F4J20 ENGINE MECHANICAL SYSTEM

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ENGINE MECHANICAL

Warnings and Precautions

Warnings

In order to avoid possible property loss, personal injury or death, always follow the instructions below before repair:

1. Temperature in engine compartment is very high when engine is running. Before removal, you must make sure that engine has shut off, and engine compartment has cooled down sufficiently, otherwise, there is a risk of scald injury.

System Overview

Description

SQRF4J20 engine has the following features

1. DVVT
2. In-line DOHC with 4 cylinders
3. Four valves per cylinder
4. Aluminum cylinder head
5. Aluminum cylinder block
6. Supercharged intercooler
7. Equipped with balance shaft

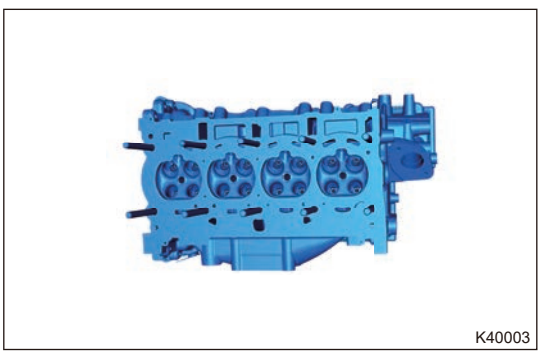
System Principle

1. SQRF4J20 engine adapts a design of transverse, direct injection, in-line 4-cylinder, 4-stroke, four valves per cylinder, DOHC, supercharged intercooler, VVT and electronic controlled multi-port fuel injection, the engine adapts independent ignition.
2. SQRF4J20 engine adapts aluminum cylinder block. Aluminum oil pan is fixed to aluminum frame with bolts. The aluminum cylinder head is secured to the cylinder block with bolts. The camshaft is installed on cylinder head. Power output from crankshaft drives camshaft by crankshaft sprocket through timing belt to rotate, thus making camshaft interact with rocker arm lifter to open and close valve. Piston assembly is an aluminum piston with cast iron connecting rod. This engine has features of reliable structure and excellent performance.

System Components Description

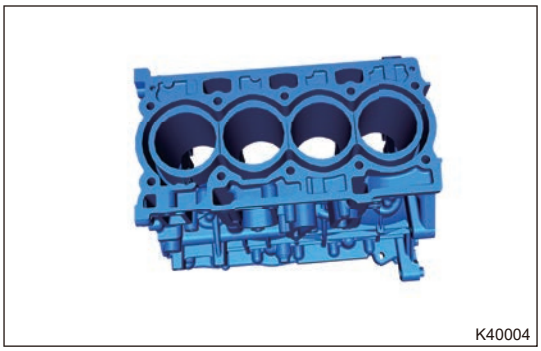
Cylinder Head

The upper part of the cylinder is closed to form a combustion chamber, and as the support of the camshaft, rocker arm, intake pipe and exhaust pipe. It mainly sucks air into the cylinder, the spark plug ignites the combustible gas mixture to drive the piston, and the exhaust gas is discharged from the exhaust pipe.


K40003

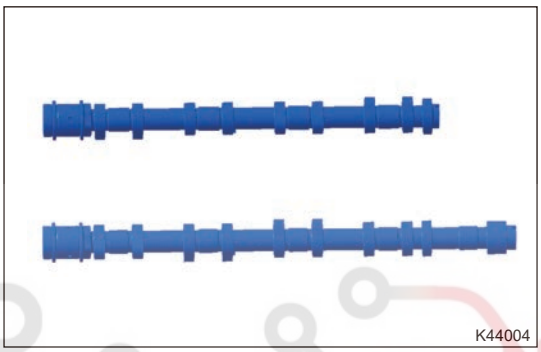
Cylinder Block

The main body of the engine, which connects each cylinder and crankcase into a whole, is the support frame for installing piston, crankshaft, other parts and accessories.


K40004

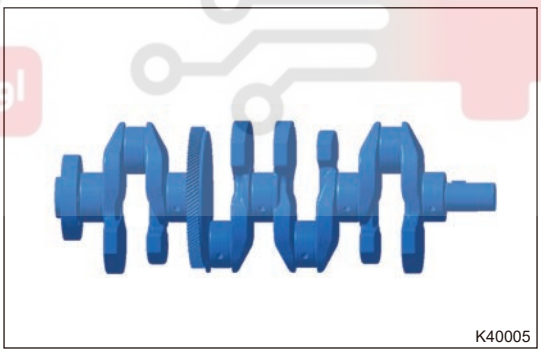
Camshaft

Camshaft is a component located inside engine, which is used to control valve opening and closing operations.


K44004

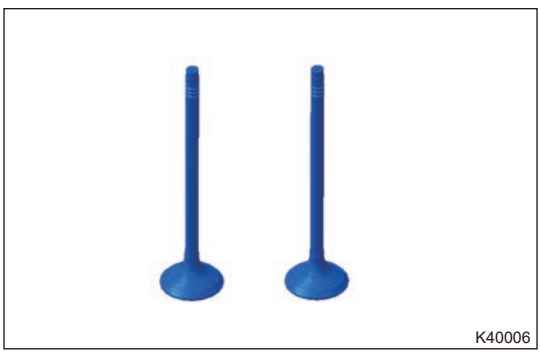
Crankshaft

Crankshaft is an important component in engine, which bears force from connecting rod and transfers it into rotation torque and outputs it through crankshaft to drives other accessories of engine.


K40005

Valve

Valve is used to allow air to flow in engine and bleed exhausted air after combustion; Intake valve is used to absorb air in engine and mix it with fuel for combustion; Exhaust valve is used to bleed exhausted air after combustion for radiation.


K40006

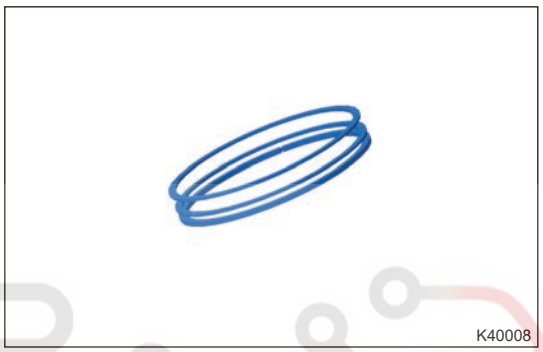
Piston

Piston is used to bear combustion compression from cylinder and transfer it to the crankshaft through piston pin and connecting rod.


K40007

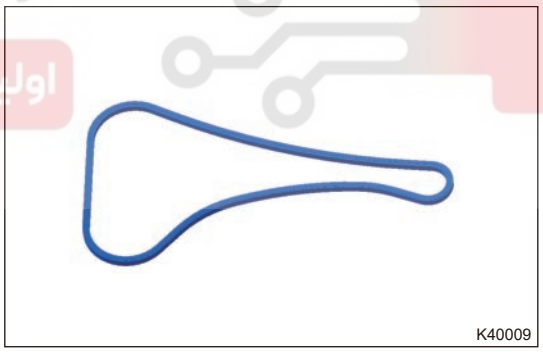
Piston Ring

Piston ring has two types of air ring and oil ring.Air ring is used to keep air tightness between cylinder and piston to avoid air leakage. Also it transmits most heat to cylinder wall which is carried away by coolant; Oil ring is used to apply and scrape the oil. Excessive oil can be scraped when oil ring moves downward and a layer of even oil can be applied to cylinder wall when oil ring moves upward. It not only can prevent oil entering the cylinder for combustion and also can reduce friction resistance between piston and cylinder. Furthermore, oil ring helps in air tightness.


K40008

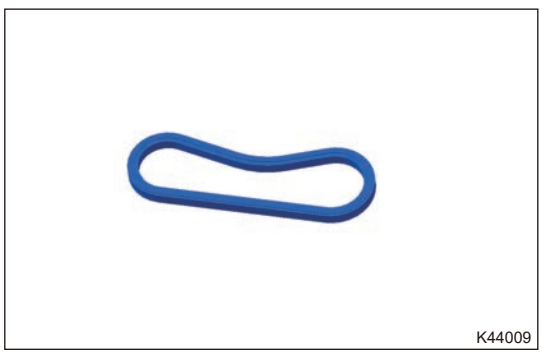
Engine Timing Chain

Engine timing chain is mainly used to drive valve mechanism, which allows intake valve and exhaust valve to open and close in proper time so that engine cylinder can absorb and exhaust air normally.


K40009

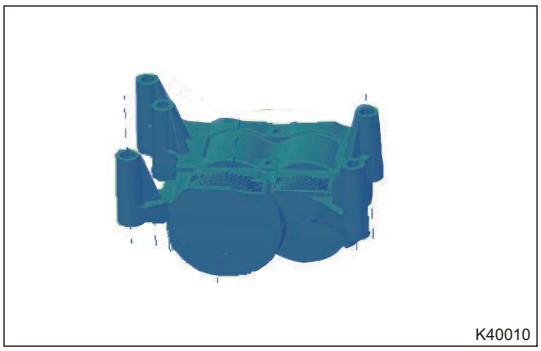
Oil Pump Chain

Oil pump chain is mainly used to drive oil pump.


K44009

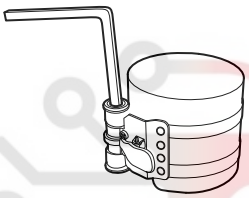
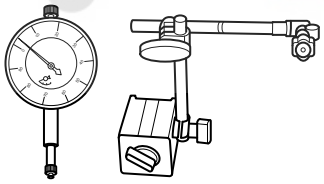
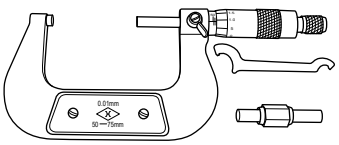
Balance Shaft Assembly

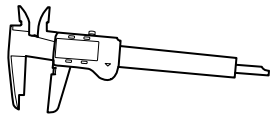
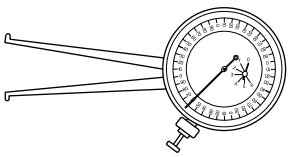
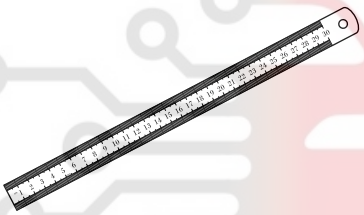
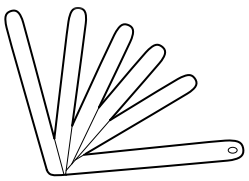
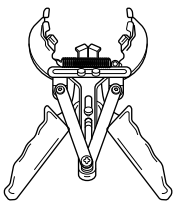
In order to balance the speed difference of piston at the top and bottom dead centers, the vibration of the engine is significantly improved, allowing engine to work more smoothly.

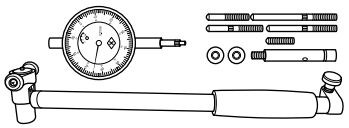
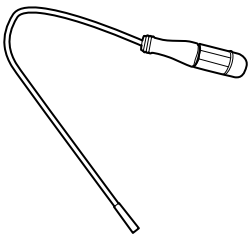
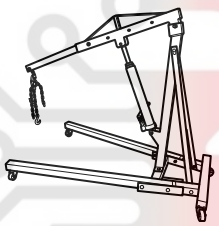
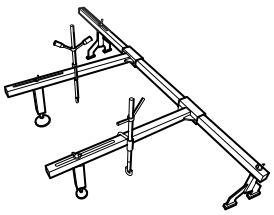
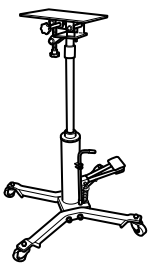


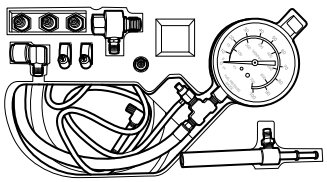
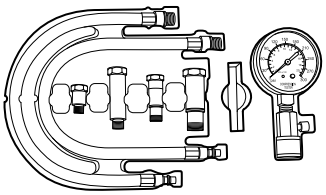
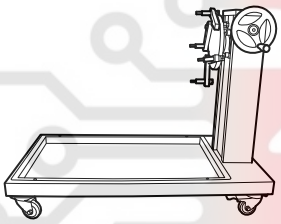
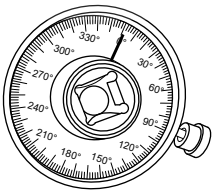
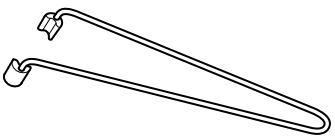
Special Tool and Equipment

General Tools

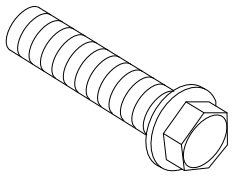
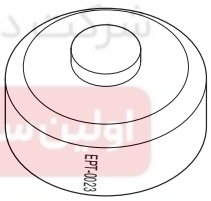
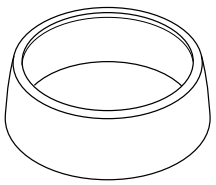
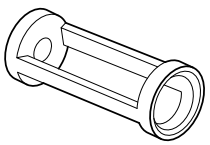
Tool Name	Tool Drawing
Piston Installer	 S00030
Dial Indicator and Magnetic Holder	 S00018
External Micrometer	 S00045

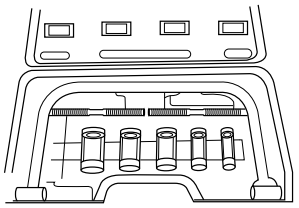
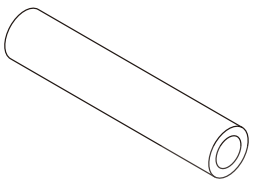
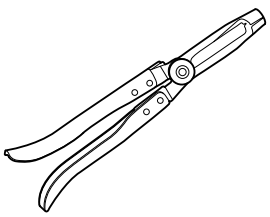
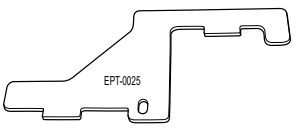
Tool Name	Tool Drawing
Vernier Caliper	 S00051
Inner Diameter Micrometer	 S00049
Precision Straightedge	 S00044
Feeler Gauge	 S00041
Piston Ring Remover	 S00047

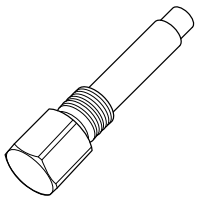
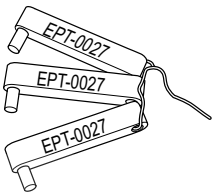
Tool Name	Tool Drawing
Cylinder Gauge	 S00046
Flexional Magnetic Rod	 S00031
Engine Hoist	 S00032
Engine Equalizer	 S00021
Transmission Carrier	 S00004

Tool Name	Tool Drawing
Fuel System Pressure Tester	 S00035
Cylinder Pressure Gauge	 S00033
Engine Service Platform	 S00039
Angle Gauge	 S00065
Valve Cotter Installer	 S00024

Special Tools

Tool Name	Applicable (Model, Power, Chassis)	Part No.	Tool Drawing	Main Application
Crankshaft Front Oil Seal Guide Tool	F4J20 Engine	EPT-0021	 S00088	Used in conjunction with the crankshaft front oil seal installer to install the crankshaft front oil seal
Crankshaft Front Oil Seal Installer	F4J20 Engine	EPT-0022	 RCH012006	Used to install the crankshaft front oil seal
Crankshaft Rear Oil Seal Installer	F4J20 Engine	EPT-0023	 RCH013006	Used to install the crankshaft rear oil seal
Crankshaft Rear Oil Seal Guide Tool	F4J20 Engine	EPT-0024	 S00091	Used in conjunction with the crankshaft rear oil seal installer to guide the rear oil seal, so as to prevent damage to rear oil seal
Valve Spring Compression Adapter	F4J16 Engine/ F4J20 Engine	EPT-0001	 S00037	

Tool Name	Applicable (Model, Power, Chassis)	Part No.	Tool Drawing	Main Application
Valve Spring Compressor	F4J16 Engine/ F4J20 Engine	EPT-0002	 S00087	
Valve Oil Seal Installer	F4J16 Engine/ F4J20 Engine	EPT-0010	 S00093	
Valve Oil Seal Guide Sleeve	F4J16 Engine/ F4J20 Engine	EPT-0009	 S00092	
Valve Oil Seal Remover	F4J16 Engine/ F4J20 Engine	EPT-0003	 S00029	
Camshaft Timing Tool	F4J20 Engine	EPT-0025	 RCH015006	Fix the intake/exhaust camshafts with special tools and perform engine camshaft timing calibration

Tool Name	Applicable (Model, Power, Chassis)	Part No.	Tool Drawing	Main Application
Crankshaft Timing Tool	F4J20 Engine	EPT-0026	 RCH014006	Fix the engine crankshaft and perform engine crankshaft timing calibration
Balance Shaft Locking Special Fixture	F4J20 Engine	EPT-0027	 RCH016006	Used for balance shaft installation
Flywheel Holding Tool	F4J16 Engine/ F4J20 Engine	EPT-0008	 S00099	

Parameters

Engine Specifications

Items	Specifications
Type	Vertical, direct injection, in-line 4-cylinder, water-cooled, 4-stroke, DOHC
Type	SQRF4J20
Valve Number Per Cylinder	4
Cylinder Diameter (mm)	80.5
Piston Stroke (mm)	98
Displacement (ml)	1998
Compression Ratio	10.2:1
Ignition Type	Independent

Items	Specifications
Rated Power (kw)	187
Max. Torque (N·m)	390
Fuel Octane Number	Unleaded gasoline, octane number 92 or above
Oil Grade	C5 0W-20
Starting Type	Electric starting
Cooling Type	Forced circulation type antifreeze cooling
Lubrication Type	Compound type (pressure, splash lubrication)
Cylinder Compression Pressure (bar) (180 - 250) r/ min	7 -10

Tolerance Matching Between Engine Main Components

Series Number	Part Name	Size and Tolerance	Matching Clearance
1	Intake Side 1st Bearing Hole	Φ33 (0, +0.025)	0.050 - 0.91
	Intake Camshaft Assembly 1st Journal	Φ33 (-0.066, -0.050)	
	Intake Side 2nd-6th Bearing Holes	Φ24 (0, +0.021)	0.040 - 0.074
	Intake Camshaft Assembly 2nd-6th Journals	Φ24 (-0.053, -0.040)	
2	Exhaust Side 1st Bearing Hole	Φ33 (0, +0.025)	0.050 - 0.91
	Exhaust Camshaft Assembly 1st Journal	Φ33 (-0.066, -0.050)	
	Exhaust Side 2nd-5th Bearing Holes	Φ24 (0, +0.021)	0.040 - 0.074
	Exhaust Camshaft Assembly 2nd-5th Journals	Φ24 (-0.053, -0.040)	
3	Cylinder Head Intake Side Camshaft Thrust Gear Width	23.85 (-0.1, 0)	0.15 - 0.275
	Intake Camshaft Assembly Thrust Gear Width	24 (0, +0.025)	
4	Cylinder Head Exhaust Side Camshaft Thrust Gear Width	23.85 (-0.1, 0)	0.15 - 0.275
	Exhaust Camshaft Assembly Thrust Gear Width	24 (0, +0.025)	
5	Hydraulic Lifter Assembly Outer Diameter	Φ11.994 ± 0.006	0.006 - 0.036
	Cylinder Head Hydraulic Lifter Hole Diameter	Φ12 (+0.006, +0.024)	

Series Number	Part Name	Size and Tolerance	Matching Clearance
6	Valve Guide Hole Diameter	Φ6 (0, +0.015)	0.013 - 0.042
	Intake Valve Stem Diameter	Φ5.98 ± 0.007	
7	Valve Guide Hole Diameter	Φ6 (0, +0.015)	0.033 - 0.062
	Exhaust Valve Stem Diameter	Φ5.96 ± 0.007	
8	Valve Guide Mounting Hole	Φ11 (0, +0.018)	-0.051 - -0.022
	Valve Guide Outer Diameter	Φ11 (+0.040, +0.051)	
9	Intake Valve Retainer Mounting Hole	Φ31.9 (0, +0.016)	-0.1 - -0.068
	Intake Valve Retainer Outer Diameter	Φ32 (-0.016, 0)	
10	Exhaust Valve Retainer Mounting Hole	Φ27.2 (0, +0.013)	-0.1 - -0.071
	Exhaust Valve Retainer Outer Diameter	Φ27.3 (-0.016, 0)	
11	Cylinder Block Bore	Φ80.5 (+0.013/0)	0.04 - 0.063
	Piston Skirt	80.455 ± 0.005	
12	Piston Pin Hole	Φ22 (+0.009/+0.004)	0.004 - 0.014
	Piston pin	Φ22 (0/-0.005)	
13	Connecting Rod Small End Bore	Φ22 (+0.018/+0.010)	0.010 - 0.023
	Piston pin	Φ22 (0/-0.005)	

Valve Timing

Intake (180.5° Wrapped Angle)

	Angle (°)	Valve Lift (mm)
Valve Opening 0 mm	346.5	0
Valve Opening 0.5mm	377.5	0.49
Valve Opening 1mm	385	0.99
Maximum Valve Lift	475.5	9.49
Valve Closed 1 mm	565.5	0.99
Valve Closed 0.5mm	573.5	0.50
Valve Closed 0mm	614.5	0

Exhaust (180.5° Wrapped Angle)

	Angle (°)	Valve Lift (mm)
Valve Opening 0 mm	107.5	0
Valve Opening 0.5mm	137	0.49
Valve Opening 1mm	144.5	0.99
Maximum Valve Lift	234	8.5
Valve Closed 1 mm	325	0.99
Valve Closed 0.5mm	333	0.50
Valve Closed 0mm	370	0

Lubrication Area

Lubrication Area	Type
Valve Guide Bottom Hole	Use same type of lubricant as engine
Intake Valve Retainer Bottom Hole	Use same type of lubricant as engine
Exhaust Valve Retainer Bottom Hole	Use same type of lubricant as engine
Valve Stem and Valve Guide Hole	Use same type of lubricant as engine
Valve Oil Seal Lip	Use same type of lubricant as engine
Hydraulic Lifter Assembly External Circular Surface and Hydraulic Lifter Hole	Use same type of lubricant as engine
Camshaft Assembly Journal and Bearing Seat Hole	Use same type of lubricant as engine
Roller Rocker Arm Assembly Bearing	Use same type of lubricant as engine
Phaser Solenoid Valve Seal Ring (O-ring)	Use same type of lubricant as engine
Upper and Lower Connecting Rod Bearing Shell and Connecting Rod Journal	Use same type of lubricant as engine
Upper and Lower Main Bearing Shell and Main Journal	Use same type of lubricant as engine
Thrust Washer (Oil Rail Side) and Crankshaft Thrust Surface	Use same type of lubricant as engine
Front and Rear Oil Seal Inner Lip and Crankshaft Oil Seal Journal	Use same type of lubricant as engine
Piston Pin Hole	Use same type of lubricant as engine
Piston Ring Groove	Use same type of lubricant as engine
Cylinder Bore Inner Wall	Use same type of lubricant as engine
Crankshaft Front and Rear Oil Seal External Circular Surface	Use same type of lubricant as engine
Timing System	Use same type of lubricant as engine

Area with Seal Gum Applied

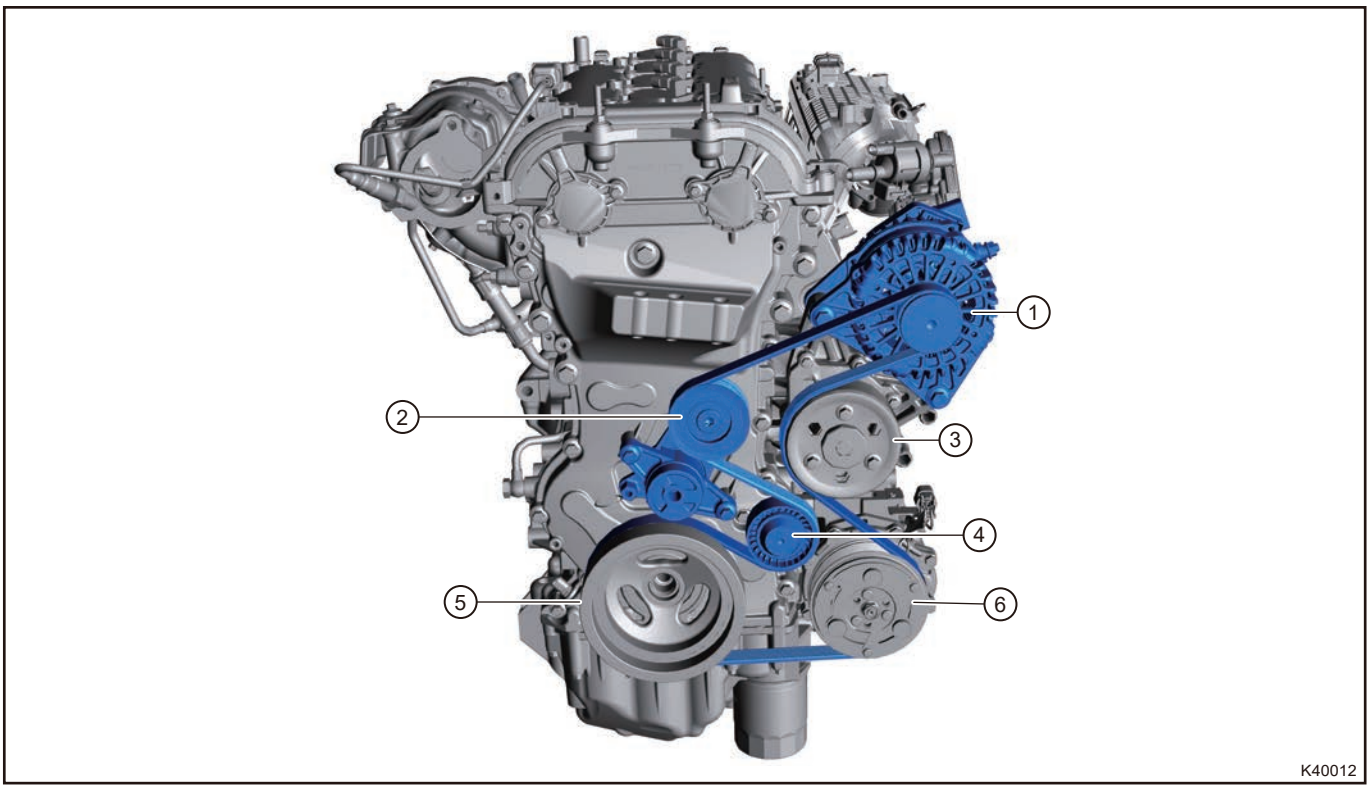
Seal Gum Application Area	Seal Gum Type
Bowl Plug - Front and Rear End	Loctite 11747
Bowl Plug - Exhaust Side	Loctite 121078
Top and Bottom Sides of Cylinder Head Front End (T-shaped Area)	Loctite 5900H
"T" Shaped Area Between Timing Chain Cover and Cylinder Head	Loctite 5900H
Timing Chain Cover Frame Bottom Arc Part	Loctite 5900H
Timing Chain Cover Seal Surface	Loctite 5900H/Loctite 5900HA
Upper Guide Rail Assembly Bolt	Loctite 243

Non-reusable Part

Non-reusable Part	
Cylinder Head Fixing Bolt	Replace it
Valve Oil Seal	Replace it
Crankshaft Front Oil Seal	Replace it
Crankshaft Rear Oil Seal	Replace it
Cylinder Head Gasket	Replace it
Connecting Rod Bearing Cap Fixing Bolt	Replace it
Flywheel Fixing Bolt	Replace it
Main Bearing Cap Fixing Bolt	Replace it

On-Vehicle Service

Accessory Pulley



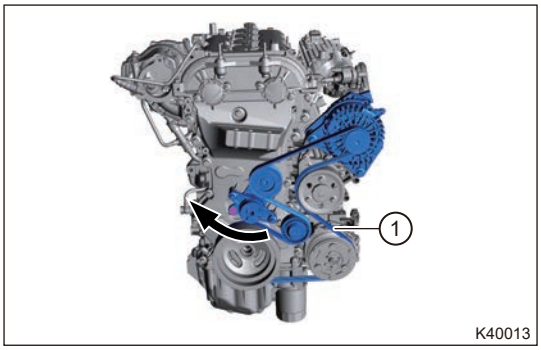
1	Alternator Assembly	4	Idler Pulley Assembly
2	Tensioner Assembly	5	Torsion Shock Absorber Assembly
3	Water Pump Pulley	6	Compressor Assembly

Removal

Warning
• Be sure to wear safety equipment to prevent accidents, when removing accessory drive belt. • Appropriate force should be applied when removing accessory drive belt. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Remove the engine trim cover assembly.

4. Insert tool into tensioner and pull it upward in direction of arrow as shown in illustration, then remove accessory drive belt assembly (1).

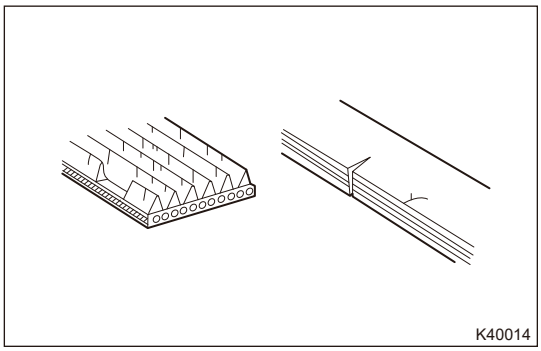


Warning
Prevent hand from contacting belt tensioner when raising it upward, so as to avoid damage.

Inspection

1. Visually check accessory drive belt for excessive wear and cords for wear, etc. If any of these defects is found, replace accessory drive belt.

   Hint:
   - If accessory drive belt has chunks missing from ribs, it should be replaced.
   - After installing accessory drive belt, check that it fits properly in the ribbed grooves. Check that belt has not slipped out of grooves on bottom of the crankshaft pulley by hand.



Installation

Caution
• Before installation, remove the dirt from accessory drive belt. • After installation, check if scale on tensioner arm is almost corresponding to the middle scale of tensioner base. • Check that belt fits well to grooves on bottom of pulley properly. Avoid improper installation and misalignment.

1. Install the accessory drive belt properly according to its moving direction.
2. Install drive belt on each pulley to operate tensioner freely.

Adjustment

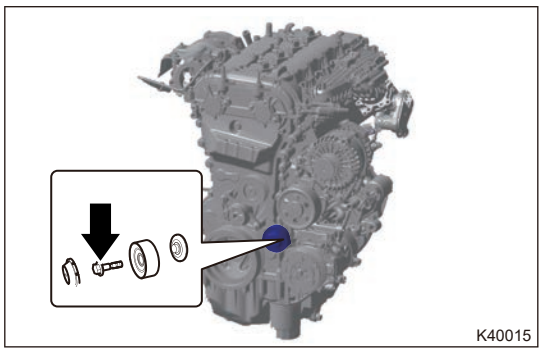
1. Rotate crankshaft pulley 2 turns, so that belt tension between each pulley is even.
2. Apply 100 N of force to center part of the belt between alternator and tensioner pulley with your thumb. Check that displacement of belt is within 5 - 6 mm. If displacement is too large or too small, adjust, check or repair.

Idler Pulley Assembly

Removal

Warning
• Be sure to wear safety equipment to prevent accidents, when removing idler pulley assembly. • Appropriate force should be applied, when removing idler pulley assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Remove the engine trim cover assembly.
4. Remove the accessory drive belt.
5. Remove the idler pulley assembly dust boot.
6. Remove fixing bolt and idler pulley assembly.



Inspection

1. Rotate idler pulley by hands and check if rotation is smooth and if abnormal noise occurs.
2. Wiggle idler pulley in axial and radial directions to check bearing for looseness.
3. Check if there is damage on idler pulley assembly operating surface.

Installation

Caution
• Pretighten it by 2 to 3 threads first. • After installation, turn crankshaft to run accessory drive belt by several turns, and check if crankshaft turns smoothly and belt runs well. If it cannot turn smoothly, reinstall accessory drive belt. • Make sure to correctly install accessory drive belt, and it does not interfere with other components.

1. Install the idler pulley assembly fixing bolt.

   Torque: 47 + 5 N·m

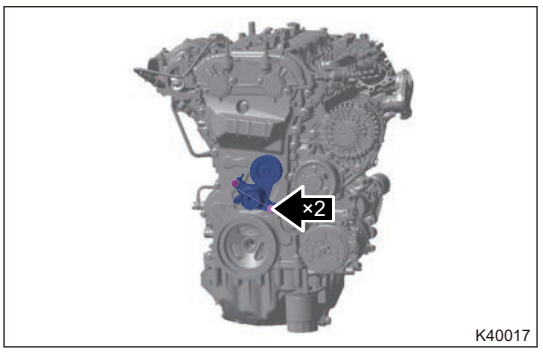
2. Install the idler pulley assembly dust boot.
3. Install the accessory drive belt.
4. Install the engine trim cover.
5. Install the engine compartment trim cover.

Tensioner Assembly

Removal

Warning
• Be sure to wear safety equipment to prevent accidents, when removing tensioner assembly. • Appropriate force should be applied, when removing the tensioner assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Remove the engine trim cover assembly.
4. Remove the accessory drive belt.
5. Remove 2 fixing bolts from tensioner assembly.



6. Remove the tensioner assembly.

Inspection

1. Rotate tensioner pulley assembly by hands and check if rotation is smooth and if abnormal noise occurs.
2. Wiggle tensioner pulley assembly in axial and radial directions to check for looseness.
3. Check if there is damage on tensioner pulley operating surface.

Installation

1. Install 2 tensioner assembly fixing bolts.

   Torque: 20 + 5 N·m

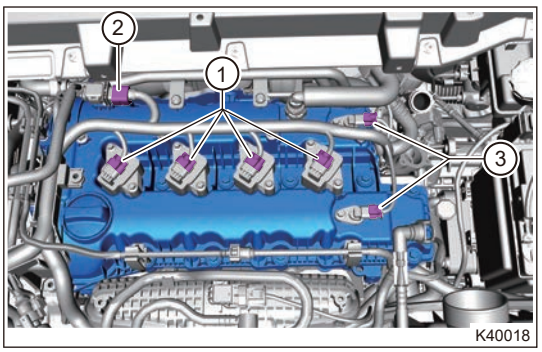
2. Install the accessory drive belt.
3. Install the engine trim cover.
4. Install the engine compartment trim cover.

Cylinder Head Cover

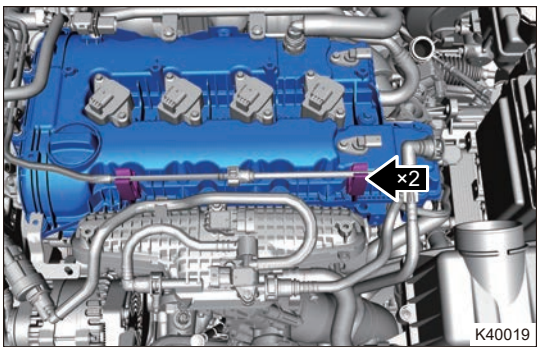
Removal

Warning
• Blow dirt and debris away from surface of cylinder head cover with compressed air. • Be sure to wear safety equipment to prevent accidents, when removing cylinder head cover. • Appropriate force should be applied when removing cylinder head cover. Be careful not to operate roughly.

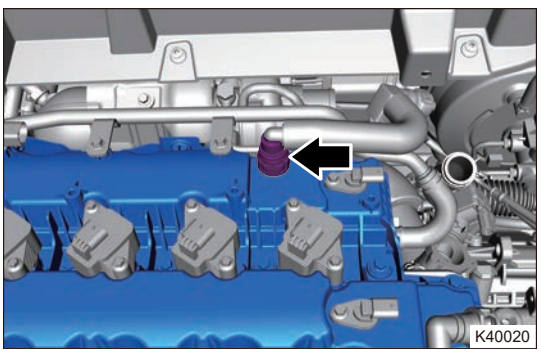
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Remove the engine trim cover.
4. Remove the intake hose.
5. Disconnect ignition coil connector (1), upstream oxygen sensor connector (2), and camshaft position sensor connector (3).



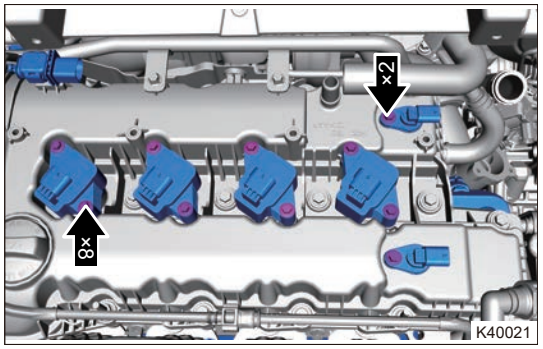
6. Remove 2 oil inlet pipe single tube clamps from cylinder head cover.



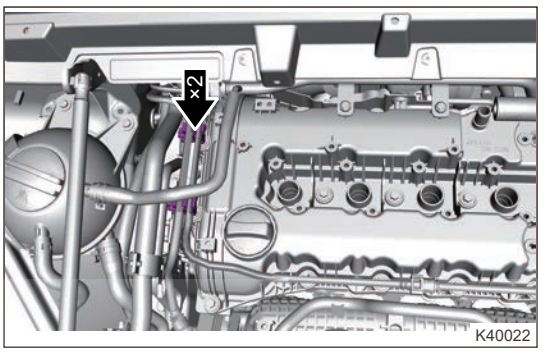
7. Disconnect the hose - intake hose from cylinder head cover.



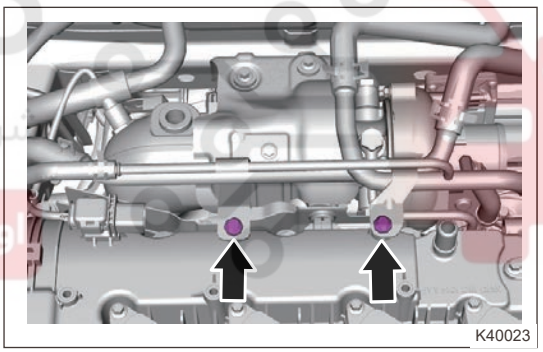
8. Remove 8 fixing bolts and ignition coil.
9. Remove 2 fixing bolts and camshaft position sensor.



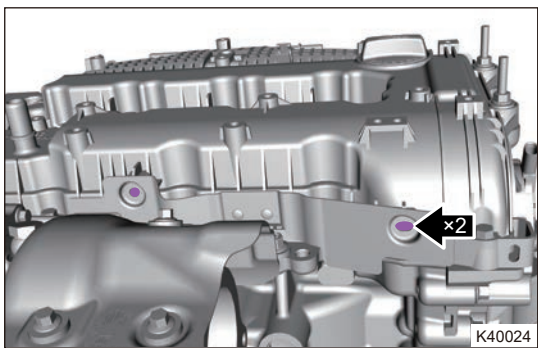
10. Remove 2 three-tube clamps from cylinder head cover.



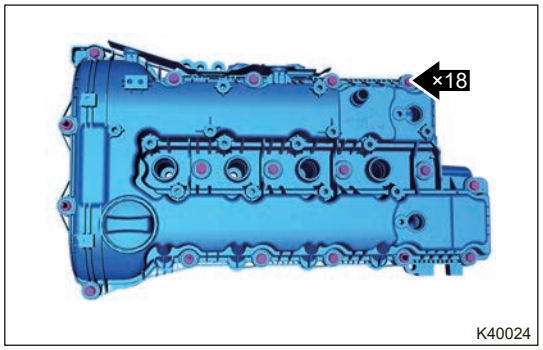
11. Remove 2 fixing bolts from cooling pipe assembly.



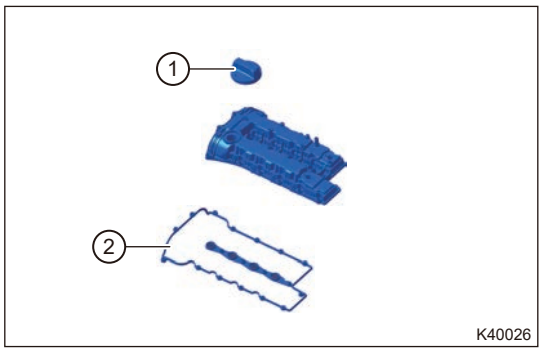
12. Remove 2 fixing bolt from heat insulator.



13. Remove 18 fixing bolts cylinder and cylinder head cover.



14. Remove fuel filler cap (1) and gasket (2) from cylinder head cover assembly.



Inspection

1. Check the appearance of the cylinder head cover for cracks, and replace the assembly if necessary.

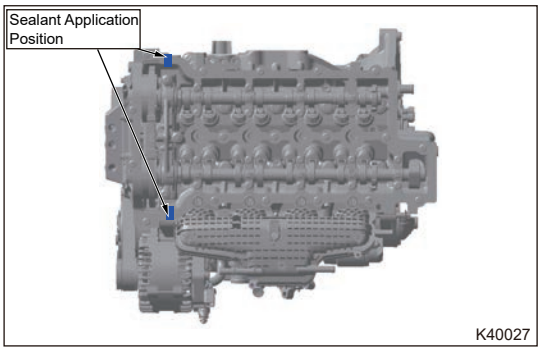
Installation

Caution
• Remove oil dirt and sealant on cylinder head cover and cylinder head before installation. • Check if gasket is damaged or loses elasticity. If so, replace gasket.

1. As shown in illustration, apply seal gum (Loctite 5900H) to "T" position of junction area between timing chain cover and cylinder head.

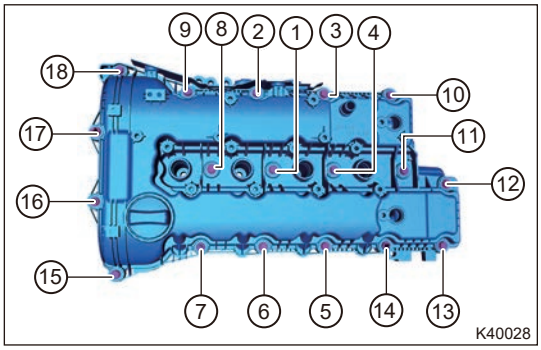
   Hint:

   - Note that the sealant should not be too thick, to prevent excess sealant into the engine when the valve chamber cover is pressed.
   - Install the cylinder head cover assembly and wait for 15 minutes to apply seal gum.



2. Install cylinder head cover and first manually install fixing bolts by 1 to 2 threads.
3. Tighten 18 cylinder head cover fixing bolts in order shown in illustration.

   Torque: 10.5 - 12.5 N·m



4. Install fuel filler door.
5. Install 2 fixing bolts to heat insulator.

   Torque: 8 + 3 N·m

6. Install the cooling pipe assembly.
7. Install the camshaft position sensor.
8. Install the ignition coil.
9. Install hose - intake hose.
10. Connect the wire harness connector.
11. Install the oil inlet pipe tube clamp.
12. Install the engine trim cover.

Crankshaft Front Oil Seal

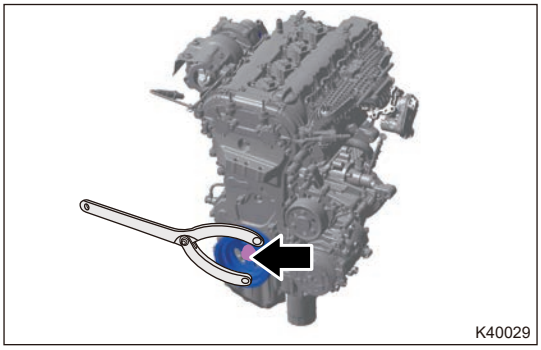
Removal

Warning
• Be sure to wear safety equipment to prevent accidents, when removing crankshaft front oil seal. • Appropriate force should be applied when removing crankshaft front oil seal. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover.
3. Disconnect the negative battery cable.
4. Remove the accessory drive belt.

5. Remove fixing bolt from torsion absorber assembly.

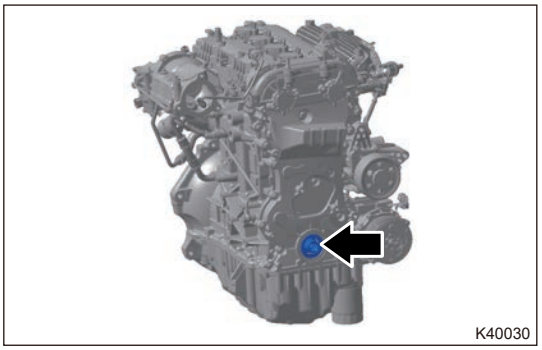
   Hint:
   Use tool to lock torsion absorber assembly and fixing bolt.



6. Remove the torsion shock absorber assembly.

7. Remove the crankshaft front oil seal with the proper tool carefully.

   Hint:
   Be careful not to scratch junction surface, when removing crankshaft front oil seal.



Installation

Caution
• Apply a small amount of engine oil to the crankshaft front oil seal guide tool before installing a new oil seal. • Remove dirt on junction surface and apply a small amount of engine oil to oil seal external circular surface and oil seal guide tool (except the oil seal with surface applied wax) before assembly. • Be sure to prevent the lip of crankshaft front oil seal from being scratched during installation; If it is damaged, replace it immediately.

1. Install crankshaft front oil seal (3) to crankshaft front oil seal installer (2), then install crankshaft front oil seal in place with crankshaft front oil seal guide tool (1).

   Hint:
   - Make sure oil seal surface is 0 to 0.5mm lower than end surface of timing chain cover oil seal hole.
   - Never allow tilting it by more than 5°, oil seal external rubber breakage or flanges during oil seal press fitting.

2. Install fixing bolt of torsion shock absorber assembly.

   Torque: 1st step: 35 ± 5 N·m, 2nd step: 30 ± 5°

3. Install the accessory drive belt.
4. Install the engine compartment trim cover assembly.

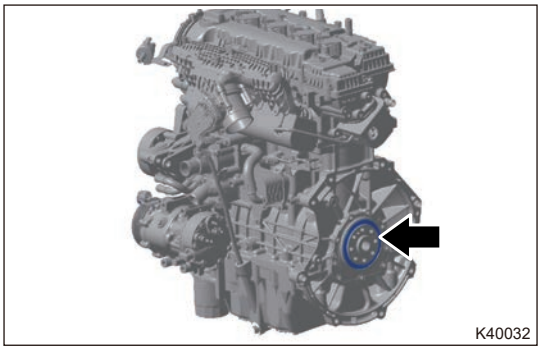
Crankshaft Rear Oil Seal

Removal

Warning
• Be sure to wear safety equipment to prevent accidents, when removing crankshaft rear oil seal. • Appropriate force should be applied when removing crankshaft rear oil seal. Be careful not to operate roughly.

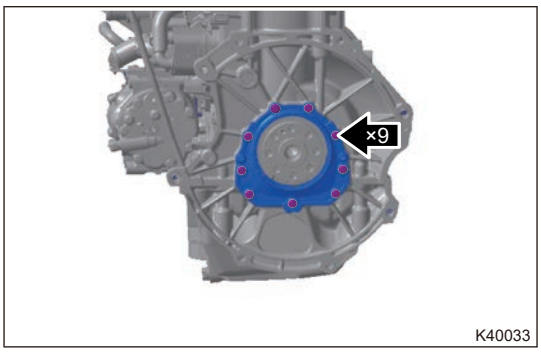
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover.
3. Disconnect the negative battery cable.
4. Remove the transmission assembly.
5. Remove the flywheel assembly.

6. Remove the crankshaft rear oil seal with the proper tool carefully.



7. Remove the crankshaft rear oil seal.

8. Remove 9 fixing bolts from rear oil seal bracket.

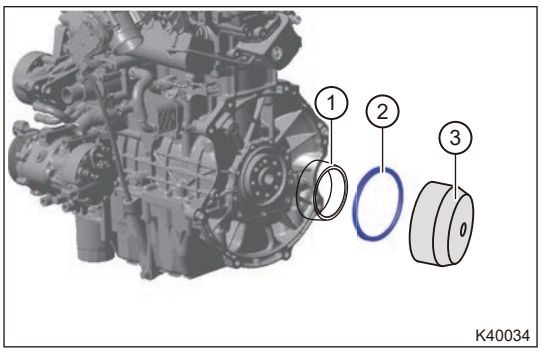


9. Remove the rear oil seal bracket.

Installation

Caution
• Be sure to clean dirt around oil seal retainer and on inside wall before installation. • Check oil seal for damage before installation. If there is any damage, replace it. • Be sure to prevent the lip of crankshaft rear oil seal from being scratched during installation. • Be careful not to damage oil seal retainer during installation.

1. Install guide tool (1) to crankshaft.
2. Install new oil seal (2) to crankshaft rear oil seal guide tool, then install new oil seal evenly and fully into oil seal retainer with a crankshaft rear oil seal installer (3).



Caution
• Make sure oil seal surface is 0.5 to 1 mm lower than end surface of timing chain cover oil seal hole. • Ensure that oil seal lip has no damage during assembly. • Never allow tilting it by more than 5°, oil seal external rubber breakage or flanges during oil seal press fitting.

3. Install the flywheel assembly.
4. Install the transmission assembly.

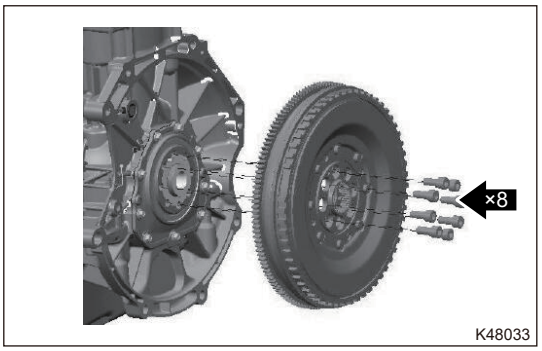
Flywheel Assembly

Removal

Warning
• Be sure to wear safety equipment to prevent accidents, when installing flywheel assembly. • Appropriate force should be applied, when removing flywheel assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Remove the transmission assembly.
4. Remove 8 fixing bolts and flywheel assembly.

   Hint:
   Flywheel assembly fixing bolts must be disposed after removal. Never reuse them.



Inspection

1. Check if crankshaft position signal gear is distorted or deformed. If damaged, replace flywheel. Clean signal gear before installation.

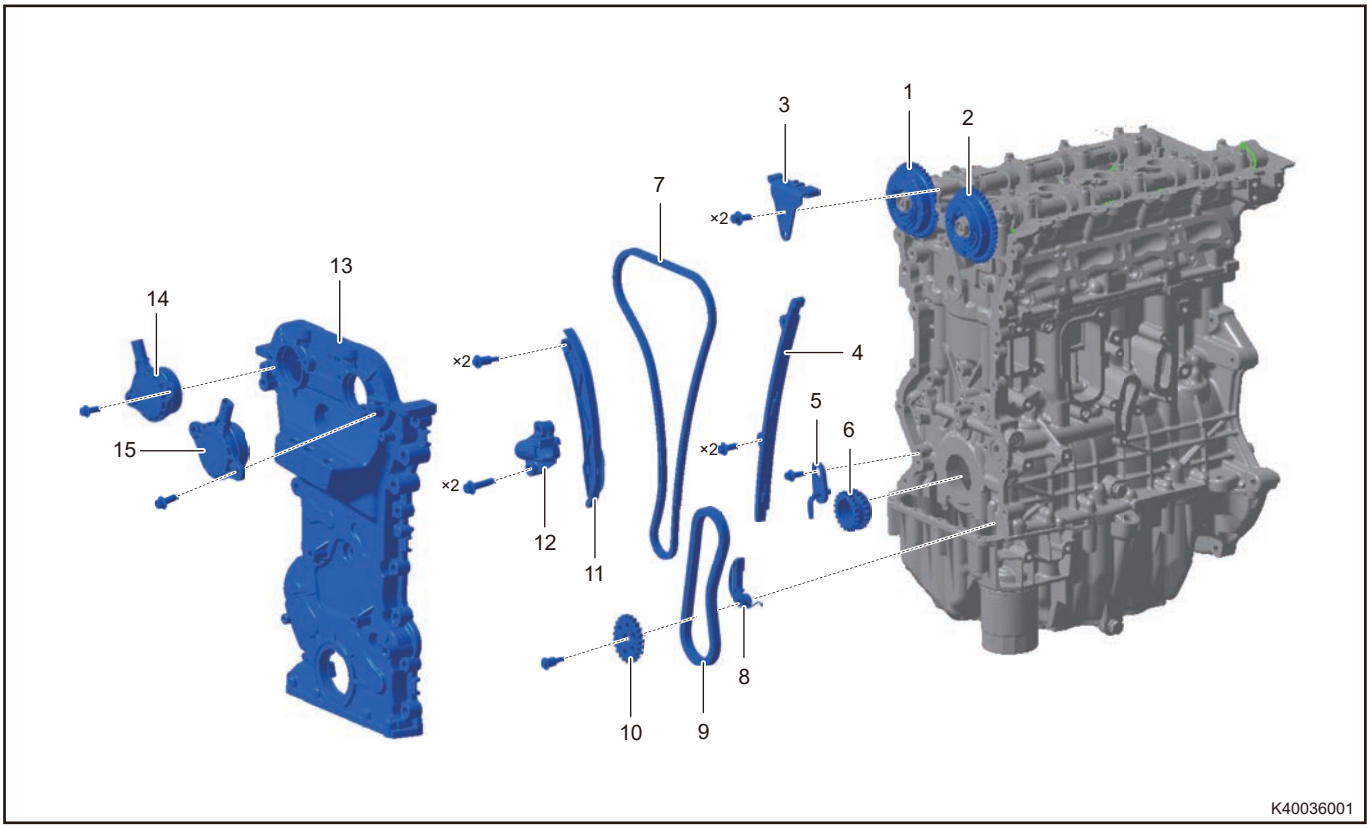
Installation

Caution
• Lightly push flywheel after alignment during assembly. Do not tap flywheel with a hammer. • Replace flywheel fixing bolts with new ones.

1. Install 8 fixing bolts to flywheel assembly, and pretighten the bolts.
2. Installing flywheel holding tool, then tighten each flywheel bolt diagonally in order.

   Torque: 1st step: 35 ± 5 N·m, 2nd step: 30 ± 5°

Engine Timing Chain

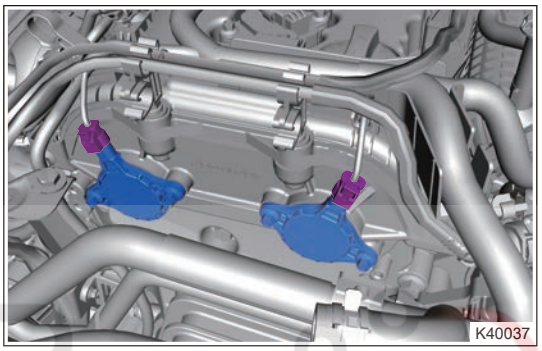


1	Exhaust Phaser Assembly	9	Oil Pump Chain Assembly
2	Intake Phaser Assembly	10	Oil Pump Sprocket
3	Upper Chain Guide Rail Assembly	11	Movable Guide Rail Assembly
4	Fixing Guide Rail Assembly	12	Hydraulic Tensioner Assembly
5	Nozzle - Timing Chain	13	Timing Chain Cover
6	Crankshaft Timing Sprocket	14	Exhaust Phaser Solenoid Valve
7	Timing Chain Assembly	15	Intake Phaser Solenoid Valve
8	Oil Pump Movable Rail Assembly		

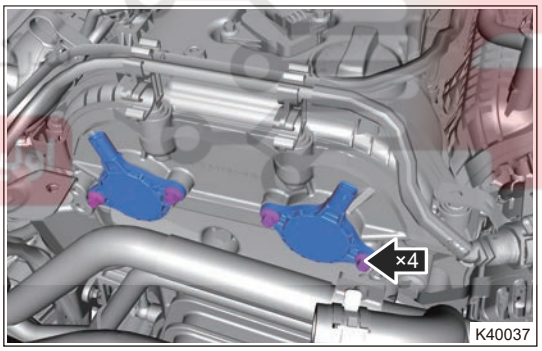
Removal

Warning
• Be sure to wear safety equipment to prevent accidents, when removing engine timing chain. • Appropriate force should be applied when removing engine timing chain. Be careful not to operate roughly.

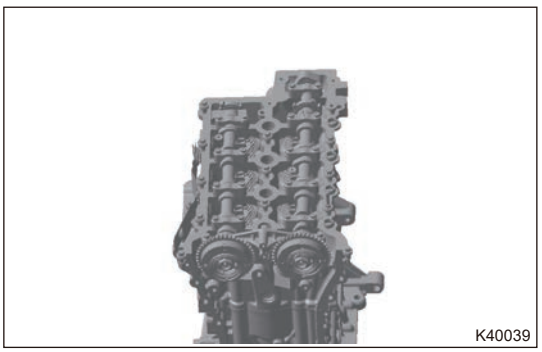
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Remove the engine trim cover assembly.
4. Remove the cylinder head cover.
5. Remove the engine lower protector assembly.
6. Remove the accessory drive belt.
7. Remove the accessory drive belt tensioner assembly.
8. Remove the idler pulley assembly.
9. Remove the torsion shock absorber assembly.
10. Use an engine equalizer to hang engine assembly.
11. Remove the engine right mounting cushion assembly.
12. Disconnect the intake/exhaust phaser solenoid valve connector.



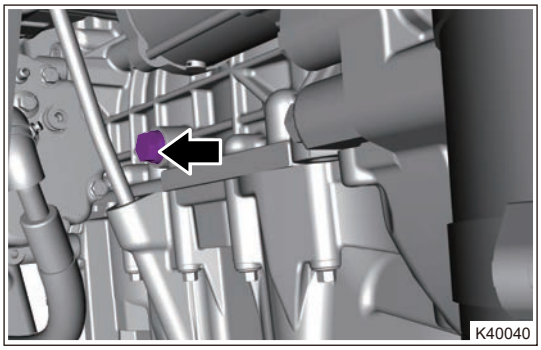
13. Remove 4 fixing bolts and intake/exhaust phaser solenoid valve.



14. Place camshaft timing positioning special tool on the back of cylinder head upper plane, rotate intake and exhaust camshafts separately in order to clamp the special tool into slots on rear end of both camshafts.

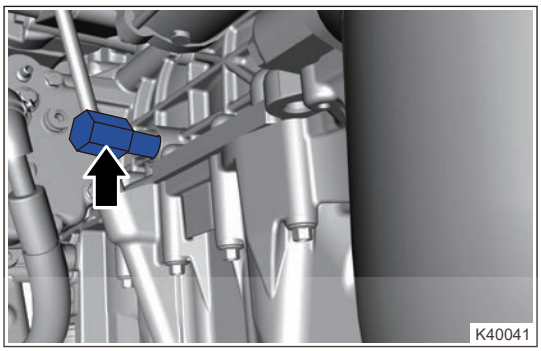


15. Remove crankshaft balancer locating hole fixing bolt from engine block.

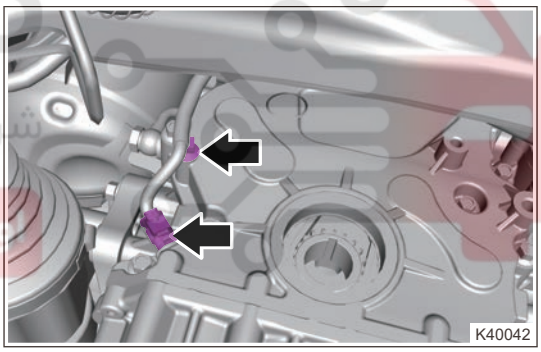


16. Install crankshaft timing positioning pin to cylinder block through thread hole on intake side of cylinder block, and insert front end of positioning pin into positioning hole of crankshaft balancer (each cylinder piston should be in the same plane).

Hint:
It takes patience to perform this operation and pay more attention to avoid damage to crankshaft.



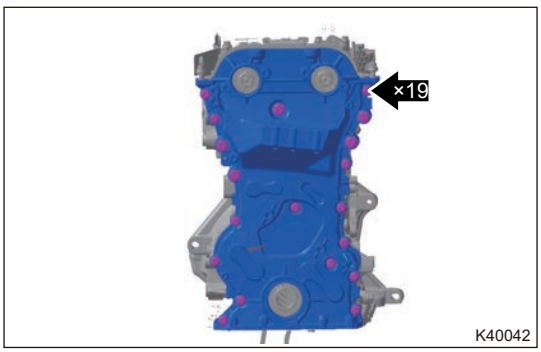
17. Disconnect oil pump assembly connector and detach wire harness fixing clip.



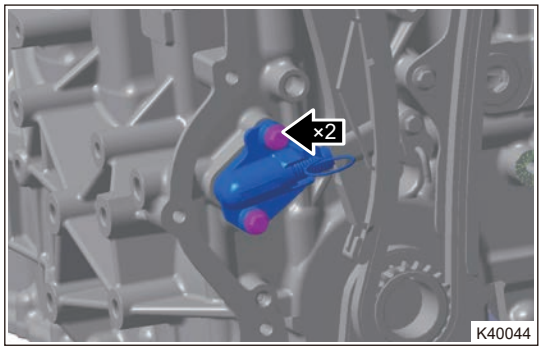
18. Remove the oil pan assembly.

19. Remove 19 fixing bolts and timing chain cover.

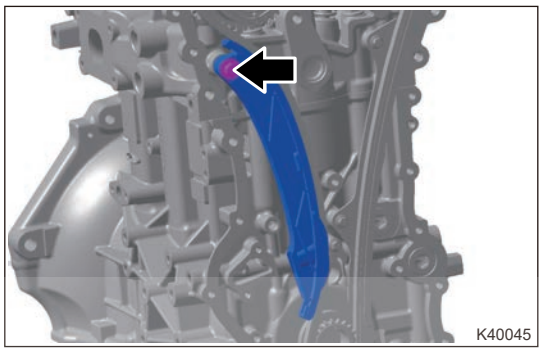
Hint:
Carefully observe timing chain cover for cracks or oil leakage; If exists, replace timing chain cover assembly.



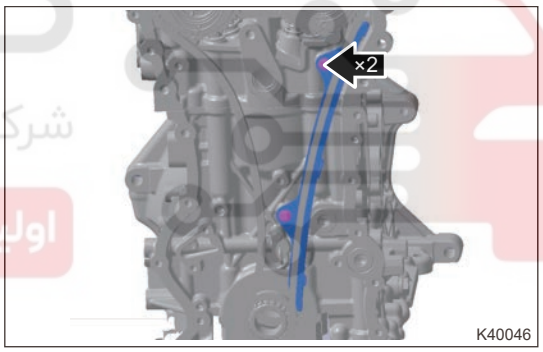
20. Remove 2 fixing bolts and hydraulic tensioner assembly.



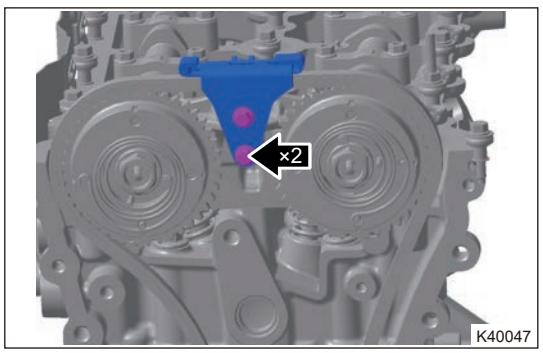
21. Remove 1 fixing bolt and movable guide rail assembly.



22. Remove 2 fixing bolts and fixing guide rail assembly.

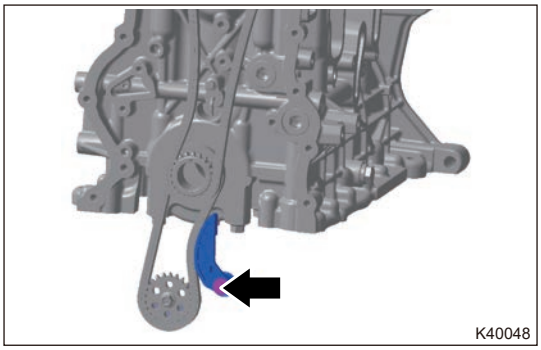


23. Remove 2 fixing bolts and upper chain guide rail assembly.



24. Remove the engine timing chain.

25. Remove 1 fixing bolt from oil pump chain movable guide rail and remove oil pump chain.

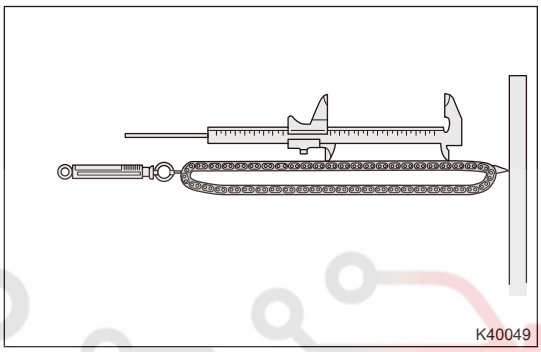


Inspection

1. Carefully check if timing chain is seriously worn or cracked If exists, replace timing chain assembly.

2. Use a force of 147 N to pull the chain. Take 15 links from chain and perform measurement with a vernier caliper. Max. elongation: 120.6 mm.

   Hint:
   Take 3 positions for measurement. If the average value is larger than max. elongation ratio, replace timing chain assembly. If it is not as specified, replace timing chain cover assembly.

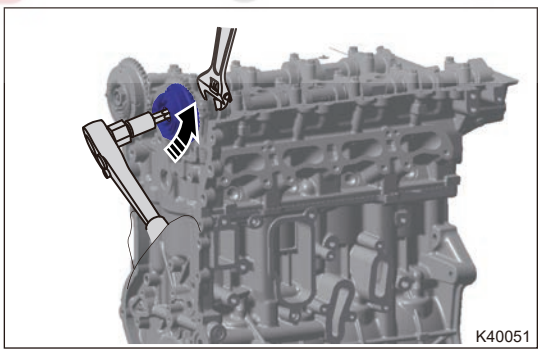


3. Measure depth of movable guide rail with a vernier caliper.

   Hint:
   If wear limit is beyond 2 mm, replace movable guide rail assembly.

Installation

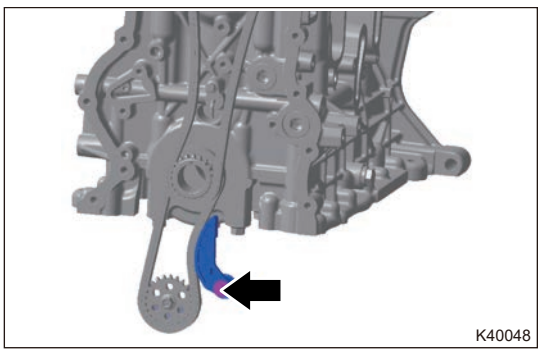
1. Use a proper wrench to hold intake camshaft and loosen fixing bolt from intake phaser assembly.



2. Install oil pump chain and 1 movable guide rail fixing bolt.

   Torque: 9 + 3 N·m

   Hint:
   The movable guide rail should rotate smoothly around the bolt after assembling and either end of spring should hook the oil pump housing.



3. Install 2 fixing bolts to upper chain guide rail assembly.

   Torque: 8 + 3 N·m

4. Install 2 fixing bolts from fixing guide rail assembly.

   Torque: 8 + 3 N·m

5. Install 1 fixing bolt to movable guide rail assembly.

   Torque: 20 + 5 N·m

   Hint:
   The movable guide rail should rotate smoothly around the bolt after installation.

6. Install the timing chain.

   Hint:
   Ensure timing chain is set to intake and exhaust phasers and crankshaft sprocket. Make sure that timing chain and upper guide rail are in level.

7. Install hydraulic tensioner assembly, and tighten 2 fixing bolts.

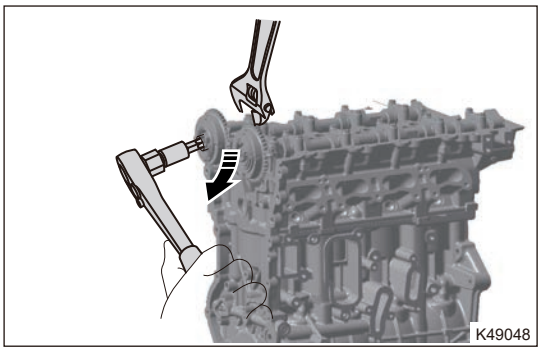
   Torque: 8 + 3 N·m

   Hint:
   Pull up hydraulic tensioner upper steal ring pin after installation and tightening.

8. Use a proper wrench to hold intake camshaft and tighten fixing bolt of intake and exhaust phaser valve body.

   Torque: 1st step: 30 ± 1.5 N·m 2nd step: clockwise rotation angle 34° ± 2°

   Hint:
   - Tighten exhaust phase valve body bolt first, and then tighten intake phaser valve body bolt. Failure to tighten in order may cause “tooth missing” phenomenon in timing chain.
   - The accumulative tightening times of the phaser valve body bolts shall not exceed three times.

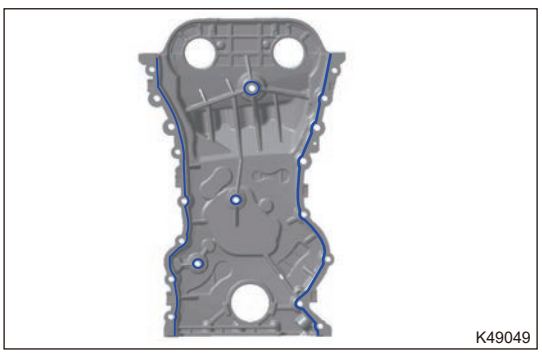

K49048

9. Remove crankshaft timing tool and camshaft timing tool, then rotate crankshaft clockwise 2 turns at least to check if timing system can operate normally.

Caution
• Never rotate crankshaft counterclockwise.

10. Apply seal gum to inside of timing chain cover mounting bolt hole.

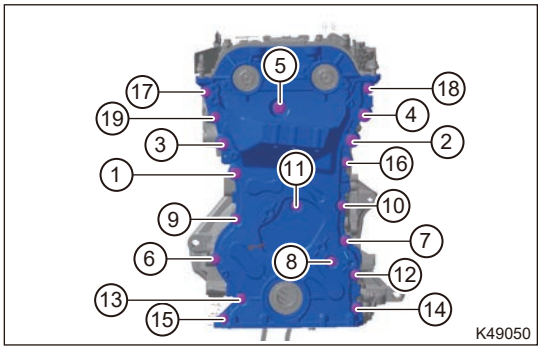
    Seal gum: Loctite 5900H


K49049

11. Install and tighten 19 cylinder head cover fixing bolts in order shown in illustration.

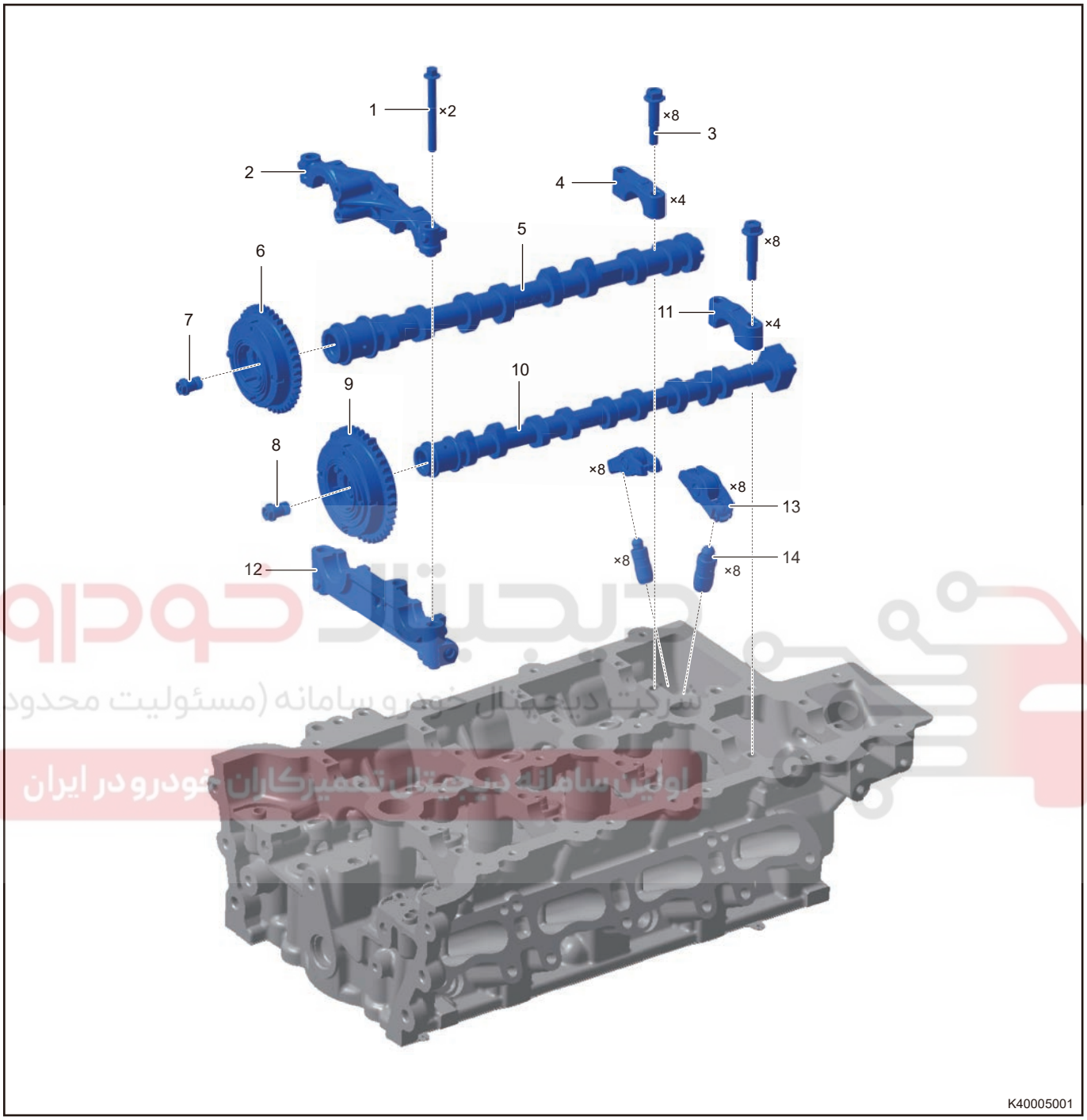
    M8x35 Torque: 25 + 5 N•m

    M10x45 Torque: 40 + 5 N•m



12. Connect the oil pump assembly connector.
13. Install the idler pulley assembly.
14. Install the torsion shock absorber assembly.
15. Install the accessory drive belt tensioner assembly.
16. Install the accessory drive belt.
17. Install the right mounting cushion assembly.
18. Install the engine lower protector assembly.
19. Install the phaser magnet.
20. Install the cylinder head cover assembly.
21. Install the engine trim cover assembly.
22. Install the engine compartment trim cover assembly.

Camshaft and Rocker Arm



1	1st Bearing Cap Fixing Bolt	8	Intake Phaser Valve Body Bolt
2	1st Bearing Upper Cap	9	Intake Phaser Assembly
3	Exhaust Camshaft Bearing Cap Fixing Bolt	10	Intake Camshaft Assembly
4	Exhaust Camshaft Bearing Cap	11	Intake Camshaft Bearing Cap
5	Exhaust Camshaft Assembly	12	1st Bearing Lower Cap

6	Exhaust Phaser Assembly	13	Roller Rocker Arm Assembly
7	Exhaust Phaser Valve Body Bolt	14	Hydraulic Lifter Assembly

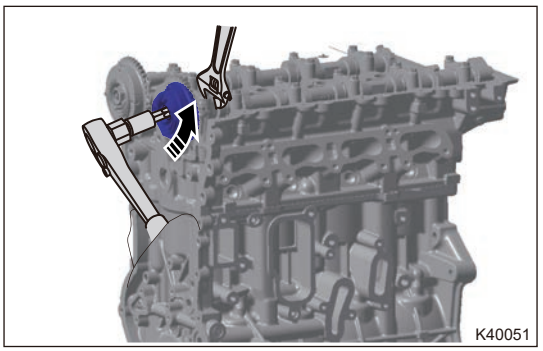
Removal

Warning
• Blow dirt and debris away from surface of cylinder head cover with compressed air. • Be sure to wear safety equipment to prevent accidents, when removing camshaft and rocker arm. • Appropriate force should be applied when removing camshaft and rocker arm. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Remove the engine trim cover assembly.
4. Remove the cylinder head cover.
5. Remove the accessory drive belt.
6. Remove the engine timing chain.

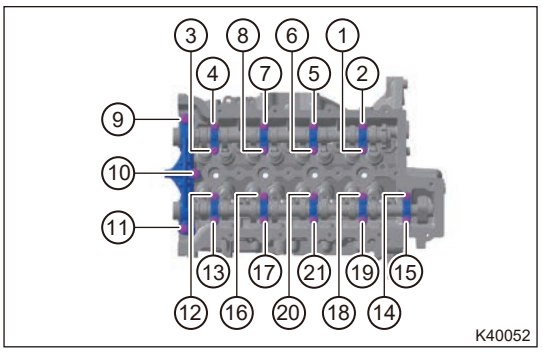
7. Use a proper wrench to hold intake camshaft, and remove fixing bolt from intake phaser in direction of arrow, remove intake phaser.

   Hint:
   Removal method for exhaust phaser is the same as that of intake phaser.



8. Remove intake and exhaust camshaft bearing cap fixing bolts.

   Hint:
   During removal, loosen fixing bolts in order shown in illustration first, and then remove bolts thoroughly in order.



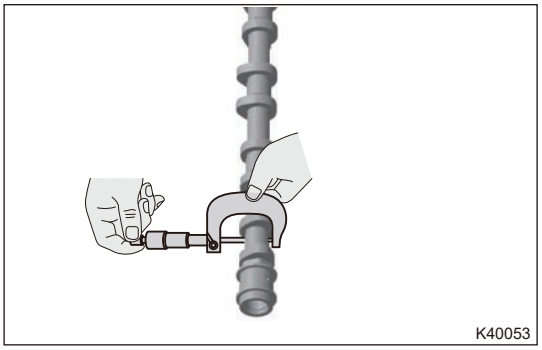
9. Remove the camshaft bearing caps.
10. Remove intake and exhaust camshaft.
11. Remove rocker arm and hydraulic lifter component.

