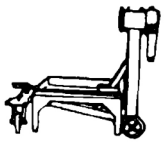
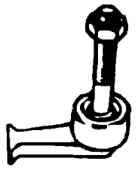
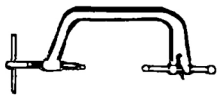
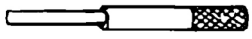
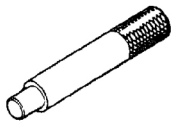
2004 ENGINES

1.8L 4-Cylinder

GENERAL

SPECIAL SERVICE TOOLS

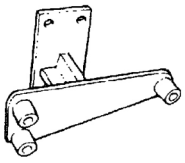
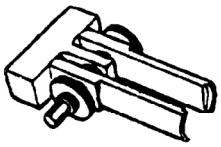
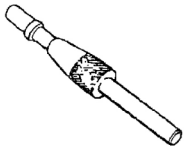
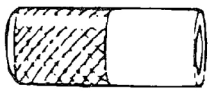
Tool (Number and Name)	Illustration	Use
0K130 160 007 Engine stand		Used to disassemble and assemble engine.
0K590 111 001 Brake, ring gear		Used to prevent engine rotation.
0K993 120 001 Arm, valve spring lifter		Used to remove and install valve.
0K201 120 011 Remover & installer, valve guide		Used to remove and install valve guide.
0K710 110 010 Remover & installer piston pin		Used to remove and install valve guide.

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Fig. 1: Service Tools (1 Of 3)

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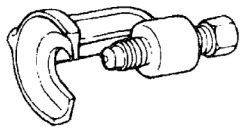
Courtesy of KIA MOTORS AMERICA, INC.

Tool (Number and Name)	Illustration	Use
0K710 101 002 Hanger, engine stand		Used to disassemble and assemble engine.
0K993 120 004 Pivot, valve spring lifter		Used to remove and install valves.
0K410 111 012 Puller, bearing		Used to remove pilot bearing.
0K130 160 010 Centering tool, clutch disc		Used to install clutch disc.
0K201 120 005/K95B-1001-E Installer valve seal/Valve seal installer		Used to install valve seal.

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Fig. 2: Service Tools (2 Of 3)
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Tool (Number and Name)	Illustration	Use
0K130 283 021 Puller, ball joint		Used to remove tie-rod end.
0K993 120 006 Valve seal remover		Used to remove valve seal.

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Fig. 3: Service Tools (3 Of 3)
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TROUBLESHOOTING GUIDE

ENGINE

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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, or electrical troubleshooting manual
	Liquid in combustion chamber	Remove with suction gun, then crank engine over with spark plugs removed
	Seized engine	Repair
Engine cranks normally,but does not star	Fuel system malfunction Ignition system malfunction Improper valve clearance Restricted exhaust system	Refer to fuel system Refer to ignition system Check HLA's 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 Emission system malfunction Ignition system malfunction improper valve clearance	Refer to fuel system Refer to emission control Refer to ignition system 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 Broken valve spring Failed cylinder head gasket	Repair or replace Repair Replace
White exhaust smoke	Usually caused by water vapor, which is a normal by-product of combustion on cold days	None required
	Excessive white smoke with engine warmed up could be caused by a failed cylinder head or intake gasket. Could also be a cracked block, cylinder head or intake manifold	Repair or replace
Black exhaust smoke	Fuel system malfunction	Refer to fuel system
	Emission system malfunction	Refer to emission control 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
Valve train noise	Worn valve guides Low oil pressure Improper valve clearance Broken valve spring Sticking valves Camshaft worn or faulty	Repair Refer to lubrication system Check HLA's Replace Free valves Replace

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Fig. 4: Engine Troubleshooting Chart (1 Of 3)
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Problem	Possible cause	Action
Insufficient power	Insufficient compression caused by:	
	1. Improper valve clearance	Check HLA's
	2. Leakage from valve seat	Repair or replace
	3. Seized valve stem	Replace
	4. Weak or broken valve spring	Replace
	5. Failed cylinder head gasket	Replace
	6. Cracked or distorted cylinder head	Repair or replace
	7. Sticking, damaged or worn piston ring	Replace
	8. Cracked or worn piston	Replace
	Fuel system malfunction	Refer to fuel system
	Slipping clutch	Refer to clutch 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 replacev
	Excessive stem to guide clearance	Repair
	Excessive valve seat runout	Repair
Engine knocks when cold	Excessive piston to wall clearance	Replace pistons
	Loose or broken damper pulley	Tighten or replace
Knock increases with 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

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Fig. 5: Engine Troubleshooting Chart (2 Of 3)
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Problem	Possible cause	Action
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 fue	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 Troubleshooting Chart (3 Of 3)
Courtesy of KIA MOTORS AMERICA, INC.

TIMING BELT

Problem	Possible cause	Action
Tooth is broken or cracked	Camshaft jamming	Inspect camshaft by removing cylinder head cover Repair or replace if necessary
Back surface is cracked and/or worn	Tensioner jamming	Remove tensioner and inspect
	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 the cylinder head cover Repair or replace if necessary
	Excessive belt tension	Remove tensioner spring and inspect Replace if necessary
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. 7: Timing Belt Troubleshooting Chart

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ENGINE SPECIFICATIONS

Engine Specifications Chart

Item			Engine model	T8 DOHC
Type				Gasoline, 4 cycle
Cylinder arrangement and number				In line, 4 cylinders
Combustion chamber				Pentroof
Valve system				OHC, belt driven (IN :2, EX : 2)
Displacement				109.4 (1,793)
Bore and stroke			cu in(cc)	3.19X3.43 (81.0X87.0)
Compression ratio			in (mm)	9.5:1
Compression pressure psi (kpa, kg/cm^2)-rpm				193 (1,333, 13.6)-300
Valve timing	IN	Open	BTDC	10°
		Close	ABDC	42°
	EX	Open	BBDC	50°
		Close	ATDC	10°
Valve clearance	IN (mm)	IN		0: Maintenance-free
		EX		0 : Maintenance-free
Idle speed			rpm	800±50
Ignition timing			BTDC	5°±10°
Firing order				1-3-4-2

ENGINE DESCRIPTION

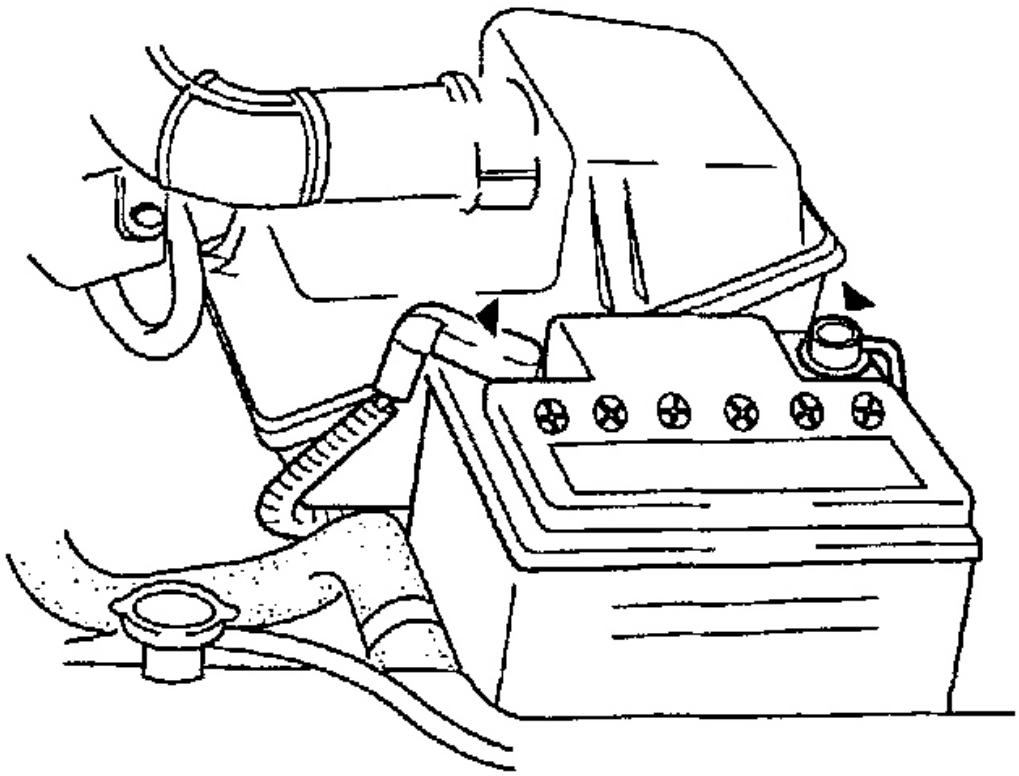
The T8 DOHC engine is a 4 cylinder overhead dual camshaft engine with a compression ratio of 9.4:1 The cylinder head is made of aluminum alloy for good heat conductivity and heat resistance and utilizes a pentroof combustion chamber with 4 valves (IN: 2, EX: 2) per cylinder. An aluminum oil pan is incorporated for reduced vibration and improved cooling capacity. Maintenance free hydraulic lash adjusters (HLA's) are used for reduced noise and vibration.

ENGINE ASSEMBLY REMOVAL & INSTALLATION

REMOVAL

1. Disconnect battery cables.

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Fig. 8: Disconnecting Battery Cables
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2. Remove battery and battery tray.
3. Drain engine coolant.

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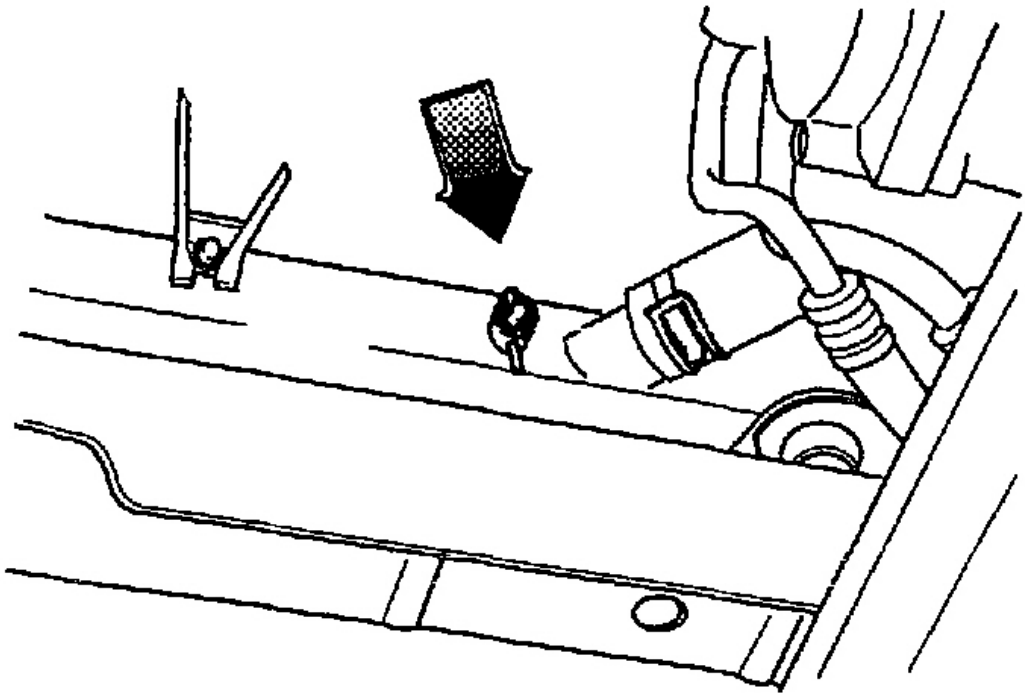
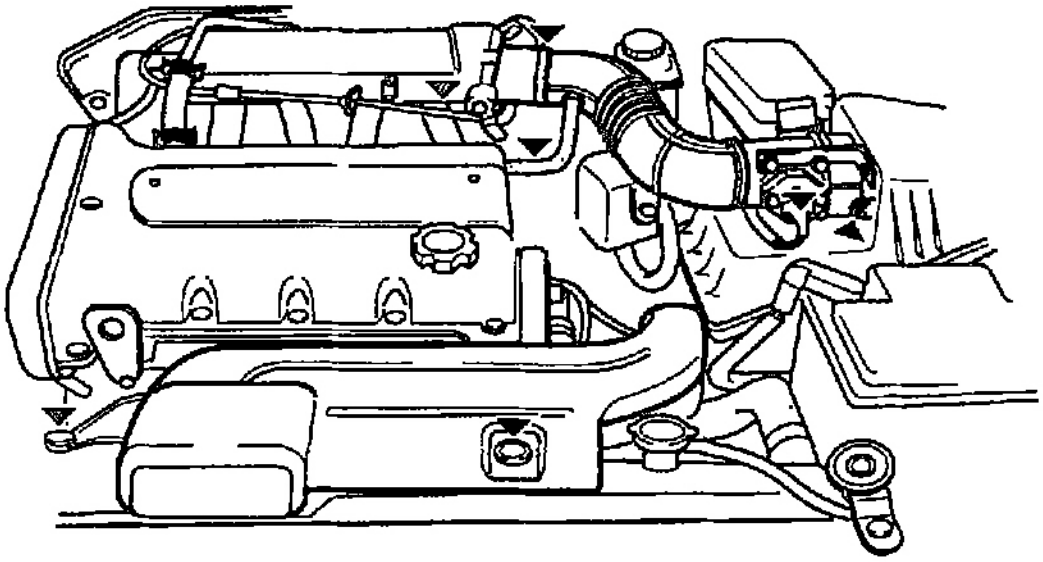


Fig. 9: Draining Engine Coolant
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove data link connector upward from mass airflow sensor bracket.
5. Disconnect intake air temperature sensor connector and mass air flow sensor connector.
6. Disconnect air intake hose from throttle body.
7. Disconnect ventilation hose.
8. Remove fresh air duct.
9. Remove accelerator cable and cruise control cable if equipped.

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Fig. 10: Removing Accelerator Cable And Cruise Control Cable If Equipped
Courtesy of KIA MOTORS AMERICA, INC.

10. Remove air cleaner assembly.
11. Disconnect brake vacuum hose and purge control vacuum hose from dynamic chamber.

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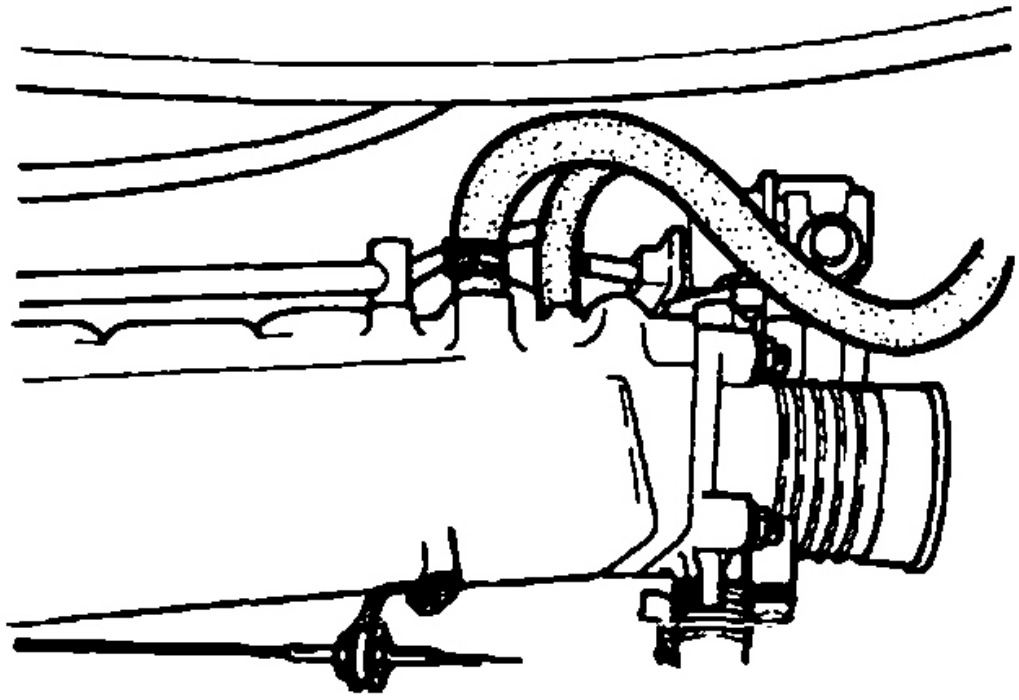


Fig. 11: Disconnecting Brake Vacuum Hose And Purge Control Vacuum Hose
Courtesy of KIA MOTORS AMERICA, INC.

12. Remove upper and lower radiator hoses.
13. Disconnect fuel hose from fuel injector rail.

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

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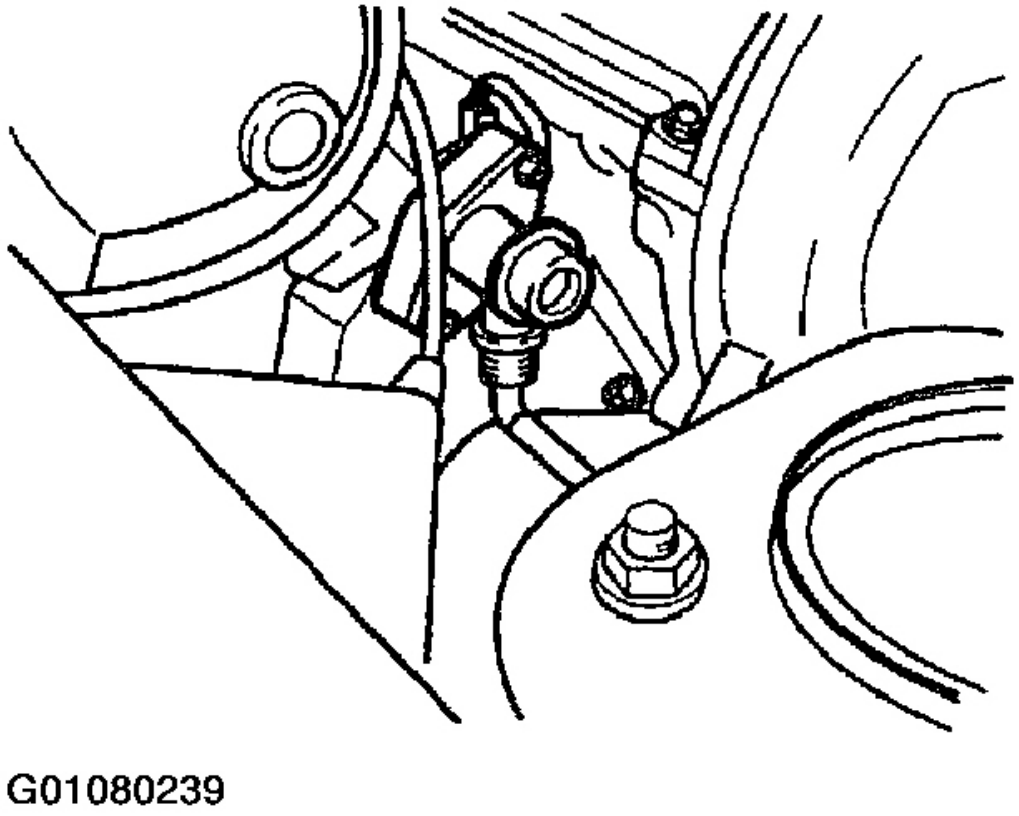
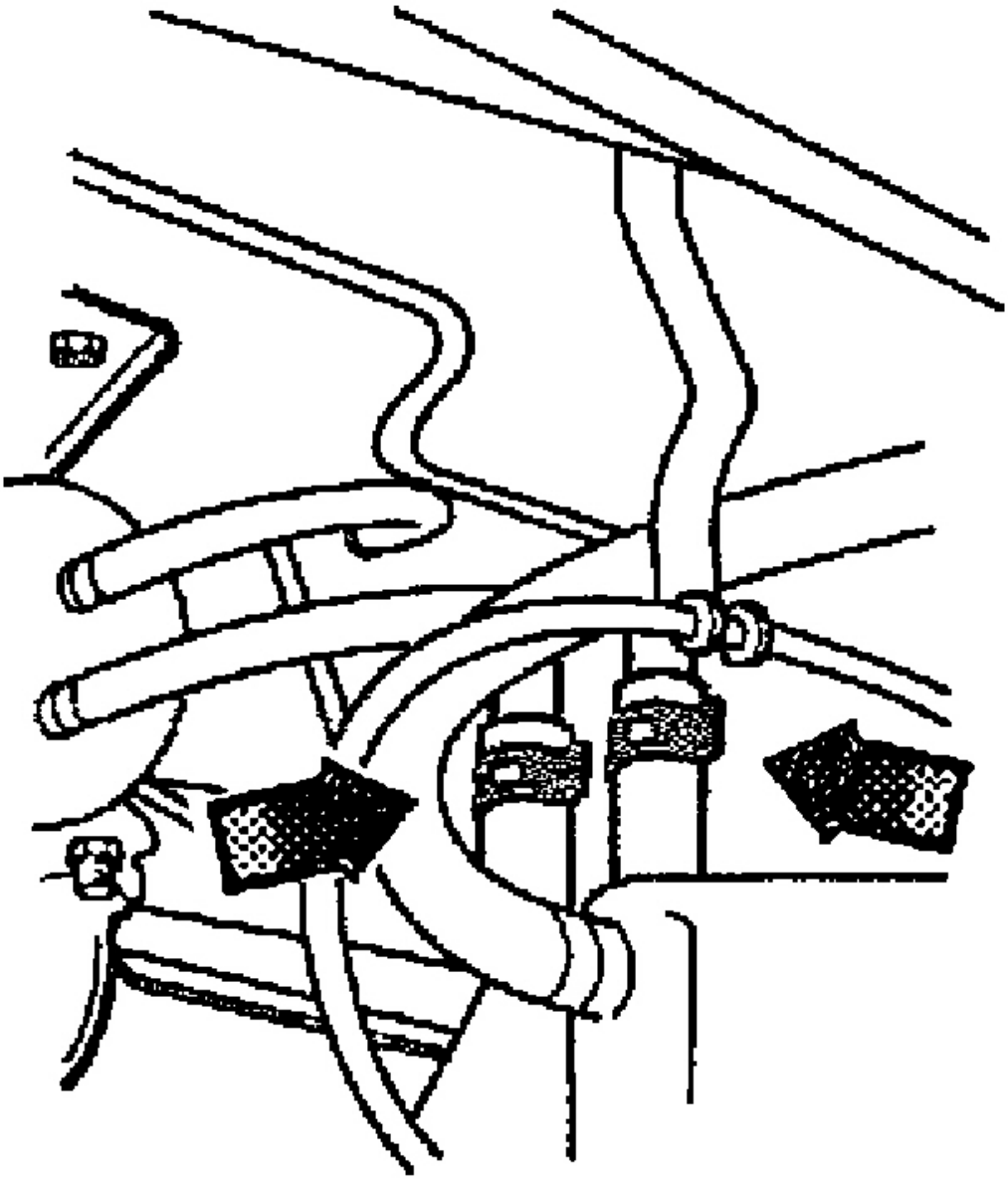


Fig. 12: Disconnecting Fuel Hose
Courtesy of KIA MOTORS AMERICA, INC.

14. Remove heater hoses.

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Fig. 13: Removing Heater Hoses
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15. Disconnect IAC and throttle position sensor connectors.

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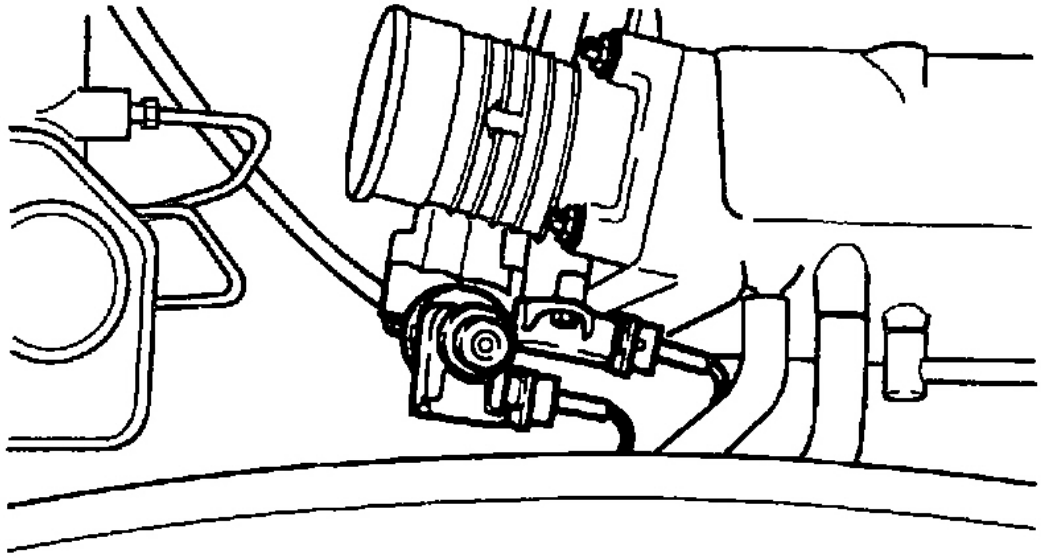


Fig. 14: Disconnecting IAC And Throttle Position Sensor Connectors
Courtesy of KIA MOTORS AMERICA, INC.

16. Disconnect injector connectors.

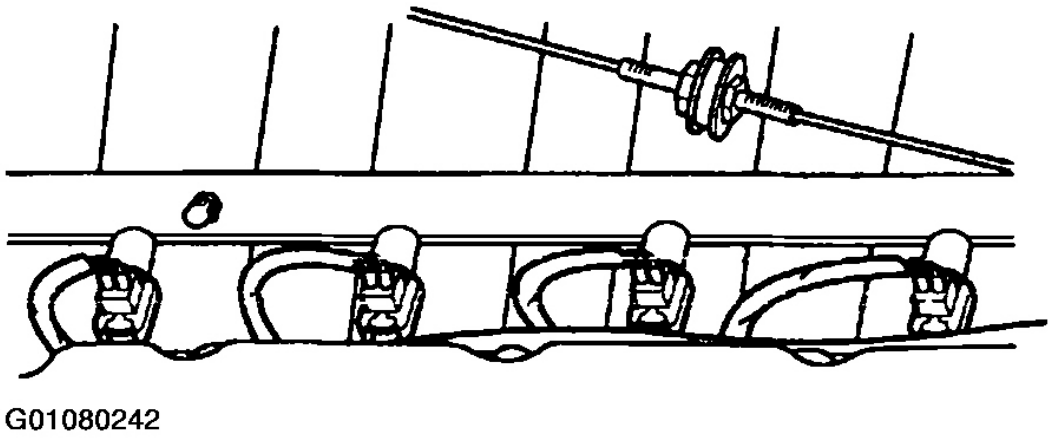


Fig. 15: Disconnecting Injector Connectors
Courtesy of KIA MOTORS AMERICA, INC.

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17. Disconnect electric connectors, bracket and reinstall engine hanger.

    Tightening torque: 27.5~38.3 lb-ft (37.2~51.9 N.m, 3.8~5.3 kg-m)

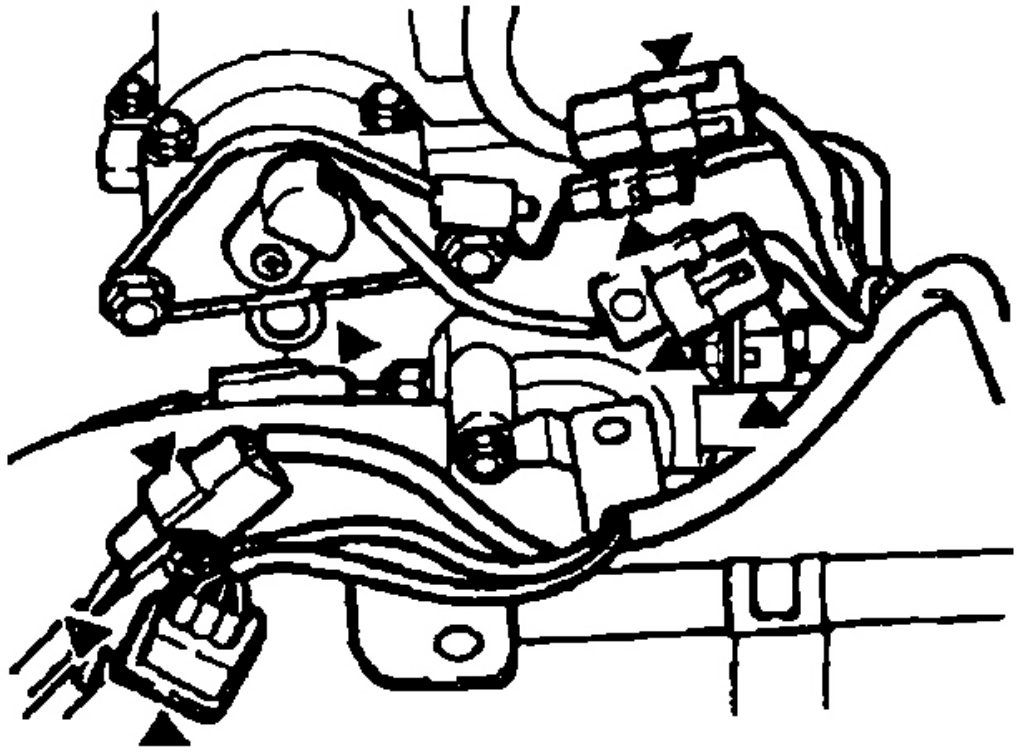


Fig. 16: Disconnecting Electric Connectors
Courtesy of KIA MOTORS AMERICA, INC.

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

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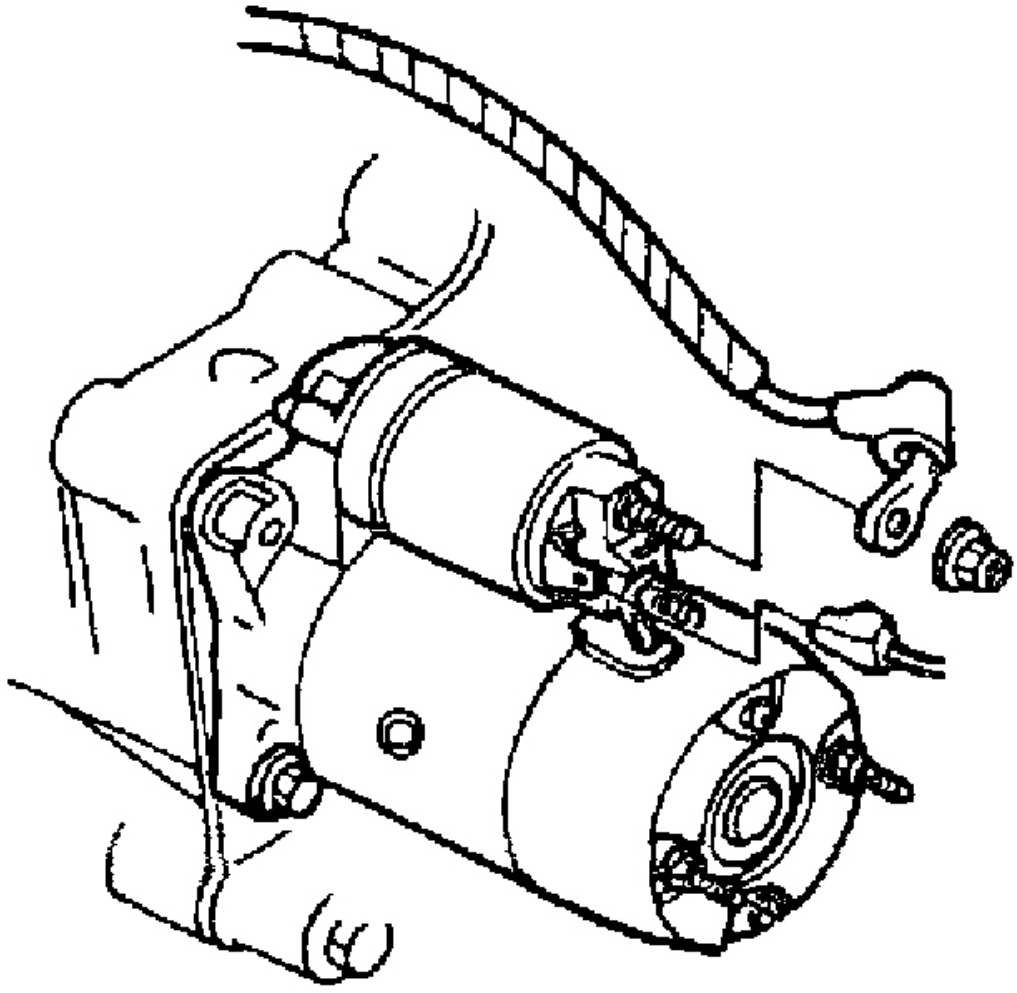


Fig. 17: Disconnecting B-Terminal And S-terminal Connectors From Starter
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19. Disconnect generator B-terminal connector and connector C121 from generator.

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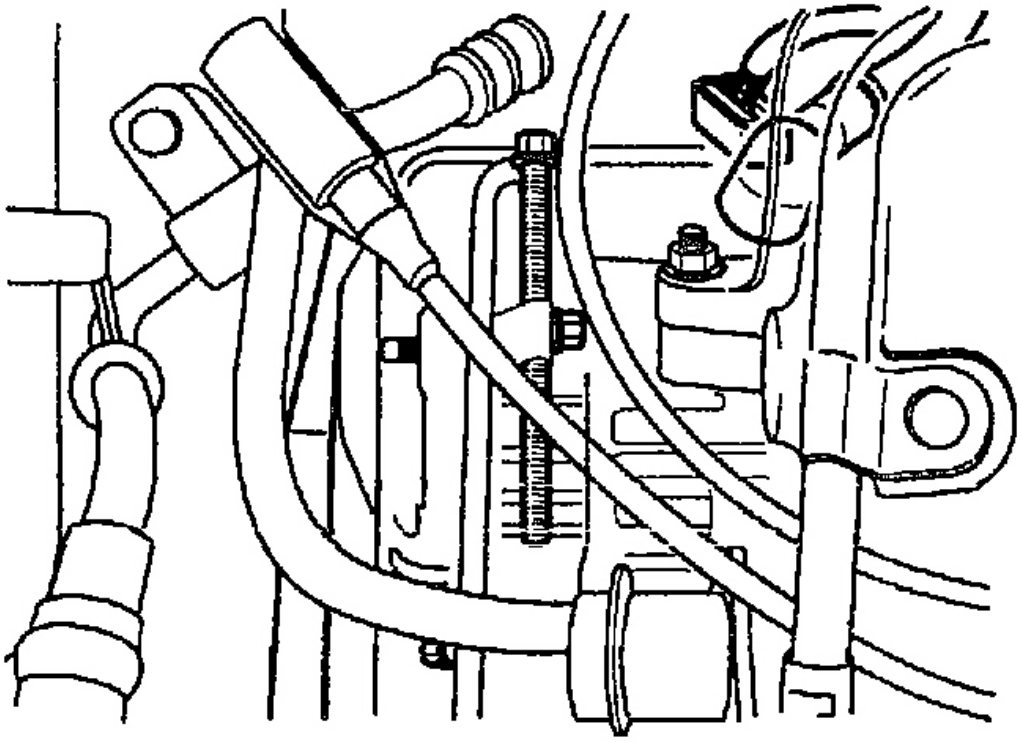


Fig. 18: Disconnecting Generator B-Terminal And Connector C121 From Generator
Courtesy of KIA MOTORS AMERICA, INC.

20. Disconnect engine ground strap.

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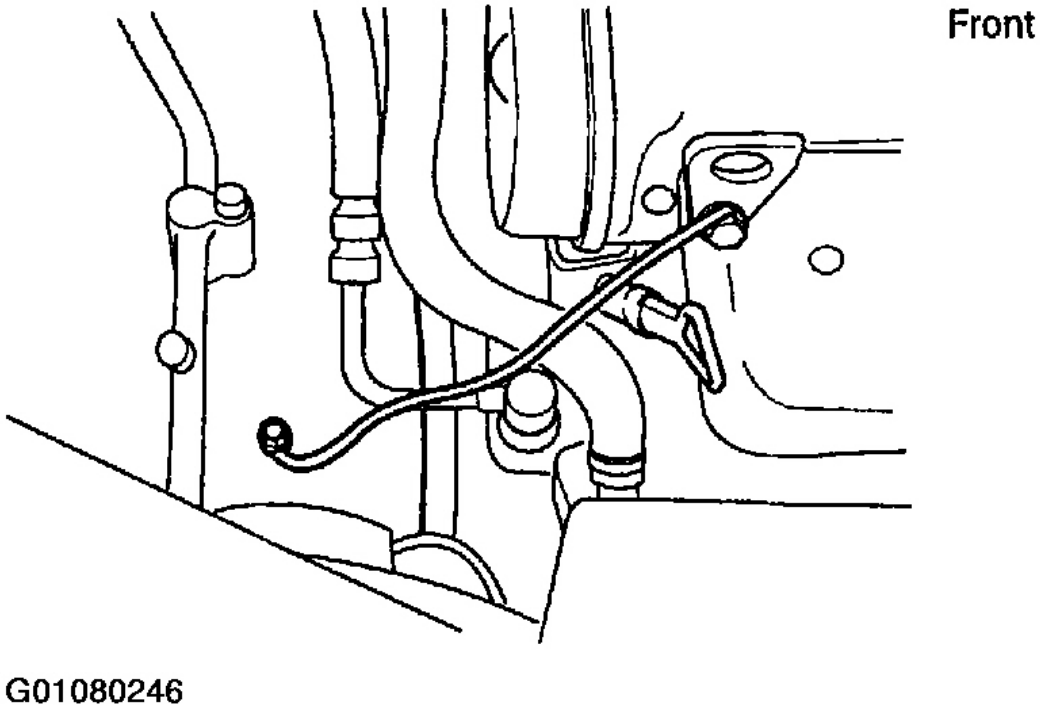
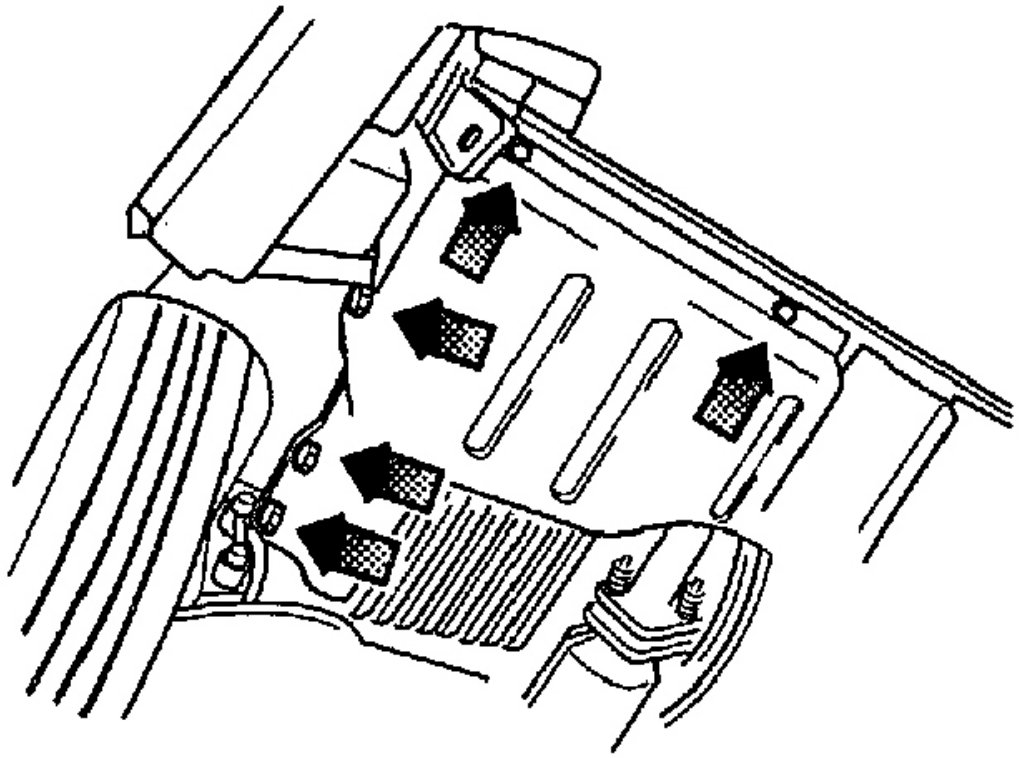


Fig. 19: Disconnecting Engine Ground Strap
Courtesy of KIA MOTORS AMERICA, INC.

21. Remove RH & LH splash shield.

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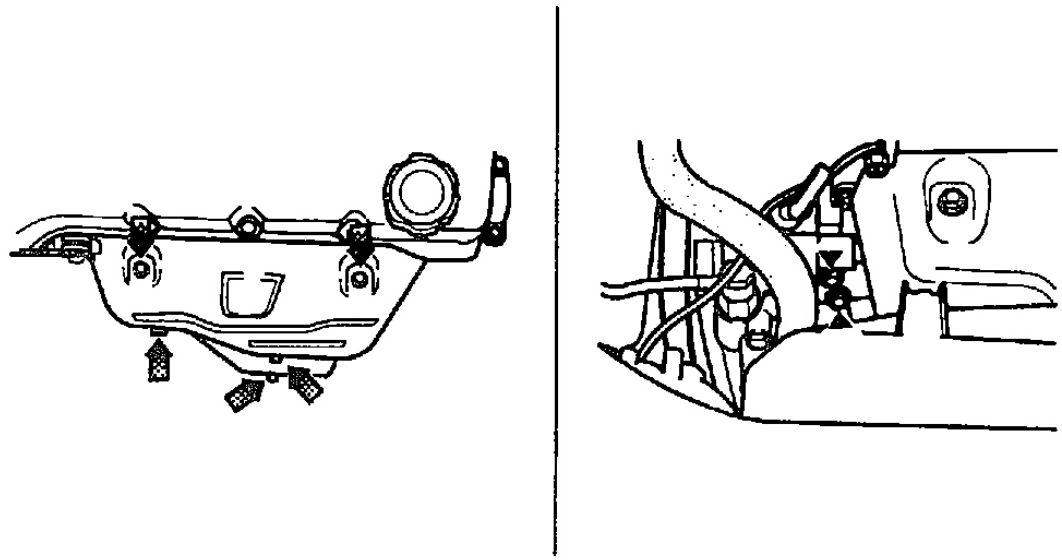


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Fig. 20: Removing RH & LH Splash Shield
Courtesy of KIA MOTORS AMERICA, INC.

22. Remove exhaust manifold heat shield and three P/S pump bracket bolts.

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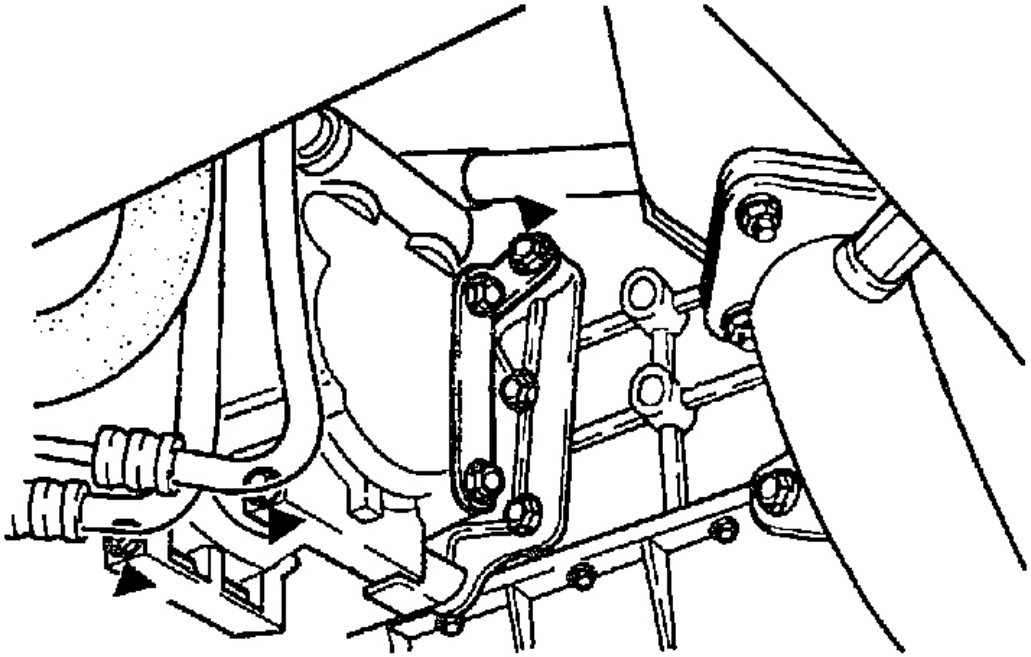


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Fig. 21: Removing Exhaust Manifold Heat Shield And P/S Pump Bracket Bolts
Courtesy of KIA MOTORS AMERICA, INC.

23. Remove four A/C compressor bolts and five A/C compressor mounting bracket bolts.

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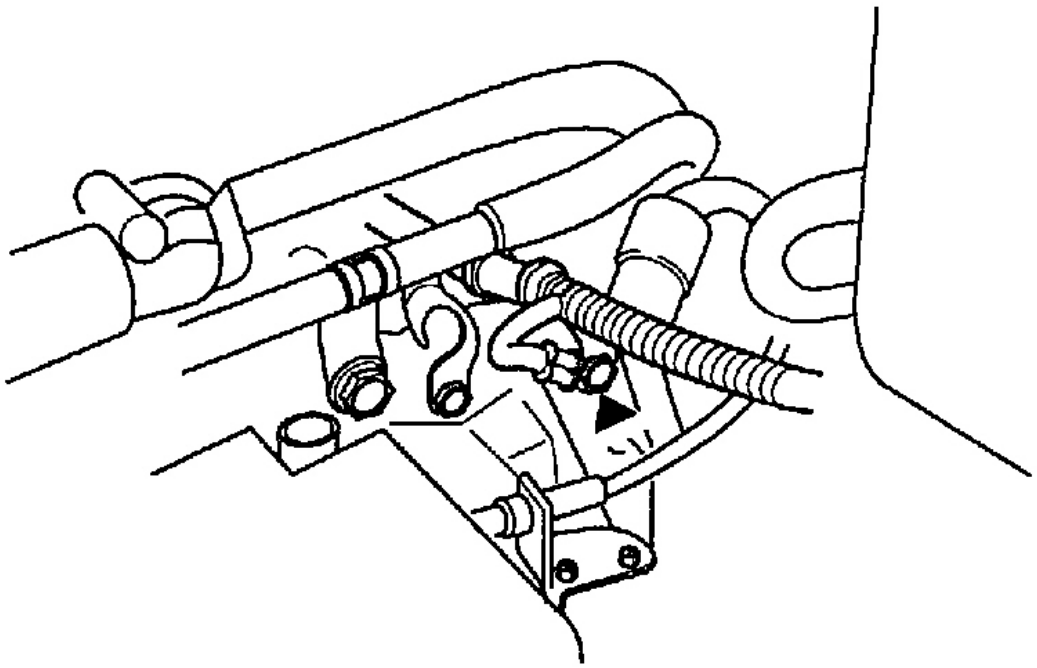


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Fig. 22: Removing A/C Compressor Mounting Bolts
Courtesy of KIA MOTORS AMERICA, INC.

24. Disconnect ground strap from top of transaxle.

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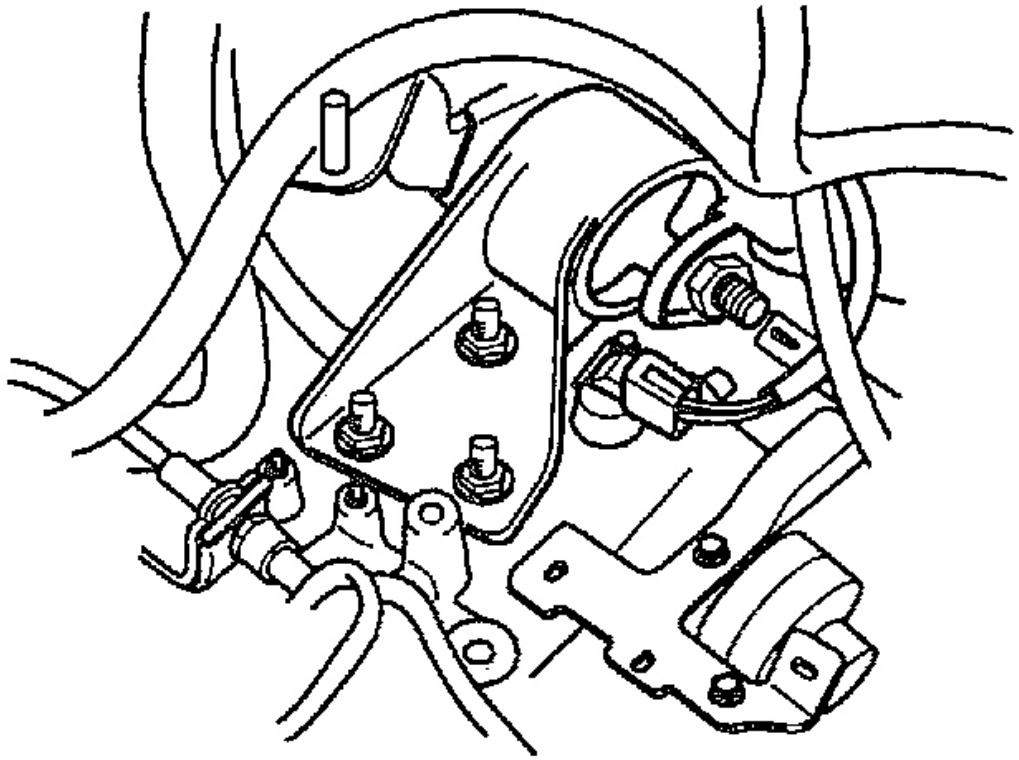


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Fig. 23: Disconnecting Ground Strap From Top Of Transaxle
Courtesy of KIA MOTORS AMERICA, INC.

25. Remove three No. 4 engine mounting nuts and one bolt and remove No. 4 engine mount.
26. Disconnect input/turbine speed sensor connector (A/T).

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Fig. 24: Disconnecting Input/Turbine Speed Sensor Connector (A/T)
Courtesy of KIA MOTORS AMERICA, INC.

27. Disconnect back-up light switch connector (M/T).
28. Disconnect vehicle speed sensor connector.

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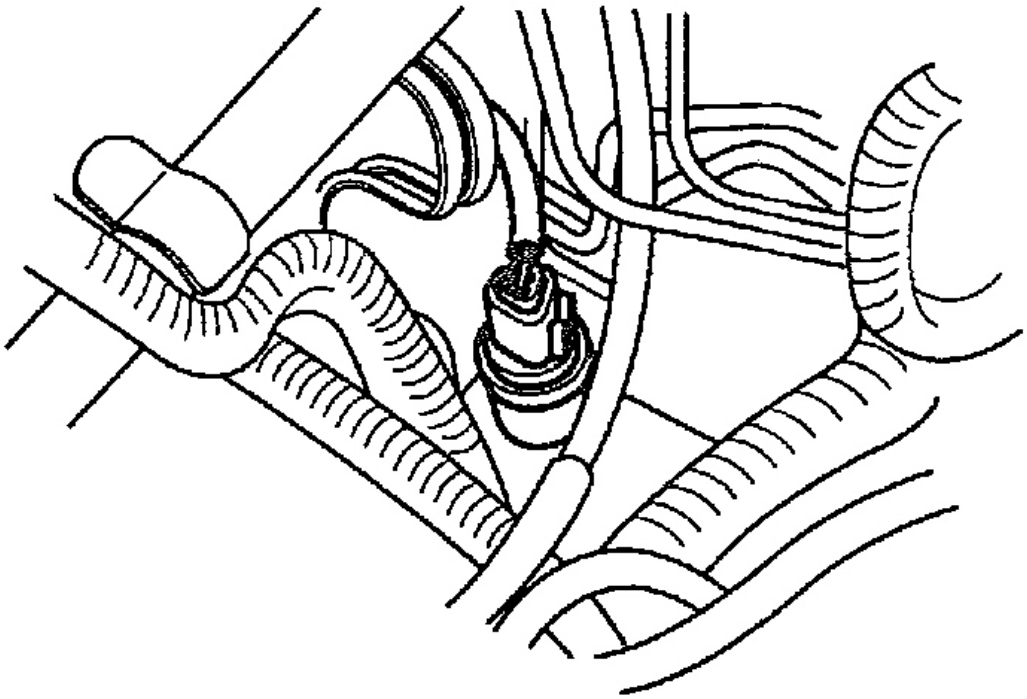


Fig. 25: Disconnecting Vehicle Speed Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

29. Remove U-clip from selector cable to transaxle linkage (A/T).
30. Remove nut and washer from transaxle linkage (A/T).

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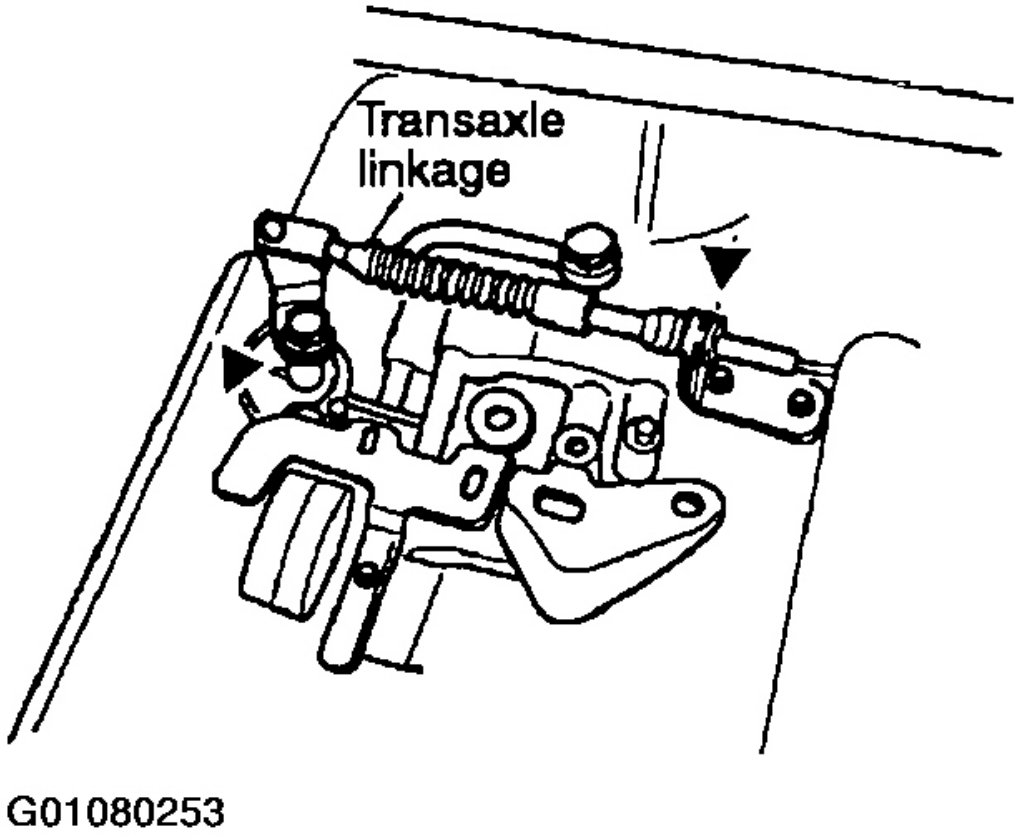
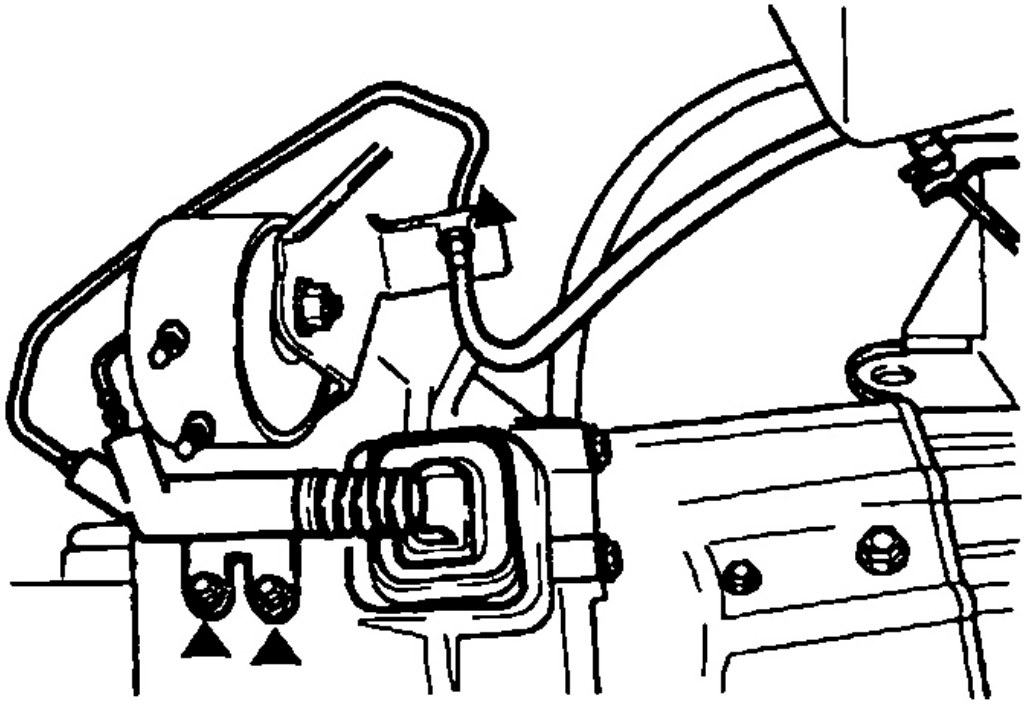


Fig. 26: Removing Transaxle Linkage
Courtesy of KIA MOTORS AMERICA, INC.

31. Remove manual transaxle linkage and extension bar (M/T).
32. Remove clutch release cylinder and pipe (M/T).

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Fig. 27: Removing Clutch Release Cylinder And Pipe (M/T)
Courtesy of KIA MOTORS AMERICA, INC.

33. Disconnect transaxle range switch connector (A/T).
34. Disconnect solenoid valve connector (A/T).
35. Disconnect two ATF cooler hoses (A/T).

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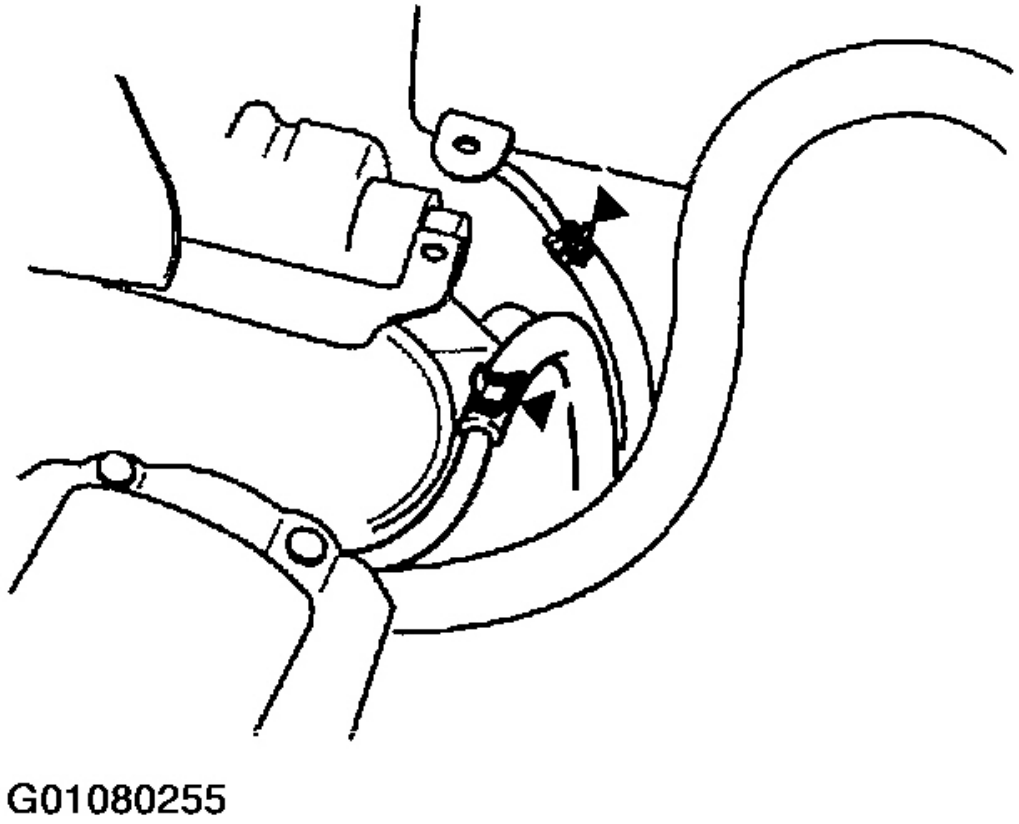
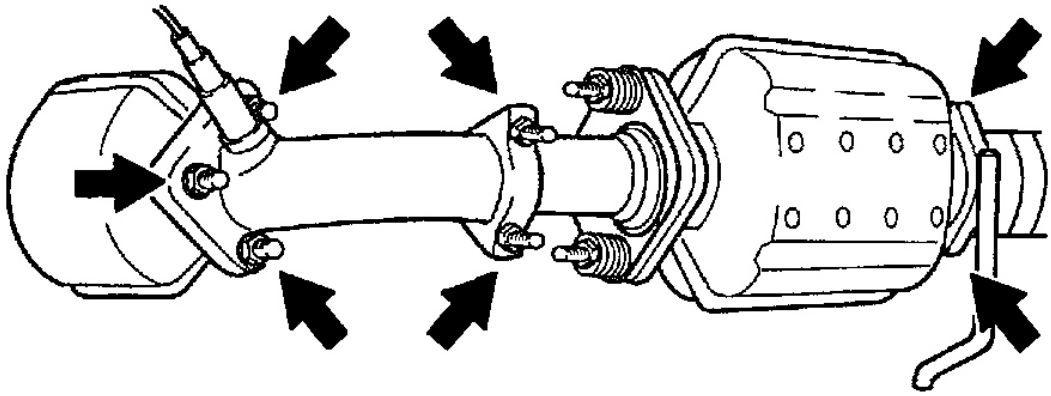


Fig. 28: Disconnecting Two ATF Cooler Hoses (A/T)
Courtesy of KIA MOTORS AMERICA, INC.

36. Remove both front wheels (four lug nuts each).
37. Disconnect front oxygen sensor connector.
38. Remove front exhaust pipe.

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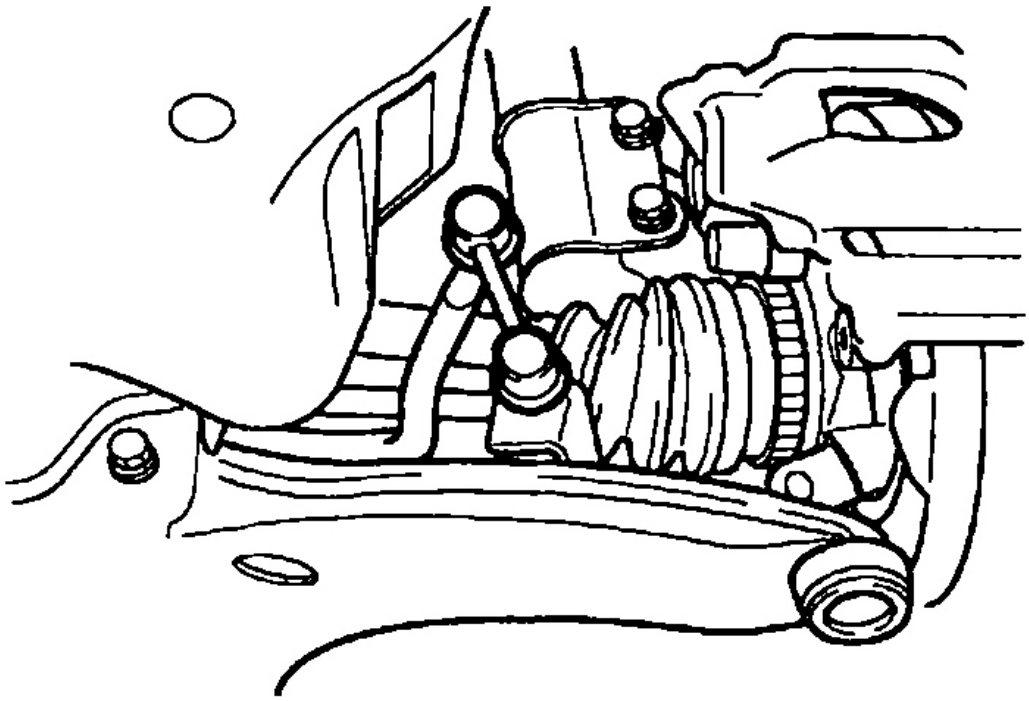


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Fig. 29: Removing Front Exhaust Pipe
Courtesy of KIA MOTORS AMERICA, INC.

39. Remove both right and left tie rod ends from steering knuckles by removing one cotter pin and one nut each.
40. Remove stabilizer control link bolt and nut from both right and left stabilizer control links then remove stabilizer control link.
41. Remove pinch bolt and nut from both right and left ball joints.
42. Separate ball joints from control arms.

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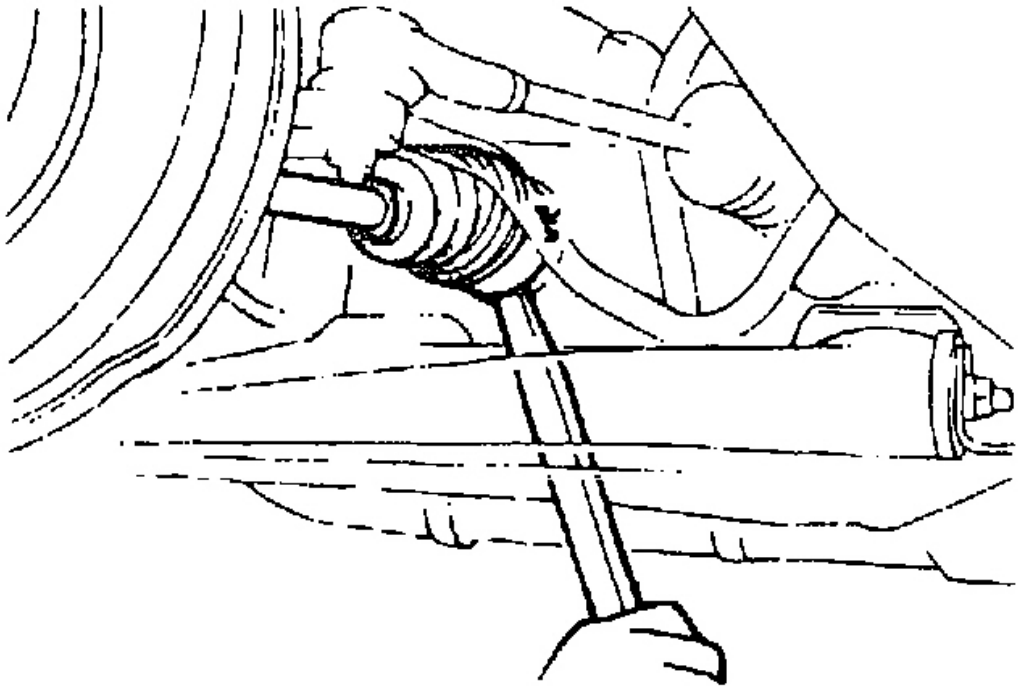


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Fig. 30: Separating Ball Joints From Control Arm
Courtesy of KIA MOTORS AMERICA, INC.

43. Remove joint shaft support bracket from engine block (three bolts).
44. Gently pry both driveshafts from transaxle.

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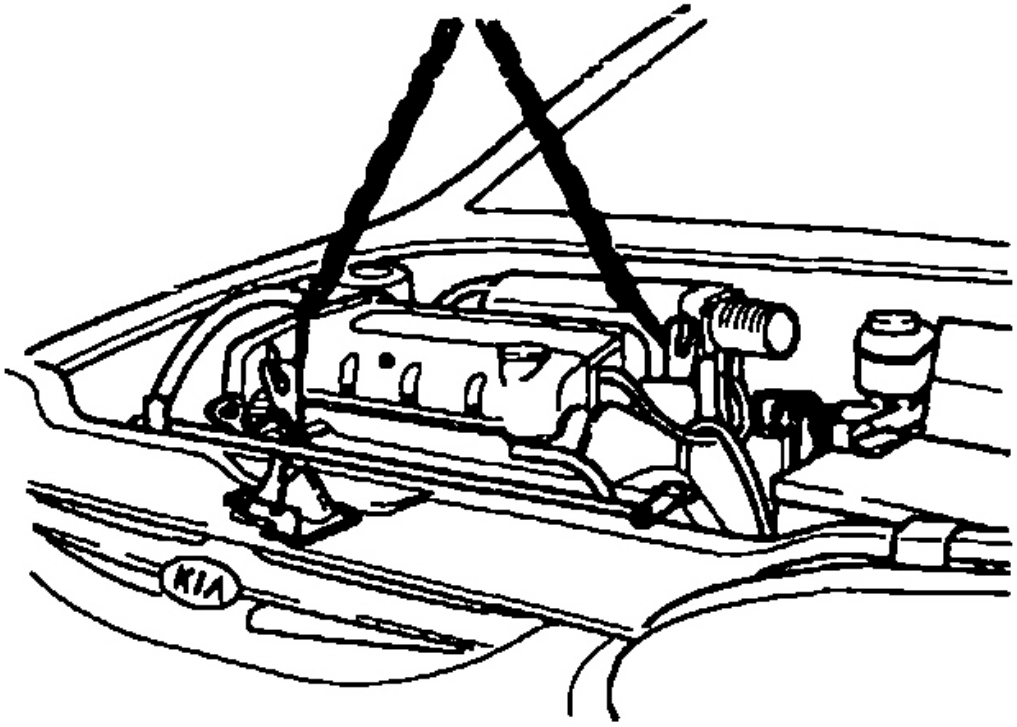


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Fig. 31: Prying Both Driveshafts From Transaxle
Courtesy of KIA MOTORS AMERICA, INC.

45. Support engine with engine hoist.

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Fig. 32: Supporting Engine With Engine Hoist
Courtesy of KIA MOTORS AMERICA, INC.

46. Remove two nuts from No. 2 engine mount-to-mounting member.

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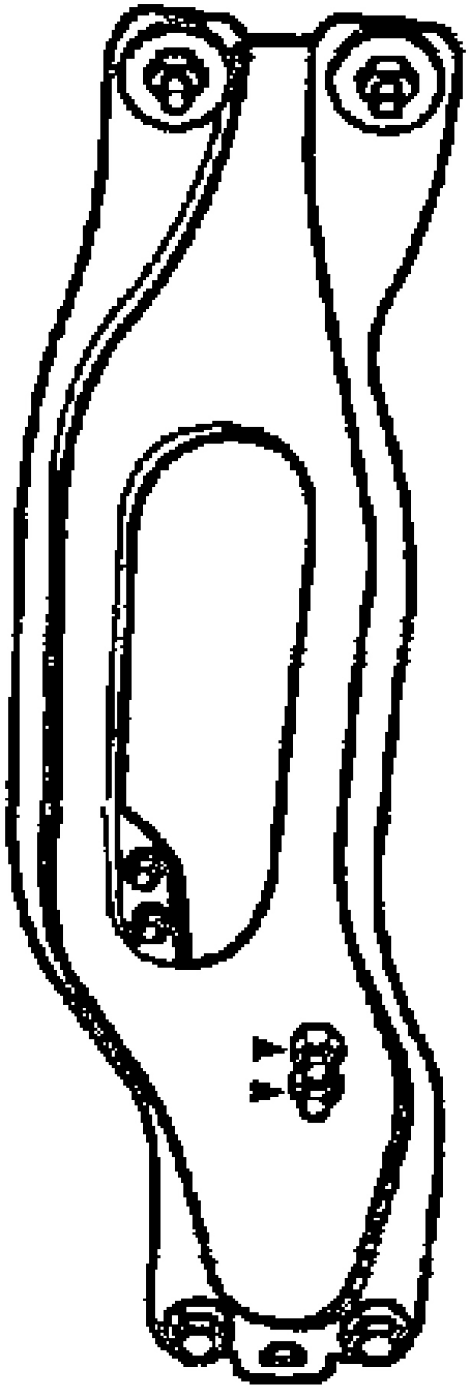


Fig. 33: Removing No. 2 Engine Mount-To-Mounting Member
Courtesy of KIA MOTORS AMERICA, INC.

47. Remove one bolt from No. 3 engine mount.
48. Remove three No. 1 engine mount bolts.

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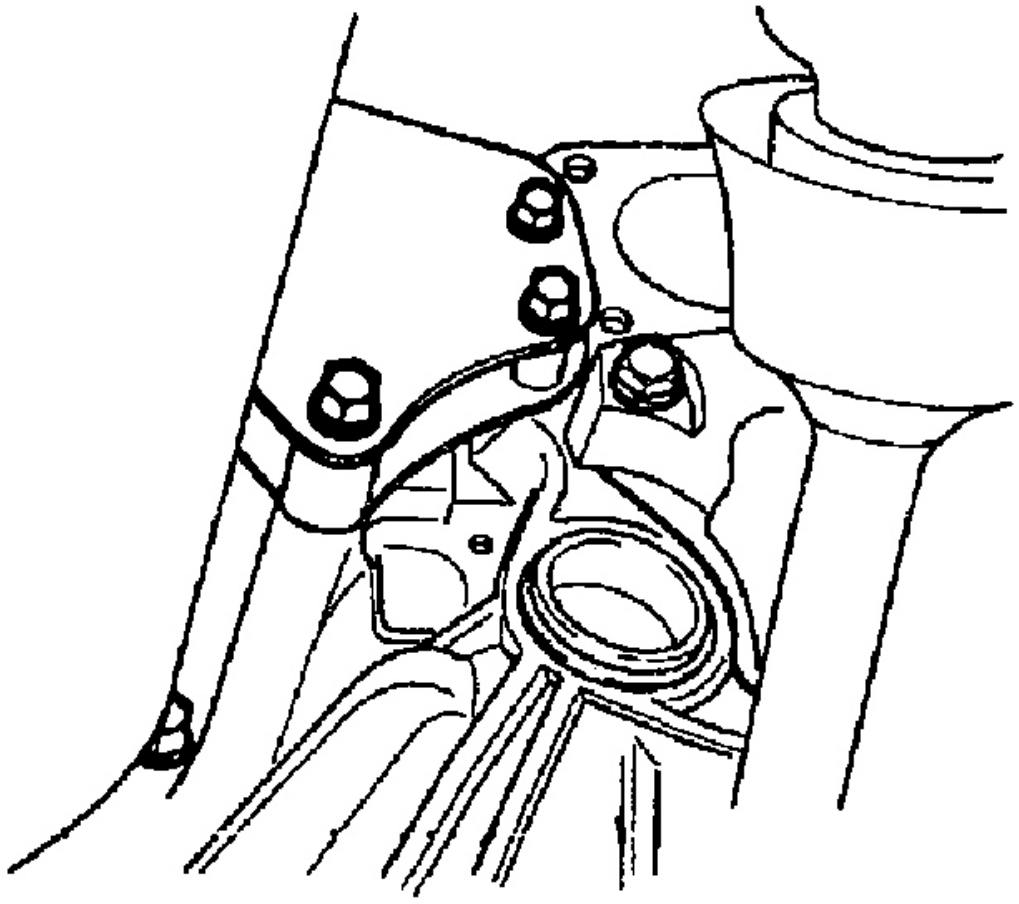


Fig. 34: Removing No. 1 Engine Mount Bolts
Courtesy of KIA MOTORS AMERICA, INC.

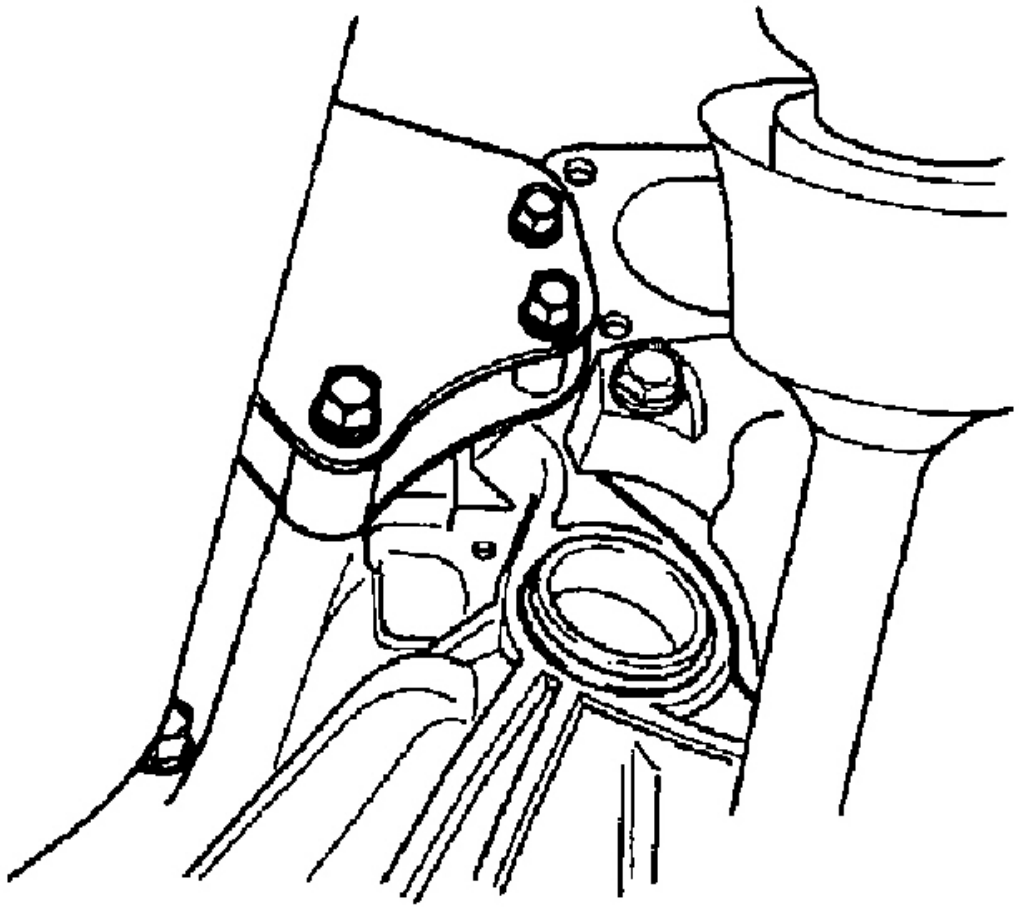
49. Lift engine and transaxle out as a unit.

INSTALLATION

1. Install engine and transaxle into engine compartment as a unit.
2. Install three No. 1 engine mount bolts.

Tightening torque: 49.2~69 lb-ft (67~93.2 N.m, 6.8~9.5 kg-m)

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Fig. 35: Installing No. 1 Engine Mount Bolts
Courtesy of KIA MOTORS AMERICA, INC.

3. Install No. 3 engine mount bolt.

   Tightening torque: 62.9~86 lb-ft (85.3~116.6 N.m, 8.7~11.9 kg-m)

4. Install two No. 2 engine mount nuts.

   Tightening torque: 28~38 lb-ft (38~51 N.m, 3.8~5.3 kg-m)

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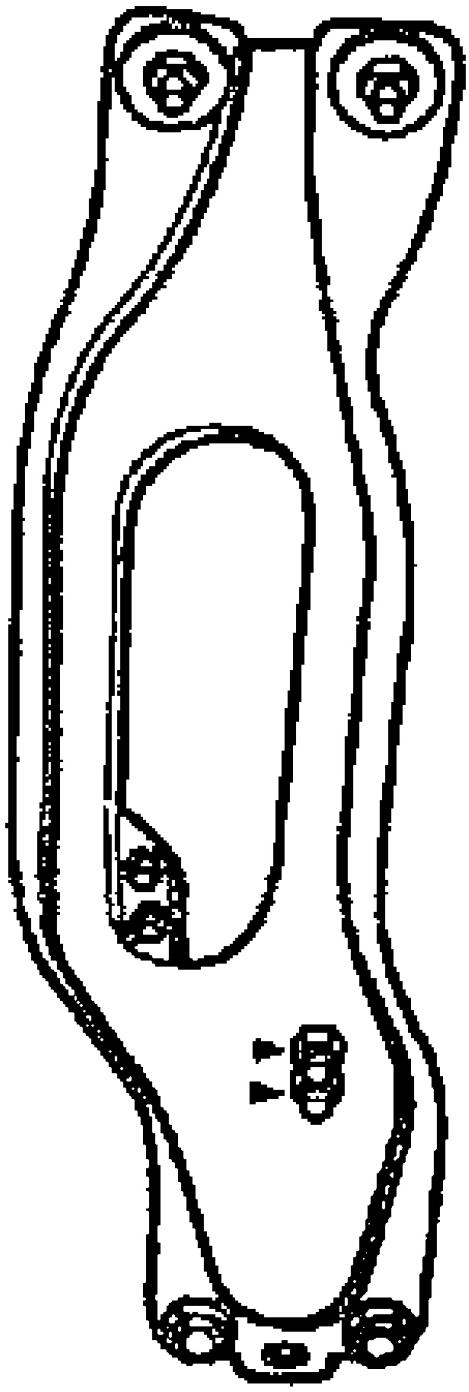


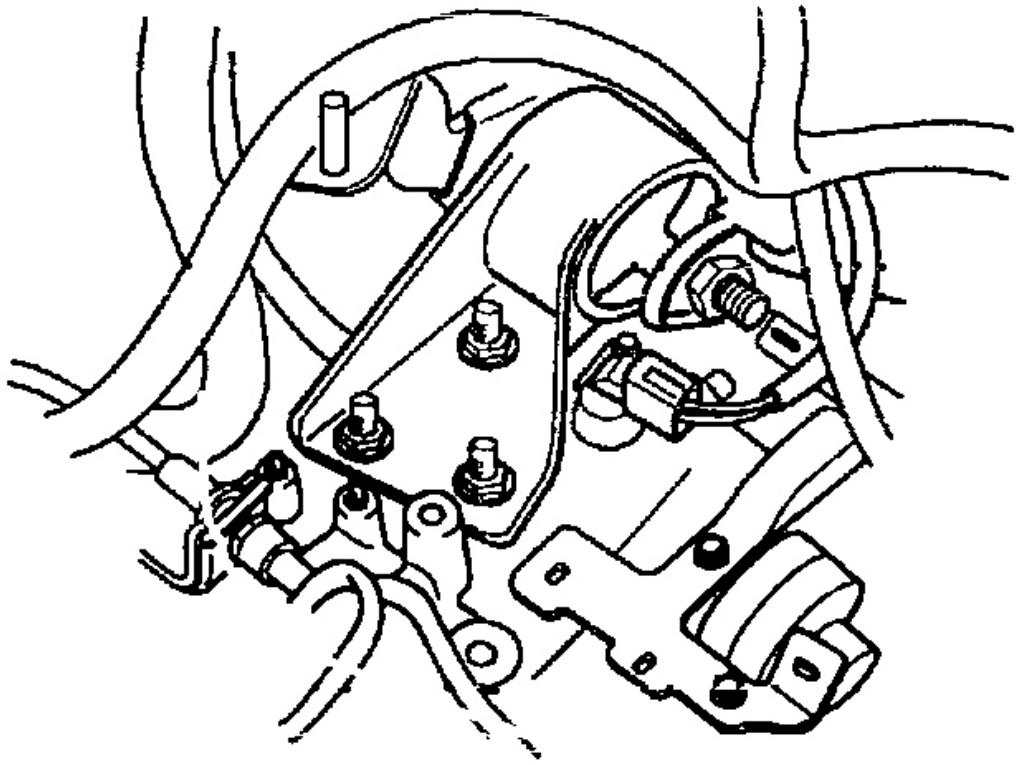
Fig. 36: Installing No. 2 Engine Mount Nuts
Courtesy of KIA MOTORS AMERICA, INC.

5. Install No. 4 engine mount.

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Tightening torque:

Nuts: 49~68 lb-ft (68~93 N.m, 6.8~9.5 kg-m)
Bolt: 47~66 lb-ft (64~89 N.m, 6.5~9.1 kg-m)



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Fig. 37: Installing No. 4 Engine Mount
Courtesy of KIA MOTORS AMERICA, INC.

6. Remove engine hoist.
7. Install new clips on driveshaft.
8. Push driveshaft and joint shaft into transaxle with opening of clips pointing upward.
9. Install joint shaft support bracket using three bolts.

Tightening torque: 32~46 lb-ft (43~62 N.m, 4.4~6.3 kg-m)

10. Install right and left lower ball joints into spindle then install pinch bolts.

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Tightening torque: 32~39 lb-ft (43~52 N.m, 4.4~5.3 kg-m)

11. Install both right and left stabilizer control links.

    Tightening torque: 32~45 lb-ft (43~61 N.m, 4.4~6.2 kg-m)

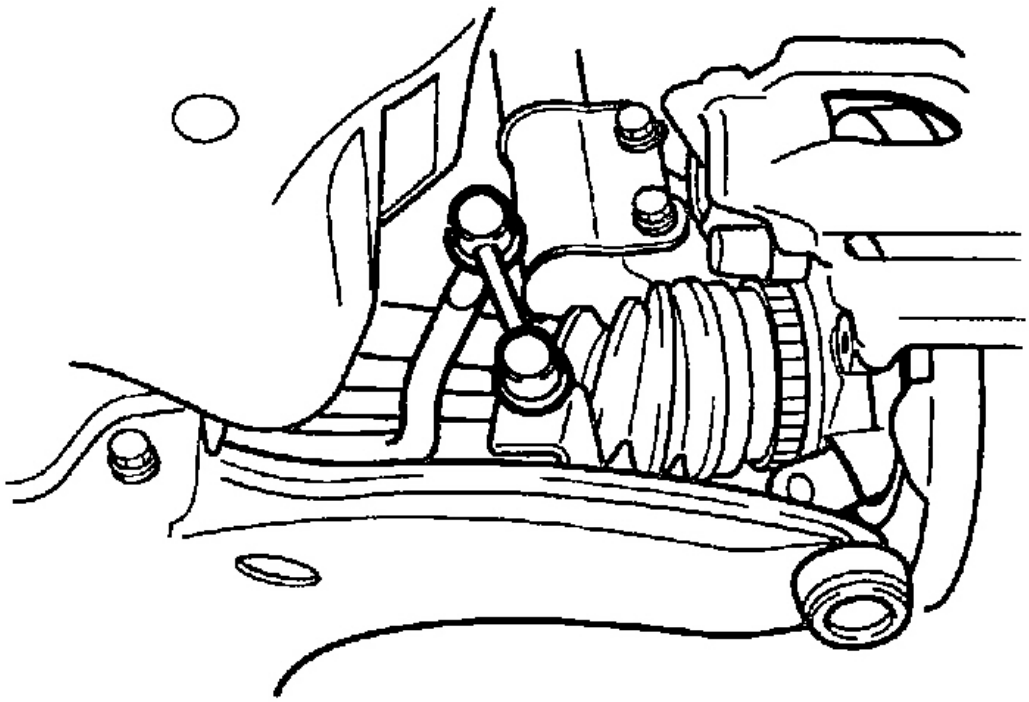


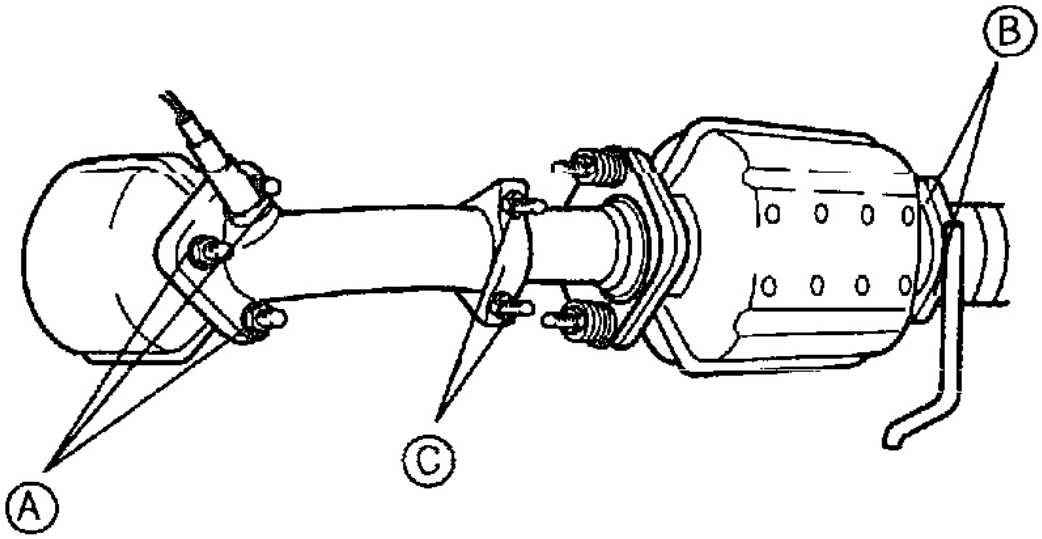
Fig. 38: Installing Both Right And Left Stabilizer Control Links
Courtesy of KIA MOTORS AMERICA, INC.

12. Install front exhaust pipe.

    Tightening torque:

    A: 29.7~40.5 lb-ft (40.2~54.9 N.m, 4.1~5.6 kg-m)
    B : 51~69 lb-ft (69~94 N.m, 6.9~9.4 kg-m)
    C : 15.2~20.2 lb-ft (20.6~27.4 N.m, 2.1~2.8 kg-m)

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Fig. 39: Installing Front Exhaust Pipe
Courtesy of KIA MOTORS AMERICA, INC.

13. Connect two ATF cooler hoses (A/T).

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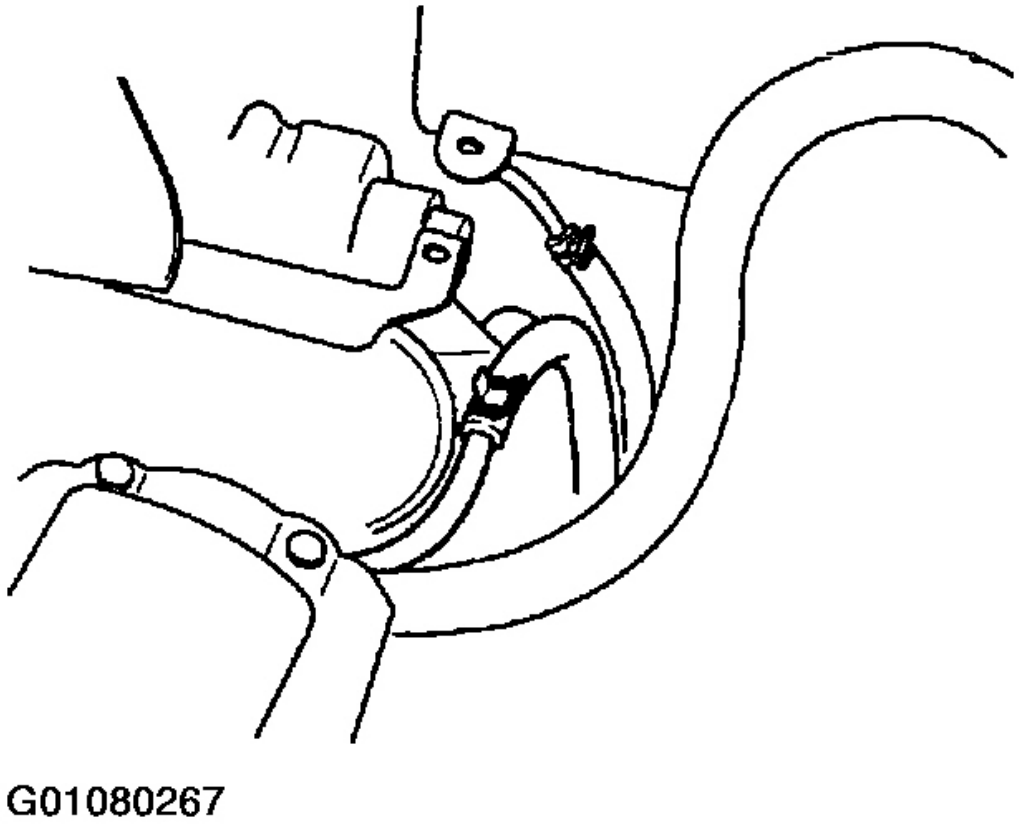
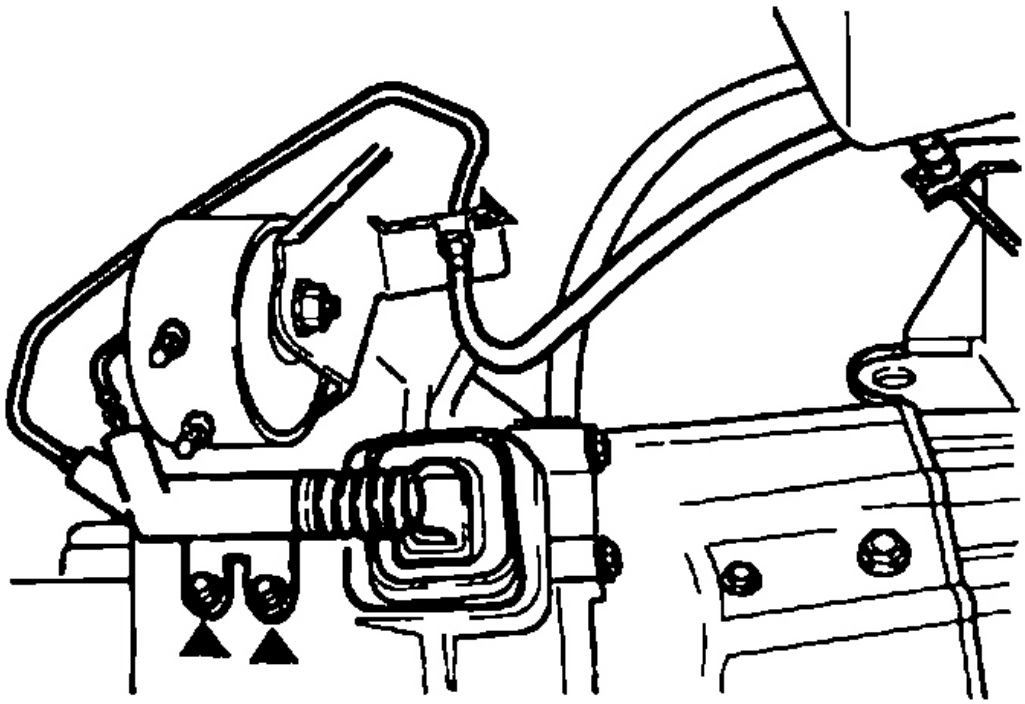


Fig. 40: Connecting Two ATF Cooler Hoses (A/T)
Courtesy of KIA MOTORS AMERICA, INC.

14. Connect solenoid valve connector (A/T).
15. Connect auto transaxle range switch connector (A/T).
16. 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)

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Fig. 41: Installing Clutch Release Cylinder And Pipe (M/T)
Courtesy of KIA MOTORS AMERICA, INC.

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

    Extension bar tightening torque: 23~34 lb-ft (32~47 N.m)

    Manual transaxle linkage tightening torque: 12~17 lb-ft (16~23 N.m)

18. Install washer and nut to auto transaxle linkage (A/T).

    Tightening torque: 24~83 lb-ft (32~46 N.m, 3.2~4.7 kg-m)

19. Insert U-clip.

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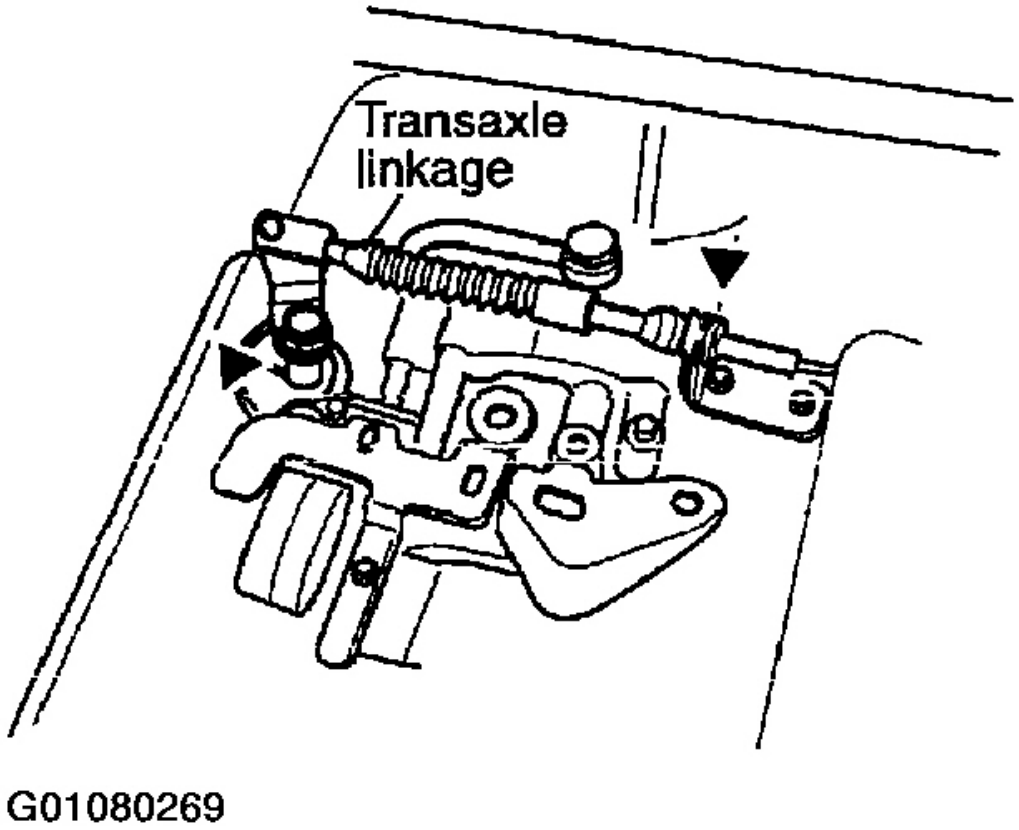
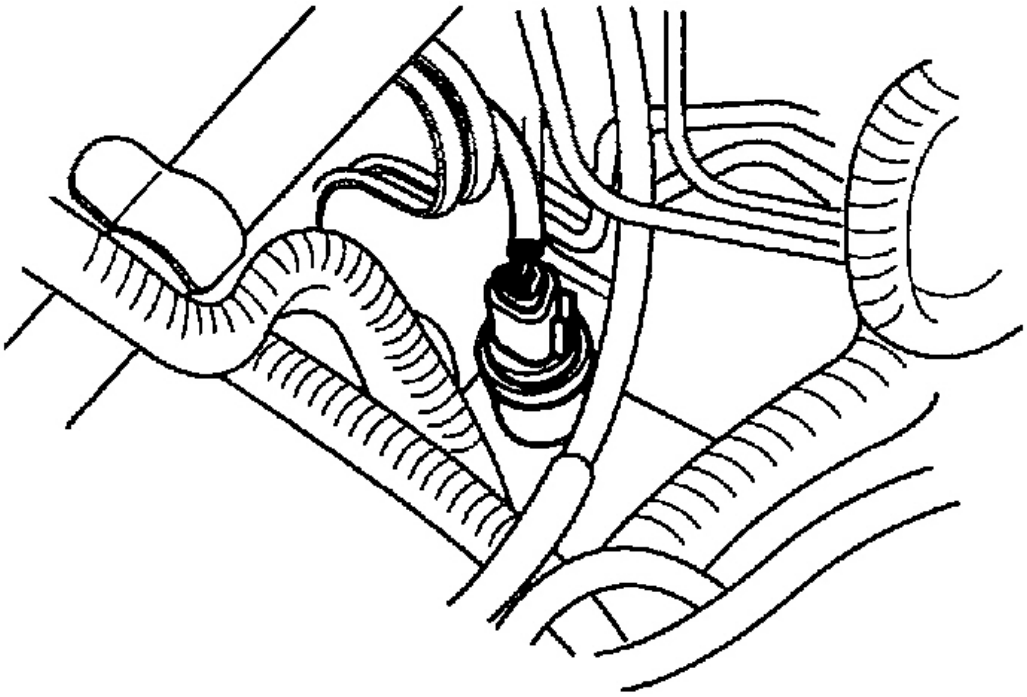


Fig. 42: Installing Washer And Nut To Auto Transaxle Linkage (A/T)
Courtesy of KIA MOTORS AMERICA, INC.

20. Connect back-up light switch connector (M/T).
21. Connect vehicle speed sensor connector (M/T).

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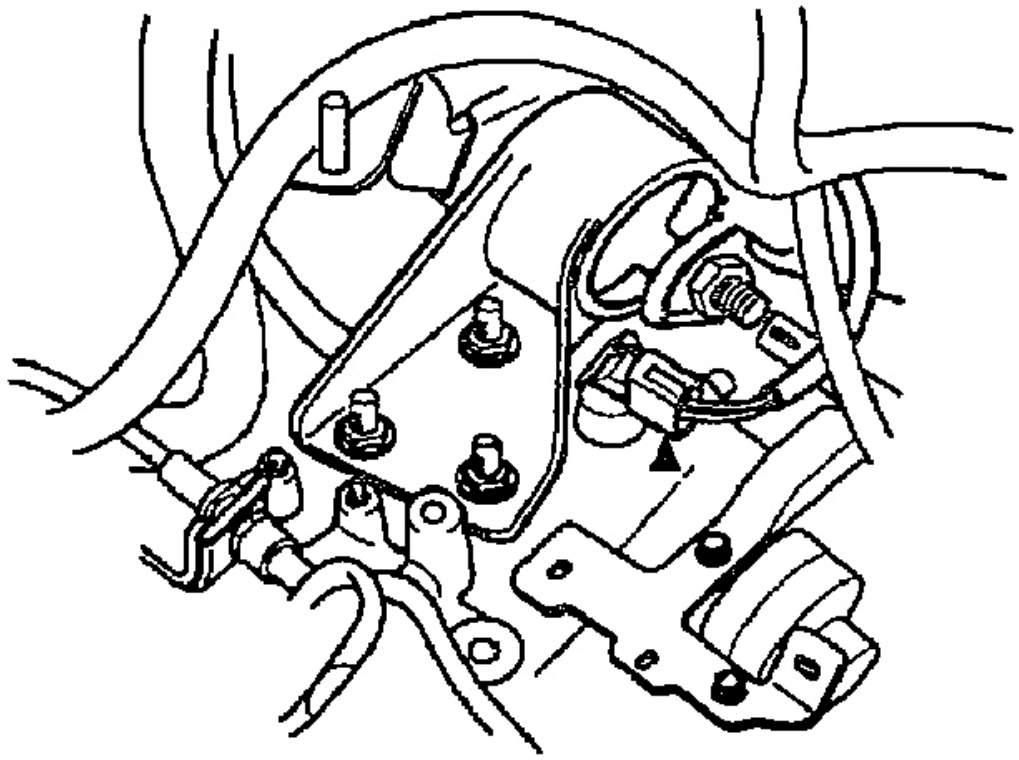


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Fig. 43: Connecting Vehicle Speed Sensor Connector (M/T)
Courtesy of KIA MOTORS AMERICA, INC.

22. Connect input turbine speed sensor connector.

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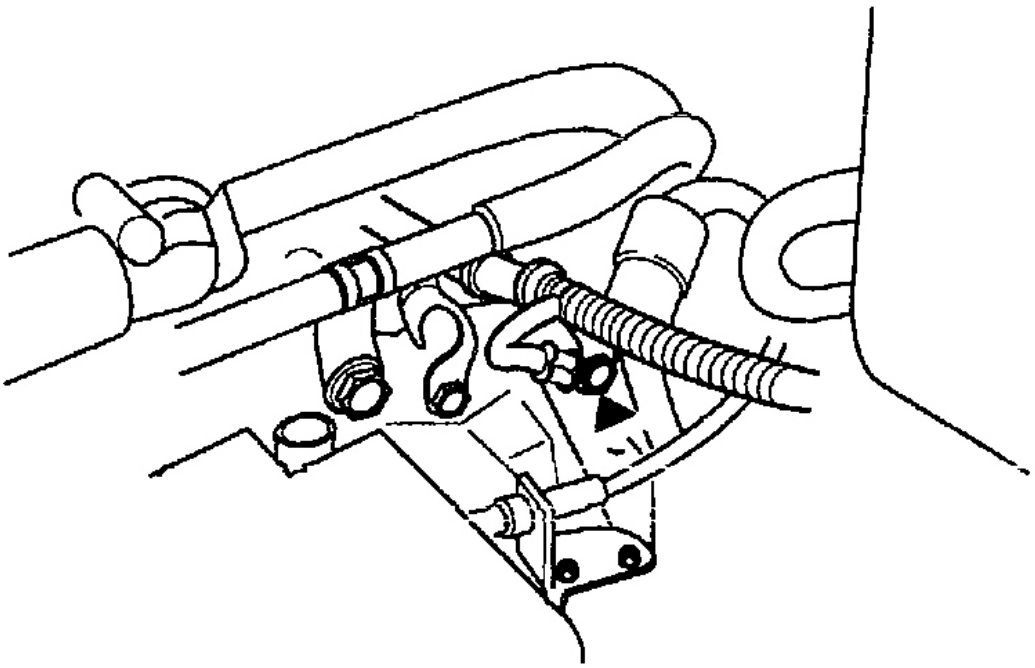


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Fig. 44: Connecting Input Turbine Speed Sensor Connector
Courtesy of KIA MOTORS AMERICA, INC.

23. Connect ground strap to top of transaxle.

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Fig. 45: Connecting Ground Strap To Top Of Transaxle
Courtesy of KIA MOTORS AMERICA, INC.

24. Install A/C compressor mounting bracket (five bolts)

Tightening torque:

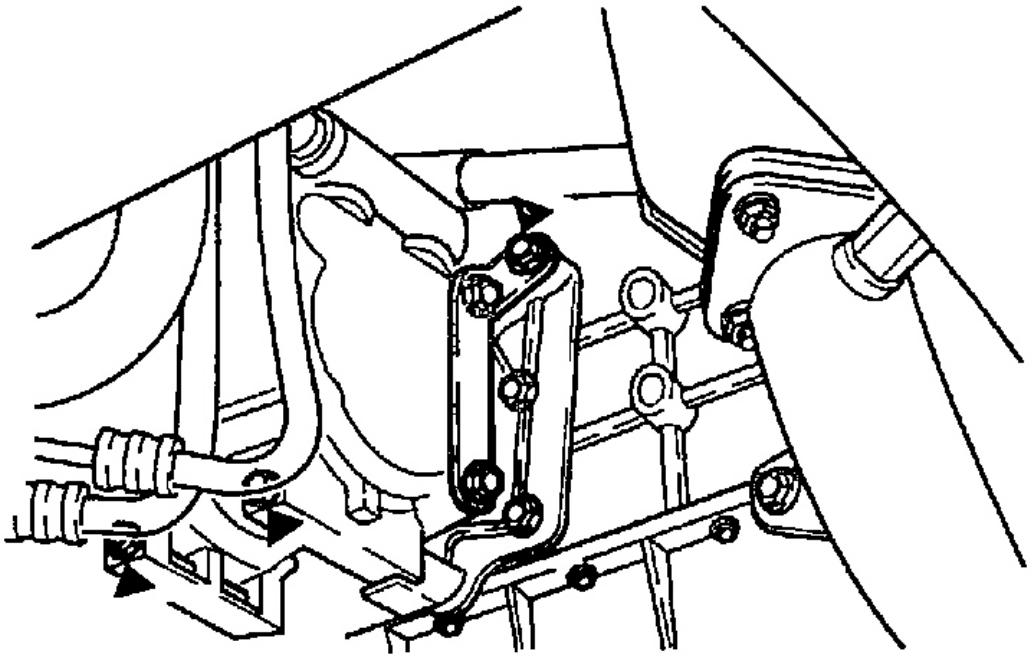
Mounting bracket:

Four (14 mm) bolts: 28~38 lb-ft (38~51 N.m, 3.9~5.2 kg-m)

One (12 mm) bolt (oil pump side): 14~18 lb-ft (19~25 N.m, 1.9~25 kg-m)

A/C compressor: 28~38 lb-ft (39~52 N.m, 3.9~5.3 kg-m)

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Fig. 46: Installing A/C Compressor Mounting Bracket
Courtesy of KIA MOTORS AMERICA, INC.

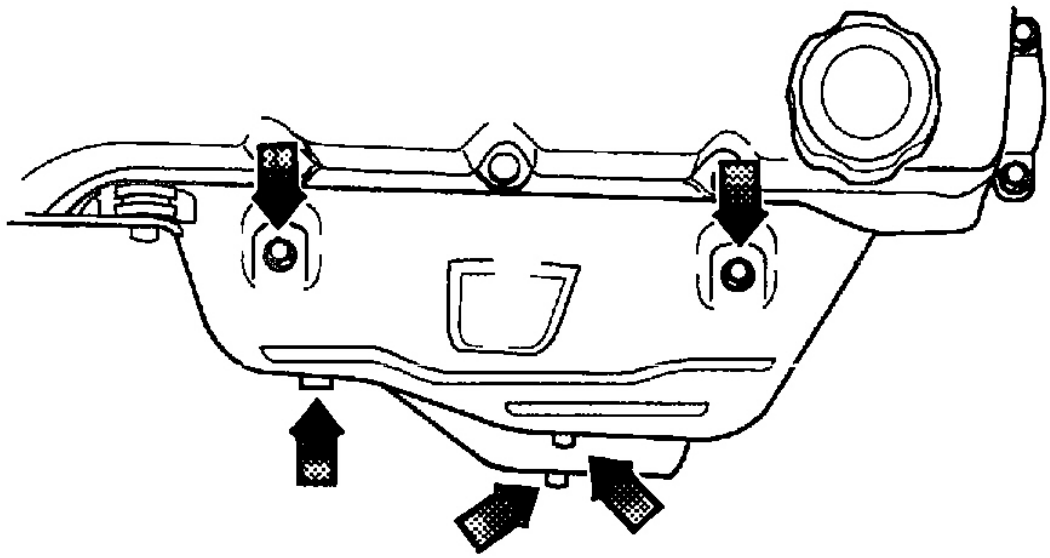
Install three P/S pump bracket bolts.

Tightening torque: 28~38 lb-ft (39~52 N.m, 3.9~5.3 kg-m)

Install exhaust manifold heat shield.

Tightening torque: 13.7~22.4 lb-ft (18.6~30.4 N.m, 1.9~3.1 kg-m)

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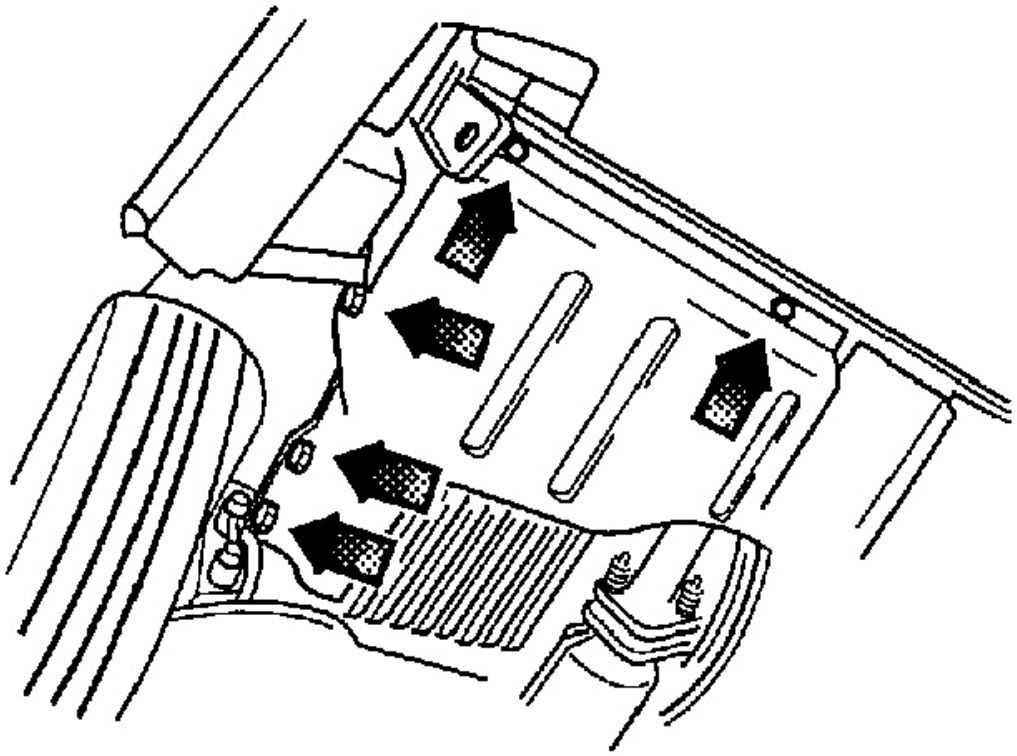
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Fig. 47: Installing Exhaust Manifold Heat Shield
Courtesy of KIA MOTORS AMERICA, INC.

Install RH & LH splash shield.

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

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Fig. 48: Installing RH & LH Splash Shield
Courtesy of KIA MOTORS AMERICA, INC.

Install both front wheels.

Tightening torque: 65~87 lb-ft (88~118 N.m, 9~12 kg-m)

Connect engine ground strap.

Tightening torque:

A:28~38 lb-ft (38~51 N.m, 3.8~5.3 kg-m)
B:5.8~8.7 lb-ft (7.8~11.8 N.m, 0.8~1.2 kg-m)

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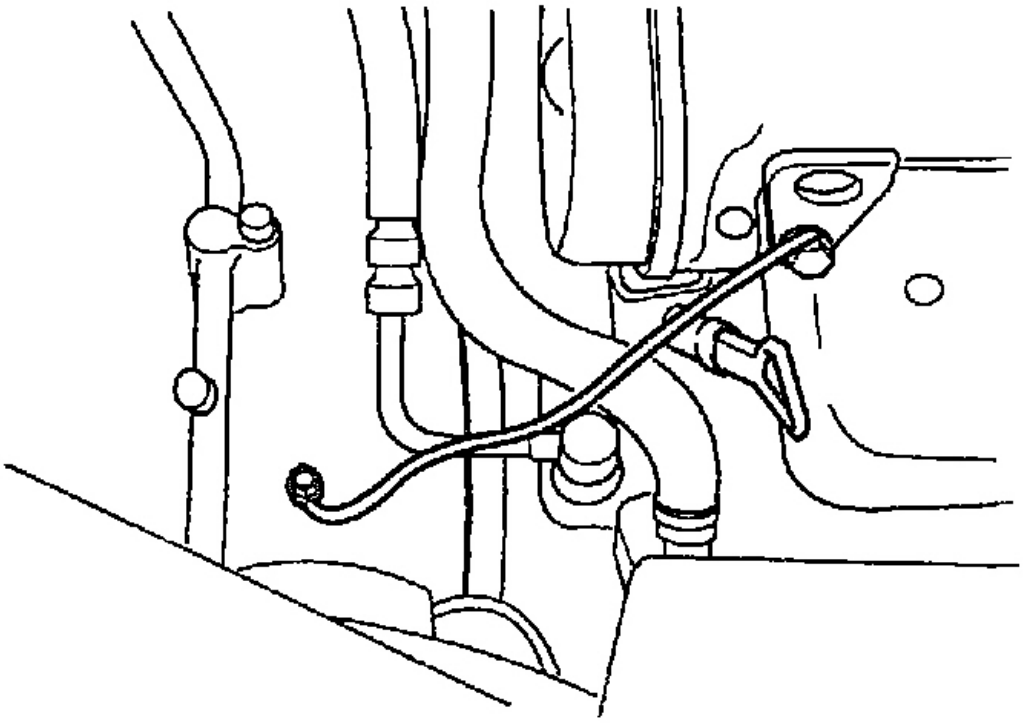
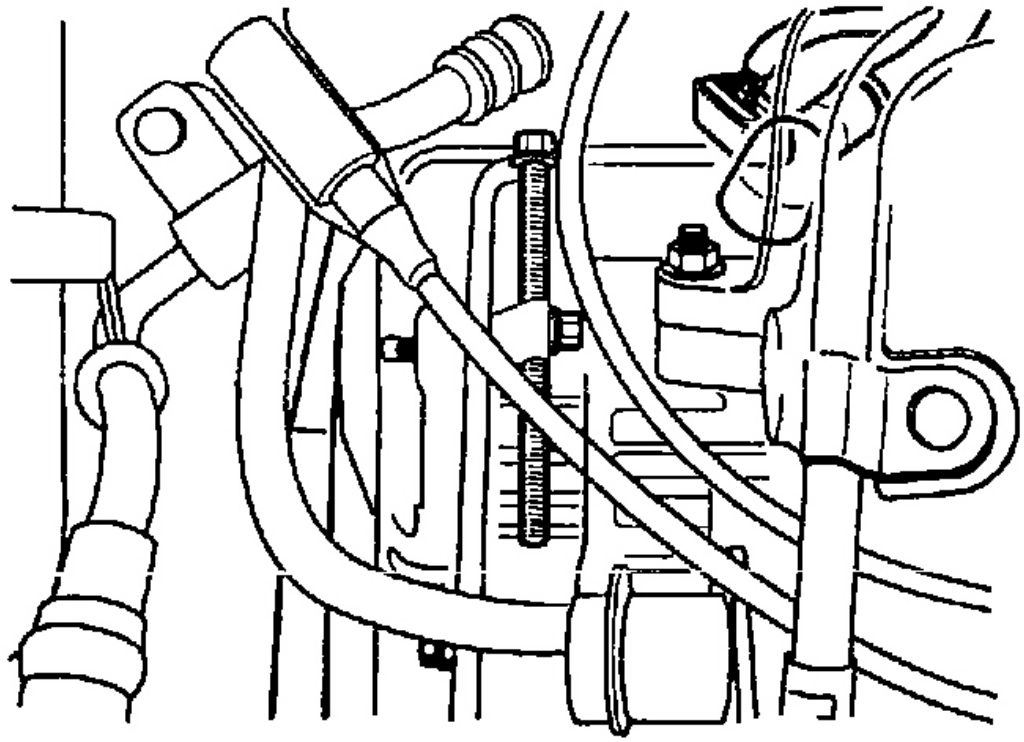


Fig. 49: Connecting Engine Ground Strap
Courtesy of KIA MOTORS AMERICA, INC.

Connect two generator connectors.

(B-terminal connector and C121 to the generator)

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Fig. 50: Connecting Two Generator Connectors
Courtesy of KIA MOTORS AMERICA, INC.

Connect B-terminal and S-terminal connectors to the starter.

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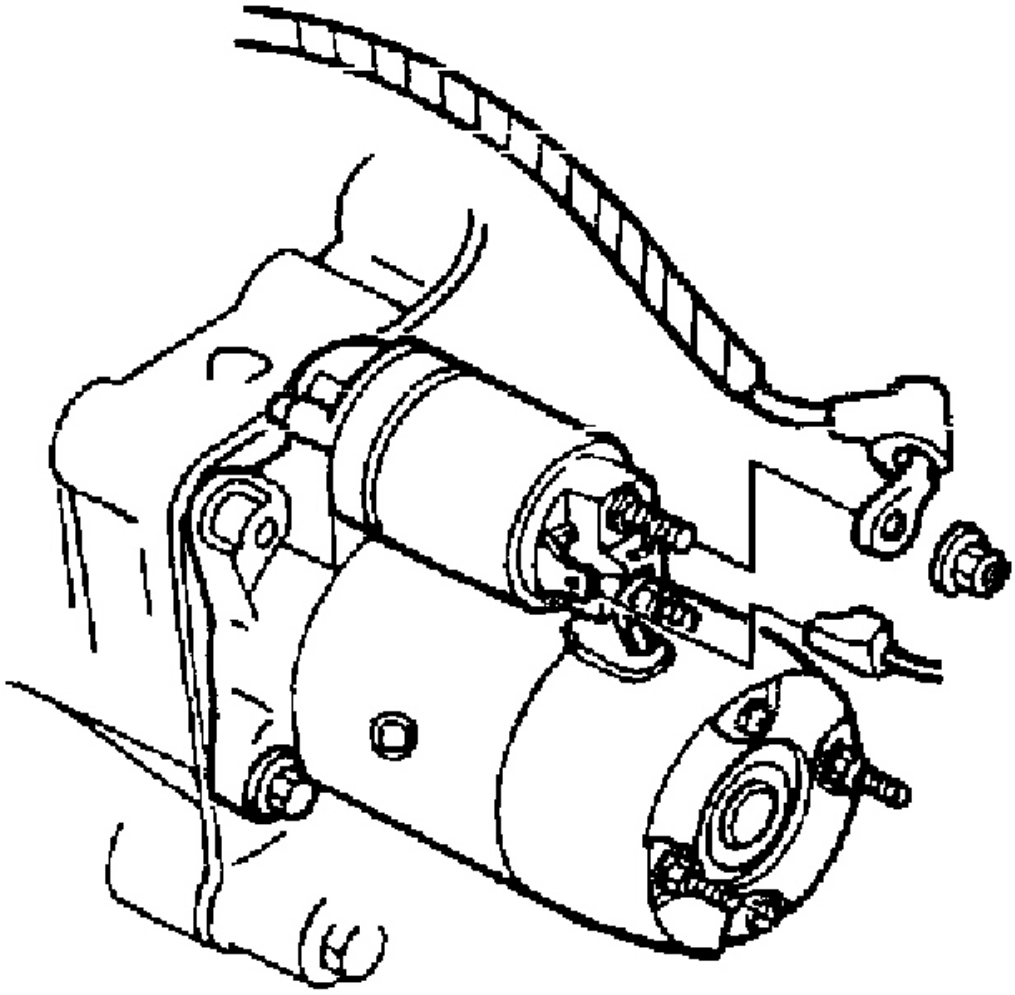
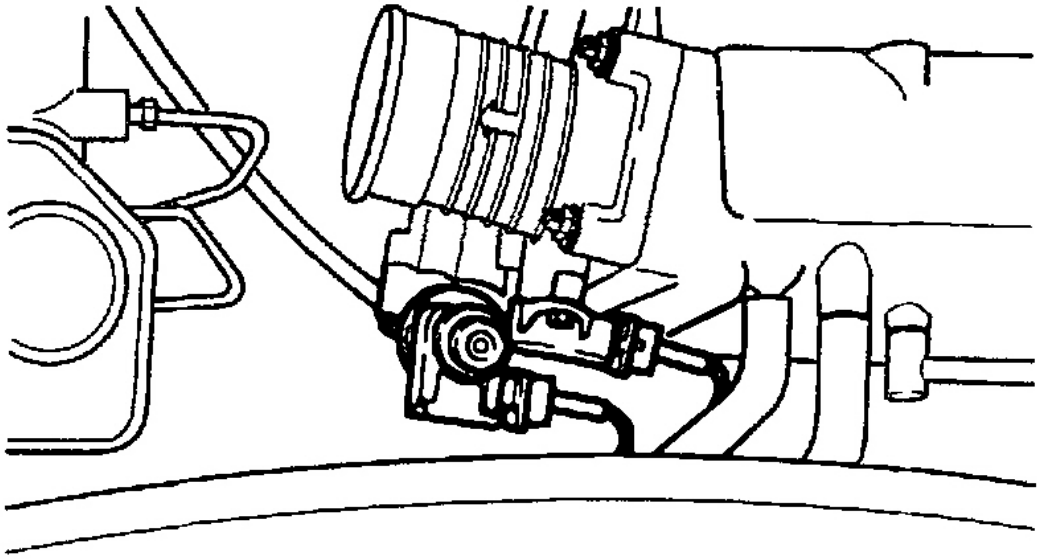


Fig. 51: Connecting B-Terminal And S-Terminal Connectors To The Starter
Courtesy of KIA MOTORS AMERICA, INC.

