

ENGINE 02

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1.6L & 1.8L ENGINE MECHANICAL

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دیجیتال خودرو
شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



GENERAL INFORMATION

Description

The 1.6L & 1.8L in-line four cylinder engines have the following features:

- Dual overhead camshafts
- Four valves per cylinder
- Aluminum cylinder head
- Cast iron cylinder block (1.8 L Engine)
- Aluminum cylinder block (1.6 L Engine)

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Operation

The 1.6L & 1.8L engines utilize 4 valve-per-cylinders and a dual overhead camshaft design. The engines use a remote coil ignition system. The cylinder block is made of cast iron and the bearing caps are integrated into the lower cylinder block assembly. An aluminum oil pan bolts to the bottom of the lower cylinder block. The camshafts are mounted in the cylinder head and act against valve tappets to open and close the valves. The camshafts are driven off the front of the cylinder head by one timing belt. The belt is driven by a sprocket that is located on the crankshaft. The piston assembly is an aluminum piston with a cast iron connecting rod.

The aluminum cylinder head contains dual overhead camshafts with four valves per cylinder. The valves are arranged in two in-line banks. The cylinder head incorporates powdered metal valve guides and seats. The cylinder head is sealed to the block using a multi-layer steel head gasket and retaining bolts.

Specifications

1.6L Engine Specifications

DESCRIPTION	SPECIFICATION
Type	In-Line OHV, DOHC
Number of Cylinders	4
Compression Ratio	10.5:1
Compression Pressure	10-15 Bar
Max. Compression Pressure Variation Between Cylinders	25%
Stroke	77.5 mm
Bore	81 mm
Displacement	1597 cc
Firing Order	1-3-4-2

1.8L Engine Specifications

DESCRIPTION	SPECIFICATION
Type	In-Line OHV, DOHC
Number of Cylinders	4
Compression Ratio	10.5:1
Compression Pressure	10-15 Bar
Max. Compression Pressure Variation Between Cylinders	25%
Stroke	89.5 mm
Bore	81 mm
Displacement	1845 cc
Firing Order	1-3-4-2

GENERAL INFORMATION

Torque Specifications

CAUTION:

When torquing a fastener in two steps, DO NOT use a torque wrench for the second step.

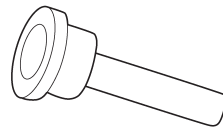
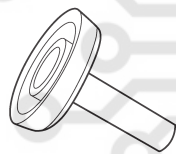
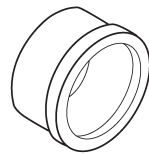
DESCRIPTION	TORQUE (N·m)
Accessory Drive Belt Tensioner Pulley Bolt	35
Camshaft Bearing Cap Bolts	11
Clutch Pressure Plate Bolts	25
Connecting Rod Cap Bolts	1st Step: Tighten the bolt to 25 N·m 2nd Step: Tighten the bolt an additional 90°
Crankshaft Holding Tool	28
Crankshaft Main Bearing Cap Bolts	1st Step: Tighten the bolt to 45 N·m 2nd Step: Tighten the bolt an additional 180°
Crankshaft Timing Belt Pulley Bolt	1st Step: Tighten the bolt to 130 N·m 2nd Step: Tighten the bolt an additional 65°
Crankshaft Vibration Damper Bolts	25
Cylinder Head Cover Bolts	11
Cylinder Head Bolts	85
Dipstick Bracket Bolts	11
Drive Plate Bolts (automatic transaxle)	75
Engine Left Mount Bolt	100
Engine Right Mount Bolt	70
Engine Front Mount Bolt	60
Engine Rear Mount Bolt	60
Engine To Transaxle Bolts	80
Exhaust Manifold Nuts	25
Exhaust Manifold Heat Shield Bolts	15
Exhaust Camshaft Timing Belt Pulley Bolt	120
Flywheel Bolts (manual transaxle)	75
Fuel Rail Bracket Bolts	11
Idler Pulley Bolt	40
Intake Camshaft Timing Belt Pulley Bolt	120
Intake Manifold Bolts	10
Intake Manifold Nuts	11
Intake Manifold Bracket Bolts	25
Lower Idler Pulley Bolt	45
Lower Cylinder Block Bolts	23
Oil Filter	25
Oil Pan Bolts	18
Oil Drain Plug	40
Oil Strainer Bolts	18
Oil Pump Bolts	11 (Apply with Loctite 5910 Thread-Locker)
Rear Timing Cover Bolts	7

GENERAL INFORMATION

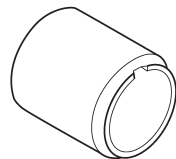
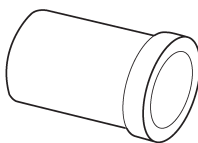
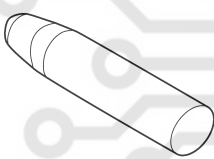
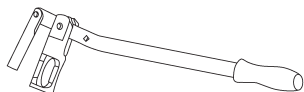
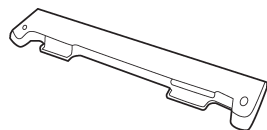
DESCRIPTION	TORQUE (N.m)
Timing Belt Upper Cover Bolts	11
Timing Belt Lower Cover Bolts	11
Timing Belt Tensioner Assembly	27
Timing Belt Tensioner Pulley Bolt	30
Throttle Body Bolts	11
Upper Idler Pulley Bolt	45

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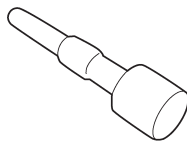
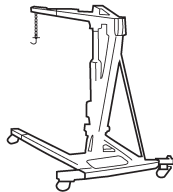
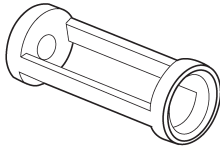
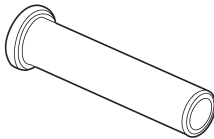
Special Tools

Camshaft Seal Installer CH-20002	 besm020001
Rear Crankshaft Oil Seal Guide CH-20006	 besm020002
Rear Crankshaft Oil Seal Installer CH-20005	 besm020003

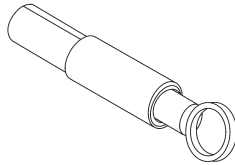
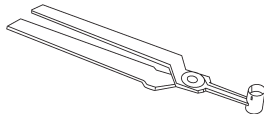
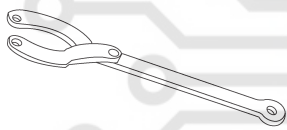
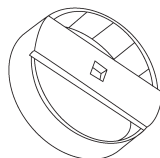
GENERAL INFORMATION

Front Crankshaft Seal Installer CH-20007	 besm020004
Front Crankshaft Seal Guide CH-20008	 besm020005
Valve Stem Seal Installer Guide CH-20012	 besm020006
Valve Spring Compressor CH-20018	 besm020007
Camshaft Holder CH-20010	 besm020008

GENERAL INFORMATION

Crankshaft Holder CH-20003	 besm020009
Engine Hoist	 besm020010
Right Engine Mount Bolt Remover CH-20001	 besm020079
Valve Spring Compressor Adaptor CH-20004	 besm020080
Valve Seal Installer CH-20011	 besm020081

GENERAL INFORMATION

Valve Seal Remover CH-20013	 besm020082
Valve Keeper Installer CH-20017	 besm020084
Crankshaft Belt Pulley Fixture CH-20019	 besm020085
Oil Filter Remover CH-10003	 besm020087

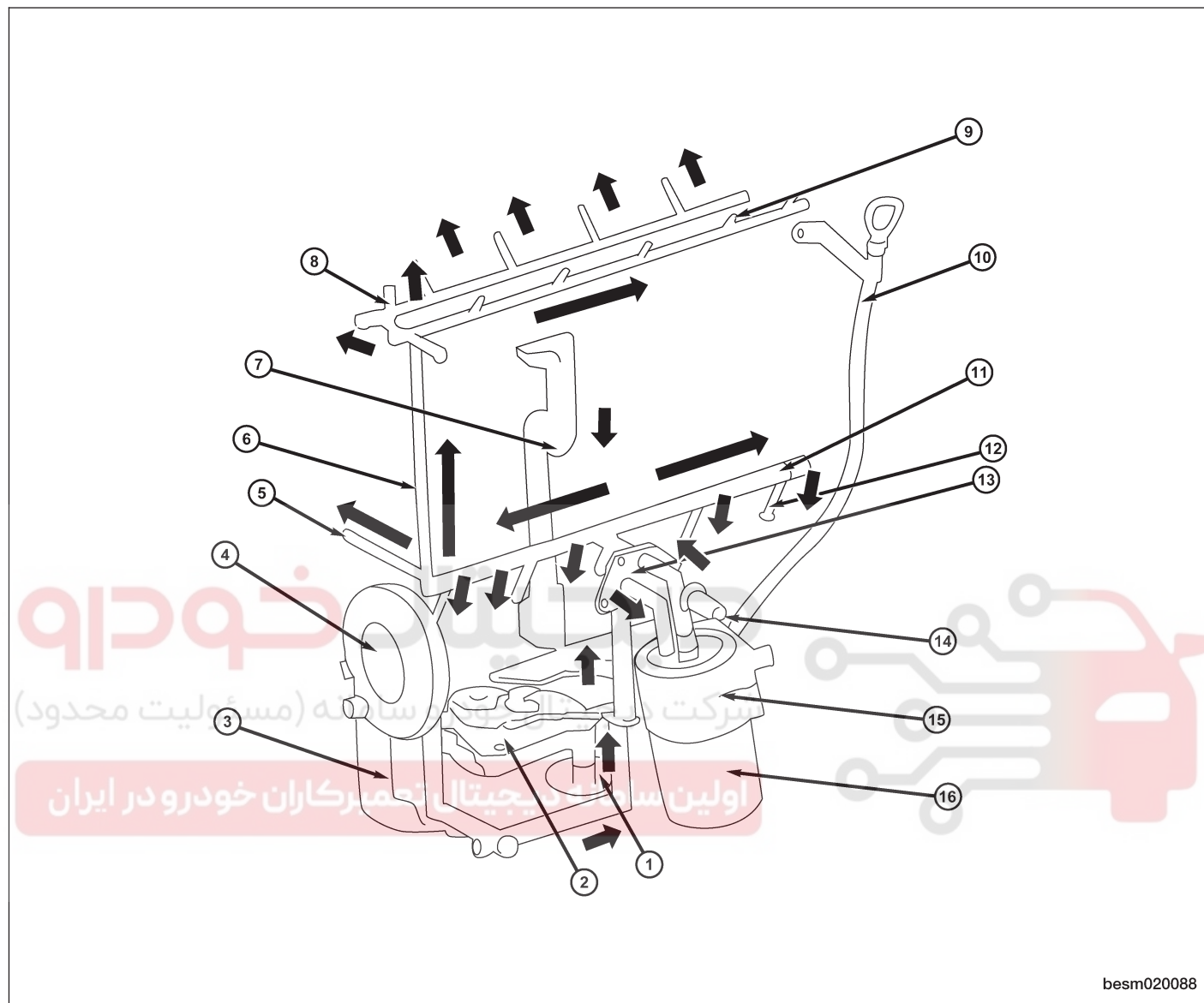
Lubrication System

The engine lubrication system operates as follows:

- Oil is drawn into the oil pump through the oil pump strainer tube in the sump of the oil pan.
- Oil is pumped through the oil filter on the cylinder block.
- Oil enters the main oil gallery where it is distributed to the crankshaft main journals and to the cylinder head.
- From the main journals, the oil is routed through cross-drilled passages in the crankshaft to lubricate the connecting rod bearings. Controlled leakage through the crankshaft main bearings and connecting rod bearings is

GENERAL INFORMATION

slung radially outward to cool and lubricate the cylinder walls as well as the entire connecting rod, piston and piston ring assembly.



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besm020088

1 – Oil Pump Strainer
2 – Baffle Plate
3 – Oil Pan
4 – Oil Pump
5 – Turbocharger Inlet Oil Gallery (if equipped)
6 – To Cylinder Head
7 – Oil Return Passage
8 – To Front Bearing Cap

9 – To Middle Bearing Cap
10 – Oil Dipstick
11 – To Crankcase
12 – Crankcase Pipe
13 – Oil Filter Bracket
14 – Oil Pressure Switch
15 – Oil Cooler
16 – Oil Filter

DIAGNOSIS & TESTING

Engine Performance Diagnostics

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE DOES NOT START	1. Weak battery. 2. Corroded or loose battery connections. 3. Faulty starter. 4. Faulty coil(s) or control unit. 5. Incorrect spark plug gap. 6. Contamination in fuel system. 7. Faulty fuel pump. 8. Incorrect engine timing.	1. Test battery. Charge or replace as necessary. 2. Clean and tighten battery connections. Apply a coat of light mineral grease to terminals. 3. Test starting system. Check for codes. (Refer to Appropriate Diagnostic Information) 4. Test and replace as needed. (Refer to Appropriate Diagnostic Information) 5. Set gap. 6. Clean system and replace fuel filter. 7. Test fuel pump and replace as needed. (Refer to Appropriate Diagnostic Information) 8. Check for a skipped timing belt.
ENGINE STALLS OR IDLES ROUGH	1. Idle speed too low. 2. Incorrect fuel mixture. 3. Intake manifold leakage. 4. Faulty ignition coil(s).	1. Test minimum air flow. (Refer to Appropriate Diagnostic Information) 2. (Refer to Appropriate Diagnostic Information) 3. Inspect intake manifold, manifold gasket, and vacuum hoses. 4. Test and replace as necessary. (Refer to Appropriate Diagnostic Information)
ENGINE LOSS OF POWER	1. Dirty or incorrectly gapped spark plugs. 2. Contamination in fuel system. 3. Faulty fuel pump. 4. Incorrect valve timing. 5. Leaking cylinder head gasket. 6. Low compression. 7. Burned, warped, or pitted valves. 8. Plugged or restricted exhaust system. 9. Faulty ignition coil(s).	1. Clean spark plugs and set gap. 2. Clean system and replace fuel filter. 3. Test and replace as necessary. (Refer to Appropriate Diagnostic Information) 4. Correct valve timing. 5. Replace cylinder head gasket. 6. Test compression of each cylinder. 7. Replace valves. 8. Perform exhaust restriction test. Install new parts. 9. Test and replace as necessary. (Refer to Appropriate Diagnostic Information)
ENGINE MISSES ON ACCELERATION	1. Dirty or incorrectly gapped spark plugs. 2. Contamination in fuel system. 3. Burned, warped, or pitted valves. 4. Faulty ignition coil(s).	1. Clean spark plugs and set gap. 2. Clean fuel system and replace fuel filter. 3. Replace valves. 4. Test and replace as necessary. (Refer to Appropriate Diagnostic Information)

DIAGNOSIS & TESTING

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE MISSES AT HIGH SPEED	1. Dirty or incorrect spark plug gap. 2. Faulty ignition coil(s). 3. Dirty fuel injector(s). 4. Contamination in fuel system.	1. Clean spark plugs and set gap. 2. Test and replace as necessary. (Refer to Appropriate Diagnostic Information) 3. Test and replace as necessary. (Refer to Appropriate Diagnostic Information) 4. Clean system and replace fuel filter.

02

Engine Mechanical Diagnostics

CONDITION	POSSIBLE CAUSES	CORRECTION
VALVE TRAIN NOISE	1. High or low oil level in crankcase. 2. Thin or diluted oil. 3. Thick oil. 4. Low oil pressure. 5. Worn cam lobe. 6. Worn valve guides. 7. Excessive runout of valve seats on valve faces.	1. Check and correct engine oil level. 2. Change oil to correct viscosity. 3. Change engine oil and filter. 4. Check and correct engine oil level. 5. Install new camshaft. 6. Replace cylinder head. 7. Grind valve seats and replace valves.
CONNECTING ROD NOISE	1. Insufficient oil supply. 2. Low oil pressure. 3. Thin or diluted oil. 4. Excessive bearing clearance. 5. Connecting rod journal out-of-round. 6. Connecting rod out-of-round. 7. Misaligned connecting rods.	1. Check engine oil level. 2. Check engine oil level. Inspect oil pump relief valve and spring. 3. Change oil to correct viscosity. 4. Measure bearings for correct clearance. Repair as necessary. 5. Replace crankshaft or grind surface. 6. Replace connecting rod. 7. Replace bent connecting rods.
MAIN BEARING NOISE	1. Insufficient oil supply. 2. Low oil pressure. 3. Thin or diluted oil. 4. Excessive bearing clearance. 5. Excessive end play. 6. Crankshaft journal out-of-round or worn. 7. Loose flywheel or torque converter.	1. Check engine oil level. 2. Check engine oil level. Inspect oil pump. 3. Change oil to correct viscosity. 4. Measure bearings for correct clearance. Repair as necessary. 5. Check thrust bearing for wear on flanges. 6. Replace crankshaft or grind journals. 7. Tighten to correct torque.
OIL PRESSURE DROP	1. Low oil level. 2. Faulty oil pressure sending unit. 3. Low oil pressure. 4. Clogged oil filter. 5. Thin or diluted oil. 6. Excessive bearing clearance.	1. Check engine oil level. 2. Install new sending unit. 3. Check sending unit and main bearing oil clearance. 4. Install new oil filter. 5. Change oil to correct viscosity. 6. Measure bearings for correct clearance.

DIAGNOSIS & TESTING

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS	1. Misaligned or deteriorated gaskets. 2. Loose fastener, broken or porous metal part. 3. Misaligned or deteriorated cup or threaded plug.	1. Replace gasket. 2. Tighten, repair or replace the part. 3. Replace as necessary.
OIL CONSUMPTION OR SPARK PLUGS FOULED	1. PCV system malfunction. 2. Worn, scuffed or broken rings. 3. Carbon in oil ring slots. 4. Rings fitted too tightly in grooves. 5. Worn valve guide(s). 6. Valve stem seal(s) worn or damaged.	1. Check system and repair as necessary. 2. Hone cylinder bores. Install new rings. 3. Install new rings. 4. Remove rings and check grooves. If groove is not proper width, replace piston. 5. Replace cylinder head. 6. Replace seal(s).

Cylinder Compression Pressure Test

- The results of a cylinder compression pressure test can be utilized to diagnose several engine malfunctions.
- Ensure the battery is completely charged and the engine starter motor is in good operating condition. Otherwise the indicated compression pressures may not be valid for diagnosis purposes.
 - Check engine oil level and add oil if necessary.
 - Disconnect the spark plug wires.
 - Remove all spark plugs from engine (as spark plugs are being removed, check electrodes for abnormal firing indicators fouled, hot, oily, etc.).
 - Record cylinder number of each spark plug for future reference.
 - Disconnect fuel injector electrical connectors.
 - Be sure throttle blade is fully open during the compression check.
 - Insert compression pressure adaptor or the equivalent into each spark plug hole in cylinder head.
 - Crank engine until maximum pressure is reached on gauge. Record each cylinder pressure.
 - Compression should not be less than 1000 kPa and not vary more than 25 percent from cylinder to cylinder.
 - If one or more cylinders have abnormally low compression pressures, repeat the compression test.
 - If the same cylinder or cylinders repeat an abnormally low reading on the second compression test, it could indicate the existence of a problem in the cylinder in question.

NOTE :

The recommended compression pressures are to be used only as a guide to diagnosing engine problems. An engine should not be disassembled to determine the cause of low compression unless some malfunction is present.

Cylinder Head Gasket Test

- A cylinder head gasket leak can be located between adjacent cylinders, between a cylinder and the adjacent water jacket or from an oil passage to the exterior of the engine.
- Possible indications of the cylinder head gasket leaking between adjacent cylinders are:
 - Loss of engine power
 - Engine misfiring
 - Poor fuel economy
- Possible indications of the cylinder head gasket leaking between a cylinder and an adjacent water jacket are:
 - Engine overheating
 - Loss of coolant
 - Excessive steam (white smoke) emitting from exhaust
 - Coolant foaming

ON-VEHICLE SERVICE

Accessory Drive Belt

Removal & Installation

WARNING!

Inspect the drive belt only when the engine is stopped.

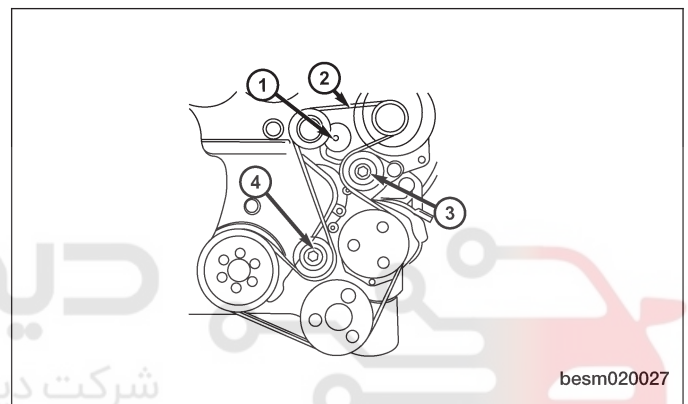
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1. While using a suitable tool and securely holding the hexagonal portion of the drive belt tensioner, rotate the pulley counterclockwise to loosen the drive belt.

WARNING!

Avoid placing hands near the drive belt tensioner while it is being held.

2. Remove the drive belt.
3. Remove accessory drive belt tensioner pulley bolt (1) if necessary.
(Tighten: Accessory drive belt tensioner pulley bolt to 35 N·m)
4. Installation is in the reverse order of removal.



Air Cleaner Element

Removal & Installation

1. Unhook the air cleaner case side clips and raise the air cleaner case (upper).
2. Remove the air cleaner element.
3. Install a new air cleaner element.
4. Installation is in the reverse order of removal.

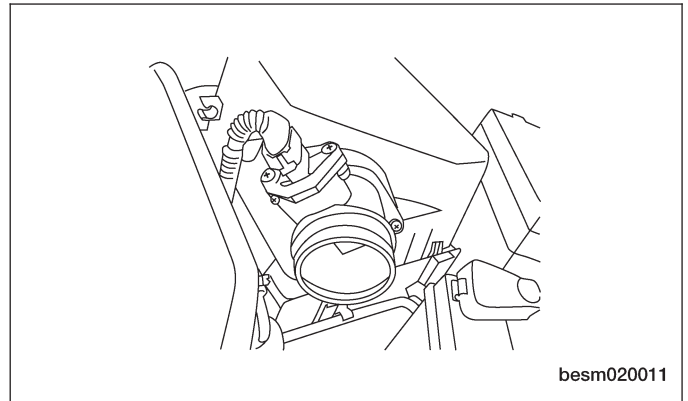
Air Cleaner Housing

Removal & Installation

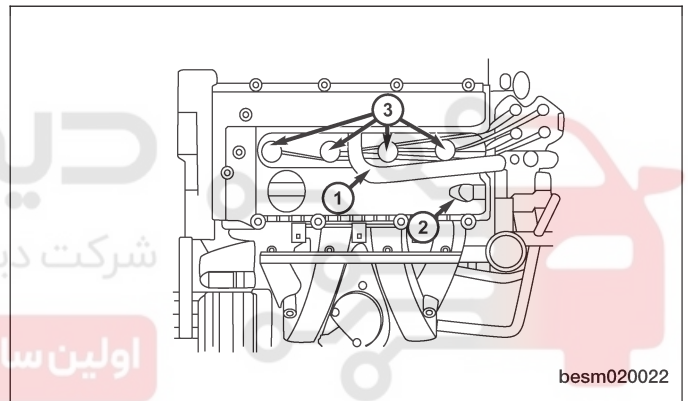
1. Disconnect the negative battery cable.
2. Disconnect the air flow sensor electrical connector.
3. Loosen the clamp between the air intake hose and the air cleaner.

ON-VEHICLE SERVICE

4. Remove the screws securing the air cleaner housing to its base.
5. Remove the air cleaner housing.
6. Remove the air cleaner base as necessary.
7. Installation is in the reverse order of removal.

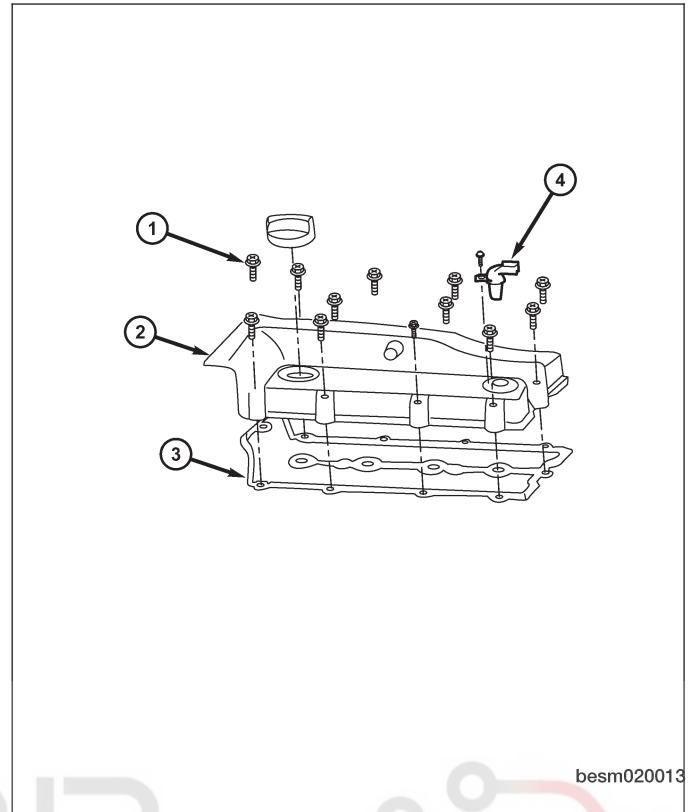
**Cylinder Head Cover****Removal & Installation**

1. Disconnect the negative battery cable.
2. Remove the engine cover.
3. Disconnect the camshaft position sensor electrical connector.
4. Remove the camshaft position sensor (2) and set aside.
5. Remove the spark plug wires (3) and set them aside.
6. Remove the PCV hose (1) from cylinder head cover.
7. Use compressed air to blow dirt and debris off the cylinder head cover prior to removal.



ON-VEHICLE SERVICE

8. Remove the cylinder head cover bolts (1).
(Tighten: Cylinder head cover bolts to 11 N.m)
9. Remove the cylinder head cover (2) from the cylinder head.
10. Remove the cylinder head cover gasket (3) if necessary.
11. Installation is in the reverse order of removal.



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Camshaft

Removal & Installation

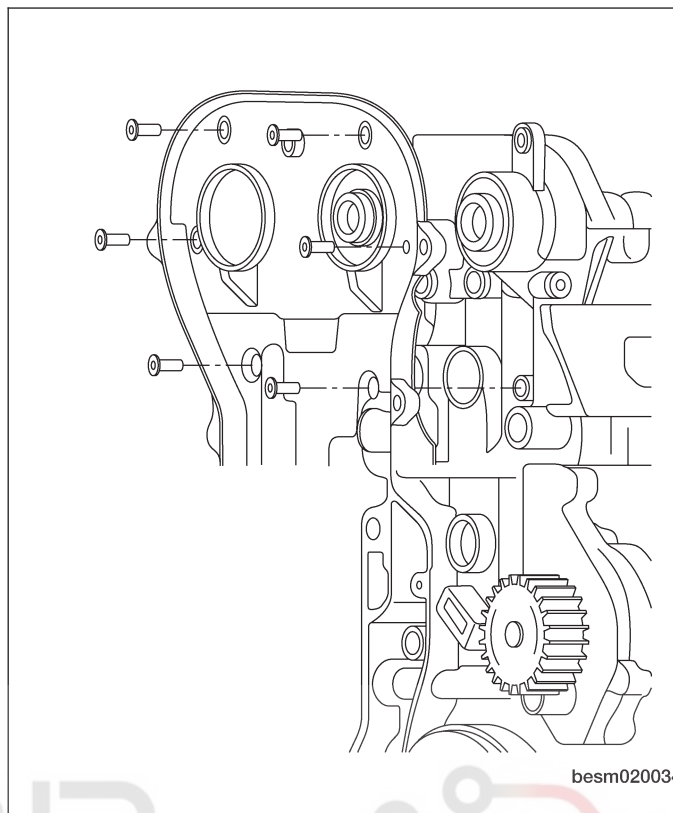
NOTE : The following special tools are required to perform the repair procedure:

- CH-20002 - Camshaft seal installer

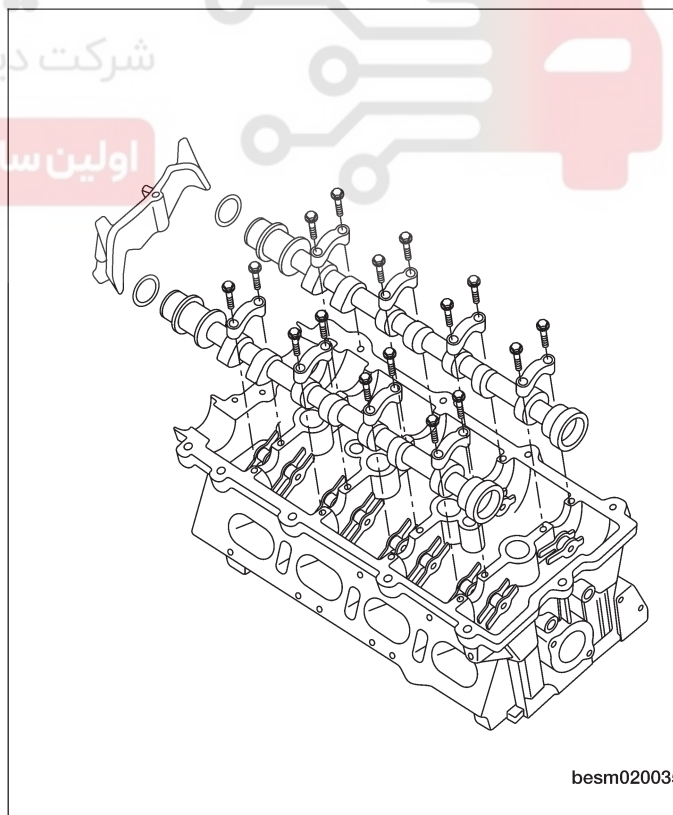
1. Remove the accessory drive belt (See Accessory Drive Belt Removal & Installation in Section 02 Engine).
2. Remove the engine timing belt (See Engine Timing Belt Removal & Installation in Section 02 Engine).
3. Remove the cylinder head cover (See Cylinder Head Cover Removal & Installation in Section 02 Engine).
4. Remove the intake or exhaust camshaft timing belt pulley.
(Tighten: Camshaft timing belt pulley bolt to 120 N.m)

ON-VEHICLE SERVICE

5. Remove the rear timing cover of the timing pulley.
(Tighten: Rear timing cover bolts to 7 N·m)



6. Remove the camshaft bearing cap bolts.
(Tighten: Camshaft bearing cap bolts to 11 N·m)
NOTE: Equally loosen camshaft bearing cap bolts in several steps.
7. Remove the camshaft bearing caps and place them in proper order.
NOTE: The camshaft bearing caps are marked for identification.
8. Remove the camshafts and then remove the camshaft seals.

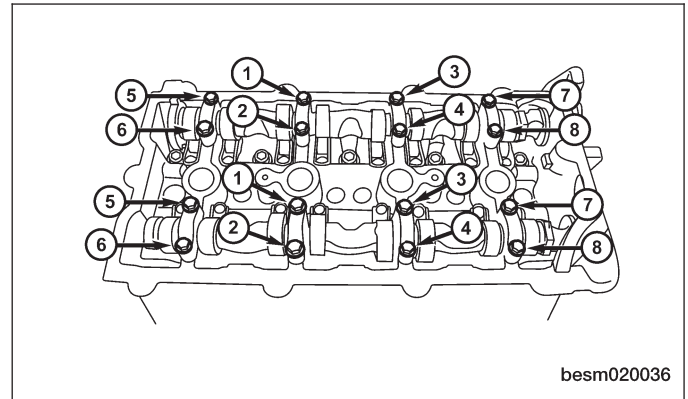


ON-VEHICLE SERVICE

9. Installation is in the reverse order of removal.

Installation Notes:

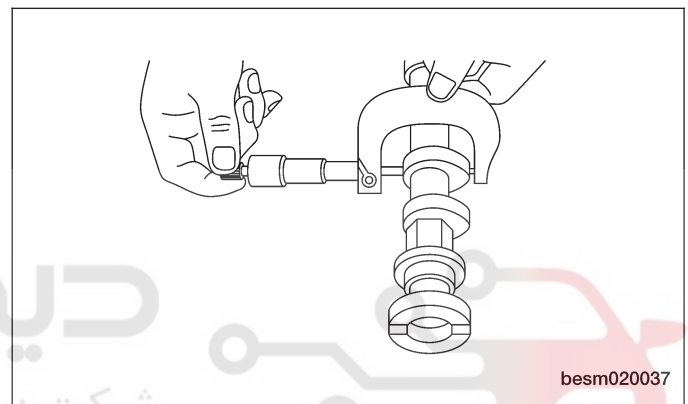
- Install the intake and exhaust camshaft bearing caps in the proper order
- Slowly tighten bolts to the specified torque
- Follow the torque sequence shown



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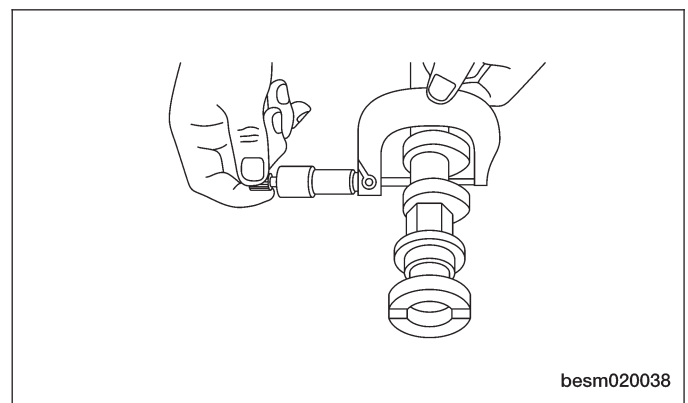
Inspection

- Measure the camshaft cam lobe height.
- If wear is beyond the limit, replace the camshaft.



CAMSHAFT CAM LOBE HEIGHT	
Intake Am Lobe Height	37.15 mm
Exhaust Cam Lobe Height	37.05 mm

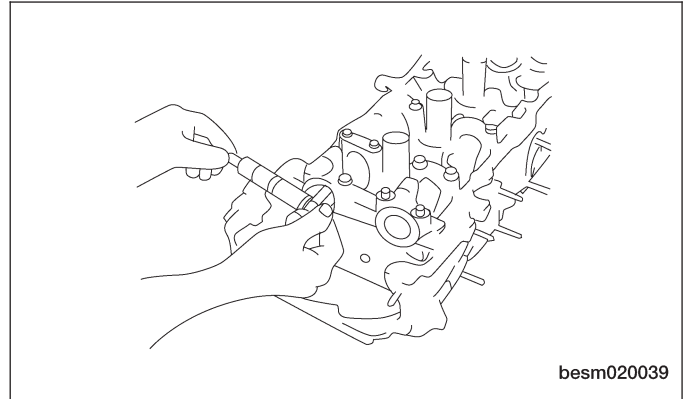
- Measure the outer diameter of the camshaft journal.



OUTER DIAMETER OF CAMSHAFT JOURNAL	
Journal #1 Outer Diameter	31.934-31.95 mm
Journal #2, #3, #4, #5, Outer Diameter	23.947-23.96 mm

ON-VEHICLE SERVICE

- Measure the inner diameter of the camshaft bearing.



besm020039

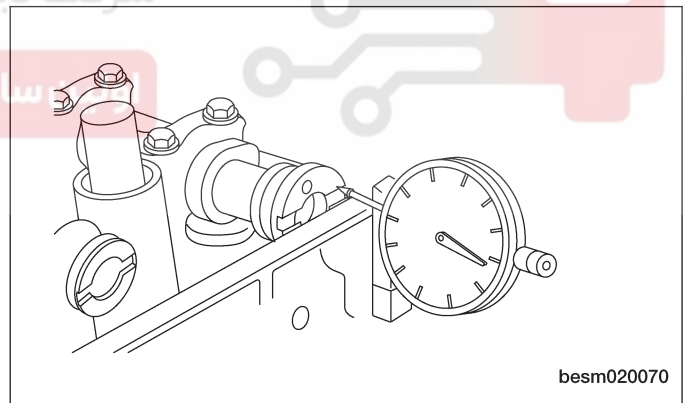
INNER DIAMETER OF CAMSHAFT BEARING	
Cam Bearing #1 Inner Diameter	32-32.025 mm
Cam Bearing #2, #3, #4, #5, Inner Diameter	24-24.021 mm

- Calculation of camshaft journal clearance

Journal clearance = (inner diameter of camshaft bearing) - (outer diameter of camshaft journal)

CAMSHAFT JOURNAL CLEARANCE	
Journal Clearance #1	0.05-0.091 mm
Journal Clearance #2, #3, #4, #5	0.04-0.074 mm

- Measure the axial clearance of camshaft.



besm020070

CAMSHAFT AXIAL CLEARANCE	
Intake Camshaft	0.15-0.20 mm
Exhaust Camshaft	0.15-0.20 mm

Cylinder Head

Removal & Installation

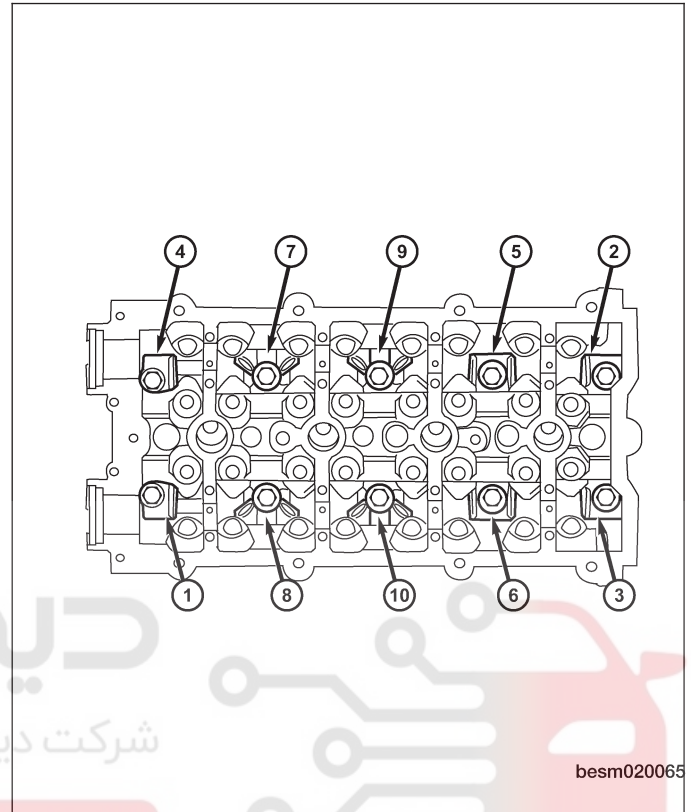
NOTE :

Replacement cylinder head comes complete with valves, seals, springs, retainers, keepers, and camshafts.

1. Remove engine timing belt (See Engine Timing Belt Removal & Installation in Section 02 Engine).
2. Remove the cylinder head cover (See Cylinder Head Cover Removal & Installation in Section 02 Engine).

ON-VEHICLE SERVICE

3. Remove the camshafts (See Camshaft Removal & Installation in Section 02 Engine).
4. Remove intake manifold (See Intake Manifold Removal & Installation in Section 02 Engine).
5. Remove exhaust manifold (See Exhaust Manifold Removal & Installation in Section 02 Engine).
6. Remove water pipe and thermostat assembly.
7. Remove the cylinder head bolts in the order shown.
(Tighten: Cylinder head bolts to 85 N·m)



02

8. Remove cylinder head gaskets.
9. Installation is in the reverse order of removal.

Installation Notes:

- Ensure cylinder head bolt holes in the block are clean, dry (free of residual oil or coolant), and threads are not damaged.
- Do not reuse the cylinder head bolts. The new bolts should be examined BEFORE use. If the bolts are stretched, the bolts should be replaced.
- Position the new cylinder head gasket on the engine block with the part number facing up. Ensure gasket is seated over the locating dowels in the block.
- Before installing the bolts, the threads should be lightly coated with engine oil.

