

ENGINE

ENGINE MECHANICAL (4HK1-TC)

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ISUZU DIESEL ENGINE (4HK1-TC)

Service Precautions

Matters that require attention in terms of maintenance

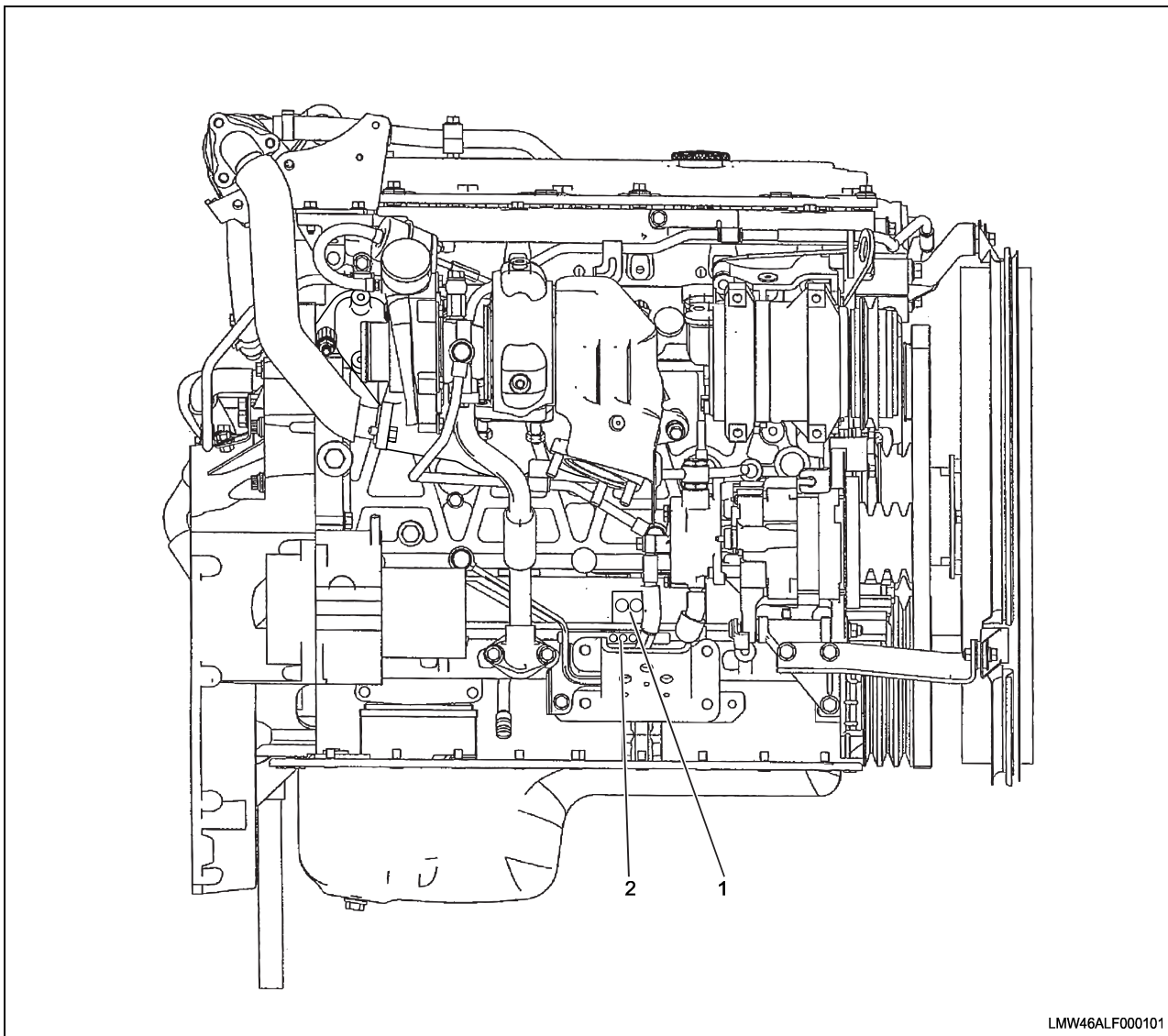
To prevent damage to the engine and ensure reliability of its performance, pay attention to the following in maintaining the engine:

