

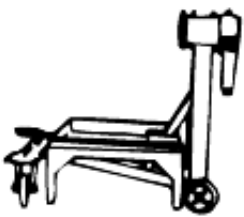
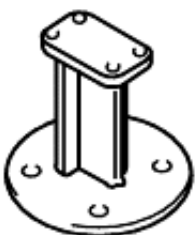
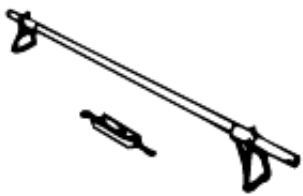


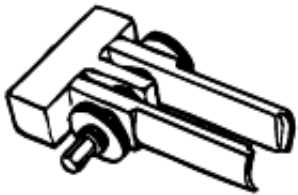


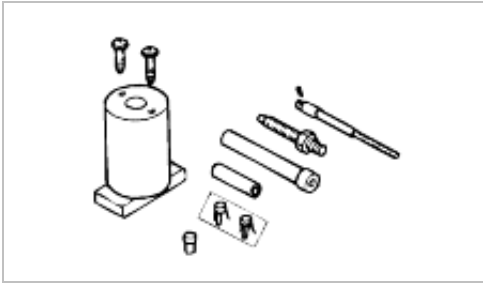
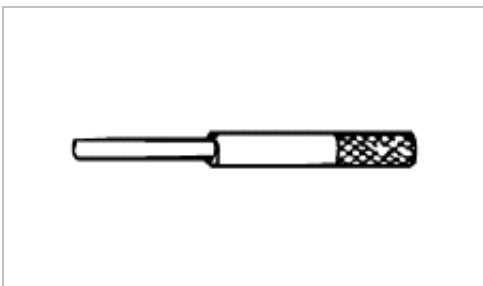
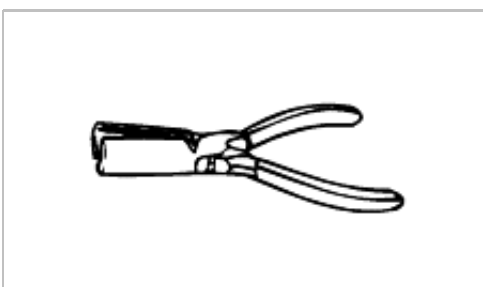
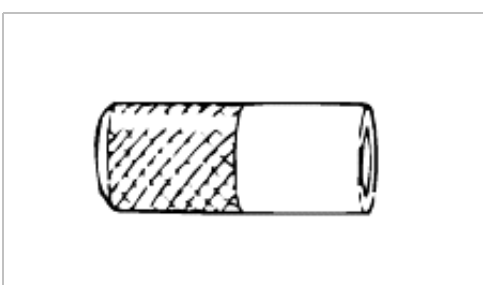
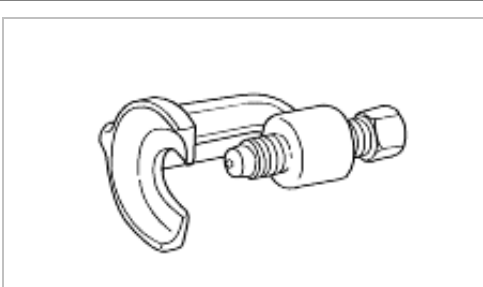

# **Engine Mechanical System**

General Information



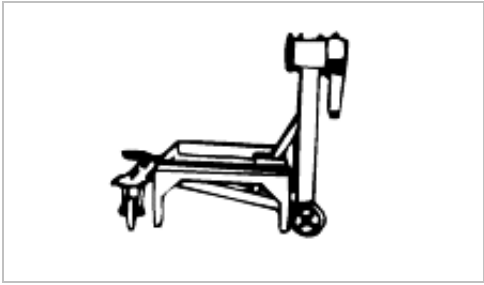
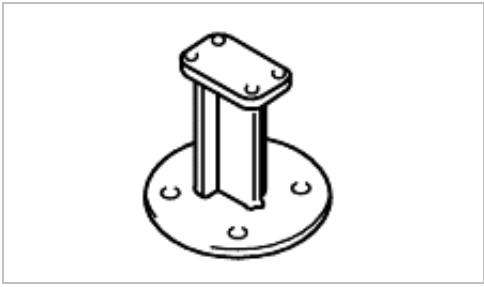
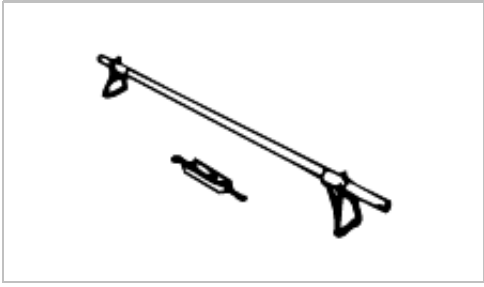
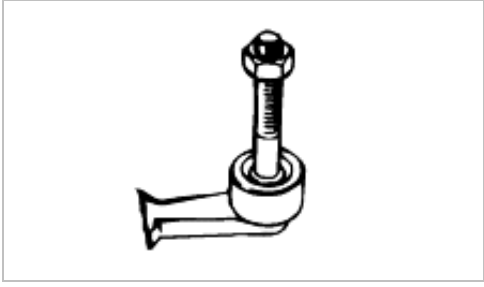
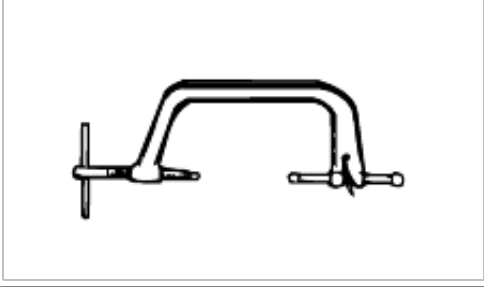
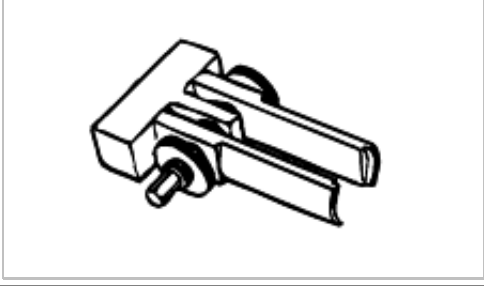
## SPECIAL SERVICE TOOLS

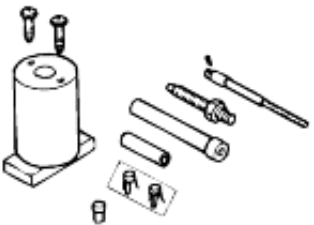
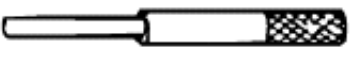


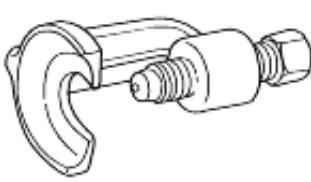

Tool(Number and Name)	Illustration	Use
OK130 990 007 Engine stand		Used to disassemble and assemble engine.
OK552 101 001 Hanger, engine stand		Used to disassemble and assemble engine.
OK201 170 AA0 Engine support		Used to remove and replace engine.
OK590 111 001 Brake, ring gear		Used to prevent engine rotation.
OK993 120 001 Arm, valve spring lifter		Used to remove and install valve.
OK993 120 004 Pivot, valve spring lifter		Used to remove and install valve.

OK993 110 AA0 Piston pin set		Used to remove and install piston pin.
OK201 120 011 Remover & installer, valve guide		Used to remove and install vale guide.
OK993 120 006 Remover, valve seal		Used to remove valve seal.
OK201 120 005 Installer, valve seal		Used to install valve seal.
OK130 283 021 Puller, ball joint		Used to remove tie-rod end.
OK670 140 015 Oil pressure gauge		Used to inspect oil pressure.

## SPECIAL SERVICE TOOLS

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OK130 283 021		Used to remove tie-rod end.

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<p>OK201 120 011 Remover &amp; installer, valve guide</p>		<p>Used to remove and install vale guide.</p>
<p>OK993 120 006 Remover, valve seal</p>		<p>Used to remove valve seal.</p>
<p>OK201 120 005 Installer, valve seal</p>		<p>Used to install valve seal.</p>
<p>OK130 283 021 Puller, ball joint</p>		<p>Used to remove tie-rod end.</p>
<p>OK670 140 015 Oil pressure gauge</p>		<p>Used to inspect oil pressure.</p>



## TROUBLESHOOTING GUIDE

### Engine

Problem	Possible cause	Action
Engine will not crank	Battery, starting system or other electrical problems	Refer to starting system, section EE, charging system, section EE, or electrical troubleshooting manual
	Liquid in combustion chamber	Remove with suction gun, then crank engine over with spark plugs removed
	Seized engine	Repair
Engine cranks normally, but does not start	Fuel system malfunction	Refer to fuel system, section FL
	Ignition system malfunction	Refer to ignition system, section EE
	Improper valve clearance	Check HLA's
	Restricted exhaust system	Refer to exhaust system
	Timing belt and/or related parts	Inspect timing belt and related parts; replace if necessary
	Low compression due to: stuck or burned valves; worn piston, piston ring or cylinder; failed cylinder head gasket	Perform a compression test, as outlined in this section; repair engine as necessary
	Camshaft worn	Replace
Poor idle quality	Fuel system malfunction	Refer to fuel system, section FL
	Emission system malfunction	Refer to emission control system, section EC
	Ignition system malfunction	Refer to ignition system, section EE
	Improper valve clearance	Check HLA's
	Uneven cylinder compression	Perform a compression test, as outlined in this section ; repair engine as necessary
	Poor valve-to-valve seat contact	Repair or replace
	Broken valve spring	Repair
	Failed cylinder head gasket	Replace
White exhaust smoke	Usually caused by water vapor, which is a normal by-product of combustion on cold days	None required
	Excessive white smoke with engine warmed up could be caused by a failed cylinder head or intake gasket. Could also be a cracked block, cylinder head or intake manifold	Repair or replace
Black exhaust smoke	Fuel system malfunction	Refer to fuel system, section FL
	Emission system malfunction	Refer to emission control system, section EC
Blue exhaust smoke	Usually caused by oil burning in combustion chambers from: worn rings, worn valve guides, worn valve seals or failed cylinder head gasket	Replace

Valve train noise	Worn valve guides	Repair
	Low oil pressure	Refer to lubrication system
	Improper valve clearance	Check HLA's
	Broken valve spring	Replace
	Sticking valves	Free valves
	Camshaft worn or faulty	Replace
Insufficient power	Insufficient compression caused by: 1. Improper valve clearance 2. Leakage from valve seat 3. Seized valve stem 4. Weak or broken valve spring 5. Failed cylinder head gasket 6. Cracked or distorted cylinder head 7. Sticking, damaged or worn piston ring 8. Cracked or worn piston	Check HLA's Repair or replace Replace Replace Replace Repair or replace Replace Replace
	Fuel system malfunction	Refer to fuel system, section FL
	Slipping clutch	Refer to clutch, section CH
	Dragging brakes	Refer to brake system, section BR
	Wrong tire size	Refer to wheels and tires, section SS
	Restricted exhaust system	Refer to exhaust system
Abnormal combustion	Improper valve clearance	Check HLA's
	Sticking or burned valve	Replace
	Weak or broken valve spring	Replace
	Carbon accumulation in combustion chamber	Eliminate carbon
Engine knocks at idle when hot	Loose or worn accessory drive belt/tensioner	Check belts and tensioners Replace if necessary
	A/C compressor or generator bearing	Replace
	Improper oil viscosity	Install proper oil viscosity for expected temperatures
	Excessive piston pin clearance	Install new piston, pin and/or connecting rod
	Connecting rod clearance	Check and replace rods if necessary
Engine knocks at idle when hot	Insufficient piston-to-bore clearance	Hone and replace rods if necessary
	Faulty timing belt tensioner or guide	Replace
	Loose damper pulley	Tighten or replace if necessary
Slight noise at idle, becomes louder as engine speed is increased	Valve spring clicking on cap, off square or broken	Repair or replace
	Excessive stem to guide clearance	Repair
	Excessive valve seat runout	Repair
Engine knocks when cold	Excessive piston to wall clearance	Replace pistons
	Loose or broken damper pulley	Tighten or replace
Knock increases with engine speed	Excessive piston to bore clearance	Replace piston

torque	Bent connecting rod	Replace
Engine has heavy knock when hot and torque is applied	Broken damper pulley	Replace
	Accessory belts too tight or damaged	Adjust or replace belt
	Belt tensioned damaged	Replace
	Flywheel cracked or loose clutch plate	Replace flywheel or clutch plate
	Excessive main bearing clearance	Repair
	Excessive rod bearing clearance	Repair
Engine has light knock when hot and under light load conditions	Improper timing	Check timing
	Piston pin and/or connecting rod	Replace piston pin and/or rod
	Poor quality fuel	Use recommended or higher grade fuel
	Exhaust leak at manifold	Tighten bolts and/or replace exhaust manifold gaskets if necessary
	Excessive rod bearing clearance	Repair
Engine knocks during initial start up and lasts only a few seconds	Improper oil viscosity	Install proper oil viscosity for expected temperatures

## TIMING BELT

Problem	Possible cause	Action
Tooth is broken or cracked	Camshaft jamming	Inspect camshaft by removing cylinder head cover Repair or replace if necessary
Back surface is cracked and/or worn	Tensioner jamming	Remove tensioner and inspect Replace if necessary
	Engine overheating	Inspect cooling system Refer to engine cooling system
	Interference with timing belt cover	Remove timing belt cover and inspect Replace if necessary
Side surface is worn and / or frayed	Improper installation of timing belt	Remove timing belt and reinstall
	Malfunction of timing belt guide plate	Remove timing belt and inspect guide plate
Teeth are worn	Poor belt cover sealing	Remove timing belt cover and inspect Replace if necessary
	Coolant leak at water pump	Inspect water pump Replace if necessary
	Camshaft malfunction	Inspect camshaft by removing cylinder head cover Repair or replace if necessary
	Excessive belt tension	Remove tensioner spring and inspect Replace if necessary
Oil or coolant is on	Poor oil sealing	Inspect front oil seals



the belt		Replace if necessary
	Coolant leak at water pump	Inspect water pump Replace if necessary
	Poor belt cover sealing	Remove timing belt cover and inspect Replace if necessary

### HLA(Hydraulic lash adjuster)

Problem	Possible cause	Action
1. Noise when engine is started immediately after oil is changed. 2. Noise when engine is started after setting approx. one day.	Oil leakage in oil passage	Run engine at 2,000~3,000 rpm. If noise stops after 2 seconds - 10 minutes*, HLA is normal. If not, replace HLA.
3. Noise when engine is started after cranking for 3 seconds or more. 4. Noise when engine is started after new HLA is installed.	Oil leakage in HLA	* Time required for engine oil to circulate within engine includes tolerance for engine oil condition and ambient temperature.
5. Noise continues more than 10 minutes.	Insufficient oil pressure	Check oil pressure. If lower than specification, check for cause. Oil pressure: 313.9~490.5 kPa (3.2~5.0 kg/cm <sup>2</sup> , 45.5~71.1 psi) - 3,000 rpm
	Faulty HLA	Press down HLA by hand. If it does not move, HLA is normal. If it moves, replace HLA. Measure valve clearance. If more than 0 mm (0 in), replace HLA.
6. Noise during idle after high-speed running.	Incorrect oil amount	Check oil level. Drain or add oil as necessary.
	Deteriorated oil	Check oil quality. If deteriorated, replace with specified type and amount of oil.

### Lubrication system

Problem	Possible cause	Action
Engine hard starting	Improper engine oil	Replace
	Insufficient engine oil	Add oil
Excessive oil consumption	Internal engine wear	Replace to main moving system
	Oil leak	Repair
Oil pressure drop	Insufficient oil	Add oil
	Oil leakage	Repair
	Worn and/or damaged oil pump gear	Replace
	Worn plunger (inside oil pump) or weak spring	Replace
	Clogged oil strainer	Clean
	Excessive main bearing or connecting rod bearing clearance	Refer to main moving system
Warning lamp illuminates while	Oil pressure drop	As described above

	Malfunction of oil pressure switch	Replace
	Malfunction of electrical system	Inspect eletrical system

Cooling system

Problem	Possible cause	Action
Overheating	Coolant level insufficient	Add
	Coolant leakage	Repair
	Radiator fins clogged	Clean
	Radiator cap malfunction	Replace
	Fan motor malfunction	Replace
	Thermostat malfunction	Replace
	Water passage clogged	Clean
	Water pump malfunction	Replace
Corrosion	Impurities in coolant	Replace



## SPECIFICATION

### Engine

Engine model				GV6 Gasoline
Item				
Type				Gasoline, 4 cycle
Cylinder arrangement and number				90°-V type, 6 cylinder
Combustion chamber				Pentroof
Valve system				DOHC, belt driven 24valve
Displacement		cu-in (cc)		152.4 (2497)
Bore and stroke		in (mm)		3.15X3.26 (80X82.8)
Compression ratio				10.4:1
Compression pressure		psi(kpa, kg/cm <sup>2</sup> )-rpm		191.9(1324,13.5)-290
Valve timing	IN	Open	BTDC	6°
		Close	ABDC	50°
	EX	Open	BBDC	40°
		Close	ATDC	12°
Valve clearance		IN		0: Maintenance-free
		EX		0: Maintenance-free
		in(mm)		
Idle speed *1		rpm		750±50
Ignition timing *2		BTDC		12°±5°
Firing order				1-6-5-4-3-2

\*1. "P" range position

\*2. Test terminal ground

## LUBRICATION SYSTEM

Engine model			GV6 Gasoline
Item			
Lubrication			Force-fed type
Oil pump	Type		Duocentric gear
	Relief pressure	psi(kpa, kg/cm <sup>2</sup> )	49.8-63.9 (343-441, 3.5-4.5)
Oil filter	Type	psi(kpa, kg/cm <sup>2</sup> )	Full-flow, paper element
	Relief pressure differential	psi(kpa, kg/cm <sup>2</sup> )	11.4-17.1 (78-118, 0.8-1.2)
Oil pressure switch activation pressure		Us qt (liter, Imp qt)	2.8-4.9 (20-34, 0.2-0.35)
Oil capacity	Total (dry engine)	Us qt (liter, Imp qt)	6.13 (5.8, 5.1)
	Oil pan	Us qt (liter, Imp qt)	5.28 (5.0, 4.4)
	Oil filter		0.42 (0.4, 0.35)
Engine oil			API service SG or SH, SAE 7.5W-30 or 10W-30

## COOLING SYSTEM

Engine model		GV6 Gasoline
Cooling system		Water-cooled, forced circulation
Cooling capacity		Us qt (liter, Imp qt)
Water pump	Type	Centrifugal
Thermostat	Type	Wax (Bottom by-pass)
	Initial opening temperature	°F (°C)
	Full-open temperature	°F (°C)
	Full-open lift	in (mm)
Radiator	Type	Corrugated fin
	Cap valve opening pressure	Psi (kPa, kg/cm <sup>2</sup> )
Cooling fan	Type	Electric
	Operating temperature	Above 208.4 (98) - Low speed
		Above 221 (105) - High speed
	Number of blades	5
	Outer diameter	in (mm)

## INTAKE AND EXHAUST SYSTEM

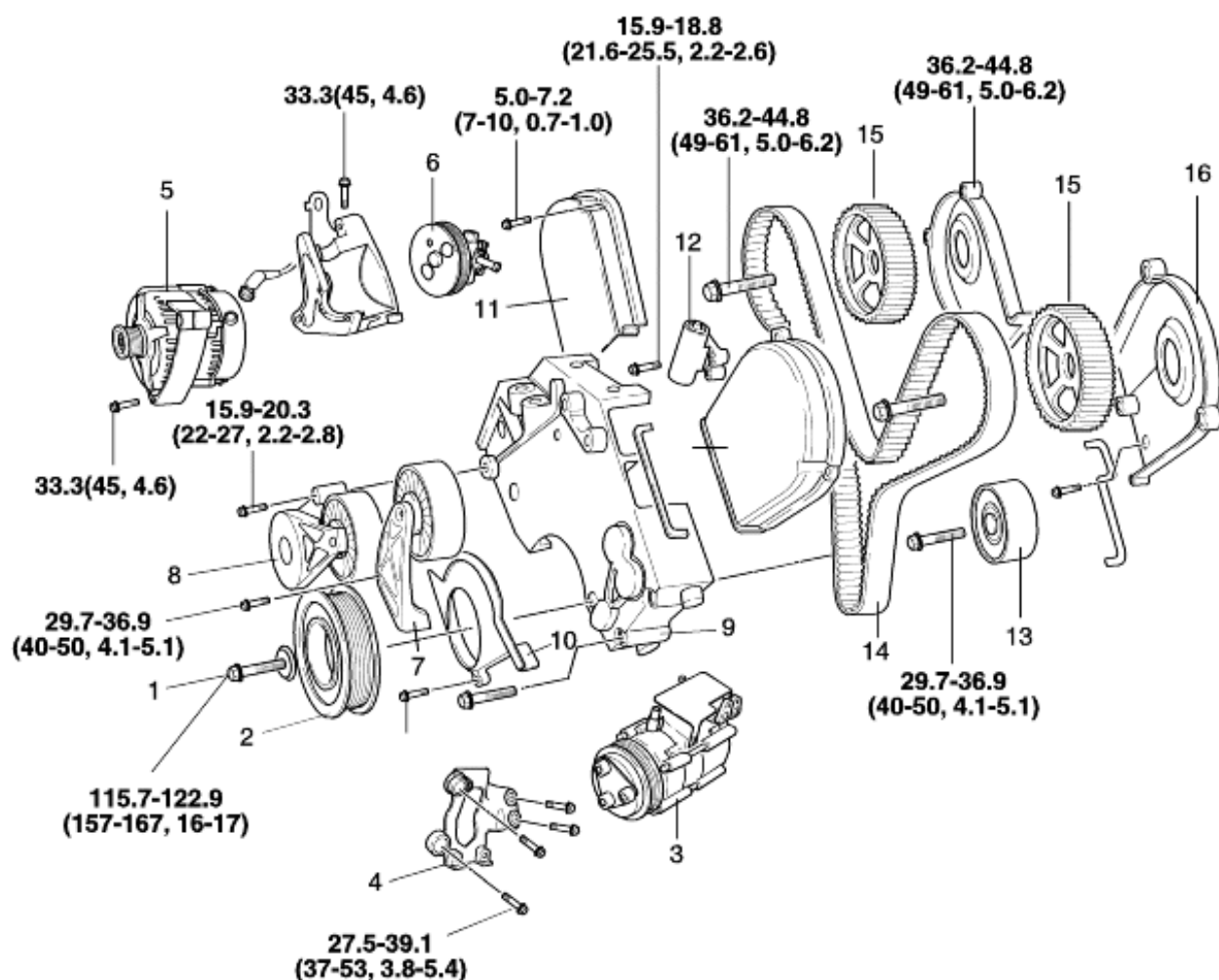
Engine model		GV6 Gasoline
Air cleaner		
Element type		Dried
Accelerator cable		
Free play		0.04-0.11 in (1-3 mm)

# **Engine Mechanical System**

Timing System - Timing Belt



## Component



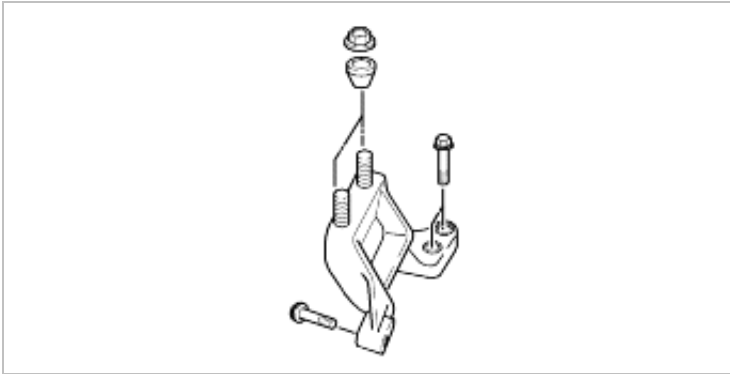
### TORQUE : lb·ft (N·m, kg·m)

- |                              |                                   |
|------------------------------|-----------------------------------|
| 1. Crankshaft pulley bolt    | 9. Front cover                    |
| 2. Crankshaft pulley         | 10. Crank pulley cover            |
| 3. A/C compressor            | 11. Timing belt front outer cover |
| 4. A/C compressor bracket    | 12. Timing belt auto-tensioner    |
| 5. Alternator                | 13. Timing belt idler             |
| 6. Power steering pump       | 14. Timing belt                   |
| 7. Drive belt idler          | 15. Front camshaft pulley         |
| 8. Drive belt auto-tensioner | 16. Timing belt front back plate  |

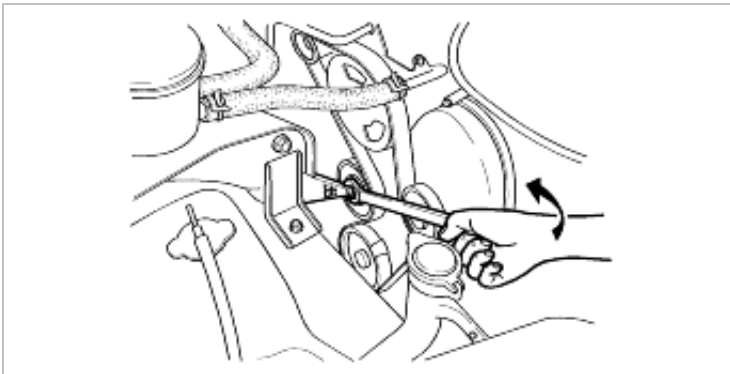


## REMOVAL

1. Disconnect negative battery cable.
2. Remove two nuts and three bolts.  
Remove No.3 engine mounting bracket.



3. Raise drive belt tensioner with spanner and then remove drive belt.

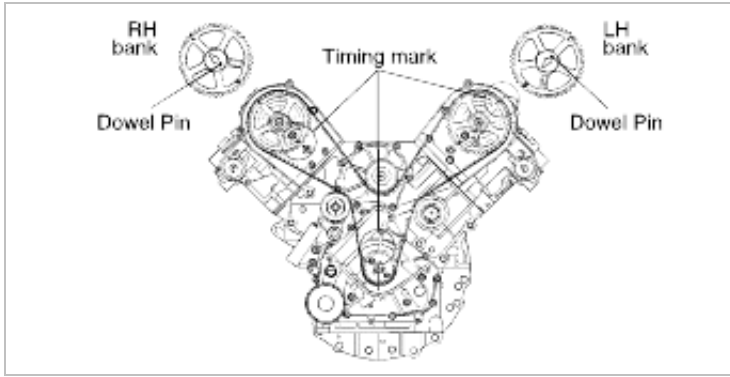


4. Remove three bolts securing power steering pump.  
Remove power steering pump and reserve tank with hoses still connected.
5. Position power steering pump and reserve tank away from engine and affix it with wire.

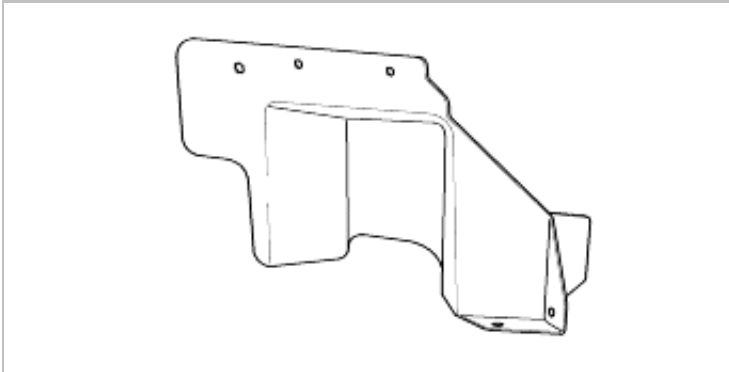


6. Disconnect B-terminal and connector from alternator.
7. Remove two bolts and release alternator from mounting bracket. Remove alternator.
8. Remove two bolts securing drive belt idler and remove idler.
9. Remove bolt securing oil level gauge pipe to cylinder head.
10. Remove two nuts securing oil level gauge pipe to oil pan. Remove oil level gauge pipe and discard gasket.
11. Remove three bolts and remove front timing belt LH cover.
12. Remove three bolts and remove front timing belt RH cover.
13. Remove five bolts securing alternator/power steering pump mounting bracket.
14. Remove mounting bracket and engine lifting bracket.
15. Remove two bolts securing drive belt tensioner and remove tensioner.

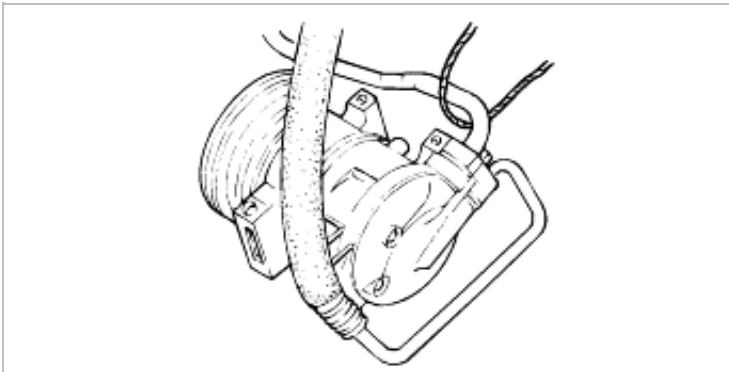
16. Set engine in timing mark position. To do this, turn crankshaft in a clockwise direction until "L" mark on camshaft pulley of LH bank positions to mark on timing belt back plate.



17. Raise and properly support vehicle.
18. Remove five bolts and remove wheel and tire.
19. Remove two bolts and three fastener securing mud guard of wheel house. Remove mud guard.

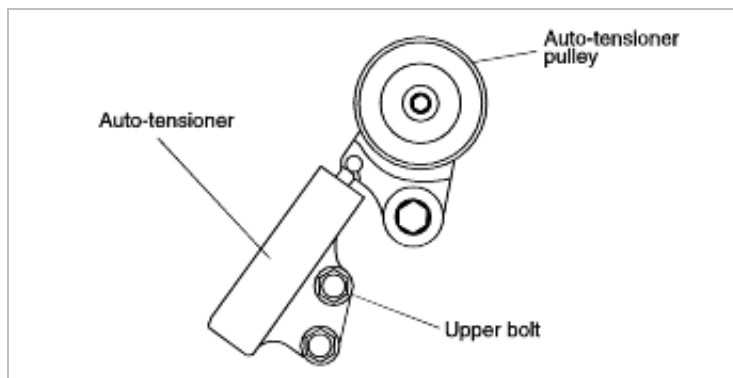


20. Remove crankshaft pulley bolt.
21. Remove crankshaft pulley.
22. Remove three bolts securing crankshaft pulley cover and remove cover.
23. Remove four bolts securing air conditioner compressor.  
Remove compressor with hoses still connected.
24. Position compressor away from engine and affix it with wire.



25. Remove four bolts securing air conditioner compressor bracket and remove bracket.
26. Remove bolt securing harness clip to front cover.
27. Remove six bolts securing front cover to engine block.
28. Remove allen bolt securing front cover to engine block.
29. Remove front cover.
30. Remove upper bolt securing timing belt auto-tensioner to engine block.





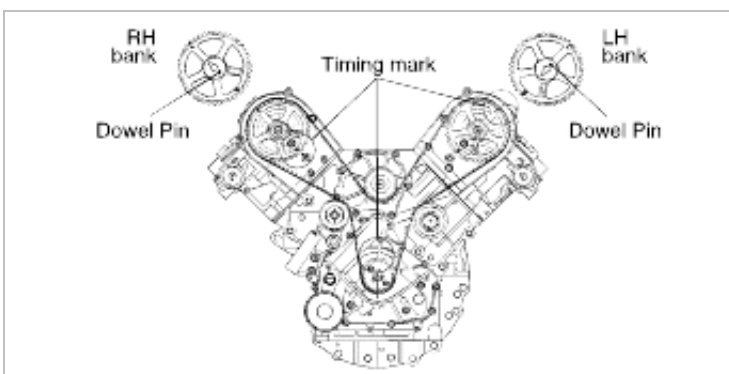
31. Slacken lower bolt and allow timing belt auto-tensioner to swing away from timing belt auto-tensioner pulley assembly.  
Remove bolt and remove auto-tensioner.
32. Remove front timing belt.

#### NOTICE

- Ease timing belt off gears using fingers only ; levers may damage belt and gears.
- Do not turn crankshaft with timing belt removed and cylinder heads fitted.

## REPLACEMENT

1. Check that timing mark on timing belt pulley is aligned with timing mark on engine.  
Check that "L" mark on camshaft pulley of LH bank is aligned with mark on timing belt back plate.  
Check that "R" mark on camshaft pulley of RH bank is aligned with mark on timing belt back plate.

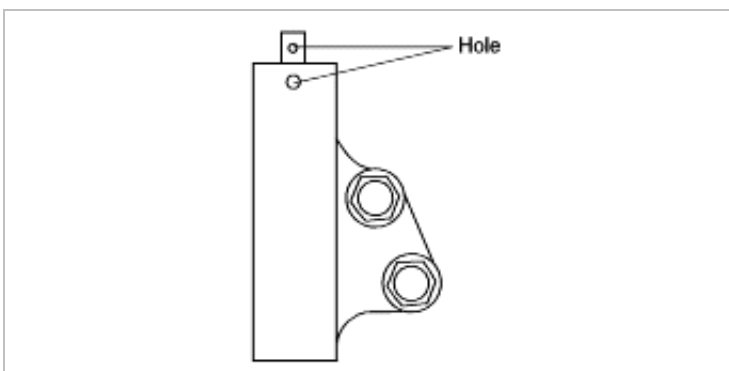


2. Using fingers only, install timing belt to pulleys, starting at timing belt pulley and working in counter-clockwise direction, keeping run as taut as possible.

#### NOTICE

Arrow mark of timing belt must be matched driving direction.

3. Using a press, slowly compress auto-tensioner rod and install a suitable pin, 0.08 in (2.0 mm) in diameter, to retain rod.

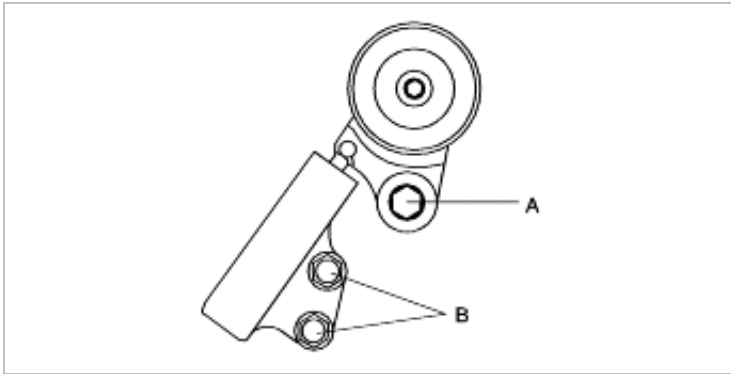


4. Position tensioner, fit bolts and tighten.

Tightening torque :

A : 15.9~18.8 lb-ft (22~25 N·m, 2.2~2.6 kg-m)

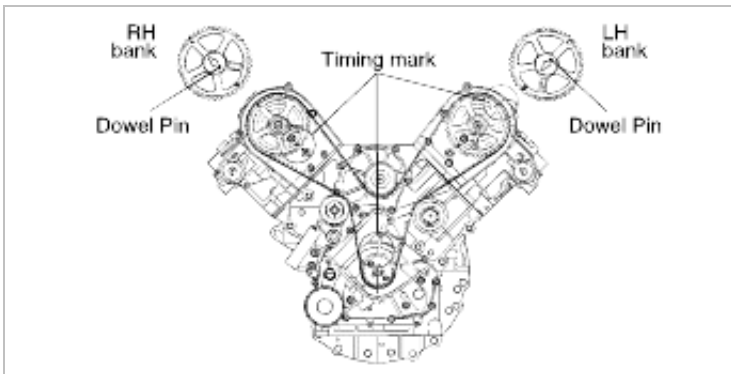
B : 29.7~36.9 lb-ft (40~50 N·m, 4.1~5.1 kg-m)



5. Release auto-tensioner pulley and remove pin from auto-tensioner.

6. Rotate crankshaft two full revolutions (clockwise only) and align timing mark on timing belt pulley with timing mark on engine block.

7. Check that "L" mark on camshaft pulley of LH bank is aligned with mark on timing belt back plate.  
Check that "R" mark on camshaft pulley of RH bank is aligned with mark on timing belt back plate.



8. If they are not aligned, remove timing belt and repeat from step 1 to step 7.

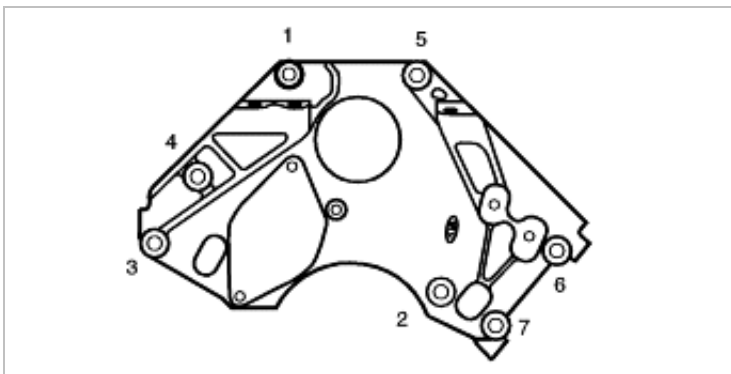
9. Install front cover.

