

FOTON TUNLAND

2017 Workshop Manual



FOTON



ENGINE MECHANICAL

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ENGINE MECHANICAL SYSTEM PRECAUTION

1. Read this manual carefully before preceding with any service, to avoid unnecessary loss caused by improper operation.
2. During servicing, follow the procedure described in the manual to avoid technical errors and ensure safety and efficiency.
3. Before the servicing, prepare a fire extinguisher in a specified place if necessary, for emergency use.
4. Before the servicing, the mechanic shall wear necessary protective shoes, gloves and goggles, to ensure personal safety.
5. Before the servicing, ensure the vehicle is properly protected, such as the protective covers for seating, steering wheel, floor and engine compartment.
6. Before lifting the vehicle, check whether the lifting system is working properly, whether the vehicle is appropriately parked and whether the connection points between the lifting arm and the vehicle are optimally adjusted. Before lifting or lowering the vehicle, ensure the space beneath the vehicle is clear.
7. If any fuel/power shutdown or pressure discharge is required during the servicing, follow the standard procedures. For example, disconnect the fuel system and release the pressure before removing the fuel rail, or disconnect the battery negative cable before removing the electrical parts. Or it may cause vehicle damage or personal injury.
8. Once the pipe or fitting is disconnected, make proper protection to prevent contamination or foreign objects from entering.
9. When servicing the interior of the engine, follow the specified procedure and carefully handle with the fragile parts.
10. Use the specified torque, sequence, direction or angle when tightening the bolts and nuts, without exceed force.
11. During engine overhaul, such as the inspection on crank, pistol and cylinder head, thoroughly clean and lubricate the parts before installation.
12. When servicing the engine, if it is necessary to clear the previous sealant before installing the oil tray, ensure the sealant interface is even and smooth, install a new seal gasket and apply a proper amount of sealant.
13. Check the battery grounding polarity (negative grounding in this diesel engine).
14. Do not adjust the electronic throttle pedal , or it may change the closing angle of the throttle valve and the engine may not work properly.
15. Do not pull up the injector cable when the engine is running. In any case, cylinder failure will cause burning corrosion by injecting the unburnt mixture into the postprocessing preheat diesel oxidation catalyst. If necessary, remove the postprocessing preheat diesel oxidation catalyst.
16. Use the engine oil with rated grade and velocity. Otherwise it will exacerbate engine wear.

- engine wear.
- 17 . **Use the original or authorized engine parts, or will damage the engine or cause operating defects.**
 - 18 . **Grind a new engine proper as required. During grinding, do not engage in sudden acceleration or heavy-duty operation.**



15-2 ENGINE MECHANICAL - ENGINE MECHANICAL SYSTEM

- 19 . **When the engine is working, in particular under high speed or high load, do not turn the ignition switch off suddenly. Allow it to run 3-5 minutes at low speed before stopping, to ensure even radiation.**
- 20 . **Sealant is widely used across the engine. It is designed to provide sufficient sealing. Pay special attention to the volume, location and interface of the sealant. Insufficient application will cause leakage, while excessive application or spillover will block or narrow the water or oil channel. Therefore, it is important to apply the sealant properly.**
- 21 . **If necessary, gently knock the parts with a wooden/rubber hammer or similar tool, in order to damage the sealant interface. Or slightly insert a flat, smooth and thin sealant scraper into the interface, without damaging it.**
- 22 . **Clear the surface with a sealant scraper or wire brush. Ensure the surface is even and smooth, free of grease and impurities. Remember to remove the sealant in the assembly holes and threaded holes.**
- 23 . **Evenly apply the sealant across the specified diameter around the assembly hole. Remove the soft sealant. Install it to the specified position within 15 minutes, when the sealant is wet. During installation, do not apply the sealant onto any unnecessary position. After installation, wait for the hardening process of the sealant, which will take about 1 hour. Do not grease or wet the applied surface or start the engine during the period.**



ENGINE MECHANICAL - ENGINE MECHANICAL SYSTEM

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DEFECTS

Defect	Possible Cause	Recommended Solution
Engine does not start	Battery (low voltage)	Check battery and replace it if necessary
	Battery cable (loose or corroded)	Clean battery and tighten connection
	Faulty starter	Check starter and replace it if necessary
	Faulty oil injector	Check oil injector and replace it if necessary
	No oil in the fuel tank	Check fuel tank and fill up fuel if necessary
	Fuel filter blocked, contaminated fuel system	Clean fuel system and replace fuel filter
	Faulty fuel pump	Check fuel pump and replace it if necessary
	Timing pulley (skipped tooth)	Reinstall or replace it
	Other electrical parts are faulty	Check the electrical parts and replace them if necessary
Engine idle rough	Air filter blocked	Replace air filter and clean air filter housing
	Leakage of the intercooler and intercooler pipe	Check the intercooler and intercooler pipe
	Fuel filter blocked, contaminated fuel system	Clean fuel system and replace fuel filter
	Leakage of intake manifold	Clean intake manifold, intake manifold gasket, crankshaft vent hose
	Leakage of turbocharger	Check turbocharger and replace it if necessary

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	Faulty electronic throttle valve	Check electronic throttle valve and replace it if necessary
	Faulty the fuel injector	Check harness and replace the fuel injector if necessary
	Other electrical parts are faulty	Check the electrical parts and replace them if necessary
Engine loss of power	Faulty turbocharger and turbocharger actuator	Check the turbocharger and turbocharger actuator and replace them if necessary



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ENGINE MECHANICAL - ENGINE MECHANICAL SYSTEM

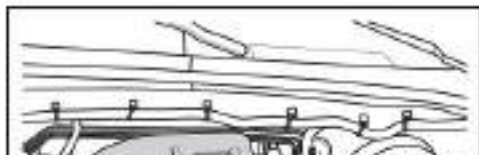
Defect	Possible Cause	Recommended Solution
	Fuel filter blocked, contaminated fuel system	Clean fuel system and replace fuel filter
	Incorrect valve timing	Reinstall and adjust toothed timing belt
	Cylinder gasket leakage	Replace cylinder gasket
	Cylinder pressure (low)	Measure cylinder pressure and overhaul if necessary
	Valve not airtight	Check valve and valve seat and replace them if necessary
	Postprocessing preheat diesel oxidation catalyst (DOC) blocked	Replace high qualified fuel and replace postprocessing preheat diesel oxidation catalyst (DOC)
	Postprocessing Diesel Particulate Filter (DPF) blocked	Replace high qualified fuel and replace postprocessing Diesel Particulate Filter (DPF)
	Pipe leakage of the fuel system	Check fuel system
	Poor performance of fuel injector	Replace fuel filter, clean injector and replace it if necessary
	Exhaust system blocked	Check exhaust system
	Air inlet system insufficient	Check air inlet system
	Faulty the fuel pump	Check the fuel pump
	Other electrical parts are faulty	Check the electrical parts and replace them if necessary



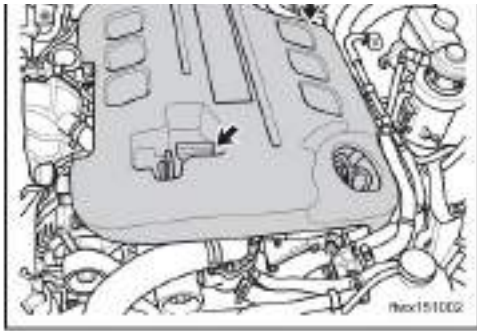
ENGINE ASSEMBLY REPLACEMENT

CAUTION

- Before disassembling the engine assembly, drain up all the fluids in the engine and disconnect the harness, pipe fittings and connections between the engine and the body.
 - Before disconnecting all harness and pipes, mark them properly to prevent mismatching or missing harness and pipes during installation.
 - Once a fitting is disconnected, seal the opening to avoid foreign objects from entering.
 - All drained fluids must be collected and handled as required. Keep the site clean and neat.
1. Discharge the pressure in the fuel system. (Refer to "Chapter 12 Fuel - fuel system, precaution")
 2. Disconnect and take out the positive and negative battery cables. (Refer to "Chapter 20. Starting & charging - battery, replacement")
 3. Drain the engine oil. (Refer to "Chapter 05 Vehicle maintenance - Replacement, engine oil and oil filter replacement")
 4. Drain the coolant. (Refer to "Chapter 05 Vehicle maintenance - Replacement, coolant replacement")
 5. Collect the refrigerant. (Refer to "Chapter 61. heating & A/C - refrigerant, replacement")
 6. Drain up the hydraulic oil in the power steering tank.



7. Screw out the engine fuel cap, and pull out the engine hood.

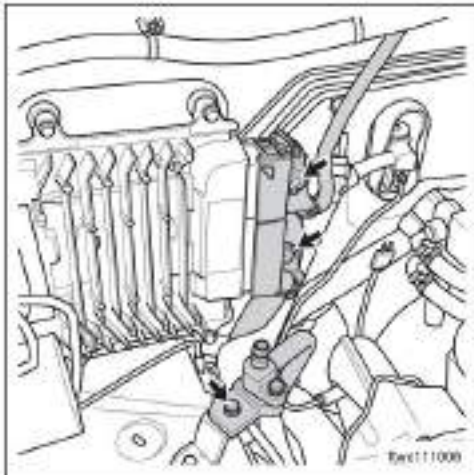


8. Disconnect the harness connector and the grounding harness:



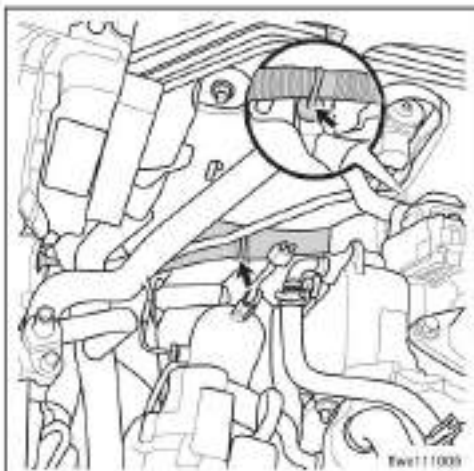
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ENGINE MECHANICAL - ENGINE ASSEMBLY

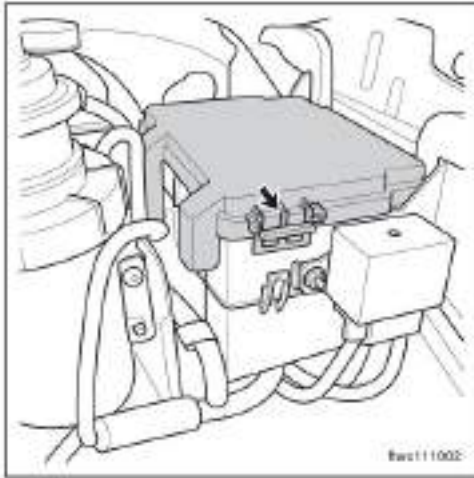


- (a) Screw out the fixing bolt of the A/C pipe, and remove the pipe.
- (b) Disconnect the ECM connector at the rear right of the engine compartment.

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- (c) Remove the fixing buckle of the ECM harness and the body.



- (d) Open the engine compartment fuse box cover.

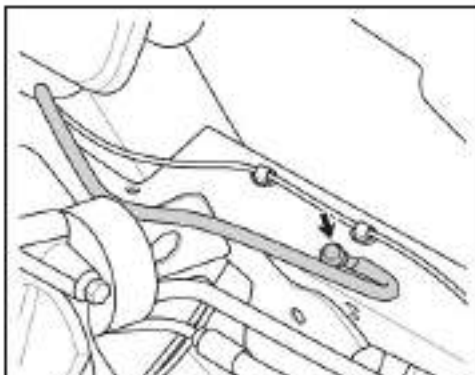


ENGINE MECHANICAL - ENGINE ASSEMBLY

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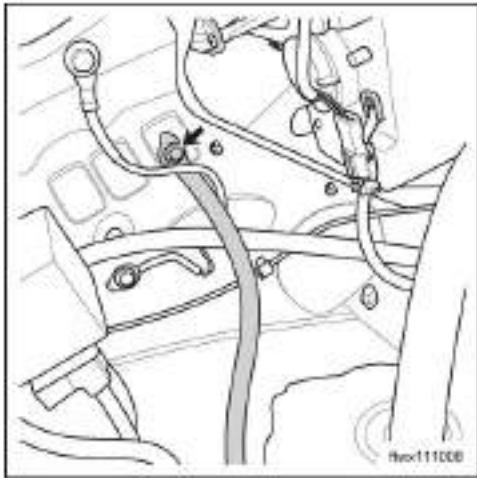


- (e) Disengage the connector of the engine harness and the engine hood fuse box cover.



- (f) Screw out the harness grounding fixing bolts, and disengage the connection between the harness and the body.

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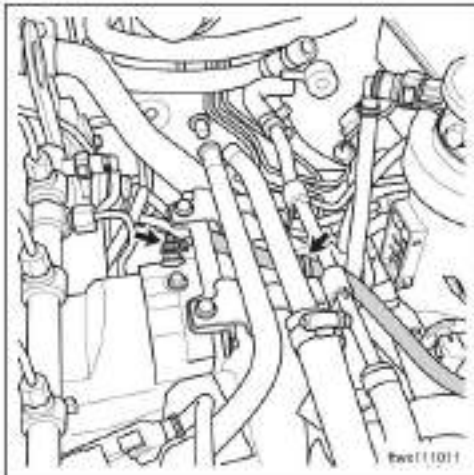


- (g) Screw out the harness grounding fixing bolts, and disengage the connection between the harness and the body.



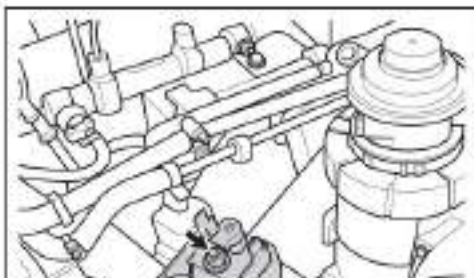
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ENGINE MECHANICAL - ENGINE ASSEMBLY

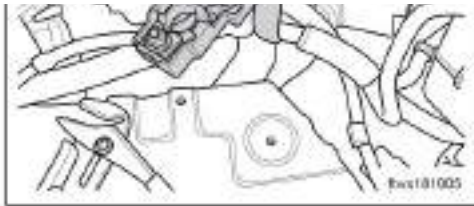


- (h) Screw out the harness fixing nuts, disengage the connection of harness and intake heater.
 (i) Disconnect fixing buckle of the harness and the heating water hose bracket.

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- (j) Screw out the harness fixing nuts, and disengage the connect of harness and battery positive pole.



- (k) Disconnect the fixing of harness and body bracket.

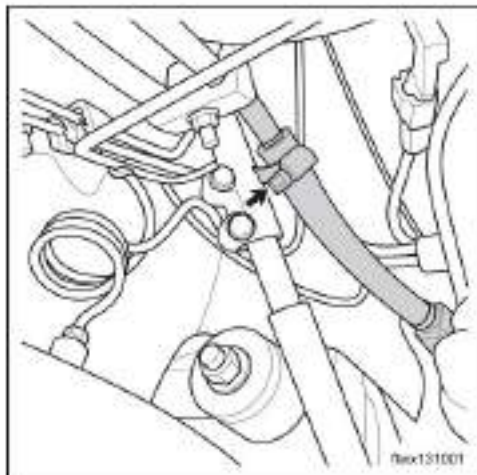
9 . Disconnect the pipe fitting:

- (a) Remove the intake air pipe. (Refer to "Chapter 14 Intake Air - Intake air pipe, replacement")



ENGINE MECHANICAL - ENGINE ASSEMBLY

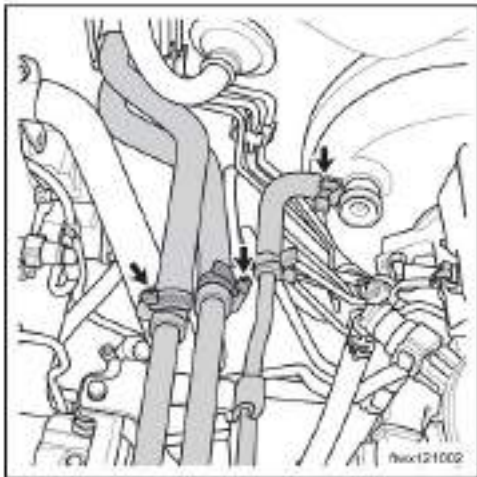
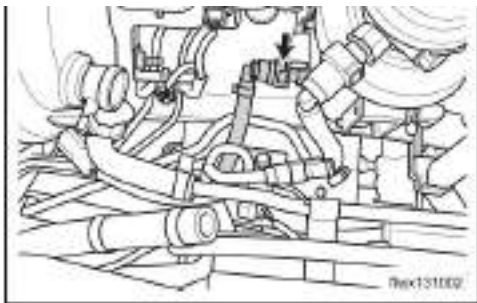
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- (b) Loose the fixing clamp, and pull out the fuel return pipe.



- (c) Press the fuel pipe clip, and pull out the fuel pump inlet pipe.

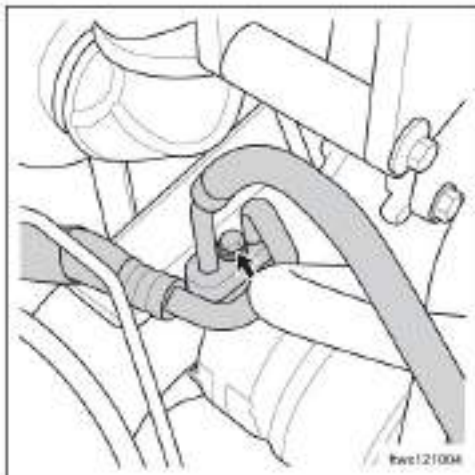


- (d) Remove the fixing clip, and remove the vacuum booster hose.
- (e) Screw out the fixing clamp, and pull out heating air inlet pipe and outlet pipe.



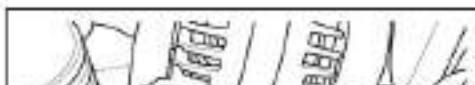
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ENGINE MECHANICAL - ENGINE ASSEMBLY

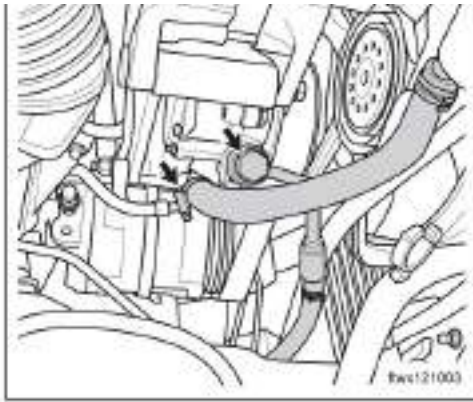


- (f) Screw out the fixing bolts of the A/C compressor pipe and disconnect the connection between the pipe and the A/C compressor.

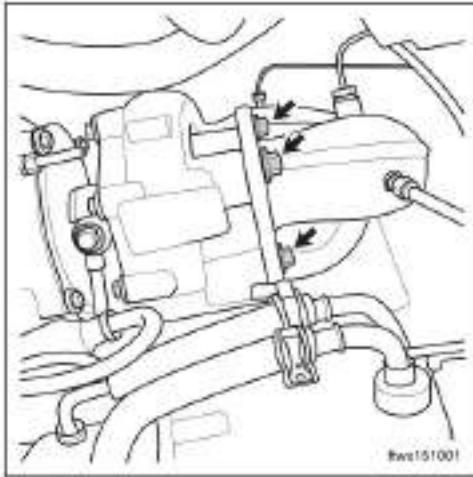
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- (g) Screw out the connecting bolt, remove the steering oil pump pipe.



- (1) Release fixing clamp, and disengage the connection between the steering oil pump pipe and the steering oil pump.



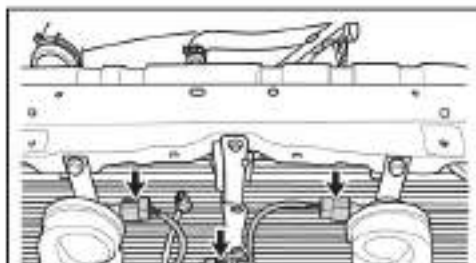
10. Screw out the fixing bolts of turbocharger and the catalyst converter assembly, and remove the gasket.

11. Remove the intercooler assembly. (Refer to "Chapter 14 Intake Air - Intake air pipe, replacement")
 12. Remove the electronic fan assembly. (Refer to "Chapter 17 Cooling - electronic fan, replacement")



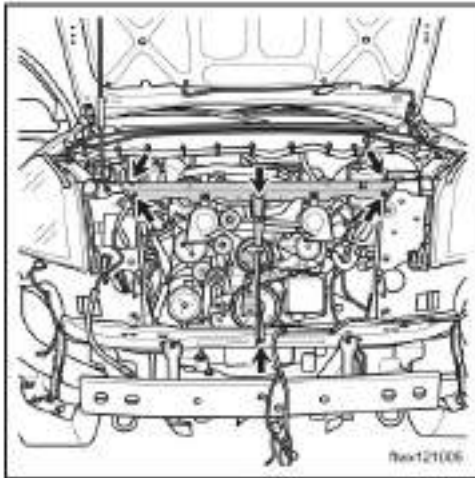
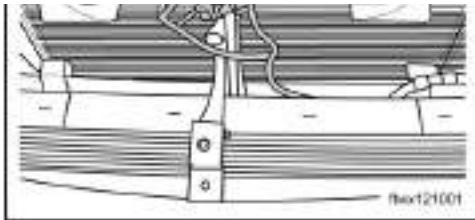
ENGINE MECHANICAL - ENGINE ASSEMBLY
15-11

13. Remove the radiator assembly. (Refer to "Chapter 17 Cooling - radiator, replacement")
 14. Remove condenser assembly. (Refer to "Chapter 61 heating & A/C - condenser, overhaul")
 15. Remove the engine hood lock. (Refer to "Chapter 85 Door Lock - engine hood lock, replacement")



16. Disconnect the horn harness connector.
 17. Disconnect the outdoor temperature sensor connector.

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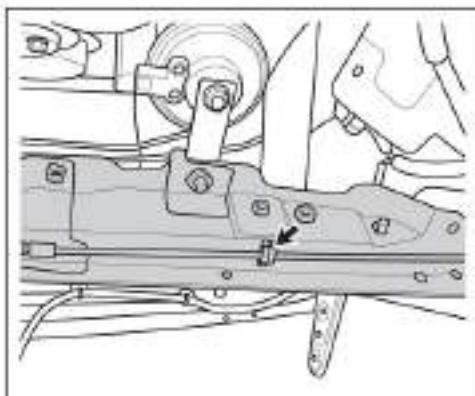


- 18 . Screw out the fixing bolts of the water tank upper beam and fixing plate.



15-12

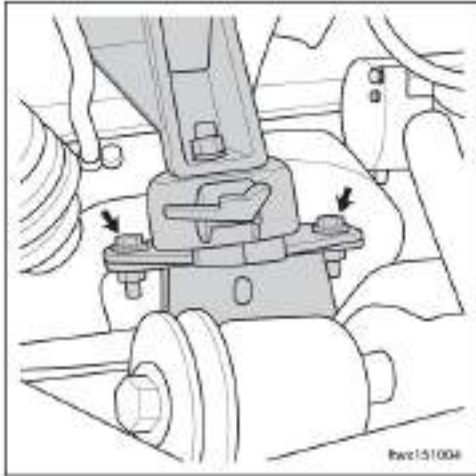
ENGINE MECHANICAL - ENGINE ASSEMBLY



- 19 . Remove the fixing clip of the water tank upper beam and the engine hood lock stay wire.



- 20 . Remove the transmission assembly. (refer to "Chapter 41 Transmission (JC538) - transmission assembly, Replacement).
- 21 . Fix the engine assembly with a tool.



- 22 . Spin out the power assembly left suspension fixing bolts and nuts .



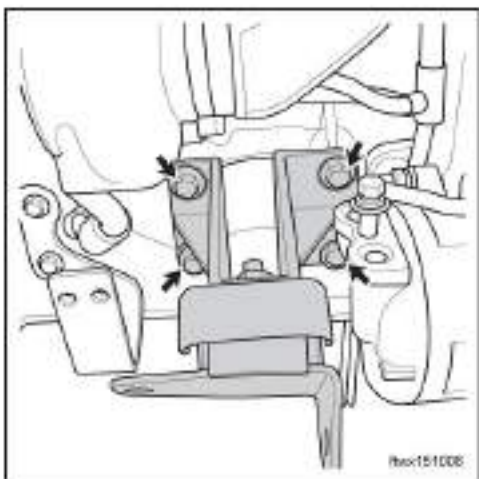
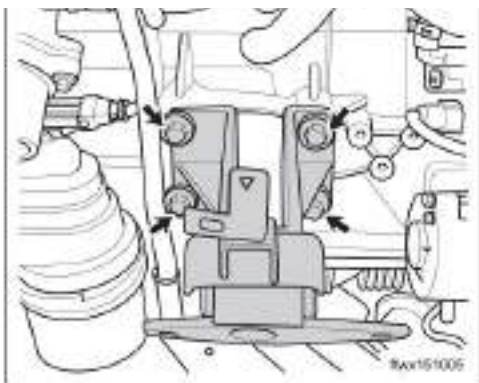
- 23 . Spin out the power assembly right suspension fixing bolts and nuts.



- 24 . Lift the engine assembly slowly , check the wiring harness between the engine and the body carefully and make sure the pipe connections are all disconnected, and remove parts that hinder engine lifting .
- 25 . Put the engine assembly on a clean place.
- 26 . Wrap off the pipe joint to avoid impurities.



- 27 . Screw out the fixing bolts, and take down the left suspension assembly.



- 28 . Screw out the fixing bolts, and take down the right suspension assembly.

- 29 . Remove the starter assembly. (Refer to "Chapter 20 Start & Charge - starter, overhaul")
- 30 . Remove the engine accessory belt. (Refer to "Chapter 15 Engine mechanical system - engine accessory belt, overhaul")
- 31 . Remove the engine assembly. (Refer to "Chapter 20 Start & Charge - starter, overhaul")
- 32 . Remove the steering oil pump assembly. (Refer to "Chapter 52 Power Steering -steering oil pump assembly, replacement")
- 33 . Remove the A/C compressor assembly. (Refer to "Chapter 61 heating & A/C - condenser, overhaul")
- 34 . Replace a new engine assembly.



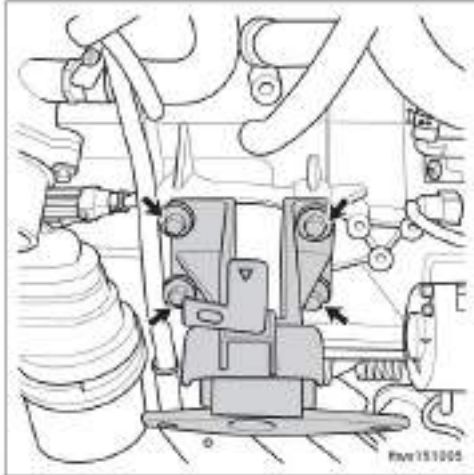
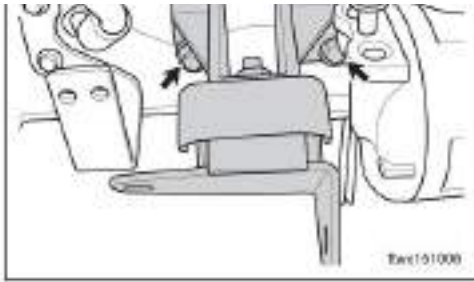
15-14

ENGINE MECHANICAL - ENGINE ASSEMBLY



- 35 . Install the right suspension assembly, tighten the fixing bolts.
Torque: 73-89N·m

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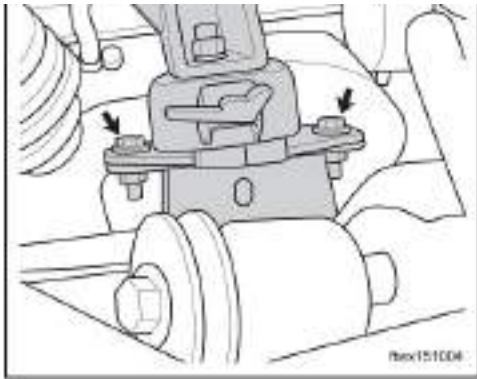


- 36 . Install the left suspension assembly, tighten the fixing bolts.
Torque: 73~89N•m**

- 37 . Install the engine assembly. (Refer to "Chapter 20 Start & Charge - starter, overhaul")**
- 38 . Install the A/C compressor assembly. (Refer to "Chapter 61 heating & A/C - condenser , overhaul")**
- 39 . Install the steering oil pump assembly. (Refer to "Chapter 52 Power Steering -steering oil pump assembly, replacement")**
- 40 . Install the engine accessory belt. (Refer to "Chapter 15 Engine mechanical system - engine accessory belt, overhaul")**
- 41 . Install the starter assembly. (Refer to "Chapter 20 Start & Charge - starter, overhaul")**
- 42 . Lift the engine assembly, fit into the engine compartment slowly, and remove parts that hinder engine lifting .**

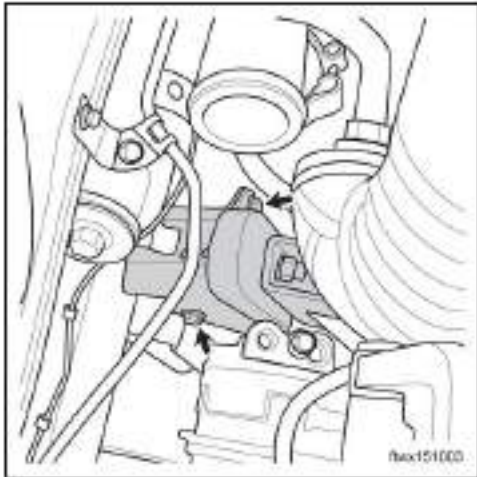


- 43 . Put the power assembly in place, tighten the left suspension fixing bolts and nuts.
Torque: 45~55 N•m**



- 44 . Tighten the right suspension fixing bolts and nuts.**

Torque: 45~55 N•m



- 45 . Refit the transmission assembly. (refer to "Chapter 41 Transmission (JC538) - transmission assembly, Replacement).**

- 46 . Install condenser assembly. (Refer to "Chapter 61 heating & A/C - condenser , overhaul")**



- 47 . Mount the fixing clip of the water tank upper beam and the engine hood lock stay wire.**

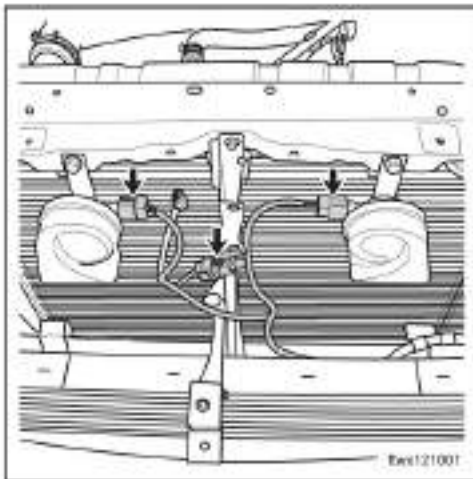


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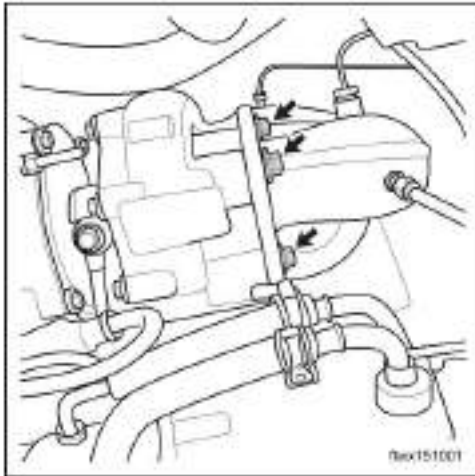
- 48 . Tighten the fixing bolts of the water tank upper beam and fixing plate .