- When lifting up or supporting the engine, do not apply a jack on the oil pan.
When taking down the engine on the ground, do not make the bearing surface of the oil pan touch directly the ground. Use a wood frame, for example, to support the engine with the engine foot and the flywheel housing.
Because there is only a small clearance between the oil pan and the oil pump strainer, it can damage the oil pan and the oil strainer.
- When the air duct or air cleaner is removed, cover the air intake opening to prevent foreign matter from getting into the cylinder. If it gets into it, it can considerably damage the cylinder and others while the engine is operating.
- When maintaining the engine, never fail to remove the battery earth cable. If not, it may damage the wire harness or electrical parts. If you need electricity on for the purpose of inspection, for instance, watch out for short circuits and others.
- To protect and lubricate the rotational surface during the initial operation, apply plenty of engine oil to it.
- When valve train parts, pistons, piston rings, connecting rods, connecting rod bearings or crankshaft journal bearings are removed, put them in order and keep them.
- When installing them, put them back to the same location as they were removed.
- Parts, such as gaskets, oil seals and O-rings, have to be replaced by brand-new ones every time the engine is dismantled.
- As for parts where a liquid gasket is used, remove an old liquid gasket completely and clean it up thoroughly so that no oil, water or dust may be clung to them. Then, apply the designated liquid gasket to each place anew before assembly.
- Assemble it within 7 minutes after applying the liquid gasket.
If 7 minutes or longer passed, remove the liquid gasket and apply it again.
- When assembling or installing parts, fasten them with the prescribed tightening torque so that they may be installed properly.

Matters that require attention in specifically dealing with this engine.

Holes or clearances in the fuel system, which serve as a passage of fuel, including the inside of the injector, are made with extreme precision. For this reason, they are highly sensitive to foreign matter and if it gets in, it can lead to an accident on the road, for instance; thus, make sure that foreign matter will be prevented from getting in.

How to read the model



LMW46ALF000101

Legend

1. Cast The Engine Model

2. Stamp An Engine Number

Explanation of functions and operations

Electronic engine control

With the control unit, the range from injection to air intake/exhaust, including fuel injection quantity, injection timing, intake air restriction, EGR, and idling rpm, is controlled.

Cylinder block

The cylinder block is cast-iron with the center distance of each bore being equal and is of the highly rigid, symmetrical structure with the crankshaft center being the center. The bearing cap is of the ladder frame structure and tightened up under the plastic range rotation angle method.

Cylinder liner

The cylinder liner is selected to match an internal diameter of a bore of the cylinder block and built, which is imprinted on the left side of the cylinder.

Piston

The piston is aluminum-alloy and an autothermatic piston with a strut cast, while the combustion chamber is a round reentrant type.

Cylinder head

The cylinder head is cast-iron and there are 4 valves per cylinder. The angular tightening method of the cylinder head bolt further increases reliability and durability.

Crankshaft

Tuffriding is given, while on the No. 1 balance weight imprinted is the grade of each journal diameter.

EGR system

Based upon data, including water temperature, engine speeds or engine loads, it is controlled via Engine Control Module (ECM) to purify exhaust by recycling part of it.

Its main components include an EGR valve, an EGR cooler and various sensors.

Connecting rod cap bolt

The angular tightening method of the connecting rod cap bolt further increases reliability and durability.

Common rail-type electronic control injection system

The common rail-type electronic control injection system is composed of a fuel supply pump that sets the target pressure of high-pressure fuel and supply it, a fuel rail that measures such high-pressure fuel and an fuel injector that turns it into a fine spray and injects it. Each is controlled via ECM based upon various signals, while injection timing or fuel injection quantity is controlled under every possible driving condition.