Tightening torque :

1 : 20.9~26.0 lb-ft (28~35 N·m, 2.9~3.6 kg-m)

5 : 29.7~36.9 lb-ft (40~50 N·m, 4.1~5.1 kg-m)

2,3,4,6,7 : 55.7~66.6 lb-ft  
(75~90 N·m, 7.7~9.2 kg-m)



10. Install harness clip to front cover.

11. Install air conditioner compressor bracket.

Tightening torque :

27.5~39.1 lb-ft (37~53 N·m, 3.8~5.4 kg-m)

12. Install air conditioner compressor.

13. Install crankshaft pulley cover.

---

Tightening torque :

5.2~7.4 lb-ft (7~10 N·m, 71.4~102 kg-cm)

---

14. Install crankshaft pulley.

---

Tightening torque :

115~123 lb-ft (157~167 N·m, 16~17 kg-m)

---

15. Install mud guard of wheel house.

16. Install wheel & tire.

---

Tightening torque :

65~79 lb-ft (88~107 N·m, 9~11 kg-m)

---

17. Install drive belt tensioner.

---

Tightening torque :

15.9~20.3 lb-ft (22~27 N·m, 2.2~2.8 kg-m)

---

18. Install alternator/power steering pump mounting bracket.

---

Tightening torque :

33.3 lb-ft (45 N·m, 4.61 kg-m)

---

19. Install front timing belt LH and RH covers taking care not to displace seals.

---

Tightening torque :

5.2~7.4 lb-ft (7~10 N·m, 71.4~102 kg-cm)

---

20. Install oil level gauge pipe using new gasket and tighten nuts and bolt.

---

Tightening torque :

5.2~7.4 lb-ft (7~10 N·m, 71.4~102 kg-cm)

---

21. Install drive belt idler.

---

Tightening torque :

29.7~36.9 lb-ft (40~50 N·m, 4.1~5.1 kg-m)

---

22. Install alternator to mounting bracket.

---

Tightening torque :

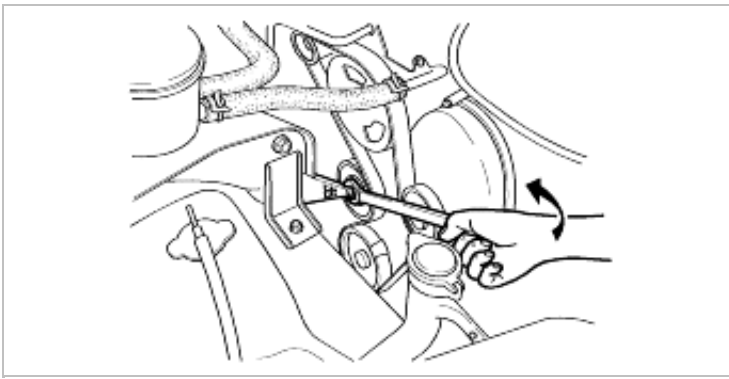
33.3 lb-ft (45 N·m, 4.6 kg-m)

---

23. Reconnect alternator B-terminal and connector to alternator.

24. Install power steering pump to mounting bracket.

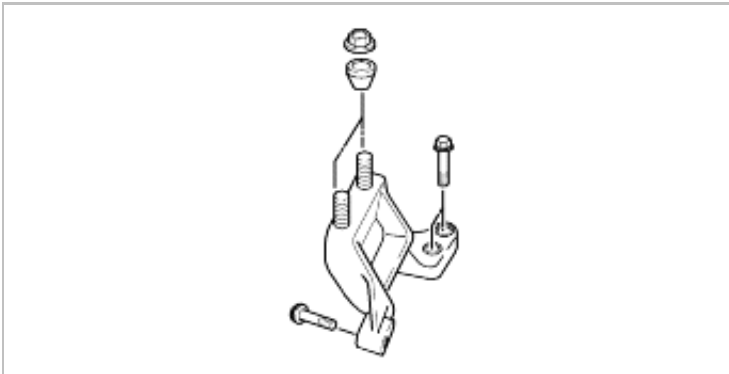
25. Raise drive belt tensioner with spanner and then install drive belt.



26. Install No.3 engine mounting bracket.

Tightening torque :

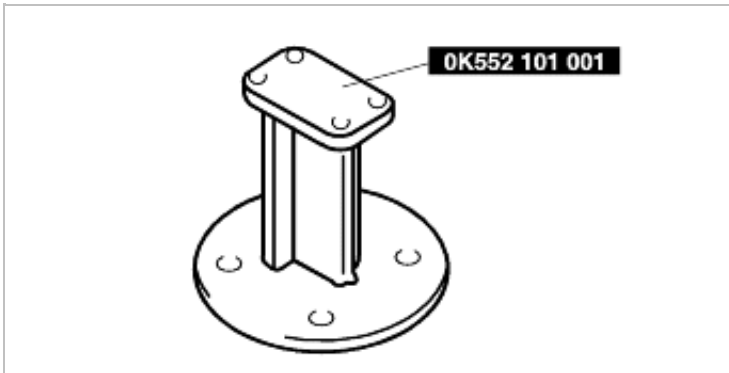
49.2~68.7 lb-ft (66.6~93.1 N·m, 6.8~9.5 kg-m)



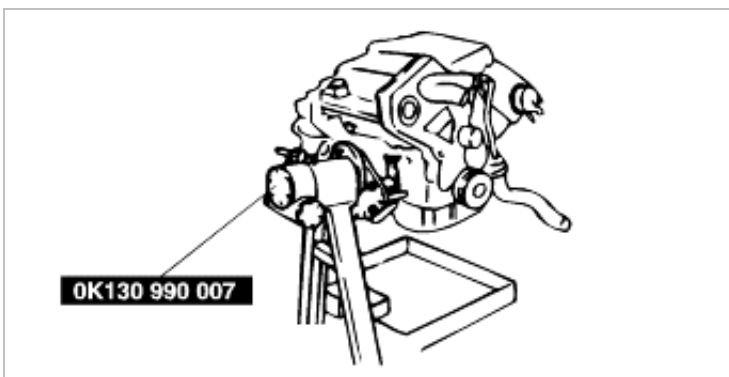
27. Reconnect negative battery cable.

## DISASSEMBLY

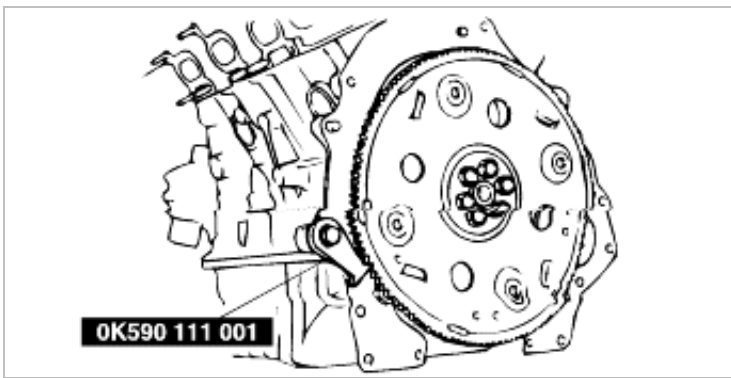
1. to engine.



2. Mount engine on engine stand(0K130 990 007).



3. .



4. Remove pulley lock bolt. Remove crankshaft pulley.
5. Remove three bolt securing crankshaft pulley cover and remove cover.
6. Remove three bolts securing power steering pump.  
Remove power steering pump from mounting bracket.
7. Disconnect B-terminal and connector from alternator.
8. Remove two bolts and release alternator from mounting bracket. Remove alternator.
9. Remove two bolts securing drive belt idler and remove idler.
10. Remove bolt securing oil level gauge pipe to cylinder head.
11. Remove two nuts securing oil level gauge pipe to oil pan. Remove oil level gauge pipe and discard gasket.
12. Remove three bolts and remove front timing belt LH cover.
13. Remove three bolts and remove front timing belt RH cover.
14. Remove five bolts securing alternator / power steering pump mounting bracket.
15. Remove mounting bracket and engine lifting bracket.
16. Remove two bolts securing drive belt tensioner and remove tensioner.
17. Remove six bolts securing front cover to engine block.
18. Remove Allen bolt securing front cover to engine block.
19. Remove front cover.
20. Remove upper bolt securing timing belt.
21. Loosen camshaft pulley lock bolt.
22. Slacken lower bolt and allow timing belt auto-tensioner to swing away from timing belt auto-tensioner pulley assembly.
23. Remove timing belt.

#### NOTICE

- Ease timing belt off gears using fingers only ; levers may damage belt and gears.
- Do not turn crankshaft with timing belt removed and cylinder heads fitted.

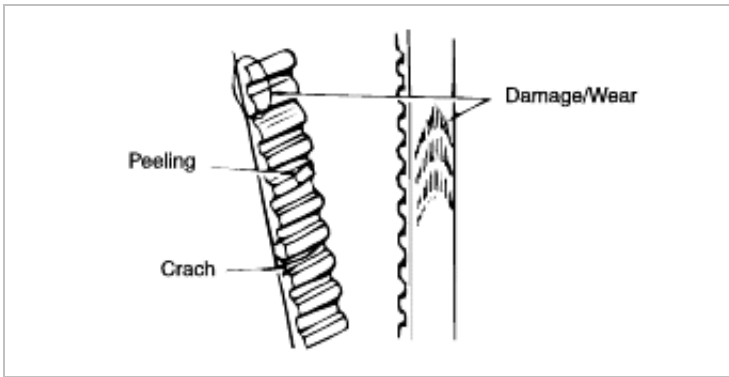
24. Remove timing belt idler.
25. Remove auto-tensioner pulley.
26. Remove front camshaft pulley.
27. Remove front timing belt back plate.

## INSPECTION

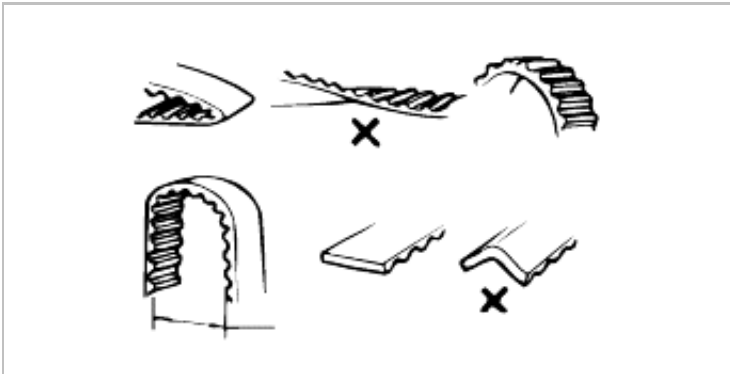
#### NOTICE

Never forcefully twist, turn inside out or bend timing belt. Do not allow oil or grease to come in contact with timing belt.

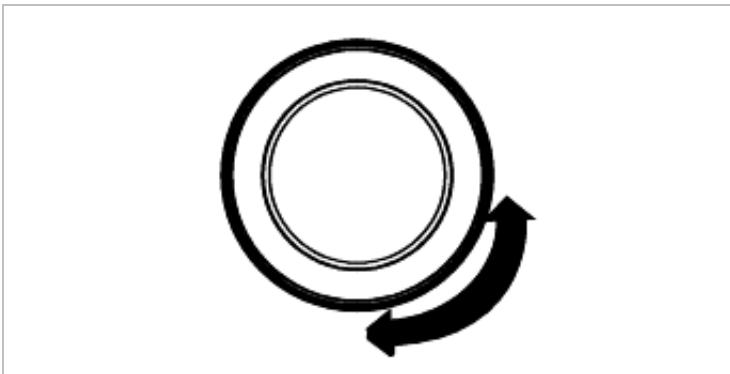
1. Replace timing belt if it is contaminated with oil or grease.
2. Check timing belt for uneven wear, fraying, peeling, cracking and hardening.  
Replace timing belt as necessary.



3. Bend timing belt into a "U" shapes as shown in figure. Distance "A" must be at least 1.0 in (25 mm).



4. Inspect both idler pulley and auto-tensioner pulley for uneven wear and smooth bearing operation.

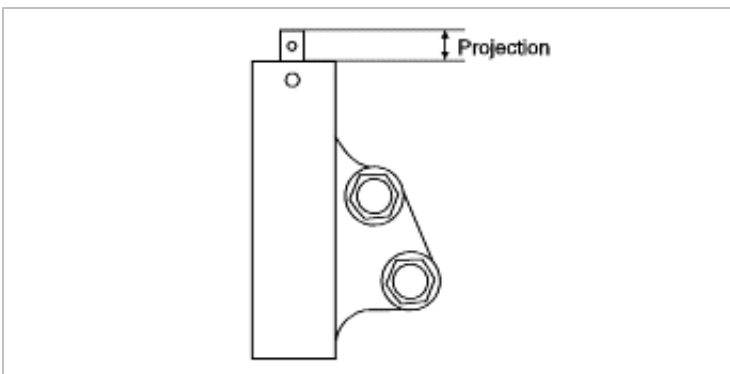


5. Check auto-tensioner for oil leakage. Replace auto-tensioner if necessary.
6. Measure auto-tensioner rod projection. Replace auto-tensioner if necessary.

---

Projection (Free length) : 0.28 in (7.2mm)

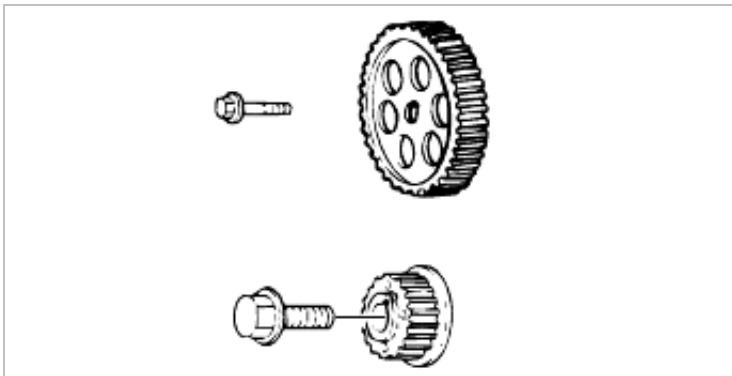
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7. Inspect camshaft pulleys and timing belt pulley for broken teeth or damage.

**NOTICE**

Replace any component that shows damage, excessive wear, or that appears prone to a possible failure.



## REASSEMBLY

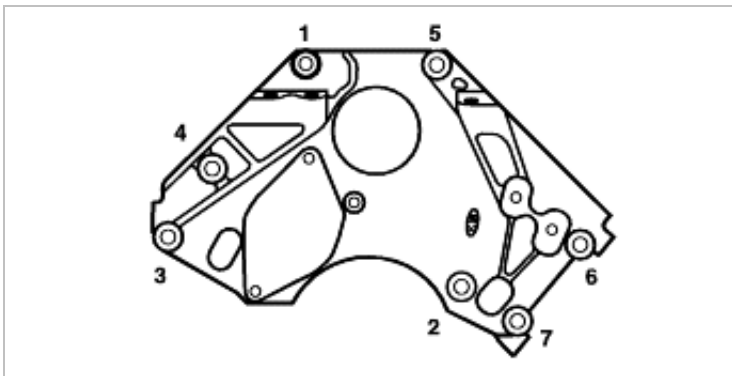
1. Install front cover.

Tightening torque :

1 : 20.9~26.0 lb-ft (28~35 N·m, 2.9~3.6 kg-m)

5 : 29.7~36.9 lb-ft (40~50 N·m, 4.1~5.1 kg-m)

2,3,4,6,7 : 55.7~66.6 lb-ft (75~90 N·m,  
7.7~9.2 kg-m)



2. Install alternator/power steering pump mounting bracket and engine lifting bracket.

Tightening torque :

33.3 lb-ft (45 N·m, 4.61 kg-m)

3. Install front timing belt LH and RH covers taking care not to displace seals.

Tightening torque :

3.6~5.0 lb-ft (5~7 N·m, 0.5~0.7 kg-m)

4. Install oil level gauge pipe using new gasket and tighten nuts and bolt.

Tightening torque :

5.2~7.4 lb-ft (7~10 N·m, 71.4~102 kg-cm)

5. Install drive belt idler.

Tightening torque :

29.7~36.9 lb-ft (40~50 N·m, 4.1~5.1 kg-m)

6. Install alternator to mounting bracket.

Tightening torque :

33.3 lb-ft (45N·m, 4.6kg-m)

7. Reconnect alternator B-terminal and connector to alternator.

8. Install power steering pump to mounting bracket.

9. Install crank-shaft pulley cover.

Install alternator to mounting bracket.

---

Tightening torque :

5.2~7.4 lb-ft (7~10 N·m, 71.4~102 kg-cm)

---

10. Install crankshaft pulley.

---

Tightening torque :

115~123 lb-ft (157~167 N·m, 16~17 kg-m)

---





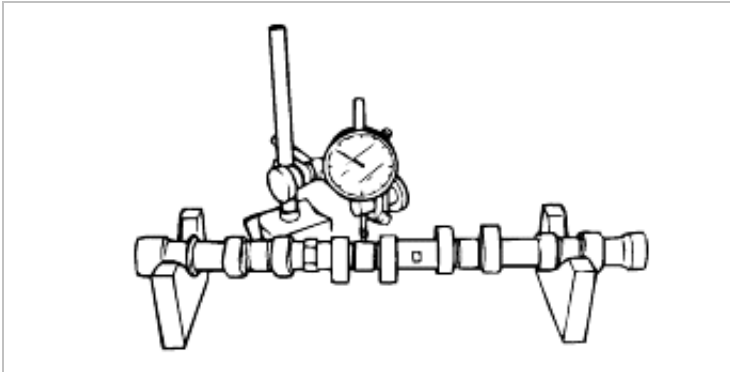
# **Engine Mechanical System**

Cylinder Head Assembly - Camshaft

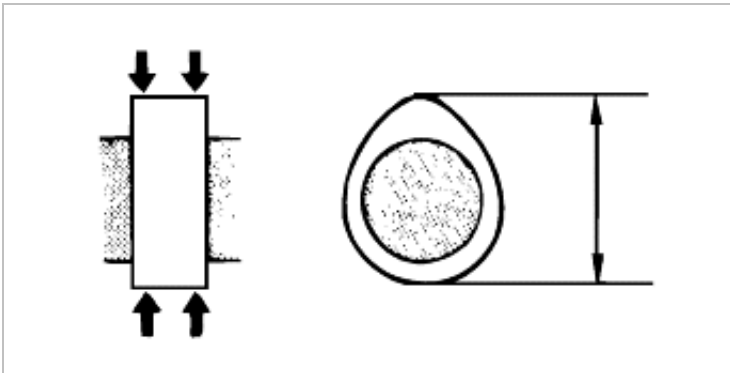
## INSPECTION

1. Set front and rear journals on V-blocks.
2. Measure camshaft runout. Replace camshaft if necessary.

Runout : 0.0012 in (0.03 mm) max.



3. Inspect camshaft for wear or damage. Replace camshaft if necessary.
4. Measure cam lobe height at two points as shown.



Cam height :

Standard :

Intake - 1.5169 in (38.53 mm)

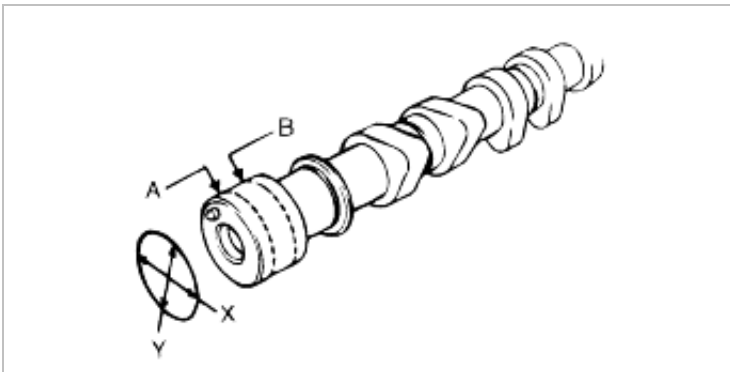
Exhaust - 1.5401 in (39.12 mm)

Minimum :

Intake - 1.5149 in (38.48 mm)

Exhaust - 1.5382 in (39.07 mm)

5. Measure journal diameters in X and Y directions at two points (A and B) shown.



Journal diameter

Intake :

1.1799~1.1811 in (29.97~30.00 mm)

Exhaust :

1.1799~1.1811 in (29.97~30.00 mm)

---

6. Measure camshaft journal oil clearances.

**CAUTION**

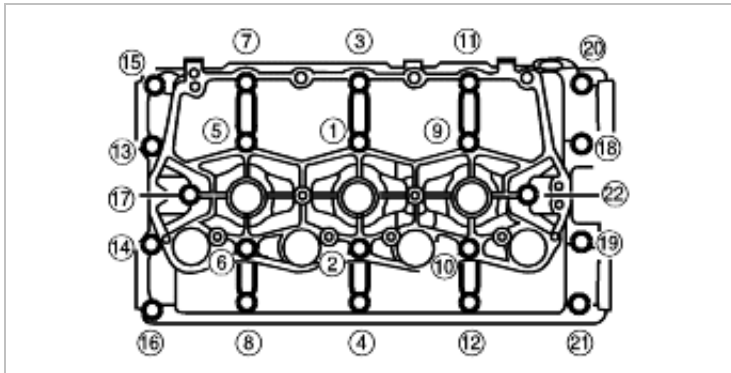
Do not install HLA when measuring oil clearance.

- (1) Remove all foreign material and oil from journals and bearing surface.
  - (2) Set camshaft onto cylinder head.
  - (3) Position Plastigauge atop journals in axial direction.
  - (4) Install camshaft carrier and tighten in order shown in figure.
- 

Tightening torque :

5.16~7.38 lb-ft (7~10 N·m, 71.4~102 kg-cm)

---



- (5) Loosen camshaft carrier bolts in reverse order of tightening.
  - (6) Measure oil clearance at each journal.
- 

Oil clearance :

0.00098~0.00232 in (0.025~0.059 mm)

---

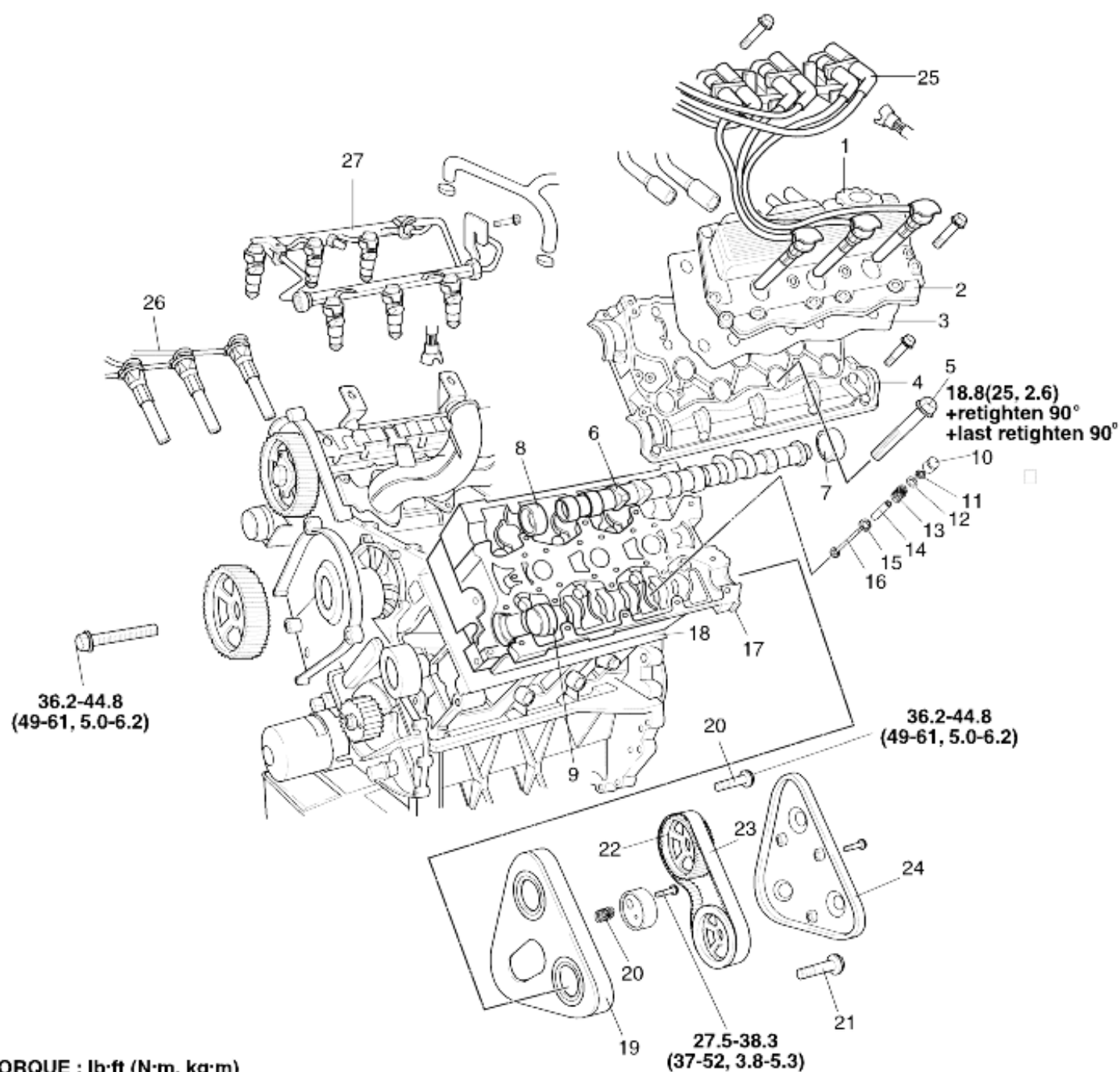
- (7) If oil clearance exceeds maximum, replace camshaft and/or cylinder head.



# **Engine Mechanical System**

Cylinder Head Assembly - Valve

## Component

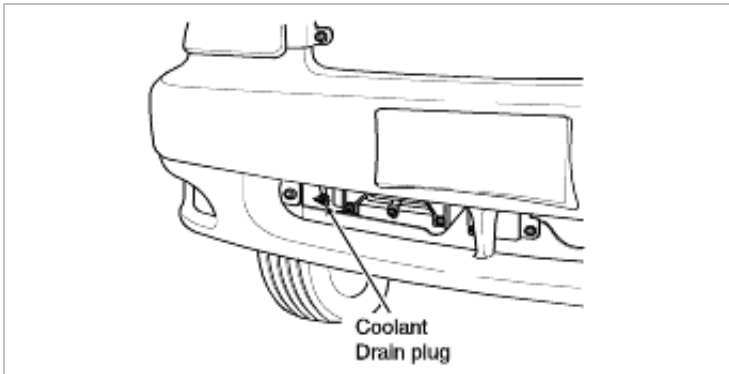


- |   |                                   |                                 |
|---|-----------------------------------|---------------------------------|
| 1. Oil filler cap                             | 10. HLA (Hydraulic Lash Adjuster) | 19. Rear timing belt back plate |
| 2. Cam cover                                  | 11. Valve cotter                  | 20. Rear timing belt tensioner  |
| 3. Cam cover gasket                           | 12. Upper seat                    | 21. Rear camshaft pulley bolt   |
| 4. Cam carrier                                | 13. Valve spring                  | 22. Rear camshaft pulley        |
| 5. Cylinder head bolt                         | 14. Valve guide                   | 23. Rear timing belt            |
| 6. Camshaft                                   | 15. Valve seat                    | 24. Rear timing belt cover      |
| 7. Rear oil seal (Brown color)                | 16. Valve                         | 25. Ignition coil               |
| 8. Front oil seal - Intake (Red color)        | 17. Cylinder head                 | 26. High-tension cord           |
| 9. Front cup oil seal - Exhaust (Black color) | 18. Cylinder head gasket          | 27. Fuel line                   |

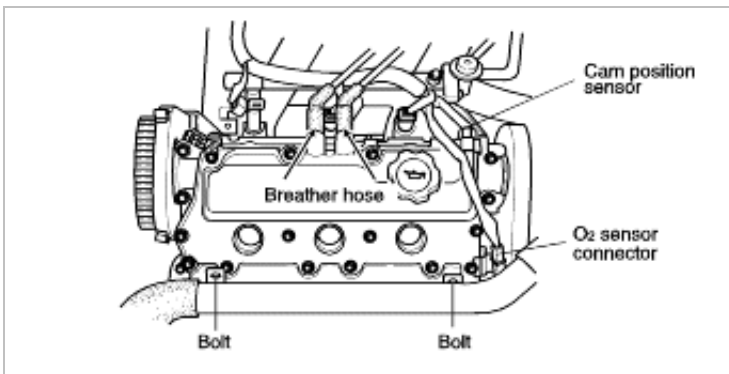


## REMOVAL

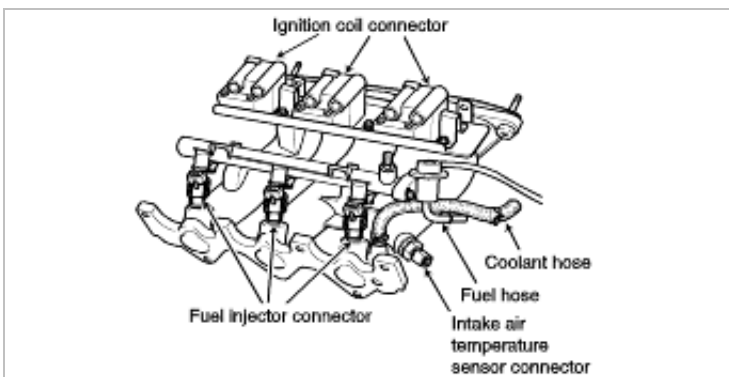
1. Disconnect negative battery cable.
2. Drain engine coolant.



3. Drain engine oil.
4. Remove rear timing belt back plate from cylinder head.  
(Refer to HLA Removal(RH bank), from step2 to step 25.)
5. Remove two bolts securing coolant upper hose.



6. Disconnect cam position sensor connector and O2 sensor connector.
7. Disconnect ignition coil connector, fuel injector connector and intake air-temperature sensor connector.

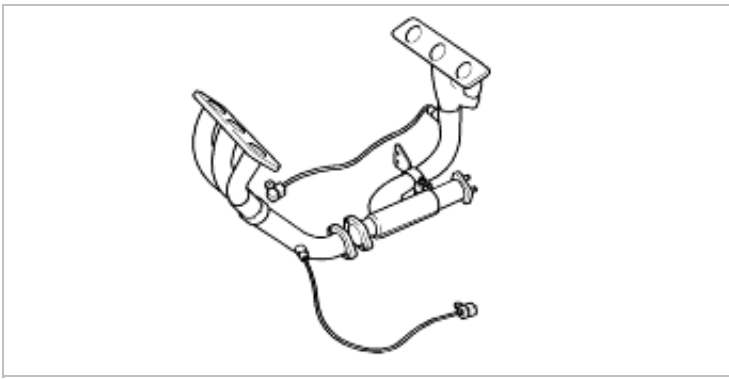


8. Disconnect fuel hose from injector rail.

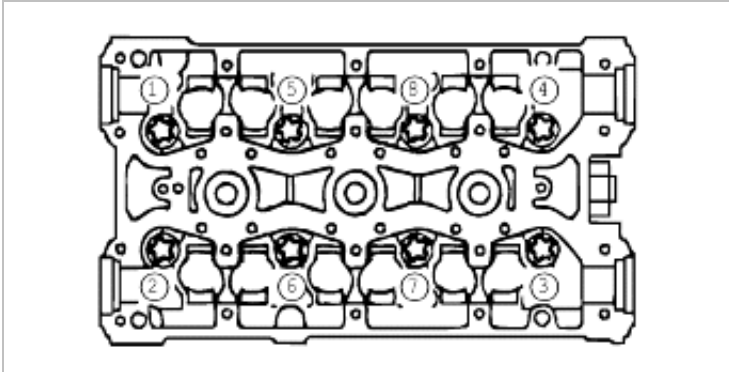
### WARNING

Keep open flames and sparks away from open fuel lines, or a fire or explosion may result.

9. Disconnect coolant hose.
10. Remove intake manifold with 5 bolts and 2 nuts.
11. Remove exhaust manifold.



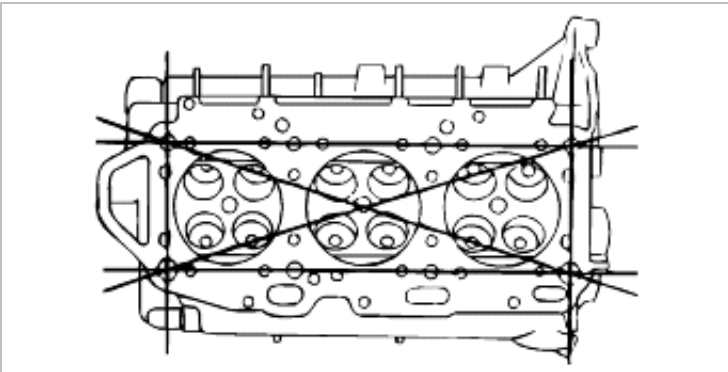
12. Remove camshaft cover.
13. Remove cylinder head.



14. Replace cylinder head gasket.

## INSPECTION

1. Check cylinder head gasket for obvious signs of leakage, coolant stains on gasket, or combustion burns across cylinders.
2. Clean cylinder head and cylinder block mounting surfaces.
3. Measure cylinder head for straightness in six directions as shown in figure.



4. If distortion exceeds specification, resurface or replace cylinder head. Only remove amount of material required to achieve a flat surface.

Maximum material removal : 0.003 in (0.08 mm)

5. Check cylinder head height.

Height : 4.683~4.687 in (118.95~119.05 mm)

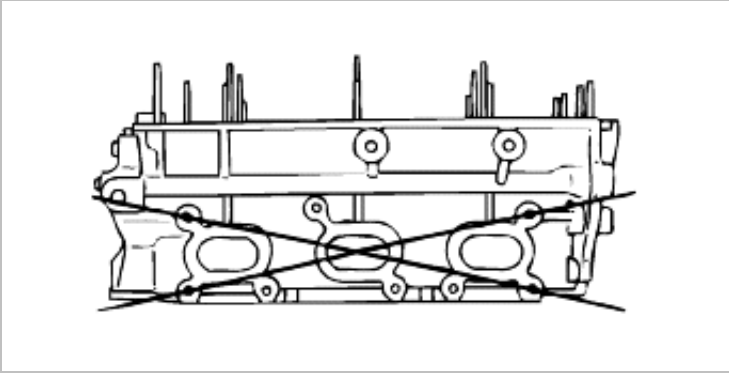
6. If cylinder head height is not within specification, replace cylinder head.

### NOTICE

If cylinder head requires machining, remove intake and exhaust manifolds and check their mounting surfaces for straightness.

7. Measure intake and exhaust manifold mating surface distortion at two directions shown in figure.

Distortion : 0.004 in (0.10 mm)



8. If distortion exceeds specification, resurfaces or replace cylinder head.

Maximum material removal : 0.003 in (0.08 mm)

9. Check cylinder block for distortion of cylinder head mating surface (block deck) in six directions.

Distortion : 0.003 in (0.08 mm)

10. If distortion exceeds specification, resurface block deck.

Maximum material removal : 0.003 in (0.08 mm)

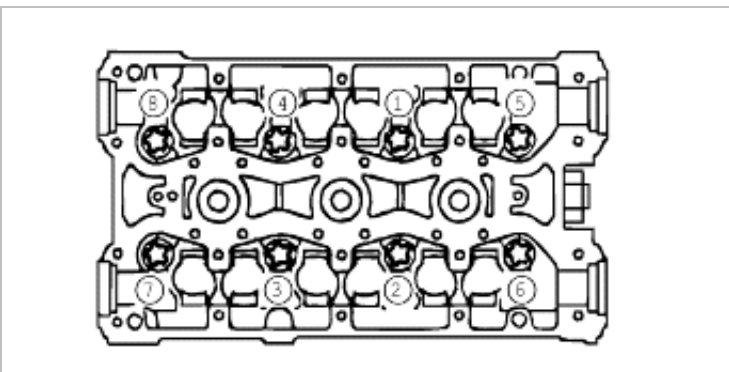
## REPLACEMENT

1. Thoroughly clean cylinder block and cylinder head mating surfaces.
2. Ensure locating dowels are correctly positioned in cylinder block.
3. Place new cylinder head gasket onto block face with word "TOP" uppermost.
4. Install cylinder head and locate onto dowels.
5. Carefully enter cylinder head bolts. Screw bolts into place by hand.

### CAUTION

Do not drop cylinder head bolts.

6. Apply engine oil to bolt threads and seat faces.
7. Tighten cylinder head bolts 18.8 lb-ft (25N·m, 2.6 kg-m) in order shown in figure. And then retighten all bolts 90° more in order shown in figure. Last retighten all bolts 90° more in order shown in figure. (When use the metal gasket)



8. Clean mating surface of camshaft cover and camshaft carrier.



9. Clean inside of camshaft cover.

10. Install camshaft cover gasket and position camshaft cover to camshaft carrier.

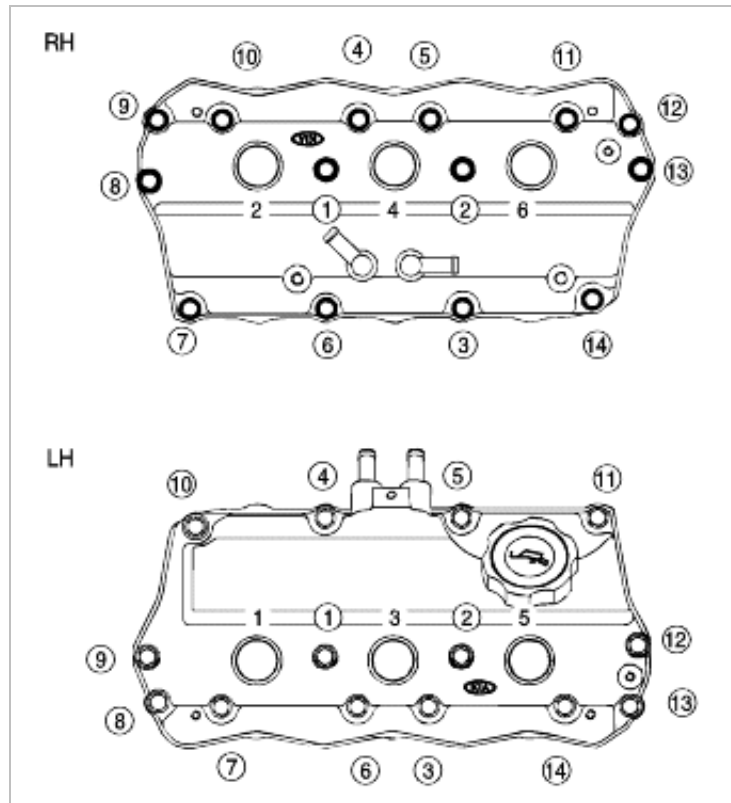
**CAUTION**

When installing new camshaft cover gasket ensure arrows point towards inlet manifold.

