

2005 Kia Rio

2004-05 ENGINES 1.6L 4-Cylinder - Rio

2004-05 ENGINES

1.6L 4-Cylinder - Rio

GENERAL

SPECIFICATIONS

Engine Specifications

Item		Engine model	A6 DOHC
Type			Gasoline, 4 cycle
Cylinders arrangement and number			In line, 4 cylinders
Combustion chamber			Pentroof
Valve system			DOHC, belt driven (IN : 2, EX : 2)
Displacement		cc (cu in)	1.594 (97.3)
Compression ratio			10.0:1
Valve timing	IN	Open BTDC	6°
		Close ABDC	46°
	EX	Open BBDC	46°
		Close ATDC	6°
Valve clearance	mm (in)	IN	0: Maintenance-free
		EX	0: Maintenance-free
Idle speed		rpm	750 ± 50
Ignition timing		BTDC	6° ± 5°
Firing order			1-3-4-2
Lubrication system			Force-fed type
Oil pump	Type		Duocentric gear
	Relief pressure	kPa (kg/cm ² , psi)	441 ~ 490 (4.5 ~ 5.0, 62 ~ 69)
Oil filter	Type		Full-flow, paper element
	Relief-valve opening pressure	kpa (kg/cm ² , psi)	98(1.0, 14)
Oil pressure switch activation pressure		kpa (kg/cm ² , psi)	25 (0.25, 3.6)
Oil capacity	Total (dry engine)	liters (US qt, Imp qt)	3.4 (3.6, 3.0)
	Oil pan	liters (US qt, Imp qt)	3.0 (3.2, 2.6)
	Oil filter	liters (US qt, Imp qt)	0.20 (0.21, 0.18)
Engine oil			API service SG
Cooling system			Water-cooled, forced circulation
Coolant capacity(with heater)		liters (US qt, Imp qt)	6.0 (6.3, 5.3)
Thermostat	Type		Wax type
	Opening temperature	°C (°F)	87.5 ~ 88.5 (189.5 ~ 191.3)
	Full-open temperature	°C (°F)	100 (212)
	Full-open lift	mm (in)	8.0 (0.31)

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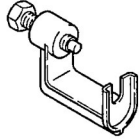
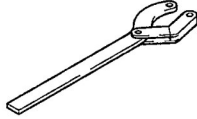
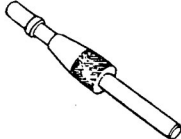
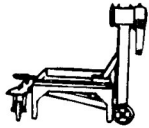
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Water pump	Type	Centrifugal
Radiator	Type	Corrugated fin type
	Cap valve pressure kPa (kg/cm ² , psi]	74 ~ 103 (0.75 ~ 1.05, 11 ~ 15)
Cooling fan	Outer diameter mm (in)	300 (11.8)
	Number of blades	4
Intake and exhaust system		
Air cleaner element type		Dried
Accelerator cable free play mm(in)		1-3 (0.039-0.11)

SPECIAL SERVICE TOOLS

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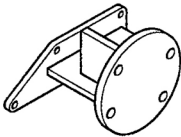
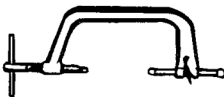
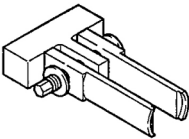
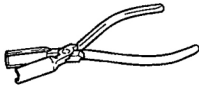
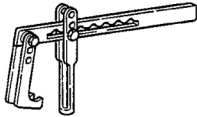
Tool (Number and Name)	Illustration	Use
OK670 321 019 Ball joint puller	 LC3B020A	Used to remove tie-rod end.
OK130 111 004 Coupling flange holder	 LC3B020B	Used to disassemble and assemble timing belt pulley.
OK130 111 002 Ring gear Brake	 LC3B020C	Used to prevent engine rotation.
OK130 160 010 Clutch disc centering tool	 LC3B020D	Used to install clutch disc.
OK130 990 007 Engine stand	 LC3B020E	Used to disassemble and assemble engine.

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Fig. 1: Special Service Tools (1 Of 3)
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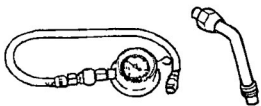
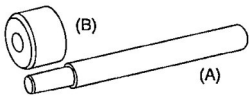
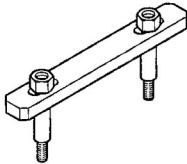
Tool (Number and Name)	Illustration	Use
0KK30 101 001 Engine stand hanger	 LC3B020F	Used to disassemble and assemble engine.
0K993 120 001 Valve spring lifter arm	 LC3B020G	Used to remove and install valve.
0K993 120 004 Valve spring lifter pivot.	 LC3B020H	Used to remove and install valve.
0K993 120 006 Valve seal remover	 LC3B020I	Used to remove valve seal.
0K2CA 120 AA0 Valve spring compressor set	 LC3B020J	Used to replace valve seal and valve spring.

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Fig. 2: Special Service Tools (2 Of 3)
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Tool (Number and Name)	Illustration	Use
0KK30 140 001 Oil pressure gauge	 LC3B020K	Used to measure fuel pressure.
09221-FD100(A) Valve guide remover 09221-FD100(B) Valve guide installer	 KFW3003A	Used to remove and install valve guide.
0K2CA 120 001 Valve spring compressor hook	 LC3B020M	Used to replace valve seal and valve spring.

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Fig. 3: Special Service Tools (3 Of 3)

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TROUBLESHOOTING

ENGINE MECHANICAL SYSTEM

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Problem	Possible cause	Action
Engine will not crank	Battery, starting system or other electrical problems	Refer to Starting system, Charging system.
	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
	Ignition system malfunction	Refer to Ignition system
	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
	Emission system malfunction	Refer to Emission control system
	Ignition system malfunction	Refer to Ignition system
	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 Emission system malfunction	Refer to Fuel system
Blue exhaust smoke	Usually caused by oil burning in the combustion chambers from: worn rings, worn valve guides, worn valve seals or failed cylinder head gasket	Replace

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Fig. 4: Engine Mechanical Troubleshooting Guide (1 Of 3)
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Problem	Possible cause	Action
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
	Slipping clutch	Refer to Clutch
	Dragging brakes	Refer to Brake system
	Wrong tire size	Refer to Wheels and tires
	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

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Fig. 5: Engine Mechanical Troubleshooting Guide (2 Of 3)
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Problem	Possible cause	Action
Knock increases with torque	Excessive piston to bore clearance	Replace piston
	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

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Fig. 6: Engine Mechanical Troubleshooting Guide (3 Of 3)
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TIMING BELT

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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

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Fig. 7: Timing Belt Troubleshooting Guide (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

Problem	Possible cause	Action
Oil or coolant is on the belt	Poor oil sealing	Inspect front oil seals 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

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Fig. 8: Timing Belt Troubleshooting Guide (2 Of 2)
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HLA (HYDRAULIC LASH ADJUSTER)

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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. * Time required for engine oil to circulate within engine includes tolerance for engine oil condition and ambient temperature.
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	
5. Noise continues more than 10 minutes.	Insufficient oil pressure	Check oil pressure If lower than specification, check for cause. Oil pressure: 12.8 Psi (88.26 kpa, 0.9 kg/cm ²) - at idle
	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.

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Fig. 9: HLA Troubleshooting Guide
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LUBRICATION SYSTEM

Problem	Possible cause	Action
Engine hard starting	Improper engine oil Insufficient engine oil	Replace Add oil
Excessive oil Consumption	Internal engine wear Oil leak	Refer to Engine Mechanical System 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 Engine Mechanical System

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Fig. 10: Lubrication System Troubleshooting Guide (1 Of 2)
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Problem	Possible cause	Action
Warning lamp illuminates while engine is running	Oil pressure drop	As described above
	Malfunction of oil pressure switch Refer to Body Electrical System	Refer to Body Electrical System
	Malfunction of electrical system	Troubleshooting manual

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Fig. 11: Lubrication System Troubleshooting Guide (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

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

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Fig. 12: Cooling System Troubleshooting Guide
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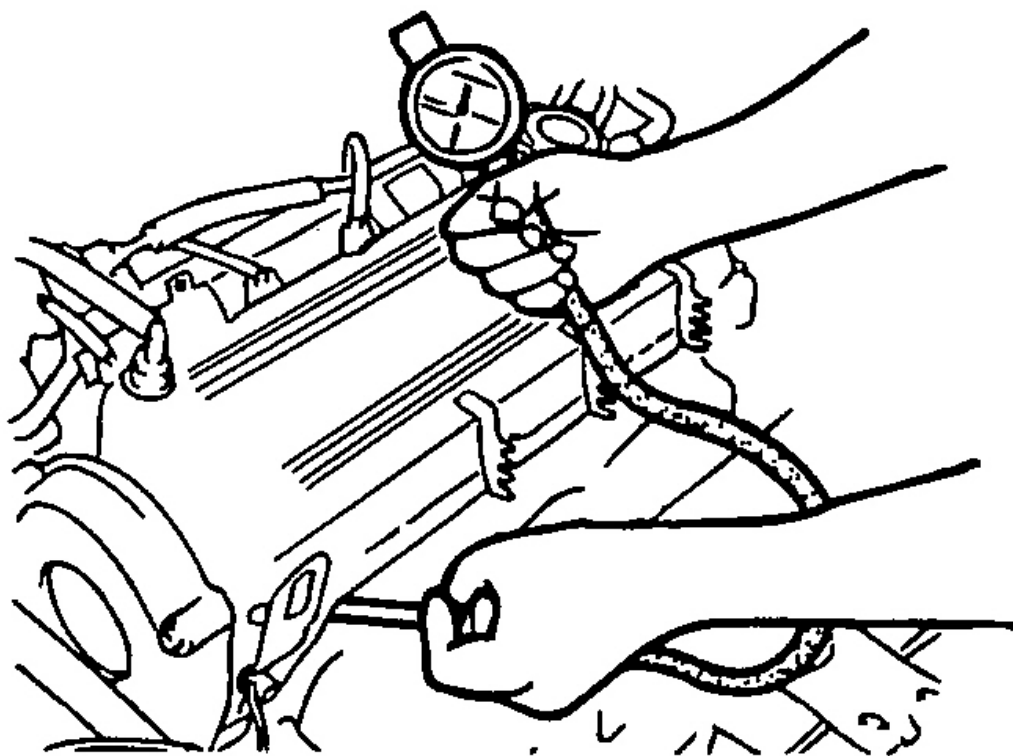
COMPRESSION

If the engine exhibits low power, poor fuel economy, or poor idle, check the following:

1. Ignition system
2. Compression
3. Fuel system

Inspection

1. Check that the battery is fully charged. Recharge it if necessary.
2. Warm up the engine to normal operating temperature.
3. Remove the center cover.
4. Disconnect the high tension lead and ignition coil.
5. Remove all spark plugs.
6. Connect a compression gauge to the No. 1 spark plug hole.



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Fig. 13: Testing Engine Compression
Courtesy of KIA MOTORS AMERICA, INC.

7. Fully depress the accelerator pedal and crank the engine.
8. Record the maximum gauge reading.
9. Check each cylinder.

Compression (kpa (kg/cm ² , psi)-rpm)	Standard	1275 (13, 184)
	Difference between cylinders	98 (1, 14.2)

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Fig. 14: Engine Compression Specification Chart
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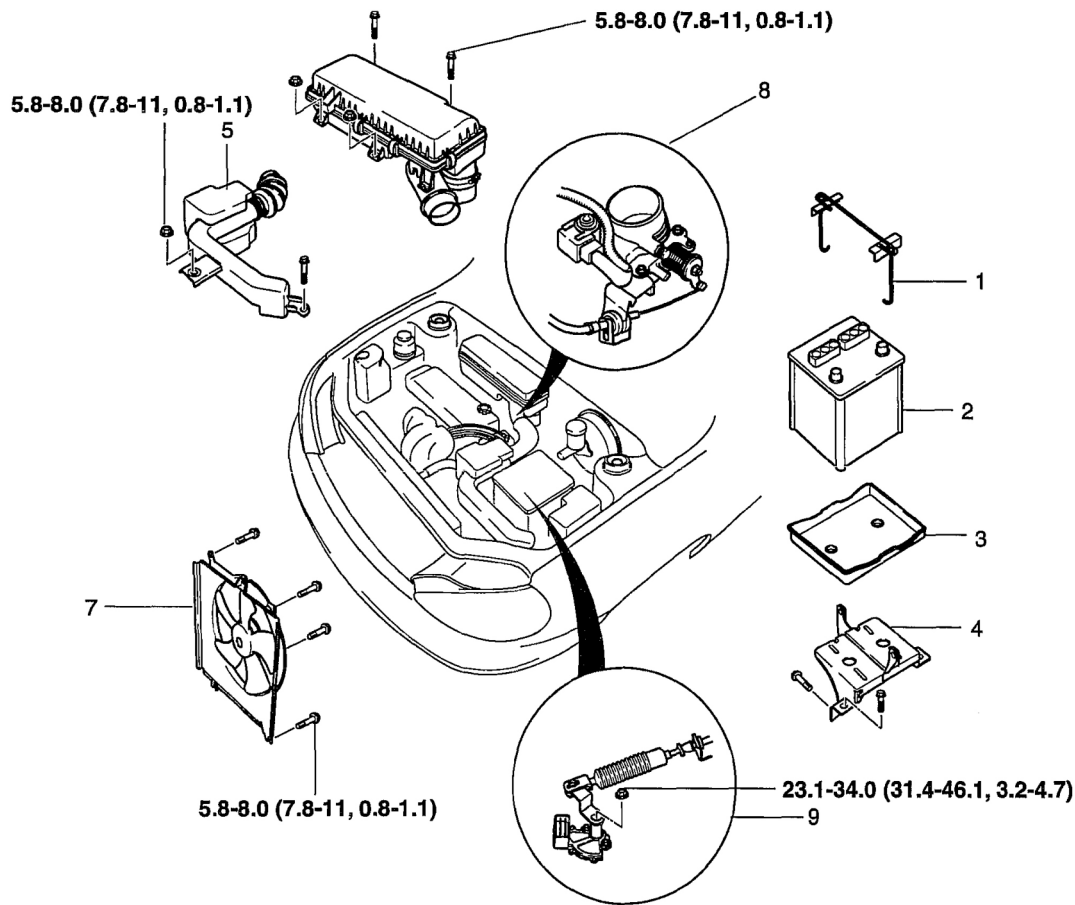
10. If the compression in one or more cylinders is low, pour a small amount of engine oil into the cylinder and recheck the compression.
 - a. If the compression increases, the piston, piston rings, or cylinder wall maybe worn.
 - b. If the compression stays low, the valve may be stuck or seating improperly.
 - c. If the compression in adjacent cylinders stays low, the cylinder head gasket may be defective or the cylinder head distorted.

ENGINE AND TRANSAXLE ASSEMBLY

COMPONENTS

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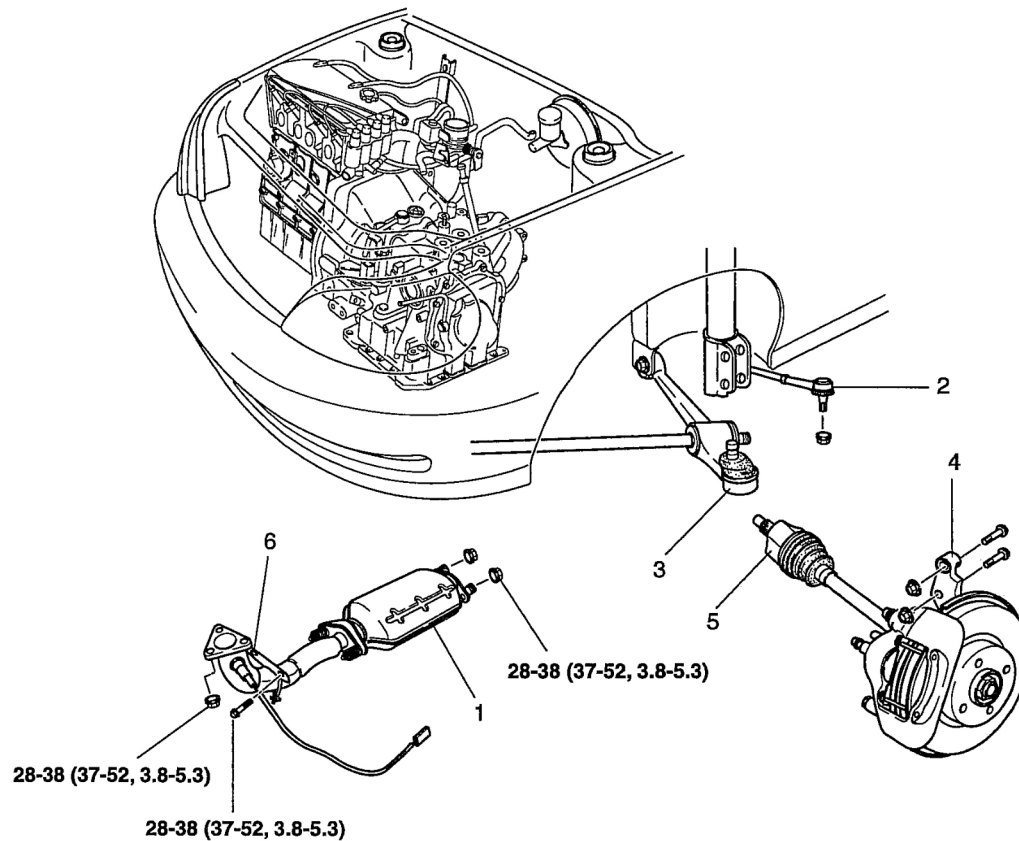


TORQUE : lb·ft (N·m, kg·m)

- | | |
|--------------------|-------------------------|
| 1. Battery clamp | 5. Fresh air duct |
| 2. Battery | 6. Air cleaner assembly |
| 3. Battery tray | 7. Cooling fan |
| 4. Battery bracket | 8. Accelerator cable |
| | 9. Shift control cable |

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Fig. 15: Identifying Engine & Transaxle Assembly Components With Torque Specifications (1 Of 4)
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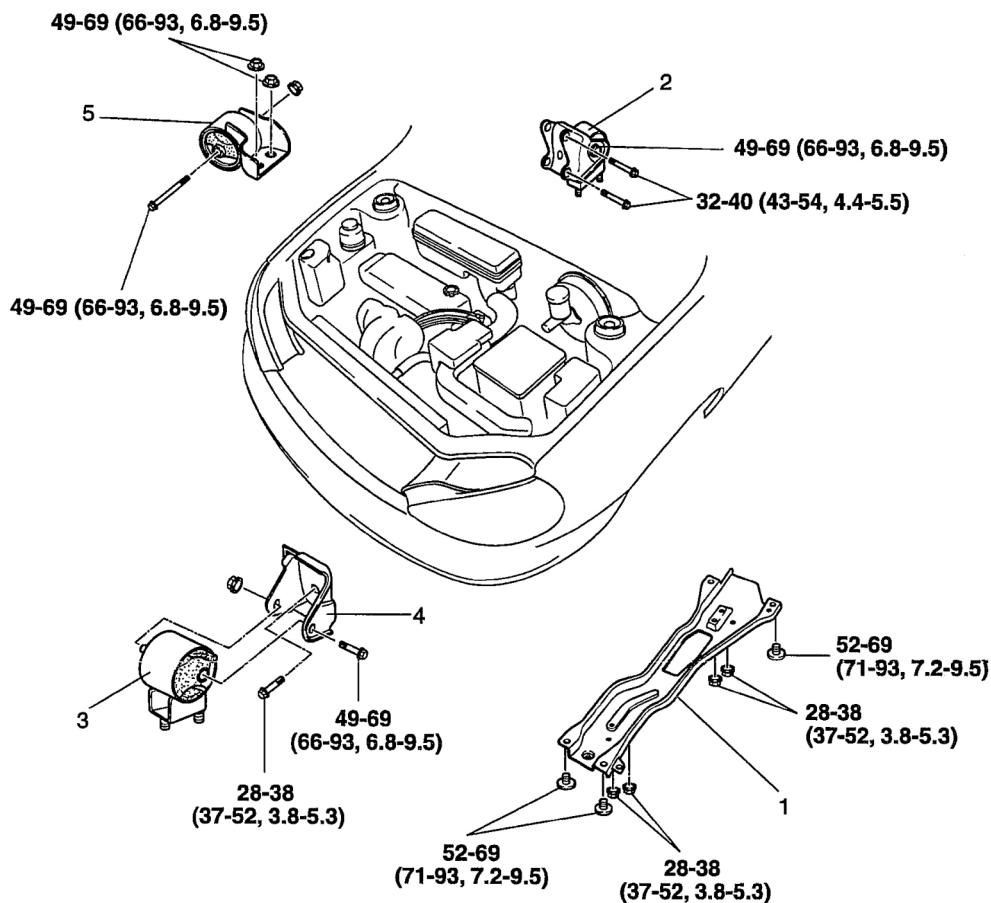


TORQUE : lb·ft (N·m, kg·m)

- | | |
|---------------------------------------|---------------|
| 1. Exhaust pipe & catalytic converter | 4. Knuckle |
| 2. Tie rod end | 5. Driveshaft |
| 3. Lower arm | 6. HO2S |

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Fig. 16: Identifying Engine & Transaxle Assembly Components With Torque Specifications (2 Of 4)
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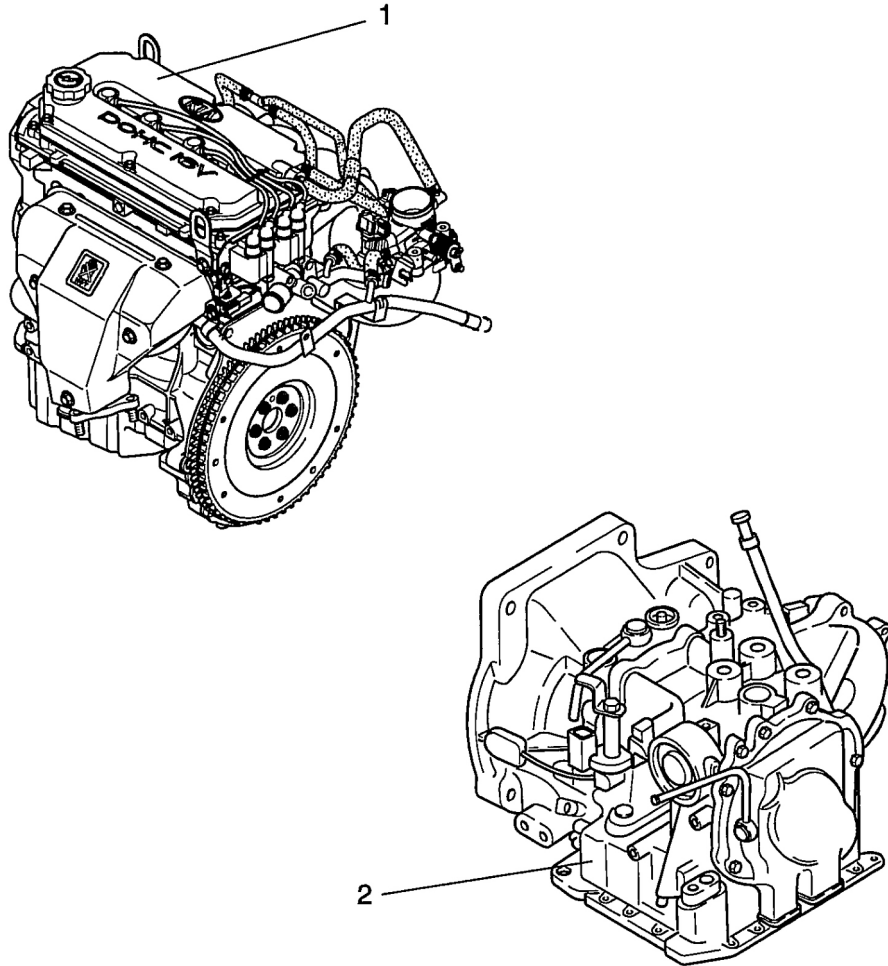


TORQUE : lb·ft (N·m, kg·m)

- 1. Engine Mounting Member
- 2. No.1 Engine Mounting Bracket
- 3. No.2 Engine Mounting Rubber
- 4. No.2 Engine Mounting Bracket
- 5. No.3 Engine Mounting Rubber

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Fig. 17: Identifying Engine & Transaxle Assembly Components With Torque Specifications (3 Of 4)
 Courtesy of KIA MOTORS AMERICA, INC.



1. Engine

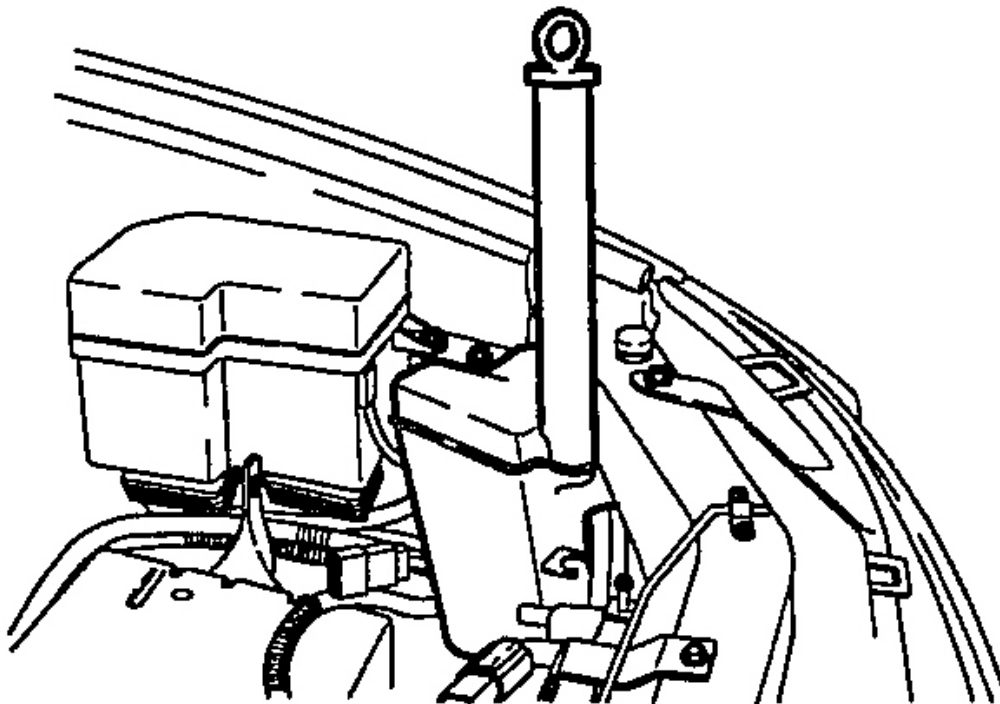
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2. Transaxle

Fig. 18: Identifying Engine & Transaxle Assembly Components With Torque Specifications (4 Of 4)
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REMOVAL

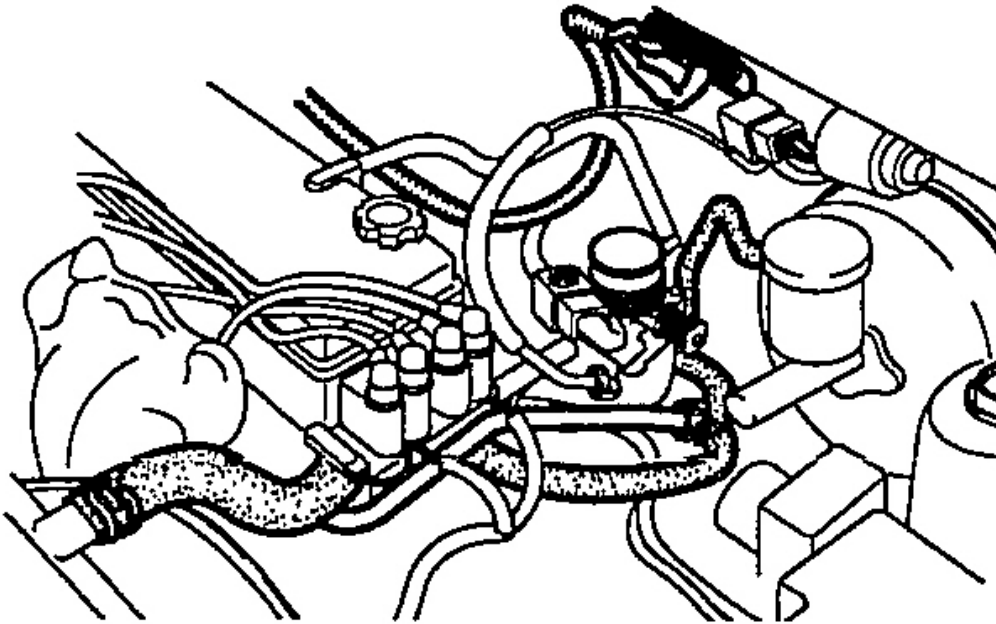
1. Disconnect battery cables.
2. Remove battery and battery tray.



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Fig. 19: Removing Battery And Battery Tray
Courtesy of KIA MOTORS AMERICA, INC.

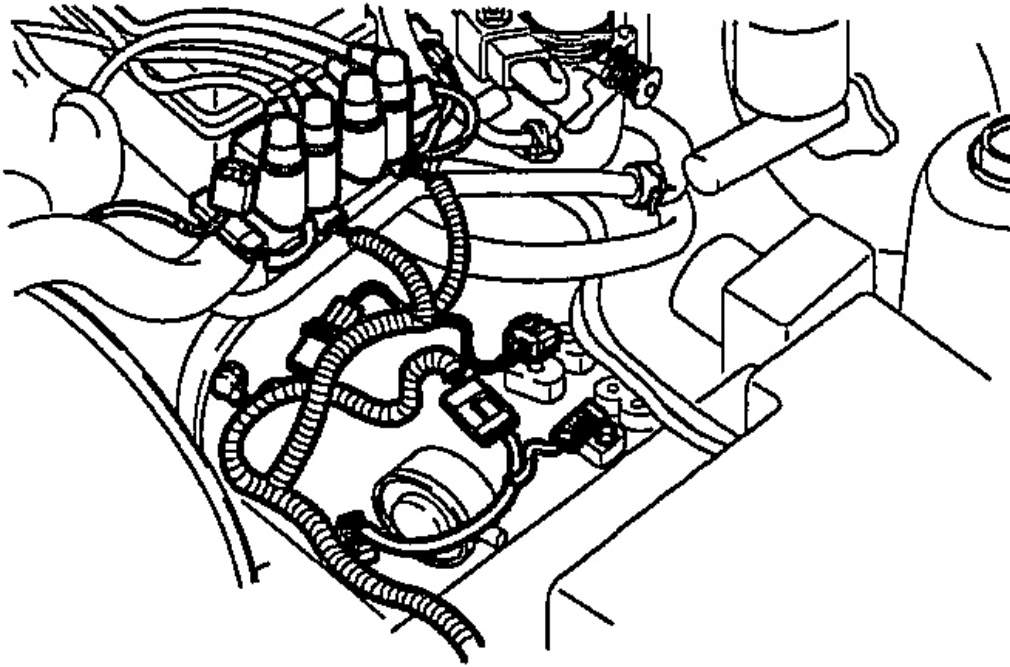
3. Drain engine coolant.
4. Remove fresh air duct.
5. Remove upper and lower radiator hose.



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Fig. 20: Removing Upper And Lower Radiator Hose
Courtesy of KIA MOTORS AMERICA, INC.

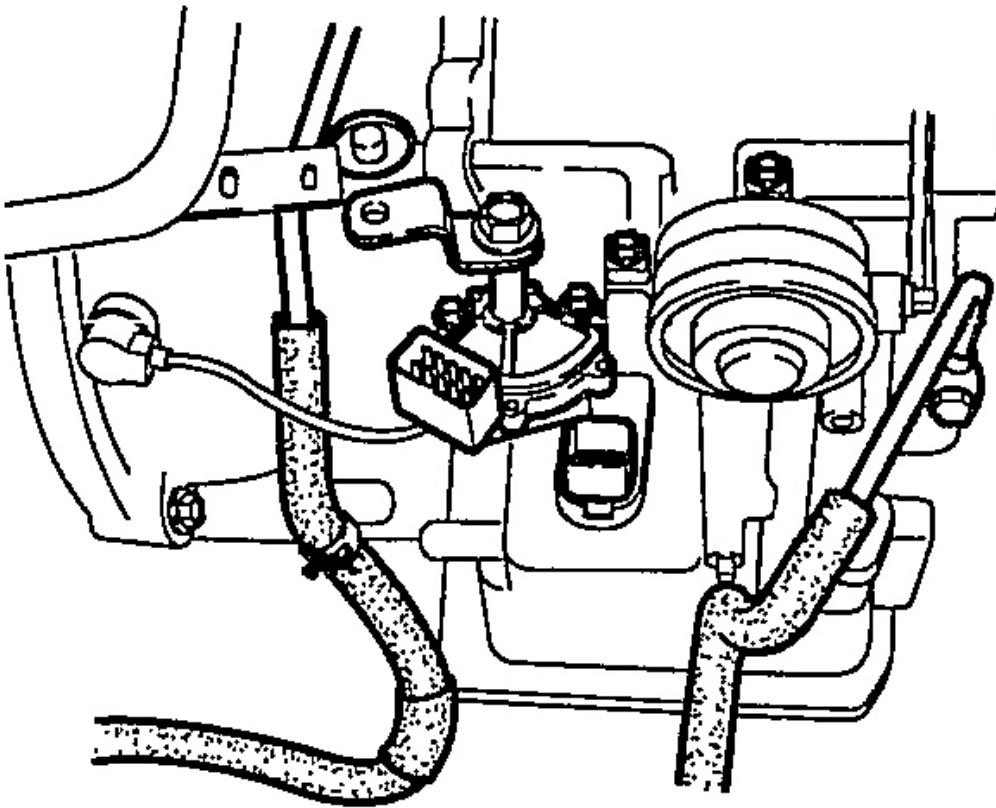
6. Remove accelerator cable.
7. Disconnect fuel hose from fuel injector rail.
8. Remove heater hose.
9. Disconnect brake vacuum hose and purge control vacuum hose from dynamic chamber.
10. Disconnect injector connectors.
11. Disconnect electric connectors.



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Fig. 21: Disconnecting Electric Connectors
Courtesy of KIA MOTORS AMERICA, INC.

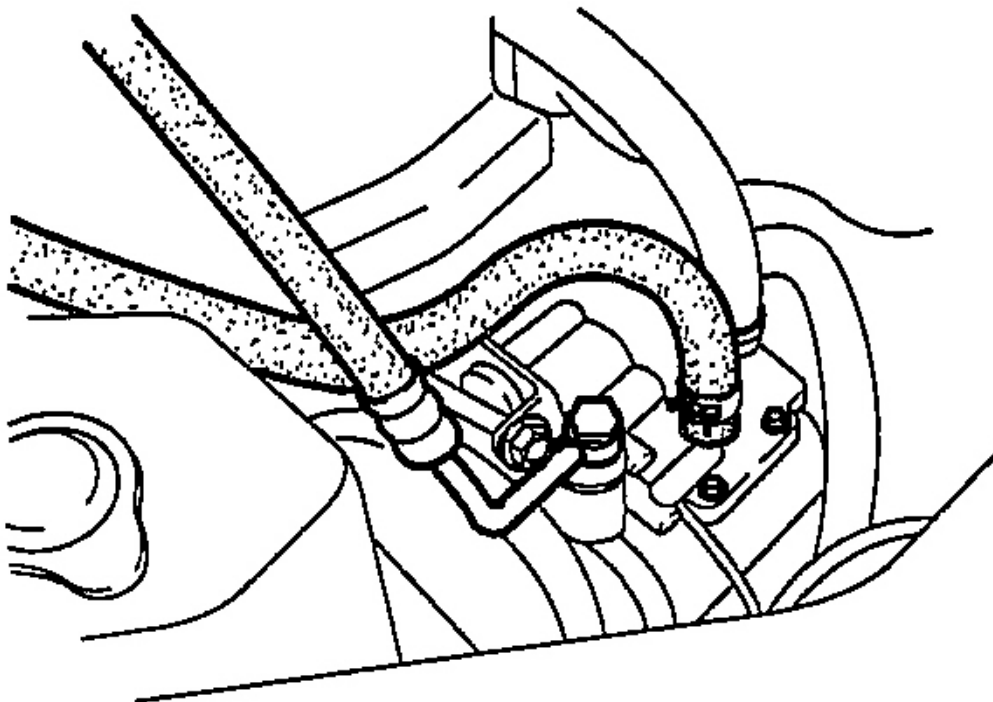
12. Remove transaxle linkage (A/T).
13. Remove manual transaxle linkage and extension bar (M/T).
14. Remove clutch release cylinder and pipe (M/T).
15. Disconnect transaxle range switch connector (A/T).
16. Disconnect solenoid valve connector (A/T).
17. Disconnect ATF cooler hose (A/T).



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Fig. 22: Disconnecting ATF Cooler Hose
Courtesy of KIA MOTORS AMERICA, INC.

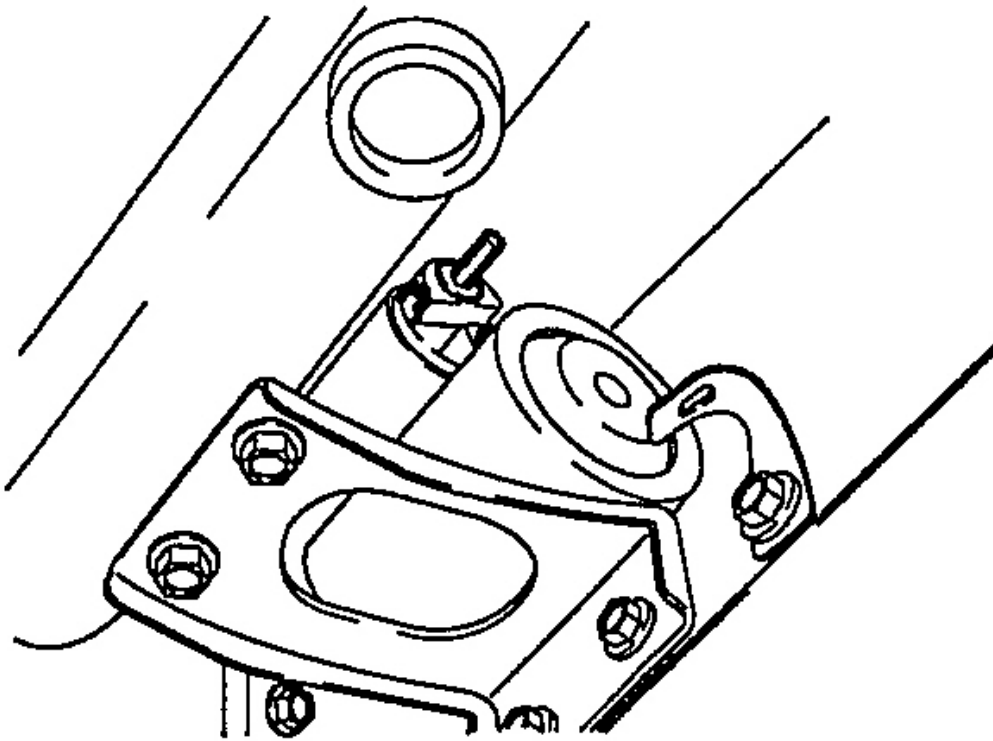
18. Disconnect power steering pump hose.



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Fig. 23: Disconnecting Power Steering Pump Hose
Courtesy of KIA MOTORS AMERICA, INC.

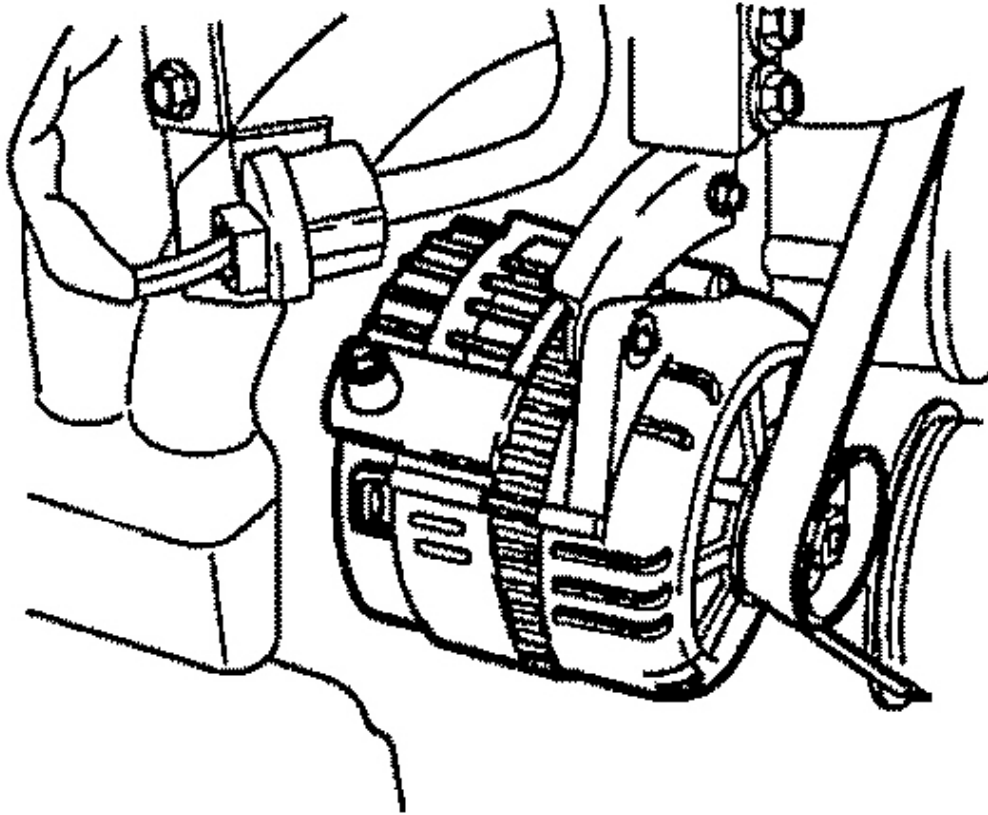
19. Disconnect B-terminal and S-terminal connector from starter.



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Fig. 24: Disconnecting Starter Connector
Courtesy of KIA MOTORS AMERICA, INC.

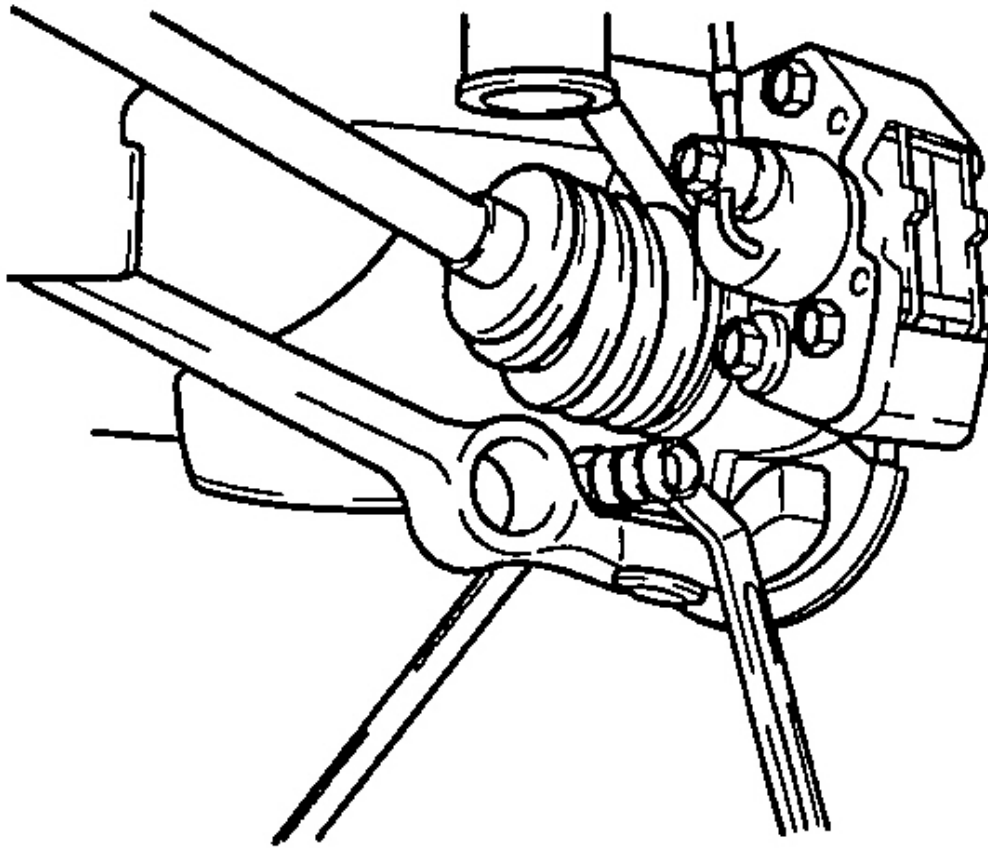
20. Disconnect generator B-terminal connector from generator.