Front Crankshaft Oil Seal**Removal & Installation****NOTE :**

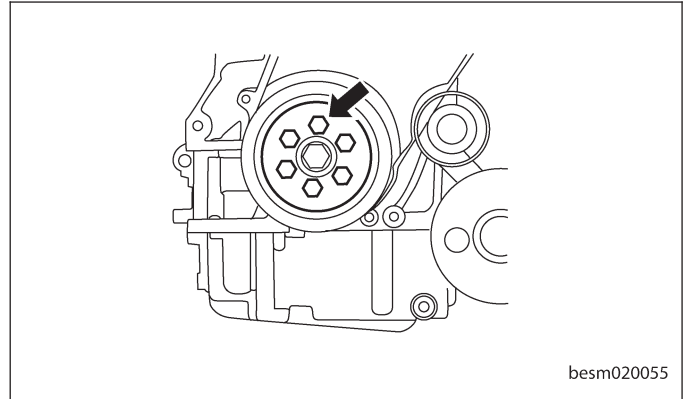
The following special tools are required to perform the repair procedure:

- CH-20007 - Front crankshaft seal installer
- CH-20008 - Front crankshaft seal guide
- CH-20019 - Crankshaft belt pulley fixture

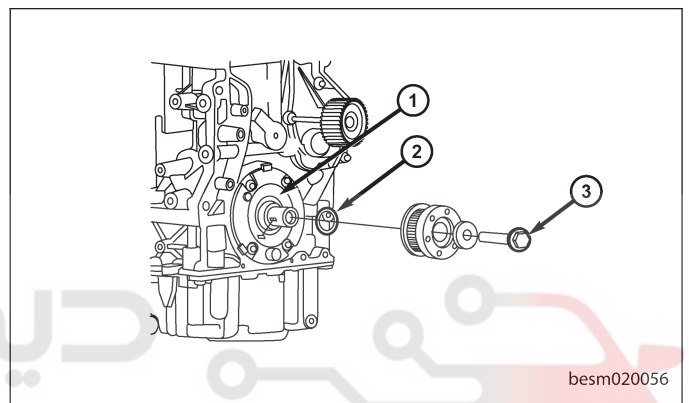
1. Remove the accessory drive belt (See Accessory Drive Belt Removal & Installation in Section 02 Engine).

ON-VEHICLE SERVICE

2. Remove the crankshaft vibration damper bolts.
(Tighten: Crankshaft vibration damper bolts to 25 N·m)



3. Remove the engine timing belt (See Engine Timing Belt Removal & Installation in Section 02 Engine).
4. Remove the crankshaft timing belt pulley bolt (3) from the crankshaft.
(Tighten: Crankshaft timing belt pulley bolt to 130 N·m + 65°)
5. Remove the key-way from the crankshaft.
6. Use an appropriate tool and remove the front crankshaft oil seal (2).

**CAUTION:**

Be careful not to damage the front cover seal surface while removing the seal.

7. Installation is in the reverse order of removal.

Installation Notes:

- Install the new seal by using the front crankshaft seal installer.
- Lubricate the new front seal with engine oil prior to assembly.

Rear Crankshaft Oil Seal**Removal & Installation****NOTE :**

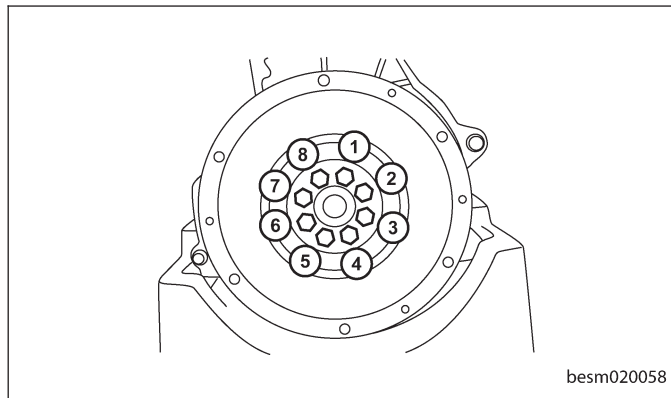
The following special tools are required to perform the repair procedure:

- CH-20005 - Rear crankshaft oil seal installer
- CH-20006 - Rear crankshaft oil seal guide

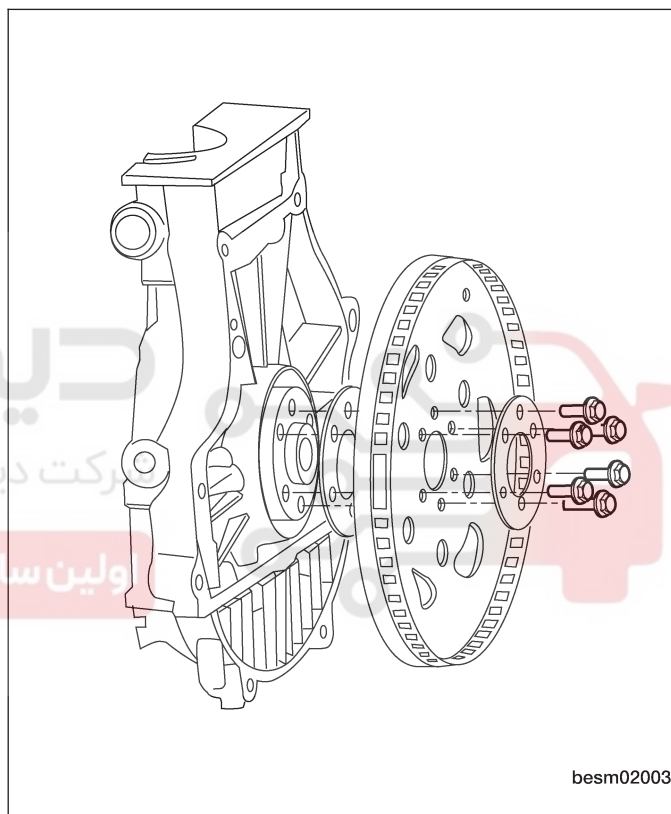
1. Remove the transaxle assembly (See Transaxle Assembly Removal & Installation in Section 08 Transmission).
2. If equipped with manual transaxle, remove clutch pressure plate.
(Tighten: Clutch pressure plate bolts to 25 N·m)

ON-VEHICLE SERVICE

3. If equipped with manual transaxle, remove the flywheel bolts and then remove the flywheel.
(Tighten: Flywheel bolts to 75 N·m)



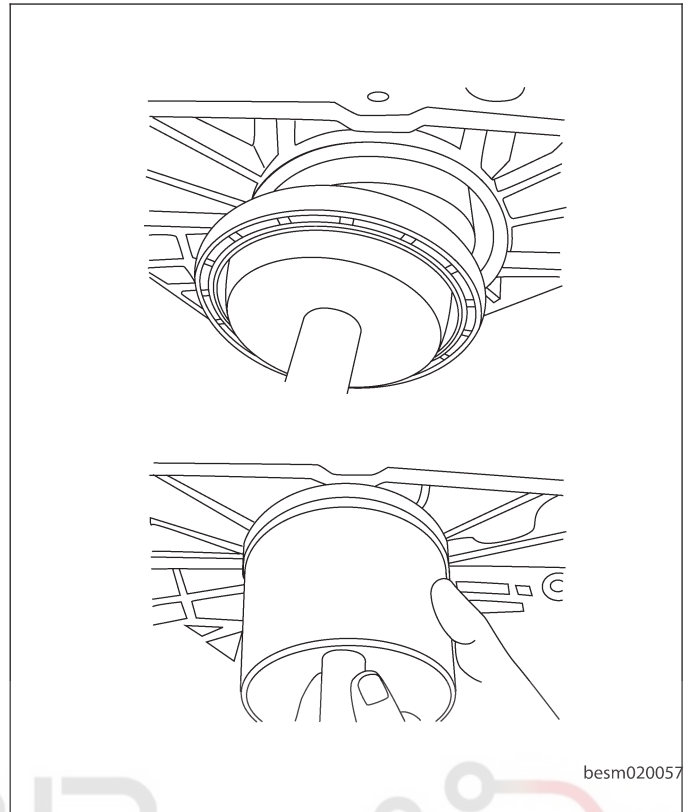
4. If equipped with automatic transaxle, remove the drive plate retaining bolts and then remove drive plate.
(Tighten: Drive plate bolts to 75 N·m)



5. Remove the rear oil seal using a suitable tool.
6. Installation is in the reverse order of removal.

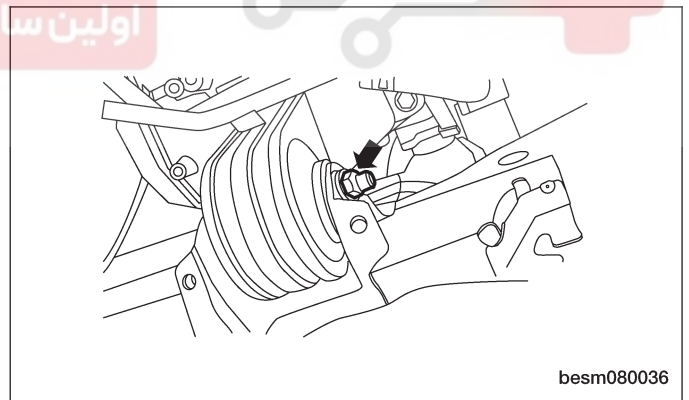
ON-VEHICLE SERVICE**Installation Notes:**

- When installing seal, lubricate seal guide with clean engine oil.
- Position the seal over the rear crankshaft seal guide.
- Guide tool should remain on crankshaft during installation of seal.
- Ensure that the lip of the seal is facing toward the crankcase during installation.

**Engine Mounts****Left Mount - Removal & Installation****NOTE :**

The following special tools are required to perform the repair procedure:

- Engine hoist
 1. Disconnect the negative battery cable.
 2. Remove the engine cover.
 3. Remove the left transaxle mount.
(Tighten: Engine left mount bolt to 100 N·m)
 4. Installation is in the reverse order of removal.



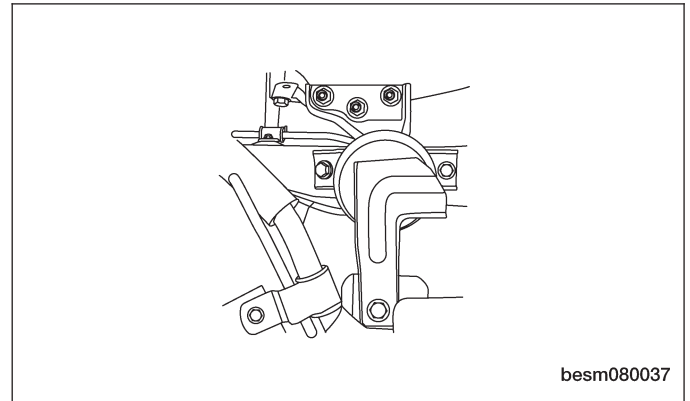
ON-VEHICLE SERVICE

Right Mount - Removal & Installation

NOTE :

The following special tools are required to perform the repair procedure:

- CH-20001 - Right engine mount bolt remover
 - Engine hoist
1. Disconnect the negative battery cable.
 2. Remove the engine cover.
 3. Using special tool CH-20001, remove the three bolts securing the right engine mount.
(Tighten: Engine right mount bolt to 70 N·m)
 4. Installation is in the reverse order of removal.



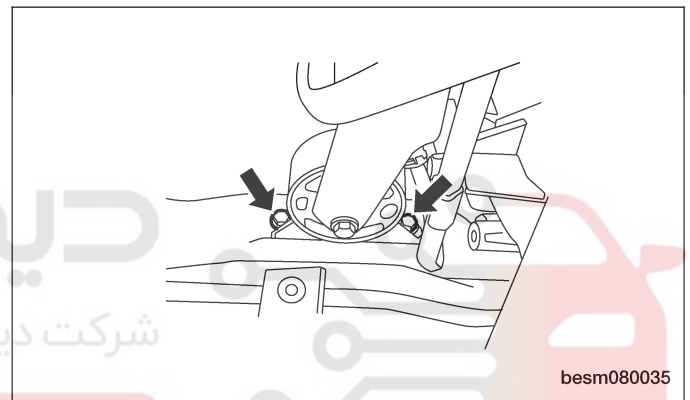
02

Front Mount - Removal & Installation

NOTE :

The following special tools are required to perform the repair procedure:

- Engine hoist
1. Disconnect the negative battery cable.
 2. Remove the engine cover.
 3. Remove the bolts securing the front engine mount.
(Tighten: Engine front mount bolt to 60 N·m)
 4. Installation is in the reverse order of removal.

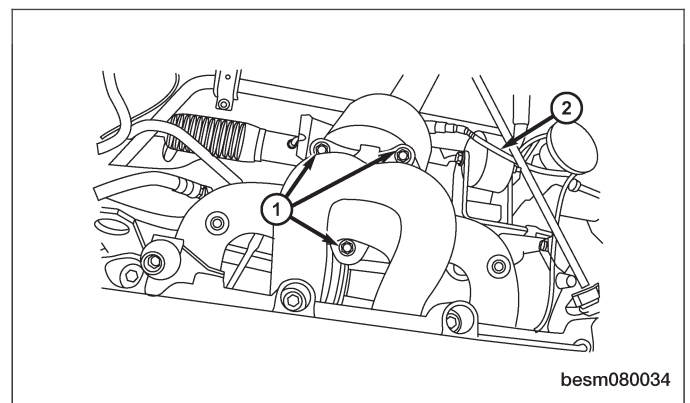


Rear Mount - Removal & Installation

NOTE :

The following special tools are required to perform the repair procedure:

- Engine hoist
1. Disconnect the negative battery cable.
 2. Remove the engine cover.
 3. Remove the rear engine mount.
(Tighten: Engine rear mount bolt to 60 N·m)
 4. Installation is in the reverse order of removal.



Engine Assembly

Removal & Installation

NOTE :

The following special tools are required to perform the repair procedure:

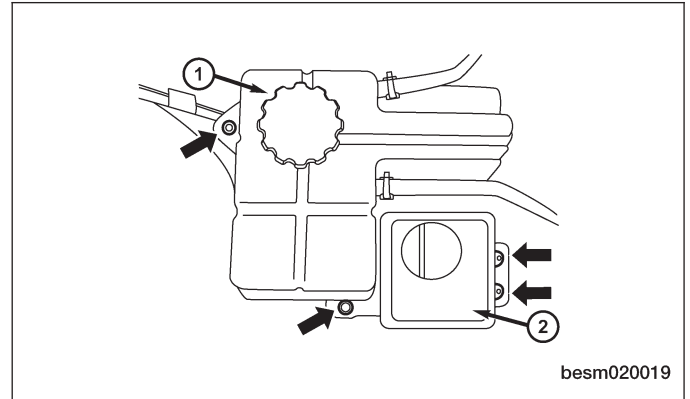
- CH-20001 - Right engine mount bolt remover
- Engine hoist

ON-VEHICLE SERVICE

NOTE :

The engine is removed with the transaxle as an assembly.

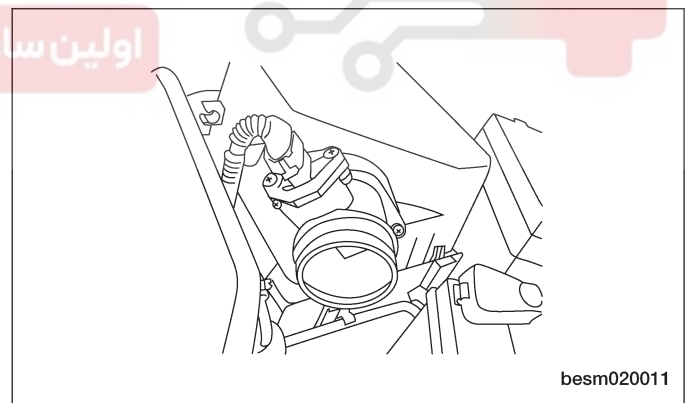
1. Remove the vehicle hood.
2. Remove the battery, battery hold downs, and battery tray (See Battery Removal & Installation in Section 05 Starting & Charging).
3. Discharge air conditioning system (See A/C System Evacuation and Recharge in Section 13 Heating and Air Conditioning).
4. Drain the cooling system, then remove coolant reservoir (1).



5. Remove the coolant fan & radiator assembly if necessary (See Coolant Fan & Radiator Assembly Removal & Installation in Section 06 Cooling).
6. Remove the starter motor wiring.
7. Remove the negative battery cable from the engine.
8. Remove the engine cover.
9. Relieve the fuel pressure (See Fuel Pressure Relief Procedure in Section 04 Fuel Delivery).
10. Disconnect and remove the fuel line at the fuel rail.
11. Remove the air inlet hose and the air cleaner case assembly.

NOTE: For 1.8L engine, disconnect the air flow sensor electrical connector.

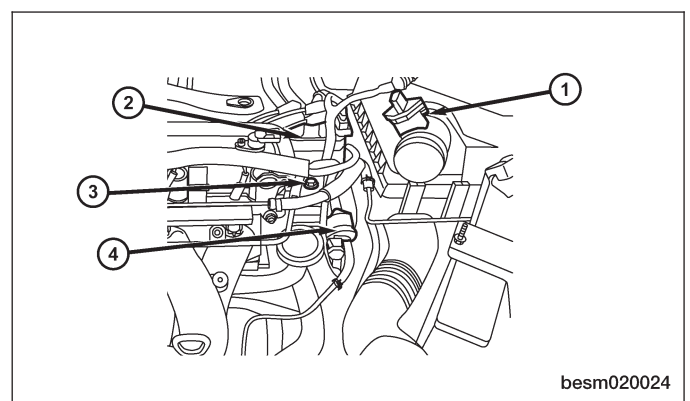
12. Remove the ground cable bolt from the cylinder head.



13. Disconnect and remove the following electrical connectors:

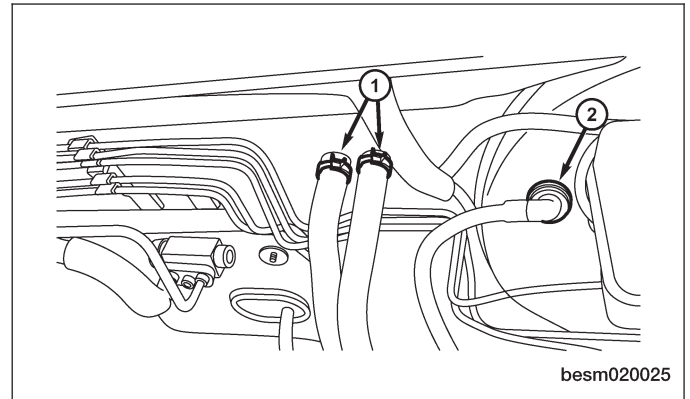
- Coolant temperature sensor
- Camshaft position sensor
- Ignition coil
- Four fuel injectors
- Intake manifold air pressure sensor (1.6L)
- Air flow sensor (1.8L)
- Carbon canister solenoid valve
- Throttle body control
- A/C compressor
- Oil pressure sensor
- Power steering pump pressure switch
- Generator

14. Remove the pipe from the canister control valve.

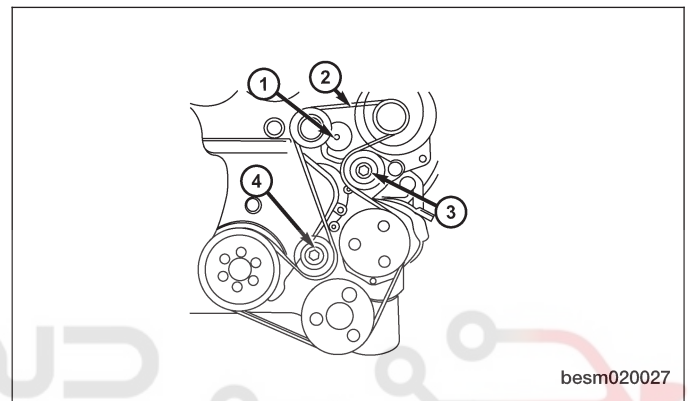


ON-VEHICLE SERVICE

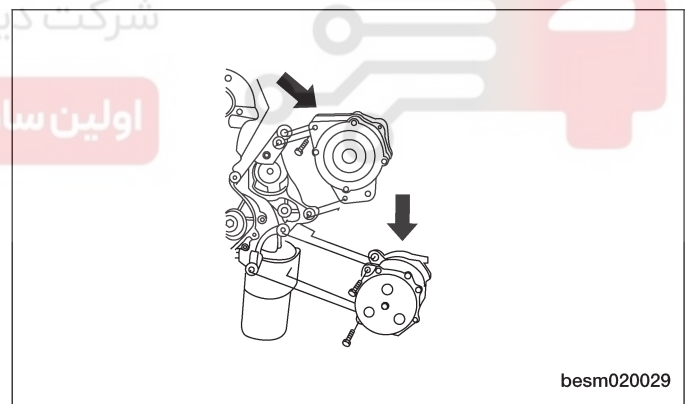
15. Disconnect the heater hoses (1) on the vehicle.
16. Remove the vacuum line from the brake booster (2).
17. Remove the dipstick.



18. Remove the accessory drive belt (2) (See Accessory Drive Belt Removal & Installation in Section 02 Engine).



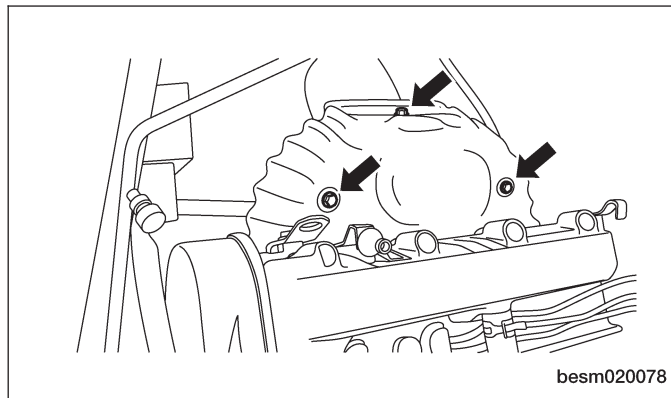
19. Remove the generator from the bracket (See Generator Removal & Installation in Section 05 Starting & Charging).



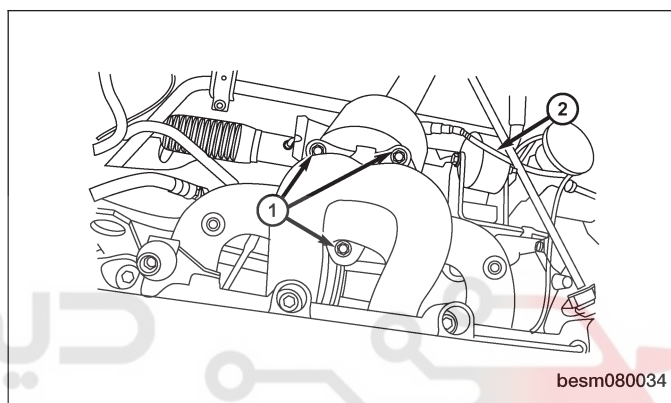
20. Remove the A/C compressor pipe.
21. Remove the transaxle shift cable.
22. Disconnect the automatic transaxle electrical connector and vehicle speed sensor electrical connector (only for automatic transaxle).
23. Remove the ground cable bolt from the transaxle (only for automatic transaxle).
24. Remove the hydraulic pipe from the clutch slave cylinder.

ON-VEHICLE SERVICE

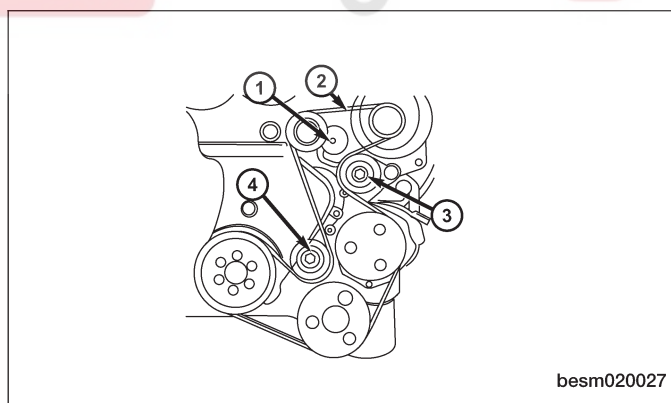
25. Remove the exhaust manifold heat shield bolts and then remove heat shield.
(Tighten: Exhaust manifold heat shield bolts to 15 N·m)



26. Disconnect the upper and lower oxygen sensor connectors.
27. Remove the catalytic converter (1) to exhaust manifold bolts.

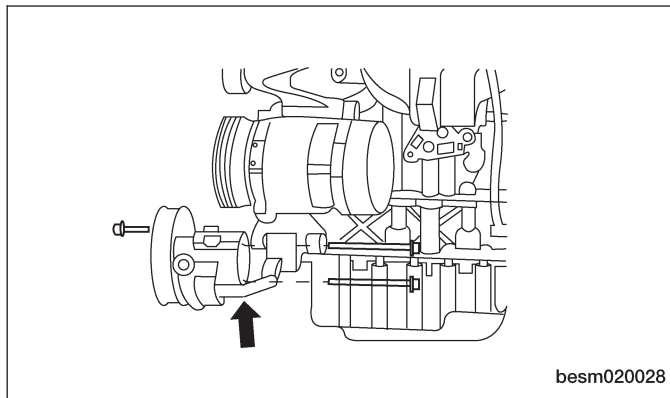


28. Remove the front axle shaft (See Front Axle Shaft Removal & Installation in Section 09 Axle).
29. Raise the vehicle.
30. Drain the engine oil.
31. Remove the idler pulley (4).



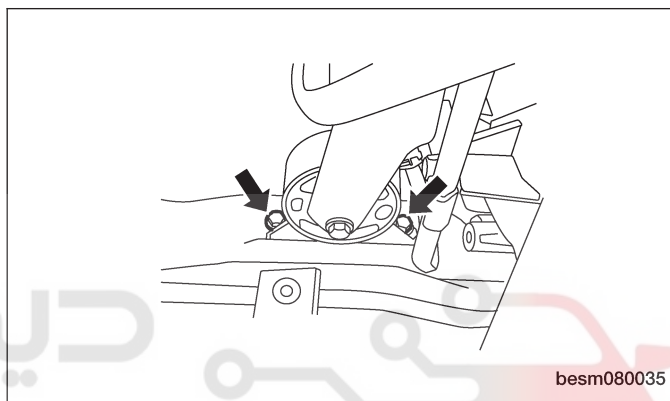
ON-VEHICLE SERVICE

32. Remove the power steering pump with piping connected and set aside with wire.

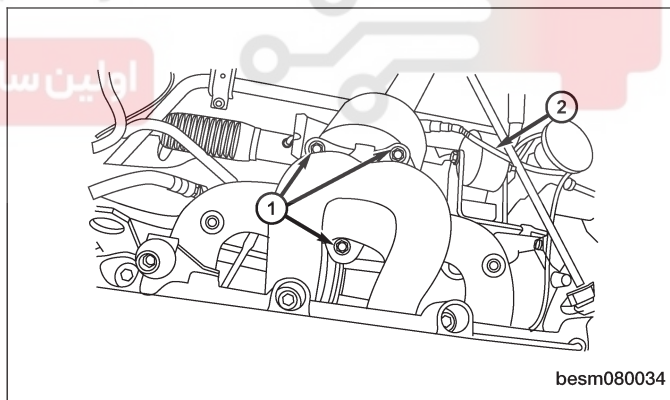


02

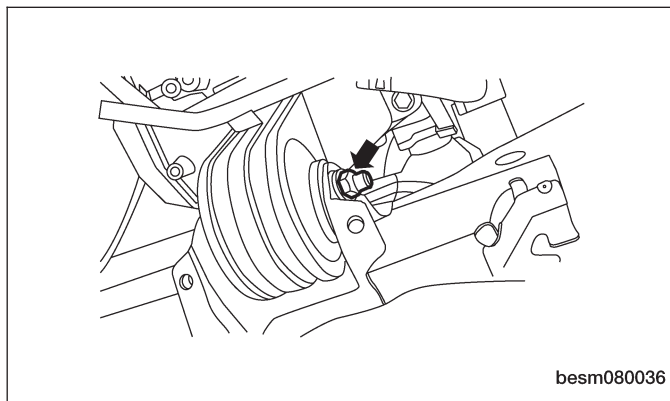
33. Lower the vehicle and install engine lift chain hangers.
34. Remove the bolts securing the front engine mount.
(Tighten: Engine front mount bolt to 60 N·m)



35. Remove the rear engine mount (2).
(Tighten: Engine rear mount bolt to 60 N·m)

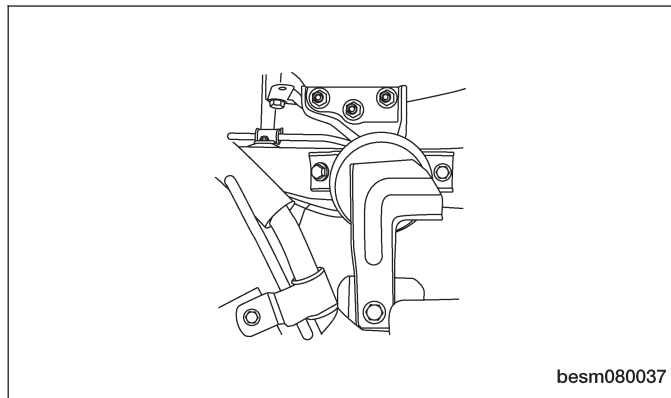


36. Remove the left transaxle mount.
(Tighten: Engine left mount bolt to 100 N·m)



ON-VEHICLE SERVICE

37. Using special tool CH-20001, remove the three bolts securing the right engine mount.
(Tighten: Engine right mount bolt to 70 N·m)
38. Remove the mount assembly.



39. Verify all components between the engine and vehicle are disconnected.
40. Hoist the engine from vehicle.

CAUTION:

Verify all electrical connectors are disconnected prior to engine/transaxle removal.

41. Separate engine and transaxle.
42. Installation is in the reverse order of removal.

Engine Timing Belt**Removal & Installation****NOTE :**

The following special tools are required to perform the repair procedure:

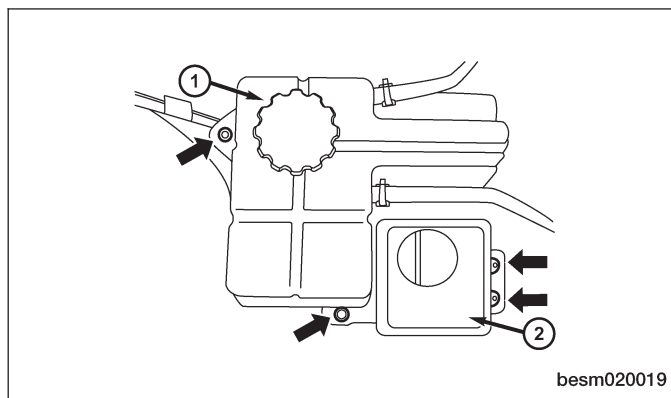
- CH-20001 - Right engine mount bolt remover
- CH-20003 - Crankshaft holder
- CH-20010 - Camshaft holder
- Engine hoist

1. Release the coolant system pressure.

WARNING!

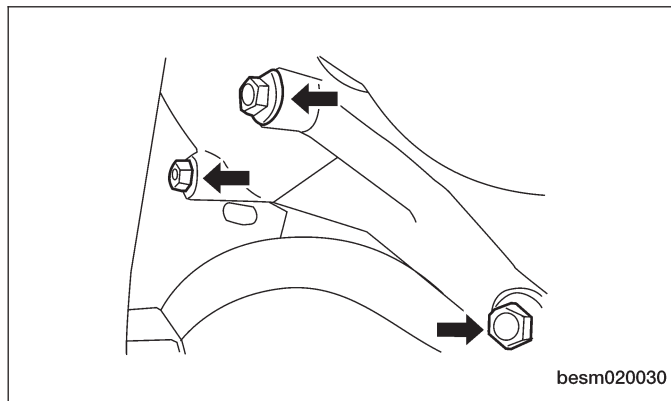
Never remove the pressure relief cap under any conditions while the engine is operating or hot. Failure to follow these instructions could result in personal injury or damage to the cooling system or engine. To avoid having scalding hot coolant or steam blow out of the cooling system, use extreme care when removing the pressure relief cap. Wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly one turn (counterclockwise). Step back while the pressure is released from the cooling system. When you are certain all the pressure has been released, (with a cloth) turn and remove the pressure relief cap. Failure to follow these instructions may result in serious personal injury.

2. Remove the coolant reservoir (1) and set aside.



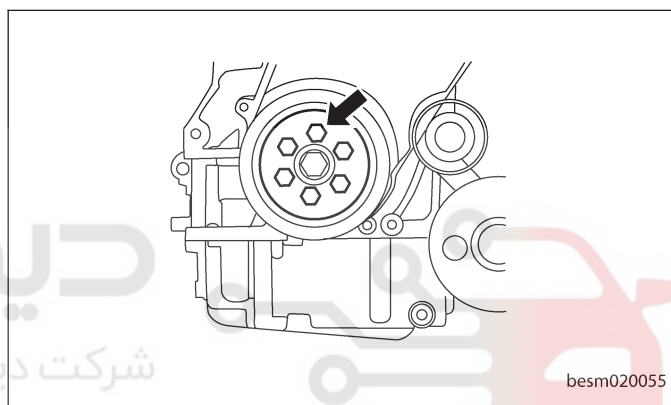
ON-VEHICLE SERVICE

3. Attach an engine hoist and support the engine using an engine hoist.
4. Using special tool CH-20001, remove the engine right mount bolts and bracket.
(Tighten: Engine right mount bolts to 70 N·m)

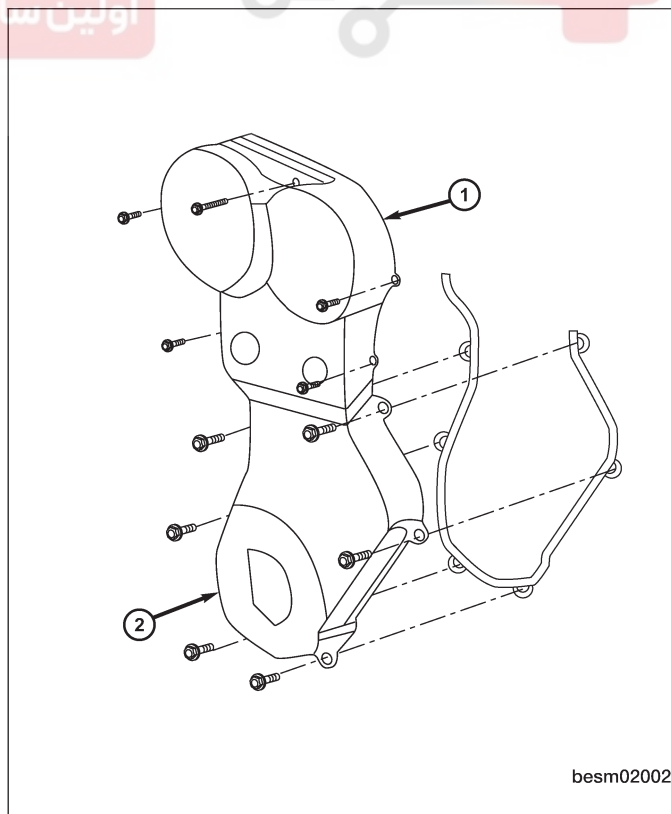


02

5. Remove the accessory drive belt (See Accessory Drive Belt Removal & Installation in Section 02 Engine).
6. Remove the crankshaft vibration damper bolts.
(Tighten: Crankshaft vibration damper bolts to 25 N·m)



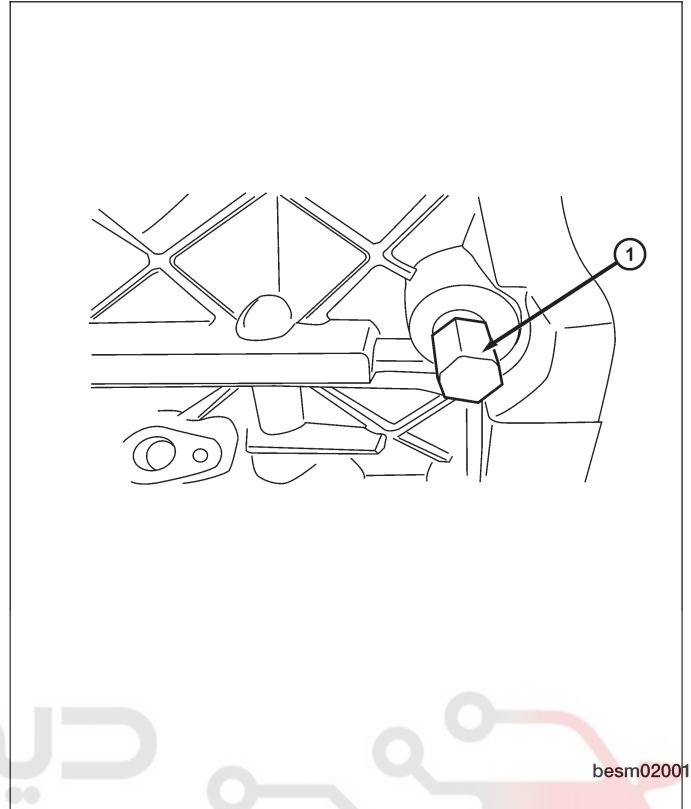
7. Remove the timing belt upper cover (1) and timing belt lower cover (2).
(Tighten: Timing belt upper cover bolts to 11 N·m)
(Tighten: Timing belt lower cover bolts to 11 N·m)



ON-VEHICLE SERVICE

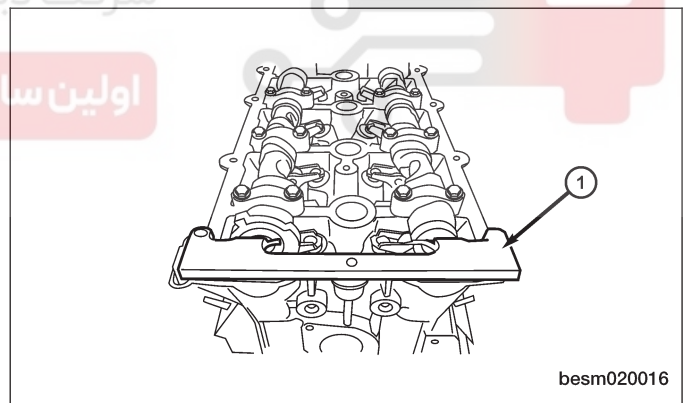
8. Remove the cylinder head cover (See Cylinder Head Cover Removal & Installation in Section 02 Engine).
9. Remove the plug in the cylinder block.
10. Using special tool CH-20003, install the crankshaft holding tool (1) into the cylinder block and rotate the crankshaft until the crankshaft tool completely holds the crankshaft in place.
(Tighten: Crankshaft holding tool to 28 N.m)

NOTE: The crankshaft holding tool will prevent the crankshaft from rotating in either direction.



11. Using special tool CH-20010 (1), install the camshaft holding tool to hold the camshafts in place.

NOTE: The camshaft holding tool will prevent the camshafts from rotating in either direction.



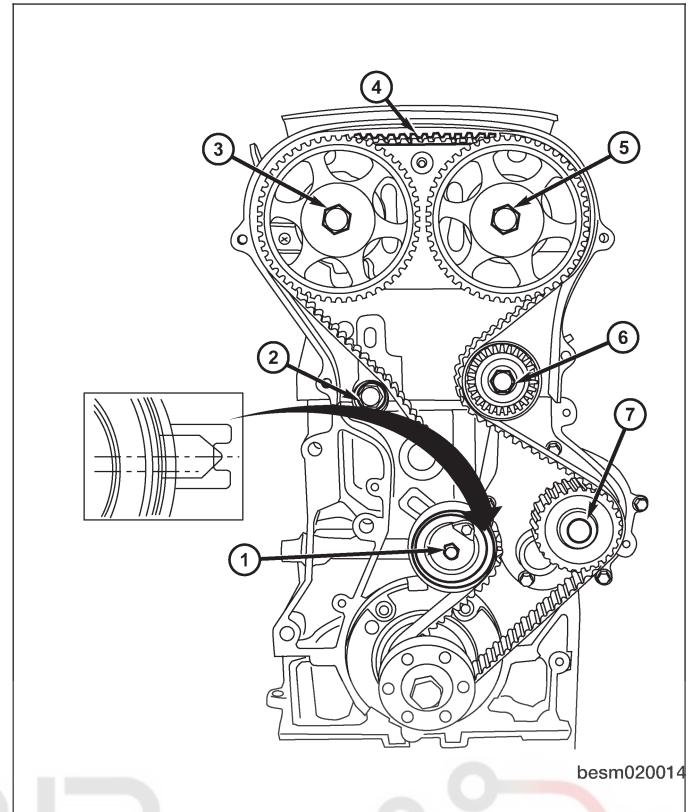
CAUTION: Rotating the camshafts or crankshaft with timing components loosened or removed can cause serious damage to the valves or pistons.

