubbles found	
		Pressure valve for opening pressure (kg/cm^2)		0.5	-	-	
		Differential Pressure valve for opening pressure (kg/cm2)		0.05	-	-	
	Water pump	Delivery volume l/min - Pump speed 2,500rpm - Water temp. 80°C - Back pressure 0.5 kg/cm^2		350 or more	-	Check the water passage	For any Restrictions
		Diameter of water pump shaft	Pulley side	ϕ25.048~ ϕ25.061	-		
			Impeller side	ϕ16.045~ ϕ16.056	-		
		Clearance of bearing		0.050~0.091			
		Clearance between impeller & housing		0.4 ~ 0.8	-	Replace if impeller & housing are damaged	
		Squareness of pulley		0.1	-	Adjust by bench press	

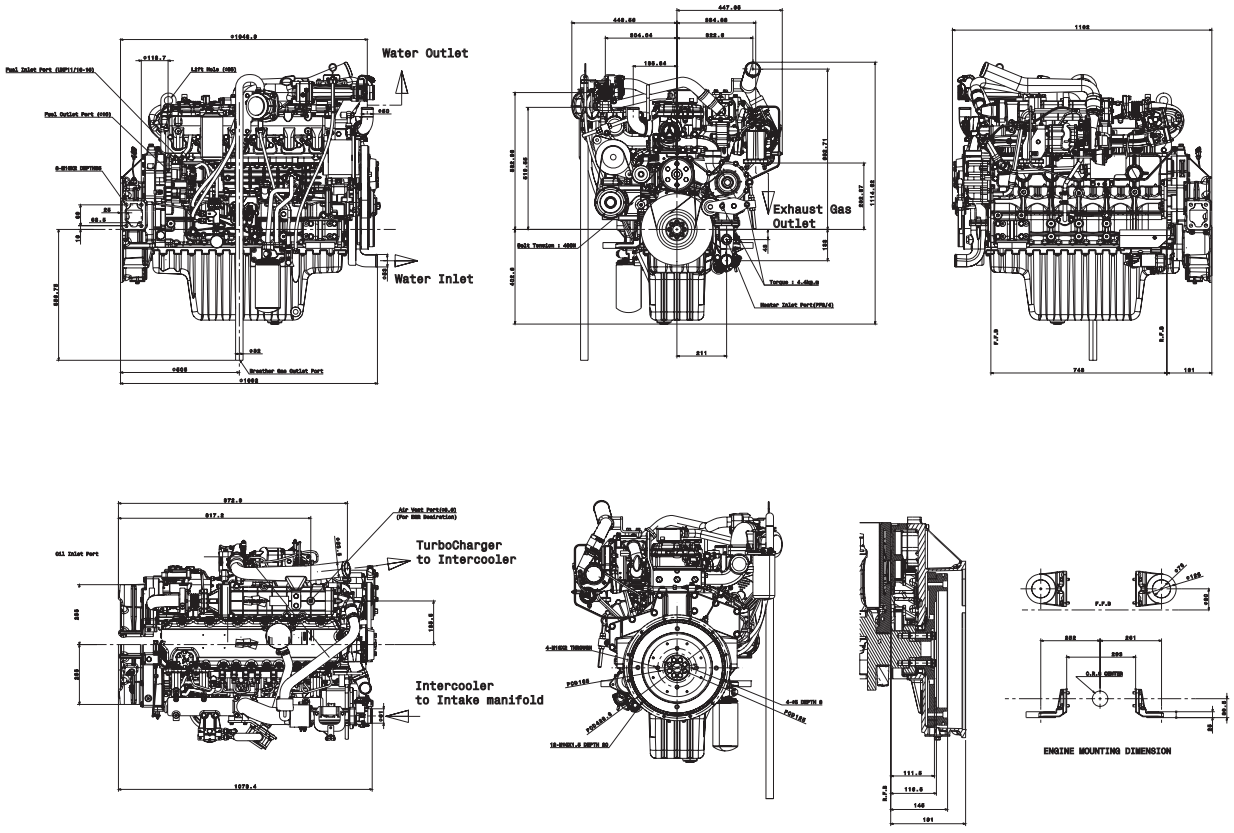
Downloaded from www.Manualslib.com manuals search engine

Group	Part	Inspection item	Stand value for assembly	Limit for use	Correction	Remark
		Fan belt depression	Refer to adjust table	-	Adjust	
	Cooling water temp	Operating temperature (permissible temp.) (°C)	82 ~ 95	-	Must not exceed this value	
		Permissible temperature in a short time (°C)	-	105		
	Thermo stat	Thermostat opening temperature °C (under atmospheric pressure)	82	-	Replace	
		Full opening temperature (°C)	95	-	Replace if defective Stroke : min. 10mm	
Fuel system	Fuel high pressure pump maker (CP pump)		Bosch	-		
	Common rail maker					
	Fuel injector maker					
	Piping & others	Fuel pipe, injection pipe & nozzle holder for damage, cracks, improper O-ring	-	-	Replace	
		Fuel filter cartridge for damage	-	-	Replace cartridge	
	Injection pressure of injector (kg/cm^2)		Max 1,600	-		
	Operating pressure of overflow valve (kg/cm^2)		10.5 ~13	-	Replace valve	
	Diameter of injector nozzle		8 - ϕ0.136			
	Projection height of nozzle from the cylinder head surface(mm)		3.0	-	Use sealing by option	
Air compressor	cylinder Inner diameter	Grade B	ϕ90.000~ ϕ90.010	-	Replace same grade	
		Grade C	ϕ90.010~ ϕ90.020	-		
		Grade D	ϕ90.020~ ϕ90.030	-		
	Diameter of piston	Grade B	ϕ89.910~ ϕ89.920	-	Replace same grade	
		Grade C	ϕ89.920~ ϕ89.930	-		
		Grade D	ϕ89.930~ ϕ89.940	-		
	Piston ring gap	#1, #2 ring	0.2 ~ 0.45	-		
		#2, #4 ring	0.2 ~ 0.4			
Drive system	Gear back lash	Cam shaft gear & idle gear	0.074 ~ 0.163	-		
		Fuel high pressure pump gear & idle gear	0.103 ~ 0.182	-		
		Crankshaft gear & oil pump driving gear	0.073 ~ 0.239	-		
		Air compressor (PTO) gear & cam gear	0.074 ~ 0.163	-		

Downloaded from www.Manualslib.com manuals search engine

https://truckmanualshub.com/

● **Engine assembly DL06K**



Downloaded from www.Manualslib.com manuals search engine