Connect IAC and throttle position sensor connectors.

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Fig. 52: Connecting IAC And Throttle Position Sensor Connectors
Courtesy of KIA MOTORS AMERICA, INC.

Install connector bracket and connect electric connectors.

Tightening torque: 27.5~38.3 lb-ft (37.2~51.9 N.m, 3.8~5.3 kg-m)

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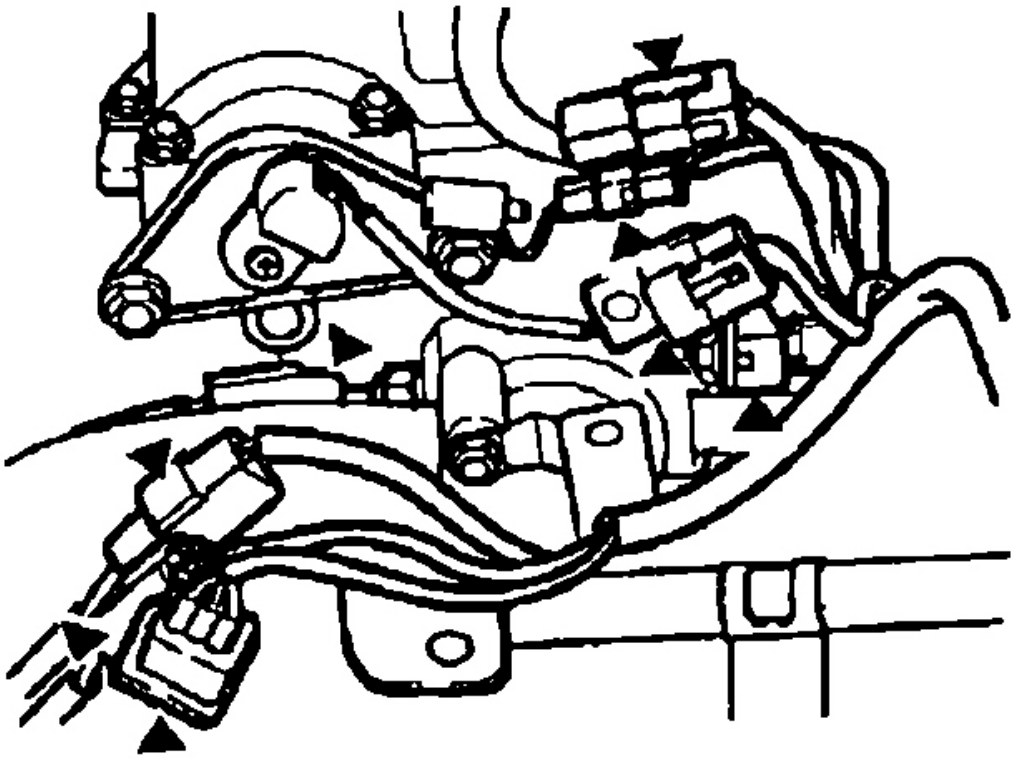


Fig. 53: Installing Connector Bracket And Connecting Electric Connectors
Courtesy of KIA MOTORS AMERICA, INC.

Connect injector connectors.

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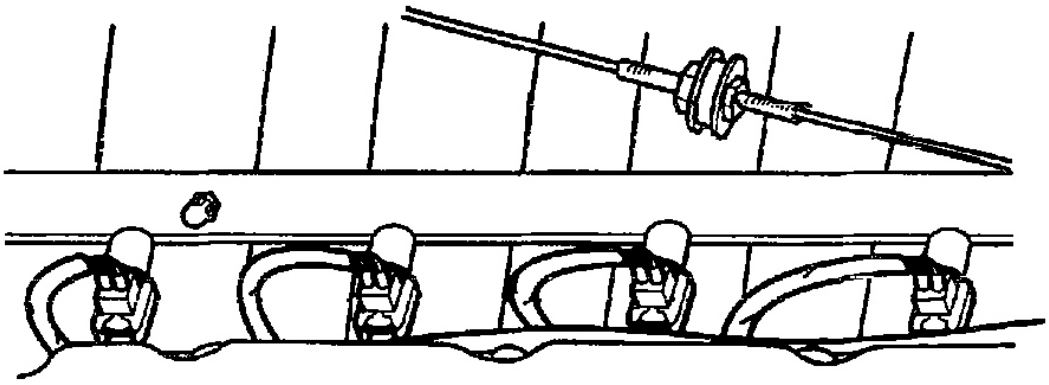
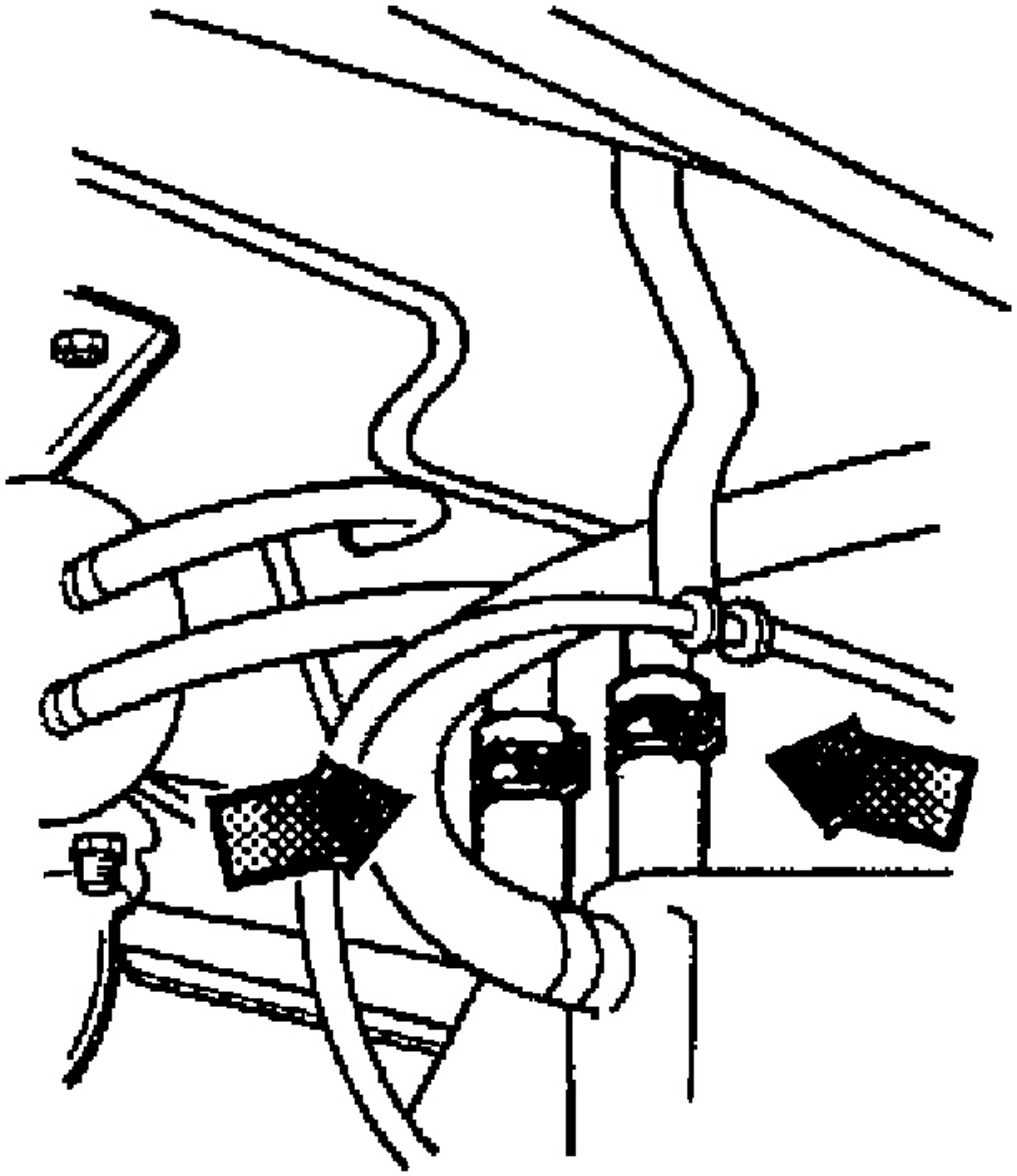


Fig. 54: Connecting Injector Connectors
Courtesy of KIA MOTORS AMERICA, INC.

Connect heater hoses.

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Fig. 55: Connecting Heater Hoses
Courtesy of KIA MOTORS AMERICA, INC.

Connect fuel hose to injector rail.

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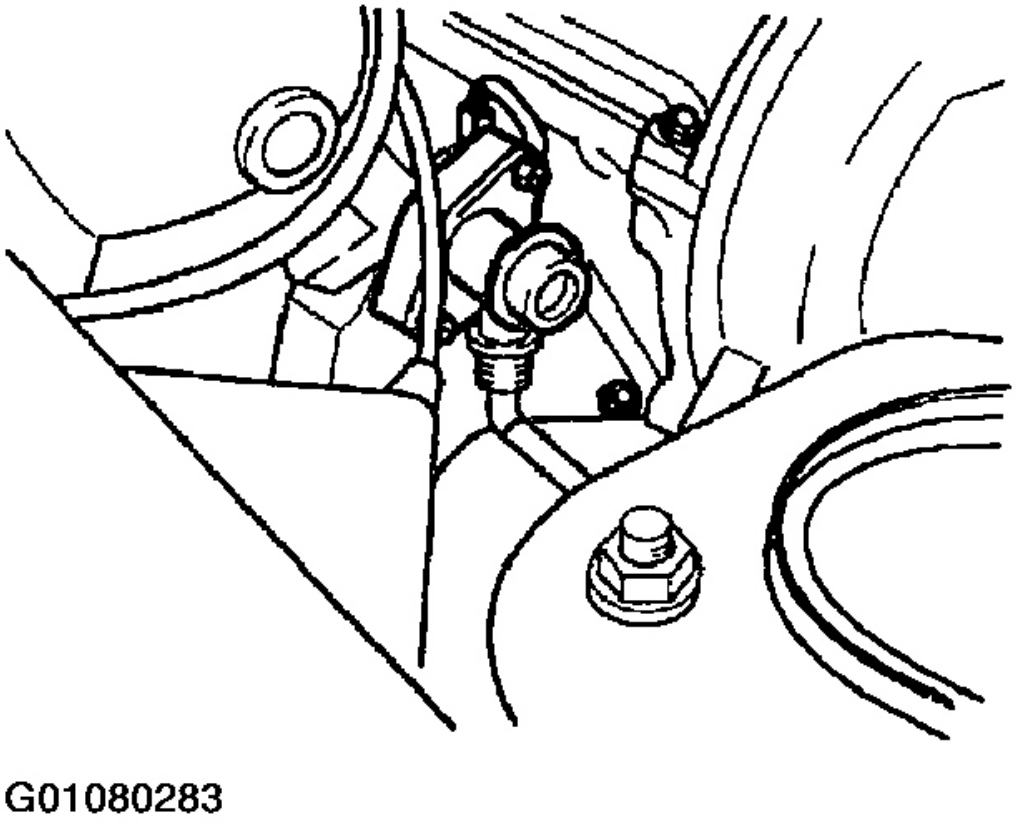


Fig. 56: Connecting Fuel Hose To Injector Rail
Courtesy of KIA MOTORS AMERICA, INC.

Connect upper and lower radiator hoses.

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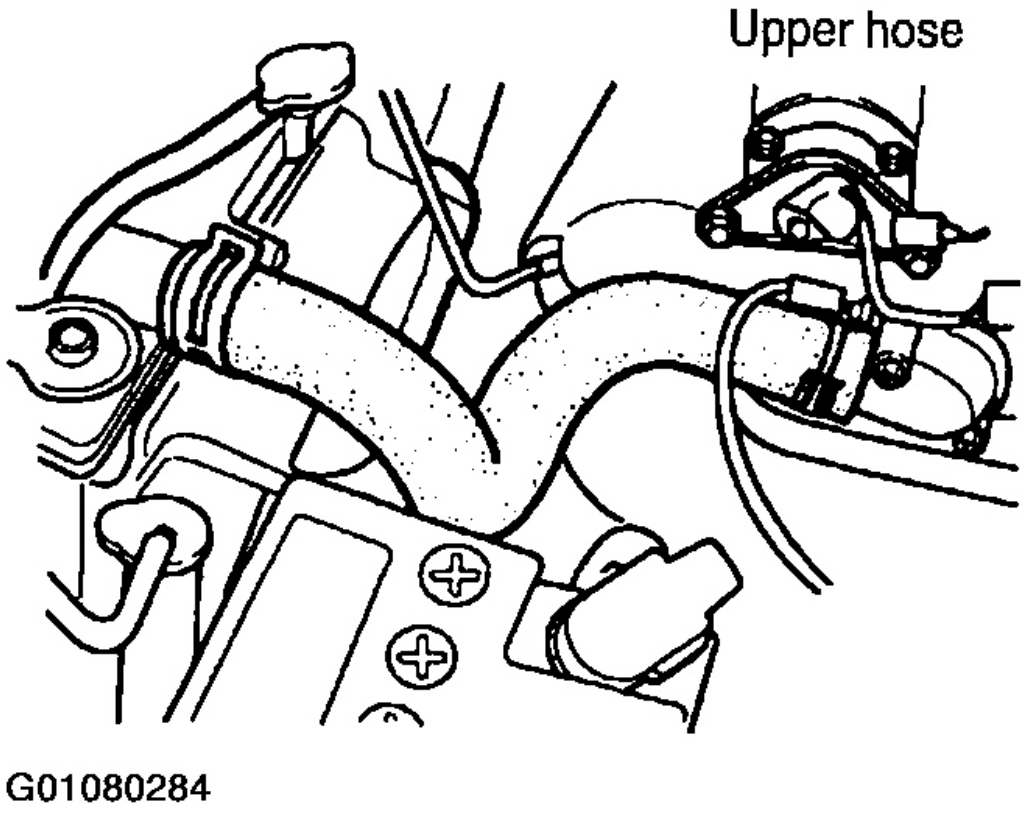


Fig. 57: Connecting Upper And Lower Radiator Hoses
Courtesy of KIA MOTORS AMERICA, INC.

Connect brake vacuum hose and purge control vacuum hose to dynamic chamber.

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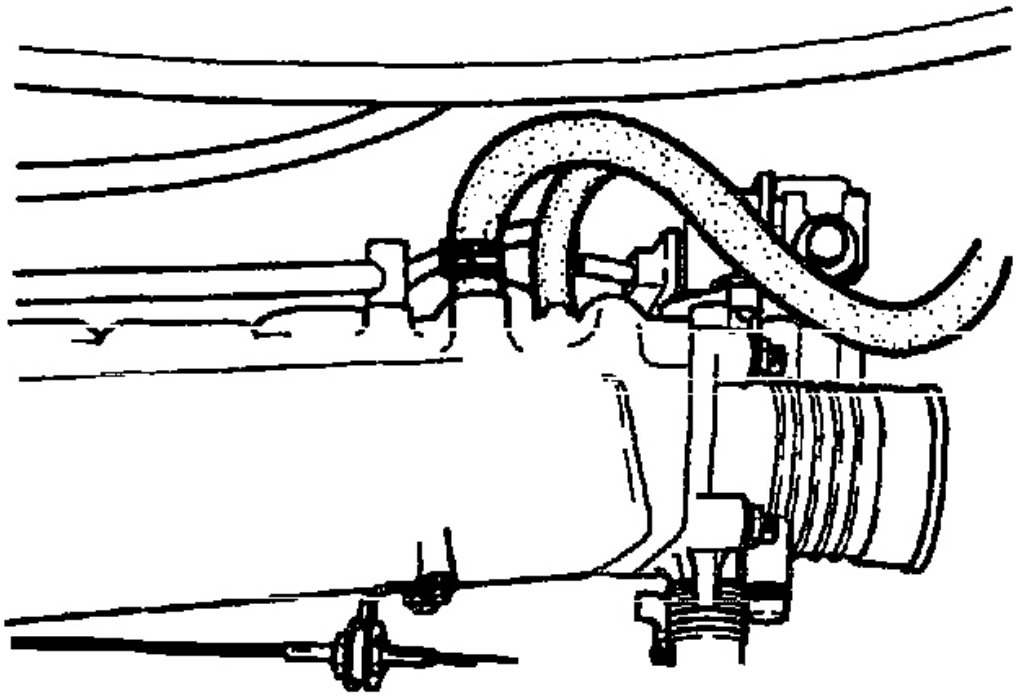
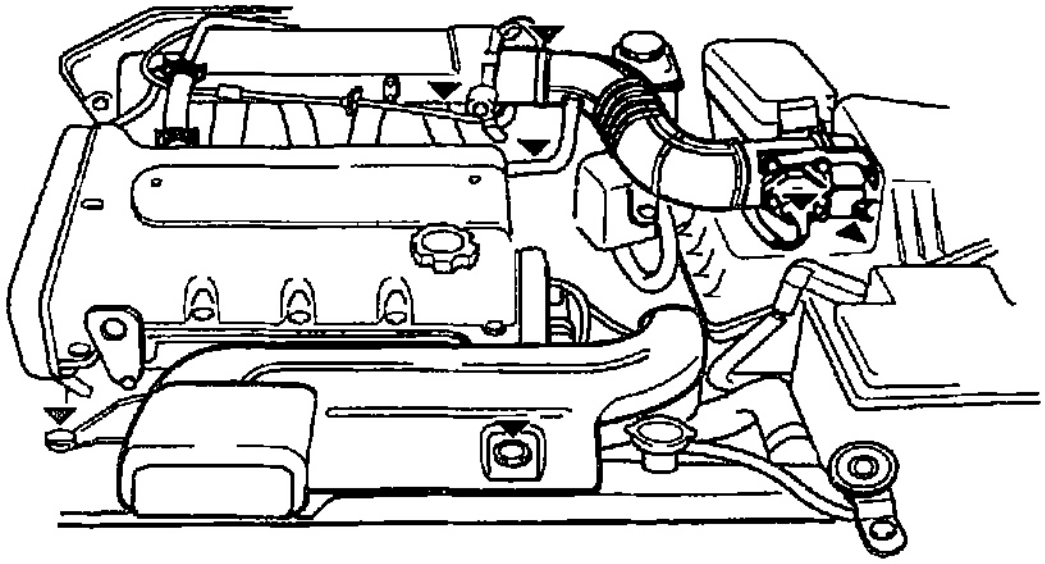


Fig. 58: Connecting Brake Vacuum Hose And Purge Control Vacuum Hose
Courtesy of KIA MOTORS AMERICA, INC.

Install air cleaner assembly and connect air intake hose to throttle body.
Install fresh air duct.
Connect ventilation hose.
Install accelerator cable and auto cruise control cable, if equipped.
Insert data link connector into mass air flow sensor bracket.
Connect intake air temperature sensor connector and mass air flow sensor connectors.

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Fig. 59: Installing Air Cleaner Assembly And Connecting Air Intake Hose To Throttle Body
Courtesy of KIA MOTORS AMERICA, INC.

Install P/S and A/C belt. Turn adjustment screw until correct belt deflection is achieved. Tighten pivot bolt and mounting bolt.

Deflection:

New: 8.0~9.0 mm (0.32~0.35 in)

Used: 9.0~10.0 mm (0.36~0.39 in)

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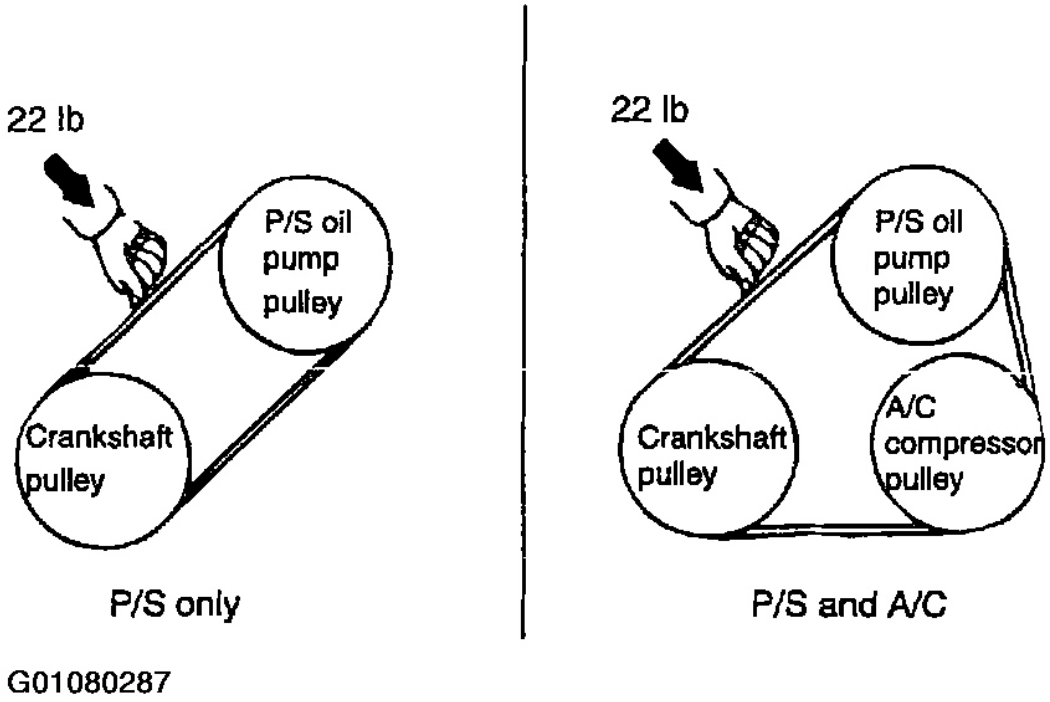


Fig. 60: Installing P/S And A/C Belt
Courtesy of KIA MOTORS AMERICA, INC.

Install battery tray and battery.

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

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

ENGINE DISASSEMBLY, INSPECTION & REASSEMBLY

DISASSEMBLY

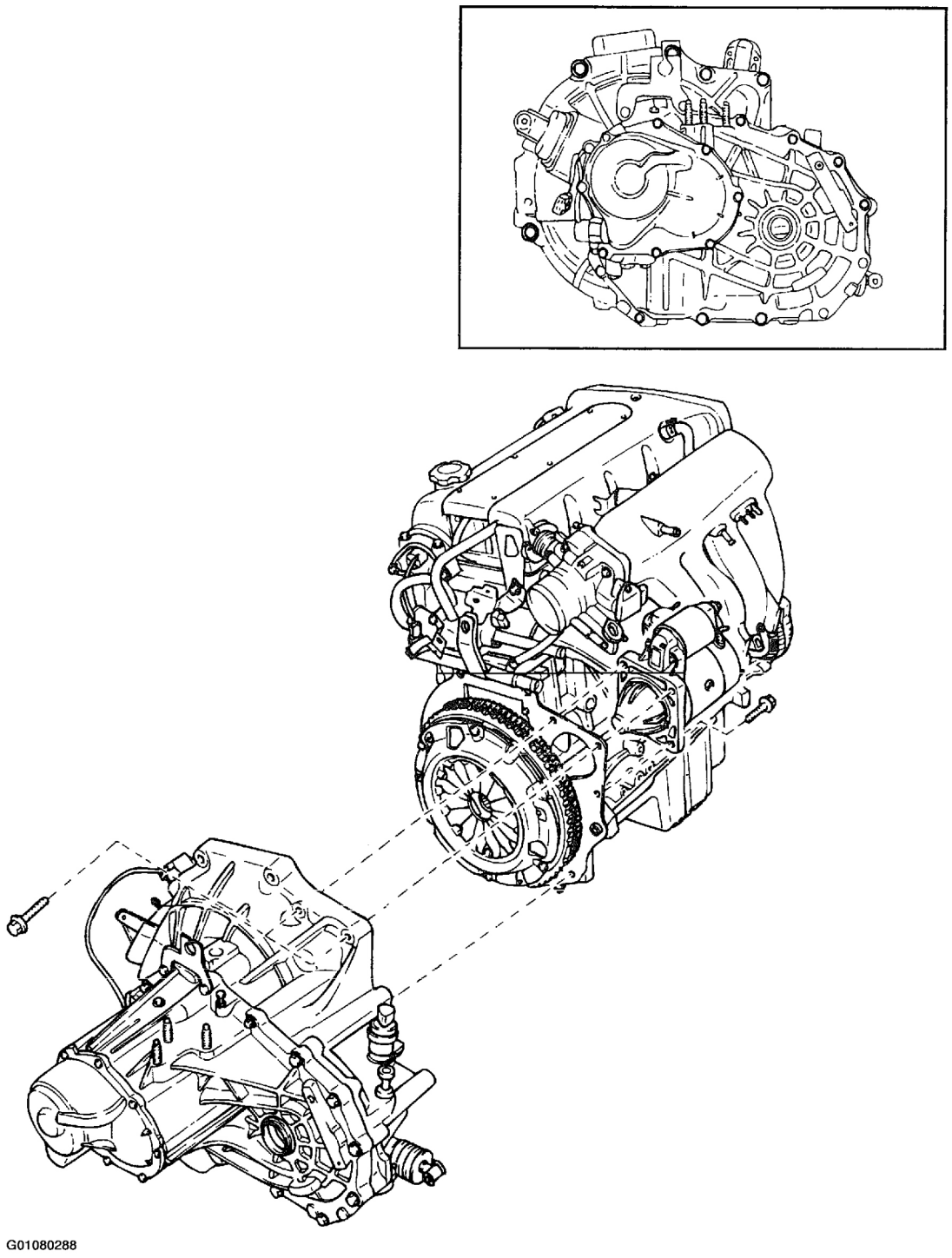


Fig. 61: Illustrating Engine-To-Transaxle Disassembly
Courtesy of KIA MOTORS AMERICA, INC.

1. Remove No. 2 engine mount.

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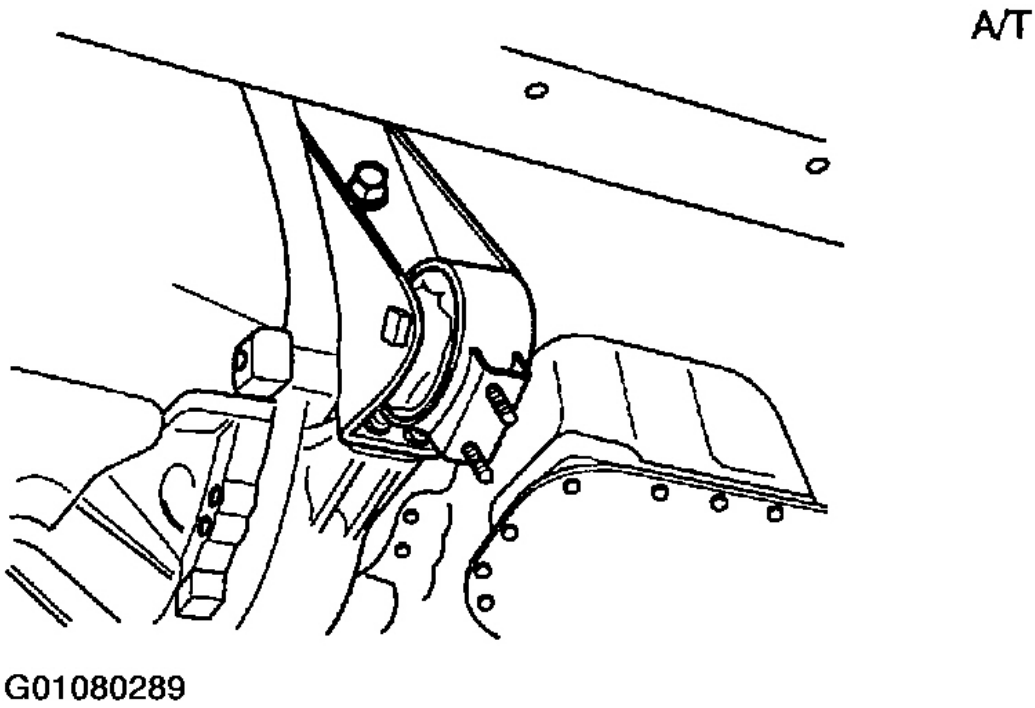


Fig. 62: Removing No. 2 Engine Mount
Courtesy of KIA MOTORS AMERICA, INC.

2. Remove No. 3 engine mount and bracket.

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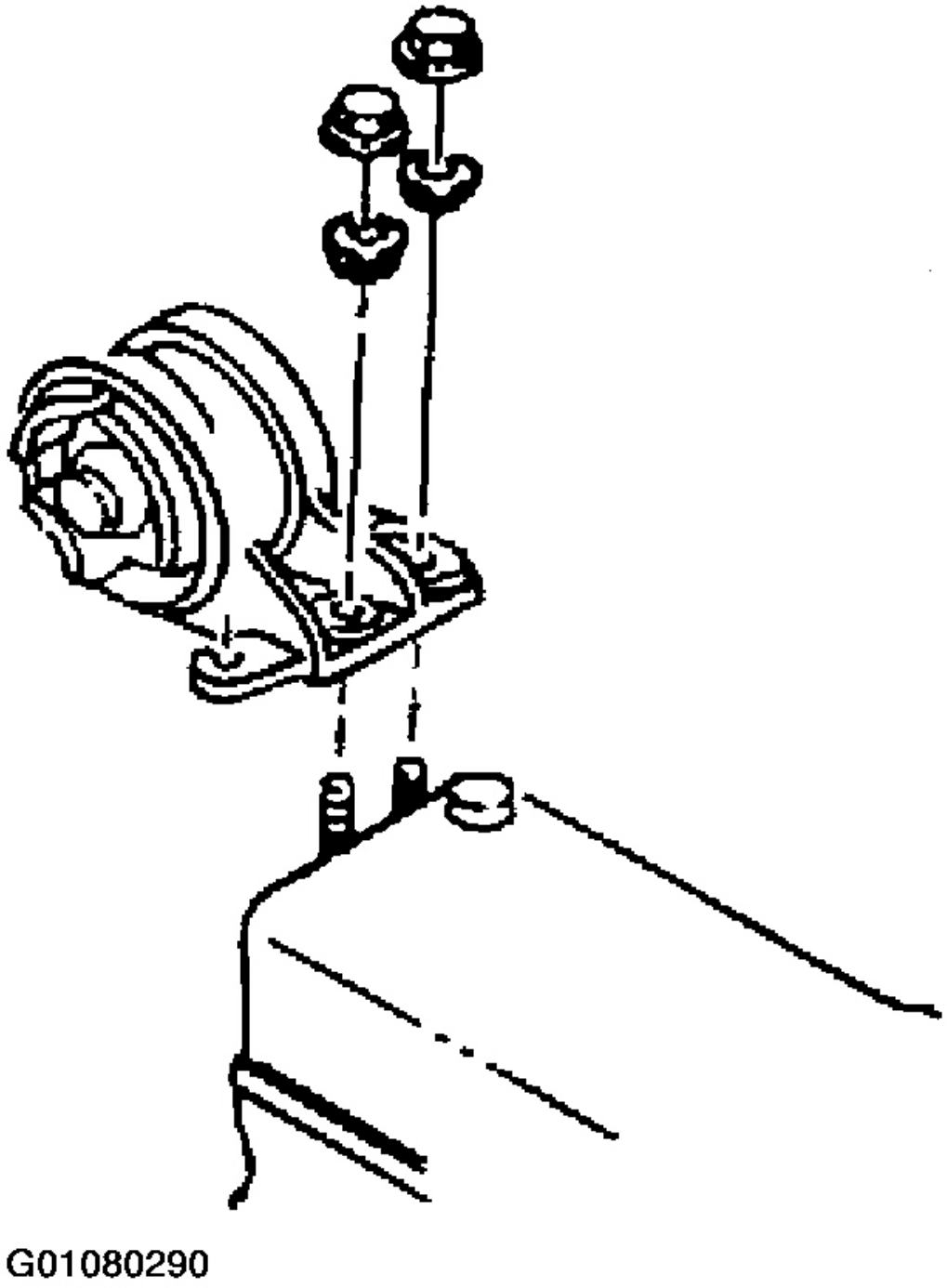


Fig. 63: Removing No. 3 Engine Mount And Bracket
Courtesy of KIA MOTORS AMERICA, INC.

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3. Remove starter (three bolts).
4. Remove eight transaxle mounting bolts and separate transaxle from engine.
5. Remove exhaust manifold and coolant bypass pipe.

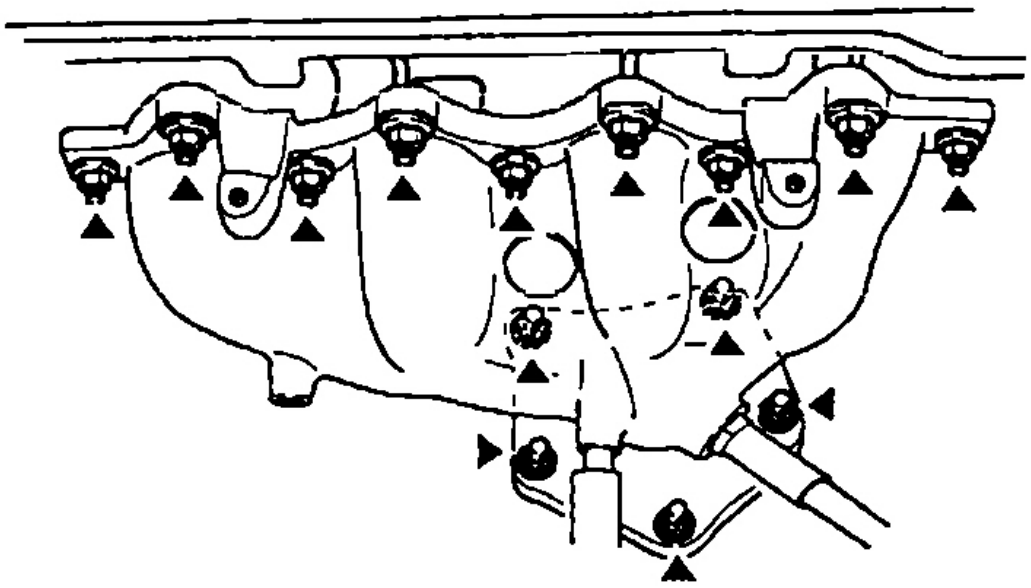


Fig. 64: Removing Exhaust Manifold And Coolant Bypass Pipe
Courtesy of KIA MOTORS AMERICA, INC.

6. Install engine to Service Tool.

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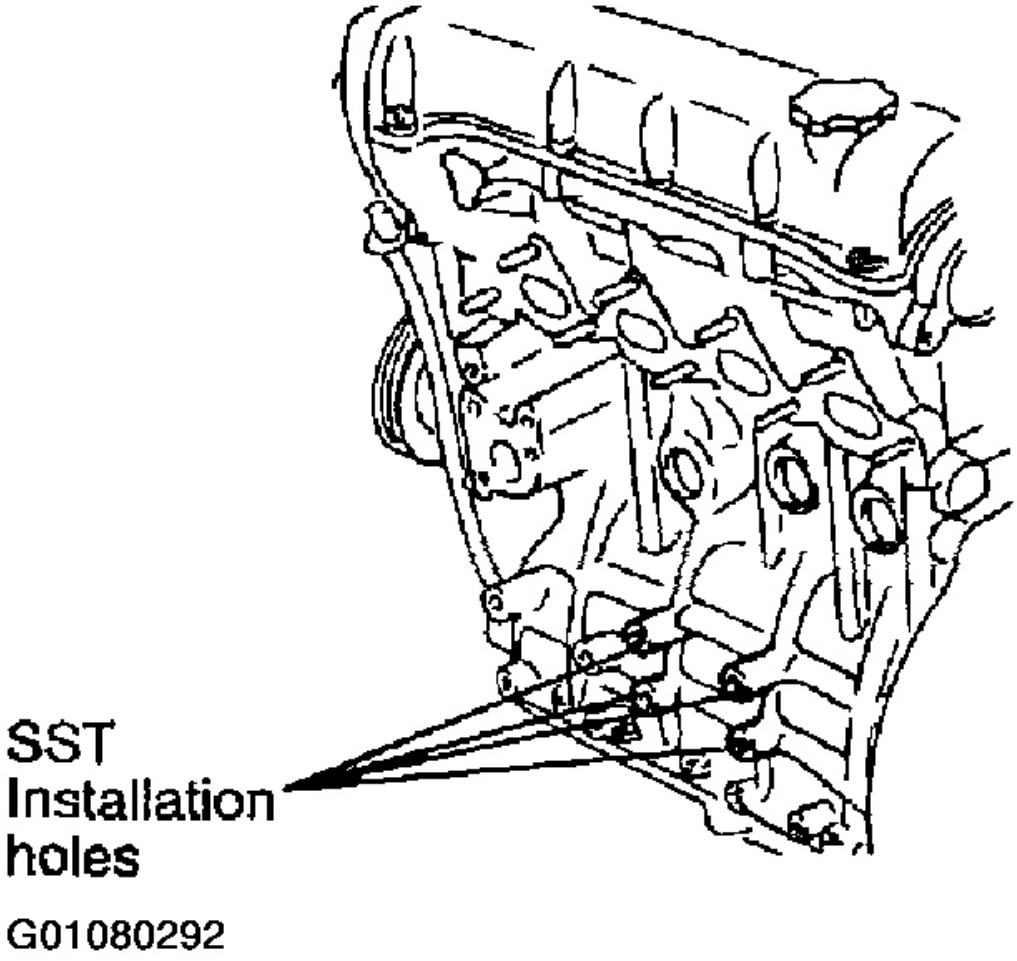
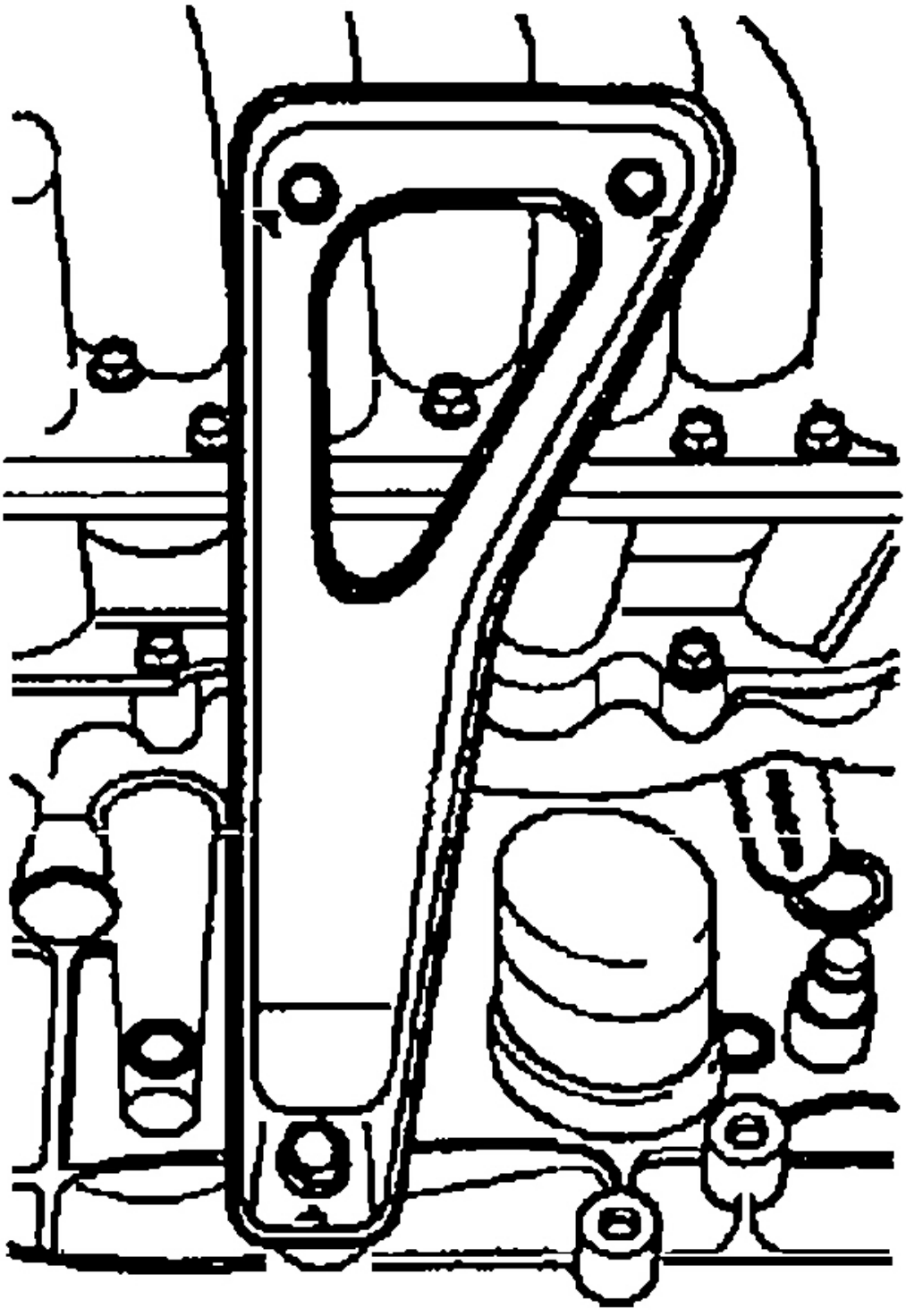


Fig. 65: Installing Engine To Service Tool
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7. Drain engine oil.
8. Remove front and rear engine hangers.
9. Remove generator by loosening adjusting bolt and removing mounting bolts and pivot bolt.
10. Remove intake manifold support bracket.

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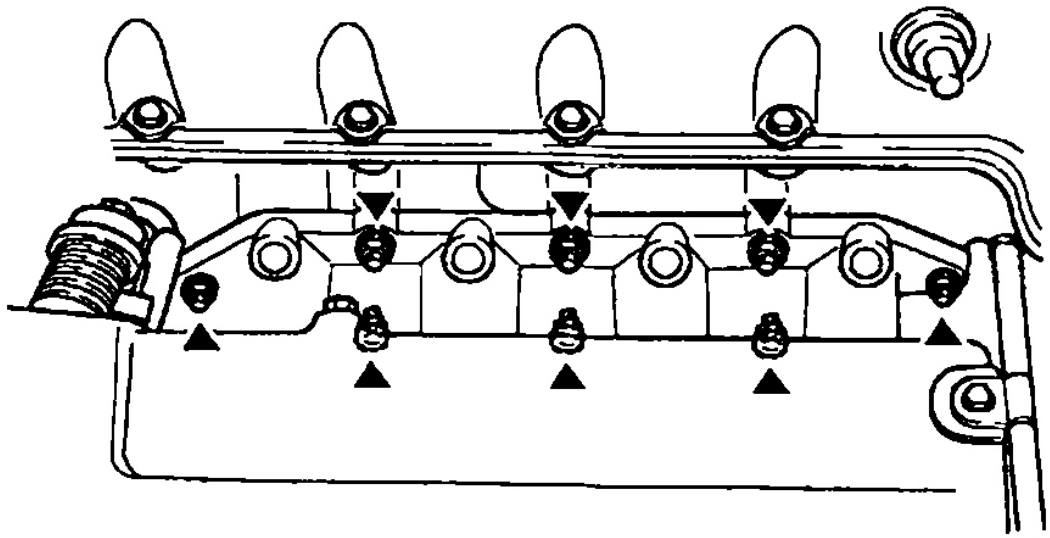


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Fig. 66: Removing Intake Manifold Support Bracket
Courtesy of KIA MOTORS AMERICA, INC.

11. Remove intake manifold.



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Fig. 67: Removing Intake Manifold
Courtesy of KIA MOTORS AMERICA, INC.

12. For timing belt removal, see **TIMING SYSTEM**.
13. Loosen cylinder head bolts in two or three steps following order shown in figure.

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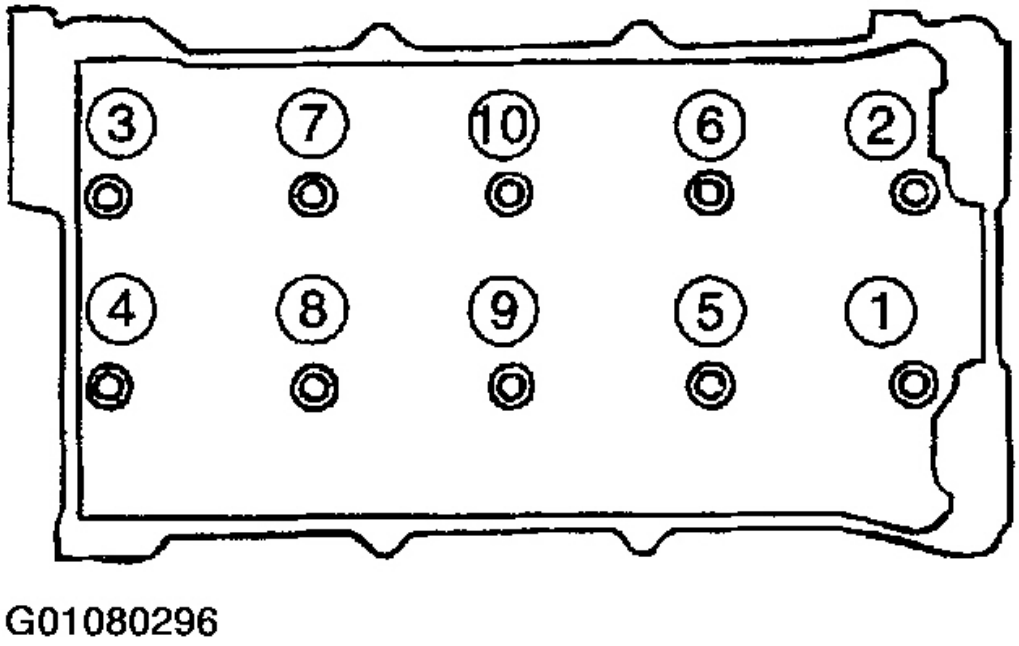


Fig. 68: Cylinder Head Loosening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

14. Remove cylinder head by lifting it off from cylinder block.

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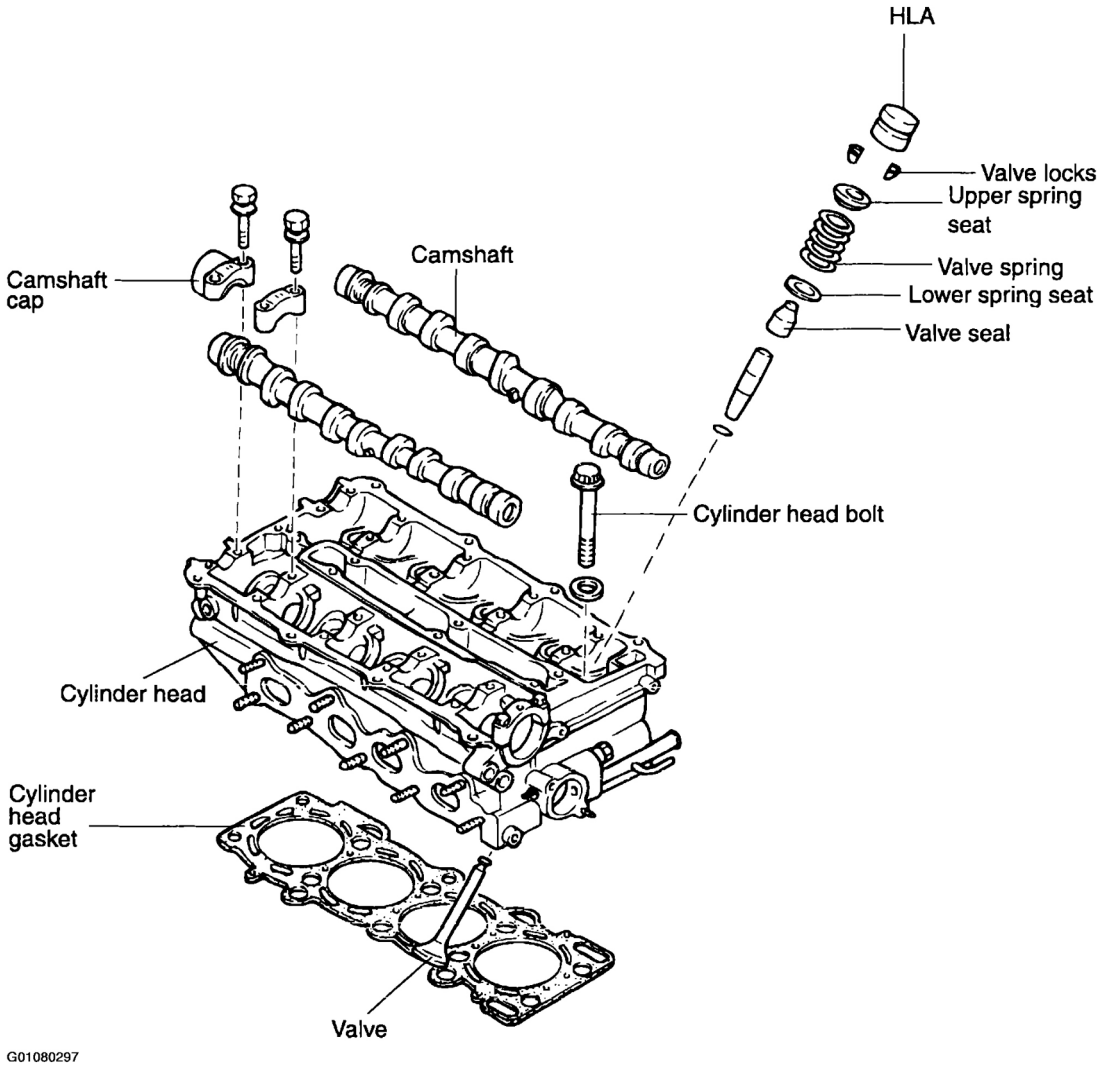


Fig. 69: Removing Cylinder Head
Courtesy of KIA MOTORS AMERICA, INC.

15. For additional cylinder head removal and disassembly information, see **CYLINDER HEAD ASSEMBLY**.
16. Remove external engine components.

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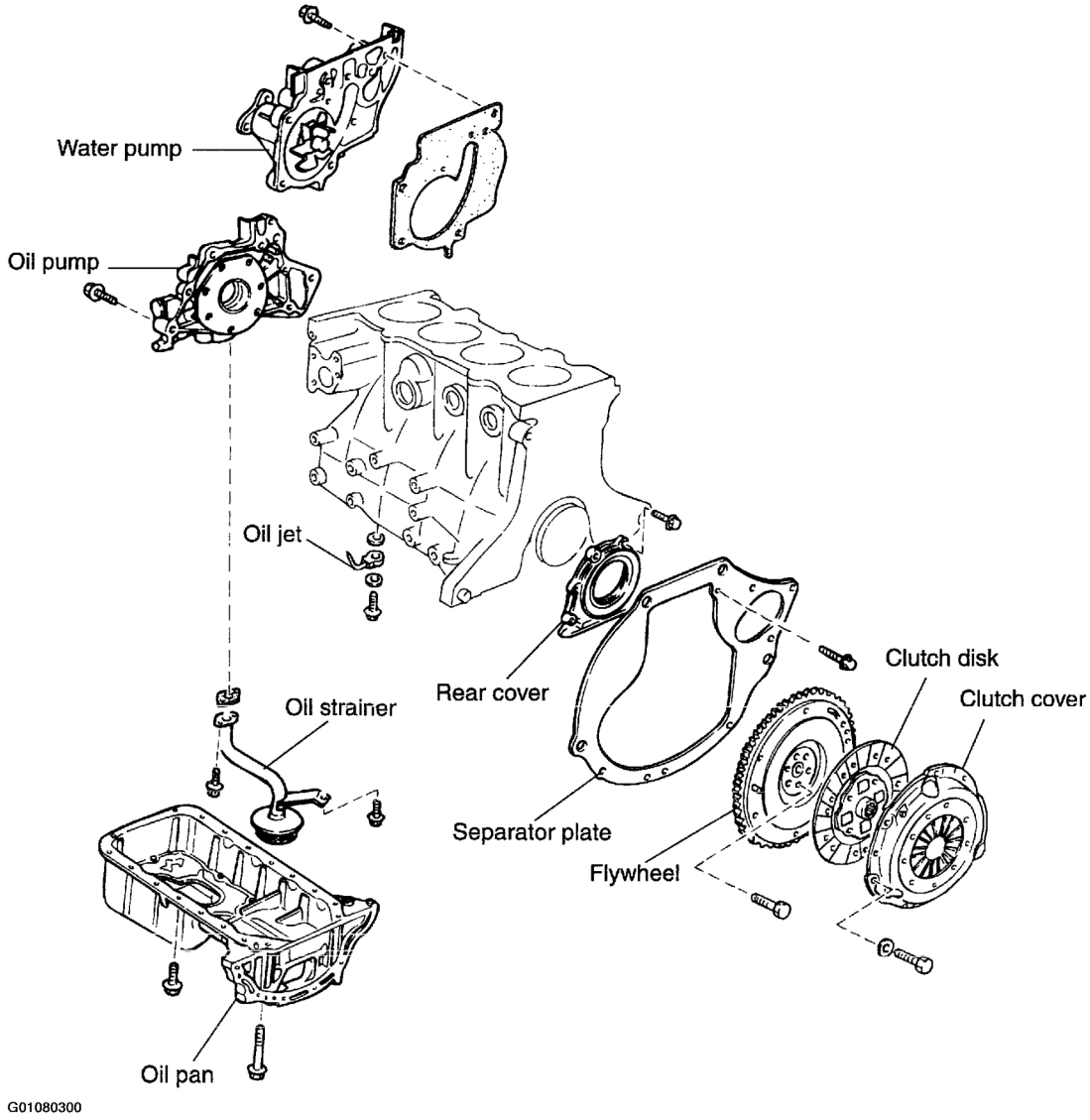


Fig. 70: Illustrating External Engine Components
Courtesy of KIA MOTORS AMERICA, INC.

17. Install SST or equivalent.

    (Clutch disc centering tool and ring gear brake)

18. Loosen each bolt one turn at a time, in a crisscross pattern, until spring tension is released then remove clutch cover and disc.

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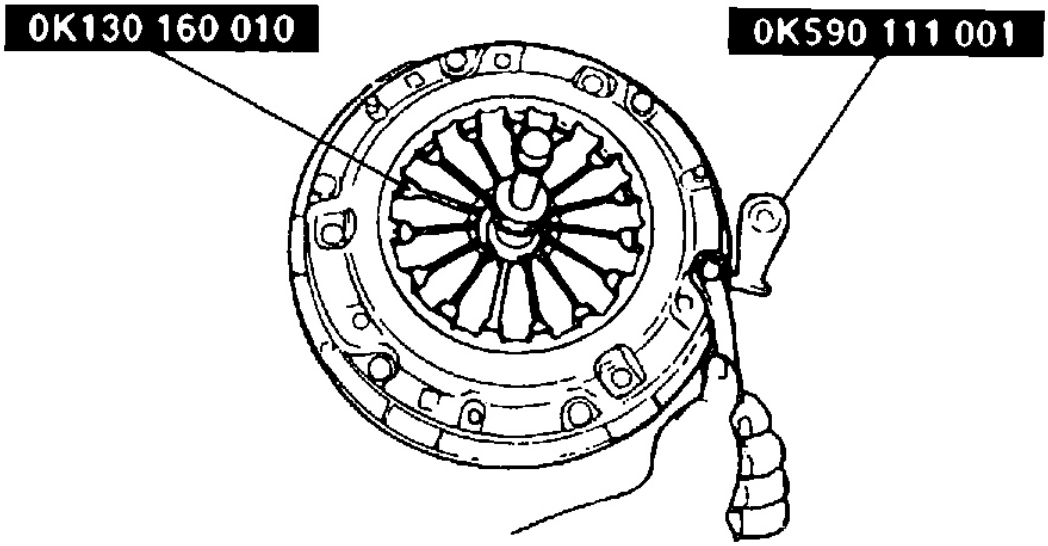


Fig. 71: Removing Clutch Cover And Disc
Courtesy of KIA MOTORS AMERICA, INC.

19. Remove pilot bearing with SST (Bearing puller) or equivalent if necessary.
20. Hold flywheel with SST (Ring gear brake) or equivalent.

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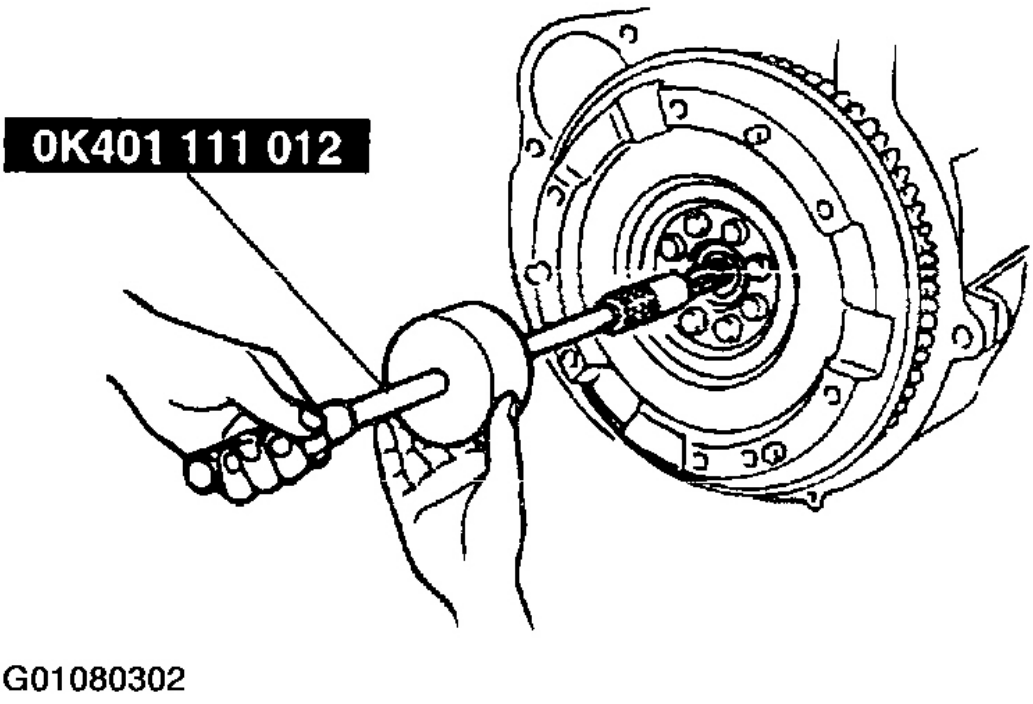


Fig. 72: Removing Pilot Bearing
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21. Remove six bolts to remove flywheel.

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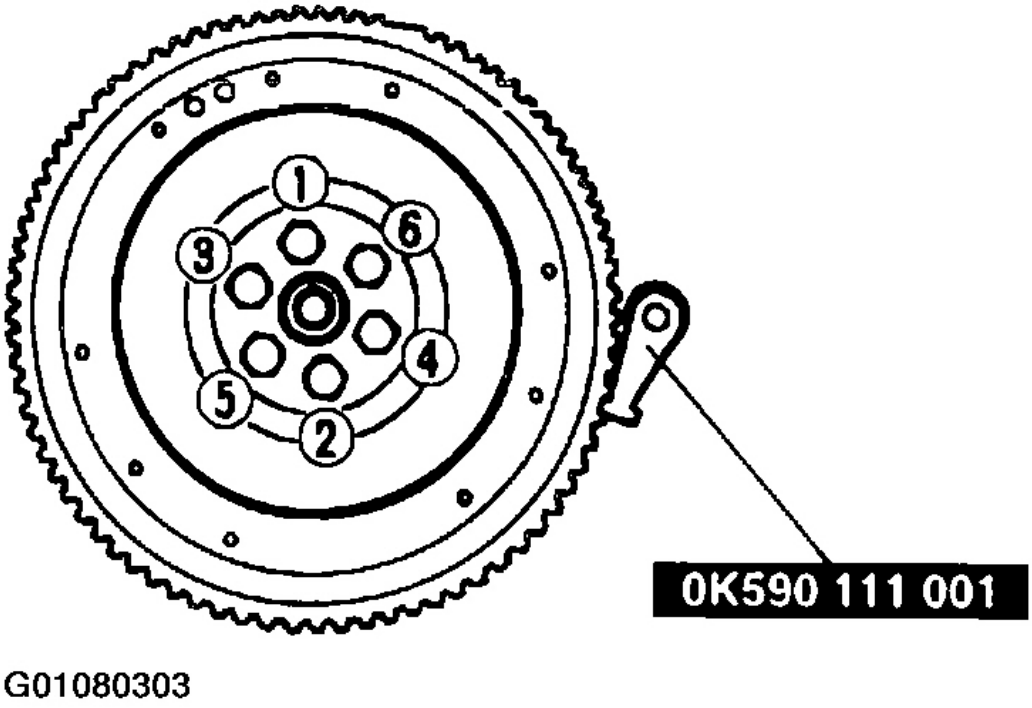
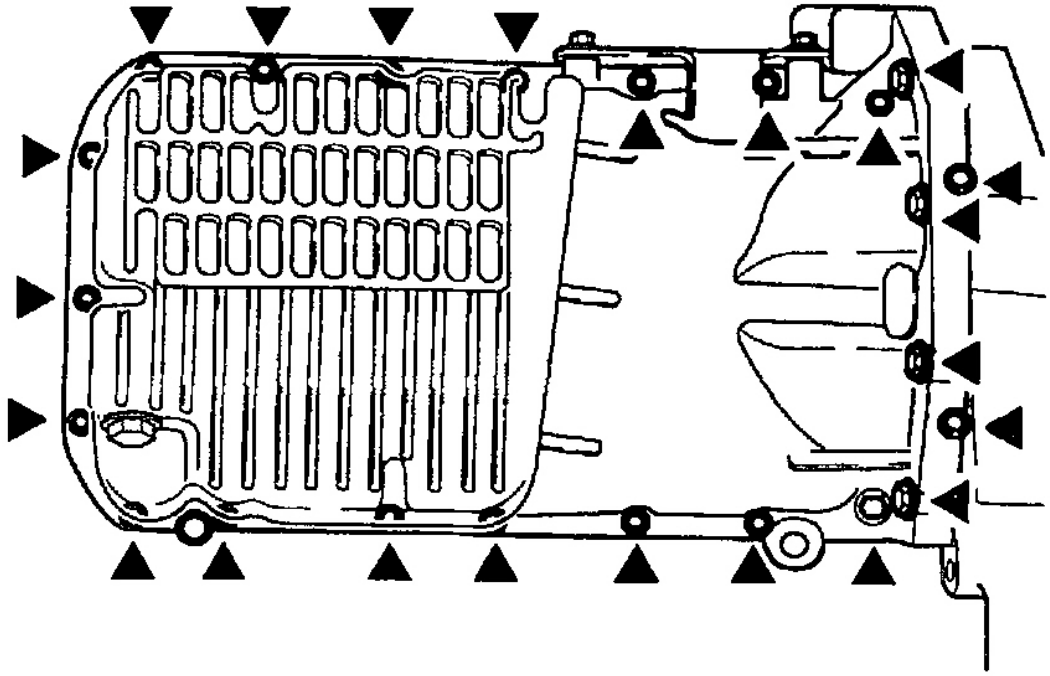


Fig. 73: Removing Flywheel
Courtesy of KIA MOTORS AMERICA, INC.

22. Remove oil pan mounting bolts.

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Fig. 74: Removing Oil Pan Mounting Bolts
Courtesy of KIA MOTORS AMERICA, INC.

23. Remove oil pan with a screwdriver or suitable tool as shown in figure. See **Fig. 75**.

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

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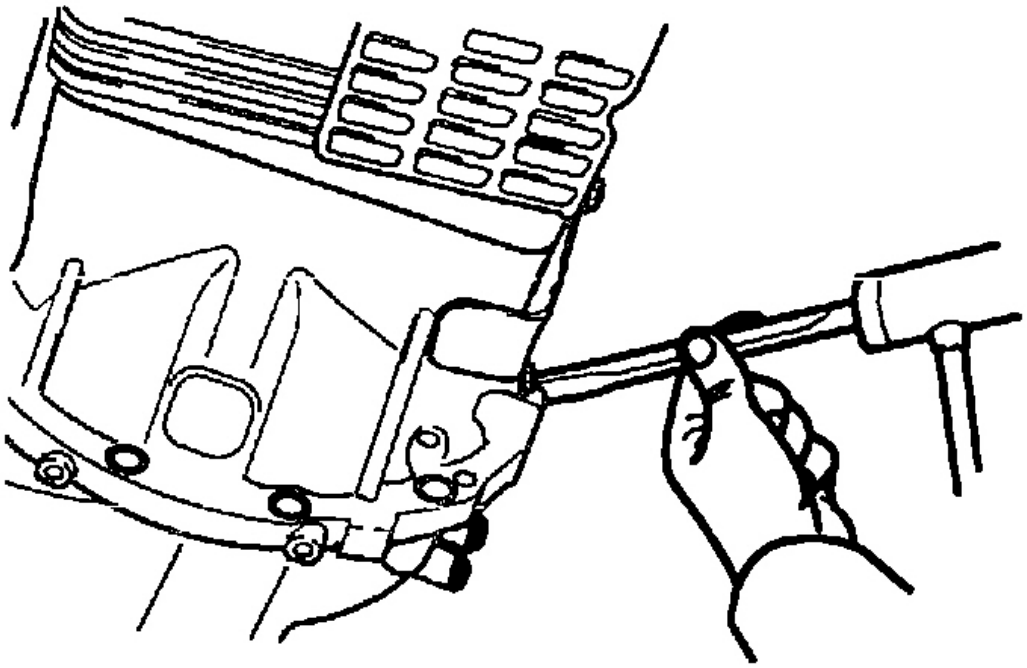
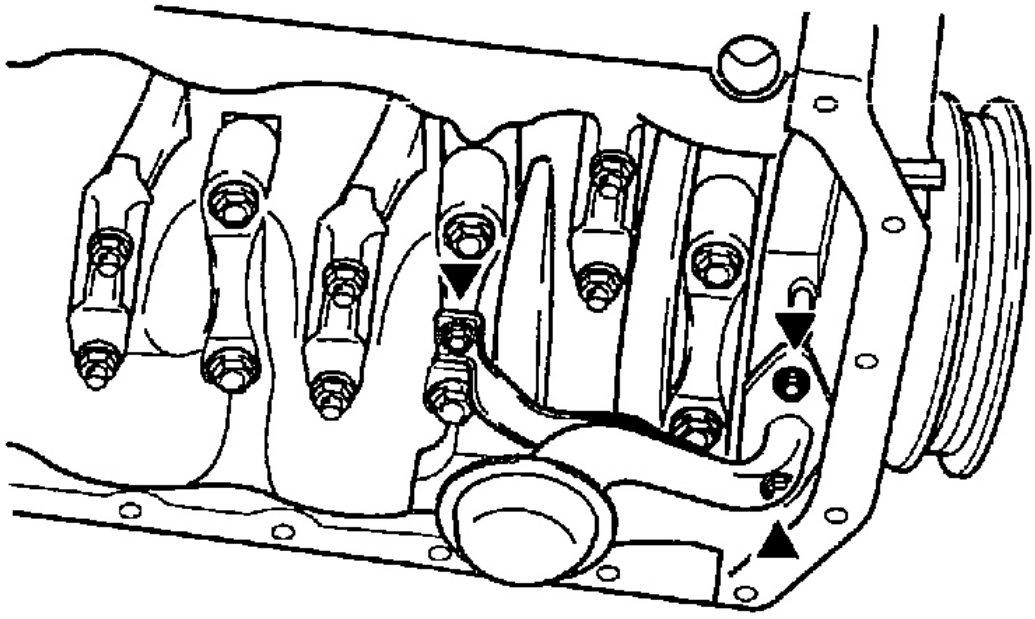


Fig. 75: Removing Oil Pan With A Screwdriver Or Suitable Tool
Courtesy of KIA MOTORS AMERICA, INC.

24. Remove oil strainer.

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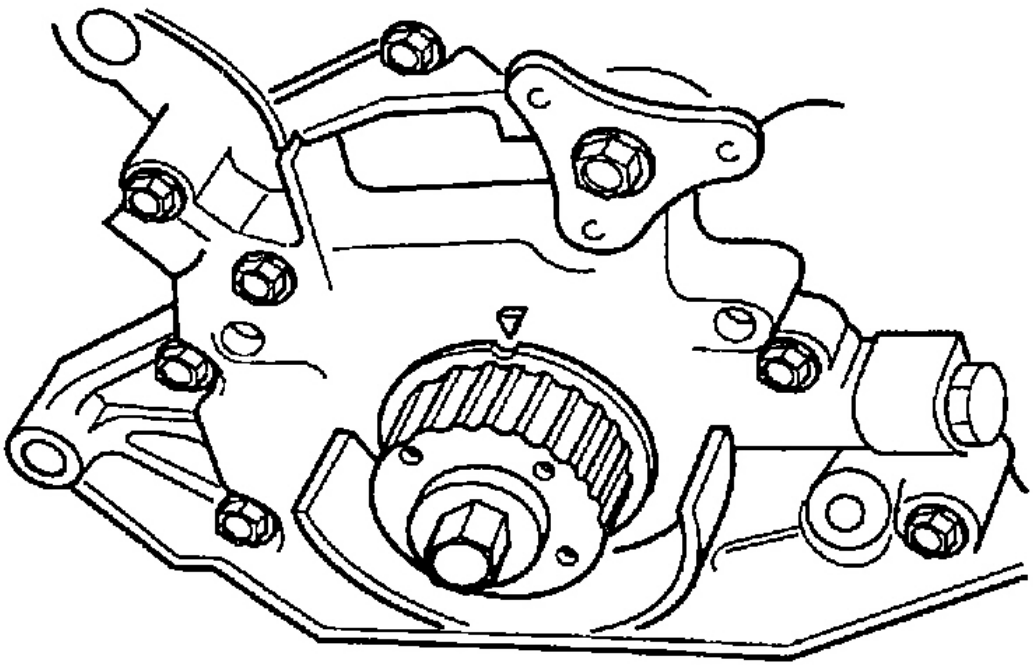


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Fig. 76: Removing Oil Strainer
Courtesy of KIA MOTORS AMERICA, INC.

25. Remove timing belt pulley.

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Fig. 77: Remove Timing Belt Pulley
Courtesy of KIA MOTORS AMERICA, INC.

26. Remove oil pump mounting bolt and oil pump.
27. Using a screwdriver covered by a rag, remove oil seal from pump cover side.

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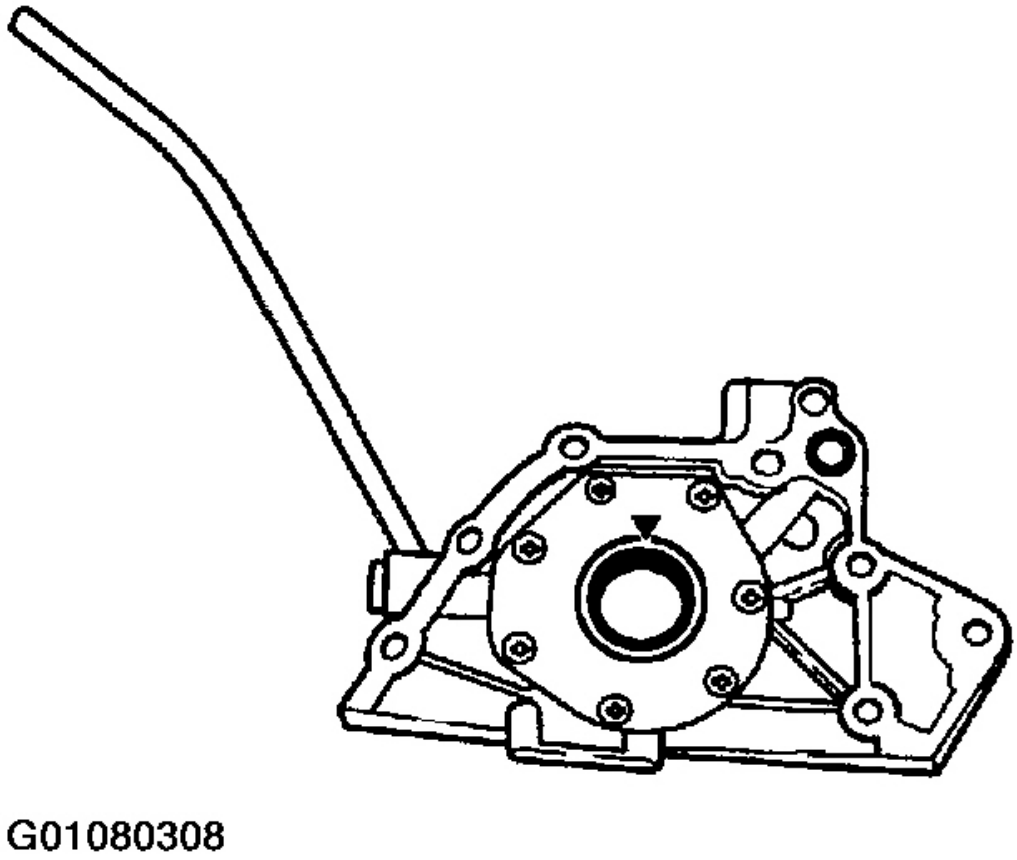
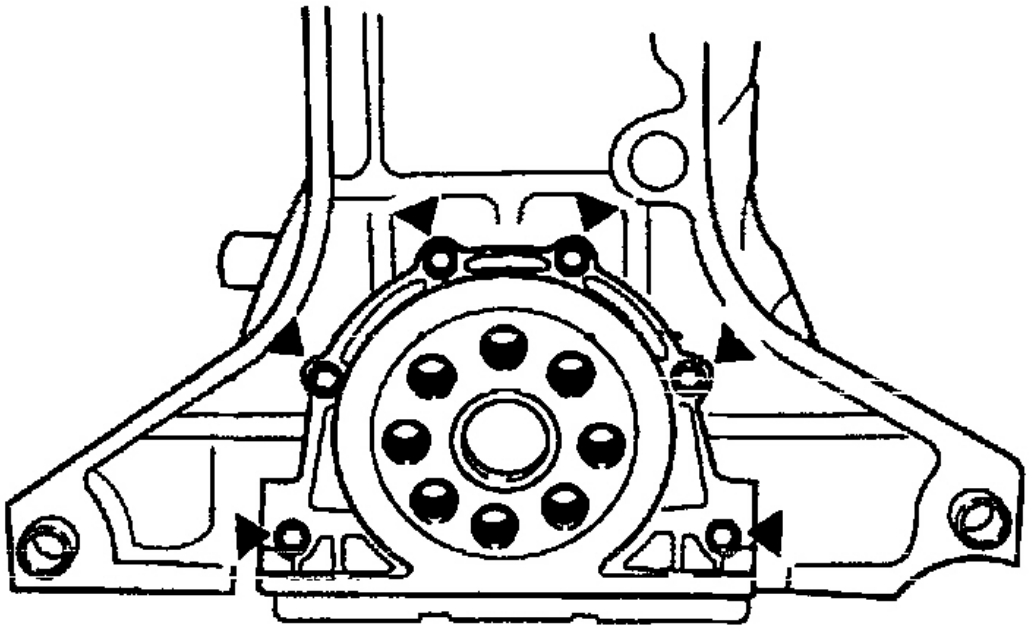


Fig. 78: Removing Oil Pump Mounting Bolt And Oil Pump
Courtesy of KIA MOTORS AMERICA, INC.

28. Remove rear cover.

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Fig. 79: Removing Rear Cover
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29. Wrap a prying tool with a shop towel and slowly pry out rear oil seal.

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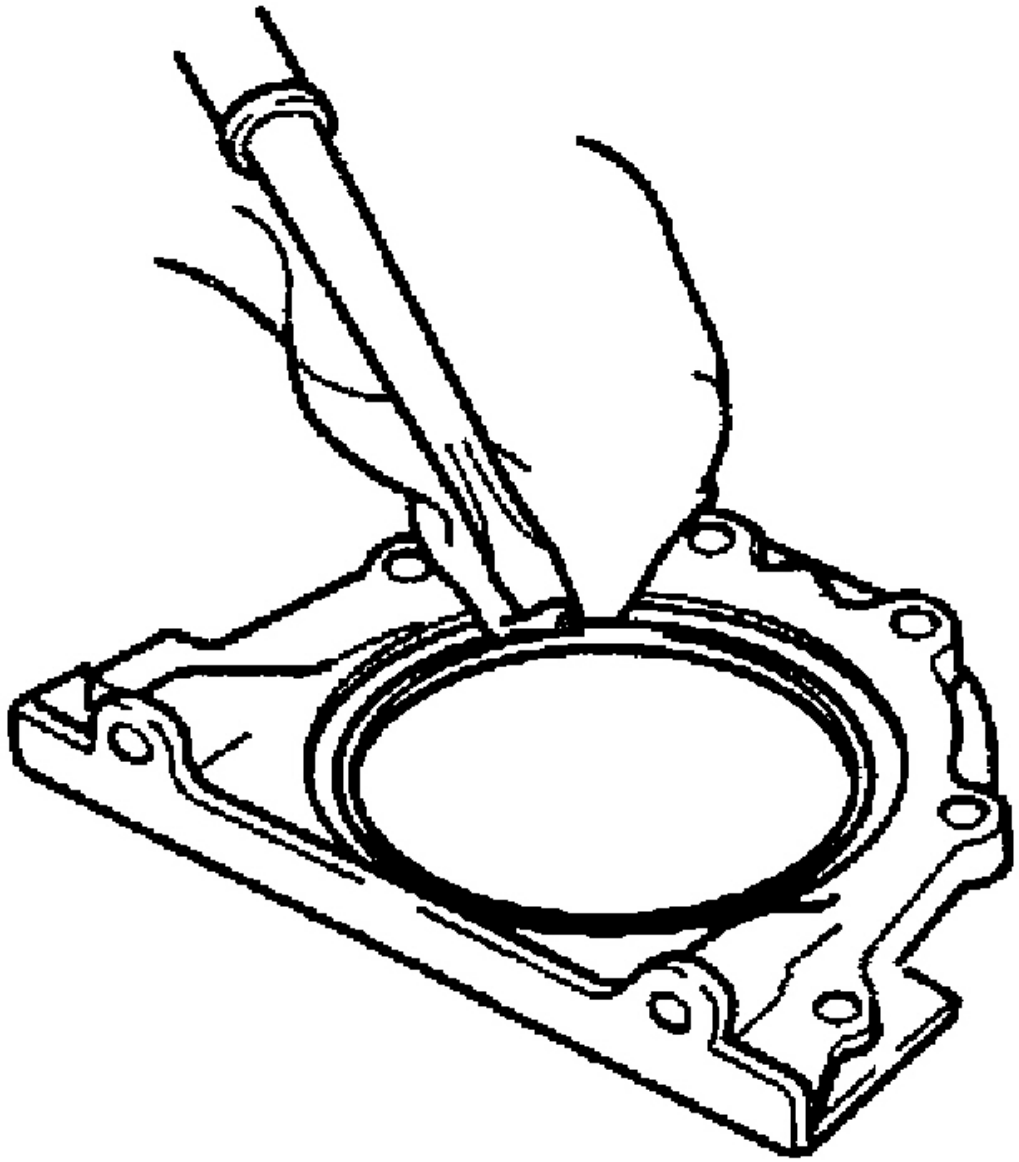
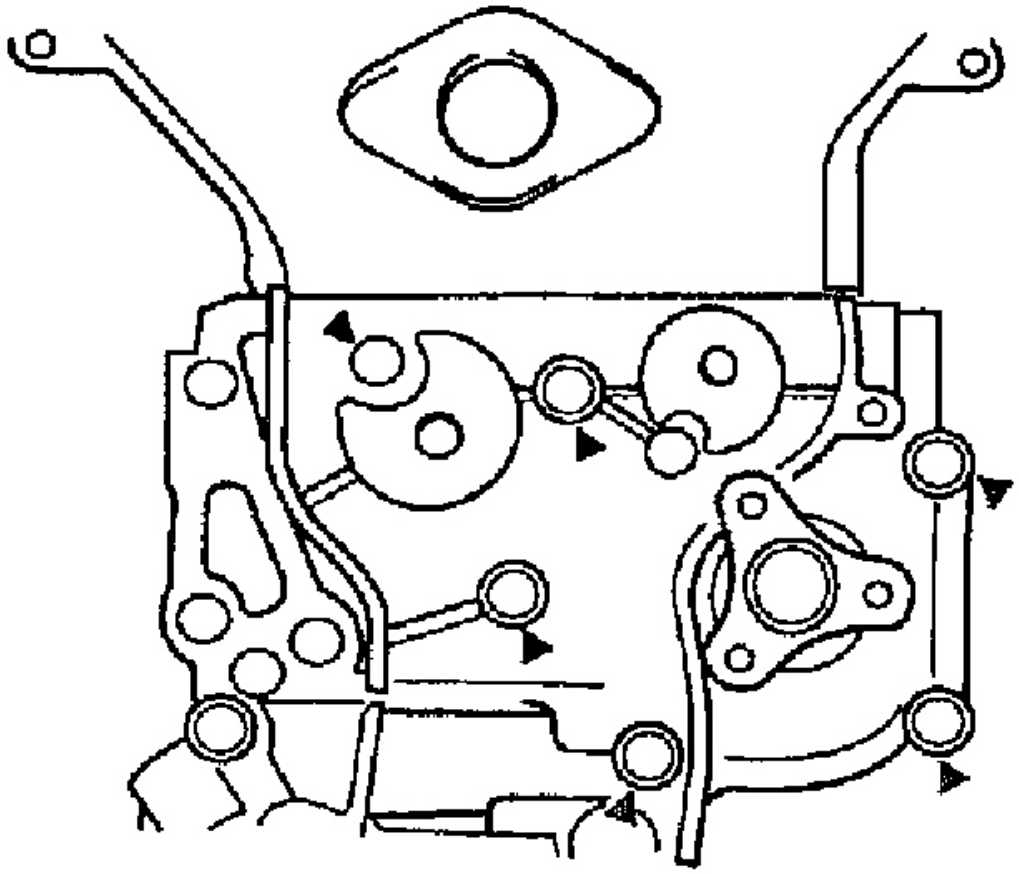


Fig. 80: Prying Out Rear Oil Seal
Courtesy of KIA MOTORS AMERICA, INC.

30. Remove water pump.

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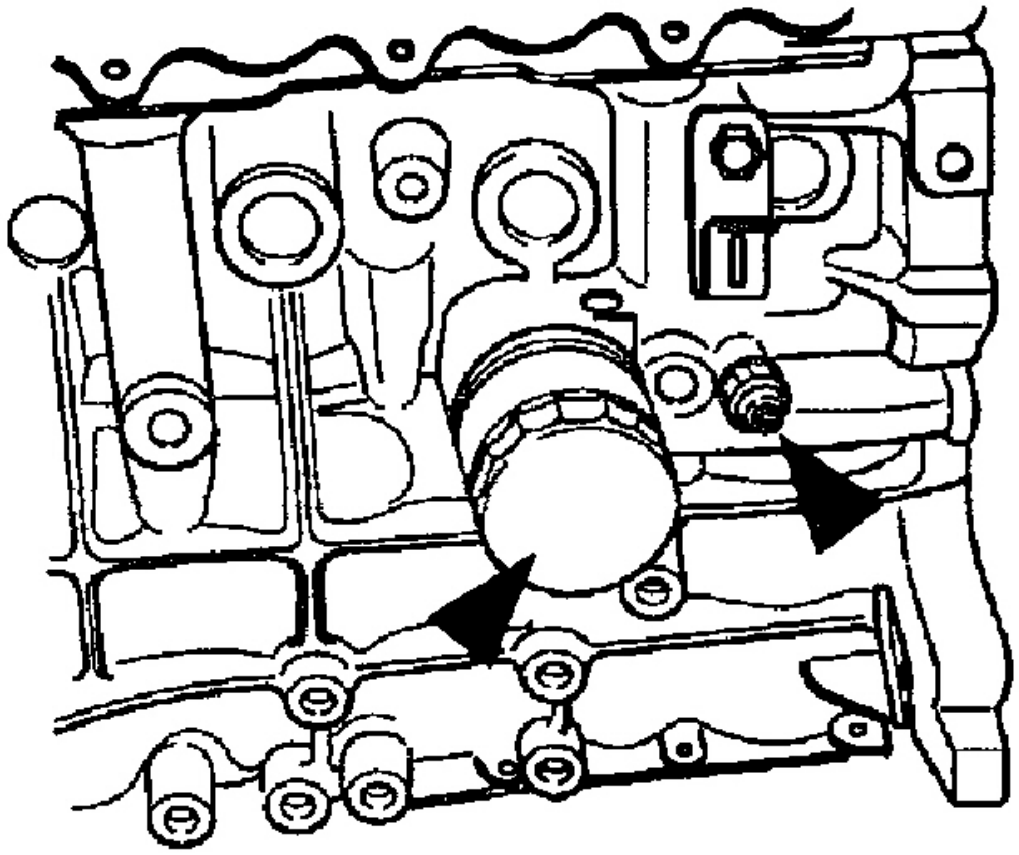


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Fig. 81: Removing Water Pump
Courtesy of KIA MOTORS AMERICA, INC.

31. Remove oil filter and oil pressure switch.

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Fig. 82: Removing Oil Filter And Oil Pressure Switch
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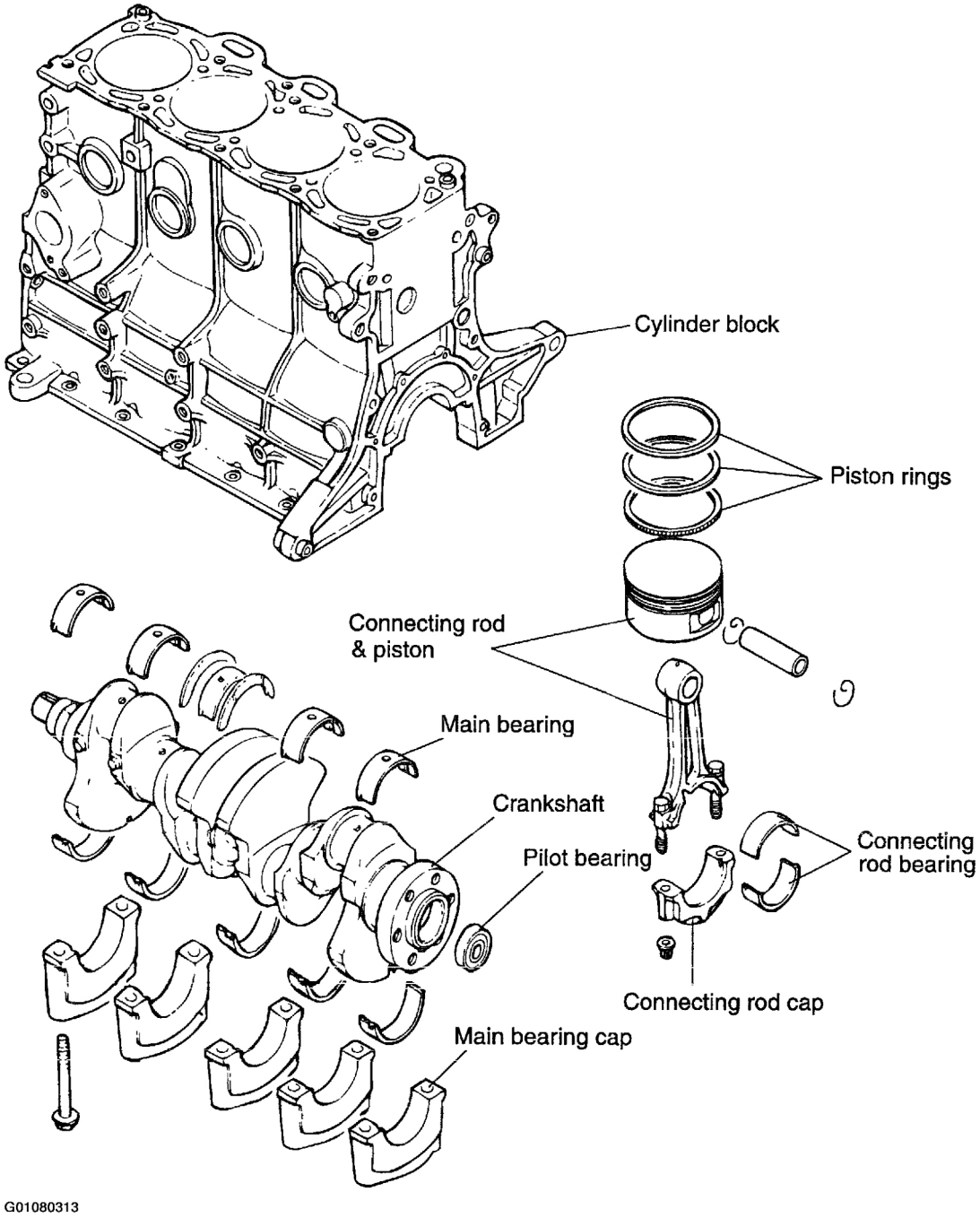


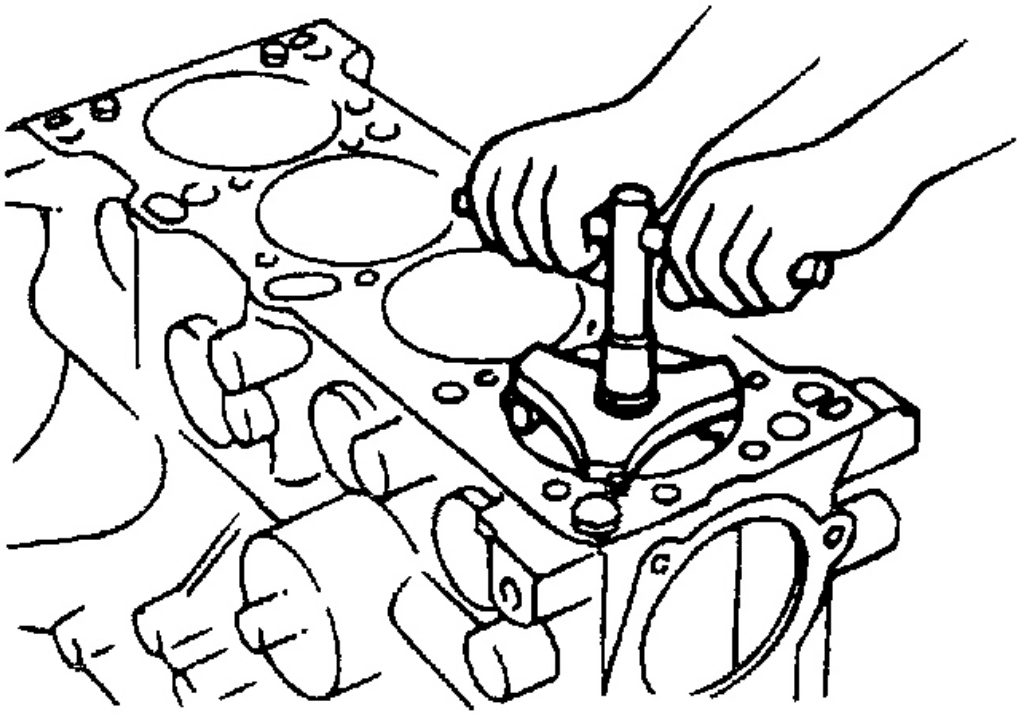
Fig. 83: Illustrating Engine Block Components
Courtesy of KIA MOTORS AMERICA, INC.

32. Check top of each cylinder for ridges.

NOTE: Failure to remove a ridge before removing piston will result in damaged ring-lands, cracked piston rings, or cracked piston.

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33. If a ridge can be felt, use a ridge reamer to remove ridge before attempting to remove piston from cylinder.



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Fig. 84: Removing Cylinder Ridge
Courtesy of KIA MOTORS AMERICA, INC.

34. Rotate engine block so that crankshaft is at Top Dead Center (TDC).
35. Rotate crankshaft so that No. 1 and No. 4 cylinders are at Bottom Dead Center (BDC).
36. Use a numbering stamp and mark rod cap and connecting rod with their corresponding cylinder number.

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

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

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39. Remove rod caps.

NOTE: Cover connecting rod bolts to protect crankshaft journals.

40. 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.
41. Repeat this procedure for each cylinder.

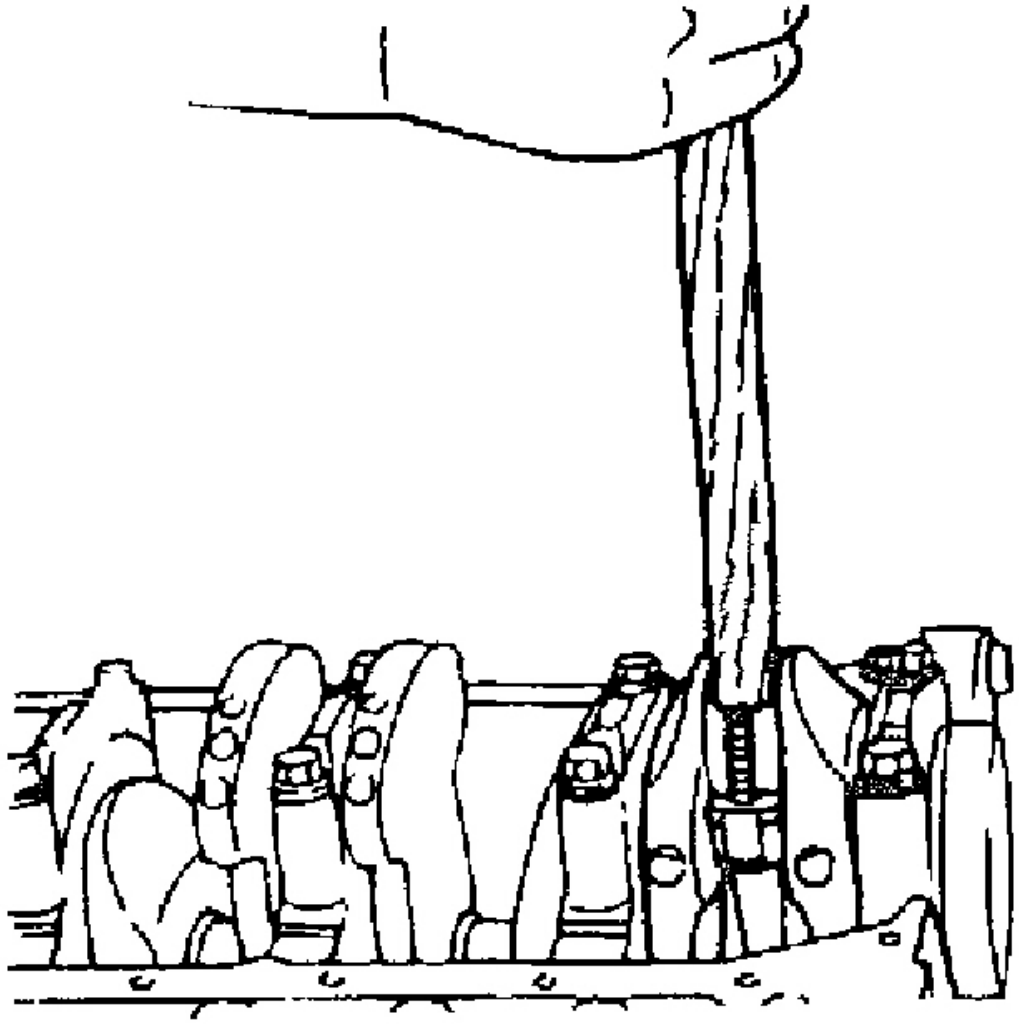
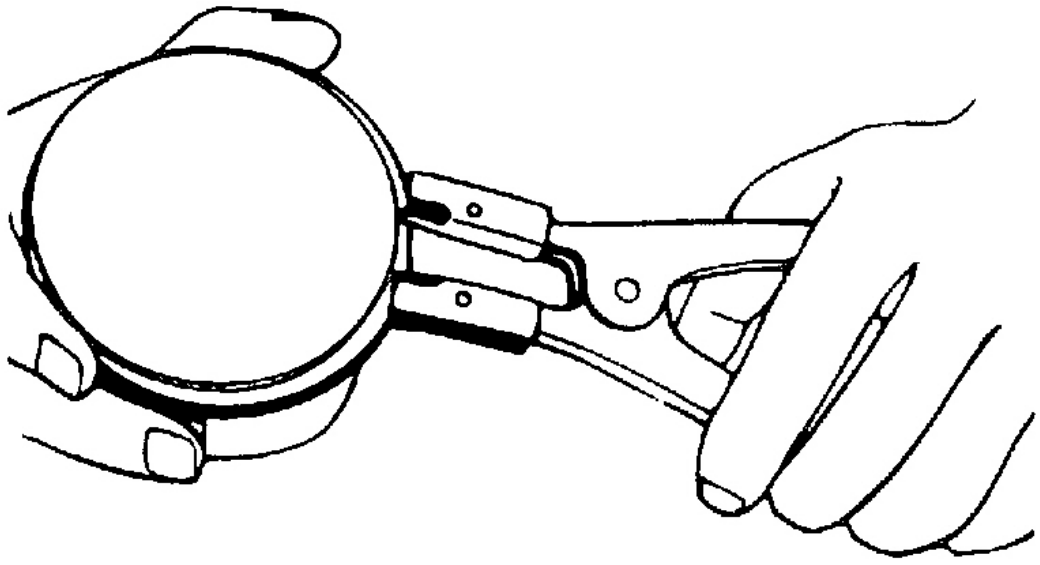


Fig. 85: Removing Piston Assemblies

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Courtesy of KIA MOTORS AMERICA, INC.

42. Mark tops of pistons with corresponding cylinder numbers they were removed from.
43. Using a piston ring expander, remove piston rings.



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Fig. 86: Removing Piston Rings
Courtesy of KIA MOTORS AMERICA, INC.

44. Hold piston upright and gently move connecting rod.
45. Release connecting rod and observe its movement.

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

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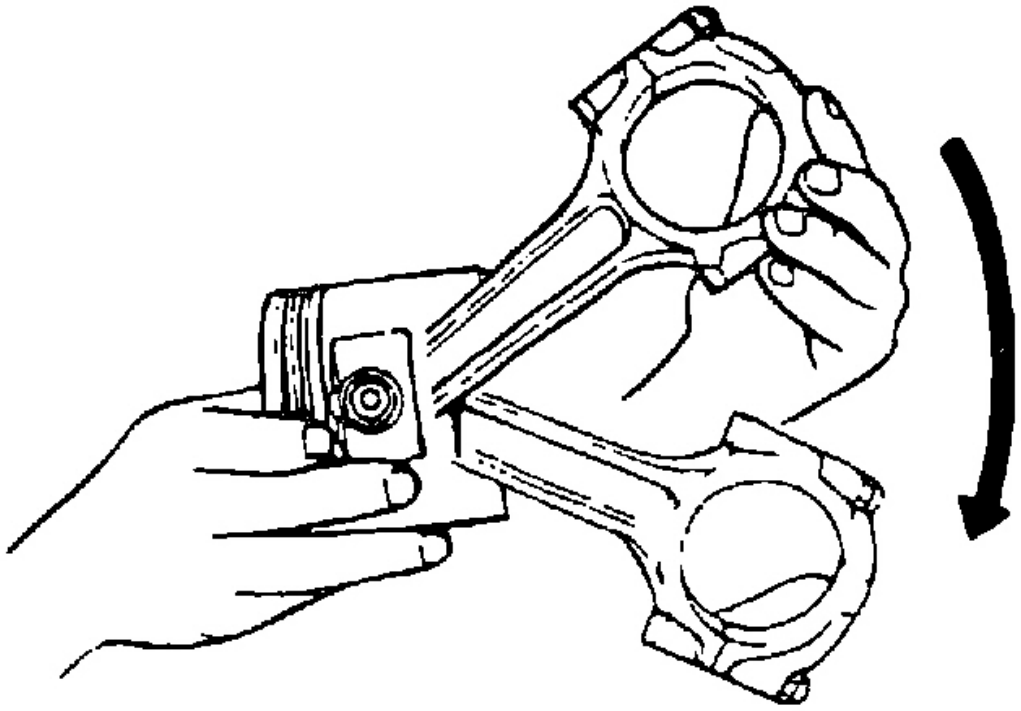


Fig. 87: Measuring Connecting Rod Movement
Courtesy of KIA MOTORS AMERICA, INC.

46. If connecting rod does not move freely, check piston pin bore and connecting rod for straightness and deformation.
47. Remove piston pin clip from ends of piston pin bore.
48. 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.

49. Remove connecting rod from piston. Keep individual piston, piston pin, and piston pin clips together for reassembly.

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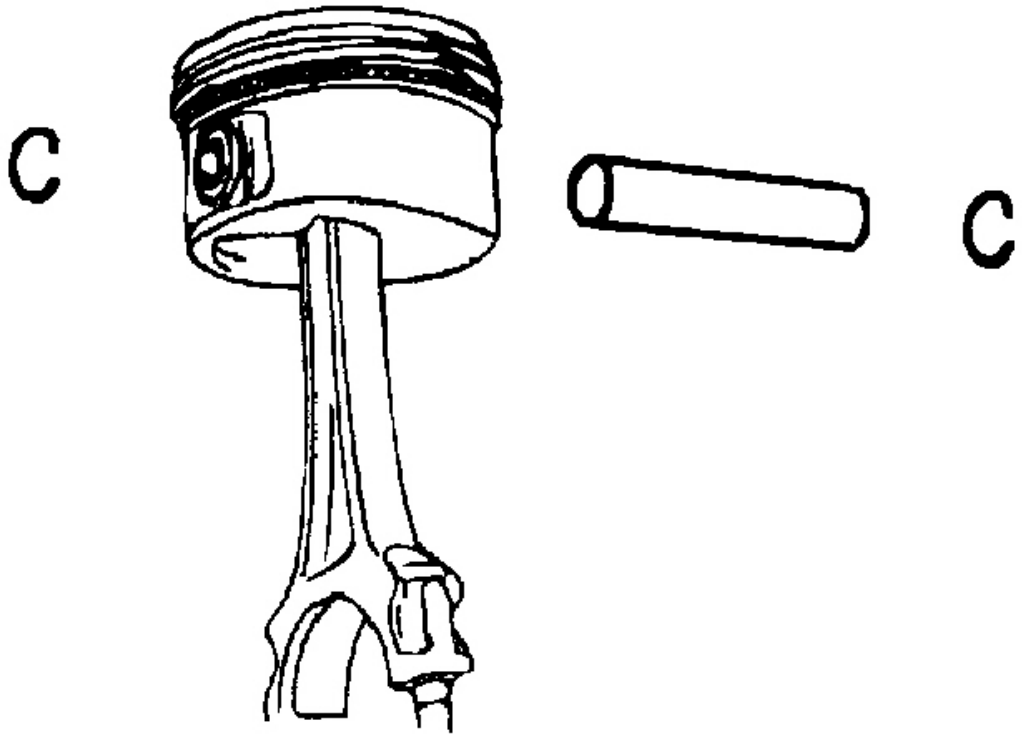


Fig. 88: Removing Connecting Rod From Piston
Courtesy of KIA MOTORS AMERICA, INC.

50. Mark main bearing caps (front to back) including direction.

NOTE: Each main bearing cap is matched to that particular journal. Installing a cap on wrong journal will cause an align bore problem that will require an expensive machine process to correct.

51. Loosen main bearing caps in two or three steps following order shown in figure.

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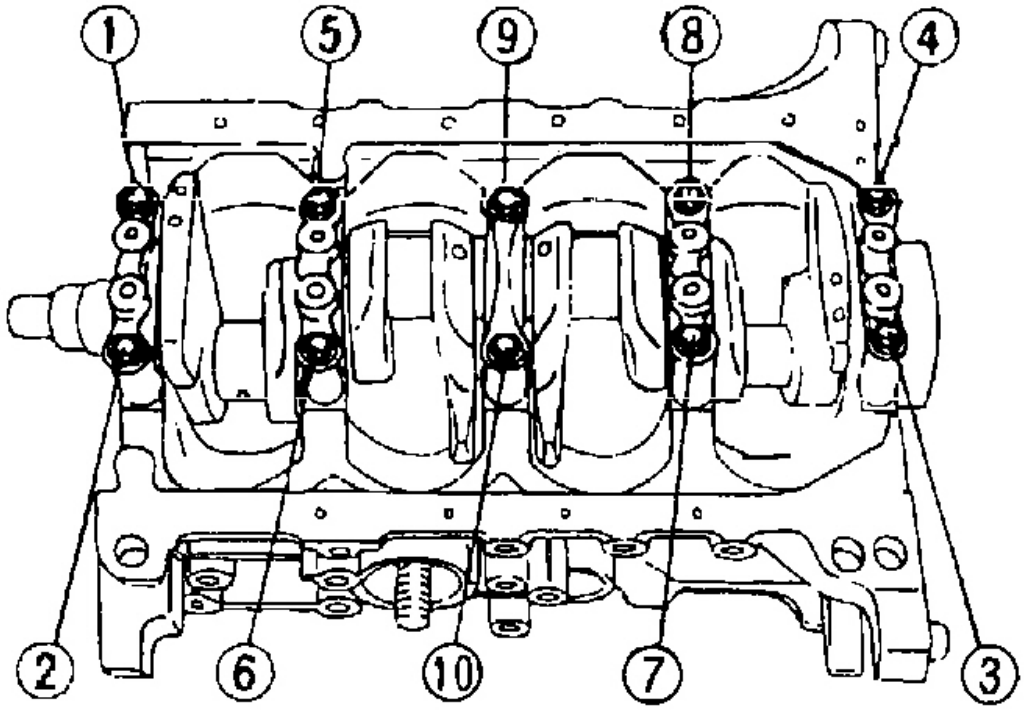


Fig. 89: Main Bearing Cap Bolt Loosening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

52. Remove main bearing caps.
53. Grasp crankshaft and lift straight out.
54. Remove main bearings and thrust bearings from cylinder block saddles.

INSPECTION

CYLINDER BLOCK

1. Check cylinder block for following conditions and repair or replace cylinder block as needed.
    a. Leakage damage
    b. Cracks
    c. Scoring of cylinders
2. Check distortion of cylinder head mating surface (block deck) in six directions shown in figure. See **Fig. 91**.

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Distortion: 0.006 in (0.15 mm) maximum

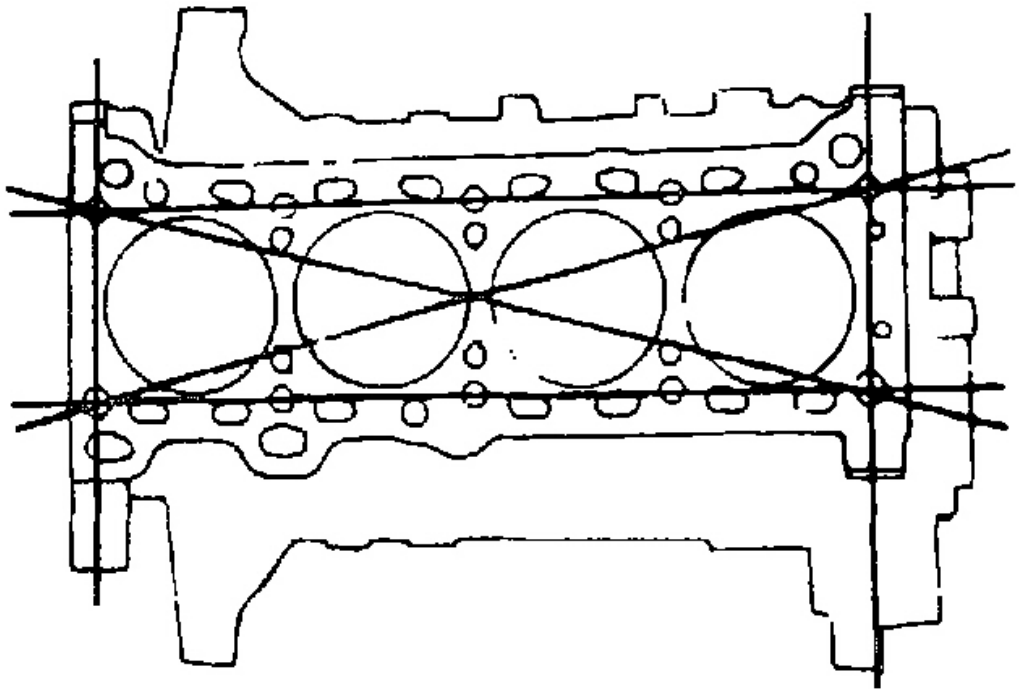


Fig. 90: Checking Distortion Of Cylinder Head Mating Surface
Courtesy of KIA MOTORS AMERICA, INC.

3. Repair block deck by surface grinding block, or in extreme cases replace cylinder block.

   Maximum resurface amount: 0.008 in (0.20 mm)

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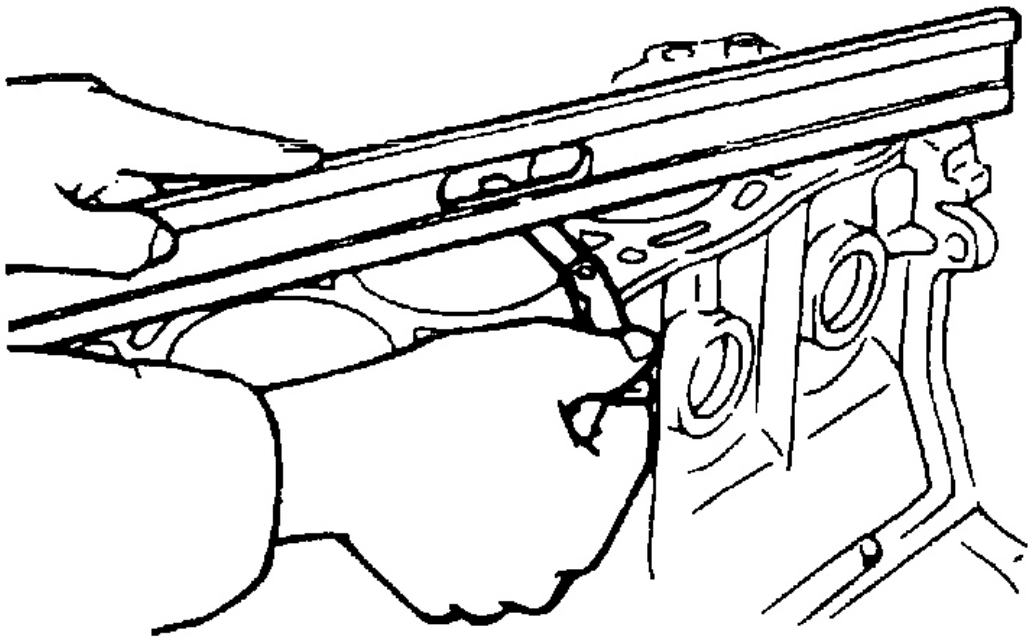


Fig. 91: Measuring Cylinder Block Distortion
Courtesy of KIA MOTORS AMERICA, INC.

4. If deck is at or below this specification, replace cylinder block.

NOTE: Before surfacing cylinder block, check deck height from center line of crankshaft to deck surface.

5. Measure cylinder bore with a dial bore gauge at X and Y vectors shown in figure. See **Fig. 92**.

Cylinder bore size

Standard: 3.1892~3.1897 in (81.006~81.019 mm)
Bore + 0.010 in (0.25 mm): 3.1990~3.1996 in (81.256~81.269 mm):
Bore + 0.020 in. (0.50 mm): 3.2089~3.2094 in (81.506~81.519 mm)

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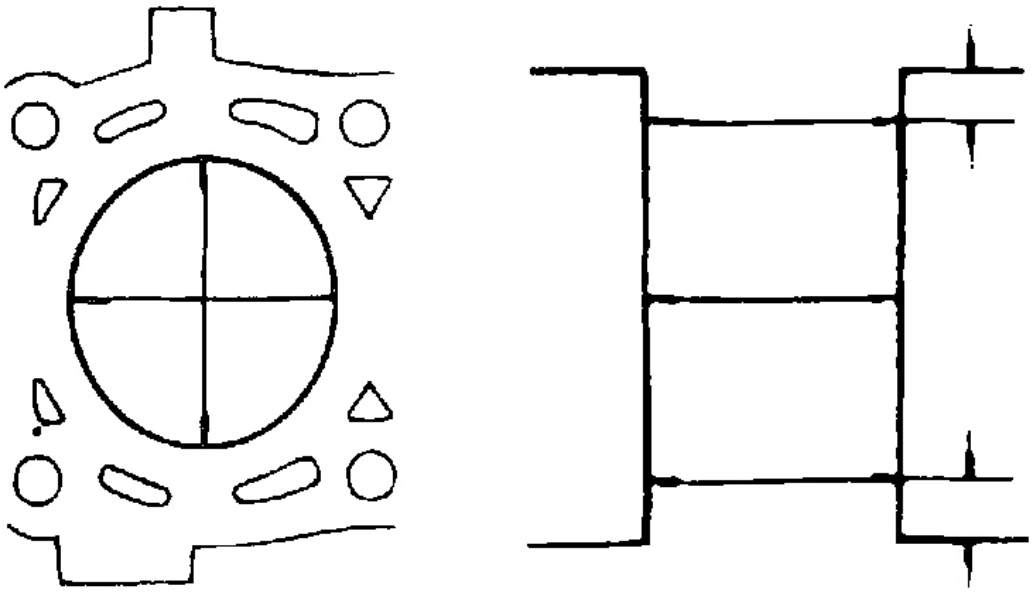


Fig. 92: Measuring Cylinder Bore With A Dial Bore Gauge
Courtesy of KIA MOTORS AMERICA, INC.

6. Take cylinder measurements at top, center and bottom of cylinder to check for cylinder diameter, taper and out-of-round.

   Taper: 0.0007 in (0.019 mm)

   Maximum Out-of-round: 0.0007 in (0.019 mm) Maximum

NOTE: Boring cylinders should be based on maximum oversized piston that can be installed without exceeding maximum overbore.

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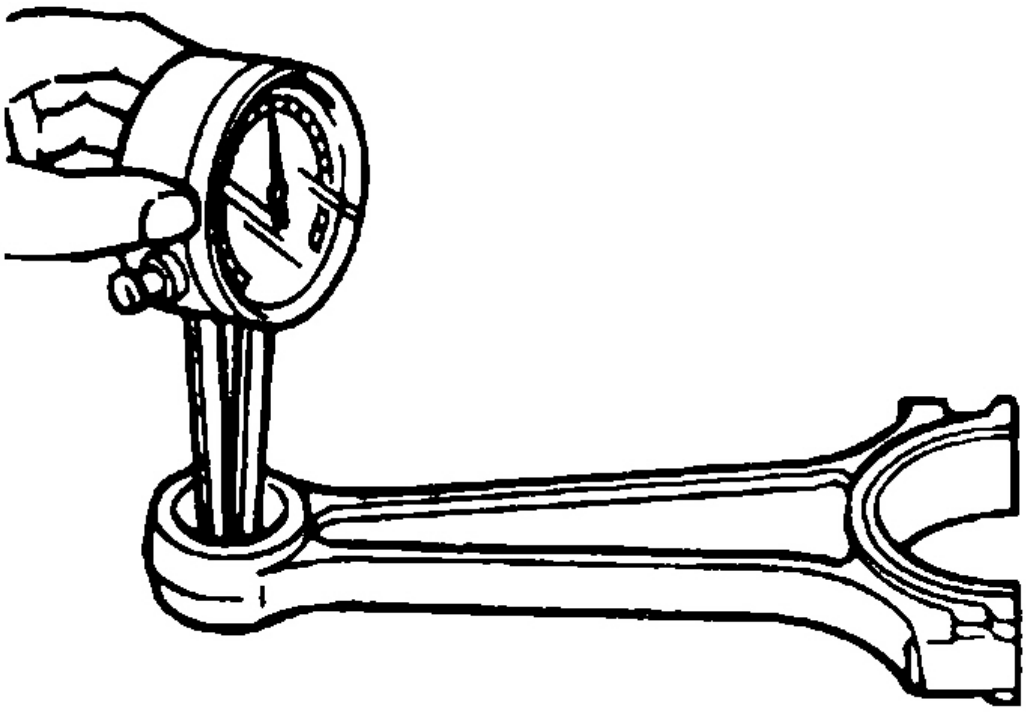
Fig. 93: Measuring Cylinder Bore Taper
Courtesy of KIA MOTORS AMERICA, INC.

CONNECTING ROD

1. Check connecting rod bushing inside diameter.

   Inside diameter: 0.9055~0.9063 in (23.0~23.021 mm)

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Fig. 94: Measuring Connecting Rod Bushing Inside Diameter
Courtesy of KIA MOTORS AMERICA, INC.

2. Subtract piston pin diameter from connecting rod bushing inside diameter to determine piston pin fit.

   Clearance: 0.0004~0.0010 in (0.010~0.027 mm)

3. If clearance is not within specification, replace connecting rod bushing.
4. Check each connecting rod for bending.

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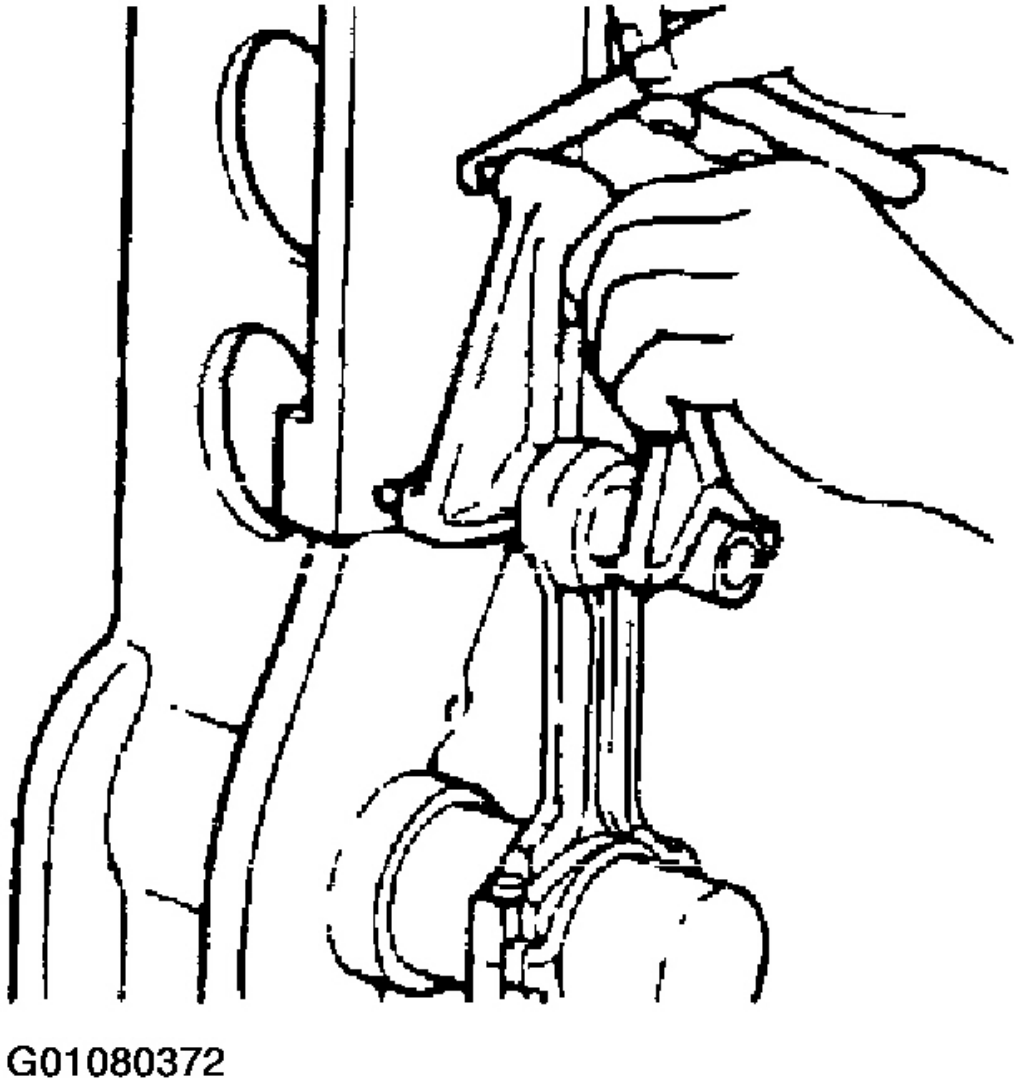


Fig. 95: Checking Connecting Rod Straightness
Courtesy of KIA MOTORS AMERICA, INC.

5. Replace connecting rods if necessary.

NOTE: Connecting rods must always be replaced as an assembly. Rod cap, rod, bolts and nuts are a matched set.