ON-VEHICLE SERVICE

12. Loosen the bolt of the timing belt tensioner pulley (1), remove the pulley.
(Tighten: Timing belt tensioner pulley bolt to 30 N·m)
13. Remove the timing belt (4).
14. Installation is in the reverse order of removal.

Installation Notes:

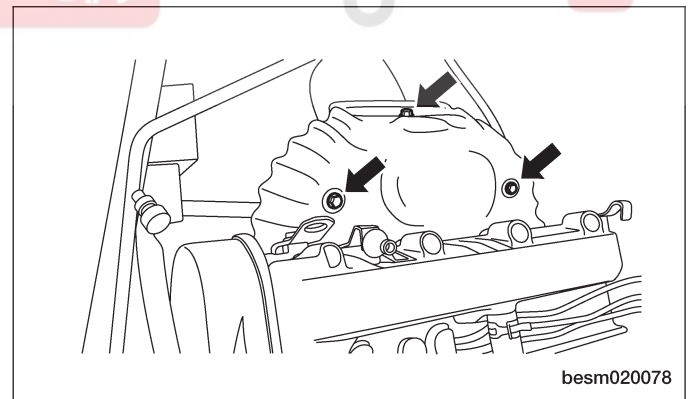
- Install the timing belt and rotate tension pulley with an Allen wrench in order to tension the belt and align the finger pointer of the tensioner to the middle of the U-slot opening. Tighten the tension pulley (1) bolt to 30 N·m, then tighten the intake and exhaust camshaft pulley bolts (3, 5) to 120 N·m.



02

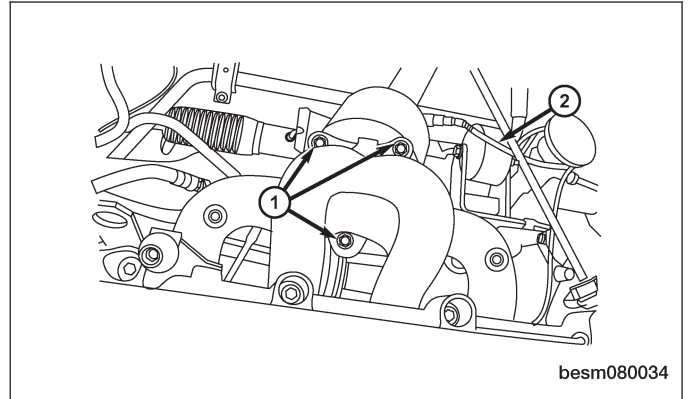
Exhaust Manifold**Removal & Installation**

1. Remove the engine cover.
2. Remove the bolts attaching the exhaust manifold heat shield.
(Tighten: Exhaust manifold heat shield bolts to 15 N·m)
3. Remove the exhaust manifold heat shield.

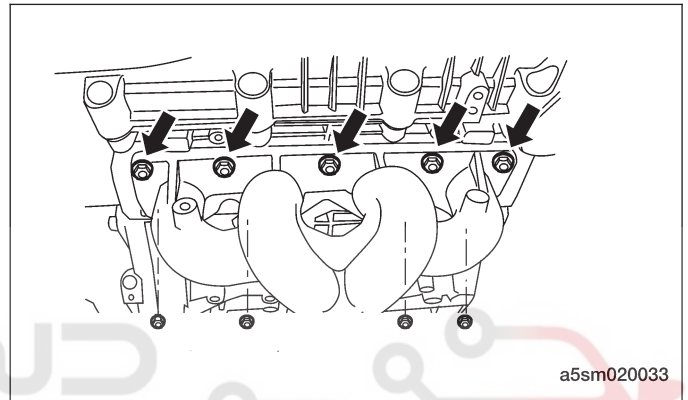


ON-VEHICLE SERVICE

4. Remove the three bolts securing the exhaust manifold to the catalytic converter assembly (1).
5. Disconnect the catalytic converter assembly from the manifold.



6. Remove the exhaust manifold nuts.
(Tighten: Exhaust manifold nuts to 25 N·m)



7. Remove and discard manifold gasket.
8. Installation is in the reverse order of removal.

Installation Notes:

- Clean all surfaces of manifold and cylinder head.

Idler Pulley**Removal & Installation**

1. While using a suitable tool and securely holding the hexagonal portion of the drive belt tensioner, rotate the pulley counterclockwise to loosen the drive belt.

WARNING!

Avoid placing hands near the drive belt tensioner while it is being held.

2. Remove the drive belt.

Upper Accessory Drive Belt Idler Pulley (3)

- Remove the bolt and the upper accessory drive belt idler pulley.

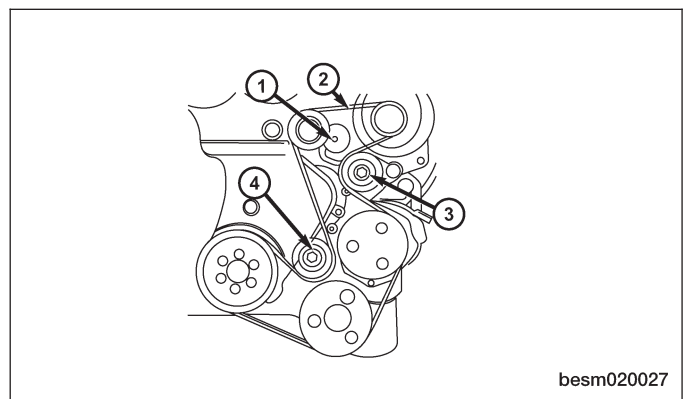
(Tighten: Upper idler pulley bolt to 45 N·m)

Lower Accessory Drive Belt Idler Pulley (4)

- Remove the bolt and the lower accessory drive belt idler pulley.

(Tighten: Lower idler pulley bolt to 45 N·m)

3. Installation is in the reverse order of removal.



ON-VEHICLE SERVICE

Intake Manifold

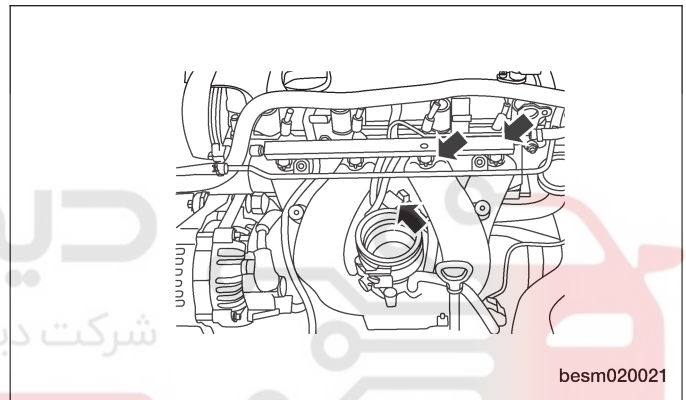
Removal & Installation

1. Disconnect the negative battery cable.
2. Remove the engine cover.
3. Drain the engine coolant.

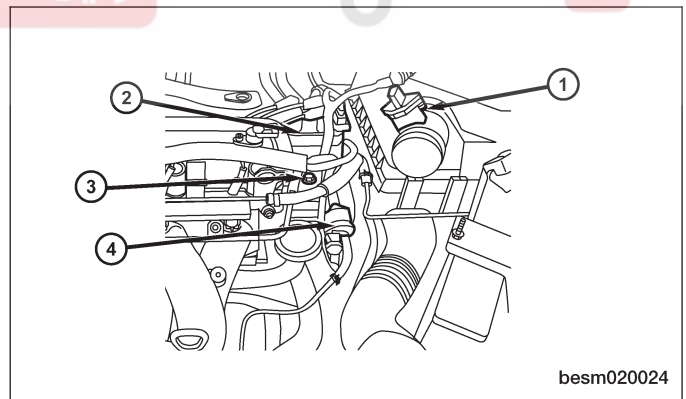
WARNING!

Never remove the pressure relief cap under any conditions while the engine is operating or hot. Failure to follow these instructions could result in personal injury or damage to the cooling system or engine. To avoid having scalding hot coolant or steam blow out of the cooling system, use extreme care when removing the pressure relief cap. Wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly one turn (counterclockwise). Step back while the pressure is released from the cooling system. When you are certain all the pressure has been released, (with a cloth) turn and remove the pressure relief cap. Failure to follow these instructions may result in serious personal injury.

4. Disconnect the four fuel injector electrical connectors.
5. Disconnect the throttle body control electrical connector (3).

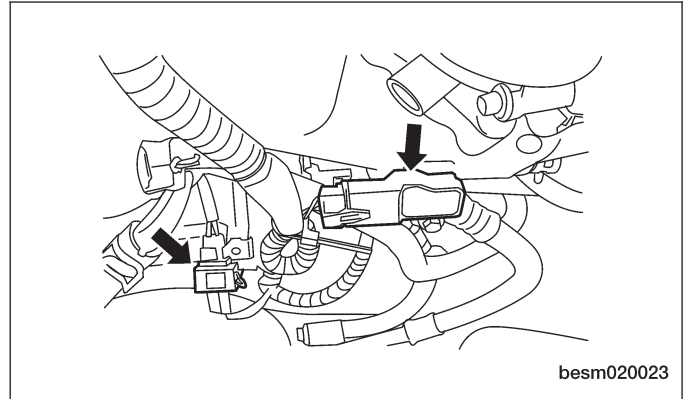


6. Disconnect the air flow sensor electrical connector (1) (1.8L engine).

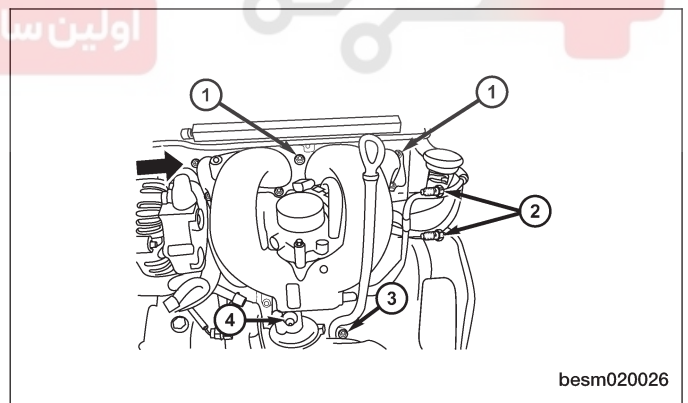
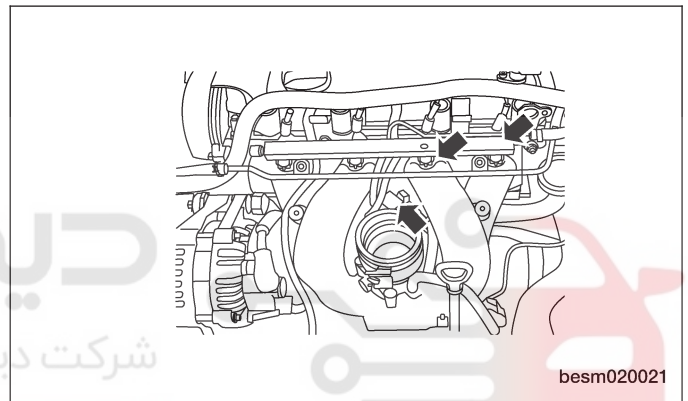


ON-VEHICLE SERVICE

7. Disconnect the air pressure sensor electrical connector (1.6L engine).
8. Remove MAP sensor from intake manifold if necessary.



9. Loosen the clamp between the air intake hose and the air cleaner.
10. Loosen the clamp between the air intake hose and the throttle body and then remove the intake pipe.
11. Loosen the clamp on the PCV hose and then disconnect the PCV hose.
12. Remove the fuel rail bracket bolts.
(Tighten: Fuel rail bracket bolts to 11 N·m)
13. Remove the fuel rail with the fuel injectors and set aside.
14. Remove the fuel injector O-rings.
15. Remove the screws securing the vacuum valve bracket to the intake manifold.
16. Set aside the vacuum valve and pipe.
17. Disconnect intake manifold electrical harness, and vacuum hose.
18. Remove the bolts (2, 3) securing the engine oil dipstick to intake manifold. Remove the dipstick.
(Tighten: Dipstick bracket bolts to 11 N·m)
19. Remove the nuts (1) securing the intake manifold to cylinder head.
(Tighten: Intake manifold nuts to 11 N·m)



NOTE: Discard gasket.

20. Installation is in the reverse order of removal.

Installation Notes:

- Clean all surfaces of manifold and cylinder head.
- Install new O-rings on the fuel injectors.

ON-VEHICLE SERVICE

Oil Filter

Removal & Installation

NOTE :

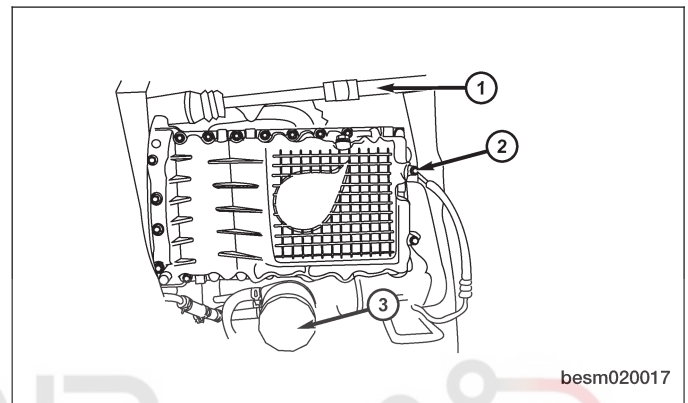
The following special tools are required to perform the repair procedure:

- CH-10003 - Oil filter remover

CAUTION:

When servicing the oil filter, avoid deforming the filter by installing the special tool against the base of the filter.

1. Using special tool CH-10003, remove the oil filter (3).
(Tighten: Oil filter to 25 N·m)



2. Installation is in the reverse order of removal.

Installation Notes:

- Clean all surfaces, and verify the oil filter does not leak.

Oil Pan

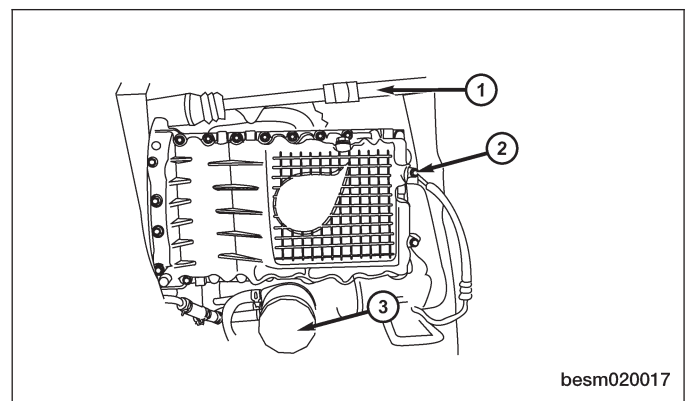
Removal & Installation

1. Remove the oil dipstick.
2. Raise the vehicle on hoist.
3. Remove the oil pan drain plug and drain the engine oil.
(Tighten: Oil pan drain plug to 40 N·m)

NOTE :

Do not pry on cylinder block to remove oil pan.

4. Remove oil pan bolts (2).
(Tighten: Oil pan bolts to 18 N·m)



5. Using a putty knife, loosen seal around oil pan.
6. Remove the oil pan.
7. Installation is in the reverse order of removal.

Installation Notes:

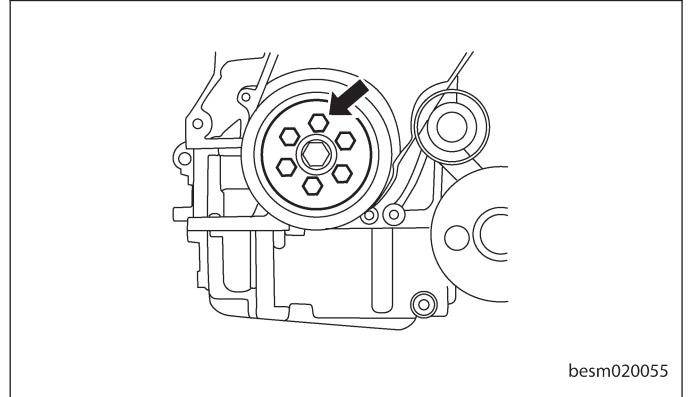
- Oil pan sealing surfaces must be free of grease or oil.

ON-VEHICLE SERVICE

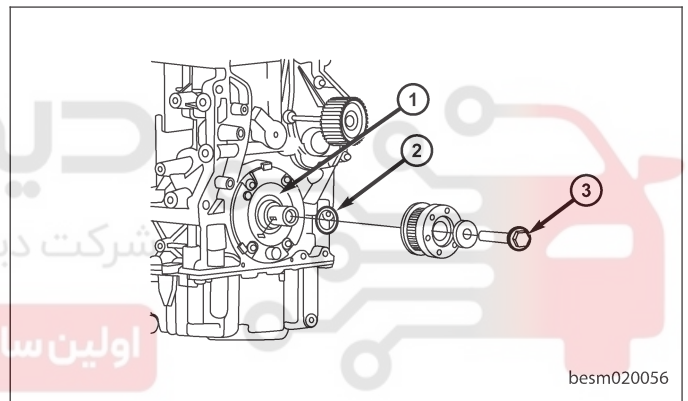
Oil Pump

Removal & Installation

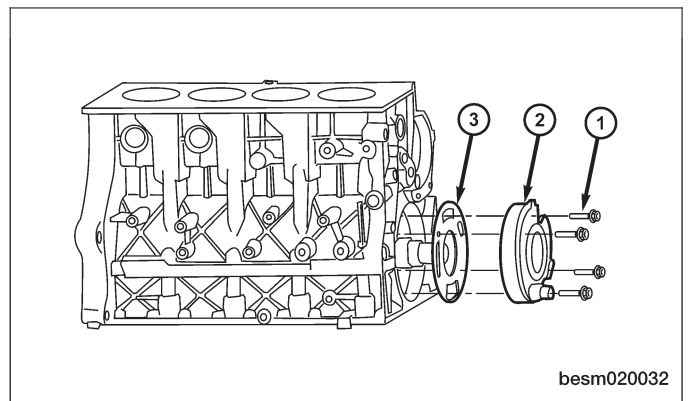
1. Remove the accessory drive belt (See Accessory Drive Belt Removal & Installation in Section 02 Engine).
2. Remove the crankshaft vibration damper retaining bolt.
(Tighten: Crankshaft vibration damper bolts to 25 N·m)



3. Remove the engine timing belt (See Engine Timing Belt Removal & Installation in Section 02 Engine).
4. Remove the crankshaft timing belt pulley bolt (3) from the crankshaft.
(Tighten: Crankshaft timing belt pulley bolt to 130 N·m + 65°)
5. Remove the key-way from the crankshaft.
6. Use an appropriate tool and remove the front crankshaft oil seal (2).
7. Remove the front crankshaft oil seal.
8. Remove the four oil pump bolts (1).
(Tighten: Oil pump bolts to 11 N·m)



9. Remove the oil pump (2) using a suitable tool.
10. Remove the oil pump gasket (3).



11. Installation is in the reverse order of removal.

Installation Notes:

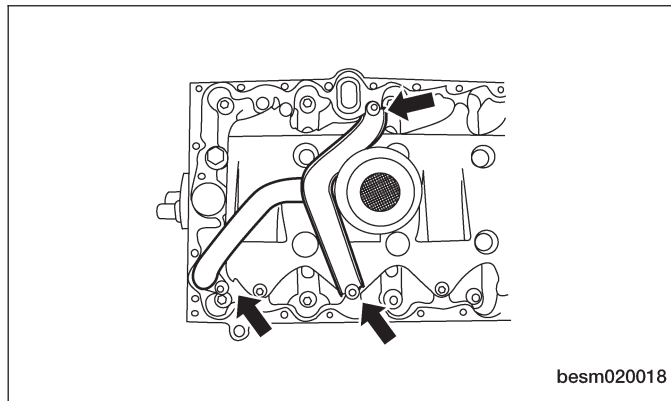
- Before installing, prime the new oil pump. Fill the oil pump with engine oil and rotate the oil pump.

ON-VEHICLE SERVICE

Oil Strainer

Removal & Installation

1. Raise the vehicle on hoist.
2. Remove the oil pan (See Oil Pan Removal & Installation in Section 02 Engine).
3. Remove the oil strainer retaining bolts.
(Tighten: Oil strainer bolts to 18 N·m)



02

4. Carefully remove the oil strainer.
5. Installation is in the reverse order of removal.

Installation Notes:

- Install new O-rings on the oil strainer pipe.

دیجیتال خودرو
شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



ENGINE UNIT REPAIR

Engine Block

Specifications

Torque Specifications

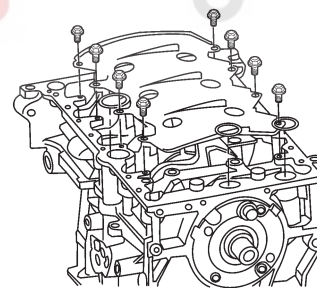
DESCRIPTION	TORQUE (N·m)
Connecting Rod Cap Bolts	1st Step: Tighten the bolt to 25 N·m 2nd Step: Tighten the bolt an additional 90°
Main Bearing Cap Bolts	1st Step: Tighten the bolt to 45 N·m 2nd Step: Tighten the bolt an additional 180°
Lower Cylinder Block Bolts	23 N·m

Clearance Specifications

DESCRIPTION	SPECIFICATION
Surface Distortion Limit	0.15 mm
Inner Diameter Standard	81 mm
Out-Of-Round	Less than 0.008 mm
Taper	Less than 0.01 mm

Disassemble

1. Remove the oil pan and then remove oil baffle.
2. Remove the oil strainer.



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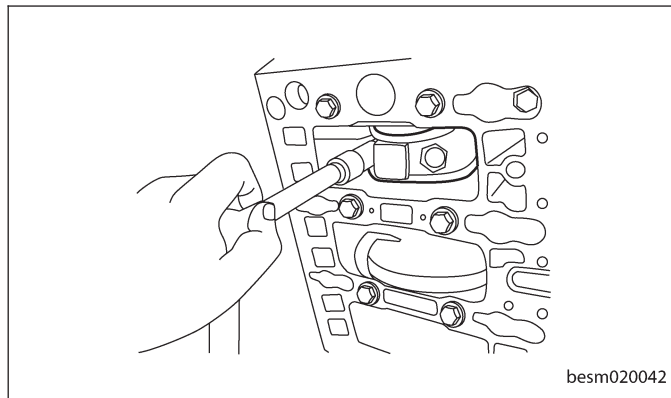
3. For each connecting rod / piston assembly to be removed, rotate the crankshaft to the bottom dead center position for each cylinder.

NOTE :

Before removing the connecting rod / piston assembly, check the connecting rod side clearance.

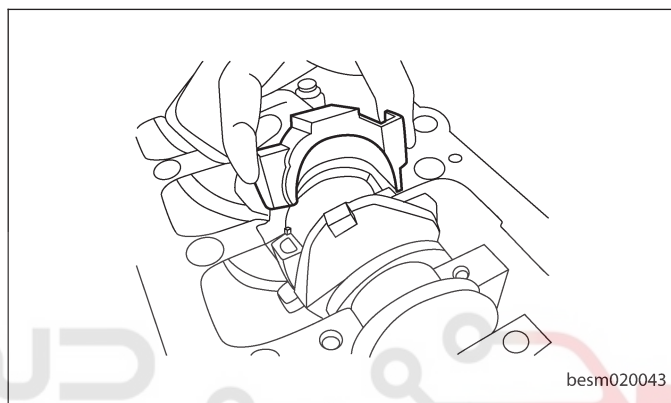
ENGINE UNIT REPAIR

4. Remove the connecting rod retaining bolts.

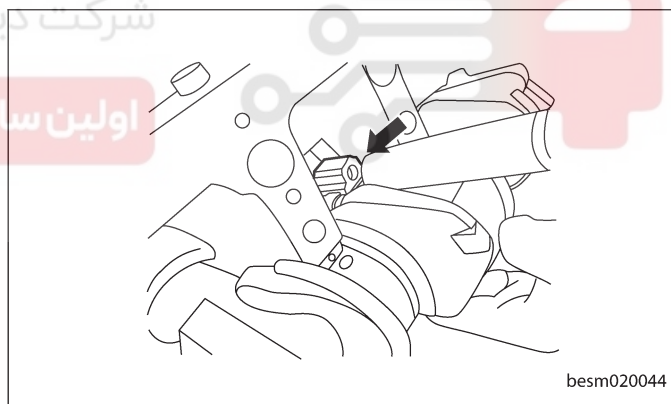


02

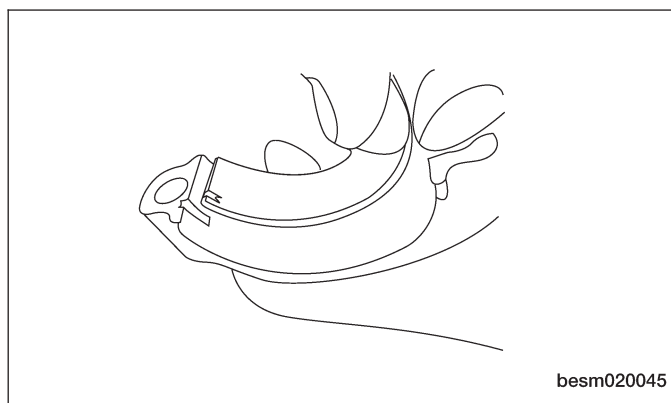
5. Remove the connecting rod bearing cap.



6. Using a hammer handle or similar tool, push the connecting rod / piston assembly out through the top of the cylinder block.



7. Remove the connecting rod bearings (See Connecting Rod Removal & Installation in Section 02 Engine).



CAUTION:When removing the connecting rod side bearings, note the installation position. Keep them in the correct order.

ENGINE UNIT REPAIR

8. Installation is in the reverse order of removal.

Inspection

NOTE :

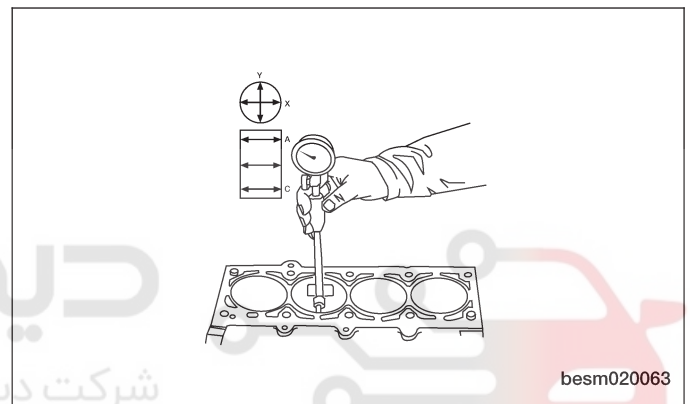
All measurements should be taken with the engine block at room temperature, 21°C.

Engine Block

- Clean cylinder block thoroughly and check all core hole plugs for evidence of leaking.
- Examine block and cylinder bores for cracks or fractures.
- Check block deck surfaces for flatness. Deck surface must be within service limit of 0.050 mm.

Cylinder Bore

- The cylinder walls should be checked for out-of-round and taper with cylinder indicator or equivalent. If the cylinder walls are badly scuffed or scored, the cylinder block should be replaced, and new pistons and rings fitted.
- Measure the cylinder bore at three levels in directions X and Y. Top measurement should be 10 mm down and bottom measurement should be 10 mm up from bottom of bore.



CYLINDER BORE	
All Cylinders	81.000-81.010 mm

Assemble

NOTE :

Cleanliness is extremely important during the engine assembly procedure. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan can cause engine failure.

NOTE :

Assemble all components in their original position.

1. Install the pistons to the connecting rods.
2. Using a piston ring expander, install the piston rings.
3. Assemble all components in the reverse order of disassembly.

ENGINE UNIT REPAIR

Pistons

Specifications

Clearance Specifications - Pistons

DESCRIPTION	SPECIFICATION
Surface Distortion Limit	0.15 mm
Inner Diameter Standard	81 mm
Out-Of-Round	Less than 0.008 mm
Taper	Less than 0.01 mm

02

Clearance Specifications - Piston Ring Groove

DESCRIPTION	SPECIFICATION
First Ring	0.04-0.08 mm
Second Ring	0.0251-0.01 mm

Clearance Specifications - Piston Ring End Gap

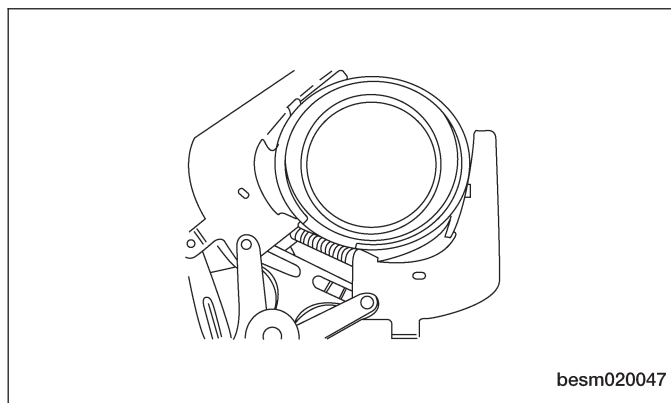
DESCRIPTION	SPECIFICATION	LIMIT
First Ring End Gap	0.2-0.4 mm	0.8 mm
Second Ring End Gap	0.4-0.6 mm	1.0 mm

Clearance Specifications - Piston to Piston Pin

DESCRIPTION	SPECIFICATION
Piston To Piston Pin	0.002-0.013 mm

Disassemble

- Piston Ring Removal
 - Using a suitable ring expander, remove upper and intermediate piston rings.
 - Remove the upper oil ring side rail, lower oil ring side rail and then oil ring expander from piston.
 - Clean ring grooves of any carbon deposits.

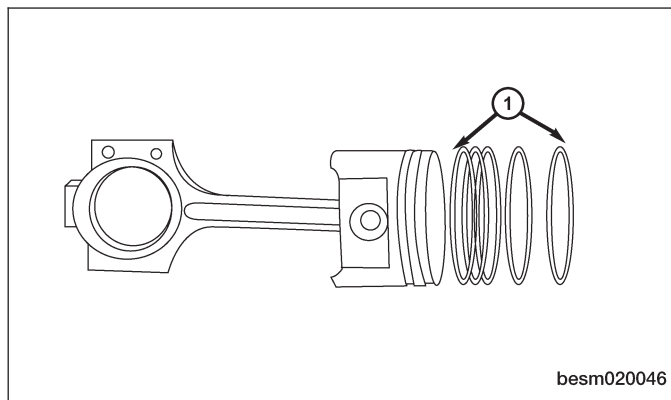


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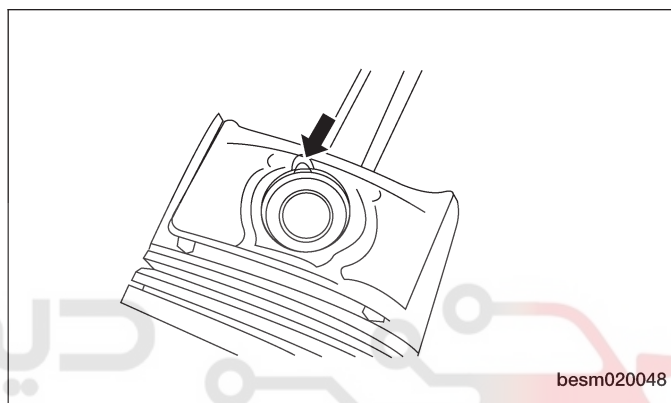
ENGINE UNIT REPAIR

CAUTION:

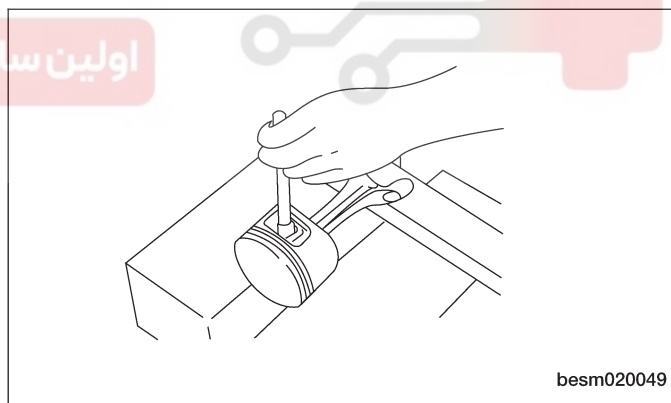
Before removing the piston rings (1), check the piston ring side clearance. Be careful to mark the location of the piston rings if they are to be reused.



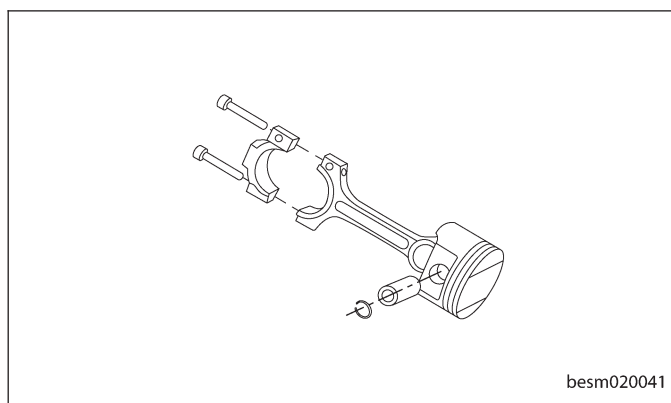
- Piston Pin Snap Ring Removal
 - Using snap ring pliers, remove the snap ring.
 - Heat the pistons as necessary.



- Piston Pin Removal
 - Push out the piston pin with a suitable tool.



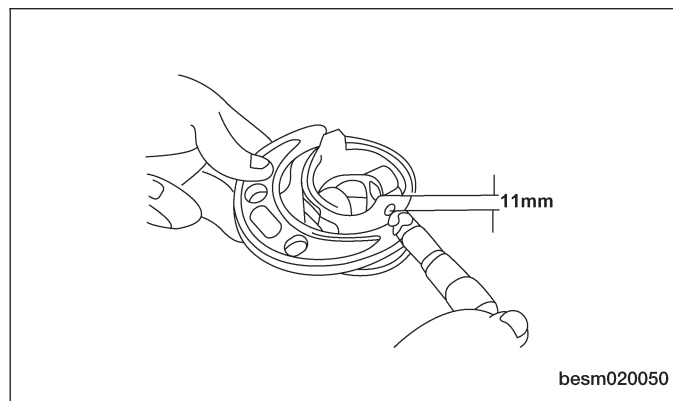
- Connecting Rod & Piston Disassembly
 - Remove the piston from the connecting rod.



ENGINE UNIT REPAIR

Inspection

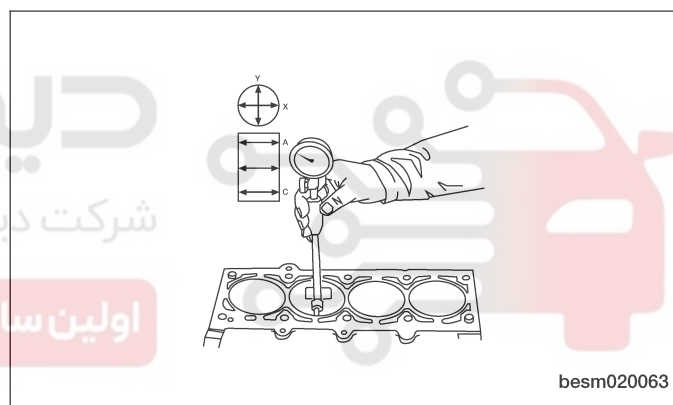
- Check the piston diameter.



02

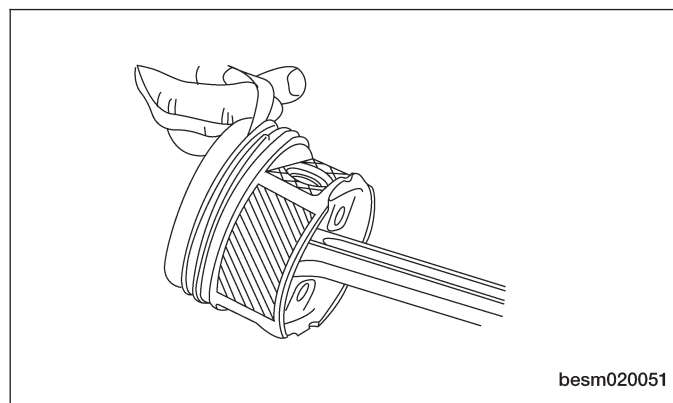
PISTON DIAMETER	
All Pistons	80.946-80.964 mm

- Check the inner diameter of each cylinder bore (See Cylinder Bore Inspection in Section 02 Engine).



CYLINDER BORE	
All Cylinders	81.000-81.010 mm

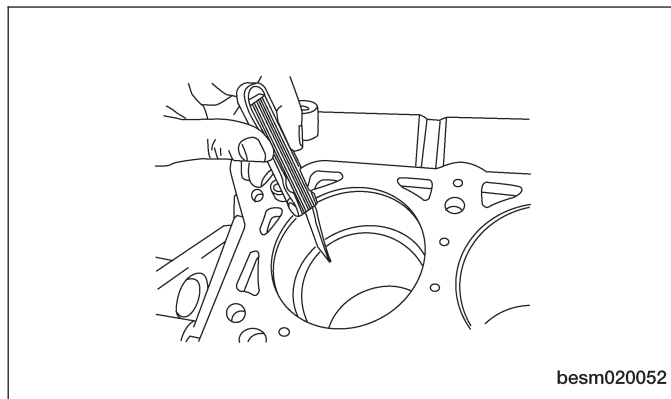
- Check piston ring to groove side clearance.
 - Clean the ring slot using a suitable tool.
 - Measure piston ring to groove side clearance.



RING GROOVE CLEARANCE	
First Ring	0.04-0.08 mm
Second Ring	0.0251-0.01 mm

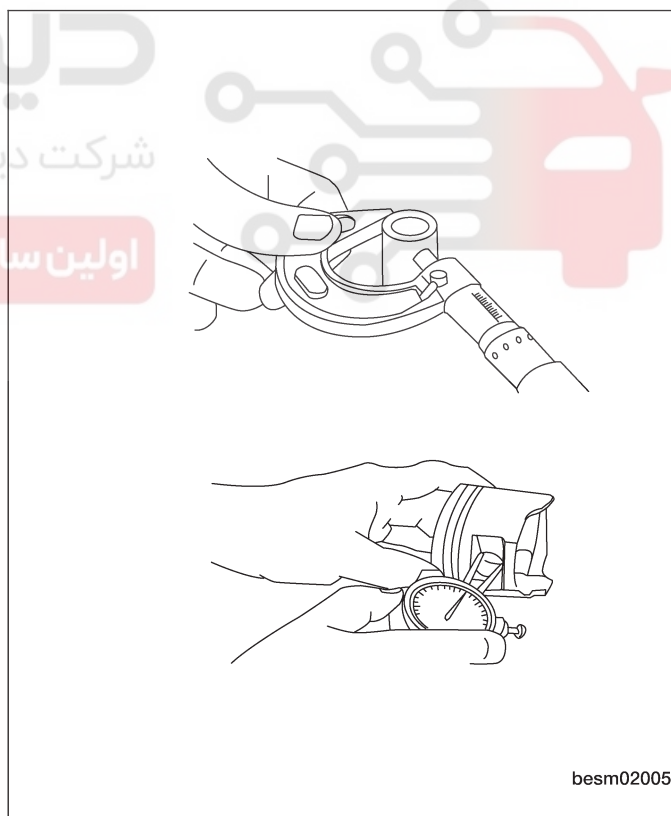
ENGINE UNIT REPAIR

- Wipe the cylinder bore clean. Insert ring and push down with piston to ensure it is square in the bore. The ring gap measurement must be made with the ring positioned at least 13 mm from bottom of cylinder bore and below the bottom of the oil ring travel where the cylinder bore has minimal wear. Check gap with feeler gauge.



