

2004 Kia Sorento LX

2004-06 ENGINES Mechanical - 3.5L V6 - Sorento

2004-06 ENGINES**Mechanical - 3.5L V6 - Sorento****GENERAL****SPECIFICATIONS****GENERAL SPECIFICATIONS**

Description	Specification	Limit
General		
Type	V-type, DOHC	
Number of Cylinders	6	
Bore	93 mm (3.661 in.)	
Stroke	85.8 mm (3.3779 in.)	
Total displacement	3497 cc	
Compression ratio	10.0	
Firing order	1 - 2 - 3 - 4 - 5 - 6	
Idle R.P.M	800 ± 100	
Ignition timing at idling speed	BTDC 10° ± 2°	
Valve timing		
Intake valve		
Opens (BTDC)	16.5°	
Closes (ABDC)	55.5°	
Exhaust valve		
Opens (BBDC)	48.5°	
Closes (ATDC)	15.5°	
Camshaft		
Drive mechanism	Cogged type belt	
Cam height intake	35.098 - 35.298 mm (1.3818 - 1.3897 in.)	
Cam height exhaust	34.81 - 35.01 mm (1.3705 - 1.3783 in.)	
Journal diameter	25.951 - 25.970 mm (1.0220 - 1.0224 in.)	
Bearing oil clearance	0.05 - 0.09 mm (0.0007 - 0.0024 in.)	
End play	0.1 - 0.15 mm (0.0039 - 0.0059 in.)	
Cylinder head		
Flatness of gasket surface	Max. 0.03 mm (0.0012 in.)	
Flatness of mounting surface		
Intake	Max. 0.5 mm (0.0197 in.)	

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Exhaust Valve guide hole diameter 0.05 (0.002) O.S. 0.25 (0.010) O.S. 0.50 (0.20) O.S. Intake valve seat ring hole diameter 0.3 (0.012) O.S. 0.6 (0.024) O.S. Exhaust valve seat ring hole diameter 0.3 (0.012) O.S. 0.6 (0.024) O.S.	Max. 0.15 mm (0.0059 in.) 12.05 - 12.068 mm (0.474 - 0.475 in.) 12.25 - 12.268 mm (0.482 - 0.483 in.) 12.50 - 12.518 mm (0.492 - 0.493 in.) 36.30 - 36.325 mm (1.429 - 1.430 in.) 36.60 - 36.625 mm (1.441 - 1.442 in.) 33.30 - 33.325 mm (1.311 - 1.312 in.) 33.60 - 33.625 mm (1.323 - 1.324 in.)	
Valve Overall length		
Intake Exhaust Stem diameter	106.28 mm (4.184 in.) 105.4 mm (4.150 in.)	105.78 mm (4.165 in.) 104.9 mm (4.130 in.)
Intake Exhaust Face angle Margin	6.565 - 6.580 mm (0.258 - 0.259 in.) 6.530 - 6.550 mm (0.257 - 0.258 in.) 45° - 45.5°	
Intake Exhaust Clearance (stem - to - guide)	1.0 mm (0.0394 in.) 1.5 mm (0.059 in.)	0.5 mm (0.0197 in.) 1.0 mm (0.0394 in.)
Intake Exhaust	0.02 - 0.05 mm (0.0009 - 0.0020 in.) 0.05 - 0.085 mm (0.0020 - 0.0033 in.)	0.1 mm (0.0039 in.) 0.15 mm (0.0059 in.)
Valve spring Free height Lode Out of squareness	46.4 mm (1.8268 in.) 24.0 kgf / 37.9 mm (53 lb /1.492 in.) Max 2°	45.4 mm (1.7874 in.) - 4°
Valve guide		

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Length		
Intake	45.5 mm (1.7913 in.)	
Exhaust	50.5 mm (1.9882 in.)	
Service oversize	0.05, 0.25, 0.50	
Valve seat contact width		
Intake	0.9 - 1.3 mm (0.035 - 0.051 in.)	
Exhaust	0.9 - 1.3 mm (0.035 - 0.051 in.)	
Service oversize	0.30, 0.60	
Seat angle		
Intake	20°	
Exhaust	45°	
Piston		
Diameter (Standard)	92.97 - 92.98 mm (3.6602 - 3.6606 in.)	
Clearance (Piston-to-cylinder)	0.03 - 0.05 mm (0.0012 - 0.0020 in.)	
Ring groove width		
No. 1	1.53 - 1.55 mm (0.0602 - 0.0610 in.)	
No. 2	1.51 - 1.53 mm (0.0594 - 0.0602 in.)	
Oil ring	3.010 - 3.030 mm (0.1185 - 0.1193 in.)	
Piston for service	0.25 mm (0.010 in.), 0.50 mm (0.020 in.)	
	Oversize	
Piston ring		
Number of rings per piston	3	
Compression ring type	2	
Oil ring	1	
Compression ring type		
No. 1	Barrel type, steel (Inner bevel)	
No. 2	Taper type, special cast iron	
Oil ring type	3-piece type	
Ring end gap		
No. 1	0.2 - 0.3 mm (0.0079 - 0.0118 in.)	0.8 mm (0.0315 in)
No. 2	0.45 - 0.60 mm (0.0177 - 0.0236 in.)	0.8 mm (0.0315 in)
Oil ring side rail	0.2 - 0.7 mm (0.0079 - 0.0276 in.)	1.0 mm (0.0394 in)
Ring side clearance		
No. 1	0.04 - 0.08 mm (0.0008 - 0.0031 in.)	0.1 mm (0.0039 in)
No. 2	0.02 - 0.06 mm (0.0016 - 0.0024 in.)	0.1 mm (0.0039 in)

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Ring for service	0.25 mm (0.010 in.), 0.50 mm (0.020 in.)	
Connecting rod	Over size	
Side clearance (Big end)	0.10 - 0.25 mm (0.0039 - 0.0098 in.)	
Bend	0.05 mm or less/100 mm (0.0020 in. or less/3.937 in.)	
Twist	0.1 mm or less/100 mm (0.0039 in. or less/3.937 in.)	
Bearing		
Oil clearance	0.022 - 0.040 mm (0.0009 - 0.0016 in.)	0.1 mm (0.004 in.)
Pin diameter	21.974 - 21.985 mm (0.8651 - 0.8655 in.)	
Crankshaft		
Journal O.D.	63.982 - 64.00 mm (2.519 - 2.5197 in.)	
Pin O.D.	54.982 - 55.00 mm (2.165 - 2.1653 in.)	
Out - of - roundness of journal and pin	Max. 0.03 mm (0.0012 in.)	
Taper of journal and pin	Max. 0.005 mm (0.0002 in.)	
End play	0.05 - 0.25 mm (0.002 - 0.0098 in.)	0.3 mm (0.012 in.)
Main bearing		
Oil clearance	0.018 - 0.036 mm (0.0007 - 0.0014 in.)	
Cylinder block		
Cylinder bore	93 mm (3.661 in.)	
Flatness of gasket surface	Max. 0.05 mm (0.002 in.)	
Out - of - roundness and taper	Max. 0.02 mm (0.0008 in.)	0.05 mm (0.002 in.)
Oil pump		
Side clearance		
Body clearance	0.100 - 0.181 mm (0.0039 - 0.0071 in.)	
Side clearance	0.040 - 0.095 mm (0.0016 - 0.0037 in.)	
Tip clearance	0.06 - 0.018 mm (0.0024 - 0.0071 in.)	
Relief spring		
Free length	46.3 mm (1.823 in.)	
Load	6.9 kg / 39.1 mm (15.2 lb. /1.54 in.)	

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Oil filter		
Type	Cartridge, full flow	
Engine oil pressure	80 kPa (0.8 bar, 11.6 psi) at idlae [Conditions : Oil temperature is 75 to 90°C (167 to 194°F)]	
Cooling method	Engine coolant cooling, forced circulation with electric fan	
Cooling system		
Quantity	11 lit (11.62 U.S.qts., 9.7 Imp.qts)	
Thermostat		
Type	Wax pellet type with jiggle valve	
Normal opening temperature	82°C (179.6°F)	
Opening temperature range	80°C - 84°C (176 - 183.2°F)	
Wide open temperature	95°C (203°F)	
Radiator cap		
Main valve opening pressure	86.1 - 124.5 kPa (0.98 - 1.27 kg/cm ² , 13.94 - 18.06 psi)	
Main valve closing pressure	83.4 kPa (0.85 kg/cm ² , 12.1 psi)	
Vacuum valve opening pressure	- 6.86 kPa (- 0.07 kg/cm ² , - 1.00 psi)	
Air cleaner		
Type	Dry type	
Element	Unwoven cloth type	
Exhaust pipe		
Muffler	Expansion resonance type	
Suspension system	Rubber hangers	

COOLANT SERVICE STANDARD**Standard Value**

Coolant concentration

Tropical area: 40%

Other area: 50%

LUBRICANT

Engine coolant : Ethylene glycol base for aluminum radiator

ENGINE COOLANT TEMPERATURE SENSOR SEALANT

Three bond No. 231 or equivalent LOCTITE 962T or equivalent

TIGHTENING TORQUE SPECIFICATIONS
TORQUE SPECIFICATIONS

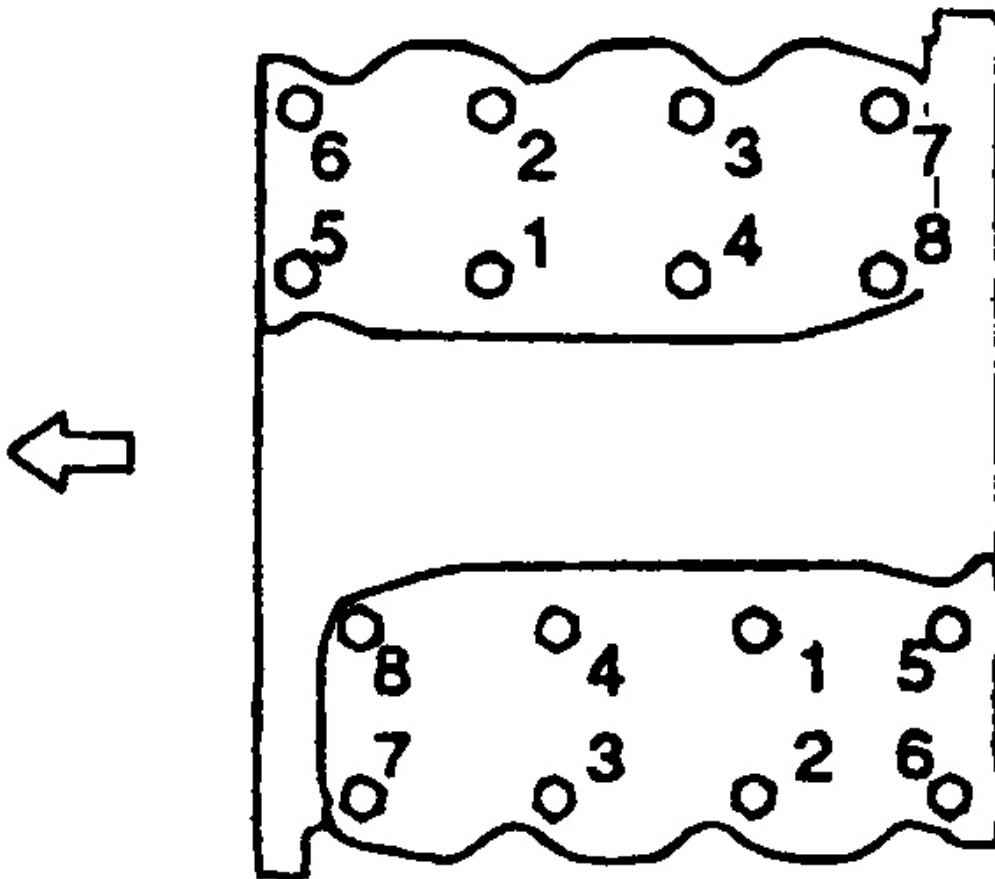
Application	Ft. Lbs. (N.m)
Air Intake Manifold (Upper) Surge Tank-To-Intake Manifold (Lower) Bolt\Nut	11-15 (15-20)
Auto Tensioner Fixing Bolt	15-20 (20-27)
Camshaft Bearing Cap Bolt ⁽¹⁾	
Inner Bolt	See INCH Lbs.
Outer Bolt	14-15 (19-21)
Camshaft Sprocket Bolt	58-72 (79-98)
Catalytic Converter Nut	22-30 (30-40)
Center Exhaust Pipe Nut	22-30 (30-40)
Connecting Rod Nut	
Step 1	26 (35)
Step 2	Plus 92 Degrees
Crankshaft Main Bearing Cap Bolt ⁽¹⁾	51-58 (69-79)
Crankshaft Pulley Bolt	133-140 (180-190)
Cylinder Head Bolts (Cold) ⁽²⁾	77-85 (105-115)
Delivery Pipe Installation Bolt	7-11 (10-15)
Drive Belt Pulley Bolt	26-41 (35-55)
Drive Belt Tensioner Nut	33-37 (45-50)
Drive Plate & Adapter Plate Bolt	54-57 (73-77)
Engine Coolant Pump-To-Cylinder Head Bolt	13-16 (17-22)
Engine Coolant Temperature Sensor	15-30 (20-40)
Engine Cooling Inlet Fitting Attaching Bolt	13-15 (17-20)
Engine Hanger Bracket Bolt	20-26 (27-35)
Exhaust Manifold-To-Cylinder Head Nut	19-22 (25-30)
Exhaust Manifold-To-Engine	30-33 (40-45)
Front Exhaust Pipe-To-Converter Bolt	30-44 (40-60)
Front Exhaust Pipe-To-Manifold Nut	22-30 (30-40)
Fuel Hose Clamp-To-Rear Cylinder Head	9-11 (12-15)
Generator Inlet Pipe-To-Front Cylinder Head Assembly Bolt	9-11 (12-15)
Generator Mount Bolt (Bracket Side)	15-22 (20-30)
Generator Mount Bracket-To-Engine Bolt	15-22 (20-30)
Generator Mount Nut (Engine Front Case Side)	15-22 (20-30)
Heat Shield-To-Exhaust Manifold Bolts	9-11 (12-15)
Intake Manifold-To-Cylinder Head Nut ⁽³⁾	15-17 (20-23)
Main Muffler Hanger Support Bracket Bolt	7-11 (10-15)
Oil Filter	8.7-11.6 (11.8-15.7)
Oil Level Gauge Guide-To-Engine Bolt	9-11 (12-15)
Oil Pan Bolt (Upper)	

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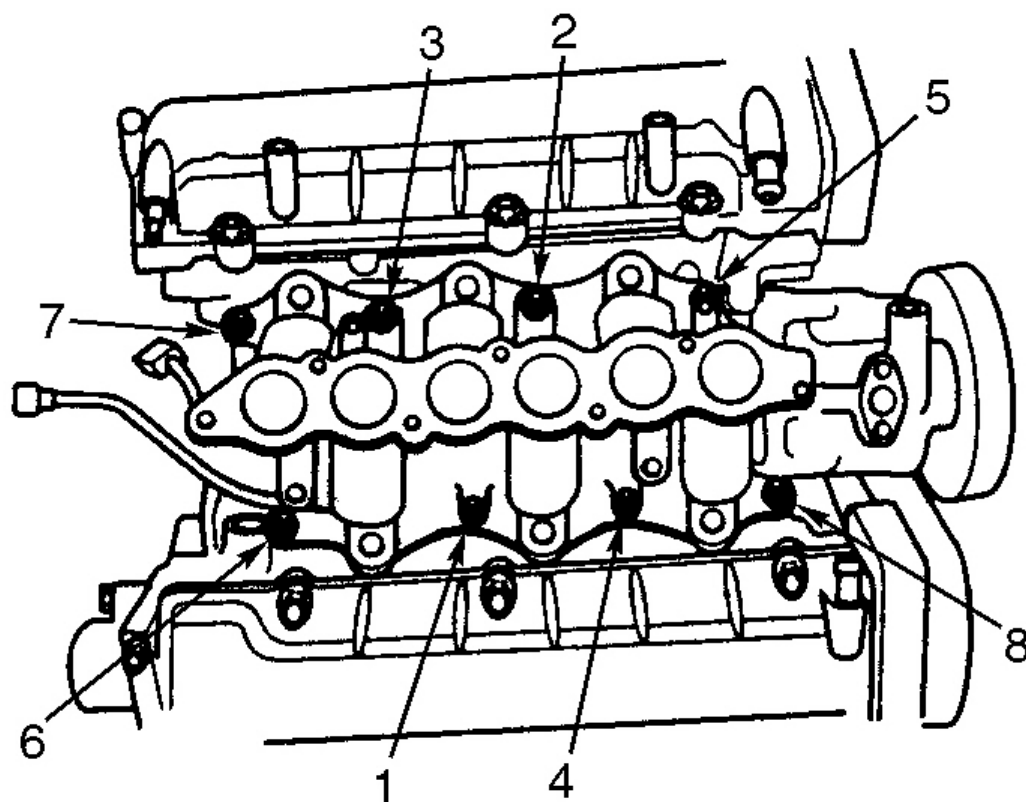
8x22 mm ⁽⁴⁾	14-21 (19-28)
10x38 mm ⁽⁴⁾	22-31 (30-42)
152.5 mm	44-62 (5-7)
171.5 mm	44-62 (5-7)
Oil Pan Drain Plug	26-33 (35-45)
Oil Pump Case Bolts	9-11 (12-15)
Oil Pump Cover Screw	5.8-11 (8-15)
Oil Relief Valve Plug	30-37 (40-50)
Oil Screen Bolt	11-16 (15-22)
Oxygen Sensor	30-37 (40-50)
Power Steering Oil Pump Bracket-To-Cylinder Head Bolt	13-19 (17-26)
Power Steering Oil Pump-To-Bracket Bolt	13-19 (17-26)
Starter-To-Engine Bolt	20-25 (27-34)
Starter-To-Engine Nut	15-22 (20-30)
Intake Manifold (Upper) Surge Tank Stay Bolt	11-15 (15-20)
Timing Belt Cover Bolt	
M6 Bolt	See INCH Lbs.
M8 Bolt	15-20 (20-27)
Timing Belt Idler Pulley Bolt	37-44 (50-60)
Timing Belt Tensioner Arm Fixing Bolt	26-41 (35-55)
Timing Belt Tensioner Pulley Bolt	32-41 (43-55)
Water Outlet Fitting Bolt	13-15 (17-20)
	INCH Lbs. (N.m)
Air Cleaner Body Installation Bolt	71-106 (8-12)
Air Cleaner Mounting Bolt	71-106 (8-12)
Camshaft Bearing Cap Bolt ⁽¹⁾	
Inner Bolt	89-106 (10-12)
Crankshaft Position Sensor Wheel Screw	35-44 (5-6)
Cylinder Head Cover Bolt ⁽⁵⁾	69-87 (7.8-9.8)
Oil Pan Bolt (Lower) ⁽⁶⁾	89-106 (10-12)
Oil Pressure Switch	71-106 (8-12)
Oil Seal Case Bolt	89-106 (10-12)
Rear Plate Bolt	89-106 (10-12)
Timing Belt Cover Bolt	
M6 Bolt	89-106 (10-12)
Throttle Body-To-Surge Tank Bolt	89-115 (10-13)
Transaxle Mounting Plate Bolt	89-106 (10-12)
(1) Tighten bolts evenly in 3-4 steps to specification.	
(2) Tighten in sequence to specification. See Fig. 1 .	

- (3) Tighten in sequence to specification. See **Fig. 2**.
- (4) Tighten in sequence to specification. See **Fig. 3**.
- (5) Tighten in sequence to specification. See **Fig. 4**.
- (6) Tighten in sequence to specification. See **Fig. 5**.



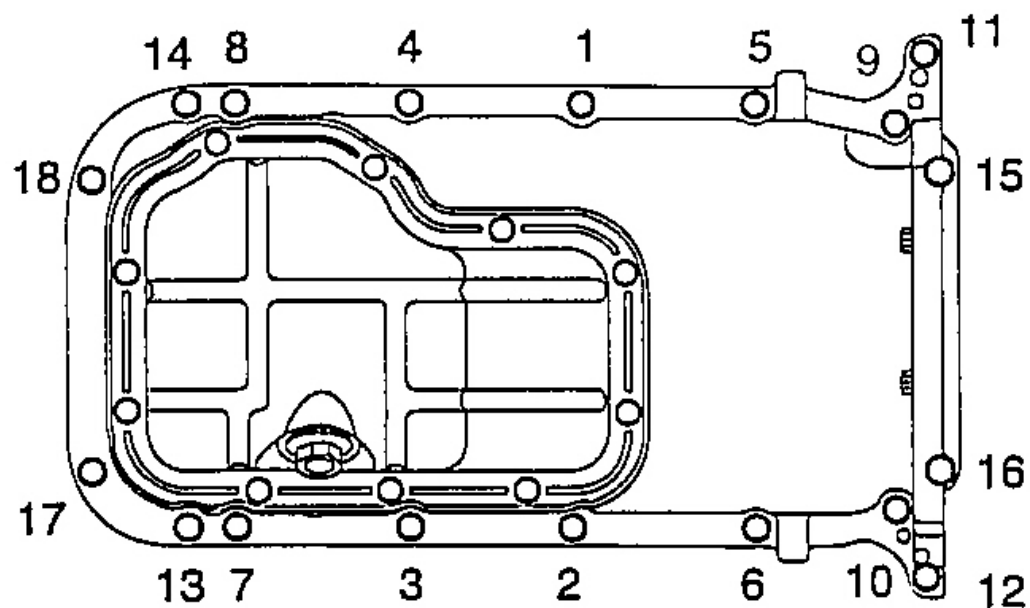
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Fig. 1: Cylinder Head Bolt Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.



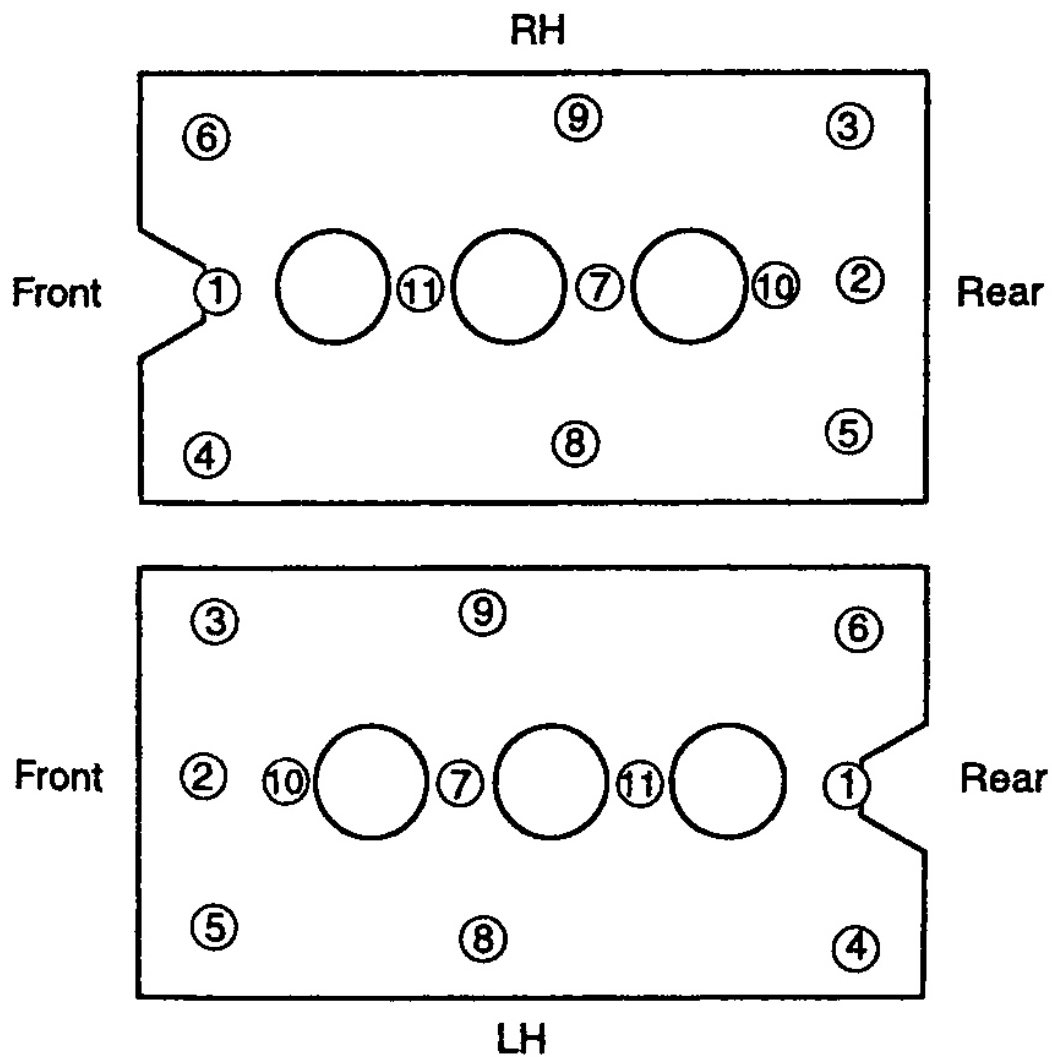
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Fig. 2: Intake Manifold Nut Tightening Sequence
 Courtesy of KIA MOTORS AMERICA, INC.



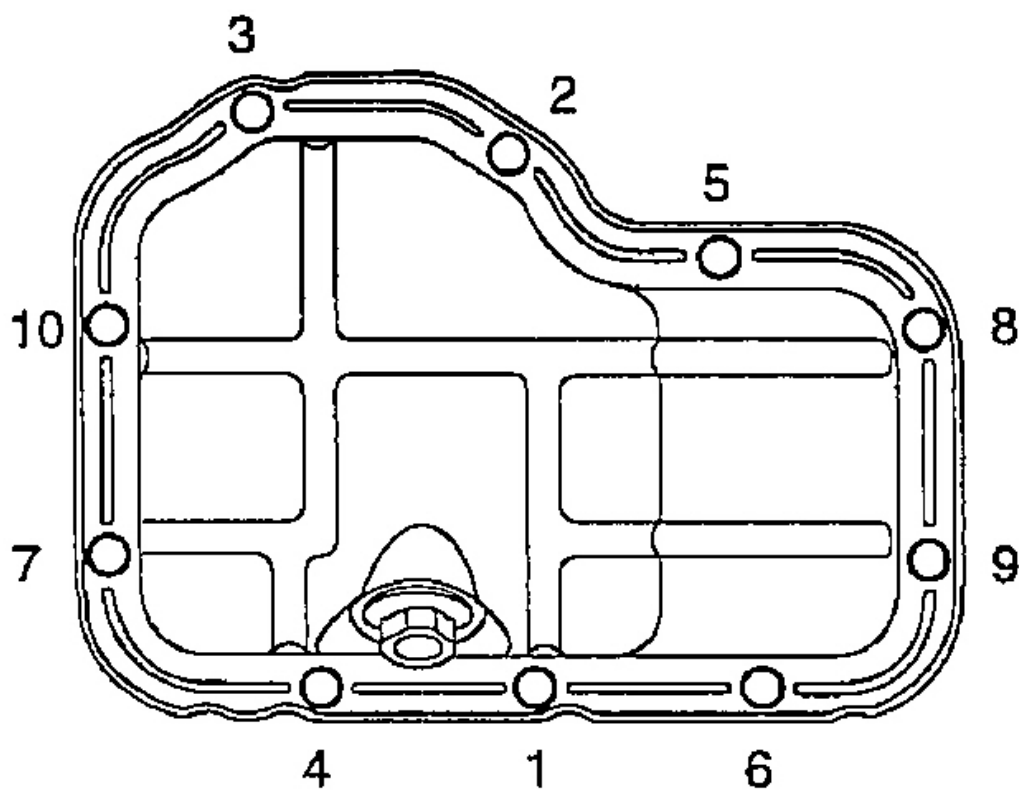
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Fig. 3: Upper Oil Pan Bolt Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.



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Fig. 4: Cylinder Head Cover Bolt Tightening Sequence
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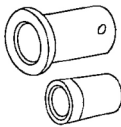
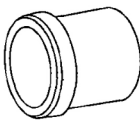
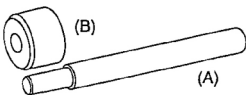
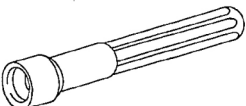
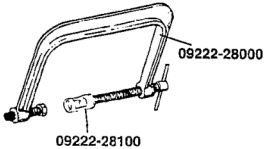
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Fig. 5: Lower Oil Pan Bolt Tightening Sequence
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SPECIAL SERVICE TOOLS

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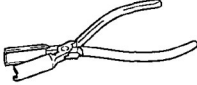
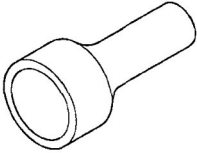
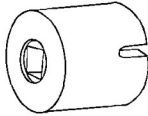
Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09214-33000)		Installation of the crankshaft front oil seal
Camshaft oil seal installer (09221-21000)	 BCAE001B	Installation of the camshaft oil seal
Valve guide remover (09221-3F000(A)) Valve guide installer (09221-3F000(B))	 BCAE001C	Removal and installation of the valve guide
Valve stem oil seal installer (09222-28200)		Installation of the valve stem oil seal
Valve spring compressor (09222-28000) Valve spring compressor adapter (09222-28100)		Removal and installation of the intake or exhaust valve

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Fig. 6: Special Service Tools (1 Of 2)
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Tool (Number and name)	Illustration	Use
Valve stem oil seal remover (09222-29000)		Removal of the valve stem oil seal
Crankshaft rear oil seal installer (09231-33000)		Installation of the crankshaft rear oil seal
Crankshaft wrench (09231-33100)		Used if the crankshaft needs to be rotated to attach the timing belt, etc.

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Fig. 7: Special Service Tools (2 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

TROUBLESHOOTING

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Symptom	Probable cause	Remedy
Knocking of crankshaft and bearing	Worn main bearing Seized bearing Bent crankshaft Excessive crankshaft end play	Replace Replace Replace Replace thrust bearing
Piston and connecting rod knock	Worn bearing Seized bearing Worn piston pin Worn piston in cylinder Broken piston ring Improper connecting rod alignment	Replace Replace Replace piston and pin or connecting rod Recondition cylinder Repair or replace Replace
Noisy valves	Faulty auto-lash adjuster Thin or diluted engine oil (low oil pressure) Worn or damaged valve stem or valve guide	Replace Change Replace
Excessively worn cylinder and piston	Shortage of engine oil Dirty engine oil Poor quality of engine oil Improperly assembled piston and connecting rod Improper piston ring end clearance Dirty air cleaner	Add or replace Check oil level on daily basis Replace Use proper oil Repair or replace Replace Clean air cleaner assembly and replace the air filter
Connecting rod and main bearing noise	Insufficient oil supply Thin or diluted engine oil Excessive bearing clearance	Check engine oil level Change and determine cause Replace
Damaged crankshaft bearing	Shortage of engine oil Low oil pressure Poor quality of engine oil Worn or out-of-round of crankshaft journal Restricted oil passage in crankshaft Worn bearing Bearing improperly installed Non-concentric crankshaft or bearing	Add or replace Check oil level on daily basis Adjust or repair Use proper engine oil Replace Clean Replace bearing and check engine oil and lubrication system Replace Replace
Timing belt noise	Incorrect belt tension	Replace
Low compression	Blown cylinder head gasket Worn or damaged piston rings Worn piston or cylinder Worn or damaged valve seat	Replace gasket Replace rings Repair or replace piston and/or cylinder block Repair or replace valve and/or seat ring
Oil pressure drop	Low engine oil level Faulty oil pressure switch Clogged oil filter Worn oil pump gears or cover Thin or diluted engine oil Oil relief valve stuck (open) Excessive bearing clearance	Check engine oil level Replace Replace Replace Change and determine cause Repair Replace
High oil pressure	Oil relief valve stuck (closed)	Repair

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Fig. 8: Troubleshooting Symptoms Table (1 Of 2)
Courtesy of KIA MOTORS AMERICA, INC.

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Symptom	Probable cause	Remedy
Excessive engine rolling and vibration	Loose engine roll stopper (front, rear) Loose transaxle mount bracket Loose engine mount bracket Loose center member Broken transaxle mount insulator Broken engine mount insulator Broken engine roll stopper insulator	Re-tighten Re-tighten Re-tighten Re-tighten Replace Replace Replace
Low coolant level	Leakage of coolant Damaged radiator core joint Corroded or cracked hoses (Radiator hose, heater hose, etc) Faulty radiator cap valve or setting of spring Faulty thermostat Faulty engine coolant pump	Replace Replace Replace Replace Replace
Clogged radiator	Foreign material in coolant	Replace
Abnormally high coolant temperature	Faulty thermostat Faulty radiator cap Restriction of flow in cooling system Loose or missing drive belt Faulty engine coolant pump Faulty temperature gauge or wiring Faulty electric fan Faulty thermo-sensor on radiator Insufficient coolant	Replace parts Replace Replace Adjust or replace Replace Repair or replace Repair or replace Replace Refill coolant
Abnormally low coolant temperature	Faulty thermostat Faulty temperature gauge or wiring	Replace Repair or replace
Leakage from oil cooling system	Loose hose and pipe connection Blocked or collapsed hose and pipe	Replace Repair or replace
Inoperative electrical cooling fan	Damaged	Replace or repair
Exhaust gas leakage	Loose connections Broken pipe or muffler	Re-tighten Repair or replace
Abnormal noise	Detached baffle plate in muffler Broken rubber hanger Pipe or muffler contacting vehicle body Broken pipe or muffler	Replace Replace Correct Repair or replace

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Fig. 9: Troubleshooting Symptoms Table (2 Of 2)
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CHECKING ENGINE OIL

1. Position a vehicle on a level surface.
2. Turn off the engine.

NOTE: **In the case of a vehicle that has not been used for a prolonged period, run the engine for several minutes. Turn off the engine and wait for 5 minutes at least, then check the oil level.**

3. Check that the engine oil level is within the level range indicated on the oil dipstick. If the oil level is found to have fallen to the lower limit (the "L" mark), refill to the "F" mark.

NOTE: When refilling, use the proper grade of engine oil.

4. Check that the oil is not dirty or mixed with coolant or gasoline, and that it has the proper viscosity.

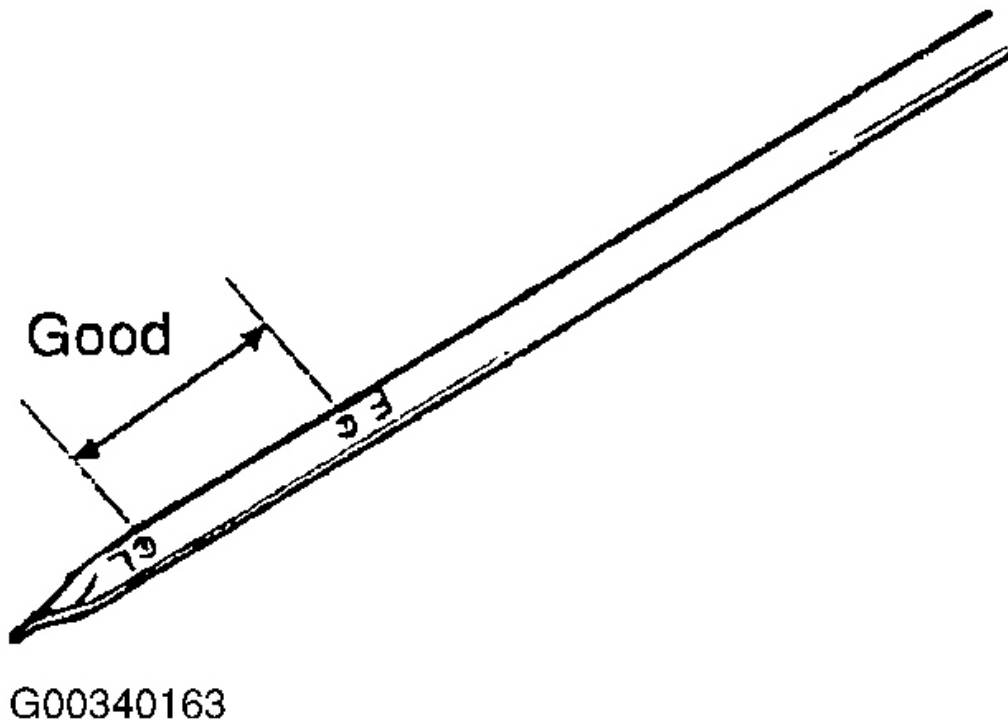


Fig. 10: Checking Engine Oil Level

Courtesy of KIA MOTORS AMERICA, INC.

SELECTION OF ENGINE OIL

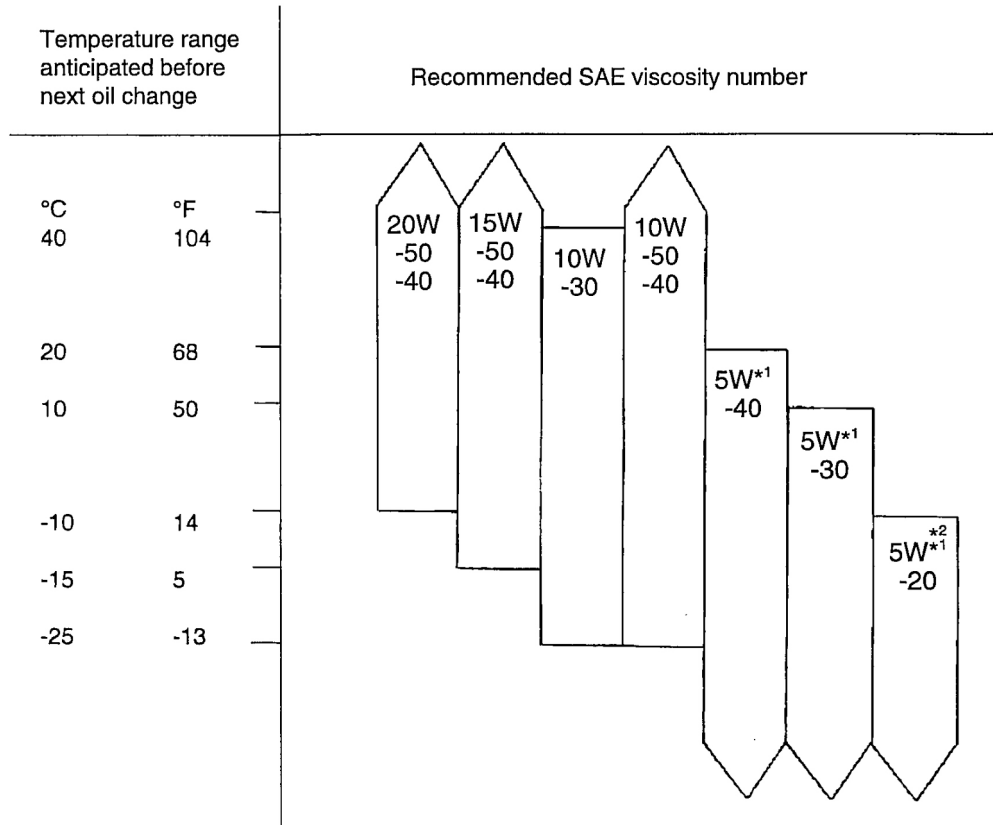
Recommended API classification: SE OR ABOVE [For General]

Recommended API classification: SG OR ABOVE [For North America Europe]

Recommended SAE viscosity grades: See Fig. 11.

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*1 Restricted by driving condition and environment.

*2 Not recommended for sustained high speed vehicle operation

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Fig. 11: Recommended SAE Viscosity Grades

Courtesy of KIA MOTORS AMERICA, INC.

NOTE: For best performance and maximum protection of all types of operation, select only those lubricants which:

- Satisfy the requirements of the API classification.
- Have the proper SAE grade number for expected ambient temperature range.

Lubricants which do not have both an SAE grade number and an API service classification on the container should not be used.

CHANGING ENGINE OIL

1. Run the engine until it reaches normal operating temperature.
2. Turn off the engine.
3. Remove the oil filler cap and oil filter and then drain plug. Drain the engine oil.

4. Tighten the drain plug to the specified torque.

Tightening torque

Oil pan drain plug: 35-45 Nm (350-450 kg. cm, 25-33 lb. ft)

NOTE: **Whenever tightening the oil drain plug, use a new drain plug gasket.**

5. Fill the new engine oil through the oil filler cap.

Drain and Refill

Oil quantity: 4.4 Liters (4.6 U.S. qts., 3.9 Imp. qts.)

NOTE: **Do not over fill. This will cause oil aeration and loss of oil pressure.**

6. Install the oil filler cap.
7. Start and run the engine.
8. Turn off the engine and then check the oil level. Add oil if necessary.

REPLACING OIL FILTER**FILTER SELECTION**

All KIA Motors Corporation engines are equipped with a high quality, disposable oil filter. This filter is recommended as a replacement filter for all vehicles. The quality of after market replacement filters varies considerably.

High quality of replacement filters should be used to assure the most efficient service. Make sure that the rubber gasket from the old oil filter is completely removed from the contact surface on the engine block before installing a new filter.

PROCEDURE FOR REPLACING OIL FILTER

1. Use a filter wrench to remove the oil filter.
2. Before installing a new oil filter on the engine, apply clean engine oil to the surface of the rubber gasket.
3. Tighten the oil filter of the specified torque.

Tightening torque

Oil filter: 11.8-15.7 N.m

(120-160 kg. cm, 8.7-11.6 lb. ft)

4. Start and run the engine and check engine for oil leaks.

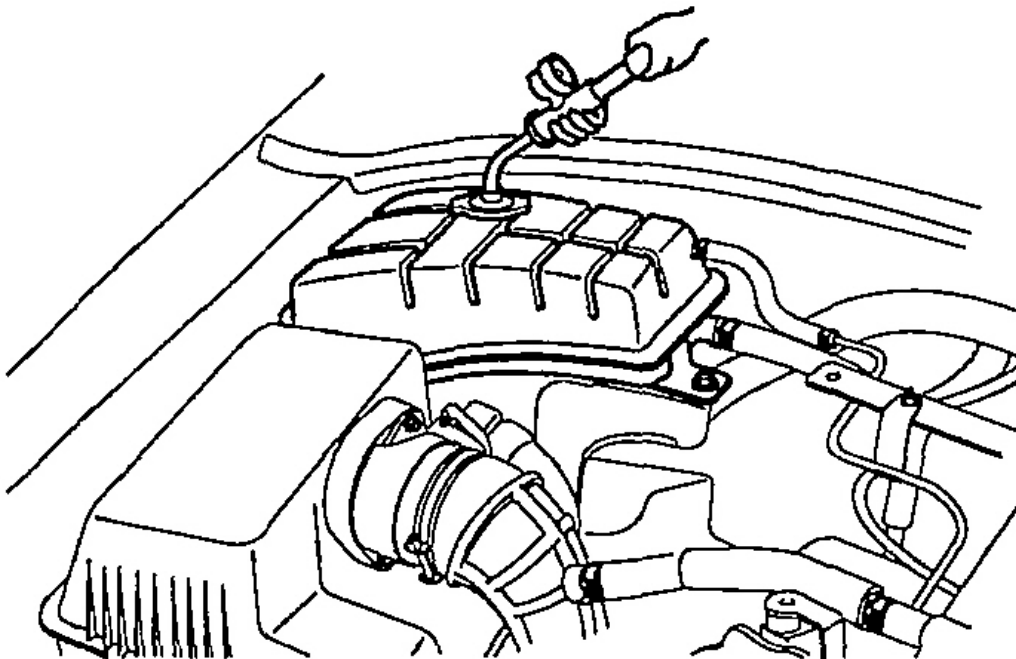
5. After stopping the engine, check the oil level and add oil as necessary.