11. Tighten camshaft cover bolts in order shown in figure.

Tightening torque :

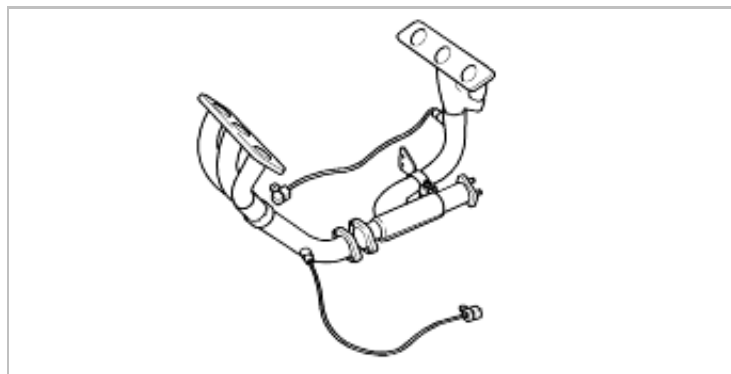
5.164~7.377 lb-ft (7~10 N·m, 71.4~102 kg-cm)



12. Install exhaust manifold.

Tightening torque :

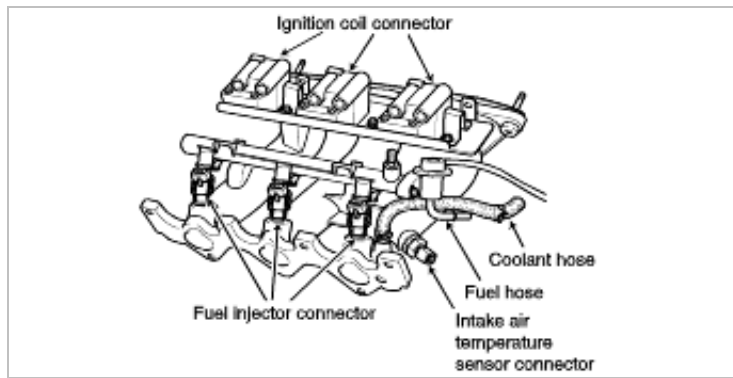
26.8~39.8 lb-ft (36.3~53.9 N·m, 3.7~5.5 kg-m)



13. Install intake manifold.

Tightening torque :

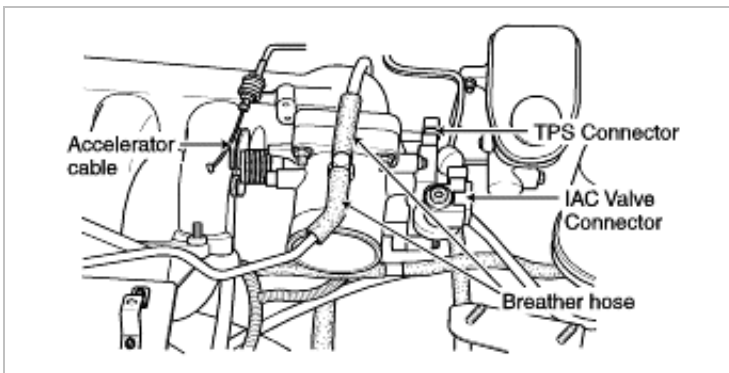
11.6~16.6 lb-ft (15.7~22.6 N·m, 1.6~2.3 kg-m)



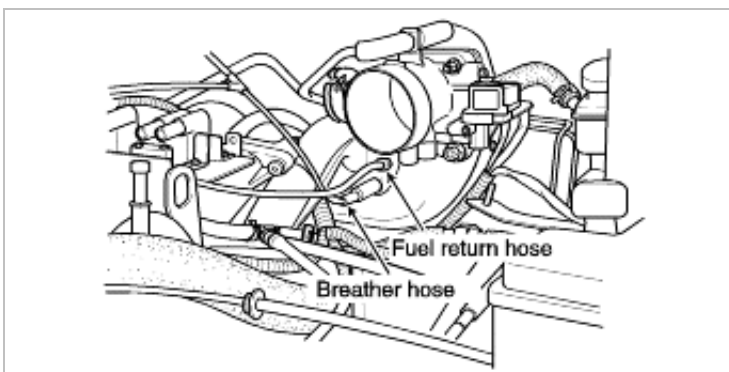
14. Reconnect coolant hose.
15. Reconnect fuel hose to injector rail.
16. Reconnect ignition coil connector, fuel injector connector and intake air-temperature sensor connector.
17. Reconnect cam position sensor connector and O2 sensor connector.
18. Install coolant upper hose.
19. Install No.3 engine mounting bracket  
(Refer to HLA Replacement (RH bank), from step 15 to step 40.)
20. Fill engine with specified amount and type of engine oil.  
(Refer to Lubrication system)
21. Fill engine with specified amount and type of coolant.  
(Refer to Cooling system)
22. Connect negative battery cable.

## DISASSEMBLY

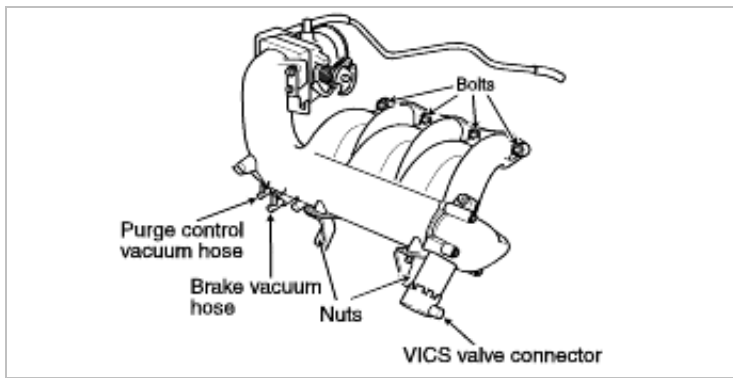
1. Disconnect TPS and IAC valve connector.



2. Disconnect breather hose from throttle body.
3. Remove high tension cords.
4. Disconnect breather hoses from LH camshaft cover.
5. Disconnect breather hose and fuel return hose at surge tank.



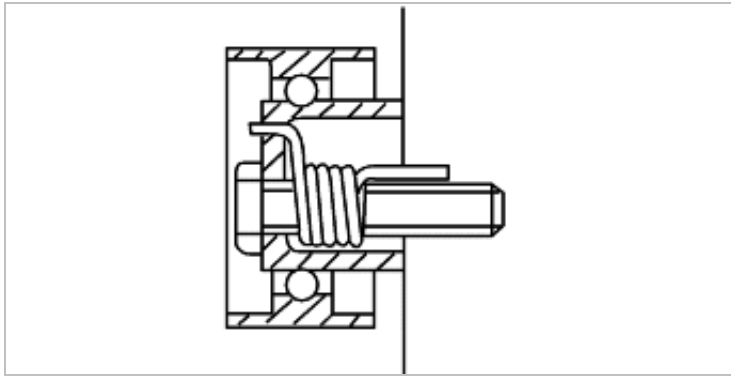
6. Remove surge tank with four bolts and two nuts.



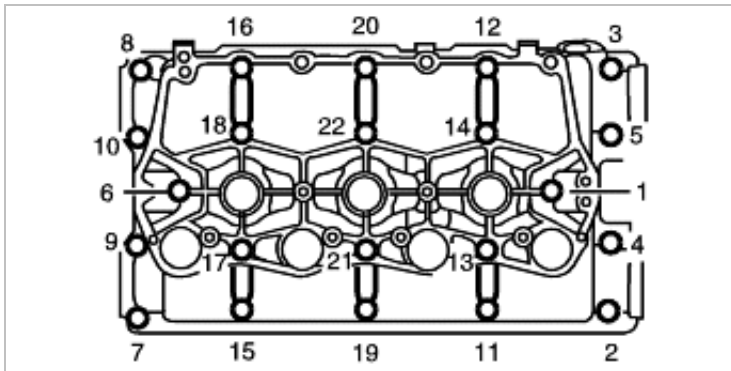
7. Disconnect ignition coil connector.
8. Disconnect fuel injector connector.
9. Remove ignition coil assembly with five bolts.
10. Remove fuel line.
11. Remove rear timing belt cover with three bolts.
12. Remove rear timing belt tensioner.

### NOTICE

Replace tensioner spring whenever timing belt is replaced.



13. Remove rear timing belt.
14. Remove rear camshaft pulleys.
15. Remove two bolts and remove rear timing belt back plate from cylinder head.
16. Remove fourteen bolts and remove camshaft cover and gasket.
17. Using sequence shown, progressively slacken twenty two bolts securing camshaft carrier to cylinder head until valve spring pressure is released. Remove bolts.



18. Remove camshaft carrier.

### NOTICE

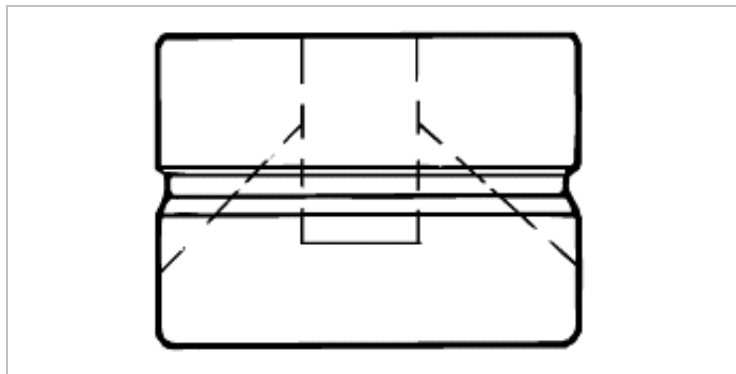
Carrier is located by dowels.

19. Remove camshafts and discard oil seals.
20. Mark HLA's to identify their original position if they will be reused.

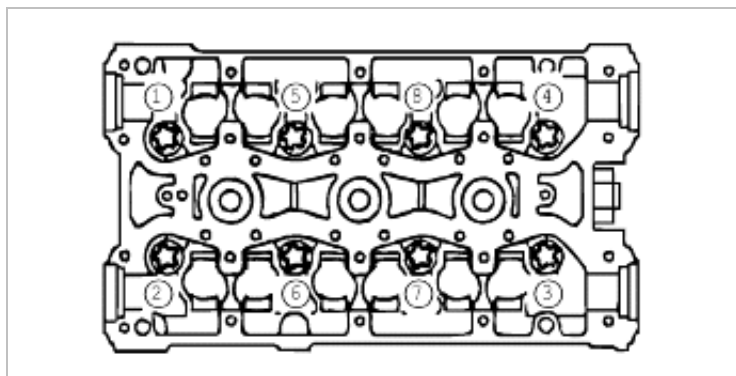
### NOTICE

Hydraulic Lash Adjusters(HLA) must be installed in location from which they were removed. Failure to install HLA's in their original location will result in premature and uneven wear of HLA's and camshafts.

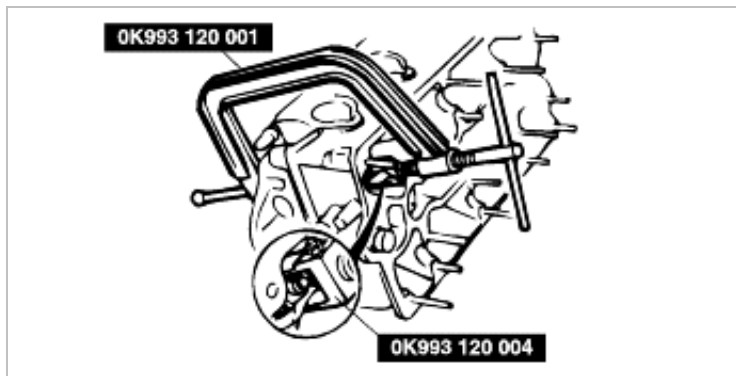
21. Using a magnet, remove twenty four HLA's from cylinder head.
22. Store HLA's upside-down in an oil-filled container.



23. Loosen cylinder head bolts in two or three steps following order shown in figure.



24. Remove cylinder head by lifting it off from cylinder block.
25. and allow enough room to remove valve cotters.

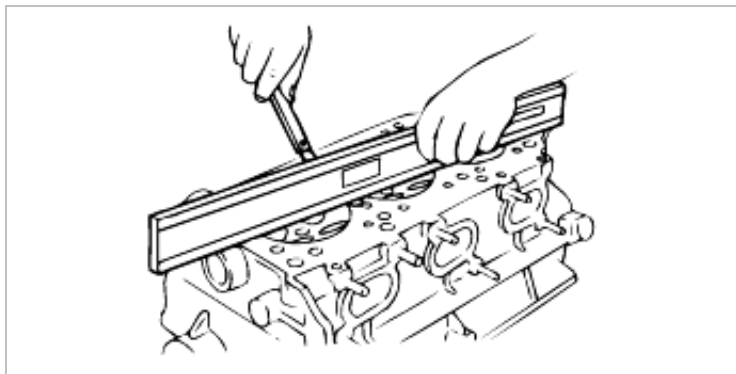
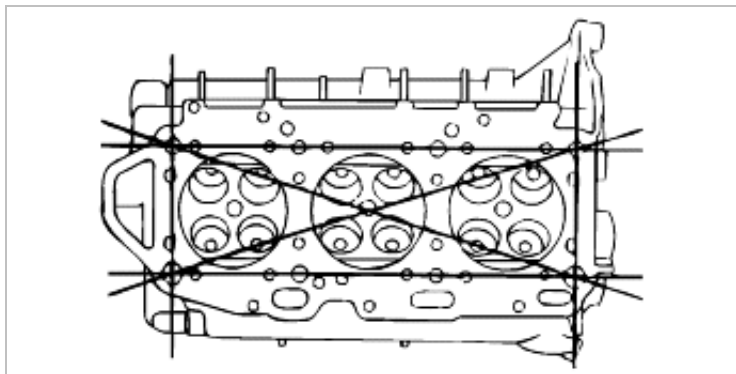


26. Slowly release pressure and remove upper seat / valve spring from cylinder head.
27. Repeat same procedure on all 24 valves.
28. Keep valves in correct order if they are to be reused.
29. Mark cylinder head so that valves can be installed to their original positions.
30. Remove valves from cylinder head.

### INSPECTION

1. Inspect cylinder head for damage, cracks, and leakage of water and oil. Replace cylinder head if necessary.
2. Measure cylinder head distortion in six directions shown in figure.

Distortion : 0.003 in (0.08 mm)



#### NOTICE

Before grinding cylinder head, check following and repair or replace cylinder head if necessary.

- Sinking of valve seats
- Damage of manifold contact surface
- Camshaft oil clearance and end play

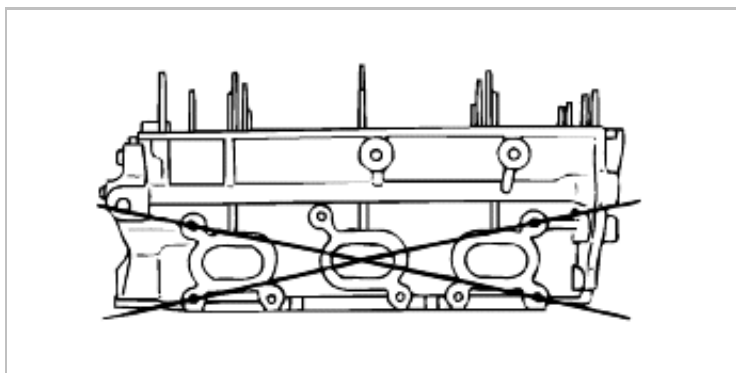
3. If cylinder head distortion exceeds specification, grind cylinder head surface.  
If cylinder head height is not within specification, replace it.

Height : 4.683~4.687 in (118.95~119.05 mm)

Grinding : 0.003 in (0.08 mm) max.

4. Measure manifold contact surface distortion in two directions shown in figure.

Distortion : 0.004 in (0.10 mm)

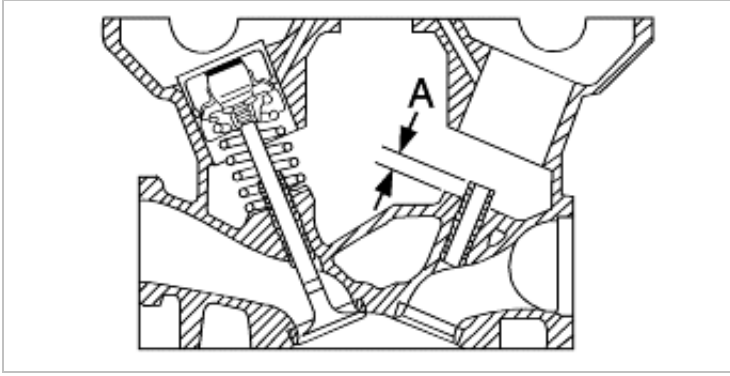


5. If distortion exceeds specification, grind surface or replace cylinder head.

## REASSEMBLY

1. Check that valve guide projection height (dimension A in figure). Replace if necessary.

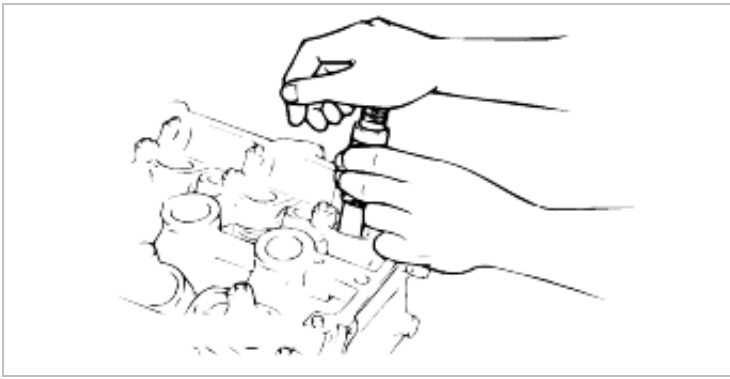
Height : 0.236 in (6 mm)



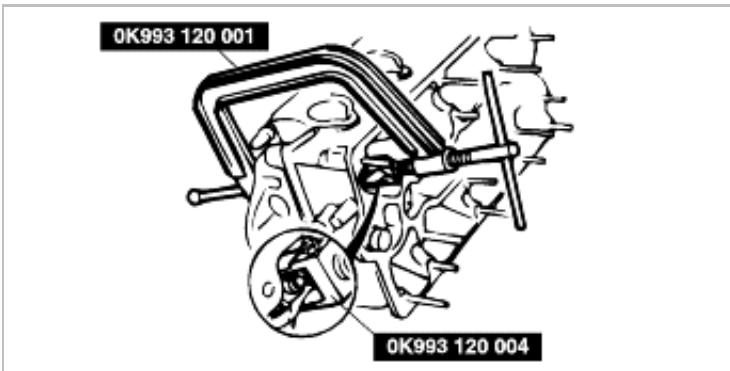
2. Install valve, then slide valve seal over valve stem and onto valve guide.
3. Install valve seal installer over valve seal.

#### CAUTION

Using a hammer will damage valve seals.



4. Install lower spring seat on cylinder head.
5. Install valve springs and upper spring seat.
6. Compress valve spring with SST ; then install valve cotters.

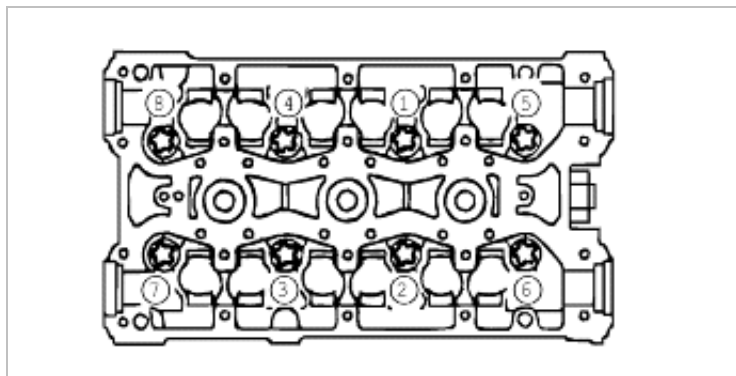


7. Tap end of valve stem lightly two or three times with a plastic hammer to confirm that cotters are all fully seated.
8. Thoroughly clean cylinder block and cylinder head mating surfaces.
9. Ensure locating dowels are correctly positioned in cylinder block.
10. Place new cylinder head gasket onto block face with word "TOP" uppermost.
11. Install cylinder head and locate onto dowels.
12. Carefully enter cylinder head bolts. Screw bolts into place by hand.

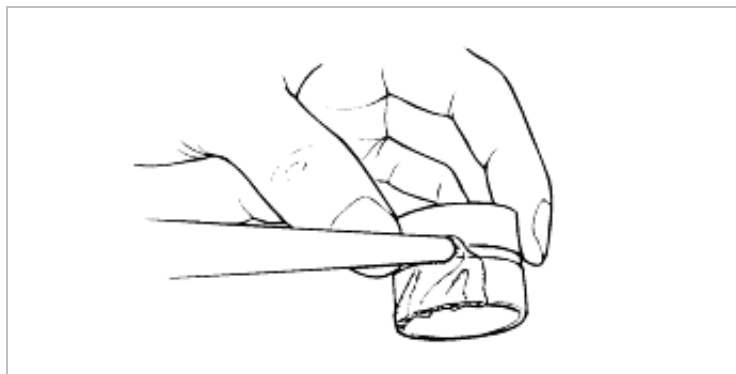
#### CAUTION

Do not drop cylinder head bolts.

13. Apply engine oil to bolt threads and seat faces.
14. Tighten cylinder head bolts 18.8 lb-ft (25 N·m, 2.6 kg-m) in order shown in figure.  
And then retighten all bolts 90° more in order shown in figure. Last retighten all bolts 90° more in order shown in figure. (when use the metal gasket)



15. Apply a coat of clean engine oil to friction surfaces of HLA.



16. Install HLA into cylinder head bore.

#### NOTICE

If HLA is being reused, install it in its original position.

17. Check that HLA moves smoothly in its bore.
18. Inspect cams and replace camshaft if scored, pitted or excessively worn.
19. Apply clean engine oil to camshaft and camshaft bearing surfaces and install camshaft.
20. Using plastic scraper from sealing kit, clean sealing surfaces on cylinder head and camshaft carrier.  
Clean sealing surfaces using Hylomar Easy Clean solvent and lint-free cloth.

#### CAUTION

Do not use a metal scraper.

21. Apply continuous thin beads of sealant to paths on camshaft carrier as shown then spread to an even film using a brush or roller.

---

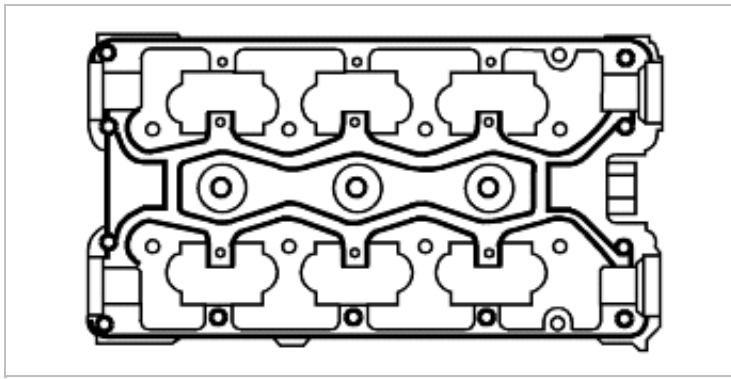
Sealant type : Hylogrip 2000  
Bead width : 0.079 in(2 mm)

---

#### CAUTION

Ensure sealant is kept clear of HLA oil feed holes and lubrication grooves in carrier and that assembly is completed within 15 minutes.





22. Install oil seal to camshafts.
23. Apply engine oil to cams and journals.
24. Install camshaft carrier and tighten bolts in order shown in figure.

Tightening torque :

5.164~7.377 lb-ft (7~10 N·m, 71.4~102 kg-cm)

25. Clean mating surface of camshaft cover and camshaft carrier.
26. Clean inside of camshaft cover.
27. Install camshaft cover gasket and position camshaft cover to camshaft carrier.

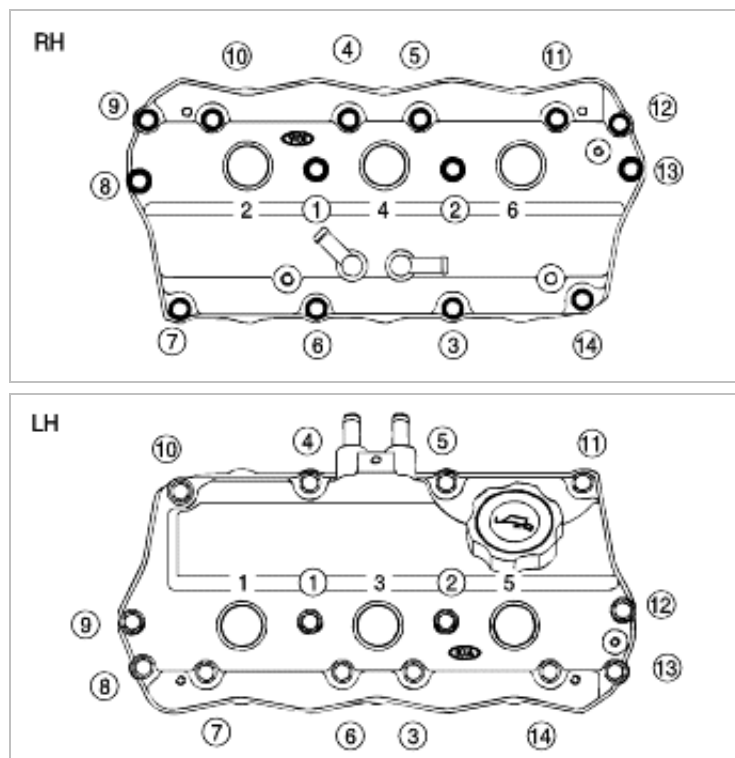
#### CAUTION

When installing new camshaft cover gasket ensure arrows point towards inlet manifold.

28. Tighten camshaft cover bolts in order shown in figure.

Tightening torque :

5.164~7.377 lb-ft (7~10 N·m, 71.4~102 kg-cm)



29. Install front timing belt back plate and rear timing belt back plate to cylinder head.

Tightening torque :

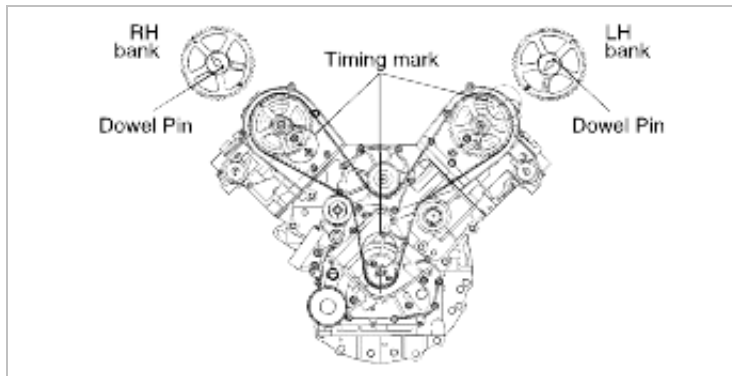
5.164~7.377 lb-ft (7~10 N·m, 71.4~102 kg-cm)



30. Install front camshaft pulley as shown in figure.

Tightening torque :

36.16~44.84 lb-ft (49~61 N·m, 5.0~6.2 kg-m)



31. Check that timing mark on timing belt pulley is aligned with timing mark on engine.

Check that "L" mark on camshaft pulley of LH bank is aligned with mark on timing belt back plate.

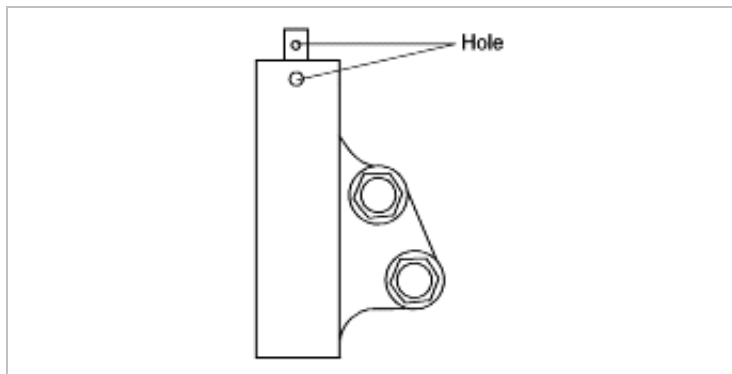
Check that "R" mark on camshaft pulley of RH bank is aligned with mark on timing belt back plate.

32. Using fingers only, install timing belt to pulleys, starting at timing belt pulley and working in counter-clockwise direction, keeping run as taut as possible.

#### NOTICE

Arrow mark of timing belt must be matched driving direction.

33. Using a press, slowly compress auto-tensioner rod and install a suitable pin, 0.08in (2.0 mm) in diameter, to retain rod.

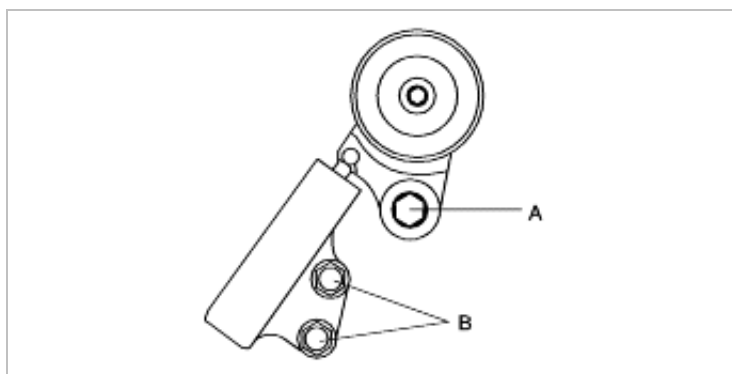


34. Position tensioner, fit bolts and tighten.

Tightening torque :

A : 15.9~18.8 lb-ft (22~25 N·m, 2.2~2.6 kg-m)

B : 29.7~36.9 lb-ft (40~50 N·m, 4.1~5.1 kg-m)

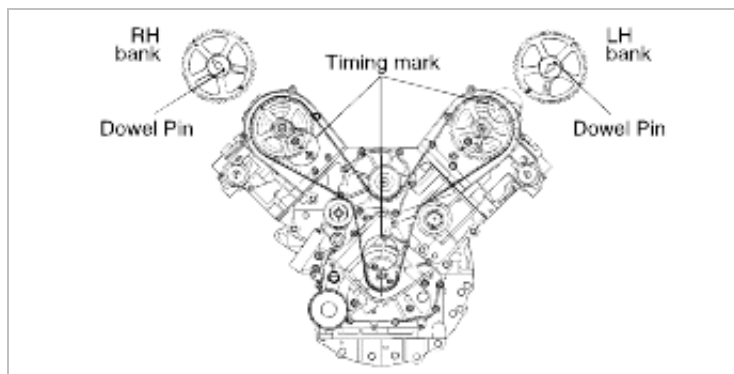


35. Release auto-tensioner pulley and remove pin from auto-tensioner.

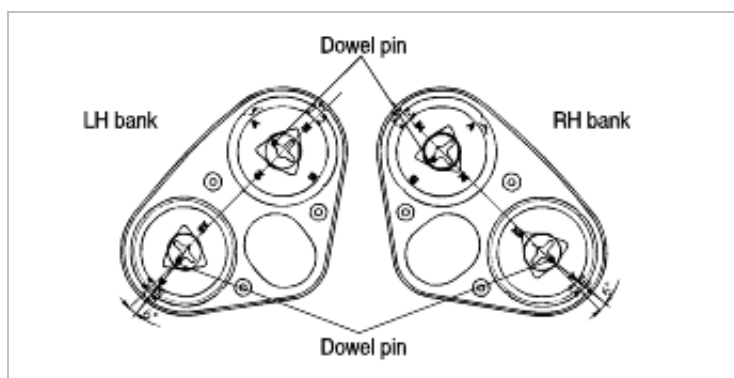
36. Rotate crankshaft two full revolutions (clockwise only) and align timing mark on timing belt pulley with timing mark

on engine block.

37. Check that "L" mark on camshaft pulley of LH bank is aligned with mark on timing belt back plate.  
Check that "R" mark on camshaft pulley of RH bank is aligned with mark on timing belt back plate.



38. If they are not aligned, remove timing belt and repeat from step 30 to step 37.
39. Install rear camshaft pulley. For intake camshaft pulley of RH bank, set "B" mark to dowel pin of camshaft and verify that "A" mark points upward.  
For intake camshaft pulley of LH bank, set "A" mark to dowel pin of camshaft and verify that "A" mark points upward.



40. For exhaust camshaft pulley, set "A" mark to dowel pin of camshaft and line up "A" mark to indicator on rear back plate at both bank.

#### NOTICE

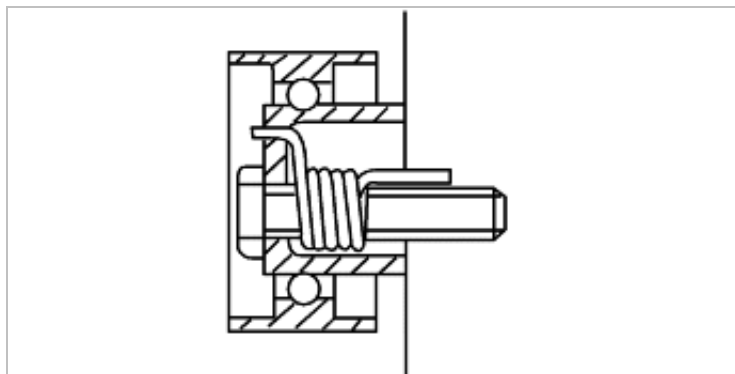
Ensure cam pulley flange direction.

Pulley lock bolt tightening torque :  
36.16~44.84 lb-ft (49~61 N·m, 5.0~6.2 kg-m)

41. Finger tighten rear timing belt tensioner.

#### NOTICE

Replace tensioner spring whenever timing belt is replaced.



42. Install rear timing belt.

43. Turn crankshaft 90° to clockwise for tensioner spring setting and then tighten tensioner lock bolt.

---

Tensioner lock bolt tightening torque :  
26.76~38.33 lb-ft (37~52 N·m, 3.7~5.3 kg-m)

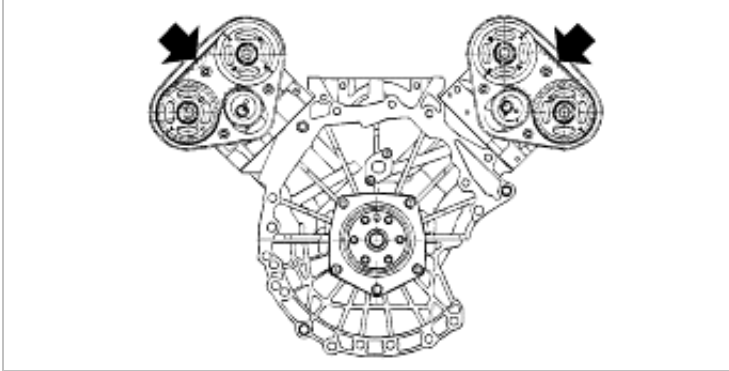
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44. Measure tension at arrow mark indicated in figure with clavis gauge

---

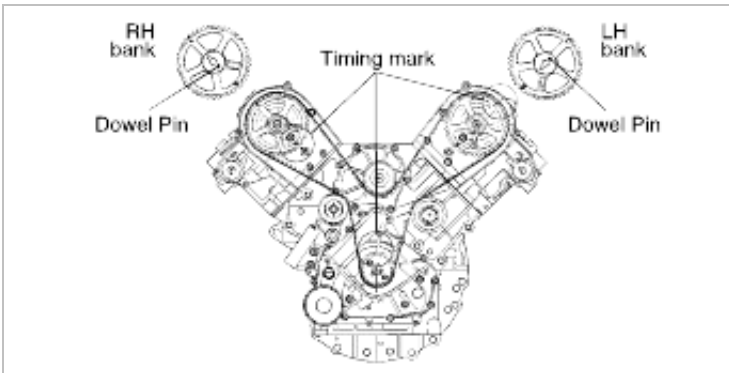
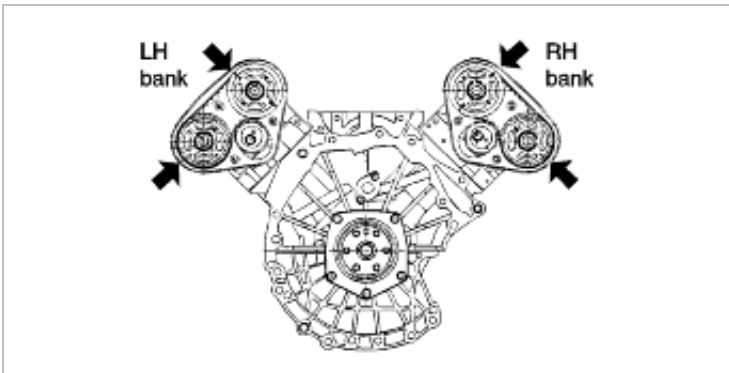
Tension : 100~140 Hz

---



45. Rotate crankshaft two full revolutions (clockwise only) and align timing mark on timing belt pulley with timing mark on engine block.

