

Chapter I Introduction

Section I How to Use This Manual

1. Index

The content (index) of this manual will guide you to the item to be repaired. For the convenience of finding information, the title of each chapter is given at the header of the singular page.

2. Preparations

Preparations list the special service tools, special service materials, sealant and lubricating oil that should be prepared before operation and their functions.

3. Repair Procedures

Most repair processes begin with an overview illustration which identifies all parts and how they are disassembled and assembled (refitted) in sequence. For example, see Fig. 1-1-1 for the disassembly / assembly schematic diagram for the oil pump parts.

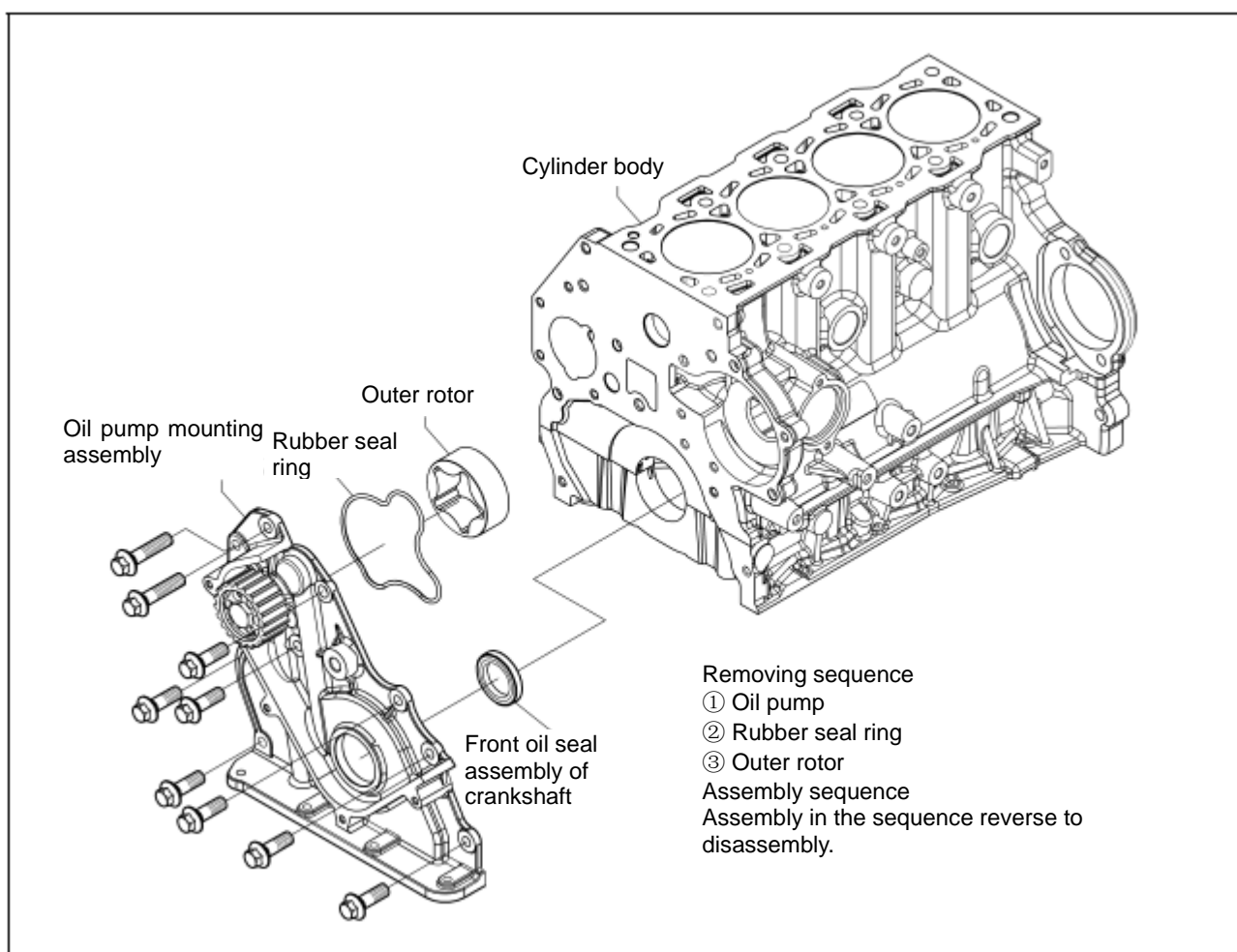


Fig. 1-1-1 Disassembly / Assembly Schematic Diagram for Oil Pump Parts

The repair procedure is introduced in the following sequence:



Chapter II Technical Information of Engine

Section I Structure of Engine

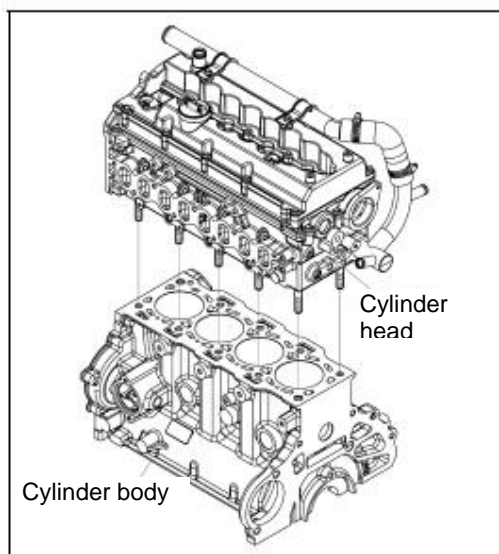


Fig. 2-1-1 Cylinder Head and Cylinder Body

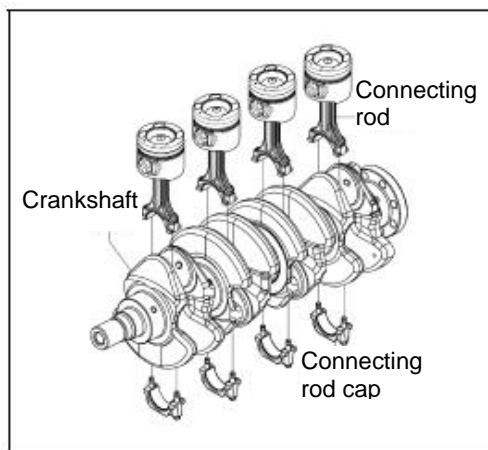


Fig. 2-1-2 Crank and Connecting Rod Mechanism

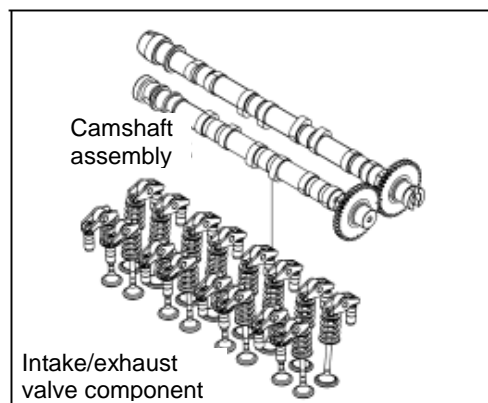


Fig. 2-1-3 Valve Actuating Mechanism

The diesel engine is a kind of complex machinery that transforms the thermal energy of fuel into mechanical power. Although there are various types of diesel engine with different structures, they all contain the following mechanisms and systems:

1. Cylinder head and cylinder body

For cylinder head and cylinder body, see Fig. 2-1-1.