Camshaft Appearance Inspection

1. Check if there are scratches on camshaft surface. If there are scratches, replace camshaft.
2. Check if there are leaking holes and cracks on camshaft bearing caps. If so, replace camshaft.

Measure camshaft journal diameter with a micrometer

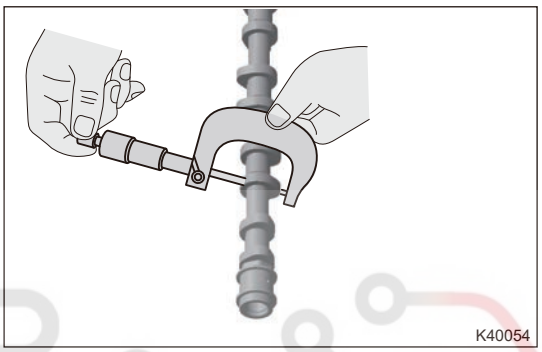
Measurement Item	Specification (mm)
1st journal diameter (same for intake and exhaust sides) (mm)	Φ30 (-0.066 - 0.050)
2nd - 5th journals (same for intake and exhaust sides)	Φ24 (-0.053 - 0.040)



Hint:
If camshaft journal diameter is not within specified range, replace intake/exhaust camshaft assembly.

Measure highest point of cam with a micrometer

Measurement Item	Specification (mm)
Cam Flange Height (Highest Point)	Intake: 37.07 - 37.31
	Exhaust: 36.94 - 37.18



Hint:
If cam height is not within specified range, replace intake/exhaust camshaft assembly.

Check camshaft axial clearance

1. Perform measurement with roller rocker arm and intake and exhaust phasers not installed.
2. Place dial indicator on cylinder head body. Press indicator tip on front end of camshaft, and push camshaft forward and backward. The difference between the two limit reading equals to camshaft axial clearance. It is normal if the difference is between 0.15 and 0.275mm.

Check hydraulic lifter

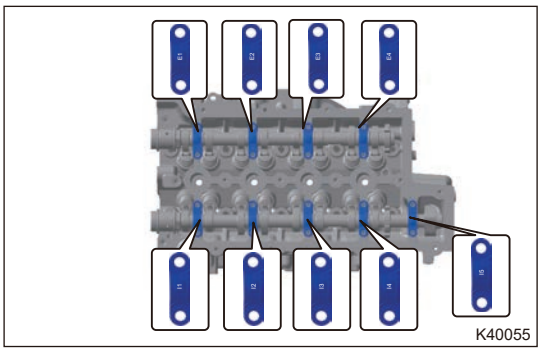
1. Check if end surface and cylindrical operating surface of hydraulic lifter are normal.
2. Check if hydraulic lifter slides smoothly in cylinder head guide hole.
3. Check each hydraulic lifter for weakness. If exists, remove and soak it for 24 hours, then press the hydraulic lifter plunger. If the plunger can be clearly pushed, it means that the tappet is “soft” and the hydraulic tappet can be replaced.

Installation

1. Clean intake and exhaust camshafts and camshaft bearing caps.
2. Apply engine oil to camshaft cam surface and add a proper amount of engine oil to camshaft bearing hole.
3. Install intake, exhaust camshaft assemblies and intake and exhaust camshaft bearing caps.

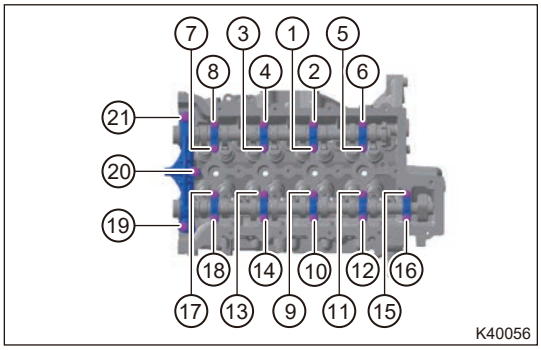
   Hint:

   - Install according to marks on bearing cap: “I” indicates intake camshaft bearing cap and “E” indicates exhaust camshaft bearing cap.



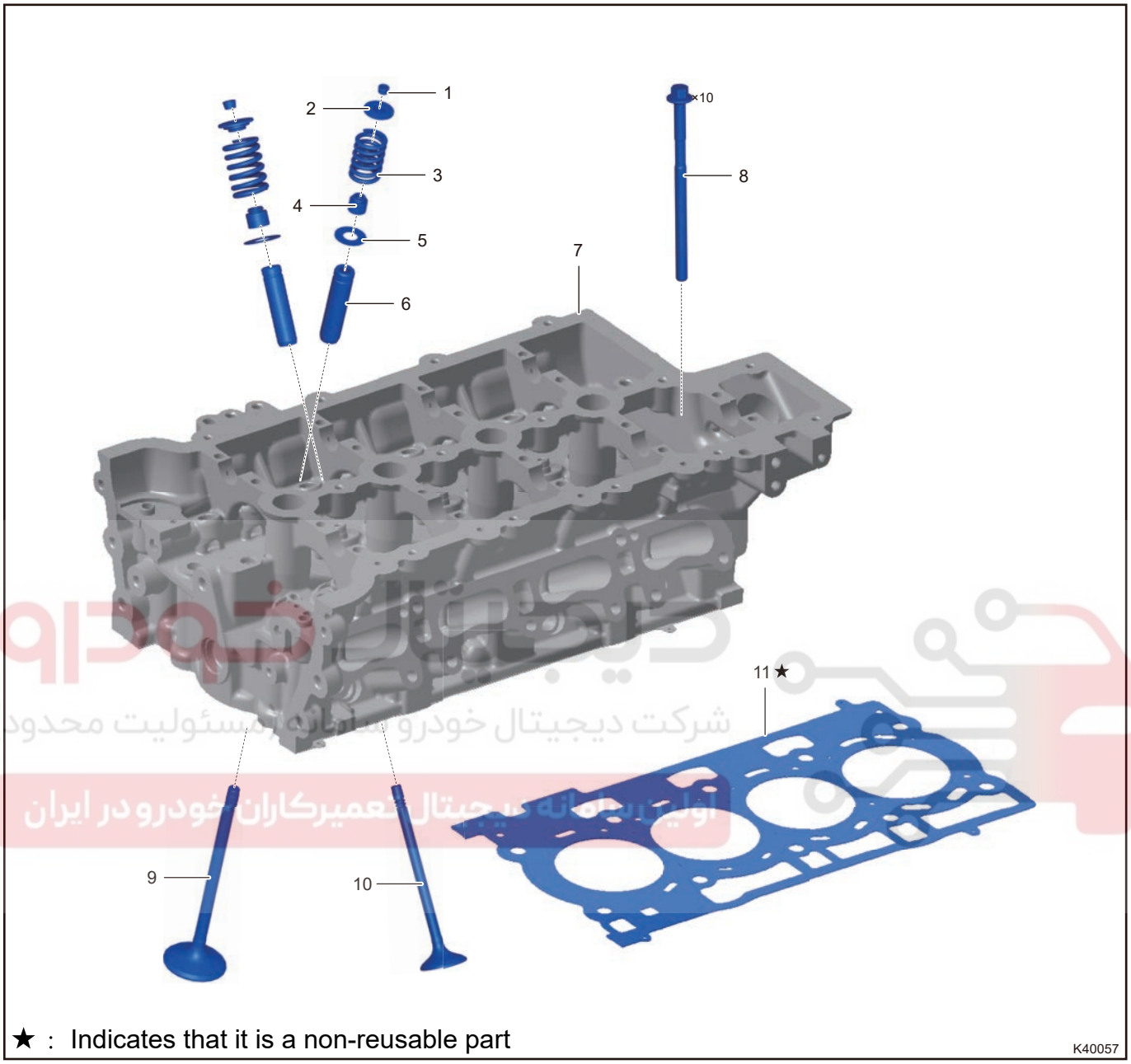
4. Tighten the camshaft bearing cap fixing bolt manually then tighten camshaft bearing cap fixing bolt.

   Torque: For the 1st bearing cap fixing bolt 20 + 3 N·m, for bearing cap bolt 8 + 3 N·m



5. Install the engine timing chain.
6. Install the accessory drive belt.
7. Install the cylinder head cover.
8. Install the engine trim cover assembly.
9. Install the engine compartment trim cover assembly.

Cylinder Head



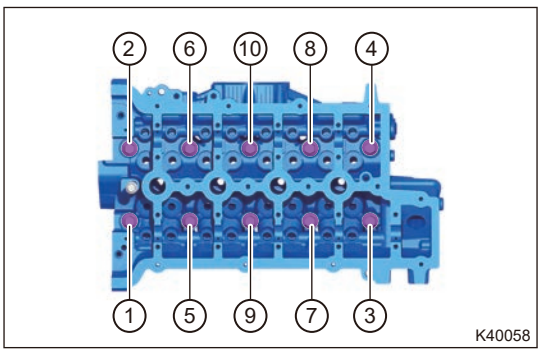
★ : Indicates that it is a non-reusable part

1	Valve Cotter	7	Cylinder Head
2	Valve Spring Upper Seat	8	Cylinder Head Bolt
3	Valve Spring	9	Exhaust Valve
4	Valve Oil Seal	10	Intake Valve
5	Valve Spring Lower Seat	11	Cylinder Gasket
6	Valve Guide	★	Non-reusable Part

Removal

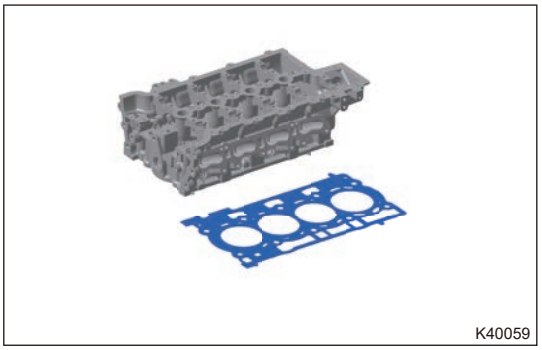
Warning
• Be sure to wear safety equipment to prevent accidents, when removing cylinder head. • Appropriate force should be applied when removing cylinder head. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Remove the engine trim cover assembly.
4. Drain engine oil.
5. Drain the coolant.
6. Remove the battery assembly.
7. Remove the battery tray assembly.
8. Remove the intake hose assembly.
9. Remove the air filter assembly.
10. Remove the cooling pipe assembly.
11. Remove expansion tank inlet pipe assembly.
12. Remove the intake manifold assembly.
13. Remove the fuel rail injector assembly.
14. Remove the precatalytic converter assembly.
15. Remove the turbocharger assembly.
16. Remove the accessory drive belt.
17. Remove the tensioner assembly.
18. Remove the idler pulley assembly.
19. Remove the cylinder head cover.
20. Remove the timing chain cover.
21. Remove the engine timing chain.
22. Remove camshaft and rocker arm.
23. Remove 10 fixing bolts from cylinder head in order shown in illustration.



Caution
• When engine is in high temperature, removal and installation may cause deformation to cylinder head, so perform removal and installation at normal temperature. • Failure to remove cylinder head bolts in order may cause cylinder head deformation. • Make scraping marks on removed cylinder head bolt, and they cannot be reused.

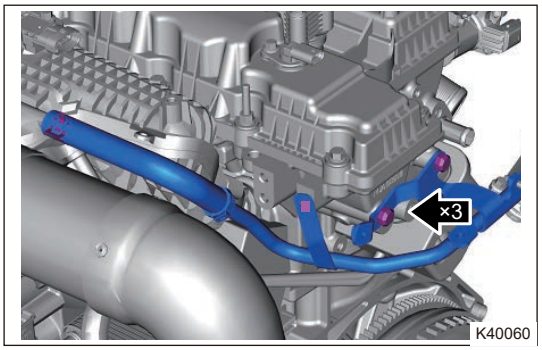
24. Remove cylinder head assembly and cylinder head gasket.



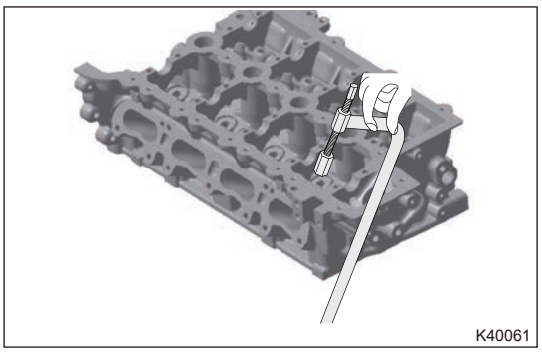
Caution
• DO NOT reuse the removed cylinder head gasket, and it is necessary to replace with a new one. • Be careful not to lose cylinder head mounting dowel pin during removal.

Disassembly

1. Remove 3 fixing bolts, elastic clamp and bracket.

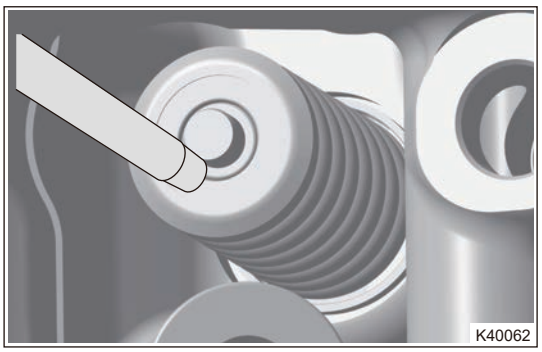


2. Using a valve spring compressor, compress valve spring to a position so that valve cotter can be removed.

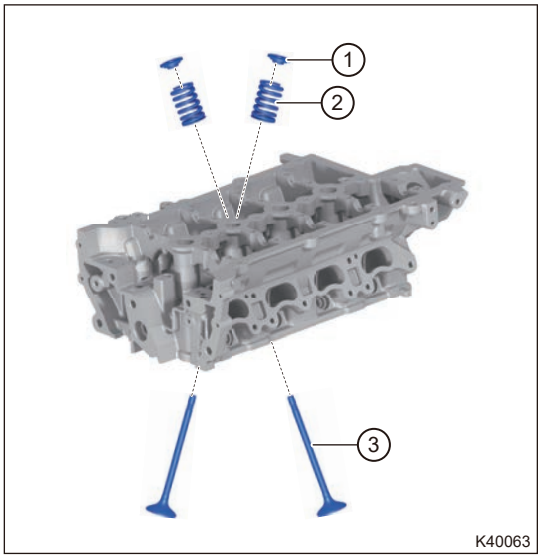


3. Using a magnetic rod, remove valve cotter.

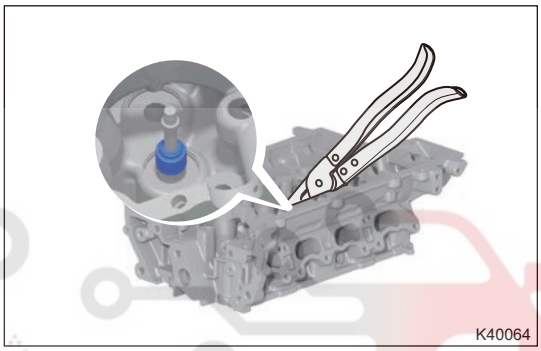
   Hint:
   Due to the valve cotter is small, please operate carefully when operating it, so as to avoid loss.



4. Remove valve spring upper seat (1), valve spring (2) and intake and exhaust valve (3) from cylinder head.



5. Using a valve oil seal remover, remove the valve oil seal.



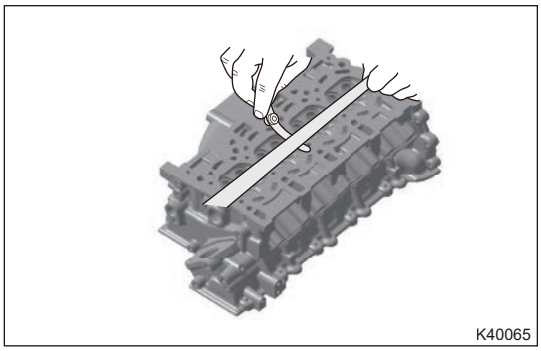
6. Using a magnetic rod, remove valve spring lower seat.

Check cylinder head

1. Check the appearance.
   a. Remove carbon deposits inside valve guides with cleaner.
   b. Make sure valve stem can move and rotate freely in its mounting hole.
2. Using a precision straightedge and feeler gauge, check cylinder head flatness.

Measurement Item	Specification (mm)
Cylinder Head Flatness	0.04

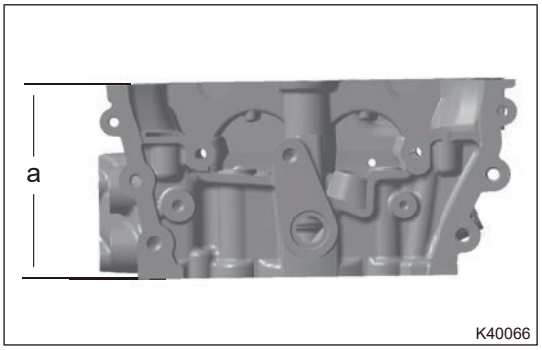
Hint:
If cylinder head flatness is not within specified range, replace cylinder head assembly.



3. Using a precision straightedge, measure cylinder head height a.

Measurement Item	Specification (mm)
Cylinder Head Height	136.9

Hint:
If cylinder head height is not within specified range, replace cylinder head assembly.

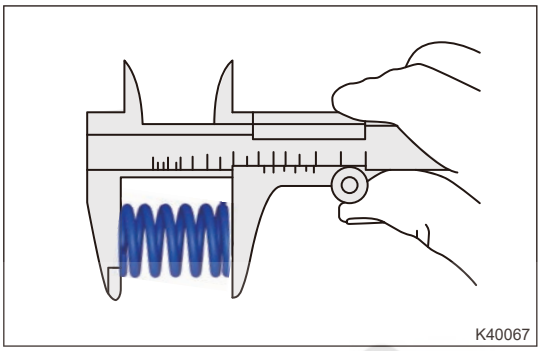


Check valve spring

1. Using a vernier caliper, measure free length of valve spring and length of valve spring under the pre-pressure of (230 ± 11 N).

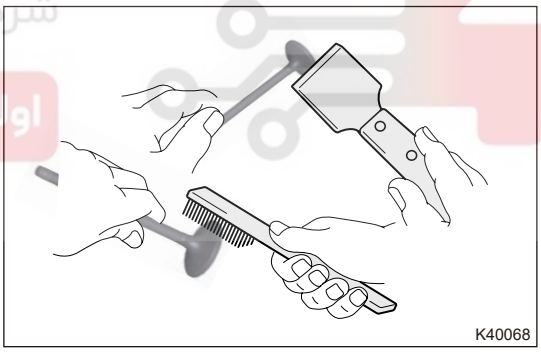
Measurement Item	Specification (mm)
Valve Spring Free Length	45.4 ± 2
Valve Spring Length Under Pre-pressure	Intake: 36.5
	Exhaust: 34.8

Hint:
If valve spring length is not within specified range, replace valve spring.



Check valve

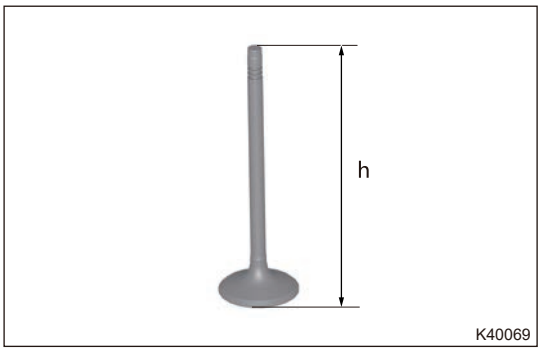
1. Clean the valve.
   a. Using a scraper, remove carbon deposited on valve head.
   b. Using a thin and soft wire brush, clean the valve thoroughly.



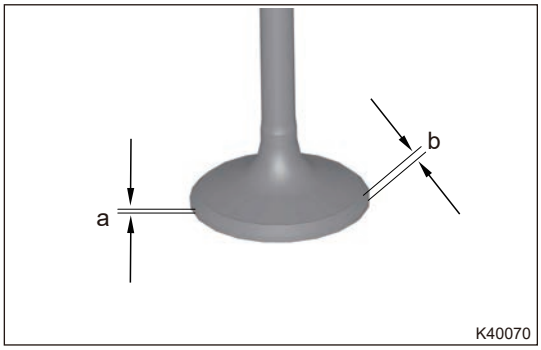
2. Using a micrometer, measure the valve height h.

Measurement Item	Specification (mm)
Intake Valve	107.86 ± 0.25
Exhaust Valve	109.06 ± 0.25

Hint:
If valve height is less than specified value, replace valve.



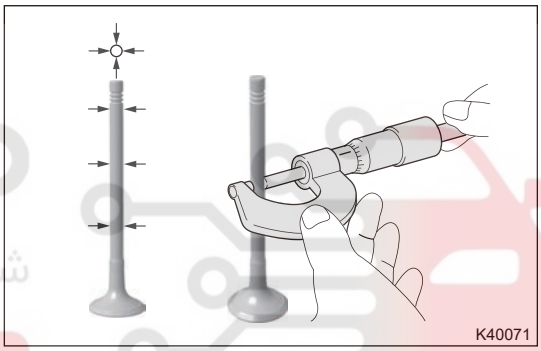
3. Check the valve head.
   a. Measure margin thickness (a) of valve head.
   b. Measure width (b) of valve face.



Measurement Item	Specification (mm)
Valve Head Margin Thickness (Intake)	1.3 ± 0.15
Valve Head Margin Thickness (Exhaust)	1.4 ± 0.15
Valve Face Width (Intake)	2.12
Valve Face Width (Exhaust)	3.12

Hint:
If valve head margin thickness and face width are not within specified range, replace valve.

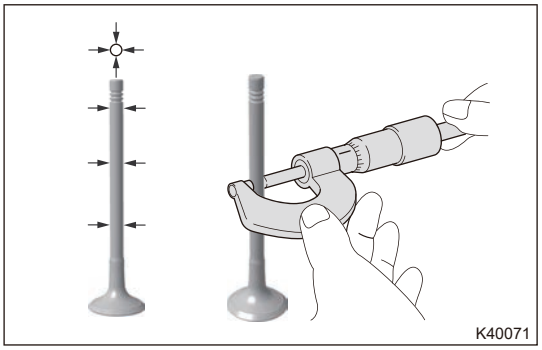
4. Using a micrometer, measure the valve stem diameter.
   a. Measure margin thickness (a) of valve head.
   b. Measure width (b) of valve face.



Measurement Item	Size and Tolerance (mm)
Valve Stem Diameter (Intake)	Φ5.98 ± 0.007
Exhaust Valve Stem Diameter (Exhaust)	Φ5.96 ± 0.007

Hint:
If valve stem diameter is not within specified range, check clearance between valve stem and valve guide.

5. Check clearance between valve stem and valve guide.
   a. Using a caliper gauge, measure inner diameter of valve guide.



Measurement Item	Size and Tolerance (mm)
Valve Guide Inner Diameter	Φ6 (0, +0.015)

   b. Clearance between valve stem and valve guide = Valve guide inner diameter - Valve stem diameter.

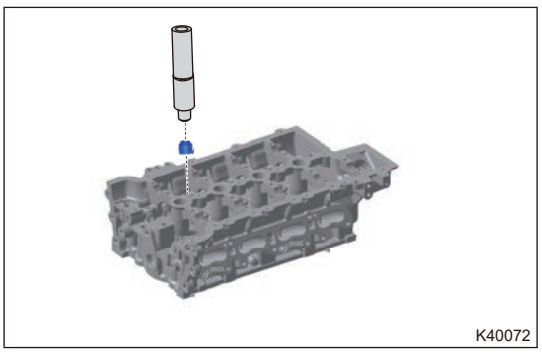
Measurement Item	Specification (mm)
Clearance Between Intake Valve and Valve Guide	0.013 - 0.042
Clearance Between Exhaust Valve and Valve Guide	0.033 - 0.062

Hint:
If clearance between valve and valve guide is not within specified range, replace valve or valve guide.

Assembly

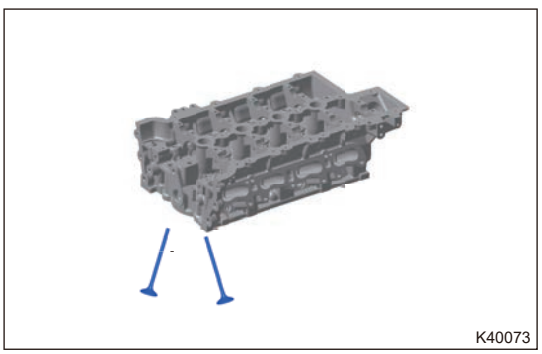
Caution
• Apply lubricant to valve oil seal lip before installing valve oil seal. • Before installing valve spring, check valve spring lower seat for proper installation. • Clean all components to be assembled thoroughly before assembly.

1. Install valve spring lower seat to valve guide end to fit it with cylinder head.
2. Install valve oil seal to valve oil seal special tool and press it on valve guide. Tap the tool end with a hammer to press in oil seal.

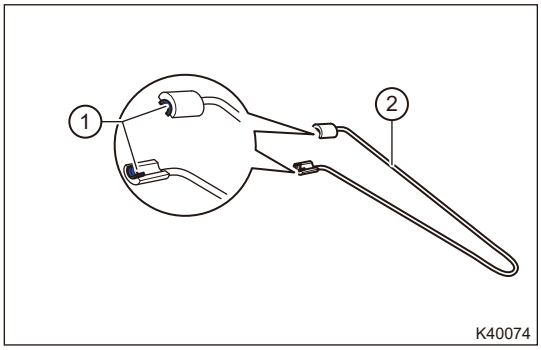


3. Clean valve surface, install exhaust valve into cylinder head guide hole.

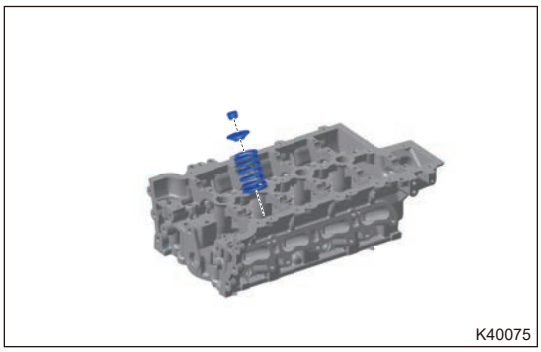
   Hint:
   Slightly rotate valve collar until valve conical face fully contacts retainer conical face.



4. Install valve cotter (1) to valve cotter installer (2).



5. Install valve spring (1) and valve spring upper seat (2). Using a valve spring compressor, compress valve spring to a position so that valve cotter can be installed; Using a valve cotter installer, install valve cotter (3) in place.

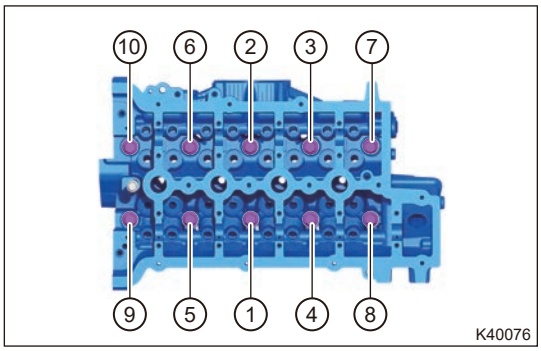


6. Tap tip of valve stem lightly with a rubber hammer to make sure valve cotter is installed in place after assembly.

Installation

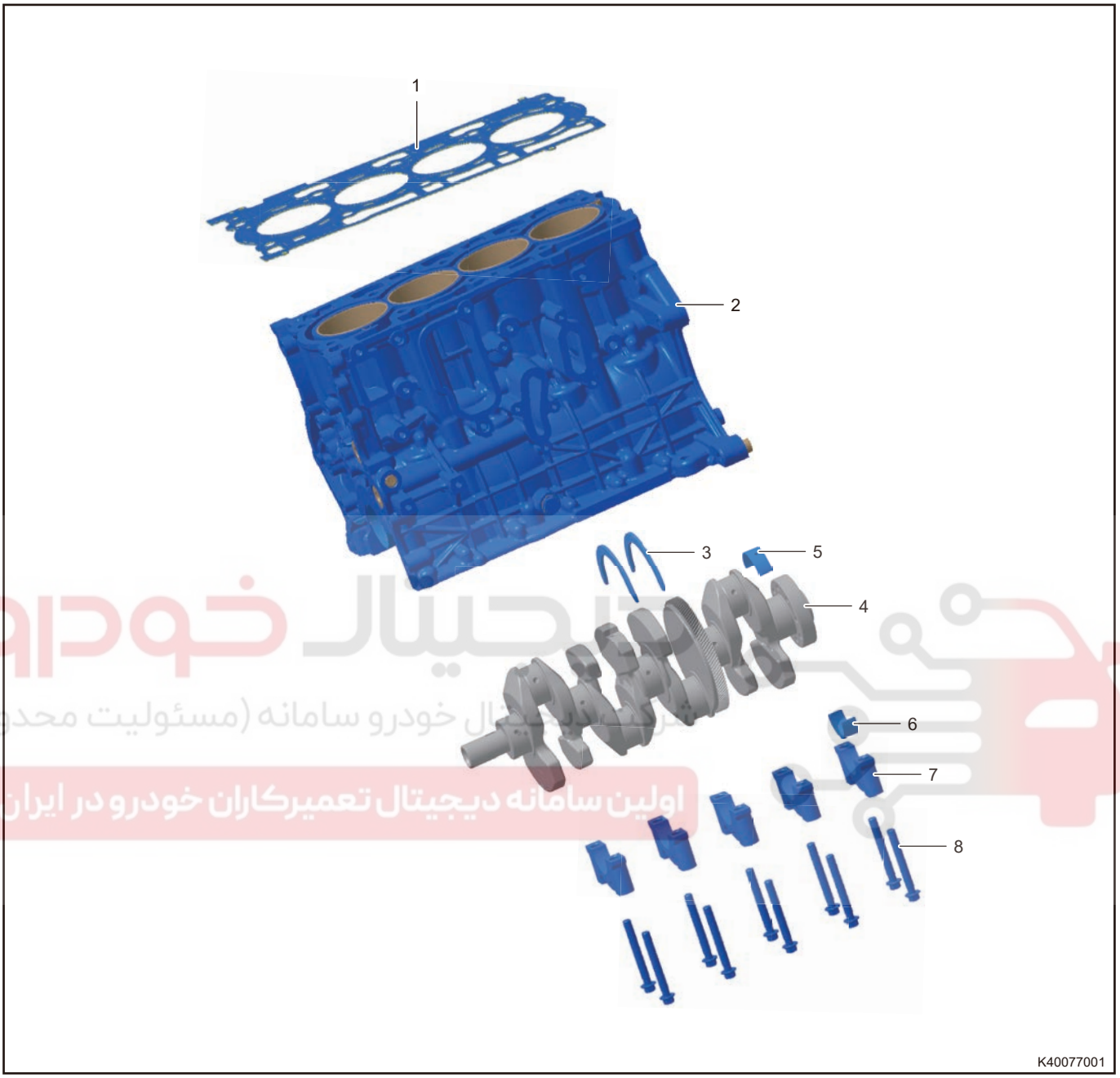
Caution
• DO NOT damage or lose dowel pin on cylinder block. • Remove residual oil on cylinder head and cylinder block. • Replace cylinder head gasket with a new one. • Check that cylinder head gasket is neat and clean without any chips and scratches. • Clean junction surface between cylinder head and combustion chamber, and remove any accumulated oil at bottom of cylinder block thread. • Replace cylinder head fixing bolt, and make scraping marks on removed cylinder head bolt.

1. Tighten bolts in place by hands.
2. 1st step: Tighten bolts to 55 ± 5 N·m in order from (1) to (10) shown in illustration.
3. 2nd step: Rotate bolts clockwise by 100° ± 5° in tightening order.
4. 3rd step: Rotate bolts clockwise by 70° ± 5° in tightening order again.

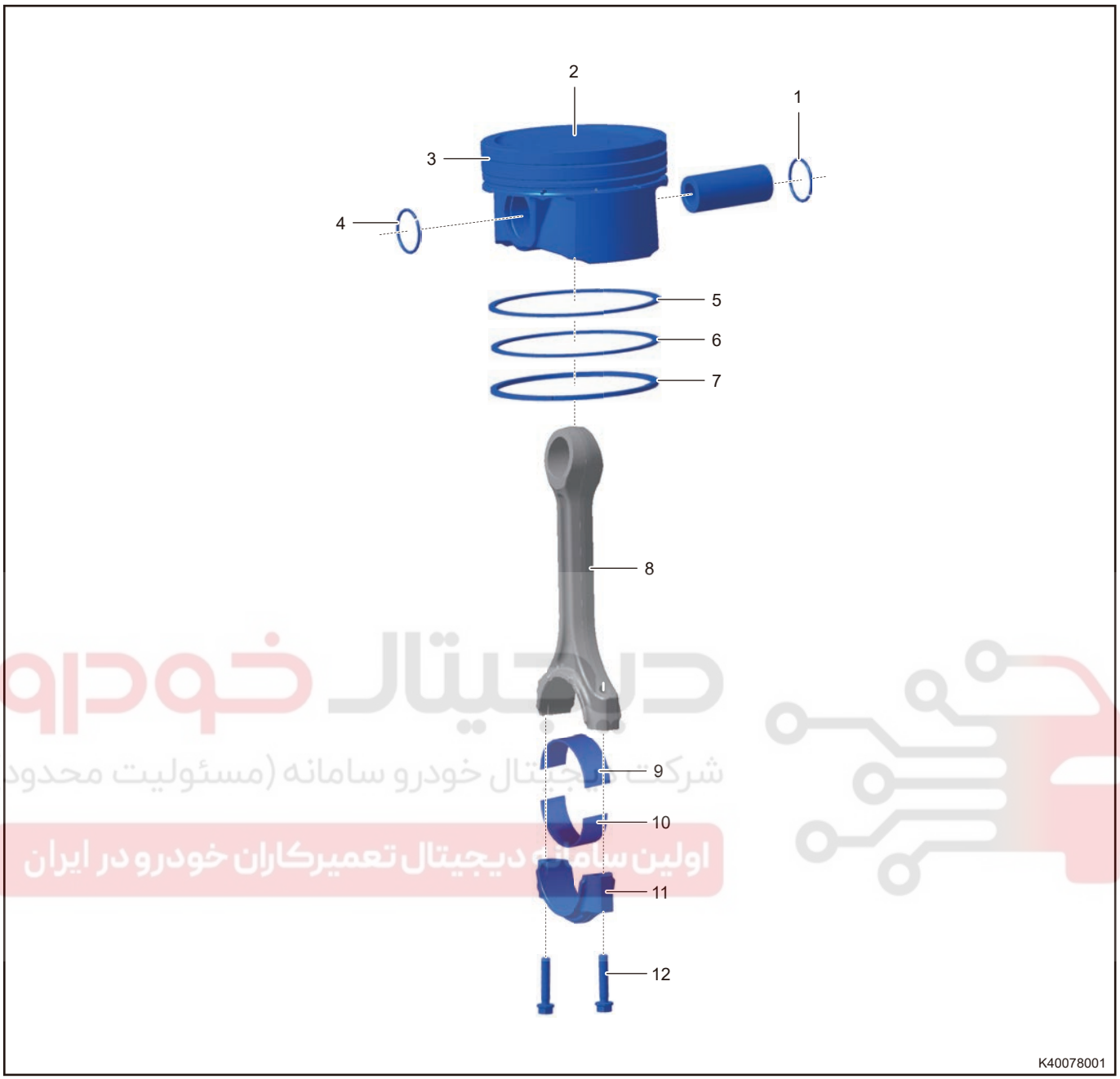


5. Install the camshaft and rocker arm.
6. Install the engine timing chain.
7. Install the cylinder head cover.
8. Install the idler pulley assembly.
9. Install the tensioner assembly.
10. Install the accessory drive belt.
11. Install the turbocharger assembly.
12. Install the precatalytic converter assembly.
13. Install the fuel rail injector assembly.
14. Install the intake manifold assembly.
15. Install the cooling pipe assembly.
16. Install the intake hose assembly.
17. Install the battery tray.
18. Install the battery assembly.
19. Install the air filter assembly.
20. Add the coolant as specified.
21. Add the engine oil as specified.
22. Install the engine trim cover assembly.
23. Install the engine compartment trim cover assembly.

Cylinder Block



1	Cylinder Gasket	5	Crankshaft Main Bearing Upper Shell
2	Cylinder Block	6	Crankshaft Main Bearing Lower Shell
3	Thrust Washer	7	Main Bearing Cap
4	Crankshaft	8	Main Bearing Cap Fixing Bolt

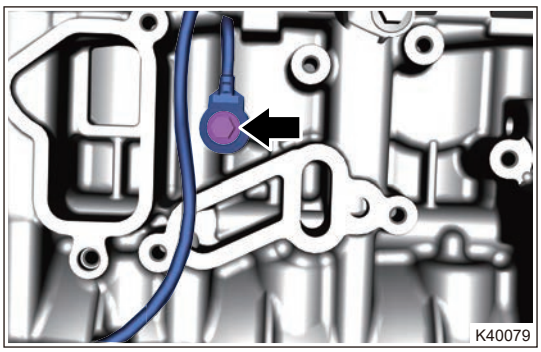


1	Elastic Circlip	7	Oil Ring Assembly
2	Piston pin	8	Connecting Rod Assembly
3	Piston	9	Connecting Rod Bearing Upper Shell
4	Elastic Circlip	10	Connecting Rod Bearing Lower Shell
5	First Compression Ring - Piston	11	Connecting Rod Bearing Cap
6	Second Compression Ring - Piston	12	Connecting Rod Bearing Cap Fixing Bolt

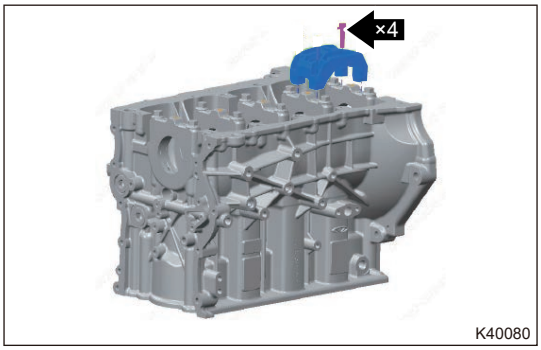
Removal

Warning
• Be sure to wear safety equipment to prevent accidents, when removing cylinder block. • Appropriate force should be applied when removing cylinder block. Be careful not to operate roughly.

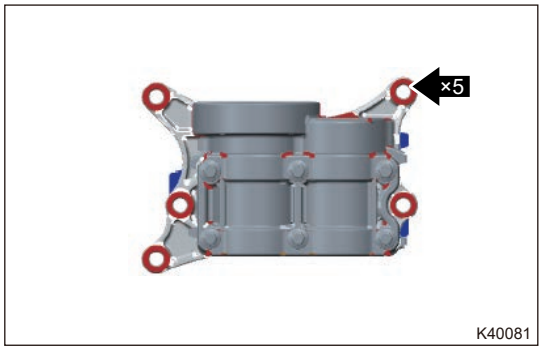
1. Remove engine assembly from vehicle.
2. Separate transmission from engine.
3. Remove the flywheel assembly.
4. Remove the turbocharger assembly.
5. Remove the turbocharger oil inlet pipe.
6. Remove the turbocharger oil return pipe.
7. Remove the intake manifold assembly.
8. Remove the accessory drive belt.
9. Remove the idler pulley assembly.
10. Remove the tensioner assembly.
11. Remove the torsion shock absorber.
12. Remove the water pump module assembly.
13. Remove the oil filter.
14. Remove the A/C compressor bracket.
15. Remove the oil pan assembly.
16. Remove the engine timing chain.
17. Remove the oil pump chain.
18. Remove the cylinder head assembly.
19. Remove the oil pump assembly.
20. Remove the knock sensor fixing bolt and remove the knock sensor.



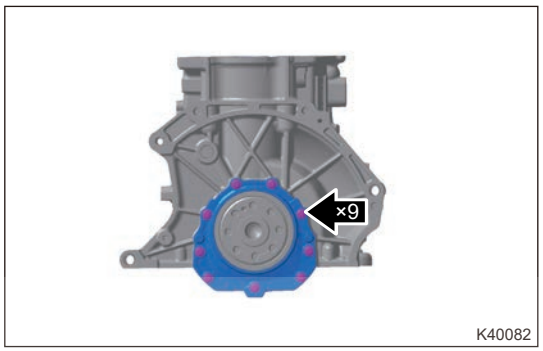
21. Remove 4 fixing bolts and connecting bracket.



22. Remove 5 fixing bolts and balance shaft with housing assembly.



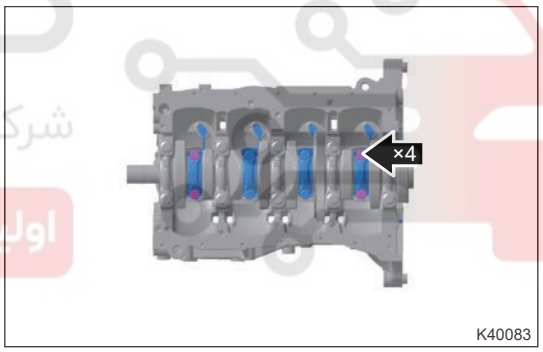
23. Remove 9 fixing bolts and crankshaft rear oil seal bracket.



24. Turn crankshaft, so that of cylinders 1 and 4 are at bottom dead center, remove fixing bolts from connecting rod bearing caps of cylinders 1 and 4, and remove connecting rod bearing caps of cylinders 1 and 4.

Hint:

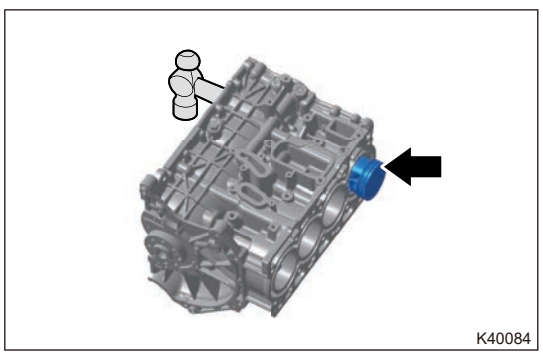
Removal procedures of cylinders 2 and 3 are the same as cylinders 1 and 4.



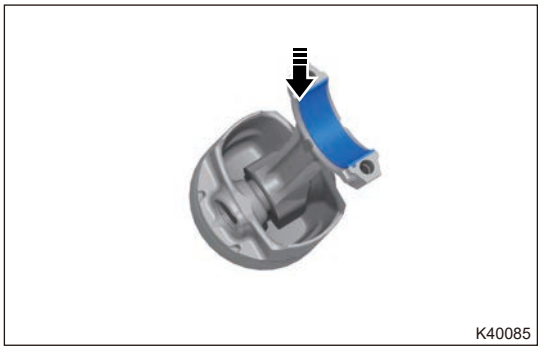
25. Using a hammer handle, push out piston connecting rod assembly from cylinder block.

Hint:

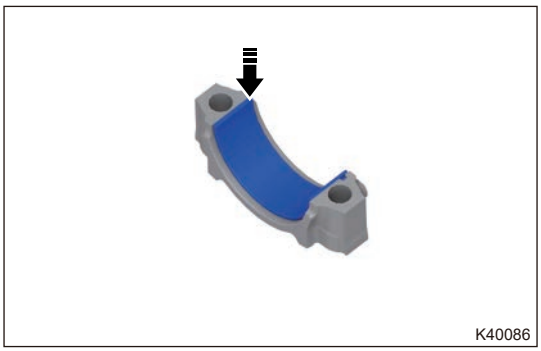
- Please operate carefully when pushing out piston, to avoid cylinder liner damage.
- Mark the removed piston connecting rod assemblies, so as to distinguish them.
- Replace with new connecting rod bearing cap bolts during assembly.



26. Push out upper shell from connecting rod body slightly in direction of arrow to remove it.

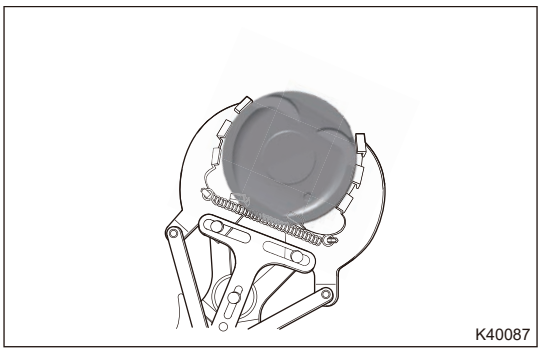


27. Push out bearing lower shell slightly from connecting rod bearing cap in direction of arrow to remove it.



28. Using a piston ring remover, remove first compression ring and second compression ring.

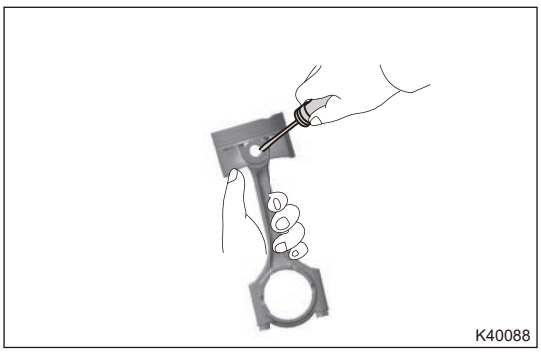
Hint:
Before removing piston ring, check piston ring side clearance; If it is necessary to be reused, be sure to mark piston ring position.



29. Remove oil ring rail and expander.

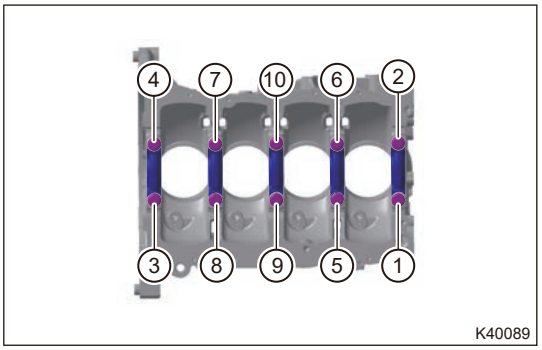
30. Using a flat tip screwdriver, pry out elastic circlips at both sides of piston pin carefully from notch.

Caution
• Elastic circlip has a large tensile force. Be careful during removal to prevent personal injury.



31. Remove the piston pin assembly.

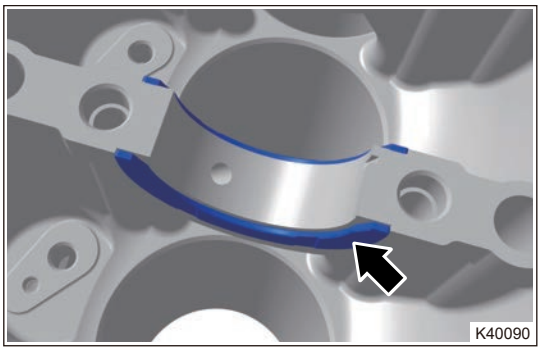
32. Remove 10 fixing bolts from crankshaft main bearing cap in order as shown in illustration.



33. Remove the crankshaft assembly.

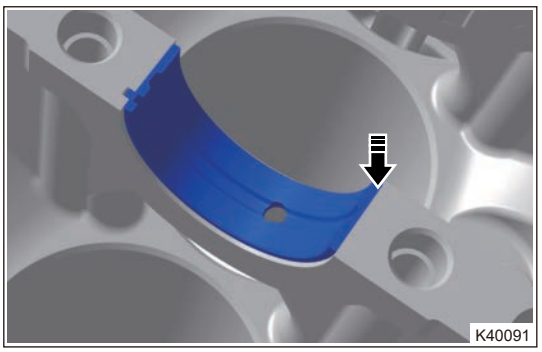
Hint:
Take care when removing crankshaft, ask other operators to assist when necessary. Avoid scratching contact surfaces between crankshaft and bearing shell.

34. Remove crankshaft thrust washers from cylinder block.



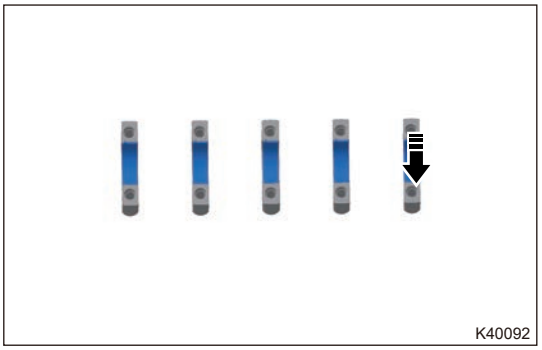
35. Push out main bearing upper shell slightly from cylinder block in direction of arrow to remove it.

Caution
• Pay attention to the notch position. Push out bearing shell carefully. It is difficult to push out bearing shell and parts may be damaged if pushing in opposite direction.

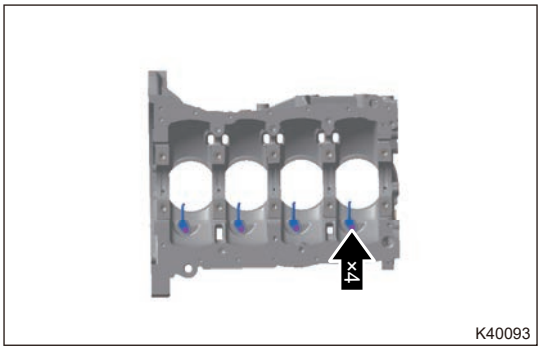


36. Push out main bearing lower shell slightly from main bearing cap in direction of arrow to remove it.

Caution
• Pay attention to the notch position. Push out bearing shell carefully. It is difficult to push out bearing shell and parts may be damaged if pushing in opposite direction.



37. Remove 4 fixing bolts and piston cooling nozzles.



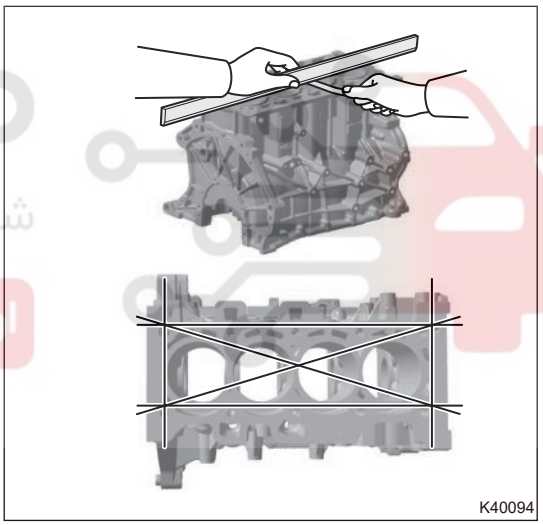
Inspection

1. Check the cylinder block appearance.
   a. Clean engine block thoroughly and check all hole passages for leakage.
   b. Check cylinder liner for cracks.
   c. Check cylinder block for cracks.

   Hint:
   DO NOT wash cylinder at high temperature; otherwise, cylinder liner will stick out beyond cylinder block.

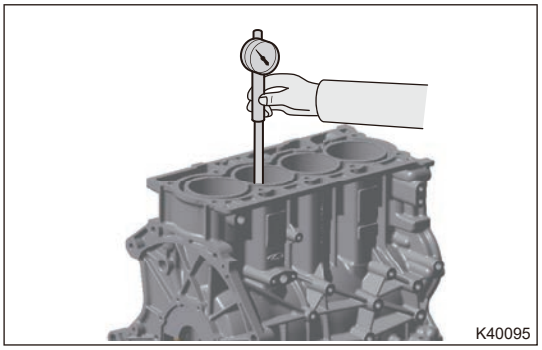
2. Check the cylinder block upper surface flatness.
   a. Clean the cylinder block upper surface, using precision straightedge and feeler gauge, measure cylinder block upper surface flatness.

Measurement Item	Specification (mm)	Limit Value (mm)
Cylinder Block Upper Surface Flatness	0.04	0.1



Hint:
Never grind the cylinder block upper surface. If the engine block upper surface flatness is above the limit, replace the engine block.

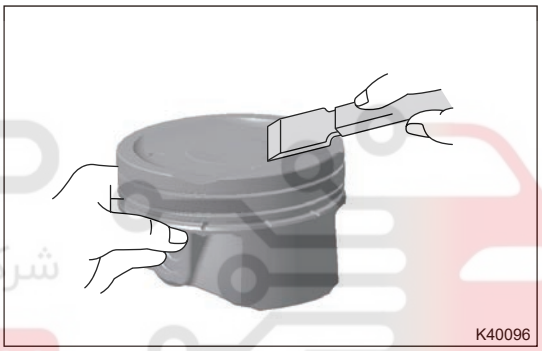
3. Check cylinder diameter and piston clearance.
   a. Using a cylinder gauge, measure cylinder diameter and calculate the gap between cylinder and piston.



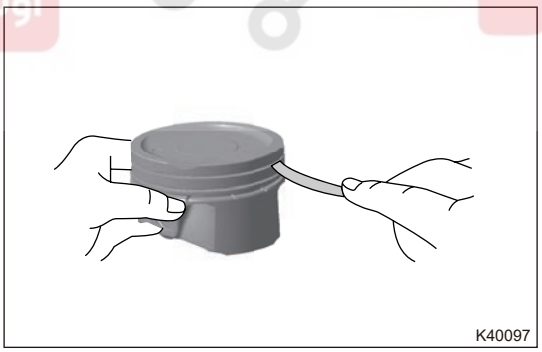
Measurement Item	Specification (mm)	Limit Value (mm)
Cylinder Diameter	80.5	80.513
Clearance Between Piston and Cylinder	0.04	0.063

Hint:
If the cylinder diameter is beyond the limit, replace the cylinder block. If the clearance between piston and cylinder is beyond the specified value, check cylinder diameter and piston diameter. Replace as necessary.

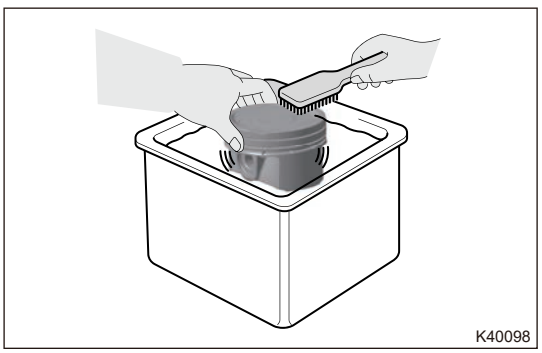
4. Check piston
   a. Using a scraper, remove carbon deposits on piston top.



   b. Using a piston ring, remove carbon deposits from piston ring grooves.

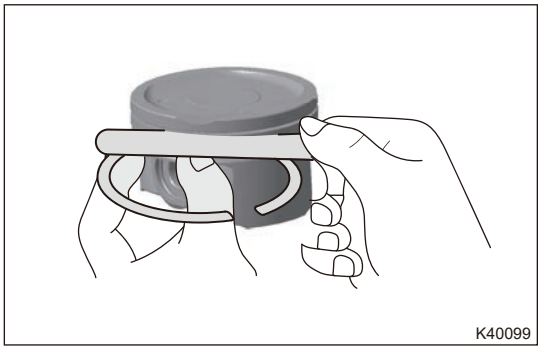


   c. Using a brush and solvent, thoroughly clean piston.



5. Check piston ring

a. Using a feeler gauge, measure clearance between new piston ring and ring groove side.

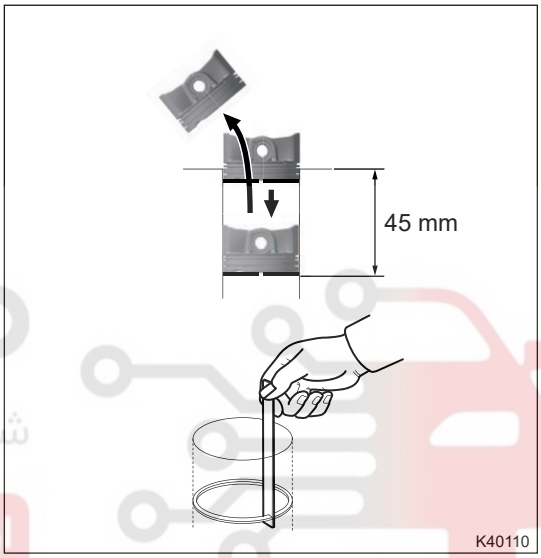


Measurement Item	Specification (mm)
First compression ring groove side clearance	0.035 - 0.075
Second compression ring groove side clearance	0.03 - 0.07

Hint:
If piston ring side clearance exceeds specified range, replace piston ring and piston assembly.

b. Using a piston, push piston ring from top of cylinder to bottom of cylinder bore, that is 45mm from bottom of cylinder bore. Keep the piston ring level.

c. Measure at the specified position, which has the minimum piston ring wear with a feeler gauge.

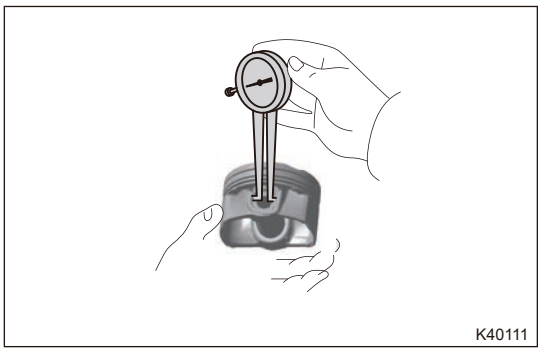


Measurement Item		Limit Value (mm)
Piston Ring End Gap	First Ring	0.2 - 0.39
	Second Ring	0.4 - 0.6

Hint:
- If piston ring end gap is not within specified range, replace piston ring with a new set.
- If end gap is still not within specified range after replacement, replace cylinder block assembly.

6. Check piston pin

a. Using a feeler gauge, measure diameter of piston pin hole.



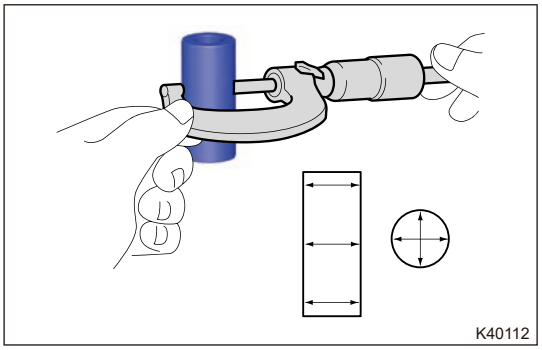
Measurement Item	Specification (mm)
Piston Pin Hole Diameter	22.004 - 22.009

Hint:
If piston pin hole diameter is not within specified range, replace piston.

b. Using an external micrometer, measure diameter of piston pin.

Measurement Item	Specification (mm)
Piston Pin Diameter	21.995 - 22

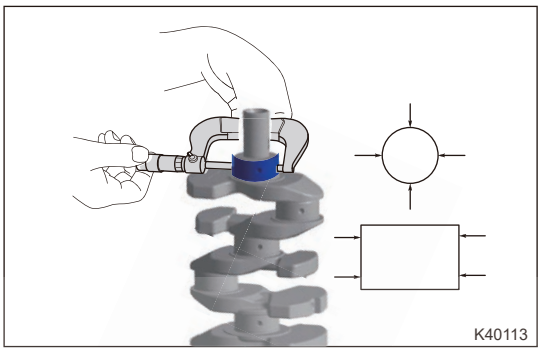
Hint:
If piston pin diameter is not within specified range, replace piston.



7. Check crankshaft main journal diameter
   a. Measure crankshaft main bearing diameter with an external micrometer, and measure again after rotating the crankshaft 90°.

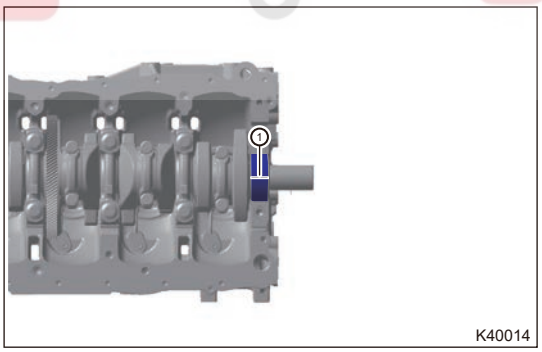
Measurement Item	Specification (mm)	Limit Value (mm)
Crankshaft Main Journal Diameter	52	51.981

Hint:
- If crankshaft main journal diameter is not within specified range, replace main bearing shells with new ones and check matching clearance of crankshaft main bearing.
- If matching clearance of main bearing is still not within specified range after replacing with new main bearing shells, replace crankshaft.

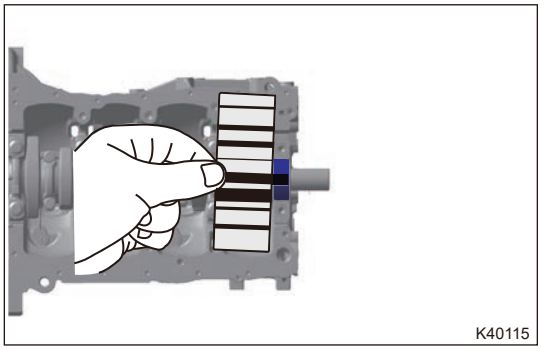


8. Check matching clearance of crankshaft main bearing
   a. Clean crankshaft main journals and main bearing shells.
   b. Install the crankshaft. Place feeler gauge (1) on crankshaft main journal, parallel to crankshaft center axis and as wide as distance covered by main bearing cap.
   c. Install main bearing cap and tighten main bearing cap fixing bolts to specified torque.

   Torque: 1st step: 60 ± 5 N·m, 2nd step: 120° ± 5°



d. Remove the main bearing cap; Using a feeler gauge, measure widest part of compressed feeler gauge. Measured value is matching clearance of crankshaft main bearing.



Measurement Item	Specification (mm)
Matching Clearance of Crankshaft Main Bearing	0.020 - 0.048

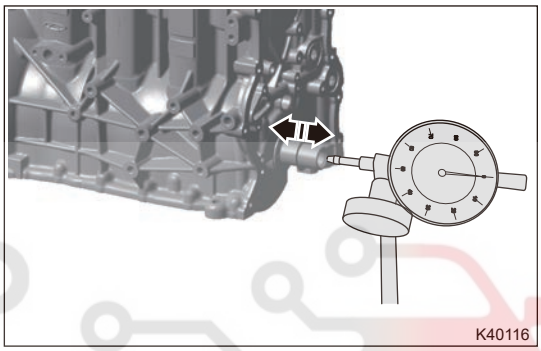
Hint:

- If matching clearance of crankshaft main bearing is not within specified range, install new main bearing shells; Replace crankshaft assembly if necessary.
- Replace bearing shells in pairs.

9. Check crankshaft axial clearance
   a. Clean crankshaft main journals and main bearing shells.
   b. Install main bearing cap and tighten main bearing cap fixing bolts to specified torque.

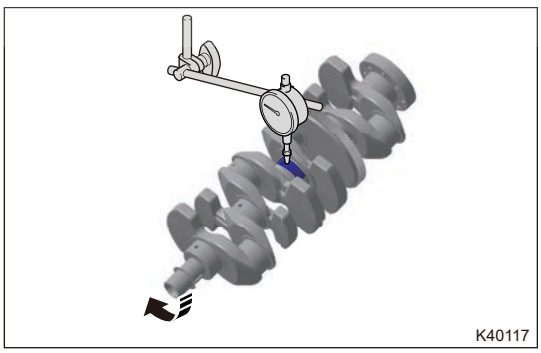
      Torque: 1st step: 60 ± 5 N·m, 2nd step: 120° ± 5°

   c. Using a flat tip screwdriver, pry crank position left and right, and read value on dial indicator.



Measurement Item	Specification (mm)	Limit Value (mm)
Crankshaft Axial Clearance	0.120 - 0.315	0.315

10. Check crankshaft main journal coaxiality
    a. Install crankshaft onto tester and keep it level.
    b. Rotate crankshaft slowly and read maximum change value from dial indicator. (Readings on dial indicator)/2 is the coaxiality of crankshaft main journal.

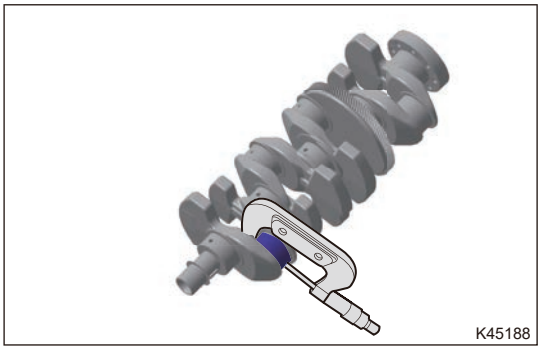


Measurement Item	Specification (mm)	Limit Value (mm)
Crankshaft Main Journal Coaxiality	0	0.05

Hint:
If crankshaft main journal coaxiality is not within specified range, replace crankshaft assembly.

11. Detect diameter of crankshaft connecting rod journal

a. Using an external micrometer, measure diameter of crankshaft connecting rod journal.



Measurement Item	Specification (mm)	Limit Value (mm)
Crankshaft Connecting Rod Journal Diameter	50	49.984

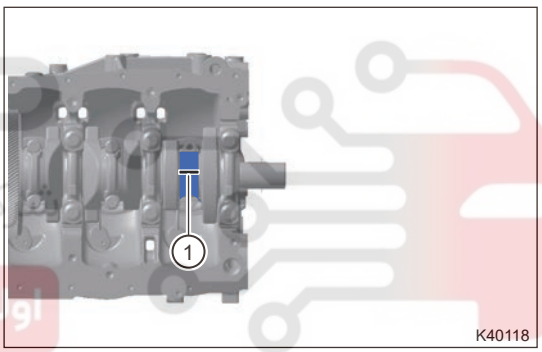
Hint:

- If connecting rod journal diameter is not within specified range, replace connecting rod bearing shells with new ones, and check radial clearance of connecting rod bearing shell.
- If radial clearance of connecting rod bearing shell is still not within specified range after replacement, replace crankshaft.

12. Check radial clearance of crankshaft connecting rod bearing shell

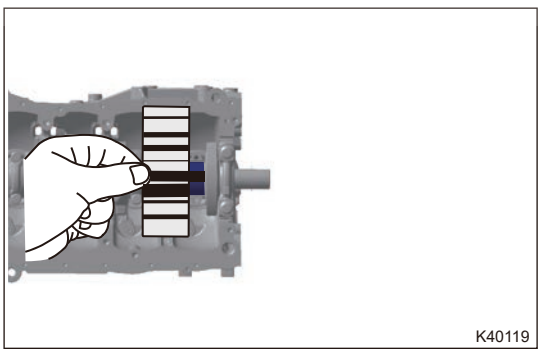
a. Clean connecting rod journals and connecting rod bearing shells.
b. Place a feeler (1) on connecting rod journal.
c. Install connecting rod bearing caps, and tighten connecting rod bearing cap fixing bolts to specified torque.

Torque: 1st step: 25 ± 3 N·m, 2nd step: 90° ± 5°



Hint:
DO NOT turn crankshaft during installation.

d. Remove the connecting rod bearing cap.
e. Using gauge scale of feeler gauge, measure the widest part of compressed feeler gauge to obtain radial clearance of connecting rod bearing shell.



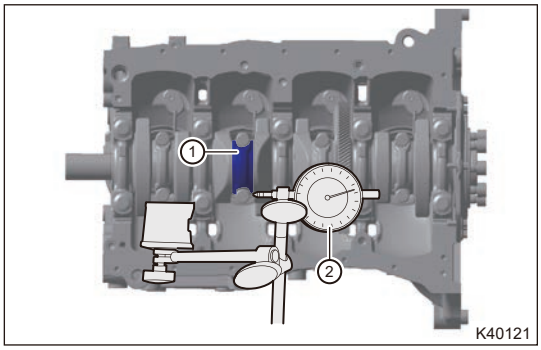
Measurement Item	Specification (mm)
Connecting Rod Bearing Shell Radial Clearance	0.035 - 0.067

Hint:
If radial clearance of connecting rod outer diameter is not within specified range, replace connecting rod bearing shells. Replace crankshaft assembly if necessary.

13. Check axial clearance of connecting rod

a. Install connecting rod bearing caps, and tighten connecting rod bearing cap fixing bolts to specified torque.

Torque: 1st step: 25 ± 3 N·m, 2nd step: 90° ± 5°



b. Install a dial indicator (2) with its plunger contacting the side of connecting rod cap (1) Reset dial of dial indicator to zero.

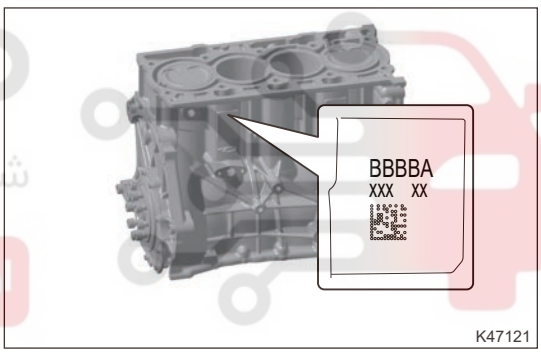
c. Push connecting rod bearing cap forward and backward (do not move crankshaft forward and backward) and read value on dial indicator.

Measurement Item	Specifications
Connecting Rod Axial Clearance	0.15 - 0.40

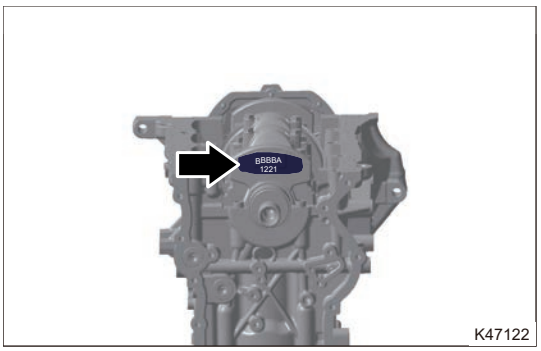
Hint:
If axial clearance of connecting rod is not within specified range, replace piston connecting rod assembly. Replace crankshaft assembly if necessary.

Selection of Main Bearing Shell

1. Related letter marks are available on cylinder block (-consisting of A, B, C). Such as “BBBBA” in illustration, each letter from left to right is corresponding to the size of each cylinder block main bearing hole. First letter "B" indicates the first main bearing hole and the fifth letter "A" indicates the fifth main bearing hole.



2. Related letter marks are available on first balancer at front end of crankshaft (consisting of A, B, C). Such as “BBBBA” in illustration, each letter from left to right is corresponding to the size of each crankshaft main journal. First letter "B" indicates the first main journal and the fifth letter "A" indicates the fifth main journal.



3. Classification methods of main bearing hole, main journal and main bearing shell

No.	Name	Color	Level	Size (mm)
1	Main Bearing Hole	Red	A	57.000 - 57.005
2	Main Bearing Hole	Blue	B	57.005 - 57.010
3	Main Bearing Hole	Yellow	C	57.010 - 57.015
4	Main Bearing Hole	Black	D	57.015 - 57.019
5	Main Bearing Upper Shell	Red	/	2.489 - 2.493
6	Main Bearing Upper Shell	Blue	/	2.493 - 2.497
7	Main Bearing Upper Shell	Yellow	/	2.497 - 2.501
8	Main Bearing Upper Shell	Black	/	2.501 - 2.505
9	Main Journal	Red	A	51.995 - 52.000
10	Main Journal	Blue	B	51.990 - 51.995
11	Main Journal	Yellow	C	51.985 - 51.990
12	Main Journal	Black	D	51.981 - 51.985
13	Main Bearing Lower Shell	Red	/	2.489 - 2.493
14	Main Bearing Lower Shell	Blue	/	2.493 - 2.497
15	Main Bearing Lower Shell	Yellow	/	2.497 - 2.501
16	Main Bearing Lower Shell	Black	/	2.501 - 2.505

4. Selection methods of main bearing shell

No.	Main Bearing Hole	Main Journal	Main Bearing Upper Shell	Main Bearing Lower Shell
1	A Red	A Red	A Red	A Red
2	A Red	B Blue	A Red	B Blue
3	A Red	C Yellow	A Red	C Yellow
4	A Red	D Black	A Red	D Black
5	B Blue	A Red	B Blue	A Red
6	B Blue	B Blue	B Blue	B Blue
7	B Blue	C Yellow	B Blue	C Yellow
8	B Blue	D Black	B Blue	D Black
9	C Yellow	A Red	C Yellow	A Red
10	C Yellow	B Blue	C Yellow	B Blue
11	C Yellow	C Yellow	C Yellow	C Yellow
12	C Yellow	D Black	C Yellow	D Black
13	D Black	A Red	D Black	A Red
14	D Black	B Blue	D Black	B Blue
15	D Black	C Yellow	D Black	C Yellow
16	D Black	D Black	D Black	D Black

Classification methods of connecting rod big end hole, connecting rod journal and connecting rod bearing shell

No.	Name	Color	Level	Size (mm)
1	Connecting Rod Big End Hole	Red	A	53.000 - 53.005
2	Connecting Rod Big End Hole	Blue	B	53.005 - 53.010
3	Connecting Rod Big End Hole	Yellow	C	53.010 - 53.015
4	Connecting Rod Big End Hole	Black	D	53.015 - 53.019

No.	Name	Color	Level	Size (mm)
5	Connecting Rod Upper Shell	Red	/	1.483 - 1.487
6	Connecting Rod Upper Shell	Blue	/	1.487 - 1.491
7	Connecting Rod Upper Shell	Yellow	/	1.491 - 1.495
8	Connecting Rod Upper Shell	Black	/	1.495 - 1.499
9	Connecting Rod Journal	Red	1	49.996 - 50.000
10	Connecting Rod Journal	Blue	2	49.992 - 49.996
11	Connecting Rod Journal	Yellow	3	49.988 - 49.992
12	Connecting Rod Journal	Black	4	49.984 - 49.988
13	Connecting Rod Lower Shell	Red	/	1.483 - 1.487
14	Connecting Rod Lower Shell	Blue	/	1.487 - 1.491
15	Connecting Rod Lower Shell	Yellow	/	1.491 - 1.495
16	Connecting Rod Lower Shell	Black	/	1.495 - 1.499

Selection of Connecting Rod Bearing Shell

No.	Connecting Rod Big End Hole	Connecting Rod Upper Shell	Connecting Rod Journal	Connecting Rod Lower Shell
1	A Red	A Red	1 Red	A Red
2	A Red	A Red	2 Blue	B Blue
3	A Red	A Red	3 Yellow	C Yellow
4	A Red	A Red	4 Black	D Black
5	B Blue	B Blue	1 Red	A Red
6	B Blue	B Blue	2 Blue	B Blue
7	B Blue	B Blue	3 Yellow	C Yellow

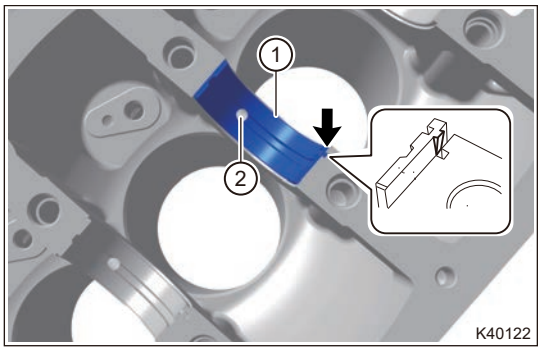
No.	Connecting Rod Big End Hole	Connecting Rod Upper Shell	Connecting Rod Journal	Connecting Rod Lower Shell
8	B Blue	B Blue	4 Black	D Black
9	C Yellow	C Yellow	1 Red	A Red
10	C Yellow	C Yellow	2 Blue	B Blue
11	C Yellow	C Yellow	3 Yellow	C Yellow
12	C Yellow	C Yellow	4 Black	D Black
13	D Black	D Black	1 Red	A Red
14	D Black	D Black	2 Blue	B Blue
15	D Black	D Black	3 Yellow	C Yellow
16	D Black	D Black	4 Black	D Black

Installation

1. Install 4 fixing bolts to piston cooling nozzles.

   Torque: 20 - 25 N·m

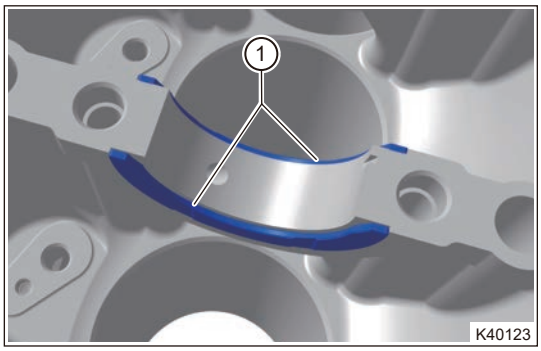
2. Carefully install crankshaft main bearing upper shell in direction of arrow, and notch of each main bearing upper shell should be aligned with cylinder block. Oil passage hole (2) on crankshaft main bearing upper shell should be aligned with passage hole on cylinder block after installation.



Caution
• Apply a proper amount of engine oil to inner surface of main bearing shell before installation. • Install main bearing lower shell in the same way of crankshaft main bearing upper shell.

3. Install crankshaft thrust washer to front and rear thrust surfaces of 3rd main bearing seat respectively.

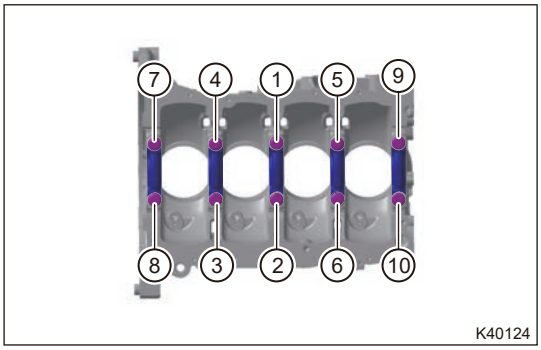
   Hint:
   The side of crankshaft thrust washers (1) without groove should face cylinder block side while the other side with groove should face crankshaft side.



4. Place crankshaft on cylinder block carefully.

5. Install the crankshaft main bearing cap. Install crankshaft main bearing cap fixing bolts in place by hands, and then tighten 10 crankshaft main bearing cap fixing bolts in order shown in illustration.