CHECKING FOR COOLANT LEAK

CAUTION:

- Radiator coolant may be extremely hot. Do not open the system while hot, or scalding engine coolant could gush out, causing personal injury. Allow the vehicle to cool before servicing this system.
- When the tester is removed, be careful not to spill any coolant from it.
- Be sure to clean away completely any coolant from the area.
- Be careful, when installing and removing the tester and when testing, not to deform the filler neck of the radiator.

1. Loosen the radiator cap.
2. Confirm that the coolant level is up to the filler neck.
3. Install a radiator cap tester to the radiator filler neck and apply 150 kPa (21 psi, 1.53 kg/cm²) pressure. Hold for two minutes, then check for leakage from the radiator, hoses or connections.



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Fig. 12: Pressure Testing Coolant System For Leaks

Courtesy of KIA MOTORS AMERICA, INC.

4. If there is leakage, repair or replace with the appropriate part.

RADIATOR CAP PRESSURE TEST

NOTE: **Be sure that the cap is clean before testing, since rust or other foreign material on the cap seal will cause an incorrect reading.**

1. Use an adapter to attach the cap to the tester.
2. Increase the pressure until the indicator of the gauge stops moving.

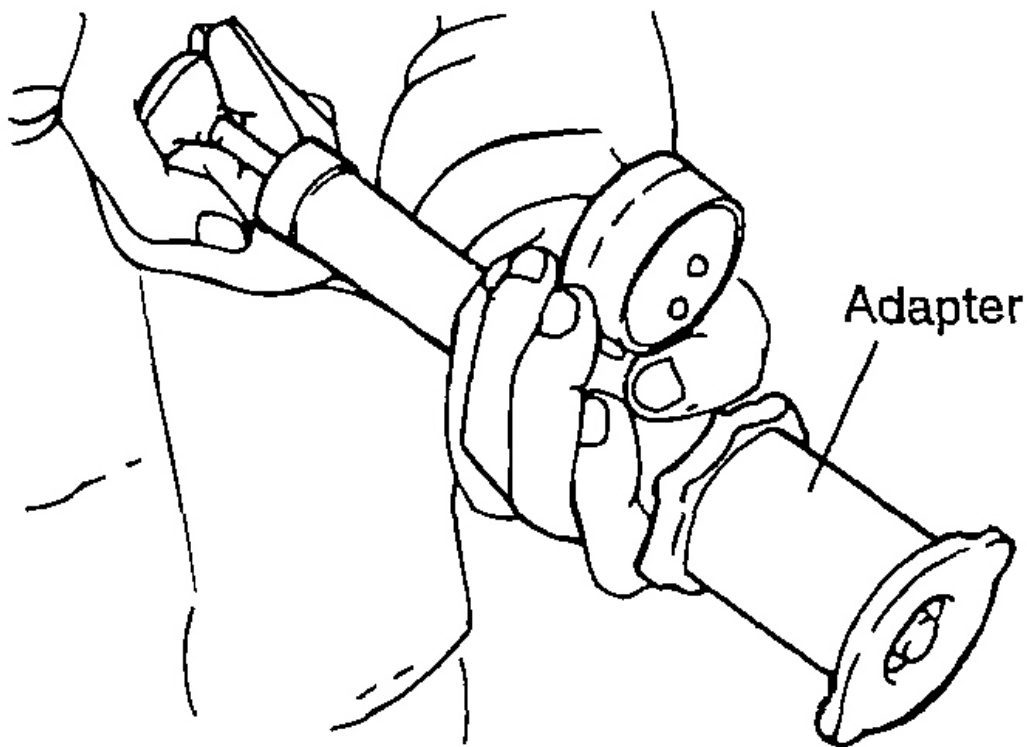
Main value opening pressure:

107.9 +/- 14.7 kPa (1.1 +/- 0.15 Kg/cm² , 15.64 +/- 2.13 psi)

Main value closing pressure:

83.4 kPa (0.85 Kg/cm² , 12.1 psi)

3. Check that the pressure level is maintained at or above the limit.
4. Replace the radiator cap if the reading does not remain at or above the limit.

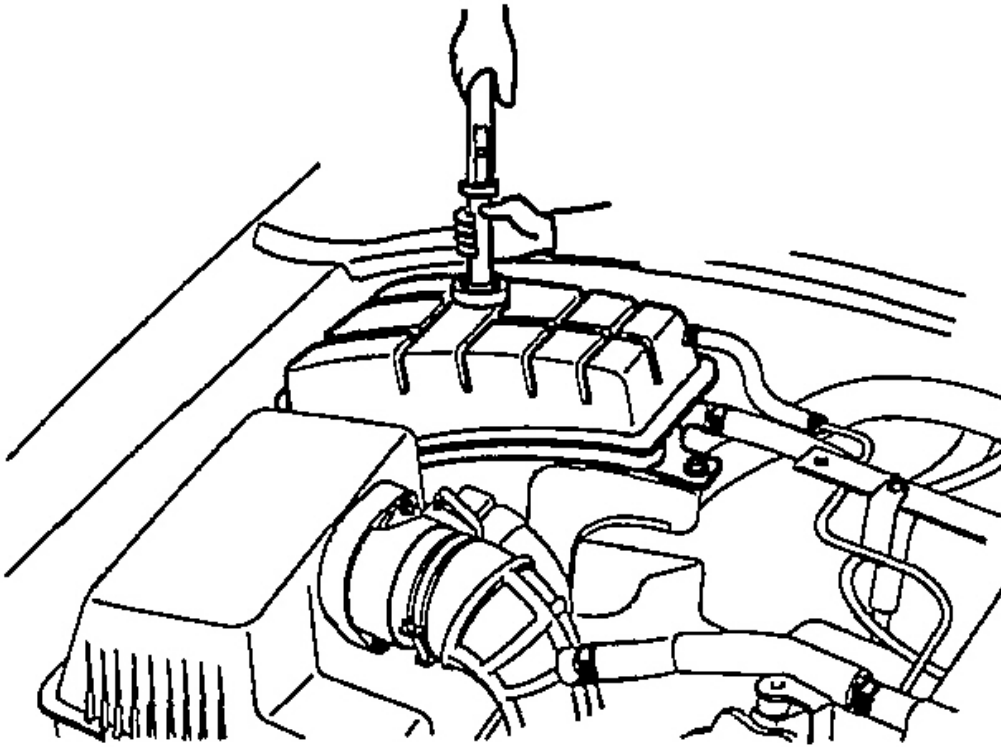


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Fig. 13: Performing Radiator Cap Pressure Test
Courtesy of KIA MOTORS AMERICA, INC.

SPECIFIC GRAVITY TEST

1. Measure the specific gravity of the coolant with a hydrometer.
2. Measure the coolant temperature and calculate the concentration from the relation between the specific gravity and temperature. Use the following illustration for reference.



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Fig. 14: Testing Specific Gravity

Courtesy of KIA MOTORS AMERICA, INC.

RELATION BETWEEN COOLANT CONCENTRATION & SPECIFIC GRAVITY

CAUTION:

- If the concentration of the coolant is below 30%, its anti-corrosion property will be adversely affected.
- If the concentration is above 60%, the engine cooling property will decrease, affecting the engine adversely. For these reasons, be sure to maintain the concentration level within the specified range.
- Do not mix types of antifreeze.

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Coolant temperature °C (°F) and specific gravity					Freezing temperature °C (°F)	Safe operating temperature °C (°F)	Coolant concentration (Specific volume)
10 (50)	20 (68)	30 (86)	40 (104)	50 (122)			
1.054	1.050	1.046	1.042	1.036	-16 (3.2)	-11 (12.2)	30%
1.063	1.058	1.054	1.049	1.044	-20 (-4)	-15(5)	35%
1.071	1.067	1.062	1.057	1.052	-25 (-13)	-20 (-4)	40%
1.079	1.074	1.069	1.064	1.058	-30 (-22)	-25 (-13)	45%
1.087	1.082	1.076	1.070	1.064	-36 (-32.8)	-31 (-23.8)	50%
1.095	1.090	1.084	1.077	1.070	-42 (-44)	-37 (-35)	55%
1.103	1.098	1.092	1.084	1.076	-50 (-58)	-45 (-49)	60%

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Fig. 15: Relation Between Coolant Concentration & Specific Gravity Table
Courtesy of KIA MOTORS AMERICA, INC.

Example

The safe operating temperature is -15°C (5°F) when the measured specific gravity is 1.058 at coolant temperature of 20°C (68°F)

RECOMMENDED COOLANT

Antifreeze	Mixture ratio of antifreeze in coolant
ETHYLENE GLYCOL BASE FOR ALUMINUM	50% [Except tropical areas] 40% [Tropical areas]

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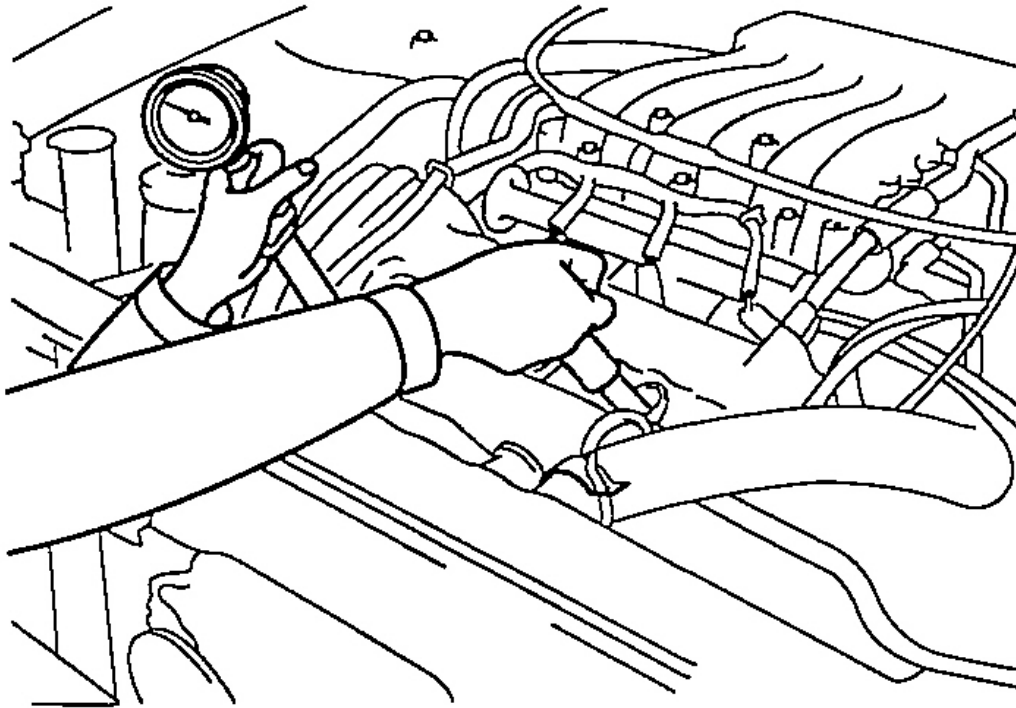
Fig. 16: Recommended Coolant
Courtesy of KIA MOTORS AMERICA, INC.

CHECKING COMPRESSION PRESSURE

1. Before checking the engine compression, check the engine oil level. Also check that the starter motor and battery are all in normal operating condition.
2. Start the engine and wait until the engine coolant temperature reaches 80-95°C (176-205°F).
3. Stop the engine and disconnect the spark plug cables.
4. Remove the spark plugs.
5. Crank the engine to remove any foreign material in the cylinders.
6. Insert the compression gauge into the spark plug hole.
7. Depress the accelerator pedal to open the throttle fully.
8. Crank the engine and read the gauge.

Standard value: 1,275 kPa (13.0 kg/cm²), 185 psi)

Limit: 1,128 kPa (11.5 kg/cm² , 164 psi)



G00340173

Fig. 17: Checking Compression Pressure
Courtesy of KIA MOTORS AMERICA, INC.

9. Repeat steps 6 to 8 for all cylinders, making sure that the pressure difference for each of the cylinders is within the specified limit.

Limit:

Max. 100 kPa (1.0 kg/cm² , 14 psi) between cylinders

10. If a cylinder's compression or pressure differential is outside the specification, add a small amount of oil through the spark plug hole, and repeat steps 6 to 9.
 1. If the addition of oil causes the compression to rise, it is possible that the piston ring is be worn.
 2. If the compression remains the same, valve seizure, poor valve seating or a compression leak in the cylinder head gasket are all possible causes.

Tightening torque

Spark plug: 20-30 N.m (200-300 kg. cm, 14-22 lb. ft)

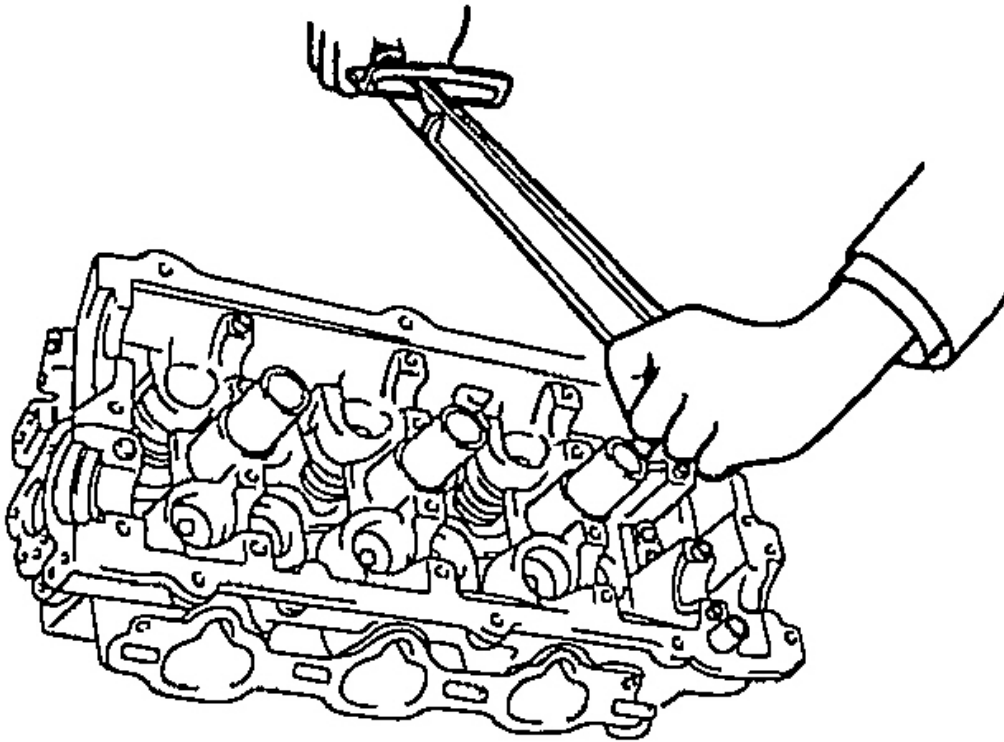
TIGHTENING CYLINDER HEAD BOLTS

1. First loosen slightly and then tighten to the specified torque.

Tightening torque

Cylinder head bolts cold [Engine temperature approximately 20°C (68°F)]:

105-115 N.m (1050-1150 kg. cm, 75-82 lb ft.)



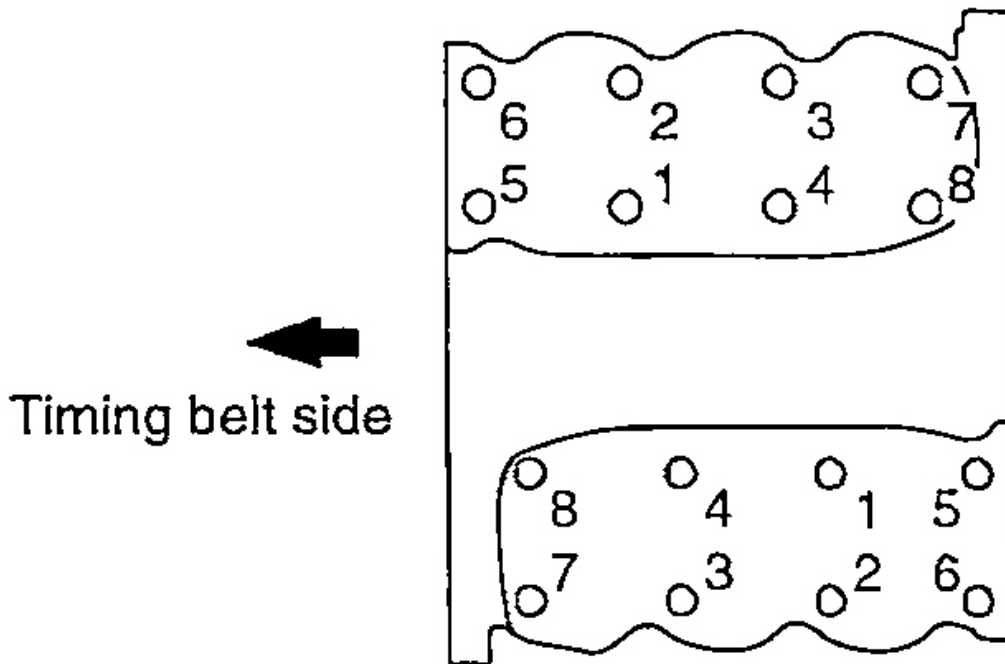
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Fig. 18: Tightening Cylinder Head Bolts
Courtesy of KIA MOTORS AMERICA, INC.

2. Be sure to follow the specific torque sequence as shown in the illustration.

NOTE: Run the engine to normal operating temperature and let it cool, then re-

torque the bolts to specifications.



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Fig. 19: Cylinder Head Bolt Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

ADJUSTING VALVE CLEARANCE

As the intake and exhaust valves are equipped with hydraulic lash adjusters, there is no need to adjust the valve clearance. The proper function of the hydraulic lash mechanism may be determined by checking for tappet noise. When there is a tappet noise or any unusual noise, check the hydraulic lash adjuster by removing and bleeding or replacing it.

ADJUSTING DRIVE BELT & TENSIONER

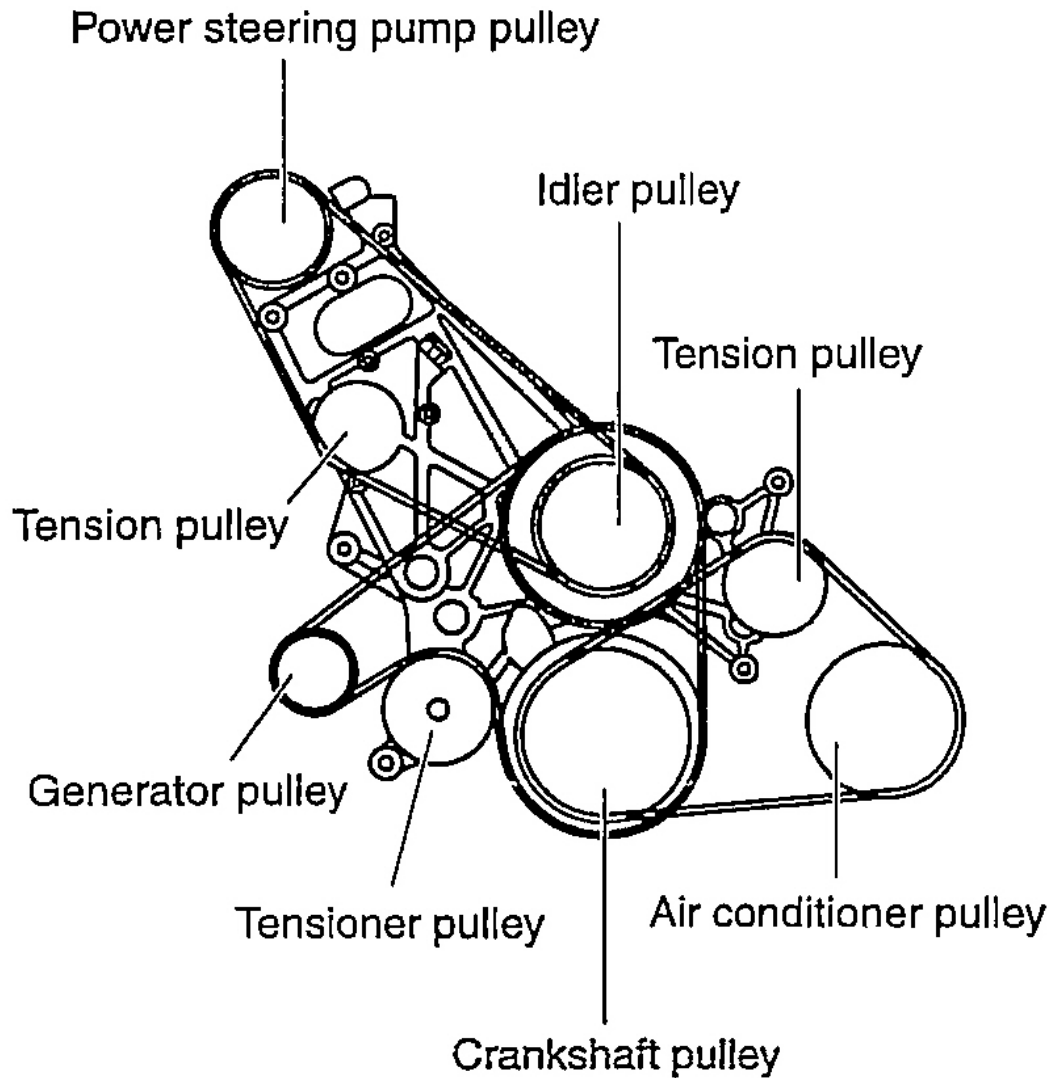
1. Hang the belt on the pulley of the tensioner and install the tensioner.

(If the tensioner is already installed, loosen its mounting bolts to allow belt installation.)

Tightening torque

Tensioner assembly bolt:

45-50 N.m (450-500 kg. cm, 33-36 lb. ft)



G00340176

Fig. 20: Adjusting Drive Belt & Tensioner
Courtesy of KIA MOTORS AMERICA, INC.

2. Install drive belt.
3. Adjust the drive belt tension to specification by turning the adjusting bolt clockwise or counter clockwise.

Standard Value

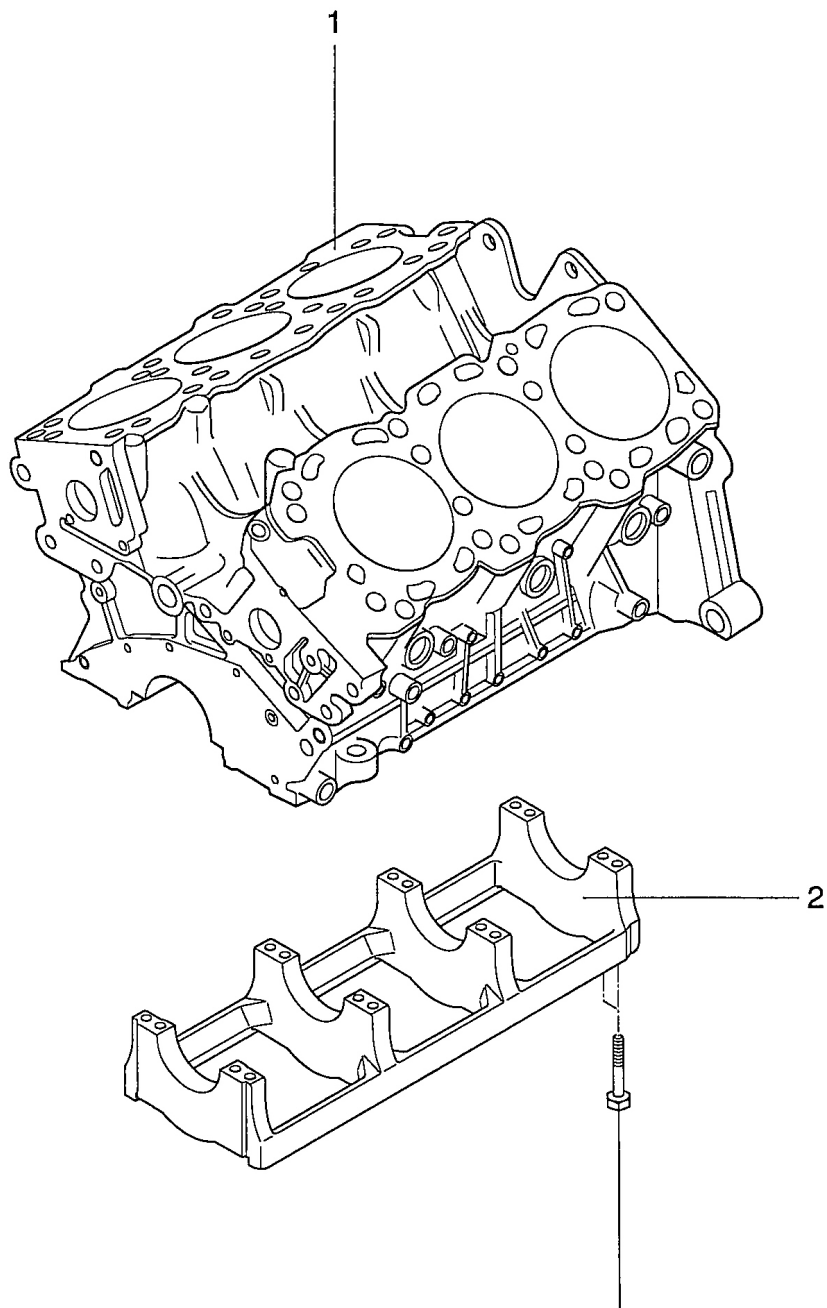
Air Conditioner compressor: 7-10 mm (0.28-0.039 In.)

Alternator: 10-13 mm (0.39-0.51 In.)

Power steering: 8-11 mm (0.31-0.43 In.)

4. When installing the belt on the pulley, make sure it is centered on the pulley.

ENGINE BLOCK**ENGINE BLOCK****COMPONENTS**



68.6-78.5 (700-800, 50.6-57.9)

TORQUE : N·m (kg·cm, lb·ft)

- 1. Cylinder Block
- 2. Main bearing cap

G00340178

Fig. 21: Crankshaft Main Bearing Cap Torque Specifications

Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

Remove the **CYLINDER HEAD ASSEMBLY**, drive plate, transaxle mounting plate, oil pan and oil pump case.

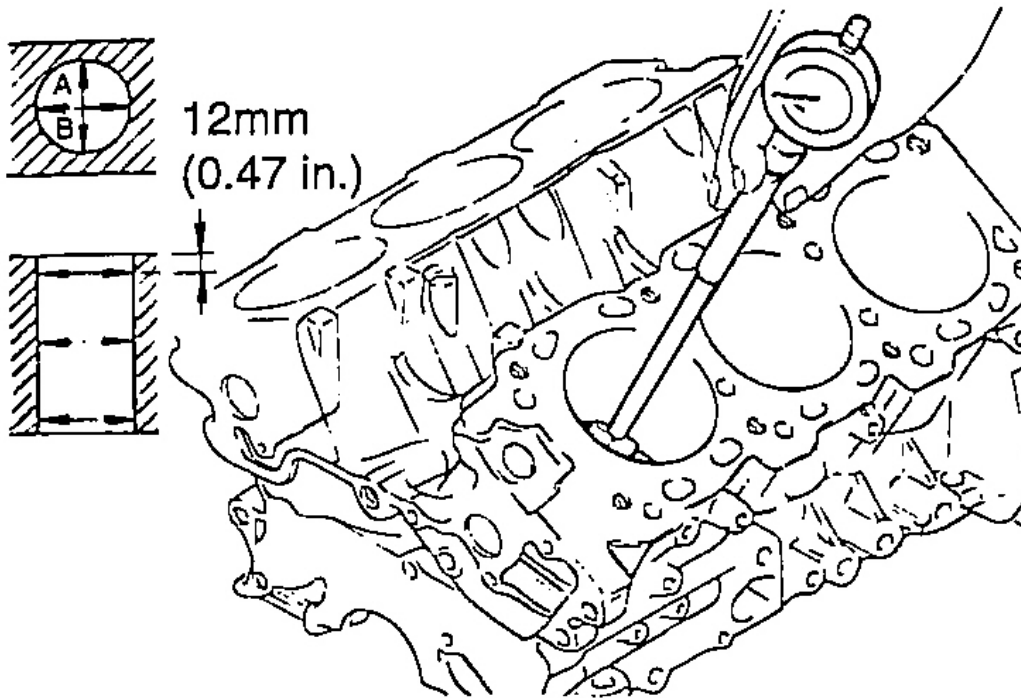
INSPECTION

1. Check the cylinder block for scores, rust and corrosion. Also check for cracks or any other defects. Replace the block if defective.
2. Measure the cylinder bore with a cylinder gauge at the three levels indicated, in the directions A and B, as shown in illustration.

Level 1: No. 1 piston ring position at TDC

Level 2: Center of cylinder

Level 3: Bottom of cylinder



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Fig. 22: Measuring Cylinder Bore**Courtesy of KIA MOTORS AMERICA, INC.**

3. If the cylinder bores show more than the specified out-of-round or taper, or if the cylinder walls are badly scuffed or scored, the cylinder block should be re-bored and honed. New oversize pistons and rings should be installed.

Standard value

Cylinder bore: 93-93.03 mm (3.661-3.6625 In.)

Out-of-round and taper of cylinder bore:

Max. 0.02 mm (0.0008 In.)

4. If a ridge exists at the top of the cylinder, cut it off with a ridge reamer.
5. Oversize pistons are available in two sizes.

Piston service size and mark mm (In.)

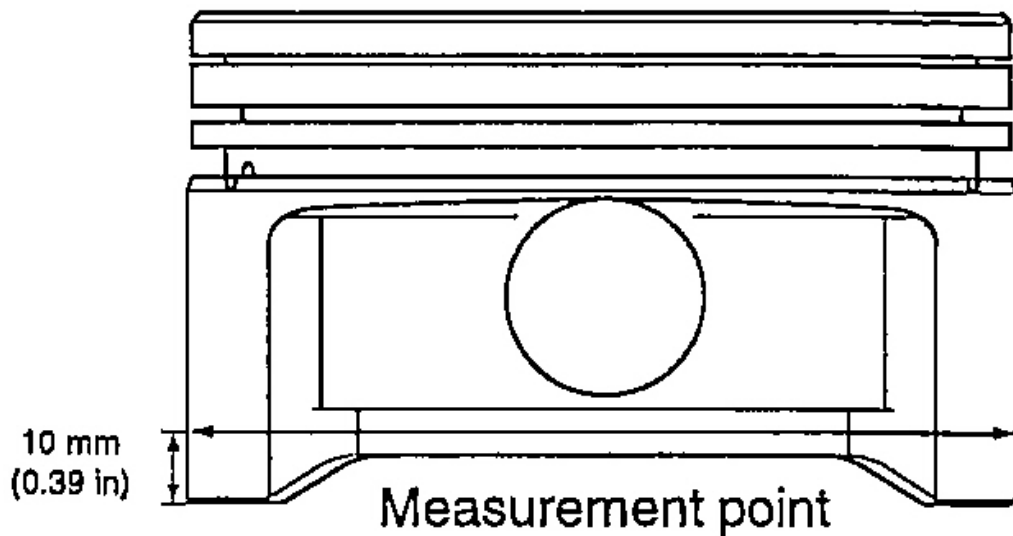
0.25 (0.010) O.S: 0.25

0.50 (0.020) O.S: 0.50

6. To re-bore the cylinder bore to the oversize, maintain the specified clearance between the oversize piston and the bore and make sure that all used pistons are the same oversize. The standard measurement of the piston outside diameter is taken at a level of 10 mm (0.39 In.) above the bottom of the piston skirt and across the thrust faces.

Piston-to-cylinder clearance:

0.03-0.05 mm (0.0012-0.0020 In.)



G00340180

Fig. 23: Measuring Piston

Courtesy of KIA MOTORS AMERICA, INC.

7. Check for damage or cracks in the cylinders.
8. Check the top surface of the cylinder block for flatness. If the top surface exceeds the limit, grind to the minimum limit or replace.

Standard value

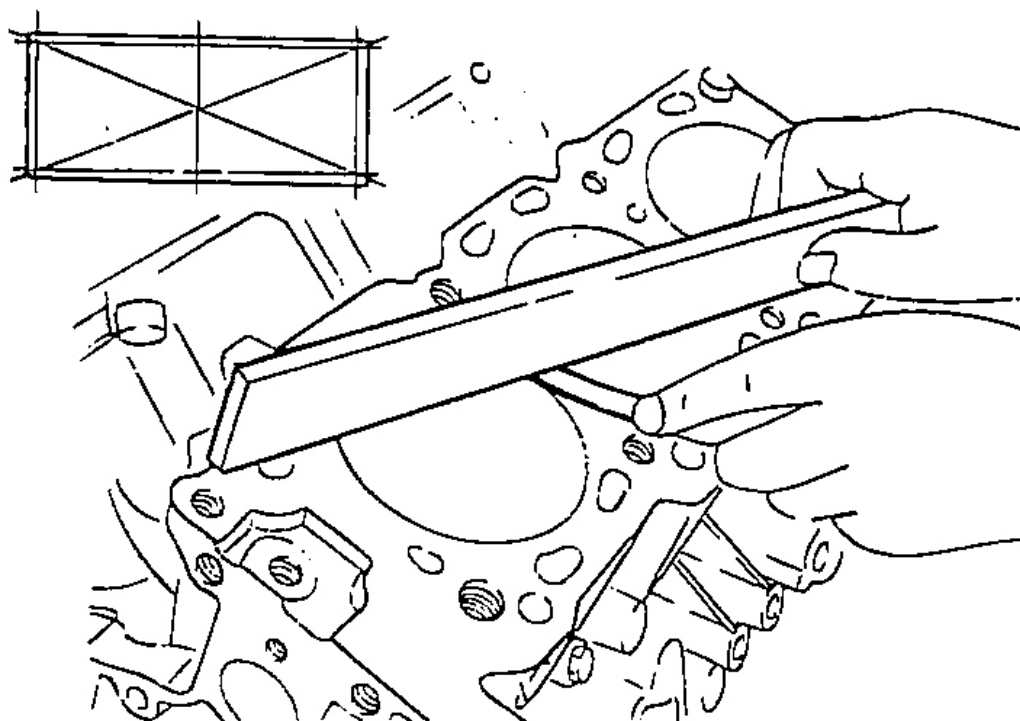
Flatness of gasket surface:

Max. 0.03 mm (0.0012 In.)

Service limit

Flatness of gasket surface: 0.05 mm (0.0020 In.)

CAUTION: When the cylinder head is assembled, grinding less than 0.2 mm (0.008 In.) is permissible.



G00340181

Fig. 24: Checking Cylinder Block For Flatness
Courtesy of KIA MOTORS AMERICA, INC.

BORING CYLINDER

1. Oversize pistons should be selected according to the largest bore cylinder.

Identification Mark	Size
0.25	0.25 mm (0.010 in.)
0.50	0.50 mm (0.020 in.)

G00340182

Fig. 25: Oversize Piston Identification

Courtesy of KIA MOTORS AMERICA, INC.

NOTE: **The size of piston is stamped on top of the piston.**

2. Measure the outside diameter of the piston to be used.
3. According to the measured O.D., calculate the new bore size.

New bore size = Piston O.D. + 0.03 to 0.05 mm (0.0012 to 0.002 In.) (clearance between piston and cylinder) -0.01 mm (0.0004 In.) (honing margin.)

4. Bore each of the cylinders to the calculated size.

CAUTION: To prevent distortion that may result from temperature rise during honing, bore the cylinder holes in the firing order.

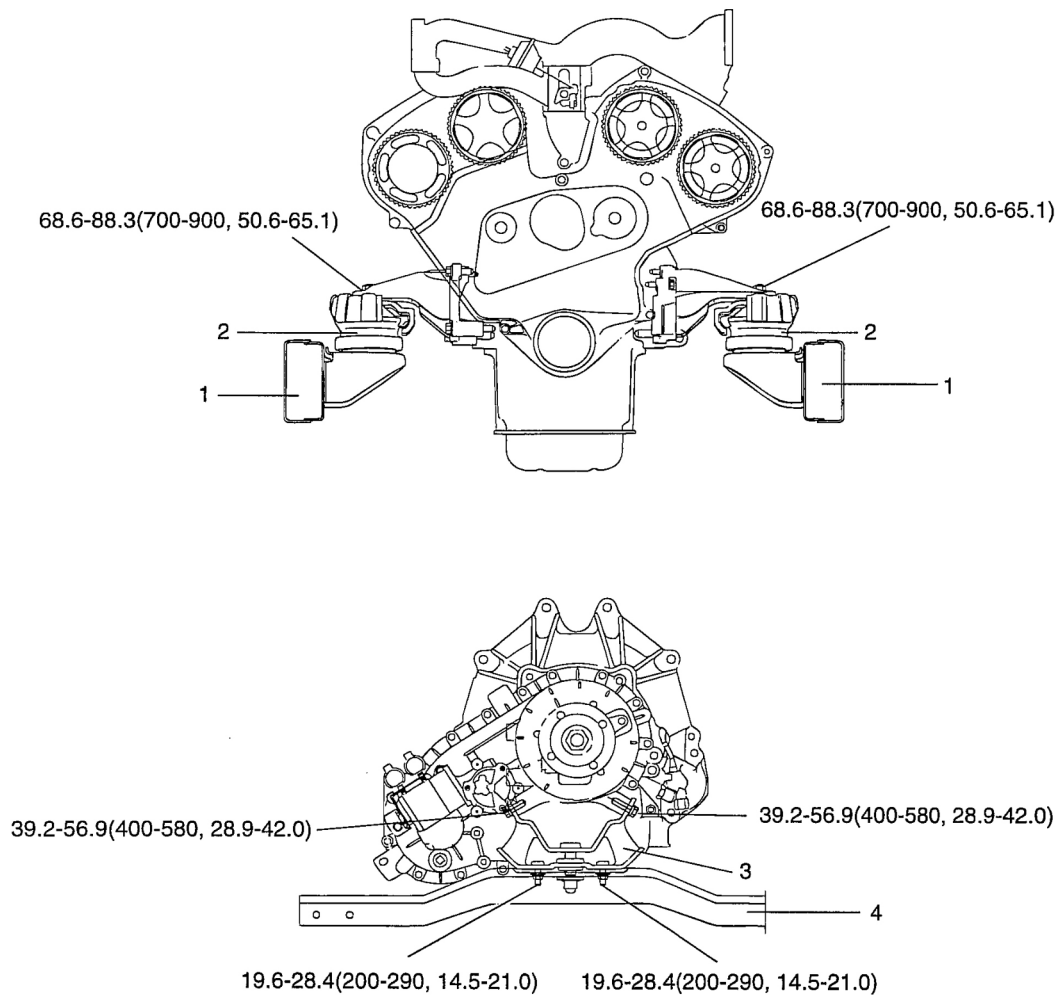
5. Hone the cylinders, finishing them to the proper dimension (piston outside diameter + gap with cylinder).
6. Check the clearance between the piston and cylinder.

Standard: 0.03-0.05 mm (0.0012- 0.0020 In.)

NOTE: **When boring the cylinders, finish all of the cylinders to the same oversize. Do not bore only one cylinder to the oversize.**

ENGINE MOUNTS

COMPONENTS



TORQUE : N·m (kg·cm, lb·ft)

- 1. Frame
- 2. Engine mounting

- 3. Transmission mounting
- 4. Cross member

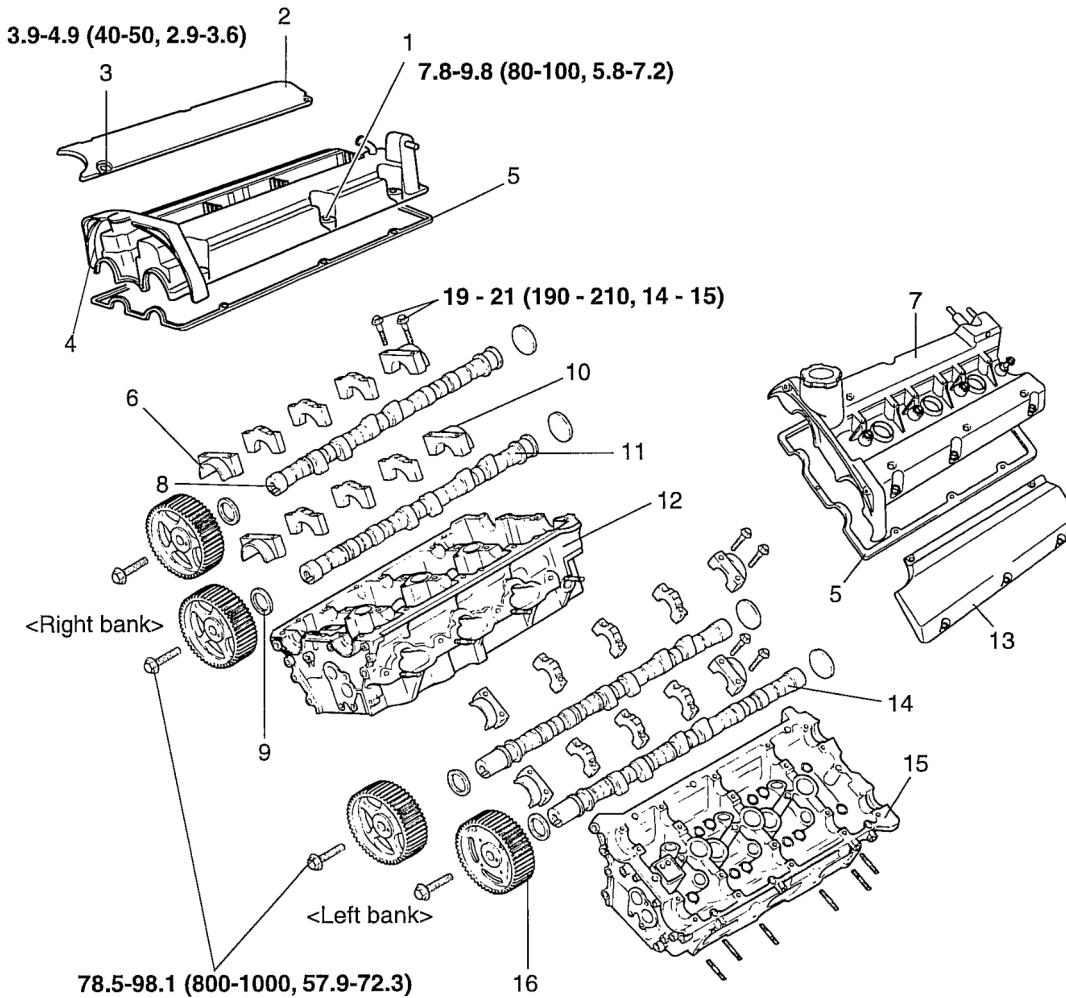
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Fig. 26: Identifying Engine Mounts & Torque Specifications
 Courtesy of KIA MOTORS AMERICA, INC.