The function of the cylinder head is to seal the upper part of the cylinder and make the upper part of the cylinder and piston crown constitute the combustion chamber. The cylinder head is mounted with the intake valve, exhaust valve, rocker arm, hydraulic lash adjuster, intake/exhaust camshaft assembly, oil injector, etc., and is laid with intake and exhaust pipelines, and cooling water jackets. The cylinder body constitutes the cylinder and is used to mount and support all mechanisms and systems of the diesel engine; it is the foundation and framework of the diesel engine.

2. Crank and Connecting Rod Mechanism

For the crank and connecting rod mechanism of engine, see Fig. 2-1-2.

The crank and connecting rod mechanism can accomplish the interconversion between the linear reciprocating motion of piston (in cylinder) and the rotation motion of crankshaft, and thereby output the propulsion produced by gas combustion through the crankshaft as the output power, and ensure the fulfillment of working cycles of the diesel engine. The crank and connecting rod mechanism mainly consists of the piston, connecting rod, crankshaft, flywheel, etc.

3. Valve Actuating Mechanism and Intake/Exhaust System

The valve actuating mechanism, intake and exhaust systems are as shown in Fig. 2-1-3, 2-1-4.

The functions of the valve actuating mechanism and intake and exhaust systems are opening and closing the intake valve and exhaust valve in time to ensure the cylinder to intake fresh and clean air as much as possible and discharge exhaust gas as clear as possible timely. It mainly consists of the valve components (the intake and exhaust valve, valve pin/clip, valve spring, spring seat, valve oil seal, etc.), transmission mechanism (the belt, pulley, intake/exhaust camshaft assembly, rocker arm,



MAINTENANCE MANUAL OF GW4D20/GW4D20B TURBOCHARGED DIESEL ENGINES

			km)	
Tension pulley, accessory wedge idle wheel and flat idle wheel	Check, maintain		when replacing the belt, replace the tension pulley subassembly, accessory wedge idle wheel and flat idle wheel depending on the their conditions	Replace the tension pulley after changing the belt twice
Water pump			Check the water leakage of overflow	
Electrical appliance			Check wiring, engine and starter	
Crankcase vent system (including intake pipeline)			Check, wash	

Note: ① When the vehicle travels in a severe condition, traveling distance and time for replacing the oil filter are: per 5000 km or per 100 h.

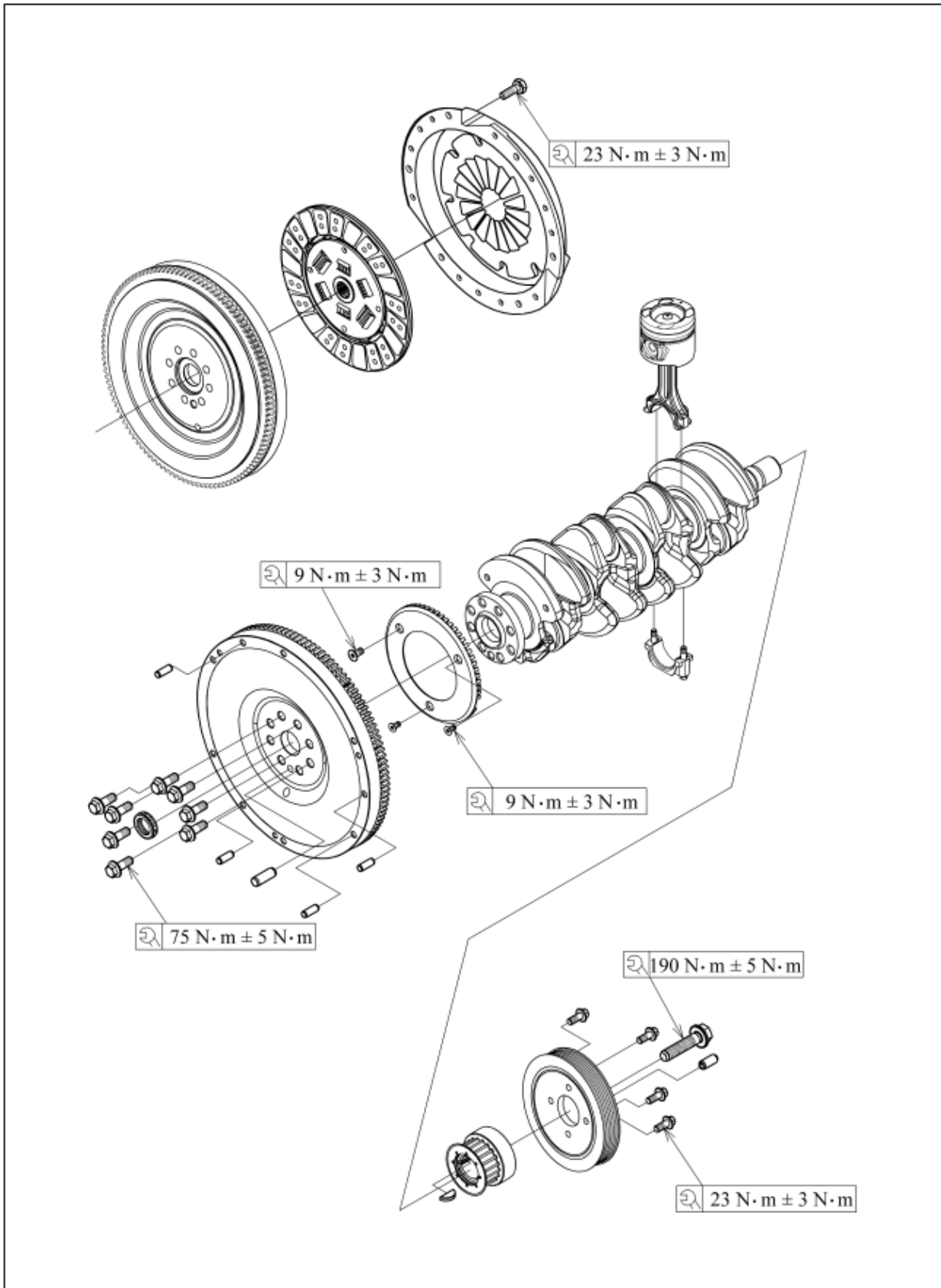
② If the diesel used contains impurities, the cycle for replacing the fuel filter should be shortened. If the fuel filter is blocked by impurities, the fuel filter should be replaced in time.

