ENGINE ASSEMBLY

1113-01/1532-00/1452-01/1130-07/1332-18/1221-01/1221-02/ 1332-01/1124-17/1130-07/1131-02/1124-16/1130-01/1130-11/ 1130-09/1311-31/1221-21/1211-32/1211-30/1532-19/1311-01/ 1311-04/1311-09/1311-05/1130-04/1130-20/1130-13/1130-21/ 1532-24/1532-00/1124-01/1211-02

GENERAL

CONFIGURATION AND FUNCTIONS

REMOVAL AND INSTALLATION

REMOVAL AND INSTALLATION

Modification basis	
Application basis	
Affected VIN	

ENGINE ASSEMBLY 1113-01

GENERAL

1. DESCRIPTION AND OPERATION

1) Cleanliness and Care

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the ten-thousanths of an inch.

When any internal engine parts are serviced, care and cleanliness are important.

A liberal coating of enigne oil should be applied to friction areas during assembly, to protect and lubricate the surfaces on initial operation. Proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure.

This is considered standard shop practice even if not specifically stated.

Whenever valve train components are removed for service, they should be kept in order. They should be installed in the same locations, and with the same mating surfaces, as when they were removed.

Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.

Modification basis	
Application basis	
Affected VIN	

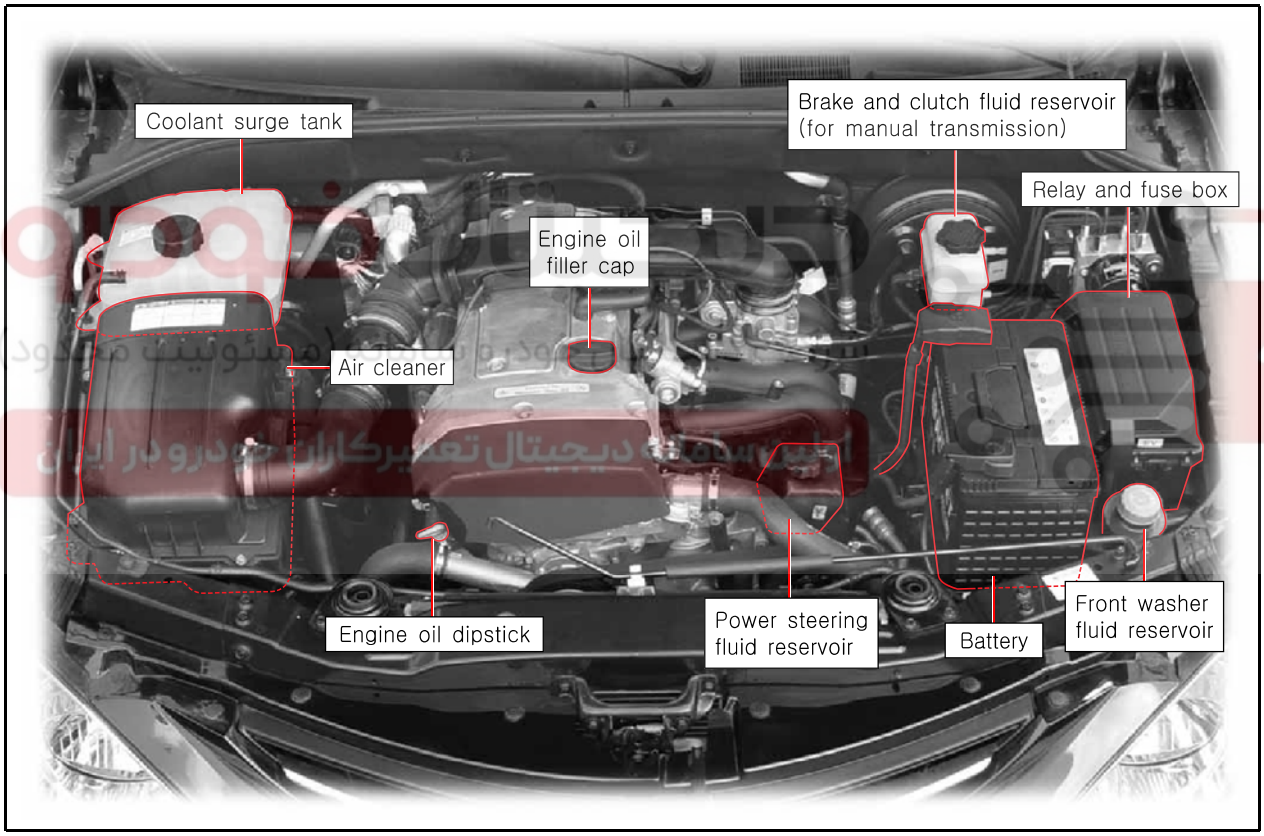
2) On-engine Service

CAUTION

- Disconnect the negative battery cable before removing or installing any electrical unit, or when a tool or equipment could easily come in contact with exposed electrical terminals.
  Disconnecting this cable will help prevent personal injury and damage to the vehicle. The ignition must also be in LOCK unless otherwise noted.

CAUTION

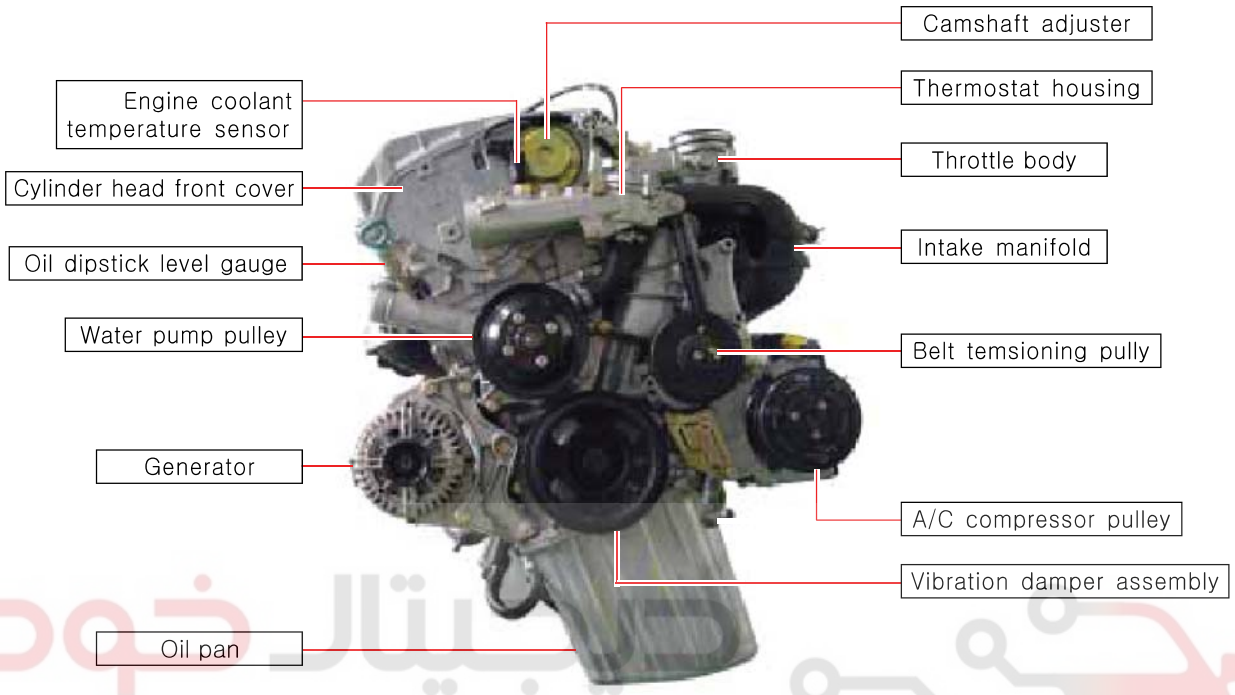
- Any time the air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material, which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.



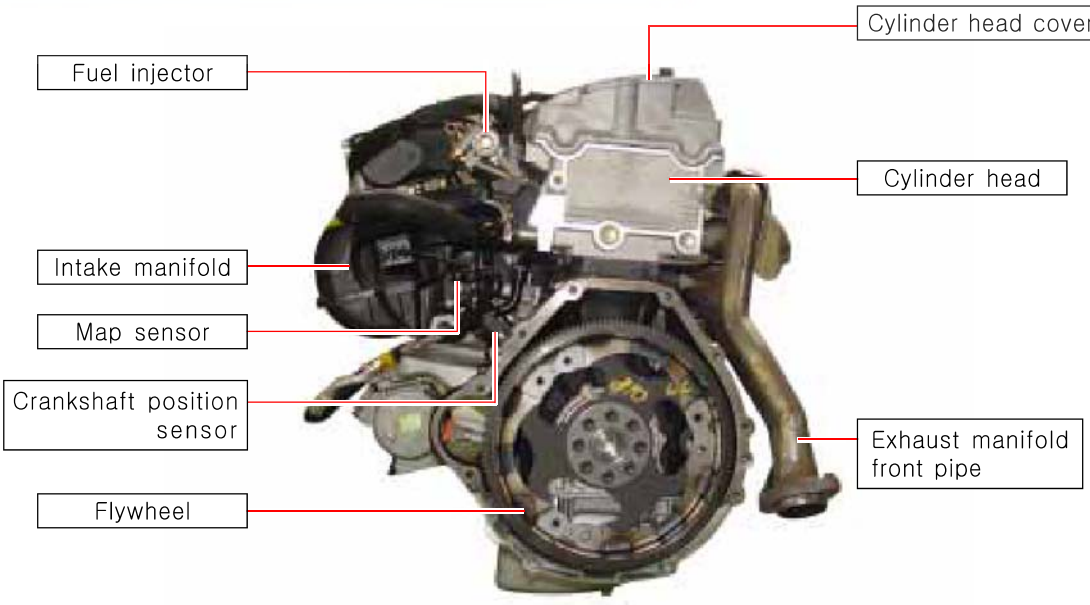
Modification basis	
Application basis	
Affected VIN	

2. G23D ENGINE ASSEMBLY

Front View

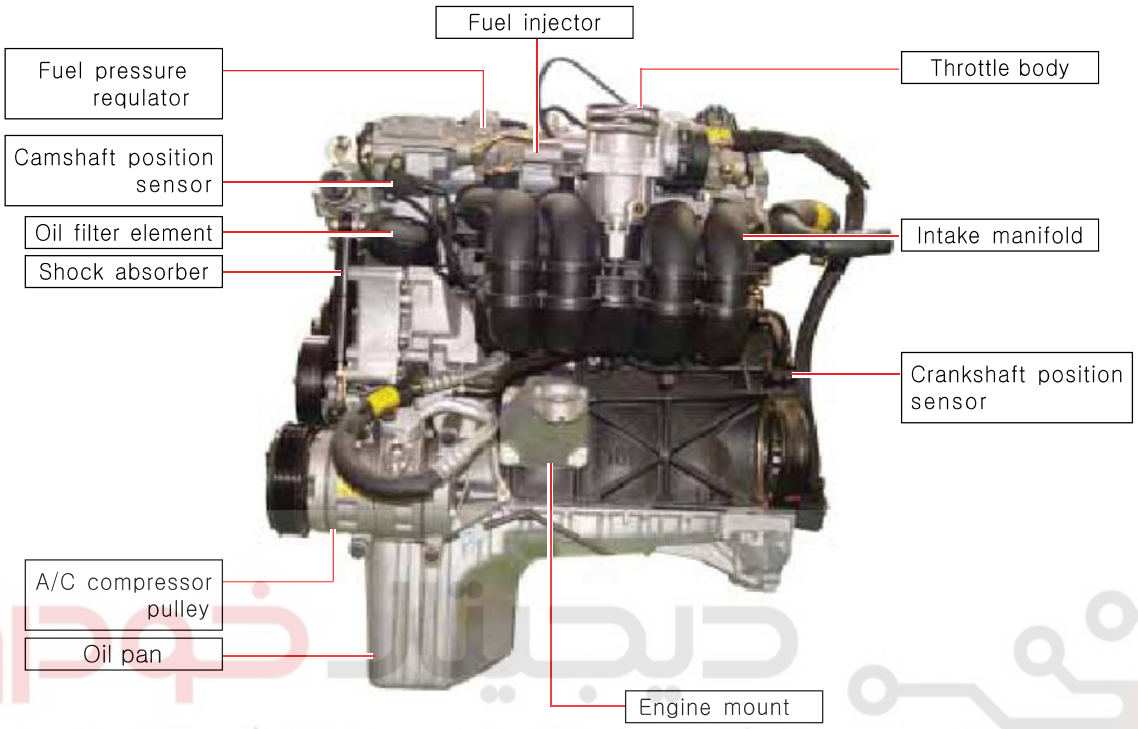


Rear View

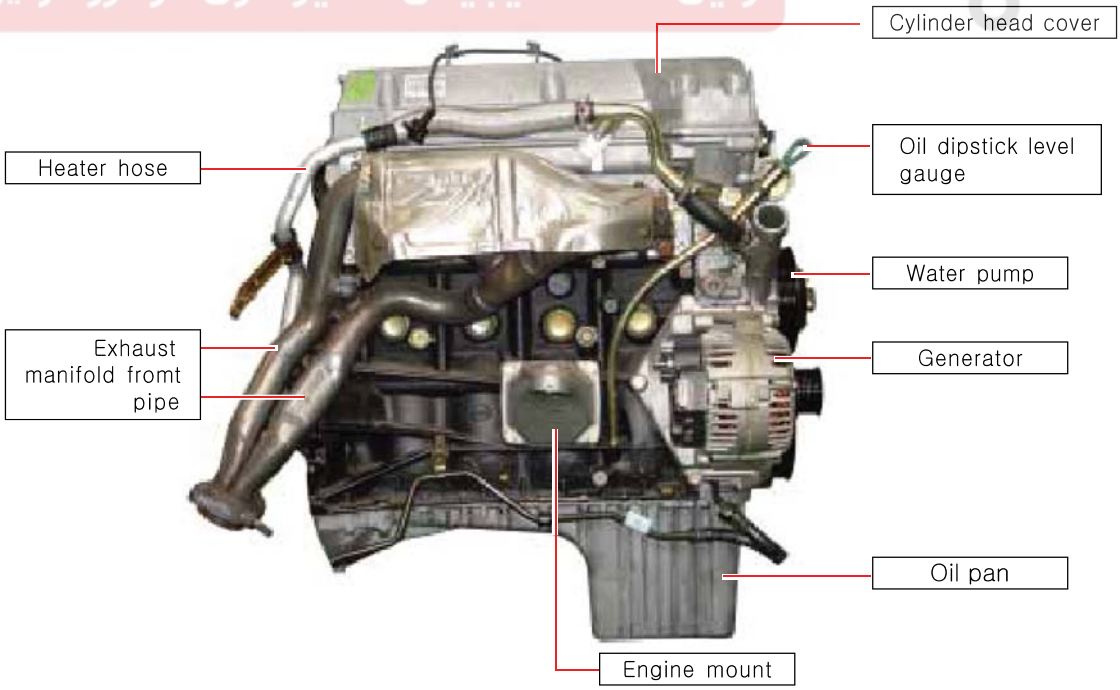


Modification basis	
Application basis	
Affected VIN	

LH Side View



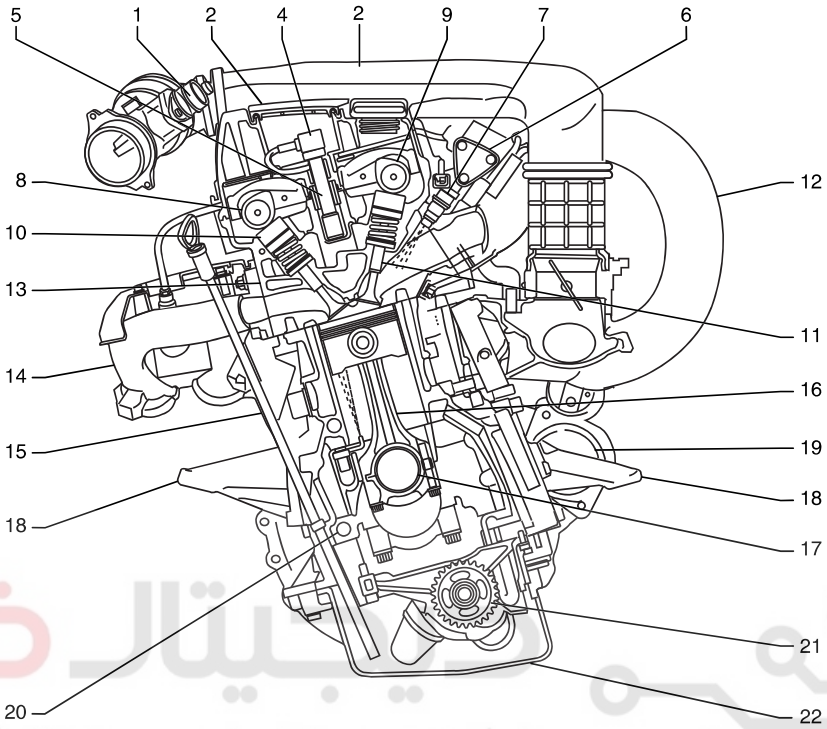
RH Side View



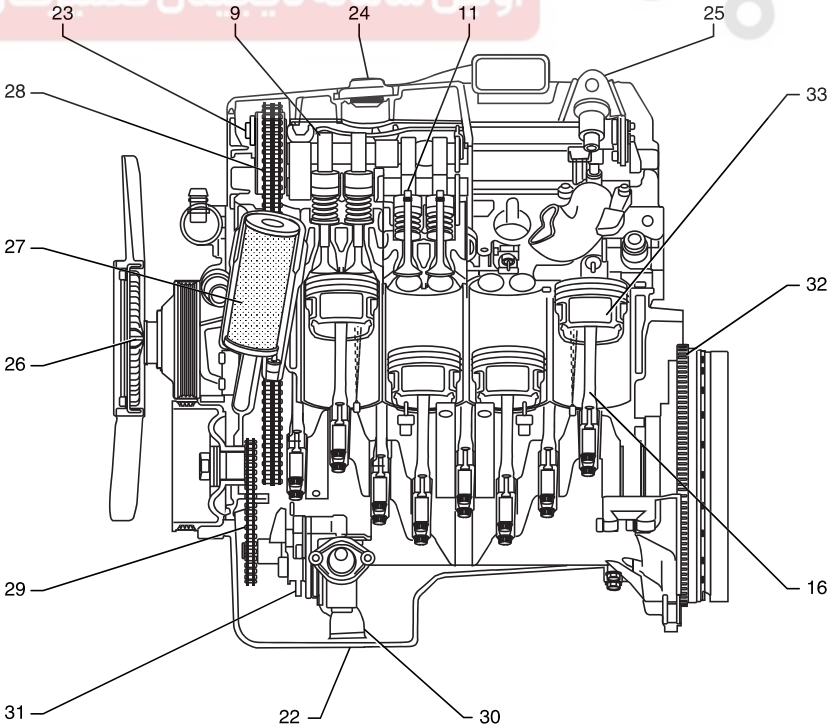
Modification basis	
Application basis	
Affected VIN	

3. G23D ENGINE STRUCTURE

Front View



Side View



Modification basis	
Application basis	
Affected VIN	

▶ **Front View**

NO.	FUNCTION	NO.	FUNCTION
1	HFM Sensor	12	Intake Manifold
2	Intake Air Duct	13	Cylinder Head
3	Cylinder Head Cover	14	Exhaust Manifold
4	Ignition Coi	15	Dipstick Guide Tube and Gauge
5	Spark Plug Connector	16	Connecting Rod
6	Fuel Distributor	17	Crankshaft
7	Injector	18	Engine Mounting Bracket
8	Exhaust Camshaft	19	Starter
9	Intake Camshaft	20	Crankcase
10	Valve Tappet	21	Oil Pump Sprocket
11	Intake Valve	22	Oil Pan

▶ **Side View**

NO.	FUNCTION	NO.	FUNCTION
23	Camshaft Adjuster	29	Oil Pump Drive Chain
24	Oil Filler Cap	30	Oil Strainer
25	Engine Hanger Bracket	31	Oil Pump
26	Cooling Fan and Viscous Clutch	32	Ring Gear and Flywheel of Drive Plate
27	Oil Filter	33	Piston
28	Timing Chain		

Modification basis	
Application basis	
Affected VIN	

4. DIAGNOSTIC INFORMATION AND PROCEDURE

1) Oil Leak Diagnosis

Most fluid oil leaks are easily located and repaired by visually finding the leak and replacing or repairing the necessary parts. On some occasions a fluid leak may be difficult to locate or repair. The following procedures may help you in locating and repairing most leaks.

▶ Finding the Leak

- Identify the fluid. Determine whether it is engine oil, automatic transmission fluid, power steering fluid, etc.
- Identify where the fluid is leaking from.
  - · After running the vehicle at normal operating temperature, park the vehicle over a large sheet of paper.
  - · Wait a few minutes.
  - · You should be able to find the approximate location of the leak by the drippings on the paper.

- Visually check around the suspected component.
  Check around all the gasket mating surfaces for leaks. A mirror is useful for finding leaks in areas that are hard to reach.
- If the leak still cannot be found, it may be necessary to clean the suspected area with a degreaser, steam or spray solvent.
  - · Clean the area well.
  - · Dry the area.
  - · Operate the vehicle for several miles at normal operating temperature and varying speeds. After operating the vehicle, visually check the suspected component.
  - · If you still cannot locate the leak, try using the powder or black light and dye method.
  - ·

▶ Powder Method

- Clean the suspected area.
- Apply an aerosol-type powder (such as foot powder) to the suspected area.
- Operate the vehicle under normal operating conditoins.
- Visually inspect the suspected component. You should be able to trace the leak path over the white powder surface to the source.

▶ Black Light and Dye Method

A dye and light kit is available for finding leaks, Refer to the manufacturer's directions when using the kit.

- Pour the specified amount of dye into the engine oil fill tube.
- Operate the vehicle normal operating conditions as directed in the kit.
- Direct the light toward the suspected area. The dyed fluid will appear as a yellow path leading to the source.

▶ Repairing the Leak

Once the origin of the leak has been pinpointed and traced back to its source, the cause of the leak must be determined in order for it to be repaired properly.

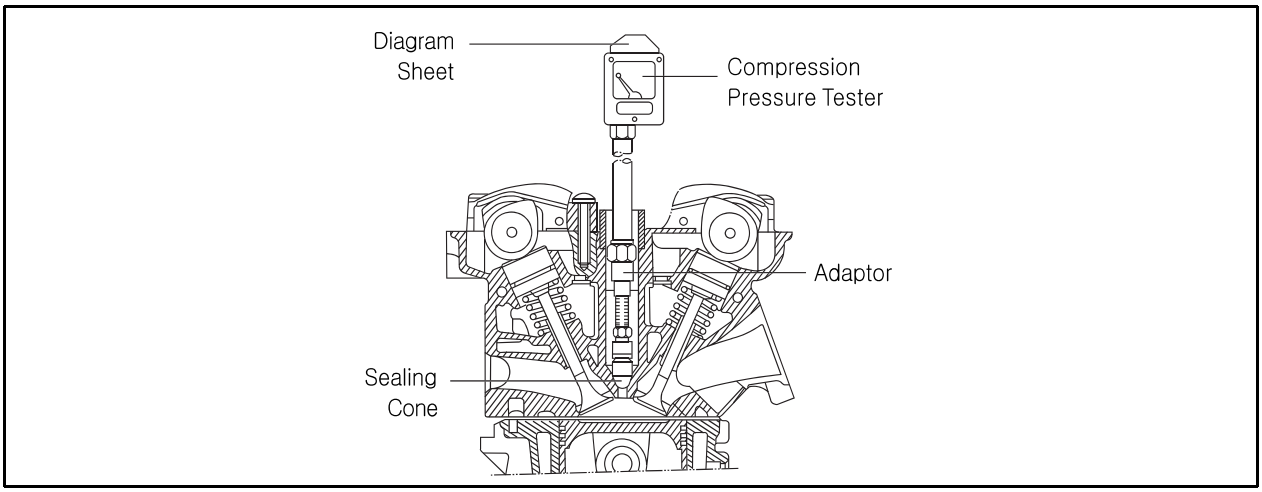
If a gasket is replaced, but the sealing flange is bent, the new gasket will not repair the leak. The bent flange must be repaired also. Before attempting to repair a leak, check for the following conditions and correct them as they may cause a leak.

▶ Gaskets

- The fluid level/pressure is too high.
- The crankcase ventilation system is malfunctioning.
- The seal bore is damaged (scratched, burred or nicked).
- The seal is damaged or worn.
- Improper installation is evident.
- There are cracks in the components.
- The shaft surface is scratched, nicked or damaged.
- A loose or worn bearing is causing excess seal wear.

Modification basis	
Application basis	
Affected VIN	

2) Compression Pressure Test



▶ Standard Service Data

Application	G23D Engine
Compression Ratio	10.4 : 1
Normal Engine Temperature	←
Normal Compression Pressure	Min. 11 bar, Max. 15 bar
Permissible Pressure Difference Between Individual C ylinders	←

CAUTION

- A9912 0012B (001 589 76 21 00) Compression Pressure Tester

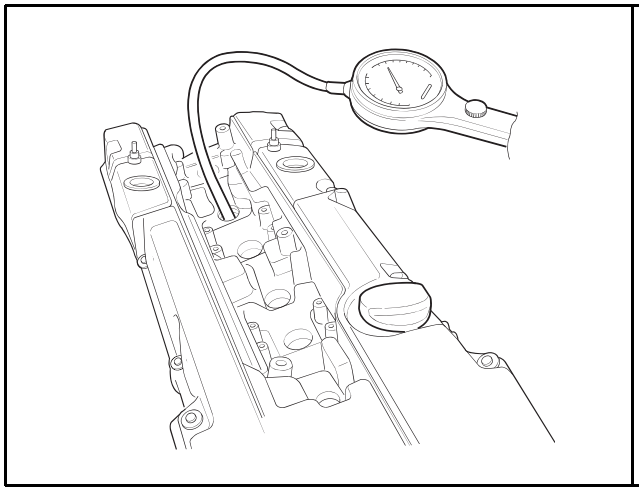
▶ Measuring Procedure

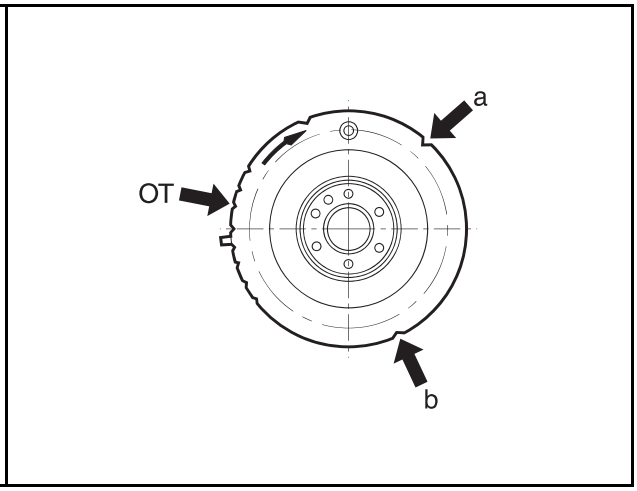
- Warm the engine up to normal operating temperature.
- Remove the spark plugs using the spark plug wrench.
- Place the diagram sheet to compression pressure tester A9912 0012B (001 589 76 21 00).
  Connect the adaptor to compression pressure tester A9912 0012B (001 589 76 21 00) and
- install it into the spark plug hole.
  Crank the engine approx. eight revolutions by using the start motor.
- Compare the measurements of compression pressure tester A9912 0012B (001 589 76 21 00)
- with the specifications.
  Measure the compression pressure of the other cylinders in the same way.
- If measured value is not within the specifications, perform the cylinder pressure leakage test.
-

CAUTION

- Discharge the combustion residues in the cylinders before testing the compression pressure.
  Apply the parking brake before cranking the engine.
-

3) Cylinder Pressure LeakageTest





▶ **Permissible Pressure Leakage**

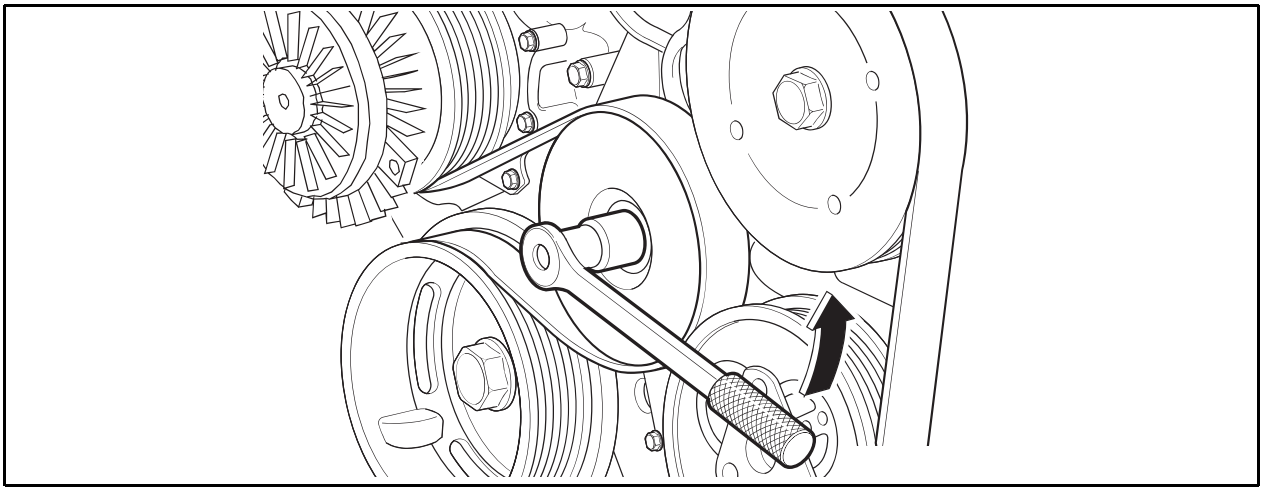
At Whole Engine	Max. 25 %
At Valve and Cylinder Head Gasket	Max. 10 %
At Piston and Piston Ring	Max. 20 %

▶ **Cylinder Number**

OT (TDC)	1, 4
UT (BDC 180 °)	2, 3

▶ **Cylinder Number**

Cylinder Pressure Leakage Tester	Bosch, EFAW210A Sun, CLT 228



▶ **Leakage Test**

- Warm the engine up to normal operating temperature.
- Disconnect the negative battery cable.
- Remove the spark plugs.
- Check the coolant level by opening the coolant reservoir cap and replenish if insufficient.
- Open the engine oil filler cap.
- Connect the tester to air pressure line and adjust the scale of tester.
- Install the connecting hose to spark plug hole.
- Position the piston of No.1 cylinder at TDC by rotating the crankshaft.
- Connect the connecting hose to tester and measure the leakage volume after blowing up 5 bar of compressed air.

CAUTION

- Measure the leakage volume in the completely opening condition of throttle valve by pulling the acceleration cable.

- Perform the pressure test according to the firing order.

CAUTION

- Firing Order: 1 - 3 - 4 - 2

- Compare the leakage pressure with the specifications.

5. GENERAL DIAGNOSIS

Condition		Probable Cause	Correction
Hard starting (With normal cranking)	Malfunction of immobilizer system	• Faulty immoblilzer system	• Check (Antenna, Immobilizer transponder) • Replace (Antenna, Immobilizer transponder)
	Malfunction of ignition system	• Faulty fuse	• Replace the fuse.
		• Faulty spark plug.	• Clean, adjust the plug gap or replace.
		• Electric leakage at the high tension cable.	• Replace the cable.
		• Poor connection of the high tension cable or lead wires.	• Replace the cable or wires.
		• Faulty ignition coil.	• Replace the ignition coil.
	Malfunction of fuel system	• Empty of fuel in the fuel tank.	• Feed the fuel.
		• Dirty or clogged fuel filter.	• Replace the filter.
		• Clogged fuel pipe.	• Clean the fuel pipe.
		• Malfunction of the fuel pump.	• Replace the fuel pump.
		• Malfunction of the fuel injector.	• Replace the injector.
		• The foreign material in the fuel tank.	• Clean the fuel tank.
	Decline of compression pressure	• Poor tightening spark plug.	• Tighten to the specified torque. Compression
		• Cracked cylinder head gasket.	• Replace the gasket.
		• Inadequate the valve clearance.	• Adjust the clearance.
		• Leakage of the valve clearance.	• Repair the valve.
		• Interference of the valve stem.	• Replace the valve or the valve guide.
		• Low elasticity or damage of the valve spring.	• Replace the valve spring.
		• Abnormal interference of pistons and cylinders.	• Replace the piston ring.
		• Excessive wear of pistons, rings, or cylinders.	• Replace the ring or the piston and boring or replace the cylinder.
	Others	• Broken timing belt.	• Replace the belt.
		• Loosening, damage or leakage of the vacuum hose.	• Connect the hose correctly or replace it.
		• Leakage of intake system.	• Replace intake system.
Lack of engine power	Decline of compression pressure	• Refer to above in this page.	• Refer to above in this page.
	Malfunction of ignition system	• Faulty spark plug.	• Adjust or replace the spark plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.

Modification basis	
Application basis	
Affected VIN	

▶ General Diagnosis (Cont'd)

Condition		Probable Cause	Correction
Lack of engine power	Malfunction of fuel system	• Clogged fuel pipe.	• Clean the pipe.
		• Clogged or contaminated fuel filter.	• Replace the filter.
	Others	• Clogged exhaust system.	• Check and repair the system.
		• Clogged or contaminated air cleaner element.	• Clean or replace the air cleaner element.
		• Leak of the intake manifold gasket.	• Replace the gasket.
		• Dragging brakes.	• Repair or replace the brakes.
Rough engine idling	Malfunction of fuel system	• Clogged fuel pipe.	• Clean the pipe.
		• Clogged or contaminated fuel filter.	• Replace the filter.
		• Malfunction of the fuel pressure regulator.	• Replace the regulator.
	Malfunction of ignition system	• Malfunction of the spark plug.	• Adjust or replace the spark plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.
		• Malfunction of the ignition coil.	• Replace the ignition coil.
	Others	• Clogged or contaminated air cleaner element.	• Clean or replace the air cleaner element.
		• Leak of the intake manifold gasket.	• Replace the gasket.
		• Poor connection or damage or leakage of the vacuum hose.	• Connect the hose correctly or replace it.
Engine hesitate (Upon pressing accelerating pedal, the engine makes delayed response This situation is remarkable when cruising or starting.)	Malfunction of ignition system	• Poor spark plug or Poor adjustment of the plug gap.	• Replace the plug or adjust the gap.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.
	Others	• Malfunction of the air cleaner system.	• Clean or replace the air cleaner system.
		• Leak of the intake manifold gasket.	• Replace the gasket.

▶ General Diagnosis (Cont'd)

Condition		Probable Cause	Correction
Engine surging (Engine power makes fluctuation in a fixed speed and speed changes without operating the accelerating pedal.)	Malfunction of fuel system	• Clogged fuel pipe.	• Clean the pipe.
		• Clogged or contaminated fuel filter.	• Replace the filter.
		• Malfunction of the fuel pressure regulator.	• Replace the fuel pressure regulator.
	Malfunction of ignition system	• Malfunction of the spark plug.	• Adjust or replace the spark plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.
		• Poor ignition timing.	• Adjust the ignition timing.
	Others	• Leak of the intake manifold gasket.	• Clean or replace the gasket.
		• Leakage of the vacuum hose.	• Connect the hose correctly or replace it.
Excessive detonation (According to the opening range of Malfunction of metallic is made with abnormal explosion)	Malfunction of fuel system	• Abnormal spark plug.	• Replace the spark plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable correctly or replace it.
	Malfunction of ignition system	• Clogged or contaminated fuel filter and fuel pipe.	• Clean or replace the fuel filter and the fuel pipe.
	Others	• Leak of the intake manifold gasket.	• Replace the gasket.
		• Excessive carbon deposit due to abnormal combustion.	• Remove the carbon.
Overheat	Malfunction of cooling system	• Lack of coolant.	• Refill coolant.
		• Malfunction of the thermostat.	• Replace the thermostat.
		• Malfunction of the cooling fan.	• Check or replace the cooling fan.
		• Poor water pump performance.	• Replace the pump.
		• Clogged or leaky radiator.	• Clean, repair or replace the radiator.
	Malfunction of lubrication system	• Poor engine oil.	• Replace engine oil with the specified one.
		• Blocking oil filter or strainer.	• Clean or repair the oil filter or the strainer.
		• Lack of engine oil.	• Refill oil.
		• Poor oil pump performance.	• Replace or repair the pump.
	Other	• Leakage of oil	• Repair.
		• Damaged cylinder head gasket.	• Replace the gasket.

Modification basis	
Application basis	
Affected VIN	

▶ General Diagnosis (Cont'd)

Condition		Probable Cause	Correction
Poor fuel consumption	Malfunction of fuel system	• Leakage of the fuel tank or the fuel pipe.	• Repair or replace the fuel tank or the fuel pipe
	Malfunction of ignition system	• Abnormal spark plug (Excessive carbon deposit, inadequate gap, burnt electrode).	• Replace the plug.
		• Electric leakage or poor connection of the high tension cable.	• Connect the cable normally or replace it.
	Malfunction of cooling system	• Malfunction of the thermostat.	• Repair the thermostat.
	Others	• Improperly installed valve.	• Repair or replace the valve.
		• Low pressure of tires.	• Adjust the pressure of tires.
Excessive consumption of engine oil	Leakage of engine oil	• Loosened oil drain plug.	• Tighten the plug.
		• Loosened oil pan bolt.	• Tighten the bolt. Engine Oil
		• Loosened oil filter.	• Tighten the filter.
		• Loosened oil pressure switch.	• Tighten the switch.
		• Leakage of camshaft front oil seal.	• Replace the seal.
		• Leakage of crankshaft front oil seal.	• Replace the seal.
		• Leakage at the cylinder head cover gasket.	• Replace the gasket.
		• Damage of the cylinder head gasket.	• Replace the gasket.
	Oil mixing in combustion chamber	• Stuck piston ring.	• Remove carbon and replace the ring.
		• Worn piston or cylinder.	• Replace the piston or the cylinder.
		• Worn piston ring or ring groove.	• Replace the piston or ring.
		• Inadequate position of the piston ring cutting part.	• Adjust the position.
		• Abrasion or damage of the valve system.	• Replace the valve system.
Low oil pressure	Malfunction of lubrication system	• Inadequate oil viscosity.	• Replace with the specified one.
		• Loosening of the oil pressure switch.	• Tighten the switch.
		• Lack of engine oil.	• Refill oil.
		• Blocking oil strainer.	• Clean the strainer.
		• Lowered function of the oil pump.	• Replace the pump.
		• Abrasion or damage of the oil pump relief valve.	• Replace the valve.

▶ **General Diagnosis (Cont'd)**

Condition		Probable Cause	Correction
Engine noise	Valve noise	• Inadequate valve clearance	• Adjust the valve clearance.
		• Abrasion of valve stem or guide.	• Replace the valve stem or the guide.
		• Weak valve spring.	• Replace the spring.
	Piston, ring, cylinder noise	• Abrasion of the piston, the ring or the cylinder.	• Boring the cylinder or replace the piston, the ring or the cylinder.
	Connecting rod noise	• Abrasion of the connecting rod bearing.	• Replace the bearing.
		• Loosened the connecting rod nut.	• Tighten to the specified torque
	Crankshaft noise	• Abrasion of the crankshaft bearing.	• Replace the bearing.
		• Abrasion of the crankshaft journal.	• Grind or replace the crankshaft journal.
		• Loosened bearing cap bolt.	• Tighten to the specified torque.
		• Excessive clearance of the crankshaft thrust bearing.	• Adjust or replace.