MAIN MOVING SYSTEM

CAMSHAFT

COMPONENTS



TORQUE : N·m (kg·cm, lb·ft)

- | | |
|-----------------------------|------------------------|
| 1. Cylinder head cover bolt | 9. Camshaft oil seal |
| 2. Center cover | 10. Bearing cap (Rear) |
| 3. Center cover bolt | 11. Camshaft (IN) |
| 4. Cylinder head cover | 12. Cylinder head (RH) |
| 5. Gasket | 13. Center cover |
| 6. Bearing cap (Front) | 14. Camshaft (EX) |
| 7. Cylinder head cover | 15. Cylinder head (LH) |
| 8. Camshaft (EX) | 16. Camshaft sprocket |

G00340184

Fig. 27: Identifying Camshaft System Components & Torque Specifications
Courtesy of KIA MOTORS AMERICA, INC.

DISASSEMBLY

1. Remove intake manifold.
2. Disconnect the breather hose and the engine harness.

3. Remove the power steering pulley, air conditioner pulley, crankshaft pulley, idler pulley and tensioner pulley.
4. Remove the timing belt cover.
5. Loosen the auto tensioner.
6. Remove the timing belt from the camshaft sprocket.
7. Remove the spark plug cables.
8. Loosen the cylinder head (valve) cover bolts and then remove it.
9. Remove the camshaft sprockets.
10. Remove the camshaft bearing caps.
11. Remove the camshafts.

INSPECTION

CAMSHAFTS

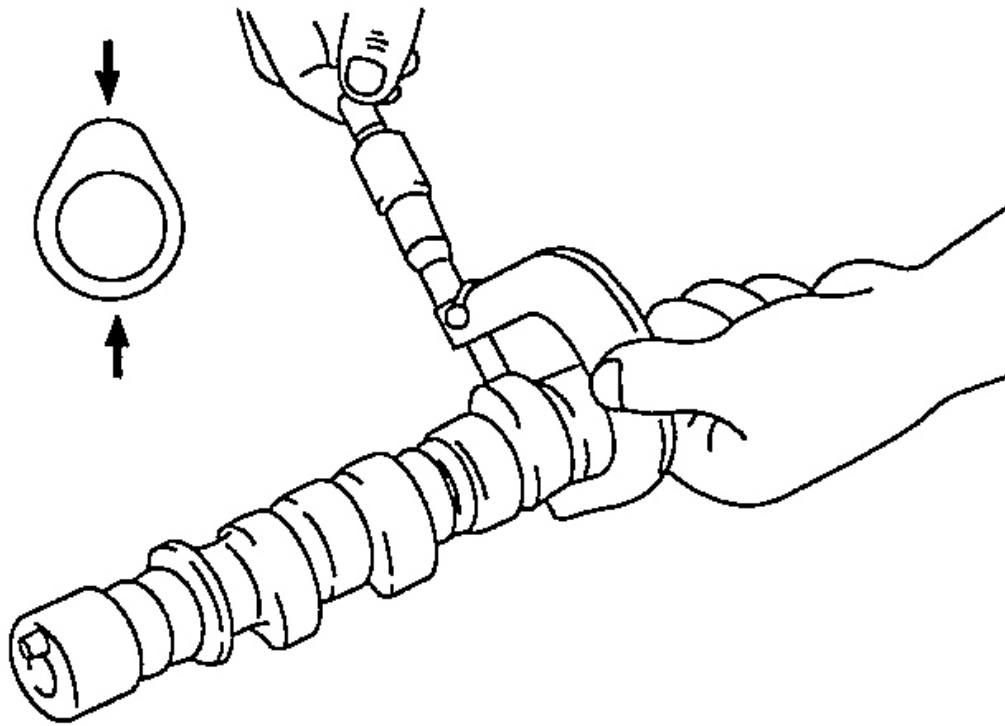
1. Check the camshaft journals for wear. If the journals are badly worn out, replace the camshaft.
2. Check the cam lobes for damage. If the lobe is damaged or excessively worn out, replace the camshaft.

Cam height

[Standard]

Intake: 35.098-35.298 mm (1.3818-1.3897 In.)

Exhaust: 34.81-35.01 mm (1.3705-1.3783 In.)



G00340188

Fig. 28: Measuring Cam Lobes

Courtesy of KIA MOTORS AMERICA, INC.

3. Check the cam surface for abnormal wear or damage, and replace if necessary.
4. Check each bearing for damage. If the bearing surface is excessively damaged, replace the cylinder head assembly or camshaft bearing cap, as necessary.

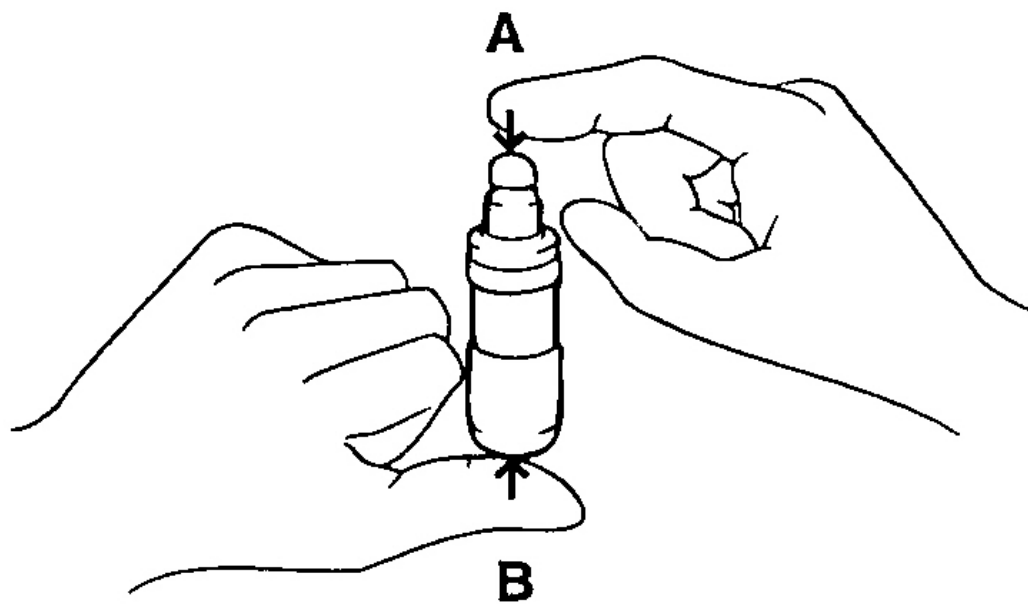
Camshaft end play: 0.1-0.15 mm (0.0039-0.0059 In.)

OIL SEAL (CAMSHAFT FRONT)

1. Check the lips for wear. If lip threads are worn out, replace the oil seal with new one.
2. Check a contact surface of oil seal lip on camshaft. If there stratified wear, replace the camshaft.

HLA (HYDRAULIC LASH ADJUSTER)

With the HLA filled with engine oil, hold A and press B by hand, as shown in illustration. If B moves, replace the HLA.



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Fig. 29: Inspecting Hydraulic Lash Adjusters
Courtesy of KIA MOTORS AMERICA, INC.

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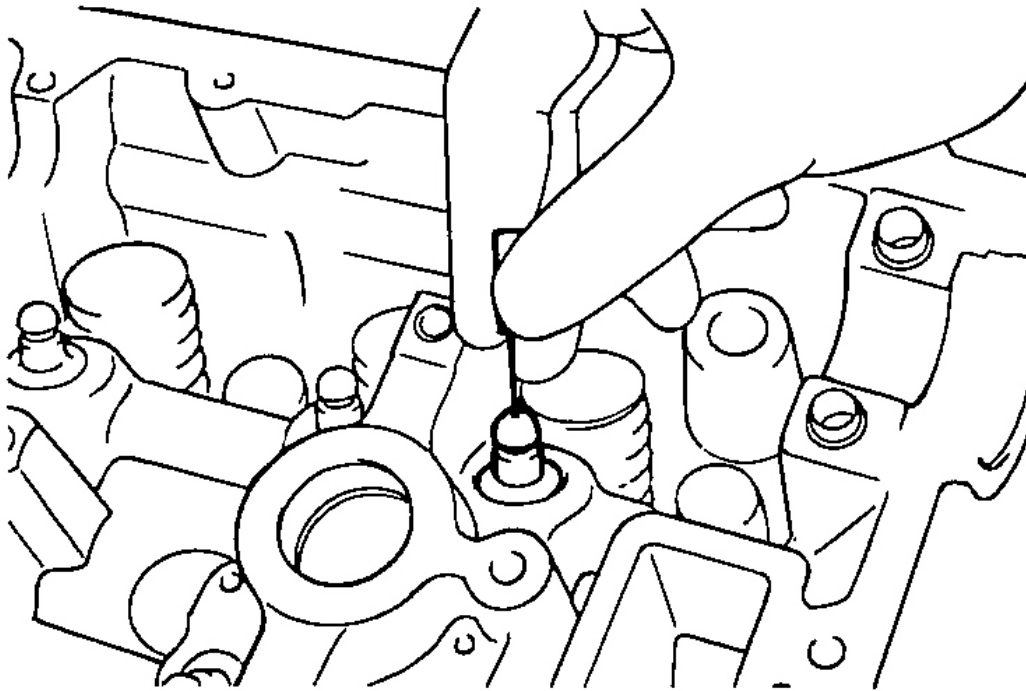
Problem	Possible cause	Action
1. Temporary noise when starting a cold engine	Normal	This noise will disappear after the oil in the engine reaches the normal pressure.
2. Continuous noise when the engine is started after parking more than 48 hours.	Oil leakage of the high pressure chamber on the HLA, allowing air to get in.	Noise will disappear within 15 minutes when engine runs at 2000-3000 rpm. If it doesn't disappear, refer to step 7 below.
3. Continuous noise when the engine is first started after rebuilding cylinder head.	Insufficient oil in cylinder head oil gallery.	
4. Continuous noise when the engine is started after excessively cranking the engine by the starter motor or band.	Oil leakage of the high-pressure chamber in the HLA, allowing air to get in. Insufficient oil in the HLA.	
5. Continuous noise when the engine is running after changing the HLA.		
		 CAUTION <i>Do not run engine at a speed higher than 3000 rpm, as this may damage the HLA.</i>
6. Continuous noise during idle after high engine speed.	Engine oil level too high or too low.	Check oil level. Drain or add oil as necessary.
	Excessive amount of air in the oil at high engine speed.	Check oil supply system.
	Deteriorated oil.	Check oil quality. If deteriorated, replace with specified type.
7. Noise continues for more than 15 minutes.	Low oil pressure.	Check oil pressure and oil supply system of each part of engine.
	Faulty HLA.	Remove the cylinder head cover and press HLA down by hand. If it moves, replace the HLA.  WARNING <i>Be careful with the hot HLAS.</i>

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Fig. 30: Hydraulic Lash Adjuster Symptom Table
 Courtesy of KIA MOTORS AMERICA, INC.

AUTO-LASH ADJUSTER

1. Check auto-lash adjusters for free play by inserting a small wire through the air bleed hole in the rocker arm and push the auto lash adjuster check ball down very lightly.
2. While lightly holding the check ball down, move the rocker arm up and down to check for free play. If there is no play, replace the auto-lash adjuster.

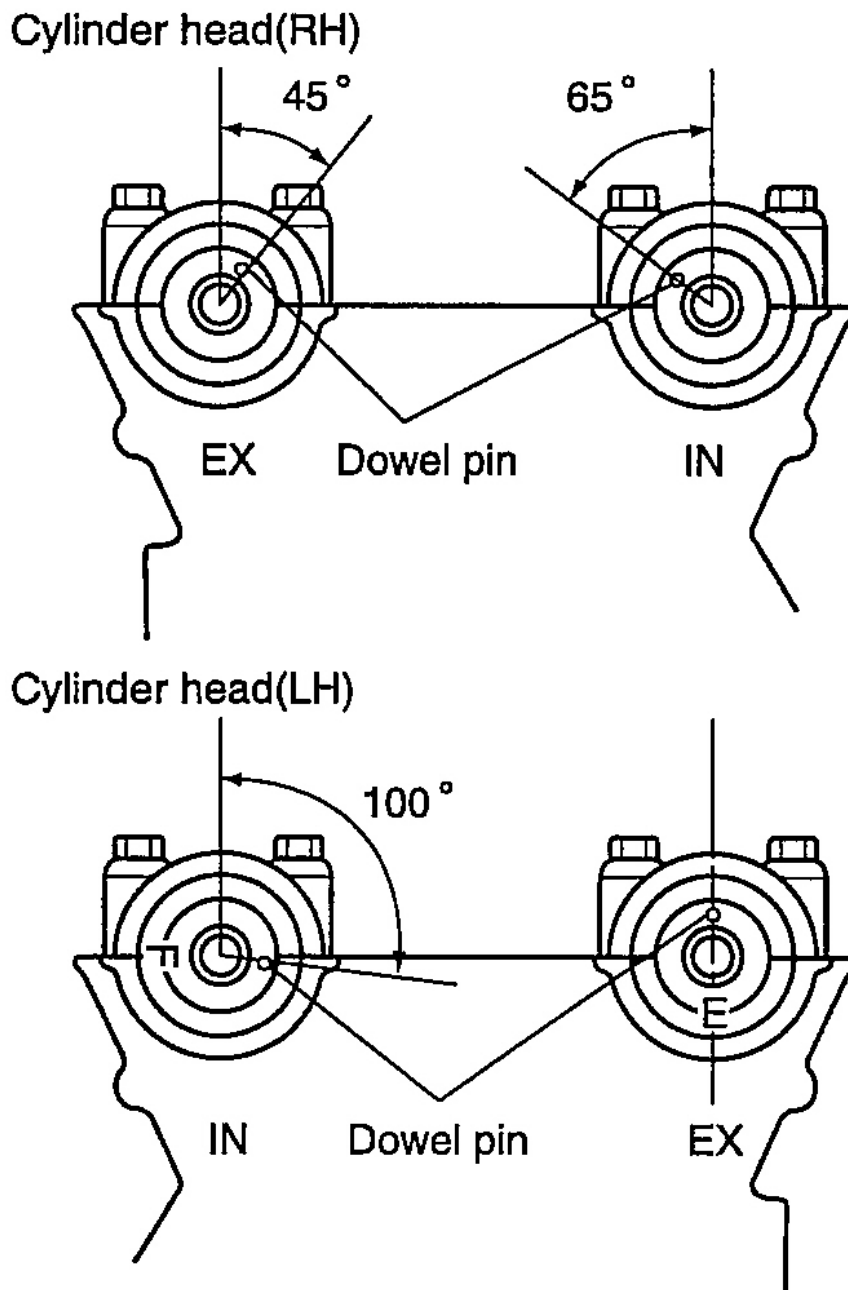


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Fig. 31: Inspecting Auto-Lash Adjusters
Courtesy of KIA MOTORS AMERICA, INC.

REASSEMBLY**CAMSHAFT & BEARING CAP**

1. Rotate the crankshaft and ensure No. 1 cylinder is in TDC (Compression stroke).
2. Ensure position of the rocker arm is installed exactly on the lash adjuster and valve.
3. Install the camshaft dowel pin as shown in illustration.



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Fig. 32: Camshaft Installation Positions At TDC
Courtesy of KIA MOTORS AMERICA, INC.

4. The left and right banks of the camshafts are different and you should be careful not to confuse them.

Identification signal

Left bank

Intake (IN) : I

Exhaust (Ex): E

Right bank

Intake (IN) : J

Exhaust (Ex): H

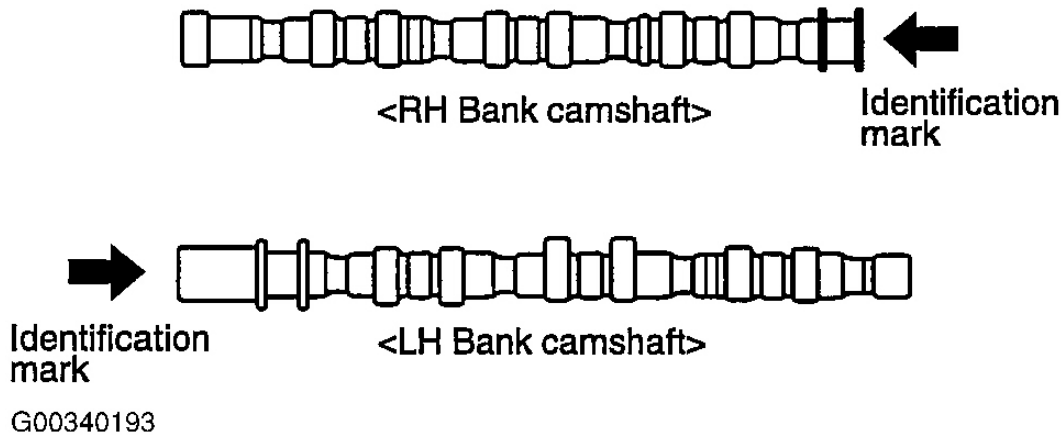


Fig. 33: Identifying Location Of Camshaft Identification Marks

Courtesy of KIA MOTORS AMERICA, INC.

5. Confirm the identification mark and the number. Bearing caps of No.3, No.4, and No.5 have the front mark and arrange the front mark upon the cylinder head while installing the bearing caps.

Identification mark

Intake : I

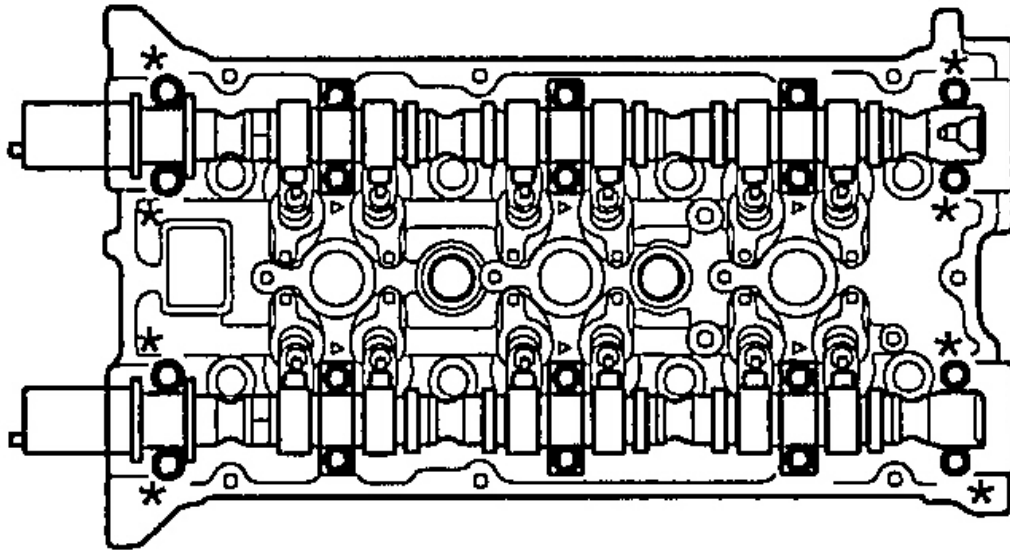
Exhaust : E

6. Tighten the bearing cap by 2 or 3 steps

Tightening Torque

Outer (See **Fig. 34** for * identification.) 16 EA: 18.6-20.6 N.m (190-210 kg. cm, 13.7-15.2 lb. ft)

Inner 24 EA: 9.8-11.8 N.m (100-120 kg. cm, 7.2-8.7 lb. ft)



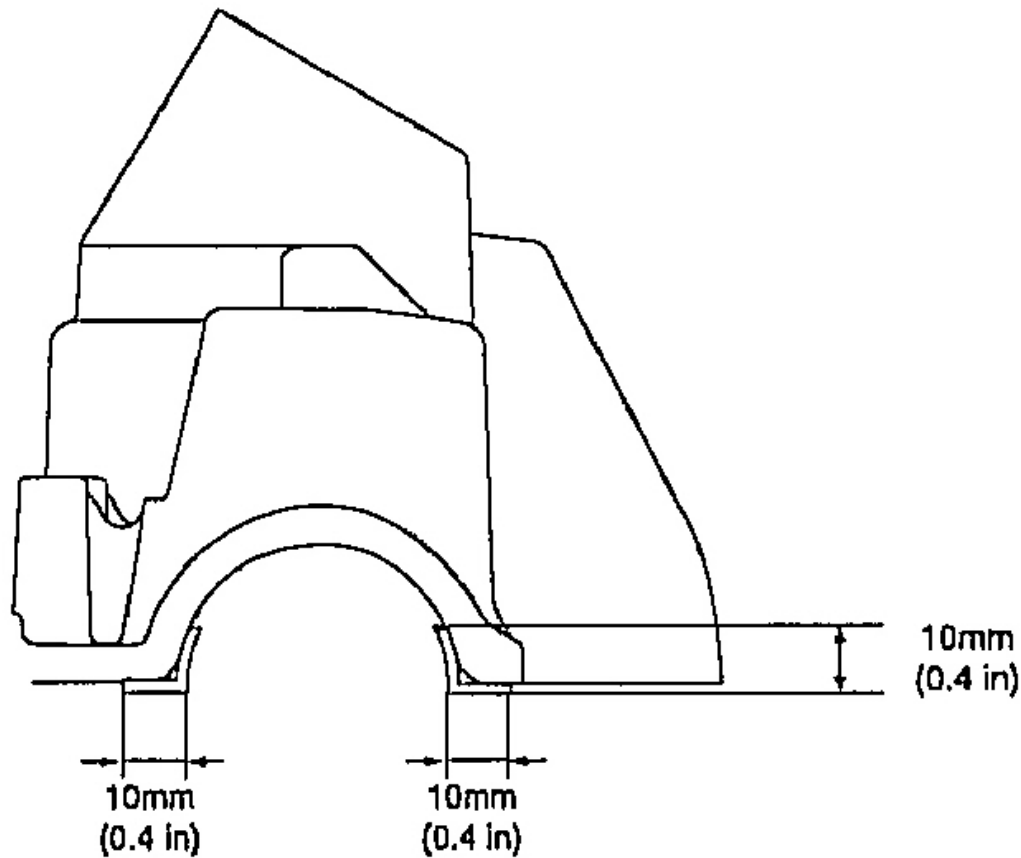
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Fig. 34: Identifying Outer Camshaft Bearing Caps
Courtesy of KIA MOTORS AMERICA, INC.

7. Install the cylinder head cover.
 1. Install the gasket to the cylinder head cover correctly.
 2. Clean sealing surface on camshaft cap.

NOTE: Clean sealing surface using a plastic scraper, to prevent oil leak.

3. Apply sealant to the sealing surface on cylinder head cover and camshaft cap.

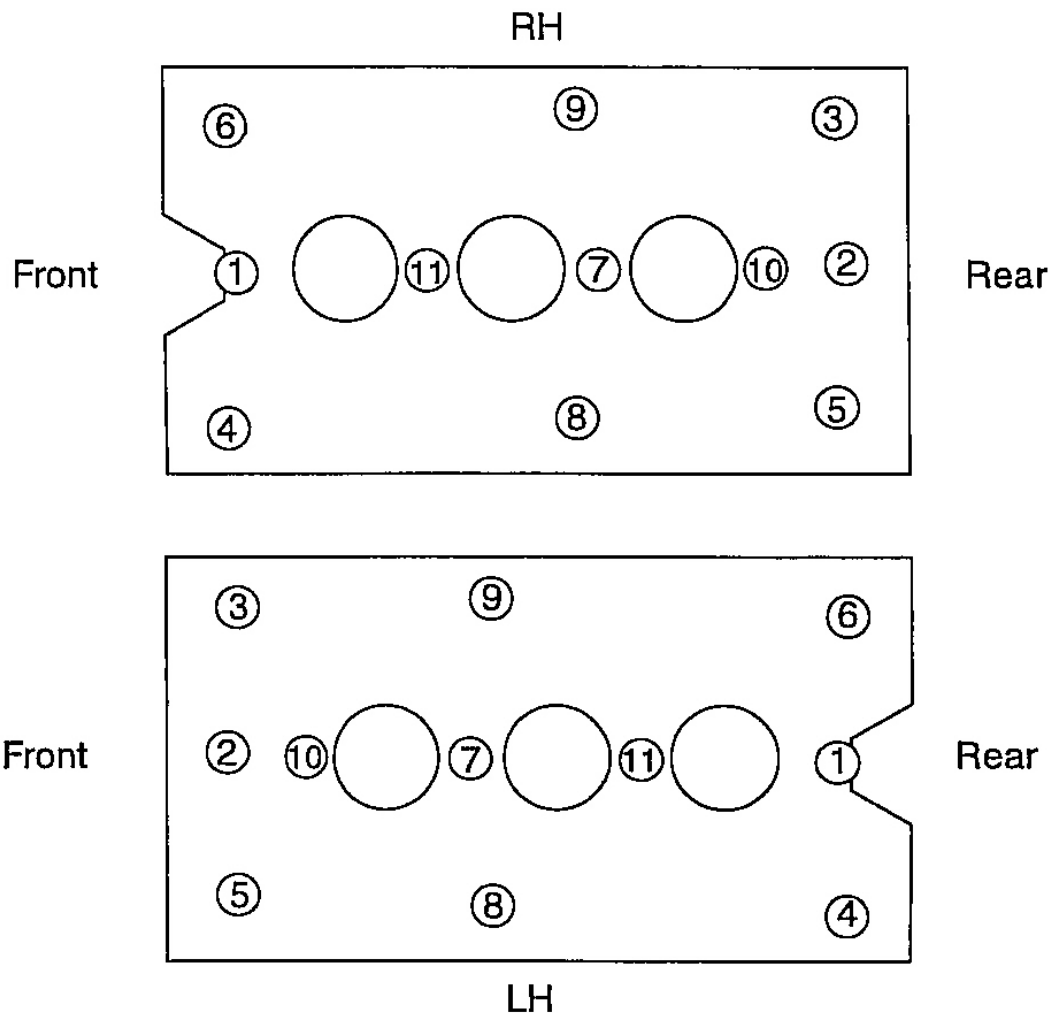


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Fig. 35: Apply Sealant To The Sealing Surface Of Camshaft Cap
Courtesy of KIA MOTORS AMERICA, INC.

4. Install the cylinder head cover to the cylinder head.

NOTE: Be careful of gasket escapement when installing the cylinder head cover. You must use the washers when installing the cylinder head cover bolts.

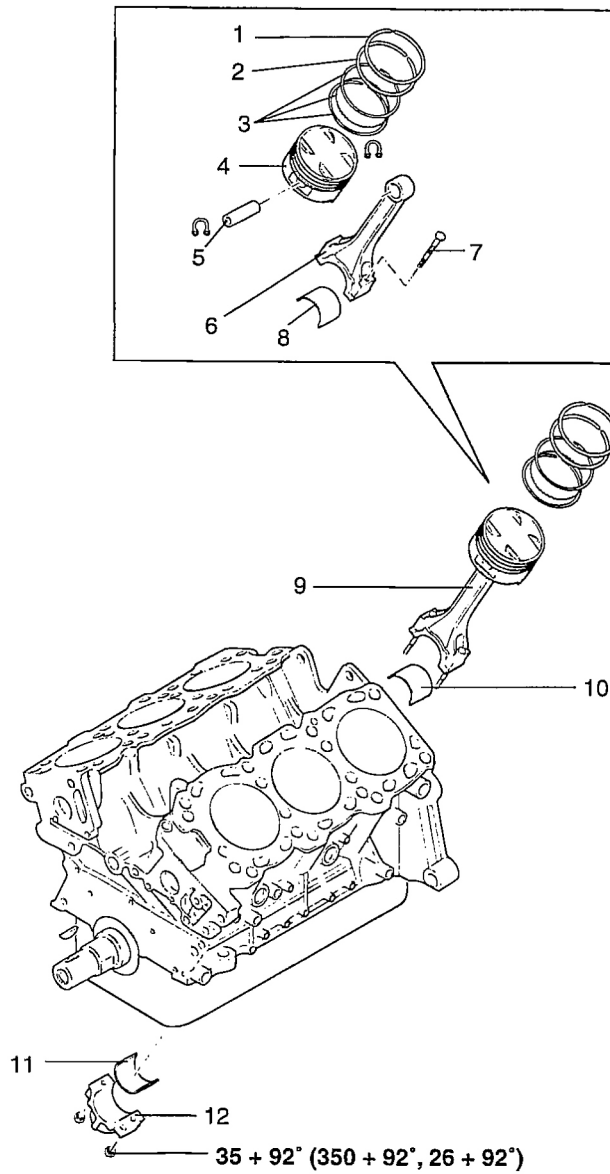


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Fig. 36: Cylinder Head Cover Bolt Tightening Sequence
 Courtesy of KIA MOTORS AMERICA, INC.

CONNECTING ROD

COMPONENTS



TORQUE : N·m (kg·cm, lb·ft)

- | | |
|----------------------|---------------------------------------|
| 1. No. 1 Piston ring | 7. Connecting rod bolt |
| 2. No. 2 Piston ring | 8. Connecting rod bearing |
| 3. Oil ring | 9. Piston and connecting rod assembly |
| 4. Piston | 10. Connecting rod upper bearing |
| 5. Piston pin | 11. Connecting rod lower bearing |
| 6. Connecting rod | 12. Connecting rod cap |

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Fig. 37: Identifying Connecting Rod Components & Torque Specifications
 Courtesy of KIA MOTORS AMERICA, INC.

DISASSEMBLY

CONNECTING ROD CAP

CAUTION: Keep the bearings in order with their corresponding connecting rods (according to cylinder numbers) for proper reassembly.

1. Remove the connecting rod cap bolts, then remove the caps and the big end lower bearing mark for reassembly.
2. Push each piston connecting rod assembly toward the top of the cylinder.

INSPECTION**PISTONS & PISTON PINS**

1. Check each piston for scuffing, scoring, wear and other defects. Replace any piston that is defective.
2. Check each piston ring for breakage, damage and abnormal wear. Replace the defective rings. When the piston requires replacement, its rings should also be replaced.
3. Check that the piston pin fits in the piston pin hole. Replace any piston and pin assembly that is defective. The piston pin must be pressed smoothly by hand into the pin hole (at room temperature).

PISTON RINGS

1. Measure the piston ring side clearance. If the measured value exceeds the service limit, insert a new ring in the ring groove to measure the side clearance. If the clearance still exceeds the service limit, replace the piston and rings together. If it is less than the service limit, replace only the piston rings.

Piston ring side clearance

No.1 : 0.04-0.08 mm (0.0016-0.0031 In.)

No.2 : 0.02-0.06 mm (0.0008-0.0024 In.)

2. To measure the piston ring end gap, insert a piston ring into the cylinder bore. Position the ring at right angles to the cylinder wall by gently pressing it down with a piston. Measure the gap with a feeler gauge. If the gap exceeds the service limit, replace the piston ring.

Piston ring end gap

[Standard dimensions]

No.1 : 0.2-0.3 mm (0.0079-0.00118 In.)

No.2 : 0.45-0.60 mm (0.0177-0.0236 In.)

Oil ring side rail : 0.2-0.7 mm (0.0079-0.0276)

When replacing the ring without correcting the cylinder bore, check the gap with the ring situated at the lower

part of cylinder that is less worn out.

PISTON RING SERVICE SIZE & MARK

NOTE: The mark can be found on the upper side of the ring next to the end.

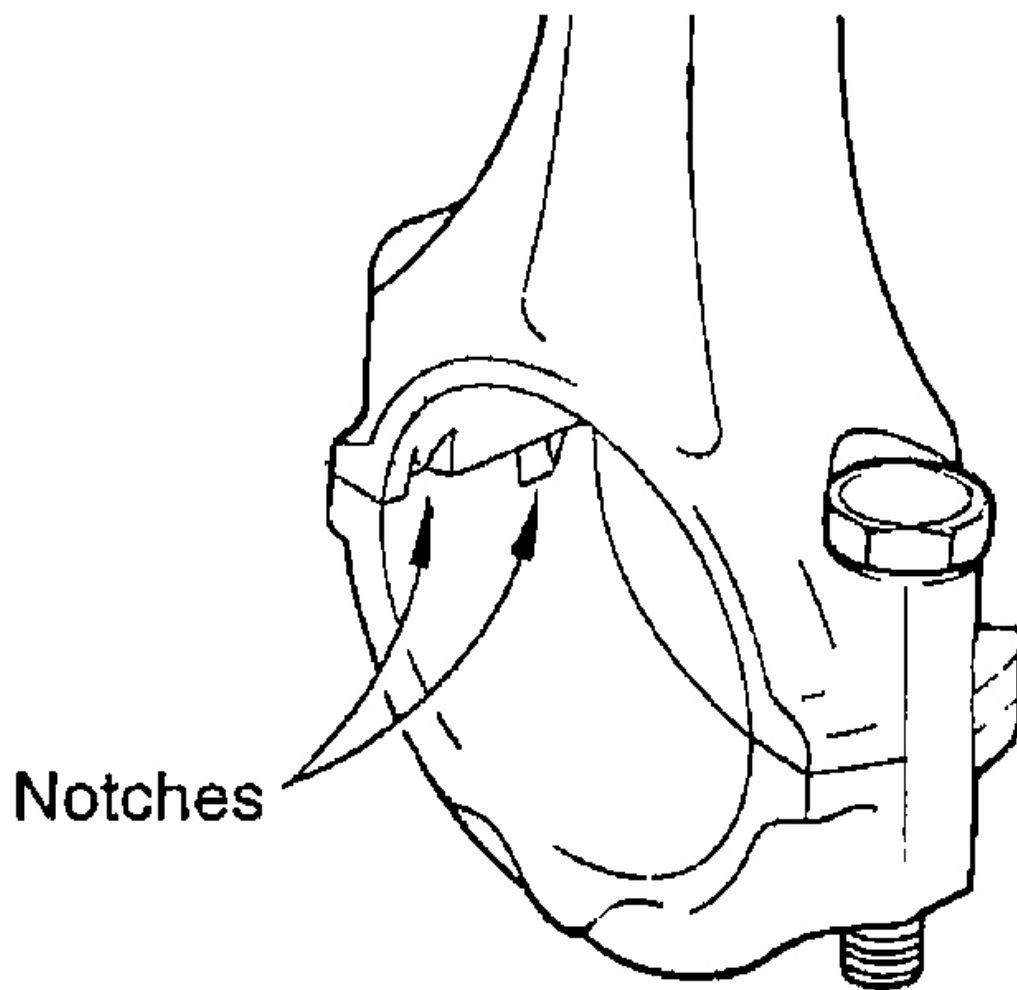
Standard	None
0.25 mm (0.010 in.) O.S	25
0.50 mm (0.020 in.) O.S	50

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Fig. 38: Piston Ring Service Size & Mark
Courtesy of KIA MOTORS AMERICA, INC.

CONNECTING RODS

1. When the connecting rod cap is installed, make sure that the cylinder numbers, marked on rod end cap at disassembly, match. When a new connecting rod is installed, make sure that the notches holding the bearings in place are on the same side.
2. Replace the connecting rod if it is damaged at either end of the thrust faces. If it has a stratified wear, or if the surface of the inside diameter of the small end is severely rough, replace the rod.

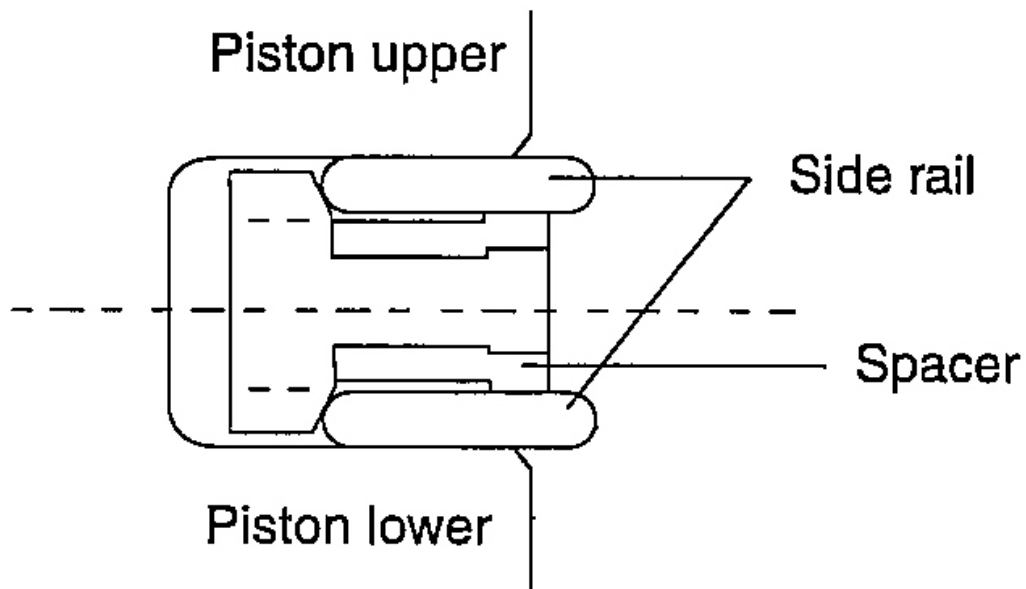


G00340202

Fig. 39: Identifying Connecting Rod Notches
Courtesy of KIA MOTORS AMERICA, INC.

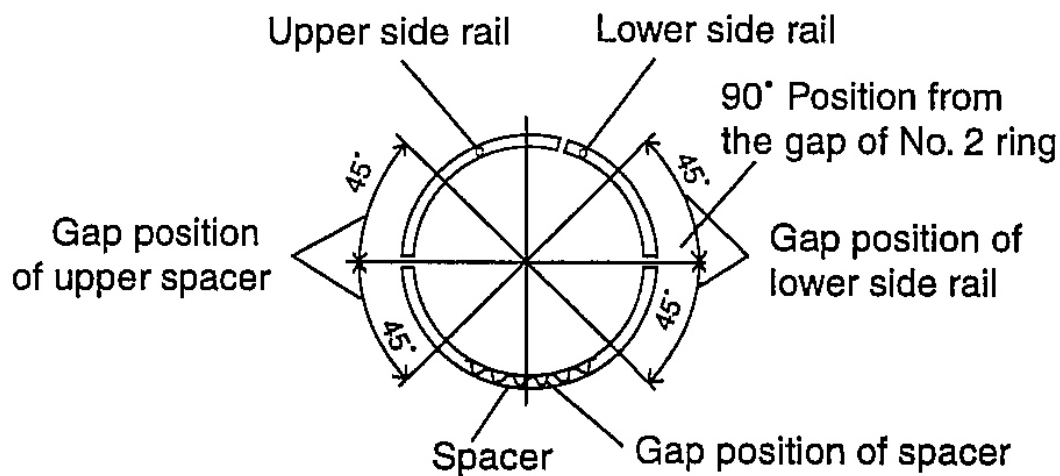
REASSEMBLY

1. Install the expander.



G00340203

Fig. 40: Identifying Oil Ring Components
 Courtesy of KIA MOTORS AMERICA, INC.



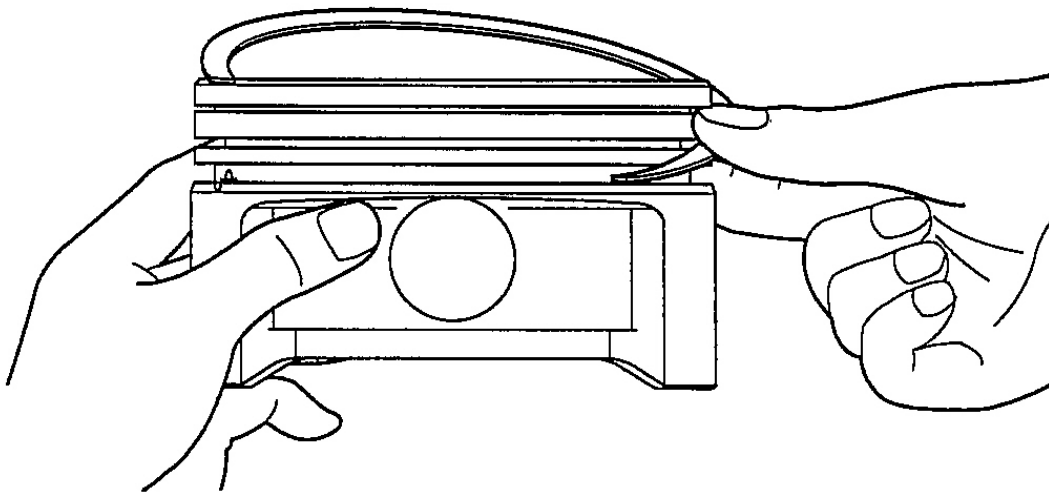
G00340204

Fig. 41: Aligning Oil Ring Spacer & Side Rail Gaps
Courtesy of KIA MOTORS AMERICA, INC.

2. Install the upper side rail. To install the side rail, first put one end of the side rail between the piston ring groove and spacer, hold it firmly, and press down with finger on the portion to be inserted into the groove (as illustrated).

CAUTION: Do not use a piston ring expander when installing the side rail.

3. Install the lower side rail by the same procedure described in Step 2.



G00340205

Fig. 42: Proper Technique To Install Side Rails
Courtesy of KIA MOTORS AMERICA, INC.

4. Apply engine oil around the piston and piston grooves.
5. Using a piston ring expander, install the No.2 piston ring.
6. Install the No. 1 piston ring.

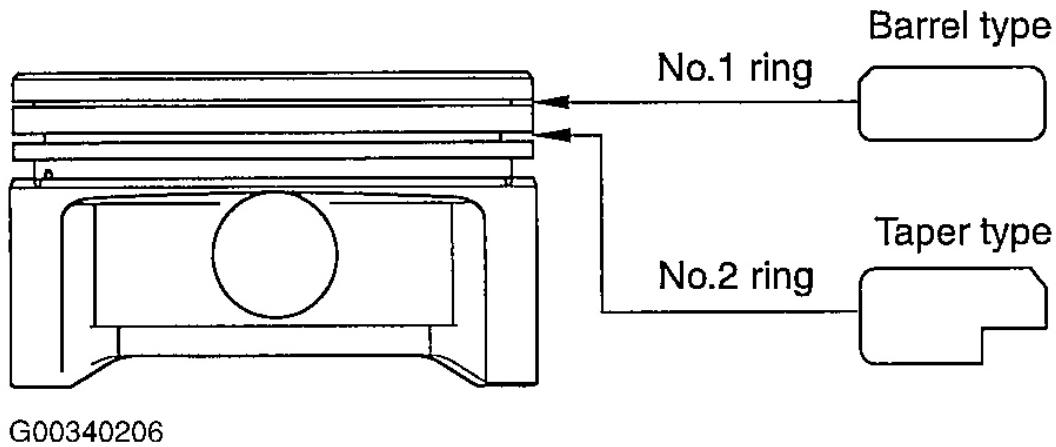


Fig. 43: Identifying No. 1 & 2 Piston Rings
Courtesy of KIA MOTORS AMERICA, INC.

7. Position each piston ring end gap as far away from its neighboring gaps as possible. Make sure that the gaps are not positioned in the thrust and pin directions.
8. Hold the piston rings firmly with a piston ring compressor as they are inserted into cylinder.