- 49 . Install the radiator assembly. (Refer to "Chapter 17 Cooling - radiator, replacement")
- 50 . Install the electronic fan assembly. (Refer to "Chapter 17 Cooling - electronic fan, replacement")
- 51 . Install the intercooler assembly. (Refer to "Chapter 61 heating & A/C - condenser , overhaul")
- 52 . Install the engine hood lock. (Refer to "Chapter 85 Door Lock - engine hood lock, replacement")



- 53 . Install the horn harness connector.
- 54 . Install the outdoor temperature sensor connector



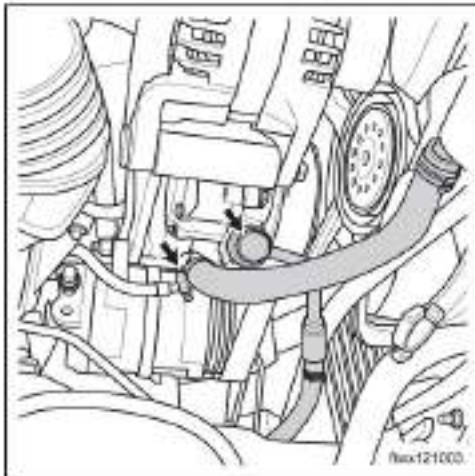


- 55 . Install a new gasket, Connect the turbocharger and the catalyst converter assembly, tighten the fixing bolts.**

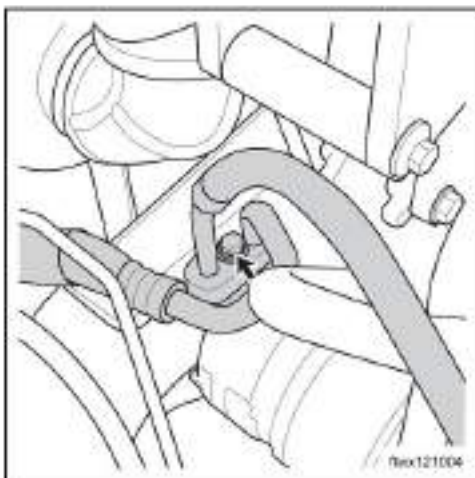
Torque: 41~51 N•m

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56 . Install the pipe joints.



- (a) Tighten the connecting bolt, install the steering oil pump pipe.
Torque: 33~42N•m
- (b) Tighten the connecting bolt, install the fixing clamp.



- (c) Install the A/C compressor pipe, tighten the fixing bolts.
Torque: 21~25N•m

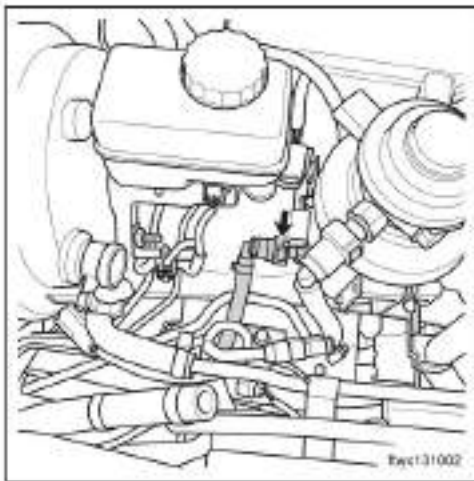
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ENGINE MECHANICAL - ENGINE ASSEMBLY

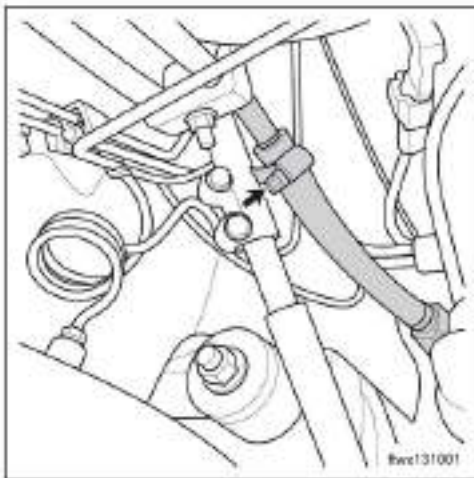
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- (d) Install the heating air inlet pipe and outlet pipe, tighten the fixing clamp.
- (e) Install the vacuum booster hose and the fixing clip.



- (f) Mount the fuel pump inlet pipe until you hear the click.



- (g) Install the fuel return pipe.

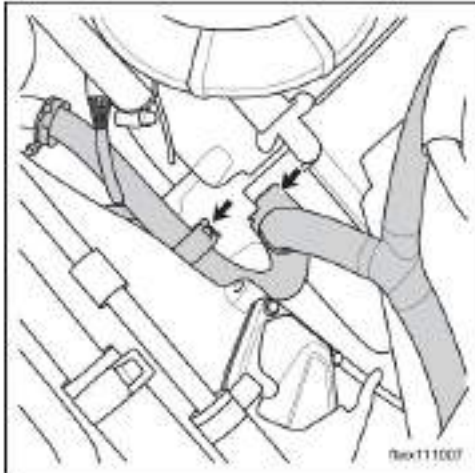
- (h) Install the intake air pipe. (Refer to "Chapter 14 Intake Air - Intake air pipe, replacement")

57 . Install the harness connector and the grounding harness:



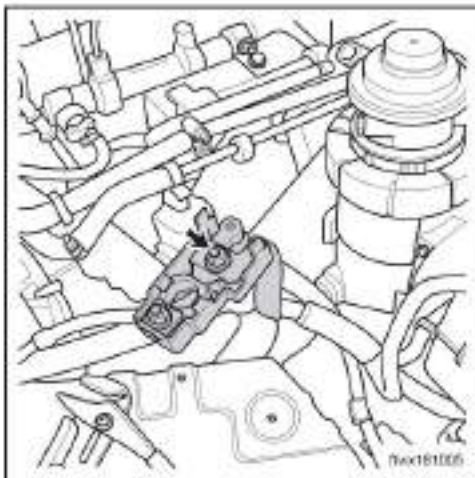
ENGINE MECHANICAL - ENGINE ASSEMBLY

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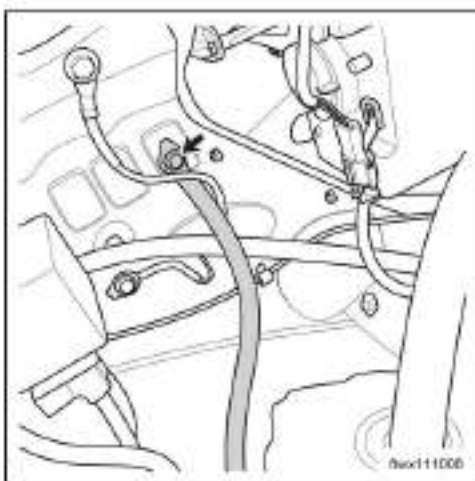


- (a) Mount the connection between the harness and the body bracket.

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- (b) Install the connect of the harness and battery positive pole , tighten the harness fixing nuts.
Torque: 9~11 N•m

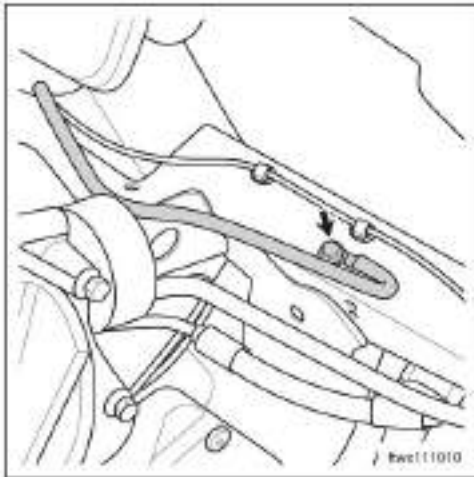


- (c) Connect the harness and the body, tighten the harness grounding fixing bolts.
Torque: 9~11 N•m



15-20

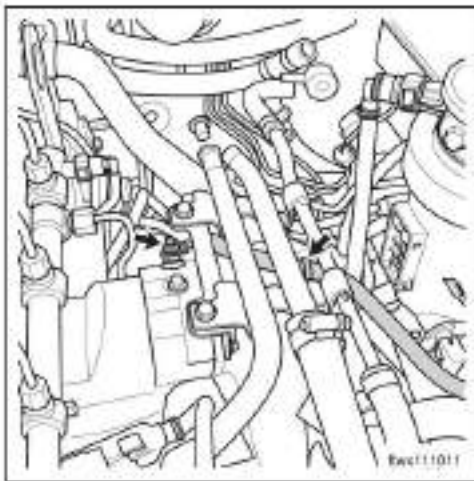
ENGINE MECHANICAL - ENGINE ASSEMBLY



- (d) Connect the harness and the body, tighten the harness grounding fixing bolts.

Torque: 21~25 N•m

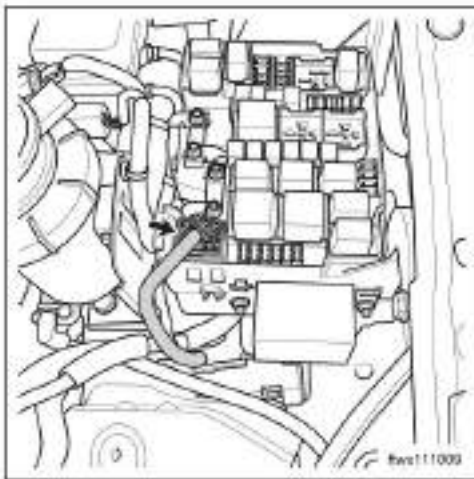
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- (e) Tighten the fixing nuts of harness and intake air heater.

Torque: 9~13 N•m

- (f) Install the fixing buckle of the harness and the heating water hose bracket.

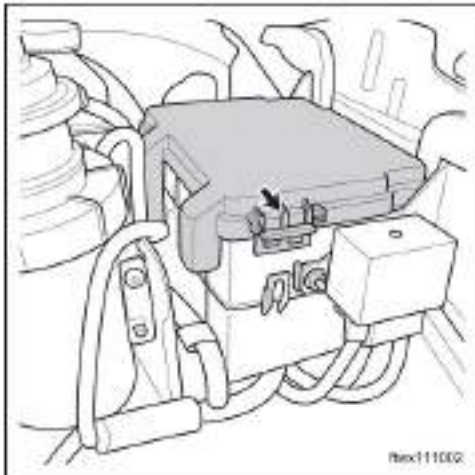


- (g) Install the connector of the engine harness and the engine hood fuse box.



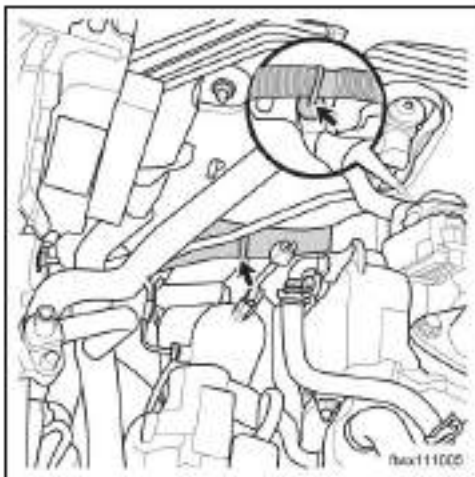
ENGINE MECHANICAL - ENGINE ASSEMBLY

15-21

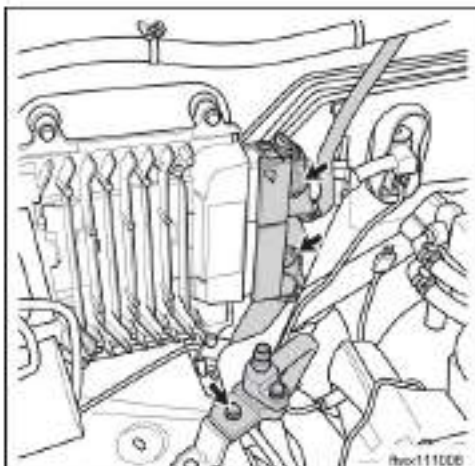


- (h) Install the engine compartment fuse box cover.

15



- (i) Install the fixing buckle of the ECM harness and the body.



- (j) Install the ECM connector at the rear right of the engine compartment.
 (k) Tighten the fixing bolt of the A/C pipe.

-
- 58 . Fill up the steering oil. (Refer to "Chapter 52 Power Steering -steering oil , replacement")
 - 59 . Fill up the refrigerant. (Refer to "Chapter 61 heating & A/C - refrigerant, replacement")
-

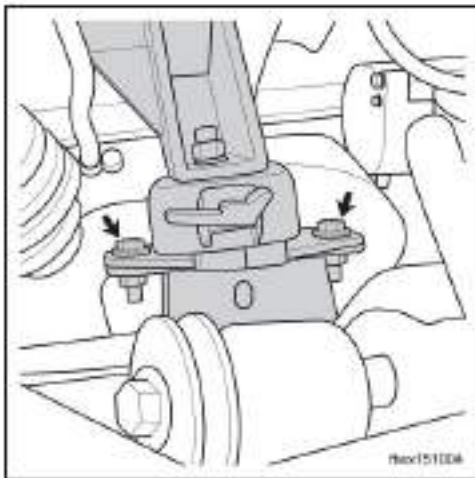
**15-22****ENGINE MECHANICAL - ENGINE ASSEMBLY**

- 60 . Fill up the coolant. (Refer to "Chapter 05 Vehicle maintenance - Replacement, coolant replacement")
- 61 . Fill up the engine oil. (Refer to "Chapter 05 Vehicle maintenance - Replacement, engine oil replacement")
- 62 . Install the battery assembly, and connect the positive and negative battery cables. (Refer to "Chapter 20. Start & charge - battery, replacement")



ENGINE MOUNTING REPLACEMENT (ENGINE MOUNTING CUSHION AND BRACKET)

1. Disconnect the positive and negative battery cables, and take it out. (Refer to "Chapter 20. Start and Charge - battery, replacement")
2. Hook the engine lug with a lifting device, straight chain and lift the engine assembly.



3. Spin out the power assembly left suspension fixing bolts and nuts.

15



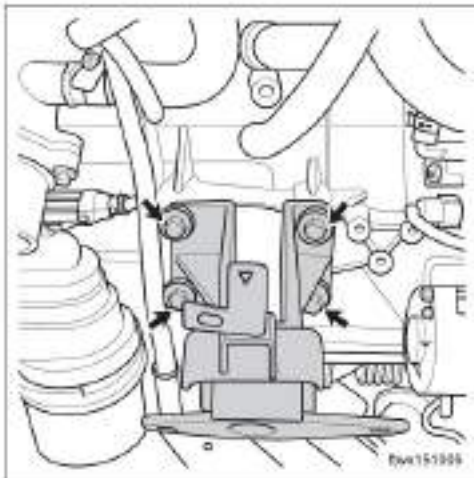
4. Spin out the power assembly right suspension fixing bolts and nuts.



15-24

ENGINE MECHANICAL - ENGINE MOUNTING

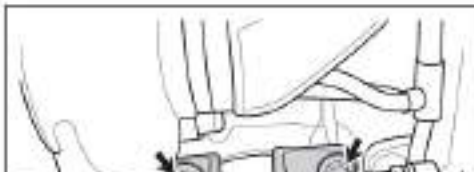
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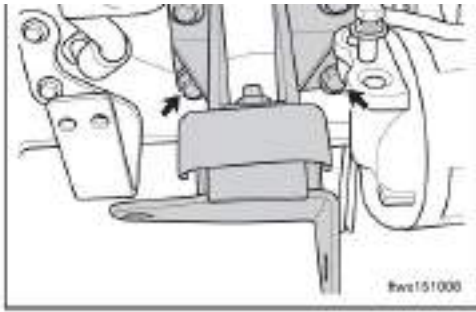
5. Screw out the fixing bolts, and take down the left suspension assembly.



6. Screw out the fixing bolts, and take down the right suspension assembly.

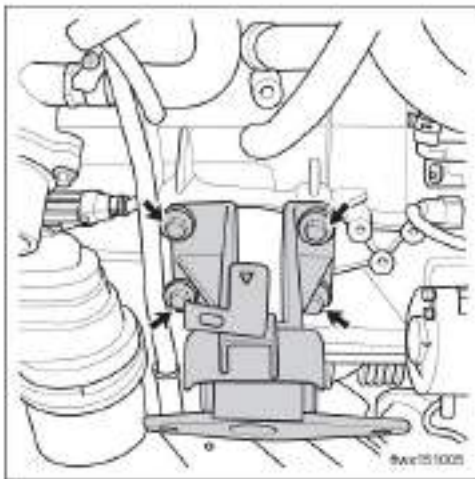


7. Install the right suspension assembly, tighten the fixing bolts.
Torque: 73~89 N·m



ENGINE MECHANICAL - ENGINE MOUNTING

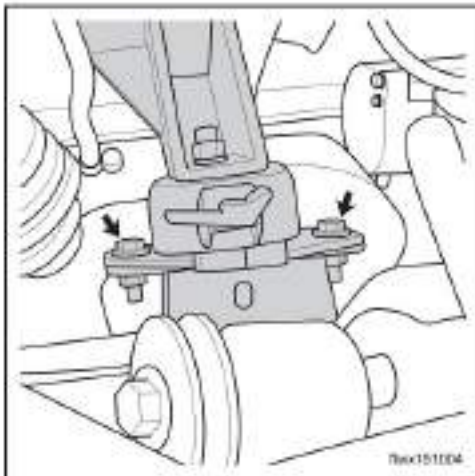
15-25



- 8 . Install the left suspension assembly, tighten the fixing bolts.**

Torque: 73~89 N·m

15

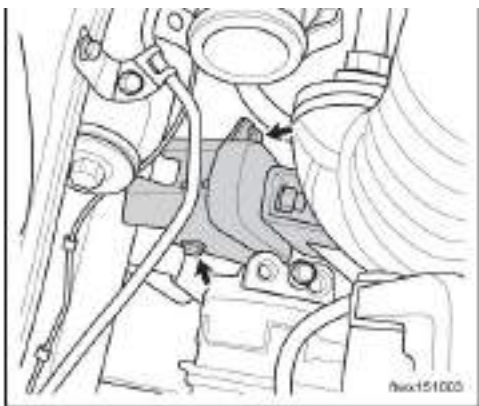


- 9 . Put the power assembly in place, tighten the left suspension fixing bolts and nuts.**

Torque: 45~55 N·m



- 10 . Tighten the right suspension fixing bolts and nuts.**



Torque: 45~55 N•m

1. Take down the lifting device.
2. Connect the battery positive and negative cables. (Refer to "Chapter 20. Start & Charge - battery, replacement")



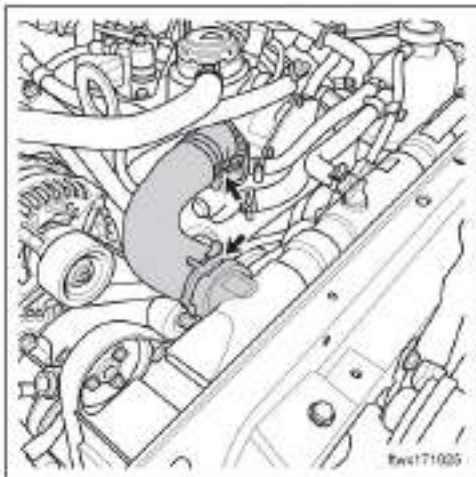
15-26

ENGINE MECHANICAL - ENGINE ACCESSORY BELT

ENGINE ACCESSORY BELT OVERHAUL

1. Switch off the ignition.
2. Open the engine hood.
3. Wait until the engine cools down.
4. Drain the coolant. (Refer to "Chapter 05 Vehicle maintenance - Replacement, coolant replacement")

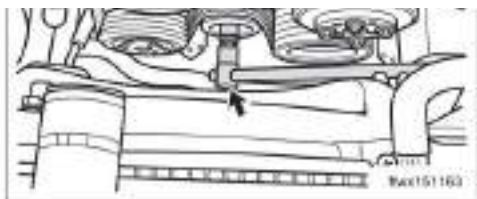
15



5. Loosen the clamp screws, pull out the engine water outlet hose.



6. Turn the accessory belt tension pulley bolts clockwise with a tool until the attachment belt is completely relaxed.



7. Remove the accessory belt and inspect. If the following damage occurs, replace the accessory belt:

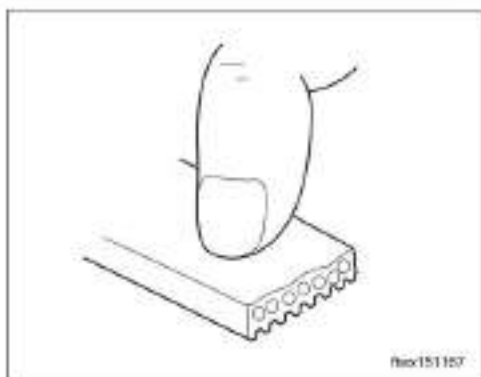
⚠ CAUTION

- Water or grease on the belt will quickly reduce its service life. Therefore, after removal, protect the belt, the belt pulley and the tensioner from water or grease. Do not wash these parts. In case of heavy contamination, replace it with a new one.
- If any water or grease is found on these parts, check whether there is fluid leakage in the engine.

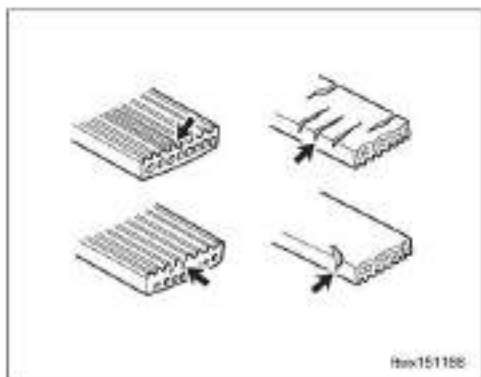


ENGINE MECHANICAL - ENGINE ACCESSORY BELT

15-27



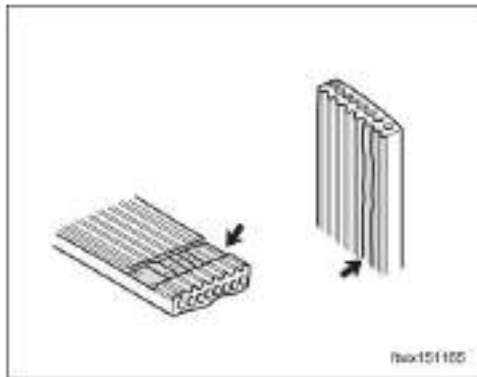
(a) Aged and shiny rubber on the back, showing no nail scratch.



- (b) Cracked or peeled canvas.
- (c) Cracked rubber on the back.
- (d) Cracked belt tooth at the bottom.
- (e) Cracked belt tooth on the side.



(f) Unusual tear and wear on the side of the belt. If the side of the belt is as neat as cut, it is normal.

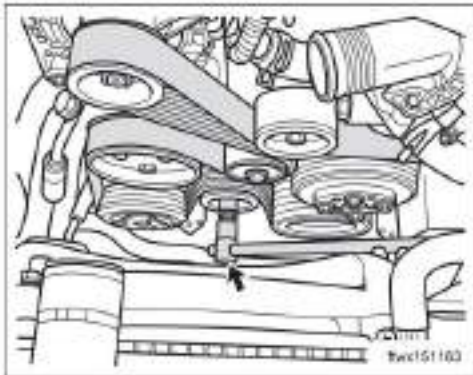


- (g) Unusual tear wear of the belt.
 (h) Missing tooth.



15-28

ENGINE MECHANICAL - ENGINE ACCESSORY BELT



8. **Attach the accessory belt to each pulley, tensioning wheel and idler wheel, leaving the generator pulley without the upper belt. Then turn the tensioning wheel bolts clockwise with the tool, and attach the belt to the generator pulley and loosen the tensioning wheel.**

⚠ CAUTION

- **After installing the accessory belt, check whether the belt is properly fitted to the pulleys. If the relative position of the belt and pulley is offset, tighten the tensioner nut with a tool. Loosen the accessory belt slightly, then make adjustments.**



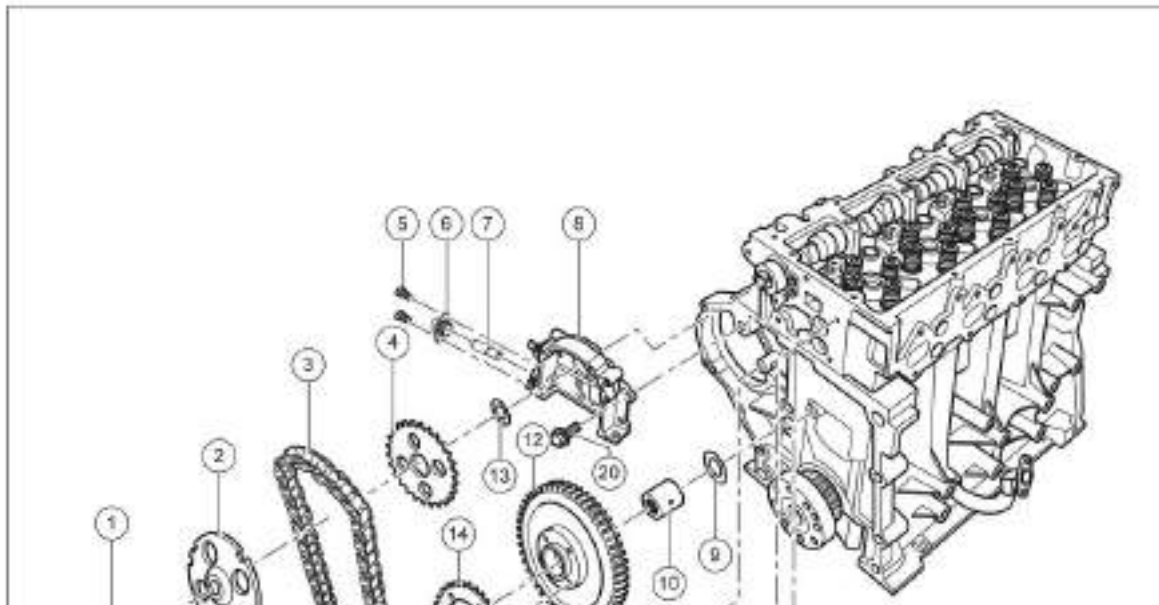
9. **Install the engine water outlet hose, tighten the clamp screws.**

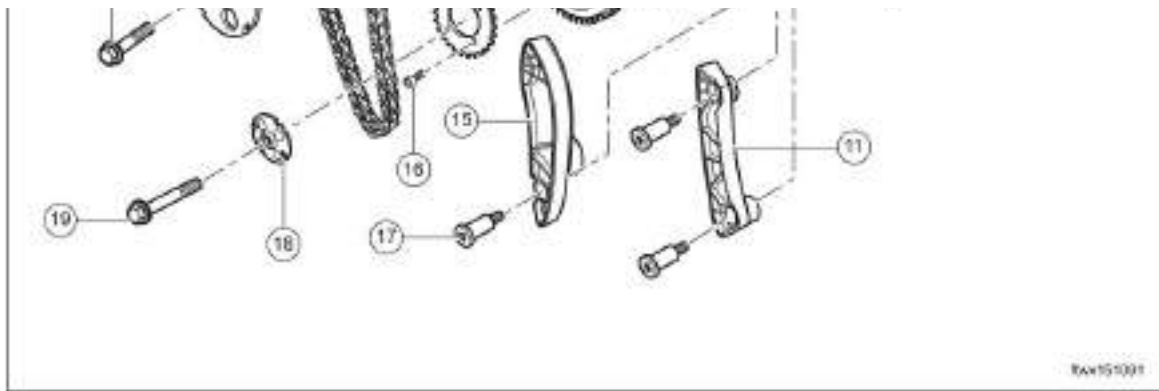


10. Fill up the coolant . (Refer to "Chapter 05 Vehicle maintenance - Replacement, coolant replacement")
11. Close the engine hood.