MAIN BEARING AND CONNECTING ROD BEARINGS

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

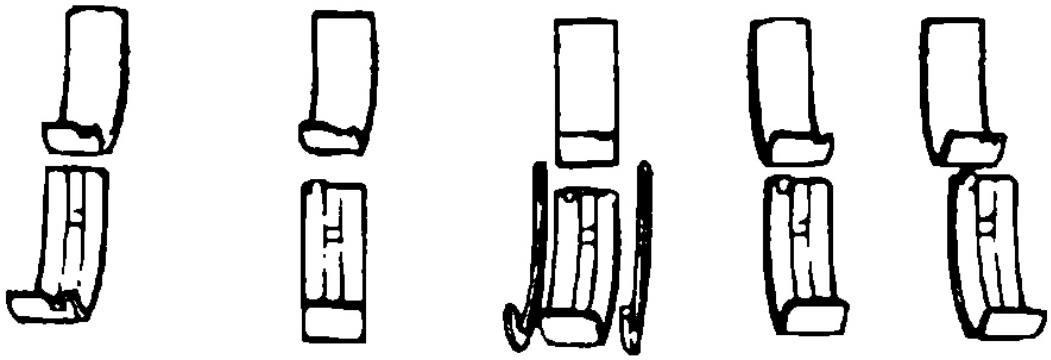


Fig. 96: Checking Main And Connecting Rod Bearings For Damage
Courtesy of KIA MOTORS AMERICA, INC.

CRANKSHAFT

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.

   Run-out:: 0.00098 in (0.025 mm)

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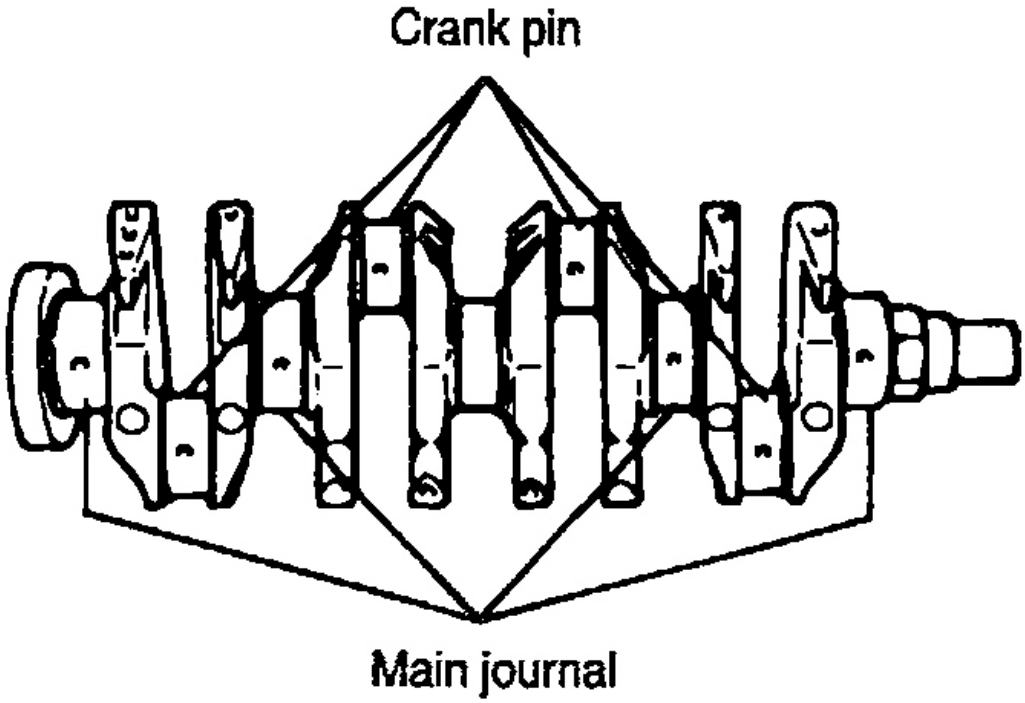


Fig. 97: Measuring Crankshaft Run-Out
Courtesy of KIA MOTORS AMERICA, INC.

5. Use a micrometer to measure crankshaft main bearing journals and crank pin journals at X and Y direction as shown in figure.

CRANKSHAFT JOURNAL DIAMETER:

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Journal	Diameter	Out of round
Main	2.1629~2.1636 in (54.938~54.956 mm)	0.0020 in (0.05 mm) Maximum
Crank pin	1.7693~1.77 in (44.940~44.958 mm)	0.0020 in (0.05 mm) Maximum

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Fig. 98: Crankshaft Journal Diameter Chart
Courtesy of KIA MOTORS AMERICA, INC.

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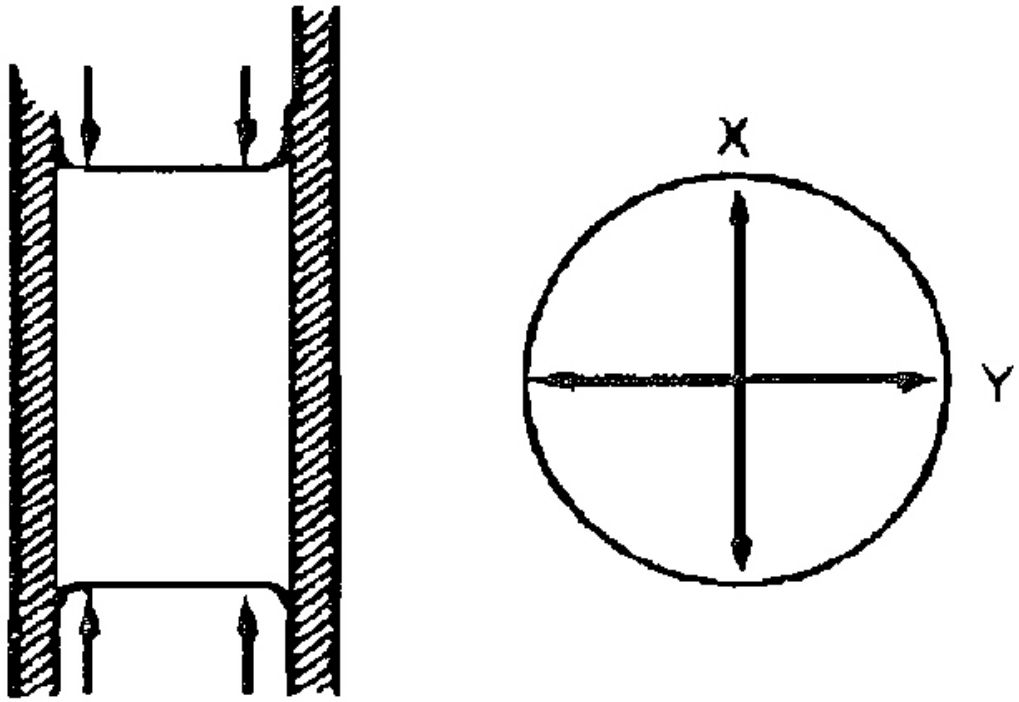


Fig. 99: Measuring Crankshaft Journal Diameter
Courtesy of KIA MOTORS AMERICA, INC.

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

MAIN JOURNAL DIAMETER UNDERSIZES:

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Bearing size	Journal diameter
0.010 in (0.25 mm) undersize	1.779~1.780 in (45.190~45.208 mm)
0.020 in (0.50 mm) undersize	1.7889~1.7897 in (45.440~45.458 mm)
0.030 in (0.75 mm) undersize	1.7988~1.7995 in (45.690~45.708 mm)

G01080377

Fig. 100: Main Journal Diameter Undersize Chart
Courtesy of KIA MOTORS AMERICA, INC.

CRANK PIN JOURNAL DIAMETER UNDERSIZES:

Bearing size	Journal diameter
0.010 in (0.25 mm) undersize	2.1728~2.1735 in (55.188~55.206 mm)
0.020 in (0.50 mm) undersize	2.1826~2.1833 in (55.438~55.456 mm)
0.030 in (0.75 mm) undersize	2.1924~2.1931 in (55.688~55.706 mm)

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Fig. 101: Crank Pin Journal Diameter Undersize Chart
Courtesy of KIA MOTORS AMERICA, INC.

PISTON ASSEMBLIES

PISTON COOLING JETS

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1. Apply compressed air to each piston cooling jet valve at (A) and verify that air passes through piston cooling jet valve at (B). If air does not pass, replace piston cooling jet valve.

   Air pressure: 35.6~44.1 psi (245.3~304.1 kpa, 3.1~2.5 kg/cm^2) maximum

2. Check piston cooling jet nozzle for clogs. Replace nozzle if necessary.

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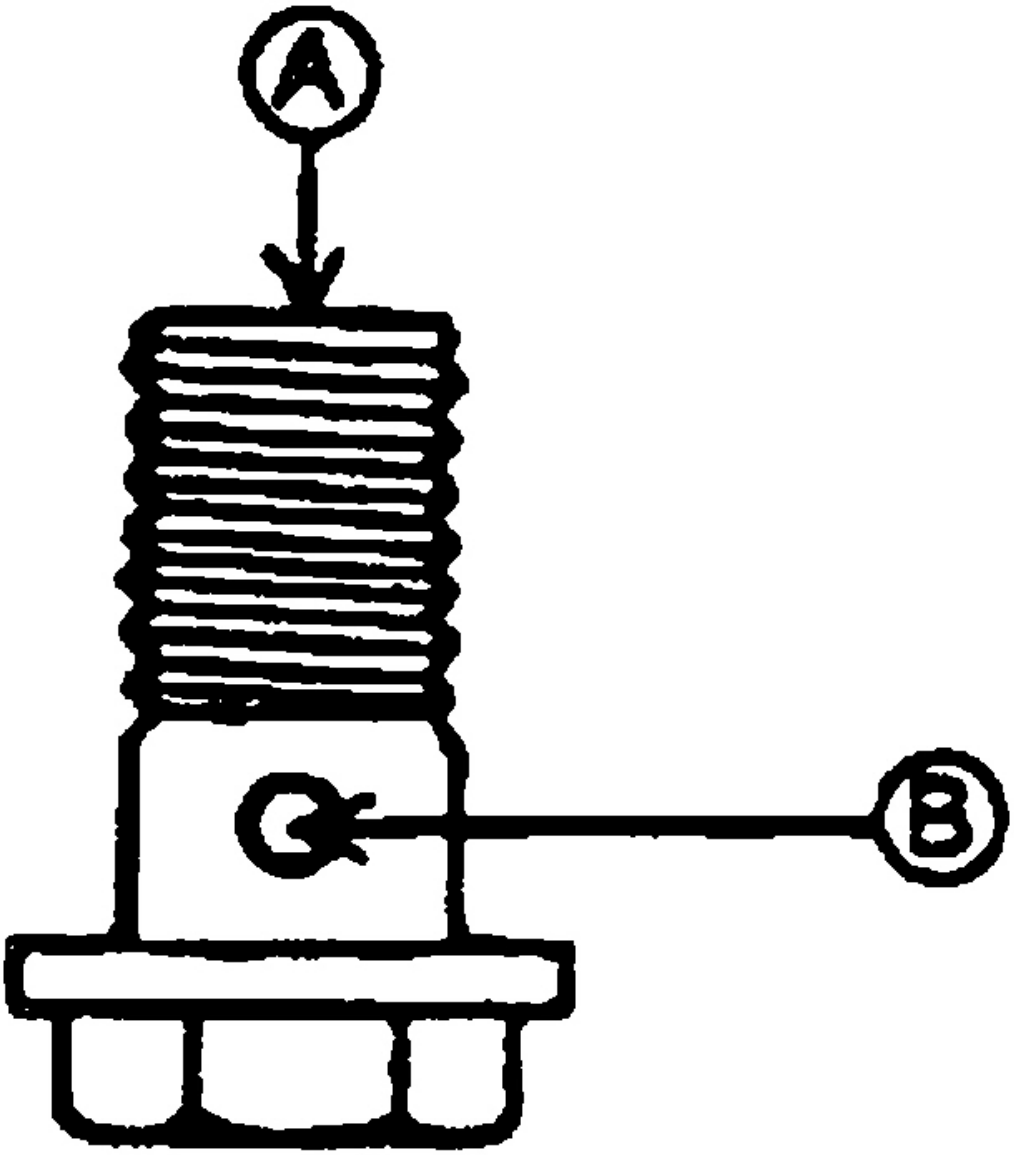


Fig. 102: Checking Piston Cooling Jet Nozzle For Clogs
Courtesy of KIA MOTORS AMERICA, INC.

PISTON

NOTE: Replacing a piston also requires replacing piston rings.

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1. Check circumference of piston for damage, scoring, or unusual wear patterns. Replace piston as needed.

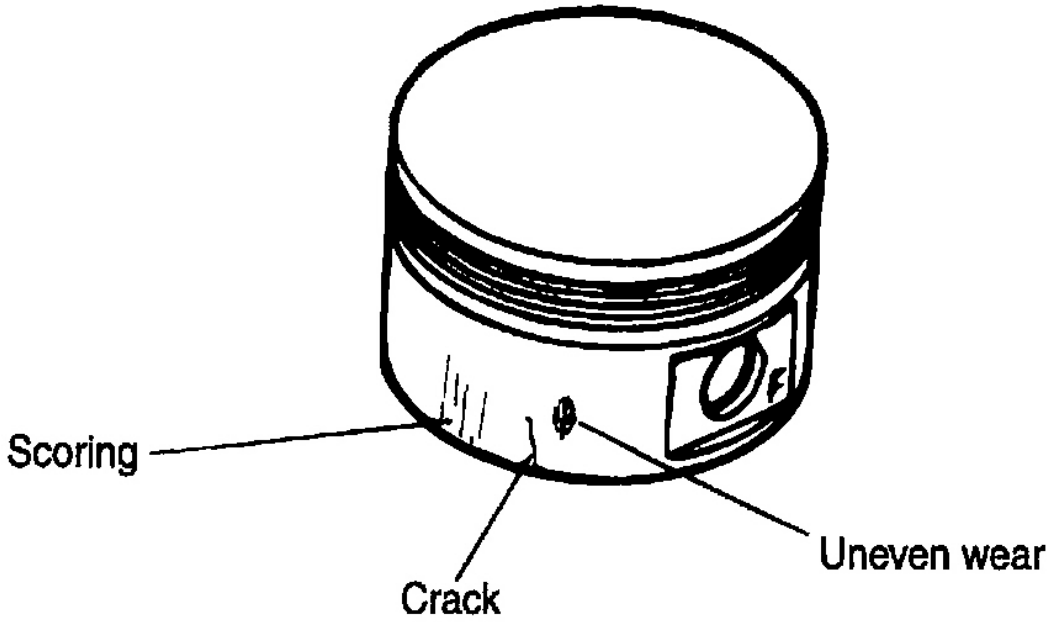


Fig. 103: Checking Circumference Of Piston For Damage, Scoring, Or Unusual Wear Patterns
Courtesy of KIA MOTORS AMERICA, INC.

2. Check outside diameter of each piston at a 90° right angle to piston pin, 0.650 in. (16.5 mm) below oil ring land's lower edge.

PISTON DIAMETER:

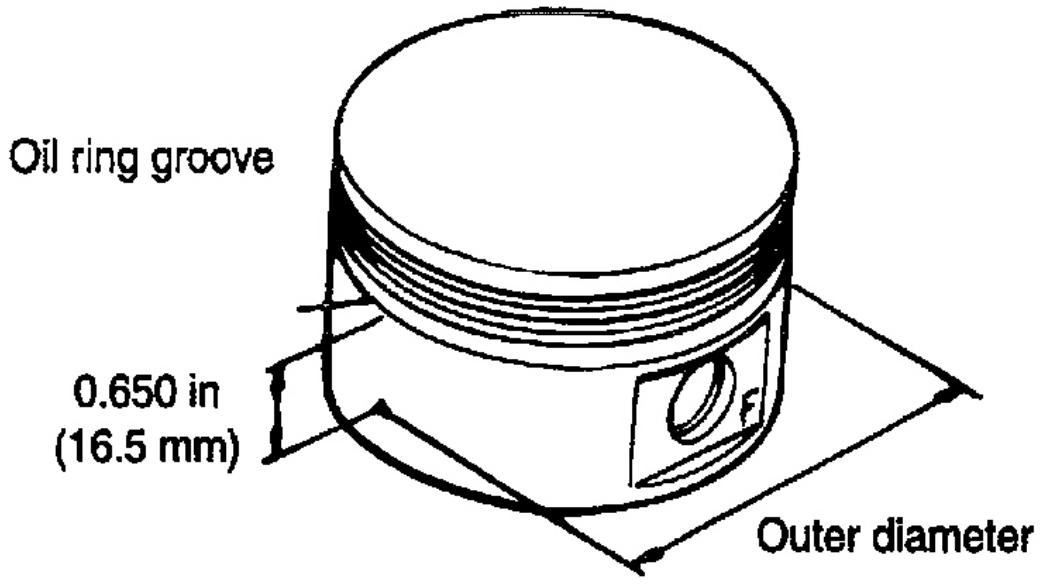
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Standard	3.1872-3.1879 in (80.954-80.9720 mm)
Standard + 0.010 in (0.25 mm)	3.197-3.1977 in (81.204-81.222 mm)
Standard + 0.020 in (0.50 mm)	3.2069-3.2076 in (81.454-81.472 mm)

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Fig. 104: Piston Diameter Chart
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: If piston is collapsed or bell mouthed, replace piston.



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Fig. 105: Measuring Piston Diameter
Courtesy of KIA MOTORS AMERICA, INC.

3. Check piston-to-cylinder wall clearance by subtracting piston diameter from the largest cylinder wall diameter, at each cylinder.

   Clearance: 0.0015~0.0021 in (0.039~0.053 mm)

   Maximum: 0.006 in (0.15 mm)
4. If clearance exceeds maximum, replace piston or rebore cylinders and fit oversized pistons to all cylinders.

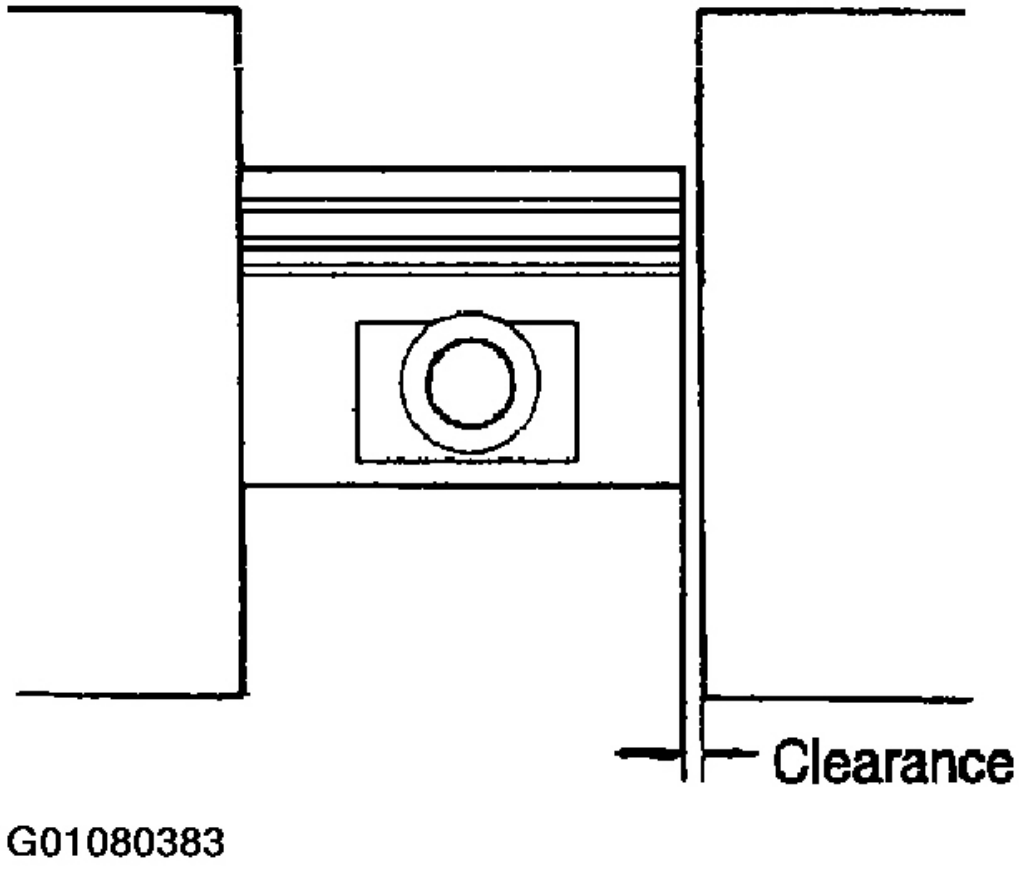


Fig. 106: Measuring Piston-To-Cylinder Wall Clearance
Courtesy of KIA MOTORS AMERICA, INC.

PISTON RINGS

1. Insert a new piston ring into a piston ring groove and check piston ring-to-side clearance.

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Ring	Standard clearance	Maximum clearance
Top	0.002-0.003 in (0.04-0.08 mm)	0.006 in (0.15 mm)
Second	0.001-0.003 in (0.03-0.07 mm)	0.006 in (0.15 mm)

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Fig. 107: Piston Ring-To-Side Clearance Chart
Courtesy of KIA MOTORS AMERICA, INC.

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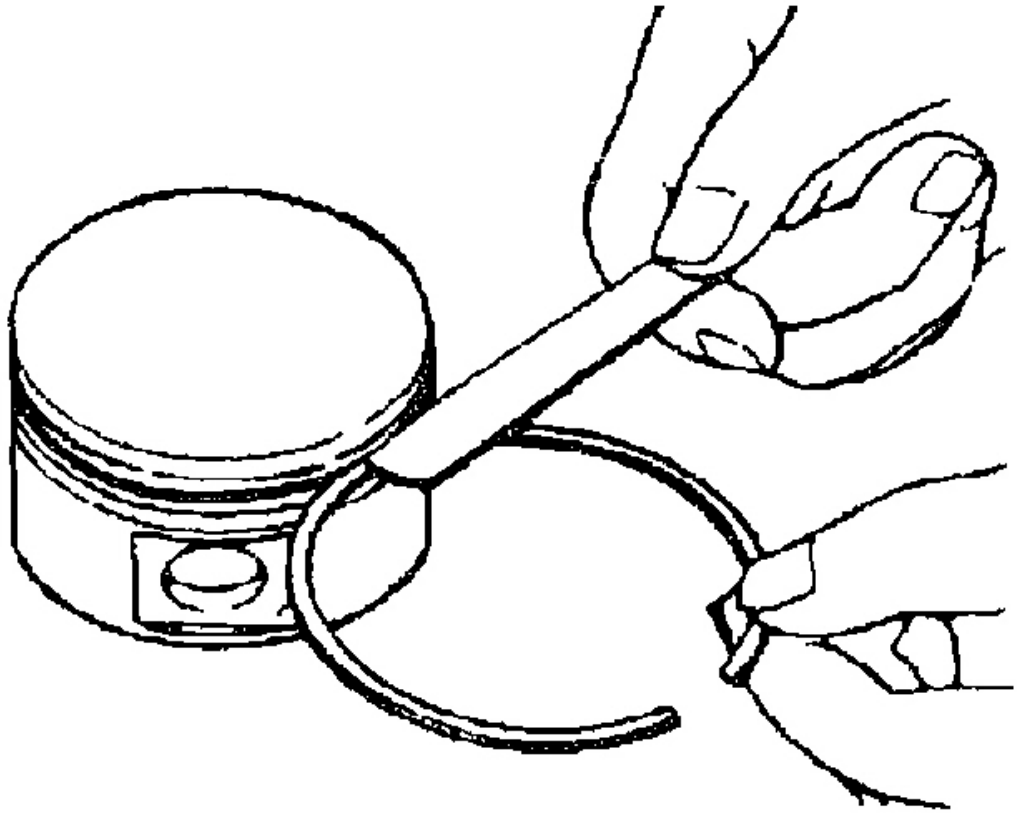


Fig. 108: Measuring Piston Ring-To-Side Clearance
Courtesy of KIA MOTORS AMERICA, INC.

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.

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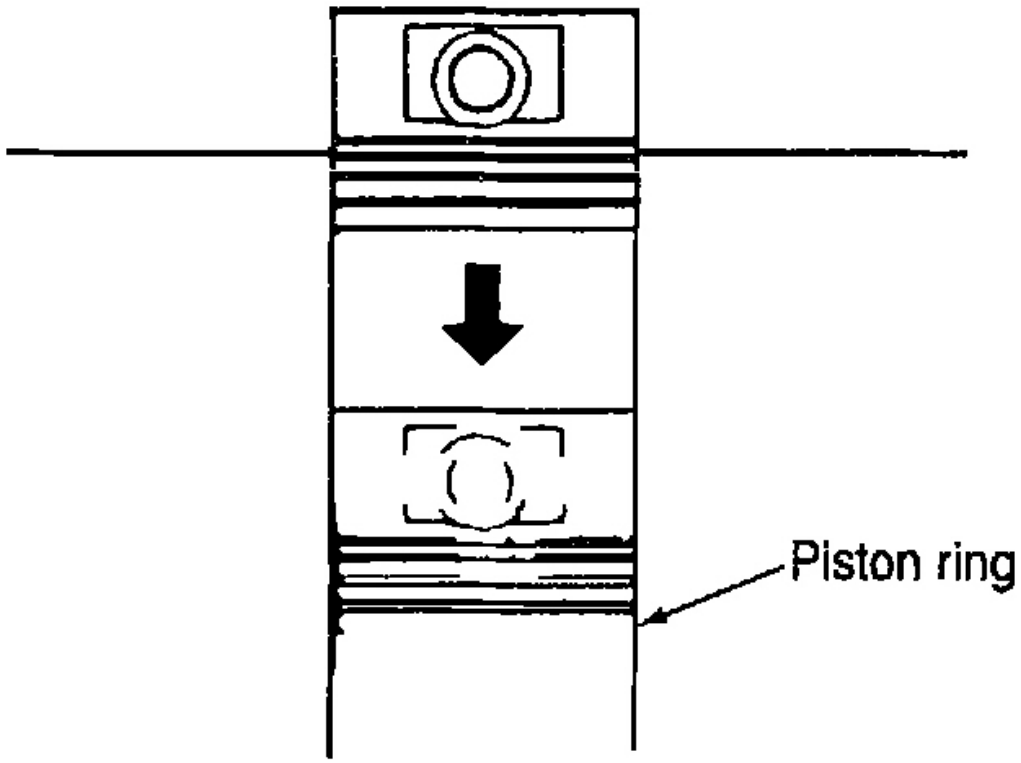


Fig. 109: Squaring Piston Ring In Cylinder
Courtesy of KIA MOTORS AMERICA, INC.

7. Place a feeler gauge in end gap and check end gap clearance.

   END GAP CLEARANCE:

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Ring	Specification
Top ring	0.006~0.011 in (0.15~0.30 mm)
Second ring	0.012~0.018 in (0.30~0.45 mm)
Oil rail	0.008~0.027 in (0.20~0.70 mm)
Maximum	0.039 in (1.0 mm)

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Fig. 110: Piston Ring End Gap Clearance Chart
Courtesy of KIA MOTORS AMERICA, INC.

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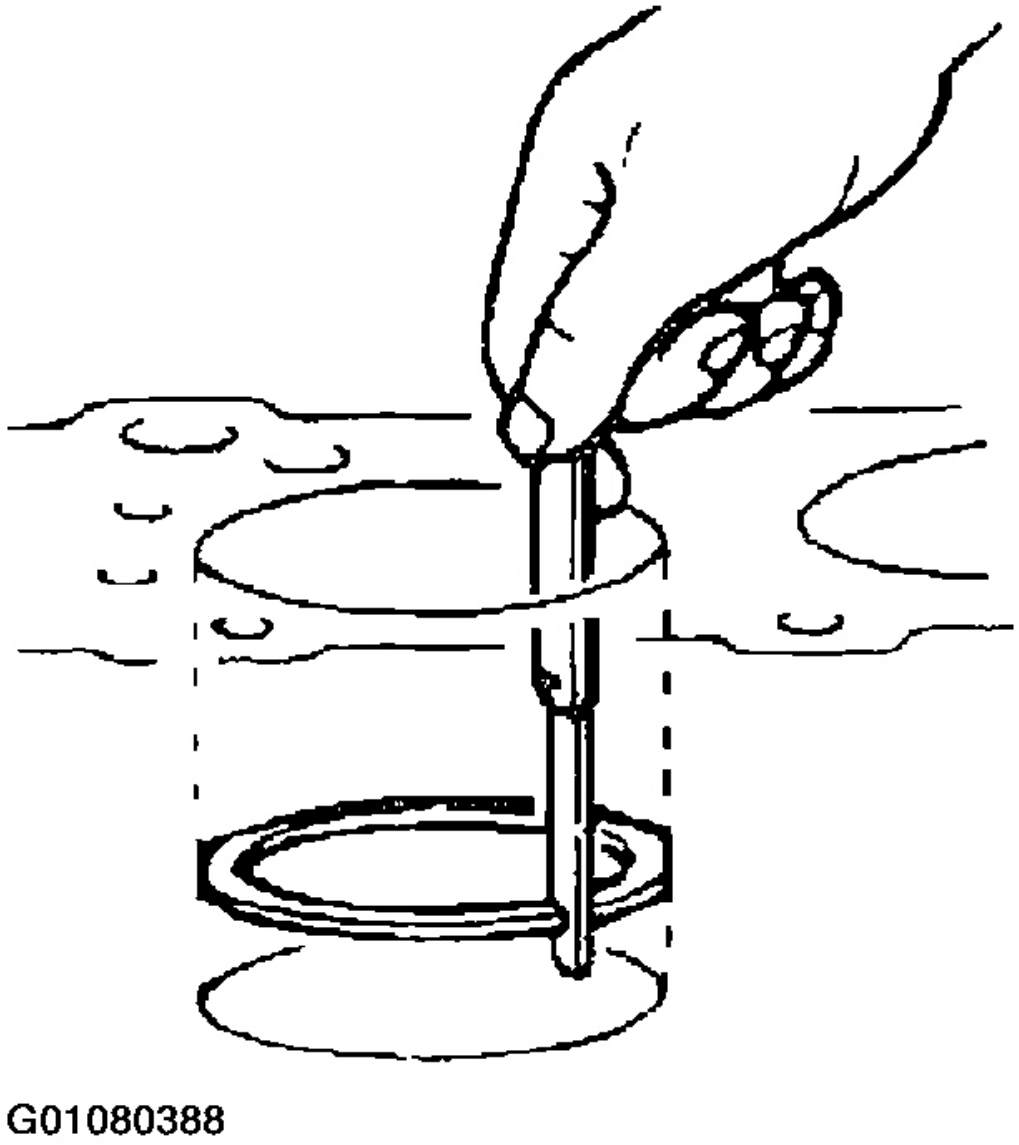


Fig. 111: Measuring Piston Ring End Gap Clearance
Courtesy of KIA MOTORS AMERICA, INC.

8. Replace piston ring if necessary.

PISTON PIN

1. Measure each piston pin hole diameter at X and Y directions in four locations shown in figure.

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Diameter: 0.7872~0.7875 in (19.994~20.002 mm)

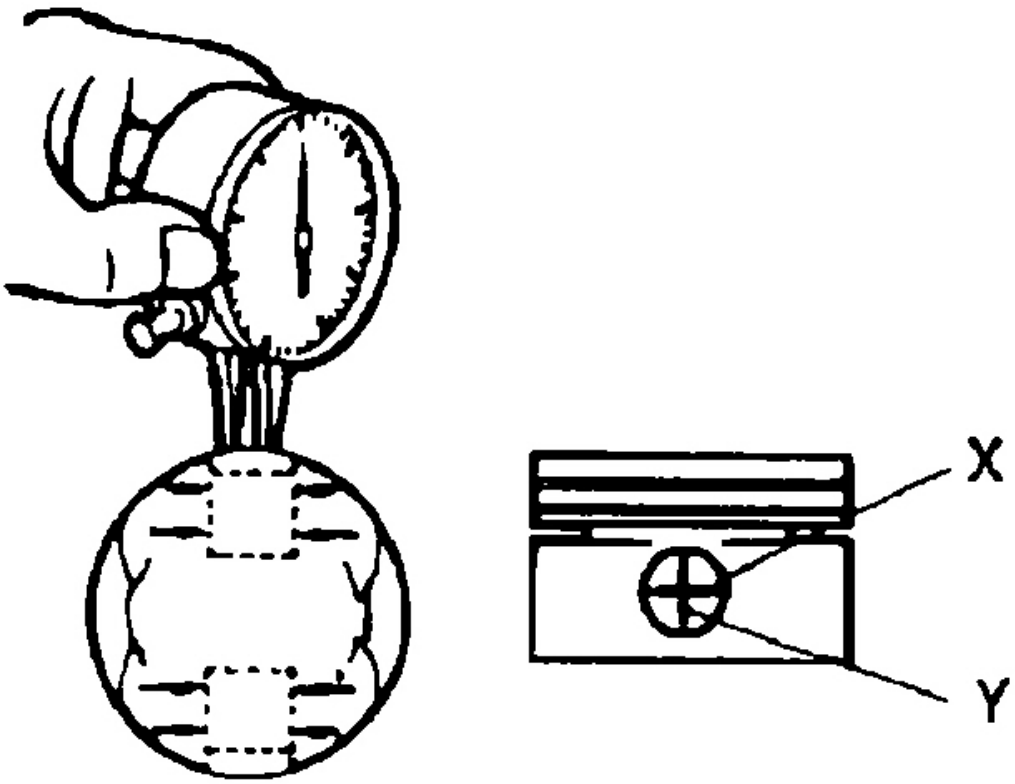


Fig. 112: Measuring Each Piston Pin Hole Diameter
Courtesy of KIA MOTORS AMERICA, INC.

2. Measure each piston pin diameter at X and Y direction at four locations shown in figure.

   Diameter: 0.7869~0.7871 in (19.987~19.993 mm)

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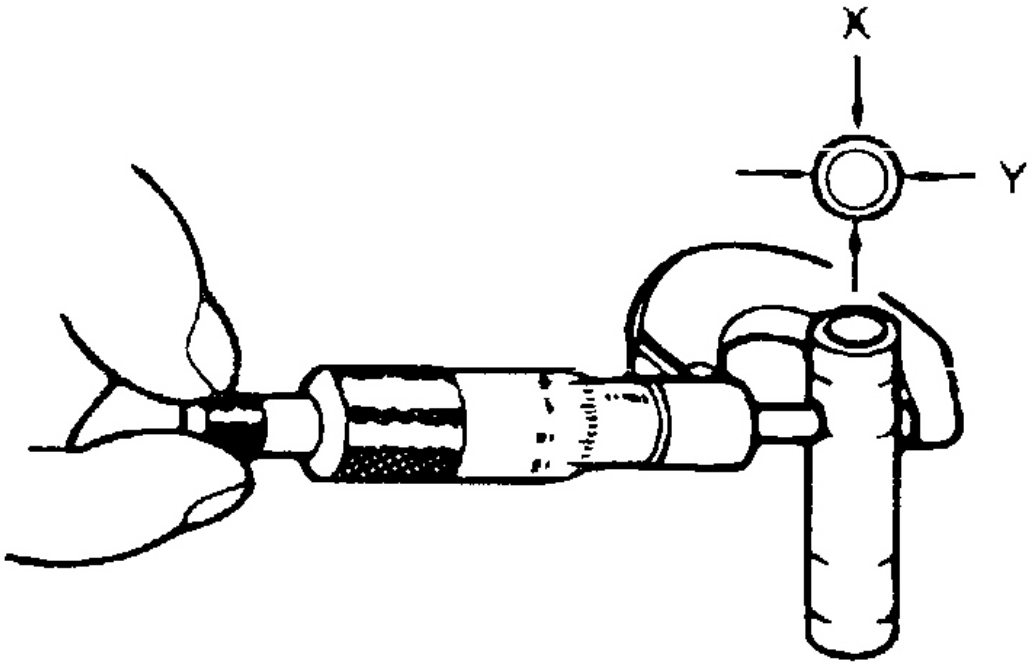


Fig. 113: Measuring Piston Pin Diameter
Courtesy of KIA MOTORS AMERICA, INC.

3. Subtract piston pin diameter from pin hole diameter to determine piston pin to piston clearance.

   Clearance: 0.00004~0.00006 in (0.001~0.015 mm)

4. If clearance exceeds specification, replace piston and piston pin.

   NOTE: Piston and piston pin are a matched set.

REASSEMBLY

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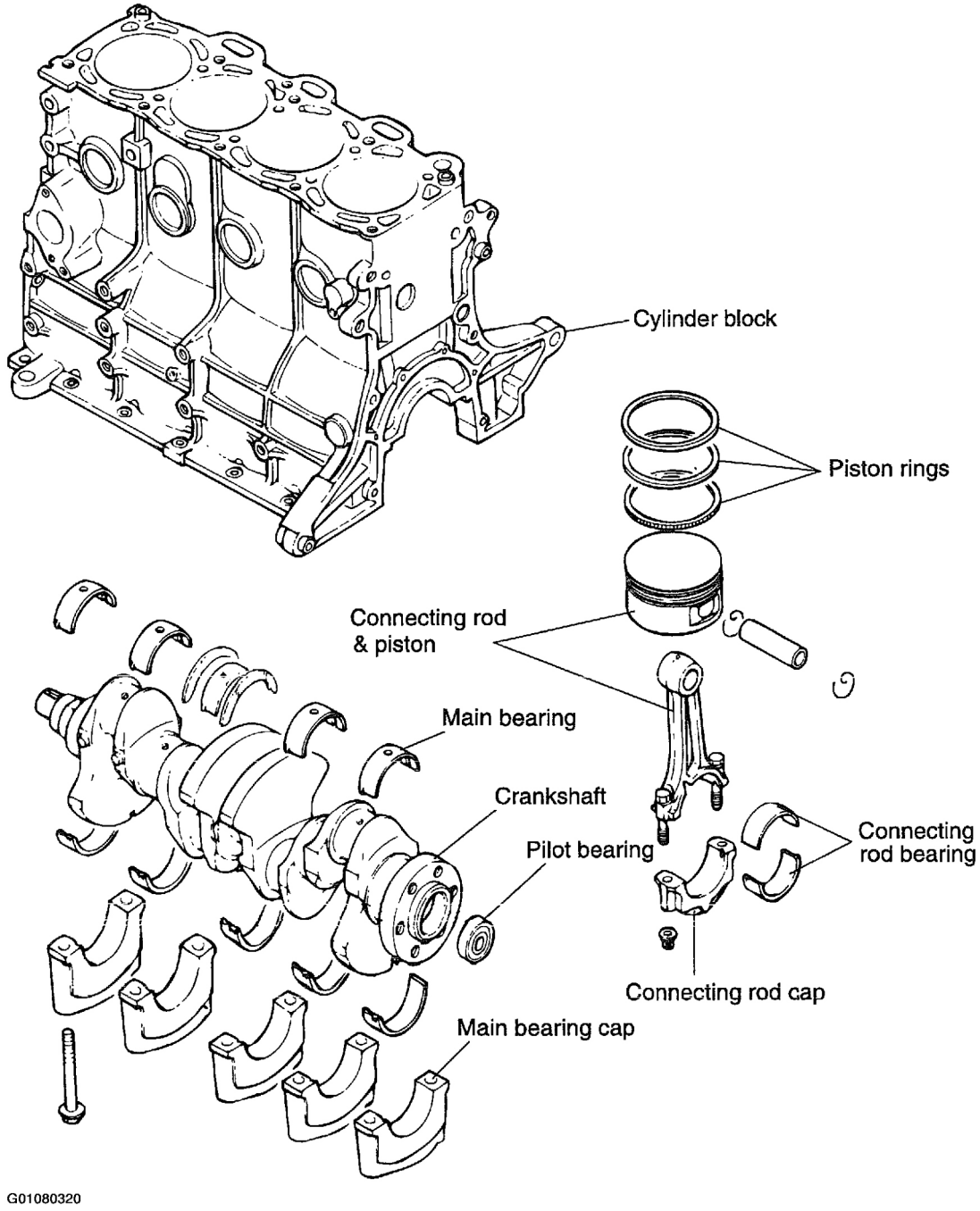


Fig. 114: Illustrating Engine Block Components
Courtesy of KIA MOTORS AMERICA, INC.

1. Clean all parts before assembly.
2. Apply a coat of clean engine oil to all sliding and rotating parts before assembly.
3. Replace main bearings and rod bearings if they are peeling, burned or otherwise damaged.

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NOTE: Do not reuse old gaskets or seals.

4. Install one piston pin clip into clip grooves on piston.
5. Insert connecting rod into piston and slide piston pin through piston and through connecting rod until it makes contact with the piston pin clip already installed.

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

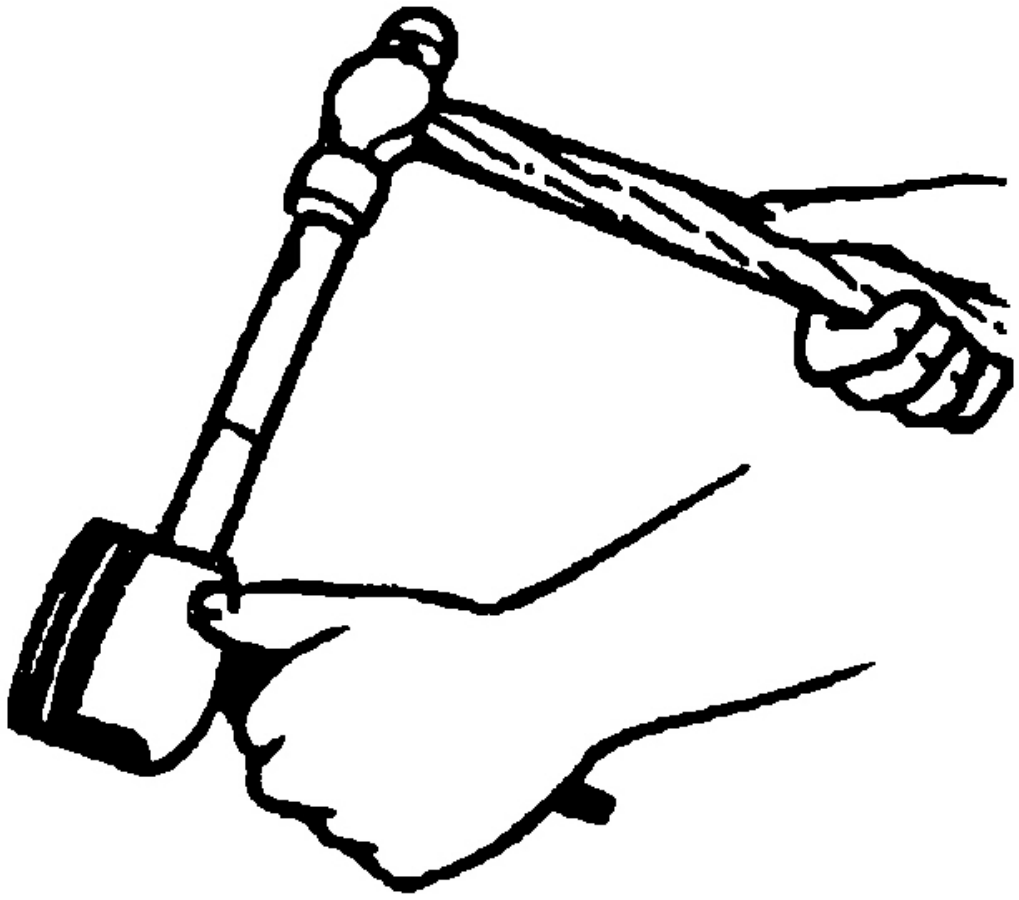


Fig. 115: Installing Connecting Rod Onto Piston
Courtesy of KIA MOTORS AMERICA, INC.

6. Install second piston pin clip into clip grooves on opposite side of piston.

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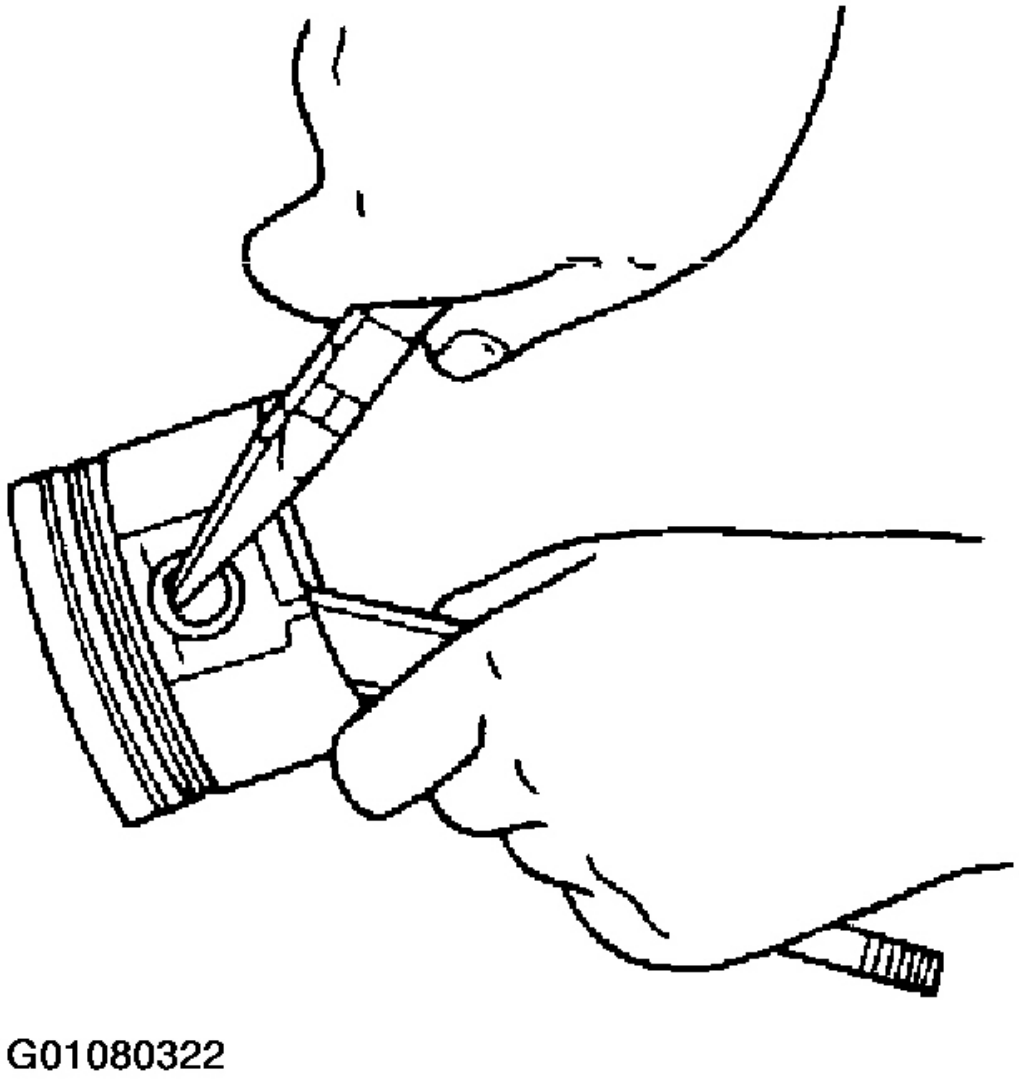


Fig. 116: Install Piston Pin Clip
Courtesy of KIA MOTORS AMERICA, INC.

7. Hold piston upright and move connecting rod back and forth. Check that rod moves freely.
8. 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.

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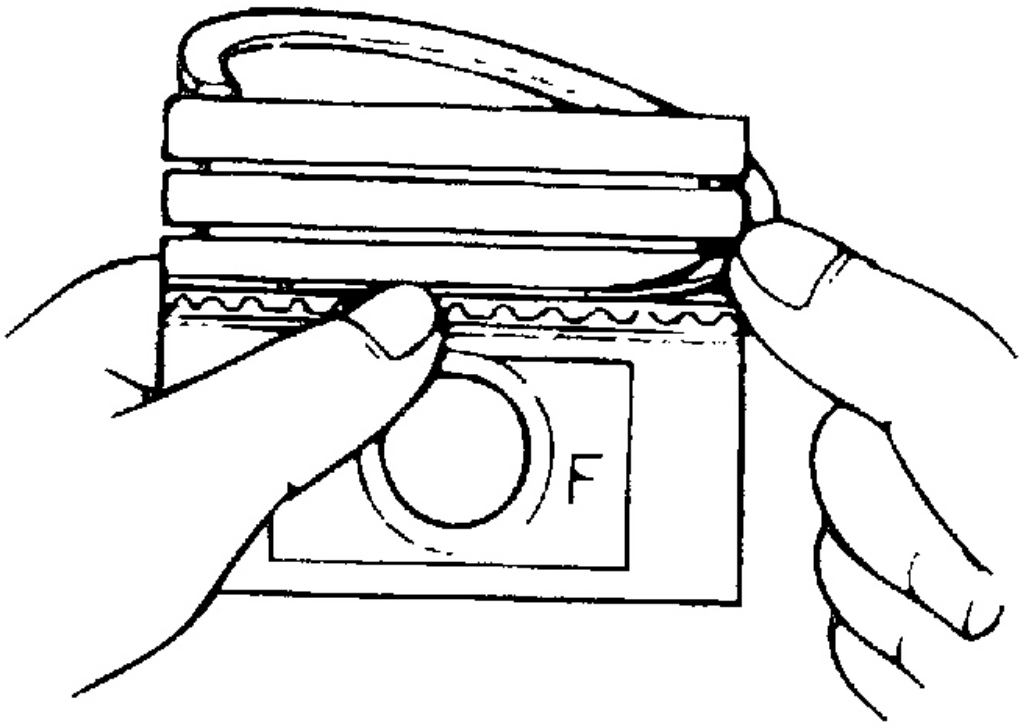


Fig. 117: Installing Lower Oil Ring Onto Piston
Courtesy of KIA MOTORS AMERICA, INC.

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

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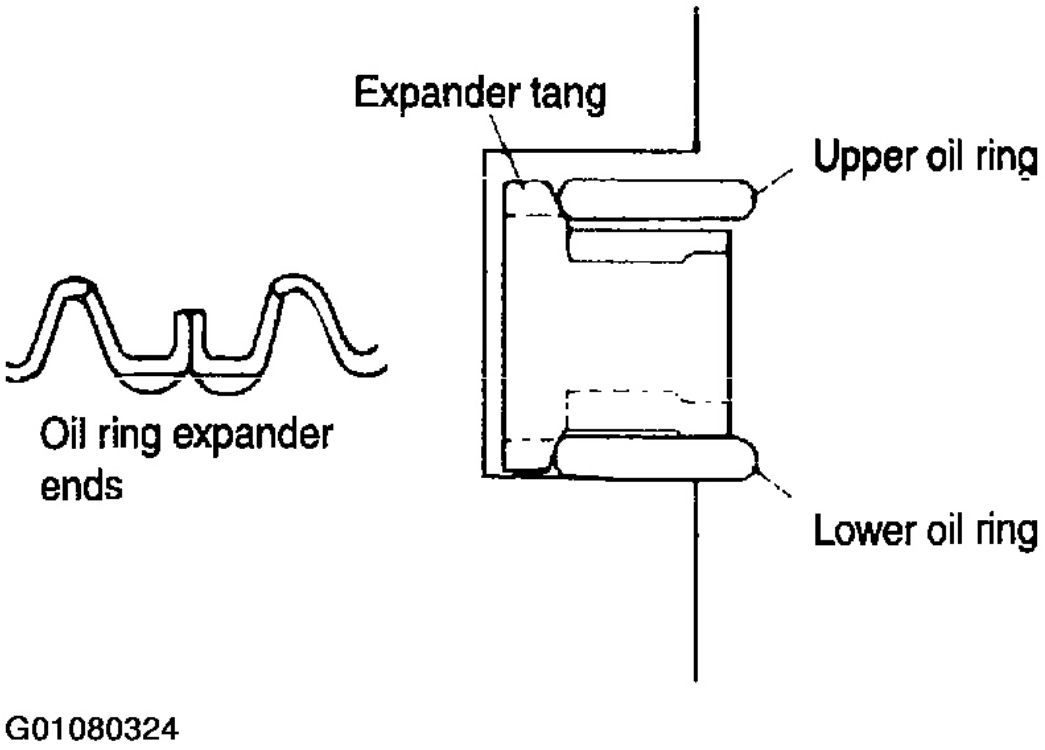


Fig. 118: Illustrating Oil Ring Position
Courtesy of KIA MOTORS AMERICA, INC.

10. Use a ring expander and install second ring.
11. Use a ring expander and install top ring.

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

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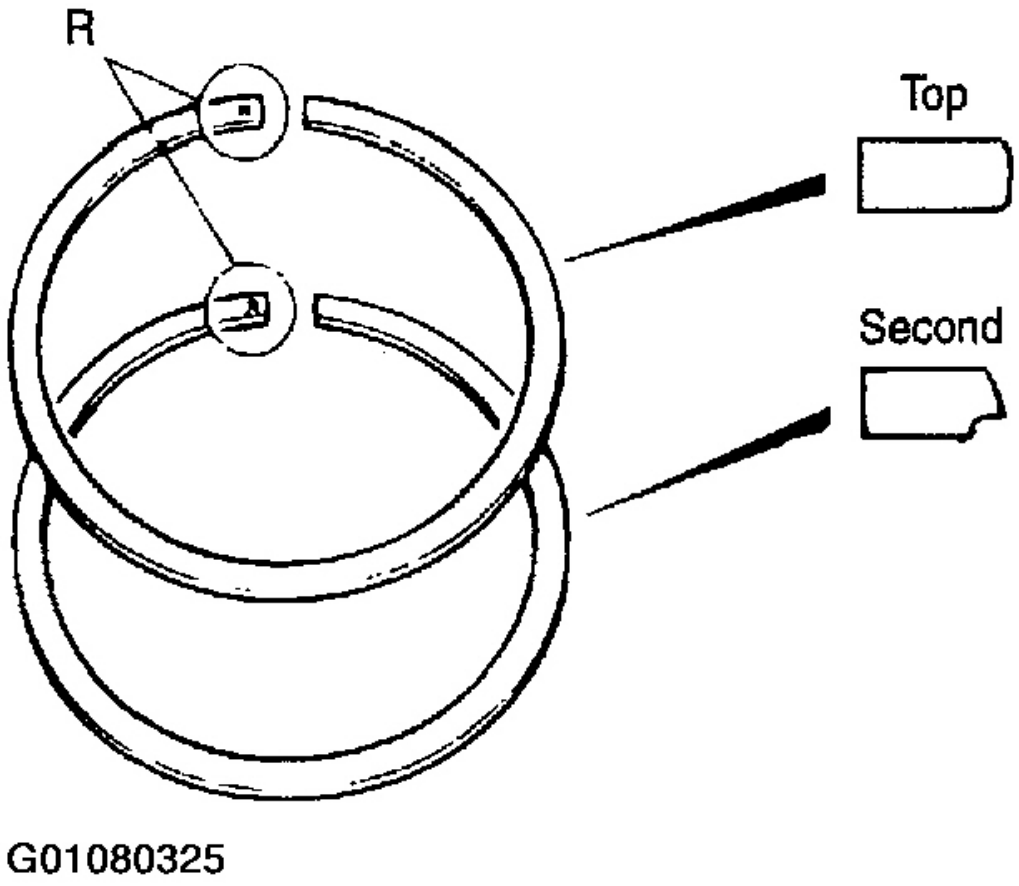


Fig. 119: Illustrating Top & Second Ring Position
Courtesy of KIA MOTORS AMERICA, INC.

12. Align piston ring gaps as shown in figure.

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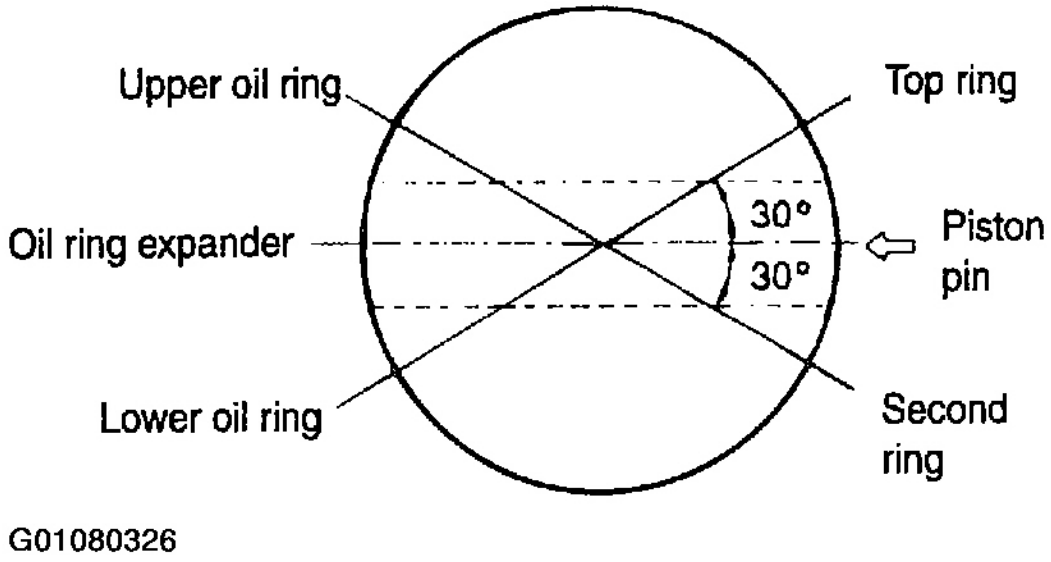


Fig. 120: Positioning Piston Ring Gaps
Courtesy of KIA MOTORS AMERICA, INC.

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

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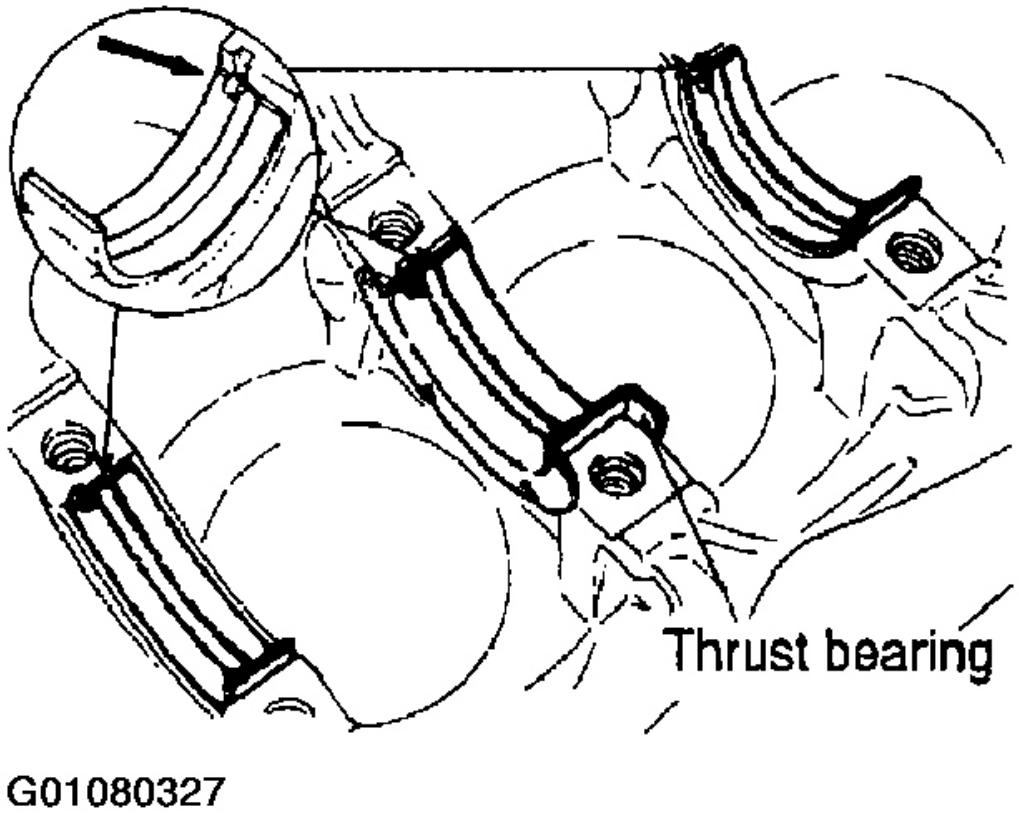


Fig. 121: Installing Thrust Bearings
Courtesy of KIA MOTORS AMERICA, INC.

16. Set crankshaft on installed bearings.
17. Install remaining main bearings into main bearing caps.
18. Position Plastigage on crankshaft journals.

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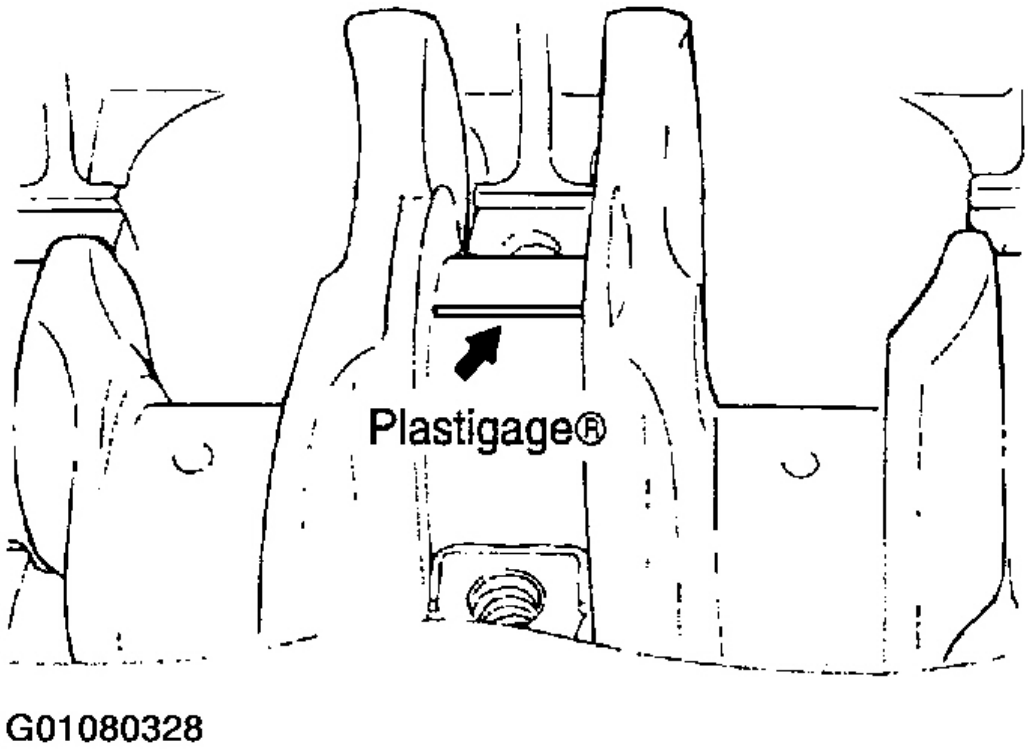


Fig. 122: Positioning Plastigage On Crankshaft Journals
Courtesy of KIA MOTORS AMERICA, INC.

19. Install main bearing caps along with lower main bearings according to cap number and mark.
20. Tighten main bearing cap bolts according to the following procedure:
    a. Tighten bolts in order shown in figure. See **Fig. 123**.

       Tightening torque: 28.9 lb-ft (39.2 N.m, 4kg-m)

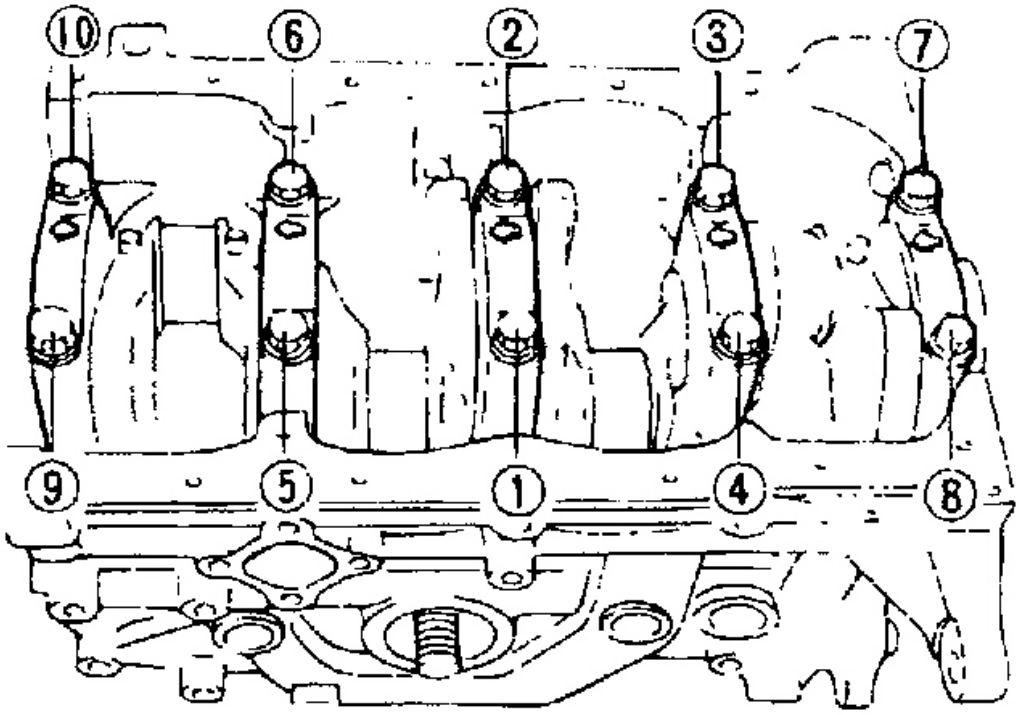
    b. Loosen bolts in reverse of order shown.
    c. Retighten bolts in order shown.

       Tightening torque: 14.5 lb-ft (19.6 N.m, 2kg-m)

    d. Mark bolts for rotational reference.
    e. Rotate bolts 90°(1/4 Turn) in order shown.
    f. Rotate bolts another 60°(1/6 Turn) in order shown.

CAUTION: Do not rotate crankshaft with Plastigage™ on crankshaft journals.

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Fig. 123: Main Bearing Cap Bolt Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

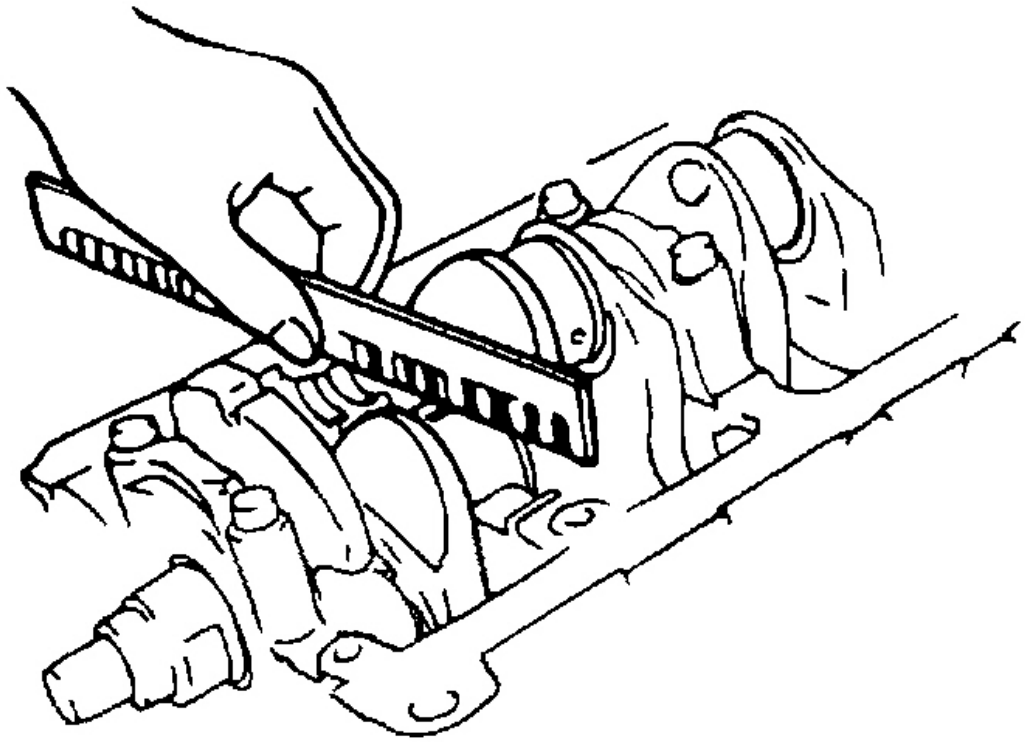
21. Remove main bearing caps and check bearing clearance.

NOTE: The widest point of Plastigage™ is the smallest clearance, and the narrowest point of Plastigage is the largest clearance.

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

Oil Clearance: 0.00095-0.00165 in (0.024-0.042 mm)

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Fig. 124: Measuring Main Bearing Clearance
Courtesy of KIA MOTORS AMERICA, INC.

23. Lift crankshaft out of cylinder block and carefully remove Plastigage from main bearings and crankshaft journals.
24. Apply a light coat of engine oil on main bearings and install crankshaft by gently lowering it onto bearings.
25. Apply a light coat of oil on crankshaft main bearing journals and on main bearings on main bearing caps.
26. Install main bearing caps along with lower main bearings according to cap number and <-- mark.
27. Tighten main bearing cap bolts according to the following procedure:
    a. Tighten bolts in order shown in figure. See **Fig. 125**.

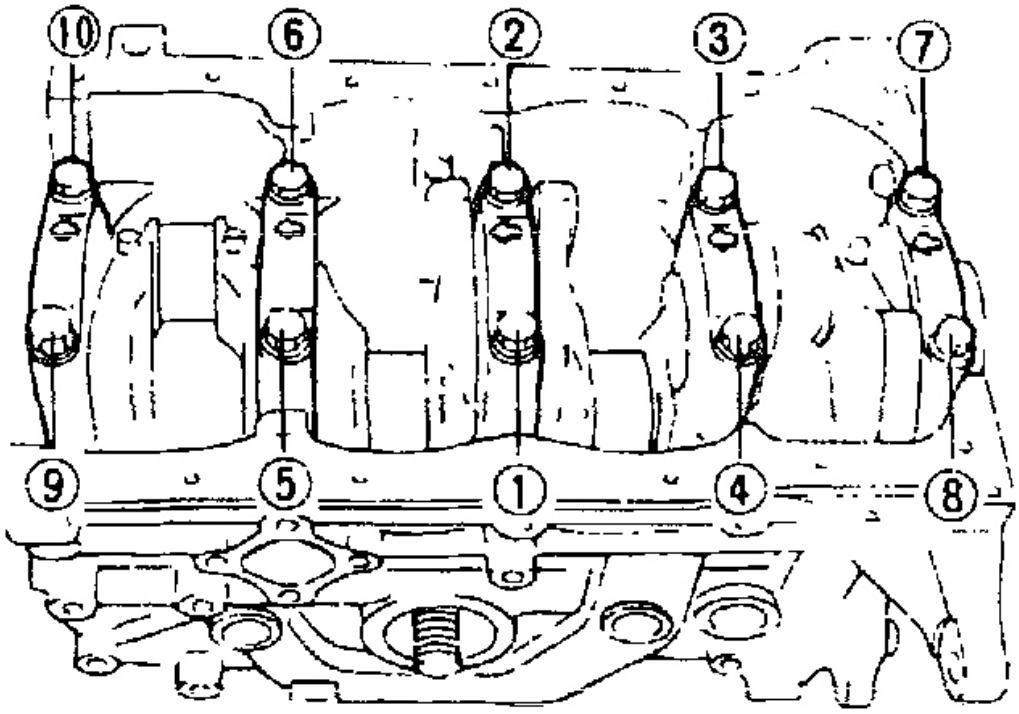
       Tightening torque: 28.9 lb-ft (39.2 N.m, 4kg-m)

    b. Loosen bolts in reverse of order shown.
    c. Retighten bolts in order shown.

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Tightening torque: 14.5 lb-ft (19.6 N.m, 2kg-m)

d. Mark bolts for rotational reference.
e. Rotate bolts 90°(1/4 Turn) in order shown.
f. Rotate bolts another 60°(1/6 Turn) in order shown.



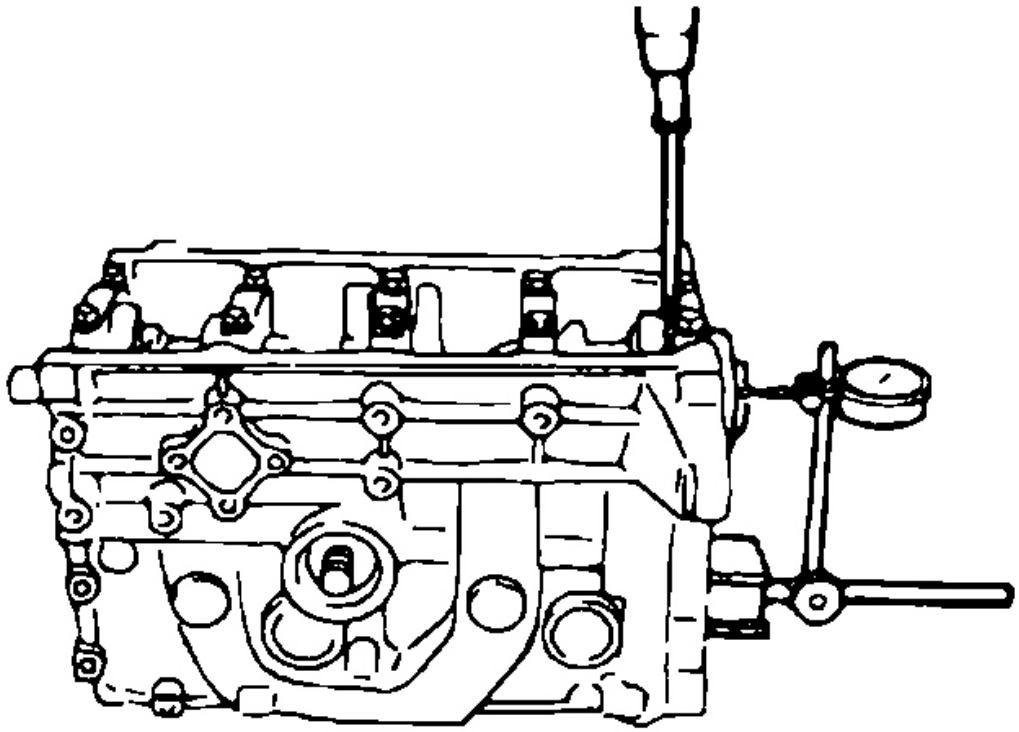
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Fig. 125: Main Bearing Cap Bolt Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

28. Rotate crankshaft to ensure it does not bind.
29. Place a dial indicator against front of crankshaft and zero gauge.
30. Using a prying tool, move crankshaft forward and zero dial indicator.
31. 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)

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Fig. 126: Measuring Crankshaft End Play
Courtesy of KIA MOTORS AMERICA, INC.

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

THRUST BEARING WIDTH

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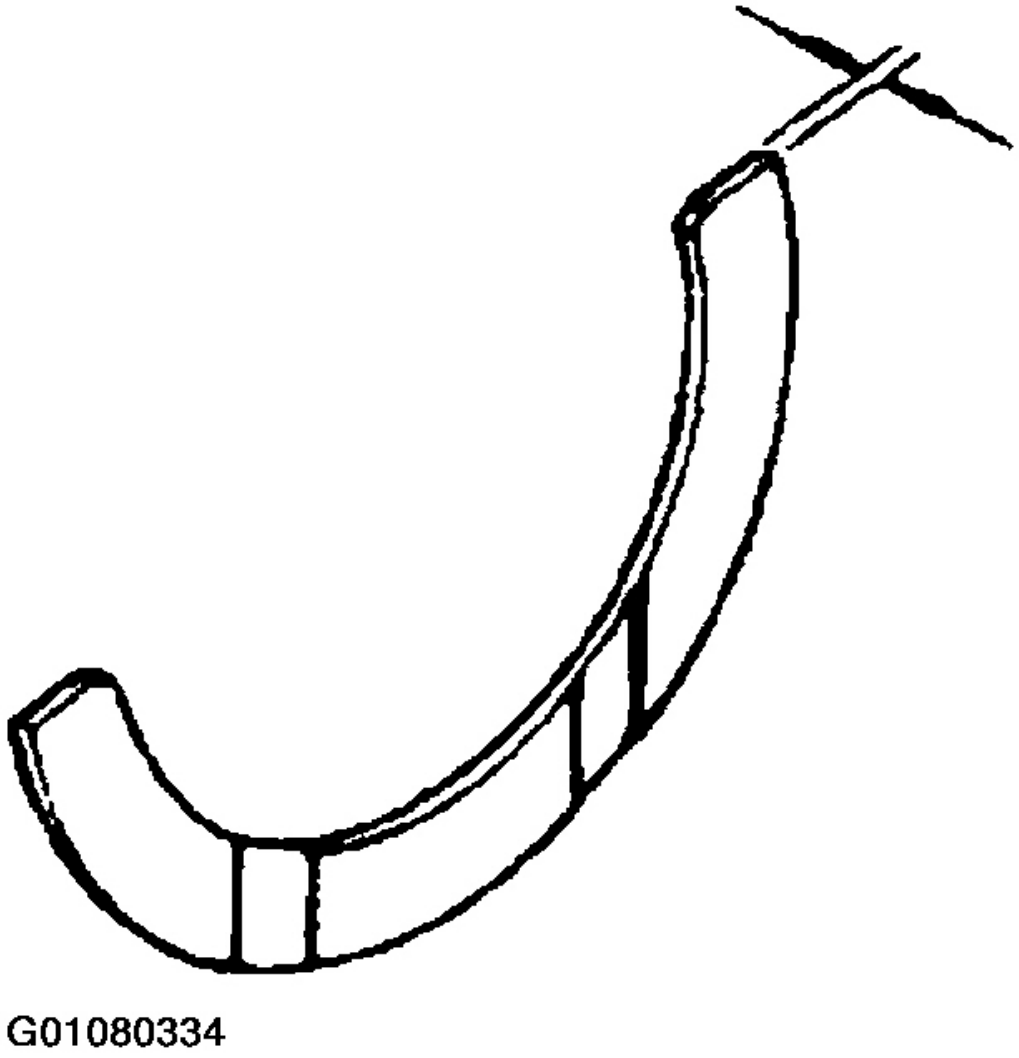


Fig. 127: Measuring Thrust Bearing Width
Courtesy of KIA MOTORS AMERICA, INC.

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Thrust bearing size	Specification
Standard	0.0985~0.1003 in (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)

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Fig. 128: Thrust Bearing Width Specification Chart
Courtesy of KIA MOTORS AMERICA, INC.

33. Install a bearing into connecting rod.
34. Place rubber sleeves (rubber fuel line works well) on connecting rod bolts to protect crankshaft from damage.

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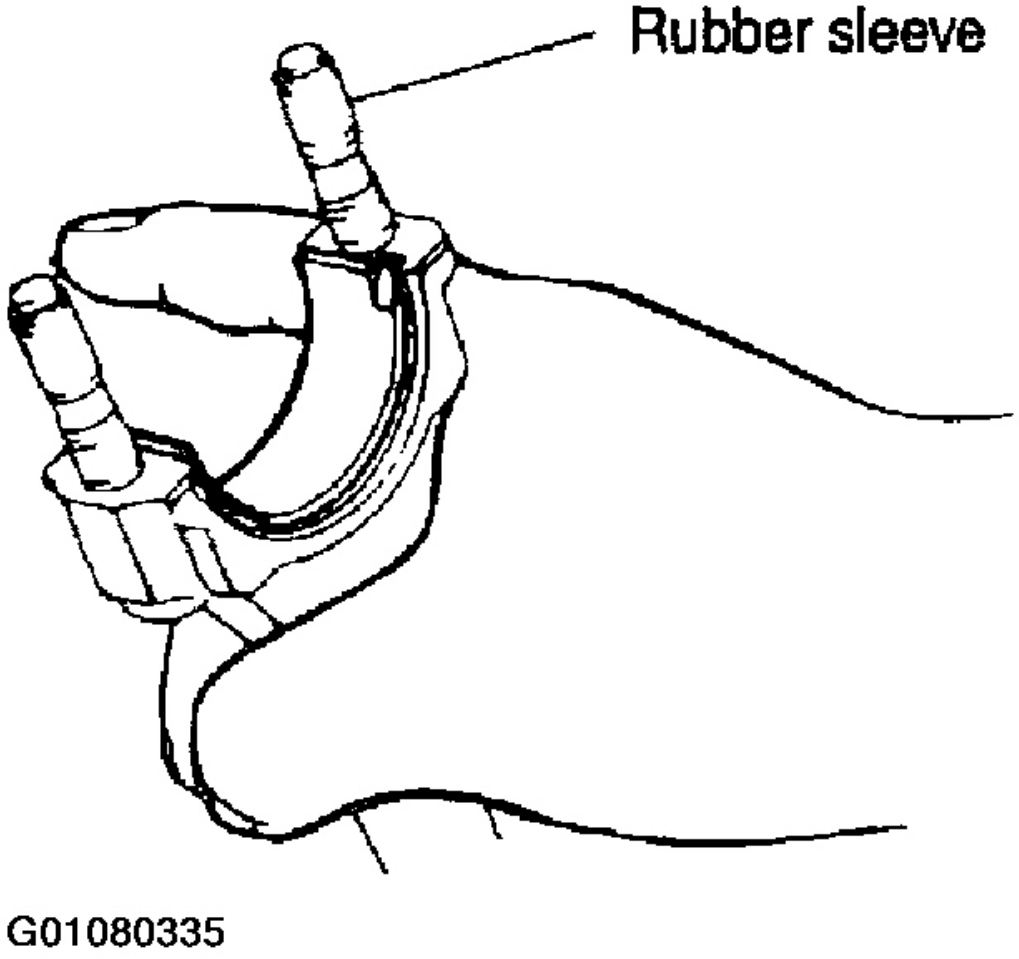


Fig. 129: Illustrating Connecting Rod Bolt Protective Sleeves
Courtesy of KIA MOTORS AMERICA, INC.

35. Check piston rings for correct end gap stagger.
36. Place piston (cylinder number one) with"F"mark facing front of engine block, then slip piston and connecting rod assembly into a piston ring compressor.
37. Rotate crankshaft so that crank pin journal for specific cylinder is at its lowest point (bottom dead center).
38. Lower piston and connecting rod assembly until piston ring compressor makes contact with deck surface of engine block.

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Fig. 130: Installing Piston And Connecting Rod Assembly
Courtesy of KIA MOTORS AMERICA, INC.

39. 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.

40. Install a connecting rod bearing in each connecting rod cap.
41. Place a piece of Plastigage™ on crank pin journals.
42. Install connecting rod caps, aligning marks made previous to disassembly and torque to specification.

Tightening torque: 34.7-36.9 lb-ft (47-50 N.m, 4.8-5.1 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.

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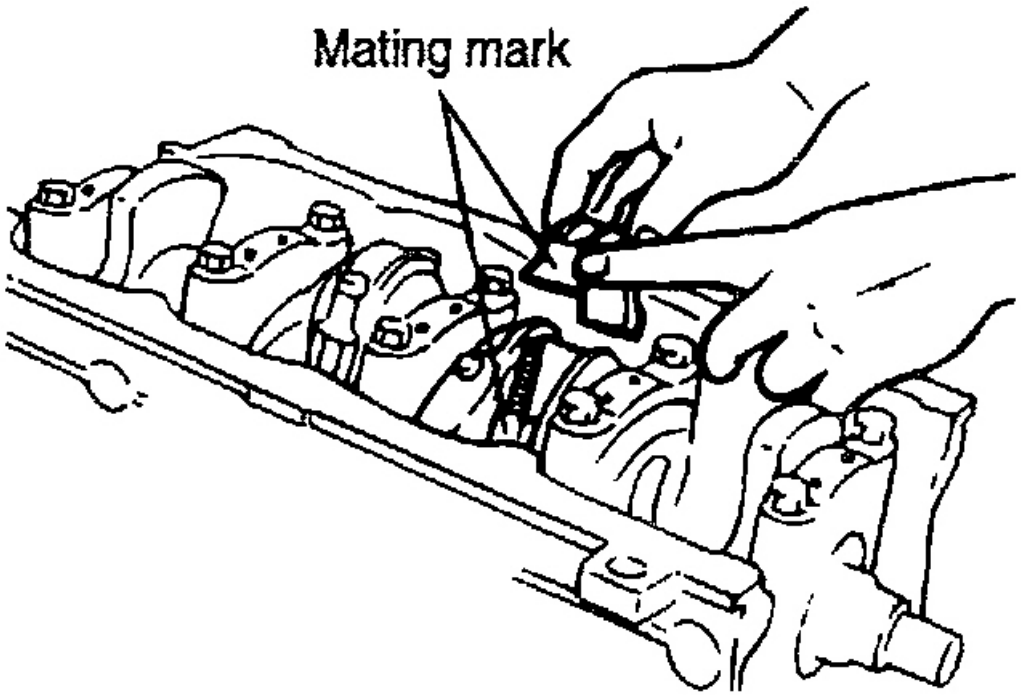


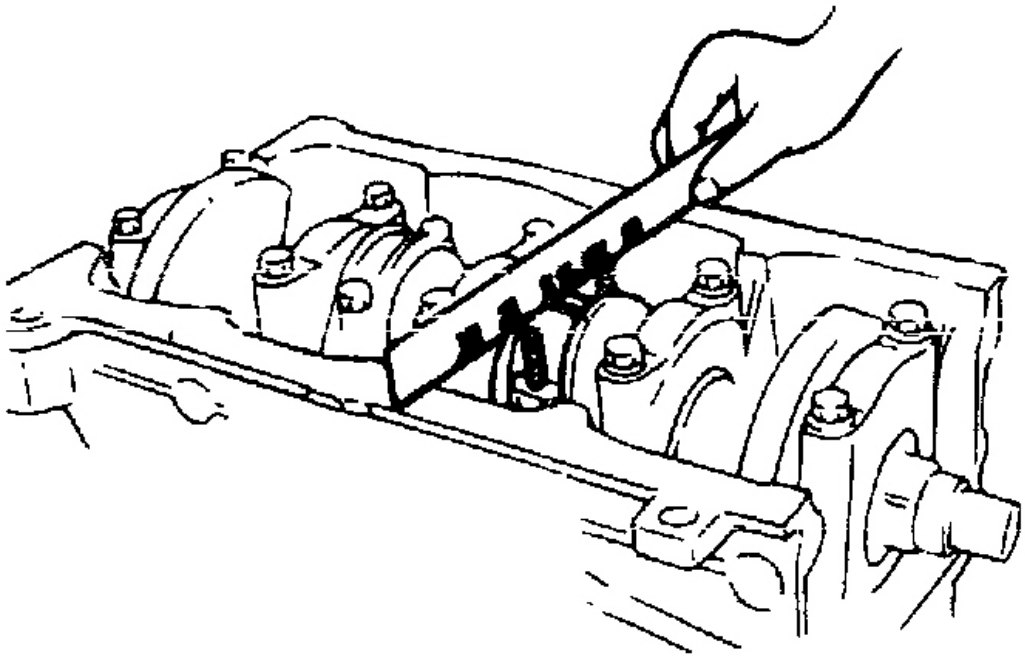
Fig. 131: Identifying Connecting Rod Mating Marks
Courtesy of KIA MOTORS AMERICA, INC.

43. Loosen and remove connecting rod caps.
44. Check the connecting rod bearing clearance.

Oil clearance: 0.0008-0.0019 in (0.020-0.05 mm)

Maximum : 0.004 in (0.10 mm)

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Fig. 132: Measuring Connecting Rod Bearing Clearance
Courtesy of KIA MOTORS AMERICA, INC.

45. If oil clearance exceeds maximum oil clearance specification, grind the crankshaft and use undersized connecting rod bearings.
46. Apply a coat of clean engine oil to connecting rod bearing in connecting rod cap.
47. Install connecting rod cap and torque to specification.

Tightening torque: 34.7-36.9 lb-ft (47-50 N.m, 4.8-5.1 kg-m)

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

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)

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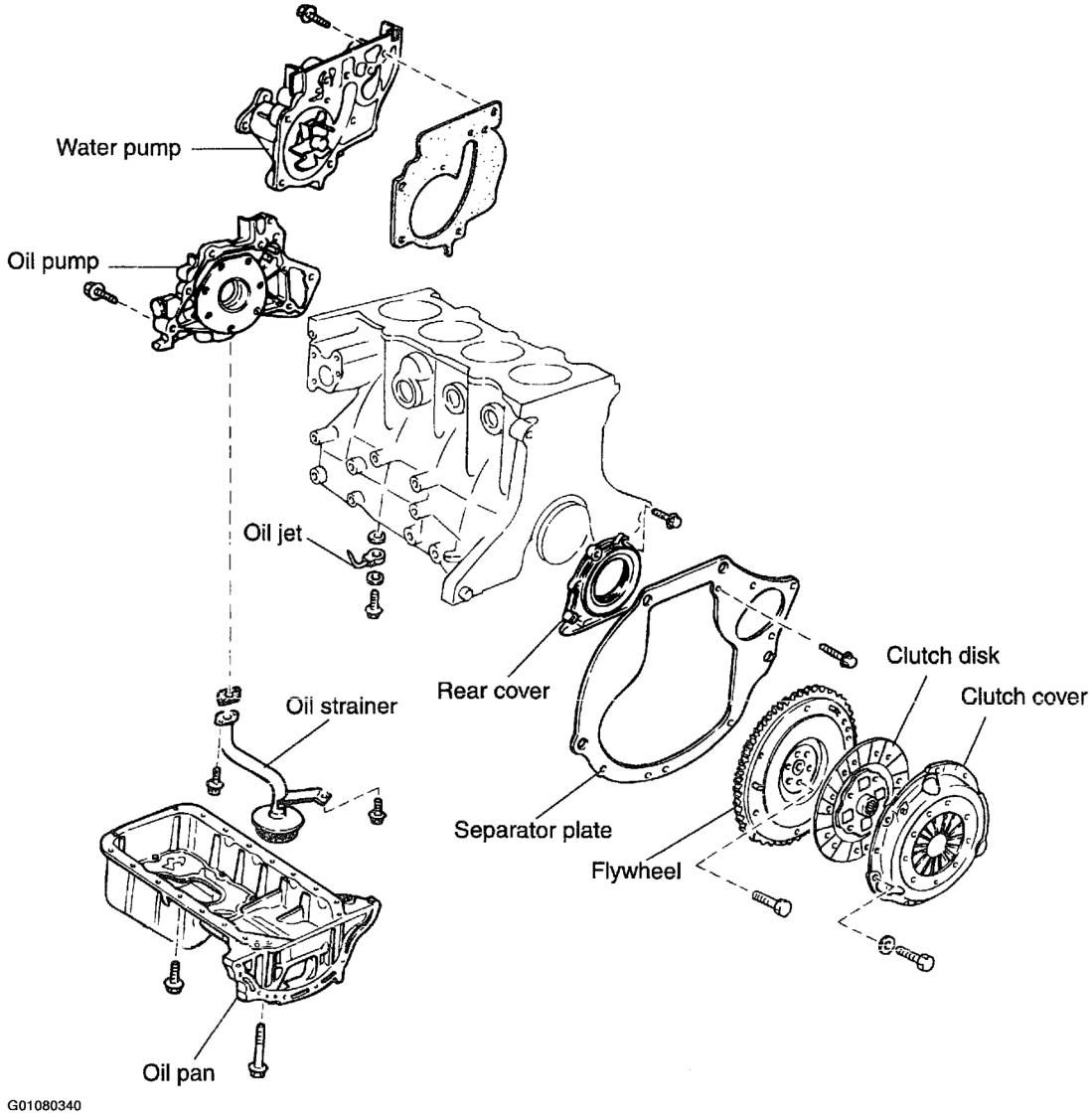


Fig. 133: Identifying Connecting Rod Side Clearance Measuring Location
Courtesy of KIA MOTORS AMERICA, INC.

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

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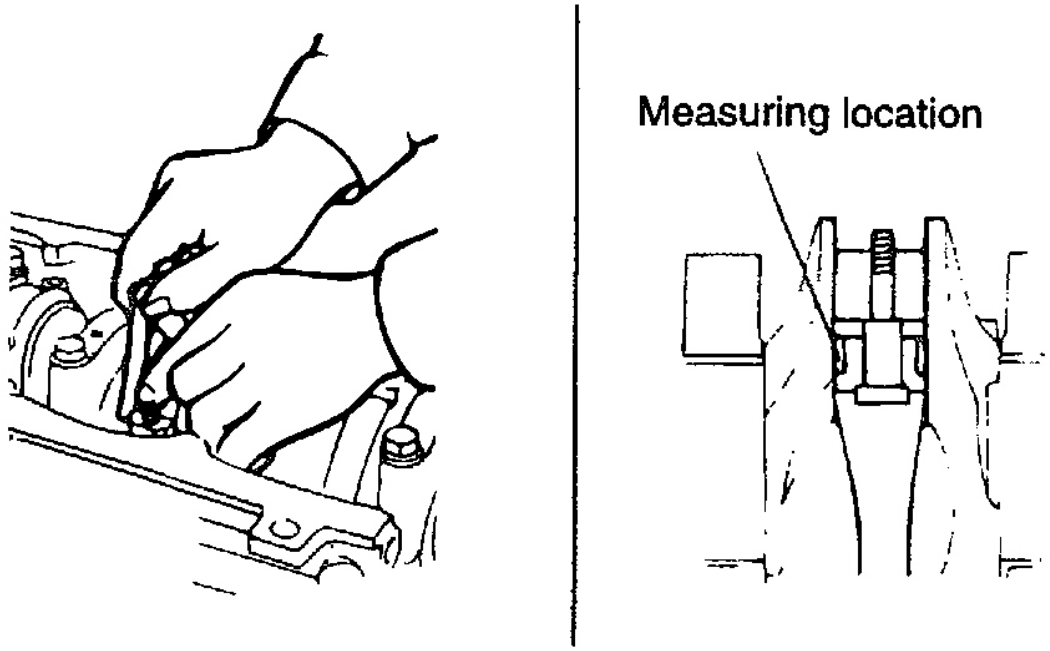


Fig. 134: Identifying Engine Block External Components
Courtesy of KIA MOTORS AMERICA, INC.

50. Apply a light coat of clean engine oil to rear oil seal.
51. Install rear oil seal into rear cover by hand.
52. Press oil seal into rear cover.

NOTE: Oil seal must be pressed in until it is nearly flush with surface of rear cover.

Protrusion: 0-0.02 in (0~0.5 mm)

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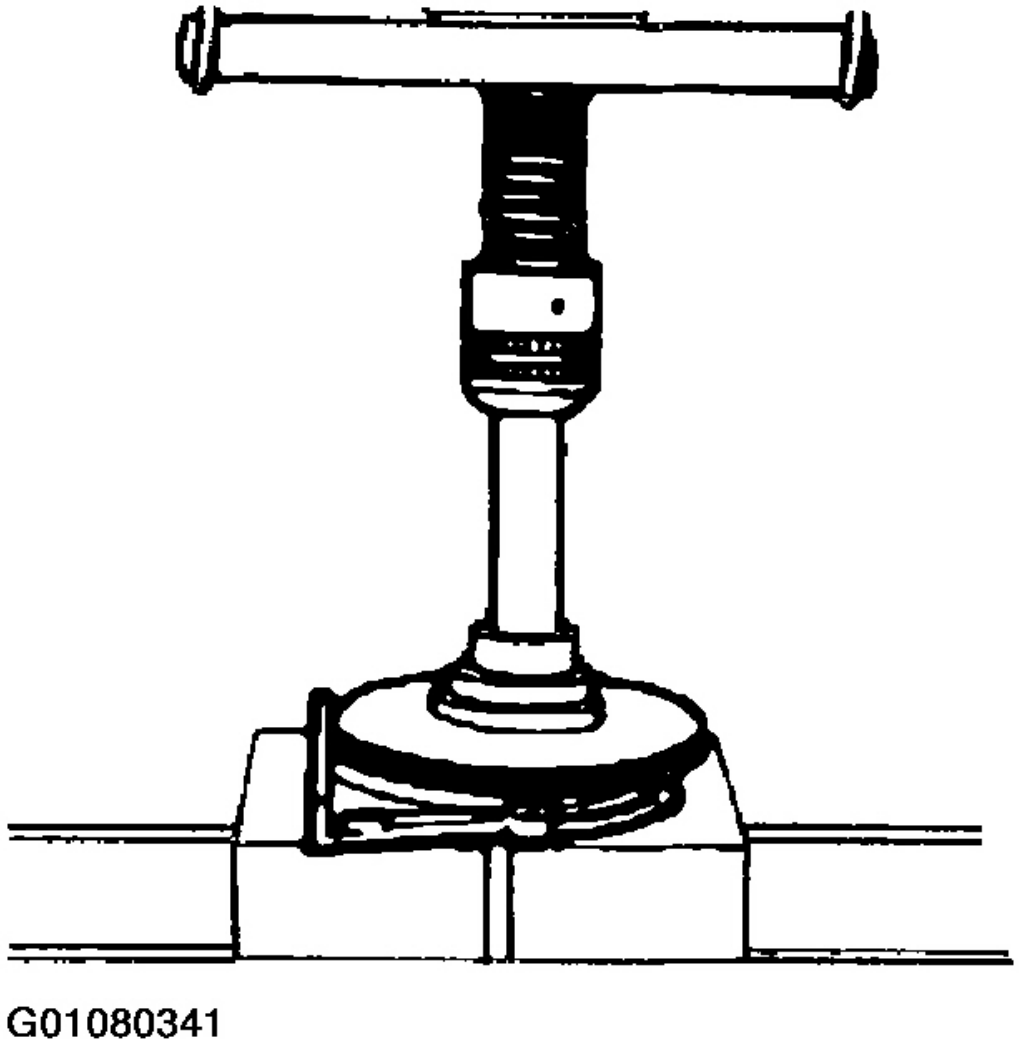


Fig. 135: Installing Oil Seal Into Rear Cover
Courtesy of KIA MOTORS AMERICA, INC.

53. Apply a coat of silicone sealer to rear cover.

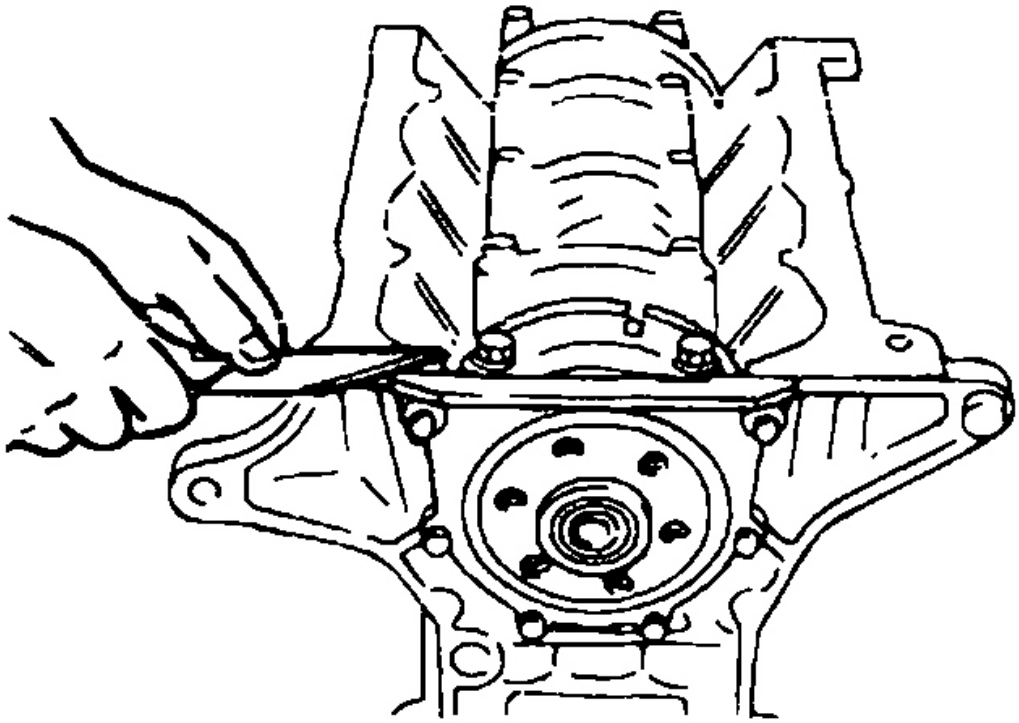
    Thickness: 0.08 in (2 mm)

54. Install the rear cover.

    Tightening torque: 5.8-8.0 lb-ft (7.8-10.8 N.m, 0.8-1.1 kg-m)

55. Remove any sealant that protrudes from rear cover onto oil pan mounting surface.

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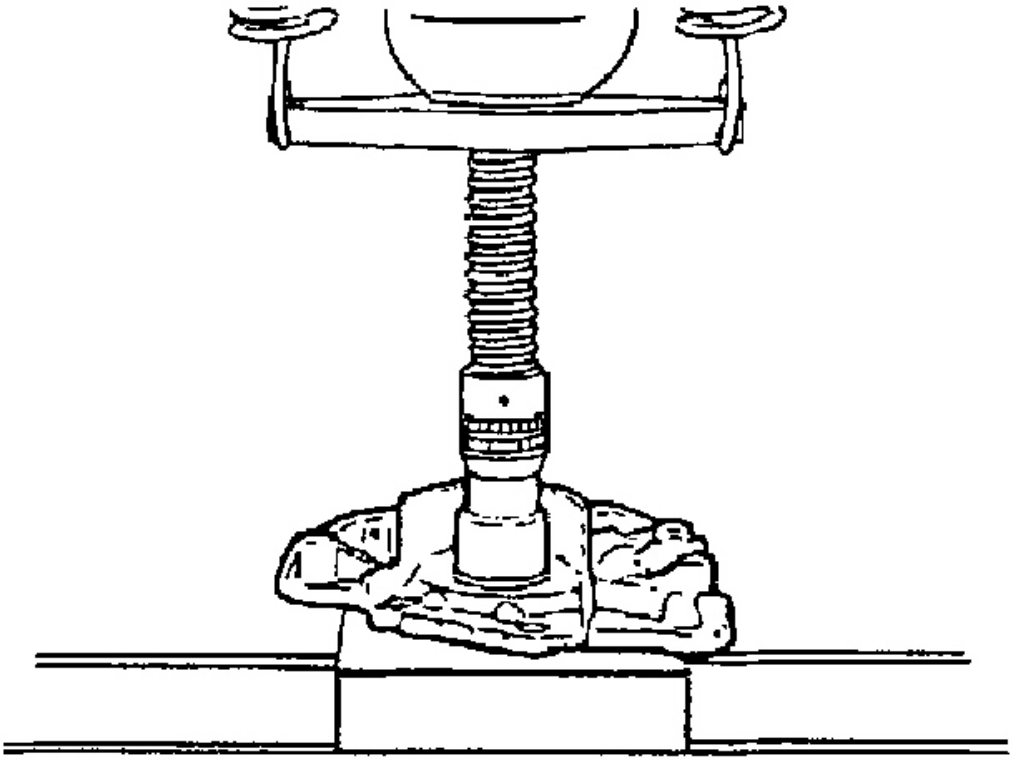
Fig. 136: Removing Any Protruding Sealant
Courtesy of KIA MOTORS AMERICA, INC.

56. Apply clean engine oil to new front oil seal and oil pump body.
57. Install front oil seal by hand.
58. Press oil seal into oil pump body.

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

Protrusion: 0.02-0.04 in (0.5-1.0 mm)

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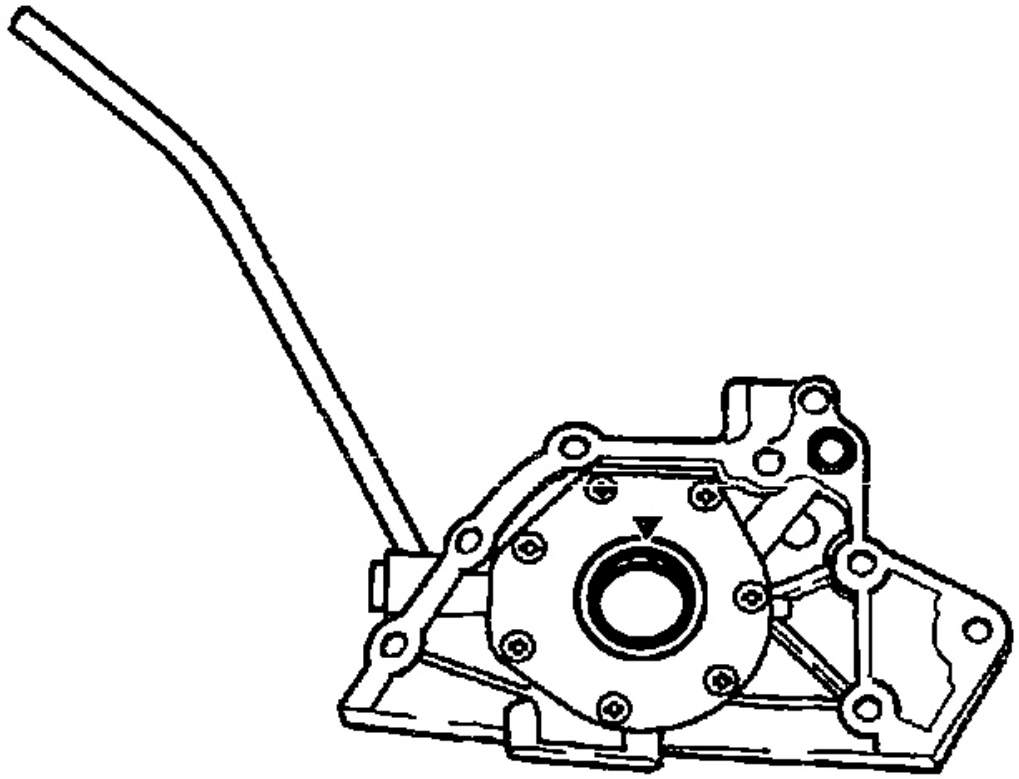
Fig. 137: Installing Oil Seal Into Oil Pump Body
Courtesy of KIA MOTORS AMERICA, INC.

59. Install a new O-ring seal.
60. Apply a bead of silicone sealant to oil pump body as shown in figure.

Thickness: 0.04-0.08 in (1-2 mm)

CAUTION: Oil pump body must be installed within 5 minutes after silicone sealant is applied.

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Fig. 138: Applying Silicone Sealant
Courtesy of KIA MOTORS AMERICA, INC.

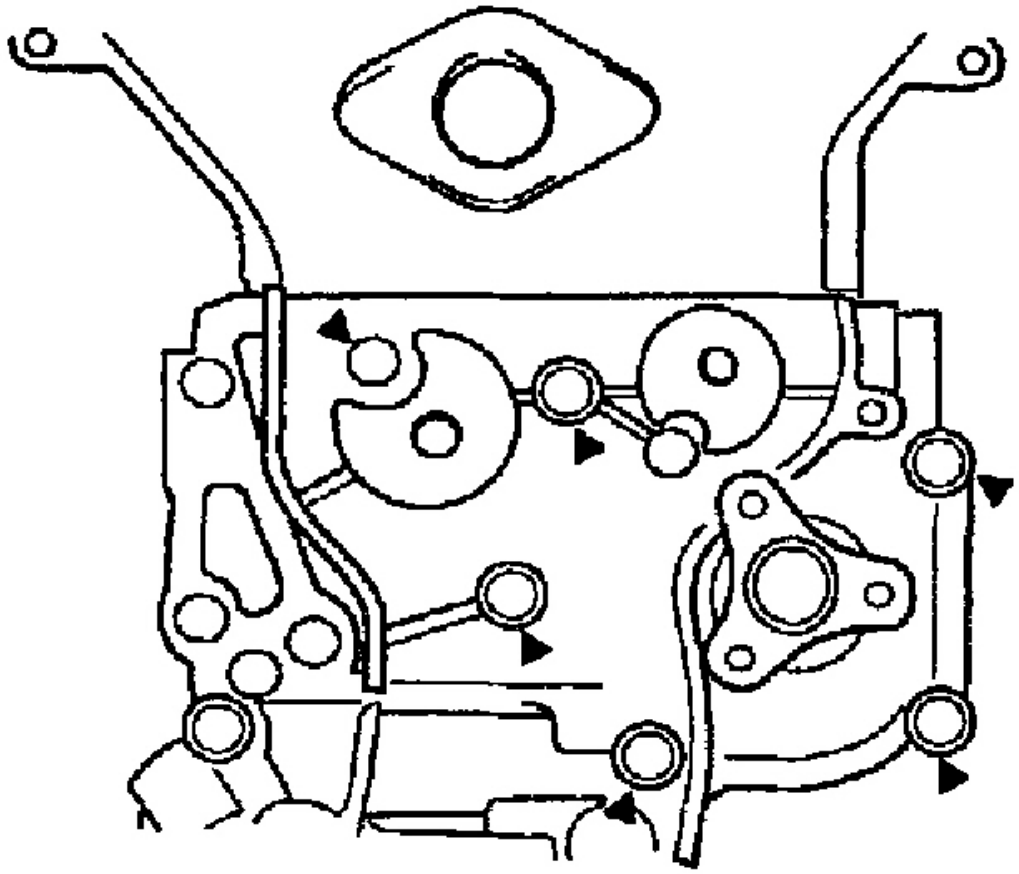
61. Install oil pump with six bolts.

    Tightening torque: 14-19 lb-ft (19-26 N.m, 1.9-2.6 kg-m)

62. Remove any sealant that protrudes from oil pump onto oil pan mounting surface.
63. Remove all foreign material from water pump mounting surface.
64. Install water pump with a new gasket and torque to specification.

    Tightening torque: 14-19 lb-ft (19-26 N.m, 1.9-2.6 kg-m)

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Fig. 139: Installing Water Pump
Courtesy of KIA MOTORS AMERICA, INC.

65. Install oil pressure switch.

    Tightening torque: 8.7-13.7 lb-ft (11.7-17.6 N.m, 1.2-1.8 kg-m)

66. Apply a small amount of engine oil to rubber seal of oil filter.
67. Install oil filter until rubber seal contacts base and then tighten filter 1 and 1/6 turn using an oil filter wrench.

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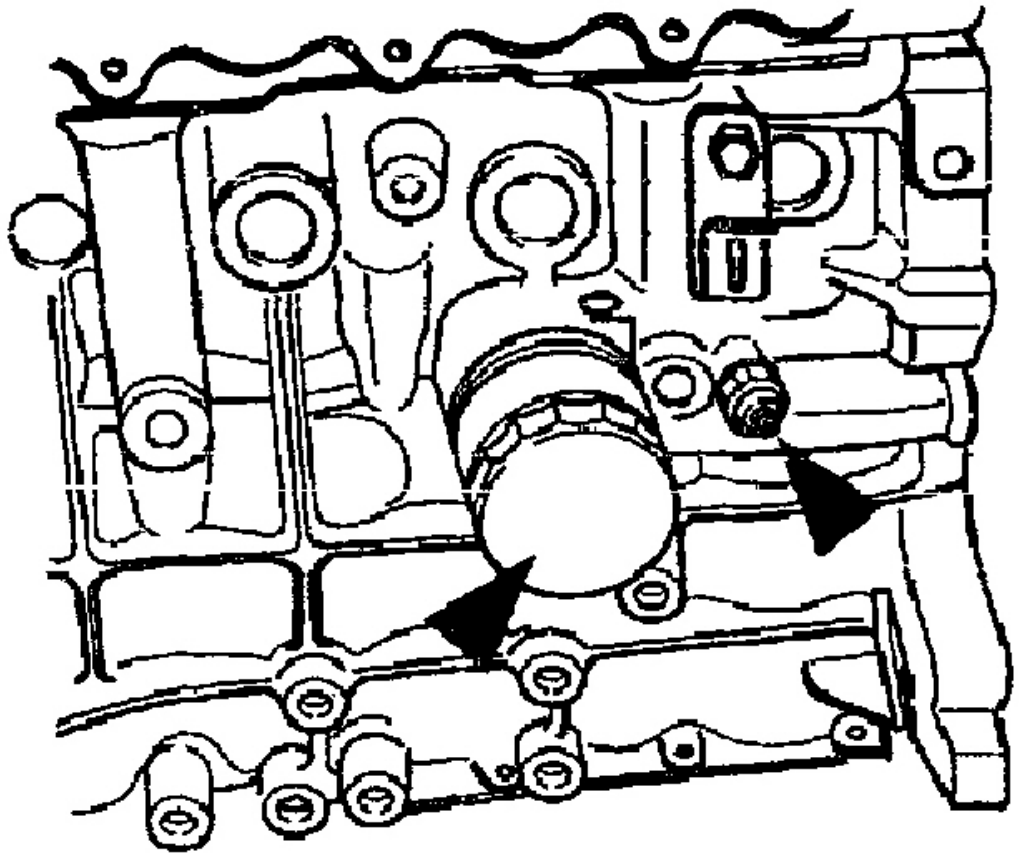
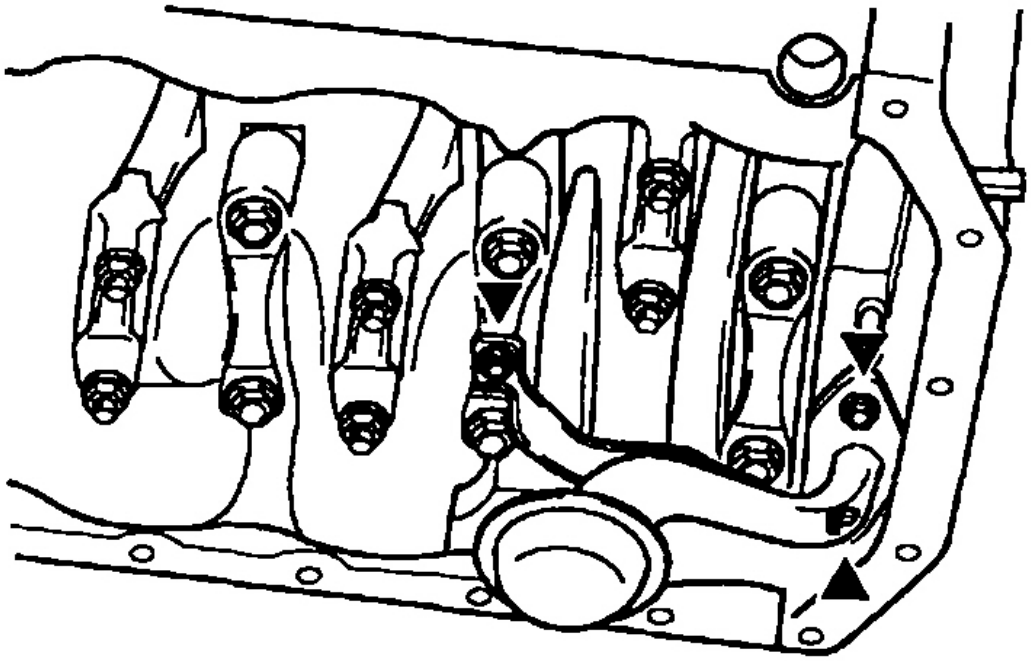


Fig. 140: Installing Oil Pressure Switch And Oil Filter
Courtesy of KIA MOTORS AMERICA, INC.

68. Install oil strainer with a new gasket.

Tightening torque: 5.8-8.7 lb-ft (7.8-11.8 N.m, 0.8-1.2 kg-m)

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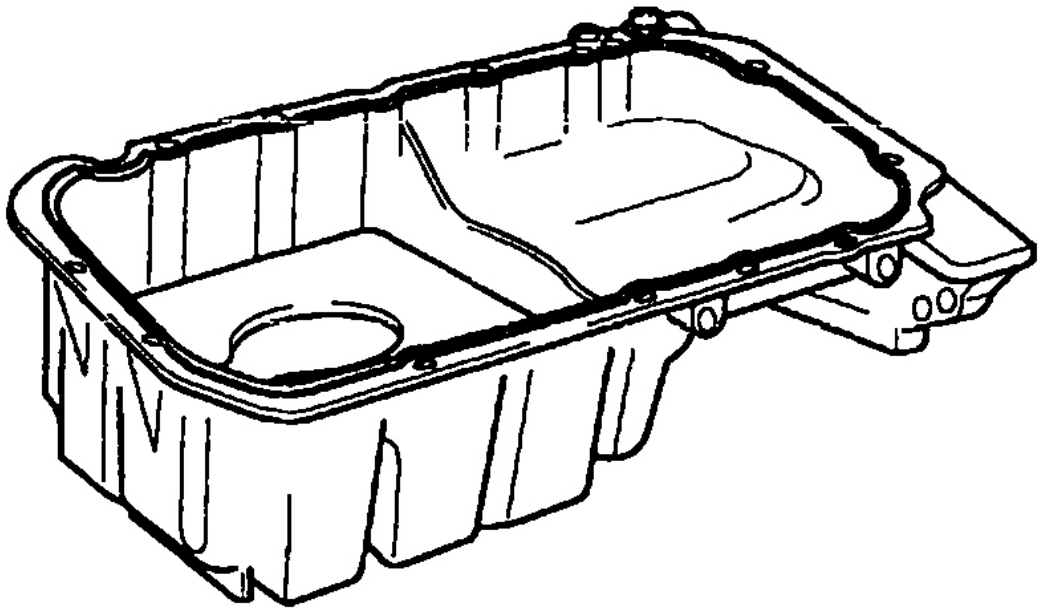
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Fig. 141: Installing Oil Strainer
Courtesy of KIA MOTORS AMERICA, INC.

69. Remove all foreign material from gasket surface.
70. Apply a continuous bead of silicone sealant to oil pan contact surfaces.

NOTE: Install oil pan within five minutes of applying silicone sealer.

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Fig. 142: Applying Silicone Sealant To Oil Pan
Courtesy of KIA MOTORS AMERICA, INC.

71. Install oil pan and tighten oil pan bolts.

Tightening torque: 5.8-8.0 lb-ft (7.8-10.8 N.m, 0.8-1.1 kg-m)

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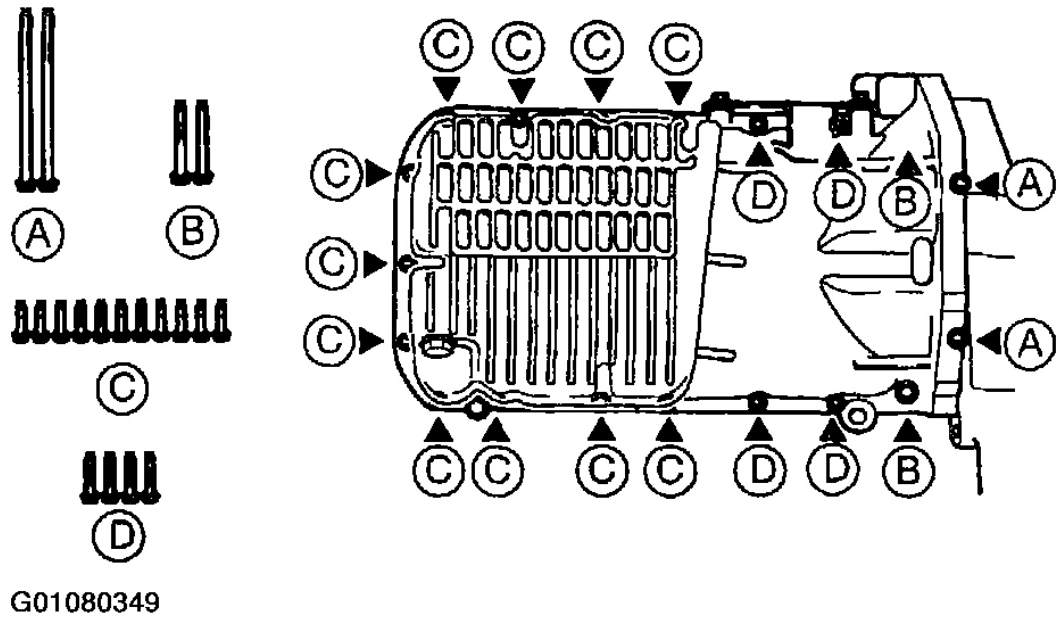


Fig. 143: Identifying Oil Pan Bolt Positions
Courtesy of KIA MOTORS AMERICA, INC.

72. Clean thread sealant from flywheel bolts and bolt holes in crankshaft.

NOTE: If thread sealant cannot be removed from bolt, replace flywheel bolt. If you are using new flywheel bolts, do not apply sealant: new bolts have sealant already applied to threads.

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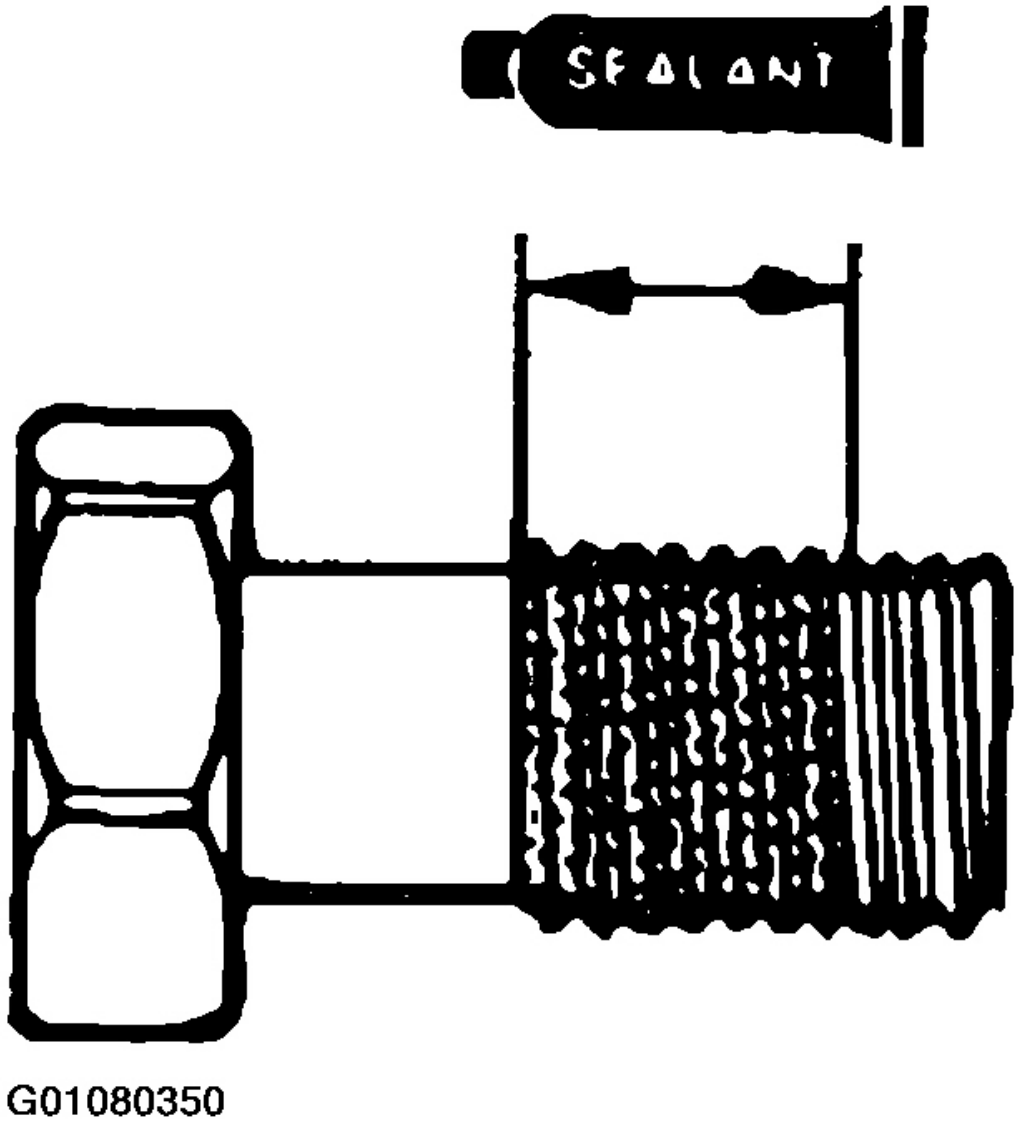


Fig. 144: Applying Sealant To Flywheel Bolts
Courtesy of KIA MOTORS AMERICA, INC.