6. SPECIFICATIONS

1) Engine Specifications

Application			G23D Engine	Remarks
Engine Model			M161.970	
Displacement			2295 cc	
Cylinder (Bore x Stroke)			90.9 x 88.4 mm	
Fuel Injection / Ignition System			MSE 3.53D	
Compression Ratio			10.0 : 1	
Number of Cylinders			4	
Camshaft Valve Arrangement			DOHC	
Camshaft Drive Type			Chain-Driven	
Max. Output			150 ps / 5500 rpm	
Max. Torque			214 Nm / 3,500 ~ 4,000 rpm	
Firing Order			1 - 3 - 4 - 2	
Ignition Type			Distributor less double ignition	
Ignition Timing			BTDC 6° ± 2°	
Valve Timing	Intake	Open/Close	ATDC 13.15° / ABDC 13.57°	
	Exhaust	Open/Close	BBDC 16.58° / BTDC 17.05°	
Valve Clearance Adjustment			←	
Idle Speed			750 ± 50 rpm	
Fuel Injection Pressure			3.2 - 4.2 kg/cm²	
Oil Capacity			7.9 ℓ	
Lubrication Type			Forced by gear pump	
Oil Filter Type			Full flow with paper filter	
Fuel			Unleaded gasoline	

MSE : Engine Control Module

3.53D : 4 Cylinder Version

2) Fastener Tightening Specifications

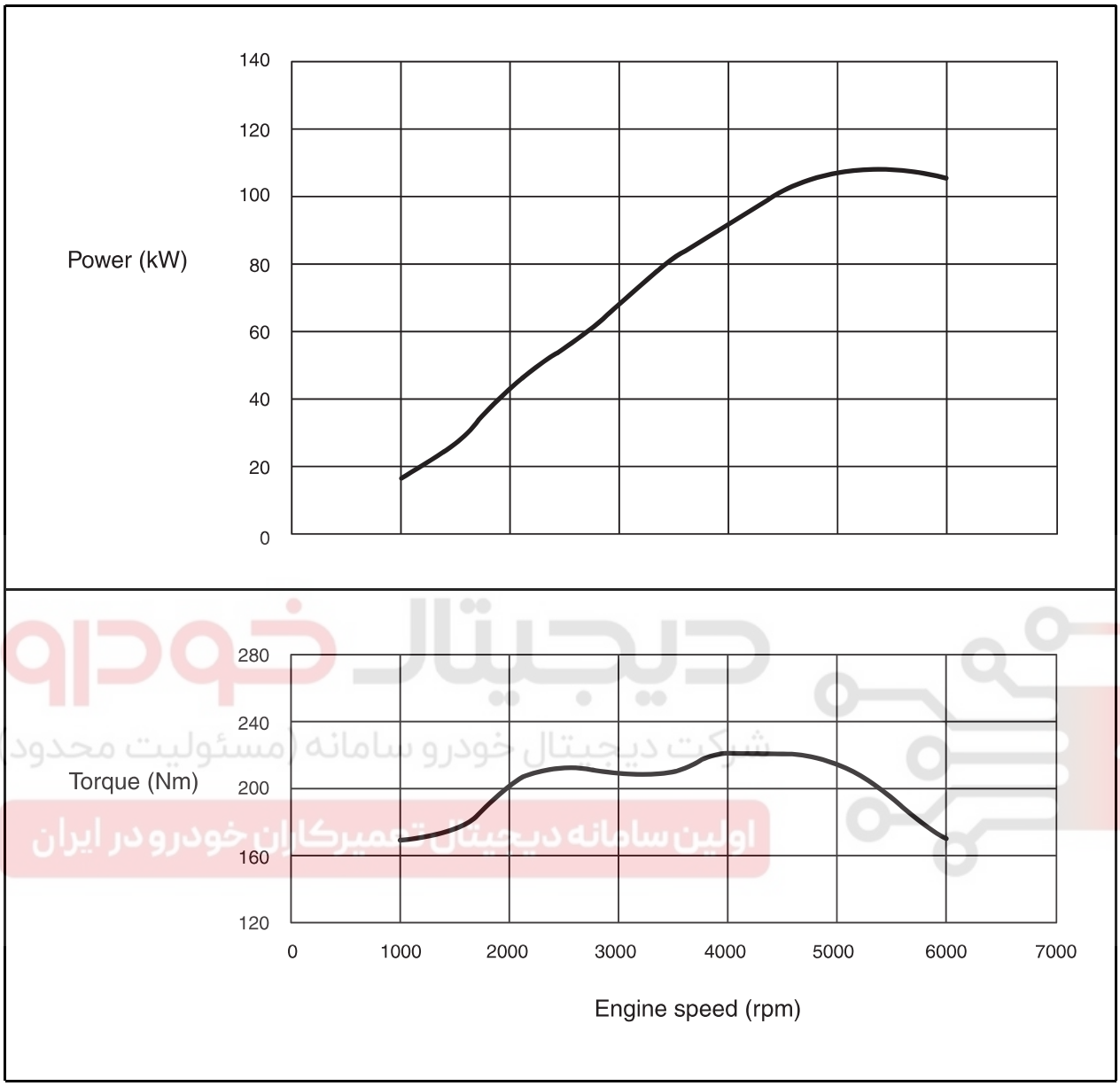
Application		N•m	Lb-Ft	Lb-In
Fuel Feed and Return Line		21 ~ 25	15 ~ 18	-
Exhaust Manifold and Pipe		30	22	-
Engine Mounting Nuts		70	52	-
Generator Carrier Bolts		25	18	-
Tensioning Pulley Bolt		40.5 ~ 49.5	29.9 ~ 36.5	-
Steering Pump Bolts		22.5 ~ 27.5	16.6 ~ 20.3	-
A/C Braket Bolts		22.5 ~ 27.5	16.6 ~ 20.3	-
Intake Air Duct Mounting Nuts		9 ~ 11	-	80 ~ 97
Spark Plug Cover Bolts		9 ~ 11	-	80 ~ 97
Cylinder Head Cover Bolts		9 ~ 11	-	80 ~ 97
Magnetic Assembly Bolt		9 ~ 11	-	80 ~ 97
Cylinder Head Front Cover Bolts	M8	22.5 ~ 27.5	16.6 ~ 20.3	-
	M6	9 ~ 11	-	80 ~ 97
Cylinder Head Bolts		55 +90° +90°	41 +90° +90°	- - 80 ~ 97
Timing Gear Case Cover Bolts		22.5 - 27.5	16.6 ~ 20.3	-
Crankshaft Sealing Rear Cover Mounting Bolts		9 ~ 11	-	-
Vibration Damper Center Bolts		200 + 20 +90° + 10°	148 + 15 +90° + 10°	- -
Flywheel Mounting Bolt		40 +90°	30 +90°	- -
Amarture Bolt in Flywheel		45 + 5	33 + 3.7	-
Camshaft Adjuster Flange Bolts		+90° + 10° 35	+90° + 10° 26	- -
Intake Flange Shaft Bolts		18 ~ 22 60° ± 5°	13 ~ 16 60° ± 5°	- -
Exhaust Camshaft Sprocket Bolts		18 ~ 22 60° ± 5°	13 ~ 16 60° ± 5°	- -
Intake Flange Shaft Bolts		18 ~ 22	13 ~ 16	-
Exhaust Camshaft Sprocket Bolts		60° ± 5°	60° ± 5°	-
Camshaft Bearing Cap Bolts		22.5 ~ 27.5	16.6 ~ 20.3	-
Chain Tensioner Screw Plug		40	30	-
Chain Tension Assembly		72 ~ 88	53 ~ 65	-
Oil Pump Sprocket Bolt		29 ~ 35	21 ~ 26	-
Tensioning Device Bolts		26 ~ 32	19 ~ 24	-
Water Pump Pulley		22.5 ~ 27.5	16.6 ~ 20.3	-
Upper Intake Manifold Bolt		22.5 ~ 27.5	16.6 ~ 20.3	-
Lower Intake Mainfold Bolt		22.5 ~ 27.5	16.6 ~ 20.3	-
Flange Bolt to Exhaust Mainfold		30	22	-

Modification basis	
Application basis	
Affected VIN	

▶ Fastener Tightening Specifications (Cont'd)

Application	N•m	Lb-Ft	Lb-In
Exhaust Mainfold Nut to Stud Bolt	26 ~ 34	19 ~ 25	-
Oil Drain Plug	25	18	-
Oil Filter Cover	25	18	-
Oil Filter Bolt	22.5 ~ 27.5	16.6 ~ 20.3	-
Oil Pump Drive Sprocket Bolt	29 ~ 35	21 ~ 26	-
Oil Pump Mounting Bolt	22.5 ~ 27.5	16.6 ~ 20.3	-
Oil Strainer Bracket Bolt	9 ~ 11	-	80 ~ 97
Oil Pressure Relief Valve Screw Plug	50	37	-
Oil Dipstick Guide Tube Bolt	9 ~ 11	-	80 ~ 97
Oil Gallery Screw Plug	15	11	-
Shock Absorber Bolts	22.5 ~ 27.5	16.6 ~ 20.3	-
Crankshaft Bearing Cap Bolts	55/+90°	41/+90°	-
Torque Converter Mounting Bracket Bolts	42	31	-

2) Performance Curve



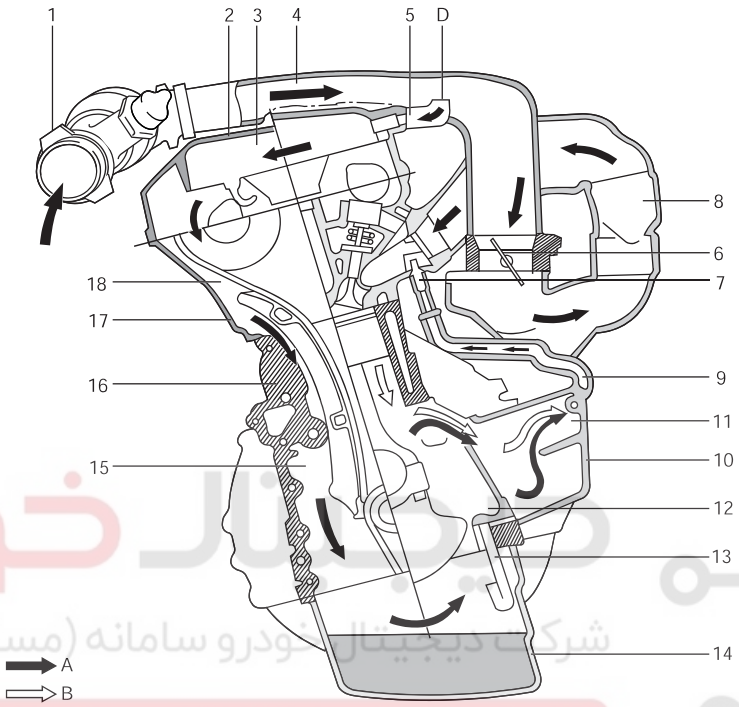
Modification basis	
Application basis	
Affected VIN	

Memo

CONFIGURATION AND FUNCTIONS

S.G.N. 1113-01 CRANKCASE VENTILATION SYSTEM

1) Components of Crankcase Ventilation System (I)



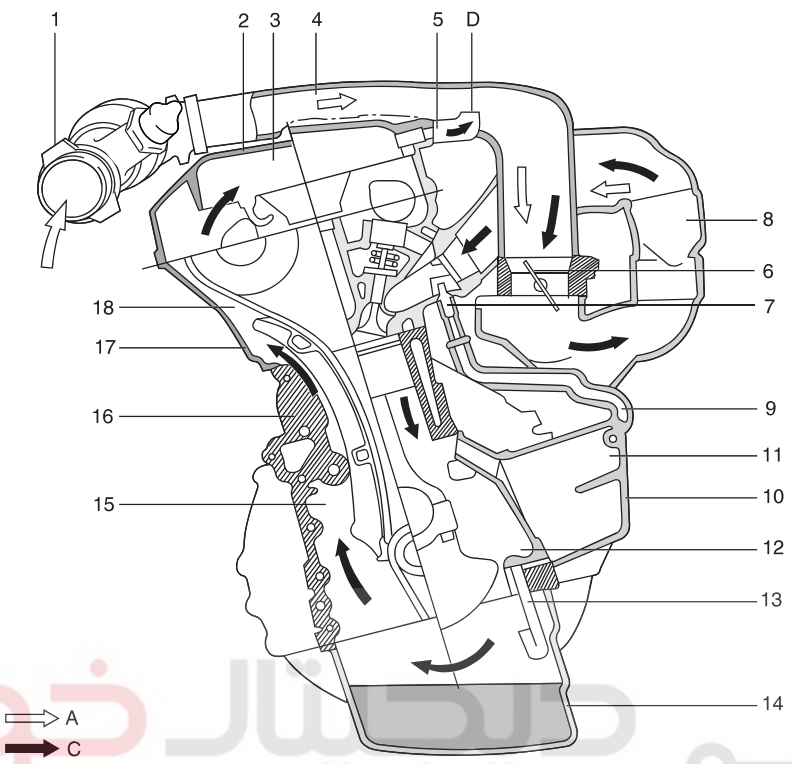
NO.	FUNCTION	NO.	FUNCTION
1	HFM Sensor	11	Oil Separation Chamber (Mid-Load at Idling)
2	Cylinder Head Cover	12	Crank Chamber
3	Oil Spearation Chamber (Full-Load or Over Mid-Load)	13	Oil Return Pipe
4	Intake Air Duct (Cross Pipe)	14	Oil Pan
5	Vent Line (Full-Load or Over Mid-Load)	15	Timing Gear Case Cover
6	Throttle Valve	16	Crankcase
7	Restrictor, Diameter 1.1mm (Mid-Load at Idling)	17	Chain Housing
8	Intake Manifold	A	Fresh Air
9	Vent Line (Mid-Load at Idling)	B	Blow-By Gas
10	Air Conditioner Bracket	D	Vent Connection

Modification basis	
Application basis	
Affected VIN	

2) Operation At Idling And Mid- Load

- The throttle valve (6) is closed or very partially opened, and the vacuum pressure in intake manifold is high.
  The blow-by gas and the fresh air that is additionally supplied through the vent connection (D) in the crank-case in partial load gets supplied to the combustion chamber from the crank chamber (12) through the oil separation chamber (11), airconditioner bracket (10), vent line (9), and restrictor (7) mounted to the cylinder head.
- The circulated engine oil returns to the oil pan through the oil return pipe (13) at the bottom of oil separation chamber (11).
  The fresh air gets supplied to the crank chamber (12) through the HFM sensor (1), intake air duct (4), vent line (5), oil separation chamber (3), chain housing (17), and the timing gear case cover (15).
  The additional supply of the fresh air is needed to prevent from forming the residues of the engine oil.

3) Components of Crankcase Ventilation System (II)



NO.	FUNCTION	NO.	FUNCTION
1	HFM Sensor	11	Oil Separation Chamber (Mid-Load at Idling)
2	Cylinder Head Cover	12	Crank Chamber
3	Oil Spearation Chamber (Full-Load or Over Mid-Load)	13	Oil Return Pipe
4	Intake Air Duct (Cross Pipe)	14	Oil Pan
5	Vent Line (Full-Load or Over Mid-Load)	15	Timing Gear Case Cover
6	Throttle Valve	16	Crankcase
7	Restrictor, Diameter 1.1mm (Mid-Load at Idling)	17	Chain Housing
8	Intake Manifold	A	Fresh Air
9	Vent Line (Mid-Load at Idling)	B	Blow-By Gas
10	Air Conditioner Bracket	D	Vent Connection

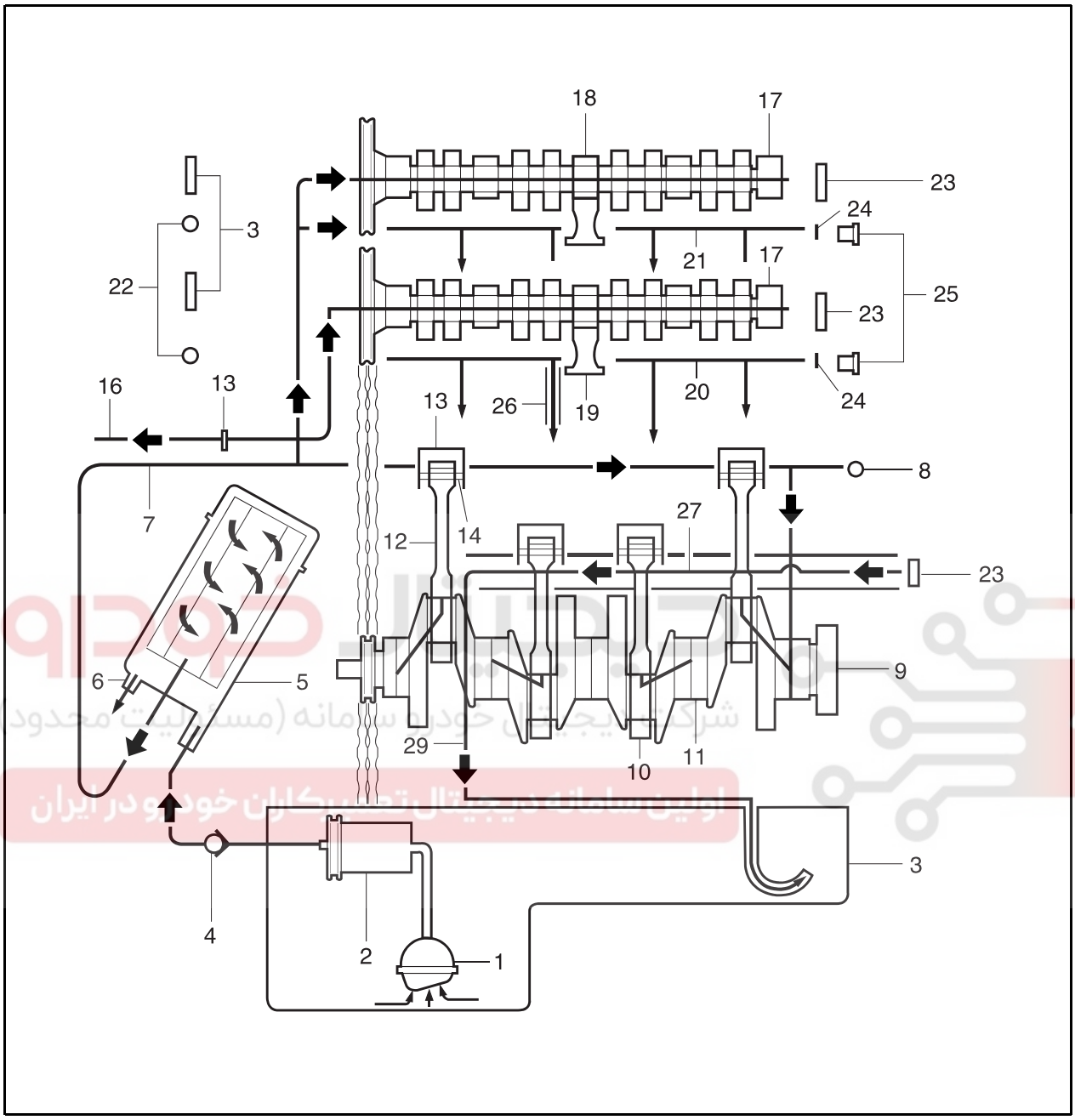
Modification basis	
Application basis	
Affected VIN	

4) Operation When Full- Load at Partial Load

- The throttle valve (6) is partially opened or fully opened.
  The air flows very rapidly through the vent line (5) s connection (D) and the intake air duct when full load at partial load.
- Consequently, most of the low-by gases are supplied to the combustion chamber through the timing gear case cover (15), chain housing (17), oil separation chamber (3), vent line (5), throttle valve (6), and intake manifold (8).

Modification basis	
Application basis	
Affected VIN	

S.G.N.
1532-00 OIL CIRCULATION



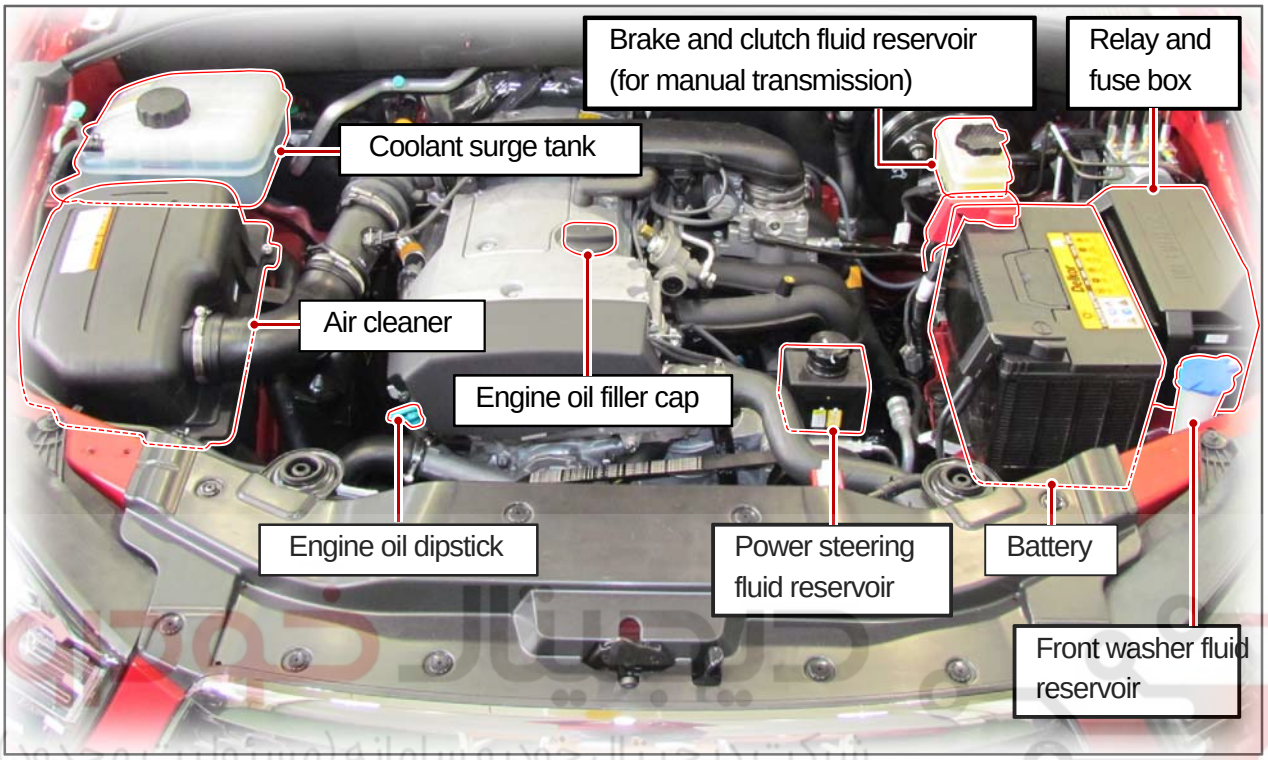
Modification basis	
Application basis	
Affected VIN	

NO.	FUNCTION	NO.	FUNCTION
1	Oil Strainer	16	Oil Supply (To Chain Tensioner)
2	Oil Pump	17	Camshaft
3	Oil Pan	18	Cam Bearing
4	Oil Non-Return Valve	19	Valve
5	Oil Filter	20	Oil Gallery (Supply Oil to Intake Tappet)
6	Oil Filter Bypass Valve	21	Oil Gallery (Supply Oil to Exhaust Tappet)
7	Main Oil Gallery	22	Ball (ϕ8 mm)
8	Closing Ball (ϕ15 mm)	23	Camshaft Plug
9	Crankshaft	24	Seal
10	Connecting Rod Bearing	25	Screw Plug
11	Crankshaft Bearing	26	Oil Return Gallery (Cylinder Head and Crankcase)
12	Connecting Rod	27	l Return Gallery (Crankcase)
13	Piston	28	End Cover (ϕ20 mm)
14	Oil Spray (Piston Crown Area)	29	Oil Return Pipe
15	Non-Return Valve (Crankcase)		

Modification basis	
Application basis	
Affected VIN	

REMOVAL AND INSTALLATION

S.G.N. 1113-01 ENGINE ASSEMBLY



1. Disconnect the negative terminal of battery.
2. Remove the hood.

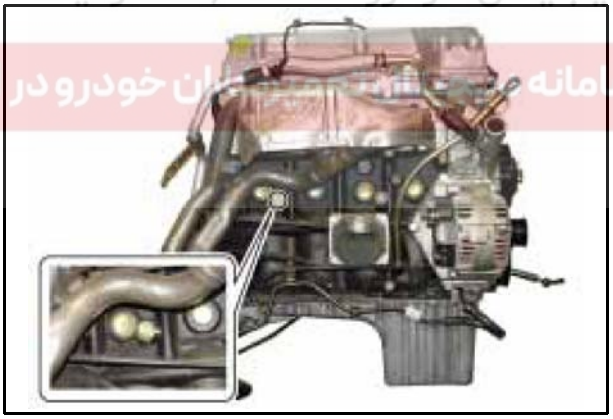
Modification basis	
Application basis	
Affected VIN	

3. Remove the under cover.

Tightening torque **28 – 47 Nm (21 - 35 lb-ft)**

4. Loosen the radiator drain cock and drain the coolant.

CAUTION
- Open the coolant reservoir cap.



5. Loosen the cylinder block drain plug and then drain the coolant completely.

Tightening torque **5 Nm (26 lb–ft)**

CAUTION
- Open the coolant reservoir cap.

6. Disconnect the coupling of HFM sensor and remove the air cleaner cross pipe.

Modification basis	
Application basis	
Affected VIN	

7. Remove the air cleaner cover.
   Remove the mounting bolts and air cleaner housing and element assembly.

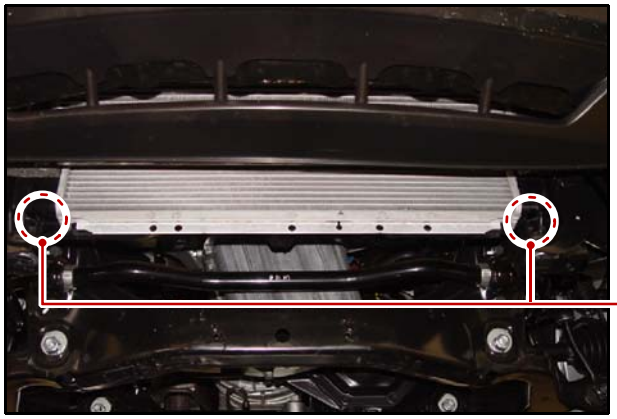
8. Remove the radiator and PWM electric fans.
   For more information, refer to "Engine Cooling" section.

- Drain the A/C refrigerant using the refrigerant collector before removing the radiator and PWM electric fan assembly.
- Disconnect the upper and the lower hoses of the radiator.

CAUTION
- Be careful not to spill the coolant when disconnecting the radiator hose.

- Disconnect the oil cooler pipe of the automatic transmission.

CAUTION
- Be careful for the oil leakage and collect it using designated collector.
- Be careful not to spill the oil on other parts.

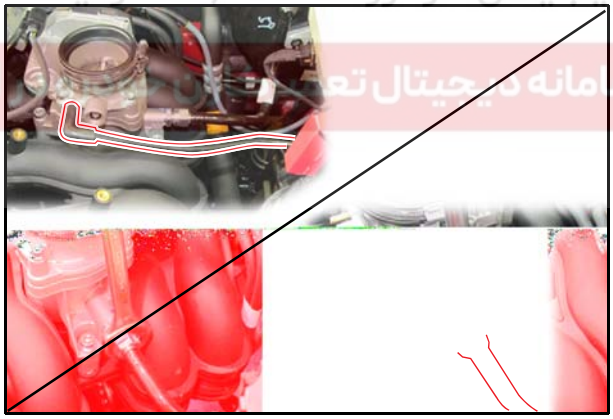


Modification basis	
Application basis	
Affected VIN	

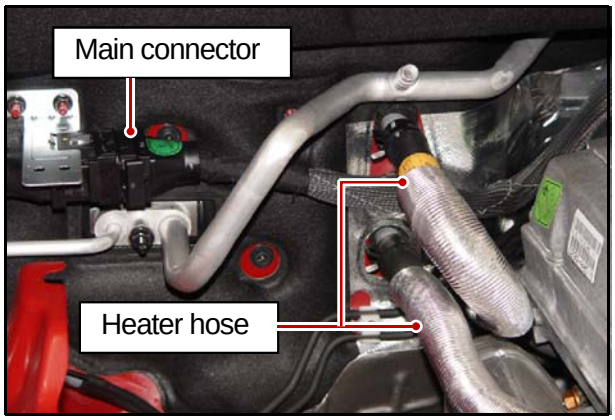
9. Disconnect the parts connected to the engine from the engine compartment.

- Disconnect the terminals and the ground terminal from the generator.

- Disconnect the ground terminal to the intake manifold.



- Disconnect the vacuum hose and the purge control hose to the intake manifold.



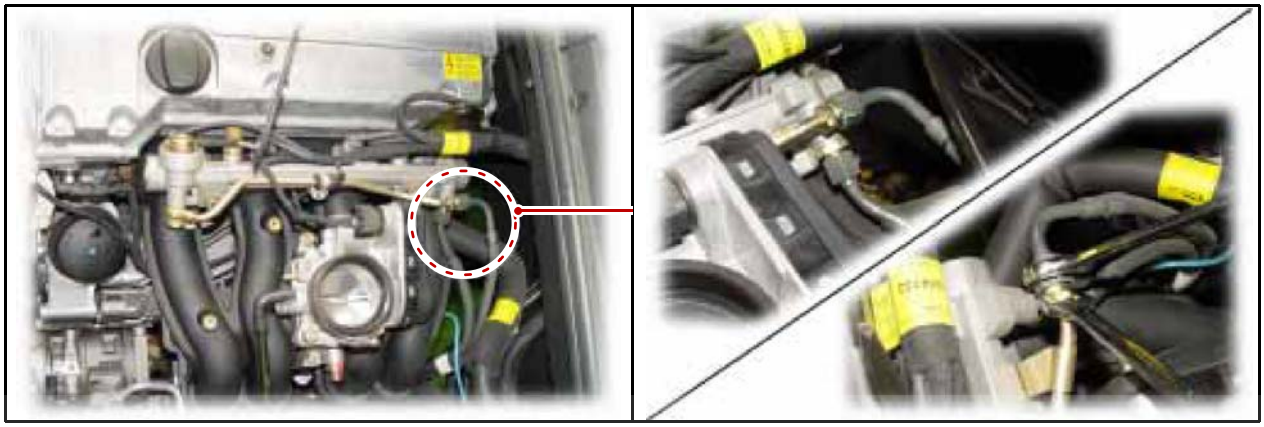
- Disconnect the inlet and outlet heater hoses and main connector.

Modification basis	
Application basis	
Affected VIN	

- Remove the fuel feed and return line. **Tightening torque** **21 - 25 Nm (15 - 18 lb-ft)**

CAUTION

- Before removing the fuel lines, release the pressure in the fuel system.

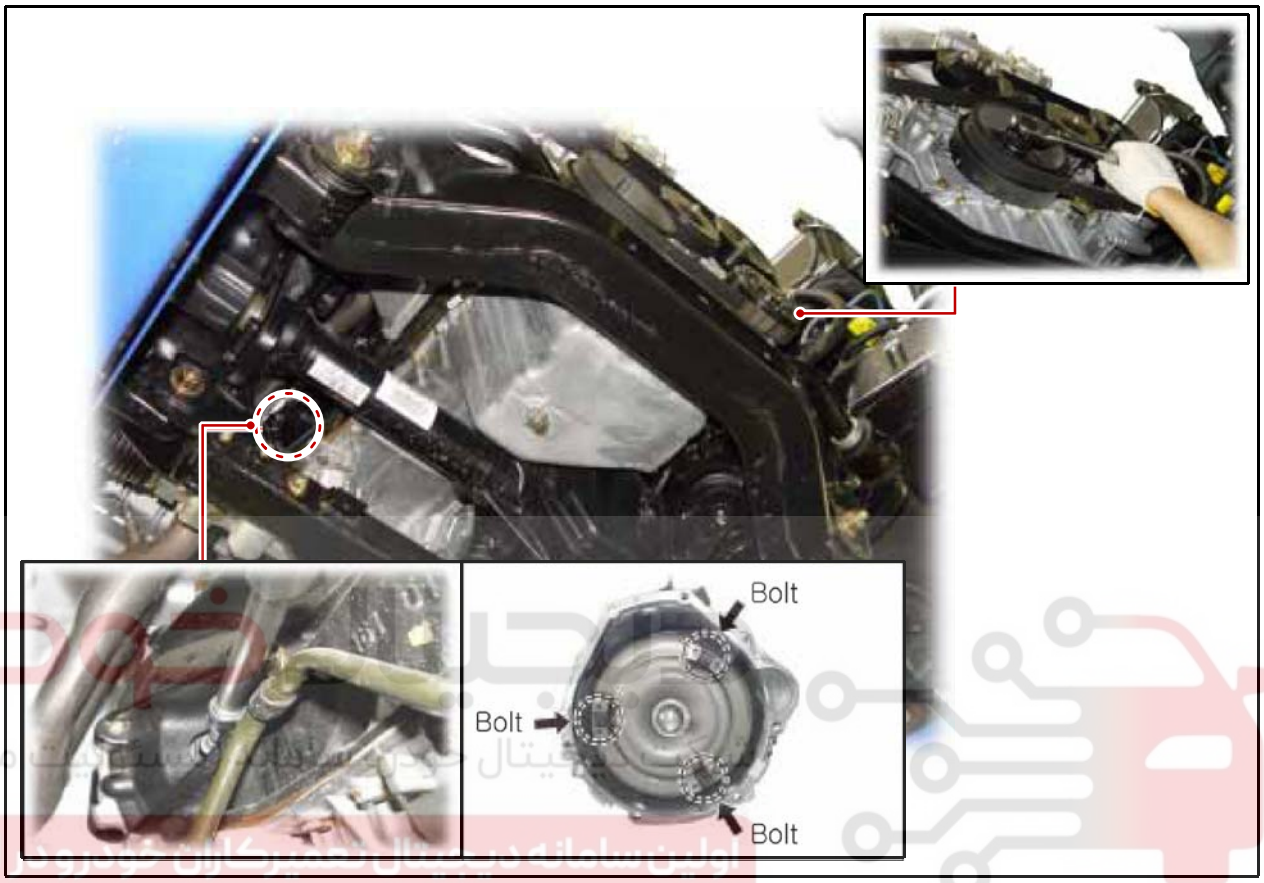


- Remove the V-belt and the power steering pump assembly from the engine.

- Discharge the refrigerant from A/C system, and disconnect the discharge pipe and suction pipe from the compressor.

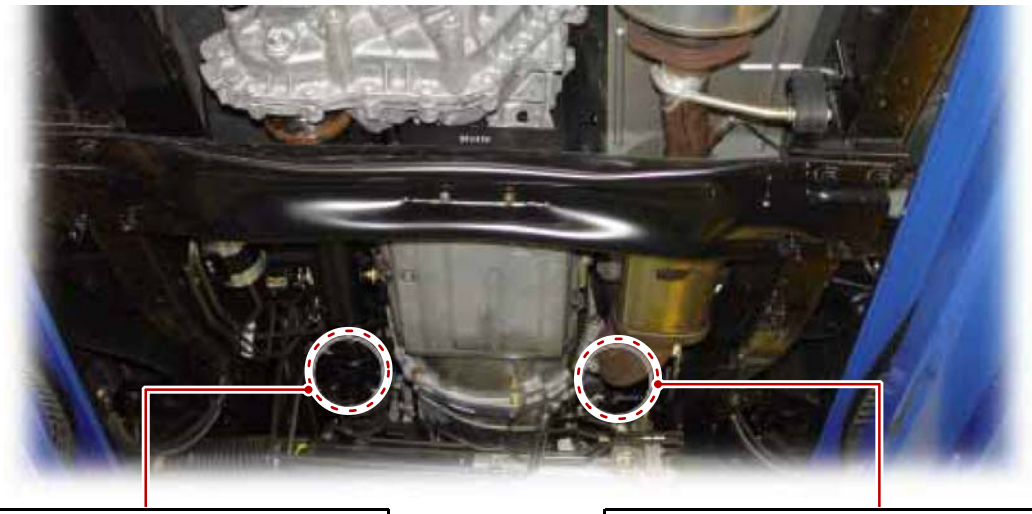
Modification basis	
Application basis	
Affected VIN	

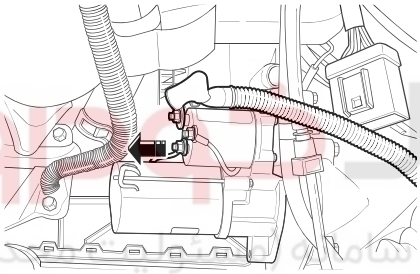
10. By rotating the crankshaft from the front of engine, remove the 6 torque converter mounting bolts from the engine ring gear plate.



11. Remove the automatic transmission oil cooler line retaining bolts from the automatic transmission side and oil pan side.
Remove the automatic transmission oil cooler line retaining bolts from engine side and oil pan side.

12.Remove the automatic transmission.





Disconnect the terminals from starter motor and remove the starter motor.

Remove the exhaust manifold and exhaust pipe.

Tightening torque 30 Nm (22 lb-ft)

Modification basis	
Application basis	
Affected VIN	

13.Connect the chain to the engine bracket and unscrew the mounting bolts and nuts (LH/RH) from the engine mounting.

A RH Mounting Nut

Tightening torque 70 Nm (52 lb–ft)

B Rear Bracket

C Front Bracket

LH Mounting Bolt

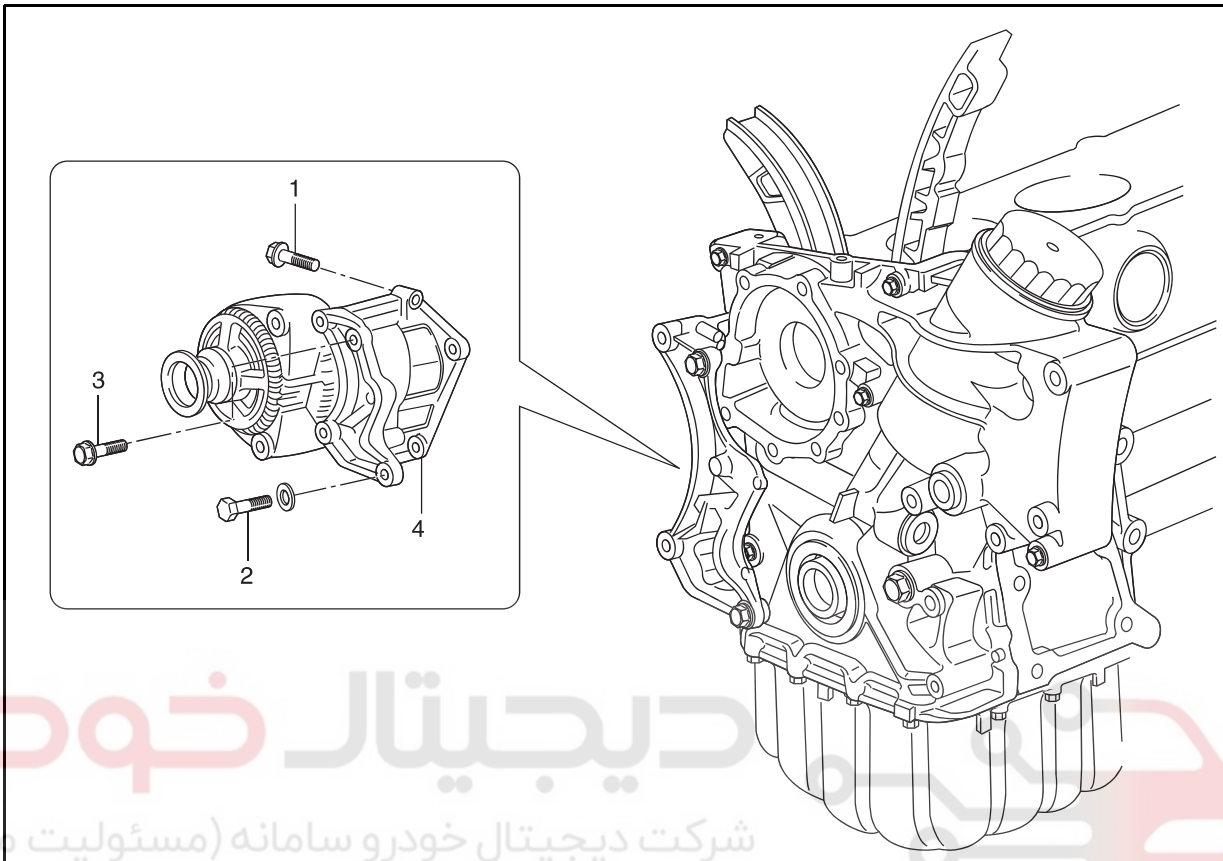
Tightening torque 70 Nm (52 lb–ft)

14.Carefully separate the engine assembly from the vehicle.

15.Installation should follow the removal procedure in the reverse order.

Modification basis	
Application basis	
Affected VIN	

S.G.N.
1452-01 ALTERNATOR



NO.	FUNCTION
1	Bolt (M8 X 40, 3 pieces)..... 22.5 - 27.5 Nm (16.6 - 20.3 lb-ft)
2	Bolt (M8 X 70, 2 pieces)..... 22.5 - 27.5 Nm (16.6 - 20.3 lb-ft)
3	Bolt (M8 X 85, 1 piece)..... 22.5 - 27.5 Nm (16.6 - 20.3 lb-ft)
4	Alternator Bracket

1. Disconnect the negative battery cable.
2. Remove the drive belt.
3. Remove the alternator.
4. Unscrew the alternator carrier bolts and remove the carrier.

Tightening torque **70 Nm (52 lb–ft)**

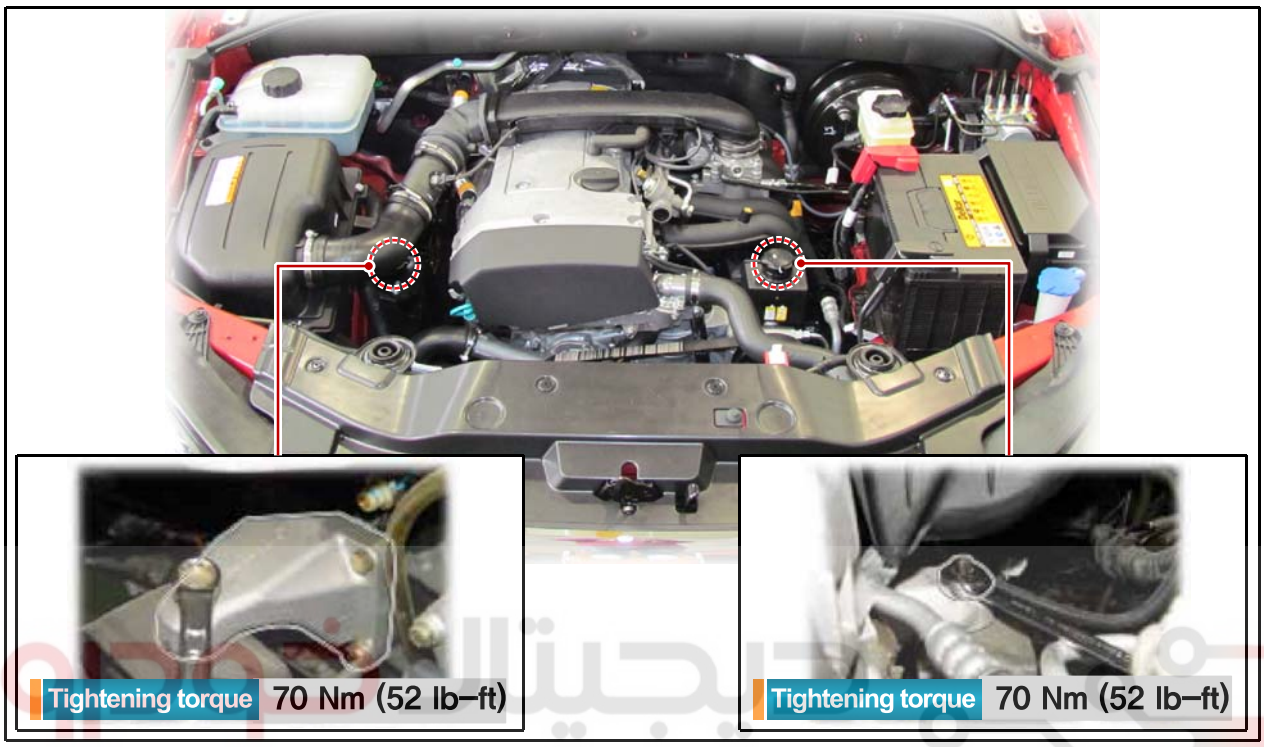
CAUTION

- Apply 3 Nm of torque when mounting the bolt (1) apply 25 Nm of torque when mounting the bolts (2), and (3) and then tighten the bolt (1) with 25 Nm of torque.

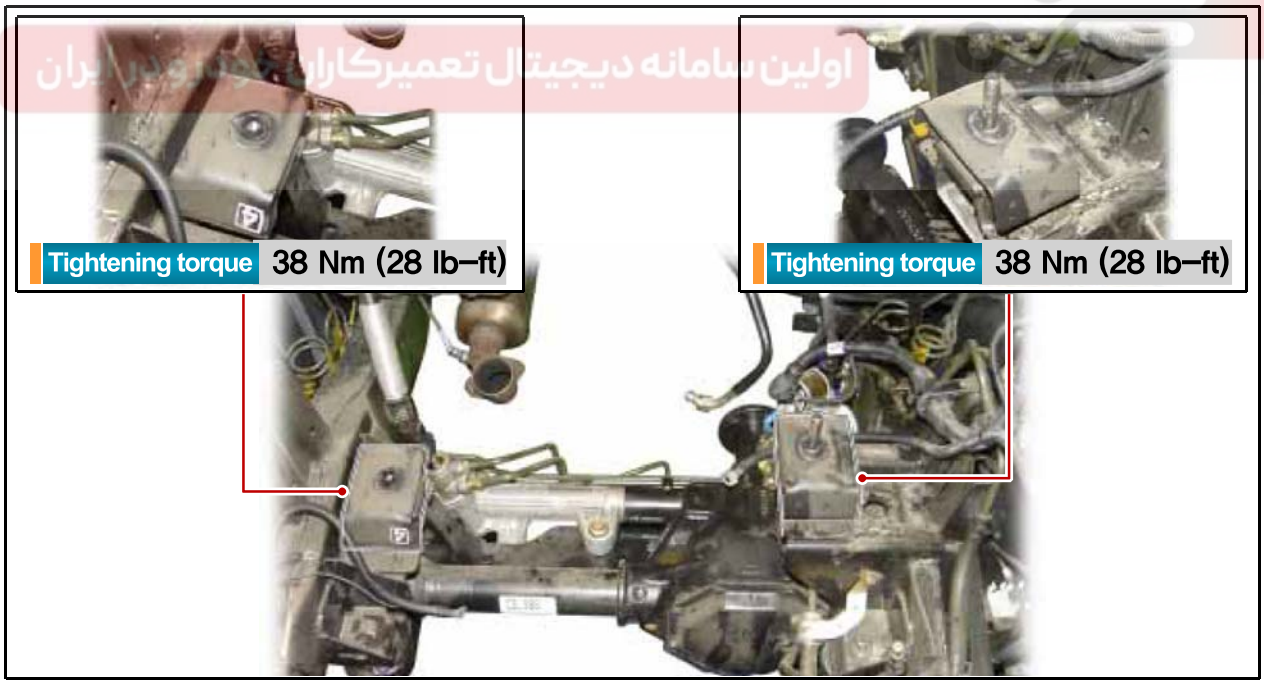
5. Installation should follow the removal procedure in the reverse order.

S.G.N.
1113-01 ENGINE MOUNT

1. Unscrew the upper engine mount nut or bolt and remove the engine.



2. Unscrew the lower nuts.



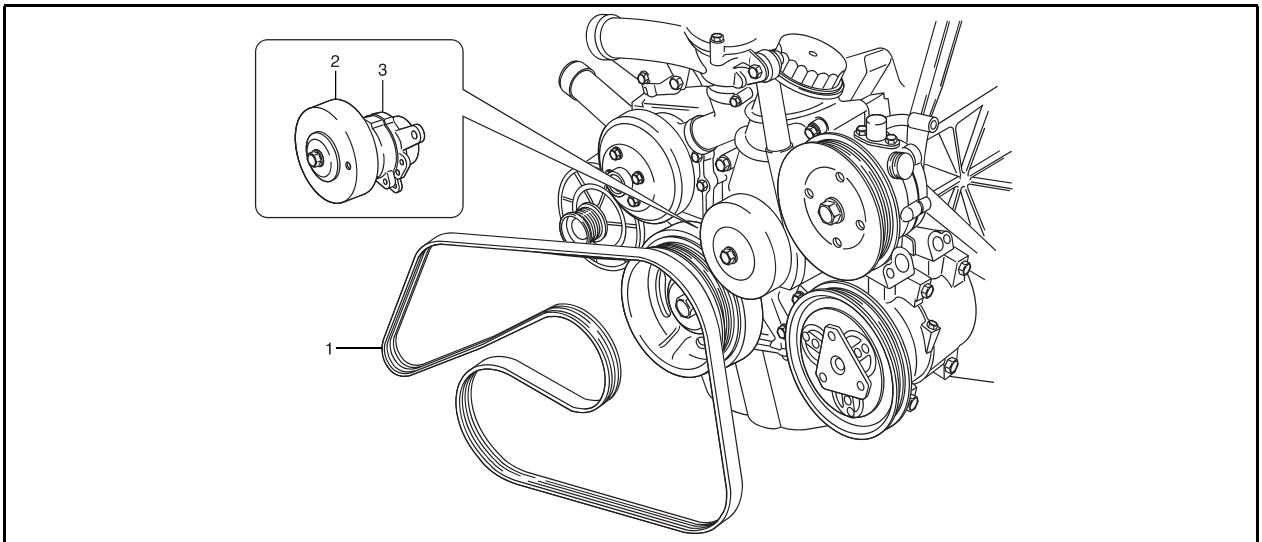
3. Remove the hydraulic engine mounting insulator.
4. Installation should follow the removal procedure in the reverse order.