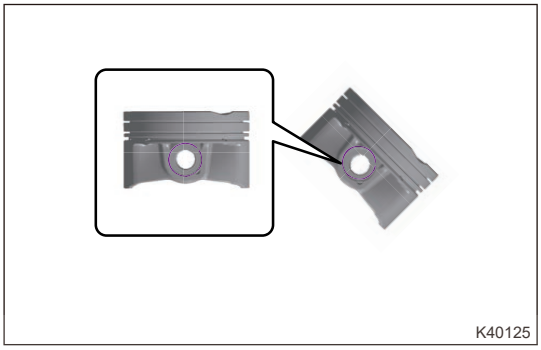
   Torque: 1st step: 60 ± 5 N·m, 2nd step: 120° ± 5°



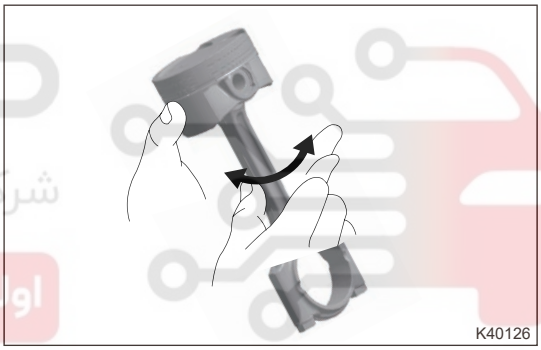
6. Using a small screwdriver, install new elastic circlip to one end of piston pin hole.

   Hint:
   Relative angle between elastic circlip opening and removed notch is 180° ± 40°

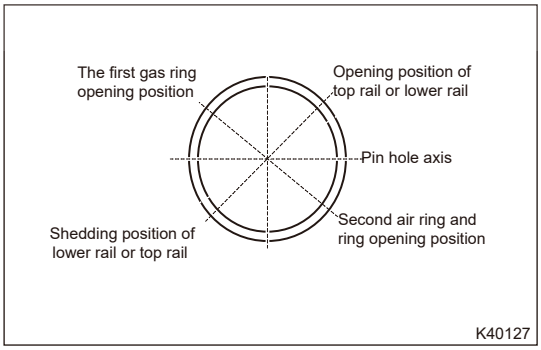
7. Align front marks on piston and connecting rod, push piston pin with thumb until it contacts with elastic circlip.



8. Install elastic circlip to the other end of piston pin hole, and check for free rotation between piston and connecting rod assembly.

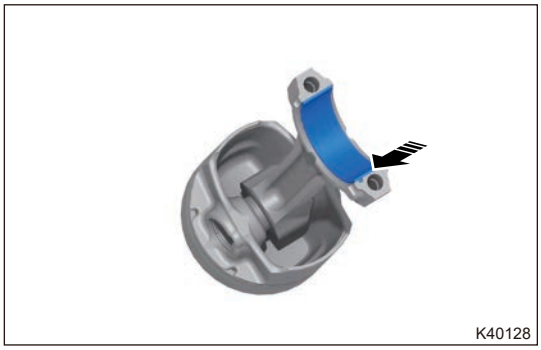


9. Apply a small amount of engine oil to piston ring groove and piston. Pay attention that the sides with words of first compression ring (1) and second compression ring (2) should face upward.
10. When installing the oil ring, first install the expander into oil groove, then install upper and lower rails with opening staggered by 90° from the expander, and the upper and lower rails at 180°. Then install the second compression ring, and install the first compression ring finally with two compression rings staggered by 90° from upper rail opening; The piston ring should rotate in the ring groove freely without any stuck condition.
11. Rotate piston ring several turns after addling engine oil to piston ring groove, and note that the position of ring notch should be the same with that described above; clean crankshaft connecting rod journal and cylinder with a non-woven fabric cloth.



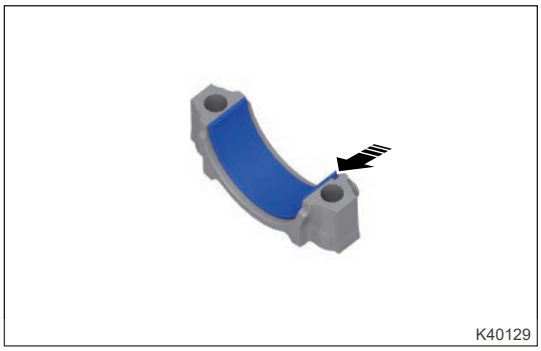
12. Carefully install the connecting rod bearing upper shell in direction of arrow, and keep notch of each connecting rod bearing upper shell face the cutout of connecting rod bearing cap.

    Hint:
    Apply a proper amount of engine oil to connecting rod bearing shell inner surface before installation.

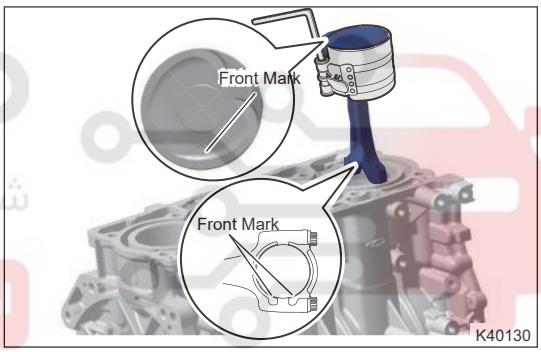


13. Carefully install connecting rod bearing lower shell in direction of arrow, and keep notch of each connecting rod bearing lower shell face the cutout of connecting rod bearing cap.

    Hint:
    Back side of connecting rod bearing shell should be clean without any foreign matter during assembly.



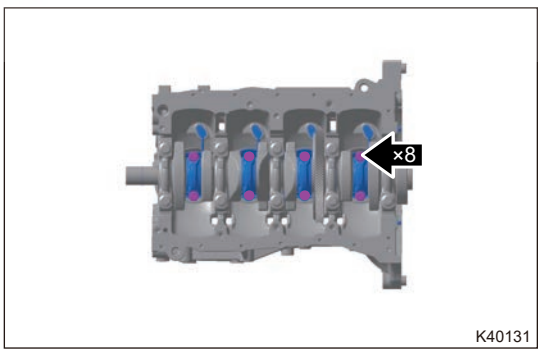
14. Rotate crankshaft to top dead center of cylinder 1 and cylinder 4.
15. Apply a coat of engine oil to piston surface and cylinder inner wall.
16. As shown in illustration, install piston connecting rod assembly to cylinder with piston installer; Pay attention to front marks on piston and connecting rod during assembly, without being reversed.



17. Install connecting rod bearing caps in place, install connecting rod bearing cap fixing bolts and tighten connecting rod bearing cap fixing bolts to specified torque.

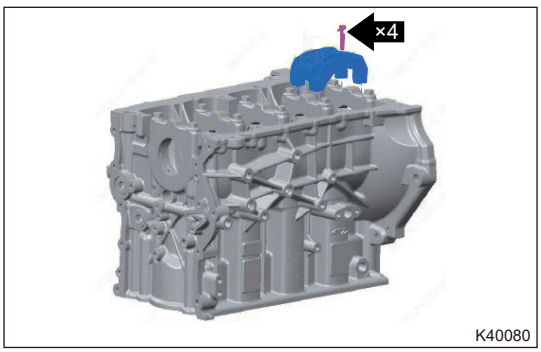
    Torque: 1st step: 25 ± 3 N·m, 2nd step: 90° ± 5°

    Hint:
    Apply a small amount of engine lubricant to connecting rods, connecting rod bearing caps and thread joint surfaces.



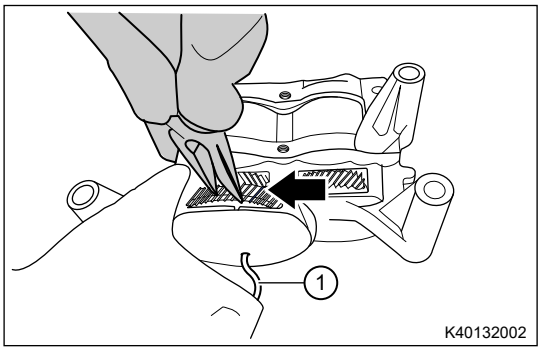
18. Install the connecting bracket and tighten 4 fixing bolts.

    Torque: 8 + 3 N•m



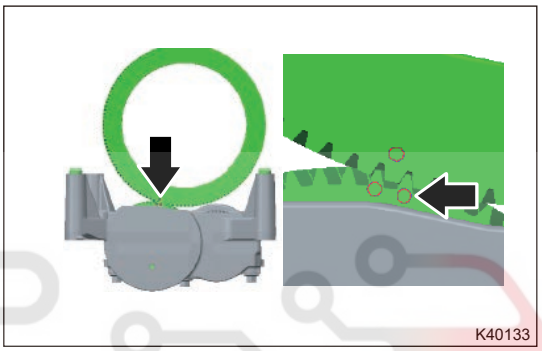
19. Install the balance shaft with housing assembly

a. After aligning the balance shaft gears, insert the locking fixture (1) and reset the balance shaft.



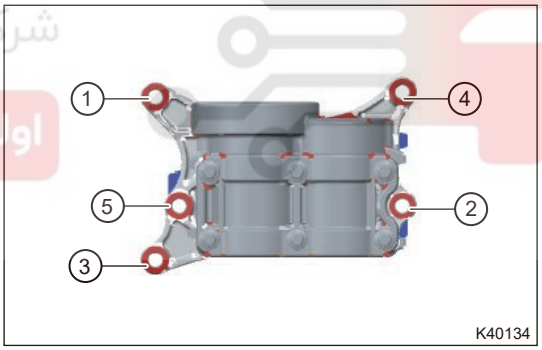
b. Align the pin sleeve hole of the balance shaft with housing assembly with the pin sleeve, assemble the balance shaft with housing assembly, slightly turn the balance shaft assembly locking fixture on the left and right to make the balance shaft gear mesh with the crankshaft gear ring.

c. Check the gear timing mark, and the three mark points are required to be aligned as shown in illustration.



d. Press the balance shaft housing firmly and make it is closed to the lower end surface of cylinder block, install 5 fixing bolts, and tighten them to the specified torque in sequence.

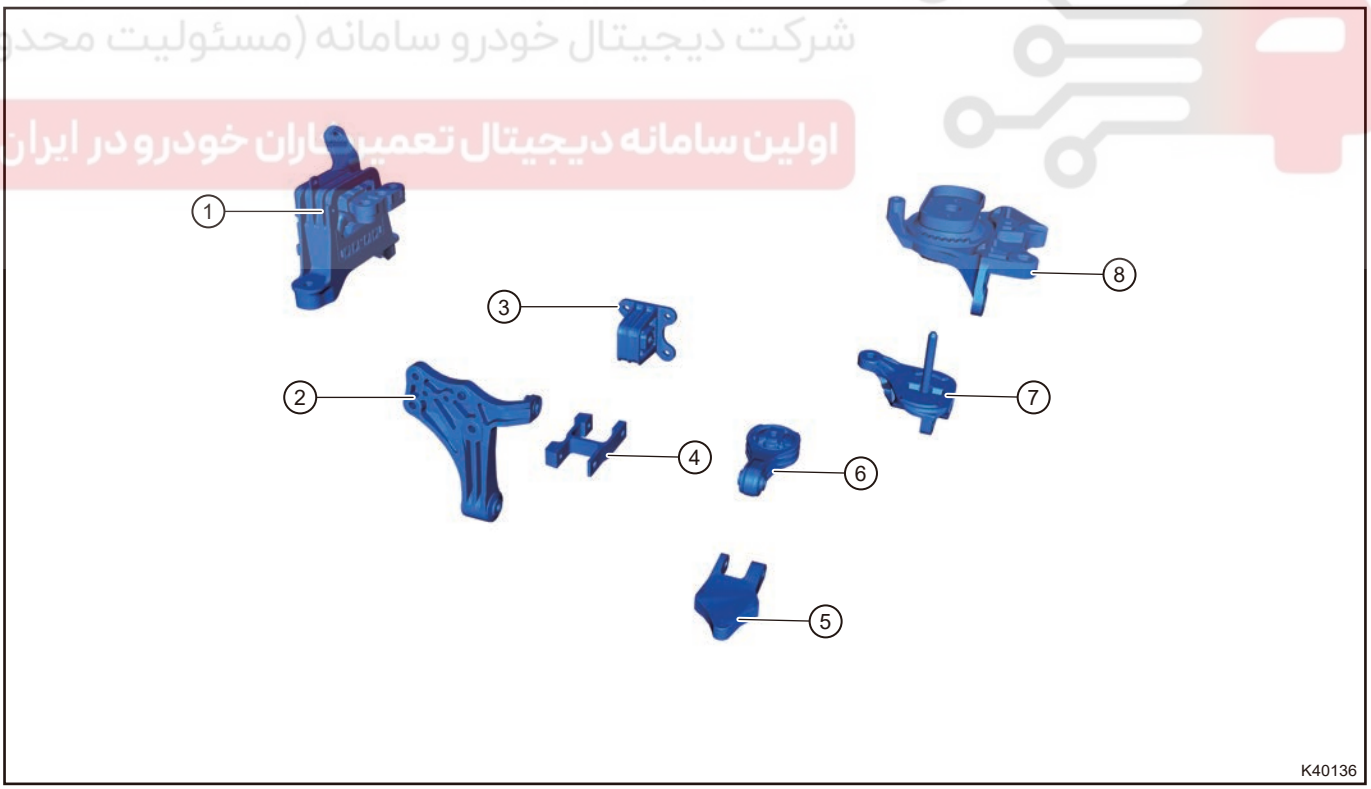
Torque: 45 ± 5 N·m



e. After the installation is complete, the balance shaft locking fixture needs to be removed.

20. Install the knock sensor.
21. Install the oil pump assembly.
22. Install the oil pump chain.
23. Install the oil pan assembly.
24. Install the cylinder head assembly.
25. Install the engine timing chain.
26. Install the A/C compressor bracket and A/C compressor.
27. Install the oil filter.
28. Install the water pump assembly.
29. Install the alternator assembly.
30. Install the timing chain cover.
31. Install the torsion shock absorber.
32. Install the tensioner assembly.
33. Install the idler pulley assembly.
34. Install the engine accessory drive belt.
35. Install the intake manifold assembly.
36. Install the turbocharger assembly.
37. Install the flywheel assembly.
38. Install the transmission assembly.
39. Install the engine assembly to vehicle body.

Engine Mounting Assembly



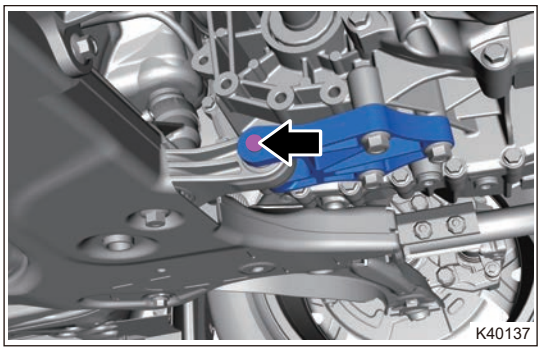
1	Right Mounting Cushion Assembly	5	Rear Mounting Bracket
2	Rear Right Mounting Bracket	6	Rear Mounting Pull Rod

3	Rear Right Mounting Cushion Assembly	7	Left Mounting Bracket
4	Rear Right Mounting Connecting Rod	8	Left Mounting Cushion Assembly

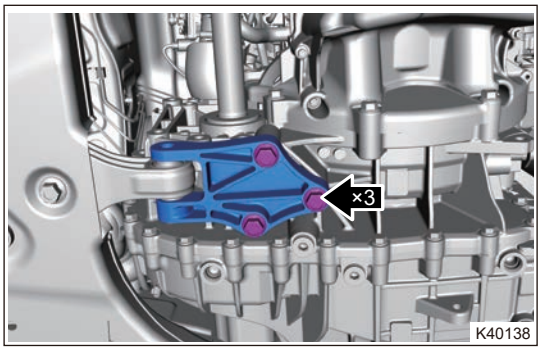
Removal of Rear Mounting Assembly

Warning
• Be sure to wear safety equipment to prevent accidents, when removing rear mounting assembly. • Appropriate force should be applied when removing rear mounting assembly. Be careful not to operate roughly.

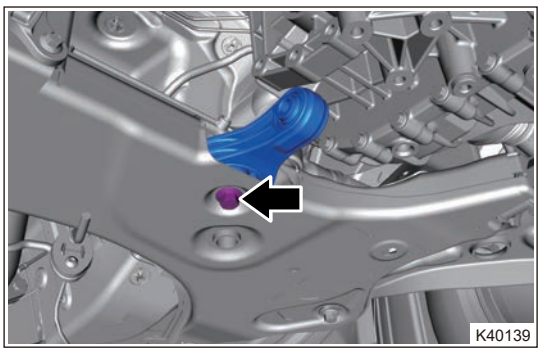
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Raise the vehicle to a proper position.
3. Remove 1 fixing bolt between rear mounting bracket and rear mounting pull rod.



4. Remove 3 fixing bolts between rear mounting bracket and transmission assembly and remove rear mounting bracket.



5. Remove 1 fixing bolt between rear mounting pull rod and front sub frame and remove rear mounting pull rod.



Inspection

1. Check rubber part on rear mounting pull rod for damage or deformation. Replace rear mounting pull rod as necessary.
2. Check rear mounting bracket for deformation or cracks. Replace rear mounting bracket as necessary.

Installation

Caution
• Pre-tighten 2 to 3 threads manually first during assembly of bolts, then pre-tighten and tighten it to specified torque with a tool.

1. Install 1 fixing bolt between rear mounting pull rod and front sub frame.

   Torque: 200 ± 15 N·m

2. Install 3 fixing bolts between rear mounting bracket and transmission assembly.

   Torque: 110 ± 8 N·m

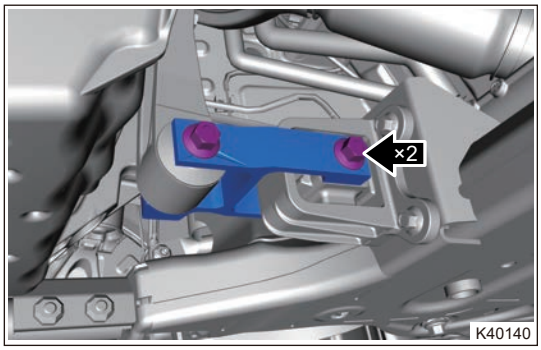
3. Install 1 fixing bolt to rear mounting pull rod and rear mounting bracket.

   Torque: 200 ± 15 N·m

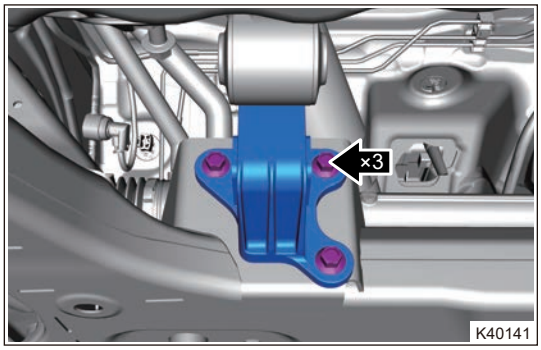
Removal of Rear Right Mounting Assembly

Warning
• Be sure to wear safety equipment to prevent accidents, when removing rear right mounting assembly. • Appropriate force should be applied when removing rear right mounting assembly. Be careful not to operate roughly.

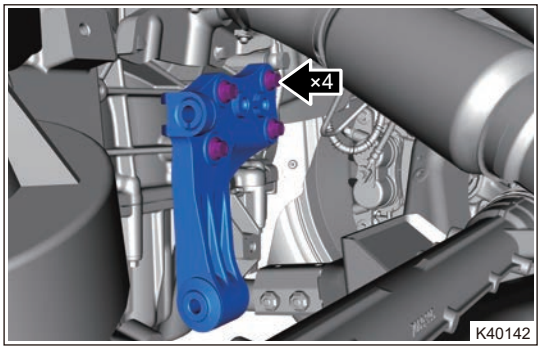
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Raise the vehicle to a proper position.
3. Remove the drive shaft.
4. Remove the transfer case assembly.
5. Remove 1 fixing bolt between rear right mounting connecting rod and rear right mounting bracket.
6. Remove 1 fixing bolt between rear right mounting connecting rod and rear right mounting cushion assembly.
7. Remove the rear right mounting connecting rod.



8. Remove 3 fixing bolts between rear right mounting cushion assembly and front sub frame and remove rear right mounting cushion assembly.



9. Remove 4 fixing bolts between rear right mounting bracket and cylinder block and remove rear right mounting bracket.



Inspection

1. Check rubber part on rear right mounting pull rod for damage or deformation. Replace rear right mounting pull rod as necessary.
2. Check rear right mounting bracket for deformation or cracks. Replace rear right mounting bracket as necessary.

Installation

Caution
• Pre-tighten 2 to 3 threads manually first during assembly of bolts, then pre-tighten and tighten it to specified torque with a tool.

1. Install 4 fixing bolts between rear right mounting bracket and cylinder block.

   Torque: 70 ± 15 N·m

2. Install 3 fixing bolts between rear right mounting cushion and front sub frame.

   Torque: 70 ± 15 N·m

3. Installation 1 fixing bolt between rear right mounting connecting rod and rear right mounting bracket.

   Torque: 105 ± 10 N·m

4. Install 1 fixing bolt between rear right mounting connecting rod and rear right mounting cushion assembly.

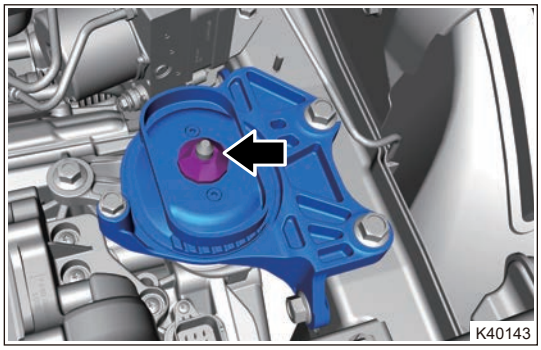
   Torque: 105 ± 10 N·m

Removal of Left Mounting Assembly

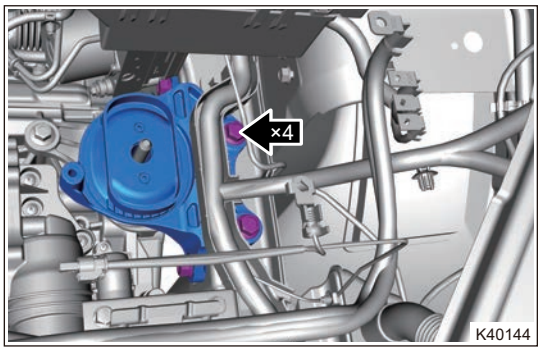
Warning
• Be sure to wear safety equipment to prevent accidents, when removing left mounting assembly. • Appropriate force should be applied when removing left mounting assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Remove the air filter assembly.
5. Remove the battery assembly.
6. Remove the battery tray.

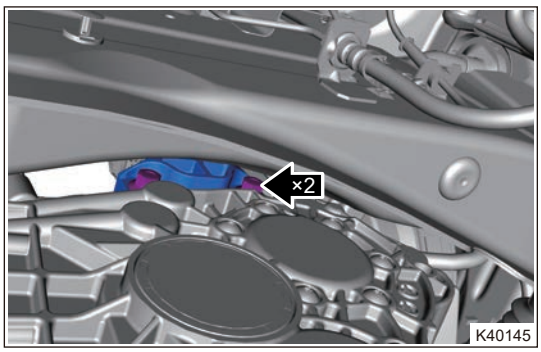
7. Remove 1 fixing nut between left mounting cushion assembly and left mounting bracket.

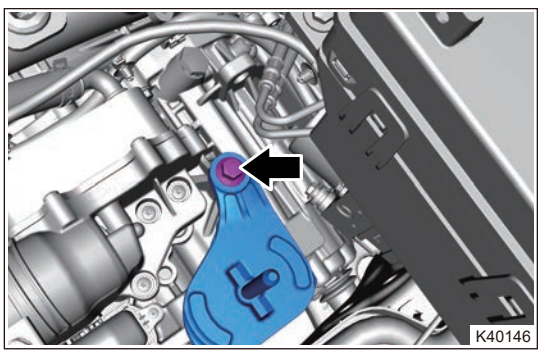


8. Remove 4 fixing bolts between left mounting cushion assembly and body and remove left mounting cushion assembly.



9. Remove 3 fixing bolts between left mounting bracket and transmission assembly and remove left mounting bracket.





Inspection

1. Check rubber part on left mounting cushion assembly for damage or deformation. Replace left mounting cushion as necessary.
2. Check left mounting bracket for deformation or cracks. Replace left mounting bracket as necessary.

Installation

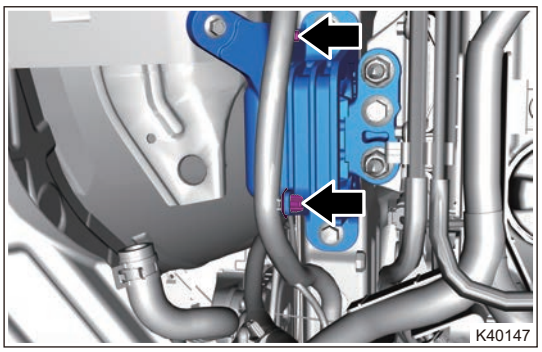
Caution
• Pre-tighten 2 to 3 threads manually first during assembly of bolts, then pre-tighten and tighten it to specified torque with a tool.

1. Install 3 fixing bolts between left mounting bracket and transmission assembly.
   Torque: 110 ± 15 N·m
2. Install 4 fixing bolts between left mounting cushion assembly and body.
   Torque: 110 ± 15 N·m
3. Install 1 fixing nut between left mounting cushion assembly and left mounting bracket.
   Torque: 110 ± 15 N·m
4. Install the battery tray.
5. Install the battery assembly.
6. Install the air filter assembly.
7. Install the engine compartment trim cover.

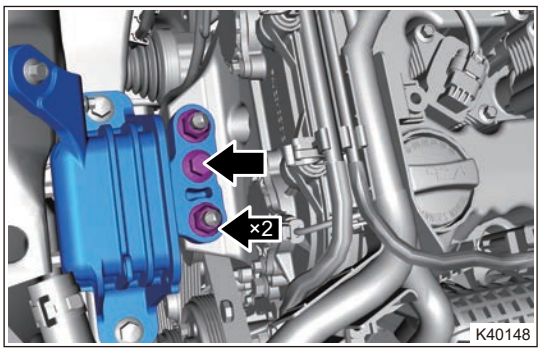
Removal of Right Mounting Cushion Assembly

Warning
• Be sure to wear safety equipment to prevent accidents, when removing right mounting cushion assembly. • Appropriate force should be applied when removing right mounting cushion assembly. Be careful not to operate roughly.

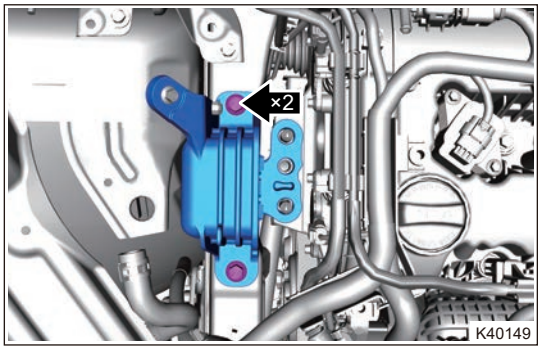
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Move the expansion tank to proper position.
4. Disconnect the fixing clips from interior floor wire harness.

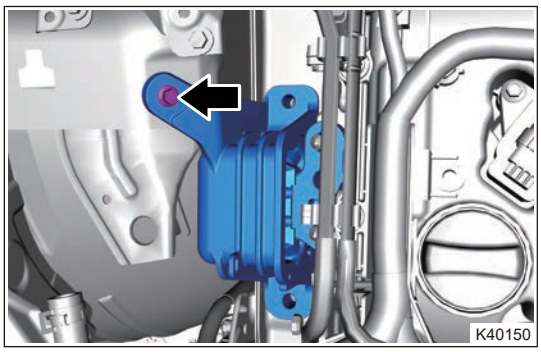


5. Remove 2 fixing nuts and 1 fixing bolt between right mounting cushion assembly and timing chain cover assembly.



6. Remove 3 fixing bolts between right mounting cushion assembly and right side rail.





7. Remove the right mounting cushion assembly.

Inspection

1. Check rubber part on right mounting cushion assembly for damage or deformation. Replace right mounting cushion as necessary.

Installation

Caution
• Pre-tighten 2 to 3 threads manually first during assembly of bolts, then pre-tighten and tighten it to specified torque with a tool.

1. Install 3 fixing bolts between right mounting cushion assembly and right side rail.

   Torque: 110 ± 15 N·m

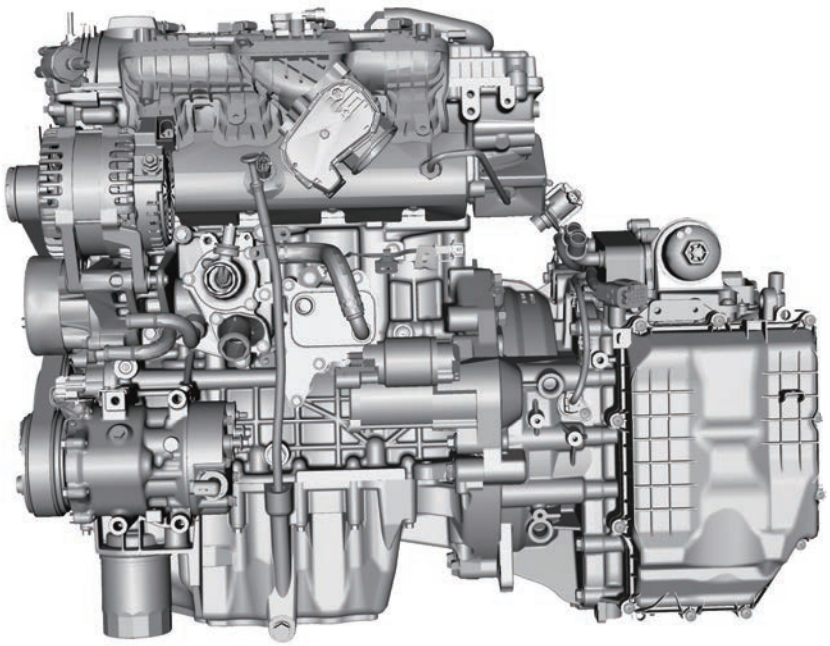
   Torque: 25 ± 3 N·m

2. Install 2 fixing nuts and 1 fixing bolt on right mounting cushion assembly and timing chain cover assembly.

   Torque: 110 ± 15 N·m

3. Fix the fixing clips to interior floor wire harness.
4. Install the expansion tank.
5. Install the engine compartment trim cover.

Engine Assembly



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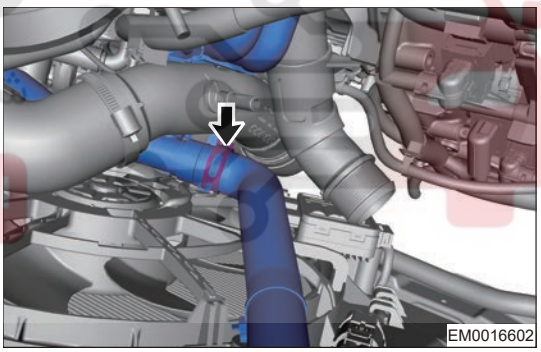
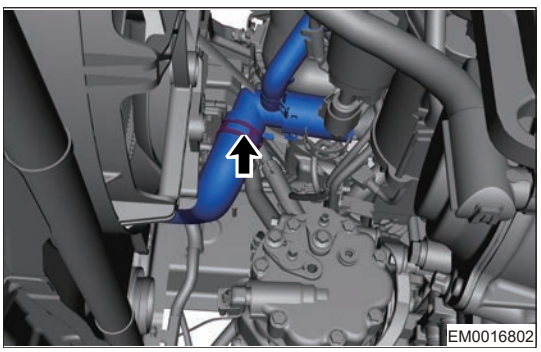
Removal

Caution
• Remove engine and transmission as an assembly. • Install protector to prevent body from being scratched. • Plug inlet port of intake pipe to prevent foreign matter from entering after removing intake system components. Or the foreign matter will block cylinder intake passage when starting to seriously damage the engine.

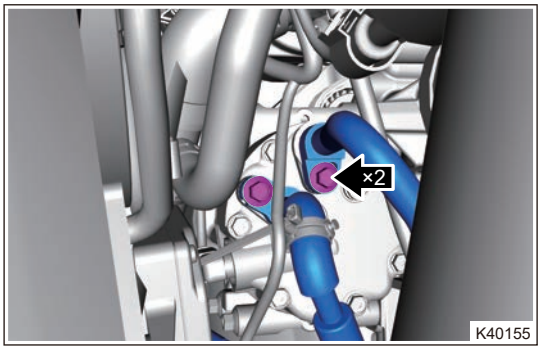
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Remove the engine trim cover assembly.
4. Disconnect the negative battery cable.
5. Drain the coolant.
6. Recover/Drain the refrigerant.
7. Drain the transmission oil.
8. Remove the air filter assembly.
9. Remove the intake hose assembly.
10. Remove the battery assembly.
11. Remove the battery tray.
12. Remove the engine compartment lower protector assembly.
13. Remove the intercooler outlet pipe assembly Ⅱ.
14. Remove the intercooler intake pipe assembly Ⅲ.
15. Remove the front wheel tire.
16. Remove the left/right side rail assembly.
17. Remove the front left drive shaft assembly.
18. Remove the front right drive shaft assembly.
19. Remove the transfer case assembly.
20. Remove the precatalytic converter assembly.
21. Remove the front sub frame assembly.
22. Loosen elastic clamps and disconnect engine inlet pipe connection.



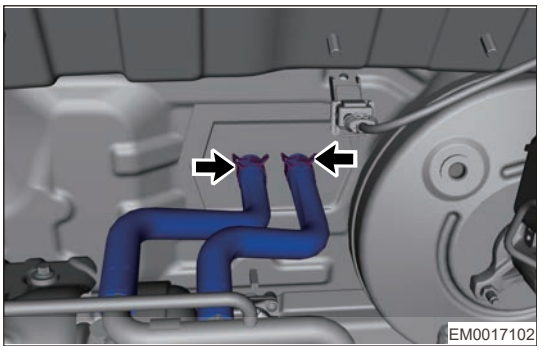
23. Loosen elastic clamps (arrow) and disconnect engine outlet pipe.



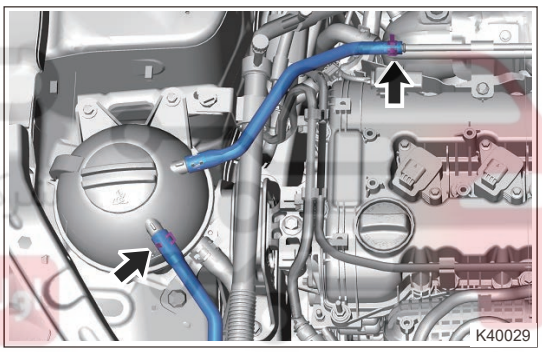
24. Remove 2 fixing bolts from A/C pipes, disconnect the compressor.



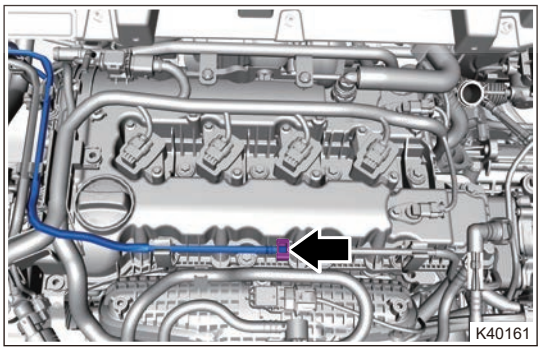
25. Loosen 2 elastic clamps and disconnect the expansion tank inlet pipe.



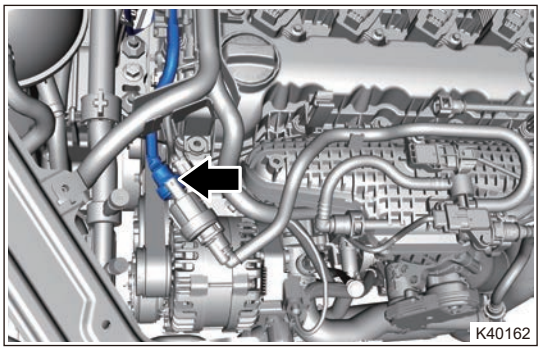
26. Loosen elastic clamp (arrow) and disconnect expansion tank water supply pipe.
27. Loosen elastic clamp (arrow) and disconnect connection between hose and expansion tank.



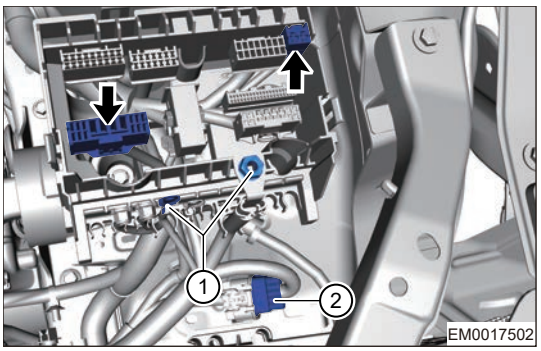
28. Disconnect the oil inlet pipe Ⅰ.



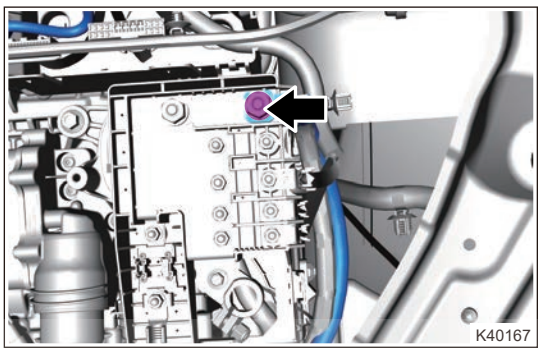
29. Disconnect the fuel vapor pipe Ⅲ.



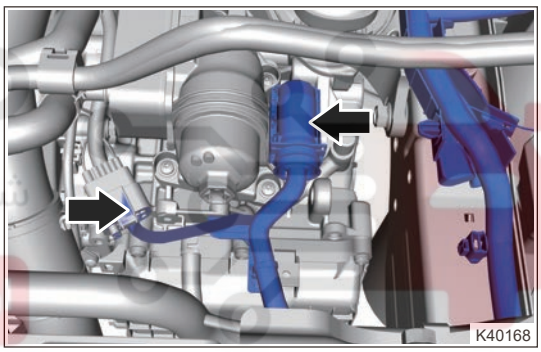
30. Loosen 2 fixing nuts (1) between positive battery wire harness and engine compartment fuse and relay box and disconnect wire harness.
31. Disconnect connector (2) between positive battery wire harness and engine electronic fuel injection wire harness.
32. Disconnect connector (arrow) between engine positive wire harness and engine compartment fuse and relay box (arrow).



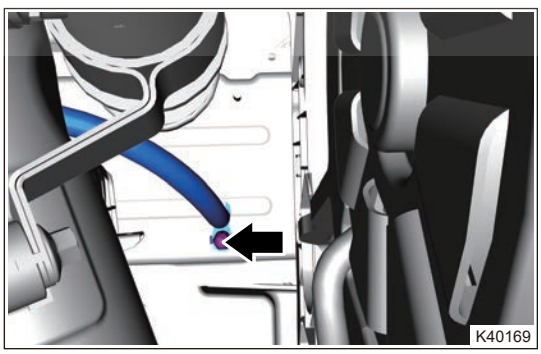
33. Disconnect ECU connector (1), and disconnect connector (2) between electronic engine injection wire harness and exterior wire harness, remove ground wire harness fixing nut (3) and move away ground wire harness.
34. Disconnect the connector (arrow) from engine compartment fuse and relay box.



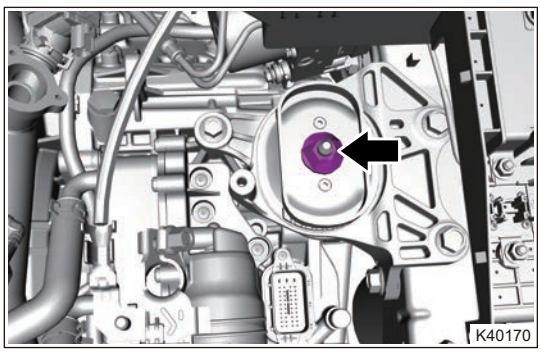
35. Disconnect the transmission assembly connectors connector.



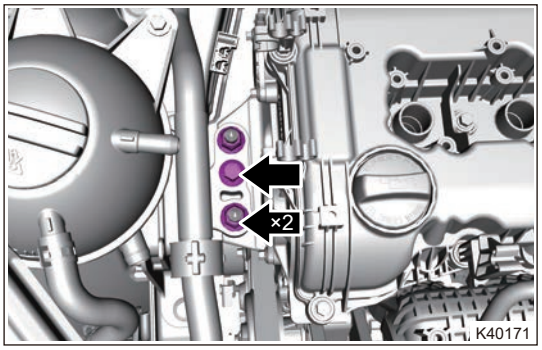
36. Remove fixing nuts from ground wire harness and move away the ground wire.



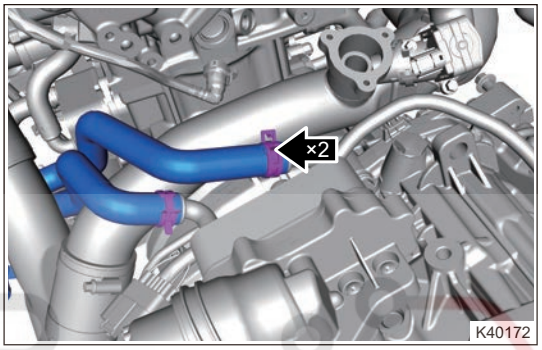
37. Remove 1 fixing nut between left mounting cushion assembly.



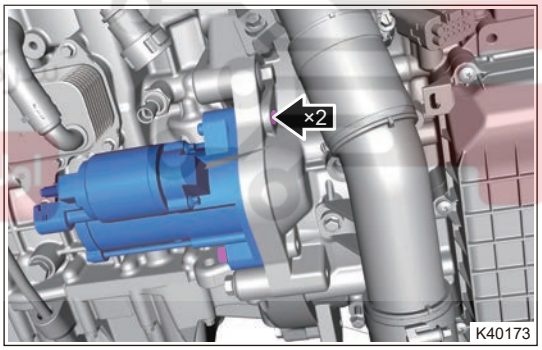
38. Remove 2 fixing nuts and 1 fixing bolt from right mounting cushion assembly.



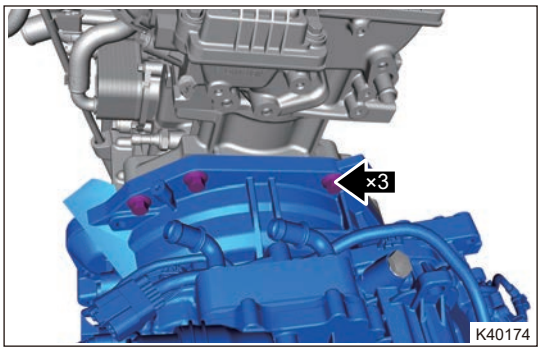
39. Check that engine assembly is separated with external components.
40. Remove engine and transmission assembly.
41. Remove engine electronic injection wire harness from engine assembly.
42. Loosen 2 elastic clamps and disconnect engine inlet pipe assembly - rear connections.



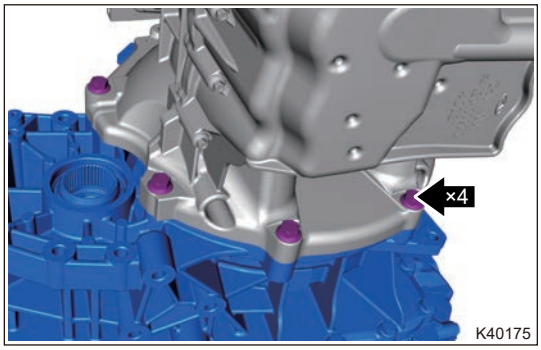
43. Remove 2 fixing bolts and starter assembly.



44. Remove 3 fixing bolts from upper part of transmission assembly.



45. Remove 4 fixing bolts from lower part of transmission assembly.



46. Separate transmission assembly from engine assembly.
47. Install engine assembly to engine service platform.

Installation

1. Install the transmission assembly.
2. Install engine electronic injection wire harness to engine.
3. Install 2 fixing nuts and 1 fixing bolt to right mounting cushion assembly.
4. Install 1 fixing nut on left mounting cushion assembly.
5. Fix the connecting clip between interior floor wire harness and right mounting cushion assembly.
6. Connect transmission assembly connectors.
7. Connect the engine ground wire harness and tighten fixing nut.
8. Install and tighten the fixing nut between it and main fuse box.
9. Connect the ECU connector.
10. Connect connectors between interior floor wire harness and engine electronic injection wire harness.
11. Connect connector between engine electronic injection wire harness and engine compartment fuse and relay box.
12. Connect boost pressure sensor.
13. Connect fuel vapor pipe III.
14. Connect oil inlet pipe Ⅰ.
15. Connect vacuum tube and install elastic clamps.
16. Connect heater inlet and outlet pipe assembly Ⅱ and install elastic clamp.
17. Connect engine outlet pipe and install elastic clamp.
18. Connect heater inlet pipe assembly Ⅱ and install elastic clamp.
19. Connect expansion tank inlet pipe assembly and install elastic clamp.
20. Connect compressor A/C line and tighten fixing bolts.
21. Connect engine inlet pipe and install elastic clamp.
22. Install the precatalytic converter assembly.
23. Install the transfer case assembly.
24. Install the front left drive shaft assembly.
25. Install the front right drive shaft assembly.
26. Install the left/right side rail assembly.
27. Install the battery tray and battery assembly.
28. Install the intake hose assembly.
29. Install the air filter assembly.
30. Add transmission oil to specified position.
31. Add coolant to specified value.
32. Connect the negative battery cable.
33. Add refrigerant to specified value.
34. Install the engine trim cover assembly.
35. Install the engine compartment trim cover assembly.
36. Install the engine compartment lower protector assembly.

Intake system

Warnings and Precautions

Warnings

In order to avoid possible property loss, personal injury or death, always follow the instructions below before repair:

1. Temperature in engine compartment is very high when engine is running. Before removal, you must make sure that engine has shut off, and engine compartment has cooled down sufficiently, otherwise, there is a risk of scald injury.

Precautions

In order to avoid dangerous operation and damage to the vehicle before repair in this section, always follow the instructions below before repair:

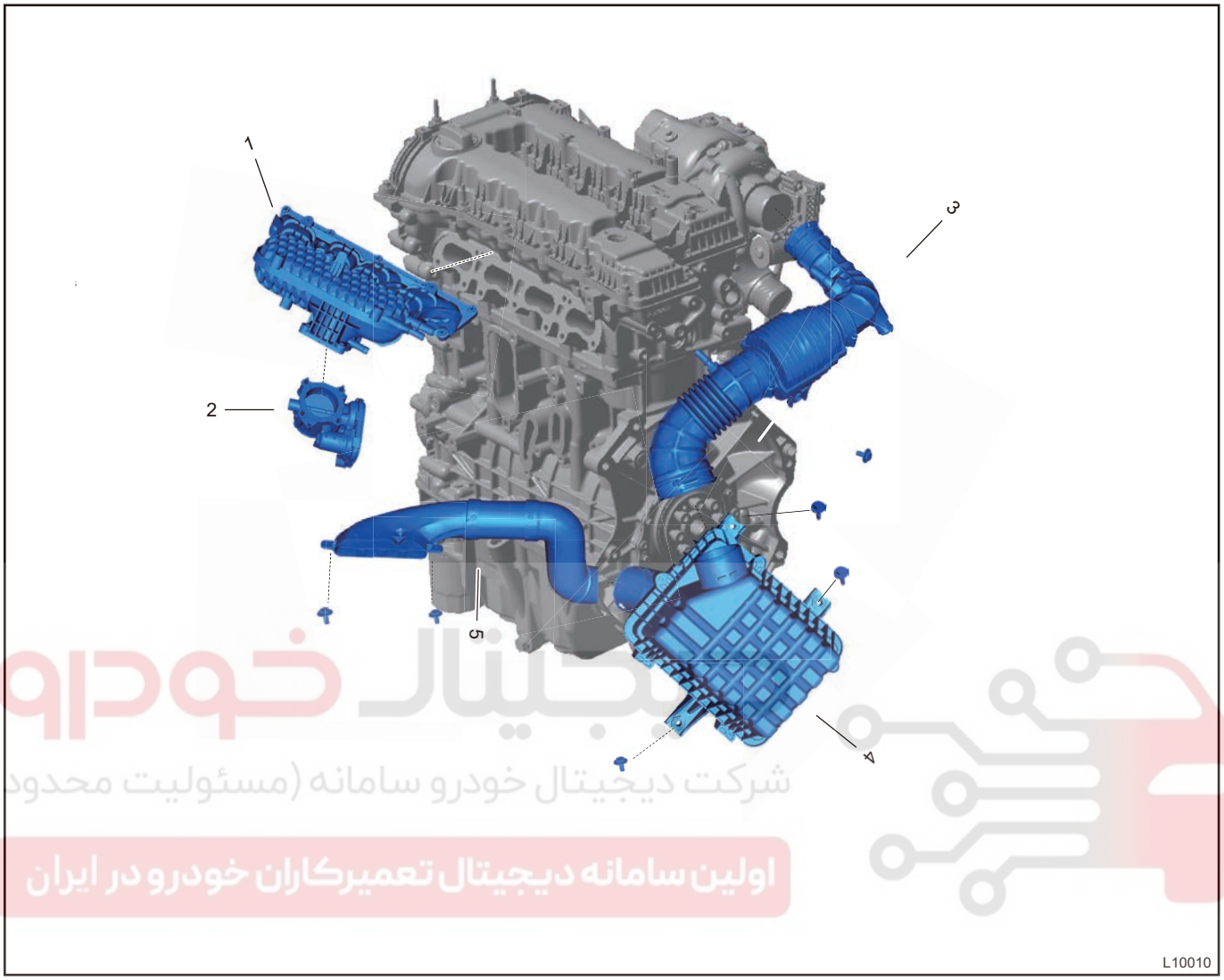
1. Wasted air filter element should be handled by the specialized department according to local laws and regulations. Never discard it at will.
2. Check for foreign matter in air filter and hose when installing. Avoid inhaling foreign matter after engine running, causing damage to the components.
3. After removing electronic throttle, block intake manifold intake port with suitable blocking pieces to prevent foreign matter from entering, causing damage to the components.

System Overview

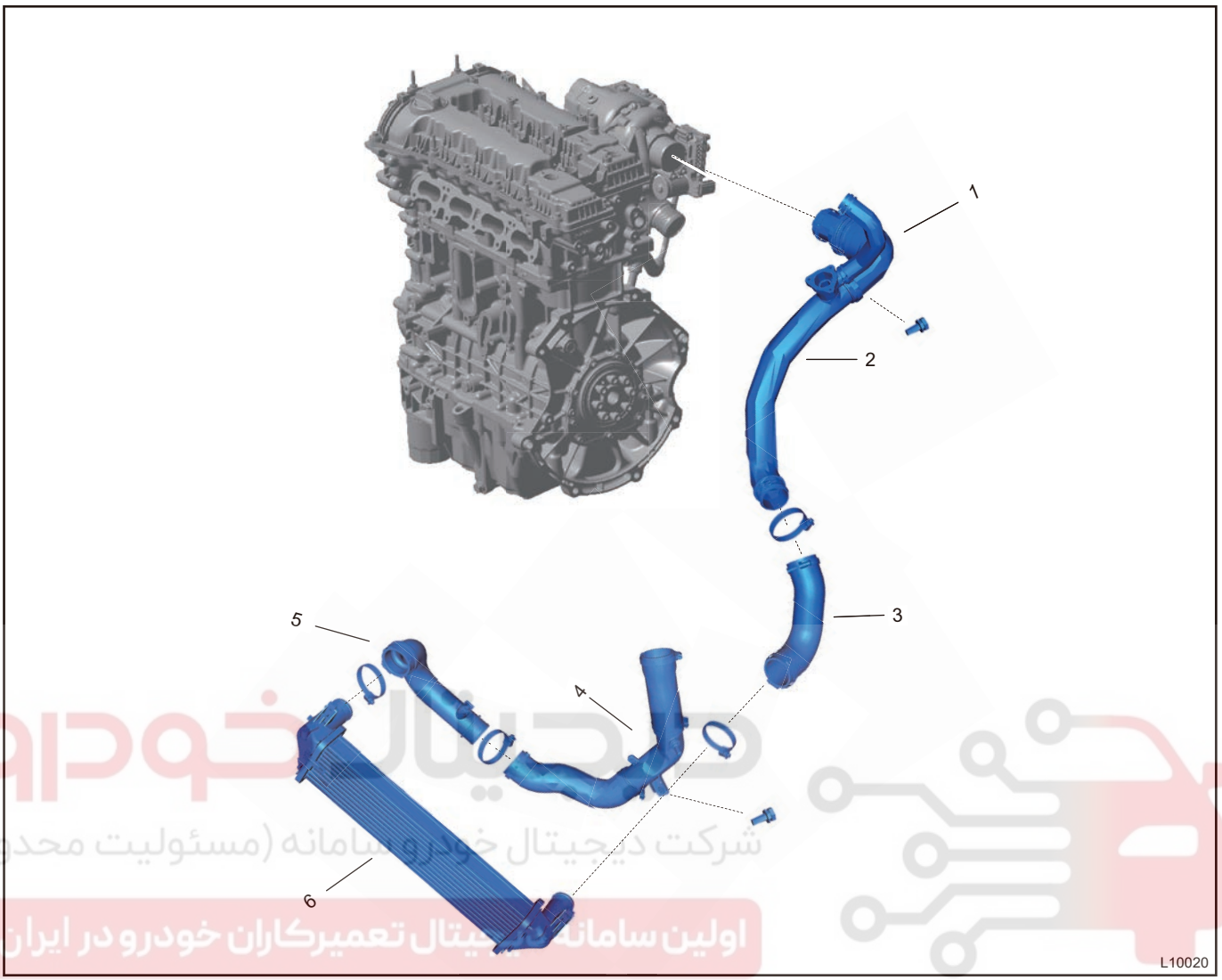
System Description

Intake system uses air filter to remove particulates and dust in the air, the air is pressurized by the turbocharger and cooled by the intercooler, then flows into the intake manifold assembly through the electronic throttle assembly, and the cooled fresh air is evenly delivered to each cylinder by the intake manifold to cooperate with the engine.

System Components Diagram

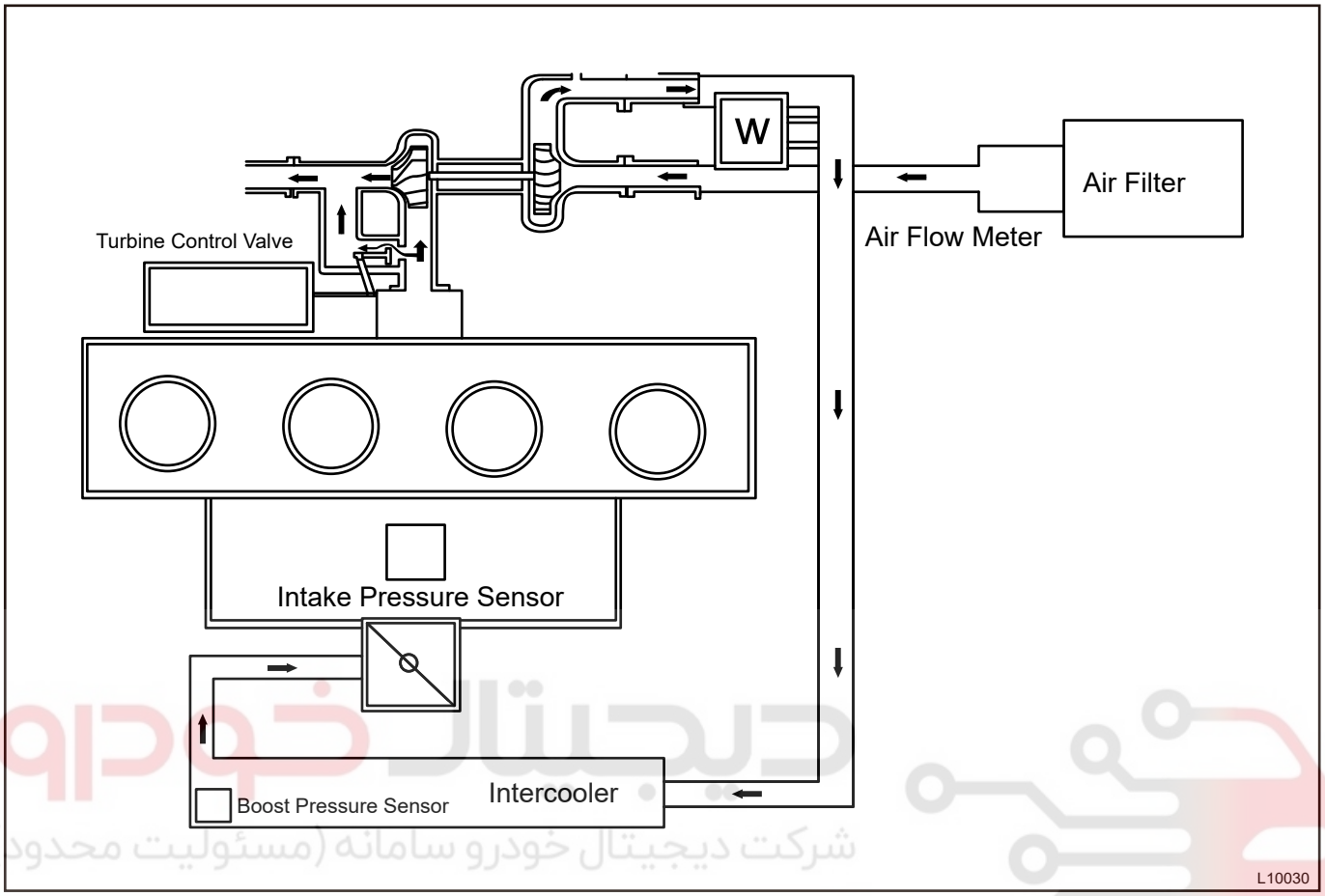


1	Intake Manifold Assembly	4	Air Filter Assembly
2	Electric Throttle Assembly	5	Air Direct Pipe Assembly
3	Intake Hose Assembly		



1	Intercooler Intake Pipe Ⅰ Assembly	4	Intercooler Outlet Pipe Ⅰ
2	Intercooler Intake Pipe Ⅱ Assembly	5	Intercooler Outlet Pipe Ⅱ
3	Intercooler Intake Pipe Ⅲ Assembly	6	Intercooler Assembly

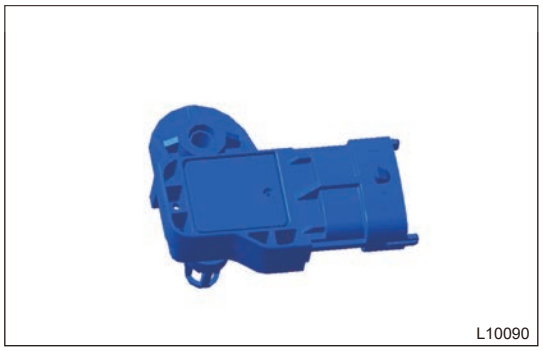
System Schematic Diagram



System Components Description

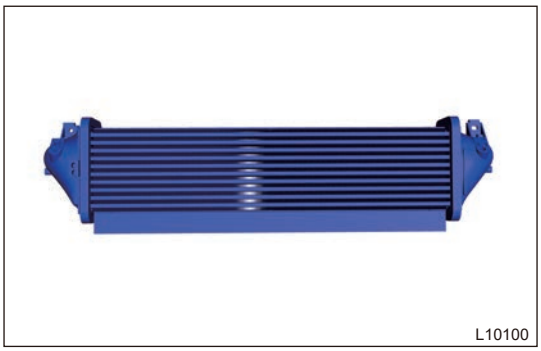
Intake pressure/temperature sensor

Intake pressure sensor: monitor absolute pressure changes of the intake manifold, send reference signal to ECU for calculating the duration of fuel injection.Intake temperature sensor: monitor intake temperature, provide it to ECU as the basis for calculating air density.



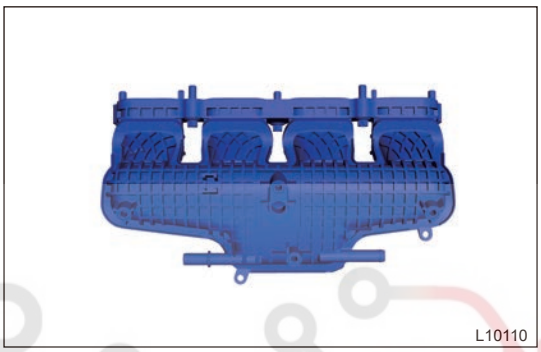
Intercooler

Its function is to reduce the high temperature air temperature after supercharging, so as to reduce the heat load of engine, increase the intake air volume, and then increase the engine power; For the engine, intercooler is an important component of supercharging system.



Intake Manifold Assembly

Distribute the fresh air cooled by intercooler to each cylinder.

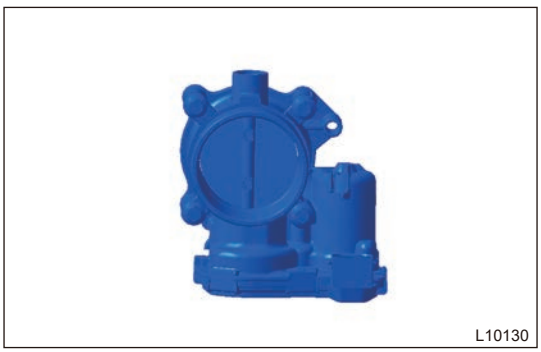


Air Filter Assembly

The air filter is mainly used to remove particulate impurities in the air.

Electronic throttle

It consist of four parts: drive module, train module, executive module and feedback module, and all components are integrated into the same throttle valve housing. Throttle feedback module uses two redundant structures. When malfunction occurs, throttle valve plate will stop at the limp home position (above mechanical bottom dead center) determined by mechanical way. Electronic throttle performs control only by corresponding electronic control unit or electronic test circuit. In principle, it is necessary to ensure that the throttle valve plate does not operate dynamically to the mechanical dead center.



Electronic Accelerator Pedal

There are two identical potentiometer type sensors in the electronic accelerator pedal, which provide the driving demand signal of driver to the ECU. This process is exactly the same as the current mechanical pedal in operation to adapt to the driver’ s driving habits for many years. Two identical sensors provide accelerator signals to ECU respectively, thus ensuring the safety and reliability of this system.

Diagnosis & Testing

Problem Symptoms Table

Hint:

Use symptoms table below to help determine cause of problem. Check each suspected area in sequence. Repair, replace or adjust faulty components as necessary.

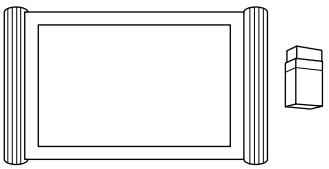
Intake system

Symptom	Possible Cause
Engine idles roughly	Electronic throttle assembly (dirty)
	Intake manifold assembly (broken, leaked)
	Activated charcoal canister solenoid valve (- remains on)
	Intake Pressure Sensor
	Electronic throttle assembly gasket (damaged)
	Fuel rail injector assembly (installed incorrectly)

On-Vehicle Service

Tools

Special Tools

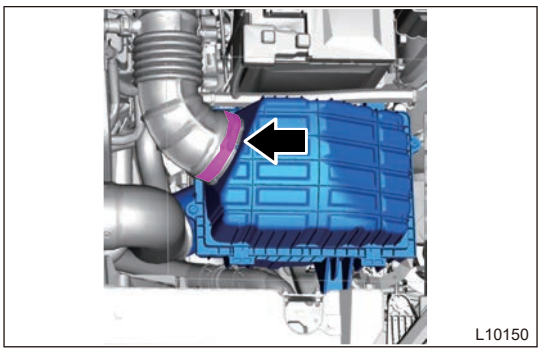
Tool Name	Tool Drawing
Diagnostic Tester	 S00001

Air Filter Element

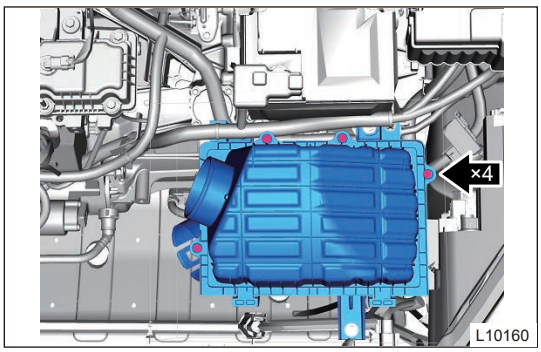
Removal

Warning
• Be sure to wear safety equipment to prevent accidents, when removing air filter element. • Appropriate force should be applied when removing air filter element. Be careful not to operate roughly.

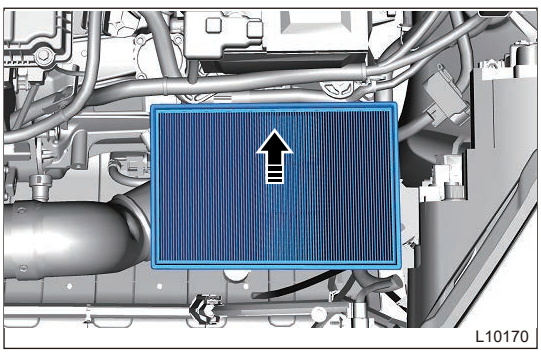
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Remove the negative battery cable.
4. Loosen worm clamp and disconnect intake hose.



5. Remove 4 fixing screws between air filter upper housing and lower housing with a cross screwdriver. And remove the upper housing carefully.



6. Remove the air filter element in the direction of arrow.



Inspection

1. Check if air filter is dirty, if it is dirty severely, it is required to replace new air filter.

Installation

Caution
• Clean the air filter upper housing and lower housing. • Wasted air filter element should be handled by the specialized department according to local laws and regulations. Never discard it at will.

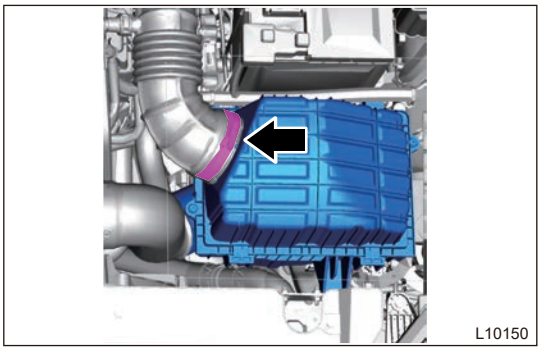
1. Install 5 fixing screws between air filter upper housing and lower housing.
   Torque: 7 ± 1 N·m
2. Connect intake hose, and tighten worm clamp.
   Torque: 3.5 ± 0.5 N·m
3. Install the engine compartment trim cover assembly.

Air Filter Assembly

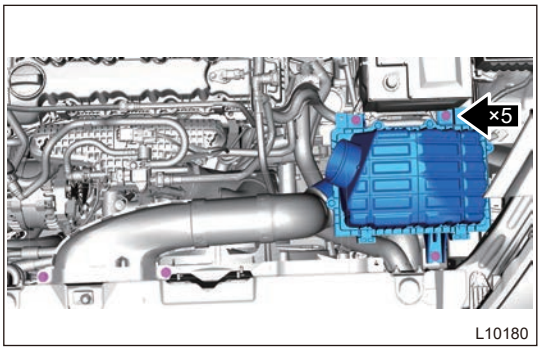
Removal

Caution
• Be sure to wear safety equipment to prevent accidents, when removing air filter assembly. • Appropriate force should be applied when removing air filter assembly. Be careful not to operate roughly.

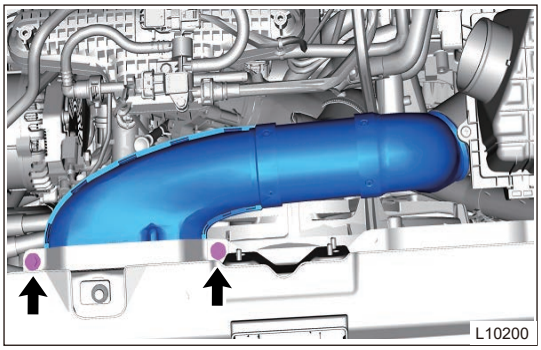
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Loosen worm clamp and disconnect intake hose.



5. Remove 3 fixing bolts from air filter assembly with a 10# socket wrench.



6. Remove 2 fixing bolts from air direct pipe, and separate it from air filter assembly carefully. Remove the air filter assembly carefully.



Installation

Caution
• Check for foreign matter in air filter and hose when installing. Avoid inhaling foreign matter after engine running, causing damage to the components.

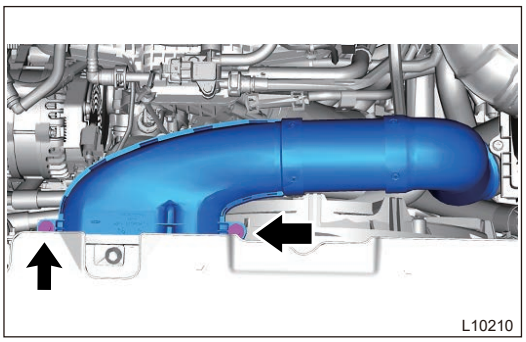
1. Insert air direct pipe into air filter assembly, and install 3 fixing bolts to air filter assembly.
   Torque: 7 ± 1 N·m
2. Connect intake hose, and tighten worm clamp.
   Torque: 3.5 ± 0.5 N·m
3. Install the engine compartment trim cover assembly.

Air Direct Pipe

Removal

Caution
• Be sure to wear safety equipment to prevent accidents, when removing air direct pipe assembly. • Appropriate force should be applied, when removing air direct pipe assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Remove the air filter assembly.
5. Remove 2 fixing bolts from air direct pipe. Remove the air direct pipe assembly carefully.



Installation

Caution
• Check for foreign matter in air filter and related line when installing. Avoid inhaling foreign matter after engine running, causing damage to the components.

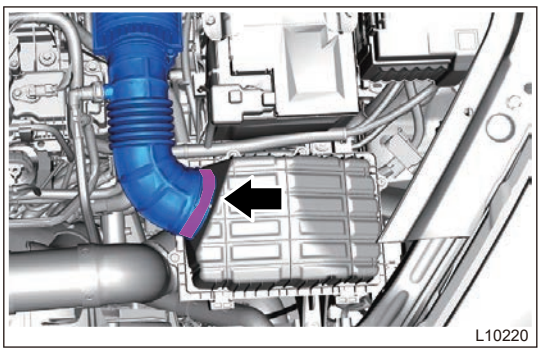
1. Insert air direct pipe into air filter assembly, and install 3 fixing bolts to air filter assembly.
   Torque: 7 ± 1 N·m
2. Install 2 fixing bolts to air direct pipe.
   Torque: 7 ± 1 N·m
3. Connect intake hose, and tighten worm clamp.
   Torque: 3.5 ± 0.5 N·m
4. Install the engine compartment trim cover assembly.

Intake Hose Assembly

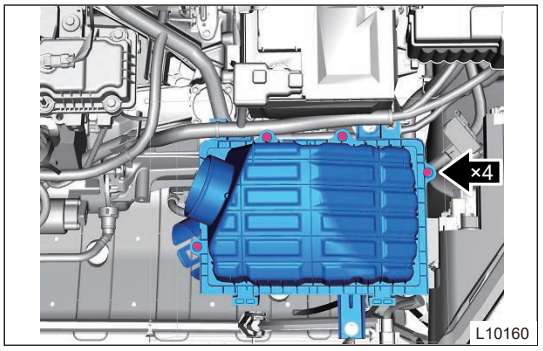
Removal

Warning
• Be sure to wear safety equipment to prevent accidents, when removing intake hose assembly. • Appropriate force should be applied, when removing intake hose assembly. Be careful not to operate roughly. • Try to prevent body paint surface from being scratched during removal of intake hose assembly.

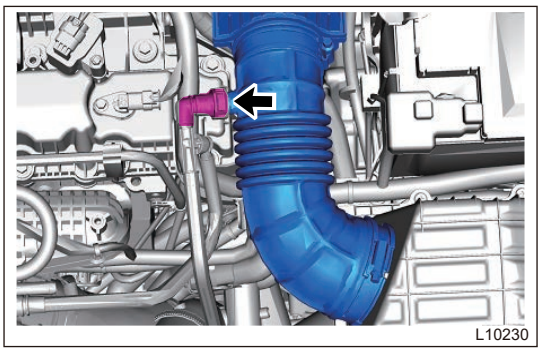
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Loosen worm clamp and disconnect intake hose from air filter assembly upper housing.

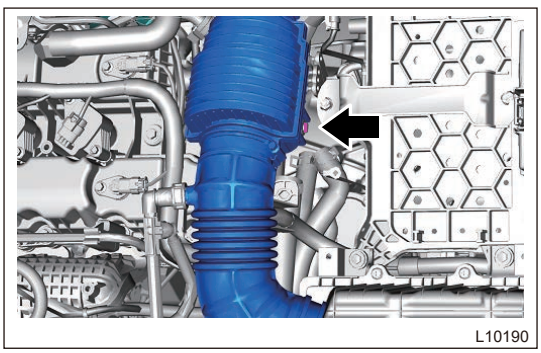


4. Remove 4 fixing screws and air filter upper housing.

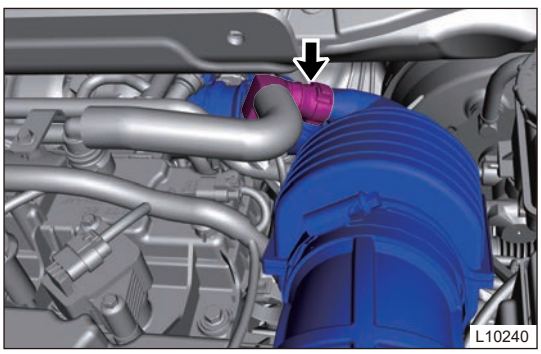


5. Disconnect the connection between canister solenoid valve outlet pipe and intake hose assembly, and remove the intake hose fixing bolt.



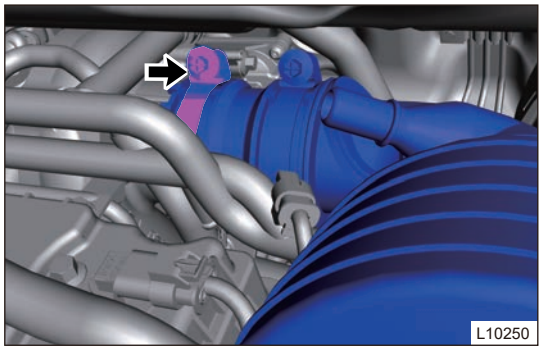


6. Disconnect the connection between crankcase ventilation tube and intake hose assembly.

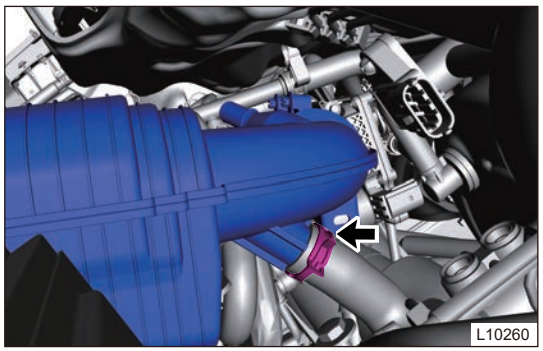


Caution
• Crankcase ventilation system pipeline is a non-reusable part, which must be damaged before removal.

7. Loosen worm clamp and disconnect connection between intake hose assembly and turbocharger.



8. Loosen elastic clamp with the slip-joint pliers and disconnect connection between intercooler intake pipe - hose and intake hose assembly.



9. Remove the intake hose assembly carefully.

Installation

1. Connect the intercooler intake pipe - hose and intake hose assembly. Return the elastic clamp to its original position with tool (slip-joint pliers).
2. Install the intake hose outlet to the inlet of turbocharger. And tighten the worm clamp.

   Torque: 3.5 ± 0.5 N·m
3. Insert the intake hose assembly muffler lower bracket into the rubber cushion.
4. Install the air filter upper housing. And tighten 4 screws.

   Torque: 7 ± 1 N·m
5. Install the intake hose inlet to air filter assembly. And tighten the worm clamp.

   Torque: 3.5 ± 0.5 N·m
6. Connect the canister solenoid valve outlet pipe and crankcase ventilation tube to intake hose respectively. Lock the lock striker of quick connector port after connection.

Caution
• When pipe is connected using quick connector, pay attention to the fitting size and direction of the connector. During assembly, install the connector into place along the axis direction of quick connector until it clamped mechanically and a "click" sound is heard. In order to check if the installation is in good condition, pull it with the appropriate force in the opposite direction to confirm that it does not fall off.