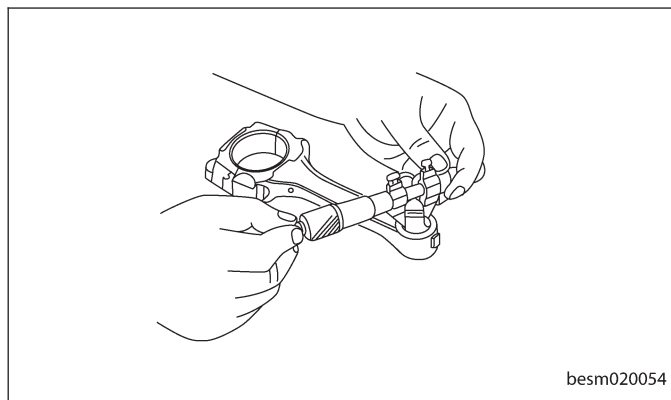
RING END GAP CLEARANCE		
First Ring	0.2-0.4 mm	0.8 mm
Second Ring	0.4-0.6 mm	1.0 mm

- Check the diameter of the piston pin bore.
- Check the outer diameter of the piston pin.



- Check the inner diameter of connecting rod (small end).

ENGINE UNIT REPAIR



02

PISTON PIN CLEARANCE

Piston and Piston Pin	0.002-0.013 mm
-----------------------	----------------

Assemble

1. Install the piston to the connecting rod. Assemble the components in their original positions.
2. Using a piston ring expander, install the piston rings. Assemble the components in their original positions.
3. Assemble all components in the reverse order of disassembly.

Connecting Rods

Specifications

Torque Specifications

DESCRIPTION	TORQUE (N·m)
Connecting Rod Bolts	1st Step: Tighten bolts to 25 N·m 2nd Step: Tighten the connecting rod bolts an additional 90°

Clearance Specifications

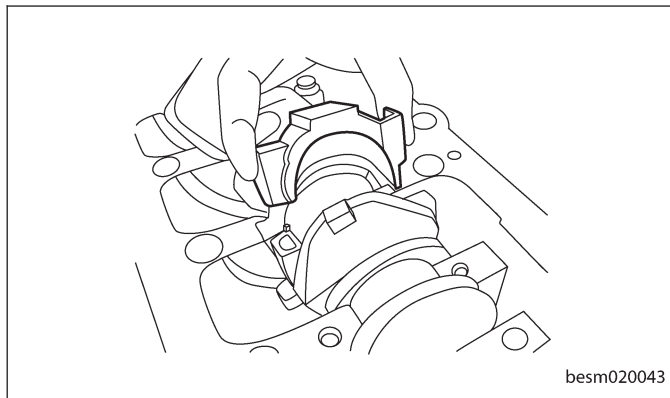
DESCRIPTION	SPECIFICATION
Connecting Rod Radial Clearance	0.016-0.051 mm
Connecting Rod Axial Clearance	0.002-0.013 mm

Disassemble

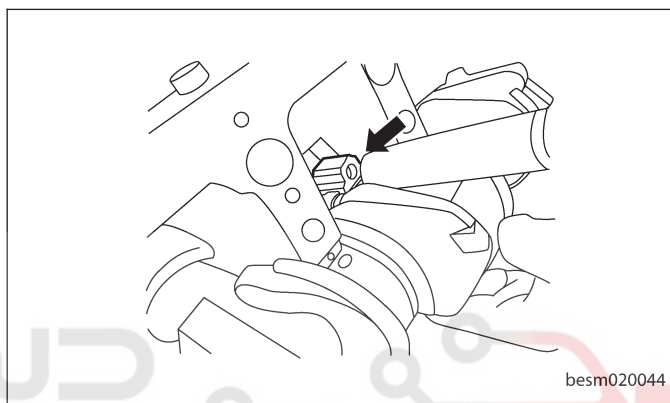
1. Remove the connecting rod cap bolts.

ENGINE UNIT REPAIR

2. Remove the connecting rod bearing cap.

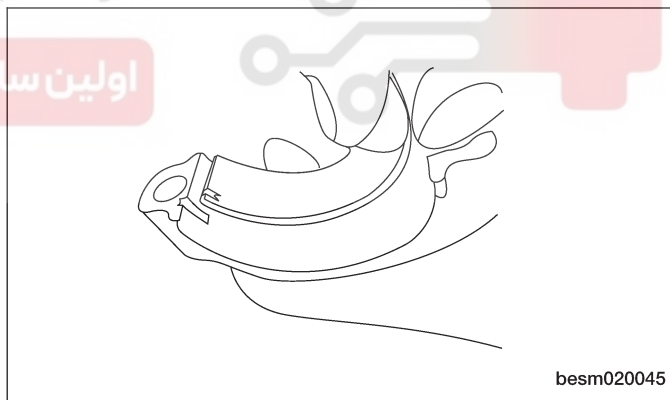


3. Using a hammer handle or similar tool, push the piston and connecting rod assembly out through the cylinder head side of the engine block.



NOTE: Before removing the piston and connecting rod assembly, check the connecting rod side clearance.

4. Remove the connecting rod bearings.



CAUTION: When removing the connecting rod side bearings, note the installation position. Keep them in the correct order.

Inspection

- Check the radial clearance of connecting rod bearing.

CONNECTING ROD RADIAL CLEARANCE	
Radial Clearance	0.016-0.051 mm

ENGINE UNIT REPAIR

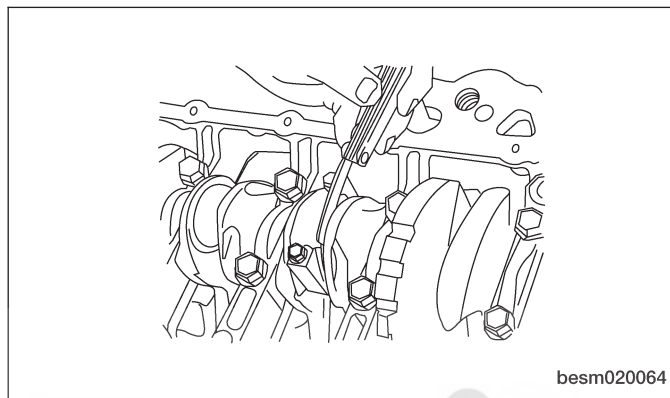
Assemble

NOTE :

The rod bolts should not be reused.

1. Before installing the NEW rod bolts, the threads and under the bolt head should be oiled with clean engine oil.
2. Install each bolt finger tight, then alternately tighten each bolt to assemble the cap properly.
3. Tighten the connecting rod bolts using the two step torque-turn method:
 - 1st Step: Tighten bolts to 25 N·m
 - 2nd Step: Tighten the connecting rod bolts an additional 90°
4. Using a feeler gauge check connecting rod side clearance.
- Check axial clearance of connecting rod.

02



Crankshaft

Specifications

Torque Specifications

DESCRIPTION	TORQUE (N·m)
Main Bearing Cap Bolts	1st Step: Tighten the bolt to 45 N·m 2nd Step: Tighten the bolt an additional 180°
Lower Cylinder Block Bolts	23 N·m

Clearance Specifications

DESCRIPTION	SPECIFICATION
Diameter of Crankshaft Main Journals	53.981-54 mm
Diameter of Crankshaft Rod Journals	47.884-47.9 mm
Out-of-Round Maximum of Crankshaft Main Journals	0.008 mm
Axial Clearance of Crankshaft	0.07-0.265 mm
Radial Clearance of Crankshaft	0.0035-0.034 mm
Coaxality Crankshaft Main Journal	0.05 mm
Thrust Washer Thickness	2.4-2.405 mm

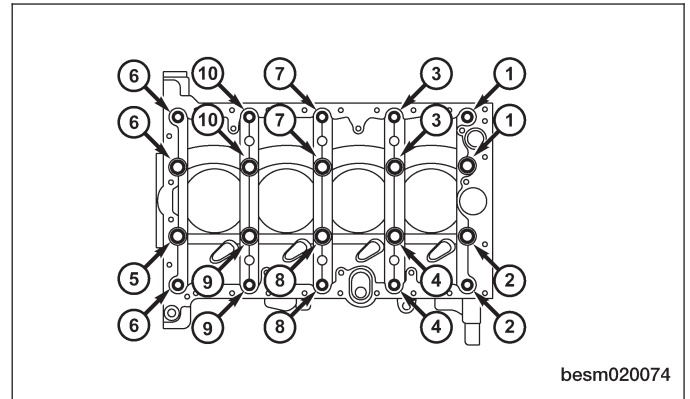
Disassemble

1. Remove the front crankshaft oil seal (See Front Crankshaft Oil Seal Removal & Installation in Section 02 Engine).
2. Remove the rear crankshaft oil seal (See Rear Crankshaft Oil Seal Removal & Installation in Section 02 Engine).

ENGINE UNIT REPAIR

3. Remove the pistons with connecting rod assemblies.
4. Remove the lower cylinder block bolts in the sequence shown.

NOTE: Before loosening the lower cylinder block bolts, measure the crankshaft side clearance.

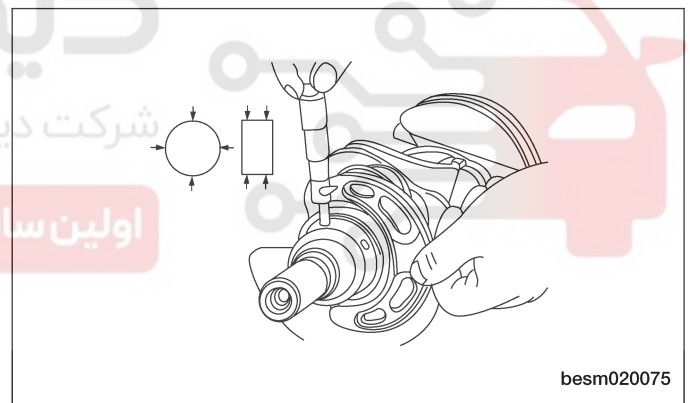


5. Remove the lower cylinder block.
6. Remove the crankshaft.
7. Remove the main bearings and thrust bearings from the cylinder block and lower cylinder block.

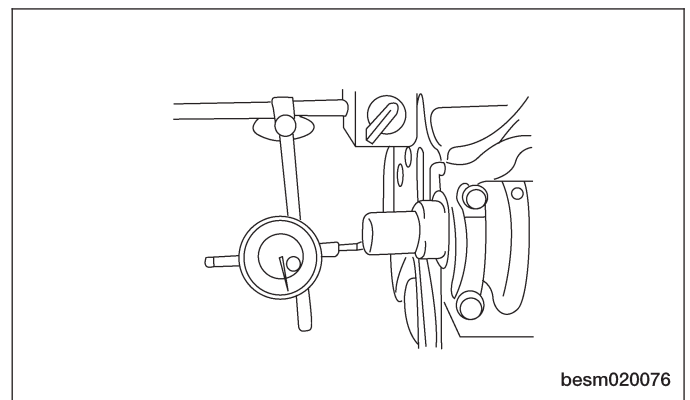
NOTE: If reusing the bearings, identify and number the bearings so that they are assembled in the same position and direction.

Inspection

- The crankshaft main journals should be checked for excessive wear, roundness and scoring. Limits of roundness on any crankshaft main journals should be held to 0.008 mm. Limits of roundness on any crankshaft rod journals should be held to 0.005 mm. DO NOT nick crank pin or bearing fillets. Limits of out of round on any crankshaft journals should be held to 0.005 mm.



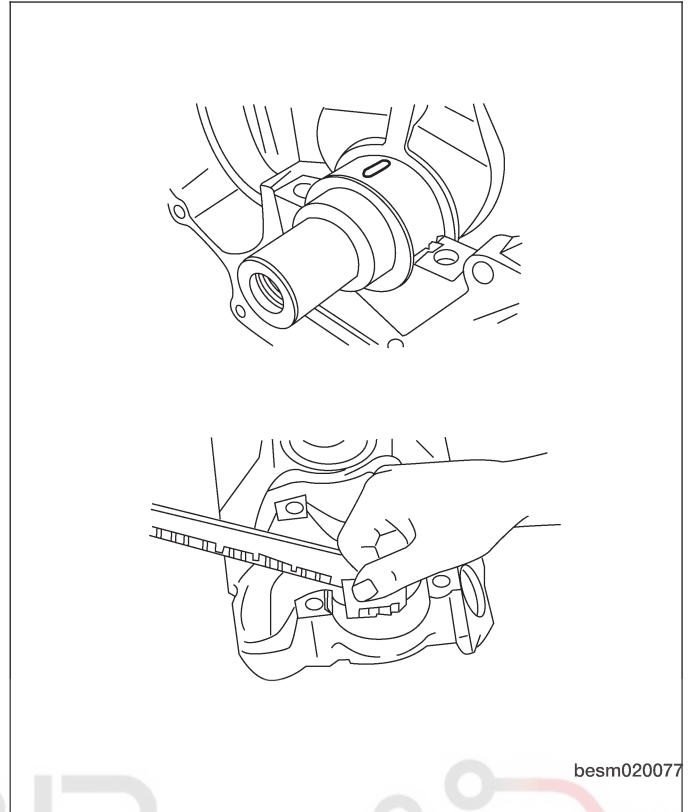
- Check the axial clearance after installation. Standard of axial clearance should be 0.07 mm. Limits of axial clearance should be held to 0.265 mm.



ENGINE UNIT REPAIR

- Oil Clearance of crankshaft main journal
 - Clean the journal and bearing.
 - Install the crankshaft.
 - Cut the plastic-gauge to the same width as the bearing, and then put it onto the crankshaft journal to make it parallel with the central line of the crankshaft.
 - Install the main bearing cap carefully, and tighten the bolts to the specified torque.
 - Remove the main bearing cap.
 - Measure the oil clearance with the plastic-gauge.

Standard oil clearance of crankshaft main journal should be 0.022 mm. Limits of oil clearance of crankshaft main journal should be 0.058 mm.



02

Assemble

1. Install the main bearings and thrust bearings to the upper cylinder block and lower cylinder block.

NOTE: Identify and number the bearings, if reusing them, so that they are assembled in the same position and direction.

2. Assemble the crankshaft and main bearings in the reverse order of disassembly.

CYLINDER HEAD UNIT REPAIR

Cylinder Head

Specifications

Torque Specifications

DESCRIPTION	TORQUE (N·m)
Cylinder Head Bolts	85 N·m
Cylinder Head Cover Bolts	11 N·m

Clearance Specifications

DESCRIPTION	SPECIFICATION
Cylinder Head Flatness	0.04 mm
Intake Valve Deflection	0.02 mm
Exhaust Valve Deflection	0.04 mm
Spring Height	47.7 mm

Disassemble

NOTE :

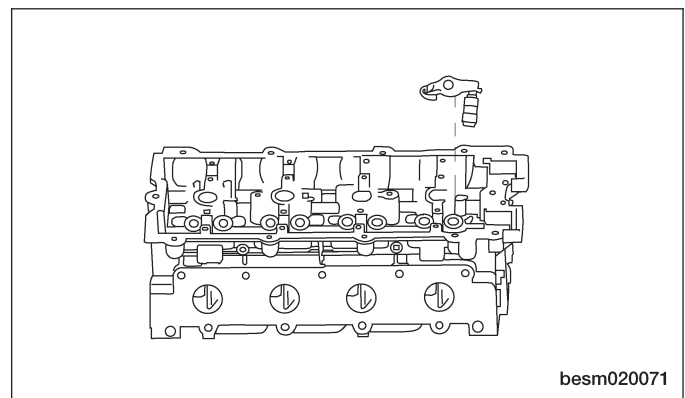
The following special tools are required to perform the repair procedure:

- CH-20011 - Valve seal installer
- CH-20012 - Valve stem seal installer guide
- CH-20013 - Valve seal remover
- CH-20017 - Valve keeper installer
- CH-20018 - Valve spring compressor

NOTE :

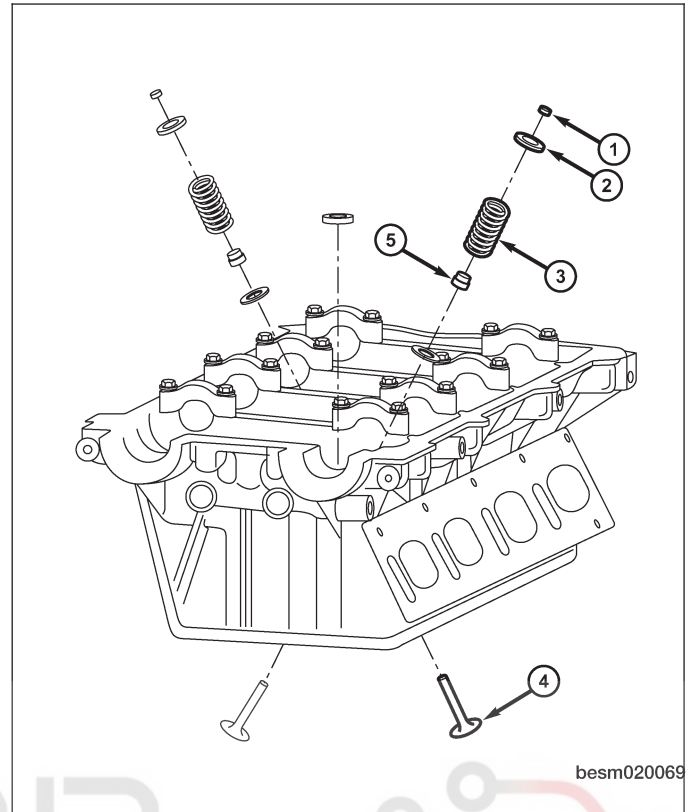
Replacement cylinder head comes complete with valves, seals, springs, retainers, keepers, tappets, and camshafts.

1. Remove camshafts.
2. Remove the hydraulic tappet assembly.



CYLINDER HEAD UNIT REPAIR

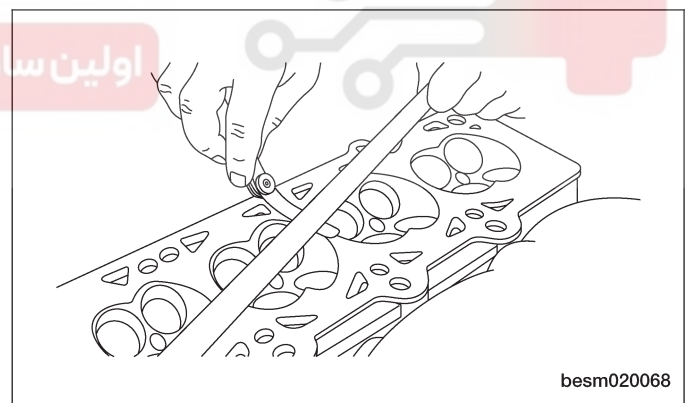
3. Using the special tool, compress the valve spring.
4. Remove the valve keeper (1), valve spring retainer (2) and valve spring (3).
5. Push the valve stem from the cylinder head and remove the valve (4).
6. Remove the valve oil seal (5) using special tool.
7. Remove the valve guide if necessary.
8. Remove the spark plugs.



02

Inspection

- Cylinder head must be flat within 0.04 mm.
- Inspect camshaft bearing journals for scoring.
- Remove carbon and varnish deposits from inside of valve guides with a valve guide cleaner.
- Verify the valve tappets move freely in their bores, and that they have been rotating.
- Check the valve guide height.

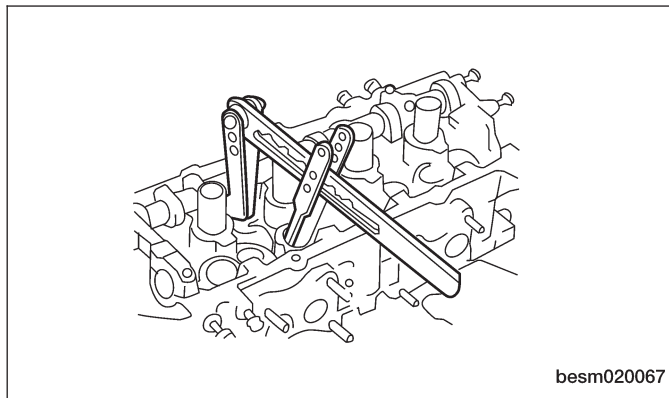


Assemble

1. Install new valve guide if necessary.
2. Install new valve seat if necessary.
3. Install the new valve oil seal using special tool.
4. Install the valves into the cylinder head (larger diameter on intake side).
5. Install the valve springs.
6. Install the valve spring retainers.

CYLINDER HEAD UNIT REPAIR

7. Compress the valve springs with valve spring compressor.
8. Install the valve keepers.



9. Tap the valve stem lightly with a plastic hammer after installation to verify proper assembly.
10. Install valve tappets in the head.
11. Install the camshafts.

Camshaft

Specifications

Camshaft Specifications

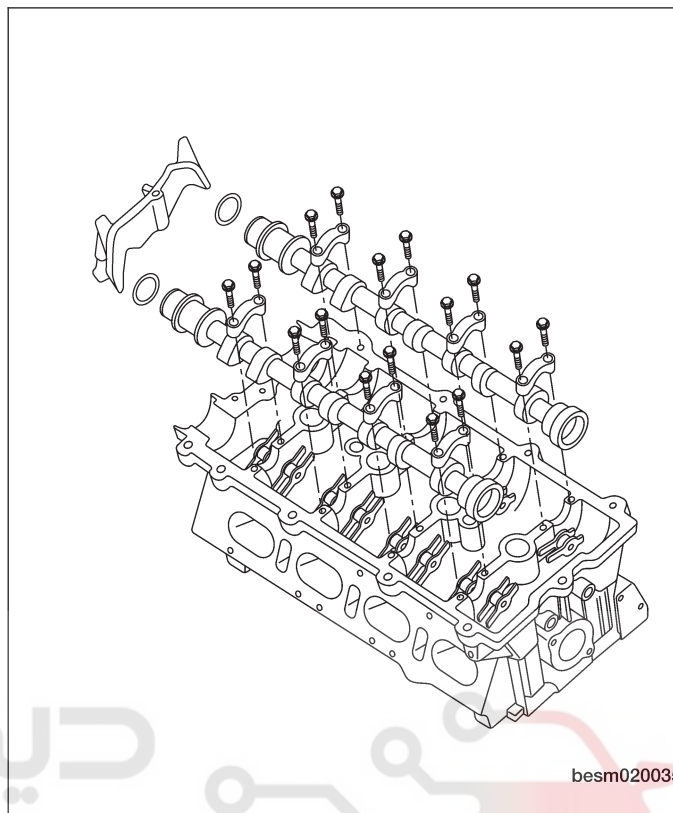
DESCRIPTION	SPECIFICATION
Intake Cam Lobe Height	37.15 mm
Exhaust Cam Lobe Height	37.05 mm
Journal #1 Outer Diameter	31.934-31.95 mm
Journal #2, #3, #4, #5, Outer Diameter	23.947-23.96 mm
Cam Bearing #1 Inner Diameter	32-32.025 mm
Cam Bearing #2, #3, #4, #5, Inner Diameter	24-24.021 mm
Journal #1 Clearance	0.05-0.091 mm
Journal #2, #3, #4, #5 Clearance	0.04-0.074 mm
Intake Camshaft Axial Clearance	0.15-0.20 mm
Exhaust Camshaft Axial Clearance	0.15-0.20 mm

CYLINDER HEAD UNIT REPAIR

Disassemble

1. Remove the camshaft bearing caps bolts.

NOTE: Equally loosen camshaft bearing cap bolts in several steps.



02

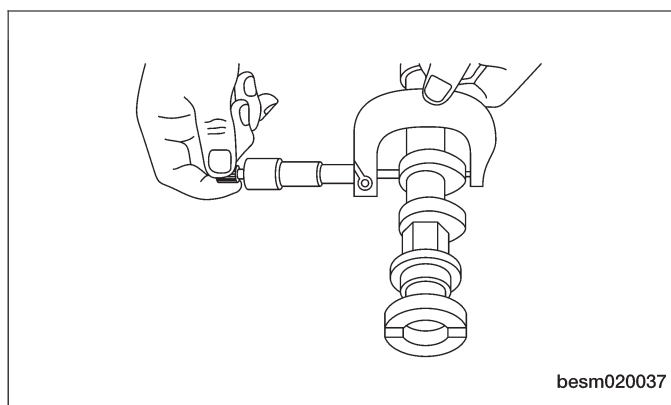
2. Remove the camshaft bearing caps and place them in proper order.

NOTE: The camshaft bearing caps are marked for identification.

3. Remove the camshafts and then remove the camshaft seals.

Inspection

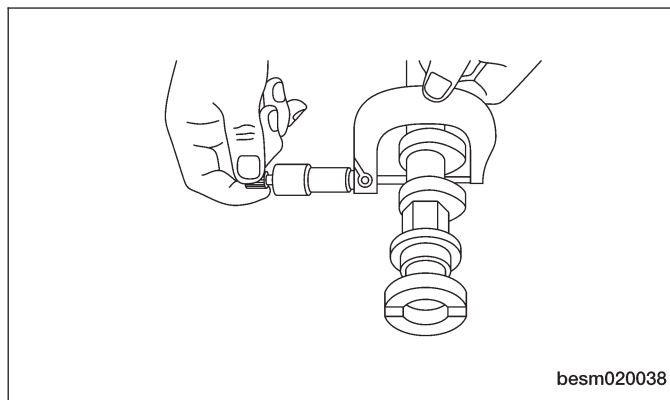
- Measure the camshaft cam lobe height.
- If wear is beyond the limit, replace the camshaft.



CAMSHAFT CAM LOBE HEIGHT	
Intake Cam Lobe Height	37.15 mm
Exhaust Cam Lobe Height	37.05 mm

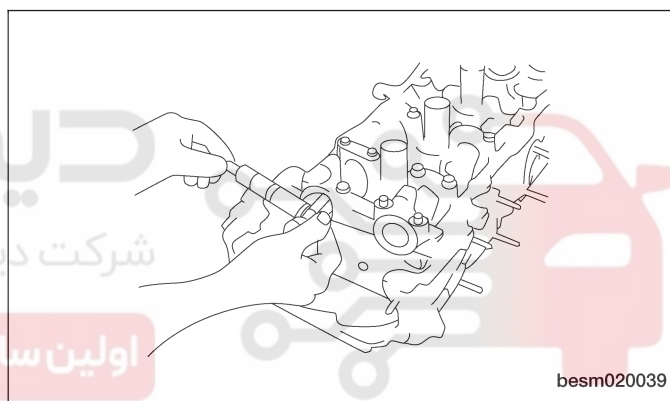
CYLINDER HEAD UNIT REPAIR

- Measure the outer diameter of the camshaft journal.



OUTER DIAMETER OF CAMSHAFT JOURNAL	
Journal #1 Outer Diameter	31.934-31.95 mm
Journal #2, #3, #4, #5, Outer Diameter	23.947-23.96 mm

- Measure the inner diameter of the camshaft bearing.



INNER DIAMETER OF CAMSHAFT BEARING	
Cam Bearing #1 Inner Diameter	32-32.025 mm
Cam Bearing #2, #3, #4, #5, Inner Diameter	24-24.021 mm

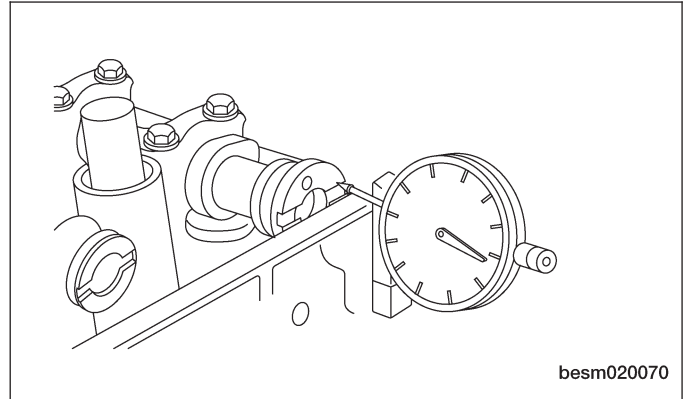
- Calculation of camshaft journal clearance

Journal clearance = (inner diameter of camshaft bearing) - (outer diameter of camshaft journal)

CAMSHAFT JOURNAL CLEARANCE	
Journal #1 Clearance	0.05-0.091 mm
Journal #2, #3, #4, #5 Clearance	0.04-0.074 mm

CYLINDER HEAD UNIT REPAIR

- Measure the axial clearance of camshaft.



02

CAMSHAFT AXIAL CLEARANCE

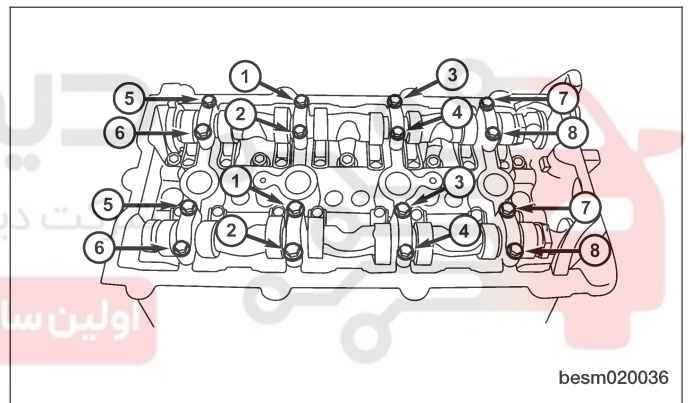
CAMSHAFT AXIAL CLEARANCE	
Intake Camshaft	0.15-0.20 mm
Exhaust Camshaft	0.15-0.20 mm

Assemble

1. Installation is in the reverse order of removal.

Installation Notes:

- Install the intake and exhaust camshaft bearing caps in the proper order
- Slowly tighten bolts to the specified torque
- Follow the torque sequence shown



Valve & Valve Guides

Specifications

Valve & Valve Guide Specifications

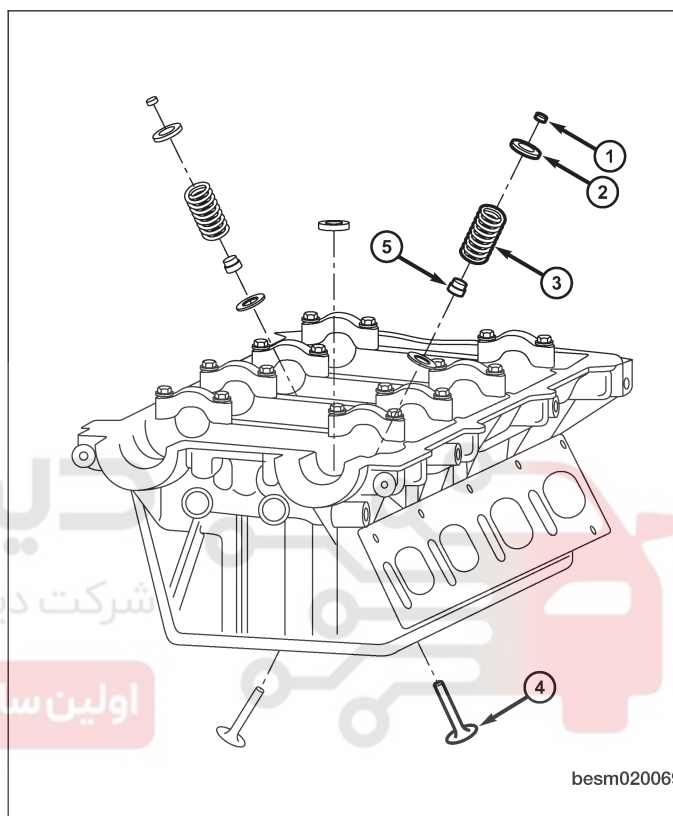
DESCRIPTION	SPECIFICATION
Intake Valve Deflection	0.02 mm
Exhaust Valve Deflection	0.04 mm
Intake Valve Guide Clearance	0.012-0.043 mm
Exhaust Valve Guide Clearance	0.032-0.063 mm

CYLINDER HEAD UNIT REPAIR**Disassemble****NOTE :**

The following special tools are required to perform the repair procedure:

- CH-20011 - Valve seal installer
- CH-20012 - Valve stem seal installer guide
- CH-20013 - Valve seal remover
- CH-20017 - Valve keeper installer
- CH-20018 - Valve spring compressor

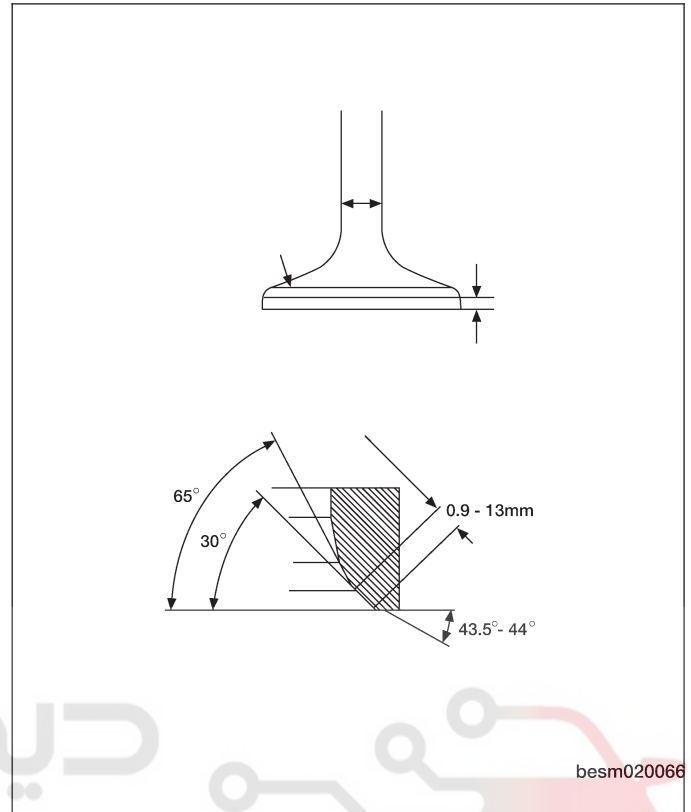
1. Using the special tool, compress the valve springs.
2. Remove the valve keeper (1), valve spring retainer (2) and valve spring (3).
3. Remove valves (4) from the cylinder head.



CYLINDER HEAD UNIT REPAIR

Inspection

- Clean all valves thoroughly and discard burned, warped and cracked valves.
- Check valve seats and valve faces for damage.
- When reconditioning valves follow the specifications outlined for both intake and exhaust valves.

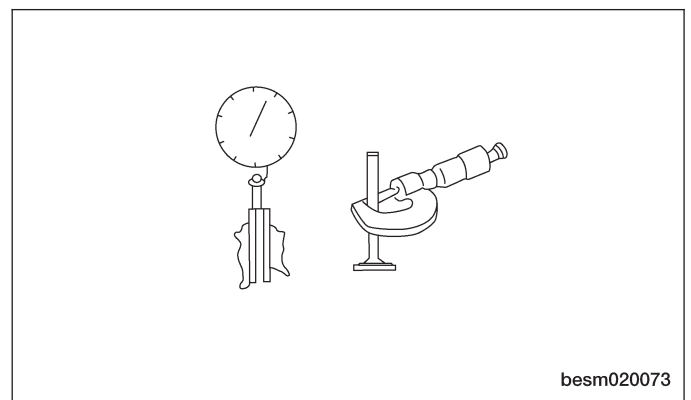


02

- Measure valve deflection.

VALVE DEFLECTION LIMIT (DIAL GAUGE READING)	
Intake Valve	0.02 mm
Exhaust Valve	0.04 mm

- If it exceeds the limit, check valve to valve guide clearance.
 - Measure valve stem diameter and valve guide inner diameter.
 - Check that clearance is within specification.
 - If it exceeds the limit, replace valve or valve guide.

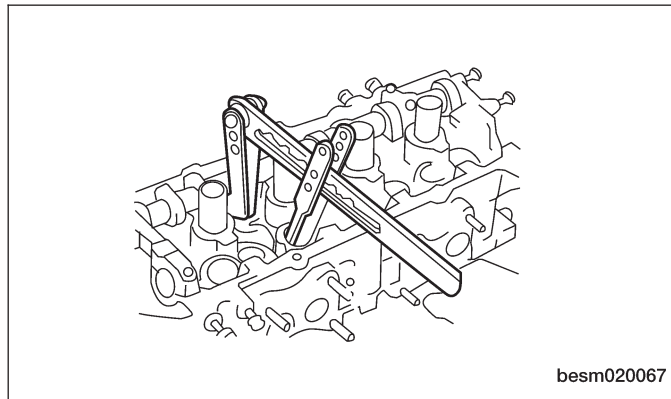


VALVE TO VALVE GUIDE CLEARANCE STANDARD	
Intake Valve	0.012-0.043 mm
Exhaust Valve	0.032-0.063 mm

CYLINDER HEAD UNIT REPAIR

Assemble

1. Install the valves into the cylinder head (larger diameter on intake side).
2. Install the valve springs.
3. Install the valve spring retainers.
4. Compress the valve springs with valve spring compressor.
5. Install the valve keepers.



6. Tap the valve stem lightly with a plastic hammer after installation to verify proper assembly.

Valve Springs**Specifications****Valve Spring Specifications**

DESCRIPTION	SPECIFICATION
Spring Free Length	47.7 mm
Spring Height At 620 Newtons Of Pressure	32.0 mm

CYLINDER HEAD UNIT REPAIR

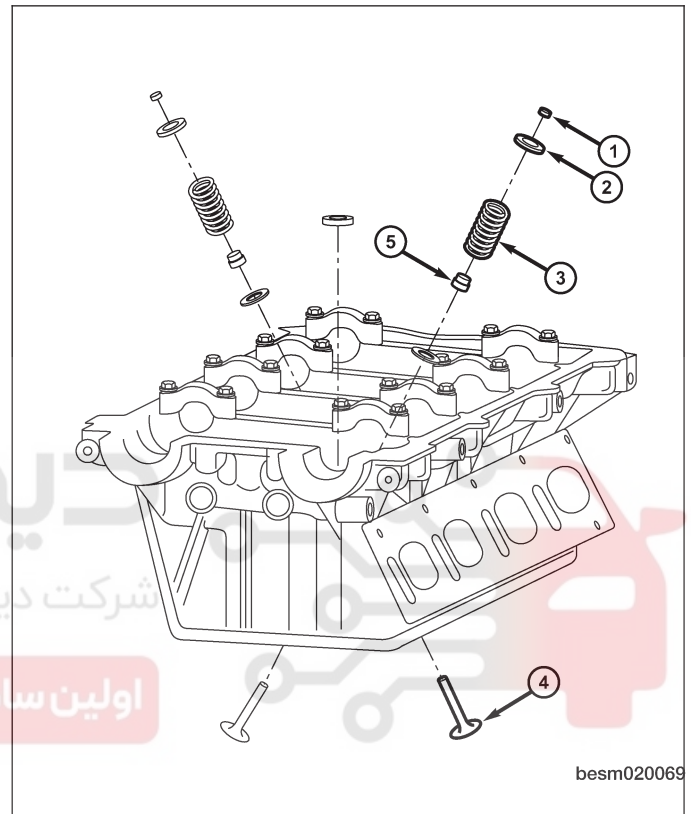
Disassemble

NOTE :

The following special tools are required to perform the repair procedure:

- CH-20011 - Valve seal installer
- CH-20012 - Valve stem seal installer guide
- CH-20013 - Valve seal remover
- CH-20017 - Valve keeper installer
- CH-20018 - Valve spring compressor

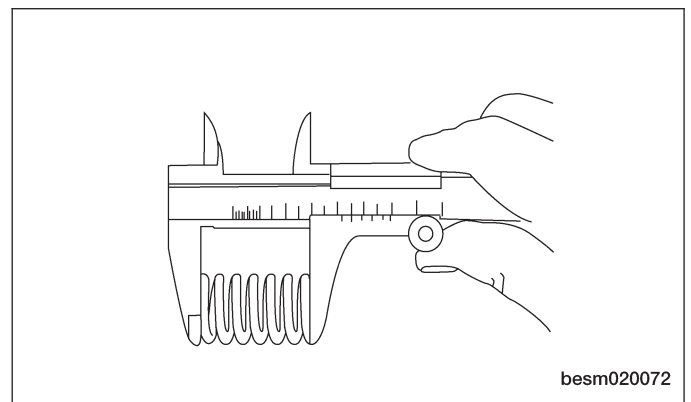
1. Using the special tool, compress the valve springs.
2. Remove the valve keeper (1), valve spring retainer (2).
3. Remove the valve springs (3) from the cylinder head.



besm020069

Inspection

- Whenever valves have been removed for inspection, reconditioning or replacement, valve springs should be tested for correct load.
- Discard the springs that do not meet specifications.
- The following specifications apply to both intake and exhaust valve springs.