TIMING DEVICE COMPONENTS





1	Signal Wheel Fixing Bolts
2	Signal Wheel
3	Timing Chain
4	Timing Sprocket
5	Chain Tensioner Cap Fixing Bolts
6	Chain Tensioner Cap
7	Chain Tensioner
8	Overhead Camshaft Sprocket Housing
9	Gasket
10	Inertia Gear Shaft

11	Right Timing Chain Guide
12	Inertia Gear
13	Gasket
14	Inertia Sprocket
15	Left Timing Chain Guide
16	Inertia Sprocket Fixing Bolt
17	Chain Guide Fixing Bolt
18	Gasket
19	Inertia Gear Fixing Bolt
20	Sprocket Room Fixing Bolt

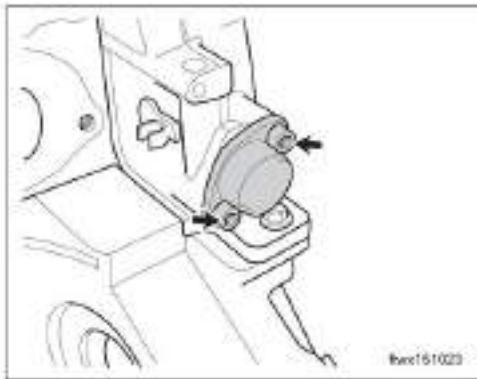


15-30

ENGINE MECHANICAL - TIMING DEVICE

CAMSHAFT DRIVE CHAIN TENSIONER OVERHAUL

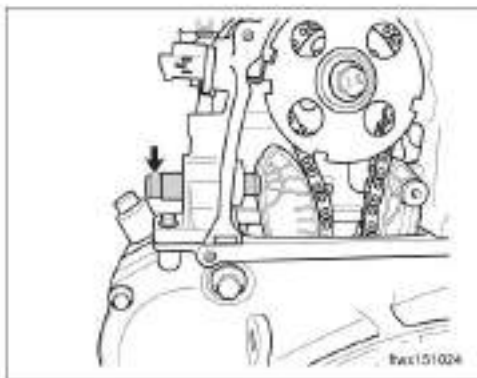
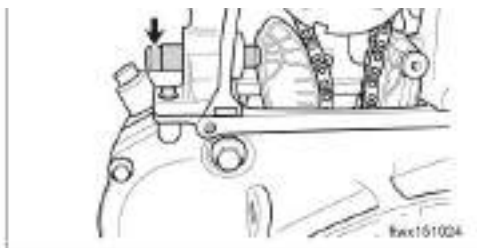
15



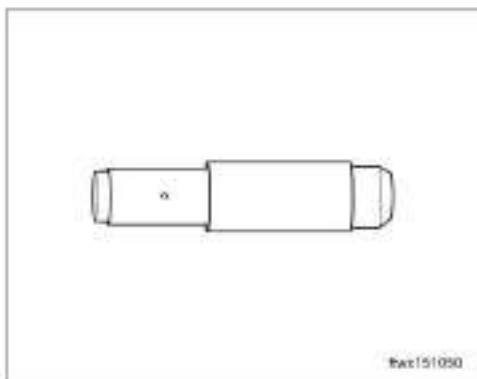
1. **Screw out the fixing bolts for the camshaft drive tensioner cap, and take down the camshaft drive chain tensioner cap.**



2. **Take down the camshaft drive chain tensioner.**



3. Install the camshaft drive chain tensioner.

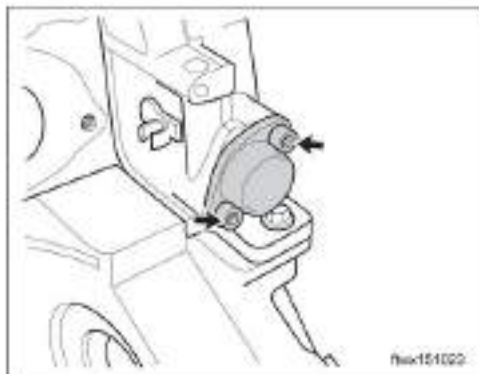


⚠ CAUTION
 Check the tension of the camshaft drive chain tensioner, replace it if necessary.



ENGINE MECHANICAL - TIMING DEVICE

15-31



4. Tighten the fixing bolts for the camshaft drive tensioner cap.
 Torque: 10Nm

⚠ CAUTION
 Check and adjust the tensioner after installation. (Refer to "Chapter 15 Engine Mechanical - Timing Device, Timing check and adjust")



⚠ CAUTION
 The the sealing apron of the camshaft drive chain tensioner should be released



tensioner cap should be replaced.



15-32

ENGINE MECHANICAL - TIMING DEVICE

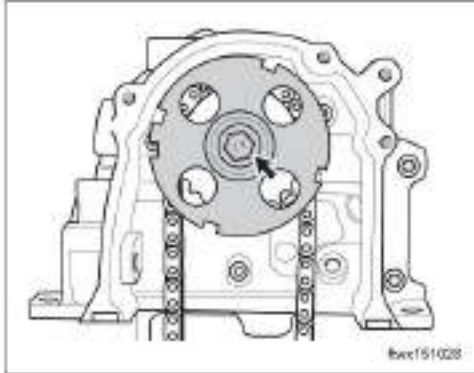
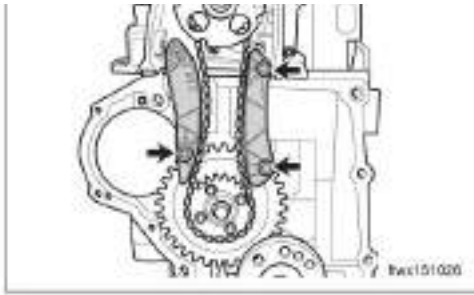
TIMING CHAIN AND GUIDE RAIL REPLACEMENT

1. Install the camshaft drive chain tensioner. (Refer to "Chapter 15 Engine Mechanical - Timing Device, camshaft drive chain tensioner overhaul")
2. Remove flywheel housing assembly. (Refer to "Chapter 15 Engine Mechanical - Flywheel, flywheel housing, cylinder block, crankshaft overhaul")
3. Remove the vacuum pump. (Refer to "Chapter 15 Engine Mechanical - Rock Arm Chamber Cover, Rock Arm, Rock Arm Cushion Block, Rock Arm Bracket & Camshaft, Camshaft overhaul")

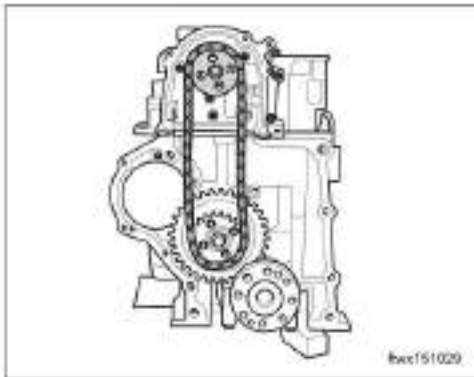
15



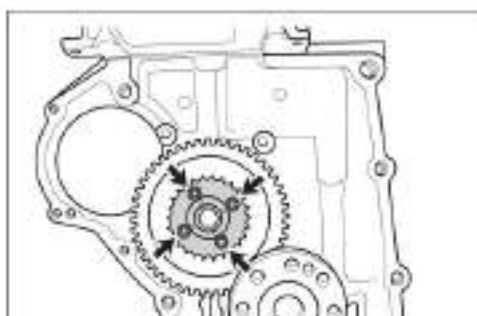
4. Screw out the fixing bolts, take off the timing chain guide.



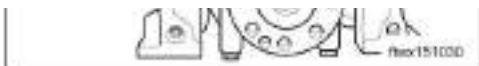
5. Fix the camshaft signal wheel with a special tool, screw out the fixing bolts, and take off the signal wheel.



6. Take off the camshaft timing sprocket and timing chain.

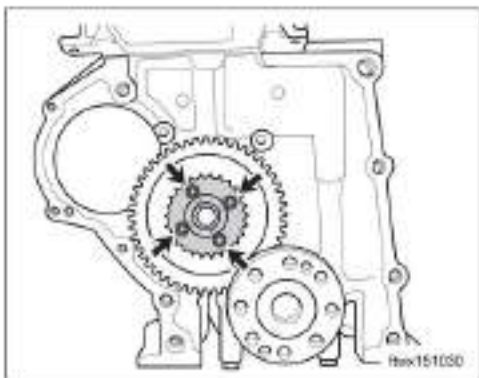


7. Screw out the fixing bolts, take off the inertia sprocket.



- 8 . Tighten the fixing bolts of the inertia sprocket.**

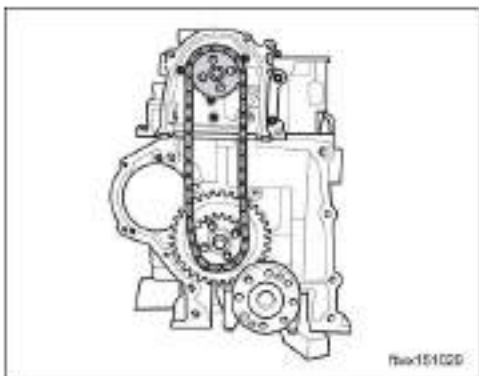
Torque: 10 Nm



- 9 . Install the camshaft timing sprocket and timing chain.**

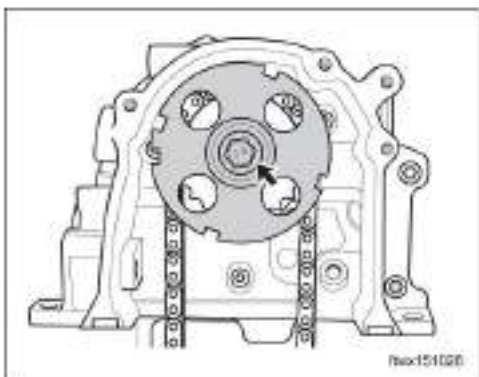
⚠ CAUTION

Do check and adjustment when installing. (Refer to "Chapter 15 Engine Mechanical - Timing Device, Timing check and adjust")



- 10 . Fix the camshaft signal wheel with a special tool, tighten the fixing bolts of the camshaft signal wheel.**

Torque: 30 Nm



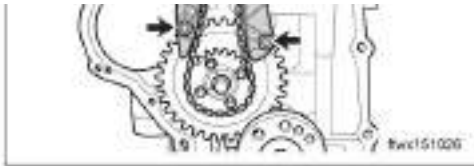
15-34

ENGINE MECHANICAL - TIMING DEVICE



- 11 . Install the timing chain guide.**

Torque: 20 Nm



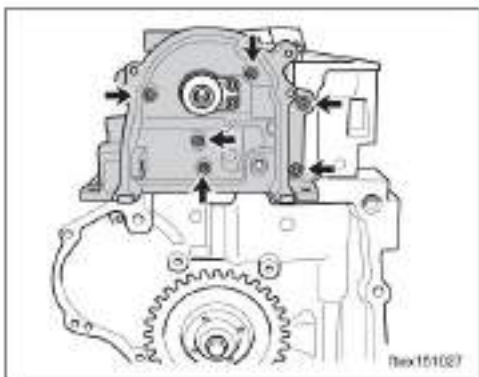
- 12 . Install flywheel housing assembly. (Refer to "Chapter 15 Engine Mechanical - Flywheel, flywheel housing, cylinder block, crankshaft overhaul ")
- 13 . Install the camshaft drive chain tensioner. (Refer to "Chapter 15 Engine Mechanical - Timing Device, camshaft drive chain tensioner overhaul")
- 14 . Install the vacuum pump. (Refer to "Chapter 15 Engine Mechanical - Rock Arm Chamber Cover, Rock Arm, Rock Arm Cushion Block, Rock Arm Bracket & Camshaft, Camshaft overhaul ")
- 15 . Install the engine assembly. (Refer to "Chapter 15 Engine mechanical system - engine assembly, replacement")



OVERHEAD MECHANISM CAMSHAFT SPROCKET HOUSING REPLACEMENT

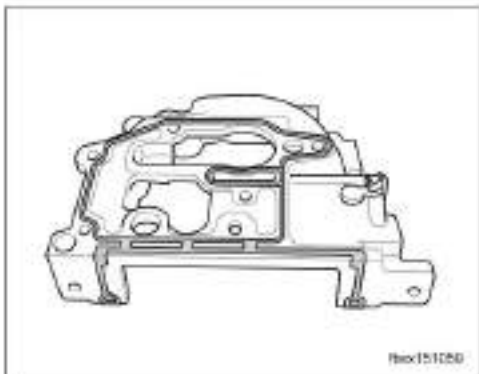
- 1 . Remove timing chain and guide rail. (Refer to "Chapter 15 Engine Mechanical

Remove timing chain and guide rail (refer to "Chapter 15 Engine mechanical - Timing Device, Timing chain and guide rail replacement")

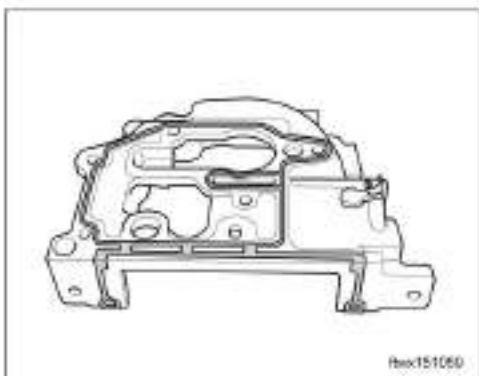


2. Screw out the fixing bolt of the overhead camshaft sprocket housing.

15



3. Take off the gasket from the overhead camshaft sprocket housing.

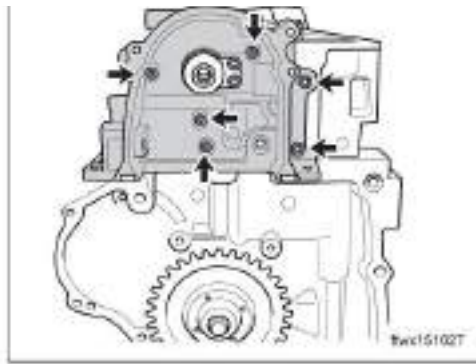


4. Mount a new gasket onto the overhead camshaft sprocket housing.

CAUTION

- Gaskets shall not be reused and must be replaced.





camshaft sprocket housing.

Torque: 20 Nm

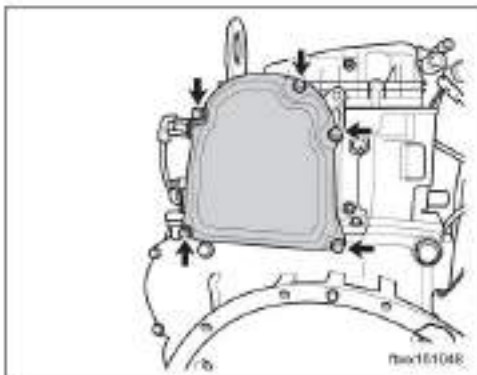
15

- 6 . Install the timing chain and guide rail . (Refer to "Chapter 15 Engine Mechanical - Timing Device, Timing chain and guide rail replacement")



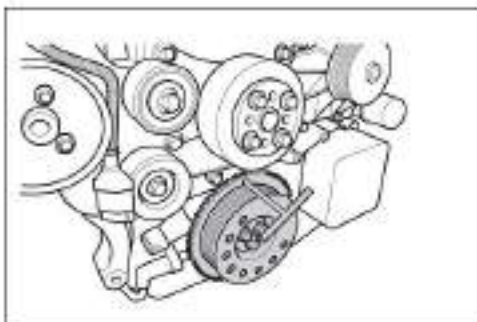
TIMING CHECK AND ADJUSTMENT

1. Remove the power assembly. (Refer to "Chapter 15 Engine mechanical system - engine assembly, replacement")



2. Screw out the fixing bolt, take off the overhead camshaft sprocket housing cap.

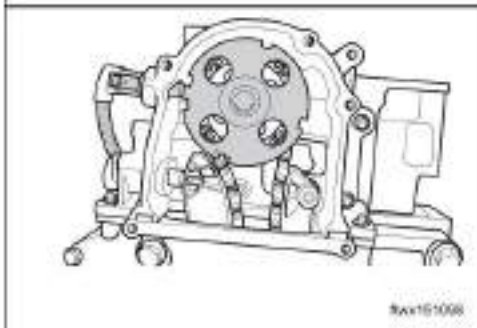
15



3. Turn crankshaft pulley clockwise, align the crankshaft belt mark and the Front gear housing mark. Insert the crankshaft timing pin into the opening with a special tool.
4. Align the camshaft signal mark with the camshaft position sensor.

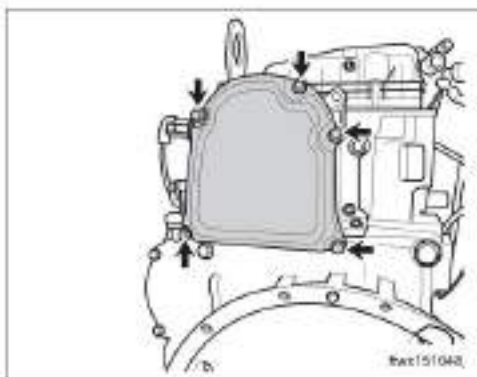
⚠ CAUTION

- If the alignment of crankshaft belt pulley mark and front gear chamber cover mark and alignment of the camshaft signal wheel mark and the camshaft position sensor don't occur at the same time, the difference is 180 degree, then turn the crankshaft pulley around again.
- If too much difference, adjust the timing: remove the camshaft signal wheel (Refer to "Chapter 15 Engine Mechanical - Rock Arm Chamber Cover, Rock Arm, Rock Arm Cushion Block, Rock Arm Bracket & Camshaft, Camshaft overhaul"), then install according to timing mark point to adjust the timing.



15-38

ENGINE MECHANICAL - TIMING DEVICE



- 5 . Tighten the fixing bolt of overhead camshaft sprocket housing cap.

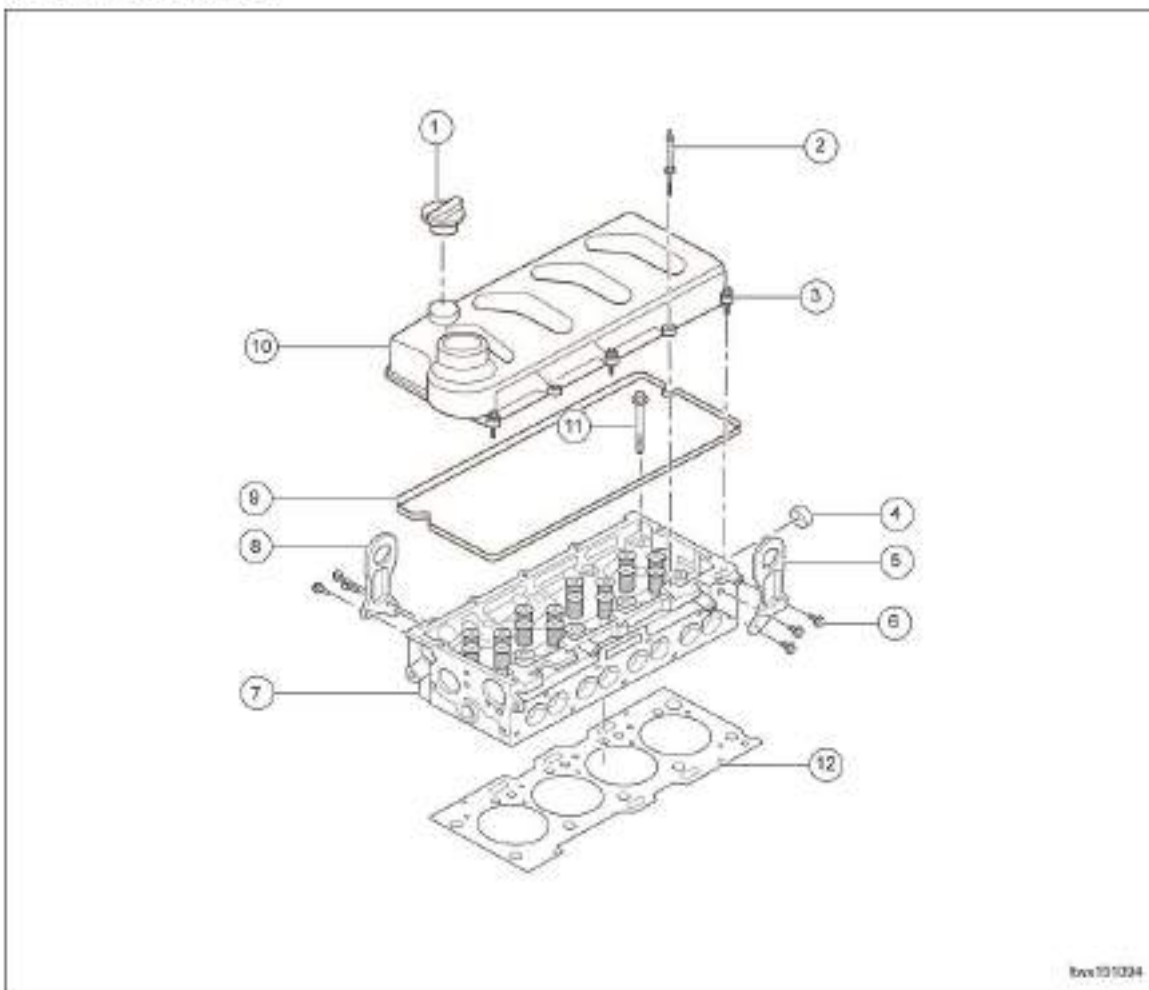
Torque: 7.5Nm

15

- 6 . Install power assembly. (Refer to "Chapter 15 Engine mechanical system - engine assembly, replacement")



ROCK ARM CHAMBER, ROCK ARM , ROCK ARM CUSHION BLOCK, ROCK ARM BRACKET & CAMSHAFT COMPONENTS



15

1	Oil Filler Cap
2	Rocker Chamber Cover Fixing Bolt
3	Rocker Chamber Cover Fixing Bolt
4	Bushing
5	Engine Rear Lug
6	Engine Lug Fixing Bolt

7	Cylinder Cover
8	Engine Front Lug
9	Rocker Chamber Cover Gasket
10	Rocker Chamber Cover
11	Cylinder Cover Fixing Bolt
12	Cylinder Gasket



**ENGINE MECHANICAL - ROCK ARM CHAMBER, ROCK ARM , ROCK ARM CUSHION BLOCK, ROCK ARM
15-40 BRACKET & CAMSHAFT**

REPLACEMENT (ROCK ARM, ROCK ARM, ROCK ARM CUSHION BLOCK, ROCK ARM BRACKET & CAMSHAFT)

⚠ CAUTION

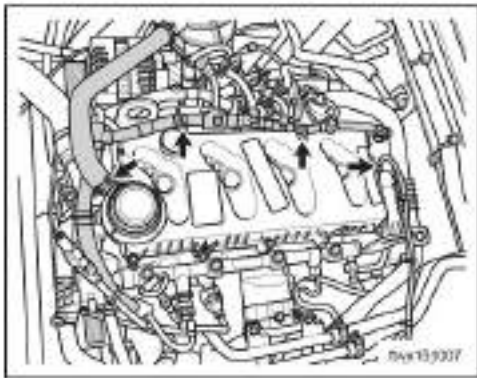
Replacement (rock arm, rock arm cushion block, rock arm bracket) . (Refer to
"Chapter 15 Rock Arm Chamber Cover, Rock Arm, Rock Arm Cushion Block, Rock
Arm Bracket & Camshaft - Camshaft Overhaul.")



ENGINE MECHANICAL - ROCK ARM CHAMBER, ROCK ARM , ROCK ARM CUSHION BLOCK, ROCK ARM BRACKET & CAMSHAFT **15-41**

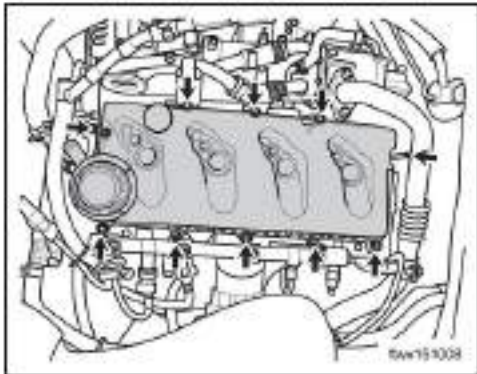
ROCK ARM CHAMBER COVER REPLACEMENT

1. Remove the fuel injector . (Refer to "Chapter 12 Fuel Supply System - Fuel Injector, replacement.")

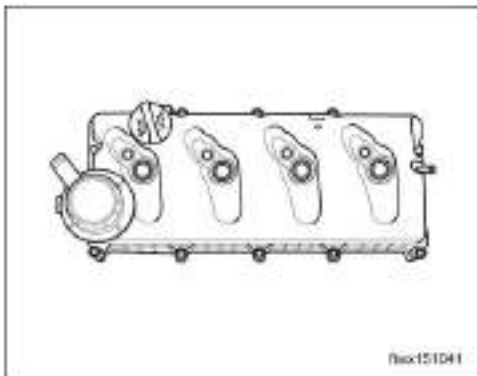


2. Remove the clamp for the crankcase ventilation hose and disengage the connection of the crankcase ventilation hose and the crankcase ventilation valve.
3. Remove the buckle of harness and rock arm chamber cover.
4. Remove the buckle of fuel injector and the rock arm chamber cover.

15



5. Screw out the fixing bolts of the rock arm chamber cover.

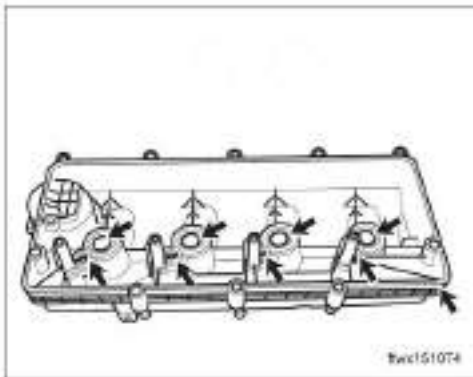


6. Take off the rock arm chamber cover.

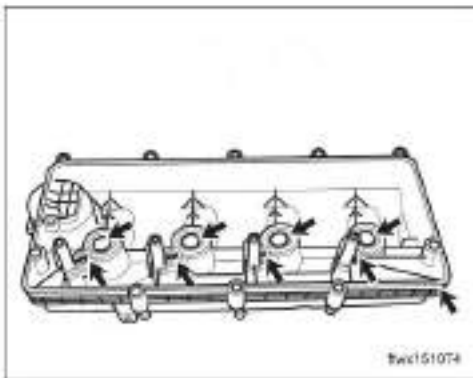


ENGINE MECHANICAL - ROCK ARM CHAMBER, ROCK ARM , ROCK ARM CUSHION BLOCK, ROCK ARM BRACKET & CAMSHAFT
15-42

15



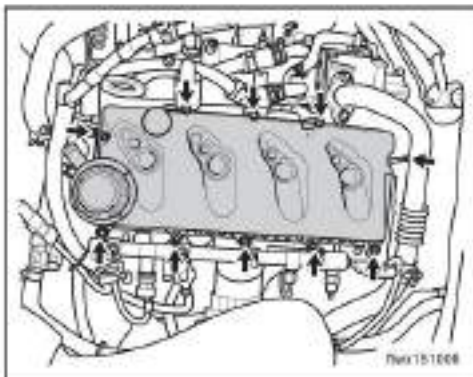
7. Remove the rock arm chamber cover gasket, injector oil seal and injector fixing bolts oil seal.



8. Fit new rock arm chamber cover gasket, injector oil seal and injector fixing bolts oil seal to the rocker chamber cover.

⚠ CAUTION

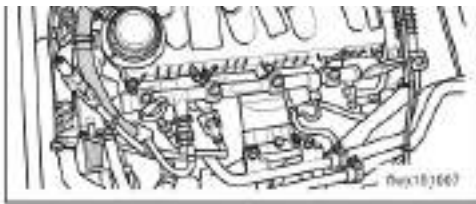
The rock arm chamber cover gasket, injector oil seal can't be reused and must be replaced.



9. Install the rock arm chamber cover.
 10. Tighten the fixing bolts of the rock arm chamber cover.
 Torque:10 N·m



11. Fit the crankcase ventilation hose fixing clamp.
 12. Install the buckle of harness and rock arm chamber cover.
 13. Install the buckle of fuel injector and rock arm chamber cover.



arm chamber cover.

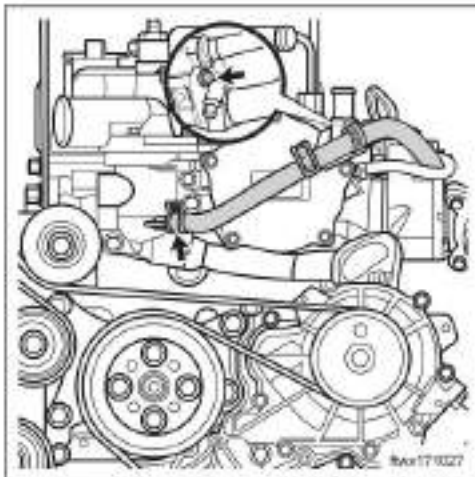
- 14 . Install the fuel injector. (Refer to "Chapter 12 Fuel Supply System - Fuel Injector, replacement.")