(continued)

Maintenance cycle	Daily technical maintenance	First level maintenance	Second level maintenance	Third level maintenance	Remarks
Maintenance Items		4000 ~ 5000 km	10000 ~ 12500 km	50000 ~ 100000 km	
Washing the cooling system				Wash the cooling system	
Washing the engine				Wash the carbon deposit, oil stains, incrustation, oil duct, oil pipe.	
Piston ring				Inspect for wear	Depending on the working condition of engine
Cylinder inner wall				Inspect for wear	
Connecting rod bearing shell				Inspect for wear	
Main shaft bearing shell				Inspect for wear	
Camshaft timing driving gear				Inspect for wear	
Thrust plate				Inspect for wear	
Intake/exhaust valve				Inspect for wear	



8. Crankshaft Flywheel and Clutch Mounting Assembly



 **Caution:**

- (1) It is not allowed to stop the diesel engine immediately or add coolant abruptly when the diesel engine is overheating. Reduce the throttle and let the engine run with no load; stop the engine for further inspection when the temperature of coolant in the cooling system is low.
- (2) Do not remove the water filler cap while the diesel engine is still hot to prevent scalding. Take care when adding coolant.
- (3) If the reason for overheat can not be found and eliminated, contact the service station or the repair factory, otherwise, it may cause damage to other parts.

10. Malfunction of the Diesel Engine Turbocharging System

Phenomenon and Cause of Malfunction		Troubleshooting
Insufficient power	<ul style="list-style-type: none"> (1) Foreign materials in the oil depositing at the sealing area of the turbine side (2) Excessive engine oil temperature, insufficient oil supply, burning damage of the floating bearing (3) Blockage and deformation of the turbocharger oil return hose, leading to oil leakage from the turbo and the compressor shaft end (4) Damage and malfunction of the turbocharger sealing ring (5) Turbo shaft rotor out of balance (6) Friction and damage of the turbo blades and the compressor blades (7) Blockage of the air cleaner (too dirty) (8) Too much dirt in the air intake/exhaust pipes or leakage at the joint part (9) Bad performance or damage of the turbocharger 	<ul style="list-style-type: none"> (1) Replace the engine oil, it is recommended to use API CI-4 or better oil from Mobil Oil Corporation, overhaul the turbocharger. (2) Check the oil supply system; overhaul the turbocharger. (3) Repair or replace the fuel return hose. (4) Replace the turbocharger sealing ring. (5) Replace the turbocharger assembly. (6) Replace the turbocharger assembly. (7) Maintain the air cleaner; replace the filter core. (8) Wash, overhaul or replace the air intake and exhaust pipe components. (9) Overhaul or replace the turbocharger.
High fuel consumption	<ul style="list-style-type: none"> (1) Too much dirt in the air intake/exhaust pipes or leakage at the joint part (2) Bad performance of the turbocharger (3) Wear of the piston ring 	<ul style="list-style-type: none"> (1) Overhaul the air intake and exhaust pipes or replace the damaged parts. (2) Wash, adjust or replace the turbocharger. (3) Check or replace the piston ring.



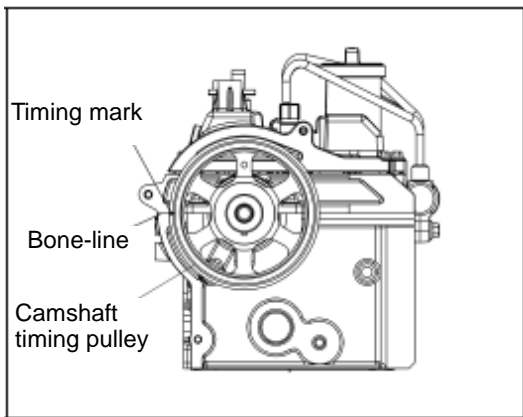


Fig. 4-1-42 Installing the camshaft timing pulley

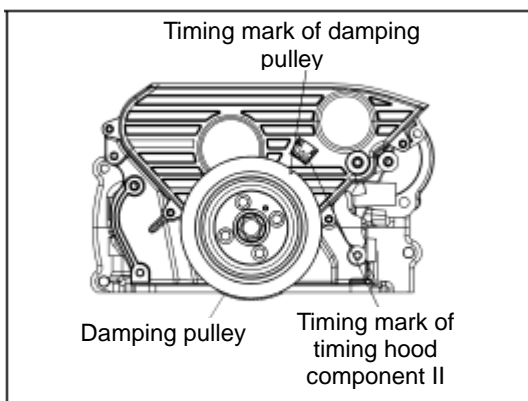


Fig. 4-1-43 Installing the timing system

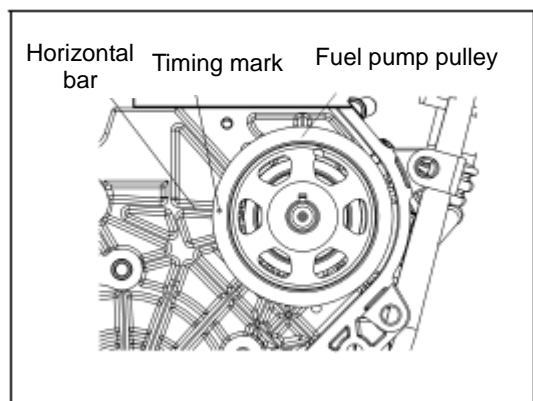


Fig. 4-1-44 Installing the timing system

Reinstalling the fuel inlet pipes of fuel injector and fuel rail ③

(1) Remove the dust cap from the upper end of the fuel injector. Install the fuel inlet pipe for the fuel injector, and tighten evenly the pipe connectors at both ends of the 4 fuel pipe as per the specified torque, as shown in Fig. 4-1-41.

(2) Install the fuel inlet pipe of fuel rail, and tighten the pipe connectors at both ends of the fuel pipe to the specified torque. See Fig. 4-1-41.



Tightening torque for fuel inlet pipe connector of fuel injector and fuel rail

32 N·m±3 N·m



Attention: Tighten the pipe connectors at both ends of the fuel injector fuel inlet pipe and ends of the fuel rail fuel inlet pipe simultaneously and evenly during installation so as to avoid pipe deformation.



Make sure the fuel inlet pipe of fuel injector and fuel rail is sealed without leakage after installation.

Reinstalling the timing system ②

(1) Install the woodruff key to the exhaust camshaft, install the timing pulley to the exhaust camshaft and tighten the fastening bolt washer component to the required torque. The camshaft timing pulley should be pressed and installed to the right position without deflection.

(2) Adjust the scale mark on camshaft timing pulley to align it with the joint (at exhaust side) between cylinder head and camshaft bearing cap. See Fig. 4-1-42.



Tightening torque for bolt washer component of camshaft timing pulley

110 N·m±5 N·m

(3) Align the timing marks on damping pulley and timing hood II. See Fig. 4-1-43.