73. Install separator plate onto cylinder block.

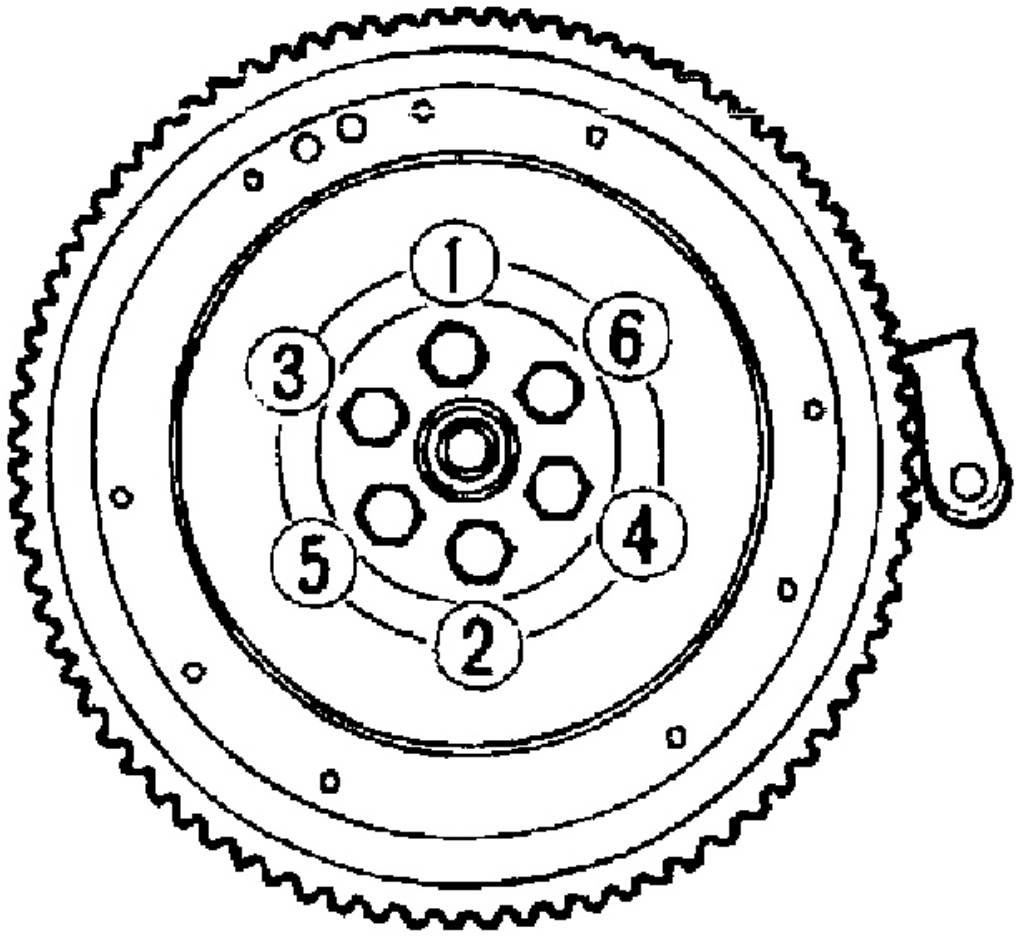
    Tightening torque: 13.7-22.4 lb-ft (18.6-30.4 N.m, 1.9-3.1 kg-m)

74. Install flywheel (M/T) or drive plate/backing plate/adapter (A/T) assembly onto crankshaft.
75. Install bolts (apply sealant to reused bolts).

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76. Install locking tool.
77. Tighten bolts in two or three steps to the specified torque.

Tightening torque: 71-75.9 lb-ft (97-103 N.m, 9.8-10.5 kg-m)



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Fig. 145: Flywheel (M/T) Or Drive Plate/Backing Plate/Adapter (A/T) Bolt Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

78. Install clutch disc and clutch cover (M/T).
79. Center the clutch disc with SST or equivalent and torque clutch cover bolts to specification (M/T).

Tightening torque: 16-24 lb-ft (22-32 N.m, 2.2-3.3 kg-m)

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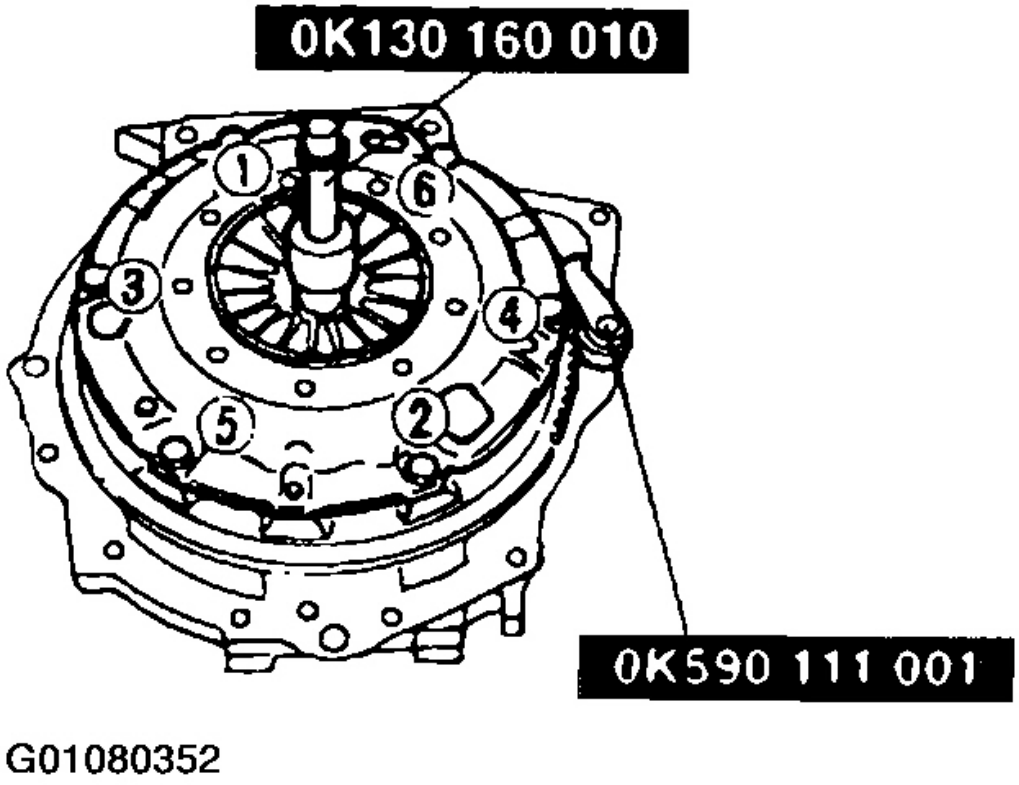
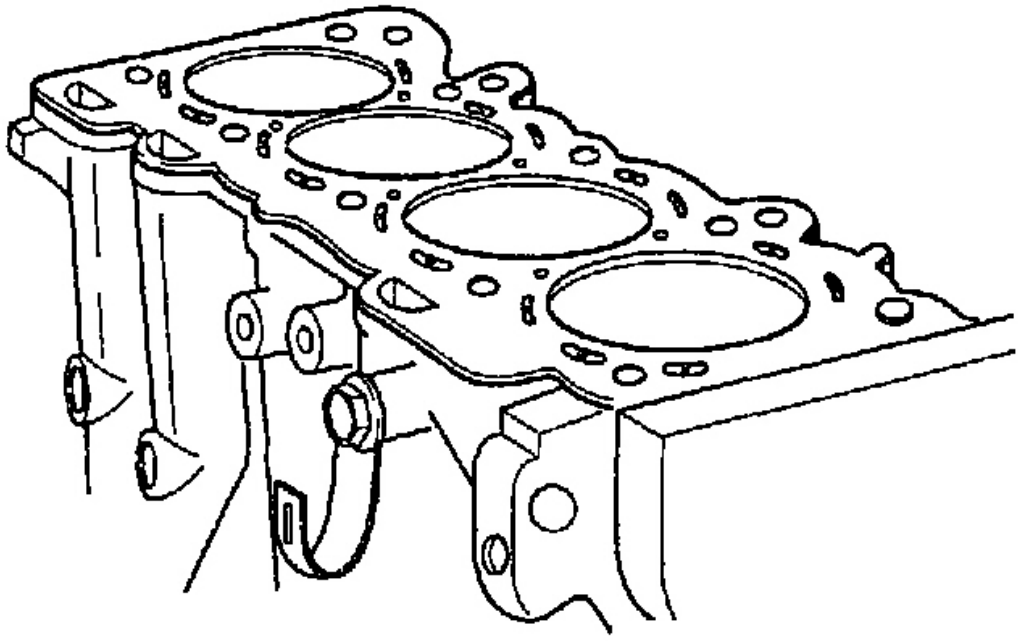


Fig. 146: Installing Clutch Disc And Clutch Cover
Courtesy of KIA MOTORS AMERICA, INC.

80. Remove locking tool.
81. Remove all foreign material from contact surface of cylinder head and cylinder block.
82. Place cylinder head gasket onto cylinder block and lower cylinder head onto cylinder block.

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Fig. 147: Installing Cylinder Head Gasket
Courtesy of KIA MOTORS AMERICA, INC.

83. For additional cylinder head installation information, see **CYLINDER HEAD ASSEMBLY**.
84. Install cylinder head bolts.
85. Tighten cylinder head bolts according to following procedure:
    a. Tighten cylinder head bolts in order shown in figure. See **Fig. 148**.

       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: 28.9 lb-ft (39.2 N.m, 4 kg-m)

    d. Mark cylinder head bolts for rotational reference.
    e. Rotate cylinder head bolts 90°(1/4 Turn) in order shown.
    f. Rotate cylinder head bolts another 90°(1/4 Turn) in order shown.

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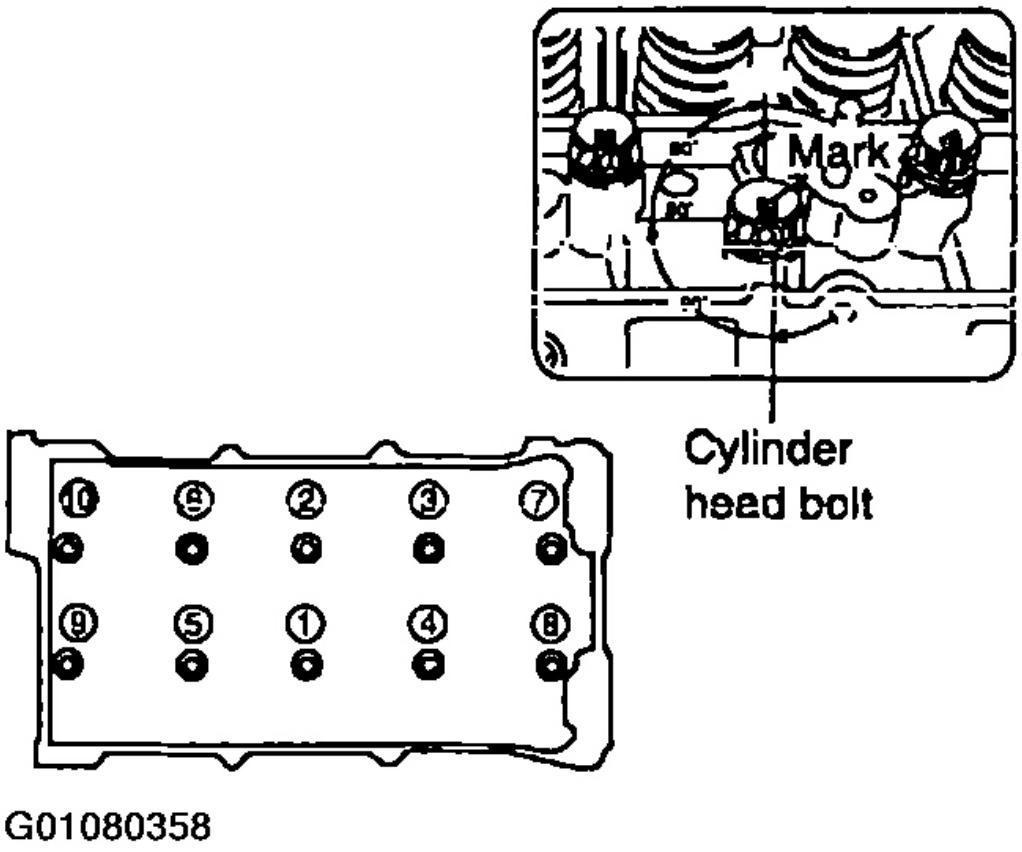


Fig. 148: Cylinder Head Bolt Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

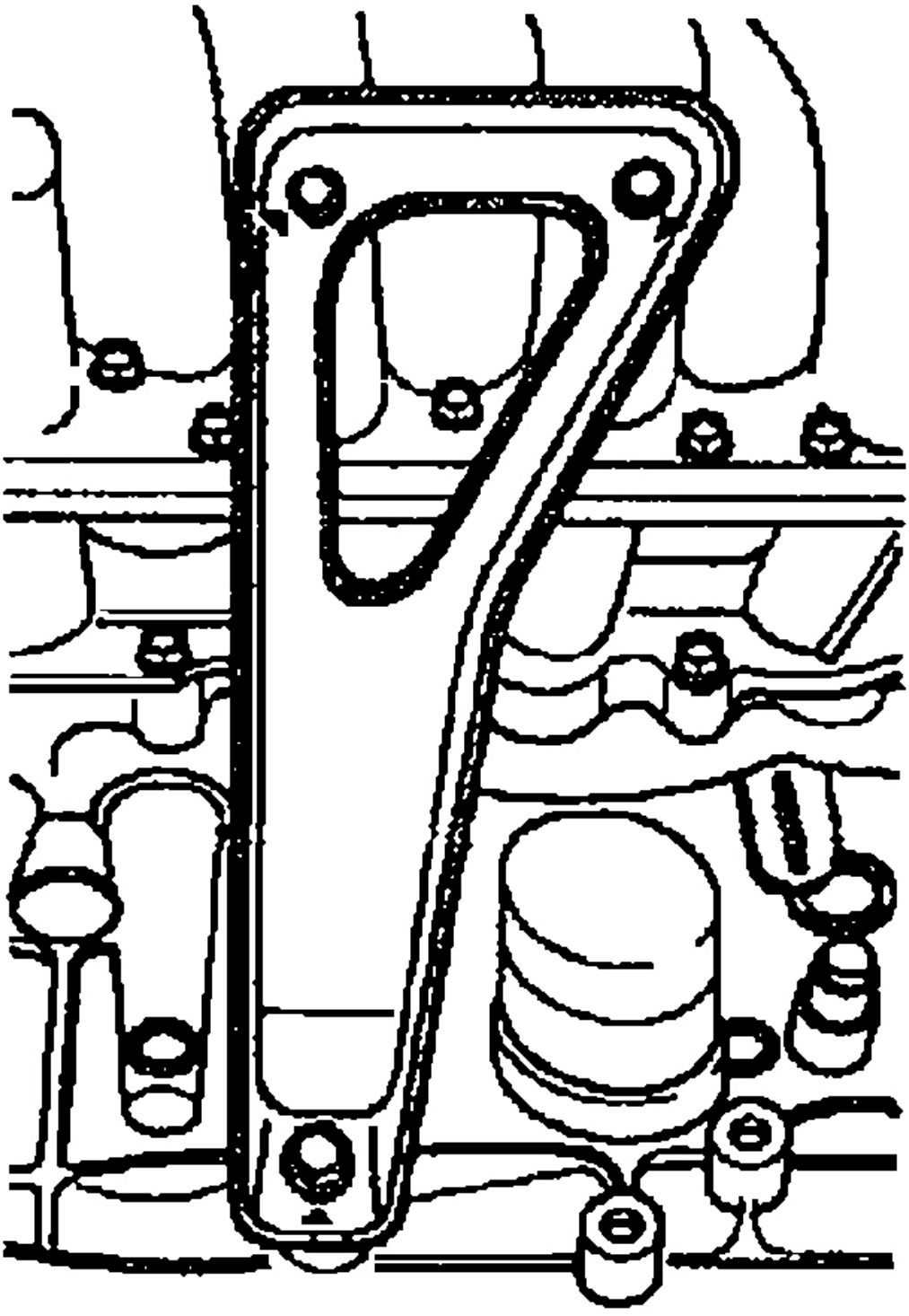
86. Install HLA's. See **HYDRAULIC LASH ADJUSTER (HLA)**.
87. For camshaft sprocket and timing belt information, see **TIMING SYSTEM**.
88. Install new intake manifold gasket.
89. Install intake manifold.

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

90. Install intake manifold bracket.

    Tightening torque: 27.5-38.3 lb-ft (37.2-51.9 N.m, 3.8-5.3 kg-m)

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Fig. 149: Installing Intake Manifold Bracket
Courtesy of KIA MOTORS AMERICA, INC.

91. Install generator and generator mounting bolts and adjusting bolt.
92. Install generator belt and adjust it to specification.
    Generator drive belt deflection
    New: 0.31-0.35 in (8-9 mm)
    Used: 0.35-0.39 in (1-90 mm)
93. Tighten all bolts to specified torque.
    Tightening torque:
    Mounting bolts: 27-38 lb-ft (37-52 N.m)
    Adjusting bolt: 14~19 lb-ft (19-52 N.m)
94. Install front and rear engine hangers.

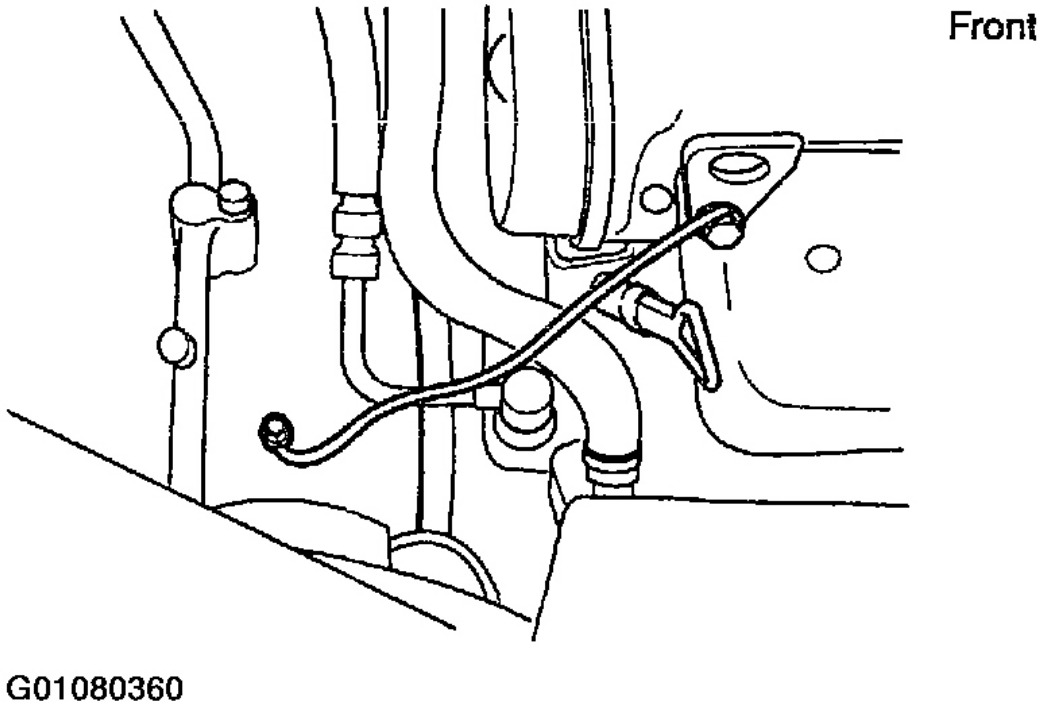


Fig. 150: Installing Front And Rear Engine Hangers And Grounds
Courtesy of KIA MOTORS AMERICA, INC.

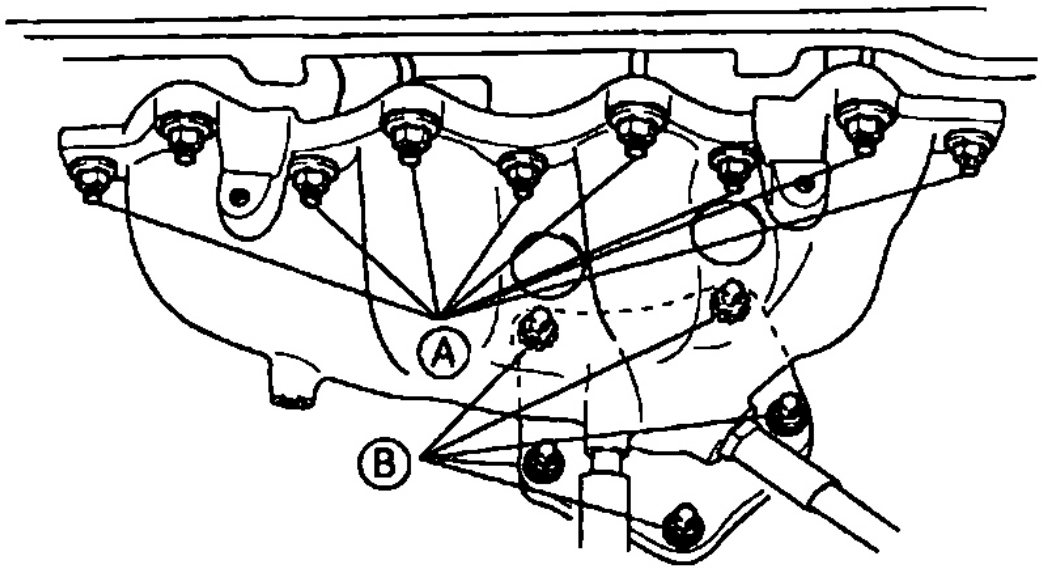
95. Hang engine with baby crane from engine stand.
96. Install exhaust manifold and coolant bypass pipe.

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Tightening torque:

A: 28.2~34 lb-ft (38.2-46.1 N.m, 3.9-4.7 kg-m)

B: 15.9~21 lb-ft (21.6-28.4 N.m, 2.2-2.9 kg-m)



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Fig. 151: Installing Exhaust Manifold Nuts
Courtesy of KIA MOTORS AMERICA, INC.

97. Install No. 3 engine mount and bracket.

Tightening torque:

54.1-75.9 lb-ft (73.5-102.9 N.m, 7.5-10.5 kg-m)

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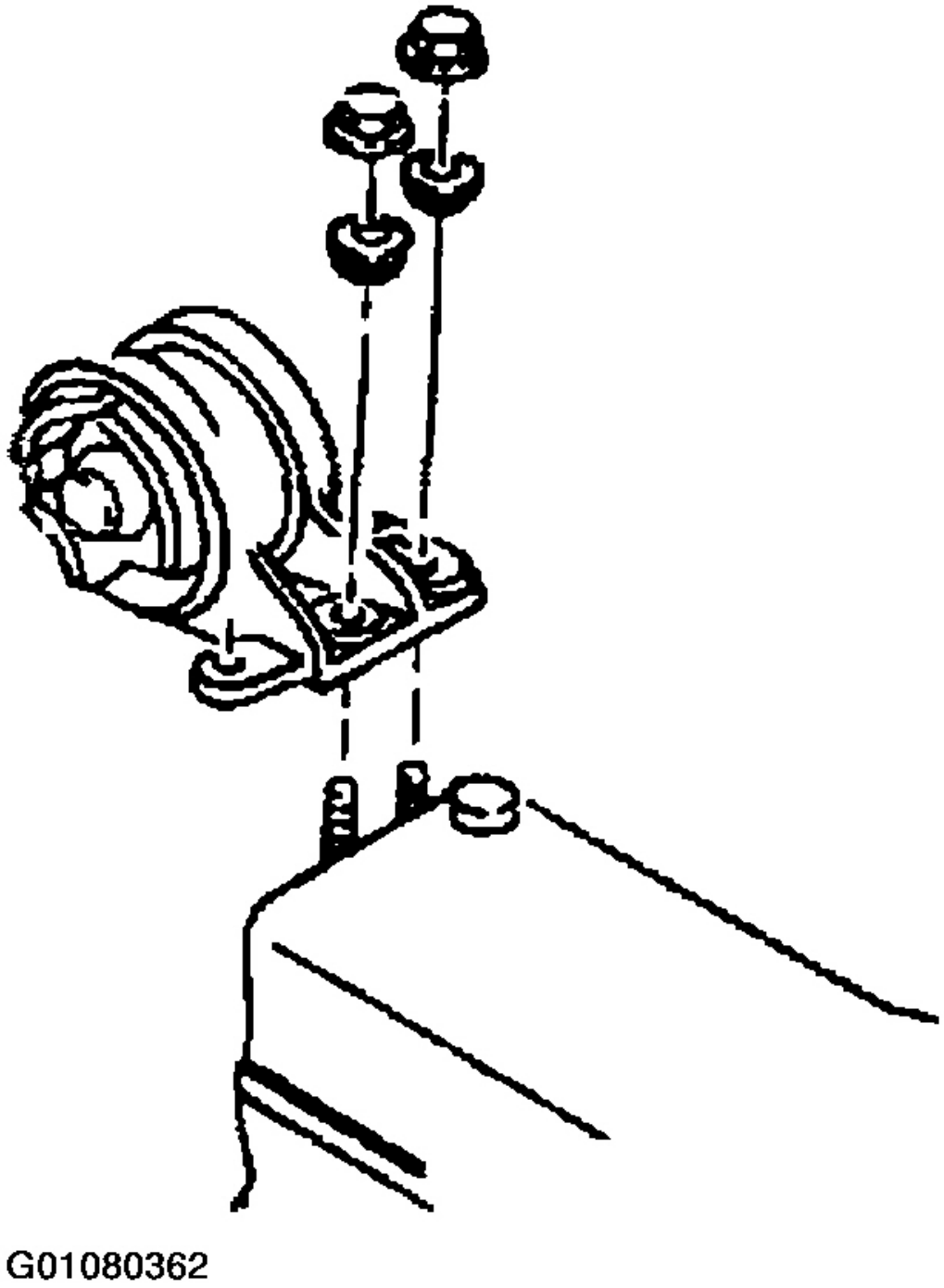


Fig. 152: Installing No. 3 Engine Mount And Bracket
Courtesy of KIA MOTORS AMERICA, INC.

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98. Install No. 2 engine mount.

    Tightening torque: 27.5-38.3 lb-ft (37.2-51.9 N.m, 3.8-5.3 kg-m)

99. Install transaxle and eight transaxle mounting bolts

    Tightening torque:

    4 upper bolts (1,2,3,4): 65.8-86.1 lb-ft (89-116 N.m, 9.1-11.9 kg-m)

    4 lower bolts (5,6,7,8): 27.5-38.3 lb-ft (37-52 N.m, 3.8-5.3 kg-m)

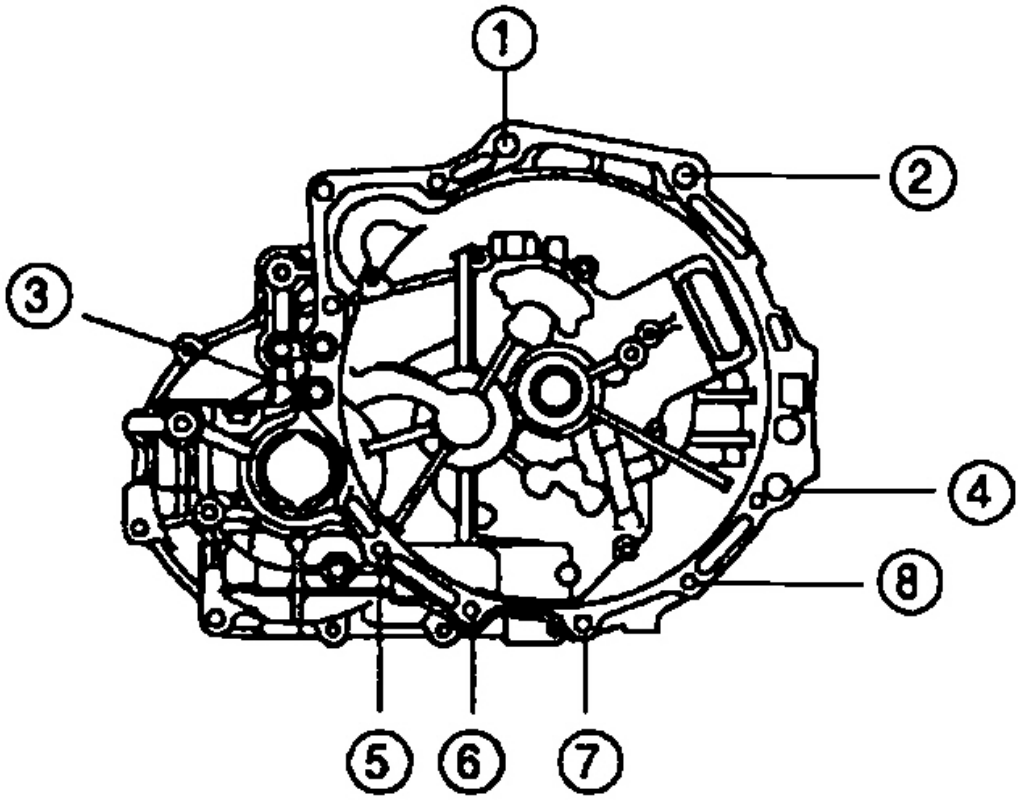


Fig. 153: Installing Transaxle Mounting Bolts
Courtesy of KIA MOTORS AMERICA, INC.

100. Install starter.

     Tightening torque: 27-38 lb-ft (37-52 N.m, 3.7~5.8 kg-m)

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101. Fill with specified type and amount of engine oil and check for leaks.

CYLINDER HEAD REMOVAL & INSTALLATION

REMOVAL

1. Disconnect negative battery cable.

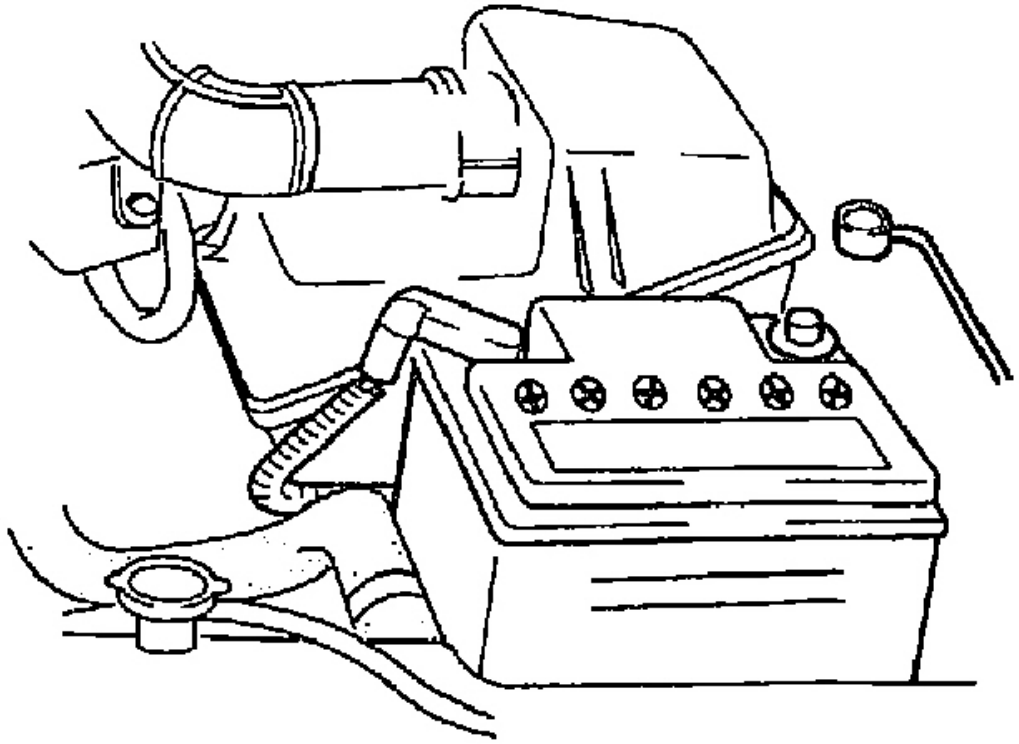


Fig. 154: Disconnecting Negative Battery Cable
Courtesy of KIA MOTORS AMERICA, INC.

2. Relieve fuel system pressure. See **FUEL DELIVERY SYSTEM** .
3. Drain engine coolant.

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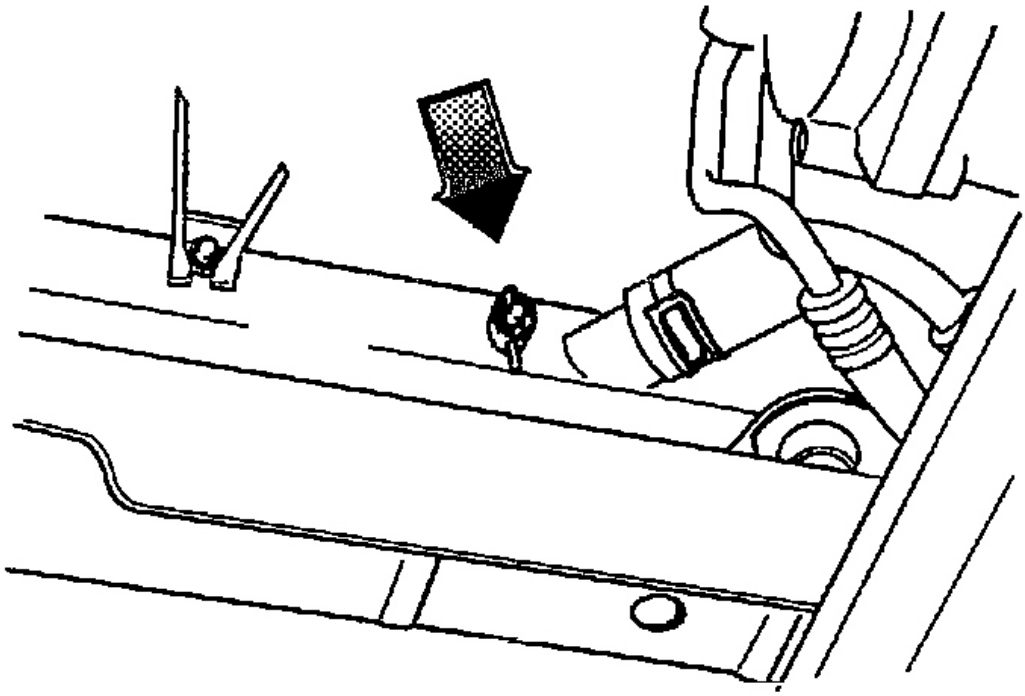


Fig. 155: Identifying Radiator Drain Plug
Courtesy of KIA MOTORS AMERICA, INC.

4. Drain engine oil.

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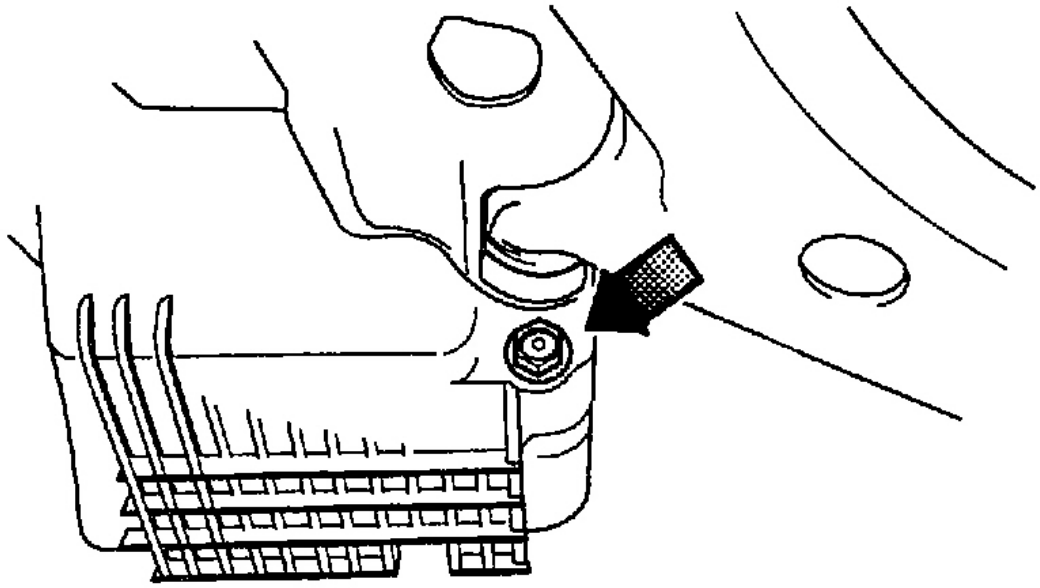
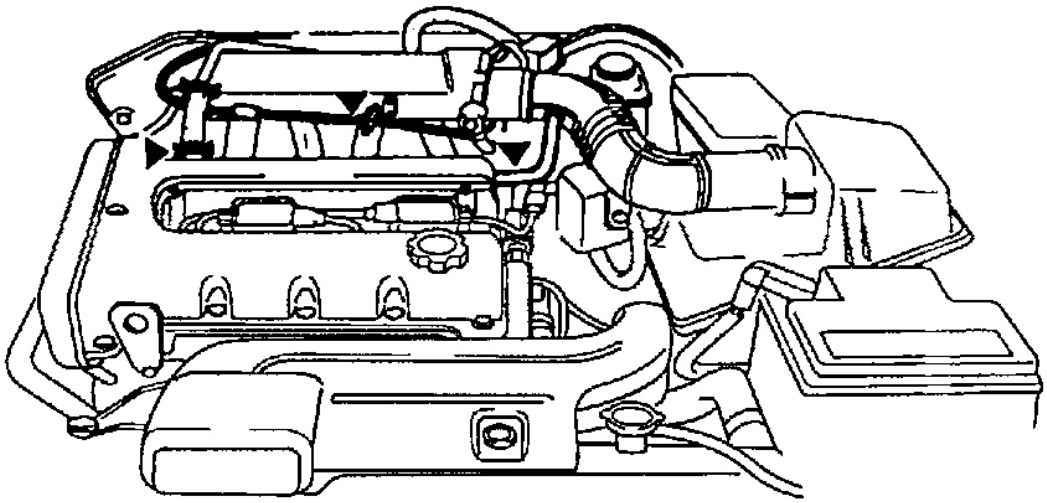


Fig. 156: Identifying Engine Oil Drain Plug
Courtesy of KIA MOTORS AMERICA, INC.

5. Remove PCV hose and ventilation hose.
6. Remove accelerator cable and auto cruise control cable if equipped.

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Fig. 157: Removing Accelerator And Cruise Control Cable
Courtesy of KIA MOTORS AMERICA, INC.

7. Remove air intake hose and fresh air duct.

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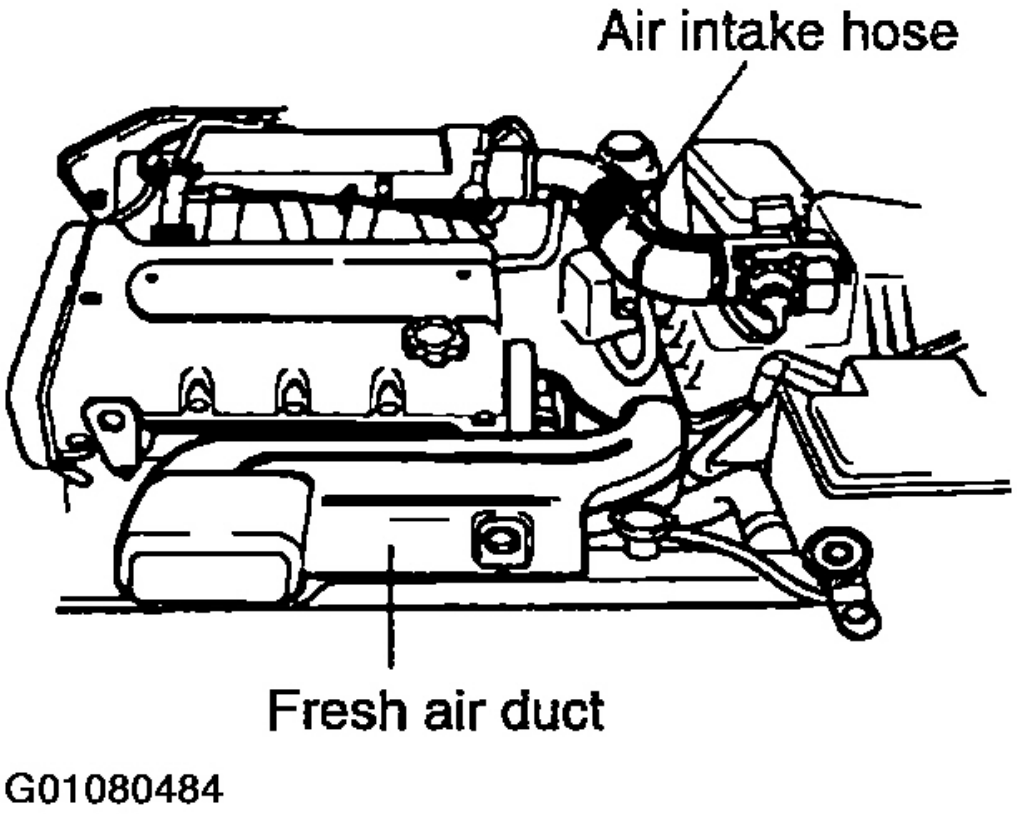


Fig. 158: Removing Air Intake Hose And Fresh Air Duct
Courtesy of KIA MOTORS AMERICA, INC.

8. Disconnect brake vacuum hose and purge control vacuum hose at dynamic chamber.

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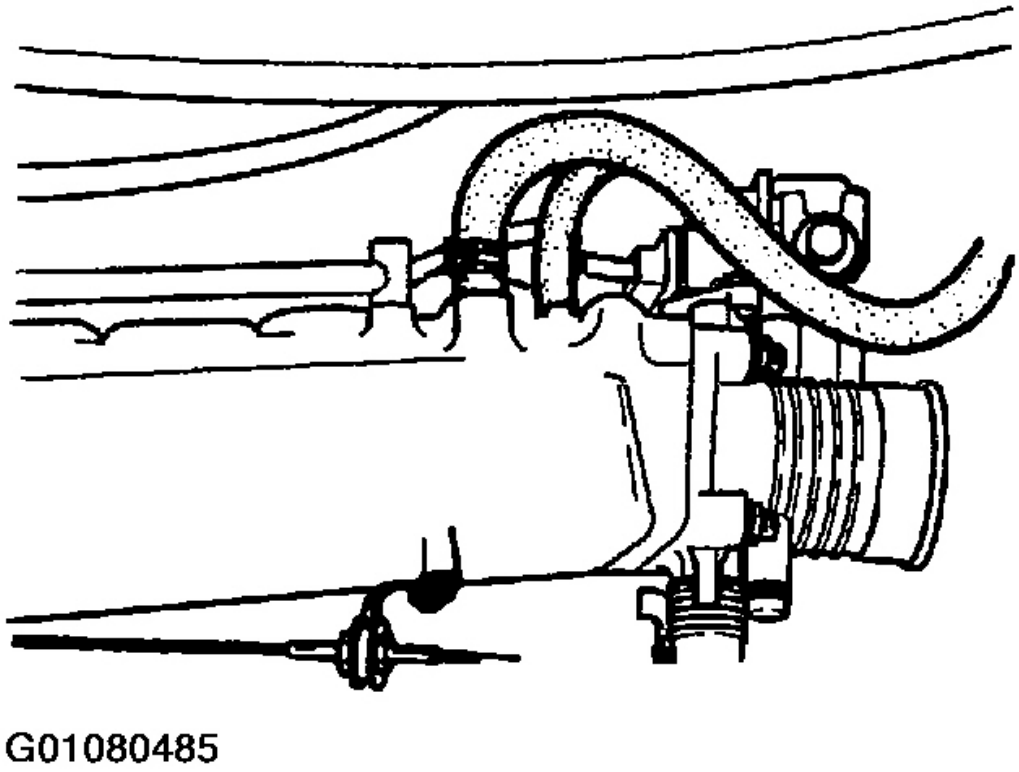


Fig. 159: Disconnecting Brake Vacuum And Purge Control Vacuum Hose
Courtesy of KIA MOTORS AMERICA, INC.

9. Remove upper radiator hose.

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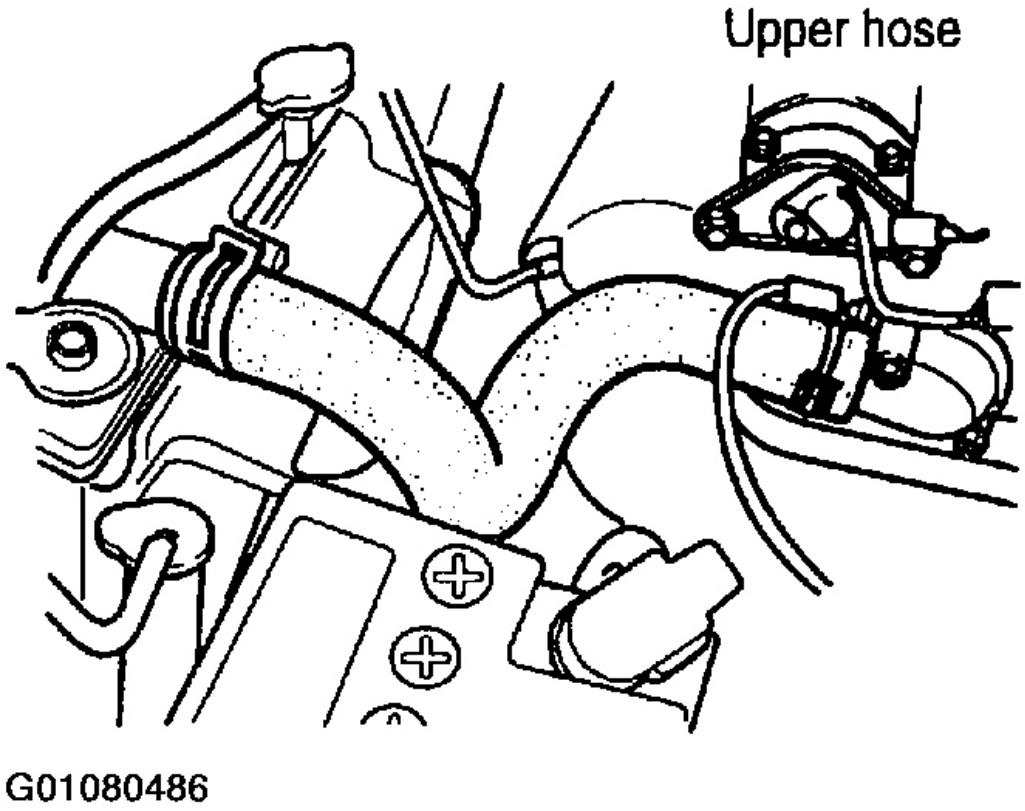


Fig. 160: Removing Upper Radiator Hose
Courtesy of KIA MOTORS AMERICA, INC.

10. Disconnect fuel hose from injector rail.

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

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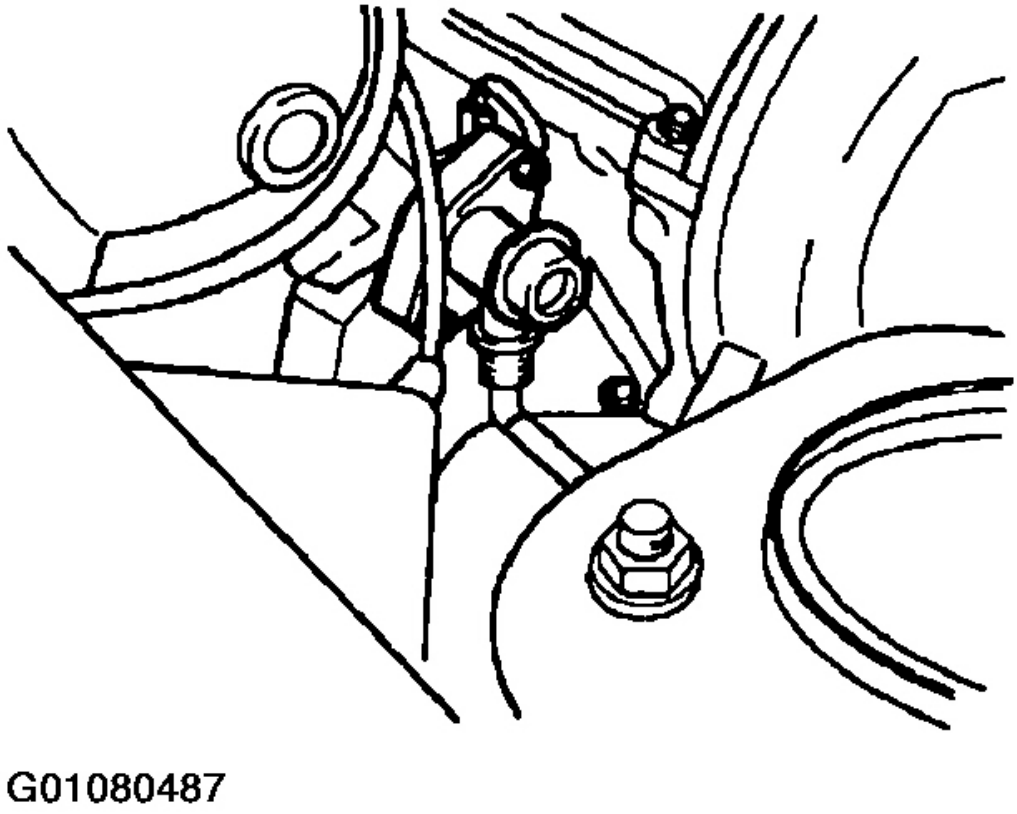


Fig. 161: Disconnecting Fuel Hose From Injector Rail
Courtesy of KIA MOTORS AMERICA, INC.

11. Remove heater hoses.

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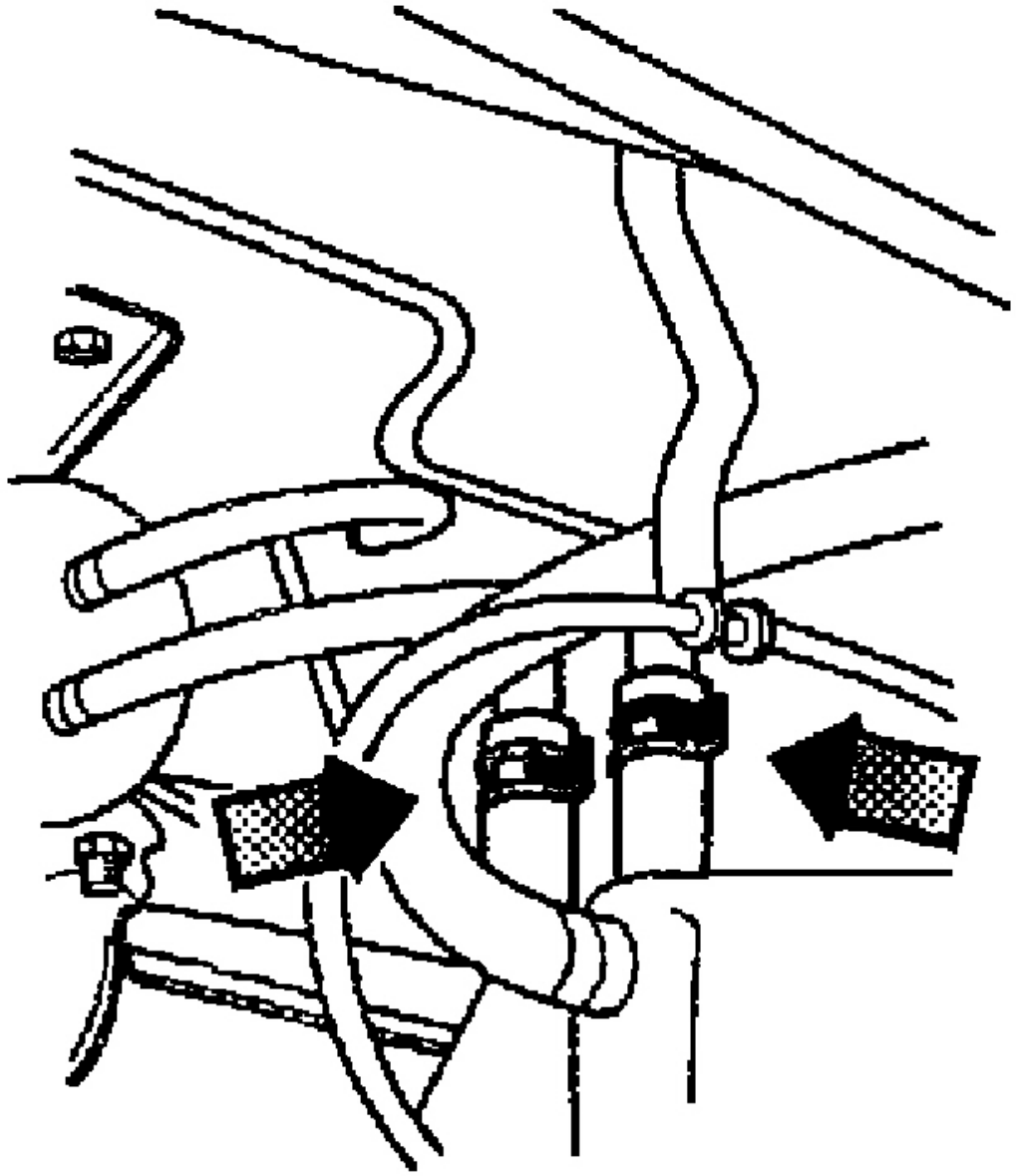
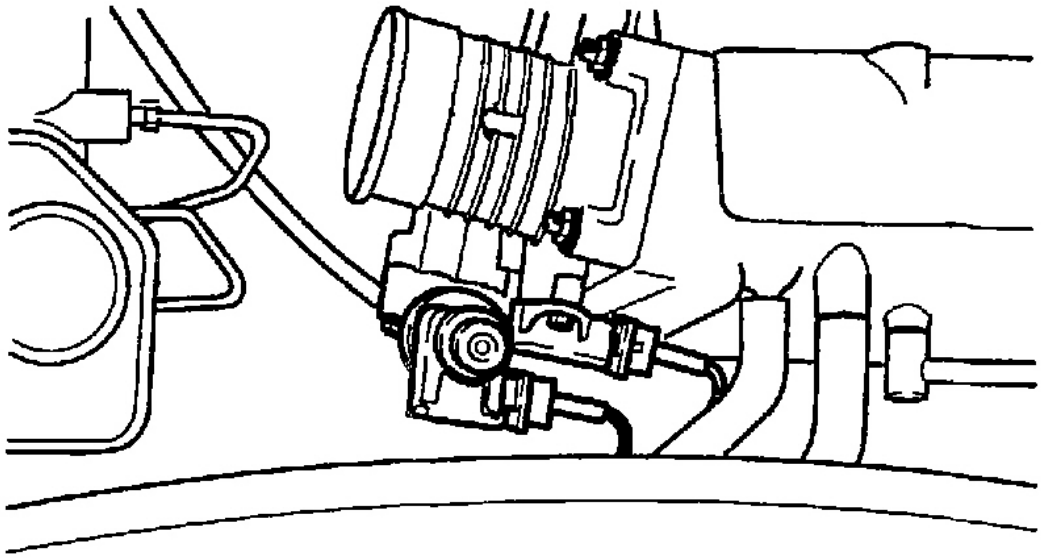


Fig. 162: Removing Heater Hoses
Courtesy of KIA MOTORS AMERICA, INC.

12. Disconnect IAC and throttle position sensor connectors.

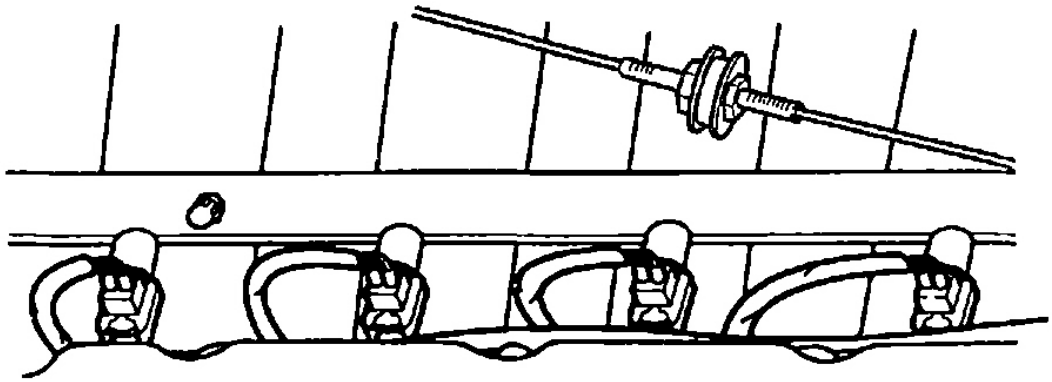
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Fig. 163: Disconnecting IAC And Throttle Position Sensor Connectors
Courtesy of KIA MOTORS AMERICA, INC.

13. Disconnect injector connectors.



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Fig. 164: Disconnecting Injector Connectors
Courtesy of KIA MOTORS AMERICA, INC.

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14. Disconnect electrical connectors, remove bracket and reinstall engine hanger.

    Tightening torque: 27.5~38.3 lb.ft (37.2~51.9 N.m, 3.8~5.3 kg.m)

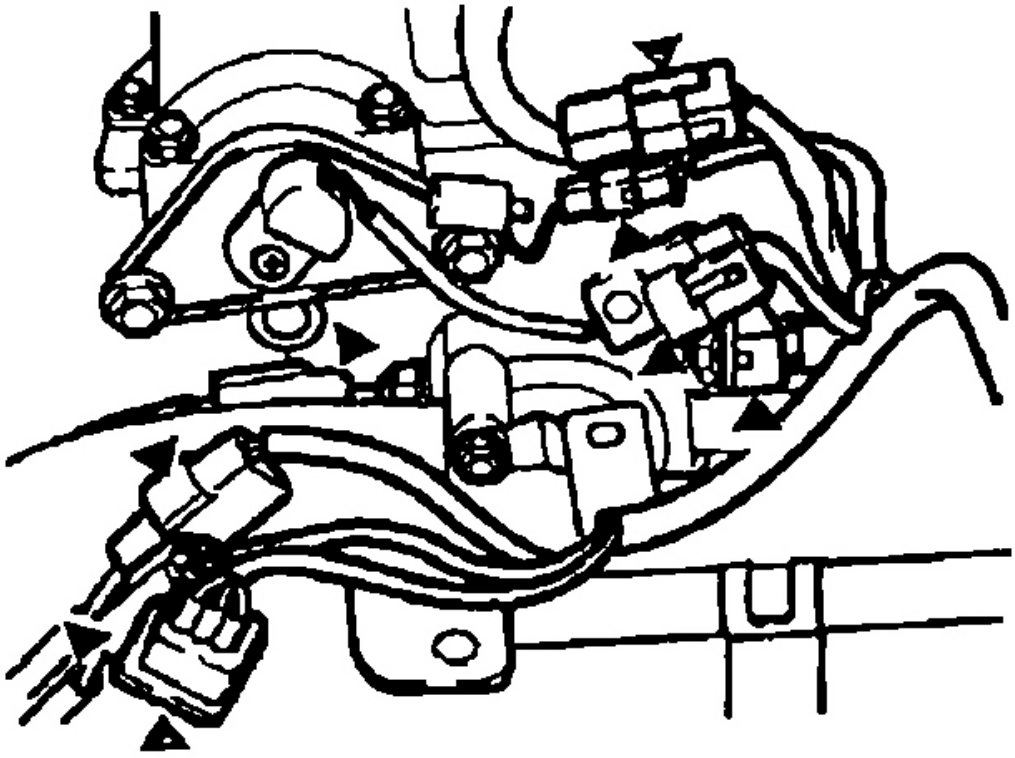


Fig. 165: Disconnecting Electrical Connectors, Removing Bracket And Reinstalling Engine Hanger
Courtesy of KIA MOTORS AMERICA, INC.

15. Disconnect ground strap.

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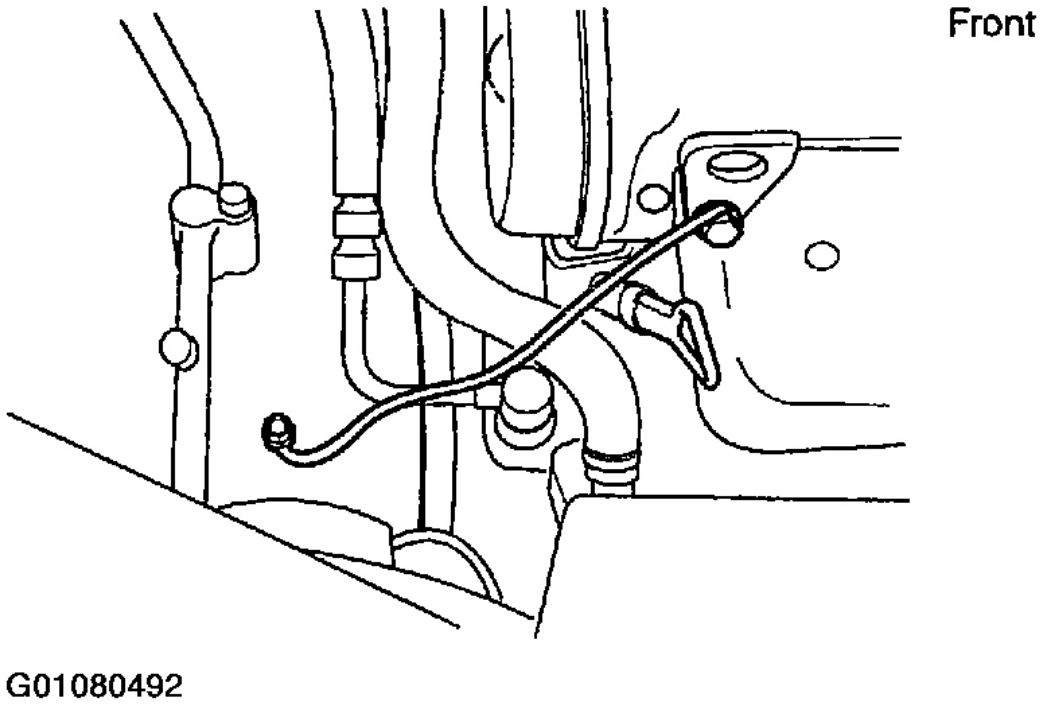


Fig. 166: Disconnecting Ground Strap
Courtesy of KIA MOTORS AMERICA, INC.

16. Remove exhaust manifold heat shield.

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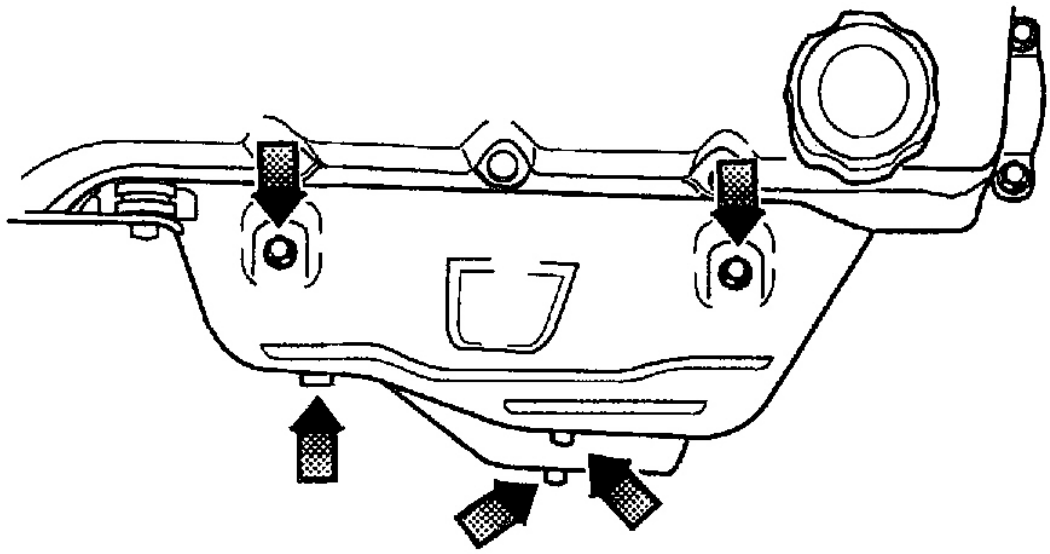
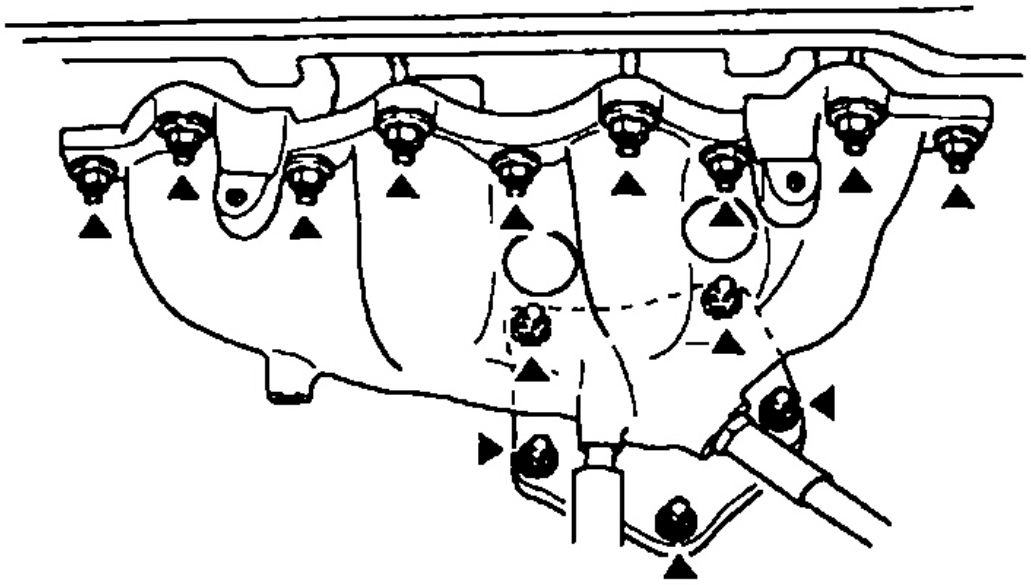


Fig. 167: Removing Exhaust Manifold Heat Shield
Courtesy of KIA MOTORS AMERICA, INC.

17. Remove exhaust manifold pipe.

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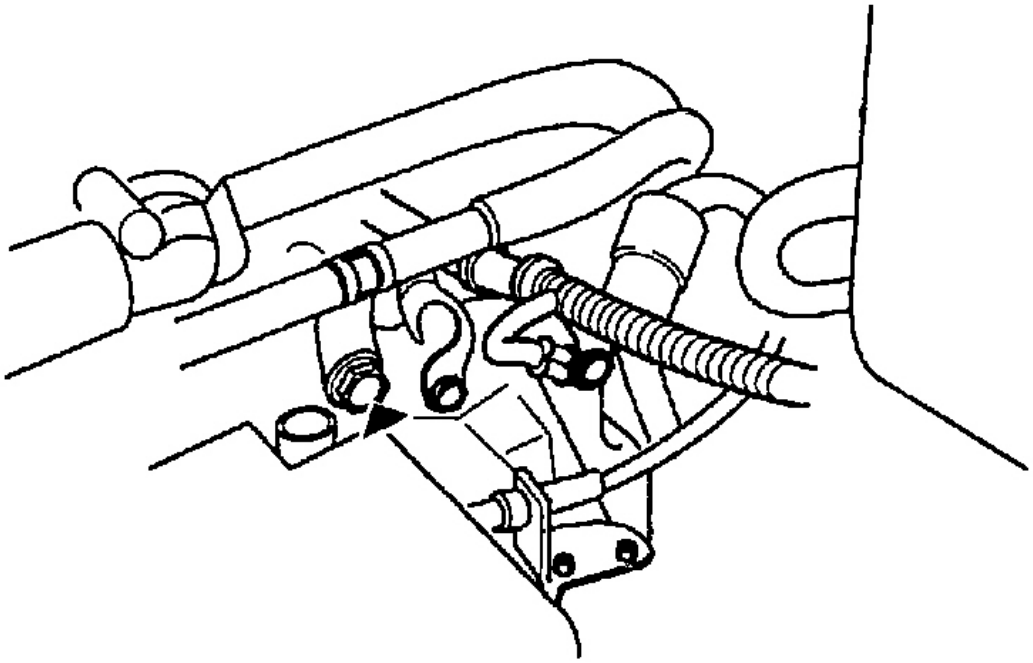


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Fig. 168: Removing Exhaust Manifold Pipe
Courtesy of KIA MOTORS AMERICA, INC.

18. Remove coolant bypass pipe.

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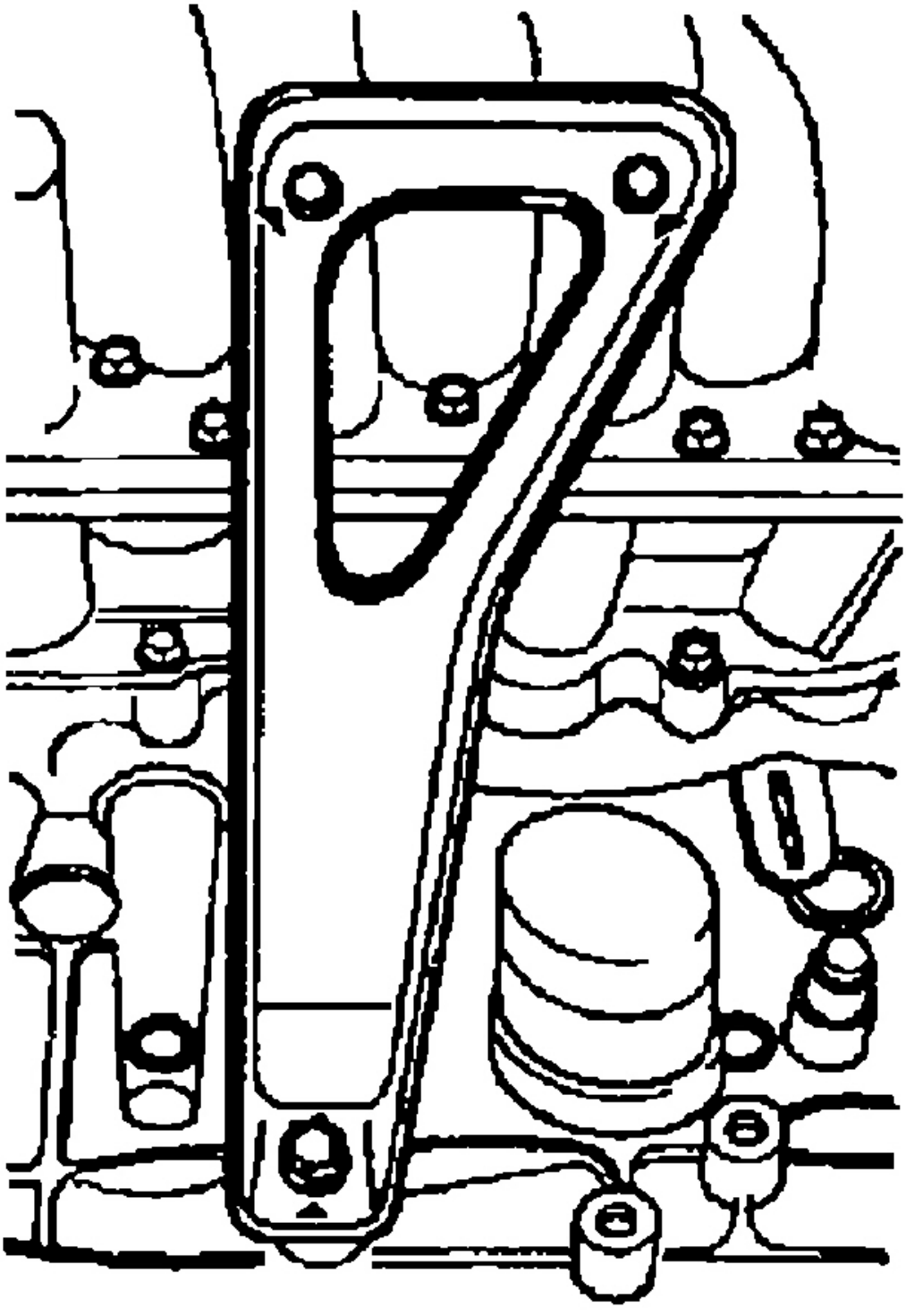


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Fig. 169: Removing Coolant Bypass Pipe
Courtesy of KIA MOTORS AMERICA, INC.

19. Remove intake manifold support bracket.

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Fig. 170: Removing Intake Manifold Support Bracket
Courtesy of KIA MOTORS AMERICA, INC.

20. For camshaft and HLA removal procedure, see **HYDRAULIC LASH ADJUSTER (HLA)**.
21. For timing belt removal procedure, see **TIMING SYSTEM**.
22. Loosen cylinder head bolts in two or three steps following order shown in figure.

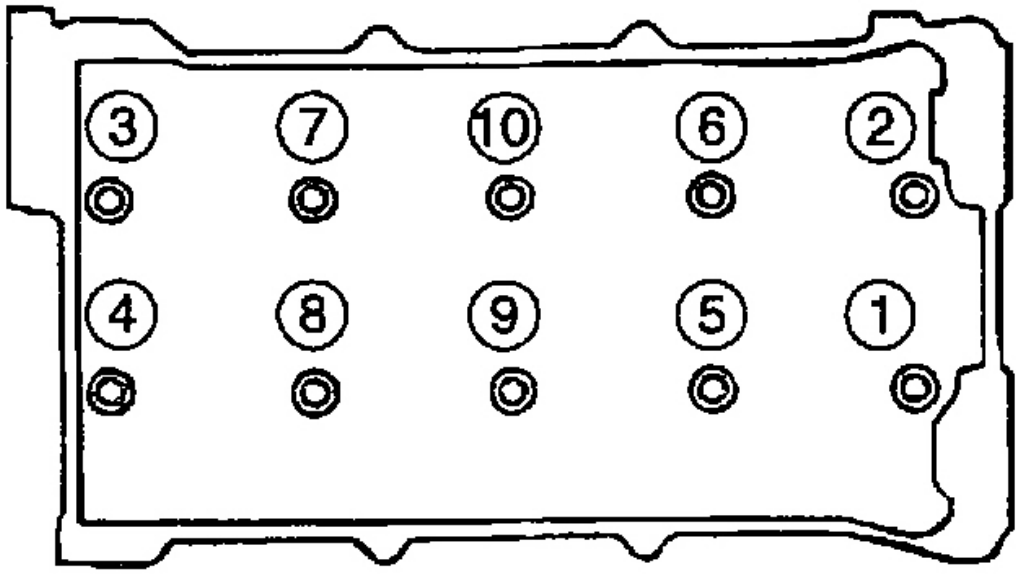


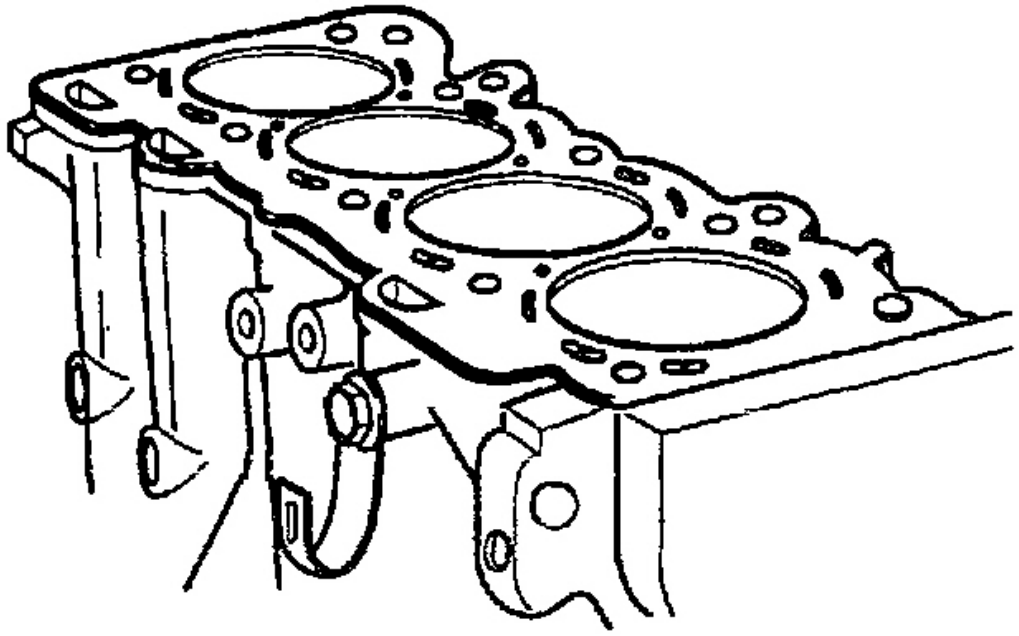
Fig. 171: Cylinder Head Bolt Loosening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

23. Remove cylinder head.

INSTALLATION

1. Install new cylinder head gasket onto cylinder block and lower cylinder head onto engine.

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Fig. 172: Installing New Cylinder Head Gasket
Courtesy of KIA MOTORS AMERICA, INC.

2. Install cylinder head bolts.
3. Tighten cylinder head bolts according to following procedure:
   a. Tighten cylinder head bolts in order shown in figure. See **Fig. 173**.

      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: 28.9 lb.ft (39.2 N.m, 4 kg.m)

   d. Mark cylinder head bolts for rotational reference.
   e. Rotate cylinder head bolts 90° (1/4 Turn) in order shown.
   f. Rotate cylinder head bolts another 90° (1/4 Turn) in order shown.

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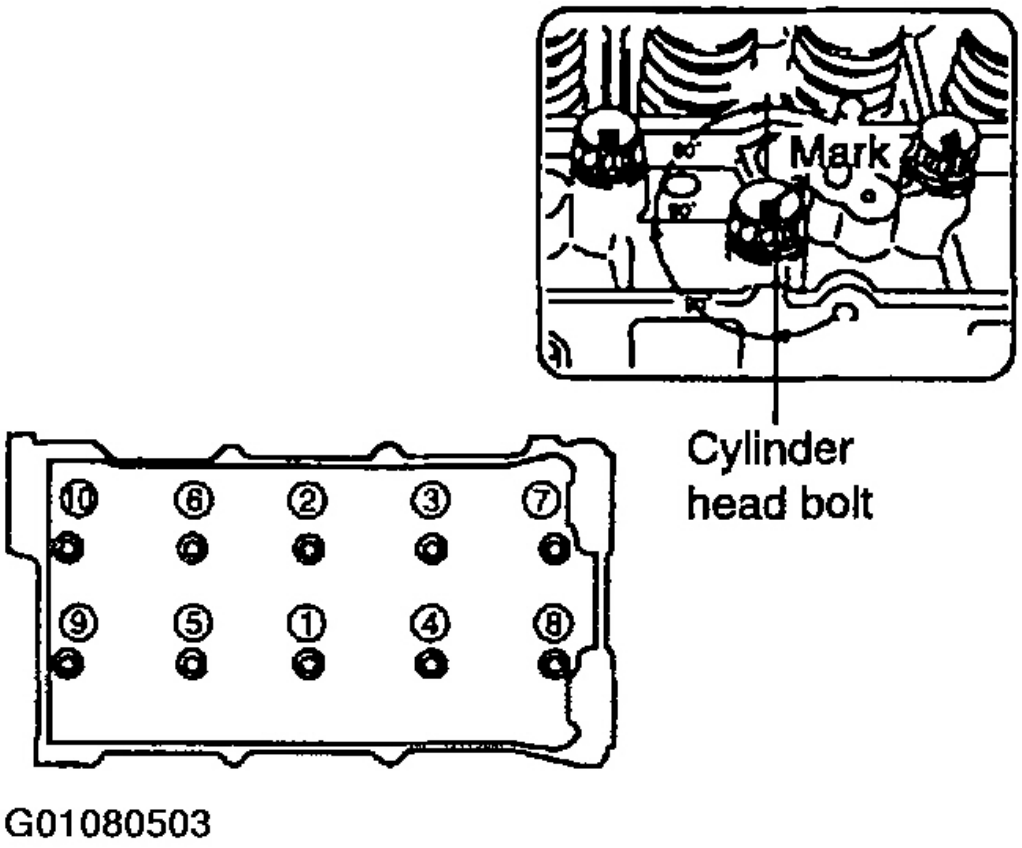
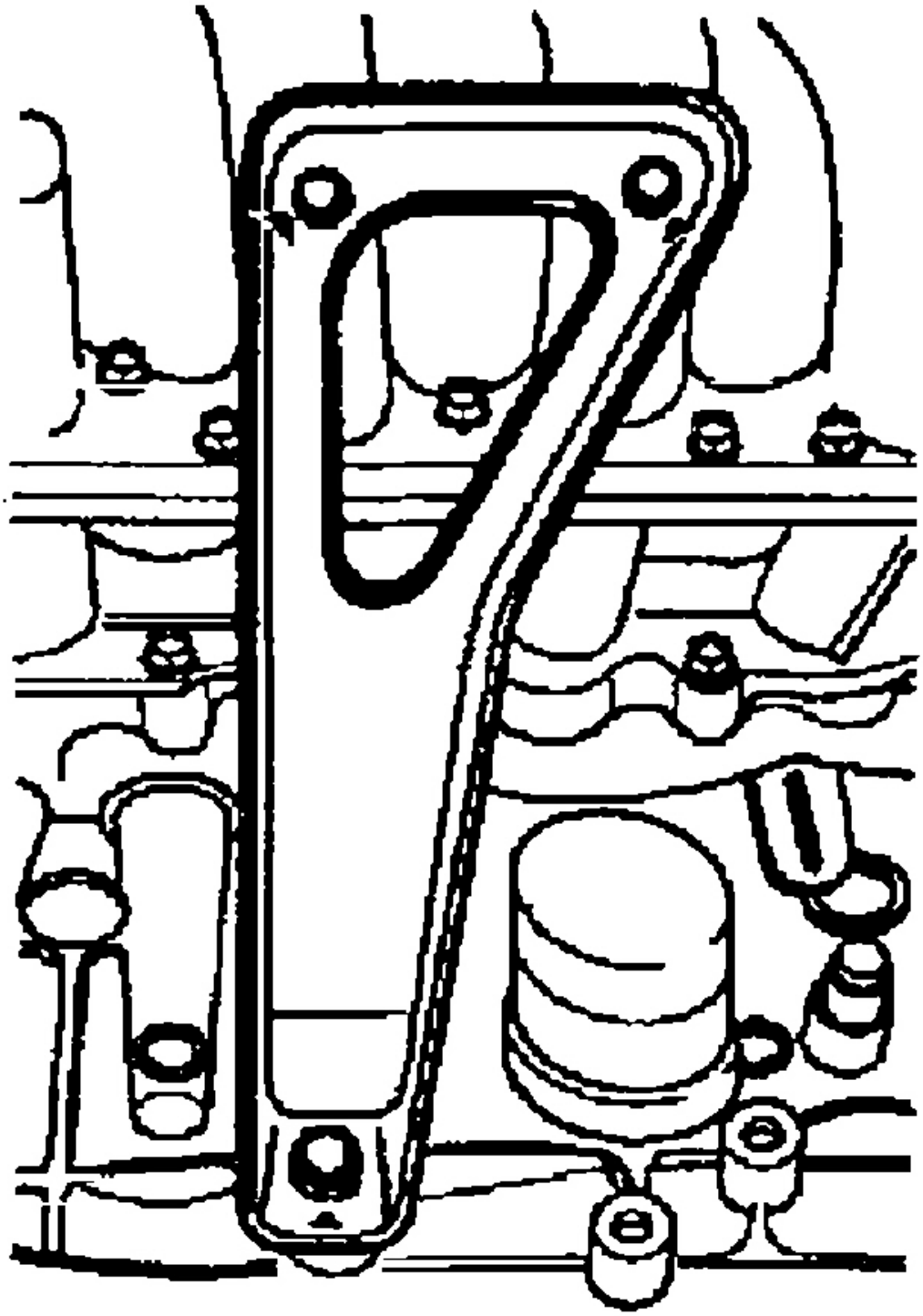


Fig. 173: Cylinder Head Bolt Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

4. For timing belt installation procedure, see **TIMING SYSTEM**.
5. For camshaft and HLA installation procedure, see **HYDRAULIC LASH ADJUSTER (HLA)**.
6. Install intake manifold support bracket.

Tightening torque: 27.5~38.3 lb.ft (37.2~51.9 N.m, 3.8~5.3 kg.m)

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Fig. 174: Installing Intake Manifold Support Bracket
Courtesy of KIA MOTORS AMERICA, INC.

7. Install coolant bypass pipe

   Tightening torque: 65.8~86 lb.ft (89.2~116.6 N.m, 9.1~11.9 kg.m)

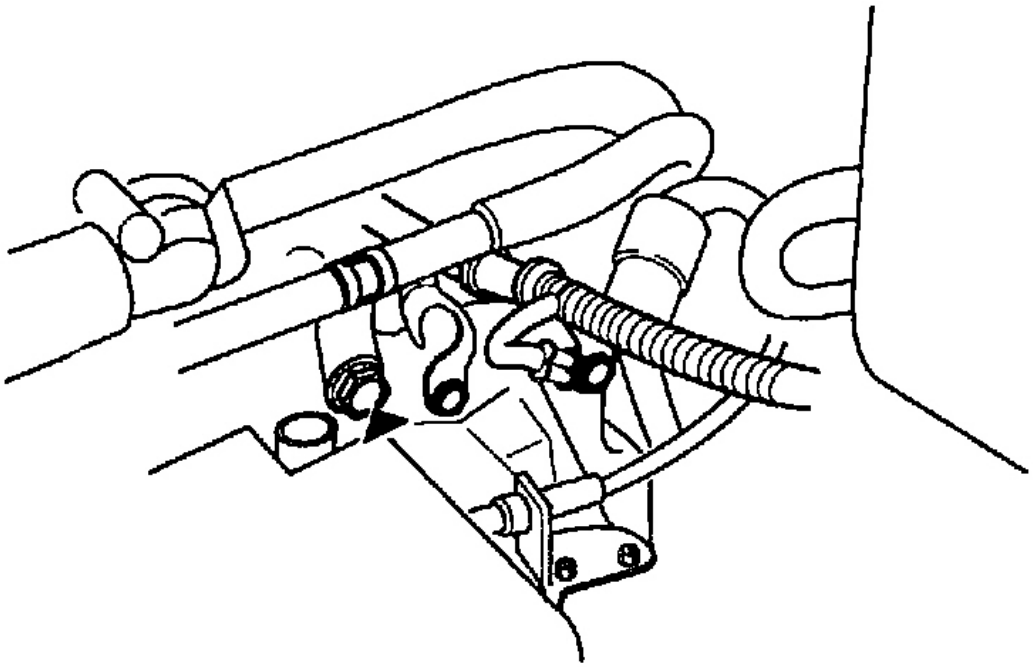
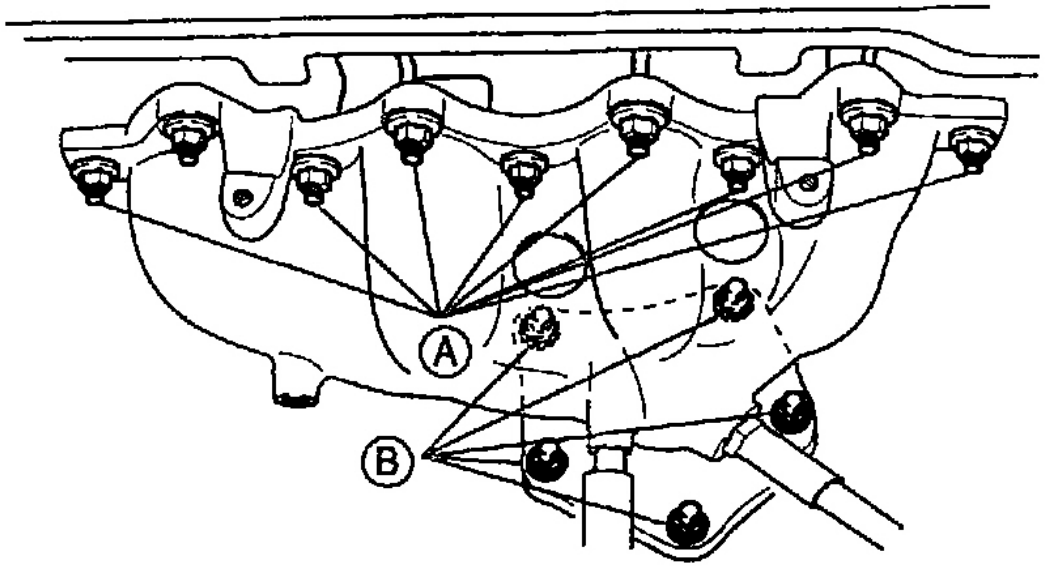


Fig. 175: Installing Coolant Bypass Pipe
Courtesy of KIA MOTORS AMERICA, INC.

8. Install exhaust manifold.
   Tightening torque:
   A: 28~34 lb.ft (38~46 N.m, 3.9~4.7 kg.m)
   B: 16~21 lb.ft (22~28 N.m, 2.2~2.9 kg.m)

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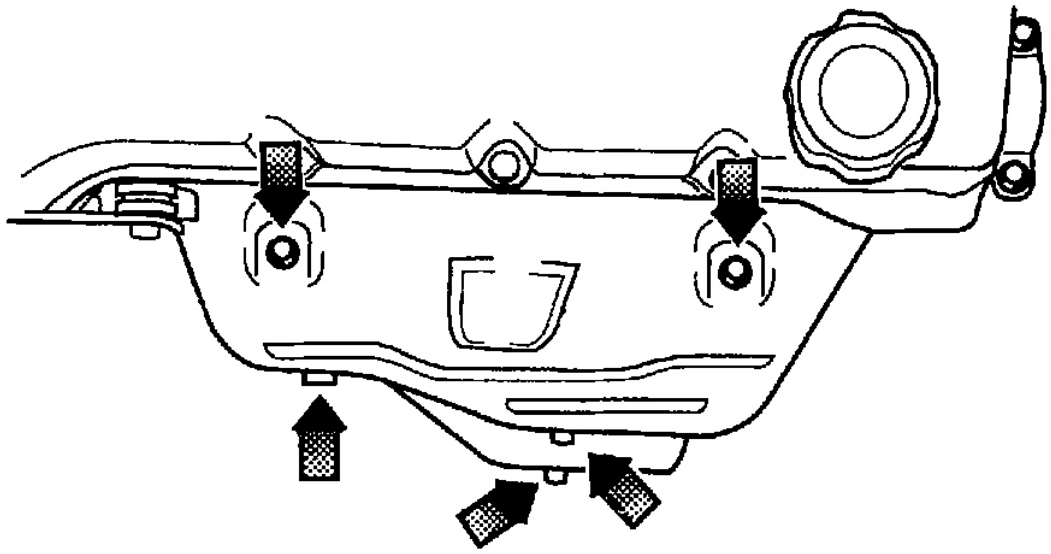
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Fig. 176: Identifying Exhaust Manifold Nut Position
Courtesy of KIA MOTORS AMERICA, INC.

9. Install exhaust manifold heat shield.

   Tightening torque: 13.7~22.4 lb.ft (18.6~30.3 N.m, 1.9~3.1 kg.m)

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Fig. 177: Installing Exhaust Manifold Heat Shield
Courtesy of KIA MOTORS AMERICA, INC.

10. Reconnect ground strap.

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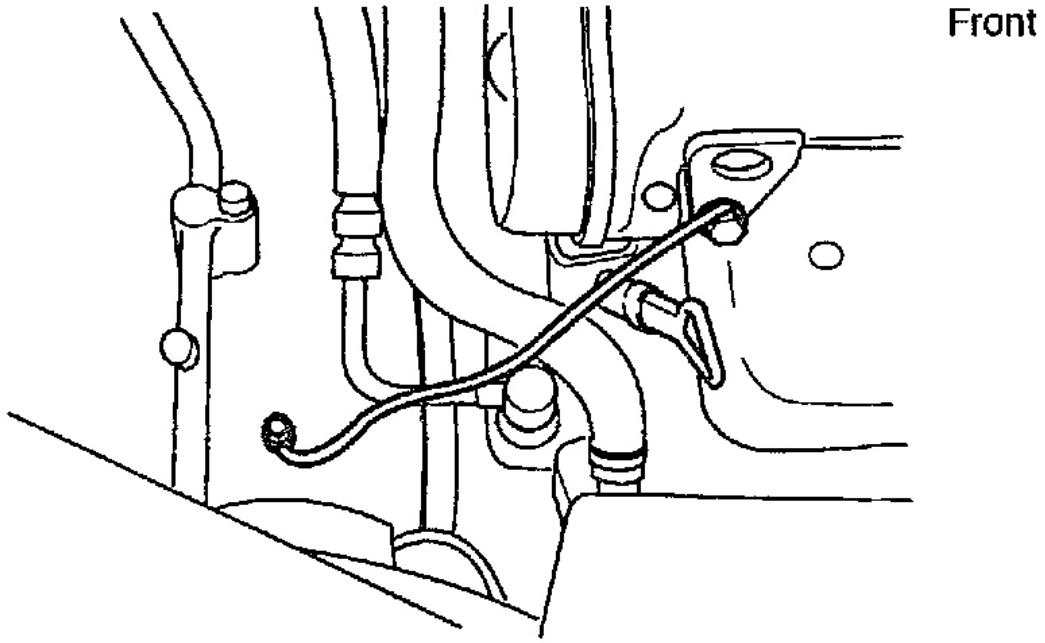


Fig. 178: Reconnecting Ground Strap
Courtesy of KIA MOTORS AMERICA, INC.

11. Install connector bracket and reconnect electrical connectors.

Tightening torque (engine hanger bolt): 27.5~38.3 lb.ft (37.2~51.9 N.m, 3.8~5.3 kg.m)

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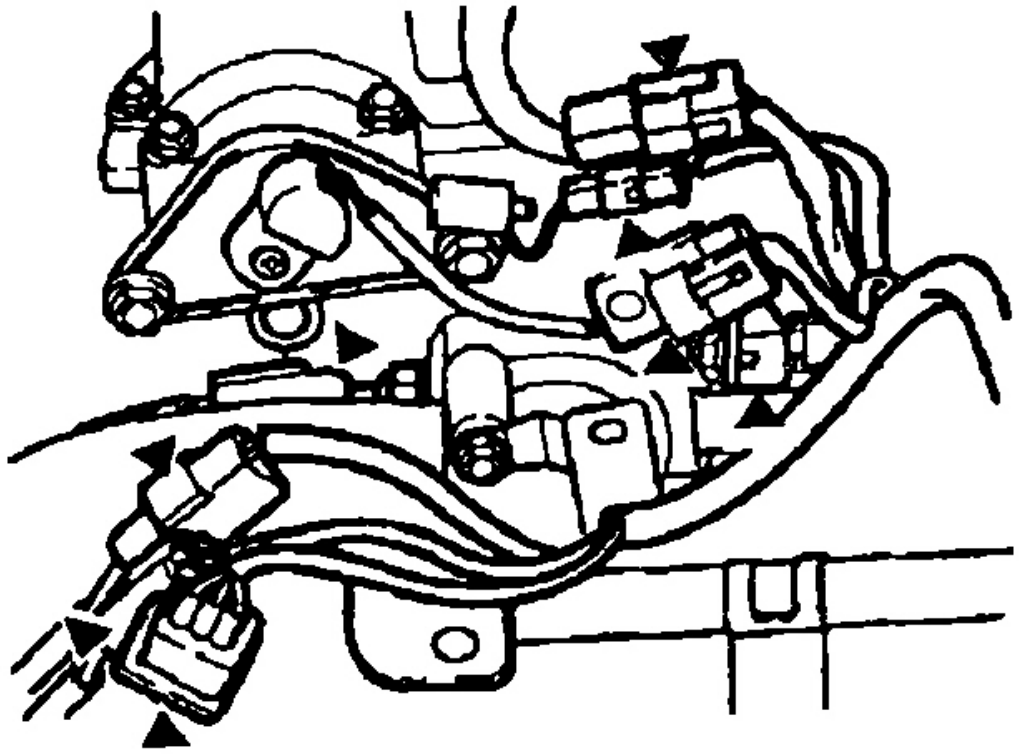


Fig. 179: Installing Connector Bracket And Reconnecting Electrical Connectors
Courtesy of KIA MOTORS AMERICA, INC.

12. Connect injector connectors.

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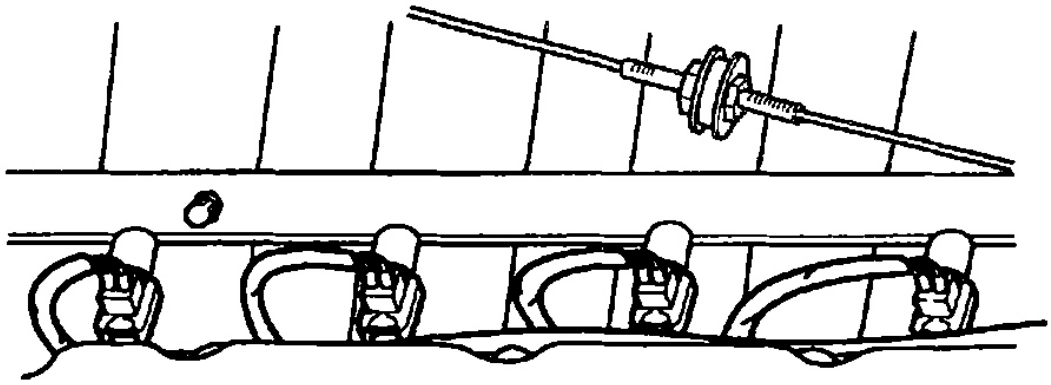


Fig. 180: Connecting Injector Connectors
Courtesy of KIA MOTORS AMERICA, INC.

13. Connect IAC and throttle position sensor connectors.

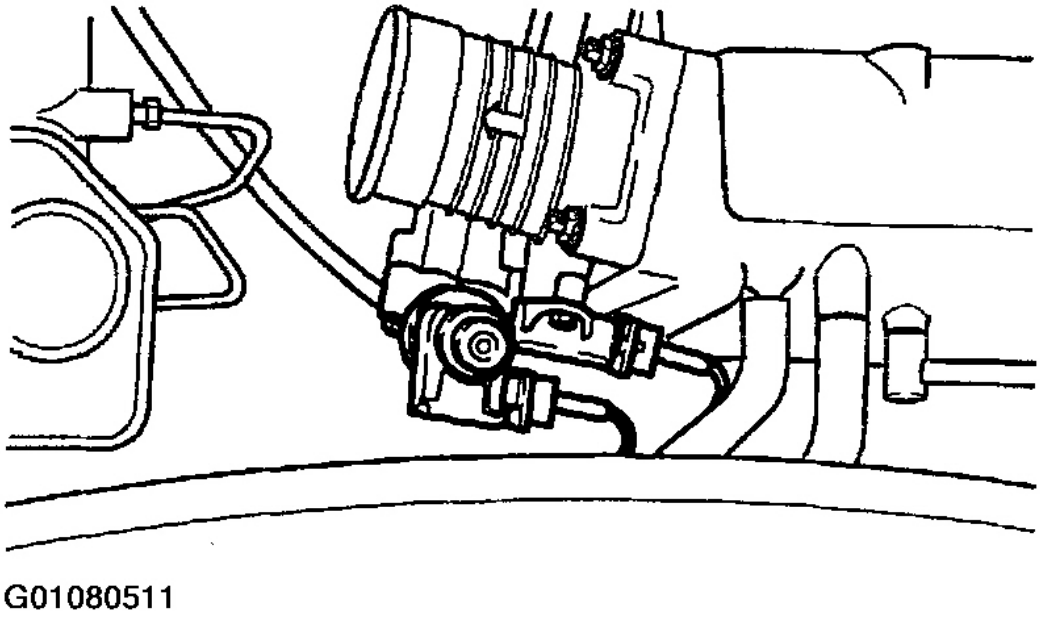


Fig. 181: Connecting IAC And Throttle Position Sensor Connectors
Courtesy of KIA MOTORS AMERICA, INC.

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14. Install heater hoses.

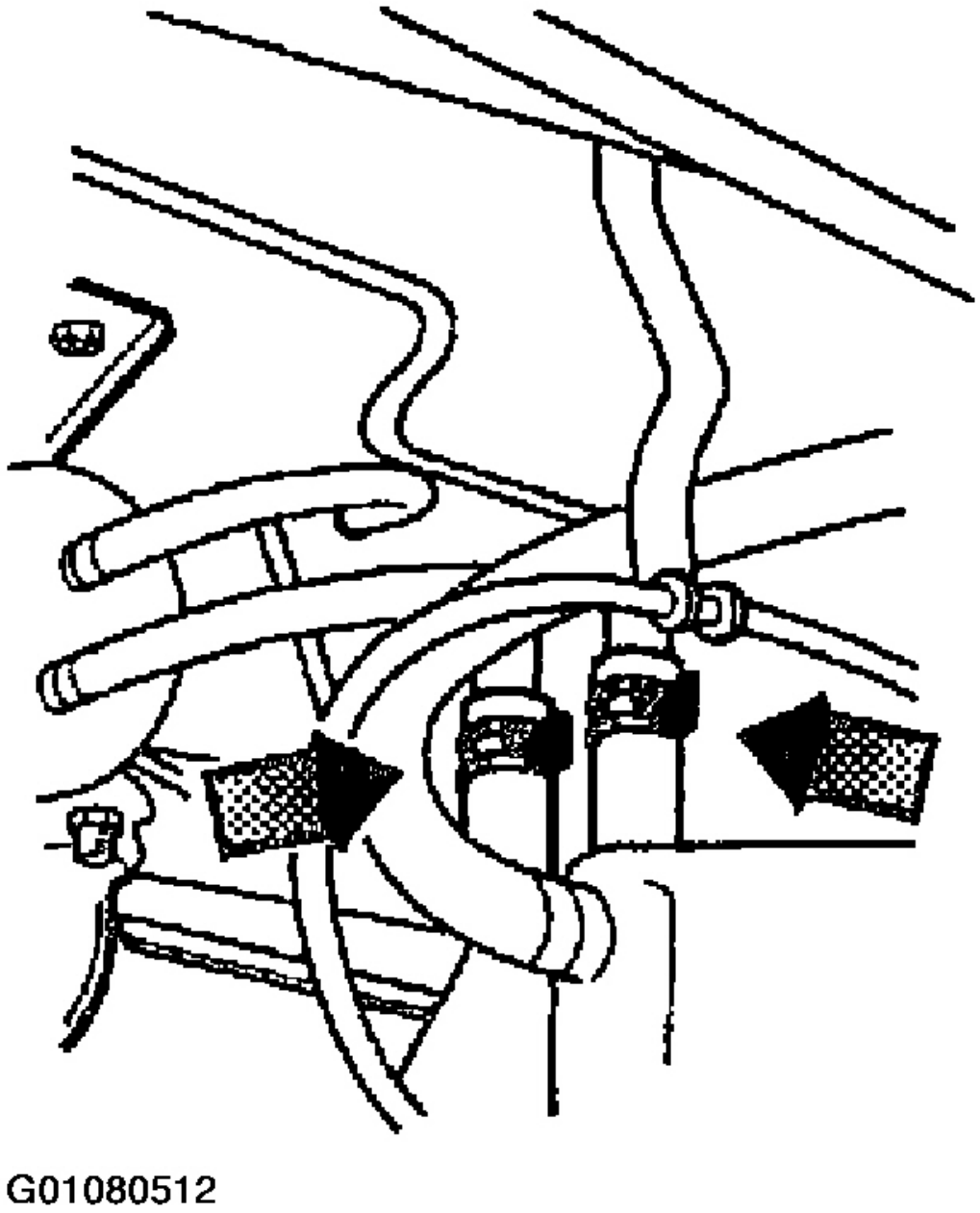


Fig. 182: Installing Heater Hoses
Courtesy of KIA MOTORS AMERICA, INC.

15. Connect fuel hose to fuel injector rail.

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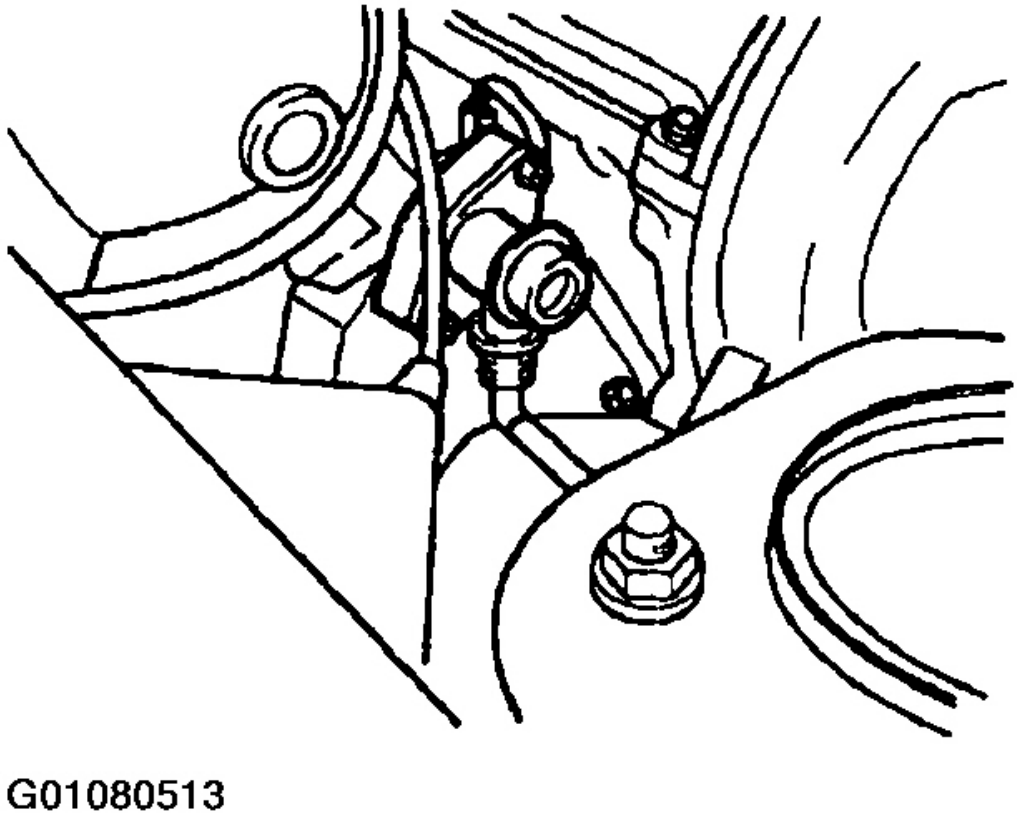


Fig. 183: Connecting Fuel Hose To Fuel Injector Rail
Courtesy of KIA MOTORS AMERICA, INC.

16. Install upper radiator hose.

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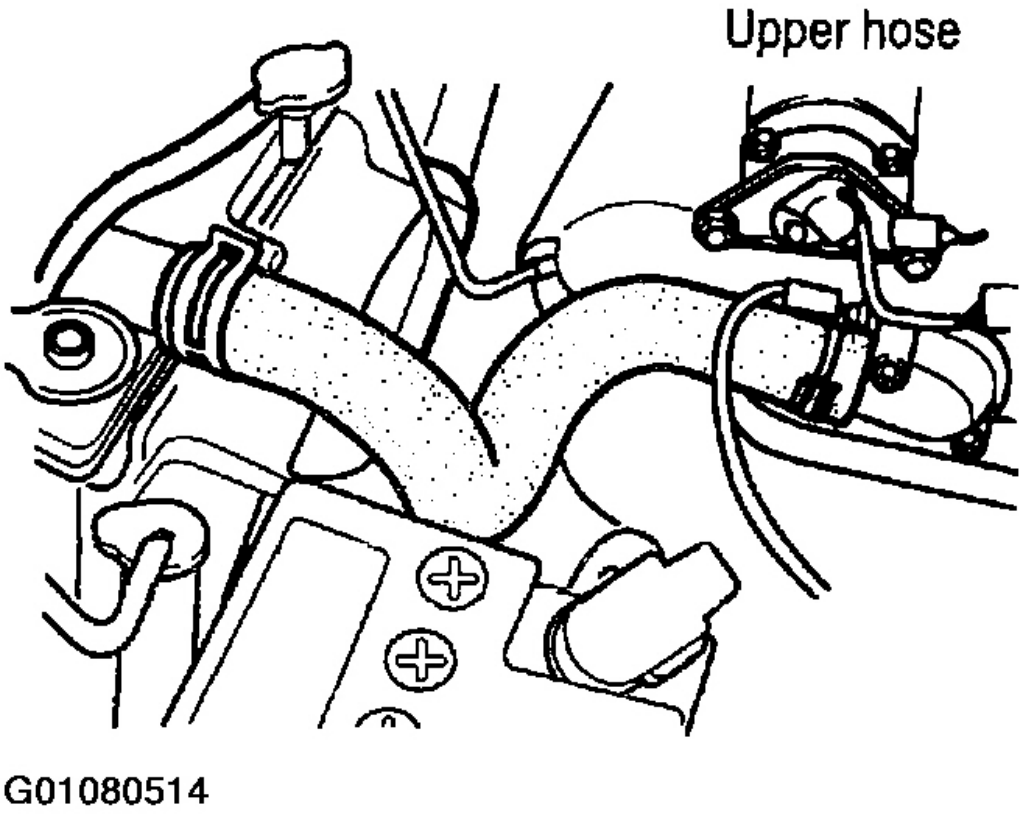


Fig. 184: Installing Upper Radiator Hose
Courtesy of KIA MOTORS AMERICA, INC.

17. Connect brake vacuum hose and purge control vacuum hose.

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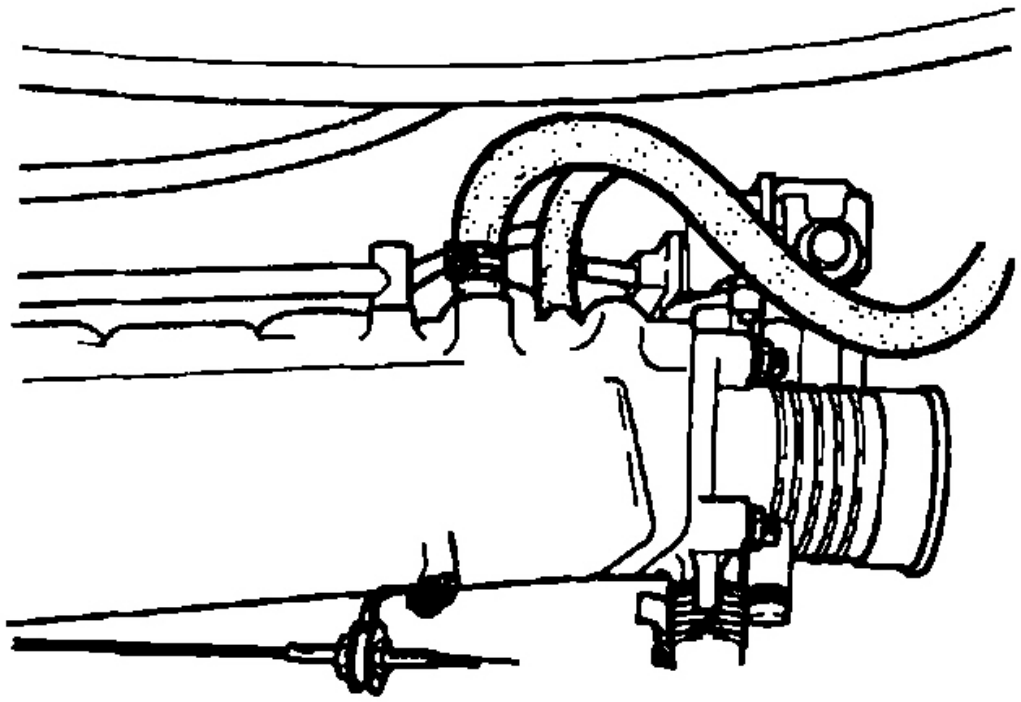


Fig. 185: Connecting Brake And Purge Control Vacuum Hoses
Courtesy of KIA MOTORS AMERICA, INC.

18. Install air intake hose and fresh air duct.

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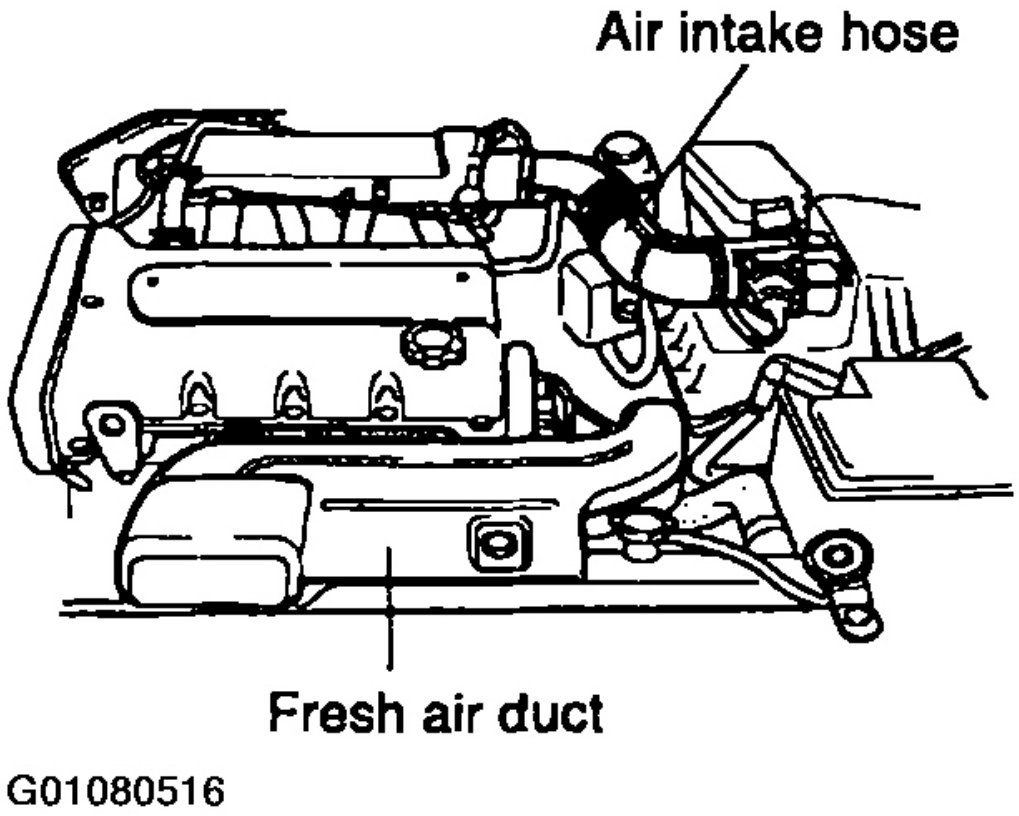


Fig. 186: Installing Air Intake Hose And Fresh Air Duct
Courtesy of KIA MOTORS AMERICA, INC.

19. Install accelerator cable and check cable deflection. If deflection is not correct, adjust by turning nut "A".

    Deflection: 0.04~0.12 in (1~3 mm)

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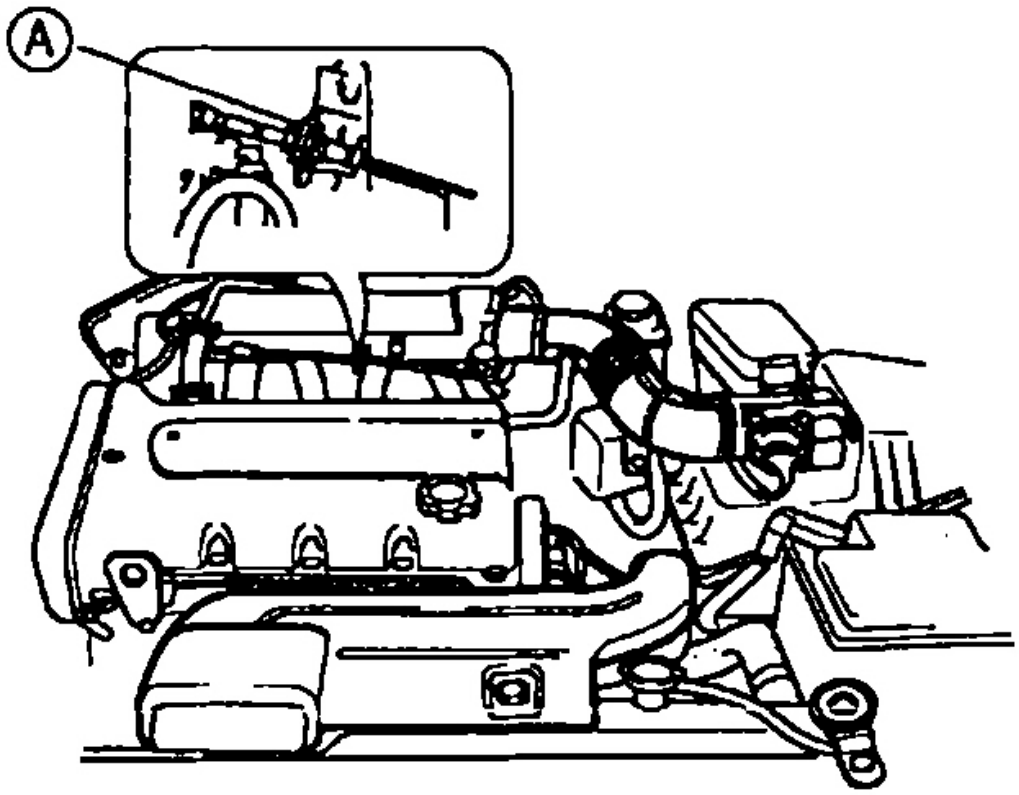
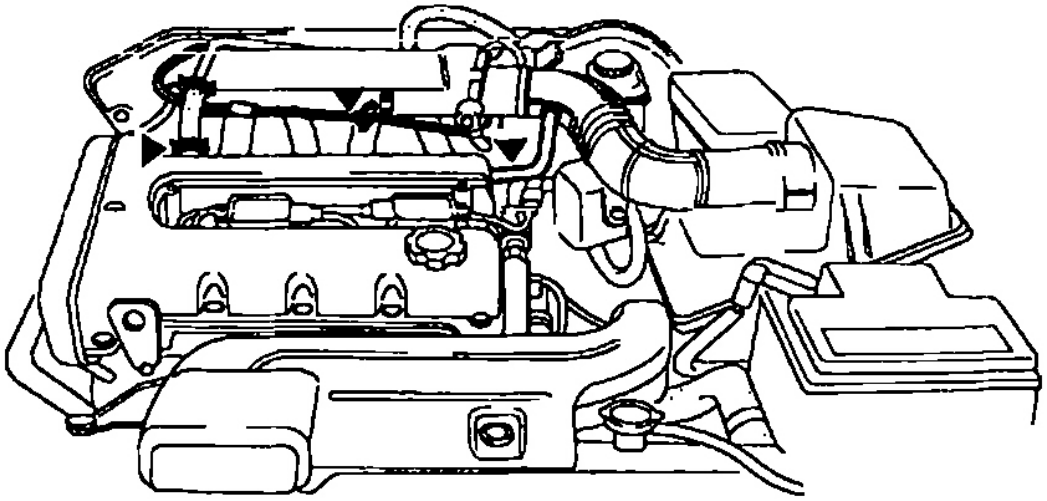


Fig. 187: Installing Accelerator Cable
Courtesy of KIA MOTORS AMERICA, INC.

20. Install cruise control cable if equipped.
21. Install PCV hose and ventilation hose.

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Fig. 188: Installing PCV And Ventilation Hoses
Courtesy of KIA MOTORS AMERICA, INC.

22. Fill engine with specified amount and type of engine oil. (Refer to **LUBRICATION SYSTEM**).
23. Fill engine with specified amount and type of coolant. (Refer to **COOLING SYSTEM**).
24. Connect negative battery cable.

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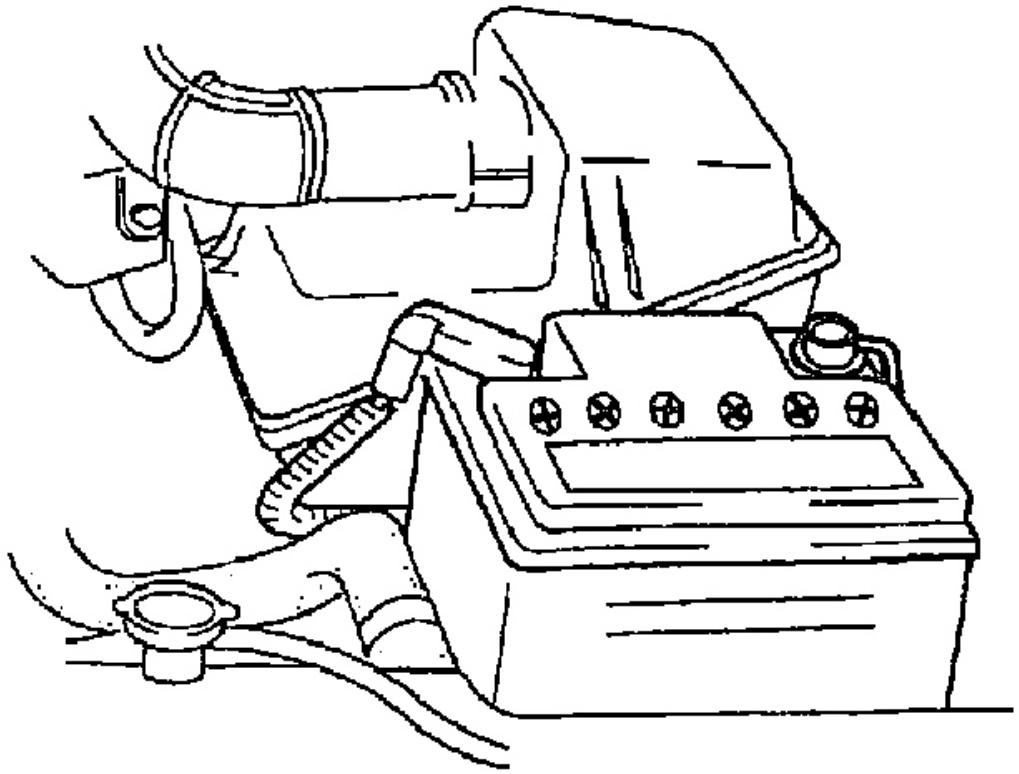


Fig. 189: Connecting Negative Battery Cable
Courtesy of KIA MOTORS AMERICA, INC.