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Fig. 25: Disconnecting Generator Connector
Courtesy of KIA MOTORS AMERICA, INC.

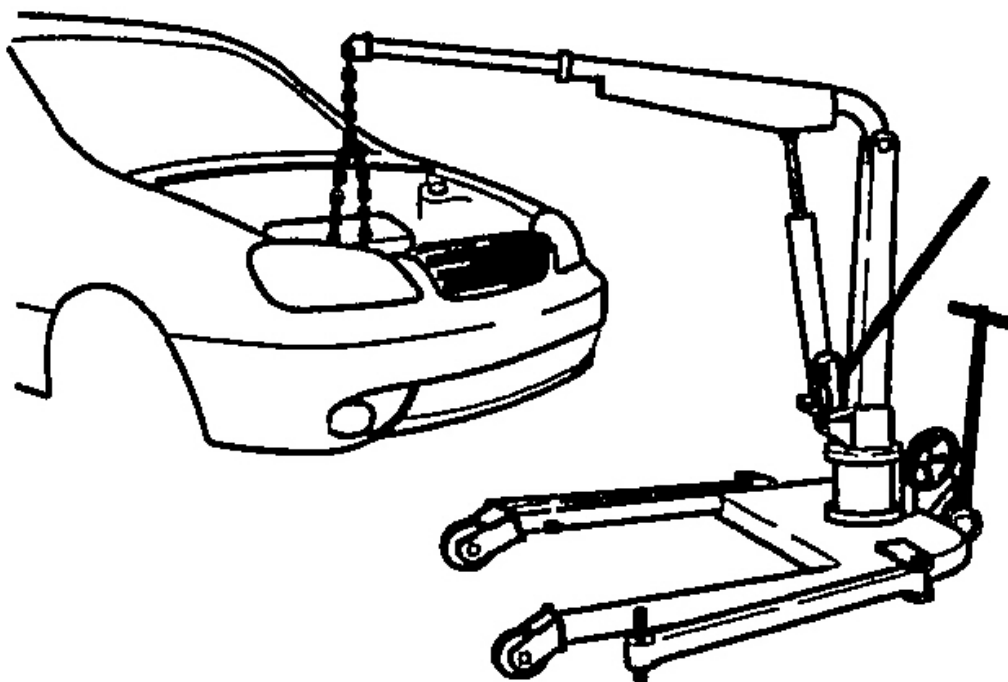
21. Remove four A/C compressor bolts.
22. Remove both front wheels.
23. Disconnect front exhaust pipe and catalytic converter.
24. Remove both right and left tie rod ends from steering knuckles by removing one cotter pin and one nut each.
25. Remove bolt and nut from both right and left lower arm and separate lower arm from steering knuckles.



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Fig. 26: Removing Lower Arm Bolt & Nut
Courtesy of KIA MOTORS AMERICA, INC.

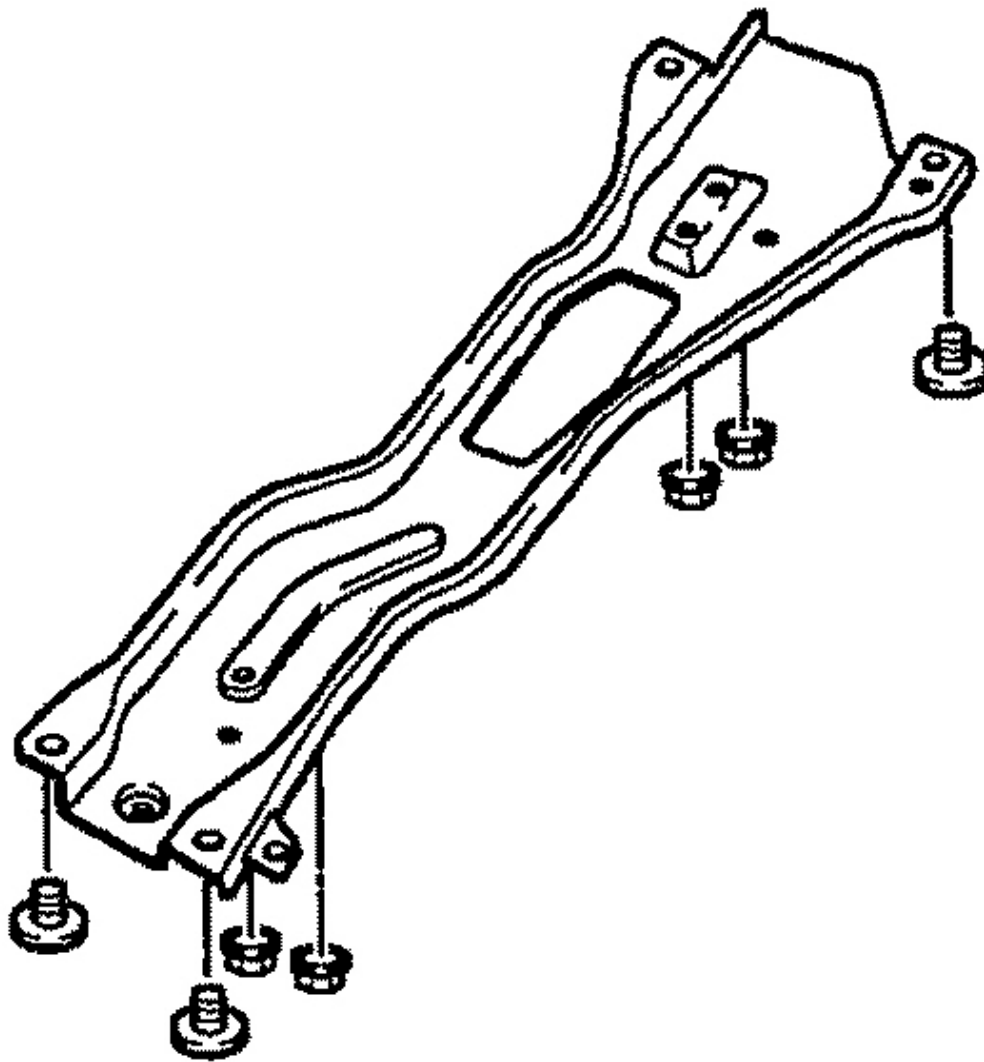
26. Remove 2 bolts and nuts from damper and separate damper from steering knuckles.
27. Gently pry both driveshafts from transaxle.
28. Support engine with engine hoist.



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Fig. 27: Supporting Engine With Engine Hoist
Courtesy of KIA MOTORS AMERICA, INC.

29. Remove four nuts and four bolts from engine mounting member.



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Fig. 28: Removing Engine Mounting Member
Courtesy of KIA MOTORS AMERICA, INC.

30. Remove two bolts from No. 1 engine mounting bracket.
31. Remove one nut from No. 2 engine mounting rubber.
32. Remove four bolts from No. 2 engine mounting bracket.
33. Remove two nuts from No. 3 engine mounting rubber.

34. Lift engine and transaxle out as a unit.

INSTALLATION

1. Install engine and transaxle into engine compartment as a unit.
2. Install two nuts to No. 3 engine mounting rubber.

Tightening torque:

49~69 lb-ft (66~93 N . m, 6.8~9.5 kg-m)

3. Install No.2 engine mounting bracket bolts and install No.2 engine mounting rubber nut.

Tightening torque:

Nut: 49~69 lb-ft (66~93 N . m, 6.8~9.5 kg-m)

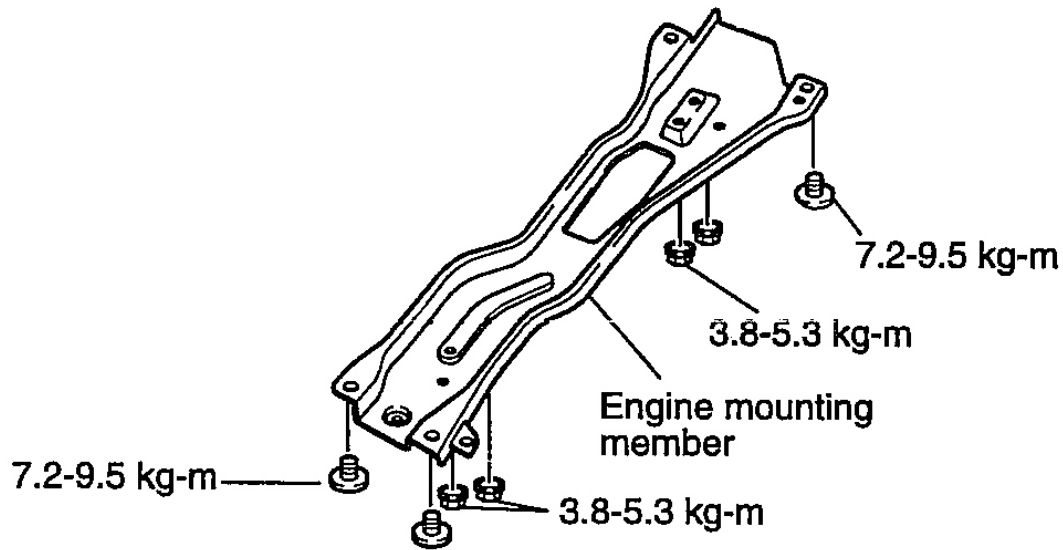
Bolts: 28~38 lb-ft (37~52 N . m, 3.8~5.3 kg-m)

4. Install four engine mounting member bolts nuts.

Tightening torque:

Nut: 28~38 lb-ft (37~52 N . m, 3.8~5.3 kg-m)

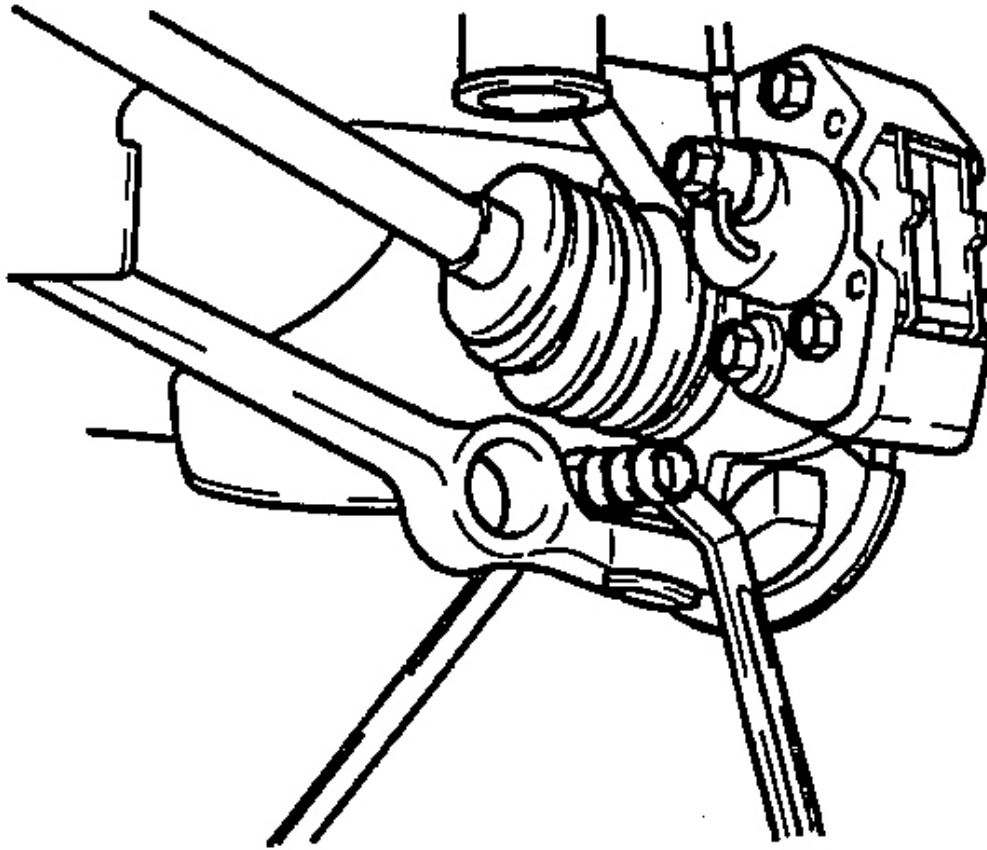
Bolts: 52~69 lb-ft (71~93 N . m, 7.2~9.5 kg-m)



G00325878

Fig. 29: Installing Four Engine Mounting Member Bolts/Nuts With Torque Specifications
Courtesy of KIA MOTORS AMERICA, INC.

5. Remove engine hoist.
6. Install new clips on driveshaft.
7. Push driveshaft and joint shaft into transaxle with opening of clips pointing upward.
8. Install damper to steering knuckles.
9. Install both right and left lower arm to steering knuckles.



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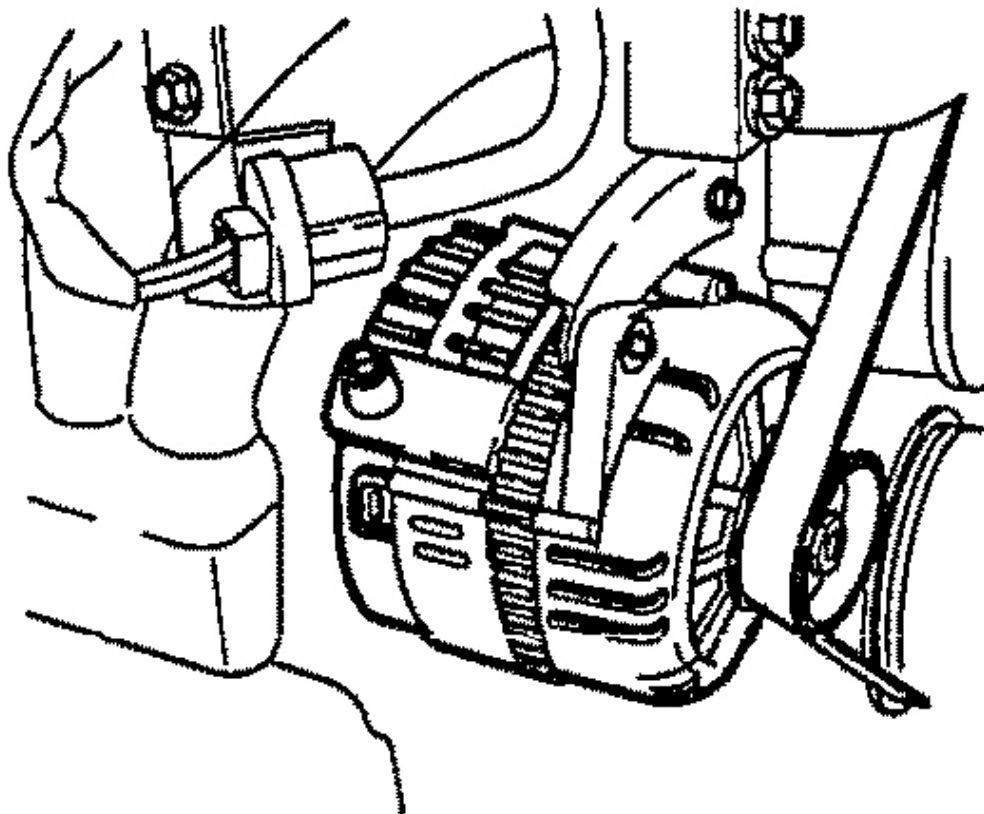
Fig. 30: Installing Both Right And Left Lower Arms
Courtesy of KIA MOTORS AMERICA, INC.

10. Install both right and left tie rod ends to steering knuckles.
11. Install front exhaust pipe and catalytic converter.

Tightening torque:

27~38 lb-ft (37.2~52 N . m, 3.8~5.3 kg-m)

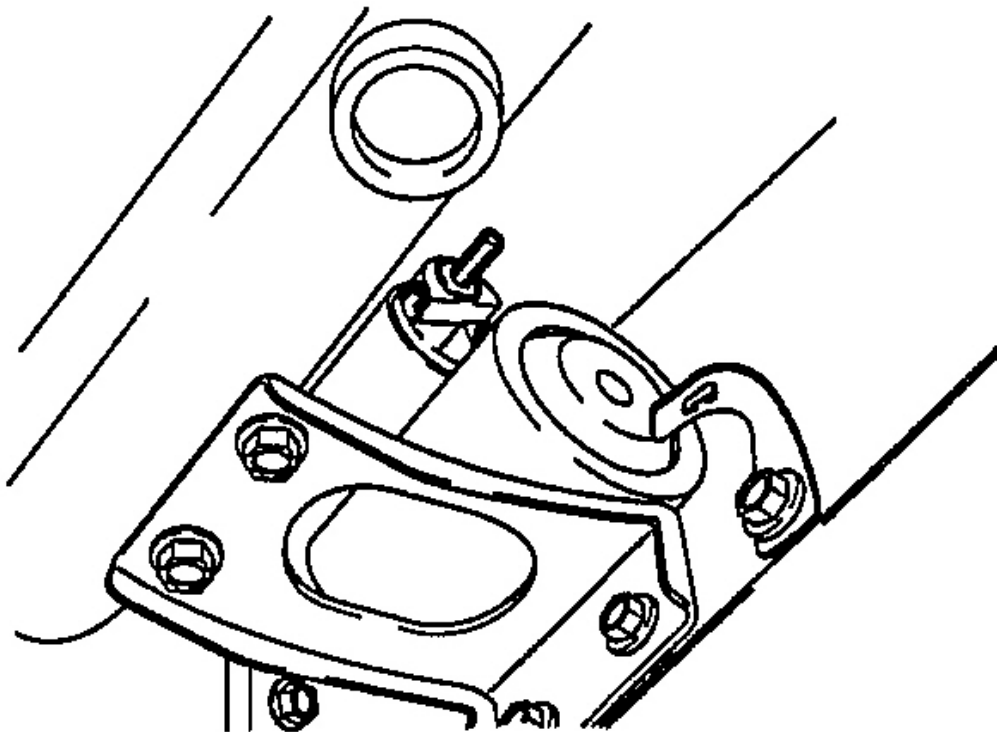
12. Install A/C compressor.
13. Connect B-terminal connector to generator.



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Fig. 31: Connecting B-Terminal Connector To Generator
Courtesy of KIA MOTORS AMERICA, INC.

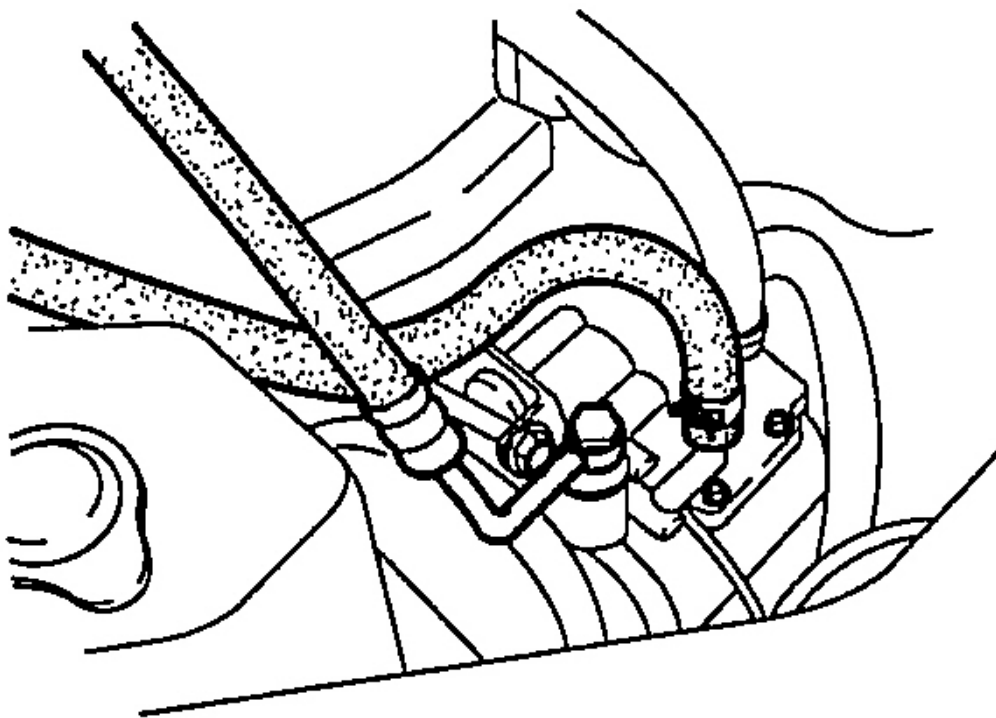
14. Connect B-terminal and S-terminal connector to starter.



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Fig. 32: Connecting B-Terminal & S-Terminal Connector To Starter
Courtesy of KIA MOTORS AMERICA, INC.

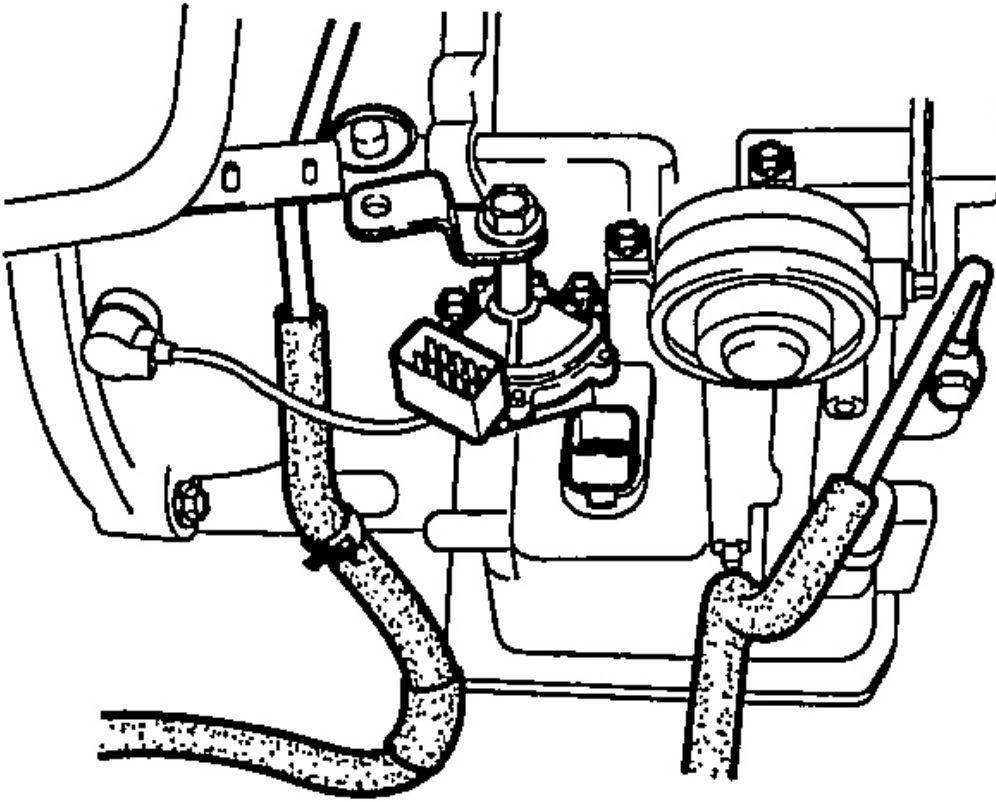
15. Connect power steering pump hose.



G00325882

Fig. 33: Connecting Power Steering Pump Hose
Courtesy of KIA MOTORS AMERICA, INC.

16. Connect ATF cooler hose (A/T).
17. Connect solenoid valve connector (A/T).
18. Connect transaxle range switch connector (A/T).



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Fig. 34: Connecting Transaxle Range Switch Connector
Courtesy of KIA MOTORS AMERICA, INC.

19. Install clutch release cylinder and pipe (M/T).

Tightening torque:

13.7~18.8 lb-ft (18.6~25.5 N . m, 1.9~2.6 kg-m)

20. Install extension bar and manual transaxle linkage (M/T).

Tightening torque:

Extension bar: 27~38 lb-ft

(37.2~52 N . m, 3.8~5.3 kg-m)

Manual transaxle linkage:

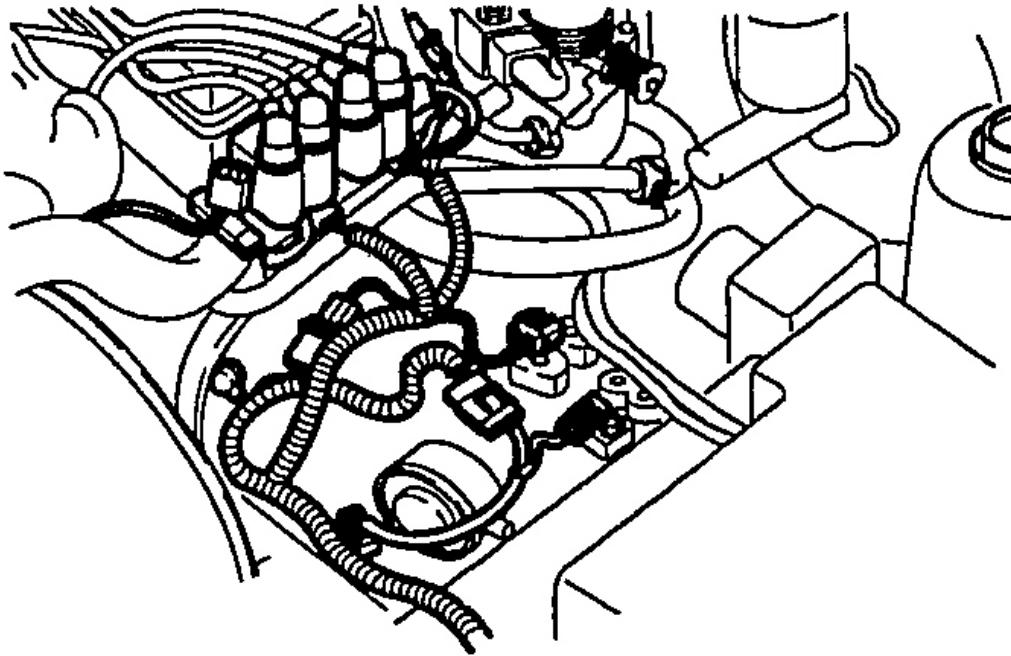
12~17 lb-ft (16~23 N . m, 1.6-2.3 kg-m)

21. Install transaxle linkage (A/T).

Tightening torque:

23.1~34.0 lb-ft (31.4~46.1 N . m, 3.2~4.7 kg-m)

22. Connect electric connectors.



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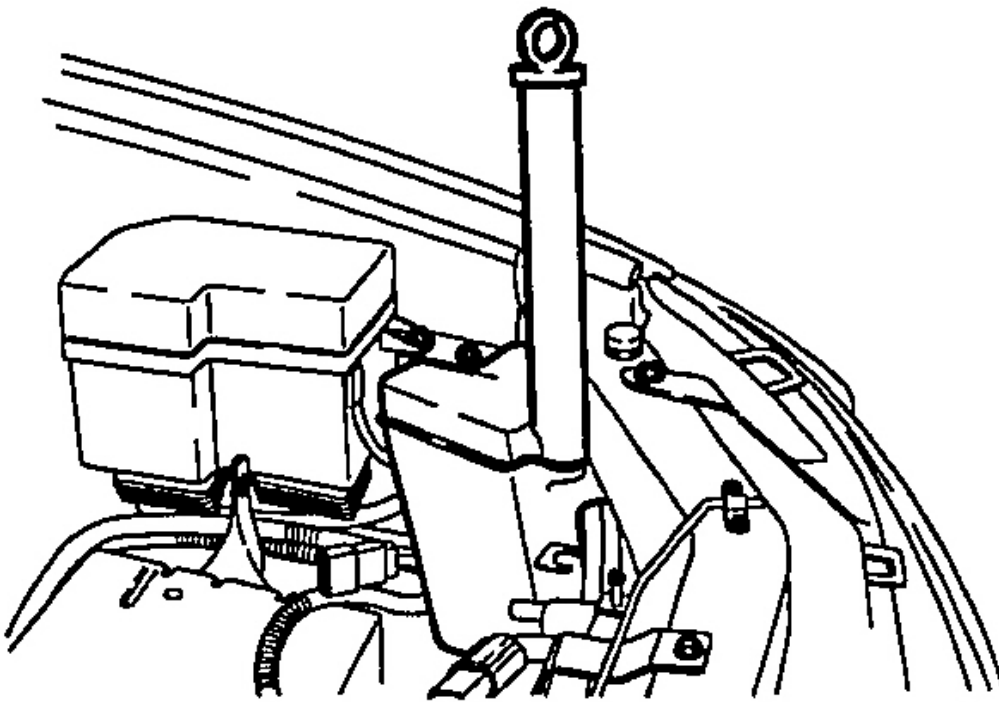
Fig. 35: Connecting Electric Connectors
Courtesy of KIA MOTORS AMERICA, INC.

23. Connect injector connectors to injector rail.
24. Connect brake vacuum hose and purge control vacuum hose to dynamic chamber.
25. Install heater hose.
26. Connect fuel hose to injector rail.
27. Install accelerator cable.

28. Install upper and lower radiator hose.
29. Install fresh air duct.
30. Install battery tray and battery.

Tightening torque:

10~12 lb-ft (13.5~16 N . m, 1.4~1.6 kg-m)



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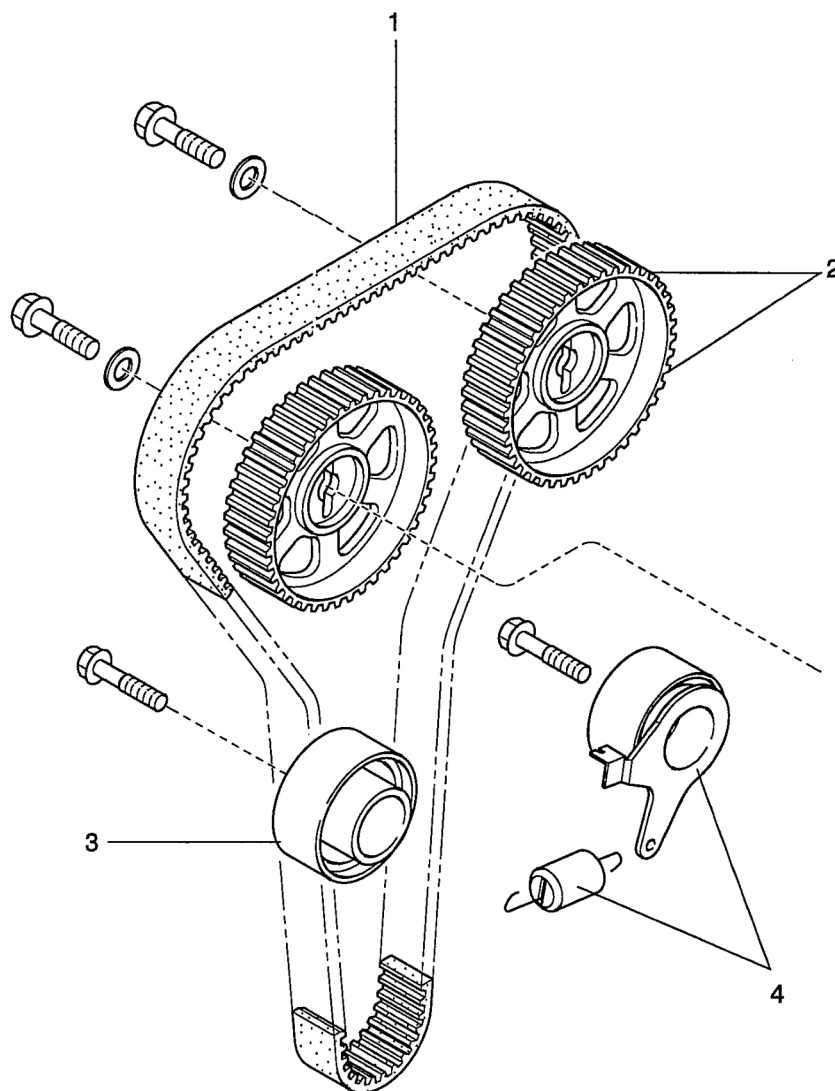
Fig. 36: Installing Battery Tray & Battery
Courtesy of KIA MOTORS AMERICA, INC.

31. Fill engine coolant with specified type and amount.
32. Connect both battery cables.
33. Check and/or fill all fluids.
34. Test run engine perform an overall check.

TIMING SYSTEM

TIMING BELT

COMPONENT



- 1. Body timing belt
- 2. Camshaft pulley

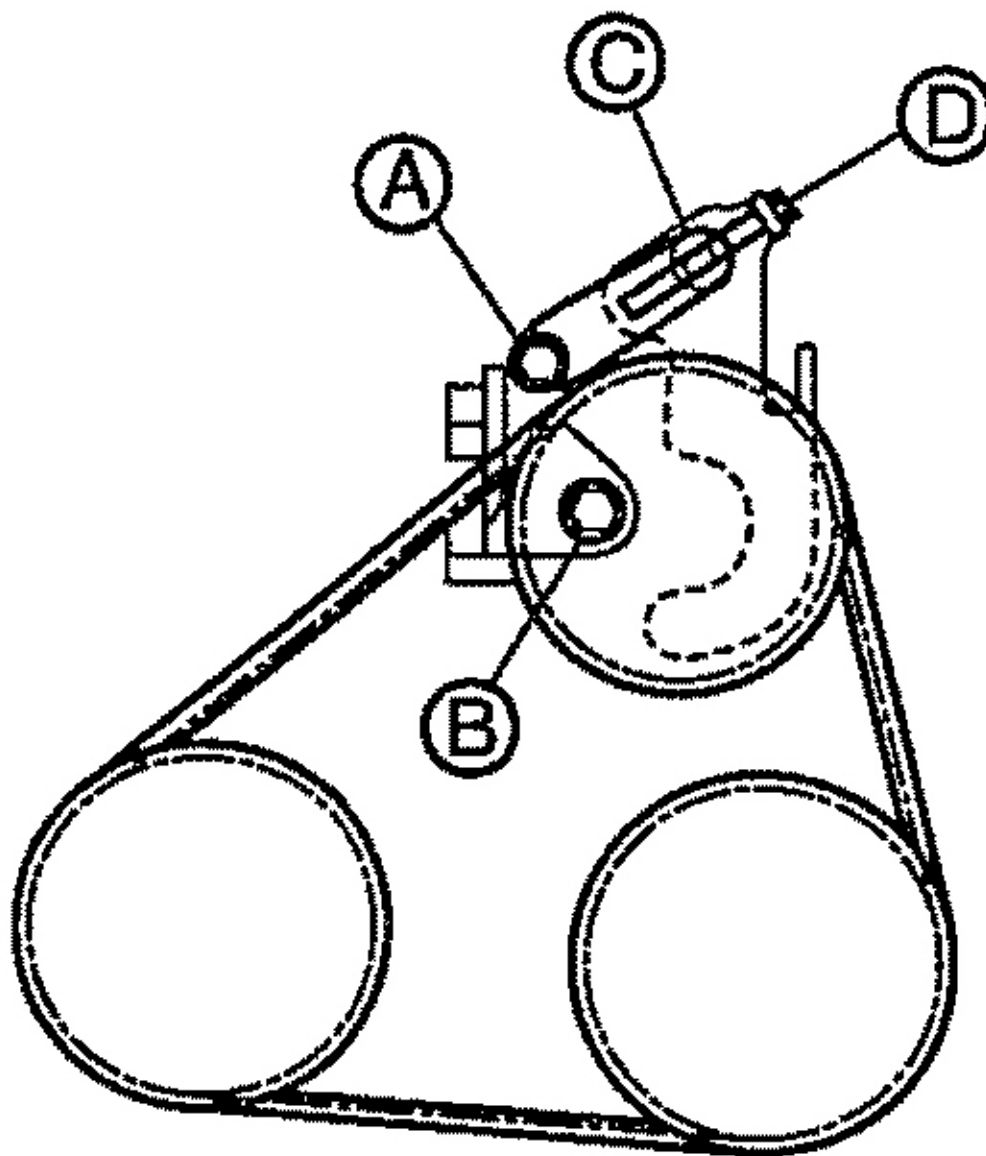
- 3. Idler
- 4. Timing belt tensioner & spring

G00325988

Fig. 37: Identifying Timing System Components
 Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

1. Disconnect negative battery cable.
2. Loosen power steering lock bolts and nuts accordingly and remove tension from power steering (P/S) and/or air conditioning (A/C) compressor drive belt.

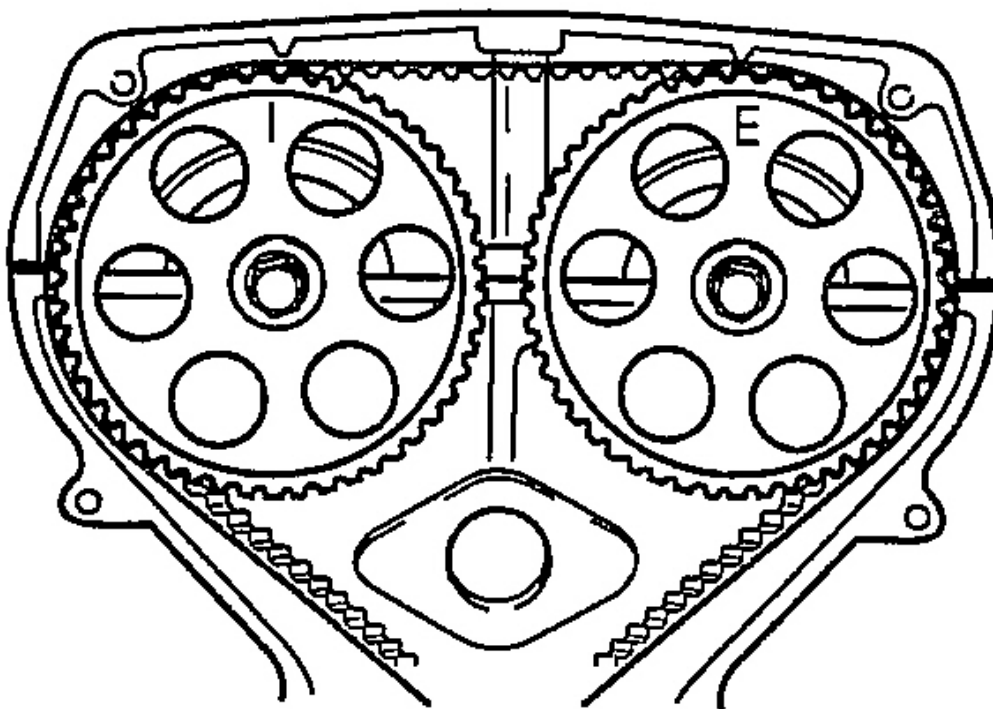


G00325989

Fig. 38: Loosening Drive Belt Tensioners
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove P/S and/or A/C drive belt.

4. Loosen generator mounting bolts and adjusting bolt.
5. Remove generator bolts.
6. Remove water pump pulley.
7. Remove crankshaft pulley.
8. Remove upper and lower timing belt covers.
9. Turn crankshaft so that timing mark on timing belt pulley is aligned with timing mark on engine.
10. Check that "I" mark on intake camshaft pulley is aligned with mark on seal plate and "E" mark on exhaust camshaft pulley is aligned with mark on seal plate.



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Fig. 39: Identifying Camshaft Timing Marks
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Do not move camshaft or crankshaft once timing marks have been correctly positioned.

11. Loosen tensioner pulley lock bolt.

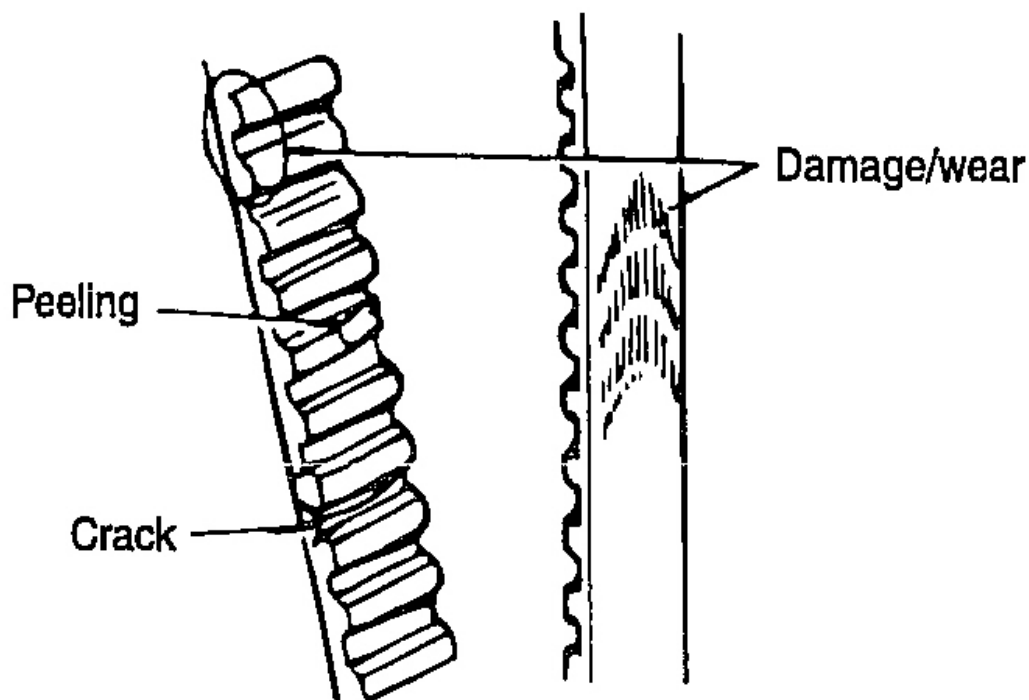
12. Protect timing belt with a rag.
13. Remove tensioner pulley.
14. Remove timing belt.

NOTE: Mark the direction of timing belt rotation (on the timing belt) for proper reinstallation.

INSPECTION

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

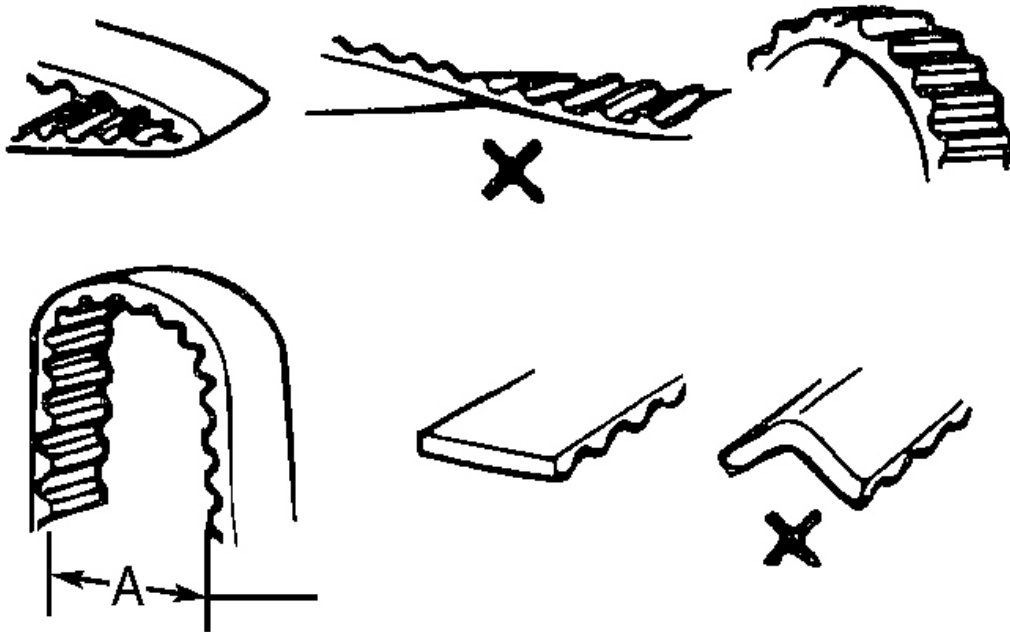
1. Replace timing belt if it is contaminated with oil or grease.
2. Check timing belt for uneven wear, fraying, peeling, cracking and hardening. Replace timing belt as necessary.