(4) Align the timing mark on the fuel pump pulley with the horizontal bar on the water pump housing. See Fig. 4-1-44.

(5) Install the timing belt. During the installation, make sure the belts, except the timing tension pulley, are connected with the pulley firmly without any looseness. See Fig. 4-1-45.

(6) Install the timing tension pulley. Fix the limit bracket of the timing tension pulley in the place where the bowl



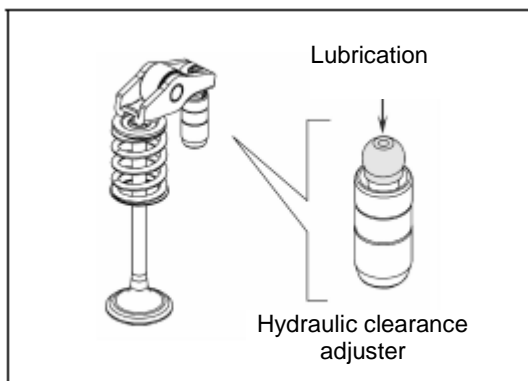


Fig. 4-5-34 Installing the hydraulic clearance adjuster and rocker arm

⚠ Attention: Check the cylinder head bolt before installation and replace it when there is any deformation, stretching or thread slipping.

(4) Reinstall the hydraulic adjuster and rocker arm.
 —Coat the ball head of the hydraulic clearance adjuster with an appropriate amount of lubricating oil. See Fig. 4-5-34.

—Fix the ball head of the hydraulic clearance adjuster into the clip at the rear of rocker arm. Make sure the tappet will not fall off after the installation.

—Coat the surfaces of the rocker arm and the hydraulic clearance adjuster with lubricating oil again, and then insert the whole part into the corresponding hole on the cylinder head, with the other side of the rocker arm overlapping on the valve. See Fig. 4-5-34.

Mobil API CI-4 lubricating oil

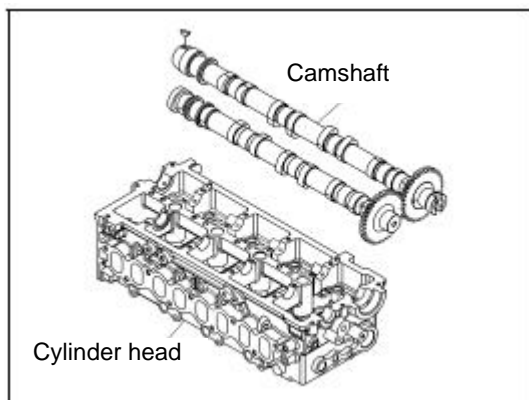


Fig. 4-5-35 Installing the exhaust/intake camshaft

(5) Reinstall the intake and exhaust camshafts.
 —Install the intake and exhaust camshafts into the cylinder head. See Fig. 4-5-35.

—Align the marks “.” on the driving gears of exhaust and intake camshafts and get them in line with the upper surface.

Axial clearance of camshaft

Standard	0.060~0.0115mm
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(6) Reinstall the camshaft bearing cap.
 —Apply the anaerobic plane sealant to the junction surface between the camshaft bearing cap and the cylinder head.

LOCTITE 510 anaerobic plane sealant

—Screw down the 16 hexagon flange face bolts (M6×35) fastening the camshaft bearing cap as per the specified order and torque, and then screw down the 6 hexagon flange face bolts (M6×20) around them according to the requirements. See Fig. 4-5-36.

Tightening torque for fastening bolt of camshaft bearing cap

9N·m±3N·m

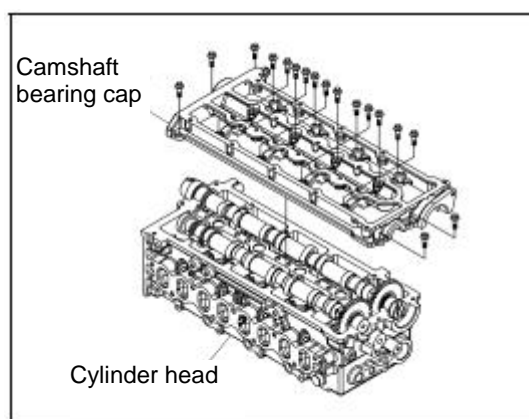


Fig. 4-5-36 Installing the camshaft bearing cap

(7) Reinstall the vacuum pump assembly.
 —The vacuum pump is installed at the rear of exhaust camshaft. The flat bump on the shaft should be



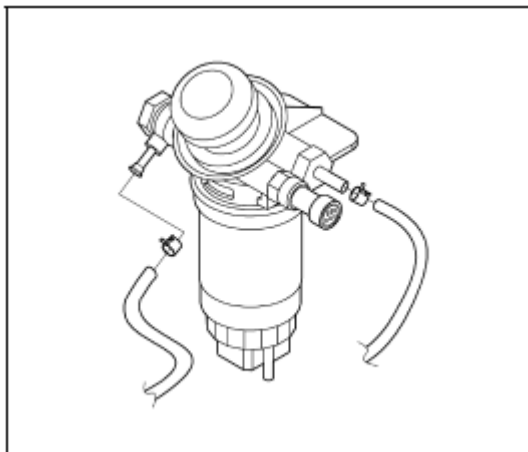


Fig. 5-2-8 Removing the fuel hose

Removing the fuel hose ⑥

- (1) Remove the clamp that fixes the fuel inlet hose and the fuel return hose.
- (2) Remove the fuel inlet hose and the fuel return hose respectively, as shown in Fig. 5-3-8.

! The fuel hose should be added with a label before being removed, for the purpose of easy recognition upon the latest connection.

Removing the wire of engine oil pressure switch ⑦

Remove the wire connector that connects the engine oil pressure switch.

! **Warning:** Pull the plug connector instead of the harness (the wire) when separating the connector.

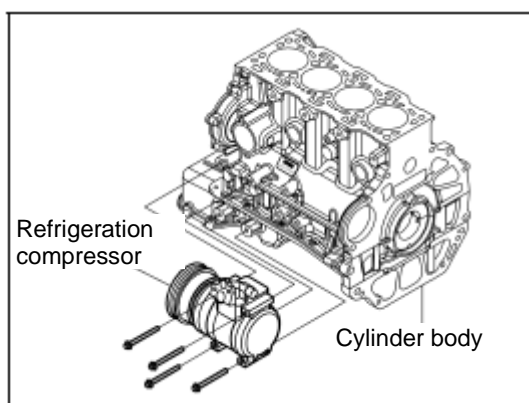


Fig. 5-3-9 Removing the refrigeration compressor assembly

Removing the refrigeration compressor assembly ⑧

- (1) Turn the accessory tension pulley with tools until the generator belt is loose enough, and then remove the generator belt.
- (2) Remove the wire connector of electromagnetic clutch.
- (3) Remove 4 hexagon flange bolts (M8x85) fastening the refrigeration compressor to the left side of the cylinder body, and take off the refrigeration compressor assembly. See Fig. 5-3-9.