7. Install the engine compartment trim cover assembly.

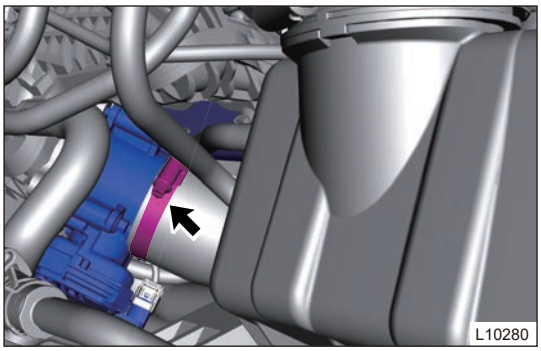
Electronic Throttle

Removal

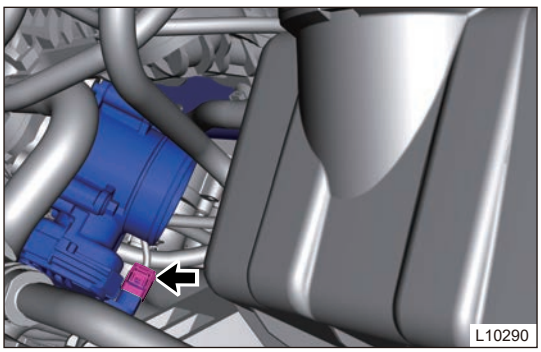
Warning
• Temperature in engine compartment is very high when engine is running. Before removal, you must make sure that engine has shut off, and engine compartment has cooled down sufficiently, otherwise, there is a risk of scald injury. • Be sure to wear safety equipment to prevent accidents, when removing electronic throttle. • Appropriate force should be applied when removing electronic throttle. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.

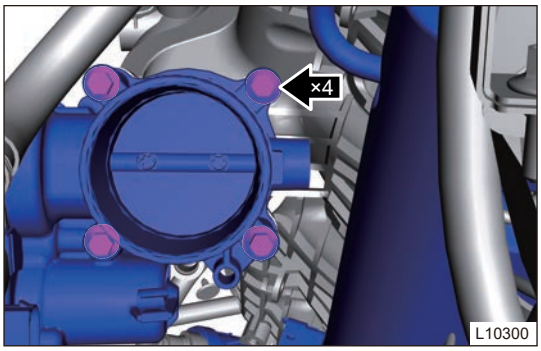
4. Loosen worm clamp and disconnect connection between electronic throttle and intercooler outlet pipe Ⅱ.



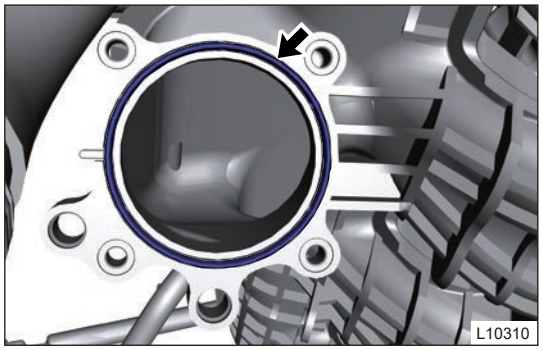
5. Disconnect the electronic throttle connector.



6. Remove 4 fixing bolts from electronic throttle with the 8# socket wrench.



7. Remove the electronic throttle assembly.
8. Remove electronic throttle gasket from intake manifold.



Caution
• After removing electronic throttle, block intake manifold intake port with suitable blocking pieces to prevent foreign matter from entering, causing damage to the components.

Throttle Cleaning

1. Cleaning Tool
   - Thin stick: Used to support throttle valve plate for cleaning the carbon deposited on contact wall between valve plate and throttle. Please use plastic, wooden or bamboo thin stick. Do not use metal thin stick to avoid scratching or deforming the valve plate.
   - Clean cloth or paper towel.

Cleaning Process

1. Remove electronic throttle assembly, and make the valve plate face upward in free condition. Avoid cleaner flowing into electronic element through valve plate shaft, resulting in functional failure.
2. Apply appropriate amount of cleaner to the inner wall of throttle valve body, and wipe off the carbon with clean cloth.
3. Support the throttle valve plate with a thin stick, and clean the carbon on valve plate and throttle valve body inner wall.

4. Turn over the throttle 90°, and clean with the same procedures as above. Repeat several times until it is clean.
5. Push the valve plate by hand, and check if it rotates smoothly. If it is stuck, clean again according to the cleaning procedures.
6. After cleaning, wipe off the cleaner in throttle valve body with absorbent paper.

Warning
• Cleaner is a kind of flammable and corrosive fluid. Follow safety cautions to prevent accidents, and avoid skin contacting with cleaner. • Pay attention to that the amount of cleaner should not be too much, so as to overflows into sensor and motor, resulting in functional failure.

Check electronic throttle

1. Judgment methods for specific mechanical damage
   - Valve plate should be in default position with power off and can rotate smoothly when flipping it by hand. If catching occurs, it indicates that internal components may be damaged.
2. Perform the simple measurement for throttle internal sensor in following steps:

Step	Operation	Test Value	Test Result	Subsequent Step
1	Apply 5V direct current to terminal 3 (+) and 2 (-), close valve plate to full close manually, and measure voltages between terminals 5 and 2, and between terminals 6 and 2 with voltage band of multimeter. Voltage between terminals 6 and 2 is within 0.25 V and 0.75 V, voltage between terminals 5 and 2 is within 4.25 V and 4.75 V, and the sum of both voltages is about 5 V.	/	Yes	Next
		/	No	Replace throttle body
2	Apply 5V direct current to terminal 3 (+) and 2 (-), turn valve plate to full open manually, and measure voltages between terminals 5 and 2, and between terminals 6 and 2 with voltage band of multimeter. Voltage between terminals 6 and 2 is within 4.4V and 4.9V, voltage between terminals 5 and 2 is within 0.1V and 0.6V, and the sum of both voltages is about 5 V.	/	Yes	Next
		/	No	Replace throttle body
3	Turn the digital multimeter to ohm band, directly measure resistance of copper windings on DC motor between terminals 1 and 4. It is usually between 1.5 and 3.0 Ω at normal temperature, this value does not change with the valve plate opening.	/	Yes	Check wire harness or perform diagnostic help
		/	No	Replace throttle body

Electronic Throttle Learning Method

1. Perform throttle body self-learning once after installing electronic throttle body (turn ENGINE START STOP switch to ON and then to OFF after waiting for 30 seconds, and then perform ignition normally). Start vehicle and observe if it operates normally after self-learning is finished.

Installation

Caution
• Clean fitting surface of electronic throttle. • Check if O-ring in the manifold fitting surface groove is in good condition has no damage. • Perform electronic throttle self-learning procedures after installation. • After self-learning is completed, start the vehicle and check for proper operation.

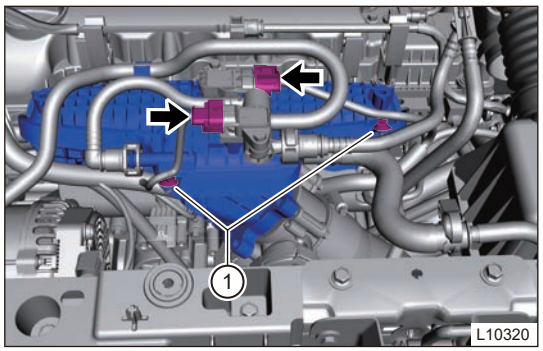
1. Install 4 fixing bolts to electronic throttle. Tighten in diagonally installation order.
   Torque: 8 + 3 N•m
2. Connect intercooler outlet pipe, and tighten worm clamp.
   Torque: 5 ± 1 N·m
3. Connect electronic throttle assembly connector.
4. Install the engine compartment trim cover assembly.

Intake Manifold Assembly

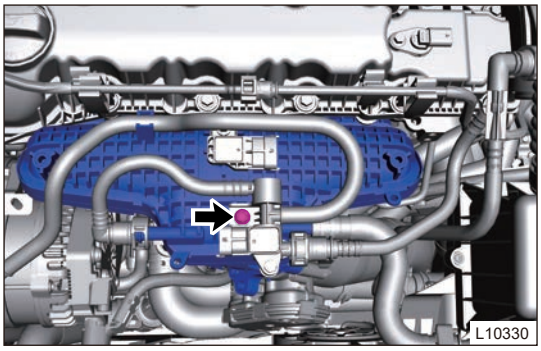
Removal

Warning
• Be sure to wear safety equipment to prevent accidents, when removing intake manifold assembly. • Appropriate force should be applied, when removing intake manifold assembly. Be careful not to operate roughly.

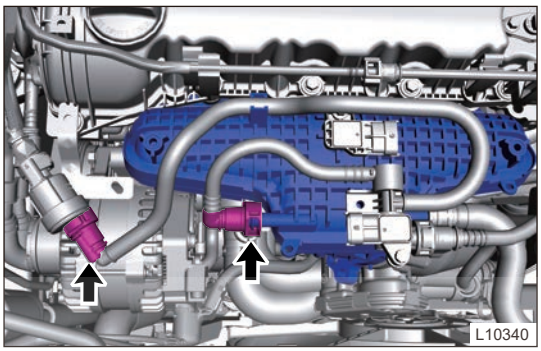
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Disconnect the intake pressure/temperature sensor connector and disengage wire harness fixing clip (1).
5. Disconnect the desorption pressure sensor connector. And disengage the wire harness fixing clip (1).

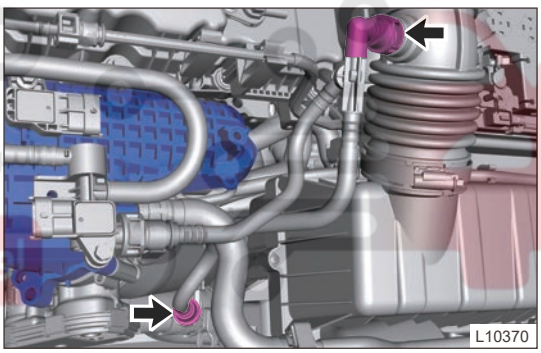


6. Remove 1 fixing bolt from canister solenoid valve outlet pipe assembly.

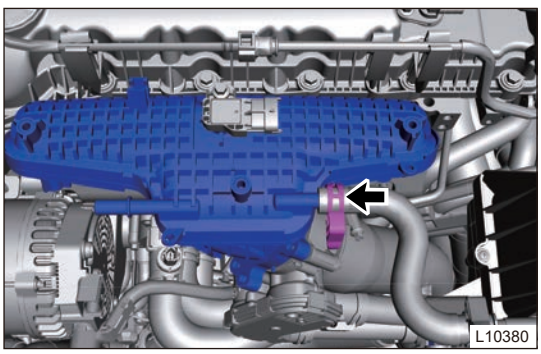


7. Disconnect 4 pipeline connections between canister solenoid valve outlet pipe and canister solenoid valve, intake manifold, intake hose and intercooler outlet pipe ⅱ separately.
8. Disengage the canister solenoid valve outlet pipe from fixing clips, and remove canister solenoid valve outlet pipe assembly.



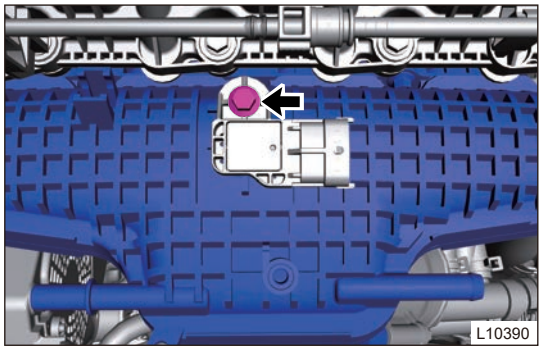


9. Loosen elastic clamp and disconnect connection between brake vacuum pipe and intake manifold assembly.

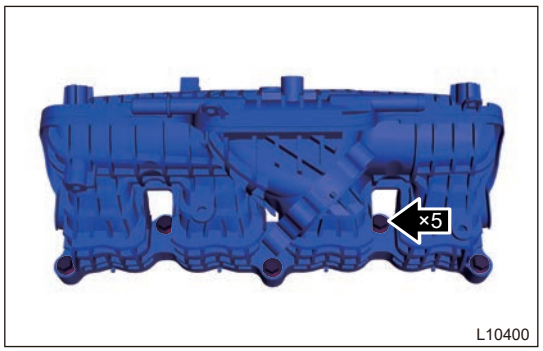


10. Remove the electronic throttle assembly.

11. Remove 1 fixing bolt and intake pressure/temperature sensor.



12. Remove 5 fixing bolts from intake manifold assembly.



13. Remove the intake manifold assembly.

Inspection

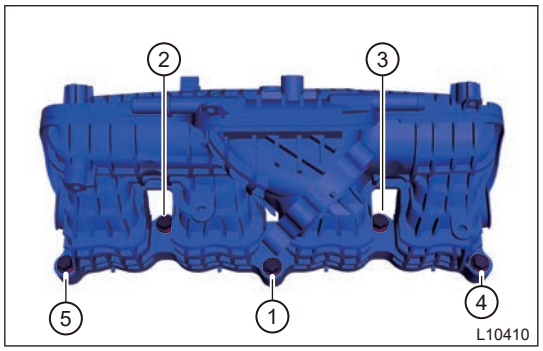
1. Clean and check contact surface between intake manifold assembly and cylinder head. If warpage on surface is greater than 0.8 mm, replace intake manifold assembly.
2. Check the appearance of intake manifold assembly for damage and cracks.
3. Check the intake manifold gasket, and replace if it is deteriorated or damaged.

Installation

Caution
• Before assembly, visually check that intake manifold surface is free of collision, and the seal rings on the flange surface of the intake manifold are free of mistakes, omissions, damages, lodging etc.

1. Align two locating pins of intake manifold and press the intake manifold into locating hole of cylinder head.
2. Install 5 fixing bolts respectively, and tighten them in the corresponding order as shown in illustration.

   Torque: 20 + 5 N•m



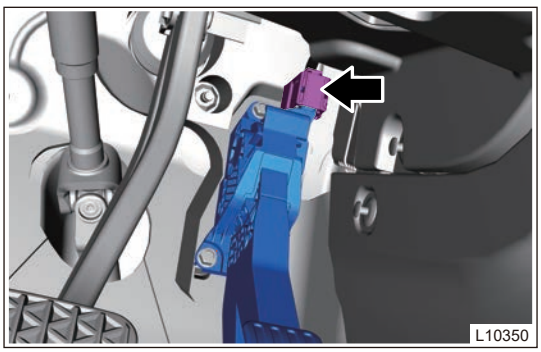
3. Fix the engine wire harness clips and bracket.
4. Install the intake pressure/temperature sensor.
5. Connect the brake vacuum pipeline.
6. Install the canister solenoid valve outlet pipe assembly.
7. Install the air filter assembly.
8. Install the engine compartment trim cover assembly.

Electronic Accelerator Pedal

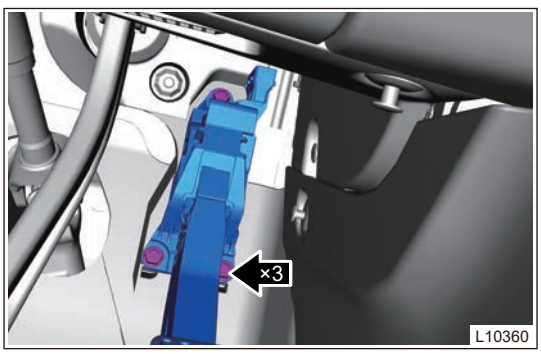
Removal

Warning
• Be sure to wear safety equipment to prevent accidents, when removing electronic accelerator pedal. • Appropriate force should be applied when removing electronic accelerator pedal. Be careful not to operate roughly. • Try to prevent interior from being scratched during removal and installation.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Disconnect the electronic accelerator pedal connector.



4. Remove 3 fixing bolts from electronic accelerator pedal.



5. Remove the electronic accelerator pedal.

Inspection

1. Press the electronic accelerator pedal by hand, If it is stuck, it indicates that internal components may be damaged.

Installation

1. Install 3 fixing bolts on electronic accelerator pedal.

   Torque: 3.5 ± 0.5 N·m

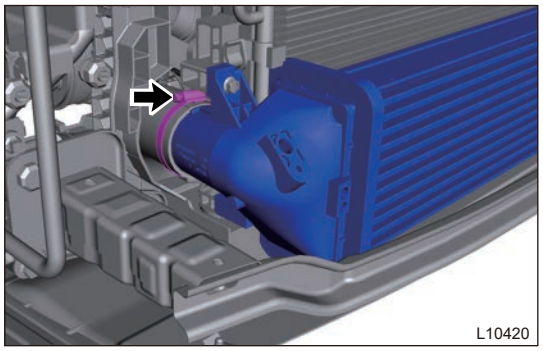
2. Connect the electronic accelerator pedal connector.

Intercooler Assembly

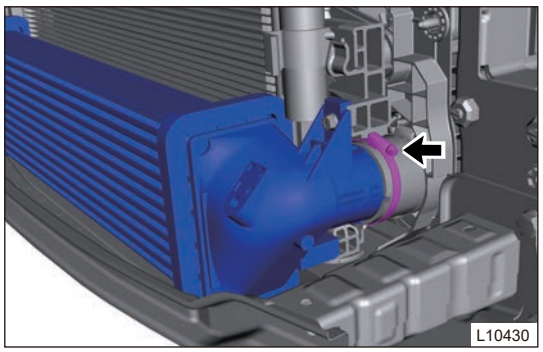
Removal

Warning
• Be sure to wear safety equipment to prevent accidents, when removing intercooler assembly. • Appropriate force should be applied, when removing the intercooler assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Remove the engine compartment lower protector assembly.
4. Remove the front bumper assembly.
5. Remove the front upper impact beam assembly.
6. Remove the left and right air deflector assembly.
7. Loosen worm clamp and disconnect connection between intercooler outlet pipe Ⅰ and intercooler.



8. Loosen worm clamp and disconnect connection between intercooler intake pipe Ⅲ and intercooler.



9. Remove 2 fixing bolts from intercooler assembly.

10. Remove the intercooler assembly.

Cleaning

1. Exterior cleaning: Use a water gun with a low pressure to spray water from top to bottom and from left to right at an angle perpendicular to the intercooler plane. Never flush the intercooler at an angle, it will damage the intercooler.
2. Interior cleaning: Fill the intercooler with water solution containing 2% soda ash at 80 ℃. After waiting for half an hour, check for leakage. If there is water leakage, it is necessary to replace intercooler. If there is no water leakage, shake it back and forth several times, and then pour out the sewage. Then fill with water solution containing 2% soda ash again until it is washed out. Increase water temperature to 90 ℃ properly at the last washing. Wash out with same method and water solution.

Installation

1. Install 2 fixing bolts on intercooler assembly.
   Torque: 5 ± 1 N·m
2. Connect intercooler intake pipe Ⅲ, and tighten worm clamp after aligning and connecting.
   Torque: 5 ± 1 N·m
3. Connect intercooler outlet pipe Ⅰ, and tighten worm clamp after aligning and connecting.
   Torque: 5 ± 1 N·m

Caution
• The connection clearance between rubber pipe and plastic should not exceed 3 mm.

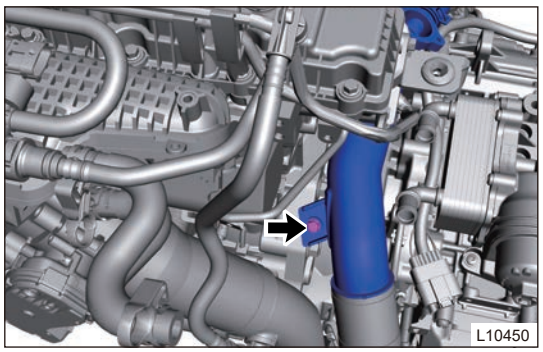
4. Install the left and right air deflector assembly.
5. Install the front upper impact beam assembly.
6. Install the front bumper assembly.
7. Install the engine compartment lower protector assembly.

Intercooler Intake Pipe Ⅰ Assembly

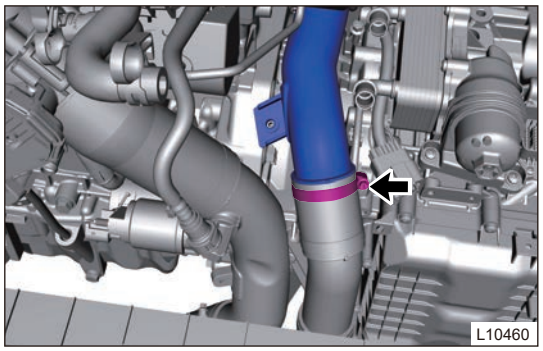
Removal

Warning
• Be sure to wear safety equipment to prevent accidents, when removing intercooler intake pipe Ⅰ assembly. • Appropriate force should be applied, when removing the intercooler intake pipe Ⅰ assembly. Be careful not to operate roughly.

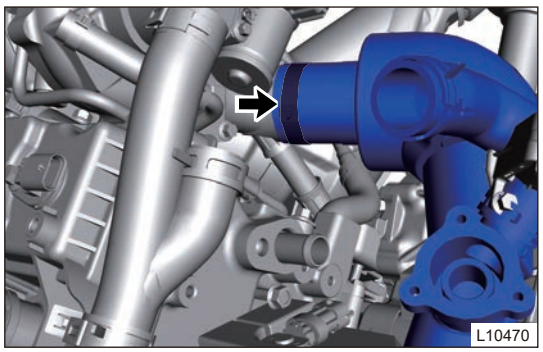
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Remove the air filter assembly.
4. Remove the intake hose assembly.
5. Remove 1 fixing bolt between intercooler intake pipe Ⅰ and transmission.



6. Disconnect the relief solenoid valve connector.
7. Loosen worm clamp and disconnect connection between intercooler intake pipe Ⅱ and intercooler intake pipe assembly I.



8. Loosen worm clamp and disconnect connection between intercooler intake pipe Ⅰ and turbocharger inlet.



9. Remove the intercooler intake pipe Ⅰ assembly carefully.
10. Remove the relief solenoid valve assembly.

Inspection

1. Check the appearance of intercooler intake pipe assembly Ⅰ for damage.
2. Check if the inner of intercooler intake pipe Ⅰ assembly is dirty.

Installation

1. Install the relief solenoid valve assembly.
2. Connect the intercooler intake pipe Ⅰ to turbocharger inlet and intercooler intake pipe Ⅱ respectively, and tighten worm clamp after aligning and connecting.

   Torque: 5 ± 1 N·m

Caution
• The connection clearance between rubber pipe and plastic should not exceed 3 mm.

3. Connect the relief solenoid valve connector.
4. Fix the intercooler intake pipe Ⅰ to transmission with 1 bolt.

   Torque: 9 ± 1.5 N·m

5. Install the intake hose assembly.
6. Install the air filter assembly.
7. Install the engine compartment trim cover assembly.

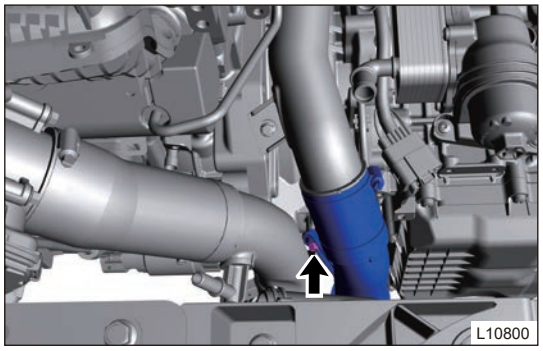
Intercooler Intake Pipe Ⅱ Assembly

Removal

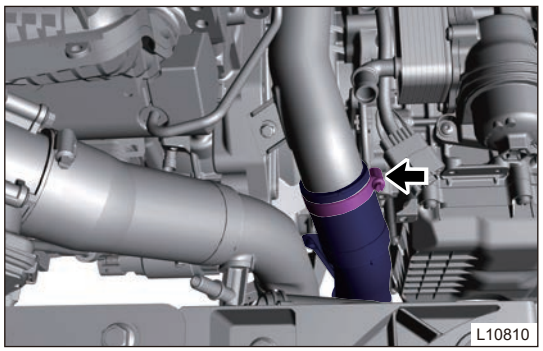
Warning
• Be sure to wear safety equipment to prevent accidents, when removing intercooler intake pipe Ⅱ assembly. • Appropriate force should be applied, when removing the intercooler intake pipe Ⅱ assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Remove the air filter assembly.

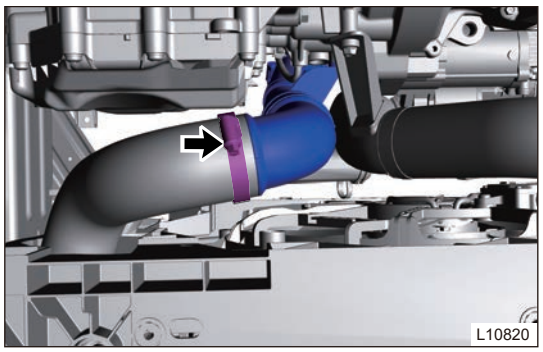
4. Remove 1 fixing bolt between intercooler intake pipe Ⅱ and transmission.



5. Loosen worm clamp and disconnect connection between intercooler intake pipe Ⅱ and intercooler intake pipe assembly Ⅰ.



6. Loosen worm clamp and disconnect connection between intercooler intake pipe Ⅱ and intercooler intake pipe Ⅲ assembly.



7. Remove the intercooler intake pipe Ⅱ assembly carefully.

Inspection

1. Check the appearance of intercooler intake pipe assembly Ⅰ for damage.
2. Check if the inner of intercooler intake pipe Ⅰ assembly is dirty.

Installation

1. Connect the intercooler intake pipe Ⅱ to intercooler intake pipe Ⅲ and intercooler intake pipe Ⅰ respectively, and tighten worm clamp after aligning and connecting.

   Torque: 5 ± 1 N·m

Caution
• The connection clearance between rubber pipe and plastic should not exceed 3 mm.

2. Fix the intercooler intake pipe Ⅱ to transmission with 1 bolt.

   Torque: 9 ± 1.5 N·m

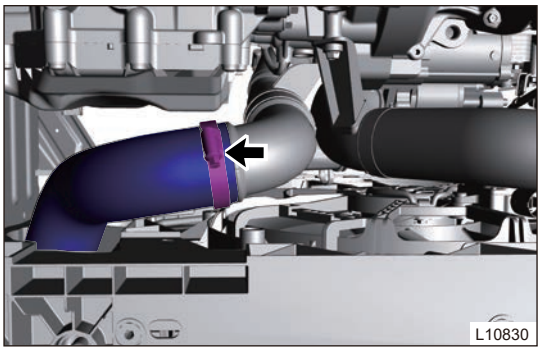
3. Install the air filter assembly.
4. Install the engine compartment trim cover assembly.

Intercooler Intake Pipe Ⅲ Assembly

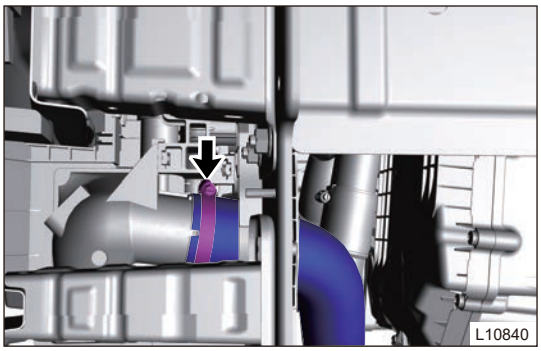
Removal

Warning
• Be sure to wear safety equipment to prevent accidents, when removing intercooler connecting pipe assembly. • Appropriate force should be applied, when removing the intercooler connecting pipe assembly. Be careful not to operate roughly.

1. Raise the vehicle to a proper position.
2. Remove the engine compartment lower protector assembly.
3. Loosen worm clamp and disconnect connection between intercooler intake pipe Ⅱ and intercooler intake pipe Ⅲ.



4. Loosen worm clamp and disconnect connection between intercooler intake pipe Ⅲ and intercooler assembly.



5. Remove the intercooler intake pipe Ⅲ assembly carefully.

Installation

1. After aligning and connecting intercooler intake pipe Ⅲ and intercooler assembly, tighten worm clamp.

   Torque: 5 ± 1 N·m

2. After aligning and connecting intercooler intake pipe Ⅲ and intercooler intake pipe Ⅱ, tighten worm clamp.
   Torque: 5 ± 1 N·m

Caution
• The connection clearance between rubber pipe and plastic should not exceed 3 mm.

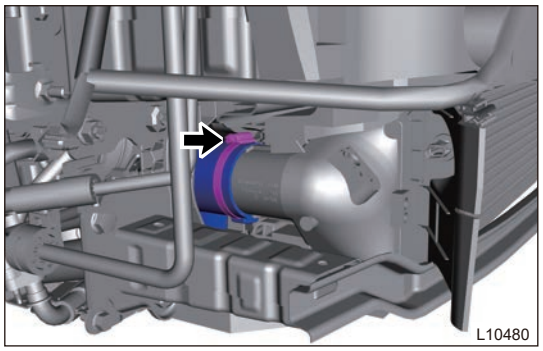
3. Install the engine compartment lower protector assembly.

Intercooler Outlet Pipe Ⅰ Assembly

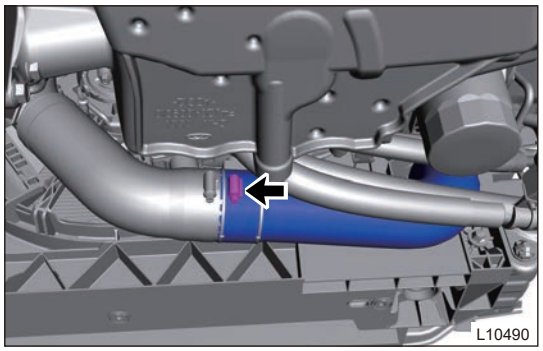
Removal

Warning
• Be sure to wear safety equipment to prevent accidents, when removing intercooler outlet pipe Ⅰ assembly. • Appropriate force should be applied, when removing the intercooler outlet pipe Ⅰ assembly. Be careful not to operate roughly.

1. Raise the vehicle to a proper position.
2. Remove the engine compartment lower protector assembly.
3. Remove the front bumper assembly.
4. Loosen worm clamp and disconnect connection between intercooler outlet pipe I and intercooler assembly.



5. Loosen worm clamp and disconnect connection between intercooler outlet pipe I and intercooler outlet pipe Ⅱ assembly.



6. Remove the intercooler outlet pipe Ⅰ assembly carefully.

Installation

1. After aligning and connecting intercooler outlet pipe Ⅰ and intercooler assembly, tighten worm clamp.
   Torque: 5 ± 1 N·m

2. After aligning and connecting intercooler outlet pipe Ⅰ and intercooler outlet pipe Ⅱ assembly, tighten worm clamp.
   Torque: 5 ± 1 N·m

Caution
• The connection clearance between rubber pipe and plastic should not exceed 3 mm.

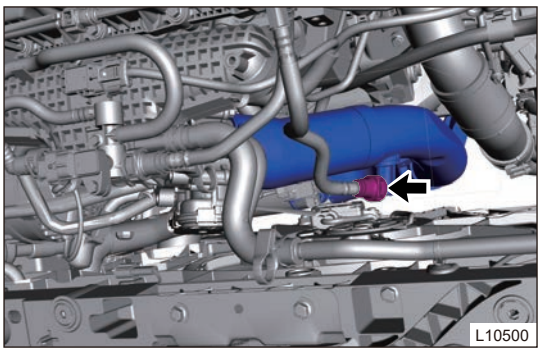
3. Install the engine compartment lower protector assembly.

Intercooler Outlet Pipe Ⅱ Assembly

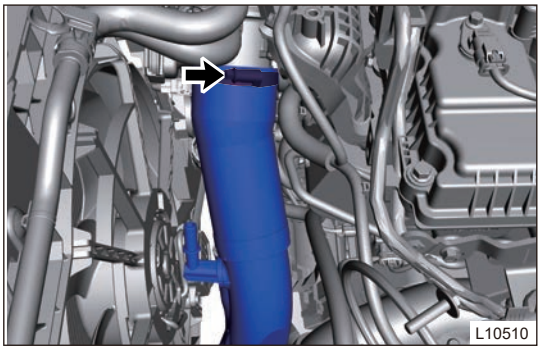
Removal

Warning
• Be sure to wear safety equipment to prevent accidents, when removing intercooler outlet pipe Ⅱ assembly. • Appropriate force should be applied, when removing the intercooler outlet pipe Ⅱ assembly. Be careful not to operate roughly.

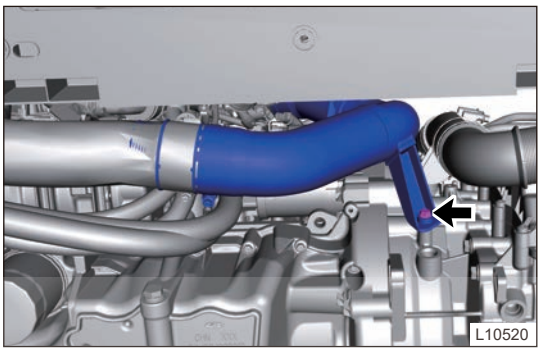
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Remove the engine compartment lower protector assembly.
5. Disconnect the canister solenoid valve outlet pipe from intercooler outlet pipe Ⅱ.



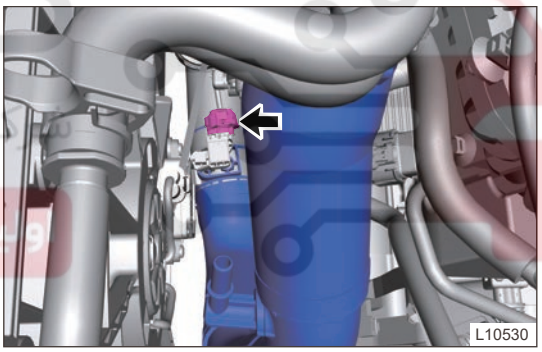
6. Loosen worm clamp and disconnect connection between intercooler outlet pipe II and throttle assembly.



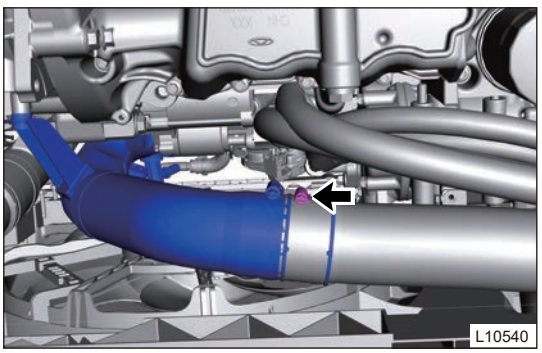
7. Remove 1 fixing bolt between intercooler outlet pipe II and transmission.



8. Disconnect the boost pressure sensor connector.



9. Loosen worm clamp and disconnect connection between intercooler outlet pipe I and intercooler outlet pipe II.



10. Remove the intercooler outlet pipe II assembly carefully.

11. Remove the boost pressure/temperature sensor from intercooler outlet pipe II.

Installation

1. Install the boost pressure/temperature sensor to intercooler outlet pipe II assembly.

2. After aligning and connecting intercooler outlet pipe Ⅱ and intercooler outlet pipe Ⅰ, tighten worm clamp.
   Torque: 5 ± 1 N·m

Caution
• The connection clearance between rubber pipe and plastic should not exceed 3 mm.

3. Connect the boost pressure/temperature sensor connector.
4. Connect intercooler outlet pipe Ⅱ to throttle assembly, and tighten worm clamp.
   Torque: 5 ± 1 N·m
5. Connect the canister solenoid valve outlet pipe to intercooler outlet pipe Ⅱ assembly.
6. Install and tighten 1 fixing bolt.
   Torque: 9 ± 1.5 N·m
7. Install the engine compartment lower protector assembly.

Exhaust system

Warnings and Precautions

Warnings

In order to avoid possible property loss, personal injury or death, always follow the instructions below before repair:

1. Before repairing the exhaust system, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury.

Precautions

In order to avoid dangerous operation and damage to the vehicle before repair in this section, always follow the instructions below before repair:

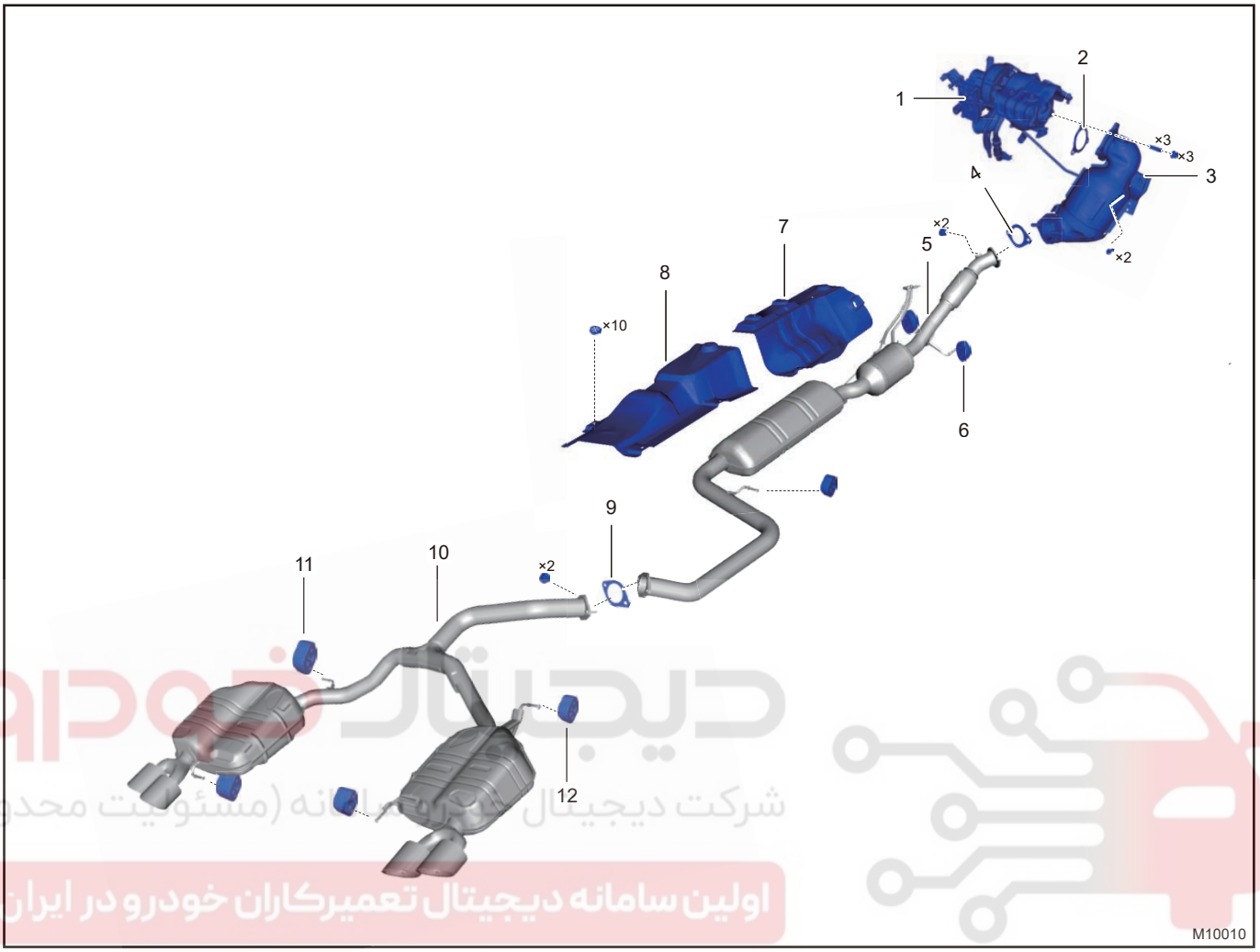
1. If exhaust gasket is damaged, replace it, and remove foreign matters on joints and threads.
2. Check exhaust gas for leakage. If gas leaks, tighten malfunctioning part to prevent leakage. Replace damaged parts as necessary.

System Overview

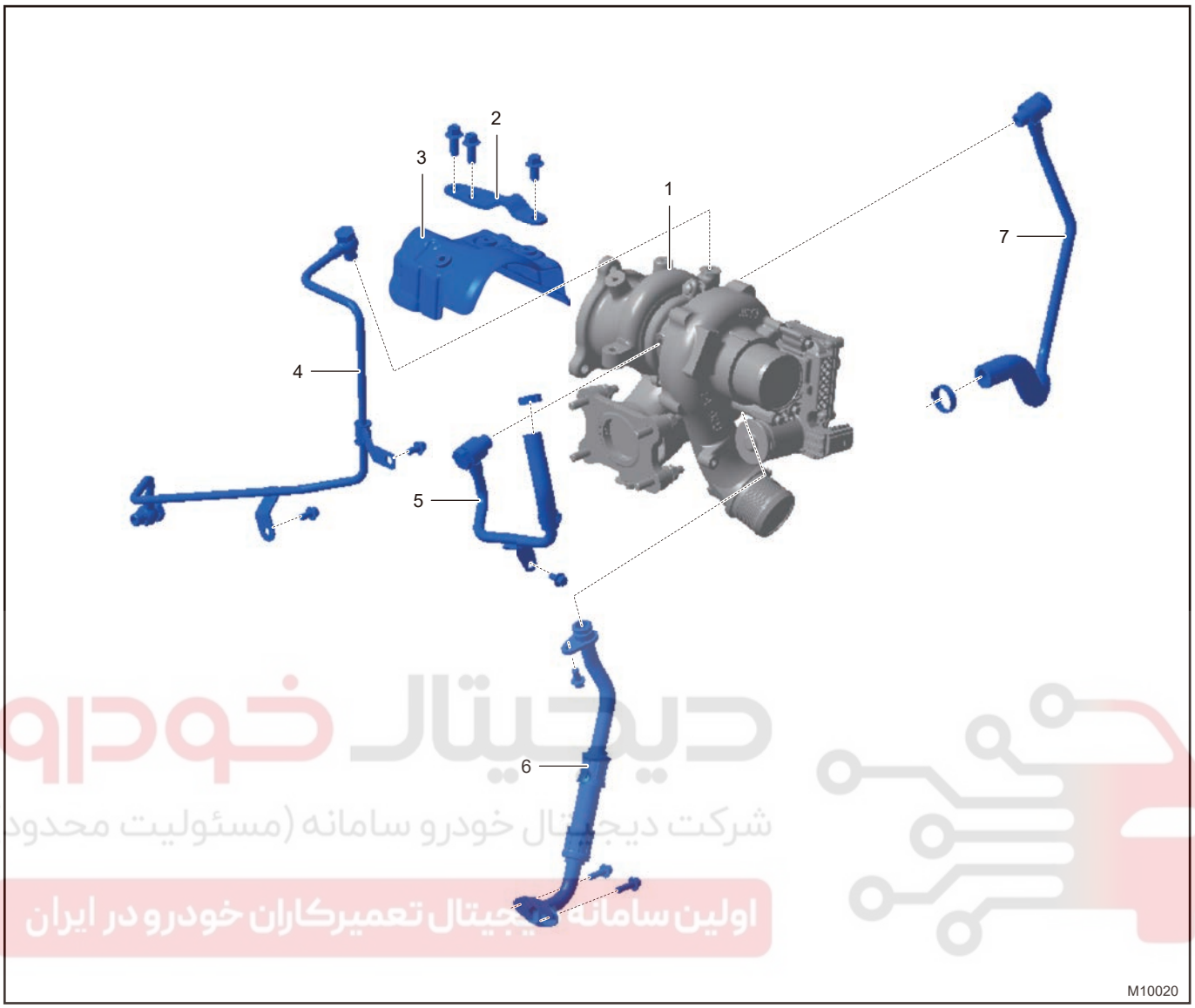
System Description

Exhaust system controls engine exhaust, reducing vehicle emissions by precatalytic converter and main catalytic converter, and eliminating exhaust noise by muffler. When exhaust system discharges exhaust gas, oxygen sensor monitors oxygen content in exhaust gas. Engine control module adjusts air-fuel ratio of combustible gas mixture to control vehicle emissions and achieve optimal fuel economy and satisfy the emissions standard of regulation according to feedback signals of oxygen sensor and combining with other sensor signals.

System Components Diagram

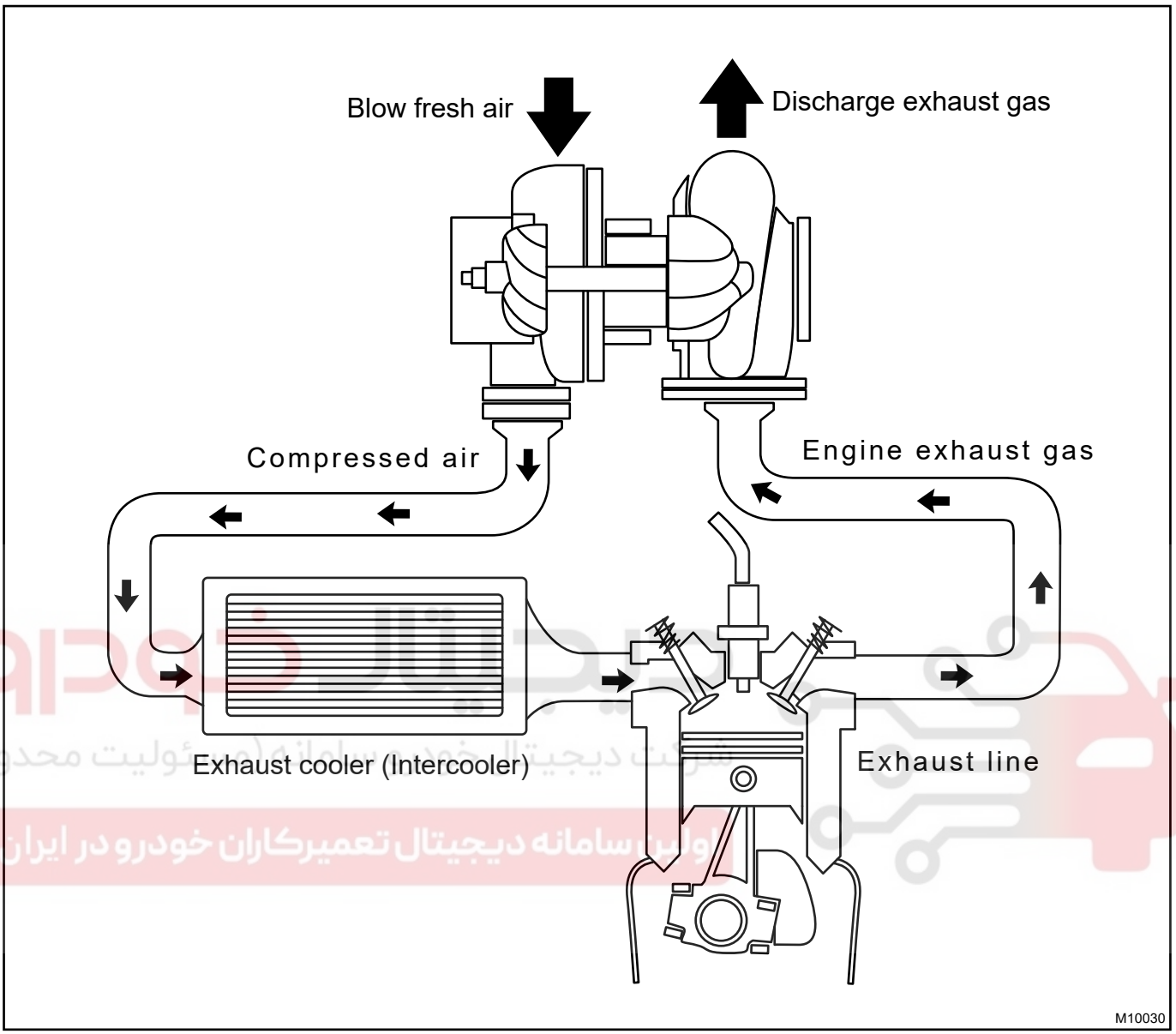


1	Turbocharger Assembly	8	Center Passage Heat Insulator III
2	Washer Between Turbocharger and Precatalytic Converter	9	Washer
3	Precatalytic Converter Assembly	10	Rear Muffler Assembly
4	Washer	11	Rear Muffler Hanger Block
5	Front Muffler and Line	12	Rear Muffler Hanger Block
6	Main Catalytic Converter Assembly Hanger Block		
7	Heat Insulator II		



1	Turbocharger Assembly	5	Turbocharger Cooling Water Outlet Pipe
2	Turbocharger Bracket	6	Turbocharger Oil Return Pipe Assembly
3	Turbocharger Heat Insulator	7	Turbocharger Water Inlet Pipe Assembly
4	Turbocharger Oil Inlet Pipe Assembly		

System Schematic Diagram

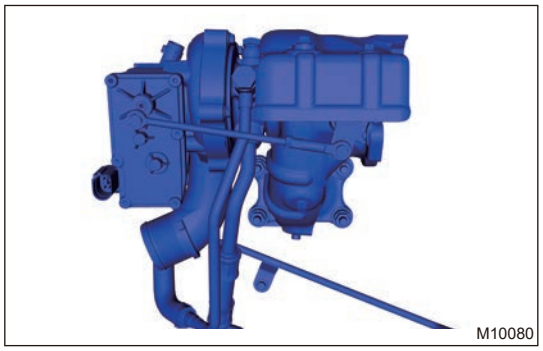


The fresh air filtered by the air filter enters the intercooler after being pressed by the turbocharger, and then enters the cylinder after being cooled by the intercooler. The exhaust gas drives turbo impeller to rotate, and then drives compressor impeller to press the inlet fresh air.

System Components Description

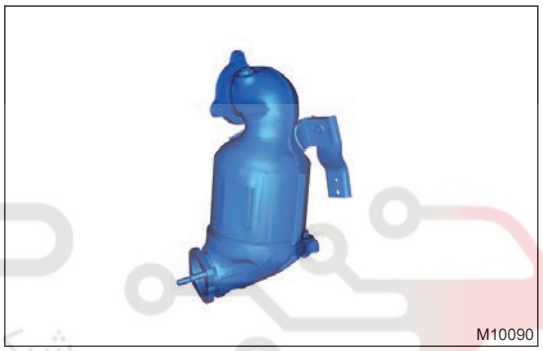
Turbocharger

Turbocharger uses the exhaust gas discharged from the engine to push the turbine impeller to rotate, and then drives the compressor impeller to pressurize the air filtered by the air filter and send it to the cylinder. As more air enters into cylinder, more fuel is allowed to be injected, which results in higher engine power. In addition, the turbocharger can also make the engine get power compensation when it works in highland.



Catalytic Converter

Catalytic converter is the most important external purification device fixed in vehicle exhaust system, which can convert harmful gases such as carbon monoxide, hydrocarbons and nitrogen oxides from exhaust gas into carbon dioxide, water and nitrogen by oxidation and reduction.



Diagnosis & Testing

Problem Symptoms Table

Hint:

Use symptoms table below to help determine cause of problem. Check each suspected area in sequence. Repair, replace or adjust faulty components as necessary.

Exhaust system

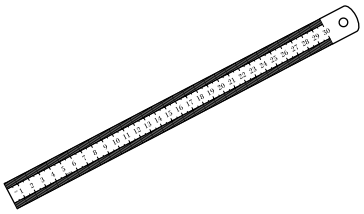
Symptom	Possible Cause
Excessive exhaust noise	Exhaust pipe (loose connection)
	Turbocharger (damaged)
	Muffler assembly (damaged or leaked)
	Main catalytic converter assembly (damaged or leaked)
	Exhaust pipe gasket (damaged)
Excessive exhaust temperature	Inadequate gas mixture combustion
	Main catalytic converter assembly (blocked)
	Precatalytic converter assembly (blocked)

Symptom	Possible Cause
	Turbocharger (blocked)
Exhaust pipe leakage	Main catalytic converter assembly (damaged or leaked)
	Muffler assembly (damaged or leaked)
	Precatalytic converter assembly (damaged or leaked)

On-Vehicle Service

Tools

General Tools

Tool Name	Tool Drawing
Precision Straightedge	 S00044

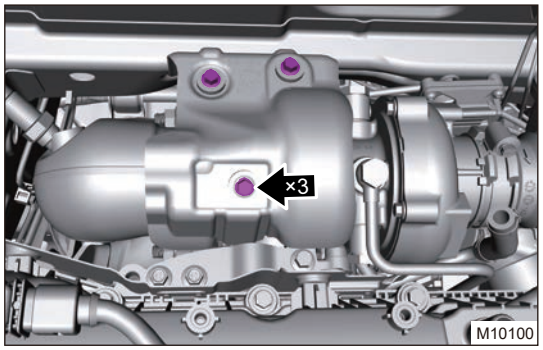
Turbocharger Heat Insulator

Removal

Warning
• Before removing turbocharger heat insulator assembly, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury. • Be sure to wear safety equipment to prevent accidents, when removing turbocharger heat insulator assembly. • Appropriate force should be applied, when removing the turbocharger heat insulator assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Remove the negative battery cable.

4. Remove 3 fixing bolts from turbocharger heat insulator assembly.



5. Remove turbocharger heat insulator assembly carefully.

Installation

1. Install 3 fixing bolts on turbocharger heat insulator assembly.

   Torque: 8 + 3 N·m

2. Install the engine compartment trim cover assembly.

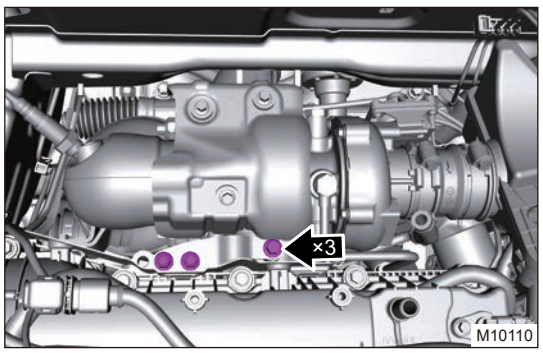
Turbocharger Bracket

Removal

Warning
• Before removing turbocharger bracket assembly, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury. • Be sure to wear safety equipment to prevent accidents, when removing turbocharger bracket assembly. • Appropriate force should be applied, when removing turbocharger bracket assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Remove the negative battery cable.

4. Remove 3 fixing bolts from turbocharger bracket assembly.

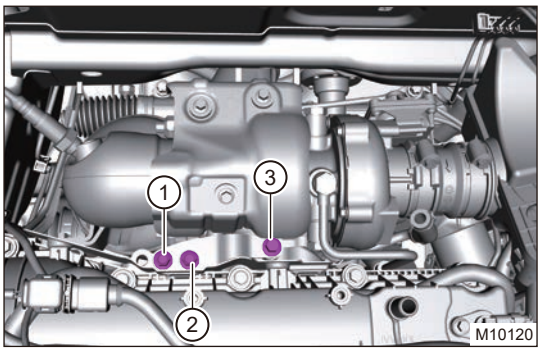


5. Remove the turbocharger bracket assembly carefully.

Installation

1. Tighten 3 mounting bolts in order shown in illustration.

   Torque: 1st step: 6 ± 2 N·m, 2nd step: 25 + 5 N·m



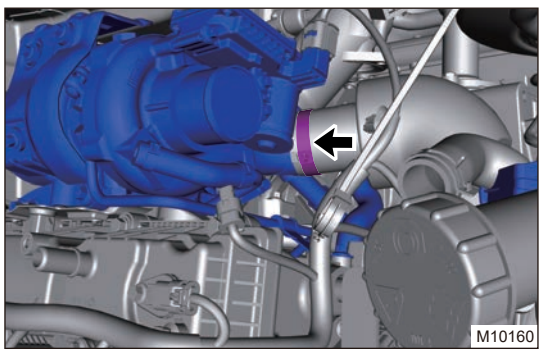
2. Install the engine compartment trim cover assembly.

Turbocharger Assembly

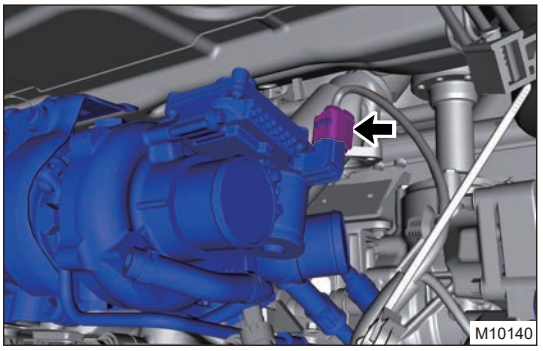
Removal

Warning
• Before removing turbocharger assembly, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury. • Be sure to wear safety equipment to prevent accidents, when removing turbocharger assembly. • Appropriate force should be applied, when removing turbocharger assembly. Be careful not to operate roughly.

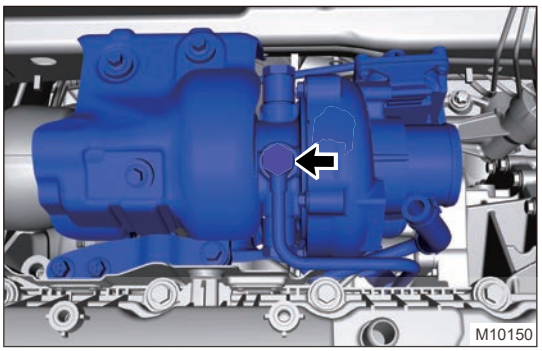
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Remove the air filter assembly.
5. Remove the intake hose assembly.
6. Drain the coolant.
7. Removal turbocharger heat insulator assembly.
8. Remove the heater inlet pipe assembly Ⅰ.
9. Remove the turbocharger bracket.
10. Remove the precatalytic converter assembly.
11. Loosen worm clamp and disconnect connection between intercooler intake pipe 1 and turbocharger assembly.



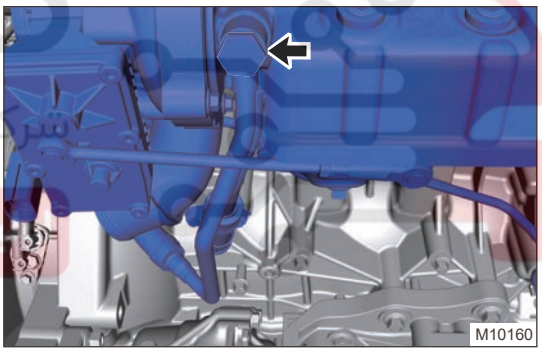
12. Disconnect the turbocharger electronic exhaust valve connector.



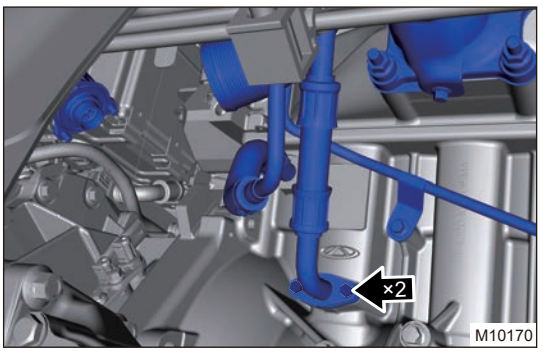
13. Remove 1 hollow bolt between oil inlet pipe assembly and turbocharger. Remove the copper washer carefully.



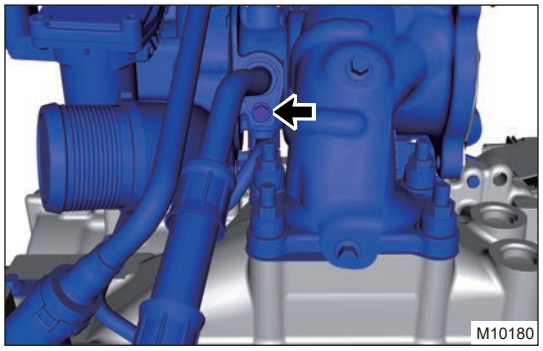
14. Remove 1 hollow bolt between water inlet pipe assembly and turbocharger. Remove the copper washer carefully.



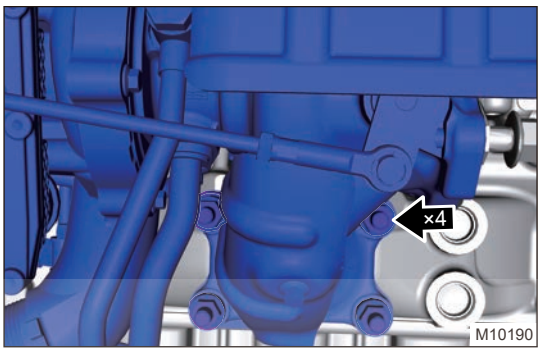
15. Remove 2 fixing bolts between oil return pipe assembly and cylinder block. Remove the washer carefully.



16. Remove 1 fixing bolt between oil return pipe assembly and turbocharger. Unplug the oil return pipe assembly from turbocharger oil return hole carefully.



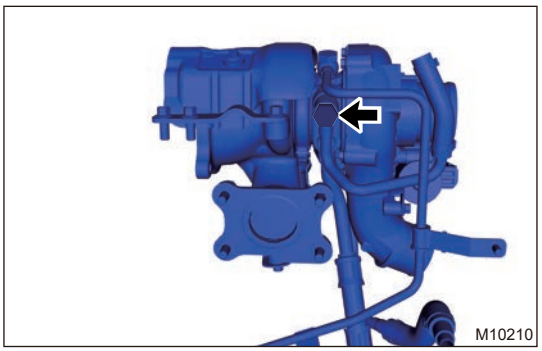
17. Remove 4 high temperature nuts between turbocharger and cylinder head, and remove spacer from each bolt carefully.



18. Remove the turbocharger assembly carefully. And remove gasket from cylinder head flange.

19. Remove 1 fixing bolt between water outlet pipe bracket and turbocharger.

20. Remove 1 hollow bolt between water outlet pipe bracket and turbocharger. Remove the washer carefully.



Daily inspection of turbocharger

1. Check the sealing and tightness of connecting lines between air filter and turbocharger, turbocharger and engine intake/exhaust pipe.
2. Check if turbocharger oil inlet pipe and return pipe are damaged or throttling, and if the connecting bolts of joints are loose.

3. Check the air filter and clean or replace the element regularly.
4. Check if engine crankcase blow-by gas is too large, breather is smooth, ensure crankcase pressure is normal.

Other requirements of turbocharger

1. Avoid low engine idle for long time (maximum should not exceed 20 minutes).
2. Never use the operation with "Accelerate - Stall - Neutral coasting",before the engine lubricating oil pressure is established, the engine must be kept in idling condition (3 - 5 minutes).
3. Before stopping the engine, let it gradually decrease its temperature and speed from maximum value (3 - 5 minutes).

Firstly perform basic inspection to turbocharger system when DTC indicating too high or too low boost pressure occurs or when power decreases.

1. Check there are no cranks causing by overheating, biting, deformation or other damage on exhaust turbocharger turbo housing, otherwise, replace exhaust turbocharger.
2. Check there are no deposition and blocking on turbo oil hole.
3. Check there are no blockage, squash, deformation or other damage on oil inlet and return pipes of exhaust turbocharger.
4. Check there is no sticking in actuator mechanism, and if actuator connector is connected normally.
5. Check there is no obvious deformation in turbocharger impeller, and the rotation is normal without blocking.
6. Check if each actuator connector is connected reliably (intake relief valve and exhaust gas bypass electric valve) and check for no damage of appearance.

Installation

Caution
• Do not pull the turbocharger actuator rod by hand, and avoid impacting the turbocharger during assembly. • Check for foreign matter in turbocharger and line when installing. Avoid inhaling foreign matter after turbocharger running, causing damage to the components.

1. If you want to remove 4 high temperature studs from cylinder head flange, you must replace bolts. Apply the high temperature resistant thread adhesive to the short threads end of high temperature stud respectively before installing bolts, and rescrew them into cylinder head thread holes according to the corresponding torque.

   Torque: 20 + 5 N·m

   Thread adhesive: Loctite 2422

Caution
• Do not apply adhesive in advance, make sure that the fastening is completed within 5 minutes after applying adhesive on the stud. If you want to remove them, you must replace bolts, reapply adhesive and retighten them.

2. Install the washer on high temperature stud and fit them on the cylinder head exhaust flange.

Caution
• Pay attention to that the direction of error proofing identification point after installation is as shown in illustration.

3. Install a washer to hollow bolt, insert the bolt into water outlet pipe ball type joint, install a washer again on the hollow bolt, then screw the bolt into the corresponding threaded hole of turbocharger. Screw in 3 teeth at least and do not screw it fully.

   Torque: 40 ± 2 N·m

4. Install and screw water outlet pipe bracket into turbocharger threaded hole with 1 fixing bolt, screw in 3 teeth at least and do not screw it fully.

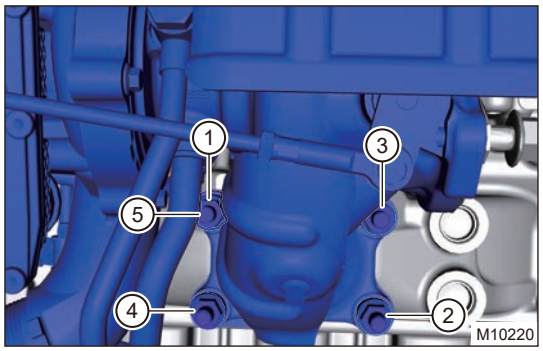
   Torque: 8 + 3 N·m

Caution
• Tighten the hollow bolt according to the torque requirements first, and then tighten the bracket fixing bolt.

5. Fit the turbocharger mounting holes to cylinder head exhaust flange studs carefully. Install 1 spacer on each bolt. Install 4 high temperature nuts, and tighten them diagonally and crosswise in the order as shown in illustration.

   Hint:
   Number 5 indicates to tighten the position 1 again.

   Torque: 33 ± 3 N·m



6. Dip a small amount of oil on the oil return pipe seal ring (oil type is consistent with engine oil), rotate and insert the end with seal ring into oil return hole in the middle of turbocharger. Screw 1 fixing bolt in 3 teeth at least and do not screw fully.

   Torque: 8 + 3 N·m

7. Install 2 bolts to oil return pipe mounting holes, install the washer and screw 2 bolts into oil return flange mounting holes of cylinder block. Screw in 3 teeth at least and do not screw it fully.

   Torque: 8 + 3 N·m

Caution
• Tighten 2 fixing bolts between oil return pipe and cylinder block side according to torque requirements first, and tighten 1 fixing bolt between oil return pipe and turbocharger side.

8. Loosen 2 fixing bolts of oil inlet pipe assembly bracket.

   Torque: 8 + 3 N·m

9. Loosen the hollow bolt between oil inlet pipe assembly and cylinder block.

   Torque: 25 + 5 N·m

   Hint:
   Loosen the hollow bolt to facilitate the installation of oil inlet pipe assembly to turbocharger side.

10. Install a washer to hollow bolt, insert the bolt into oil inlet pipe ball type joint, install a washer again on the hollow bolt, then screw the bolt into the corresponding threaded hole of turbocharger. And tighten it.

    Torque: 25 + 5 N·m

Caution
• Tighten the hollow bolts at both ends of the oil inlet pipe assembly according to torque requirements first, and then tighten 2 fixing bolts of oil inlet pipe bracket.

11. Install a washer to hollow bolt, insert the bolt into water inlet pipe ball type joint, install a washer again on the hollow bolt, then screw the bolt into the corresponding threaded hole of turbocharger. And tighten it.

    Torque: 40 ± 2 N·m

12. Connect the intercooler intake pipe assembly Ⅰ and turbocharger, and tighten worm clamp.

    Torque: 5 ± 1 N·m

13. Connect the turbocharger exhaust electric valve connector.
14. Install the precatalytic converter assembly.
15. Install the turbocharger bracket.
16. Install the heater inlet pipe assembly Ⅰ.
17. Install the turbocharger heat insulator assembly.
18. Install the intake hose assembly.
19. Install the air filter assembly.
20. Add the coolant.
21. Refill the oil to a proper position.
22. Install the engine compartment trim cover assembly.

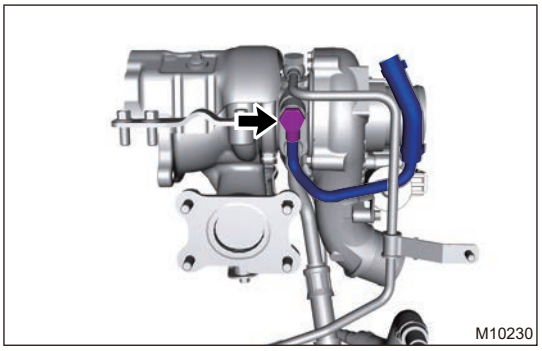
Turbocharger Cooling Water Outlet Pipe

Removal

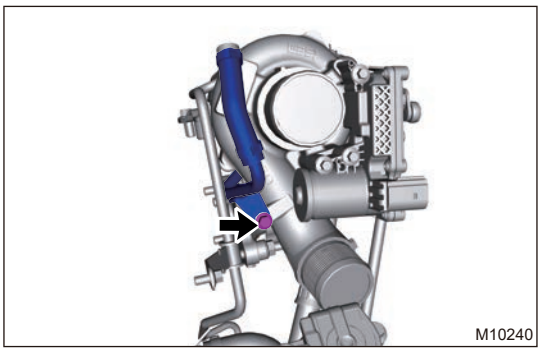
Warning
• Before removing turbocharger cooling water outlet pipe assembly, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury. • Be sure to wear safety equipment to prevent accidents, when removing turbocharger cooling water outlet pipe assembly. • Appropriate force should be applied, when removing turbocharger cooling water outlet pipe. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Remove the air filter assembly.
5. Remove the intake hose assembly.
6. Drain the coolant.
7. Remove the turbocharger assembly.

8. Remove 1 hollow bolt between water outlet pipe and turbocharger water outlet. Remove the copper washer carefully.



9. Remove 1 fixing bolt from water outlet pipe bracket.



10. Remove the turbocharger water outlet pipe assembly.

Installation

1. Install a washer to hollow bolt, insert the bolt into water outlet pipe ball type joint, install a washer again on the hollow bolt, then screw the bolt into the corresponding threaded hole of turbocharger. Screw in 3 teeth at least and do not screw it fully.

   Torque: 40 ± 2 N·m

2. Install and screw water outlet pipe bracket into turbocharger threaded hole with 1 fixing bolt, screw in 3 teeth at least and do not screw it fully.

   Torque: 8 + 3 N·m

Caution
• Tighten the hollow bolt according to the torque requirements first, and then tighten the bracket fixing bolt.

3. Install a clamping ring to water outlet pipe, and insert the pipe into the corresponding branch of heater steel pipe. Adjust the position of clamping ring so that the center of clamping ring is aligned with the center of water outlet pipe end T-shaped mark, and tighten clamping ring with clamp pliers.

Caution
• When turbocharger cooling water outlet pipe is connected with heater steel pipe, you can apply a small amount of lubricant as necessary, and the same type of engine coolant can be used as lubricant.

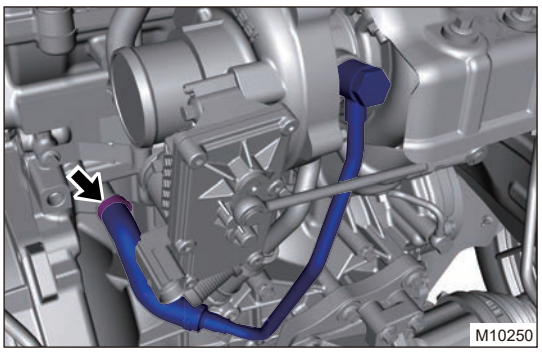
4. Install the turbocharger.
5. Install the intake hose assembly.
6. Install the air filter assembly.
7. Add the antifreeze.
8. Install the engine compartment trim cover assembly.

Turbocharger Water Inlet Pipe Assembly

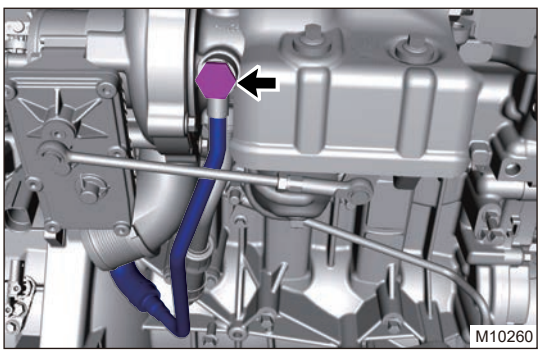
Removal

Warning
• Before removing turbocharger water inlet pipe assembly, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury. • Be sure to wear safety equipment to prevent accidents, when removing turbocharger water inlet pipe assembly. • Appropriate force should be applied, when removing turbocharger water inlet pipe. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Remove the intercooler intake pipe Ⅰ assembly.
5. Drain the coolant.
6. Loosen clamping ring and disconnect connection between water inlet pipe and cylinder block pipe joint.



7. Remove 1 hollow bolt between water inlet pipe and turbocharger water inlet. Remove the copper washer carefully.



8. Remove the turbocharger water inlet pipe assembly carefully.

Installation

1. Install a clamping ring to cylinder block pipe joint, insert water inlet pipe hose until the limiter of cylinder block pipe joint. Adjust the water pipe so that T-shaped mark faces towards rear end surface of engine. And then adjust the position of clamping ring so that the center of clamping ring is aligned with the center of water inlet pipe T-shaped mark, and tighten clamping ring with clamp pliers.

Caution
• When turbocharger water inlet pipe is connected with cylinder block pipe joint, you can apply a small amount of lubricant as necessary, and the same type of engine coolant can be used as lubricant.

2. Install a washer to hollow bolt, insert the bolt into water inlet pipe ball type joint, install a washer again on the hollow bolt, then screw the bolt into the corresponding threaded hole of turbocharger. And tighten it.

   Torque: 40 ± 2 N·m

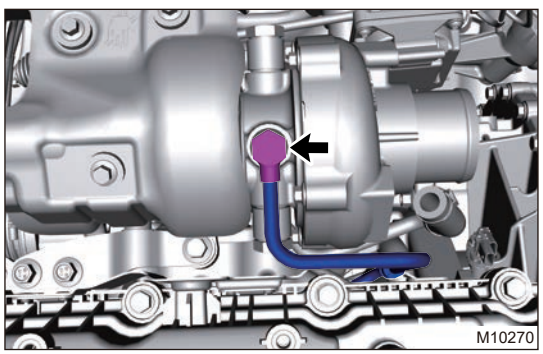
3. Install the intercooler intake pipe Ⅰ assembly.
4. Add the coolant.
5. Install the engine compartment trim cover assembly.

Turbocharger Oil Inlet Pipe Assembly

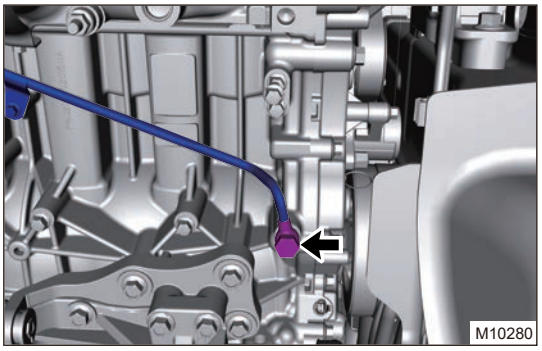
Removal

Warning
• Before removing turbocharger oil inlet pipe assembly, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury. • Be sure to wear safety equipment to prevent accidents, when removing turbocharger oil inlet pipe assembly. • Appropriate force should be applied, when removing turbocharger oil inlet pipe assembly. Be careful not to operate roughly.

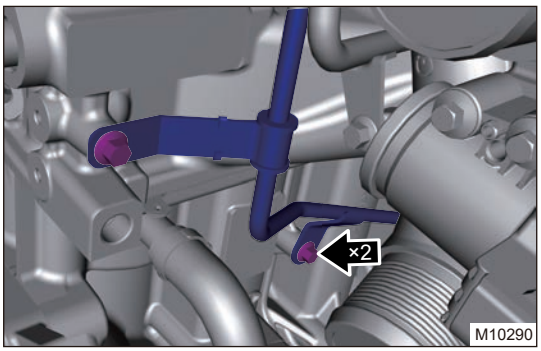
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Remove the air filter assembly.
5. Remove the intake hose assembly.
6. Remove the rear right mounting connecting rod assembly.
7. Remove the rear right mounting cushion assembly.
8. Remove 1 hollow bolt between oil inlet pipe and turbocharger oil inlet. Remove the copper washer carefully.



9. Remove 1 hollow bolt between oil inlet pipe and cylinder block. Remove the copper washer carefully.



10. Remove 2 fixing bolts from oil inlet pipe assembly bracket.



11. Remove the turbocharger oil inlet pipe assembly carefully.

Installation

1. Install a washer to hollow bolt, insert the bolt into oil inlet pipe ball type joint, install a washer again on the hollow bolt, then screw the bolt into the corresponding threaded hole of turbocharger. Screw in 3 teeth at least and do not screw it fully.

   Torque: 25 + 5 N·m

2. Install 2 fixing bolts to oil inlet pipe assembly bracket, screw in 3 teeth at least and do not screw it fully.

   Torque: 8 + 3 N·m

3. Install a washer to hollow bolt, insert the bolt into oil inlet pipe ball type joint, install a washer again on the hollow bolt, then screw the bolt into the corresponding threaded hole of cylinder block. Screw in 3 teeth at least and do not screw it fully.

   Torque: 25 + 5 N·m

Caution
• Tighten the hollow bolts at both ends of the oil inlet pipe assembly according to torque requirements first, and then tighten 2 fixing bolts of oil inlet pipe bracket.

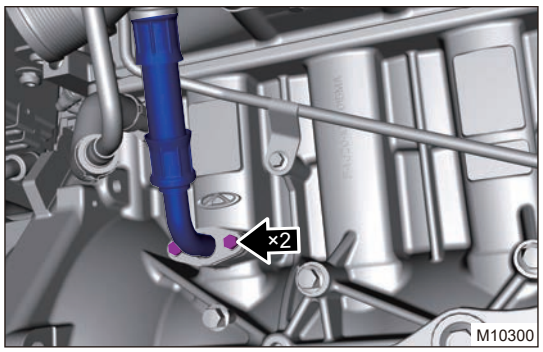
4. Install the rear right mounting cushion assembly.
5. Install the rear right mounting connecting rod assembly.
6. Install the intake hose assembly.
7. Install the air filter assembly.
8. Refill the oil to a proper position.
9. Install the engine compartment trim cover assembly.

Turbocharger Oil Return Pipe Assembly

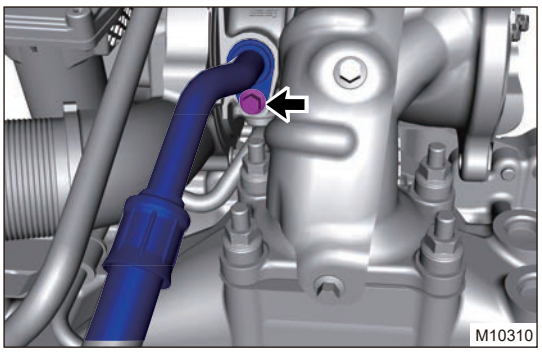
Removal

Warning
• Before removing turbocharger oil return pipe assembly, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury. • Be sure to wear safety equipment to prevent accidents, when removing turbocharger oil return pipe assembly. • Appropriate force should be applied, when removing turbocharger oil return pipe assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine lower protector assembly.
3. Remove the rear right mounting connecting rod assembly.
4. Remove the rear right mounting cushion assembly.
5. Remove 2 fixing bolts between oil return pipe assembly and cylinder block. Remove the washer carefully.