ENGINE MECHANICAL - ROCK ARM CHAMBER, ROCK ARM , ROCK ARM CUSHION BLOCK, ROCK ARM BRACKET & CAMSHAFT 15-43

CAMSHAFT OVERHAUL

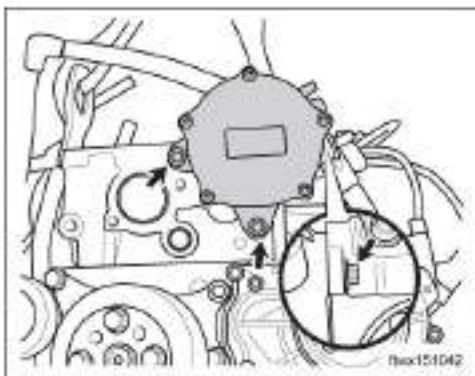
- 1 . Remove the engine assembly. (Refer to "Chapter 15 Engine mechanical system - engine assembly, replacement")
- 2 . Remove the rock arm chamber cover. (Refer to "Chapter 15 Engine Mechanical - Rock Arm Chamber Cover, Rock Arm, Rock Arm Cushion Block, Rock Arm Bracket & Camshaft, rock arm chamber cover overhaul ")



- 3 . Remove the fixing clamps and disengage the connection between the vacuum pump and the vacuum pipe.
- 4 . Screw out the fixing bolts for the bypass pipe.
- 5 . Remove the fixing clamps and disengage connection between thermostat outlet pipe and thermostat.

15

- 6 . Remove the thermostat housing assembly. (Refer to "Chapter 17 Cooling - thermostat housing, replacement")



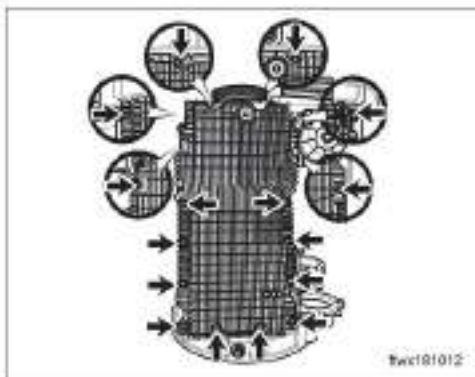
- 7 . Remove the fixing bolts, and take off vacuum pump and gasket .

- 8 . Remove the starter assembly. (Refer to "Chapter 20 Start & Charge - starter, overhaul")

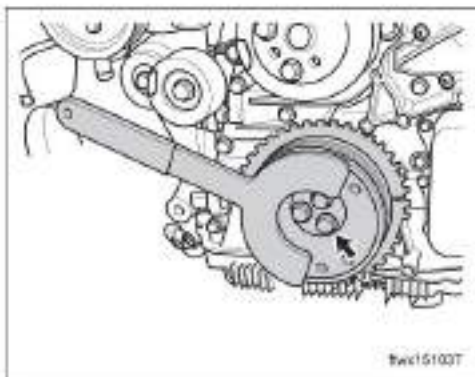


ENGINE MECHANICAL - ROCK ARM CHAMBER, ROCK ARM, ROCK ARM CUSHION BLOCK, ROCK ARM BRACKET & CAMSHAFT
15-44

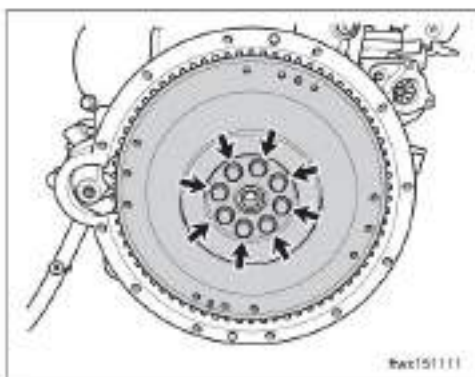
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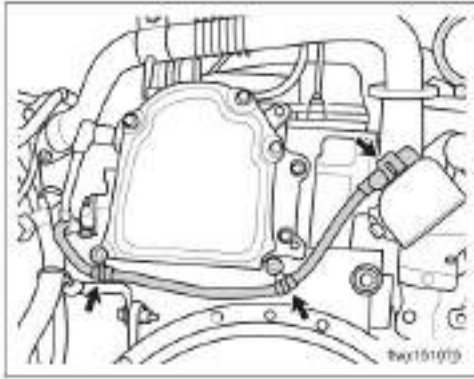
9. Screw out the fixing bolts of the oil sump assembly, and take off the oil sump assembly.



10. Fix the crankshaft pulley with the brake tool.



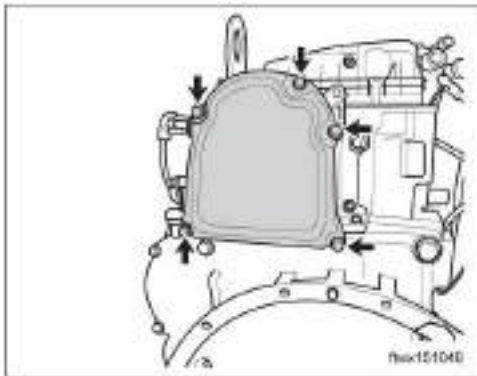
11. Screw out the fixing bolts of the flywheel assembly, and take off the flywheel assembly.



12. Disconnect the fixing buckle of the EGR actuator connector and its harness.
13. Remove fixing buckle of the engine harness and bracket.
14. Screw out the fixing bolts of harness bracket.



ENGINE MECHANICAL - ROCK ARM CHAMBER, ROCK ARM, ROCK ARM CUSHION BLOCK, ROCK ARM BRACKET & CAMSHAFT **15-45**



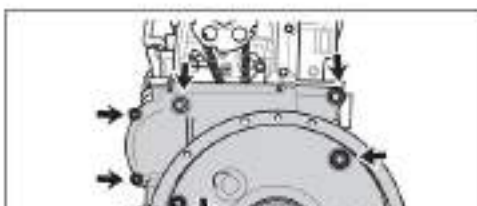
15. Screw out fixing bolt of the overhead camshaft sprocket housing cover assembly, and take off the overhead camshaft sprocket housing cover assembly.

15

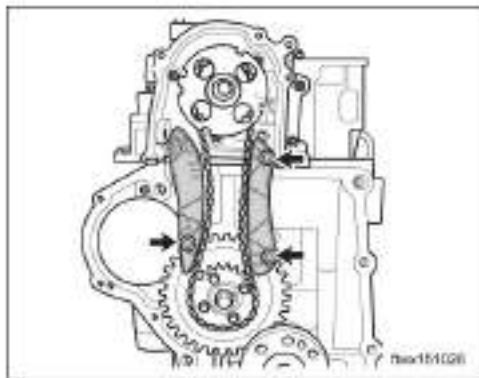
16. Install the camshaft drive chain tensioner. (Refer to "Chapter 15 Engine Mechanical - Timing Device, camshaft drive chain tensioner overhaul")



17. Screw out the fixing bolt of overhead camshaft sprocket housing and flywheel housing.



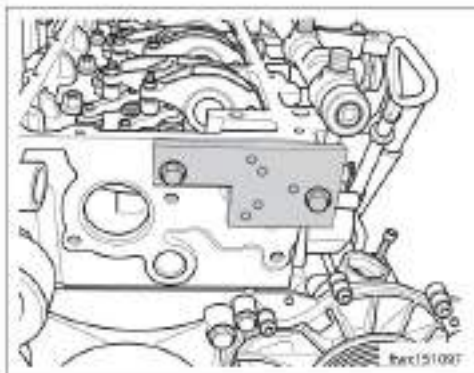
18. Screw out the fixing bolts of the flywheel housing, and take off the flywheel housing.



- 19 . Screw out the fixing bolts of the timing chain guide rail, and take off the timing chain guide rail.

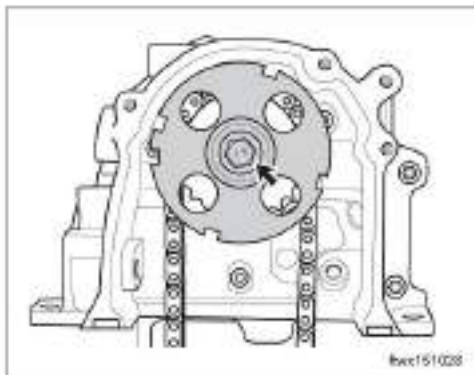


ENGINE MECHANICAL - ROCK ARM CHAMBER, ROCK ARM , ROCK ARM CUSHION BLOCK, ROCK ARM BRACKET & CAMSHAFT
15-46

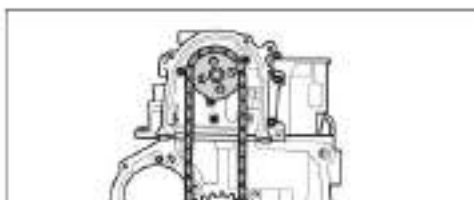


- 20 . Fix the camshaft with special tools.

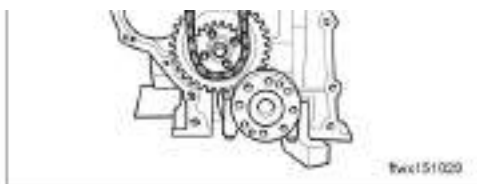
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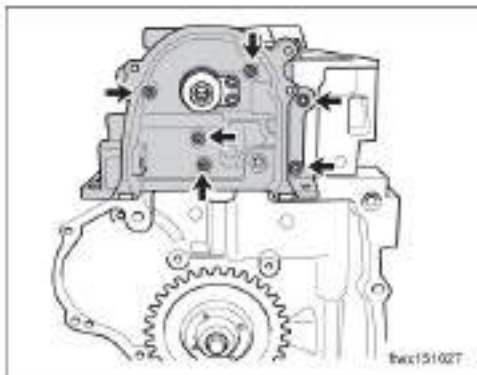
- 21 . Screw out the fixing bolts, take off the camshaft signal wheel.



- 22 . Take off the camshaft timing sprocket and timing chain.



ftec151020

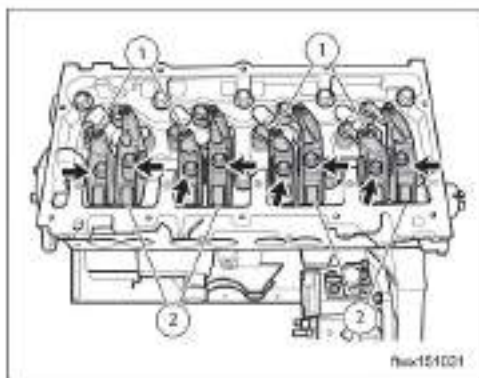


ftec151027

- 23 . Screw out the fixing bolt, and take off the overhead camshaft sprocket housing.



ENGINE MECHANICAL - ROCK ARM CHAMBER, ROCK ARM, ROCK ARM CUSHION BLOCK, ROCK ARM BRACKET & CAMSHAFT **15-47**



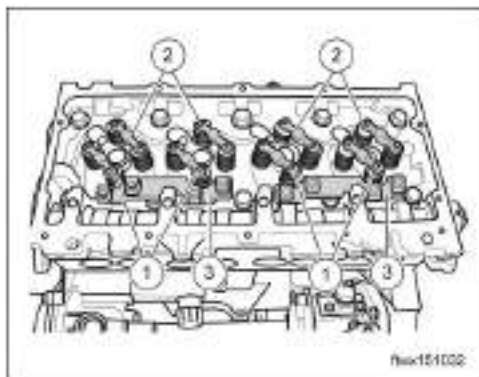
ftec151001

- 24 . Screw out the fixing bolt, take off intake rock arm 1 and exhaust rock arm 2.

⚠ CAUTION

When removing, set assembly marks on the intake rock arm and the exhaust rock arm for installation.

15



ftec151002

- 25 . Take off intake rock arm cushion lock 1 and exhaust rock arm cushion lock 2.

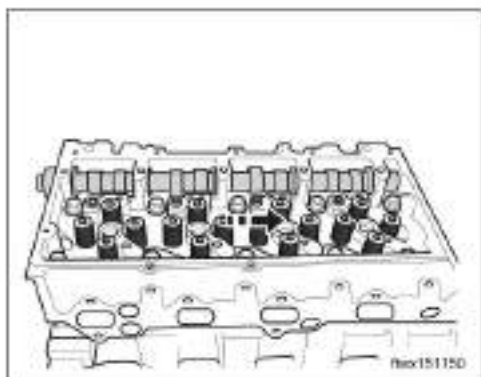
⚠ CAUTION

- When removing, set assembly marks on the intake rock arm cushion lock and the exhaust rock arm cushion lock for installation.

- 26 . Take off intake and exhaust rock arm bracket 3.



- 27 . Remove the gasket.
28 . Screw out the fixing bolts, take off the thrust pad.



29 . Pull out the camshaft in directions.

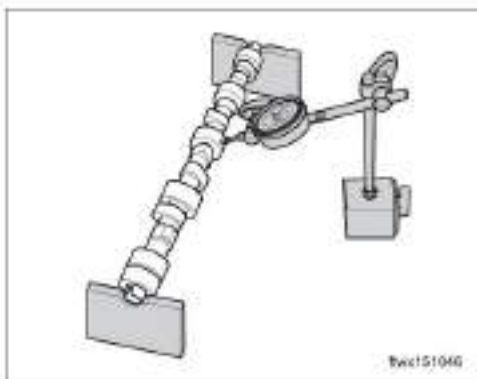
30 . Check the camshaft.



ENGINE MECHANICAL - ROCK ARM CHAMBER, ROCK ARM , ROCK ARM CUSHION BLOCK, ROCK ARM BRACKET & CAMSHAFT
15-48

⚠ CAUTION

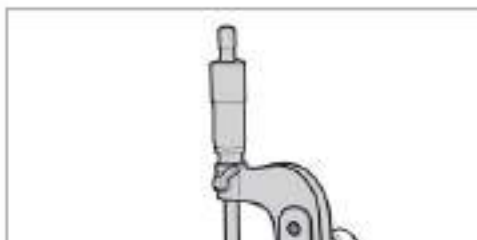
- Since the camshaft is hard and brittle, do not bump or drop with care.



- Check whether there is any corrosion, wear or crack on the surface of the camshaft. Replace it if any.
- Place the camshaft on the V-shaped blocks.
- Rotate the camshaft, and measure the intermediate shaft neck roundness with a dial gage.

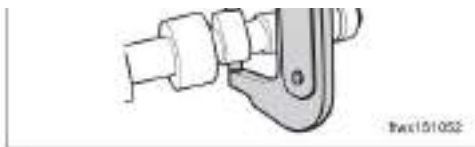
⚠ CAUTION

- If the maximum roundness exceeds the specified value, replace the camshaft.

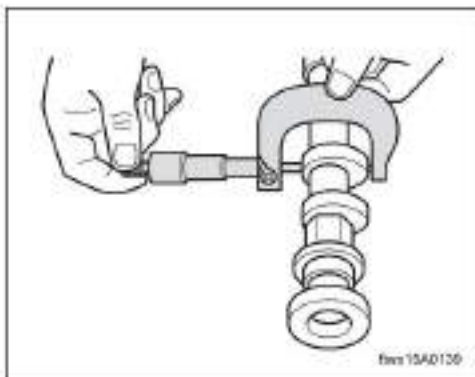


- Measure the cam height with a micrometer.
Standard Height:
Intake cam: 34.51~35.49mm
Exhaust cam: 33.41~34.55mm

⚠ CAUTION



If the measured value is less than the minimum, replace the camshaft.



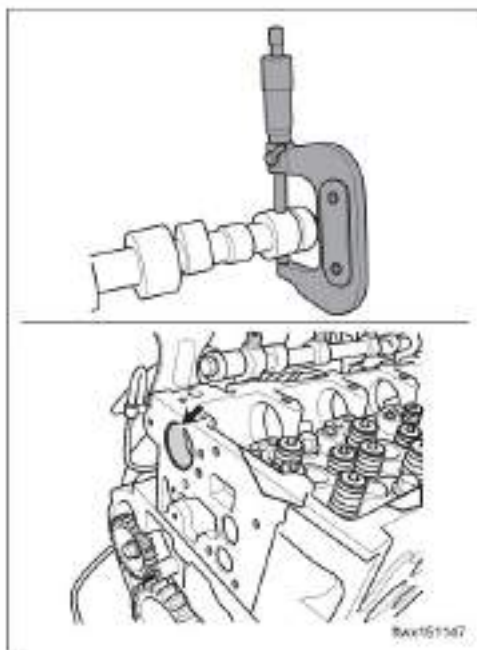
- (e) Measure camshaft No. 5 journal diameter and No. 1~4 Journal diameter with micrometer.
 Camshaft No. 5 journal diameter: 38.955 ~ 39.105mm
 Camshaft No. 1~4 journal diameter: 42.955 ~ 43.105mm

CAUTION

- If the measured value does not meet the specified value, check the camshaft journal oil film gap.



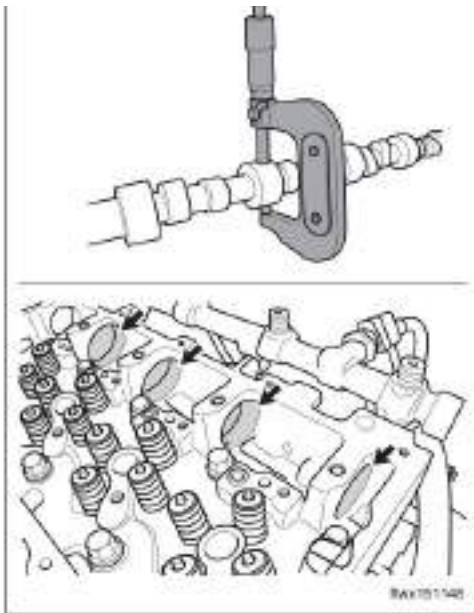
ENGINE MECHANICAL - ROCK ARM CHAMBER, ROCK ARM, ROCK ARM CUSHION BLOCK, ROCK ARM BRACKET & CAMSHAFT **15-49**



- (f) Measure camshaft No. 5 journal diameter with micrometer.
 Standard: 38.955~39.105mm
- (g) Measure the inside diameter of the camshaft bushing with a caliper. Standard: 39.16~40.00mm
- (h) Subtract camshaft rear axle journal diameter from inside diameter of camshaft bushing, and calculate the oil film gap at the rear axle journal of the camshaft.

15

- (i) Measure camshaft No. 1~4 journal diameter



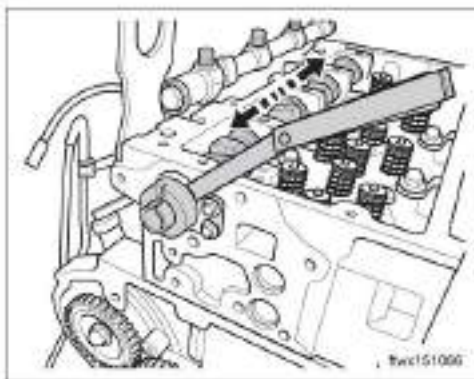
with micrometer.

Standard: 42.955~43.105mm

- (j) Internal diameter of camshaft journal bore 1~4 with a caliper.
Max value:43.2mm
- (k) Subtract the other journal diameters of the camshaft 1 from the inner diameter of the other journal bores of the camshaft, and calculate the oil film gap of the camshaft other journal.



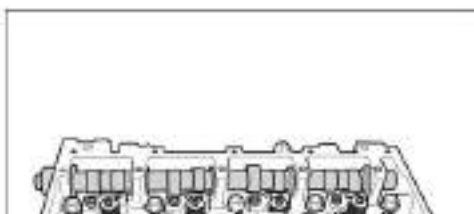
ENGINE MECHANICAL - ROCK ARM CHAMBER, ROCK ARM, ROCK ARM CUSHION BLOCK, ROCK ARM BRACKET & CAMSHAFT 15-50



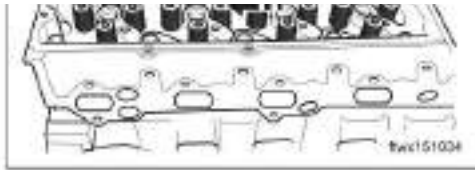
- (l) Position camshaft on cylinder head.
- (m) Install the feeler between the front end of the camshaft and the thrust pad.
- (n) Move the camshaft front and back in the direction of the arrow to measure the thrust clearance.

Standard thrust clearance: 0.10~0.36mm

15

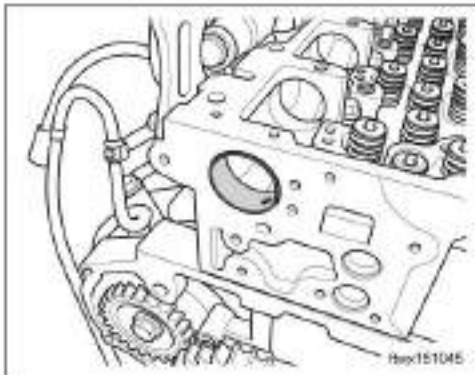


- 31. Install the camshaft in directions.

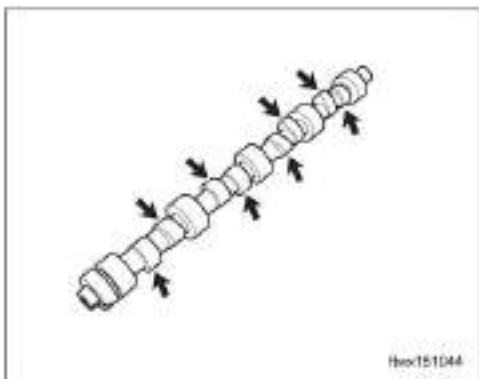


ENGINE MECHANICAL - ROCK ARM CHAMBER, ROCK ARM , ROCK ARM CUSHION BLOCK, ROCK ARM BRACKET & CAMSHAFT **15-51**

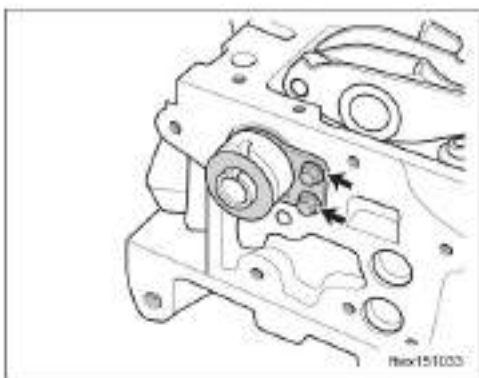
⚠ CAUTION



- (a) Check whether there is unusual wear on the bushing of the camshaft. Replace it if needed.



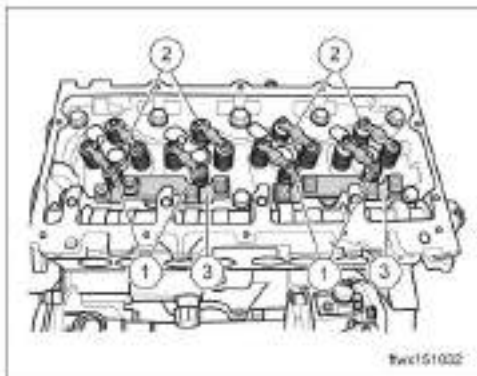
- (b) Before installing the camshaft, apply lubricating oil to the thrust at each flange on the camshaft (the left and right sides of the flange).



- 32 . Install the thrust pad, and tighten the fixing bolts.
Torque: 10 Nm
- 33 . Install the gasket.



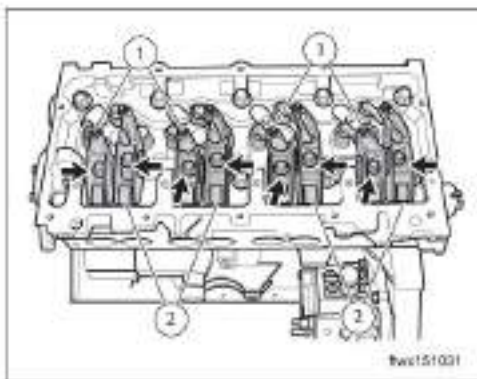
ENGINE MECHANICAL - ROCK ARM CHAMBER, ROCK ARM , ROCK ARM CUSHION BLOCK, ROCK ARM BRACKET & CAMSHAFT
15-52



- 34 . Install the intake and exhaust rock arm bracket 3.
- 35 . Install the intake rock arm cushion block 1 and exhaust rock arm cushion block 2.

CAUTION

- If the intake and exhaust rock arm cushion block are worn within the standard range, they shall be installed according to the disassembly mark. Otherwise, replace new rocker arm cushion blocks.

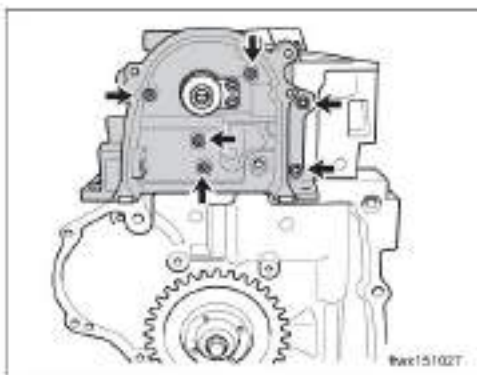


36 . Tighten the intake rock arm 1 and exhaust rock arm 2.

Torque: 36 Nm

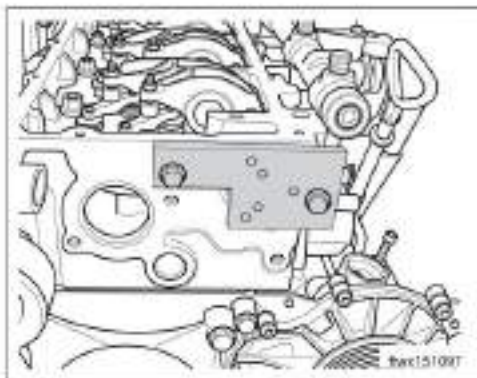
CAUTION

- If the intake and exhaust rock arm are worn within the standard range, they shall be installed according to the disassembly mark. Otherwise, replace new rock arms.



37 . Tighten the fixing bolt of overhead camshaft sprocket housing.

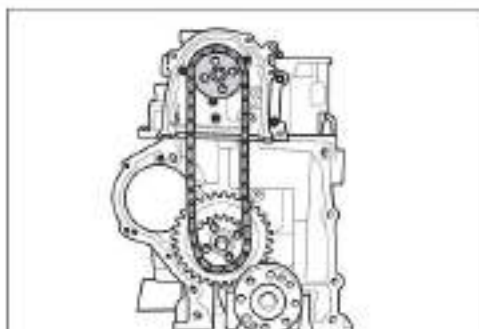
Torque:10 Nm



38 . Fix the camshaft with special tools.



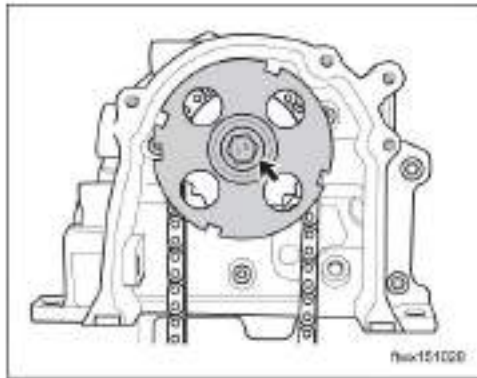
ENGINE MECHANICAL - ROCK ARM CHAMBER, ROCK ARM, ROCK ARM CUSHION BLOCK, ROCK ARM BRACKET & CAMSHAFT **15-53**



39 . Install the camshaft timing sprocket and timing chain.

CAUTION

- When installing, do necessary check and adjustment. (Refer to "Chapter 15 Engine Mechanical - Timing Device, Timing check and adjust")

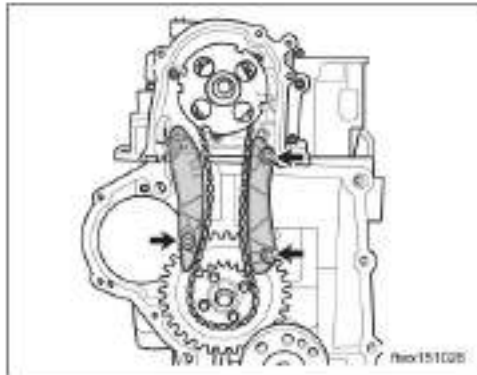


- 40 . Install the camshaft signal wheel.**
41 . Tighten the fixing bolts of the camshaft signal wheel.