25. Start engine and check for oil and coolant leaks and HLA noise.
26. Operate engine until cooling fans cycle and check ignition timing (Refer to Ignition system).

CYLINDER HEAD DISASSEMBLY, INSPECTION & REASSEMBLY

DISASSEMBLY

1. For camshaft and HLA disassembly, see **HYDRAULIC LASH ADJUSTER (HLA)**.
2. Protect HLA bore with SST(K95A-1000-E) or equivalent. Compress valve springs with SST or equivalent and allow enough room to remove valve locks.
3. Slowly release pressure and remove valve spring from cylinder head.

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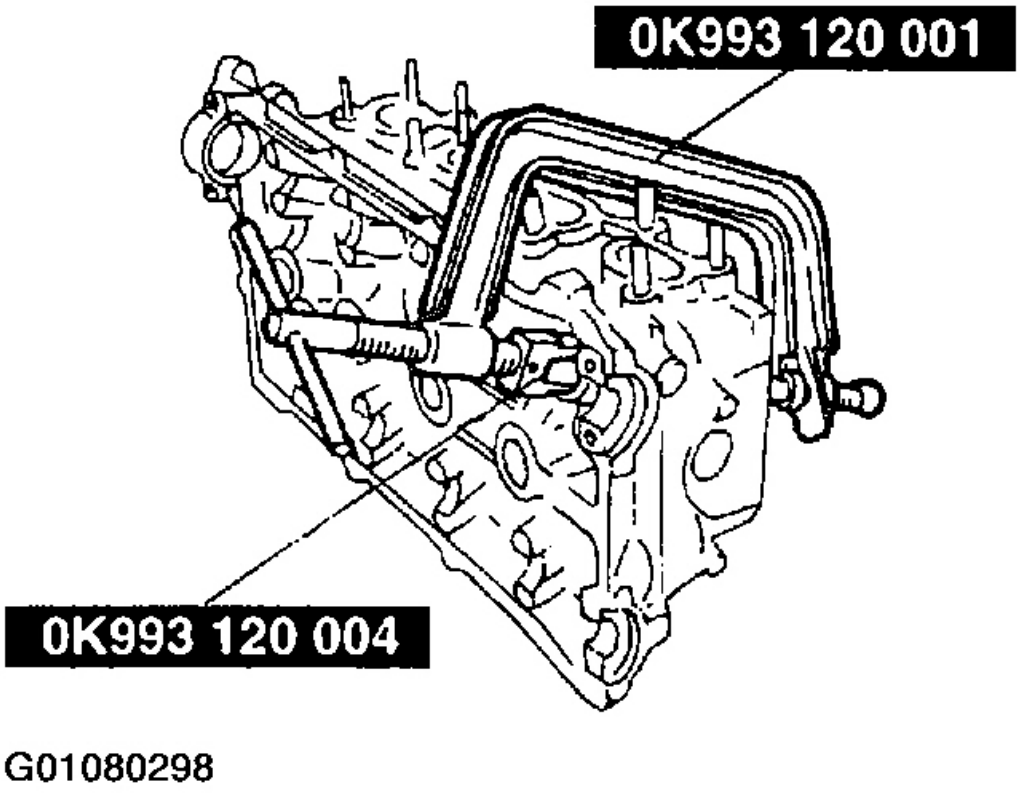


Fig. 190: Removing Valve Spring From Cylinder Head
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove valve seals with SST or equivalent.

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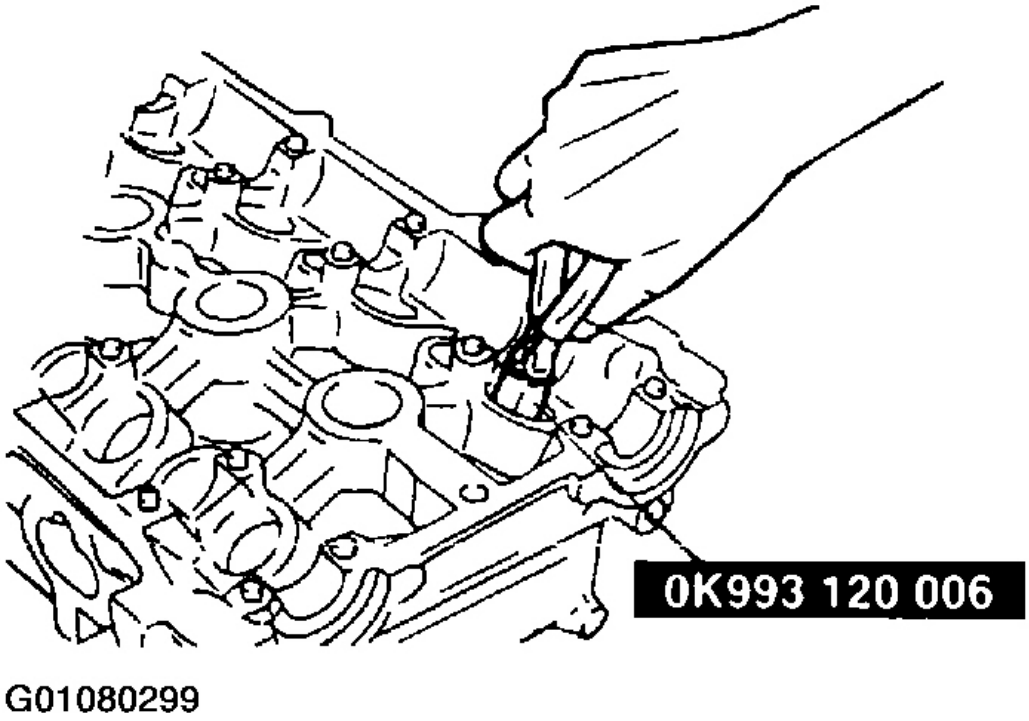


Fig. 191: Removing Valve Seals
Courtesy of KIA MOTORS AMERICA, INC.

5. Repeat same procedure on all 16 valves.
6. Keep valves in correct order if they are to be reused.
7. Mark cylinder so that valves can be installed to their original positions.
8. Remove valves from cylinder head.
9. Remove lower spring seals from cylinder head.

INSPECTION

CYLINDER HEAD

1. Inspect cylinder head for damage, cracks, and leakage of oil and water.

   Replace cylinder head if necessary.

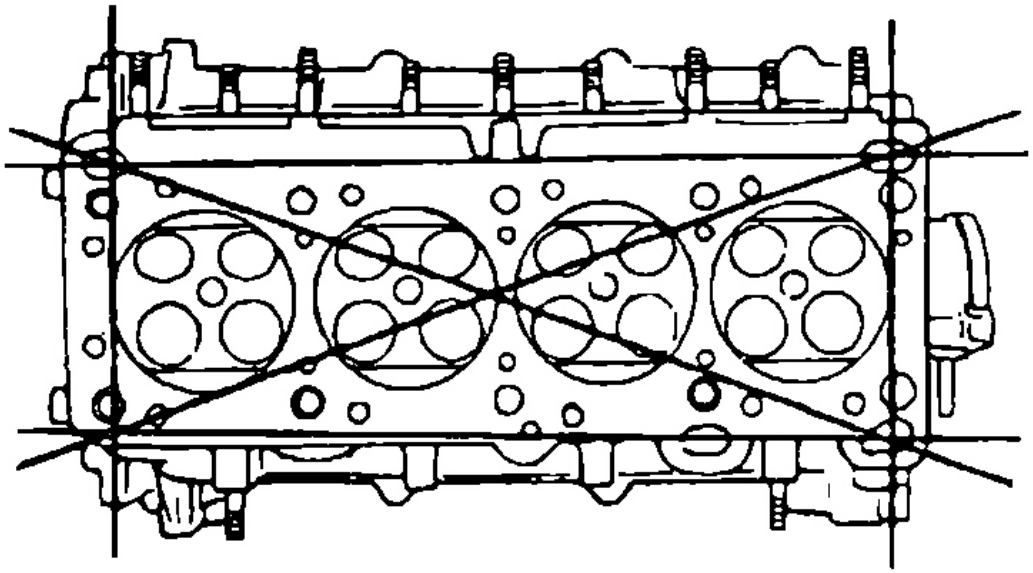
2. Clean cylinder head and cylinder block mounting surfaces of all gasket material.

NOTE: Do not allow gasket material to fall into oil passages or oil control plug.

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3. Measure cylinder head for straightness in six directions as shown in figure.

   Distortion: 0.004 in (0.10 mm) Maximum



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Fig. 192: Measuring Cylinder Head Straightness
Courtesy of KIA MOTORS AMERICA, INC.

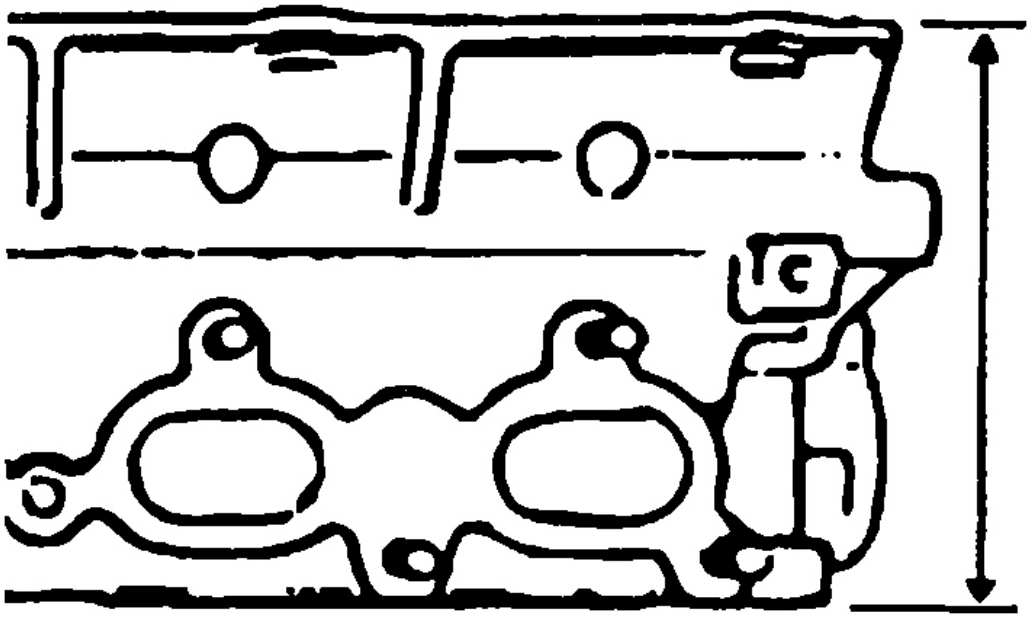
4. If distortion exceeds specification, resurface or replace cylinder head. Only remove the amount of material required to achieve a flat surface.

   Maximum material removal: 0.004 in (0.1 mm)

5. Check cylinder head height.

   Height: 5.272~5.280 in (133.9~134 mm)

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Fig. 193: Checking Cylinder Head Height
Courtesy of KIA MOTORS AMERICA, INC.

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

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

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

Distortion: 0.008 in (0.20 mm) Maximum

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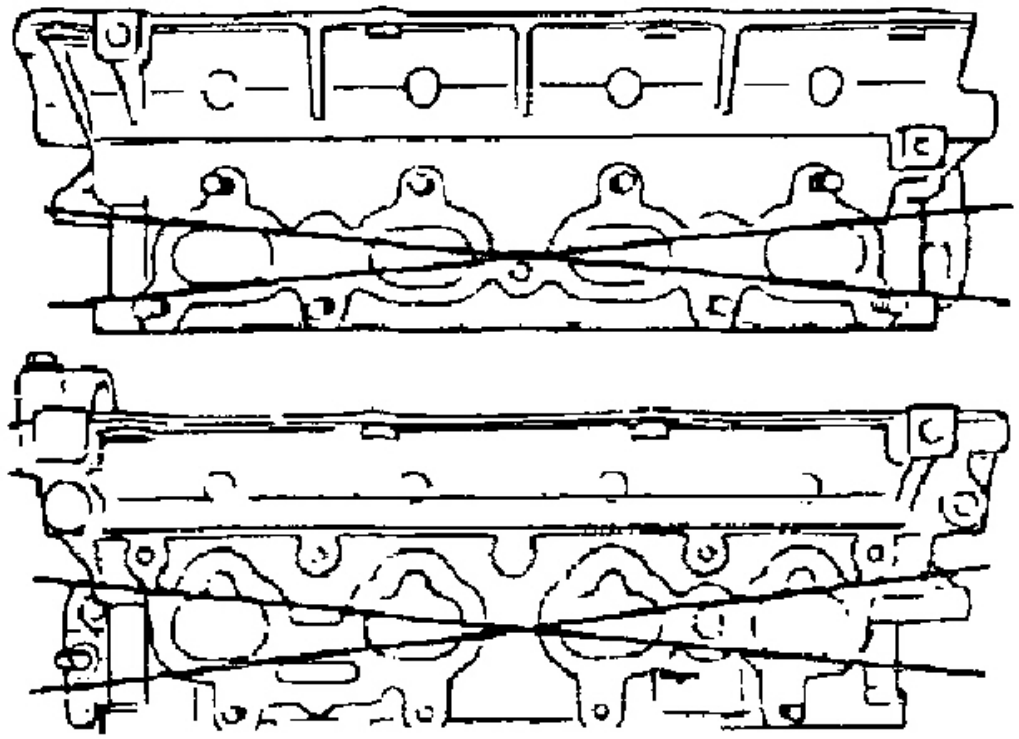


Fig. 194: Measuring Intake And Exhaust Manifold Mating Surface Distortion
Courtesy of KIA MOTORS AMERICA, INC.

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

   Maximum material removal: 0.008 in (0.20 mm)

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

   Distortion: 0.006 in (0.15 mm) Maximum

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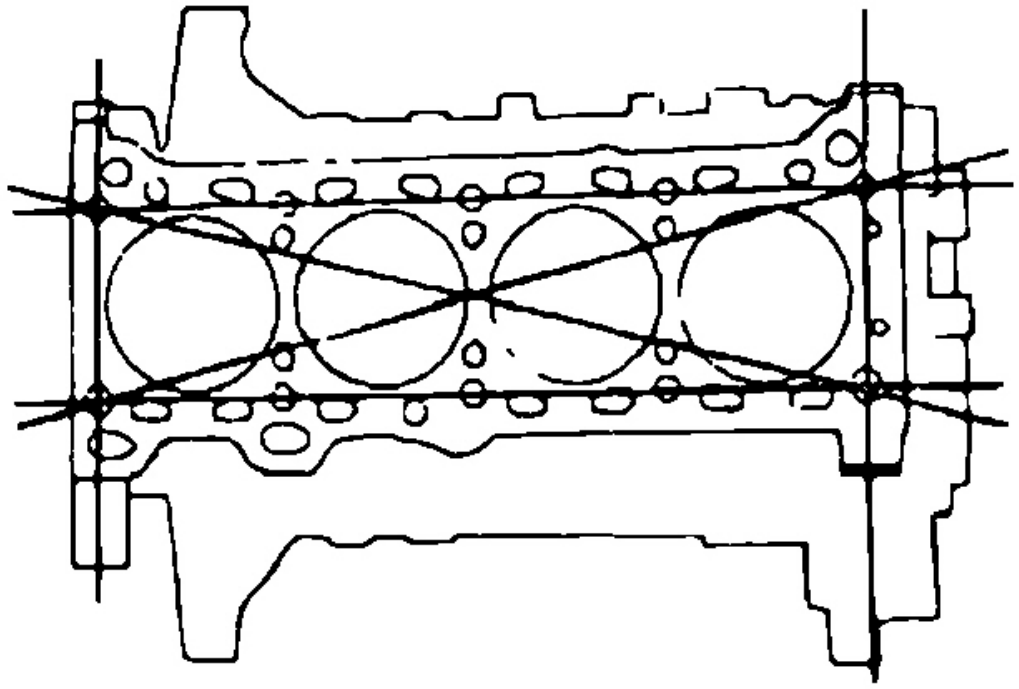


Fig. 195: Checking Cylinder Block For Distortion
Courtesy of KIA MOTORS AMERICA, INC.

10. If distortion exceeds specification, resurface block deck.

Maximum material removal: 0.008 in (0.20 mm)

CAMSHAFT

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

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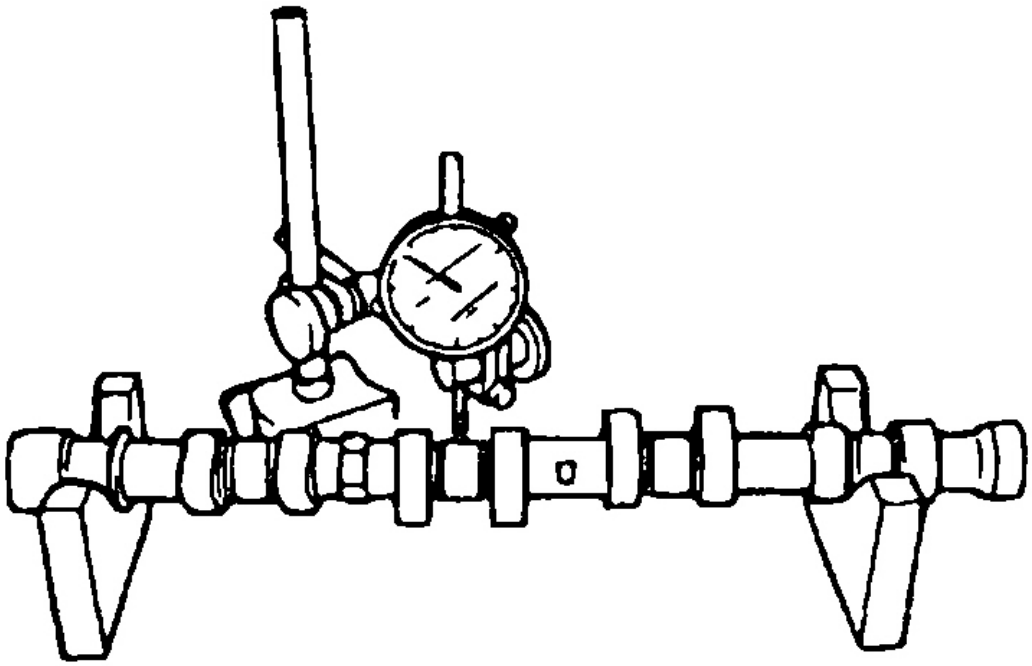


Fig. 196: Measuring Camshaft Runout
Courtesy of KIA MOTORS AMERICA, INC.

4. Check camshaft for uneven wear patterns, cracks, or damage.
5. Measure cam lobe heights at two points as shown in figure. See **Fig. 197**.

Lobe height

Intake: 1.6415 in (41.6949 mm)

Exhaust: 1.6629 in (42.2369 mm)

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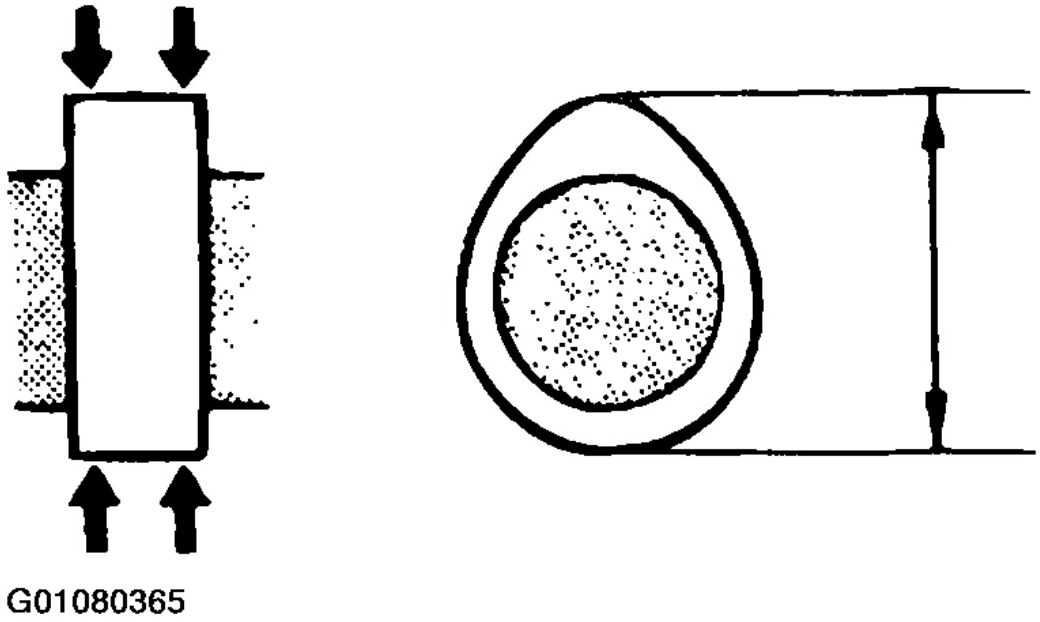


Fig. 197: Measuring Camshaft Lobe Height
Courtesy of KIA MOTORS AMERICA, INC.

6. Check camshaft bearing journal diameter (X and Y directions) on both sides (A and B) of journal as shown in figure. See **Fig. 198**.

   Standard diameter: 1.0606~1.0616 in (26.940-26.965 mm)

   Minimum diameter: 1.0594 in (26.910 mm)

   Out-of-round: 0.002 in (0.05 mm) maximum

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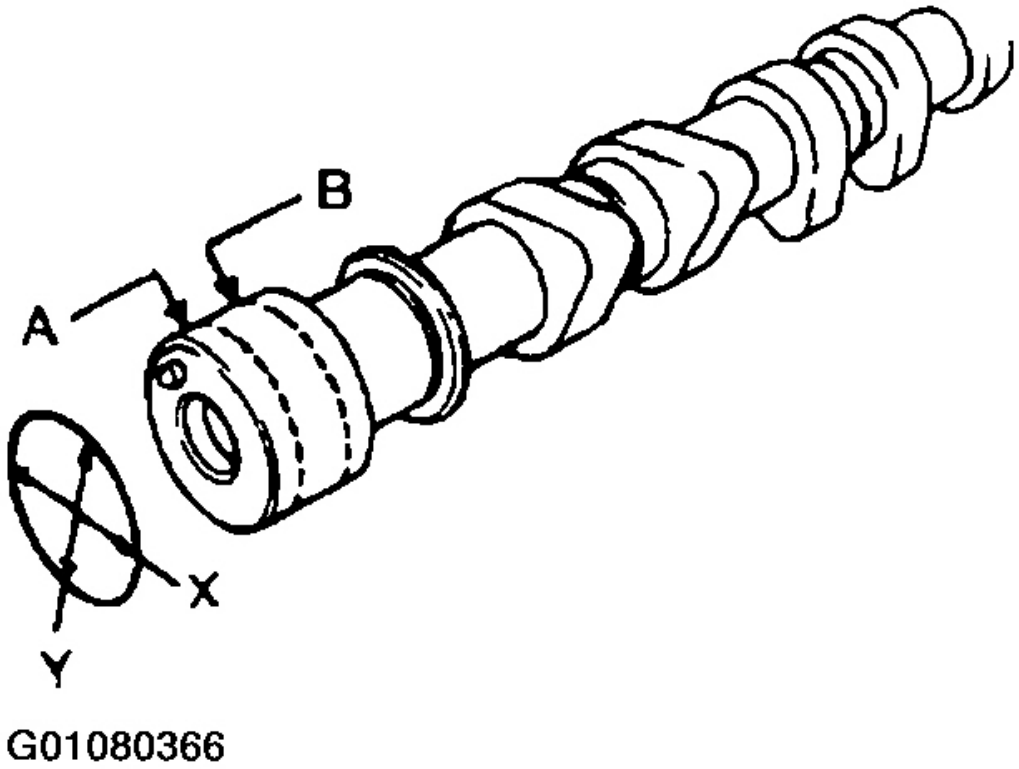


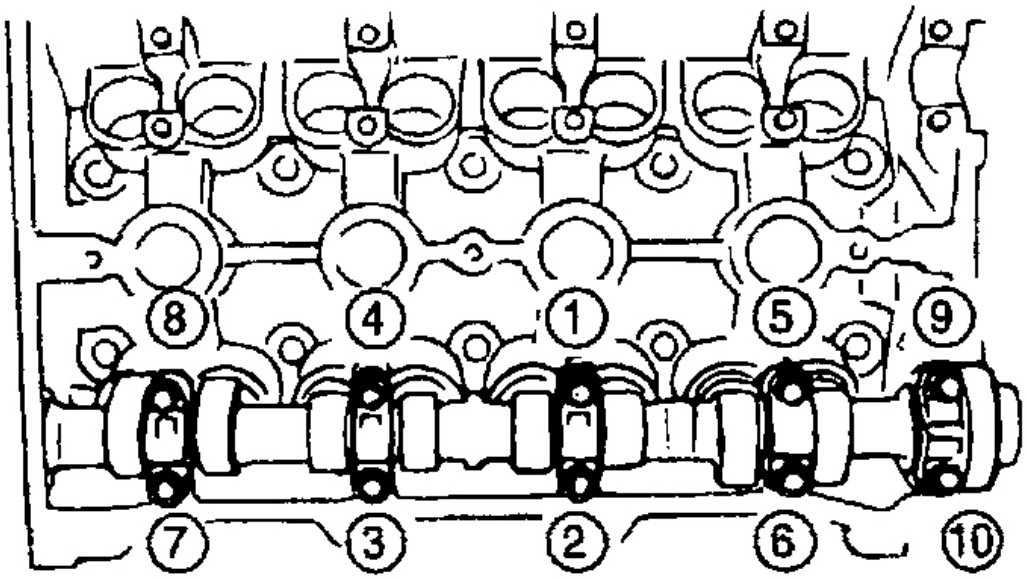
Fig. 198: Measuring Camshaft Bearing Journal Diameter
Courtesy of KIA MOTORS AMERICA, INC.

7. Replace camshafts if necessary.
8. Measure camshaft journal oil clearance with HLAs removed.
9. Remove all foreign material and oil from journals and bearing surfaces.
10. Set camshafts onto cylinder head.
11. Position Plastigage™ on journals in axial direction.
12. Do not rotate camshafts.
13. Install camshaft caps according to cap number and arrow mark.
14. Install cap bolts. Tighten them in five or six steps in order shown in figure. See **Fig. 199**.

Tightening torque:

8.32-10.49 lb-ft (11.28-14.22 N.m, 1.15~1.45 kg-m)

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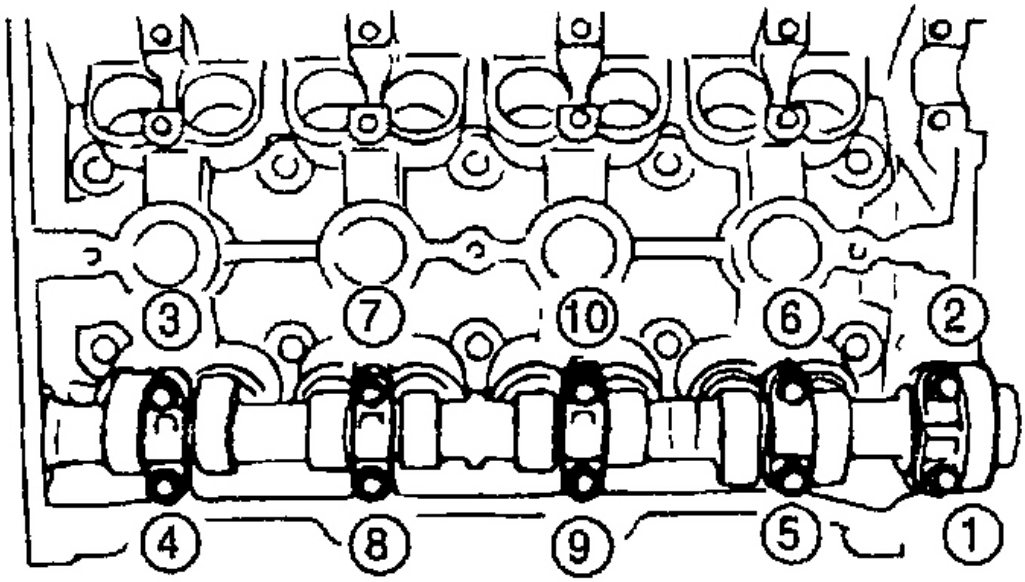


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Fig. 199: Camshaft Bearing Cap Bolt Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

15. Loosen camshaft cap bolts in five or six steps in order shown in figure.
16. Remove camshaft caps.

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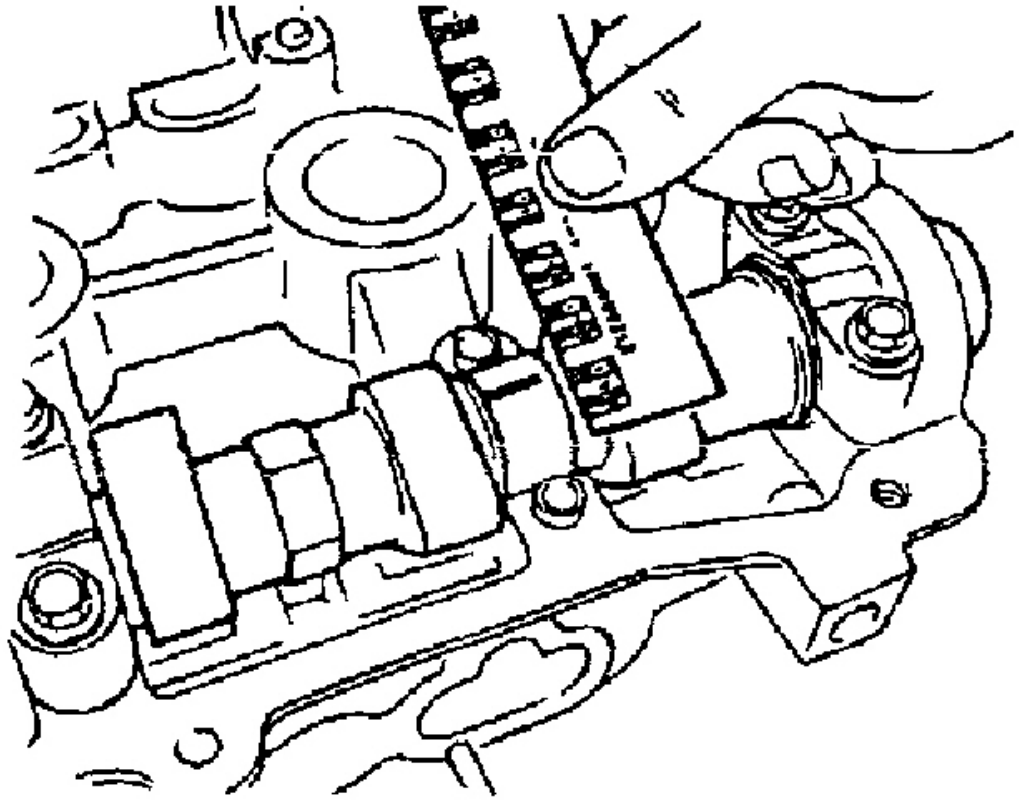


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Fig. 200: Camshaft Bearing Cap Removal Sequence
Courtesy of KIA MOTORS AMERICA, INC.

17. Measure oil clearances.
    Oil clearance: 0.0014~0.0031 in (0.035~0.081 mm)
    Maximum: 0.006 in (0.15 mm)
18. If oil clearance exceeds specification, replace cylinder head.

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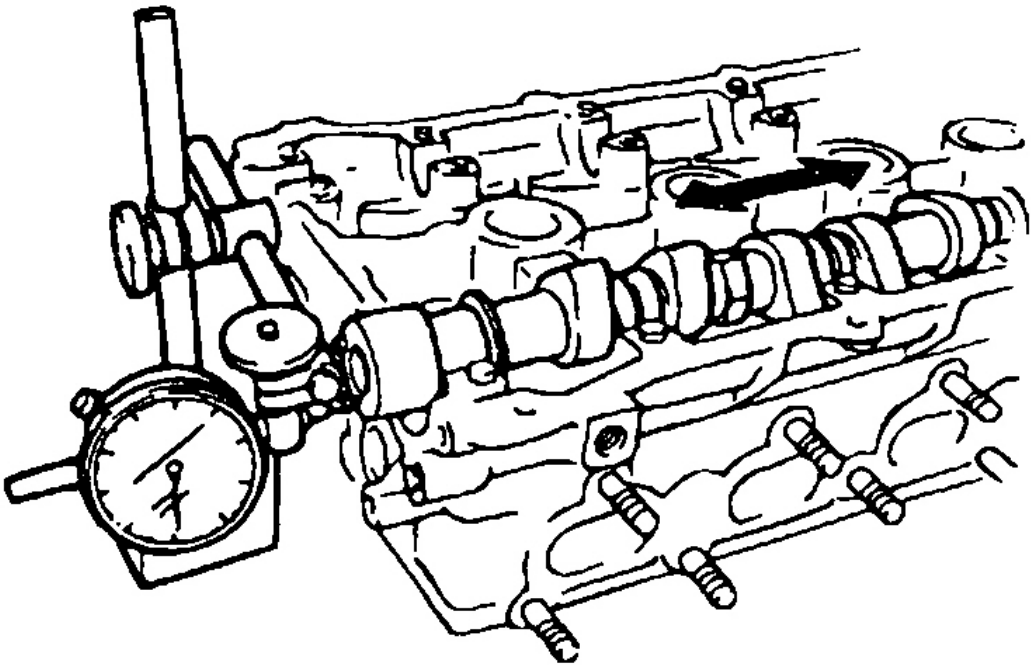
Fig. 201: Measuring Camshaft Bearing Oil Clearance
Courtesy of KIA MOTORS AMERICA, INC.

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: 0.0003~0.0004 in (0.08~0.10 mm)

    Maximum: 0.008 in (0.20 mm

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Fig. 202: Measuring Camshaft End Play
Courtesy of KIA MOTORS AMERICA, INC.

VALVES

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: 0.0472 in (1.2 mm)

    Exhaust: 0.0472 in (1.2 mm)

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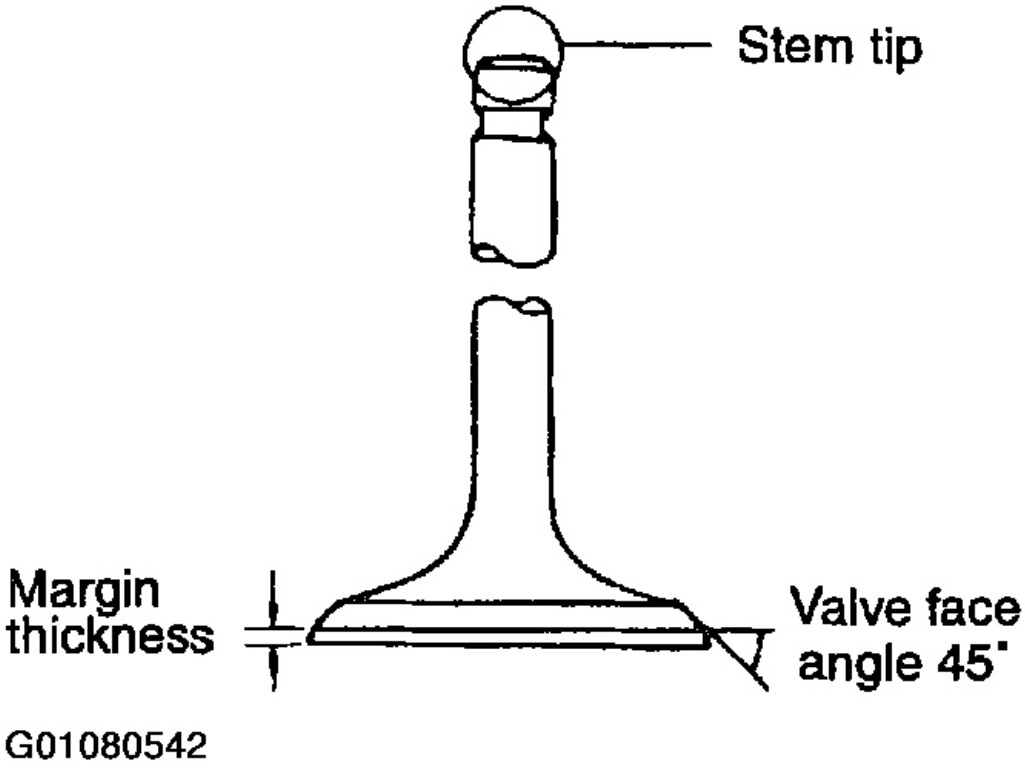


Fig. 203: Measuring Valve Margin
Courtesy of KIA MOTORS AMERICA, INC.

3. Measure length of each valve.
   Length
   Intake: 4.052 in (102,92 mm)
   Exhaust: 3.993 in (101.42 mm)

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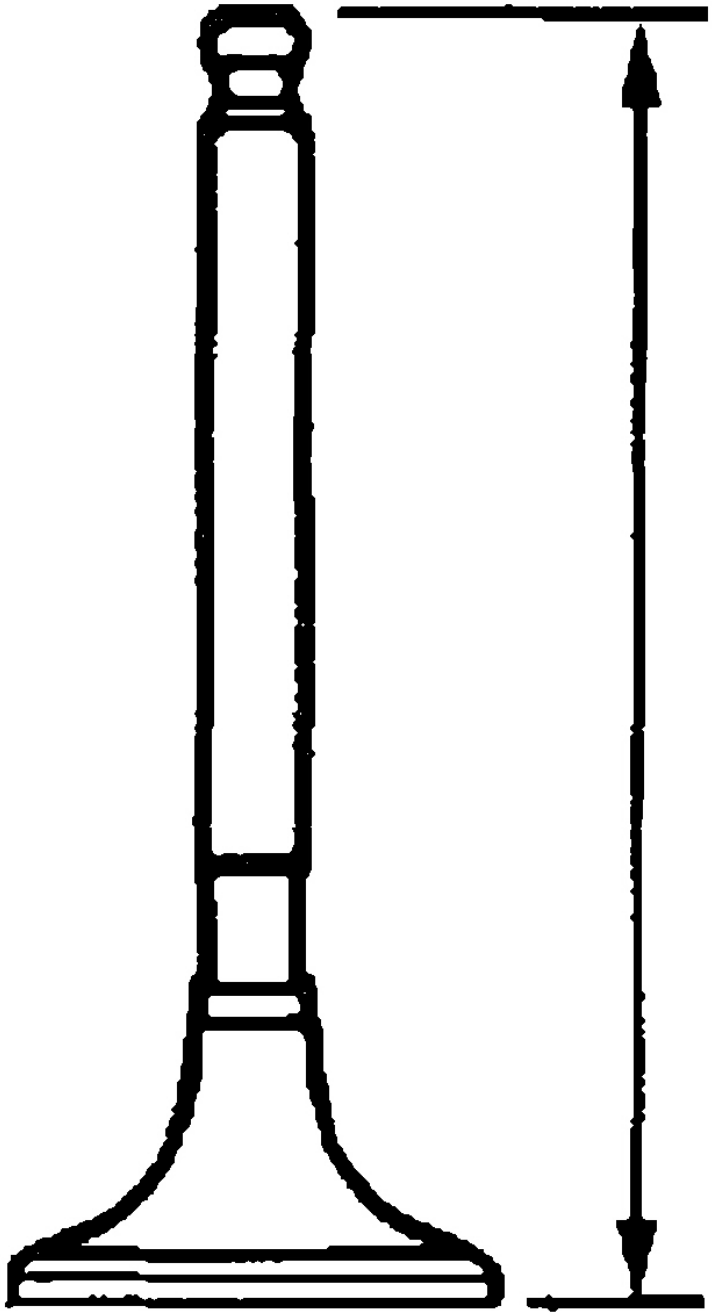


Fig. 204: Measuring Valve Length
Courtesy of KIA MOTORS AMERICA, INC.

4. Measure diameter of each valve stem.

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Diameter

Intake:0.2350~0.2356 in (5.970-5.985 mm)

Exhaust: 0.2348-0.2354 in (5.965-5.980 mm)

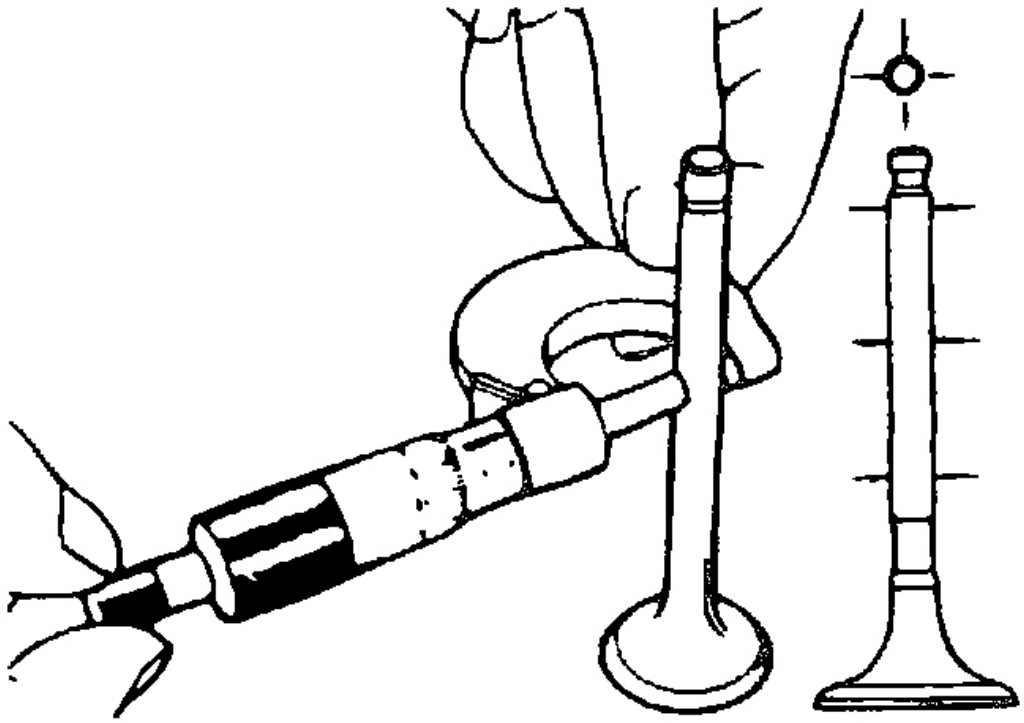


Fig. 205: Measuring Valve Diameter
Courtesy of KIA MOTORS AMERICA, INC.

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

   Diameter intake and exhaust valve guide: 0.2367-0.2374 in (6.01-6.03 mm)

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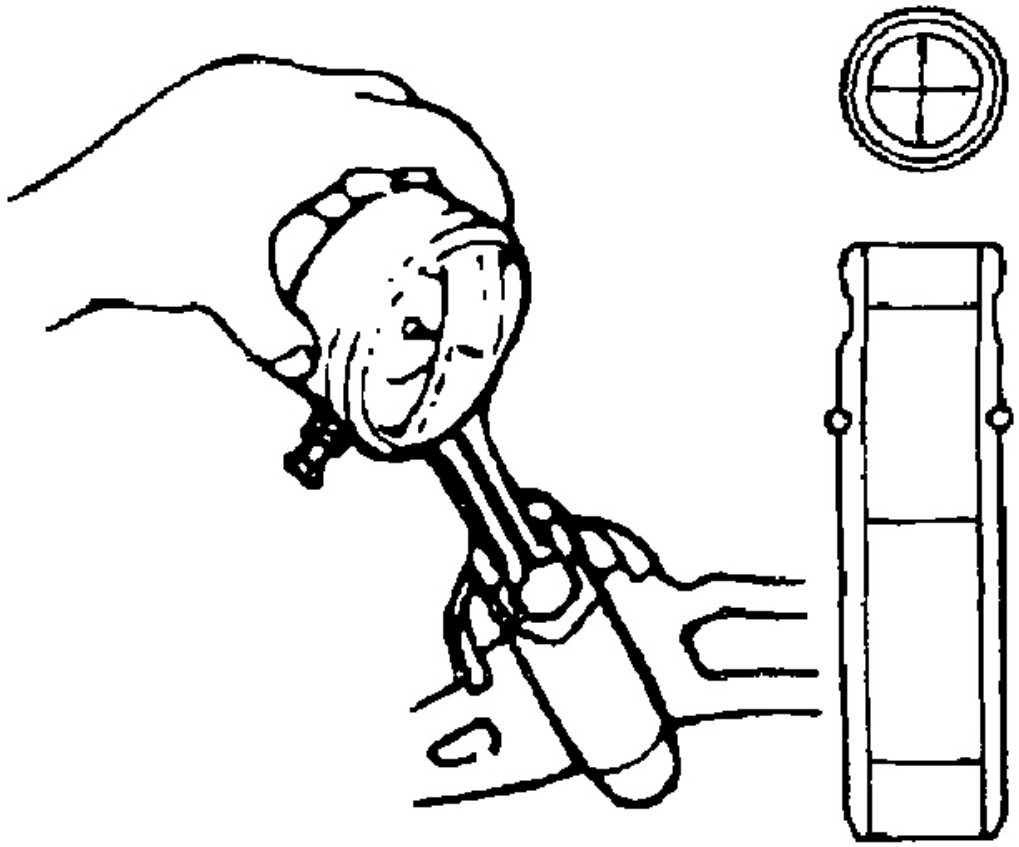


Fig. 206: Measuring Valve Guide Inside Diameter
Courtesy of KIA MOTORS AMERICA, INC.

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

Clearance>

Intake valve: 0.0010-0.0023 in (0.025-0.060 mm)

Exhaust valve: 0.0012-0.0025 in (0.030-0.065 mm)

Max: 0.008 in (0.20 mm)

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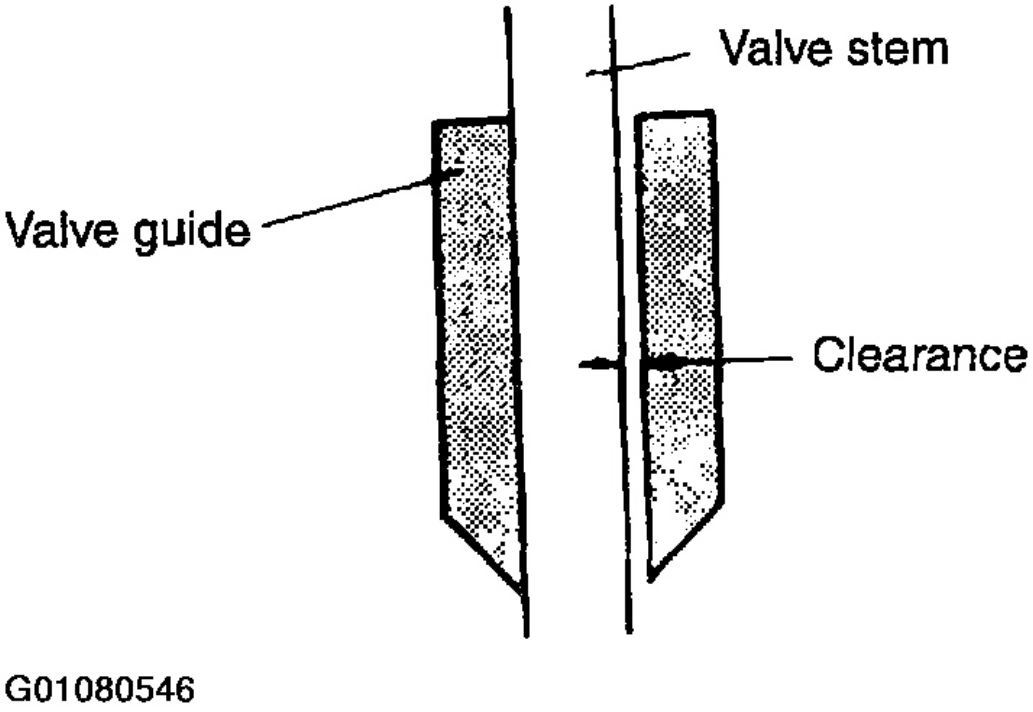


Fig. 207: Calculating Valve Stem-To-Valve Guide Clearance
Courtesy of KIA MOTORS AMERICA, INC.

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

A: Intake: 0.539-0.563 in (13.7-14.3 mm)

B: Exhaust: 0.658-0.681 in (16.7-17.3 mm)

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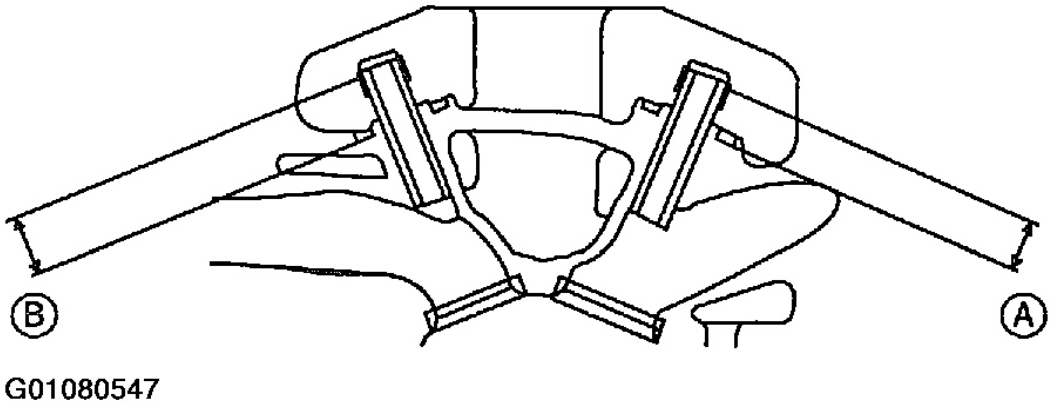


Fig. 208: Measuring Valve Guide Protrusion Height
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Intake and exhaust valve guides are different. Be sure to use correct valve guide.

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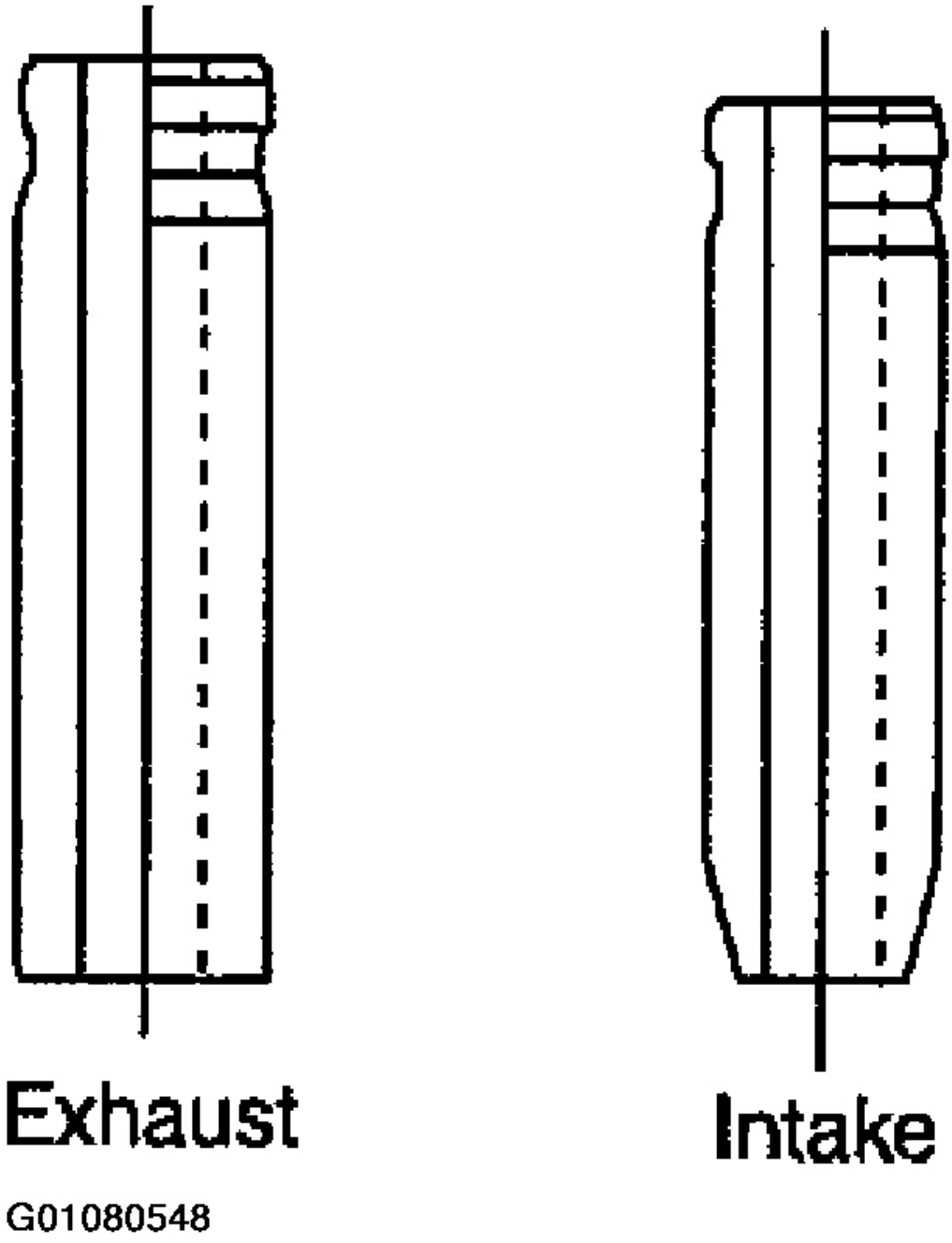


Fig. 209: Identifying Proper Valve Guides
Courtesy of KIA MOTORS AMERICA, INC.

VALVE SEAT

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1. Inspect contact surface of each valve seat and valve face for following:
   a. Roughness
   b. Damage
   c. Pitting
   d. Cracks

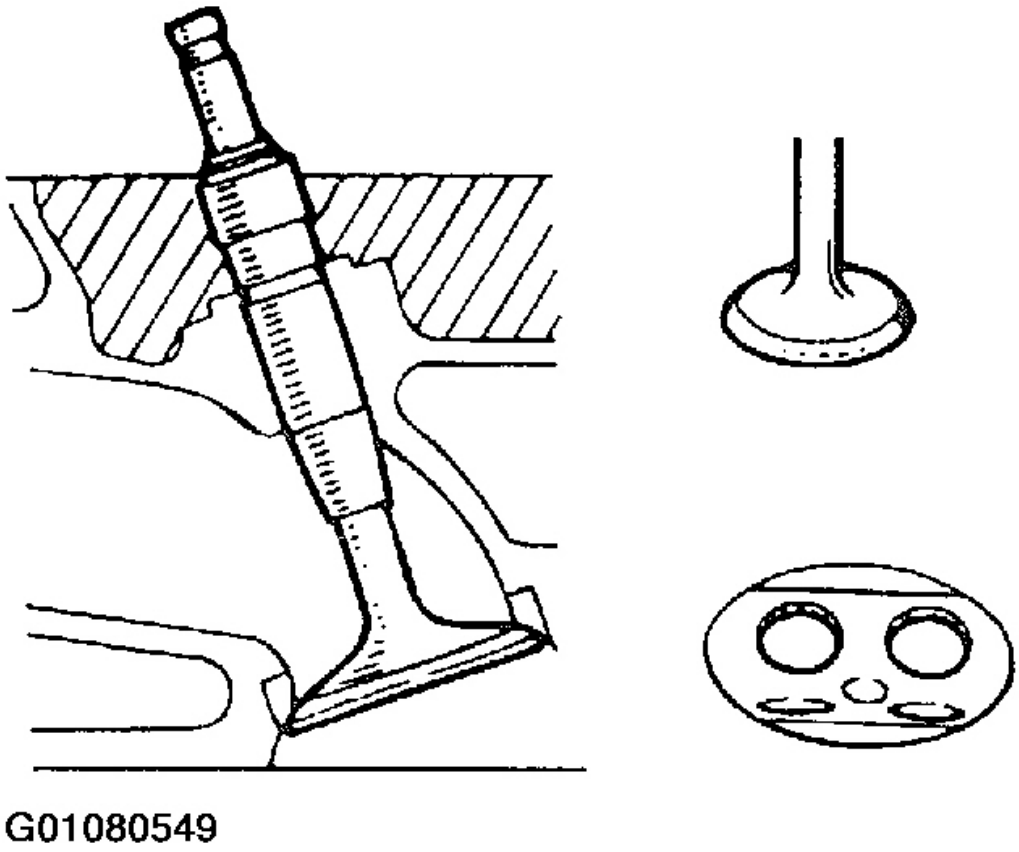
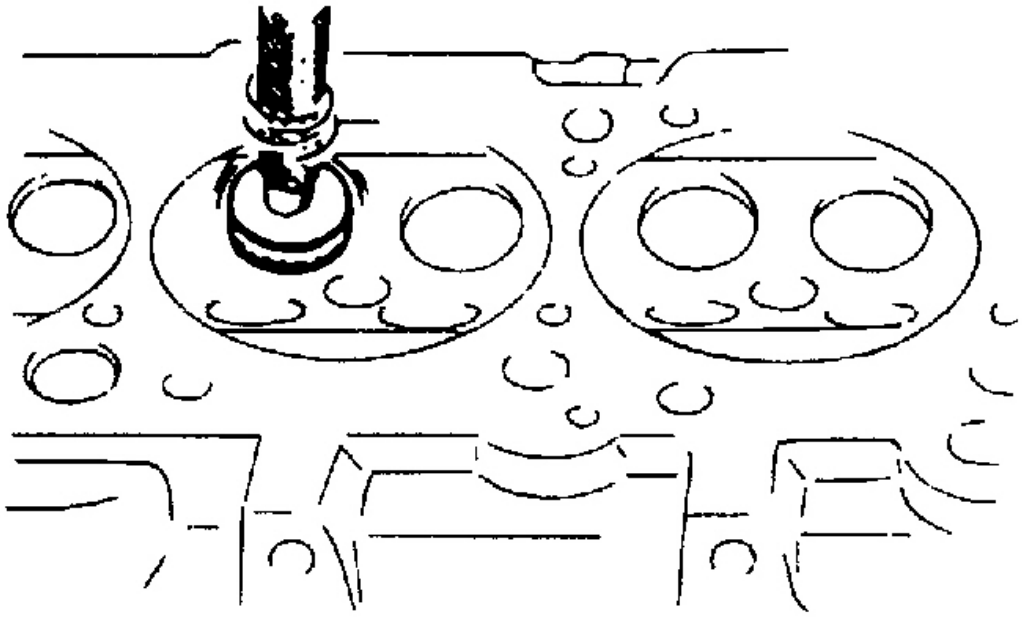


Fig. 210: Inspecting Valve Seat And Face Surface
Courtesy of KIA MOTORS AMERICA, INC.

2. Resurface valve seats with a 45° valve seat cutter. Resurface valve faces as needed.

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Fig. 211: 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: 0.078-1.059 in (1.98-2.69 mm)

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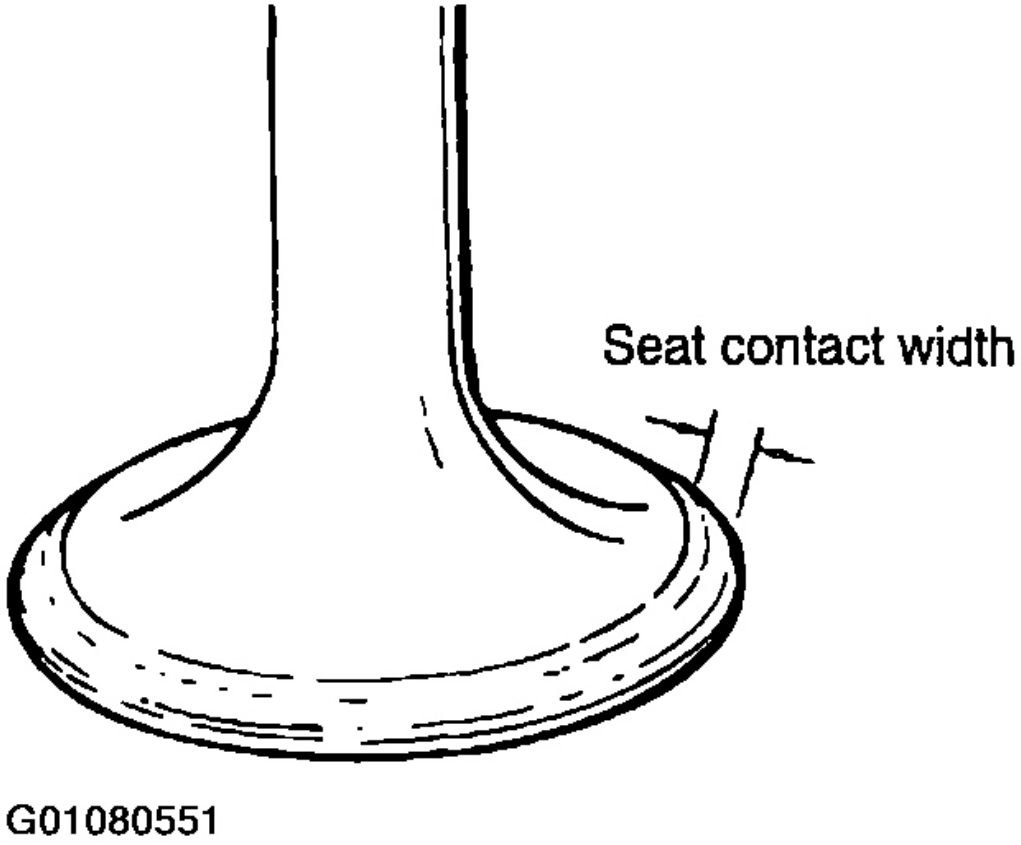


Fig. 212: Measuring Seat Contact Width
Courtesy of KIA MOTORS AMERICA, INC.

6. Check that valve seat contact area is at center of valve face.
   a. If valve seating position is too high, correct valve seat with a 63° valve seat cutter, and a 45° cutter.
   b. If seating position is too low, correct valve seat with a 0° and a 45° cutter.

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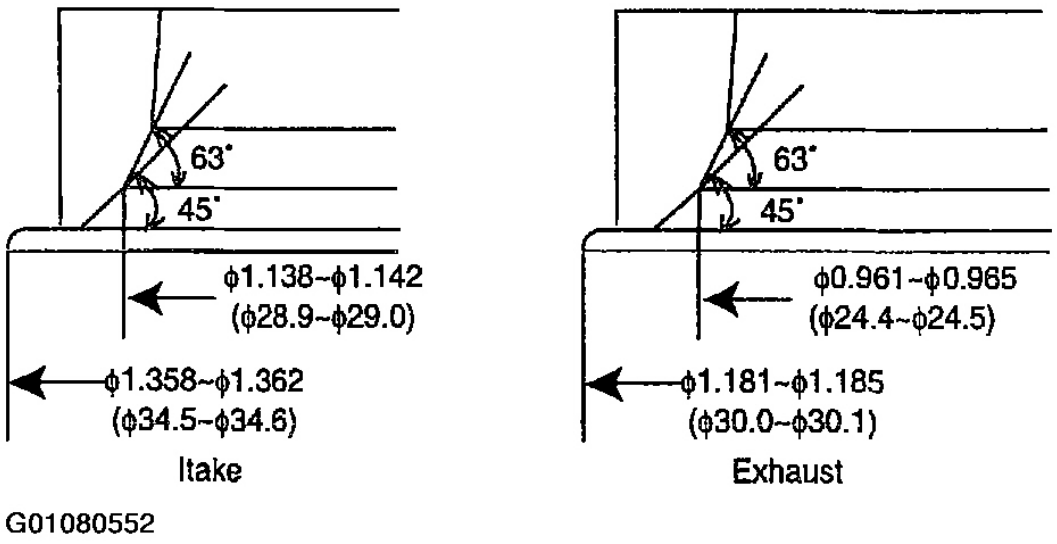
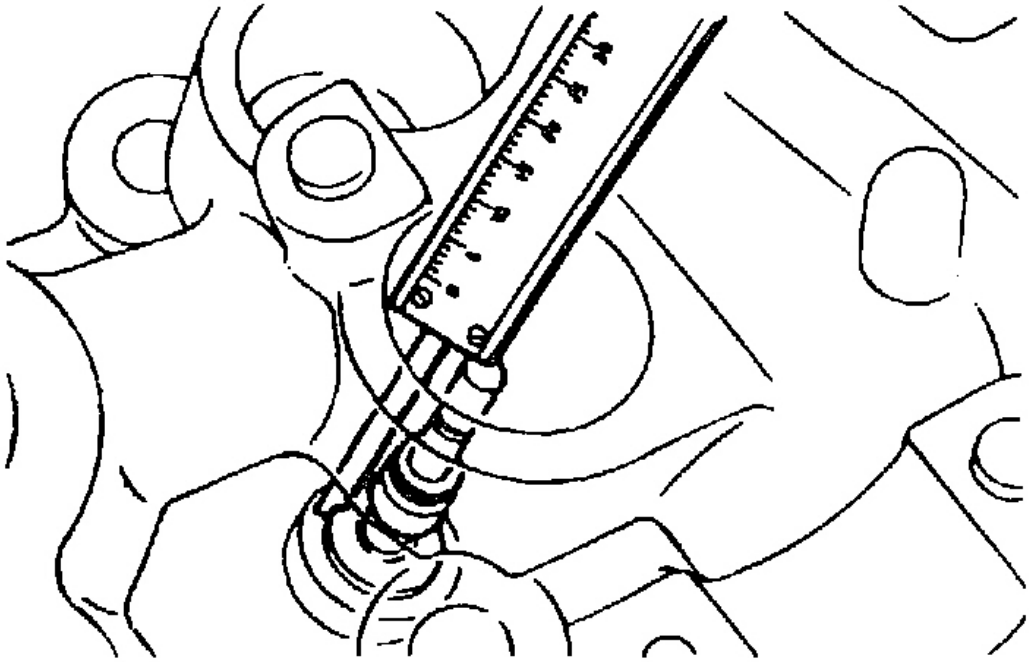


Fig. 213: Checking Valve Seat Contact Area
Courtesy of KIA MOTORS AMERICA, INC.

7. Complete seat-cutting process by lapping valve to seat using valve-lapping compound.
8. Inspect valve seat for sinking.

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

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Fig. 214: Measuring Valve Seat Position
Courtesy of KIA MOTORS AMERICA, INC.

9. Check for valve sink by measuring protruding length (Dimension L) of valve stem to lower valve spring seat.

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Dimentsion L measurement	Action
IN : 1.432-1.467 in (36.37-37.27 mm) EX : 1.431-1.467 in (36.39-37.26 mm)	No correction needed
IN : 1.467-1.495 in (37.27-37.97 mm) EX : 1.467-1.494 in (37.26-37.96 mm)	Adjust with washer on spring seat area of cylinder head
IN:1.495 in (37.97 mm) EX:1.494 in (37.96 mm)	Replace the cylinder head

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Fig. 215: Valve Sink Dimension Chart
Courtesy of KIA MOTORS AMERICA, INC.

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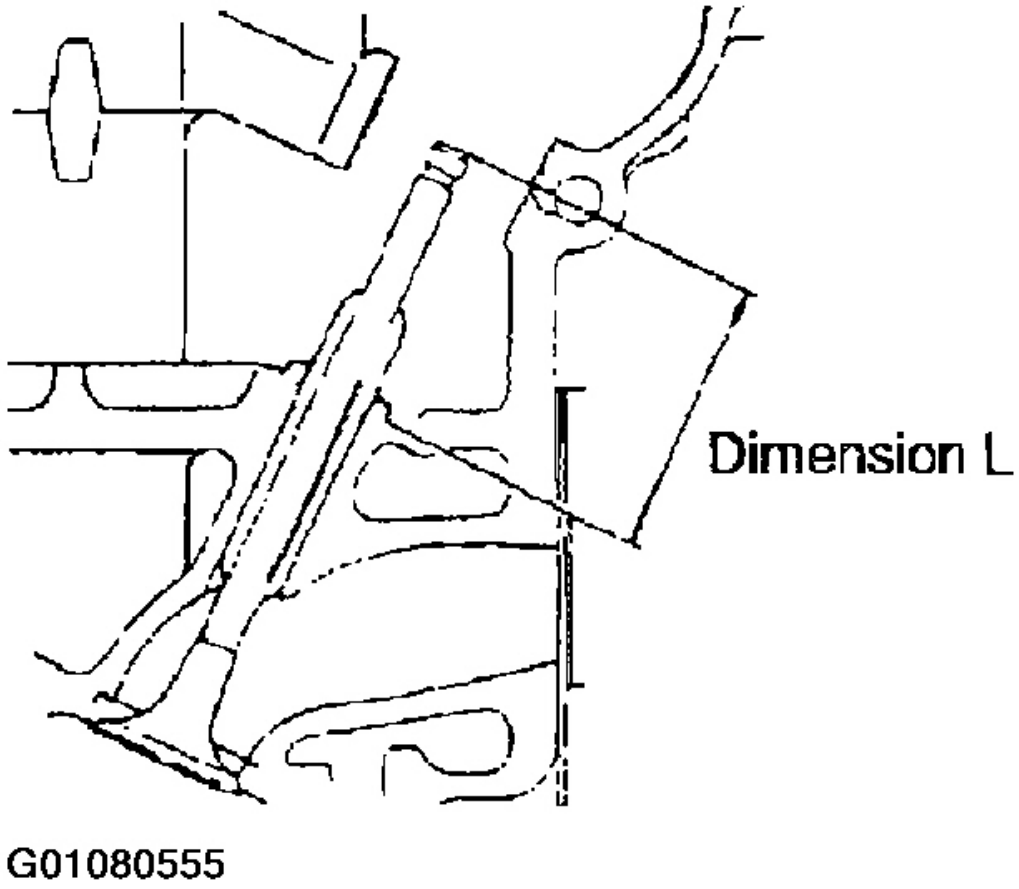


Fig. 216: Measuring For Valve Sink
Courtesy of KIA MOTORS AMERICA, INC.

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: 1.84 in (46.7 mm)

Out-of-square: 0.0638 in (1.62 mm) maximum

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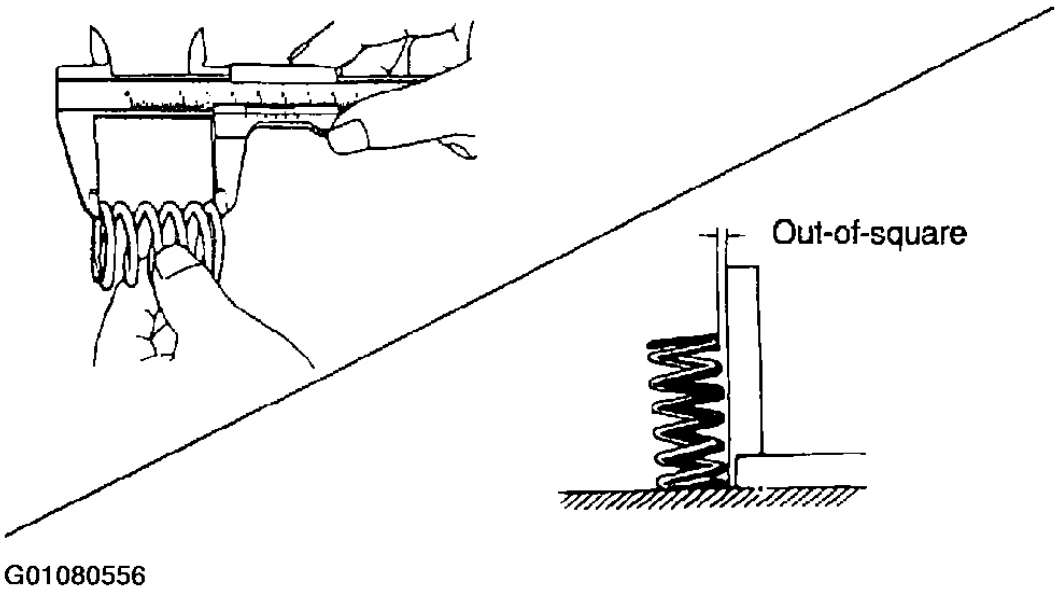


Fig. 217: Measuring Valve Spring Free Length And Out-Of-Square
Courtesy of KIA MOTORS AMERICA, INC.

REASSEMBLY

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

NOTE: Intake and exhaust valve seals are different. Only exhaust valve seals have four teeth.

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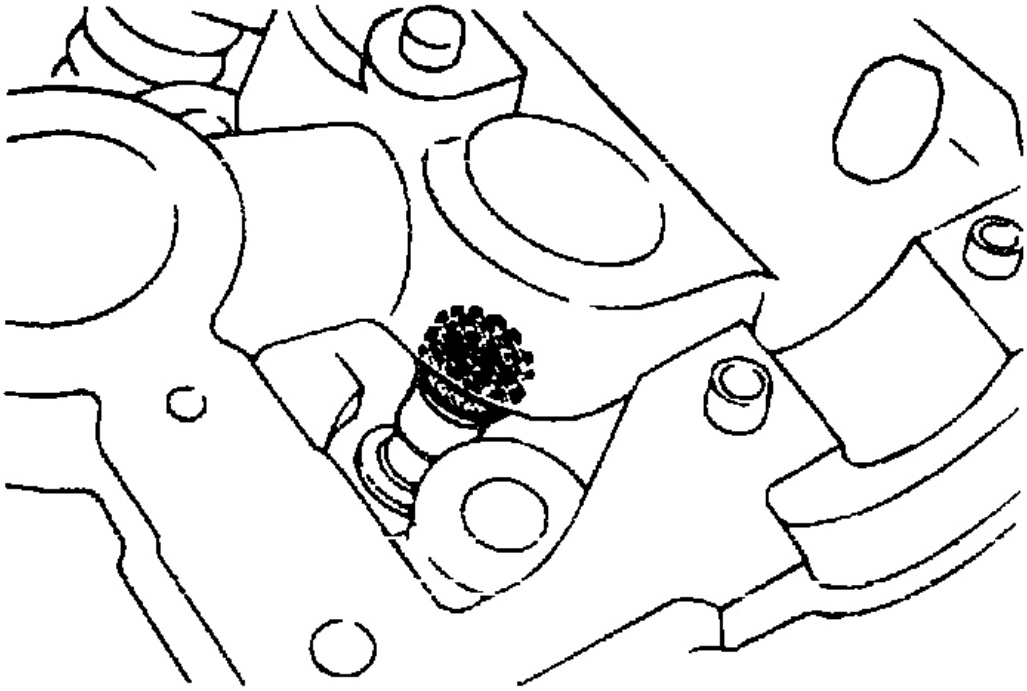


Fig. 218: Installing Valve Guide Seal Installer
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: Using a hammer will damage valve seals.

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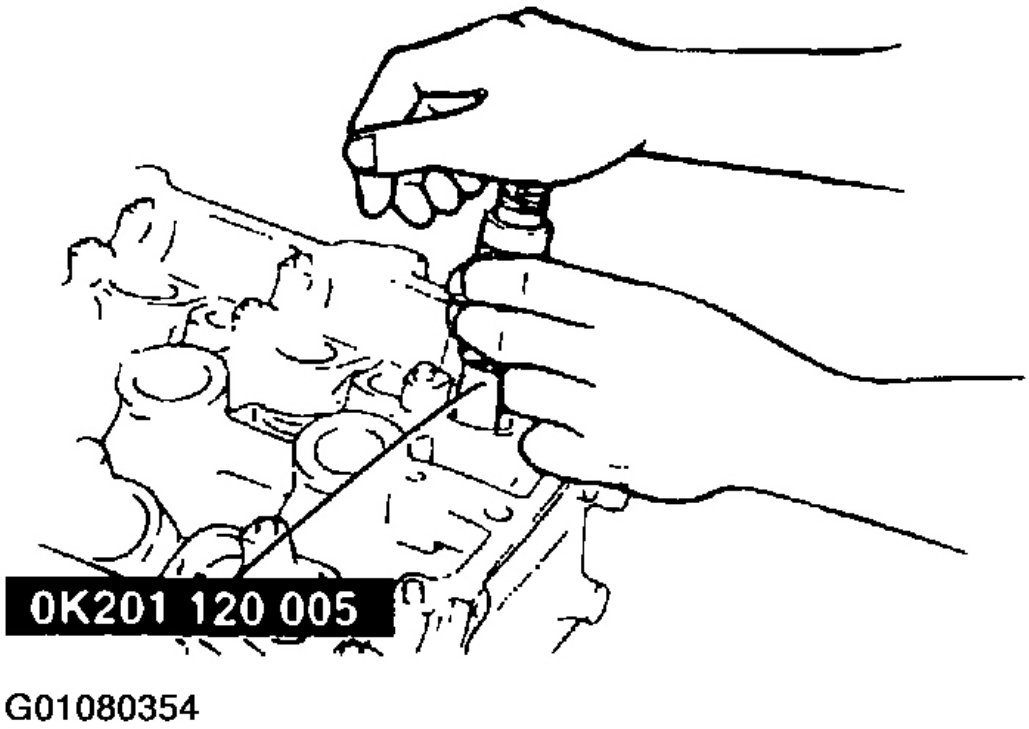


Fig. 219: Installing Valve Guide Seals
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove the valve guide seal installer.
4. Install lower spring seat on cylinder head.
5. Install HLA protector **SST(K95A-1000-E)** if available.
6. Install valve spring with narrow spring coils (B) toward cylinder head, and wider coils (A) toward upper spring seat.

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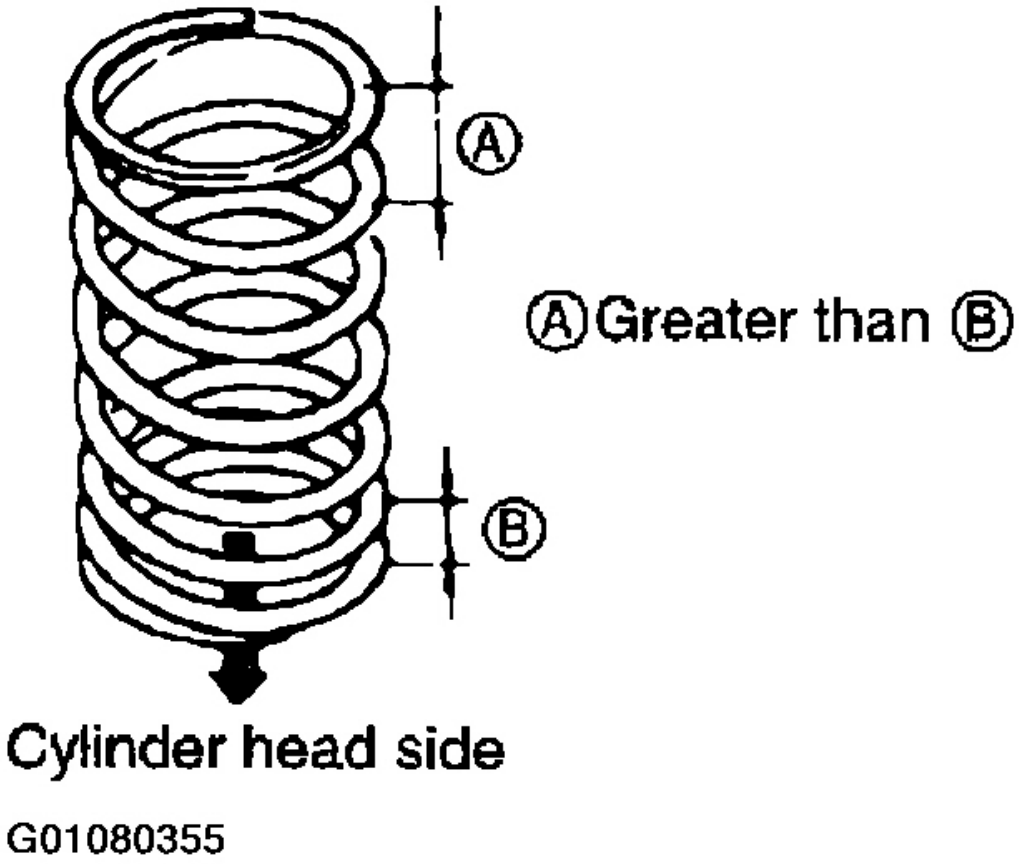


Fig. 220: Identifying Valve Spring Position
Courtesy of KIA MOTORS AMERICA, INC.

7. Install upper spring seat and compress valve spring with **SST** or equivalent.

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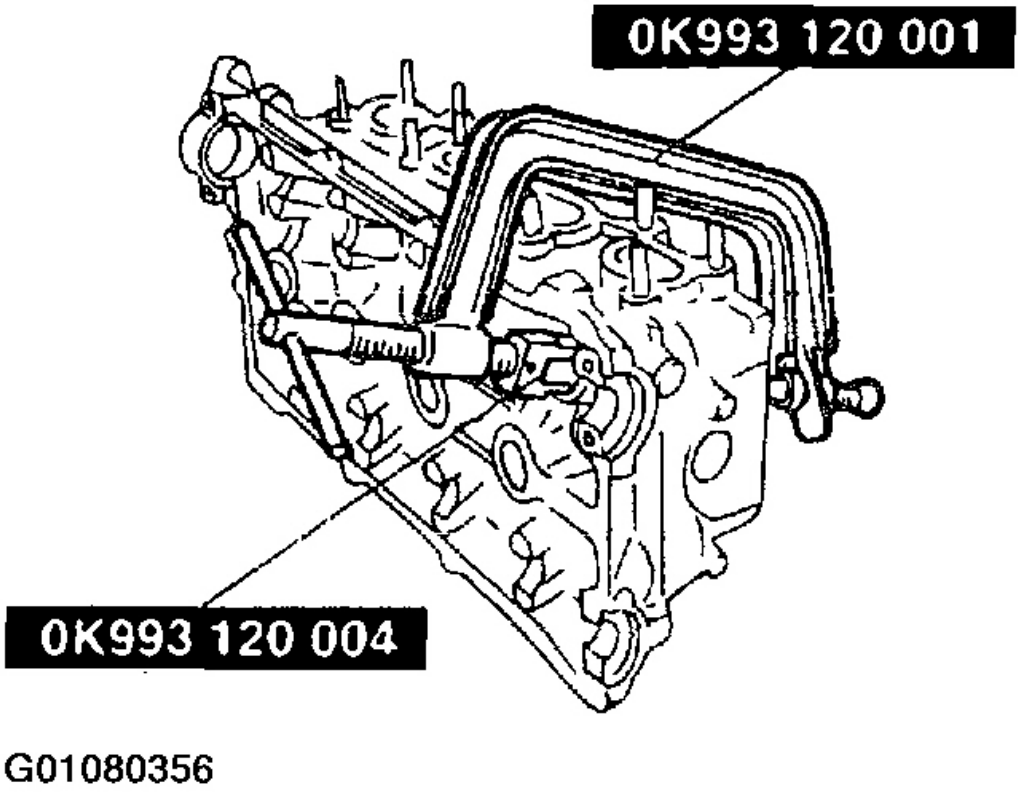


Fig. 221: Compressing Valve Spring
Courtesy of KIA MOTORS AMERICA, INC.

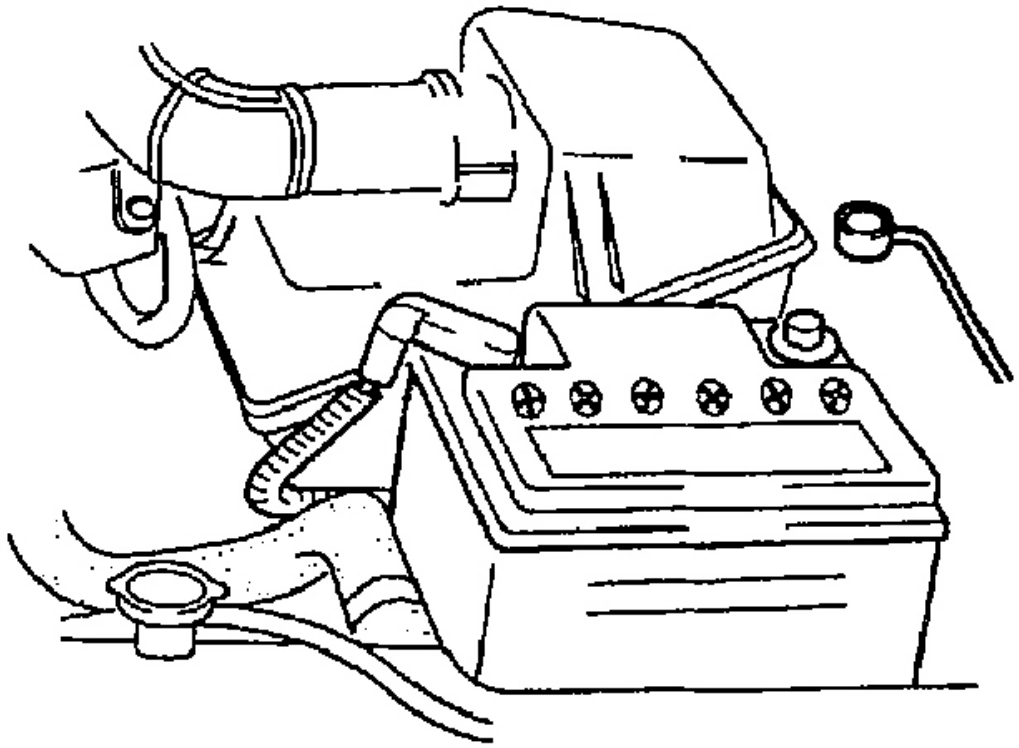
8. Install valve locks and release **SST** or equivalent from valve spring.
9. Tap end of valve stem lightly two or three times with a plastic hammer to verify that valve locks are fully seated.
10. Remove HLA protector (K-95A-1000-E) if used. Repeat procedure for remaining valve assembles.

HYDRAULIC LASH ADJUSTER (HLA)

REMOVAL

1. Disconnect negative battery cable.

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Fig. 222: Disconnecting Negative Battery Cable
Courtesy of KIA MOTORS AMERICA, INC.

2. Remove center cover.

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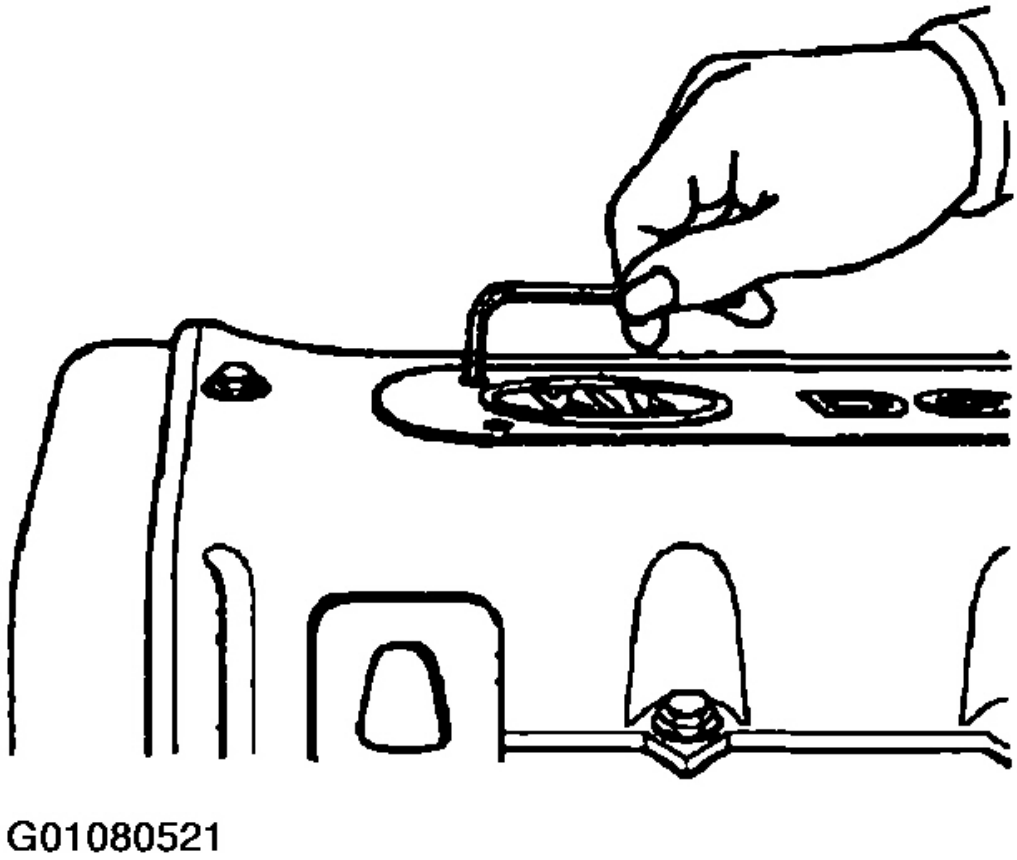
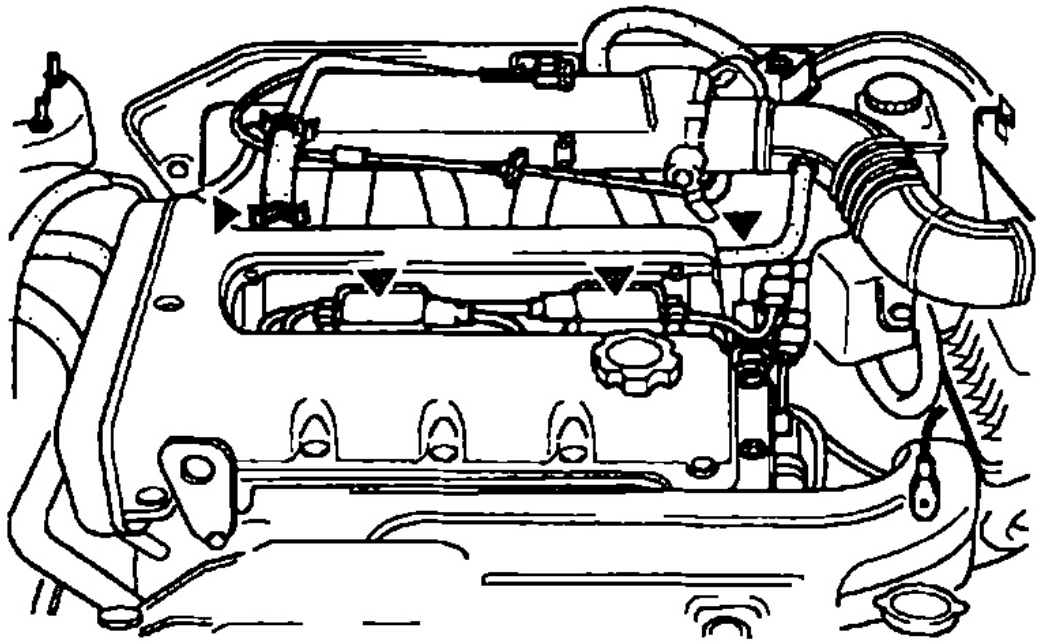


Fig. 223: Removing Center Cover
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove ignition coils and high-tension cords.
4. Disconnect PCV hose and ventilation hose.

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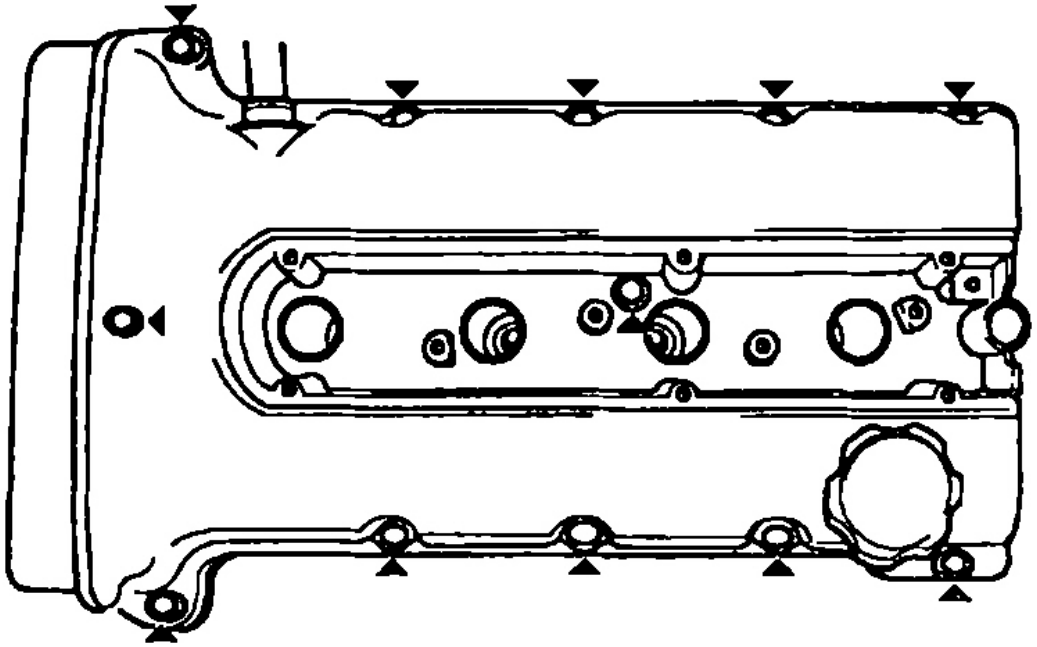


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Fig. 224: Disconnecting PCV And Ventilation Hoses
Courtesy of KIA MOTORS AMERICA, INC.

5. Remove timing belt. See **TIMING SYSTEM**.
6. Remove cylinder head cover.

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Fig. 225: Removing Cylinder Head Cover
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Align camshaft and crankshaft timing belt alignment marks.

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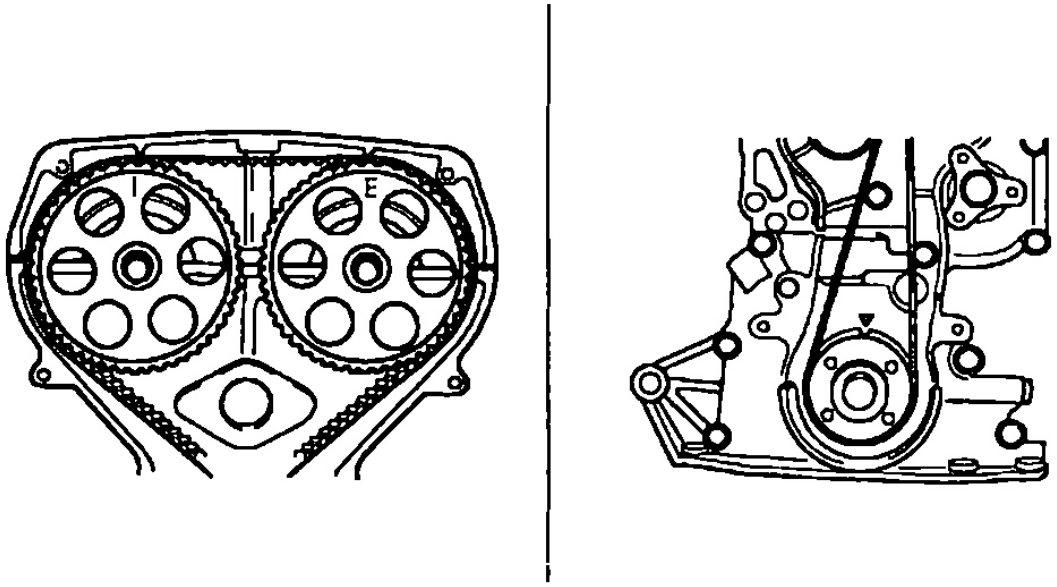
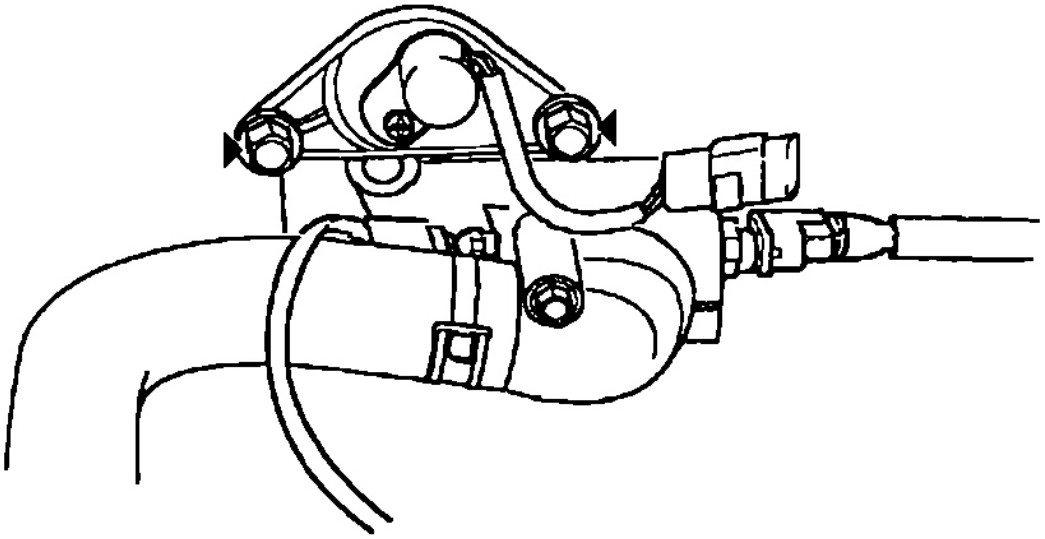


Fig. 226: Aligning Camshaft And Crankshaft Timing Belt Alignment Marks
Courtesy of KIA MOTORS AMERICA, INC.

7. Remove phase sensor.

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Fig. 227: Removing Phase Sensor
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8. Remove camshaft pulleys.

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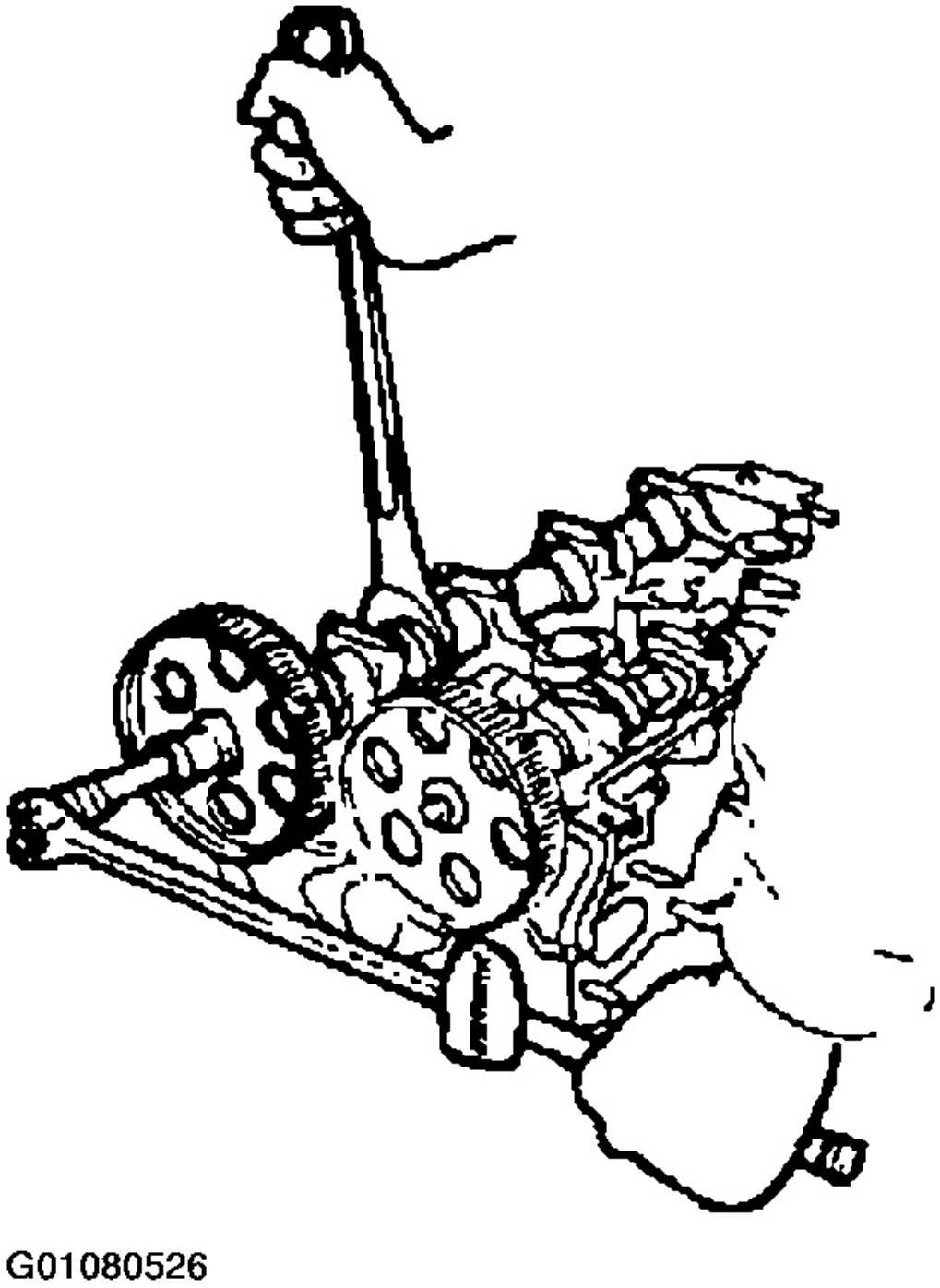


Fig. 228: Removing Camshaft Pulleys
Courtesy of KIA MOTORS AMERICA, INC.

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9. Loosen camshaft bearing cap bolts in five or six steps in order shown in figure.

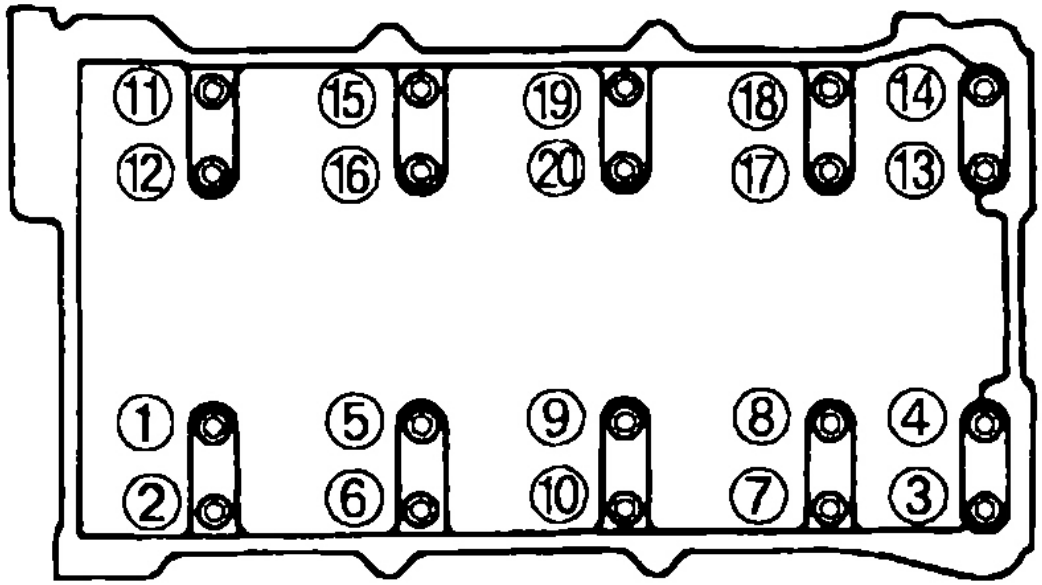
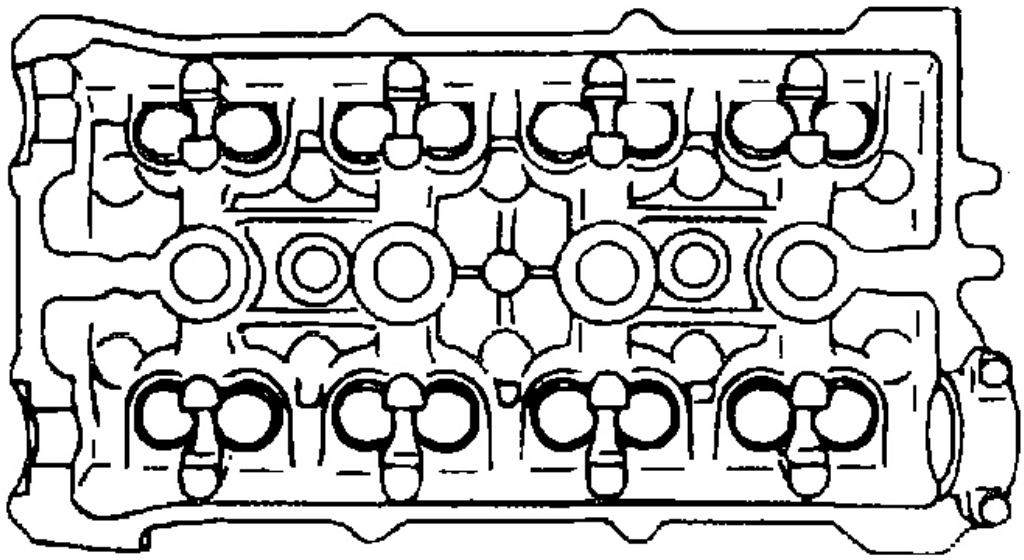


Fig. 229: Camshaft Bearing Cap Bolt Removal Sequence
Courtesy of KIA MOTORS AMERICA, INC.

10. Remove camshafts.
11. Mark HLA's to identify their original position if they will be reused.

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

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Fig. 230: Identifying Hydraulic Lash Adjusters
Courtesy of KIA MOTORS AMERICA, INC.

12. Remove HLA's from cylinder head.
13. Store HLA's upside-down in an oil-filled container.

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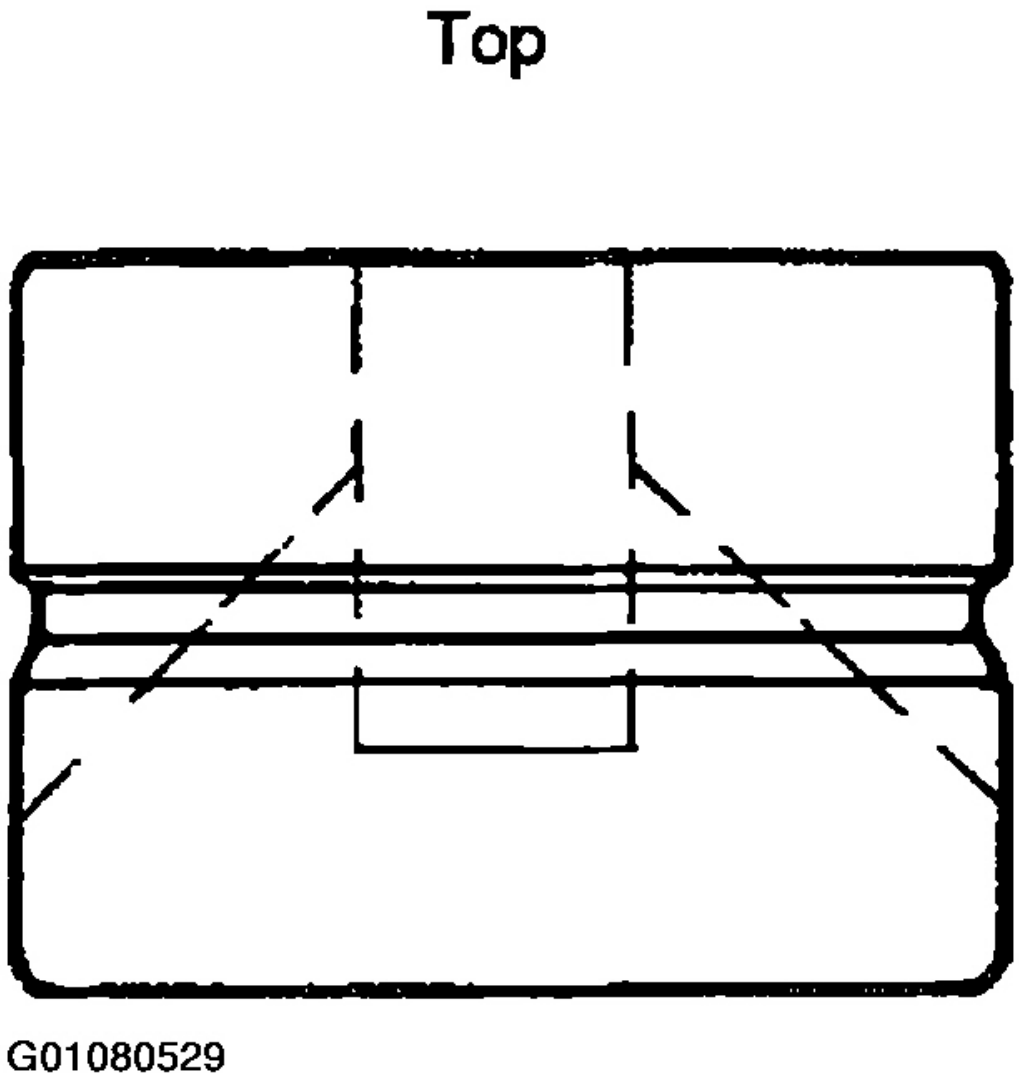


Fig. 231: Storing HLA'S
Courtesy of KIA MOTORS AMERICA, INC.

INSPECTION

1. Check HLA face for wear or damage, and replace if necessary.
2. With HLA filled with engine oil, hold (A) and press down on (B) by hand. If (B) moves, replace HLA.

NOTE: Never attempt to repair or disassemble an HLA.

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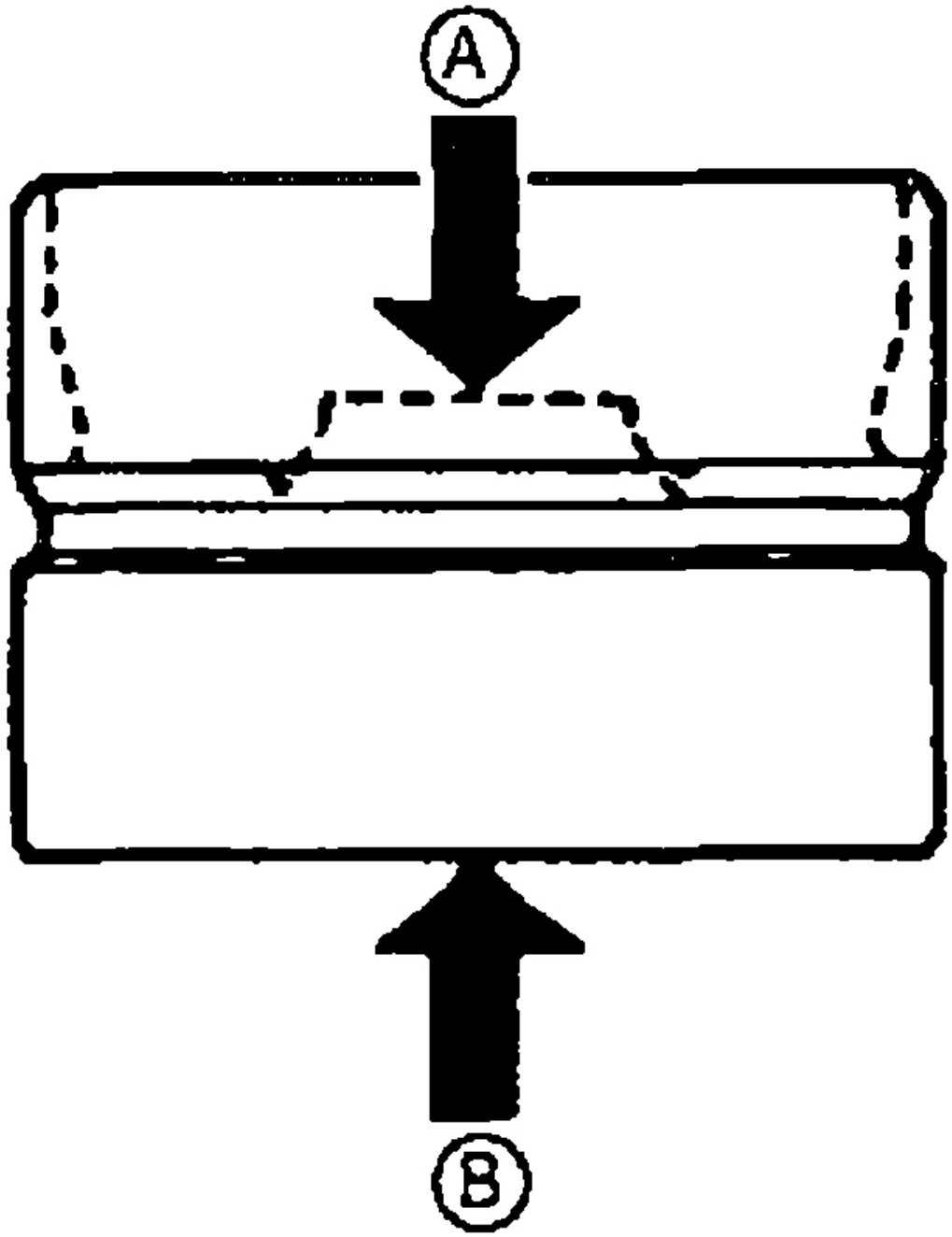


Fig. 232: Testing HLA Function
Courtesy of KIA MOTORS AMERICA, INC.

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3. Measure HLA bore diameters (X and Y directions) at two points (A and B) as shown in figure.

   Distortion: 1.1812~1.1820 in (30.000~30.025 mm)

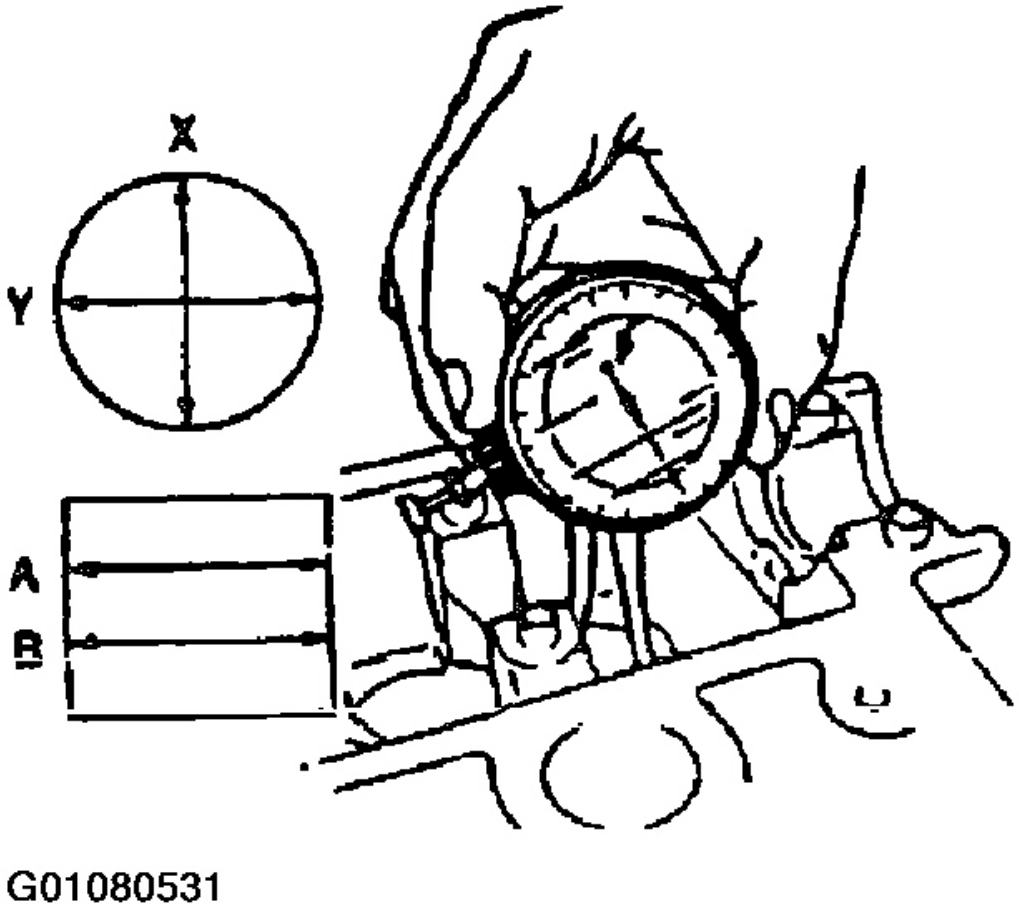


Fig. 233: Measuring HLA Bore Diameters
Courtesy of KIA MOTORS AMERICA, INC.

4. Measure HLA diameters (X and Y directions) at two points (A and B) as shown in figure. See **Fig. 234**.

   Diameter:

   1.1795~1.1801 in (29.959~29.975 mm)

5. Calculate clearance between HLA diameter and related HLA bore. Replace HLA and/or cylinder head if necessary.

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Clearance: 0.00099~0.00259 in (0.025~0.066 mm)

Maximum: 0.0071 in (0.180 mm)

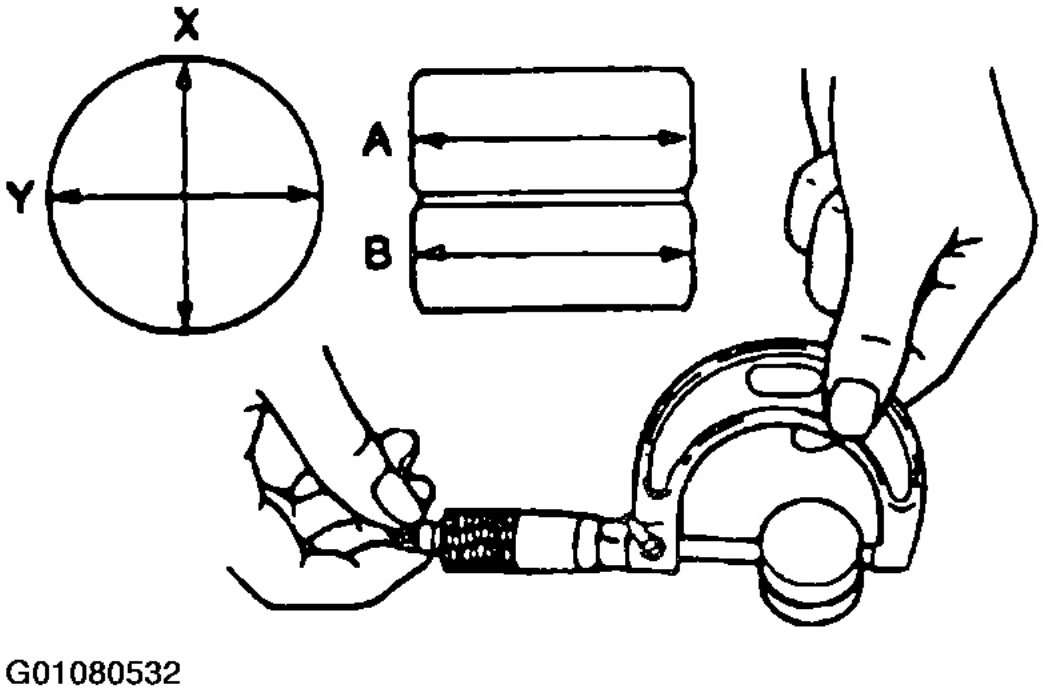
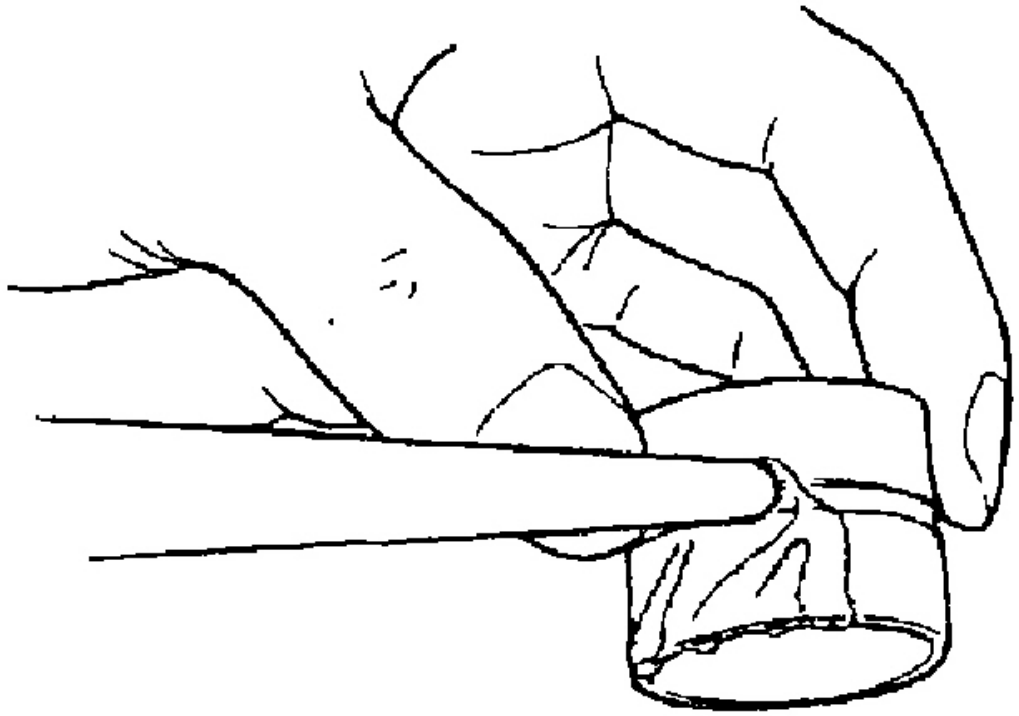


Fig. 234: Measuring HLA Clearance
Courtesy of KIA MOTORS AMERICA, INC.

INSTALLATION

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

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Fig. 235: Applying Oil To HLA
Courtesy of KIA MOTORS AMERICA, INC.