6. Remove 1 fixing bolt between oil return pipe assembly and turbocharger. Remove the oil return pipe assembly from turbocharger oil return hole carefully.



Installation

1. Dip a small amount of oil on the oil return pipe seal ring (oil type is consistent with engine oil), rotate and insert the end with seal ring into oil return hole in the middle of turbocharger. Screw 1 fixing bolt in 3 teeth at least and do not screw fully.

   Torque: 8 + 3 N·m

2. Install 2 bolts to oil return pipe mounting holes, install the washer and screw 2 bolts into oil return flange mounting holes of cylinder block. Screw in 3 teeth at least and do not screw it fully.

   Torque: 8 + 3 N·m

Caution
• Tighten 2 fixing bolts between oil return pipe and cylinder block side according to torque requirements first, and tighten 1 fixing bolt between oil return pipe and turbocharger side.

3. Install the rear right mounting cushion assembly.
4. Install the rear right mounting connecting rod assembly.
5. Refill the oil to a proper position.
6. Install the engine lower protector assembly.

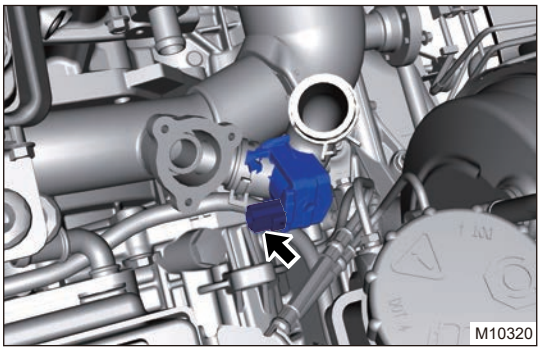
Relief Control Solenoid Valve

Removal

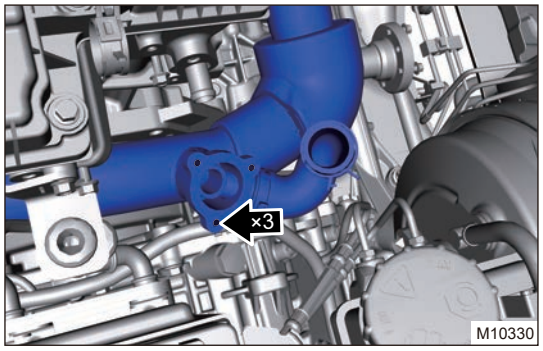
Warning
• Before removal of pressure discharge control solenoid valve assembly, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury. • Be sure to wear safety equipment to prevent accidents, when removing relief control solenoid valve assembly. • Appropriate force should be applied, when removing relief control solenoid valve assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Remove the engine compartment trim cover assembly.
4. Remove the intake hose assembly.

5. Disconnect the relief control solenoid valve connector.



6. Remove 3 fixing bolts from relief control solenoid valve.



7. Remove the relief solenoid valve assembly.

Installation

1. Install relief control solenoid valve and tighten 3 fixing bolts.
   Torque: 8 + 3 N·m
2. Connect the relief control solenoid valve connector.
3. Install the intake hose assembly.
4. Install the engine compartment trim cover assembly.

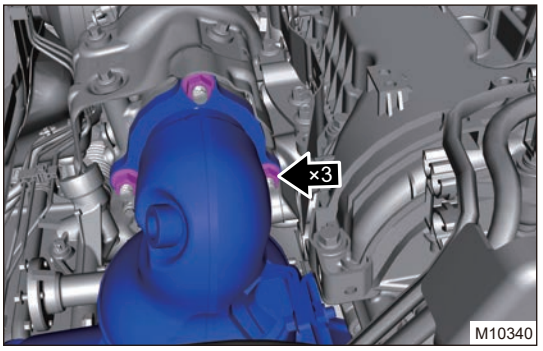
Precatalytic Converter Assembly

Removal

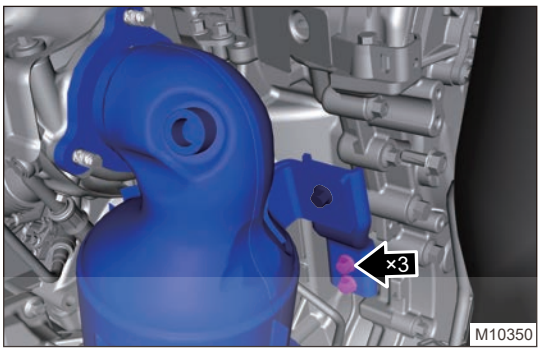
Warning
• Temperature of exhaust system is very high when engine is running. Before removal, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury. • Be sure to wear safety equipment to prevent accidents, when removing precatalytic converter assembly. • Appropriate force should be applied, when removing the precatalytic converter assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Remove the engine compartment trim cover assembly.
4. Remove the engine lower protector assembly.
5. Remove the upstream oxygen sensor.

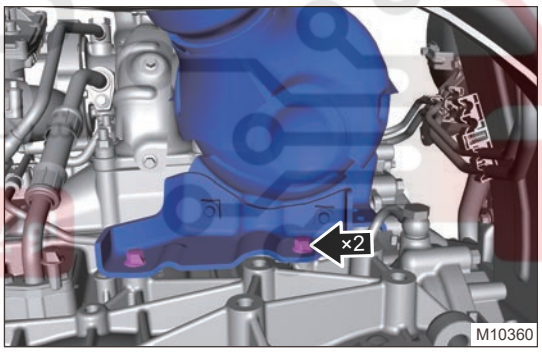
6. Remove 3 fixing nuts between precatalytic converter and turbocharger.



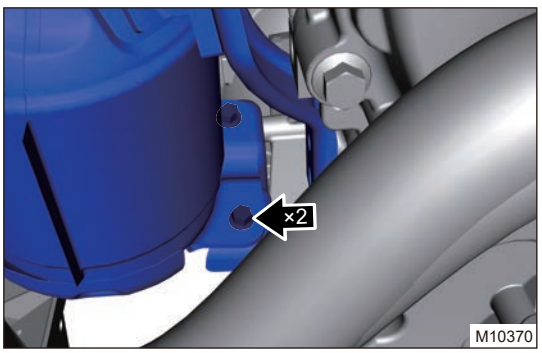
7. Remove 1 coupling bolt between precatalytic converter upper bracket and precatalytic converter.
8. Removal 2 fixing bolts between precatalytic converter upper bracket and cylinder block. Remove the precatalytic converter upper bracket.



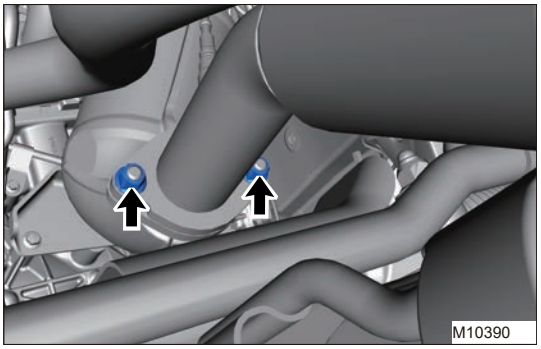
9. Remove 2 coupling bolts between bracket and cylinder block.



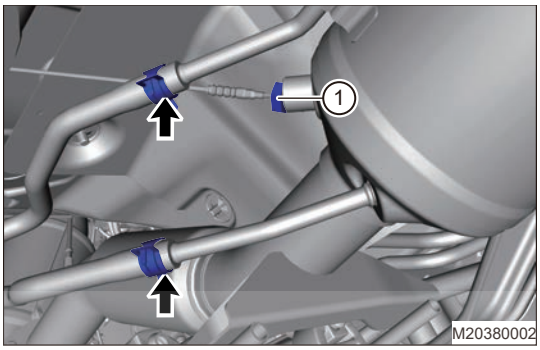
10. Remove 2 coupling bolts between bracket and precatalytic converter. Remove the bracket.



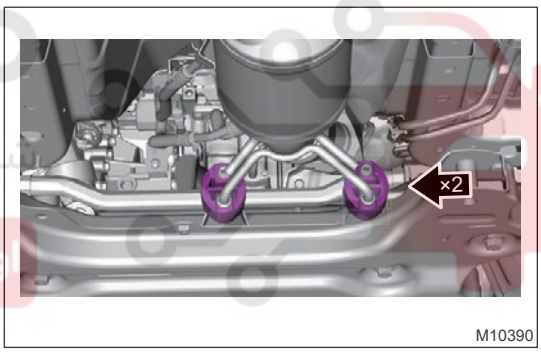
11. Remove 2 coupling nuts between precatalytic converter and front muffler.



12. Loosen 2 elastic clamps (arrow) and separate hose from pipe.
13. Remove the exhaust temperature sensor (1).



14. Disconnect 2 connections between precatalytic converter and body hook.



15. Remove the precatalytic converter assembly carefully and slowly.

Installation

1. Install and move the precatalytic converter to a proper position so that the corresponding studs of turbocharger are inserted into three holes of precatalytic converter. Meanwhile, they are inserted into two mounting holes of front muffler. And install and pre-tighten nuts at both ends.
2. Connect the precatalytic converter and body hook.
3. Install the precatalytic converter upper bracket, and tighten it to 2 fixing bolts of cylinder block.
   Torque: 25 ± 5 N·m
4. Install the bracket, and pre-tighten 2 fixing bolts to cylinder block.
5. Tighten 3 coupling nuts between precatalytic converter and turbocharger.
   Torque: 45 ± 5 N·m

6. Tighten 2 coupling bolts between precatalytic converter and bracket.
   Torque: 25 ± 5 N·m

7. Tighten 1 coupling bolt between precatalytic converter and upper bracket.
   Torque: 25 ± 5 N·m

8. Tighten 2 coupling bolts between bracket and cylinder block.
   Torque: 25 ± 5 N·m

9. Tighten 2 coupling nuts between precatalytic converter and front muffler.
   Torque: 45 ± 5 N·m

10. Install the upstream oxygen sensor.
11. Install the engine lower protector assembly.
12. Install the engine compartment trim cover assembly.
13. Install the negative battery cable.

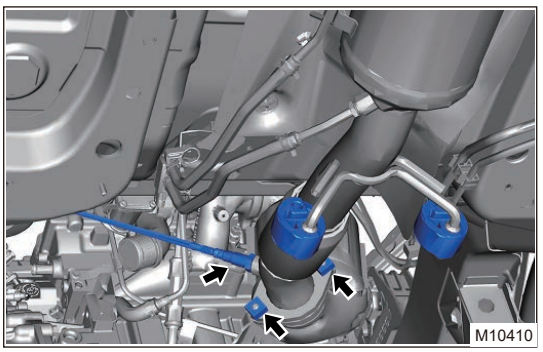
Front Muffler Assembly

Removal

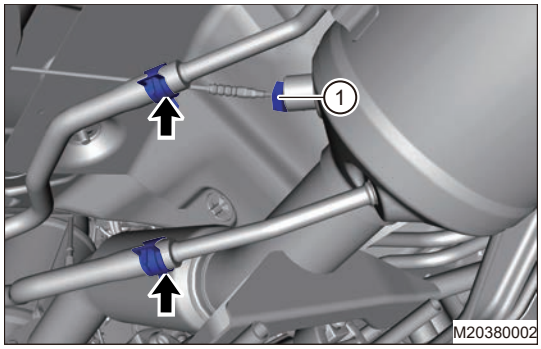
Warning
• Temperature of exhaust system is very high when engine is running. Before removal, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury. • Be sure to wear safety equipment to prevent accidents, when removing front muffler assembly. • Appropriate force should be applied, when removing the front muffler assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.

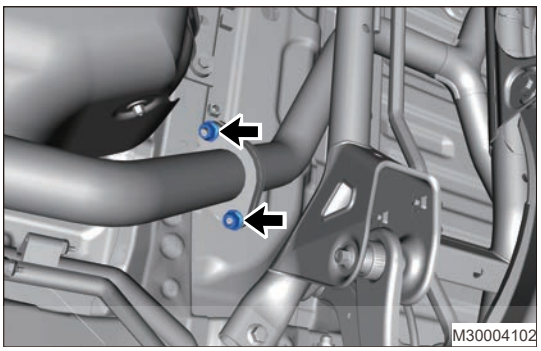
3. Remove 2 coupling nuts between precatalytic converter and front muffler.
4. Disconnect the downstream oxygen sensor connector.



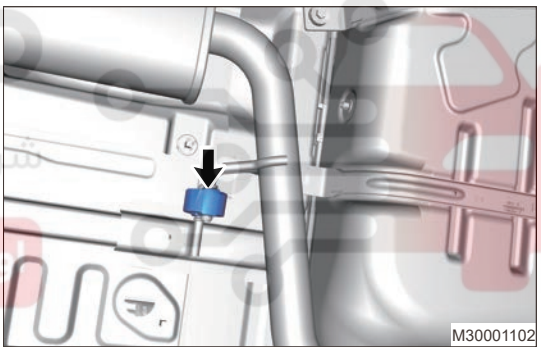
5. Loosen 2 elastic clamps (arrow) and separate hose from pipe.
6. Remove the exhaust temperature sensor (1).



7. Remove 2 coupling nuts (arrow), then disconnect connection between front muffler assembly and rear muffler assembly, and remove gasket from connecting part.



8. Separate the diamond shaped hanger block (arrow) between front muffler assembly and body hook.



9. Remove the front muffler assembly carefully.

Installation

1. Install and move the front muffler to a proper position so that 2 holes of front muffler are inserted into the corresponding mounting holes of pre-catalytic converter. Meanwhile, they are inserted into two mounting holes of rear muffler. And install and tighten nuts at both ends.

   Torque: 45 ± 5 N·m

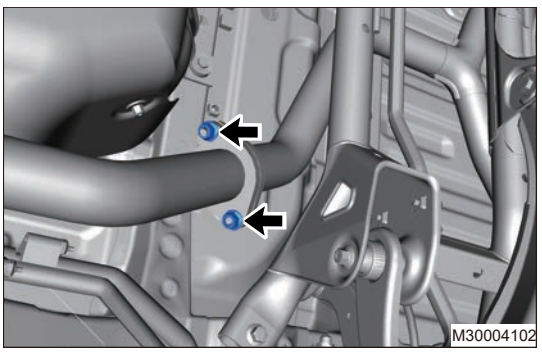
2. Connect the front muffler and body hanger block.

Rear Muffler Assembly

Removal

Warning
• Temperature of exhaust system is very high when engine is running. Before removal, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury. • Be sure to wear safety equipment to prevent accidents, when removing rear muffler assembly. • Appropriate force should be applied, when removing the rear muffler assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Remove 2 fixing nuts between front muffler and rear muffler.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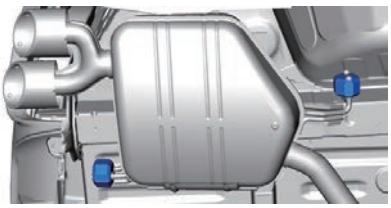
4. Disengage 4 fixing hanger blocks from rear muffler assembly.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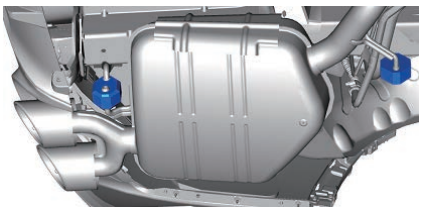
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5. Remove the rear muffler assembly carefully.

Installation

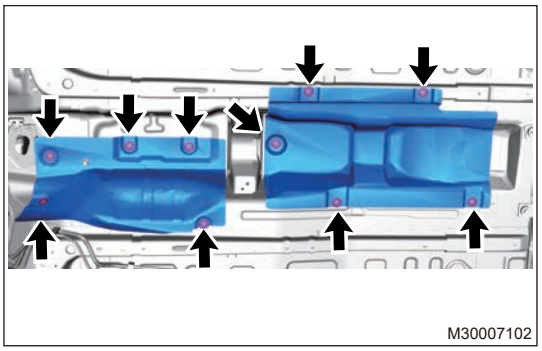
1. Install the 4 fixing hanger blocks on rear muffler.
2. Tighten 2 fixing nuts between rear muffler and front muffler.
   Torque: 45 ± 5 N·m

Center Passage Heat Insulator

Removal

Warning
• Temperature of exhaust system is very high when engine is running. Before removal, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury. • Be sure to wear safety equipment to prevent accidents, when removing center passage heat insulator assembly. • Appropriate force should be applied, when removing the center passage heat insulator assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Remove the front muffler assembly.
4. Remove 10 clamping washers from muffler heat insulator.



5. Remove the center passage heat insulator.

Installation

1. Installation is in the reverse order of removal.

Ignition System

Warnings and Precautions

Warnings

In order to avoid possible property loss, personal injury or death, always follow the instructions below before repair:

1. It is prohibited to use short circuit spark test to test ignition function during repair, otherwise it may damage the module.
2. During using, do not remove ignition coil from spark plug with bare hands with power on, and do not contact the metal part and rubber guide rod directly, to avoid electric shock.
3. Make sure that ground wire of ignition coil assembly is short to the nearest GND separately from ECU and other electrical device to reduce signal interfere as possible.
4. Ensure that connector or wire harness has no damage; the wire harness connector is connected correctly. Ensure that wire harness and connector have no short circuit or poor contact.

Precautions

In order to avoid dangerous operation and damage to the vehicle before repair in this section, always follow the instructions below before repair:

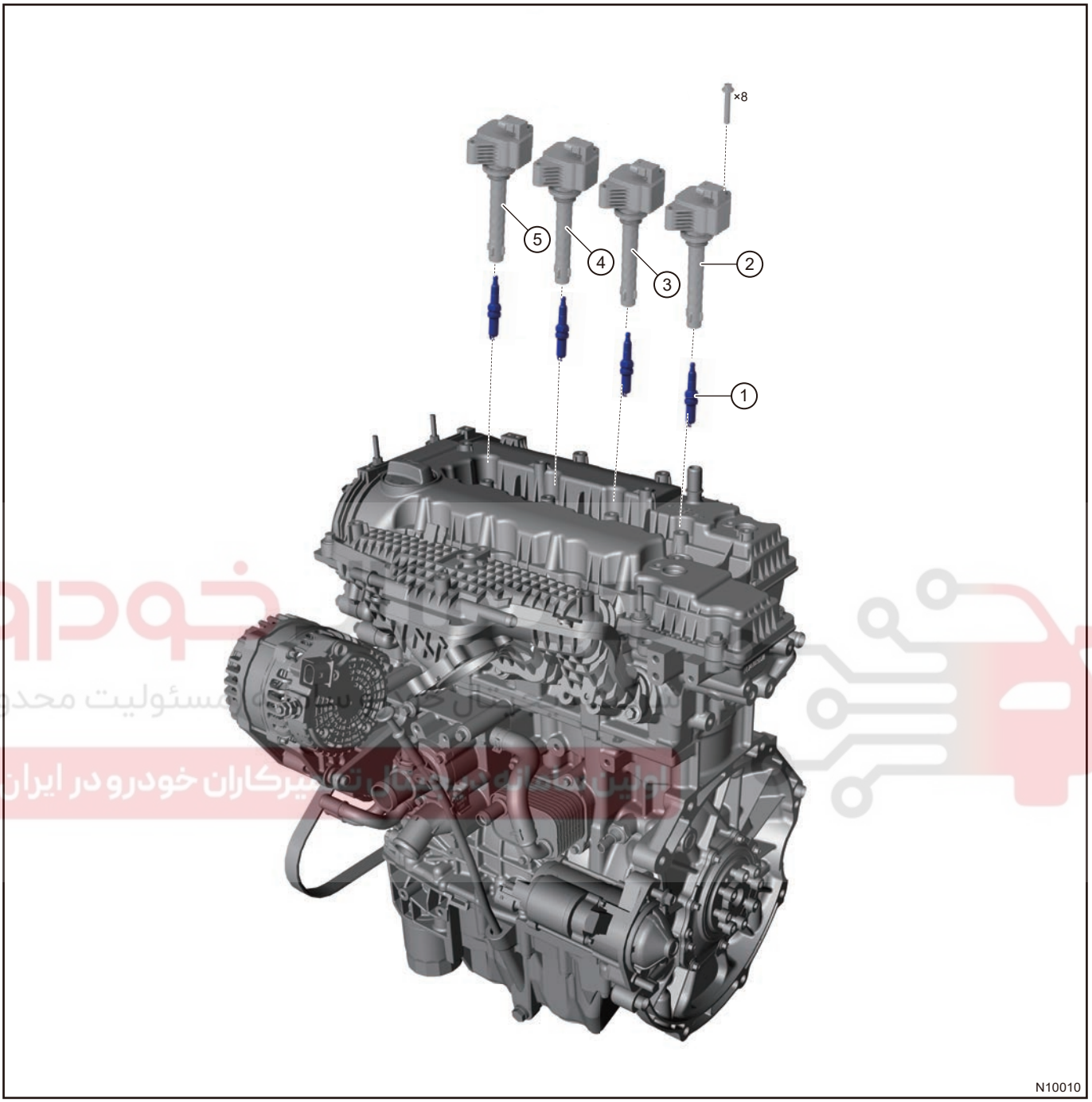
1. DO NOT remove the spark plugs when engine is hot; failure to do this may cause damage to the spark plug thread holes on cylinder head.
2. When installing spark plug and ignition coil, check if there is impurities in cylinder head mounting holes, and if the inner wall is smooth.
3. Do not make paint mark on spark plug assembly ceramic body. If there is paint or other organic mark, it is necessary to clean. Never apply grease such as lubricant and anti-rust oil etc. on spark plug assembly. If so, it is required to clean it.
4. Before removal, remove the dirt and foreign matter around ignition coil and ignition coil mounting hole to prevent them from dropping into cylinders.
5. After removing or when replacing ignition coil, do not place ignition coil on the ground or other dusty places, otherwise, dust or foreign matter may enter rubber guide and lead to ignition coil failure.
6. When replacing spark plug, remove and install ignition coil carefully. Do not rotate ignition coil (avoid scratching rubber guide).
7. Do not separate ignition coil rubber guide and ignition coil body. If so, it may cause the decrease of seal performance and fuel gas enter and corrode inner structure when reinstalling.

System Overview

System Description

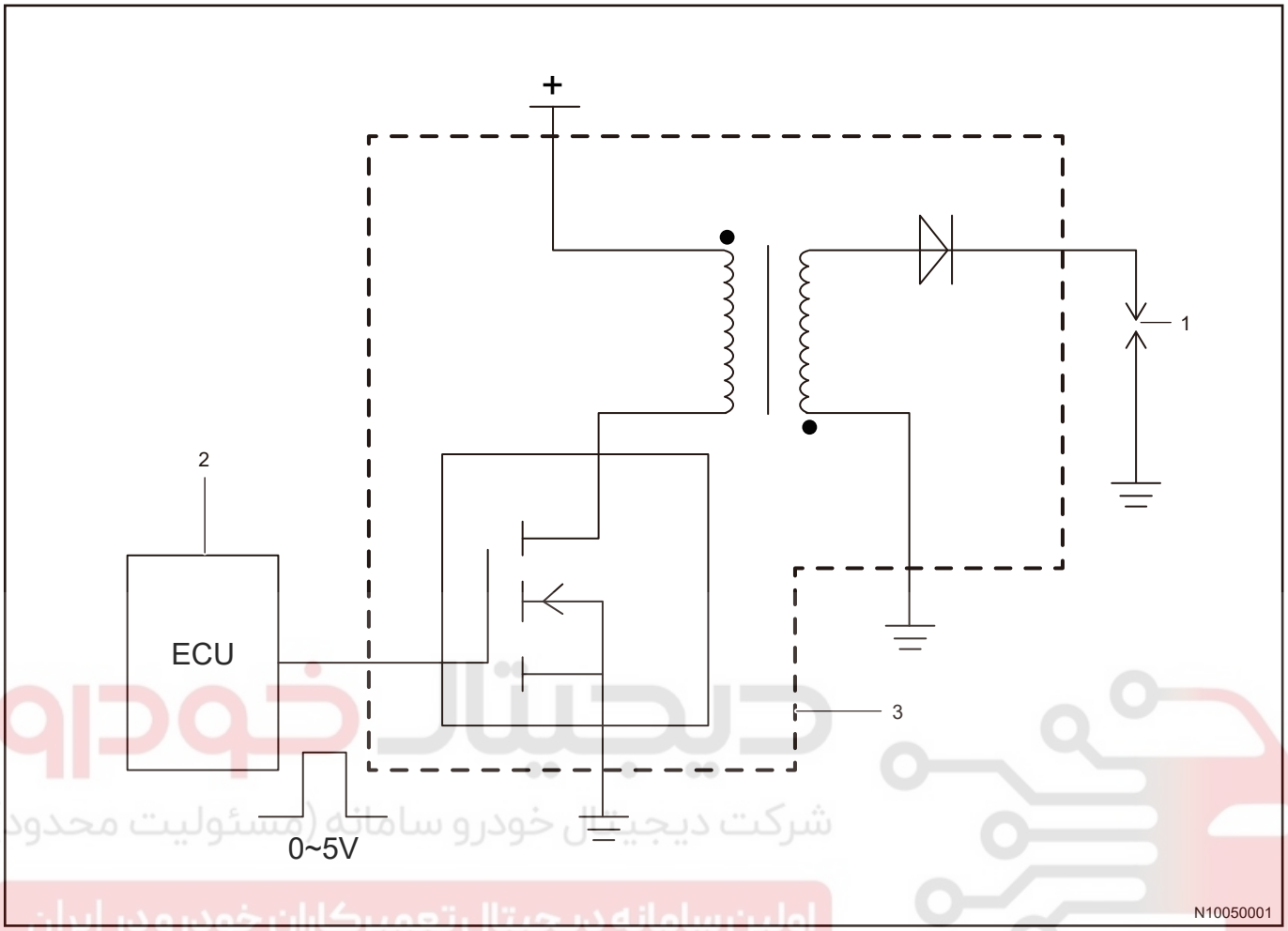
Ignition system mainly consists of sensors, engine control module, ignition coils (integrated drive module can not be disassembled), spark plugs, etc.Ignition coil integrated drive module uses 4-line coil-on-plug system, and has over current and overtime protection function.The secondary (secondary high-voltage terminal) of each ignition coil is connected to spark plugs in engine cylinder respectively via high-voltage damping anti-interference rubber connecting rod. Ignition coil primary (original low-voltage terminal) is controlled by the internal integrated drive module via the pulse signal command issued by the engine control module (working state: power on, power off)Engine control module receives the top dead center position of each cylinder piston via camshaft position sensor, and uses the speed sensor signal to issue pulse drive command. Correct ignition advance angle according to knock sensor signal. Make its ignition system can operate normally.

System Components Diagram



1	Spark Plug	4	Cylinder 2 Ignition Coil Assembly
2	Cylinder 4 Ignition Coil Assembly	5	Cylinder 1 Ignition Coil Assembly
3	Cylinder 3 Ignition Coil Assembly		

System Schematic Diagram



1	Spark Plug	3	Ignition Coil
2	Engine Control Unit		

System Components Description

Ignition Coil

Ignition coil consists of primary winding, secondary winding, integrated module, iron core and housing etc.When the ground circuit of a primary winding is on, this primary winding starts charging (magnetizing). When ECU cut off pulse signal (high level to low level) circuit, charging (-magnetizing) is terminated. At this time, high voltage will be induced in the secondary winding by the magnetic field coupling. In the process of passing the spark plug circuit, the spark plug will discharge (ignition).

Spark Plug

Spark plug consists of wired nut, insulator ceramic body, wired screw, central electrode, side electrode (the side electrode is wield to case) and case.The high-voltage current passes through the center electrode of the spark plug to the side electrode ,which forms a circuit. In this process, the high-voltage current break through the air to produce sparks, that is, ignite the combustible mixture in the cylinder.

Diagnosis & Testing

Problem Symptoms Table

Hint:
Use symptoms table below to help determine cause of problem. Check each suspected area in sequence. Repair, replace or adjust faulty components as necessary.
Ignition system

Symptom	Possible Cause
Stall	Ignition Coil
	Camshaft position sensor
	Spark Plug
	Intake camshaft phaser control valve
	Exhaust camshaft phaser control valve
	Wire harness
	ECU
Knock	Ignition Coil
	Knock sensor
	ECU
Difficult to start	Battery
	Ignition Coil
	Spark Plug
	Engine speed sensor
Engine hesitation, power drop, unstable performance	Ignition Coil
	Intake camshaft phaser control valve
	Exhaust camshaft phaser control valve
	Engine speed sensor
	Spark Plug

Symptom	Possible Cause
	Camshaft position sensor
	ECU

Spark Plug Common Problems

Normal

Spark plug porcelain small end is between white and yellowish, gray or brownish.Air-fuel ratio and ignition time are normal, there is no misfire, and cold-start enriching function is normal.

Carbon Accumulation

A layer of velvety black charcoal smoke attaches on the insulator small end, electrode and spark plug body		
Cause	Result	Treatment
Mixture is excessively rich due to improper adjustment of air fuel mixture.	Poor starting ability	Check air filter and adjust air-fuel ratio and cold starting system.
Traveling distance of vehicle is too short, engine temperature is low, and combustion is incomplete.		
Fuel quality is poor or fuel deteriorates, fuel is abnormal.		
Spark plug type is incorrect.		

Oil Dirt

A layer of black oily charcoal smoke and dirt attach on the insulator small end, electrode and spark plug body		
Cause	Result	Treatment
Piston ring has bad elasticity or is worn excessively, and oil breaks into combustion chamber.	Difficult to start.	Check and repair engine, or replace spark plug.
Excessive matching clearance between piston skirt and cylinder wall causes oil breaking and air leakage.		
Air leakage occurs due to incorrect installation of piston ring in direction of inside and outside tangent angle, causing oil breaking into combustion chamber.		
Excessive clearance occurs between valve stem and valve guide due to excessive wear, or valve guide oil seal fails, causing oil leakage.		
Oil level is too high and oil breaks into combustion chamber.		

Lead Deposits

Brownish yellow enamels or greenish deposits exist on the insulator small end		
Cause	Result	Treatment
The fuel additive contains lead, when engine runs under high load conditions with throttle partially opened for a long time, enamel is formed.	Causing misfire	Replace spark plug.

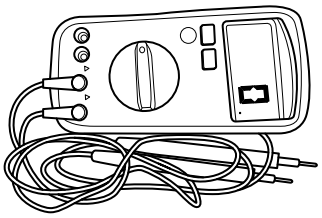
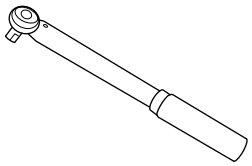
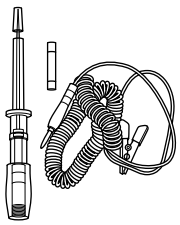
Red Deposits

There are severe red brown deposits on insulator skirt and electrodes, and clear radial discharge traces can be seen on the surface of insulator small end		
Cause	Result	Treatment
In the unleaded gasoline, Mn-based anti-riot agent MMT is used instead of lead tetraethyl, the oxide of Mn after combustion adheres on the surface of insulator and electrode.	At high temperature, these deposits are easily conductive, resulting in flashover on insulator skirt surface, unstable combustion, high engine speed, and jitter under heavy load conditions.	Use qualified fuel, replace spark plug.

On-Vehicle Service

Tools

General Tools

Tool Name	Tool Drawing
Digital multimeter	 S00002
5 - 25 N·m Torque Wrench	 S00079
LED Test Light	 S00077

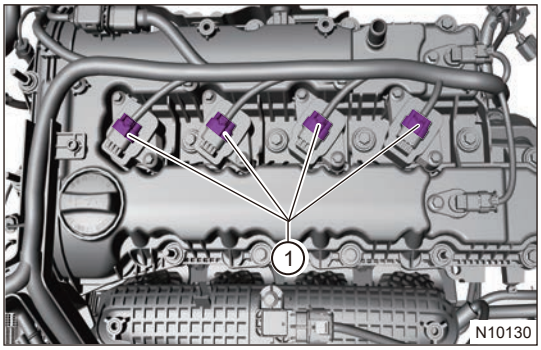
Ignition Coil Assembly

Removal

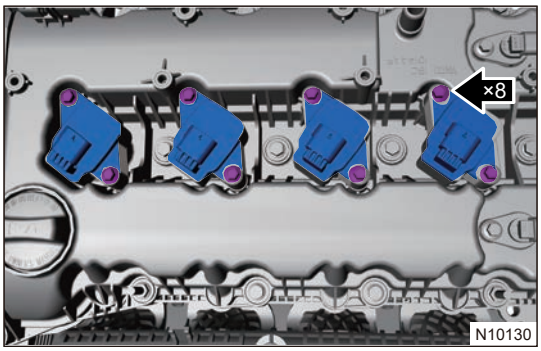
Warning
• Appropriate force should be applied, when removing ignition coil assembly. Be careful not to operate roughly. • It is prohibited to use short circuit spark test to test ignition function during repair, otherwise it may damage the module. • During using, do not remove ignition coil from spark plug with bare hands with power on, and do not contact the metal part and rubber guide rod directly, to avoid electric shock.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Remove the engine trim cover.

5. Disconnect the ignition coil assembly connectors (1), and move away the wire harness connectors from ignition coil.



6. Remove 8 fixing bolts from ignition coil assembly with an 8# socket wrench.



7. Remove the ignition coil assembly.

Caution
• After removing ignition coil, do not place ignition coil on the ground or other dusty places, otherwise, dust or foreign matter may enter rubber guide and torsion ignition coil failure. • Remove ignition coil carefully. Do not rotate ignition coil (avoid scratching rubber guide). • Do not separate ignition coil rubber guide and ignition coil body. If so, it may cause the decrease of seal performance and air oil enter and corrode inner structure when reinstalling.

Inspection

Caution
• It is prohibited to use short circuit spark test to test ignition coil performance, otherwise it may cause damage to electronic controller. • During inspection, do not remove ignition coil from spark plug with bare hands with power on, and do not contact the metal part and rubber guide rod directly, to avoid electric shock.

Terminal	Terminal Definition
1	Ground
2	Ground

Terminal	Terminal Definition
3	Power supply
4	Pulse drive signal

1. Use a digital multimeter to measure if ignition coil power supply/ground is normal.
2. Use LED test light to measure the pulse drive signal of ignition coil and obverse if LED test light flashes.
3. The ignition coil assembly can be exchanged for each cylinder to judge if the ignition coil assembly is in good condition.

Installation

Caution
• Make sure that ground wire of ignition coil assembly is short to the nearest GND separately from ECU and other electrical device to reduce signal interfere as possible. • Ignition coil assembly rubber guide rod end is applied with specified grease of its self, which can help in assembly of ignition coil assembly and spark plug assembly. Do not remove it arbitrarily. • Make sure that the connection of ignition coil high-voltage output terminal and spark plug is reliable, or it may cause high-voltage leakage, resulting in poor ignition. • Before installation, check the mounting hole of cylinder head spark plug, and no impurities can be brought in during assembly. • Install the ignition coil into cylinder head cover mounting hole and press it to close to mounting boss on cylinder head cover. Never turn ignition coil to left/right after pressing and do not tap ignition coil with a hammer etc. • To prevent accidental scratches to ignition coil assembly, do not allow sharp edge to contact with rubber guide rod under ignition coil assembly during installation.

1. Install 8 fixing bolts on ignition coil assembly.
   Torque: 8 ± 3 N·m
2. Connect the ignition coil assembly connector.
3. Install the engine trim cover.
4. Install the engine compartment trim cover assembly.

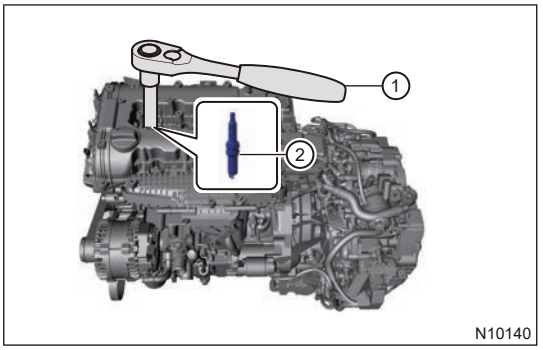
Spark Plug Assembly

Removal

Warning
• Be sure to wear safety equipment to prevent accidents, when removing spark plug. • Appropriate force should be applied when removing spark plug. Be careful not to operate roughly. • DO NOT remove the spark plugs when engine is hot; failure to do this may cause damage to the spark plug thread holes on cylinder head. • Before removal, remove the dirt and foreign matter around spark plug holes to prevent them from dropping into cylinders.

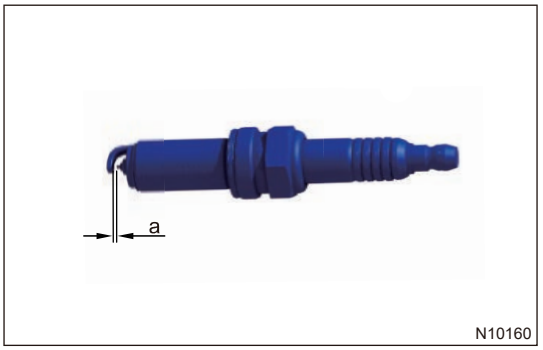
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Remove the engine trim cover.
5. Remove the ignition coil assembly.

6. Using a special spark plug socket ratchet wrench (1), loosen the spark plug.
7. Remove the spark plug (2).



Inspection

1. Check the spark plug gap a: 0.7 - 0.8 mm
   - It is not necessary to adjust the gap

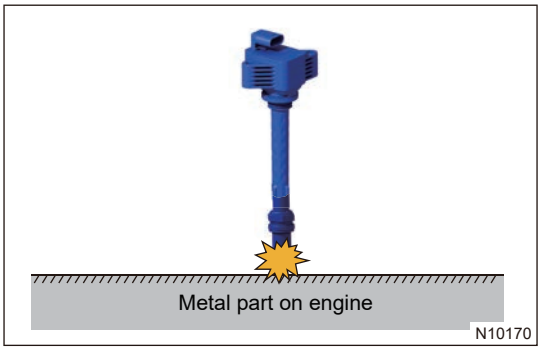


Spark Jump Test Method

1. Remove the spark plug from engine and connect it to high-voltage cable, put the spark plug case 5 - 7 mm away from engine body and start vehicle to check the spark jump.

Warning
• Always disconnect the injector circuit before test to avoid injection during spark jump test.

2. If there is a thick spark with blue-white color and popping occurs between spark plug and engine body and also spark generated between center electrode and side electrode, that indicates ignition system is normal.



3. If the spark is red and short or there is no spark, check ignition coil, circuit and ECU.

Installation

Caution
• Check the spark plug type to confirm if it is suitable. • Check if there is impurities in cylinder head mounting holes, the inner wall is smooth. • Do not make paint mark on spark plug assembly ceramic body. If there is paint or other organic mark, it is necessary to clean. Never apply grease such as lubricant and anti-rust oil on spark plug assembly. If so, it is required to clean it. • Please install spark plug with a special spark plug socket, and never damage the normal spark plug gap. • Avoid to install the spark plug from higher position from mounting hole during installation to prevent spark plug side electrode gap from damaging, resulting in poor ignition. • Always tighten the spark plug according to specified torque using a torque wrench when installing it.

1. Install 4 spark plugs respectively into the cylinder head mounting holes for pre-tightening tighten, and then retighten the spark plugs with a torque wrench.

   Torque: 20 ± 3 N·m

2. Install the ignition coil assembly.
3. Install the engine trim cover.
4. Install the engine compartment trim cover assembly.

Emission Control System

Warnings and Precautions

Warnings

In order to avoid possible property loss, personal injury or death, always follow the instructions below before repair:

1. Temperature in engine compartment is very high when engine is running. Before removal, you must make sure that engine has shut off, and engine compartment has cooled down sufficiently, otherwise, there is a risk of scald injury.
2. Temperature of exhaust system is very high when engine is running. Before removal, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury.

Precautions

In order to avoid dangerous operation and damage to the vehicle before repair in this section, always follow the instructions below before repair:

1. Specified grease must be used and use of other grease will lead to oxygen sensor poisoning. New parts has been applied with grease and grease must be applied on mounting threads during reassembly.
2. Unneeded activated charcoal canister assembly should be handled by the specialized department according to local laws and regulations. Never discard it at will.
3. If the oxygen sensor falls, never pick it up to install and it needs to return to factory for testing.

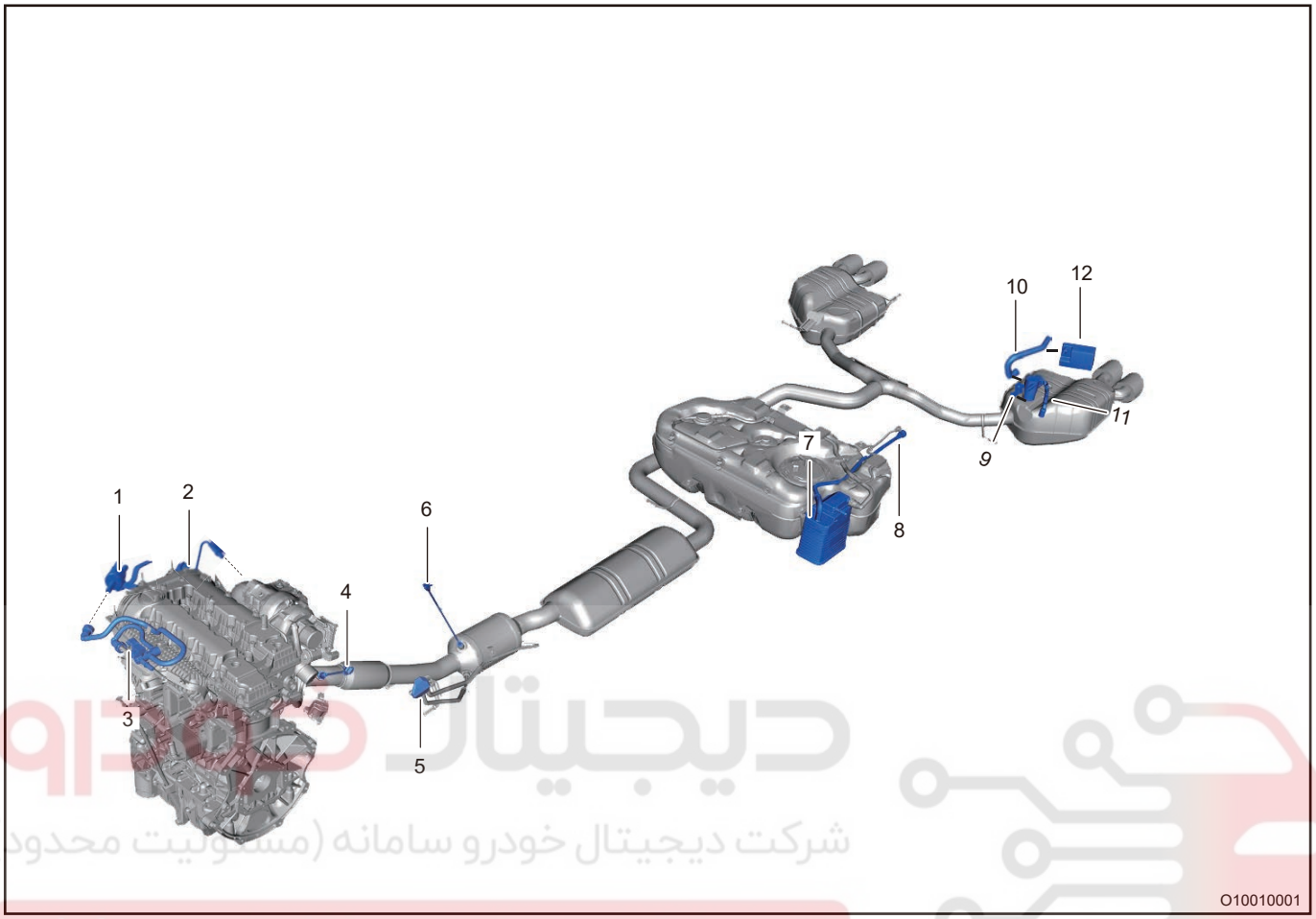
System Overview

System Description

Emission control system includes: Fuel vapor recovery/leakage diagnosis system, exhaust emission conversion system, Gasoline Particulate Filter (GPF) system and crankcase forced ventilation system.

1. The function of fuel vapor recovery/leakage diagnosis system: Fuel vapor (HC) is recovered and inhaled into engine cylinder for combustion, which can reduce emission and improve fuel economy. According to National VI regulation, fuel vapor recovery system adds leakage diagnosis function, the generated fuel vapor is not allowed to leak into atmosphere in the process of recovery, desorption and refilling etc. The system judge whether it leaks according to leakage diagnosis test. Once leakage occurs, the system will turn on malfunction light to warn and avoid polluting environment.
2. The function of exhaust emission conversion system: Through front and rear oxygen sensors determine whether oxygen is excess (namely oxygen content) in exhaust gas after engine combustion, convert oxygen content into voltage signal and transmit to alternator computer, then engine can realize closed-loop control which aims at excess air coefficient. Make sure three-way catalytic converter can convert harmful gases such as CO, HC and NOX from exhaust gas into harmless carbon dioxide, water and nitrogen by oxidation and reduction. Avoid polluting environment.
3. The function of Gasoline Particulate Filter (GPF) system: According to National VI regulation, GPF is added in order to avoid the emission of gasoline particulates, which can reduce the particulates leaked into the air and avoid polluting environment.
4. The function of crankcase forced ventilation system: The air in cylinder leaks into crankshaft space during normal engine operation. The leaked air contains unburned fuel and all exhaust air contents, which will cause the deterioration of lubricant and increase of crankshaft pressure and temperature. In order to avoid this, the gas leaked into crankshaft is inhaled into cylinder for combustion and recover HC, which reduces the air pollution.

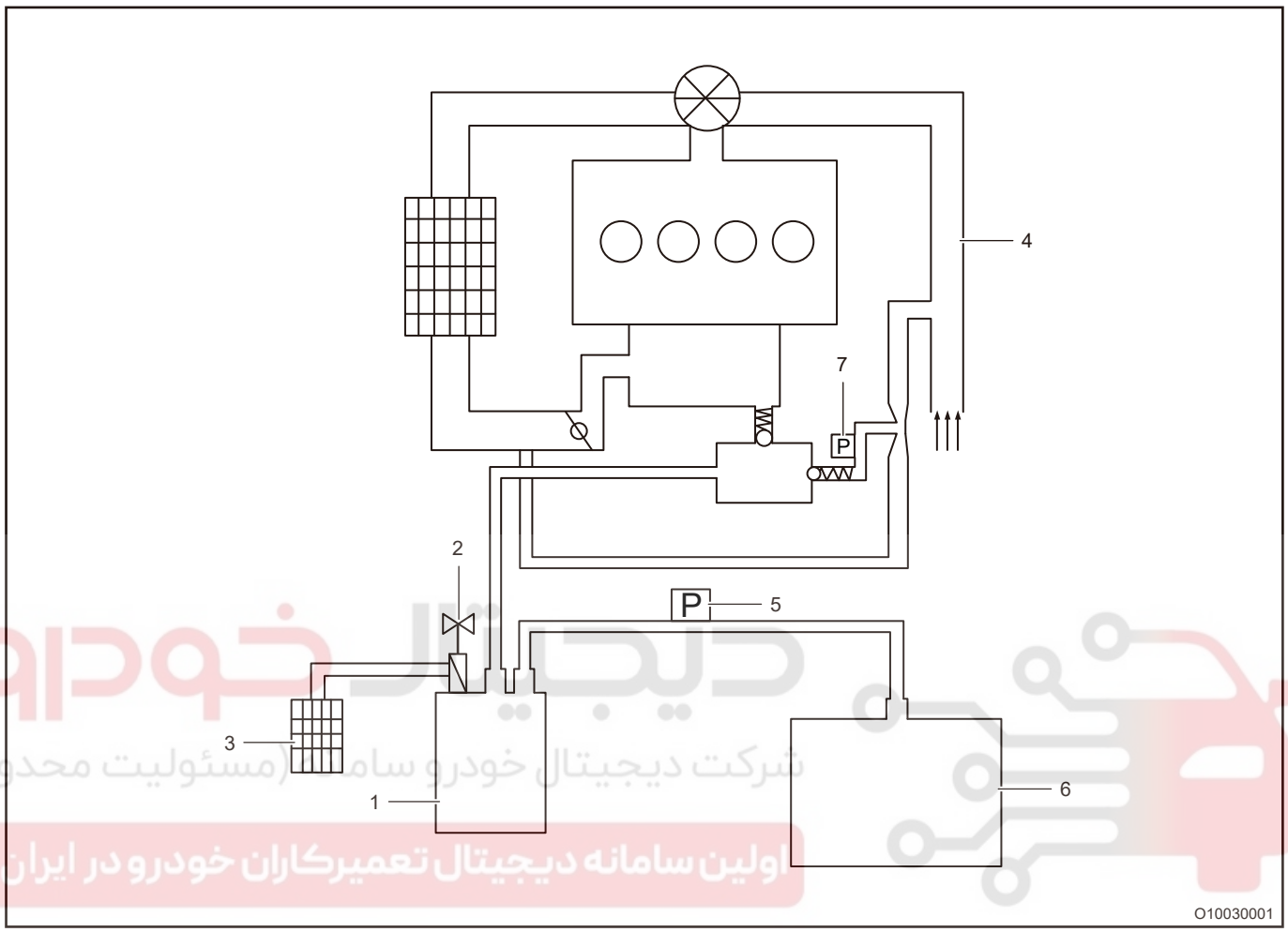
System Components Diagram



1	Canister Solenoid Valve Assembly	7	Activated Charcoal Canister Assembly
2	Upstream Oxygen Sensor	8	Activated Charcoal Canister Breather Pipe Assembly
3	Canister Solenoid Valve Outlet Pipe	9	Canister Cut-off Valve Bracket
4	Downstream Oxygen Sensor	10	Activated Charcoal Canister Breather Pipe III Assembly
5	Differential Pressure Sensor	11	Activated Charcoal Canister Breather Pipe II Assembly (With Canister Cut-off Valve)
6	Exhaust Temperature Sensor	12	Activated Charcoal Canister Filter

System Schematic Diagram

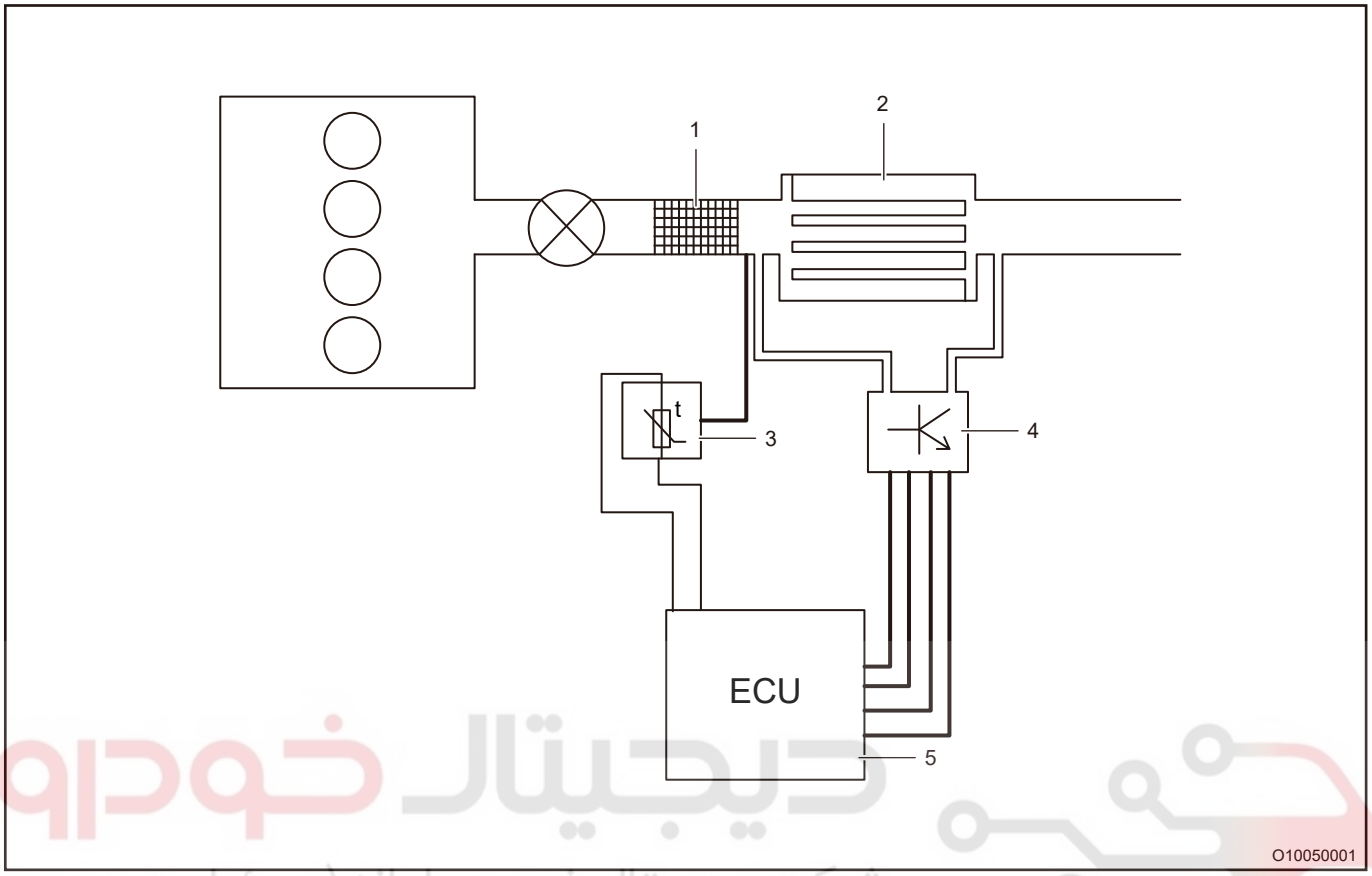
Fuel Vapor Recovery/Leakage Diagnosis System



1	Activated Charcoal Canister Assembly	5	Fuel Tank Pressure Sensor
2	Activated Charcoal Canister Cut-off Valve	6	Fuel Tank Assembly
3	Dust Filter	7	Charcoal Canister Desorption Pressure Sensor
4	Intake Hose Assembly		

Two desorption pipelines are equipped in fuel vapor recovery system. One desorption pipeline is connected to intake manifold through canister solenoid valve, which is low load desorption pipeline. Another desorption pipeline is connected to intake hose through canister solenoid valve pipeline (venturi tube), which is high load desorption pipeline.Principle of fuel vapor leakage diagnosis: After closing the charcoal canister ventilation valve, pump the fuel tank into a certain negative pressure through the intake manifold vacuum degree. If the negative pressure cannot be established, it is considered that there is a large leakage, i.e. a coarse leakage. Then close the canister solenoid valve, and form a closed space between canister solenoid valve rear pipe and fuel tank. When there are holes and no holes, the attenuation gradient of vacuum degree in this closed space is different, so it can be judged whether there is leakage.

Gasoline Particulate Filter (GPF) System



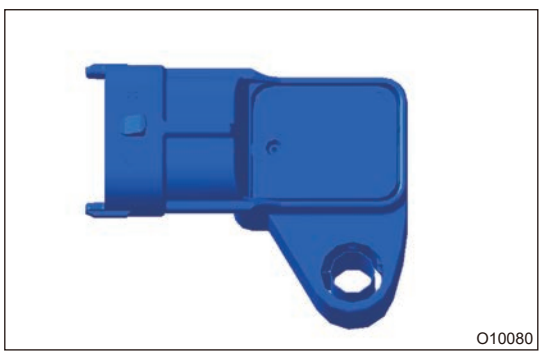
1	Precatalytic Converter Assembly	4	Differential Pressure Sensor
2	Gasoline Particulate Filter	5	Engine Control Unit
3	Exhaust Temperature Sensor		

GPF is a ceramic filter installed in gasoline engine emission system, which can capture gasoline particulates before they enter the atmosphere.Although GPF can capture the gasoline particulates in exhaust gas effectively, with the increase of captured gasoline particulates, exhaust back pressure will increase, which will effect the vehicle power and economy.When particulates in GPF are accumulated to a certain extent, particulates in GPF will be oxidized and burned by adjusting engine operation condition (-such as fuel cut-off, delayed ignition angle), ECU controls the regeneration of GPF and remove particulates in GPF, and finally realize positive cycle of “capture-regeneration-capture”.

System Components Description

Charcoal Canister Desorption Pressure Sensor

As a varistor type, the sensor mainly detects whether the pressure (negative pressure) in high load desorption pipeline meets charcoal canister desorption requirement. Thereby complete high load desorption.

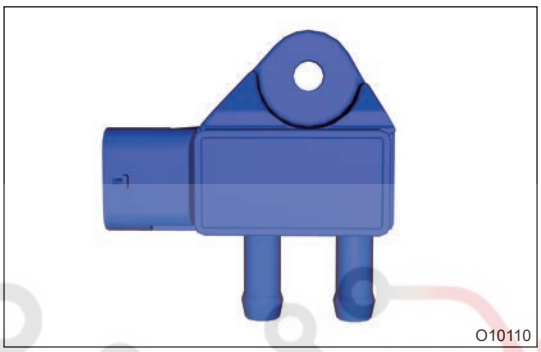


Canister Solenoid Valve Outlet Pipe II (Venturi Tube)

Venturi effect is adopted in the venturi tube. The principle of venturi tube is to change the air flow from coarse to fine, so as to speed up the air flow rate and form a "vacuum area" at the rear side of venturi tube outlet; this vacuum area will produce certain adsorption to the outside, thereby complete high load desorption.

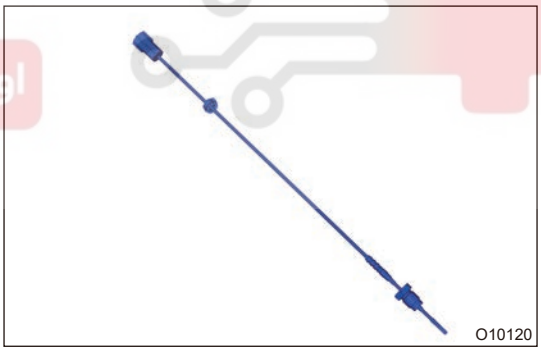
Differential Pressure Sensor

The sensor is a dual-mode differential pressure sensor, and the output dual-mode signals are digital signals, which mainly detects pressure difference between the two ends of GPF, so as to indirectly judges the amount of captured particulates. Realize the “regeneration” condition.



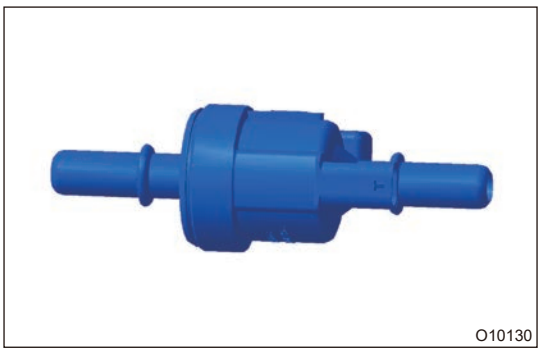
Exhaust Temperature Sensor

The sensor is a positive temperature coefficient thermistor (PTC) whose resistance value becomes larger as the temperature increases and becomes smaller as the temperature decreases. It mainly detects GPF inlet temperature and make sure GPF can regenerate safely.



Canister Solenoid Valve

Canister solenoid valve consists of solenoid coil, armature, valve body and other parts, and it is controlled by ECU by means of duty ratio control.



Activated Charcoal Canister Assembly

The inside of charcoal canister is filled with active carbon with strong adsorption. The excess fuel vapor in fuel tank is no longer discharged into the atmosphere, but introduced into the charcoal canister by hose. The active carbon absorbs the fuel vapor. When it meets engine desorption conditions, the canister solenoid valve is opened, and the absorbed fuel vapor is poured into the intake manifold for combustion, so as to achieve the purpose of fuel saving and environmental protection.

Upstream Oxygen Sensor

The upstream oxygen sensor is a ceramic body and is integrated with a micro pump for oxygen ion transportation. The pump supplies enough oxygen to the electrode on the exhaust gas contact side to keep the voltage on both sides constant, about 450 mV. The electronic controller converts the power consumption of pump into excess air coefficient. The output current is almost linearly related to λ, and λ = 0.65 ~ infinity, so it is also called a linear oxygen sensor. It can not only determine whether λ is greater than 1 or less than 1. Moreover, the specific value of λ can be measured in the lean and rich regions, so that the excess air coefficient in a larger range (i.e. broadband) can be measured, and continuous control of λ < 1 to λ > 1 can be realized.

Downstream Oxygen Sensor

The sensing element of downstream oxygen sensor is a ceramic flat body with pores. The outer side of ceramic is surrounded by engine exhaust, and the inner side is open to atmosphere. Sensing ceramic body wall is a type of solid electrolyte with heating electrodes inside. Operation of oxygen sensor is realized by converting the concentration difference of oxygen ions inside and outside the sensing ceramic body into voltage signals for output. When the temperature of sensing ceramic body reaches 350 ℃, it will have the characteristics of solid electrolyte. Oxygen ions can freely pass through it due to special material of ceramic body. It is precisely by taking advantage of this characteristic, it converts the concentration difference into the potential difference, thus forming the electrical signal output. If the gas mixture is rich, the concentration difference of oxygen ions inside and outside of ceramics body is higher, potential difference is higher, a large amount of oxygen ions move from inside to outside, and the output voltage is higher (approximately 800 mV - 1000 mV); If the gas mixture is lean, the concentration difference of oxygen ions inside and outside of ceramics body is lower, potential difference is lower, only a few oxygen ions move from inside to outside, and the output voltage is lower (-approximately 100 mV). Signal voltage changes suddenly when near the theoretical equivalent air-fuel ratio (λ = 1).

Diagnosis & Testing

Problem Symptoms Table

Hint:
Use symptoms table below to help determine cause of problem. Check each suspected area in sequence. Repair, replace or adjust faulty components as necessary.
Emission Control System

Symptom	Possible Cause
Fuel tank flat	Charcoal canister closed valve (damaged)
	Activated charcoal canister (blocked)
	Activated charcoal canister filter (blocked)
Lean mixture	Intake Pressure Sensor
	Oxygen sensor invalid
	Low fuel pressure in electric fuel pump
	Fuel injector blocked
Rich mixture	Fuel injector leakage
	Air filter blocked
	Oxygen sensor invalid
Lack of power	Oxygen sensor invalid
	Air flow meter malfunction
	Fuel pressure too low
	Cylinder compression pressure drop

On-Vehicle Service

Tools

General Tools

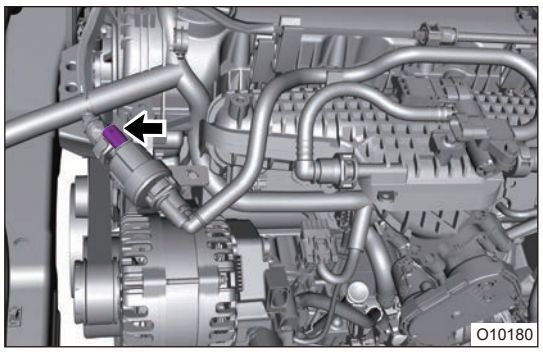
Tool Name	Tool Drawing
Battery Tester	 090

Canister Solenoid Valve

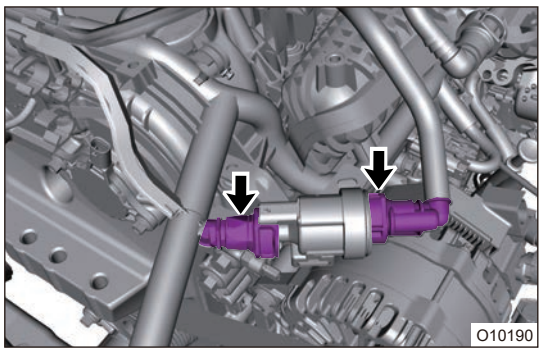
Removal

Warning
• Be sure to wear safety equipment to prevent accidents, when removing canister solenoid valve. • Appropriate force should be applied, when removing canister solenoid valve. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Remove the negative battery cable.
4. Disconnect the canister solenoid valve connector.



5. Disconnect fuel vapor pipe Ⅲ and canister solenoid valve outlet pipe from canister solenoid valve assembly.



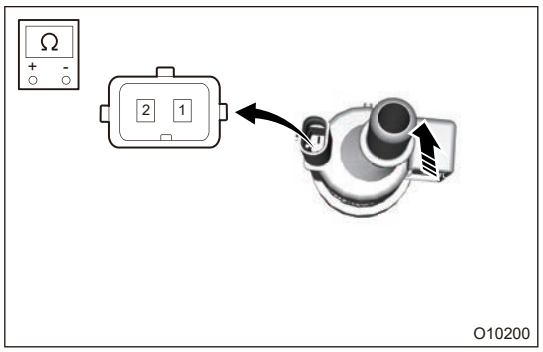
6. Remove the canister solenoid valve assembly.

Inspection

1. Measure the resistance of canister solenoid valve with a digital multimeter.

Measurement Temperature	Specification (Ω)
20 ℃	16 ± 2

Hint:
If resistance is not as specified, replace the canister solenoid valve assembly.



2. Connect the positive battery to canister solenoid valve No. 1 pin and connect the negative battery to canister solenoid valve No. 2 pin. Check if the canister solenoid valve can open. After it opened, bleed air to direction of canister solenoid valve (arrow), and air flows easily.

Installation

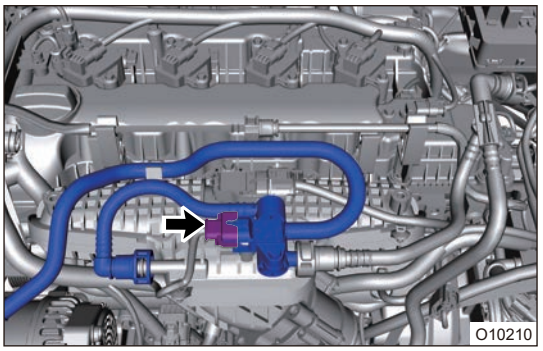
1. Install canister solenoid valve, and connect fuel vapor pipe Ⅲ and canister solenoid valve outlet pipe to both ends of canister solenoid valve.
2. Connect the canister solenoid valve connector.
3. Install the engine compartment trim cover assembly.

Canister Solenoid Valve Outlet Pipe Assembly

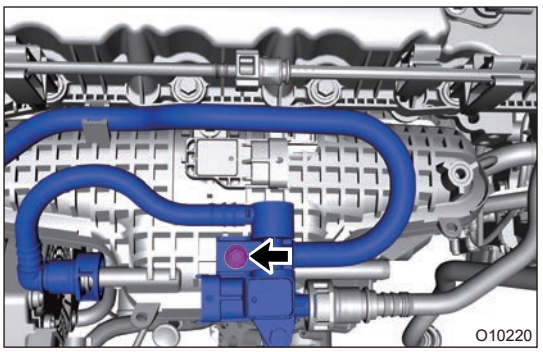
Removal

Caution
• Be sure to wear safety equipment to prevent accidents, when removing canister solenoid valve outlet pipe assembly. • Appropriate force should be applied, when removing canister solenoid valve outlet pipe assembly. Be careful not to operate roughly.

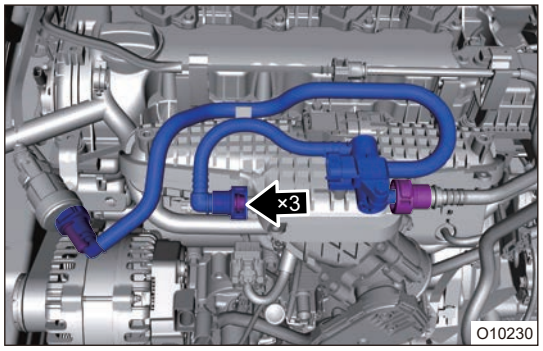
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Disconnect the charcoal canister desorption pressure sensor connector.



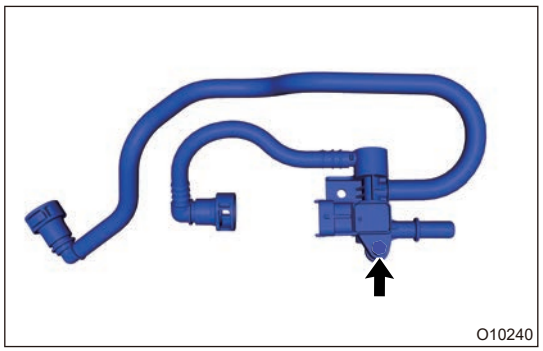
5. Remove 1 fixing bolt from canister solenoid valve outlet pipe three way bracket.



6. Disconnect the connection between canister solenoid valve outlet pipe and canister solenoid valve.
7. Disconnect the connection between canister solenoid valve outlet pipe and intake manifold.
8. Disconnect the connection between canister solenoid valve outlet pipe and canister solenoid valve outlet pipe Ⅱ.



9. Remove the canister solenoid valve outlet pipe assembly, remove 1 fixing bolt from charcoal canister desorption pressure sensor, and separate charcoal canister desorption pressure sensor.



Installation

1. Install charcoal canister desorption pressure sensor and fix 1 bolt.
   Torque: 8 + 3 N·m
2. Install 1 fixing bolt to canister solenoid valve outlet pipe three way bracket.
   Torque: 7 ± 1 N·m
3. Connect the canister solenoid valve outlet pipe to canister solenoid valve.
4. Connect the canister solenoid valve outlet pipe to intake manifold.
5. Connect the canister solenoid valve outlet pipe Ⅱ to canister solenoid valve outlet pipe.
6. Connect the desorption pressure sensor connector.
7. Install the engine compartment trim cover assembly.

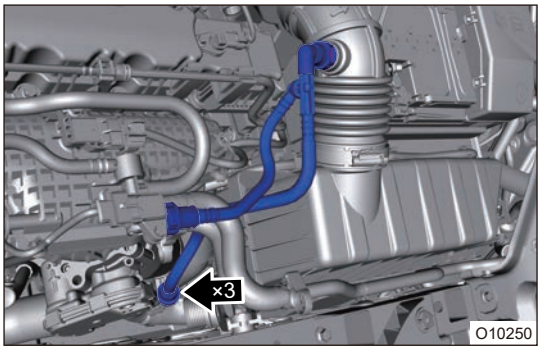
Canister Solenoid Valve Outlet Pipe Ⅱ Assembly

Removal

Caution
• Be sure to wear safety equipment to prevent accidents, when removing canister solenoid valve outlet pipe Ⅱ assembly. • Appropriate force should be applied, when removing canister solenoid valve outlet pipe Ⅱ assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.

3. Disconnect the connection between canister solenoid valve outlet pipe Ⅱ and canister solenoid valve outlet pipe.
4. Disconnect the connection between canister solenoid valve outlet pipe Ⅱ and intercooler outlet pipe Ⅱ.
5. Disconnect the connection between canister solenoid valve outlet pipe Ⅱ and intake hose.



6. Remove canister solenoid valve outlet pipe Ⅱ assembly.

Installation

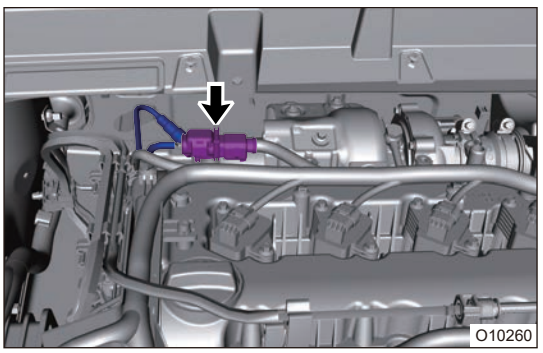
1. Connect the canister solenoid valve outlet pipe Ⅱ to canister solenoid valve outlet pipe.
2. Connect the canister solenoid valve outlet pipe Ⅱ to intercooler outlet pipe Ⅱ.
3. Connect the canister solenoid valve outlet pipe Ⅱ to intake hose.
4. Install the engine compartment trim cover assembly.

Upstream Oxygen Sensor

Removal

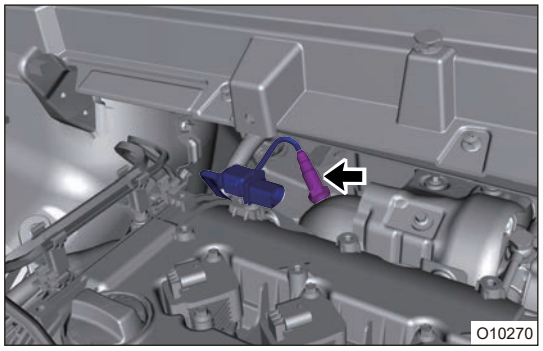
Warning
• Temperature of exhaust system is very high when engine is running. Before removal, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury. • Appropriate force should be applied when removing upstream oxygen sensor. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Take off and disconnect upstream oxygen sensor connector from fixing bracket.



5. Remove the upstream oxygen sensor from front part of precatalytic converter assembly.

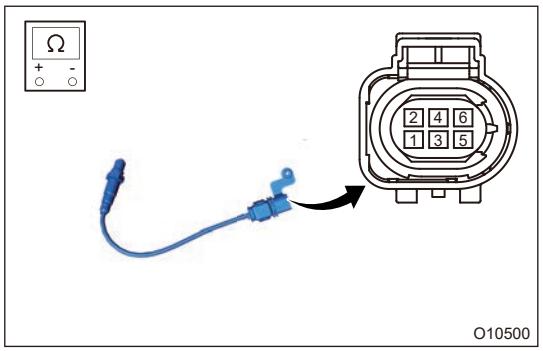
   Hint:
   Remove it with special oxygen sensor socket.



Inspection

1. Measure the resistance of upstream oxygen sensor with a digital multimeter.

Multimeter Connection	Terminal Definition
Terminal 1	Controlled by oxygen pump
Terminal 2	(Reference ground) Analog ground
Terminal 3	Heater power supply
Terminal 4	Heater control
Terminal 5	Correction resistance
Terminal 6	Refererence signal



Multimeter Connection	Condition	Specified Condition
Terminal 3 - Terminal 4	Normal Temperature	4 - 5 Ω
Terminal 1 - Terminal 5	Normal Temperature	114 Ω

Hint:
If result is not as specified, replace the upstream oxygen sensor.

Installation

Warning
• If oxygen sensor falls, never install it directly.

1. Install upstream oxygen sensor with special oxygen sensor socket.

   Torque: 45 ± 5 N·m

2. Install the upstream oxygen sensor connector.
3. Install the engine compartment trim cover assembly.

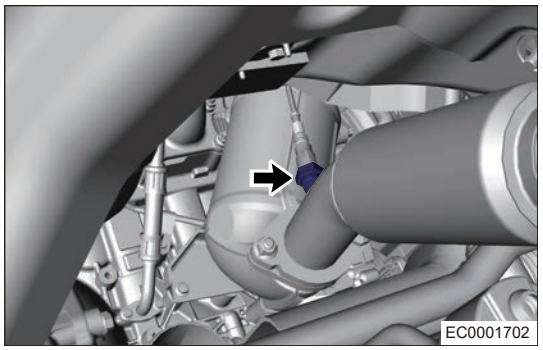
Downstream Oxygen Sensor

Removal

Warning
• Temperature of exhaust system is very high when engine is running. Before removal, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury. • Appropriate force should be applied when removing downstream oxygen sensor. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Raise the vehicle to a proper position.
4. Remove the downstream oxygen sensor.

   Hint:
   Remove it with special oxygen sensor socket.

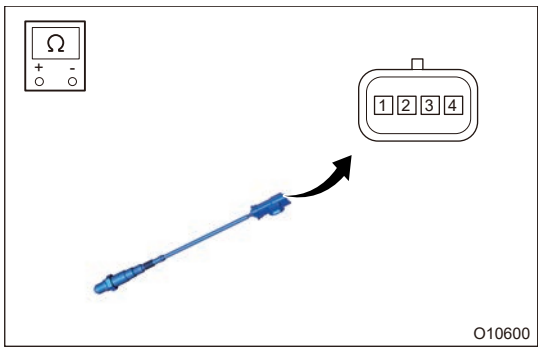


Inspection

1. Measure the resistance of upstream oxygen sensor with a digital multimeter.

Multimeter Connection	Terminal Definition
Terminal 1	Ground
Terminal 2	Signal
Terminal 3	Heating control
Terminal 4	Heater power supply

Multimeter Connection	Condition	Specified Condition
Terminal 3 - Terminal 4	Normal Temperature	5 - 22 Ω
Terminal 1 - Terminal 2	Always	No continuity
Terminal 1 - Terminal 4		
Terminal 2 - Terminal 3		
Terminal 2 - Terminal 4		



Installation

Warning
• If oxygen sensor falls, never install it directly.

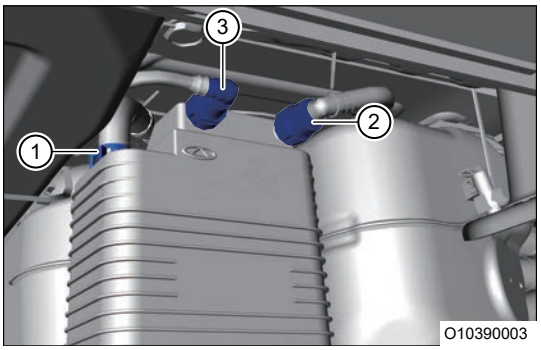
1. Install downstream oxygen sensor with special oxygen sensor socket.
   Torque: 45 ± 5 N·m
2. Install the downstream oxygen sensor connector.