Torque:

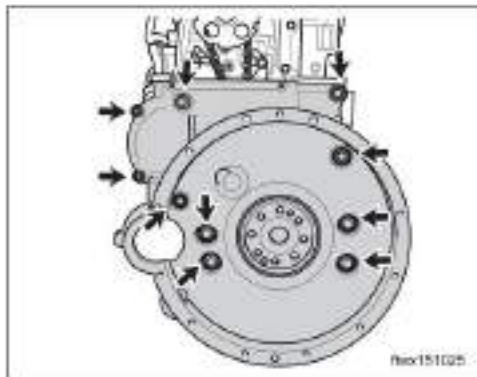
First level tightening: 30 Nm

Second level tightening: 160 Nm



- 42 . Tighten the fixing bolts of the timing chain guide rail.**

Torque: 20 Nm



- 43 . Install the flywheel housing and tighten the fixing bolts of the flywheel housing.**

Torque: 24 Nm

Torque: 85 Nm



ENGINE MECHANICAL - ROCK ARM CHAMBER, ROCK ARM, ROCK ARM CUSHION BLOCK, ROCK ARM BRACKET & CAMSHAFT
15-54

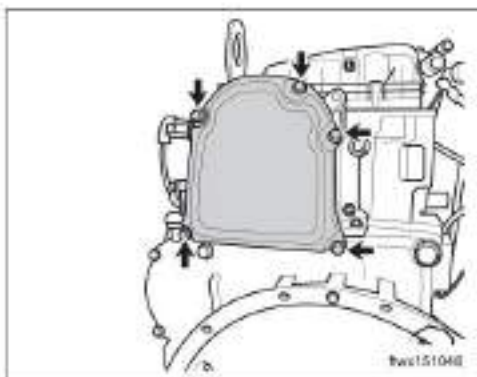


- 44 . Tighten the fixing bolt of overhead camshaft sprocket housing and flywheel housing.**

Torque: 12 Nm



- 45 . Install the camshaft drive chain tensioner. (Refer to "Chapter 15 Engine Mechanical - Timing Device, camshaft drive chain tensioner overhaul")

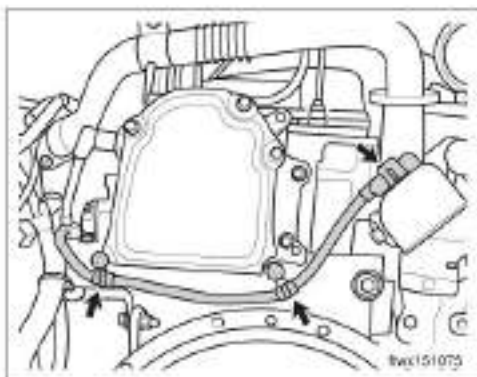


- 46 . Tighten the fixing bolt of the overhead camshaft sprocket housing assembly.
Torque: 7.5 Nm

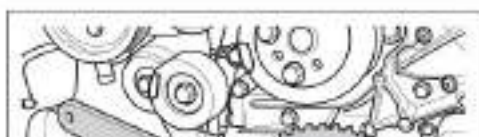


CAUTION

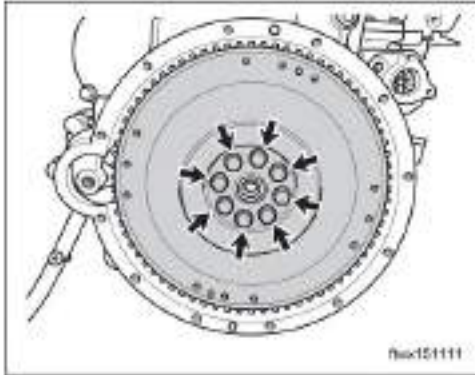
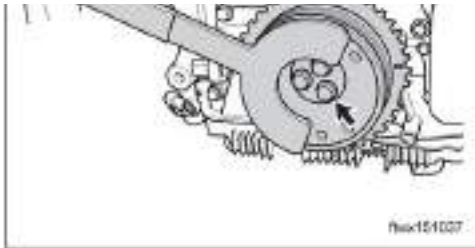
- The sealing washer of the overhead camshaft sprocket housing cove must be replaced.



- 47 . Tighten the fixing bolts of harness bracket.
Torque: 7.5 Nm
- 48 . Mount the fixing buckle of the EGR actuator connector and its harness.
- 49 . Mount the fixing buckle of the engine harness and bracket.



- 50 . Fix the crankshaft pulley with the brake tool.



- 51 . Install the flywheel housing assembly, and tighten the fixing bolts of the flywheel housing assembly.**

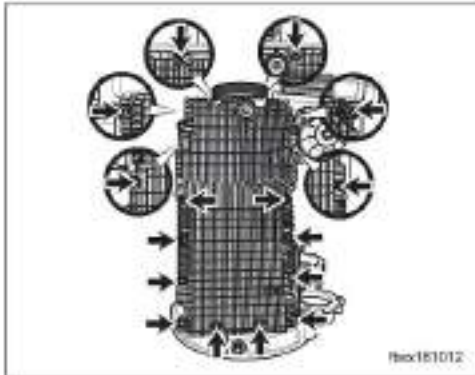
Torque:

Level 1 tightening: 30 Nm

Level 2 tightening: turn counterclockwise and loosen 180 degrees

Level 3 tightening: 30 Nm

Level 4 tightening: clockwise rotation of 90 degrees



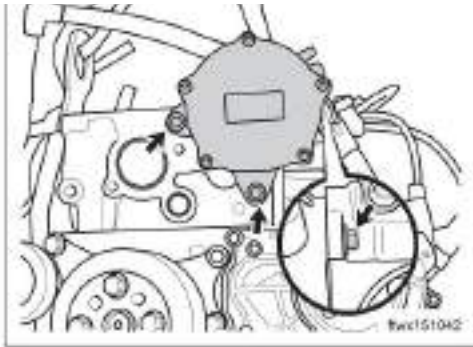
- 52 . Install the oil sump assembly, and tighten the fixing bolts of the oil sump assembly.**

Torque: 24 Nm

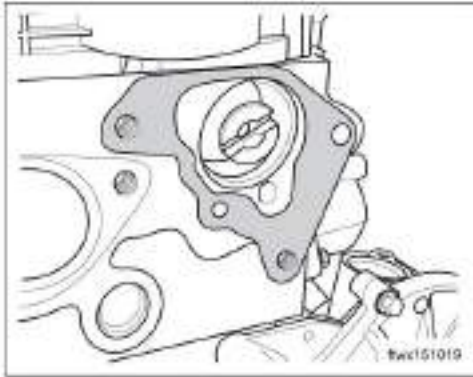
- 53 . Install the starter assembly. (Refer to "Chapter 20 Start & Charge - starter, overhaul")**



15



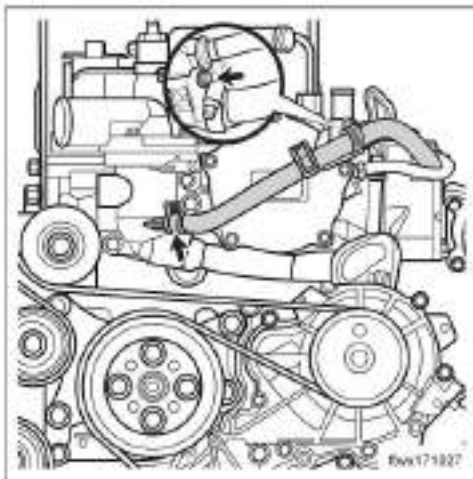
fixing bolts.



⚠ CAUTION

- Gaskets of the vacuum pumps should not be reused. New gaskets must be replaced.

55 . Fit the thermostat housing assembly. (Refer to "Chapter 17 Cooling - thermostat housing , replacement")



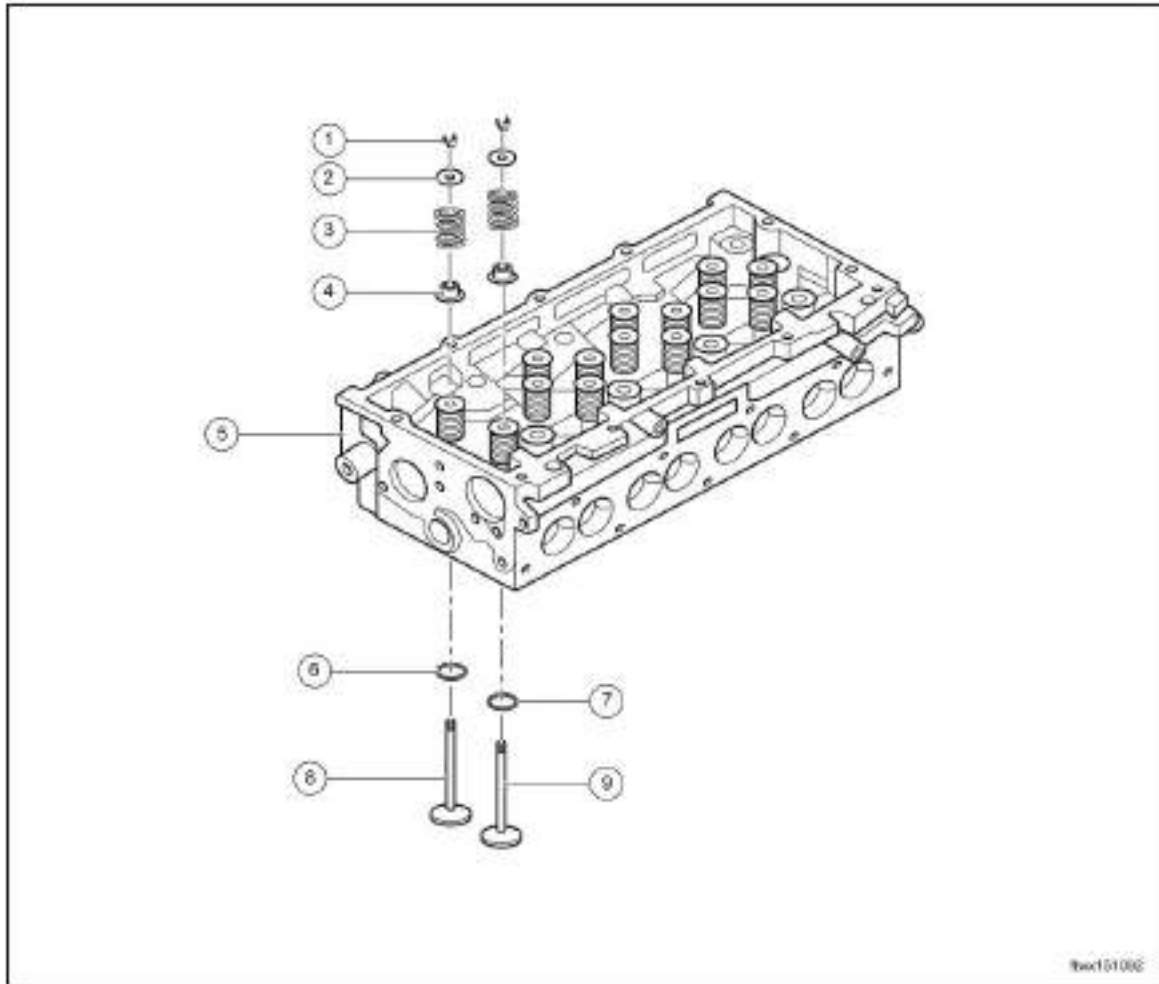
- 56 . Tighten the fixing bolts for the bypass pipe.**
- 57 . Mount the fixing buckle of the thermostat outlet pipe and thermostat.**
- 58 . Mount the fixing buckle of the vacuum pump and the vacuum pipe.**

59 . Install rock arm chamber cover. (Refer to "Chapter 15 Engine Mechanical - Rock Arm Chamber Cover, Rock Arm, Rock Arm Cushion Block, Rock Arm Bracket & Camshaft, rock arm chamber cover overhaul ")

60 . Install the engine assembly. (Refer to "Chapter 15 Engine mechanical system - engine assembly, replacement")



CYLINDER HEAD, VALVE COMPONENTS



1	Valve lock
2	Valve Spring Retainer
3	Valve Spring
4	Valve Oil Seal
5	Cylinder Head

6	Intake Valve Seat Ring
7	Exhaust Valve Seat Ring
8	Intake Valve
9	Exhaust Valve



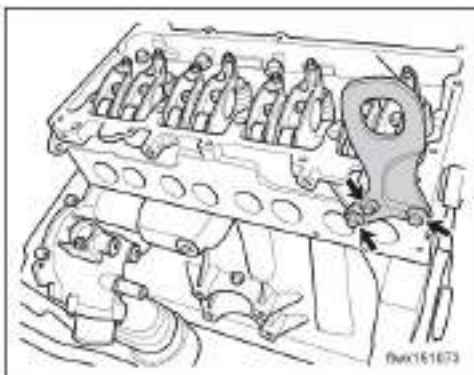
CYLINDER HEAD OVERHAUL

1. Remove the camshaft. (Refer to "Chapter 15 Engine Mechanical - Rock Arm Chamber Cover, Rock Arm, Rock Arm Cushion Block, Rock Arm Bracket & Camshaft, Camshaft overhaul ")
2. Remove the engine intake air manifold. (Refer to "Chapter 14 Intake Air - Intake air manifold. replacement")
3. Remove the engine exhaust air manifold. (Refer to "Chapter 14 Intake Air - Exhaust air manifold. replacement")

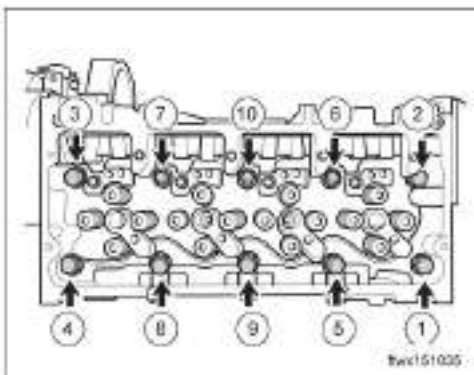
15



4. Screw out the fixing bolts of the engine front suspension lug and the engine cylinder head.



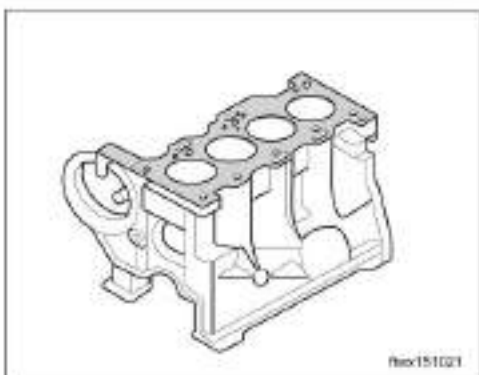
5. Screw out the fixing bolts of the engine rear suspension lug and the engine cylinder head.



6. Remove the retaining bolts of the cylinder head in numeric sequence.

⚠ CAUTION

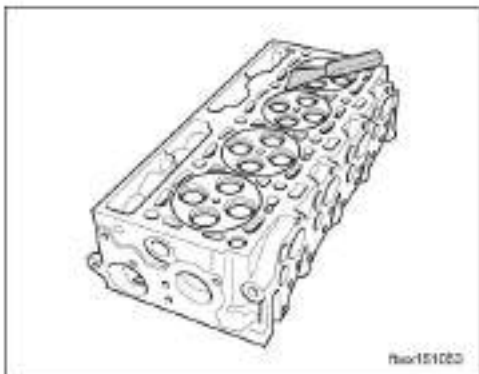
- When loosening the bolts, exert even and gradual torque to ensure balanced force on the cylinder head.
7. Take out the cylinder head.



8 . Take off the cylinder head gasket.

15

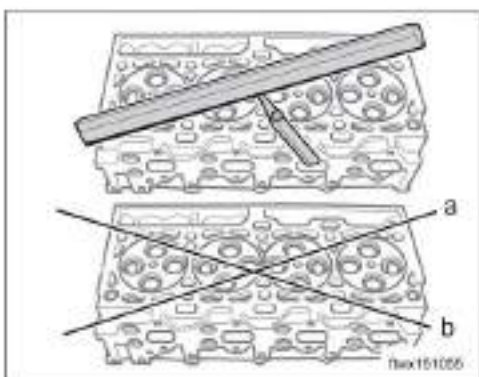
9 . Remove the valve module. (Refer to "Chapter 15 Engine mechanical system - Cylinder Head, Valve, Valve Overhaul")



10 . Clean the cylinder head and check whether there is crack or serious damage. Replace it if necessary.



11 . Blow off the residual oil and water in the thread hole of cylinder block with high-pressure air guns.



12 . Check the evenness of the cylinder head bottom with a ruler and a feeler blade. In case of excessive deformation, polish it (both cylinder head and body) or replace it.

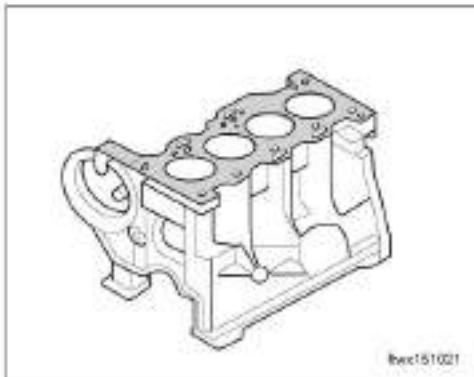
Flatness Limit: 0.15 mm



15-60

ENGINE MECHANICAL - CYLINDER HEAD, VALVE

13. Check the height of the cylinder head and replace it if unqualified.



14. Install a new cylinder head gasket.

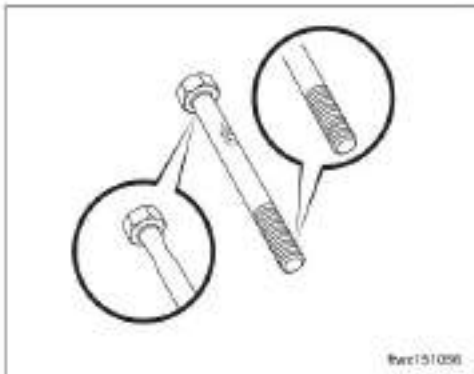
DANGER

- It is important to correctly install the cylinder gasket, with the hole aligned to that on the cylinder surface, or it may lead to serious engine damage.

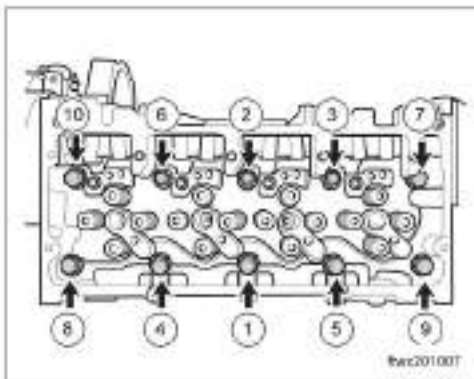
15

15. Install the valve module. (Refer to "Chapter 15 Engine mechanical system - Cylinder Head, Valve, Valve Overhaul")

16. Install the cylinder head and fix it until the dowel pin is installed.



17. Before installing the cylinder head bolts, make sure whether the bolt has any damaged threads, the corrosion surface or reduced diameter (as the bolt is stretched); if there is any of the above problems, replace the cylinder head bolt. Corrosion area: 1cm²



18. Tighten the fixing bolts of the cylinder head in the following steps and numeric sequence:

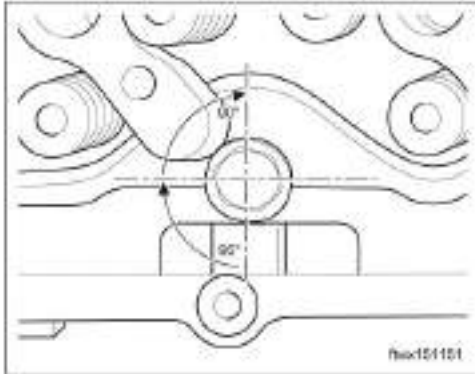
CAUTION

- Apply a proper amount of engine oil on the threaded part and gasket of the cylinder head bolts, to facilitate tightening.
- In case of excess torque, loose the bolts completely and retighten them.



ENGINE MECHANICAL - CYLINDER HEAD, VALVE

15-61

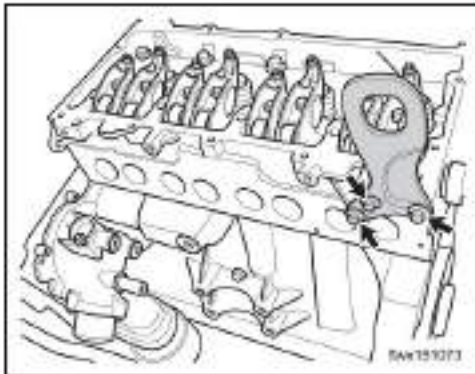


- (a) Tighten the retaining bolts of the cylinder head in numeric sequence.
Torque: 60 N•m
- (b) Draw straight lines with paint, as marks on the bolt heads and the cylinder head.
- (c) Tighten the cylinder head bolts to 90° in the sequence of tightening.
- (d) Tighten the bolts to another 90° in the same sequence and ensure the mark on the bolt head is aligned to that on the cylinder head.

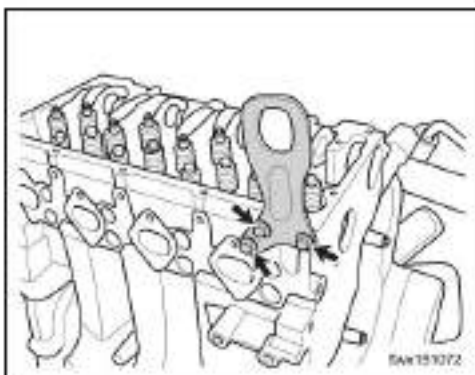
15

19 . Install the camshaft. (Refer to "Chapter 15 Engine Mechanical - Rock Arm Chamber Cover, Rock Arm, Rock Arm Cushion Block, Rock Arm Bracket & Camshaft, Camshaft overhaul ")

20 . Install the rock arm, rock arm cushion block and rock arm bracket. (Refer to "Chapter 15 Engine Mechanical - Rock Arm Chamber Cover, Rock Arm, Rock Arm Cushion Block, Rock Arm Bracket & Camshaft, Camshaft overhaul ")



- 21 . Tighten the fixing bolts of the engine rear suspension lug and the engine cylinder head.
Torque: 33 N•m



- 22 . Tighten the fixing bolts of the engine front suspension lug and the engine cylinder head.
Torque: 33 N•m

23 . Install the rock arm chamber cover. (Refer to "Chapter 15 Engine Mechanical - Rock Arm Chamber Cover, Rock Arm, Rock Arm Cushion Block, Rock Arm

- Bracket & Camshaft, rock arm chamber cover overhaul ")**
- 24 . Install the thermostat housing assembly. (Refer to "Chapter 17 Cooling - thermostat housing , replacement")**
 - 25 . Install the engine exhaust air manifold. (Refer to "Chapter 14 Intake Air - Exhaust air manifold. replacement")**

**15-62****ENGINE MECHANICAL - CYLINDER HEAD,VALVE**

- 26 . Install the engine exhaust air pipe. (Refer to "Chapter 14 Intake Air - Exhaust air pipe. replacement")**
- 27 . Install the engine intake air manifold. (Refer to "Chapter 14 Intake Air - Intake air manifold, replacement")**
- 28 . Install the engine intake air pipe. (Refer to "Chapter 14 Intake Air - Intake air pipe, replacement")**
- 29 . Install the engine accessory belt. (Refer to "Chapter 15 Engine mechanical system - engine accessory belt, overhaul")**
- 30 . Fill up the engine coolant. (Refer to "Chapter 17 Cooling - coolant, replacement")**
- 31 . Connect the battery negative cable. (Refer to "Chapter 20. Starting & Charging - battery, replacement")**

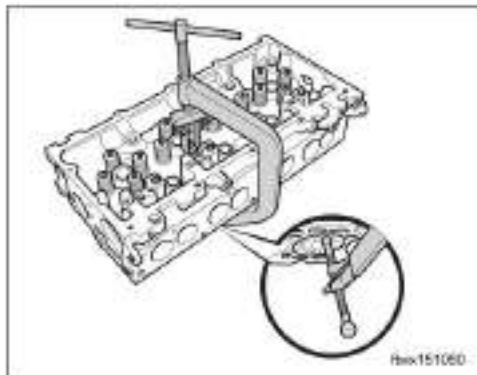


VALVE OVERHAUL

1. Remove the cylinder head. (Refer to "Chapter 15 Engine mechanical system - Cylinder Head, Valve, Cylinder Head Overhaul")

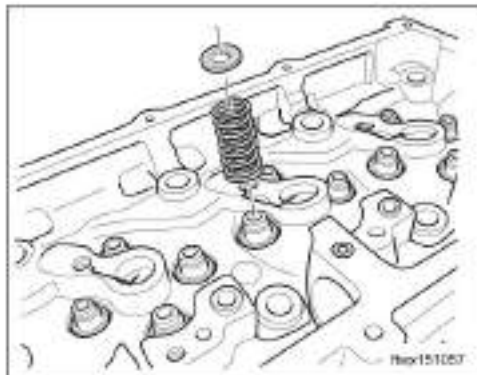
⚠ CAUTION

- Mark the removed valve, valve spring and other parts with the cylinder number and installation position. Keep them well to ease installation.

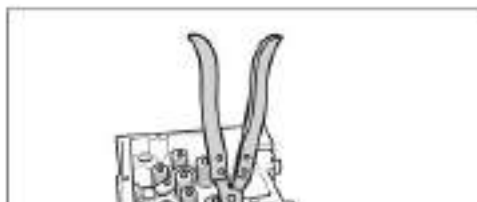


2. Use an appropriate tool to remove the valve lock.

15



3. Remove the upper valve spring retainer, the valve spring.



4. Remove the valve oil seal and then the valve.

⚠ CAUTION

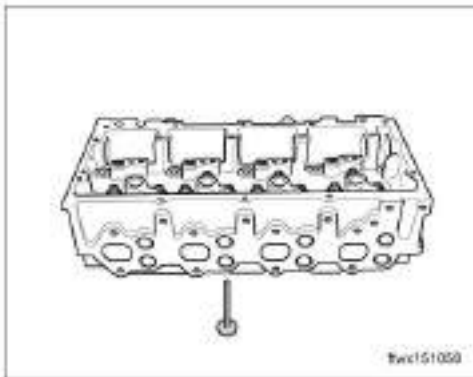
- The valve oil seal cannot be reused.



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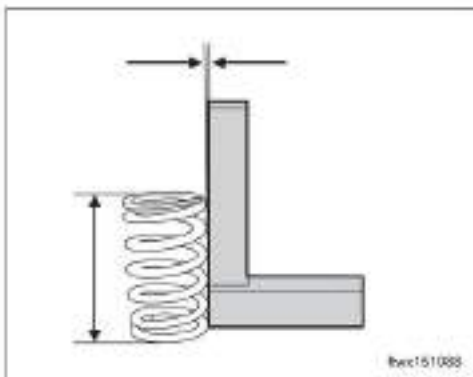
ENGINE MECHANICAL - CYLINDER HEAD, VALVE

15



5. Take down the valve.

6. Check the valve spring:



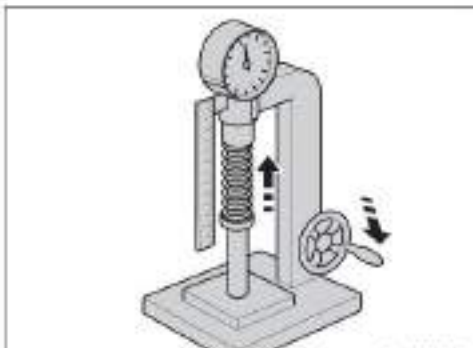
- (a) Measure the uprightness of the central line of the spring to the bottom surface. Replace it if beyond limit.

Maximum skewness: 1.5mm

- (b) Measure the free height of the valve spring. Replace it if below limit.

Standard: 42.6 mm

Limit: 50.0mm



- (c) Use the spring tester to compress the valve spring. When the spring is compressed to 31.583mm, measure the tension of the valve spring at this time. If the tension is not up to the standard value, replace the valve.

Standard: 218~242.8 Nm

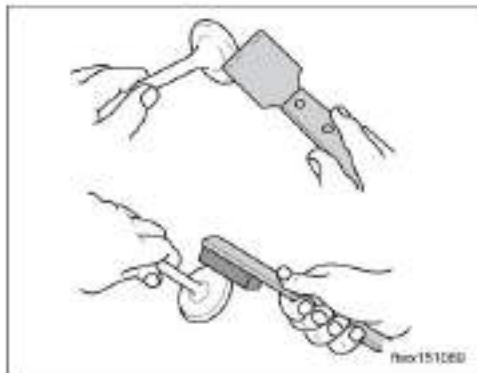


7. Check the valve:

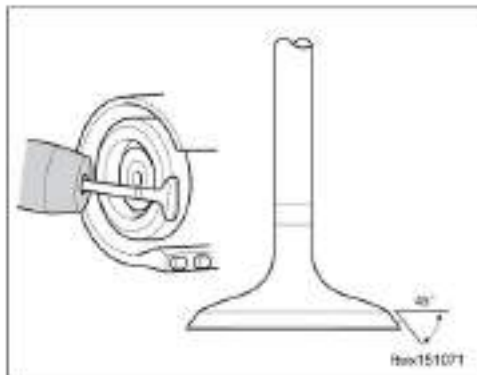


ENGINE MECHANICAL - CYLINDER HEAD, VALVE

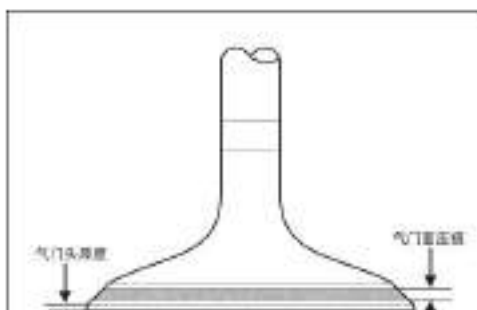
15-65



- (a) Check whether the valve has carbon deposits. If so, clean the valve thoroughly with steel brush.



- (b) Check whether the working surface of the valve and the valve seat is airtight. If not, polish it with a valve polisher. The contact surface of the valve seat shall be consistent with the center of the valve working face.
- (c) Check whether the valve has ablation, dents and carbon stains, and if so, remove them.
- (d) Check whether the angle of the valve surface is 45 degrees. If not, grind it to 45 degrees.

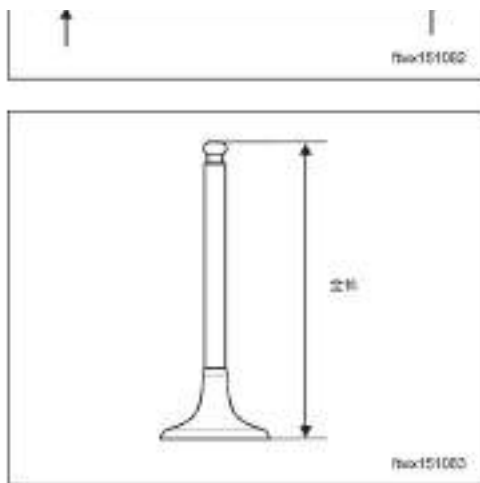


- (e) Check the valve head thickness .
 Intake valve head thickness limit: 1.10mm
 Exhaust valve head thickness limit: 1.90mm

⚠ CAUTION

If the intake or exhaust valve head thickness is less than the minimum, the replacement the valve.