G00325991

Fig. 40: Inspecting Timing Belt For Damage
Courtesy of KIA MOTORS AMERICA, INC.

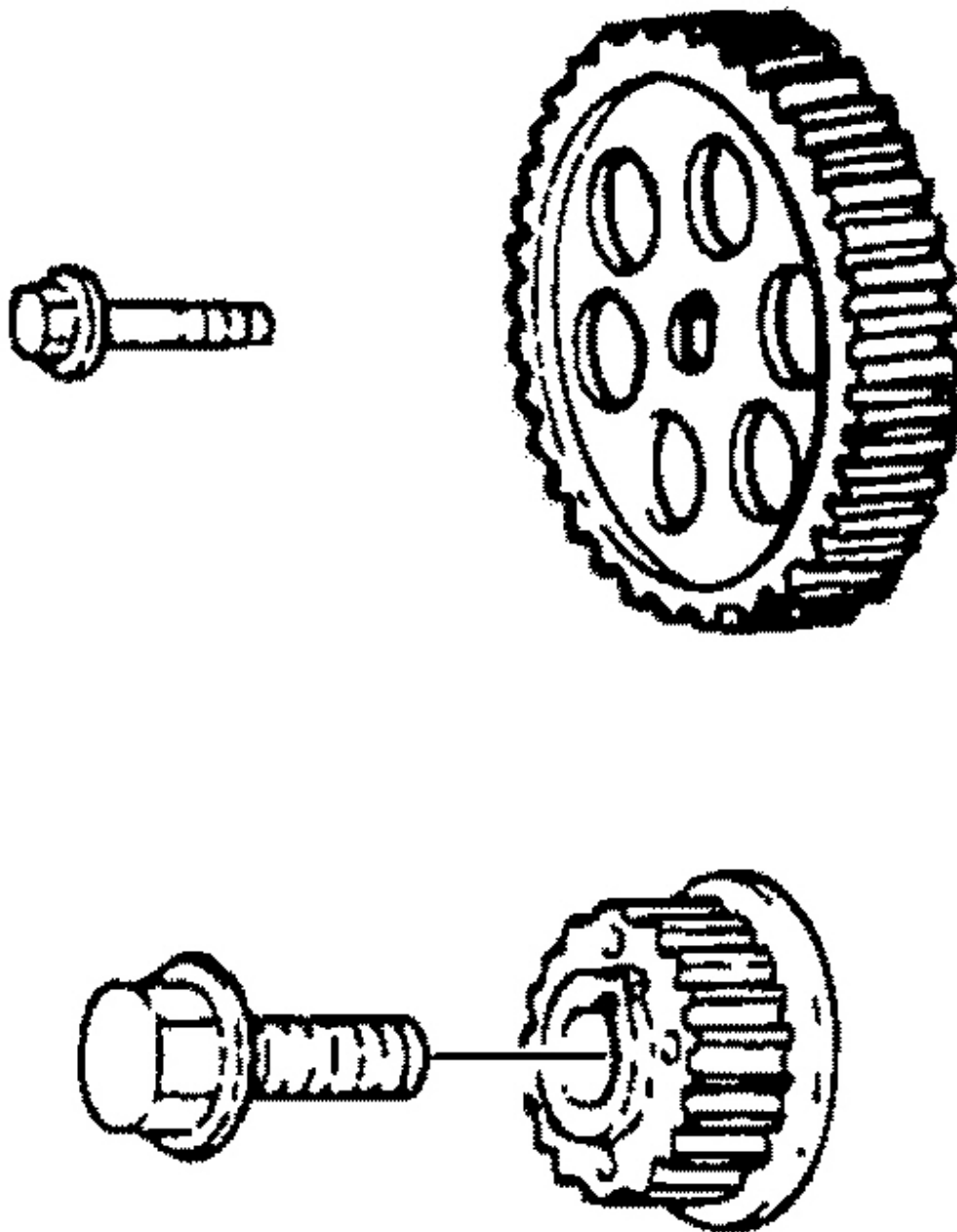
3. Bend timing belt into a "U" shape as shown in figure. Distance "A" must be at least 1.0 in (25 mm).



G00325992

Fig. 41: Inspecting Timing Belt Wear
Courtesy of KIA MOTORS AMERICA, INC.

4. Inspect both idler pulley and tensioner pulley for uneven wear and smooth bearing operation.
5. Inspect camshaft pulleys and timing belt pulley for broken teeth or damage.



G00325993

Fig. 42: Inspect Camshaft And Timing Belt Pulleys For Damage

Courtesy of KIA MOTORS AMERICA, INC.

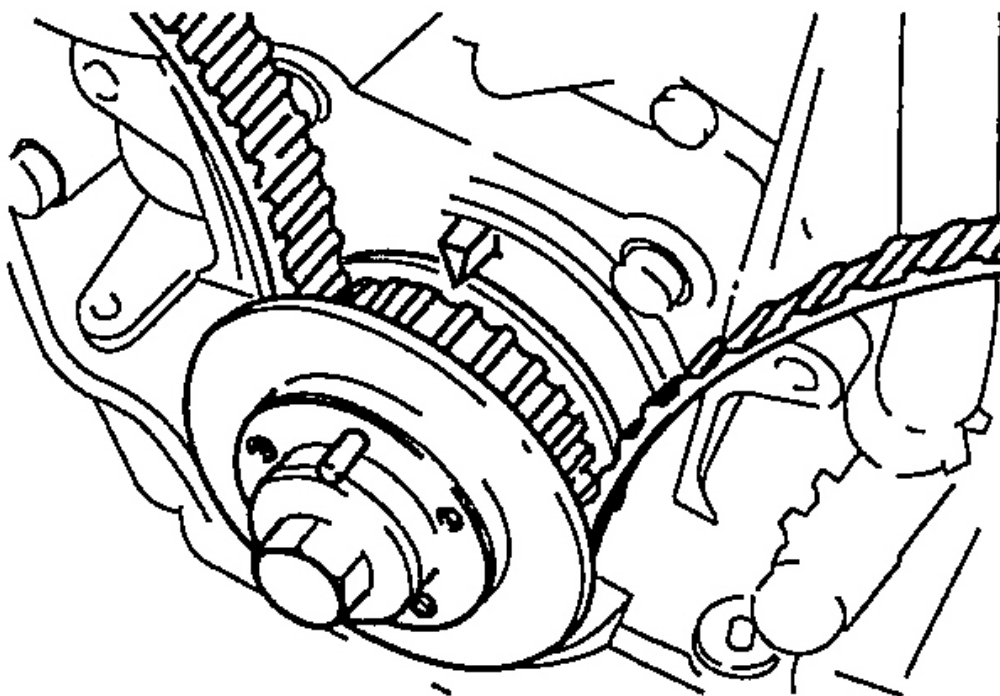
NOTE: Replace any component that shows damage, excessive wear, or that appears prone to a possible failure.

INSTALLATION

1. Install tensioner pulley.

NOTE: Replace tensioner spring whenever timing belt is replaced.

2. Pull tensioner pulley to its furthest point and tighten lock bolt.
3. Check that timing mark on timing belt pulley is aligned with timing mark on engine.



G00325994

Fig. 43: Aligning Timing Belt Pulley Timing Marks
Courtesy of KIA MOTORS AMERICA, INC.

4. Check that "I" mark on intake camshaft pulley is aligned with mark on seal plate and "E" mark on exhaust

camshaft pulley is aligned with mark on seal plate.

NOTE: **If existing timing belt is being reused, install belt in proper rotation direction marked prior to removal.**

5. Install timing belt onto timing belt pulley first, then idler pulley, exhaust camshaft pulley, intake camshaft pulley, and tensioner pulley in that order.
6. Check that there is no looseness in belt between idler pulley and exhaust camshaft pulley or between intake and exhaust camshaft pulleys.
7. Loosen tensioner pulley lock bolt and allow tensioner spring to apply tension to timing belt.

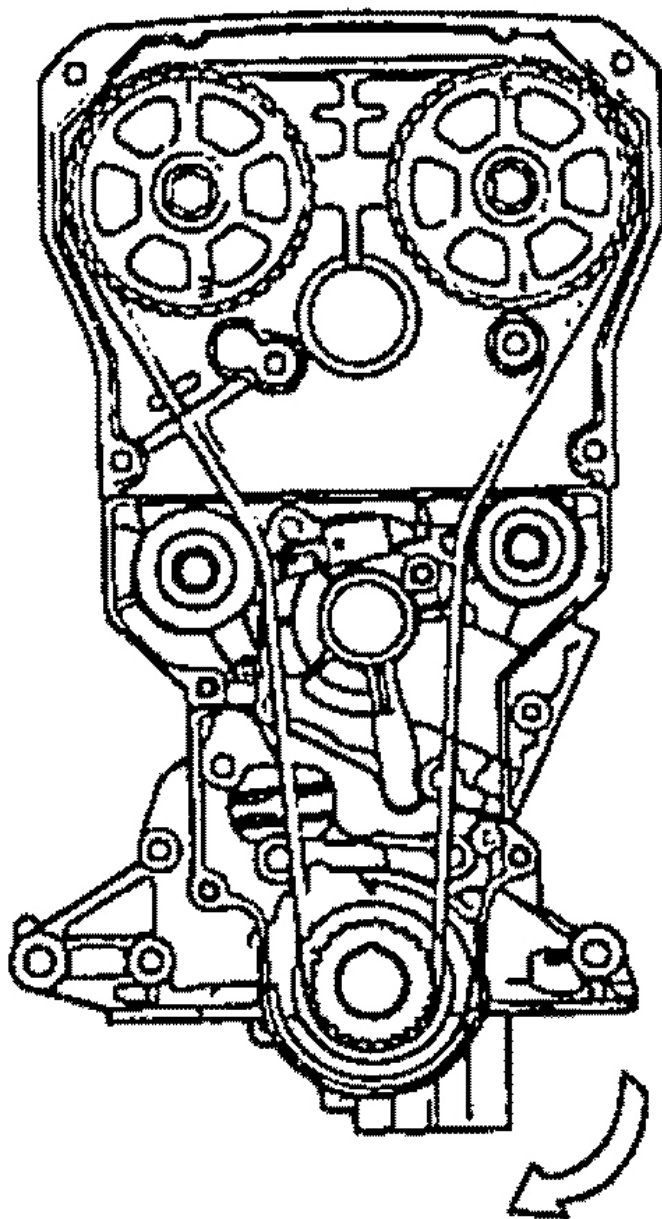
NOTE: **Do not add additional tension.**

8. Tighten tensioner pulley lock bolt to specified torque.

Tightening torque:

28~38 lb-ft (38~51 N . m, 3.9~5.2 kg-m)

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



G00325995

Fig. 44: Identifying Proper Crankshaft Rotation
Courtesy of KIA MOTORS AMERICA, INC.

10. Check that "I" mark on intake camshaft pulley and "E" mark on exhaust camshaft pulley are aligned with marks on seal plate.

11. If they are not aligned, remove timing belt and start process from tensioner installation.
12. Measure timing belt deflection by applying moderate pressure midway between camshaft pulleys. If deflection is not correct, repeat from tensioner installation.

Deflection pressure:

22 lb. (98 N, 10 kg)

Deflection:

0.39~0.50 in. (11~13 mm)

13. Install lower and upper timing belt covers in that order.

Tightening torque:

5.8~8.0 lb-ft (7.9~10.7 N . m, 0.8~1.1 kg-m)

14. Install timing belt Guide plate and crankshaft pulley.

Tightening torque:

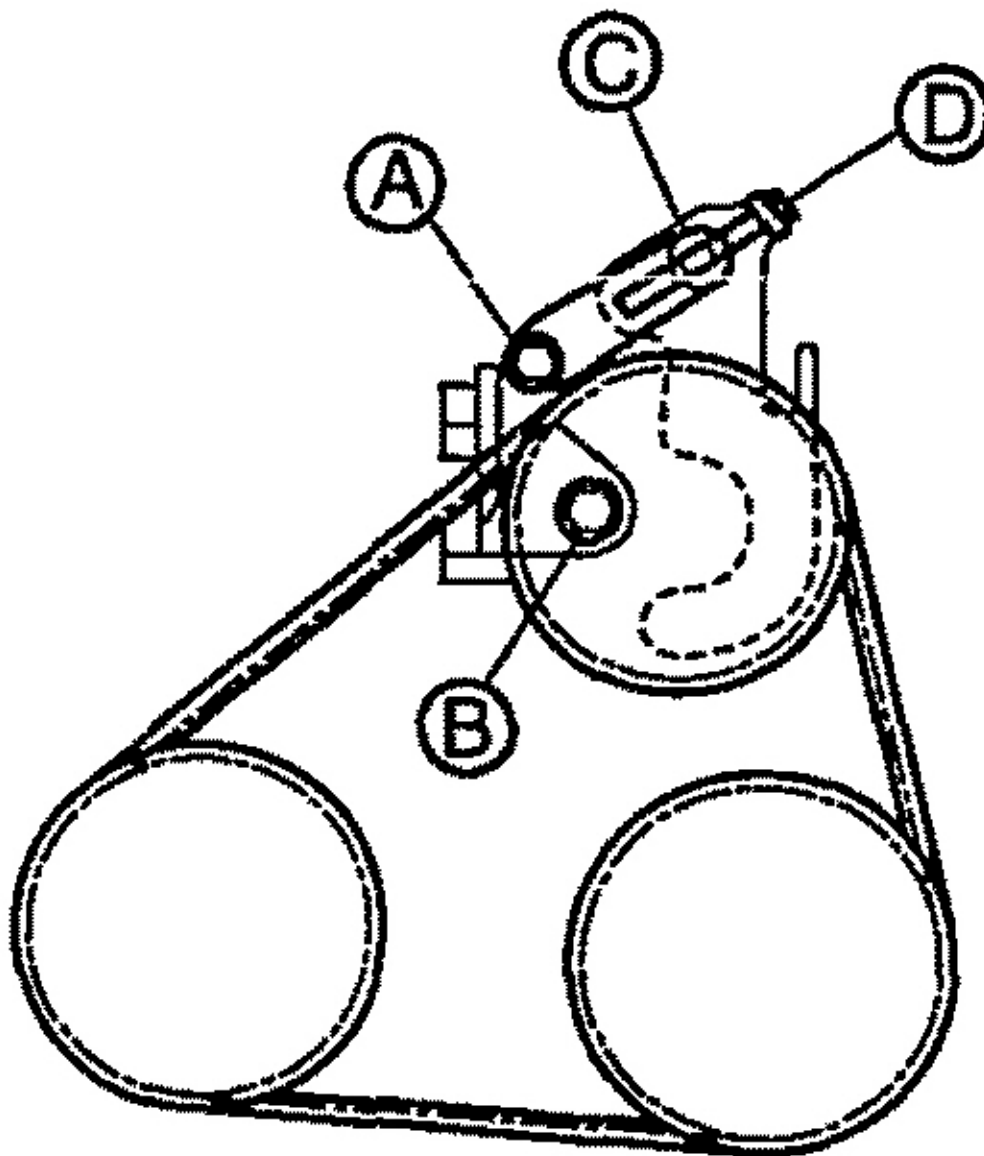
9.0~12.6 lb-ft (12.3~17.2 N . m, 1.3~1.8 kg-m)

15. Install water pump pulley.

Tightening torque:

9.0~12.6 lb-ft (12.3~17.2 N . m, 1.3~1.8 kg-m)

16. Install generator belt and adjust the tension.



G00325996

Fig. 45: Installing Generator Belt
Courtesy of KIA MOTORS AMERICA, INC.

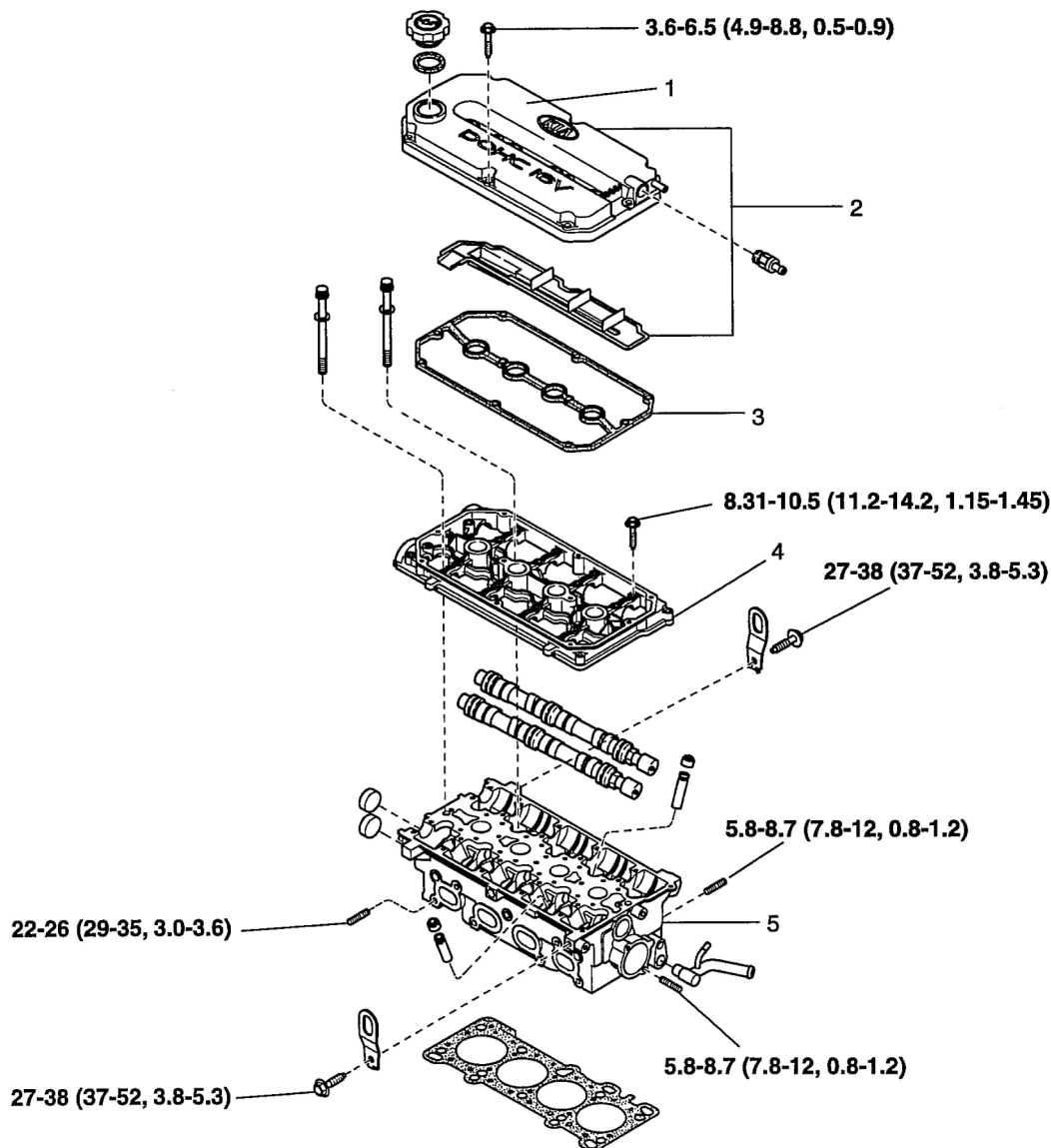
17. Install P/S and/or A/C drive belt and adjust the tension.

18. Connect negative battery cable.

CYLINDER HEAD ASSEMBLY

CYLINDER HEAD

COMPONENT



TORQUE : lb·ft (N·m, kg·m)

- 1. Cylinder head cover
- 2. Cylinder head cover

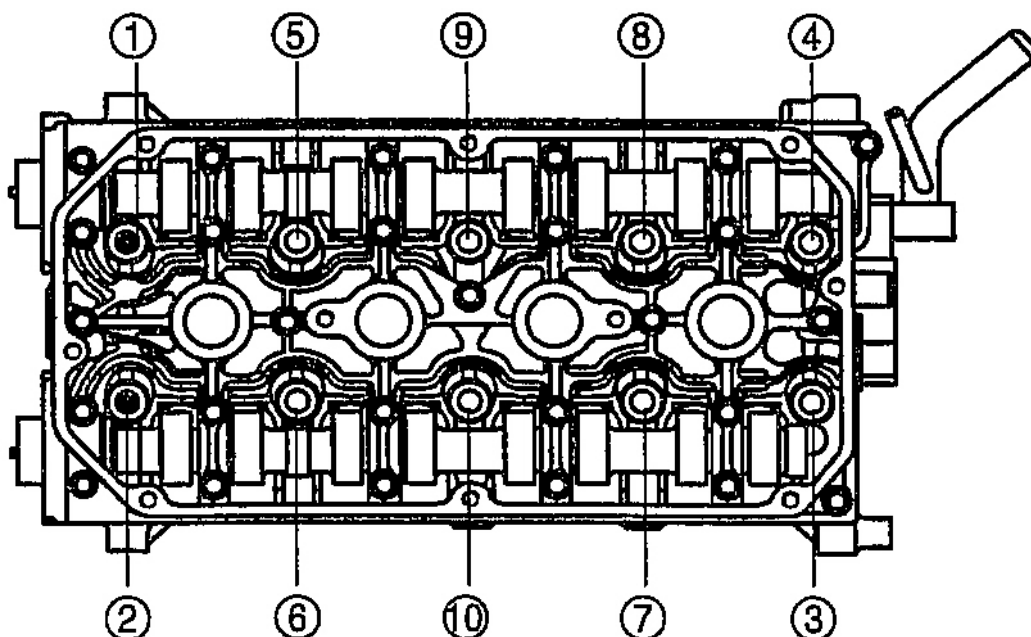
- 3. Cylinder head cover gasket
- 4. Cam carrier assembly
- 5. Cylinder head

G00325969

Fig. 46: Identifying Cylinder Head Components With Torque Specifications
Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

1. Drain the coolant and disconnect the upper radiator hose.
2. Remove the breather hose (between the air cleaner and the head cover).
3. Remove the air-intake hose.
4. Remove the vacuum hose, fuel hose and coolant hose
5. Remove the cables from the spark plugs. The cables should be removed by holding the boot portion.
6. Remove the ignition coil.
7. Remove the power steering oil pump and bracket.
8. Remove the intake manifold.
9. Remove the heat protector and exhaust manifold assembly.
10. Remove the coolant pump pulley and the crankshaft pulley.
11. Remove the timing belt cover.
12. Remove the timing belt tensioner pulley.
13. Remove the timing belt.
14. Remove the head cover and cam carrier assembly.
15. Remove the cylinder head assembly. The cylinder head bolts should be removed by using Special Tool, Cylinder Head Bolt Wrench, in the sequence as shown in the illustration below.



G00325970

Fig. 47: Cylinder Head Bolt Loosening Sequence
 Courtesy of KIA MOTORS AMERICA, INC.

16. Remove the gasket pieces from cylinder block top surface and cylinder head bottom surface.

NOTE: Make sure that the gasket pieces do not fall in the engine

INSPECTION

1. Clean all components.
2. Remove gasket fragments, dirt, oil, grease, carbon, moisture, residue, and other foreign materials.
3. Inspect cylinder head for damage, cracks, and leakage of oil and water. Replace cylinder head if necessary.
4. Measure cylinder head mating surface in six directions as shown in figure.

Distortion:

0.0012 in (0.03 mm) maximum

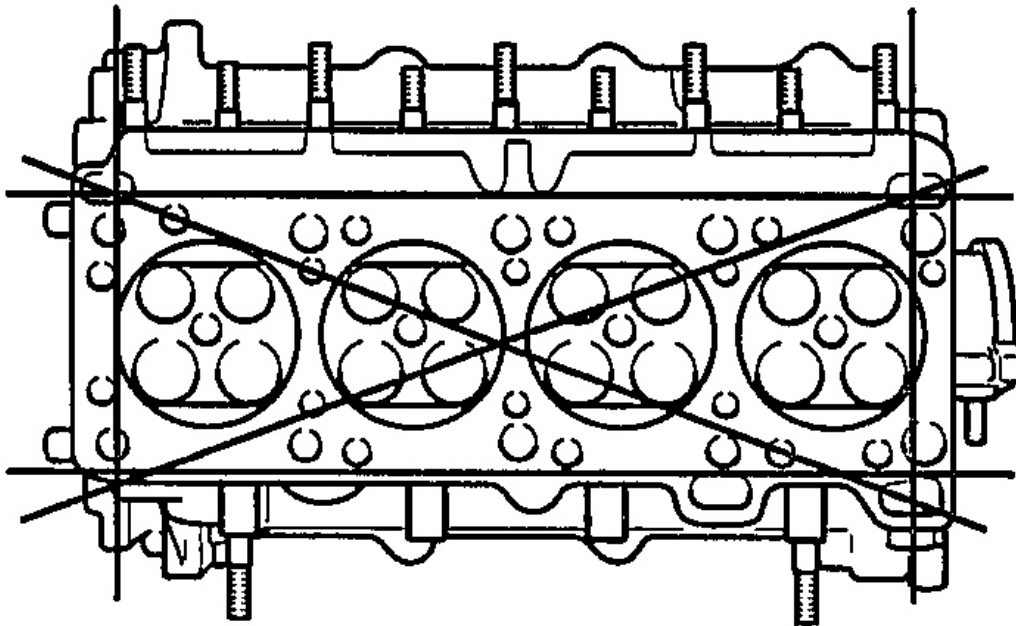
NOTE: Before resurfacing cylinder head, check following repair or replace cylinder head if necessary

- **Sunken valve seats.**
- **Damage at intake and exhaust manifold mating surfaces.**
- **Camshaft oil clearances and end play.**

5. Grind cylinder head mating surface if distortion exceeds specification.

Distortion:

0.0012 in (0.03 mm) maximum



G00325971

Fig. 48: Measuring Cylinder Head Distortion
Courtesy of KIA MOTORS AMERICA, INC.

1. Check cylinder head height by measuring from cylinder deck surface to cylinder head cover gasket surface.
2. If cylinder head height is not within specification, replace cylinder head.

Height:

5.031~5.039 in (127.8~128 mm)

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

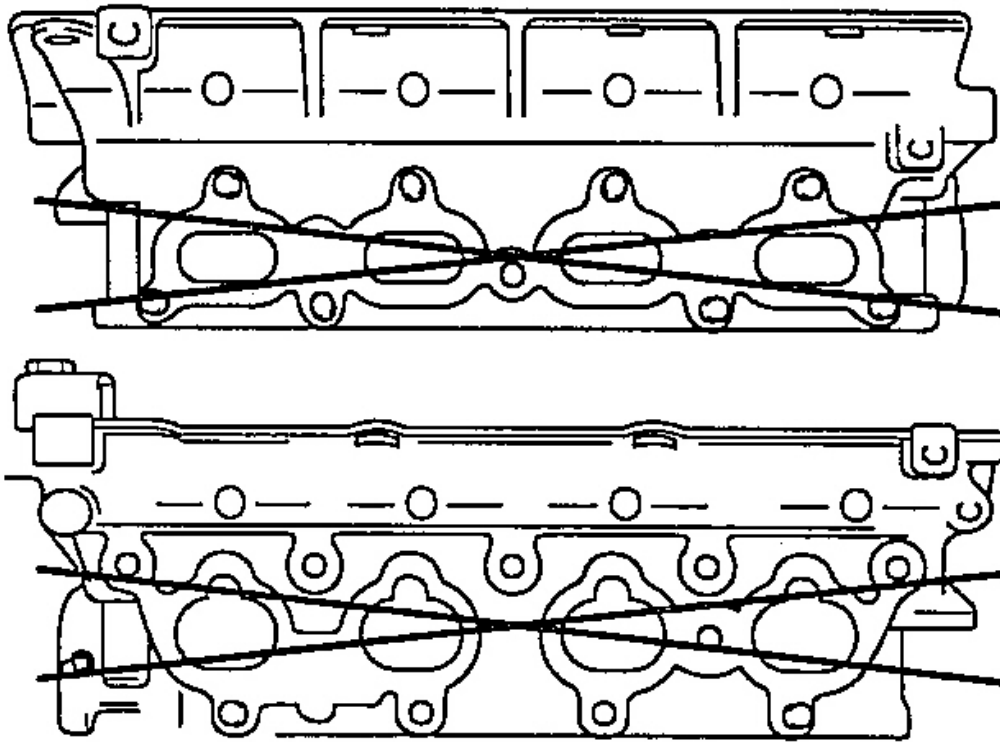
Distortion:

0.002 in (0.05 mm) maximum

4. If distortion exceeds specification, resurface or replace cylinder head.

Distortion:

0.002 in (0.05 mm) maximum



G00325972

Fig. 49: Measuring Cylinder Head-To-Manifold Mating Surface Distortion
Courtesy of KIA MOTORS AMERICA, INC.

INSTALLATION

1. Clean all gasket surfaces of the cylinder block and the cylinder head.

2. Install a new cylinder head gasket onto the cylinder head assembly.

Apply sealant to the gasket and do not reuse the old cylinder head gasket.

- a. Tighten cylinder head bolts in order shown.

Tightening torque:

36.1 lb-ft (49 N . m, 5 kg-m)

- b. Loosen bolts in reverse of order shown.
- c. Retighten cylinder head bolts in order shown.

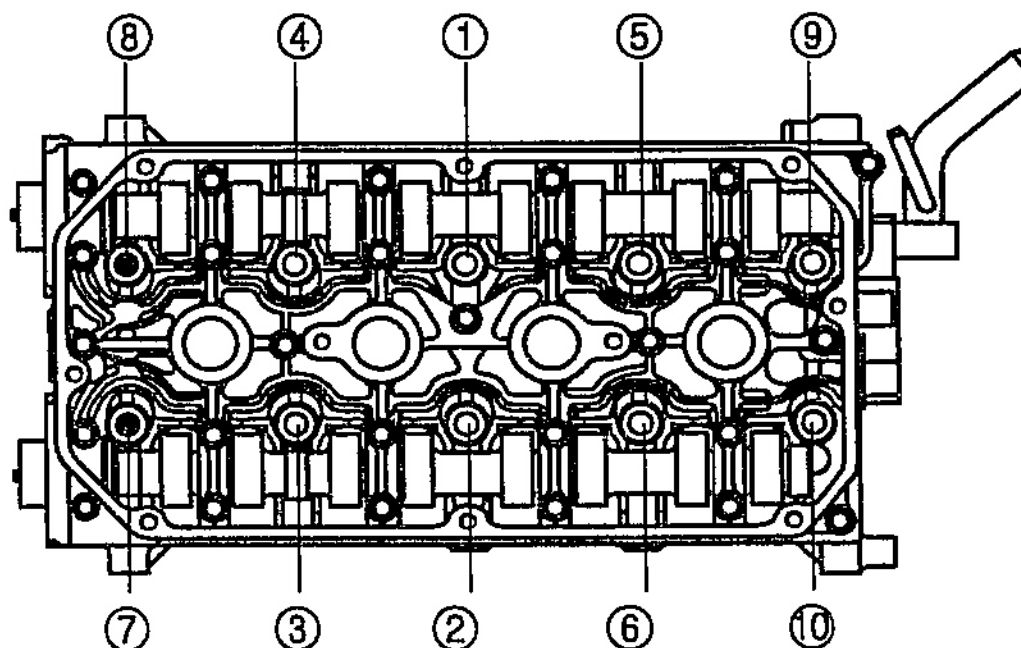
Tightening torque:

18 lb-ft (25 N . m, 2.5 kg-m)

- d. Mark cylinder head bolts for rotational reference.
- e. Rotate cylinder head bolts 90° (1/4 Turn) in order shown. See **Fig. 50**.

CAUTION:

- **Do not rotate crankshaft without timing belt.**
- **Make sure that all pistons are positioned in the middle of cylinder before installing cylinder head.**
- **Two bolts (No.7 and No.8) are shorter than other bolts. Never install the two bolts in other position. (for A6D)**
- **Do not reuse the old cylinder head bolts.**



G00325974

Fig. 50: Cylinder Head Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

3. Install the timing belt tensioner pulley.
4. Install the timing belt on the camshaft sprocket, marking sure that the tension side is tightened by turning the camshaft sprocket in reverse, all timing marks are in alignment.
5. Adjust the timing according to **TIMING BELT**.
6. Install the rocker cover and tighten the bolts to the specified torque.

Tightening torque:

Rocker cover bolt

3.6~6.5 lb-ft (5~9 N . m, 0.5~0.9 kg-m)

7. Install the timing belt cover.
8. Install the new intake manifold gasket and the intake manifold. Tighten the nuts and bolts to the specified torque.
9. Install the exhaust manifold gasket and the exhaust manifold. Tighten the exhaust manifold attaching nuts to the specified torque.
10. Install the surge tank and tighten the nuts and bolts to the specified torque.

Tightening torque:

Manifold nuts and bolts (both intake and exhaust)

11~14 lb-ft (15~20 N . m, 1.5~2.0 kg-m)

Tightening torque:

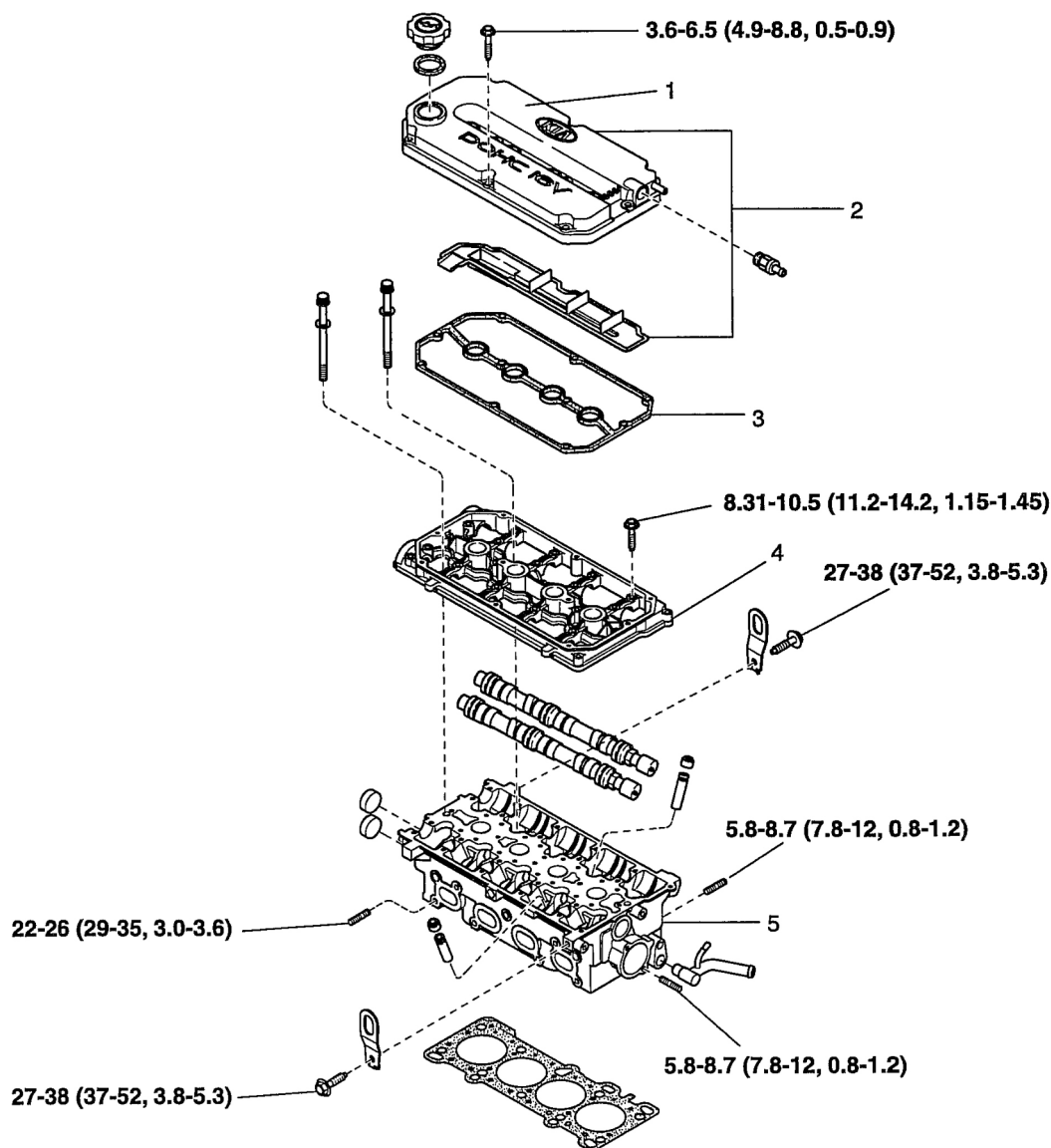
Surge tank to inlet manifold nuts and bolts

11~14 lb-ft (15~20 N . m, 1.5~2.0 kg-m)

11. Install the power steering oil pump and bracket.
12. Install the ignition coil.
13. Install the air intake hose.
14. Connect the vacuum hose, fuel hose and water hose.
15. Install breather hose.

CAMSHAFT

COMPONENT (DOHC)



TORQUE : lb·ft (N·m, kg·m)

1. Cylinder head cover
2. Cylinder head cover

3. Cylinder head cover gasket
4. Cam carrier assembly
5. Cylinder head

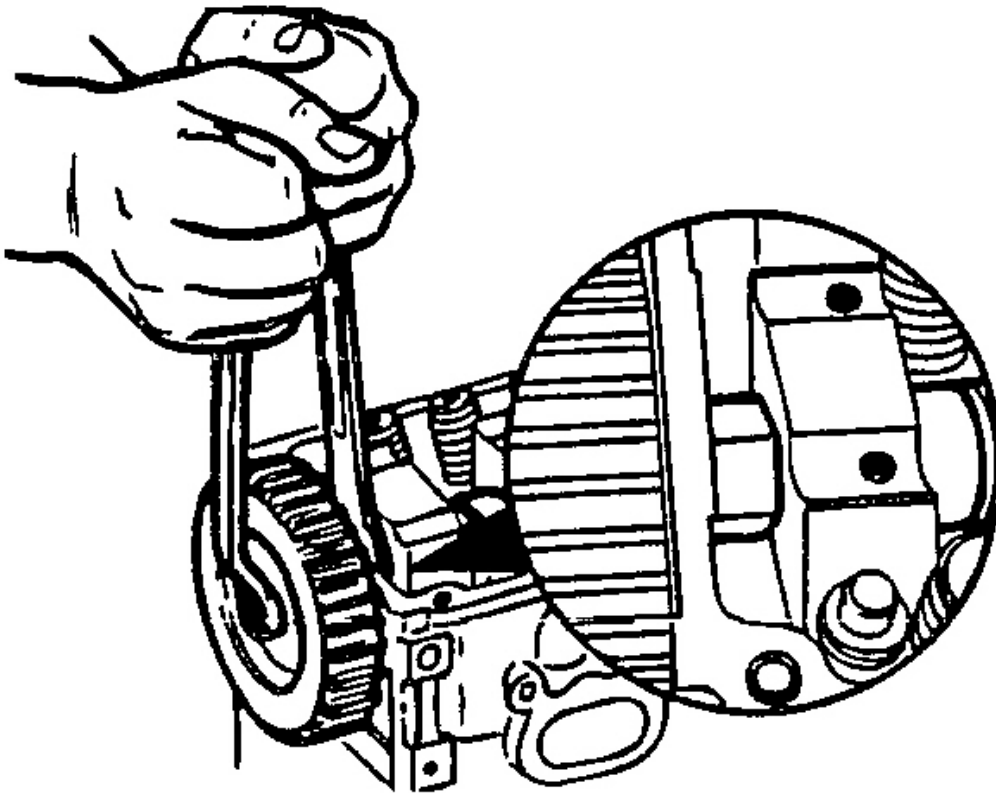
G00325890

Fig. 51: Identifying Camshaft Components With Torque Specifications With Torque Specifications
Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

1. Disconnect the breather hose and the PCV hose.
2. Remove the coolant pump pulley and crankshaft pulley.

3. Remove the timing belt cover.
4. Loosen the timing belt tensioner pulley and temporarily secure it.
5. Remove the timing belt from the camshaft sprocket.
6. Loosen the center cover bolts and then remove the center cover.
7. Remove the ignition coil assembly.
8. Loosen the cylinder head cover bolts and then remove it.
9. Remove the camshaft pulley.



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Fig. 52: Removing The Camshaft Pulley
Courtesy of KIA MOTORS AMERICA, INC.

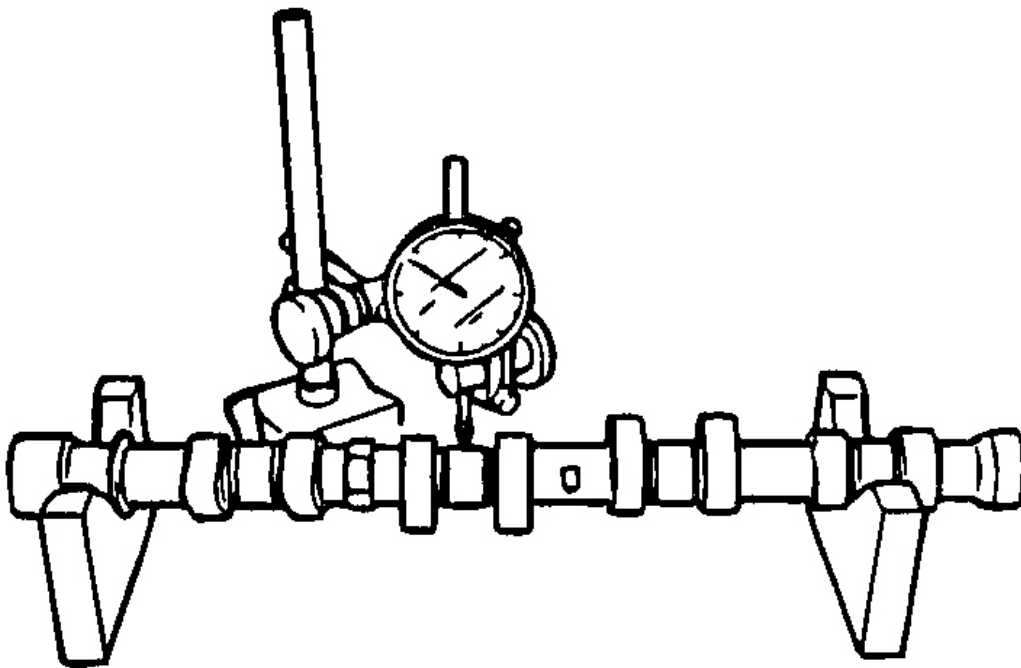
10. Remove the cam carrier assembly.
11. Remove the camshaft.
12. Remove the HLA.

INSPECTION

1. Set front and rear camshaft bearing journals on V-blocks.
2. Position a dial indicator on center bearing journal and zero dial.
3. Rotate camshaft in V-blocks and check runout.

Runout:

0.0012 in (0.03 mm) maximum



G00325892

Fig. 53: Testing Camshaft Bearing Journal Runout
Courtesy of KIA MOTORS AMERICA, INC.

4. Check camshaft for uneven wear patterns, cracks, or damage.
5. Measure cam lobe heights at two points as shown.

Lobe height

Intake, Exhaust

Standard: 1.6878 in (42.870 mm)

Minimum: 1.6877 in (42.868 mm)

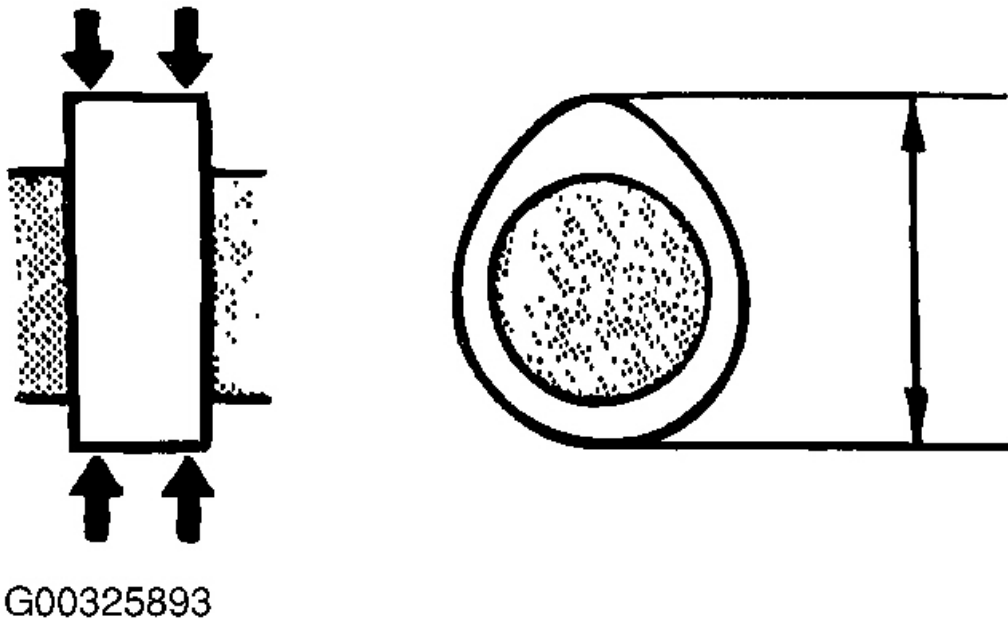


Fig. 54: Measuring Camshaft Lobe Height
 Courtesy of KIA MOTORS AMERICA, INC.