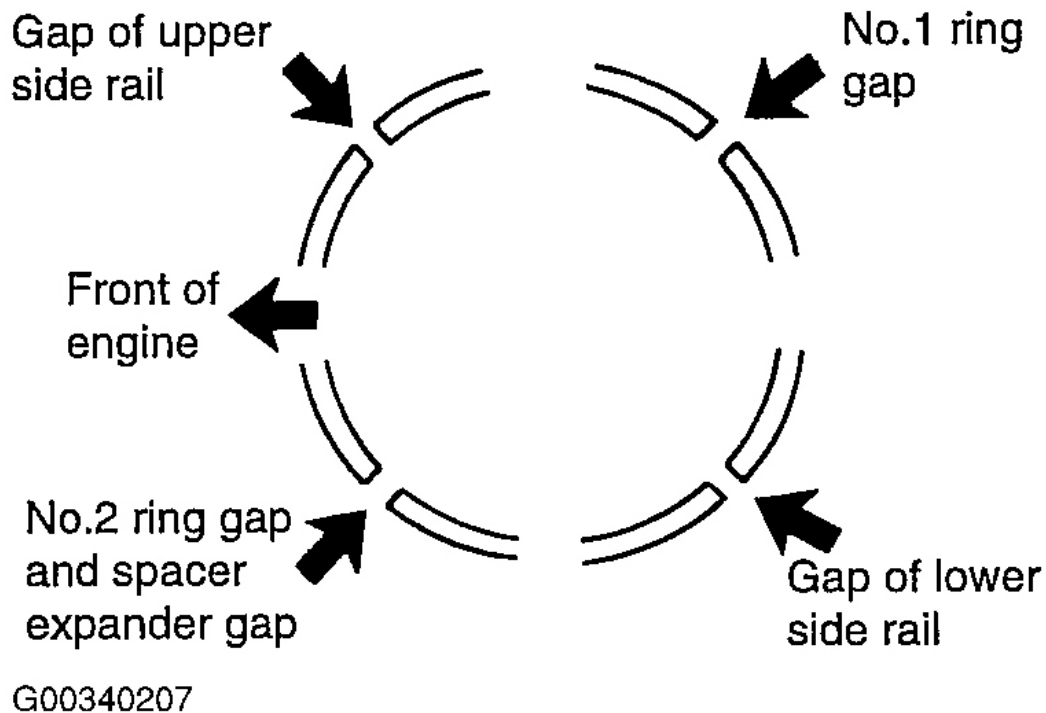


Fig. 44: Aligning Piston Rings Gaps
Courtesy of KIA MOTORS AMERICA, INC.

9. Install the upper connecting rod bearings in the connecting rod.
10. Install the lower connecting rod bearing in the connecting rod bearing caps.
11. Make sure that the front mark of the piston and the front mark (identification mark) of the connecting rod are directed toward the front of the engine.
12. When the connecting rod cap is installed, make sure that any cylinder numbers placed on the rod and cap at disassembly match.
13. When a new connecting rod is installed, make sure that the notches for holding the bearing in place are on the same side.
14. When assembling, bolts should be fastened using the plastic angle technique as follows.
 1. Apply oil to the threads and matching areas.
 2. Tighten the connecting rod bolt.

Tightening torque

Connecting rod bolt:

35 N.m + 92° (350 kg. cm + 92°, 26 lb. ft + 92°)

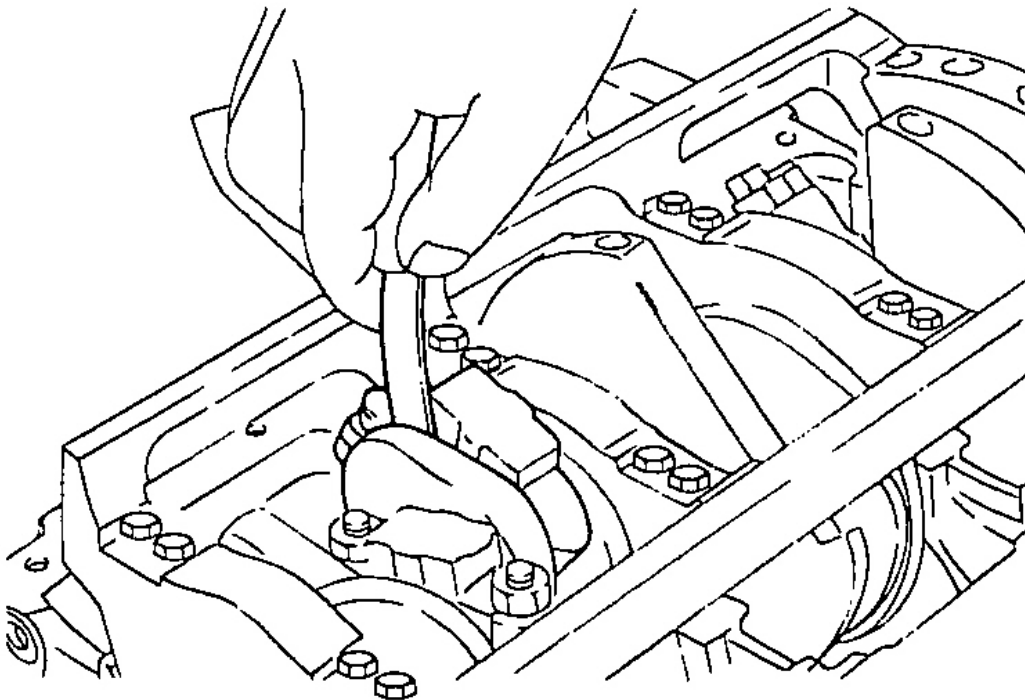
CAUTION: After removing the connecting rod bolt, do not use it again. When using a new bolt, do not tighten the bolt more than 3 times.

15. Check the connecting rod side clearance.

Connecting rod side clearance

Standard: 0.10-0.25 mm (0.0039-0.0098 In.)

Limit : 0.4 mm (0.0157 In.)



G00340209

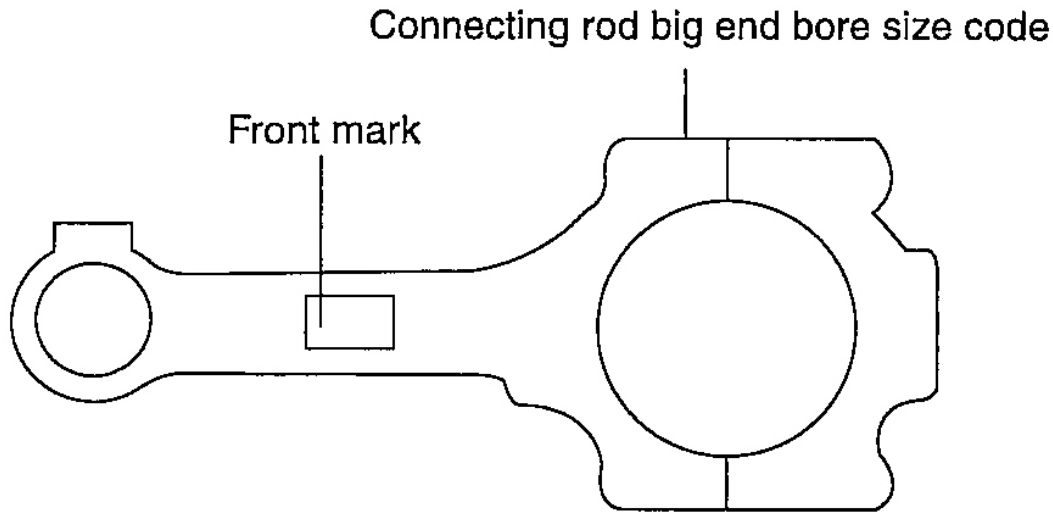
Fig. 45: Measuring Connecting Rod Side Clearance
Courtesy of KIA MOTORS AMERICA, INC.

REPLACEMENT

CONNECTING ROD BEARING

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

NOTE: Record the connecting rod big end bore size code letters on connecting rod cap as shown in illustration.



G00340210

Fig. 46: Identifying Location Of Connecting Rod Big End Bore Size Code
Courtesy of KIA MOTORS AMERICA, INC.

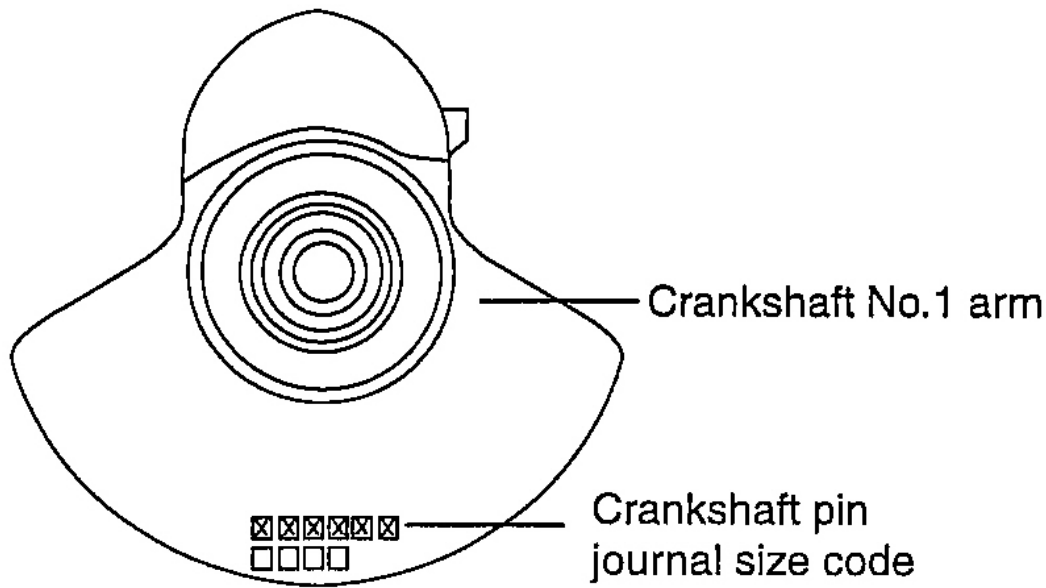
Code	Connecting rod big-end diameter mm (in)
0	58.000 - 58.006 (2.2835 ~ 2.2837)
1	58.006 - 58.012 (2.2837 ~ 2.2839)
2	58.012 - 58.018 (2.2839 ~ 2.2842)

G00340211

Fig. 47: Connecting Rod Big End Diameter Table
Courtesy of KIA MOTORS AMERICA, INC.

2. Check the crankshaft pin journal size code.

NOTE: Record the pin journal size code letters on the crankshaft balance weight. Reading order is from left to right as shown in illustration, with No. 1 pin journal size code shown first.



G00340212

Fig. 48: Identifying Location Of Crankshaft Pin Journal Size Code
Courtesy of KIA MOTORS AMERICA, INC.

Code	Crankshaft pin journal diameter mm (in)
I	54.994 - 55.000 (2.1651 ~ 2.1654)
II	54.988 - 54.994 (2.1649 ~ 2.1651)
III	54.982 - 54.988 (2.1646 ~ 2.1649)

G00340213

Fig. 49: Crankshaft Pin Journal Diameter Table

Courtesy of KIA MOTORS AMERICA, INC.

3. Choose proper connecting rod bearing as shown in illustration.

		Connecting rod big-end bore size code		
		0	1	2
Crankshaft pin journal size code	I	Pink	Red	None
	II	Red	None	Black
	III	None	Black	Brown

G00340214

Fig. 50: Connecting Rod Bearing Selection Table
Courtesy of KIA MOTORS AMERICA, INC.

Connecting rod bearing oil clearance:

0.026-0.044 mm (0.0010-0.0017 in)

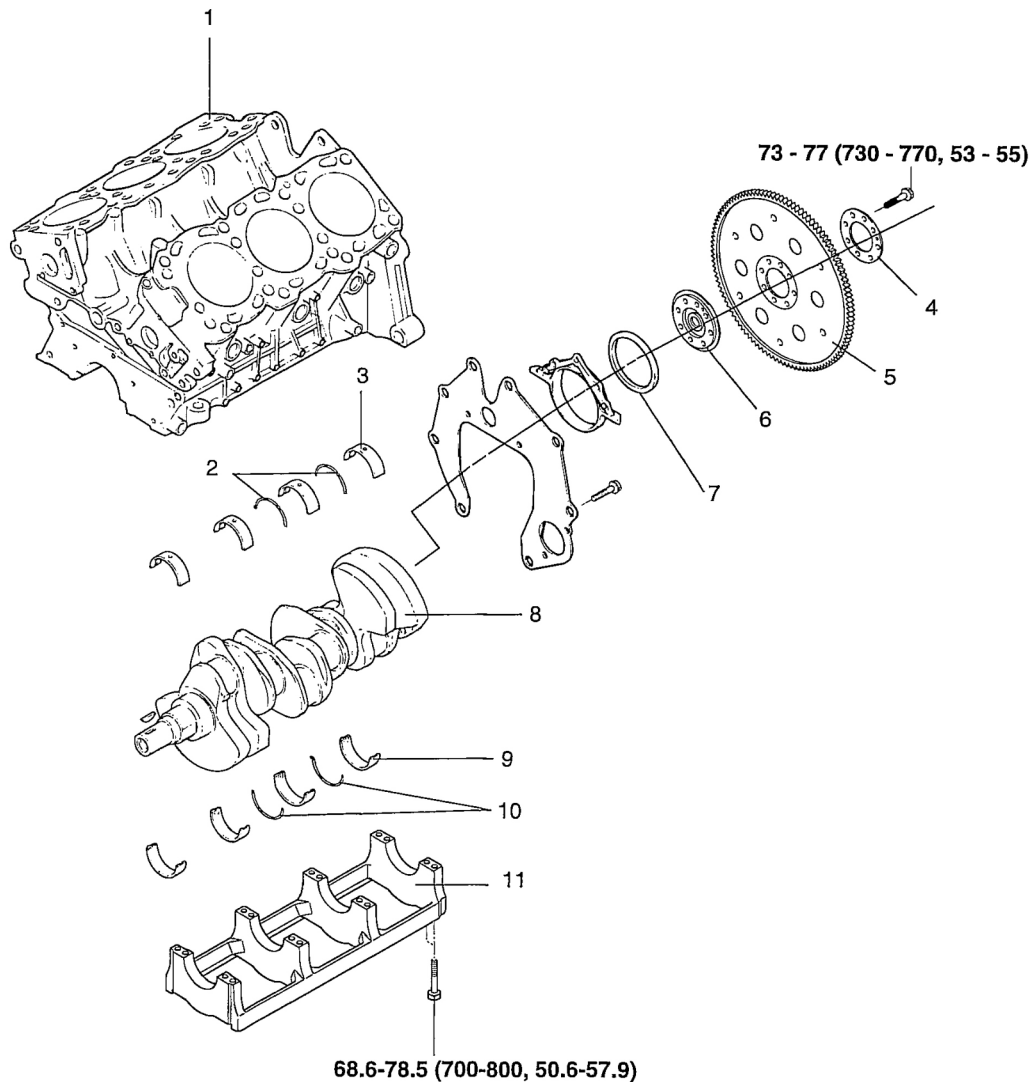
Color	Connecting rod bearing thickness mm(in)
Pink	1.484 - 1.487 (0.0584- 0.0585)
Red	1.487 - 1.490 (0.0585 - 0.0587)
None	1.490 - 1.493 (0.0587 - 0.0588)
Black	1.493 - 1.496 (0.0588 - 0.0589)
Brown	1.496 - 1.499 (0.0589 - 0.0590)

G00340215

Fig. 51: Connecting Rod Bearing Thickness Table (Reference Data)
Courtesy of KIA MOTORS AMERICA, INC.

CRANKSHAFT

COMPONENTS



TORQUE : N·m (kg·cm, lb·ft)

- | | |
|-----------------------|----------------------|
| 1. Cylinder block | 7. Rear oil seal |
| 2. Thrust bearing | 8. Crankshaft |
| 3. Upper bearing | 9. Lower bearing |
| 4. Adapter plate | 10. Thrust bearing |
| 5. Drive plate | 11. Main bearing cap |
| 6. Crankshaft adapter | |

G00340216

Fig. 52: Identifying Crankshaft Components & Torque Specifications
 Courtesy of KIA MOTORS AMERICA, INC.

DISASSEMBLY

1. Remove the **CYLINDER HEAD ASSEMBLY** and oil pan.
2. Remove the rear plate and the rear oil seal.
3. Remove the connecting rod caps.

NOTE: **Mark the main bearing caps to be able to reassemble in the original position and direction.**

4. Remove the main bearing caps and remove the crankshaft. Keep the bearings in order according to the cap number.

INSPECTION

CRANKSHAFT

1. Check the crankshaft journals and pins for damage, uneven wear and cracks. Also check the oil holes for restrictions. Repair or replace any defective parts.
2. Inspect the crankshaft journal and pin for out-of-round and taper.

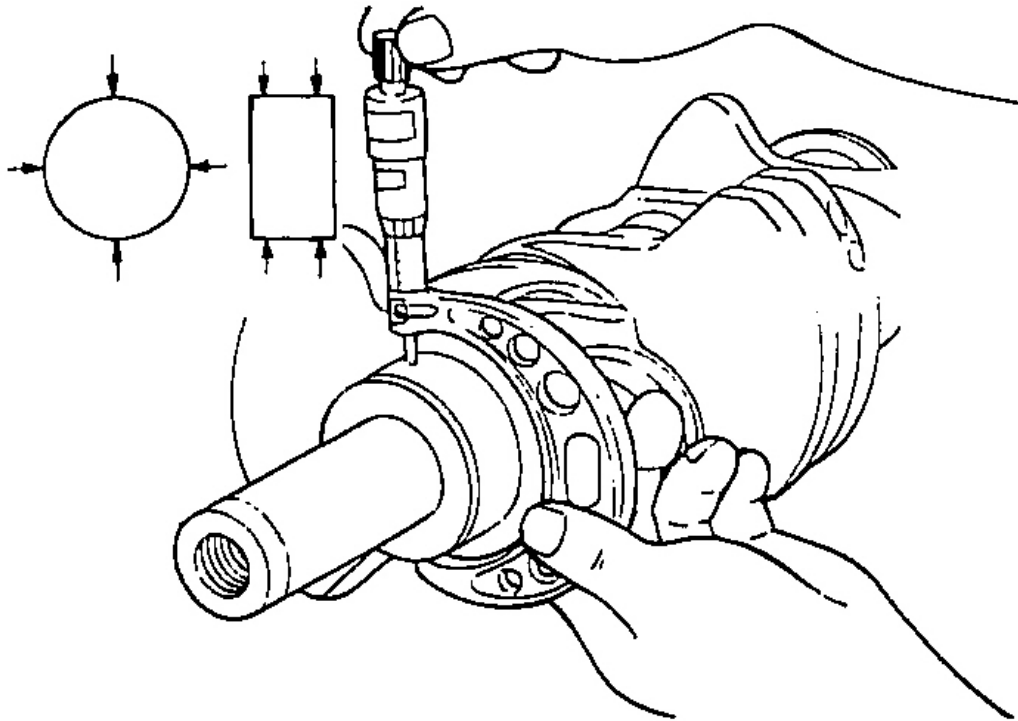
Standard value

Crankshaft journal O.D.:

63.982-64.00 mm (2.519-2.5197 In.)

Crankshaft pin O.D.:

54.982-55.00 mm (2.165-2.1653 In.)



G00340217

Fig. 53: Measuring Crankshaft Outside Dimensions (O.D.)
Courtesy of KIA MOTORS AMERICA, INC.

MAIN BEARINGS & CONNECTING ROD BEARINGS

Visually inspect each bearing for peeling, melting, seizure and improper contact. Replace any defective bearings.

MEASURING OIL CLEARANCE

Check for oil clearance by measuring the outside diameter of the crankshaft journal and the inside diameter of the bearing. The clearance can be obtained by calculating the difference between the measured outside diameters.

Standard value

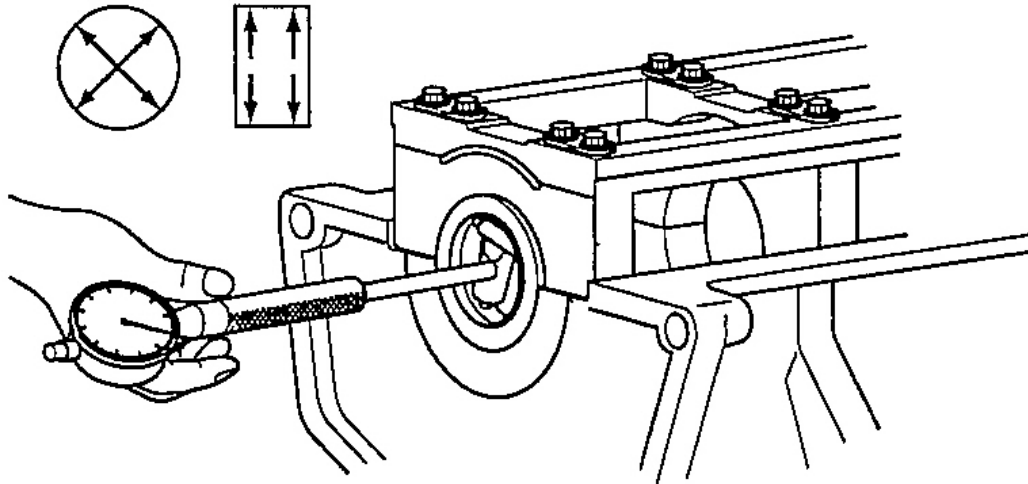
Oil clearance

Crankshaft main bearing:

0.018-0.036 mm (0.0007-0.0014 In.)

Connecting rod bearing:

0.022-0.048 mm (0.0009-0.002 In.)



G00340218

Fig. 54: Measuring Crankshaft Journal Bearings
Courtesy of KIA MOTORS AMERICA, INC.

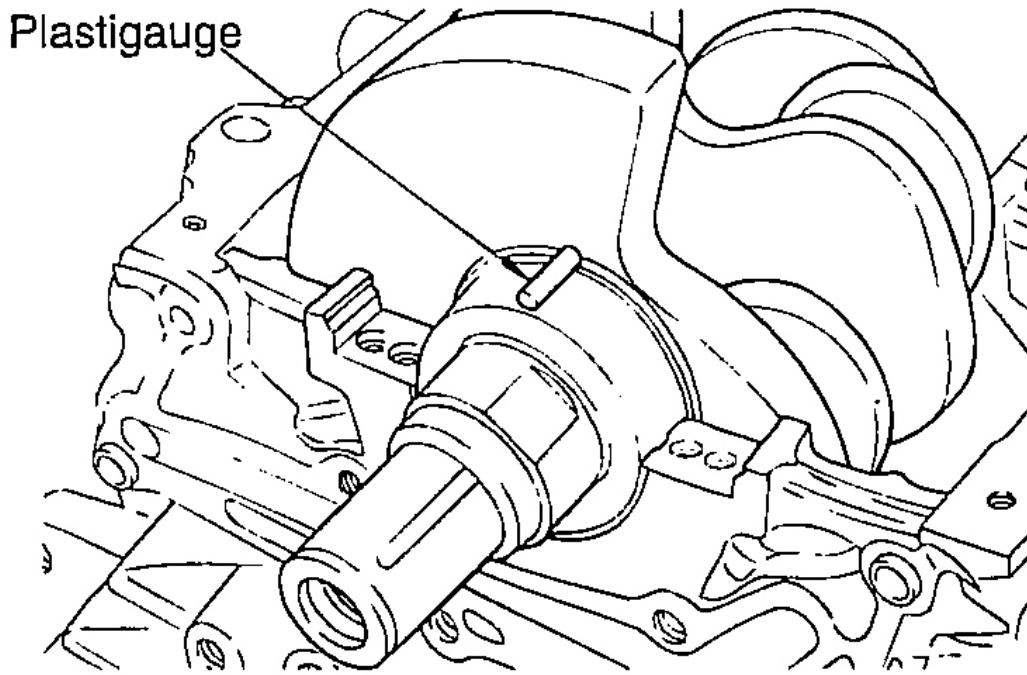
PLASTIGAGE METHOD

Plastigage may be used to measure the clearance.

1. Remove oil, grease and any other dirt from the bearings and journals.
2. Cut the plastigage the same length as the width of the bearing and place it in parallel with the journal, avoiding the oil holes.
3. Install the crankshaft, bearings and caps and tighten them to the specified torques. During this operation, do not turn the crankshaft. Remove the caps. Measure the width of the plastigage at the widest part by using the scale printed on the gauge package.

If the clearance exceeds the service limit, the bearing should be replaced or an undersize bearing should be used. When installing a new crankshaft, be sure to use standard size bearings.

If the standard clearance can not be obtained even after replacing the bearing, the journal and pin should be ground to the undersize and a bearing of the corresponding size should be installed.



G00340219

Fig. 55: Using Plastigage

Courtesy of KIA MOTORS AMERICA, INC.

OIL SEAL

Check the front and rear oil seals for damage or worn surfaces. Replace any seal that is defective.

DRIVE PLATE (A/T)

Replace distorted, damaged, or cracked drive plates.

REASSEMBLY**MAIN BEARING**

1. Install a grooved main bearing (upper bearing) on the cylinder block side.
2. Install a grooveless main bearing (lower bearing) on the main bearing cap side.
3. Install the crankshaft. Apply engine oil to journal and pin.
4. Install the bearing caps with the arrow mark directed toward the front of the engine. Cap number must be correct.
5. Tighten the cap bolts to the specified torque.

Tightening torque

Main bearing cap bolts:

68.6-78.5 N.m (700-800 kg. cm, 50.6-57.9 lb. ft)

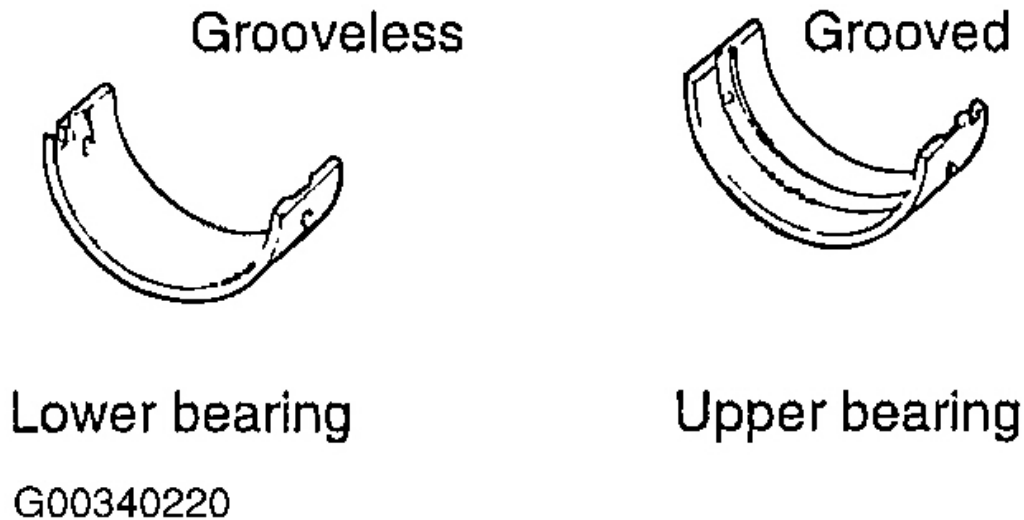


Fig. 56: Identifying Grooved & Grooveless Bearings

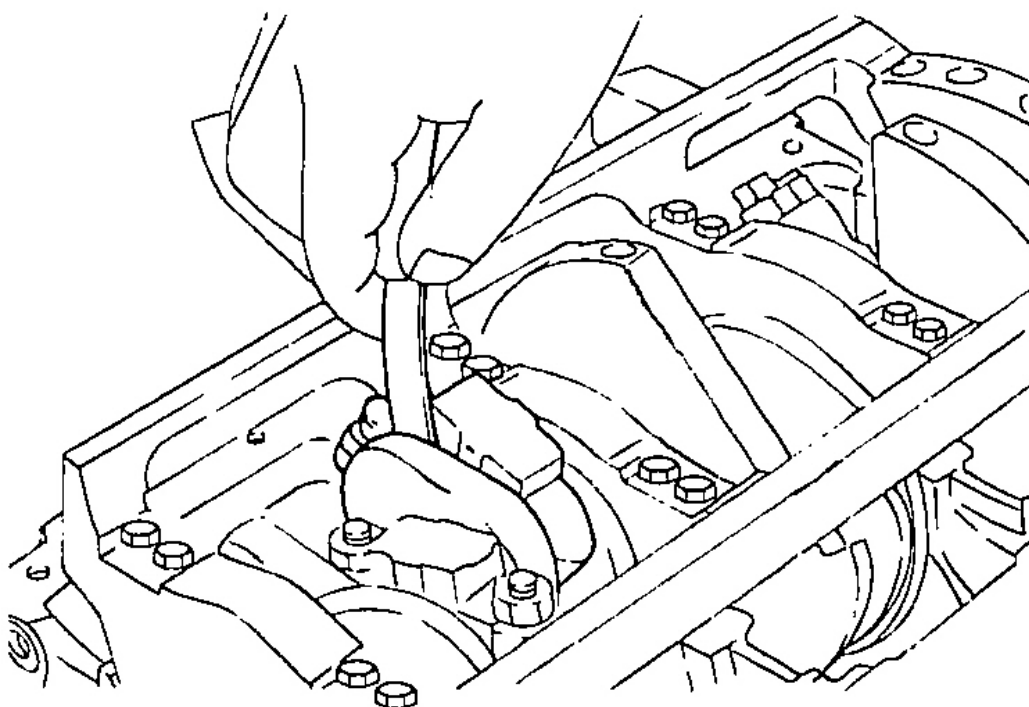
Courtesy of KIA MOTORS AMERICA, INC.

6. Cap bolts should be tightened evenly in stages 4 to 5 increments before they are tightened to the specified torque.
7. Make certain that crankshaft turns freely and check the end play of the crankshaft.

Crankshaft end play

Standard: 0.070-0.250 mm (0.0028-0.0098 In.)

Limit: 0.35 mm (0.014 In.)



G00340221

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

8. Using special tool (09231-33000), install the rear oil seal in oil seal case.
9. Apply sealant to the area shown in the illustration. Install the oil seal case in the cylinder block.

Tightening torque

Oil seal case bolt:

10-12 N.m (100-120 kg. cm, 7-9 lb. ft)

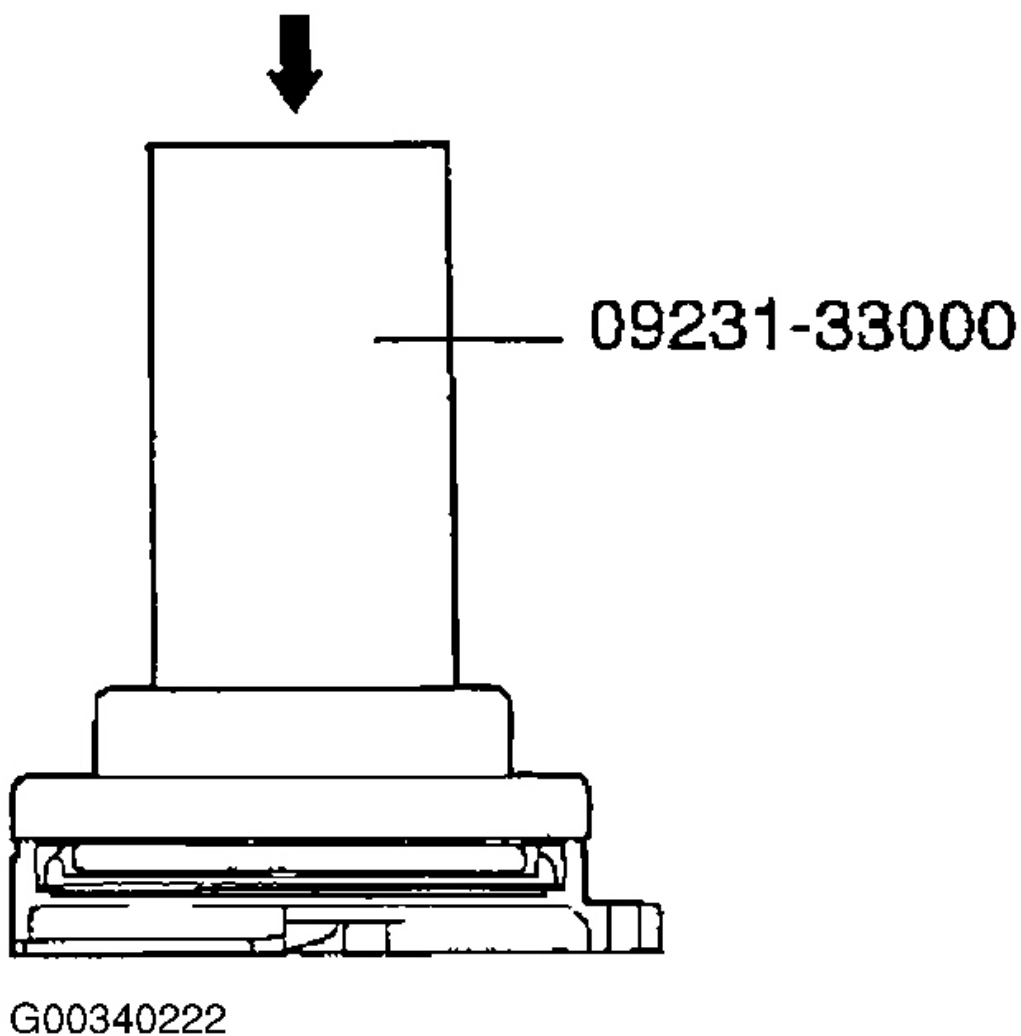
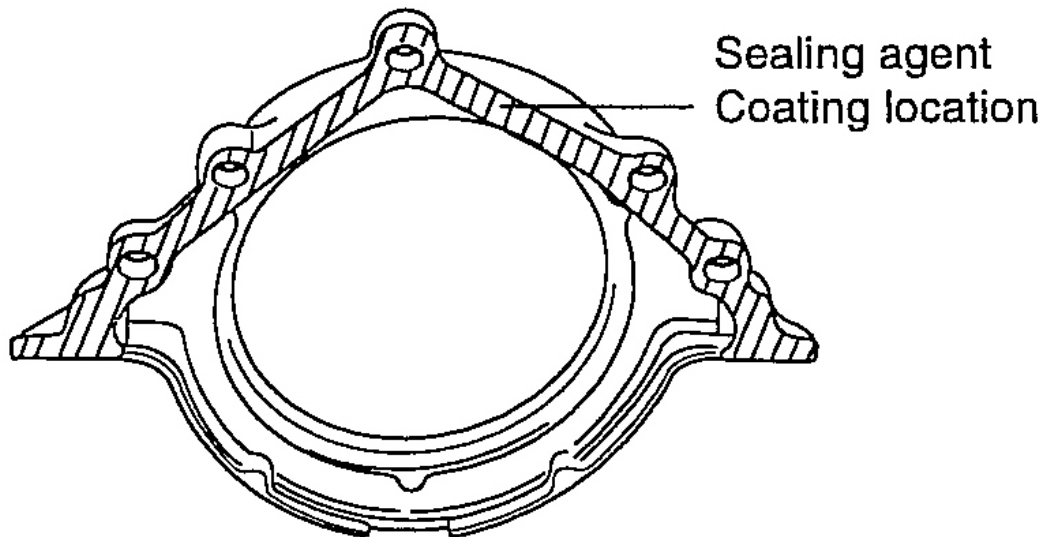


Fig. 58: Using Special Tool, Install Rear Oil Seal In Oil Seal Case
Courtesy of KIA MOTORS AMERICA, INC.



G00340223

Fig. 59: Apply Sealant To The Oil Seal Case
Courtesy of KIA MOTORS AMERICA, INC.

10. Tighten the rear plate to the specified torque.

Tightening torque

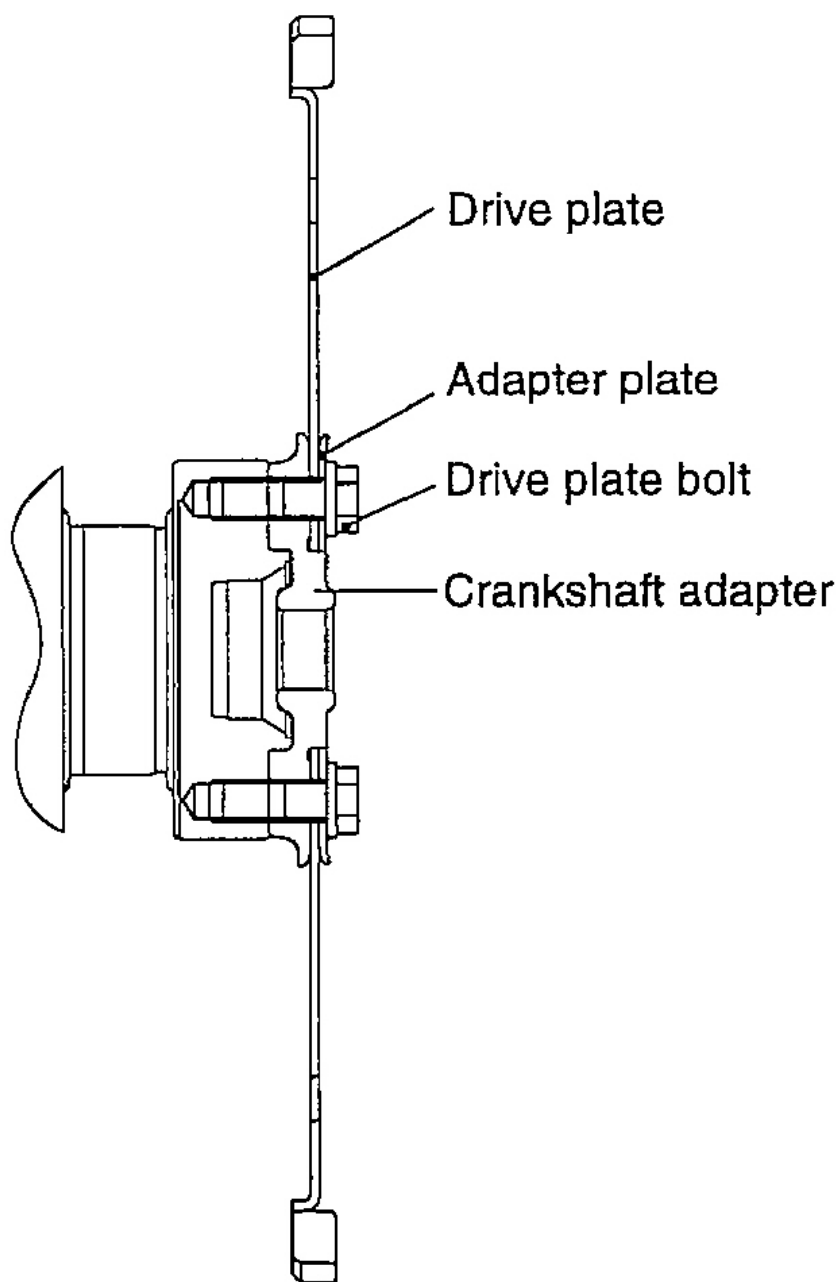
Rear plate: 10-12 N.m (100-120 kg. cm, 7-9 lb. ft)

11. Tighten the drive plate and the adapter plate (A/T).

Tightening torque

Drive plate and adapter plate bolt:

73-77 N.m (730-770 kg. cm, 53-56 lb. ft)



G00340224

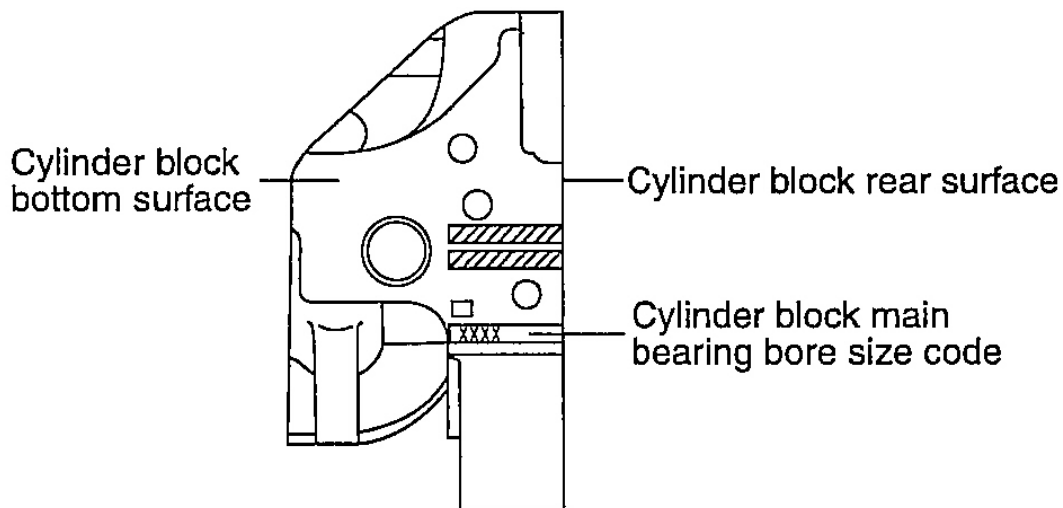
Fig. 60: Identifying Drive & Adapter Plate Components
Courtesy of KIA MOTORS AMERICA, INC.

REPLACEMENT

CRANKSHAFT MAIN BEARING

1. Check the cylinder block main bearing bore size code.

NOTE: Record the cylinder block main bearing bore size code letters on cylinder block as shown in illustration.
Reading order is from left to right with front main bearing bore size code shown first.



G00340225

Fig. 61: Identifying Location Of Cylinder Block Main Bearing Bore Size Code
Courtesy of KIA MOTORS AMERICA, INC.

Code	Cylinder block main bearing bore diameter mm (in)
A	68.000 ~ 68.006 (2.6772 ~ 2.6774)
B	68.006 ~ 68.012 (2.6774 ~ 2.6776)
C	68.012 ~ 68.018 (2.6776 ~ 2.6779)

G00340226

Fig. 62: Cylinder Block Main Bearing Bore Diameter Table
Courtesy of KIA MOTORS AMERICA, INC.

2. Check the crankshaft main journal size code.

NOTE: Record the main journal size code letters on the crankshaft balance weight.
Reading order is from left to right as shown in illustration, with No. 1 main journal size code shown first.

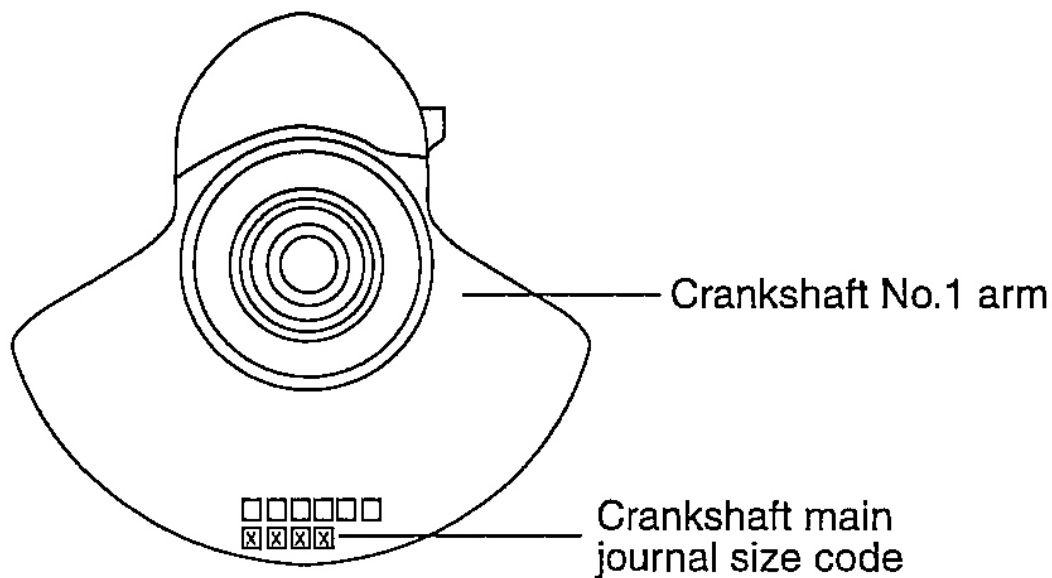


Fig. 63: Identifying Location Of Main Journal Size Code
Courtesy of KIA MOTORS AMERICA, INC.