Fuel Injector

The fuel injector is a 7-hole nozzle that adjusts fuel injection quantity or injection timing by opening or closing an electromagnetic valve on the head of the fuel injector.

ECM corrects the dispersion of fuel injection quantity between fuel injectors according to ID code data in memory. At the replacement of fuel injectors, ID code data should be stored in ECM.

Fuel filter with sedimenter

It is a fuel filter with sedimenter that gets rid of water by making use of the difference in specific gravity between light oil and water, which comes with an indicator that notifies you that it is filled with water.

Preheating system

The preheating system consists the ECM, the glow relay, glow plugs and the glow indicator lamp. (OBD II specification consists the ECM, the glow plug controller, glow plugs.) The preheating system is operated when the engine coolant temperature is low, and make the engine easy to start.

Lubrication system

It is an oil filter with full-flow bypass, which uses a water-cool oil cooler and oil jet to cool the piston.

Functional inspection

Inspection/adjustment of valve clearance

1. Inspection of valve clearance
 - Remove the cylinder head cover.
 - Remove the fuel injector harness assembly.
 - Loosen the terminal nuts alternately to remove.
 - Remove the leak off pipe.

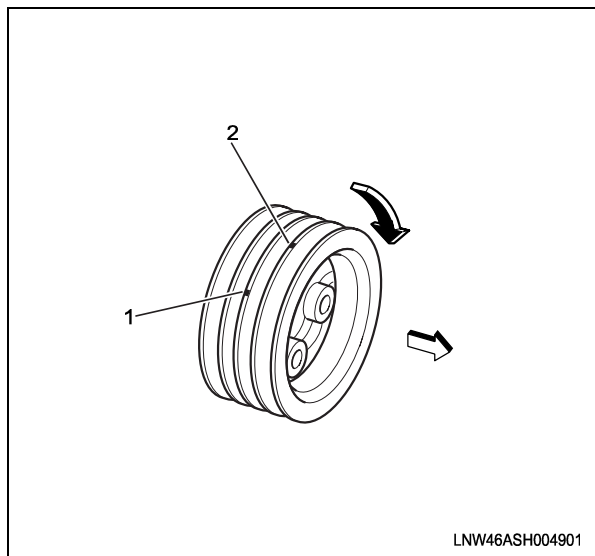
- Rotate the crankshaft to make the No.1 cylinder meet the compression top dead center (TDC).

Notice:

There are 2 timing marks on the crankshaft pulley. Mark (1) is near the cylinder block and is used to bring the 4HK1-TC engine to TDC.

Mark (2) is not applicable to this engine.

Be sure to use mark (1) when bringing the engine to TDC.



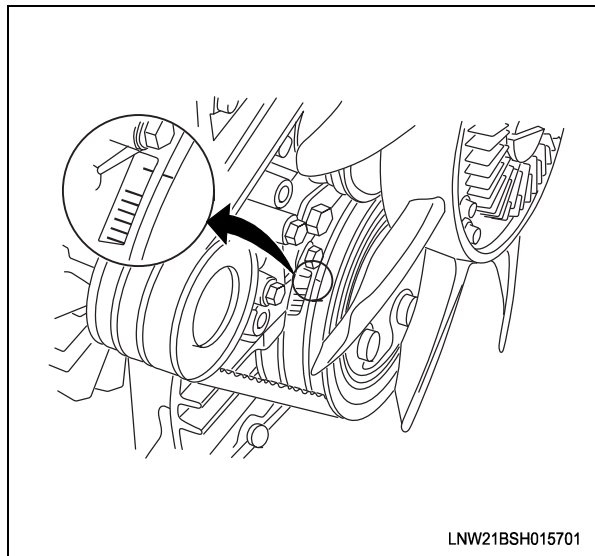
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- Insert a 0.4 mm thickness gauge into a clearance between the rocker arm and the bridge to check it and adjust it if needed.