46. Verify if timing mark of front and rear camshaft pulleys aligned proper position.



47. Install rear timing belt cover.

---

Tensioner lock bolt tightening torque :  
2.2~2.5 lb-ft (3~5 N·m, 0.3~0.35 kg-m)

---

48. Install intake manifold.  
49. Install fuel line.  
50. Install ignition coil assembly.  
51. Reconnect fuel injector connector.  
52. Reconnect ignition coil connector.  
53. Install surge tank.

54. Reconnect breather hose and fuel return hose to surge tank.
55. Reconnect breather hose from LH camshaft cover.
56. Install high tension cords.
57. Reconnect breather hose to throttle body.
58. Reconnect TPS and IAC sensor connectors.



# **Engine Mechanical System**

Cylinder Head Assembly - Cylinder Head



## Inspection

### VALVE AND VALVE GUIDE

1. Inspection each valve for following. Replace or resurface if necessary.

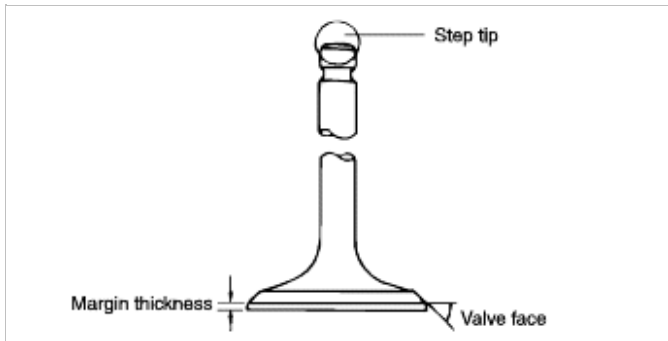
- (1) Damage or bent stem
- (2) Roughness or damage to face
- (3) Damage or uneven wear of stem tip

2. Check valve head margin thickness. Replace if necessary.

Margin thickness :

Intake : 0.0519~0.0622 in (1.32~1.58 mm)

Exhaust : 0.0716~0.0818 in (1.82~2.08 mm)



3. Measure valve length.

Valve length :

Standard :

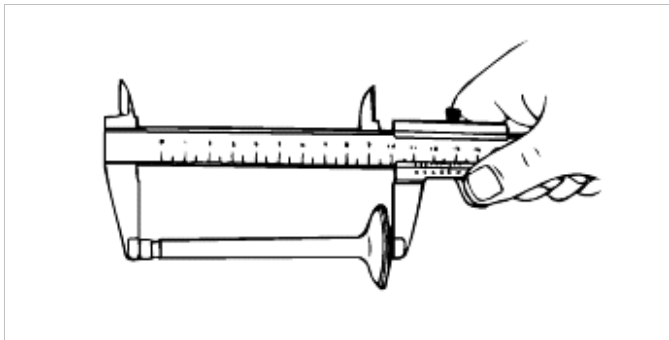
Intake - 3.527 in (89.6 mm)

Exhaust - 3.543 in (90.0 mm)

Minimum :

Intake - 3.519 in (89.39 mm)

Exhaust - 3.531 in (89.79 mm)

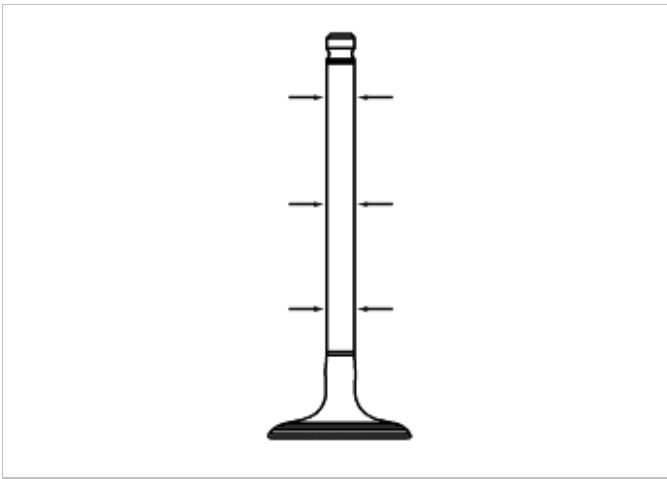


4. Measure valve stem diameter.

Diameter

Intake : 0.2343~0.2349 in (5.952~5.957 mm)

Exhaust : 0.2341~0.2347 in (5.947~5.962 mm)

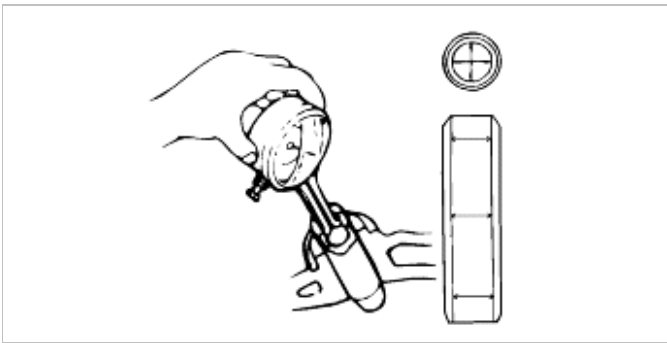


5. Measure valve guide inner diameter.

Inner diameter

Intake, Exhaust:

0.2362~0.2372 in (6.000~6.025 mm)

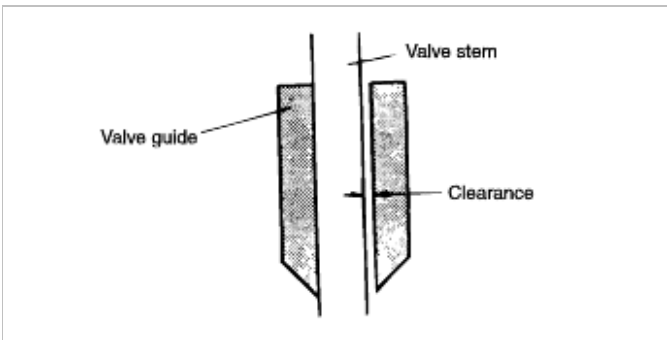


6. Measure valve stem to guide clearance by subtract outer diameter of valve stem from inner diameter of corresponding valve guide.

Clearance

Intake : 0.0013~0.0029 in (0.033~0.073 mm)

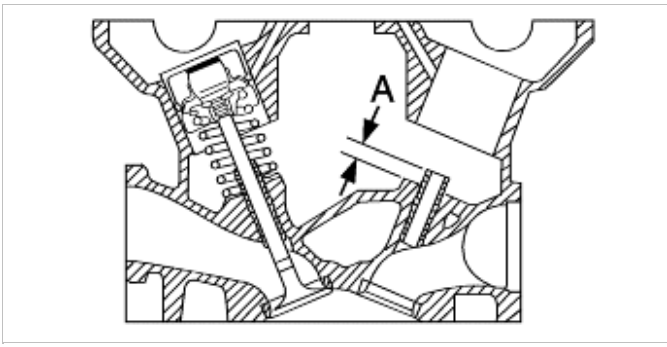
Exhaust : 0.0015~0.0031 in (0.038~0.078 mm)



7. If clearance exceeds maximum, replace valve and/or valve guide.

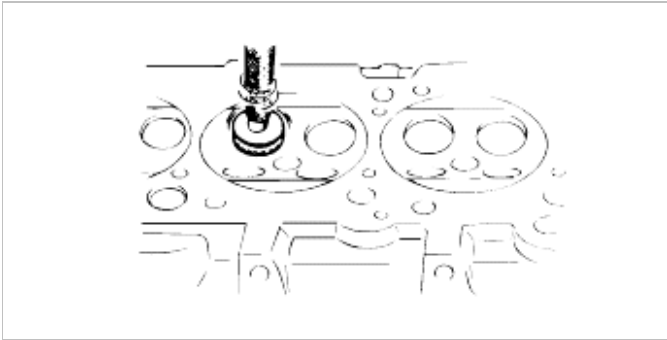
8. Check that valve guide projection height (dimension A in figure). Replace if necessary.

Height : 0.236 in (6 mm)

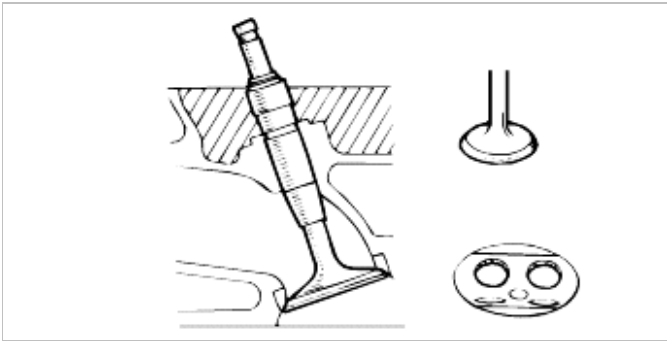


## VALVE SEAT

1. Inspect contact surface of valve seat and valve face for following.
  - (1) Roughness
  - (2) Damage
2. If necessary, resurface valve seat with a 45° valve seat cutter and/or resurface valve face.



3. Apply a thin coat of prussian blue to valve face.
4. Check valve seating by rotating valve against seat.
  - (1) If blue does not appear 360° around valve face, replace valve.
  - (2) If blue does not appear 360° around valve seat, resurface valve.

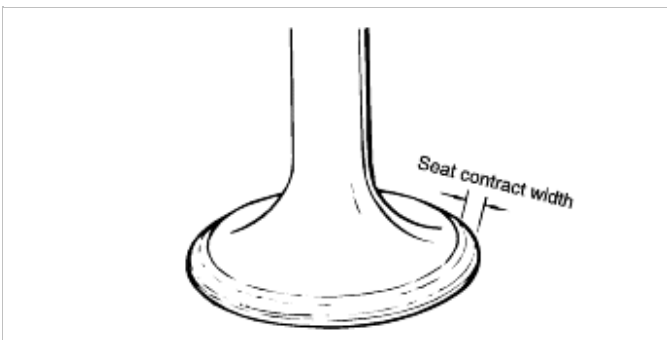


5. Check seat contact width.

---

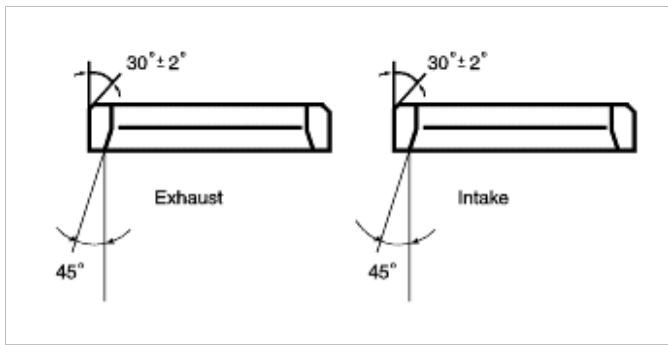
Width : 0.047~0.67 in (1.2~1.7 mm)

---



6. Check that valve seating position is at center of valve face
  - (1) If seating position is too high, correct valve seat with a 45° cutter.
  - (2) If seating position is too low, correct valve seat with a 45° cutter.



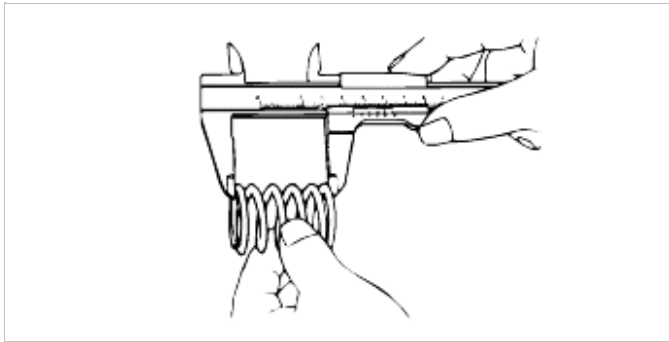


7. Seat valve to valve seat with a lapping compound.

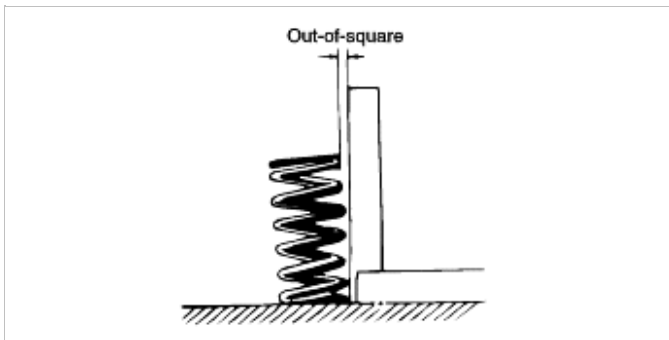
## VALVE SPRING

1. Inspect each valve spring for cracks or damage.
2. Check free length and out-of-square. Replace if necessary.

Free length : 1.874 in (47.6 mm)



Out-of-square : 0.056 in (1.42 mm)



3. Check spring pressure when length of spring is 1.45 in (37 mm) , and replace it if necessary.

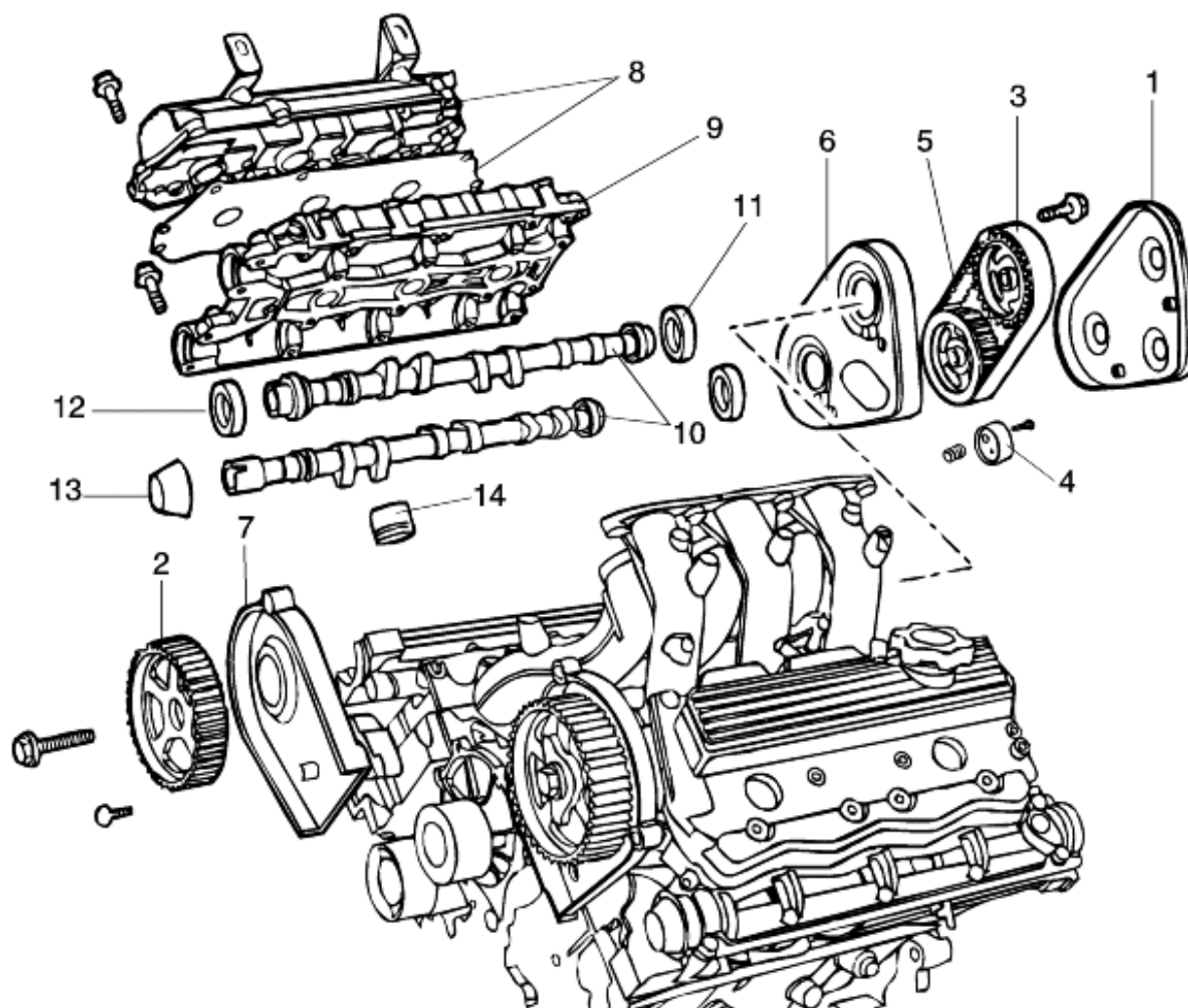
Spring pressure :  
20.1~22.74 kg/1.45in(37mm)

# **Engine Mechanical System**

Cylinder Head Assembly - Hydraulic Lash  
Adjuster

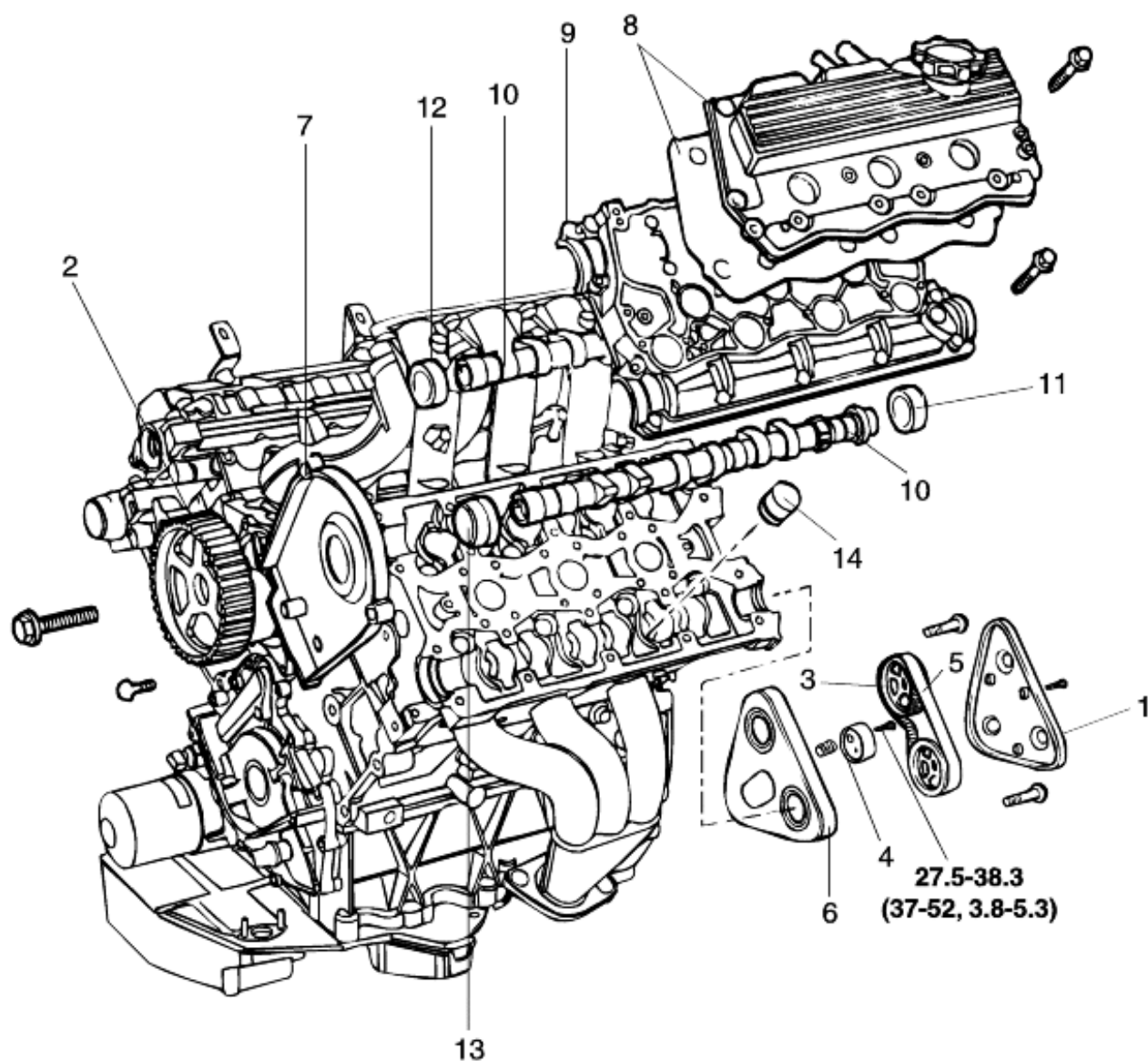


## RH bank (HLA)



- |                                 |  |
|---------------------------------|--|
| 1. Rear timing belt cover       | 8. Camshaft cover and gasket                   |
| 2. Front camshaft pulley        | 9. Camshaft carrier                            |
| 3. Rear camshaft pulley         | 10. Camshaft                                   |
| 4. Rear timing belt tensioner   | 11. Rear oil seal (Brown color)                |
| 5. Rear timing belt             | 12. Front oil seal - Intake (Red color)        |
| 6. Rear timing belt back plate  | 13. Front cup oil seal - Exhaust (Black color) |
| 7. Front timing belt back plate | 14. HLA (Hydraulic Lash Adjuster)              |

## LH BANK



**TORQUE : lb·ft (N·m, kg·m)**

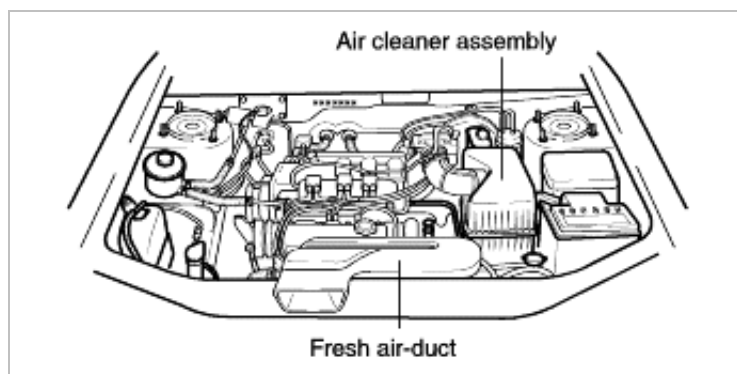
1. Rear timing belt cover
2. Front camshaft pulley
3. Rear camshaft pulley
4. Rear timing belt tensioner
5. Rear timing belt
6. Rear timing belt back plate
7. Front timing belt back plate

8. Camshaft cover and gasket
9. Camshaft carrier
10. Camshaft
11. Rear oil seal (Brown color)
12. Front oil seal - Intake (Red color)
13. Front cup oil seal - Exhaust (Black color)
14. HLA (Hydraulic Lash Adjuster)

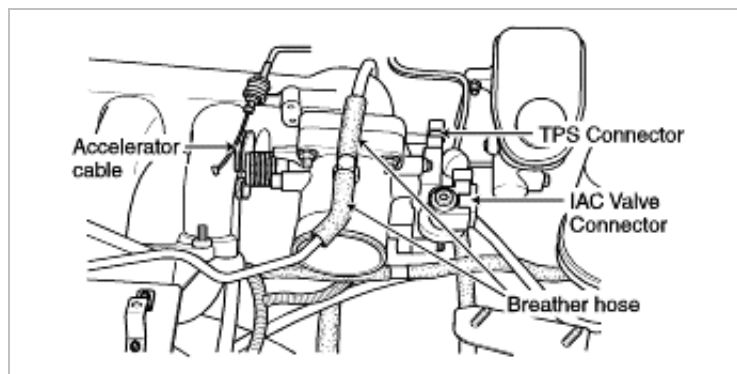


## REMOVAL (RH BANK)

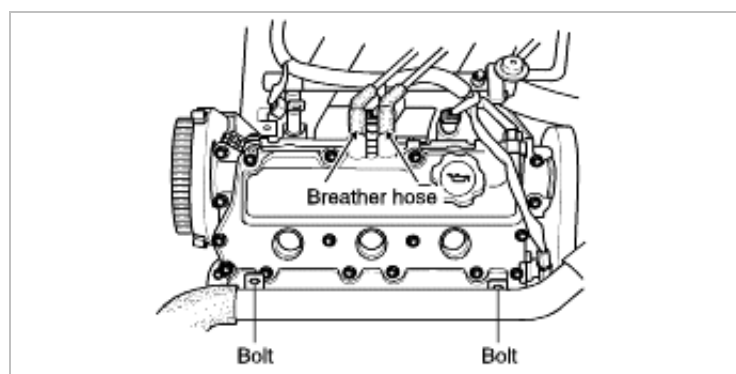
1. Disconnect negative battery cable.
2. Remove front cover.  
(Refer to Front Timing belt removal ; from step1 to step28.)
3. Remove fresh air-duct with two bolts and clamp.



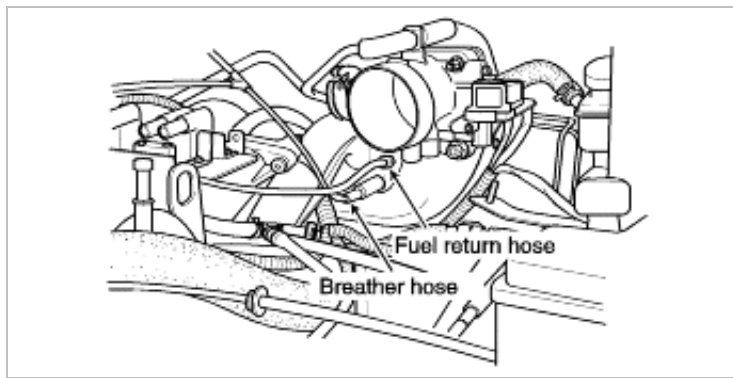
4. Disconnect air flow sensor connector.
5. Remove air cleaner assembly with three bolts and clamp.
6. Remove accelerator cable.



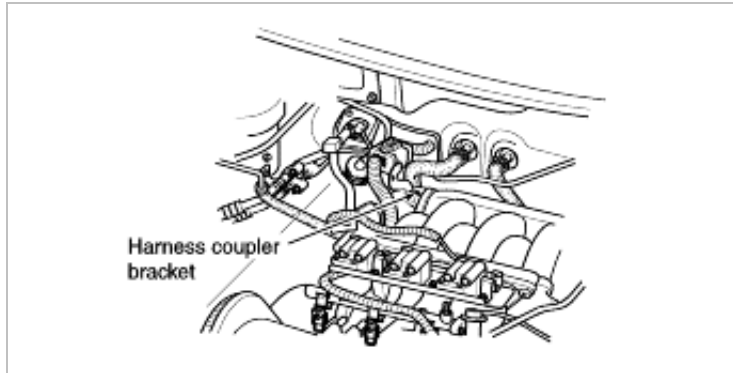
7. Disconnect TPS and IAC valve connectors.
8. Disconnect breather hose from throttle body.
9. Remove high-tension cords.
10. Disconnect breather hoses from LH camshaft cover.



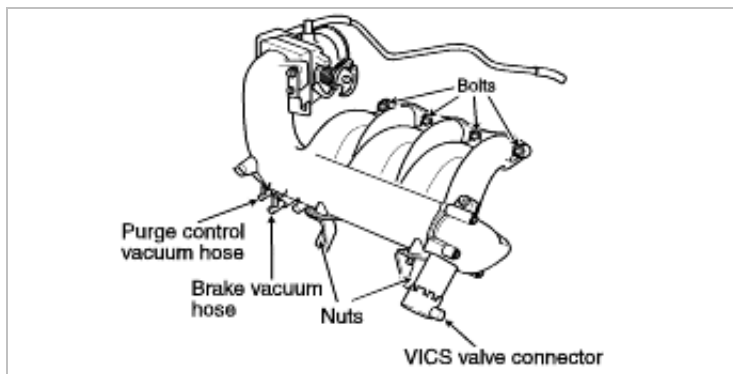
11. Disconnect breather hose and fuel return hose at surge tank.



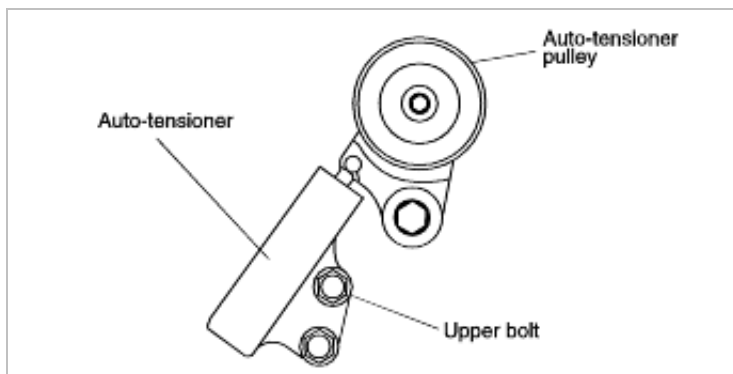
12. Remove harness coupler bracket from surge tank.



13. Disconnect VICS valve connector , brake vacuum hose and purge control vacuum hose.



14. Remove surge tank with four bolts and two nuts.
15. Remove rear timing belt cover with three bolts.
16. Slacken front camshaft pulley bolt and rear camshaft pulleys bolts.
17. Remove upper bolt securing front timing belt auto-tensioner to engine block.



18. Slacken lower bolt and allow front timing belt auto -tensioner to swing away from timing belt auto-tensioner pulley assembly.  
Remove bolt and remove auto-tensioner.
19. Remove front timing belt.

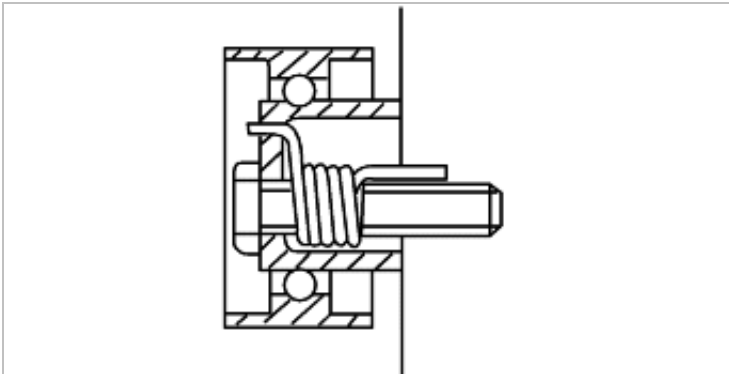
**NOTICE**

- Ease timing belt off gears using fingers only ; levers may damage belt and gears.
- Do not turn crankshaft with timing belt removed and cylinder heads fitted.

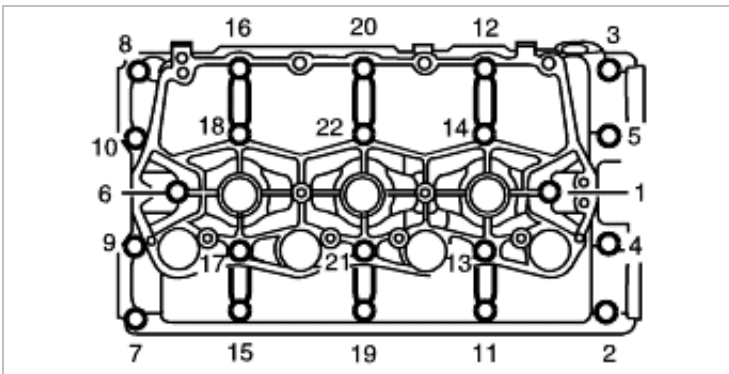
20. Remove front camshaft pulley.
21. Remove four bolts and remove front timing belt back plate from cylinder head.
22. Remove rear timing belt tensioner.

#### NOTICE

Replace tensioner spring whenever timing belt is replaced.



23. Remove rear timing belt.
24. Remove rear camshaft pulleys.
25. Remove two bolts and remove rear timing belt back plate from cylinder head.
26. Remove fourteen bolts and remove camshaft cover and gasket.
27. Using sequence shown, progressively slacken twenty two bolts securing camshaft carrier to cylinder head until valve spring pressure is released. Remove bolts.



28. Remove camshaft carrier.

#### NOTICE

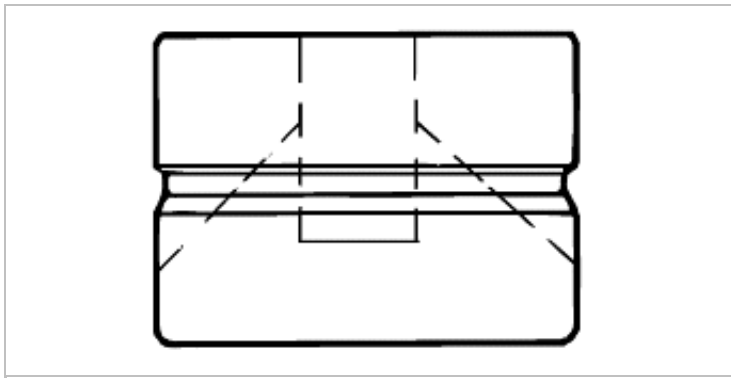
Carrier is located by dowels.

29. Remove camshafts and discard oil seals.
30. Mark HLA's to identify their original position if they will be reused.

#### NOTICE

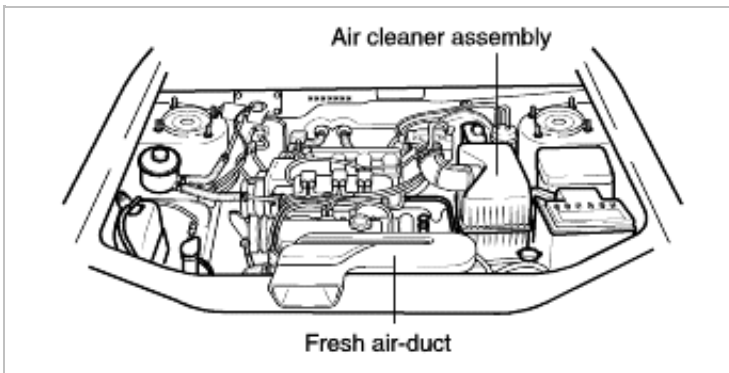
Hydraulic Lash Adjusters(HLA) must be installed in location from which they were removed. Failure to install HLA's in their original location will result in premature and uneven wear of HLA's and camshafts.

31. Using a magnet, remove twelve HLA's from cylinder head.
32. Store HLA's upside-down in an oil-filled container.

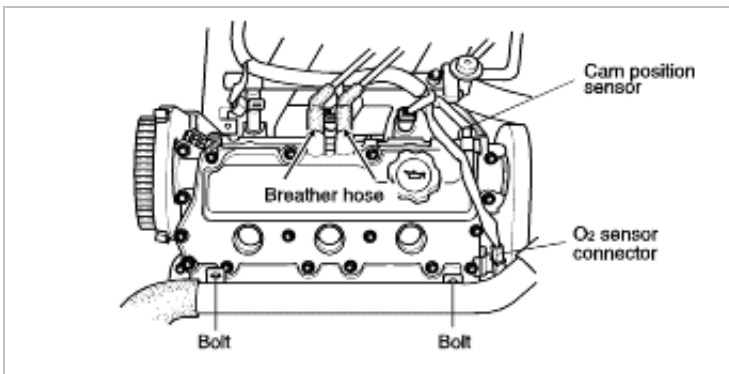


## REMOVAL (LH BANK)

1. Disconnect negative battery cable.
2. Remove front cover.  
(Refer to Front timing belt removal ; from step1 to step 29.)
3. Remove fresh air-duct with two bolts and clamp.



4. Disconnect air flow sensor connector.
5. Remove air cleaner assembly with three bolts and clamp.
6. Remove high-tension cords.
7. Disconnect breather hoses from LH camshaft cover.

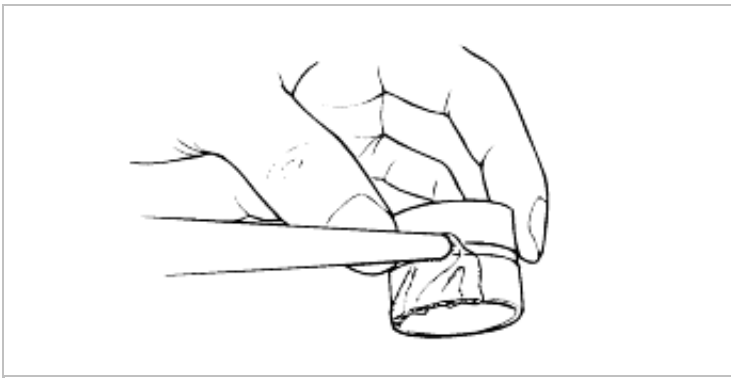


8. Remove two bolts securing coolant upper hose.
9. Disconnect cam position sensor connector and O2 sensor connector.
10. Remove twelve HLA's from cylinder head.  
(Refer to HLA(RH bank) removal ; from step 15 to step32.)

## REPLACEMENT (RH BANK)

1. Apply a coat of clean engine oil to friction surfaces of HLA.





2. Install HLA into cylinder head bore.

#### NOTICE

If HLA is being reused, install it in its original position.

3. Check that HLA moves smoothly in its bore.
4. Inspect cams and replace camshaft if scored, pitted or excessively worn.
5. Apply clean engine oil to camshaft and camshaft bearing surfaces and install camshaft.
6. Using plastic scraper from sealing kit, clean sealing surfaces on cylinder head and camshaft carrier.  
Clean sealing surfaces using Hylomar Easy Clean solvent and lint-free cloth.