6. Check camshaft bearing journal diameter (X and Y directions) on both sides (A and B) of journal as shown in figure.

Standard diameter:

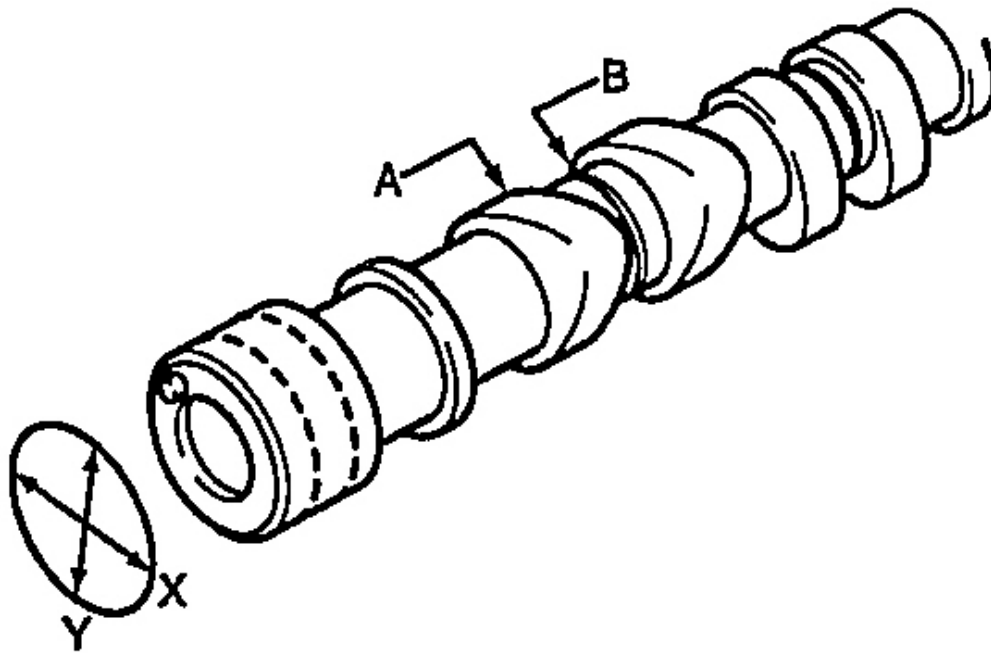
1.3370-1.3386 in (33.961-34.0 mm)

Minimum diameter:

1.0594 in (26.910 mm)

Out-of-round:

0.0012 in (0.03 mm) maximum



G00325894

Fig. 55: Measuring Camshaft Journal Diameter
Courtesy of KIA MOTORS AMERICA, INC.

7. Replace camshafts if necessary.
8. Measure camshaft journal oil clearance with HLA's removed.
9. Remove all foreign material and oil from journals and bearing surfaces.
10. Set camshafts onto cylinder head.
11. Position Plastigauge on journals in axial direction.
12. Do not rotate camshafts.
13. Install cam carrier assembly.
14. Install cam carrier bolts.

Tightening torque:

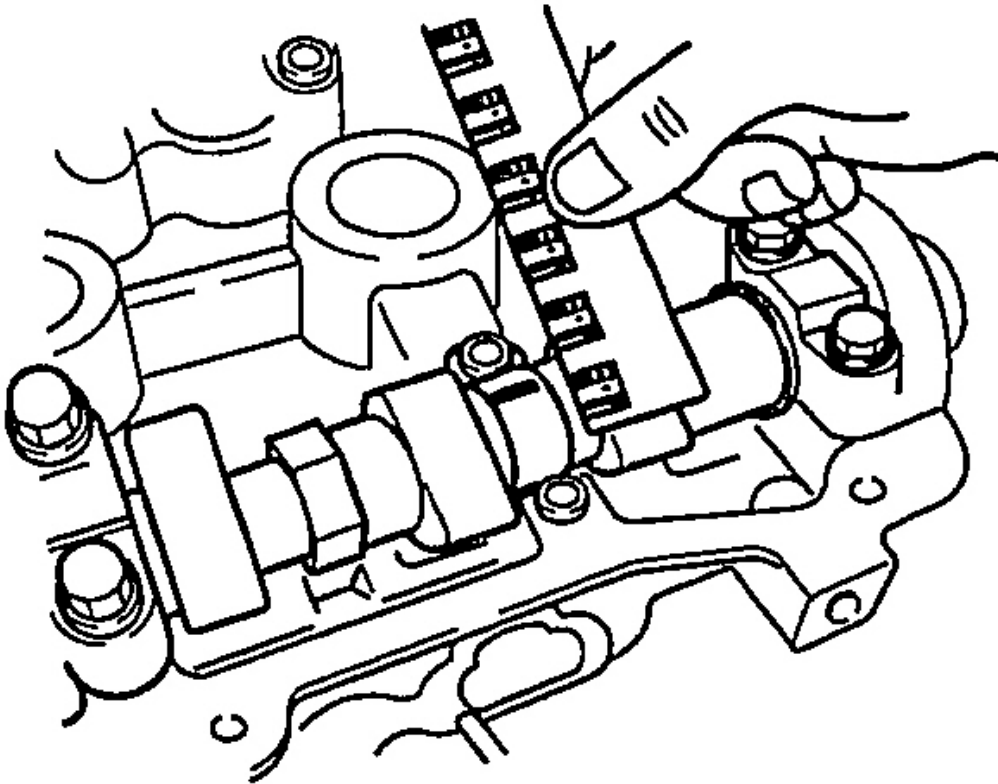
8.3~10.5 lb-ft (11.3~14.2 N . m 1.15~1.45 kg-m)

15. Loosen cam carrier assembly bolts.

16. Remove cam carrier assembly.
17. Measure oil clearances.

Oil clearance: 0.0014~0.0032 in (0.035~0.081 mm)

Maximum: 0.006 in (0.15 mm)



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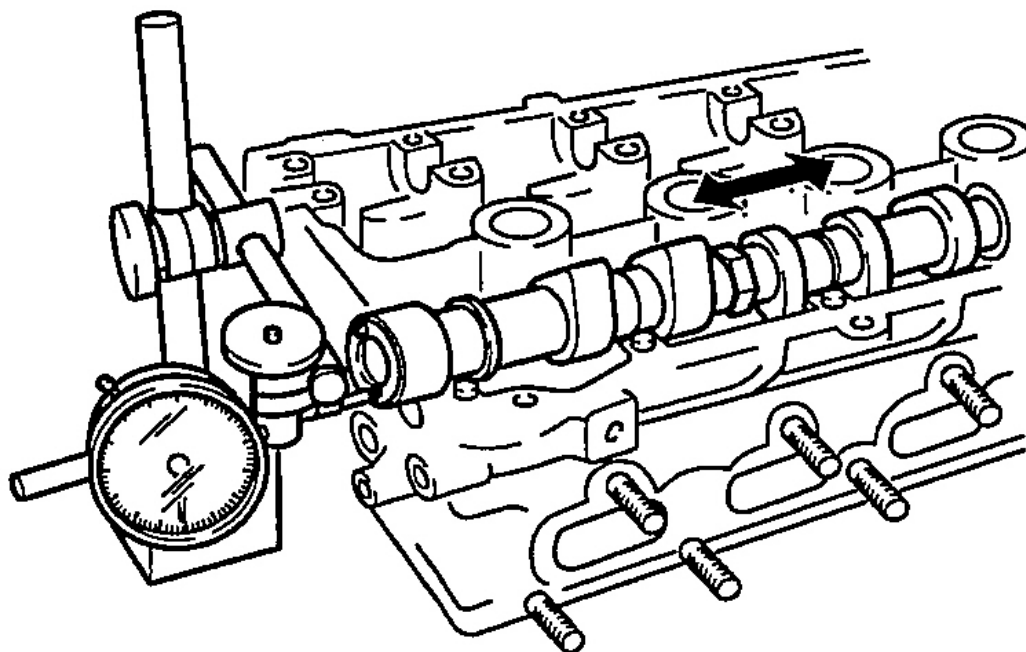
Fig. 56: Measuring Camshaft Bearing Oil Clearance
Courtesy of KIA MOTORS AMERICA, INC.

18. If oil clearance exceeds specification, replace cylinder head.
19. Install camshafts.
20. Place a dial indicator against end of camshaft.
21. Using a prying tool, move camshaft as far forward as possible.
22. Zero dial.

23. Using prying tool, move camshaft as far rearward as possible.
24. Check gauge to determine how much end play is present.

End play: 0.0026~0.0054 in (0.067~0.137 mm)

Maximum: 0.0058 in (0.147 mm)



G00325897

Fig. 57: Measuring Camshaft End Play
Courtesy of KIA MOTORS AMERICA, INC.

INSTALLATION

1. Install the HLA.
2. Install the phase sensor target wheel to the intake camshaft.

NOTE: The knock pin of camshaft and the white paint mark of target wheel must be symmetrical each other centering around axis of camshaft when installing the target wheel.

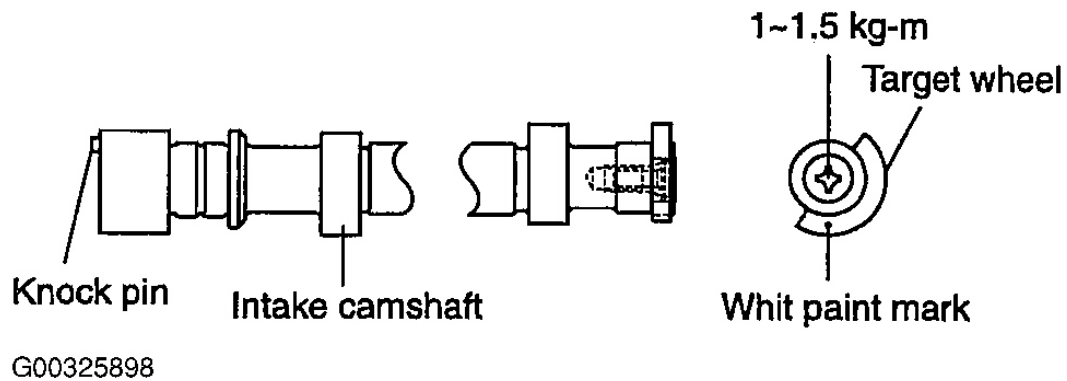
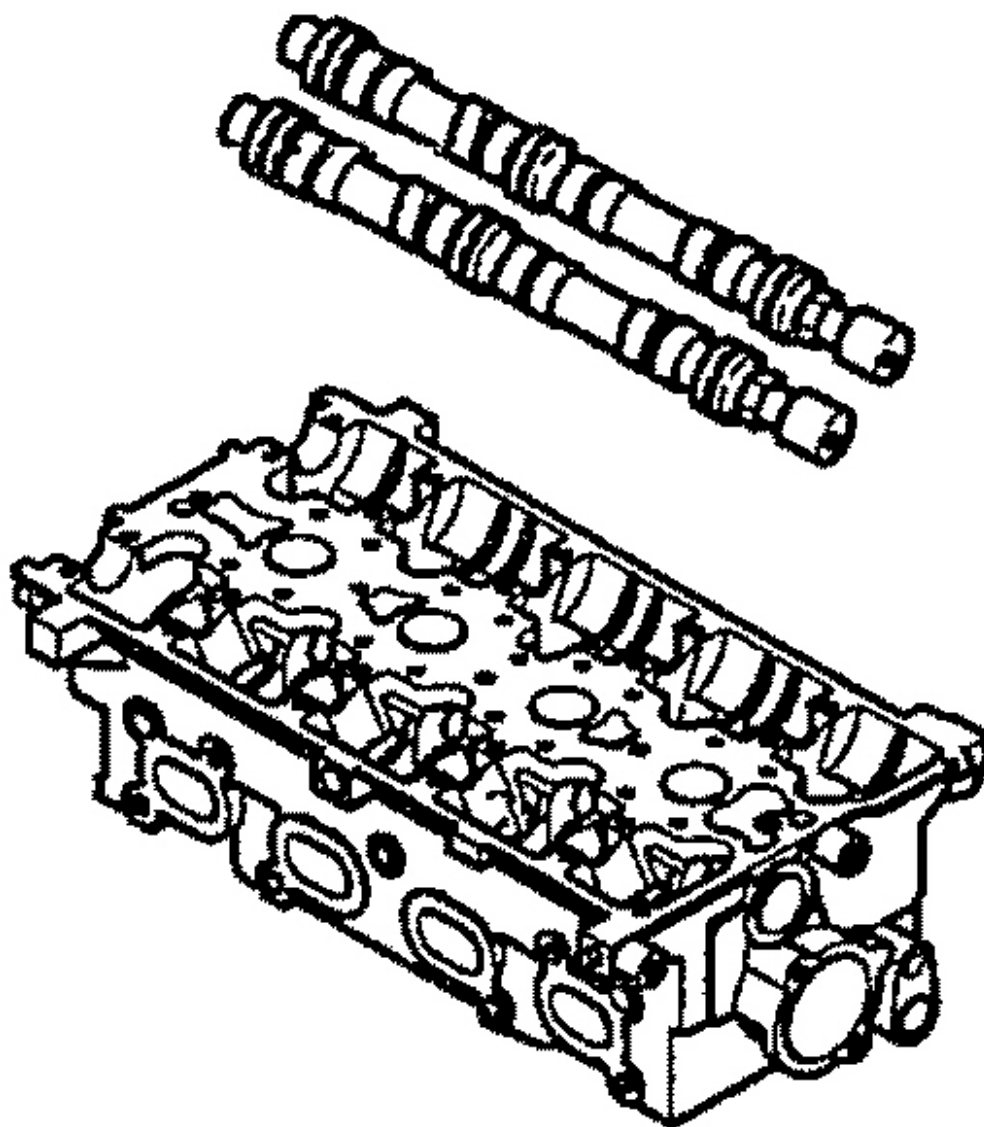


Fig. 58: Identifying Phase Sensor Target Wheel
 Courtesy of KIA MOTORS AMERICA, INC.

3. Install the camshaft after lubricating the journal of camshaft with engine oil.



G00325899

Fig. 59: Installing Camshafts

Courtesy of KIA MOTORS AMERICA, INC.

4. Apply liquid sealant on the cam carrier as shown illustration.

Sealant type : HYLOGRIP 3000

Bead width : 0.0787 in (2 mm)

NOTE:

- Clean the foreign material from mating surface before applying sealant.
- Assembly procedure must be completed within 15 minutes after applying sealant.

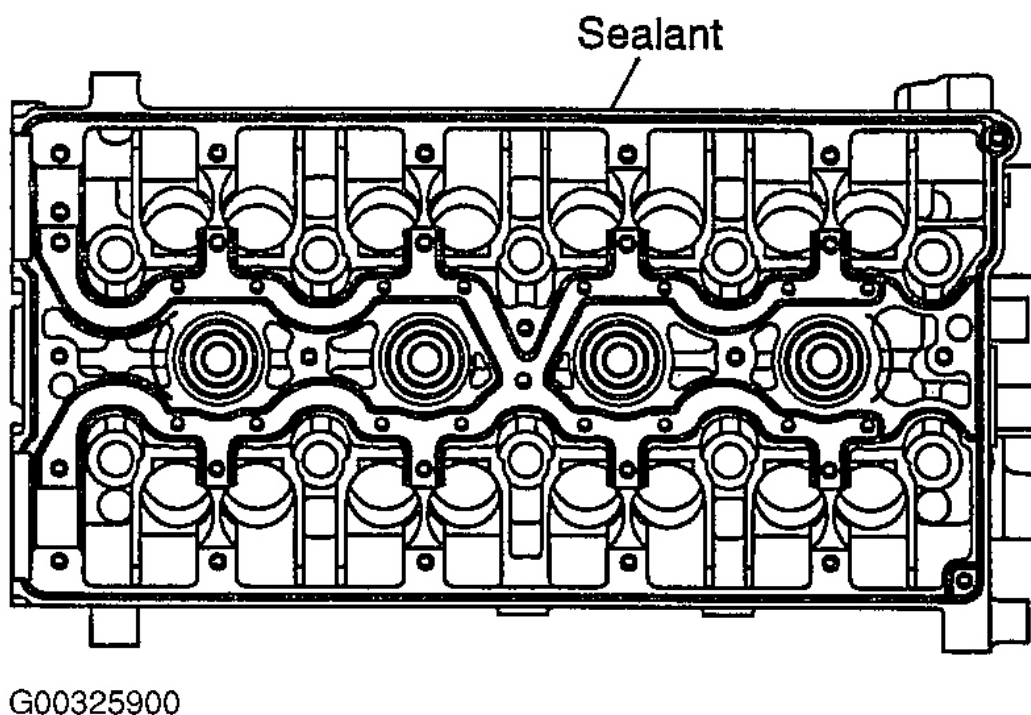
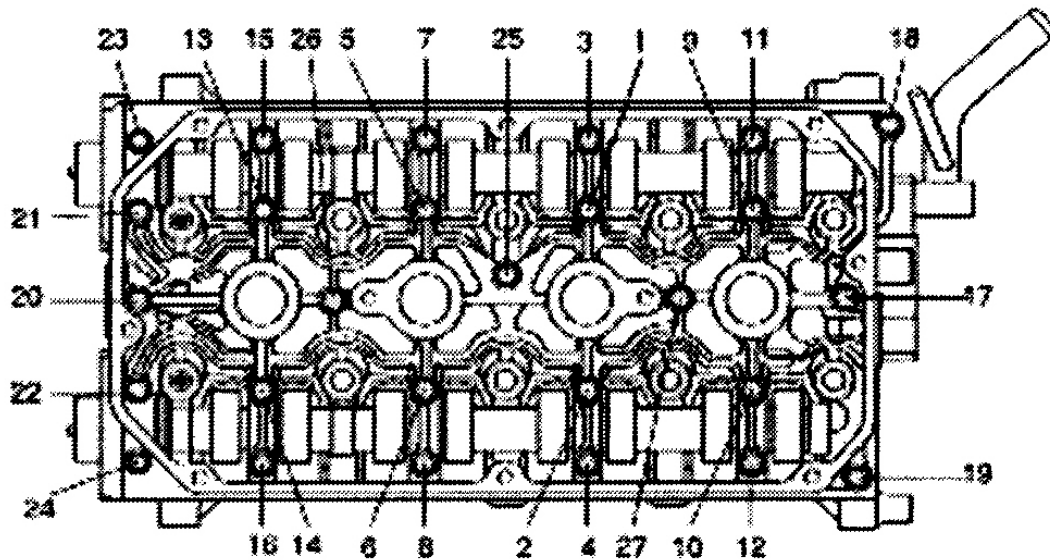


Fig. 60: Applying Sealant Onto The Cam Carrier
Courtesy of KIA MOTORS AMERICA, INC.

5. Install the cam carrier assembly. Tighten the cam carrier bolts as shown illustration.



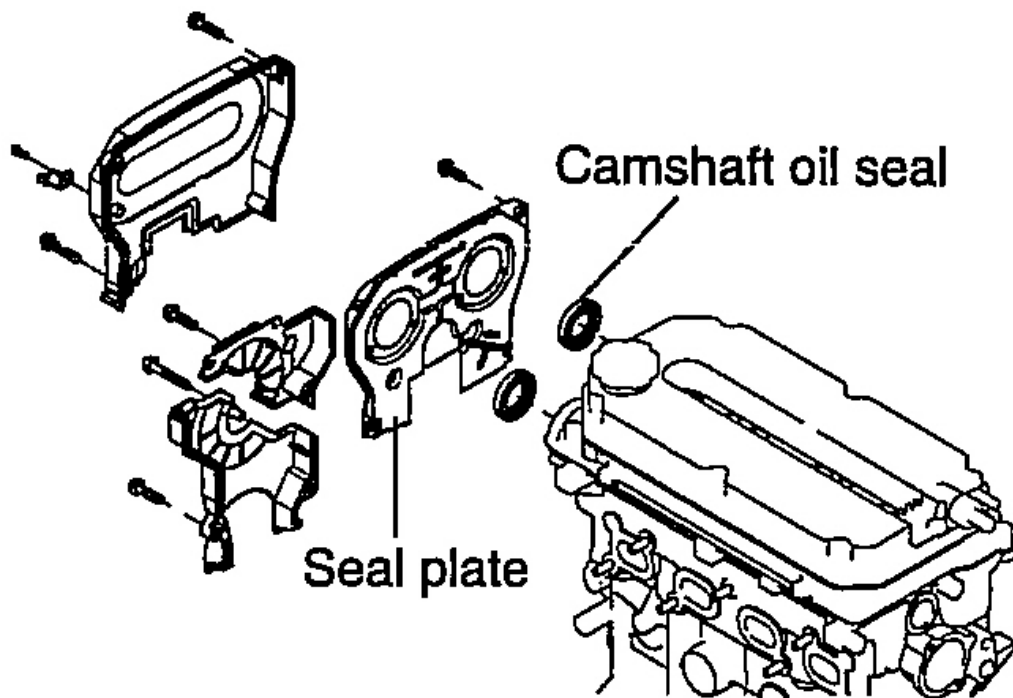
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Fig. 61: Camshaft Carrier Assembly Tightening Sequence
 Courtesy of KIA MOTORS AMERICA, INC.

Tightening torque:

8.3~10.5 lb-ft (11.3~14.2 N-m, 1.15~1.45kg-m)

6. Install the camshaft oil seal. Be sure to apply engine oil to the external surface of the oil seal. Insert the oil seal along the camshaft front end until the oil seal is fully seated.



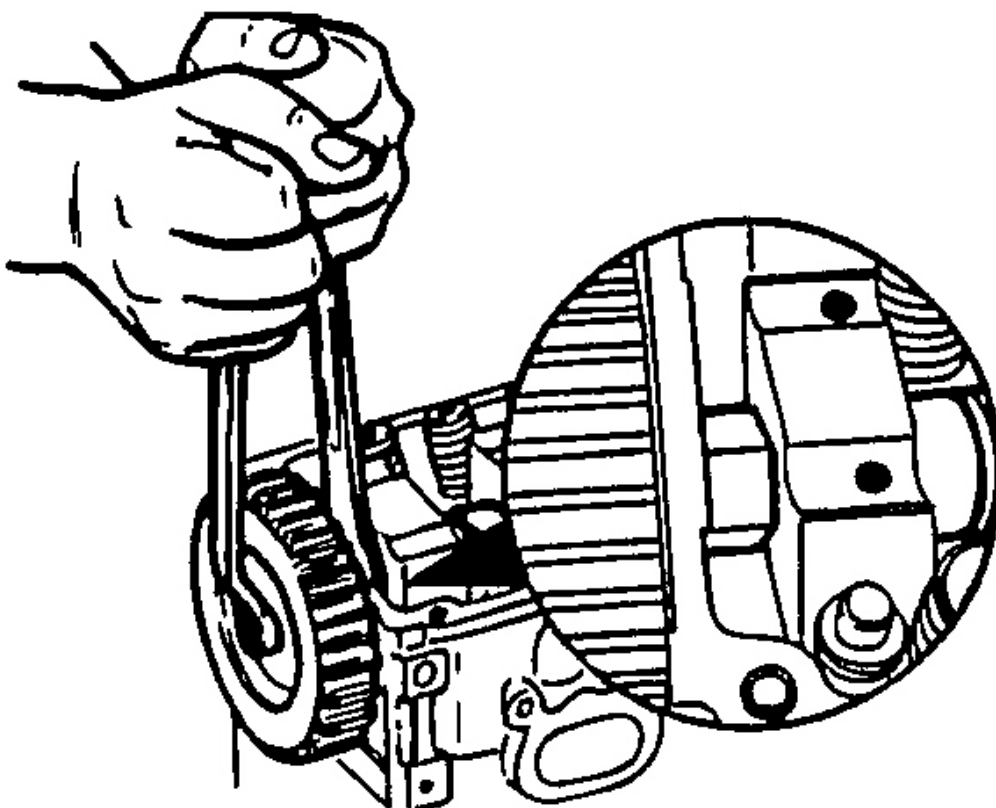
G00325901

Fig. 62: Installing The Camshaft Oil Seal
Courtesy of KIA MOTORS AMERICA, INC.

7. Install the seal plate.
8. Install the camshaft pulley.

Tightening torque:

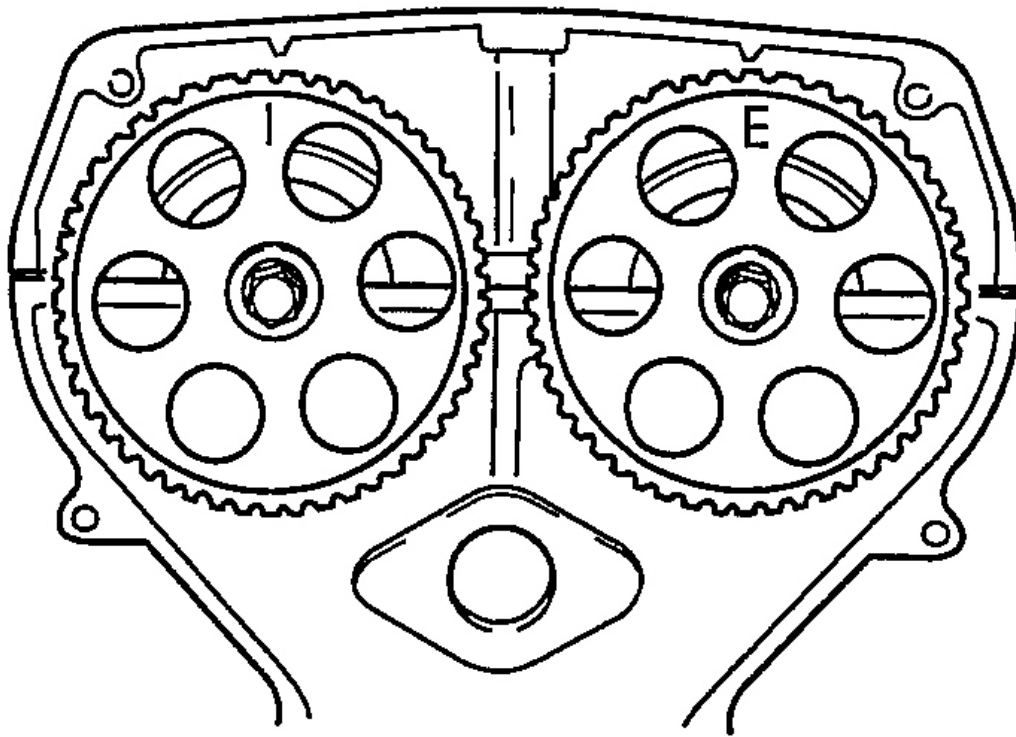
55.0~77.4 lb-ft (74.5~104.9 N-m, 7.6~10.7 kg-m)



G00325902

Fig. 63: Installing The Camshaft Pulley
Courtesy of KIA MOTORS AMERICA, INC.

9. Check that "I" mark on intake camshaft pulley is aligned with mark on seal plate and "E" mark on exhaust camshaft pulley is aligned with mark on seal plate.



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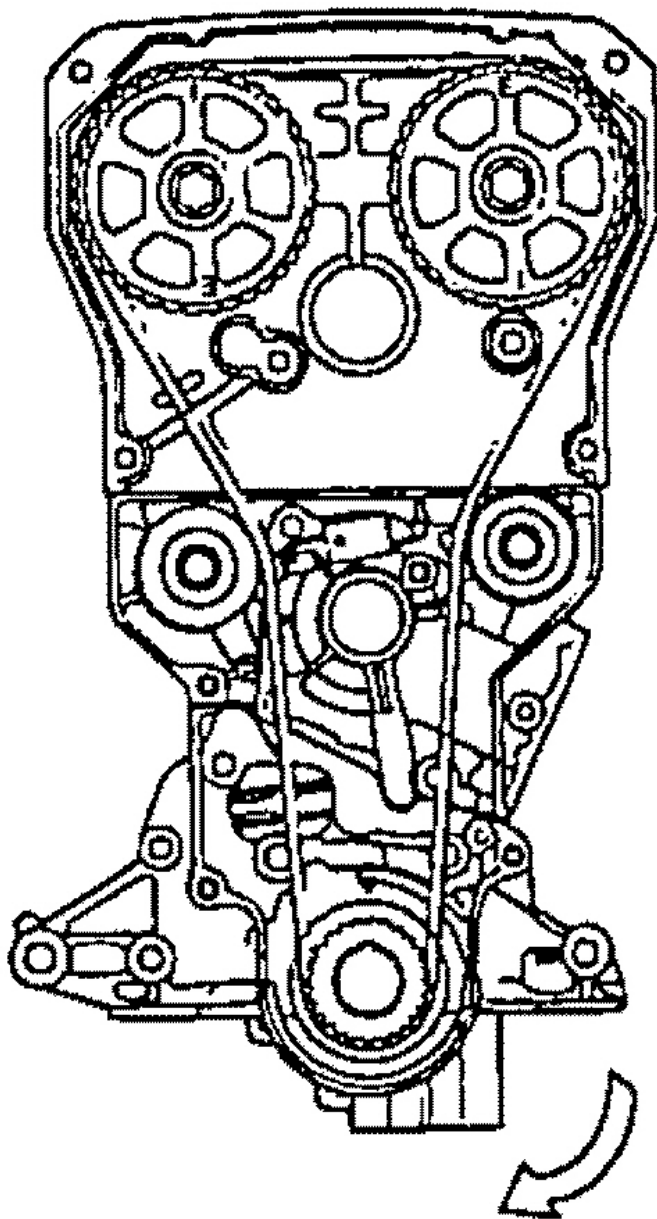
Fig. 64: Aligning Camshaft Timing Marks
Courtesy of KIA MOTORS AMERICA, INC.

10. Install the cylinder head cover.

Tightening torque:

3.6~6.5 lb-ft (4.9~8.8 N-m, 0.5~0.9 kg-m)

11. Install the ignition coil.
12. Install the timing belt.



G00325904

Fig. 65: Illustrating Timing Belt Rotation Direction
Courtesy of KIA MOTORS AMERICA, INC.

13. Tighten the timing belt tensioner pulley.

Tightening torque:

27.5~38.3 lb-ft (37.3~52.0 N-m, 3.8~5.3 kg-m)

14. Install the timing belt cover.

VALVES

INSPECTION

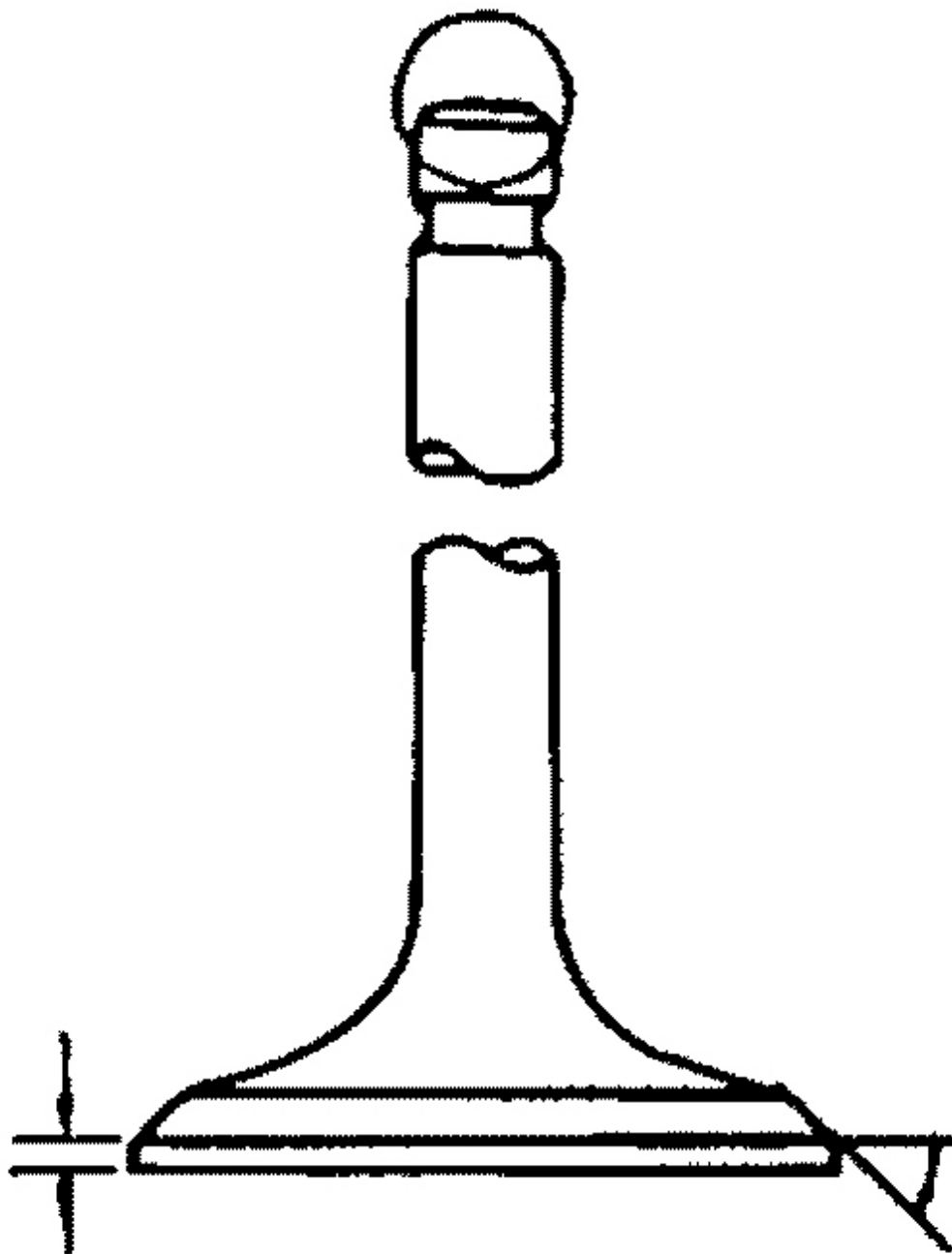
VALVE MECHANISM

1. Inspect each valve for following:
 - a. Damaged or bent valve stem
 - b. Rough or damaged face
 - c. Damaged or unevenly worn stem tip
2. Resurface or replace valve as needed.

Margin thickness

Intake: 0.0394 in (1.0 mm)

Exhaust: 0.0394 in (1.0 mm)



G00325975

Fig. 66: Inspecting Valve Stem Tip
Courtesy of KIA MOTORS AMERICA, INC.

3. Measure length of each valve.

Length

Intake: 3.7815 in (96.05 mm)

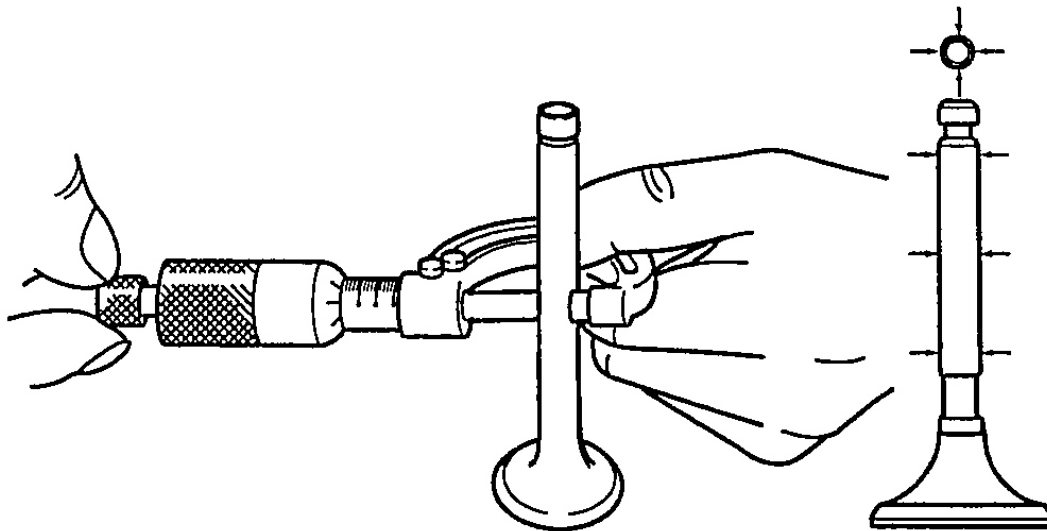
Exhaust: 3.7402 in (95.00 mm)

4. Measure diameter of each valve stem.

Diameter

Intake: 0.2152~0.2157 in (5.465~5.480 mm)

Exhaust: 0.2138~0.2146 in (5.430~5.450 mm)



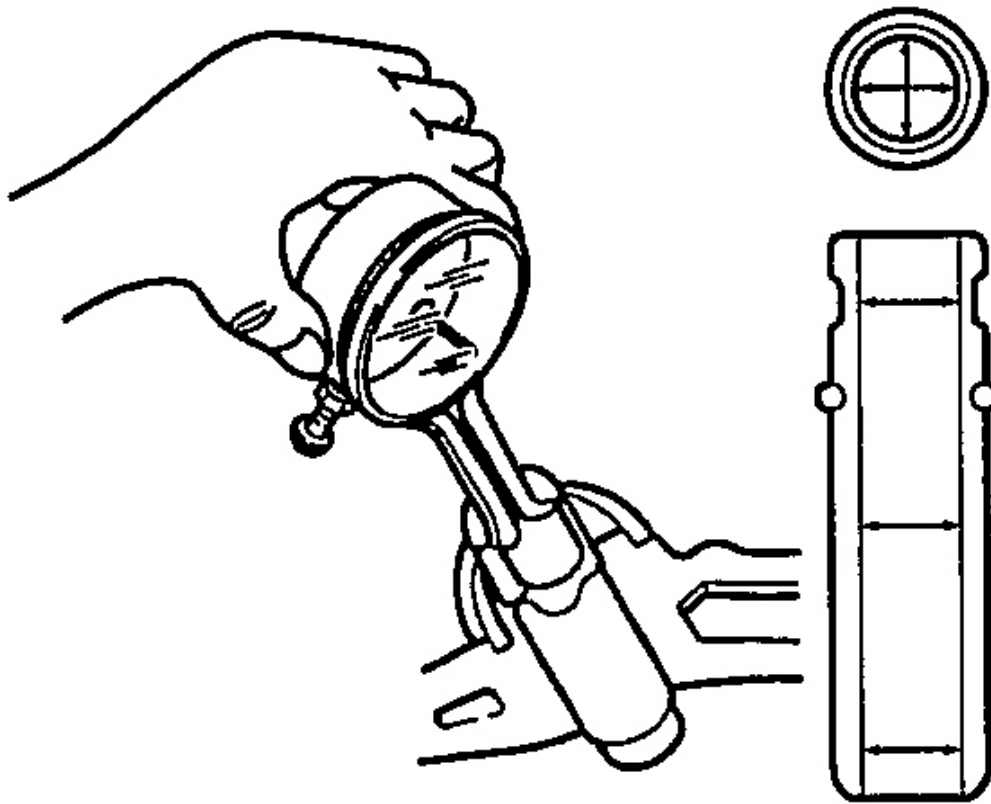
G00325977

Fig. 67: Measuring Valve Stem Diameter
Courtesy of KIA MOTORS AMERICA, INC.

5. Measure inside diameter of each valve guide at points shown in figure.

Diameter intake and exhaust valve Guide:

0.2165~0.2171 in (5.500~5.515 mm)



G00325978

Fig. 68: Measuring Valve Guide Inside Diameter
Courtesy of KIA MOTORS AMERICA, INC.

6. Calculate valve stem-to-valve Guide clearance. Subtract outer diameter of valve stem from inside diameter of respective valve Guide.

Clearance

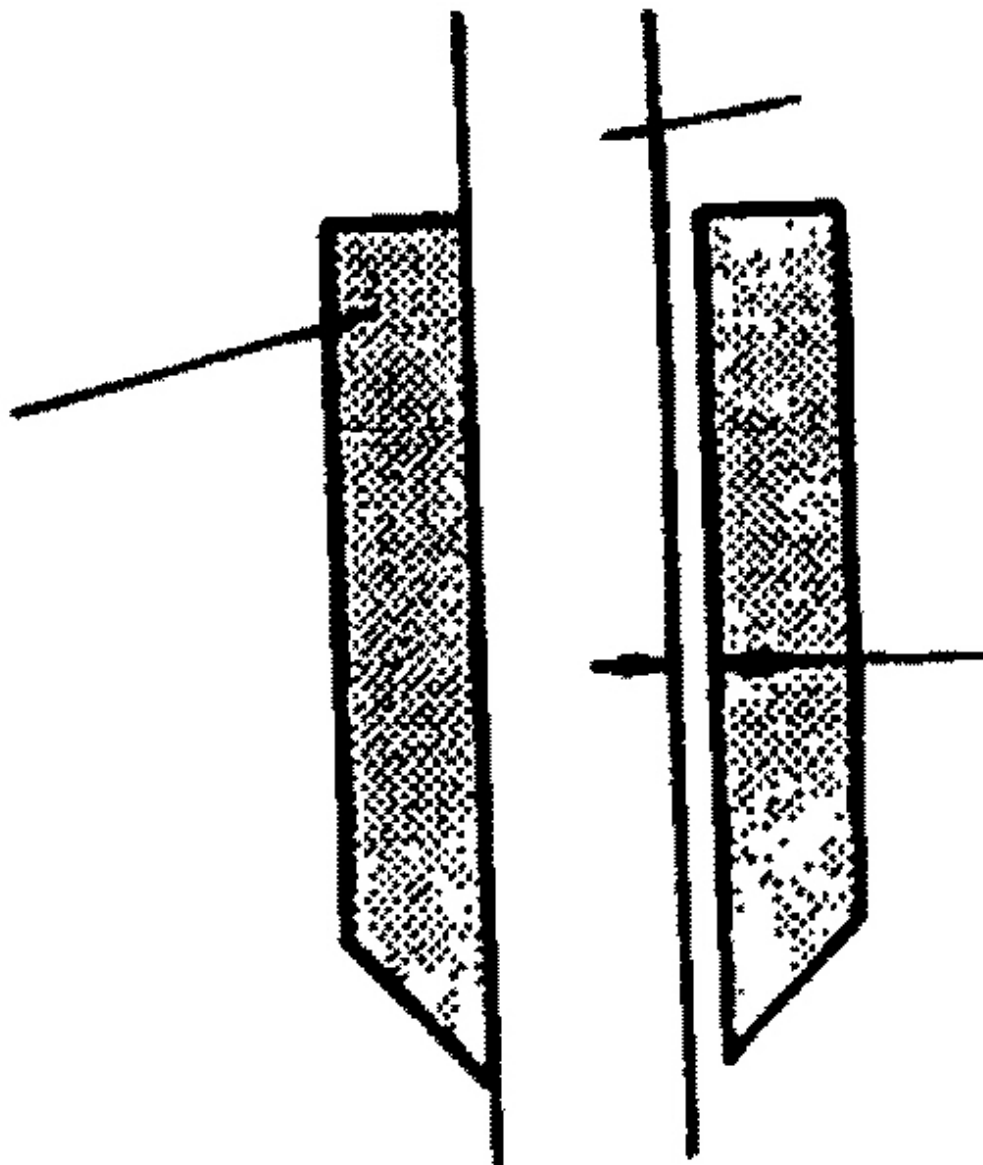
Intake valve:

0.0008~0.0020 in (0.020~0.050 mm)

Exhaust valve:

0.0020~0.0033 in (0.050~0.085 mm)

Max: 0.008 in (0.20 mm)



G00325962

Fig. 69: Measuring Valve Stem-To-Guide Clearance
Courtesy of KIA MOTORS AMERICA, INC.