15



- (h) Check the total height of the valve. Replace it if below limit:

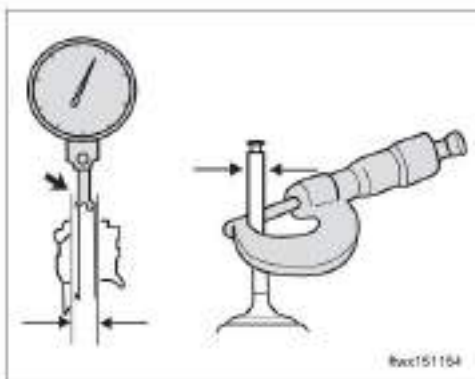
⚠ CAUTION

- If the top surface of the valve stem is worn, grind the valve surface with the grinding rod or replace the valve.
- The valve length must not be reduced to less than the minimum.



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ENGINE MECHANICAL - CYLINDER HEAD, VALVE



8. Check the clearance between the valve guide and the valve rod. Replace either or both of them if beyond limit, until the clearance meets the requirement.

Valve tappet diameter: 5.98~5.996mm

15

9. Follow the steps to replace the valve guide:

⚠ CAUTION

- Do not use a new valve guide of the same dimension as the removed one.
- Heat the cylinder head and remove the valve seat.
 - With a tool, drive out the valve guide towards the lower surface of the cylinder head.
 - Treat the valve guide hole on the cylinder head so that the diameter meets the dimension of a larger guide.

Valve hole diameter: 6.042~6.062mm

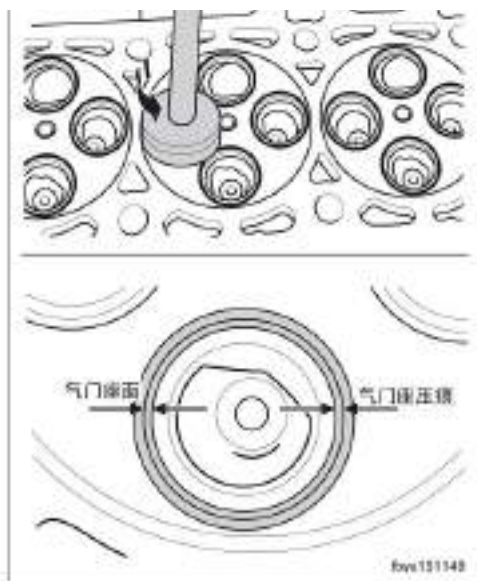
⚠ CAUTION

- If the wear of valve guide hole exceed the maximum value, or the valve guide rod id damaged, replace the cylinder cap.



10. Check the valve seat:

- Carefully fix the carbon deposits on the



- surface of the valve seat by using a 45 degree reamer.
- Check the valve seat indentation must be around 360 degrees and concentric with the valve guide and valve seat. Otherwise, the valve cone must be ground again
 - Check that the valve seat indentation is in the middle of the valve seat and the width is within the standard range. If not, trim the valve seat. (Refer to "Chapter 15 Engine mechanical system - Cylinder Head, Valve, Valve Overhaul")

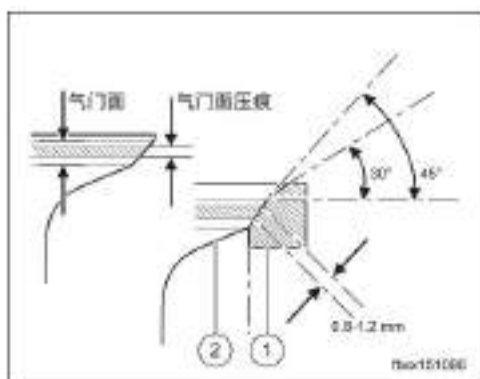
11. Finish the valve seat:



ENGINE MECHANICAL - CYLINDER HEAD, VALVE

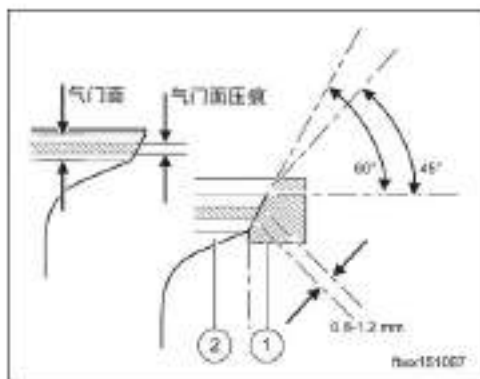
15-67

- Before finishing the valve seat, check the clearance between the valve guide and the valve rod. Finish it after replacement if necessary.



- Finish the width and angle of the valve seat to the rated values with a grinder. If the valve contact position is too high, that is, the valve face indentation is above average in the range of the valve face, corrected the valve seat with 30 degrees and 45 degrees reamer.

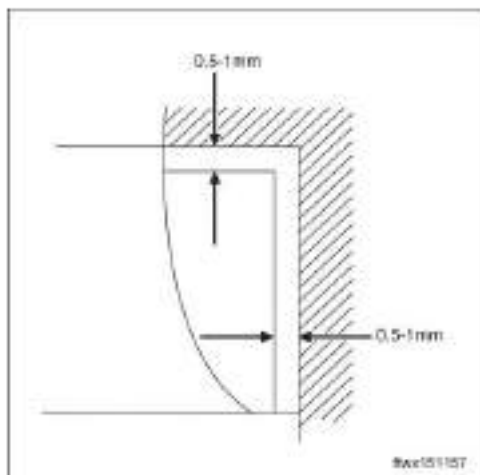
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- If the valve contact position is too low, that is, the valve face indentation is below average in the range of the valve face, corrected the valve seat with 60 degrees and 45 degrees reamer.

- The valve face indentation is the actual contact area of valve seat 1 and valve 2.
- Grind the joint plane of the valve and valve seat with the valve running in.
- Clean the valve and valve seat ring after running in.

- (d) Once finished, polish the valve and the valve seat together with abrasive. Then measure the protruded height of the valve rod.



12. Replace the valve seat:

- (a) Cut part of the valve seat to replace from inside and remove it.
 (b) Finish the valve seat hole on the cylinder head subject to the outer diameter of the larger valve seat.

Inner diameter of valve seat insert hole of cylinder head

Standard value of inside diameter (exhaust valve) of cylinder cap insert ring: 0.922~30.948mm

Standard value of inside diameter (intake valve) of cylinder cap insert ring: 33.485~33.485mm

- (c) Before installing the valve seat, heat the cylinder head to 250°C, or chill the seat in



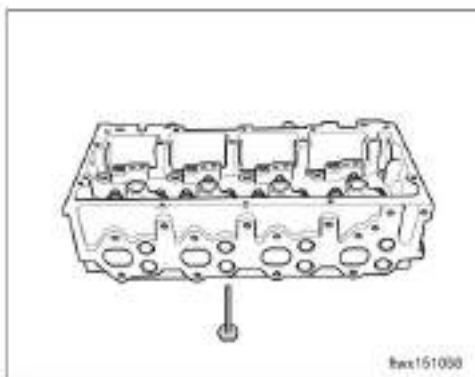
15-68

ENGINE MECHANICAL - CYLINDER HEAD, VALVE

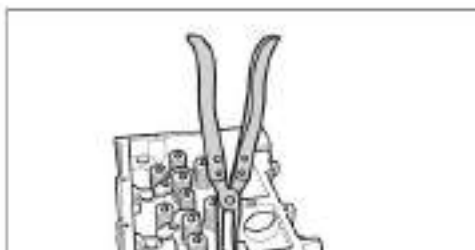
liquid nitrogen, to avoid possible blockage inside the cylinder head.

- (d) With a valve seat miller, finish the seat to rated width and angle.

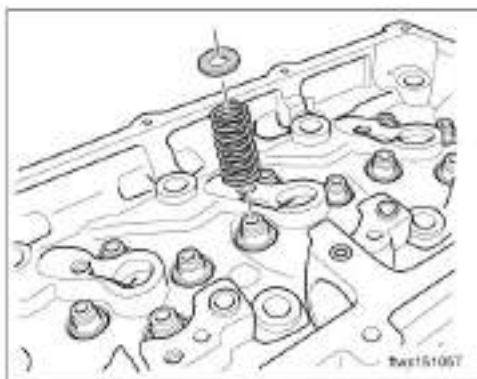
13. Install the valve as marked during removal.



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14. Install a new valve oil seal with a tool.



15 . Install the valve spring.

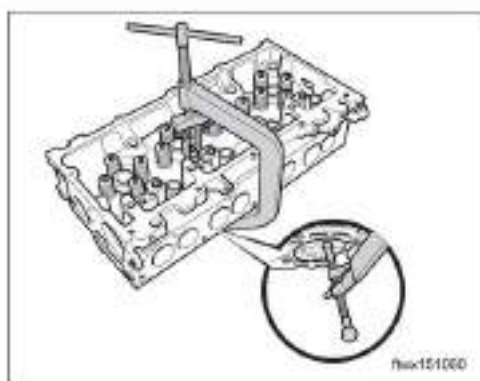
⚠ CAUTION

- **When installing the valve spring, face the color-coded end towards the upper valve spring retainer.**
- 16 . Install the upper valve spring retainer.**



ENGINE MECHANICAL - CYLINDER HEAD, VALVE

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17 . With a tool, install the valve lock.

18 . Install the cylinder head. (Refer to "Chapter 15 Engine mechanical system - Cylinder Head, Valve, Cylinder Head Overhaul")



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ENGINE MECHANICAL - CYLINDER HEAD, VALVE

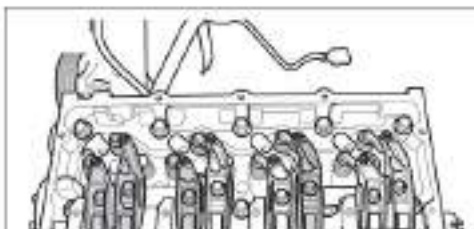
VALVE CLEARANCE CHECK AND ADJUSTMENT

⚠ CAUTION

When ambient air temperature is not higher than 30 degrees°C [86°F], let the engine cool for 1.5 hours before checking or setting the valve clearance. When ambient air temperature is higher than 30 degrees°C [86°F], let the engine cool for 2.5 hours before checking or setting the valve clearance.

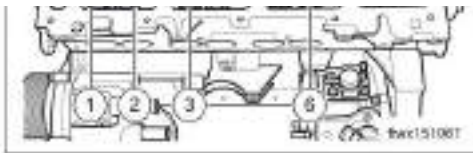
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1. Transfer the 1 cylinder piston to the top dead center of the compression stroke. (Refer to "Chapter 15 Engine Mechanical - Timing Device, Timing check and adjust")

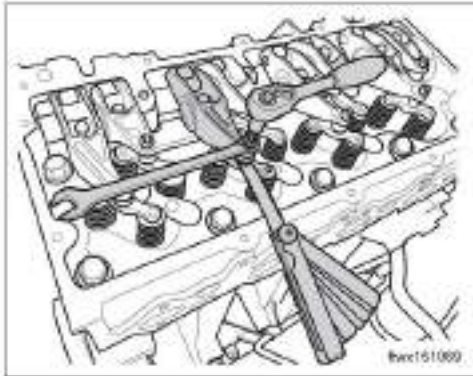


2. Do adjustment to the intake valve 1 and the exhaust valve 2 of the first cylinder; the intake valve 3 and the exhaust valve 4 of the second cylinder; the exhaust valve 6 of the third cylinder.

Intake valve clearance (nominal) :0.20~

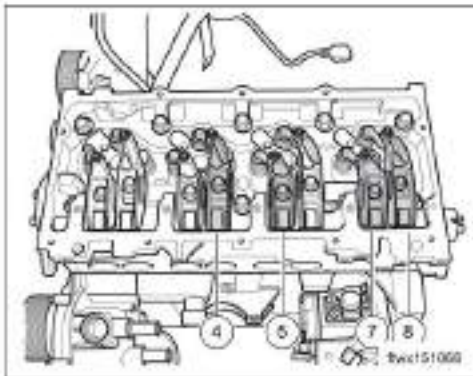


0.30mm

Exhaust valve clearance (nominal) : 0.46~
0.56mm

3. Insert the eligible the valve clearance gauge between the rock arm 1 and the rockarm cushion block 2. At the same time, loosen the corresponding rock arm lock nut 3 and rotate the screw 4 with a tool. Should make the feeler can move slightly, then tighten the lock nut 3.

Torque: 10 Nm



4. After adjustment for above valve, rotate the crankshaft to 360 degrees. Then the fourth cylinder piston is at compression stroke top dead center. Check and adjust in accordance with the same method to the exhaust valve 4 of the second cylinder, the intake valve 5 of the third cylinder, the intake valve 7 the exhaust valve 8 of the forth cylinder.

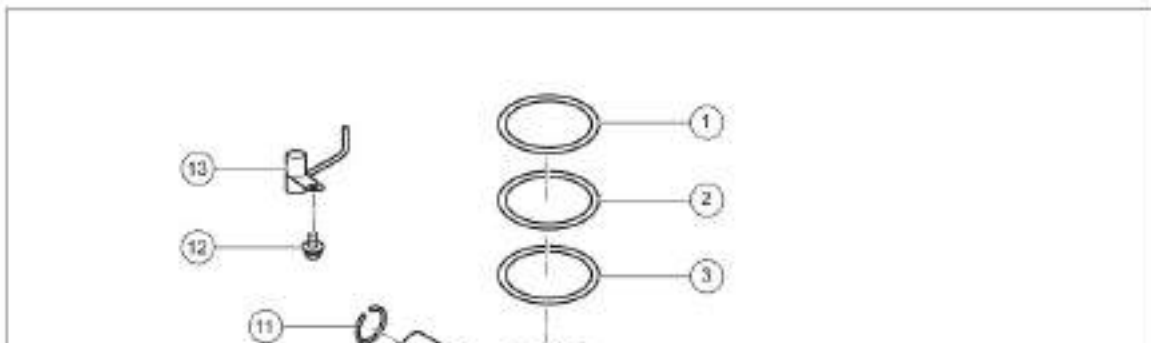
Intake valve clearance (nominal)0.20~
0.30mmExhaust valve clearance (nominal) : 0.46~
0.56mm

5. Install the rock arm chamber cover.. (Refer to "Chapter 15 Engine Mechanical - Rock Arm Chamber Cover, Rock Arm, Rock Arm Cushion Block, Rock Arm Bracket & Camshaft, rock arm chamber cover overhaul ")

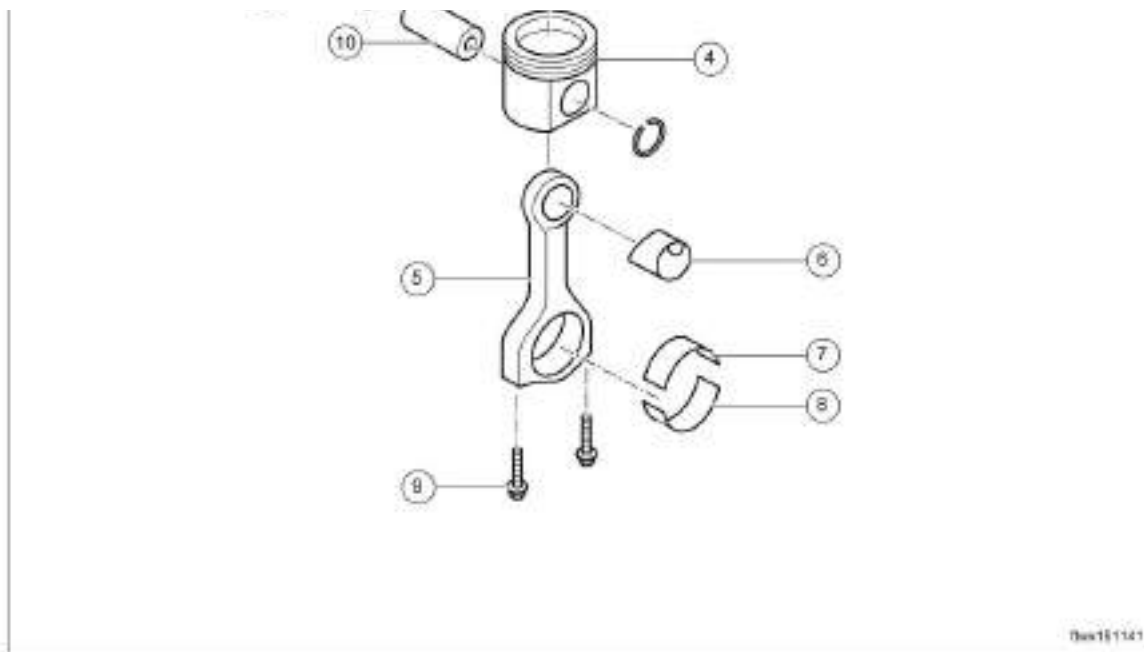


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PISTON & CONNECTING ROD ASSEMBLY COMPONENTS



15



1	1st Gas Ring
2	2nd Gas Ring
3	Oil Ring
4	Piston
5	Connecting Rod
6	Connecting Rod Small End Bushing
7	Upper Connecting Rod Bearing

8	Lower Connecting Rod Bearing
9	Connecting Rod Bolt
10	Piston Pin
11	Piston Pin Circlip
12	Bolt
13	Piston Cooling Nozzle



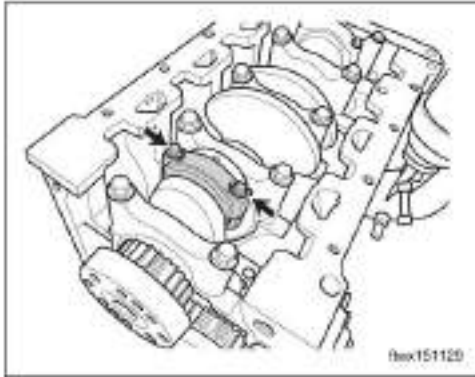
OVERHAUL

⚠ CAUTION

- In order not to confuse the installation direction and order in the cleaning and assembly of each component, assemble the piston rod assembly after removing each of the piston connecting rod groups. Mark all the piston rod groups removed and place them in sequence.

⚠ CAUTION

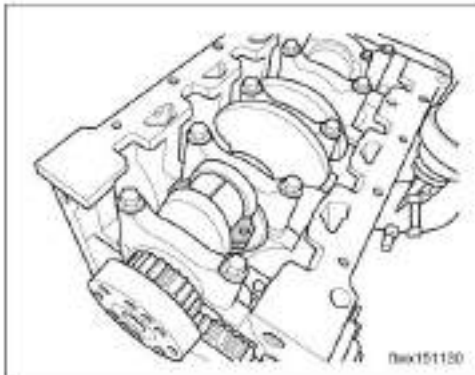
- **The following pistons and connecting rod disassembly take the fourth cylinder as an example. Other cylinder disassembly method is the same.**
1. **Remove the engine assembly. (Refer to "Chapter 15 Engine mechanical system - engine assembly, replacement(MT/AT)")**
 2. **Remove the Cylinder Head. (Refer to "Chapter 15 Engine mechanical system - Cylinder Head, Valve, Cylinder Head Overhaul")**
 3. **Remove the oil tray. (Refer to "Chapter 18 Lubrication - oil try, replacement")**
 4. **Remove piston connecting rod assembly:**



- (a) Screw out the fixing bolt, and take off the connecting rod bearing cap.

⚠ CAUTION

- **Connecting rod bolt shall not be reused and must be replaced.**



- (b) Push piston and connecting rod assembly to the side of the cylinder head.

⚠ CAUTION

- **After disassembling the piston rod, assemble the components so as not to mess up other parts of the piston connecting rod assembly.**

- (c) Separate connecting rod bearing.

5. **Use tool to remove piston pin:**



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ENGINE MECHANICAL - PISTON & CONNECTING ROD ASSEMBLY

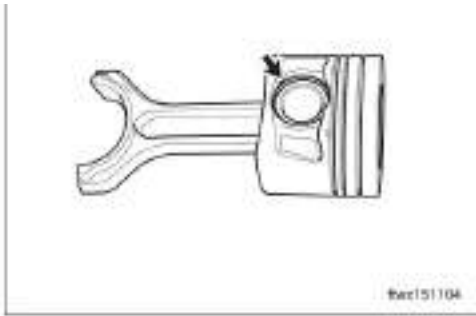
⚠ CAUTION

- **Put down the piston, the piston pin and the connecting rod in the order of cylinder number, to avoid confusion.**



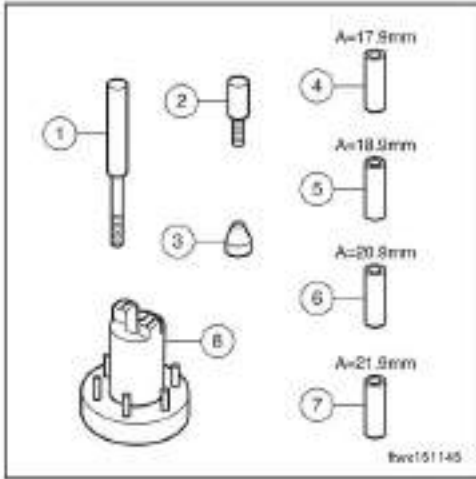
- (a) Pry out the piston pin circlip with a tool.

⚠ CAUTION



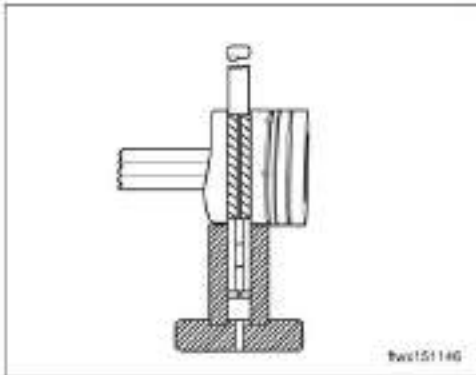
fwc151104

- The circlip needs to be replaced after disassembly, and Just remove one side.



fwc151145

1	Push Rod
2	Guide Block B
3	Guide Block C
4	Guide A
5	Block C 4
6	Guide A
7	Guide A
8	Base



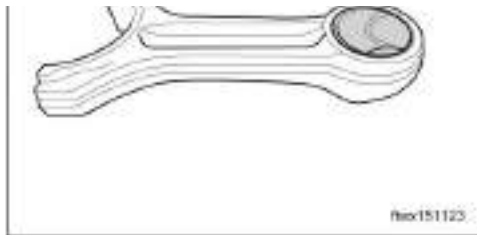
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- (b) Insert the push rod (special tool) into the piston from the side with arrow and attach the Guide Block C to the end of the push rod.
- (c) Keep the forward mark of the piston upward and install the piston & connecting rod assembly onto the base of the piston pin installer.
- (d) Press the piston pin out with pressure.

6 . Remove the connecting rod small end bushing:



- (a) Press out connecting rod small bushing from the connecting rod.



7. Piston cleaning:



- (a) Clean the carbon deposition in the piston ring groove with piston ring groove cleaner or fractured piston ring.
- (b) Thoroughly clean the piston and piston ring groove with volatile solvent and soft brush.

⚠ CAUTION

- **Can not use a steel brush to clean the piston.**

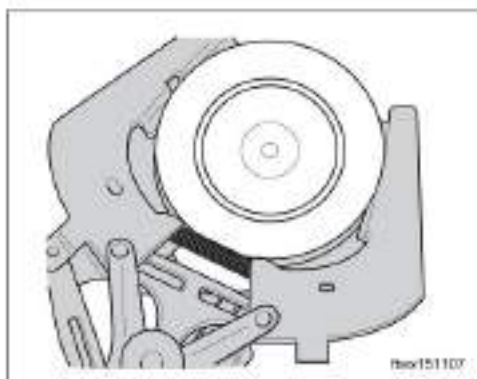
8. Remove the 1st and 2nd gas rings and the oil ring:

⚠ CAUTION

- **Clean the carbon residue on the surface of the piston and inside the gas ring, as well as the grease inside the oil ring.**
- **Be careful not to scratch the piston surface.**

⚠ CAUTION

- **Check whether there is damage, over wear or crack on the piston ring and replace it if any. If replace the piston, must replace the piston ring together.**



- (a) Remove the first gas ring and second gas rings from the piston with a piston ring expander.



- (b) Remove the oil ring and oil ring sleeve ring.

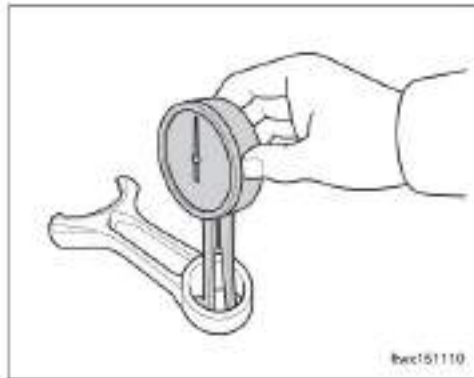
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⚠ CAUTION

- The disassembly and installation of the oil ring assembly can only be operated manually.
- Place the piston rings in the correct order.

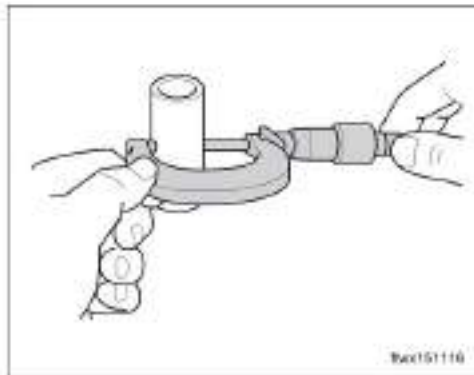
9. Check the piston pin oil film clearance:



- (a) Measure internal diameter of the connecting rod small end bush with a calipers.
- Internal diameter standard value: Minimum: 34.54mm maximum: Minimum: 34.54mm Maximum: 34.56mm

⚠ CAUTION

- Pay attention to avoid oil passages when measuring.



- (b) Measure the diameter of the piston pin with an outside micrometer.
- Diameter standard value: Minimum: 34.494mm Maximum: 34.50mm

- (c) Subtract the piston pin diameter from the inside diameter of the connecting rod small end bush to calculate piston pin oil film clearance.

⚠ CAUTION

- If the piston pin oil film clearance exceeds the maximum value, replace the connecting rod small end bush, or replace the whole set of piston and piston pin if necessary.

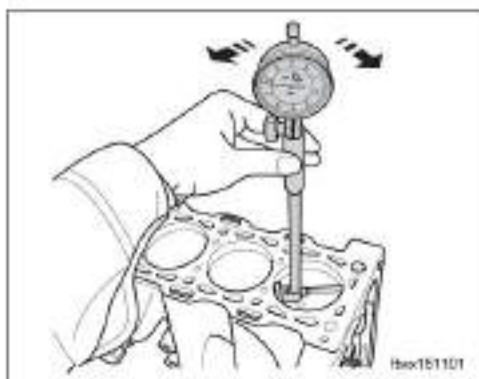
10. Check the piston oil film clearance:



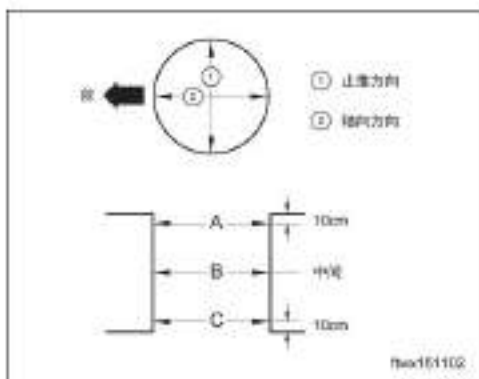


- (a) Use an outside micrometer to measure the diameter in the vertical direction of the piston pin center line and upward from the bottom to the 12mm.
- Piston diameter standard value:
 Minimum: 93.901mm
 Maximum: 93.919mm

11. Measure the diameter along the thrust direction of the cylinder:



- (a) Measure cylinder internal diameter with an inside micrometer.



- (b) Measure the internal diameter along the thrust direction in the A, B and C position.
- Cylinder hold standard bore:
 Minimum: 93.99mm
 Maximum: 94.01mm

- (c) The measured cylinder diameter minus the piston diameter to calculate the piston oil film clearance.

⚠ CAUTION

- If the piston oil film clearance exceeds the maximum value, replace 4 pistons, or replace the cylinder if necessary.

12. Check piston ring groove clearance:



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ENGINE MECHANICAL - PISTON & CONNECTING ROD ASSEMBLY

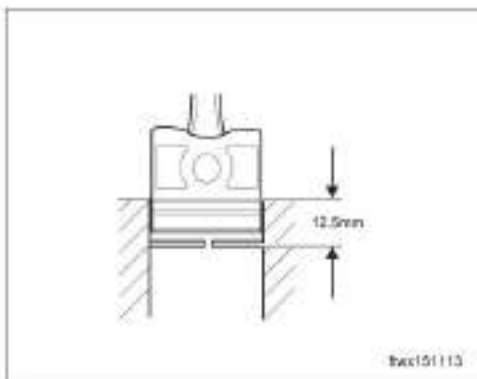


- (a) Measure the clearance between the new piston ring and the piston ring groove side with a feeler gauge.
- Second piston ring groove standard clearance:
- Minimum: 0.05mm
Maximum: 0.10mm
- Third piston ring groove standard clearance:
- Minimum: 0.04mm
Maximum: 0.09mm

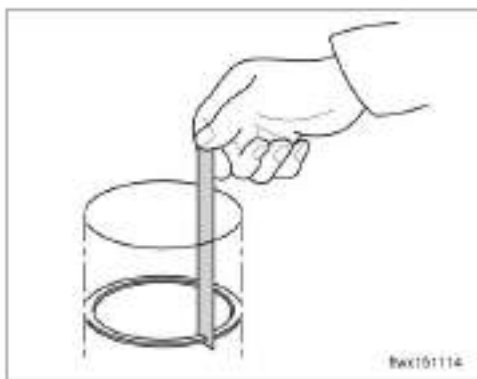
⚠ CAUTION

- If the clearance do not meet requirements, replace the piston.