2. Install HLA into cylinder head bore.

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

3. Check that HLA moves smoothly in its bore.
4. Apply clean engine oil to camshaft and camshaft bearing surfaces and install camshaft so that camshaft dowel pins point straight up.
5. Install camshaft bearing caps according to cap number with the directional arrows pointing forward.
6. Install bolts to camshaft bearing caps and tighten in five or six steps in order shown in figure.

Tightening torque: 8.32~10.49 lb.ft (11.28~14.22 N.m, 1.15~1.45 kg.m)

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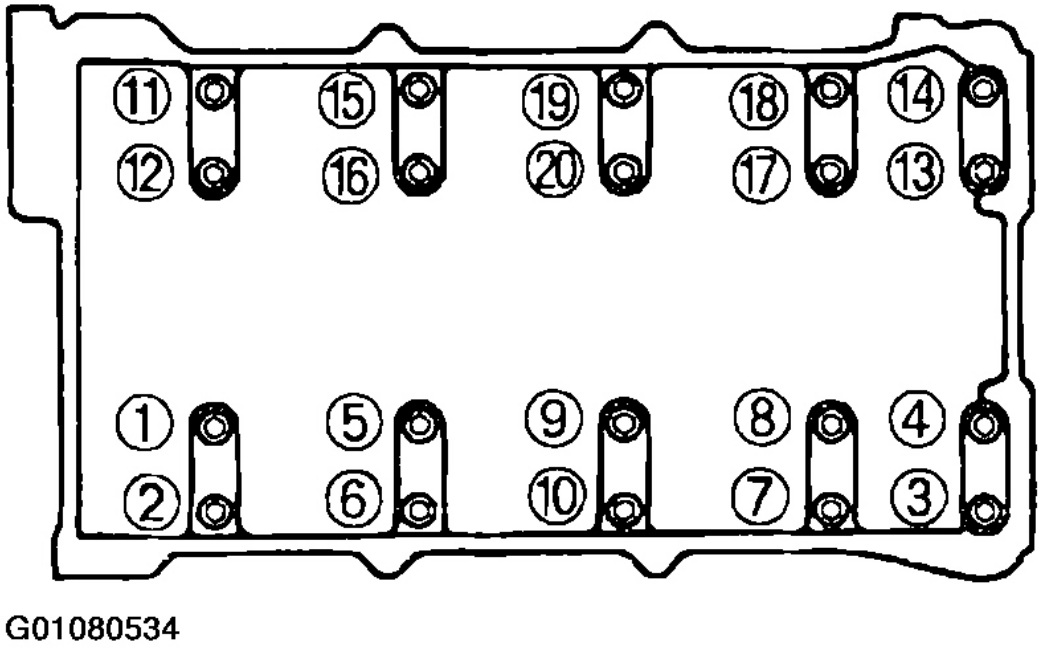


Fig. 236: Camshaft Bearing Cap Bolt Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

7. Apply a coat of clean engine oil to the lip of new camshaft seal.
8. Seat camshaft seal by hand and tap the seal in place until it is flush with the edge of camshaft bearing cap.

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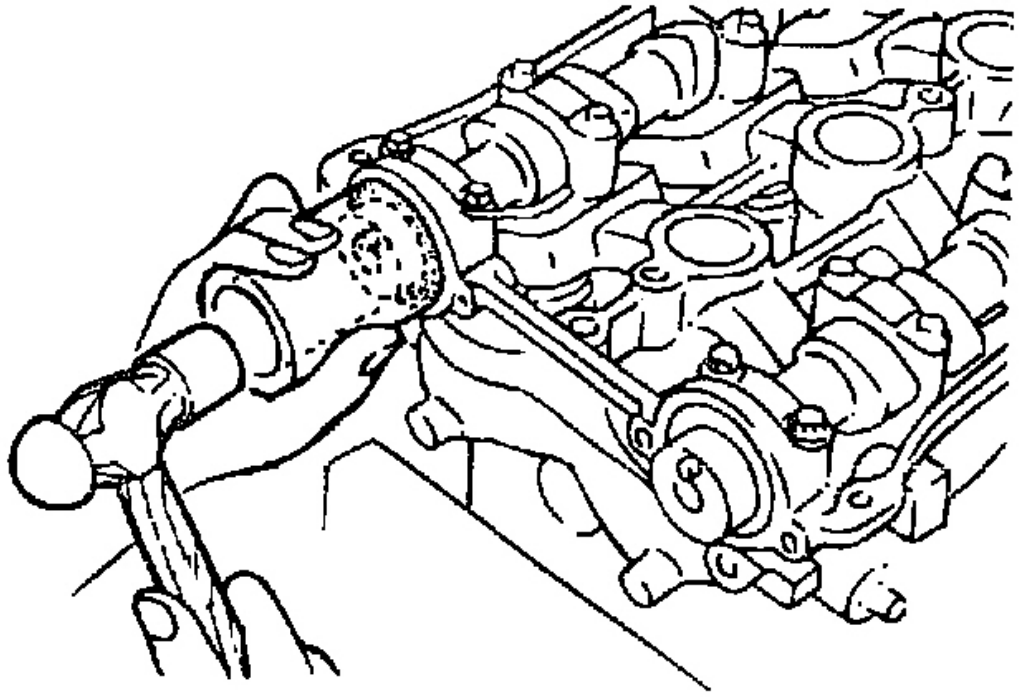
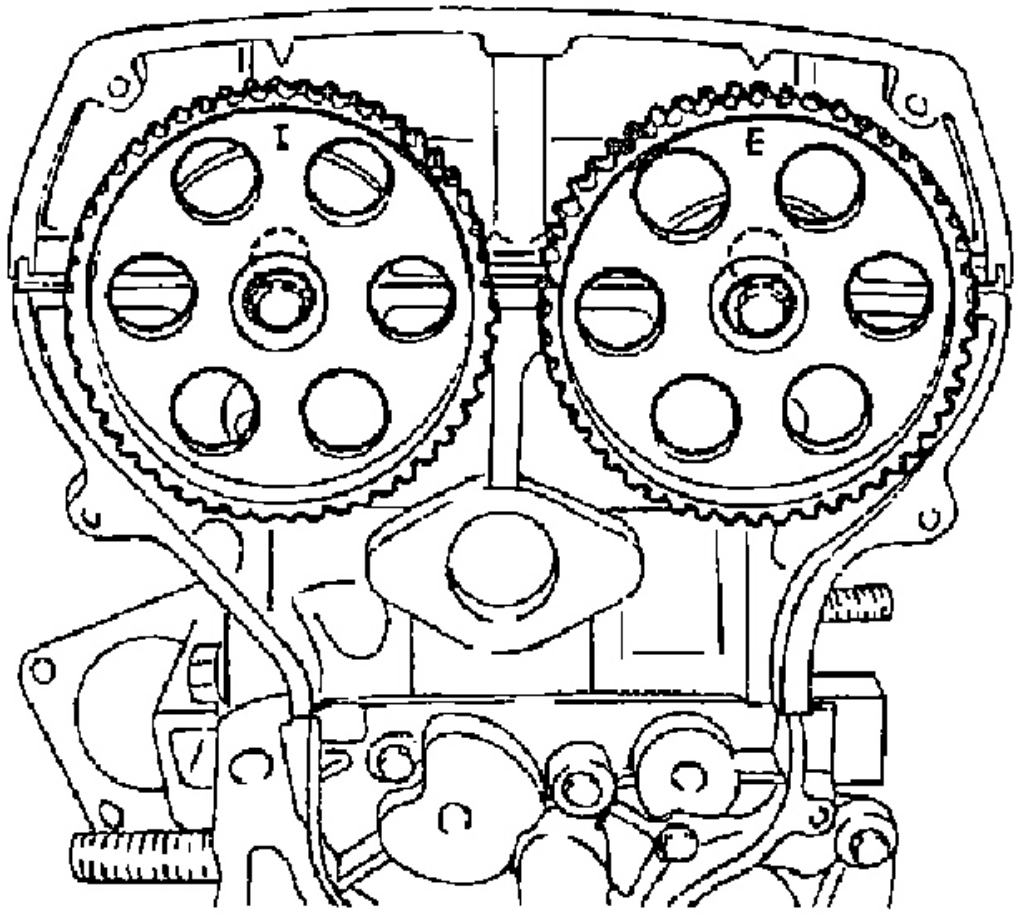


Fig. 237: Installing Camshaft Seal
Courtesy of KIA MOTORS AMERICA, INC.

9. Install camshaft pulleys onto camshaft, aligning "I" mark with the intake camshaft dowel pin, and "E" mark with exhaust camshaft dowel pin.

   Tightening torque: 36.2~44.8 lb.ft (49~60.8 N.m, 5.0~6.2 kg.m)

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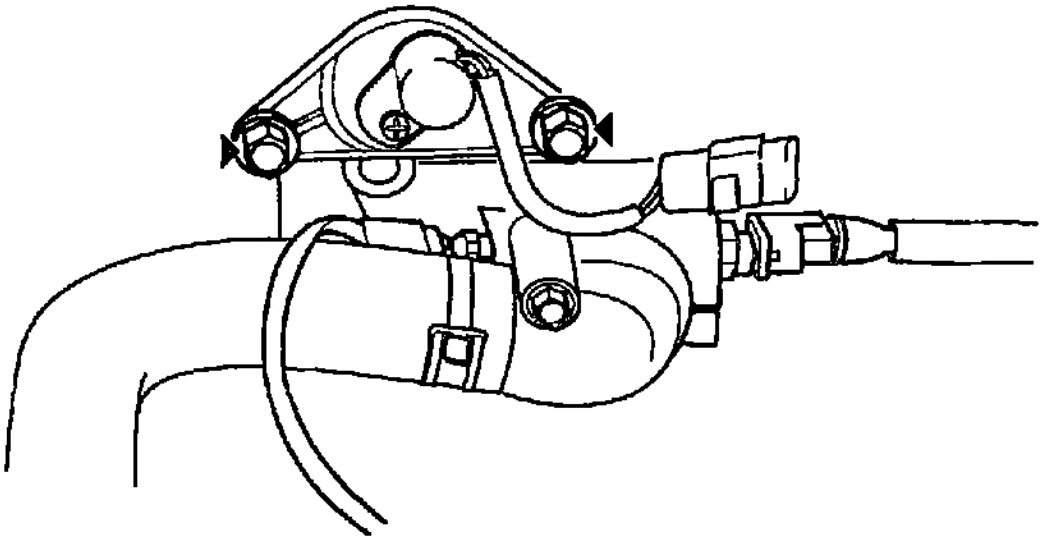


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Fig. 238: Installing Camshaft Pulleys
Courtesy of KIA MOTORS AMERICA, INC.

10. Install phase sensor.

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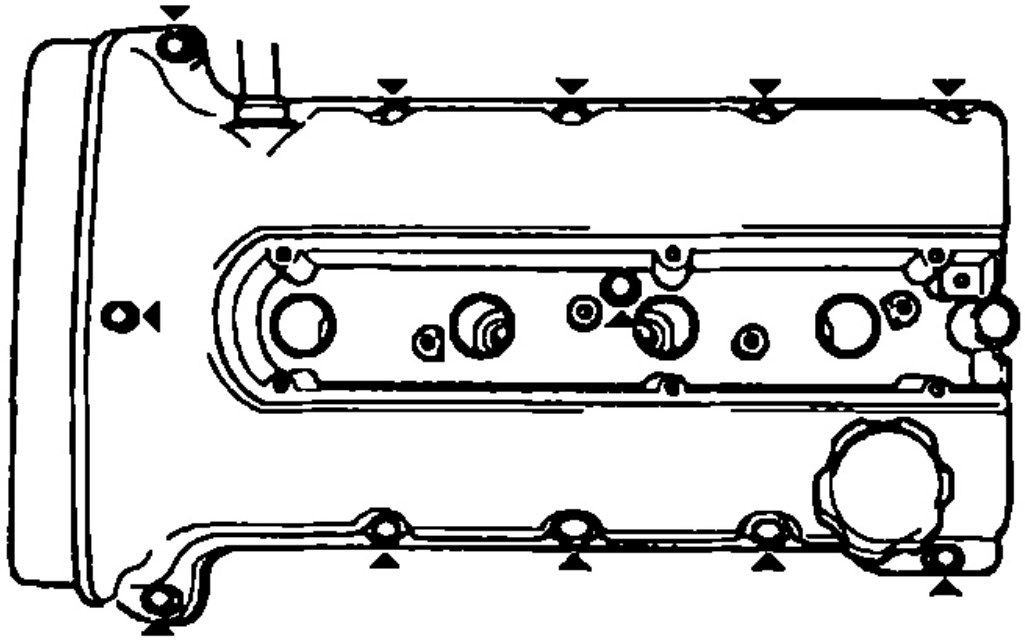
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Fig. 239: Installing Phase Sensor
Courtesy of KIA MOTORS AMERICA, INC.

11. Install cylinder head cover.

    Tightening torque: 5.8~8.7 lb.ft (7.8~11.8 N.m, 0.8~1.2 kg.m)

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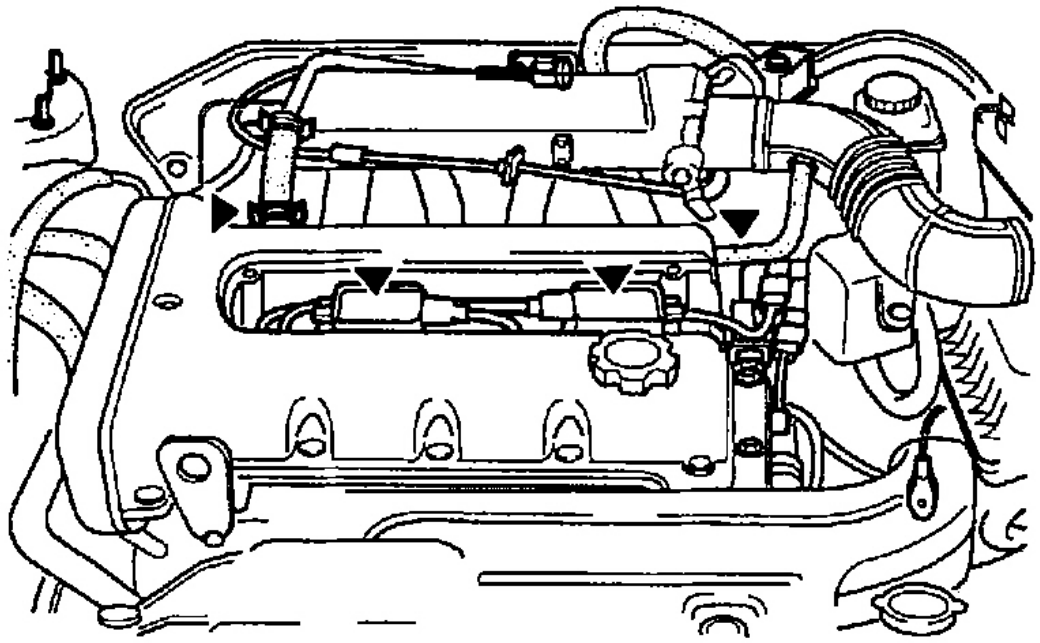


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Fig. 240: Installing Cylinder Head Cover
Courtesy of KIA MOTORS AMERICA, INC.

12. Install timing belt. See **TIMING SYSTEM**.
13. Connect PCV hose and ventilation hose.
14. Install high tension cords and ignition coils.

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Fig. 241: Installing High Tension Cords And Ignition Coils
Courtesy of KIA MOTORS AMERICA, INC.

15. Install center cover.

Tightening torque: 3.6~6.5 lb.ft (4.9~8.8 N.m, 0.5~0.9 kg.m)

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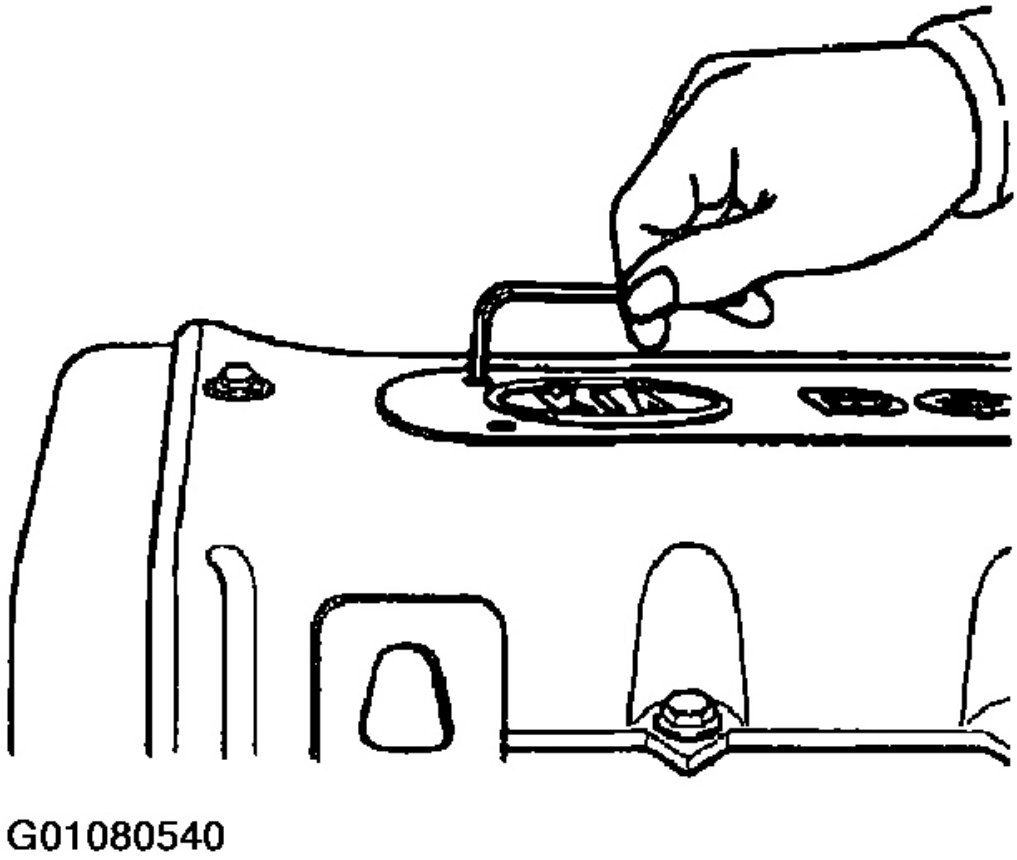
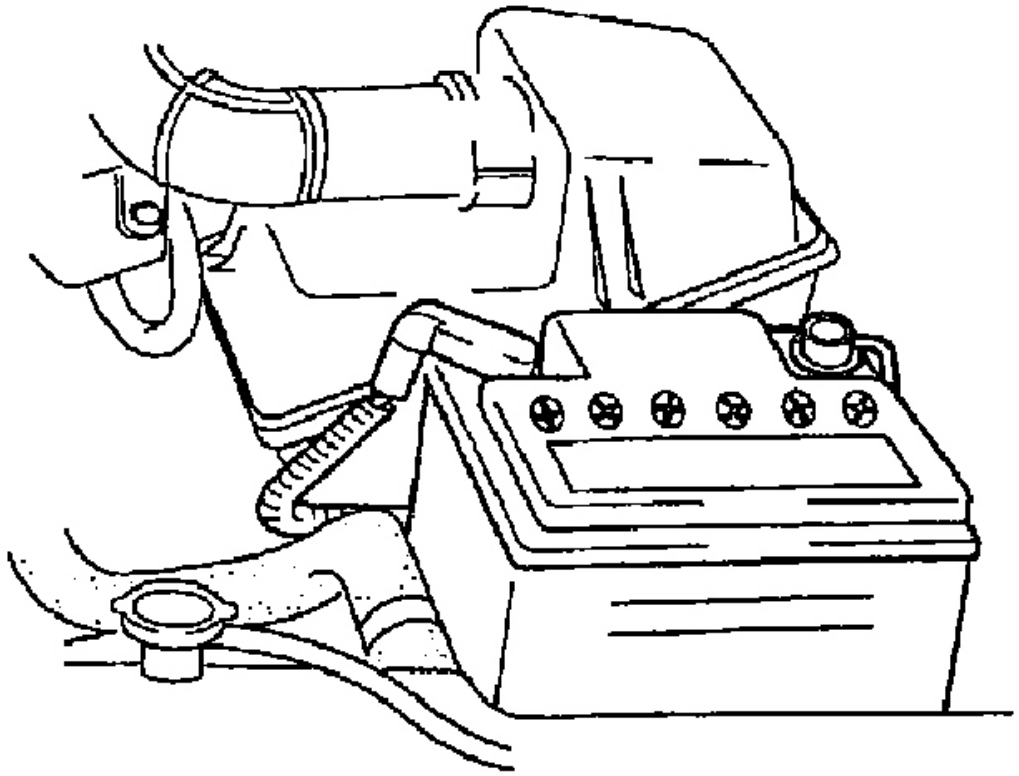


Fig. 242: Installing Center Cover
Courtesy of KIA MOTORS AMERICA, INC.

16. Connect negative battery cable.

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Fig. 243: Connecting Negative Battery Cable
Courtesy of KIA MOTORS AMERICA, INC.

OIL PAN

REMOVAL

1. Disconnect negative battery cable.

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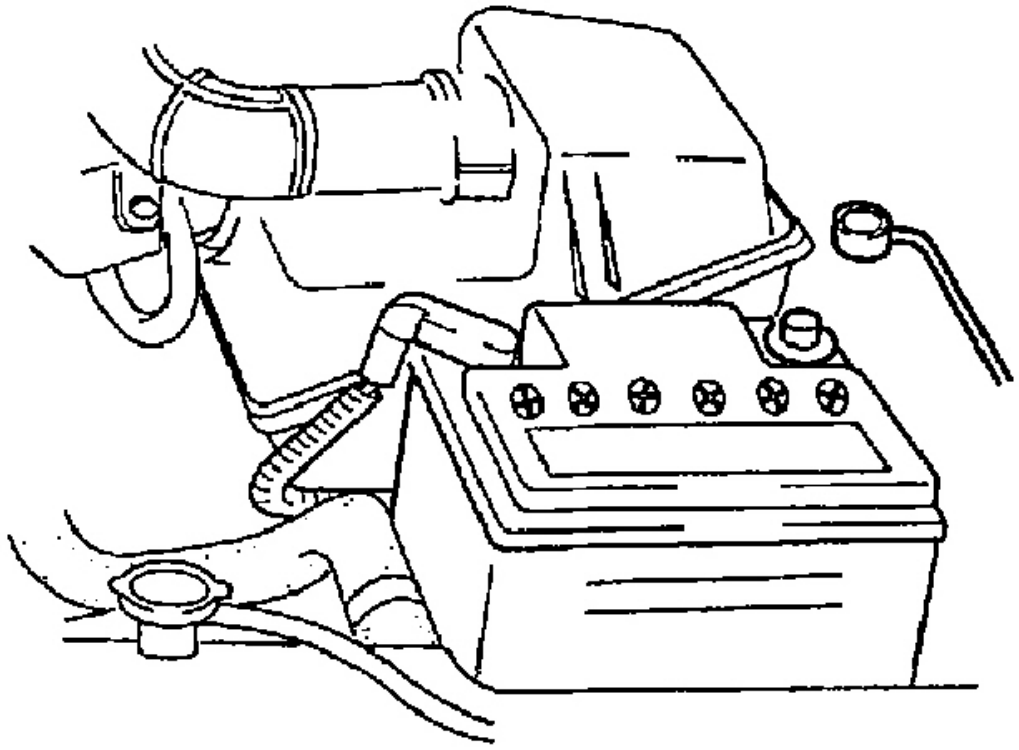


Fig. 244: Disconnecting Negative Battery Cable
Courtesy of KIA MOTORS AMERICA, INC.

2. Drain engine oil.

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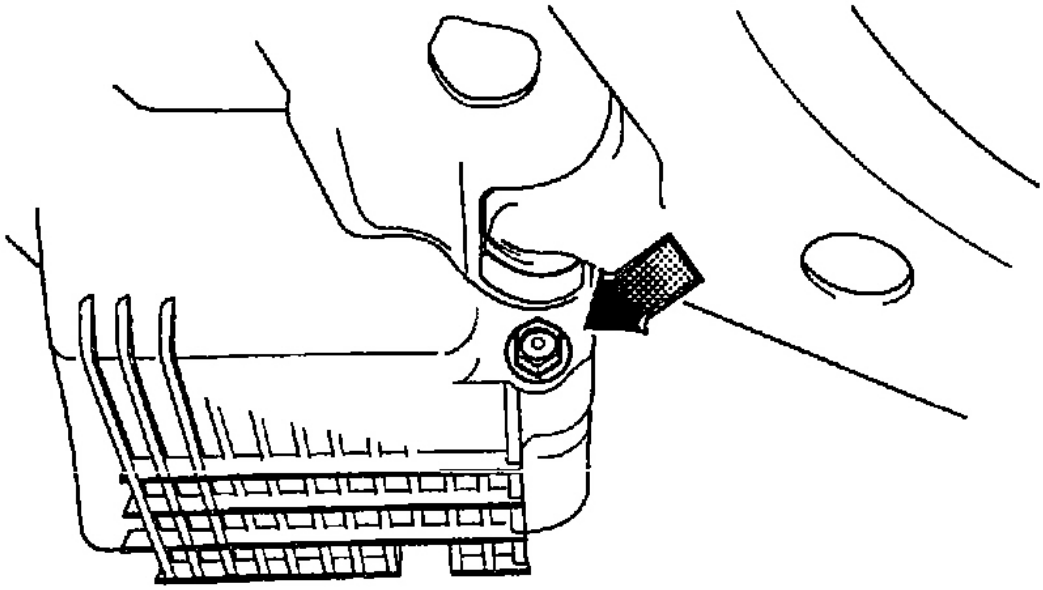


Fig. 245: Draining Engine Oil
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove LH and RH side splash shields.

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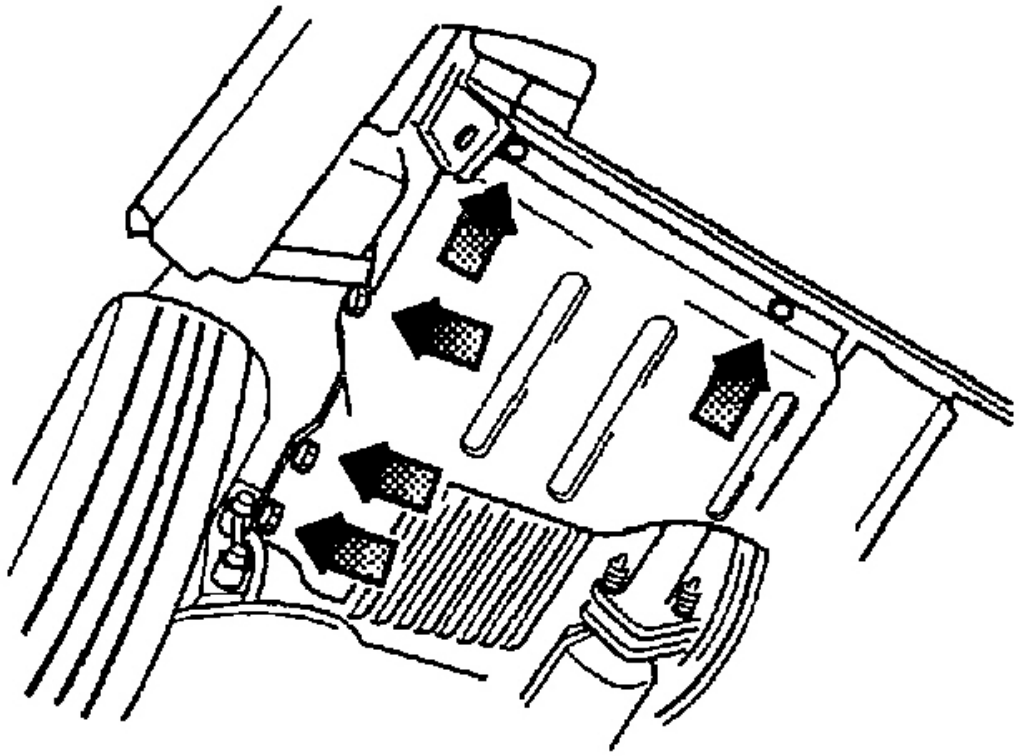
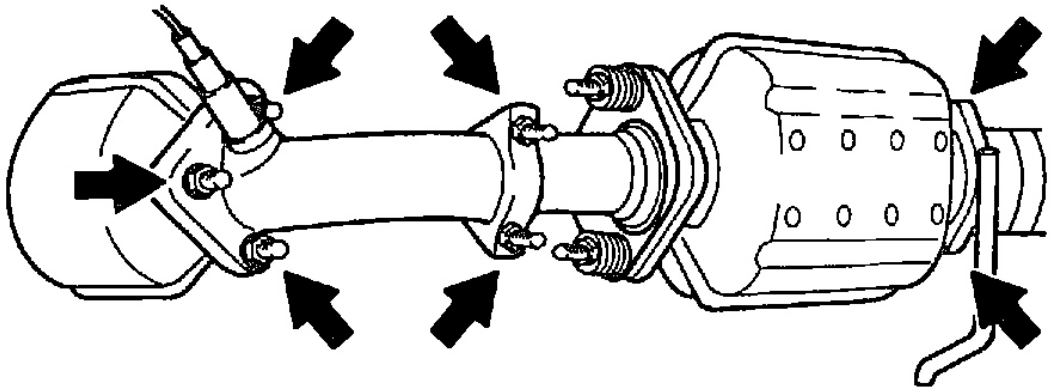


Fig. 246: Removing LH And RH Side Splash Shields
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove front exhaust pipe.

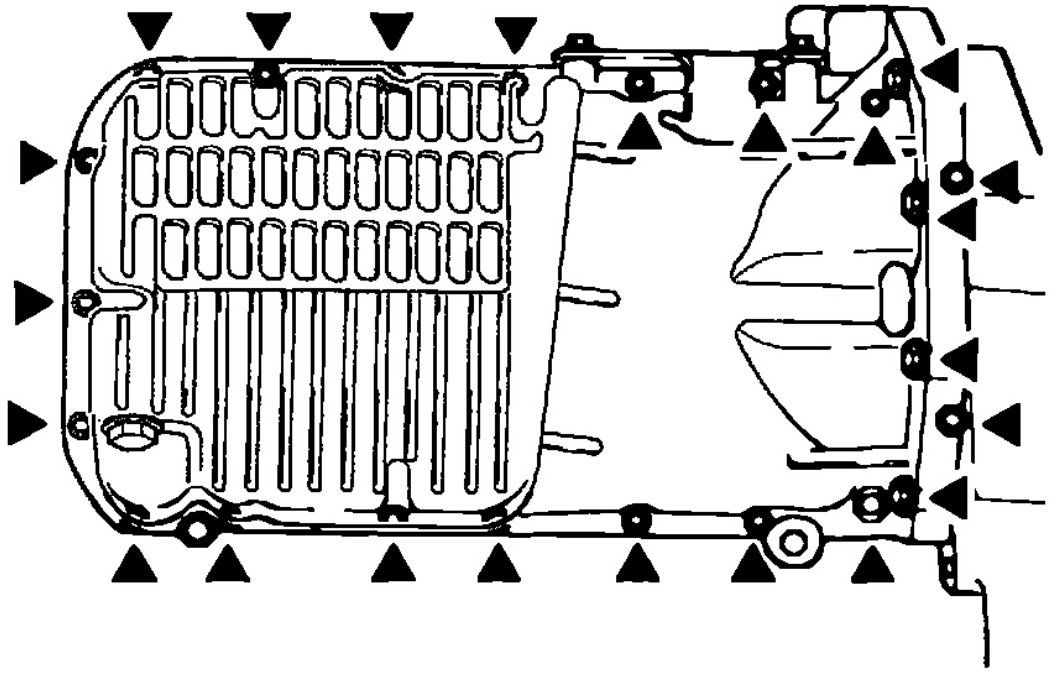
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Fig. 247: Removing Front Exhaust Pipe
Courtesy of KIA MOTORS AMERICA, INC.

5. Remove oil pan mounting bolts.



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Fig. 248: Removing Oil Pan Mounting Bolts
Courtesy of KIA MOTORS AMERICA, INC.

6. Remove oil pan with screwdriver or suitable tool as shown in figure. See **Fig. 249**.

CAUTION:
a. Do not force tools between cylinder block and oil pan because this may damage sealing surfaces.
b. Do not damage sealing surfaces when removing old sealant.

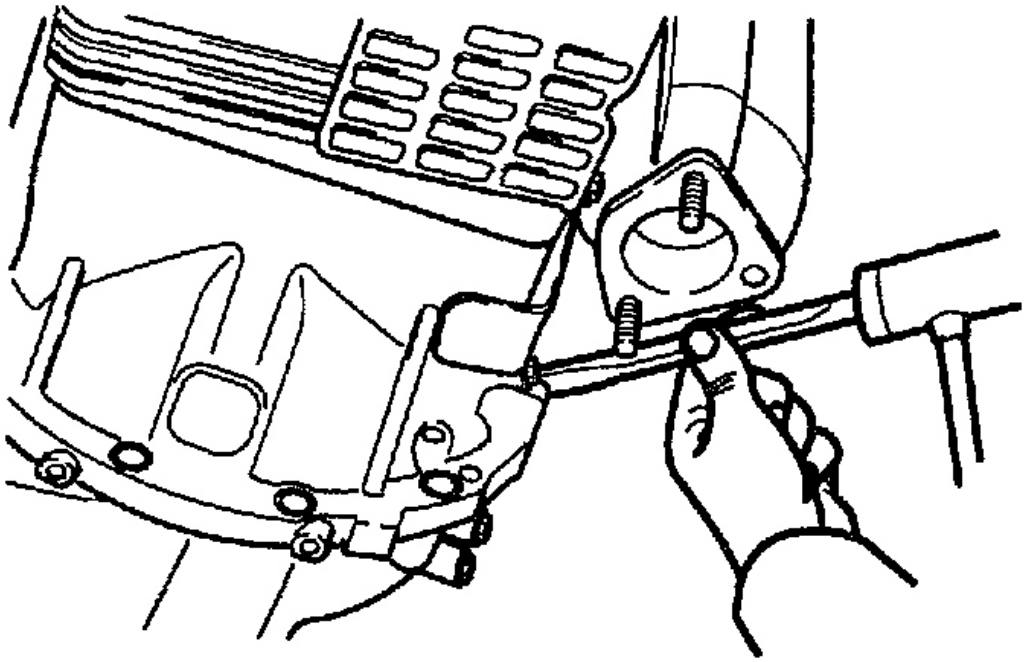
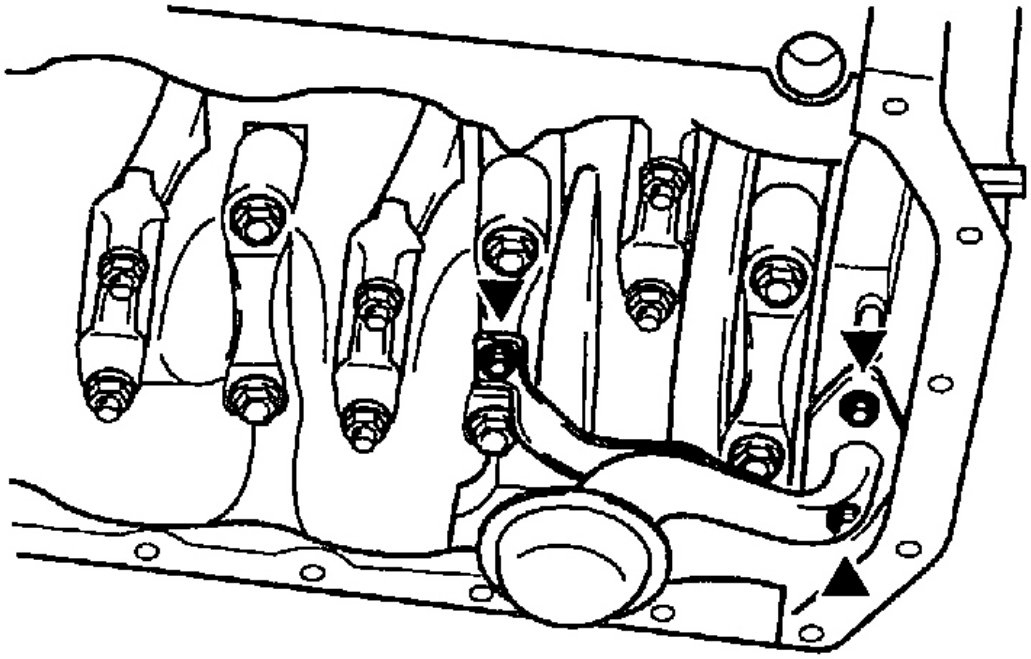


Fig. 249: Removing Oil Pan With Screwdriver Or Suitable Tool
Courtesy of KIA MOTORS AMERICA, INC.

7. Remove oil strainer.

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Fig. 250: Removing Oil Strainer
Courtesy of KIA MOTORS AMERICA, INC.

INSTALLATION

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

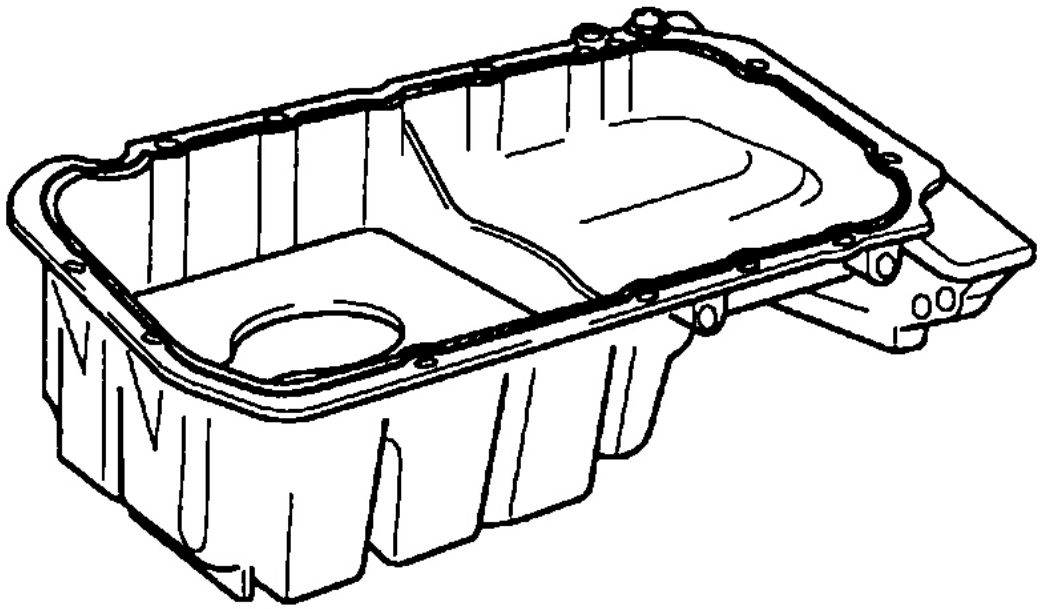
1. Install oil strainer.

   Tightening torque: 5.8~8.7 lb-ft (7.8~11.8 N.m, 0.8~1.2 kg-m)

2. Apply a continuous bead of silicone sealant to baffle plate along inside of bolt holes on contact surfaces.

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

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G01080230

Fig. 251: Applying A Continuous Bead Of Silicone Sealant To Baffle Plate
Courtesy of KIA MOTORS AMERICA, INC.

3. Install oil pan.

   Tightening torque: A, B, C, D: 5.8~8.0 lb-ft (7.8~10.8 N.m, 0.8~1.1 kg-m)

   E: 28~38 lb-ft (38~51 N.m, 3.8~5.3 kg-m)

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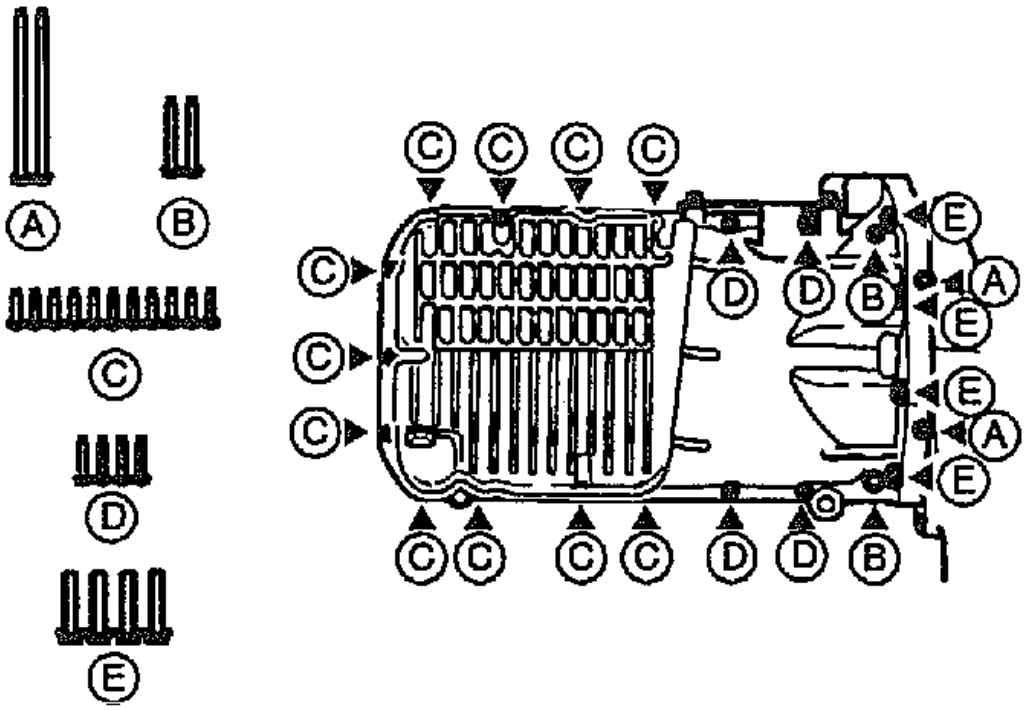


Fig. 252: Illustrating Oil Pan Bolt Locations
Courtesy of KIA MOTORS AMERICA, INC.

4. Install front exhaust pipe.

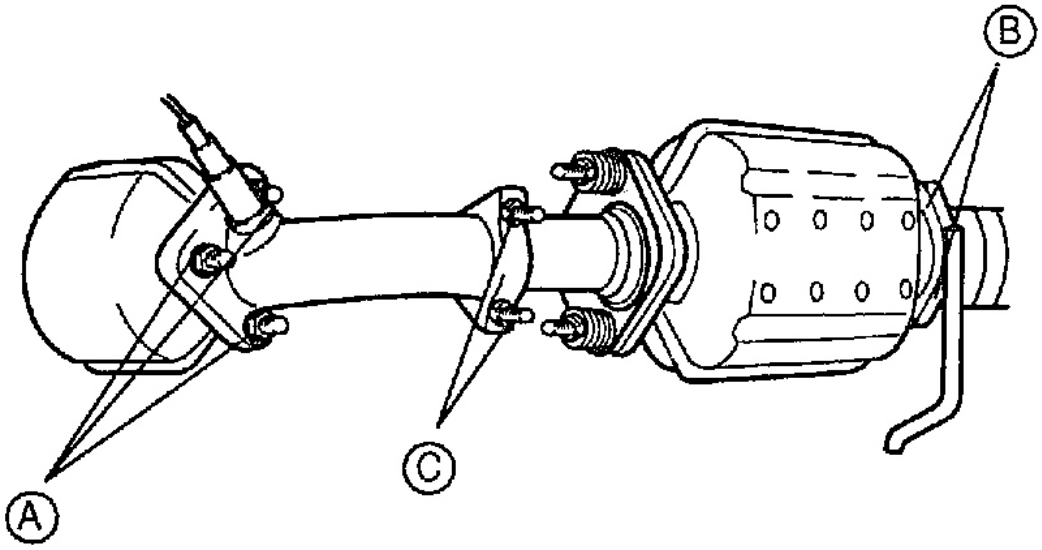
Tightening torque:

A : 29.7~40.5 lb-ft (40.2~54.9 N.m, 4.1~5.6 kg-m)

B : 51~69 lb-ft (69~94 N.m, 6.9~9.4 kg-m)

C : 15.2~20.2 lb-ft (20.6~27.4 N.m, 2.1~2.8 kg-m)

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Fig. 253: Installing Front Exhaust Pipe
Courtesy of KIA MOTORS AMERICA, INC.

5. Install LH and RH side splash shields.

   Tightening torque: 12~18 lb-ft (16~24 N.m, 1.6~2.4 kg-m)

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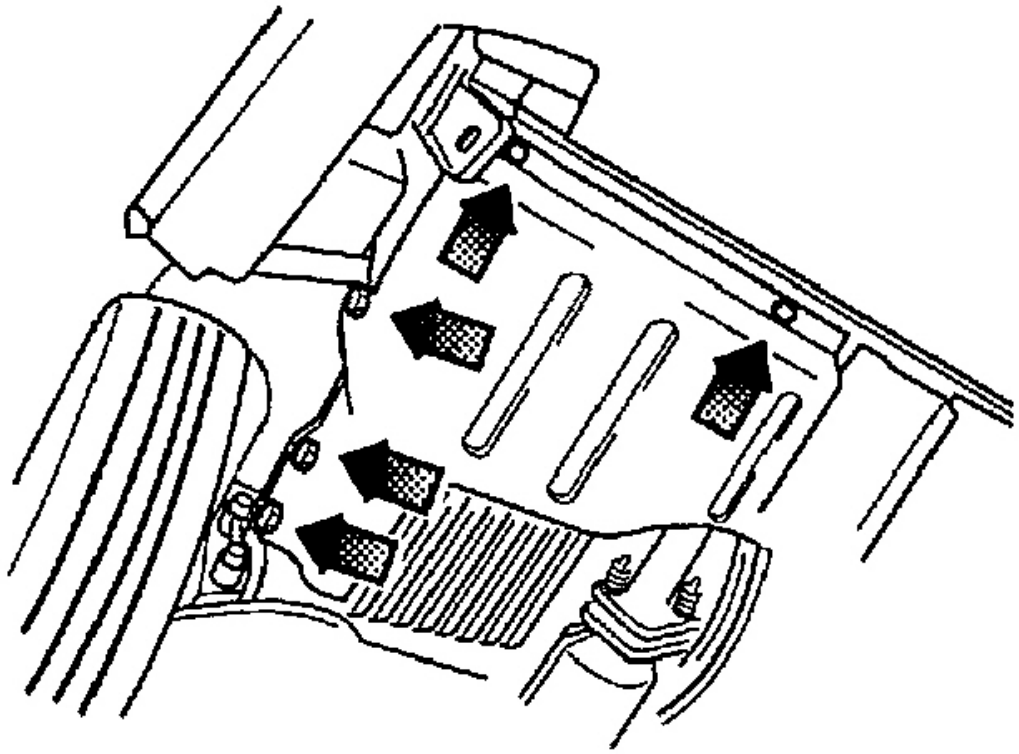
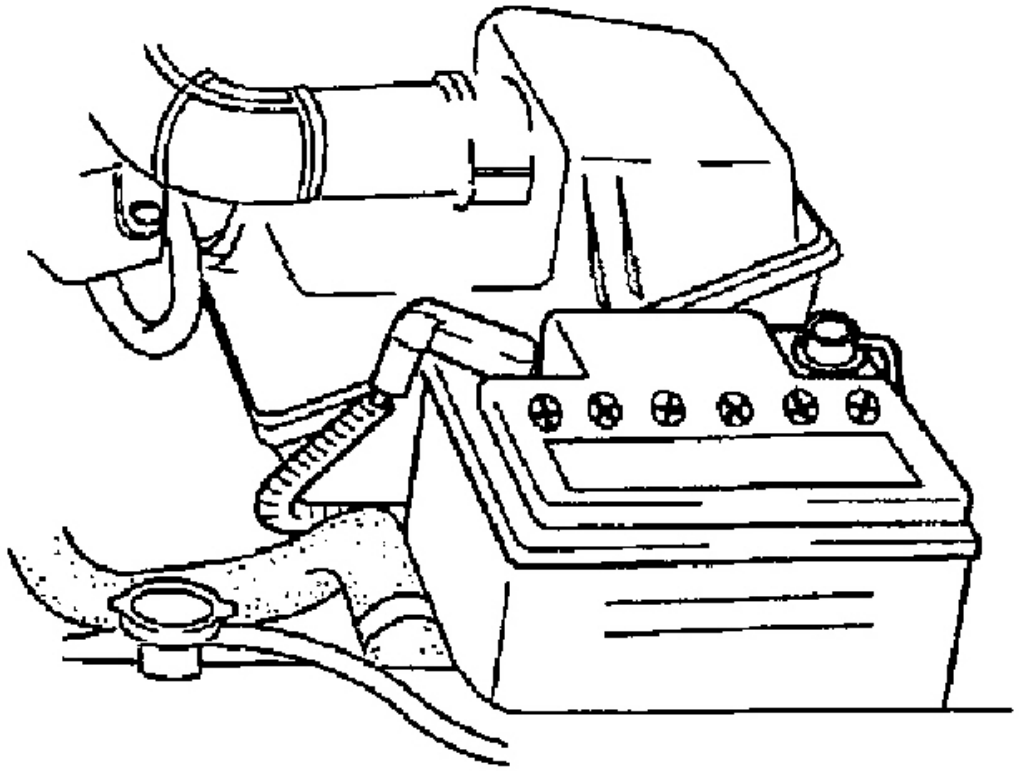


Fig. 254: Installing LH And RH Side Splash Shields
Courtesy of KIA MOTORS AMERICA, INC.

6. Fill with specified amount and type of engine oil.
7. Connect negative battery cable.

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Fig. 255: Connecting Negative Battery Cable
Courtesy of KIA MOTORS AMERICA, INC.

8. Start engine and check for leaks.
9. Check oil level and add oil if necessary.

COOLING SYSTEM

TROUBLESHOOTING GUIDE

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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. 256: Cooling System Troubleshooting Guide
Courtesy of KIA MOTORS AMERICA, INC.

SPECIFICATION

Item			Engine T8 DOHC
Cooling system			Water-cooled, forced circulation
Cooling capacity		Us qt (liters, Imp qt)	6.3(6.0, 5.3)
Water pump	Type		Centrifugal
	Water seal		Unified mechanical seal
Thermostat Type	Type		WAX 80.5~83.5
	Initial opening temperature	°F(°C)	176.9~182.3 (80.5~83.5)
	Full-open temperature	°F(°C)	203 (95)
	Full-open lift In(mm)	Main	0.31 (8.0) minimum
	Type		Corrugated fin
Radiator	Core size in (mm)	Width	27.5 (699)
		Height	13.6 (345)
		Thickness	1.1 (28)
	Heat dissipation capacity	kcal/h	43,000 (M/T), 46,000 (A/T)
	Automatic transaxle oil cooler	Type	Double tube type
		Heat dissipation capacity kcal/h kcal/h	1,700
Cooling fan	Type		Electric
	Number of blades		7
	Outer diameter	in(mm)	12.6 (320)
	Capacity	W-V	120-12
	Current	A	13

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Fig. 257: Cooling System Specifications
Courtesy of KIA MOTORS AMERICA, INC.

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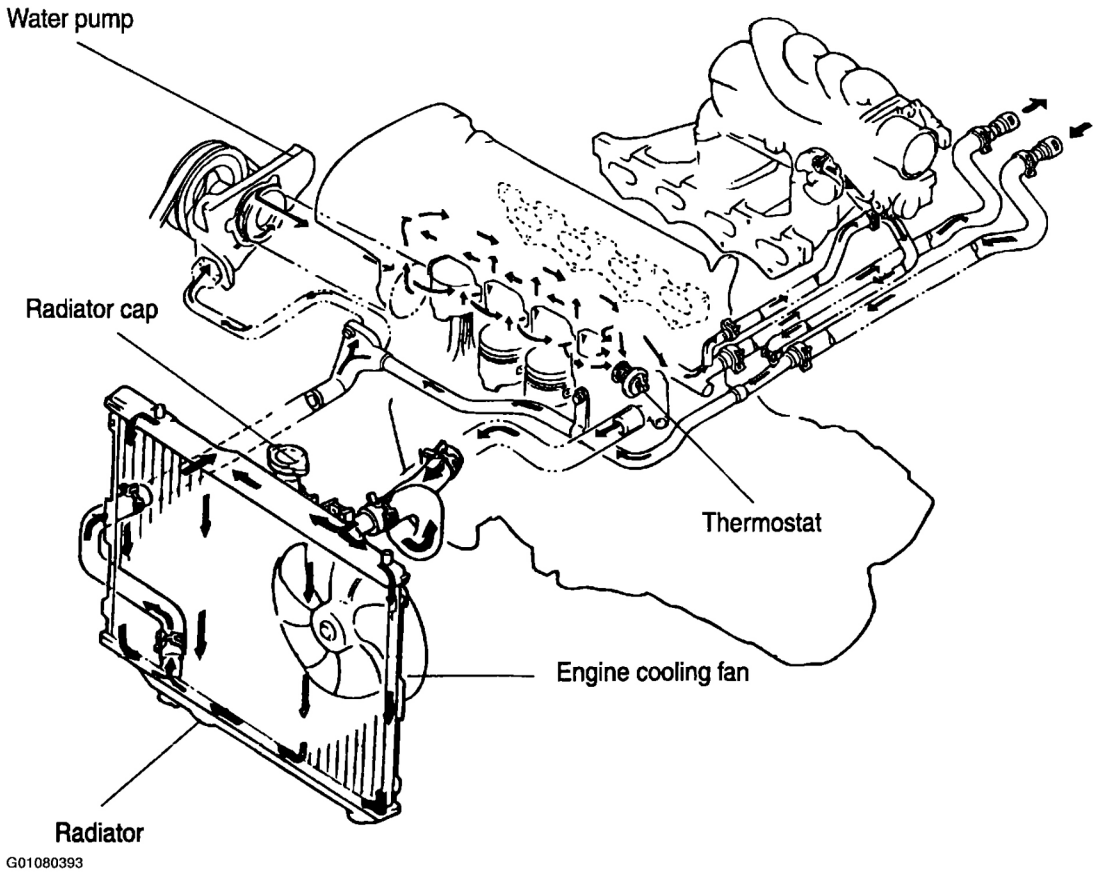


Fig. 258: Cooling System Functional Diagram
Courtesy of KIA MOTORS AMERICA, INC.

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. Locate coolant level overflow reservoir.
2. Add coolant as necessary.

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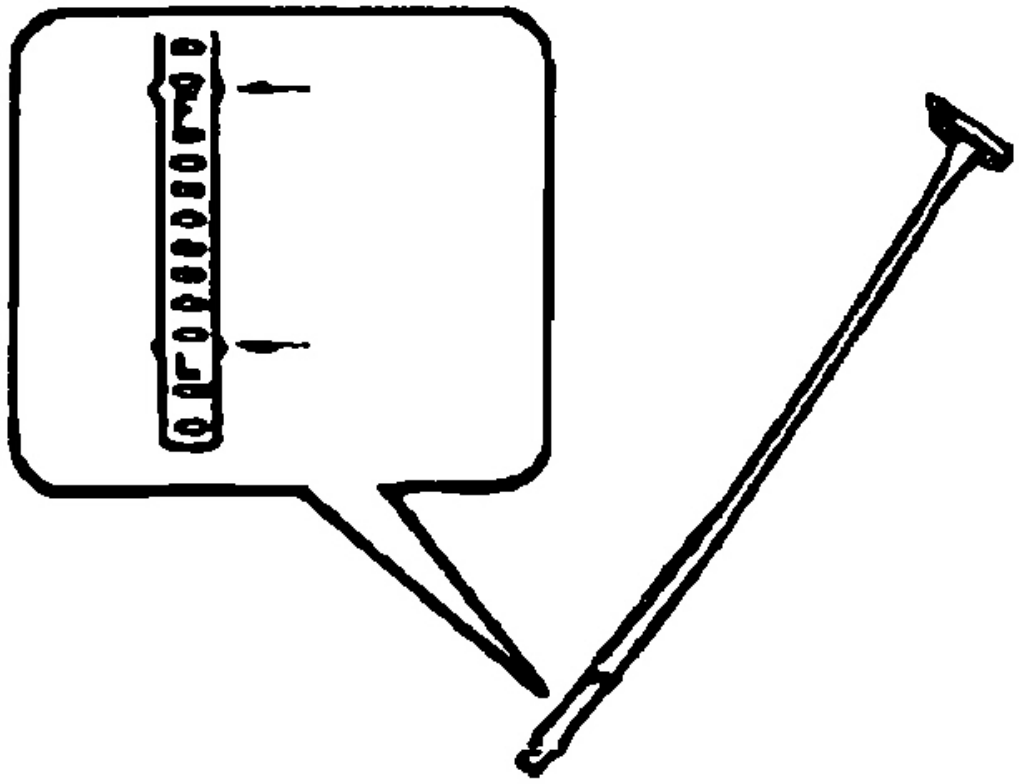


Fig. 259: Measuring Coolant Level
Courtesy of KIA MOTORS AMERICA, INC.

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.

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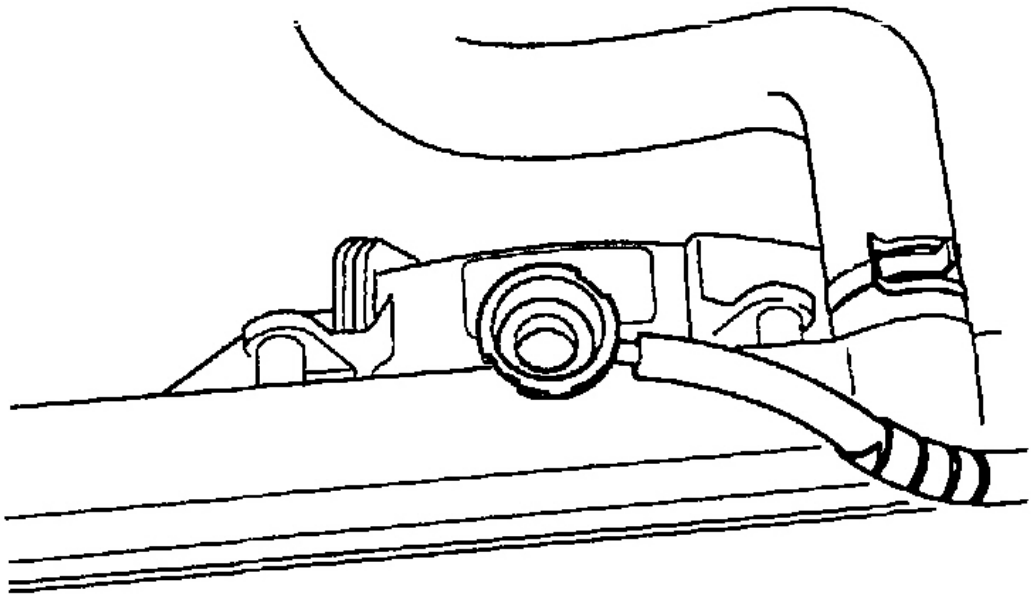


Fig. 260: Verifying Coolant Quality
Courtesy of KIA MOTORS AMERICA, INC.

LEAKAGE

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

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.

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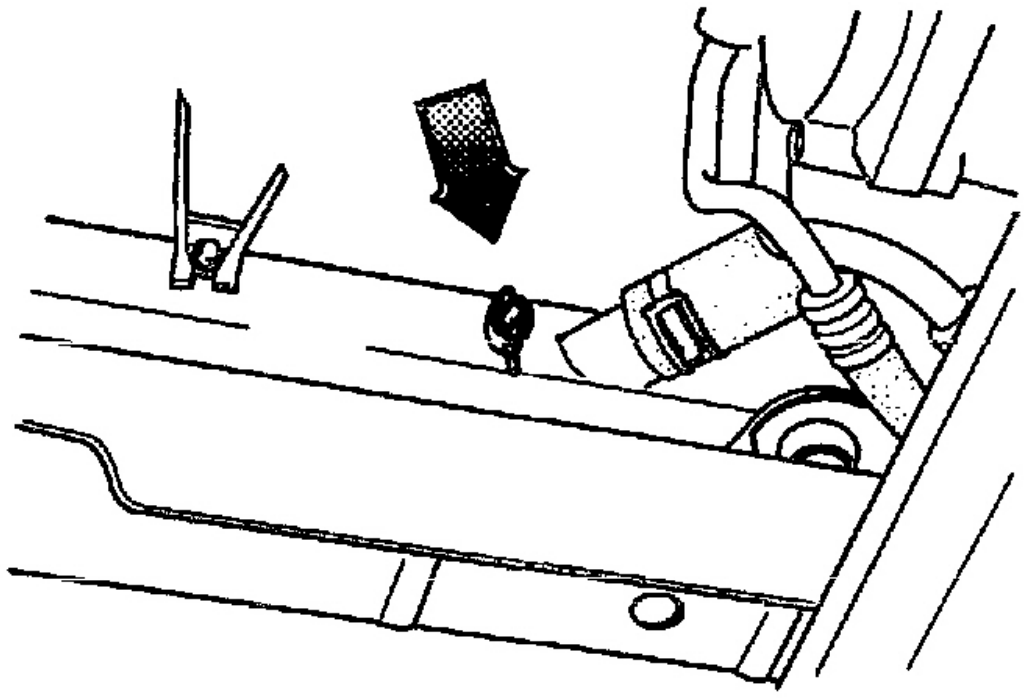


Fig. 261: Identifying Radiator Drain Plug
Courtesy of KIA MOTORS AMERICA, INC.

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: 6.3 Us qt (6.0 liters, 5.3 lmp 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

REMOVAL

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

1. Disconnect negative battery cable.

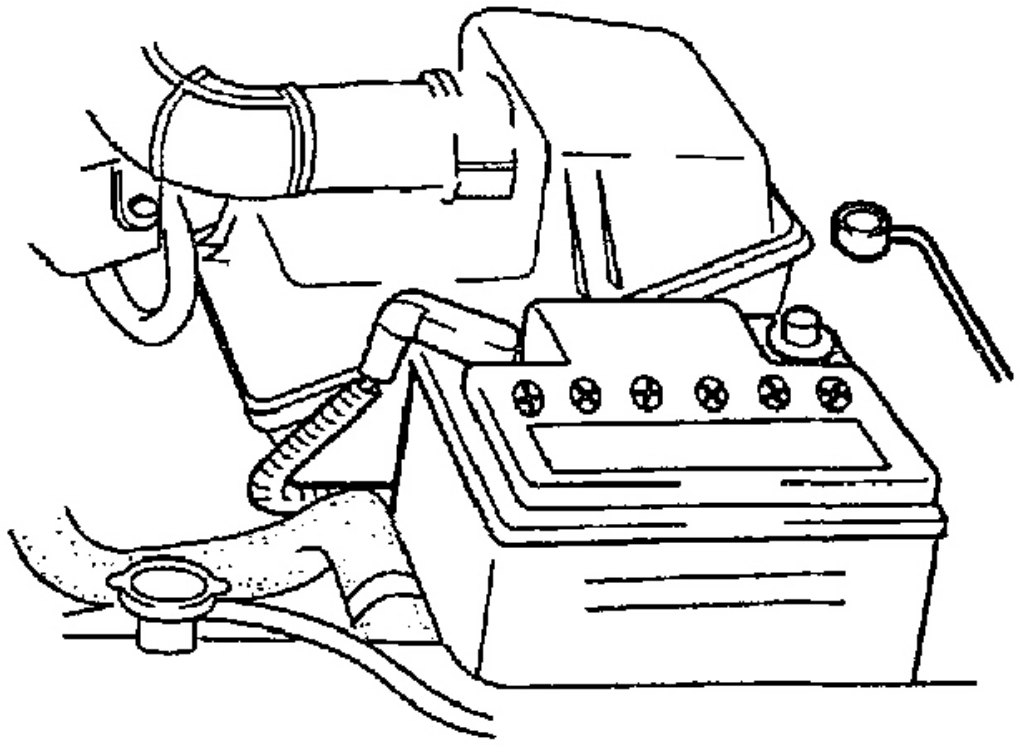


Fig. 262: Disconnecting Negative Battery Cable
Courtesy of KIA MOTORS AMERICA, INC.

2. Drain engine coolant.

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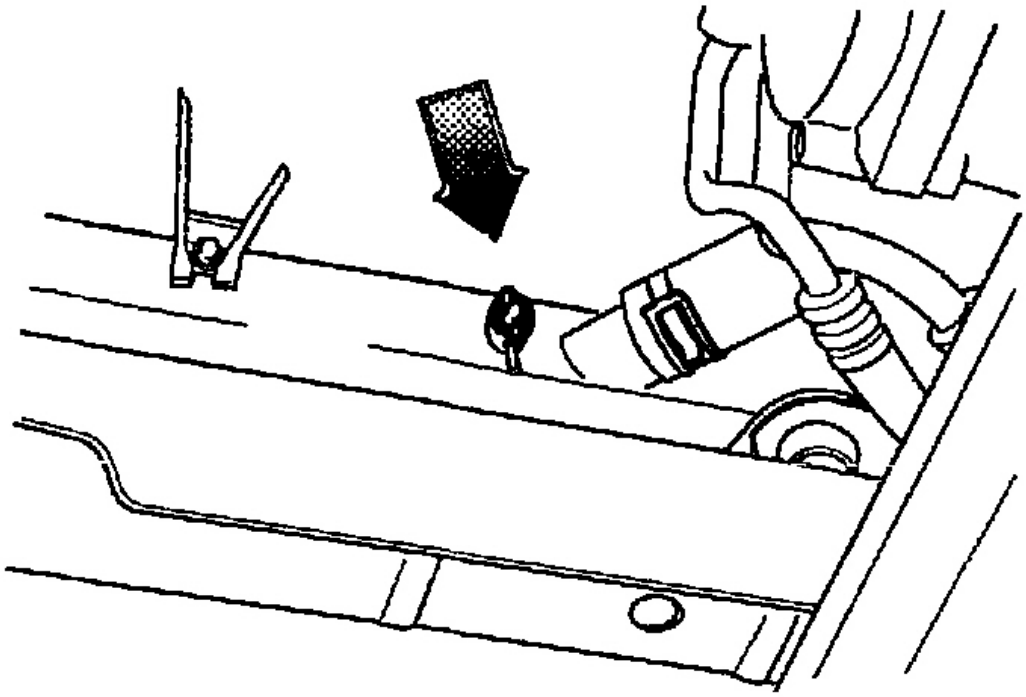
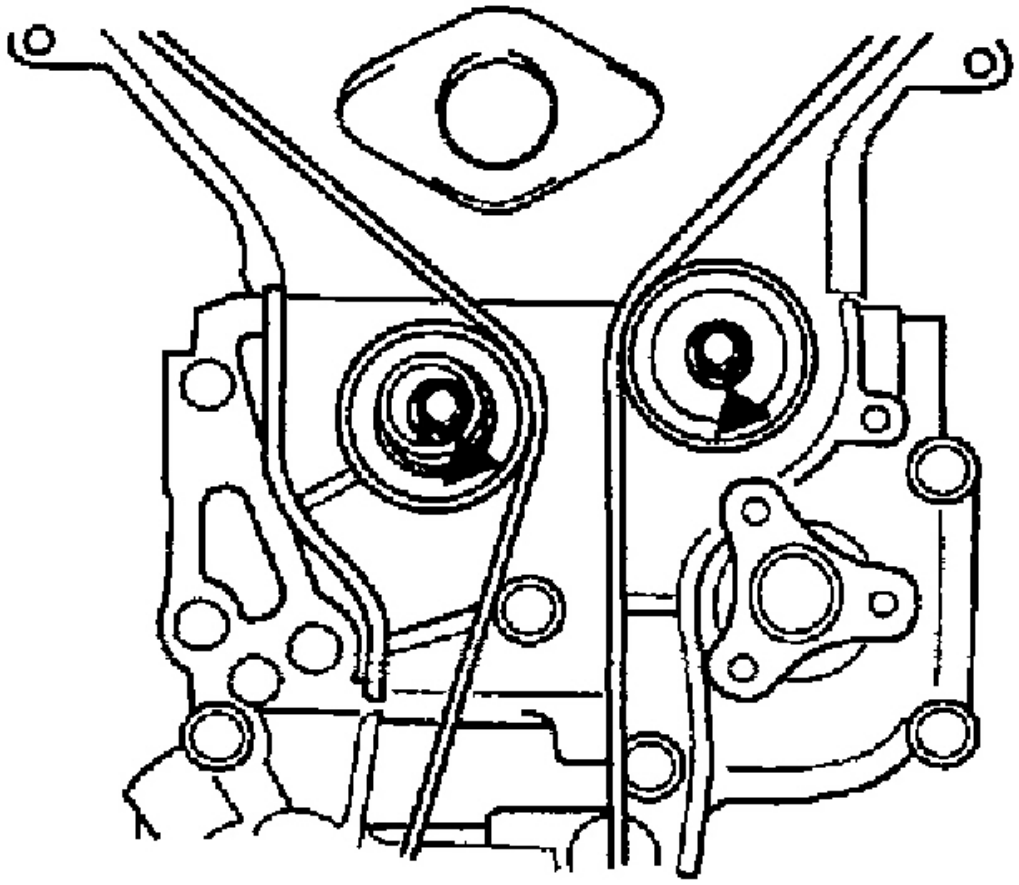


Fig. 263: Identifying Radiator Drain Plug
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove timing belt. See **TIMING SYSTEM**.
4. Remove tensioner and idler.

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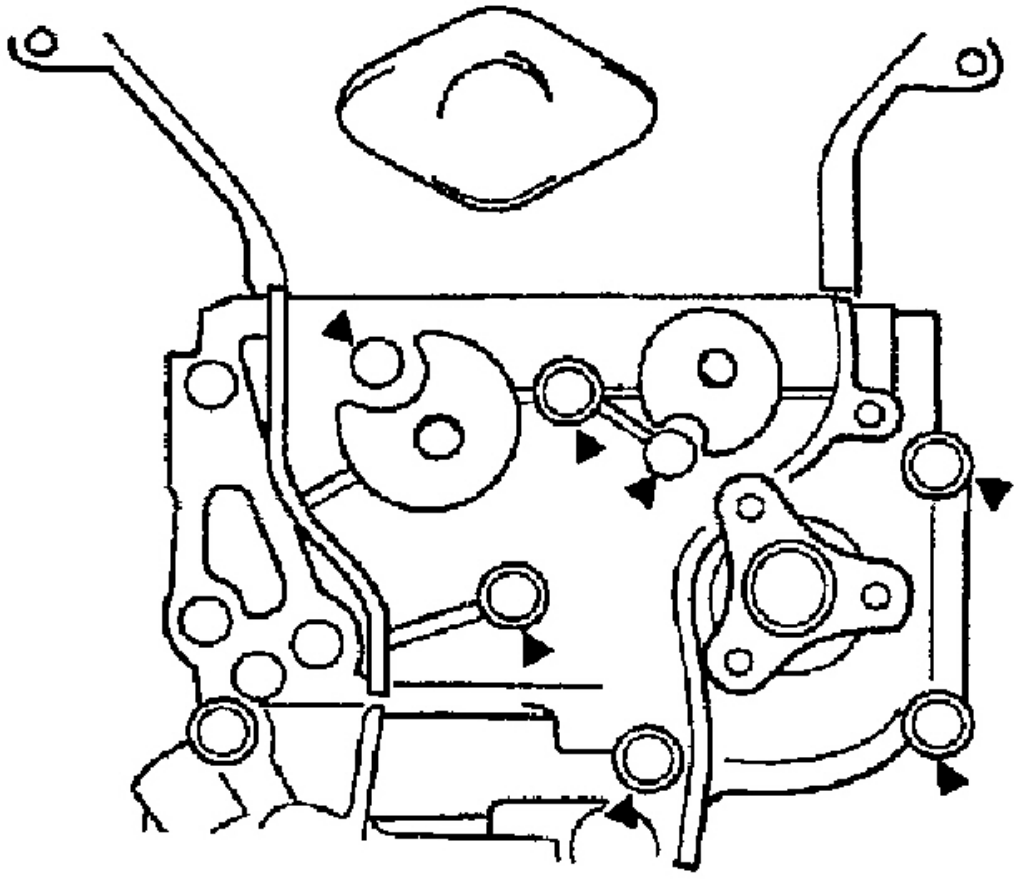


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Fig. 264: Removing Timing Belt Tensioners
Courtesy of KIA MOTORS AMERICA, INC.

5. Remove water pump.

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Fig. 265: Removing Water Pump
Courtesy of KIA MOTORS AMERICA, INC.

INSPECTION

1. Check water pump for cracks and damage.
2. Check for abnormal noise, bearing sticking or loose.
3. Replace water pump if necessary.

INSTALLATION

1. Remove any gasket fragments, dirt or oil from sealing surfaces.
2. Install new gasket on water pump.

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NOTE: To prevent dropping the gasket when installing, put sealant in gasket groove. But do not apply to sealing surfaces.

3. Install water pump.

   Tightening torque: 14~19 lb-ft (19~26 N.m, 1.9~2.6 kg-m)

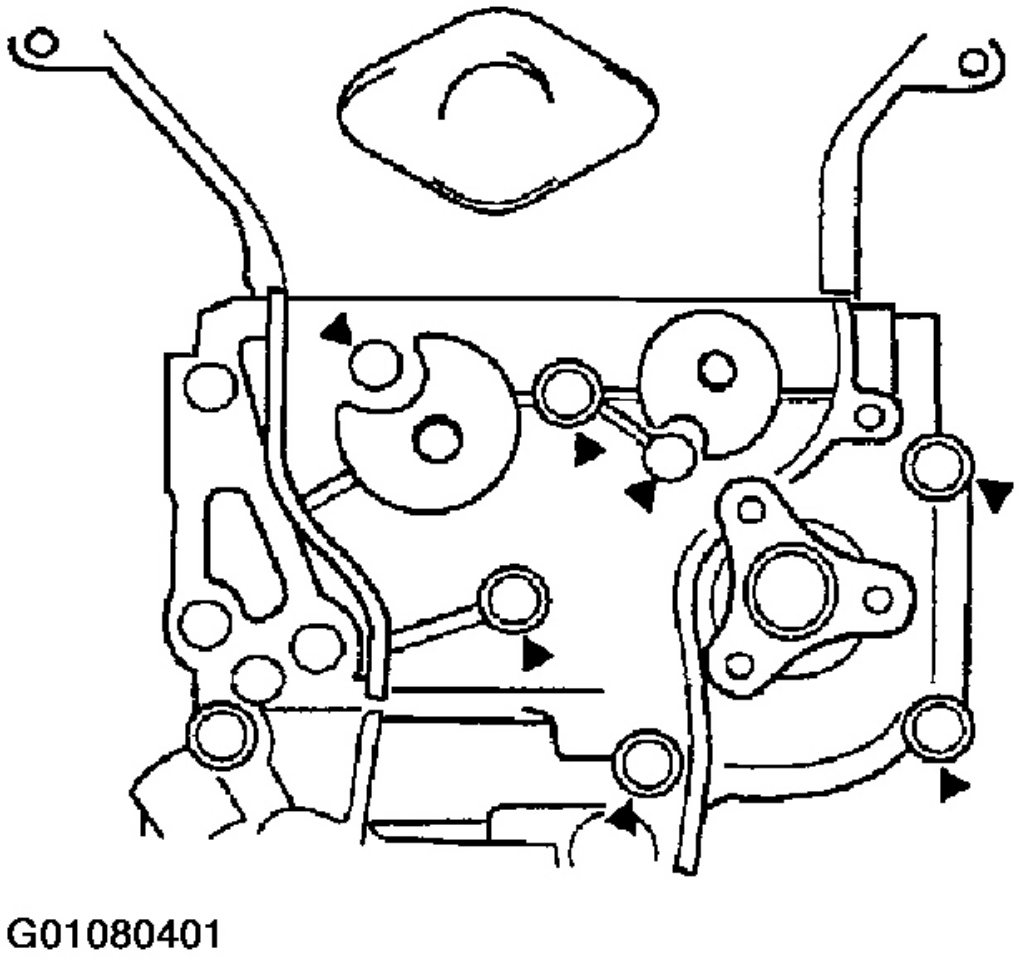


Fig. 266: Installing Water Pump
Courtesy of KIA MOTORS AMERICA, INC.

4. Install tensioner, idler and timing belt. See **TIMING SYSTEM**.
5. Fill engine coolant.
6. Connect negative battery cable.

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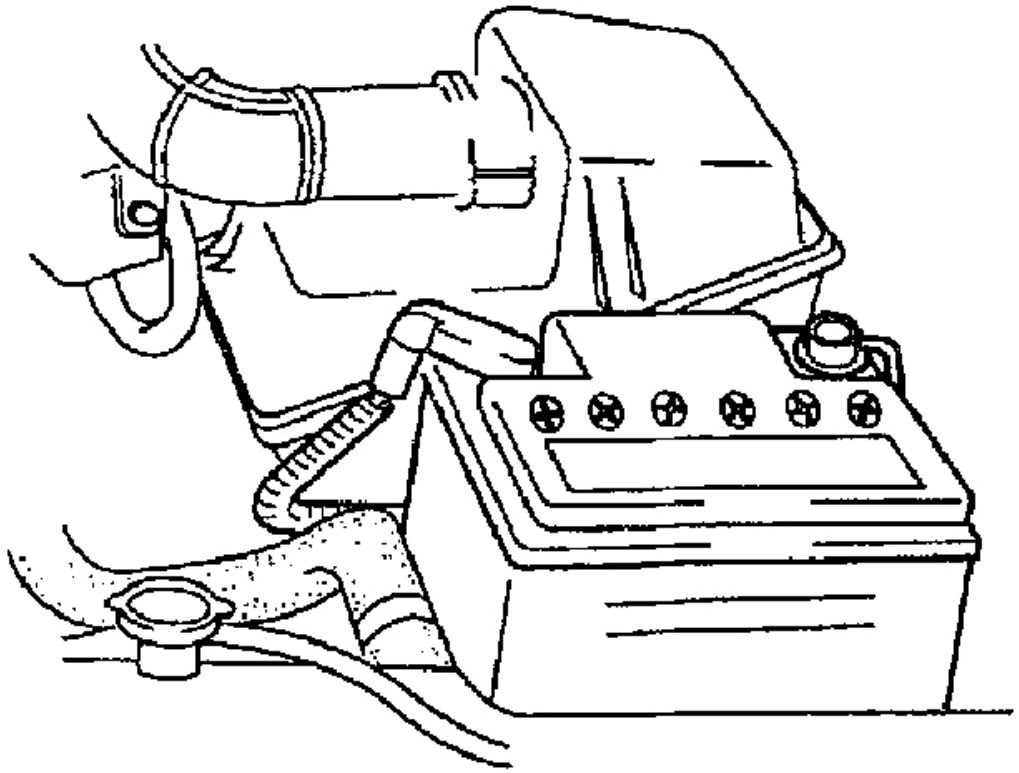


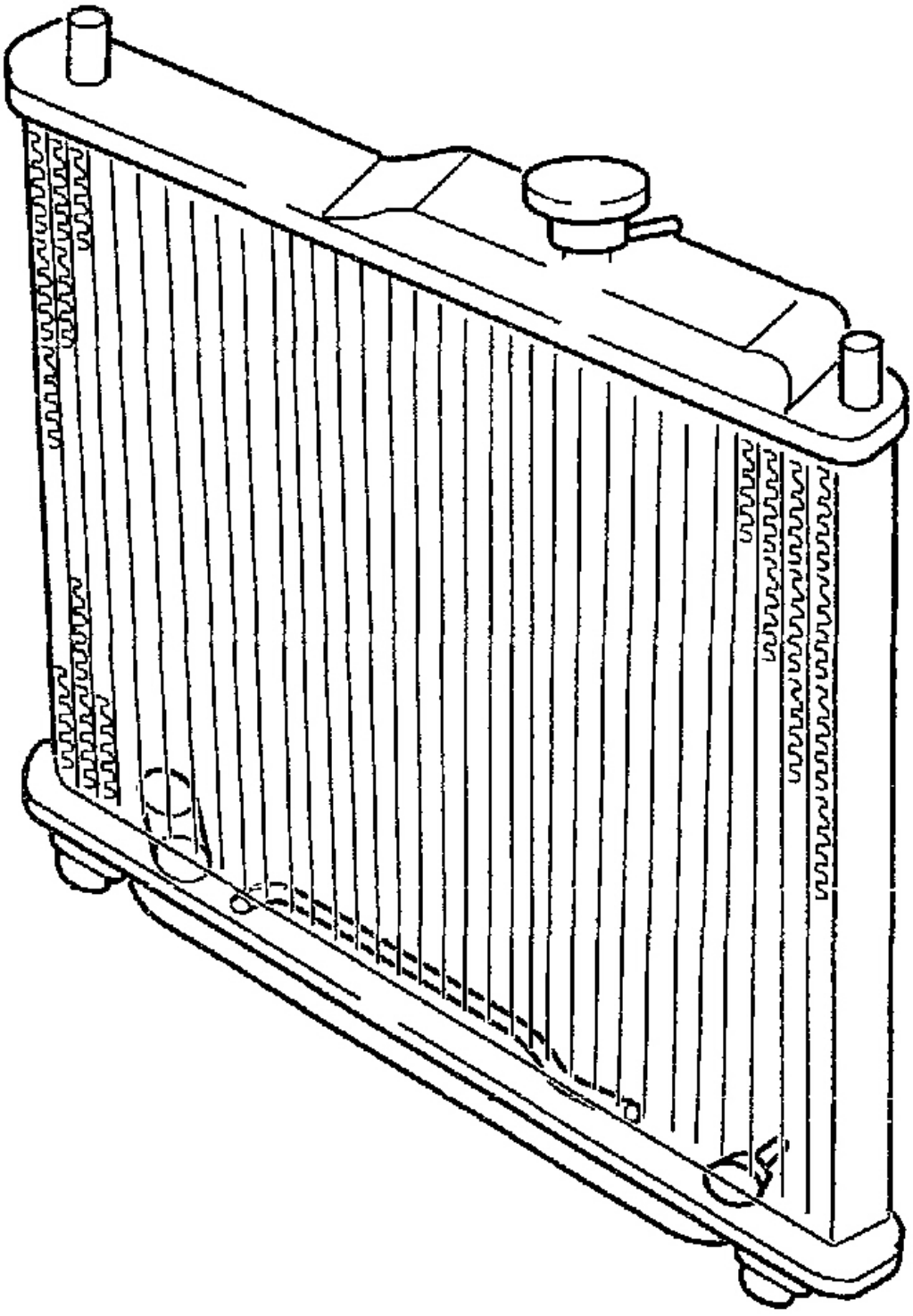
Fig. 267: Connecting Negative Battery Cable
Courtesy of KIA MOTORS AMERICA, INC.

7. Start engine and check for leaks.

RADIATOR

COMPONENT

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Fig. 268: Identifying Radiator
Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

1. Disconnect negative battery cable.

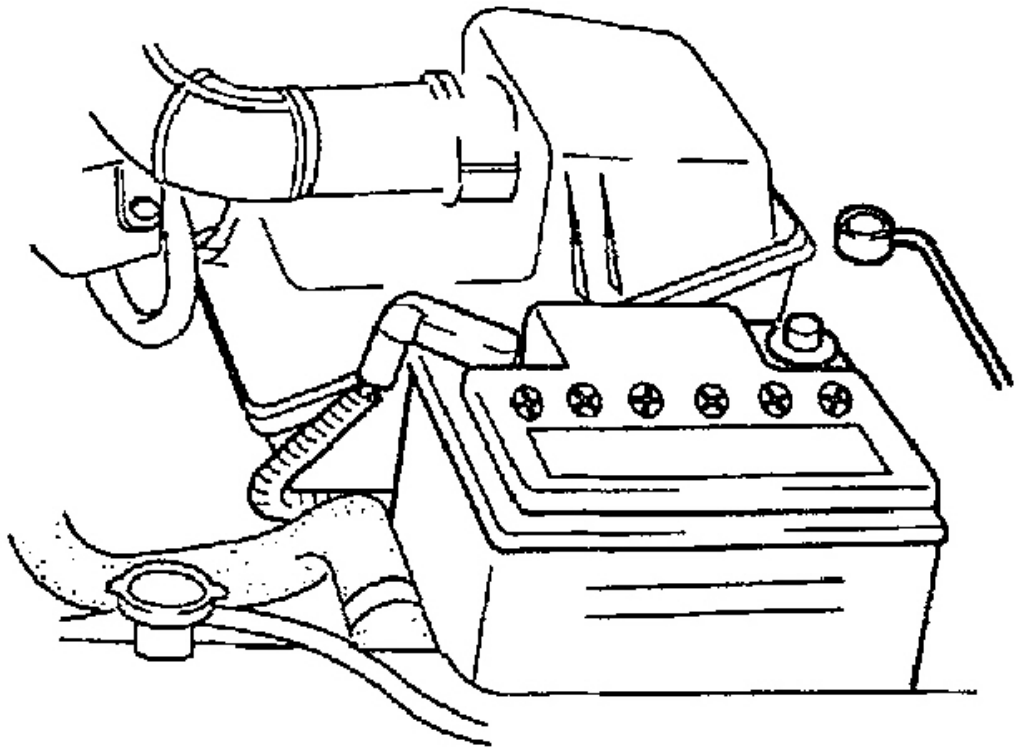


Fig. 269: Disconnecting Negative Battery Cable
Courtesy of KIA MOTORS AMERICA, INC.

2. Drain engine coolant.

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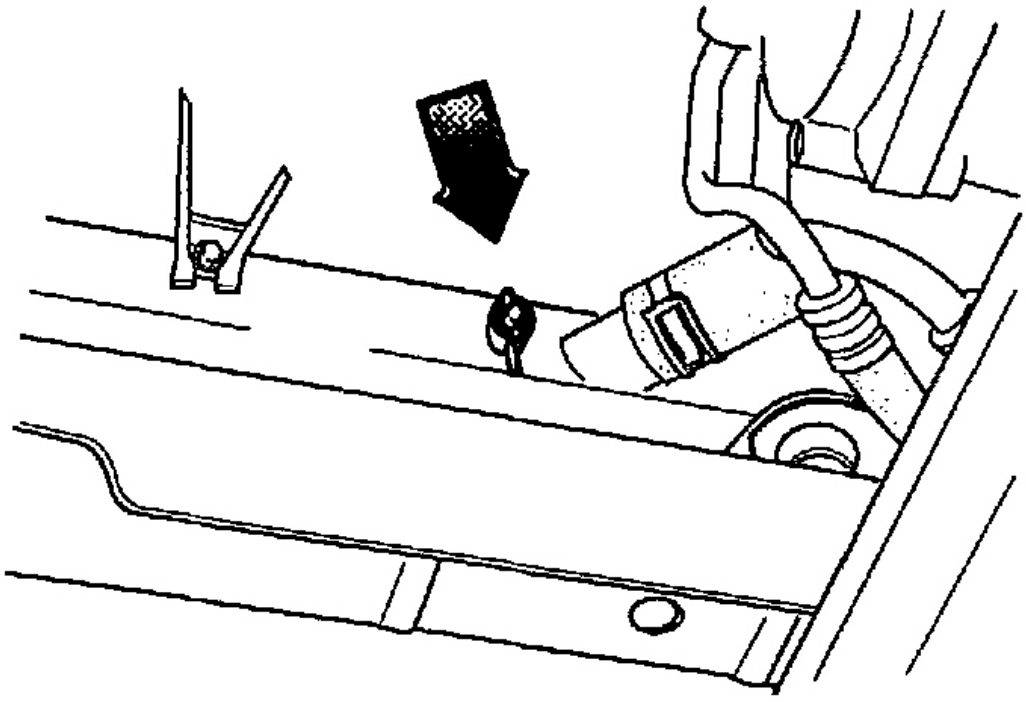
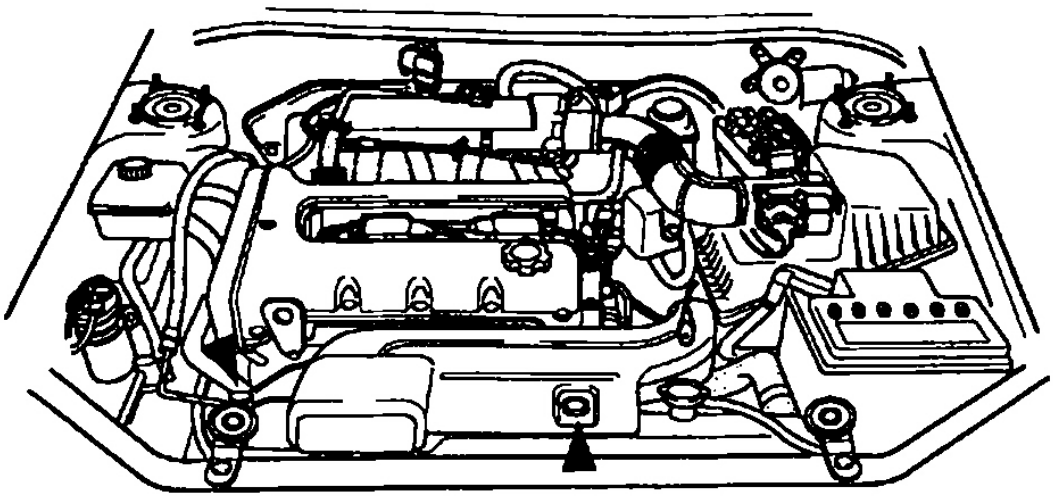


Fig. 270: Identifying Radiator Drain Plug
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove fresh air duct.

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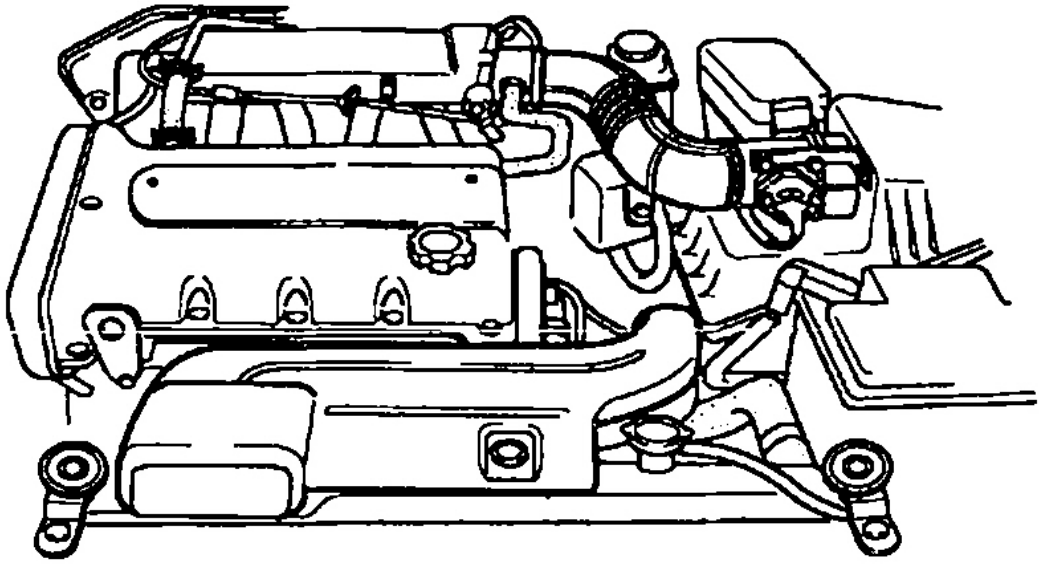


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Fig. 271: Removing Fresh Air Duct
Courtesy of KIA MOTORS AMERICA, INC.

4. Disconnect upper radiator hose.
5. Disconnect cooling fan motor connector.
6. Disconnect condenser fan motor connector.
7. Disconnect coolant reservoir hose.
8. Remove radiator brackets.

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G01080408

Fig. 272: Removing Radiator Brackets
Courtesy of KIA MOTORS AMERICA, INC.

9. Disconnect Automatic Transaxle Fluid (ATF) inlet and outlet pipe.

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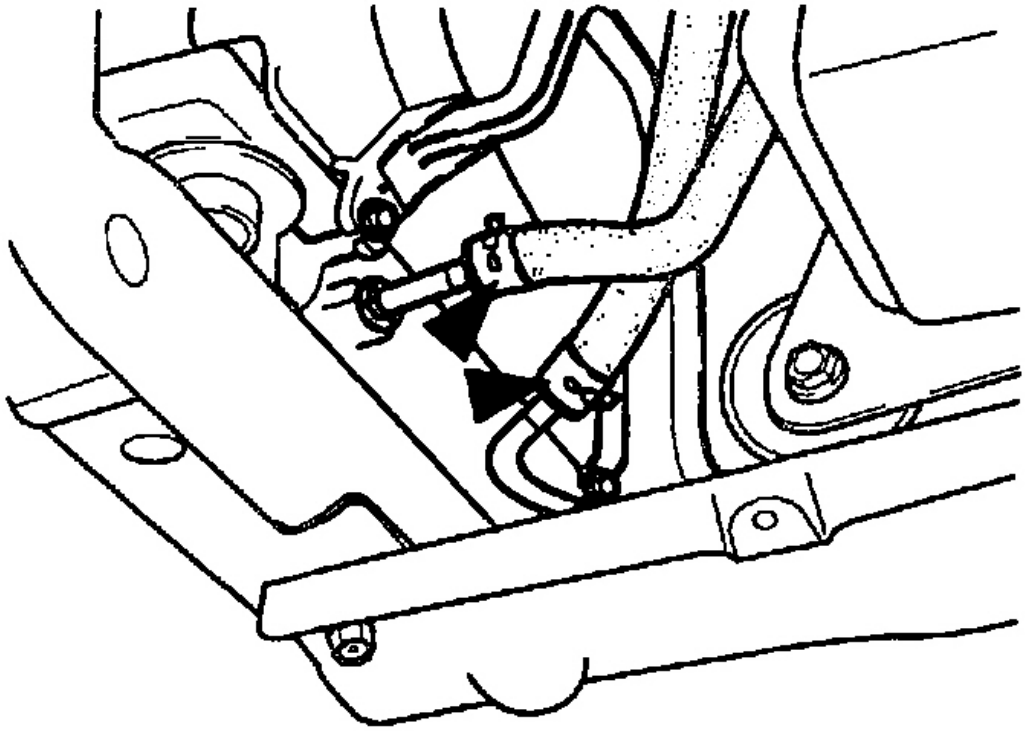


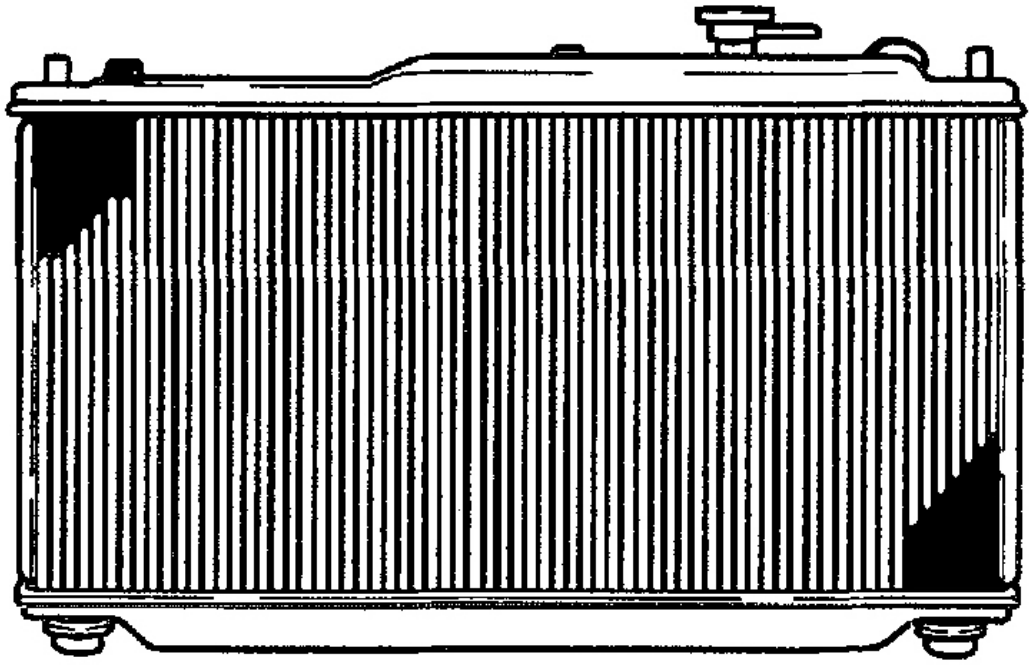
Fig. 273: Disconnecting Automatic Transaxle Fluid Inlet And Outlet Pipe
Courtesy of KIA MOTORS AMERICA, INC.

10. Disconnect lower radiator hose.
11. Lift radiator assembly from engine compartment.
12. Remove cooling fan assembly and condenser fan assembly.

INSPECTION

1. Check for cracks, damage or water leakage.
2. Check for bent fins. If bent, repair with a fin comb or similar tool.

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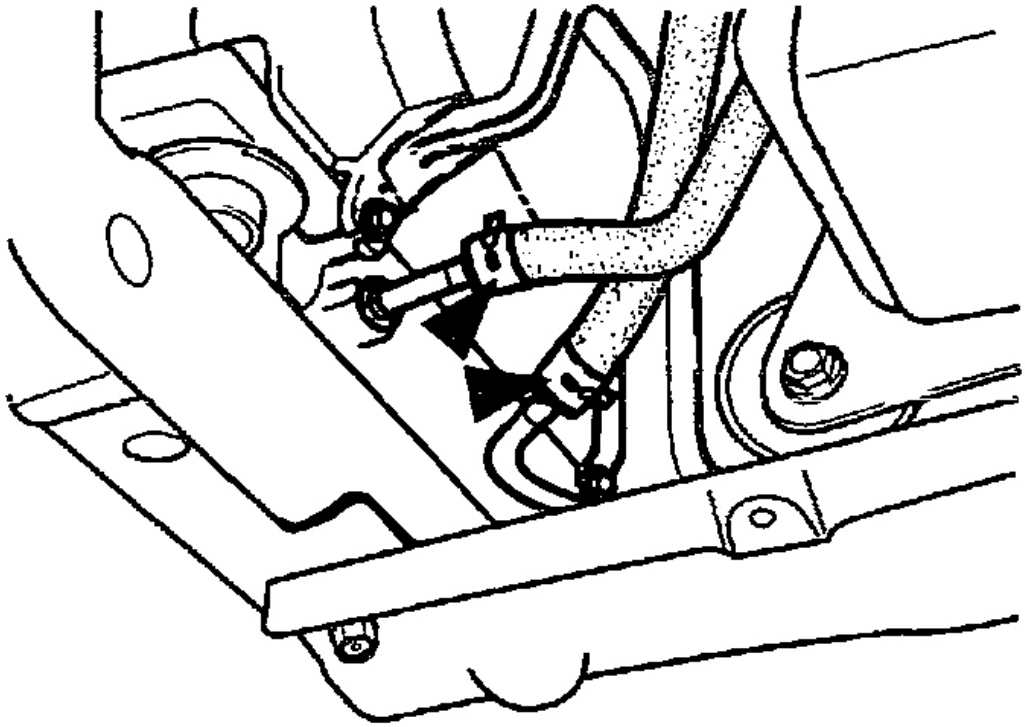
Fig. 274: Inspecting Radiator
Courtesy of KIA MOTORS AMERICA, INC.

3. Check for damaged radiator inlet and outlet and hose connections.

INSTALLATION

1. Install cooling fan assembly and condenser fan assembly.
2. Install radiator assembly into engine compartment.
3. Connect lower radiator hose.
4. Connect ATF inlet and outlet pipes.

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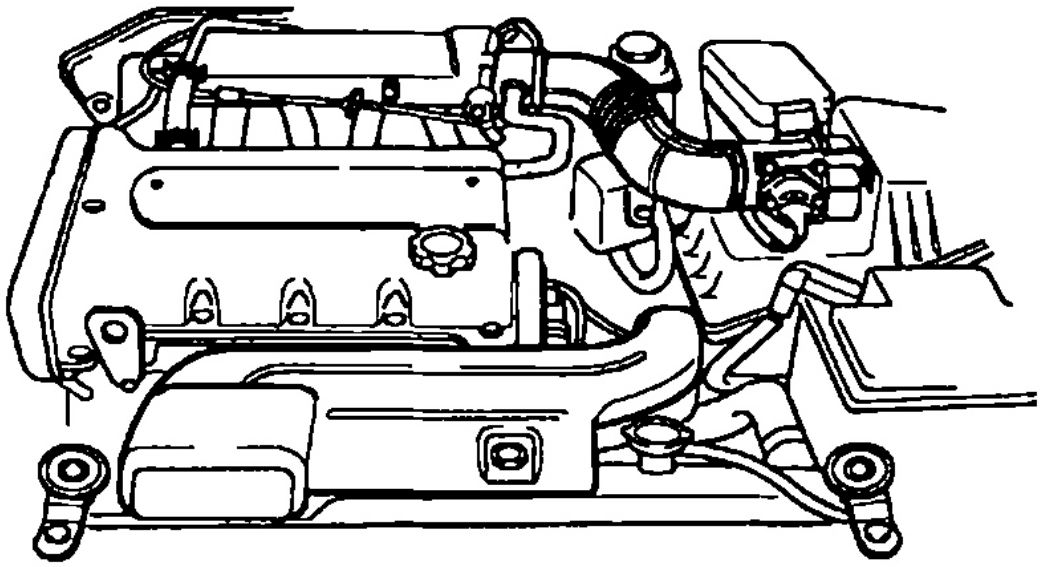


G01080411

Fig. 275: Connecting ATF Inlet And Outlet Pipes
Courtesy of KIA MOTORS AMERICA, INC.

5. Install radiator brackets.
6. Connect coolant reservoir hose.
7. Connect condenser fan motor connector.
8. Connect cooling fan motor connector.
9. Connect upper radiator hose.
10. Install fresh air duct.

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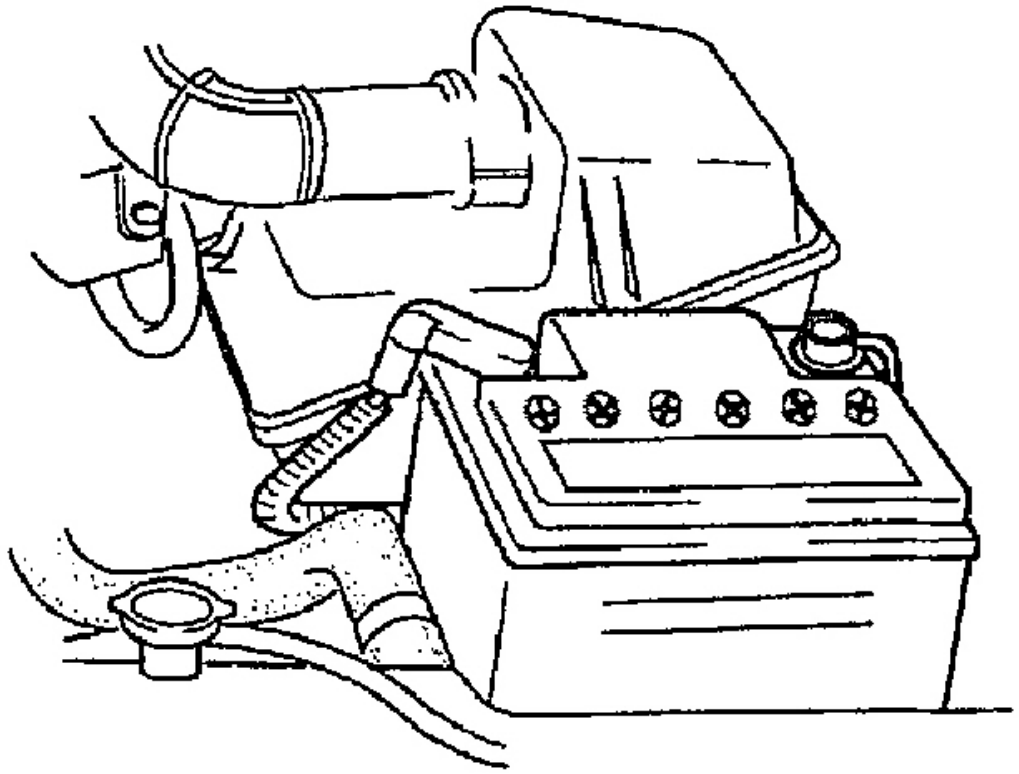


G01080412

Fig. 276: Installing Fresh Air Duct
Courtesy of KIA MOTORS AMERICA, INC.

11. Connect negative battery cable.

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G01080413

Fig. 277: Connecting Negative Battery Cable
Courtesy of KIA MOTORS AMERICA, INC.

12. Fill engine coolant. See **ENGINE COOLANT**.

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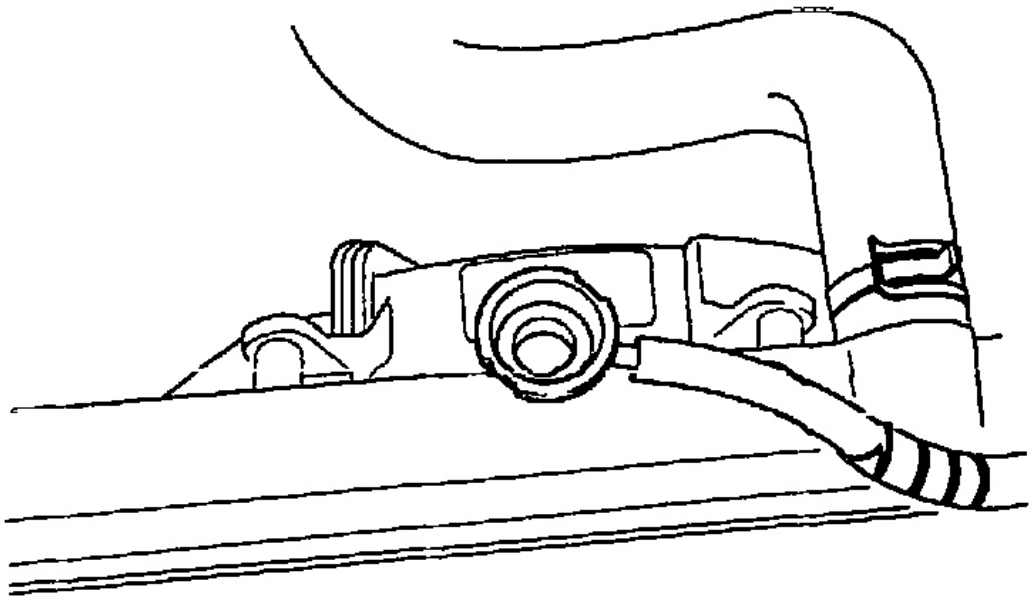


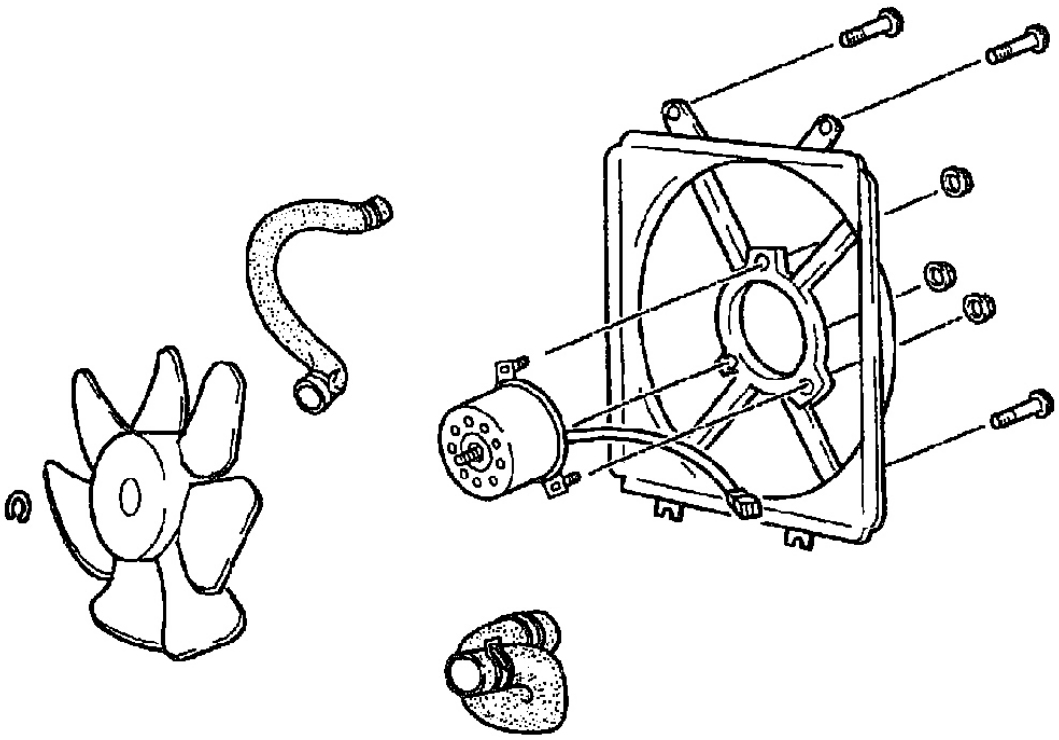
Fig. 278: Filling Engine Coolant
Courtesy of KIA MOTORS AMERICA, INC.

13. Start engine and check for leaks.

RADIATOR FAN MOTOR

COMPONENT

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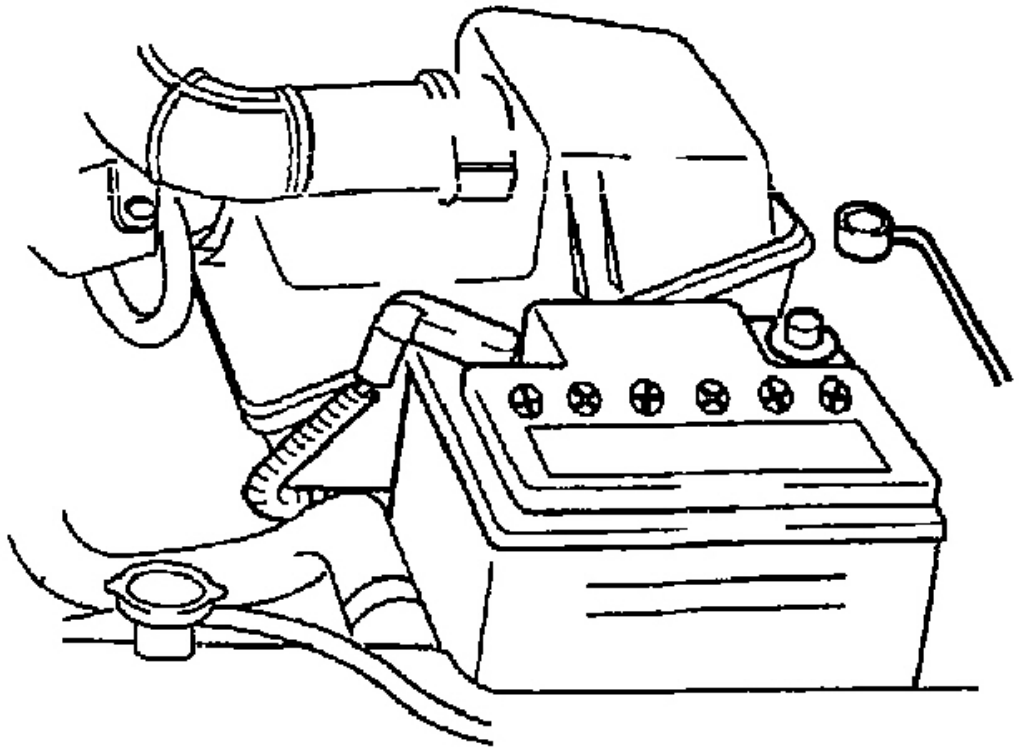
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Fig. 279: Identifying Radiator Fan Motor
Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

1. Disconnect negative battery cable.

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Fig. 280: Disconnecting Negative Battery Cable
Courtesy of KIA MOTORS AMERICA, INC.

2. Drain engine coolant.

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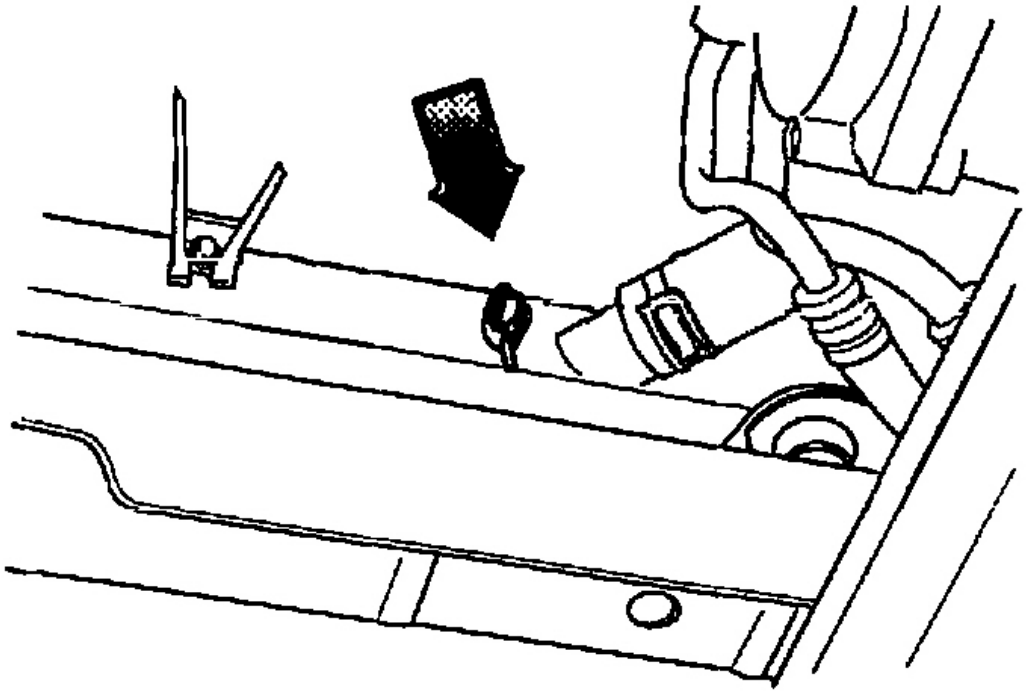
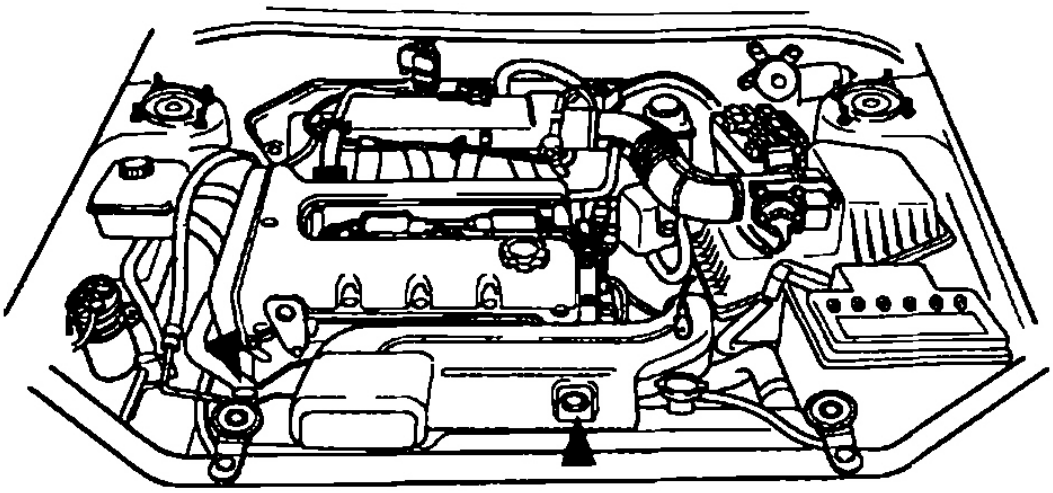


Fig. 281: Draining Engine Coolant
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove fresh air duct.

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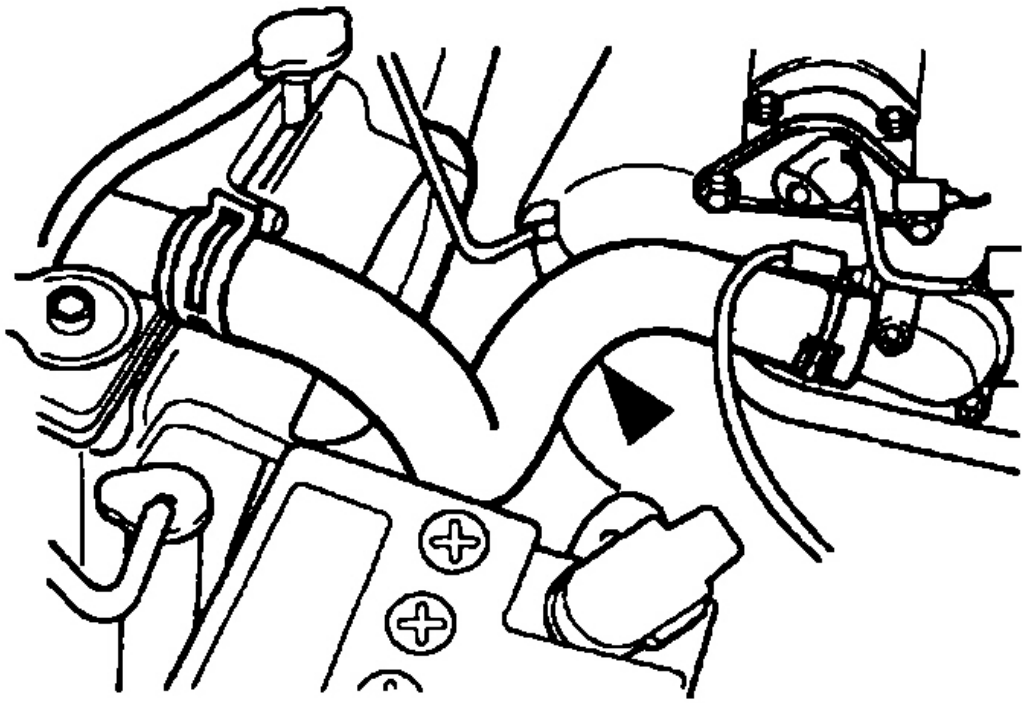


G01080418

Fig. 282: Removing Fresh Air Duct
Courtesy of KIA MOTORS AMERICA, INC.

4. Disconnect cooling fan motor connector.
5. Remove upper radiator hose.

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Fig. 283: Removing Upper Radiator Hose
Courtesy of KIA MOTORS AMERICA, INC.

6. Remove upper two radiator cowling bolts.
7. Remove lower two radiator cowling bolts.

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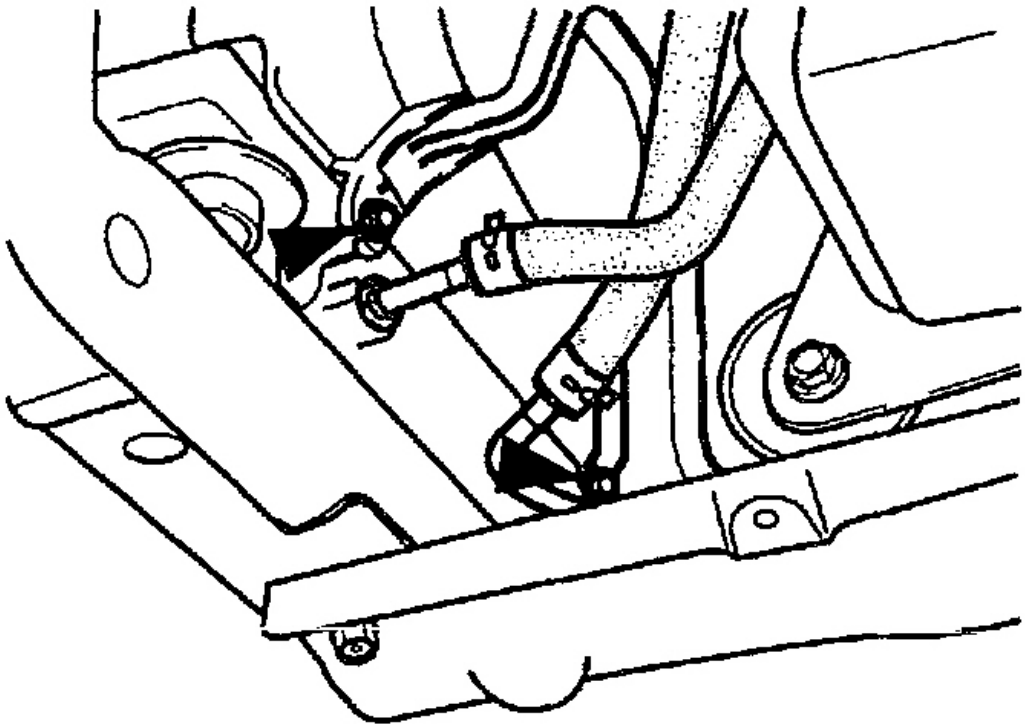


Fig. 284: Removing Lower Radiator Cowling Bolts
Courtesy of KIA MOTORS AMERICA, INC.

8. Lift radiator cowling from engine compartment.
9. Remove clip and fan.

Remove three fan motor bolts and nuts.

INSPECTION

- Check current as shown with an ammeter.

Current (A): 8~13A

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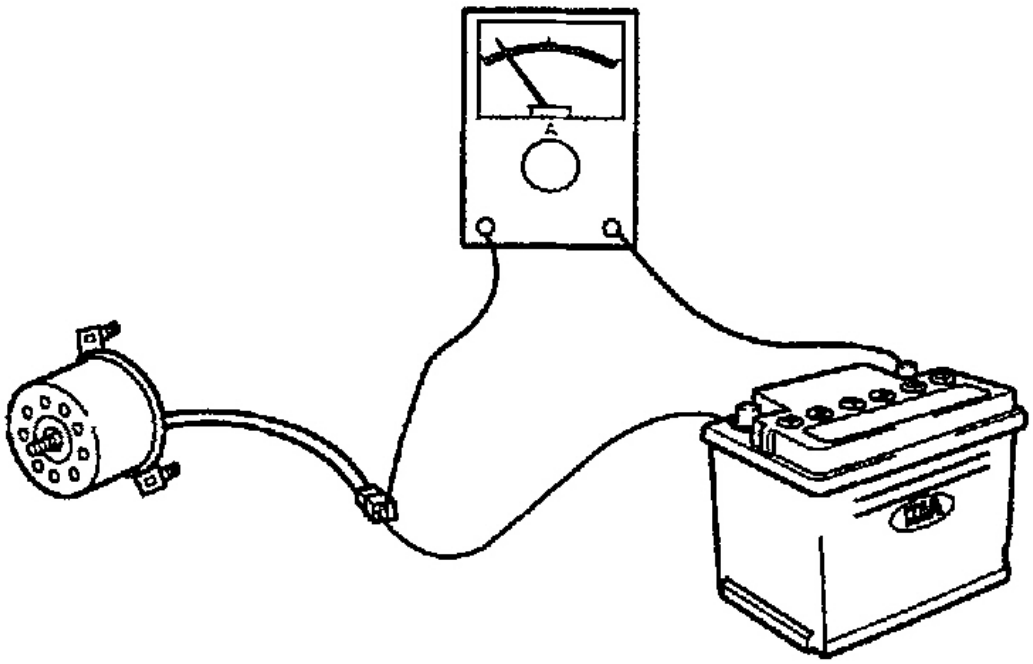


Fig. 285: Testing Fan Motor
Courtesy of KIA MOTORS AMERICA, INC.