Activated Charcoal Canister Assembly

Removal

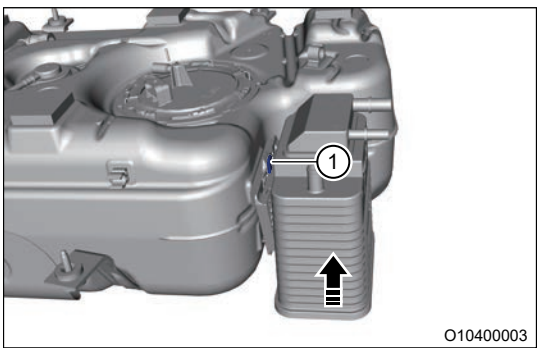
Warning
• Be sure to wear safety equipment to prevent accidents when removing activated charcoal canister assembly. • Appropriate force should be applied when removing activated charcoal canister assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Remove the activated charcoal canister assembly.
5. Loosen elastic clamp (1), and disconnect connection of activated charcoal canister breather pipe.
6. Disconnect connection between fuel vapor pipe IV (3) and activated charcoal canister assembly.
7. Disconnect connection between fuel vapor pipe Ⅲ (2) and activated charcoal canister assembly.



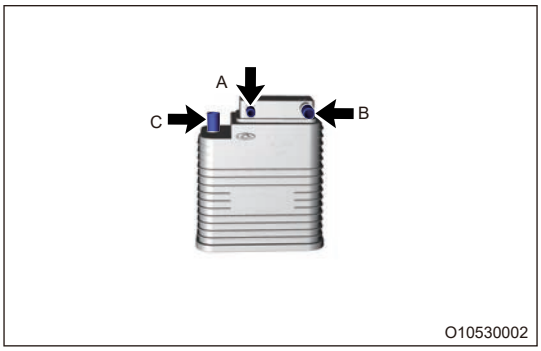
8. Using a screwdriver, pry off fixing clips (1) from activated charcoal canister and push up in direction of arrow to remove activated charcoal canister assembly.

Hint: The scrap activated charcoal canister assembly should be handled by the specialized department according to local laws and regulations. Never discard it at will.



Inspection

1. Close port C and blow compressed air into port A, check that air flows from port B. If result is not as specified, replace canister.
2. Close port C and blow compressed air into port B, check that air flows from port A. If result is not as specified, replace the canister.
3. Close port A and use vacuum pump to pump the vacuum from port B, check that air enters from port C. If result is not as specified, replace the filter and canister.



Installation

Caution
• Positioning distance from hose end to elastic clamp is 3 to 5 mm.

1. Installation is in the reverse order of removal.

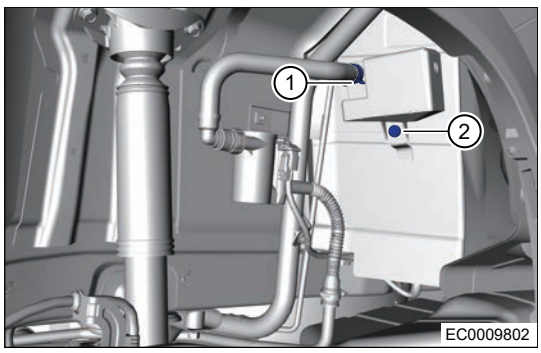
Activated Charcoal Canister Filter

Removal

Warning
• Be sure to wear safety equipment to prevent accidents when removing dust filter. • Appropriate force should be applied when removing dust filter. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Remove the rear left wheel.
4. Remove the rear left wheel house protector.
5. Remove the activated charcoal canister filter.
6. Loosen elastic clamp (1) and disconnect the activated charcoal canister breather pipe Ⅲ.
7. Remove 1 fixing bolt (2) from activated charcoal canister filter.

Tightening torque: 7 ± 1 N·m



8. Remove the dust filter.

Installation

Caution
• Positioning distance from hose end to elastic clamp is 3 to 5 mm.

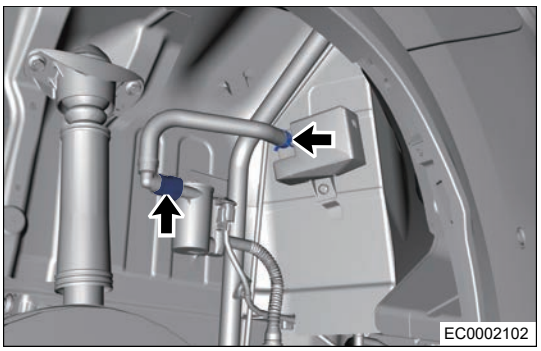
1. Installation is in the reverse order of removal.

Activated Charcoal Canister Breather Pipe III Assembly

Removal

Caution
• Be sure to wear safety equipment to prevent accidents when removing activated charcoal canister breather pipe assembly. • Appropriate force should be applied when removing activated charcoal canister breather pipe assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Remove the rear left wheel.
4. Remove the rear left wheel house protector.
5. Remove the activated charcoal canister breather pipe III assembly.
6. Loosen elastic clamp (arrow) and disconnect connection between activated charcoal canister breather pipe Ⅲ assembly and activated charcoal canister filter.
7. Disconnect the connection (arrow) between activated charcoal canister breather pipe Ⅲ assembly and activated charcoal canister breather pipe Ⅱ assembly.



8. Remove the activated charcoal canister breather pipe III assembly.

Inspection

1. Check activated charcoal canister breather pipe for blockage, damage.

Installation

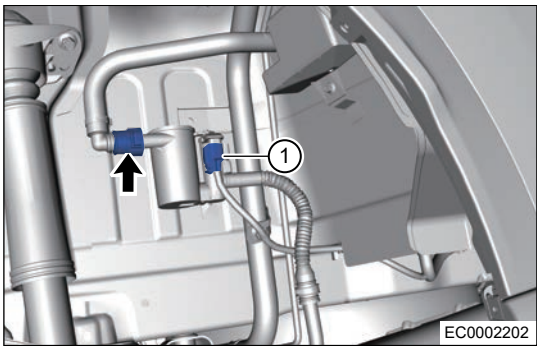
1. Installation is in the reverse order of removal.

Activated Charcoal Canister Breather Pipe II Assembly

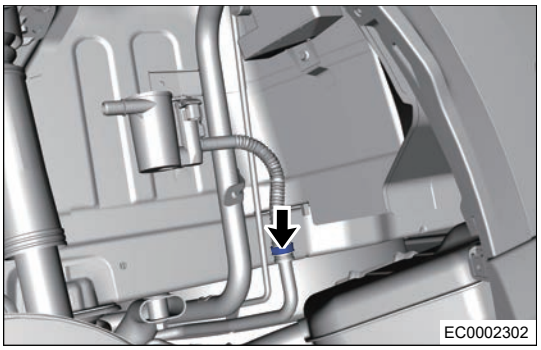
Removal

Caution
• Be sure to wear necessary safety equipment to prevent accidents when removing activated charcoal canister breather pipe II assembly. • Appropriate force should be applied when removing activated charcoal canister breather pipe II assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Remove the rear left wheel.
4. Remove the rear left wheel house protector.
5. Remove the activated charcoal canister breather pipe II assembly.
6. Disconnect the charcoal canister cutoff valve connector (1).
7. Disconnect the activated charcoal canister breather pipe III assembly (arrow).

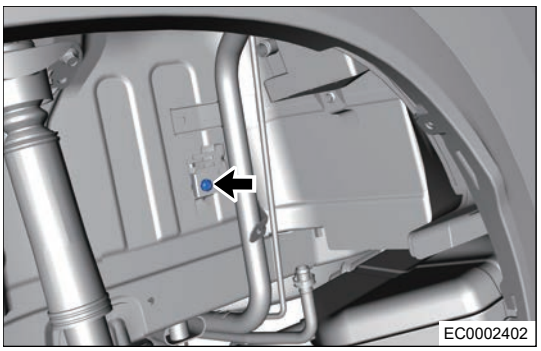


8. Loosen worm clamp (arrow) and disconnect the filler tube assembly.



9. Remove the activated charcoal canister breather pipe II assembly.
10. Remove fixing bolt (arrow) and activated charcoal canister cutoff valve bracket.

Tightening torque: 7 ± 1 N·m



Installation

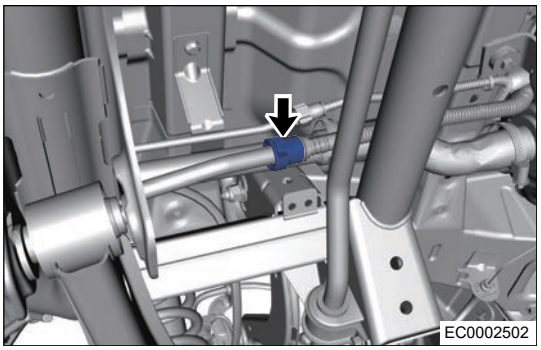
1. Installation is in the reverse order of removal.

Activated Charcoal Canister Breather Pipe Assembly

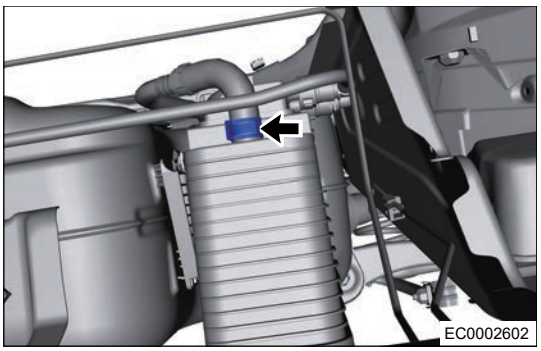
Removal

Caution
• Be sure to wear safety equipment to prevent accidents when removing activated charcoal canister breather pipe assembly. • Appropriate force should be applied when removing activated charcoal canister breather pipe assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Raise the vehicle to a proper position.
4. Remove the activated charcoal canister breather pipe assembly.
5. Disconnect the filler tube assembly (arrow).
6. Remove fuel tank fixing strap and lower fuel tank to a proper position.



7. Loosen elastic clamp (arrow) and disconnect connection between activated charcoal canister breather pipe assembly and activated charcoal canister assembly.



8. Remove the activated charcoal canister breather pipe assembly.

Installation

1. Installation is in the reverse order of removal.

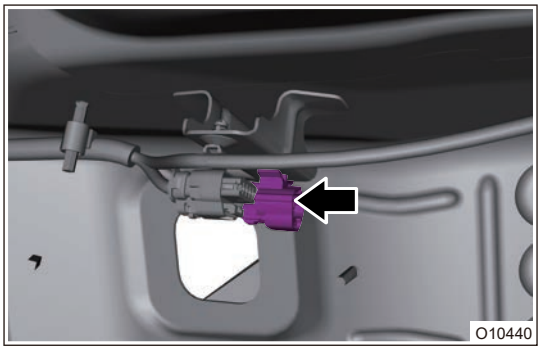
Exhaust Temperature Sensor

Removal

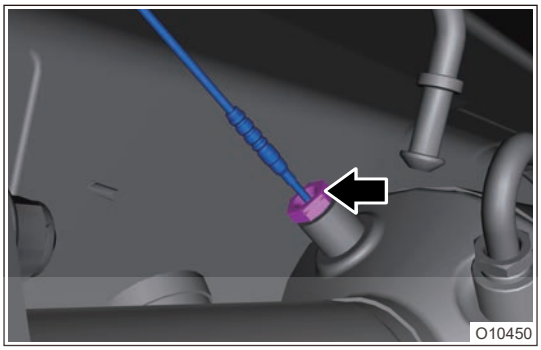
Warning
• Temperature of exhaust system is very high when engine is running. Before removal, make sure that engine has stopped running and exhaust system has cooled down sufficiently, otherwise, there is a risk of scald injury. • Appropriate force should be applied when removing exhaust temperature sensor. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Raise the vehicle to a proper position.

4. Disconnect the exhaust temperature sensor connector.



5. Remove exhaust temperature sensor from the front end of GPF.



Inspection

1. Heating the front end of sensor, measure resistance with multimeter ohm band. The resistance should change in accordance with temperature.
2. Turn digital multimeter to ohm band, connect two probes to two terminals (no polarity) respectively, the normal resistance should be 200 ~ 230 Ω at normal temperature (0 ~ 40 ℃). If the resistance is abnormal (out of range), the performance is invalid. Abnormal conditions usually include open (-resistance is ∞) or short (resistance is 0).

Temperature (℃)	Resistance (Ω)
-40	170.68
0	201.50
10	209.15
50	239.49
100	276.90
150	313.72
200	349.96
250	385.61
300	420.68
350	455.16
400	489.06
450	522.37
500	555.10
550	587.24

Temperature (℃)	Resistance (Ω)
600	618.80
650	649.77
700	680.16
750	709.96
800	739.18
850	767.81
900	795.86

Installation

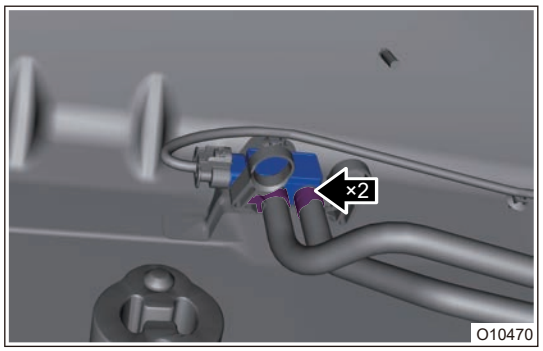
1. Install the exhaust temperature sensor.
   Torque: 35 ± 5 N·m
2. Connect the exhaust temperature sensor connector.

Differential Pressure Sensor

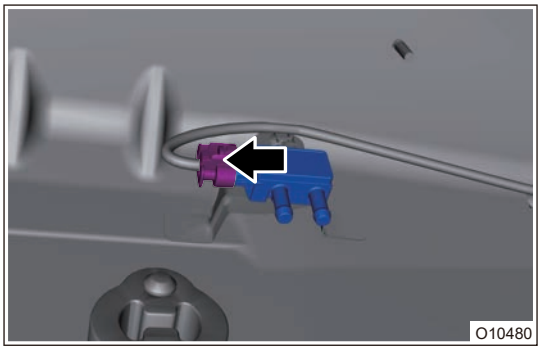
Removal

Warning
• Be sure to wear safety equipment to prevent accidents, when removing differential pressure sensor. • Appropriate force should be applied when removing differential pressure sensor. Be careful not to operate roughly.

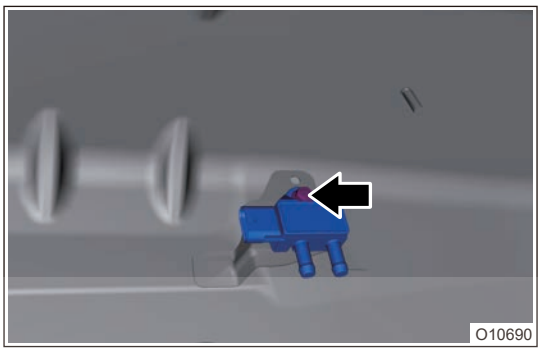
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Raise the vehicle to a proper position.
4. Loosen 2 elastic clamps and disconnect connection between hose and differential pressure sensor.



5. Disconnect the differential pressure sensor connector.



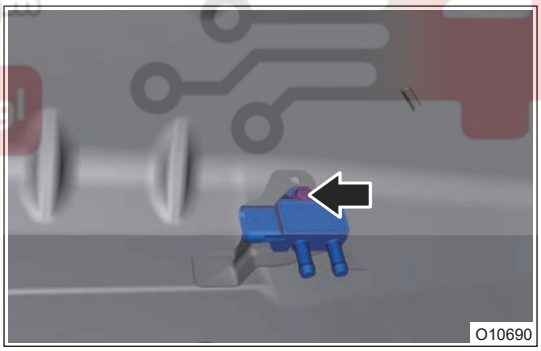
6. Remove 1 fixing bolt from differential pressure sensor.



7. Remove the differential pressure sensor assembly carefully.

Inspection

1. Turn digital multimeter to ohm band, ground the black probe 3#, connect red probe to pins 1# and 2# respectively. It is normal that resistance is greater than 2.5 MΩ.



2. Connect pin 4# VDD of sensor to 5V power supply, pin 3# GND to ground, and connect output pins 1# and 2# through SENT signal collector (oscilloscope). At normal temperature (30 ± 10°) and normal pressure (101 kpa ± 5 kpa), the output value in decimal number 1184 ~ 1423 is normal.

   Hint:
   SENT is the abbreviation of Single Edge Nibble Transmission. As a point-to-point and one-way transmission scheme launched by Society of Automotive Engineers (SAE), it is used to transmit HD sensor data between vehicle sensor and electronic control unit (ECU). Sensor data is transmitted through a series of pulse sequence between two falling periods. SENT provides a reference calibration pulse at the beginning of signal and provides a check bit at the end. The length of message varies with half bit value. As a new interface standard of vehicle sensor, compared with analog output and PWM output, SENT (SAE J2717) has a good EMC performance with low cost which saves wire harness and pin connector, and it can transmit DTC, so that sensor system has an excellent malfunction diagnosis ability.

Installation

1. Install 1 fixing bolt to differential pressure sensor.
   Torque: 9 ± 1.5 N·m

2. Connect the differential pressure sensor connector.
3. Connect hose to differential pressure sensor and install elastic clamp.

Cooling System

Warnings and Precautions

Warnings

In order to avoid possible property loss, personal injury or death, always follow the instructions below before repair:

1. Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns.
2. If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital.

Precautions

In order to avoid dangerous operation and damage to the vehicle before repair in this section, always follow the instructions below before repair:

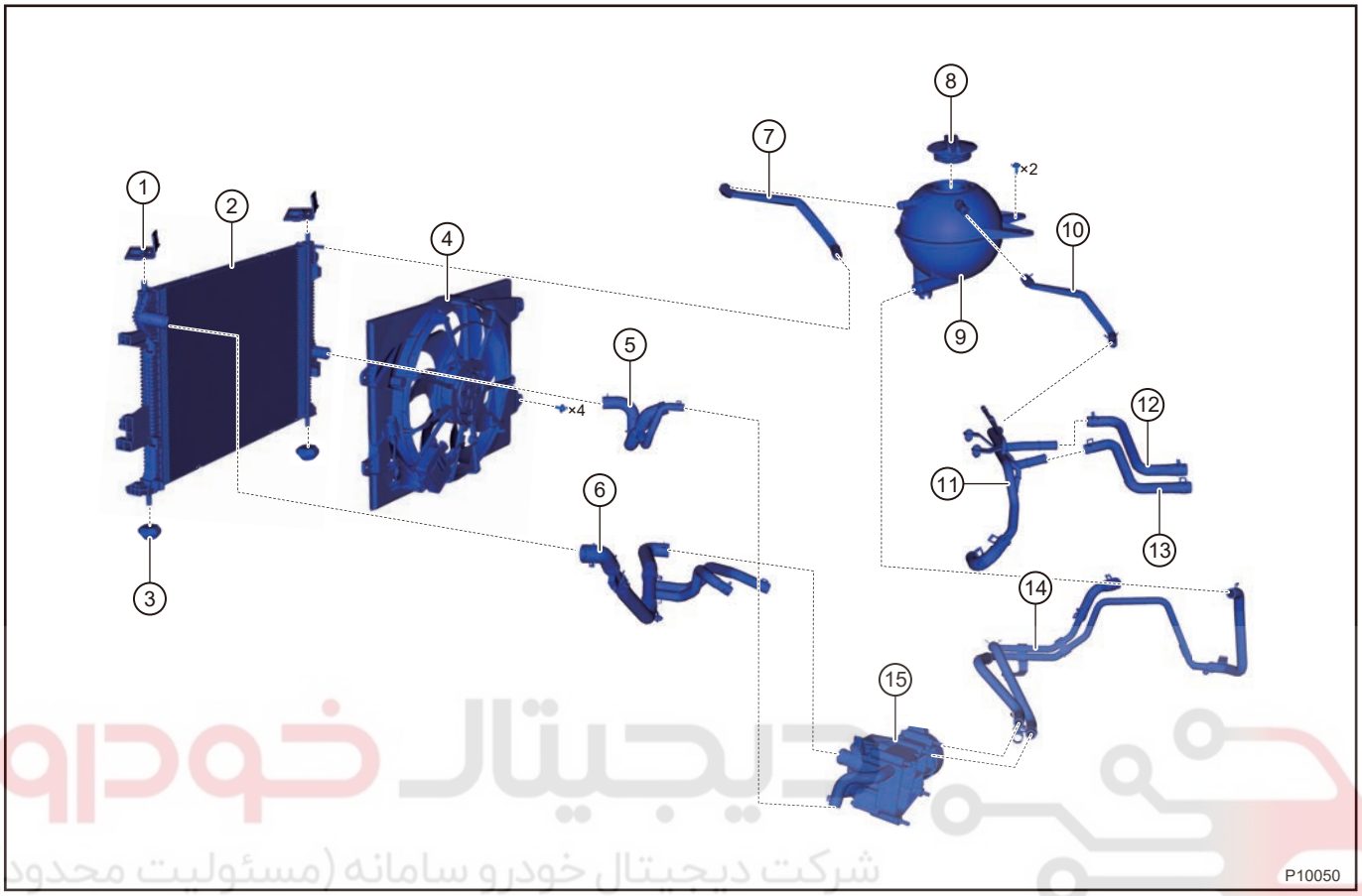
1. When testing cooling system, please pressurize the system to specified pressure. Otherwise, system components may be damaged.
2. DO NOT mix different colors or types of coolant.
3. Please select coolant which is suitable for local climate in different areas.

System Overview

System Description

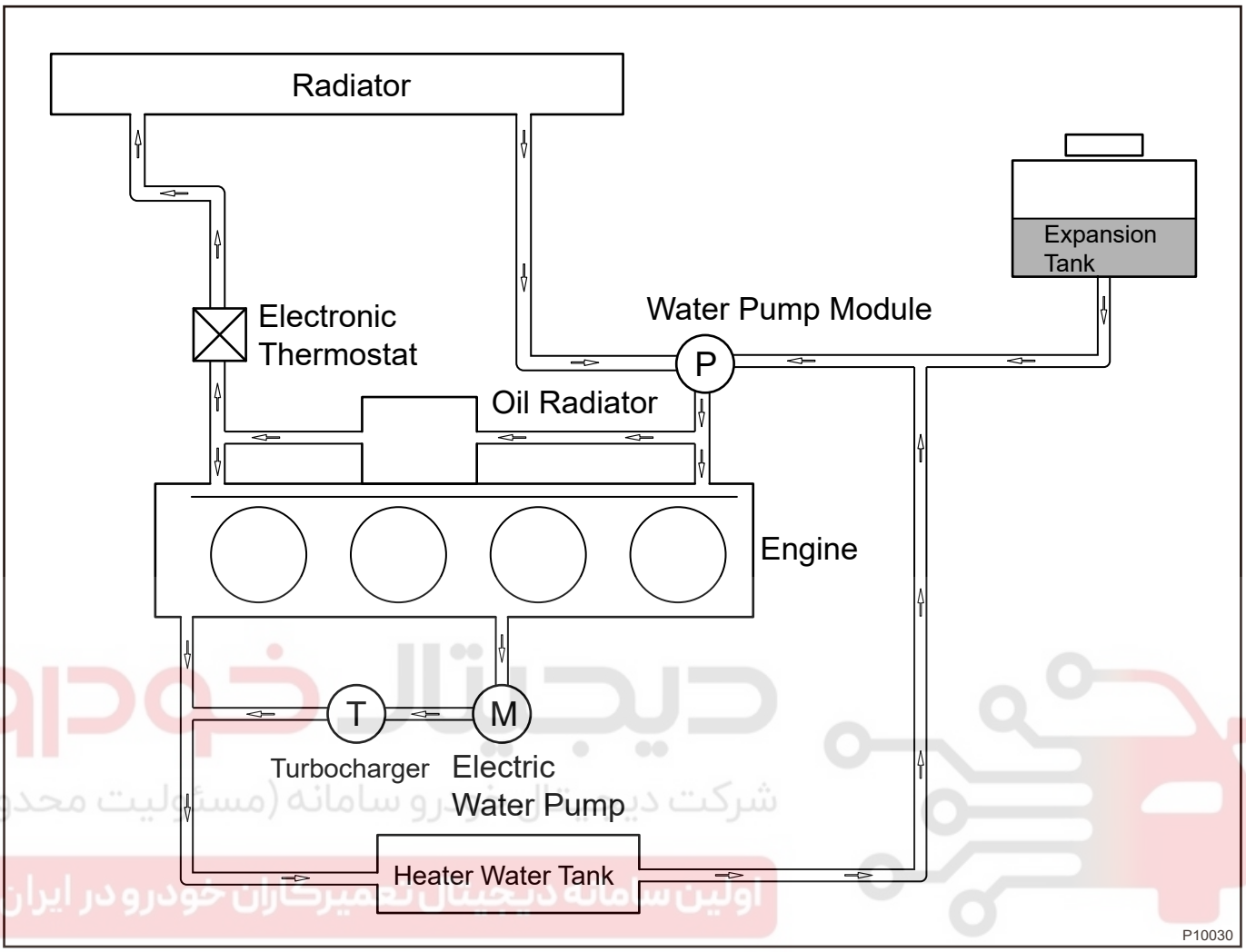
Engine cooling system adjusts engine operating temperature by the flow of coolant and makes engine operate normally under various operating conditions. And effectively improve the service life and fuel economy of the engine.

System Components Diagram



1	Tank Upper Bracket	9	Expansion Tank
2	Radiator Assembly	10	Water Pipe - Engine to Expansion Tank
3	Rubber Cushion	11	Cooling Pipe Assembly
4	Cooling Fan Assembly	12	Heating Inlet Pipe
5	Engine Outlet Pipe	13	Heating Outlet Pipe
6	Engine Inlet Pipe	14	Expansion Tank Inlet Pipe Assembly
7	Water Pipe - Engine to Expansion Tank	15	Water Pump Module
8	Expansion Tank Cap		

System Schematic Diagram



After engine operates, the water pump starts operating. Coolant begins to flow circularly. Displacement of water pump depends on engine speed. The higher the speed, the larger the displacement, and vice versa. When the coolant temperature does not reach the opening temperature of electronic thermostat, the engine coolant circulates in cylinder block, the cylinder head, turbocharger and warm air water tank under the operation of water pump, and the coolant does not radiate through the radiator.When coolant temperature reaches the opening temperature of electronic thermostat, coolant flowing out of cylinder block enters radiator for radiating. It then returns to cylinder block for circulation by water pump. Due to radiating in radiator, engine coolant temperature decreases quickly to prevent engine from overheating.

System Components Description

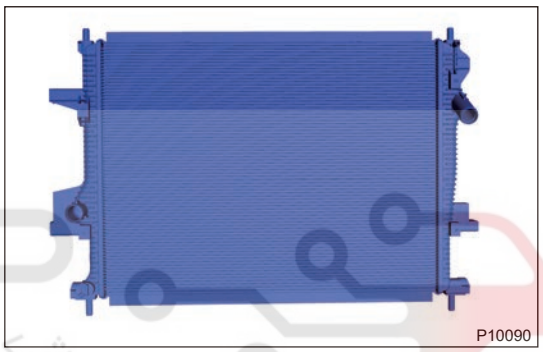
Expansion Tank Body

The expansion tank is an integral part of the vehicle cooling system. When the engine is running, the coolant will circulate continuously in the cooling water channel, and will flow through the expansion tank at halfway. If the pressure is too high or the coolant is too much, the excess gas and coolant will flow out of the bypass water channel of the expansion tank to avoid the high pressure of the cooling system.


P10080

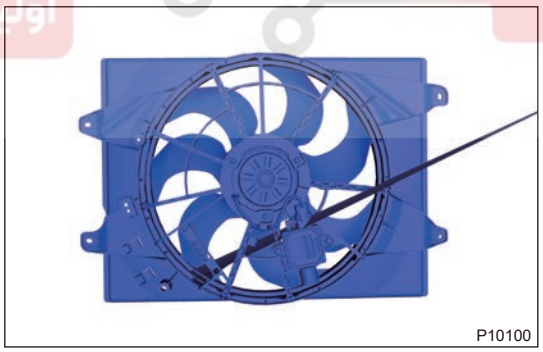
Radiator Assembly

The radiator is composed of three parts: Inlet chamber, outlet chamber and radiator core. The coolant flows in the radiator core and the air flows outside the radiator core. The hot coolant cools down because radiating heat to air, and the cold air heats up because absorbing the heat from the coolant, so the radiator is a heat exchanger.


P10090

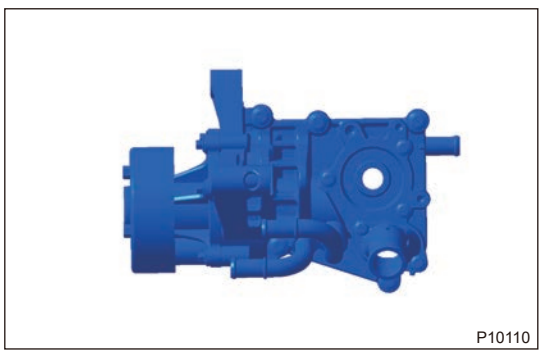
Cooling Fan Assembly

The rotation of radiator fan helps to radiate the radiator. Fan speed is controlled by ECU according to coolant temperature.


P10100

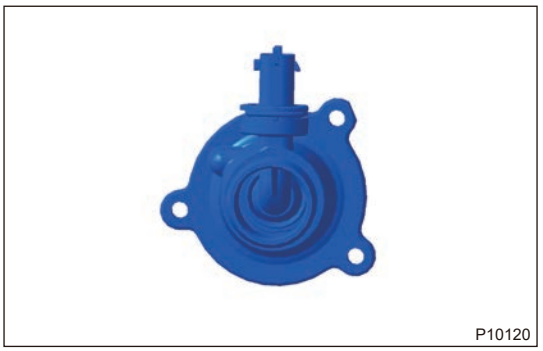
Water Pump Assembly

Pressurize coolant to ensure it can circulate in cooling system. Its displacement varies with engine speed.


P10110

Electronic Thermostat

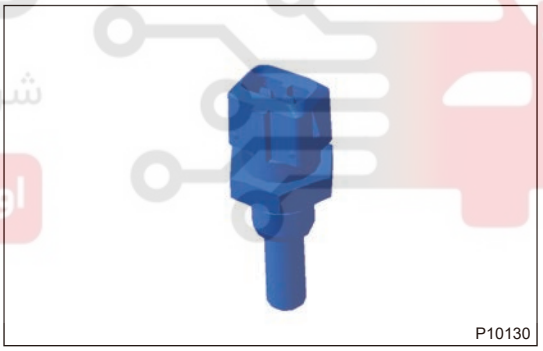
The electronic thermostat can calculate the target temperature according to engine running speed, load state, intake air temperature, coolant temperature, etc., accurately regulate the coolant temperature to ensure that the engine always works at a reasonable temperature. According to the calculated value of the sensor signal, ECU provides the signal working voltage to heating resistance element in electronic thermostat, which makes the paraffin expand and displace. Through this displacement, the temperature regulating unit mechanically adjusts the large circulation and small circulation of water temperature.The operation of electronic thermostat shall meet the following conditions at the same time:


P10120

1. Under low speed and low load, electronic thermostat controls to open at 105 ℃ to improve fuel economy.
2. Under high speed and high load, electronic thermostat controls to open at 90 ℃ to ensure engine safety.
3. If there is fault in line, electronic thermostat can be opened mechanically. Initially opening temperature: 100 ℃ ± 2 ℃, fully opening temperature: 110 ℃ ± 2 ℃.
4. Opening stroke of thermostat: 8mm.

Coolant Temperature Sensor

NTC thermistor packaged inside temperature sensor is used for coolant temperature sensor, its resistance changes in accordance with ambient temperature, thus accurately reflecting the small changes in coolant temperature. The temperature of contact medium can be reflected by measuring its output resistance, and the signals from both terminals of resistor are output to ECM. Engine coolant temperature can be obtained by ECU according to output signal of the sensor, thus judging the engine operating condition.


P10130

Diagnosis & Testing

Problem Symptoms Table

Hint:

Use symptoms table below to help determine cause of problem. Check each suspected area in sequence. Repair, replace or adjust faulty components as necessary.

Cooling System

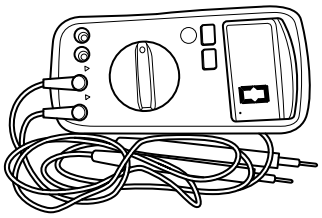
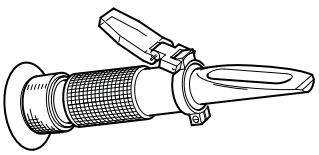
Symptom	Possible Cause
Insufficient coolant	Coolant pipe (deteriorated and leaks)
	Expansion tank (leakage)
	Radiator assembly (leakage)
	Heater core (leakage)

Symptom	Possible Cause
	Electronic thermostat improperly sealed
	Water pump (improperly sealed)
	Engine cylinder head gasket (damaged)
	Engine cylinder head (cracked and Leakage)
	Engine cylinder block (water jacket leaks and cylinder block cracked)
Engine overheating	Low coolant level
	Air resistance exists in cooling pipe
	Expansion luggage cap damaged
	ECU fault
	Cooling Fan Assembly
	Electronic Thermostat
	Radiator Assembly
	Coolant Temperature Sensor
Engine overcooling	Electronic Thermostat
	Cooling fan
Unable to reach normal engine temperature	Cooling fan (constantly operating)
	Electronic Thermostat
Cooling fan does not operate or operate abnormally	Cooling fan
	Cooling fan controller
	Fan controller wire harness
	ECU fault

On-Vehicle Service

Tools

General Tools

Tool Name	Tool Drawing
Digital multimeter	 S00002
Freezing Point Tester	 S00005

Cooling System Leakage Test

Test Procedures

Warning

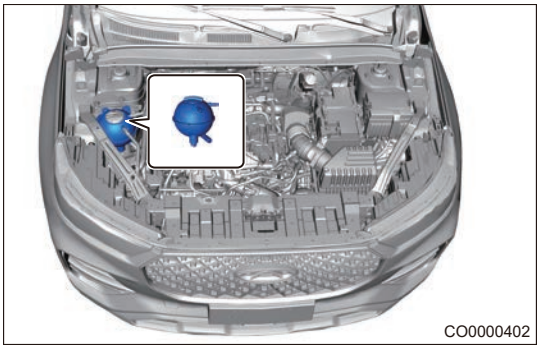
- Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns.

Caution

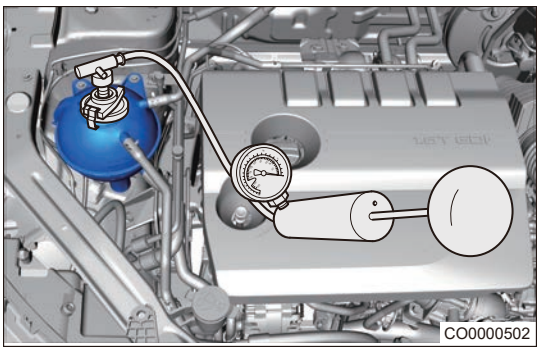
- When testing cooling system, please pressurize the system to specified pressure. Otherwise, system components may be damaged.
- Before testing cooling system, do not perform operation until coolant temperature drops to normal level. Otherwise, it may cause scald.

1. Turn off all electrical equipment and ENGINE START STOP switch.

2. Check if coolant level is between "MAX" and "MIN" lines. If coolant level is below "MIN" line, add coolant.



3. Connect cooling system pressure tester to coolant pressure release cap opening (expansion tank body cap opening) and tighten it slowly.



Caution
• Make sure there is no leakage in connecting part of coolant system pressure tester, in order to avoid pressure leakage during test.

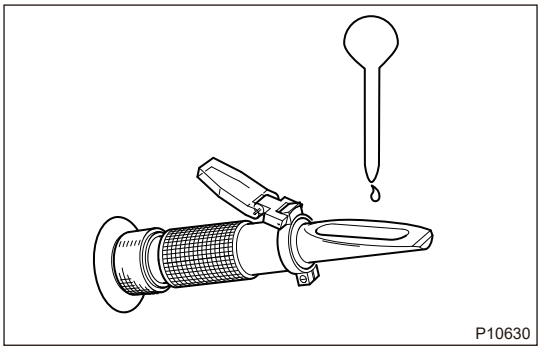
4. Pressurize cooling system to 1.2 bar with the cooling system pressure tester, and then observe the pressure changes. If system pressure does not drop within 2 minutes, it indicates there is no leakage in system. If pressure changes greatly, it indicates that there is a leakage in system; find the leaking area and perform troubleshooting.

Coolant Freezing Point Test

Test Procedures

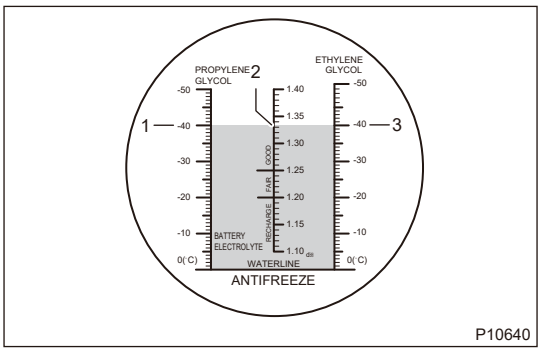
Caution
• DO NOT mix different colors or types of coolant. • Please select coolant which is suitable for local climate in different areas. • Please read measured value at the scale line. In order to distinguish the scale line more clearly, drip a drop of water on the glass of freezing point tester with a pipette, then the scale line can be clearly distinguished via a “waterline”.

1. As shown in illustration, drip a drop of coolant on the glass of freezing point tester with a pipette, and then observe freezing point value of coolant.



2. As shown in illustration, observe scale 3 of freezing point tester to read ethylene glycol coolant freezing point value. The freezing point value must be kept at -40 °C (value varies with geography, climate or freezing point).

   Hint:
   Scale 1 is used to measure the freezing point value of propylene glycol coolant, and scale 2 is used to measure the battery electrolyte concentration.



3. If freezing point is beyond the specified value, replace the coolant.

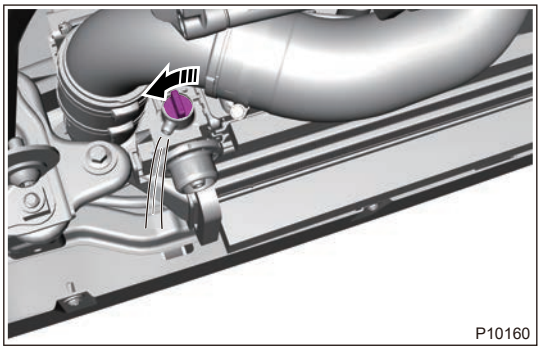
Draining and Adding Coolant

Draining Coolant

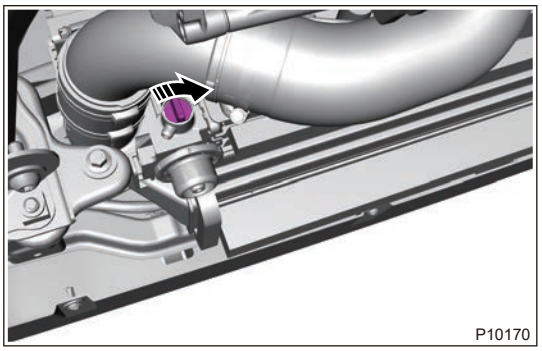
Warning
• Never open expansion tank cap when engine is operating or temperature is high. Otherwise, it may cause scald. • Be careful when opening expansion tank cap, the high-pressurized hot engine coolant and steam may flow out and cause serious burns. • Wait until the engine has cooled down, and then cover the expansion tank cap with a piece of damp cloth and turn it one turn slowly (counterclockwise). Step back when releasing cooling system pressure. After confirming that all pressure has been released, turn the pressure release cap with cloth covered and remove it. • Violating above descriptions may cause serious personal injury.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Remove the expansion tank cap when engine temperature is low.
4. Remove the engine lower protector assembly.

5. Put a coolant collector under the vehicle, rotate the radiator drain cock plug counterclockwise as shown in figure and drain the coolant in radiator and expansion tank.



6. After coolant stops flowing, re-tighten the radiator drain cock plug.



Caution
• Tighten drain cock plug to prevent leakage. • Wasted coolant should be handled by the specialized department according to local laws and regulations. Never discard it at will.

Coolant Adding

Warning
• If it is necessary to add coolant when engine is hot, loosen expansion tank cap slightly first to release internal pressure and loosen the cap completely after waiting for a while, and then add coolant. • If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital.

Coolant Capacity

Type	Capacity (L)
Without rear heater	7.5 ± 0.5 L
with rear heater	10.4 ± 0.2 L

1. Open expansion tank body cap until add coolant until coolant level reaches the “MAX” line.

2. Tighten expansion tank body cap, start and run engine. Maintain engine speed between 2000 and 2500 rpm to warm up the engine until cooling fan operates.

⚠ Caution
• If there is no coolant in expansion tank body after engine just starts, perform the followings: Stop the engine; wait until coolant cools down; add coolant to "MAX" line on expansion tank; run the engine at 2500 rpm until coolant level becomes stable.

3. Stop engine and wait until coolant temperature drops to the ambient temperature. Check that coolant level is between “MAX” and “MIN” lines. If coolant level is below the “MIN” line, repeat all the above procedures. Keep the coolant level between “MAX” and “MIN” lines.

4. Check each pipe for leaks, lack of antifreeze, if so, handle it.

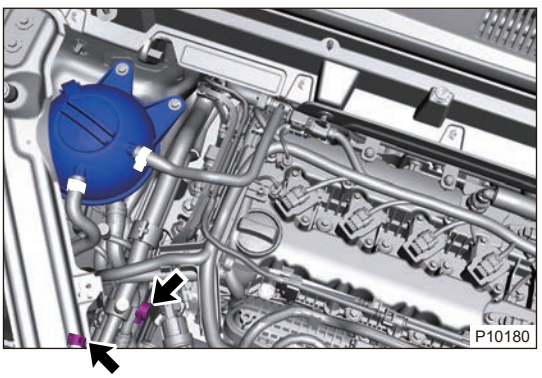
Caution
• Do not open the expansion tank cap at high engine temperature to prevent burns.

Expansion Tank Body

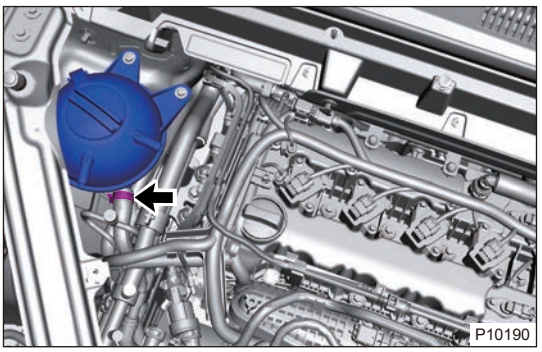
Removal

Warning
• Always make sure engine is cold before operating cooling system. Never open expansion tank body cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns. • If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital. • Be sure to wear necessary safety equipment to prevent accidents when repairing.

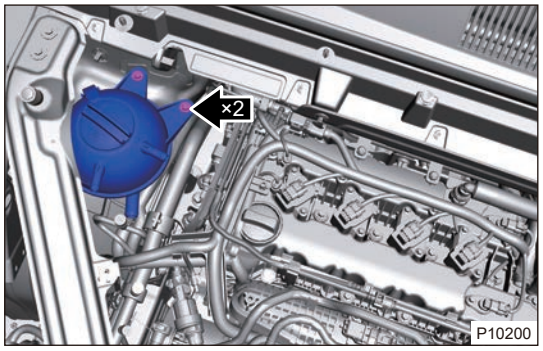
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Drain the coolant.
5. Loosen elastic clamp and disconnect connection between radiator discharge pipe Ⅰ and expansion tank body.
6. Loosen elastic clamp and disconnect connection between engine discharge pipe and expansion tank body.



7. Loosen elastic clamp and disconnect connection between inlet pipe and expansion tank body.



8. Remove 2 fixing bolts from expansion tank body.



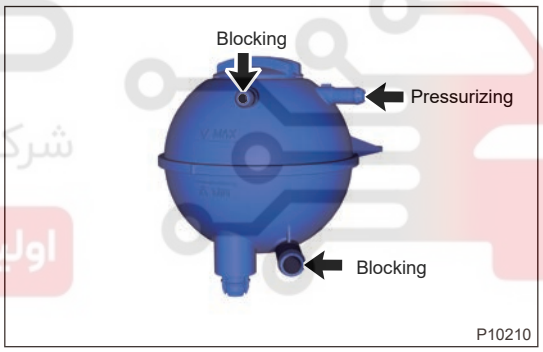
9. Remove the expansion tank body assembly carefully.

Check expansion tank body

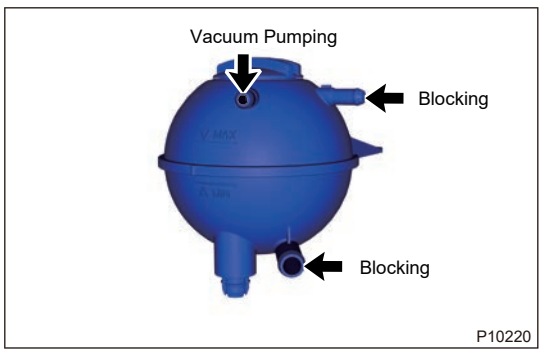
1. Check that the expansion tank is welded firmly, and there are no defects such as fractures and cracks at the weld.
2. The expansion tank should be colorless and transparent. During use of vehicle, expansion tank assembly is not allowed to have discoloration that affects the appearance and function, and scale line should be clearly visible.

Check expansion tank cap

1. Block two holes of expansion tank and pressurize one of them. When pressure reaches the opening pressure of relief valve (120 - 150 kpa), the pressure in expansion tank should be maintained at the relief valve opening pressure value.



2. Block two holes of expansion tank and vacuumize one of them. When vacuum pressure reaches the opening pressure of vacuum valve (-2 - 10 kpa), vacuum pressure in expansion tank should be maintained at the vacuum valve opening pressure value.



Installation

Caution
• When connecting engine discharge pipe and expansion tank body, align the “土” mark on pipe port with boss, and align center position of elastic clamp tabs with “I” position of “土” mark, align the edge of elastic clamp with lower edge of “二” position of “土” mark. • When connecting engine inlet pipe and expansion tank body, align the “土” mark on pipe port with boss, and align center position of elastic clamp tab with “I” position of “土” mark, align the edge of elastic clamp with lower edge of “二” position of “土” mark. • When connecting radiator discharge pipe Ⅰ and expansion tank body, align the “工” mark on pipe port with boss, and align center position of elastic clamp tabs with “I” position of “工” mark, align the edge of elastic clamp with lower edge of “二” position of “工” mark. • Check that coolant has been added to the specified level after installation.

1. Connect the inlet pipe to expansion tank body, and install elastic clamp.
2. Install 2 fixing bolts to expansion tank body.
   Torque: 5 ± 1 N·m
3. Connect the engine discharge pipe to expansion tank body, and install elastic clamps.
4. Connect the radiator discharge pipe Ⅰ to expansion tank body, and install elastic clamp.
5. Add the coolant.
6. Install the engine compartment trim cover assembly.

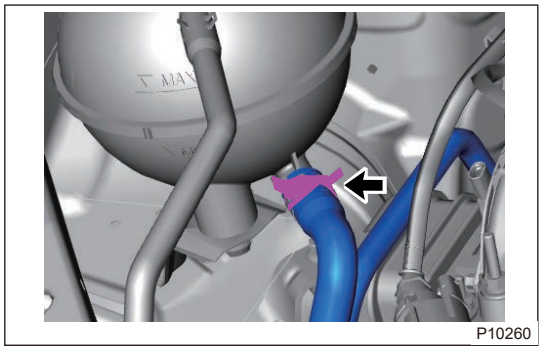
Inlet Pipe Assembly

Removal

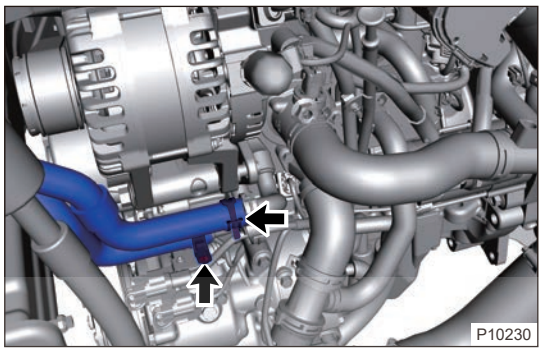
Warning
• Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns. • If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital. • Be sure to wear necessary safety equipment to prevent accidents when repairing.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Drain the coolant.
4. Remove the expansion tank body assembly.

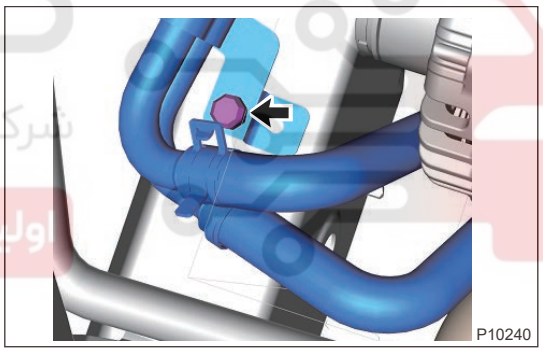
5. Loosen 1 elastic clamp and disconnect connection between expansion tank inlet pipe and expansion tank.

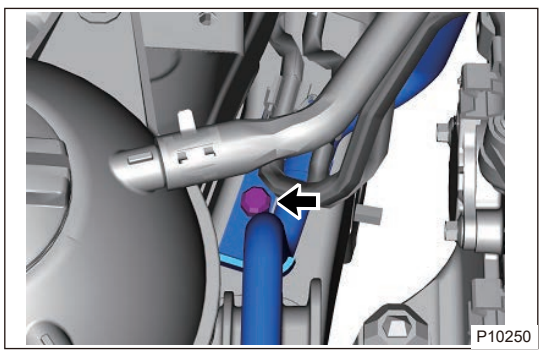


6. Loosen 2 elastic clamps and disconnect connection between inlet pipe assembly and water pump module.

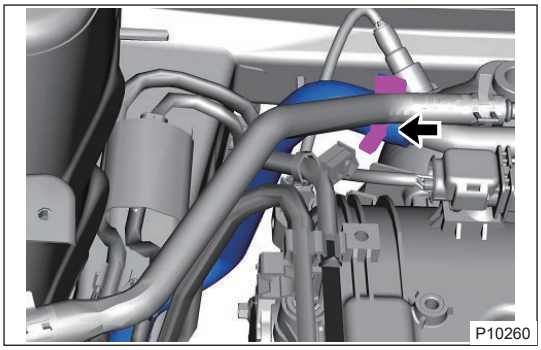


7. Remove 2 fixing bolts from inlet pipe assembly.





8. Remove the inlet pipe assembly fixing clamp to disengage two pipelines.



9. Remove the inlet pipe assembly carefully.

Installation

Caution
• Check that coolant has been added to the specified level after installation.

1. Installation is in the reverse order of removal.
   Torque: 5 ± 1 N·m

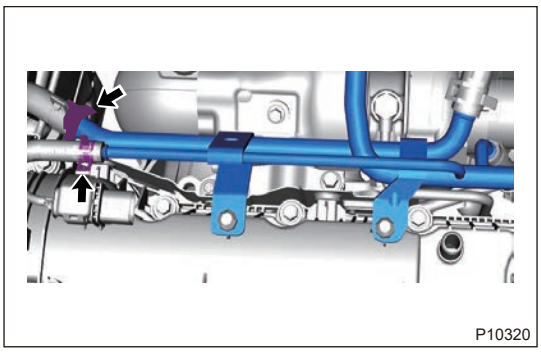
Cooling Pipe Assembly

Removal

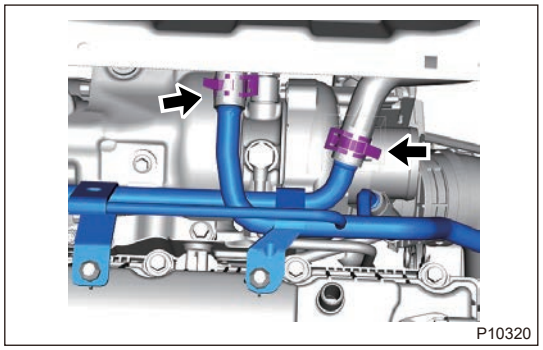
Warning
• Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns. • If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Remove the intake hose assembly.
4. Drain the coolant.
5. Remove the coolant pipe assembly.

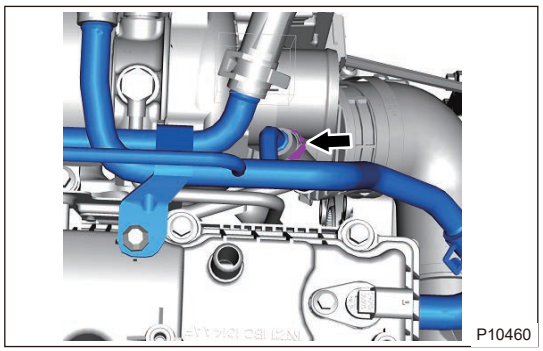
6. Loosen elastic clamp (arrow) and disconnect connection between cooling pipe assembly and expansion tank water pipe.
7. Loosen elastic clamp (arrow) and disconnect connection between cooling pipe assembly and expansion tank inlet pipe.



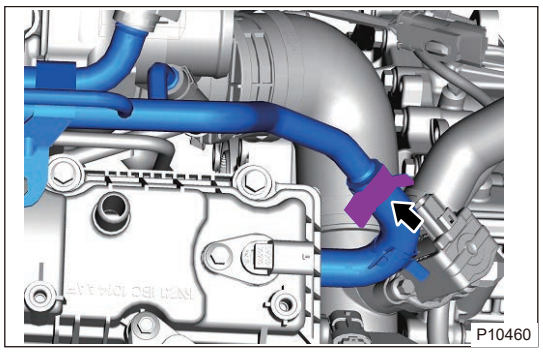
8. Loosen elastic clamp (arrow) and disconnect connections between cooling pipe assembly and heating inlet & outlet pipes.



9. Loosen elastic clamp (arrow) and disconnect connection between cooling pipe assembly and turbocharger outlet pipe.

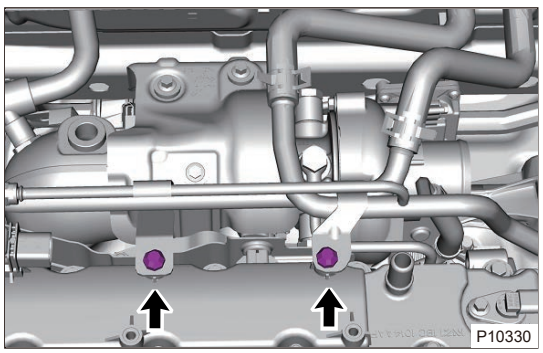


10. Loosen elastic clamp (arrow) and disconnect connection between cooling pipe assembly and cylinder head outlet.



11. Remove 2 fixing bolts (arrow) and cooling pipe assembly.

Tightening torque: 5 ± 1 N·m



Installation

Caution
Check that coolant has been added to the specified level after installation.

1. Installation is in the reverse order of removal.

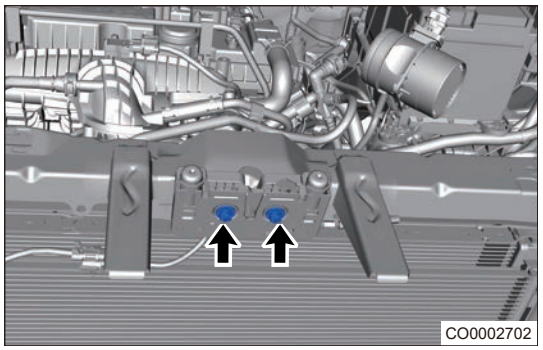
Tank Upper Crossmember

Removal

Warning
• Temperature in engine compartment is very high when engine is running. Before removal, you must make sure that engine has shut off, and engine compartment has cooled down sufficiently, otherwise, there is a risk of scald injury. • Be sure to wear safety equipment to prevent accidents, when removing tank upper crossmember. • Appropriate force should be applied when removing tank upper crossmember. Be careful not to operate roughly.

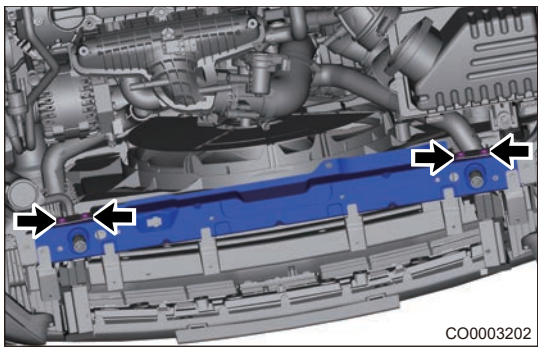
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the air filter assembly.
3. Remove the grille.
4. Remove the tank upper crossmember.

5. Remove 2 fixing bolts (arrow) from engine hood lock.

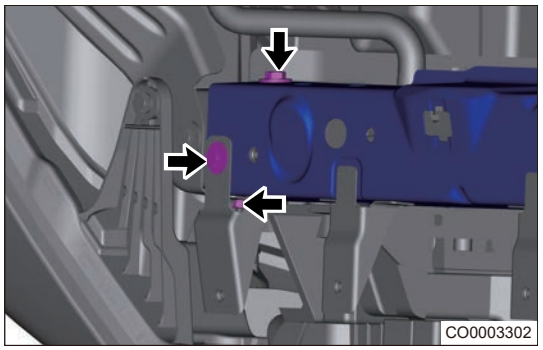


6. Remove 4 fixing bolts (arrow) from tank left and right mounting brackets.

Tightening torque: 10 ± 1.5 N·m



7. Remove 6 fixing bolts (arrow) from tank upper crossmember.



8. Remove the tank upper crossmember.

Installation

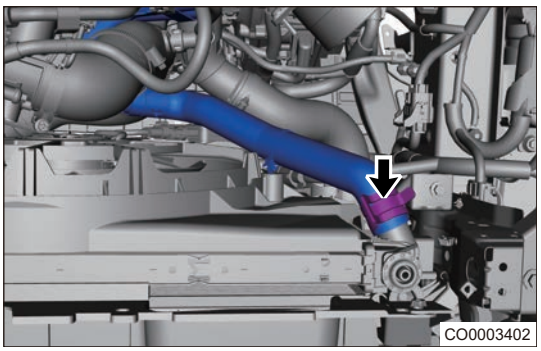
1. Installation is in the reverse order of removal.

Cooling Fan Assembly

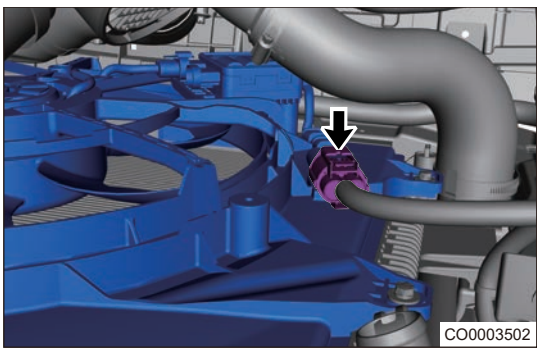
Removal

Warning
• Perform removal procedures with engine compartment at low temperature, after cooling fan stops completely, to prevent accidents. • Be sure to wear safety equipment to prevent accidents, when removing cooling fan assembly. • Appropriate force should be applied, when removing cooling fan assembly. Be careful not to operate roughly.

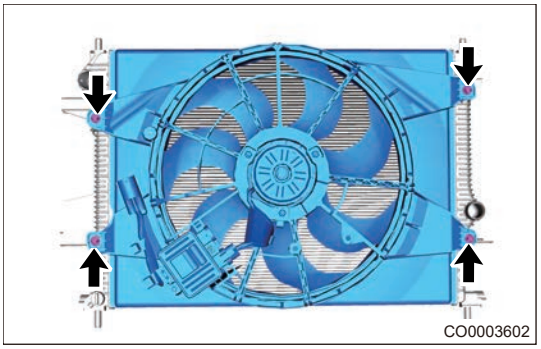
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Remove the air filter assembly.
5. Remove the tank upper crossmember assembly.
6. Remove the cooling fan assembly.
7. Loosen elastic clamp (arrow) and disconnect the engine inlet pipe.



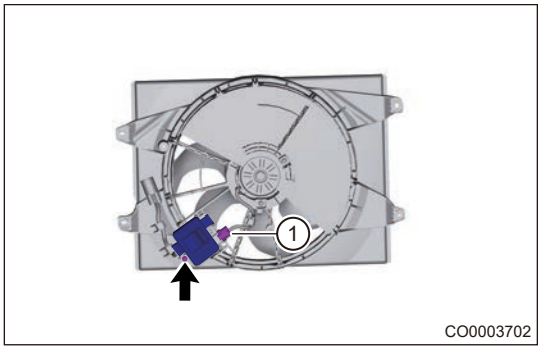
8. Disconnect the cooling fan connector (arrow).



9. Remove 4 fixing bolts (arrow) between cooling fan assembly and radiator assembly.



10. Remove the cooling fan assembly.
11. Disconnect the cooling fan connector (1) and remove 1 fixing bolt (arrow) from cooling fan controller.



12. Remove the cooling fan controller.

Installation

1. Installation is in the reverse order of removal.

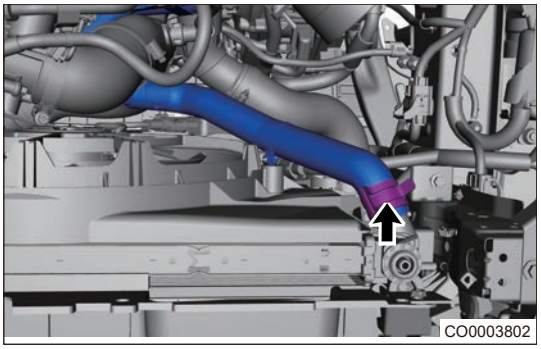
Radiator Assembly

Removal

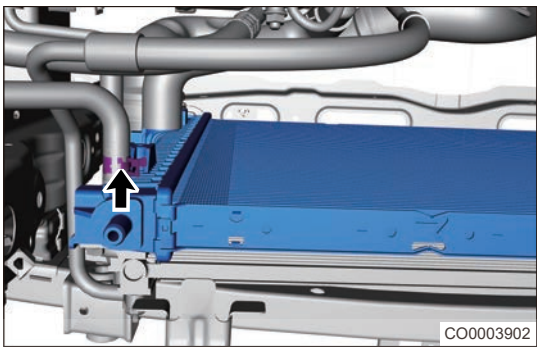
Warning
• Temperature in engine compartment is very high when engine is running. Before removal, you must make sure that engine has shut off, and engine compartment has cooled down sufficiently, otherwise, there is a risk of scald injury. • Be sure to wear safety equipment to prevent accidents, when removing radiator assembly. • Appropriate force should be applied, when removing the radiator assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Remove the air filter assembly.
5. Remove the front bumper assembly.
6. Remove the front impact beam assembly.
7. Remove the air deflector assembly.
8. Remove the radiator assembly.

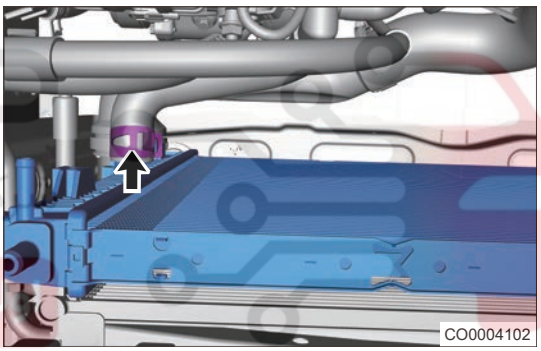
9. Loosen elastic clamp (arrow) and disconnect connection between engine inlet pipe and radiator assembly.


CO0003802

10. Loosen elastic clamp (arrow) and disconnect connection between radiator assembly water pipe and expansion tank.

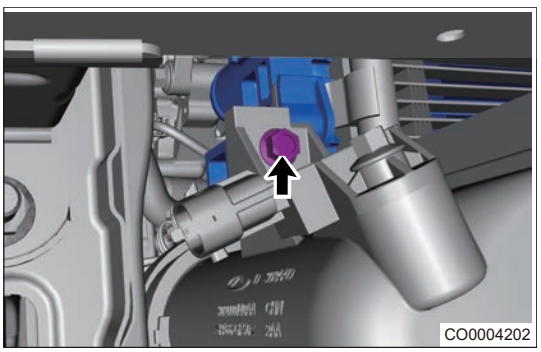

CO0003902

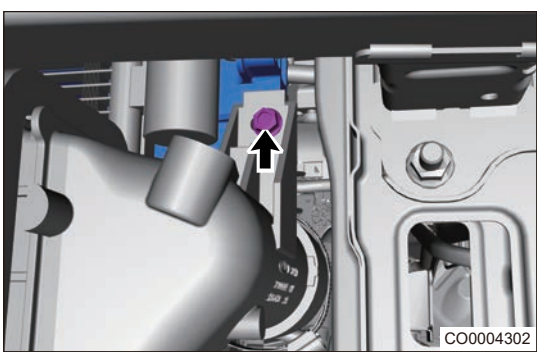
11. Loosen elastic clamp and disconnect connection between engine outlet pipe and radiator assembly.


CO0004102

12. Remove 2 fixing bolts (arrow) between radiator assembly and intercooler.

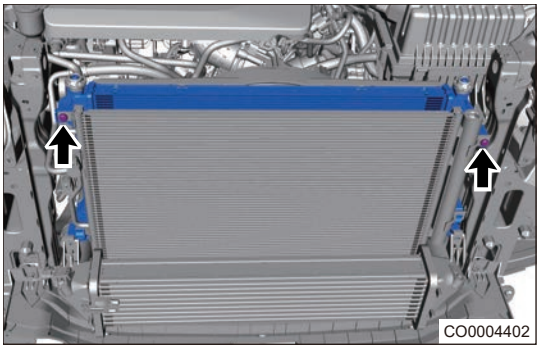
Tightening torque: 5 ± 1 N·m


CO0004202


CO0004302

13. Remove 2 fixing bolts (arrow) between radiator assembly and condenser assembly.

Tightening torque: 5 ± 1 N·m



14. Remove the radiator assembly.

Installation

Caution
Check that coolant has been added to the specified level after installation.

1. Installation is in the reverse order of removal.

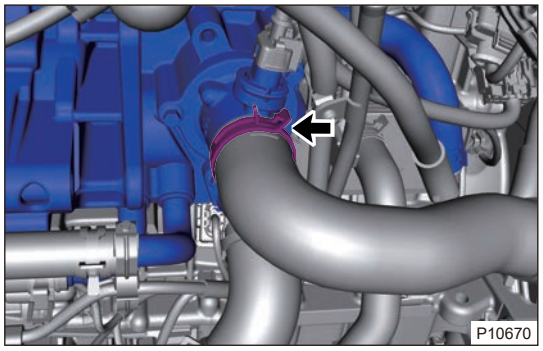
Water Pump Module Assembly

Removal

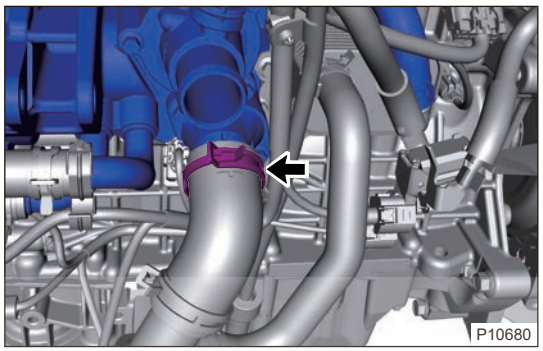
Warning
• Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns. • If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital. • Be sure to wear safety equipment to prevent accidents, when removing water pump module. • Appropriate force should be applied when removing water pump module. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Remove the engine compartment lower protector assembly.
5. Remove the engine accessory belt.
6. Drain the coolant.
7. Remove the alternator assembly.
8. Remove the oil dipstick guide assembly.

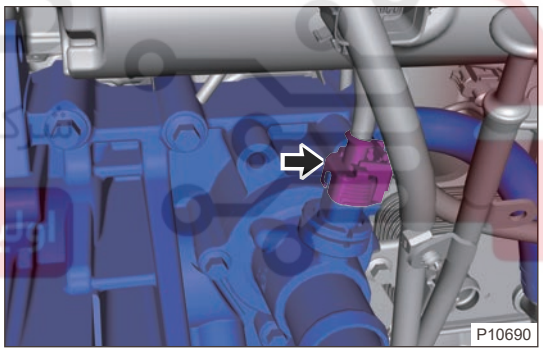
9. Loosen elastic clamp and disconnect connection between water pump module assembly and engine inlet pipe.



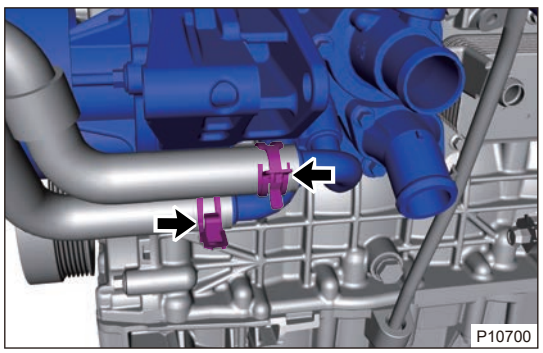
10. Loosen elastic clamp and disconnect connection between water pump module assembly and engine outlet pipe.



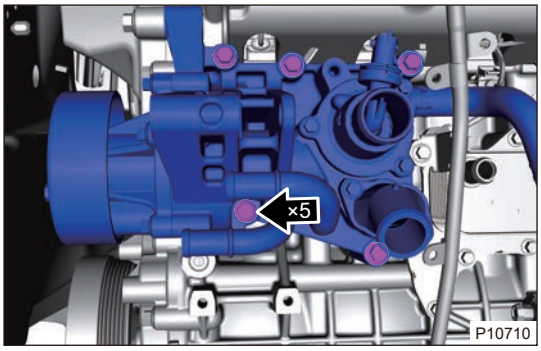
11. Disconnect the electronic thermostat connector.



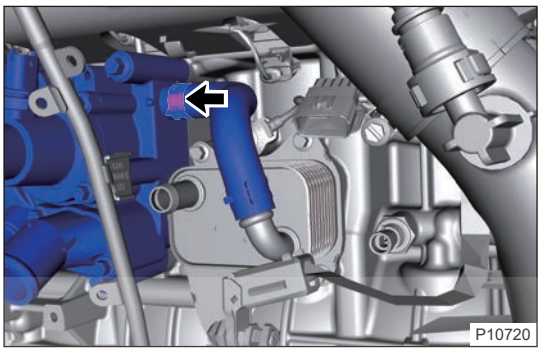
12. Loosen elastic clamp and disconnect connection between water pump module assembly and inlet pipe.



13. Remove 5 fixing bolts from water pump module.



14. Loosen clamping ring and disconnect connection between water pump module assembly and oil filter module inlet pipe.



15. Remove water pump module assembly carefully.

Installation

1. Connect the oil filter module inlet pipe to water pump module, and tighten clamping ring.
2. Install the water pump module assembly to cylinder block mounting surface and install 5 bolts to the corresponding positions. Pre-tighten the bolts first so that water pump module can be pressed and fitted, and then tighten them to specified torque.

   Torque: 20 + 5 N•m

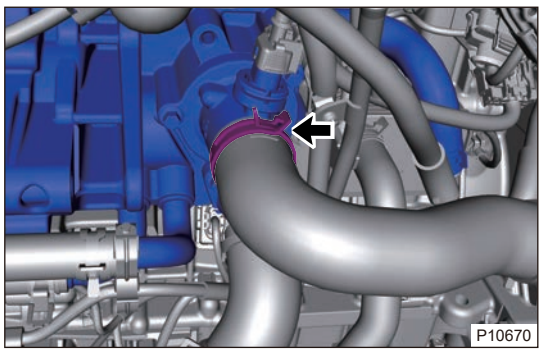
3. Connect the inlet pipe to water pump module, and install elastic clamp.
4. Connect the engine outlet pipe to water pump module, and install elastic clamp.
5. Connect the engine inlet pipe to water pump module, and install elastic clamp.
6. Connect the electronic thermostat connector.
7. Install the oil dipstick guide assembly.
8. Install the alternator assembly.
9. Add the coolant.

Electronic Thermostat Assembly

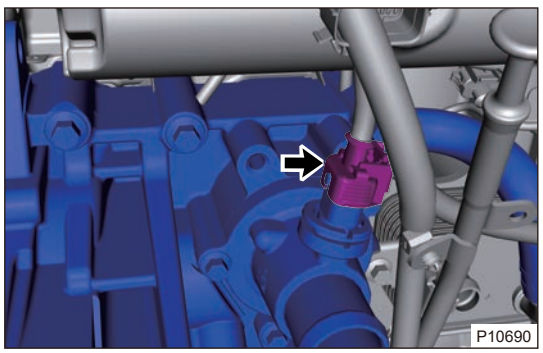
Removal

Warning
• Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns. • If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital. • Be sure to wear safety equipment to prevent accidents, when removing water pump module. • Appropriate force should be applied when removing water pump module. Be careful not to operate roughly.

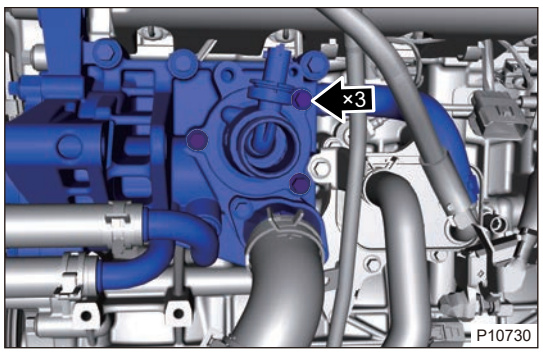
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Drain the coolant.
5. Loosen elastic clamp and disconnect connection between water pump module assembly and engine inlet pipe.



6. Disconnect the electronic thermostat connector.



7. Remove 3 fixing bolts from electronic thermostat.



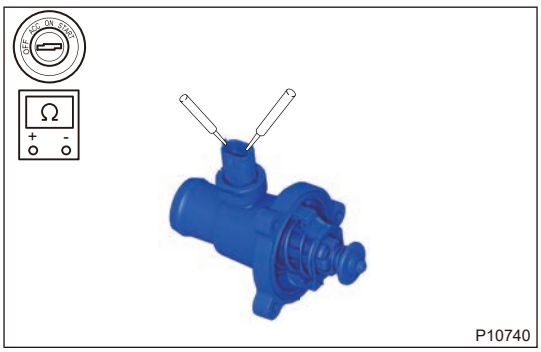
8. Remove the electronic thermostat.

Inspection

1. Check the electronic thermostat assembly seal ring for damage.

2. As shown in illustration, check the electronic thermostat heating resistance with ohm band of multimeter.

Multimeter Connection	Specified Value (Ω)
Terminal 1 - Terminal 2	15.3

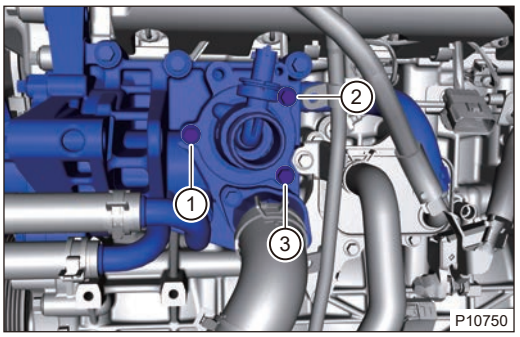


Caution
• If resistance is not as specified, replace the electronic thermostat.

Installation

1. Install the electronic thermostat to water pump module, pre-tighten 3 fixing bolts with tools, then tighten them in order (1 - 2 - 3 - 1) shown in illustration.

   Torque: 8 + 3 N·m



2. Connect the engine inlet pipe to water pump module, and install elastic clamp.
3. Connect the electronic thermostat connector.
4. Add the coolant.

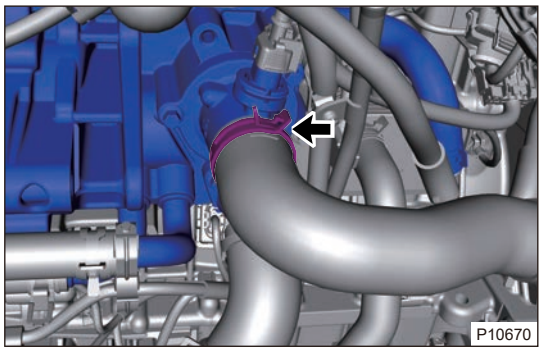
Engine Outlet Cover Assembly

Removal

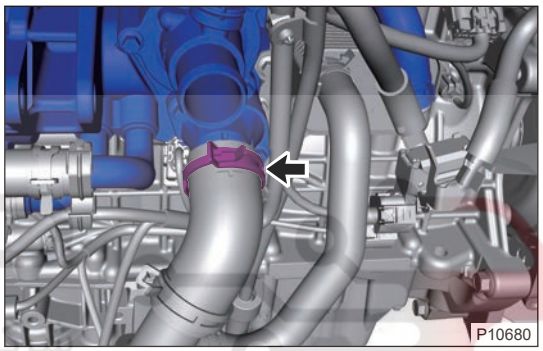
Warning
• Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns. • If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital. • Be sure to wear safety equipment to prevent accidents, when removing engine outlet cover. • Appropriate force should be applied, when removing engine outlet cover. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Drain the coolant.

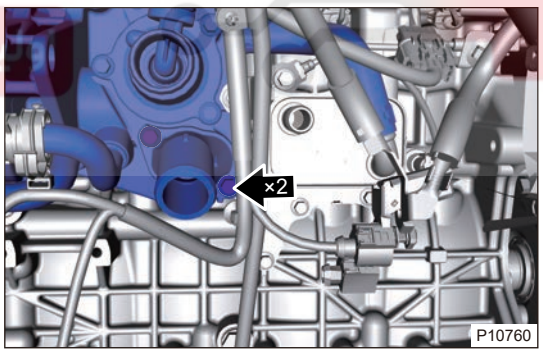
5. Loosen elastic clamp and disconnect connection between water pump module assembly and engine inlet pipe.