Code	Crankshaft main journal diameter mm (in)
1	63.994 ~ 64.000 (2.5194 ~ 2.5197)
2	63.988 ~ 63.994 (2.5192 ~ 2.5194)
3	63.982 ~ 63.988 (2.5190 ~ 2.5192)

G00340228

Fig. 64: Crankshaft Main Journal Diameter Table
Courtesy of KIA MOTORS AMERICA, INC.

3. Choose proper main journal bearing as shown in illustration.

		Cylinder block main bearing bore size code		
		A	B	C
Crankshaft main journal size code	1	Pink	Red	None
	2	Red	None	Black
	3	None	Black	Brown

G00340229

Fig. 65: Main Journal Bearing Selection Table
Courtesy of KIA MOTORS AMERICA, INC.

Main journal bearing oil clearance:

0.022-0.040 mm (0.0009-0.0016 in)

Color	Main journal bearing thickness mm (in)
Pink	1.986 ~1.989 (0.0782 ~ 0.0783)
Red	1.989 ~ 1.992 (0.0783 ~ 0.0784)
None	1.992 ~ 1.995 (0.0784 ~ 0.0785)
Black	1.995 ~ 1.998 (0.0785 ~ 0.0787)
Brown	1.998 ~ 2.001 (0.0787 ~ 0.0788)

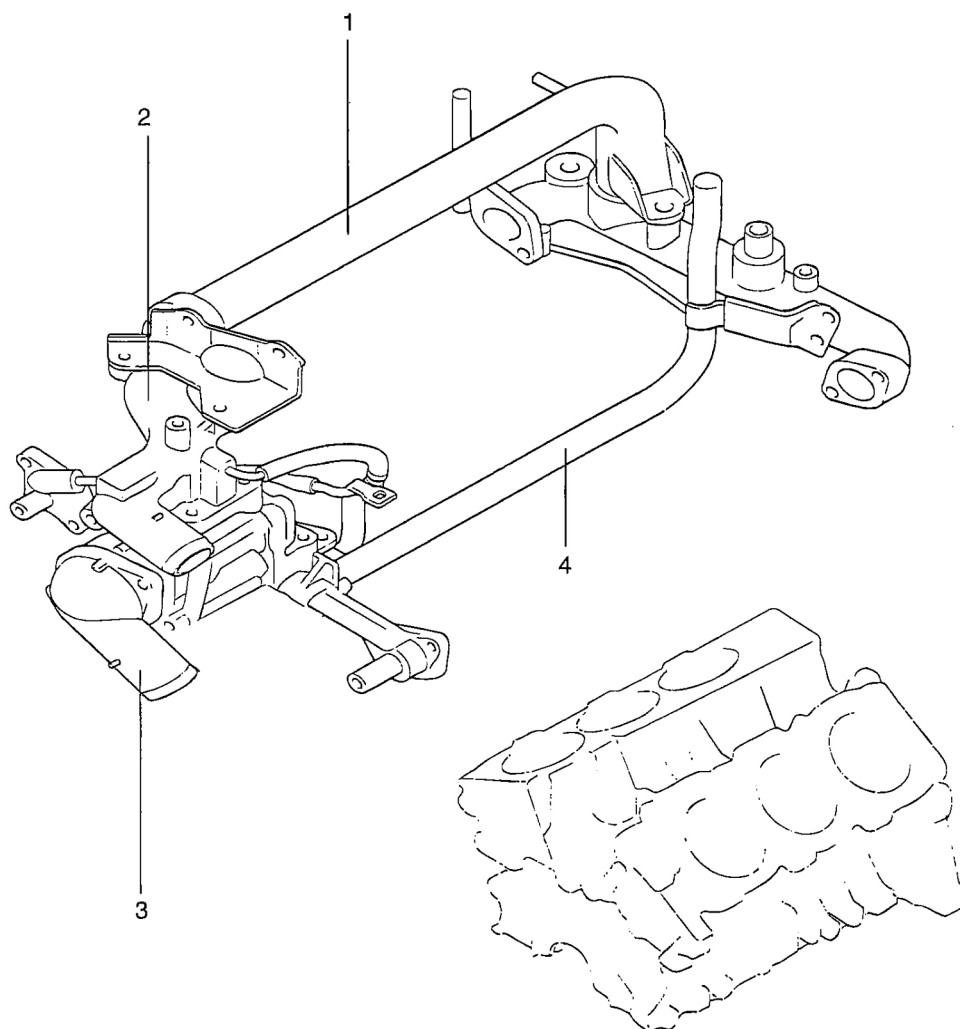
G00340230

Fig. 66: Main Journal Bearing Thickness Table (Reference Data)
Courtesy of KIA MOTORS AMERICA, INC.

COOLING SYSTEM

ENGINE COOLANT HOSE/PIPES

COMPONENTS



1. Water outlet pipe
2. Water outlet fitting

3. Water inlet fitting
4. Bypass pipe

G00340231

Fig. 67: Identifying Engine Coolant Pipe Components
Courtesy of KIA MOTORS AMERICA, INC.

INSPECTION

Check the engine coolant pipe and hose for cracks, damage and restrictions. Replace if necessary.

REASSEMBLY

Fit the O-ring in the groove of the engine coolant inlet pipe end. Wet the periphery of the O-ring with water and insert the engine coolant inlet pipe.

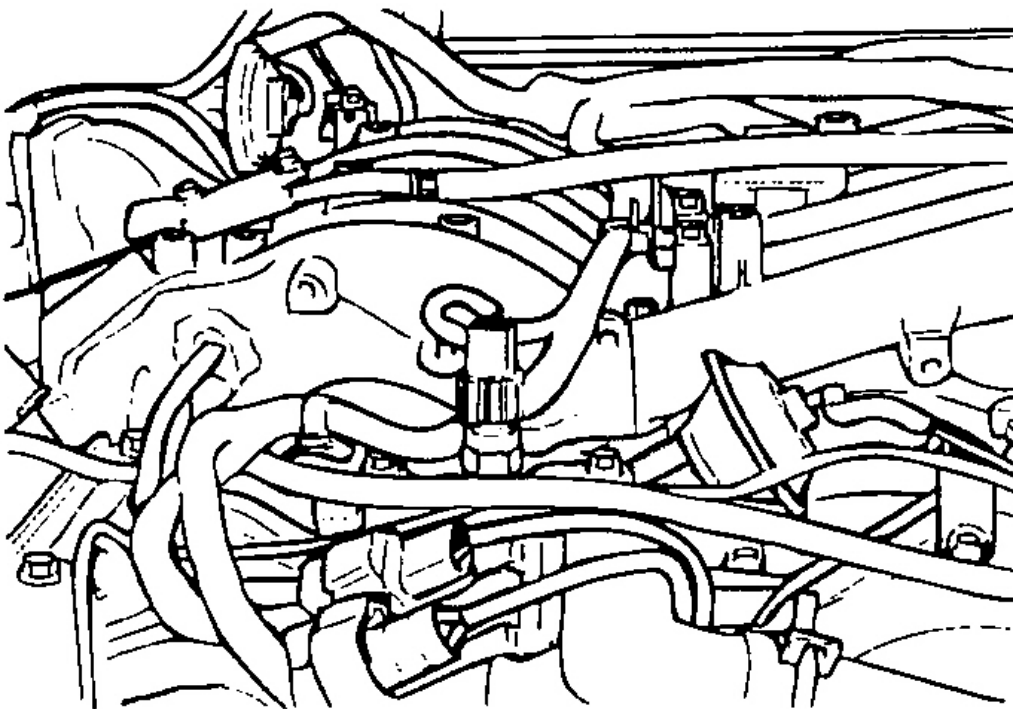
NOTE:

- Do not apply oil or grease to the engine coolant pipe O-ring.
- Keep the engine coolant pipe connections free of sand, dust, etc.
- Insert the engine coolant pipe into the end of the engine coolant pump inlet.
- Whenever installing the engine coolant inlet pipe, always replace the O-ring with a new one.

COOLANT TEMPERATURE SENSOR

REMOVAL

1. Drain the engine coolant.
2. Disconnect the engine coolant temperature sensor connector after disconnecting the ground cable of the battery.
3. Remove the engine coolant temperature sensor.



G00340233

Fig. 68: Identifying Engine Coolant Temperature Sensor
Courtesy of KIA MOTORS AMERICA, INC.

INSTALLATION

1. Apply sealant to the sensor's threads. Tighten it to the specified torque.

Recommended sealant:

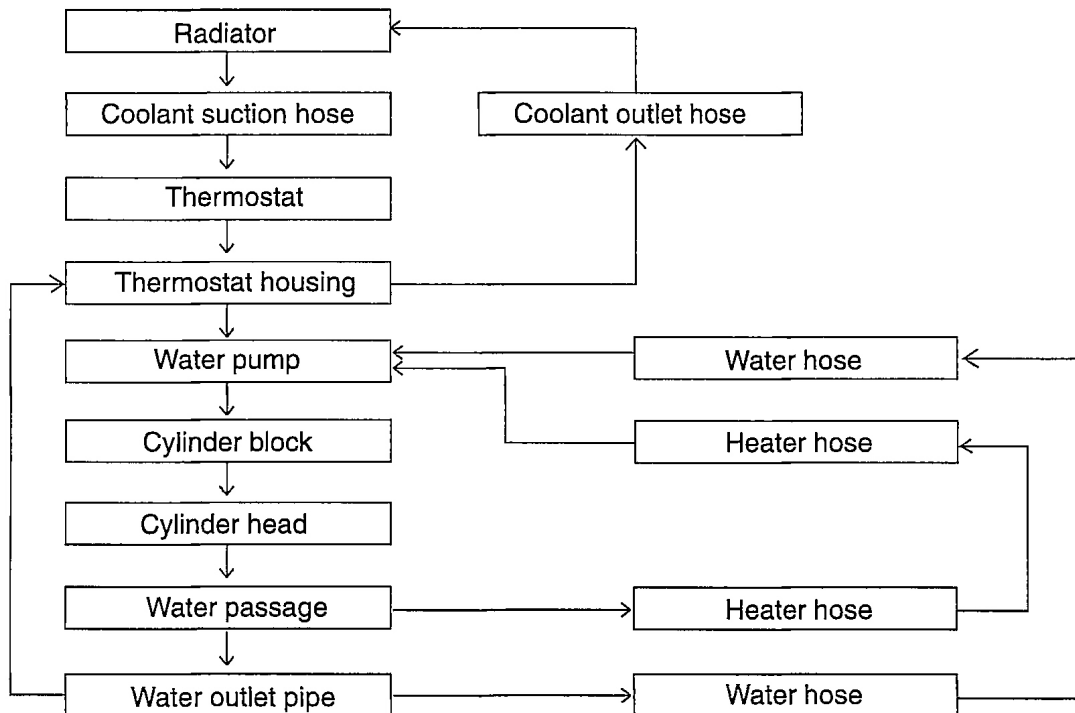
Three bond No. 2310 or LOCTITE 962T

Tightening torque

The coolant sensor:

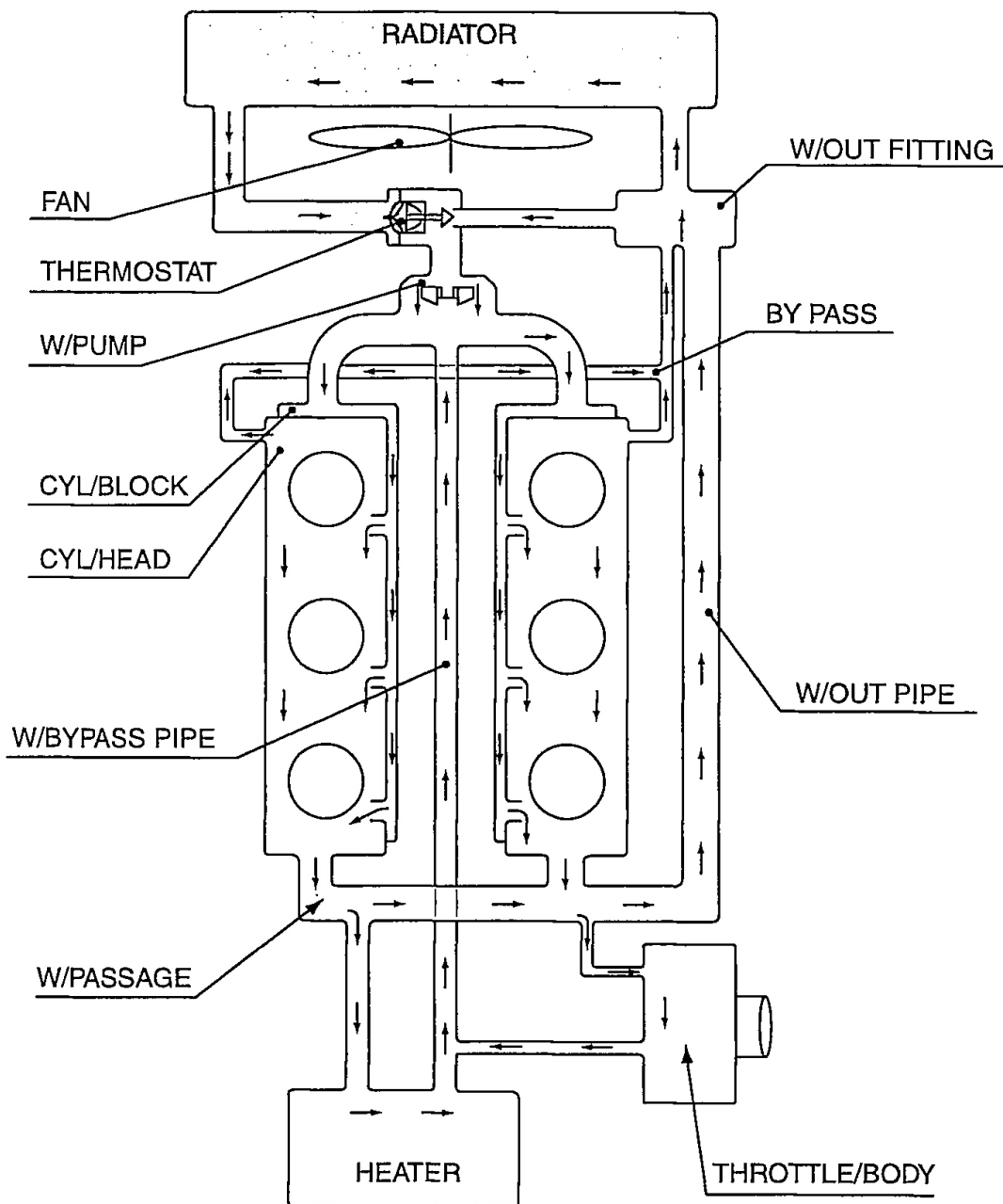
20-40 N.m (200-400 kg. cm, 14-29 lb. ft)

2. Connect the coolant temperature sensor to the harness.
3. Connect the ground cable of battery.
4. Refill the coolant.

SCHEMATIC DIAGRAM

G00340234

Fig. 69: Inlet Control Schematic
 Courtesy of KIA MOTORS AMERICA, INC.

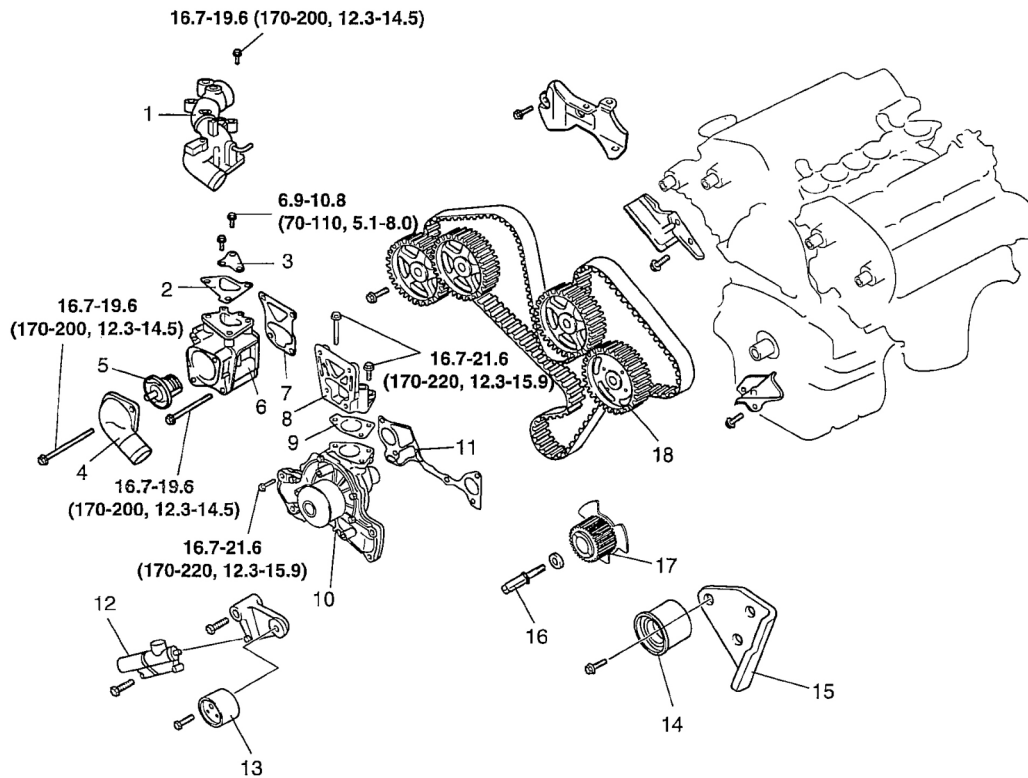


G00340235

Fig. 70: Identifying Coolant Flow Chart
 Courtesy of KIA MOTORS AMERICA, INC.

ENGINE COOLANT PUMP

COMPONENTS



TORQUE : N·m (kg·cm, lb·ft)

- | | |
|----------------------------|-------------------------|
| 1. Water outlet fitting | 10. Water pump |
| 2. Gasket | 11. Gasket |
| 3. Thermostat case bracket | 12. Auto tensioner |
| 4. Water inlet fitting | 13. Tension bearing |
| 5. Thermostat | 14. Idler |
| 6. Thermostat case | 15. Idler bracket |
| 7. Gasket | 16. Damper pulley bolt |
| 8. Water pump fitting | 17. Crankshaft sprocket |
| 9. Gasket | 18. Camshaft sprocket |

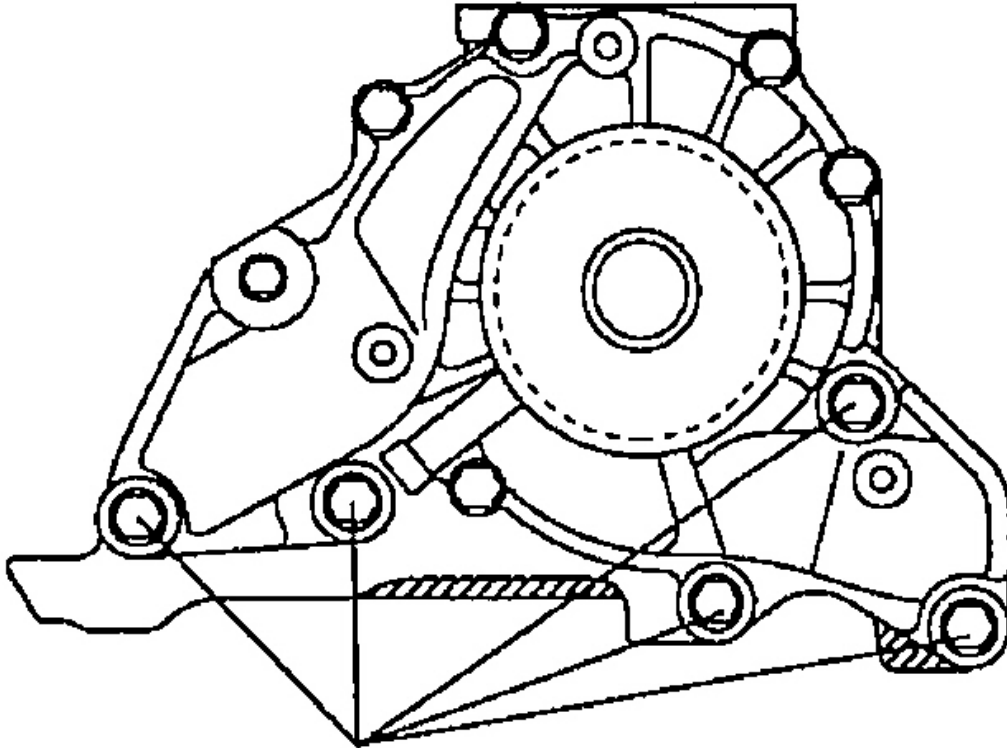
G00340236

Fig. 71: Identifying Engine Coolant Pump Components & Torque Specifications
Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

1. Using the drain plug, drain the coolant.
2. Remove the drive belt and the engine coolant pump pulley.
3. Remove the timing belt cover, the auto tensioner and idler pulley.
4. Remove the water outlet fitting, the thermostat case and the water pump fitting.

5. Remove the engine coolant pump mounting bolts.
6. Remove the engine coolant pump assembly from the cylinder block.



Water pump mounting bolt

G00340237

Fig. 72: Identifying Engine Coolant Pump Mounting Bolts
Courtesy of KIA MOTORS AMERICA, INC.

INSPECTION

1. Check the engine coolant pump for cracks, damage or wear, and replace the pump assembly if necessary.
2. Check the bearing for damage, abnormal noise and sluggish rotation and replace the pump assembly if necessary.
3. Check the seal for leaks and replace the pump assembly if necessary.

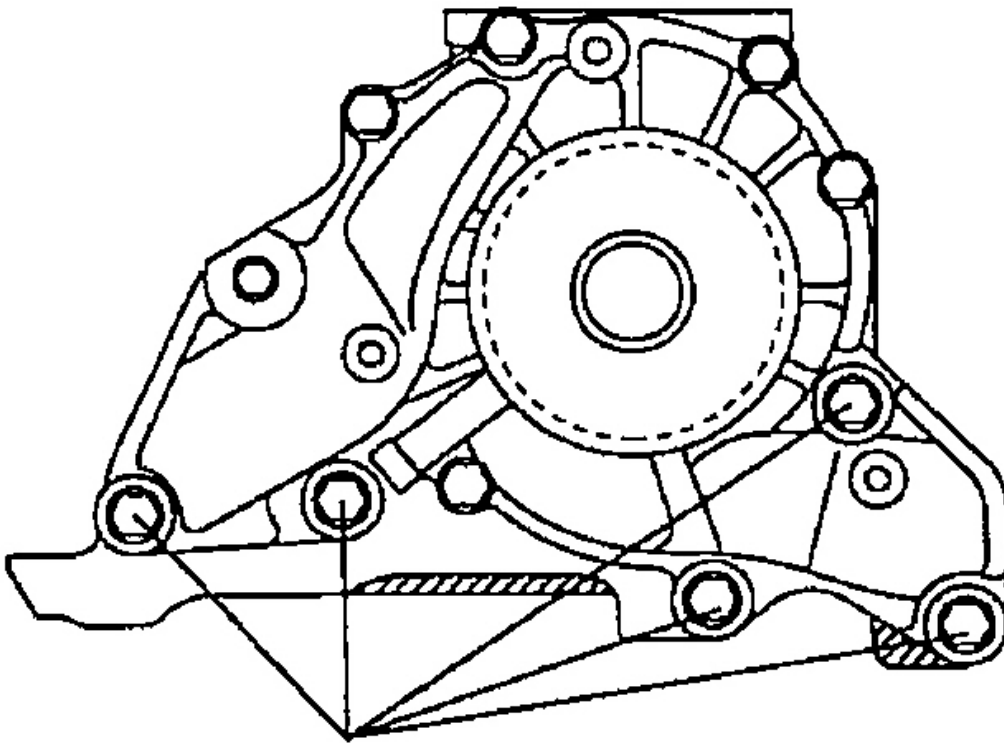
INSTALLATION

1. Clean the gasket surfaces of the engine coolant pump body and the cylinder block.
2. Install the new engine coolant pump gasket and pump assembly. Tighten the bolts to the specified torque.

Tightening torque

Engine coolant pump bolt:

Head mark "7": 17-22 N.m (170-220 kg. cm, 12-16 lb. ft)

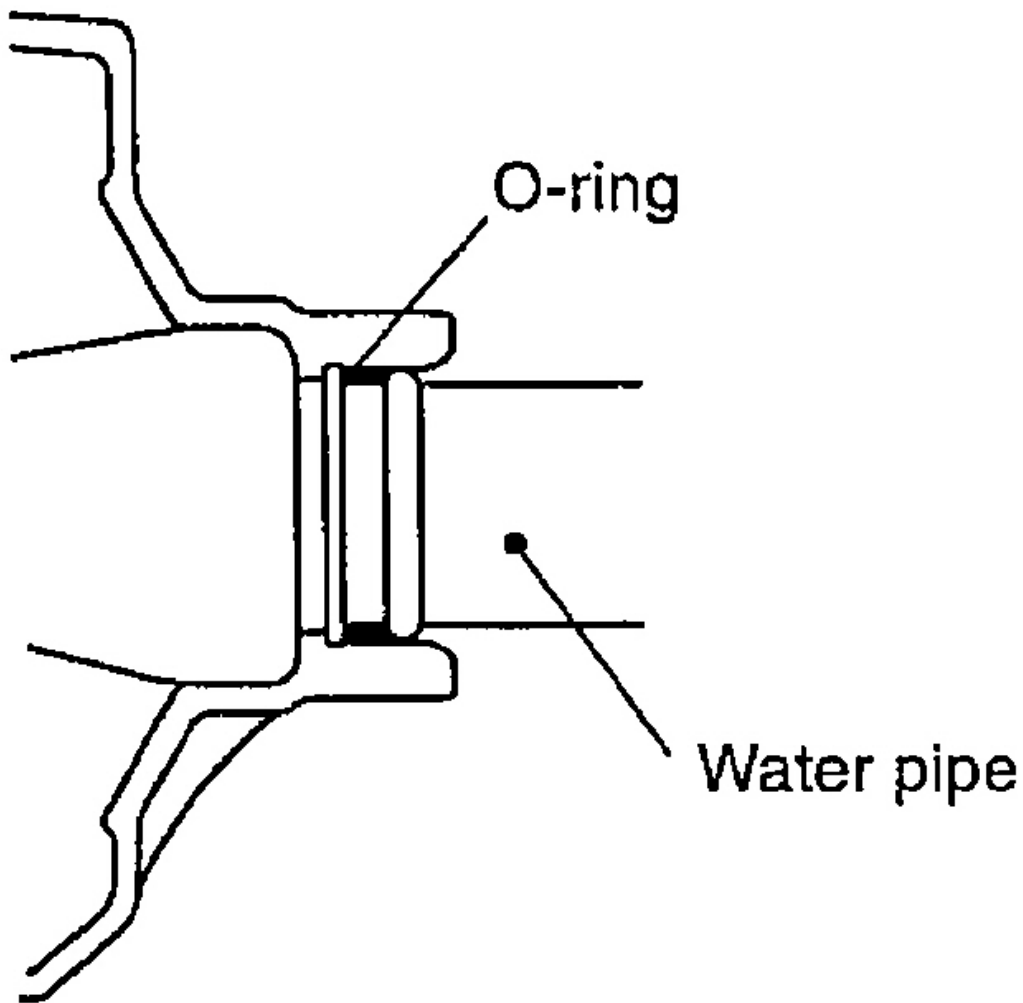


Water pump mounting bolt

G00340239

Fig. 73: Identifying Water Pump Mounting Bolts
Courtesy of KIA MOTORS AMERICA, INC.

3. Install the water pump fitting, the thermostat case and the water outlet fitting.



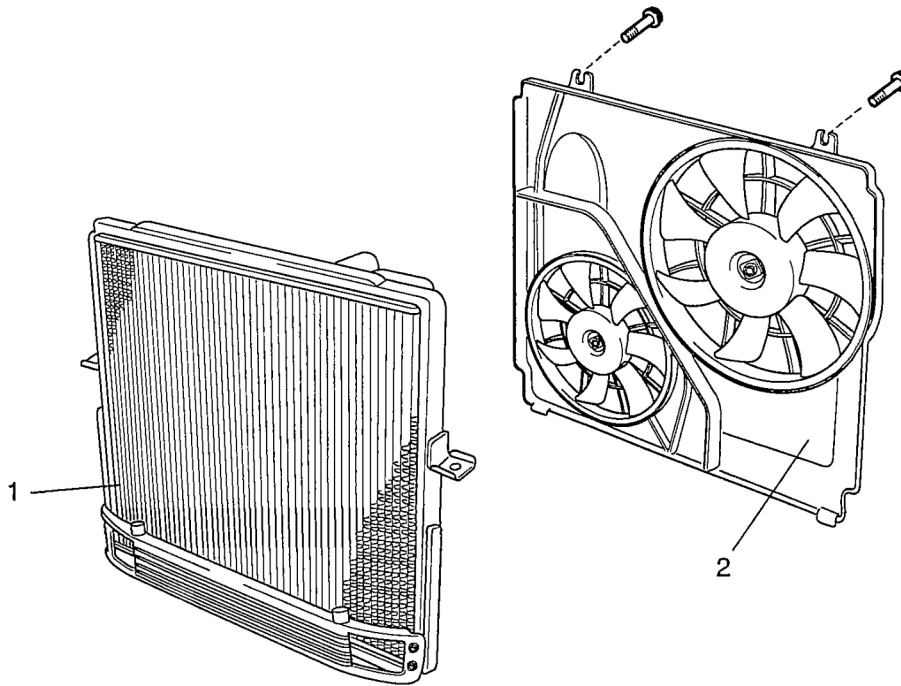
G00340238

Fig. 74: Ensure Water Pipe O-Ring Engagement
Courtesy of KIA MOTORS AMERICA, INC.

4. Install the auto tensioner and timing belt. Adjust the timing belt tension, then install the timing belt cover.
5. Install the driver belt, coolant pump pulley and then adjust the auto tensioner.
6. Refill the coolant.
7. Run the engine and check for leaks.

RADIATOR

COMPONENTS



1. Radiator
2. Radiator fan and condenser fan assembly

G00340240

Fig. 75: Identifying Radiator & Fan Components
 Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

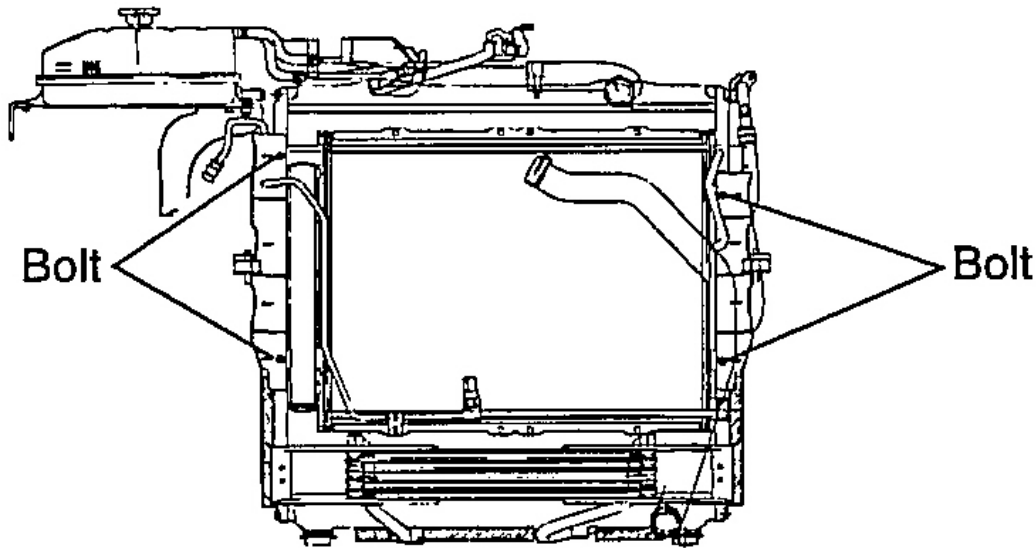
1. Disconnect the ground cable from the battery terminal.
2. Disconnect the fan motor connector.
3. Loosen the radiator drain plug to drain the coolant.
4. Disconnect the upper and lower hoses and overflow tube after marking the radiator hose and the hose clamp for reassembly reference.

CAUTION: Cover or plug the hose and inlets of the radiator so that dust and other foreign material etc. cannot enter after the hose is disconnected from the radiator.

5. For vehicles with automatic transaxles, disconnect the oil cooler hoses from the automatic transaxle. Plug

hoses and inlets to prevent fluid leakage.

6. Remove the air conditioner condenser fixing bolts and radiator bracket fixing nuts.



G00340241

Fig. 76: Identifying Condenser Mounting Bolts

Courtesy of KIA MOTORS AMERICA, INC.

7. Remove the radiator and the fan motor.
8. Remove the radiator fan motor and condenser fan motor from the radiator.

INSPECTION

1. Check for foreign material between the radiator fins.
2. Check the radiator fins for damage and straighten if necessary.
3. Check the radiator for corrosion, damage, rust or scale.
4. Check the radiator hoses for cracks, damage or deterioration.
5. Check the reservoir tank for damage.
6. Check the automatic transaxle oil cooler hoses for cracking, damage or deterioration (only A/T).

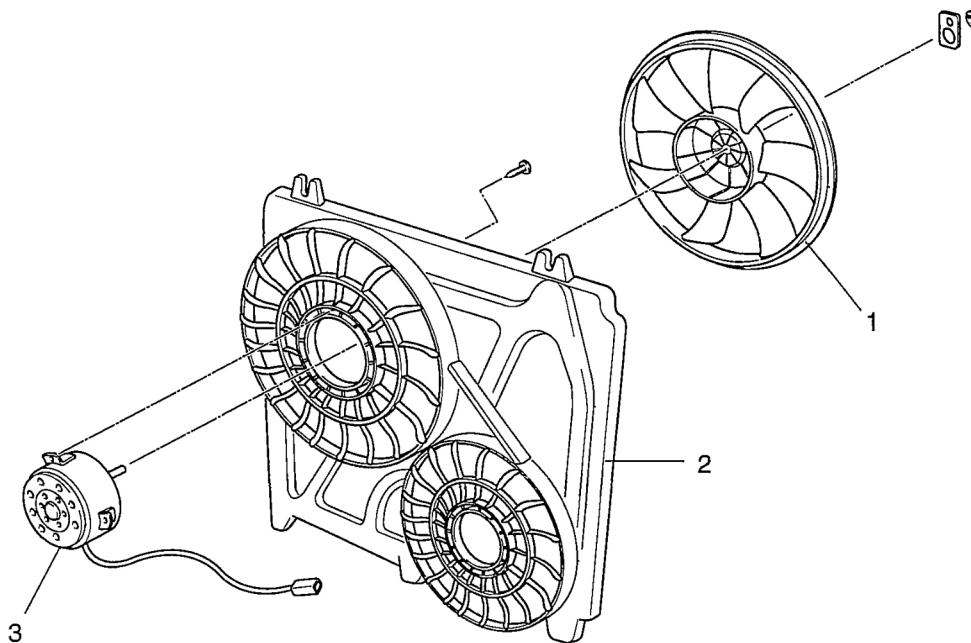
INSTALLATION

1. To install, reverse removal procedure.
2. Fill the radiator and reservoir tank with a clean coolant mixture.

3. Run the engine until the coolant warms up enough so that the thermostat value opens and then turn off the engine.
4. Remove the radiator cap and pour the coolant up to the filler neck of the radiator. Fill the reservoir tank to the upper level.
5. Check that there are no leaks from the radiator, hoses or connections.
6. Check auto transmission fluid level and fill to appropriate level, as necessary.

RADIATOR FAN MOTOR

COMPONENTS



1. Fan
2. Shroud

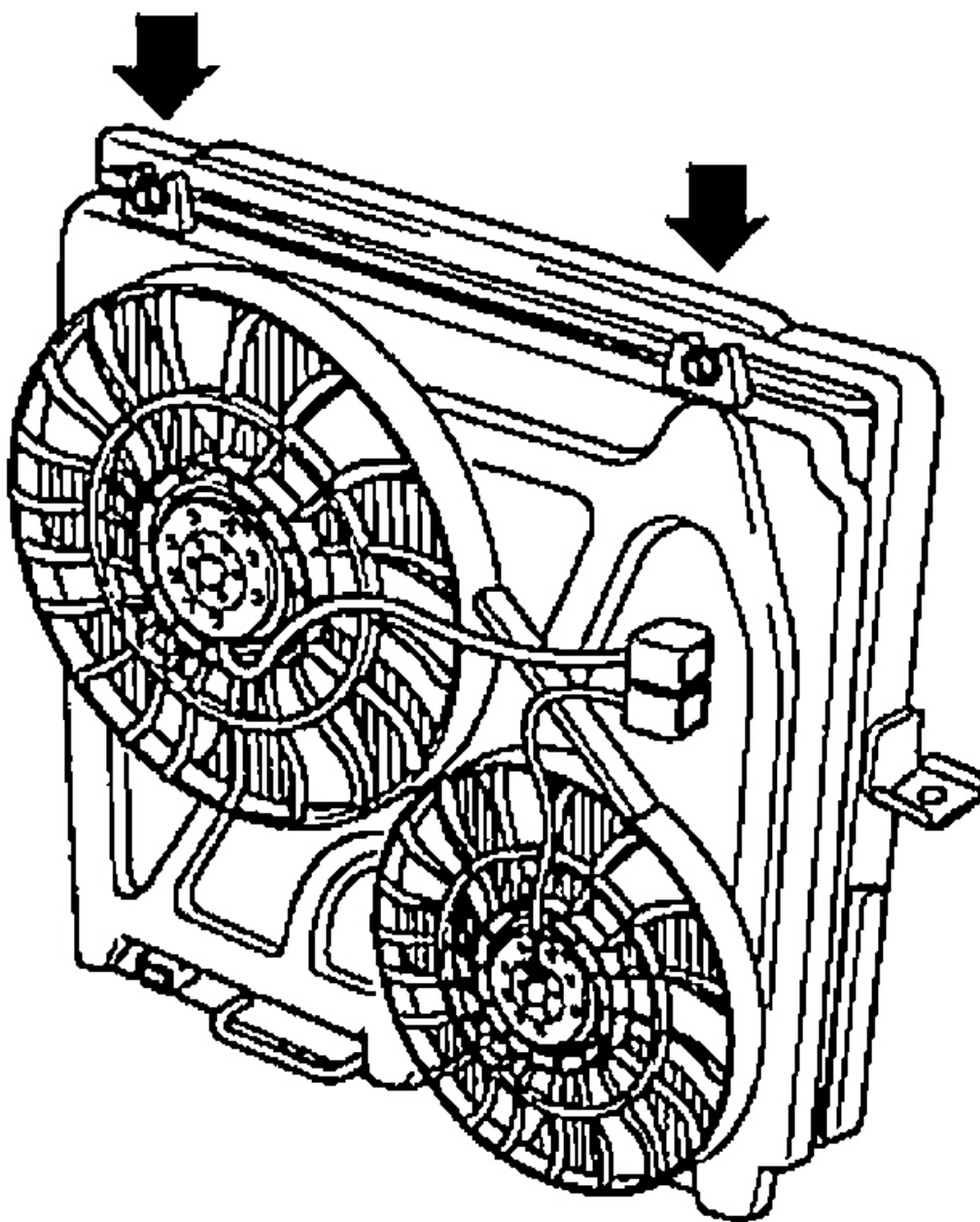
3. Motor

G00340242

Fig. 77: Identifying Radiator Fan Motor Components
Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

1. Disconnect the ground cable from the battery cable.
2. Disconnect the connectors from the fan motor.
3. Remove the radiator fan assembly mounting bolts.



G00340243

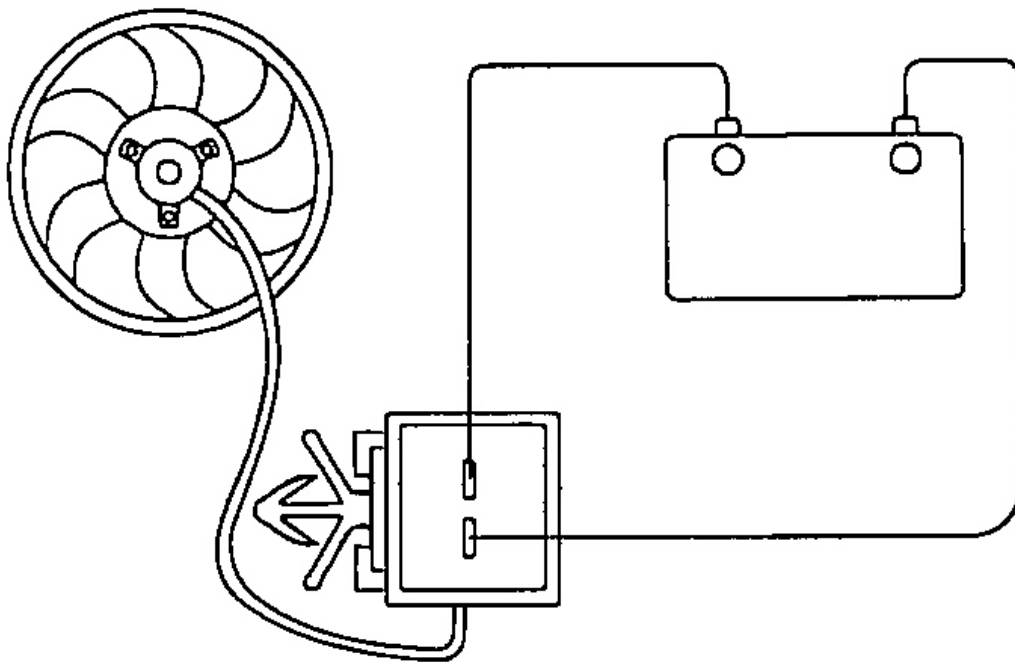
Fig. 78: Identifying Radiator Fan Assembly Mounting Bolts
Courtesy of KIA MOTORS AMERICA, INC.

4. Remove the radiator fan assembly from the radiator.

5. Remove the fan mounting clip and detach the fan from the fan motor.

INSPECTION**RADIATOR FAN MOTOR & CONDENSER FAN MOTOR**

1. Check that the radiator fan rotates when battery voltage is applied between the terminals.
2. Check that there are no abnormal noises while the motor is running.



G00340244

Fig. 79: Testing Fan Motors**Courtesy of KIA MOTORS AMERICA, INC.****RADIATOR FAN MOTOR RELAY**

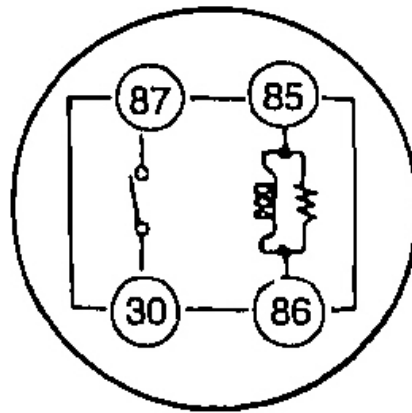
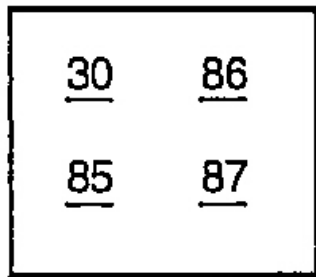
1. Remove the radiator fan motor relay from the relay box in the engine room.
2. Check continuity with an ohmmeter.