Modification basis	
Application basis	
Affected VIN	

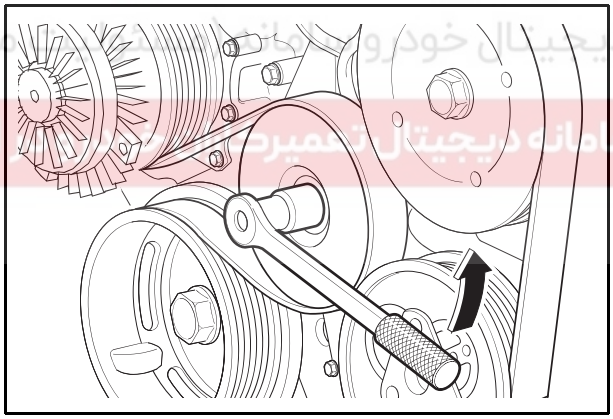
S.G.N. 1130-07

POLY V-BELT

Preceding work 1. Removal of cooling fan



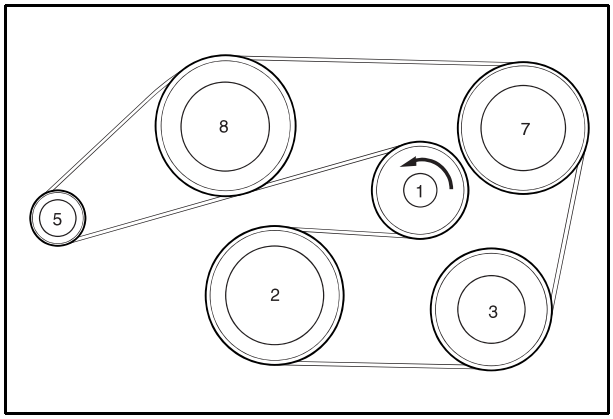
NO.	FUNCTION	NO.	FUNCTION
1	Poly V-Belt (2,155 mm)	3	Belt Tensioner
2	Belt Tensioning Pulley		



1. Release the belt tension by turning the stud on the cap with 12 sided wrench or spanner counterclock-wise.
2. Remove the poly v-belt.

CAUTION
- Check the belt for damage and tensioning pulley bearing point for wear and replace them if necessary.

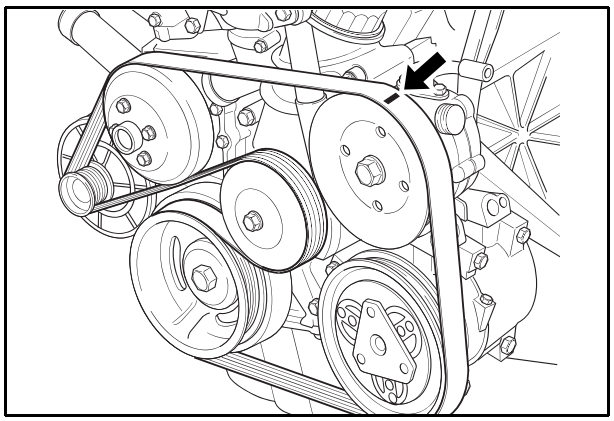
3. Install the belt after prying the tensioning pulley.



CAUTION
- Belt Tensioning Pulley
- Crankshaft Belt Pulley
- A/C Compressor Pulley
- Generator Pulley
- Power Steering Pump Pulley
- Water Pump Pulley

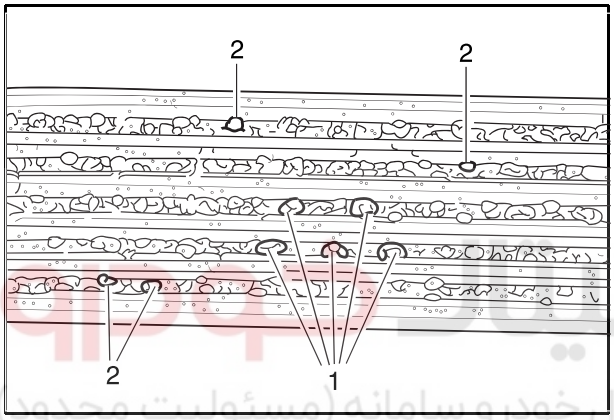
Modification basis	
Application basis	
Affected VIN	

S.G.N.
1130-07 POLY V-BELT INSPECTION

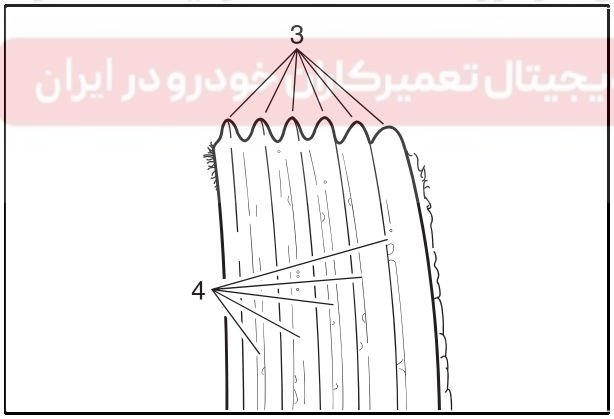


Preceding work 1. Rotate the engine and check the belt for damage.

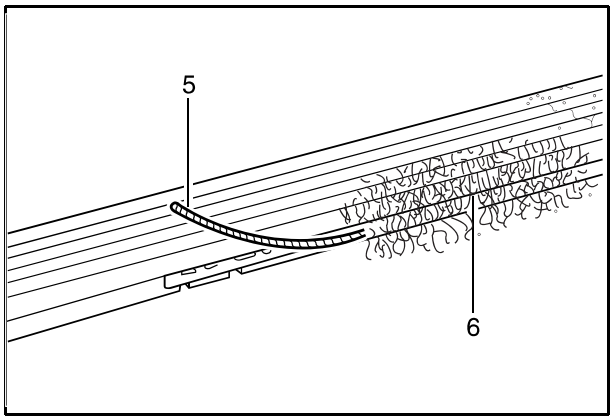
CAUTION
If one of the following types of damages is found, replace the belt.



1. Rubber lumps in the base of rib.
2. Dirt or grit ingrained.

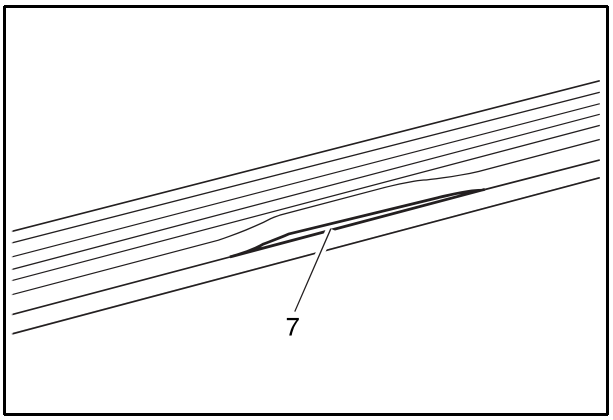


3. Pointed rib.
4. Belt cord visible in the base of rib.

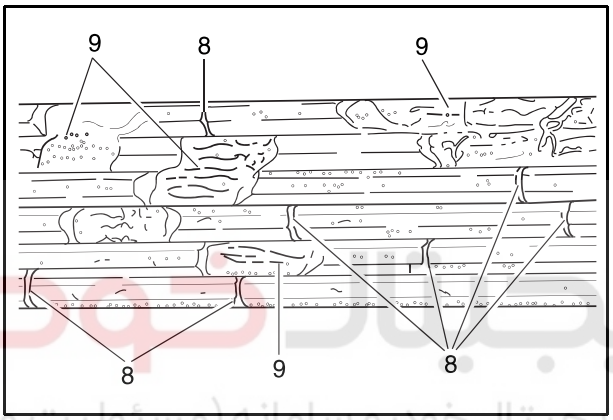


5. Cord torn out at the side.
6. Outer cords frayed.

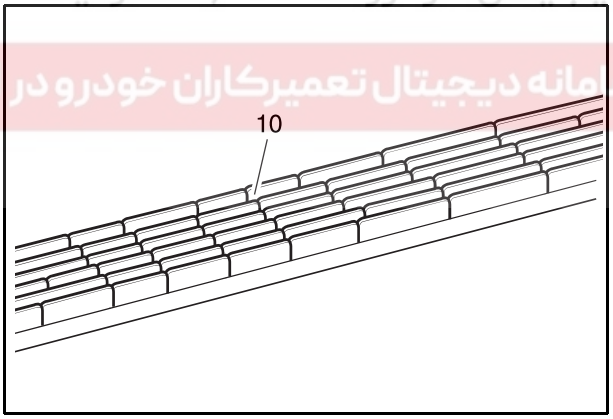
Modification basis	
Application basis	
Affected VIN	



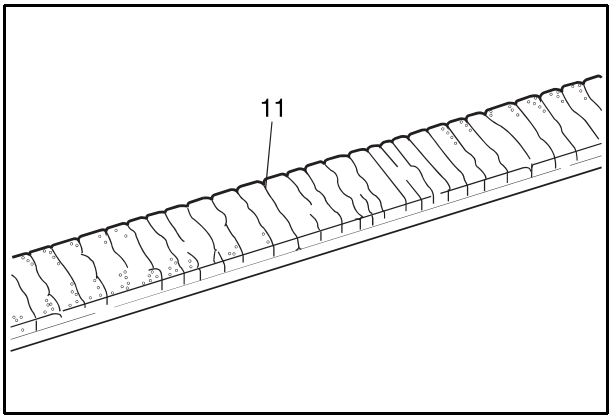
7. Rib detached from the base of belt.



8. Splits across the rib.
9. Sections of rib torn out.



10.Splits across several ribs.

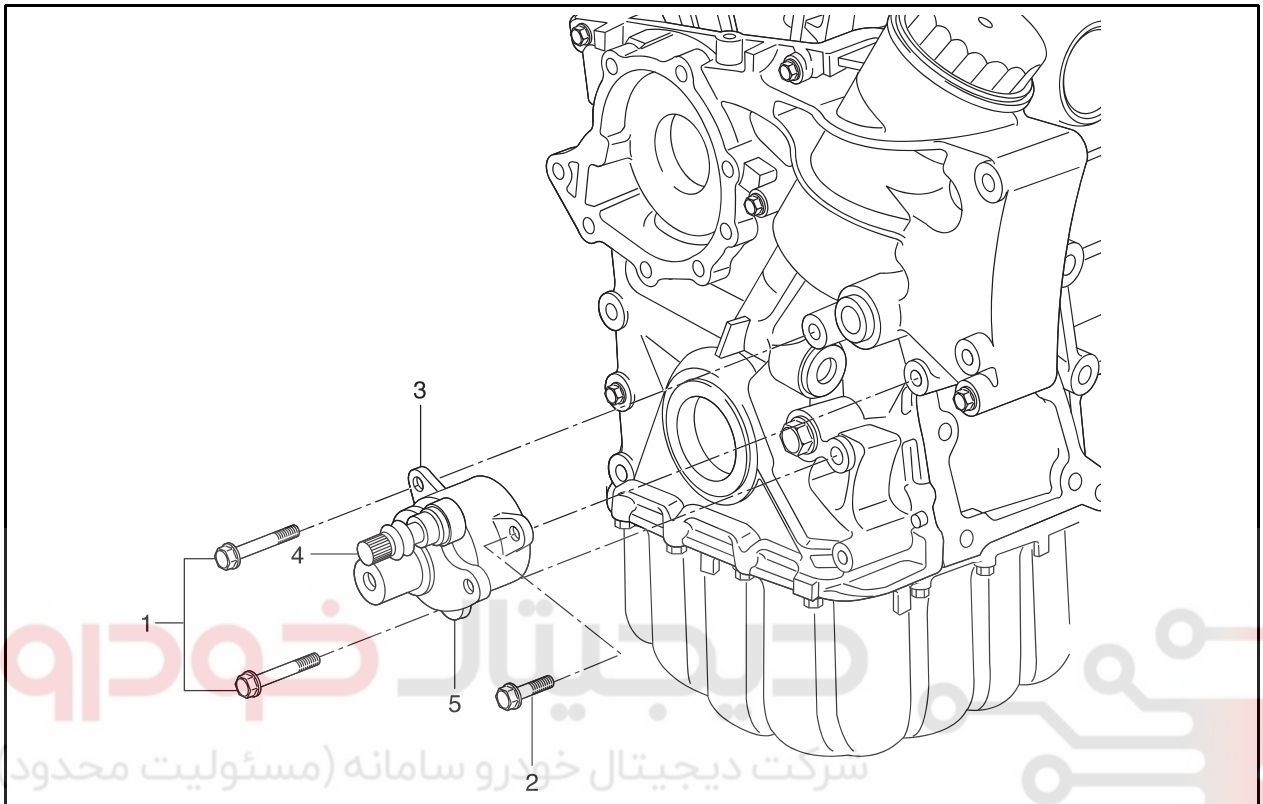


11.Splits across the back of the belt.

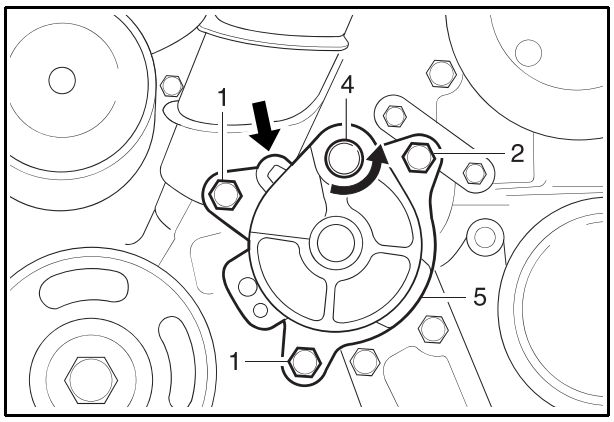
Modification basis	
Application basis	
Affected VIN	

S.G.N.
1332-18 TENSIONING DEVICE

Preceding work 1. Removal of tensioning device shock absorber



NO.	FUNCTION
1	Bolt (M8 x 75, 2 pieces) + Washer ..... 22.5 - 27.5 Nm (16.6 - 0.3 lb-ft)
2	Bolt (M8 x 25, 1 pieces) + Washer ..... 22.5 - 27.5 Nm (16.6 - 0.3 lb-ft)
3	Tensioning Device
4	Stud bolt
5	Tensioning Arm



1. Turn the stud bolt to counterclockwise.
2. Insert the pin into the hole in tensioning arm.
   Unscrew the bolts (1, 2) and remove the
3. tensioning device.

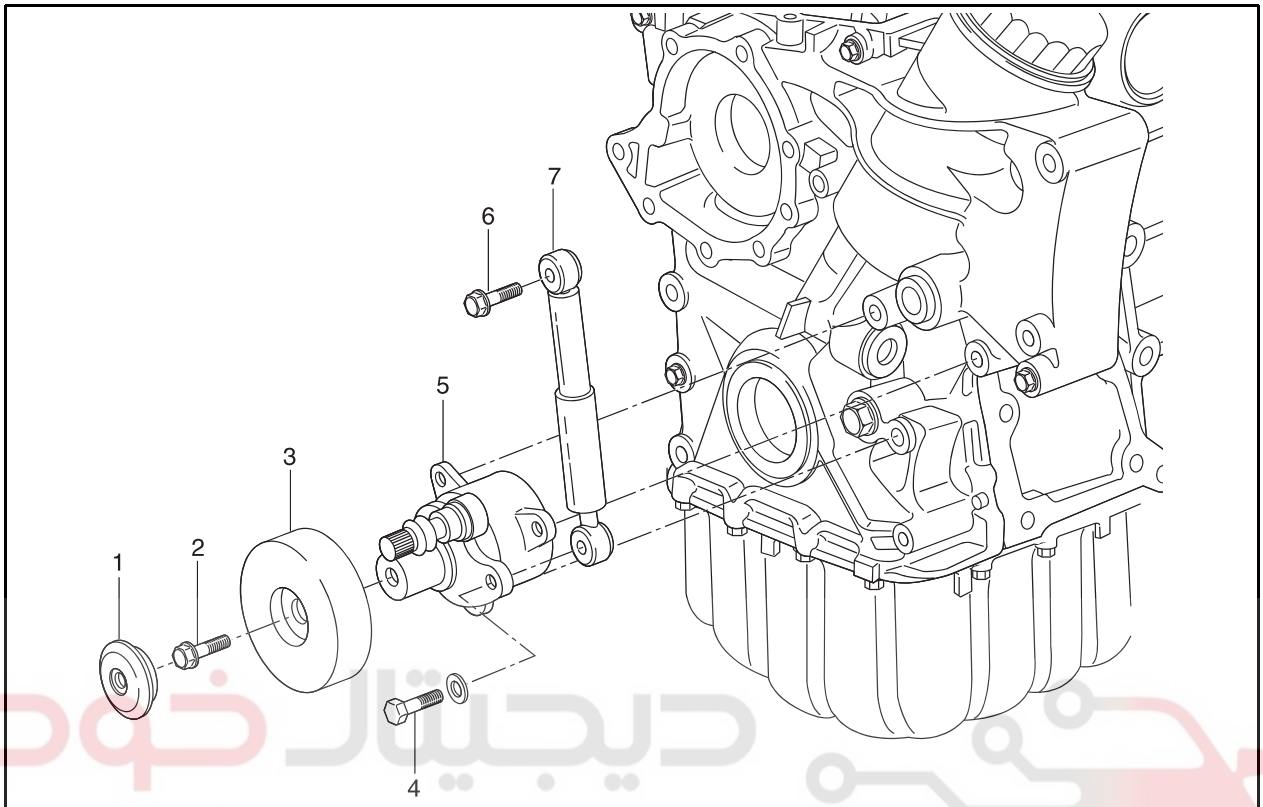
Tightening torque **22.5 – 27.5 Nm (16.6 - 20.3 lb-ft)**

4. Installation should follow the removal procedure in the reverse order.

Modification basis	
Application basis	
Affected VIN	

S.G.N. 1332-18

TENSIONING DEVICE SHOCK ABSORBER



NO.	FUNCTION
1	End Cover
2	Bolt ..... 40.5 - 9.5 Nm (29.9 - 6.5 lb-ft)
3	Tensioning Pulley
4	Bolt (M8 X 25) + Washer ..... 22.5 - 7.5 Nm (16.6 - 0.3 lb-ft)
5	Tensioning Device
6	Bolt (M8 X 35) + Washer ..... 22.5 - 7.5 Nm (16.6 - 0.3 lb-ft)
7	Shock Absorber

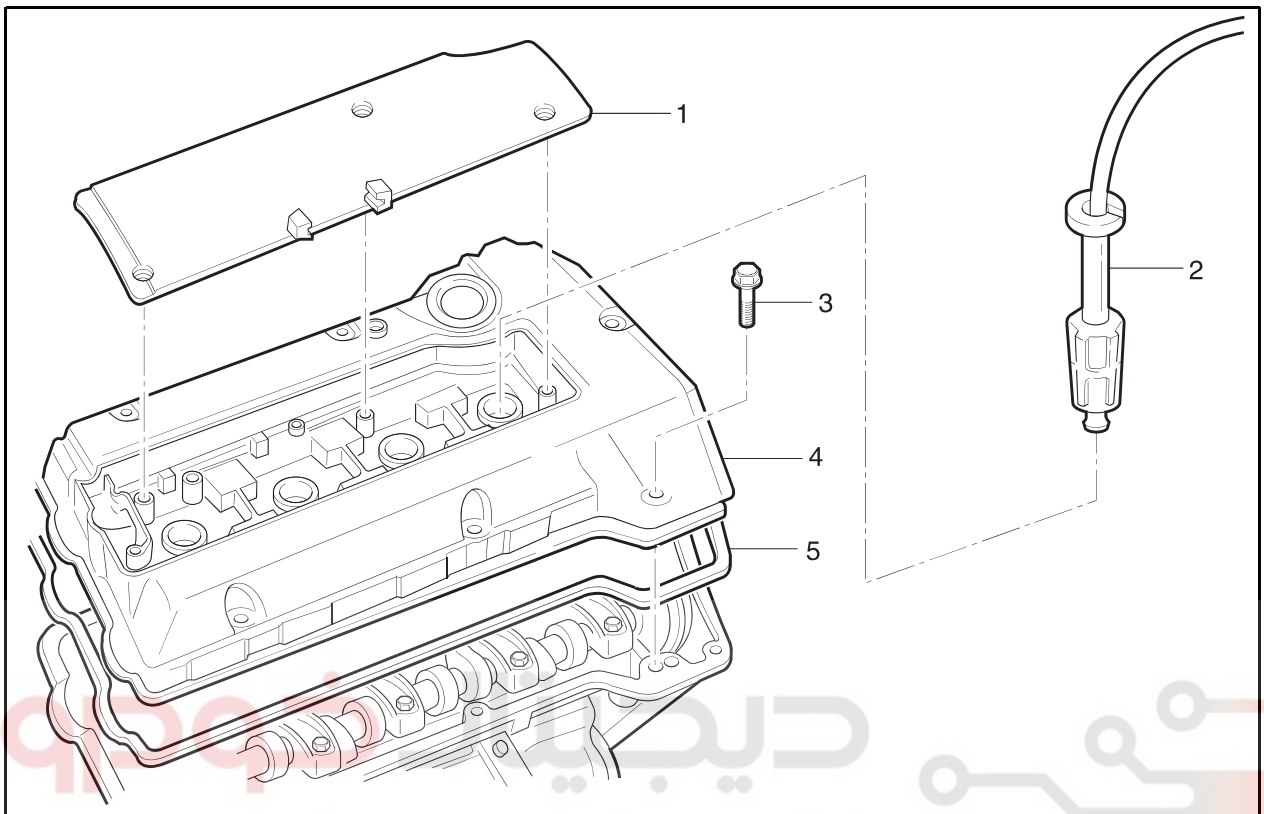
1. Remove the end cover (1).
2. Remove the bolt (2) and remove the tensioning pulley (3).

   Tightening torque **40.5 – 49.5 Nm (29.9 - 36.5 lb-ft)**
3. Unscrew the bolts (4,6) and remove the shock absorber (7).

   Tightening torque **22.5 – 27.5 Nm (16.6 - 20.3 lb-ft)**

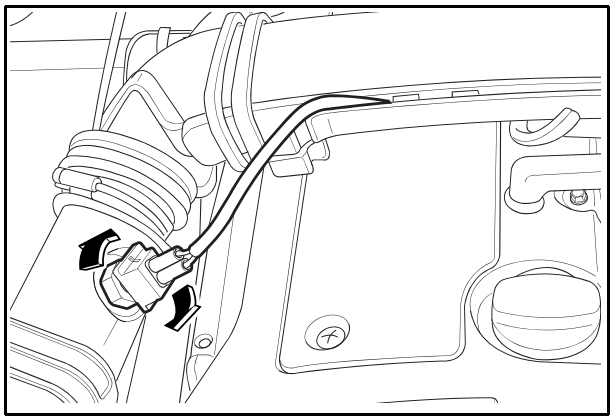
Modification basis	
Application basis	
Affected VIN	

S.G.N.
1221-01 CYLINDER HEAD COVER



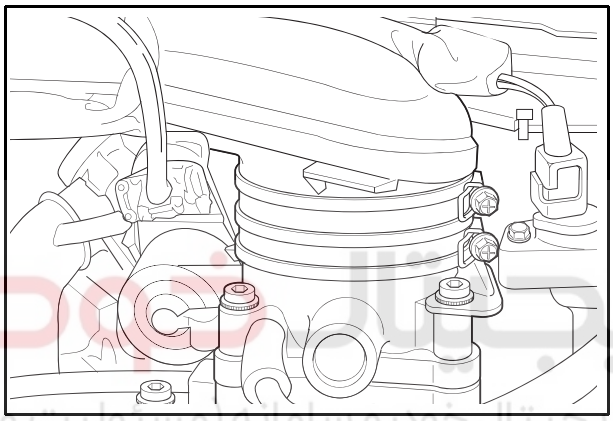
NO.	FUNCTION
1	Spark Plug Cover
2	Spark Plug Connector
3	Bolt (M6 X 45 : 4 pieces, M6 X 60 : 6 pieces) ..... 9 - 11 Nm (80 - 97 lb-in)
4	Cylinder Head Cover
5	Gasket .....Replace

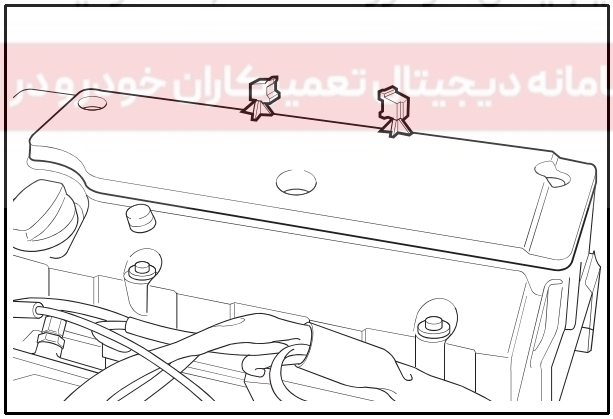
Modification basis	
Application basis	
Affected VIN	



1. Remove the intake air duct.

Tightening torque 9 – 11 Nm (80 - 97 lb-ft)





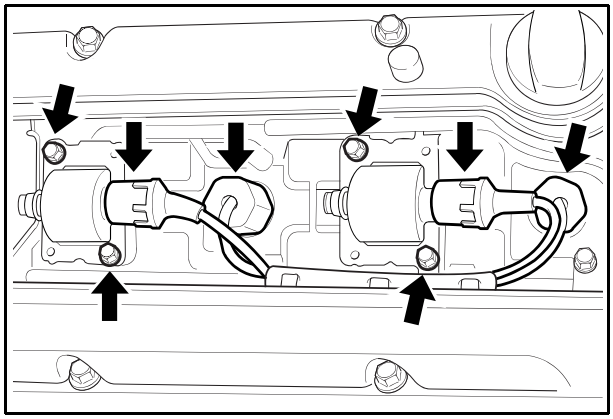
2. Remove the spark plug cover.

Tightening torque 9 – 11 Nm (80 - 97 lb-ft)

CAUTION

- Release 3 screws from the spark plug cover and remove the cover for G23D Engine coil.

3. Remove the spark plug connector and ignition cable.
4. Unscrew the bolts (3) and remove the head cover and the gasket.



Tightening torque 9 – 11 Nm (80 - 97 lb-ft)

CAUTION

- Replace the gasket with a new one if necessary.

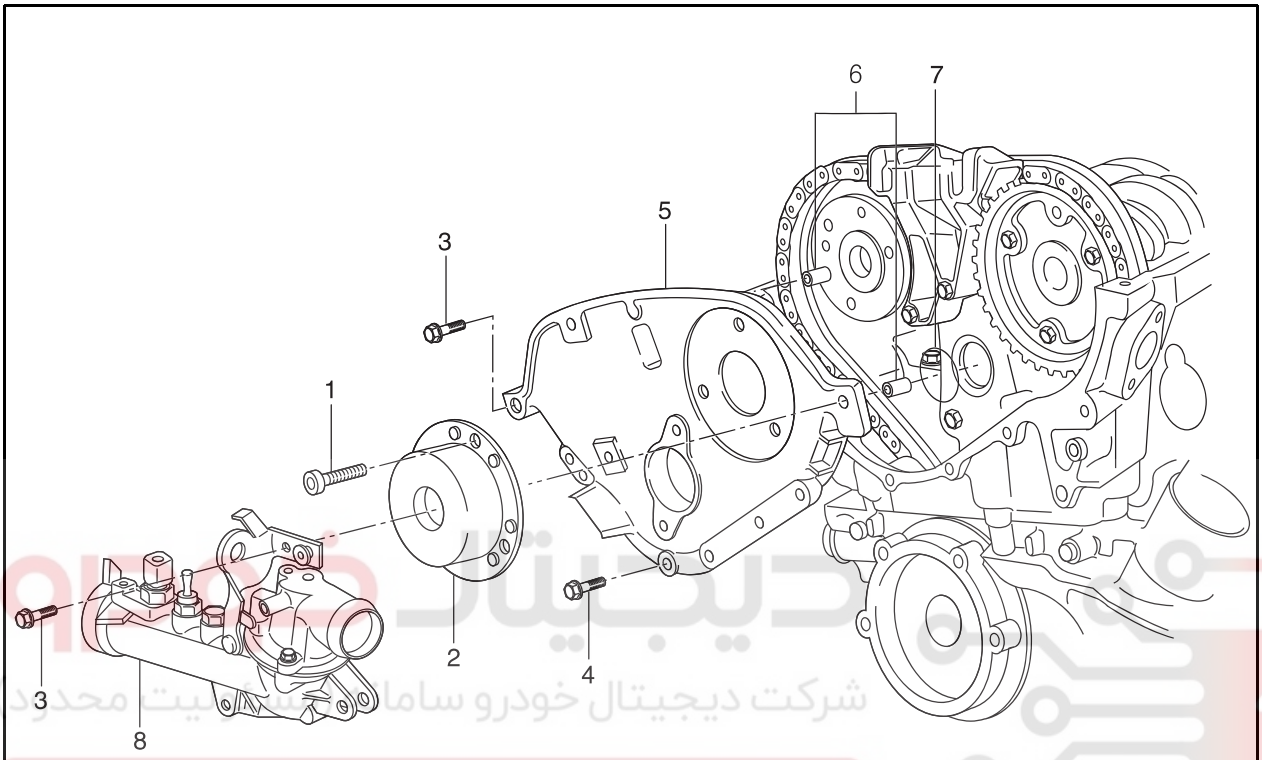
5. Installation should follow the removal procedure in the reverse order.
6. Check for oil leaks by operating the engine.

Modification basis	
Application basis	
Affected VIN	

S.G.N.
1221-02 CYLINDER HEAD FRONT COVER

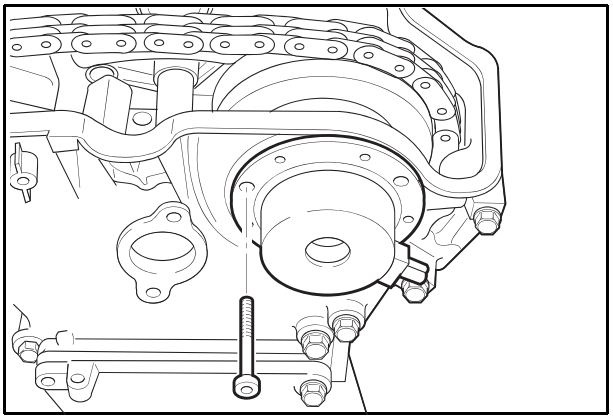
Preceding work

1. Removal of cylinder head cover
2. Removal of thermostat housing assembly
3. Removal of engine hanger bracket



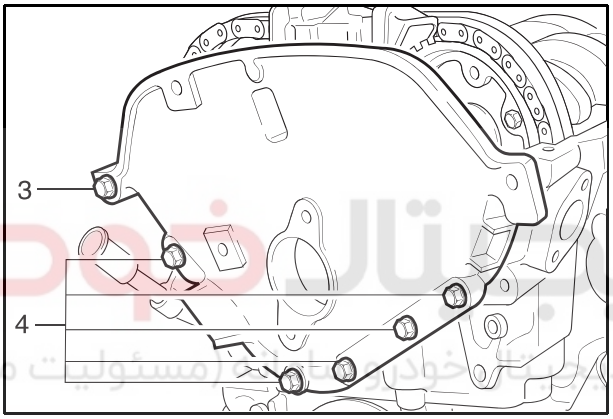
NO.	FUNCTION
1	Bolt (M6 X 16, 3 pieces) ..... 9 - 11 Nm (80 - 97 lb-in)
2	Camshaft Adjuster
3	Bolt (M8 X 35, 2 pieces) ..... 22.5 - 27.5 Nm (16.6 - 20.3 lb-ft)
4	Bolt (M6 X 22, 6 pieces) ..... 9 - 11 Nm (80 - 97 lb-in)
5	Front Cover (E20 : G23D.943)
6	Sleeve
7	O-Ring .....Replace
8	Thermostat Housing.

Modification basis	
Application basis	
Affected VIN	



1. Disconnect the camshaft adjuster connector and remove the camshaft adjuster.

Tightening torque **9 – 11 Nm (80 - 97 lb-ft)**



2. Remove the cylinder head front cover.

Tightening torque **22.5 – 27.5 Nm (16.6 - 20.3 lb-ft)**

- Apply the sealant at the mating surface of the cylinder head and the front cover.

3. Remove the O-Ring.

CAUTION

- Replace the O-ring with new one and apply the sealant.

4. Installation should follow the removal procedure in the reverse order.

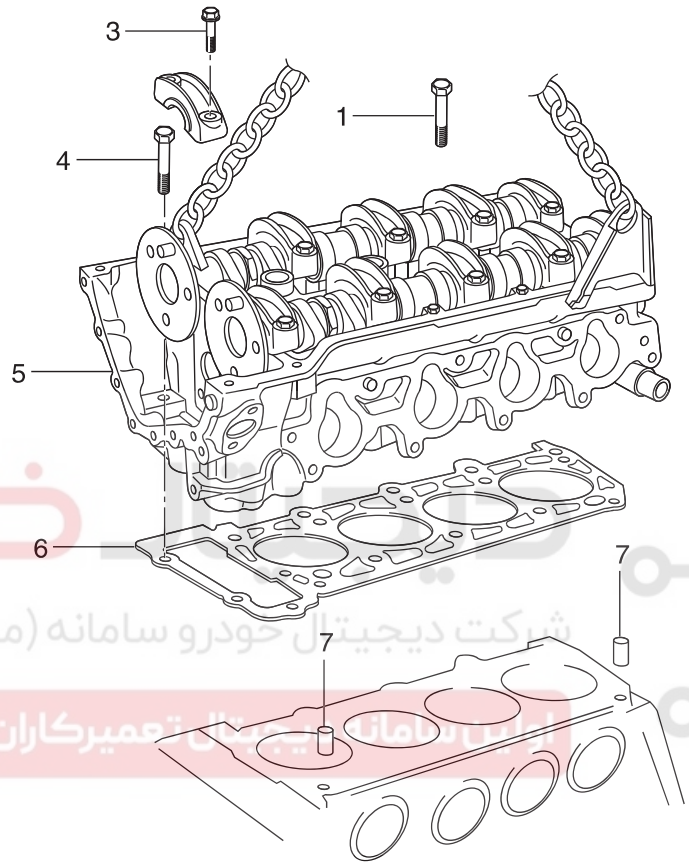
Modification basis	
Application basis	
Affected VIN	

S.G.N. 1221-02

CYLINDER HEAD

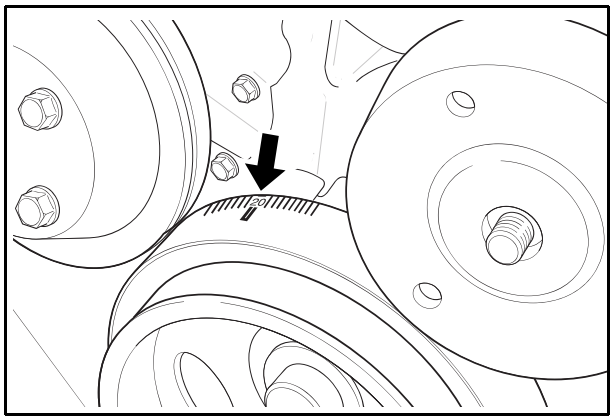
Preceding work

1. Removal of cylinder head cover
2. Removal of cylinder head front cover
3. Removal of intake manifold
4. Removal of cylinder head lower line (intake manifold side)



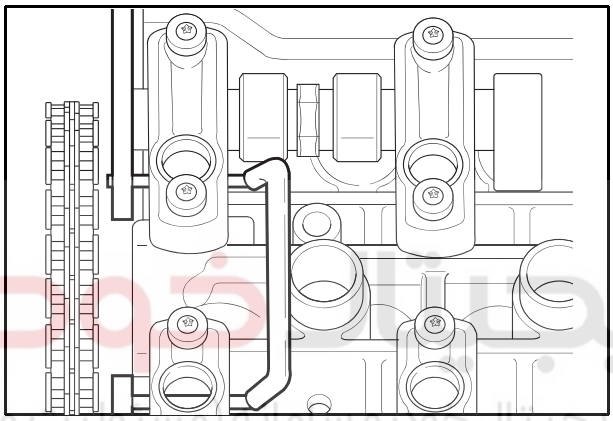
NO.	FUNCTION
1	Cylinder Head Bolt (M12 X 100, 10 pieces) ..... 1ststep 55 Nm (41 lb-ft) ..... 2nd step 90 rotation°added ..... 3rd step 90 rotation°addedio
3	Bolt (M8 X 35, 4 pieces) ..... 22.5 - 27.5 Nm (16.6 - 0.3 lb-ft)
4	Camshaft Bearing cap
5	Cylinder Head
6	Gasket .....Replace
7	Dowel Sleeve..... Note

Modification basis	
Application basis	
Affected VIN	

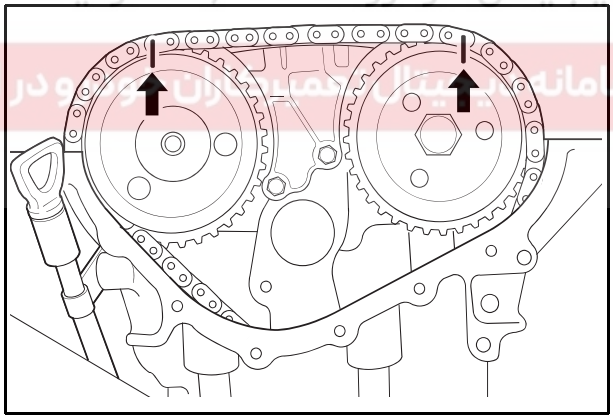


CAUTION
- A9912 0080B (617 589 00 10 00) Allen Wrench Socket
- A9913 0080B (116 589 20 33 00) Sliding Hammer
- A9913 0061B (116 589 01 34 00) Threaded Pin

1. Rotate the crankshaft so that the piston of number 1 cylinder is at ATDC 20.

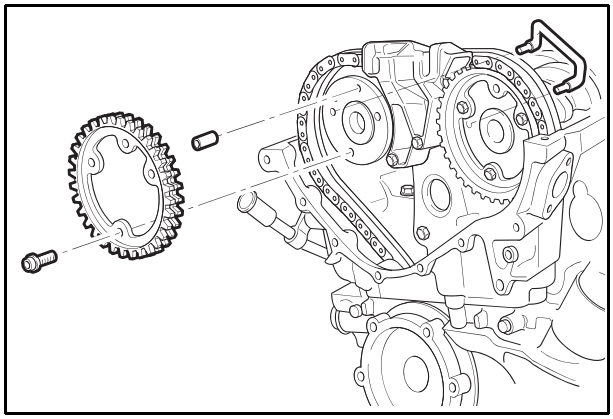


2. Put the holding pin A9913 0052B (111 589 03 15 00) into the cam-shaft bearing cap.



3. Put the alignment marks (arrows) on the timing chain and camshaft sprocket.
4. Remove the chain tensioner.

Tightening torque 72 – 88 Nm (53 - 65 lb-ft)

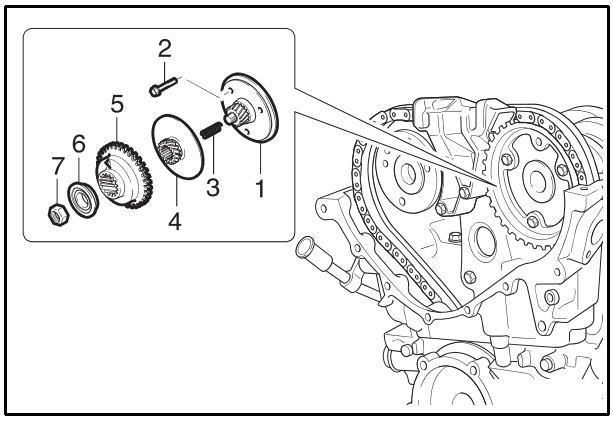


5. Remove the exhaust camshaft sprocket.

Tightening torque 1st step: 18 – 22 Nm (13 - 16 lb-ft)
2nd step: 60° ± 5°

CAUTION
- The flange bolt is designed to be used only once, so always replace with new one.

Modification basis	
Application basis	
Affected VIN	

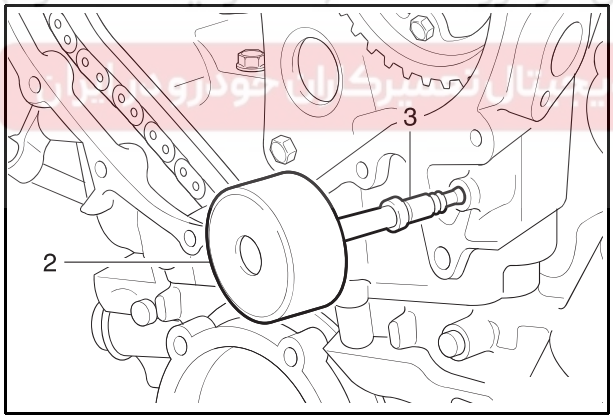


6. Remove the camshaft adjuster.

Tightening torque **1st step: 18 – 22 Nm (13 - 16 lb-ft)**
2nd step: 60° ± 5°

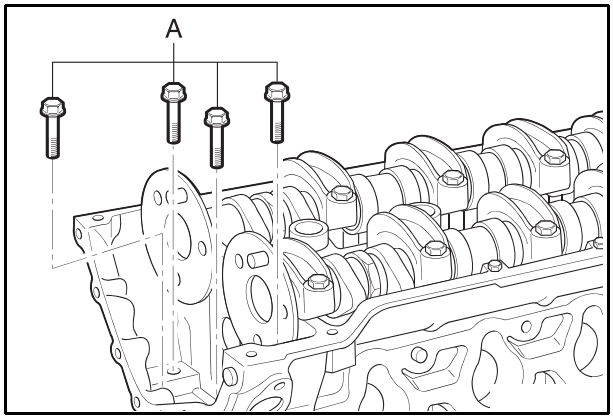
CAUTION
- The flange bolt is designed to be used only once, so always replace with new one.

- Flange Shaft
- Flange Bolt
- Compression Spring
- Adjust Piston
- Camshaft Sprocket
- Seal Cover
- Nut



7. Remove the guide rail pin using the sliding hammer A9913 0080B (116 589 20 33 00) (02) and the threaded pin A9913 0061B (116 589 01 34 00) (03).

CAUTION
- Apply the sealant on guide rail pin when installation.