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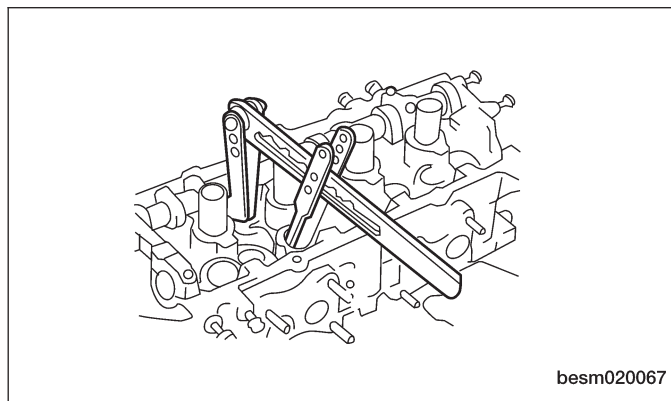
VALVE SPRING LENGTH/HEIGHT	
Spring Free Length	47.7 mm
Spring Height At 620 Newtons Of Pressure	32.0 mm

CYLINDER HEAD UNIT REPAIR

If it is not within specifications, replace the valve spring.

Assemble

1. Install the valve springs.
2. Install the valve spring retainers.
3. Compress the valve springs with valve spring compressor.
4. Install the valve keepers.



5. Tap the valve stem lightly with a plastic hammer after installation to verify proper assembly.

دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



2.0L ENGINE MECHANICAL

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Oil Pump

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Cylinder Head

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GENERAL INFORMATION

Description

The 2.0L in-line four cylinder engines have the following features:

- Dual overhead camshafts
- Four valves per cylinder
- Aluminum cylinder head
- Aluminum cylinder block

Operation

The 2.0L engine utilizes 4 valve-per-cylinders and a dual overhead camshaft design. The engine uses a remote coil ignition system. The cylinder block is made of aluminum and the bearing caps are integrated into the lower cylinder block assembly. An aluminum oil pan bolts to the bottom of the lower cylinder block. The camshafts are mounted in the cylinder head and act against valve tappets to open and close the valves. The camshafts are driven off the front of the cylinder head by one timing belt. The belt is driven by a sprocket that is located on the crankshaft. The piston assembly is an aluminum piston with a cast iron connecting rod.

The aluminum cylinder head contains dual overhead camshafts with four valves per cylinder. The valves are arranged in two in-line banks. The cylinder head incorporates powdered metal valve guides and seats. The cylinder head is sealed to the block using a multi-layer steel head gasket and retaining bolts.

Specifications

2.0L Engine Specifications

DESCRIPTION	SPECIFICATION
Type	In-Line OHV, DOHC
Number of Cylinders	4
Compression Ratio	10:1
Compression Pressure	10-15 Bar
Max. Compression Pressure Variation Between Cylinders	25%
Stroke	90 mm
Bore	83.5 mm
Displacement	1971 cc
Firing Order	1-3-4-2

Torque Specifications

CAUTION:

When torquing a fastener in two steps, DO NOT use a torque wrench for the second step.

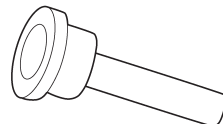
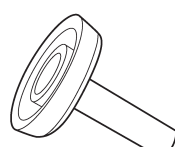
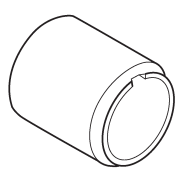
DESCRIPTION	TORQUE (N·m)
Accessory Drive Belt Tensioner Pulley Bolt	35
Camshaft Bearing Cap Bolts	11
Clutch Pressure Plate Bolts	25
Connecting Rod Cap Bolts	1st Step: Tighten the bolt to 25 N·m 2nd Step: Tighten the bolt an additional 90°
Crankshaft Holding Tool	28
Crankshaft Main Bearing Cap Bolts	1st Step: Tighten the bolt to 45 N·m 2nd Step: Tighten the bolt an additional 180°

GENERAL INFORMATION

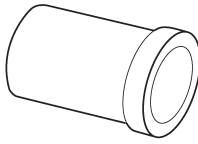
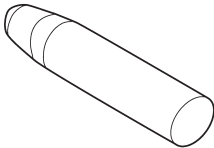
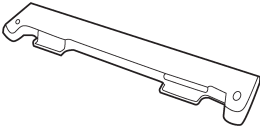
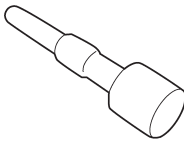
DESCRIPTION	TORQUE (N·m)
Crankshaft Timing Belt Pulley Bolt	1st Step: Tighten the bolt to 130 N·m 2nd Step: Tighten the bolt an additional 65°
Crankshaft Vibration Damper Bolts	25
Cylinder Head Cover Bolts	11
Cylinder Head Bolts	85
Dipstick Bracket Bolts	11
Drive Plate Bolts (automatic transaxle)	75
Engine Left Mount Bolt	100
Engine Right Mount Bolt	70
Engine Front Mount Bolt	60
Engine Rear Mount Bolt	60
Engine To Transaxle Bolts	80
Exhaust Manifold Nuts	25
Exhaust Manifold Heat Shield Bolts	15
Exhaust Camshaft Timing Belt Pulley Bolt	120
Flywheel Bolts (manual transaxle)	75
Fuel Rail Bracket Bolts	11
Idle Pulley Bolt	40
Intake Camshaft Timing Belt Pulley Bolt	120
Intake Manifold Bolts	10
Intake Manifold Nuts	11
Intake Manifold Bracket Bolts	25
Lower Idle Pulley Bolt	45
Lower Cylinder Block Bolts	23
Oil Filter	25
Oil Pan Bolts	18
Oil Drain Plug	40
Oil Strainer Bolts	18
Oil Pump Bolts	11 (Apply with Loctite 5910 Thread-Locker)
Rear Timing Cover Bolts	7
Timing Belt Upper Cover Bolts	11
Timing Belt Lower Cover Bolts	11
Timing Belt Tensioner Assembly	27
Timing Belt Tensioner Pulley Bolt	30
Throttle Body Bolts	11
Upper Idle Pulley Bolt	45

GENERAL INFORMATION

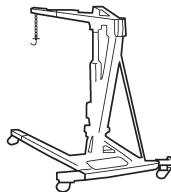
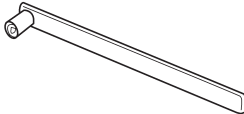
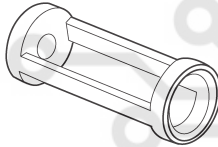
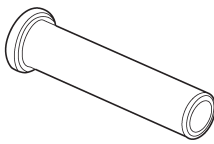
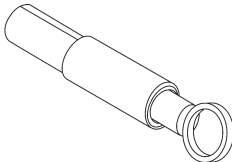
Special Tools

Camshaft Seal Installer CH-20002	 besm020001
Rear Crankshaft Oil Seal Guide CH-20006	 besm020002
Rear Crankshaft Oil Seal Installer CH-20005	 besm020003
Front Crankshaft Seal Installer CH-20007	 besm020004

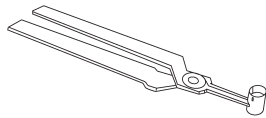
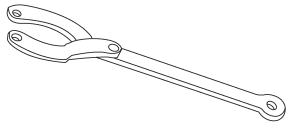
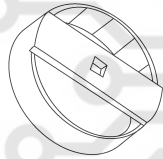
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Front Crankshaft Seal Guide CH-20008	 besm020005
Valve Stem Seal Installer Guide CH-20012	 besm020006
Valve Spring Compressor CH-20018	 besm020007
Camshaft Holder CH-20010	 besm020008
Crankshaft Holder CH-20003	 besm020009

GENERAL INFORMATION

Engine Hoist	 besm020010
Right Engine Mount Bolt Remover CH-20001	 besm020079
Valve Spring Compressor Adaptor CH-20004	 besm020080
Valve Seal Installer CH-20011	 besm020081
Valve Seal Remover CH-20013	 besm020082

GENERAL INFORMATION

Valve Keeper Installer CH-20017	 besm020084
Crankshaft Belt Pulley Fixture CH-20019	 besm020085
Oil Filter Remover CH-10003	 besm020087

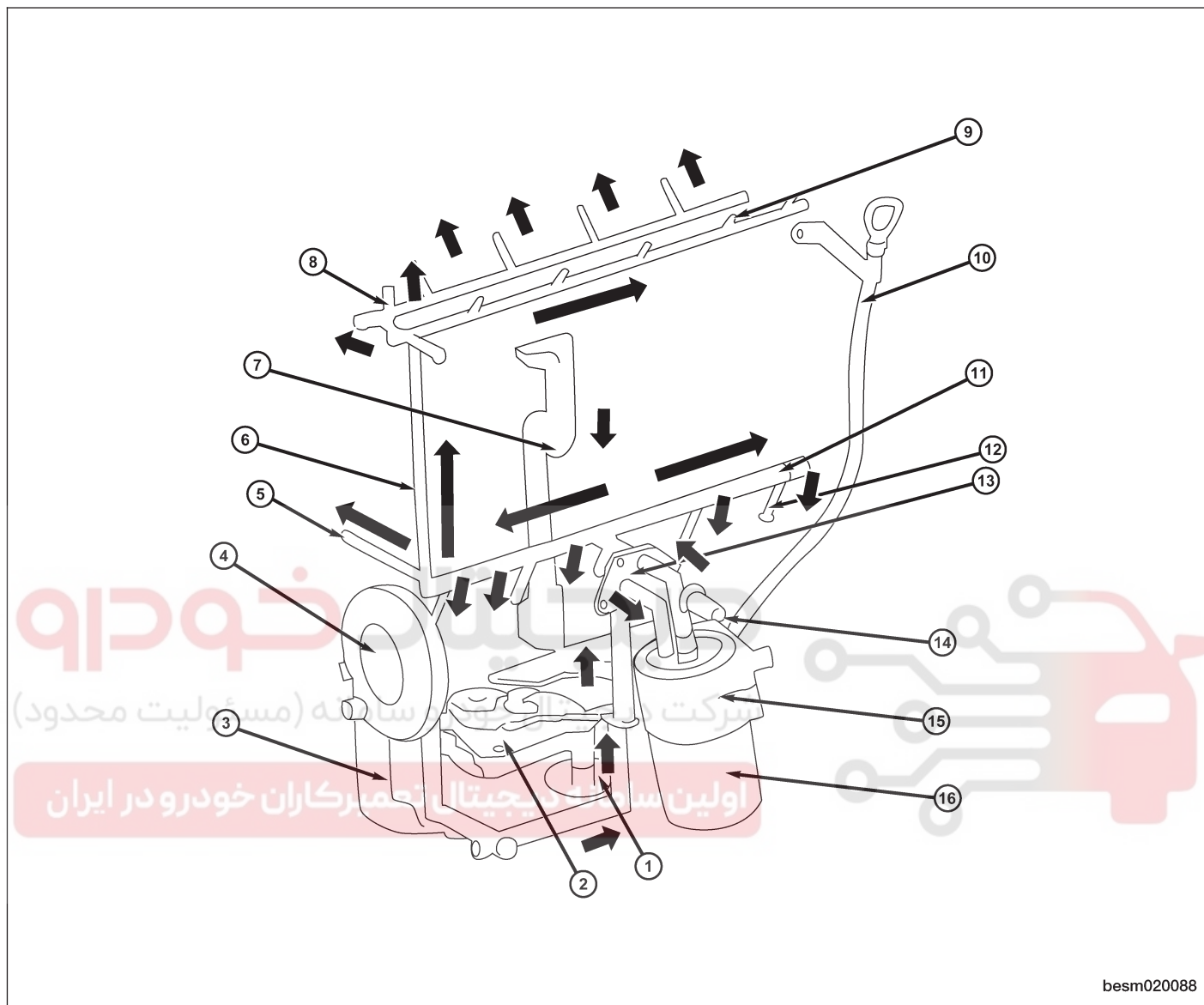
Lubrication System

The engine lubrication system operates as follows:

- Oil is drawn into the oil pump through the oil pump strainer tube in the sump of the oil pan.
- Oil is pumped through the oil filter on the cylinder block.
- Oil enters the main oil gallery where it is distributed to the crankshaft main journals and to the cylinder head.
- From the main journals, the oil is routed through cross-drilled passages in the crankshaft to lubricate the connecting rod bearings. Controlled leakage through the crankshaft main bearings and connecting rod bearings is

GENERAL INFORMATION

slung radially outward to cool and lubricate the cylinder walls as well as the entire connecting rod, piston and piston ring assembly.



besm020088

1 – Oil Pump Strainer
2 – Baffle Plate
3 – Oil Pan
4 – Oil Pump
5 – Turbocharger Inlet Oil Gallery (if equipped)
6 – To Cylinder Head
7 – Oil Return Passage
8 – To Front Bearing Cap

9 – To Middle Bearing Cap
10 – Oil Dipstick
11 – To Crankcase
12 – Crankcase Pipe
13 – Oil Filter Bracket
14 – Oil Pressure Switch
15 – Oil Cooler
16 – Oil Filter

DIAGNOSIS & TESTING

Engine Performance Diagnostics

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE DOES NOT START	1. Weak battery. 2. Corroded or loose battery connections. 3. Faulty starter. 4. Faulty coil(s) or control unit. 5. Incorrect spark plug gap. 6. Contamination in fuel system. 7. Faulty fuel pump. 8. Incorrect engine timing.	1. Test battery. Charge or replace as necessary. 2. Clean and tighten battery connections. Apply a coat of light mineral grease to terminals. 3. Test starting system. Check for codes. (Refer to Appropriate Diagnostic Information) 4. Test and replace as needed. (Refer to Appropriate Diagnostic Information) 5. Set gap. 6. Clean system and replace fuel filter. 7. Test fuel pump and replace as needed. (Refer to Appropriate Diagnostic Information) 8. Check for a skipped timing belt.
ENGINE STALLS OR IDLES ROUGH	1. Idle speed too low. 2. Incorrect fuel mixture. 3. Intake manifold leakage. 4. Faulty ignition coil(s).	1. Test minimum air flow. (Refer to Appropriate Diagnostic Information) 2. (Refer to Appropriate Diagnostic Information) 3. Inspect intake manifold, manifold gasket, and vacuum hoses. 4. Test and replace as necessary. (Refer to Appropriate Diagnostic Information)
ENGINE LOSS OF POWER	1. Dirty or incorrectly gapped spark plugs. 2. Contamination in fuel system. 3. Faulty fuel pump. 4. Incorrect valve timing. 5. Leaking cylinder head gasket. 6. Low compression. 7. Burned, warped, or pitted valves. 8. Plugged or restricted exhaust system. 9. Faulty ignition coil(s).	1. Clean spark plugs and set gap. 2. Clean system and replace fuel filter. 3. Test and replace as necessary. (Refer to Appropriate Diagnostic Information) 4. Correct valve timing. 5. Replace cylinder head gasket. 6. Test compression of each cylinder. 7. Replace valves. 8. Perform exhaust restriction test. Install new parts. 9. Test and replace as necessary. (Refer to Appropriate Diagnostic Information)
ENGINE MISSES ON ACCELERATION	1. Dirty or incorrectly gapped spark plugs. 2. Contamination in fuel system. 3. Burned, warped, or pitted valves. 4. Faulty ignition coil(s).	1. Clean spark plugs and set gap. 2. Clean fuel system and replace fuel filter. 3. Replace valves. 4. Test and replace as necessary. (Refer to Appropriate Diagnostic Information)

DIAGNOSIS & TESTING

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE MISSES AT HIGH SPEED	1. Dirty or incorrect spark plug gap. 2. Faulty ignition coil(s). 3. Dirty fuel injector(s). 4. Contamination in fuel system.	1. Clean spark plugs and set gap. 2. Test and replace as necessary. (Refer to Appropriate Diagnostic Information) 3. Test and replace as necessary. (Refer to Appropriate Diagnostic Information) 4. Clean system and replace fuel filter.

Engine Mechanical Diagnostics

CONDITION	POSSIBLE CAUSES	CORRECTION
VALVE TRAIN NOISE	1. High or low oil level in crankcase. 2. Thin or diluted oil. 3. Thick oil. 4. Low oil pressure. 5. Worn cam lobe. 6. Worn valve guides. 7. Excessive runout of valve seats on valve faces.	1. Check and correct engine oil level. 2. Change oil to correct viscosity. 3. Change engine oil and filter. 4. Check and correct engine oil level. 5. Install new camshaft. 6. Replace cylinder head. 7. Grind valve seats and replace valves.
CONNECTING ROD NOISE	1. Insufficient oil supply. 2. Low oil pressure. 3. Thin or diluted oil. 4. Excessive bearing clearance. 5. Connecting rod journal out-of-round. 6. Connecting rod out-of-round. 7. Misaligned connecting rods.	1. Check engine oil level. 2. Check engine oil level. Inspect oil pump relief valve and spring. 3. Change oil to correct viscosity. 4. Measure bearings for correct clearance. Repair as necessary. 5. Replace crankshaft or grind surface. 6. Replace connecting rod. 7. Replace bent connecting rods.
MAIN BEARING NOISE	1. Insufficient oil supply. 2. Low oil pressure. 3. Thin or diluted oil. 4. Excessive bearing clearance. 5. Excessive end play. 6. Crankshaft journal out-of-round or worn. 7. Loose flywheel or torque converter.	1. Check engine oil level. 2. Check engine oil level. Inspect oil pump. 3. Change oil to correct viscosity. 4. Measure bearings for correct clearance. Repair as necessary. 5. Check thrust bearing for wear on flanges. 6. Replace crankshaft or grind journals. 7. Tighten to correct torque.
OIL PRESSURE DROP	1. Low oil level. 2. Faulty oil pressure sending unit. 3. Low oil pressure. 4. Clogged oil filter. 5. Thin or diluted oil. 6. Excessive bearing clearance.	1. Check engine oil level. 2. Install new sending unit. 3. Check sending unit and main bearing oil clearance. 4. Install new oil filter. 5. Change oil to correct viscosity. 6. Measure bearings for correct clearance.

DIAGNOSIS & TESTING

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS	1. Misaligned or deteriorated gaskets. 2. Loose fastener, broken or porous metal part. 3. Misaligned or deteriorated cup or threaded plug.	1. Replace gasket. 2. Tighten, repair or replace the part. 3. Replace as necessary.
OIL CONSUMPTION OR SPARK PLUGS FOULED	1. PCV system malfunction. 2. Worn, scuffed or broken rings. 3. Carbon in oil ring slots. 4. Rings fitted too tightly in grooves. 5. Worn valve guide(s). 6. Valve stem seal(s) worn or damaged.	1. Check system and repair as necessary. 2. Hone cylinder bores. Install new rings. 3. Install new rings. 4. Remove rings and check grooves. If groove is not proper width, replace piston. 5. Replace cylinder head. 6. Replace seal(s).

02

Cylinder Compression Pressure Test

- The results of a cylinder compression pressure test can be utilized to diagnose several engine malfunctions.
- Ensure the battery is completely charged and the engine starter motor is in good operating condition. Otherwise the indicated compression pressures may not be valid for diagnosis purposes.
 - Check engine oil level and add oil if necessary.
 - Disconnect the spark plug wires.
 - Remove all spark plugs from engine (as spark plugs are being removed, check electrodes for abnormal firing indicators fouled, hot, oily, etc.).
 - Record cylinder number of each spark plug for future reference.
 - Disconnect fuel injector electrical connectors.
 - Be sure throttle blade is fully open during the compression check.
 - Insert compression pressure adaptor or the equivalent into each spark plug hole in cylinder head.
 - Crank engine until maximum pressure is reached on gauge. Record each cylinder pressure.
 - Compression should not be less than 1000 kPa and not vary more than 25 percent from cylinder to cylinder.
 - If one or more cylinders have abnormally low compression pressures, repeat the compression test.
 - If the same cylinder or cylinders repeat an abnormally low reading on the second compression test, it could indicate the existence of a problem in the cylinder in question.

NOTE :

The recommended compression pressures are to be used only as a guide to diagnosing engine problems. An engine should not be disassembled to determine the cause of low compression unless some malfunction is present.

Cylinder Head Gasket Test

- A cylinder head gasket leak can be located between adjacent cylinders, between a cylinder and the adjacent water jacket or from an oil passage to the exterior of the engine.
- Possible indications of the cylinder head gasket leaking between adjacent cylinders are:
 - Loss of engine power
 - Engine misfiring
 - Poor fuel economy
- Possible indications of the cylinder head gasket leaking between a cylinder and an adjacent water jacket are:
 - Engine overheating
 - Loss of coolant
 - Excessive steam (white smoke) emitting from exhaust
 - Coolant foaming

ON-VEHICLE SERVICE

Accessory Drive Belt

Removal & Installation

WARNING!

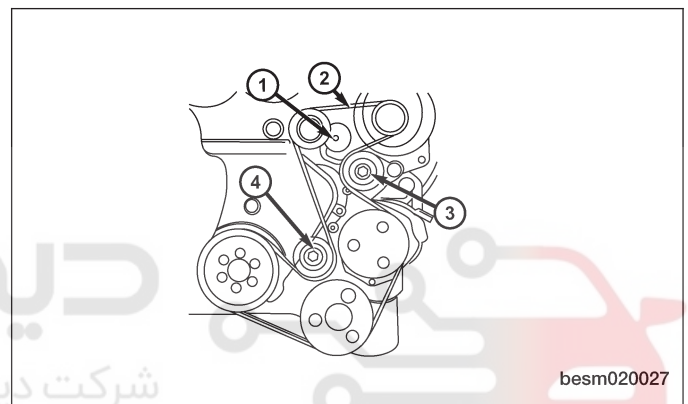
Inspect the drive belt only when the engine is stopped.

1. While using a suitable tool and securely holding the hexagonal portion of the drive belt tensioner, rotate the pulley counterclockwise to loosen the drive belt.

WARNING!

Avoid placing hands near the drive belt tensioner while it is being held.

2. Remove the drive belt.
3. Remove accessory drive belt tensioner (1) if necessary.
4. Remove idler pulleys (3, 4) if necessary.
5. Installation is in the reverse order of removal.



Air Cleaner Element

Removal & Installation

1. Unhook the air cleaner case side clips and raise the air cleaner case (upper).
2. Remove the air cleaner element.
3. Install a new air cleaner element.
4. Installation is in the reverse order of removal.

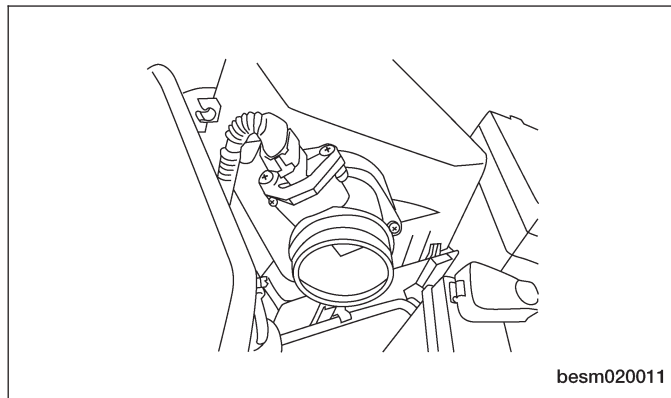
Air Cleaner Housing

Removal & Installation

1. Disconnect the negative battery cable.
2. Disconnect the air flow sensor electrical connector.
3. Loosen the clamp between the air intake hose and the air cleaner.

ON-VEHICLE SERVICE

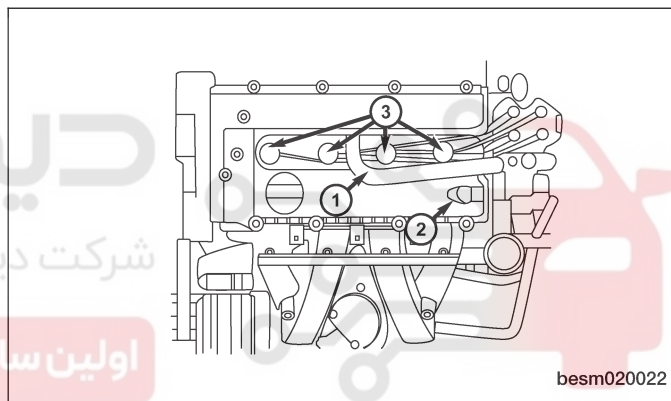
4. Remove the screws securing the air cleaner housing to its base.
5. Remove the air cleaner housing.
6. Remove the air cleaner base as necessary.
7. Installation is in the reverse order of removal.



02

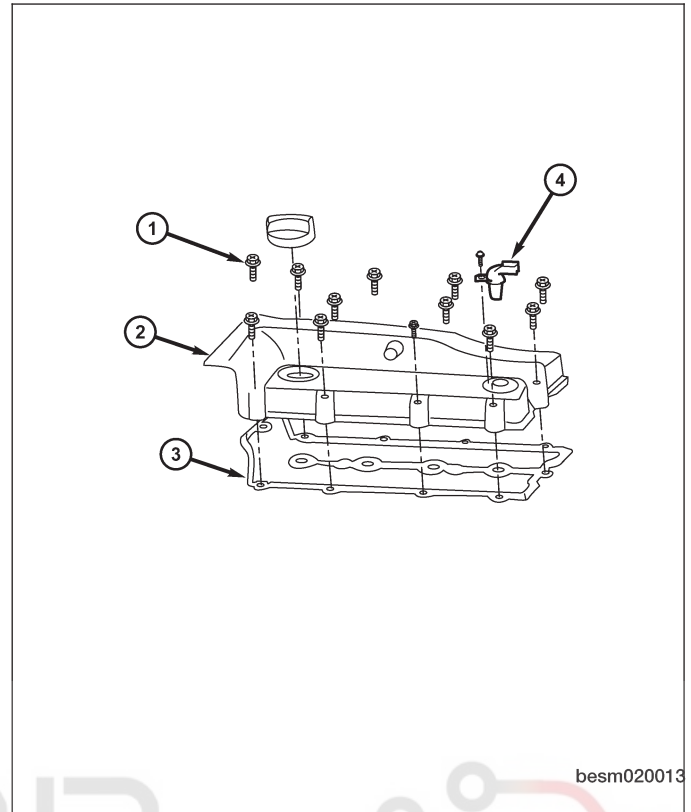
Cylinder Head Cover**Removal & Installation**

1. Disconnect the negative battery cable.
2. Remove the engine cover.
3. Disconnect the camshaft position sensor electrical connector.
4. Remove the camshaft position sensor (2) and set aside.
5. Remove the spark plug wires (3) and set them aside.
6. Remove the PCV hose (1) from cylinder head cover.
7. Use compressed air to blow dirt and debris off the cylinder head cover prior to removal.



ON-VEHICLE SERVICE

8. Remove the cylinder head cover bolts (1).
(Tighten: Cylinder head cover bolts to 11 N.m)
9. Remove the cylinder head cover (2) from the cylinder head.
10. Remove the cylinder head cover gasket (3) if necessary.
11. Installation is in the reverse order of removal.



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Camshaft

Removal & Installation

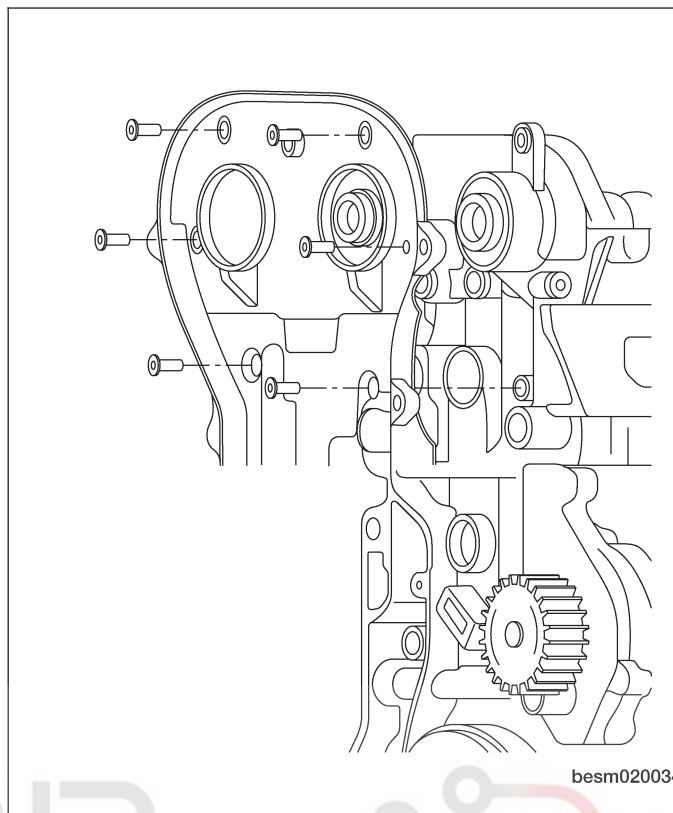
NOTE : The following special tools are required to perform the repair procedure:

- CH-20002 - Camshaft seal installer

1. Remove the accessory drive belt (See Accessory Drive Belt Removal & Installation in Section 02 Engine).
2. Remove the engine timing belt (See Engine Timing Belt Removal & Installation in Section 02 Engine).
3. Remove the cylinder head cover (See Cylinder Head Cover Removal & Installation in Section 02 Engine).
4. Remove the intake or exhaust camshaft timing belt pulley.
(Tighten: Camshaft timing belt pulley bolt to 120 N.m)

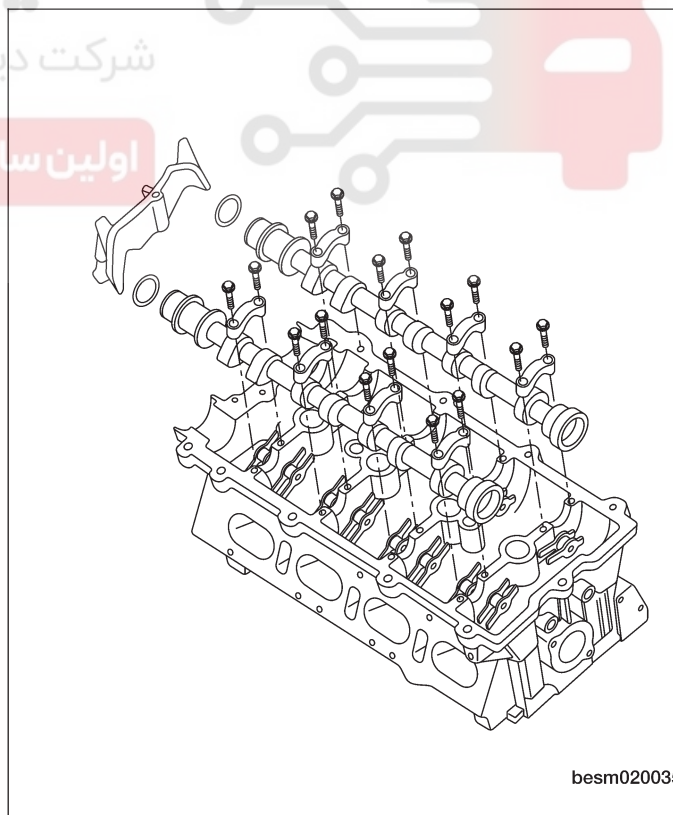
ON-VEHICLE SERVICE

5. Remove the rear timing cover of the timing pulley.
(Tighten: Rear timing cover bolts to 7 N·m)



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6. Remove the camshaft bearing cap bolts.
(Tighten: Camshaft bearing cap bolts to 11 N·m)
NOTE: Equally loosen camshaft bearing cap bolts in several steps.
7. Remove the camshaft bearing caps and place them in proper order.
NOTE: The camshaft bearing caps are marked for identification.
8. Remove the camshafts and then remove the camshaft seals.

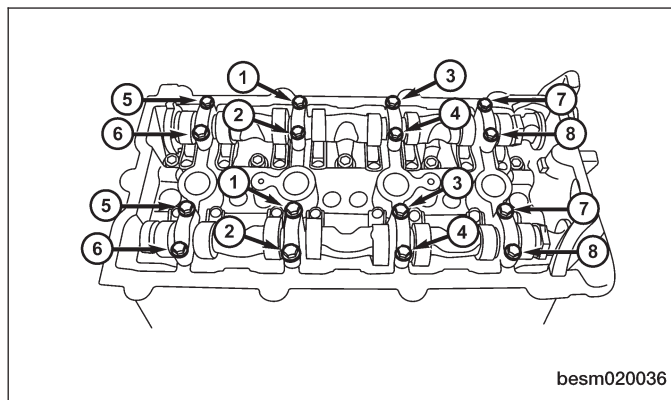


ON-VEHICLE SERVICE

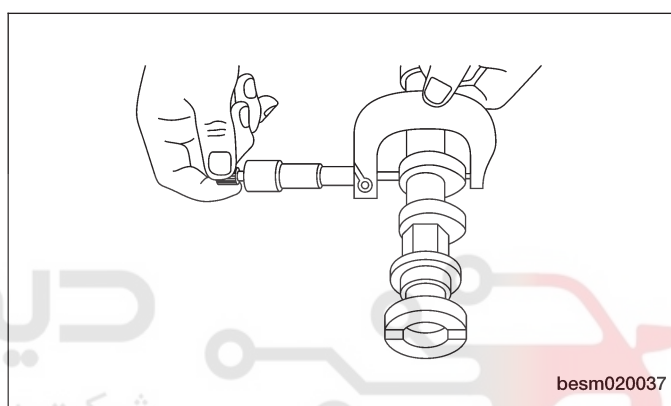
9. Installation is in the reverse order of removal.

Installation Notes:

- Install the intake and exhaust camshaft bearing caps in the proper order
- Slowly tighten bolts to the specified torque
- Follow the torque sequence shown

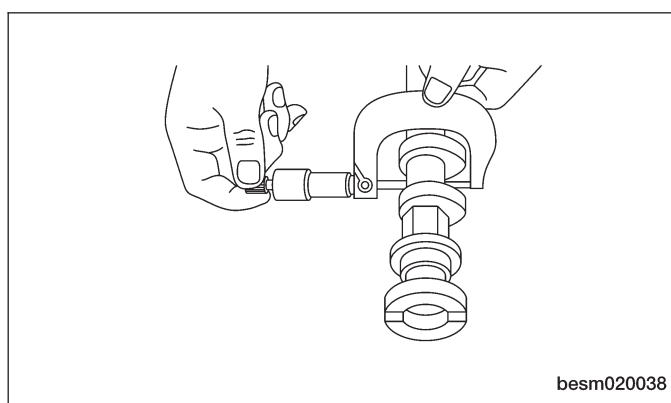
**Inspection**

- Measure the camshaft cam lobe height.
- If wear is beyond the limit, replace the camshaft.



CAMSHAFT CAM LOBE HEIGHT	
Intake Am Lobe Height	37.15 mm
Exhaust Cam Lobe Height	37.05 mm

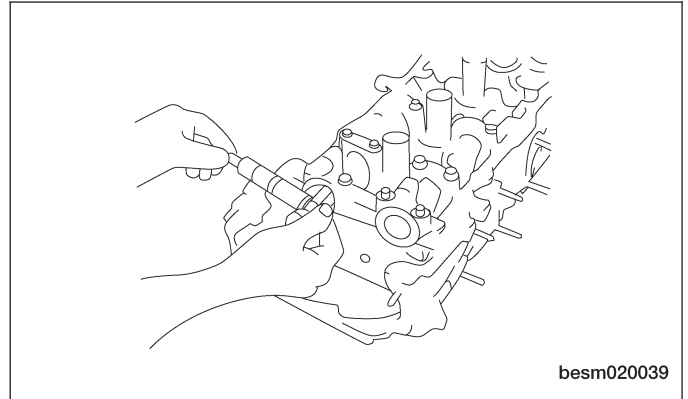
- Measure the outer diameter of the camshaft journal.



OUTER DIAMETER OF CAMSHAFT JOURNAL	
Journal #1 Outer Diameter	31.934-31.95 mm
Journal #2, #3, #4, #5, Outer Diameter	23.947-23.96 mm

ON-VEHICLE SERVICE

- Measure the inner diameter of the camshaft bearing.



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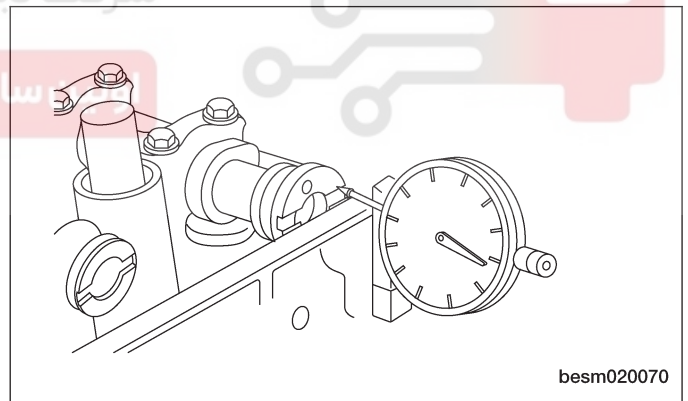
INNER DIAMETER OF CAMSHAFT BEARING	
Cam Bearing #1 Inner Diameter	32-32.025 mm
Cam Bearing #2, #3, #4, #5, Inner Diameter	24-24.021 mm

- Calculation of camshaft journal clearance

Journal clearance = (inner diameter of camshaft bearing) - (outer diameter of camshaft journal)

CAMSHAFT JOURNAL CLEARANCE	
Journal Clearance #1	0.05-0.091 mm
Journal Clearance #2, #3, #4, #5	0.04-0.074 mm

- Measure the axial clearance of camshaft.



CAMSHAFT AXIAL CLEARANCE	
Intake Camshaft	0.15-0.20 mm
Exhaust Camshaft	0.15-0.20 mm

Cylinder Head

Removal & Installation

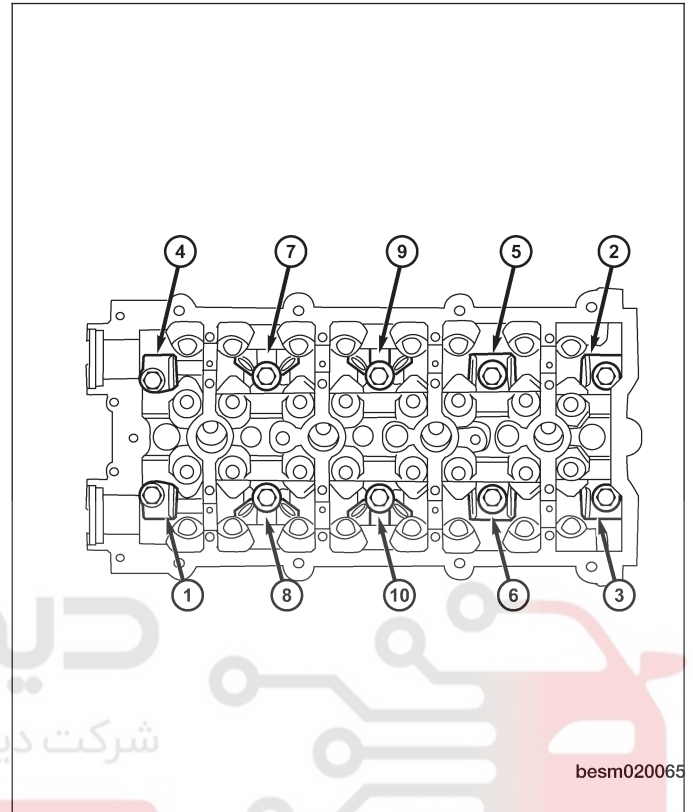
NOTE :

Replacement cylinder head comes complete with valves, seals, springs, retainers, keepers, and camshafts.

- Remove engine timing belt (See Engine Timing Belt Removal & Installation in Section 02 Engine).
- Remove the cylinder head cover (See Cylinder Head Cover Removal & Installation in Section 02 Engine).

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3. Remove the camshafts (See Camshaft Removal & Installation in Section 02 Engine).
4. Remove intake manifold (See Intake Manifold Removal & Installation in Section 02 Engine).
5. Remove exhaust manifold (See Exhaust Manifold Removal & Installation in Section 02 Engine).
6. Remove water pipe and thermostat assembly.
7. Remove the cylinder head bolts in the order shown.
(Tighten: Cylinder head bolts to 85 N·m)



8. Remove cylinder head gaskets.
9. Installation is in the reverse order of removal.

Installation Notes:

- Ensure cylinder head bolt holes in the block are clean, dry (free of residual oil or coolant), and threads are not damaged.
- Do not reuse the cylinder head bolts. The new bolts should be examined BEFORE use. If the bolts are stretched, the bolts should be replaced.
- Position the new cylinder head gasket on the engine block with the part number facing up. Ensure gasket is seated over the locating dowels in the block.
- Before installing the bolts, the threads should be lightly coated with engine oil.