Valve clearance	mm (in)
Intake valve	0.4 (0.016)
Exhaust valve	0.4 (0.016)

Caution:

Adjust while being cold.



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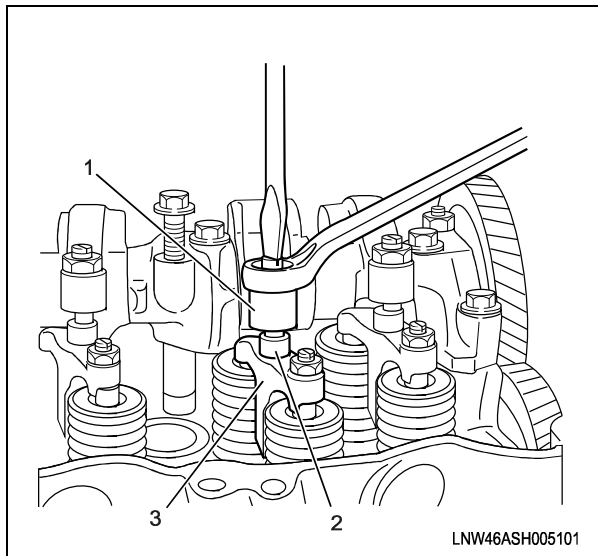
2. Adjustment of valve clearance

Caution:

Adjust valve clearance carefully so that the bridge may become level (hit the end of the 2 valve axes).

- Completely loosen all of the bridge and rocker arm adjusting nuts and adjusting screws (8 nuts and 8 screws).
- Place a 0.4 mm thickness gauge between the No. 1 cylinder rocker arm end and the bridge cap.
- Tighten the rocker arm adjusting screw until the thickness gauge is snug (not tight) between the rocker arm end and the bridge cap.
- Tighten the rocker arm lock nut.
- Tighten the bridge adjusting screw until the bridge contacts the valve head.
- Tighten the bridge lock nut.
- Check that the thickness gauge is still held snugly between the rocker arm end and the bridge cap. If it is too tight, slightly loosen the bridge adjusting screw and lock nut to restore snugness.
- Remove the thickness gauge.
- Repeat Steps 2 through 5 for the remaining cylinders.

Tightening torque: 22 N·m (16 lb ft)



Legend

- Rocker arm
- Bridge cap
- Bridge

- With a thickness gauge kept inserted, tighten an adjusting screw of the bridge lightly and make sure that the tip of the adjusting screw touches the end of valve axis and the movement of the thickness gauge has become tight.

- Then, check if the end of the valve axis on the opposite side is unstable or hits diagonally. If so, loosen the bridge adjusting screw a little so that the end of the valves on both sides may touch properly.

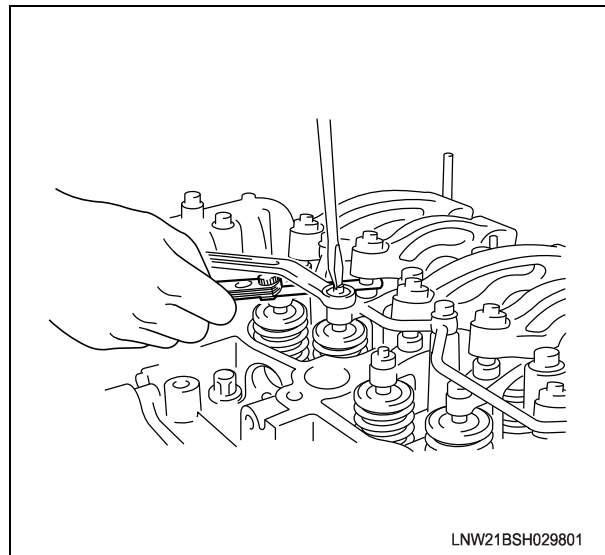
Valve bridge clearance: ± 0.1 mm (0.0039 in) or less

- After making an adjustment so that the end of the valves on both sides may touch properly, tighten up an adjusting screw nut of the bridge with a minus driver so that the bridge adjusting screw may not rotate.