13. Check Piston ring opening clearance:



- (a) Use the piston without piston ring to push the piston ring into the 12.5mm from the top of the cylinder and remove the piston.

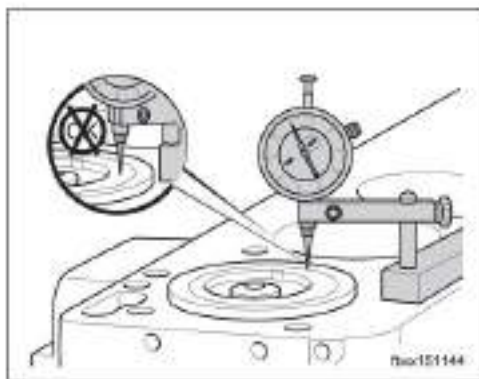


- (b) Measure the piston ring opening clearance with a feeler gauge.
- First piston ring opening standard clearance:
- Minimum: 0.26mm
Maximum: 0.36mm
- Second piston ring opening standard clearance:
- Minimum: 0.50mm
Maximum: 0.75mm
- Third piston ring opening standard clearance:
- Minimum: 0.25mm
Maximum: 0.50mm

⚠ CAUTION

- **If the opening clearance still do not meet requirements after replace a new piston ring, bore cylinder or replace the cylinder block.**

14 . Piston protrusion check:



- (a) Measuring piston protrusion with depth gauge assembly. If the piston protrusion exceeds the range, check whether the piston is mounted properly or the flatness of cylinder block.

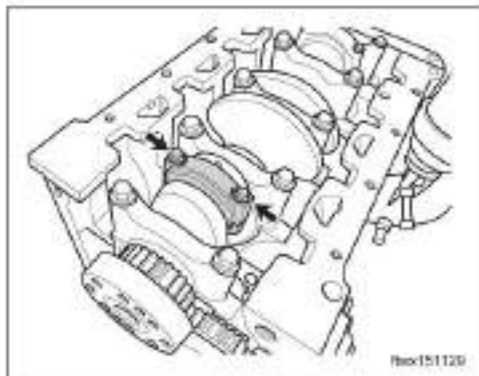
Piston protrusion standard value:

Minimum: 0.034mm

Maximum: 0.260mm

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15 . Connecting rod bearing oil clearance check:

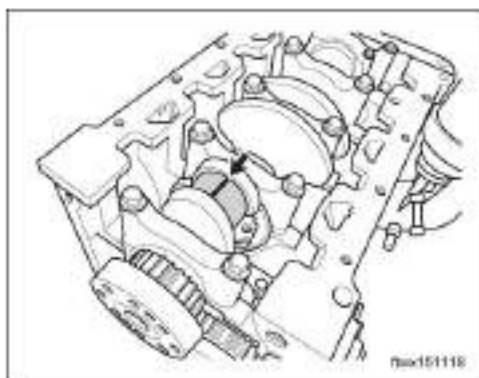


- (a) Screw out the connecting rod bearing cap fixing bolt, and take off the connecting rod bearing cap.

⚠ CAUTION

- **If the connecting rod bearing cap is difficult to be removed directly, knock it loose with the rubber hammer.**

- (b) Clean crankshaft connecting rod journal and connecting rod bearing, and check whether there is any dent or abrasion mark.

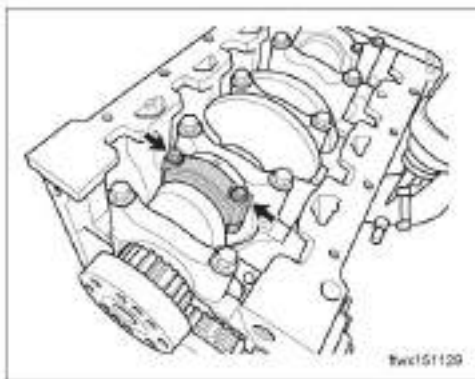


- (c) The plastic gauge at the arrow across the crank.



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ENGINE MECHANICAL - PISTON & CONNECTING ROD ASSEMBLY



- (d) Fit connecting rod bearing and connecting rod bearing cap and tighten fixing bolt.

Bolt tightening torque:

Level 1 tightening: 34Nm

Level 2 tightening: rotate 60 degrees counterclockwise

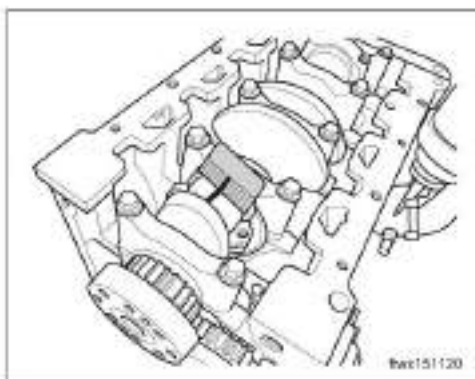
Level 3 tightening: 34Nm

Level 4 tightening: rotate 60 degrees clockwise

- (e) Remove the connecting rod bearing cap retaining bolt, remove the connecting rod bearing cap.

⚠ CAUTION

- The crankshaft must not be turned when removing and installing the connecting rod bearing cap.



- (f) Measure the width of the widest point with a plastic gauge.

Standard oil film clearance:

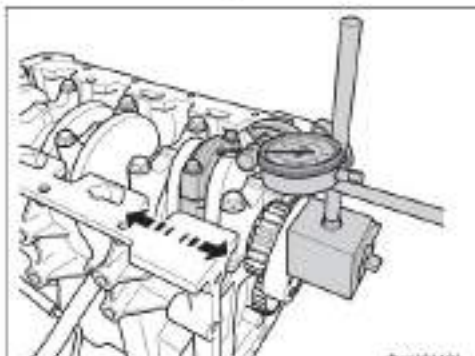
Minimum: 0.030mm

Maximum: 0.070mm

⚠ CAUTION

- If the oil film clearance is greater than the maximum value, replace the connecting rod bearing and grind the crankshaft connecting rod journal or replace the crankshaft as required.

16. Connecting rod thrust clearance check:



- (a) Dial gauge rod head vertically hold out against the connecting rod big end front plane, and adjust the dial gauge to zero.

- (b) Push the connecting rod big end along the direction of the arrow to measure the thrust clearance.

Standard thrust clearance:

Minimum: 0.100mm

Maximum: 0.35mm



⚠ CAUTION

- If the thrust clearance is greater than the maximum value, replace the connecting rod assembly. The connecting rod assembly and the crankshaft must be replaced together.

17. Fit the oil ring, the second gas ring and the first gas ring:

15

⚠ CAUTION

- Clean the carbon residue on the surface of the piston and inside the gas ring, as well as the grease inside the oil ring.
- Be careful not to scratch the piston surface.

⚠ CAUTION

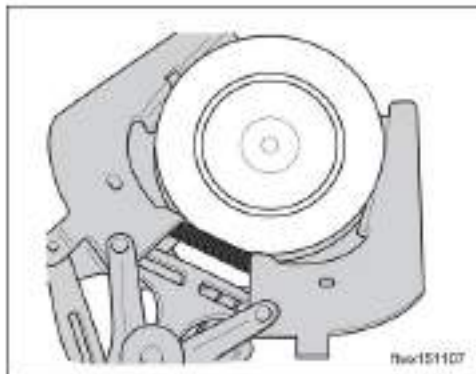
- Check the piston rings for damage, excessive wear and tear and replace if any. If replace the piston, must replace the piston ring together.



- (a) Install the oil ring and oil ring sleeve ring.

⚠ CAUTION

- The disassembly and installation of the oil ring assembly can only be operated manually.
- Place the piston rings in the correct order.



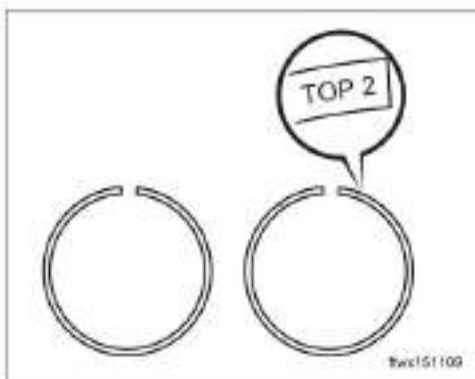
- (b) Install the first gas ring and second gas rings with a piston ring expander.



15-82

ENGINE MECHANICAL - PISTON & CONNECTING ROD ASSEMBLY

15



- (c) After installing each piston ring, check whether it can rotate smoothly in the piston ring groove.

⚠ CAUTION

- The first gas ring without any mark, the second air ring with identification mark "TOP 2".
- During installation, the gas ring identification mark shall be directed toward the top of the piston.

18 . Fit the piston pin with a tool:



- (a) Press the connecting rod small bush into the connecting rod.

⚠ CAUTION

- When installing, the bevel of the connecting rod small end bush is aligned with the bevel of the connecting rod small end.



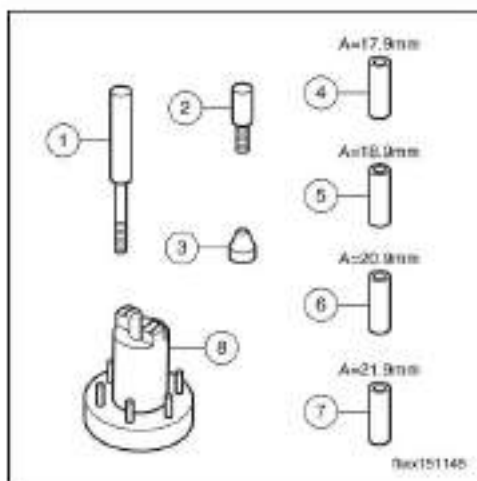
- (b) Apply clean oil to the surface of the piston pin, and push the piston pin into the connecting rod by hand, then check that whether the connecting rod small bush is properly installed.

19 . Install the piston pin with a tool:



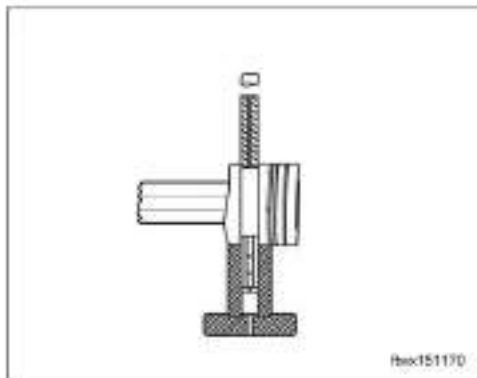
ENGINE MECHANICAL - PISTON & CONNECTING ROD ASSEMBLY

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1	Push Rod
2	Guide Block B
3	Guide Block C
4	Guide A
5	Guide A
6	Guide A
7	Guide A
8	Base

15



- Insert the push rod (special tool) into the piston from the side with arrow and attach the Guide Block C to the end of the push rod.
- Keep the forward mark of the piston upward and install the piston & connecting rod assembly onto the base of the piston pin installer.
- Press the piston pin out by force.



- When assembling pistons and connecting rods, note that the lug arrow A on the piston and the lug arrow B on the connecting rod are on different sides.

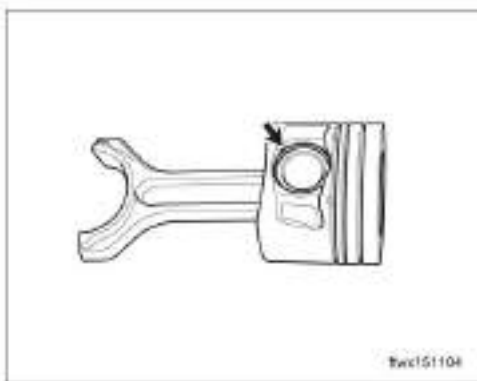
⚠ CAUTION

- When installing the piston pin, apply clean oil to the moving friction parts.



15-84 ENGINE MECHANICAL - PISTON & CONNECTING ROD ASSEMBLY

15

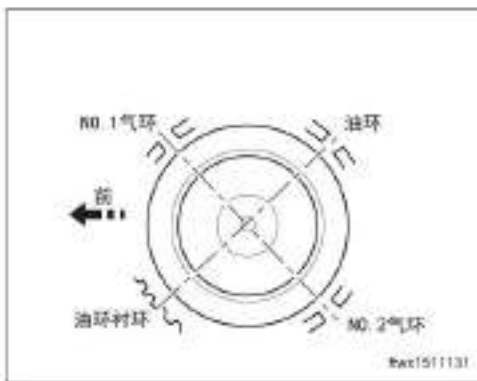


(e) Install a new piston pin circlip.

20 . Fit piston connecting rod assembly:

⚠ CAUTION

- Before installing the piston, clean piston connecting rod, cylinder and crankshaft journal, lubricate surface with clean engine oil.



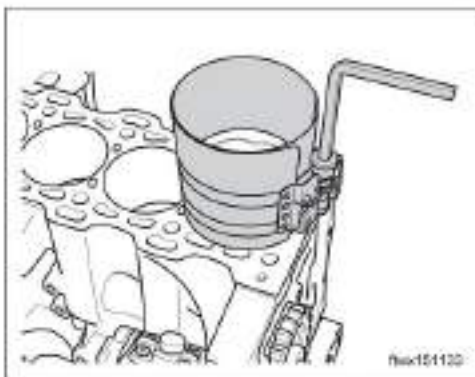
(a) Adjust the openings of piston rings to the position shown.

(b) Assemble the connecting rod bearing.

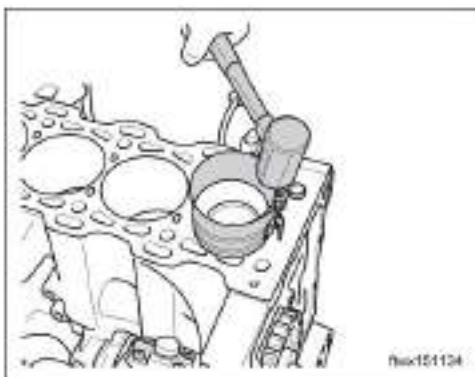
(c) Confirm the mark during the disassembly, do not mix the cylinders pistons, and connecting rod components.



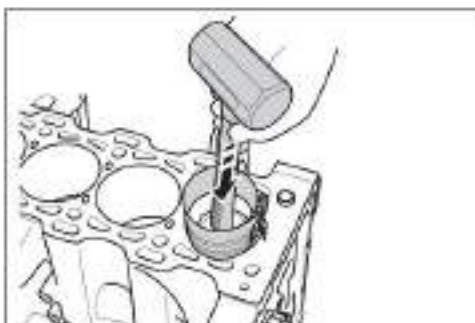
(d) When installing, put the lug on the connecting rod toward the front of the engine.


ENGINE MECHANICAL - PISTON & CONNECTING ROD ASSEMBLY
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- (e) Use piston mounting tool to tighten the piston ring.



- (f) Use a rubber hammer to lightly knock a few turns along the ring opening of the piston mounting tool so that the other side of the piston mounting tool is attached to the end of the cylinder tightly.



- (g) Push the piston into the cylinder carefully with the rubber hammer bar in the direction of the arrow that perpendicular to the top of the piston .

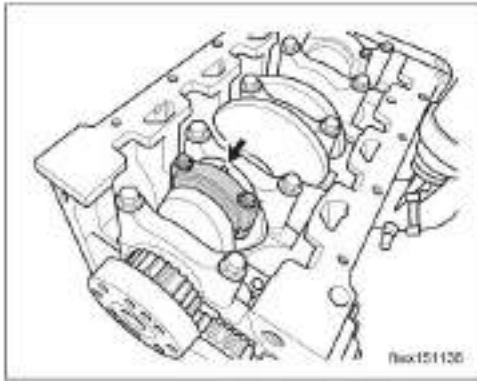
⚠ CAUTION

- During installing the piston rod assembly into the cylinder, note that the connecting rod big end don't scrap crankshaft

15



connecting rod journal. Can hold the connecting rod big end by hand.



- (h) Fit the connecting rod bearing cover assembly, makes its raised arrow facing the front.

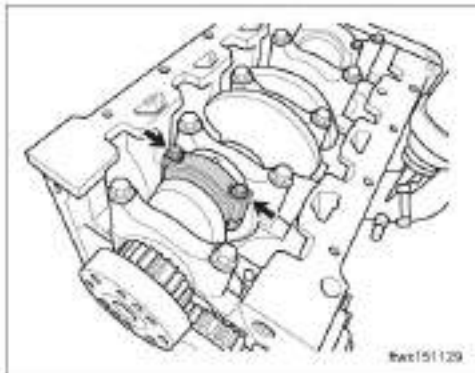
CAUTION

- **The front refers to the engine belt side, also the vehicle front direction.**



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ENGINE MECHANICAL - PISTON & CONNECTING ROD ASSEMBLY



- (i) Tighten the fixing bolts.
Bolt tightening torque:
Level 1 tightening: 34Nm
Level 2 tightening: rotate 60 degrees counterclockwise
Level 3 tightening: 34Nm
Level 4 tightening: rotate 60 degrees clockwise

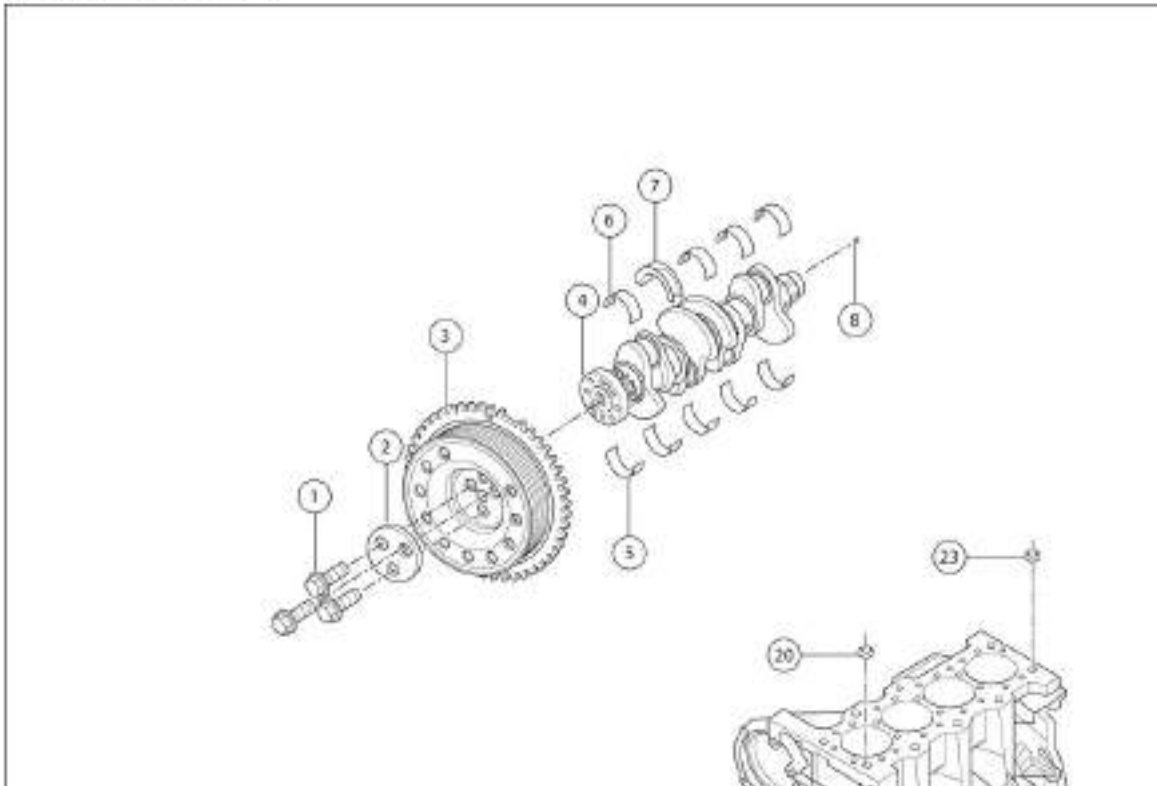
CAUTION

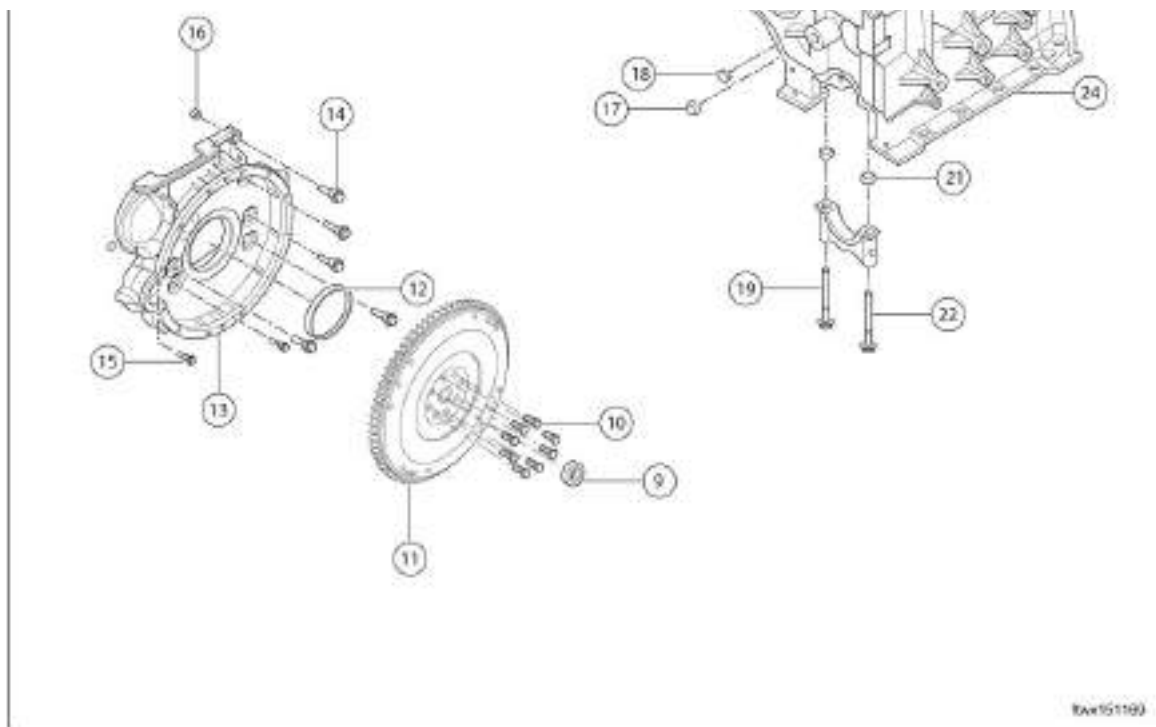
- If the bolt is deformed or damaged, replace the bolt.
 - Apply a thin layer of oil under the threaded and connecting rod bearing cap bolts.
 - If any bolt can not be locked to the specified torque, replace the entire set of connecting rod and connecting rod bearing cap fixing bolts.
 - Check whether the rotation of crankshaft is smooth. Install the oil tray.
- 21 . Install the oil tray. (Refer to "Chapter 18 Lubrication - oil try, replacement")
22 . Install the Cylinder Head. (Refer to "Chapter 15 Engine mechanical system - Cylinder Head, Valve, Cylinder Head Overhaul")
23 . Install the engine assembly. (Refer to "Chapter 15 Engine mechanical system - engine assembly, replacement(MT/AT)")



ENGINE MECHANICAL - FLYWHEEL, FLYWHEEL HOUSING, CYLINDER BLOCK & CRANKSHAFT 15-87

FLYWHEEL, FLYWHEEL HOUSING, CYLINDER BLOCK & CRANKSHAFT COMPONENTS





15-26 ENGINE MECHANICAL - FLYWHEEL, FLYWHEEL HOUSING, CYLINDER BLOCK & CRANKSHAFT

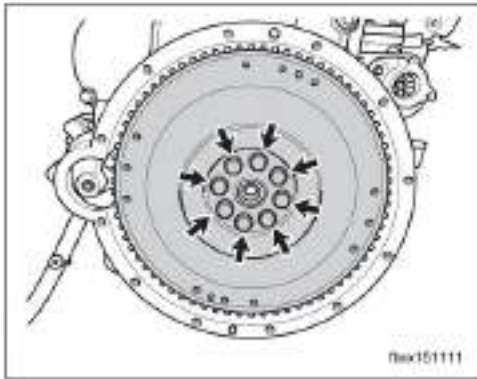
1	Crankshaft Pulley Bolt
2	Crankshaft Pulley Plate
3	Crankshaft Pulley
4	Crankshaft
5	Upper Crankshaft Bearing
6	Lower Crankshaft Bearing
7	Crankshaft Thrust Washer
8	Dowel Pin
9	Bearing
10	Flywheel Bolt
11	Flywheel
12	Crankshaft Rear Oil Seal

13	Flywheel Housing
14	Flywheel Housing Fixing Bolt
15	Flywheel Housing Fixing Bolt
16	Dowel Pin
17	Dowel Pin
18	Dowel Block
19	Crankshaft Bolt
20	Dowel Pin
21	Dowel Pin
22	Crankshaft Bolt
23	Dowel Pin
24	Cylinder Block

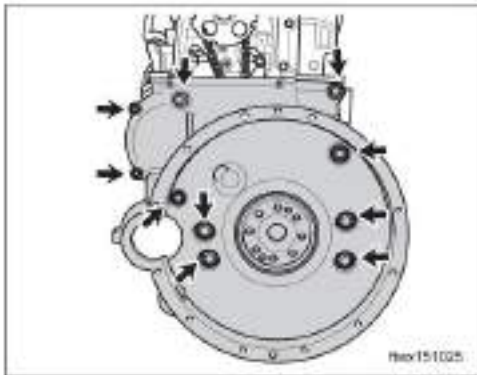


ENGINE MECHANICAL - FLYWHEEL, FLYWHEEL HOUSING, CYLINDER BLOCK & CRANKSHAFT**OVERHAUL**

1. Remove the engine assembly. (Refer to "Chapter 15 Engine mechanical system - engine assembly, replacement")
2. Remove the cylinder head. (Refer to "Chapter 15 Engine mechanical system - Cylinder Head, Valve, Cylinder Head Overhaul")
3. Remove the oil try. (Refer to "Chapter 18 Lubrication - oil try, replacement")
4. Remove the generator. (Refer to "Chapter 20 Starting & Charging - generator, overhaul")
5. Remove the starter. (Refer to "Chapter 20 Starting & Charging - starter, overhaul")
6. Remove the A/C compressor. (Refer to "Chapter 61 heater and air conditioning -condenser , overhaul")
7. Remove the steering oil pump. (Refer to "Chapter 52 Steering -steering oil pump assembly, replacement")
8. Remove high the pressure fuel pump. (Refer to "Chapter 12 Steering -Fuel, high pressure fuel pump, replacement")
9. Remove the timing sprocket. (Refer to "Chapter 15 Engine Mechanical - Timing Device, Timing chain and guide rail replacement")
10. Remove the piston connecting rod assembly. (Refer to "Chapter 15 Engine mechanical system - Piston & Connecting Rod Assembly, overhaul")
11. Remove the flywheel and flywheel housing.



- (a) Fix the flywheel with the tool, screw out the flywheel fixing bolt and take off the flywheel.

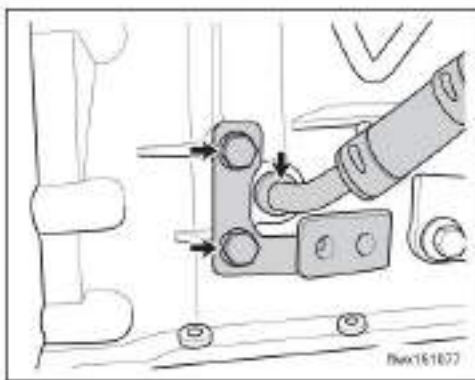


- (b) Screw out the fixing bolts of the flywheel housing, and take off the flywheel housing.

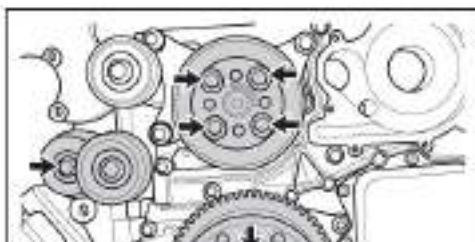
12. Remove the cylinder block:



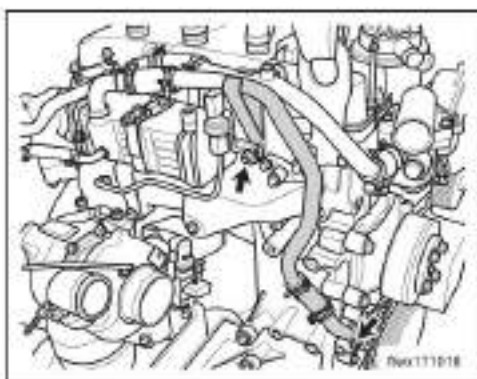
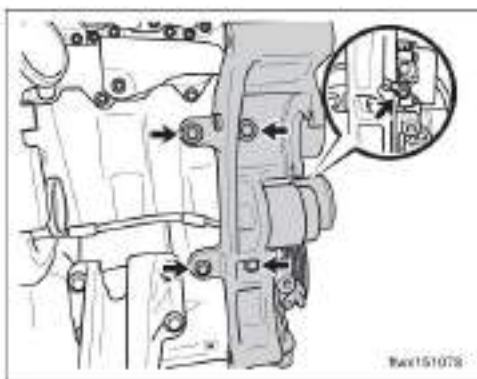
15-00 ENGINE MECHANICAL - FLYWHEEL, FLYWHEEL HOUSING, CYLINDER BLOCK & CRANKSHAFT



- (a) Remove the fixing bolts of the catalytic converter and remove the bracket.
 (b) Lever off the return line of the turbocharger.