Terminal	Continuity
30-87	No
85-86	Yes

G00340245

Fig. 80: Fan Relay Terminal Continuity Specifications Table
 Courtesy of KIA MOTORS AMERICA, INC.

3. Apply 12V to terminal 85 and ground to terminal 86. Check for continuity between terminals 30 and 87.



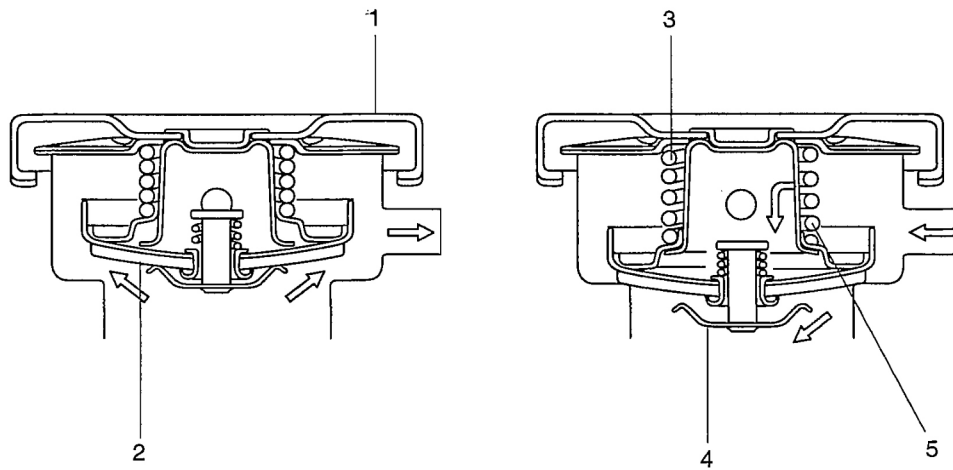
G00340246

Fig. 81: Identifying Fan Relay Terminals
 Courtesy of KIA MOTORS AMERICA, INC.

4. If there is no continuity, replace fan motor relay.

RADIATOR CAP

COMPONENTS



Pressure : 107.9±14.7 (1.1±0.15, 15.64±2.13)

Pressure : 83.4 (0.85, 12.1)

PRESSURE : Kpa (kg/cm², psi)

- 1. Radiator cap
- 2. High pressure valve
- 3. Spring

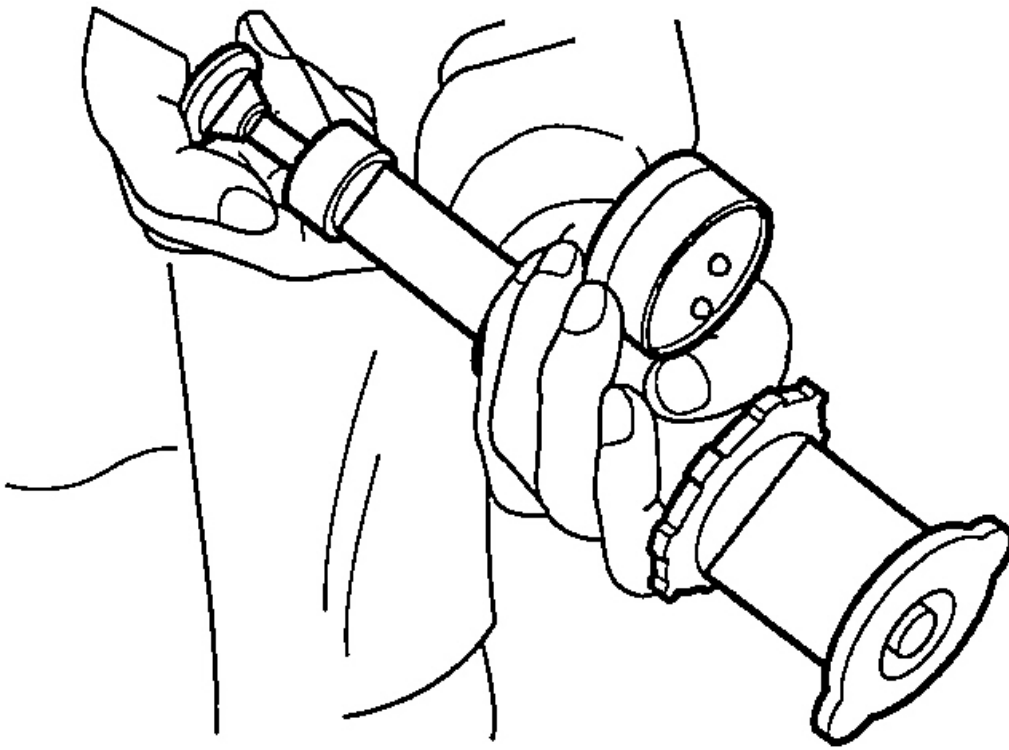
- 4. Bent valve
- 5. Vacuum spring

G00340247

Fig. 82: Identifying Radiator Cap Flow & Pressure Specifications
 Courtesy of KIA MOTORS AMERICA, INC.

INSPECTION

1. Check the radiator cap for damage, cracks or weakening.
2. Connect the tester to the radiator cap.
3. Increase the pressure until the indicator of the gauge stops moving.
4. Replace the radiator cap if the reading does not hold steady for about 10 seconds.



G00340249

Fig. 83: Pressure Testing Radiator Cap
Courtesy of KIA MOTORS AMERICA, INC.

THERMOSTAT

REMOVAL

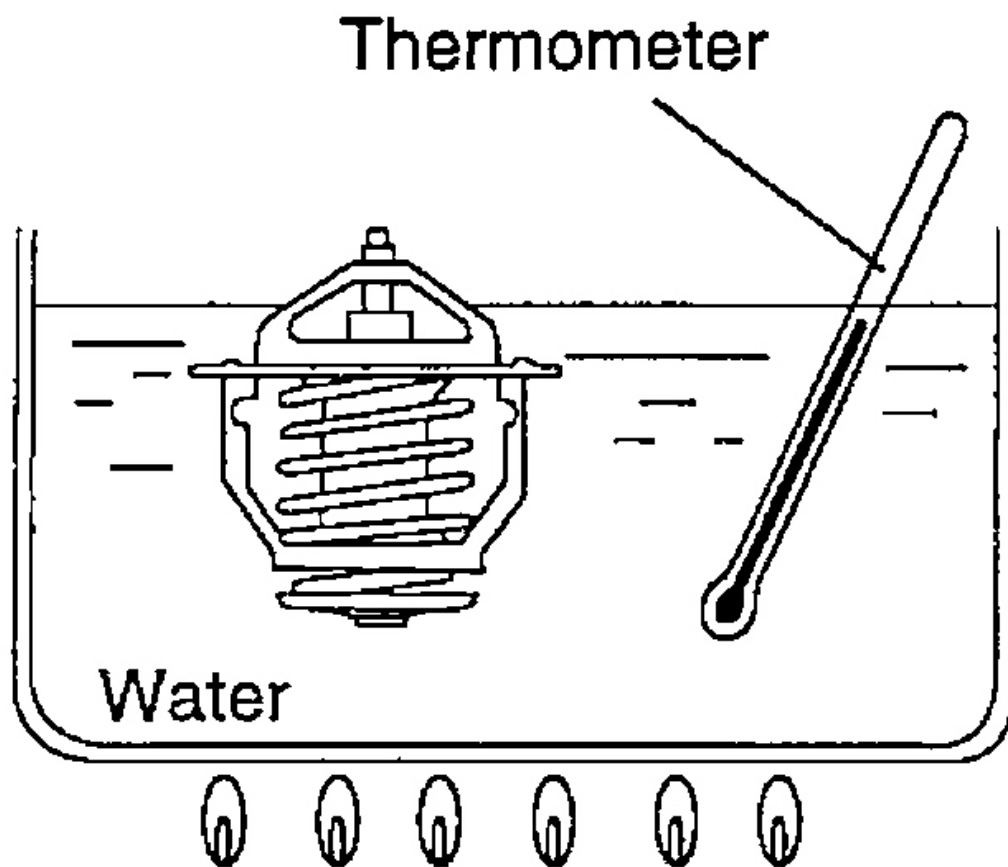
1. Drain the coolant to thermostat level or below.
2. Remove the inlet fitting and gasket.
3. Remove the thermostat.

INSPECTION

1. Heat the thermostat as shown in the illustration.
2. Check that the valve operates properly.
3. Verify the temperature at which the valve begins to open.

Valve opening temperature: 80-84°C (176-183.2°F)

Full opening temperature: 95°C (203°C)

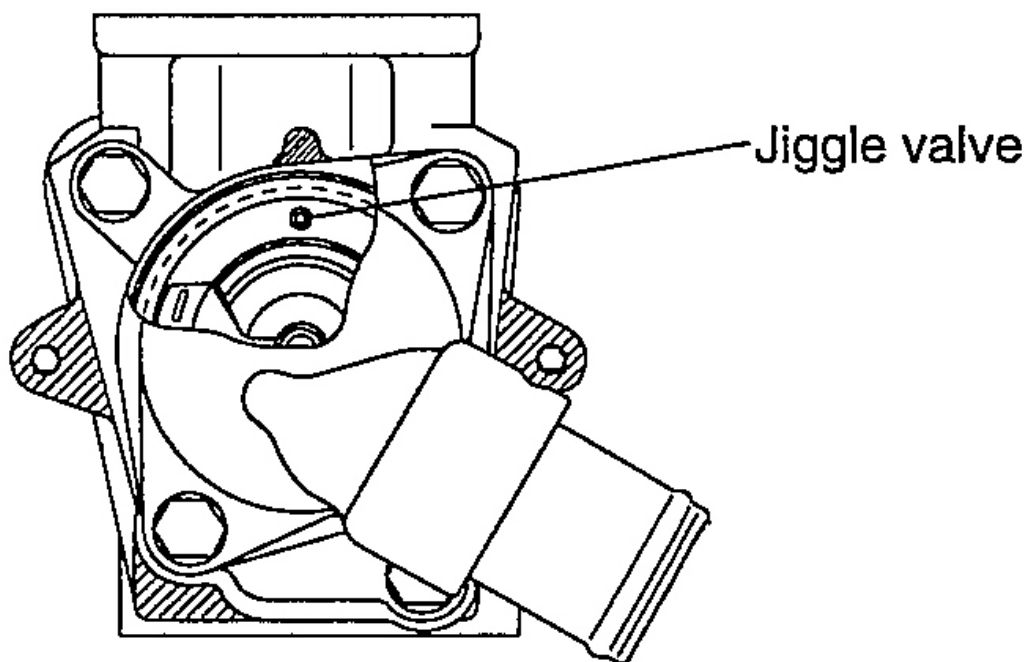


G00340250

Fig. 84: Heating Thermostat For Testing
Courtesy of KIA MOTORS AMERICA, INC.

INSTALLATION

1. Check that the flange of the thermostat is correctly placed in the socket of the thermostat housing.



G00340251

Fig. 85: Identifying Installation Position Of Thermostat
Courtesy of KIA MOTORS AMERICA, INC.

2. Install the inlet fitting.

Tightening torque

Engine coolant inlet fitting bolt:

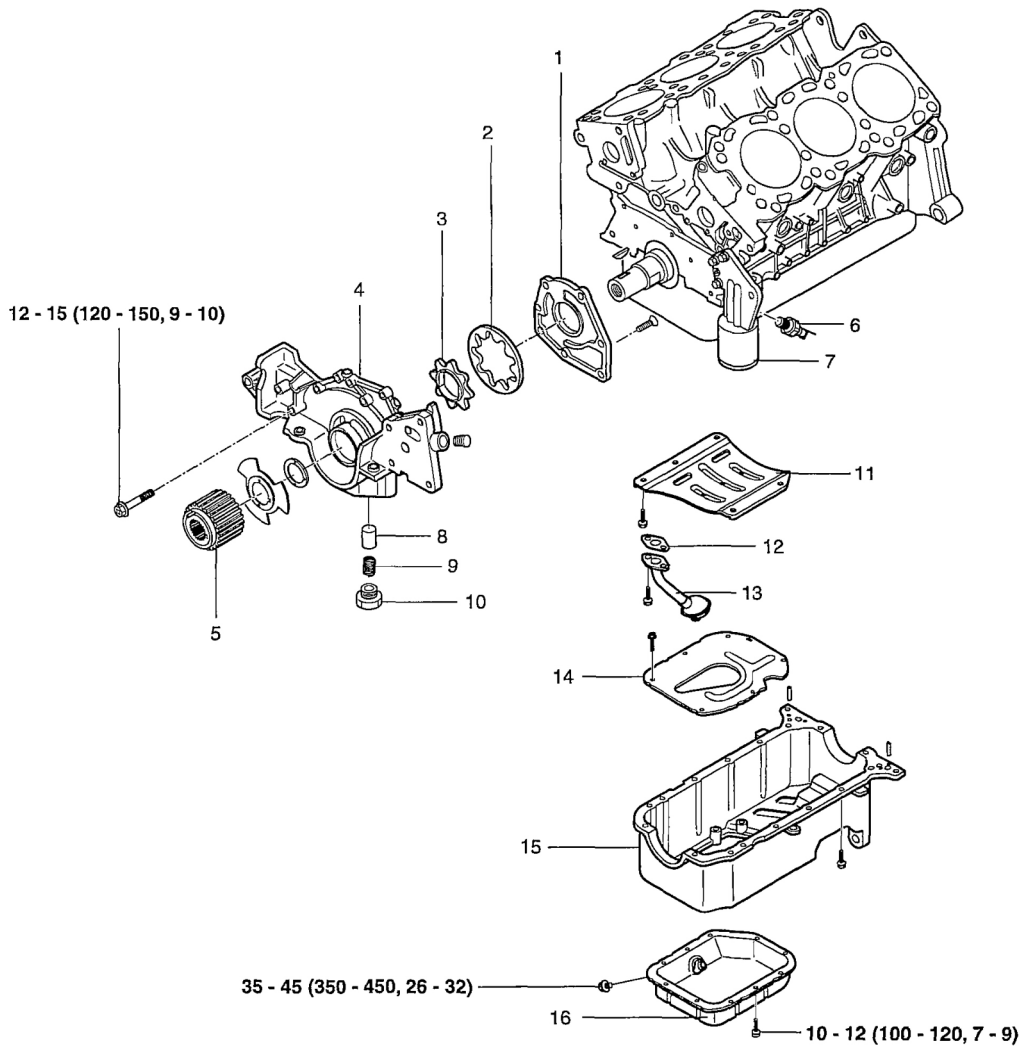
17-20 N.m (170-200 kg. cm, 12-14 lb. ft)

3. Refill the coolant.

LUBRICATION SYSTEM

OIL PUMP

COMPONENTS



TORQUE : N·m (kg·cm, lb·ft)

- | | |
|-------------------------|------------------------|
| 1. Oil pump cover | 9. Relief valve spring |
| 2. Oil pump outer rotor | 10. Relief valve plug |
| 3. Oil pump inner rotor | 11. Upper baffle plate |
| 4. Oil pump case | 12. Gasket |
| 5. Crankshaft sprocket | 13. Oil screen |
| 6. Oil pressure switch | 14. Lower baffle plate |
| 7. Oil pump | 15. Upper oil pan |
| 8. Relief valve plunger | 16. Lower oil pan |

G00340252

Fig. 86: Identifying Lubrication System Components & Torque Specifications
Courtesy of KIA MOTORS AMERICA, INC.

DISASSEMBLY

1. Remove the oil pressure switch, using 24 mm deep socket.

NOTE: Since a sealant is used on the threaded area, be careful not to damage the

oil pressure switch.

2. Remove the oil filter and the oil pan.
3. Remove the oil screen and gasket.
4. Remove the three bracket securing bolts and remove the oil filter bracket and gasket.
5. Remove the oil relief value plug from the oil pump case.
6. Remove the oil pump case.

INSPECTION**OIL PUMP**

1. Visually check the parts of the oil pump case for cracks and damage.
2. Assemble the rotor on the oil pump and then check the clearance with a thickness gauge.

Oil pump side clearance

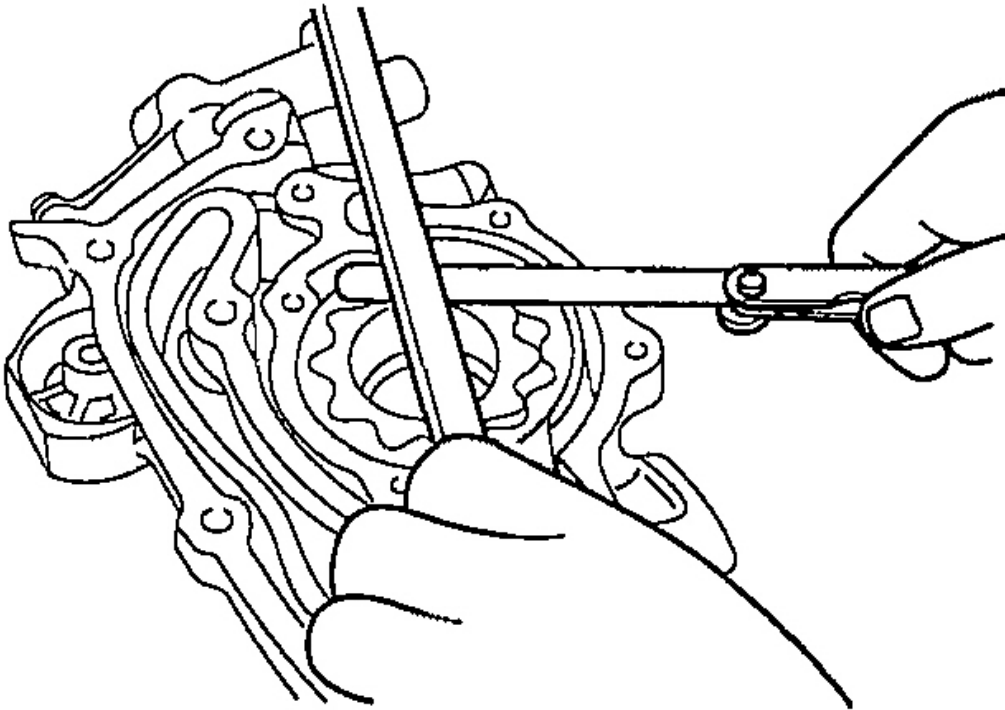
Standard value

Body clearance: 0.100-0.181 mm (0.0039-0.0071 In.)

Side clearance: 0.040-0.095 mm (0.0016-0.0037 In.)

Oil pump Tip clearance

0.06-0.18 mm (0.0024-0.0071 In.)



G00340255

Fig. 87: Measuring Oil Pump Clearances
Courtesy of KIA MOTORS AMERICA, INC.

RELIEF PLUNGER & SPRING

1. Check the relief plunger for smooth operation.
2. Check the relief spring for deformation or breaks.

OIL FILTER BRACKET

1. Make sure that there is no damage on the oil filter mating surface.
2. Check the oil filter bracket for oil leaks or cracks.

OIL PRESSURE SWITCH

1. Check the continuity between the terminal and the body with an ohmmeter. If there is no continuity, replace the oil pressure switch.
2. Check the continuity between the terminal and the body when a fine wire is pushed in through oil hole. If

there is continuity even when the fine wire is pushed, replace the switch.

3. If there is no continuity when a 50 kPa (0.5 kg/cm² , 7 psi) vacuum is applied through the oil hole, the switch is operating properly.
4. Check for air leakage. If air leaks, the diaphragm is broken. Replace it.

Operation Pressure

Oil Pressure switch:

19.6-39.2 kPa (0.2-0.4 kg/cm² , 2.8-5.7 psi) or more

REASSEMBLY

1. Install the oil pump case with the gasket.

Tightening torque

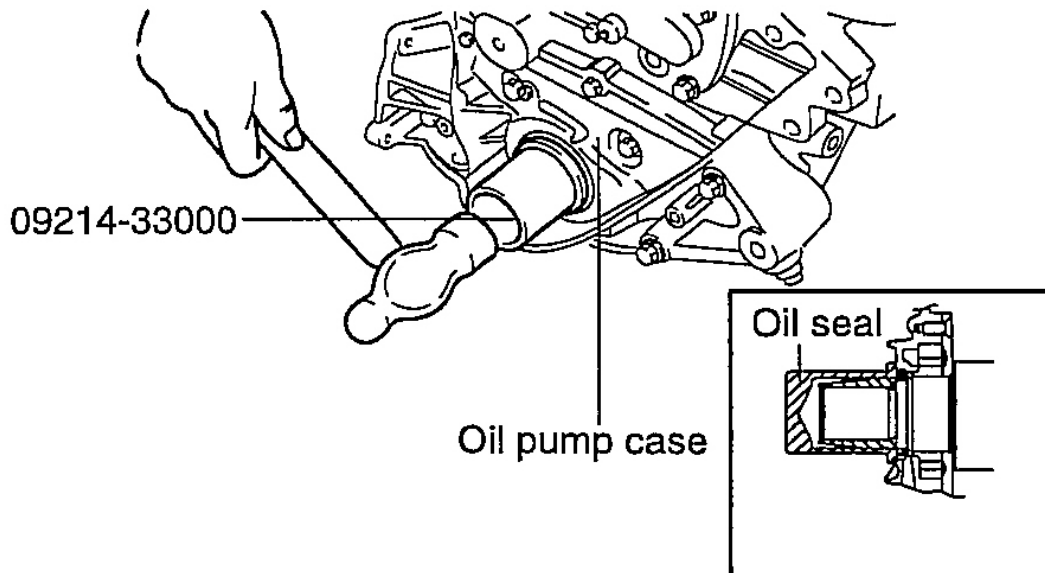
Oil pump case bolt:

12-15 N.m (120-150 kg. cm, 9-11 lb. ft)

Oil pump cover screw:

8-12 N.m (80-120 kg. cm, 6-9 lb. ft)

2. Install the oil seal into the oil pump case as tightly as possible, using the special tool (09214-33000).



G00340259

Fig. 88: Using The Special Tool, Install The Oil Seal Into The Oil Pump Case
 Courtesy of KIA MOTORS AMERICA, INC.

3. Install the relief plunger and spring, and tighten the oil relief valve plug to the specified torque.

Tightening torque

Oil relief valve plug:

40-50 N.m (400-500 kg. cm, 29-36 lb. ft)

4. Install the oil screen and a new gasket.

Tightening torque

Oil screen bolt:

15-22 N.m (150-220 kg. cm, 11-15 lb. ft)

5. Clean the gasket surfaces of the cylinder block and the oil pan.
6. Apply sealant to the groove of the oil pan flange.

NOTE:

- Make the first cut approximately 4 mm from the end of the nozzle furnished with the sealant. After application of the sealant, do not

exceed 15 minutes before installing the oil pan.

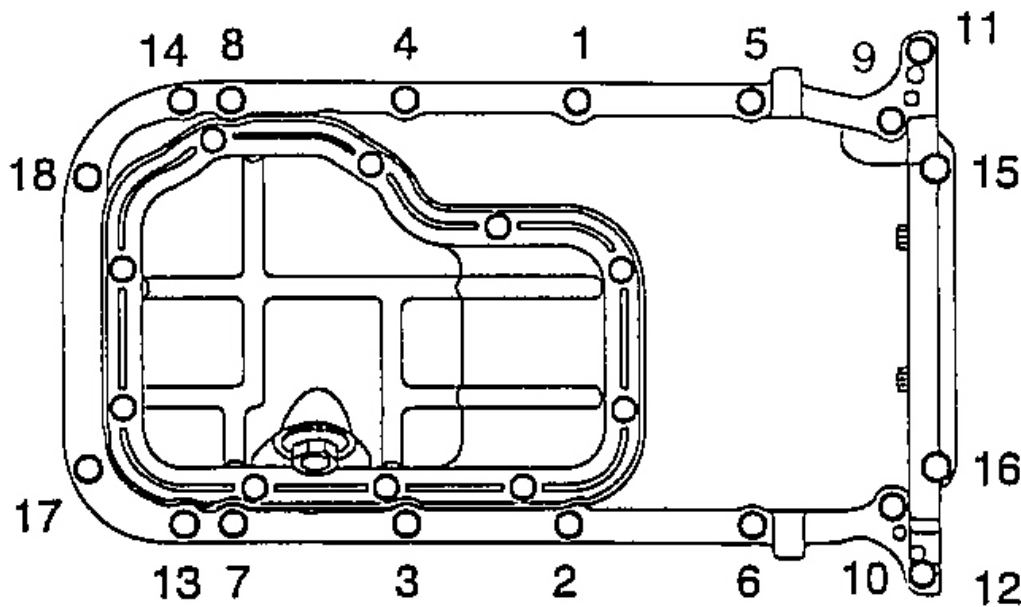
- Make sure that the sealant doesn't enter the inside of the oil pan.

7. Tighten the oil pan bolts as shown in the illustration.

Tightening torque

9.8-11.8 N.m (100-120 kg. cm, 7.2-8.7 lb. ft)

4.9-6.9 N.m (50-70 kg. cm, 3.6-5.1 lb. ft) (No. 15-16)



G00340262

Fig. 89: Identifying Upper Oil Pan Bolt Tightening Sequence

Courtesy of KIA MOTORS AMERICA, INC.

8. Tighten the transmission mounting bolts from oil pan.

Tightening torque (mounting bolts)

29.4-41.2 N.m (300-420 kg. cm, 21.7-30.4 lb. ft)

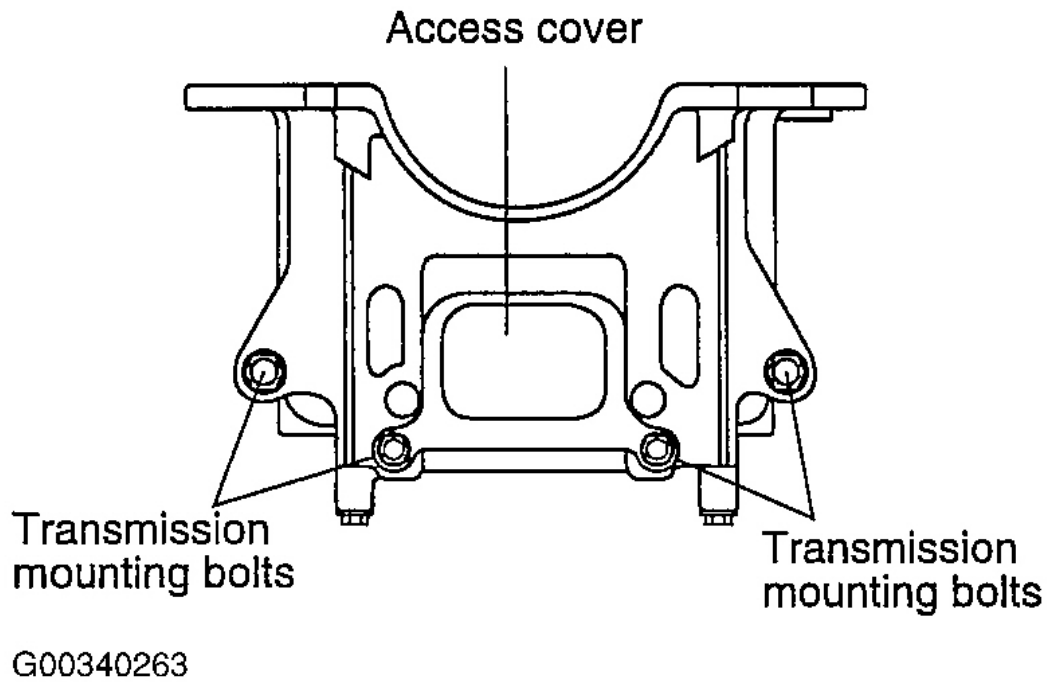


Fig. 90: Identifying Transmission Mounting Bolts
Courtesy of KIA MOTORS AMERICA, INC.

9. Using a 24 mm deep socket, install the oil pressure switch after applying sealant to the threaded area.

Sealant: Three bond No. 1104E or equivalent

NOTE: Do not torque the oil pressure switch too much.

Tightening torque

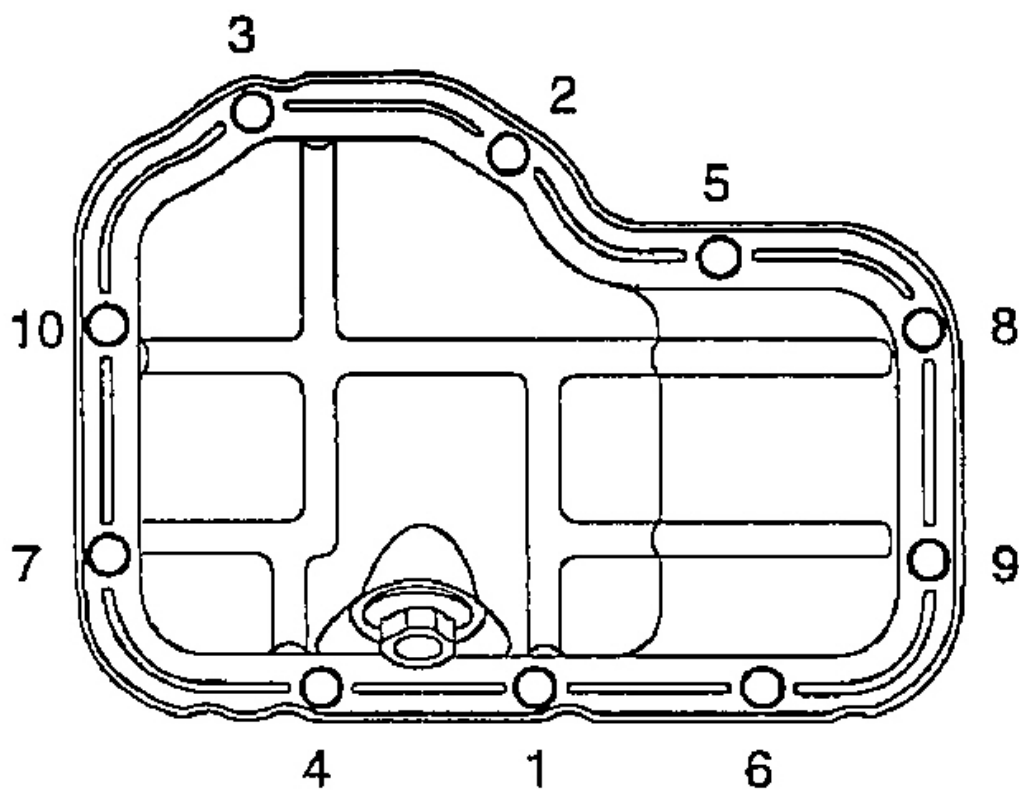
Oil pressure switch:

8-12 N.m (80-120 kg. cm, 6-9 lb. ft)

10. Tighten the lower oil pan bolts as shown in illustration.

Tightening torque

9.8-11.8 N.m (100-120 kg. cm, 7.2-8.7 lb. ft)



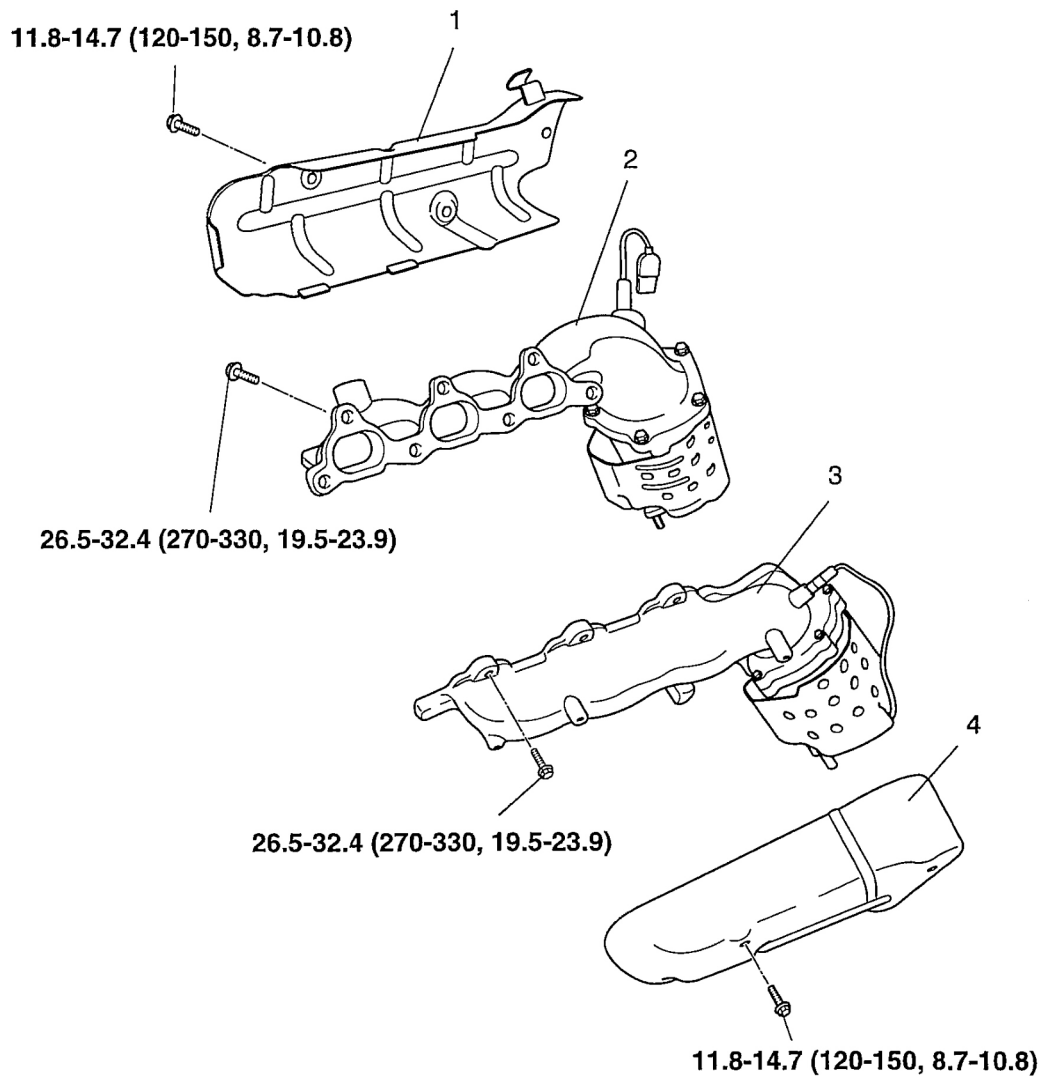
G00340265

Fig. 91: Identifying Lower Oil Pan Bolt Tightening Sequence
Courtesy of KIA MOTORS AMERICA, INC.

INTAKE & EXHAUST SYSTEM

EXHAUST MANIFOLD

COMPONENTS



TORQUE : N·m (kg·cm, lb·ft)

- 1. Heat protector
- 2. Exhaust manifold

- 3. Exhaust manifold
- 4. Heat protector

G00340266

Fig. 92: Identifying Exhaust Manifold Components & Torque Specifications
 Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

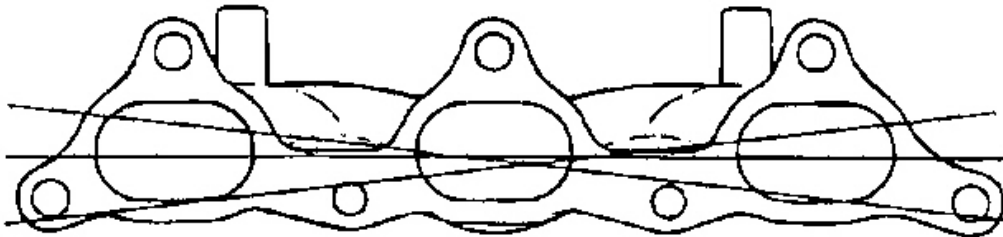
1. Remove the heat protector.
2. Remove the exhaust manifold.
3. Remove the exhaust manifold gasket.

INSPECTION

1. Check for damage or cracks.
2. Using a straight edge and feeler gauge, check for distortion on the exhaust manifold.

Standard value: 0.15 mm (0.006 In.) or less

Service limit: 0.3 mm (0.012 In.) or less



G00340269

Fig. 93: Inspecting Exhaust Manifold For Distortion
Courtesy of KIA MOTORS AMERICA, INC.

INSTALLATION

1. Install the exhaust manifold with gasket.

Tightening torque

26.5-32.4 N.m (270-330 kg. cm, 19.5-23.9 lb. ft)

NOTE: Do not re-use an exhaust manifold gasket.

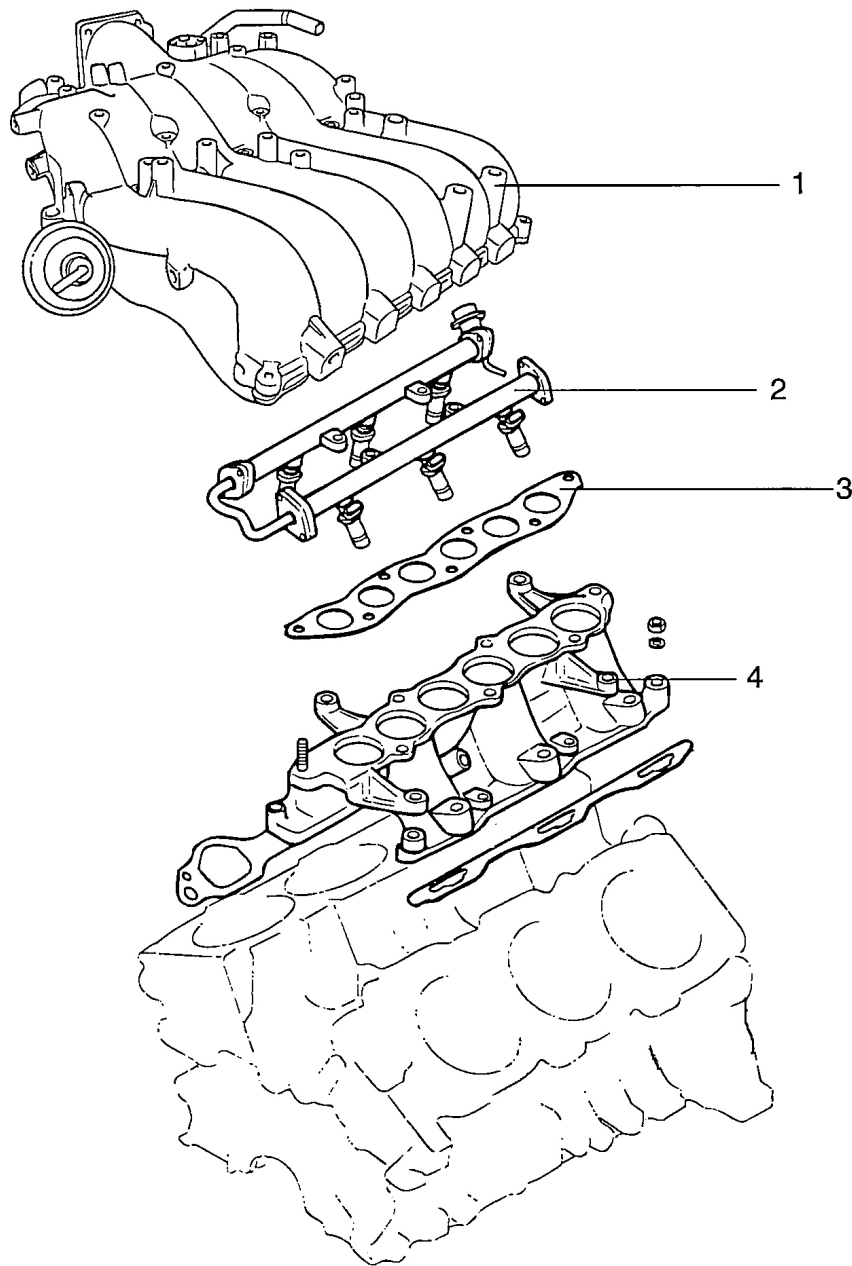
2. Install the heat protector.

Tightening torque

11.8-14.7 N.m (120-150 kg. cm, 8.7-10.8 lb. ft)

INTAKE MANIFOLD

COMPONENTS



1. Surge tank
2. Delivery pipe

3. Gasket
4. Intake manifold

G00340272

Fig. 94: Identifying Intake Manifold Components
Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

1. Remove the air intake hose connected to the throttle body.
2. Remove the accelerator and cruise control cables.
3. Remove the engine coolant hose and throttle body.
4. Remove the P.C.V. hose and brake booster vacuum hoses.
5. Disconnect the vacuum hose connections.
6. Remove the surge tank stay.

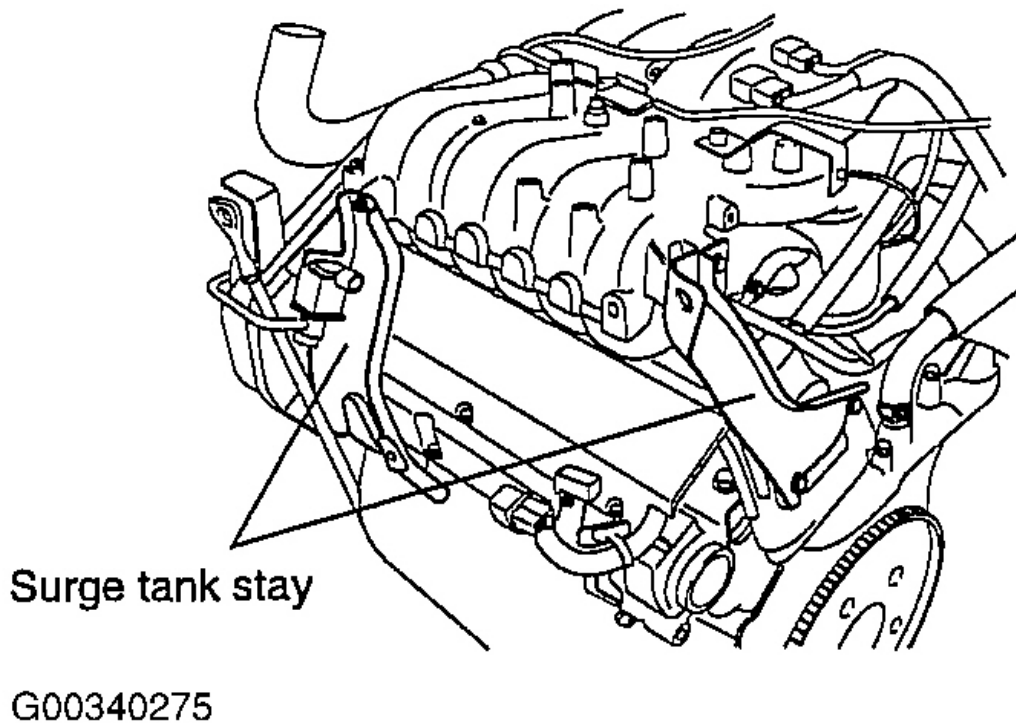


Fig. 95: Identifying Surge Tank Stays (Engine Left Rear View)
Courtesy of KIA MOTORS AMERICA, INC.