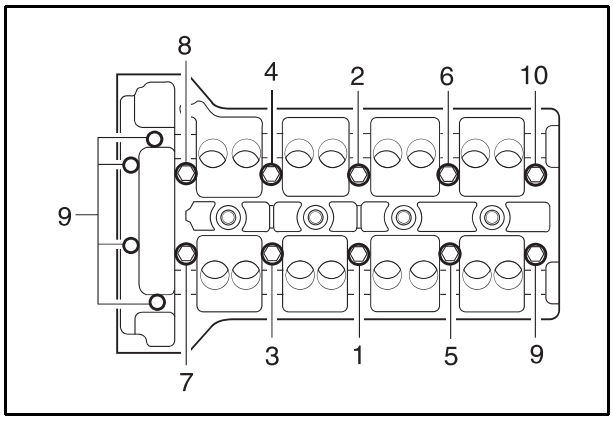


8. Unscrew the bolts (A).

Tightening torque **22.5 – 27.5 Nm (16.6 - 20.3 lb-ft)**

- Bolt (A) : (M8 X 35, 4 pieces)

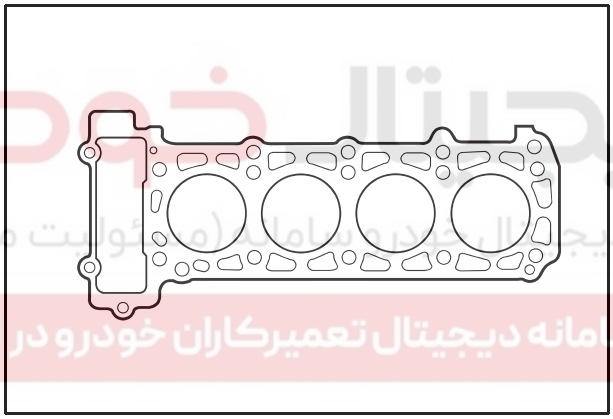
Modification basis	
Application basis	
Affected VIN	



9. Remove the cylinder head bolts in the reverse order of the numerics (No.10 → No.1) using allen wrench socket A9912 0080B (617 589 00 10 00).
   - Tighten the bolts as numerical order with specified torque (No.1 No.10). →

Tightening torque **1st step: 55 Nm(41 lb-ft)**
2nd step: +90 °
3rd step: +90 °

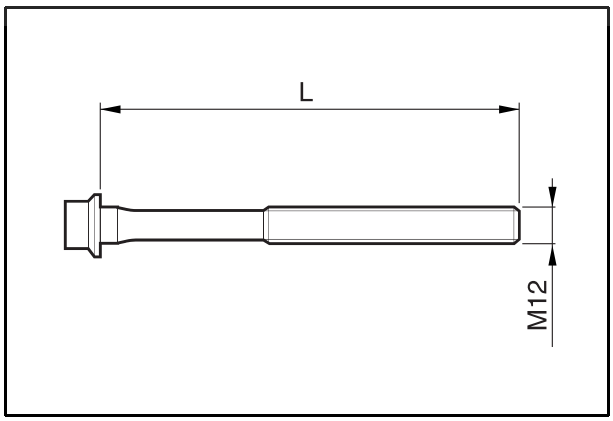
CAUTION
- Operate during engine cooling.



10. Remove the No. 1 bearing cap of the exhaust camshaft.

Tightening torque **22.5 – 27.5 Nm (16.6 - 20.3 lb-ft)**

11. Carefully remove the cylinder head.
12. Check the cylinder head mating surface and clean the crankcase head bolt mounting hole.
13. Replace the cylinder head gasket with new one.



14. Check the length of the cylinder head bolt.

Length (L)	**When New 100 mm**
	Max. Length 105 mm

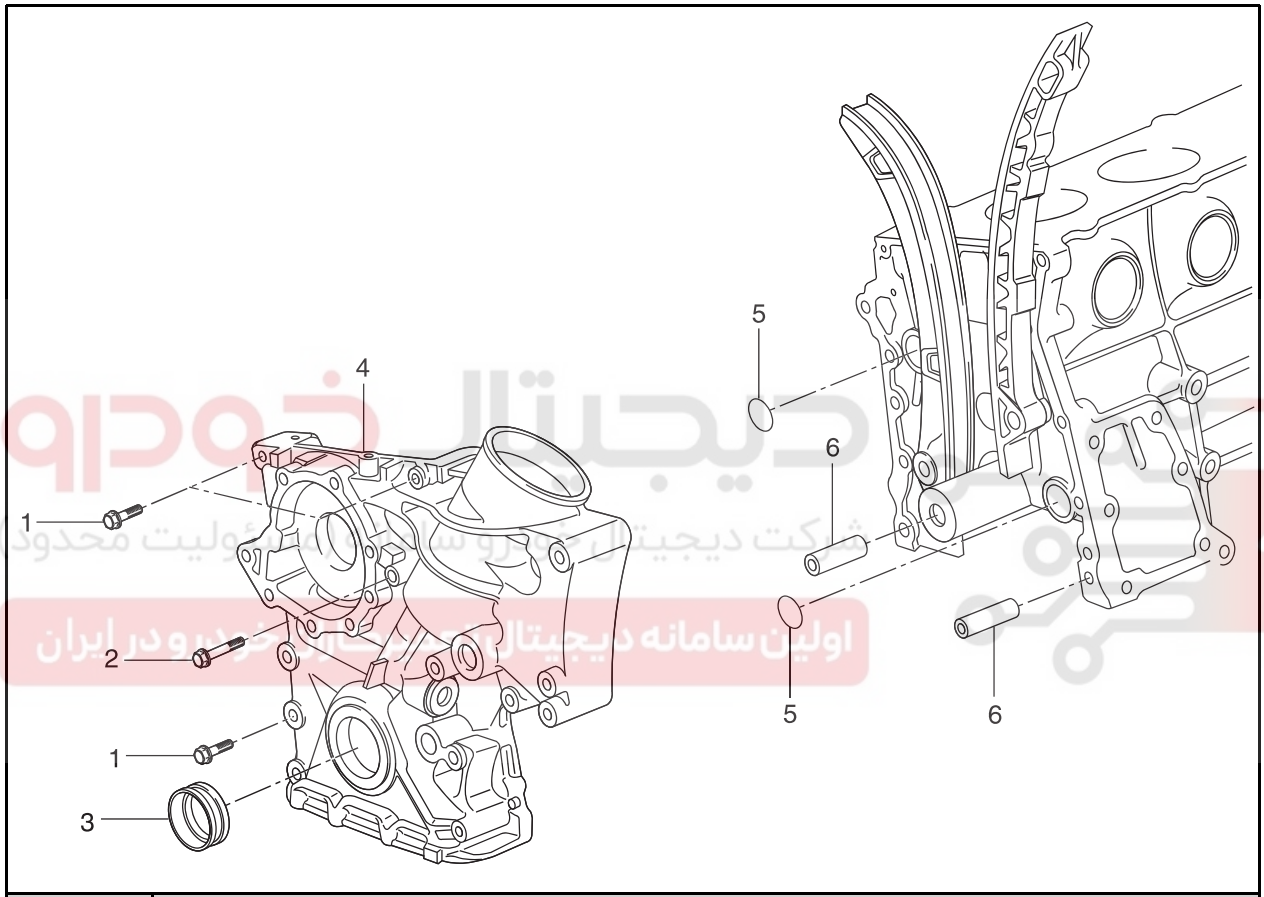
CAUTION
- Replace the bolt if the measured length exceed the max. length.

15. Installation should follow the removal procedure in the reverse order.

S.G.N.
1332-01 TIMING GEAR CASE COVER

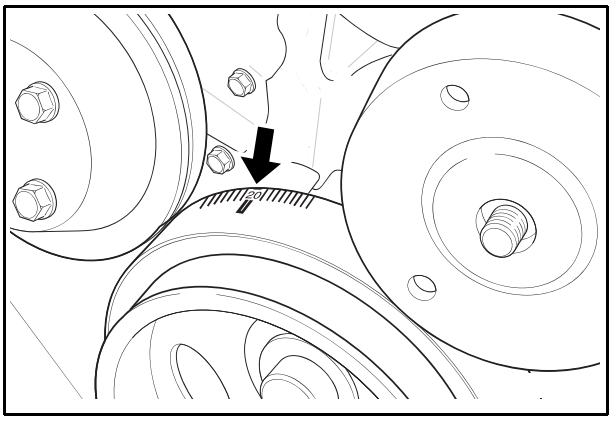
Preceding work

1. Removal of viscous clutch
2. Removal of cylinder head front cover
3. Removal of tensioning device
4. Removal of water pump
5. Removal of oil filter element
6. Removal of oil pan
7. Removal of generator bracket



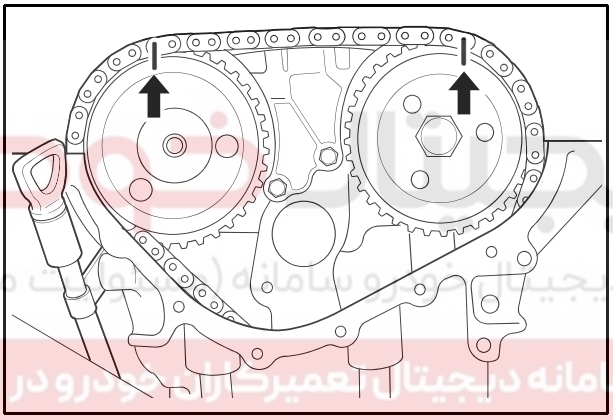
NO.	FUNCTION
1	Bolt (M8 X 60, 3 pieces) ..... 22.5 - 27.5 Nm (16.6 - 20.3 lb-ft)
2	Bolt (M8 X 75, 1 piece) ..... 22.5 - 27.5 Nm (16.6 - 20.3 lb-ft)
3	Seal
4	Timing Gear Case Cover
5	O-Ring
6	Sleeve.

Modification basis	
Application basis	
Affected VIN	



CAUTION
- A9913 0080B (116 589 20 33 00) Sliding Hammer
- A9913 0061B (116 589 01 34 00) Threaded Pin

1. Remove the power steering belt pulley and A/C compressor bracket.
2. Remove the oil line from power steering pump.
3. Rotate the crankshaft so that the piston of number, cylinder is at ATDC 20 °.



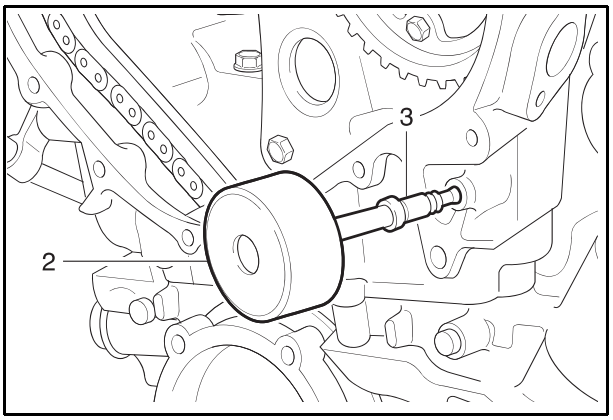
4. Put the alignment marks (arrows) on the timing chain and camshaft sprocket.
5. Remove the chain tensioner.

Tightening torque 72 – 88 Nm (53 - 65 lb-ft)

6. Remove the intake and exhaust camshaft sprocket (remove the camshaft adjuster assembly in E23 engine).

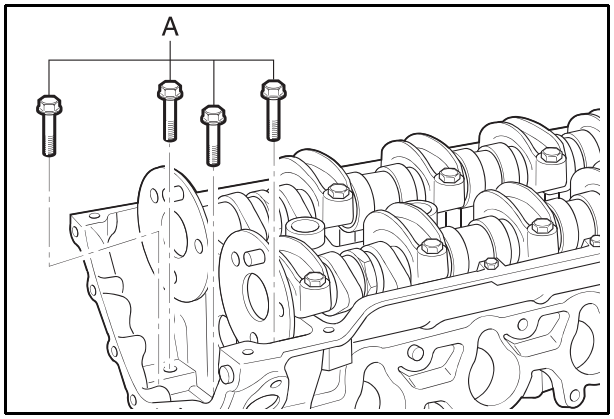
Tightening torque 1st step: 18 – 22 Nm (13 - 16 lb-ft)
2nd step: 60° ± 5°

CAUTION
- The flange bolt is designed to be used only once, so always replace with new one.



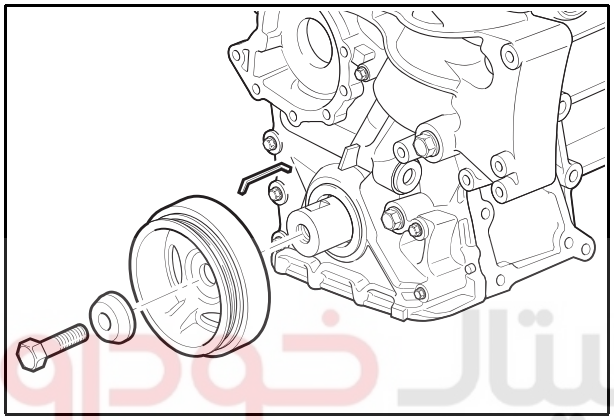
7. Remove the guide rail pin using the sliding hammer A9913 0080B (116 589 20 33 00) (02) and the threaded pin A9913 0061B (116 589 01 34 00) (03).

CAUTION
- Apply the sealant on guide rail pin when installation.



8. RUnscrew the bolts (A).

Tightening torque **22.5 – 27.5 Nm (16.6 - 20.3 lb-ft)**

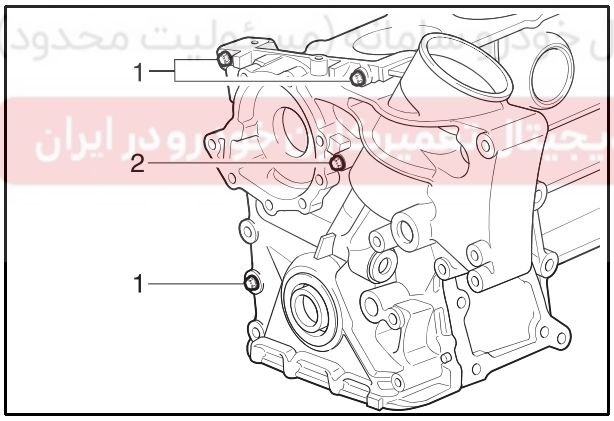


9. Remove the belt pulley and vibration damper.

Tightening torque **1st step: 200 + 20 Nm (148 + 15 lb-ft)**
2nd step: 90° ± 10°

10. Unscrew the bolts (1, 2) on timing gear case cover and remove the timing gear case cover.

Tightening torque **22.5 – 27.5 Nm (16.6 - 20.3 lb-ft)**



CAUTION
- Be careful not to damage the cylinder head gas-ket.

11. Remove the radial shaft seal.

CAUTION
- Installation note replace the seal with new one.

12. Clean the timing gear case cover and crankcase sealing surface.
13. Replace the O-ring with new one and apply the sealant on the sealing surface.

CAUTION
- Be careful not to stain the oil chamber of chain tensioner with the sealant.

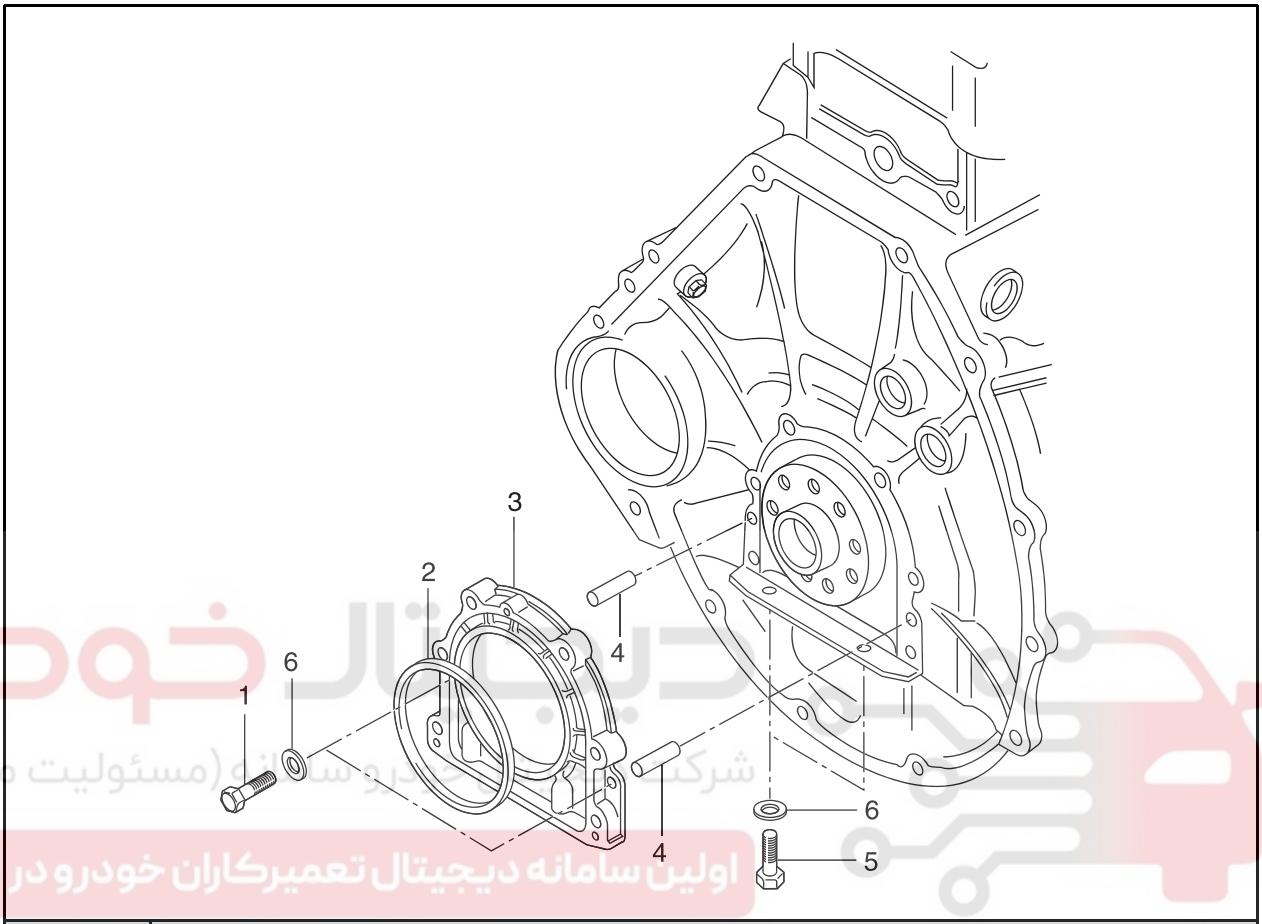
14. Installation should follow the removal precedure in the reverse order.
15. Warm up the engine and check for oil leaks.

Modification basis	
Application basis	
Affected VIN	

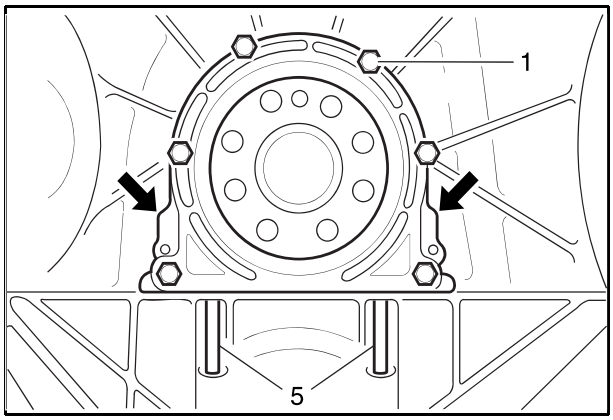
S.G.N. 1124-17

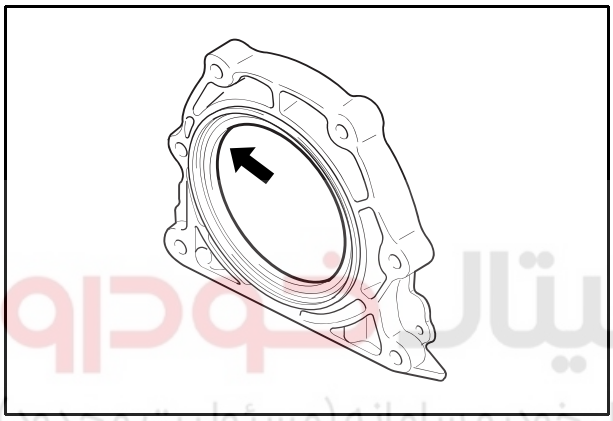
CRANKSHAFT SEALING REAR COVER

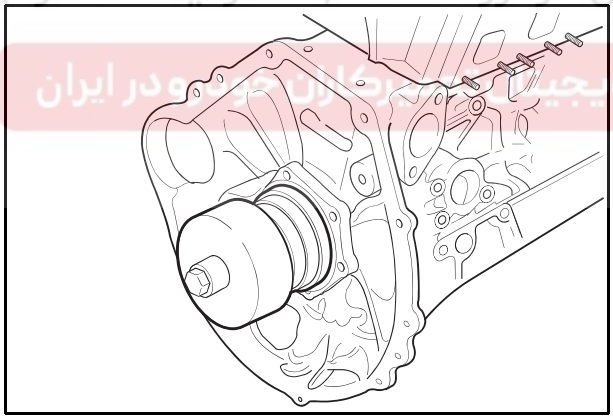
Preceding work 1. Removal of the automatic transmission drive plate or flywheel

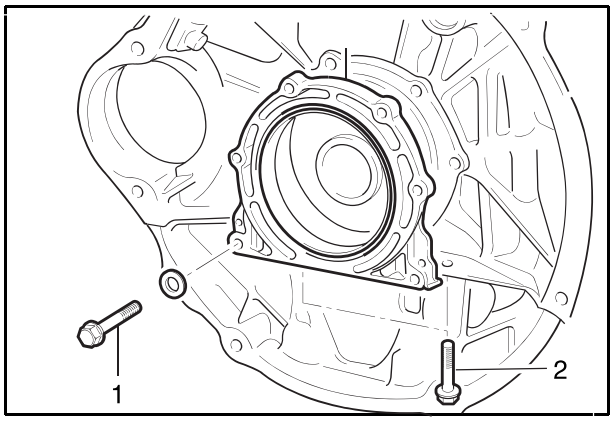


NO.	FUNCTION
1	Bolt (M6 x 20, 6 pieces) ..... 9 - 11 Nm (80 - 97 lb-in)
2	Radial Shaft Seal
3	Rear Cover
4	leeve
5	Bolt (M6 x 85, 2 pieces) ..... 9 - 11 Nm (80 - 97 lb-in)
6	Washer









CAUTION
- W9911 0020B (601 589 03 43 00) Crankshaft Rear Seal Installer

1. Unscrew the bolts (1) and (5) and remove the closing cover by pulling the rear cover lug (arrows).

CAUTION
- Be careful not to damage the oil pan gasket.

2. Clean the sealing surface of the crankcase and the rear sealing cover.
3. Check the radial shaft seal and replace it if necessary.
4. Apply the Loctite 573 to the rear cover sealing surface.
5. Apply the engine oil to the dust lip of the radial shaft seal.

CAUTION
- Do not use the grease.

6. Install the crankshaft rear radial seal and the crankshaft sealing rear cover, using crankshaft rear seal installer W9911 0020B (601 589 03 43 00).

7. Install the crankshaft sealing rear cover mounting bolts and remove the crankshaft rear seal installer W9911 0020B (601 589 03 43 00).

Tightening torque 9 – 11 Nm (80 - 97 lb-ft)

8. Installation should follow the removal procedure in the reverse order.

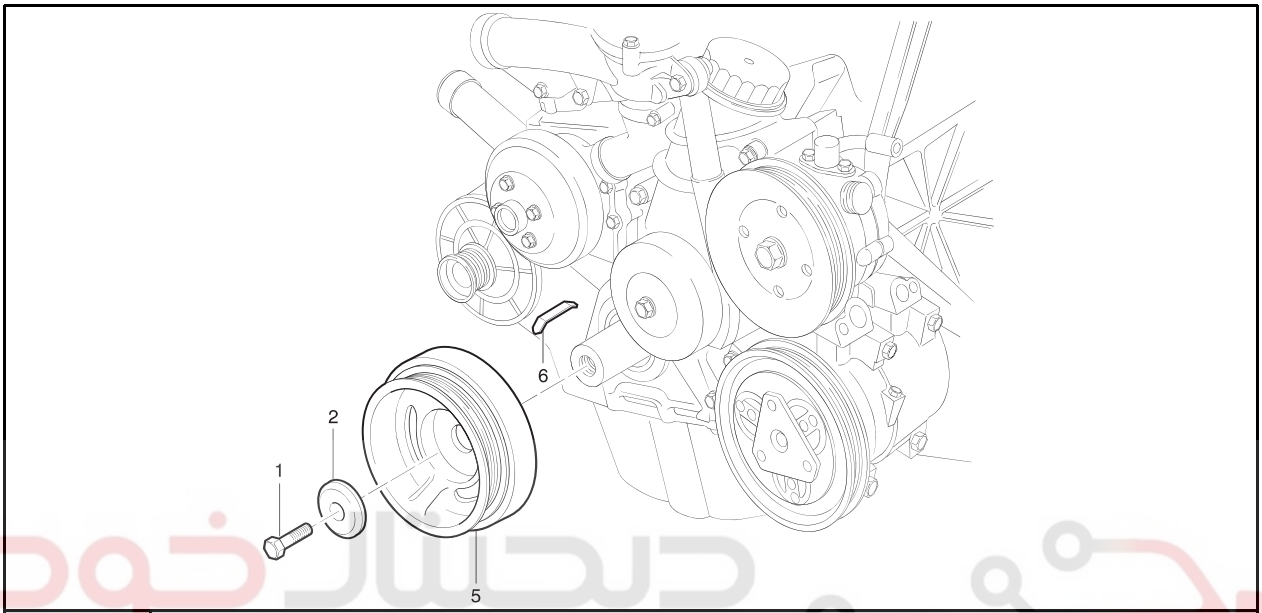
Modification basis	
Application basis	
Affected VIN	

S.G.N. 1130-07

BELT PULLEY AND VIBRATION DAMPER

Preceding work

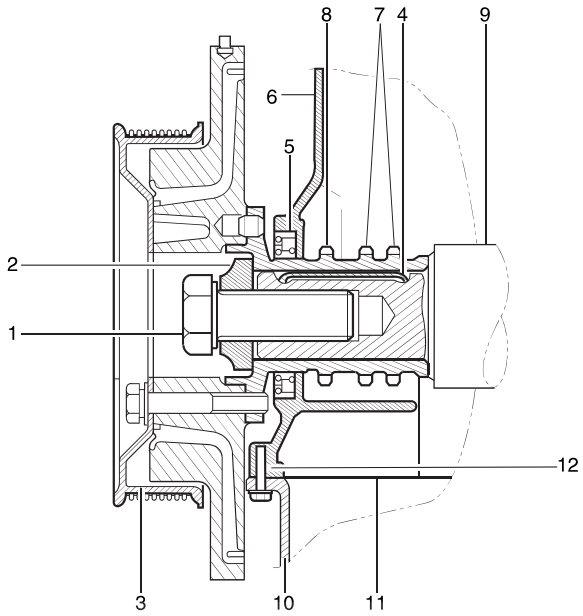
1. Removal of cooling fan and viscous clutch
2. Removal of fan shroud
3. Removal of drive belt



NO.	FUNCTION
1	Vibration Damper Center 1st step 200+20 Nm (148 + 15 lb-ft) 2nd step 90°+ 10° rotation added
2	Vibration Damper Disk
5	Vibration Damper Assembly
6	Key

Modification basis	
Application basis	
Affected VIN	

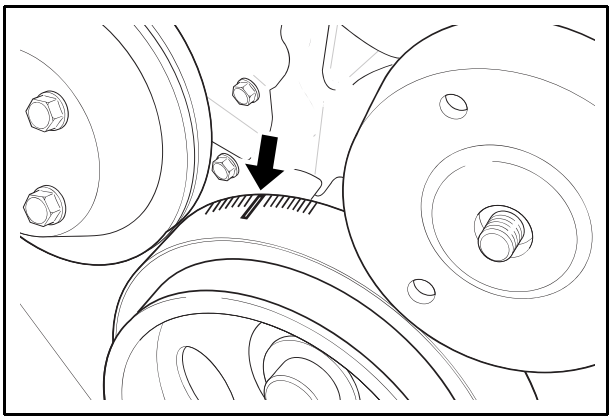
▶ Components



NO.	FUNCTION
1	Center Bolt (M18 x 50)
2	Center Bolt Washer
3	Vibration Damper and Pulley Assembly
4	Key
5	Crankshaft Front Seal
6	Timing Gear Case Cover
7	Crankshaft Sprocket (Camshaft Driven)
8	Crankshaft Sprocket (Oil Pump Driven)
9	Crankshaft
10	Oil Pan
11	Oil Pan Gasket
12	Oil Pan Mounting Bolt (M6 x 22)

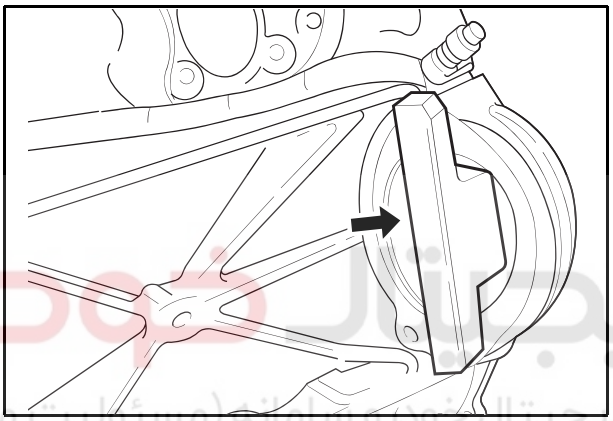
▷ Service Data Standard

Permissble Deviation of The Vibration Damper	**Radial Runout**	0.6 mm
	Axial Ruout	0.6 mm



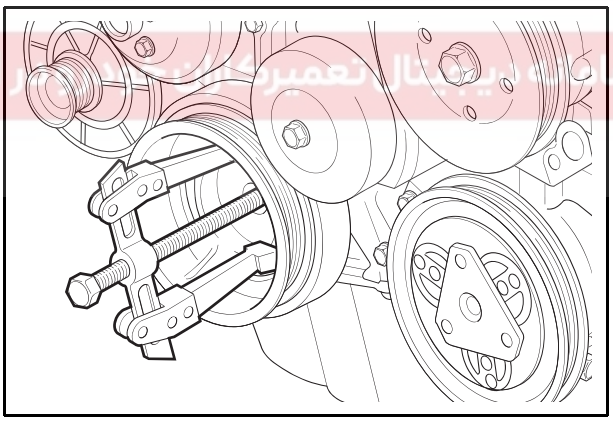
CAUTION
- A9910 0150B (602 589 00 40 00) Engine Lock

1. Adjust the piston of number 1 cylinder to the TDC.



2. Remove the start motor and install the engine lock A9910 0150B (602 589 00 40 00) to the flywheel ring gear.
3. Remove the vibration damper center bolt.

Tightening torque 1st step: 200 + 20 Nm (148 + 15 lb-ft)
2nd step: 90° ± 10°



4. Remove the vibration damper assembly using the puller.
5. Installation should follow the removal procedure in the reverse order.

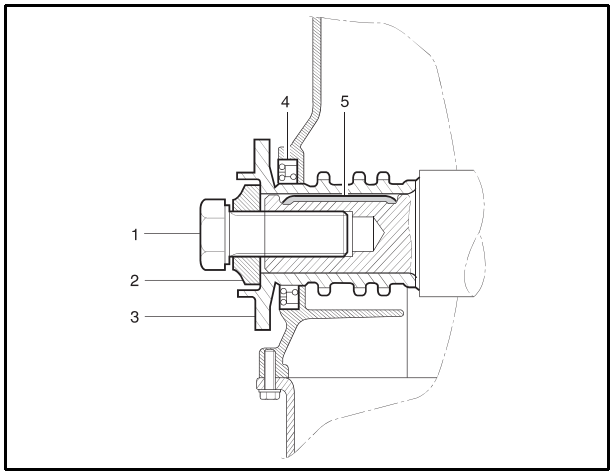
CAUTION
- If possible, don't separate the vibration damper and the pulley.

Modification basis	
Application basis	
Affected VIN	

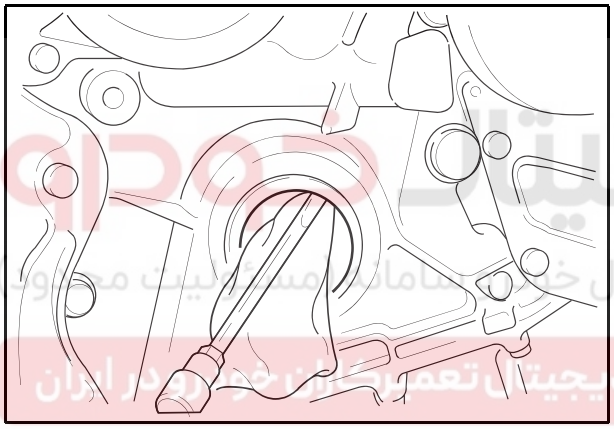
S.G.N. 1131-02

CRANKSHAFT FRONT RADIAL SEAL

Preceding work 1. Removal of belt pulley and vibration damper



1. Center Bolt (M18 x 50)
   - 1st step 200 + 20 45 Nm (148 +15 lb-ft)
   ..... 2nd step 90 + 10 °
2. Center Bolt Washer
3. Crankshaft Front Seal Installer
4. Crankshaft Front Seal
5. Key



CAUTION
- A9911 0060B (601 589 03 14 00) Crankshaft Front Seal Installer

1. Remove the radial seal with a screw driver.

CAUTION
- Use a clean cloth not to damage the radial seal mounting hole and the crankshaft.

2. Coat the radial sealing lip with engine oil.
3. Using the crankshaft front seal installer A9911 0060B (601 589 03 14 00), assemble the radial seal.
4. Align the sleeve groove and the woodruff key and tighten the center bolt until the center bolt and the damper disk stop in the movement.

Tightening torque **1st step: 200 + 20 Nm (148 + 15 lb-ft)**
2nd step: 90° ± 10°

5. Remove the crankshaft front seal installer A9911 0060B (601 589 03 14 00), and install the belt pulley and the vibration damper.
   Check for leaks while operating the engine.
6.

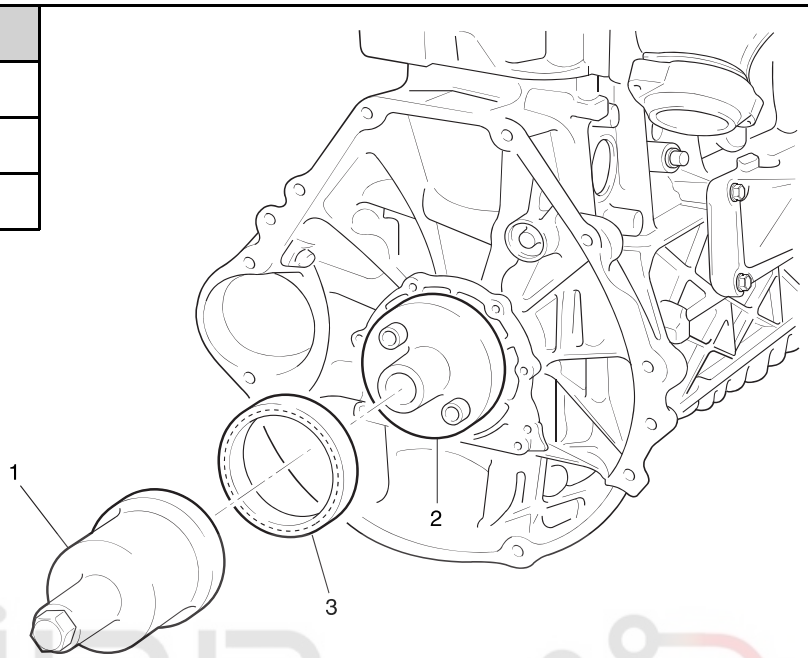
Modification basis	
Application basis	
Affected VIN	

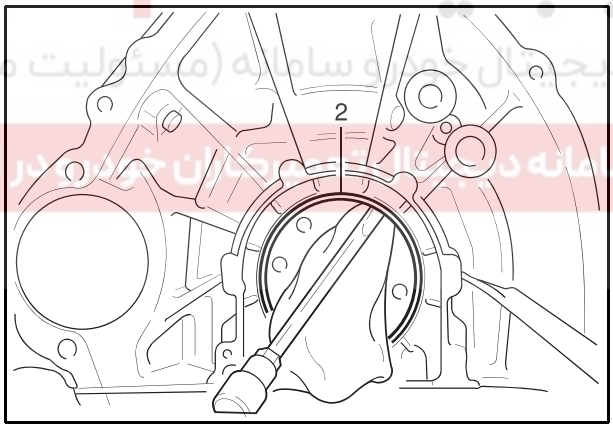
S.G.N. 1124-16

CRANKSHAFT REAR RADIAL SEAL

Preceding work 1. Removal of flywheel or drive plate

NO.	FUNCTION
1	Special Tool
2	Special Tool
3	Crankshaft Rear Seal





CAUTION
- W9911 0020B (601 589 03 43 00) Crankshaft Rear Seal Installer

1. Remove the radial seal with a screw driver.

CAUTION
- Use a clean cloth not to damage the radial seal mounting hole and the crankshaft.

2. Install the special tool (2) to the crankshaft.
3. Apply the engine oil on the special tool (2).

CAUTION
- Do not use the grease.

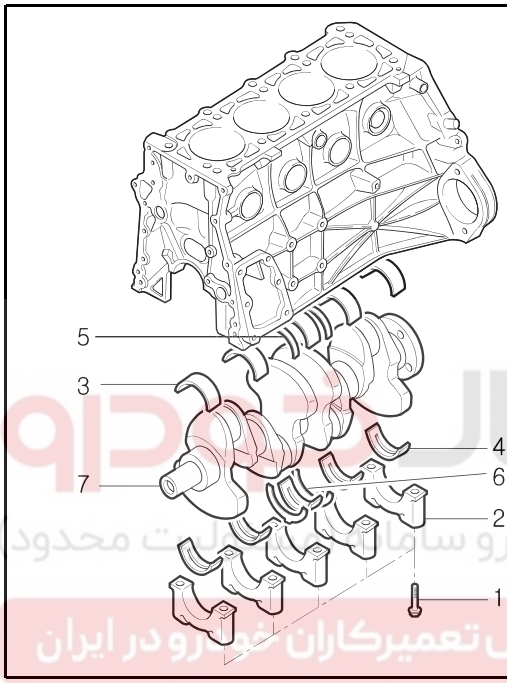
4. Install the radial seal on the inner parts assembler.
5. Press in the special tool (1) until the radial seal is stopped.
6. Check for leaks while operating the engine.

Modification basis	
Application basis	
Affected VIN	

S.G.N.
1130-01 CRANKSHAFT

Preceding work

1. Removal of engine
2. Removal of cylinder head
3. Removal of timing gear case cover
4. Removal of crankcase sealing rear cover
5. Removal of oil pan
6. Removal of baffle plate
7. Removal of oil pump



NO.	FUNCTION
1	Bearing Cap Bolt (M8 X 55 - 10 pieces) ..... 1ststep 55 Nm (41 lb-ft) .....2nd step 90 °rotation added
2	Bearing Cap
3	Upper Main Bearing
4	Lower Main Bearing
5	Upper Thrust Bearing
6	Lower Thrust Bearing
7	Crankshaft.

▶ Service Data Standard (Crankshaft Main Bearing Gap)

Item	Measuring Position	Gap (mm)
Main Bearing Journal (NO.1,5,7)	Radial	Static condition : 0.015 - 0.039 Dynamic condition : 0.031 - 0.051 (Consider the expansion 0.011 - 0.016)
	Axial	0.010 - 0254

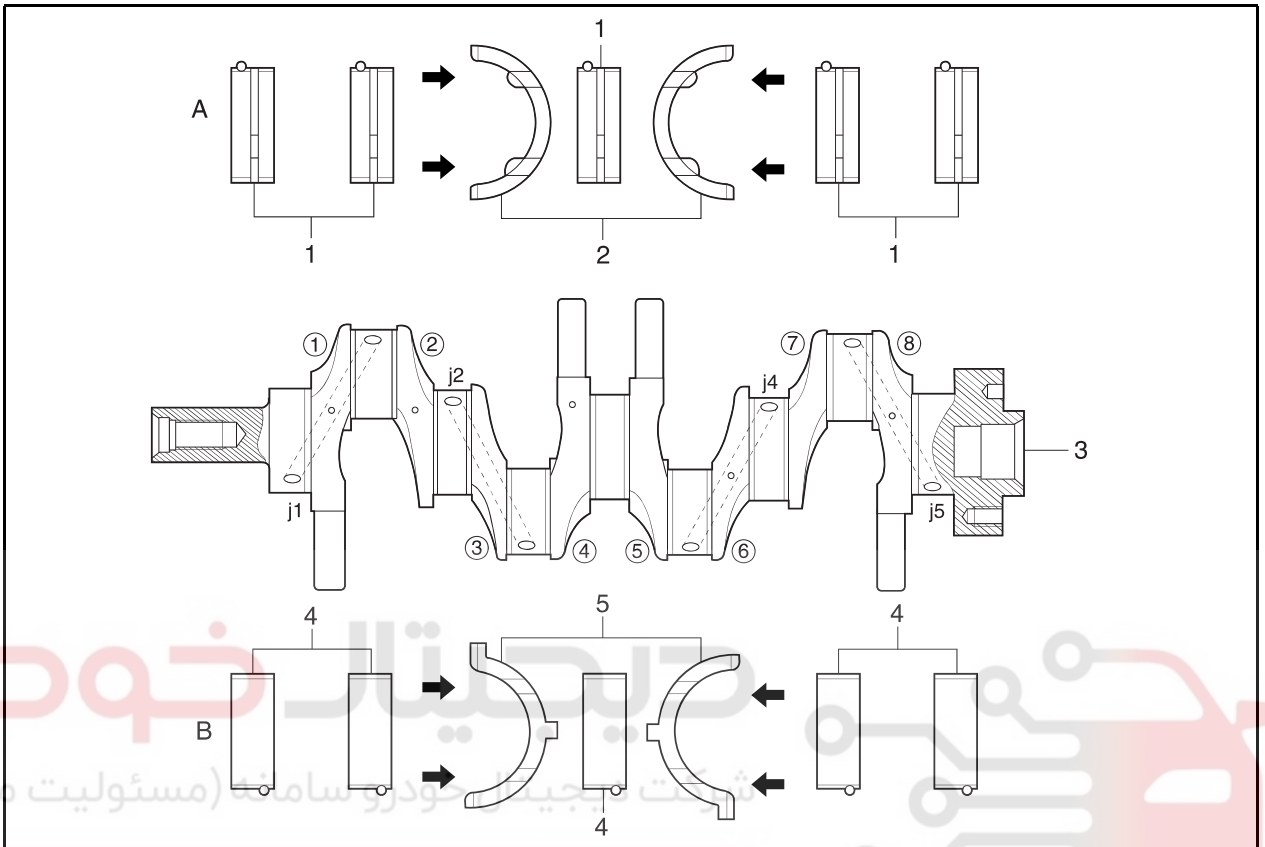
▶ Service Data Standard (Connecting Rod Bearing Gap)

Item	Item	Gap (mm)
Connection Rod Bearing	Radial	0.020 - 0.065

Modification basis	
Application basis	
Affected VIN	

S.G.N. 1130-11

ARRANGEMENT OF THE THRUST BEARING AND THE MAIN BEARING



NO.	FUNCTION	NO.	FUNCTION
1	Upper Main Bearing	A	Crankcase Side
2	Upper Thrust Bearing	B	Bearing Cap Side (Oil Pan Side)
3	Crankshaft		
4	Lower Main Bearing		
5	Lower Thrust Bearing		

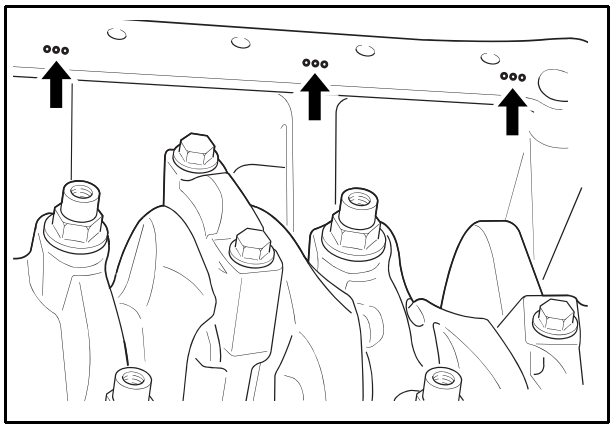
Color Dot Marking	Crankshaft Journal Diameter (mm)
Blue	57.960 - 57.965
Yellow	57.955 - 57.960
Red	57.950 - 57.955
White	57.945 - 57.950
Violet	57.940 - 57.945

▷ (1) - (8) Weight Balance/Color Marking Point
▷ j1 - j5 Journal Main Bearing #1 - #5
- Color Dot Marking

▷ The color dot marking are put on the (1), (2), (4), (6), (8), and it indicates the diameter of crankshaft journal by color as below.