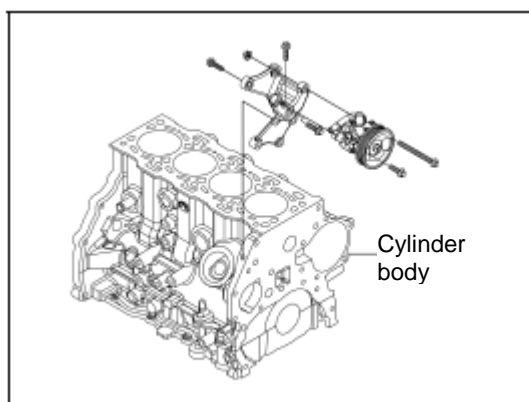


Fig. 5-3-10 Removing the power steering pump assembly

Removing the power steering pump assembly ⑨

- (1) Remove the fuel inlet hose and the fuel return hose of the power steering pump.
- (2) Remove 1 hexagon flange nut and 1 hexagon flange bolt (M8x30) fastening the power steering pump to the bracket of power steering pump, and then take off the bracket of power steering pump. See Fig. 5-3-10.
- (3) Remove 3 hexagon flange bolts (M8x25, M8x30) fastening the bracket of power steering pump to the cylinder body, and then take off the bracket of power steering pump. See Fig. 5-2-10.