7. If clearance exceeds specification, replace valve, and/or valve Guide.
8. Measure protrusion height of each valve Guide. Replace valve Guide as needed.

Intake: 0.5039~0.5276 in (12.8~13.4 mm)

Exhaust: 0.5039~0.5276 in (12.8~13.4 mm)

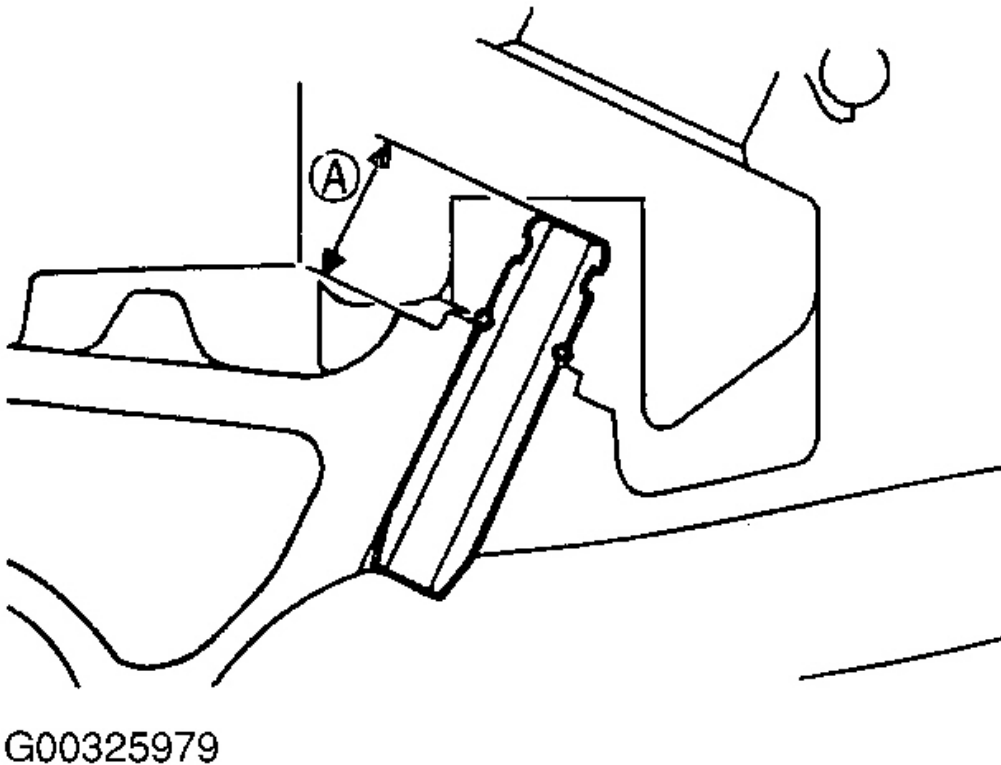


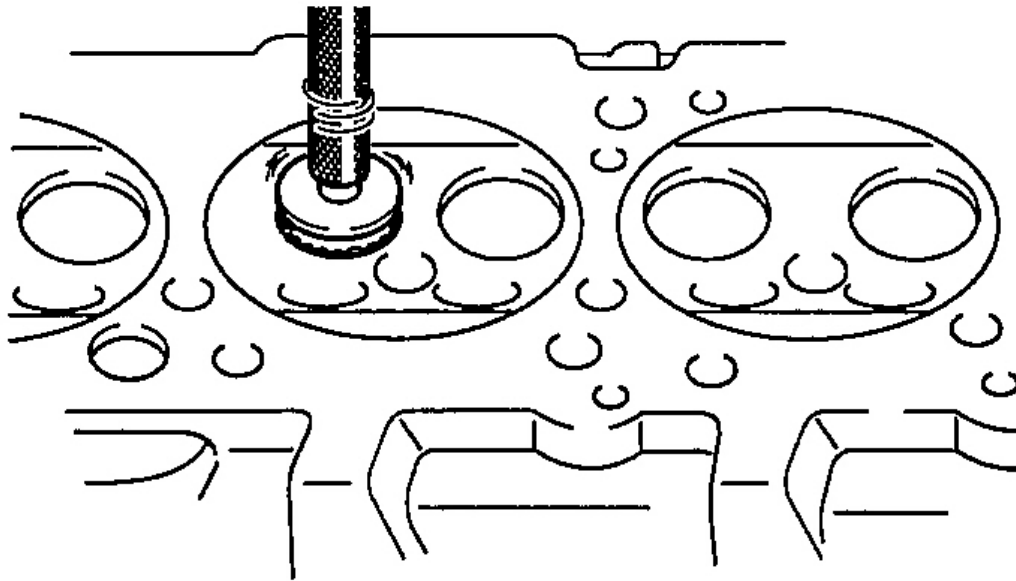
Fig. 70: Measuring Valve Guide Protrusion Height
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Intake and exhaust valve Guides are different.
Be sure to use correct valve Guide.

VALVE SEAT

1. Inspect contact surface of each valve seat and valve face for following:
 - a. Roughness
 - b. Damage

- c. Pitting
 - d. Cracks
2. Resurface valve seats with a 45° valve seat cutter. Resurface valve faces as needed.

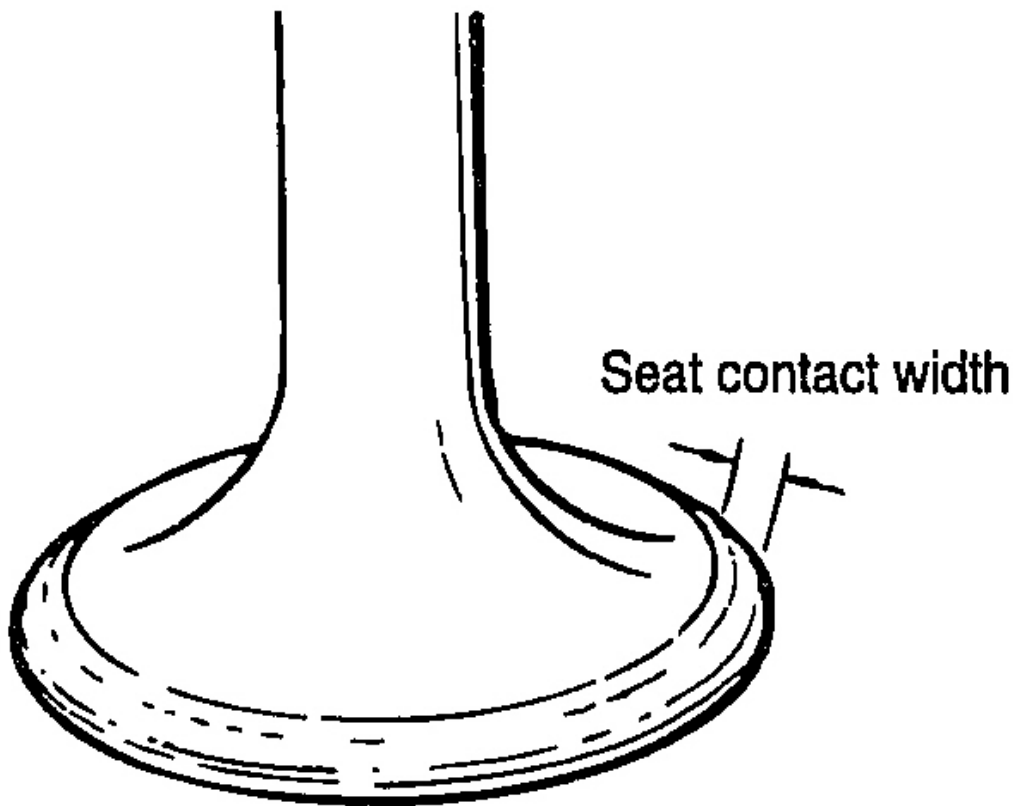


G00325980

Fig. 71: Resurfacing Valve Seats
Courtesy of KIA MOTORS AMERICA, INC.

3. Apply a coat of Dychem blue to valve face and valve seat and allow to dry.
4. Inspect valve seating by pressing valve against seat and rotating valve 360°.
 - a. If Dychem blue is not removed 360° around valve face, replace valve.
 - b. If Dychem blue is not removed 360° around valve seat, resurface valve seat.
5. Measure seat contact width.

Width: 0.0382~0.0618 in (0.97~1.57 mm)



G00325981

Fig. 72: Measuring Seat Contact Width
Courtesy of KIA MOTORS AMERICA, INC.

6. Complete seat-cutting process by lapping valve to seat using valve-lapping compound.

NOTE: Clean valves thoroughly before reassembly, and insure that all traces of lapping compound has been removed.

VALVE SPRING

1. Inspect each valve spring for cracks and damage.
2. Measure free length and out-of-square. Replace valve springs as needed.

Free length:

Standard: 1.5354 in (39.0 mm)

Limit: 1.5276 in (38.8 mm)

Out-of-square: 0.0402 in (1.02 mm)

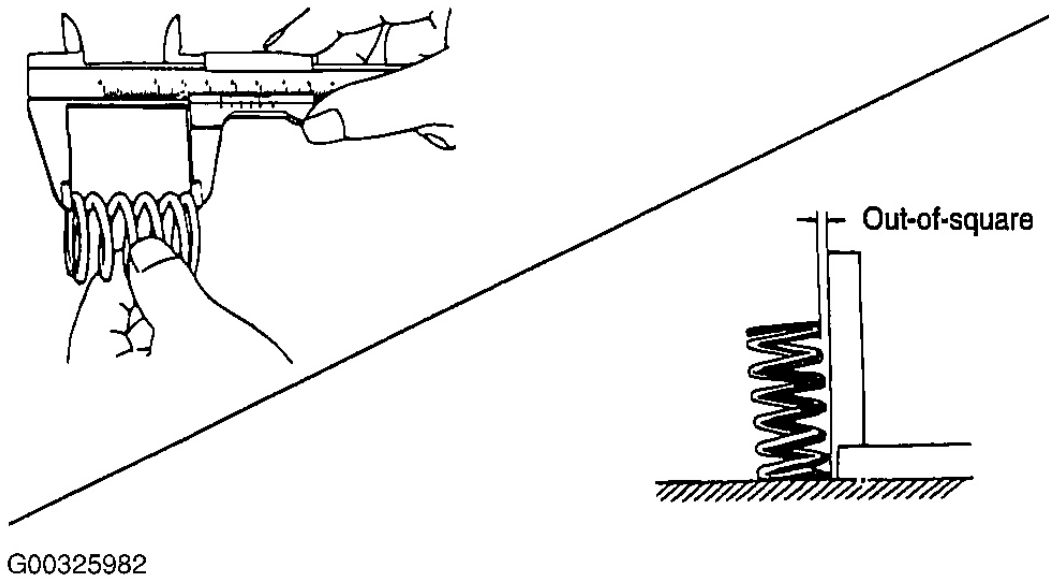
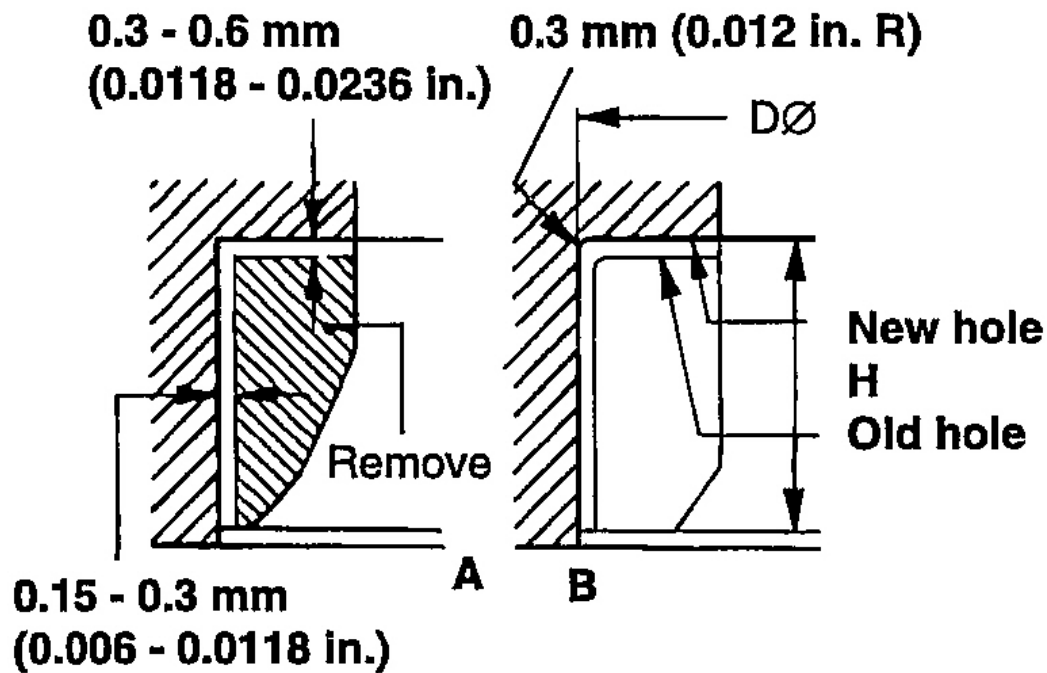


Fig. 73: Measuring Valve Spring Free Length And Out-Of-Square
Courtesy of KIA MOTORS AMERICA, INC.

REPLACEMENT

VALVE SEAT RING

1. Cut away the inner face of the valve seat to reduce the wall thickness.



G00325983

Fig. 74: Illustrating Valve Seat Inner Face Removal Area
Courtesy of KIA MOTORS AMERICA, INC.

2. Enlarge the cylinder head hole so that matches the specified cylinder head hole inner diameter of new valve seat ring.
3. Heat the cylinder head to about 250°C (480°F) and press-fit an oversize seat ring for the cylinder head hole size.
4. Using lapping compound, lap the valve to the new seat.

Valve seat contact width:

0.0382~0.0618 in (0.97~1.57 mm)

2005 Kia Rio

2004-05 ENGINES 1.6L 4-Cylinder - Rio

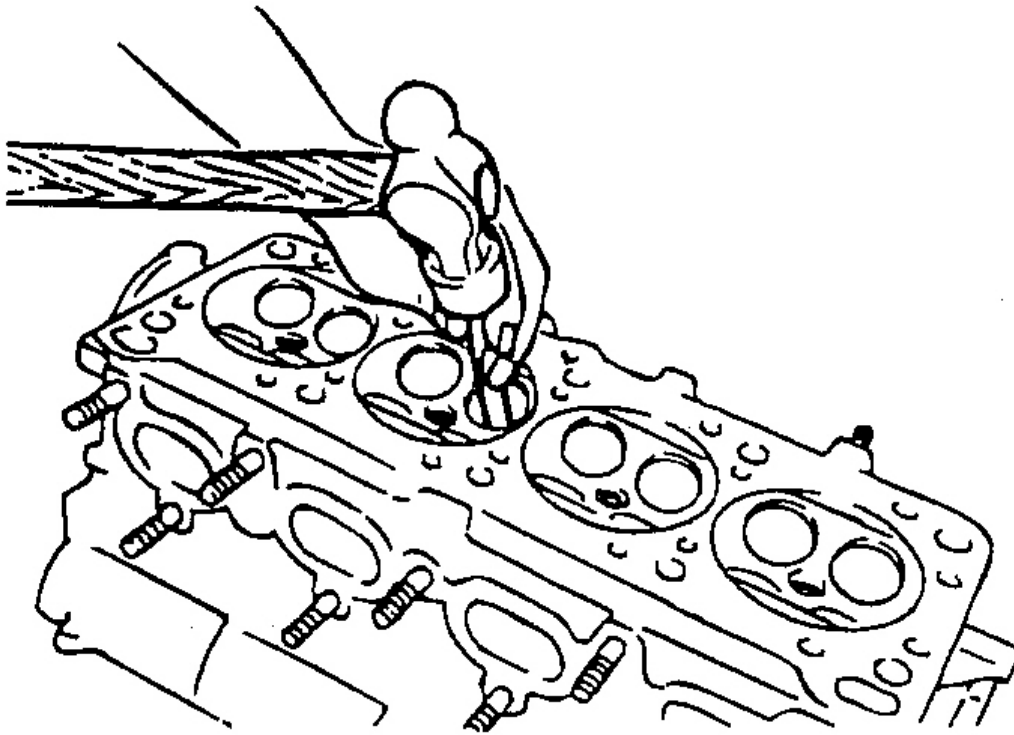
Item	Over size (in (mm))	Size mark	Cylinder head hole inner diameter (in (mm))	Seat ring outer diameter (in (mm))	Seat ring height (in (mm))
Intake valve seat ring	STD	-	1.1961-1.1968 (30.38-30.40)	1.2000-1.2008 (30.480-30.500)	0.1858-0.1890 (4.72-4.80)
	0.012 (0.3) OS	30	1.2079-1.2087 (30.68-30.70)	1.2118-1.2126 (30.780-30.800)	0.1976-0.2008 (5.02-5.10)
	0.024 (0.6) OS	60	1.2197-1.2205 (30.98-31.00)	1.2236-1.2244 (31.080-31.100)	0.2094-0.2126 (5.32-5.40)
Exhaust valve seat ring	STD	-	1.0819-1.0827 (27.48-27.50)	1.0858-1.0866 (27.580-27.600)	0.1858-0.1890 (4.72-4.80)
	0.012 (0.3) OS	30	1.0937-1.0945 (27.78-27.80)	1.0976-1.0984 (27.880-27.900)	0.1976-0.2008 (5.02-5.10)
	0.024 (0.6) OS	60	1.1055-1.1063 (28.08-28.10)	1.1094-1.1102 (28.180-28.200)	0.2094-0.2126 (5.32-5.40)

G00325984

Fig. 75: Valve Seat Ring Oversize Chart
Courtesy of KIA MOTORS AMERICA, INC.

VALVE GUIDE

1. Using the special tool (09221-FD100(A)), withdraw the old valve Guide toward the bottom of cylinder head.



G00325985

Fig. 76: Removing Valve Guide

Courtesy of KIA MOTORS AMERICA, INC.

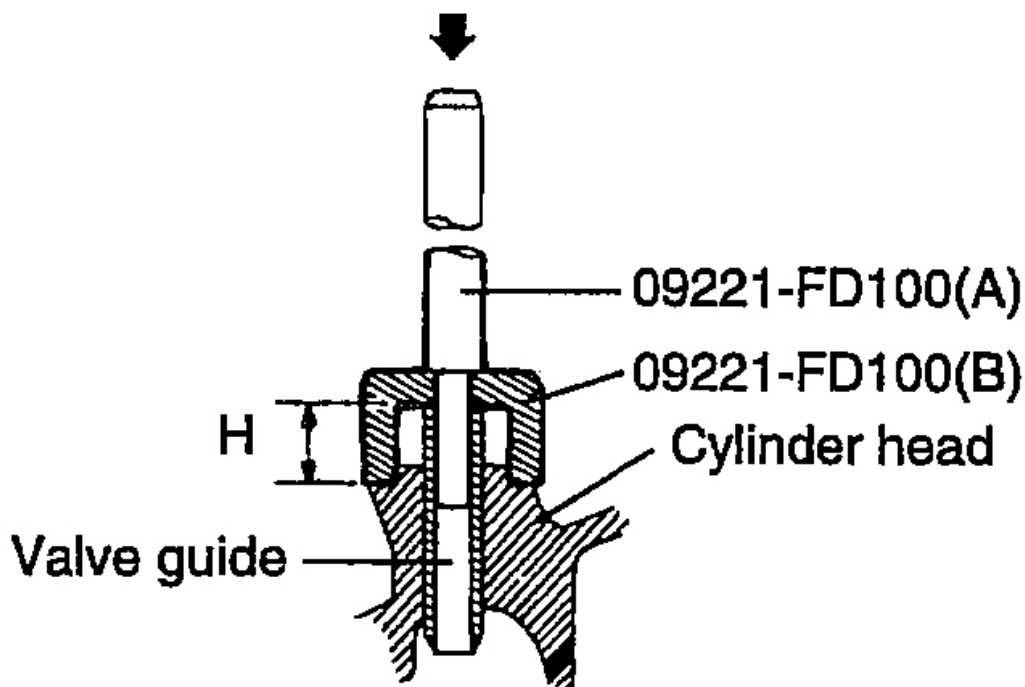
2. Recondition the cylinder head hole so that it can match the newly press-fitted oversize valve Guide.
3. Using the special tool (09221-FD100(A),(B)), press-fit the valve Guide. The valve Guide must be press-fitted from the upper side of the cylinder head.

NOTE: **Do not install a valve Guide unless it is oversize.**

Item	Over size (in (mm))	Size mark	Cylinder head hole inner diameter (in (mm))	Valve guide outer diameter (in (mm))	Valve guide protrusion height (in (mm))
Valve guide	STD	-	0.3740-0.3747 (9.500-9.518)	0.3753-0.3757 (9.533-9.544)	0.5039-0.5276 (12.8-13.4)
	0.002 (0.05) OS	5	0.3760-0.3767 (9.550-9.568)	0.3773-0.3777 (9.583-9.594)	
	0.010 (0.25) OS	25	0.3839-0.3846 (9.750-9.768)	0.3852-0.3856 (9.783-9.794)	
	0.020 (0.50) OS	50	0.3937-0.3944 (10.000-10.018)	0.3950-0.3954 (10.033-10.044)	

G00325987

Fig. 77: Valve Guide Oversize Chart
Courtesy of KIA MOTORS AMERICA, INC.



G00325986

Fig. 78: Installing Valve Guide
Courtesy of KIA MOTORS AMERICA, INC.

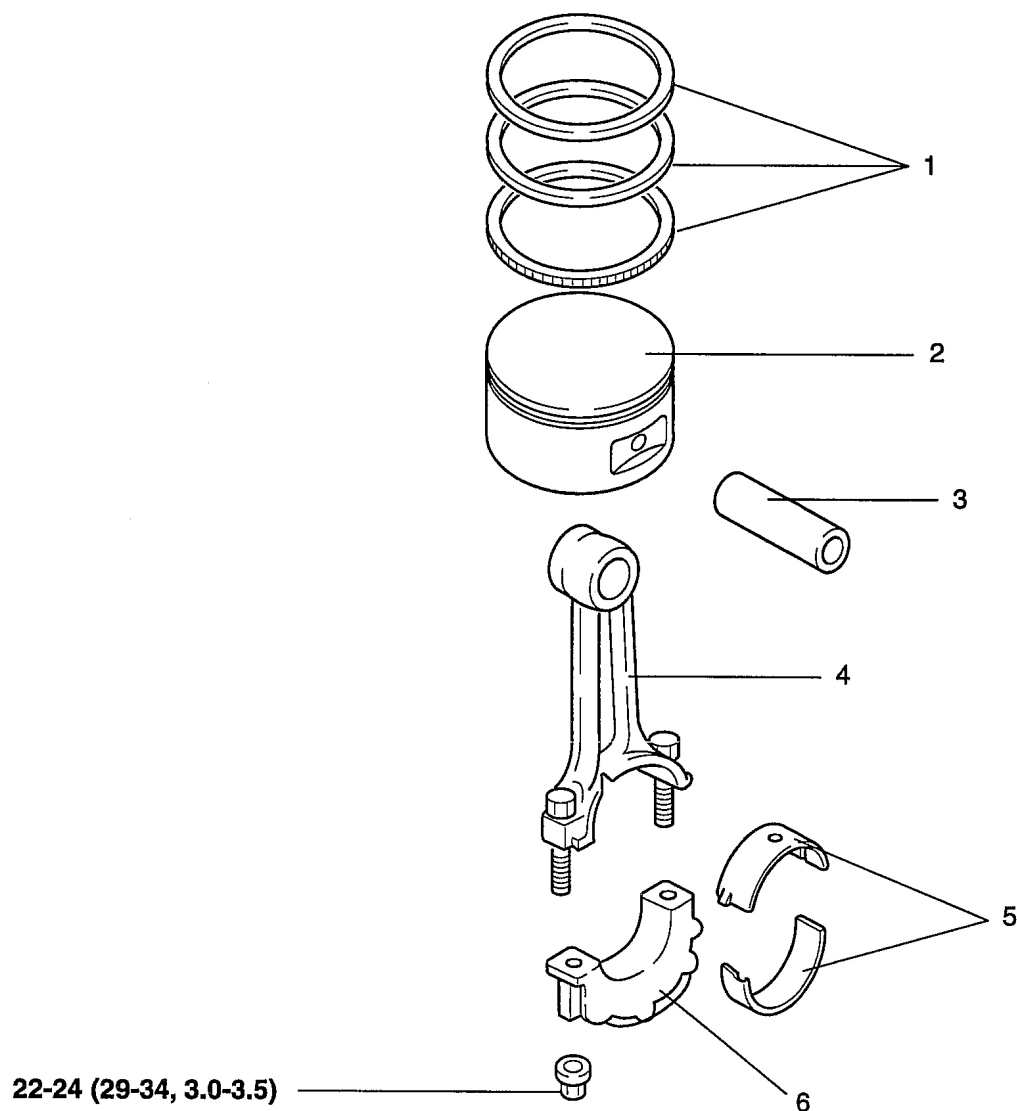
- After the valve Guide is press-fitted, insert a new valve and check for proper stem-to-Guide clearance.

5. After the valve Guide is replaced, check that the valve is seated properly. Recondition the valve seats as necessary.

MAIN MOVING SYSTEM

PISTON & CONNECTING ROD ASSEMBLY

COMPONENT



TORQUE : lb·ft (N·m, kg·m)

- 1. Piston ring
- 2. Piston
- 3. Piston pin

- 4. Connecting rod
- 5. Connecting rod bearing
- 6. Connecting rod cap

G00325905

Fig. 79: Identifying Piston & Connecting Rod Assembly Components With Torque Specifications
 Courtesy of KIA MOTORS AMERICA, INC.

DIASSEMBLY

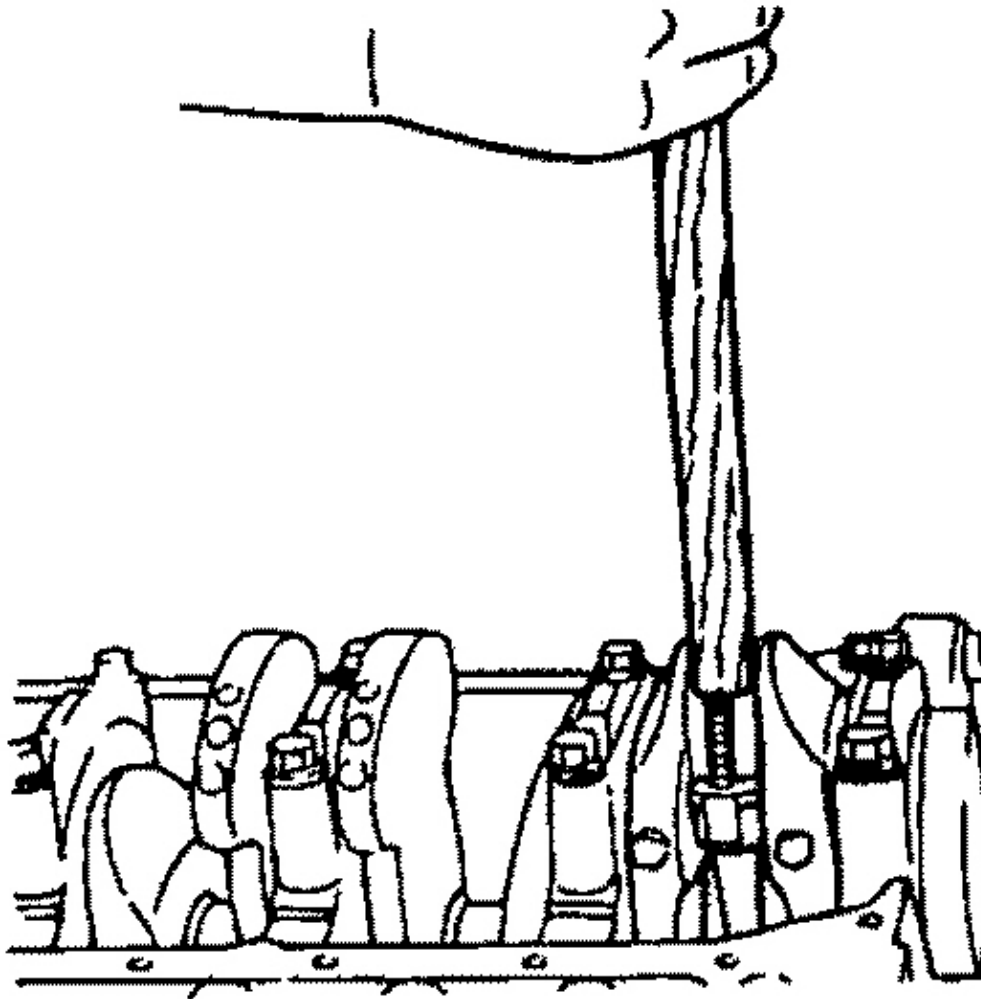
1. Mark corresponding cylinder number on rod cap and connecting rod with a numbering stamp.

NOTE: Mark connecting 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.

2. Rotate crankshaft so that cylinders No.2 and No.3 are at Bottom Dead Center (BDC) and repeat marking procedure.
3. Remove connecting rod nuts and gently loosen rod caps by tapping cap with a light plastic mallet.
4. Remove rod caps.

NOTE: Cover connecting rod bolts to protect crankshaft journals

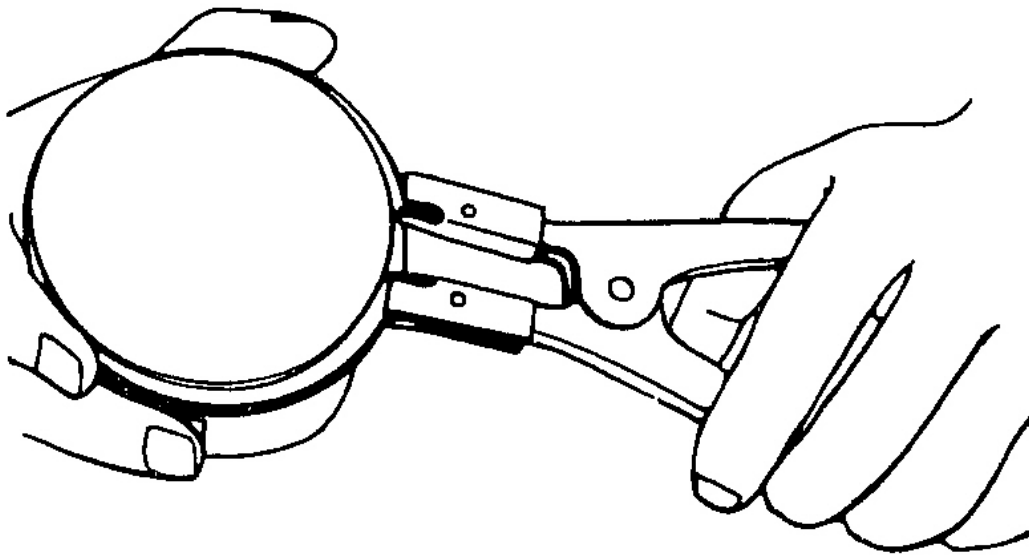
5. Push connecting rod and piston as far up into cylinder as possible. Using a wooden dowel, tap gently on piston to release it from cylinder.



G00325906

Fig. 80: Removing Piston & Rod Assembly
Courtesy of KIA MOTORS AMERICA, INC.

6. Repeat this procedure for each cylinder.
7. Mark tops of pistons with corresponding cylinder numbers they were removed from.
8. Using a piston ring expander, remove piston rings.



G00325907

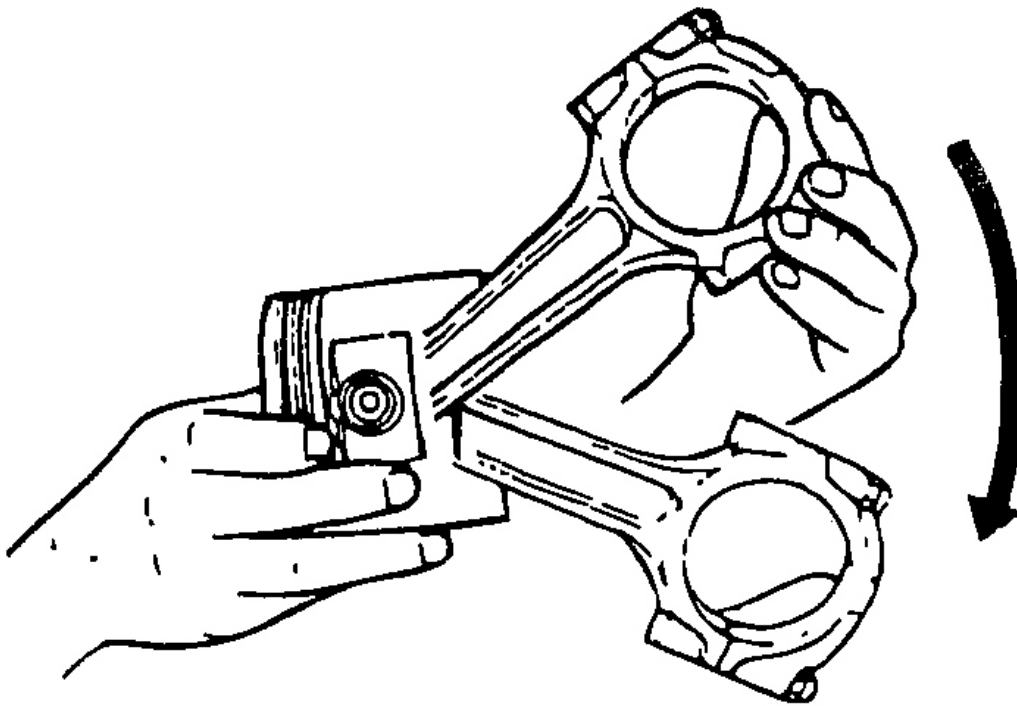
Fig. 81: Removing Piston Ring

Courtesy of KIA MOTORS AMERICA, INC.

9. Hold piston upright and gently move connecting rod.
10. Release connecting rod and observe its movement.

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

11. If connecting rod does not move freely, check piston pin bore and connecting rod for straightness and deformation.



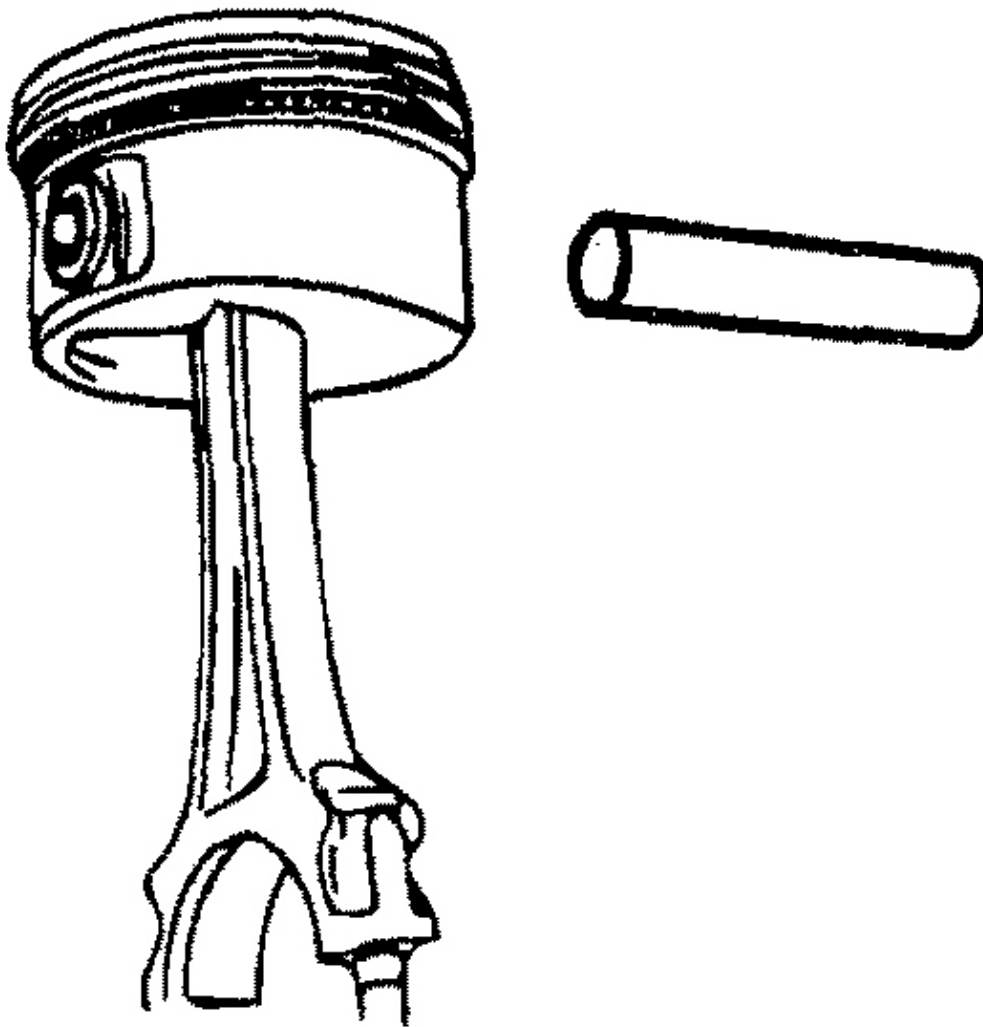
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Fig. 82: Testing Piston Pin Operation
Courtesy of KIA MOTORS AMERICA, INC.

12. Remove piston pin clip from ends of piston pin bore.
13. Tilt piston and allow piston pin to slide out into your hand. Piston pins may need to be pressed out.

NOTE: Do not allow pins to drop to the ground.

14. Remove connecting rod from piston. Keep individual piston and piston pin together for reassembly.



G00325909

Fig. 83: Removing Connecting Rod From Piston
Courtesy of KIA MOTORS AMERICA, INC.

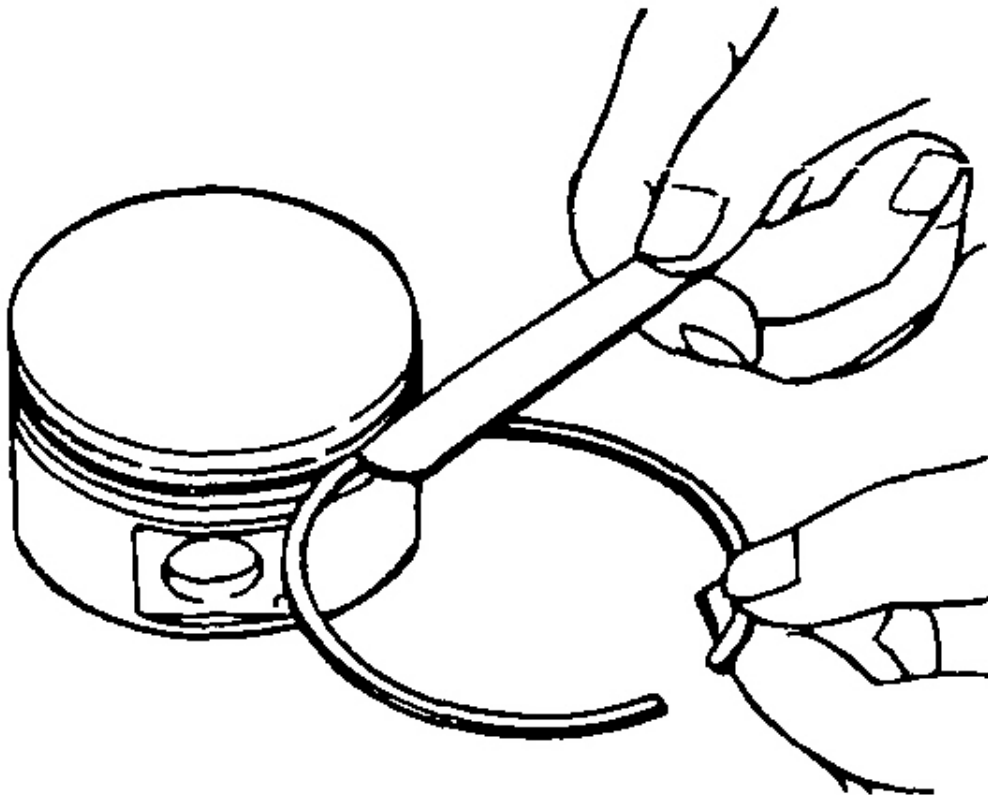
INSPECTION

PISTON RING

1. Insert a new piston ring into a piston ring groove and check clearance between piston ring and ring end.
Clearance between ring and ring end

Standard: 0.0012-0.0028 in (0.03-0.07 mm)

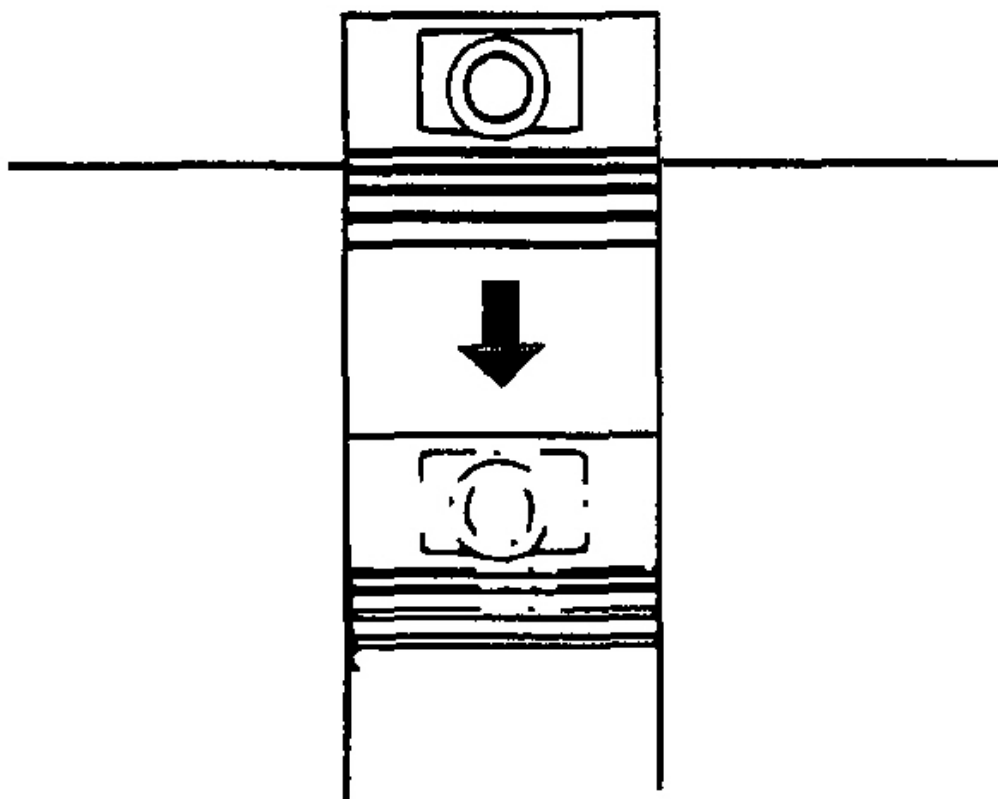
Maximum: 0.0039 in (0.10 mm)



G00325910

Fig. 84: Measuring Piston Ring Side Clearance
Courtesy of KIA MOTORS AMERICA, INC.

2. If clearance exceeds the maximum, replace piston.
3. Inspect piston rings for damage, abnormal wear, or breakage.
4. Replace piston rings if necessary.
5. Insert piston ring into cylinder by hand.
6. Square ring in cylinder by inverting a piston into cylinder and pushing ring to the bottom of its travel in cylinder.
7. Place a feeler gauge in end gap and check end gap clearance.



G00325911

Fig. 85: Positioning Piston Ring For End Gap Measurement
 Courtesy of KIA MOTORS AMERICA, INC.