Modification basis	
Application basis	
Affected VIN	

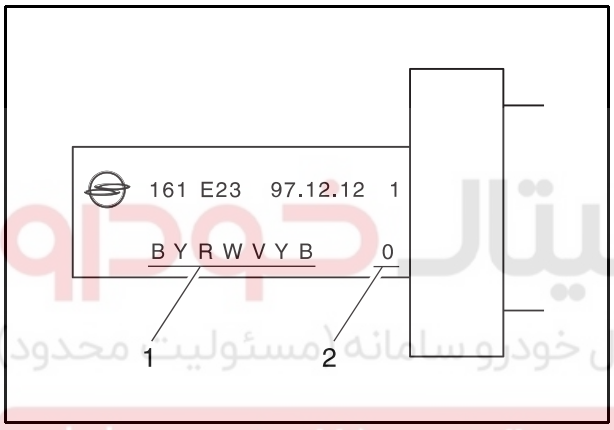
▶ Selection of Crankshaft Main Bearing



▷ Crankcase Side

There are seven punching marks on the mating surface to oil pan. This mark is correspondent to the bearing distinguished by color. Select the relevant bearing according to the punching mark when repaired.

Purching Mark	Bearing Color Selected
B	Blue
Y	Yellow
R	Red



▷ Crankshaft Bearing Cap Side

Select the crankshaft main bearing according to the marking letter on the crank shaft main journal when repaired.

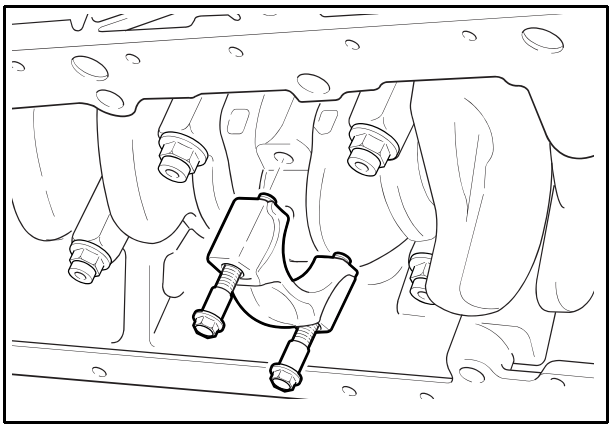
Marking Letter	Bearing Color Selected
B	Blue
Y	Yellow
R	Red
W	White
V	Violet

▶ Service Data

Crankshaft Standard and Repair Size	Crankshaft Bearing Journal Diameter	Crankshaft Bearing Diameter	Crankshaft Journal Width at fit bearing	Connecting Rod Bearing Journal Diameter	Connecting Rod Bearing Journal Width
Standard size	57.940 - 57.965	58	24.50 - 24.533	47.935 - 47.965	27.958 - 28.042
1st repair size	57.705 - 57.715	-	-	47.700 - 47.715	-
2nd repair size	57.450 - 57.465			47.450 - 47.465	
3rd repair size	57.205 - 57.215			47.200 - 4.215	
4th repair size	56.955 - 56.965			46.950 - 46.965	

Modification basis	
Application basis	
Affected VIN	

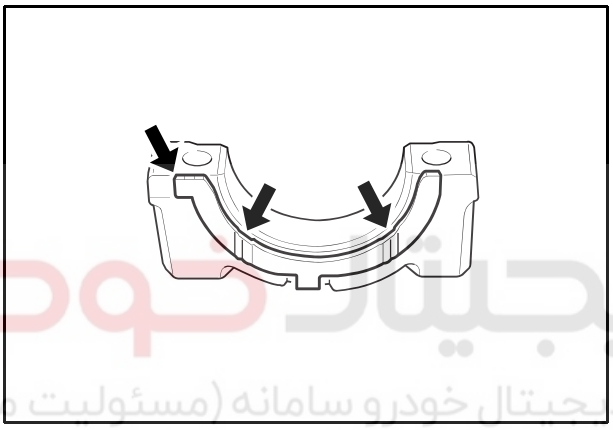
1) Removal & Installation



1. Unscrew the connecting rod bearing cap bolt and remove the bearing cap.

Tightening torque 40 Nm (30 lb–ft) + 90°

- Make sure that the upper and lower bearing shells do not change each other. Coat the bearing shell with engine oil.
- Install the bearing cap according to the
- consecutive number.



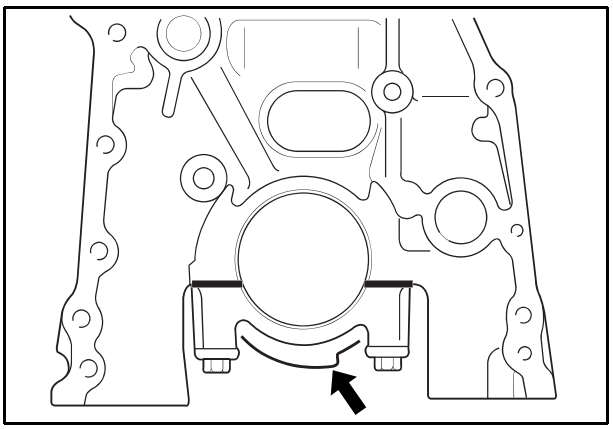
2. Unscrew the crankshaft bearing cap bolts and separate the upper and lower bearing shells and thrust washers.

Tightening torque 55 Nm (41 lb–ft)+ 90°

- Remove the bearing cap from front (pulley side) to rear.
- Make sure that the upper and lower bearing shells do not change each other and coat with engine oil.
- The oil grooves (arrows) in the thrust washers must face outward and insert the thrust bearing into the bearing cap.
- There are five kinds of thrust washers by thick-ness.
  Select the proper washer when repaired.

Part No. : 601 030 00 62 2.15 mm
Part No. : 601 030 01 62 2.20 mm
Part No. : 601 030 02 62 2.25 mm
Part No. : 601 030 03 62 2.30 mm
Part No. : 601 030 04 62 2.40 mm

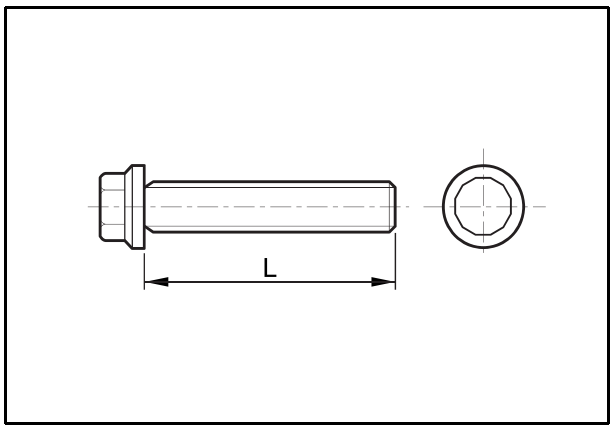
3. Remove the crankshaft.
4. Installation should follow the removal procedure in the reverse order.
5. After completion of the installation, check for the rotating condition of the crankshaft.



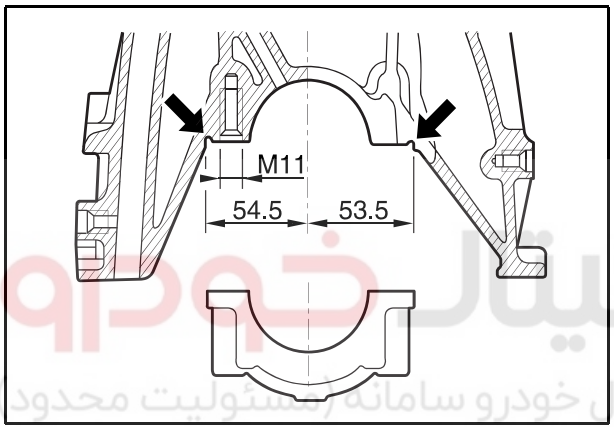
CAUTION

- Make sure the crankshaft bearing cap properly seated in place in the crankcase side. When perfectly installed, the projected part (arrow) locates in the left side (intake manifold side).
- Assemble so that the projected part of the cap and crankcase face the same direction.

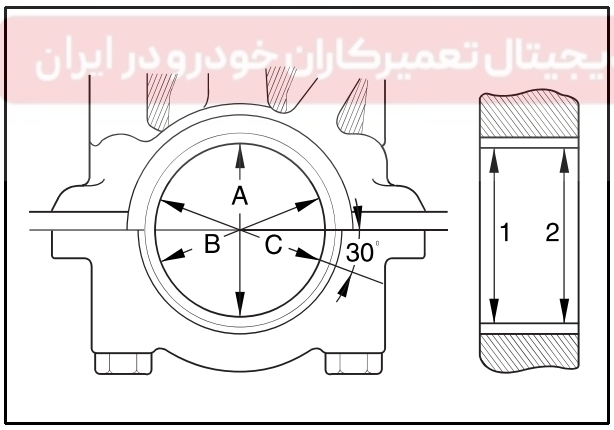
2) Inspection



1. If the length 'L' of the crankshaft bearing cap bolt exceeds 63.8 mm, replace it.



2. Make sure the crankshaft bearing cap is properly seated on the cylinder block (arrows).

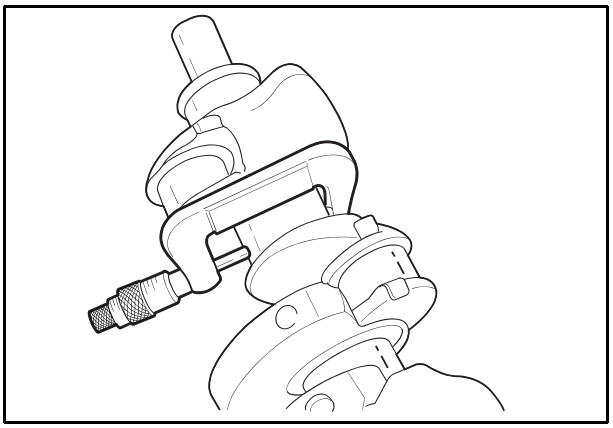


3. Measure and record the inner diameter of the crankshaft bearing.

CAUTION

- Measure at 2 points (1, 2).
- Measure 'A', 'B' and 'C' as shown. If average value of 'B' and 'C' is less than value 'A', then the average value of 'B' and 'C' is actual average value.
  If average value of 'B' and 'C' is more than value 'A' is actual average value.

Modification basis	
Application basis	
Affected VIN	



4. Measure and record the diameter of the crankshaft bearing journal.

CAUTION

- Record the mean value when measured at 3 points (A,B,C).
- Measure the inner diameter of bearing and the diameter of journal and if it is out of the standard data, replace the bearing shell.

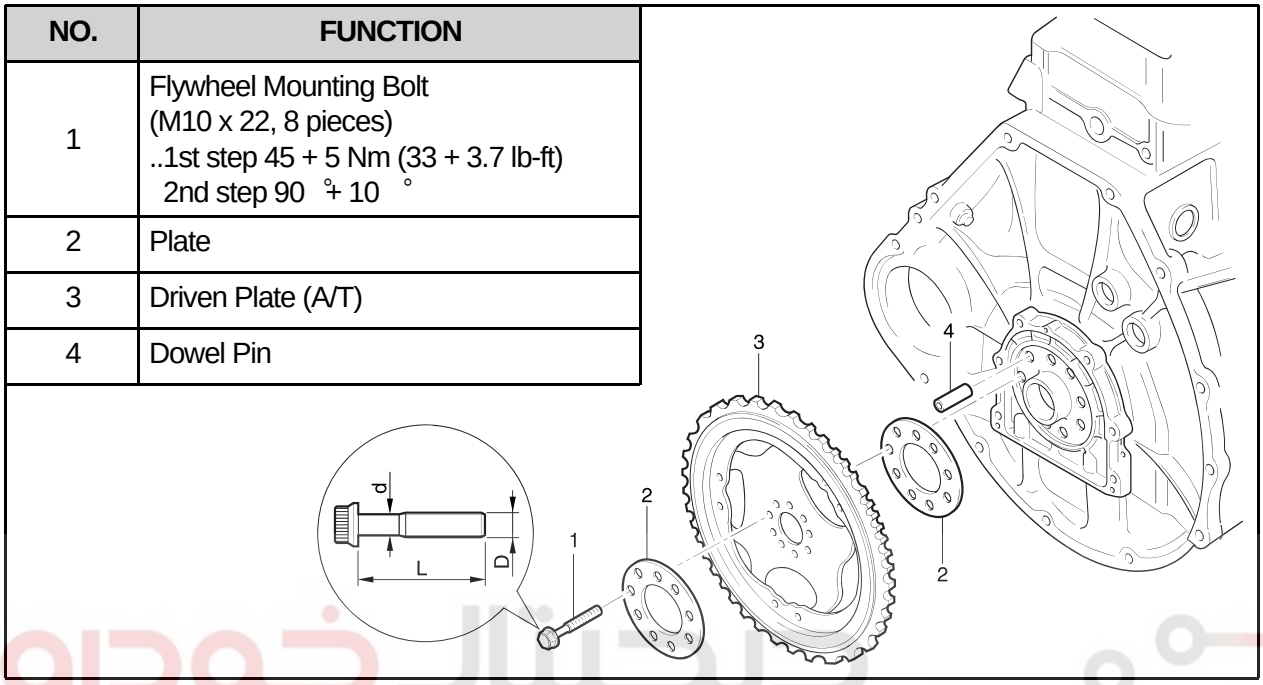
Modification basis	
Application basis	
Affected VIN	

S.G.N. 1130-09

FLYWHEEL/ DRIVE PLATE

Preceding work 1. Removal of manual or automatic transmission

NO.	FUNCTION
1	Flywheel Mounting Bolt (M10 x 22, 8 pieces) ..1st step 45 + 5 Nm (33 + 3.7 lb-ft) 2nd step 90 ° + 10 °
2	Plate
3	Driven Plate (A/T)
4	Dowel Pin



▶ **Service Data Standard (Stretch Bolt)**

Normal Size	D	-	M x 15
Stretch Side Diameter	d	When New	8.5 - 0.2 mm
		Min. Diameter	8.0 mm
Bolt Length	L	When New	21.8 - 22.2 mm
Tightening Torque	1st step 45 + 5 N•m (33 + 37 lb-ft), 2nd step 90° + 10°		

1) Removal & Installation Procedure

1. Unscrew the flywheel mounting bolt.

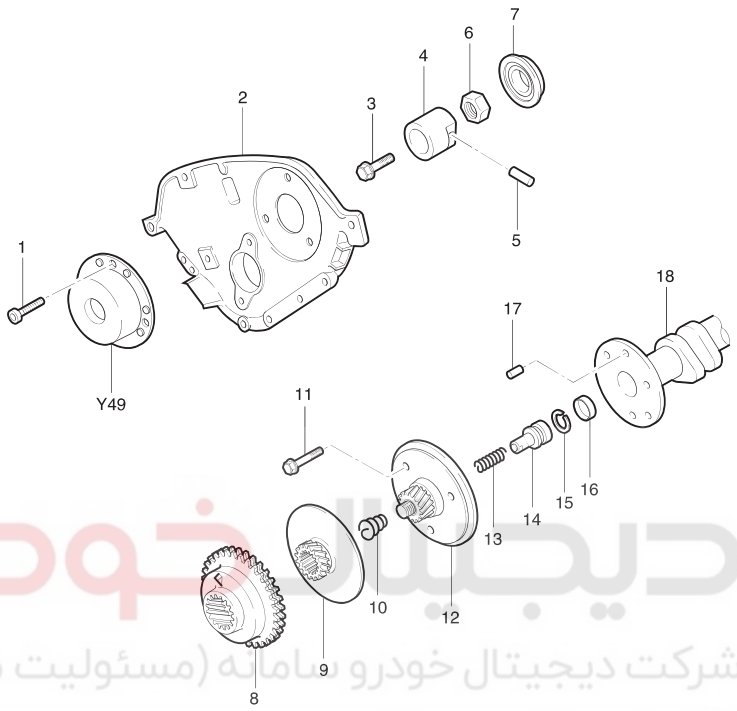
Tightening torque **1st step: 45 + 5 Nm (33 + 3.7 lb-ft)**
2nd step: 90° ± 10°

- Replace the bolt when the stretch side diameter (d) of the flywheel mounting bolt is less than 8.0mm.
- For the flywheel mounting bolt tightening, keep the socket wrench and Tommy-bar to be 90 ° and tighten as specified.

2. Remove the flywheel for manual transmission vehicles, or the driven plate (3), and plate (2) for Auto transmission vehicle.
3. Installation should follow the removal procedure in the reverse order.

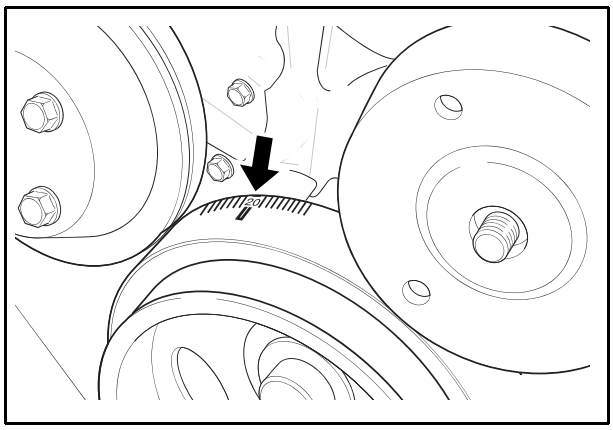
Modification basis	
Application basis	
Affected VIN	

S.G.N.
1311-31 CAMSHAFT ADJUSTER



1. Bolt (M6 X 16, 3 pieces)
   9 - 11 Nm (80 - 97 lb-in)
2. Cylinder Head Front Cover
3. Bolt 35 Nm (26 lb-ft)
4. Armature
5. RollPin
6. Nut (M20 X 1.5)
   60 - 70 Nm (44 - 52 lb-ft)
7. Seal Cover
8. Camshaft Sprocket
9. Adjust Piston
10. Conical Spring
11. Flange Bolt (M7 X 13, 3 pieces)
    1stStep 18 - 22 Nm
    (13 - 16 lb-ft)
    2nd Step 60 ° ± 5 °Rotation
    Added
12. Flange Shaft
13. Compression Spring
14. Control Piston
15. Circlip
16. Oil Gallery
17. Straight Pin
18. Intake Camshaft

Y49 Magnetic Actuator
(2 - Pin Connector)

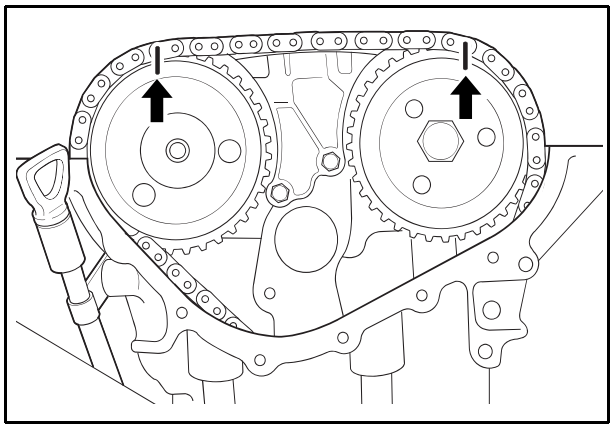


1. Turn the crankshaft and position the no.1 cylinder piston at ATDC 20 °.

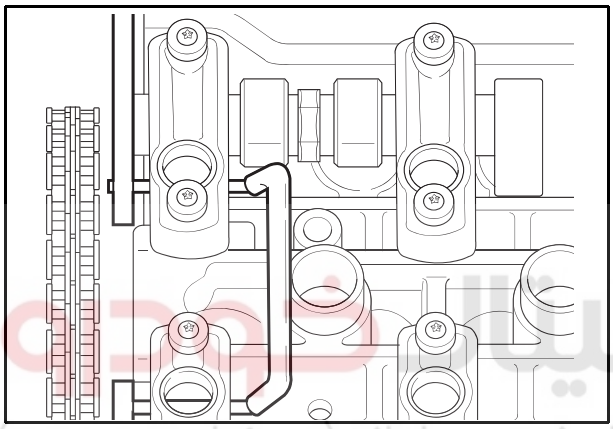
CAUTION
- Turn the crankshaft in the direction of engine rotation.

2. Remove the cylinder head front cover.

Modification basis	
Application basis	
Affected VIN	



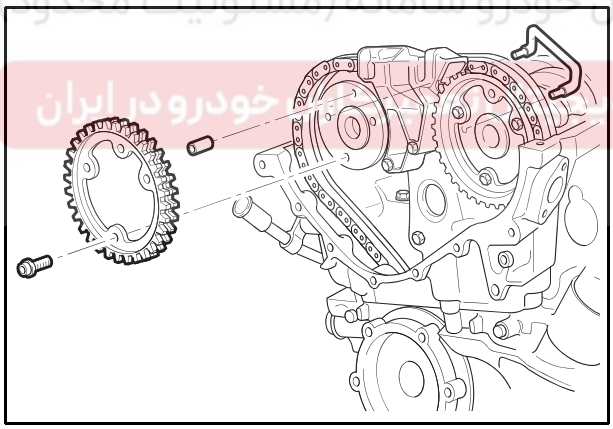
3. Put the alignment marks (arrows) on the camshaft sprocket and the timing chain.



4. Insert the holding pin A9913 0052B (111 589 03 15 00) into the no.1 and no.6 bearing cap hole on camshaft to secure intake and exhaust camshaft.
5. Remove the chain tensioner.
6. Unscrew the exhaust sprocket bolt and remove the exhaust camshaft sprocket.

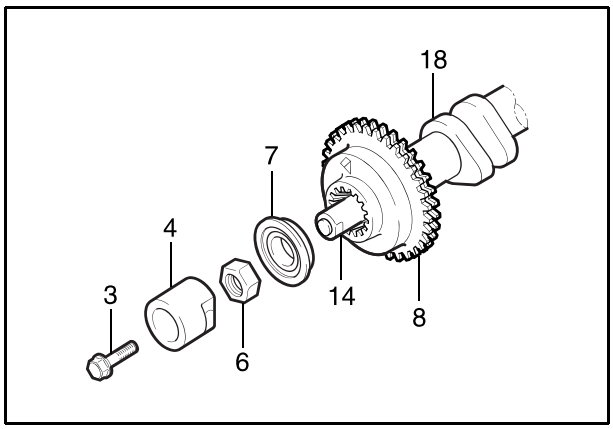
Tightening torque 1st step: 18 – 22 Nm (13 - 16 lb-ft)
2nd step: 60° ± 5°

CAUTION
- The flange bolt is designed to be used only once, so always replace with new one.



7. Unscrew the bolt (3) from the armature (4) and re ove the roll pin, and remove the armature.

Tightening torque 35 Nm (26 lb–ft)



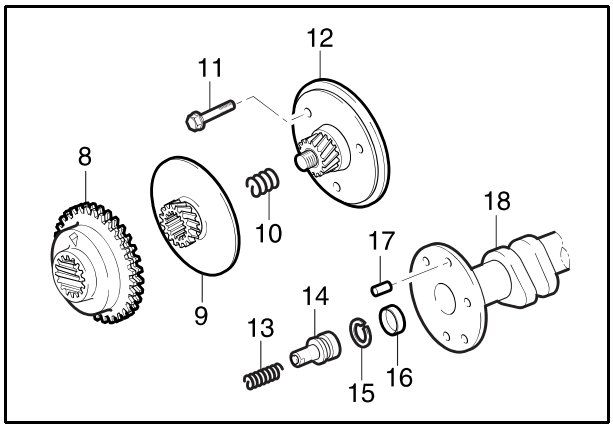
8. Unscrew the nut (6) and remove the seal cover (7).

Tightening torque 60 – 70 Nm (44 - 52 lb-ft)

CAUTION
- Put the locking slot of nut toward armarture.

9. Take off the timing chain from intake camshaft sprocket.

Modification basis	
Application basis	
Affected VIN	



10. Remove the adjuster piston (9) and conical spring (10) from intake camshaft sprocket.
11. Unscrew the bolt (11) and remove the flange shaft.

Tightening torque **1st step: 18 – 22 Nm (13 - 16 lb-ft)**
2nd step: 60° ± 5°

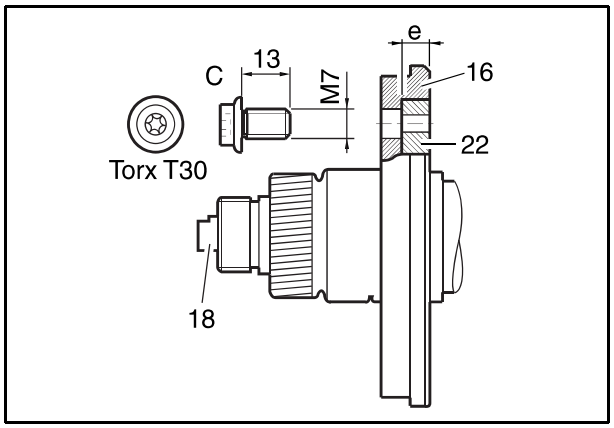
CAUTION
- The flange bolt is designed to be used only once, so always replace with new one.

12 Installation should follow the removal procedure in the reverse order.
13. Check and adjust the camshaft timing.

Modification basis	
Application basis	
Affected VIN	

1) Camshaft Sprocket Bolt

▶ Intake Flange Shaft Bolt

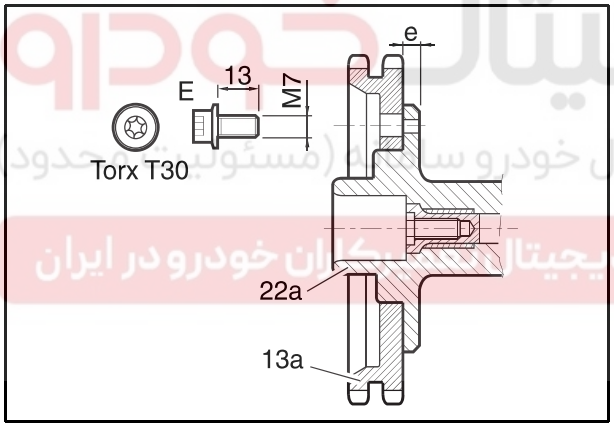


Tightening torque **1st step: 18 – 22 Nm (13 - 16 lb-ft)**
2nd step: 60° ± 5°

CAUTION
- The sprocket bolts are designed to be used only once, so always replace with new one.

C. M7 x 13 Collar Bolt Torx-T30
E. 6.8 mm
16.Flange Shaft
18.Control Piston
22.Intake Camshaft

▶ Exhaust Camshaft Sprocket Bolt



Tightening torque **1st step: 18 – 22 Nm (13 - 16 lb-ft)**
2nd step: 60° ± 5°

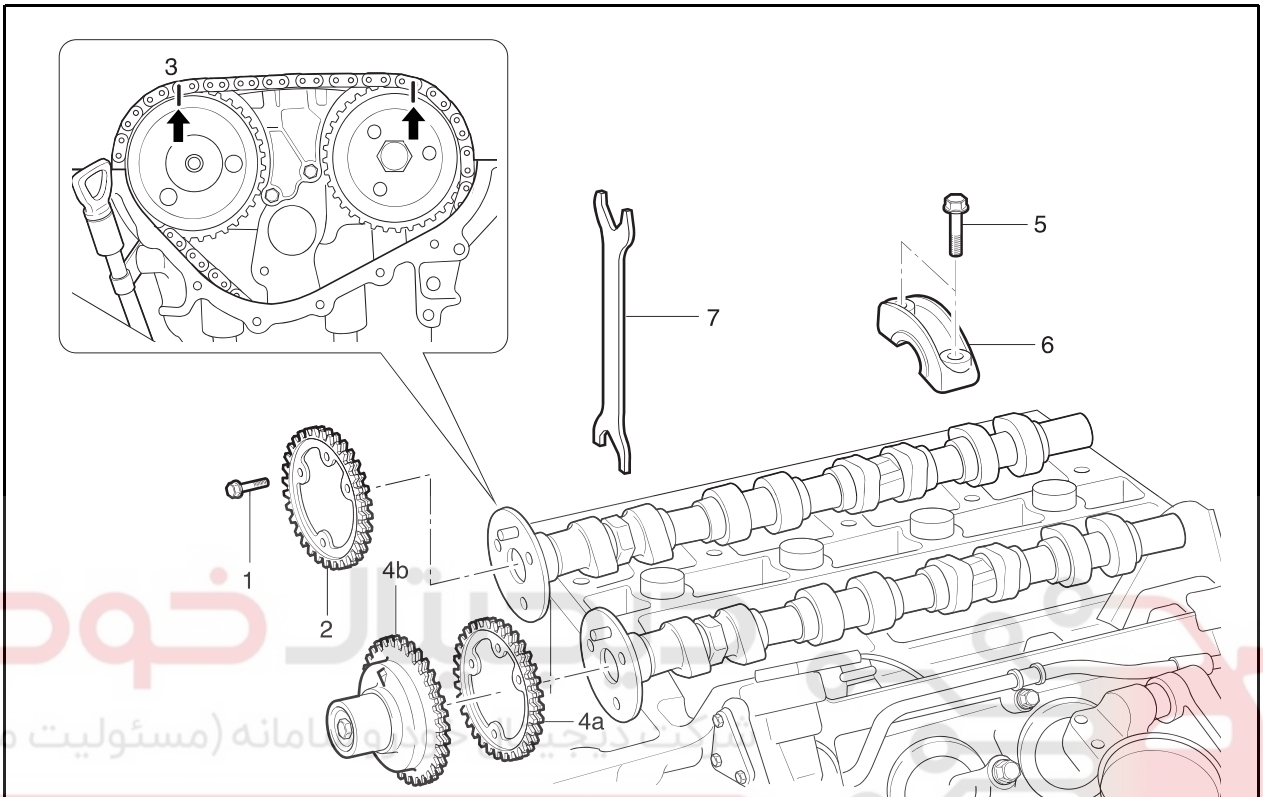
CAUTION
- The sprocket bolts are designed to be used only once, so always replace with new one.

E. M7 x 13 Collar Bolt Torx-T30
e. 6.8 mm
13a. Camshaft Sprocket
22a. Exhaust Camshaft

Modification basis	
Application basis	
Affected VIN	

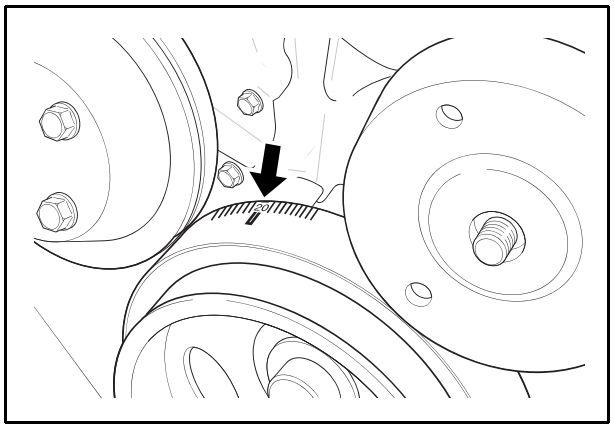
S.G.N.
1221-21 CAMSHAFT

Preceding work
1. Removal of cylinder head cover
2. Removal of camshaft adjust actuator and cylinder head front cover



NO.	FUNCTION
1	Bolt (M7 X 13, 3 pieces) ..... 1st Step 18 - 22 Nm (13 - 16 lb-ft) ..... 2nd Step 60 ° ± 5 ° Rotation Added
2	Exhaust Camshaft Sprocket
3	Timing Chain 4a. Intake Camshaft Spocket (E20) 4b. Camshaft Adjuster and Camshaft Sprocket (E23)
5	Bearing Cap Bolt (20 pieces) ..... 22.5 - 27.5 Nm (16.6 - 20.3 lb-ft)
6	Camshaft Bearing Cap
7	Wrench

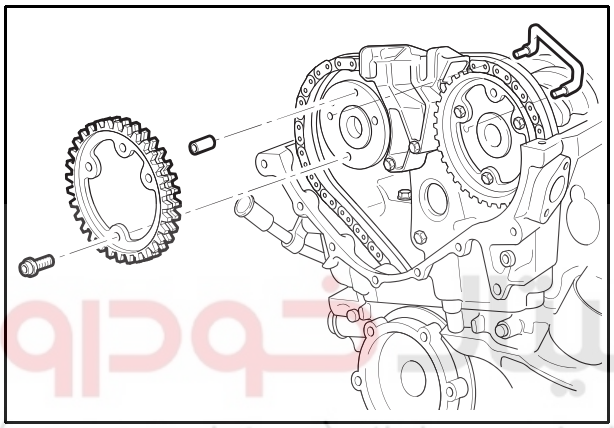
Modification basis	
Application basis	
Affected VIN	



1. Turn the crankshaft and position the no.1 cylinder piston at ATDC 20 °.
2. Put the alignment marks (arrows) on the camshaft sprocket and the timing chain.
3. Remove the chain tensioner.

Tightening torque

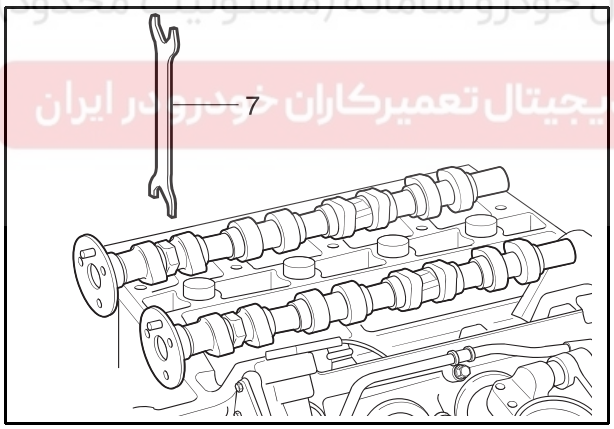
Screw Plug	40 Nm (30 lb-ft)
Tensioner Assembly	72 - 88 Nm (53 - 65 lb-ft)



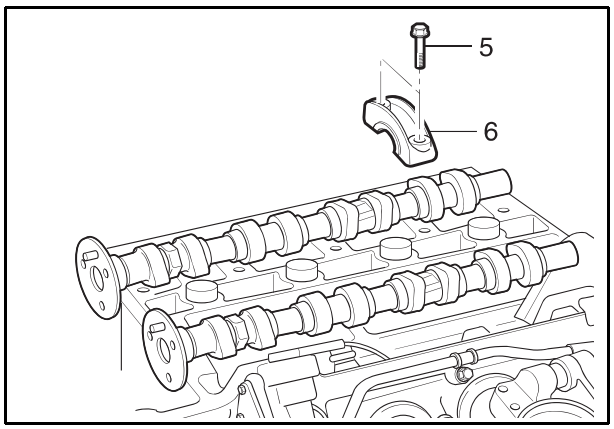
4. Remove the exhaust camshaft sprocket.

Tightening torque **1st step: 18 – 22 Nm (13 - 16 lb-ft)**
2nd step: 60° ± 5°

CAUTION
- The sprocket bolt is designed to be used only once, so always replace with new one.



5. Take off the timing chain from intake camshaft sprocket, and secure it not to fall down into the timing gear case.
6. Using the wrench (7), turn the camshaft until there is no resistence in camshaft bearing area.

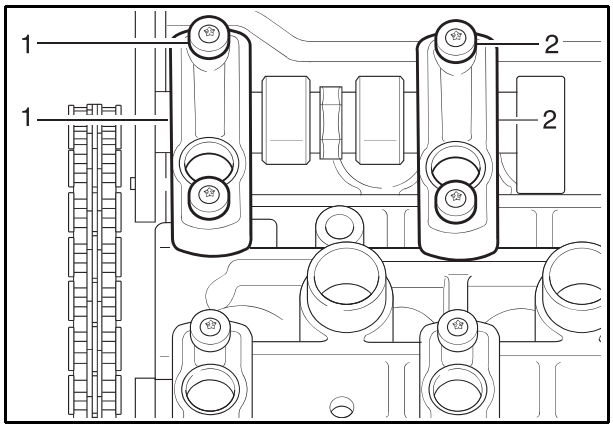


7. Remove the bearing cap, and remove the intake and the exhaust camshaft.

Tightening torque **60 – 70 Nm (44 - 52 lb-ft)**

CAUTION
- Check the numbers on the bearing cap not to be mixed up.

Modification basis	
Application basis	
Affected VIN	



8. Apply the engine oil on the valve tappet and camshaft bearing.
9. Installation should follow the removal procedure in the reverse order.

CAUTION
- Base circle of cam should cantact with the valve tappet.
- Install the camshaft bearing caps according to the numbers on the cylinder head cast and bearing cap.

10. Check the camshaft timing position.

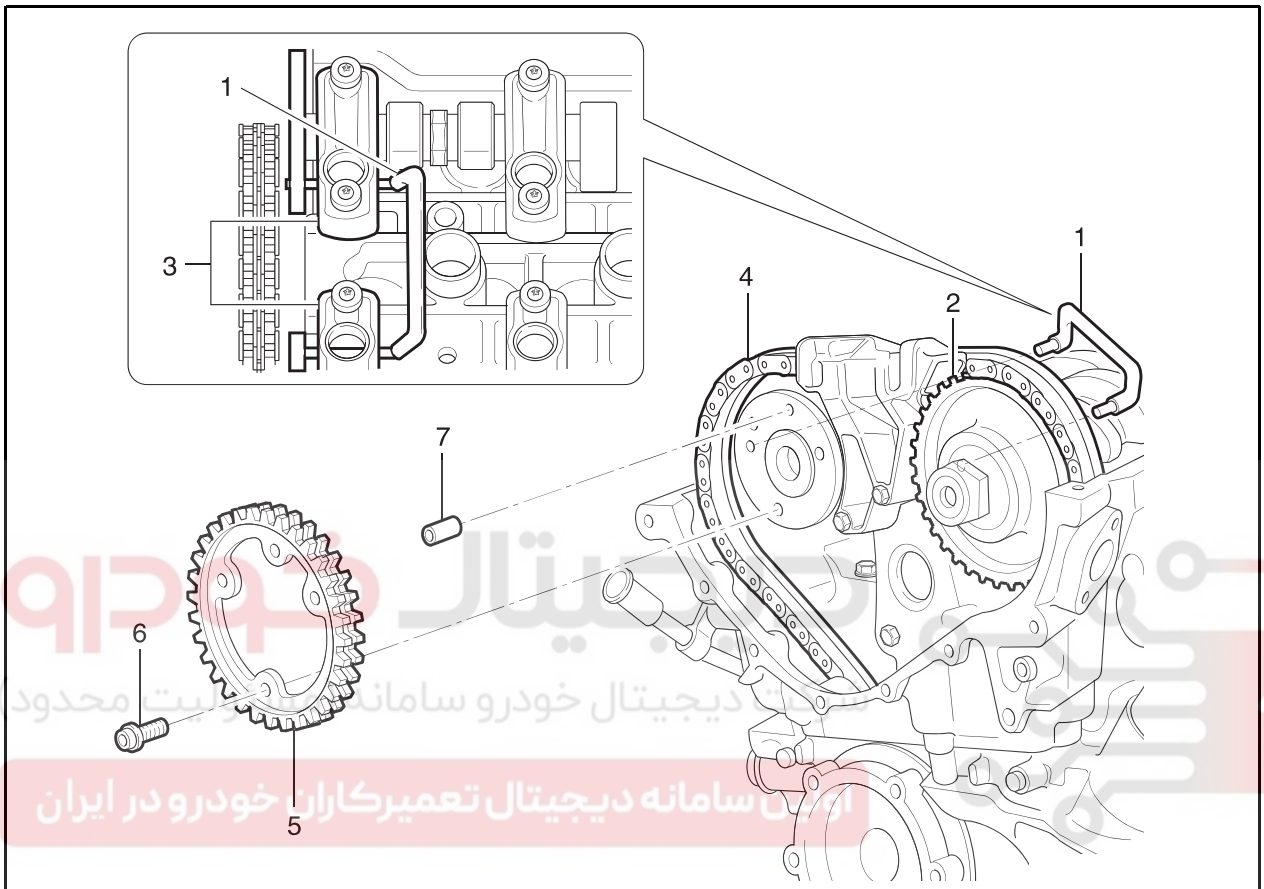
Modification basis	
Application basis	
Affected VIN	

S.G.N. 1221-21

INSPECTION AND ADJUSTMENT OF CAMSHAFT TIMING POSITION

Preceding work

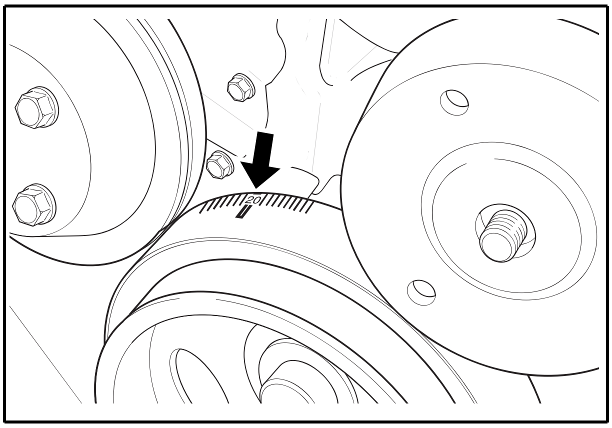
1. Removal of cylinder head cover
2. Removal of cylinder head front cover



NO.	FUNCTION
1	Holding Pin A9913 0052B (111 589 03 15 00)
2	Intake Camshaft Sprocket
3	Camshaft Bearing Cap
4	Timing Chain
5	Exhaust Camshaft Sprocket
6	Bolt (M7 X 13, 3 pieces) ..... 1st step 18 - 22 Nm (13 - 16 lb-ft) .....2nd step 60 ° ± 5 °rotation added
7	StratePin

Modification basis	
Application basis	
Affected VIN	

1) Inspection Procedure



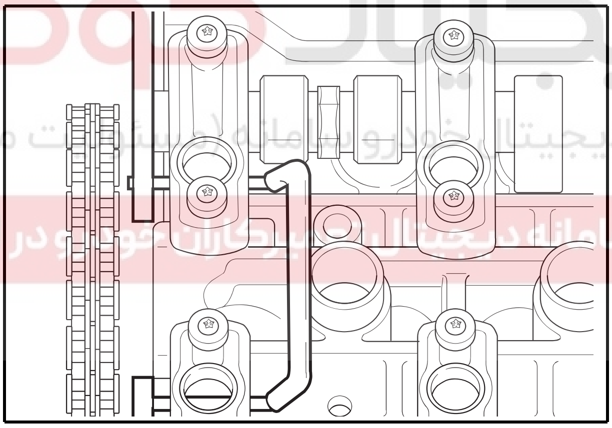
CAUTION

- A9913 0052B (111 589 03 15 00) Holding Pin

1. Position the NO.1 cylinder piston to ATDC 20 °by turning the crankshaft.

CAUTION

- When the ATDC 20 ° mark on vibration damper is aligned with timing gear case cover, the intake and ex-haust cam of cylinder will make the slope to the center and will face up. In this way, the insert hole in NO.1 and NO.4 camshaft bearing cap will match in line with the flange hole for camshaft sprocket.



2. Check the timing as below procedure
   - Check if the holding pin A9913 0052B (111 589 03 15 00) can be inserted into the NO.1 and NO.4 bearing cap hole.
   - At this condition, check if the ATDC 20° mark on vibration damper aligns with the marker on the timing gear case.

Modification basis	
Application basis	
Affected VIN	

2) Adjustment Procedure

1. Position the NO.1 cylinder to ATDC 20 °.
2. Remove the chain tensioner.
3. Remove the exhaust camshaft sprocket.
4. Adjust the timing position with inserting the holding pin A9913 0052B (111 589 03 15 00) into the NO.1 and NO.4 camshaft bearing cap hole and flange hole while rotating the camshaft by using wrench.
5. Install the chain to the intake camshaft sprocket.
6. Install the chain to the exhaust camshaft sprocket and tighten the bolt.

Tightening torque **1st step: 18 – 22 Nm (13 - 16 lb-ft)**
2nd step: 90° ± 5°

- The sprocket bolt is designed to be used only once, so replace with new one.