Tightening torque: 22 N·m (16 lb ft)

Caution:

If the adjusting screw of the bridge is poorly adjusted, the bridge would tilt and be pushed down and seized, which may damage the bridge guide, for example. Thus, adjust it accurately.



Tightening torque:

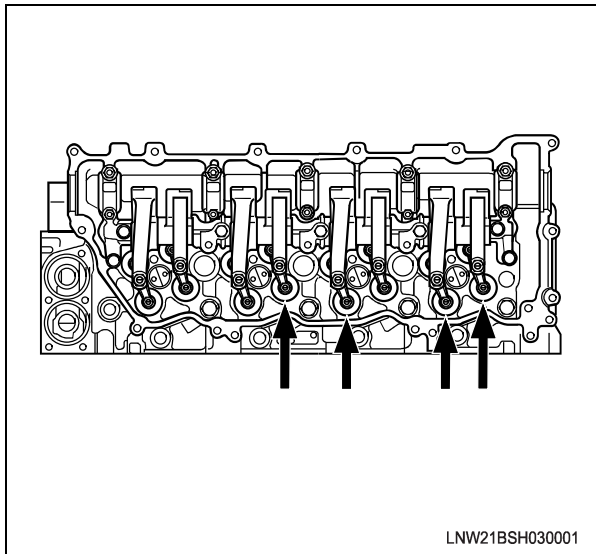
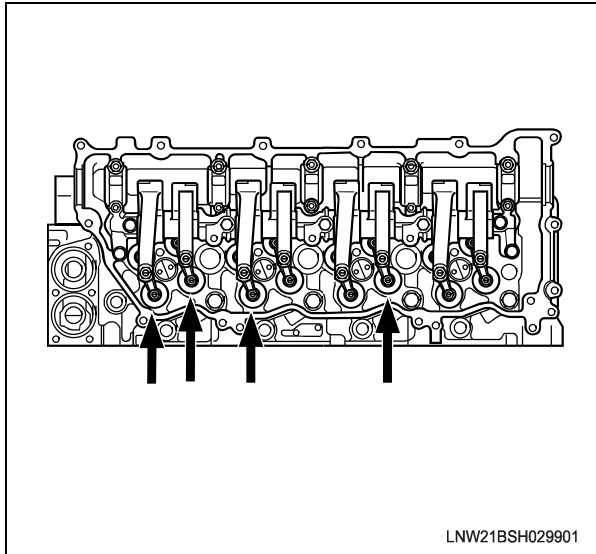
Rocker arm adjustment Screw nut 22 N·m (16 lb ft)

Bridge adjustment Screw nut 22 N·m (16 lb ft)

Adjustment table

Cylinder No.	1		2		3		4	
Valve arrangement	IN	EX	IN	EX	IN	EX	IN	EX
No. 1 cylinder Compression TDC	○	○	○			○		
No. 4 cylinder Compression TDC				×	×		×	×

- If the No. 1 cylinder is the compression TDC, adjust a valve clearance with ○ mark given on the table and if the No. 4 cylinder is the compression top dead center, that with × mark.



- Attach the harness assembly to the fuel injector.
Tighten the harness bracket with the designated torque.

Tightening torque: 48 N·m (35 lb ft)

- Attach the terminal nuts to the fuel injector.

Tightening torque: 2 N·m (17 lb in)

Notice:

- Tighten the terminal nuts alternately in order to prevent imbalance in tightening because they are unified.
- Do not tighten the nuts too tightly because it leads to damage to the terminal studs.

- Install the cylinder head cover.
Refer to the "cylinder head cover."