#### CAUTION

Do not use a metal scraper.

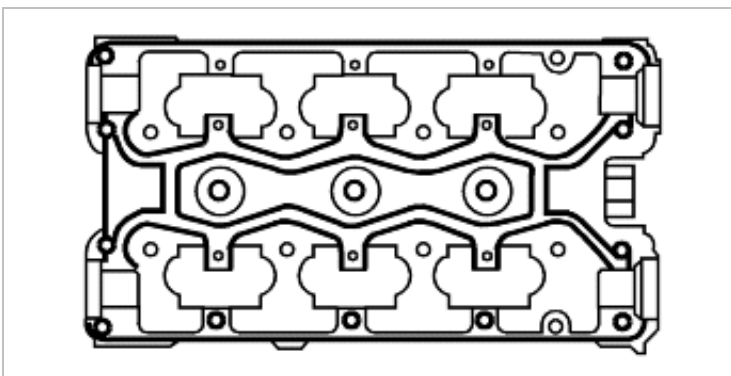
7. Apply continuous thin beads of sealant to paths on camshaft carrier as shown then spread to an even film using a brush or roller.

Sealant type : Hylogrip 2000

Bead width : 0.079 in (2 mm)

#### CAUTION

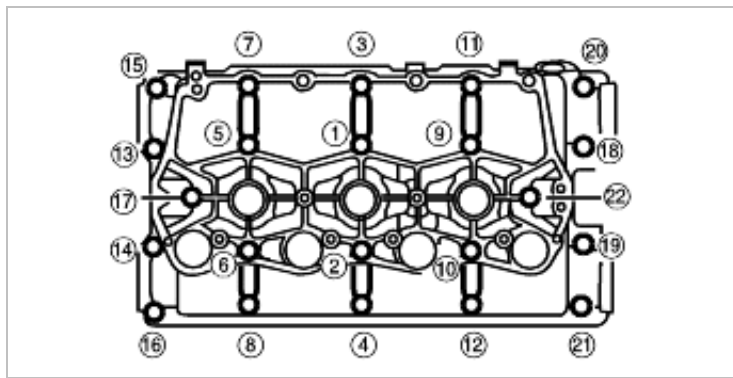
Ensure sealant is kept clear of HLA oil feed holes and lubrication grooves in carrier and that assembly is completed within 15 minutes.



8. Install oil seal to camshafts.
9. Apply engine oil to cams and journals.
10. Install camshaft carrier and tighten bolts in order shown in figure.

Tightening torque:

5.164~7.377 lb-ft (7~10 N·m, 71.4~102 kg-cm)



11. Clean mating surface of camshaft cover and camshaft carrier.
12. Clean inside of camshaft cover.
13. Install camshaft cover gasket and position camshaft cover to camshaft carrier.

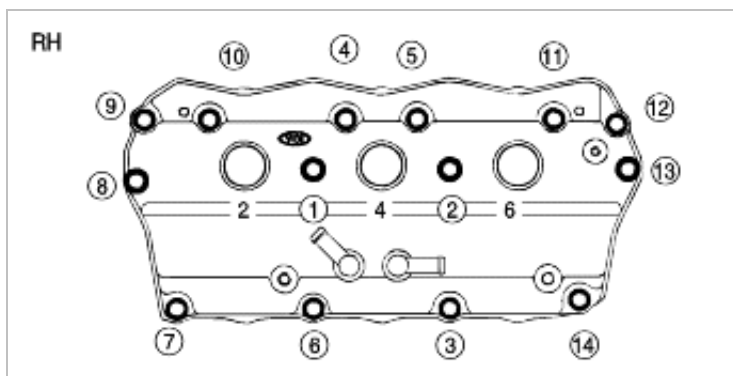
#### CAUTION

When installing new camshaft cover gasket ensure arrows point towards inlet manifold.

14. Tighten camshaft cover bolts in order shown in figure.

Tightening torque:

5.164~7.377 lb-ft (7~10 N·m, 71.4~102 kg-cm)



15. Install front timing belt back plate and rear timing belt back plate to cylinder head.

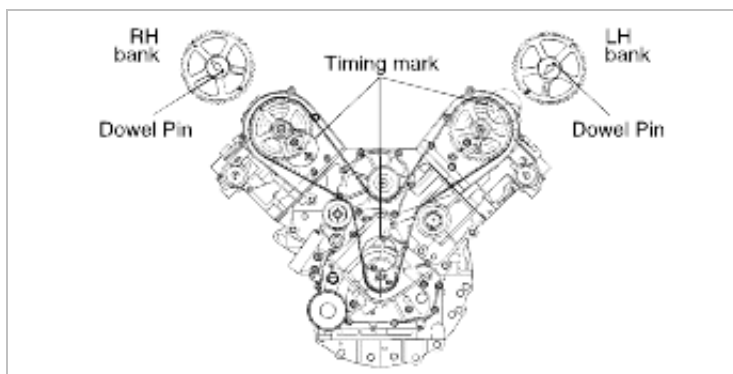
Tightening torque:

5.164~7.377 lb-ft (7~10 N·m, 71.4~102 kg-cm)

16. Install front camshaft pulley as shown in figure.

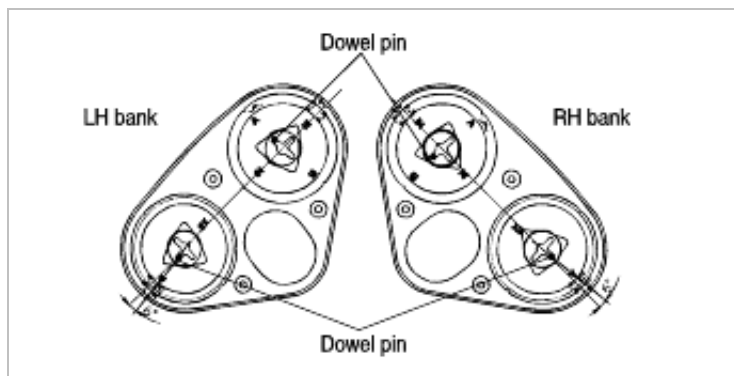
Tightening torque:

36.16~44.84 lb-ft (49~61 N·m, 5.0~6.2 kg-cm)



17. Install front timing belt.  
(Refer to Front timing belt Replacement : from step1 to step5.)

18. Install rear camshaft pulley. For intake camshaft pulley of RH bank, set "B" mark to dowel pin of camshaft and verify that "A" mark points upward.



19. For exhaust camshaft pulley, set "A" mark to dowel pin of camshaft and line up "A" mark to indicator on rear back plate at both bank.

**NOTICE**

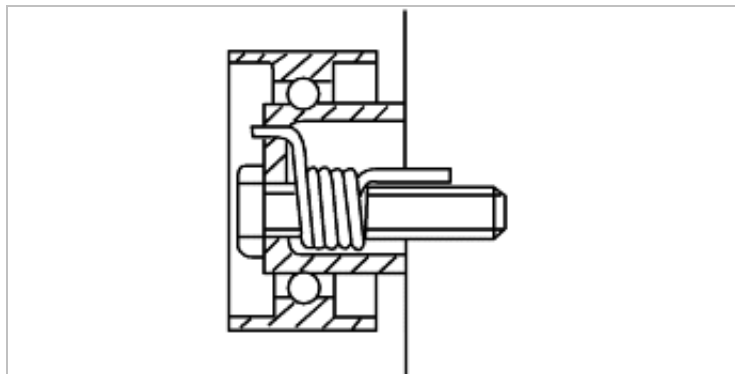
Ensure cam pulley flange direction.

Pulley lock bolt tightening torque :  
36.16~44.84 lb-ft (49~61 N·m, 5.0~6.2 kg-m)

20. Finger tighten rear timing belt tensioner.

**NOTICE**

Replace tensioner spring whenever timing belt is replaced.

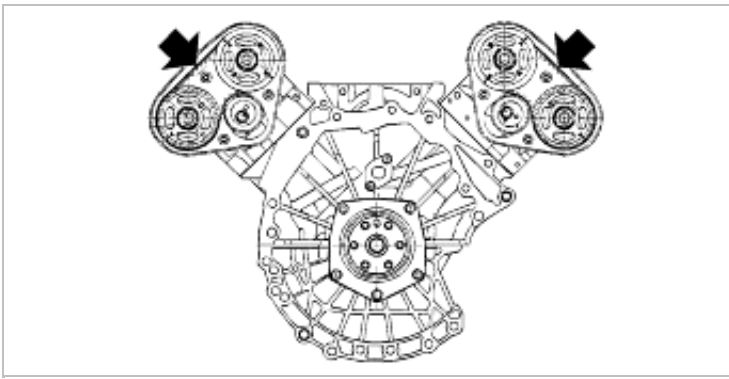


21. Install rear timing belt.  
22. Turn crankshaft 90° to clockwise for tensioner spring setting and then tighten tensioner lock bolt.

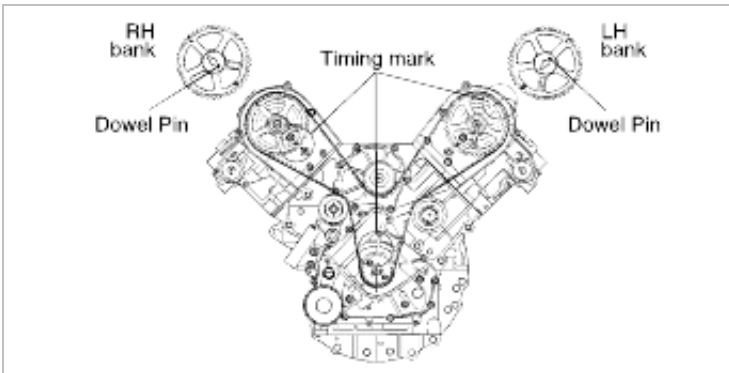
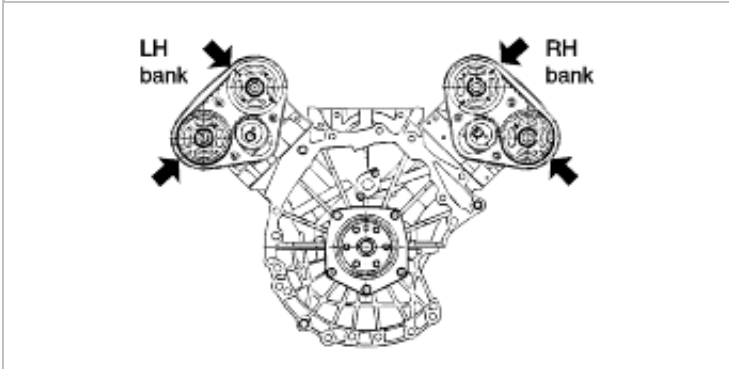
Tensioner lock bolt tightening torque :  
26.76~38.33 lb-ft (37~52 N·m, 3.7~5.3 kg-m)

23. Measure tension at arrow mark indicated in figure with clavis gauge.

Tension : 100~140 Hz



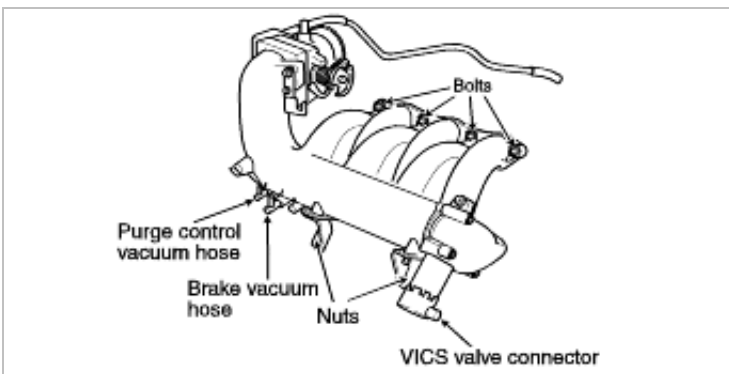
24. Rotate crankshaft two full revolutions (clockwise only) and align timing mark on timing belt pulley with timing mark on engine block.
25. Verify if timing mark of front and rear camshaft pulleys aligned proper position.



26. Install rear timing belt cover.

Tensioner lock bolt tightening torque :  
2.2~3.6 lb-ft (3~5 N·m, 0.3~0.5 kg-cm)

27. Install surge tank.



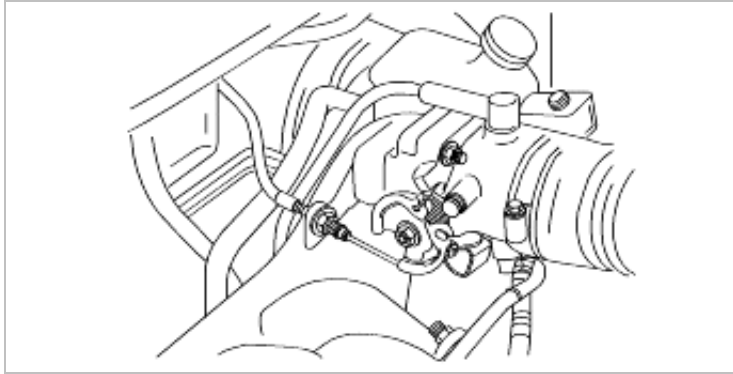
28. Connect VICS valve connector, brake vacuum hose and purge control vacuum hose.
29. Install harness coupler bracket to surge tank.
30. Connect breather hose and fuel return hose to surge tank.
31. Connect breather hose to camshaft cover.

32. Install high-tension cords.
33. Connect breather hose to throttle body.
34. Connect TPS and IAC sensor connectors.
35. Install accelerator cable.
36. Measure free play of accelerator cable.

---

Free play : 0.04~0.11 in (1~3 mm)

---



37. Install air cleaner assembly.
38. Connect air flow sensor connector.
39. Install fresh air-duct.
40. Install No.3 engine mounting bracket.  
(Refer to Front timing belt Replacement : from step9 to step26.)
41. Connect negative battery cable.

## REPLACEMENT (LH BANK)

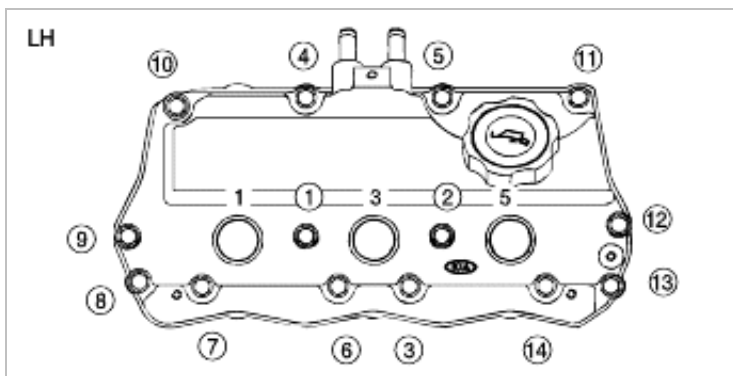
1. Install camshaft cover.  
(Refer to HLA(RH bank) Replacement ; from step 1 to step13.)
2. Tighten camshaft cover bolts in order shown in figure.

---

Tightening torque:

5.164~7.377 lb-ft (7~10 N·m, 71.4~102 kg-cm)

---



3. Install front timing belt back plate and rear timing belt back plate to cylinder head.

---

Tightening torque:

5.164~7.377 lb-ft (7~10 N·m, 71.4~102 kg-cm)

---

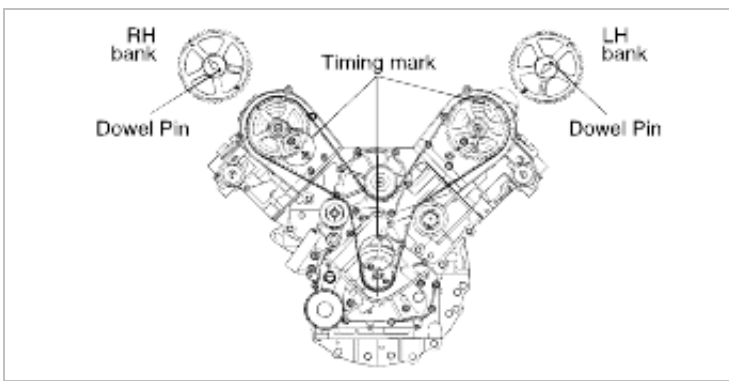
4. Install front camshaft pulley as shown in figure.

---

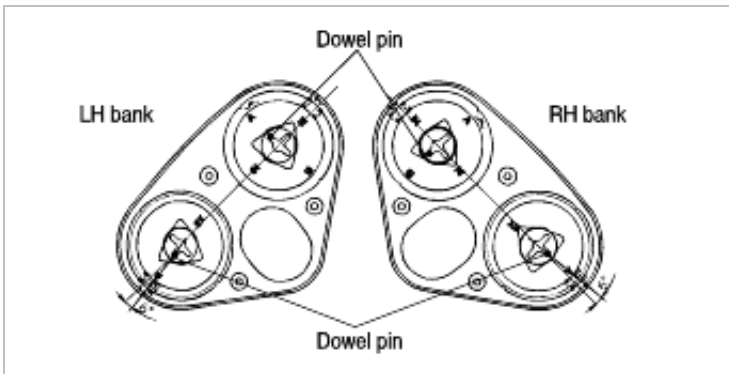
Tightening torque:

36.16~44.84 lb-ft (49~61 N·m, 5.0~6.2 kg-cm)

---



5. Install front timing belt.  
(Refer to Front timing belt Replacement : from step1 to step5.)
6. Install rear camshaft pulley. For intake camshaft pulley of LH bank, set "A" mark to dowel pin of camshaft and verify that "A" mark points upward.



7. For exhaust camshaft pulley, set "A" mark to dowel pin of camshaft and line up "A" mark to indicator on rear back plate at both bank.

#### NOTICE

Ensure cam pulley flange direction.

---

Pulley lock bolt tightening torque :  
36.16~44.84 lb-ft (49~61 N·m, 5.0~6.2 kg-m)

---

8. Install rear timing belt cover.  
(Refer to HLA(RH bank) Replacement ; from step 20 to step 26.)
9. Connect cam position sensor connector and O2 sensor connector.
10. Install bolts securing coolant upper hose.
11. Connect breather hoses to LH camshaft cover.
12. Install high-tension cords.
13. Install air cleaner assembly.
14. Connect air flow sensor connector.
15. Install fresh air-duct.
16. Install No.3 engine mounting bracket.  
(Refer to Front timing belt Replacement : from step9 to step26.)
17. Connect negative battery cable.

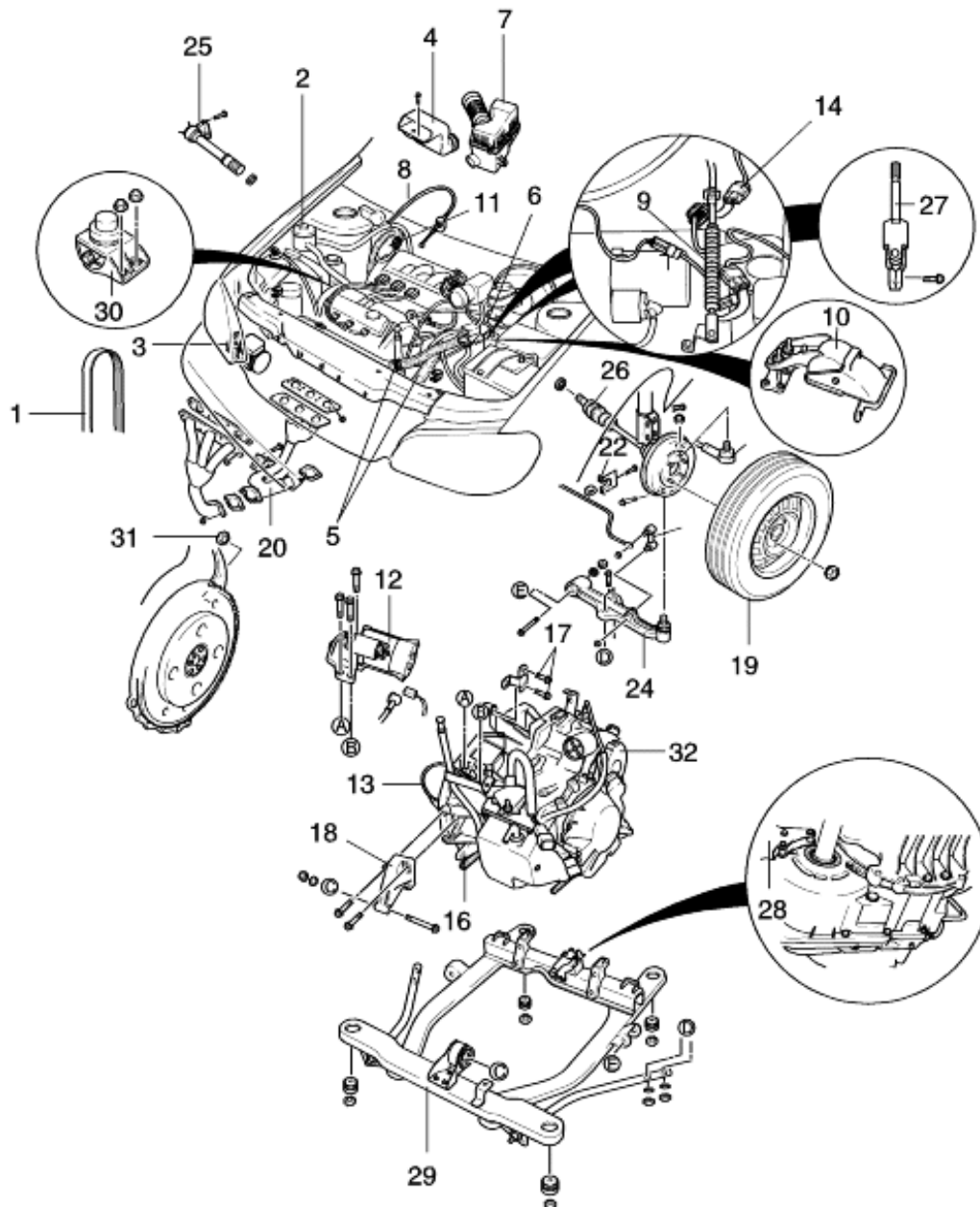


# **Engine Mechanical System**

Engine And Transaxle Assembly



## Component

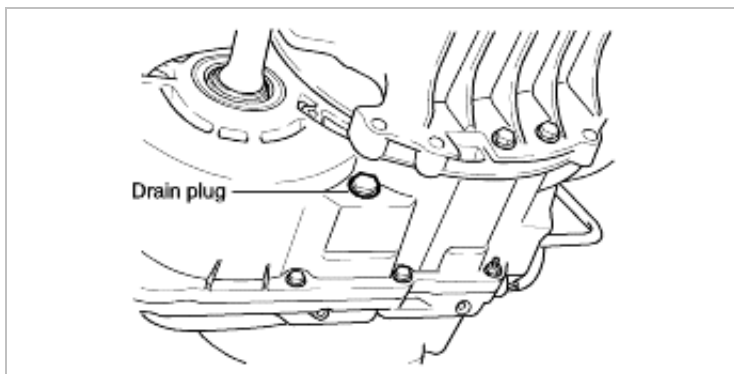


1. Drive belt
2. Power steering pump and reserve tank
3. A/C compressor
4. Flash air duct
5. Upper and lower radiator hose
6. Fuel hose
7. Air cleaner assembly
8. Accelerator cable
9. Transaxle linkage
10. No.4 engine mounting
11. Solenoid connector
12. Starter motor
13. Crank position sensor connector
14. Vehicle speed sensor connector
15. Oxygen sensor connector
16. ATF cooler hose
17. Upper converter housing bolt
18. No.2 engine mounting
19. Wheel and tire
20. Exhaust manifold
21. Tie-rod end
22. Stabilizer bracket
23. Control link
24. Lower arm
25. Joint shaft support bracket
26. Driveshaft
27. Intermediate shaft
28. No.1 engine mounting
29. Sub frame
30. No.3 engine mounting
31. Torque converter mounting nut
32. Auto transaxle

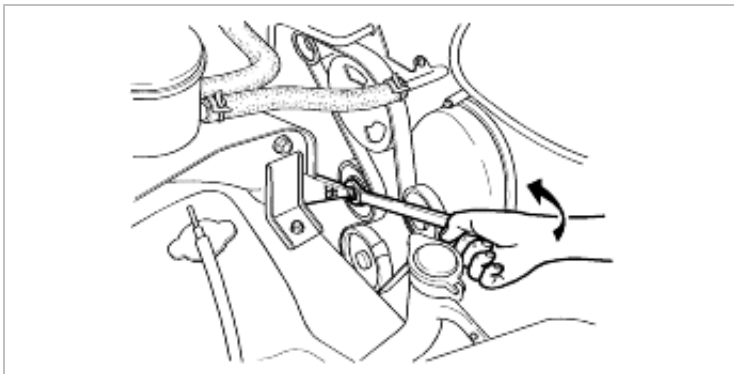


## REMOVAL

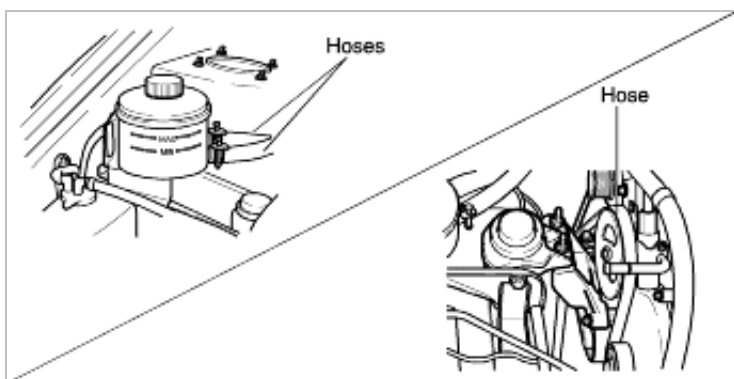
1. Disconnect negative battery cable.
2. Raise and properly support vehicle.
3. Drain engine coolant (Refer to cooling system).
4. Drain ATF.



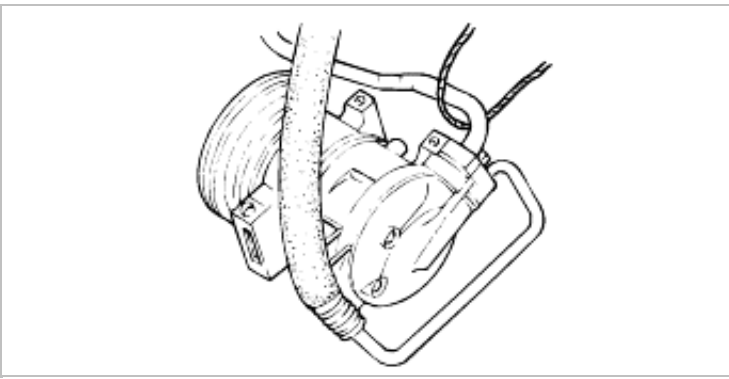
5. Raise an auto tensioner with spanner and then remove drive belt.



6. Remove two hoses from reserve tank.
7. Remove hose from power steering pump.



8. Remove A/C compressor with hoses still connected.
9. Position A/C compressor away from engine and affix it with wire.

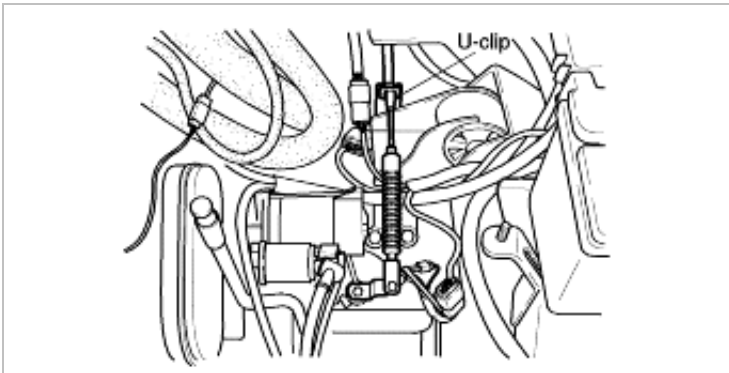


10. Remove fresh air duct.
11. Remove upper and lower radiator hoses.
12. Remove heater hoses and brake hose.
13. Remove fuel hose (Refer to section FL, fuel system).

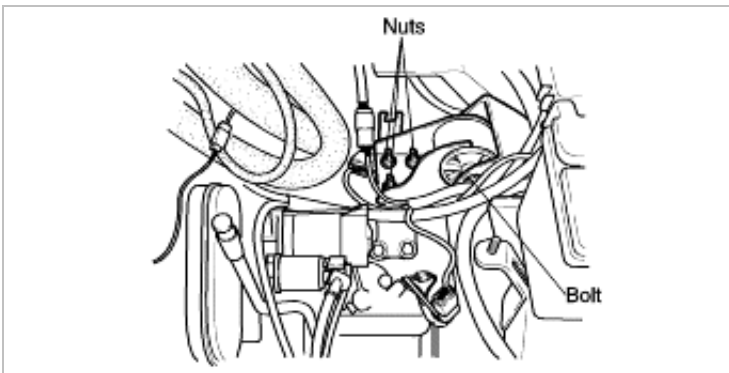
#### **WARNING**

- Before disconnecting fuel hose, keep sparks, cigarettes, and open flames away from it.
- Cover hose with a rag because fuel will spray out when disconnecting.
- Plug disconnected hoses to avoid fuel leakage.

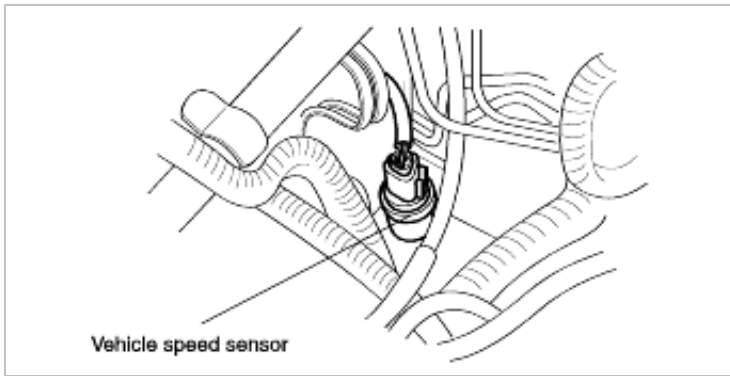
14. Remove three air cleaner assembly nuts and then remove air cleaner assembly.
15. Remove accelerator cable.
16. Remove U-clip from selector cable to auto transaxle linkage.
17. Remove nut and washer from auto transaxle linkage.



18. Remove three No.4 engine mounting nuts and then loosen engine mounting bolt.

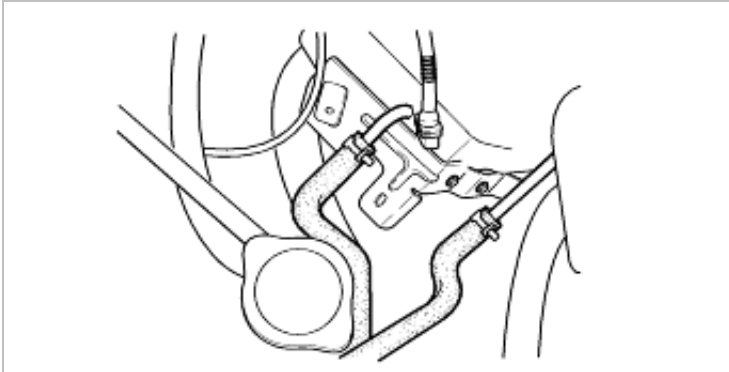


19. Disconnect solenoid connector.
20. Remove starter motor (Refer to section EE, starting system).
21. Disconnect crank position sensor connector.
22. Disconnect vehicle speed sensor connector.



23. Disconnect two oxygen sensor connectors.

24. Disconnect two ATF cooler hoses.



25. Remove No.3 engine mounting.

26. Remove both front wheels (five lug nuts each).

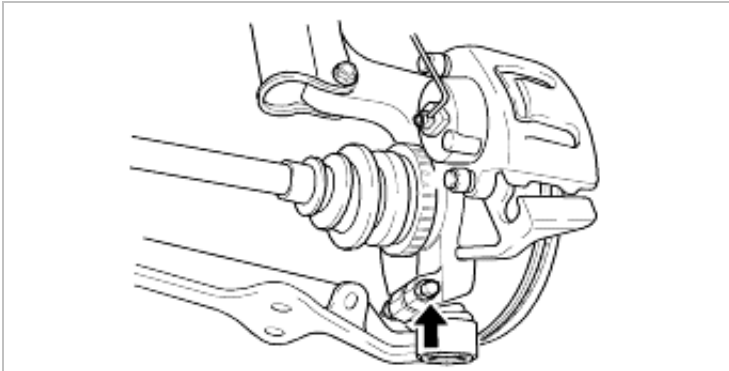
27. Remove exhaust manifold (Refer to intake and exhaust system).

28. Remove both right and left tie rod ends from steering knuckles by removing a cotter pin and a nut each.

29. Remove stabilizer bracket and then remove control link from stabilizer.

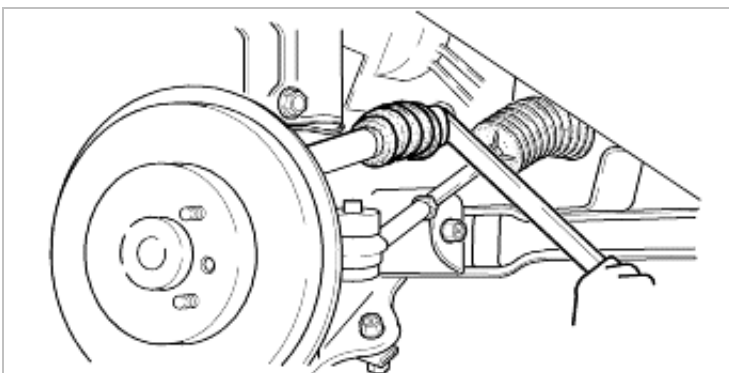
30. Remove control link from knuckle.

31. Remove pinch bolt and nut from both right and left knuckles. Separate lower arm from knuckle.



32. Remove joint shaft support bracket from engine block (three bolts).

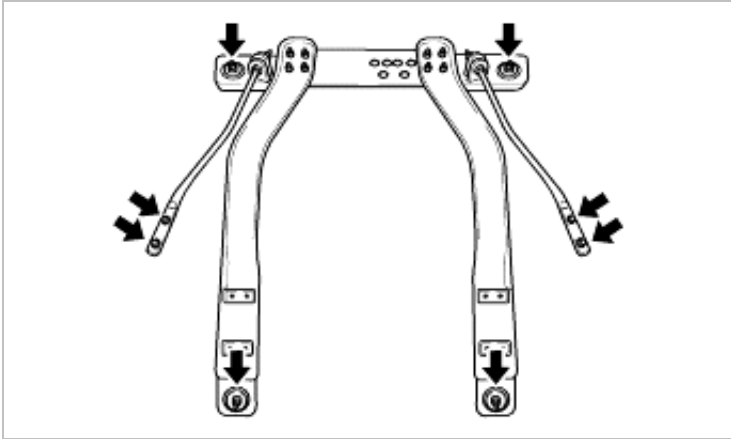
33. Gently pry both driveshafts from auto transaxle.



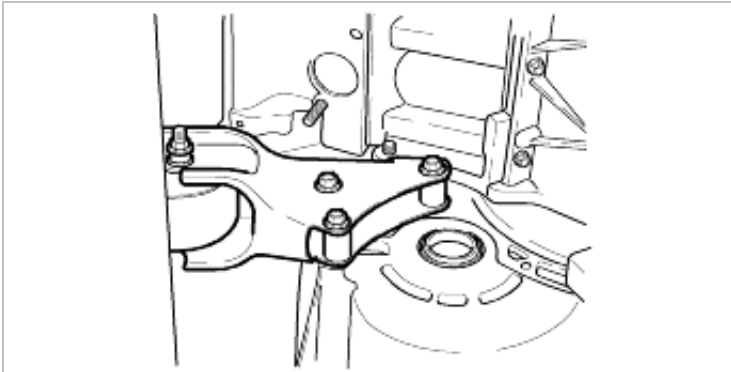
34. Remove intermediate shaft bolt (Refer to section ST, steering system).
35. Support auto transaxle, engine and sub-frame with a suitable floor jack.



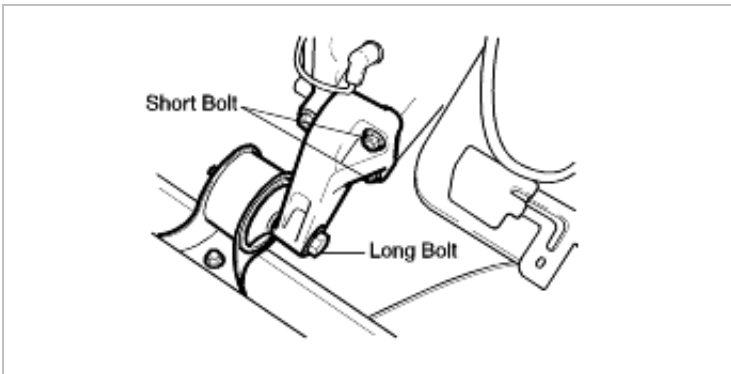
36. Remove four sub-frame nuts and four tension rod, nuts and then remove sub-frame.