7. Install the chain tensioner.

Tightening torque

Screw Plug	40 Nm (30 lb-ft)
Tensioner Assembly	72 - 88 Nm (53 - 65 lb-ft)

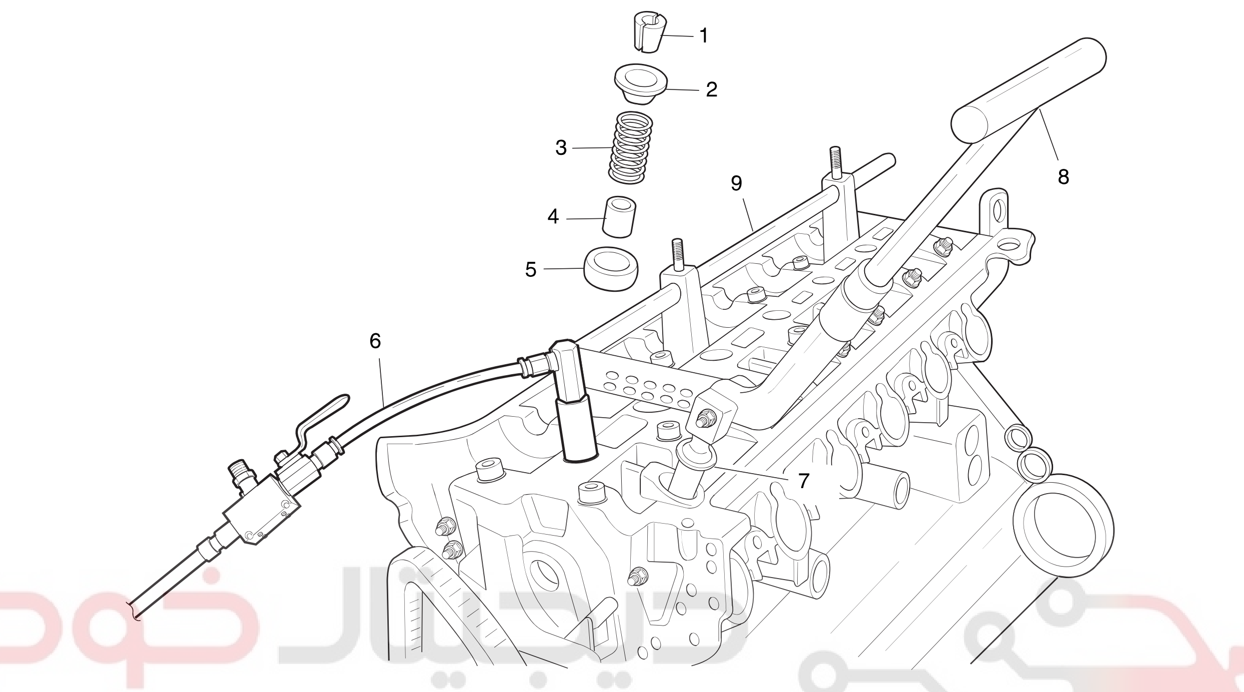
8. Check the camshaft timing.

S.G.N.

1211-32 VALVE SPRING

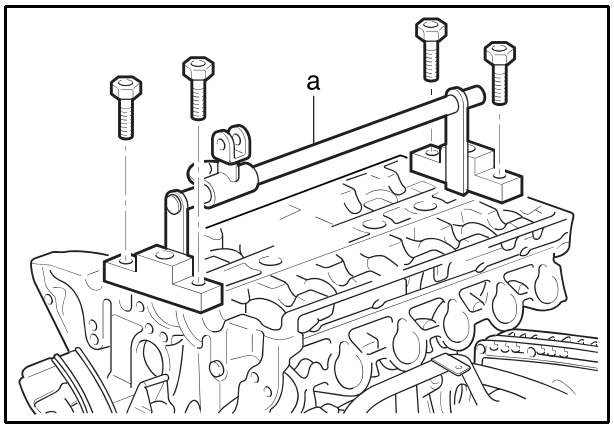
Preceding work

1. Removal of camshaft
2. Removal of spark plug



NO.	FUNCTION	NO.	FUNCTION
1	Valve Cotter	6	Connecting Hose A9912 0012B (DW110 - 090)
2	Valve Spring Retainer	7	Thrust Piece A9917 0121B (111 589 25 63 00)
3	Valve Spring	8	Lever Pusher A9917 0111B (111 589 18 61 00)
4	Valve Stem Seal	9	Supporting Bar A9917 0101B (111 589 01 59 00)
5	Lower Retainer		

Modification basis	
Application basis	
Affected VIN	

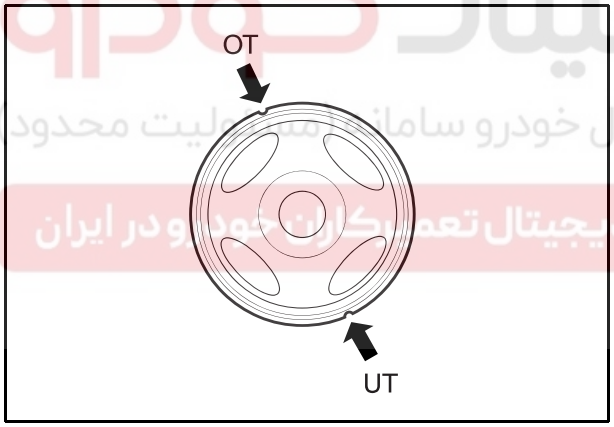


CAUTION

- A9917 0101B (111 589 01 59 00) Supporting Bar
- A9917 0111B (111 589 18 61 00) Lever Pusher
- A9917 0121B (111 589 25 63 00) Thrust Piece
- A9910 0150B (602 589 00 40 00) Engine Lock
- A9912 0012B (DW110 - 090) Connecting Hose

1. Place the supporting bar A9917 0101B (111 589 01 59 00) (a) at the camshaft bearing cap and tighten them with the bearing cap bolt.

Tightening torque **22.5 – 27.5 Nm (16.6 - 20.3 lb-ft)**

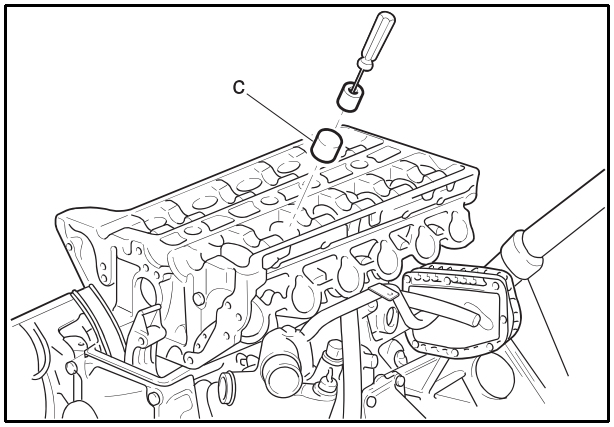


2. Turn the crankshaft to position the each cylinder piston at TDC.

Tightening torque **1st step: 18 – 22 Nm (13 - 16 lb-ft)**
2nd step: 90° ± 5°

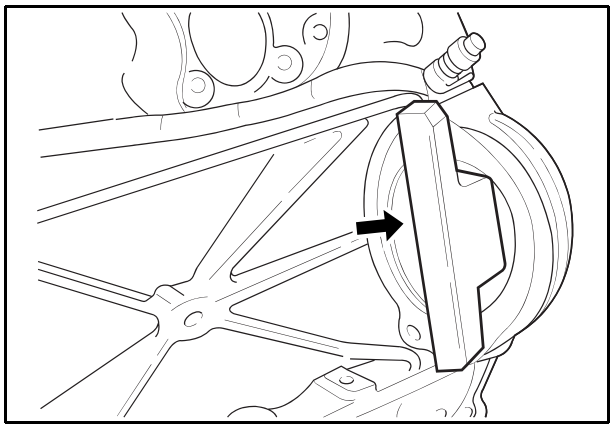
CAUTION

- Remove the valve spring only at TDC.
- Always rotate the crankshaft by holding the chain to prevent from timing chain damage and tangling, and for smooth rotation.

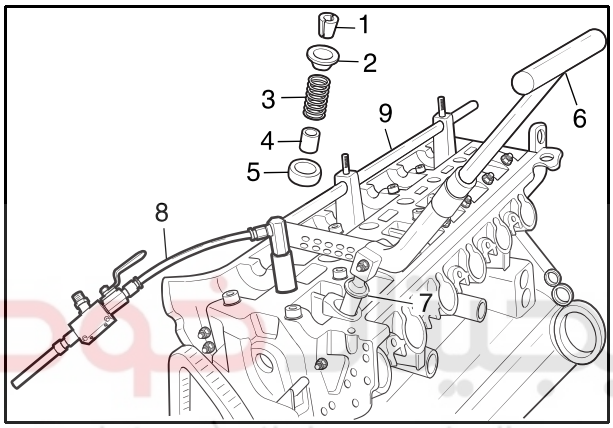


3. Remove the valve tappet using the valve tappet remover.
4. Install the connecting hose A9912 0012B (DW110 - 090) (c) to the spark plug hole.

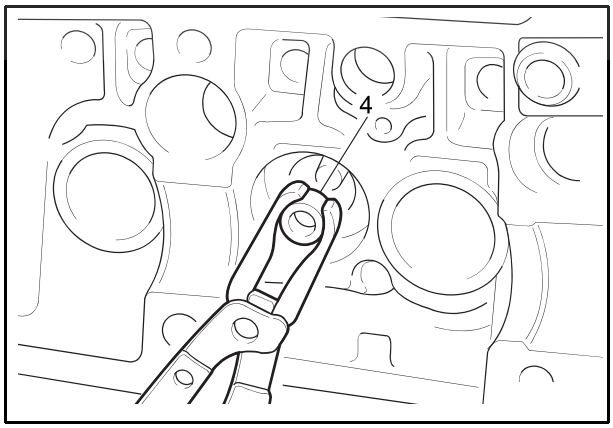
Modification basis	
Application basis	
Affected VIN	



5. Install the engine lock A9910 0150B (602 589 00 40 00) to the ring gear to prevent the crankshaft from rotating.
6. Blow up with compressed air.



7. Install the supporting bar A9917 0101B (111 589 01 59 00) (d) and the lever pusher A9917 0111B (111 589 18 61 00) (a).
8. Mount the thrust piece A9917 0121B (111 589 25 63 00) (b) vertically to the valve spring retainer (2).
9. Press the valve spring (3) by using the lever pusher A9917 0111B (111 589 18 61 00) (a).
10. Remove the valve cotter (1) using the pincette.
11. Remove the upper retainer (2) and the valve spring (3).



12. Remove the valve stem seal (4) and replace if necessary.

CAUTION

- Check the valve stem seal for damage and replace if necessary.

13. Remove the lower retainer (5).

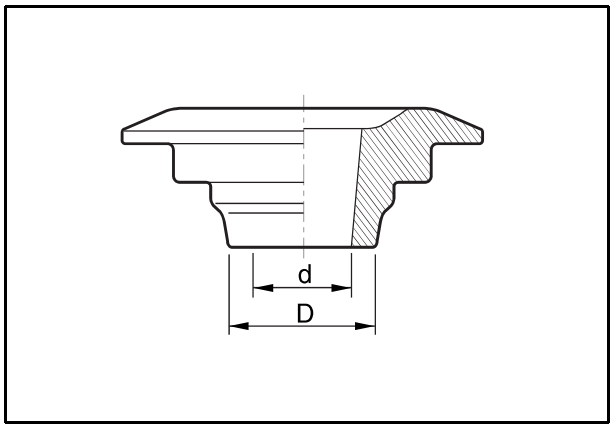
CAUTION

- Check the retainer for damages and replace with a new one if necessary.

14. Installation should follow the removal procedure in the reverse order.

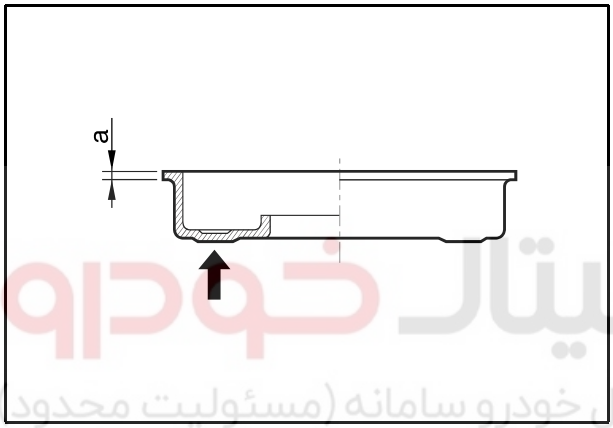
Modification basis	
Application basis	
Affected VIN	

▶ **Test (Upper and Lower Valve Tappet and Valve Cotter)**



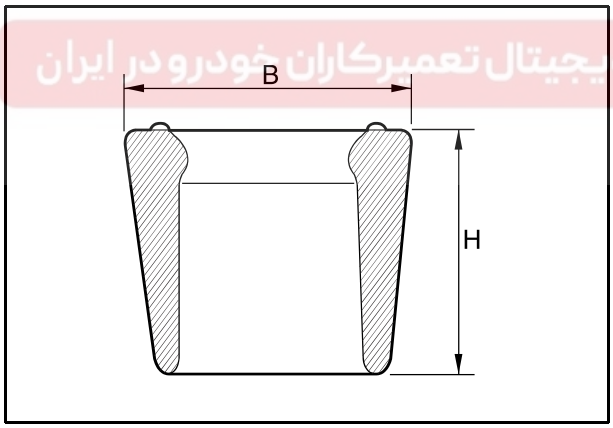
- Upper Valve Spring Retainer

Size (mm)		
	(d)	8.5
	(D)	12.3



- Lower Valve Spring Retainer

Size (mm)		
	(a)	0.8 - 1.0



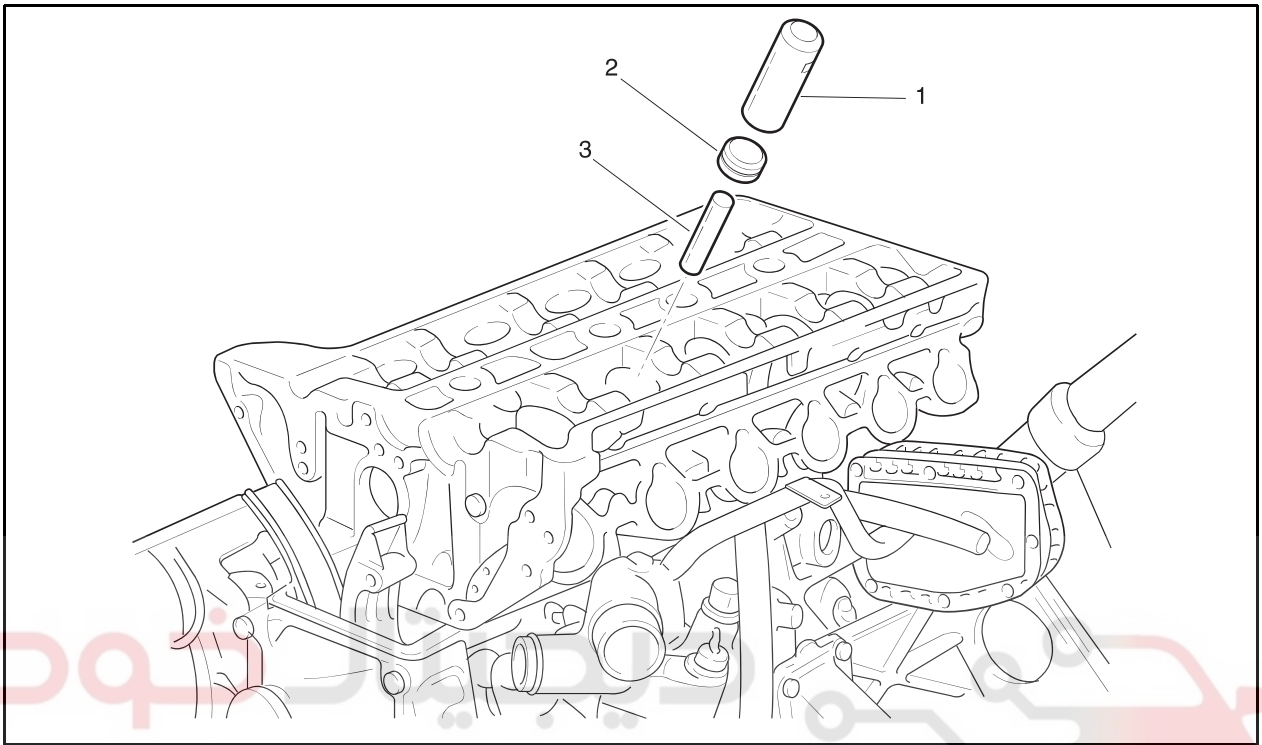
- Valve Cotter

Size (mm)		
	(B)	9.0
	(H)	9.2 - 9.8

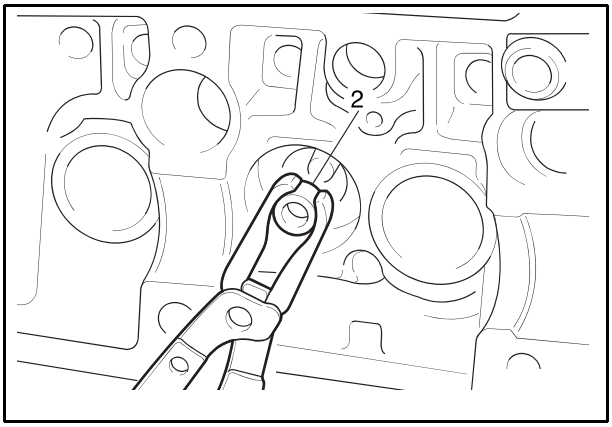
S.G.N. 1211-30

VALVE STEM SEAL

Preceding work 1. Removal of valve spring



NO.	FUNCTION
1	Drift 119 589 00 43 00
2	Valve Stem Seal
3	Protective Sleeve



CAUTION
- A9917 0171B (119 589 00 43 00) Drift

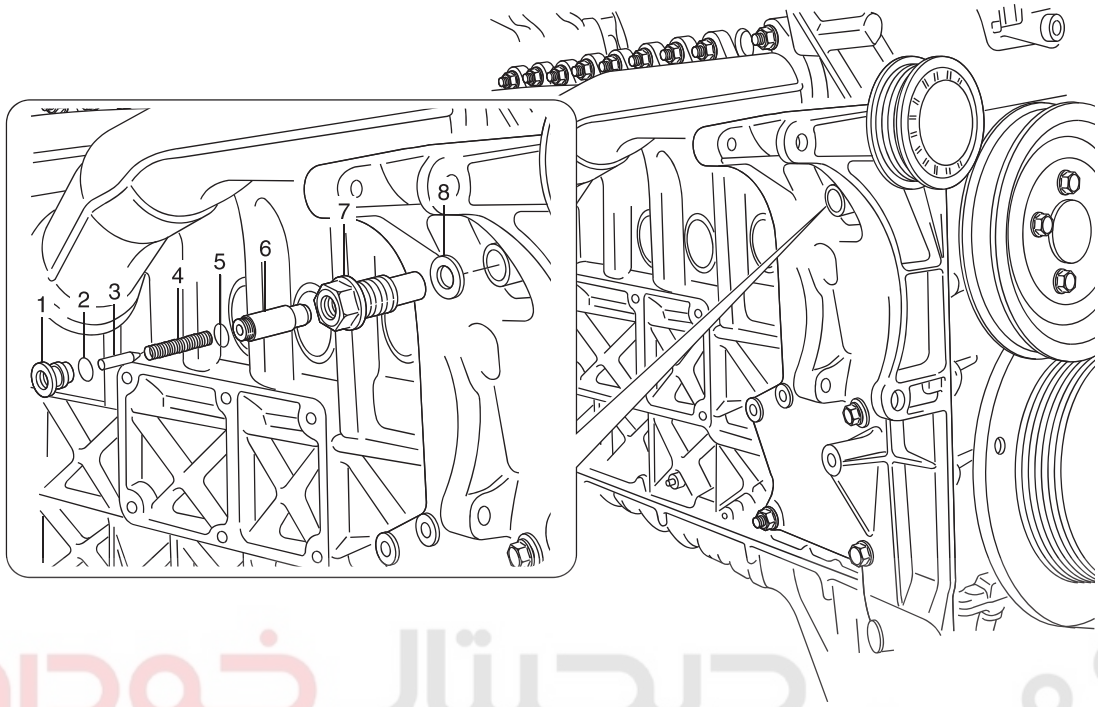
1. Remove the valve stem seal (2) using the pliers.

CAUTION
- Check the valve stem seal for damage and replace if necessary.

2. Coat the valve stem seal with oil and assemble it with the protective sleeve.
3. Insert the valve stem seal by pressing it with the drift A9917 0171B (119 589 00 43 00).

Modification basis	
Application basis	
Affected VIN	

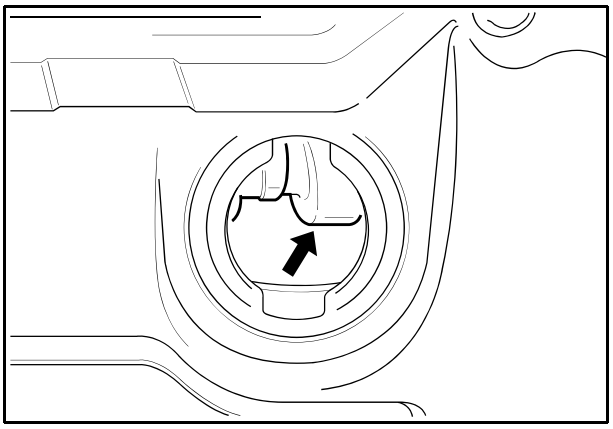
S.G.N.
1532-19 CHAIN TENSIONER



NO.	FUNCTION
1	Screw Plug ..... 40 Nm (30 lb-ft)
2	Seal
3	Filler Pin
4	Compression Spring
5	Snap Ring
6	Thrust Pin
7	Chain Tensioner Housing ..... 72 - 88 Nm (53 - 65 lb-ft)
8	Seal

Modification basis	
Application basis	
Affected VIN	

1) Removal Procedure

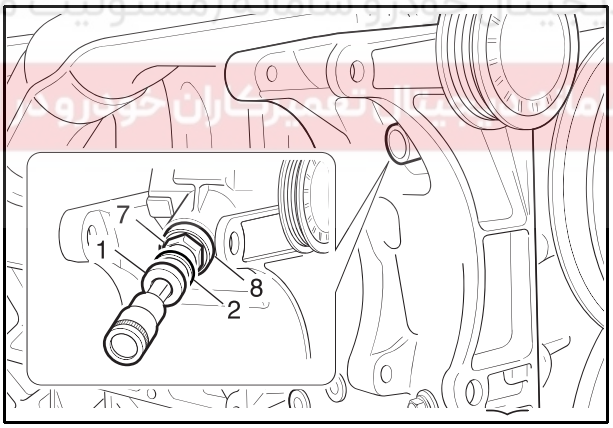


1. Position the number 1 cylinder to ATDC 20°.

CAUTION
- Remove the oil filler cap at adjustment position, and check whether the intake camshaft cam's lobe (arrow) stays in the upper side.

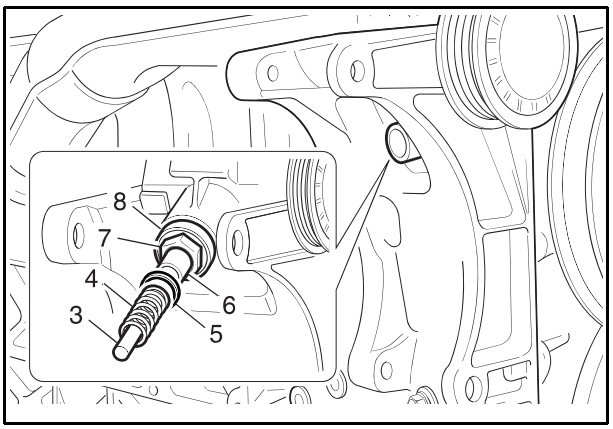
2. Cover the generator with a clean cloth.
3. Release the tension by unscrewing the screw plug once.

CAUTION
- In case that the tension is reduced by unscrewing the screw plug, reinstall after completely removing the chain tensioner. If the chain tensioner is tightened again without completely reducing its tension, then the snap ring doesn't return to the original position and the tension gets exceeded.



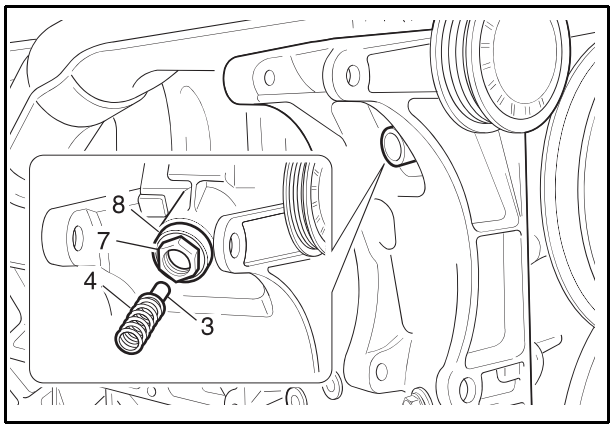
4. Carefully unscrew the screw plug (1), and remove the seal (2).

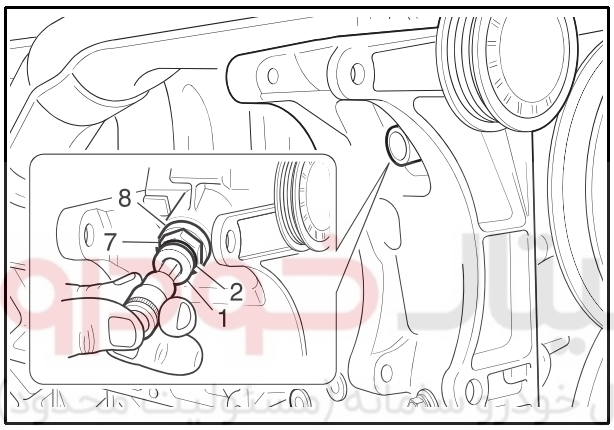
CAUTION
- For the removal of screw plug, be careful that it can be jumped out due to the force of compression spring.
- Remove the screw plug only when the seal and compression spring are damaged.



5. Carefully remove the filler pin (3), compression spring (4), snap ring (5), and the thrust pin (6).
6. Remove the chain tensioner housing (7) and the seal (8).

2) Installation Procedure





1. Connect the thrust pin (6) and the snap ring (5) to the chain tensioner housing (7).

CAUTION
- Remove the oil filler cap at adjustment When connecting the thrust pin, push in the thrust pin far enough so that it doesn't protrude at the chain tensioner housing.

2. Install the chain tensioner housing (7), thrust pin (6), snap ring (5), and the seal (8).

Tightening torque 72 – 88 Nm (53 - 65 lb-ft)

3. Insert the compression spring (4) with the filler pin (3) into chain tensioner housing.
4. Lightly apply the grease to the seal (2) and install the screw plug (1).

Tightening torque 40 Nm (30 lb–ft)

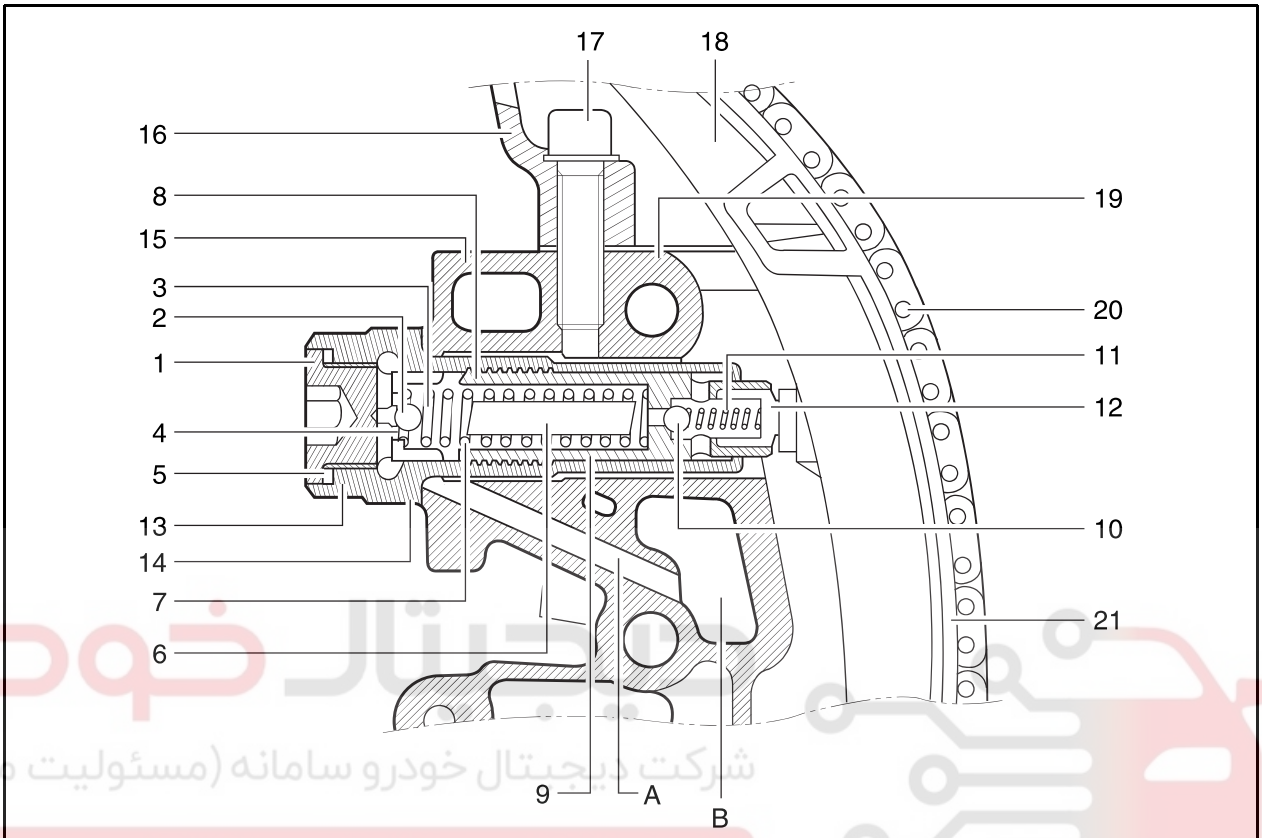
5. Check for leaks by operating the engine.

Modification basis	
Application basis	
Affected VIN	

S.G.N. 1311-01

TIMING CHAIN

1) Sectional View

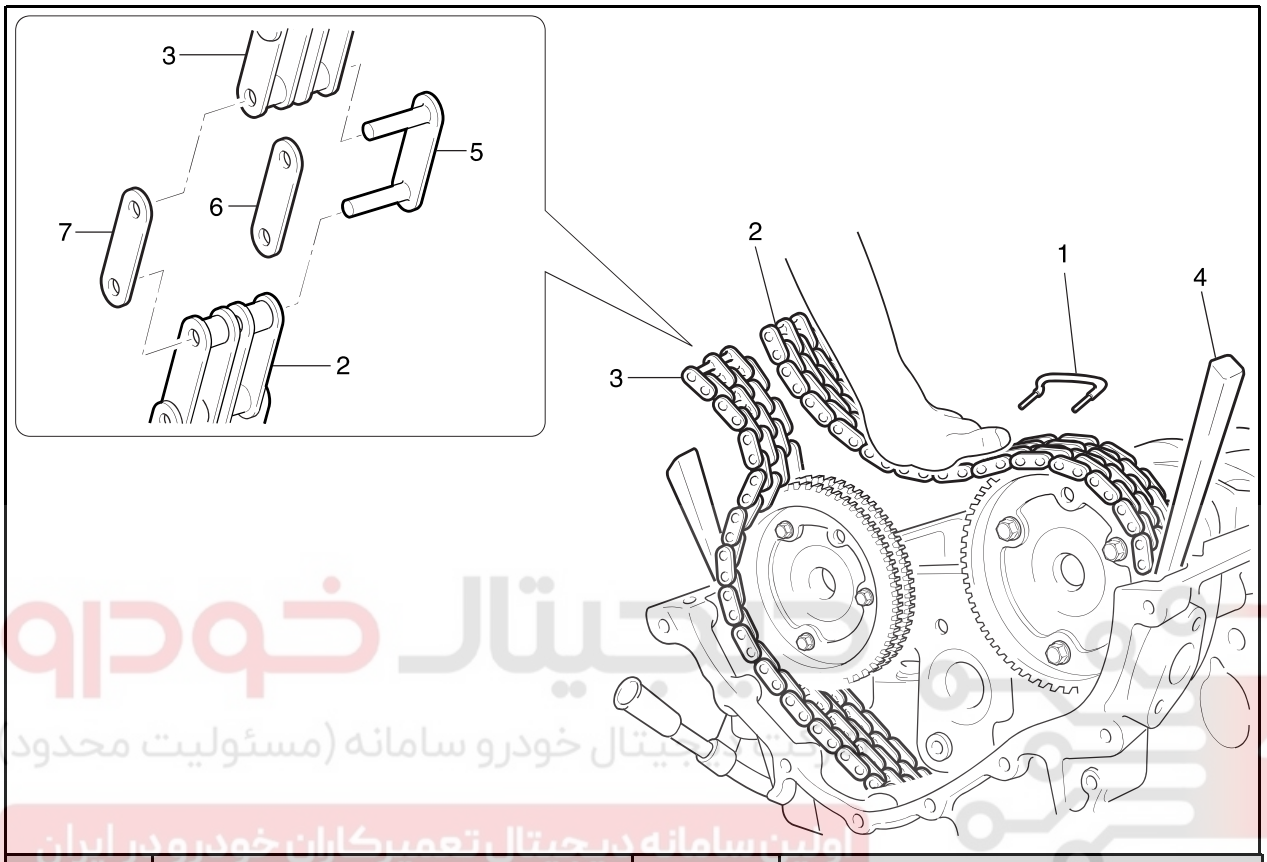


NO.	FUNCTION	NO.	FUNCTION
1	Screw Plug	13	Chain Tensioner Housing
2	Ball (Nonreturn Valve)	14	Seal
3	Compression Spring	15	Timing Gear Case Cover
4	Ball Guide	16	Cylinder Head
5	Seal (Aluminum)	17	Bolt / Washer
6	Filler Pin	18	Tensioning Rail
7	Compression Spring	19	Cylinder Head Gasket
8	Snap Ring	20	Timing Chain
9	Thrust Pin	21	Tensioning Rail Base (Sliding Surface)
10	Ball (Nonreturn Valve)		
11	Compression Spring	A	Oil Supply Hole
12	Thrust Piece	B	Chain Tensioner Oil Storage Hole

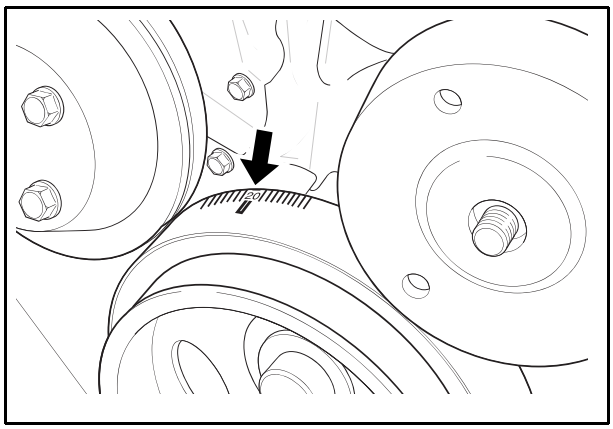
2) Removal And Installation

Preceding work

1. Removal of cylinder head cover
2. Removal of spark plug



NO.	FUNCTION	NO.	FUNCTION
1	Pin	5	Link
2	New Timing Chain	6	Center Plate
3	Timing Chain (Used)	7	Outer Plate
4	Wedge		

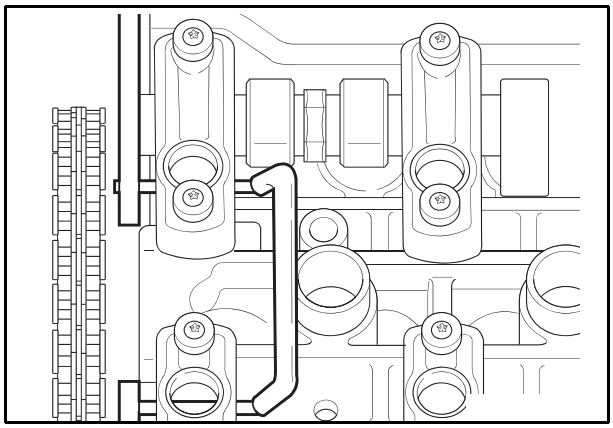


CAUTION

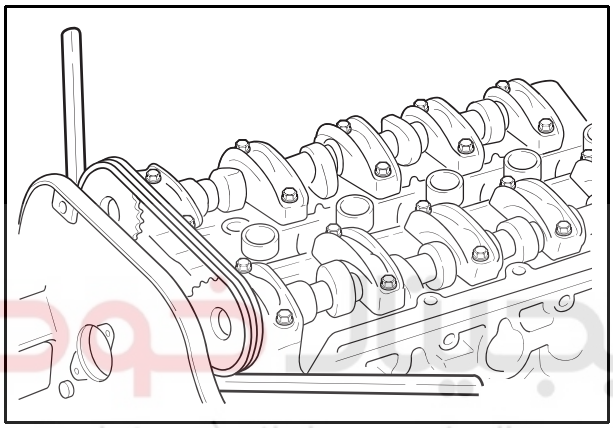
- A9913 0010B (000 589 58 43 00) Chain Assembly
- A9913 0052B (111 589 03 15 00) Holding Pin

1. Position the NO.1 cylinder to ATDC 20°.

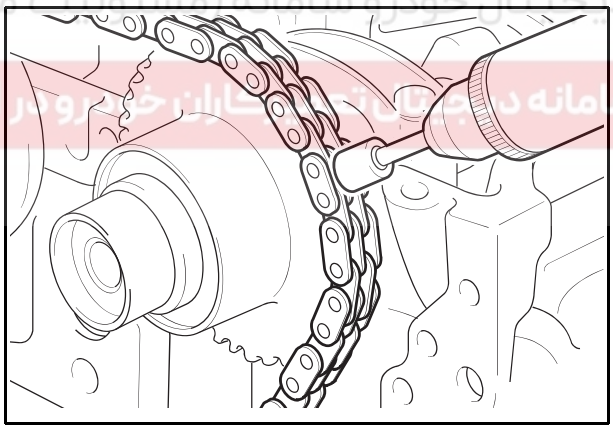
Modification basis	
Application basis	
Affected VIN	



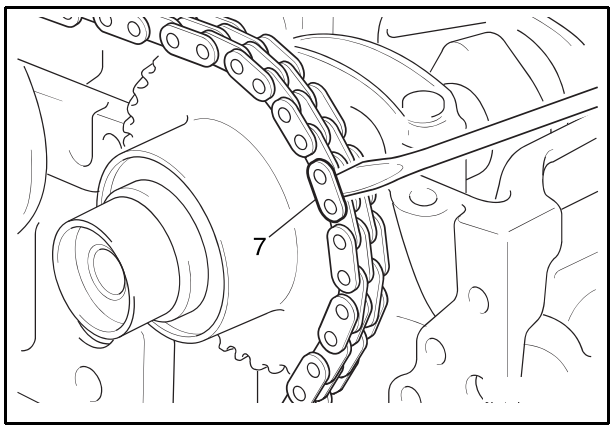
2. Insert the holding pin A9913 0052B (111 589 03 15 00) to the intake and exhaust camshaft flange not to rotate camshaft.
3. Remove the chain tensioner.



4. Mount the wedges to both sides of the camshaft sprocket as shown in the figure.

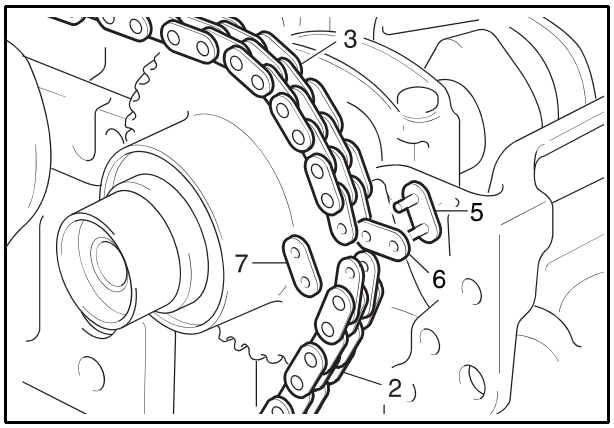


5. Cover the chain housing with a clean cloth, and grind off the timing chain pin from the intake camshaft sprocket with the grinder.



6. Remove the outer plate (7) with the screw driver and remove the link (5).

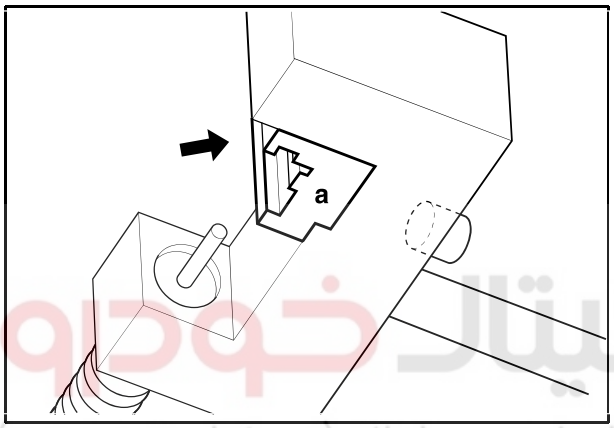
Modification basis	
Application basis	
Affected VIN	



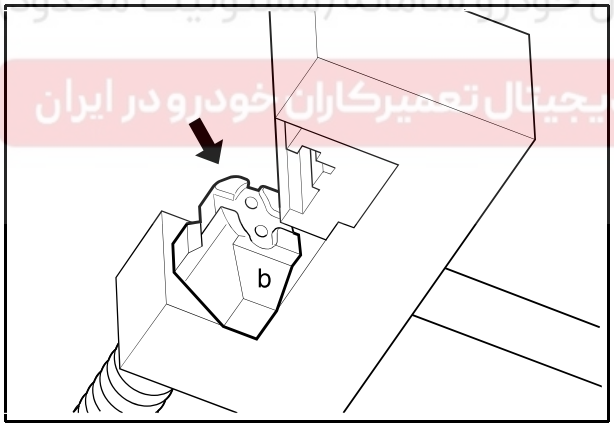
7. Connect the new timing chain (2) to the used timing chain (3) with the link (5), center plate (6, thickness 1.6 mm), and the outer plate (7). Rotate the crankshaft in the direction if engine
8. revolution by pressing the new timing chain against the exhaust camshaft sprocket to prevent it to be tangled.

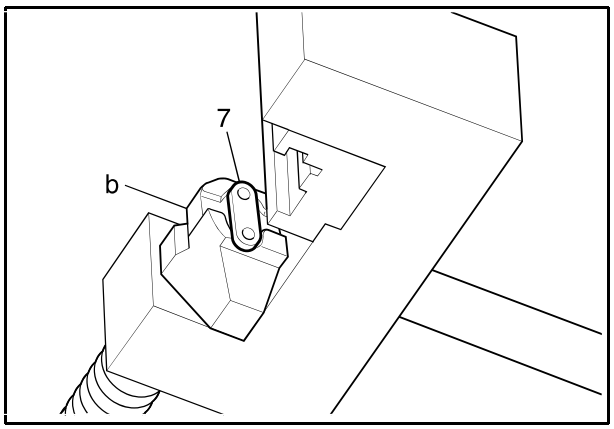
CAUTION

- Be sure to remove the wedge before cranking the engine.



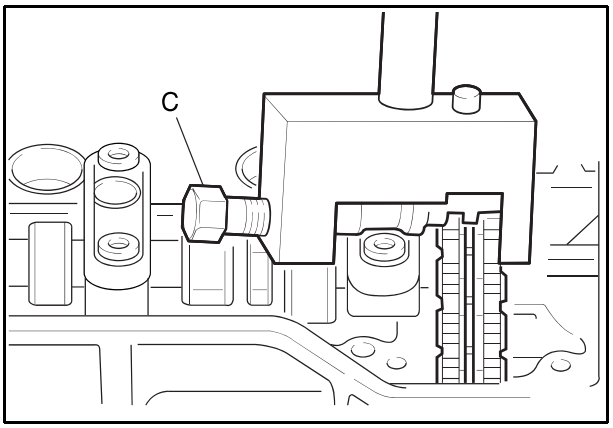
9. Take out the used timing chain out from the chain housing.
10. Connect both separators of the new timing chain with the link (5) and the center plate (6).
11. Install the jaw (a) and the thrust piece (b) to the assembly tool as shown in the figures.