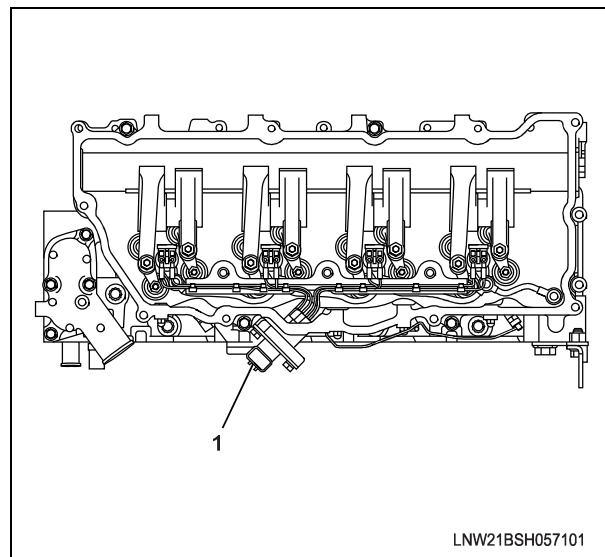
Compression pressure inspection

- Warm up the engine.
- Remove a minus terminal of the battery and remove all the glow plugs.
- Remove the harness connector for the fuel injector built on the lower head cover (no fuel will be injected).

Caution:

When the harness connector is removed, ECM judges that it broke down and DTC is recorded. Upon completion of measurement, never fail to clear memory of ECM.

(For how to clear memory of ECM, refer to the Engine Control System Section)



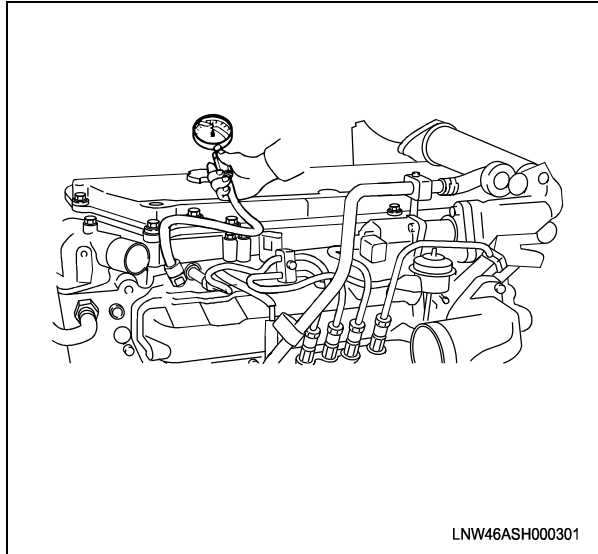
Legend

- 1. Fuel Injector Harness Connector

- Install the minus terminal of the battery.
- Turn on the starter to emit foreign matter within the cylinders.

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- Install an adapter and a gauge of a compression gauge of the special tool.



Compression gauge: J-26999-12
Gauge adapter: EN-46722

- Turn on the starter to inspect compression pressure.

Compression pressure	MPa(psi) / 200 rpm
Standard	2.84 – 3.24 (412 – 469)
Limit	1.96 (284)
Differences among the cylinders	294 kPa (43)

- Measure each cylinder one by one.

Caution:

To keep engine speed at 200 rpm or more, use fully charged batteries.

- Remove a compression gauge of the special tool.
- Remove a minus terminal of the batteries.
- Install a harness connector for the fuel injector built on the lower head cover.
- Install all the glow plugs.

Tightening torque: 20 N·m (15 lb ft)

- Install a minus terminal of the batteries.