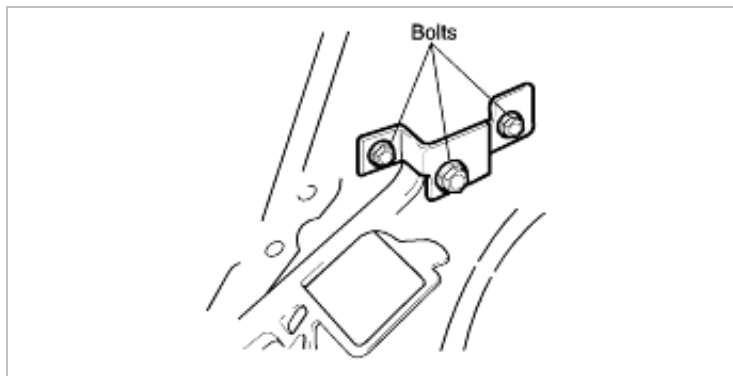
37. Slowly lower engine, auto transaxle and sub-frame.
38. Remove three No.1 engine mounting-to-sub-frame bolts.



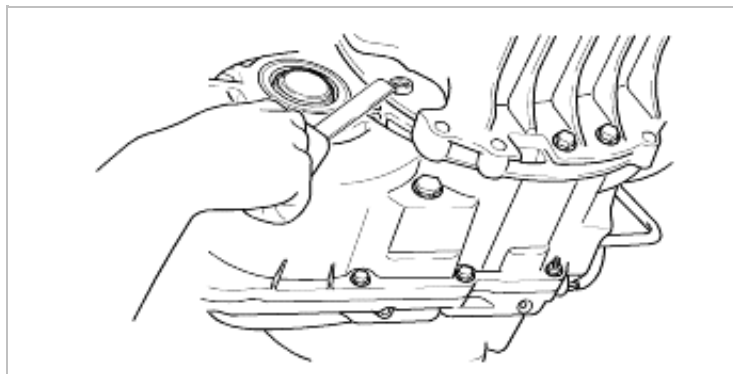
39. Remove four No.2 engine mounting bolts and then remove No.2 engine mounting from auto transaxle and sub-frame.



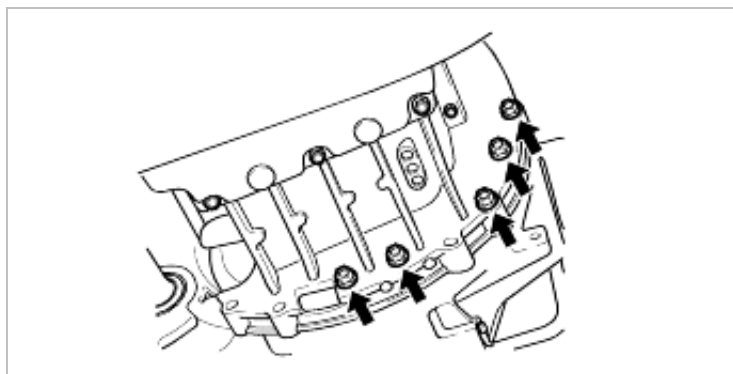
40. Remove three upper converter housing bolts.



41. Remove six drive plate-to-torque converter mounting nuts. Rotate engine at crank pulley to gain access to all six nuts.



42. Remove nine remaining converter housing bolts.



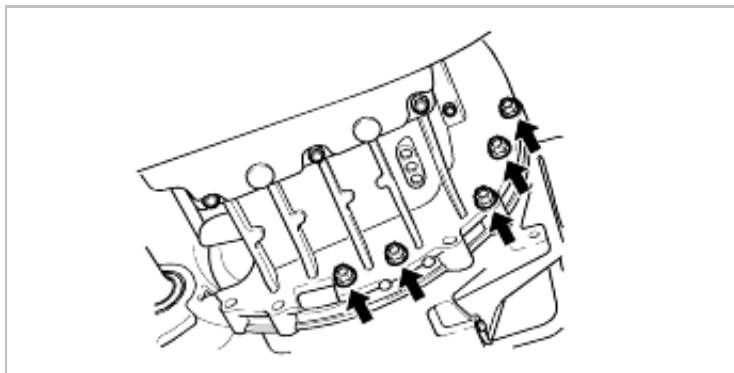
43. Gently separate transaxle from engine.

## Replacement

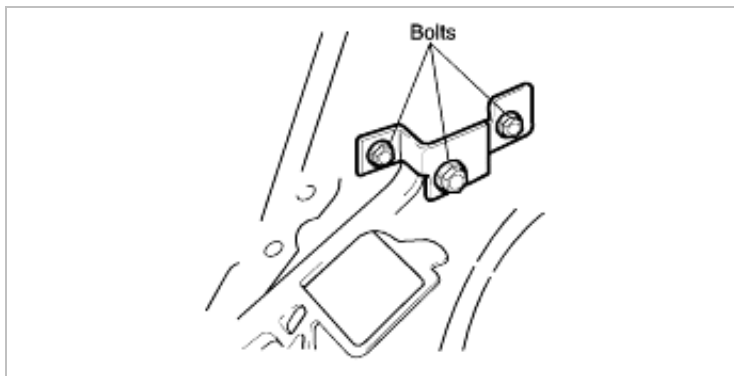
1. Install transaxle to engine and then install converter housing bolts.

Tightening torque:

47.0~65.8 lb-ft (63.7~89.2 N·m, 6.5~9.1 kg-m)



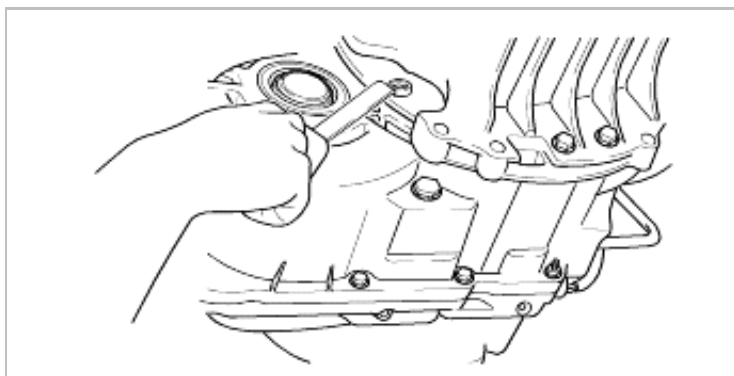
2. Install three upper converter housing bolts.



3. Install six drive plate-to-torque converter mounting nuts. Rotate engine at crank pulley to gain access to all six nuts.

Tightening torque:

25.3~36.1 lb-ft (34.3~49.0 N·m, 3.5~5.0 kg-m)



4. Install No.2 engine mounting to auto transaxle then install four bolts.

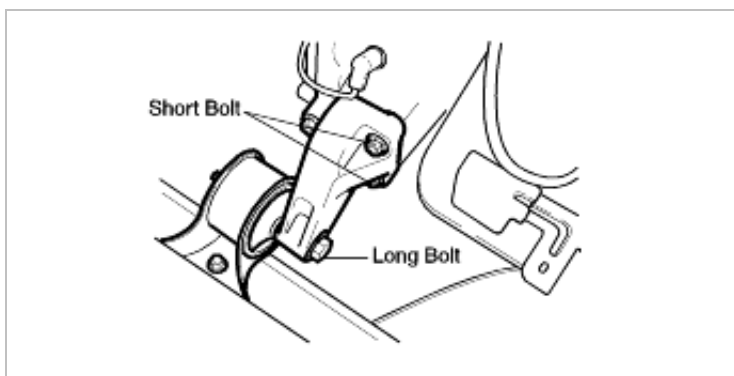
Tightening torque:

Short bolts: 49.1~68.7 lb-ft

(66.7~93.1 N·m, 6.8~9.5 kg-m)

Long bolt: 62.9~86.0 lb-ft

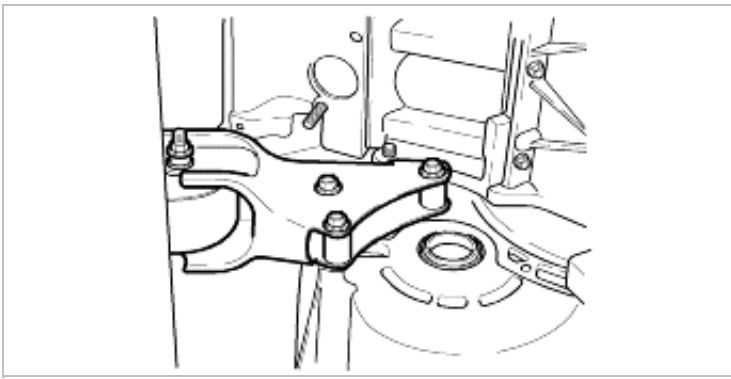
(85.3~116.7 N·m, 8.7~11.9 kg-m)



5. Install three No.1 engine mounting-to-sub-frame bolts.

Tightening torque:

49.1~68.7 lb-ft (66.7~93.1 N·m, 6.8~9.5 kg-m)



6. Set auto transaxle, engine and sub-frame on suitable floor jack and then place under vehicle.
7. Raise auto transaxle, engine and sub-frame and then align with engine compartment.

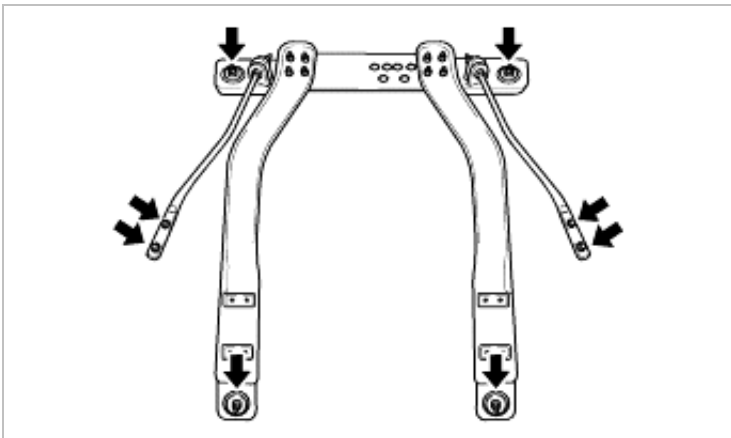


8. Install four sub-frame nuts and four tension rod nuts.

Tightening torque:

Sub-frame: 88.2~101.2 lb-ft  
(119.6~137.3 N·m, 12.2~14.0 kg-m)

Tension rod: 68.7~84.6 lb-ft  
(93.1~114.7 N·m, 9.5~11.7 kg-m)



9. Remove suitable floor jack from auto transaxle and engine.
10. Install No.3 engine mounting.

Tightening torque:

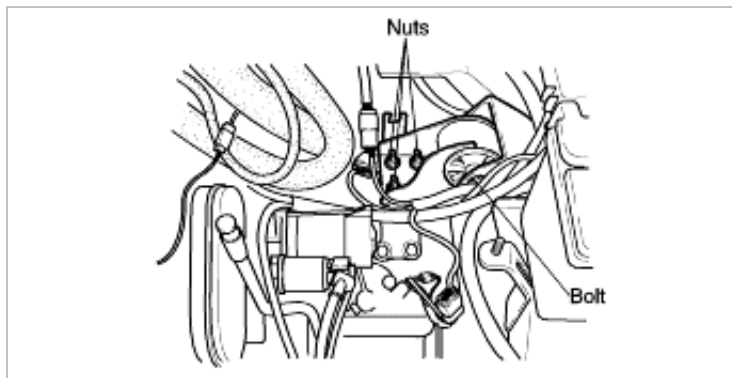
Nuts: 49.1~68.7 lb-ft  
(66.7~93.1 N·m, 6.8~9.5 kg-m)

Bolts: 62.9~86.0 lb-ft  
(85.3~116.7 N·m, 8.7~11.9 kg-m)

11. Install No.4 engine mounting.

Tightening torque:

49.1~68.7 lb-ft (66.7~93.1 N·m, 6.8~9.5 kg-m)



12. Install intermediate shaft bolt (Refer to section ST, steering system).
13. Install new clips on driveshaft.
14. Push driveshaft and joint shaft into transaxle with opening of pointing upward.
15. Install joint shaft support bracket then install three bolts.

Tightening torque:

31.1~45.5 lb-ft (42.1~61.8 N·m, 4.3~6.3 kg-m)

16. Install right and left lower arms to sub frame.

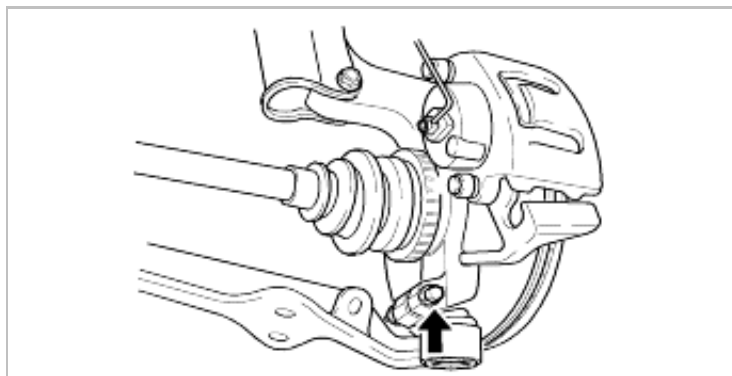
Tightening torque:

88.2~101.2 lb-ft (119.6~137.3 N·m,  
12.2~14.0 kg-m)

17. Install both right and left lower arm ball joints into spindle then install pinch bolts.

Tightening torque:

68.7~84.6 lb-ft (93.1~114.7 N·m, 9.5~11.7 kg-m)



18. Install both right and left control links.

Tightening torque:

68.7~84.6 lb-ft (93.1~114.7 N·m, 9.5~11.7 kg-m)

19. Install both right and left tie rod ends to steering knuckle then install tie rod end nuts.

Tightening torque:

43.3~58.5 lb-ft (58.8~79.4 N·m, 6.0~8.1 kg-m)

Insert cotter pin and bend over.

20. Install exhaust manifold (Refer to intake and exhaust system).
21. Install both right and left wheels then tighten both right and left lug nuts (five lug nuts each).

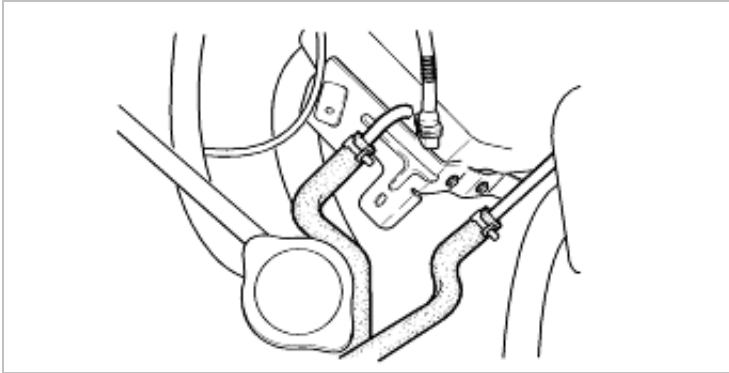
Tightening torque:



22. Lower vehicle.

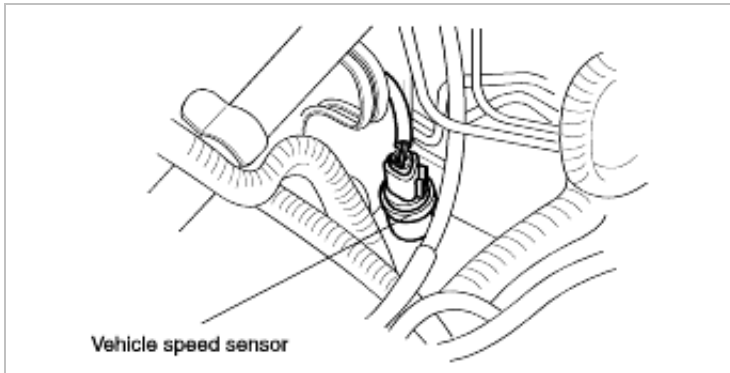
23. Slide ATF inlet and outlet hose onto ATF cooler pipe until it is fully seated against ridge.

24. Install hose clamp onto hose at center of mark and at angle shown.



25. Connect two oxygen sensor connector.

26. Connect vehicle speed sensor connector.



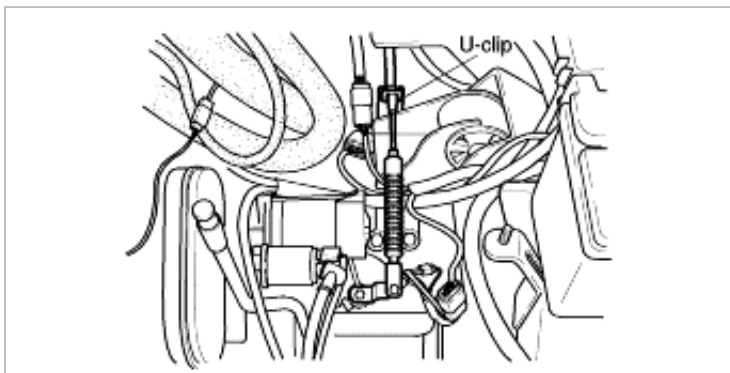
27. Install starter motor (Refer to section EE, starting system).

28. Connect solenoid connector.

29. Connect crank position sensor connector.

30. Install nut to transaxle linkage.

31. Insert U-clip.



32. Install accelerator cable (Refer to intake and exhaust system).

33. Install fuel hose (Refer to section FL, fuel system).

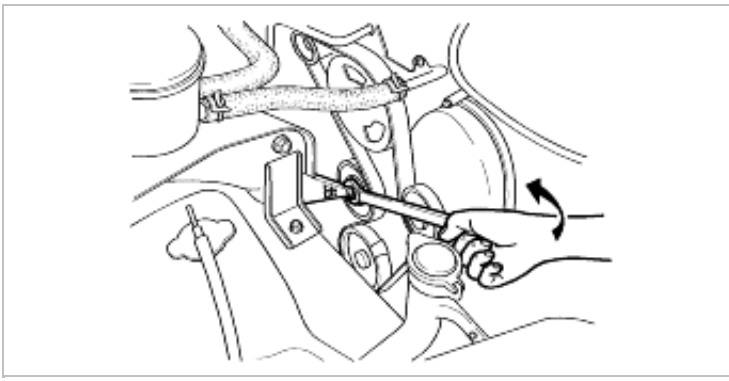
34. Install heater hoses and brake hose.

35. Install upper and lower radiator hose.

36. Install A/C compressor (Refer to air conditioner system).

37. Install power steering hoses (Refer to section ST, power steering system).

38. Raise an auto tensioner with spanner and then install drive belt.



39. Install air cleaner assembly.
40. Install fresh air duct.
41. Connect negative battery cable.
42. Fill transaxle with ATF (Refer to section AT, Automatic transaxle system).
43. Adjust auto transaxle control cable.
44. Fill engine coolant with specified type and amount (Refer to cooling system).
45. Fill power steering fluid (Refer to section ST, power steering system).
46. Adjust accelerator cable (Refer to intake and exhaust system).
47. Start engine and then check for leaks.



# **Engine Mechanical System**

Cylinder Block - Piston and Connecting Rod



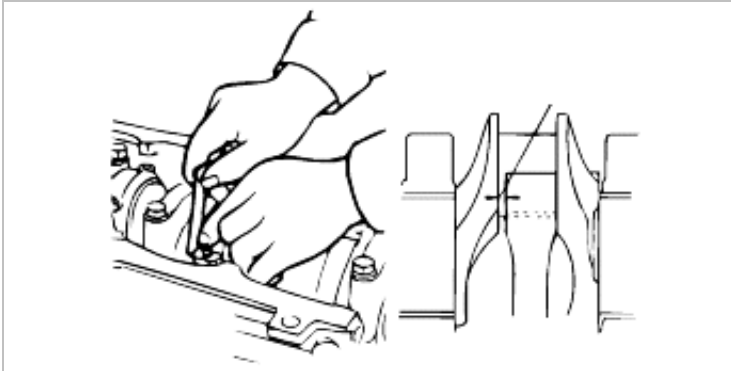
## Inspection

### CONNECTING ROD CAP

1. Before removing connecting rod, measure connecting rod side clearance.

Side clearance :

0.0055~0.0133 in (0.14~0.34 mm)



2. Remove connecting rod cap.
3. Measure connecting rod bearing oil clearance.
  - (1) Remove all foreign material and oil from journals and bearing surface.
  - (2) Position Plastigage atop journals in axial direction.
  - (3) Install connecting rod cap and tighten.

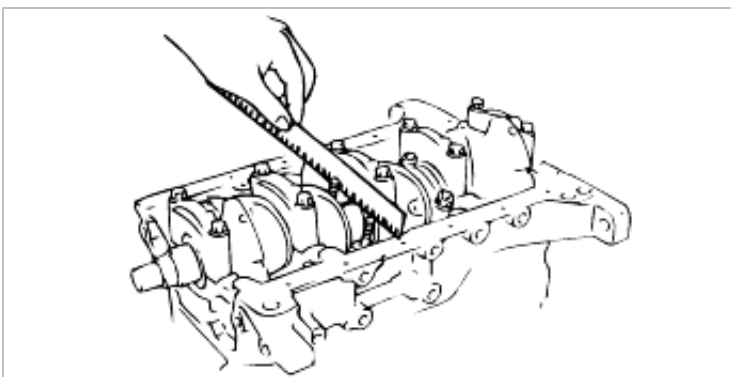
Tightening torque :

Pretighten 13.0~15.9 lb-ft (17.6~21.6 N·m,  
1.8~2.2 kg-m) and then tighten 40~50°.

- (4) Loosen connecting rod cap bolts.
- (5) Measure oil clearance at each journal.

Oil clearance :

0.00086~0.00157 in (0.022~0.040 mm)

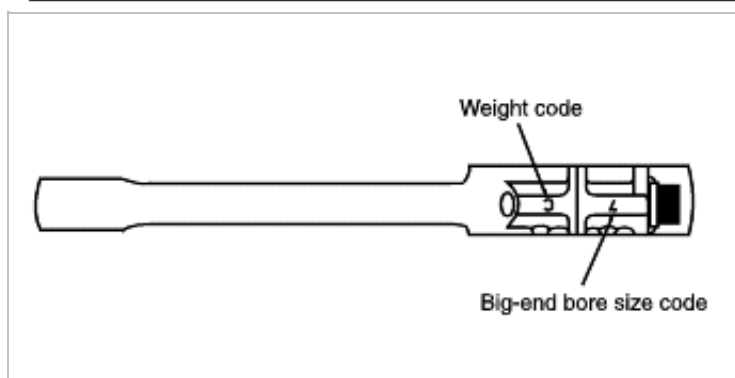


### PIN JOURNAL BEARING SELECTION

1. Check connecting rod big-end bore size code.

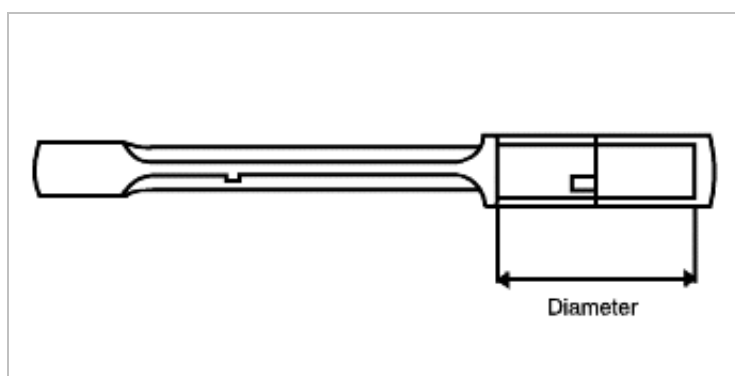
#### NOTICE

- Number stamped connecting rod cap is big-end bore size code. Letter stamped connecting rod is connecting rod weight code.
- Each of six Connecting rods must be set by same weight code in one engine.



#### Connecting rod big-end bore diameter

Code	Connecting rod big-end bore diameter
7	2.27050-2.27074 in (57.671-57.677 mm)
8	2.27027-2.27050 in (57.665-57.671 mm)
9	2.27003-2.27027 in (57.659-57.665 mm)

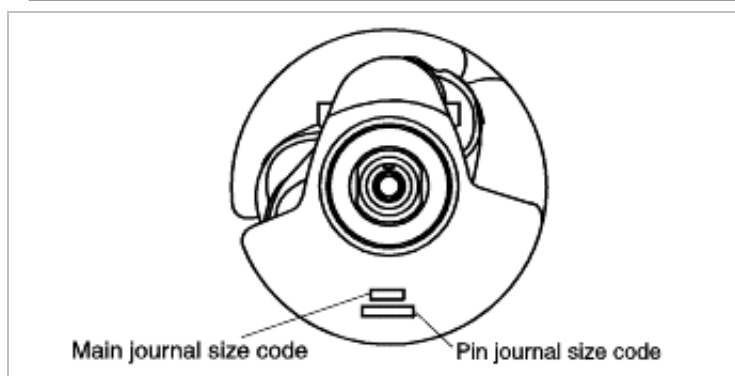


2. Check crankshaft pin journal size code.

#### NOTICE

Record pin journal size code letters on crankshaft web.

Reading order is left to right as shown, with No. 1 pin journal size code shown first.



#### Crankshaft pin journal diameter

Code	Crankshaft pin journal diameter
A	2.12790-2.12814 in (54.049-54.055 mm)
B	2.12767-2.12790 in (54.043-54.049 mm)
C	2.12743-2.12767 in (54.037-54.043 mm)

3. Choose proper pin journal bearing in below table.

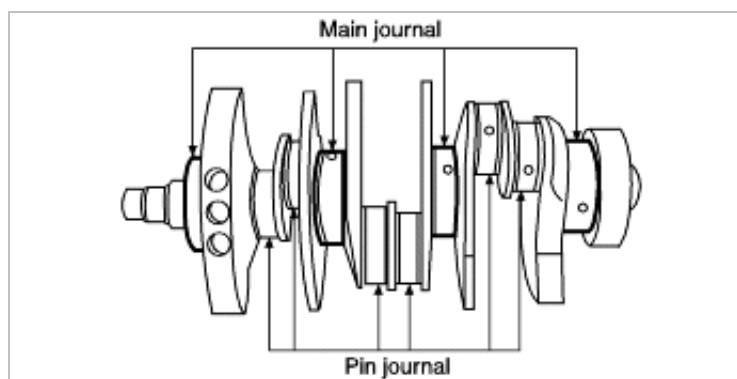
#### Pin journal bearing selection table

		Connecting rod big-end bore size code		
		7	8	9
<b>Crankshaft pin journal size code</b>	A	Brown	Green	Yellow
	B	Black	Brown	Green
	C	Blue	Black	Brown

Pin journal bearing clearance :  
0.000866~0.001574 in (0.022~0.040 mm)

#### Pin journal bearing thickness

Color	Pin journal bearing thickness
Blue	0.07086-0.07098 in (1.800-1.803 mm)
Black	0.07074-0.07086 in (1.797-1.800 mm)
Brown	0.07062-0.07074 in (1.794-1.797 mm)
Green	0.07051-0.07062 in (1.791-1.794 mm)
Yellow	0.07039-0.07051 in (1.788-1.791 mm)



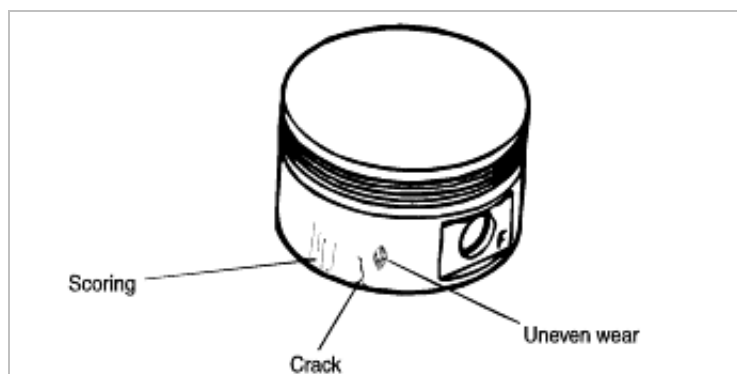
- Position properly upper bearing and lower bearing to connecting rod and connecting rod cap and then install connecting rod and connecting rod cap to crankshaft pin journal

Tightening torque :  
Pretighten 13.0~15.9 lb-ft (17.6~21.6 N·m,  
1.8~2.2 kg-m) and then tighten 40~50°.

## INSPECTION

### Piston

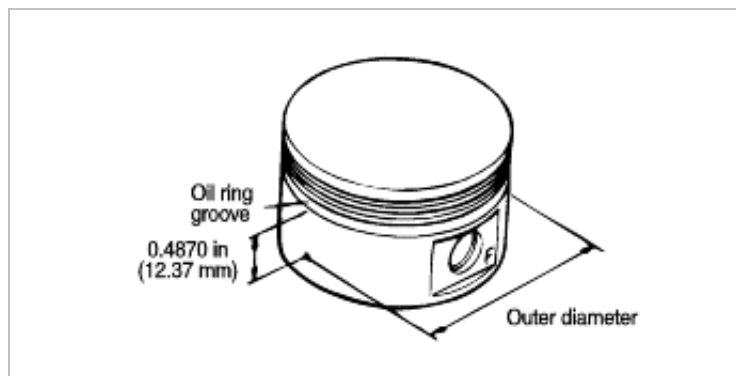
- Inspect outer circumference of all pistons for crack, scoring or unusual wear patterns. Replace piston if necessary.



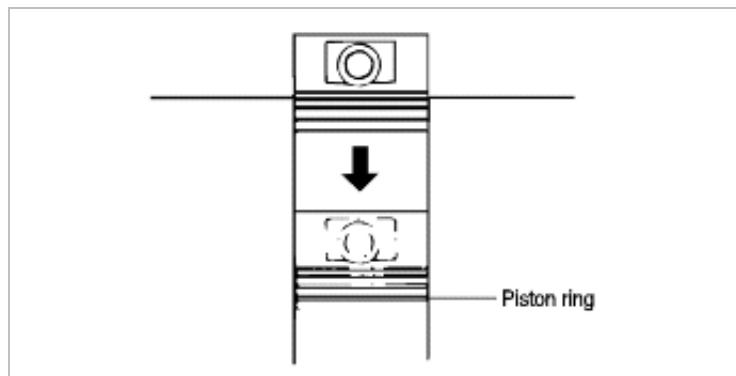
- Check outside diameter of each piston at a 90° right angle to piston pin, 0.4870 in (12.37 mm) below oil ring land's lower edge.

### Piston outside diameter

Code	Outside diameter
C	3.14842-3.14882 in (79.970-79.980 mm)
D	3.14886-3.14921 in (79.981-79.990 mm)
E	3.14925-3.14961 in (79.991-80.000 mm)



3. Insert piston ring into cylinder liner by hand and push it to 0.7874 in (20 mm) from bottom of ring travel in using piston.



4. Measure each piston ring end gap with a feeler gauge. Replace if necessary.

End gap : 0.000787~0.001575 in (0.02~0.04 mm)

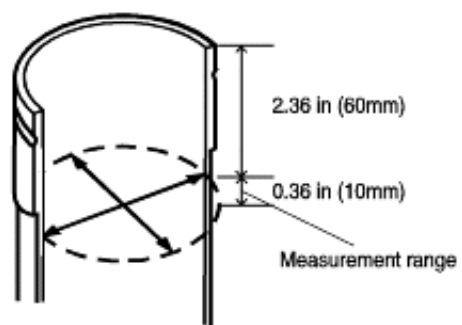


### CYLINDER LINER

1. Inspect cylinder liner for scoring and sticking. Replace cylinder liner if necessary.
2. Check cylinder liner inner diameter as shown in figure.

#### Cylinder liner inner diameter

Code	Inner diameter
C	3.14961-3.15000 in (80.000-80.010 mm)
D	3.15004-3.15039 in (80.011-80.020 mm)
E	3.15043-3.15079 in (80.021-80.030 mm)







# **Engine Mechanical System**

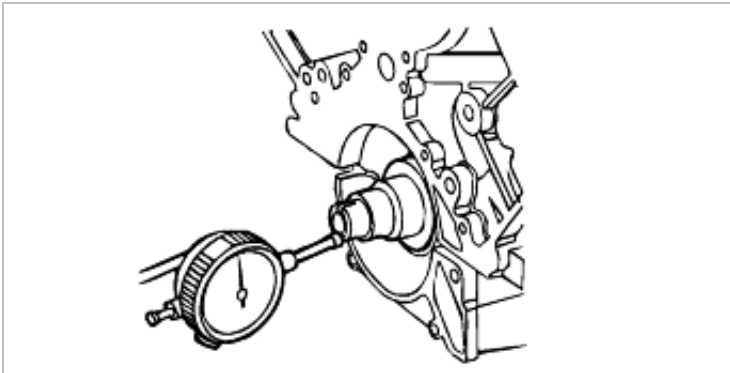
Cylinder Block - Crankshaft

## Inspection

### BEARING LADDER

1. Before removing bearing ladder, measure crankshaft end play.

End play : 0.0039~0.0118 in (0.1~0.3 mm)



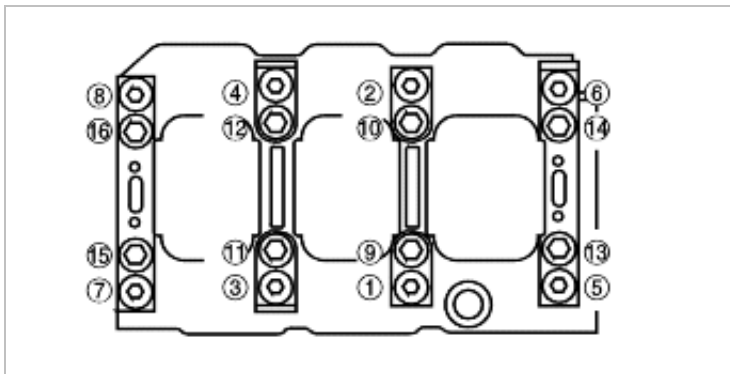
2. Remove bearing ladder.
3. Measure main bearing oil clearance
  - (1) Remove all foreign material and oil from journals and bearing surface.
  - (2) Position Plastigauge atop journals in axial direction.
  - (3) Install bearing ladder and tighten in order shown in figure.

Tightening torque :

Tighten 7.2 lb-ft (9.8 N·m, 1.0 kg-m), tighten

14.4 lb-ft (19.6 N·m, 2.0 kg-m) and

then tighten 90°.



- (4) Loosen bearing ladder bolts in reverse order of tightening.
- (5) Measure oil clearance at each journal.

Oil clearance :

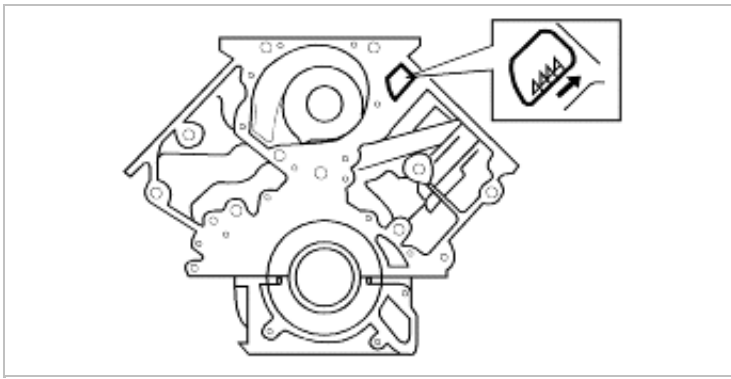
0~0.0006 in (0~0.015 mm)

### MAIN JOURNAL BEARING SELECTION

1. Check cylinder block main bearing bore size code.

#### NOTICE

Record cylinder block main bearing bore size code letters on front face of cylinder block as shown. Reading order is from left to right with front main bearing bore size code first.



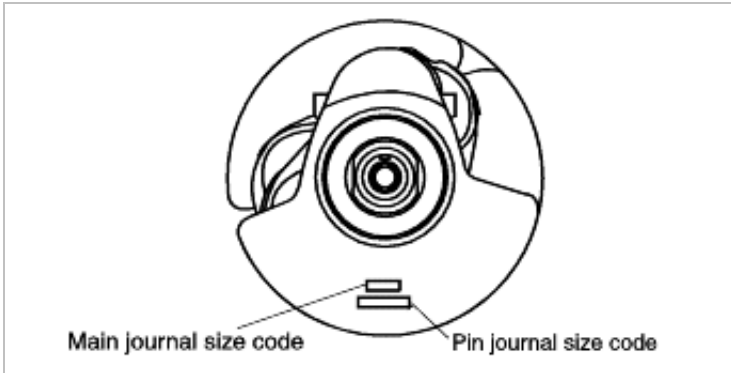
**Cylinder block main bearing bore diameter**

Code	Cylinder block main bearing bore diameter
A	2.81861-2.81889 in (71.593-71.600 mm)
B	2.81834-2.81861 in (71.586-71.593 mm)
C	2.81806-2.81834 in (71.579-71.586 mm)

2. Check crankshaft main journal size code.

**NOTICE**

Record pin journal size code numbers on crankshaft web.  
 Reading order is from left to right as shown, with No. 1 main journal size code shown first.