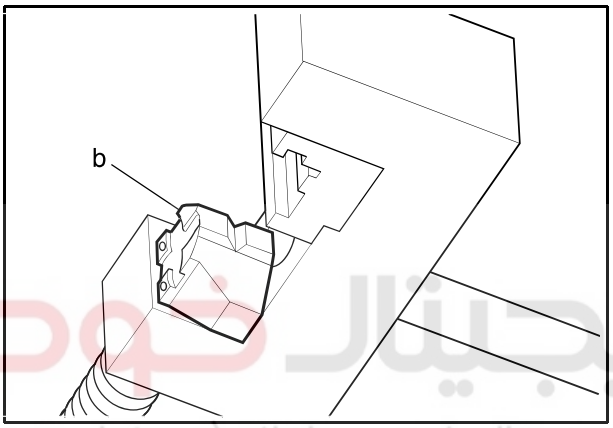


12. Place the outer plate (7, thickness 1.2 mm) inside the thrust piece (b).

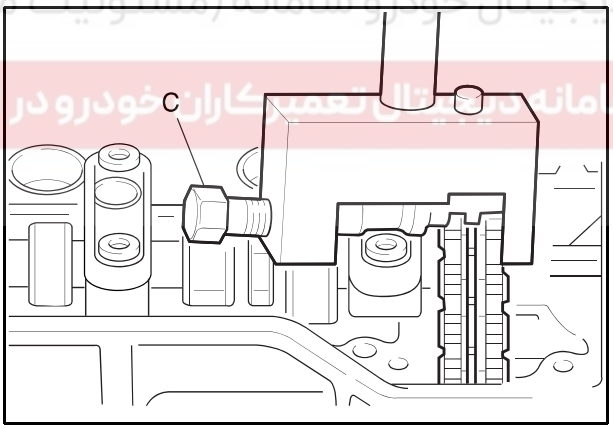
Modification basis	
Application basis	
Affected VIN	



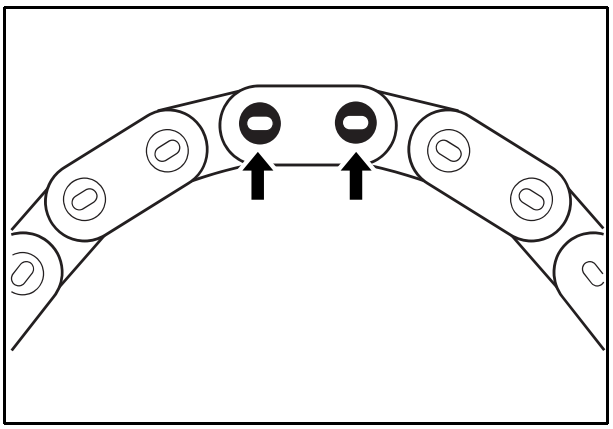
13. Install the chain assembly A9913 0010B (000 589 58 43 00)above the link and tighten the spindle (c) until a block is felt.
14. Place the chain assembly A9913 0010B (000 589 58 43 00).



15. Replace the thrust piece (b) as shown in the figure.



16. Install the chain assembly A9913 0010B (000 589 58 43 00) to the link pin and tighten the spindle (c).



17. Rivet the link pin.
    Check the condition and it again if necessary.
18. Install the chain tensioner.

Tightening torque

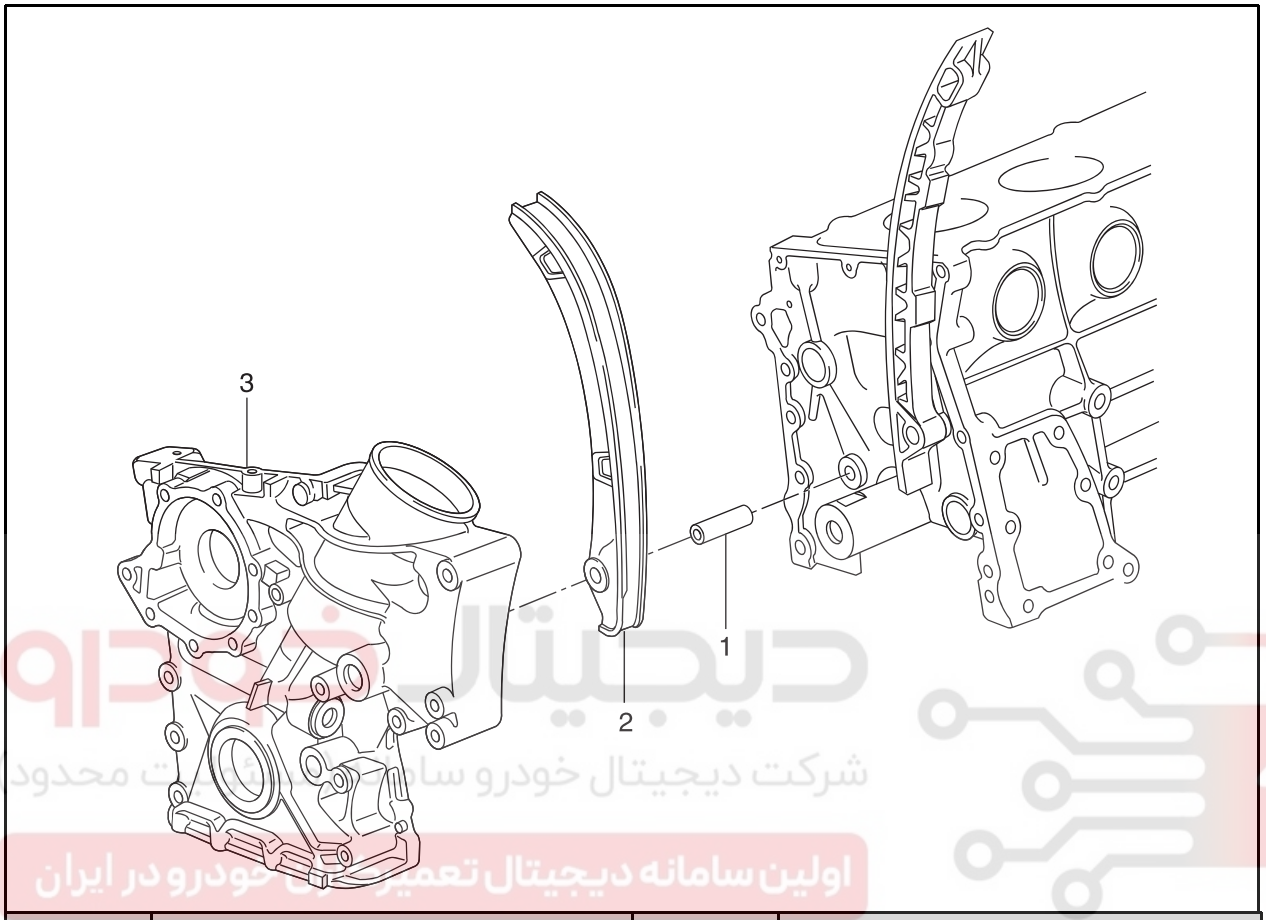
Screw Plug	40 Nm (30 lb-ft)
Tensioner Assembly	72 - 88 Nm (53 - 65 lb-ft)

19. Check the camshaft timing position.

S.G.N. 1311-04

TENSIONING RAIL

Preceding work 1. Removal of cylinder head



NO.	FUNCTION	NO.	FUNCTION
1	Sliding Rail Pin	3	Timing Gear Case Cover
2	Sliding Rail		

1. Remove the timing gear case cover (3).

CAUTION
- Be careful not to damage the gasket.

2. Remove the sliding rail (1) from the sliding rail pin (2).

CAUTION
- Replace the plastic guide (2) if it is damaged.
- For installation, exactly align the plastic guide (2) with the sliding rail (1).

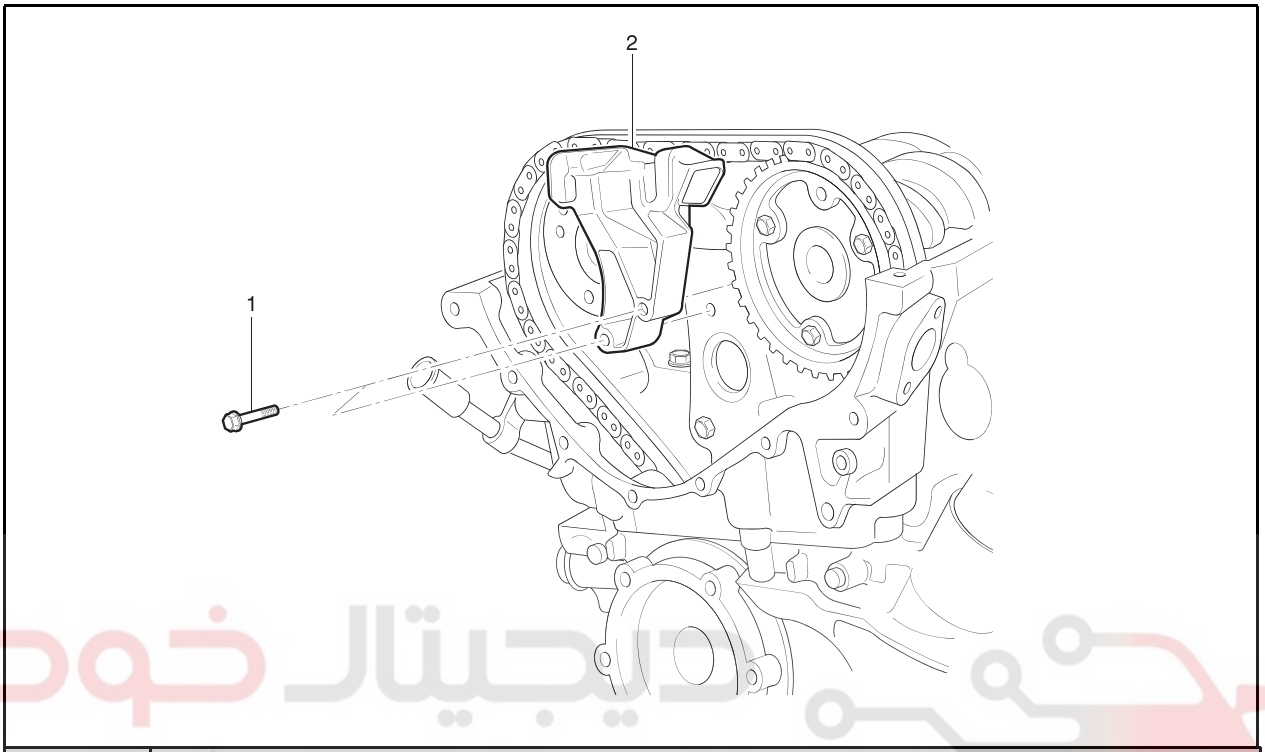
3. Installation should follow the removal procedure in the reverse order.

Modification basis	
Application basis	
Affected VIN	

S.G.N. 1311-09

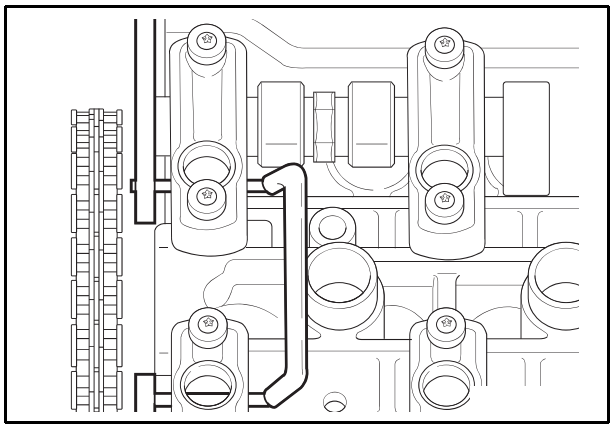
CYLINDER HEAD GUIDE RAIL

Preceding work 1. Removal of cylinder head front cover



NO.	FUNCTION
1	Bolt (M6 X 45, 2 pieces) 9 - 11 Nm (80 - 97 lb-in)
2	Guide Rail

Modification basis	
Application basis	
Affected VIN	



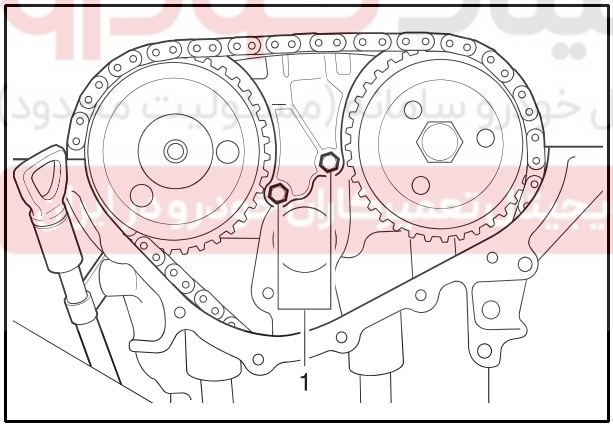
CAUTION

- A9913 0052B (111 589 03 15 00) Holding Pin

1. Position the number 1 cylinder to ATDC 20 ° guide rail.
2. Install the holding pin A9913 0052B (111 589 03 15 00) into the no.1 and no.6 bearing cap hole.
3. Remove the chain tensioner.

Tightening torque

Screw Plug	40 Nm (30 lb-ft)
Tensioner Assembly	72 - 88 Nm (53 - 65 lb-ft)



4. Unscrew the bolt (1) and remove the guide rail.

Tightening torque **9 – 11 Nm (80 - 97 lb-ft)**

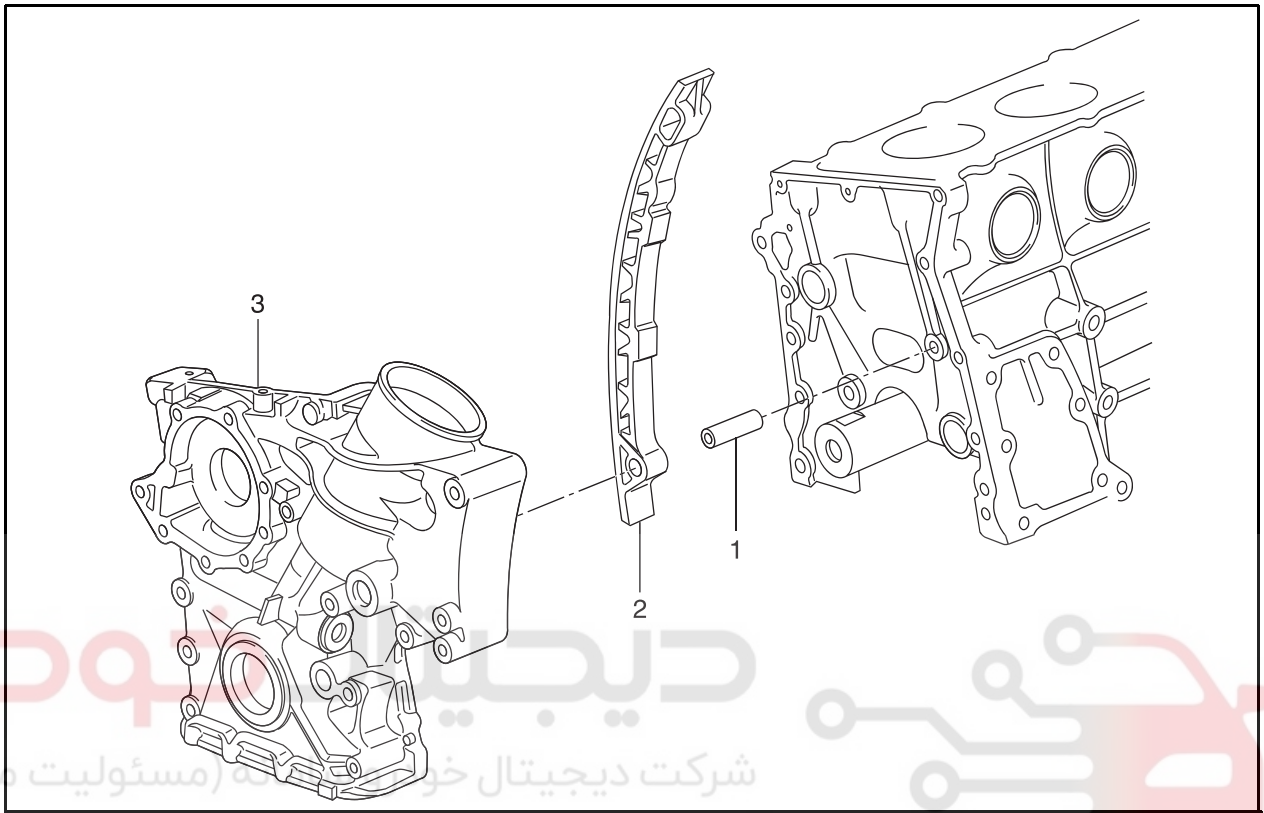
5. Installation should follow the removal procedure in the reverse order.

Modification basis	
Application basis	
Affected VIN	

S.G.N. 1311-05

CRANKCASE GUIDE RAIL

Preceding work 1. Removal of timing gear case cover



NO.	FUNCTION
1	Guide Rail Pin
2	Guide Rail
3	Timing Gear Case Cover

1. Remove the timing gear case cover (3).

CAUTION
- Be careful not to damage the gasket when removing / installing the timing gear case cover.

2. Remove the guide rail (2) from the guide rail pin (1).

CAUTION
- Replace the plastic guide (2) if damaged.
- Connect the plastic guide (2) and the guide rail (1) by aligning them accurately when installing.

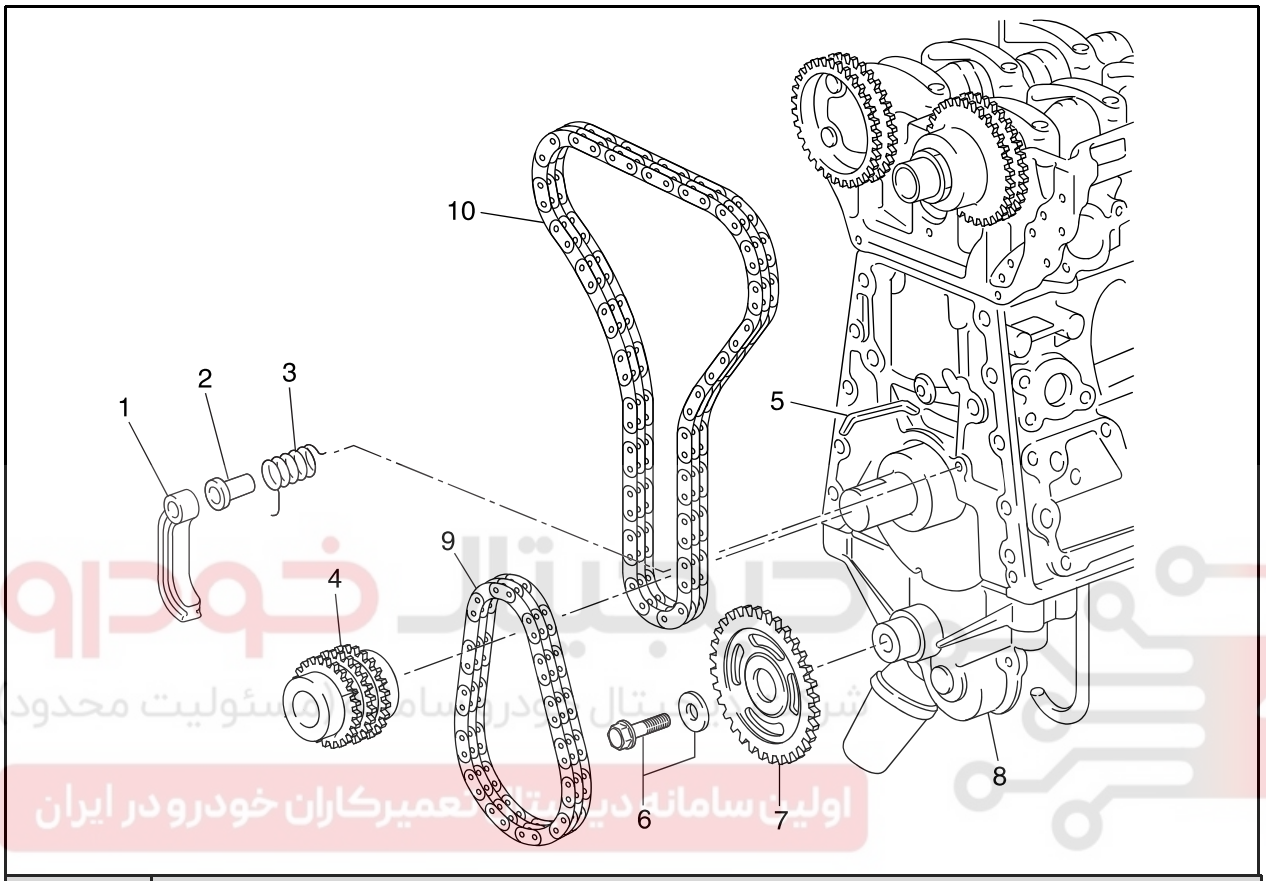
3. Installation should follow the removal procedure in the reverse order.

Modification basis	
Application basis	
Affected VIN	

S.G.N.
1130-04 CRANKSHAFT SPROCKET

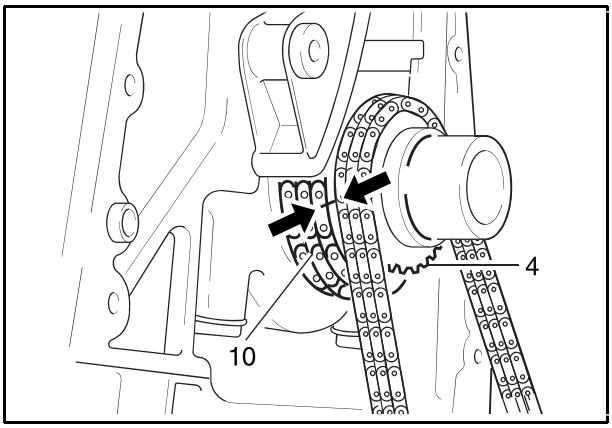
Preceding work

1. Removal of oil pan
2. Removal of tensioning rail
3. Removal of crank case guide rail



NO.	FUNCTION
1	Oil Pump Chain Tensioner
2	Oil Pump Chain Bushing
3	Oil Pump Chain Spring
4	Crankshaft Sprocket
5	Key
6	Bolt (M8 x 20, 1 piece) / Washer ..... 29 - 35 Nm (21 - 26 lb-ft)
7	Oil Pump Sprocket
8	Oil Pump
9	Oil Pump Roller Chain
10	Timing Chain

Modification basis	
Application basis	
Affected VIN	



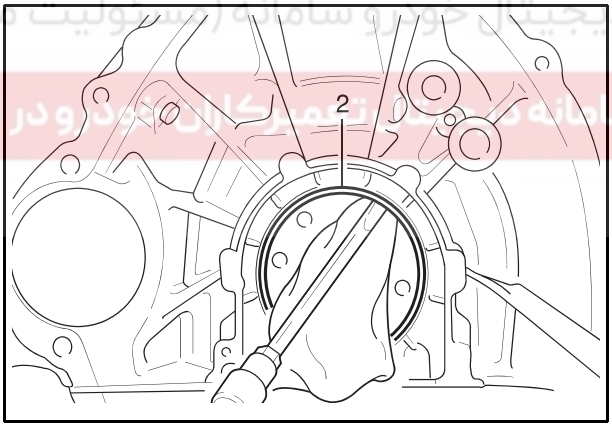
CAUTION
- W9911 0050B (615 589 01 33 00) Crankshaft Sprocket Puller

1. Put the assembly mark at the crankshaft sprocket (4) and the timing chain (10) with the paint (arrow).

CAUTION
- Align the assembly marks on crankshaft sprocket and timing chain. Also, align the assembly marks on camshaft sprocket and timing chain when installing.

2. Unscrew the bolt (6) and remove the oil pump sprocket (7) from the oil pump.

Tightening torque **29 – 35 Nm (21 - 26 lb-ft)**



3. Remove the oil pump roller chain (9).
4. Remove the oil pump chain tensioner (1), oil pump chain bushing (3), and the oil pump chain spring (2).
5. Remove the crankshaft sprocket (4) using crankshaft sprocketpuller W9911 0050B (615 589 01 33 00).

CAUTION
- Make sure not to lose the crankshaft pulley key (5) when removing.
- Install the crankshaft sprocket (4) after warming it up.

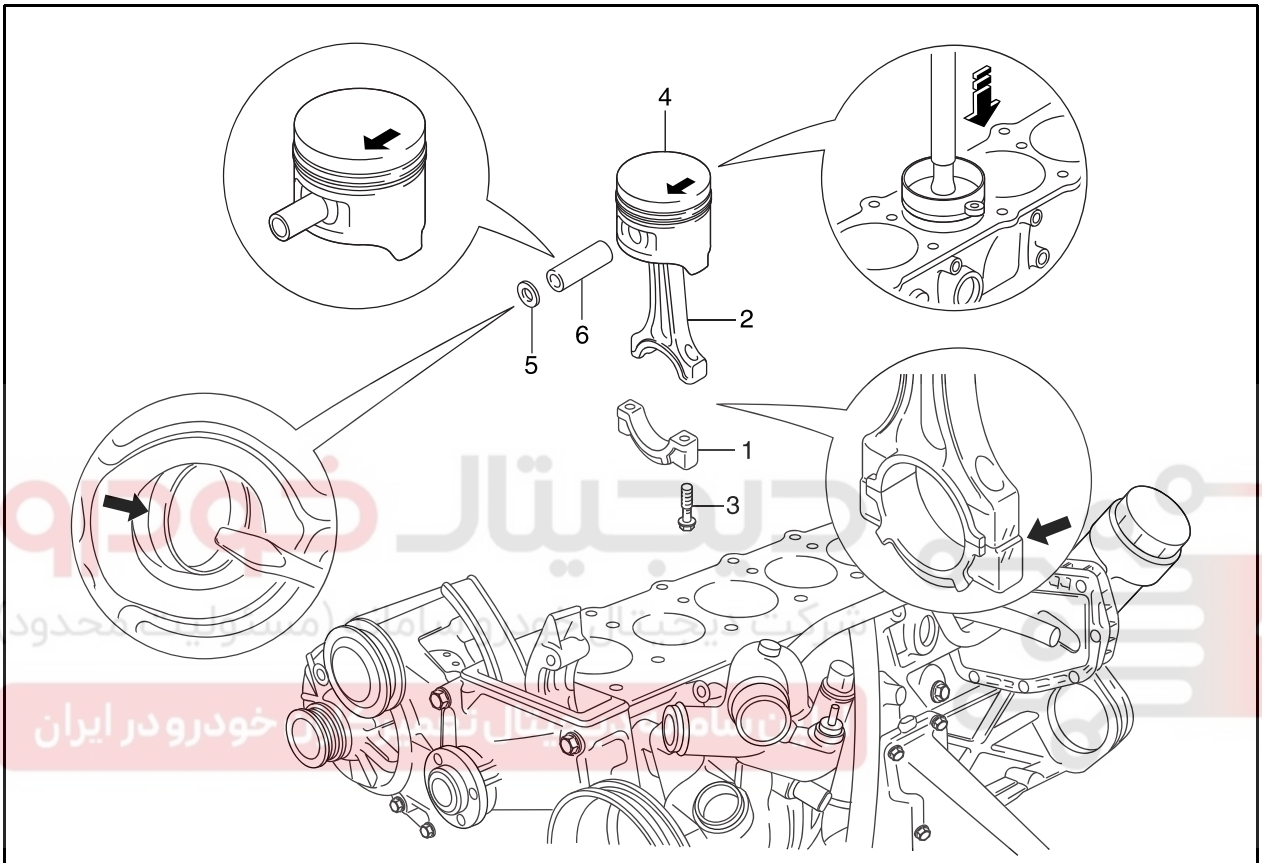
6. Installation should follow the removal procedure in the reverse order.

Modification basis	
Application basis	
Affected VIN	

S.G.N.
1130-20 PISTON

Preceding work

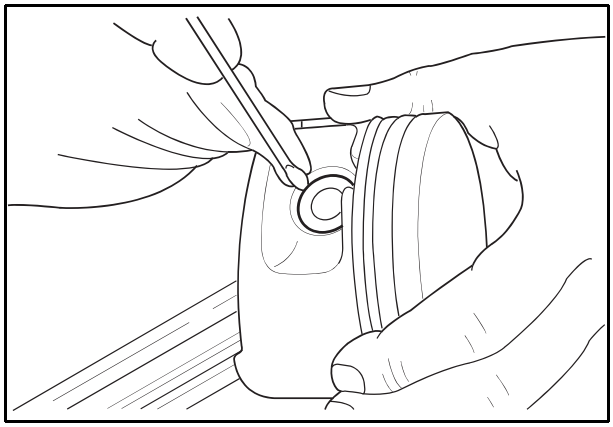
1. Removal of engine
2. Removal of cylinder head
3. Removal of oil pan
4. Removal of oil pump
5. Removal of baffle plate



NO.	FUNCTION
1	Connecting Rod Bearing Cap
2	Connecting Rod
3	Connecting Rod Bolt (M9 x 52, 8 pieces) ..... 1st step 40 Nm (30 lb-ft) ..... 2nd step 90 °
4	Piston
5	Snap Ring
6	Piston Pin

Modification basis	
Application basis	
Affected VIN	

1) Removal Procedure



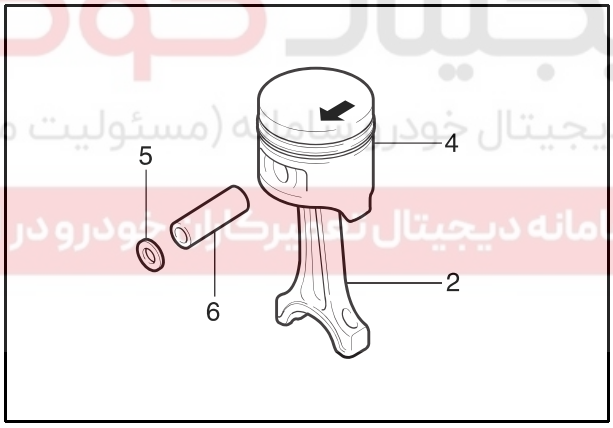
1. Unscrew the connecting rod bolt (3) and remove the cap.
2. Remove the connecting rod and the piston upward.

CAUTION
- Make sure that the bearing cap and shell are not changed each other.

3. Removethe snapring (5) and pulloutthepiston pin (6).

CAUTION
- Remove the snap ring using a clean cloth as shown in the right picture so that the piston, piston ring, and the snap ring don't get damaged.

2) Installation Procedure



1. Check the piston ring gap and apply the engine oil to the piston pin and the connecting rod bushing.
2. Connect the piston and the connecting rod by pressing in the piston pin (6) and install the snap ring to the groove.
3. Clean the cylinder bore, connecting rod bearing journal, connecting rod bearing shell and the piston and coat them with engine oil. Install the piston ring.
4. Install the piston so that the arrow on the
5. piston head faces to the forward of the vehicle.
   After aligning the connecting rod and the
6. bearing cap mark (// or a number), tighten the bolts.

Tightening torque **1st step: 40 Nm (30 lb-ft)**
2nd step: 90°

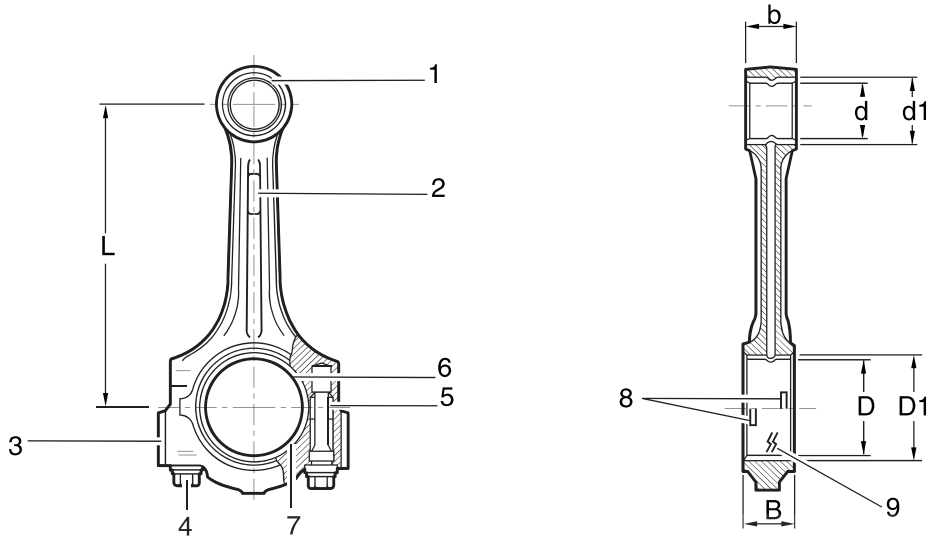
- Apply the engine oil to the bearing cap upper and lower bearing shells.

7. Check if the crankshaft rotates without any trouble by rotating it.

S.G.N. 1130-13

CONNECTING ROD

Preceding work 1. Removal of piston



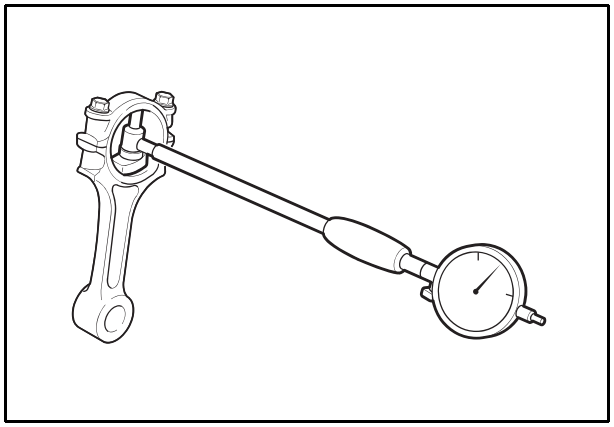
NO.	FUNCTION
1	Connecting Rod Bushing
2	Oil Gallery
3	Balance Weight
4	Connecting Rod Bearing Cap Bolt (M9 x 52, 8 pieces) ..... 1ststep 40 Nm (30 lb-ft) ..... 2nd step 90 °
5	Fit Sleeve
6	Upper Connecting Rod Bearing
7	Lower Connecting Rod Bearing
8	Bearing Shell Lug
9	Marking [Indication (//) or Numbers]

Modification basis	
Application basis	
Affected VIN	

▶ Service Data Standard

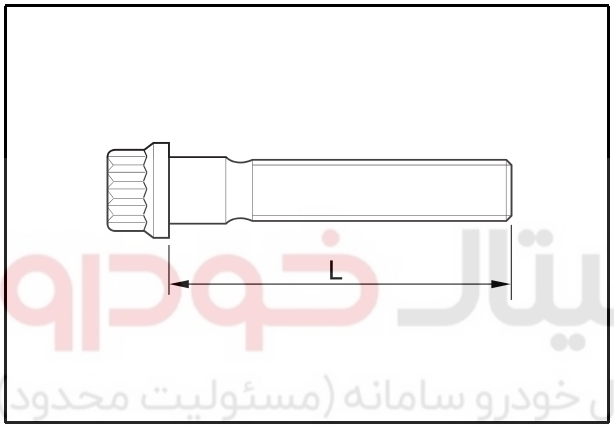
Distance (L) from The Connecting Rod Bearing to Bushing Bore Center	149 ±0.05 mm
Width of The Connecting Rod (B) at Bearing Bore	21.940 - 22.000 mm
Width of The Connecting Rod (b) at Bushing Bore	21.940 - 22.000 mm
Basic Bore at The Bearing Shell (D1)	51.600 - 51.614 mm
Basic Bore at The Bushing (d1)	24.500 - 24.521 mm
Bushing Inner Diameter (d)	22.007 - 22.013 mm
Clearance Between The Piston Pin and The Bushing	0.007 - 0.018 mm
Peak-to-valley Height of Connecting Rod Bushing on Inside	0.005 mm
Permissible Wwist of Connecting Rod Bearing Bore to Connecting Rod Bushing Bore	0.1/100 mm
Permissible Deviation of Axial Paralleism of Connecting Rod Bearing Bore to Connecting Rod Bushing Bore	0.045/100 mm
Permissible Deviation of Axial Paralleism of Connecting Rod Bearing Bore from Concentricity	0.01 mm
Permissible Difference of Each Connecting Rod in Weight	0.4 g

1) Inspection



1. Measure the basic bore of the connecting rod bearing.

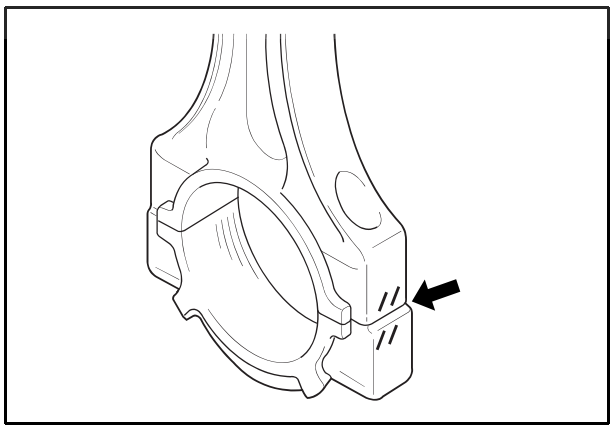
CAUTION
- If the basic bore exceeds the value of 51.614 mm, replace the bearing or check the connecting rod.



2. Check connecting rod bolts.

Length When New (L)	51.7 - 52 mm
Max. Length (L)	52.9 mm
Tightening Torque	1st step : 40 Nm (30 lb-ft)
	2nd step : 90°

CAUTION
- If the length exceeds max. length, replace it.



3. Check the assembly mark (indication//or number: arrow) of the connecting rods and the bearing cap when installing.

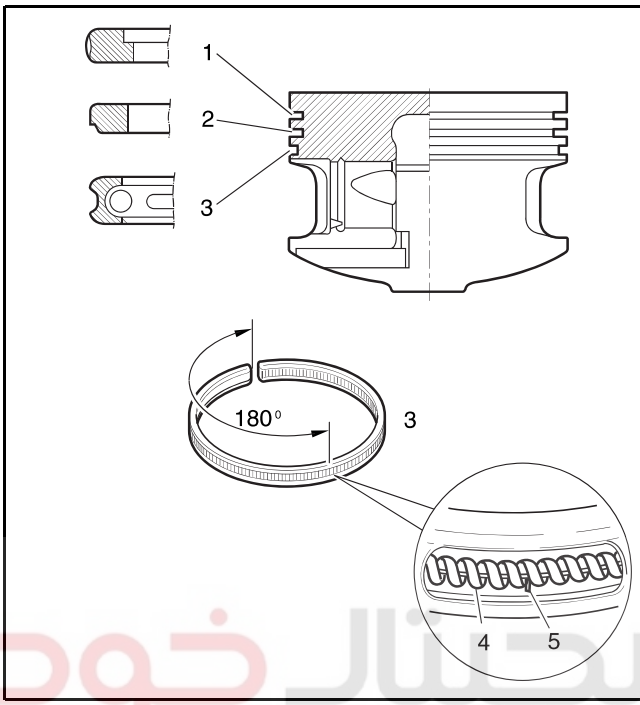
CAUTION
- Make sure it doesn't exceed over 4g with other connecting rods when replacing the connecting rods.
- Check if the connecting rod and the bearing cap are accurately seated on the groove when replacing the bearing.

Modification basis	
Application basis	
Affected VIN	

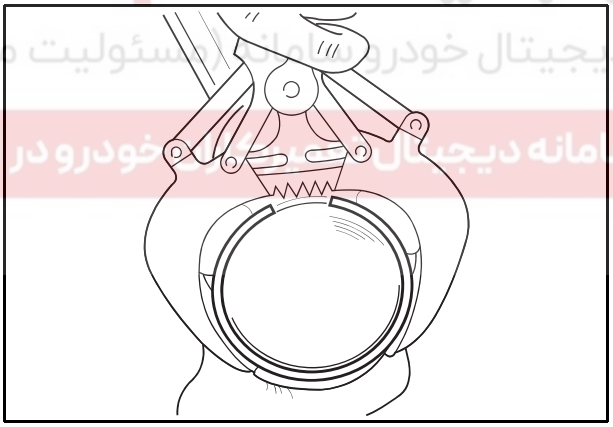
S.G.N. 1130-21

PISTON RING

Preceding work 1. Removal of piston



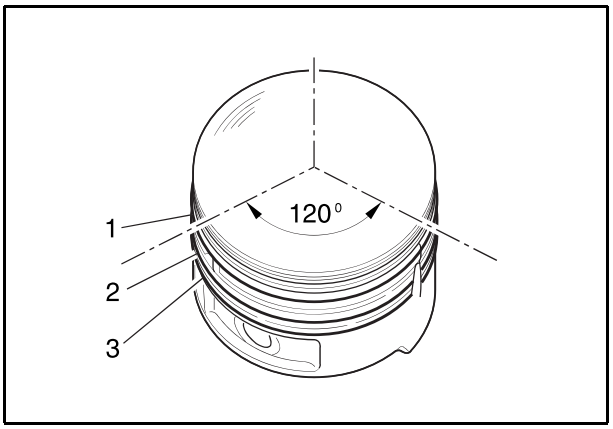
NO.	FUNCTION
1	Piston Compression Ring (Top Ring)
2	Piston Compression Ring (2nd Ring)
3	Piston Oil Ring
4	Spring
5	Spacer
6	SideRail



1. Measure the piston ring's gap.

End Gap of the Piston Ring	Groove 1 0.20 - 0.40 mm
	Groove 2 0.20 - 0.40 mm
	Groove 3 0.20 - 0.45 mm
Gap Between the Piston and the Piston Ring	Groove 1 0.028 - 0.060 mm
	Groove 2 0.010 - 0.045 mm
	Groove 3 0.010 - 0.045 mm

CAUTION
- If out of specification, replace the piston ring.



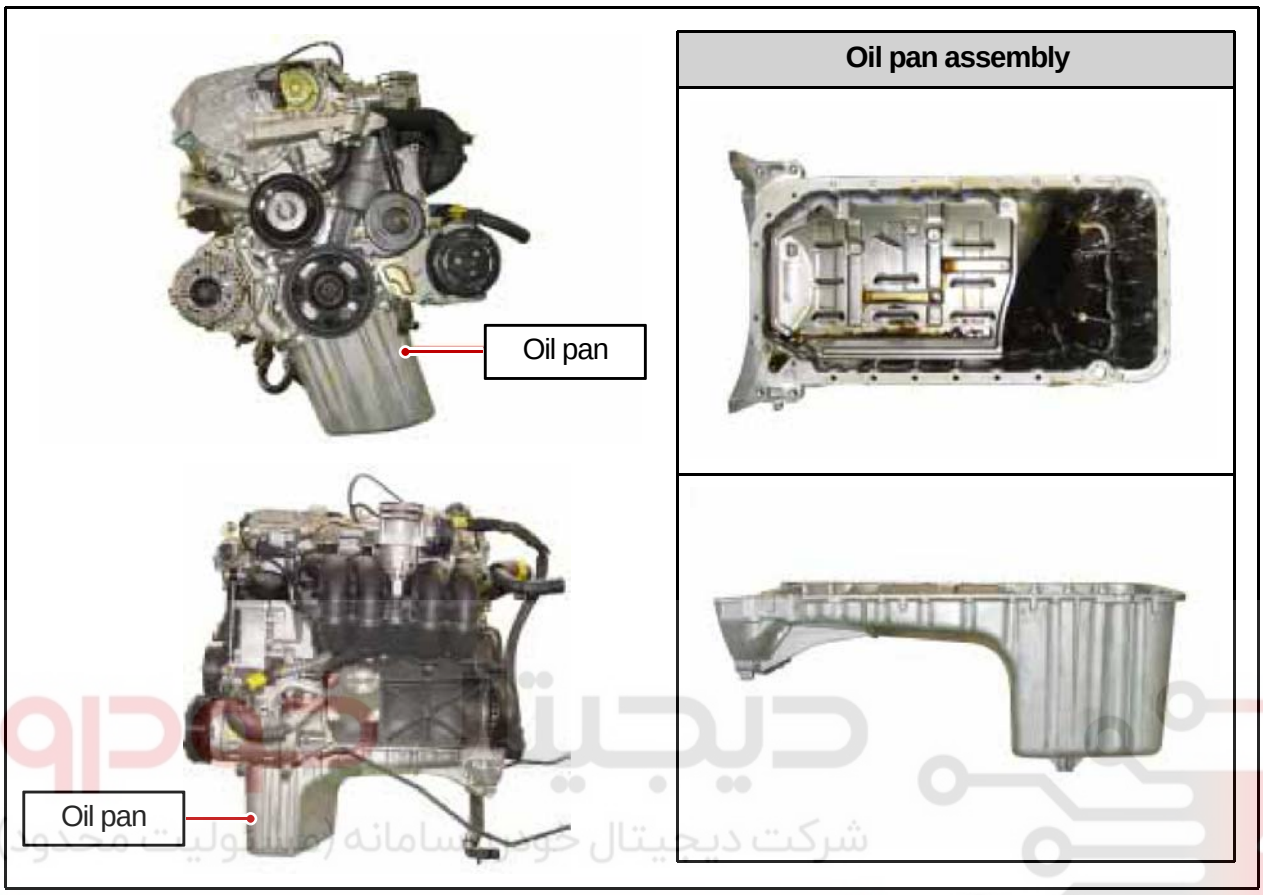
2. Remove the piston ring with a pliers.