6. Loosen elastic clamp and disconnect connection between water pump module assembly and engine outlet pipe.



7. Remove 2 fixing bolts from engine outlet cover.



8. Remove the engine outlet cover.

Inspection

1. Check the engine outlet cover seal ring for damage.
2. Install the seal ring to engine outlet cover, and check if it is installed in place.

Installation

1. Install the engine outlet cover to water pump module, pre-tighten 2 fixing bolts first, and then tighten them.

   Torque: 8 + 3 N·m

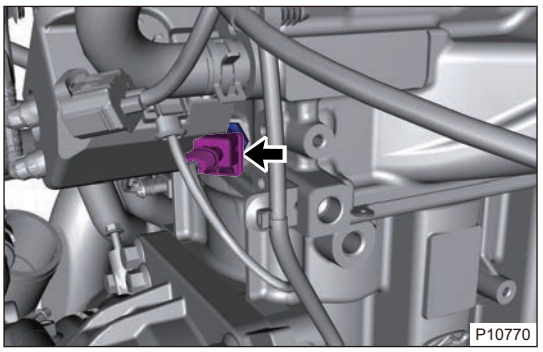
2. Connect the engine outlet pipe to water pump module, and install elastic clamp.
3. Connect the engine inlet pipe to water pump module, and install elastic clamp.
4. Add the coolant.
5. Install the engine compartment trim cover assembly.

Coolant Temperature Sensor

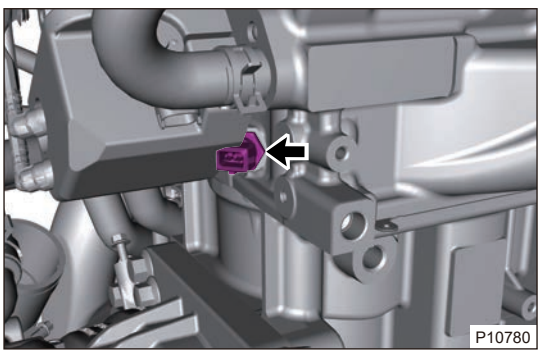
Removal

Warning
• Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns. • If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital. • Be sure to wear safety equipment to prevent accidents, when removing coolant temperature sensor Ⅰ. • Appropriate force should be applied when removing coolant temperature sensor Ⅰ. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Remove the intake hose assembly.
5. Remove the intercooler intake pipe Ⅱ.
6. Drain the coolant.
7. Disconnect the coolant temperature sensor connector.



8. Remove the coolant temperature sensor.



Installation

1. Install the coolant temperature sensor.

   Torque: 15 ± 1 N·m

   Seal gum: Loctite 577

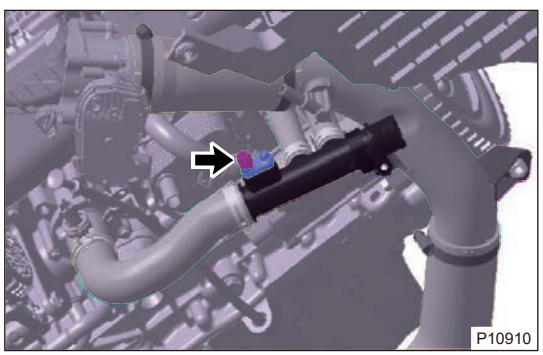
2. Connect the coolant sensor connector.
3. Install intercooler intake pipe Ⅱ.
4. Install the intake hose assembly.
5. Add the coolant.
6. Install the engine compartment trim cover assembly.

Coolant Temperature Sensor

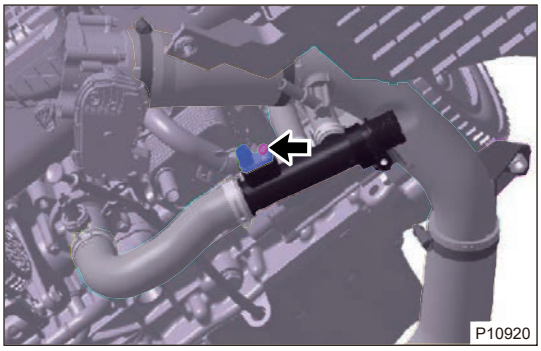
Removal

Warning
• Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns. • If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital. • Be sure to wear safety equipment to prevent accidents, when removing coolant temperature sensor Ⅱ. • Appropriate force should be applied when removing coolant temperature sensor Ⅱ. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Drain the coolant.
5. Disconnect the coolant temperature sensor connector.



6. Remove 1 fixing bolt of coolant temperature sensor from engine inlet pipe.



7. Remove the coolant temperature sensor.

Installation

1. Install the coolant temperature sensor.
   Torque: 9 ± 1.5 N·m
2. Connect the coolant temperature sensor connector.
3. Add the coolant.
4. Install the engine compartment trim cover assembly.

Lubrication System

Warnings and Precautions

Warnings

In order to avoid possible property loss, personal injury or death, always follow the instructions below before repair:

1. Prolonged and repeated contact with engine oil will result in the removal of natural oils from skin, leading to dryness, irritation and dermatitis. In addition, the used engine oil contains potentially harmful contaminants, which may cause skin cancer.
2. Wear protective clothing and gloves.
3. Wash your skin thoroughly with soap and water, or use waterless hand cleaner to remove any used engine oil.
4. Never use gasoline, thinners or solvents.
5. Before performing the operation. Wait for the engine to cool down completely.

Precautions

In order to avoid dangerous operation and damage to the vehicle before repair in this section, always follow the instructions below before repair:

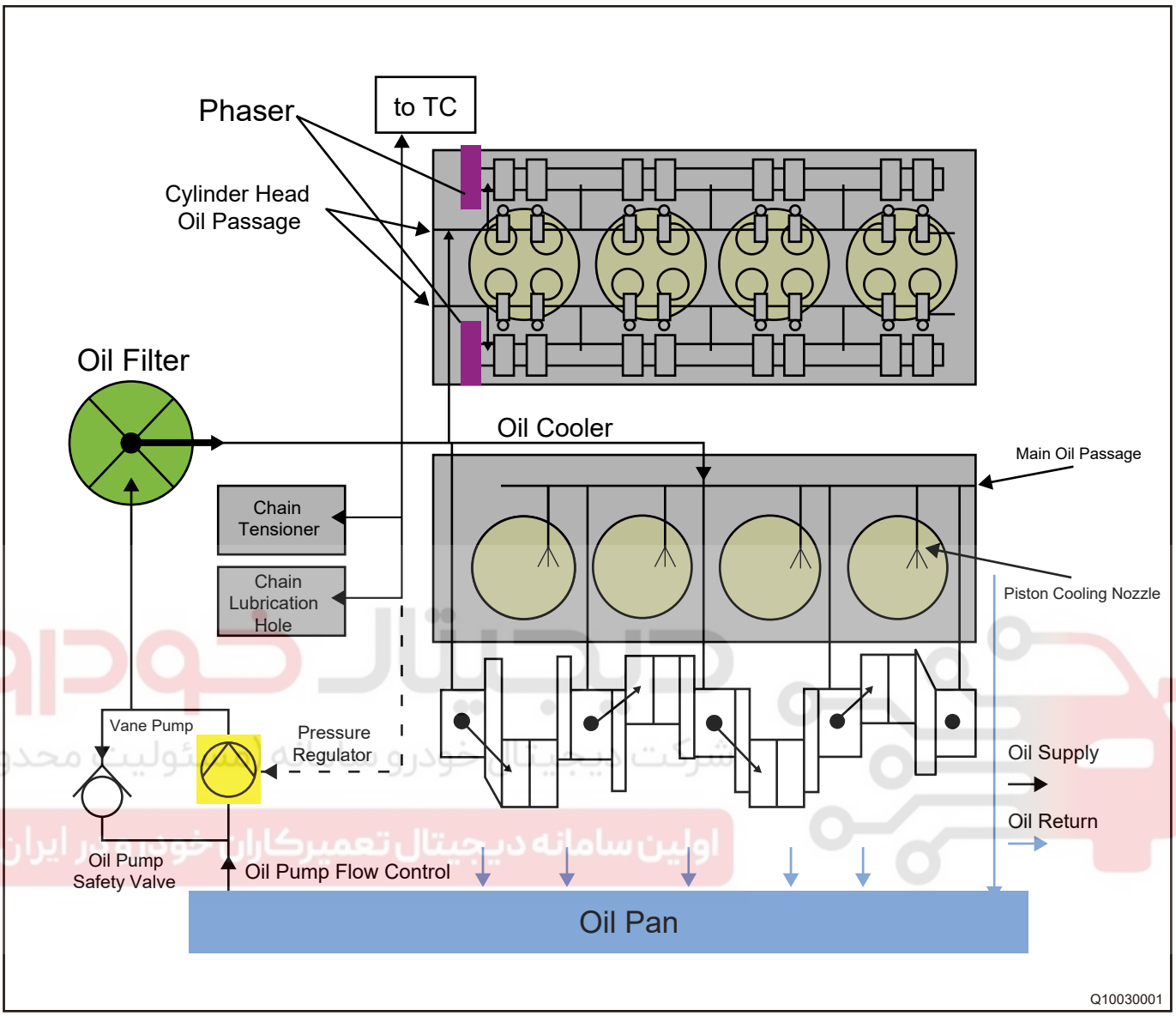
1. Wasted engine oil should be handled by specialized department according to local laws and regulations. Never discard it at will.
2. DO NOT use inferior engine oil.
3. DO NOT mix different types of engine oil.

System Overview

System Description

The function of lubrication system is that when engine is operating, crankshaft drives the oil pump through chain to suck out the oil from oil pan, and engine oil is filtered by oil filter The filtered oil then flows through oil passages to friction surfaces of all engine drive parts and forms oil films between friction surfaces to realize liquid friction and finally returns to the oil pan, thus reducing friction resistance between drive parts, power consumption and increasing reliability and durability of engine operation.Oil pump of SQRF4J20 engine is installed in oil pan. Crankshaft transmits power to it through chain. Oil pump is a two-stage variable displacement pump, and its displacement is changed by controlling oil pressure regulating solenoid valve through ECU.

System Schematic Diagram



Crankshaft drives oil pump to sucks oil from oil pan. The oil is filtered by oil filter and delivered to crankshaft connecting rod mechanism and cam valve mechanism, including some accessories such as turbocharger through main oil passage.

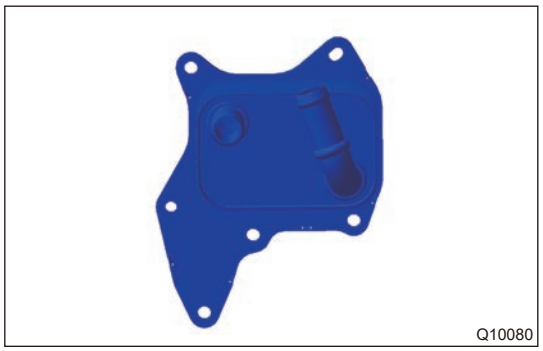
System Components Description

Oil Pump Assembly

Oil pump of SQRF4J20 engine is installed in oil pan. Crankshaft transmits power to it through chain. Oil pump is a two-stage variable displacement pump, and its displacement is controlled by ECU through oil pressure regulating solenoid valve. Oil pump adopts vane type variable displacement structure, and main structure is stator and rotor; There are two oil pressure chambers on the outer ring of stator to apply pressure control to the stator, so that it can deflect clockwise or counterclockwise around the fulcrum, changing the eccentricity ratio of vane pump and adjusting displacement.

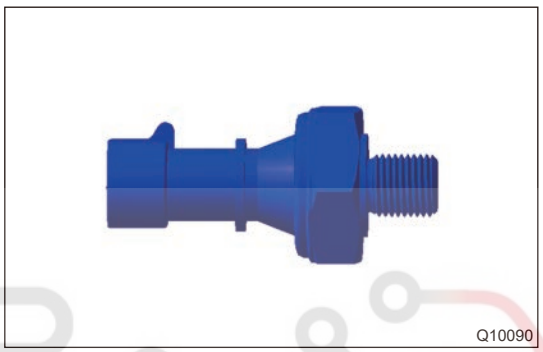
Oil Cooler Assembly

Oil cooler is on the circulation oil passage of lubrication system. During engine running, as oil viscosity becomes lean with temperature increasing , lubricating ability is reduced. Oil cooler is used to cool the lubricant, keep the oil temperature within normal operating range, reduce oil temperature and maintain a certain viscosity of lubricant.



Oil Pressure Switch

Oil pressure switch is installed on the main oil passage of engine block and used to detect the value of engine oil pressure. When the value is lower than the specified value, oil pressure warning light is turned on.



Oil Filter

It is used to remove impurities such as dust, metal particles, carbon deposits and soot particles in oil to protect the engine.

Oil Collector

In order to make oil pump work well, filter large particle impurities in lubricant before entering oil pump.

Diagnosis & Testing

Problem Symptoms Table

Hint:

Use symptoms table below to help determine cause of problem. Check each suspected area in sequence. Repair, replace or adjust faulty components as necessary.

Lubrication System

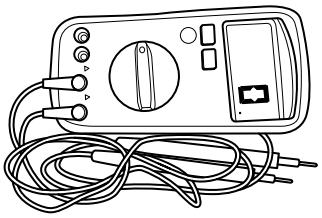
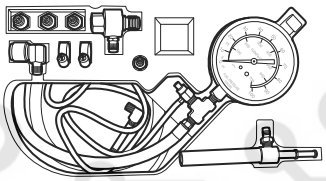
Symptom	Possible Cause
Low pressure in lubrication system	Oil pan (dirty, leaky)

Symptom	Possible Cause
	Oil collector (mesh dirty, blocked)
	Spark Plug
	Line blocked
High pressure in lubrication system	Oil with high viscosity
	Oil passage blocked
	Oil pump (non-variable displacement)
Mix oil with water	Oil filter module assembly internal leakage
	Cylinder head gasket improperly sealed
	Cylinder block cracks
High oil consumption	Engine oil (excessive filling capacity)
	Oil filter module assembly (leaky)
	Crankshaft front oil seal (damaged)
	Crankshaft rear oil seal (damaged)
	Oil pressure switch (leaky)
	Oil drain plug (leaky)
	Oil pan (leaked)
	Cylinder head gasket (damaged)
	Piston ring (damaged)
	Each engine seal surface leakage
Oil pressure warning light comes on	Engine oil (insufficient oil, low oil viscosity)
	Oil filter element (blocked)
	Oil strainer (blocked)
	Crankshaft front oil seal (damaged)
	Crankshaft rear oil seal (damaged)
	Oil pressure switch (damaged)
	Instrument cluster (oil pressure warning light)
	Cylinder block (cracks occur in water jacket, resulting in coolant leaking into oil pan, which will cause oil dilution)
	Line (blocked)

On-Vehicle Service

Tools

General Tools

Tool Name	Tool Drawing
Digital Multimeter	 S00002
Oil Pressure Tester	 S00035

Lubrication Areas on Engine

No.	Lubrication Area	Lubricant Type	Note
1	Oil Collector O-ring	Same type as engine oil	
2	Oil Filter O-ring	Same type as engine oil	Operation during maintenance
4	Dipstick Tube O-ring	Same type as engine oil	
5	Dipstick Handle O-ring	Same type as engine oil	
6	Oil Pump Rotor Cavity	Same type as engine oil	
7	Oil Filter Inlet	Same type as engine oil	

Seal Gum Application Areas on Engine

No.	Area with Seal Gum Applied	Seal Gum Type	Note
1	Mounting Flange Surfaces Between Oil Pan and Cylinder Block & Timing Chain Cover	Loctite 5900H	
2	Oil Pressure Switch Thread	Loctite 577	
3	Oil Pump Mounting Bolt	Loctite 243	

No.	Area with Seal Gum Applied	Seal Gum Type	Note
4	Collector Mounting Bolt	Loctite 243	
5	Oil Cooler Mounting Bolt	Loctite 243	

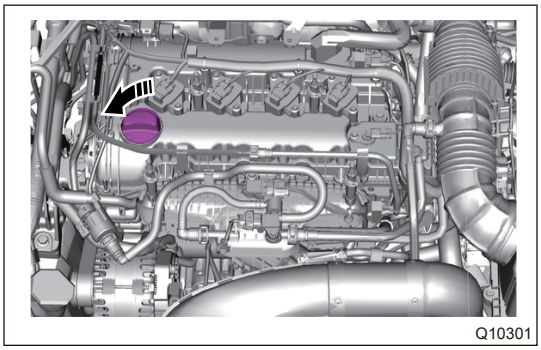
Engine Oil Draining, Adding and Inspection

Drain the engine oil

Warning

- Wait for the engine cool down completely before operation.
- Prolonged and repeated contact with engine oil will result in the removal of natural oils from skin, leading to dryness, irritation and dermatitis. In addition, the used engine oil contains potentially harmful contaminants, which may cause skin cancer. Therefore, always take proper skin protection measures when performing vehicle service. Be sure to take appropriate skin protection measures.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Remove the engine compartment trim cover assembly.
4. Turn the oil filler door counterclockwise to open.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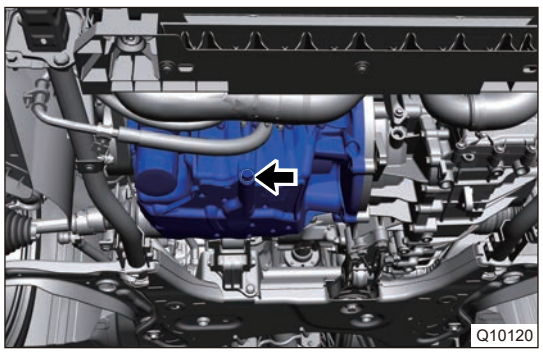
5. Raise the vehicle to a proper position.
6. Remove drain plug with a #17 socket wrench, and drain the oil into a container.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Caution

- Apply a certain pushing force to drain plug while loosening the plug by hand, and have the drain plug attached to thread tightly to prevent oil from overflowing in advance. Move away your hand quickly to prevent burn by oil with a certain temperature.
- Wasted engine oil should be handled by specialized department according to local laws and regulations. Never discard it at will.

7. Wipe off the drain plug and tighten it.
   Torque: 35 ± 3 N•m

Caution
• The drain plug gasket must be replaced each time the drain plug is removed.

Engine Oil Adding

Caution
• DO NOT use inferior engine oil. • DO NOT mix different types of engine oil. • Be careful not to spill engine oil on any part of the engine when adding engine oil.

1. It is recommended to add lubricant to upper center of dipstick, there are several situations:

	Engine Status	Recommended Value
Charging Capacity	Status without oil (apply to the first adding after assembling such as engine production and major maintenance)	4.6 ± 0.2
	Replace oil filter assembly and lubricant at same time	4.0 ± 0.1
	Do not replace oil filter assembly, only replace lubricant	3.5 ± 0.2
Oil Type	C5 0W - 20	
Others	1. If lubricant needs to be added during maintenance, it is recommended to add to upper center of dipstick measurement part. 2. Do not exceed upper line of dipstick while adding lubricant, or it will affect the engine performance.	

2. Start engine, and check the vehicle for leakage after replacing oil.

Inspection Method of Lubricant Level

1. Park the vehicle in a relatively horizontal position.
2. Keep engine running at least 2 minutes and leave is stopped for 3 ~ 5 minutes.
3. Pull out the dipstick, wipe off the measurement part and insert it into dipstick tube, then leave it for 3 ~ 5 s.
4. Pull out the dipstick steady and place the measurement part horizontally. Visually check that oil level of measurement part is within upper mark and lower mark, it indicates oil level is normal.

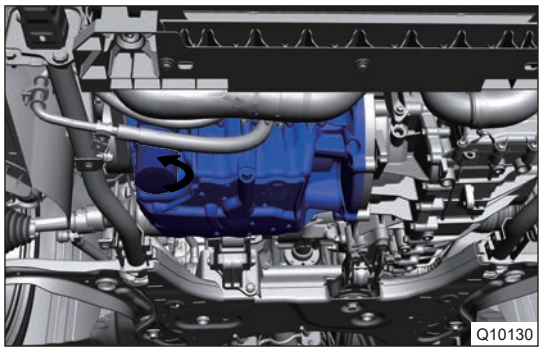
Caution
• Do not start the engine during the measurement.

Oil Filter

Removal

Warning
• DO NOT remove oil filter until engine cools down, avoiding being burned by high temperature lubricant and parts. • Prolonged and repeated contact with engine oil will be harmful to your skin. If engine oil spills on your skin, wash it off immediately with water. In addition, the used engine oil contains potentially harmful contaminants, which may cause skin cancer. Therefore, always take proper skin protection measures when performing vehicle service.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Remove the engine lower protector assembly.
4. Drain engine oil.
5. Rotate it counterclockwise with special tools until oil filter is removed.



6. There may be residual oil in oil filter after removing oil filter. Make sure to place the oil filter port with it faces up after removing and discard the old oil filter assembly in an environmentally friendly way.

Installation

Caution
• Check oil pan upper mounting surface for foreign matter, such as old oil filter seal ring before installation. • Check oil filter seal ring for defect or foreign matter. When assembling, seal ring needs to be lubricated.

1. Tighten the pipe joints with tools again.

   Torque: 50 ± 5 N·m

2. Clean the mounting surface of oil filter and add a proper amount of oil in oil filter. Recommended adding amount: 5 mL. Apply a small amount of lubricant to oil filter mounting surface seal ring evenly.
3. Install the oil filter manually until seal ring contacts mounting surface, then tighten it with special wrench tools.

   Torque: 22 ~ 25 N·m

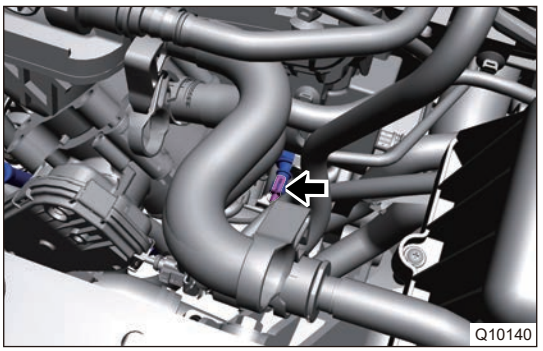
4. Add the lubricant to engine according to the recommended adding amount after installation.

Oil Pressure Switch

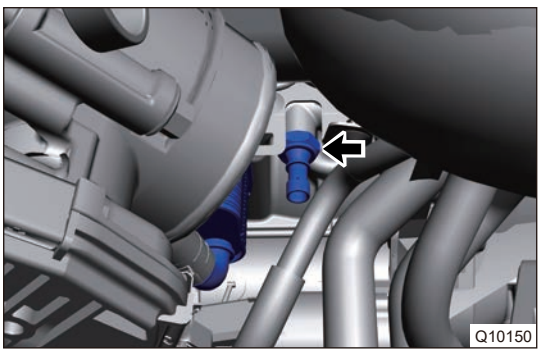
Removal

Caution
• DO NOT remove oil pressure switch until engine cools down, avoiding being burnt by high temperature lubricant and parts. • Prolonged and repeated contact with engine oil will be harmful to your skin. If engine oil spills on your skin, wash it off immediately with water. In addition, the used engine oil contains potentially harmful contaminants, which may cause skin cancer. Therefore, always take proper skin protection measures when performing vehicle service.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover.
3. Disconnect the negative battery cable.
4. Disconnect the connection between intercooler outlet pipe assembly Ⅱ and electronic throttle.
5. Disconnect the oil pressure switch connector.



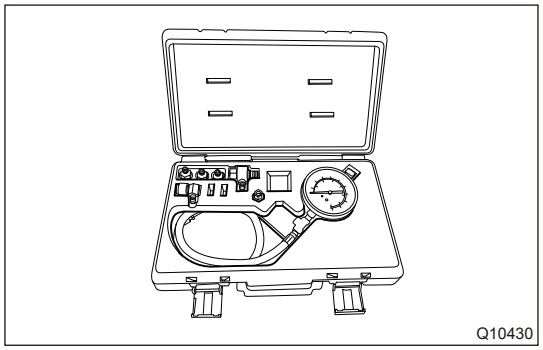
6. Remove the oil pressure switch.



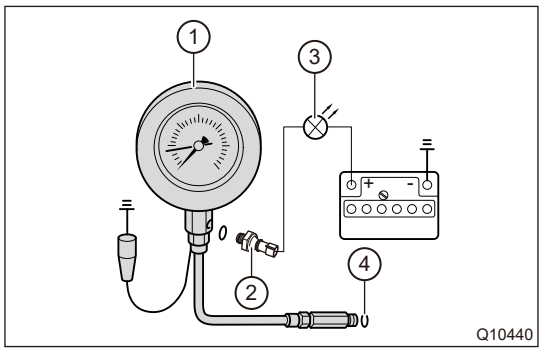
Inspection

Caution
• Before inspecting oil pressure switch, please make sure that oil level is proper and coolant temperature is above 90℃, and that oil filter is used within 5000 Km.

1. Use an oil pressure gauge as shown in the illustration.



2. Install the oil pressure gauge into the threaded hole (4) of oil pressure switch as shown in the illustration.
3. Install the oil pressure switch (2) to the gauge (1), and connect the LED light (3).
4. When engine is not started, observe the pressure reading on gauge. Oil pressure alarm value is 30 - 50 kPa.



Installation

Caution
• Apply seal gum (Loctite 577) to threads when assembling oil pressure switch.

1. Apply a circle of sealant to oil pressure switch thread head (2nd - 5th tooth) evenly.
2. Install the oil pressure switch to cylinder block and use extended sleeve tools to tighten it.

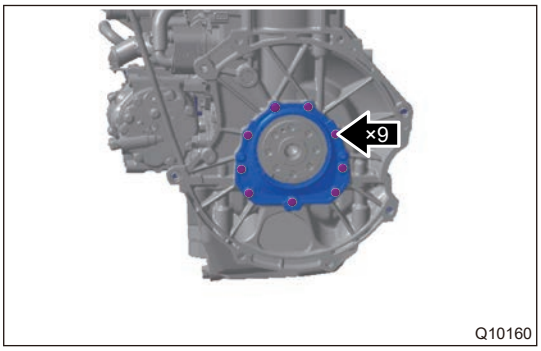
   Torque: 12 ~ 15 N·m

Oil Pan Assembly

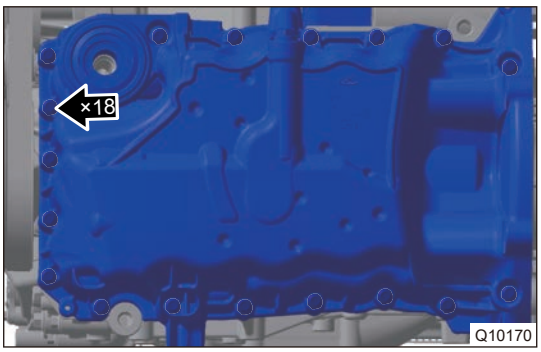
Removal

Warning
• DO NOT drain oil and remove oil pan until engine cools down. • Prolonged and repeated contact with engine oil will be harmful to your skin. If engine oil spills on your skin, wash it off immediately with water. In addition, the used engine oil contains potentially harmful contaminants, which may cause skin cancer. Therefore, always take proper skin protection measures when performing vehicle service.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Drain engine oil.
4. Remove the engine compartment lower protector assembly.
5. Remove the engine accessory belt.
6. Remove fixing bolts from the compressor assembly, and move compressor assembly to a proper position.
7. Remove the oil filter assembly.
8. Remove the pipe joints.
9. Remove the transmission assembly.
10. Remove 9 fixing bolts from rear oil seal bracket.



11. Remove 18 fixing bolts around the oil pan.



12. Clamp the oil pan special tool into joint, and tap all around oil pan slightly with a rubber hammer to remove oil pan assembly.

Caution
• Because the seal gum is sealed between oil pan and cylinder block, never use hard objects, such as a hammer, to tap it during removal, but it can be tapped slowly from left and right with a rubber hammer. • A transmission carrier can be used to support the oil pan during removal, to prevent personal injury from sudden dropping of oil pan. • DO NOT damage or miss dowel pin when removing oil pan.

13. Remove the residual seal gum on oil pan and engine frame with flat scraper.

Caution
• Remove residue of seal gum on mounting surface between oil pan and engine frame. Threaded hole can be cleaned with cleaner properly.

Inspection

1. Check the appearance of oil pan assembly for damage.
2. Check if the oil pan mounting surface is within the specified range.

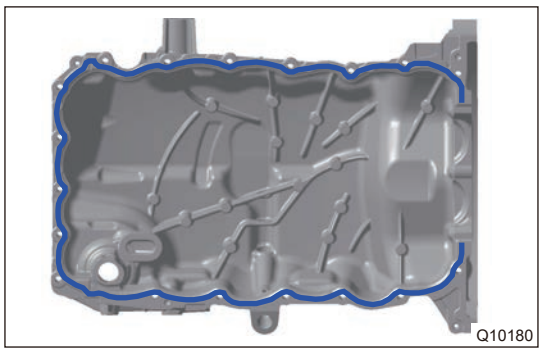
Installation

Caution
• When applying seal gum, check the type and expiration date of seal gum. • Check mounting surface for impact or abrasion. • Remove impurities, iron chips and residue of seal gum on oil pan. • Remove oil stain and residue of seal gum on the threaded hole of cylinder block and oil pan. • Seal gum should not be applied too thick; otherwise it will overflow into oil pan due to squeezing, which will block the oil collector. • Add engine oil until seal gum solidifies after installing oil pan.

1. As shown in illustration, apply seal gum to inside of oil pan installation bolt hole evenly.

   Recommended seal gum: Loctite 5900H

   Seal gum line diameter: 2 - 3 mm

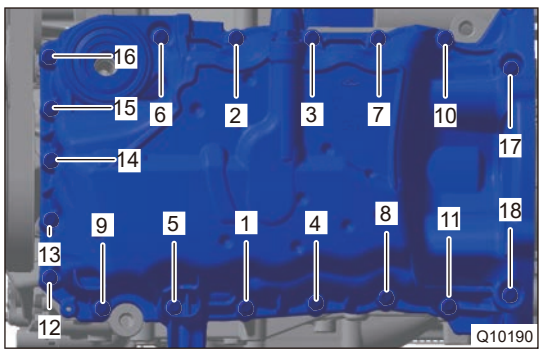


Caution
• The applied gum line should be continuous without broken. • The assembly of oil pan must be finished within 10 minutes after applying gum.

2. Align oil pan with frame dowel pin, assemble oil pan and tap it slightly to fit it with frame closely.

3. As shown in illustration, pre-tighten oil pan fixing bolts until oil pan is pressed tightly. Then tighten bolts in order.

   Torque: 8 + 3 N·m



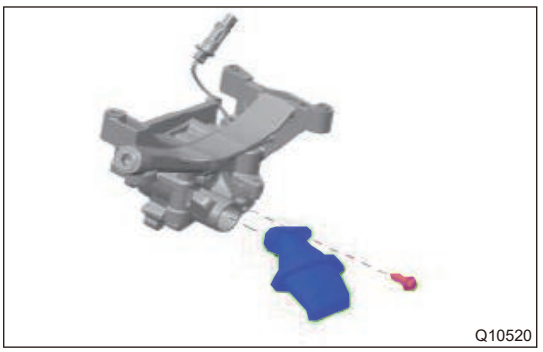
4. Install the rear oil seal bracket.
5. Install the transmission assembly.
6. Install the pipe joints assembly.
7. Install the oil filter assembly.
8. Install 1 fixing bolt to oil pan and drive shaft bracket.
9. Install 3 fixing bolts between oil pan and transmission assembly.
10. Install the compressor assembly.
11. Install the engine lower protector assembly.
12. Add engine oil to specified value.

Oil Collector

Removal

Warning
• DO NOT drain oil and remove oil pan until engine cools down. • Prolonged and repeated contact with engine oil will be harmful to your skin. If engine oil spills on your skin, wash it off immediately with water. In addition, the used engine oil contains potentially harmful contaminants, which may cause skin cancer. Therefore, always take proper skin protection measures when performing vehicle service.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Drain engine oil.
4. Remove the oil pan assembly.
5. Remove 1 fixing bolt from oil collector.



6. Remove the oil collector carefully.

Inspection

1. Check collector O-ring for damage or cracks.
2. Check oil collector for dirty or blockage, and clean or replace it as necessary.

Installation

Caution
• Add a certain amount of lubricant to oil collector mounting hole of oil pump before installing, so that oil pump rotor cavity can be lubricated. Recommended adding amount is: 5 mL.

1. Apply a small amount of lubricant to O-ring surface of the oil collector.
2. Install oil collector to oil pump mounting hole, and align the fixing bolt hole.
3. Apply a circle of fixing bolt threads head evenly. Ensure application amount for (3 - 5) teeth. Insert the bolts into bolt holes and tighten bolts.

   Recommended lock adhesive: Loctite 243

   Torque: 8 + 3 N·m

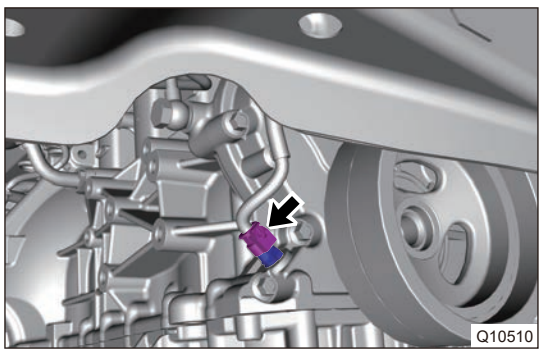
4. Install the oil pan assembly.
5. Add engine oil to specified value.

Oil Pump Assembly

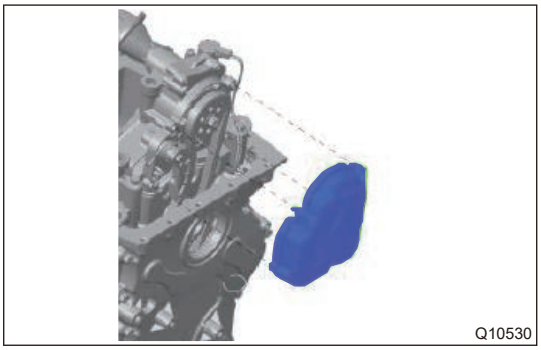
Removal

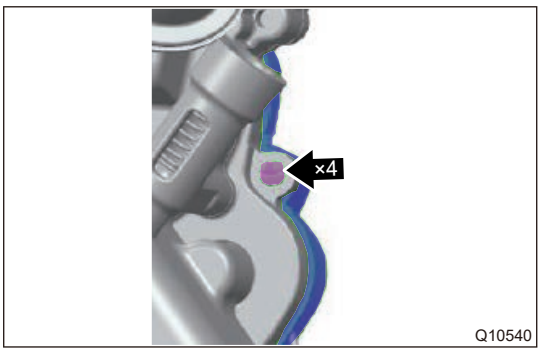
Warning
• DO NOT drain oil and remove oil pan until engine cools down. • Prolonged and repeated contact with engine oil will be harmful to your skin. If engine oil spills on your skin, wash it off immediately with water. In addition, the used engine oil contains potentially harmful contaminants, which may cause skin cancer. Therefore, always take proper skin protection measures when performing vehicle service.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Drain engine oil.
4. Remove the oil pan assembly.
5. Remove the oil collector assembly.
6. Disconnect the oil pump solenoid valve connector.



7. After retracting all four buckles of sprocket cover to mounting holes with a flat tip screwdriver, and then pull them out firmly and smoothly.

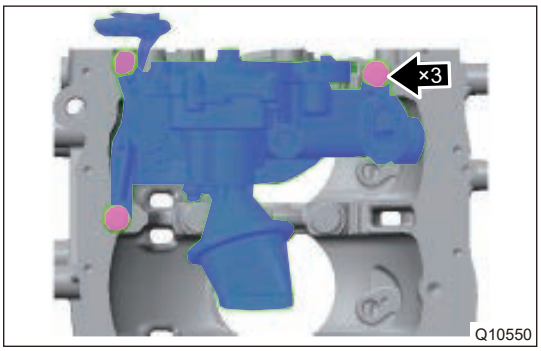

Q10530



Q10540

Caution
• During assembly and disassembly, the insertion and pull-out directions of sprocket cover buckles should be operated along the axis direction of mounting hole as far as possible. When operating in a serious skewed way, it will be difficult to assemble and even damage the buckles.

8. Remove 3 fixing bolts from oil pump assembly, separate the connector locking buckle and remove the connector.



Q10550

9. Push chain movable rail, move away chain from oil pump assembly, remove oil pump assembly carefully.

Inspection

1. Rotate oil pump shaft, check if rotation of oil pump is smooth.

Installation

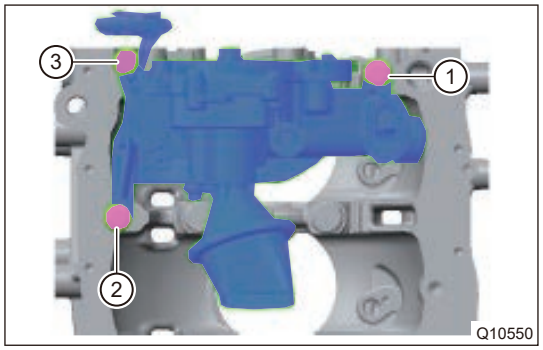
Caution
• Wasted engine oil pump assembly should be handled by specialized department according to local laws and regulations. Never discard it at will.

1. Align the oil pump set sleeve with locating hole on cylinder block and insert it, so that oil pump installation surface fits to cylinder block installation surface, and set the oil pump solenoid valve connector to outside.

2. Apply a circle of lock adhesive to threads head of 3 bolts evenly. Ensure application amount for (3 - 5) teeth. Insert them to bolt holes and tighten the bolts in order shown in illustration.

   Recommended lock adhesive: Loctite 243

   Torque: 20 + 5 N·m



3. Insert the connector of solenoid valve from the inside of cover into the mating hole. After inserting, you can hear a “click” sound of buckle or you can see that locking buckles have been clamped on outside edge of mounting holes. Surface assembly is finished.

4. Push the chain movable rail to attach the chain to oil pump sprocket. Release the movable rail slowly until chain is in tension status.

5. Align four buckles on sprocket cover with buckle holes of oil pump, insert them into holes firmly and smoothly, when a “click” sound is heard, it indicates that buckles are assembled into place.

Caution
• Assembly is finished after four buckles are assembled into place, check if the fit between sprocket cover and oil pump is normal.

6. Install oil collector.
7. Install the oil pan assembly.
8. Connect the oil pump solenoid valve connector.
9. Add engine oil to specified value.

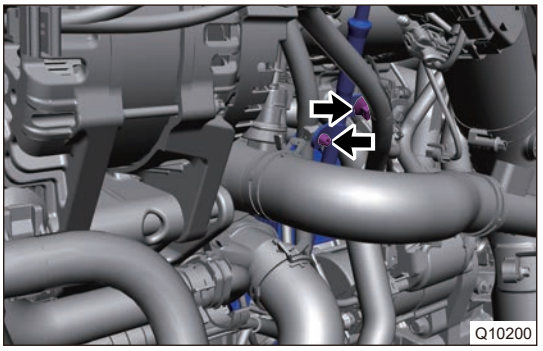
Oil Dipstick Tube (Dipstick) Assembly

Removal

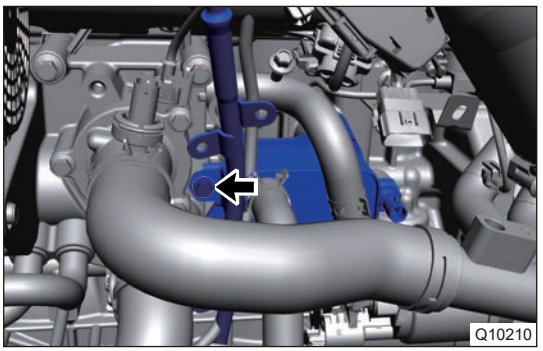
Warning
• Prolonged and repeated contact with engine oil will be harmful to your skin. If engine oil spills on your skin, wash it off immediately with water. In addition, the used engine oil contains potentially harmful contaminants, which may cause skin cancer. Therefore, always take proper skin protection measures when performing vehicle service.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Remove the engine compartment trim cover assembly.
4. Remove the engine trim cover assembly.

5. Remove the wire harness clips from oil dipstick tube.



6. Remove 1 fixing bolt between oil dipstick tube and water pump module mounting hole.



7. Remove the oil dipstick tube assembly carefully.

Installation

Caution
• Check O-ring before assembly to make sure it is not damaged, otherwise replace with a new one. • Apply a small amount of lubricant to dipstick tube and dipstick handle O-ring before assembly. • When inserting dipstick tube into timing chain cover mounting hole, insert lower end as far as possible along shaft line direction. If it tilts, it may be difficult to assemble O-ring, even damage O-ring.

1. Insert the oil dipstick tube into oil pan mounting hole along the axis direction of mounting hole.
2. Install 1 fixing bolt between oil dipstick tube and water pump module mounting hole.

   Torque: 8 + 3 N·m

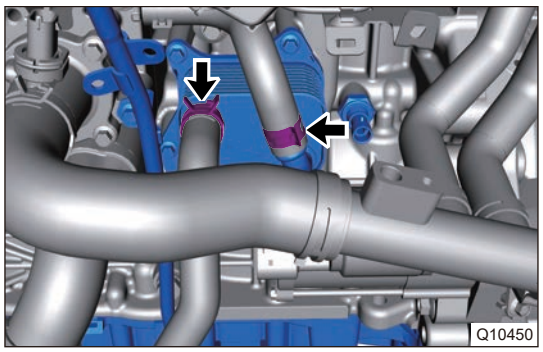
3. Fix the wire harness clips to oil dipstick tube.
4. Install the engine compartment trim cover.

Oil Cooler Assembly

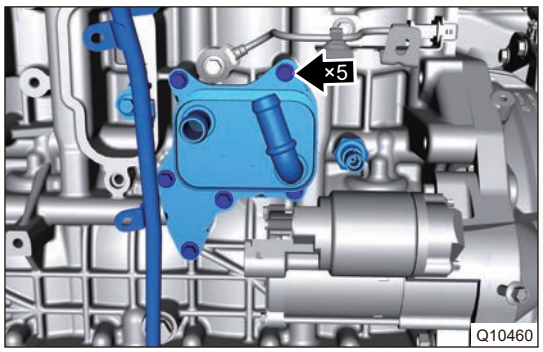
Removal

Warning
• DO NOT remove oil cooler assembly until engine cools down. • Prolonged and repeated contact with engine oil will be harmful to your skin. If engine oil spills on your skin, wash it off immediately with water. In addition, the used engine oil contains potentially harmful contaminants, which may cause skin cancer. Therefore, always take proper skin protection measures when performing vehicle service. • Always make sure engine is cold before operating cooling system. Never open expansion tank cap or remove drain cock plug, when engine is operating or cooling system temperature is high. High-pressurized hot engine coolant and steam may flow out and cause serious burns. • If your body contacts coolant accidentally, clean it with water immediately. If it is serious, please go to hospital. • Be sure to wear safety equipment to prevent accidents, when removing oil cooler assembly. • Appropriate force should be applied, when removing the oil cooler assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Remove the starter assembly.
5. Remove the engine lower protector assembly.
6. Drain the coolant.
7. Loosen elastic clamp and clamping ring, and disconnect water outlet and inlet pipelines from oil cooler assembly.



8. Remove 5 fixing bolts from oil cooler assembly.

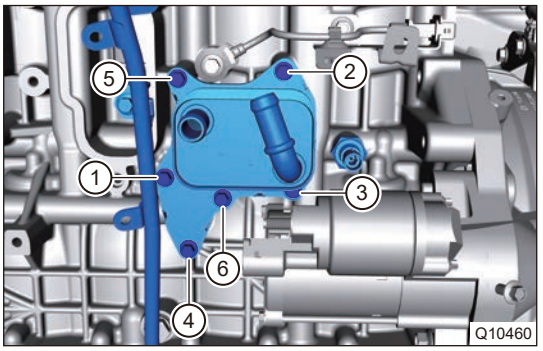


9. Remove the oil cooler assembly carefully.

Installation

1. Align the oil cooler bolt mounting holes with the corresponding bolt holes, install and tighten 5 fixing bolts in order shown in illustration.

   Torque: 8 + 3 N·m



2. Connect the water outlet and inlet pipelines to oil cooler assembly.
3. Install the starter assembly.
4. Add the coolant.
5. Refill the engine oil to a proper position.

STARTING AND CHARGING SYSTEM

Warnings and Precautions

Warnings

In order to avoid possible property loss, personal injury or death, always follow the instructions below before repair:

1. Battery acid is highly corrosive, so it is necessary to wear protective gloves and goggles when working.
2. Do not dump the battery, because acid may spill from vent hole.
3. Never throw the used battery into household garbage. There is risk of explosion.

Precautions

In order to avoid dangerous operation and damage to the vehicle before repair in this section, always follow the instructions below before repair:

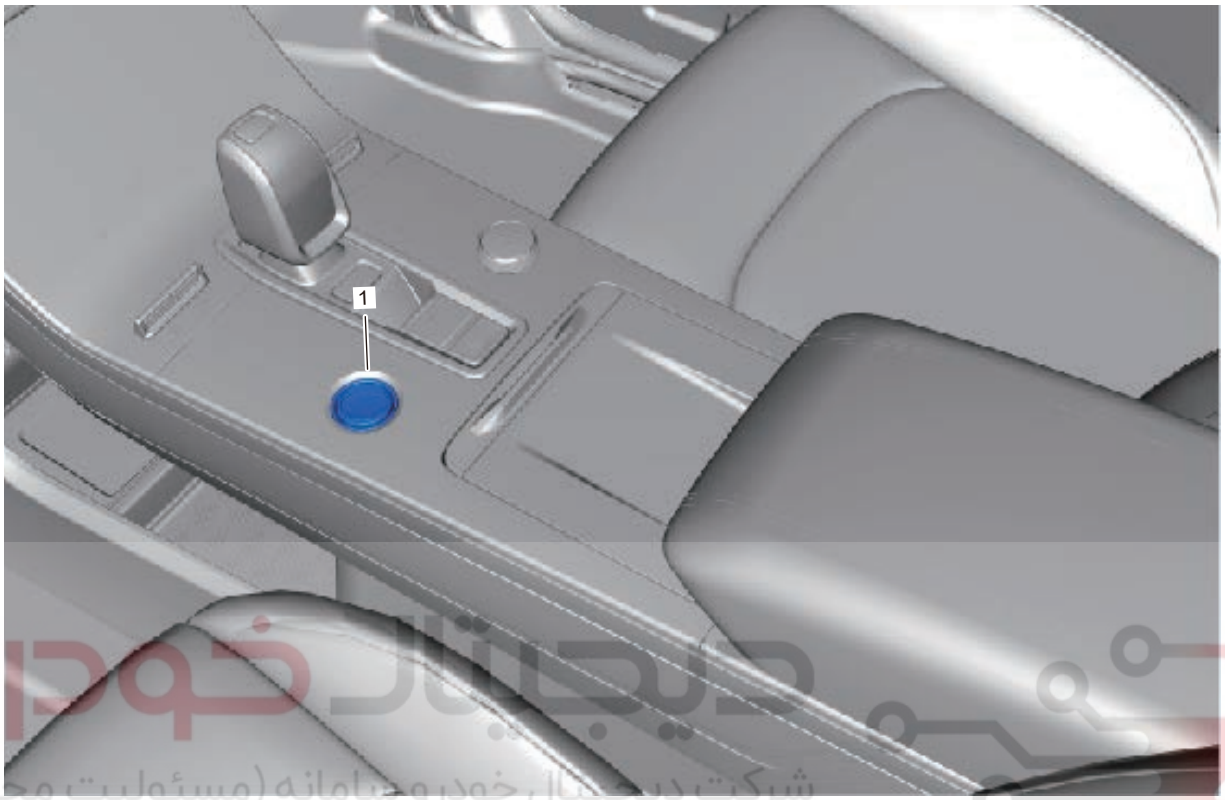
1. Deliver the used battery to designated recycling site.
2. Never allow the children approaching acid and battery.

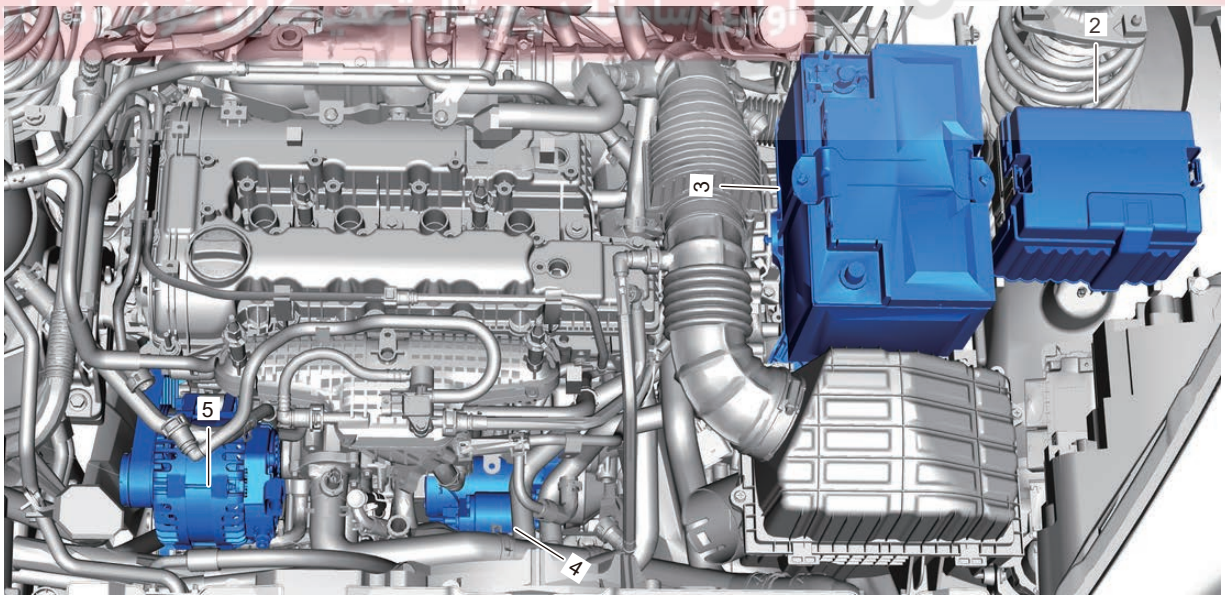
System Overview

System Description

Starting system consists of battery, starting switch and starter, etc. Starting system converts electrical energy from battery into mechanical energy, allowing engine to crank initially, and disconnects power transmission between starter and engine when engine starts successfully.Charging system is consist of battery, alternator and charging state indicator device. Alternator is the main power supply component while vehicle is operating. It is used to supply power to all the electric equipment (except for the starting system) and charge the battery. Since alternator is rotated through drive belt which is driven by the engine, voltage will changes depending on engine speed. To meet electric device power supply and battery charging requirements, voltage regulator is equipped in charging system (inside alternator). The voltage regulator maintains voltage output stability of alternator by adjusting exciting current in alternator while engine speed and load is changing. Charging state indicator is used to show the charging system operation and indicate whether the battery is in a charging or discharging state.

System Components Diagram





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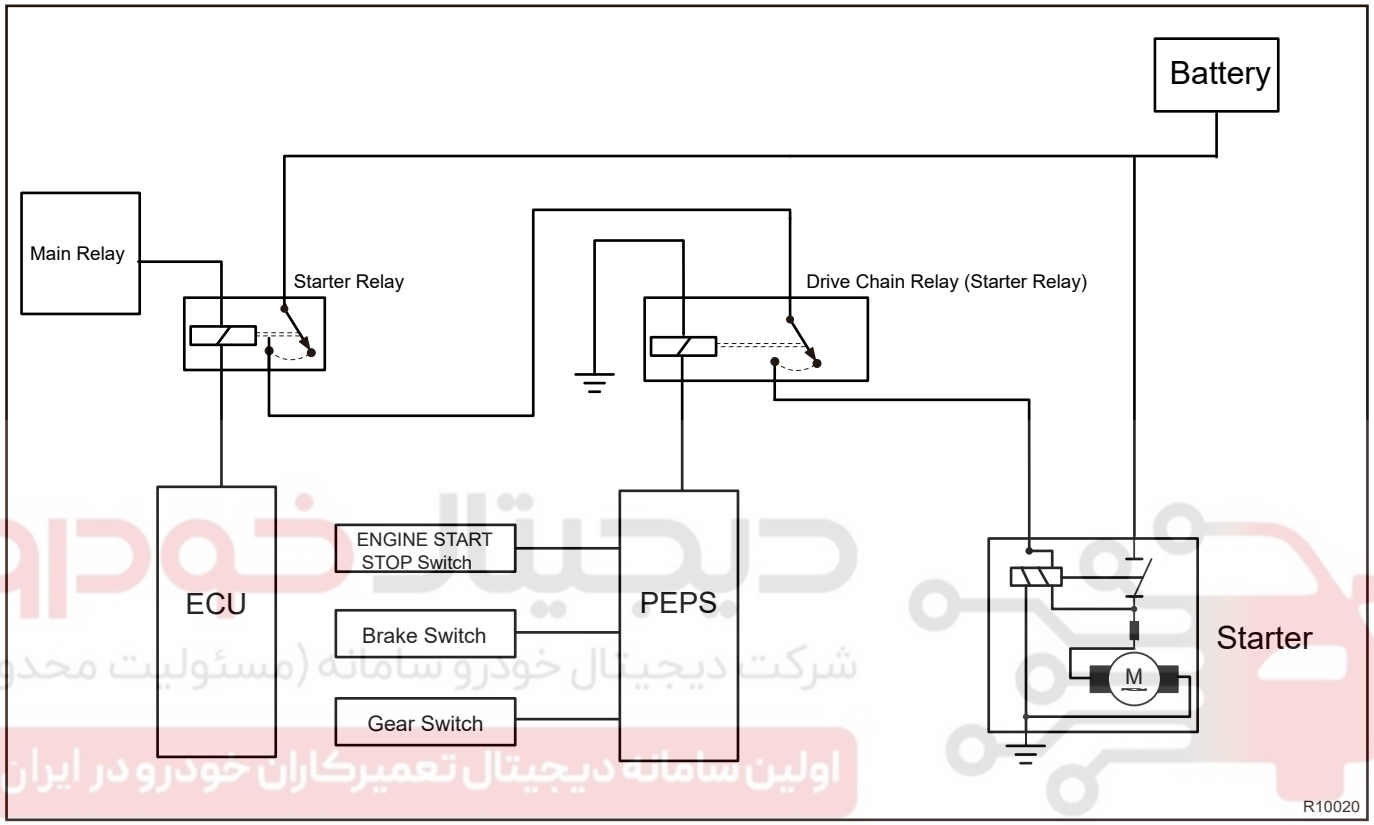
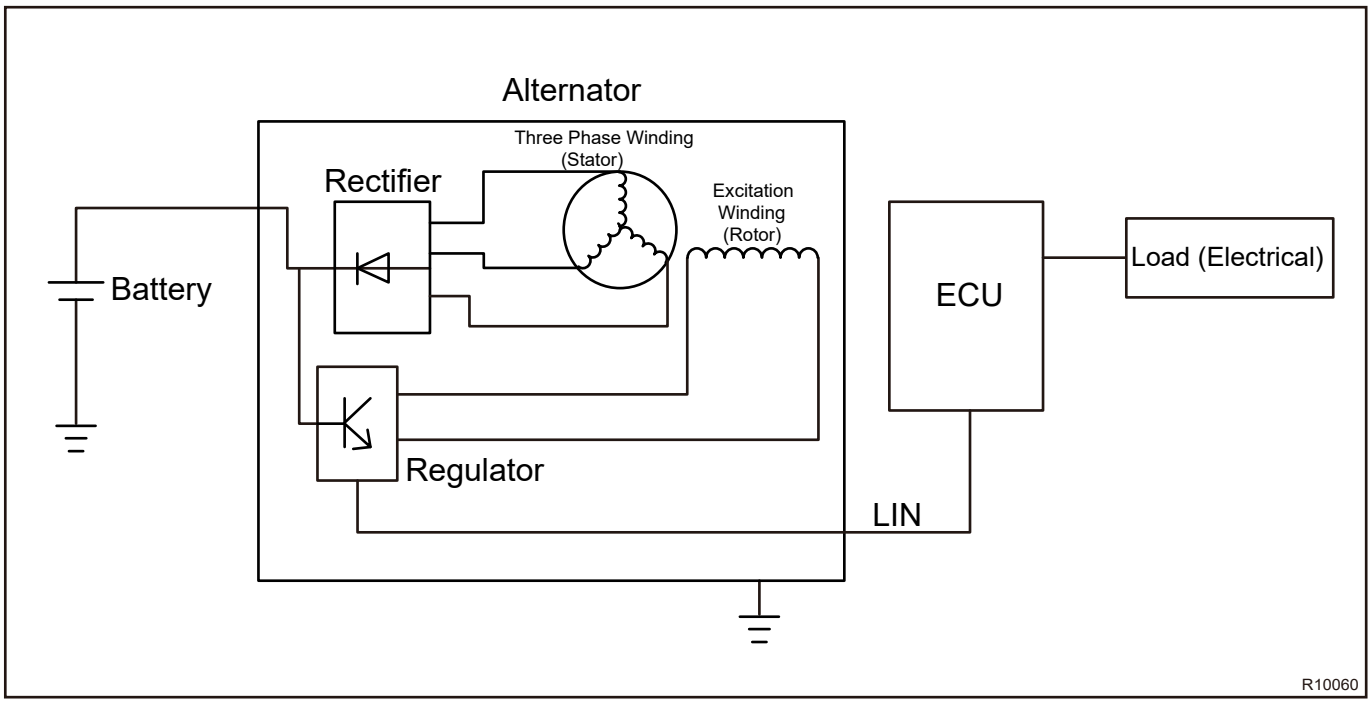
1	ENGINE START STOP Switch	4	Starter Assembly
2	Engine Compartment Fuse and Relay Box	5	Alternator Assembly
3	Battery Assembly	6	

System Schematic Diagram



When battery voltage is normal starting voltage and transmission is in P position, press ENGINE START STOP switch while depressing brake pedal. When PEPS receives signal, it controls the starter relay to engage, then the starter runs normally.



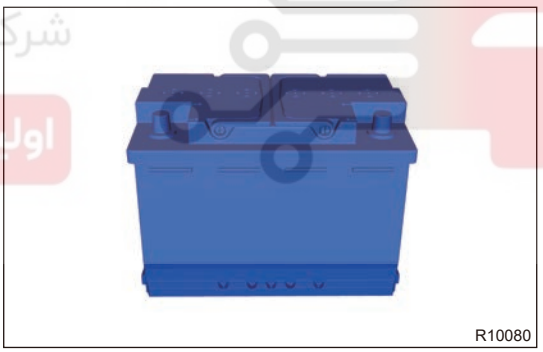
Three-phase alternating current generated by alternator is converted to direct current from alternating current by rectifier, and direct current is transmitted to the vehicle electrical system and battery.

System Components Description

Battery Assembly

Main function

When starting the engine, it is responsible for providing the working current required by the starter; When engine is running, it can help alternator to supply power to electric device; When engine is stationary, it can supply power to electric device separately; Moreover, battery is a large capacity capacitor which protects vehicle electrical device.

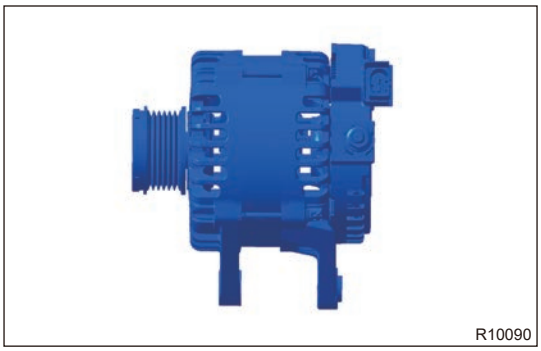


Battery

Type	Specifications
Sail AGM	12V 70AH

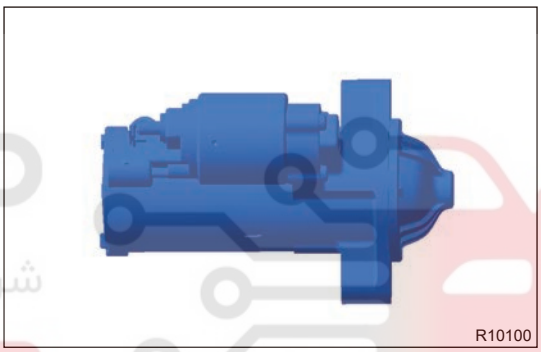
Alternator Assembly

Alternator is a silicon rectifying alternator, which mainly consists of rotor, stator and rectifier.When excitation direct current flows to rotor winding, rotor winding establishes a magnetic field and magnetizes the rotor claw poles, forming the corresponding poles.The three-phase stator coil is installed on the outside of rotor, which is secured together with the front and rear end covers of alternator.When the rotor of the generator is rotated by the drive belt, the magnetic pole lines cut the stator winding, causing a change in the magnetic flux in the stator winding, and an alternating induced electromotive force is generated in the stator winding, thereby generating alternating current. The generated three-phase alternating current is converted to direct current by rectifier, and direct current is transmitted to the vehicle electrical system and battery by further adjusting by regulator.


R10090

Starter Assembly

Starter consists of three parts: control mechanism, drive train mechanism and DC motor.Control mechanism (-solenoid switch): Controls engagement and disengagement between starter drive gear and engine flywheel gear and switches on/off the DC circuit.Drive train mechanism: When engine starts, it engages starter drive gear with flywheel gear ring and transmits starter torque to the engine crankshaft; after engine starts, drive gear will automatically disengage from the flywheel gear, so that engine cannot drive starter at high speed, avoiding damage to the starter. DC motor: Converts electrical energy from battery into electromagnetic moment.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Diagnosis & Testing

Problem Symptoms Table

Hint:

Use symptoms table below to help determine cause of problem. Check each suspected area in sequence. Repair, replace or adjust faulty components as necessary.

Starting and Charging system

Symptom	Possible Cause
Housing is cracked	Housing cracked is the most serious and destructive malfunction. When vehicle is subjected to strong vibration, lead acid battery overheating, too high pressure or electrolyte frozen expansion, the housing of lead acid battery will be damaged. For such malfunction, replacing battery is the sole way for treatment.
Electrode is loose	The cause of loosen electrode is that excessive force is applied during removal and installation of wire harness and inspection of contact. It is necessary to replace the battery assembly.

Symptom	Possible Cause
Connecting part of electrode is corroded or burnt	Check if the generated electricity is normal and if the charging voltage is too high.
Battery swells	The causes are that battery is aging and resistance is excessively high. It is necessary to replace the battery.

Common Trouble Diagnosis

Operation Content	Operation Description
Appearance inspection: Confirm if there is any washer fluid, coolant, oil, sludge and other foreign matters adhered.	If the washer fluid, coolant, oil enters rotor slip ring, brush holder, it will cause oxidization to alternator rotor slip ring and poor contact to brush, resulting in charging light remaining on or flashing.
Turn over the center of alternator belt by hand and observe if the max. turning angle is over 90°。	Loose belt will cause low alternator speed, resulting in low electric energy production or failing to generate energy; if the angle is over 90°， check the belt tension.
Measure battery voltage with a multimeter.	Confirm if the battery is depleted (more than 12 V). If so, unplug the generator excitation coil connector and retest the battery voltage (more than 12 V). If such condition still exists, charge the battery.
Confirm if there is any looseness, short circuit, dirt on alternator B+, excitation end, battery pile line and ground line and also confirm if the connectors are connected firmly.	Confirm if the wire harness is connected normally. Poor contact will cause that the alternator voltage is high, the indicator light doesn’ t come on, remains on or flashes. If there is any looseness, please tighten it firmly.

Charging indicator light remains on (do not generate electricity or power is low, vehicle cannot start, etc.)	
Operation Content	Operation Description
Unplug the alternator connector, start the engine and depress the accelerator (engine speed is above 1500rpm), turn off the vehicle load, measure B+ voltage to ground with multimeter and observe 2-3 minutes.	If B+ voltage is about 13.8 V, the alternator is normal. If B+ voltage is the battery voltage, it indicates alternator malfunction. Replace the alternator.
If the alternator operates normally, reconnect the alternator connector, start the engine and keep it idling, turn on some electrical load on vehicle, such as A/C, headlight, etc. Meanwhile, depress the accelerator pedal or decelerate the vehicle. Measure B+ voltage to ground with multimeter and observe 2 - 3 minutes.	When vehicle load or speed changes, the alternator normal voltage should change within 10.6 - 16 V. If the charging indicator remains on, check if communication is normal with an oscilloscope or other test software.

Charging indicator (unstable electricity generation)	
Operation Content	Operation Description
Start the engine and keep it idling, remove alternator excitation coil and observe if the meter indicator flashes.	If the light flashes, it indicates that some excitation coil has outer leakage and intermittently ground. Check the circuit malfunction.

Indicator does not come on during self-check	
Operation Content	Operation Description
Turn ENGINE START STOP switch to “ON” position, remove the engine excitation coil and measure the alternator excitation coil terminal voltage to ground with multimeter.	If the light flashes, it indicates that some excitation coil has outer leakage and intermittently ground. Check the circuit malfunction.

Adjusting voltage is high (headlight and other electrical appliances used on vehicle are burnt out)	
Operation Content	Operation Description
Start the engine and keep it idling, measure B+ voltage to ground with multimeter and observe 2 - 3 minutes to check if the max. value exceeds 16 V.	If so, it indicates that the regulator in alternator is damaged which causes voltage out of control. Replace the alternator.

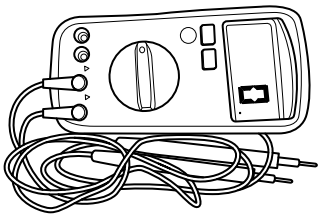
Instrument indicator or headlight dims and then goes off during vehicle driving (fail to generate energy, low electric energy production)	
Operation Content	Operation Description
Start the engine and keep it idling for 5 minutes (- turn off the electrical appliances with large power, test with light load as possible), measure the alternator B+ voltage.	If the measured voltage is 13 V - 14.8 V, the alternator is normal; if not, the alternator is abnormal. Replace the alternator.

Abnormal noise occurs in alternator	
Operation Content	Operation Description
Check if the alternator mounting bolt is installed in place and tightened with specified torque.	Improper installation of bolt will cause pulley jumps as alternator operate, resulting in abnormal noise. Tighten the bolt.
Remove the alternator belt, rotate the pulley by hand. Listen and observe near the motor if there is any abnormal noise during alternator rotation.	Excessive belt tension or dirt in alternator will cause alternator baring failure or poor rotor dynamic balance which causing abnormal noise. Replace the alternator.

On-Vehicle Service

Tools

General Tools

Tool Name	Tool Drawing
Digital multimeter	 S00002

Special Tools

Tool Name	Tool Drawing
Battery Tester	 S00064

Battery Assembly

Check Charging System Voltage

Warning
• Following the related specifications on appliances connected with battery, in repair manual and owner’s manual. • Battery acid is highly corrosive, so it is necessary to wear protective gloves and goggles when working. • Keep away from open fire, spark, light devices without protective measures and no smoking. Never generate any sparks when operating cable/wire and electrical devices. Avoid short circuit in battery. • Wear eye protective mask/glasses. • Never allow the children approaching acid and battery. • Deliver the used battery to designated recycling site. Never throw the used battery into household garbage.

1. Leave vehicle under no load test condition and idle the engine. Measure battery voltage with a digital multimeter.

   Standard voltage: 13.5V - 14.8V

Hint:
If result is not as specified, replace the alternator.

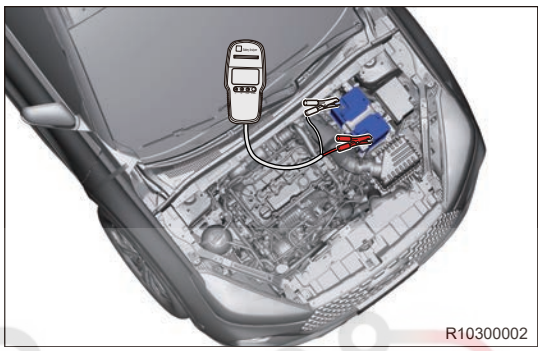
2. Leave vehicle under load test condition and idle the engine. Measure battery voltage with a digital multimeter.
   a. Set headlight to high beam.
   b. Turn on blower and adjust blower speed to the highest.
   c. Turn on the "A/C" switch.

   Standard voltage: 13.2V - 14.8 V

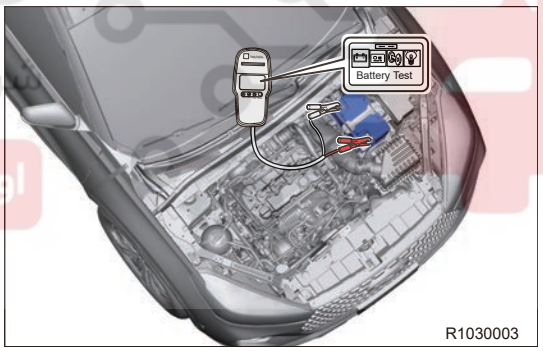
Usage of Battery Tester

1. Connect the battery tester to battery.

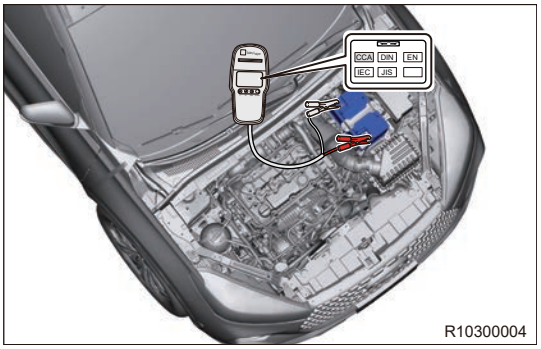
   Hint:
   Connect red tube clamp to battery positive terminal while black tube clamp to battery negative terminal.



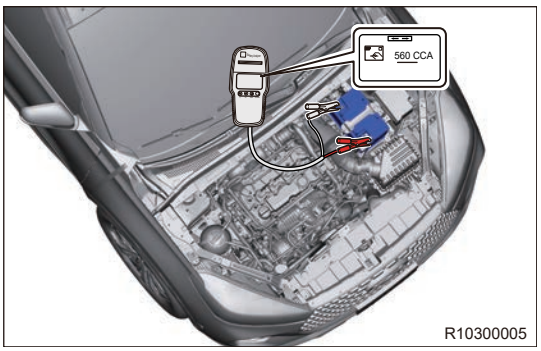
2. Operate tester to select “Battery Test” and click “Enter”.



3. Select “CCA” and click “Enter”.

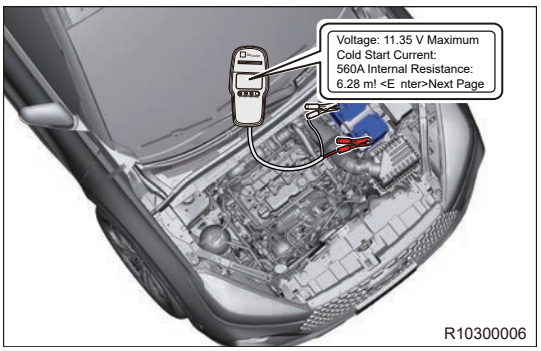


R10300004



R10300005

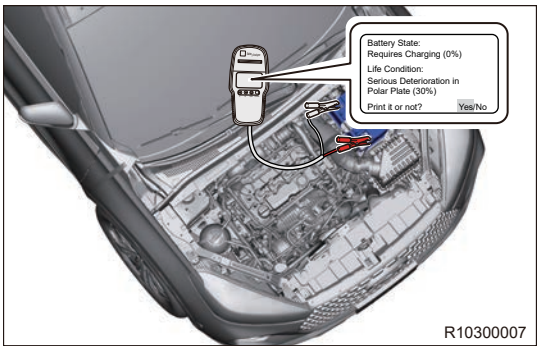
4. Operate “L and R” on tester to adjust and set the battery capacity (such as 560CCA, this value indicates the battery low temperature starting performance) and click “Enter”.



R10300006

5. The battery condition is displayed on tester.

   Hint:
   Recharge or replace battery according to the tested data.

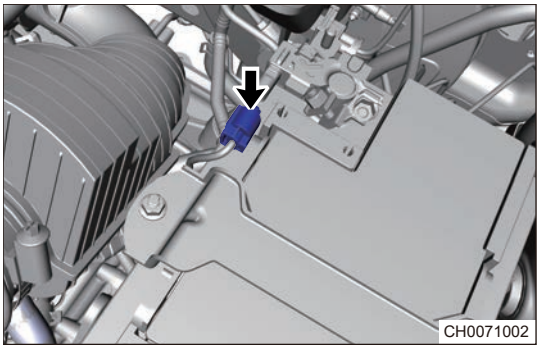


R10300007

Removal of Battery Sensor

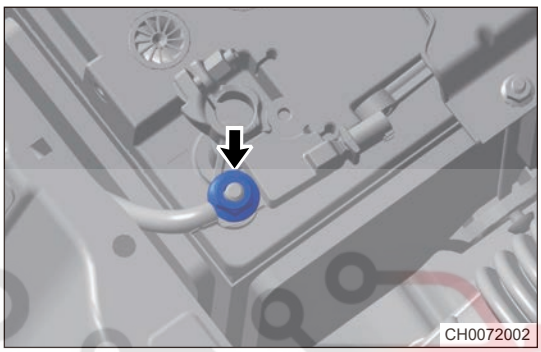
Warning
• Be sure to wear safety equipment to prevent accidents, when removing battery sensor. • Appropriate force should be applied when removing battery sensor. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Remove the battery sensor.
4. Disconnect the battery sensor connector (arrow).



5. Remove the coupling nut (arrow) between battery sensor and body ground wire.

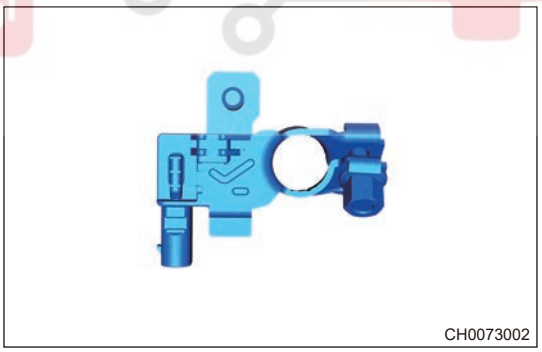
Tightening torque: 20 ± 2 N m



6. Remove the battery sensor.

Inspection

1. Check the appearance of battery sensor
2. Check appearance of battery sensor for corrosion or cracks.
3. Check for desoldering between battery sensor and negative terminal connector. If so, replace the battery sensor.



Multimeter Connection	Normal temperature (20°C)
Terminal 1 - Body (Case)	3 MΩ
Terminal 2 - Body (Case)	1.6 MΩ
Terminal 1 - Terminal 2	5.5 - 6 MΩ

Hint:

If result is not as specified, replace the battery sensor assembly.

Installation

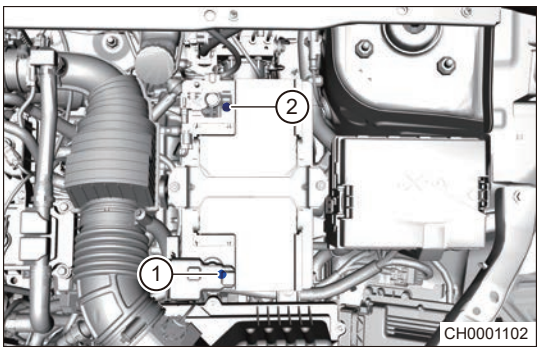
1. Installation is in the reverse order of removal.

Removal of Battery

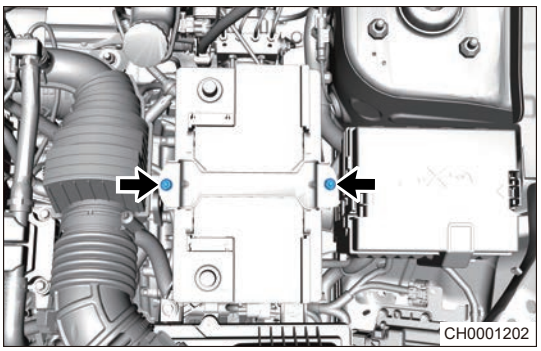
Caution
• Be sure to wear safety equipment to prevent accidents, when removing battery assembly. • Appropriate force should be applied, when removing battery assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Remove the air filter assembly.
4. Remove the battery assembly.
5. Loosen the locking nuts of positive and negative battery terminals with 10# socket wrench, and remove the positive and negative battery terminals (1) (2).

   Hint:
   When removing the battery positive and negative battery terminals, remove negative terminal before positive terminal.



6. Remove 2 fixing bolts and battery pressure plate with 10# socket wrench.



7. Remove the battery assembly from protective cover carefully.

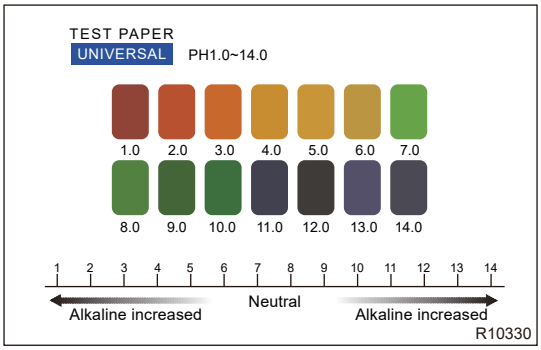
Caution
• When removing battery, be careful to prevent metal tools from contacting both electrodes of battery at the same time or touching the positive electrode and vehicle body.

Battery Fluid Leakage Test

1. PH test paper is used for judgment.

   Hint:
   Test paper model: PH 1 - 14.

2. Take a piece of PH test paper (never allow it contacting with other fluid before test) to wipe the leaking area, so as to make the fluid adhere on the PH test paper. Then compare it with the color bar to judge the PH value.
3. If the PH value is less than 7, it is an acidic liquid, which indicates battery leakage.
4. If the PH value is 7 or higher, it is non-acidic liquid (-neutral or alkaline) which indicates “Petroleum jelly” fluid or other fluids leakage on battery surface.