**Crankshaft main journal diameter**

Code	Crankshaft main journal diameter
1	2.66704-2.66727 in (67.743-67.749 mm)
2	2.66680-2.66704 in (67.737-67.743 mm)
3	2.66656-2.66680 in (67.731-67.737 mm)

3. Choose proper main journal bearing in below table.

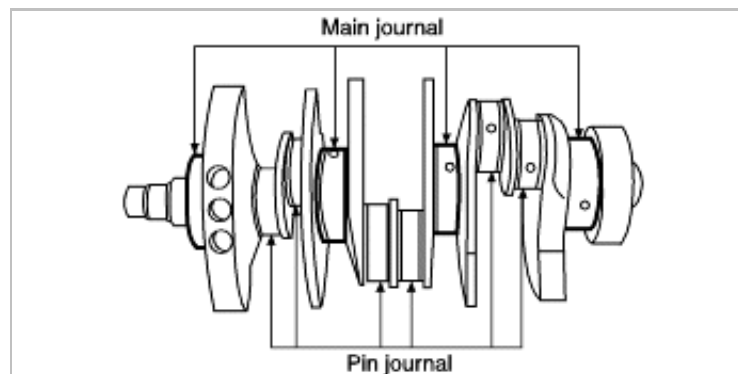
**Main journal bearing selection table**

		Cylinder block main bearing bore size code		
		A	B	C
<b>Crankshaft main journal size code</b>	1	Brown	Green	Yellow
	2	Black	Brown	Green
	3	Blue	Black	Brown

Main journal bearing clearance :  
 0~0.00059 in (0~0.015 mm)

## Main journal bearing thickness

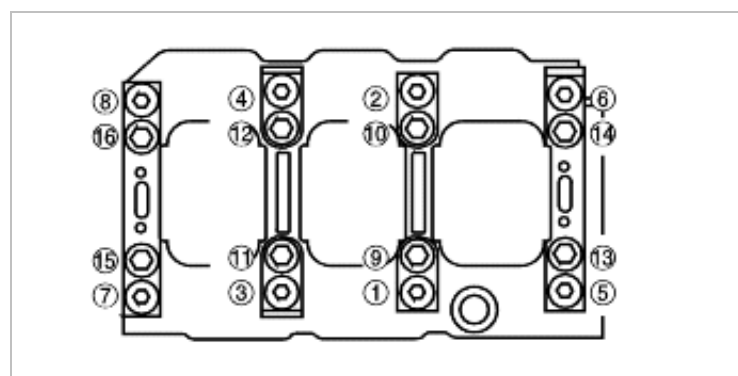
Code	Main journal bearing thickness
Blue	0.07586-0.07598 in (1.927-1.930 mm)
Black	0.07574-0.07586 in (1.924-1.927 mm)
Brown	0.07562-0.07574 in (1.921-1.924 mm)
Geen	0.07551-0.07562 in (1.918-1.921 mm)
Yellow	0.07539-0.07551 in (1.915-1.918 mm)



4. Position properly upper bearing and lower bearing to cylinder block and bearing ladder.
5. Set crankshaft to cylinder block and then install bearing ladder to cylinder block.

Tightening torque :

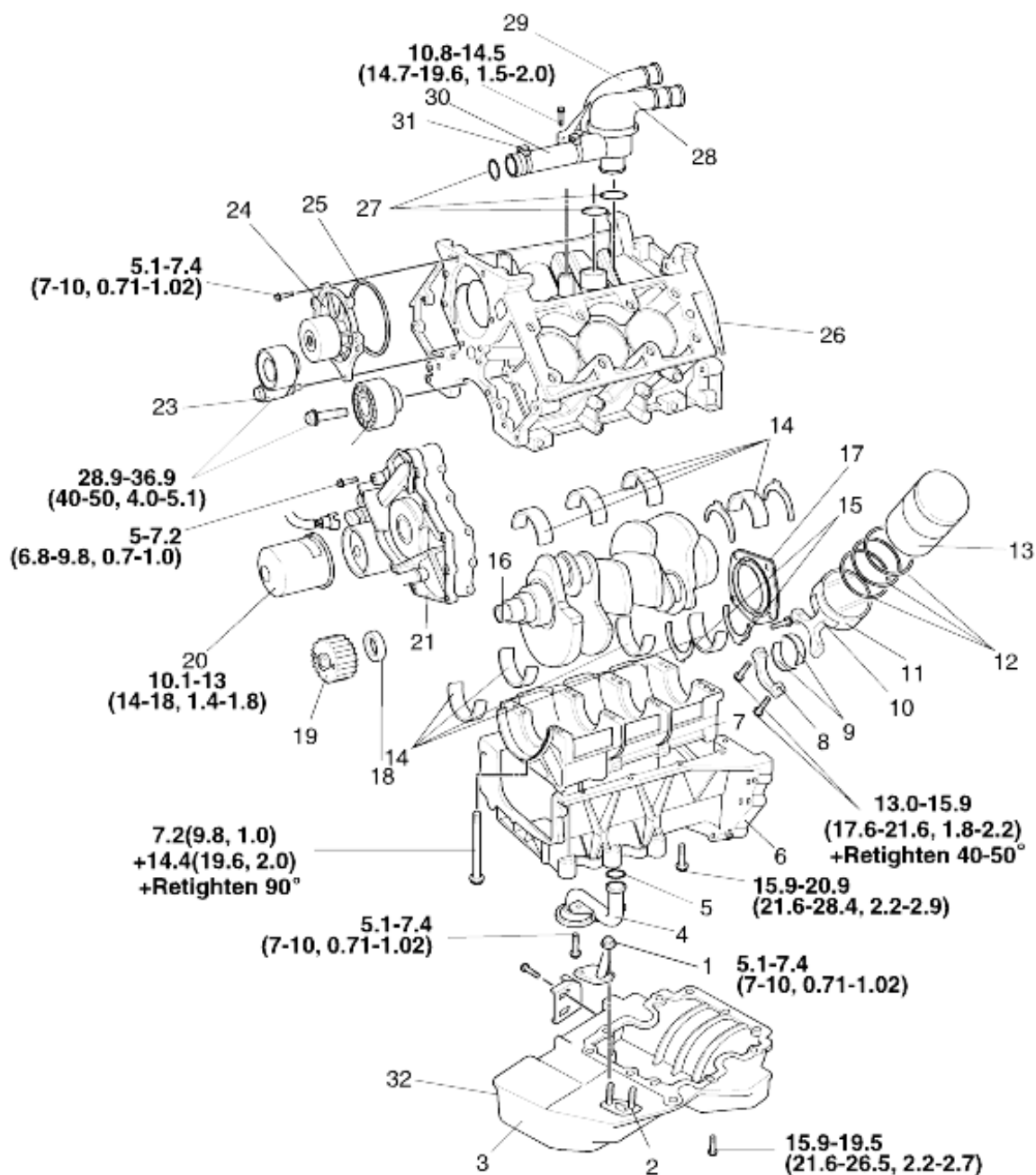
Tighten 7.2 lb-ft (9.8 N·m, 1.0 kg-m), tighten  
14.4 lb-ft (19.6 N·m, 2.0 kg-m) and then tighten 90°.



# **Engine Mechanical System**

Cylinder Block - Cylinder Block

## Components

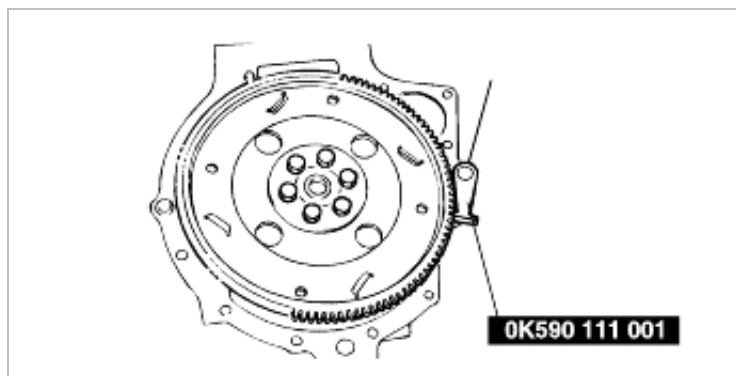


### TORQUE : lb·ft (N·m, kg·m)

1. Oil level gauge pipe	9. Connecting rod bearing	17. Rear oil seal	24. Water pump assembly
2. Oil level gauge gasket	10. Connecting rod	18. Front oil seal	25. Gasket
3. Oil pan	11. Piston	19. Timing belt pulley	26. Cylinder block
4. Oil strainer	12. Piston ring	20. Oil filter	27. "O" ring
5. "O" ring	13. Cylinder liner	21. Oil pump	28. Thermostat housing
6. Lower crank case	14. Main bearing	22. Timing belt idler	assembly
7. Ladder bearing	15. Thrust bearing	23. Timing belt auto	29. Water out pipe assembly
8. Connecting rod cap	16. Crankshaft	tensioner pulley	30. Water in pipe assembly
			31. Plastic clip
			32. Oil drain block

## DISASSEMBLY

1. .



2. Remove drive plate lock bolts.

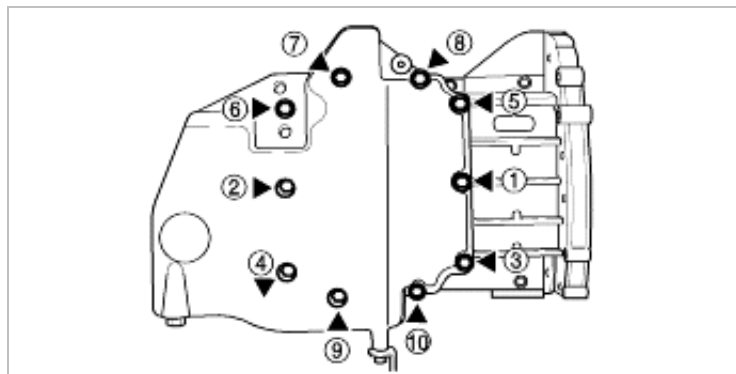
3. Remove backing plate, drive plate and adapter.

4. .

5. Remove rear oil seal with 5 bolts.

6. Remove oil pan mounting bolts(10EA).

Note position of 4 long bolts.



7. Remove oil pan with a screwdriver or suitable tool.

### CAUTION

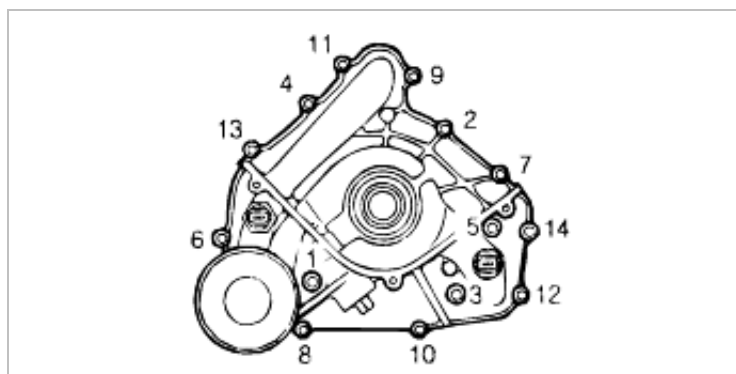
- Do not force tools between cylinder block and oil pan as this may damage sealing surface.
- Do not damage sealing surface when removing old sealant.

8. Remove oil filter element.

9. Disconnect oil pressure switch connector and oil temperature sensor connector.

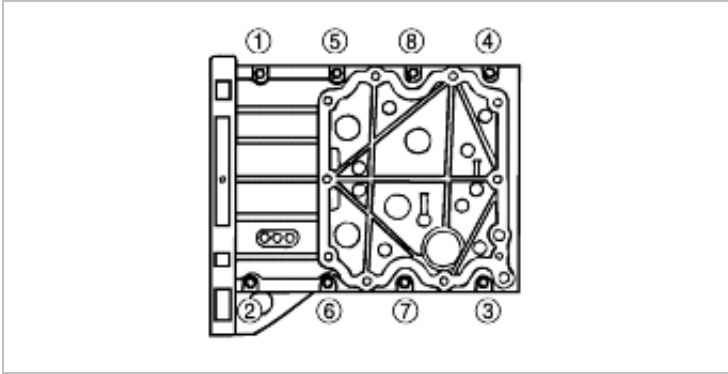
10. Remove timing belt pulley.

11. Remove oil pump and gasket with 14 bolts.

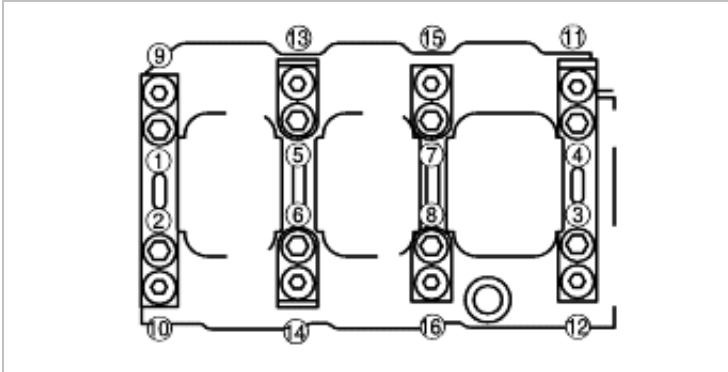


12. Using a screwdriver covered by a rag, remove oil seal from pump cover side.

13. Remove oil strainer and discard "O" ring.
14. Remove lower crank case with 8 bolts.



15. Remove bearing ladder with 16 bolts.



16. Remove main bearing and 2 thrust bearing halves from bearing ladder , keep in fitted order.
17. Use a numbering stamp and mark connecting rod cap and connecting rod with their corresponding cylinder number.

#### NOTICE

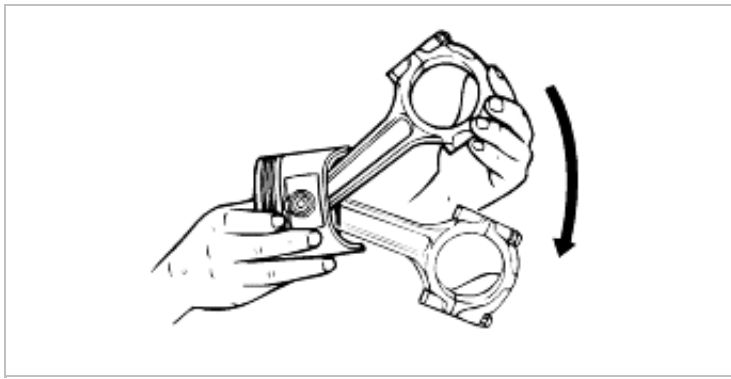
Mark all rods on same side and make a reference mark on block so that rods are installed in correct position and direction. Failure to install rods properly with result in oil starvation, spun bearings, or damaged internal engine components.

18. Remove 4 dowel bolts and remove connecting rod caps from No.1 and No.2 connecting rods.
19. Release connecting rods from crankshaft.
20. Remove connecting rod bearing from connecting rod and cap.
21. Turn crankshaft, remove bolts from remaining connecting rod caps and remove connecting rod bearing.
22. Remove crankshaft, remove main bearing and thrust bearing from cylinder block.
23. Position cylinder block to enable each piston and liner to be removed.
24. Carefully push each piston assembly and cylinder liner from cylinder block.
25. Remove piston assemblies from liners, keep liners in their respective positions.
26. Refit caps onto connecting rods, lightly tighten dowel bolts.
27. Hold piston upright and gently move connecting rod.
28. Release connecting rod and observe its movement.

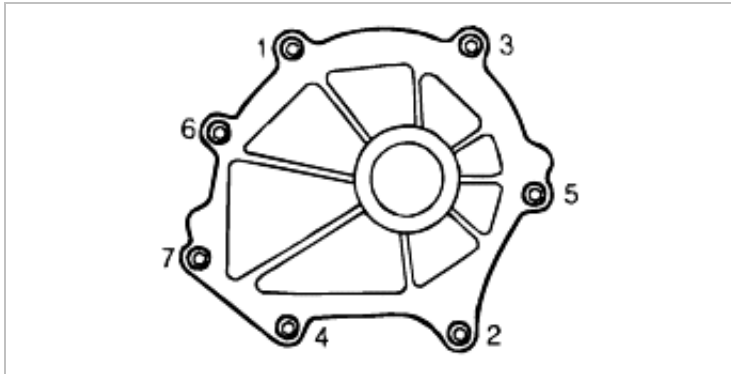
#### NOTICE

Do not swing connecting rod wildly. Constant, hard contact with piston will cause a bell-mouth condition that will require piston replacement.





29. If connecting rod does not move freely, replace piston and connecting rod assembly.
30. Remove water pump assembly and gasket with 7 bolts.



31. Remove timing belt auto-tensioner pulley.
32. Remove timing belt idler pulley.
33. Remove thermostat housing assembly and discard "O" rings.

## REASSEMBLY

1. Clean all parts before assembly.
2. Apply a coat of clean engine oil to all sliding and rotating parts before assembly.
3. If connecting rod does not move freely, replace piston and connecting rod assembly.

### NOTICE

Do not reuse old gaskets or seals.

4. Install "O" rings and thermostat housing assembly.
5. Install timing belt idler pulley.

Tightening torque :  
29.7~36.9 lb-ft (40~50 N·m, 4.1~5.1 kg-m)

6. Install timing belt auto-tensioner pulley.

Tightening torque :  
29.7~36.9 lb-ft (40~50 N·m, 4.1~5.1 kg-m)

7. Install gasket and water pump assembly.

Tightening torque :  
5~7.2 lb-ft (6.8~9.8 N·m, 0.7~1 kg-m)

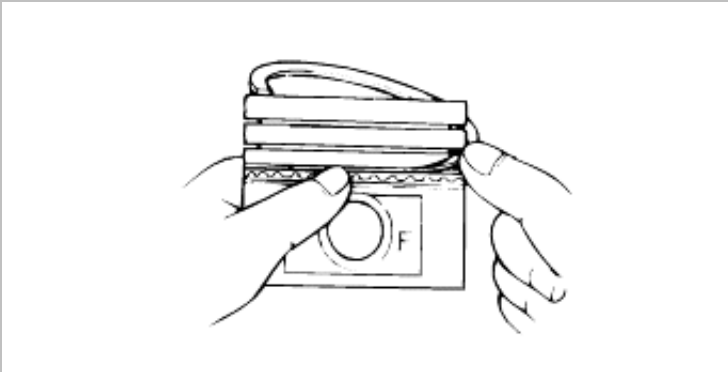
8. Install three-piece oil rings on pistons.  
(1) Apply engine oil to oil ring spacer and rails.

(2) Install oil ring spacer so that opening faces upward.

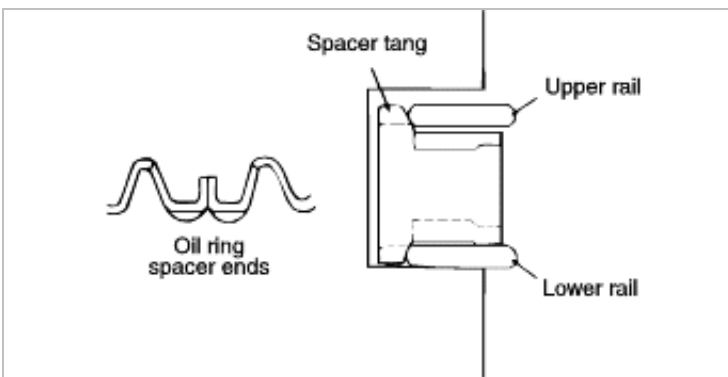
(3) Install upper rail and lower rail.

#### NOTICE

- Upper rail and lower rail are same.
- Each rail can be installed with either face upward.



9. Check that both rails are expanded by spacer tangs as shown in figure by checking that both rails turn smoothly in both directions.

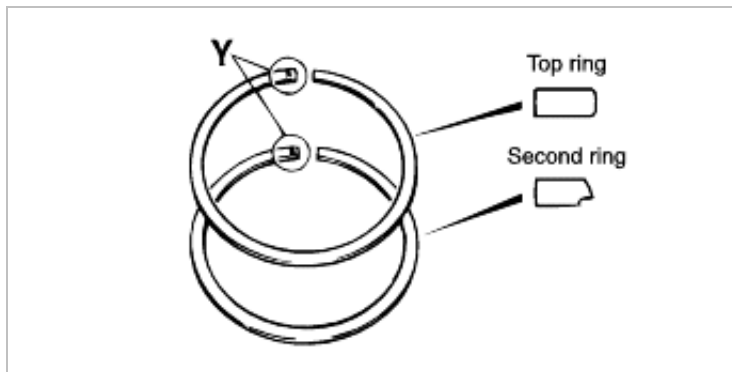


10. Install second ring to piston first, then install top ring. Use piston ring expander.

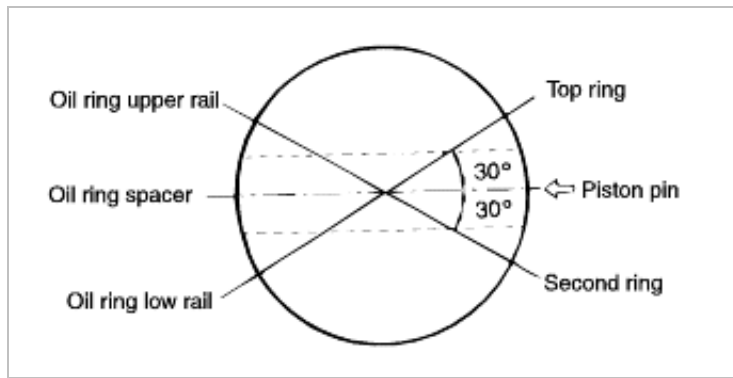
#### NOTICE

Rings must be installed with "Y" marks facing upward.

11. Apply a liberal amount of clean engine oil to second and top piston rings.



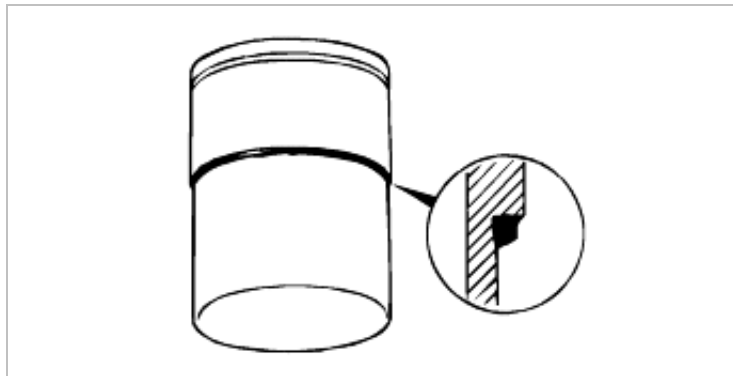
12. Position opening of each ring as shown in figure.



13. Install piston assemblies to cylinder liners.
14. Inspect journals and bearings for any foreign material. Clean crankshaft, oil holes, and main bearing journals thoroughly, and dry components with compressed air.
15. Install grooved main bearings into saddles on cylinder block. (Refer to main journal bearing selection.)
16. Install main bearings to bearing ladder.
17. Apply grease to crankshaft thrust bearings and install to bearing ladder with oil grooves facing outwards.
18. Set crankshaft on cylinder block.
19. Apply 2.0 mm thick continuous bead of Hylomar Universal Blue sealant around shoulder of cylinder liner.

#### NOTICE

Ensure that sealing surfaces of cylinder block and liners are clean.



20. Install bearing into connecting rod and cap.  
(Refer to pin journal bearing selection.)
21. Keeping cylinder liner "square" to cylinder block, push each liner fully down until shoulder of liner seats against cylinder block with "front" mark on piston to engine front.
22. Install connecting rod caps, aligning marks made previous to disassembly and torque to specification.

Tightening torque :

Pretighten 13.0~15.9 lb-ft (17.6~21.6 N·m,  
1.8~2.2 kg-m) and then tighten 40~50°.

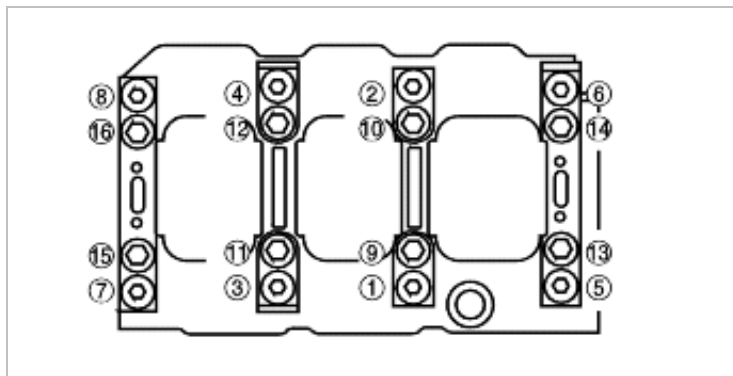
#### NOTICE

When installing connecting rods, match marks made on connecting rod and cap to reference mark made on cylinder block to prevent oil starvation to connecting rod bearings.

23. Install bearing ladder to cylinder block.

Tightening torque :

Tighten 7.2 lb-ft (9.8 N·m, 1.0 kg-m), tighten  
14.4 lb-ft (19.6 N·m, 2.0 kg-m) and then tighten 90°.

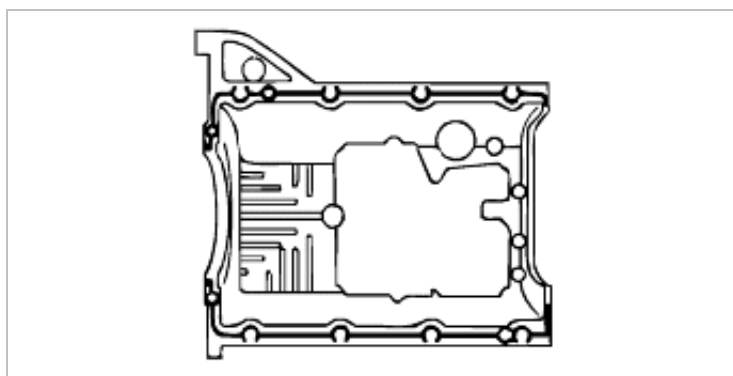


24. Using plastic scraper, clean sealing surfaces on crankcase and cylinder block.

25. Apply a continuous bead of sealant to paths shown on crankcase then spread to an even film with brush or roller.

### CAUTION

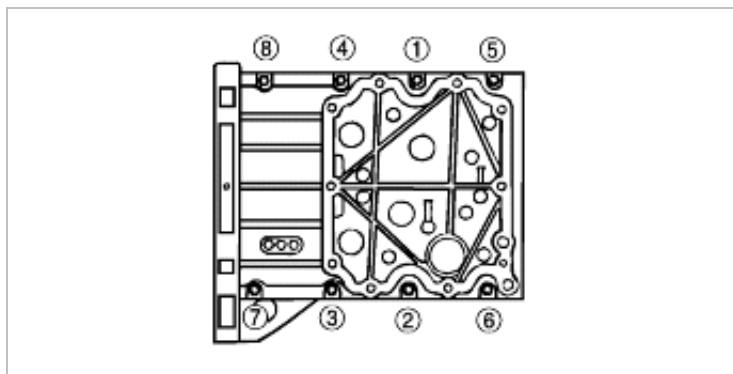
To avoid contamination, assembly should be completed immediately after application of sealant.



26. Install lower crankcase to cylinder block.

Tightening torque :

15.9~20.9 lb-ft (21.6~28.4 N·m, 2.2~2.9 kg-m)



27. Install "O" ring and oil strainer.

Tightening torque :

5~7.2 lb-ft (6.9~9.8 N·m, 0.7~1 kg-m)

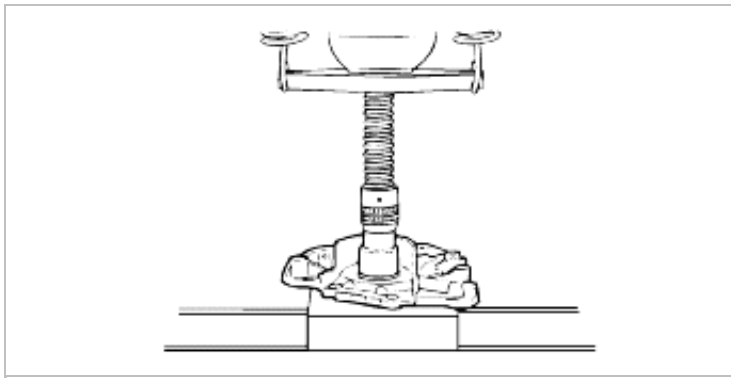
28. Apply clean engine oil to new front oil seal and oil pump body.

29. Install front oil seal by hand.

30. Press oil seal into oil pump body.

### NOTICE

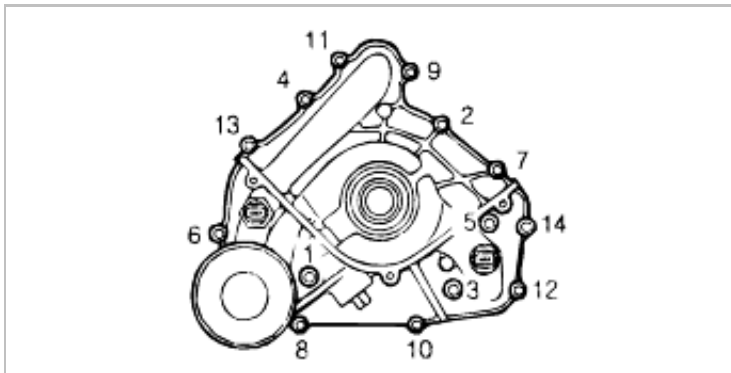
Oil seal must be pressed in until it is nearly flush with front surface of oil pump body.



31. Install gasket and oil pump with 14 bolts.

Tightening torque :

5~7.2 lb-ft (6.9~9.8 N·m, 0.7~1 kg-m)



32. Install timing belt pulley.
33. Reconnect oil pressure switch connector and oil temperature sensor connector.
34. Apply a small amount of engine oil to rubber seal of oil filter.
35. Install oil filter until rubber seal contacts base and then tighten filter 1 and 1/6 turn using an oil filter wrench.

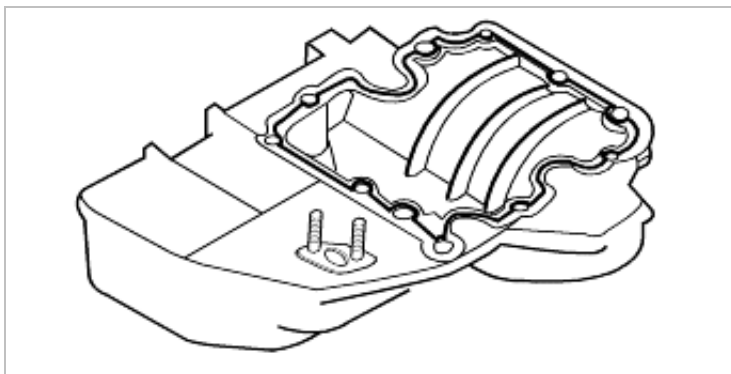
Tightening torque :

10~13 lb-ft (13.7~17.6 N·m, 1.4~1.8 kg-m)

36. Clean crankcase and oil pan surfaces.
37. Apply continuous thin beads of sealant to paths on oil pan as shown then spread to an even film using a brush or roller.

Sealant type : HYLOGRIP 2000

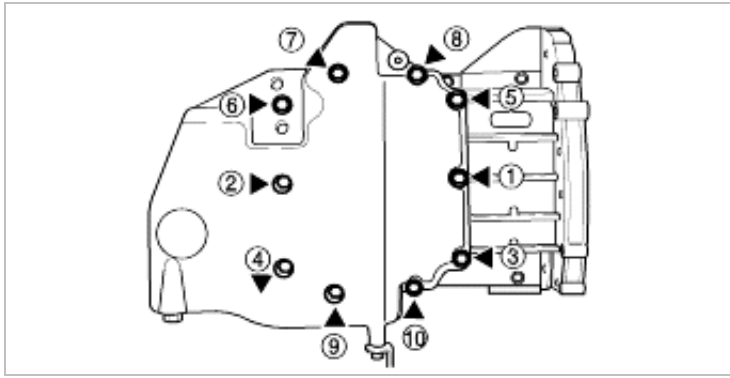
Bead width : 0.118 in (3 mm)



38. Install oil pan and tighten bolts in order shown in figure.

Tightening torque :

15.9~19.5 lb-ft (21.6~26.5 N·m, 2.2~2.7 kg-m)

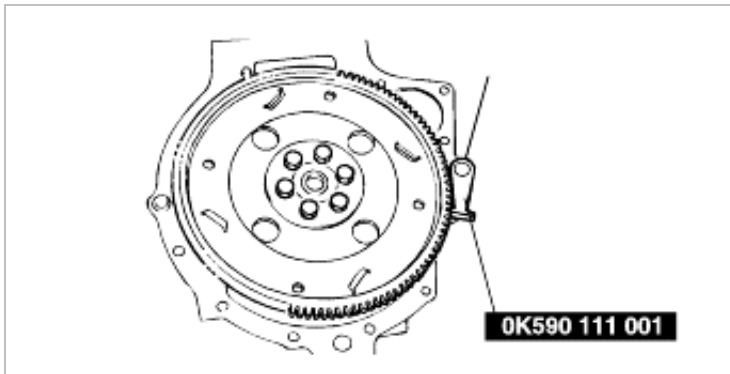


39. Lubricate rear oil seal running surface with engine oil.
40. Install rear oil seal and tighten.

Tightening torque :

5~7.2 lb-ft (6.8~9.8 N·m, 0.7~1 kg-m)

41. Install backing plate, drive plate and adapter.
42. Install drive plate lock bolts and finger tight.
43. .



44. Tighten drive plate lock bolts.

Tightening torque :

70~77 lb-ft (95~105 N·m, 9.7~10.7 kg-m)

# **Engine Mechanical System**

Cooling System - Coolant



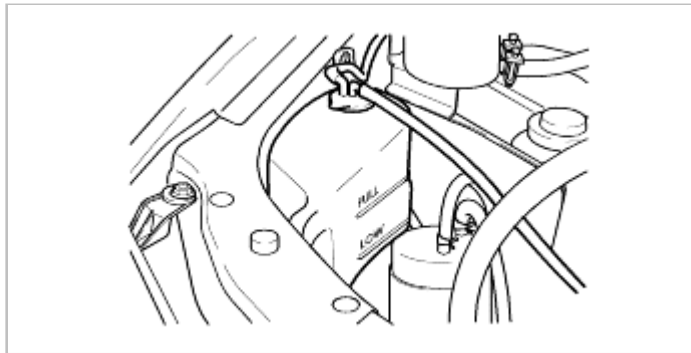
## INSPECTION

### WARNING

- Never remove radiator cap while engine is hot.
- Wrap a thick cloth around radiator cap before removing.
- When removing radiator cap, loosen slowly to first stop and wait until pressure in radiator is released, then completely remove.

### LEVEL

1. Verify that the coolant level is near the radiator filler neck.
2. Check that the level in the coolant reservoir is between the "Full" and "L" marks.



3. Add coolant if necessary.

## COOLANT QUALITY

1. Verify that there is no build up of rust or scale around the radiator cap of radiator filler neck.
2. Verify that the coolant is free of oil.
3. Replace the coolant if necessary.

### LEAKAGE

1. Connect a coolant system pressure tester to the radiator filler neck.
2. Apply 15 psi (103kpa, 1.05kg/cm<sup>2</sup>) pressure to the system.
3. Verify that the pressure remains steady at 15 psi (103kpa, 1.05kg/cm<sup>2</sup>).
4. If not, check system for coolant leakage.

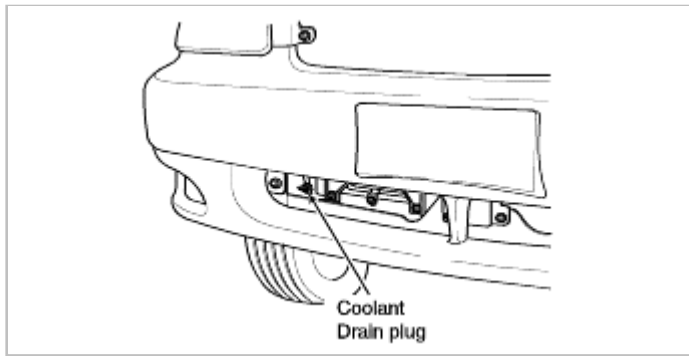
## REPLACEMENT

### CAUTION

Never use 100% of water as coolant. The 45% mixture of water and antifreeze is recommended. (To avoid corrosion of cylinder head and cylinder block made of aluminum.) - GV6 GASOLINE

1. Remove radiator cap and loosen drain plug.





2. Drain coolant into a suitable container.
3. Flush cooling system with water until all traces of color are gone ; then let system drain completely.
4. Install drain plug.
5. Fill with proper mixture of ethylene glycol-based coolant.

---

Coolant capacity:

9.93 Us qt (9.4 liter, 8.27 Imp qt)

---

6. Run the engine with the radiator cap removed until the upper radiator hose is hot.
7. With the engine idling, add coolant to the radiator until it reaches the bottom of the filler neck.
8. Install the radiator cap.
9. Allow engine to cool and coolant level.

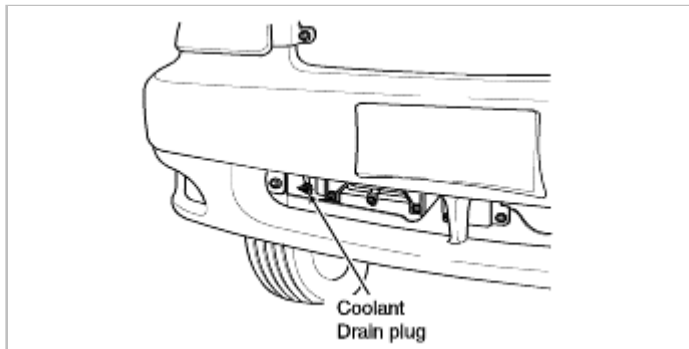
# **Engine Mechanical System**

Cooling System - Water Pump

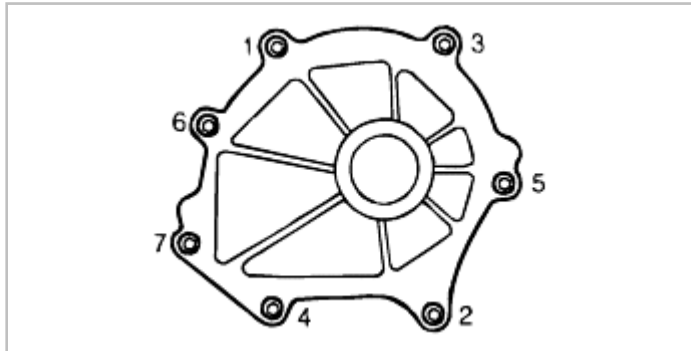


## REMOVAL

1. Drain engine coolant.



2. Remove front timing belt.  
(Refer to Front timing belt removal ; from step 1 to step 32.)
3. Remove water pump assembly and gasket with 7 bolts.