3. For installation, position the piston ring to be the 'TOP' mark on the piston ring upward and arrange the piston ring ends to be 120 ° part.
4. Adjust the hook spring joint in the oil ring 180 ° way from the ring end.

Modification basis	
Application basis	
Affected VIN	

S.G.N. 1532-24

OIL PAN

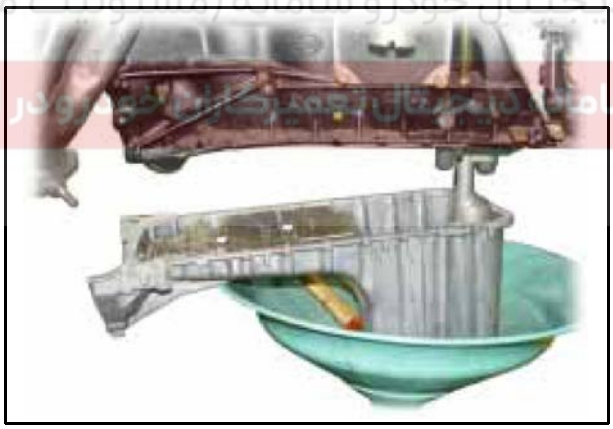


Modification basis	
Application basis	
Affected VIN	

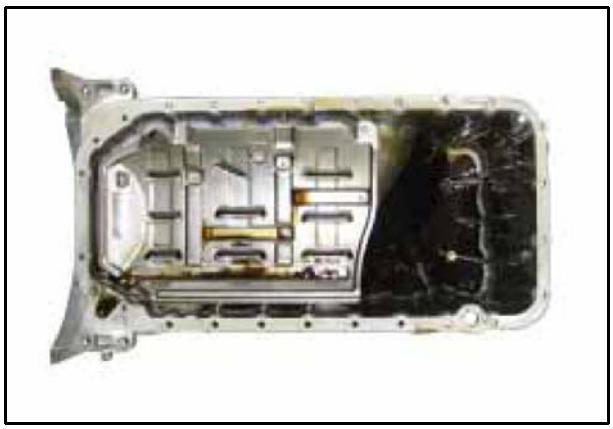
1. Remove the drain plug and drain the oil completely.

2. Unscrew the bolts and remove the oil pan and gasket.

CAUTION
- Arrange the bolts according to each size.



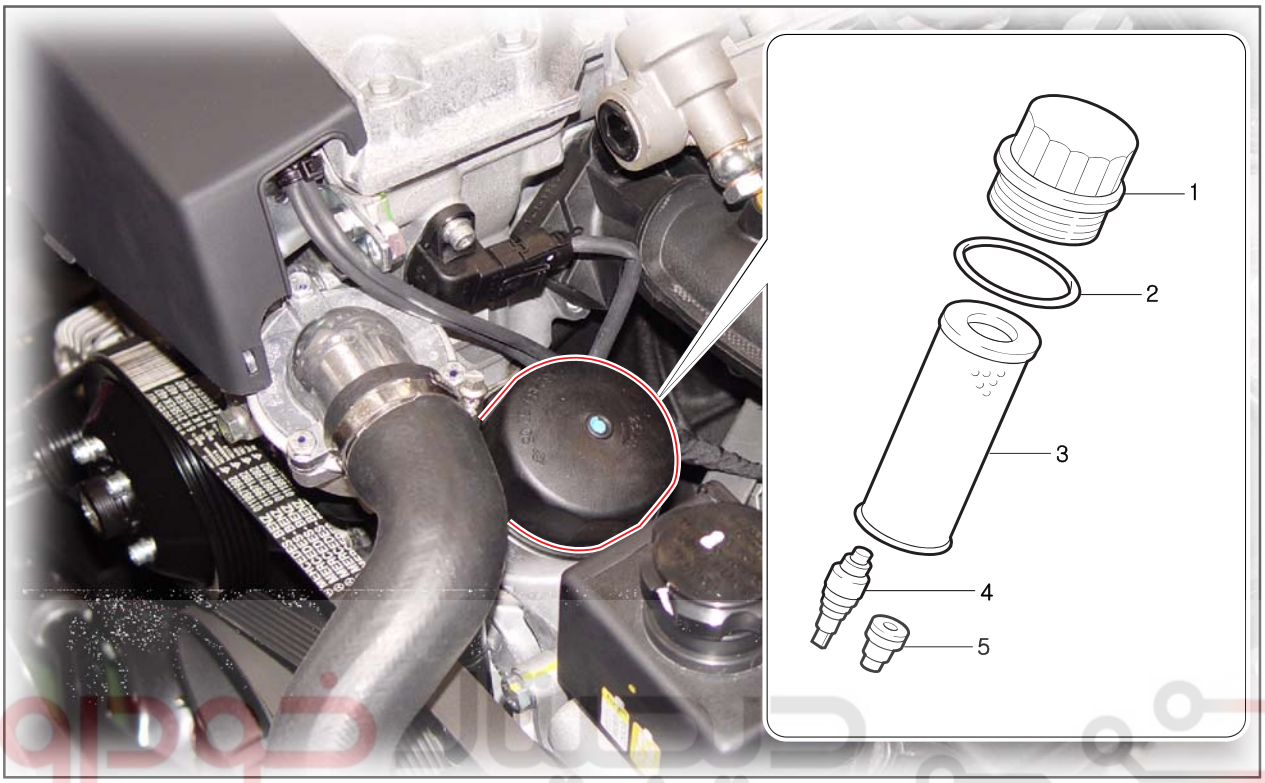
3. Clean the inside of oil pan and sealing surface, then apply the sealant.
4. Replace the gasket with new one.
5. Install the oil pan with gasket, and tighten each bolt in specified torque.



6. Check for oil leaks while running the engine.

Modification basis	
Application basis	
Affected VIN	

S.G.N.
1532-00 ENGINE OIL AND OIL FILTER ELEMENT



NO.	FUNCTION	NO.	FUNCTION
1	Oil Filter Cover 25 Nm (18 lb-ft)	4	Oil Drain Plug
2	O-Ring Replace	5	Oil Filter Bypass Valve
3	Oil Filter Element		

CAUTION
- A9910 0050A (103 589 02 09 00) Oil Filter Remover

1. Install the oil filter remover A9910 0050A (103 589 02 09 00) on the oil filter cover.

CAUTION
- Make the screw cover removable by tightening the bolt at the side of the oil filter remover 103 589 02 09 00.

2. Install the wrench to the upper bolt in the oil filter remover A9910 0050A (103 589 02 09 00) and remove the oil cover by turning it.
3. Remove the oil filter element.

CAUTION
- Work with a cloth under the vehicle when removing the oil filter element to not drain the oil.

Modification basis	
Application basis	
Affected VIN	

4. Remove the drain plug and drain the engine oil.

CAUTION
- Leave the oil filler cap open to ease the engine oil discharge.

5. Tighten the engine oil drain plug after cleaning it.

Tightening torque 25 Nm (18 lb-ft)

- Replace the seal washer with new one.

6. Replace the O-ring in the oil filter cover with new one.

CAUTION
- Apply the engine oil to the O-ring.

7. Insert new oil filter element into the oil filter housing.
8. Temporarily tighten the oil filter cover. Install the Oil filter remover A9910 0050A (103 589 02 09 00), and then completely tighten it.

Tightening torque 25 Nm (18 lb-ft)

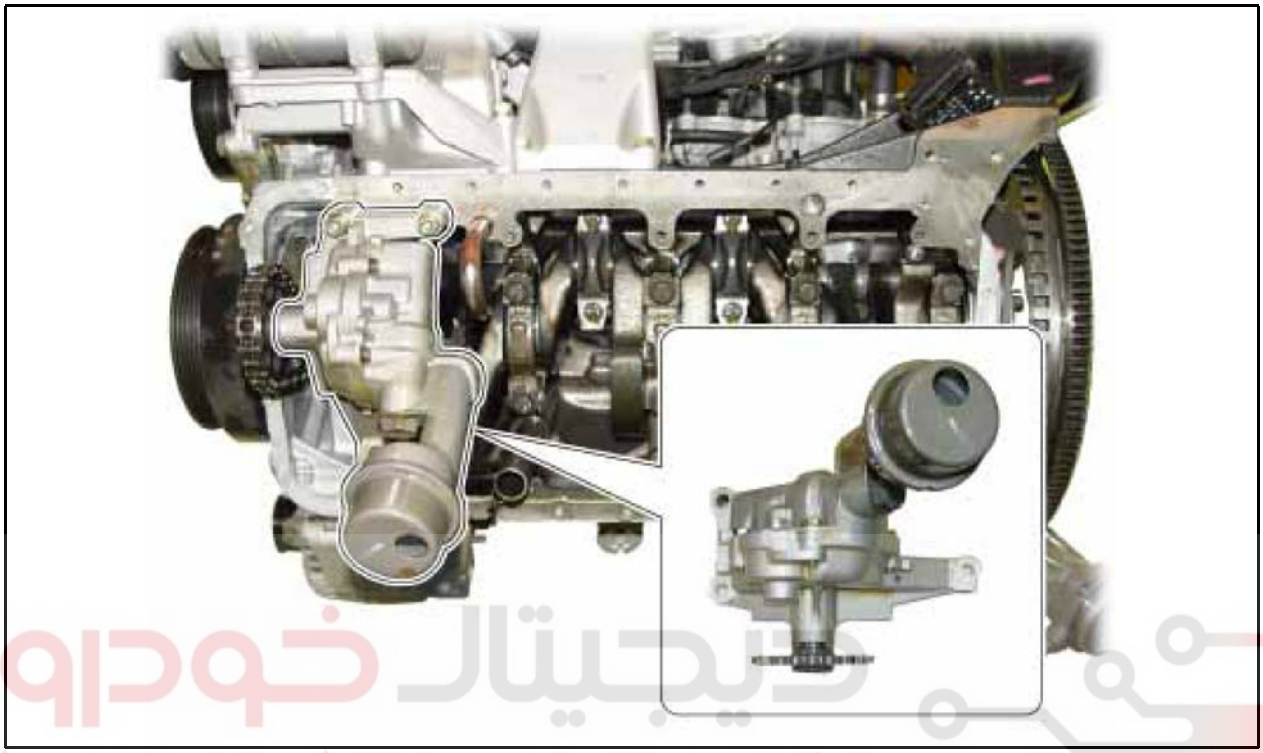
9. Fill up engine oil through the engine oil filler opening (3).
10. Check for oil leaks at normal engine temperature after starting the engine.
11. Stop the engine and wait 5 minutes.
    Check the oil level and fill up as specified if necessary.

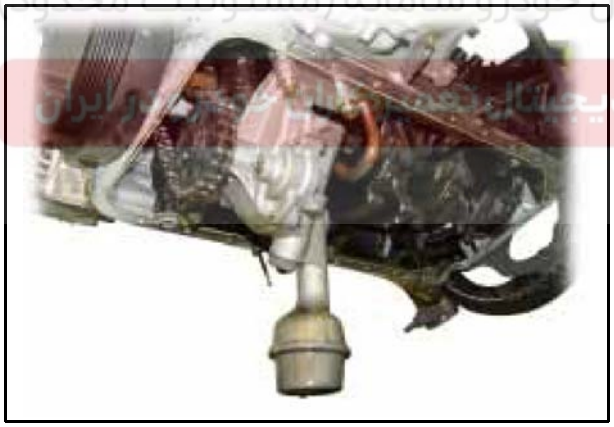
Modification basis	
Application basis	
Affected VIN	

S.G.N. 1532-00

OIL PUMP

Preceding work 1. Removal of oil pan





1. Unscrew the three bolt (1) and remove the oil pump.

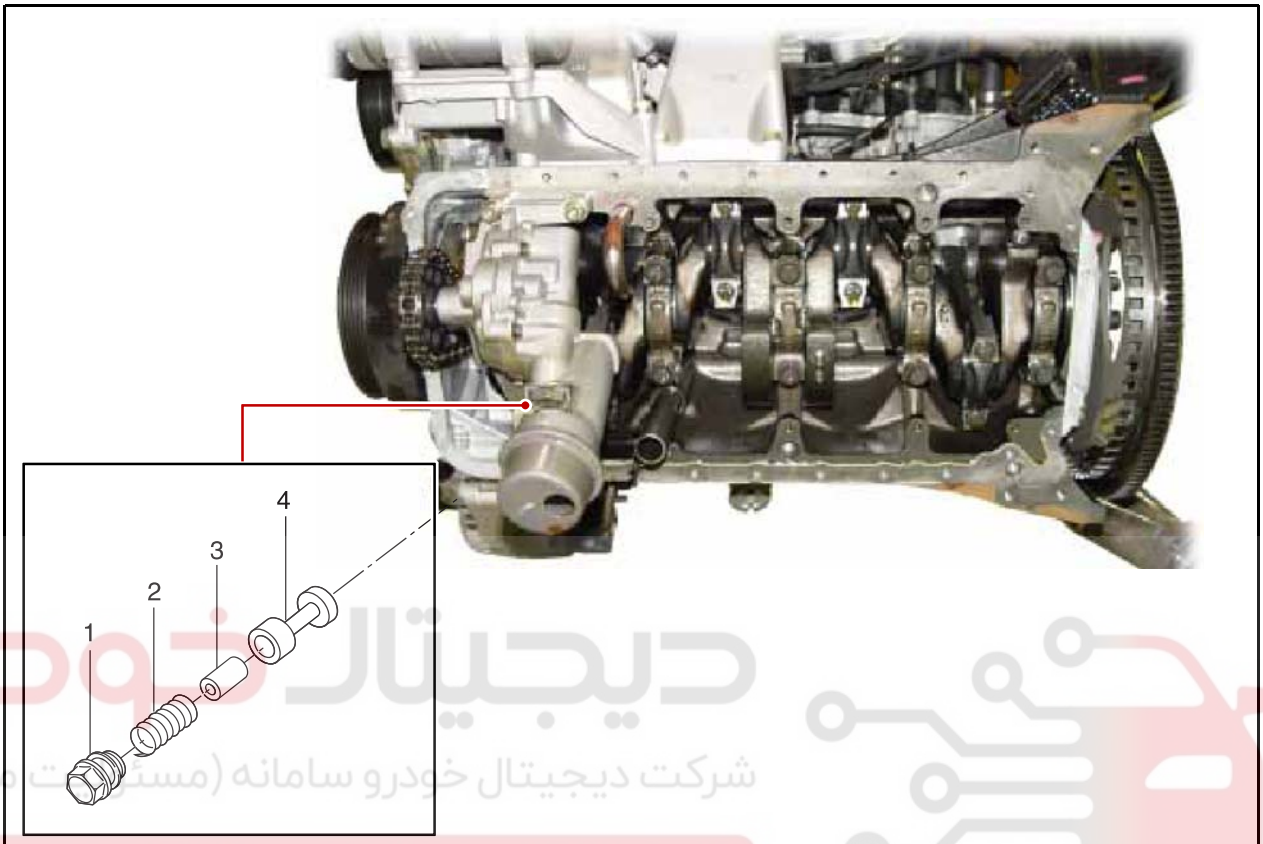
Tightening torque **22.5 – 27.5 Nm (16.6 - 20.3 lb-ft)**

2. Remove the oil pump from the cylinder block.

Modification basis	
Application basis	
Affected VIN	

S.G.N.
1532-00 OIL PRESSURE RELIEF VALVE

Preceding work 1. Removal of oil pan



NO.	FUNCTION	NO.	FUNCTION
1	Screw Plug ..... 50 Nm (37 lb-ft)	3	Guide Pin
2	Compression Spring	4	Piston

1. Remove the screw plug (1).

   Tightening torque **50 Nm (37 lb-ft)**

2. Remove the spring (2), guide pin (3) and the piston (4).
3. Installation should follow the removal procedure in the reverse order.

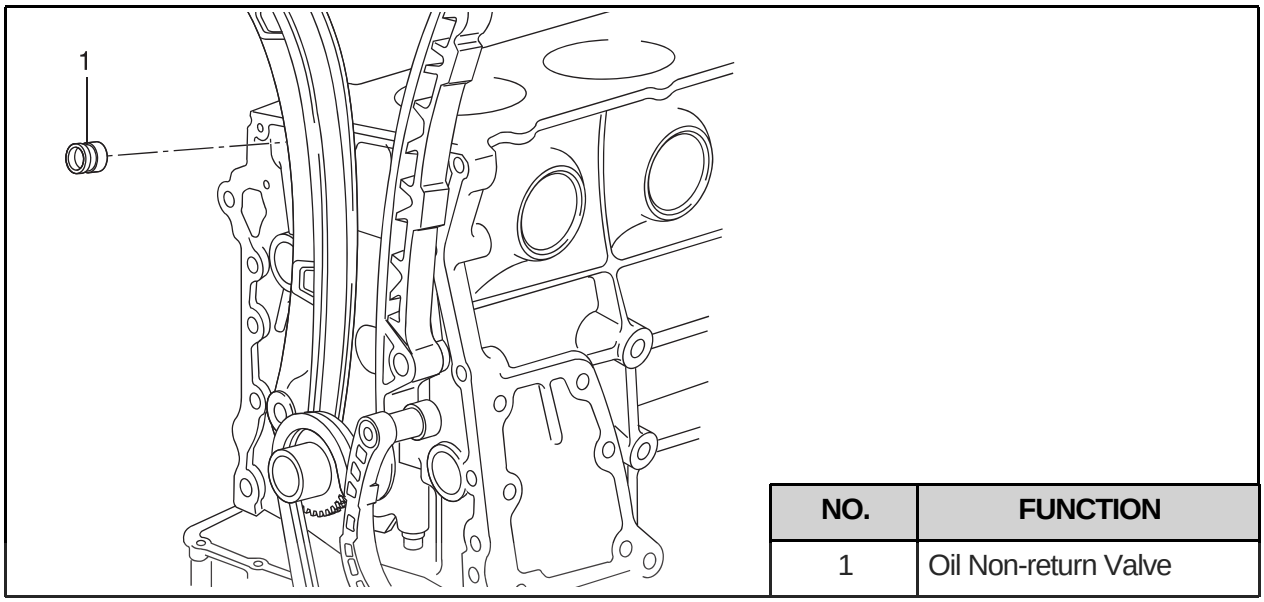
CAUTION

- Don't use the seal for the screw plug.

Modification basis	
Application basis	
Affected VIN	

S.G.N.
1532-00 OIL NON-RETURN VALVE

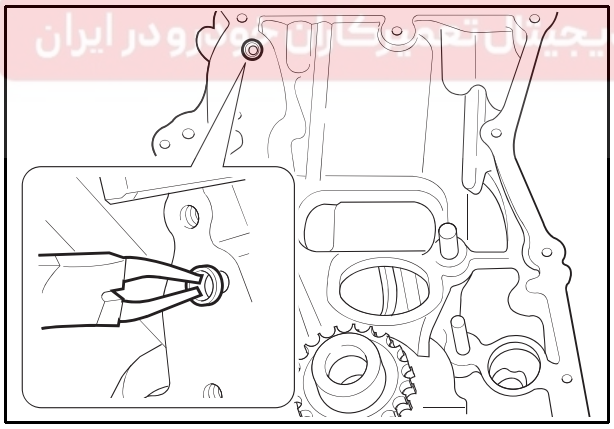
Preceding work 1. Removal of timing gear case cover



NO.	FUNCTION
1	Oil Non-return Valve

▶ Functions

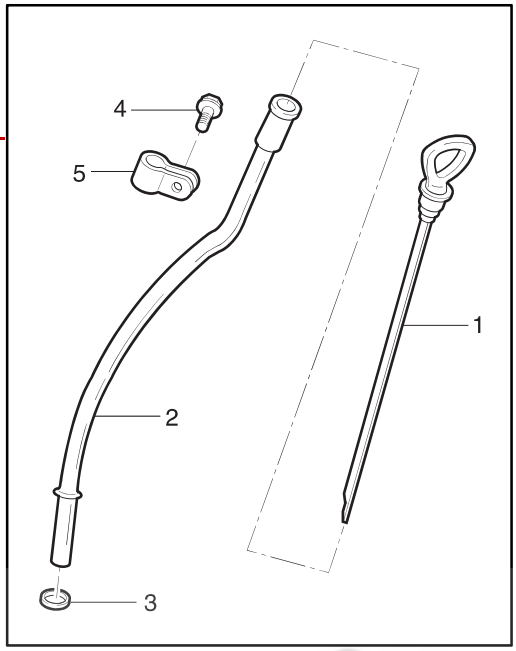
The non-return valve prevents the oil in the chain tensioner from drying up. In other words, it stops oil-returning in order to prevent the oil in the chain tensioner from getting dry. As a result, the chain tensioner can be activated with oil in itself.



1. Remove the non-return valve using a pliers.
2. Insert new non-return valve with hand.

Modification basis	
Application basis	
Affected VIN	

S.G.N.
1532-00 OIL DIPSTICK GUIDE TUBE



NO.	FUNCTION
1	Oil Dipstick Level Gauge
2	Oil Dipstick Guide Tube
3	O-Ring
4	Bolt (M6 X 16, 1 piece) ..... 9 - 11 Nm (80 - 97 lb-in)
5	Clamp

1. Pull out the oil dipstick level gauge (1).
2. Unscrew the bolt (4) and remove the oil dipstick guide tube (2).

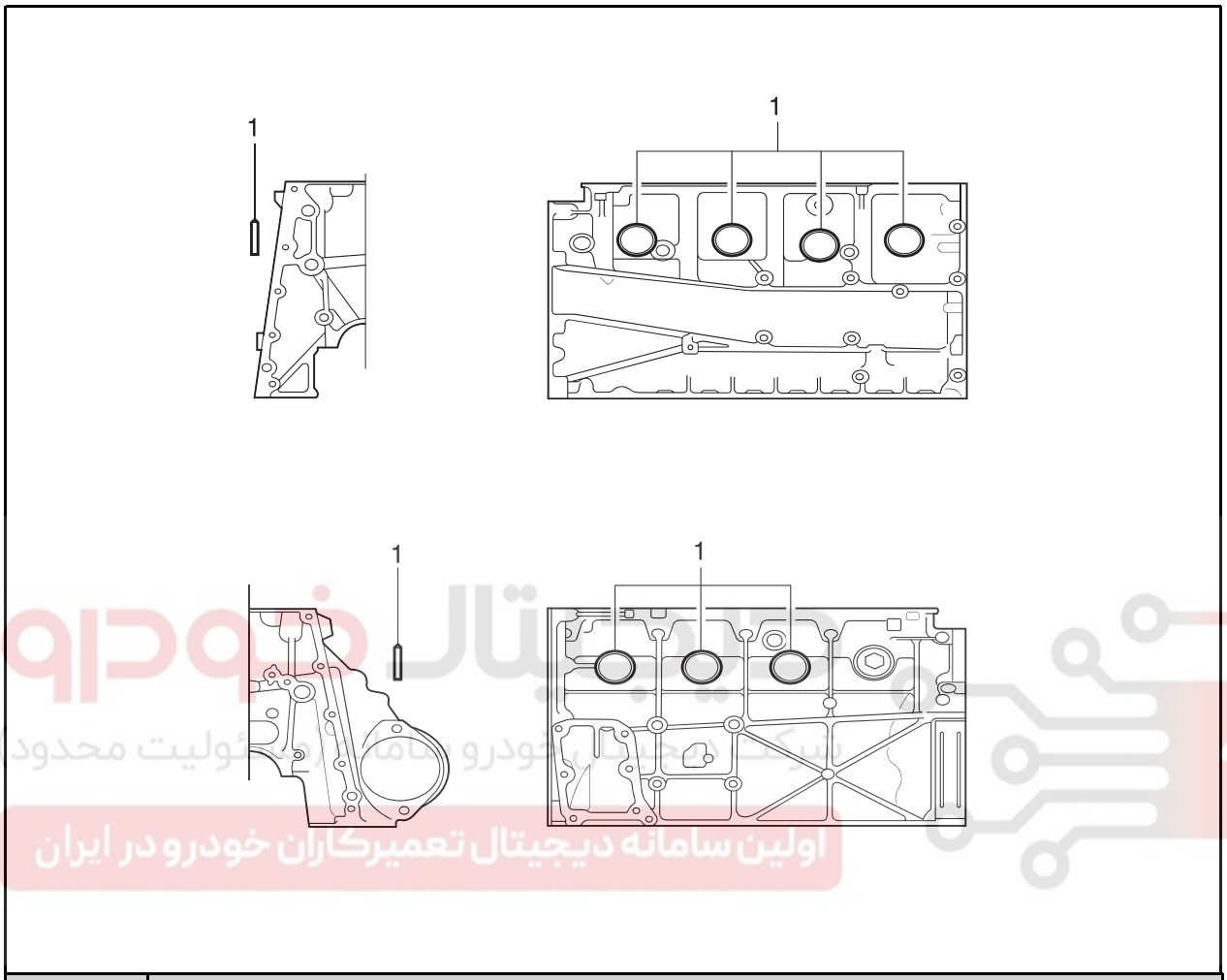
   Tightening torque **9 – 11 Nm (80 - 97 lb-ft)**

   - It is very hard to remove the oil dipstick guide tube without special tool. If it is not necessary, do not remove the guide tube.
3. Installation should follow the removal procedure in the reverse order.
4. Check for leaks by starting the engine.

Modification basis	
Application basis	
Affected VIN	

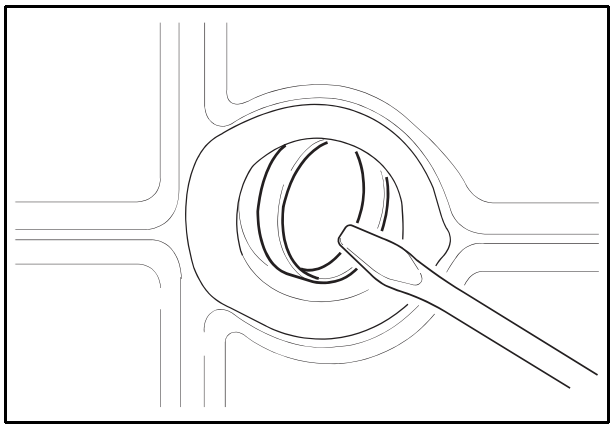
S.G.N.
1311-31 REPAIR OF CORE PLUGS IN CRANKCASE

Preceding work 1. Draining of the coolant



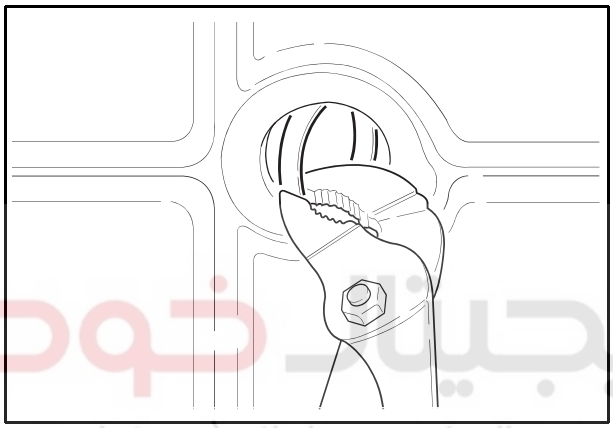
NO.	FUNCTION
1	Core Plug .....Replace

Modification basis	
Application basis	
Affected VIN	

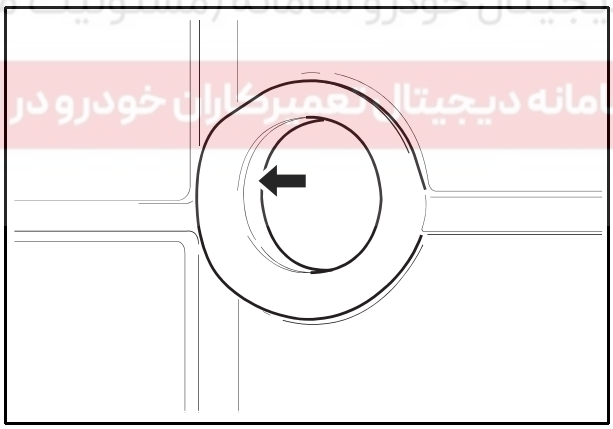


CAUTION
- W9911 0010B (102 589 00 15 00) Drift

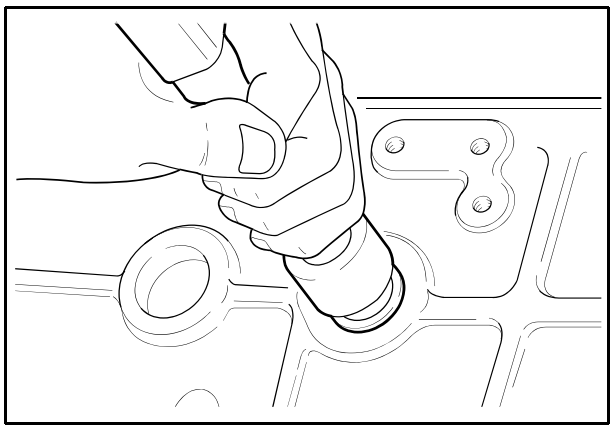
1. Remove the intake and exhaust manifolds.
   Pull back the core plug until the end of one
2. side comes out using the screw driver.



3. Pull out the plug carefully using a pliers.



4. Clean the sealing surface and apply Loctite 241.



5. Press in new plug using a drift.

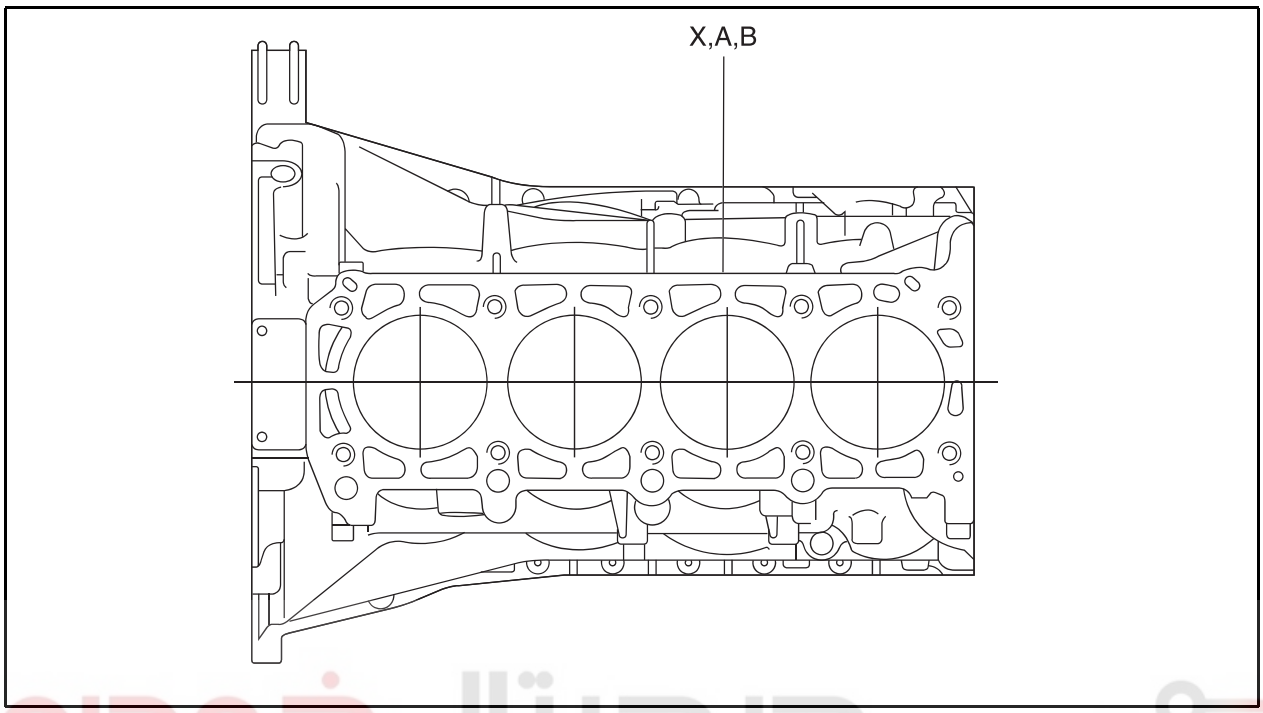
CAUTION
- Wait for about 45 minutes before filling the coolant so that the Loctite 241 hardens.

6. Warm up the engine and check the coolant for leaks.

Modification basis	
Application basis	
Affected VIN	

S.G.N. 1124-01

CYLINDER BORE



▶ Group Code Letter and Cylinder Bore Size

Engine	Group Code Letter of Cylinder	Piston Type to be Used	Cylinder Bore Size (mm)
G23D	A	A or X	ϕ90.906 -ϕ90.912
	X	A, X or B	ϕ90.906 -ϕ90.912
	B	X or B	ϕ90.912 -ϕ90.918
	X + 5	X + 5	ϕ90.950 -ϕ90.968
	X + 10	X + 10	ϕ91.000 -ϕ91.018

Group Code Letter Cylinder	Group Code Letter [1]	Cylinder Bore Size (mm)
Standard Size ϕ 90.9	A	ϕ89.900 -ϕ89.906
	X	ϕ89.906 -ϕ89.912
	B	ϕ89.912 -ϕ89.918
1st Repair Size (Standard Size + 0.25)	A	ϕ90.150 -ϕ90.156
	X	ϕ89.156 -ϕ90.162
	B	ϕ90.162 -ϕ90.168
2nd Repair Size (Standard Size + 0.5)	A	ϕ90.400 -ϕ90.406
	X	ϕ90.406 -ϕ90.412
	B	ϕ90.412 -ϕ90.418

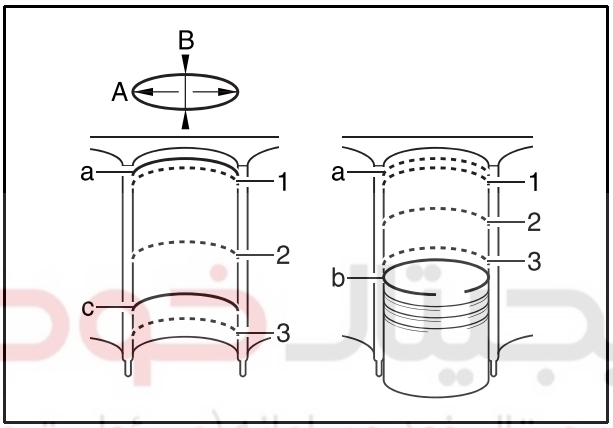
1) The group code letters are carved on the surface of the piston crown and in the mating surface of the crankcase.

Modification basis	
Application basis	
Affected VIN	

▶ Service Data Standard

Wear Limit in Longitudinal and Transverse Direction		0.1 mm
Permissible Deviation of Cylinder Out-of-round	When new	0.007 mm
	Wear limit	0.05 mm
Permissible Deviation of Rectangular Cylinder Height (Except Chamfered Area)		0.05 mm
Basic Peak-to-valley Height After Final Honing and Brushing		0.003 - 0.006 mm
Chamfer Angle		75 °
Honing Angle		50 ° ± 10 °

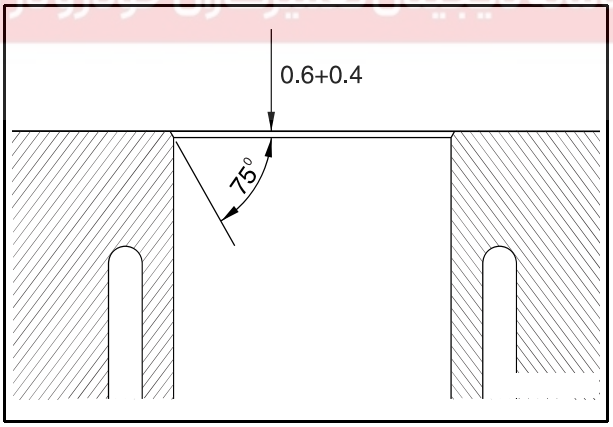
▶ Measurement of Cylinder Bore



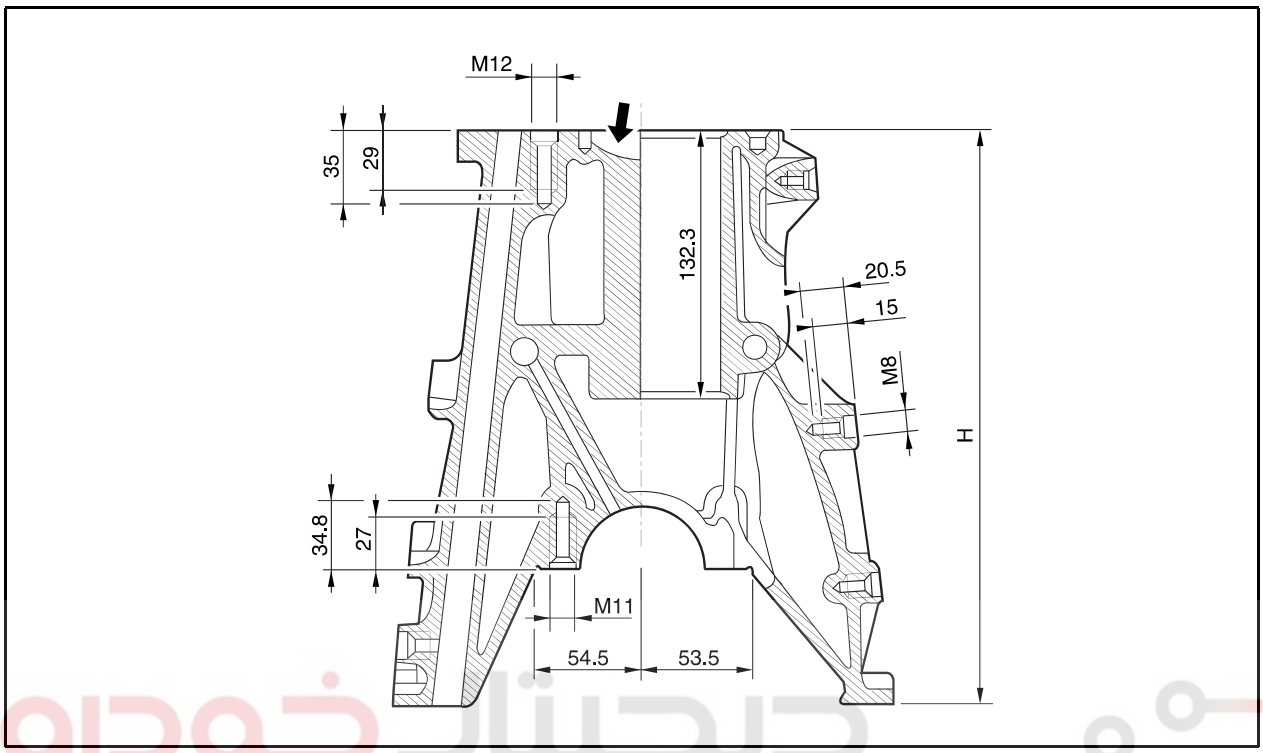
1. Clean the cylinder wall.
2. Using a internal diameter gauge, measure the bore size in axial and transverse direction at three points (1,2,3).

- 1, 2, 3 Measuring Points
  A. Axial Direction
  B. Transverse Direction
  a. Location of the No.1 Piston Ring at TDC
  b. Location of the Piston BDC
  c. Location of the Oil Ring at BDC

▶ Chamfer Angle



S.G.N.
1311-31 CRANKCASE MATING SURFACE

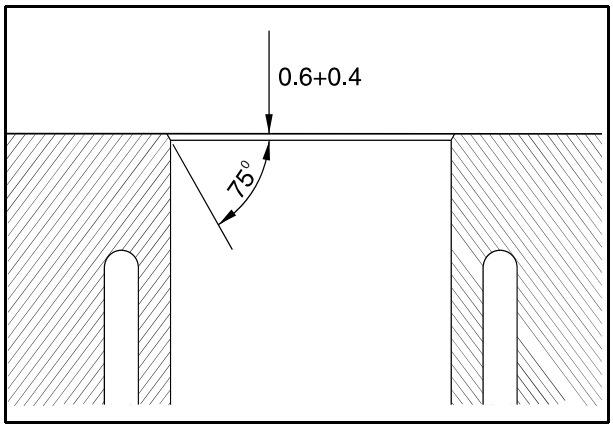


▶ Service Data Standard

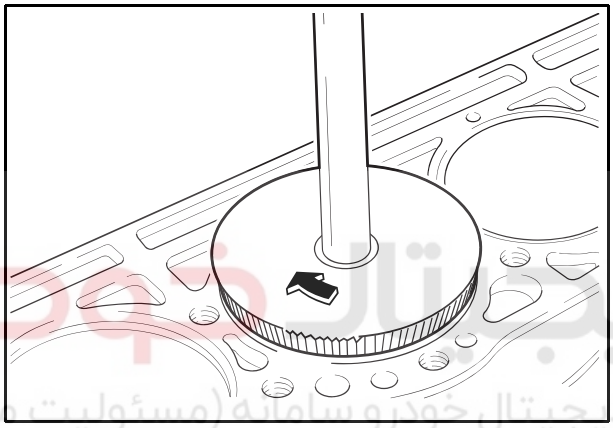
Height of The Crankcase 'H' (When new)		289.35 - 289.45 mm
Minimum Height After Milling		289.05 mm
Flatness	Crankcase Upper Mating Surface	0.03 mm
	Crankcase Lower Mating Surface	0.04 mm
Permissible Deviation of Parallelismof The Upper to Lower Mating Surface	Axial Direction	0.1 mm
	Transverse Direction	0.05 mm
Peak-to-valley Height	Crankcase Upper Mating Surface	0.012 - 0.009 mm
	Crankcase Lower Mating Surface	0.025 - 0.020 mm

Modification basis	
Application basis	
Affected VIN	

▶ **Service Data Standard**



1. Chamfer angle : 75 °

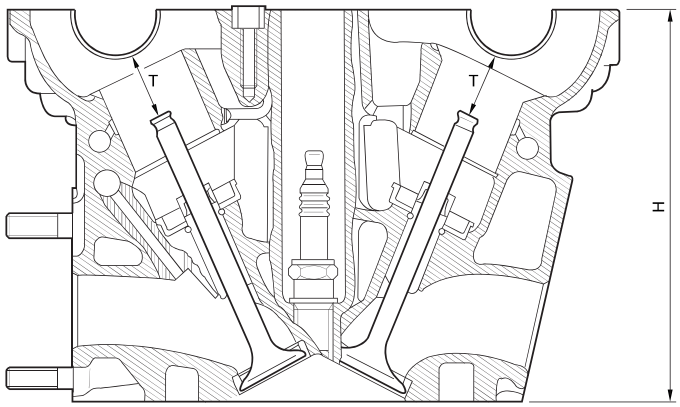


2. Polish the lower chamfered area evenly with a grinder after finishing the chamfering with a suitable tool (e.g., hand milling cutter).

Modification basis	
Application basis	
Affected VIN	

S.G.N.
1211-02 CYLINDER HEAD MATING SURFACE

Preceding work 1. Removal of valves



▶ Service Data Standard

Overall Height of Cylinder Head			135.9 - 136.0 mm
Minimum Height After Machining			135.5 mm
Flatness	Axial Direction		0.08 mm
	Transverse Direction		0.0 mm
Distance 'T' (Between Camshaft Bearing and Valve Stem)	Standard Size	Intake	24.21 - 24.75 mm
		Exhaust	22.21 - 22.75 mm
	Repair Size	Intake	23.96 - 24.51 mm
		Exhaust	21.96 - 22.51 mm

CAUTION

- Do not exceed 0.4 mm for the milling of the mating surface of crankcase and cylinder head.

Modification basis	
Application basis	
Affected VIN	

▶ Measurement of Mating Surfac

1. Measure the height (H) of the cylinder head (refer to Service data standard).
2. Check the mating surface of the cylinder head.
3. Mill the sharp edge of the combustion chamber.
4. Re-measure the height (H) of the cylinder head.
5. Seal the intake and exhaust valves.
6. Measure the dimension (T) between the camshaft bearing and the valve system (refer to Service data standard).
7. Mill the cylinder head valve seat (refer to Service data standard).

▶ Universal Tool

Surface Grinding Machine	Sceledum, Type RTY Roaro Schio / Italy

Memo