Battery (Off-Vehicle) Charging

1. Because the battery has the characteristic of self-discharging, even if the battery is not in use, it is necessary to perform regular charging maintenance. When the discharging ratio for battery capacity is lower than 50%, the capacity cannot restore to 100% if charging with small current while the battery temperature increases and the plate active material will fall off easily if charging with large current, affecting the performance and life of battery.
   - Charging with constant voltage: Voltage is limited at 14.40 V. During charging, make sure the charger is connected to the maximum charging current so as to get the preset voltage value (14.40 V) according to the current battery status and temperature. After the voltage reaches the limiting value, the charging current will drop gradually until it closes to 0 A (maintain the condition charging current).

Battery (On-vehicle) External Power Supply Charging

1. If battery external power supply charging is necessary, it’ s important to keep external charger is properly connected. If charging process is not correct, the sensor cannot recognize the charging current, and SOC value cannot be calculated correctly. Positive clamp of external charging device must clamp positive terminal of battery, and negative clamp must be ground instead of negative terminal of battery. Battery sensor only properly balances the charge when there is a continuous current through it.

Installation

Caution
• Replace battery with a new one which conforms to the specifications. • During installation, make sure the directions of positive and negative terminals are correct. • Used battery contains sulfuric acid and lead, so never discard it at will. Please dispose of it at a qualified local waste treatment station. • When installing the battery positive and negative battery terminals, install negative terminal before positive terminal.

1. Place the battery into battery tray carefully.
2. Install 2 fixing bolts to battery pressure plate.

   Torque: 5 ± 1 N·m
3. Install and tighten battery positive and negative battery terminals.

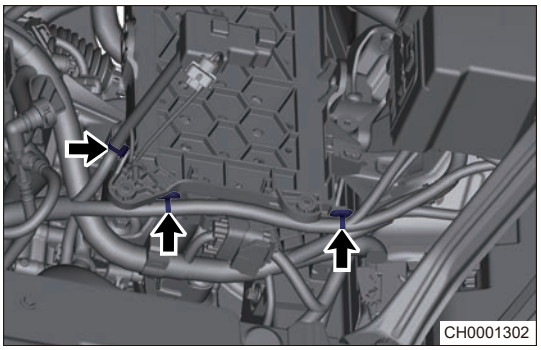
   Torque: 7 ± 1 N·m

Battery Tray

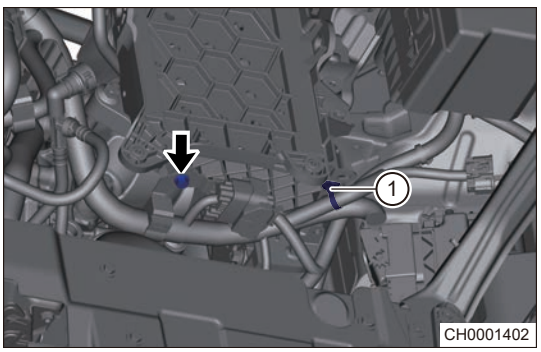
Removal

Warning
• Be sure to wear safety equipment to prevent accidents, when removing battery tray. • Appropriate force should be applied, when removing battery tray. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable
3. Remove the engine compartment trim cover assembly.
4. Remove the air filter assembly.
5. Remove the battery assembly.
6. Remove the battery tray.
7. Disengage 3 fixing clips (arrow) from battery positive wire harness.

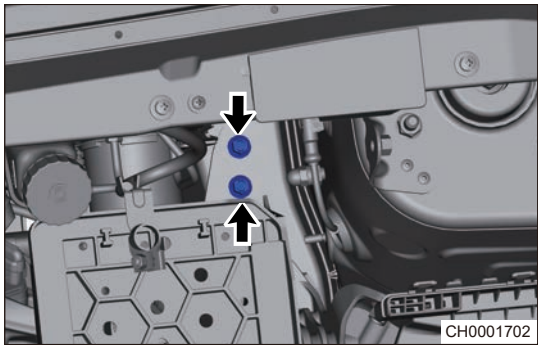


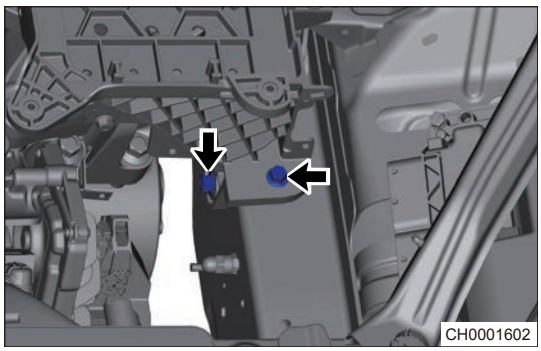
8. Remove 1 fixing bolts (arrow) from electronic engine injection wire harness bracket, and disconnect fixing clip (1).



9. Remove 4 fixing bolts (arrow) between battery tray and front left side rail front body.

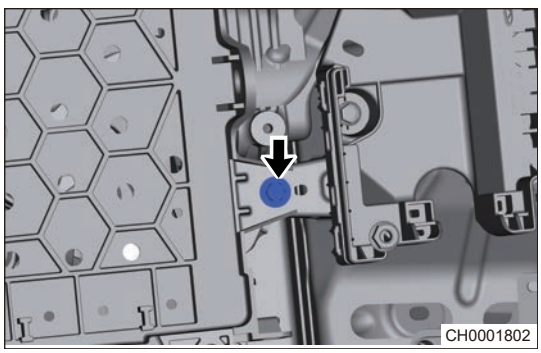
Tightening torque: 25 ± 4 N·m





10. Remove 1 fixing bolt (arrow) between battery tray and small bracket.

Tightening torque: 9 ± 1 N·m



11. Remove the battery tray assembly.

Installation

1. Installation is in the reverse order of removal.

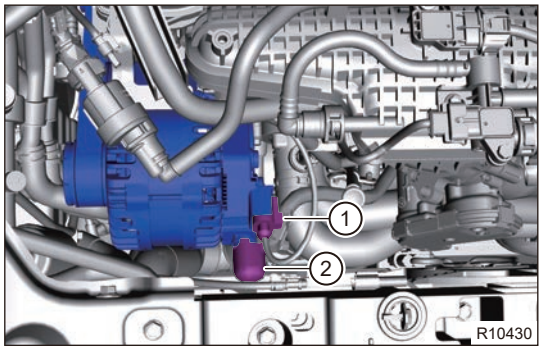
Alternator Assembly

Removal

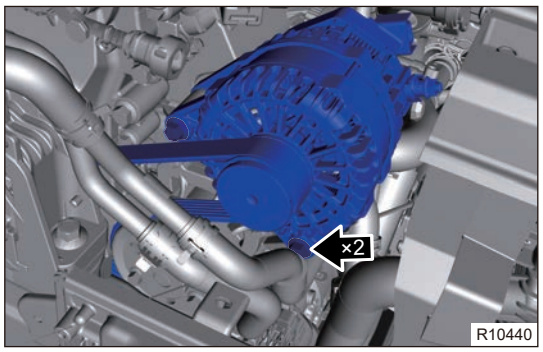
Warning
• When removing alternator assembly, be sure to wear safety equipment to prevent accidents. • Appropriate force should be applied, when removing alternator assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Remove the engine trim cover.
5. Remove the engine accessory belt.
6. Remove the alternator assembly.

7. Disconnect the alternator assembly connector (1) and remove alternator positive cable harness fixing nut (2).



8. Remove 2 fixing bolts from alternator assembly.



9. Remove the alternator assembly carefully.

Installation

1. Install the alternator assembly to the corresponding position of water pump module, insert 2 fixing bolts and tighten them in order after pre-tightening 2 - 3 teeth with hand.

   Torque: 40 + 5 N·m

Caution
• After alternator bolt is tightened, visually check for clearance between two sliding sleeves as well as between module sliding sleeve and the module. If clearance exists, it meets the installation requirement.

2. Install alternator positive wire harness port and secure the nut.

   Torque: 13 ± 2 N·m

3. Connect alternator assembly connector.
4. Install the alternator accessory belt.
5. Install the engine compartment trim cover.

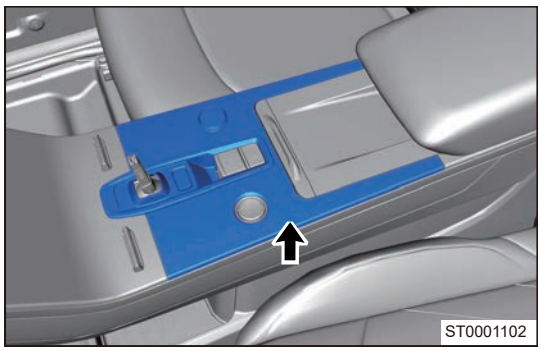
ENGINE START STOP Switch

Removal

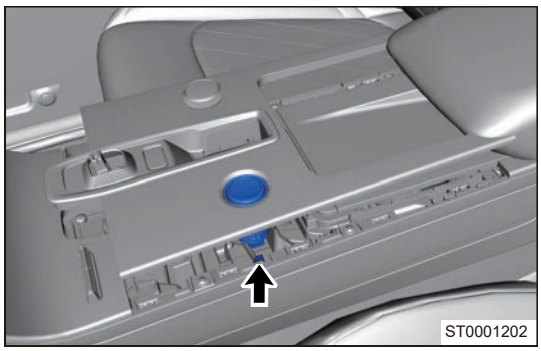
Warning
• Be sure to wear safety equipment to prevent accidents, when removing ENGINE START STOP switch. • Try to prevent interior protector from being scratched during removal and installation.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Remove the shift lever assembly.
4. Remove the ENGINE START STOP switch

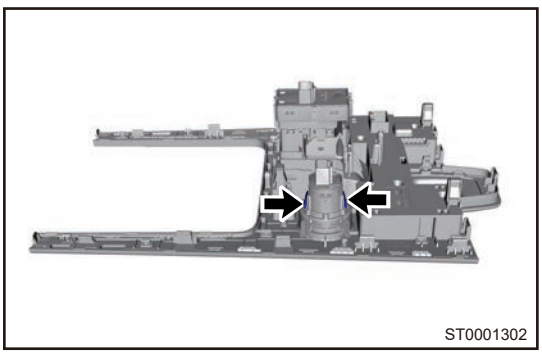
5. Using an interior crow plate, remove the lower left protector body assembly.



6. Disconnect ENGINE START STOP switch connector.



7. Push both fixing clips (arrow) on ENGINE START STOP switch and remove ENGINE START STOP switch.



Inspection

1. Using a digital multimeter, check the continuity of ENGINE START STOP switch according to the table below.

Multimeter Connection	Switch Condition	Specified Condition
Terminal 1 - Terminal 2	Not pressed	No continuity
Terminal 3 - Terminal 2	Not pressed	No continuity
Terminal 1 - Terminal 2	Pressed	Continuity
Terminal 3 - Terminal 2	Pressed	Continuity

Caution
• If measure result is not as specified, replace the ENGINE START STOP switch assembly.

Installation

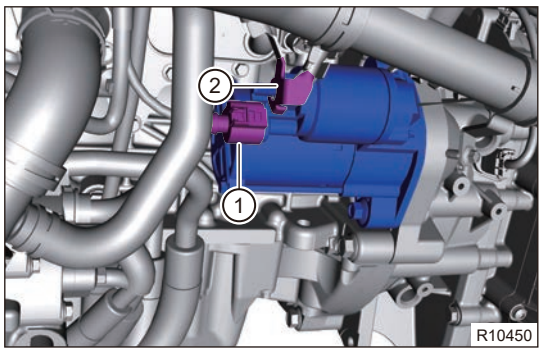
1. Installation is in the reverse order of removal.

Starter Assembly

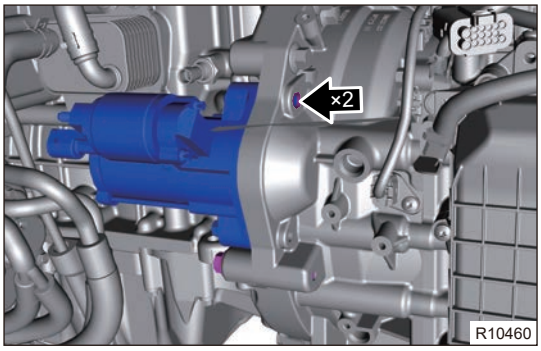
Removal

Warning
• Be sure to wear safety equipment to prevent accidents, when removing starter assembly. • Appropriate force should be applied, when removing starter assembly. Be careful not to operate roughly.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Remove the air filter assembly.
4. Remove the engine compartment lower protector assembly.
5. Remove the intercooler intake pipe Ⅱ assembly.
6. Remove the starter assembly.
7. Disconnect the starter assembly connector (1) and remove positive cable fixing nut (2).



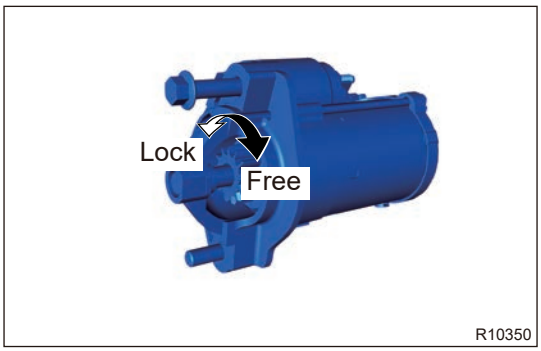
8. Remove 2 set bolts between starter assembly and transmission case.



9. Remove the starter assembly carefully.

Check the starter clutch

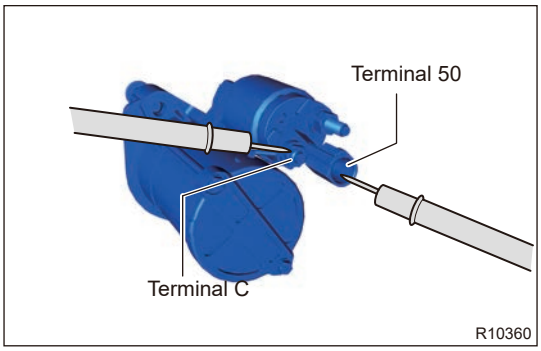
1. Rotate the clutch pinion gear clockwise to check that it rotates freely. Rotate the clutch pinion gear counterclockwise to check that it locks. If result is not as specified, replace the starter.



Check the pull-in coil

1. Measure the resistance between terminal 50 and terminal C.

   Hint:
   Standard resistance should be below 2Ω. If the resistance is abnormal, replace the starter assembly.

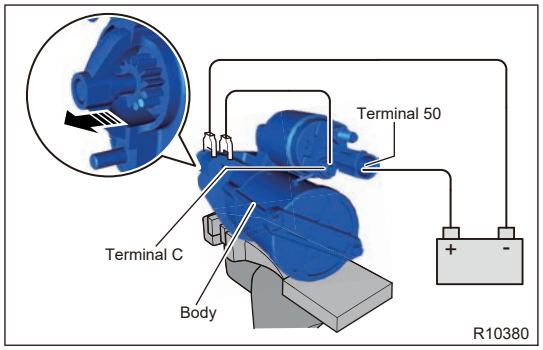


Check the starter assembly

Caution
• These measurements must be performed within 3 to 5 seconds to avoid coil burnout. • Place the starter assembly onto a vise. The jaws of vise should be covered by aluminum sheet or brass plate; otherwise, the starter assembly will be easily damaged when clamping it.

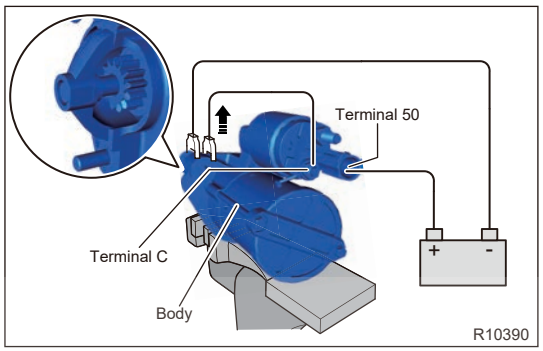
1. Perform pull-in test.
   - Remove the nut and disconnect the field coil lead from terminal C.
   - As shown in illustration, connect battery to solenoid switch, and check that starter clutch pinion sticks out normally.

   Hint:
   If starter clutch pinion does not move, replace the starter assembly.



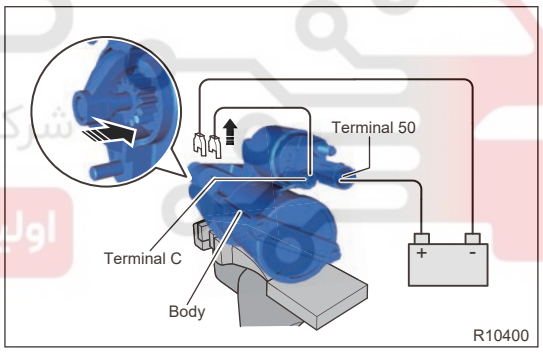
2. Perform pull-in test.
   - Keep the starter clutch pinion sticking out and the connection condition of battery mentioned above, and disconnect the negative battery cable from terminal C.
   - Check if starter clutch pinion keeps sticking out.

   Hint:
   If starter clutch pinion moves inward, replace the starter assembly.



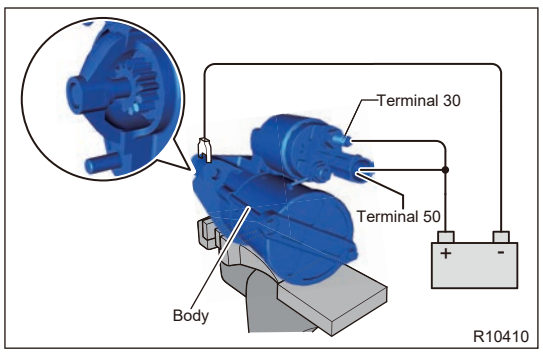
3. Check if starter clutch pinion returns back.
   - Disconnect negative battery cable from starter body and check that starter clutch pinion returns back.

   Hint:
   If starter clutch pinion moves inward, replace the starter assembly.



4. Check if starter rotates smoothly.
   - Connect the field coil lead to terminal C, and tighten it with a nut.
   - As shown in illustration, connect battery to starter; And check that starter rotates smoothly when the starter clutch pinion moves outward.

   Hint:
   The lead to be connected should avoid the pinion side to prevent lead stuck as pinion rotates.
   If result is not as specified, replace the starter assembly.



Installation

1. Align starter with the corresponding holes on transmission, install 2 bolts and tighten it in order after pre-tightening 2-3 teeth with hand.

   Torque: 40 + 5 N·m

2. Install positive wire harness port and secure the nut.
   Torque: 13 ± 2 N·m

3. Connect starter assembly connector.
4. Install intercooler intake pipe Ⅱ assembly.
5. Install the air filter assembly.
6. Install the engine lower protector assembly.
7. Install the negative battery cable.

Fuel system

Warnings and Precautions

Warnings

In order to avoid possible property loss, personal injury or death, always follow the instructions below before repair:

1. As the pressure of high pressure fuel system is high, the pressure must be released before removal.
2. During removal, make sure the areas near stored parts are clean and free of dirt.
3. Perform removal after engine cools down.
4. Operation staff should wear protective glasses and rubber gloves during repair and avoid inhaling much fuel gas.

Precautions

In order to avoid dangerous operation and damage to the vehicle before repair in this section, always follow the instructions below before repair:

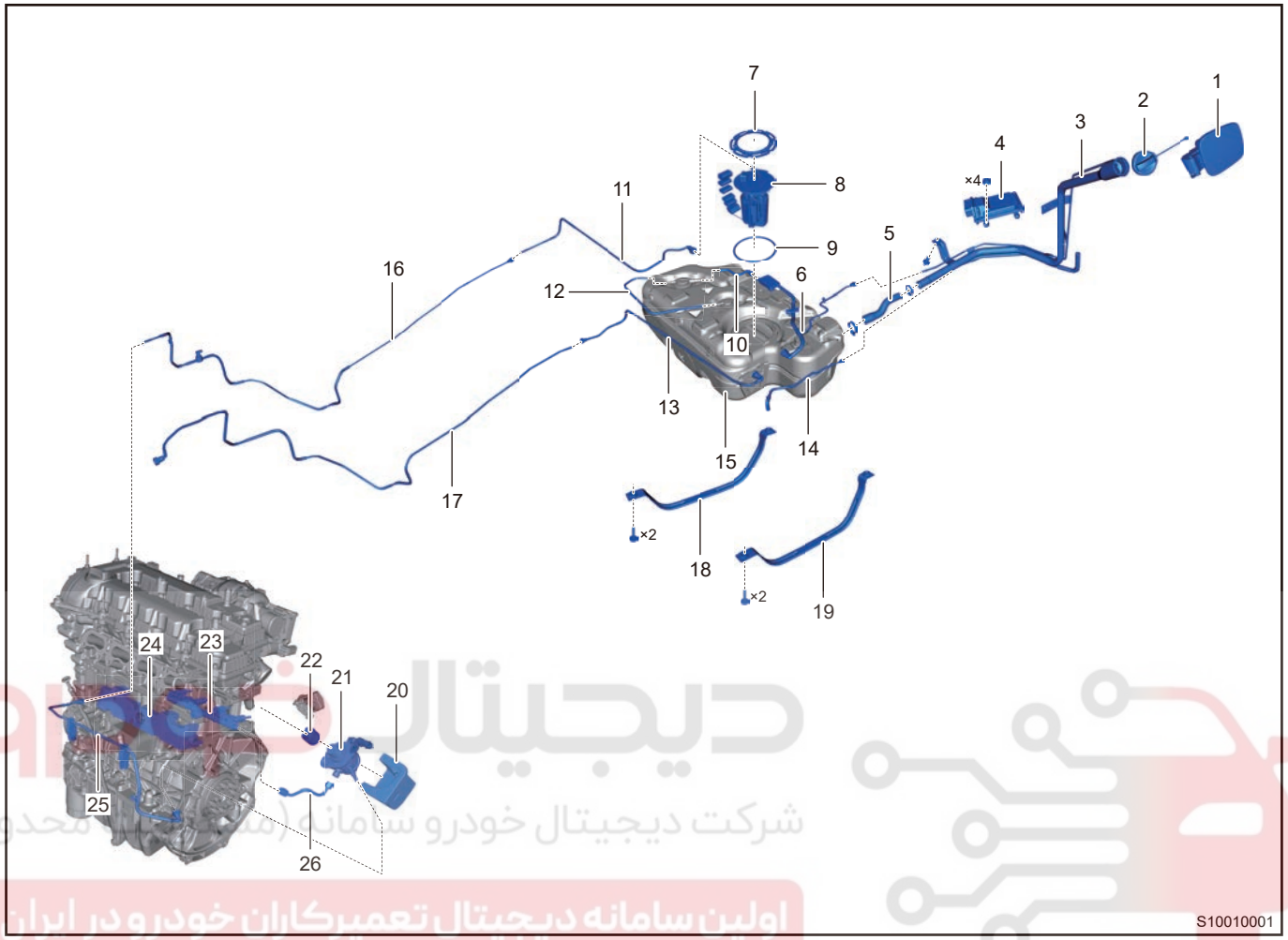
1. If fuel leakage occurs when operating the fuel supply system, please handle the leaked fuel in time.
2. When operating the fuel supply system, work area should be in good ventilation and keep fire sources or open flames away from the work area, in which fire extinguisher should be equipped.

System Overview

System Description

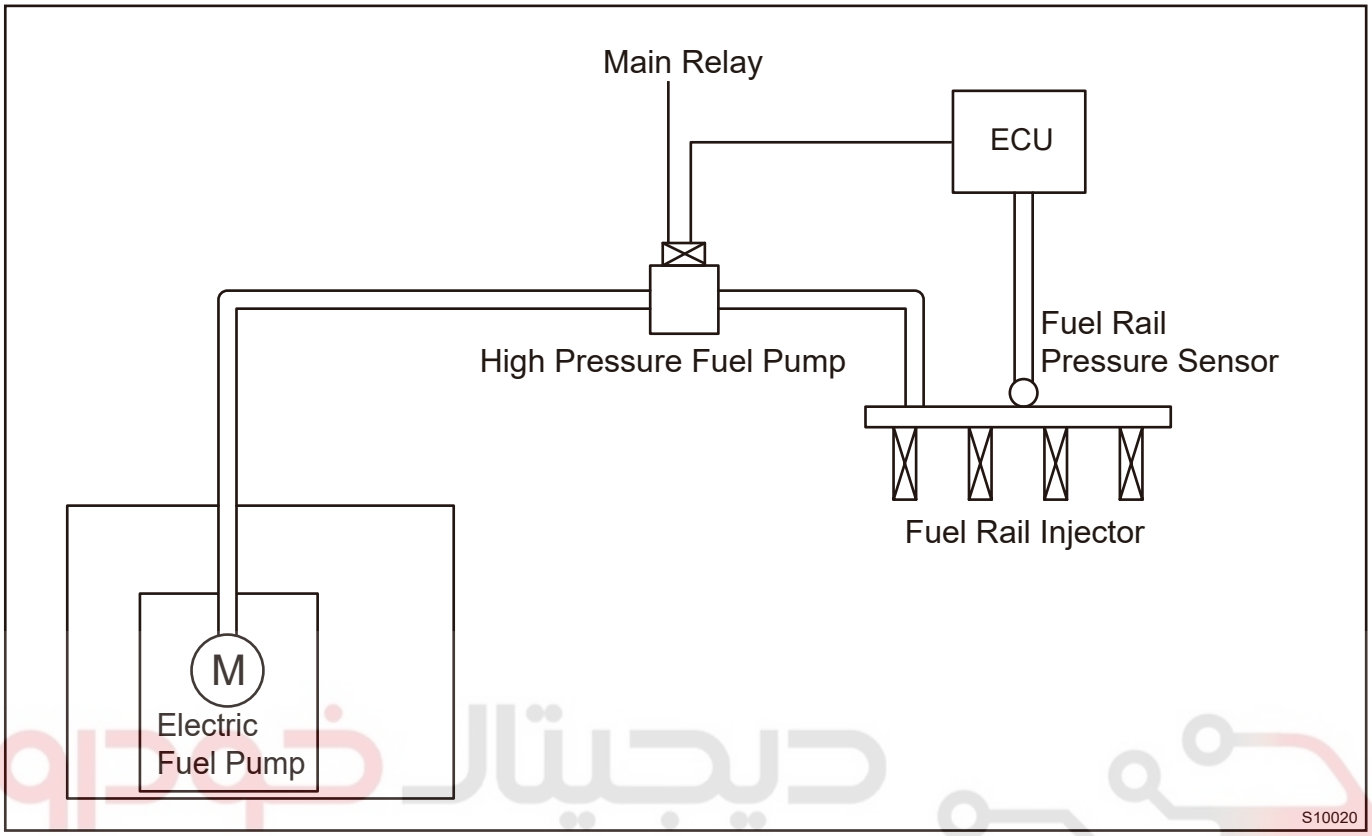
Fuel supply system uses direct injection in cylinder. The high pressure fuel pump is driven by square cam on intake camshaft, thus sucking fuel from the low-pressure end for compression and boosting, and the pressure can be raised up to 200 bar. ECU monitors fuel rail pressure through oil pressure sensor. Fuel is sent to fuel rail after further adjustment by the fuel pressure regulator. The vehicle adopts a direct injection system with Bosch 4-hole nozzle and a side nozzle layout; According to the control signal of ECU, fuel is injected into the combustion chamber and mixed with gas for combustion.In low pressure fuel system, fuel pump is controlled by individual fuel pump control module by means of duty ratio control, and monitors the low-pressure end pressure through low pressure fuel pressure sensor realizing closed-loop control.

System Components Diagram



1	Electric Fuel Filler Cap Assembly	14	Activated Charcoal Canister Breather Pipe
2	Fuel Tank Cap Assembly	15	Fuel Tank Assembly
3	Filler Tube Assembly	16	Inlet Pipe II
4	Fuel Pump Control Module	17	Fuel Vapor Pipe V
5	Fuel Filler Hose	18	Fuel Tank Fixing Strap II
6	Fuel Vapor Pipe III Assembly	19	Fuel Tank Fixing Strap I
7	Fuel Tank Pressure Cap	20	Sound Insulator
8	Electric Fuel Pump Assembly	21	High Pressure Fuel Pump
9	Fuel Tank Seal Ring	22	Roller Tappet
10	Fuel Vapor Pipe II Assembly	23	Fuel Rail Injector Assembly
11	Inlet Pipe I	24	Sound Insulator
12	Fuel Vapor Pipe I Assembly	25	Inlet Pipe III
13	Fuel Vapor Pipe IV Assembly	26	High Pressure Fuel Pipe

System Schematic Diagram



System Components Description

Electric Fuel Pump

Electric fuel pump consists of pump body, DC motor and housing. Its basic operation principle is that DC motor drives the rotor in pump housing to rotate at high speed after it is energized. The section at lower end of rotor shaft combines with the section at the inner hole of impeller, so that rotor shaft drives impeller to rotate as rotor rotates. During high speed rotation of impeller, the low pressure vacuum is created at the inlet part, and then the filtered fuel is sucked from the inlet of pump cover. The sucked fuel enters the pump housing after being pressurized by fuel pump impeller and then it is pushed out of outlet to provide fuel with a certain pressure for the fuel system.

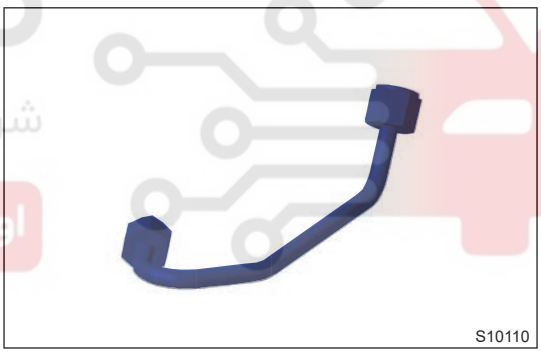
High Pressure Fuel Pump

High pressure fuel pump is an element specially used for direct injection engine. It functions to increase the system pressure and provide high pressure fuel for the fuel rail assembly. High pressure fuel pump supplies fuel for system as demands, thus providing a better fuel economy. It is made of stainless steel material and has a wide fuel application; also, it has the advantages of light weight, small volume, zero evaporative emission, etc.The high pressure fuel pump uses a single plunger pump design integrated with regulator, flow control valve and pressure relief valve. Its operation principle is to drive high pressure pump plunger to move up and down by cam, thus achieving oil suction and outlet. Using the pressure sensor on fuel rail, ECU controls the flow of high pressure fuel pump through flow control valve according to the set control procedure, so as to perform closed loop control of pressure in high pressure fuel rail. Regulator functions to suppress the pressure pulsation at the low pressure end and improve the stability of system. Pressure relief valve will open when high pressure fuel rail pressure exceeds the safety limit, so as to protect the system.


S10100

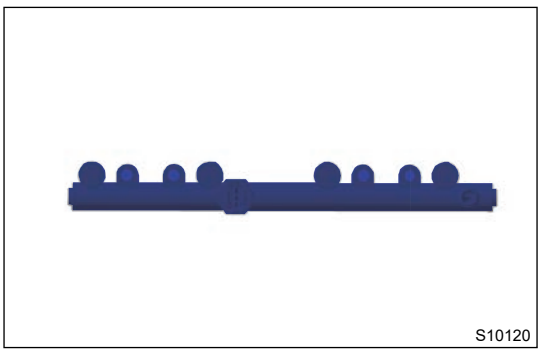
High Pressure Fuel Pipe

High pressure fuel pipe connects the high pressure fuel pump with the fuel rail injector assembly and delivers high pressure fuel to fuel rail injector assembly.


S10110

Fuel Rail Injector

The high pressure fuel distribution pipe assembly is integrated with high pressure fuel distribution pipe (fuel rail), high pressure fuel injector and high pressure sensor. Its operation principle is to optimize design through structure of high pressure fuel distribution pipe, the accurate fuel rail pressure signal feedback can uniformly and precisely distribute fuel for engine through injector.


S10120

Diagnosis & Testing

Problem Symptoms Table

Hint:
Use symptoms table below to help determine cause of problem. Check each suspected area in sequence. Repair, replace or adjust faulty components as necessary.
Fuel system

Symptom	Possible Cause
Fuel pressure in fuel supply system is too low	Electric fuel pump assembly (strainer blocked or fuel pressure regulator damaged)
	Low fuel level
Fuel pressure in fuel supply system is too high	Fuel injector (clogged)
	Electric fuel pump assembly (fuel pressure regulator damaged)
Electric fuel pump assembly has loud noise or a delay in operating	Low fuel level
	Electric Fuel Pump Assembly
Fuel injector is clogged or leaks	Fuel injector
	Poor fuel quality
	Excessive impurities in fuel tank
Fuel injector does not work	Fuel supply system line (broken)
	Fuel injector (short in coil)
	Electric fuel pump assembly (damaged)
	Wire harness

Lubrication Areas During Assembly

Lubrication Area	Note
High Pressure Fuel Pump O-ring	Engine Oil

Non-reusable Part

Non-reusable Part	Note
High Pressure Fuel Pipe	Replace it
Teflon Grommet of Fuel Injector	Replace it

High Pressure Fuel System Pressure Release

1. Method 1: Stop vehicle for 8 hours or more.
2. Method 2: Unplug high pressure fuel pump connector, and idle the engine for 10 seconds. In this case, the malfunction light on instrument cluster of vehicle will come on. After repair, connect high pressure fuel pump connector and operate it again for a period of time, then the fault will disappear.

Low Pressure Fuel System Pressure Release

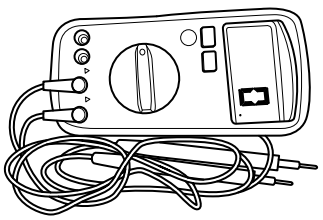
1. Method 1: Turn ENGINE START STOP switch OFF and leave vehicle for 30 minutes.

2. Method 2: Turn ENGINE START STOP switch OFF, remove fuel pump control module power supply fuse, start engine and make it stop automatically in Idling condition, then start engine twice or three times again, and release pressure residuals from fuel pipe by starting injection.

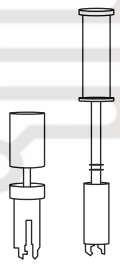
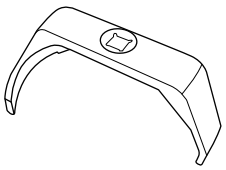
On-Vehicle Service

Tools

General Tools

Tool Name	Tool Drawing
Digital Multimeter	 S00002

Special Tools

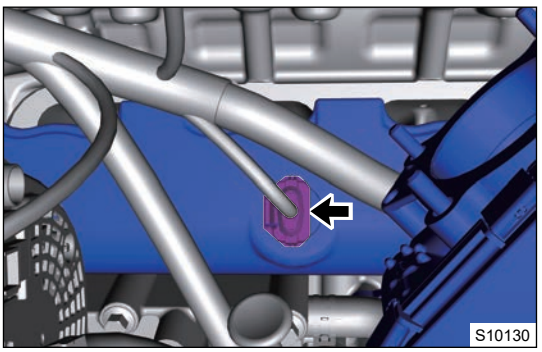
Tool Name	Part No.	Tool Drawing
Fuel Injector Remover	EPT-0020	 S00084
Fuel Tank Pressure Cap Remover	ECH-0006	 S00083

Fuel Rail Injector Assembly

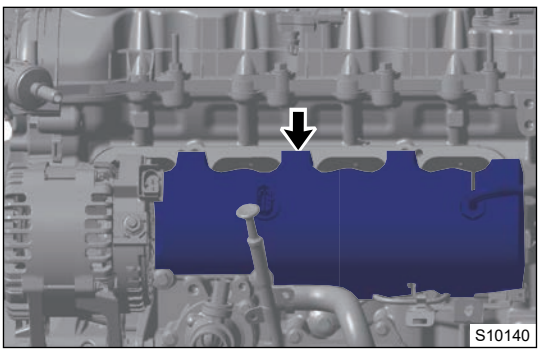
Removal

Warning
• As the pressure of high pressure fuel system is high, the pressure must be released before removal. • During removal, make sure the areas near stored parts are clean and free of dirt. • Teflon grommet at injector head cannot be reused after fuel rail injector is removal, and it must be replaced with a new one during installation, therefore, be sure to confirm if removal is necessary before removal. • Perform removal after engine cools down.

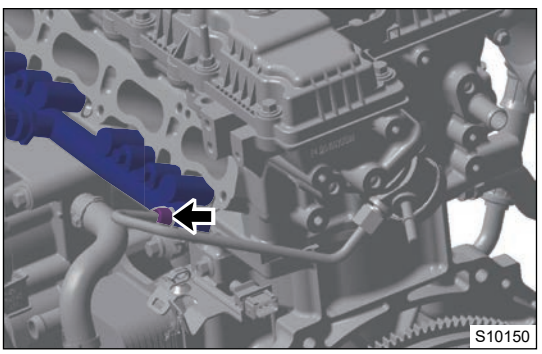
1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Remove the negative battery cable.
4. Remove the intake manifold assembly.
5. Disconnect the fuel rail pressure sensor connector.



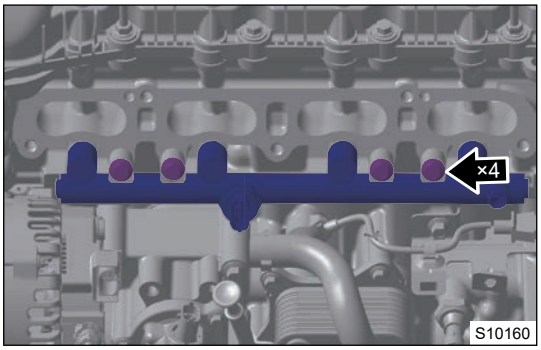
6. Remove the fuel rail injector sound insulator.



7. Loosen coupling nut between high pressure fuel pipe and fuel rail injector pipe joint.



8. Remove 4 fixing bolts from fuel rail injector and remove fuel rail injector assembly.



Inspection

1. Check if wire harness connector of fuel rail injector assembly is abnormal.
2. Check connection part between fuel rail and injector for oil leakage, and check injector mounting holes for air or oil leakage.
3. Use ohm band of multimeter to measure resistance between both pins of injector.

   Normal value: 1.5 Ω ± 5 % (at 23℃)

Installation

Caution
• If it is necessary to reassemble injector, assemble it after Teflon grommet at injector head is replaced. • Before installation, make sure injector mounting hole on engine cylinder head is clean and free of foreign matters. • Never lubricate Teflon grommet at injector head. • During installation, align injector with mounting hole on cylinder head, and press it into mounting hole in axis direction of injector at a constant speed. If a press-fitting device is used, keep the force balance when pressing to prevent system from being damaged due to the unbalanced stress. The maximum pressing force should not be greater than 800N. After fuel rail is pressed into place, loosen the press-fitting device and insert bolt into the mounting hole on fuel rail injector, and screw 3-5 teeth into the screw hole on cylinder head. • If no press-fitting device is available and fuel rail cannot be pressed into place, it is allowed to use a fuel rail bolt to bring it in, and tighten it several times in sequence of 3-2-4-1. It is not allowed to tighten an individual bolt directly. Tighten until fuel rail and cylinder head fit, then loosen all fuel rail bolts, and tighten fuel rail fixing bolts after fuel pipe is installed and tightened.

1. Pre-tighten 2 - 3 teeth between high pressure fuel pipe and fuel rail injector pipe joint.
2. Install 4 fixing bolts to fuel rail and loosen all fuel rail bolts after fuel rail and cylinder head fit.

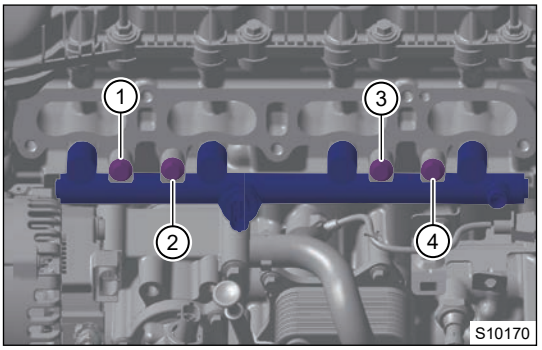
Caution
• Tightening sequence of bolts: 3-2-4-1.

3. Tighten high pressure fuel pipe nuts.

   Torque: 20 ± 2 N·m

4. Tighten fuel rail fixing bolts several times in sequence of 3-2-4-1.

   Torque: 25 ± 3 N·m



5. Tighten high pressure fuel pipe nuts again.

   Torque: 30 ± 2 N·m

6. Install fuel rail injector sound insulator.
7. Connect the fuel rail pressure sensor connector.
8. Install the intake manifold assembly.
9. Install the engine compartment trim cover assembly.

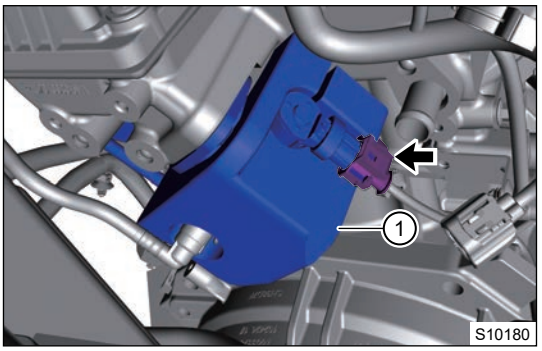
High Pressure Fuel Pump Assembly

Removal

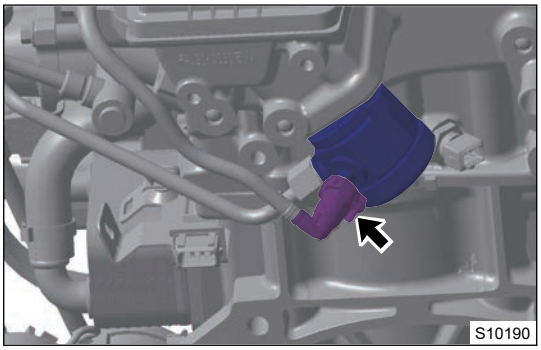
Warning
• As the pressure of high pressure fuel system is high, the pressure must be released before removal. • Be sure to wear necessary safety equipment to prevent accidents when repairing. • During removal, make sure the areas near stored parts are clean and free of dirt. • There is residual fuel in high pressure fuel pump. Please pay attention to the leakage of fuel during removal to avoid fire. • Perform removal after engine cools down.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Remove the engine compartment trim cover assembly.
3. Disconnect the negative battery cable.
4. Remove the intake hose assembly.

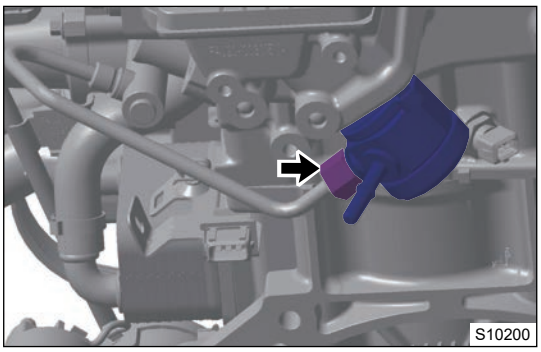
5. Disconnect the high pressure fuel pump (fuel pressure regulating solenoid valve) connector.
6. Remove the high pressure fuel pump sound insulator (1) carefully.



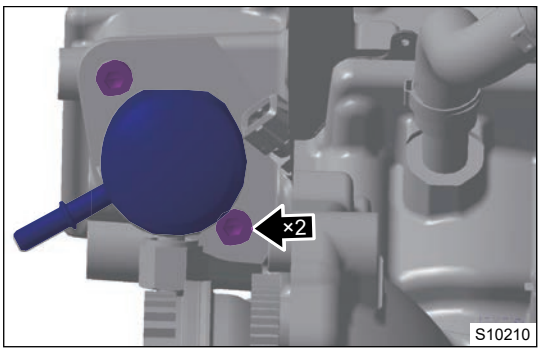
7. Disconnect the connection between inlet pipe Ⅱ and high pressure fuel pump.



8. Loosen high pressure fuel pipe joint, and disconnect connection between high pressure fuel pipe and high pressure fuel pump.



9. Remove 2 fixing bolts from high pressure fuel pump.



Caution
• During removal, loosen fixing bolts in turn, and then remove bolts completely. Never remove a bolt completely in one time.

10. Rotate high pressure fuel pump gently and pull it outwards. Never swing high pressure fuel pump in radial direction.

Caution
• When pulling out high pressure fuel pump, the roller tappet may fall naturally. In order to prevent damage in falling, hold it by hand when pulling out the high pressure fuel pump.

Check high pressure fuel pump

1. Check if high pressure fuel pump connector is abnormal.
2. Check resistance between both pins of high pressure fuel pump connector.
3. Measure resistance of high pressure fuel pump (fuel pressure regulating solenoid valve) coil.

Measurement Temperature (℃)	Coil Resistance (0 mileage) (Ω)		Coil Resistance (after driving) (Ω)	
	Minimum	Maximum	Minimum	Maximum
-40	0.379	0.417	0.372	0.426
20	0.495	0.545	0.485	0.556
160	0.765	0.843	0.750	0.859

Check the roller tappet

1. Check if appearance of roller tappet is complete, if wear is serious, and if roller bearing can rotate smoothly.
2. Check if roller tappet diameter is obviously out of tolerance. If it is out of tolerance, replacement is recommended. Diameter: 26 mm (— 0.020, 0.055)

   Hint:
   If above problems occur, replacing with a new roller tappet is recommended.

Installation

Caution
• Before installation, make sure the part model of high pressure fuel pump is correct and available. • Before installation, make sure sealing caps of high pressure fuel pump joint are complete. Never use high pressure fuel pump without sealing cap. • High pressure fuel pump O-ring must be lubricated with lubricating oil before installation. • During installation of high pressure fuel pump, never tighten a bolt firmly in one time, and they must be tightened in turn.

1. Apply a coat of oil to O-ring of high pressure fuel pump, install roller tappet and high pressure fuel pump and then place them into mounting hole. When replacing, be sure to align anti-rotating pin of roller tappet with anti-rotating groove in mounting hole.

2. Pre-tighten fixing bolts of high pressure fuel pump several turns in order, and never tighten a bolt completely in one time. Do not use sharp tools or tap components during installation to avoid damaging high pressure fuel pipe.

   Torque: 27 + 3 N·m

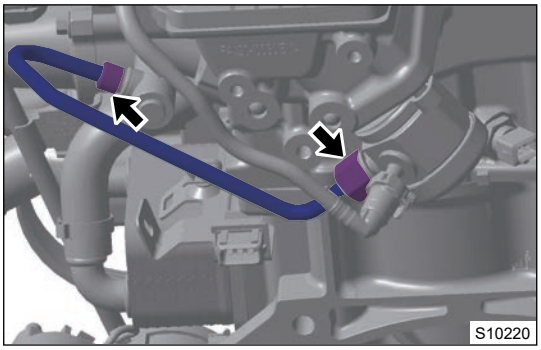
3. Do not allow skin to contact the roller tappet directly during installation. During the operation, it is necessary to wear cleaning gloves to prevent roller tappet surface from being contaminated by sweat and foreign matters.

High Pressure Fuel Pipe

Removal

Warning
• As the pressure of high pressure fuel system is high, the pressure must be released before removal. • Be sure to wear necessary safety equipment to prevent accidents when repairing. • During removal, make sure the areas near stored parts are clean and free of dirt. • Perform removal after engine cools down.

1. Release the high pressure fuel system pressure.
2. Turn off all electrical equipment and ENGINE START STOP switch.
3. Remove the intake hose assembly.
4. Remove the high pressure fuel pump sound insulator.
5. After pressure of high pressure fuel system is released completely, use a wrench to remove nuts on both sides of high pressure fuel pipe completely.



6. Remove high pressure fuel pipe.

Caution
• The removed high pressure fuel pipe should be marked with scraping marks and cannot be reused.

Installation

Caution
• High pressure fuel pipe is a non-reusable part, never reassemble it for a secondary use. • Before installing high pressure fuel pipe, make sure that the part model is correct, the sealing caps on both ends of high pressure fuel pipe are intact. Never use any high pressure fuel pipe without sealing cap. • Do not use sharp tools during installation to avoid scratching high pressure fuel pipe joint. • During installation of high pressure fuel pipe, pay attention to avoid collision with the fuel rail injector joint and end of high pressure fuel pump joint. • Before installing high pressure fuel pipe, confirm if fixing bolts of fuel rail injector are tightened. If they are tightened completely, loosen all of them and then install the high pressure fuel pipe.

1. Unplug protective cap of high pressure fuel pipe, and pre-tighten both ends of high pressure fuel pipe to high pressure fuel pump and fuel rail joint respectively in correct direction.

   Torque: 20 + 2 N·m

2. Tighten fuel rail fixing bolts several times in sequence of 3-2-4-1.

   Torque: 25 ± 3 N·m

Caution
• Tightening sequence of bolts: 3-2-4-1.

3. Tighten high pressure fuel pipe nuts again.

   Torque: 30 ± 2 N·m

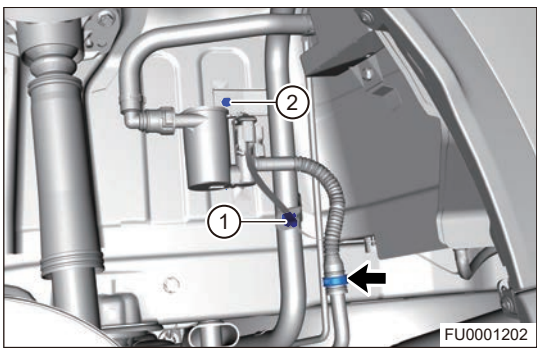
Filler Tube Assembly

Removal

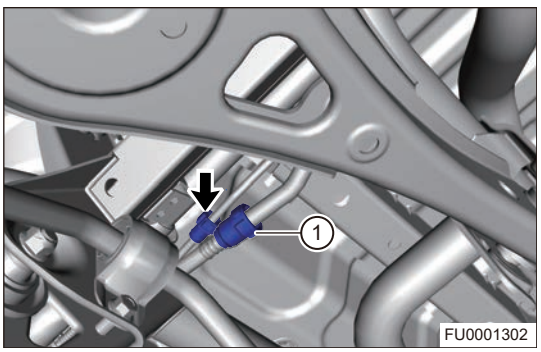
Warning
• Before operating the fuel supply system, please touch the vehicle body to discharge static electricity; failure to do so will cause a fire, even result in an explosion. • When operating the fuel supply system, work area should be in good ventilation and keep fire sources or open flames away from the work area, in which fire extinguisher should be equipped. • If fuel leakage occurs when operating the fuel supply system, please handle the leaked fuel in time.

Caution
• Be sure to wear necessary safety equipment to prevent accidents when repairing.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Remove the rear left tire.
4. Remove the rear left wheel house protector.
5. Open fuel filler cap, and rotate fuel tank cap assembly counterclockwise to remove it.
6. Remove the electric fuel filler cap assembly.
7. Remove the filler tube assembly.
8. Loosen worm clamp (arrow) and disconnect fuel breather pipe.
9. Disconnect the wire harness fixing clip (1).
10. Remove fixing bolt (2) between upper part of fuel filler pipe and body.

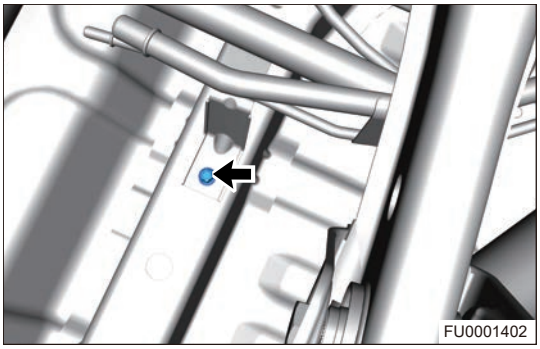


11. Disconnect connection between fuel vapor pipe Ⅲ (arrow) and fuel filler pipe assembly.
12. Disconnect activated charcoal canister breather pipe (1) and fuel filler tube assembly.



13. Remove 1 fixing bolt (arrow) between filler tube assembly and body.

Tightening torque: 7 ± 1 N·m



14. Remove the filler tube assembly.

Caution
• When assembling hose, make sure that hose is not twisted and kinked. • Note that when you hear a sound of “click” during disconnecting and connecting quick connector, it indicates that it is installed in place.

Installation

1. Installation is in the reverse order of removal.

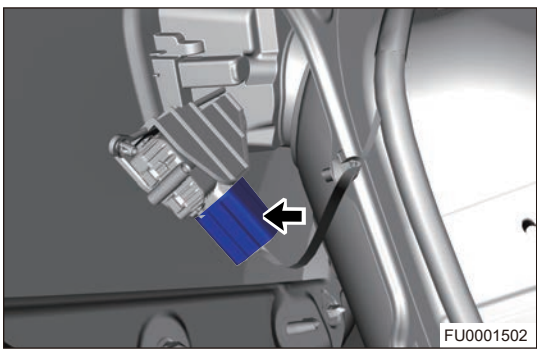
Electric Fuel Filler Cap Assembly

Removal

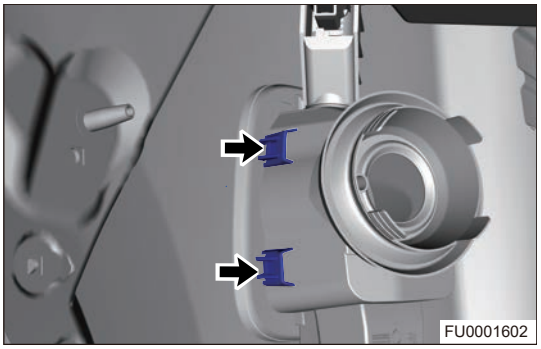
Warning
• Before operating the fuel supply system, please touch the vehicle body to discharge static electricity; failure to do so will cause a fire, even result in an explosion. • When operating the fuel supply system, work area should be in good ventilation and keep fire sources or open flames away from the work area, in which fire extinguisher should be equipped. • If fuel leakage occurs when operating the fuel supply system, please handle the leaked fuel in time.

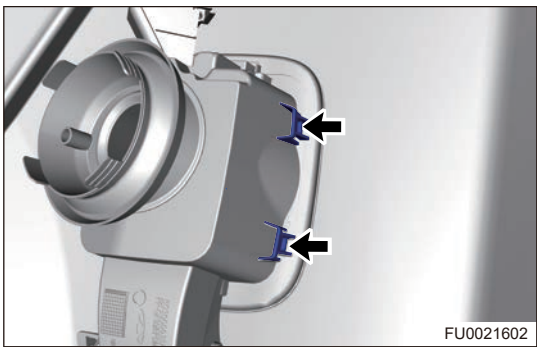
Caution
• Be sure to wear necessary safety equipment to prevent accidents when repairing.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Remove the luggage compartment left wheel house assembly.
4. Remove the electric fuel filler cap assembly.
5. Disconnect the electric fuel filler cap assembly connector (arrow).



6. Insert hand into and press 4 fixing clips (arrow) of fuel filler cap assembly from interior, push them out and remove electric fuel filler cap assembly.





Installation

1. Installation is in the reverse order of removal.

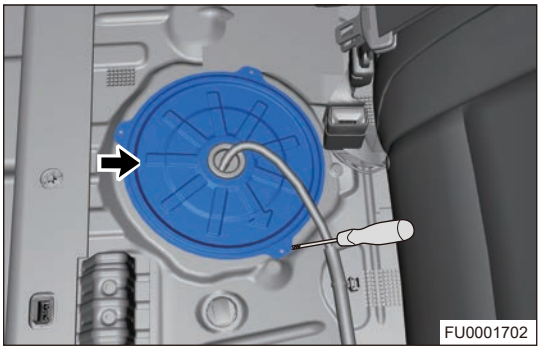
Electric Fuel Pump Assembly

Removal

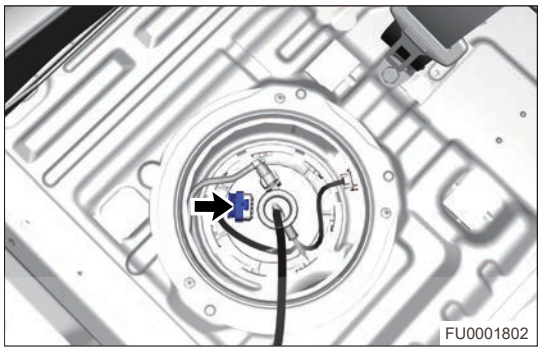
Warning
• Before operating the fuel supply system, please touch the vehicle body to discharge static electricity; failure to do so will cause a fire, even result in an explosion. • When operating the fuel supply system, work area should be in good ventilation and keep fire sources or open flames away from the work area, in which fire extinguisher should be equipped. • If fuel leakage occurs when operating the fuel supply system, please handle the leaked fuel in time. • Operation staff should wear protective glasses and rubber gloves during repair and avoid inhaling much fuel gas. • Only use parts approved by Chery Automobile Co., Ltd. to replace the electric fuel pump assembly. • Keep electric fuel pump assembly and work area clean when replacing electric fuel pump assembly; otherwise the electric fuel pump assembly element will be clogged. • DO NOT damage the disconnected fuel system line or connectors. Cover the line joints or connectors with plastic bags or equivalent, preventing foreign matter from entering. • Keep fuel tank and line clean.

1. Release the low pressure fuel system pressure.
2. Turn off all electrical equipment and ENGINE START STOP switch.
3. Disconnect the negative battery cable.
4. Open fuel tank cap to discharge fuel vapor.
5. Remove the second row left seat assembly.

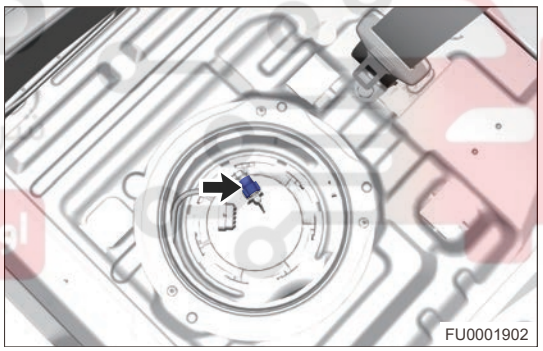
6. Using a screwdriver wrapped with protective tape, pry off electric fuel pump assembly protective cap (arrow).



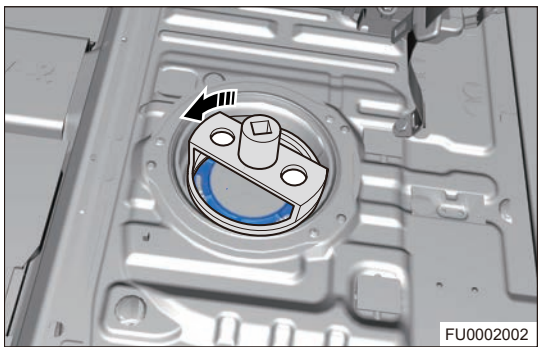
7. Disconnect the electric fuel pump assembly connector (arrow).



8. Disconnect connection between inlet pipe I (arrow) and electric fuel pump assembly.



9. Using a fuel tank pressure cap special tool, remove fuel tank pressure cap in counterclockwise direction.



10. Remove electric fuel pump assembly from fuel tank, and dispose of fuel in electric fuel pump assembly.

Caution
• Operate carefully when taking the electric fuel pump assembly out of fuel tank, preventing damaging lines and floats. • Cover the electric fuel pump assembly completely with a plastic bag or equivalent to prevent foreign matter from entering. • Electric fuel pump assembly can be put into a container and taken out of the cabin, thus preventing fuel in the pump from dropping into the cabin. • It is not allowed to perform running test for electric fuel pump assembly under dry state or in water. Otherwise service life will be reduced. In addition, do not inversely connect electric fuel pump assembly positive and negative poles.

Installation

Caution
• Replace fuel tank seal ring with a new one when installing electric fuel pump assembly, align it with installation position of fuel tank and do not run the electric fuel pump assembly with no fuel in fuel tank, preventing damaging electric fuel pump assembly. • Before connecting the hose, check if there is any damage or foreign matter on the hose or joint. • During installation, push in fuel pipe connector until a click sound is heard, then check that fuel pipe joint clip is on the collar of fuel pipe joint. After installing the pipe joint clip, check that fuel pipe joint cannot be pulled out. Be careful not to damage joint. If clip is damaged, replace it. • Turn ignition switch to ON (without starting engine) to apply fuel pressure to fuel supply system, and then check connections for leakage.

1. Using a fuel tank pressure cap special tool, install fuel tank pressure cap.

   Torque: 400 N·m.

2. Connect inlet pipe.
3. Connect the electric fuel pump assembly connector.
4. Install the second row left seat assembly.

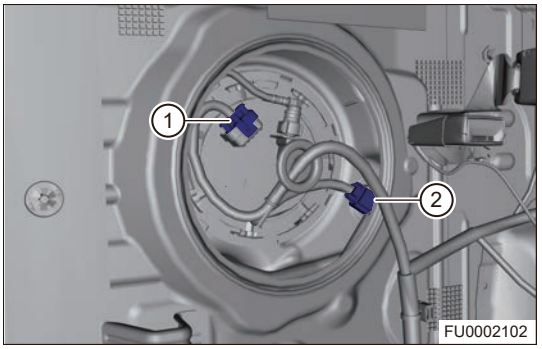
Fuel Tank Assembly

Removal

Warning
• Before operating the fuel supply system, please touch the vehicle body to discharge static electricity; failure to do so will cause a fire, even result in an explosion. • When operating the fuel supply system, work area should be in good ventilation and keep fire sources or open flames away from the work area, in which fire extinguisher should be equipped. • If fuel leakage occurs when operating the fuel supply system, please handle the leaked fuel in time. • Operation staff should wear protective glasses and rubber gloves during repair and avoid inhaling much fuel gas. • DO NOT damage the disconnected fuel system line or connectors. Cover the line joints or connectors with plastic bags or equivalent, preventing foreign matter from entering. • Keep fuel tank and line clean.

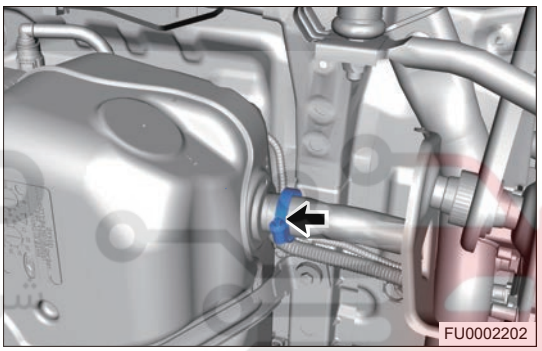
1. Release the low pressure fuel system pressure.
2. Turn off all electrical equipment and ENGINE START STOP switch.
3. Disconnect the negative battery cable.
4. Open the fuel tank cap assembly and discharge the fuel vapor in fuel tank.
5. Remove the fuel tank assembly.

6. Disconnect the electric fuel pump assembly connector (1).
7. Disconnect the fuel tank pressure sensor connector (2).

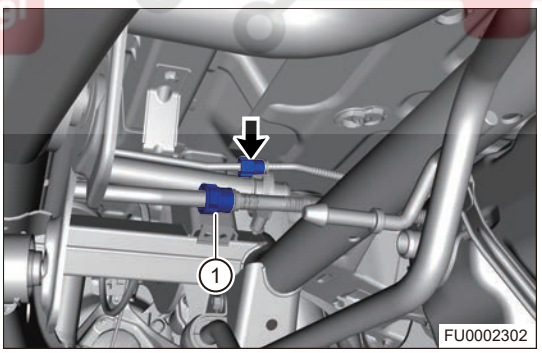


8. Raise vehicle to a proper position, loosen worm clamp (-arrow) and disconnect connection between fuel filler hose and fuel tank assembly.

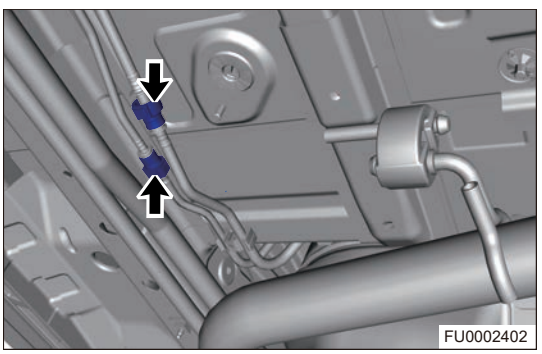
Tightening torque: 3 ± 0.5 N·m



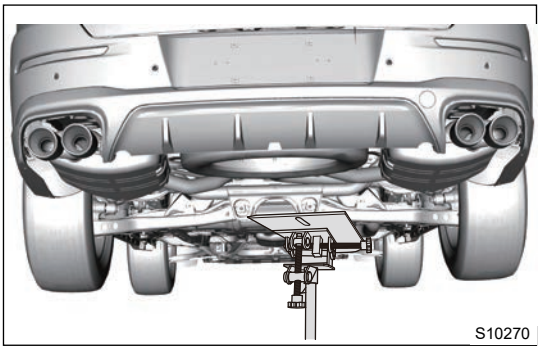
9. Disconnect connection between fuel vapor pipe Ⅲ (-arrow) and fuel filler pipe assembly.
10. Disconnect activated charcoal canister breather pipe (1) and fuel filler tube assembly.



11. Disconnect connection (arrow) between fuel vapor pipe Ⅳ and fuel vapor pipe Ⅴ.
12. Disconnect connection (arrow) between inlet pipe Ⅰ and inlet pipe Ⅱ.

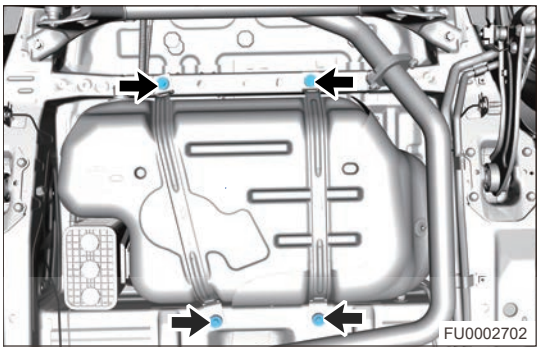


13. Support fuel tank assembly with a transmission carrier.

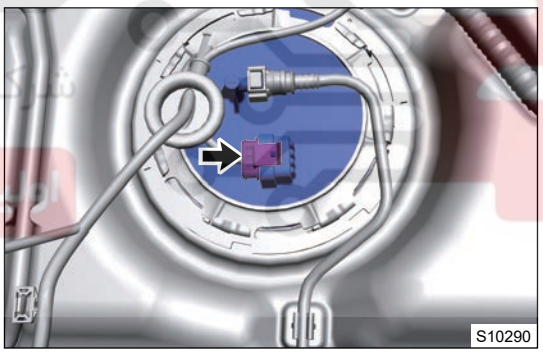


14. Remove 4 fixing bolts (arrow) between fuel tank assembly fixing straps and body.

Tightening torque: 23 ± 2 N·m

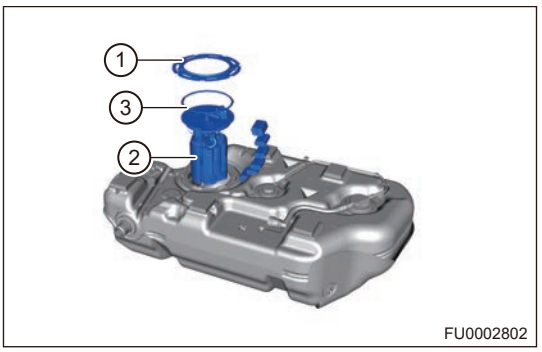


15. Lower lift to a proper position, and remove fuel tank assembly.
16. Disconnect the fuel pump assembly connector carefully.

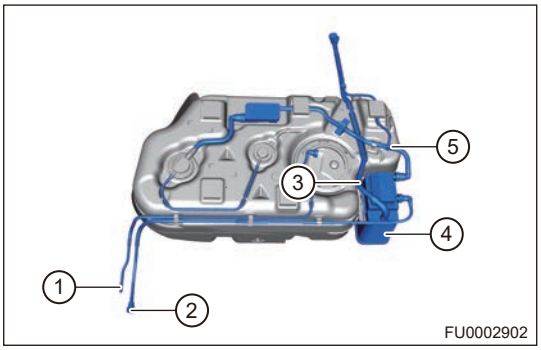


17. Lower lift to a proper position slowly, and remove fuel tank assembly carefully.

18. Using a special tool, remove electric fuel pump pressure cap (1).
19. Remove electric fuel pump assembly (2) and fuel tank seal ring (3) from fuel tank assembly.



20. Remove the fuel vapor pipe Ⅱ from fuel tank fixing clip.
21. Remove inlet pipe Ⅰ (1) from fuel tank assembly.
22. Remove fuel vapor pipe Ⅳ assembly (2) from fuel tank assembly.
23. Remove activated charcoal canister breather pipe assembly (3) from fuel tank assembly.
24. Remove activated charcoal canister assembly (4) from fuel tank assembly.
25. Remove fuel vapor pipe Ⅲ assembly (5) from fuel tank assembly.



Installation

Caution
• Before connecting the hose, check if there is any damage or foreign matter on the hose or joint. • During installation, push in fuel pipe connector until a click sound is heard, then check that fuel pipe joint clip is on the collar of fuel pipe joint. After installing the pipe joint clip, check that fuel pipe joint cannot be pulled out. Be careful not to damage joint. If clip is damaged, replace it. • Turn ENGINE START STOP switch to ON (without starting engine) to apply fuel pressure to fuel supply system, and then check connections for leakage.

1. Installation is in the reverse order of removal.

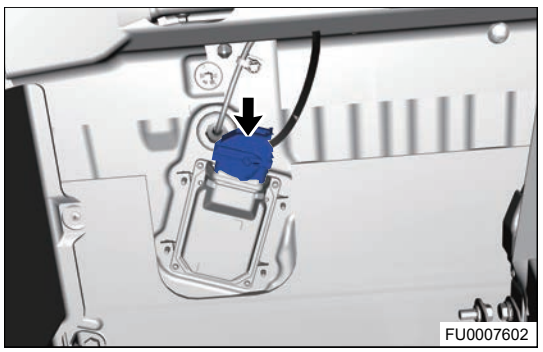
   Torque: 400 N·m.

Fuel Pump Control Module

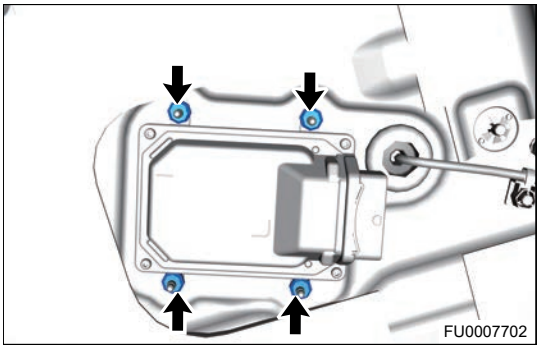
Removal

Warning
• Be sure to wear necessary safety equipment to prevent accidents when repairing.

1. Turn off all electrical equipment and ENGINE START STOP switch.
2. Disconnect the negative battery cable.
3. Remove the left luggage compartment protector body.
4. Disconnect the fuel pump control module connector.



5. Remove 4 fixing nuts from fuel pump control module.



6. Remove the fuel pump control module.

Installation

1. Install 4 fixing nuts to fuel pump control module.
   Torque: 7 ± 1 N·m
2. Connect the fuel pump control module connector.
3. Install the left luggage compartment protector body.

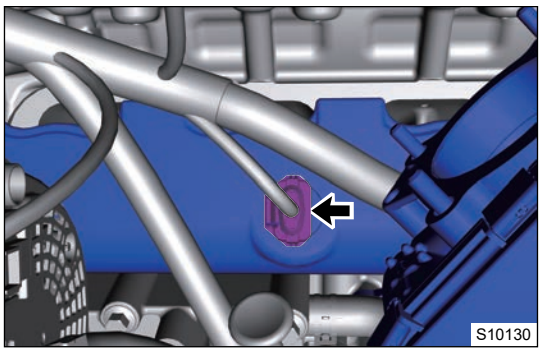
Fuel Rail Pressure Sensor

Removal

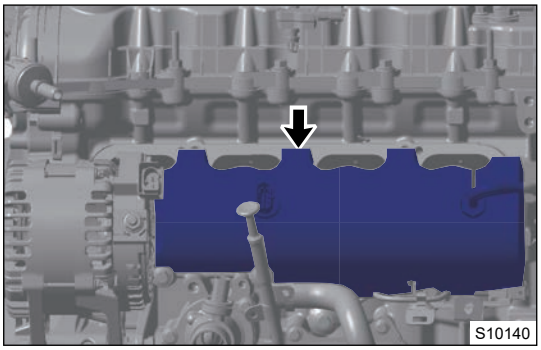
Warning
• Before operating the fuel supply system, please touch the vehicle body to discharge static electricity; failure to do so will cause a fire, even result in an explosion. • When operating the fuel supply system, work area should be in good ventilation and keep fire sources or open flames away from the work area, in which fire extinguisher should be equipped.

1. Release the high pressure fuel system pressure.
2. Turn off all electrical equipment and ENGINE START STOP switch.
3. Disconnect the negative battery cable.
4. Remove the intake manifold assembly.

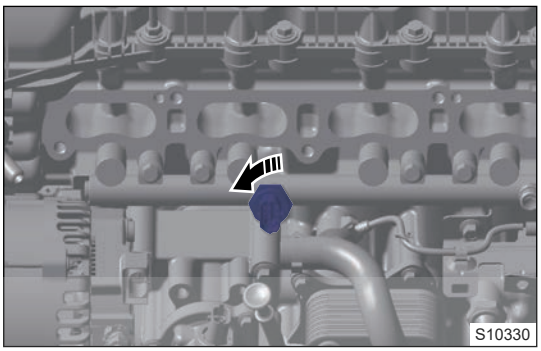
5. Disconnect the fuel rail pressure sensor connector.



6. Remove the fuel rail injector sound insulator.



7. Remove fuel rail pressure sensor counterclockwise in direction of arrow as shown in illustration.



Inspection

Use ohm band of multimeter to measure resistance among 3 pins of fuel rail pressure sensor (pay attention to the positive and negative orders).

Sensor Pin (corresponding to positive and negative poles of multimeter in front-and-rear sequence)	Normal Value
1 - 2	301 ± 100 kΩ
1 - 3	24 ± 1 kΩ
2 - 1	∞
2 - 3	∞
3 - 1	24 ± 1 kΩ
3 - 2	301 ± 100 kΩ

Installation

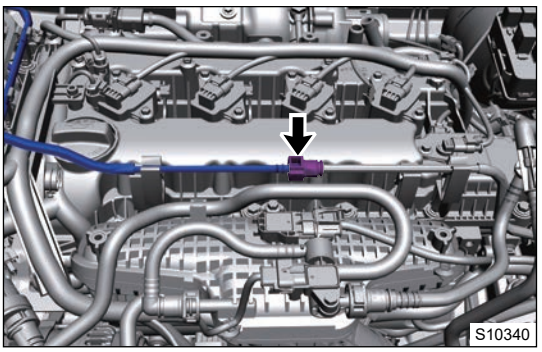
1. Install fuel rail pressure sensor.
2. Install fuel rail injector sound insulator.
3. Install the intake manifold assembly.

Low Pressure Fuel Pressure Sensor

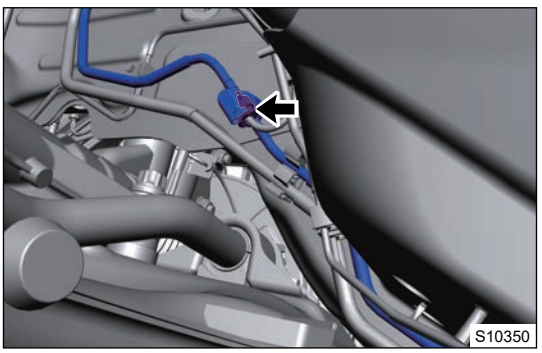
Removal

Warning
• Before operating the fuel supply system, please touch the vehicle body to discharge static electricity; failure to do so will cause a fire, even result in an explosion. • When operating the fuel supply system, work area should be in good ventilation and keep fire sources or open flames away from the work area, in which fire extinguisher should be equipped.

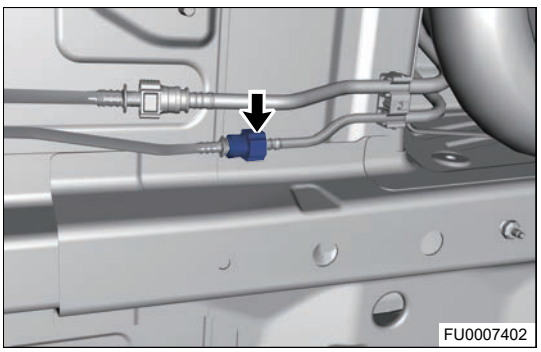
1. Release the high pressure fuel system pressure.
2. Turn off all electrical equipment and ENGINE START STOP switch.
3. Disconnect the negative battery cable.
4. Remove the low pressure fuel pressure sensor.
5. Disconnect connection between inlet pipe Ⅱ and inlet pipe Ⅰ.



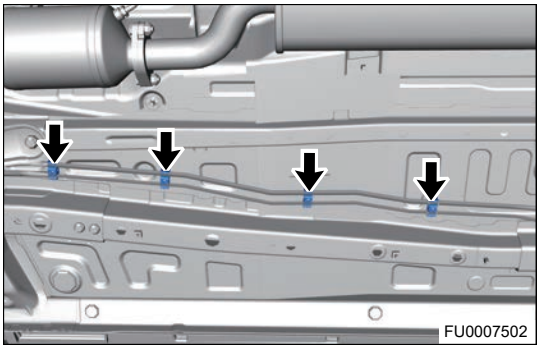
6. Disconnect the low pressure fuel pressure sensor connector.



7. Disconnect the inlet pipe Ⅰ (arrow).



8. Disengage and remove oil inlet pipe II with low pressure fuel pressure sensor from double-groove pipe clamp (arrow).



9. Remove inlet pipe I assembly from double groove pipe clamp carefully.

Installation

1. Fix the inlet pipe I to double groove pipe clamp.
2. Connect the low pressure fuel pressure sensor connector.
3. Connect pipe joints to inlet pipe and inlet pipe II respectively.