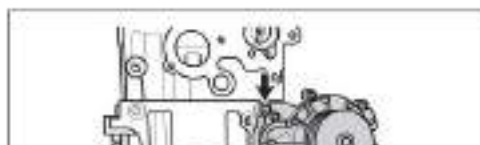
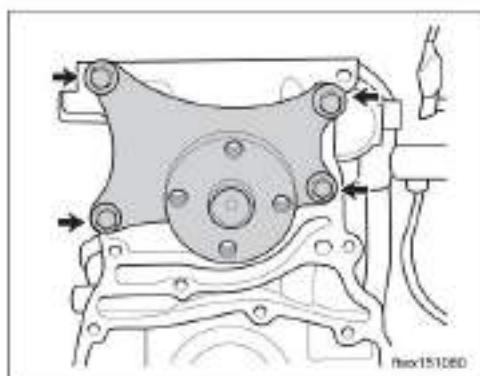
- (b) Screw out the fan pulley fixing bolts and remove the fan pulley.
 (c) Screw out the tensioner fixing bolts and remove the tensioner.
 (d) Screw out the crankshaft pulley fixing bolts and remove the crankshaft pulley.



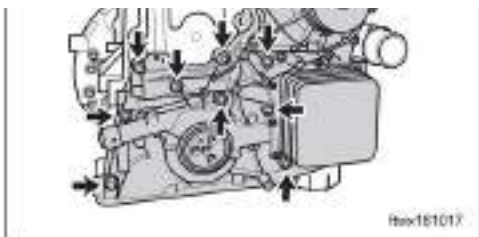
- (e) Screw out the engine bracket fixing bolts and remove the engine bracket.
- (f) Screw out the fixing bolts of the turbocharger oil supply pipe and cylinder block, and remove the turbocharger oil supply pipe.
- (g) Screw out the fixing bolts of the EGR cooler coolant supply pipe and cylinder block, and disengage connection of the EGR cooler coolant supply pipe and cylinder block.



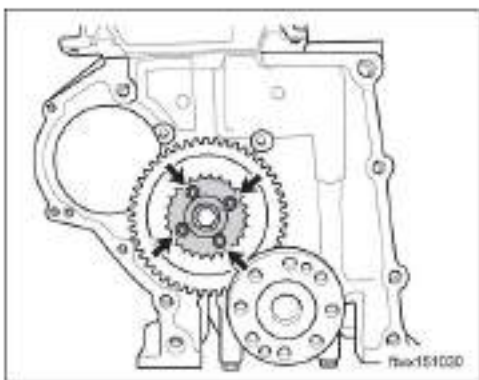
ENGINE MECHANICAL - FLYWHEEL, FLYWHEEL HOUSING, CYLINDER BLOCK & CRANKSHAFT



- (h) Screw out the fixing bolts of the middle idler bracket, and remove the middle idler bracket.
- (i) Screw out the fixing bolts of the engine oil pump cover, and remove the engine oil pump cover.

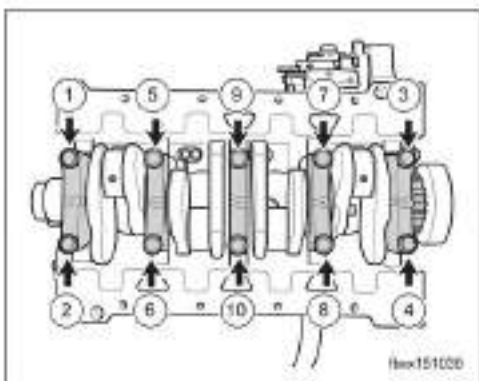


- (j) Screw out the fixing bolts of the timing middle gear , and remove the timing middle gear.

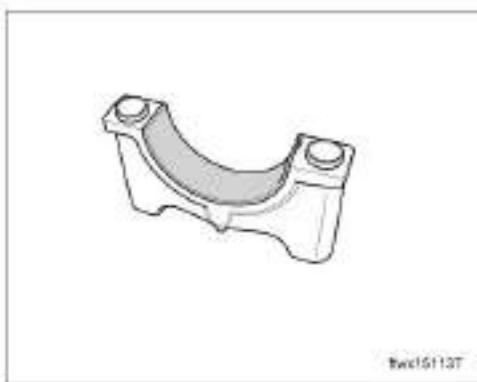


13 . Remove the camshaft:

- (a) Tighten the retaining bolts of the crankshaft main bearing cap in numeric sequence from 1 to 10.



15-02 ENGINE MECHANICAL - FLYWHEEL, FLYWHEEL HOUSING, CYLINDER BLOCK & CRANKSHAFT

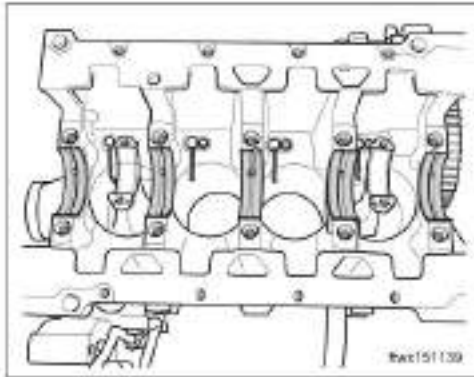
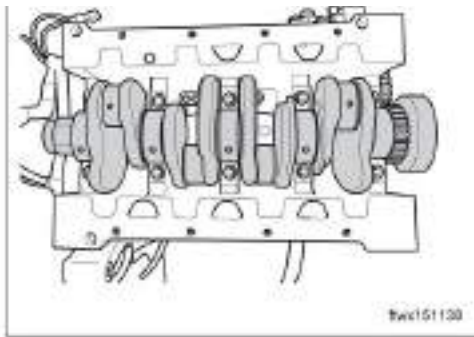


- (b) Remove the crankshaft main bearing from the crankshaft main bearing cap.

⚠ CAUTION

- Check if the crankshaft main bearing is abnormally worn, and replace it if necessary.
- The main crankshaft bearings shall be placed in order and must not be confused.

- (c) Take out crankshaft in the vertical direction.

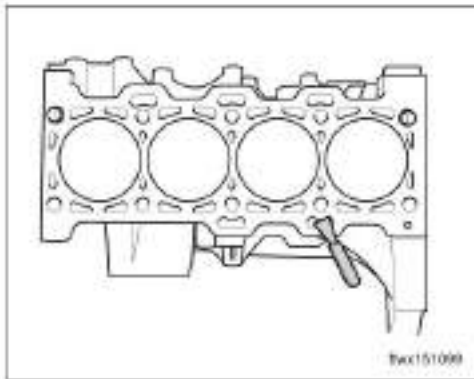


- (d) Take off the crankshaft main bearing.

⚠ CAUTION

- Check if the crankshaft main bearing is abnormally worn, and replace it if necessary.
- The main crankshaft bearings shall be placed in order and must not be confused.

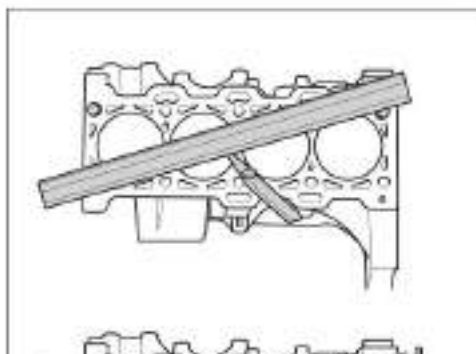
14. Cylinder block check:



- (a) Use a scraper to remove all the remains of the cylinder surface.
- (b) Check whether there is any leak in the hole.
- (c) Check whether the cylinder body has cracks and whether the installation plane has severe scratches.



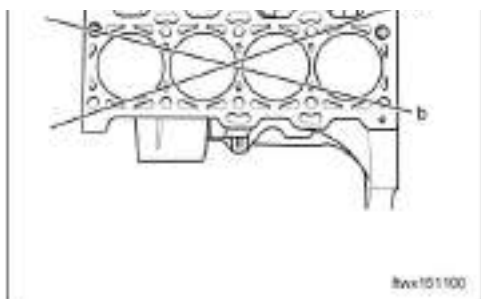
ENGINE MECHANICAL - FLYWHEEL, FLYWHEEL HOUSING, CYLINDER BLOCK & CRANKSHAFT



- (d) Along diagonal a, b, check the cylinder head flatness with a ruler and a feeler blade.
Flatness maximum: 0.010mm

⚠ CAUTION

- If the flatness exceeds the maximum, replace the cylinder block.

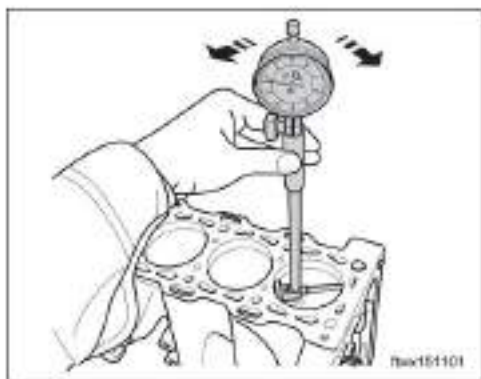


15. Cylinder check:

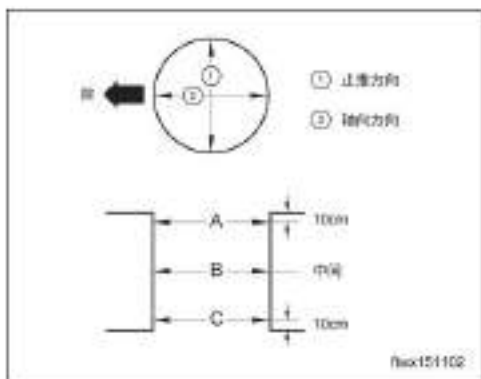
(a) Visually inspect whether there is a vertical scratch in the inner wall of the cylinder.

⚠ CAUTION

- If any, replace the cylinder.



(b) Measuring cylinder bore with a dial gage.



(c) Measure the thrust and axial bore of the cylinder at the positions of A, B and C.

Cylinder bore:

Minimum: 93.99mm

Maximum: 94.01mm

⚠ CAUTION

- If it exceeds the maximum, replace the cylinder block when necessary.



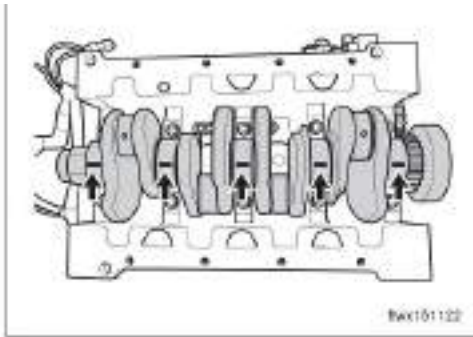
15-04 ENGINE MECHANICAL - FLYWHEEL, FLYWHEEL HOUSING, CYLINDER BLOCK & CRANKSHAFT

16. Crankshaft bearing oil clearance check:

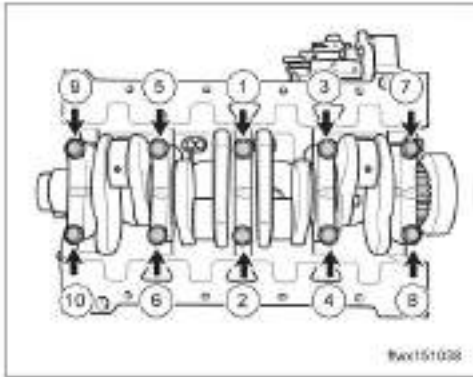
⚠ CAUTION

- Clean crankshaft journal, crankshaft bearing and bearing cap and wipe off oil on the surface.

(a) Fit crankshaft upper bearing on cylinder block



- (b) The plastic gauge arrow across the crankshaft journal.



- (c) Fit the crankshaft main bearing and bearing cap. Apply a thin layer of clean oil on the screw thread of the crankshaft bearing cap bolt and screw in the bolt by hand.
- (d) As cross order in accordance with the diagram, tighten the crankshaft bearing cap bolts evenly.

Bolt tightening torque:

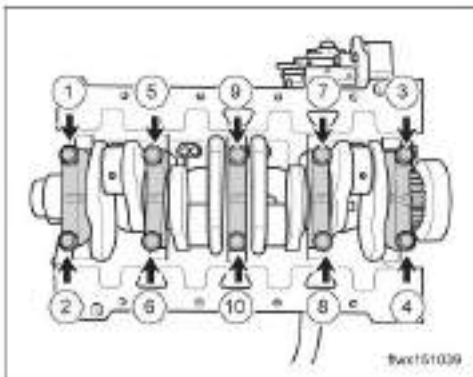
Level 1 tightening: 50 Nm

Level 2 tightening: 80 Nm

Level 3 tightening: clockwise rotate 90 degrees

⚠ CAUTION

- If the bolt cannot be tightened to the specified torque, replace it.



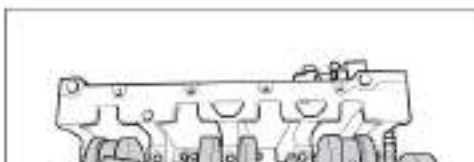
- (e) As shown in the diagram, screw out crankshaft bearing cap bolts evenly and take off the crankshaft bearing cap.

⚠ CAUTION

- The crankshaft must not be rotated during the installation and removal of the crankshaft bearing cap.



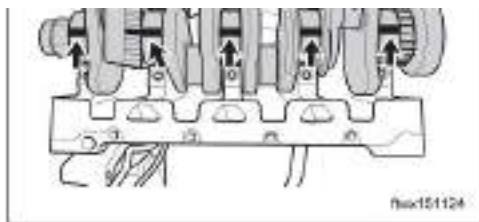
ENGINE MECHANICAL - FLYWHEEL, FLYWHEEL HOUSING, CYLINDER BLOCK & CRANKSHAFT



- (f) Measure the width of the widest point with a plastic gauge.

Standard oil film clearance:

Minimum: 0.041mm



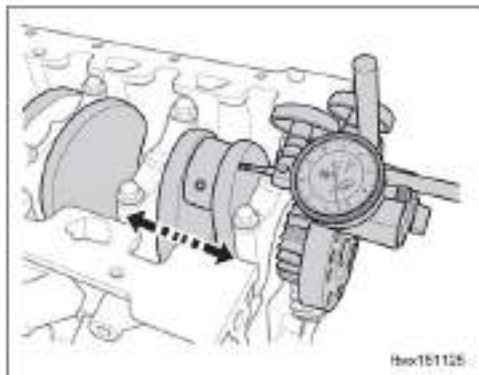
Maximum: 0.105mm

CAUTION

- If the oil film clearance is bigger than maximum, replace the crankshaft bearing.

15

17. Crankshaft thrust clearance check:



- Install gauge and bracket, stand against crank pin side plane with dial gauge top rod, then adjust the dial gauge to zero.
- Drive the crankshaft in the direction of the arrow and measure its thrust clearance.

Standard thrust clearance:

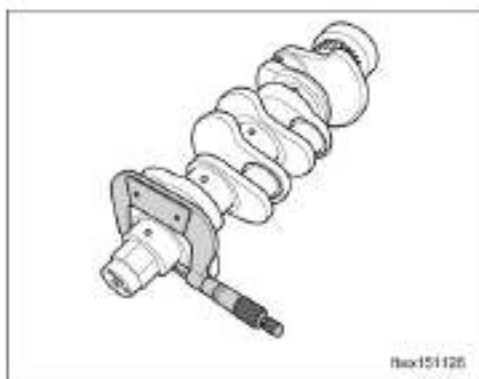
Minimum: 0.115mm

Maximum: 0.365mm

CAUTION

- If the thrust clearance is greater than the maximum, replace the crankshaft or replace the cylinder block.

18. Crankshaft journal check:



- Measure crankshaft journal diameter with a dial gauge.
Crankshaft journal diameter standard value:
Minimum: 73.987mm
Maximum: 74.013mm

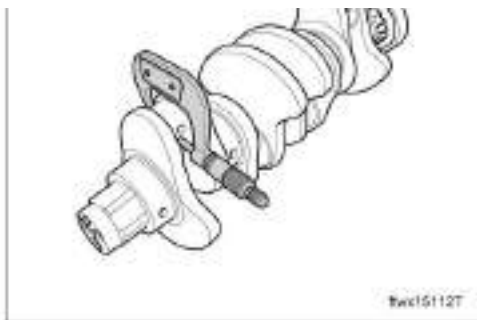
CAUTION

- If the crankshaft connecting rod journal diameter does not meet the standard, then replace the crankshaft.



- Measure crankshaft connecting rod journal diameter with a dial gauge.

15



Crankshaft connecting rod journal diameter standard value:

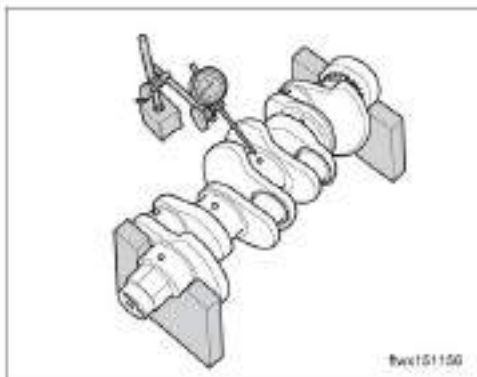
Minimum: 58.990mm

Maximum: 59.010mm

⚠ CAUTION

- If the crankshaft connecting rod journal diameter does not meet the standard, then replace the crankshaft.

19 . Crankshaft roundness check:



(a) Place the crankshaft on the V shaped block.

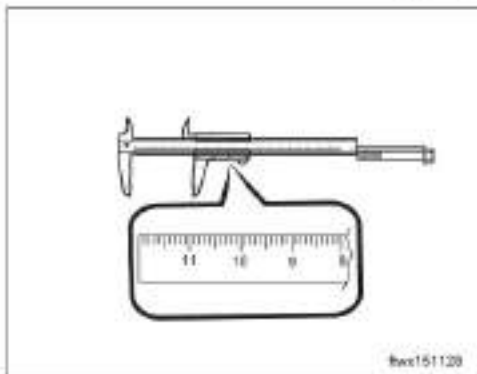
(b) Measure the intermediate shaft neck roundness with a dial gage.

Roundness maximum: 0.01mm

⚠ CAUTION

- If the crankshaft roundness exceeds the maximum value, replace the crankshaft.

20 . Crankshaft main bearing cap bolt check:



(a) Measure bolt length of main bearing cap with the vernier caliper.

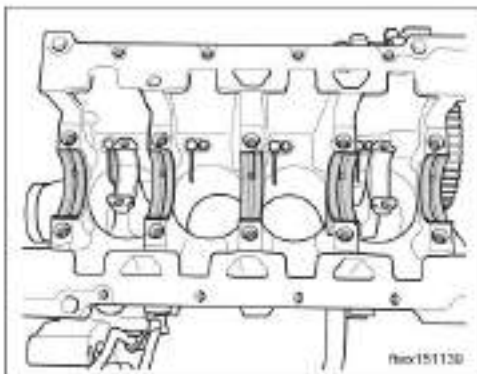
Maximum length: 119.25mm

⚠ CAUTION

- If the length of the main bearing cap bolt is bigger than the maximum length, replace the bolt.

21 . Fit crankshaft:



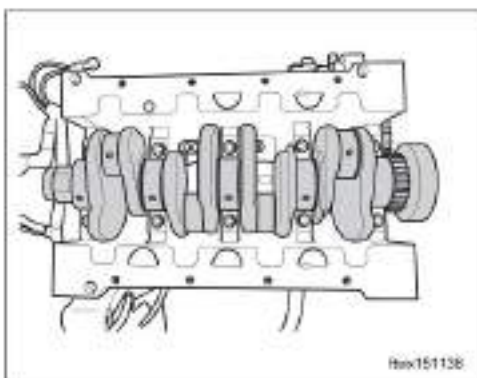


(a) Fit crankshaft main bearing.

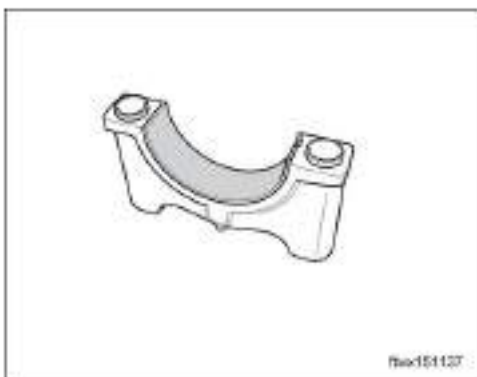
CAUTION

- Check if the crankshaft main bearing is abnormally worn and replace if necessary.

15



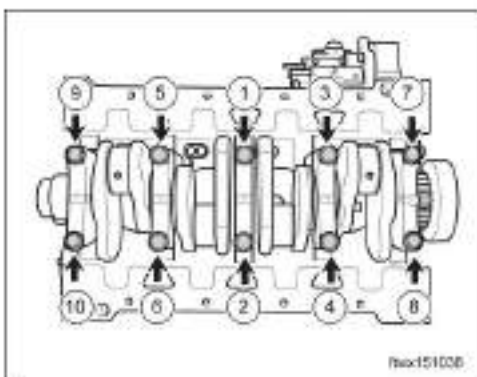
(b) Fit crankshaft in the vertical direction.



(c) Fit the crankshaft main bearing on the crankshaft main bearing cap.

CAUTION

- Check if the crankshaft main bearing is abnormally worn and replace if necessary.



(d) Install the camshaft main bearing, and tighten the retaining bolts of the crankshaft main bearing cap in numeric sequence.

Bolt tightening torque:

level 1 tightening: 50 Nm

Level 2 tightening: 80 Nm

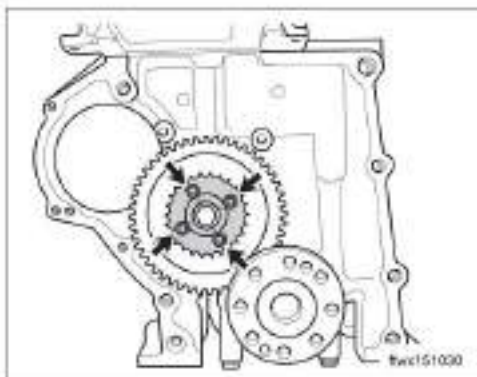
Level 3 tightening: clockwise rotate 90 degrees

22. Install the cylinder block:

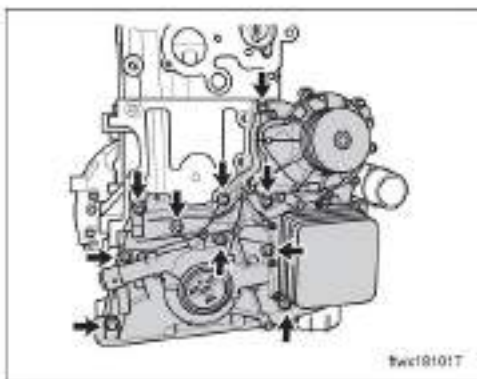


15-06 ENGINE MECHANICAL - FLYWHEEL, FLYWHEEL HOUSING, CYLINDER BLOCK & CRANKSHAFT

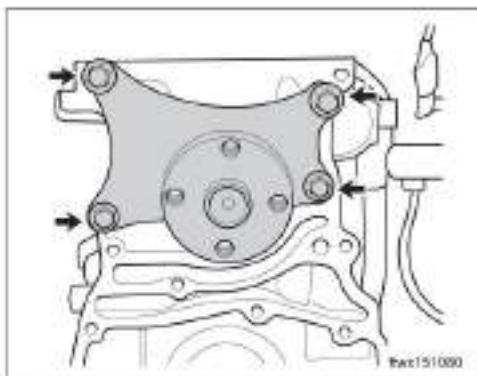
15



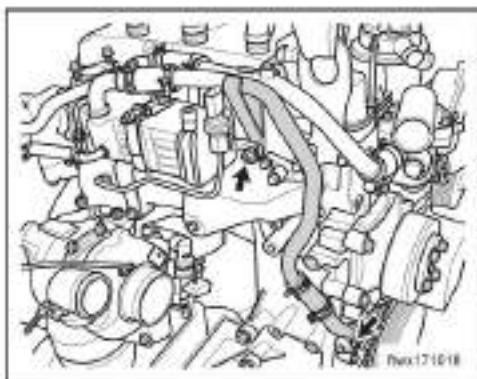
- (a) Install the timing middle gear, tighten the fixing bolts of the timing middle gear.



- (b) Install the engine oil pump cover, tighten the fixing bolts of the engine oil pump cover.



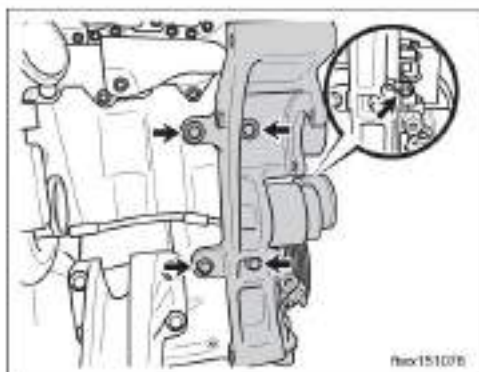
- (c) Install the middle idler bracket, tighten the fixing bolts of the middle idler bracket.



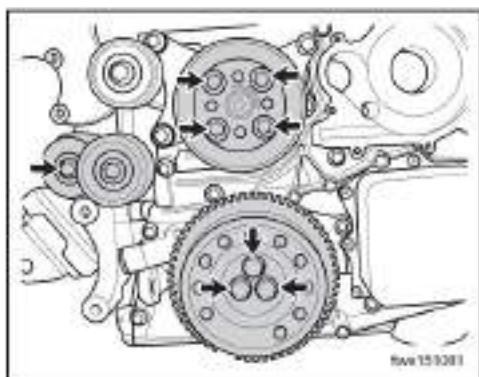
- (d) Connect the EGR cooler coolant supply pipe and cylinder block, tighten the fixing bolts of the EGR cooler coolant supply pipe and cylinder block.

ENGINE MECHANICAL - FLYWHEEL, FLYWHEEL HOUSING, CYLINDER BLOCK & CRANKSHAFT

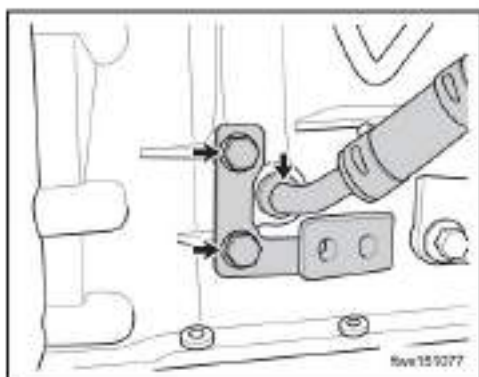
15



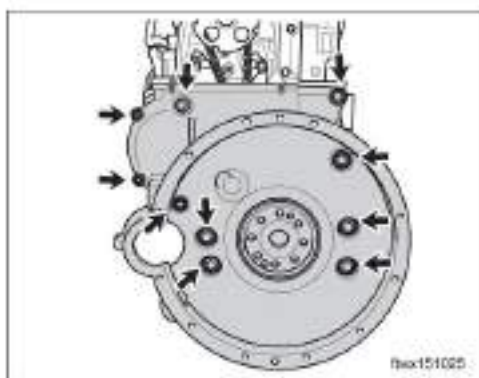
- (e) Install the turbocharger oil supply pipe, tighten the fixing bolts of the turbocharger oil supply pipe and cylinder block.
- (f) Install the engine bracket, tighten the fixing bolts of the engine bracket.



- (g) Install the fan pulley, tighten the fan pulley fixing bolts.
- (h) Install the tensioner, tighten the tensioner. Install the crankshaft pulley, tighten the crankshaft pulley fixing bolts.
- (i) Install the crankshaft pulley, tighten the crankshaft pulley fixing bolts.



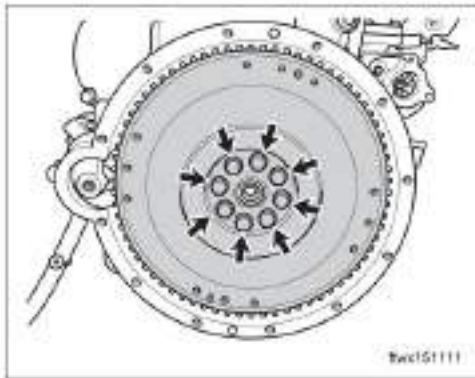
- (j) Install the bracket, tighten the fixing bolts of the catalytic converter.
- (k) Install the return line of the turbocharger

23. Install the flywheel and flywheel housing:

- (a) Install the flywheel housing and tighten the fixing bolts of the flywheel housing.



15-ENGINE MECHANICAL - FLYWHEEL, FLYWHEEL HOUSING, CYLINDER BLOCK & CRANKSHAFT



- (b) Install the flywheel, fix the flywheel with a tool, and tighten flywheel fixing bolts.

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- 24 . Install the piston connecting rod. (Refer to "Chapter 15 Engine mechanical system - Piston & Connecting Rod Assembly, overhaul")
- 25 . Install the cylinder head. (Refer to "Chapter 15 Engine mechanical system - Cylinder Head, Valve, Cylinder Head Overhaul")
- 26 . Install the timing sprocket. (Refer to "Chapter 15 Engine Mechanical - Timing Device, Timing chain and guide rail replacement")
- 27 . Install the high pressure fuel pump. (Refer to "Chapter 12 Steering - Fuel, high pressure fuel pump, replacement")
- 28 . Refit the oil try. (Refer to "Chapter 18 Lubrication - oil try, replacement")
- 29 . Install the generator. (Refer to "Chapter 20 Start & Charge - generator, overhaul")
- 30 . Install the starter. (Refer to "Chapter 20 Start & Charge - starter, overhaul")
- 31 . Install the A/C compressor assembly. (Refer to "Chapter 61 heater and air conditioning -condenser , overhaul")
- 32 . Install the steering oil pump assembly. (Refer to "Chapter 52 Steering -steering oil pump assembly, replacement")
- 33 . Install the engine assembly. (Refer to "Chapter 15 Engine mechanical system - engine assembly, replacement")