Ring	A6 DOHC
Top ring	0.006~0.011 in (0.15~0.30 mm)
Second ring	0.016~0.021 in (0.40~0.55 mm)
Oil rail	0.008~0.027 in (0.20~0.70 mm)
Maximum	0.039 in (1.0 mm)

G00325912

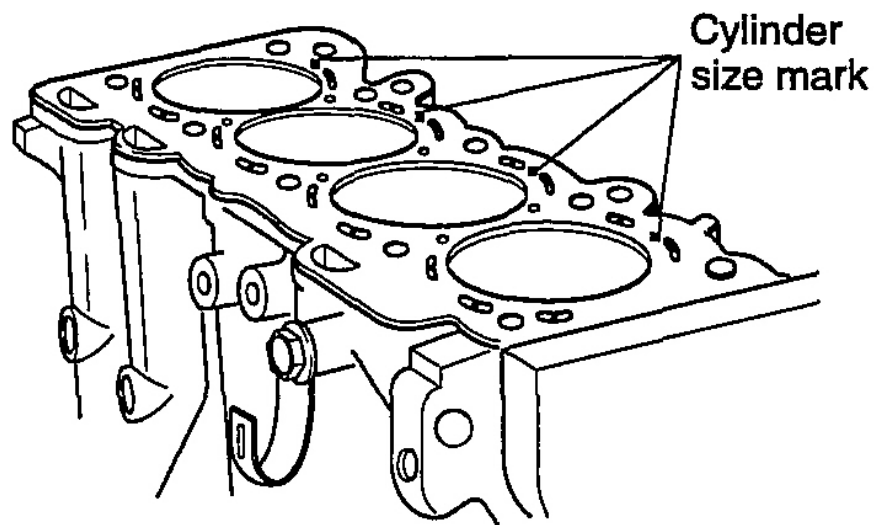
Fig. 86: End Gap Clearance Chart

Courtesy of KIA MOTORS AMERICA, INC.

REASSEMBLY

1. Select the piston which has the size mark which is identical with the size mark of the corresponding cylinder.
 - Cylinder size mark marking location
 - Piston size mark marking location

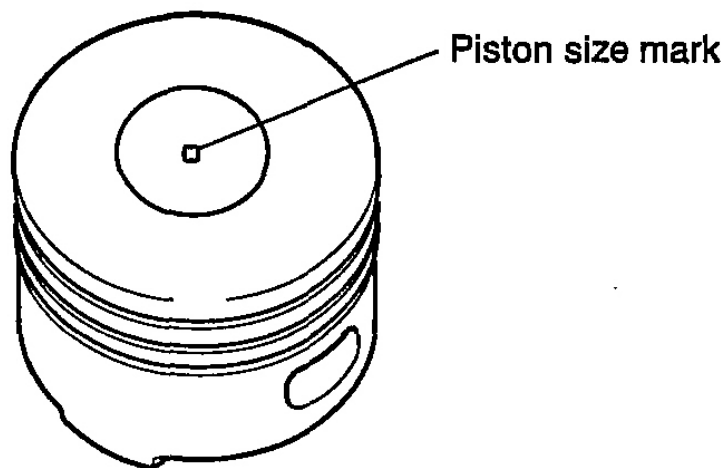
■ Cylinder size mark marking location



G00325913

Fig. 87: Identifying Cylinder Size Mark Location
Courtesy of KIA MOTORS AMERICA, INC.

■ Piston size mark marking location



G00325914

Fig. 88: Identifying Piston Size Mark Location
 Courtesy of KIA MOTORS AMERICA, INC.

Item Mark	A6D (16000cc)	
	Piston outer diameter (in(mm))	Cylinder bore inner diameter (in(mm))
A	3.0702-3.0704 (77.982-77.989)	3.0714-3.0716 (78.013-78.019)
.	3.0699-3.0702 (77.976-77.982)	3.0711-3.0714 (78.006-78.013)
B	3.0696-3.0699 (77.969-77.976)	3.0709-3.0711 (78.000-78.006)

(Clearance : 0.0009-0.0015 in (0.024-0.037 mm))

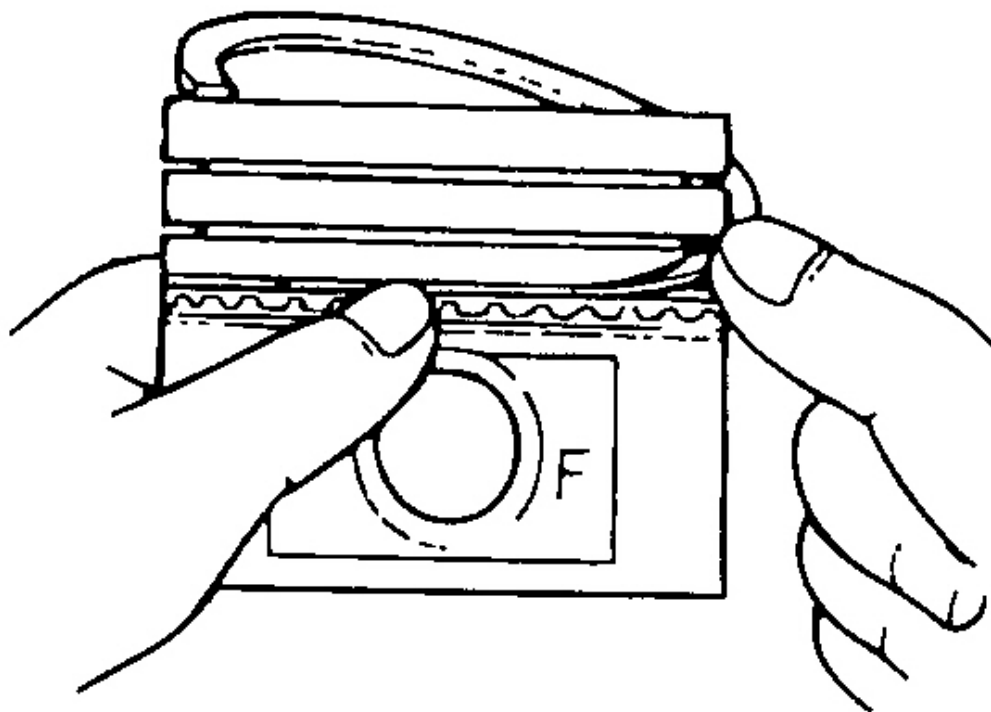
G00325915

Fig. 89: Piston Outer Diameter & Cylinder Bore Inner Diameter Chart
 Courtesy of KIA MOTORS AMERICA, INC.

2. Insert connecting rod into piston and slide piston pin through piston and connecting rod.

NOTE: **Verify that piston and rod are assembled in same direction as they were prior to disassembly.**

3. Hold piston upright and move connecting rod back and forth. Check that rod moves freely.
4. Install three piece oil ring onto piston.
 - a. Apply clean engine oil to the oil ring expander and upper and lower oil rings.
 - b. Install expander onto piston so that expander ends face upward.
 - c. Install lower oil ring onto piston. Ring may be installed with either face upward.
 - d. Install upper oil ring onto piston. Ring may be installed with either face upward.

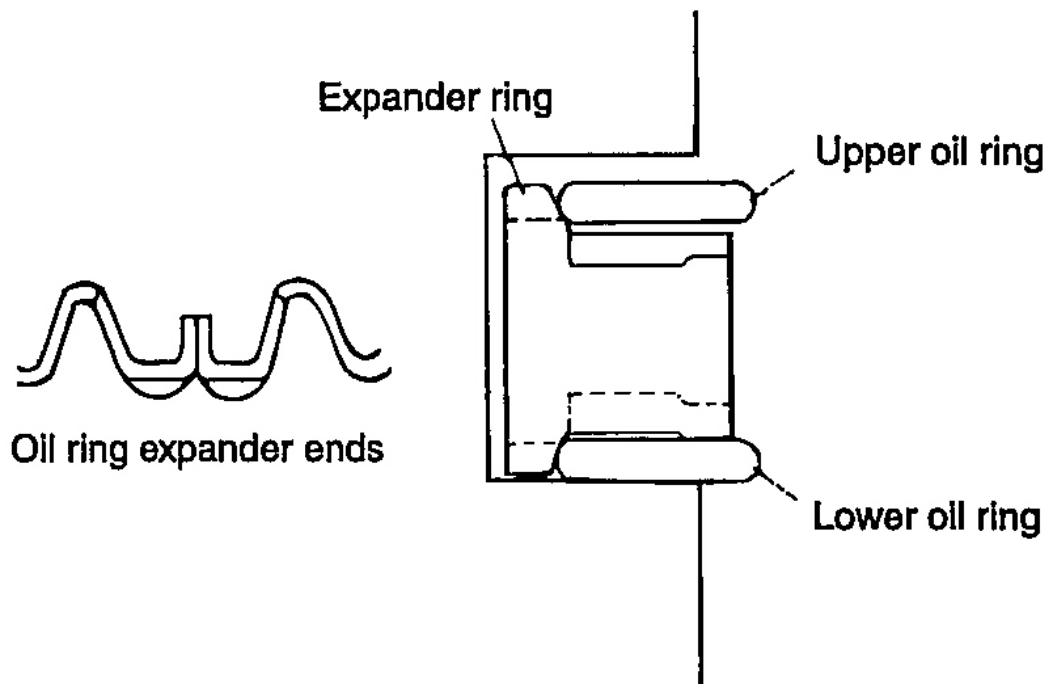


G00325916

Fig. 90: Installing Oil Ring

Courtesy of KIA MOTORS AMERICA, INC.

5. Check that oil ring expander separates upper and lower oil rings, and that oil ring assembly spins freely on piston.

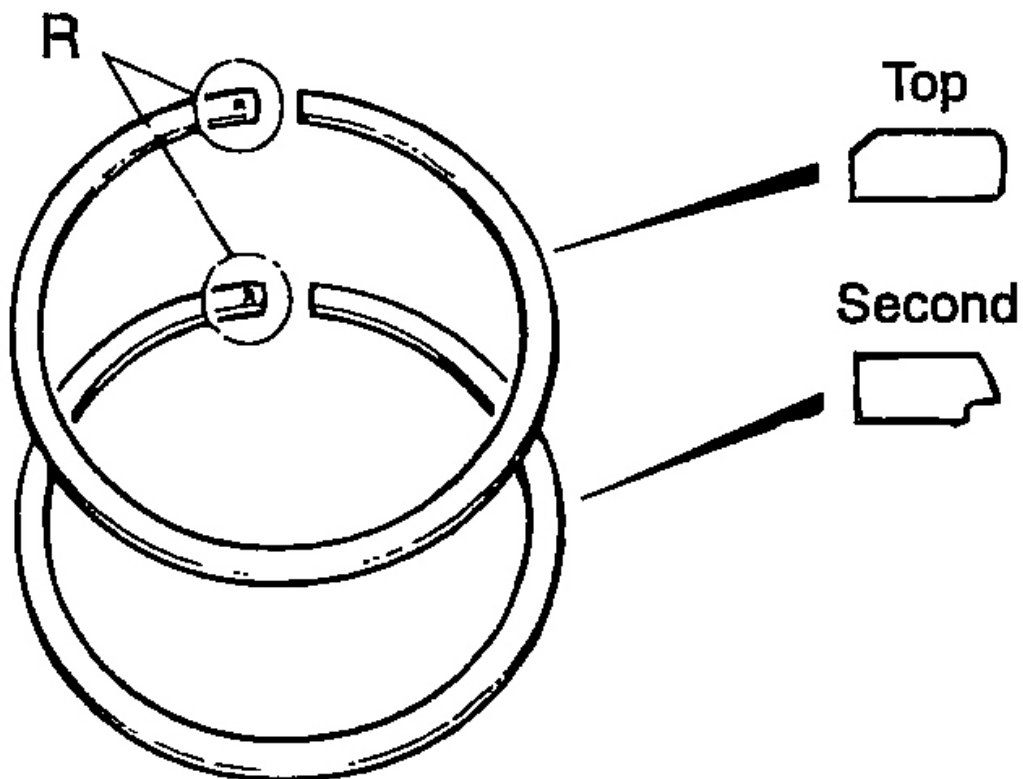


G00325917

Fig. 91: Illustrating Oil Ring Position
Courtesy of KIA MOTORS AMERICA, INC.

6. Use a ring expander and install second ring.
7. Use a ring expander and install top ring.

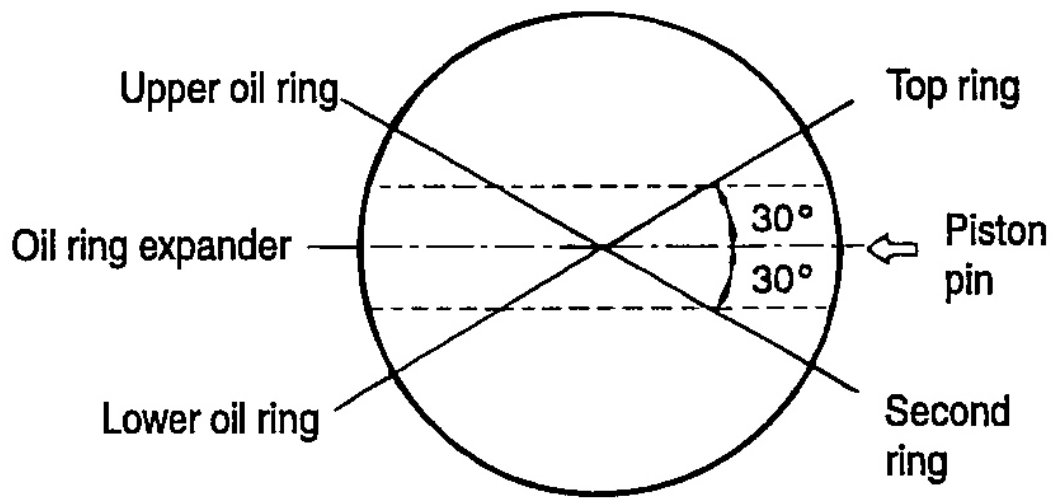
NOTE: Top ring and second ring should be installed with "R" or "Y" mark facing up.



G00325918

Fig. 92: Identifying Top & Second Ring Direction
Courtesy of KIA MOTORS AMERICA, INC.

8. Align piston ring gaps as shown.

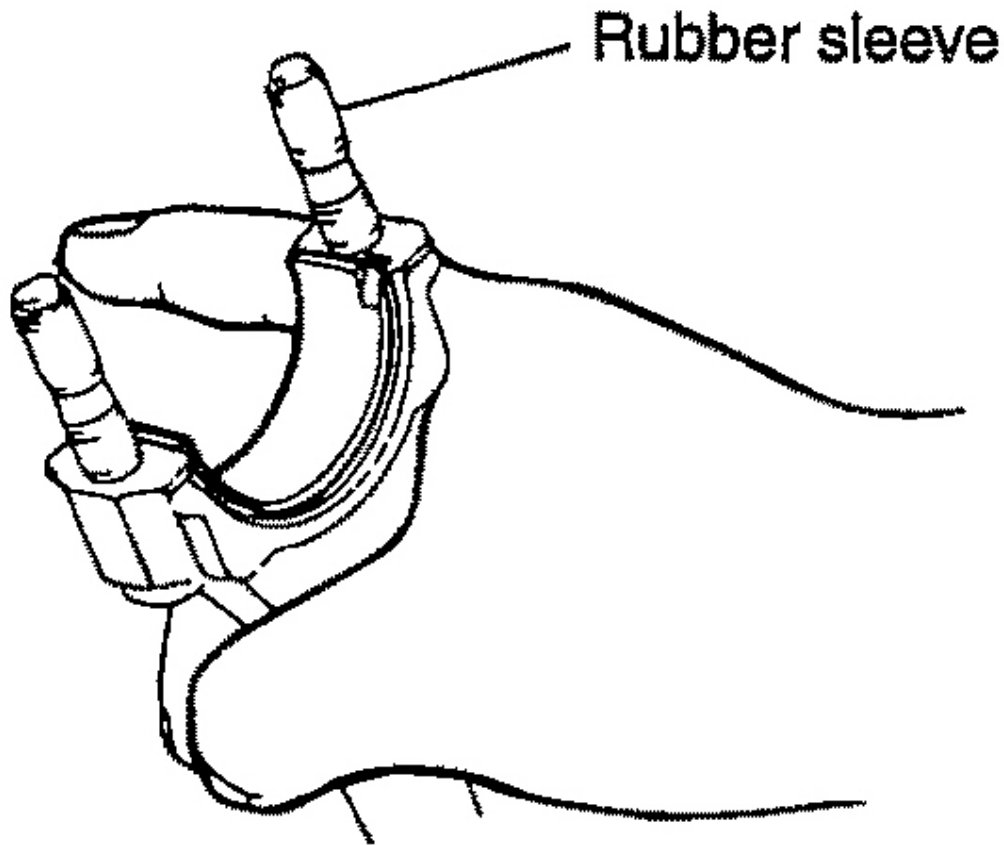


G00325919

Fig. 93: Aligning Piston Ring Gaps

Courtesy of KIA MOTORS AMERICA, INC.

9. Install a bearing into connecting rod.
10. Place rubber sleeves on connecting rod bolts to protect crankshaft from damage.



G00325920

Fig. 94: Positioning Protective Sleeves On Connecting Rod
Courtesy of KIA MOTORS AMERICA, INC.

11. Check piston rings for correct end gap stagger.
12. Place piston with "F" mark facing front of engine block, then slip piston and connecting rod assembly into a piston ring compressor.



G00325921

Fig. 95: Compressing Piston Rings
Courtesy of KIA MOTORS AMERICA, INC.

13. Rotate crankshaft so that crank pin journal for specific cylinder is at its lowest point (bottom dead center).
14. Lower piston and connecting rod assembly until piston ring compressor makes contact with deck surface of engine block.
15. Using butt end of a hammer, tap the top of piston into cylinder and continue tapping until connecting rod makes contact with crankshaft.

NOTE: Follow this procedure for remaining piston and connecting rod assemblies.

16. Install a connecting rod bearing in each connecting rod cap.
17. Place a piece of Plastigauge (R) on crank pin journals.
18. Install connecting rod caps, aligning marks made previous to disassembly and torque to specification.

Tightening torque:

22~24 lb-ft (29~34 N . m, 3.0~3.5 kg-m)

NOTE:

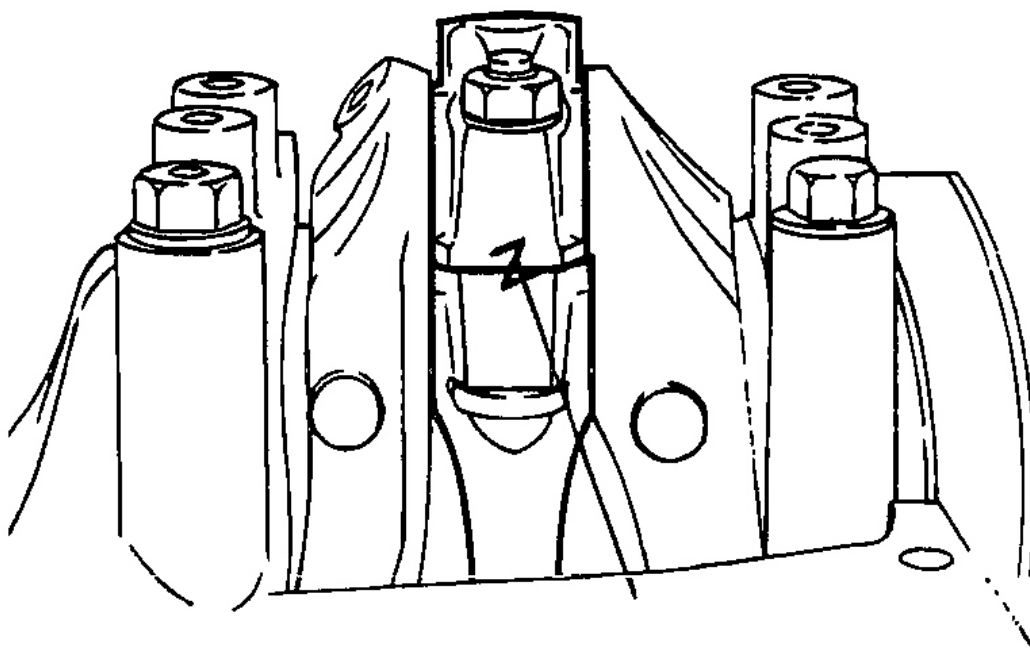
- When installing the connecting rods, match marks made on the connecting rod and cap to reference mark made on cylinder block to prevent oil starvation to the connecting rod bearings.
- When installing the piston assembly into cylinder block, position the piston between TDC and BDC, then install the cylinder head in order to prevent pistons and valves from contacts which may cause damage.

19. Loosen and remove connecting rod caps.
20. Check the connecting rod bearing clearance.

Oil clearance:

0.0010 ~ 0.0021 in (0.026 ~ 0.054 mm)

Maximum: 0.004 in (0.10 mm)

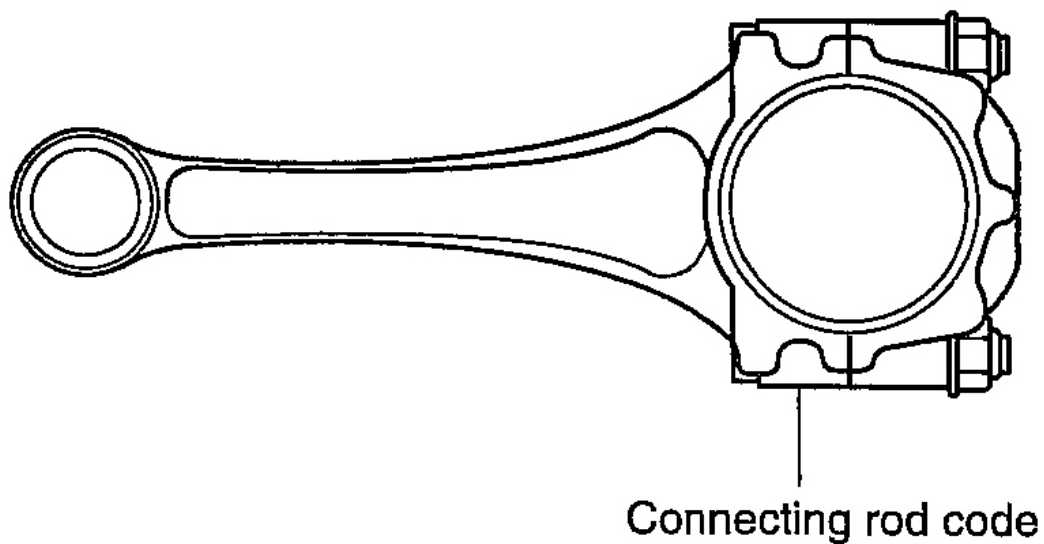


G00325922

Fig. 96: Identifying Connecting Rod Match Marks
Courtesy of KIA MOTORS AMERICA, INC.

21. If oil clearance exceeds maximum oil clearance specification, grind the crankshaft and use undersized

connecting rod bearings.



G00325924

Fig. 97: Illustrating Connecting Rod Code Position
Courtesy of KIA MOTORS AMERICA, INC.

Connecting rod code Pin journal shaft diameter	1	2	3
1.5724-1.5731 in (39.940-39.956 mm)	Green	Blue	Red

G00325923

Fig. 98: Connecting Rod Bearing Selection Table
Courtesy of KIA MOTORS AMERICA, INC.

Code	Connecting rod bearing housing bore size
1	1.6929-1.6931 in (43.000-43.006 mm)
2	1.6931-1.6934 in (43.006-43.012 mm)
3	1.6934-1.6935 in (43.012-43.016 mm)

G00325925

Fig. 99: Connecting Rod Bearing Housing Bore Size Chart
Courtesy of KIA MOTORS AMERICA, INC.

Connecting rod bearing		bearing thickness
Standard bearing	Green	0.0593-0.0594 in (1.506-1.509 mm)
	Blue	0.0594-0.0595 in (1.509-1.512 mm)
	Red	0.0595-0.0596 in (1.512-1.515 mm)
Undersize bearing	0.25	0.0642-0.0644 in (1.631-1.635 mm)
	0.50	0.0691-0.0693 in (1.756-1.760 mm)
	0.75	0.0741-0.0742 in (1.881-1.885 mm)

G00325926

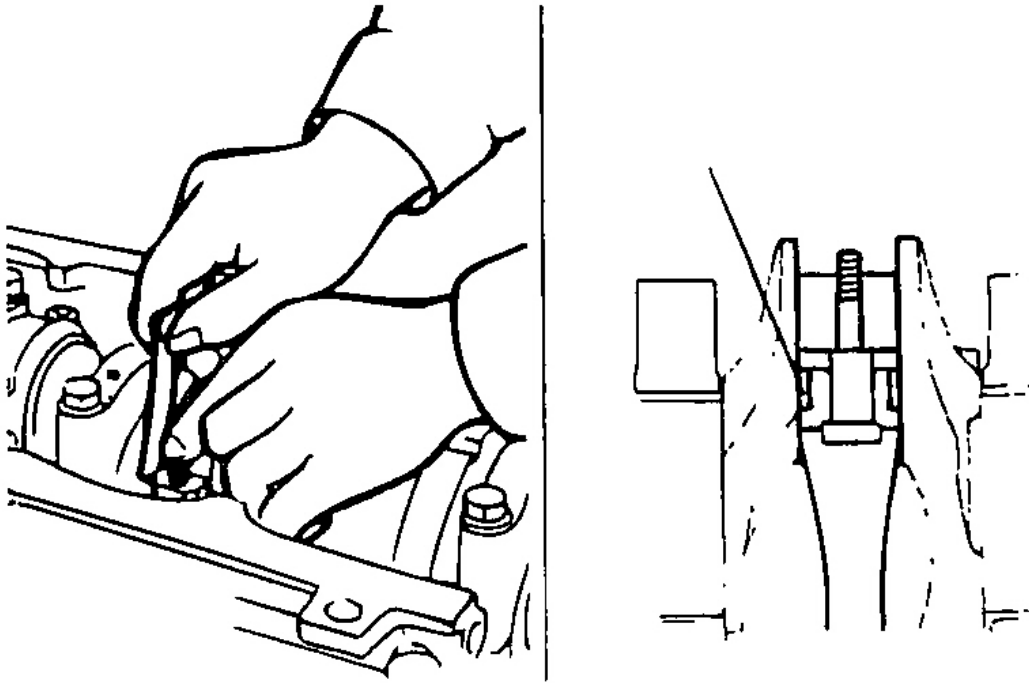
Fig. 100: Connecting Rod Bearing Thickness Chart
 Courtesy of KIA MOTORS AMERICA, INC.

22. Apply a coat of clean engine oil to connecting rod bearing in connecting rod cap.
23. Install connecting rod cap and torque to specification.

Tightening torque:

22~24 lb-ft (29~34 N . m, 3.0~3.5 kg-m)

24. Insert a thickness gauge between connecting rod and crankshaft and check connecting rod side clearance.



G00325927

Fig. 101: Measuring Connecting Rod Side Clearance

Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Do not measure between connecting rod cap and crankshaft.

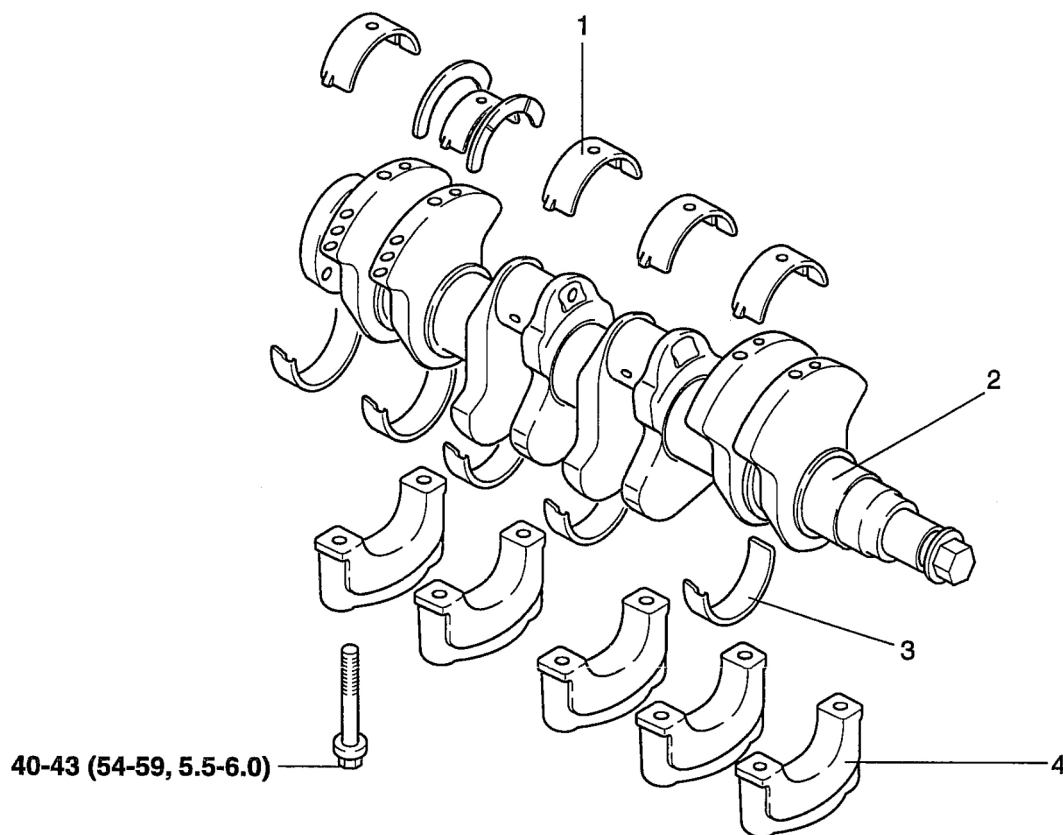
Side clearance:

0.0044~0.0103 in (0.110~0.262 mm)

Maximum: 0.012 in (0.30 mm)

25. If side clearance exceeds maximum side clearance specification, replace connecting rod and cap.

CRANKSHAFT**COMPONENT**



TORQUE : lb·ft (N·m, kg·m)

- 1. Main bearing
- 2. Crank shaft

- 3. Main bearing
- 4. Main bearing cap

G00325928

Fig. 102: Illustrating Crankshaft Components
 Courtesy of KIA MOTORS AMERICA, INC.

DISASSEMBLY

1. Remove the timing belt, front case, flywheel cylinder head assembly and oil pan. For details, refer to respective components.
2. Remove the rear plate and the rear oil seal.
3. Remove the connecting rod caps.

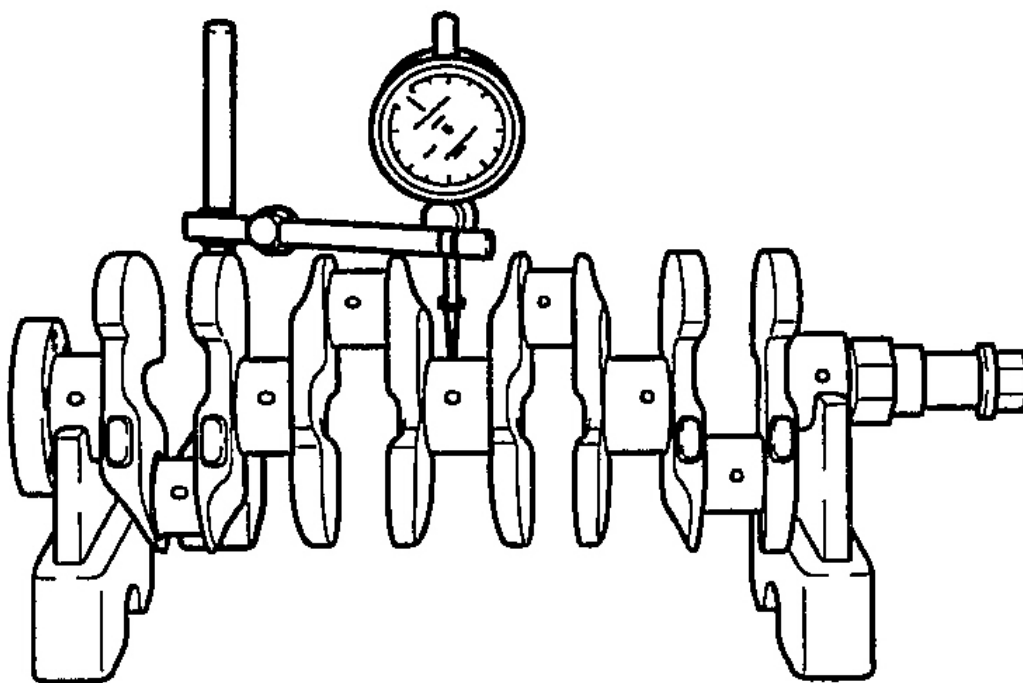
NOTE: Mark the main bearing caps to permit reassembly in the original position and direction.

4. Remove the main bearing caps and remove the crankshaft.

Keep the bearings in order by cap number.

INSPECTION

1. Check crankshaft bearing and crank pin journals for damage and scoring.
2. Check oil holes for clogging.
3. Set crankshaft on V-blocks.
4. Measure crankshaft run-out at center journal. Replace crankshaft if it is not within specification.



G00325929

Fig. 103: Measuring Crankshaft Run-Out
Courtesy of KIA MOTORS AMERICA, INC.

Run-out: 0.0016 in (0.04 mm)

5. Grind crankshaft only if there is visible scoring, or if out-of-round is excessive.
6. Only grind crankshaft amount necessary to correct condition.
7. If a crankshaft must be ground 0.020 in (0.50 mm) or more, heat-treat crankshaft to ensure durability.

Bearing size	Journal diameter
0.010 in (0.25 mm) undersize	1.9562~1.9569 in (49.688~49.706 mm)
0.020 in (0.50 mm) undersize	1.9464~1.9471 in (49.438~49.456 mm)
0.030 in (0.75 mm) undersize	1.9365~1.9372 in (49.188~49.206 mm)

G00325930

Fig. 104: Main Journal Diameter Undersize Chart

Courtesy of KIA MOTORS AMERICA, INC.

Bearing size	Journal diameter
0.010 in (0.25 mm) undersize	1.5626~1.5632 in (39.690~39.706 mm)
0.020 in (0.50 mm) undersize	1.5528~1.5534 in (39.440~39.456 mm)
0.030 in (0.75 mm) undersize	1.5429~1.5435 in (39.190~39.206 mm)

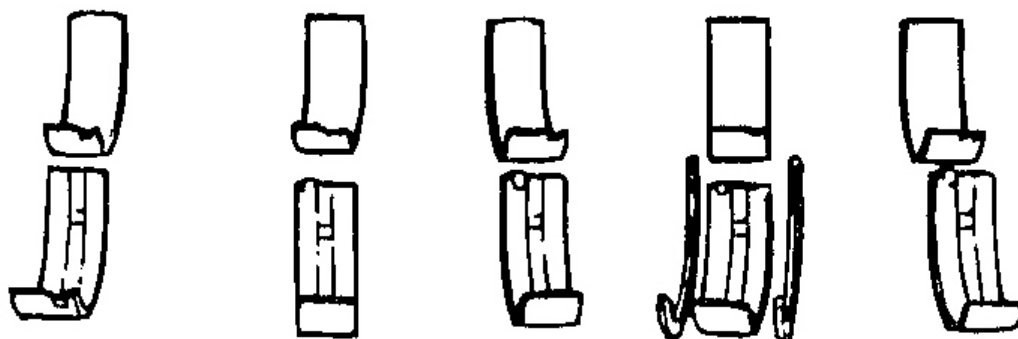
G00325931

Fig. 105: Crank Pin Journal Diameter Undersize Chart

Courtesy of KIA MOTORS AMERICA, INC.

MAIN BEARING AND CONNECTING ROD BEARINGS

- Check main and connecting rod bearings for peeling, scoring and other damage.



G00325932

Fig. 106: Checking Bearing Condition

Courtesy of KIA MOTORS AMERICA, INC.

MAIN BEARING SELECTION

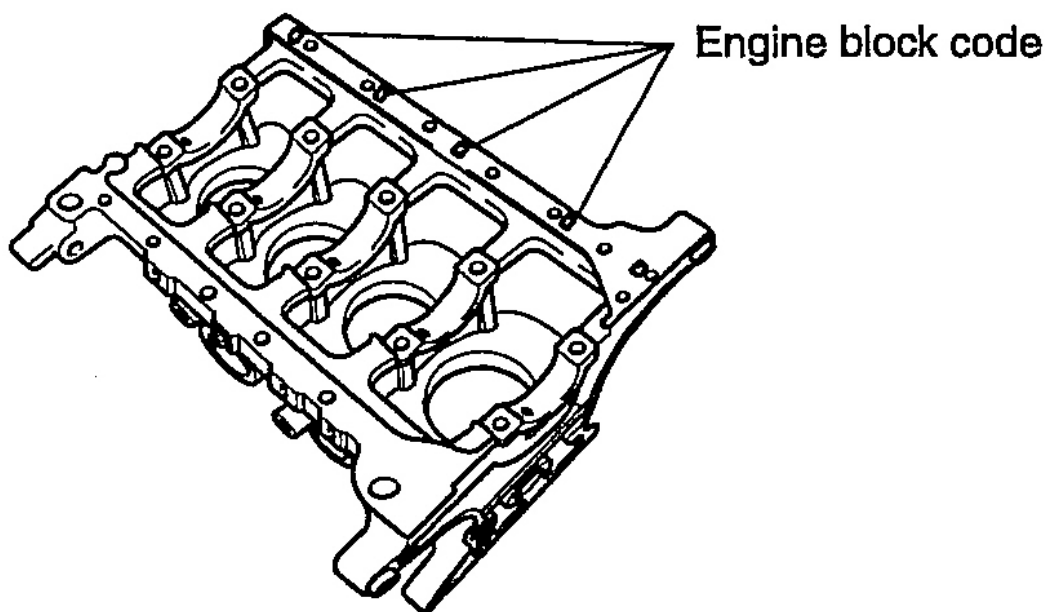
1. Standard main bearing selection:

Main journal code \ Engine block code	A	.	C
A	Black	Blue	Red
.	Brown	Black	Blue
C	Green	Brown	Black

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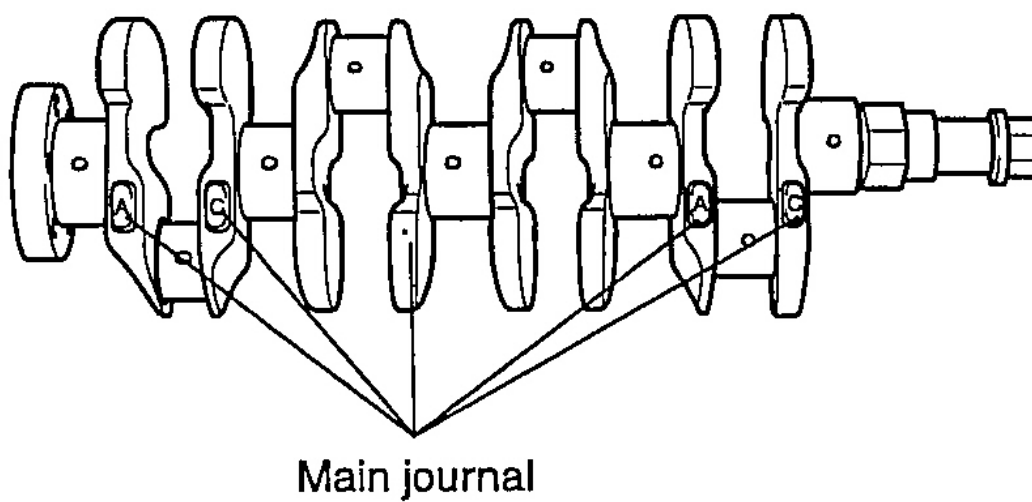
Fig. 107: Main Bearing Selection Chart

Courtesy of KIA MOTORS AMERICA, INC.



G00325934

Fig. 108: Identifying Engine Block Code Location
Courtesy of KIA MOTORS AMERICA, INC.



G00325935

Fig. 109: Identifying Crankshaft Code Location
 Courtesy of KIA MOTORS AMERICA, INC.

2. Main bearing housing bore size:

Code	Main bearing housing bore size
A	2.1260-2.1262 in (54.000-54.006 mm)
.	2.1262-2.1265 in (54.006-54.012 mm)
C	2.1265-2.1267 in (54.012-54.018 mm)

G00325936

Fig. 110: Main Bearing Housing Bore Size Chart
 Courtesy of KIA MOTORS AMERICA, INC.

3. Main journal shaft diameter:

Code	Main journal shaft diameter
A	1.9661-1.9663 in (49.938-49.944 mm)
.	1.9663-1.9665 in (49.944-49.950 mm)
C	1.9665-1.9668 in (49.950-49.956 mm)

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Fig. 111: Main Journal Shaft Diameter Chart
 Courtesy of KIA MOTORS AMERICA, INC.

4. Main bearing thickness:

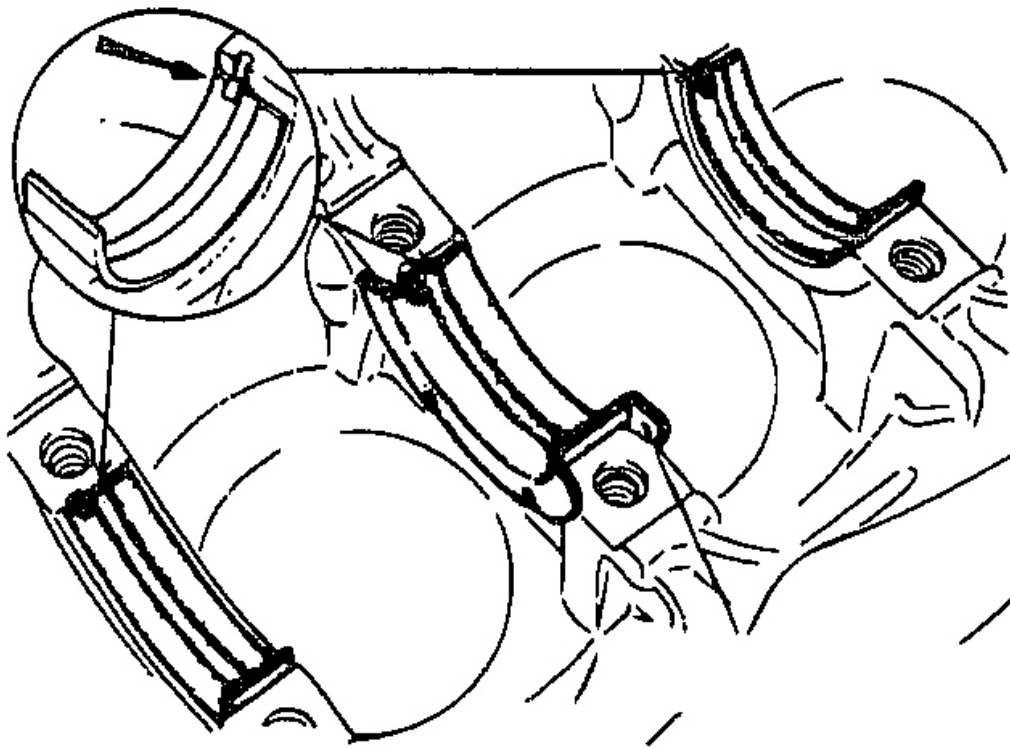
Main bearing		Thickness
Standard bearing	Yellow	0.0790-0.0791 in (2.007-2.010 mm)
	Green	0.0791-0.0793 in (2.010-2.013 mm)
	Brown	0.0793-0.0794 in (2.013-2.016 mm)
	Black	0.0794-0.0795 in (2.016-2.019 mm)
	Blue	0.0795-0.0796 in (2.019-2.022 mm)
	Red	0.0796-0.0797 in (2.022-2.025 mm)
Undersize bearing	0.25	0.0840-0.0841 in (2.133-2.137 mm)
	0.50	0.0889-0.0891 in (2.258-2.262 mm)
	0.75	0.0938-0.0940 in (2.383-2.387 mm)

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Fig. 112: Main Bearing Thickness Chart
 Courtesy of KIA MOTORS AMERICA, INC.