Section XX Cylinder Body Assembly

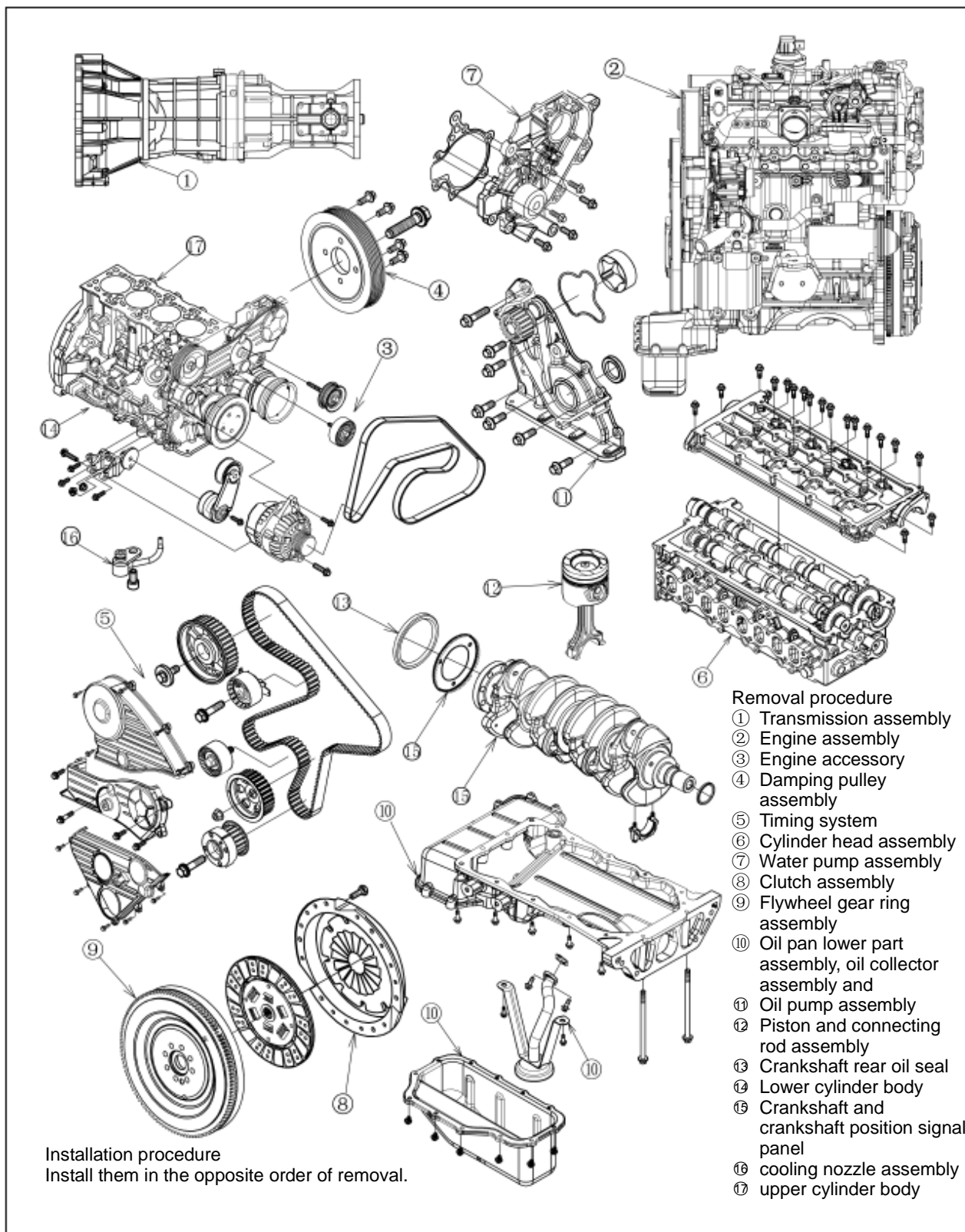


Fig. 5-20-1 Cylinder Body Assembly Removal Procedure



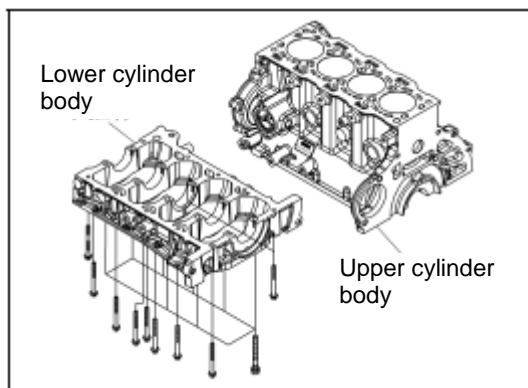


Fig. 5-20-16 Removing the lower cylinder body

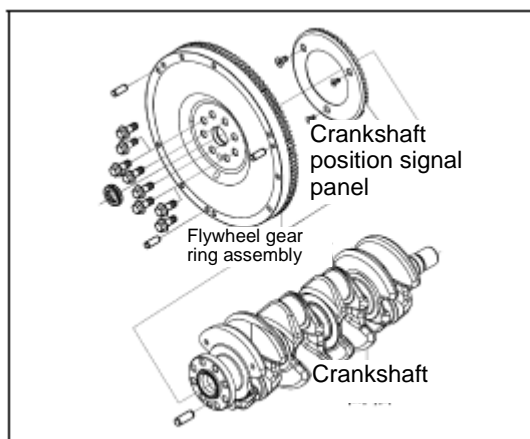


Fig. 5-20-17 Removing the crankshaft and the crankshaft position signal panel

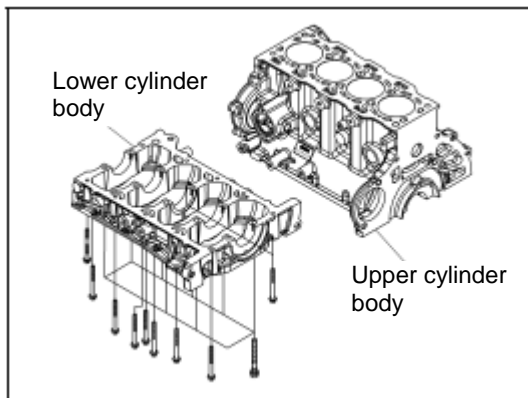


Fig. 5-20-18 裝配上缸體 Fig. 5-20-18
Installing upper cylinder body

head screws (M6×12) fastening the signal panel and remove the panel from the rear end of the crankshaft. See Fig. 5-20-17.

Removing the cooling nozzle assembly ⑩

(1) Remove the 4 hexagon socket mushroom head screws (M6×12) fastening the cooling nozzle and remove the 4 cooling nozzles from the upper cylinder body.

⚠ Attention: When removing it, do not bump the head of the cooling nozzle.

(2) Keep the cooling nozzle properly after removing it to avoid pollution and bumping.

Removing the upper cylinder body ⑪

(1) Remove the thermostat cover, the thermostat and the thermostat shield from the upper cylinder body.

(2) Remove the water drain bolt, the crankshaft position sensor and the oil pressure alarm from the right side of the upper cylinder body.

(3) Check the wearing condition of the wall of the cylinder bore and replace the upper and lower cylinder bodies if the condition is worse than that required.

↔ Installation

Installing the upper cylinder body ⑫

(1) Install the oil return pipe assembly. After applying a small amount of sealant to the oil return pipe installing position, beat it into the corresponding hole on the upper cylinder body with a hand hammer.

(2) Install the positioning sleeve to the corresponding position on the cylinder body.

(3) Install the turbocharger oil return pipe connector to the upper cylinder body after applying a small amount of sealant to the connector.

(4) Install the 2 Ø18mm bowl-shaped plugs to the main oil duct of the cylinder body after applying a small amount of sealant to them.

📦 The new 1608 bowl-shaped plug sealant can be used.

(5) Install the crankshaft position sensor and the engine oil pressure alarm to the right side of cylinder body.

(6) Installing the water drain bolt

Apply anaerobic thread lock sealant to the thread of the water drain bolt. Install the water drain bolt into the mounting screw hole on the cylinder body and tighten it

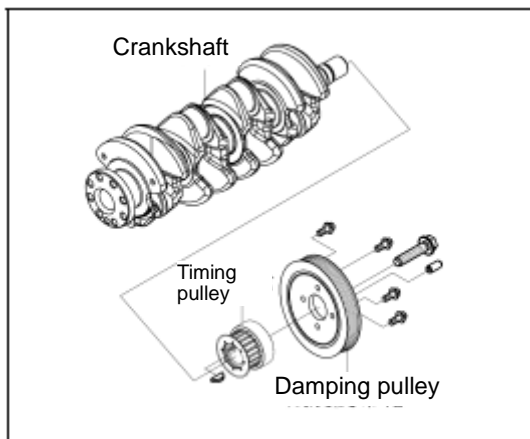


Fig. 5-20-49 Installing the damping pulley assembly

the cylinder head and the front end of the cylinder body according to specified torques.

Tightening torques for fastening bolts of the timing hood and the timing hood components I and II

M6	9N·m±3N·m
M10	45N·m±3N·m

Installing the damping pulley assembly④

(1) Install the elastic cylindrical spring pin into the pin hole of the crankshaft timing belt pulley.

(2) Align the damping pulley pin holes, install the damping pulley to the front end of crankshaft, and screw down 4 hexagon flange bolts (M8×20) as per specified torque. See Fig. 5-20-49.

Tightening torque for fastening bolt of damping pulley

23N·m±3N·m

Attention: After the assembly, the timing mark of the damping pulley should be set forward.

Installing the engine accessories ③

(1) Install the steering pump support.
 (2) Install the engine bracket and the engine assembly. See Fig. 5-20-60.

(3) Install the accessories such as the flat idle wheel assembly and the wedge idle wheel.

(4) Install the tension pulley.

Installing the engine assembly ②

(1) Use a crane to evenly place the engine to the frame mounting position with the engine hook attached to the crane. See Fig. 5-20-51.

(2) Tighten the 2 fixing nuts connecting the left and right brackets of the engine with the frame studs. See Fig. 5-20-52.

Tightening torques for fastening nuts of the engine bracket

95N·m±10N·m

(3) Install the power steering pump, the refrigerating compressor and the generator belt.

(4) Install the front exhaust pipe.