INSTALLATION

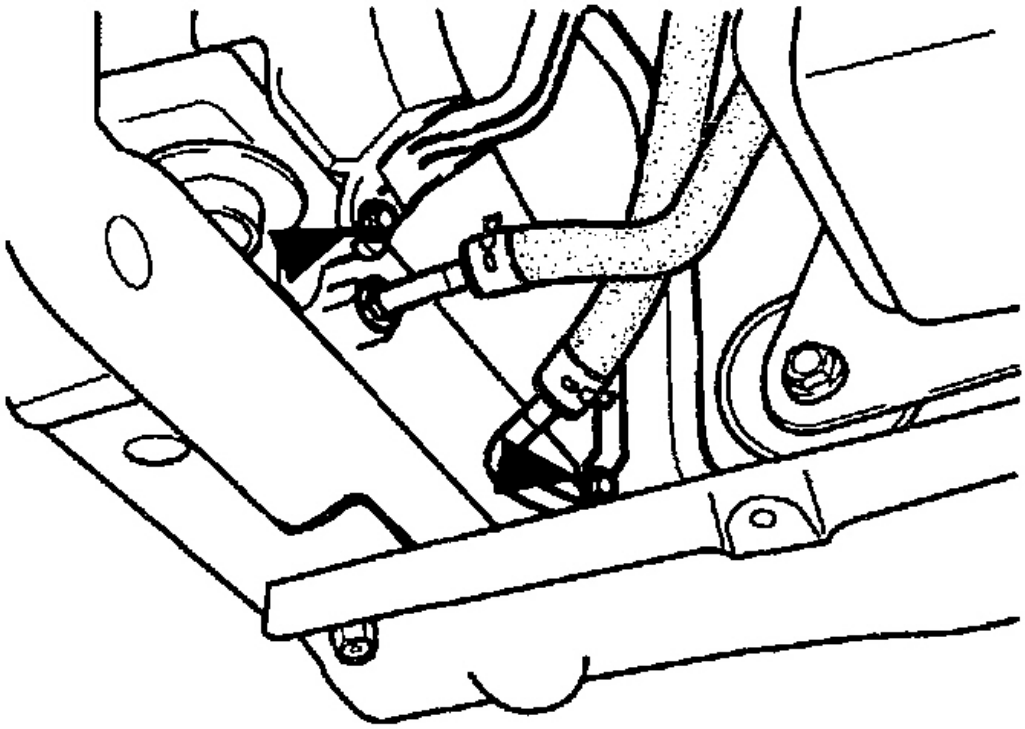
1. Install fan motor and tighten three fan motor bolts and nuts.
2. Install fan and clip
3. Install radiator cowling to radiator.
4. Install and tighten two upper radiator cowling bolts.

   Tightening torque: 5.8~7.9 lb.ft (7.8~10.8 N.m, 0.8~1.1 kg.m)

5. Install and tighten lower two radiator cowling bolts.

   Tightening torque: 5.8~7.9 lb.ft (7.8~10.8 N.m, 0.8~1.1 kg.m)

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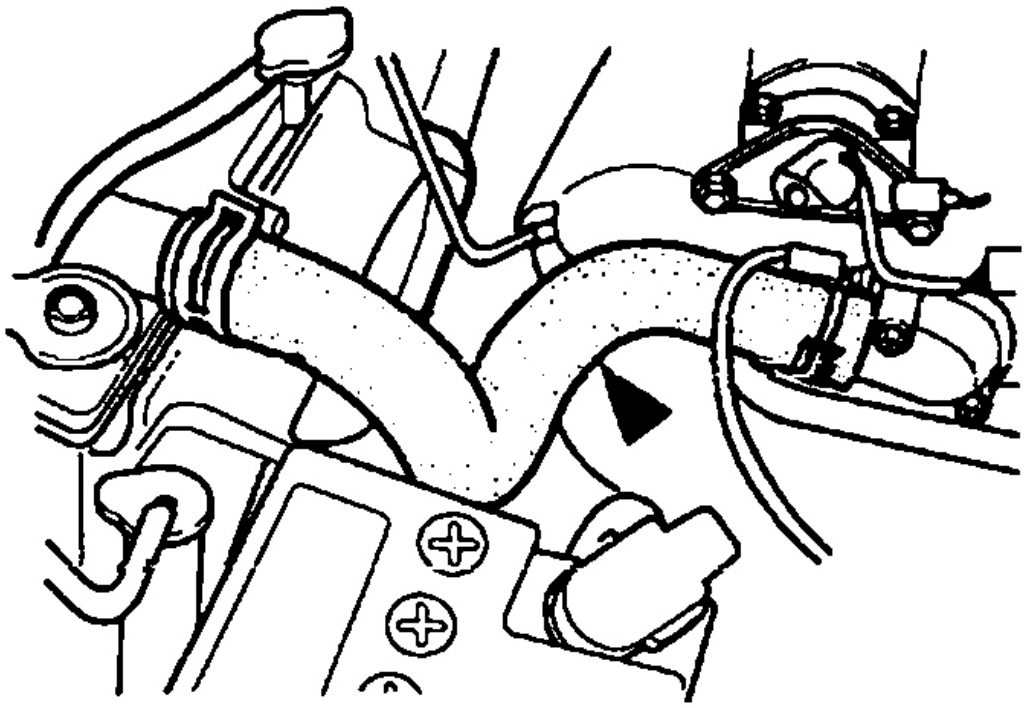


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Fig. 286: Installing And Tightening Lower Two Radiator Cowling Bolts
Courtesy of KIA MOTORS AMERICA, INC.

6. Install upper radiator hose.

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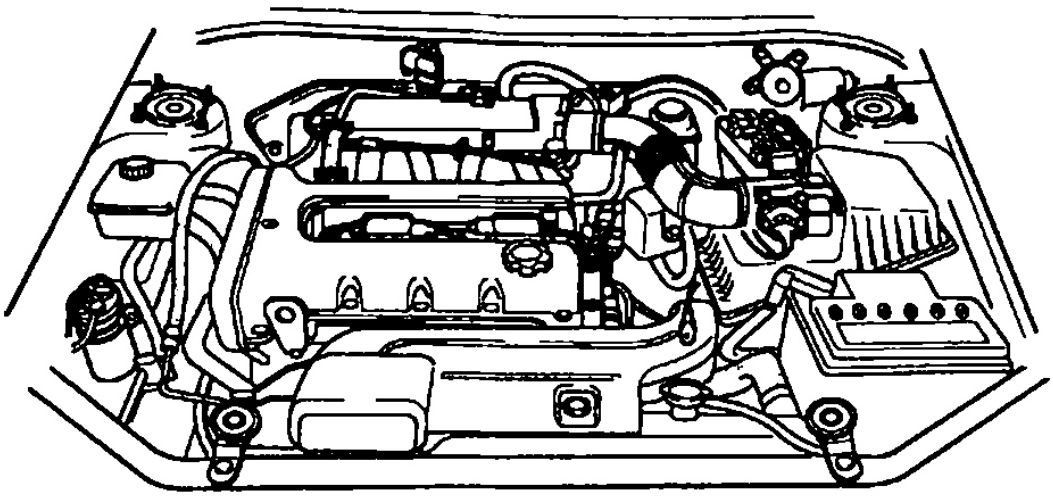


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Fig. 287: Installing Upper Radiator Hose
Courtesy of KIA MOTORS AMERICA, INC.

7. Connect cooling fan motor connector.
8. Install fresh air duct and tighten bolt and nut.

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Fig. 288: Installing Fresh Air Duct And Tightening Bolt And Nut
Courtesy of KIA MOTORS AMERICA, INC.

9. Fill engine coolant See **ENGINE COOLANT**.
10. Connect negative battery cable.

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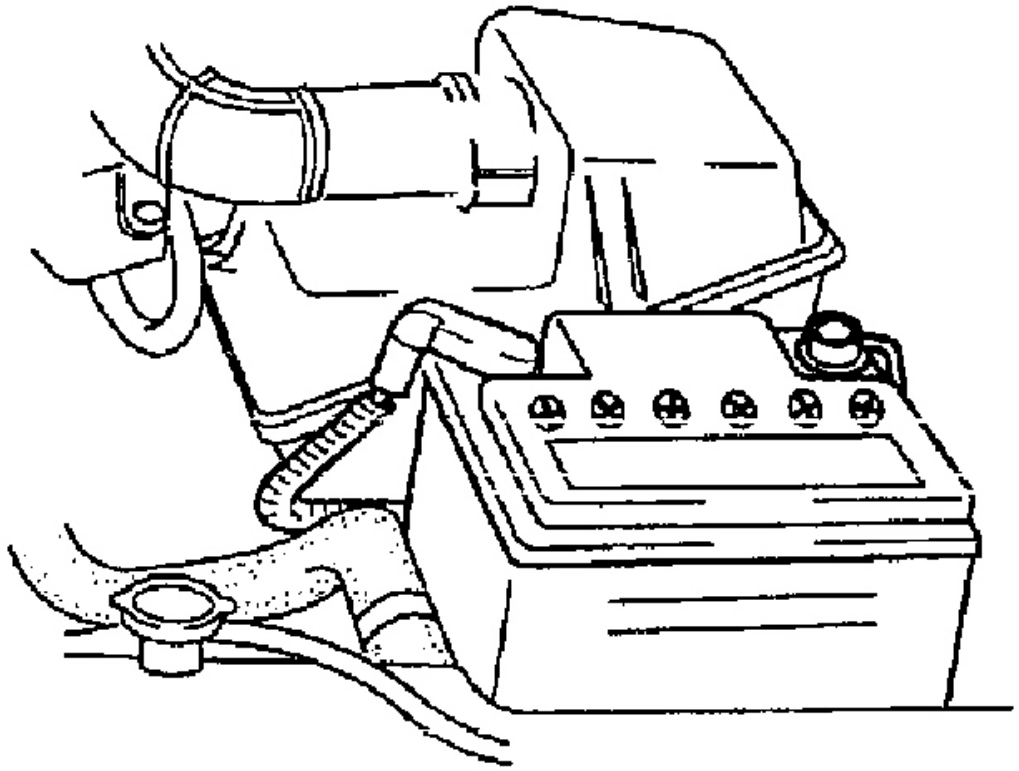


Fig. 289: Connecting Negative Battery Cable
Courtesy of KIA MOTORS AMERICA, INC.

11. Start engine and check for leaks.

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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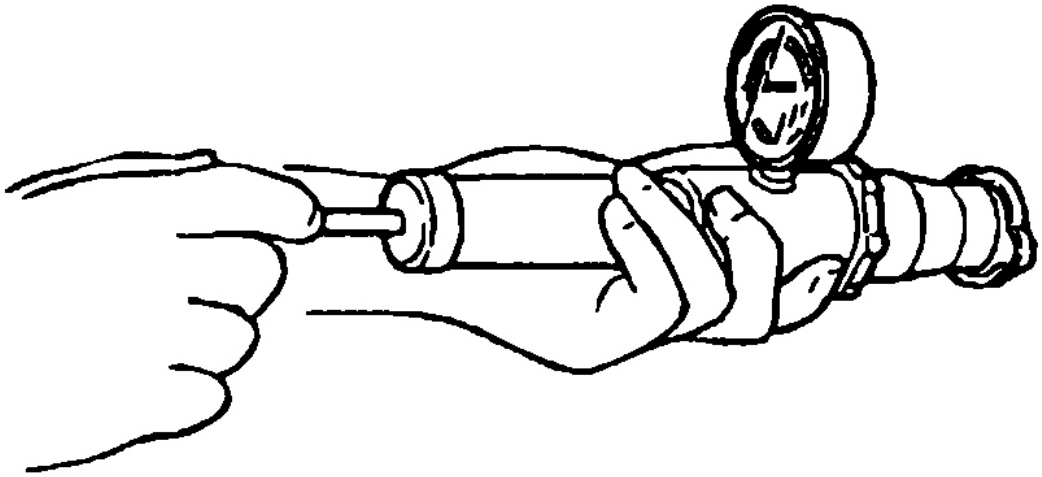


Fig. 290: Testing Radiator Cap Valve
Courtesy of KIA MOTORS AMERICA, INC.

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.
2. Check for damage on contact surfaces, and for a cracked or deformed seal.

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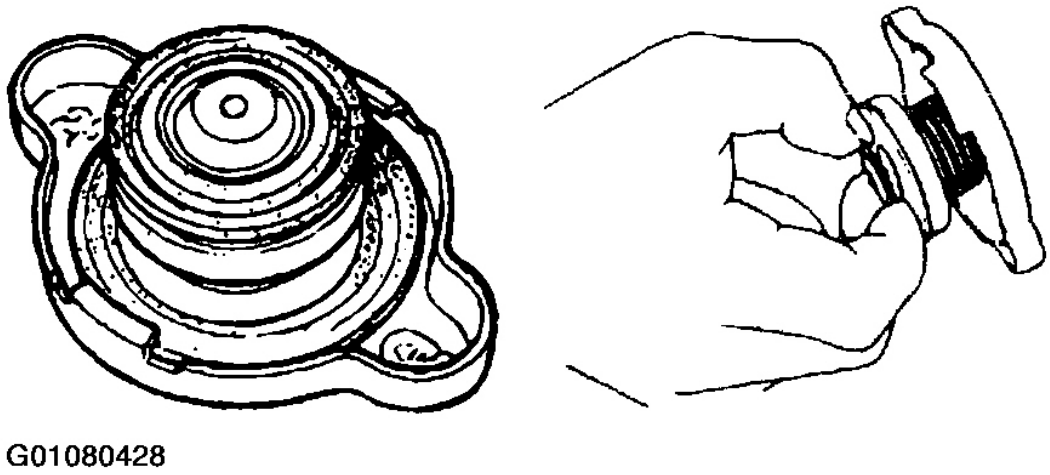


Fig. 291: Testing Radiator Cap Negative Pressure Valve
Courtesy of KIA MOTORS AMERICA, INC.

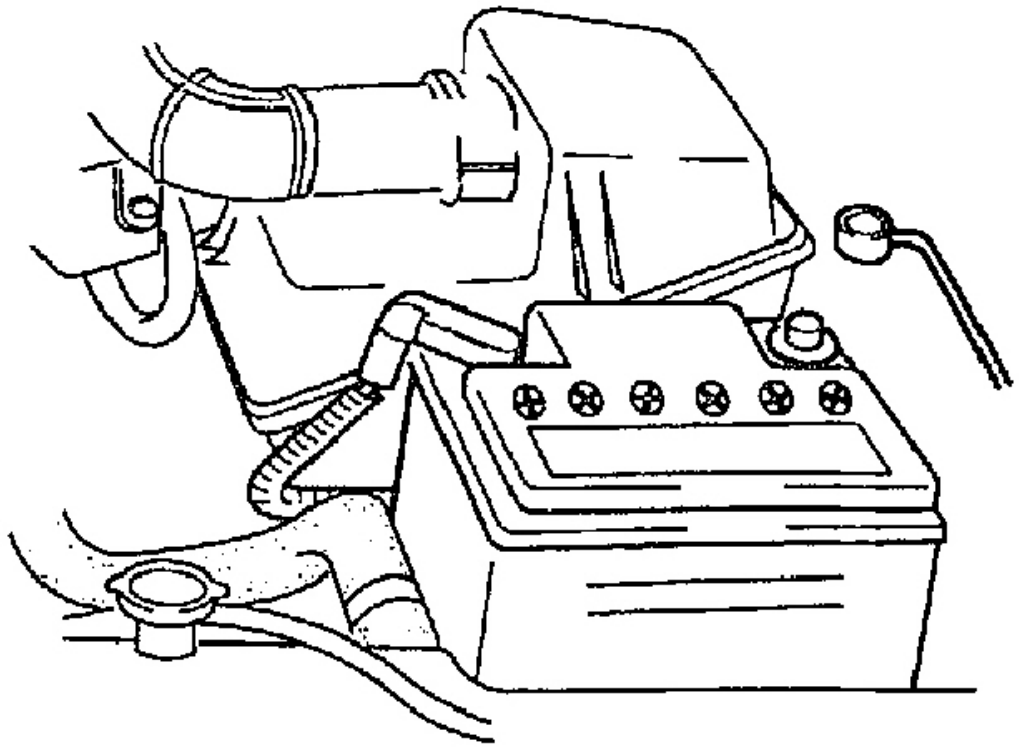
3. Replace radiator cap as necessary.

THERMOSTAT

REMOVAL

1. Disconnect negative battery cable.

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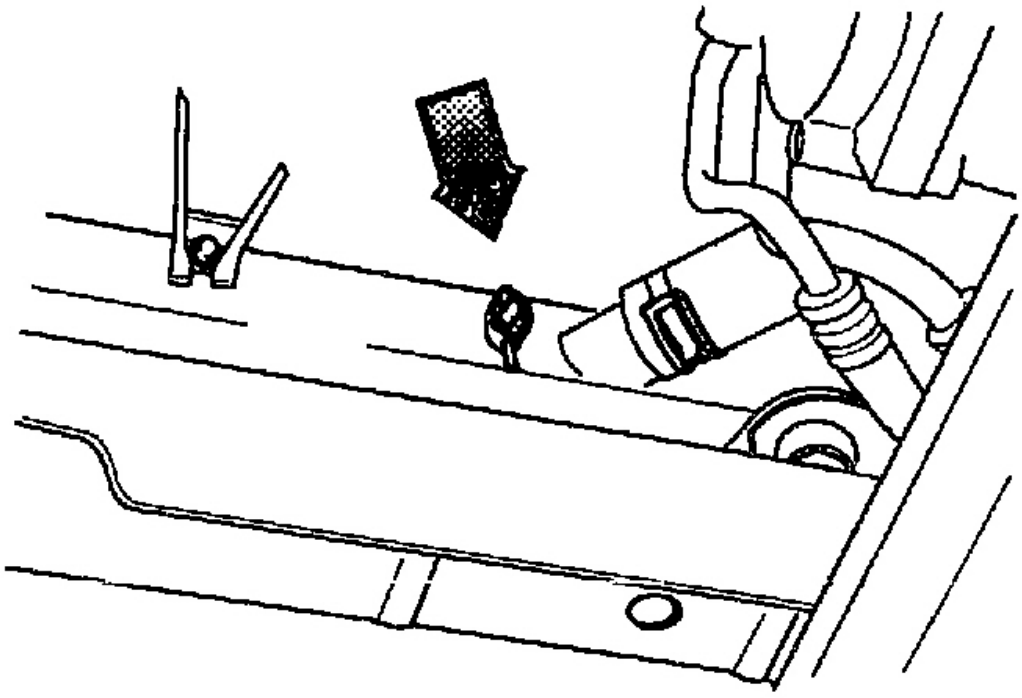


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Fig. 292: Disconnecting Negative Battery Cable
Courtesy of KIA MOTORS AMERICA, INC.

2. Drain engine coolant.

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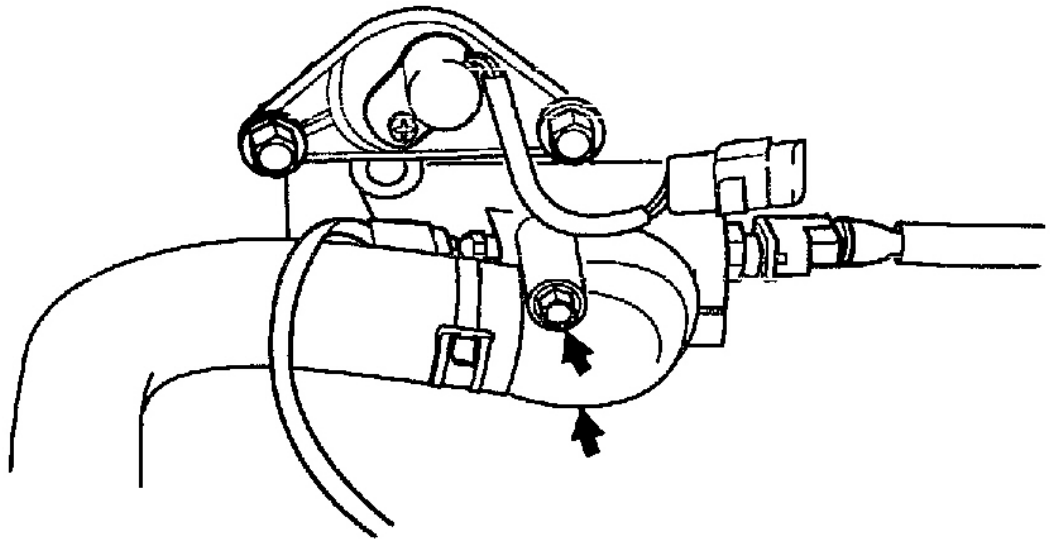


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Fig. 293: Draining Engine Coolant
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove bolt and nut of thermostat housing.

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G01080431

Fig. 294: Removing Thermostat Housing Bolt and Nut
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove thermostat housing and thermostat.

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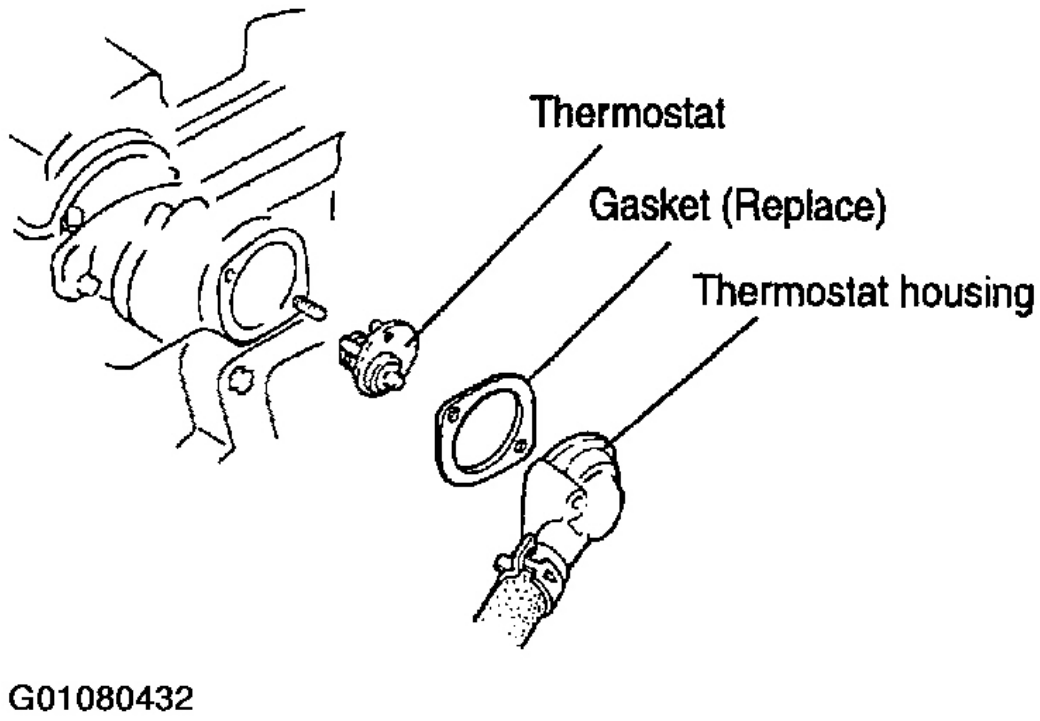


Fig. 295: Removing Thermostat Housing And Thermostat
Courtesy of KIA MOTORS AMERICA, INC.

INSPECTION

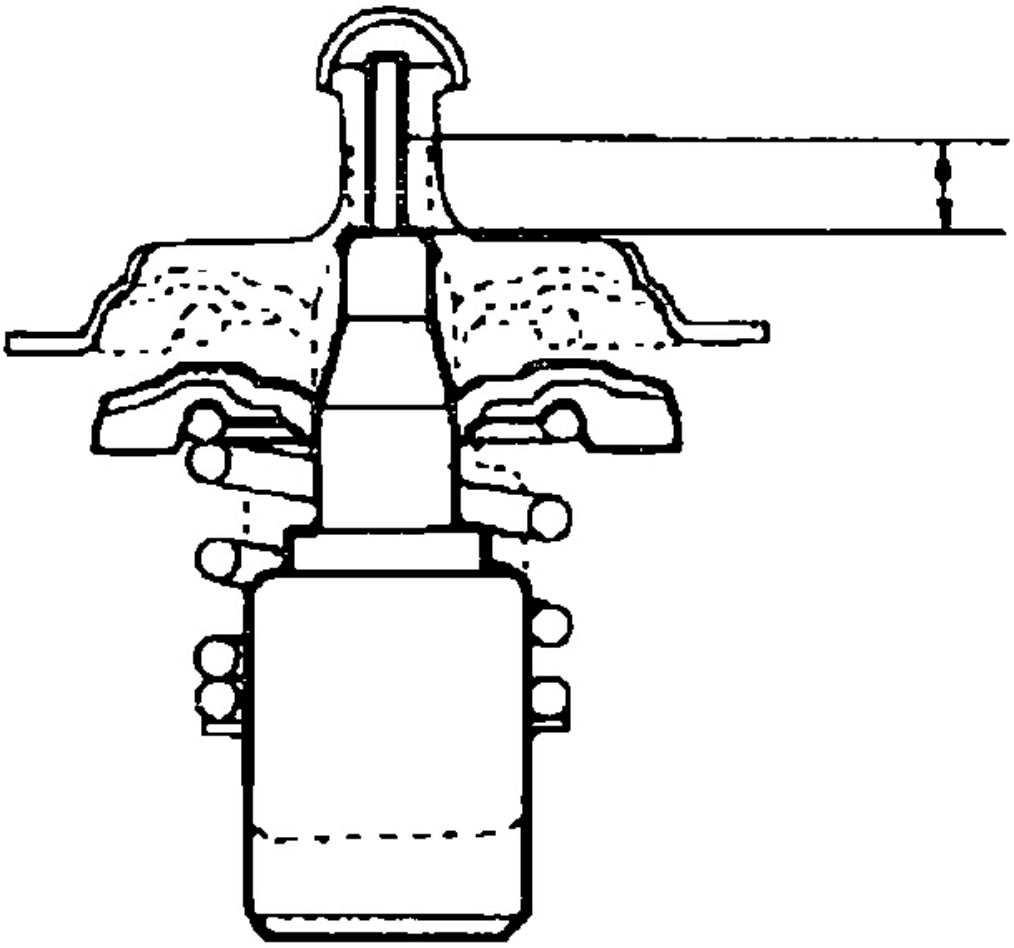
1. Visually check that thermostat is airtight.
2. Place thermostat and a thermometer in water.
3. Gradually heat water and check following.

Initial opening temperature: 177~182°F (80.5~83.5°C)

Full open temperature: 203°F (95°C)

Full open lift: 0.31 in (8.0 mm) minimum.

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Fig. 296: Testing Thermostat Operation
Courtesy of KIA MOTORS AMERICA, INC.

INSTALLATION

1. Install thermostat into cylinder head with jiggle pin positioned up.
2. Install new gasket.

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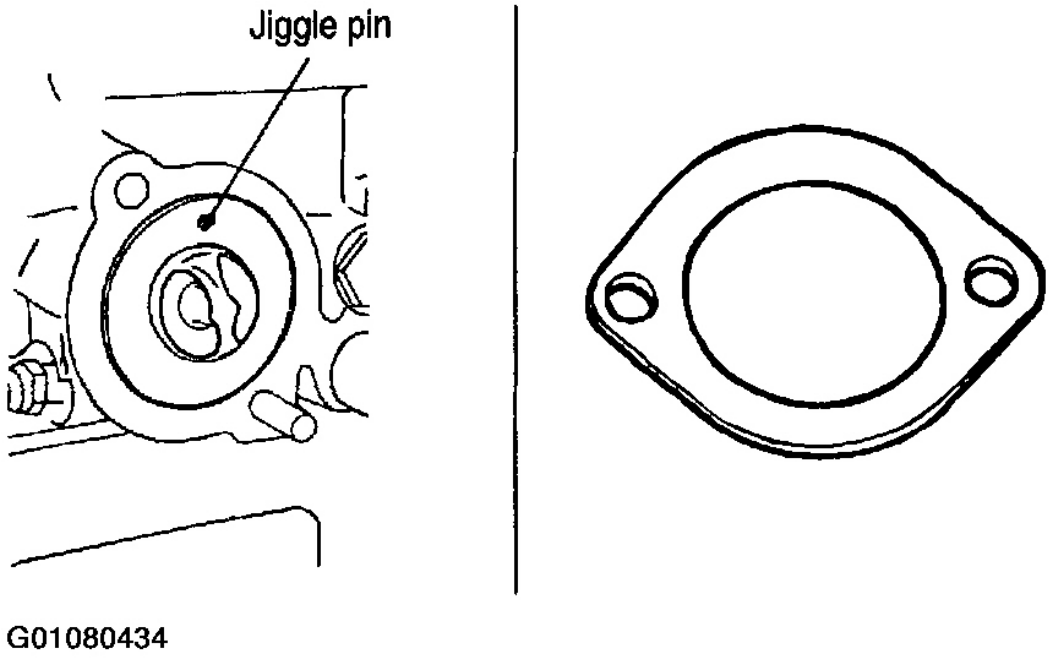
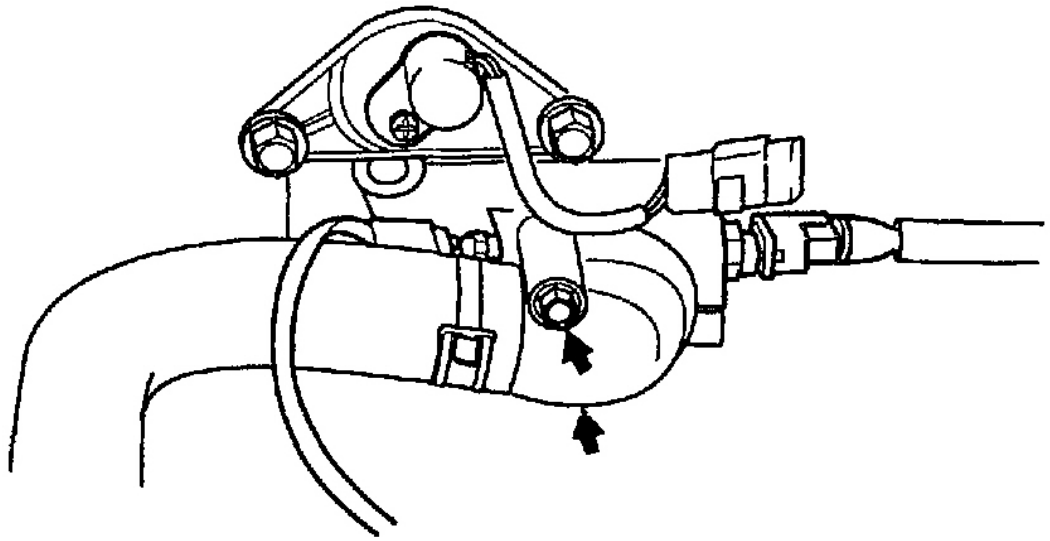


Fig. 297: Installing Thermostat Into Cylinder Head
Courtesy of KIA MOTORS AMERICA, INC.

3. Place thermostat housing and tighten bolt and nut.

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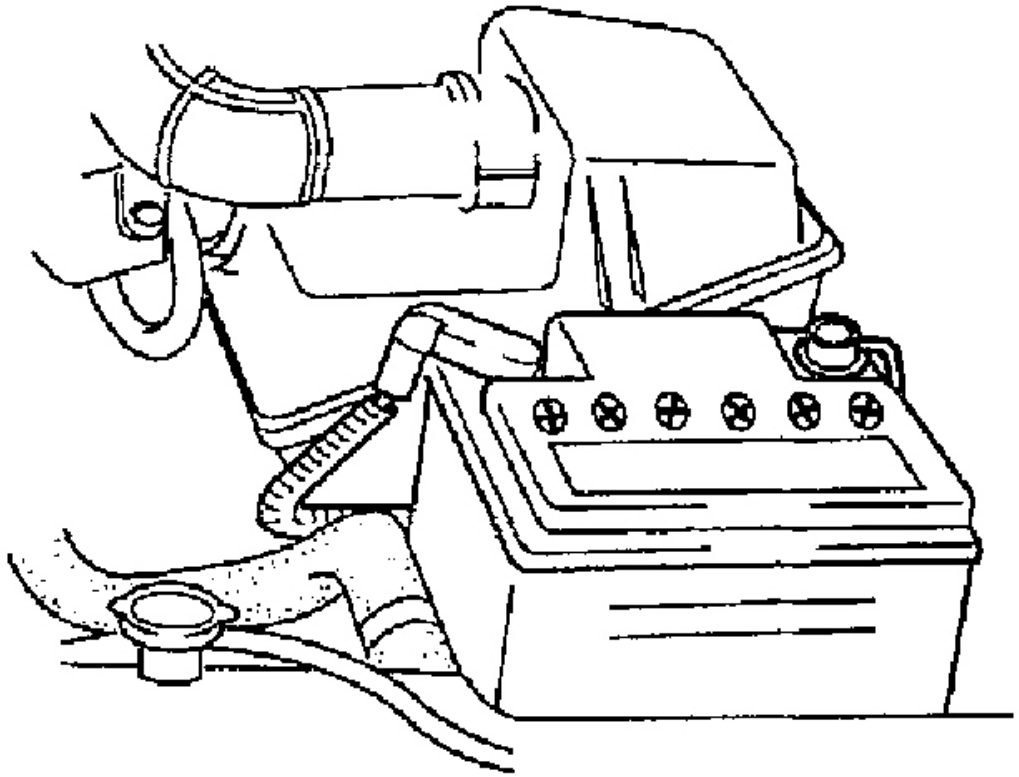
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Fig. 298: Installing Thermostat Housing And Tightening Bolt And Nut
Courtesy of KIA MOTORS AMERICA, INC.

Tightening torque: 14~19 lb.ft (19~26 N.m, 1.9~2.6 kg.m)

4. Fill radiator with specified amount and type of engine coolant.
5. Connect negative battery cable.

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Fig. 299: Connecting Negative Battery Cable
Courtesy of KIA MOTORS AMERICA, INC.

6. Start engine and check for leaks.

LUBRICATION SYSTEM

TROUBLESHOOTING GUIDE

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Problem	Possible Cause	Action
Engine hard starting	Improper engine oil Insufficient engine oil	Replace Add oil
Excessive oil consumption	Internal engine wear Oil leak	Repair 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	Replace
Warning lamp illuminates while engine is running	Oil pressure drop	As described above
	Malfunction of oil pressure switch	Inspection
	Malfunction of electrical system	Inspection

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Fig. 300: Lubrication System Troubleshooting Guide
Courtesy of KIA MOTORS AMERICA, INC.

SPECIFICATION

Item			Specifications
Lubrication system			Force-fed type
Oil pump	Type		Duo-Centric rotor
	Relief pressure	psi (kPa, kg/cm²)	64~78 (441~539, 4.5~5.5)
Oil filter	Type		Full-flow, paper element
	Relief pressure differential	psi (kPa, kg/cm²)	11~17 (78~118, 0.8~1.2)
Oil pressure switch activation pressure		psi (kPa, kg/cm²)	3.6 (25, 0.25)
Oil capacity	Total (dry engine)	US qt (liters, Imp qt)	4.2 (4.0, 3.5)
	Oil pan	US qt (liters, Imp qt)	3.8 (3.6, 3.2)
	Oil filter	US qt (liters, Imp qt)	0.21 (0.20, 0.18)
Engine oil			API service SG or SH

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Fig. 301: Lubrication System Specification Chart
Courtesy of KIA MOTORS AMERICA, INC.

GENERAL DESCRIPTION

The engine lubrication system consists of an oil pan, oil pump, oil filter and various oil passages. A rotor-type oil pump is driven by crankshaft. The oil pump has a pressure relief valve which controls lubrication system pressure by bypassing oil back to oil pan. The oil pump rotates and draws oil from the oil pan through an oil strainer. The oil is pressurized as it passes through the pump.

Pressurized oil is first directed through a full-flow paper element where impurities are removed, and then to a

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main oil gallery. Oil in this gallery is divided into two passages. In one passage, oil is pumped to the crankshaft main bearings. Oil is supplied to the connecting rod bearings through intersecting passages drilled in the crankshaft. Piston cooling jets in each cylinder provide additional piston cooling and lubrication. In the second passage, oil flows to the cylinder head to lubricate valve train components.

After passing through the cylinder block and cylinder head, oil is returned by gravity to the oil pan. Those internal parts that have no direct oil feed are supplied with lubrication by either gravity or splash from other direct feed components.

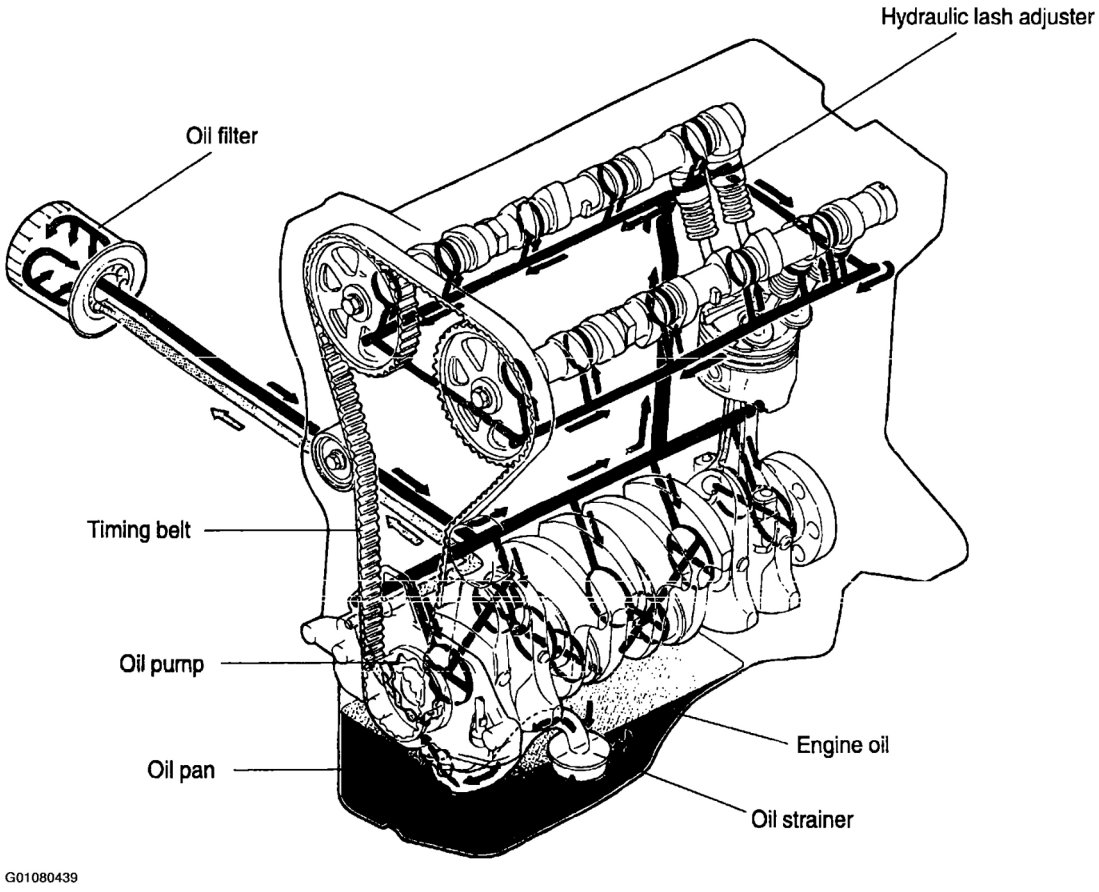


Fig. 302: Illustrating Lubrication Flow
Courtesy of KIA MOTORS AMERICA, INC.

ENGINE OIL

INSPECTION

1. Be sure vehicle is on level ground.
2. Warm engine to normal operating temperature and turn engine off.
3. Wait for five minutes.
4. Remove oil level dipstick and check oil level and condition.

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5. Add or replace oil as necessary.

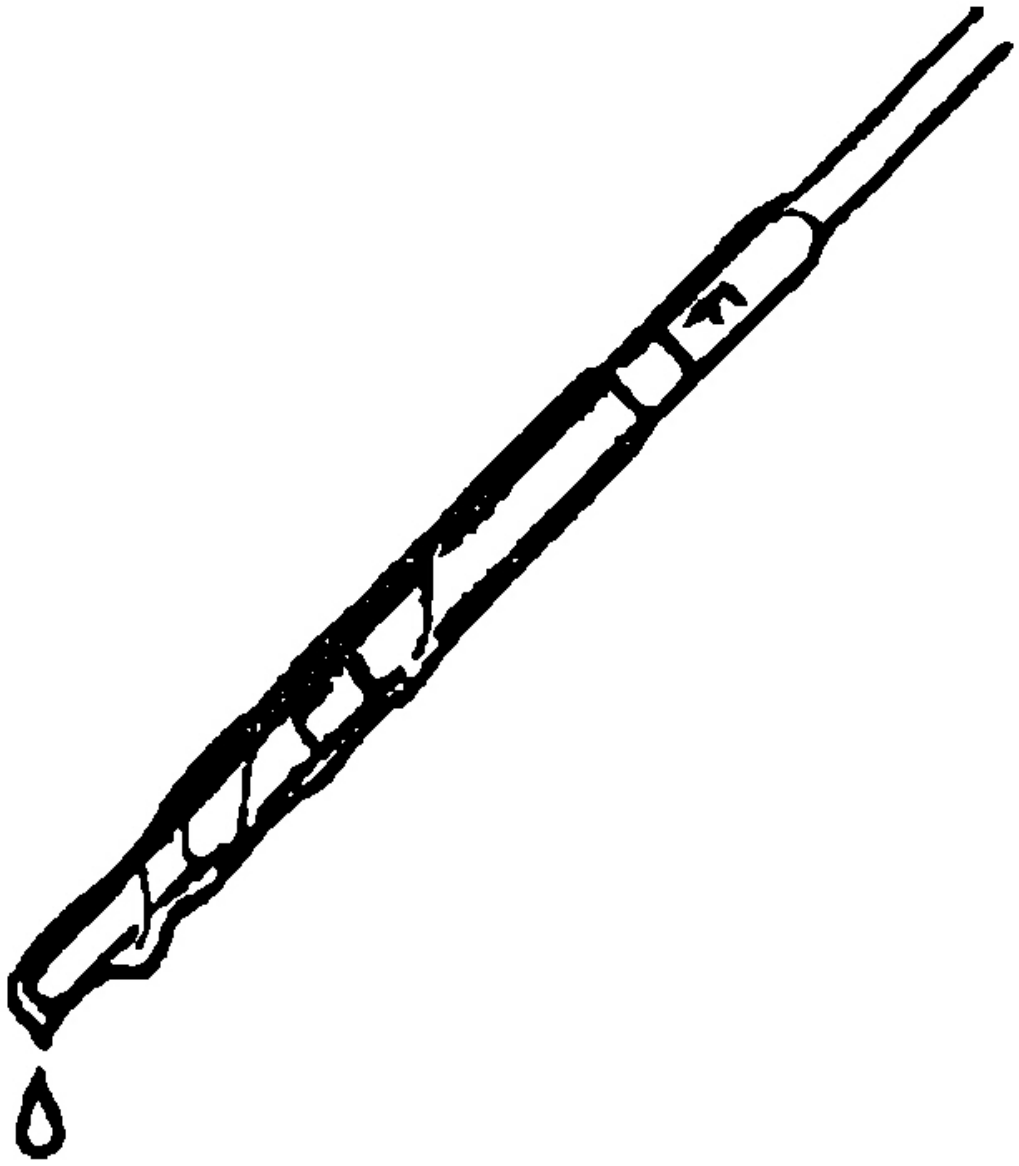


Fig. 303: Checking Oil Level And Condition
Courtesy of KIA MOTORS AMERICA, INC.

REPLACEMENT

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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.

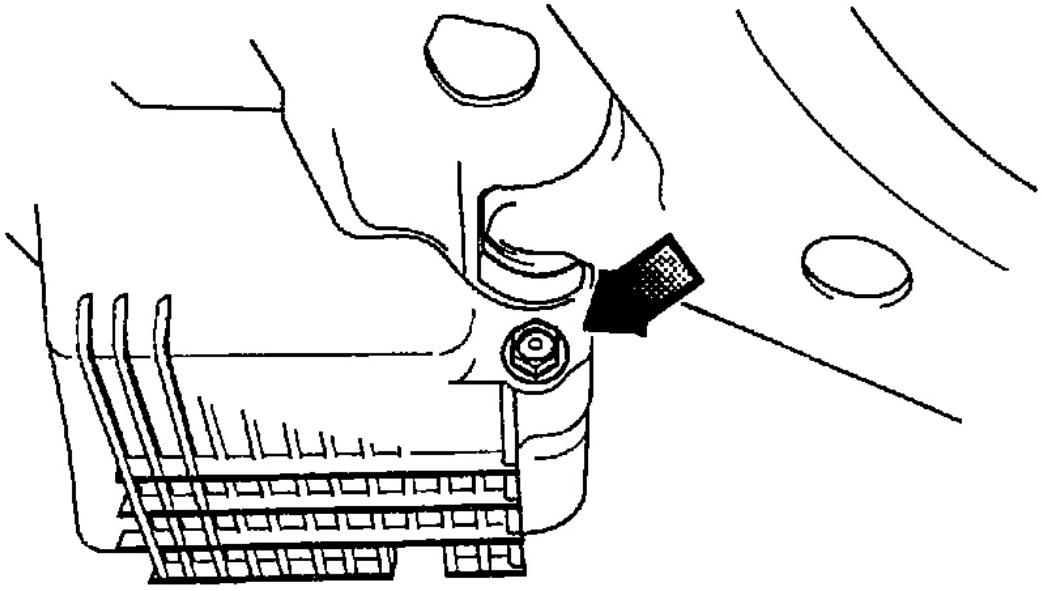


Fig. 304: Identifying Engine Oil Drain Plug
Courtesy of KIA MOTORS AMERICA, INC.

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. Install oil filler cap.
7. Run engine and check for leaks.
8. Check oil level and add oil if necessary.

Oil pan capacity: 3.8 U.S. qt (3.6 liters, 3.2 Imp qt)

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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.

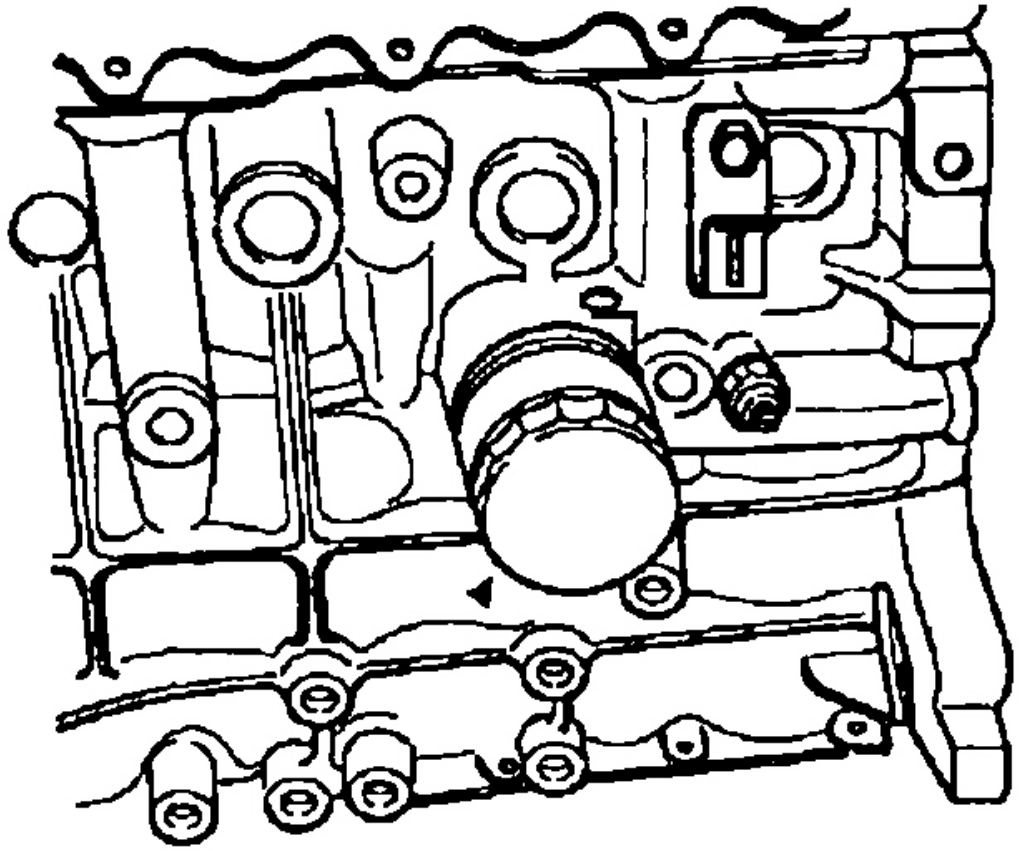


Fig. 305: Installing Oil Filter
Courtesy of KIA MOTORS AMERICA, INC.

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.

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7. Turn engine off, and wait 5 minutes.

   Check oil level and add oil if necessary.

   Oil filter capacity: 0.21 U.S. qt (0.2 liter, 0.18 Imp qt)

OIL PRESSURE CHECK

1. Disconnect and remove oil pressure switch.

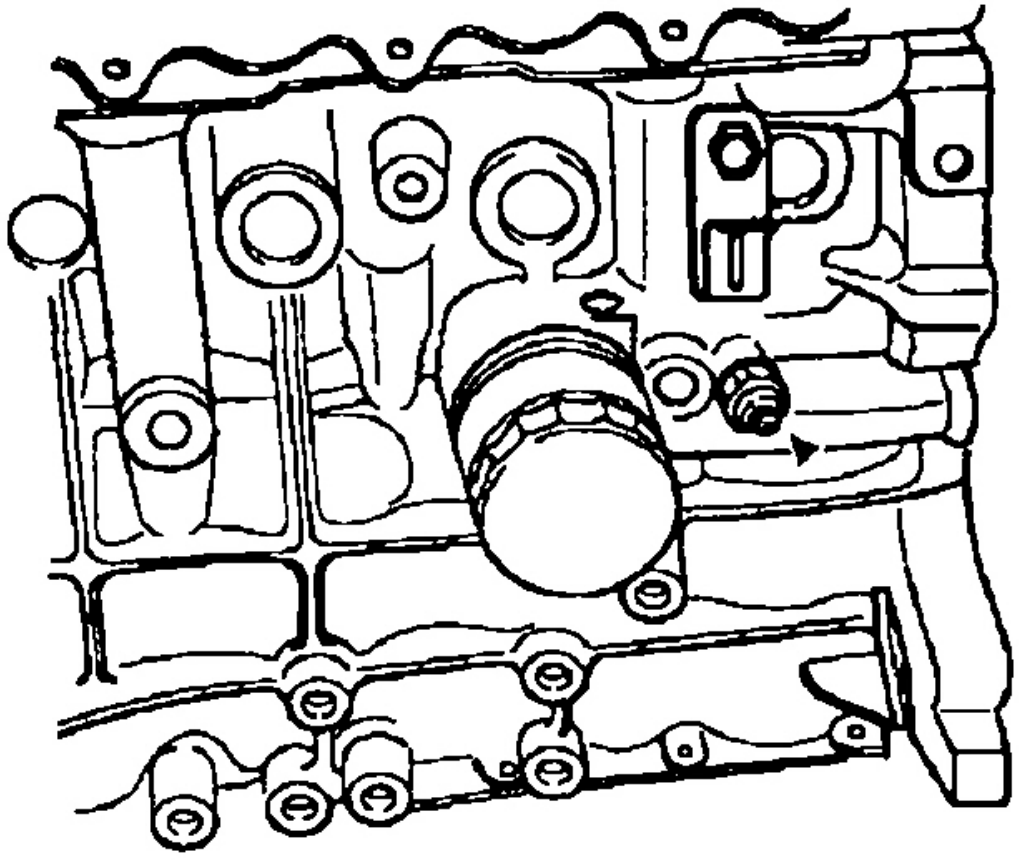
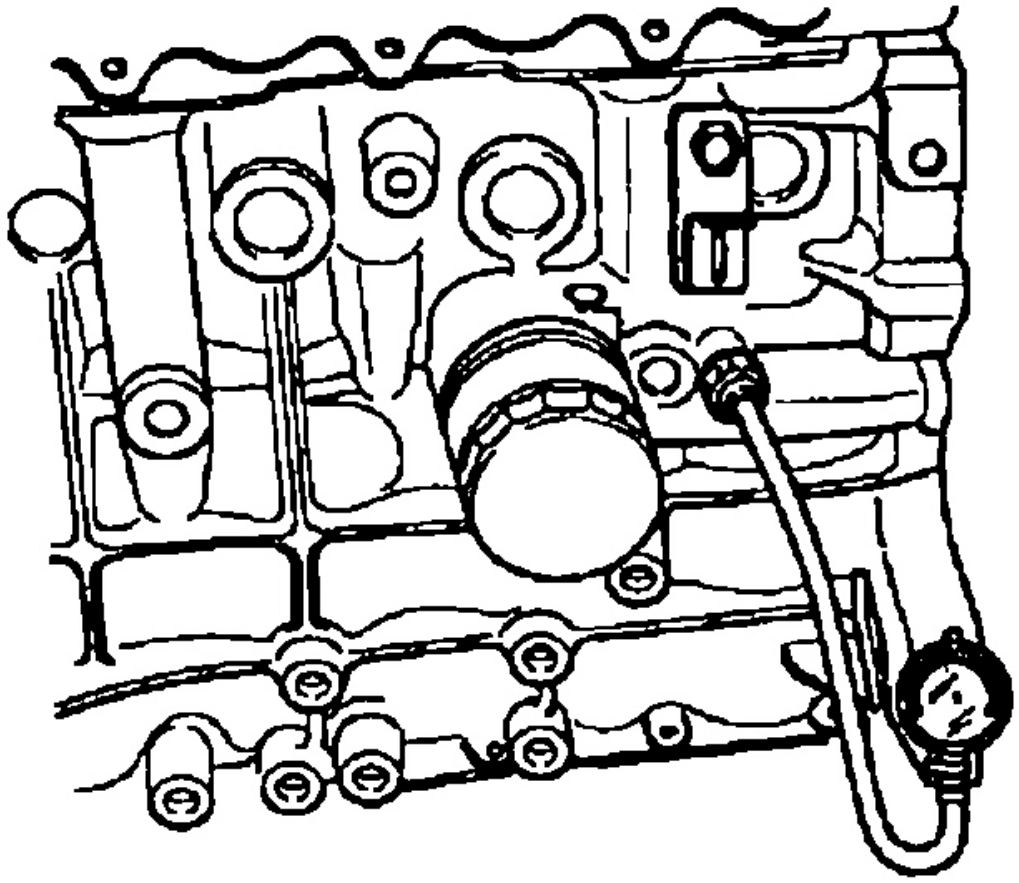


Fig. 306: Removing Oil Pressure Switch
Courtesy of KIA MOTORS AMERICA, INC.

2. Install oil pressure gauge into oil pressure switch installation hole.

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Fig. 307: Installing Oil Pressure Gauge
Courtesy of KIA MOTORS AMERICA, INC.

3. Warm engine to normal operating temperature.
4. Run engine at 3,000 RPM, and note gauge readings.

Oil pressure: 43~57 psi (294~392 kPa, 3.0~4.0 kg/cm2)

5. If pressure is not within specification, check for cause, and repair. See **TROUBLESHOOTING GUIDE**.
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)

OIL PUMP

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COMPONENT

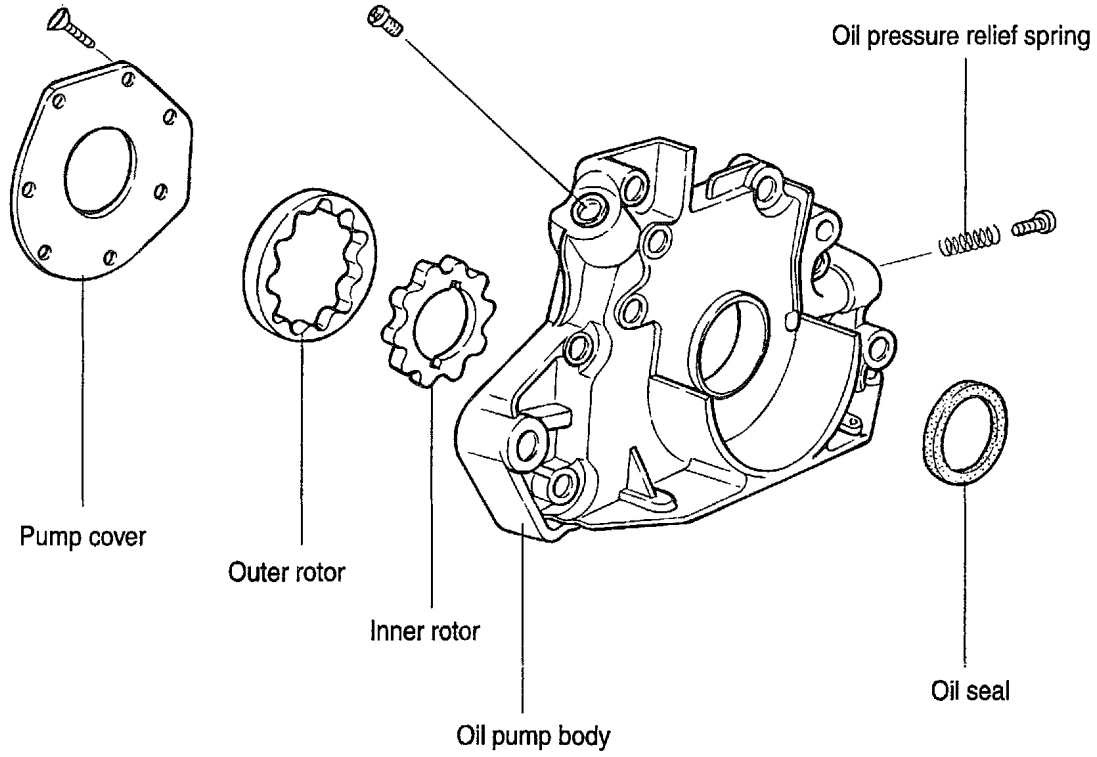
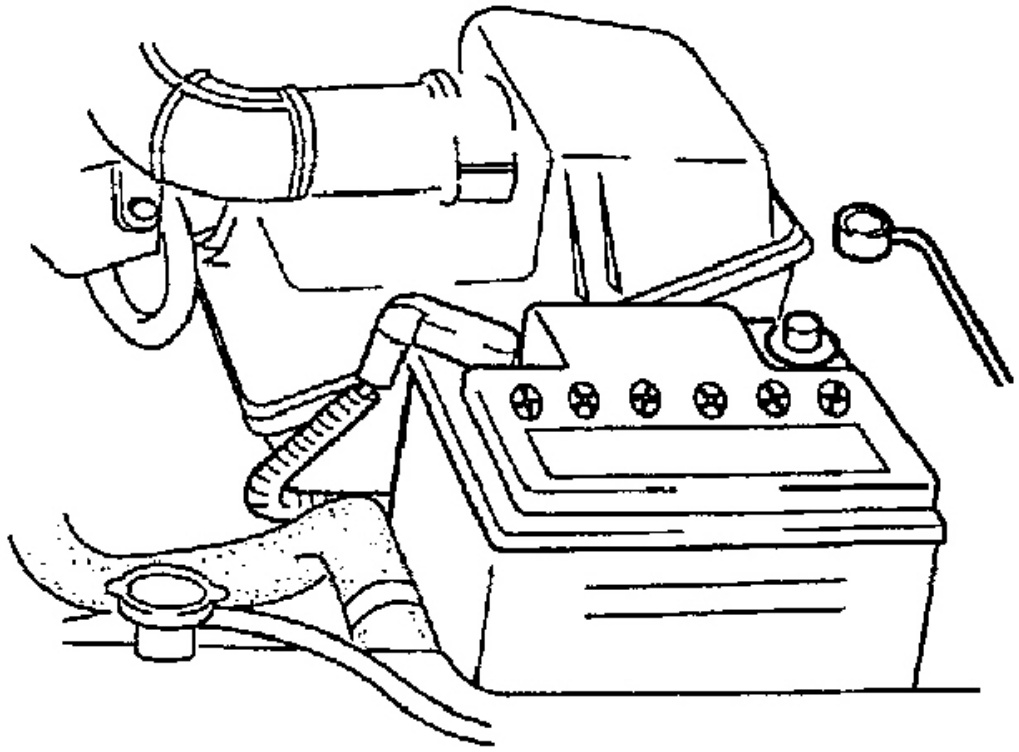


Fig. 308: Identifying Oil Pump Components
Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

1. Disconnect negative battery cable.

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Fig. 309: Disconnecting Negative Battery Cable
Courtesy of KIA MOTORS AMERICA, INC.

2. Drain engine oil.

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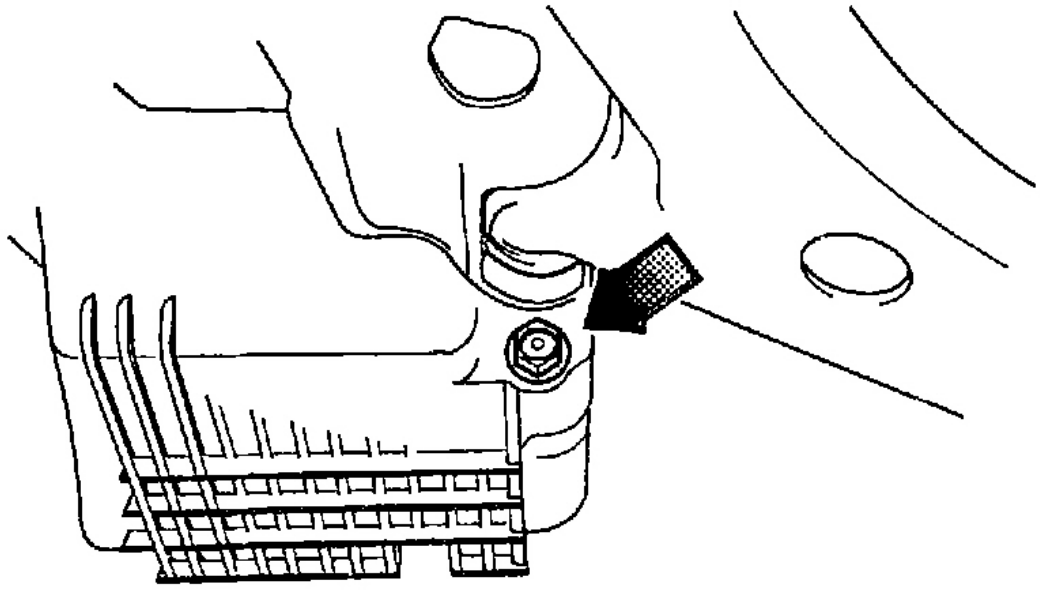


Fig. 310: Draining Engine Oil
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove timing belt. See **TIMING SYSTEM**.
4. Remove oil pan and oil strainer. See **OIL PAN**.
5. Remove generator. See **CHARGING SYSTEMS** .
6. Remove A/C compressor and A/C compressor bracket if equipped.
7. Remove crankshaft pulley lock bolt.
8. Remove timing belt pulley.
9. Remove oil pump mounting bolt.

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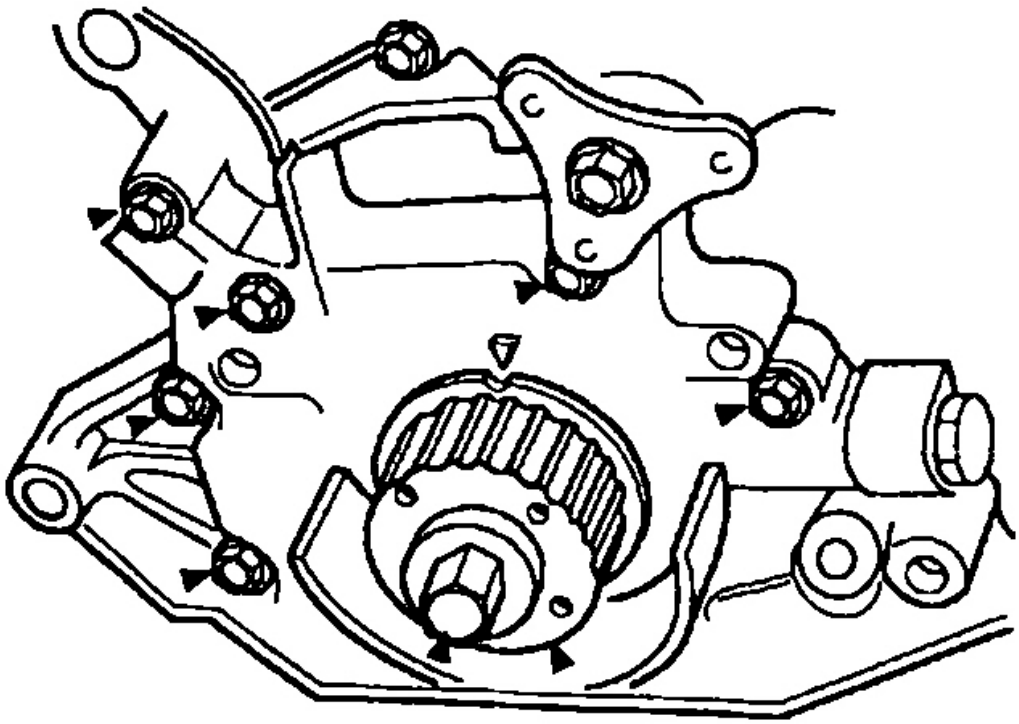


Fig. 311: Removing Oil Pump Mounting Bolt
Courtesy of KIA MOTORS AMERICA, INC.

10. Remove oil pump.

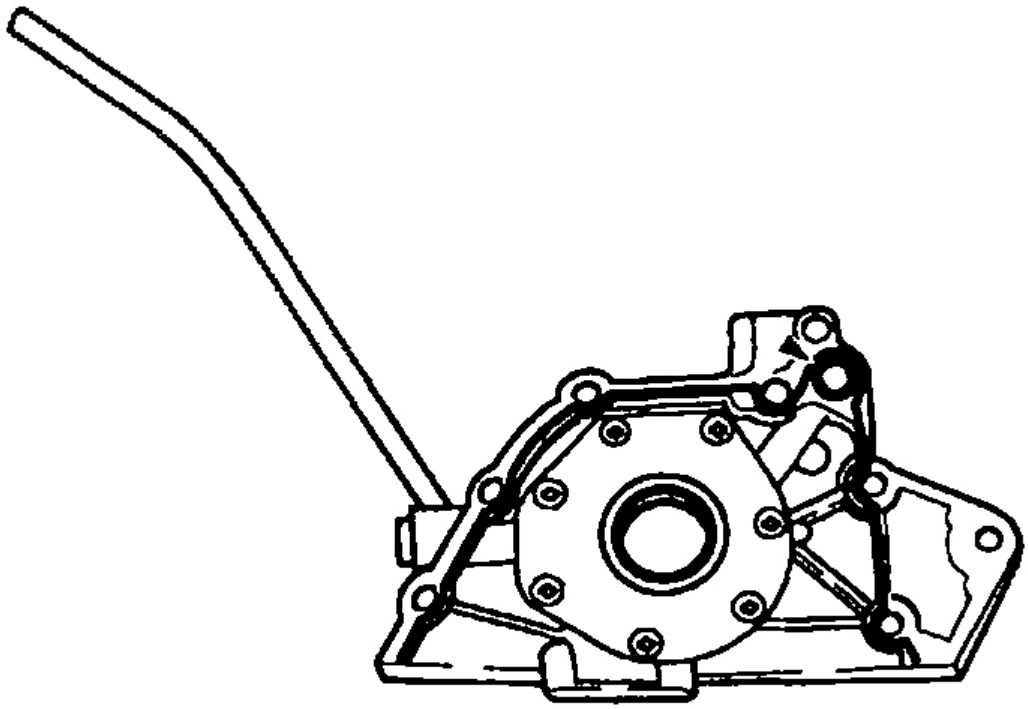
INSTALLATION

1. Apply a continuous bead of silicone sealant to oil pump sealing surface.

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

2. Apply grease to a new O-ring and install it in oil pump.

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Fig. 312: Applying Grease To A New O-Ring
Courtesy of KIA MOTORS AMERICA, INC.

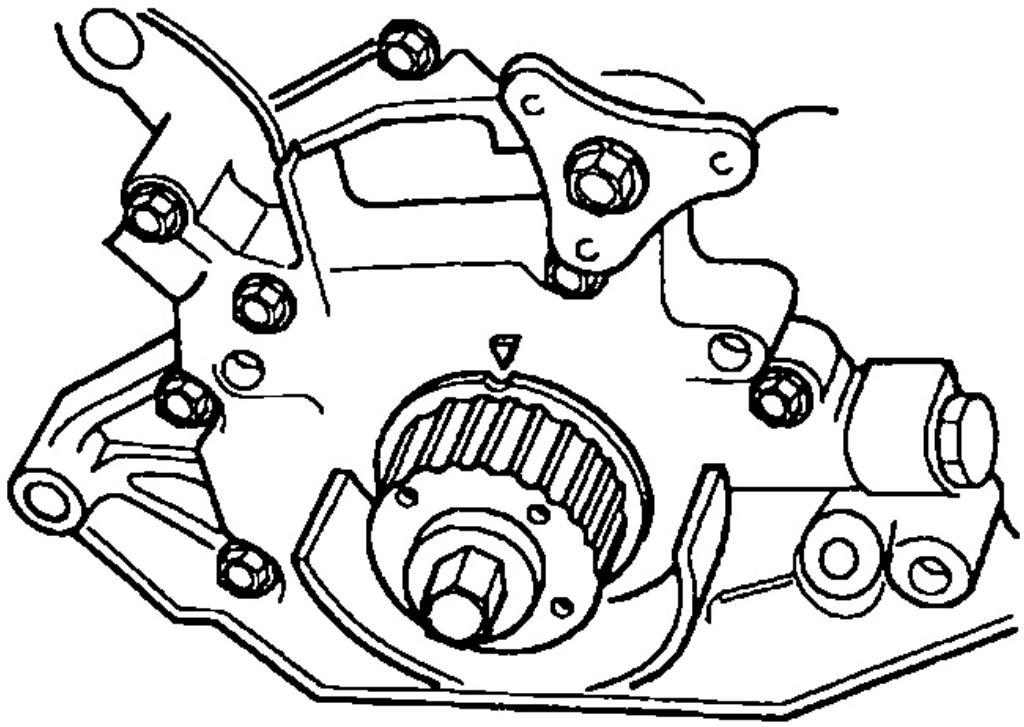
3. Install oil pump.

   Tightening torque: 14~19 lb.ft (19~26 N.m, 1.9~2.6 kg.m)

4. Install timing belt pulley and crankshaft pulley lock bolt.

   Tightening torque: 115.7~122.9 lb.ft (156.8~166.6 N.m, 16~17 kg.m)

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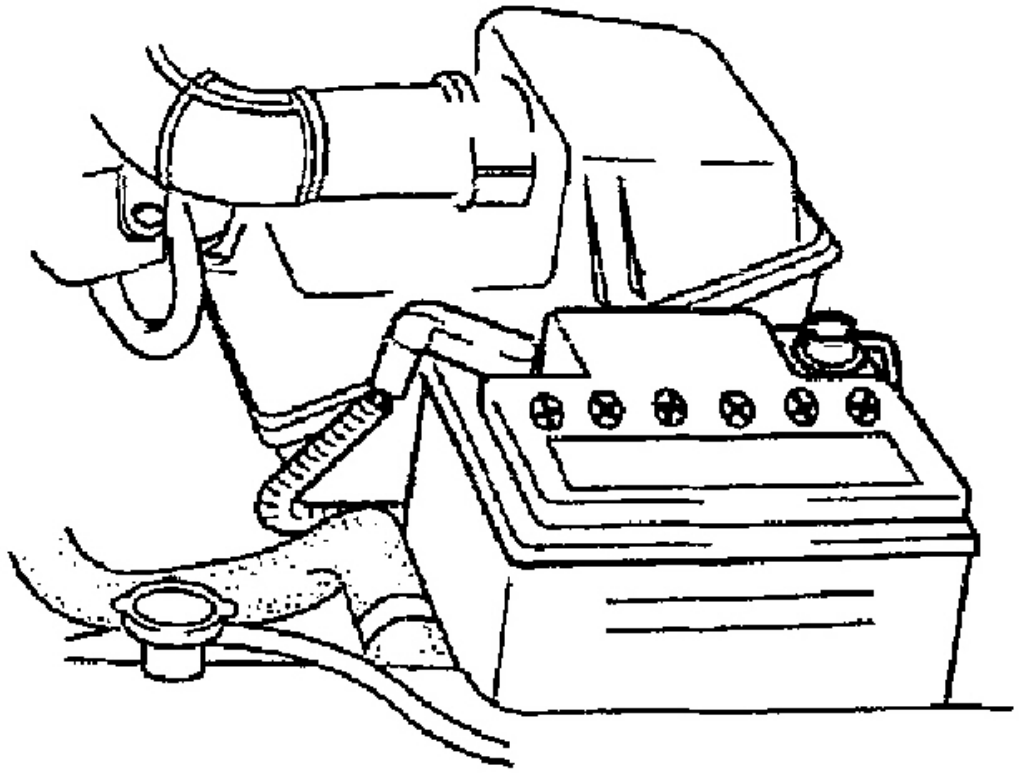


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Fig. 313: Installing Timing Belt Pulley And Crankshaft Pulley Lock Bolt
Courtesy of KIA MOTORS AMERICA, INC.

5. Install A/C compressor bracket and A/C compressor.
6. Install generator. See **CHARGING SYSTEMS** .
7. Install oil strainer and oil pan. See **OIL PAN**.
8. Install timing belt. See **TIMING SYSTEM**.
9. Fill with specified amount and type of engine oil.
10. Connect negative battery cable.

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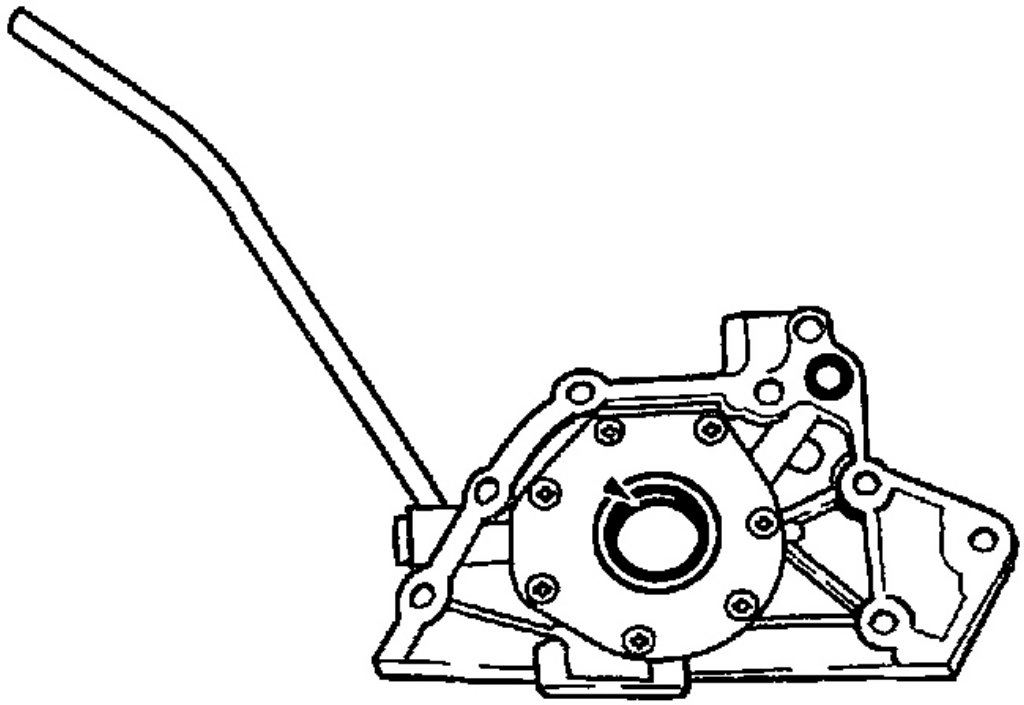
Fig. 314: Connecting Negative Battery Cable
Courtesy of KIA MOTORS AMERICA, INC.

11. Start engine and check for leaks.
12. Check oil level and add oil if necessary.

DISASSEMBLY

1. Remove oil seal using a screwdriver covered by a rag to protect sealing surface from pump cover side.

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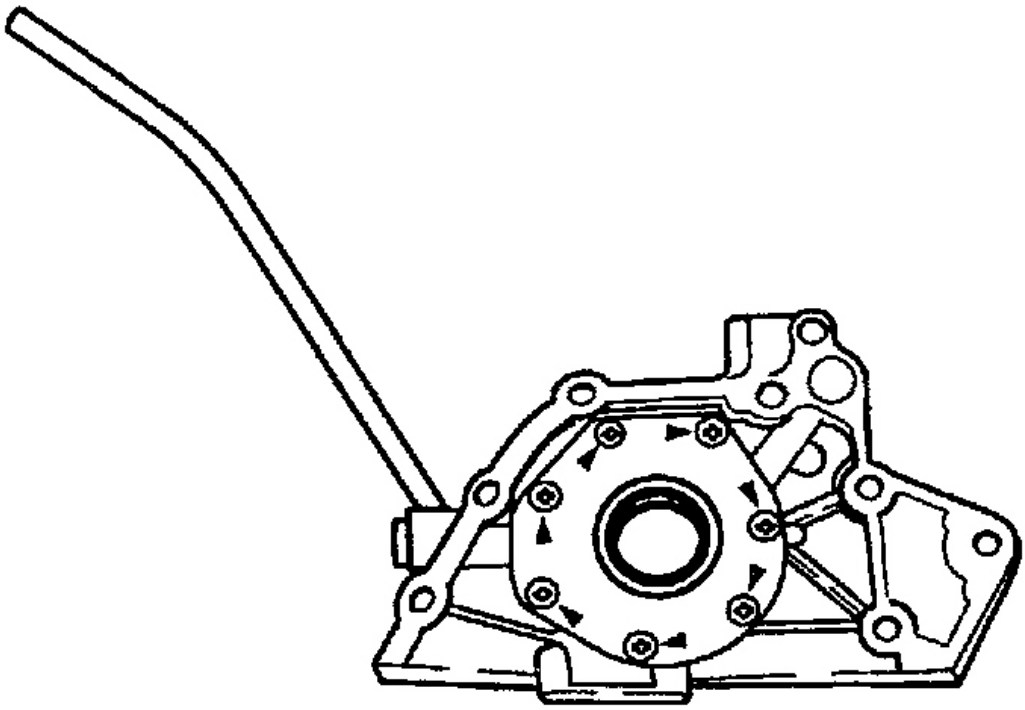


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Fig. 315: Removing Oil Seal
Courtesy of KIA MOTORS AMERICA, INC.

2. Remove seven screws and remove pump cover.

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Fig. 316: Removing Oil Pump Cover
Courtesy of KIA MOTORS AMERICA, INC.

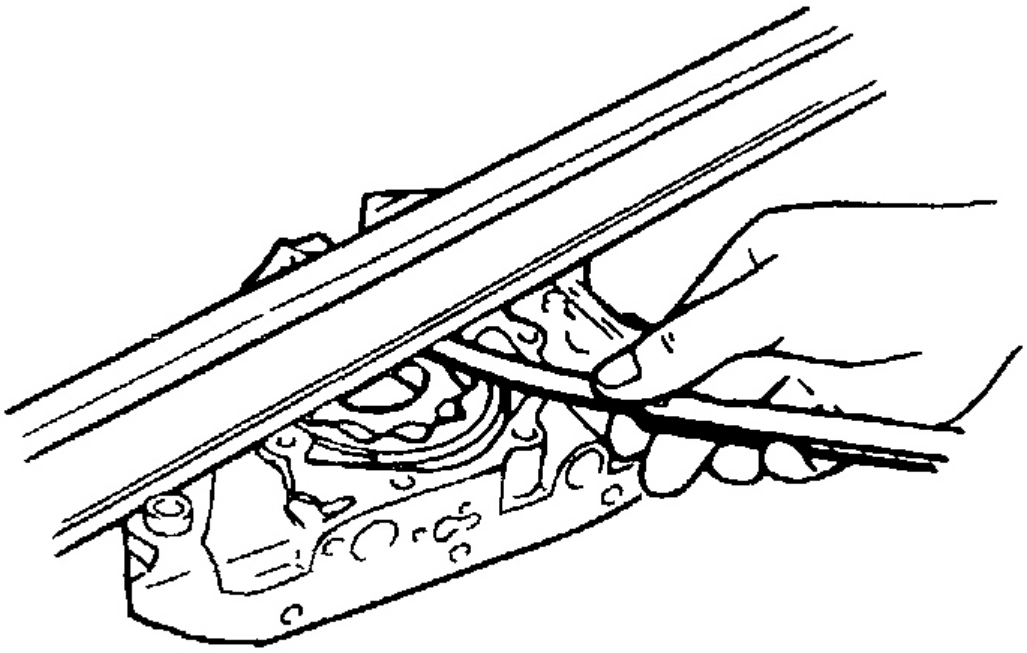
3. Remove outer rotor and inner rotor.

INSPECTION

1. Check the following and replace any faulty parts.
   - Distorted or damaged oil pump body or cover.
   - Worn or damaged plunger.
   - Weak or broken plunger spring.
2. Measure side clearance.

   Clearance: 0.0035 in (0.09 mm) Max.

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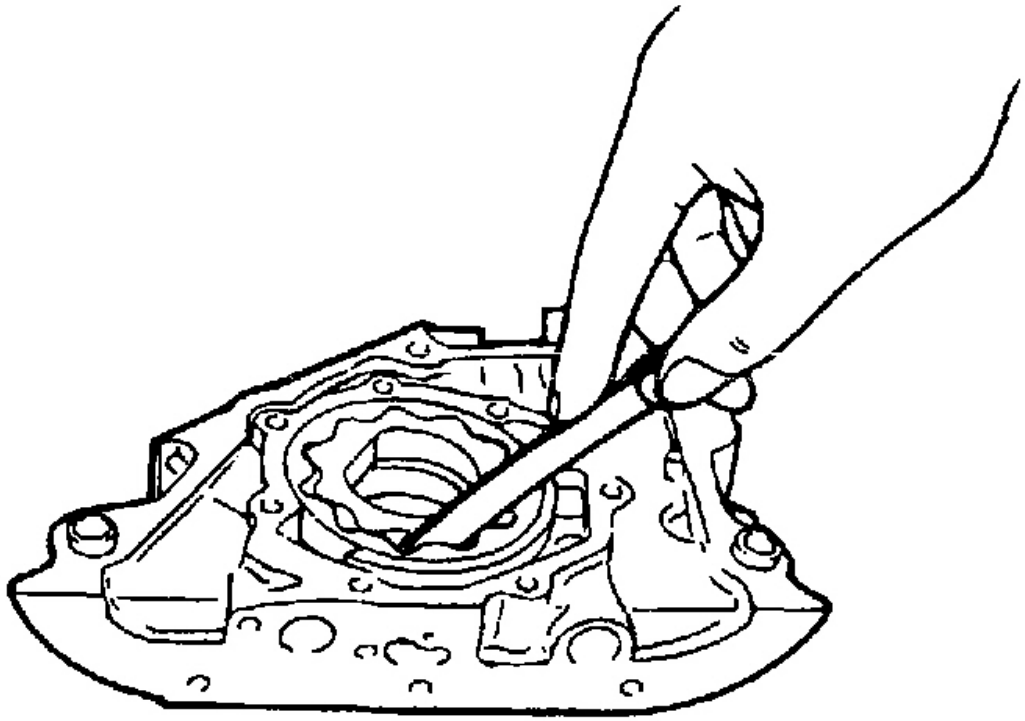
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Fig. 317: Measuring Side Clearance
Courtesy of KIA MOTORS AMERICA, INC.

3. Measure tooth tip clearance.

   Clearance: 0.007 in (0.18 mm) Max.

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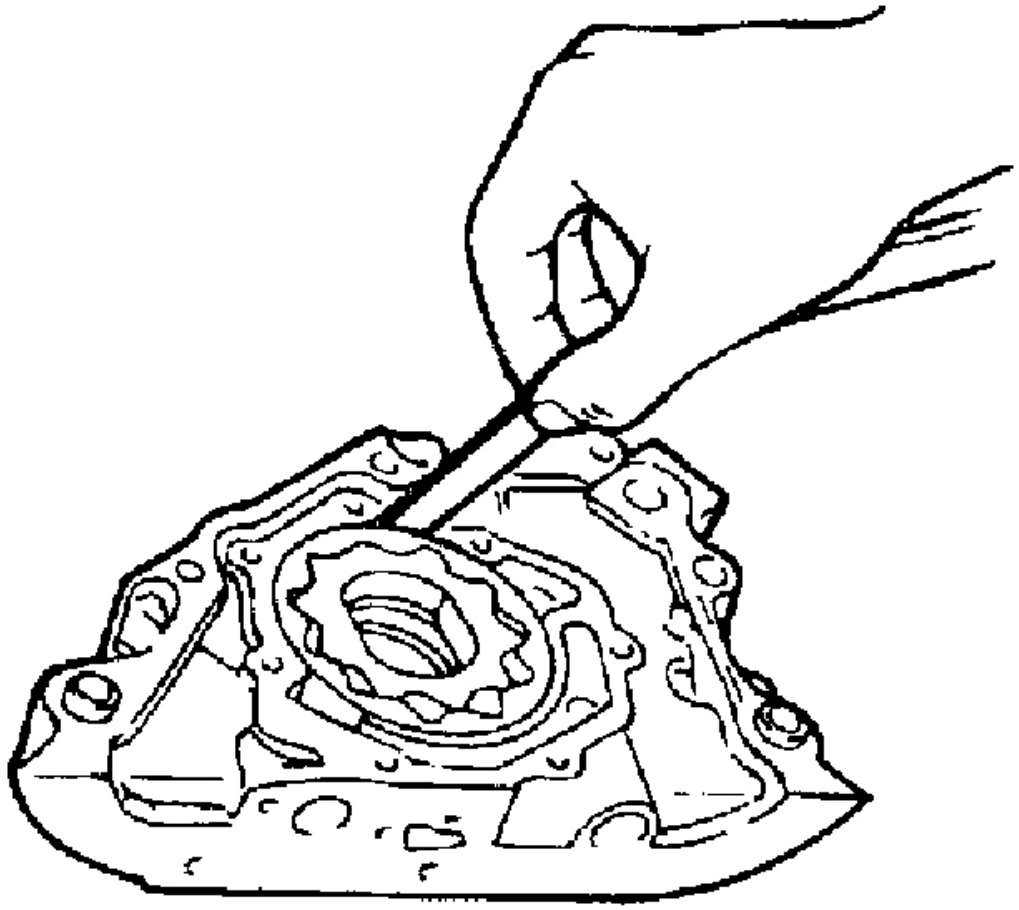
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Fig. 318: Measuring Tooth Tip Clearance
Courtesy of KIA MOTORS AMERICA, INC.

4. Measure outer rotor to pump body clearance.

   Clearance: 0.015 in (0.376 mm) Max.

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Fig. 319: Measuring Outer Rotor To Pump Body Clearance
Courtesy of KIA MOTORS AMERICA, INC.

REASSEMBLY

1. Assemble outer rotor and inner rotor into oil pump body.

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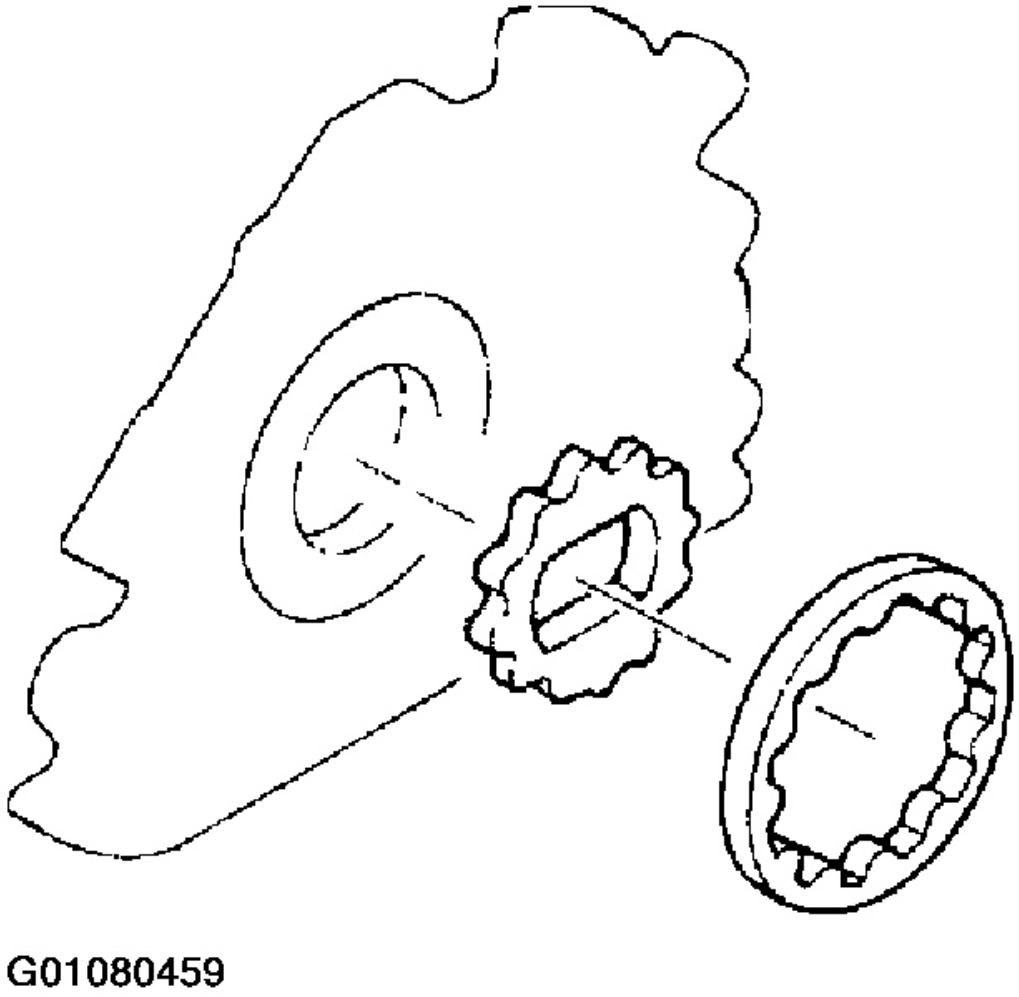
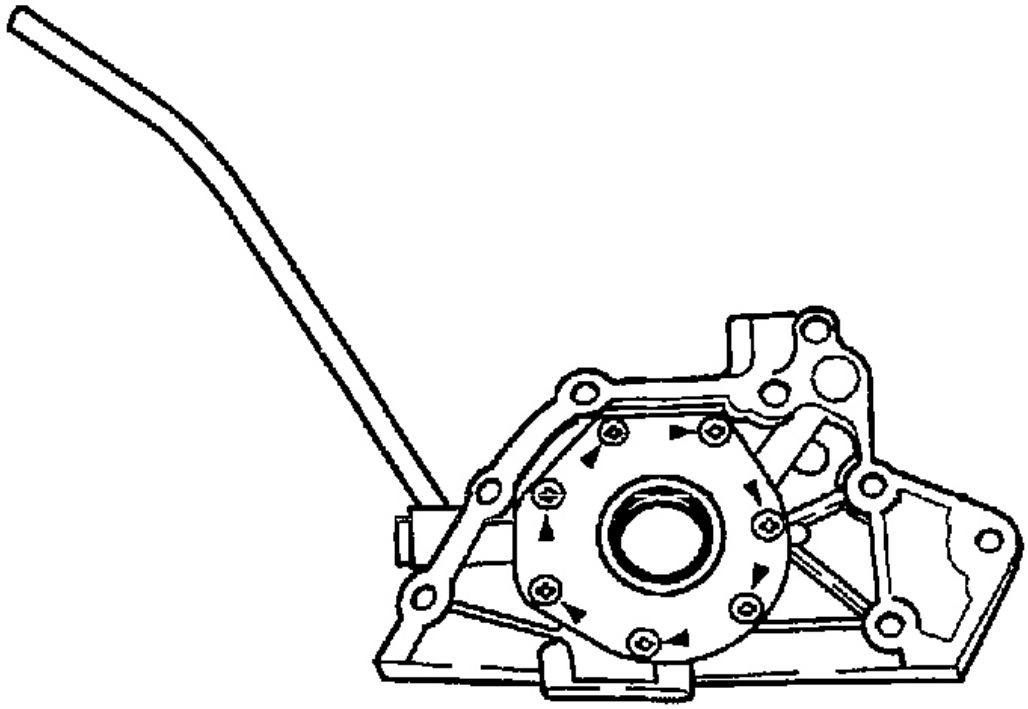


Fig. 320: Assembling Outer And Inner Rotor Into Oil Pump Body
Courtesy of KIA MOTORS AMERICA, INC.

2. Apply thread locking compound to cover mounting screw threads.
3. Assemble oil pump cover to oil pump body.

Tightening torque: 4.3~6.5 lb.ft (6~9 N.m, 0.6~0.9 kg.cm)

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Fig. 321: Installing Oil Pump Cover To Oil Pump Body
Courtesy of KIA MOTORS AMERICA, INC.

4. Apply engine oil to outside of new oil seal and oil pump body.
5. Press oil seal into oil pump body.

CAUTION: Oil seal must be pressed in until it is protruding with front face of oil pump body.

Protrusion: 0.02~0.04 in (0.5~1.0 mm)

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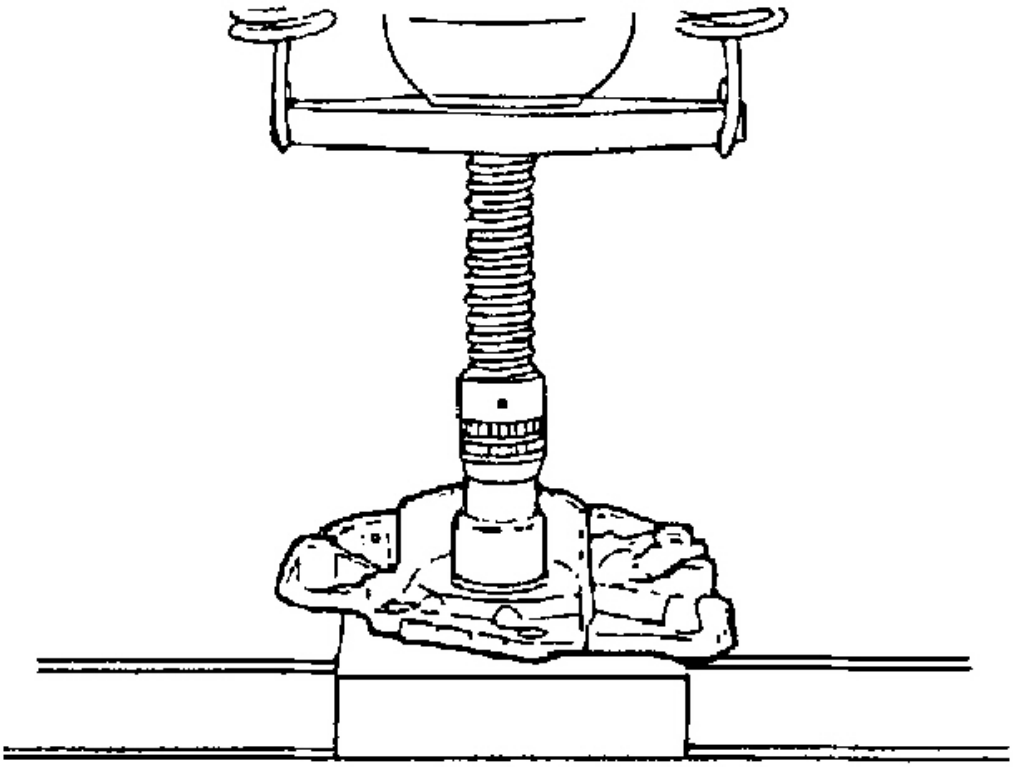


Fig. 322: Pressing Oil Seal Into Oil Pump Body
Courtesy of KIA MOTORS AMERICA, INC.

FRONT OIL SEAL

REMOVAL

1. Remove oil pump. See **OIL PUMP**.
2. Remove front oil seal.

REPLACEMENT

1. Install oil seal. See **OIL PUMP**.
2. Install oil pump.

REAR OIL SEAL

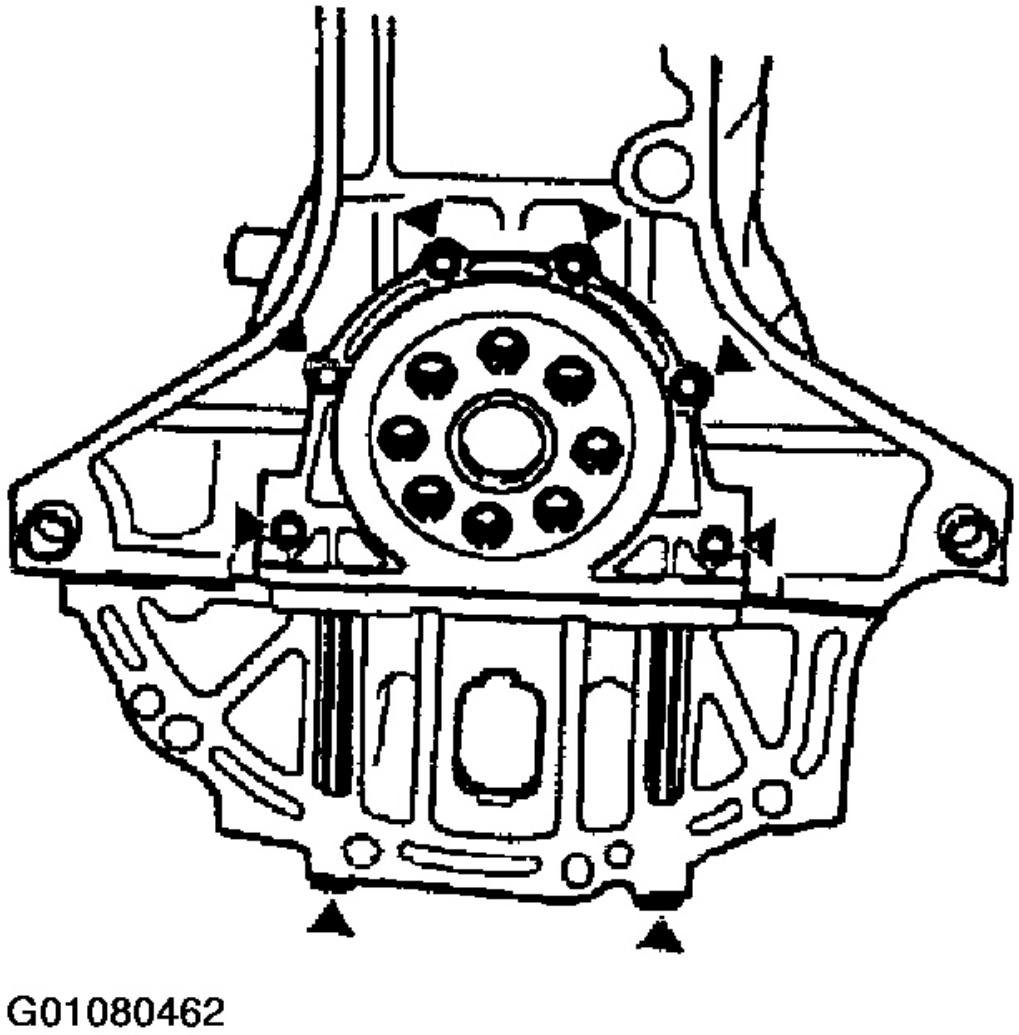
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REMOVAL

1. Disconnect negative battery cable.
2. Remove flywheel, in case of A/T, remove drive plate.

NOTE: Use a flywheel locking tool or equivalent when removing flywheel or drive plate.

3. Remove rear cover.



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Fig. 323: Removing Rear Cover
Courtesy of KIA MOTORS AMERICA, INC.

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4. Wrap a prying tool with a shop towel and slowly pry old seal out.

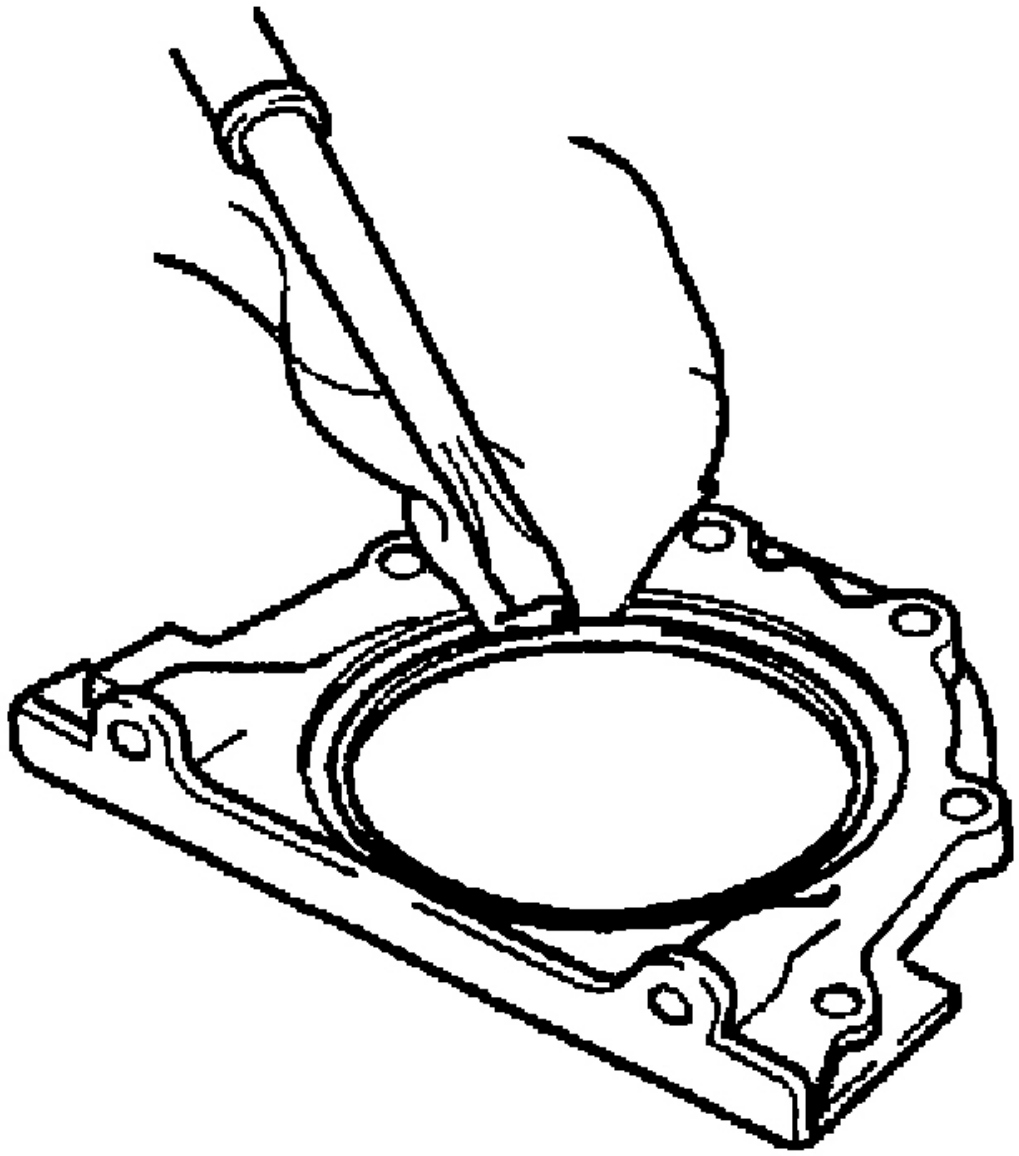


Fig. 324: Prying Out Oil Seal
Courtesy of KIA MOTORS AMERICA, INC.

REPLACEMENT

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1. Apply engine oil to rear cover, oil seal and oil seal lip.
2. Press oil seal into rear cover.

NOTE: Oil seal must be tapped in until it is nearly flush with surface of rear cover.

Protrusion: 0~0.02 in (0~0.5 mm)

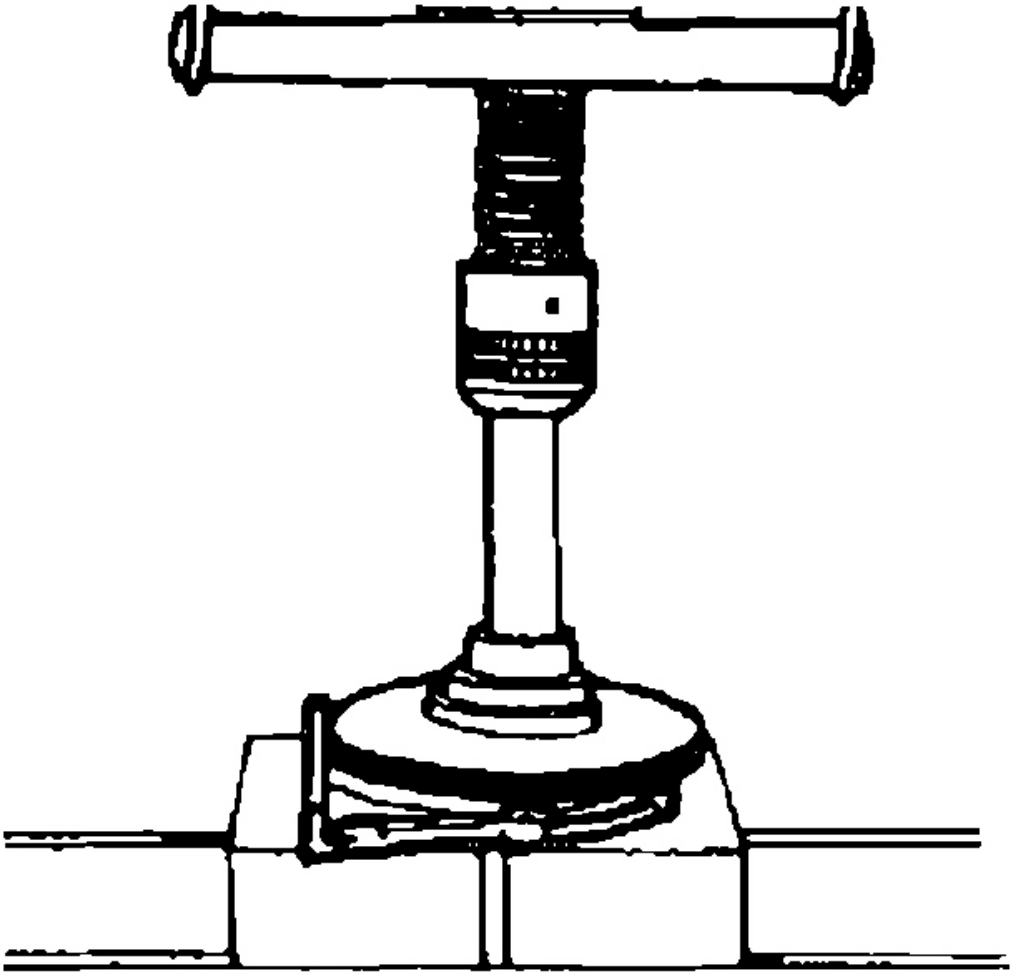


Fig. 325: Pressing Oil Seal Into Rear Cover
Courtesy of KIA MOTORS AMERICA, INC.

3. Cut away silicon sealer that has been squeezed out from rear cover assembly toward oil pan mounting

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surface.

CAUTION: Do not scratch rear cover assembly.

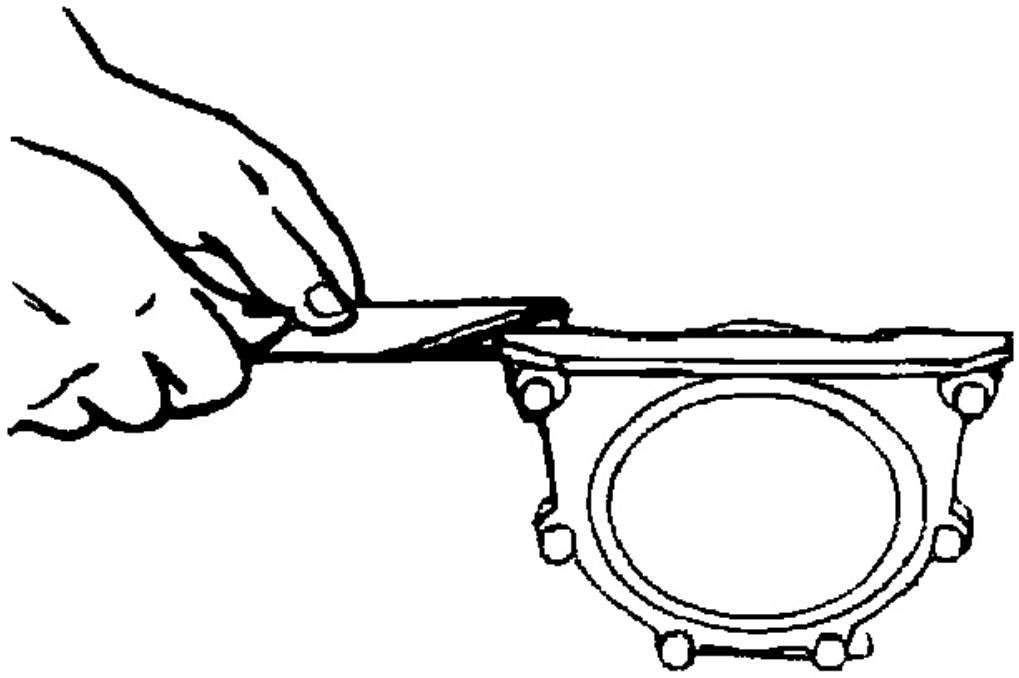


Fig. 326: Removing Excess Sealer
Courtesy of KIA MOTORS AMERICA, INC.

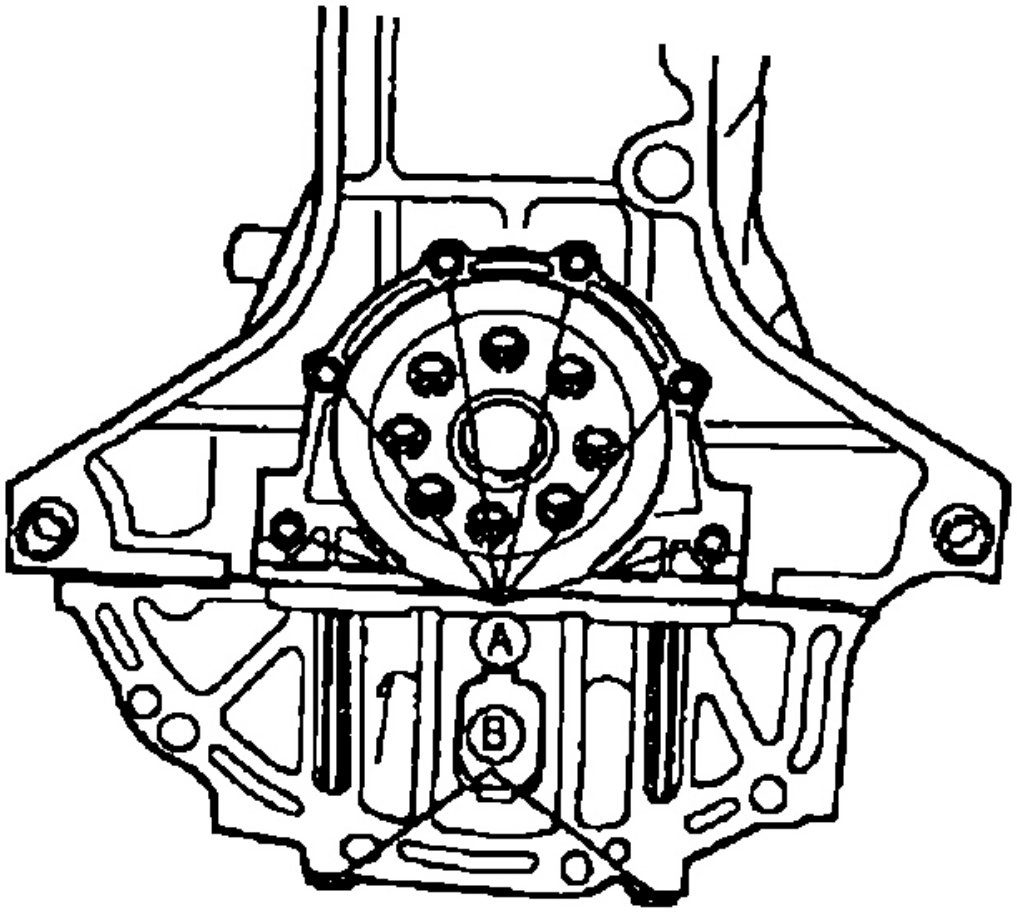
4. Install rear cover.

Tightening torque:

A: 5.8~8.0 lb.ft (7.8~10.8 N.m, 0.8~1.1 kg.m)

B: 29.7~40.5 lb.ft (40.2~54.9 N.m, 4.1~5.6 kg.m)

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Fig. 327: Installing Rear Cover
Courtesy of KIA MOTORS AMERICA, INC.

5. Install flywheel and manual transaxle, see **Fig. 144**. In case of A/T, install drive plate and automatic transaxle.
6. Connect negative battery cable.

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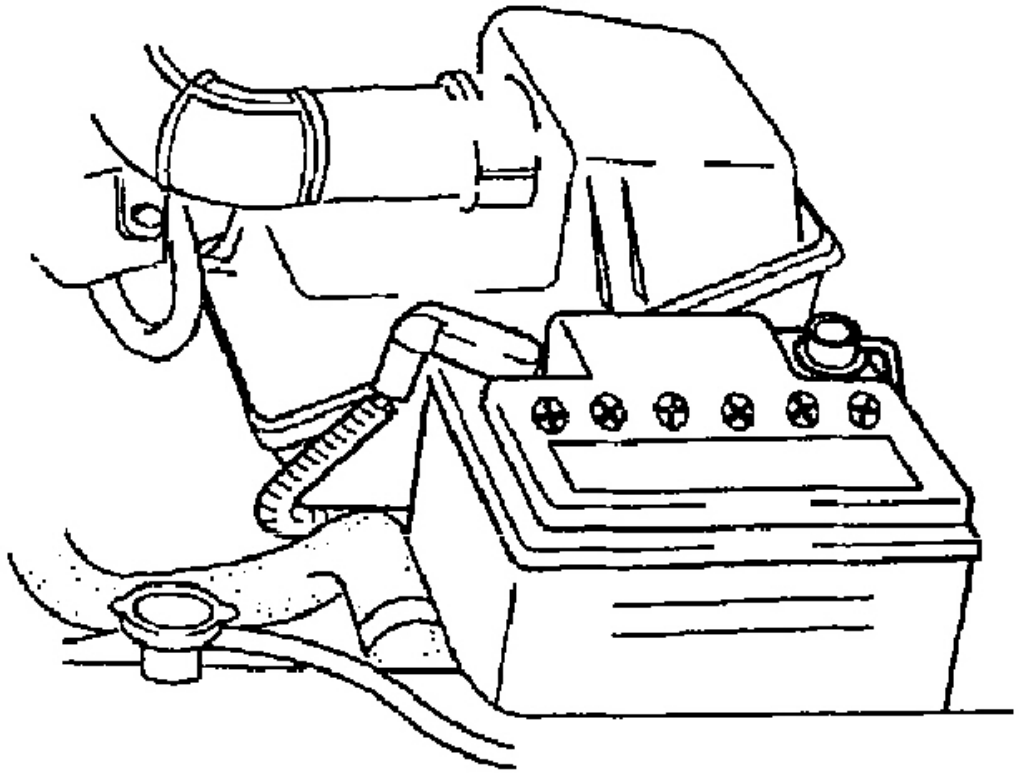


Fig. 328: Connecting Negative Battery Cable
Courtesy of KIA MOTORS AMERICA, INC.

INTAKE AND EXHAUST SYSTEM

TROUBLESHOOTING GUIDE

EXHAUST SYSTEM

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Problem	Possible cause	Action
Exhaust noise	Hole in front exhaust pipe	Replace
	Hole in three-way catalytic (TWC)	Replace
	Hole in muffler	Replace
	Leaking gasket(s)	Replace
Engine sluggish and will not pass smog test even after a tune up	Three-way catalytic (TWC) converter	Replace
Exhaust system rattle	Broken support(s)	Replace

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Fig. 329: Exhaust System Troubleshooting Guide
Courtesy of KIA MOTORS AMERICA, INC.

GENERAL DESCRIPTION

EXHAUST SYSTEM

The principal parts that comprise the engine exhaust system are warm-up catalytic converter, the front exhaust pipe, the catalytic converter, the pre-silencer and the main silencer. Each component is joined with a gasket to prevent exhaust leaks. The system is secured to the frame with five rubber supports. They provide support and isolation. The engine exhaust gases consist mainly of nitrogen (N2). However, they also contain carbon monoxide (CO), carbon dioxide (CO2), water vapor (H2O), oxygen (O2), nitrogen oxides (NOx) and hydrogen (H2) as well as various other unburned hydrocarbons (HC). Three of these exhaust gases, CO, NOx and HC are major air pollutants. Their emissions must be controlled. The warm-up catalytic converter is positioned as far upstream in the exhaust flow as possible to take advantage of the high exhaust temperatures in the manifold. The operating temperature of the warm-up catalytic converter increases very rapidly after initial cold start to decrease the amount of emissions emitted during cold engine operation. The three-way catalytic converter is mounted, in-line, between the header pipe and the pre-silencer. It reacts with exhaust gases to convert them to less harmful products and therefore reduce the pollutant levels to within legally prescribed limits. The catalytic metals are thin-coated onto and supported by a honeycomb-shaped, high temperature ceramic. The honeycomb is mounted inside the converter shell which is surrounded by a heat shield. This design produces little restriction to the flow of exhaust gases and has proven to be durable.

CAUTION: Do not touch the catalytic converter heat shield when the engine is running. The conversion process produces high heat. Even when the engine is not running, it remains hot a long time. It will remain hot after other pipes have cooled. Touching the heat shield may produce a serious burn.

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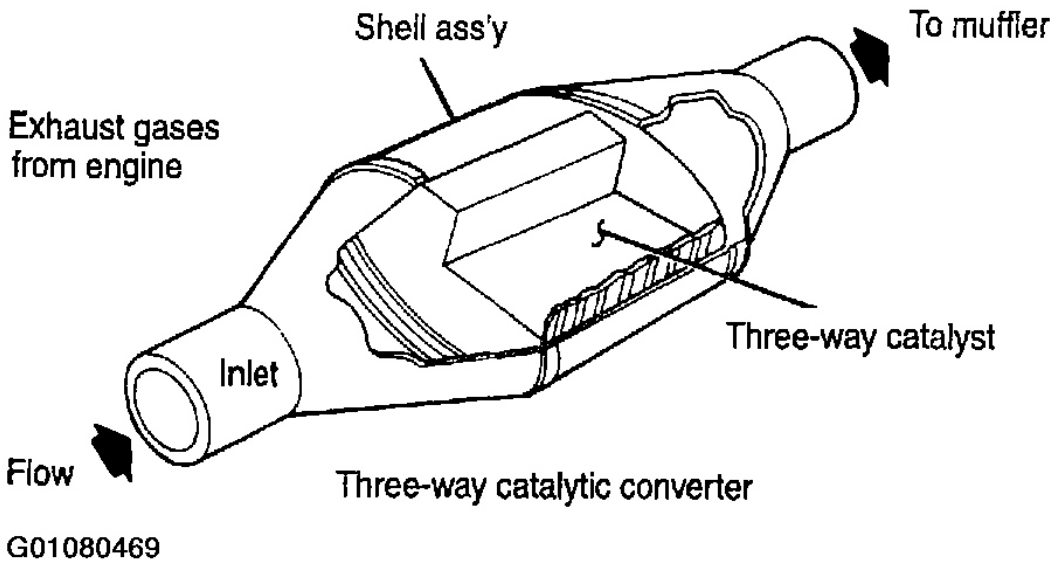


Fig. 330: Illustrating Exhaust System (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

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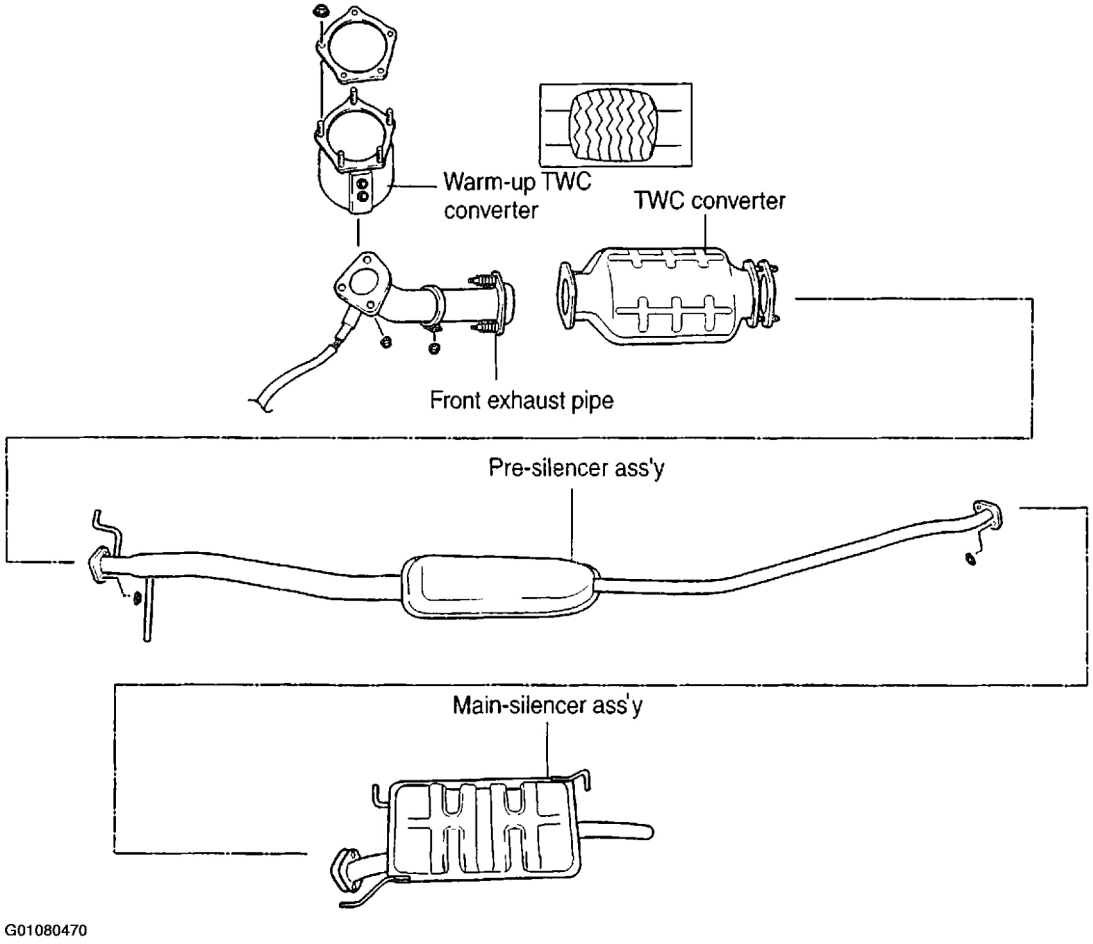


Fig. 331: Illustrating Exhaust System (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

EXHAUST SYSTEM INSPECTION

WARNING: Leaking exhaust systems are potentially hazardous to a vehicle's passengers because carbon monoxide is poisonous.