Front Crankshaft Oil Seal

Removal & Installation

NOTE :

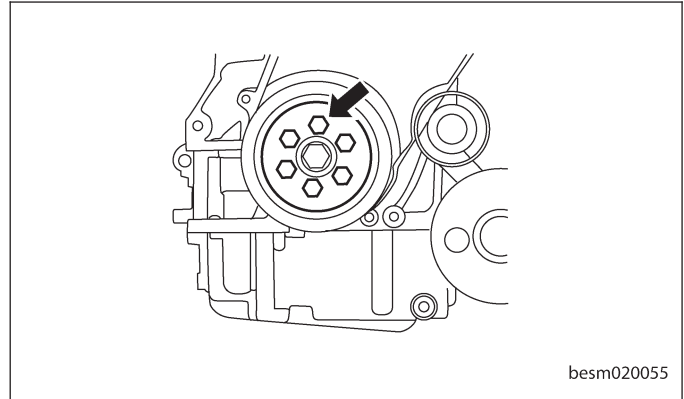
The following special tools are required to perform the repair procedure:

- CH-20007 - Front crankshaft seal installer
- CH-20008 - Front crankshaft seal guide
- CH-20019 - Crankshaft belt pulley fixture

1. Remove the accessory drive belt (See Accessory Drive Belt Removal & Installation in Section 02 Engine).

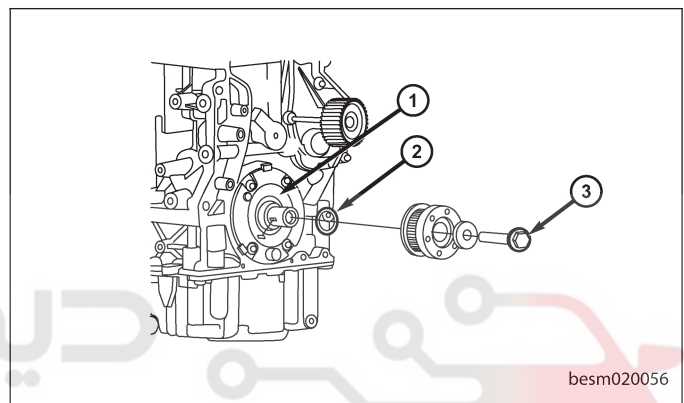
ON-VEHICLE SERVICE

2. Remove the crankshaft vibration damper bolts.
(Tighten: Crankshaft vibration damper bolts to 25 N·m)



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3. Remove the engine timing belt (See Engine Timing Belt Removal & Installation in Section 02 Engine).
4. Remove the crankshaft timing belt pulley bolt (3) from the crankshaft.
(Tighten: Crankshaft timing belt pulley bolt to 130 N·m + 65°)
5. Remove the key-way from the crankshaft.
6. Use an appropriate tool and remove the front crankshaft oil seal (2).

**CAUTION:**

Be careful not to damage the front cover seal surface while removing the seal.

7. Installation is in the reverse order of removal.

Installation Notes:

- Install the new seal by using the front crankshaft seal installer.
- Lubricate the new front seal with engine oil prior to assembly.

Rear Crankshaft Oil Seal**Removal & Installation****NOTE :**

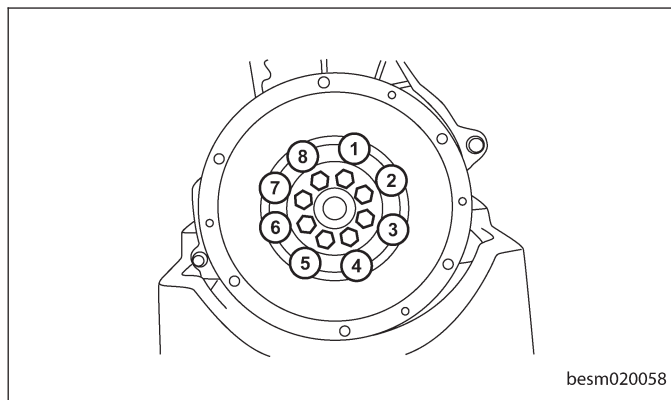
The following special tools are required to perform the repair procedure:

- CH-20005 - Rear crankshaft oil seal installer
- CH-20006 - Rear crankshaft oil seal guide

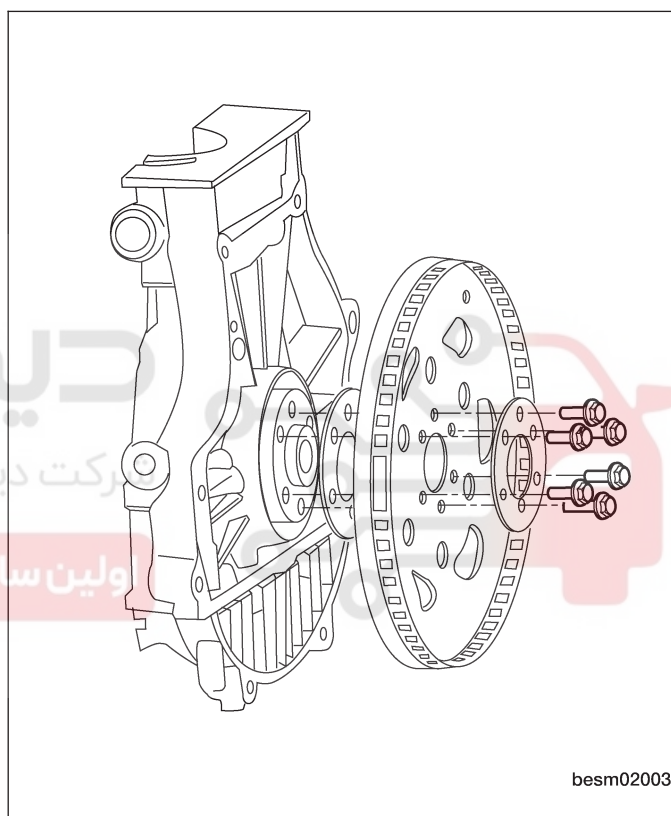
1. Remove the transaxle assembly (See Transaxle Assembly Removal & Installation in Section 08 Transmission).
2. If equipped with manual transaxle, remove clutch pressure plate.
(Tighten: Clutch pressure plate bolts to 25 N·m)

ON-VEHICLE SERVICE

3. If equipped with manual transaxle, remove the flywheel bolts and then remove the flywheel.
(Tighten: Flywheel bolts to 75 N·m)



4. If equipped with automatic transaxle, remove the drive plate retaining bolts and then remove drive plate.
(Tighten: Drive plate bolts to 75 N·m)

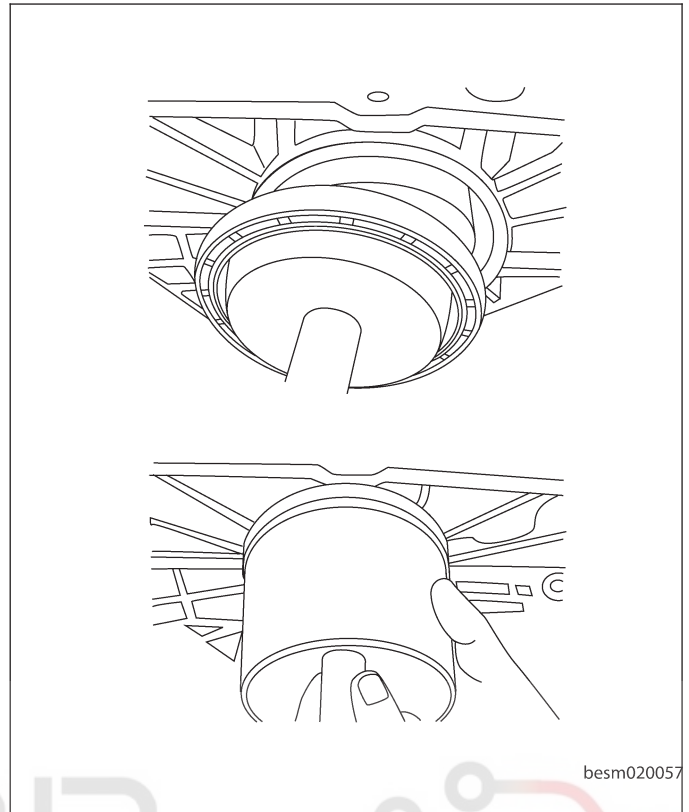


5. Remove the rear oil seal using a suitable tool.
6. Installation is in the reverse order of removal.

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Installation Notes:

- When installing seal, lubricate seal guide with clean engine oil.
- Position the seal over the rear crankshaft seal guide.
- Guide tool should remain on crankshaft during installation of seal.
- Ensure that the lip of the seal is facing toward the crankcase during installation.

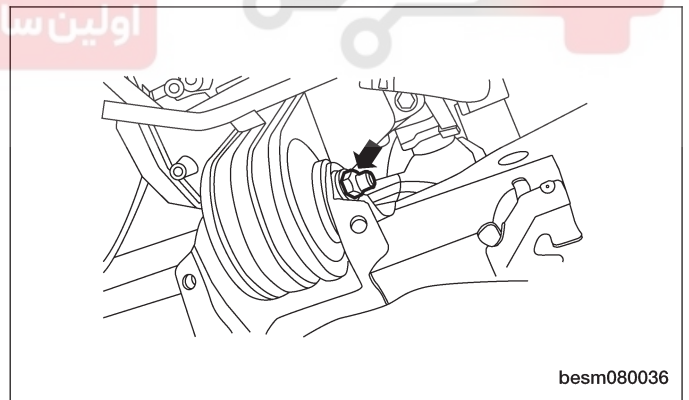


02

Engine Mounts**Left Mount - Removal & Installation****NOTE :**

The following special tools are required to perform the repair procedure:

- Engine hoist
 1. Disconnect the negative battery cable.
 2. Remove the engine cover.
 3. Remove the left transaxle mount.
(Tighten: Engine left mount bolt to 100 N·m)
 4. Installation is in the reverse order of removal.



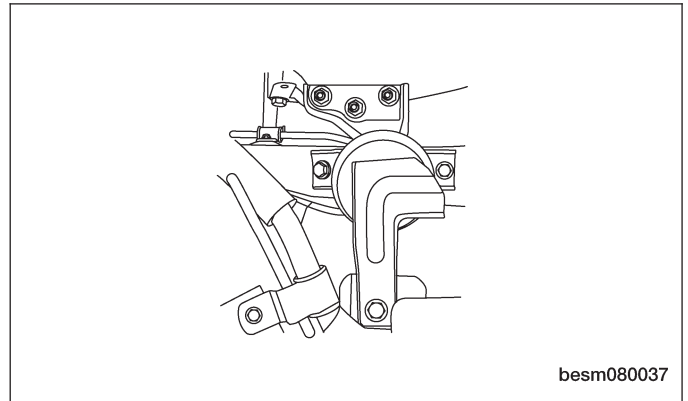
ON-VEHICLE SERVICE

Right Mount - Removal & Installation

NOTE :

The following special tools are required to perform the repair procedure:

- CH-20001 - Right engine mount bolt remover
 - Engine hoist
1. Disconnect the negative battery cable.
 2. Remove the engine cover.
 3. Using special tool CH-20001, remove the three bolts securing the right engine mount.
(Tighten: Engine right mount bolt to 70 N·m)
 4. Installation is in the reverse order of removal.

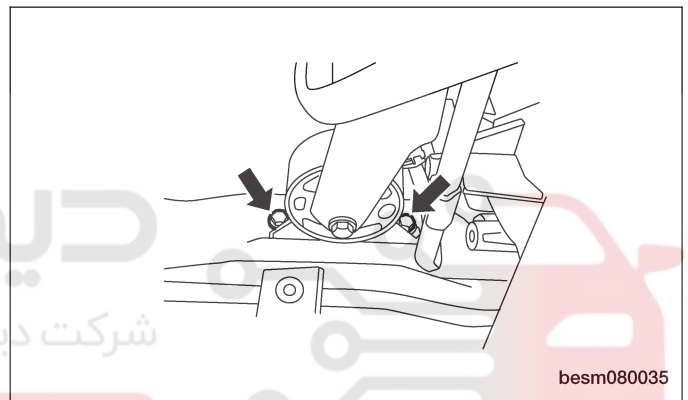


Front Mount - Removal & Installation

NOTE :

The following special tools are required to perform the repair procedure:

- Engine hoist
1. Disconnect the negative battery cable.
 2. Remove the engine cover.
 3. Remove the bolts securing the front engine mount.
(Tighten: Engine front mount bolt to 60 N·m)
 4. Installation is in the reverse order of removal.

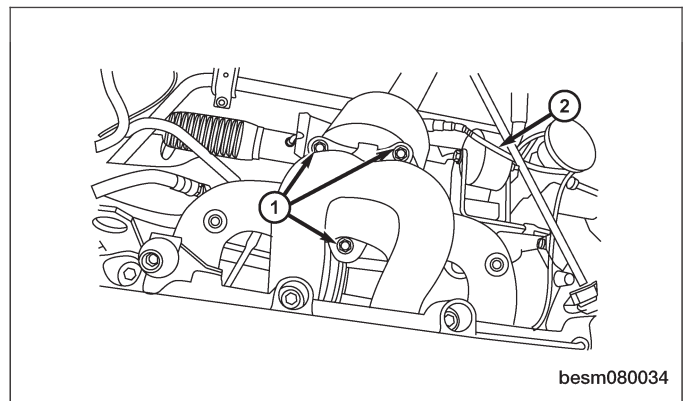


Rear Mount - Removal & Installation

NOTE :

The following special tools are required to perform the repair procedure:

- Engine hoist
1. Disconnect the negative battery cable.
 2. Remove the engine cover.
 3. Remove the rear engine mount.
(Tighten: Engine rear mount bolt to 60 N·m)
 4. Installation is in the reverse order of removal.



Engine Assembly

Removal & Installation

NOTE :

The following special tools are required to perform the repair procedure:

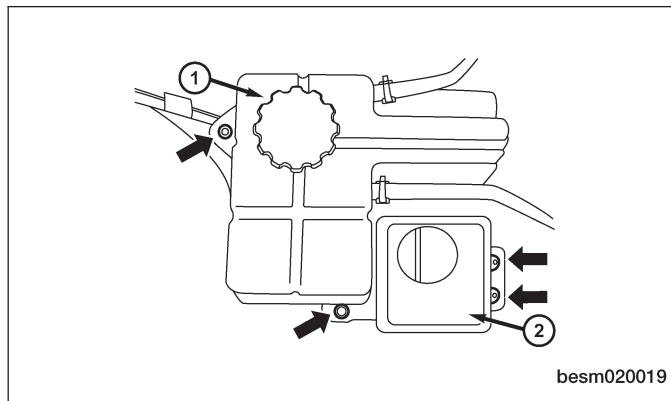
- CH-20001 - Right engine mount bolt remover
- Engine hoist

ON-VEHICLE SERVICE

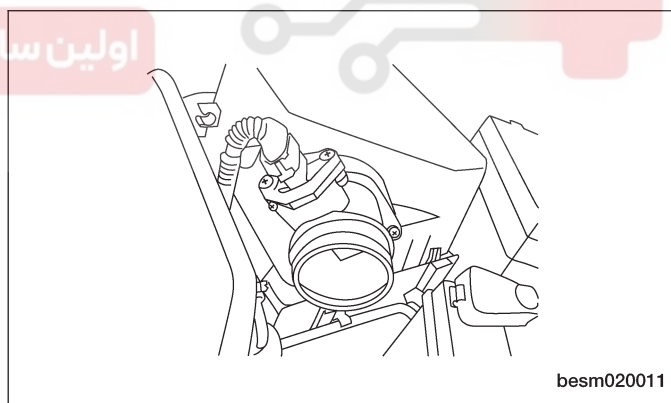
NOTE :

The engine is removed with the transaxle as an assembly.

1. Remove the vehicle hood.
2. Remove the battery, battery hold downs, and battery tray (See Battery Removal & Installation in Section 05 Starting & Charging).
3. Discharge air conditioning system (See A/C System Evacuation and Recharge in Section 13 Heating and Air Conditioning).
4. Drain the cooling system, then remove coolant reservoir (1).



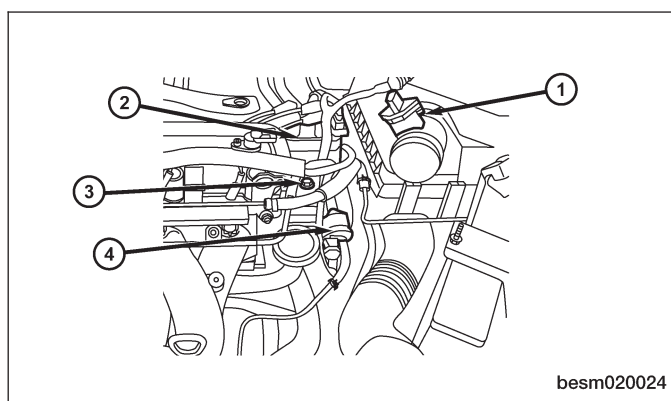
5. Remove the coolant fan & radiator assembly if necessary (See Coolant Fan & Radiator Assembly Removal & Installation in Section 06 Cooling).
6. Remove the starter motor wiring.
7. Remove the negative battery cable from the engine.
8. Remove the engine cover.
9. Relieve the fuel pressure (See Fuel Pressure Relief Procedure in Section 04 Fuel Delivery).
10. Disconnect and remove the fuel line at the fuel rail.
11. Remove the air inlet hose and the air cleaner case assembly.
12. Remove the ground cable bolt from the cylinder head.



13. Disconnect and remove the following electrical connectors:

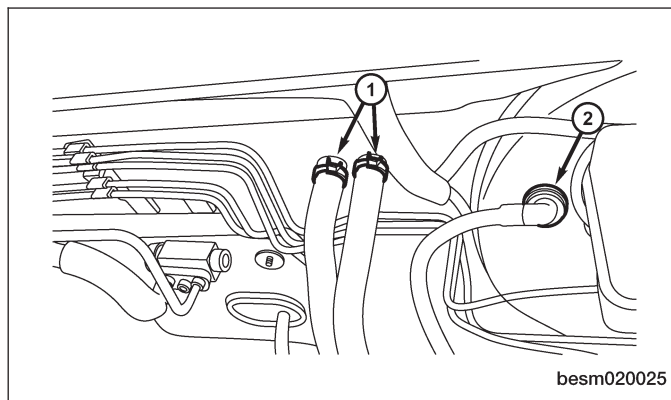
- Coolant temperature sensor
- Camshaft position sensor
- Ignition coil
- Four fuel injectors
- Intake manifold air pressure sensor
- Carbon canister solenoid valve
- Throttle body control
- A/C compressor
- Oil pressure sensor
- Power steering pump pressure switch
- Generator

14. Remove the pipe from the canister control valve.

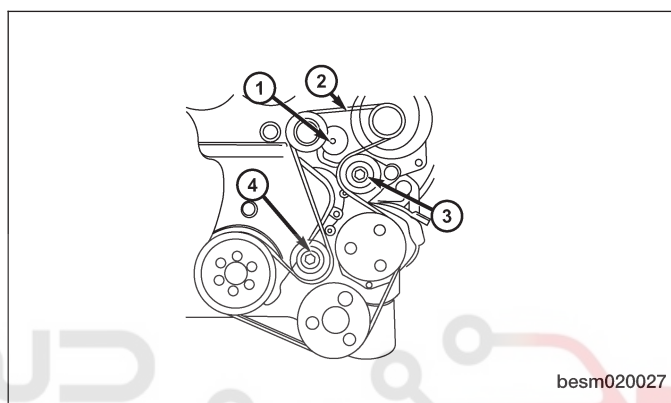


ON-VEHICLE SERVICE

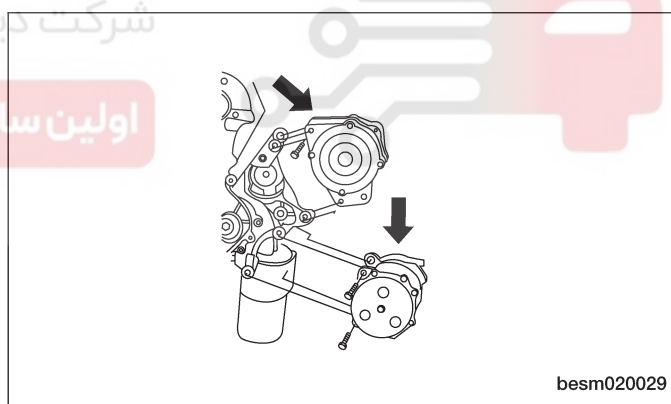
15. Disconnect the heater hoses (1) on the vehicle.
16. Remove the vacuum line from the brake booster (2).
17. Remove the dipstick.



18. Remove the accessory drive belt (2) (See Accessory Drive Belt Removal & Installation in Section 02 Engine).



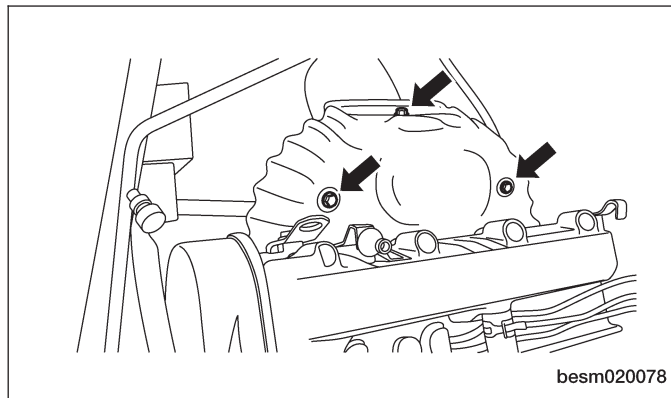
19. Remove the generator from the bracket (See Generator Removal & Installation in Section 05 Starting & Charging).



20. Remove the A/C compressor pipe.
21. Remove the transaxle shift cable.
22. Disconnect the automatic transaxle electrical connector and vehicle speed sensor electrical connector (only for automatic transaxle).
23. Remove the ground cable bolt from the transaxle (only for automatic transaxle).
24. Remove the hydraulic pipe from the clutch slave cylinder.

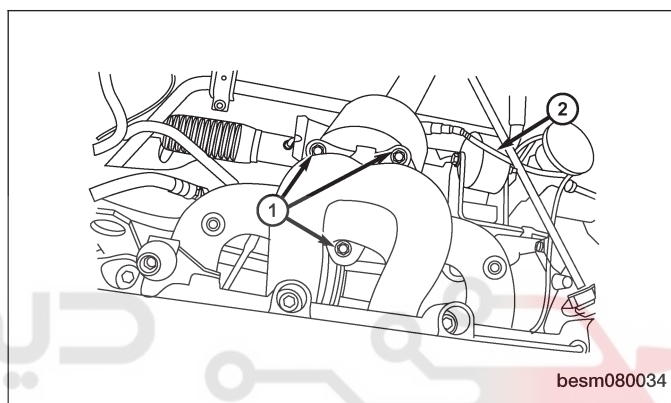
ON-VEHICLE SERVICE

25. Remove the exhaust manifold heat shield bolts and then remove heat shield.
(Tighten: Exhaust manifold heat shield bolts to 15 N·m)

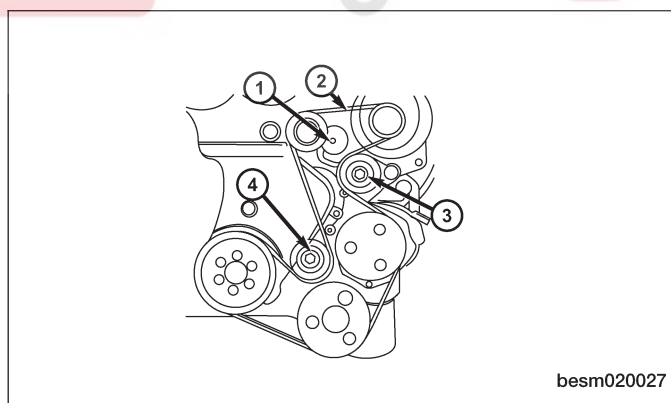


02

26. Disconnect the upper and lower oxygen sensor connectors.
27. Remove the catalytic converter (1) to exhaust manifold bolts.

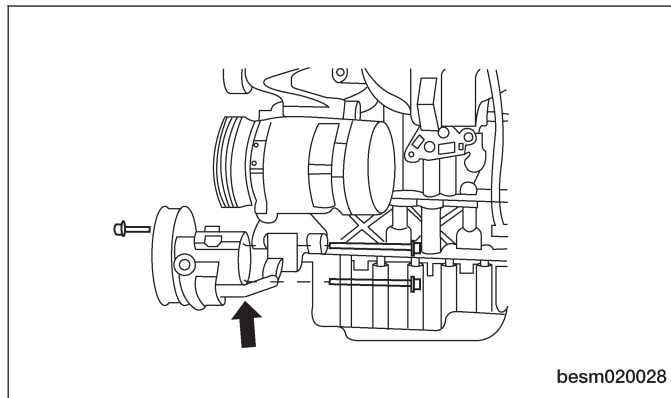


28. Remove the front axle shaft (See Front Axle Shaft Removal & Installation in Section 09 Axle).
29. Raise the vehicle.
30. Drain the engine oil.
31. Remove the idler pulley (4).

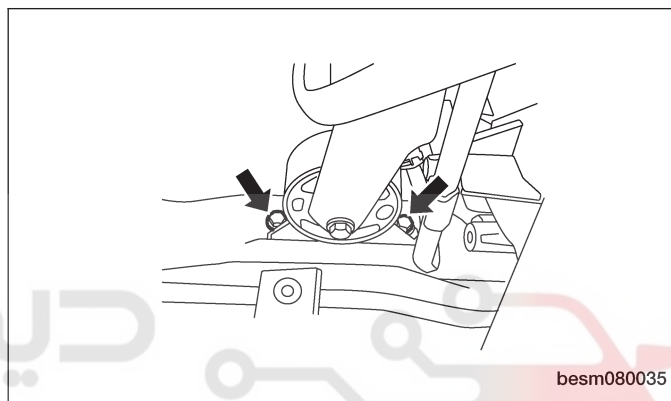


ON-VEHICLE SERVICE

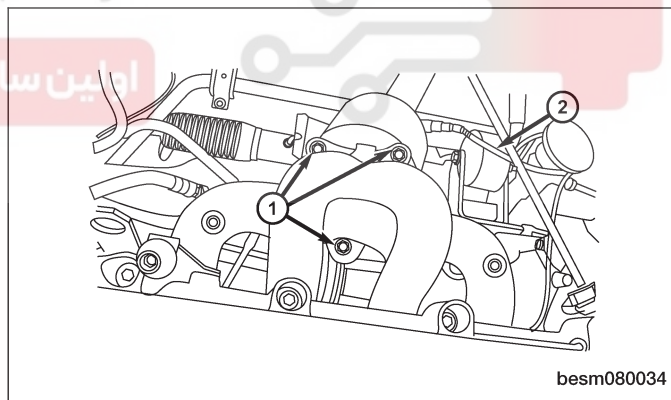
32. Remove the power steering pump with piping connected and set aside with wire.



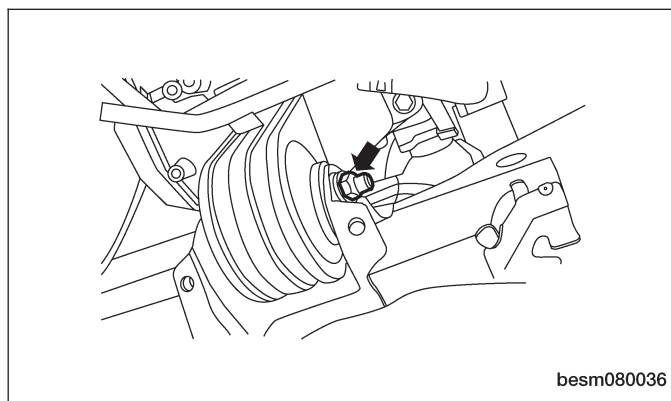
33. Lower the vehicle and install engine lift chain hangers.
34. Remove the bolts securing the front engine mount.
(Tighten: Engine front mount bolt to 60 N·m)



35. Remove the rear engine mount (2).
(Tighten: Engine rear mount bolt to 60 N·m)

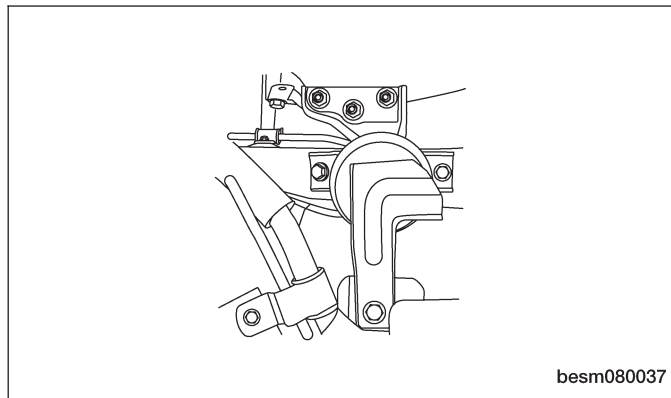


36. Remove the left transaxle mount.
(Tighten: Engine left mount bolt to 100 N·m)



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37. Using special tool CH-20001, remove the three bolts securing the right engine mount.
(Tighten: Engine right mount bolt to 70 N·m)
38. Remove the mount assembly.



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39. Verify all components between the engine and vehicle are disconnected.
40. Hoist the engine from vehicle.

CAUTION:

Verify all electrical connectors are disconnected prior to engine/transaxle removal.

41. Separate engine and transaxle.
42. Installation is in the reverse order of removal.

Engine Timing Belt**Removal & Installation****NOTE :**

The following special tools are required to perform the repair procedure:

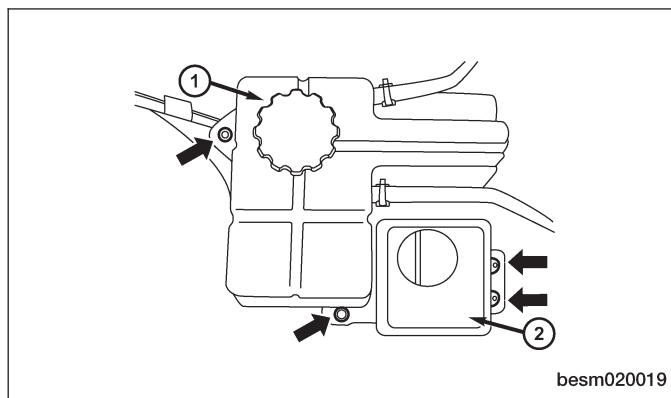
- CH-20001 - Right engine mount bolt remover
- CH-20003 - Crankshaft holder
- CH-20010 - Camshaft holder
- Engine hoist

1. Release the coolant system pressure.

WARNING!

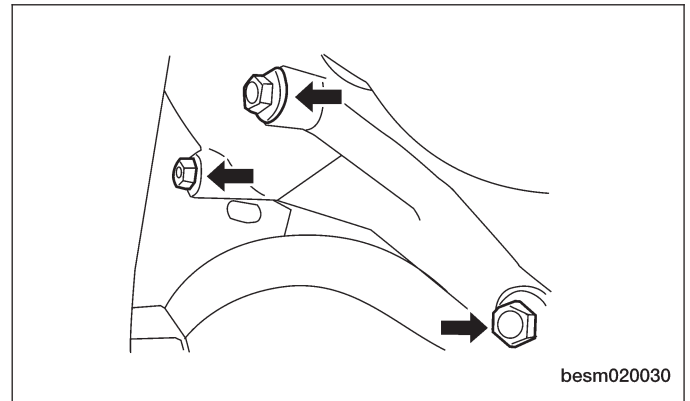
Never remove the pressure relief cap under any conditions while the engine is operating or hot. Failure to follow these instructions could result in personal injury or damage to the cooling system or engine. To avoid having scalding hot coolant or steam blow out of the cooling system, use extreme care when removing the pressure relief cap. Wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly one turn (counterclockwise). Step back while the pressure is released from the cooling system. When you are certain all the pressure has been released, (with a cloth) turn and remove the pressure relief cap. Failure to follow these instructions may result in serious personal injury.

2. Remove the coolant reservoir (1) and set aside.

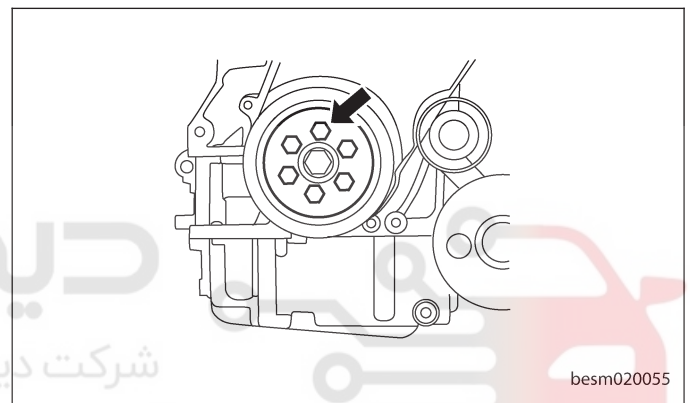


ON-VEHICLE SERVICE

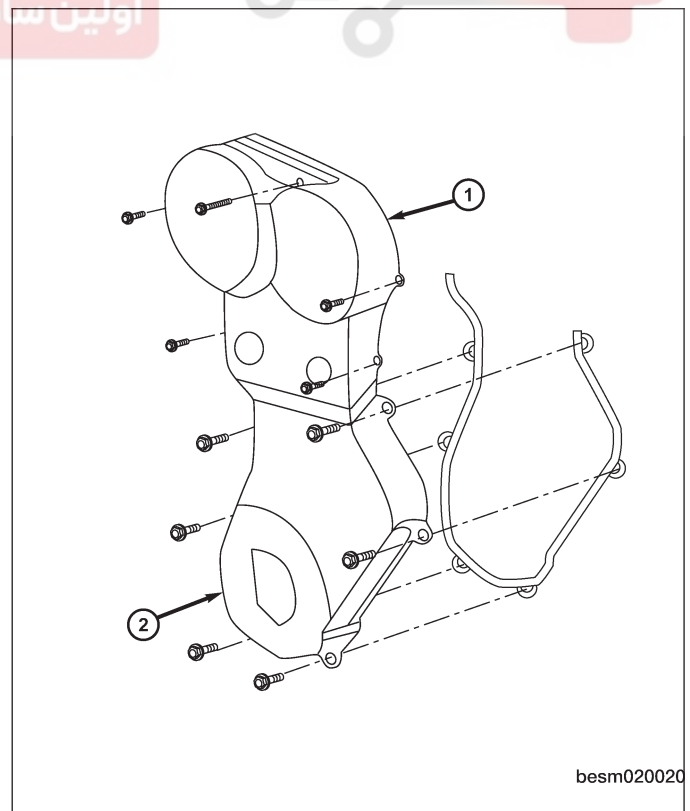
3. Attach an engine hoist and support the engine using an engine hoist.
4. Using special tool CH-20001, remove the engine right mount bolts and bracket.
(Tighten: Engine right mount bolts to 70 N·m)



5. Remove the accessory drive belt (See Accessory Drive Belt Removal & Installation in Section 02 Engine).
6. Remove the crankshaft vibration damper bolts.
(Tighten: Crankshaft vibration damper bolts to 25 N·m)



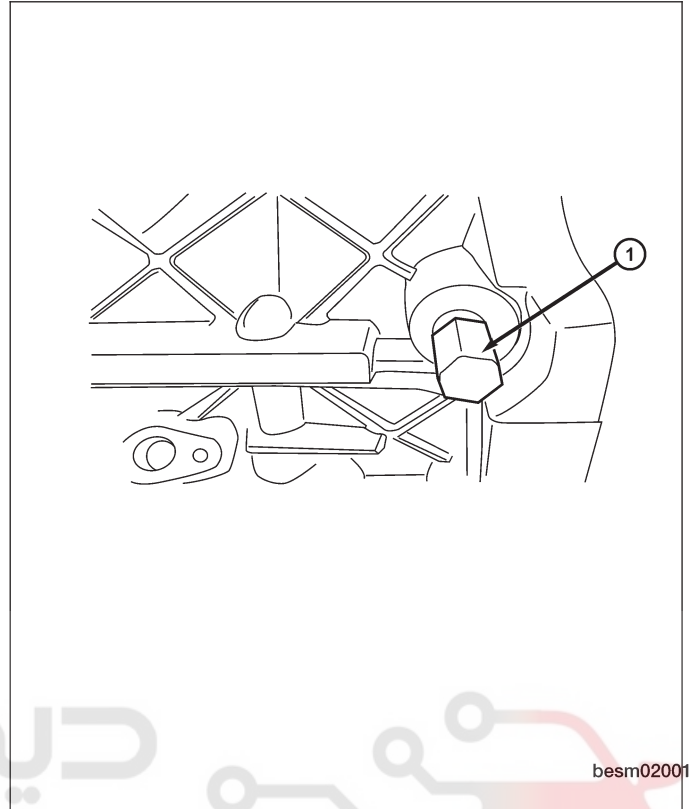
7. Remove the timing belt upper cover (1) and timing belt lower cover (2).
(Tighten: Timing belt upper cover bolts to 11 N·m)
(Tighten: Timing belt lower cover bolts to 11 N·m)



ON-VEHICLE SERVICE

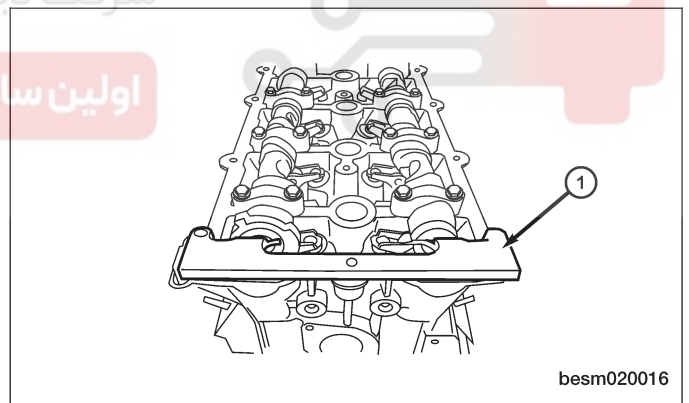
8. Remove the cylinder head cover (See Cylinder Head Cover Removal & Installation in Section 02 Engine).
9. Remove the plug in the cylinder block.
10. Using special tool CH-20003, install the crankshaft holding tool (1) into the cylinder block and rotate the crankshaft until the crankshaft tool completely holds the crankshaft in place.
(Tighten: Crankshaft holding tool to 28 N.m)

NOTE: The crankshaft holding tool will prevent the crankshaft from rotating in either direction.



11. Using special tool CH-20010 (1), install the camshaft holding tool to hold the camshafts in place.

NOTE: The camshaft holding tool will prevent the camshafts from rotating in either direction.



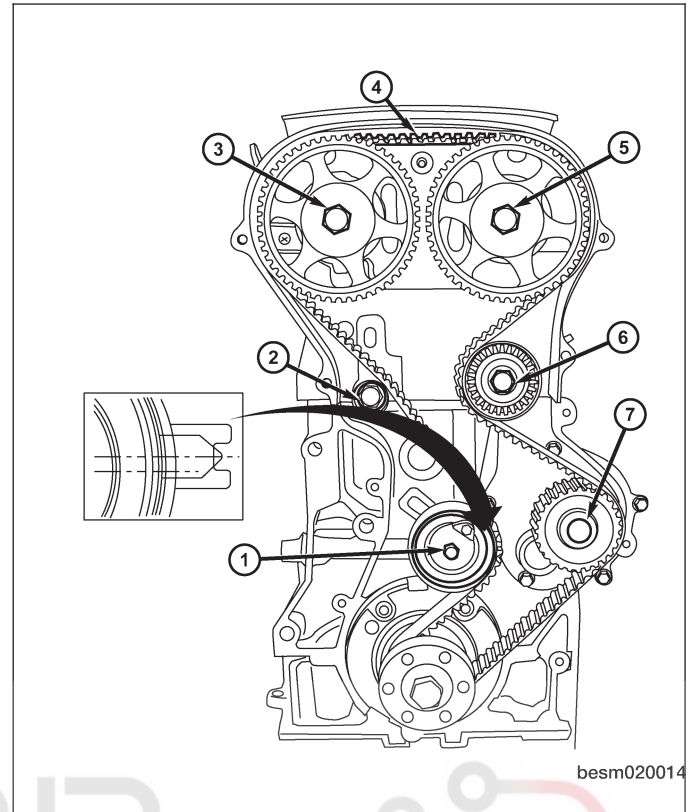
CAUTION: Rotating the camshafts or crankshaft with timing components loosened or removed can cause serious damage to the valves or pistons.