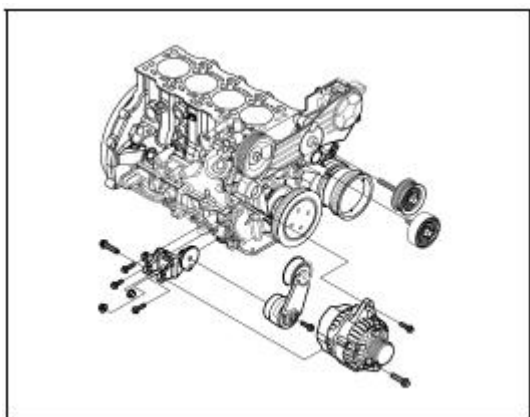


Fig. 5-20-50 Installing the engine accessories

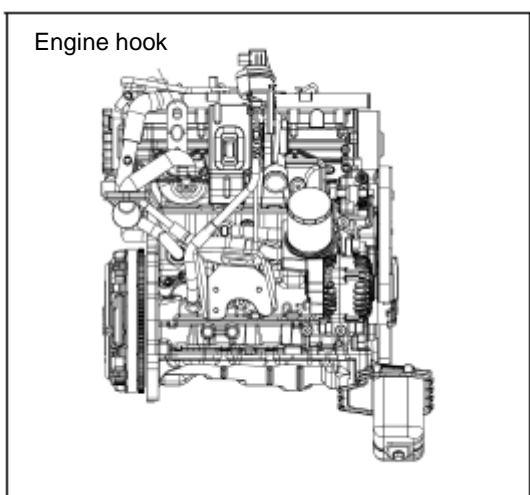


Fig. 5-20-51 Installing the engine assembly





Fig. 6-2-6 Alarm indicator lamp of fuel-water separator

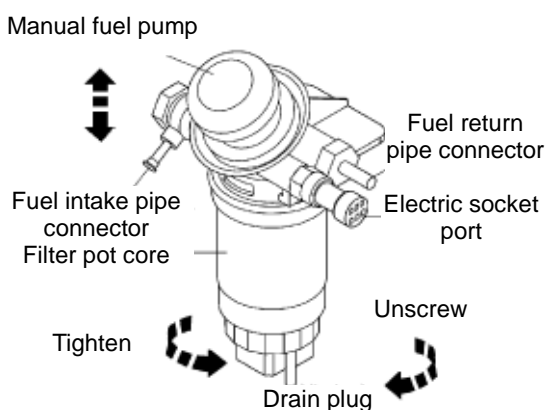


Fig. 6-2-7 Draining by using the fuel filter

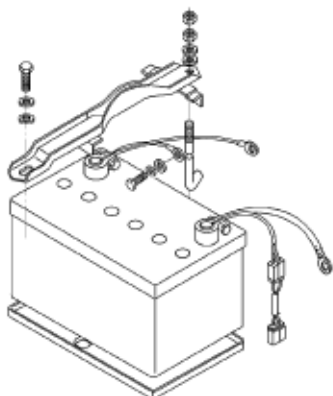


Fig. 6-2-8 Connecting the earthing cables of storage battery

(3) Install the fuel return pipe of high-pressure fuel pump.

(4) Start the engine. If the engine fails to start within 10 seconds, repeat the air release steps mentioned above.

(5) Ensure that no leakage of fuel exists, and tighten the cover of manual fuel delivery pump.



Draining

When water in the fuel-water separator reaches the required amount, the alarm lamp in cab instrument board will go on (see Fig. 6-2-6). At this time, the following steps for draining shall be obeyed:

- (1) Stop the vehicle at a safe and flat place.
- (2) Open the engine hood and put the container (capacity: 0.2 L) at the drain pipe end below the fuel-water separator drain plug.
- (3) Loosen the drain plug. The tightening and loosening directions for drain plug are the same with those for common bolts. See Fig. 6-2-7.
- (4) Operate the manual fuel delivery pump to drain repeatedly until the fuel-water separator is full of fuel.
- (5) Tighten the drain plug after draining.
- (6) Operate the manual fuel delivery pump repeatedly and check whether any fuel leakage is present.
- (7) Start the engine, ensure that no fuel leaks out from the drain plug, and meanwhile check whether the alarm indicator lamp goes out.



Attention: The fuel used does not accord with the requirements, if the operation of draining are frequently needed. If the accumulated water exists in the fuel tank, the fuel tank shall be sent to the service station for the purpose of draining.

After installation, perform the following steps:

- (1) Connect the earthing cables of storage battery. See Fig. 6-2-8.
- (2) Start the engine and check the fuel system for normal working.



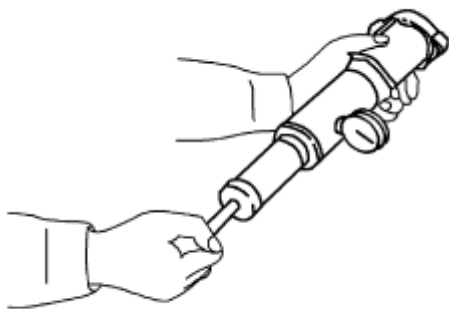


Fig. 7-2-32 Determining the opening pressure of Pressure Valve for radiator cap

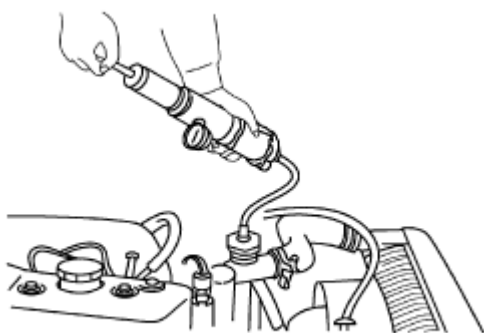


Fig. 7-2-33 Checking the coolant leakage

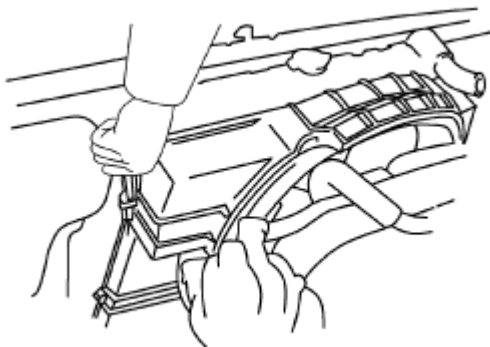


Fig. 7-2-34 Installing the radiator assembly

replaced.

Opening pressure of vacuum valve:

12.8~17.0 kPa

2. Checking the Radiator Core

(1) The deformation of radiator fins will lower the effect of heat dissipation and causes the overheat to the cooling system. Level the radiator fins, but do not damage the roots of radiator fins.

(2) Remove all dust and other foreign matters from the radiator core.

3. Rinsing the Radiator

Rinse the radiator inside and the coolant passage by the water and neutral cleaning solution. Remove all incrustation and scale.

4. Checking the coolant leakage

Send the compressed air with a pressure of 196.9 kPa from the radiator filling hole into the radiator inside by using the radiator cap tester, and check the cooling system for leakage. See Fig. 7-2-33.



Tester for the radiator filler cap: 5-8840-2036-0



Installation

Installing the radiator assembly ⑤

(1) Install the radiator assembly which has some hoses. See Fig. 7-2-34.

(2) Use the specified torque to tighten the bolts connecting the radiator with the upper support.



Tightening torque for the fastening bolts of radiator:

23 N•m ± 3 N•m



Caution: Do not let the fan vanes scratch the radiator core during the installation.

Installing the radiator fan ④

(1) Install the radiator fan to the radiator, and tighten the fastening bolts by the specified torque. See Fig. 7-2-35.