A list of defective phenomena

- The engine does not revolve.
- The engine revolves, but does not start.
- Emits plenty of black exhaust.
- Emits plenty of white exhaust.
- The engine knocks.
- Defective revolutions of the engine
- Insufficient charging

Trouble Shooting**Engine does not turn over**

Condition	Possible Cause	Correction
Starter motor does not rotate	Dead or weak battery	Charge battery Replace battery
	Incomplete circuit	Connect Repair
	Starter motor brushes stuck, worn, or broken	Replace brushes
	Starter motor internal damage	Repair motor
Starter motor not meshed with flywheel	Ring gear abrasion	Replace ring gear
	Magnetic switch (starter motor) not properly adjusted	Adjust
Starter motor pinion meshed with ring gear but does not rotate	Dead or weak battery	Charge battery Replace battery
	Insufficient contact pressure between starter motor brushes and commutator	Adjust pressure
	Armature (starter motor) stuck	Repair armature
	Engine internal damage (Seizure)	Repair engine

Engine turns over but does not start

Condition	Possible Cause	Correction
Fuel is not delivered to fuel supply pump	Air in fuel system	Bleed air from fuel system
	Air entering fuel pipe	Replace pipe and bleed air from fuel system
	Empty fuel tank	Replenish fuel
	Clogged strainer (fuel suction)	Clean or replace strainer
	Clogged fuel pipe	Clean or replace pipe
	Feed pump malfunction	Replace pump
	Use of wrong fuel for prevailing temperatures	Drain existing fuel and replace with appropriate fuel
Fuel is delivered to fuel supply pump	Clogged fuel filter	Replace filter
	Loose injection pipe connections	Tighten connections
	Loose or broken electrical connectors	Tighten and/or replace connectors
	Bad rotational sensor	Replace sensor
Insufficient or unstable fuel delivery volume	Engine control system malfunction	System diagnosis
	Air in fuel system	Bleed air from fuel system
	Feed pump malfunction	Repair pump
	Loose or broken electrical connectors	Tighten and/or replace connectors
	Clogged fuel filter	Replace filter
Engine control system malfunction	System diagnosis	

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Excessive black exhaust smoke

Condition	Possible Cause	Correction
Bad injection timing	Engine control system malfunction	System diagnosis
Bad injection nozzle condition	Carbon deposit at nozzle tip	Clean nozzle tip
	Sticking nozzle	Replace fuel injector assembly
	Engine control system malfunction	System diagnosis
Insufficient compression pressure	Excessive valve clearance	Adjust clearance
	Sticking valve stem (valve open)	Repair or replace valve
	Damaged valve spring	Replace spring
	Valve seat abrasion	Repair valve seat
	Compression leakage due to damaged piston ring	Replace piston ring
	Damaged gasket	Replace gasket
	Piston scoring	Replace piston
Fuel condition	Water in fuel	Drain existing fuel and replace with new fuel
	Poor fuel quality	Drain existing fuel and replace with new fuel
Poor engine aspiration	Clogged intake pipes	Clean or replace pipes
	Clogged air cleaner element	Clean or replace element
Malfunction detected by engine control system	Defective sensor	Replace sensor
	Engine control system malfunction	System diagnosis
EGR valve and/or intake throttle valve malfunction	Intake throttle valve sticking	Repair or replace valve
	EGR valve sticking	Repair or replace valve
	Exhaust brake valve sticking	Repair or replace valve
	Engine control system malfunction	System diagnosis
Turbocharger malfunction	Damaged turbocharger fan	Replace turbocharger
	Rough turbocharger shaft rotation	Replace turbocharger
	Oil leakage from oil seal	Replace turbocharger
	Defective booster sensor	Replace sensor

Excessive white exhaust smoke

Condition	Possible Cause	Correction
Bad injection timing	Engine control system malfunction	System diagnosis
Malfunction detected by engine control system	Defective sensor	Replace sensor
	Control unit malfunction	Replace unit
	Engine control system malfunction	System diagnosis
Insufficient compression pressure	Excessive valve clearance	Adjust clearance
	Sticking valve stem (valve open)	Repair or replace valve
	Damaged valve spring	Replace spring
	Valve seat abrasion	Repair valve seat
	Compression leakage due to damaged piston ring	Replace piston ring
	Damaged gasket	Replace gasket
	Piston scoring	Replace piston