CAUTION: Do not touch the catalytic converter heat shield when the engine is running. The conversion process produces high heat. Even when the engine is not running, it remains hot a long time. It will remain hot after other pipes have cooled. Touching the heat shield may produce a serious burn. A hot exhaust system can produce a serious burn.

1. Raise vehicle with engine running.
2. Inspect front exhaust pipe for leaks.
3. Inspect catalytic converter for leaks. Since catalytic converter is covered by heat shield, visual inspection

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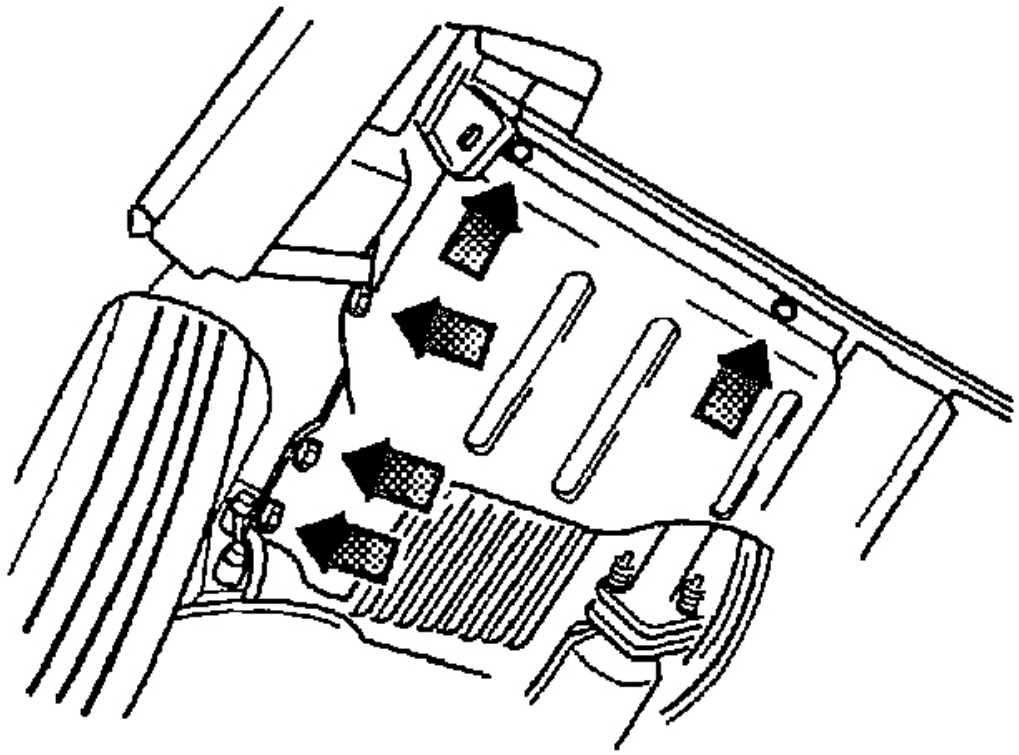
will not be effective. Listening for leaks will be more productive.

4. Inspect pre-silencer for leaks. Pipe joining catalytic converter and pre-silencer also has a heat shield. Listening for leaks is the best method.
5. Inspect main-silencer for leaks.
6. Turn engine off and let exhaust system cool.

WARM-UP THREE-WAY CATALYTIC (TWC) CONVERTER

REMOVAL

1. Remove one nut and one bolt attaching fresh air duct.
2. Remove five bolts attaching heat shield and remove.
3. Remove five nuts that attach warm-up TWC converter to exhaust manifold.
4. Raise vehicle.
5. Remove seven bolts attaching splash shield.



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Fig. 332: Removing Splash Shield
Courtesy of KIA MOTORS AMERICA, INC.

6. Remove three nuts that attach warm-up TWC converter to front exhaust pipe.

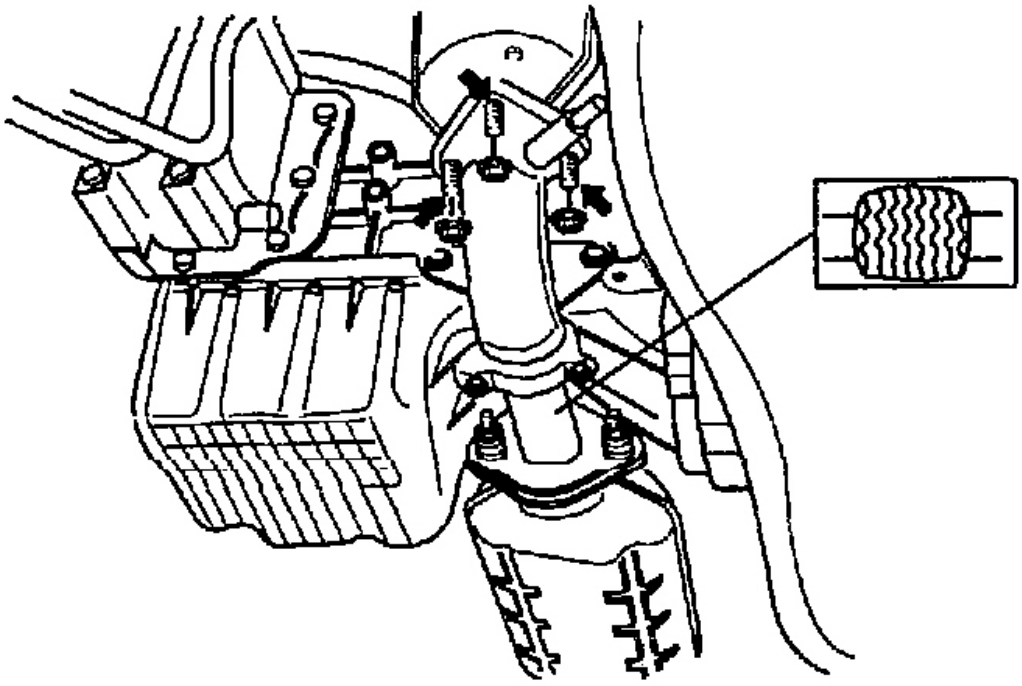


Fig. 333: Removing Front Exhaust Pipe Nuts
Courtesy of KIA MOTORS AMERICA, INC.

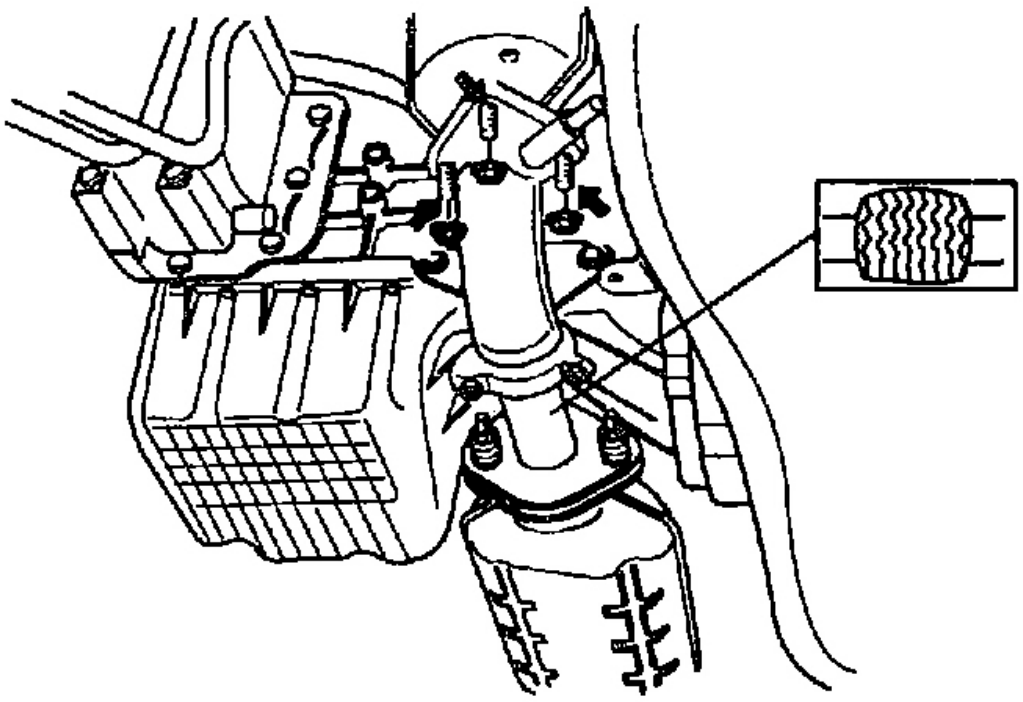
7. Remove warm-up TWC converter.
8. Remove two gaskets.

INSTALLATION

1. Clean mating surfaces as required.
2. Install new gaskets.
3. Raise vehicle.
4. Position warm-up TWC converter for installation.
5. Tighten three nuts that attach warm-up TWC converter to front exhaust pipe

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Tightening torque: 27.4~38.3 lb.ft (37.2~51.9 N.m, 3.8~5.3 kg.m)



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Fig. 334: Installing Front Exhaust Pipe Nuts
Courtesy of KIA MOTORS AMERICA, INC.

6. Install splash shield.

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

7. Lower vehicle.
8. Tighten five nuts that attach warm-up TWC converter to exhaust manifold.

   Tightening torque: 27.4~38.3 lb.ft (37.2~51.9 N.m, 3.8~5.3 kg.m)

9. Install heat shield.

   Tightening torque: 69~95 lb.in (7.8~10.8 N.m, 80~110 kg.cm)

10. Tighten one bolt and one nut at fresh air duct.

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FRONT EXHAUST PIPE

CAUTION: A hot exhaust system can produce a serious burn.

REMOVAL

1. Remove three nuts that attach front exhaust pipe to warm-up TWC converter.
2. Remove two nuts at spring-loaded flange of front exhaust pipe.
3. Remove two nuts from bracket at bottom of front exhaust pipe.
4. Remove front exhaust pipe.
5. Remove one gasket.

INSTALLATION

1. Clean mating surfaces as required.
2. Install new gasket.
3. Position front exhaust pipe for installation.
4. Install two nuts to attach bottom end of front exhaust pipe to bracket.

   Tightening torque: 15.2-20.3 lb.ft (20.6-27.5 N.m, 2.1-2.8 kg.m)

5. Install two nuts at spring-loaded flange of front exhaust pipe.

   Tightening torque: 27.4~38.3 lb.ft (37.2~51.9 N.m, 3.8~5.3 kg.m)

6. Install three nuts that attach front exhaust pipe to warm-up TWC converter.

   Tightening torque: 27.4~38.3 lb.ft (37.2~51.9 N.m, 3.8~5.3 kg.m)

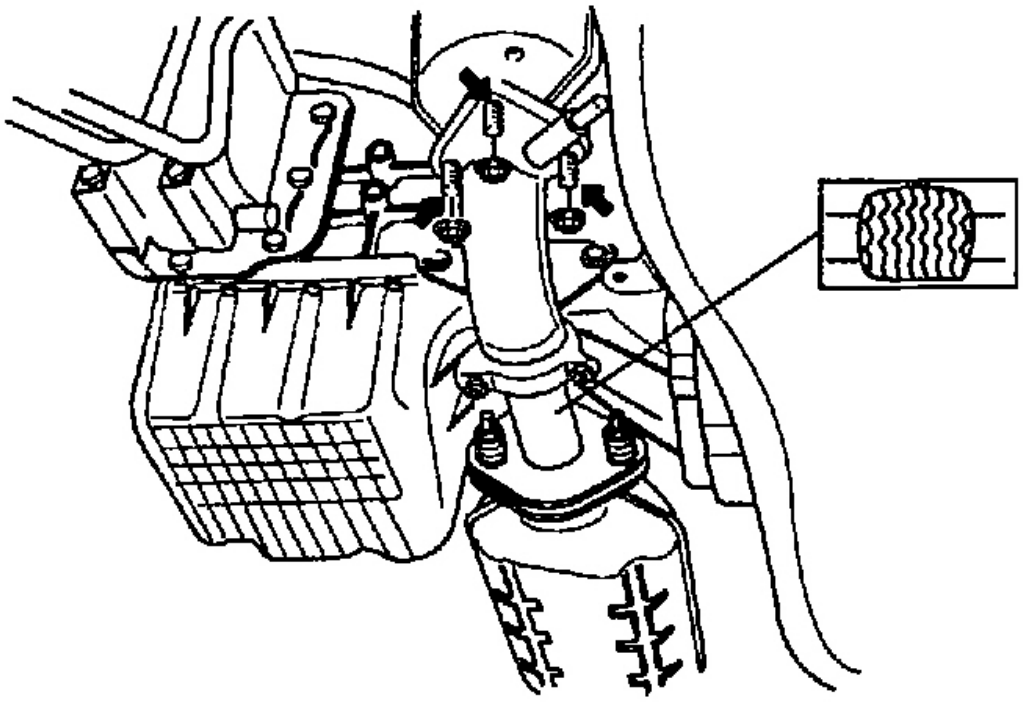
THREE-WAY CATALYTIC (TWC) CONVERTER

CAUTION: Do not touch the TWC converter heat shield when the engine is running. The conversion process produces high heat. Even when the engine is not running, it remains hot a long time. It will remain hot after the tail pipe has cooled. Touching the heat shield may produce a serious burn.

REMOVAL

1. Remove two nuts at spring-loaded flange of front exhaust pipe.

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Fig. 335: Removing Front Flange Nuts
Courtesy of KIA MOTORS AMERICA, INC.

2. Remove two nuts from forward pre-silencer flange.
3. Remove one gasket.

INSTALLATION

1. Clean mating surfaces as required.
2. Install one new gasket.
3. Position TWC converter for installation.
4. Tighten two nuts at the forward pre-silencer flange.

   Tightening torque: 27.4~38.3 lb.ft (37.2~51.9 N.m, 3.8~5.3 kg.m)

5. Tighten two nuts at spring-loaded flange of front exhaust pipe.

   Tightening torque: 27.4~38.3 lb.ft (37.2~51.9 N.m, 3.8~5.3 kg.m)

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PRE-SILENCER

CAUTION: A hot exhaust system can produce a serious burn.

REMOVAL

1. Remove two nuts at forward flange of pre-silencer.
2. Remove two supports from pre-silencer.
3. Remove two nuts at main-silencer flange.

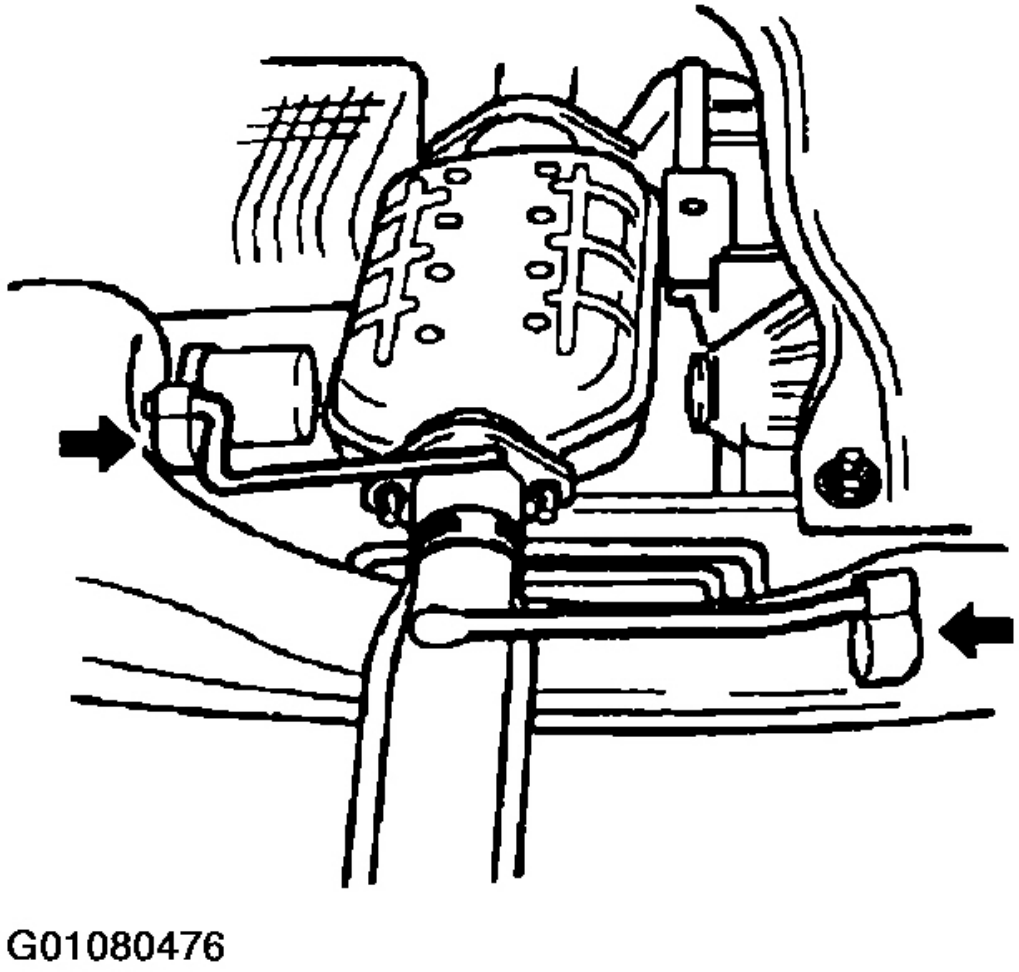


Fig. 336: Removing Silencer Flange Nuts
Courtesy of KIA MOTORS AMERICA, INC.

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4. Remove two gaskets.

INSTALLATION

1. Lubricate inside of two pre-silencer hangers with a silicone lubricant.
2. Clean mating surfaces as required.
3. Install two new gaskets on bolts.
4. Install two nuts at main-silencer flange.

   Tightening torque: 27.4~38.3 lb.ft (37.2~51.9 N.m, 3.8~5.3 kg.m)

5. Install pre-silencer in two hangers.
6. Install two nuts at forward flange of the pre silencer.

   Tightening torque: 27.4~38.3 lb.ft (37.2~51.9 N.m, 3.8~5.3 kg.m)

MAIN SILENCER

CAUTION: A hot exhaust system can produce a serious burn.

REMOVAL

1. Remove two nuts at main-silencer flange.
2. Remove three supports from main-silencer.

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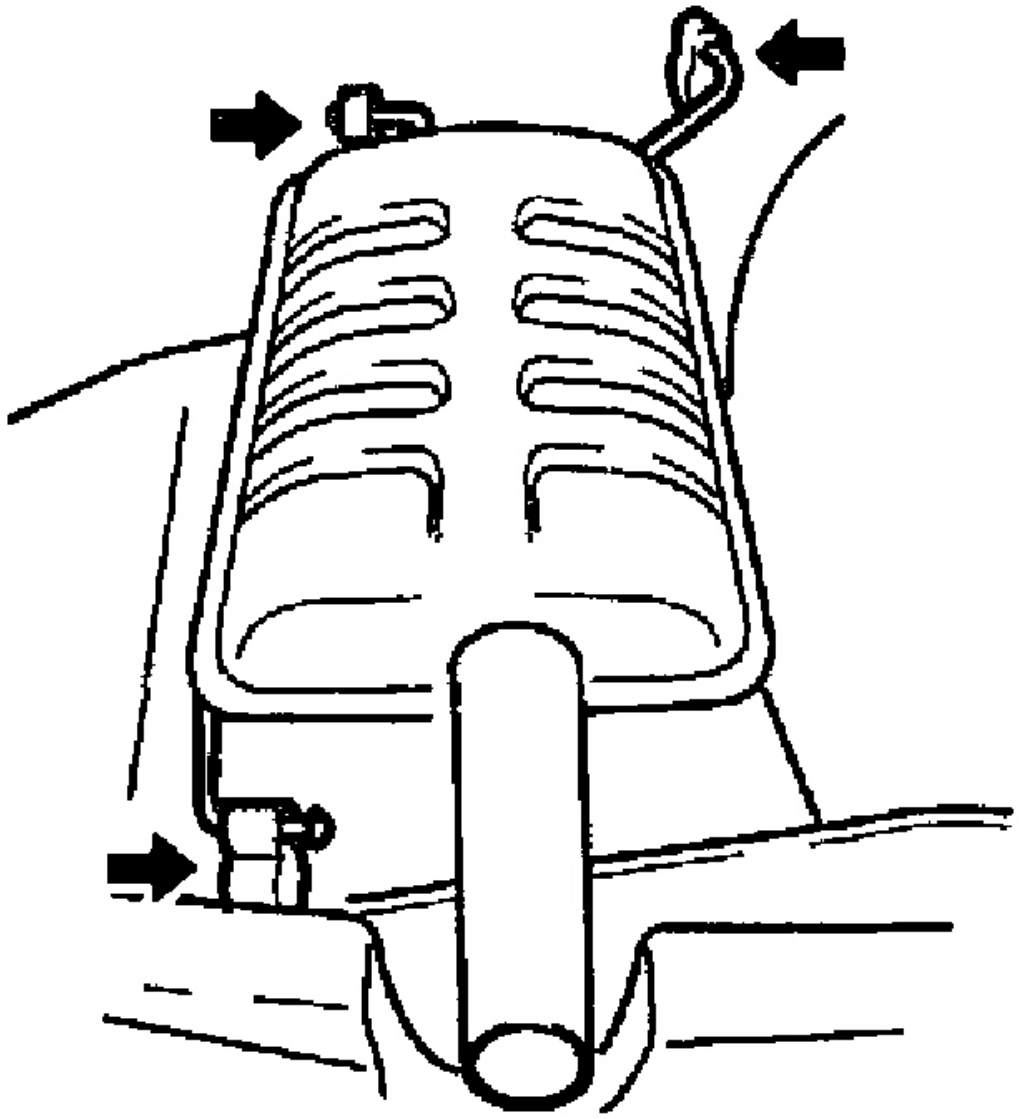


Fig. 337: Removing Main-Silencer Supports
Courtesy of KIA MOTORS AMERICA, INC.

3. Remove one gasket.

INSTALLATION

1. Lubricate inside of three main-silencer hangers with a silicone lubricant.

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2. Clean mating surfaces as required.
3. Install one new gasket on bolts.
4. Install main silencer in three hangers.
5. Install two nuts at main silencer flange.

Tightening torque: 27.4~38.3 lb.ft (37.2~51.9 N.m, 3.8~5.3 kg.m)

AIR CLEANER (ACL)

REMOVAL

1. Disconnect intake air temperature sensor connector.
2. Disconnect mass air flow sensor connector.
3. Loosen clamp on outlet hose of air cleaner housing.

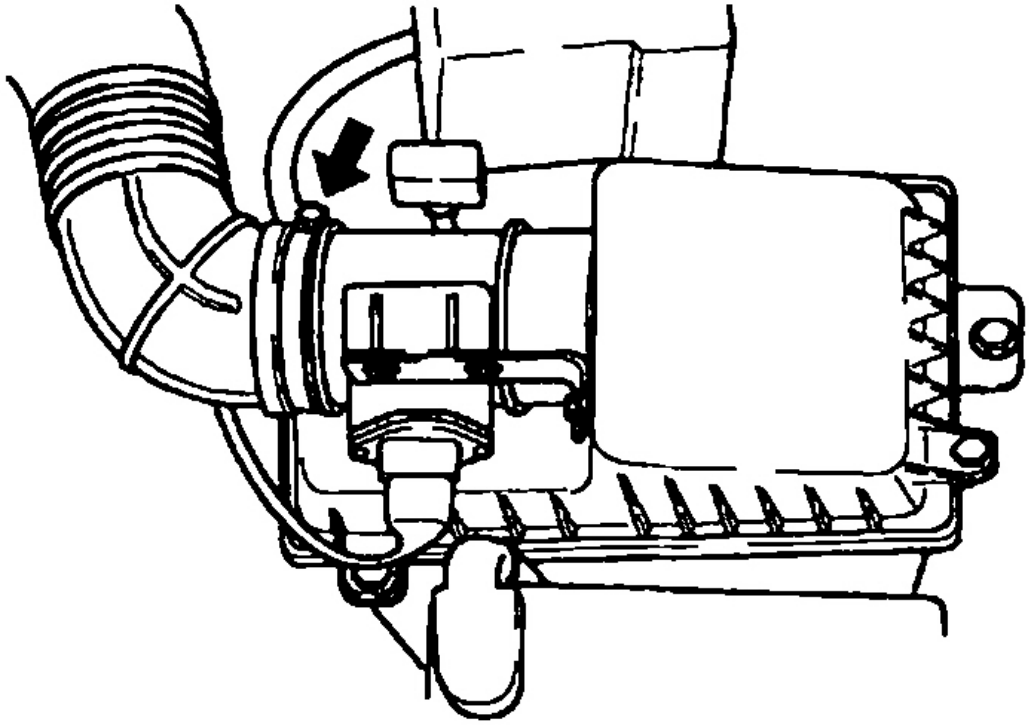


Fig. 338: Loosening Air Cleaner Outlet Hose Clamp
Courtesy of KIA MOTORS AMERICA, INC.

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4. Remove air intake hoses from air cleaner housing.
5. Remove bolts holding the top of air cleaner housing in place.
6. Remove top of air cleaner housing.
7. Remove air cleaner element.
8. Clean air cleaner housing of any dirt or dust.

INSTALLATION

1. Install new air cleaner element.
2. Reinstall top of air cleaner housing and three bolts.
3. Install air intake hoses and tighten clamps.
4. Connect intake air temperature sensor and mass air flow sensor connectors.

TIMING SYSTEM

TIMING BELT

COMPONENT

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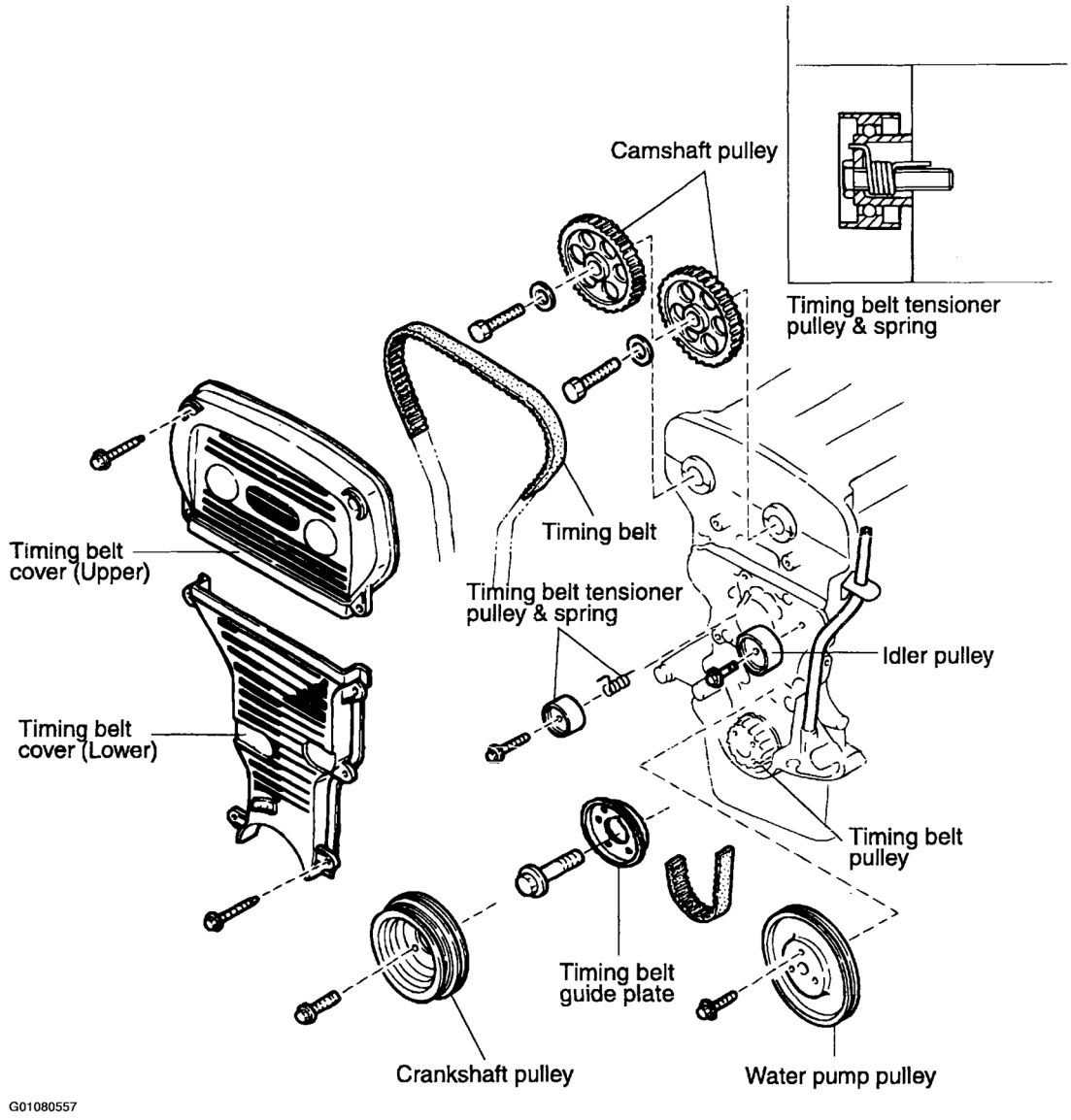
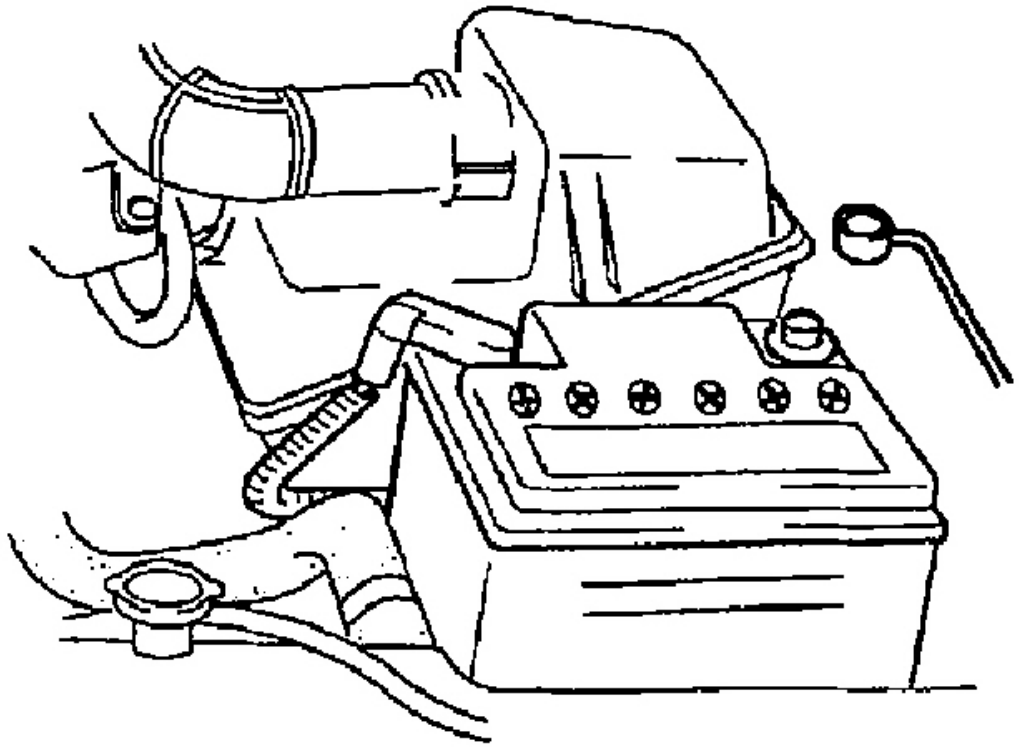


Fig. 339: Identifying Timing Belt Components
Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

1. Disconnect negative battery cable.

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Fig. 340: Disconnecting Negative Battery Cable
Courtesy of KIA MOTORS AMERICA, INC.

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

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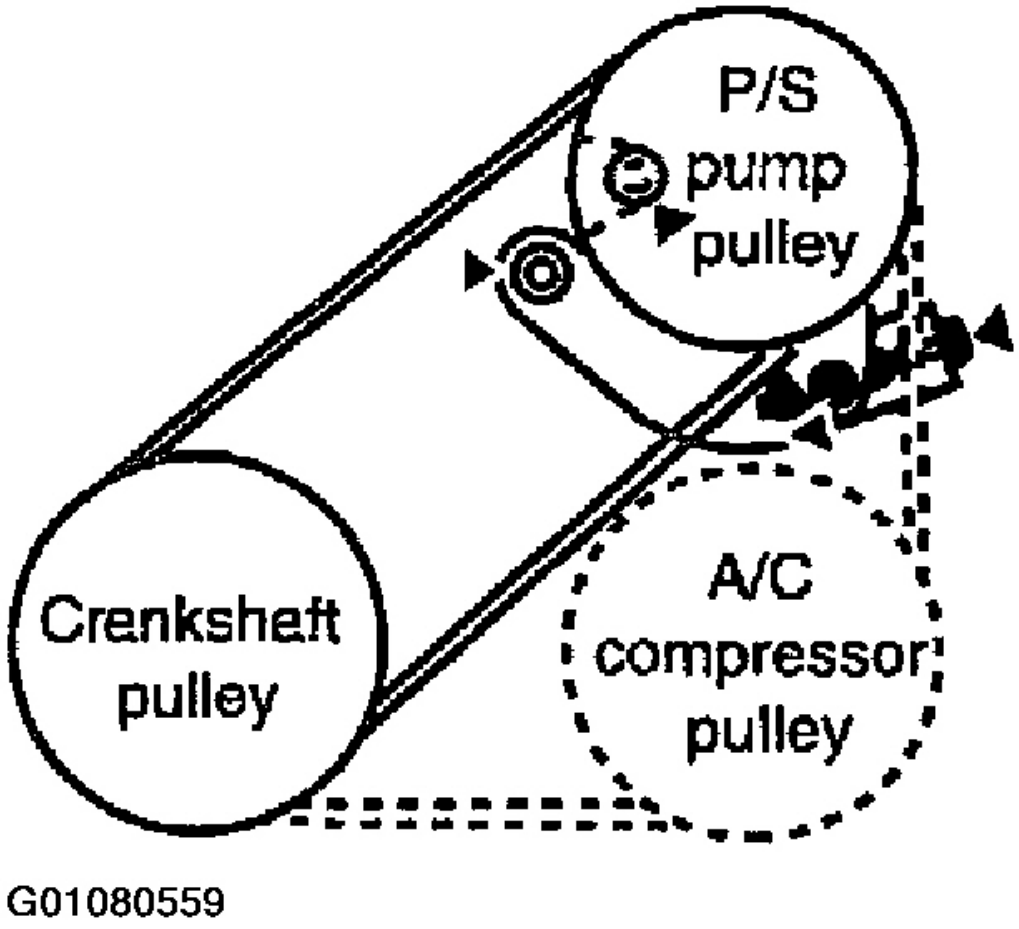
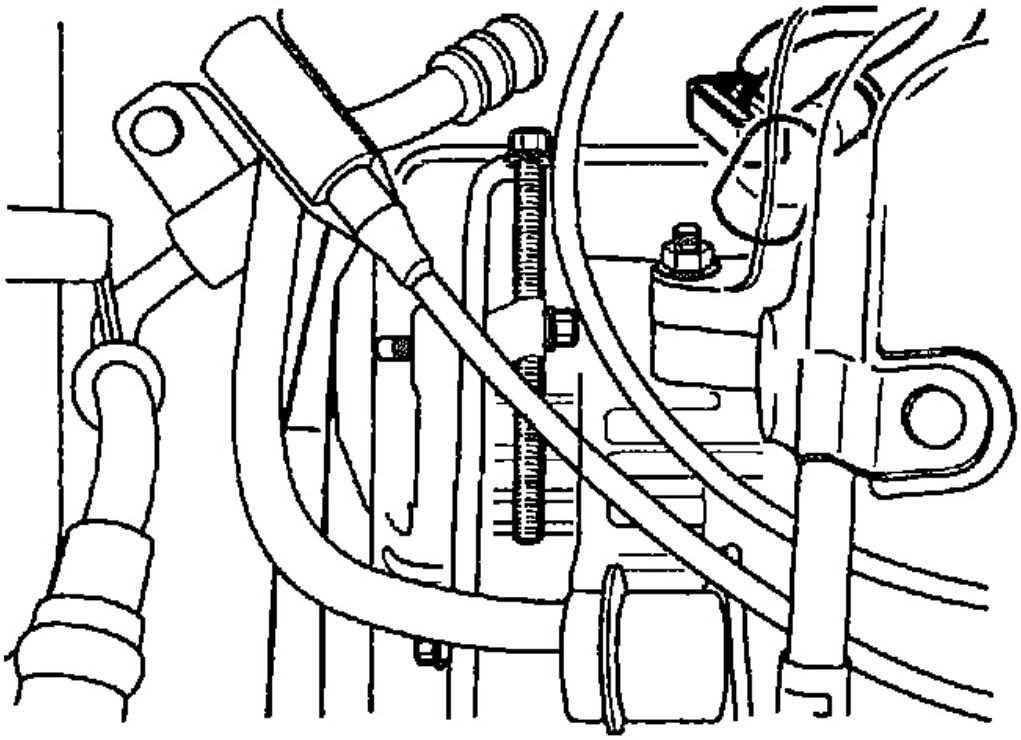


Fig. 341: Removing P/S And/Or A/C Drive Belt
Courtesy of KIA MOTORS AMERICA, INC.

4. Loosen generator mounting bolts and adjusting bolt.
5. Remove generator bolts.

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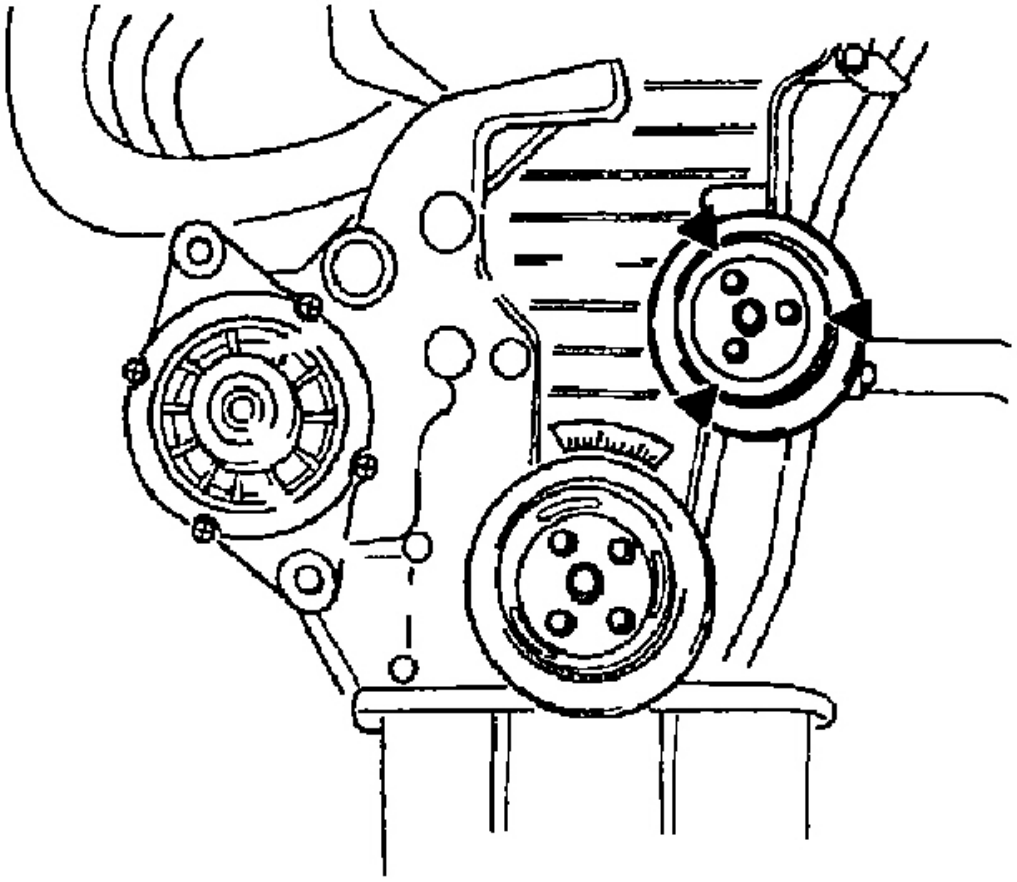


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Fig. 342: Loosening Generator Mounting And Adjusting Bolts
Courtesy of KIA MOTORS AMERICA, INC.

6. Remove water pump pulley.

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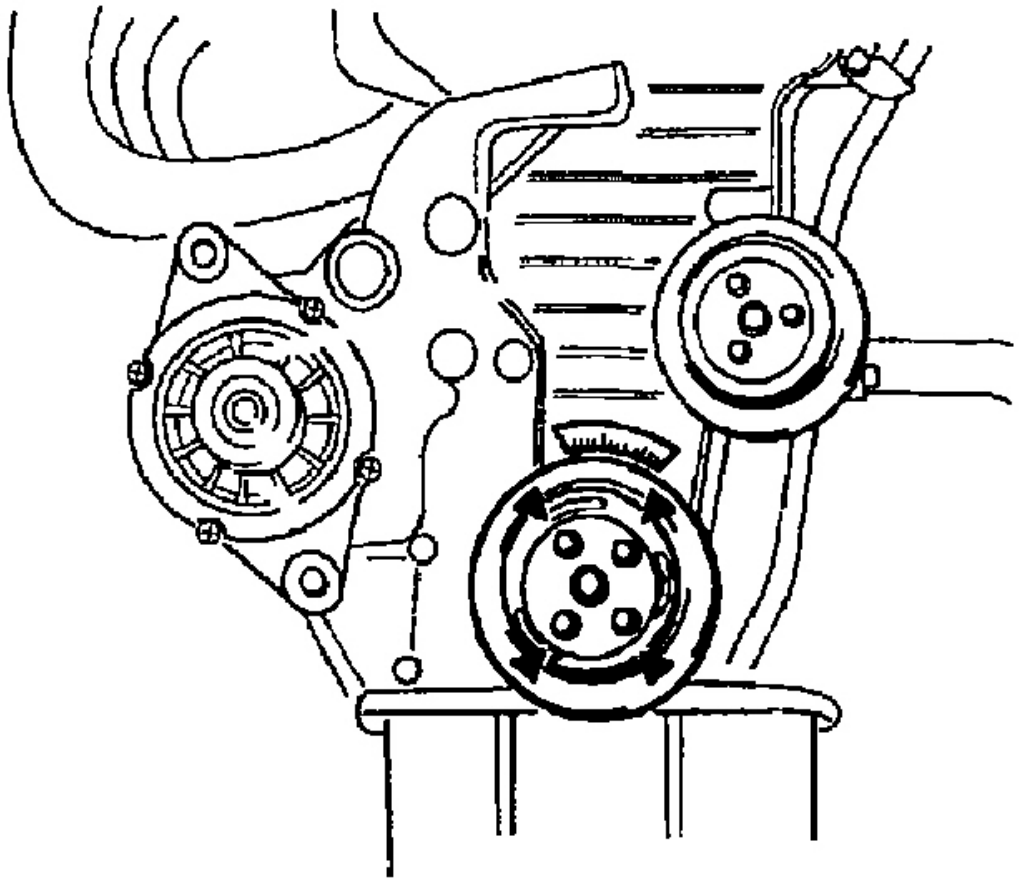


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Fig. 343: Removing Water Pump Pulley
Courtesy of KIA MOTORS AMERICA, INC.

7. Remove crankshaft pulley and timing belt guide plate.

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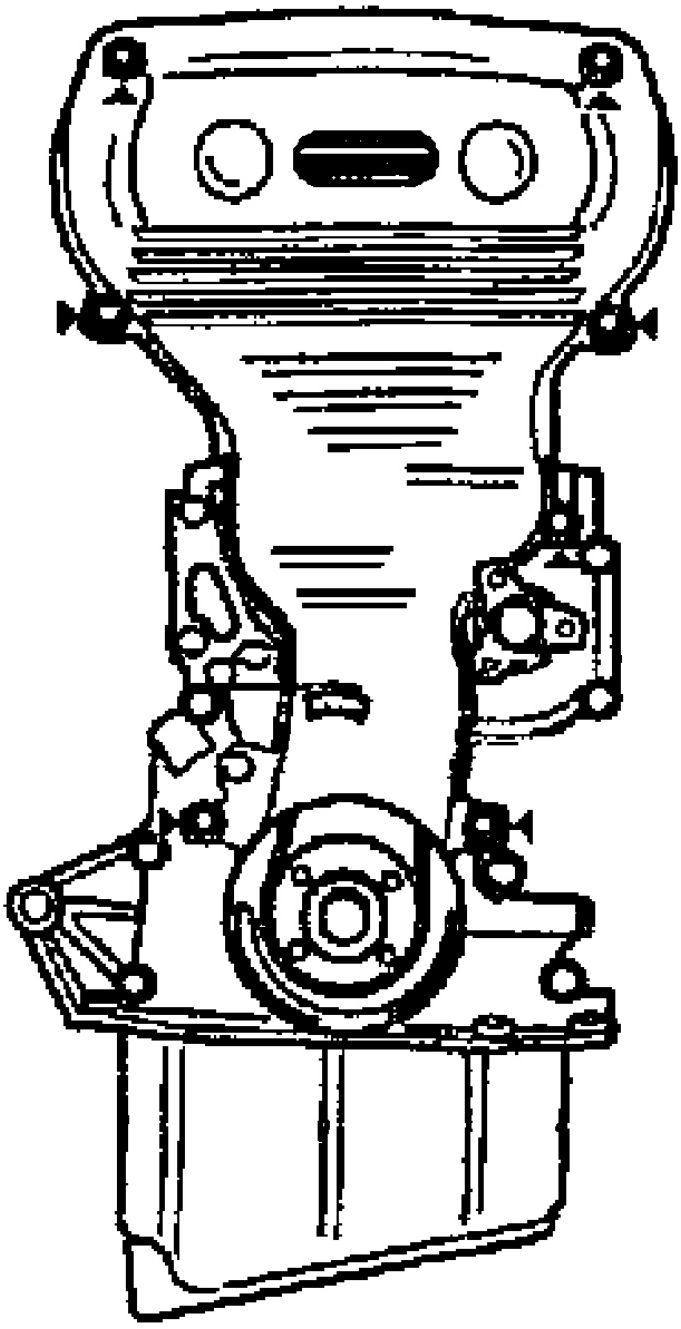


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Fig. 344: Removing Crankshaft Pulley And Timing Belt Guide Plate
Courtesy of KIA MOTORS AMERICA, INC.

8. Remove upper and lower timing belt covers.

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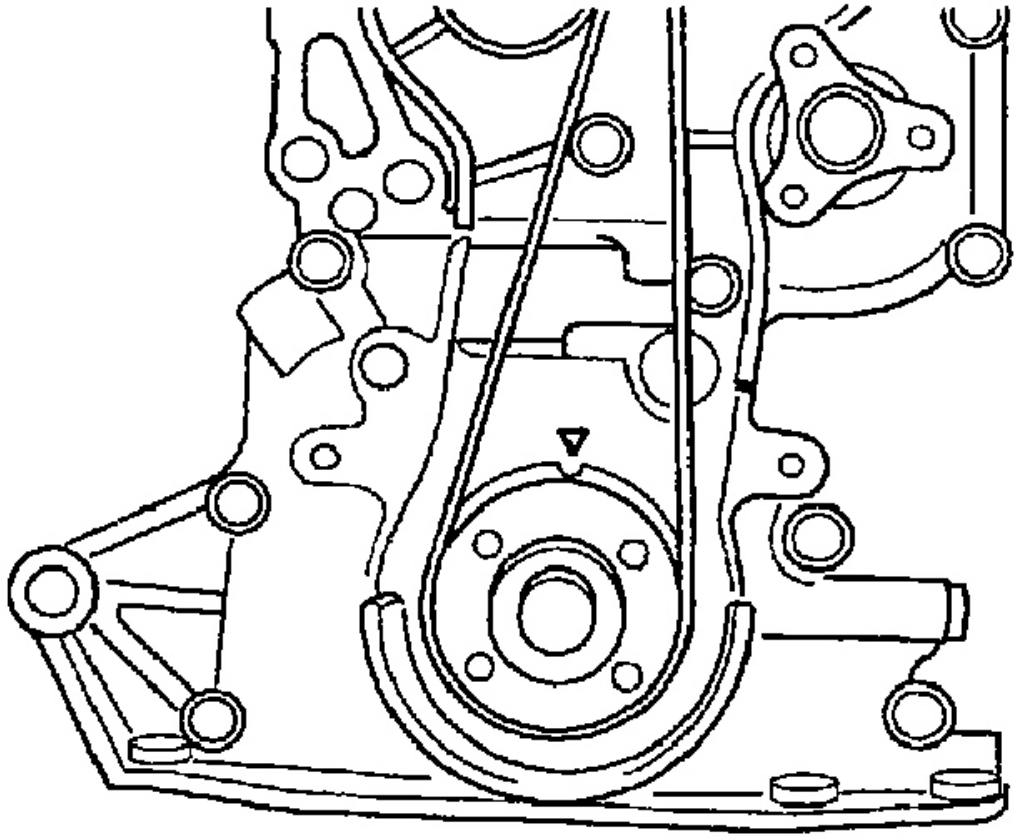


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Fig. 345: Removing Upper And Lower Timing Belt Covers
Courtesy of KIA MOTORS AMERICA, INC.

9. Turn crankshaft so that timing mark on timing belt pulley is aligned with timing mark on engine.

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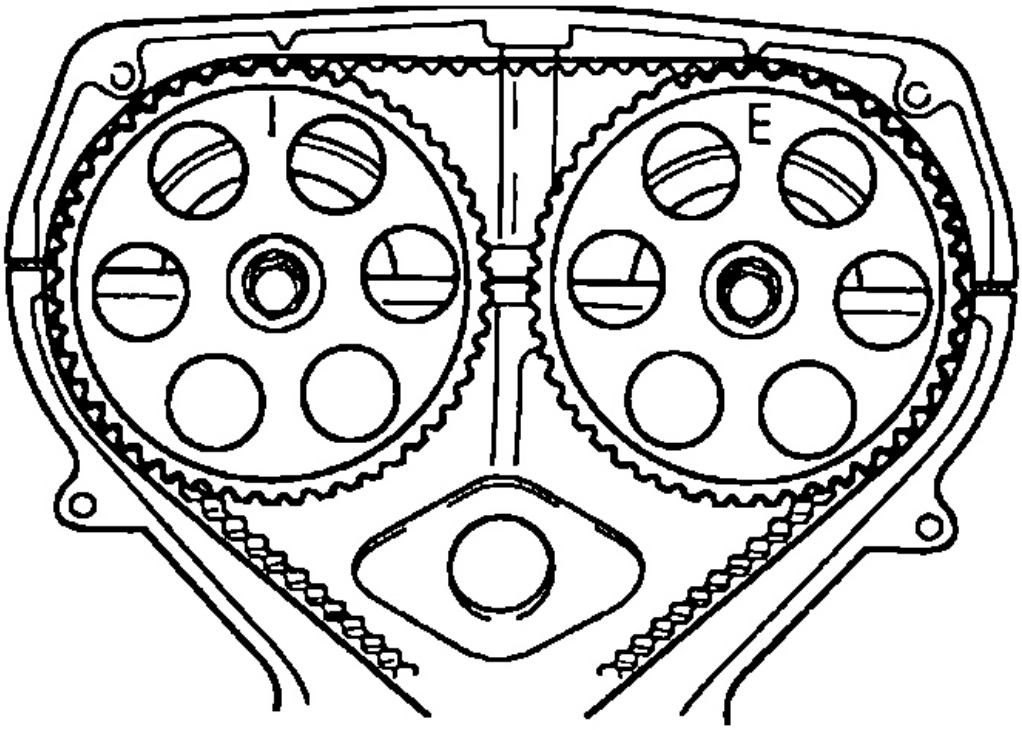
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Fig. 346: Aligning Timing Mark On Crankshaft
Courtesy of KIA MOTORS AMERICA, INC.

10. Check that T mark on intake camshaft pulley is aligned with mark on cylinder head cover and "E" mark on exhaust camshaft pulley is aligned with mark on cylinder head cover.

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

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Fig. 347: Aligning Camshaft Timing Marks
Courtesy of KIA MOTORS AMERICA, INC.

11. Loosen tensioner pulley lock bolt.
12. Protect timing belt with a rag.
13. Remove tensioner pulley.

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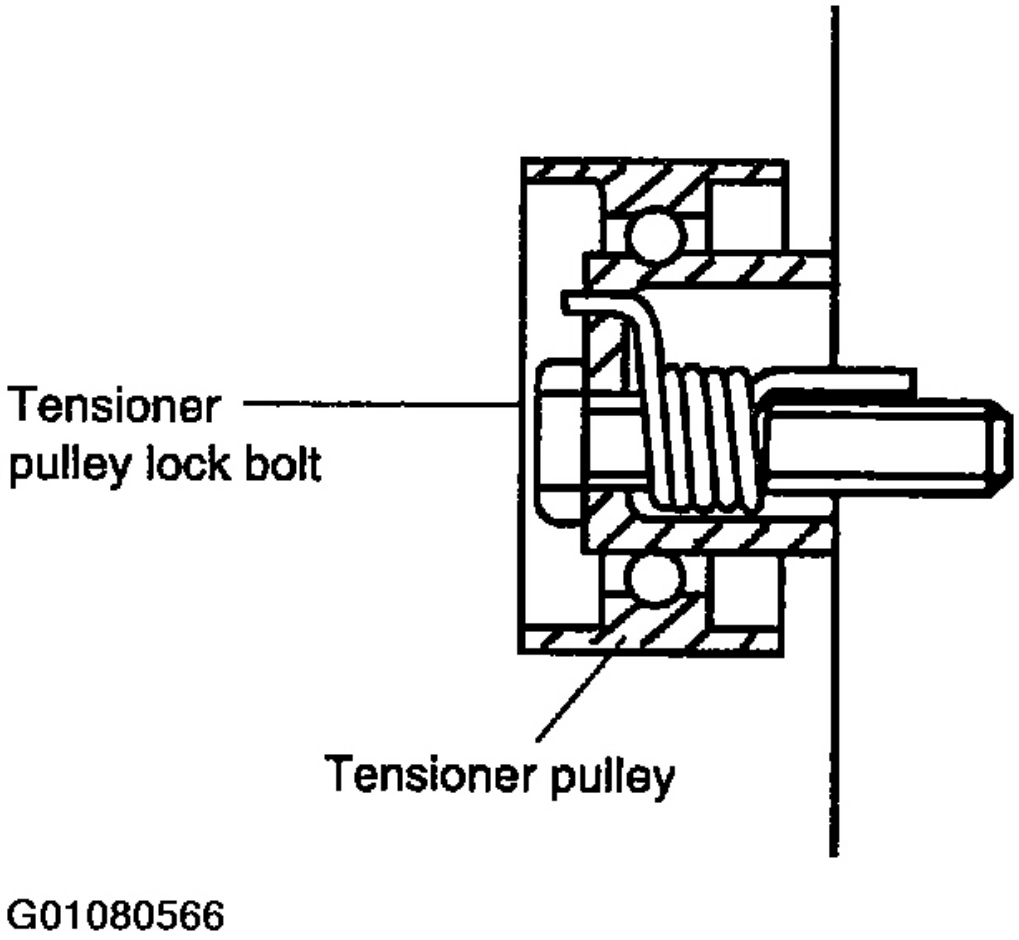


Fig. 348: Identifying Tensioner Pulley Lock Bolt
Courtesy of KIA MOTORS AMERICA, INC.

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.

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2. Check timing belt for uneven wear, fraying, peeling, cracking and hardening. Replace timing belt as necessary.

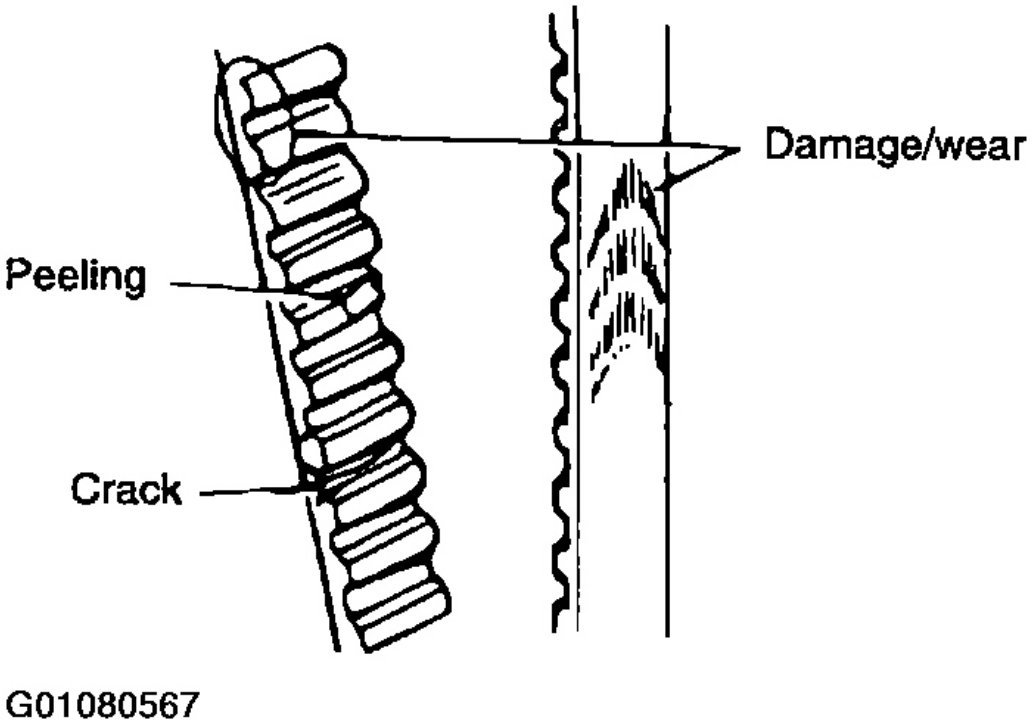


Fig. 349: Inspecting Timing Belt For Wear
Courtesy of KIA MOTORS AMERICA, INC.

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

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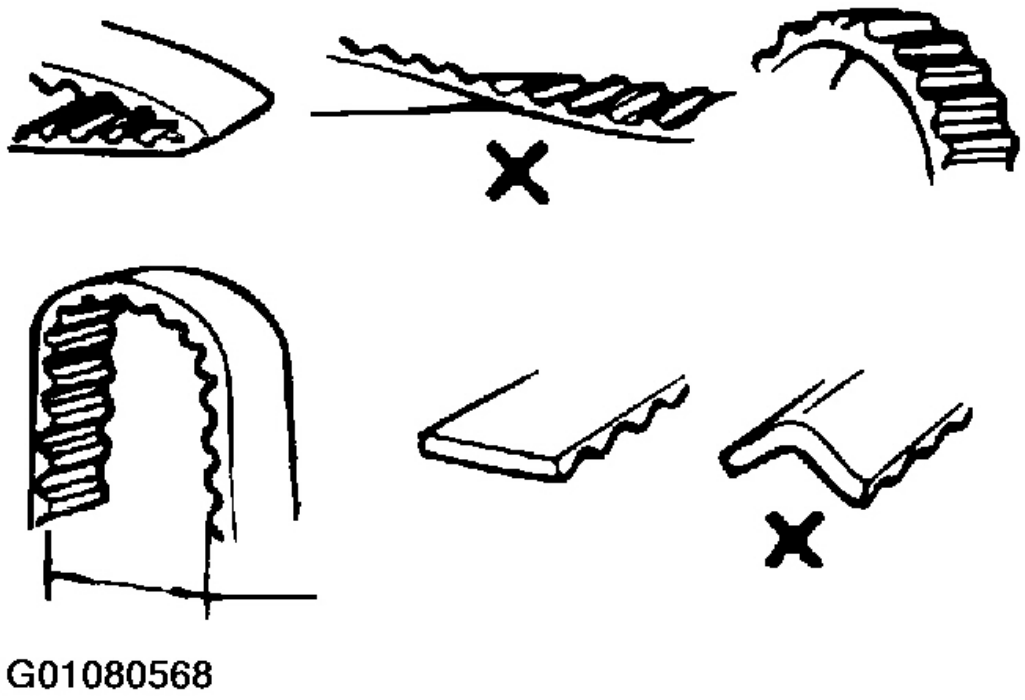
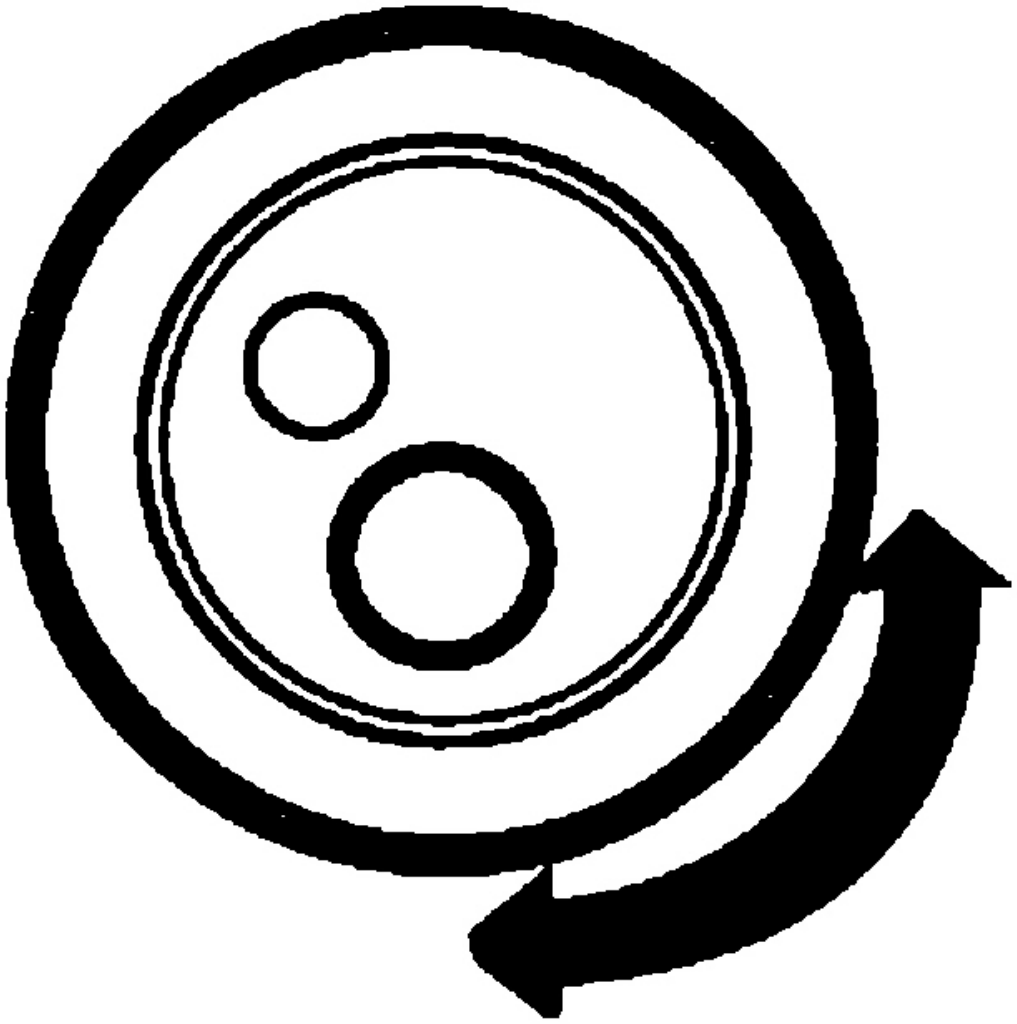


Fig. 350: Inspecting Timing Belt Condition
Courtesy of KIA MOTORS AMERICA, INC.

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

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G01080569

Fig. 351: Inspecting Timing Belt Tensioner Pulley
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Do not clean tensioner pulley or idler pulley with cleaning fluids. If needed, use a soft rag to wipe them clean. Avoid scratching tensioner pulley or idler pulley as it can affect integrity of timing belt.

5. Check the free length of tensioner spring. Replace tensioner spring if necessary.

Free Length 1.402 in (35.6 mm)

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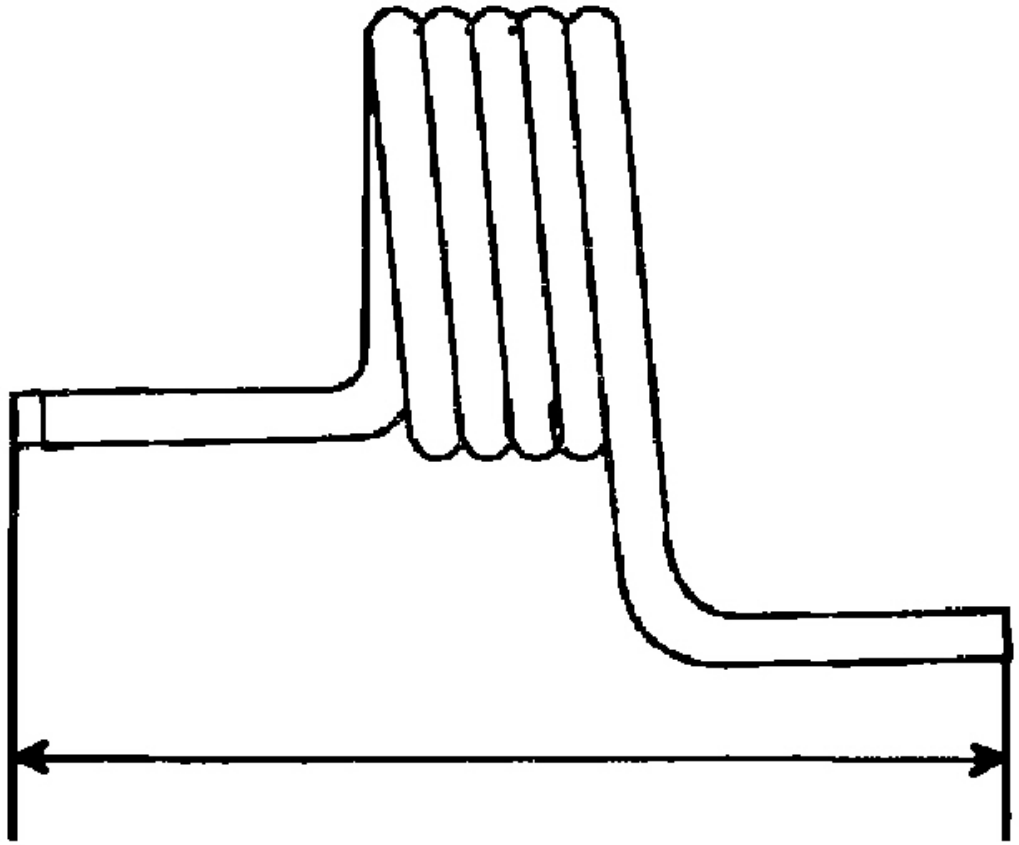


Fig. 352: Measuring Tension Spring Free Length
Courtesy of KIA MOTORS AMERICA, INC.

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

NOTE:

- **Replace any component that shows damage, excessive wear, or that appears prone to a possible failure.**
- **Do not clean pulleys with cleaning fluids. If needed, use a soft cloth to wipe them clean, and avoid scratching the pulleys as it will affect integrity of the timing belt.**

REPLACEMENT

1. Install tensioner pulley.

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NOTE: Replace tensioner spring whenever timing belt is replaced.

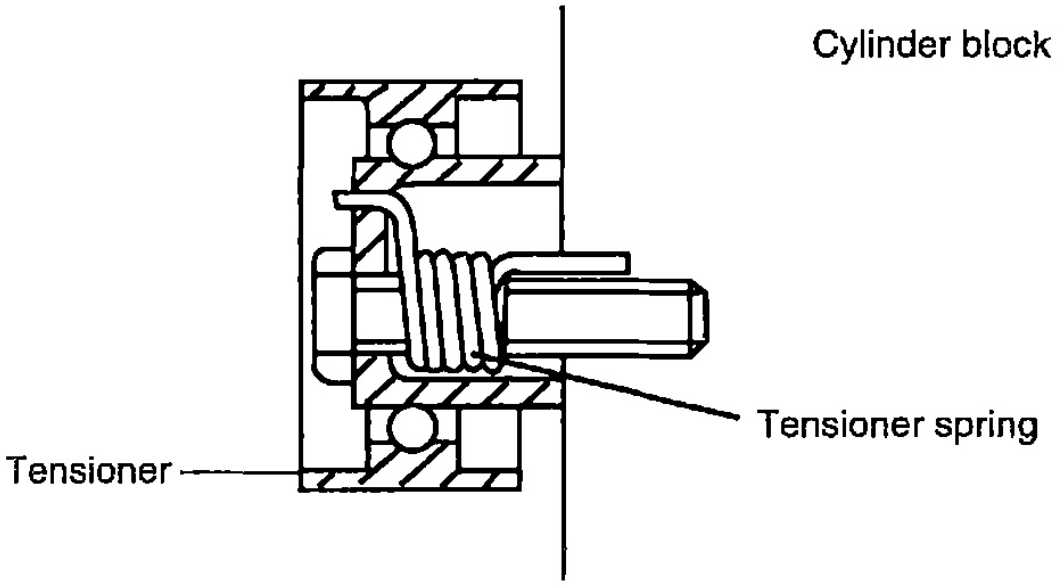
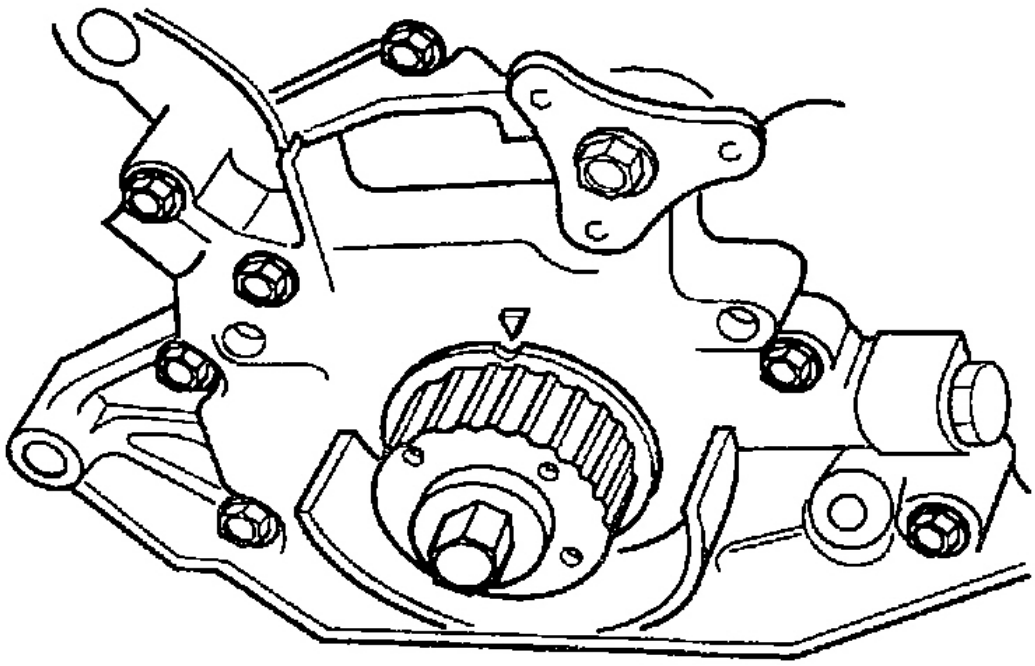


Fig. 353: Installing Tensioner Pulley
Courtesy of KIA MOTORS AMERICA, INC.

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.

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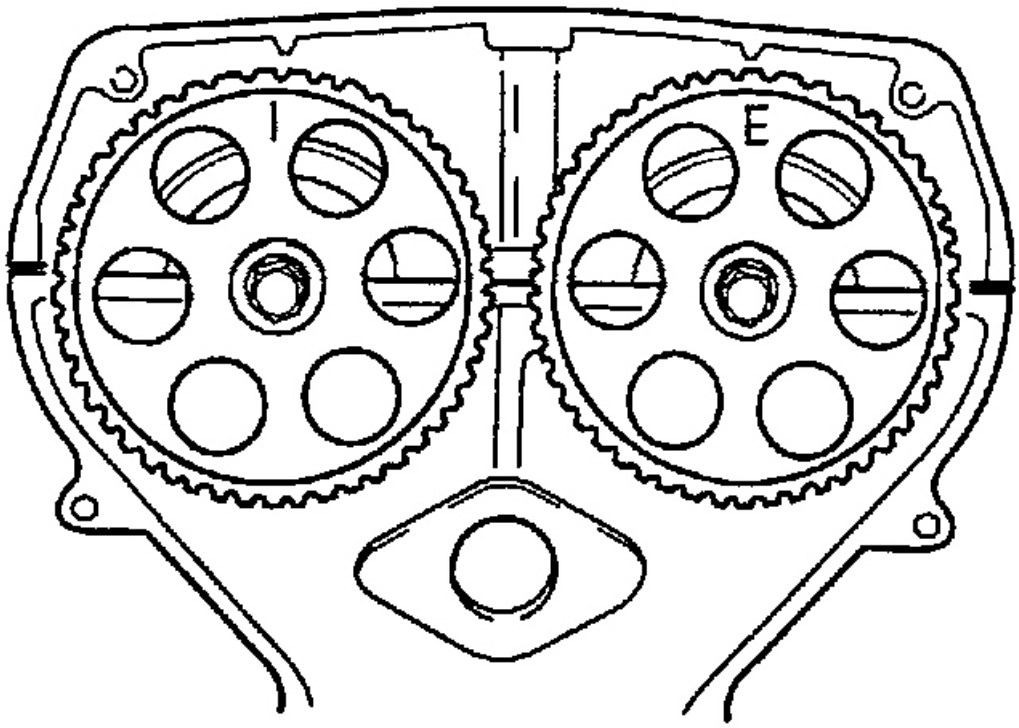


G01080573

Fig. 354: Aligning Crankshaft Timing Mark
Courtesy of KIA MOTORS AMERICA, INC.

4. Check that "I" mark on intake camshaft pulley is aligned with mark on cylinder head cover and "E" mark on exhaust camshaft pulley is aligned with mark on cylinder head cover.

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Fig. 355: Aligning Camshaft Timing Marks
Courtesy of KIA MOTORS AMERICA, INC.

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

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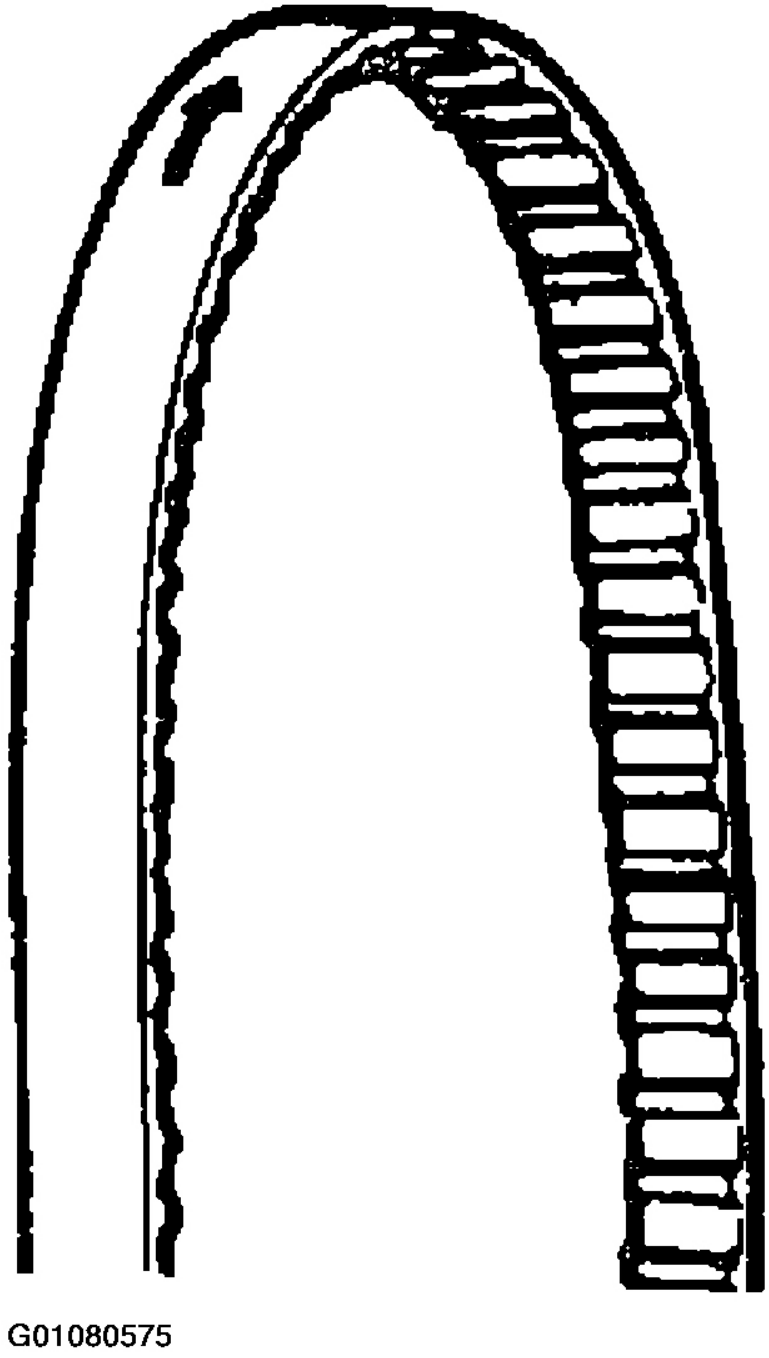
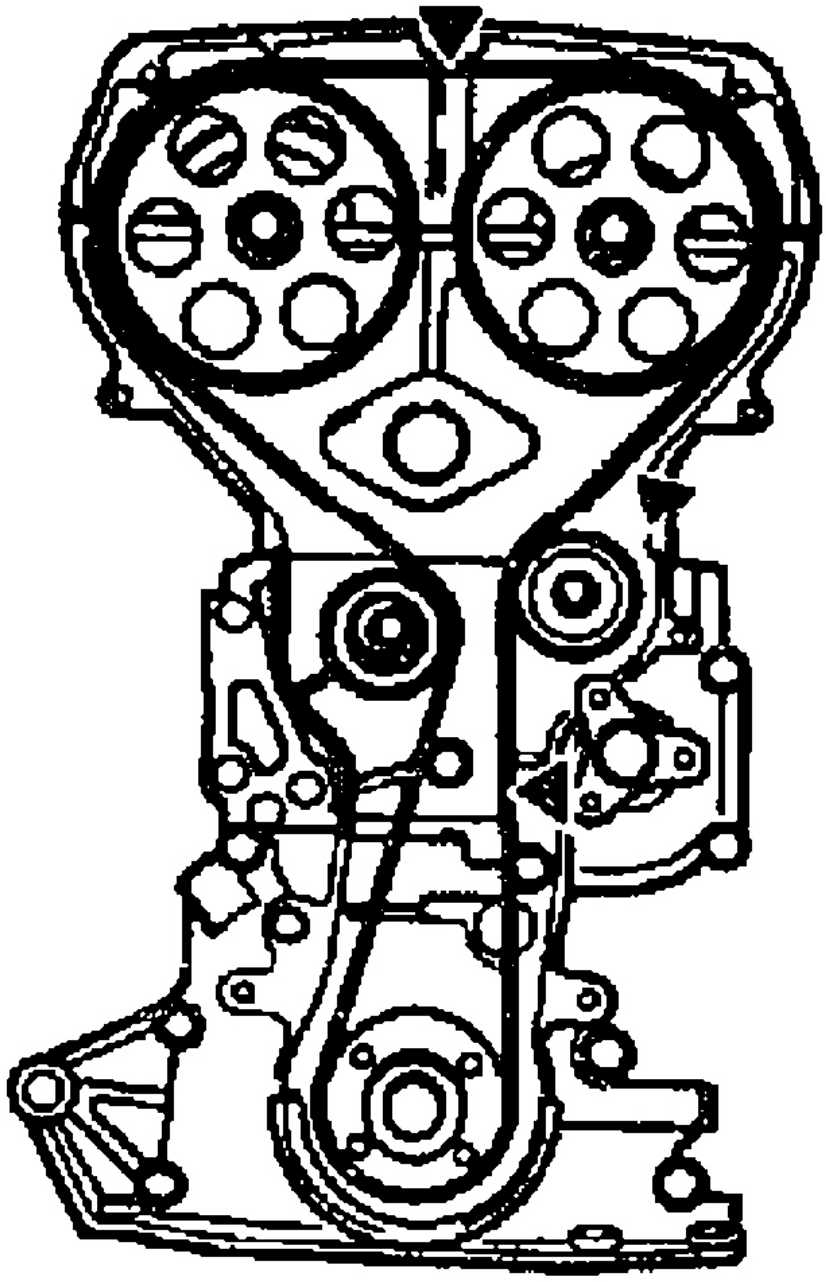


Fig. 356: Identifying Timing Belt Rotation Direction
Courtesy of KIA MOTORS AMERICA, INC.

5. Install timing belt onto timing belt pulley first, then idler pulley, exhaust camshaft pulley, intake camshaft pulley, and tensioner pulley in that order.

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6. Check that there is no looseness in belt between idler pulley and exhaust camshaft pulley or between intake and exhaust camshaft pulleys.



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Fig. 357: Illustrating Proper Timing Belt Position
Courtesy of KIA MOTORS AMERICA, INC.

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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.

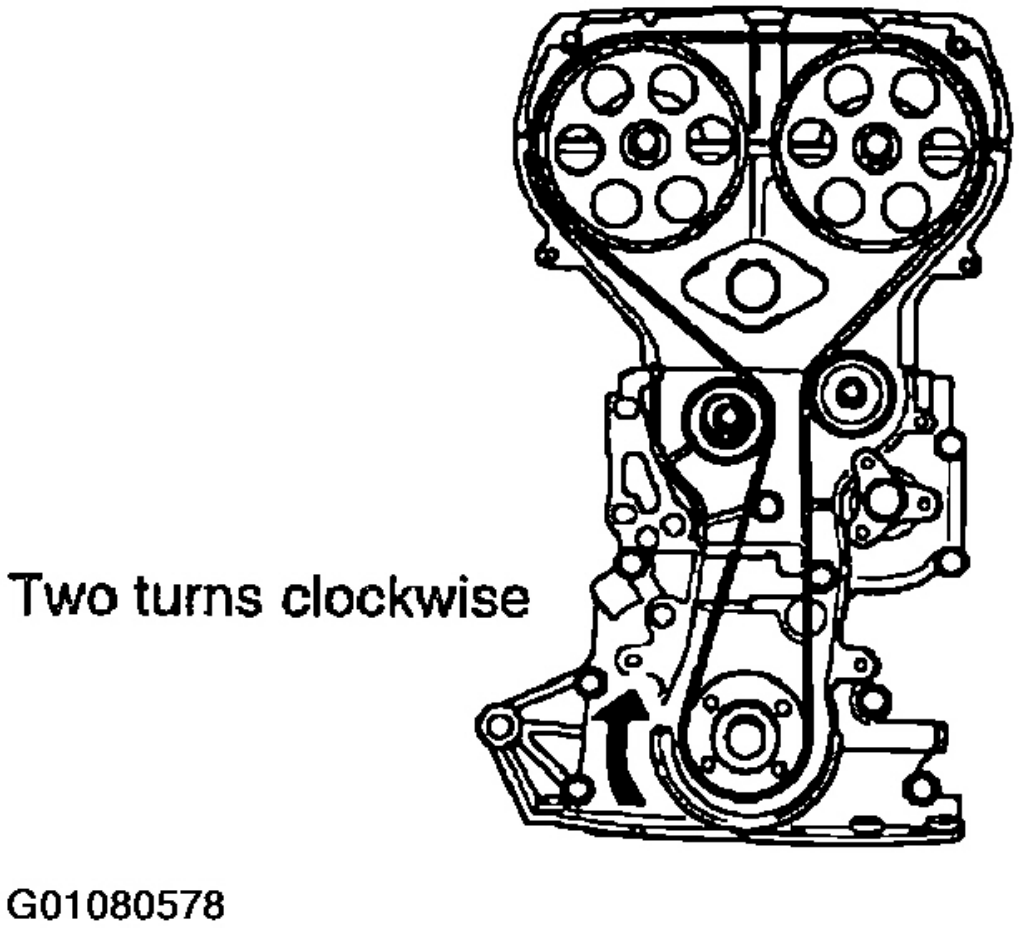
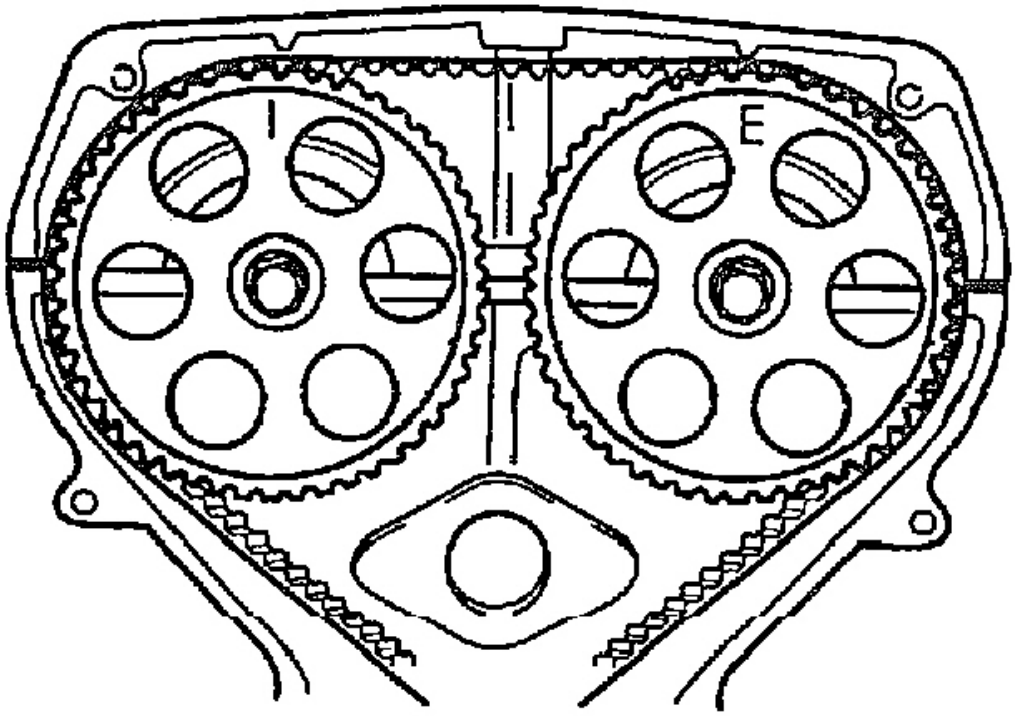


Fig. 358: Identifying Engine Rotation Direction
Courtesy of KIA MOTORS AMERICA, INC.

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10. Check that "I" mark on intake camshaft pulley "E" mark on exhaust camshaft pulley are aligned with marks on cylinder head cover.



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Fig. 359: Aligning Camshaft Timing Marks
Courtesy of KIA MOTORS AMERICA, INC.

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: 0.36~0.45 in. (9.0~11.0 mm)

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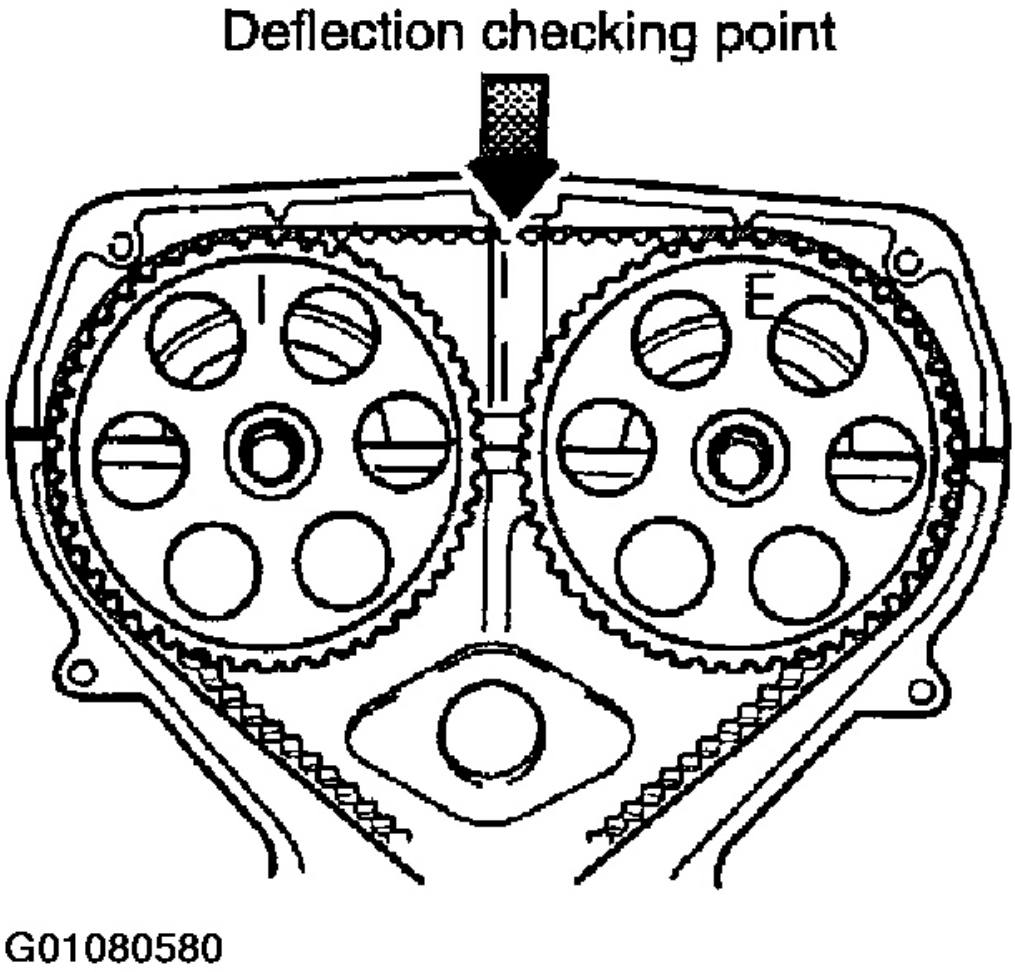
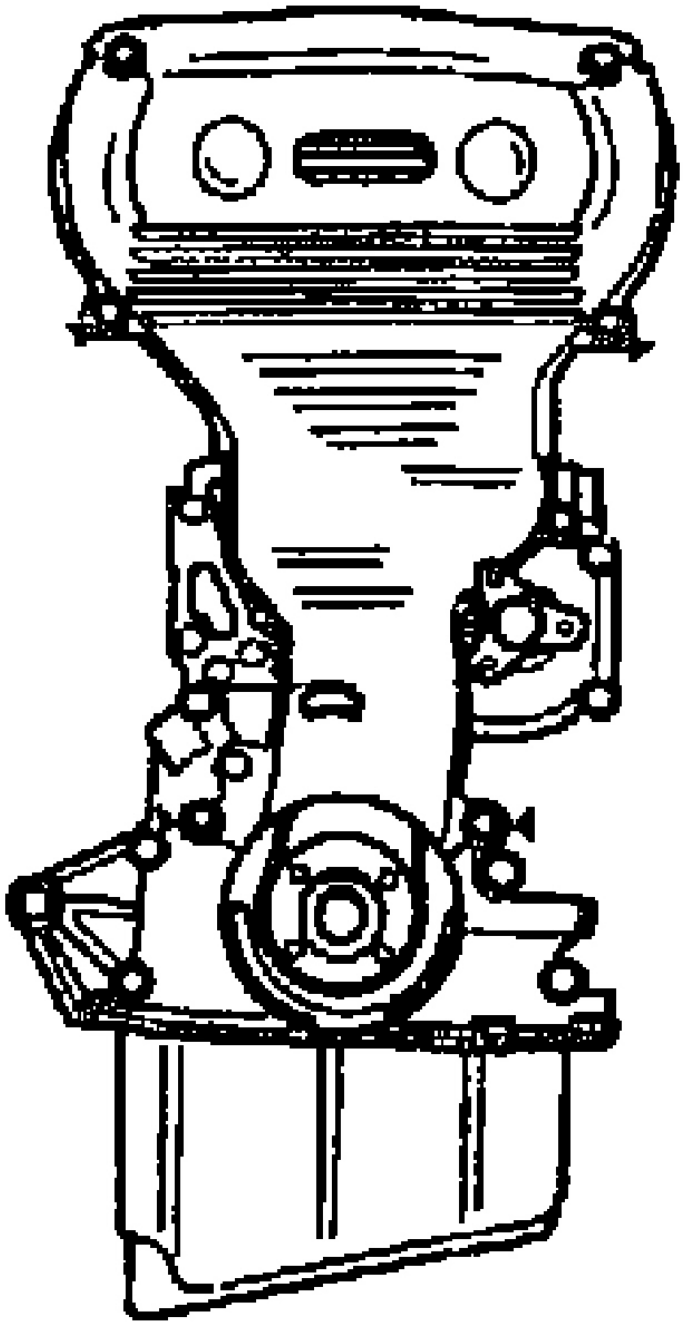


Fig. 360: Measuring Timing Belt Deflection
Courtesy of KIA MOTORS AMERICA, INC.

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

    Tightening torque: 70~96 lb.ft (7.9~10.7 N.m, 0.8~1.1 kg.m)

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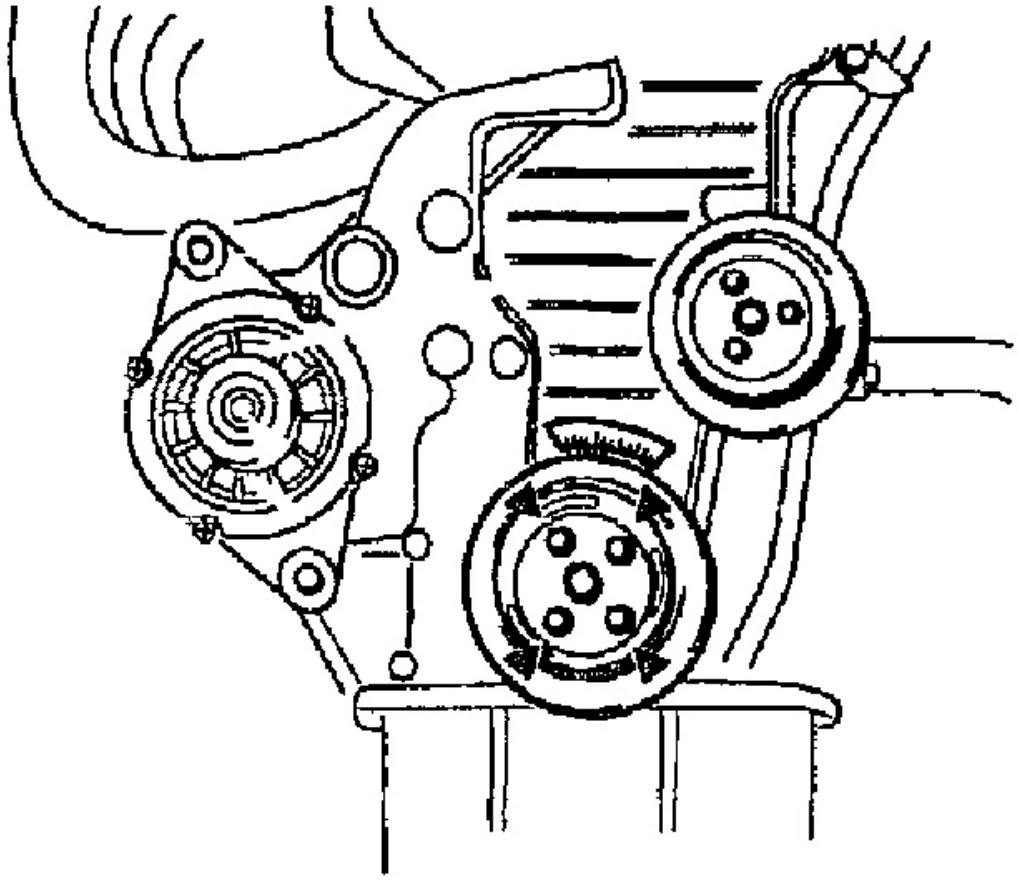
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Fig. 361: Installing Lower And Upper Timing Belt Covers
Courtesy of KIA MOTORS AMERICA, INC.

14. Install timing belt guide plate and crankshaft pulley.

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



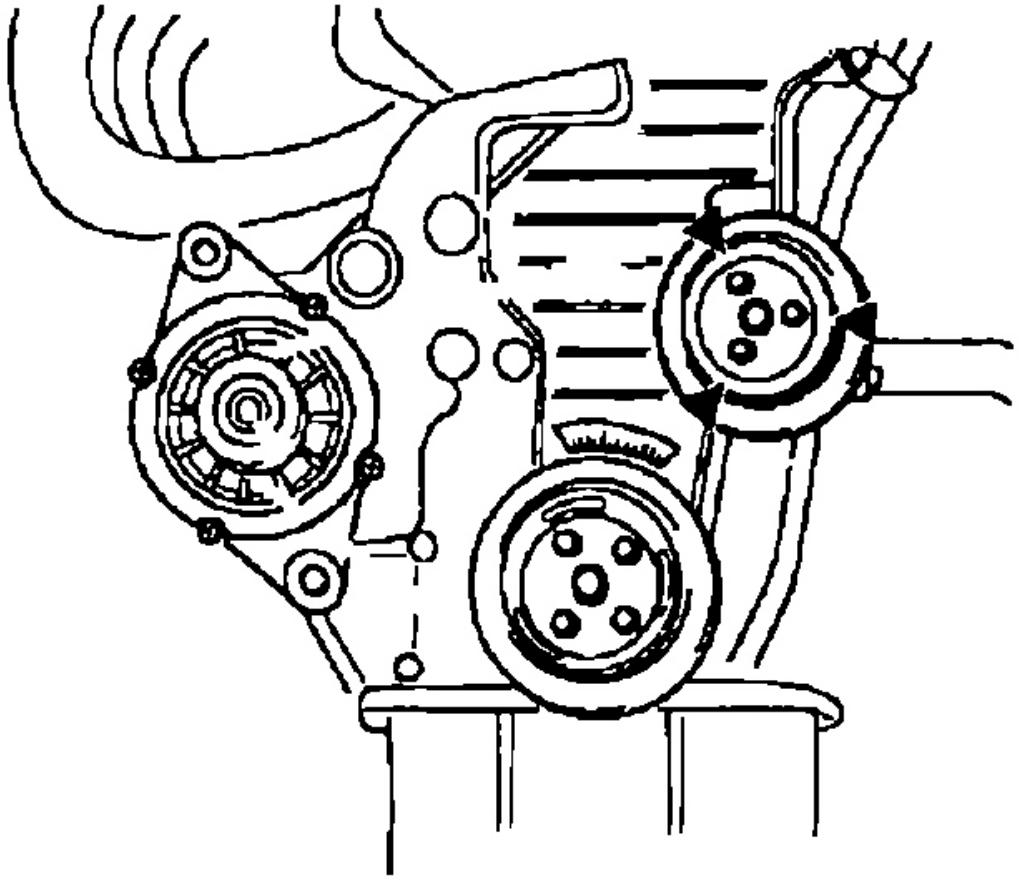
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Fig. 362: Installing Timing Belt Guide Plate And Crankshaft Pulley
Courtesy of KIA MOTORS AMERICA, INC.

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)

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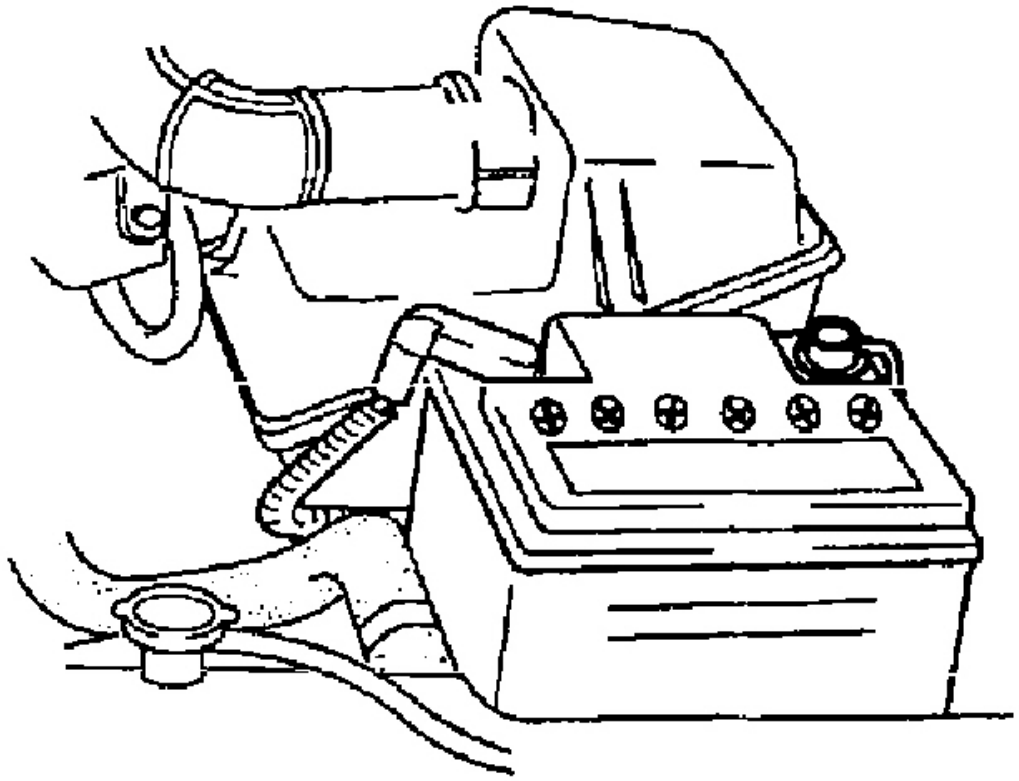


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Fig. 363: Installing Water Pump Pulley
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16. Install generator belt and adjust the tension.
17. Install P/S and/or A/C drive belt and adjust the tension.
18. Connect negative battery cable.

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Fig. 364: Connecting Negative Battery Cable
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TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
A/C Compressor Bracket Bolt	
12-mm	14-18 (19-25)
14-mm	28-38 (38-51)
A/C Compressor Mounting Bolt	29-38 (39-52)
Automatic Transaxle Linkage Nut	24-34 (32-46)
Camshaft Timing Belt Pulley Bolt	36-45 (49-61)
Connecting Rod Nut	35-37 (47-50)
Crankshaft\Timing Belt Pulley Bolt	116-123 (157-167)

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Cylinder Head Bolts (1)	
Step 1	36 (49)
Step 2	Loosen Bolts In Sequence
Step 3	29 (39)
Step 4	Plus Torque Angle 90 Degrees
Step 5	Plus Torque Angle Additional 90 Degrees
Engine Ground Strap-To-Engine Bolts	28-38 (38-52)
Engine Hanger Bolt	28-38 (38-52)
Engine Mount Bolts/Nuts	
No. 1 (2)	49-69 (67-93)
No. 2 (3)	28-38 (38-52)
No. 3 (4)	63-86 (85-117)
No. 4 (5)	
Bolt	47-66 (64-89)
Nut	50-69 (68-93)
Exhaust Manifold Heat Shield Bolt	14-18 (19-25)
Exhaust Manifold-To-Head Bolt/Nut	28-34 (38-46)
Flywheel\Drive Plate Bolt	72-76 (97-103)
Front Exhaust Pipe Nuts	
Clamp Nuts	15-20 (20-27)
Converter Hanger Nuts	51-69 (69-94)
Pipe-To-TWC Warmup Converter Nuts	30-41 (40-55)
Intake Manifold Bolt	14-18 (19-25)
Intake Manifold Support Bracket Bolt	27-38 (37-52)
Joint Shaft Support Bracket Bolts	32-46 (43-62)
Main Bearing Cap Bolts (6)	
Step 1	29 (39)
Step 2	Loosen To Zero
Step 3	15 (20)
Step 4	Plus Torque Angle 90 Degrees
Step 5	Plus Torque Angle Additional 60 Degrees
Oil Pan Bolts	14-17 (19-23)
Oil Pump Bolt	14-19 (19-26)
Pinch Bolts	32-38 (43-52)
Power Steering Pump Mounting Bolt	28-38 (38-52)
Rear Seal Cover Long Bolt	30-41 (40-55)

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Stabilizer Control Link Bolts	32-45 (43-61)
Starter Bolt	27-38 (37-52)
Tensioner Pulley Lock Bolt	28-38 (38-52)
Thermostat Housing Bolt	14-19 (19-26)
Water Pump Bolt	14-19 (19-26)
	INCH Lbs. (N.m)
Camshaft Bearing Cap Bolts (7)	97-124 (11-14)
Center Cover Bolt	44-80 (5-9)
Crankshaft Pulley Bolt	106-150 (12-17)
Cylinder Head Cover Bolt	71-89 (8-10)
Engine Ground Strap-To-Frame Bolt	71-106 (8-12)
Oil Pressure Switch Connection	106-159 (12-18)
Oil Strainer Bolt	71-106 (8-12)
Rear Seal Cover Short Bolt	71-97 (8-11)
Timing Belt Cover Bolt	71-97 (8-11)
Timing Belt Guide Plate Bolt	106-150 (12-17)
Water Pump Pulley Bolt	106-150 (12-17)

(1) Tighten in sequence to specification. See **Fig. 365**.

(2) For illustration of engine mount No. 1, see **Fig. 366**.

(3) For illustration of engine mount No. 2, see **Fig. 367**.

(4) Manufacturer does not provide illustration for mount No. 3.

(5) For illustration of engine mount No. 4, see **Fig. 368**.

(6) Tighten in sequence to specification. See **Fig. 369**.

(7) Tighten in sequence to specification. See **Fig. 370**.

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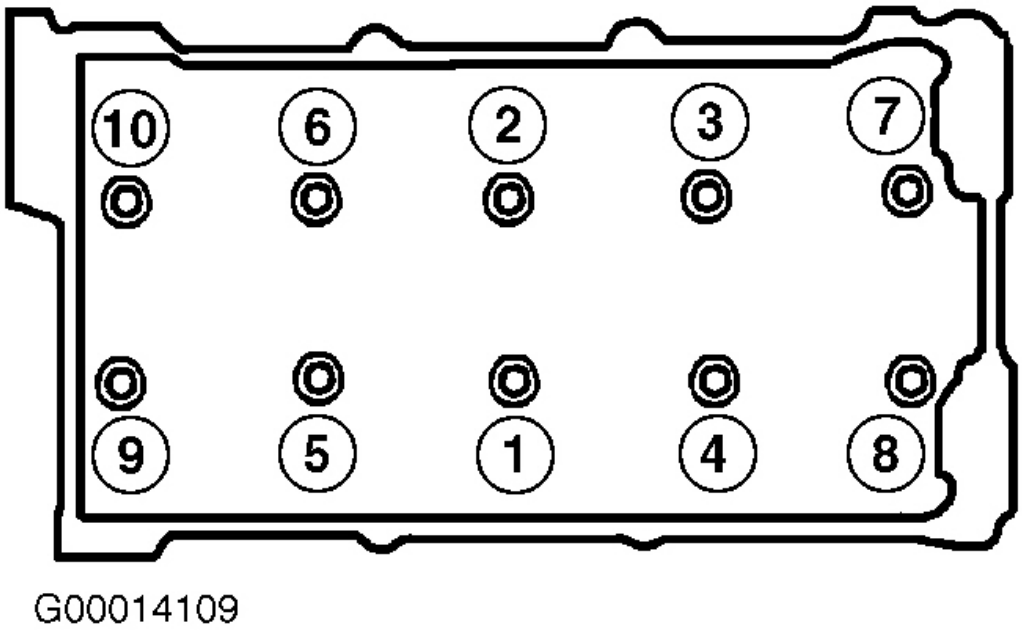


Fig. 365: Cylinder Head Bolt Tightening Sequence
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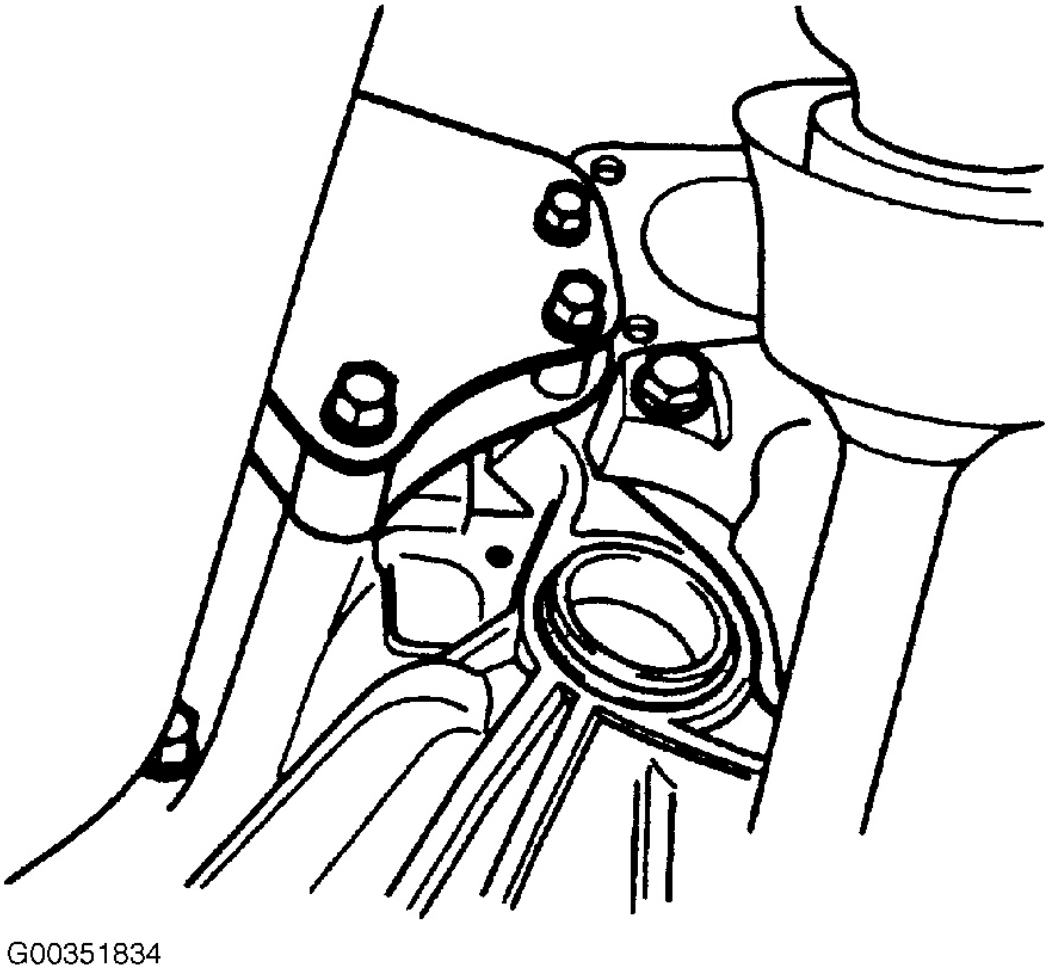


Fig. 366: Illustrating Engine Mount No. 1
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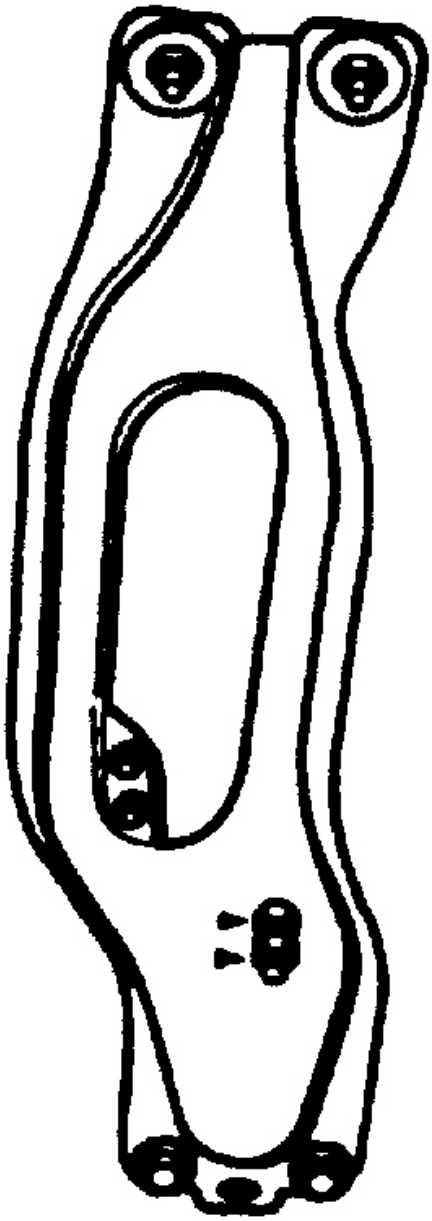
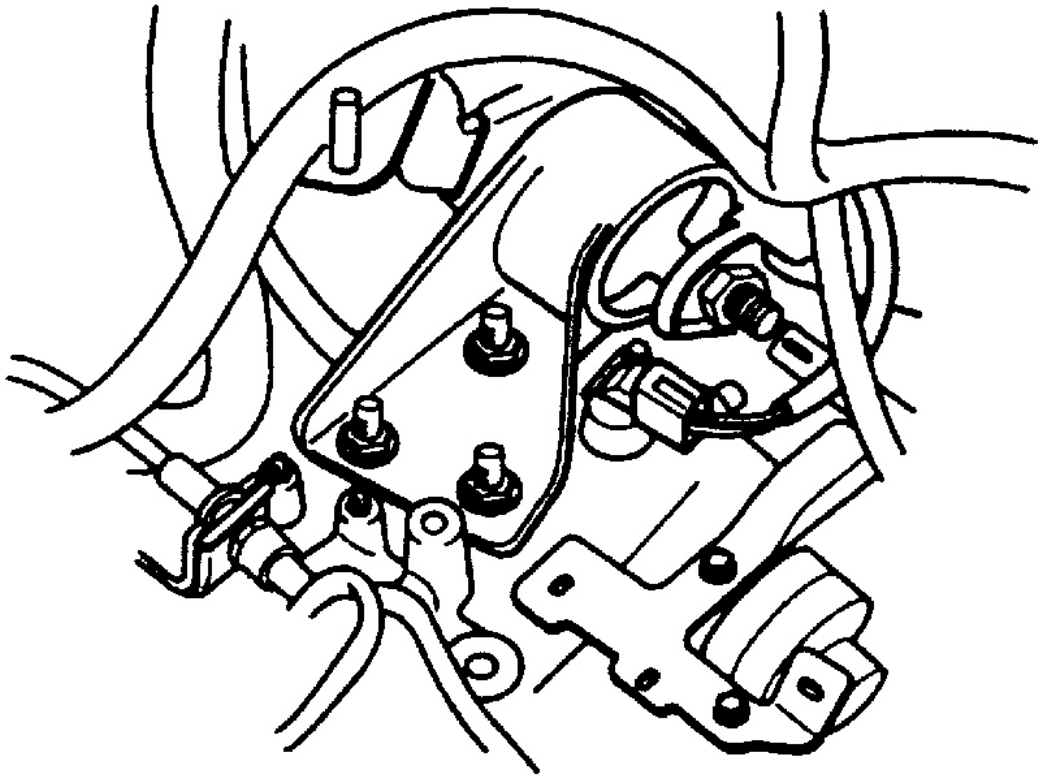


Fig. 367: Illustrating Engine Mount No. 2
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Fig. 368: Illustrating Engine Mount No. 4
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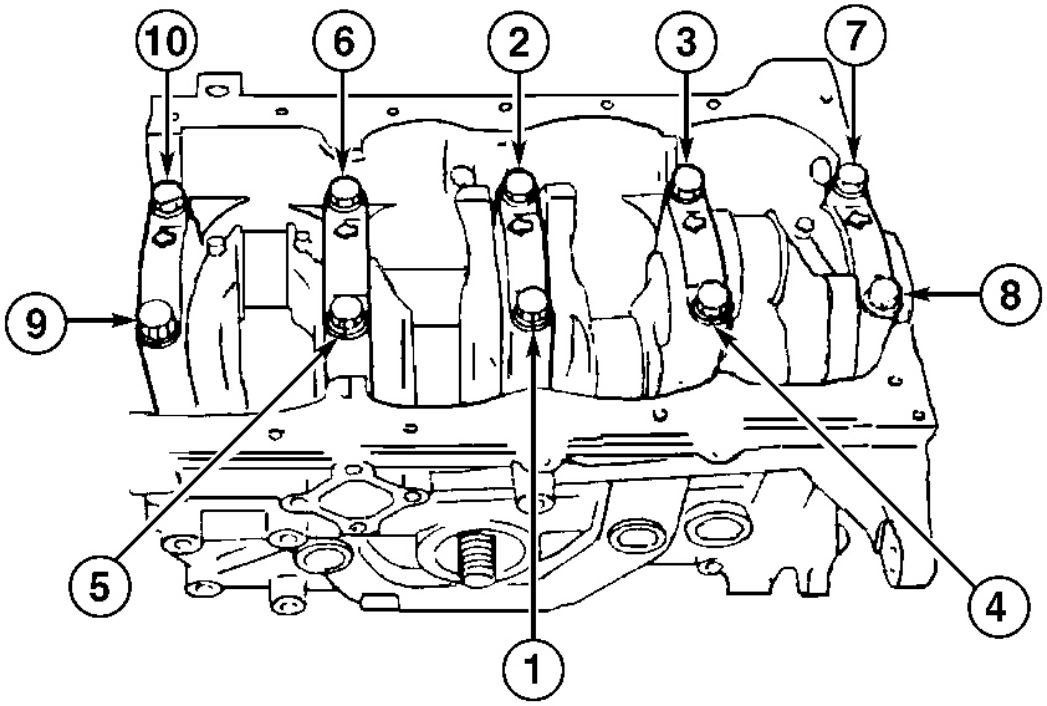


Fig. 369: Main Bearing Cap Bolt Tightening Sequence
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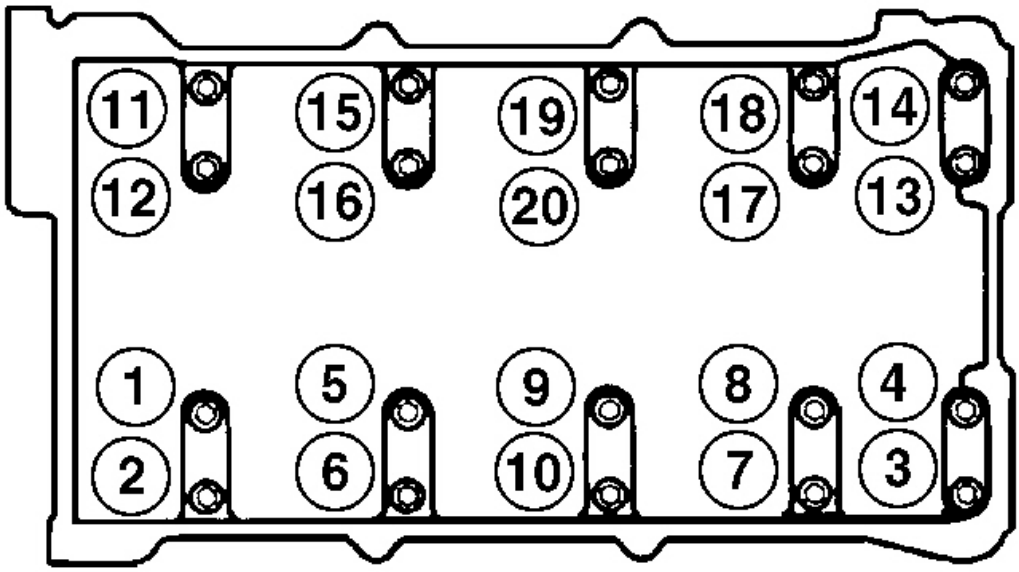


Fig. 370: Camshaft Bearing Cap Bolt Removal/Installation Sequence
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