Tightening torque for the fastening bolts of radiator fan:



Section II On-board Maintenance

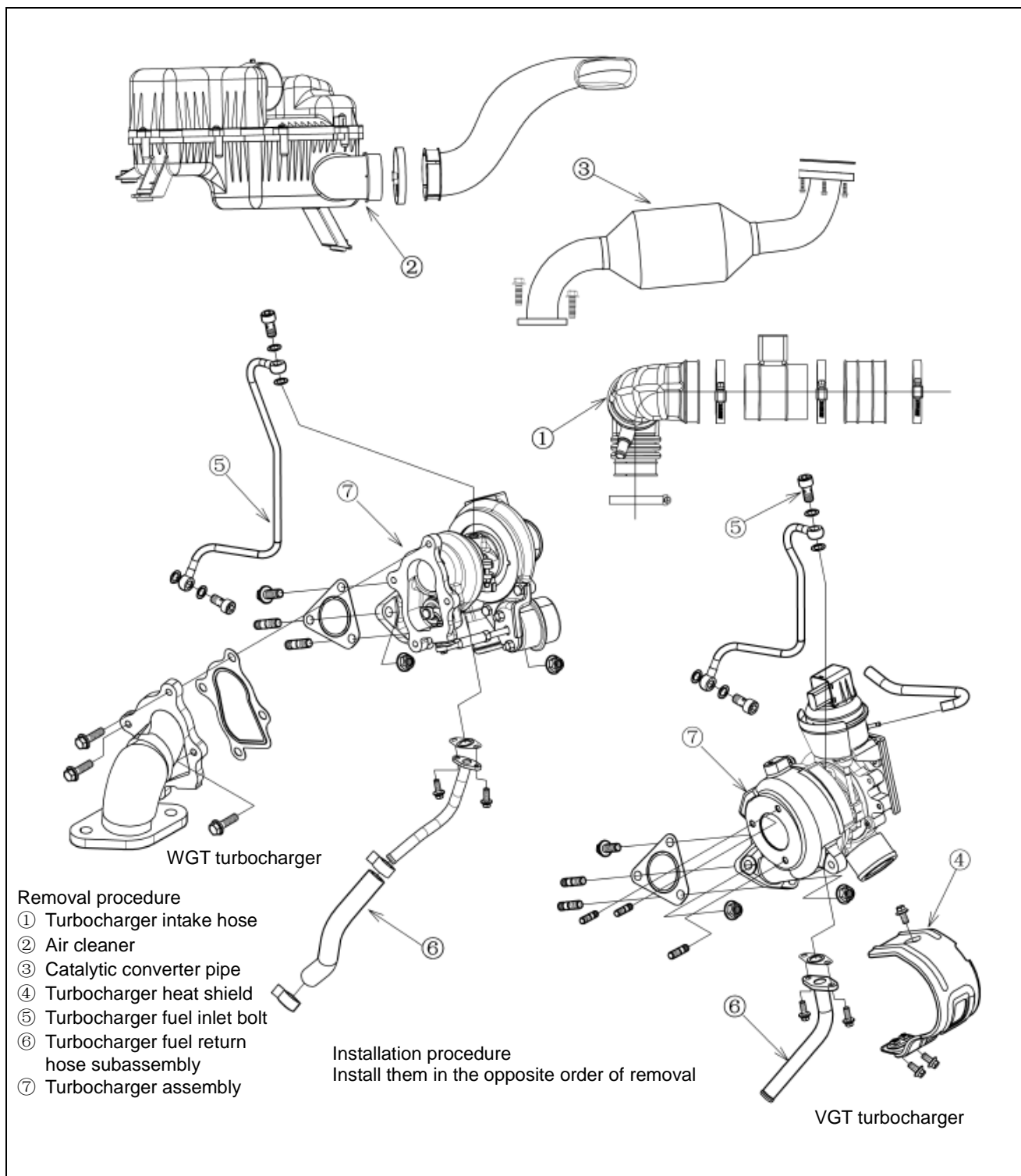


Fig. 9-2-1 Removal and installation procedures of the turbocharging system



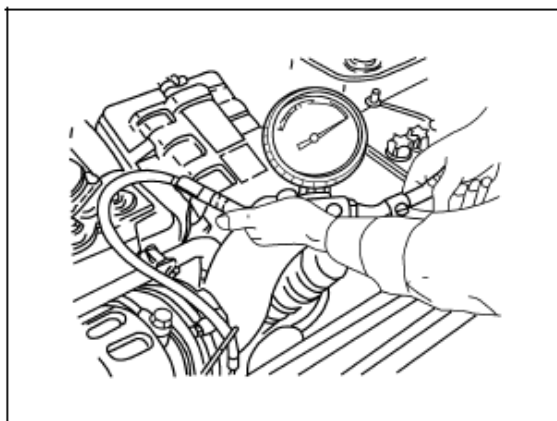


Fig. 9-3-2 Checking the working condition of the turbocharger

2. Checking the working condition of the turbocharger

Check whether the pressure for moving the control rod for 2 mm is within the following limit value.

Working pressure of the control rod

About 0.118Mpa

For the turbocharger maintenance, please contact with the “Great Wall Baoding Internal Combustion Engine Manufacturing Company Limited” service station.

The following standard value and limit value for the important axial clearance and bearing clearance of the impeller shafts are for reference only.

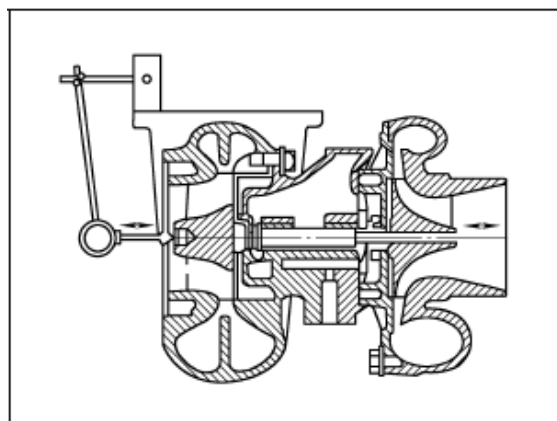


Fig. 9-3-3 Measuring the axial clearance of the impeller shaft

3. Checking the axial clearance of the impeller shaft.

Measure the axial clearance of the impeller by dial indicator. See Fig. 9-3-3. Apply a 0.12N force on the gas compressor impeller and the turbine impeller alternately.

Axial clearance of the impeller shaft

Standard value	Limit value
0.06 ~ 0.09mm	0.11 mm

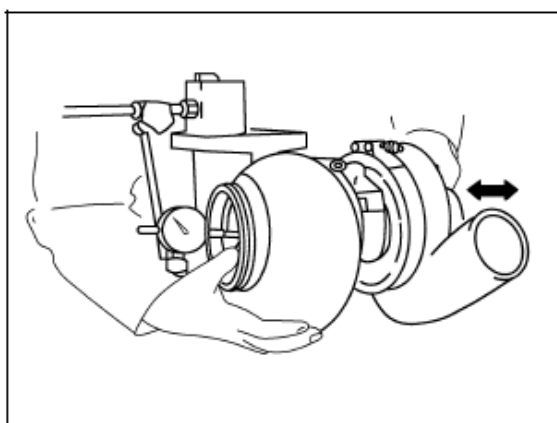


Fig. 9-3-4 Checking the turbocharger

4. Checking the axial clearance of the rotor

During the inspection, fix the magnetic base on the turbine housing outlet flange surface to connect the dial indicator to the turbine rotor shaft end face, and then push or pull the turbine rotor axially. The measured difference value is the axial clearance value.

Rotor of the new turbocharger

Axial clearance	0.01 mm
Operation limit	≤0.25mm

When the axial clearance of the turbocharger rotor exceeds the operation limit, please disassemble the assembly and replace the wearing parts.