REASSEMBLY

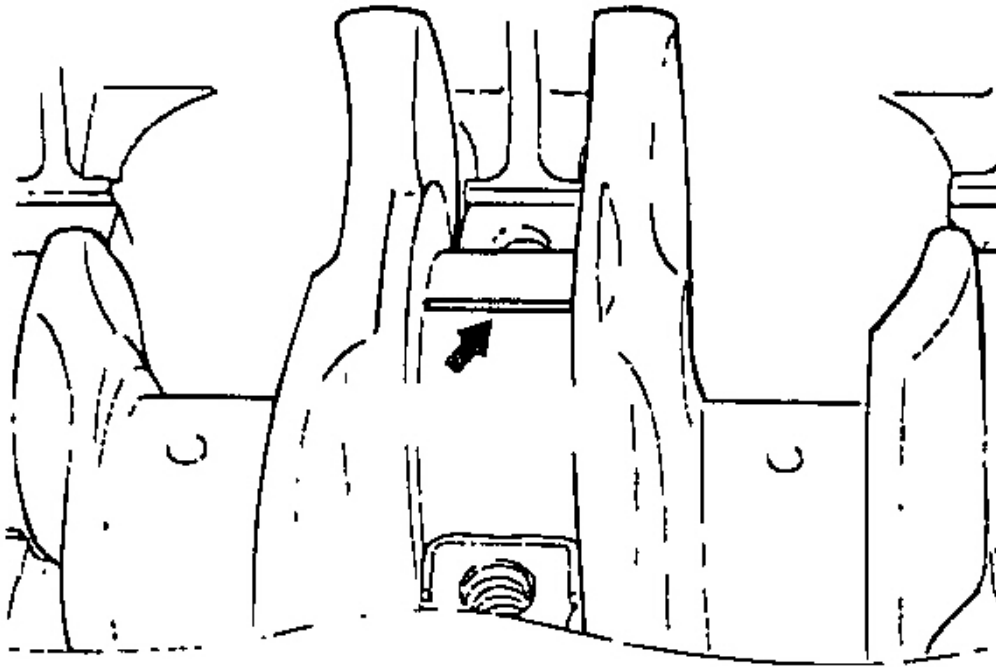
1. Inspect journals and bearings for any foreign material. Clean crankshaft, oil holes, and main bearing journals thoroughly, and dry components with compressed air.
2. Install grooved main bearings into saddles on engine block.
3. Install thrust bearings with oil groove facing crankshaft.



G00325939

Fig. 113: Positioning Thrust Bearings
Courtesy of KIA MOTORS AMERICA, INC.

4. Set crankshaft on installed bearings.
5. Install remaining main bearings into main bearing caps.
6. Position Plastigauge on crankshaft journals.



G00325940

Fig. 114: Positioning Plastigauge

Courtesy of KIA MOTORS AMERICA, INC.

7. Install main bearing caps along with lower main bearings according to cap number and <-- mark.
8. Tighten main bearing cap bolts.

Tightening torque:

40~43 lb-ft (54~59 N . m, 5.5~6.0 kg-m)

CAUTION: Do not rotate crankshaft with Plastigauge on crankshaft journals.

9. Remove main bearing caps and check bearing clearance.

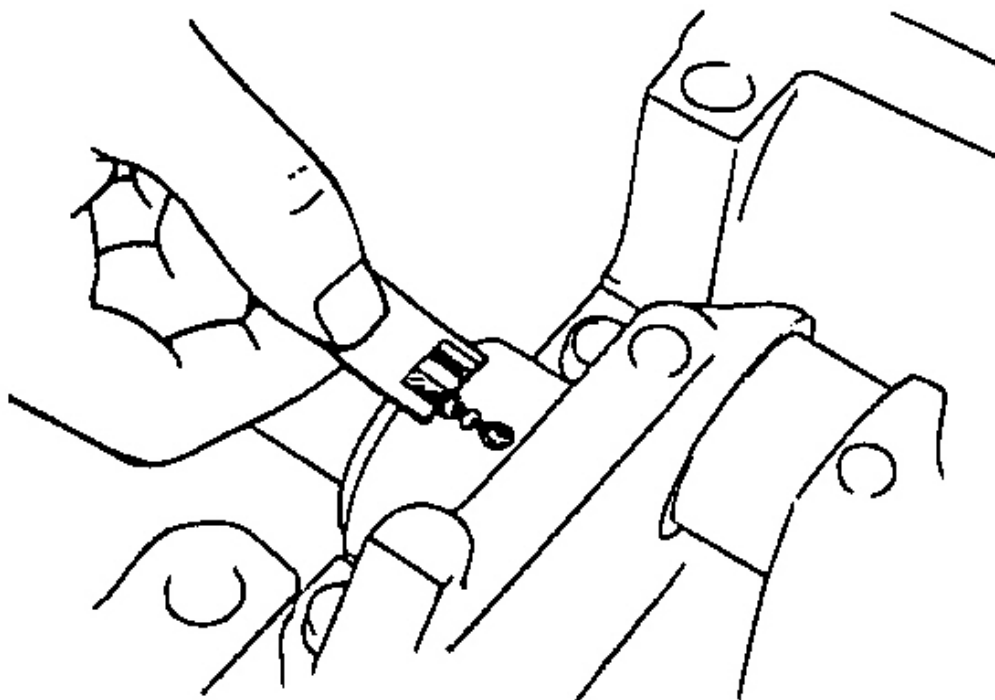
NOTE: **The widest point of Plastigauge is the smallest clearance, and the narrowest point of Plastigauge is the largest clearance.**

10. If oil clearance exceeds specification, grind and polish crankshaft and use undersized main bearings.

Oil Clearance:

0.0007~0.0014 in (0.018~0.036 mm)

MAXIMUM: 0.0031 in (0.08 mm)



G00325942

Fig. 115: Measuring Oil Clearance
Courtesy of KIA MOTORS AMERICA, INC.

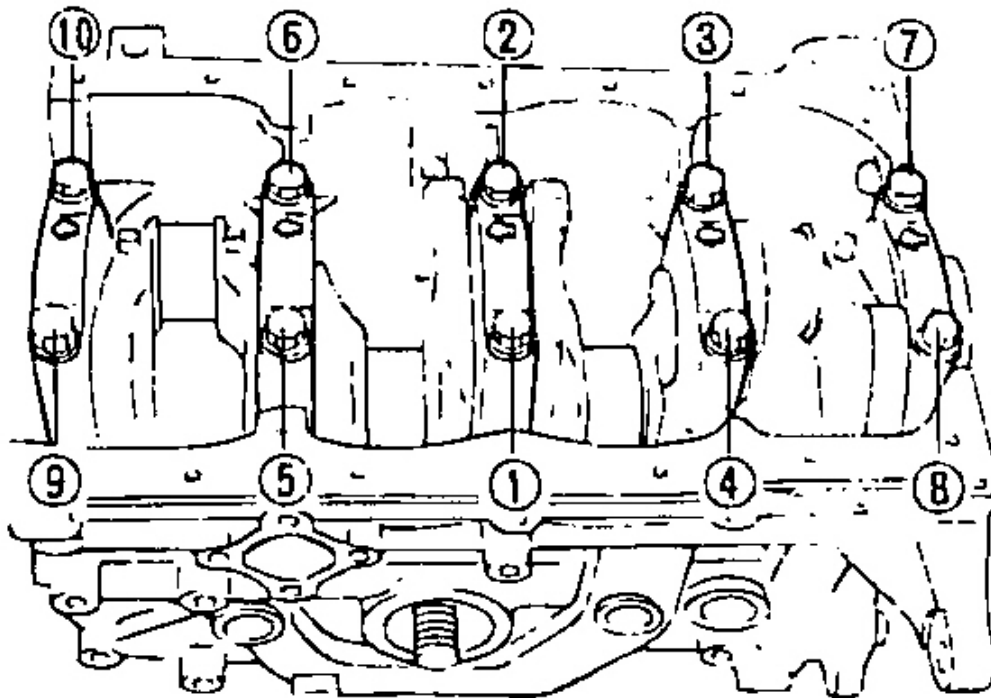
11. Lift crankshaft out of cylinder block and carefully remove Plastigauge from main bearings and crankshaft journals.
12. Apply a light coat of engine oil on main bearings and install crankshaft by gently lowering it onto bearings.
13. Apply a light coat of oil on crankshaft main bearing journals and on main bearings on main bearing caps.
14. Install main bearing caps along with lower main bearings according to cap number and <-- mark.

15. Tighten main bearing cap bolts according to the following procedure:

Tighten bolts in order shown in **Fig. 116**.

Tightening torque:

40~43 lb-ft (54~59 N . m, 5.5~6.0 kg-m)



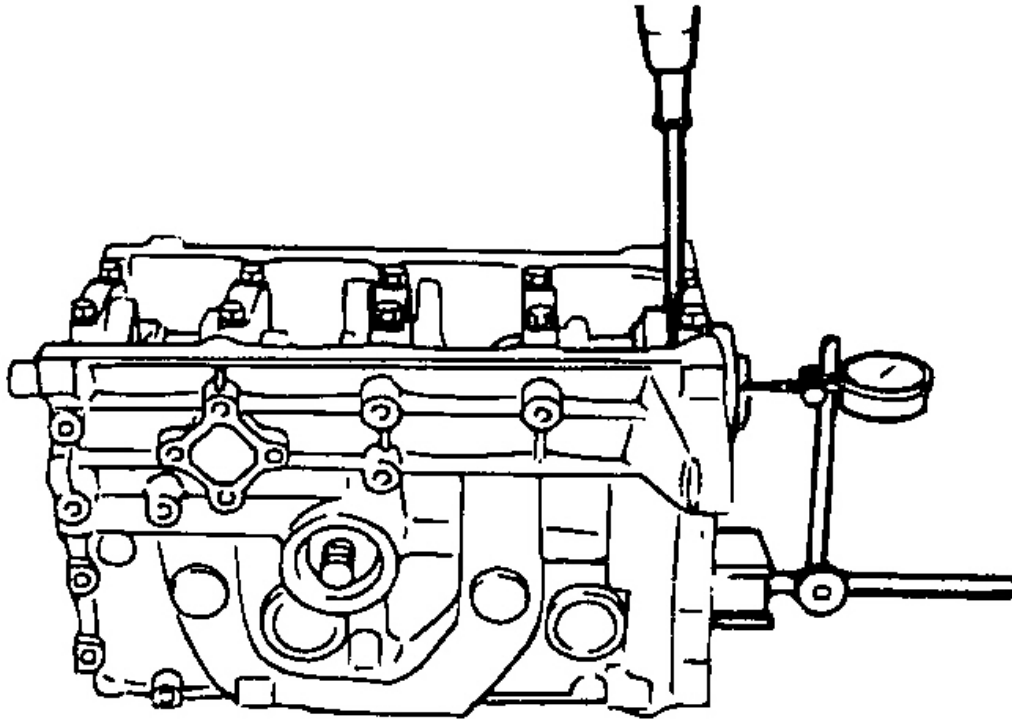
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Fig. 116: Crankshaft Main Bearing Bolt Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

16. Rotate crankshaft to ensure it does not bind.
17. Place a dial indicator against front of crankshaft and zero gauge.
18. Using a prying tool, move crankshaft forward and zero dial indicator.
19. Move the crankshaft toward the rear of block with prying tool and check the amount of movement on dial indicator.

End Play:

0.0032~0.0111 in (0.080~0.282 mm)



G00325944

Fig. 117: Measuring Crankshaft End Play
Courtesy of KIA MOTORS AMERICA, INC.

20. If end play exceeds specification, grind crankshaft and install oversized thrust bearings, or replace crankshaft and thrust bearings.

OVERSIZE THRUST BEARING WIDTH

Thrust bearing size	Specification
Standard	0.0985~0.1003in (2.500~2.550 mm)
Standard + 0.010 in (0.25 mm)	0.1034~0.1053 in (2.625~2.675 mm)
Standard + 0.020 in (0.50 mm)	0.1083~0.1102 in (2.750~2.800 mm)
Standard + 0.030 in (0.75 mm)	0.1132~0.1151 in (2.875~2.925 mm)

G00325945

Fig. 118: Oversize Thrust Bearing Chart
 Courtesy of KIA MOTORS AMERICA, INC.

21. Install the oil seal in the crankshaft rear oil seal case. Press fit the oil seal all the way in, being careful not to mis-align it.
22. Install the rear plate and tighten the bolts.
23. Install the connecting rod caps. See **PISTON & CONNECTING ROD ASSEMBLY**.
24. Install the flywheel, front case, oil pan and timing belt. For further details, refer to the respective components.

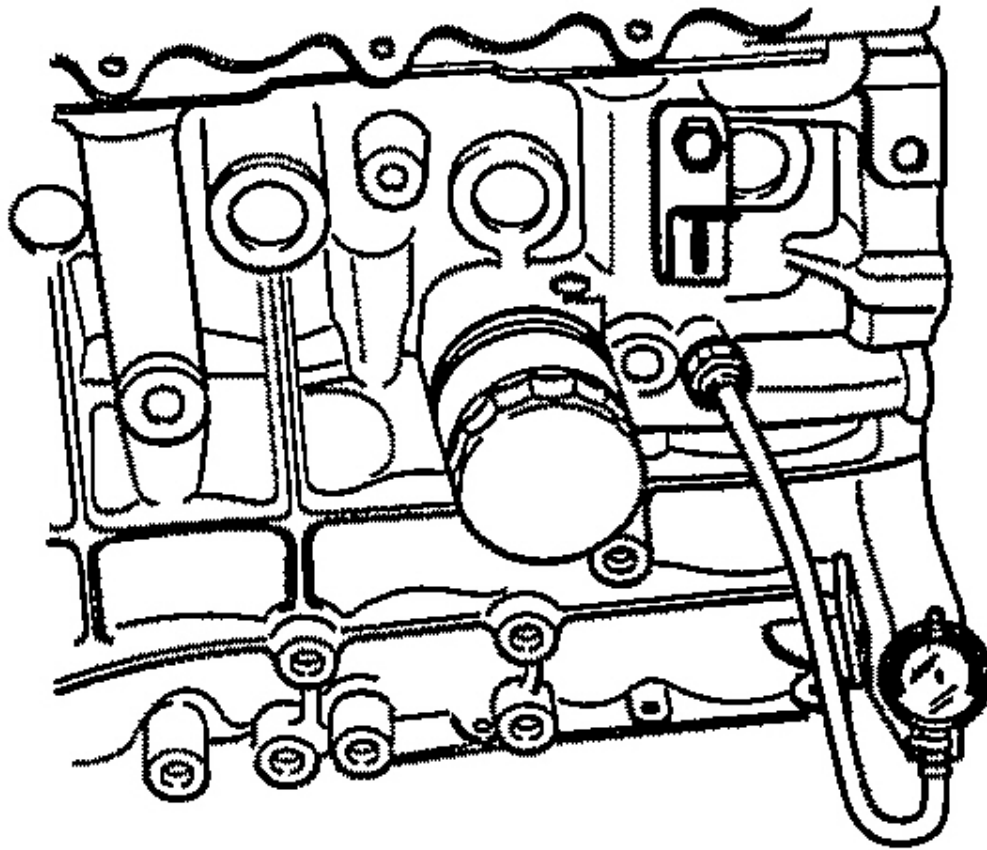
LUBRICATION SYSTEM

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 at idle and note gauge readings.

Oil pressure:

12.8 psi (88.26 kPa, 0.9 kg/cm²) above



G00325956

Fig. 119: Measuring Oil Pressure
Courtesy of KIA MOTORS AMERICA, INC.

5. If pressure is not within specification, check for cause, and repair.
6. Remove oil pressure gauge and install oil pressure switch.

Tightening torque:

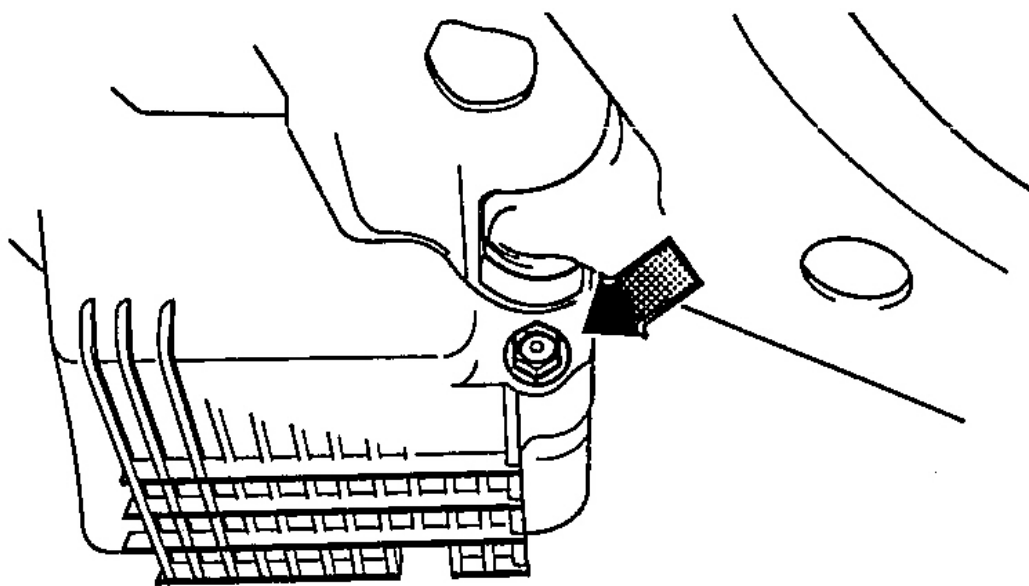
8.7~13.0 lb-ft (12~18 N.m, 1.2~1.8 kg-m)

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.



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Fig. 120: Identifying Oil Pan Drain Plug
Courtesy of KIA MOTORS AMERICA, INC.

3. Allow oil to be fully drained.
4. Install drain plug with new gasket.

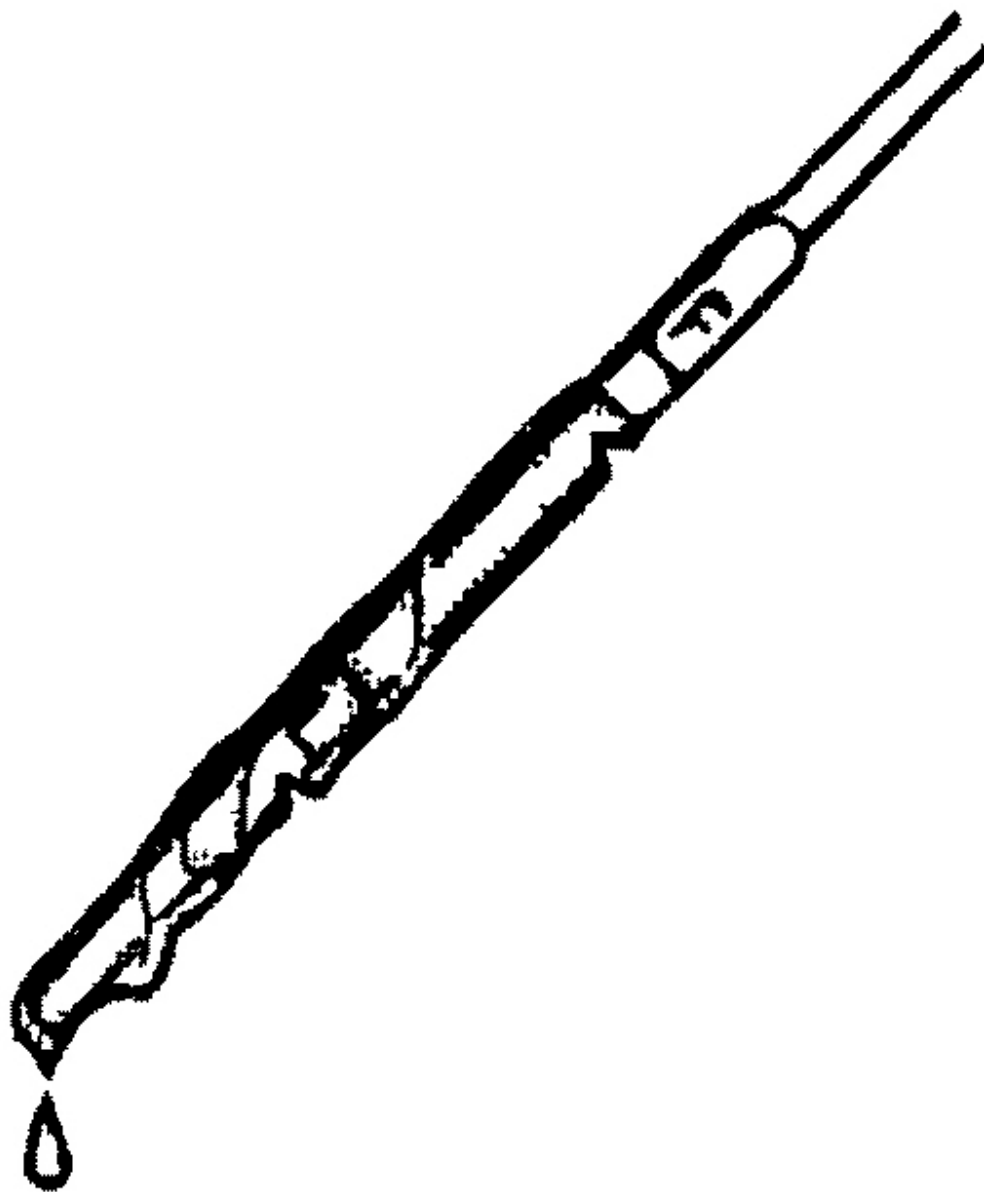
Tightening torque:

22~30 lb-ft (29~41 N.m, 3.0~4.2 kg-m)

5. Refill engine with specified type and amount of engine oil.
6. Run engine and check for leaks.
7. Check oil level and add oil if necessary.

Oil pan capacity:

3.2 U.S. qt (3.0 liters, 2.6 Imp qt)



G00325958

Fig. 121: Checking Oil Level

Courtesy of KIA MOTORS AMERICA, INC.

8. Install oil filler cap.

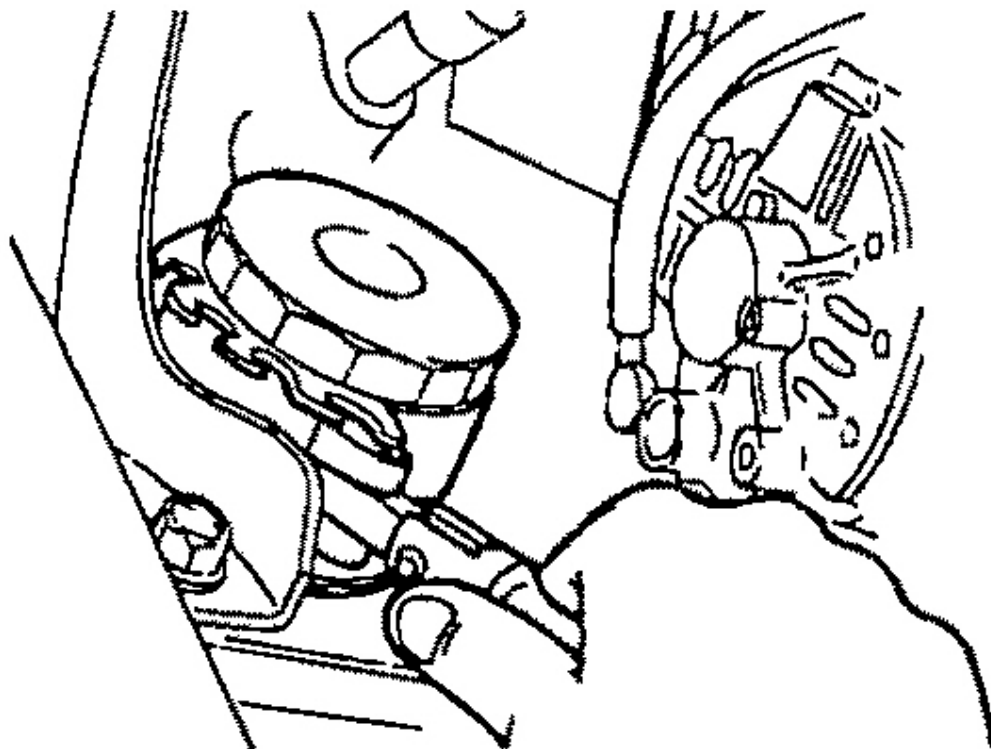
OIL FILTER

REPLACEMENT

1. Raise vehicle.
2. Remove oil filter with oil filter wrench. If rubber seal is stuck to engine, remove it.
3. Apply a small amount of clean engine oil to rubber seal of new filter.
4. Install oil filter and turn it by hand until rubber seal contacts base.
5. Tighten filter 1-1/6 turns with filter wrench.
6. Start engine and check for leaks.
7. Turn engine off, and wait 5 minutes. Check oil level and add oil if necessary.

Oil filter capacity:

0.21 U.S. qt (0.20 liter, 0.18 Imp qt)



G00325959

Fig. 122: Removing Oil Filter

Courtesy of KIA MOTORS AMERICA, INC.

OIL PAN

COMPONENT



- G00325887

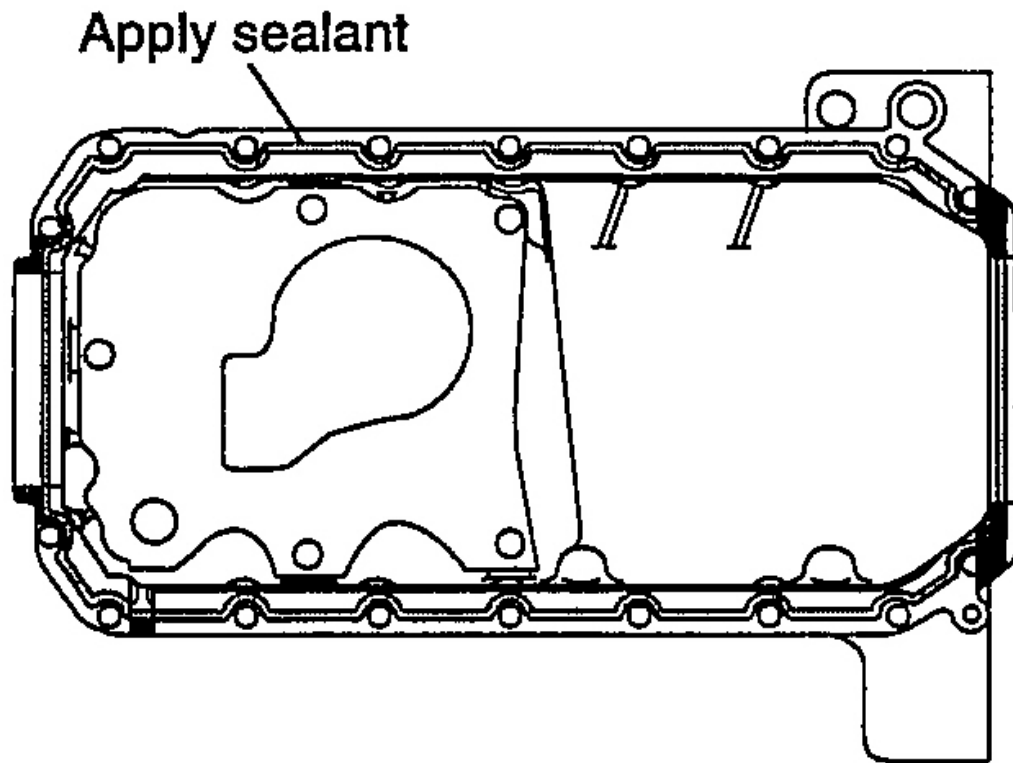
INSTALLATION

- Sealant type: LOCTITE 5900

Bead width: 0.1575 in (4 mm)

NOTE:

- Clean the foreign material from mating surface before applying sealant.
- Assembly procedure must be completed within 4 minutes after applying sealant.



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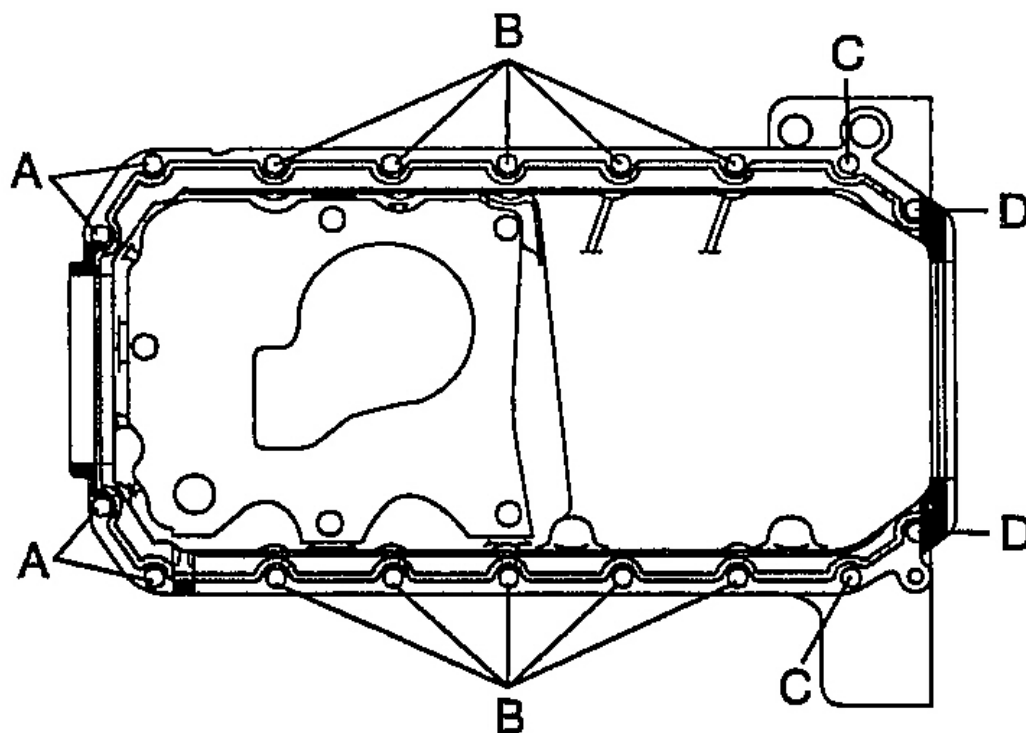
Fig. 124: Applying Oil Pan Sealant
Courtesy of KIA MOTORS AMERICA, INC.

2. Install the oil pan.

Tightening torque:

A: 7.2~8.7 lb-ft (9.8~11.8 N-m, 1.0~1.2 kg-m)

B, C, D: 7.2~9.4 lb-ft (9.8~12.7 N-m, 1.0~1.3 kg-m)

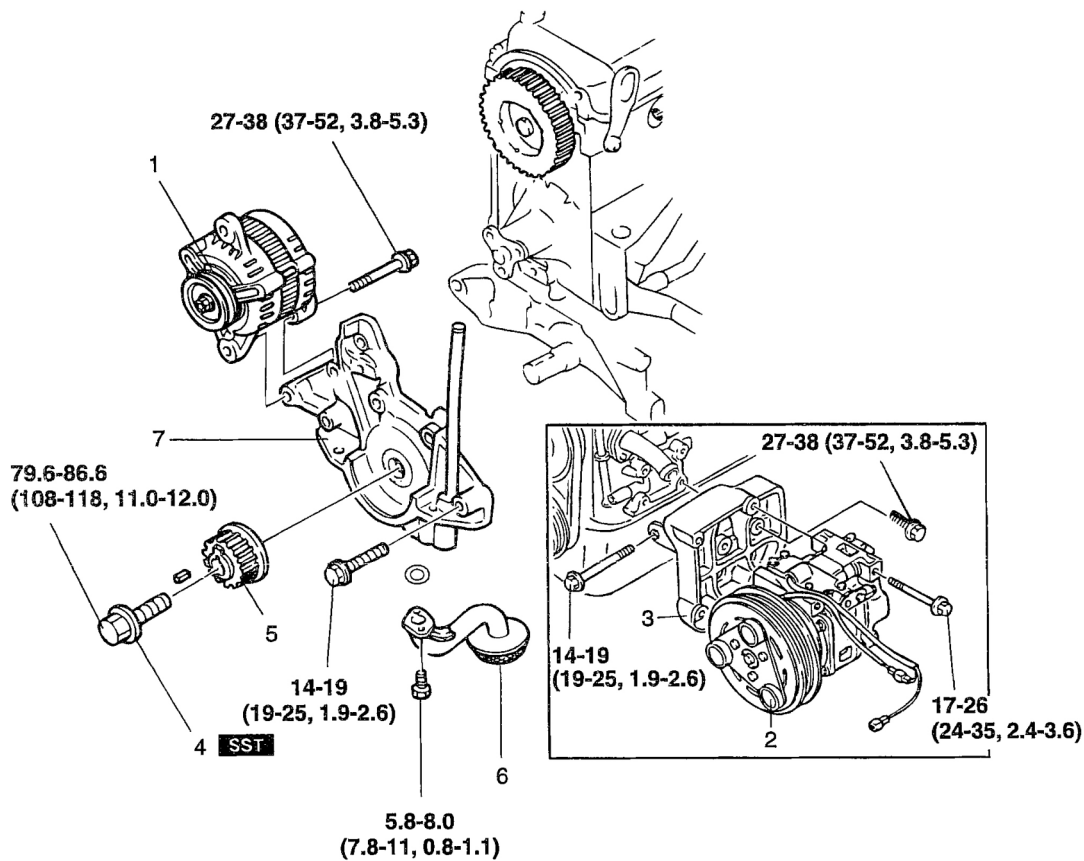


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Fig. 125: Identifying Oil Pan Bolt Position
Courtesy of KIA MOTORS AMERICA, INC.

OIL PUMP

COMPONENT

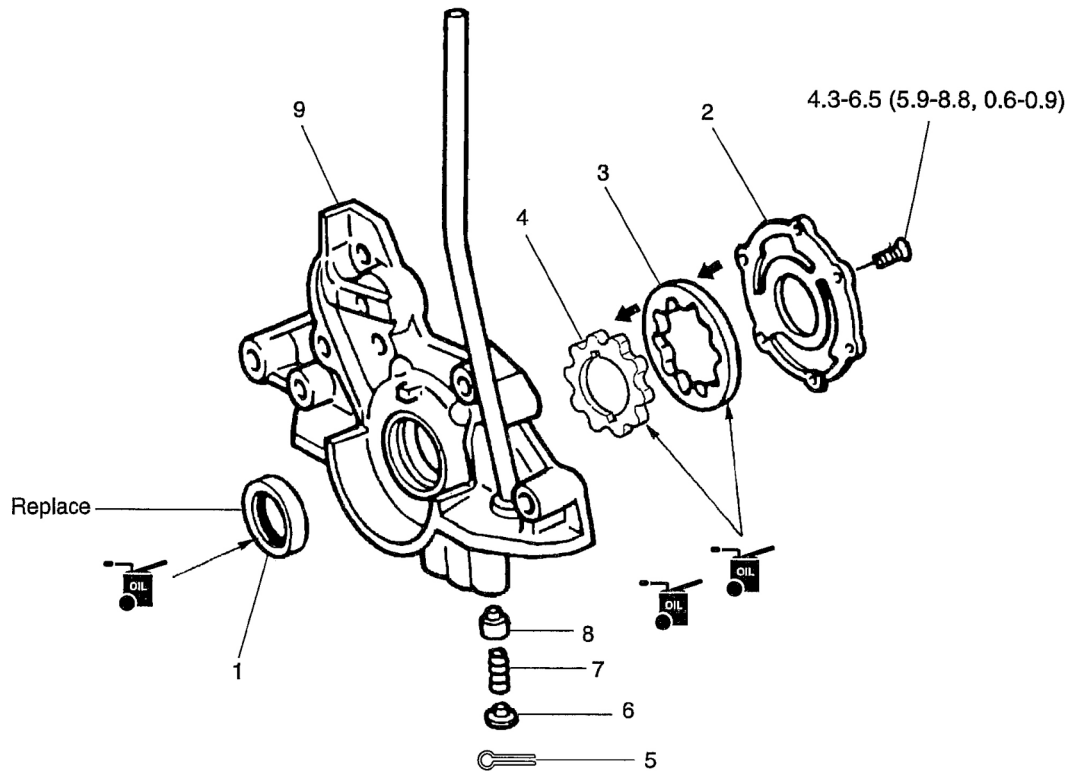


TORQUE : lb·ft (N·m, kg·m)

- | | |
|------------------------|---------------------------------|
| 1. Alternator | 4. Timing belt pulley lock bolt |
| 2. Compressor assembly | 5. Timing belt pulley |
| 3. Compressor bracket | 6. Oil strainer |
| | 7. Oil pump assembly |

G00325960

Fig. 126: Identifying Oil Pump Components (1 Of 2) With Torque Specifications
 Courtesy of KIA MOTORS AMERICA, INC.



TORQUE : lb·ft (N·m, kg·m)

- | | |
|----------------|--------------------|
| 1. Oil seal | 5. Pin |
| 2. Pump cover | 6. Spring seat |
| 3. Outer rotor | 7. Pressure spring |
| 4. Inner rotor | 8. Control plunger |
| | 9. Pump body |

G00325961

Fig. 127: Identifying Oil Pump Components (2 Of 2) With Torque Specifications
 Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

1. Disconnect negative battery cable.
2. Drain engine oil.
3. Remove Drive belt.
4. Remove timing belt.
5. Remove components in the order shown in illustration. See **Fig. 126**.

INSPECTION

1. Clean all components and clean off dust from all components.
2. Check all components with specifications and replace as necessary.

Component	Specification
Oil pump	
Side clearance	0.0039 in (0.10 mm)
Tooth tip clearance	0.0071 in (0.18 mm)
Outer rotor to pump body clearance	0.0078 in (0.20 mm)

G00325963

Fig. 128: Oil Pump Clearance Chart
Courtesy of KIA MOTORS AMERICA, INC.

INSTALLATION

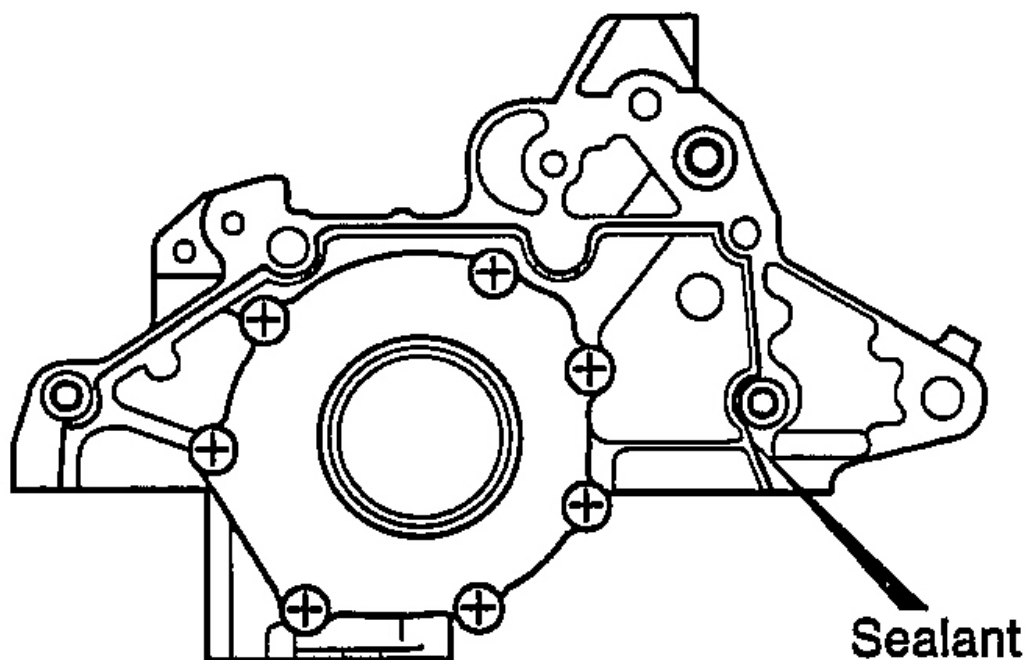
1. Apply continuous sealant to mating surface as shown illustration.

Sealant type: LOCTITE 5900

Bead width: 0.0394~0.0787 in (1~2 mm)

NOTE:

- Clean the foreign material from mating surface before applying sealant.
- Be careful for sealant not to enter the oil hole.



G00325964

Fig. 129: Applying Oil Pump Sealant
Courtesy of KIA MOTORS AMERICA, INC.

2. Install the oil pump.

Tightening torque:

13.7~18.8 lb-ft (18.6~25.5 N.m, 1.9~2.6 kg-m)

COOLING SYSTEM

ENGINE 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 (ENGINE COLD)

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

COOLANT QUALITY

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

REPLACEMENT**WARNING:**

- **Never open radiator cap while engine is hot.**
- **Wrap a thick cloth around cap before loosening.**
- **Use caution when draining hot coolant.**

CAUTION:

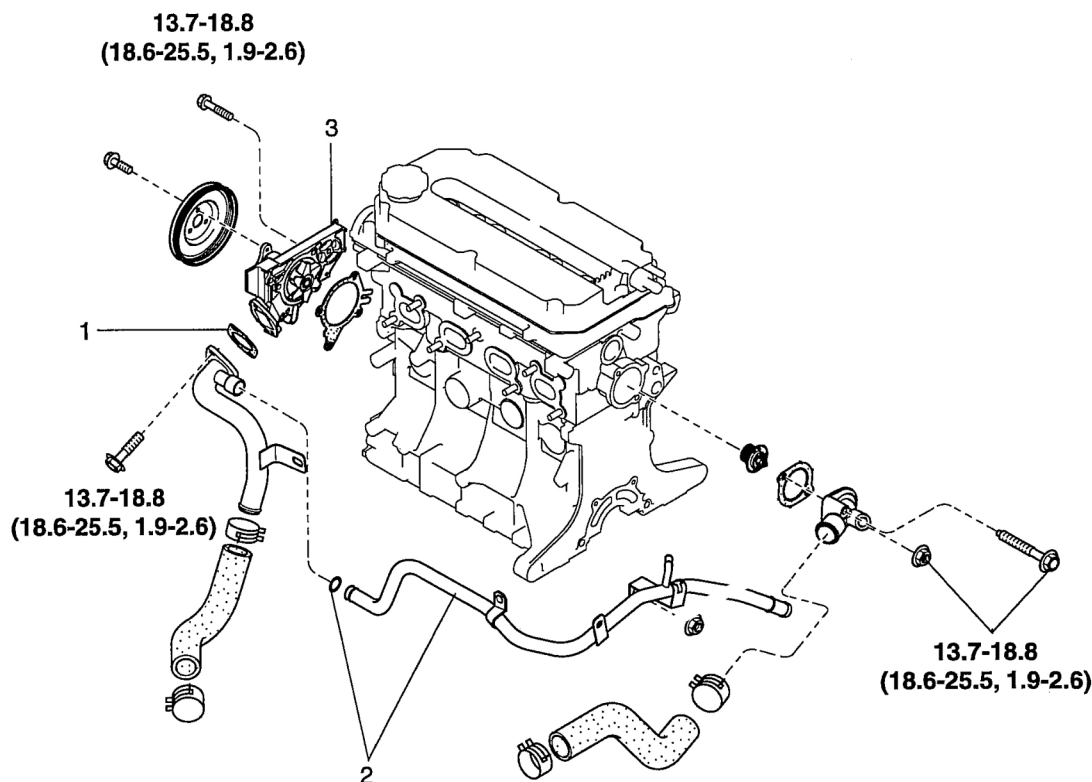
- **Do not use alcohol or methanol-based coolant.**
- **Use only demineralized water in coolant mixture.**

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: 6.0 liters (6.3 US qt, 5.3 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 check coolant level.

ENGINE COOLANT PUMP**COMPONENT**

**TORQUE : lb·ft (N·m, kg·m)**

- | | |
|---------------------------------|------------------------|
| 1. Water inlet pipe and gasket | 3. Water pump assembly |
| 2. Water bypass pipe and O-ring | 4. Water pump gasket |

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Fig. 130: Identifying Engine Coolant Pump Components With Torque Specifications
 Courtesy of KIA MOTORS AMERICA, INC.