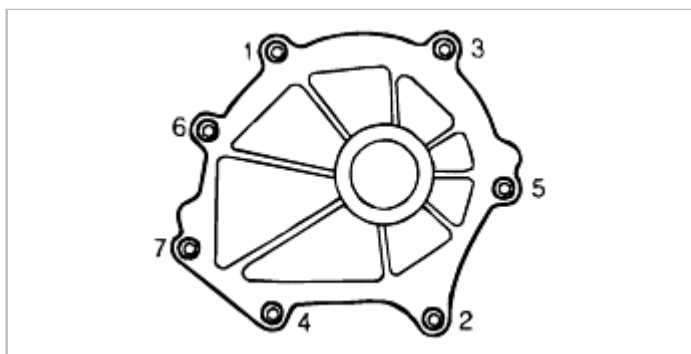


## REPLACEMENT

1. Install new gasket and water pump assembly.

Tightening torque:

5~7.2 lb-ft (6.8~9.8 N·m, 0.7~1 kg-m)



2. Install No.3 engine mounting bracket.  
(Refer to front timing belt replacement ; from step 1 to step 27.)
3. Refill engine coolant.  
(Refer to engine coolant replacement.)

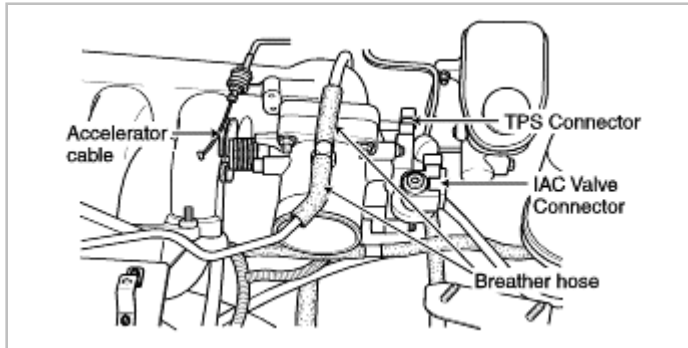
# **Engine Mechanical System**

Cooling System - Thermostat

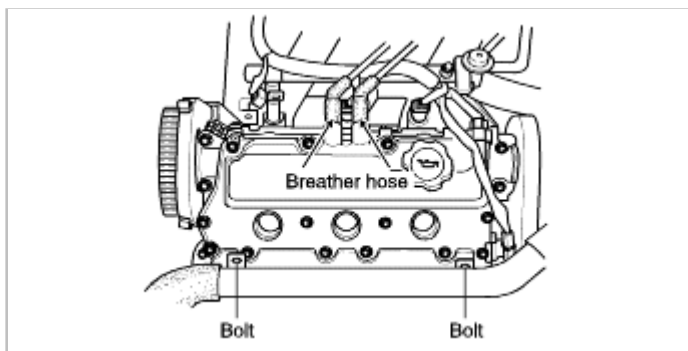


## REMOVAL

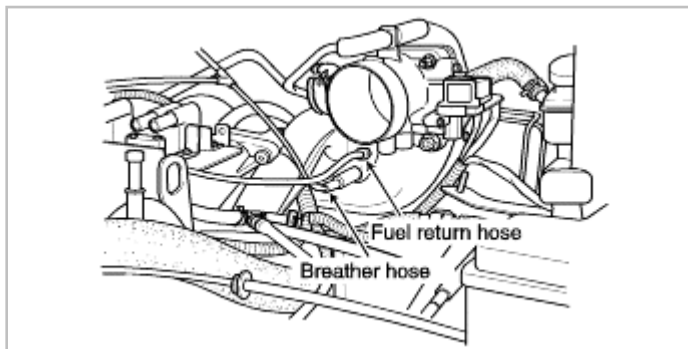
1. Disconnect negative battery cable.
2. Drain engine coolant.
3. Remove accelerator cable.



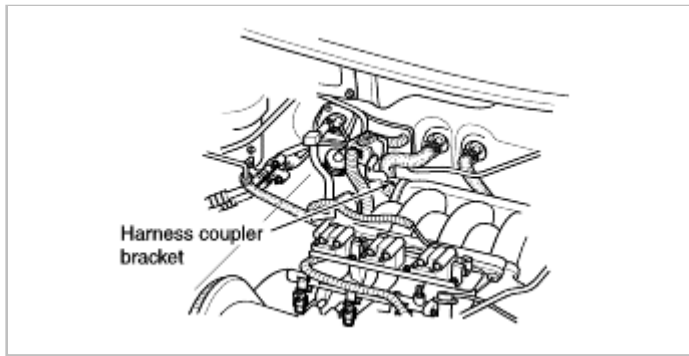
4. Disconnect TPS and IAC valve connectors.
5. Disconnect breather hose from throttle body.
6. Remove high-tension cords.
7. Disconnect breather hoses from LH camshaft cover.



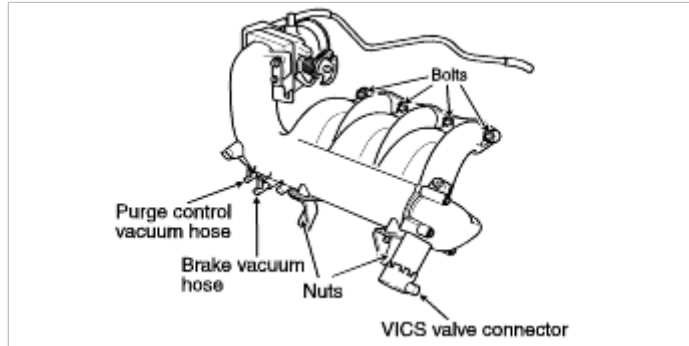
8. Disconnect breather hose and fuel return hose at surge tank.



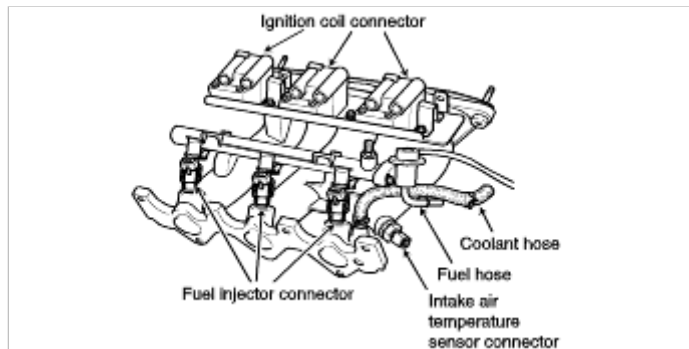
9. Remove harness coupler bracket from surge tank.



10. Disconnect VICS valve connector, brake vacuum hose and purge control vacuum hose.



11. Remove surge tank with four bolts and two nuts.
12. Disconnect ignition coil connector, fuel injector connector and intake air-temperature sensor connector.



13. Disconnect fuel hose from injector rail.

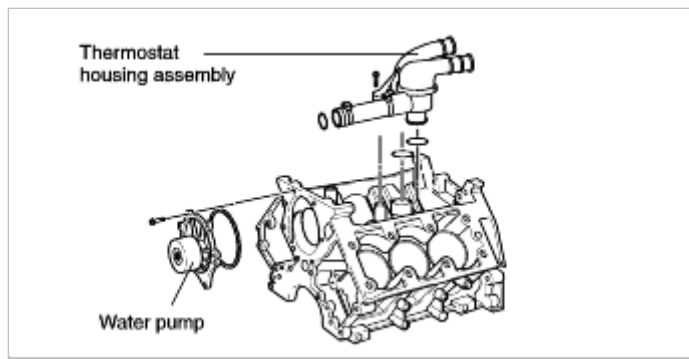
#### WARNING

Keep open frames and sparks away from open fuel lines, or a fire or explosion may result.

14. Disconnect coolant hose from intake manifold.
15. Remove intake manifold with 5 bolts and 2 nuts.
16. Disconnect coolant hoses from thermostat.
17. Remove thermostat housing assembly.

#### NOTICE

If thermostat is damaged, have to replace assembly.



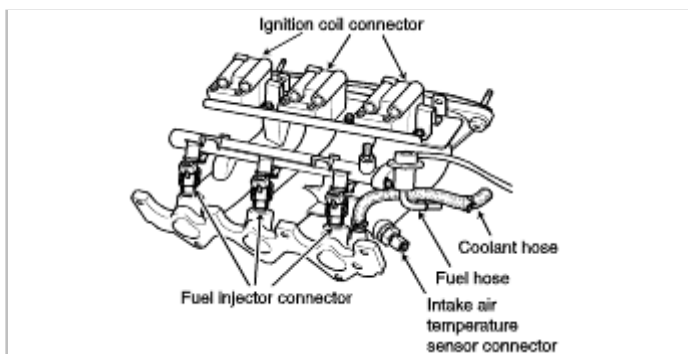
## REPLACEMENT

1. Install new "O" ring and thermostat housing assembly.

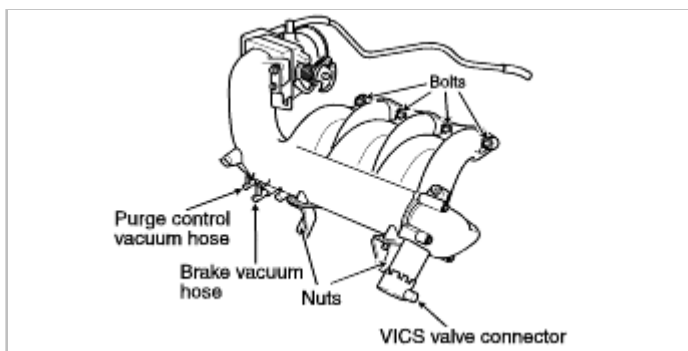
Tightening torque:

10.9~14.5 lb-ft (14.7~19.6 N·m, 1.5~2.0 kg-m)

2. Reconnect coolant hoses to thermostat housing.
3. Install intake manifold.
4. Reconnect coolant hose to intake manifold.
5. Reconnect fuel hose to injector rail.
6. Reconnect ignition coil connector, fuel injector connector and intake air-temperature sensor connector.



7. Install surge tank.
8. Reconnect VICS valve connector, brake vacuum hose and purge control vacuum hose.



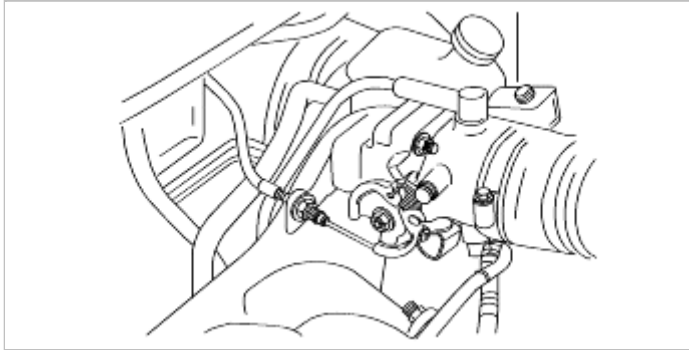
9. Install harness coupler bracket from surge tank.
10. Reconnect breather hose and fuel return hose to surge tank.
11. Reconnect breather hoses to LH camshaft cover.
12. Install high-tension cords.
13. Reconnect breather hose to throttle body.

14. Reconnect TPS and IAC valve connectors.
15. Install accelerator cable.
16. Measure free play of accelerator cable.

---

Free play : 0.04~0.11 in (1~3 mm)

---



17. Refill engine coolant.  
(Refer to engine coolant replacement)
18. Reconnect negative battery cable.





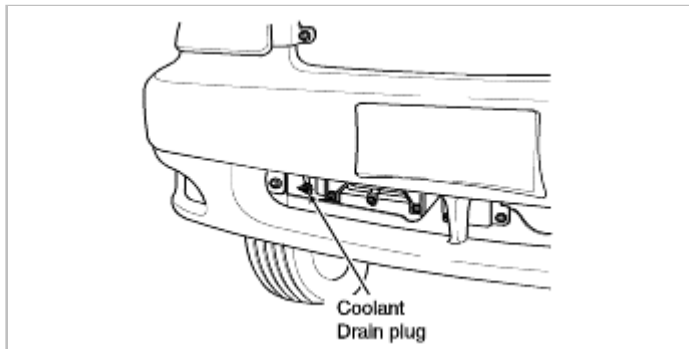
# **Engine Mechanical System**

Cooling System - Radiator

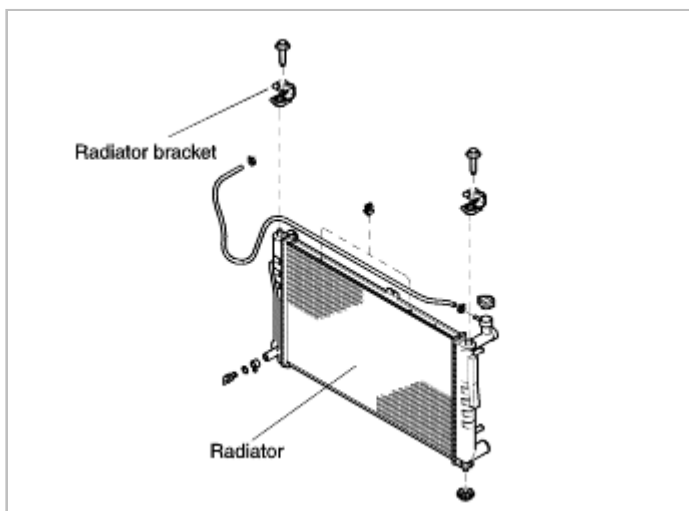


## REMOVAL

1. Drain engine coolant.



2. Remove cooling fan assembly.  
(Refer to cooling fan motor removal ; from step 1 to step 6.)
3. Disconnect coolant upper hose.
4. Disconnect reserve tank hose.
5. Disconnect coolant lower hose.
6. Remove radiator brackets.



7. Remove radiator.

## REPLACEMENT

1. Install radiator.
2. Install radiator bracket.
3. Reconnect coolant lower hose.
4. Reconnect reserve tank hose.
5. Reconnect coolant upper hose.
6. Install cooling fan assembly.  
(Refer to cooling fan motor replacement ; from step 3 to step 7.)
7. Refill engine coolant.  
(Refer to engine coolant replacement)

# **Engine Mechanical System**

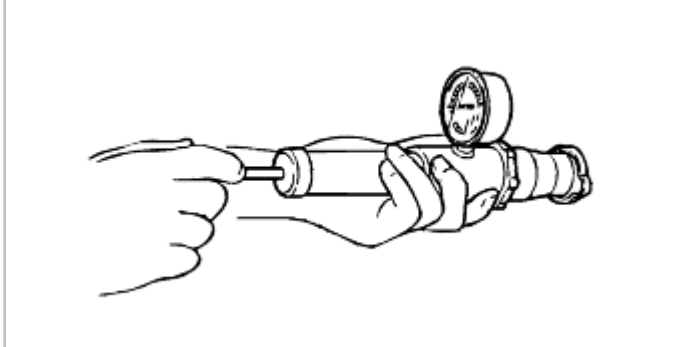
Cooling System - Radiator Cap



## INSPECTION

### RADIATOR CAP VALVE

1. Remove foreign material from radiator cap valve and the valve seat.
2. Attach radiator cap to a radiator cap tester. Apply pressure gradually to 15 psi (103kpa, 1.05kg/cm<sup>2</sup> ).



3. Wait about 10 seconds. Verify that pressure has not decreased.
4. Replace radiator cap as necessary.

### NEGATIVE PRESSURE VALVE

1. Pull negative pressure valve to open it. Verify that it closes completely when released.
2. Check for damage on contact surfaces, and for a cracked or deformed seal.
3. Replace radiator cap as necessary.

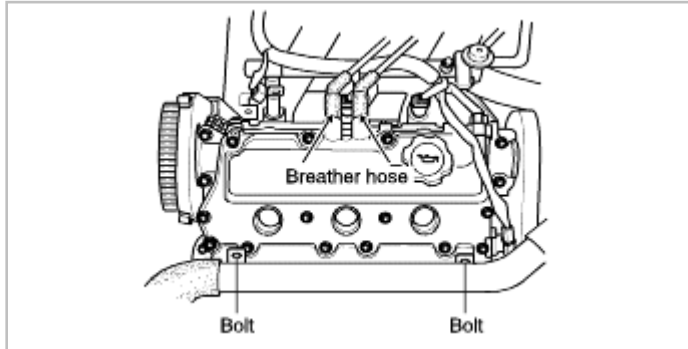
# **Engine Mechanical System**

Cooling System - Cooling Fan Motor  
Assembly

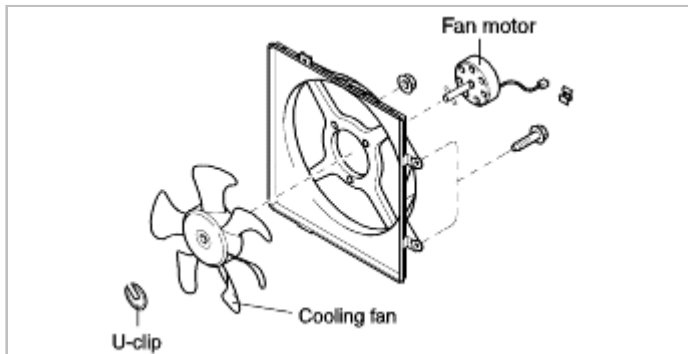


## REMOVAL

1. Disconnect negative battery cable.
2. Remove fresh air duct.
3. Disconnect cooling fan motor connector.
4. Remove two bolts securing coolant upper hose.



5. Remove three bolts securing cooling fan assembly.



6. Remove cooling fan assembly.
7. Remove U-clip securing cooling fan and remove cooling fan.
8. Remove nuts securing fan motor and remove fan motor.

## REPLACEMENT

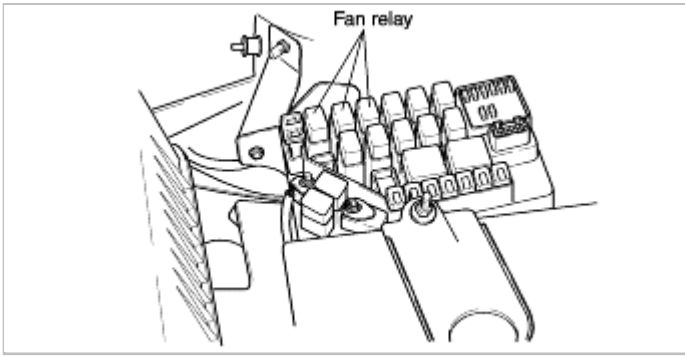
1. Install fan motor.
2. Install cooling fan to fan motor by use of U-clip.
3. Install cooling fan assembly.
4. Reconnect cooling fan motor connector.
5. Install two bolts securing coolant upper hose.
6. Install fresh air duct.
7. Reconnect negative battery cable.

## INSPECTION

### Cooling fan relay

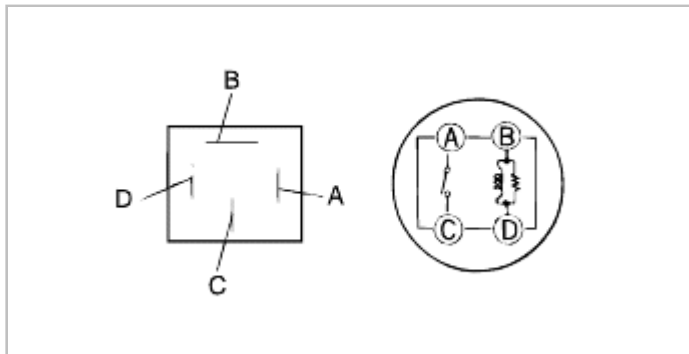
#### NOTICE

Cooling fan motor relay is located in the engine compartment fuse/relay box.



1. Disconnect negative battery cable.
2. Remove cooling fan motor relay from engine compartment fuse/relay box.
3. Check continuity with an ohmmeter.

Terminal	Continuity
A - C	No
B - D	Yes



4. Apply 12V to terminal B and ground to terminal D. Check for continuity between terminals A and C.
5. If there is no continuity, replace fan motor relay.

## Engine coolant temperature sensor

1. Check for resistance.

Water temperature	Resistance (k $\Omega$ )
-4°F (-20°C)	1436-17.8
68°F (20°C)	2.2-2.7
176°F (80°C)	0.29-0.35

2. If not as specified, replace the engine coolant temperature sensor.



# **Engine Mechanical System**

Lubrication System





## LUBRICATION SYSTEM

### Engine oil replacement

#### WARNING

Be careful when draining because oil is hot and could cause personal injury.

1. Warm engine to normal operating temperature and turn engine off. Position a suitable container under oil pan.
2. Remove oil filler cap and oil pan drain plug.
3. Allow oil to be fully drained.
4. Install drain plug with new gasket.

Tightening torque:

18.1-21.7 lb-ft (24.5-29.4 N·m, 2.5-3.0 kg-m)

5. Refill engine with specified type and amount of engine oil. (Refer to specification table)
6. Install oil filler cap.
7. Run engine and check for leaks.
8. Check oil level by level gauge and add oil if necessary.

### Oil pressure check

1. Disconnect and remove oil pressure switch.
2. Install oil pressure gauge into oil pressure switch installation hole.
3. Warm engine to normal operating temperature.
4. Run engine and note gauge readings.

Oil pressure:

49.8 psi (343 kPa, 3.5 kg/cm<sup>2</sup>)-Idle rpm

49.8-71.1 psi (343-490 kPa, 3.5-5.0 kg/cm<sup>2</sup>)-3,000 rpm

5. If pressure is not within specification, check for cause, and repair. (Refer to Troubleshooting guide)
6. Remove oil pressure gauge and install oil pressure switch.

Tightening torque:

8.7-13.0 lb-ft (11.7-17.6 N·m, 1.2-1.8 kg-m)

### Oil filter replacement

1. Remove oil filter with oil filter wrench. If rubber seal is stuck to engine, remove it.
2. Apply a small amount of clean engine oil to rubber seal of new filter.
3. Install oil filter and turn it by hand until rubber seal contacts base.
4. Tighten filter 1-1/6 turns with filter wrench.

Tightening torque:

10-13 lb-ft (13.7-17.6 N·m, 1.4-1.8 kg-m)

5. Start engine and check for leaks.

6. Turn engine off, and wait 5 minutes. Check oil level and add oil if necessary.

## LUBRICATION SYSTEM

### Engine oil replacement

#### WARNING

Be careful when draining because oil is hot and could cause personal injury.

1. Warm engine to normal operating temperature and turn engine off. Position a suitable container under oil pan.
2. Remove oil filler cap and oil pan drain plug.
3. Allow oil to be fully drained.
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6. Remove oil pressure gauge and install oil pressure switch.

Tightening torque:

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Tightening torque:

10-13 lb-ft (13.7-17.6 N·m, 1.4-1.8 kg-m)

5. Start engine and check for leaks.

6. Turn engine off, and wait 5 minutes. Chcek oil level and add oil if necessary.

# **Engine Mechanical System**

Lubrication System - Oil Pan



## REMOVAL

1. Disconnect negative battery cable.
2. Drain engine oil to suitable container.
3. Remove exhaust manifold.
4. Remove oil pan mounting bolts.
5. Remove oil pan.

## REPLACEMENT

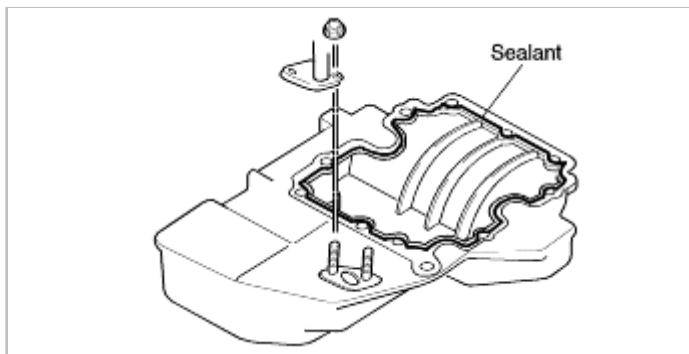
### CAUTION

- If oil pan is reused, remove all foreign material from sealing surfaces of cylinder block and oil pan.
- If bolts are reused, remove old sealant from bolt threads.

1. Apply a continuous bead of silicone sealant to oil pan along inside of bolt holes on contact surfaces.

### CAUTION

The oil pan must be installed no longer than 5 minutes after silicone sealant is applied.



2. Tighten oil pan mounting bolts.

Tightening torque:

15.9~19.5 lb-ft (21.6~26.5 N·m, 2.2~2.7 kg-m)

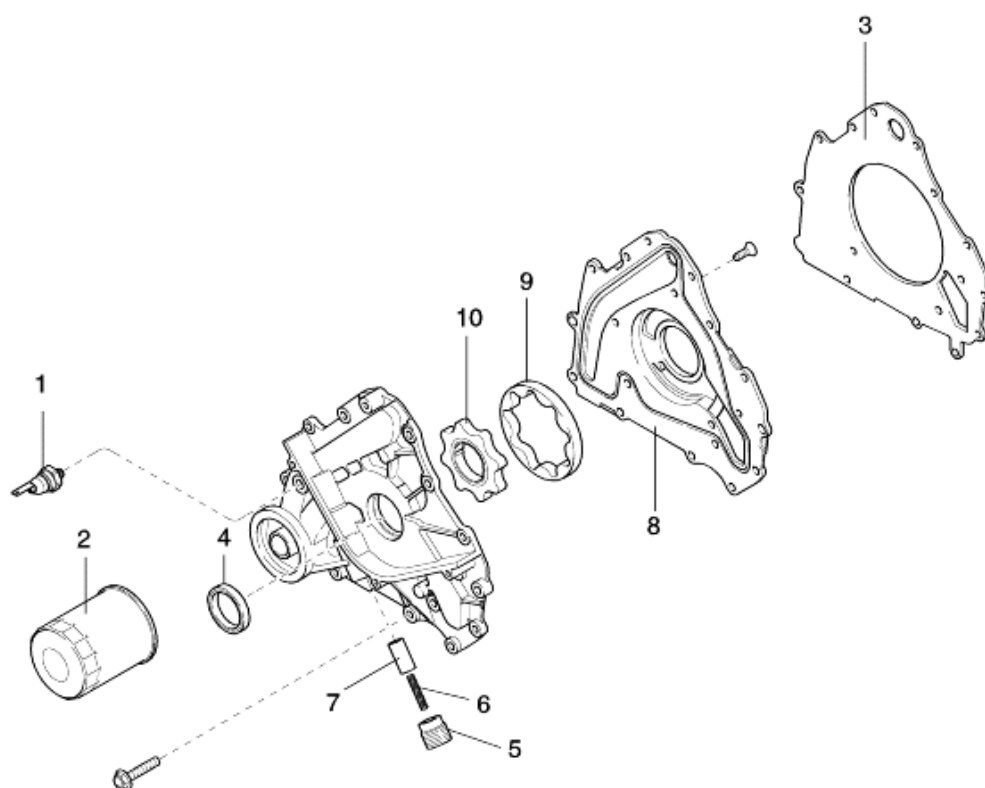
3. Install exhaust manifold.
4. Fill with specified amount and type of engine oil.
5. Connect negative battery cable.
6. Start engine and check for leaks.
7. Check oil level and add oil if necessary.

# **Engine Mechanical System**

Lubrication System - Oil Pump



## Component



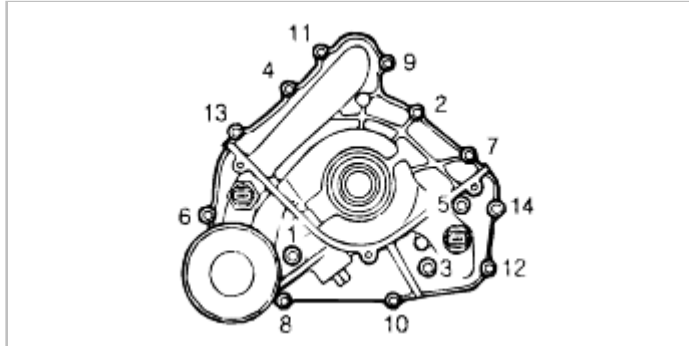
- 1. Oil pressure switch
- 2. Oil filter
- 3. Oil pump gasket
- 4. Front oil seal
- 5. Relief valve plug

- 6. Relief valve spring
- 7. Relief valve plunger
- 8. Oil pump cover
- 9. Outer rotor
- 10. Inner rotor



## REMOVAL

1. Remove front timing belt.  
(Refer to Front belt removal ; from step 1 to step 32.)
2. Remove oil pump and gasket with 14 bolts.



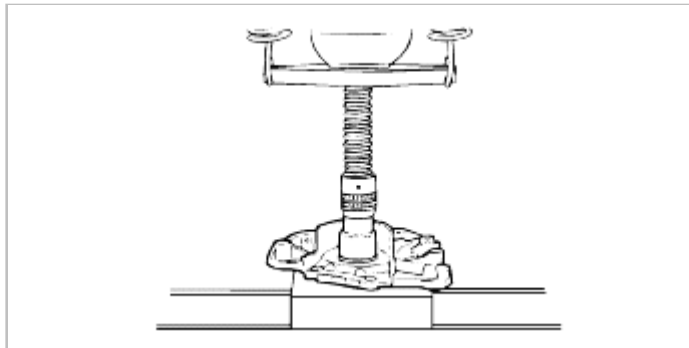
3. Using a screwdriver covered by a rag, remove front oil seal from pump cover side.

## REPLACEMENT

1. Apply clean engine oil to new front oil seal and oil pump body.
2. Install front oil seal by hand.
3. Press oil seal into oil pump body.

### NOTICE

Oil seal must be pressed in until it is nearly flush with front surface of oil pump body.



4. Install new gasket and oil pump with 14 bolts.

Tightening torque:

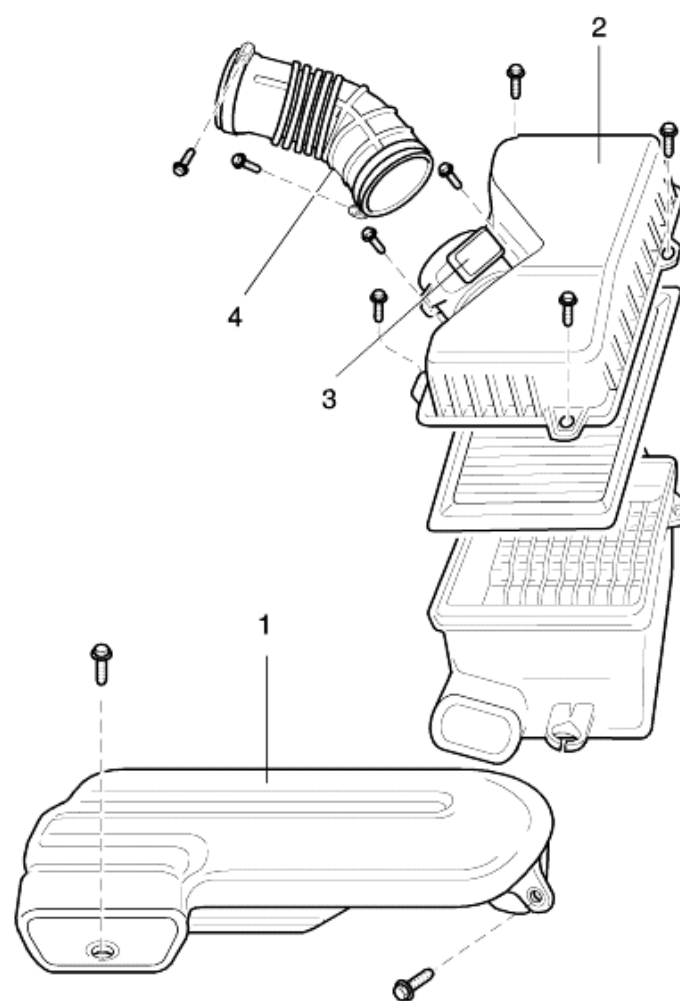
5~7.2 lb-ft (6.9~9.8 N·m, 0.7~1 kg-m)

5. Install No.3 engine mounting bracket.  
(Refer to front timing belt replacement ; from step 1 to step 27.)



# **Engine Mechanical System**

Intake And Exhaust System - Air Cleaner

**Component**

1. Fresh air duct  
2. Air cleaner assembly

3. Mass air flow sensor  
4. Air intake hose assembly



## REMOVAL AND REPLACEMENT

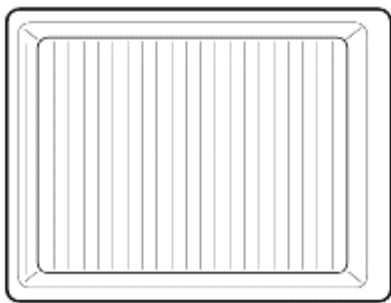
1. Remove in the order shown in the figure.
2. Inspect the intake air system components visually and repair or replace if necessary.
3. Install in the reverse order of removal.

## INSPECTION

1. Check the air cleaner element for excessive dirt, damage, or oil, and replace or clean if necessary.

### NOTICE

Use a compressed air to clean to element from the internal side to the external side, or from the upper to the lower.



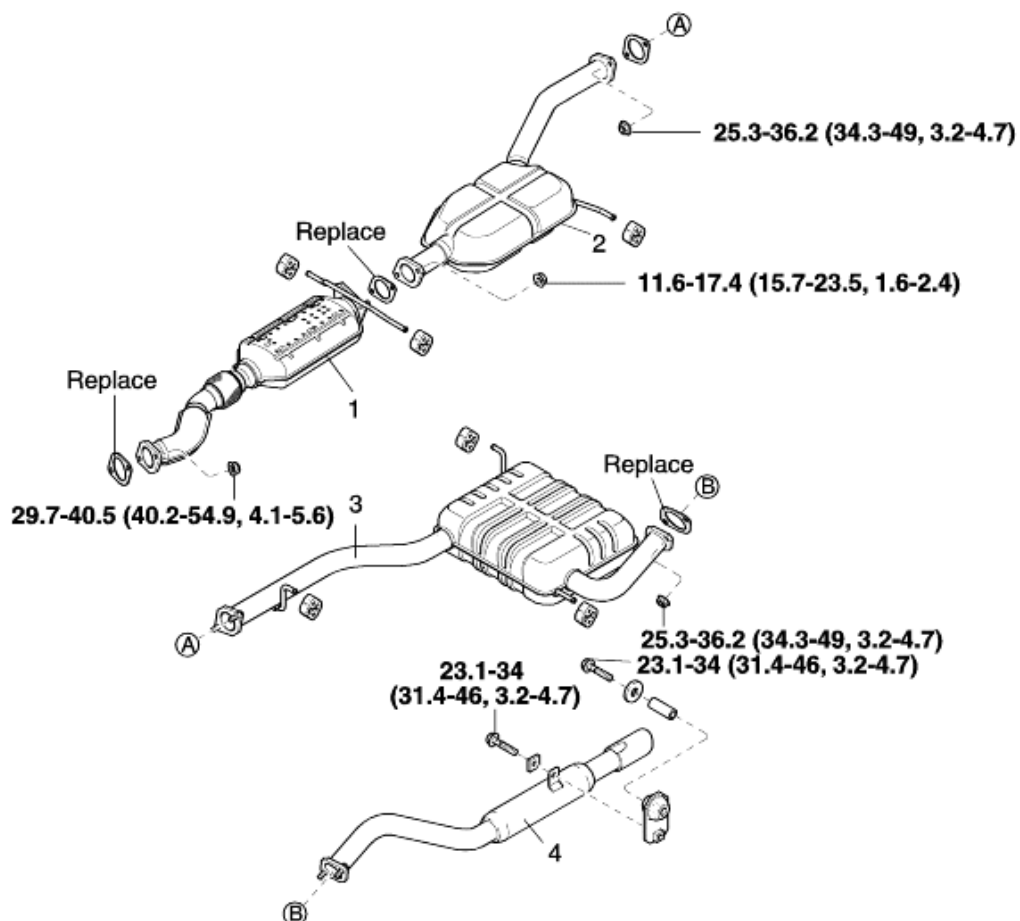
# **Engine Mechanical System**

Intake And Exhaust System - Front Exhaust  
Pipe



## Exhaust pipe

## Components



**TORQUE : lb·ft (N·m, kg·m)**

- 1. Catalytic converter assembly
- 2. Pre-silencer assembly

- 3. Main-silencer assembly
- 4. Tail pipe assembly



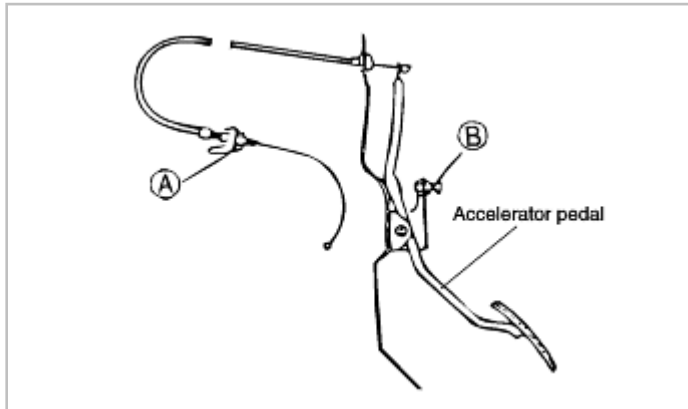
## REMOVAL AND REPLACEMENT

1. Remove in the order shown in the figure.
2. Check the exhaust component parts and repair or replace if necessary.
3. Install in the reverse order of removal.



## ACCELERATOR CABLE

1. Depress accelerator pedal to floor and check that the throttle valve is fully opened.  
Adjust with bolt (A), if necessary.



2. Measure free play of the accelerator cable.

---

Free play: 0.04~0.11 in (1~3 mm)

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3. If not as specified, adjust by turning locknut (A).