ON-VEHICLE SERVICE

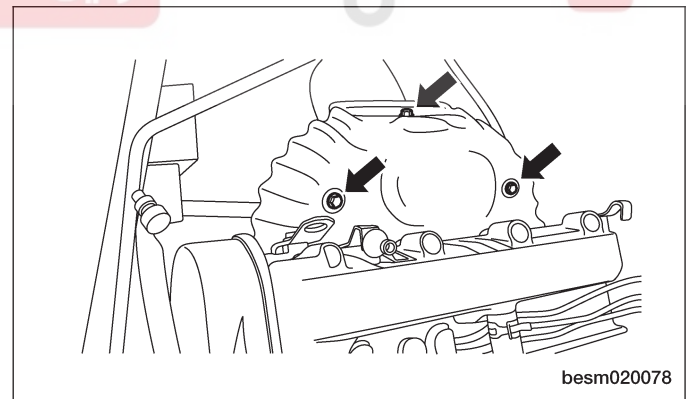
12. Loosen the bolt of the timing belt tensioner pulley (1), remove the pulley.
(Tighten: Timing belt tensioner pulley bolt to 30 N·m)
13. Remove the timing belt (4).
14. Installation is in the reverse order of removal.

Installation Notes:

- Install the timing belt and rotate tension pulley with an Allen wrench in order to tension the belt and align the finger pointer of the tensioner to the middle of the U-slot opening. Tighten the tension pulley (1) bolt to 30 N·m, then tighten the intake and exhaust camshaft pulley bolts (3, 5) to 120 N·m.

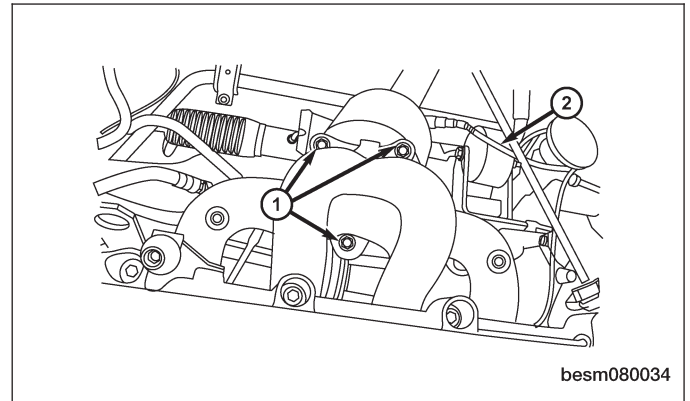
**Exhaust Manifold****Removal & Installation**

1. Remove the engine cover.
2. Remove the bolts attaching the exhaust manifold heat shield.
(Tighten: Exhaust manifold heat shield bolts to 15 N·m)
3. Remove the exhaust manifold heat shield.

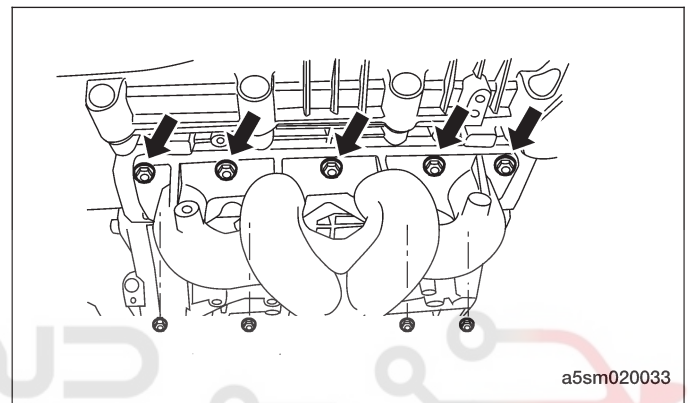


ON-VEHICLE SERVICE

4. Remove the three bolts securing the exhaust manifold to the catalytic converter assembly (1).
5. Disconnect the catalytic converter assembly from the manifold.



6. Remove the exhaust manifold nuts.
(Tighten: Exhaust manifold nuts to 25 N·m)



7. Remove and discard manifold gasket.
8. Installation is in the reverse order of removal.

Installation Notes:

- Clean all surfaces of manifold and cylinder head.

Idler Pulley**Removal & Installation**

1. While using a suitable tool and securely holding the hexagonal portion of the drive belt tensioner, rotate the pulley counterclockwise to loosen the drive belt.

WARNING!

Avoid placing hands near the drive belt tensioner while it is being held.

2. Remove the drive belt.

Upper Accessory Drive Belt Idler Pulley (3)

- Remove the bolt and the upper accessory drive belt idler pulley.

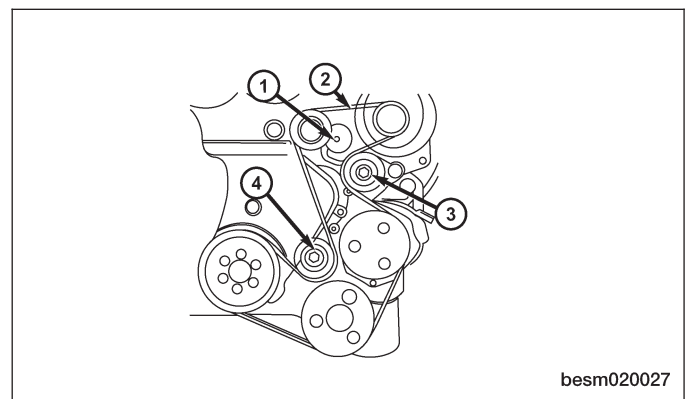
(Tighten: Upper idler pulley bolt to 45 N·m)

Lower Accessory Drive Belt Idler Pulley (4)

- Remove the bolt and the lower accessory drive belt idler pulley.

(Tighten: Lower idler pulley bolt to 45 N·m)

3. Installation is in the reverse order of removal.



ON-VEHICLE SERVICE

Intake Manifold

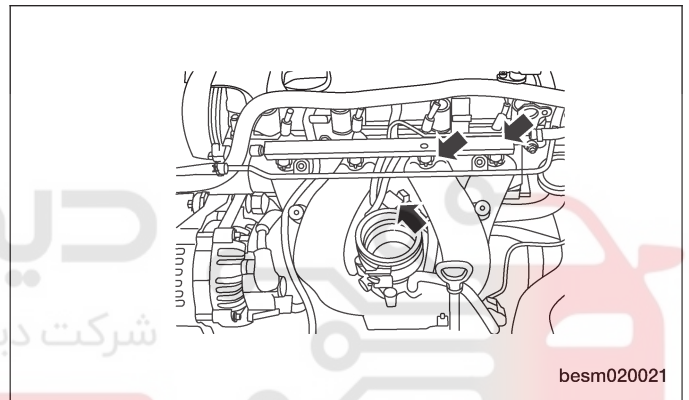
Removal & Installation

1. Disconnect the negative battery cable.
2. Remove the engine cover.
3. Drain the engine coolant.

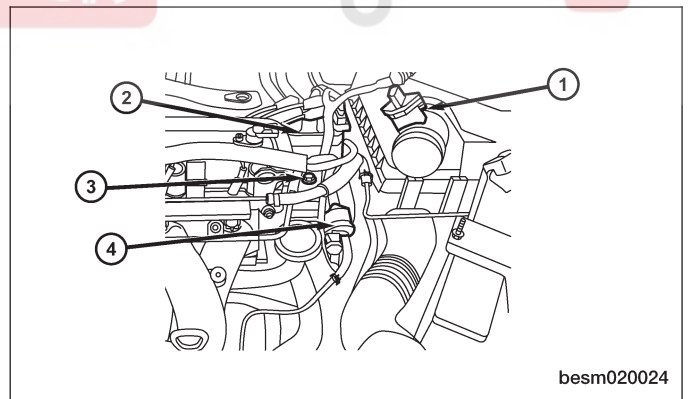
WARNING!

Never remove the pressure relief cap under any conditions while the engine is operating or hot. Failure to follow these instructions could result in personal injury or damage to the cooling system or engine. To avoid having scalding hot coolant or steam blow out of the cooling system, use extreme care when removing the pressure relief cap. Wait until the engine has cooled, then wrap a thick cloth around the pressure relief cap and turn it slowly one turn (counterclockwise). Step back while the pressure is released from the cooling system. When you are certain all the pressure has been released, (with a cloth) turn and remove the pressure relief cap. Failure to follow these instructions may result in serious personal injury.

4. Disconnect the four fuel injector electrical connectors.
5. Disconnect the throttle body control electrical connector (3).



6. Disconnect the air flow sensor electrical connector (1).



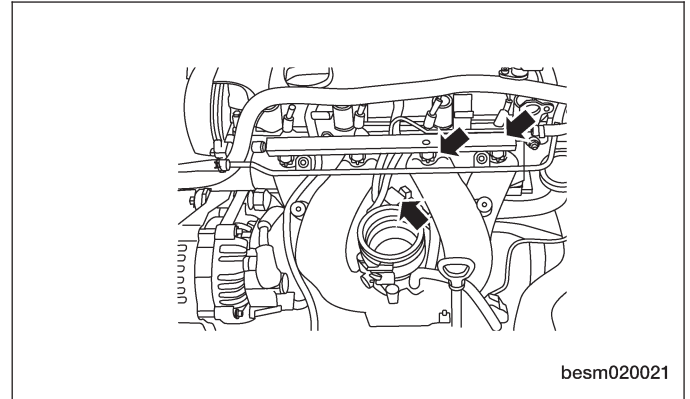
7. Loosen the clamp between the air intake hose and the air cleaner.
8. Loosen the clamp between the air intake hose and the throttle body and then remove the intake pipe.
9. Loosen the clamp on the PCV hose and then disconnect the PCV hose.

ON-VEHICLE SERVICE

10. Remove the fuel rail bracket bolts.
(Tighten: Fuel rail bracket bolts to 11 N·m)
11. Remove the fuel rail with the fuel injectors and set aside.
12. Remove the fuel injector O-rings.

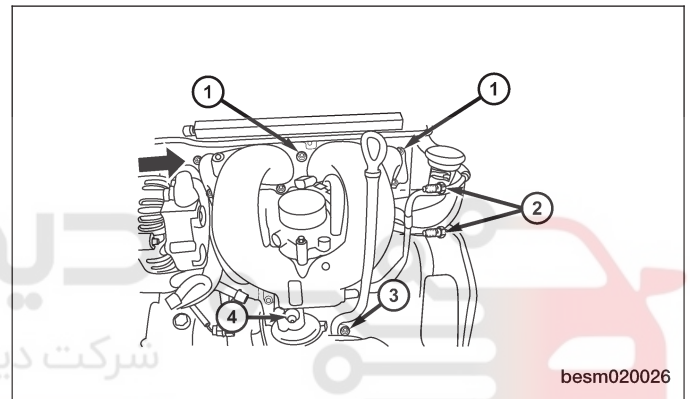
NOTE :

Install new O-rings on the fuel injectors.



02

13. Remove the screws securing the vacuum valve bracket to the intake manifold.
14. Set aside the vacuum valve and pipe.
15. Disconnect intake manifold electrical harness, and vacuum hose.
16. Remove the bolts (2, 3) securing the engine oil dipstick to intake manifold. Remove the dipstick.
(Tighten: Dipstick bracket bolts to 11 N·m)
17. Remove the nuts (1) securing the intake manifold to cylinder head.
(Tighten: Intake manifold nuts to 11 N·m)



NOTE: Discard gasket.

18. Installation is in the reverse order of removal.

Installation Notes:

- Clean all surfaces of manifold and cylinder head.
- Install new O-rings on the fuel injectors.

Oil Filter**Removal & Installation****NOTE :**

The following special tools are required to perform the repair procedure:

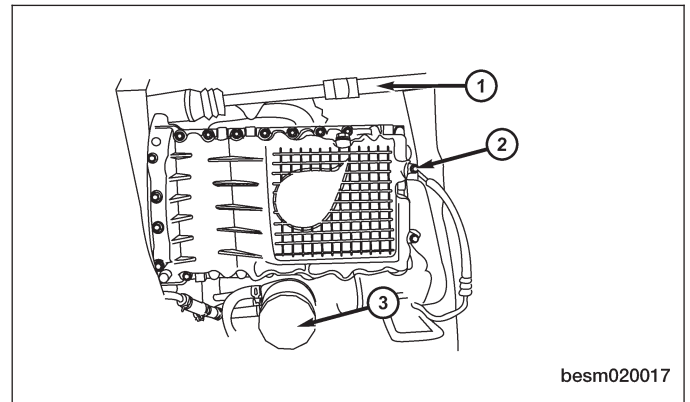
- CH-10003 - Oil filter remover

ON-VEHICLE SERVICE

CAUTION:

When servicing the oil filter, avoid deforming the filter by installing the special tool against the base of the filter.

1. Using special tool CH-10003, remove the oil filter (3).
(Tighten: Oil filter to 25 N·m)



2. Installation is in the reverse order of removal.

Installation Notes:

- Clean all surfaces, and verify the oil filter does not leak.

Oil Pan

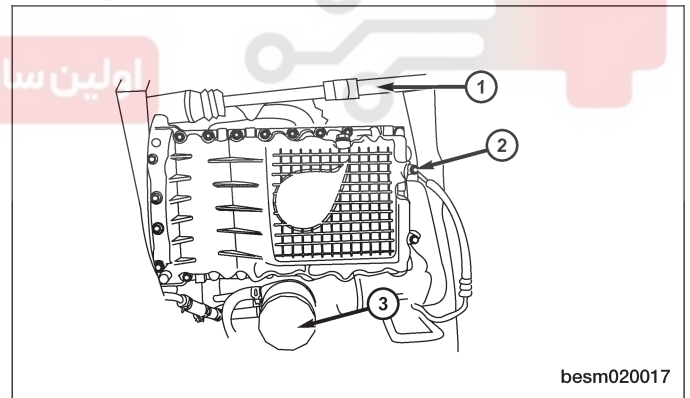
Removal & Installation

1. Remove the oil dipstick.
2. Raise the vehicle on hoist.
3. Remove the oil pan drain plug and drain the engine oil.
(Tighten: Oil pan drain plug to 40 N·m)

NOTE :

Do not pry on cylinder block to remove oil pan.

4. Remove oil pan bolts (2).
(Tighten: Oil pan bolts to 18 N·m)



5. Using a putty knife, loosen seal around oil pan.
6. Remove the oil pan.
7. Installation is in the reverse order of removal.

Installation Notes:

- Oil pan sealing surfaces must be free of grease or oil.

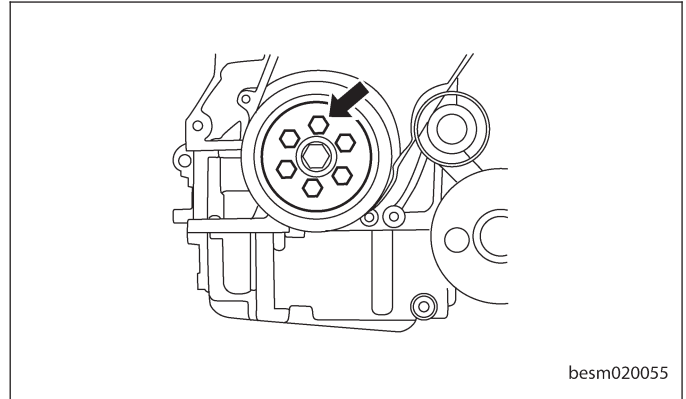
Oil Pump

Removal & Installation

1. Remove the accessory drive belt (See Accessory Drive Belt Removal & Installation in Section 02 Engine).

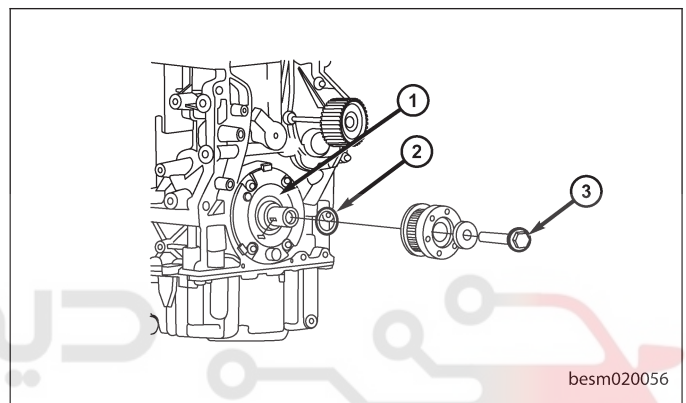
ON-VEHICLE SERVICE

2. Remove the crankshaft vibration damper retaining bolt.
(Tighten: Crankshaft vibration damper bolts to 25 N·m)

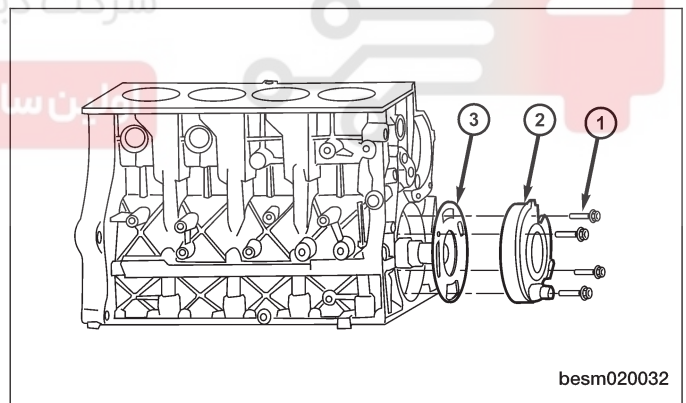


02

3. Remove the engine timing belt (See Engine Timing Belt Removal & Installation in Section 02 Engine).
4. Remove the crankshaft timing belt pulley bolt (3) from the crankshaft.
(Tighten: Crankshaft timing belt pulley bolt to 130 N·m + 65°)
5. Remove the key-way from the crankshaft.
6. Use an appropriate tool and remove the front crankshaft oil seal (2).
7. Remove the front crankshaft oil seal.
8. Remove the four oil pump bolts (1).
(Tighten: Oil pump bolts to 11 N·m)



9. Remove the oil pump (2) using a suitable tool.
10. Remove the oil pump gasket (3).



11. Installation is in the reverse order of removal.

Installation Notes:

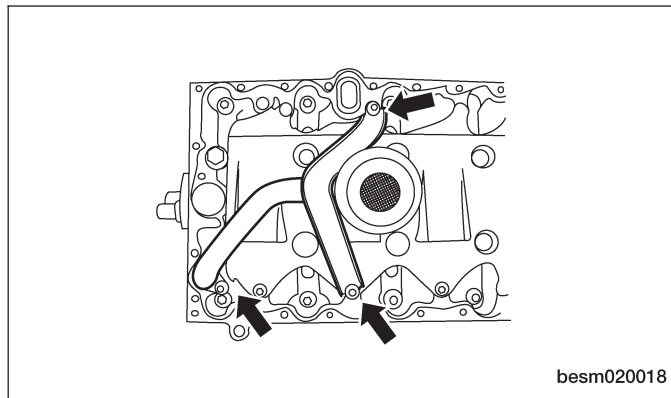
- Before installing, prime the new oil pump. Fill the oil pump with engine oil and rotate the oil pump.

Oil Strainer**Removal & Installation**

1. Raise the vehicle on hoist.
2. Remove the oil pan (See Oil Pan Removal & Installation in Section 02 Engine).

ON-VEHICLE SERVICE

3. Remove the oil strainer retaining bolts.
(Tighten: Oil strainer bolts to 18 N·m)



4. Carefully remove the oil strainer.
5. Installation is in the reverse order of removal.

Installation Notes:

- Install new O-rings on the oil strainer pipe.

دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



ENGINE UNIT REPAIR

Engine Block

Specifications

Torque Specifications

DESCRIPTION	TORQUE (N·m)
Connecting Rod Cap Bolts	1st Step: Tighten the bolt to 25 N·m 2nd Step: Tighten the bolt an additional 90°
Main Bearing Cap Bolts	1st Step: Tighten the bolt to 45 N·m 2nd Step: Tighten the bolt an additional 180°
Lower Cylinder Block Bolts	23 N·m

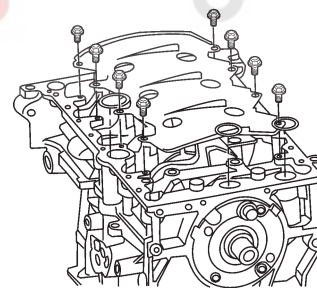
02

Clearance Specifications

DESCRIPTION	SPECIFICATION
Surface Distortion Limit	0.15 mm
Inner Diameter Standard	81 mm
Out-Of-Round	Less than 0.008 mm
Taper	Less than 0.01 mm

Disassemble

1. Remove the oil pan and then remove oil baffle.
2. Remove the oil strainer.



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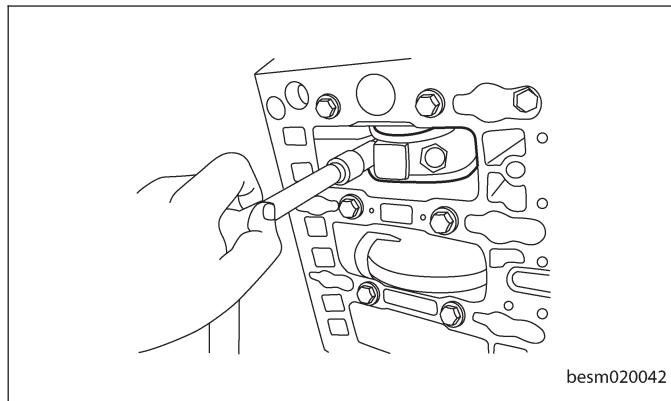
3. For each connecting rod / piston assembly to be removed, rotate the crankshaft to the bottom dead center position for each cylinder.

NOTE :

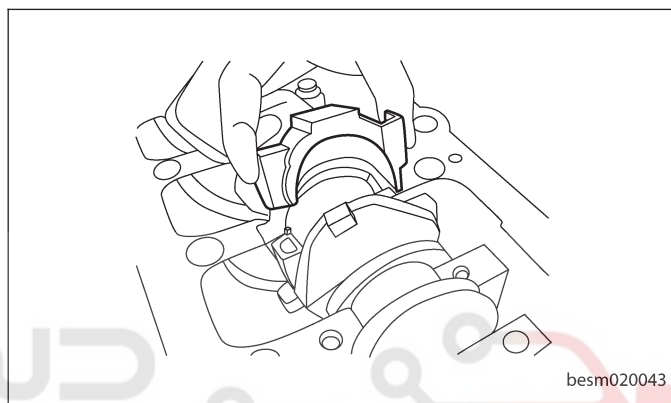
Before removing the connecting rod / piston assembly, check the connecting rod side clearance.

ENGINE UNIT REPAIR

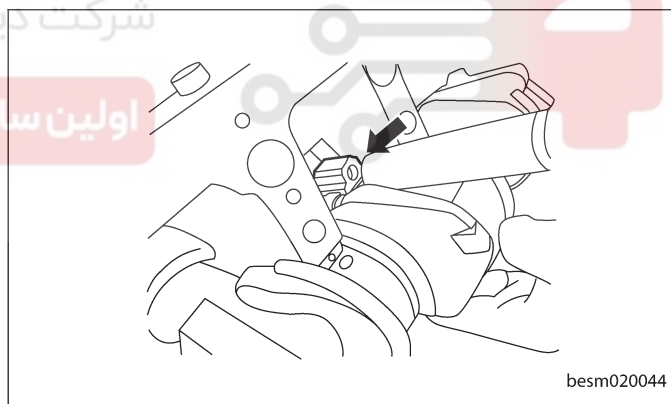
4. Remove the connecting rod retaining bolts.



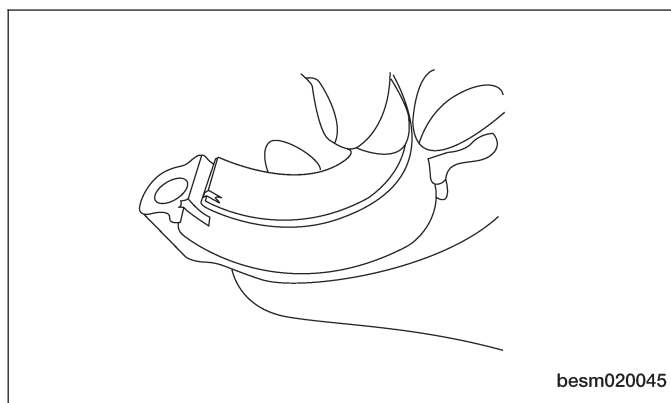
5. Remove the connecting rod bearing cap.



6. Using a hammer handle or similar tool, push the connecting rod / piston assembly out through the top of the cylinder block.



7. Remove the connecting rod bearings (See Connecting Rod Removal & Installation in Section 02 Engine).



CAUTION:When removing the connecting rod side bearings, note the installation position. Keep them in the correct order.

ENGINE UNIT REPAIR

8. Installation is in the reverse order of removal.

Inspection

NOTE :

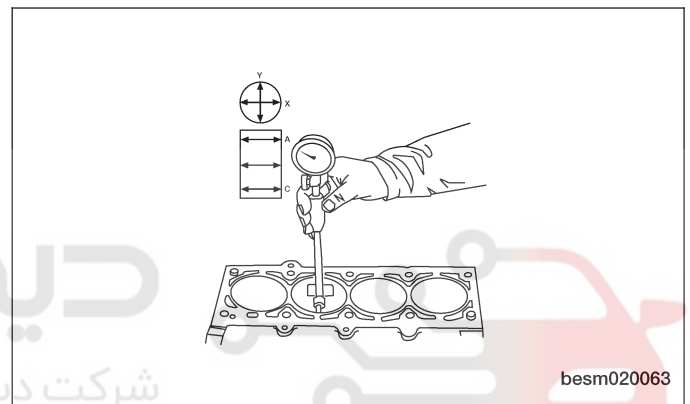
All measurements should be taken with the engine block at room temperature, 21°C.

Engine Block

- Clean cylinder block thoroughly and check all core hole plugs for evidence of leaking.
- Examine block and cylinder bores for cracks or fractures.
- Check block deck surfaces for flatness. Deck surface must be within service limit of 0.050 mm.

Cylinder Bore

- The cylinder walls should be checked for out-of-round and taper with cylinder indicator or equivalent. If the cylinder walls are badly scuffed or scored, the cylinder block should be replaced, and new pistons and rings fitted.
- Measure the cylinder bore at three levels in directions X and Y. Top measurement should be 10 mm down and bottom measurement should be 10 mm up from bottom of bore.



CYLINDER BORE	
All Cylinders	83.500-83.510 mm

Assemble

NOTE :

Cleanliness is extremely important during the engine assembly procedure. Any foreign material, including any material created while cleaning gasket surfaces, that enters the oil passages, coolant passages or the oil pan can cause engine failure.

NOTE :

Assemble all components in their original position.

1. Install the pistons to the connecting rods.
2. Using a piston ring expander, install the piston rings.
3. Assemble all components in the reverse order of disassembly.

ENGINE UNIT REPAIR

Pistons

Specifications

Clearance Specifications - Pistons

DESCRIPTION	SPECIFICATION
Surface Distortion Limit	0.15 mm
Inner Diameter Standard	81 mm
Out-Of-Round	Less than 0.008 mm
Taper	Less than 0.01 mm

Clearance Specifications - Piston Ring Groove

DESCRIPTION	SPECIFICATION
First Ring	0.04-0.08 mm
Second Ring	0.0251-0.01 mm

Clearance Specifications - Piston Ring End Gap

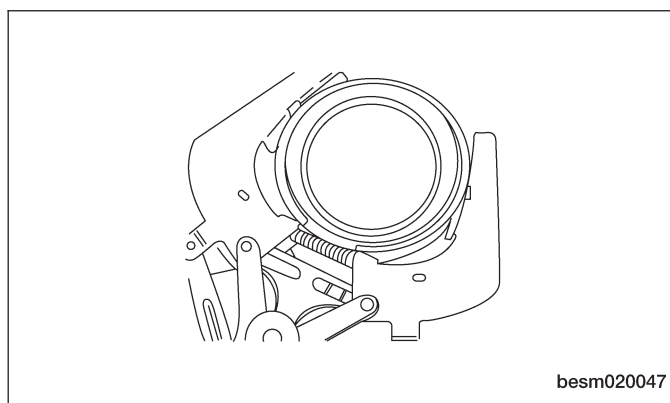
DESCRIPTION	SPECIFICATION	LIMIT
First Ring End Gap	0.2-0.4 mm	0.8 mm
Second Ring End Gap	0.4-0.6 mm	1.0 mm

Clearance Specifications - Piston to Piston Pin

DESCRIPTION	SPECIFICATION
Piston To Piston Pin	0.002-0.013 mm

Disassemble

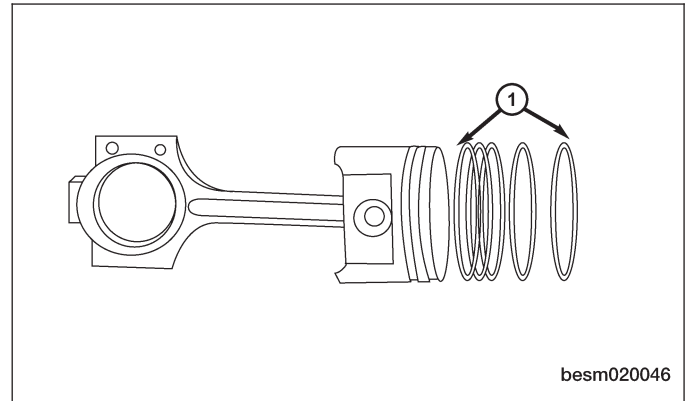
- Piston Ring Removal
 - Using a suitable ring expander, remove upper and intermediate piston rings.
 - Remove the upper oil ring side rail, lower oil ring side rail and then oil ring expander from piston.
 - Clean ring grooves of any carbon deposits.



ENGINE UNIT REPAIR

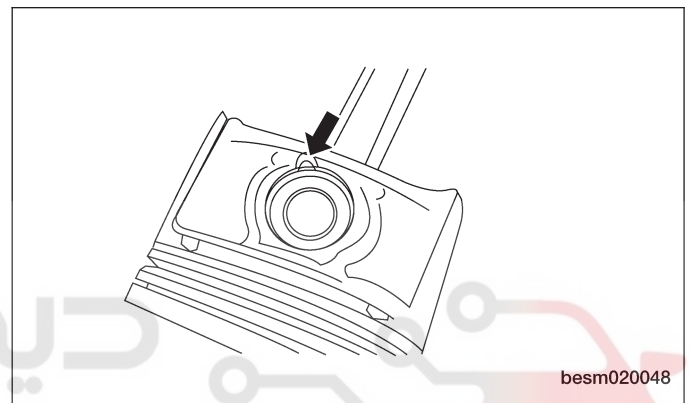
CAUTION:

Before removing the piston rings (1), check the piston ring side clearance. Be careful to mark the location of the piston rings if they are to be reused.

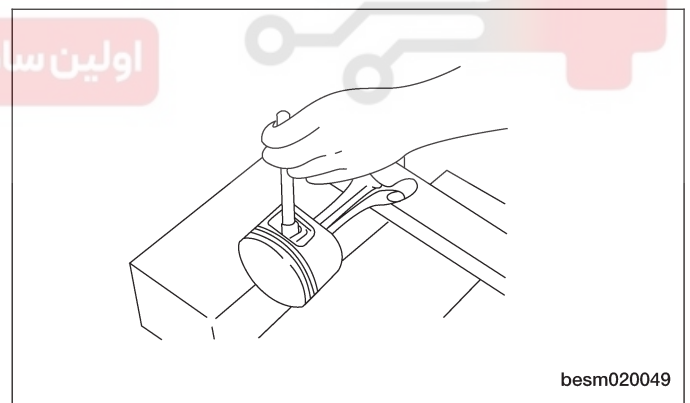


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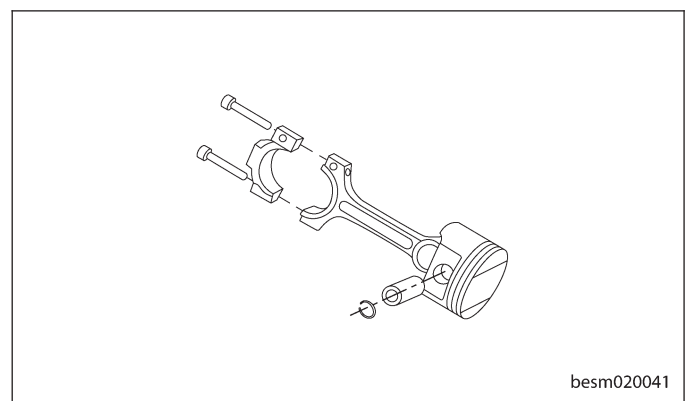
- Piston Pin Snap Ring Removal
 - Using snap ring pliers, remove the snap ring.
 - Heat the pistons as necessary.



- Piston Pin Removal (مسئله) شرکت دیجیتال خودرو
- Push out the piston pin with a suitable tool.



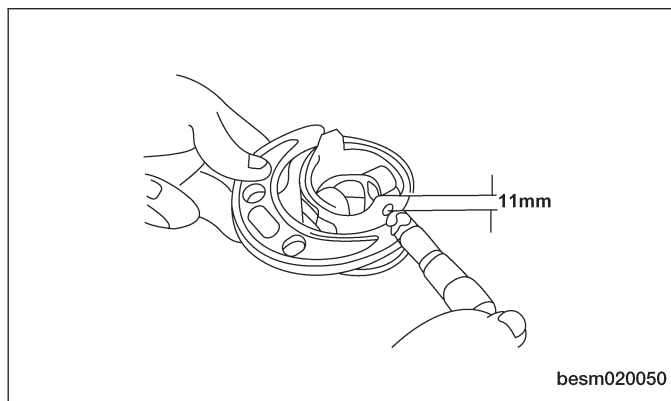
- Connecting Rod & Piston Disassembly
 - Remove the piston from the connecting rod.



ENGINE UNIT REPAIR

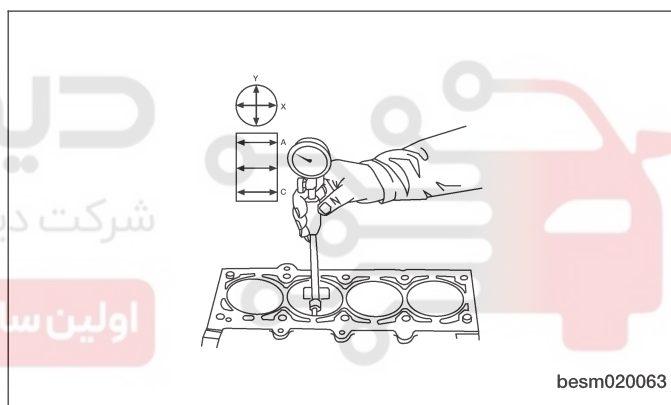
Inspection

- Check the piston diameter.



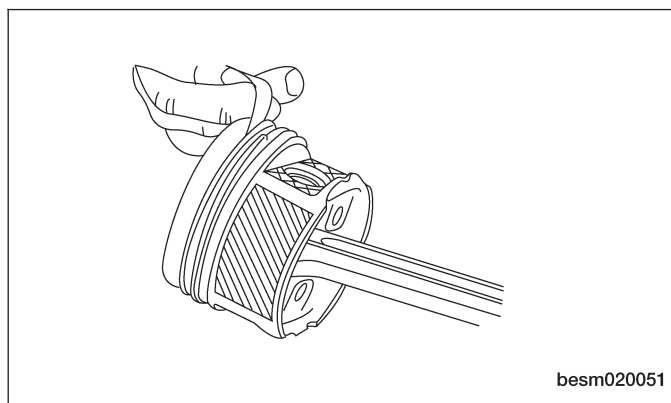
PISTON DIAMETER	
All Pistons	83.451-83.469 mm

- Check the inner diameter of each cylinder bore (See Cylinder Bore Inspection in Section 02 Engine).



CYLINDER BORE	
All Cylinders	83.500-83.510 mm

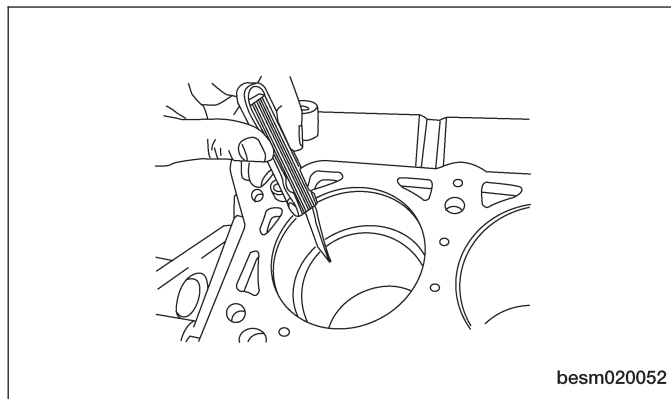
- Check piston ring to groove side clearance.
 - Clean the ring slot using a suitable tool.
 - Measure piston ring to groove side clearance.



RING GROOVE CLEARANCE	
First Ring	0.04-0.08 mm
Second Ring	0.0251-0.01 mm

ENGINE UNIT REPAIR

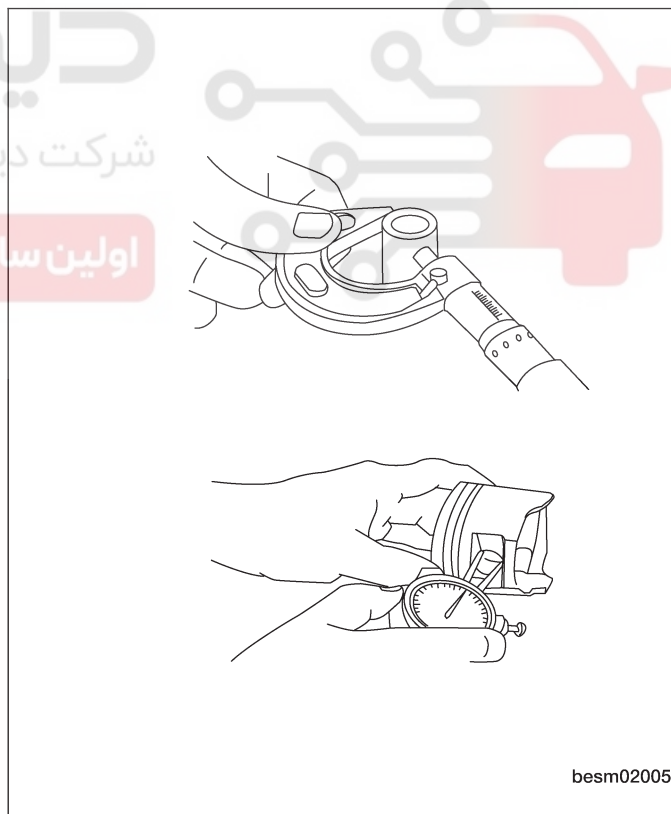
- Wipe the cylinder bore clean. Insert ring and push down with piston to ensure it is square in the bore. The ring gap measurement must be made with the ring positioned at least 13 mm from bottom of cylinder bore and below the bottom of the oil ring travel where the cylinder bore has minimal wear. Check gap with feeler gauge.



02

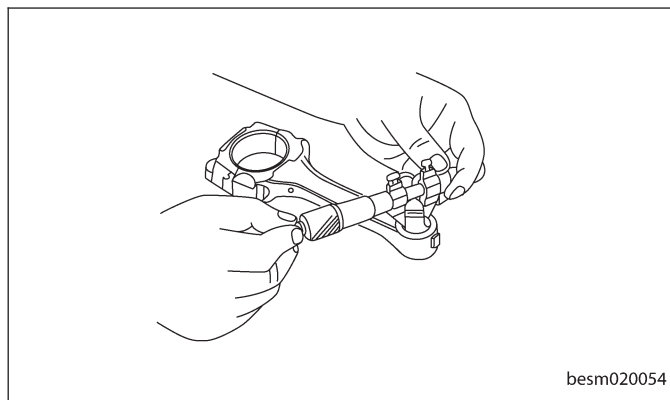
RING END GAP CLEARANCE		
First Ring	0.2-0.4 mm	0.8 mm
Second Ring	0.4-0.6 mm	1.0 mm

- Check the diameter of the piston pin bore.
- Check the outer diameter of the piston pin.



- Check the inner diameter of connecting rod (small end).

ENGINE UNIT REPAIR



PISTON PIN CLEARANCE	
Piston and Piston Pin	0.002-0.013 mm

Assemble

1. Install the piston to the connecting rod. Assemble the components in their original positions.
2. Using a piston ring expander, install the piston rings. Assemble the components in their original positions.
3. Assemble all components in the reverse order of disassembly.