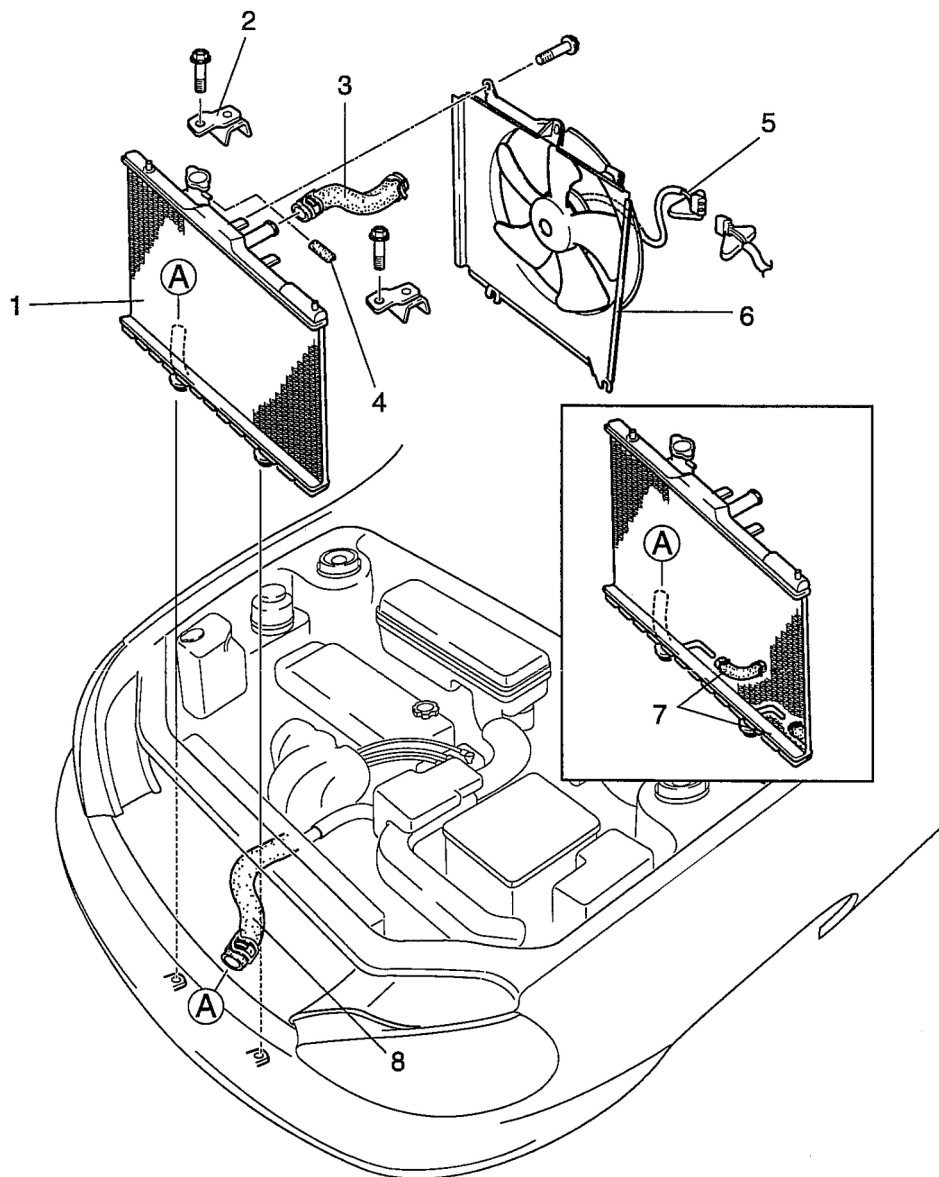
REMOVAL & INSTALLATION

CAUTION: Do not disassemble water pump assembly. If a problem is found, replace assembly as a unit.

1. Disconnect negative battery cable.
2. Remove drive belt.
3. Remove timing belt.
4. Remove power steering pump in order to remove water inlet pipe.
5. Remove components in the order shown in illustration. See **Fig. 130**.
6. Installation procedure is reverse of removal.

RADIATOR

COMPONENT



1. Radiator
2. Radiator bracket
3. Radiator hose
4. Coolant reservoir hose

5. Cooling fan connector
6. Cooling fan
7. Oil cooler hose
8. Radiator hose

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Fig. 131: Identifying Radiator Components

Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

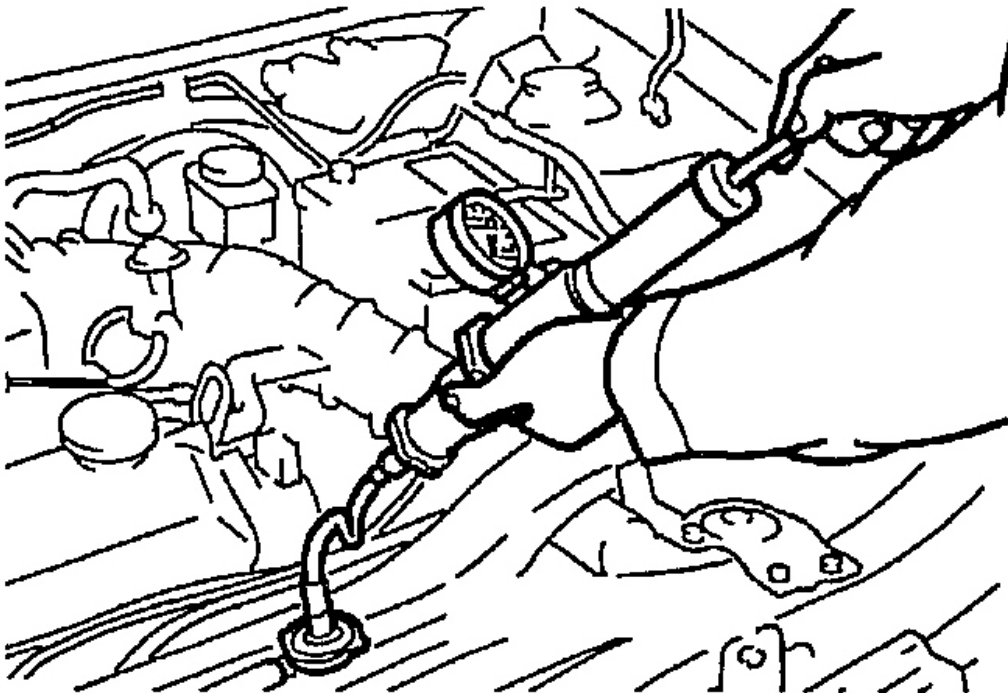
1. Disconnect negative battery cable.
2. Remove fresh air duct.
3. Drain coolant.
4. Remove components in the order shown. See **Fig. 131**.

INSTALLATION

1. Install in the reverse order of removal.
2. After installation, fill engine coolant and check coolant leakage

LEAKAGE

1. Connect a coolant system pressure tester to the radiator filler neck.
2. Apply 15 psi (103 kPa, 1.05 kg/cm²) pressure to the system.



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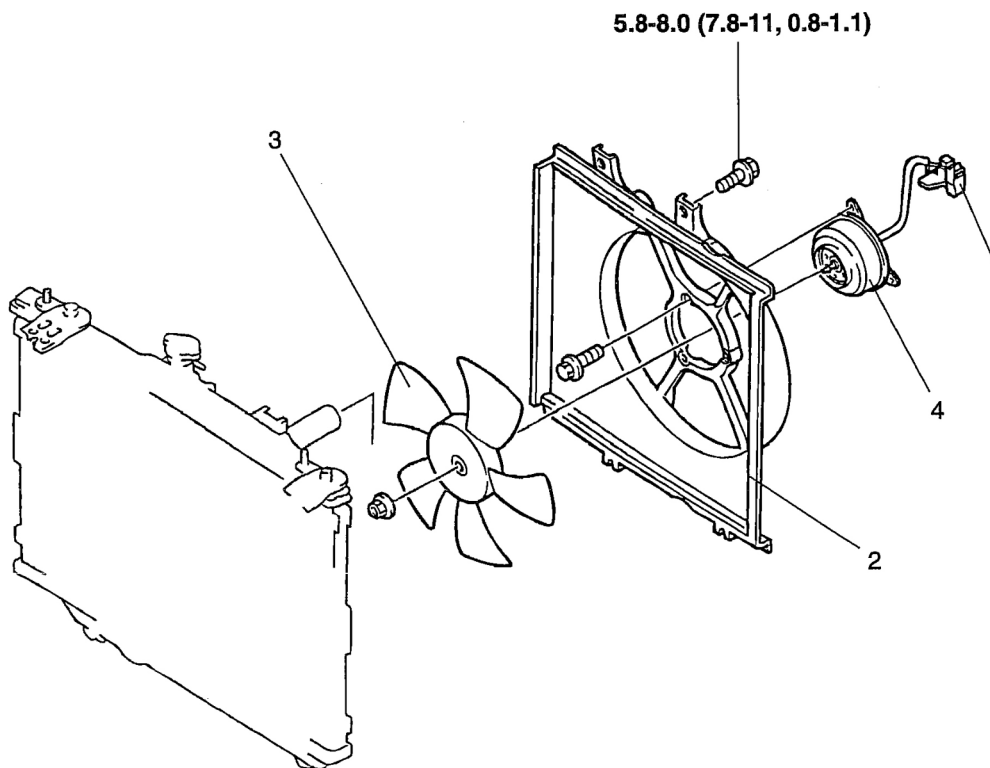
Fig. 132: Pressure Testing Cooling System
 Courtesy of KIA MOTORS AMERICA, INC.

3. Verify that the pressure remains steady at 15 psi (103 kPa, 1.05 kg/cm²).
4. If not, check system for coolant leakage.

RADIATOR FAN MOTOR

COMPONENT

Remove components in the order shown in illustration.



TORQUE : lb·ft (N·m, kg·m)

- | | |
|--------------------------|----------------|
| 1. Cooling fan connector | 3. Cooling fan |
| 2. Radiator cowl | 4. Fan motor |

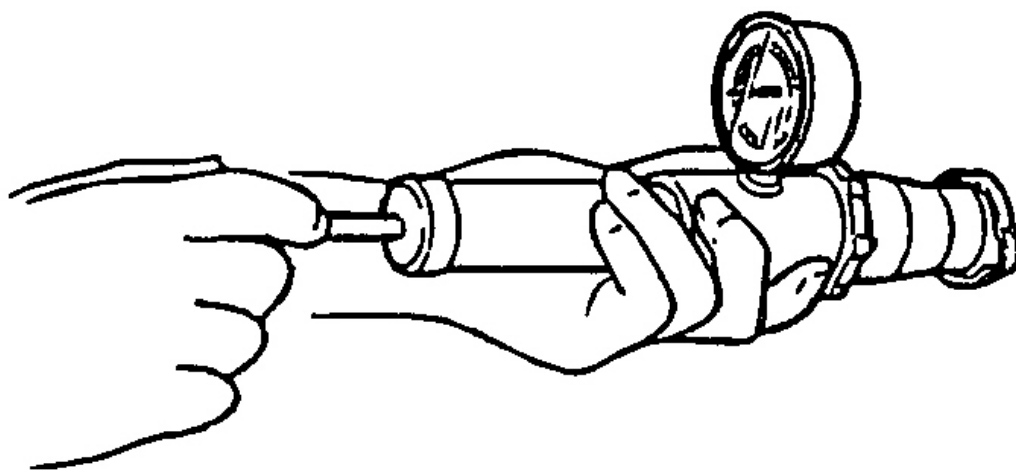
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Fig. 133: Identifying Radiator Fan Components With Torque Specifications
 Courtesy of KIA MOTORS AMERICA, INC.

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 (103 kPa, 1.05 kg/cm²).



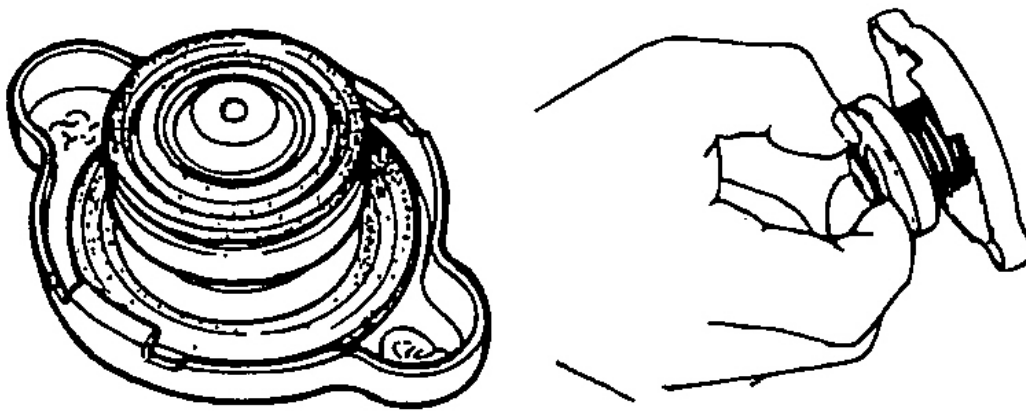
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Fig. 134: Pressure Testing Radiator Cap
Courtesy of KIA MOTORS AMERICA, INC.

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.



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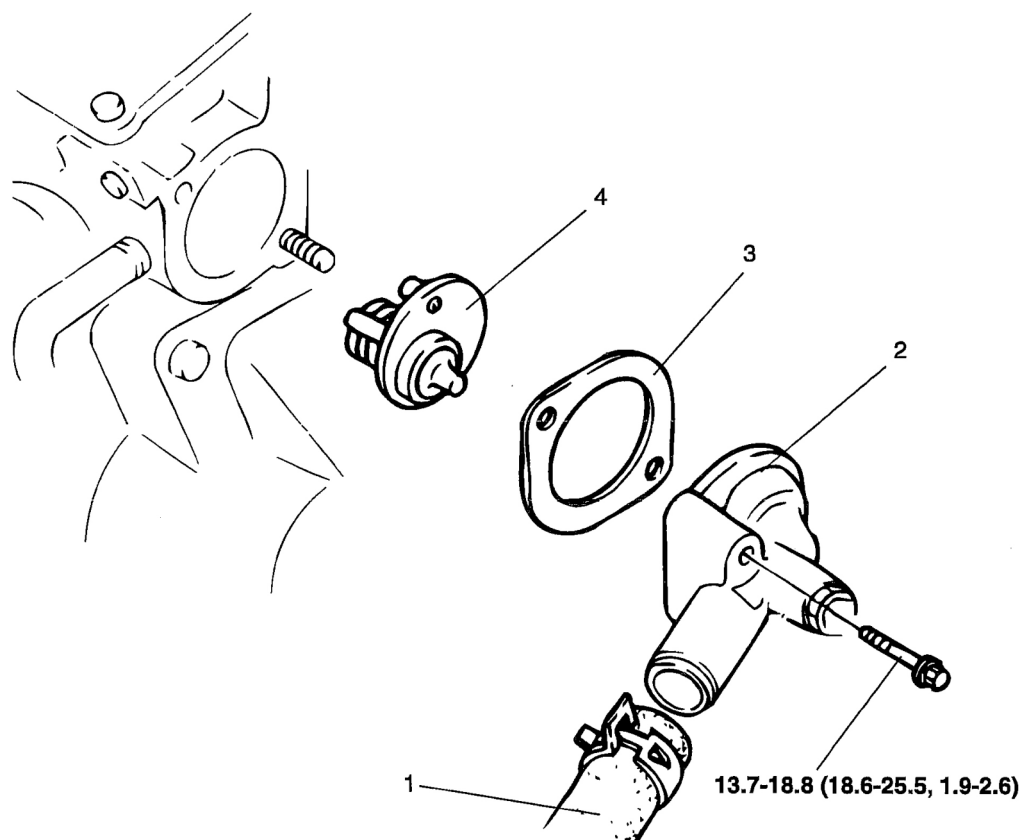
Fig. 135: Testing Negative Pressure Valve
Courtesy of KIA MOTORS AMERICA, INC.

2. Check for damage on contact surfaces, and for a cracked or deformed seal.
3. Replace radiator cap as necessary.

THERMOSTAT

COMPONENT

Remove components in the order shown in illustration.



TORQUE : lb·ft (N·m, kg·m)

- 1. Radiator upper hose
- 2. Thermostat cover

- 3. Gasket
- 4. Thermostat

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Fig. 136: Identifying Thermostat Components With Torque Specifications
 Courtesy of KIA MOTORS AMERICA, INC.

INSPECTION

- 1. Visually check that thermostat is air tight.
- 2. Place a thermostat and a thermometer in water.
- 3. Gradually heat water and check following.

Initial opening temperature:

189.5~191.3°F (87.5~88.5°C)

Full open temperature:

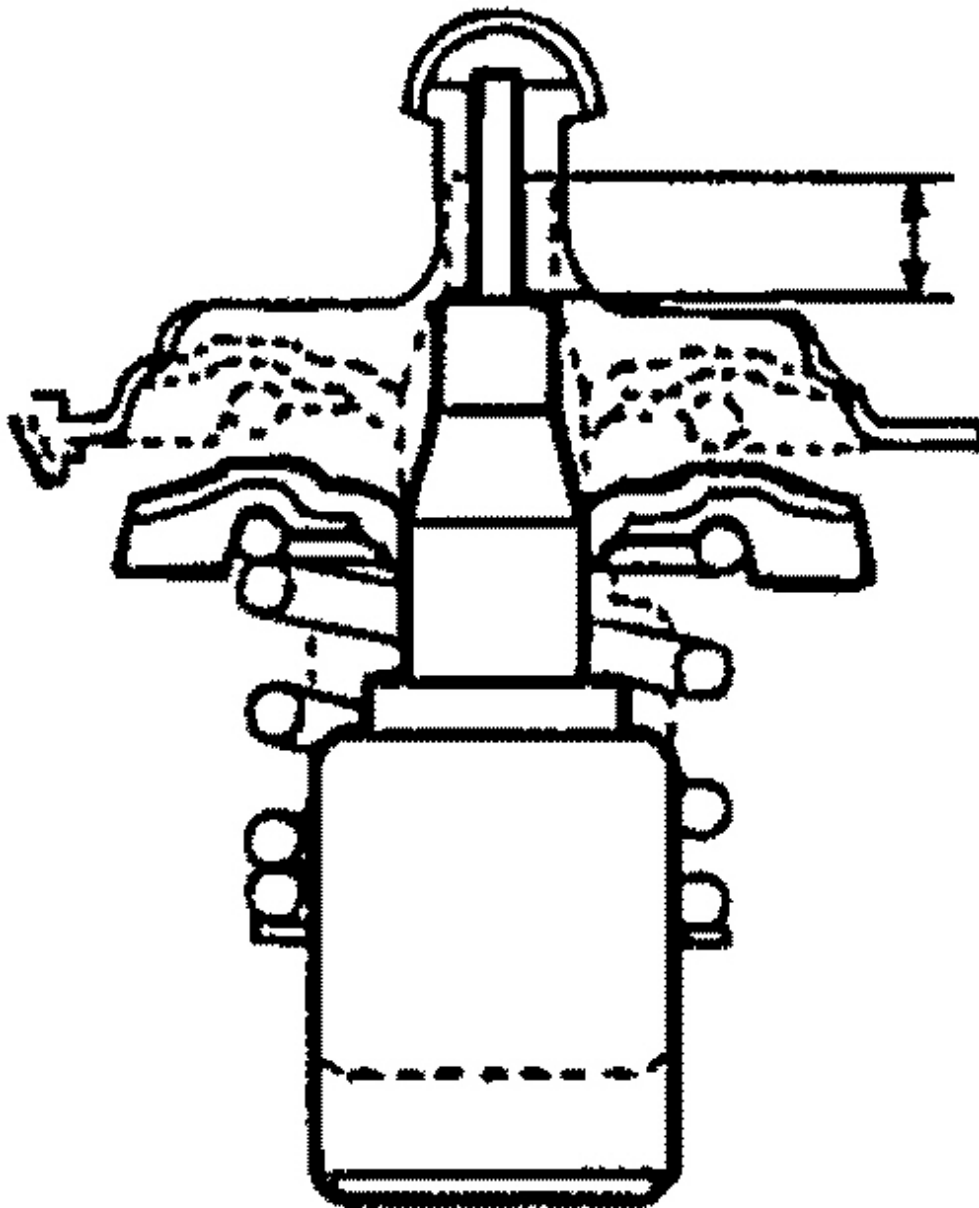
2005 Kia Rio

2004-05 ENGINES 1.6L 4-Cylinder - Rio

212°F (100°C)

Full open lift:

0.31 in (8.0 mm) minimum



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Fig. 137: Testing Thermostat
Courtesy of KIA MOTORS AMERICA, INC.

INSTALLATION

1. Install thermostat into cylinder head with jiggle pin positioned up.
2. Install in the reverse of removal.

NOTE: When installing thermostat gasket, make sure that printing side of gasket is facing toward cylinder head.

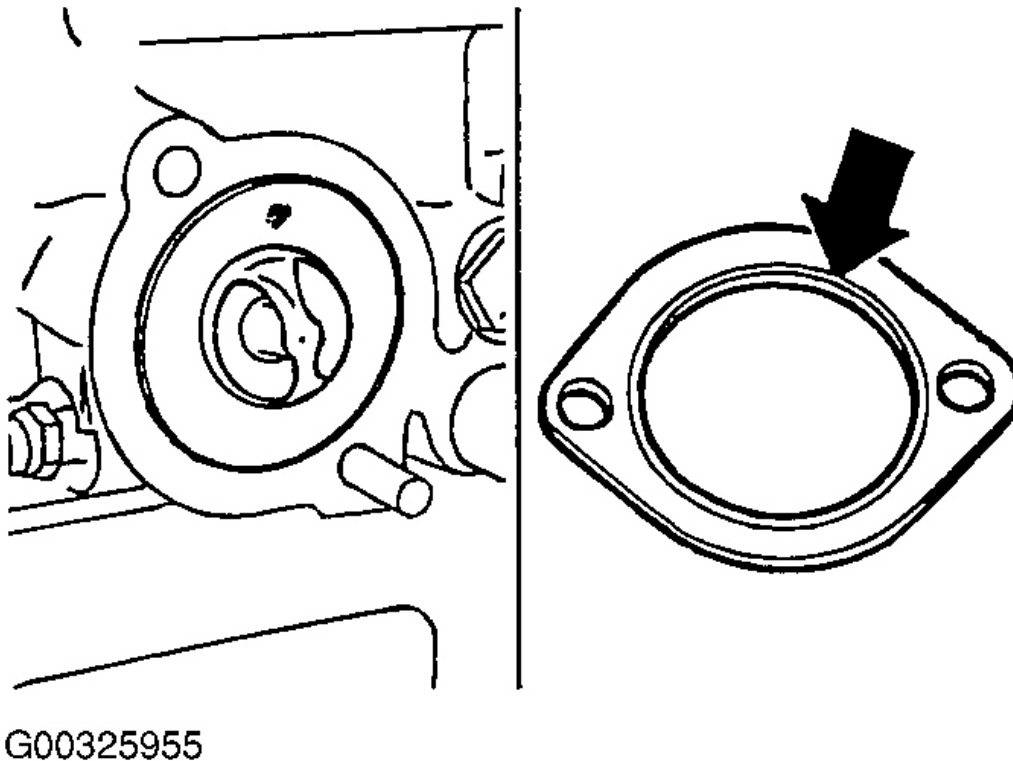
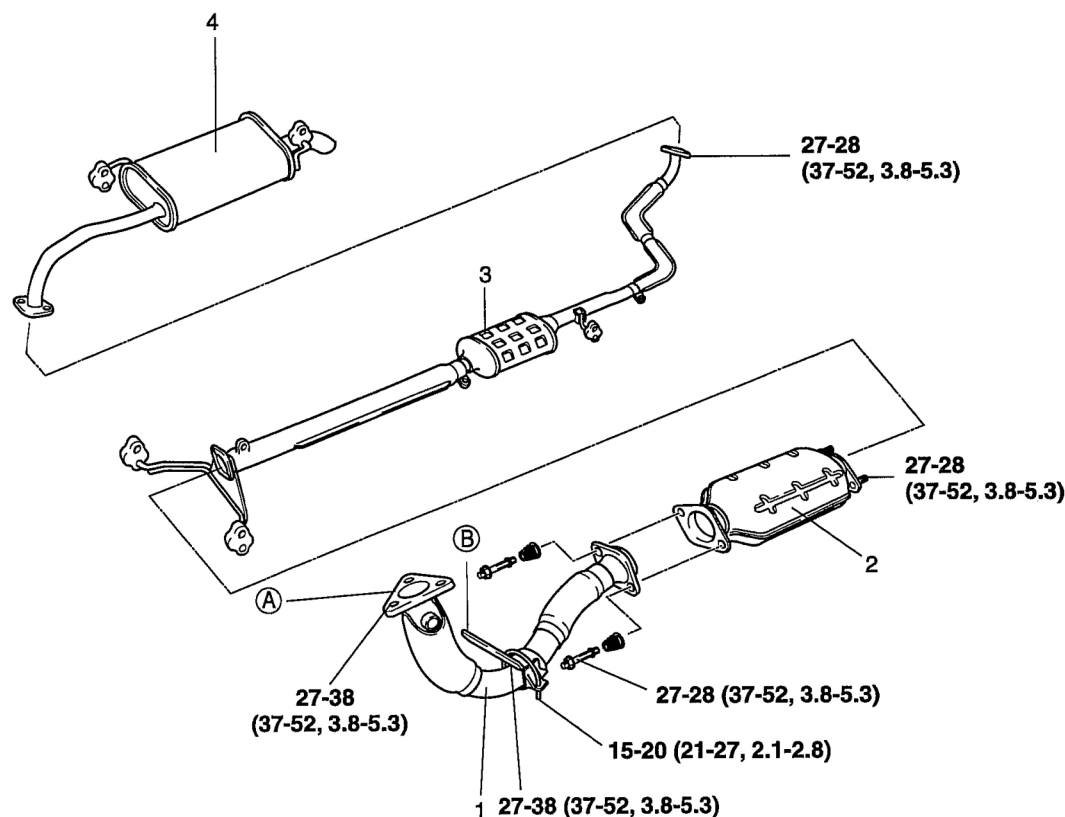


Fig. 138: Identifying Thermostat Gasket Position
Courtesy of KIA MOTORS AMERICA, INC.

INTAKE AND EXHAUST SYSTEM**EXHAUST PIPE****COMPONENT**

Remove components in the order shown in illustration.



TORQUE : lb·ft (N·m, kg·m)

1. Front pipe assembly
2. Catalytic converter

3. Pre silencer assembly
4. Main silencer assembly

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Fig. 139: Identifying Exhaust System Components With Torque Specifications
 Courtesy of KIA MOTORS AMERICA, INC.

INSTALLATION

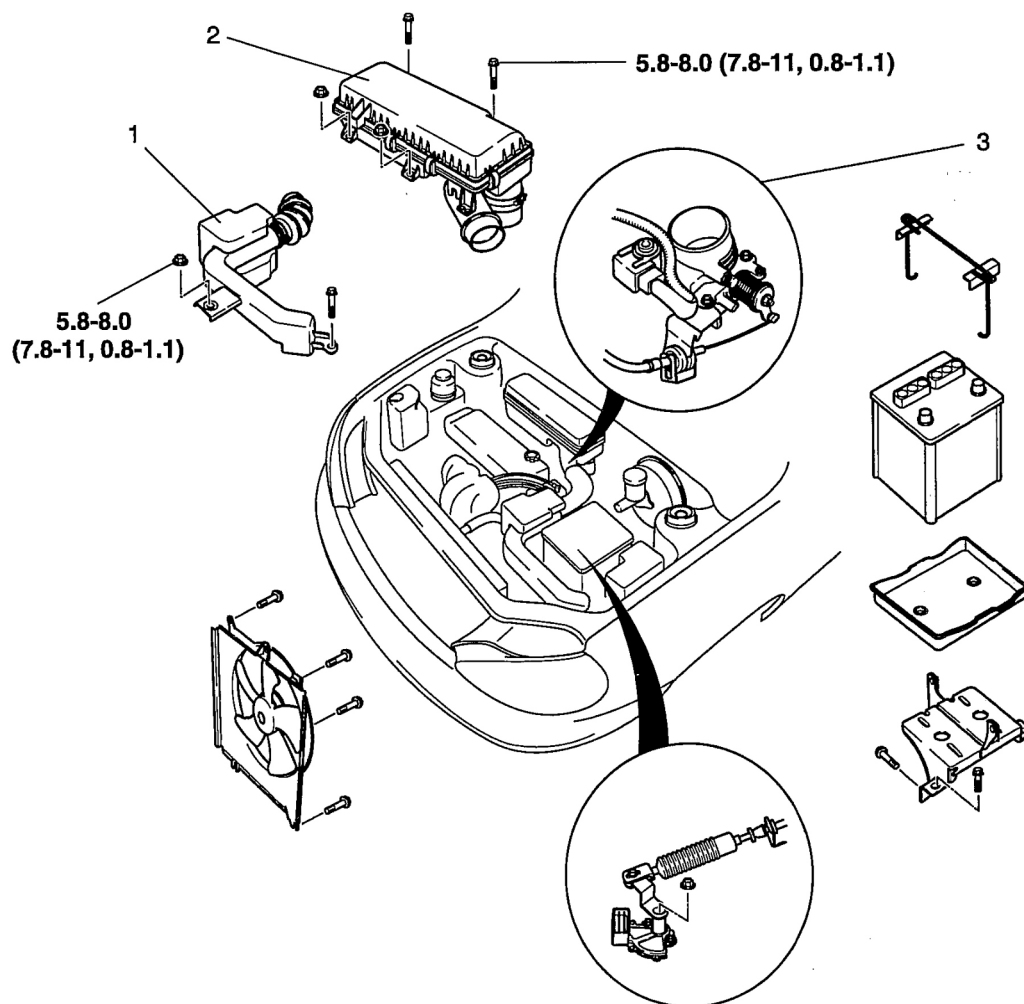
Install front exhaust as follows:

1. Tighten (A) temporarily
2. Tighten (B) temporarily
3. Tighten (A) fully
4. Check the connection between the pipe of (B) and bracket
5. Tighten (B) fully

AIR CLEANER (ACL)

INTAKE SYSTEM

Remove components in the order shown in illustration.



TORQUE : lb·ft (N·m, kg·m)

1. Fresh air duct

2. Air cleaner assembly

3. Accelerator

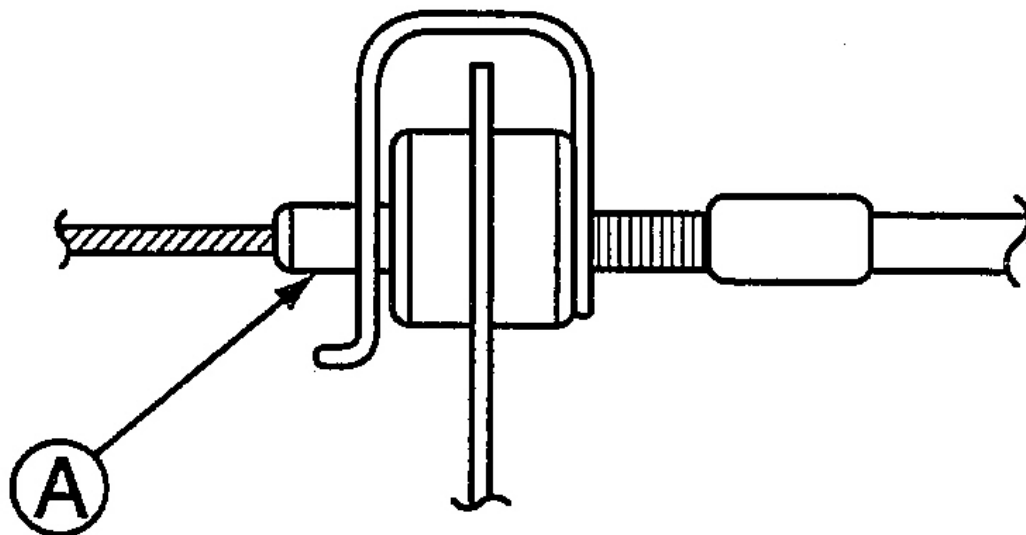
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Fig. 140: Identifying Air Cleaner Components With Torque Specifications
Courtesy of KIA MOTORS AMERICA, INC.

ACCELERATOR CABLE

1. Depress the accelerator pedal to the floor and check that the throttle valve is fully opened. Adjust with nut (A), if necessary.
2. Measure the free play of the accelerator cable.

Free play: 0.16~0.28 in (4~7 mm)

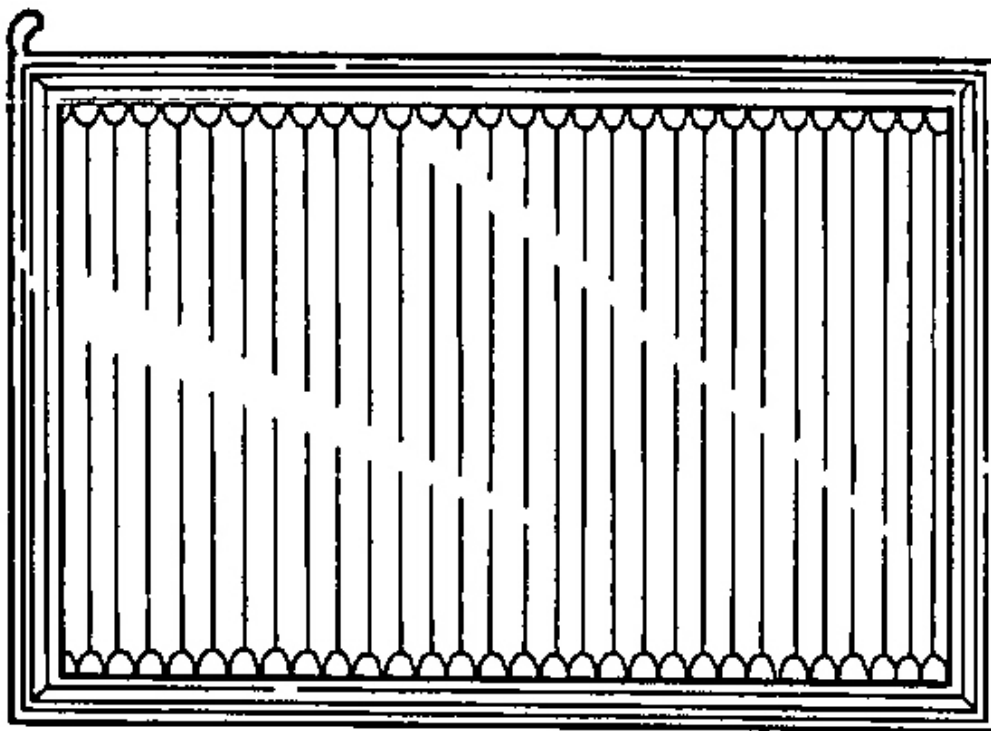


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Fig. 141: Measuring Accelerator Cable Free Play
Courtesy of KIA MOTORS AMERICA, INC.

INSPECTION

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



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Fig. 142: Identifying Air Cleaner Element
 Courtesy of KIA MOTORS AMERICA, INC.

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

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

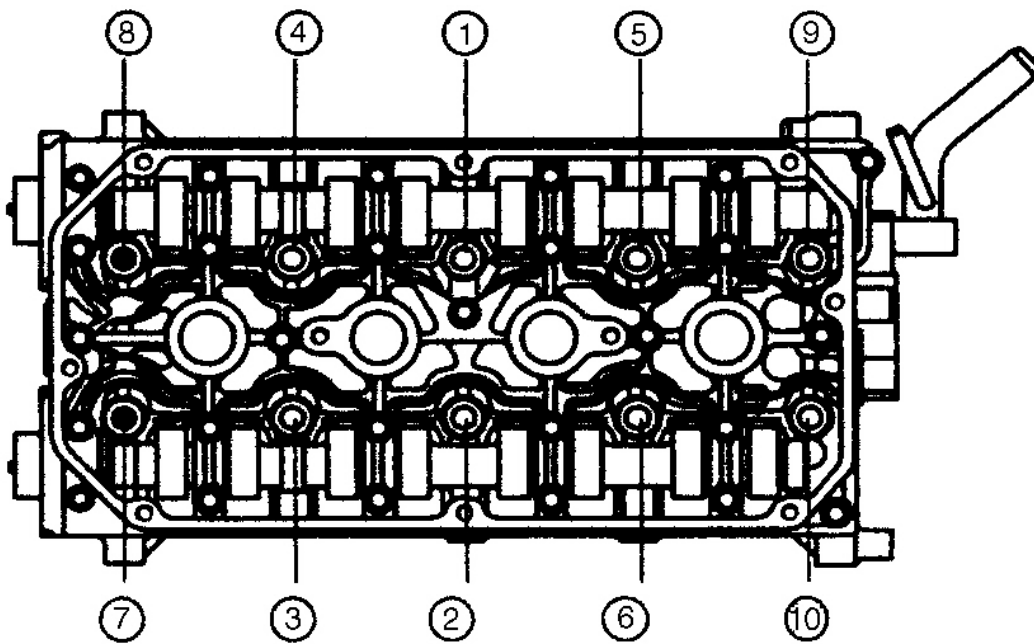
Application	Ft. Lbs. (N.m)
A/C Compressor Bracket-To-Block Long Bolt	14-19 (19-26)
A/C Compressor Bracket-To-Block Short Bolt	27-38 (37-52)
A/C Compressor-To-Bracket Bolt	18-26 (24-35)
Automatic Transaxle Linkage Nut	23-34 (31-46)
Camshaft Pulley Bolt	55-77 (75-105)
Connecting Rod Nut	21-25 (29-34)

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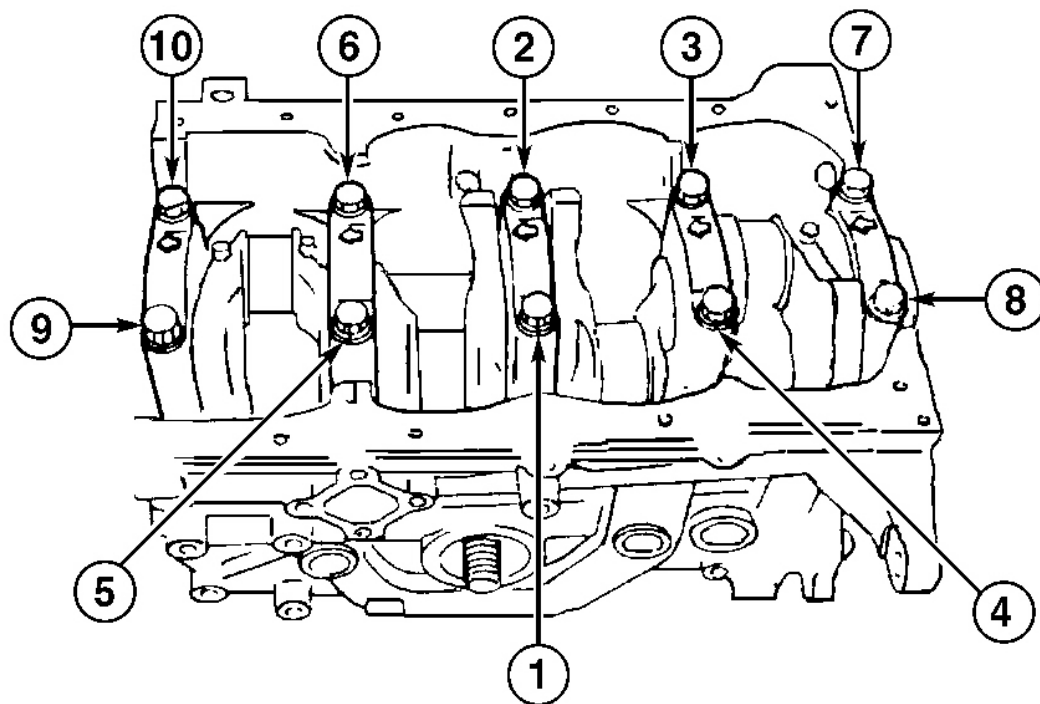
Crankshaft Pulley Bolt	9-13 (12-17)
Crankshaft Sprocket Bolt	80-87 (108-118)
Cylinder Head Bolts ⁽¹⁾	
Step 1	36 (49)
Step 2	Loosen Bolts In Reverse Order
Step 3	18 (25)
Step 4	Plus Torque Angle 90 Degrees
Engine Hanger	27-38 (37-52)
Engine Mount Bolts/Nuts	
No. 1 Bracket-To-Engine Bolt	32-40 (43-54)
No. 1 Bracket-To-Rubber Bolt	49-69 (66-93)
No. 2 Bracket-To-Engine Bolt	28-38 (38-52)
No. 2 Bracket-To-Rubber Bolt	49-69 (66-93)
No. 3 Bracket-To-Engine Nut	49-69 (66-93)
No. 3 Bracket-To-Rubber Bolt	49-69 (66-93)
Engine Mounting Crossmember	
Crossmember-To-Frame Bolt	52-69 (71-93)
Crossmember-To-No. 1 Mount Nut	28-38 (38-52)
Exhaust Manifold	
Manifold-To-Head Nut	11-15 (15-20)
Manifold-To-Head Stud	21-26 (29-35)
Front Exhaust Pipe	
Converter Hanger Nut	27-38 (37-52)
Pipe-To-TWC Nut	27-38 (37-52)
Generator Bolt	27-38 (37-52)
Intake Manifold Support Bracket Bolt	27-38 (37-52)
Intake Manifold-To-Head Nut	11-15 (15-20)
Main Bearing Cap Bolts ⁽²⁾	40-44 (54-59)
Oil Pan Drain Plug	21-30 (29-41)
Oil Pump Bolt	14-19 (19-26)
Tensioner Pulley Lock Bolt	28-38 (38-52)
Thermostat Housing Bolt	14-19 (19-26)
Timing Belt Guide Plate Bolt	9-13 (12-17)
Water Pump Bolt	14-19 (19-26)
Water Pump Pulley Bolt	9-13 (12-17)
INCH Lbs. (N.m)	
Camshaft Bearing Carrier Bolts	97-124 (11-14)
Cylinder Head Cover Bolt	44-80 (5-9)
Oil Pan Bolts	
⁽³⁾	
A Bolts	89-106 (10-12)

B, C & D Bolts	89-115 (10-13)
Oil Pump Cover Bolt	53-80 (6-9)
Oil Strainer Bolt	71-97 (8-11)
Timing Belt Cover Bolt	71-97 (8-11)
(1) Tighten cylinder head bolts in sequence. See Fig. 143. (2) Tighten main bearing cap bolts in sequence. See Fig. 144. (3) Tighten oil pan bolts in sequence. See Fig. 145.	



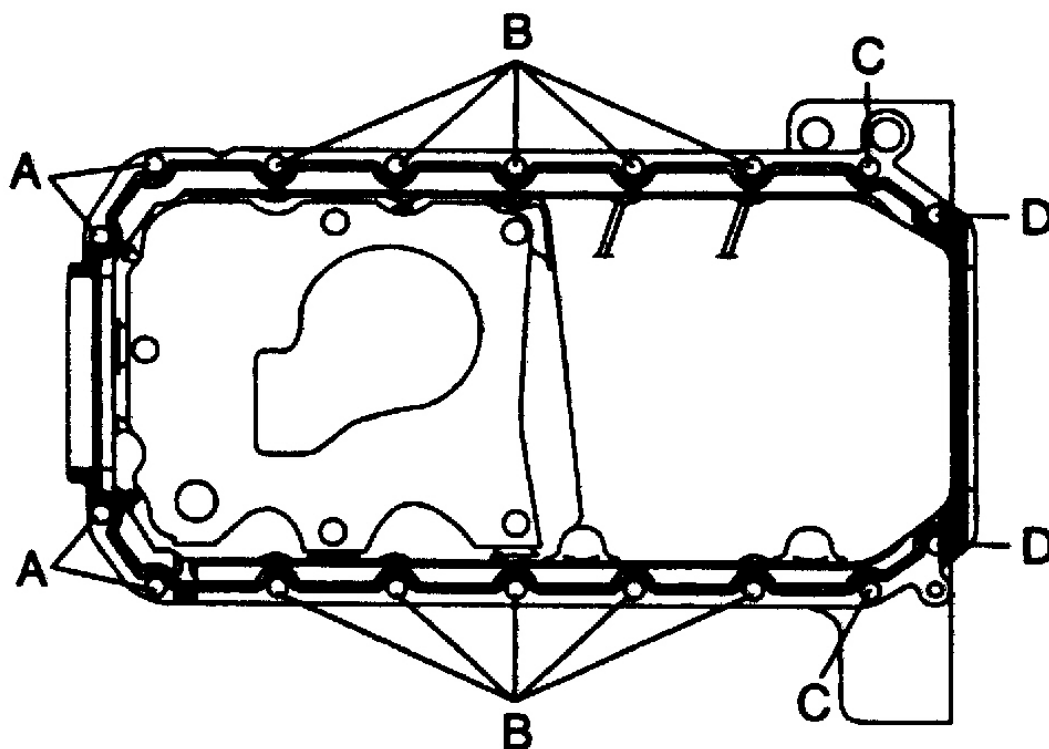
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Fig. 143: Cylinder Head Bolt Tightening Sequence
 Courtesy of KIA MOTORS AMERICA, INC.



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Fig. 144: Main Bearing Cap Bolt Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.



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Fig. 145: Oil Pan Bolt Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.