Connecting Rods

Specifications

Torque Specifications

DESCRIPTION	TORQUE (N·m)
Connecting Rod Bolts	1st Step: Tighten bolts to 25 N·m 2nd Step: Tighten the connecting rod bolts an additional 90°

Clearance Specifications

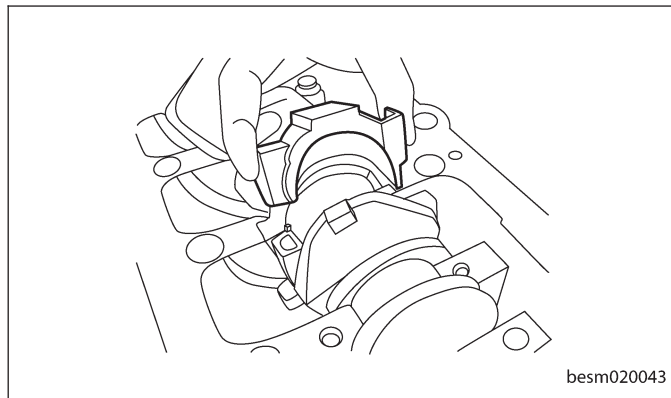
DESCRIPTION	SPECIFICATION
Connecting Rod Radial Clearance	0.016-0.051 mm
Connecting Rod Axial Clearance	0.002-0.013 mm

Disassemble

1. Remove the connecting rod cap bolts.

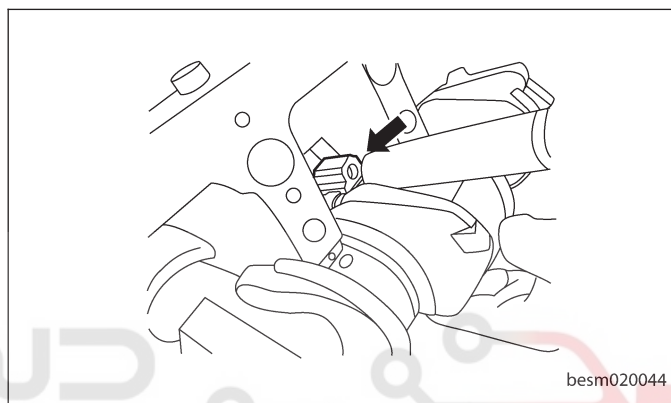
ENGINE UNIT REPAIR

2. Remove the connecting rod bearing cap.



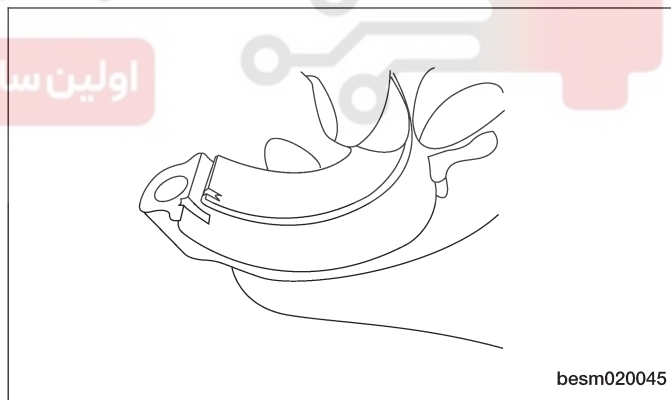
02

3. Using a hammer handle or similar tool, push the piston and connecting rod assembly out through the cylinder head side of the engine block.



NOTE: Before removing the piston and connecting rod assembly, check the connecting rod side clearance.

4. Remove the connecting rod bearings.



CAUTION: When removing the connecting rod side bearings, note the installation position. Keep them in the correct order.

Inspection

- Check the radial clearance of connecting rod bearing.

CONNECTING ROD RADIAL CLEARANCE	
Radial Clearance	0.016-0.051 mm

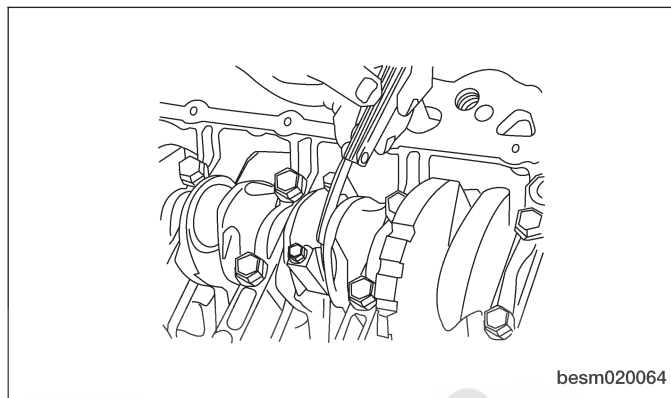
ENGINE UNIT REPAIR

Assemble

NOTE :

The rod bolts should not be reused.

1. Before installing the NEW rod bolts, the threads and under the bolt head should be oiled with clean engine oil.
2. Install each bolt finger tight, then alternately tighten each bolt to assemble the cap properly.
3. Tighten the connecting rod bolts using the two step torque-turn method:
 - 1st Step: Tighten bolts to 25 N·m
 - 2nd Step: Tighten the connecting rod bolts an additional 90°
4. Using a feeler gauge check connecting rod side clearance.
- Check axial clearance of connecting rod.



Crankshaft

Specifications

Torque Specifications

DESCRIPTION	TORQUE (N·m)
Main Bearing Cap Bolts	1st Step: Tighten the bolt to 45 N·m 2nd Step: Tighten the bolt an additional 180°
Lower Cylinder Block Bolts	23 N·m

Clearance Specifications

DESCRIPTION	SPECIFICATION
Diameter of Crankshaft Main Journals	53.981-54 mm
Diameter of Crankshaft Rod Journals	47.884-47.9 mm
Out-of-Round Maximum of Crankshaft Main Journals	0.008 mm
Axial Clearance of Crankshaft	0.07-0.265 mm
Radial Clearance of Crankshaft	0.0035-0.034 mm
Coaxality of Crankshaft Main Journals	0.05 mm
Thrust Washer Thickness	2.4-2.405 mm

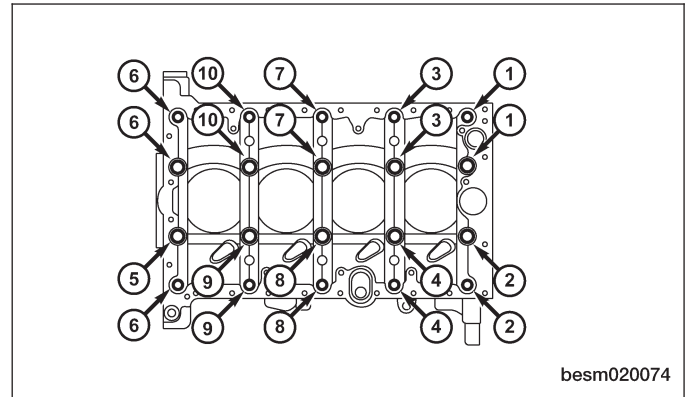
Disassemble

1. Remove the front crankshaft oil seal (See Front Crankshaft Oil Seal Removal & Installation in Section 02 Engine).
2. Remove the rear crankshaft oil seal (See Rear Crankshaft Oil Seal Removal & Installation in Section 02 Engine).

ENGINE UNIT REPAIR

3. Remove the pistons with connecting rod assemblies.
4. Remove the lower cylinder block bolts in the sequence shown.

NOTE: Before loosening the lower cylinder block bolts, measure the crankshaft side clearance.



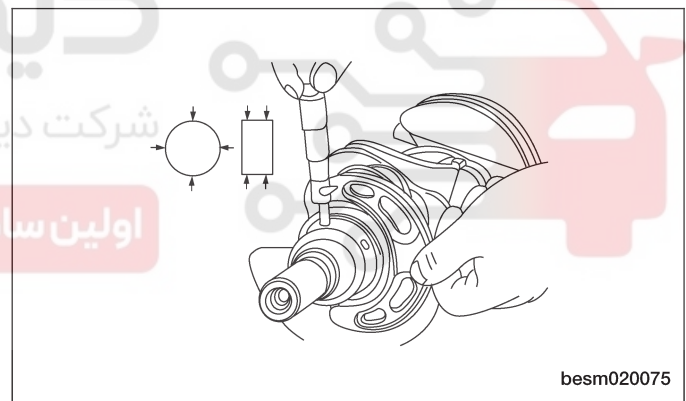
02

5. Remove the lower cylinder block.
6. Remove the crankshaft.
7. Remove the main bearings and thrust bearings from the cylinder block and lower cylinder block.

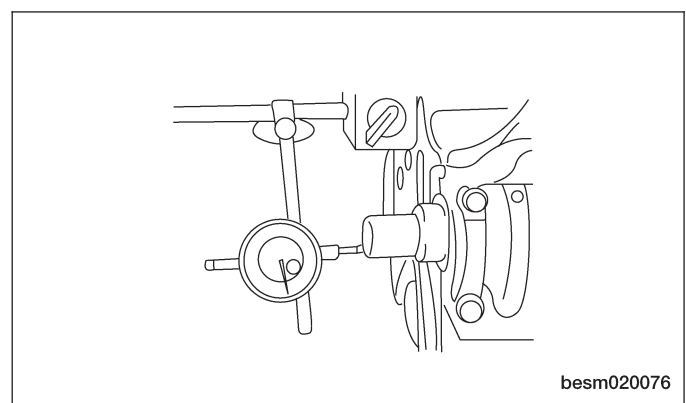
NOTE: If reusing the bearings, identify and number the bearings so that they are assembled in the same position and direction.

Inspection

- The crankshaft main journals should be checked for excessive wear, roundness and scoring. Limits of roundness on any crankshaft main journals should be held to 0.008 mm. Limits of roundness on any crankshaft rod journals should be held to 0.005 mm. DO NOT nick crank pin or bearing fillets. Limits of out of round on any crankshaft journals should be held to 0.005 mm.



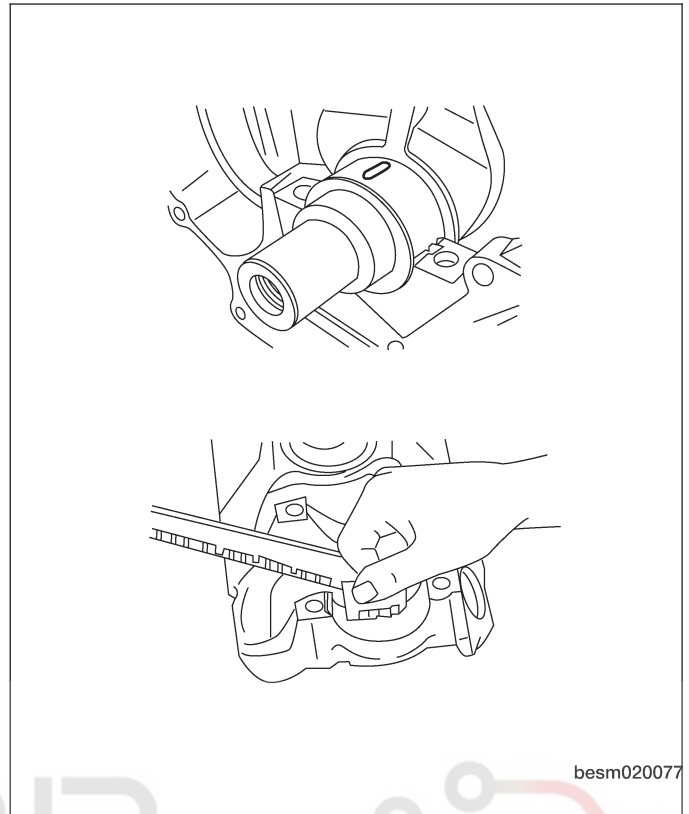
- Check the axial clearance after installation. Standard of axial clearance should be 0.07 mm. Limits of axial clearance should be held to 0.265 mm.



ENGINE UNIT REPAIR

- Oil Clearance of crankshaft main journal
 - Clean the journal and bearing.
 - Install the crankshaft.
 - Cut the plastic-gauge to the same width as the bearing, and then put it onto the crankshaft journal to make it parallel with the central line of the crankshaft.
 - Install the main bearing cap carefully, and tighten the bolts to the specified torque.
 - Remove the main bearing cap.
 - Measure the oil clearance with the plastic-gauge.

Standard oil clearance of crankshaft main journal should be 0.022 mm. Limits of oil clearance of crankshaft main journal should be 0.058 mm.

**Assemble**

1. Install the main bearings and thrust bearings to the upper cylinder block and lower cylinder block.

NOTE: Identify and number the bearings, if reusing them, so that they are assembled in the same position and direction.

2. Assemble the crankshaft and main bearings in the reverse order of disassembly.

CYLINDER HEAD UNIT REPAIR

Cylinder Head

Specifications

Torque Specifications

DESCRIPTION	TORQUE (N·m)
Cylinder Head Bolts	85 N·m
Cylinder Head Cover Bolts	11 N·m

02

Clearance Specifications

DESCRIPTION	SPECIFICATION
Cylinder Head Flatness	0.04 mm
Intake Valve Deflection	0.02 mm
Exhaust Valve Deflection	0.04 mm
Spring Height	47.7 mm

Disassemble

NOTE :

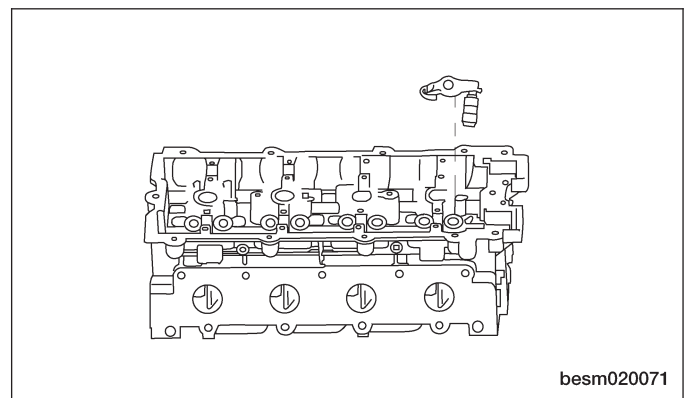
The following special tools are required to perform the repair procedure:

- CH-20011 - Valve seal installer
- CH-20012 - Valve stem seal installer guide
- CH-20013 - Valve seal remover
- CH-20017 - Valve keeper installer
- CH-20018 - Valve spring compressor

NOTE :

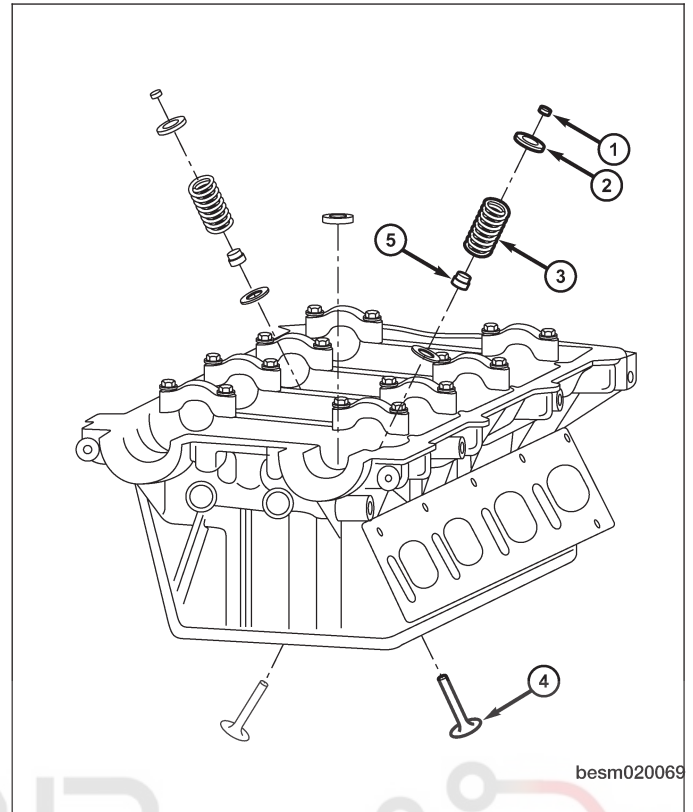
Replacement cylinder head comes complete with valves, seals, springs, retainers, keepers, tappets, and camshafts.

1. Remove camshafts.
2. Remove the hydraulic tappet assembly.

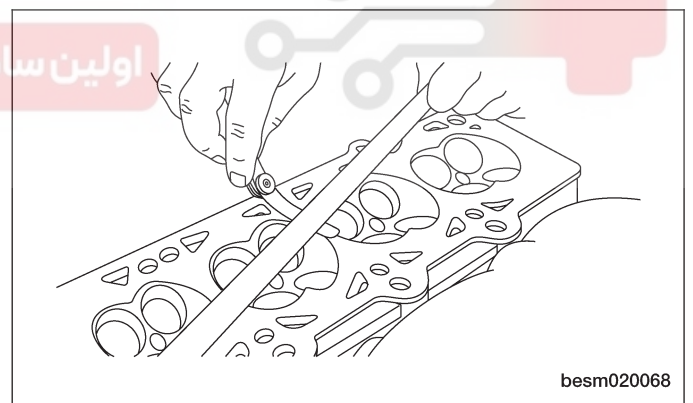


CYLINDER HEAD UNIT REPAIR

3. Using the special tool, compress the valve spring.
4. Remove the valve keeper (1), valve spring retainer (2) and valve spring (3).
5. Push the valve stem from the cylinder head and remove the valve (4).
6. Remove the valve oil seal (5) using special tool.
7. Remove the valve guide if necessary.
8. Remove the spark plugs.

**Inspection**

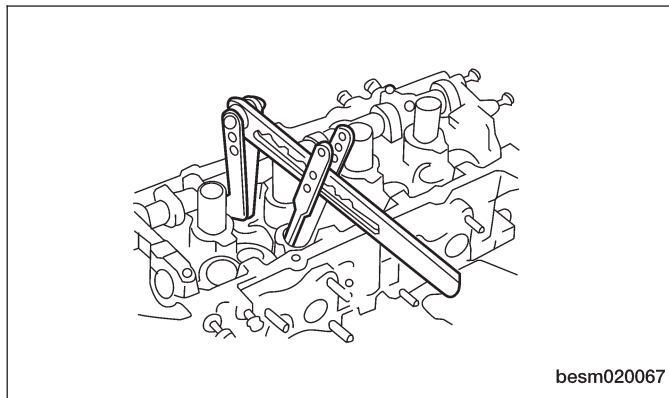
- Cylinder head must be flat within 0.04 mm.
- Inspect camshaft bearing journals for scoring.
- Remove carbon and varnish deposits from inside of valve guides with a valve guide cleaner.
- Verify the valve tappets move freely in their bores, and that they have been rotating.
- Check the valve guide height.

**Assemble**

1. Install new valve guide if necessary.
2. Install new valve seat if necessary.
3. Install the new valve oil seal using special tool.
4. Install the valves into the cylinder head (larger diameter on intake side).
5. Install the valve springs.
6. Install the valve spring retainers.

CYLINDER HEAD UNIT REPAIR

7. Compress the valve springs with valve spring compressor.
8. Install the valve keepers.



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9. Tap the valve stem lightly with a plastic hammer after installation to verify proper assembly.
10. Install valve tappets in the head.
11. Install the camshafts.

Camshaft

Specifications

Camshaft Specifications

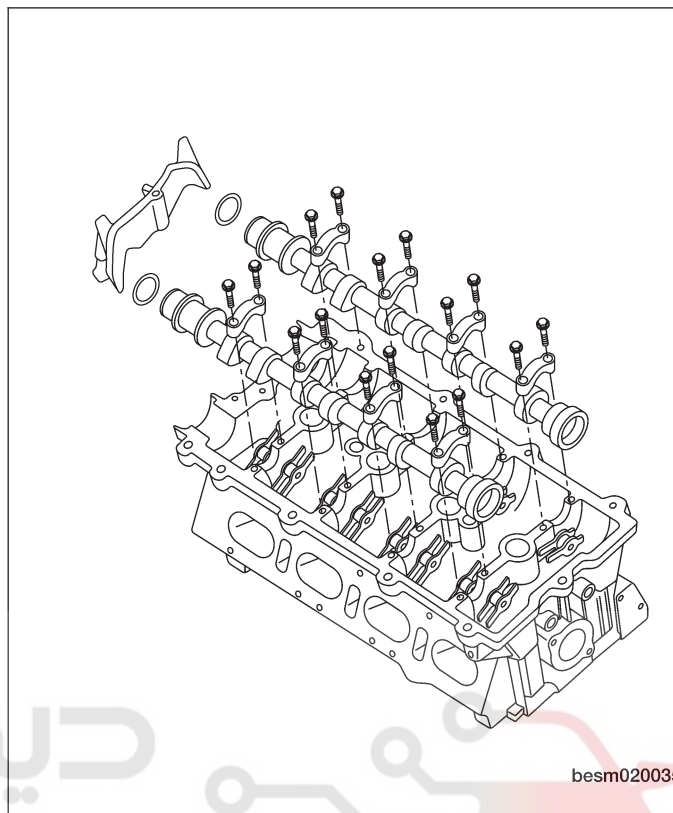
DESCRIPTION	SPECIFICATION
Intake Cam Lobe Height	37.15 mm
Exhaust Cam Lobe Height	37.05 mm
Journal #1 Outer Diameter	31.934-31.95 mm
Journal #2, #3, #4, #5, Outer Diameter	23.947-23.96 mm
Cam Bearing #1 Inner Diameter	32-32.025 mm
Cam Bearing #2, #3, #4, #5, Inner Diameter	24-24.021 mm
Journal #1 Clearance	0.05-0.091 mm
Journal #2, #3, #4, #5 Clearance	0.04-0.074 mm
Intake Camshaft Axial Clearance	0.15-0.20 mm
Exhaust Camshaft Axial Clearance	0.15-0.20 mm

CYLINDER HEAD UNIT REPAIR

Disassemble

1. Remove the camshaft bearing caps bolts.

NOTE: Equally loosen camshaft bearing cap bolts in several steps.



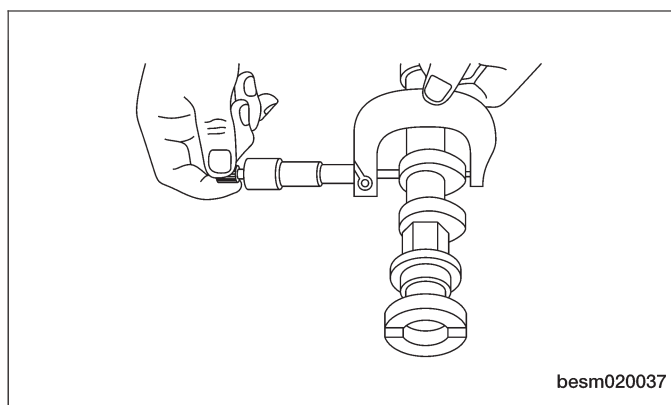
2. Remove the camshaft bearing caps and place them in proper order.

NOTE: The camshaft bearing caps are marked for identification.

3. Remove the camshafts and then remove the camshaft seals.

Inspection

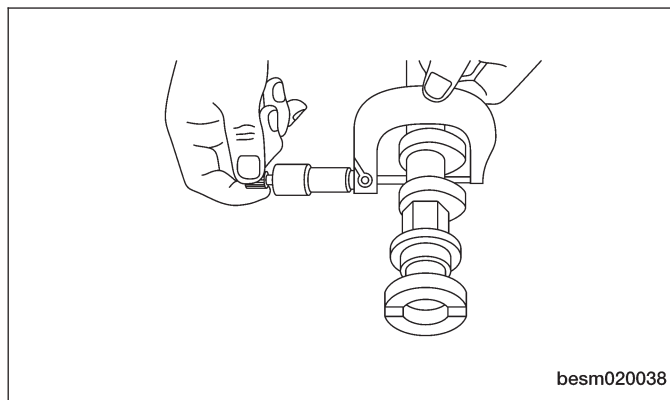
- Measure the camshaft cam lobe height.
- If wear is beyond the limit, replace the camshaft.



CAMSHAFT CAM LOBE HEIGHT	
Intake Cam Lobe Height	37.15 mm
Exhaust Cam Lobe Height	37.05 mm

CYLINDER HEAD UNIT REPAIR

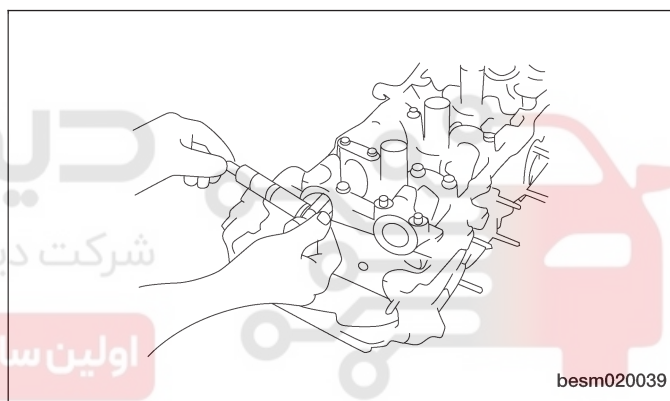
- Measure the outer diameter of the camshaft journal.



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OUTER DIAMETER OF CAMSHAFT JOURNAL	
Journal #1 Outer Diameter	31.934-31.95 mm
Journal #2, #3, #4, #5, Outer Diameter	23.947-23.96 mm

- Measure the inner diameter of the camshaft bearing.



INNER DIAMETER OF CAMSHAFT BEARING	
Cam Bearing #1 Inner Diameter	32-32.025 mm
Cam Bearing #2, #3, #4, #5, Inner Diameter	24-24.021 mm

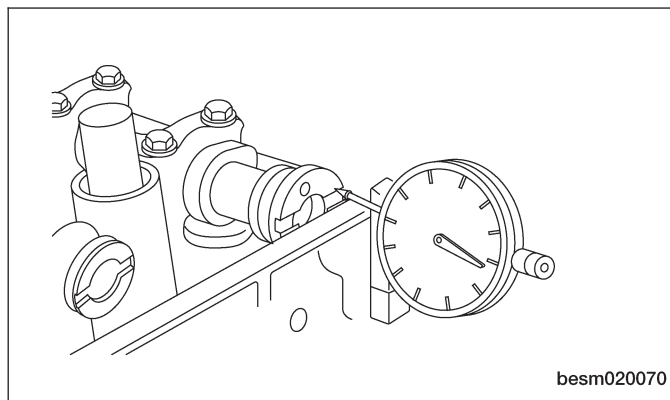
- Calculation of camshaft journal clearance

Journal clearance = (inner diameter of camshaft bearing) - (outer diameter of camshaft journal)

CAMSHAFT JOURNAL CLEARANCE	
Journal #1 Clearance	0.05-0.091 mm
Journal #2, #3, #4, #5 Clearance	0.04-0.074 mm

CYLINDER HEAD UNIT REPAIR

- Measure the axial clearance of camshaft.



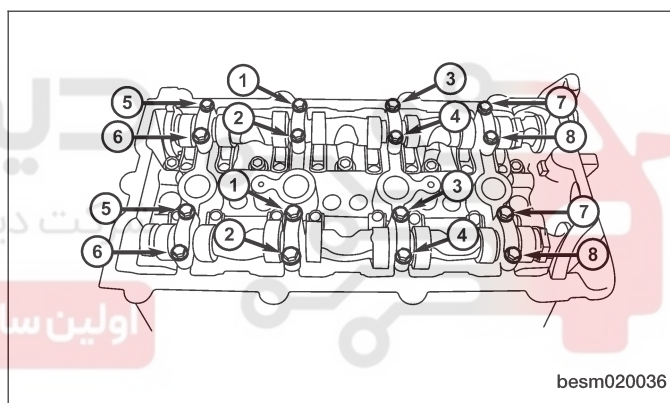
CAMSHAFT AXIAL CLEARANCE	
Intake Camshaft	0.15-0.20 mm
Exhaust Camshaft	0.15-0.20 mm

Assemble

1. Installation is in the reverse order of removal.

Installation Notes:

- Install the intake and exhaust camshaft bearing caps in the proper order
- Slowly tighten bolts to the specified torque
- Follow the torque sequence shown



Valve & Valve Guides

Specifications

Valve & Valve Guide Specifications

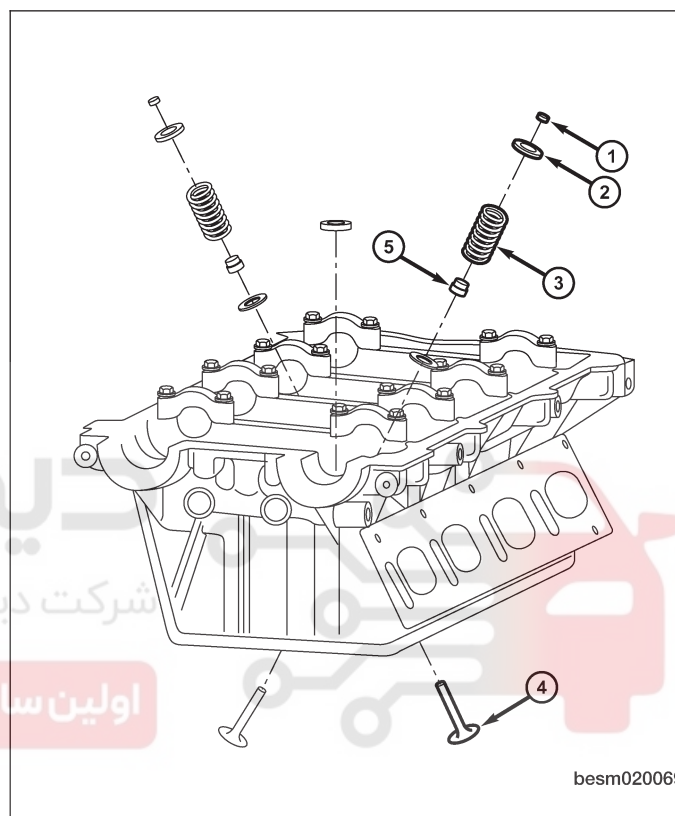
DESCRIPTION	SPECIFICATION
Intake Valve Deflection	0.02 mm
Exhaust Valve Deflection	0.04 mm
Intake Valve Guide Clearance	0.012-0.043 mm
Exhaust Valve Guide Clearance	0.032-0.063 mm

CYLINDER HEAD UNIT REPAIR**Disassemble****NOTE :**

The following special tools are required to perform the repair procedure:

- CH-20011 - Valve seal installer
- CH-20012 - Valve stem seal installer guide
- CH-20013 - Valve seal remover
- CH-20017 - Valve keeper installer
- CH-20018 - Valve spring compressor

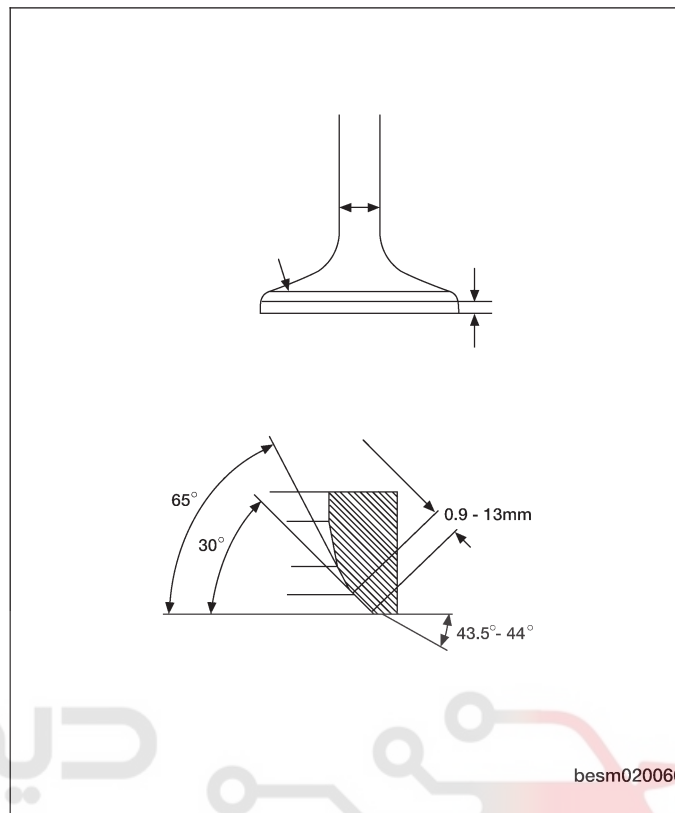
1. Using the special tool, compress the valve springs.
2. Remove the valve keeper (1), valve spring retainer (2) and valve spring (3).
3. Remove valves (4) from the cylinder head.



CYLINDER HEAD UNIT REPAIR

Inspection

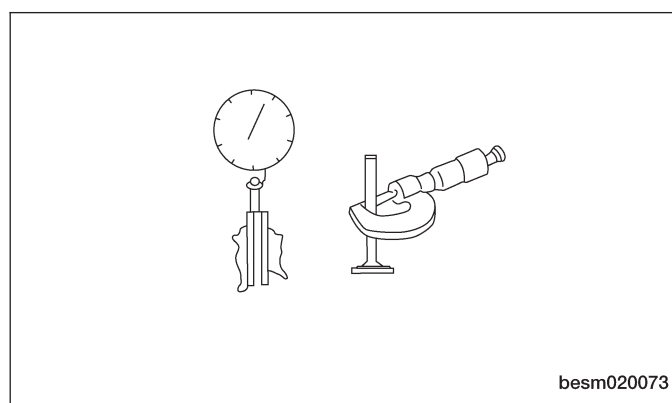
- Clean all valves thoroughly and discard burned, warped and cracked valves.
- Check valve seats and valve faces for damage.
- When reconditioning valves follow the specifications outlined for both intake and exhaust valves.



- Measure valve deflection.

VALVE DEFLECTION LIMIT (DIAL GAUGE READING)	
Intake Valve	0.02 mm
Exhaust Valve	0.04 mm

- If it exceeds the limit, check valve to valve guide clearance.
 - Measure valve stem diameter and valve guide inner diameter.
 - Check that clearance is within specification.
 - If it exceeds the limit, replace valve or valve guide.

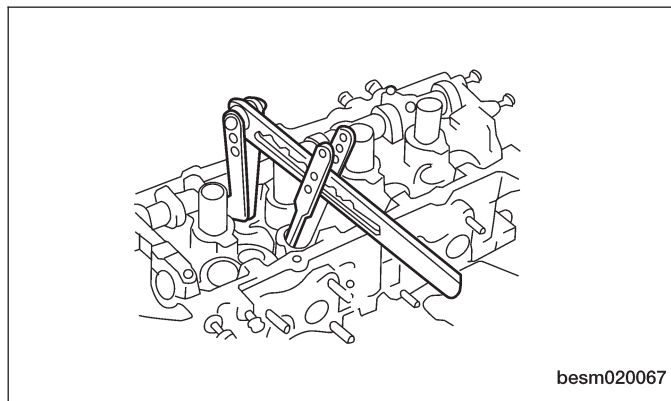


VALVE TO VALVE GUIDE CLEARANCE STANDARD	
Intake Valve	0.012-0.043 mm
Exhaust Valve	0.032-0.063 mm

CYLINDER HEAD UNIT REPAIR

Assemble

1. Install the valves into the cylinder head (larger diameter on intake side).
2. Install the valve springs.
3. Install the valve spring retainers.
4. Compress the valve springs with valve spring compressor.
5. Install the valve keepers.



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6. Tap the valve stem lightly with a plastic hammer after installation to verify proper assembly.

Valve Springs

Specifications

Valve Spring Specifications

DESCRIPTION	SPECIFICATION
Spring Free Length	47.7 mm
Spring Height At 620 Newtons Of Pressure	32.0 mm

CYLINDER HEAD UNIT REPAIR

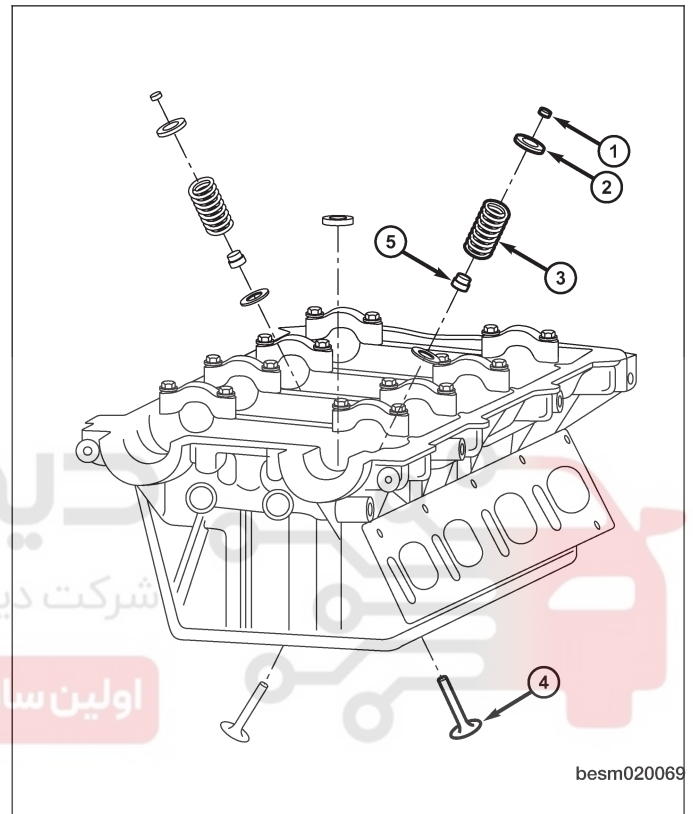
Disassemble

NOTE :

The following special tools are required to perform the repair procedure:

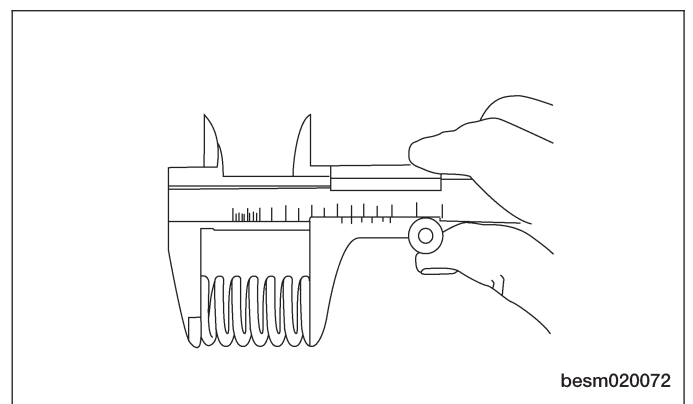
- CH-20011 - Valve seal installer
- CH-20012 - Valve stem seal installer guide
- CH-20013 - Valve seal remover
- CH-20017 - Valve keeper installer
- CH-20018 - Valve spring compressor

1. Using the special tool, compress the valve springs.
2. Remove the valve keeper (1), valve spring retainer (2).
3. Remove the valve springs (3) from the cylinder head.



Inspection

- Whenever valves have been removed for inspection, reconditioning or replacement, valve springs should be tested for correct load.
- Discard the springs that do not meet specifications.
- The following specifications apply to both intake and exhaust valve springs.



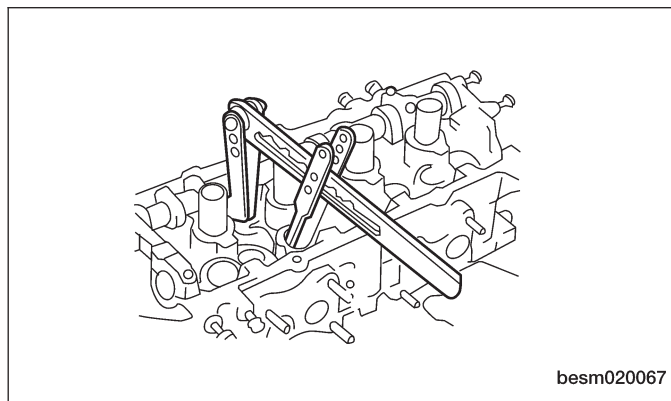
VALVE SPRING LENGTH/HEIGHT	
Spring Free Length	47.7 mm
Spring Height At 620 Newtons Of Pressure	32.0 mm

CYLINDER HEAD UNIT REPAIR

If it is not within specifications, replace the valve spring.

Assemble

1. Install the valve springs.
2. Install the valve spring retainers.
3. Compress the valve springs with valve spring compressor.
4. Install the valve keepers.



02

5. Tap the valve stem lightly with a plastic hammer after installation to verify proper assembly.

دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران