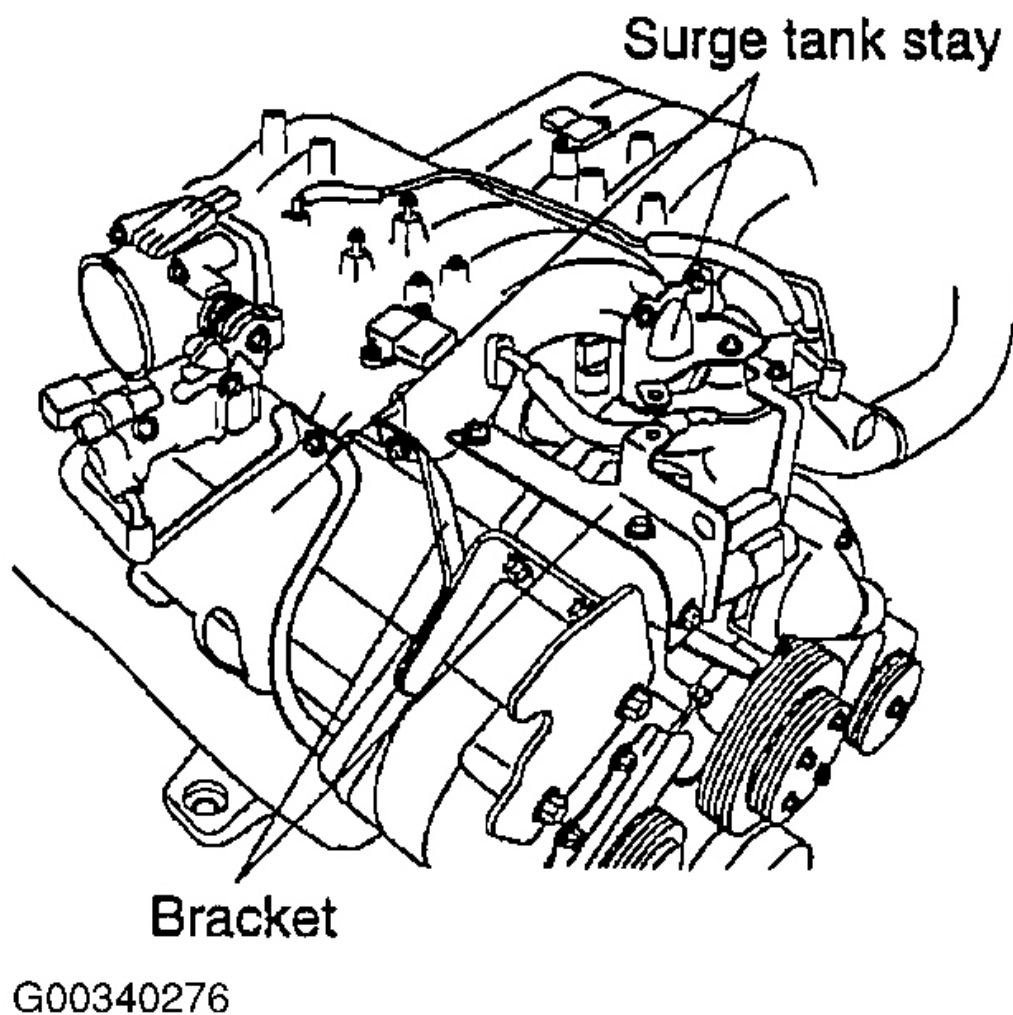
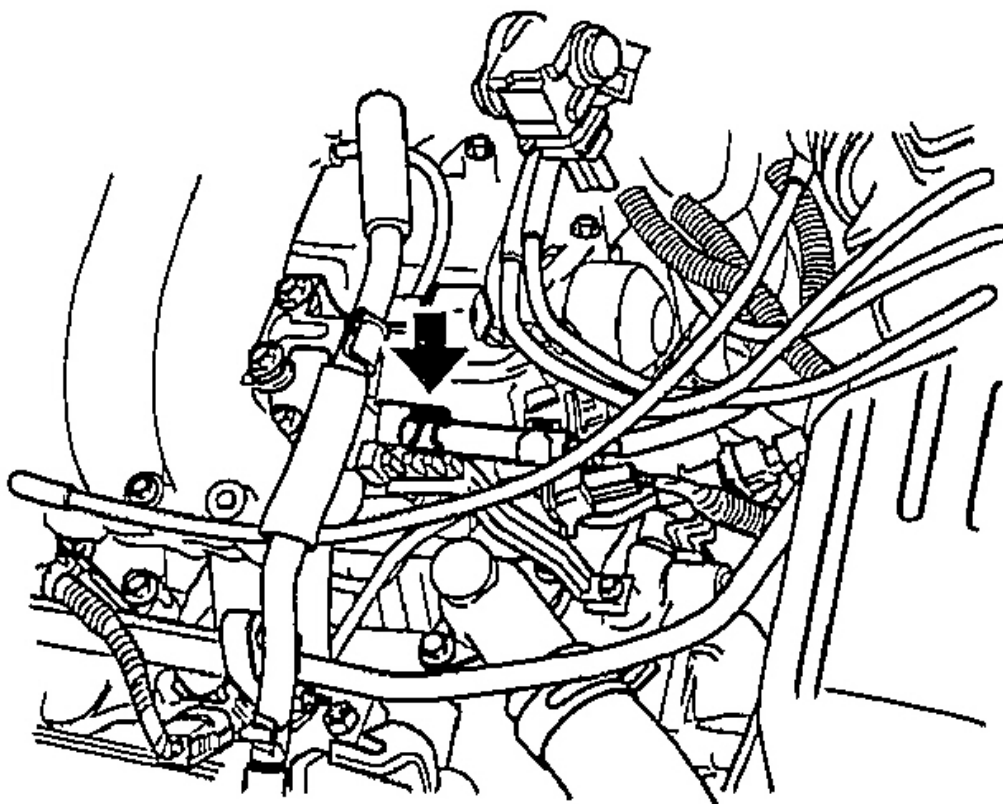


Fig. 96: Identifying Surge Tank Stays (Engine Right Front View)

Courtesy of KIA MOTORS AMERICA, INC.

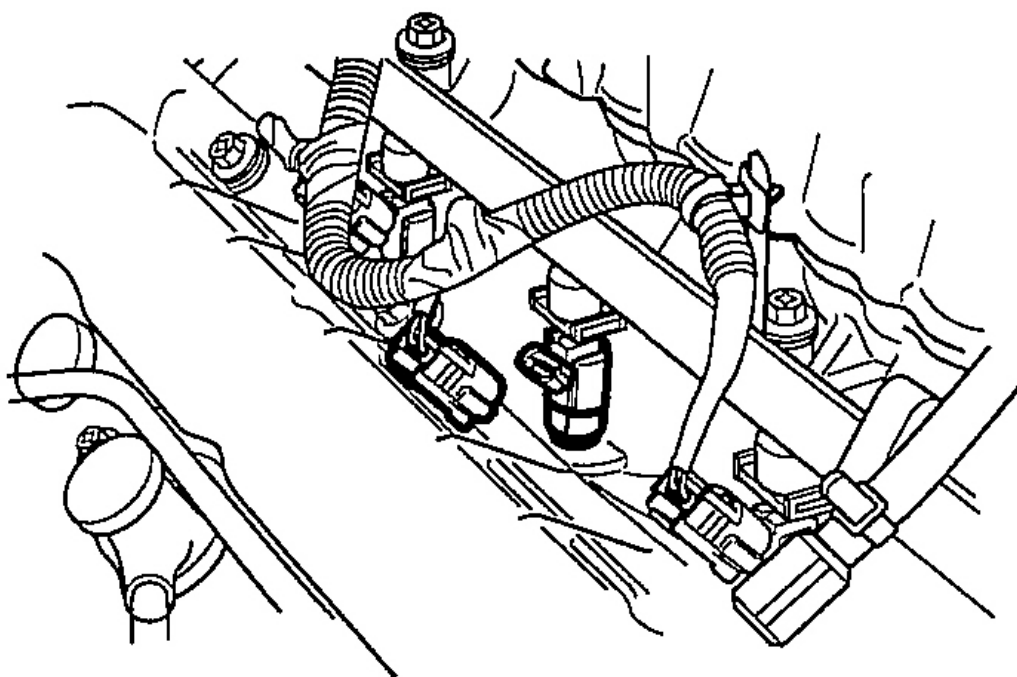
7. Bleed off the pressure in the fuel pipe line to prevent the fuel from spilling.
8. Disconnect the connector from high pressure hose.



G00340277

Fig. 97: Identifying Connector From High Pressure Hose
Courtesy of KIA MOTORS AMERICA, INC.

9. Remove bolts and the surge tank and gasket.
10. Disconnect the fuel injector harness connector.

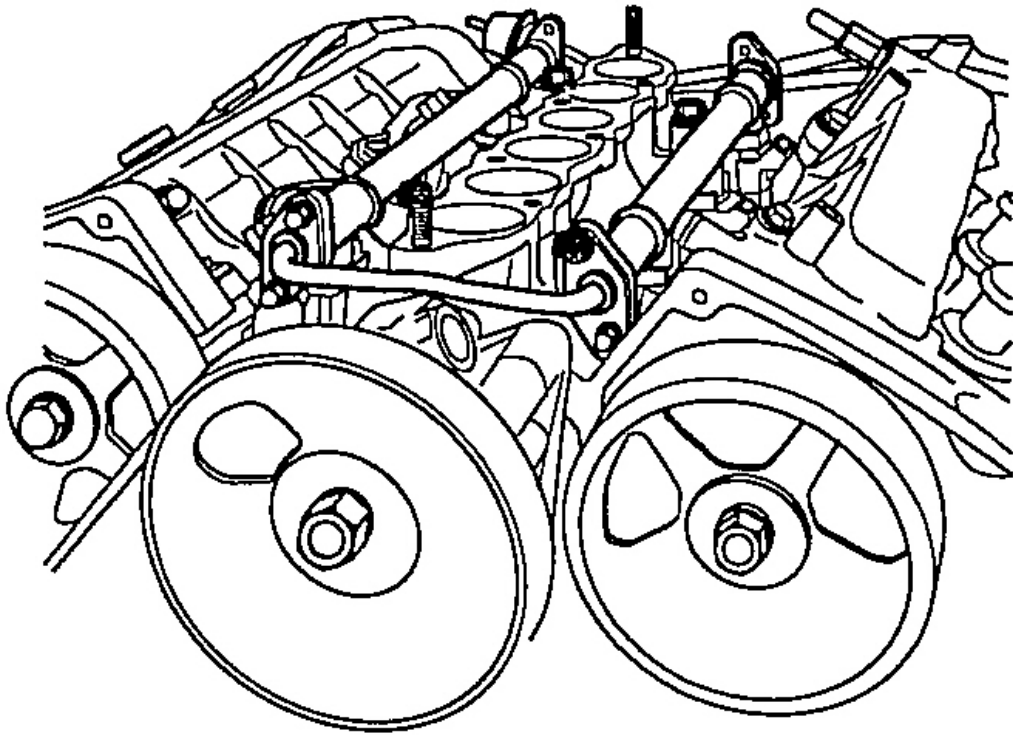


G00340279

Fig. 98: Disconnect The Fuel Injector Harness Connector
Courtesy of KIA MOTORS AMERICA, INC.

11. Remove the delivery pipe with the fuel injector and the pressure regulator.

NOTE: When the delivery pipe is removed, be careful not to drop an injector.



G00340280

Fig. 99: Remove Delivery Pipe

Courtesy of KIA MOTORS AMERICA, INC.

12. Disconnect the wiring harness of the coolant sensor assembly.
13. Remove the bolts and intake manifold.

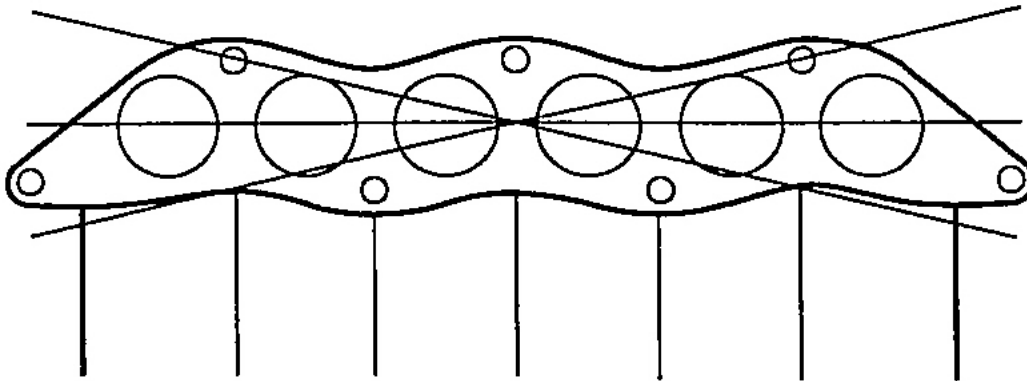
INSPECTION

SURGE TANK & INTAKE MANIFOLD

1. Check the surge tank and intake manifold for damage, cracking or restriction of the vacuum outlet port, water or gas passages.
2. Check for distortion on the surface using a straight edge and feeler gauge.

Standard value: 0.15 mm (0.006 In.) or less

Service limit: 0.2 mm (0.0078 In.)



G00340282

Fig. 100: Using A Straight Edge & Feeler Gauge, Check Surge Tank & Intake Manifold For Distortion
Courtesy of KIA MOTORS AMERICA, INC.

INSTALLATION

- Install the intake manifold and delivery pipe reversing the order of the removal procedure.

Tightening torque

Intake manifold:

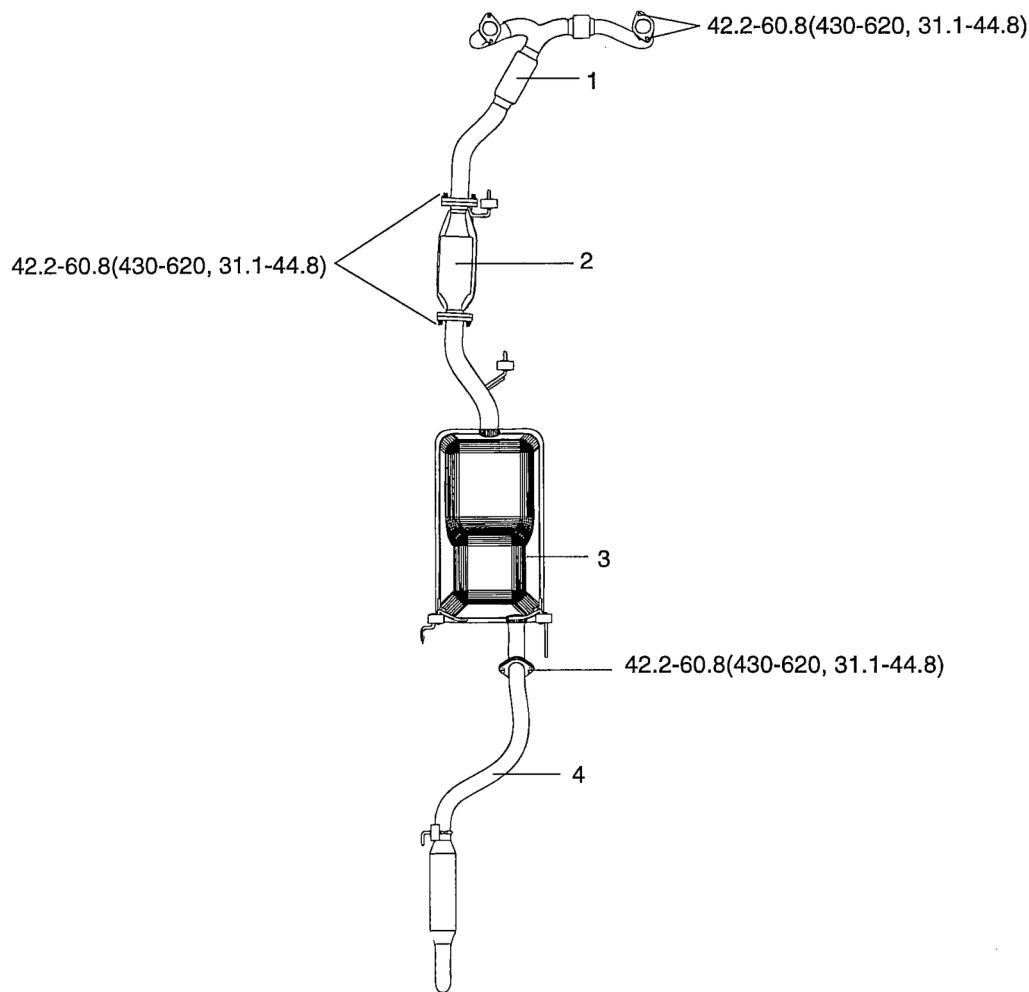
19.6-22.6 N.m (200-230 kg. cm, 14.5-16.6 lb. ft)

Surge tank stay:

15-20 N.m (150-200 kg. cm, 11-14 lb. ft)

MUFFLER

COMPONENTS



TORQUE : N·m (kg·cm, lb·ft)

- 1. Front pipe
- 2. Front muffler

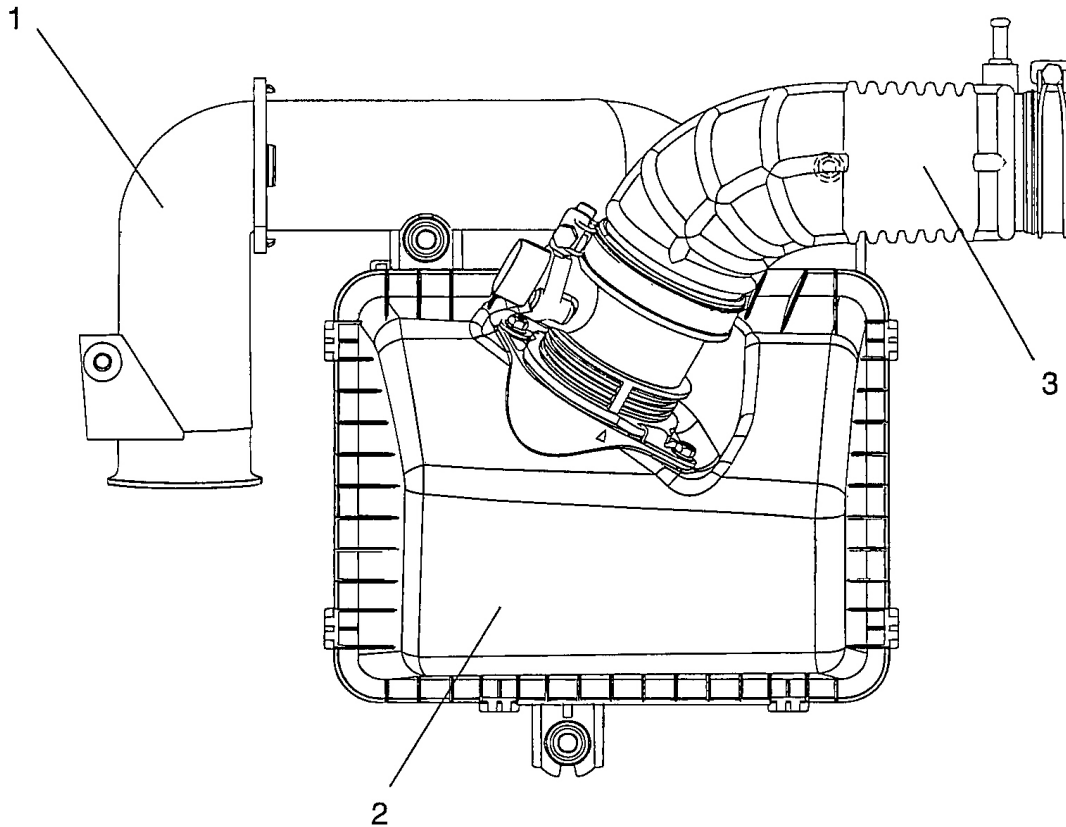
- 3. Main muffler
- 4. Tail pipe

G00340286

Fig. 101: Identifying Exhaust Muffler Components & Torque Specifications
 Courtesy of KIA MOTORS AMERICA, INC.

AIR CLEANER

COMPONENTS



- 1. Air duct
- 2. Air cleaner assembly
- 3. Air hose

G00340287

Fig. 102: Identifying Air Cleaner Components
 Courtesy of KIA MOTORS AMERICA, INC.

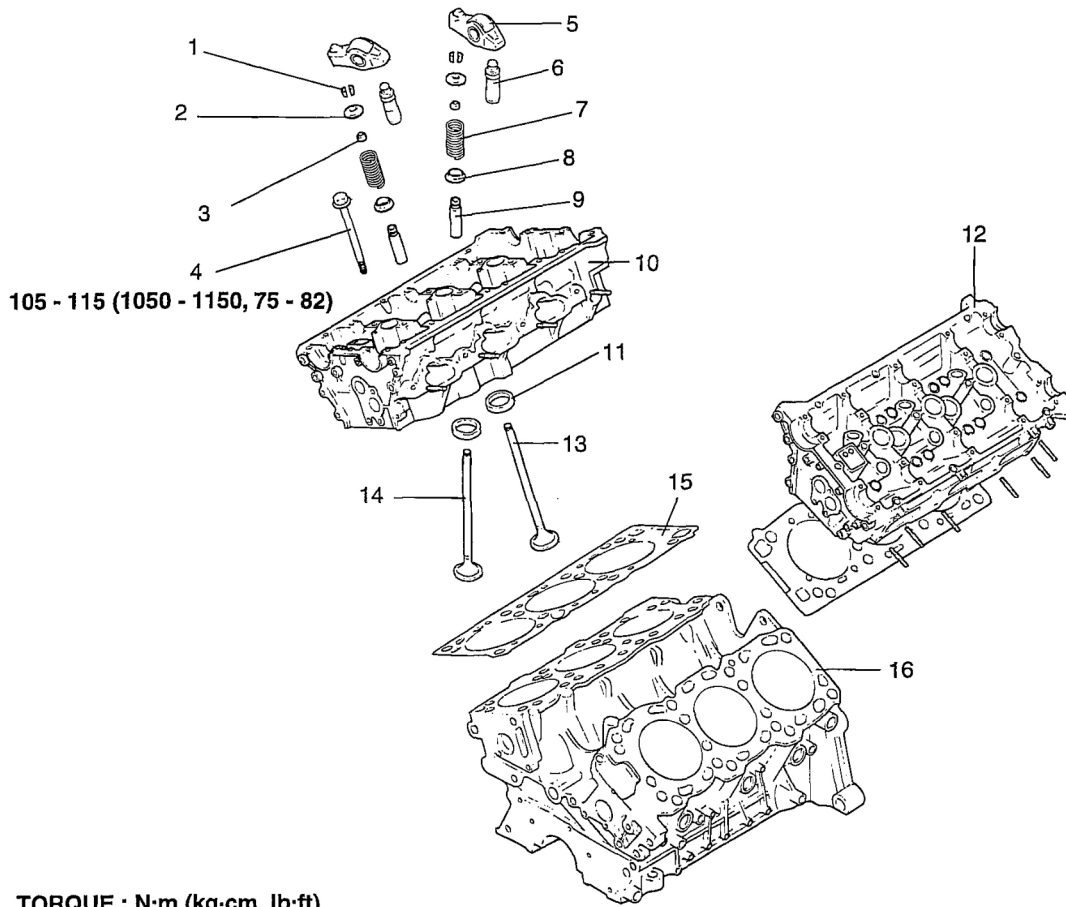
INSPECTION

- 1. Check the air intake hose and air cleaner cover for damage.
- 2. Check the air duct for damage.
- 3. Check the air cleaner element for restriction, contamination or damage.
- 4. If the element is slightly restricted, remove dust and debris by blowing compressed air from the inside of the element. Replace the element if it cannot be cleaned.

CYLINDER HEAD ASSEMBLY

CYLINDER HEAD

COMPONENTS



TORQUE : N·m (kg·cm, lb·ft)

- | | |
|--------------------------|-----------------------------|
| 1. Retainer lock | 9. Valve guide |
| 2. Valve spring retainer | 10. Cylinder head (RH) |
| 3. Valve stem seal | 11. Exhaust valve seat ring |
| 4. Cylinder head bolt | 12. Cylinder head (LH) |
| 5. Rocker arm | 13. Exhaust valve |
| 6. Lash adjuster | 14. Intake valve |
| 7. Valve spring | 15. Gasket |
| 8. Spring seat | 16. Cylinder block |

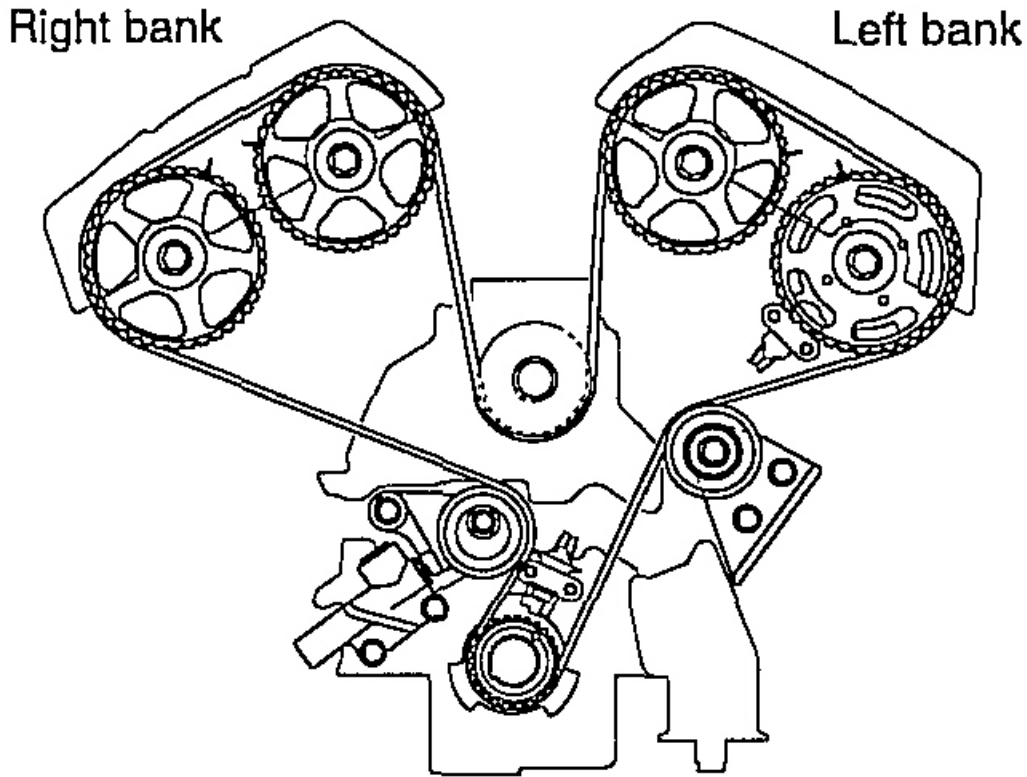
G00340290

Fig. 103: Identifying Cylinder Head Components & Torque Specifications
 Courtesy of KIA MOTORS AMERICA, INC.

DISASSEMBLY

1. Drain the coolant and disconnect the upper radiator hose.
2. Remove the breather hose and air-intake hose.
3. Remove the vacuum hose, fuel hose and coolant hose.
4. Remove the intake manifold.
5. Remove the cables from the spark plugs. The cables should be removed by holding the boot portion.
6. Remove the ignition coil.

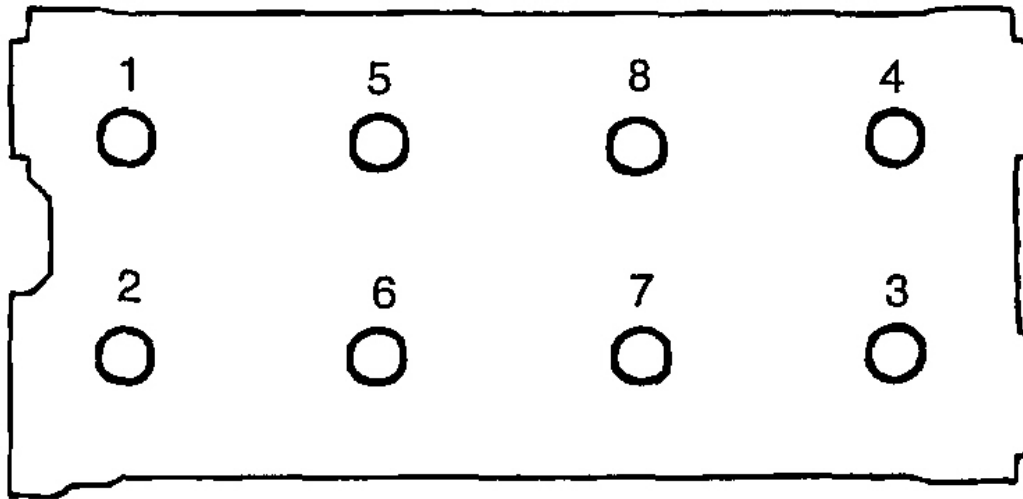
7. Remove the upper and lower timing belt cover.
8. Remove the timing belt and camshaft sprockets. See **TIMING BELT**.



G00340291

Fig. 104: Identifying Timing Belt & Camshaft Sprockets
Courtesy of KIA MOTORS AMERICA, INC.

9. Remove the heat protector and exhaust manifold assembly.
10. Remove the coolant pump pulley and head cover.
11. Remove the intake and exhaust camshaft.
12. Remove the cylinder head assembly. The cylinder head bolts should be removed using the 12 mm socket, in two or three steps following the sequence as shown in illustration.



G00340293

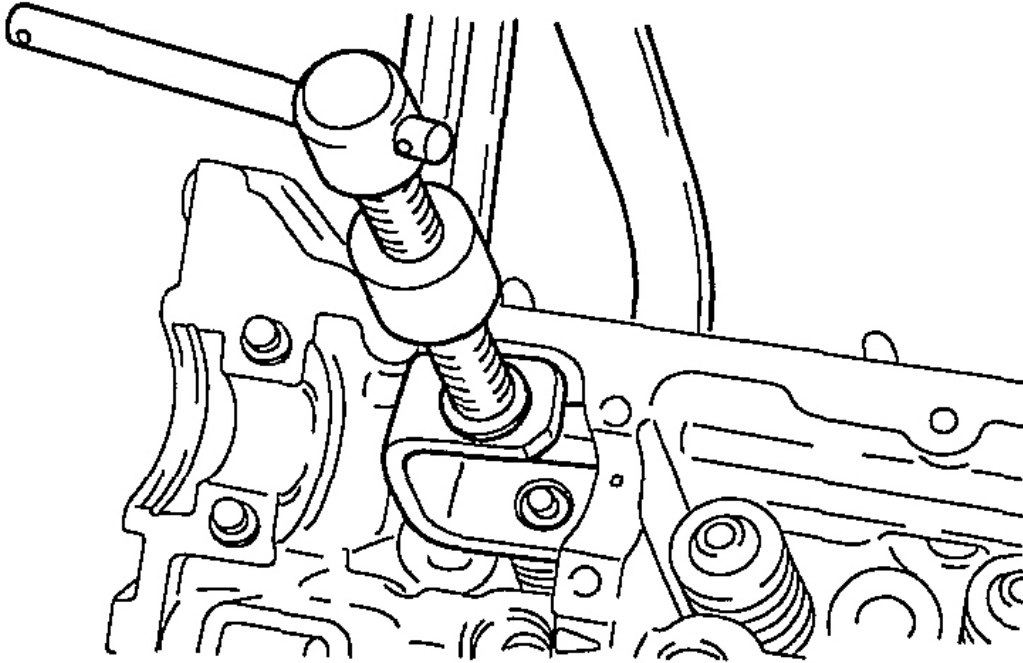
Fig. 105: Identifying Cylinder Head Bolt Removal Sequence
Courtesy of KIA MOTORS AMERICA, INC.

13. Clean the gasket pieces from the cylinder block top surface and cylinder head bottom surface.

NOTE: **Make sure that fragments from the gasket do not fall in the engine.**

RETAINER LOCK

1. Compress the valve spring using special tool (09222-28000, 09222-28100).
2. Remove the retainer lock.



G00340294

Fig. 106: Using Special Tool, Compress Spring & Remove Retainer Locks
Courtesy of KIA MOTORS AMERICA, INC.

INSPECTION

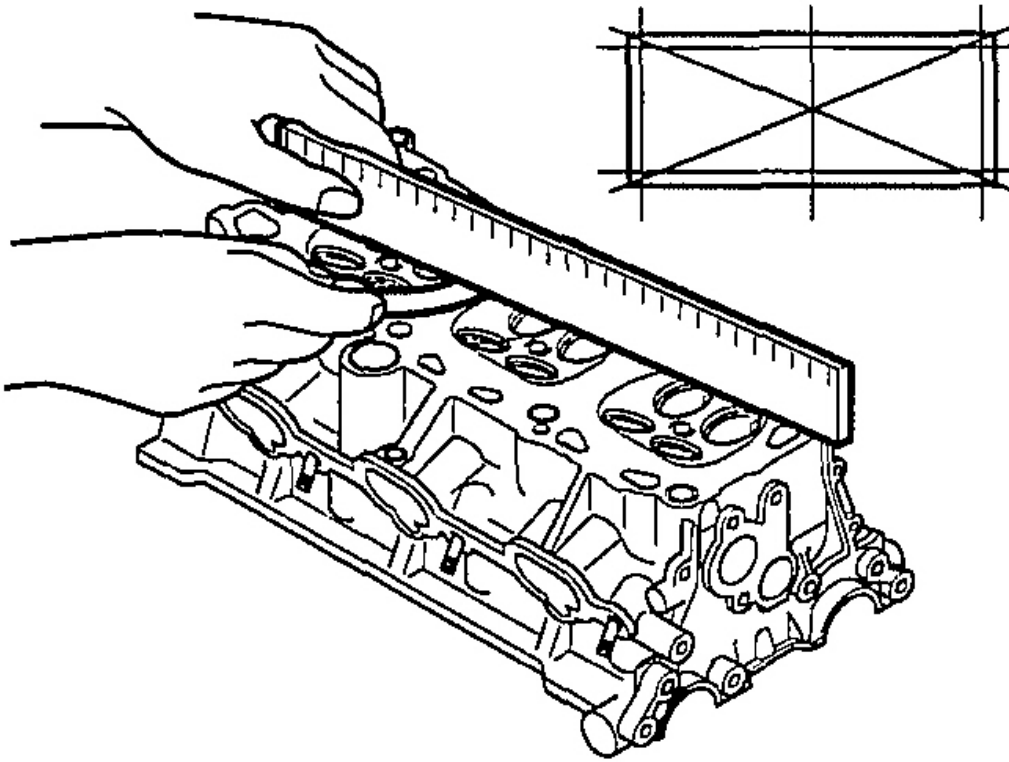
CYLINDER HEAD

1. Remove scale, sealing compound and carbon deposits. After cleaning oil passages, apply compressed air to make certain that the passages are not clogged.
2. Visually check the cylinder head for cracks, damage or water leakage.
3. Check the cylinder head surface for flatness with a straight edge and feeler gauge as shown in the illustration.

Cylinder head flatness:

Standard dimensions: Max. 0.03 mm (0.0059 In.)

Service limit: 0.05 mm (0.0020 In.)



G00340295

Fig. 107: Checking Cylinder Head Flatness
Courtesy of KIA MOTORS AMERICA, INC.

VALVE GUIDES

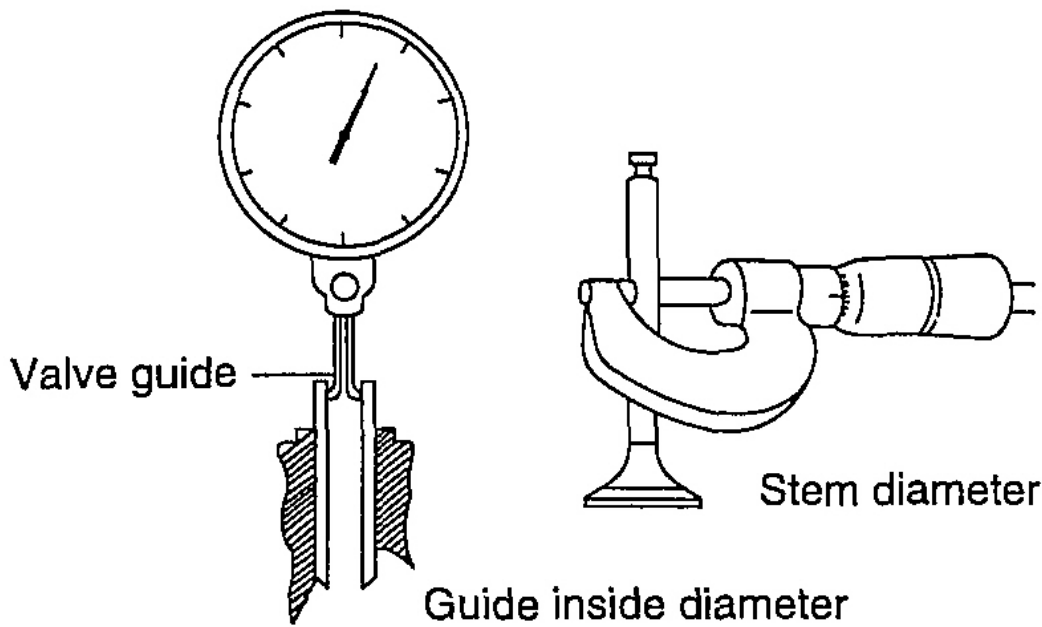
Check the valve stem-to-guide clearance. If the clearance exceeds the service limit, replace the valve guide with a new oversize guide.

Valve stem-to-guide clearance

Standard value

Intake: 0.02-0.05 mm (0.0009-0.0020 In.)

Exhaust: 0.050-0.085 mm (0.0020-0.0033 In.)



G00340296

Fig. 108: Checking Valve Stem-To-Guide Clearance
 Courtesy of KIA MOTORS AMERICA, INC.

VALVE

1. Replace the valve if its stem is bent, worn or damaged. Also replace it if the stem end (the surface contacting the hydraulic-lash adjuster) is hollowed out.
2. Check the valve face contact area, and recondition or replace as necessary.
3. Replace the valve if the width of the margin (thickness of the valve head) is less than the minimum specified.

Valve margins

Standard value

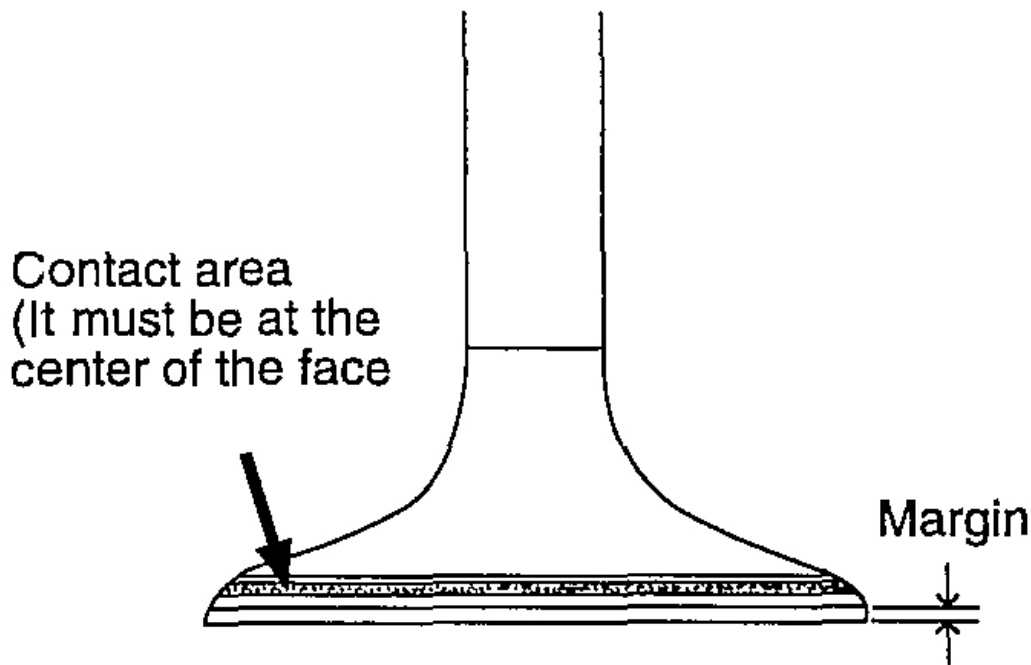
Intake: 1.0 mm (0.0394 in)

Exhaust: 1.5 mm (0.0590 in)

Service limit

Intake: 0.5 mm (0.0197 in)

Exhaust: 1.0 mm (0.0394 in)



G00340298

Fig. 109: Identifying Valve Margins
Courtesy of KIA MOTORS AMERICA, INC.

VALVE SPRING

1. Check the free height of each valve spring and replace if necessary.
2. Using a square, test the squareness of each valve spring. If the spring is excessively out-of-square, replace it.

Valve spring

Standard value

Free height: 46.4 mm (1.8268 In.)

Load : 24 kg / 37.9 mm (53 lb / 1.492 In.)

Out-of-square: Max. 2°

2004 Kia Sorento LX

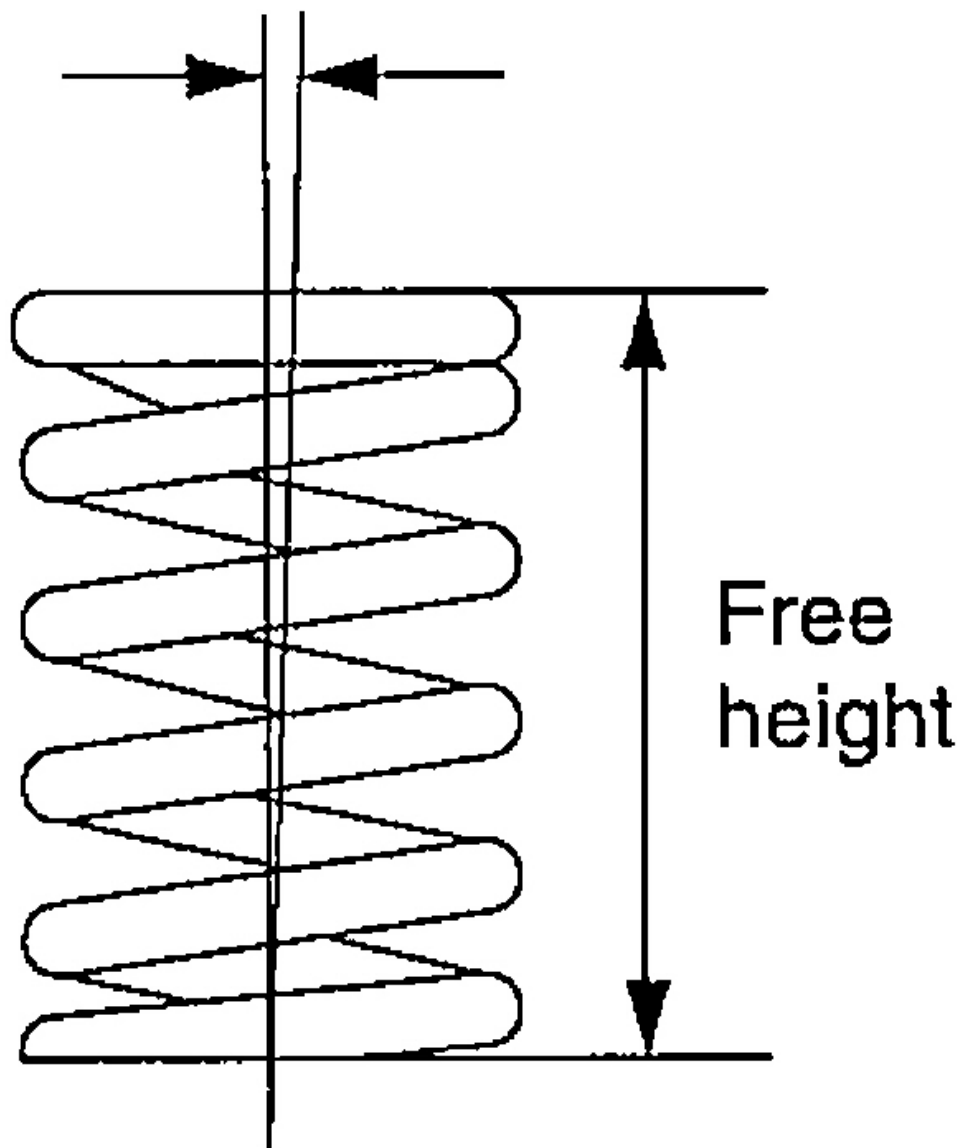
2004-06 ENGINES Mechanical - 3.5L V6 - Sorento

Service limit

Free height: 45.4 mm (1.7874 In.)

Out-of-square: Max 4°

Out-of-square (2°)



G00340299

Fig. 110: Checking Valve Springs

Courtesy of KIA MOTORS AMERICA, INC.

RECONDITIONING VALVE SEAT

1. Before reconditioning, check the valve guide for wear. Replace worn guides if necessary and then recondition the valve seats.
2. Recondition the valve seat using the Valve Seat Cutter and Pilot.
3. After reconditioning, the valve and valve seat should be lapped lightly with a lapping compound.

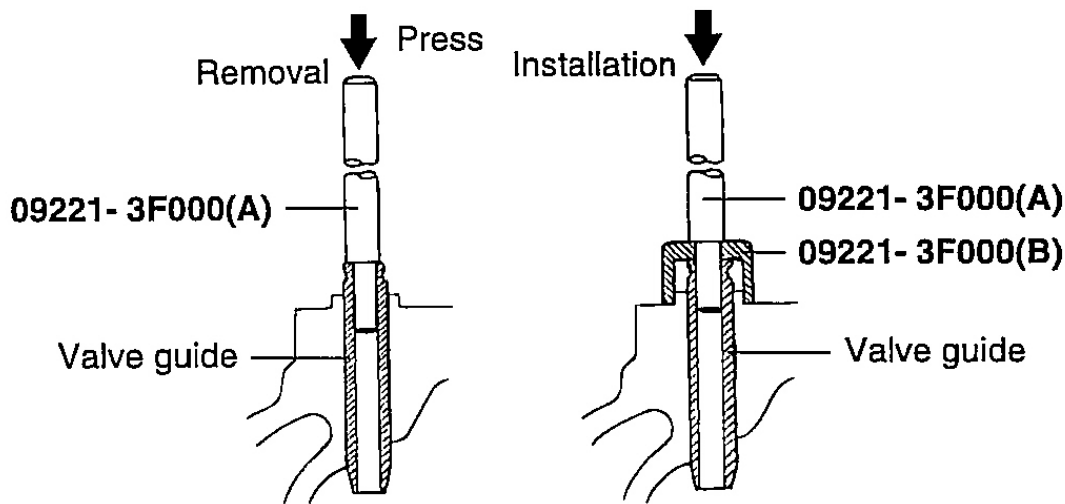
REPLACING VALVE GUIDE

1. Using the special tool (09221-3F000(A)), withdraw the old valve guide out the bottom of the cylinder head.
2. Recondition the valve guide hole so that it can receive the newly press-fitted oversize valve guide.

Size mm (in.)	Size Mark	Oversize valve guide hole size mm (in.)
0.05 (0.002) O.S.	5	12.05 - 12.068 (0.474 - 0.475)
0.25 (0.010) O.S.	25	12.25 - 12.268 (0.482 - 0.483)
0.50 (0.020) O.S.	50	12.50 - 12.518 (0.492 - 0.493)

G00340301

Fig. 111: Valve Guides Oversize Table
Courtesy of KIA MOTORS AMERICA, INC.



G00340302

Fig. 112: Removing & Installing Valve Guides
Courtesy of KIA MOTORS AMERICA, INC.

3. Using the special tool (09221-3F000(A), 09221-3F000(B)) press-fit the valve guide. The valve guide must be press-fitted from the upper side of the cylinder head. Keep in mind that the intake and exhaust valve guides are different in length.
4. After the valve guide is press-fitted, insert a new valve and check for proper clearance.
5. After the valve guide is replaced, check that the valve is fully seated. Recondition the valve seats as necessary.

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

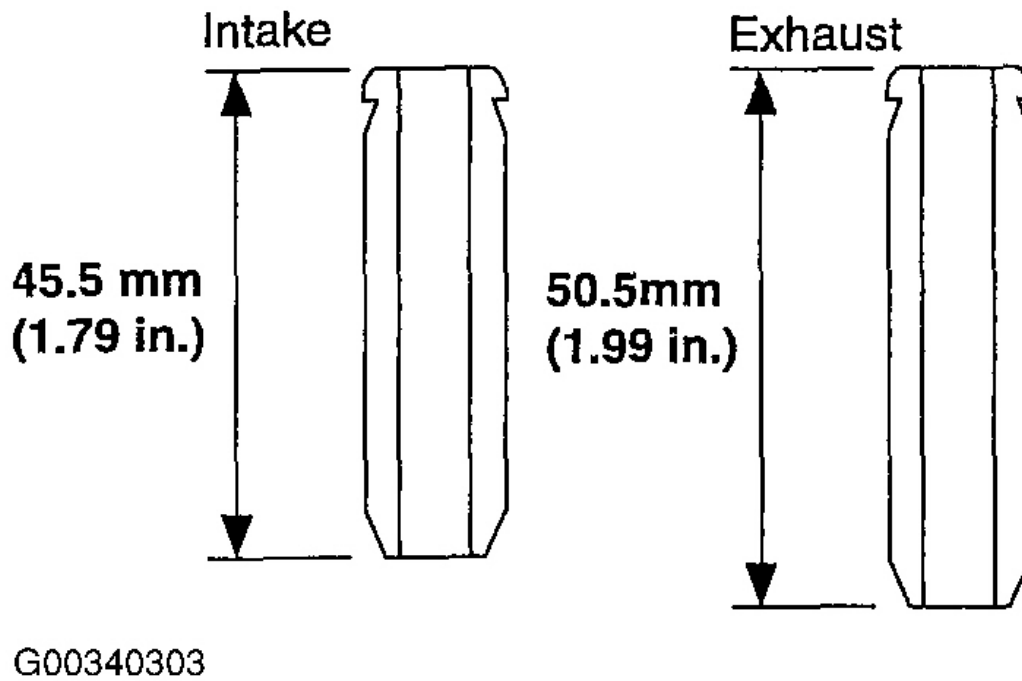
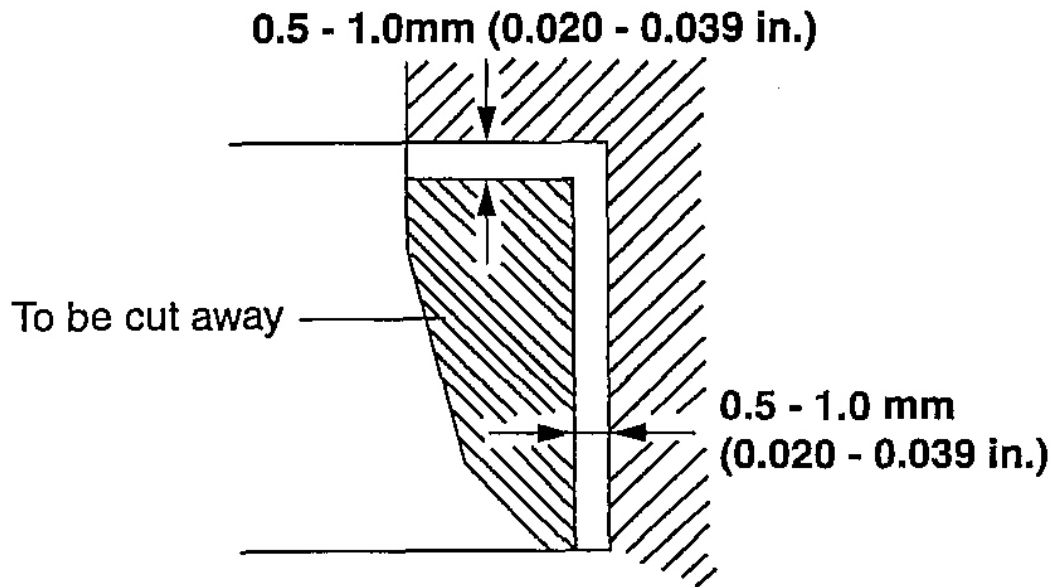


Fig. 113: Identifying Different Valve Guide Lengths
Courtesy of KIA MOTORS AMERICA, INC.

REPLACING VALVE SEAT RING

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



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Fig. 114: Identifying Area To Be Cut Away For Valve Seat Ring Replacement
 Courtesy of KIA MOTORS AMERICA, INC.

2. Enlarge the diameter of the valve seat so that it matches the specified hole diameter of the new valve seat ring.

Description	Size mm (in.)	Size Mark	Seat ring height H mm (in.)	Oversize hole diameter I.D. mm (in.)
Intake valve seat ring	0.3 (0.012) O.S.	30	7.5 - 7.7 (0.2953 - 0.3031)	36.300 - 36.325 (1.429 - 1.430)
	0.6 (0.024) O.S.	60	7.8 - 8.0 (0.3071 - 0.3150)	36.600 - 36.625 (1.441 - 1.442)
Exhaust valve seat ring	0.3 (0.012) O.S.	30	8.0 - 8.2 (0.3150 - 0.3228)	33.300 - 33.325 (1.311 - 1.312)
	0.6 (0.024) O.S.	60	8.3 - 8.5 (0.3268 - 0.3346)	33.600 - 33.625 (1.323 - 1.324)

G00340306

Fig. 115: Valve Seat Rings Oversize Table
 Courtesy of KIA MOTORS AMERICA, INC.

3. Heat the cylinder head to about 250°C (480°F) and press-fit an oversize seat ring for the bore in the cylinder head.
4. Using lapping compound, lap the valve to the new seat.

Valve seat contact width

Intake: 0.9-1.3 mm (0.035-0.051 In.)

Exhaust: 0.9-1.3 mm (0.035-0.051 In.)

REASSEMBLY

1. Install the spring seats.
2. Using special tool (09222-28200), lightly tap the seal in position.

NOTE:

- Do not reuse old valve stem seals.
- Incorrect installation of the seal could result in oil leakage from the valve guides.

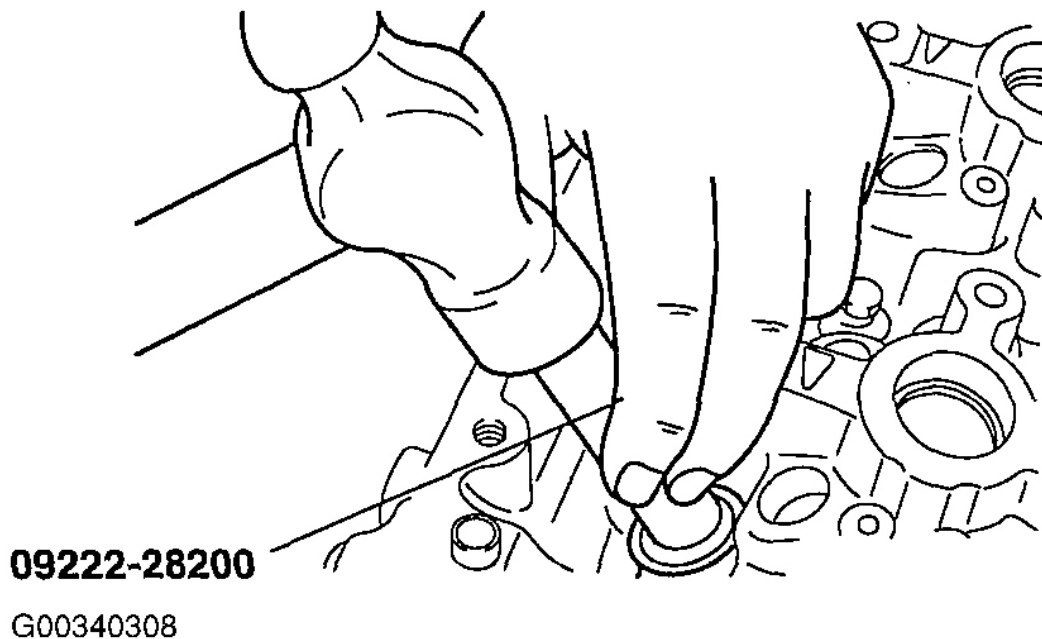
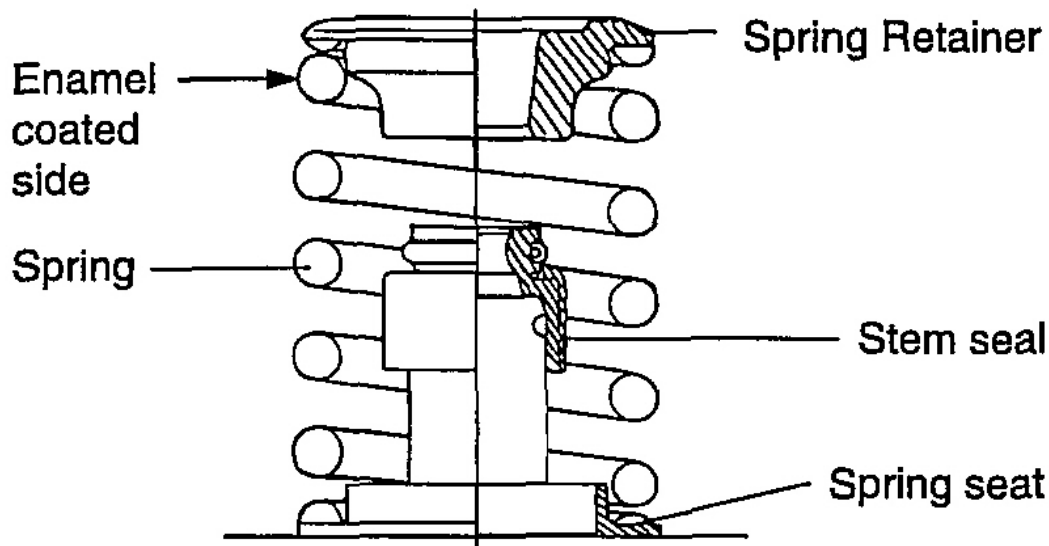


Fig. 116: Using Special Tool, Lightly Tap Valve Seal In Position
Courtesy of KIA MOTORS AMERICA, INC.

3. Apply engine oil to each valve. Insert the valve into their guides. Avoid pushing the valve into the seal by force. After installing the valve, check that it moves smoothly.
4. Place valve springs so that the side coated with enamel faces toward the valve spring retainer.



G00340309

Fig. 117: Place Valve Springs So That Side Coated With Enamel Faces Toward Valve Spring Retainer

Courtesy of KIA MOTORS AMERICA, INC.

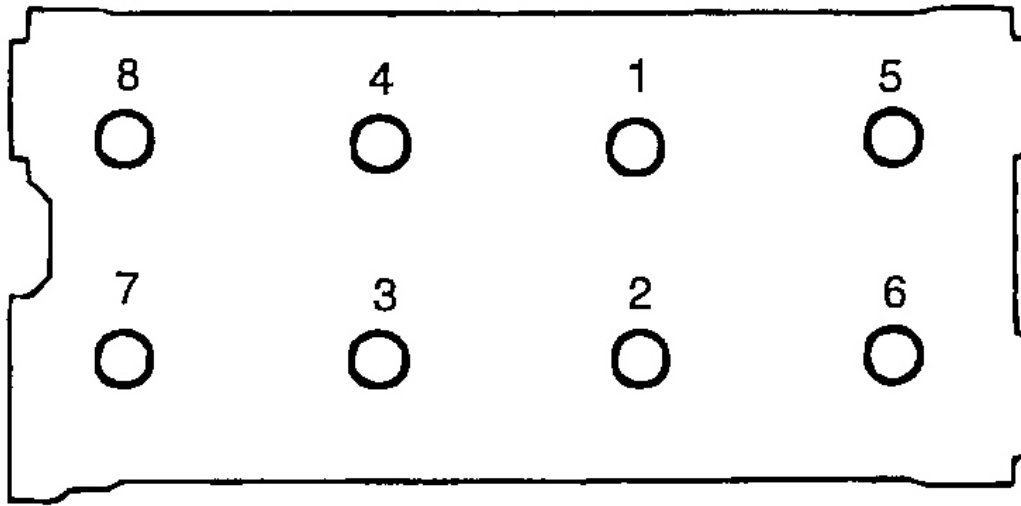
5. Using the special tool (09222-28000, 09222-28100), compress the spring and install the retainer locks. After installing the valves, ensure that the retainer locks are correctly in place before releasing the valve spring compressor.

NOTE: When the spring is compressed, check that the valve stem seal is not pressed against the bottom of the retainer.

6. Clean both gasket surfaces of the cylinder head and cylinder block.
7. Verify the identification marks on the cylinder head gasket.
8. Install the gasket so that the surface with the identification mark faces toward the cylinder head.

NOTE: Do not apply sealant to these surfaces.

9. using a torque wrench, tighten the cylinder head bolts in the sequence shown in the illustration.



G00340313

Fig. 118: Identifying Cylinder Head Bolt Tightening Sequence

Courtesy of KIA MOTORS AMERICA, INC.

10. Tighten the cylinder head bolts using the torque-angle method. Starting at top center, tighten all cylinder head bolts in sequence as shown in the illustration, using the 12 mm socket.

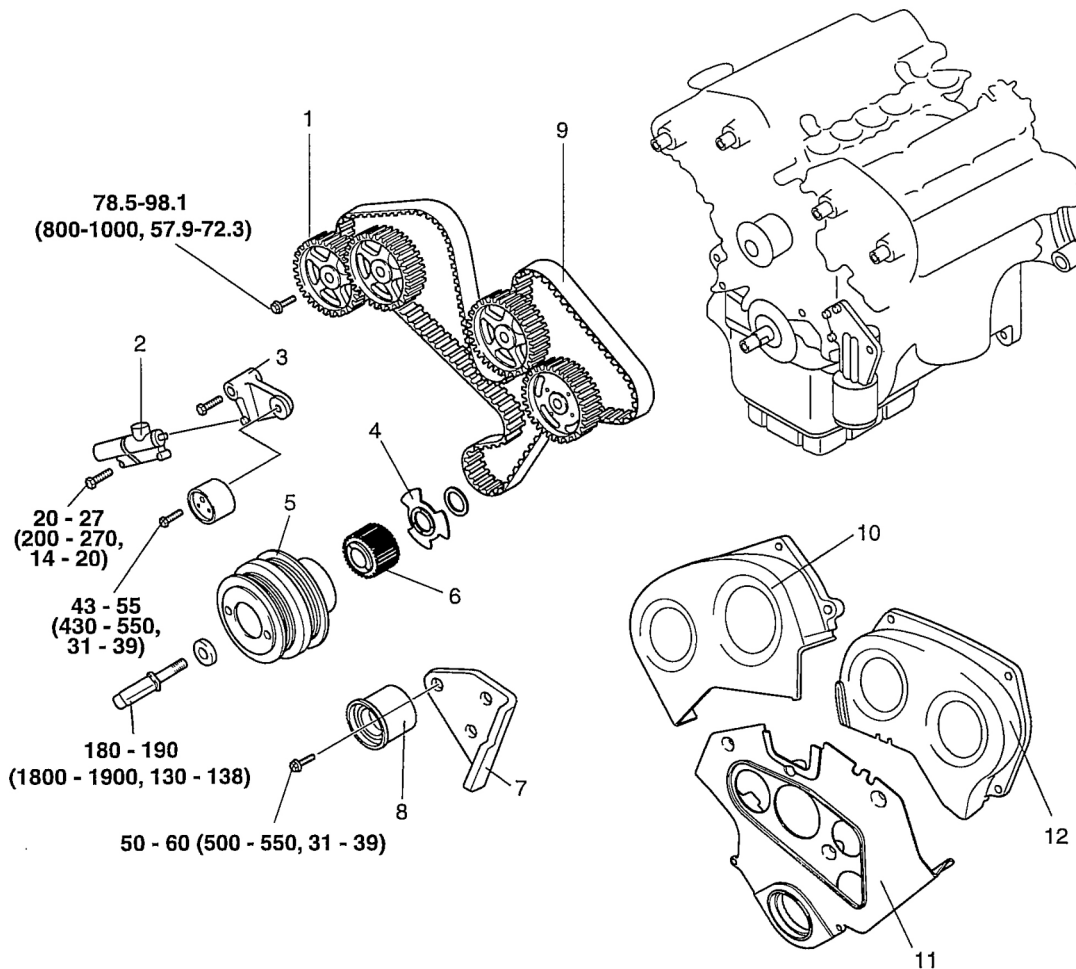
Tightening procedure

Cylinder head bolt:

105-115 N.m (1050-1150 kg. cm, 75-82 lb. ft)

TIMING SYSTEM**TIMING BELT****COMPONENTS**

CAUTION: Crankshaft pulley bolt is a "one-time" use and must be replaced whenever it is removed.



TORQUE : N·m (kg·cm, lb·ft)

- 1. Camshaft sprocket
- 2. Auto tensioner
- 3. Tensioner arm
- 4. Sensing blade
- 5. Crankshaft pulley
- 6. Crankshaft sprocket

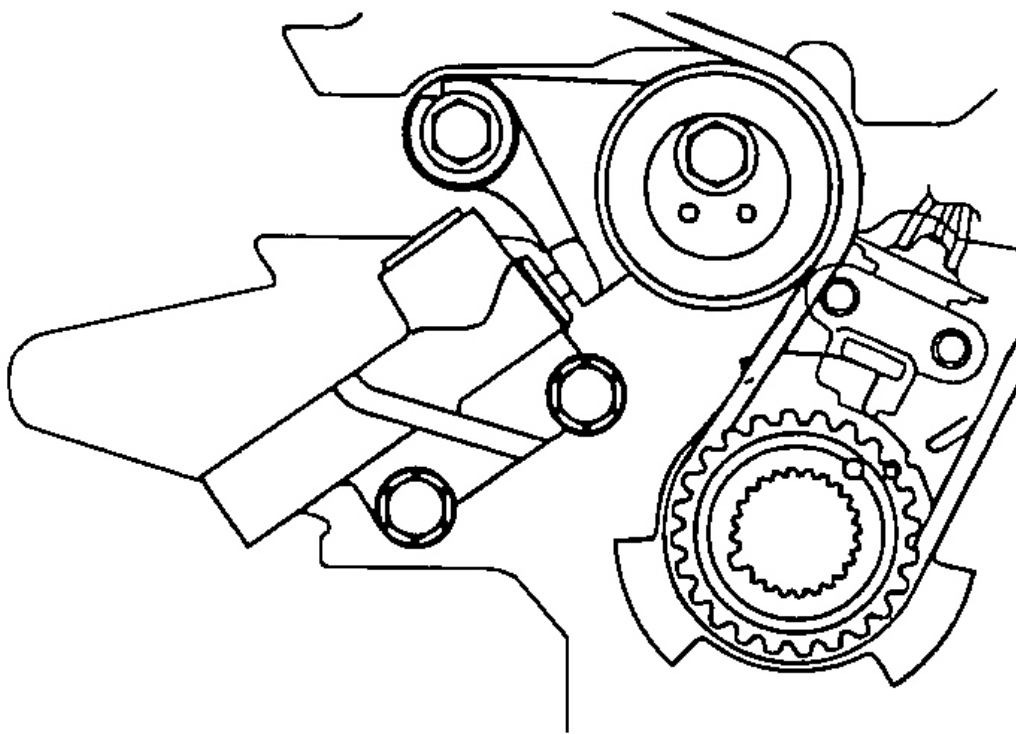
- 7. Idler bracket
- 8. Idler
- 9. Timing belt
- 10. Timing belt upper cover (RH)
- 11. Timing belt lower cover
- 12. Timing belt upper cover (LH)

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Fig. 119: Identifying Timing System Components & Torque Specifications
Courtesy of KIA MOTORS AMERICA, INC.

REMOVAL

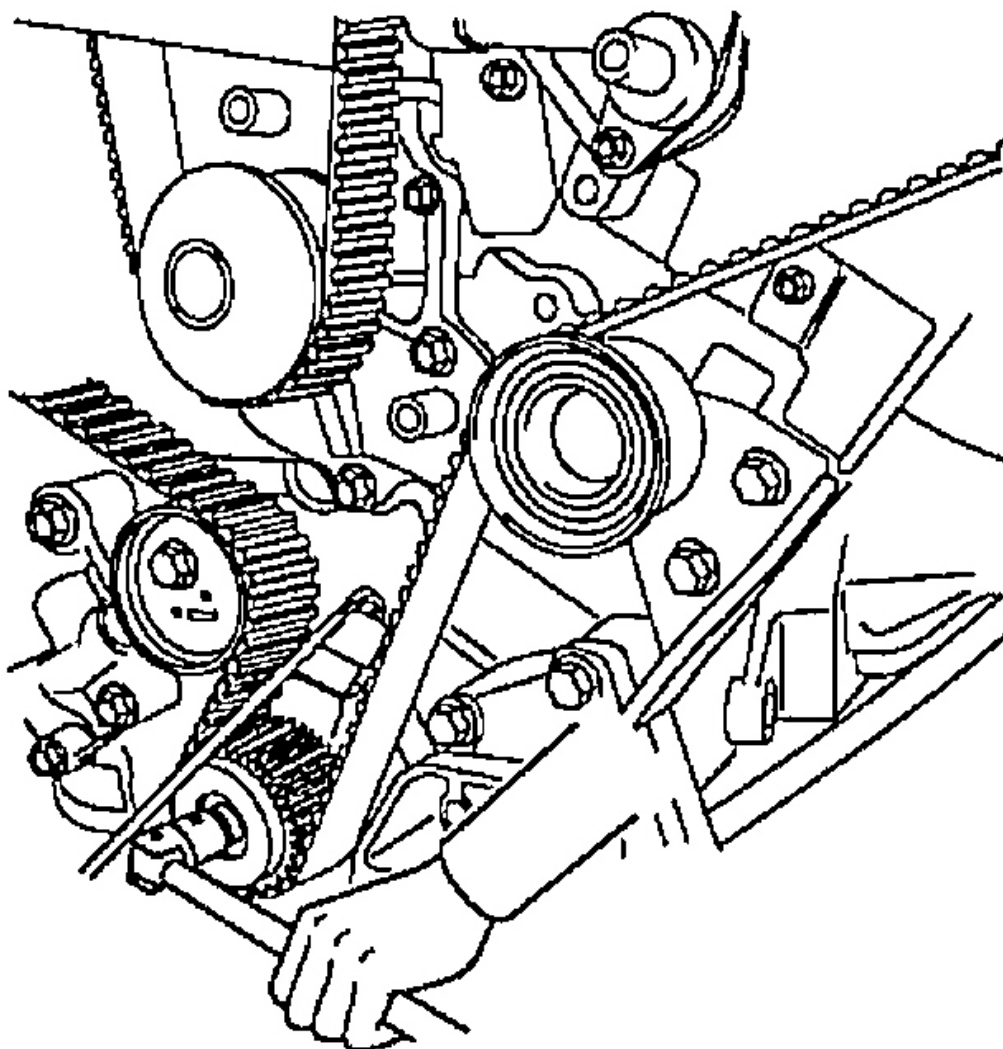
1. Using a 16 mm socket, rotate the tensioner arm clockwise (about 14°) and remove the belt from the pulley.
2. Remove the power steering pump pulley, idler pulley, tensioner pulley and crankshaft pulley.
3. Remove the upper and lower timing belt covers.
4. Remove the auto tensioner.



G00340315

Fig. 120: Identifying Auto Tensioner
Courtesy of KIA MOTORS AMERICA, INC.

NOTE: Rotate the crankshaft clockwise and align the timing mark to set the No. 1 cylinder's piston to TDC (compression stroke). At this time, the timing marks of the camshaft sprocket and cylinder head cover should coincide with each other.



G00340316

Fig. 121: Rotating The Crankshaft Clockwise
Courtesy of KIA MOTORS AMERICA, INC.

5. Unbolt the tensioner to remove the timing belt.

NOTE: If you plan to use the timing belt again, mark the rotation direction on the belt so you can reinstall it correctly.

INSPECTION

1. Inspect the belt closely. If the following problems are evident, replace the belt with a new one.
 1. Hardened back surface of rubber. Back surface is shiny, non-elastic and so hard that when the nail of your finger is pressed into it, no mark is produced.
 2. Cracked back surface of rubber.

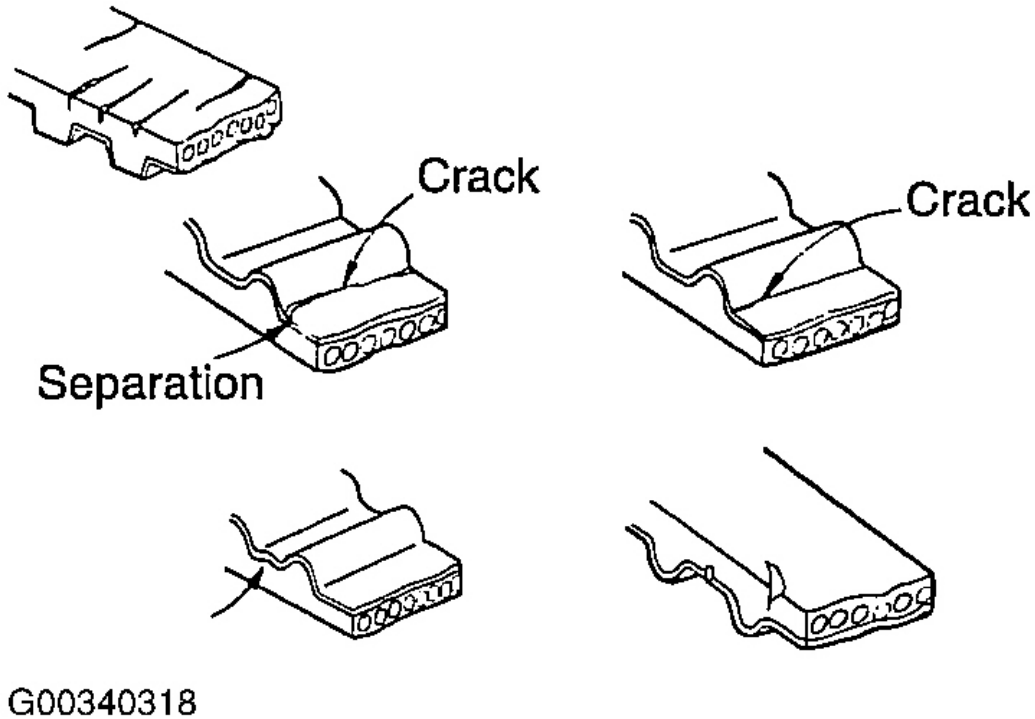
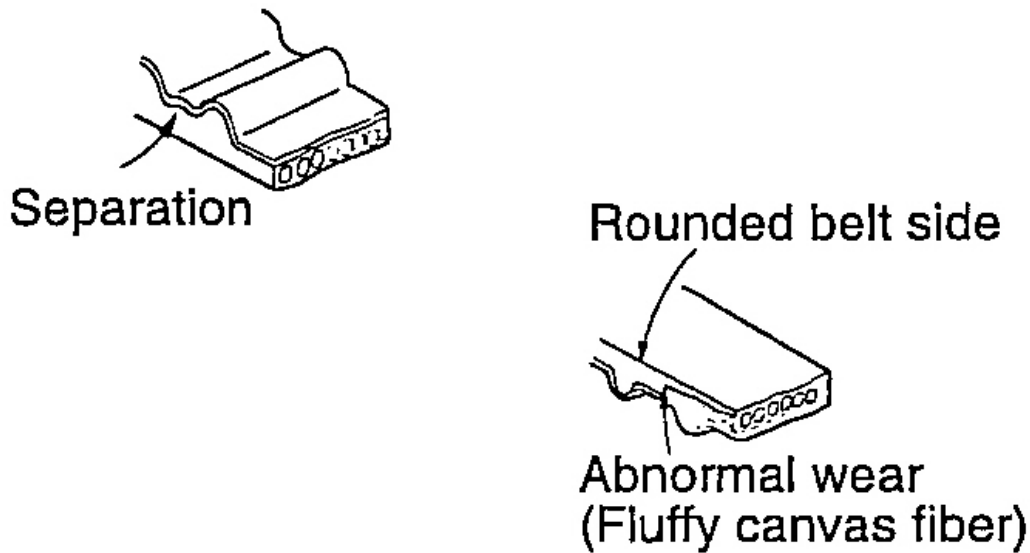


Fig. 122: Examples Of A Bad Timing Belt (1 Of 3)
Courtesy of KIA MOTORS AMERICA, INC.

3. Side of belt is badly worn.

NOTE: A belt in good condition should have clear-cut sides as if it were cut with a sharp knife.



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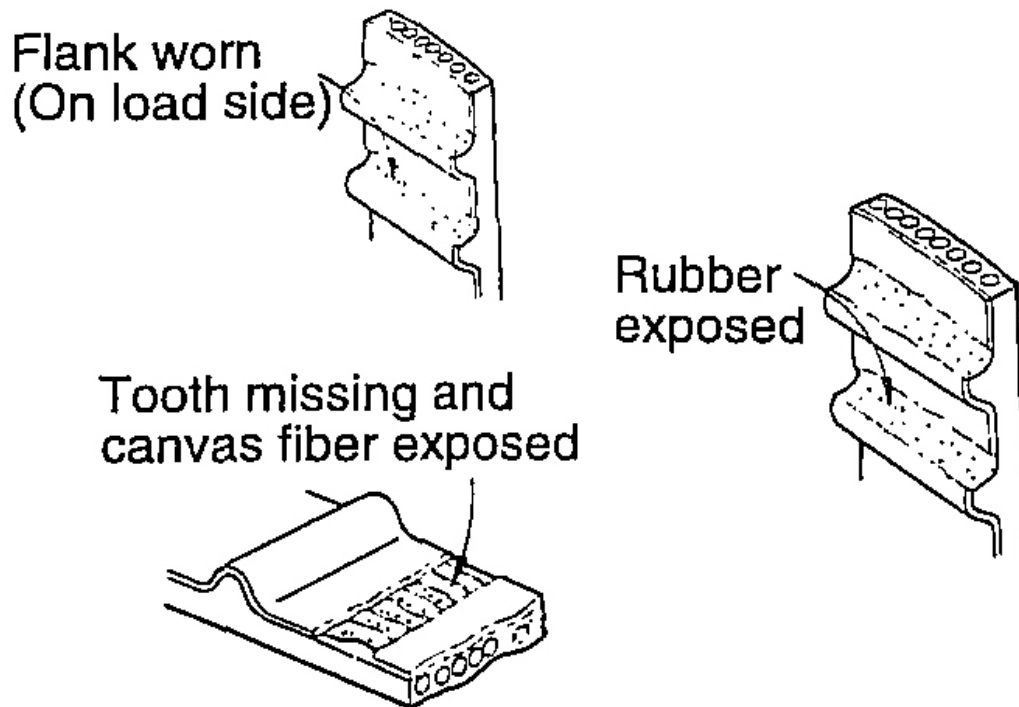
Fig. 123: Examples Of A Bad Timing Belt (2 Of 3)
Courtesy of KIA MOTORS AMERICA, INC.

4. Teeth are badly worn out.

Initial stage: Canvas on load side of the tooth flank worn (fluffy canvas fibers, rubber gone, color changed to white, and unclear canvas texture)

Last stage: Canvas on the load side of the tooth flank worn down and rubber exposed (tooth width reduced).

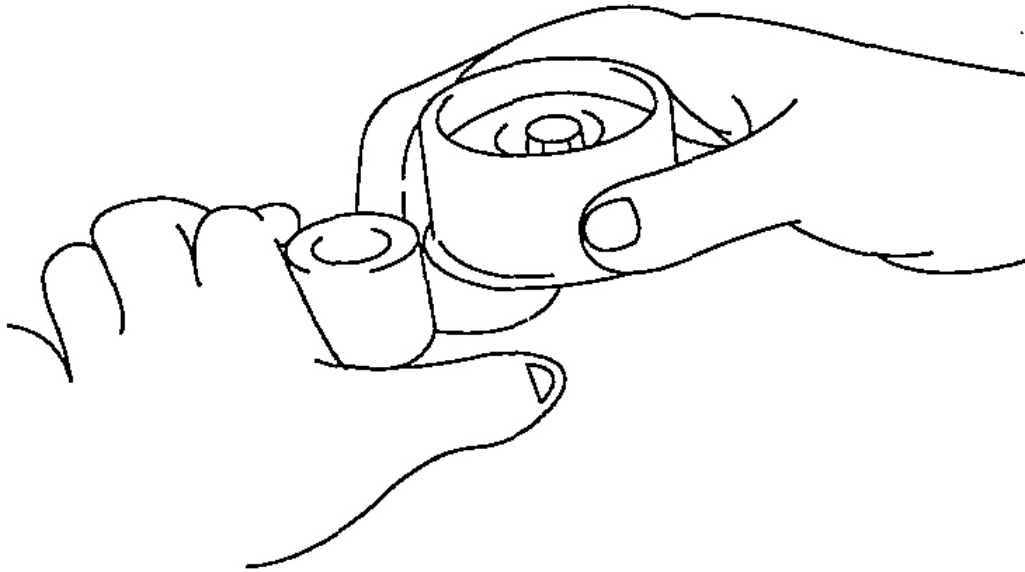
5. Missing tooth



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Fig. 124: Examples Of A Bad Timing Belt (3 Of 3)
Courtesy of KIA MOTORS AMERICA, INC.

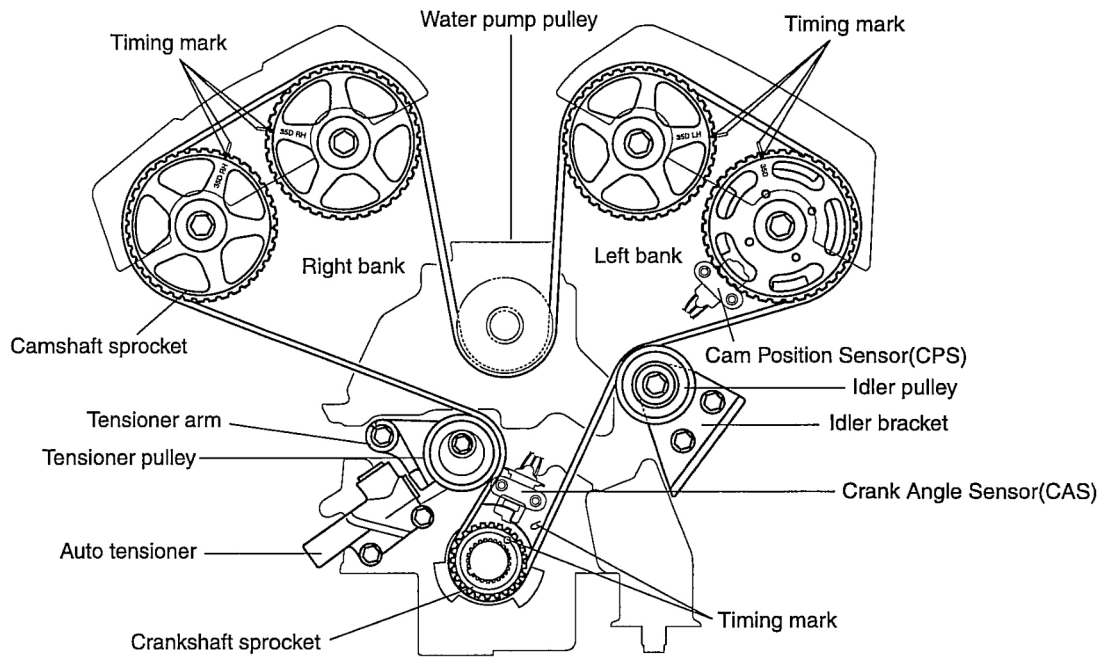
2. If backlash or an irregular noise is observed when rotating the pulley, replace the timing belt tensioner and idler pulley.



G00340321

Fig. 125: Inspecting Auto Tensioner
Courtesy of KIA MOTORS AMERICA, INC.

TIMING BELT



G00340322

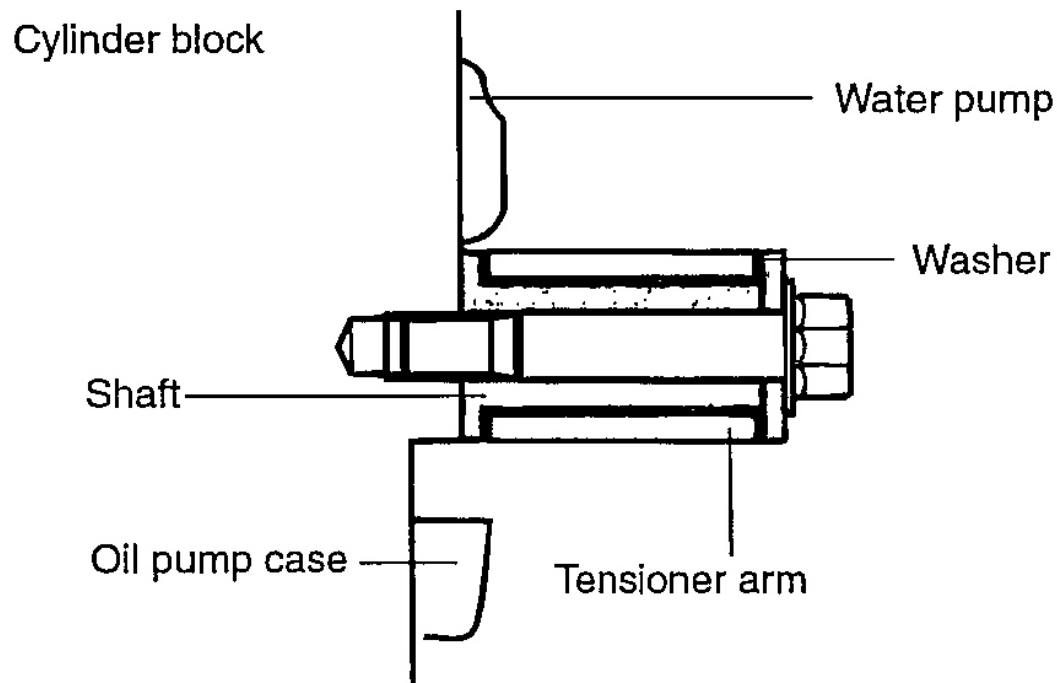
Fig. 126: Identifying Timing Belt At TDC (Installed Position)
 Courtesy of KIA MOTORS AMERICA, INC.

INSTALLATION

Install timing belt and auto tensioner using the following procedure.

1. Install idler pulley to idler bracket.
2. Install tensioner arm, shaft and plane washer to cylinder block.

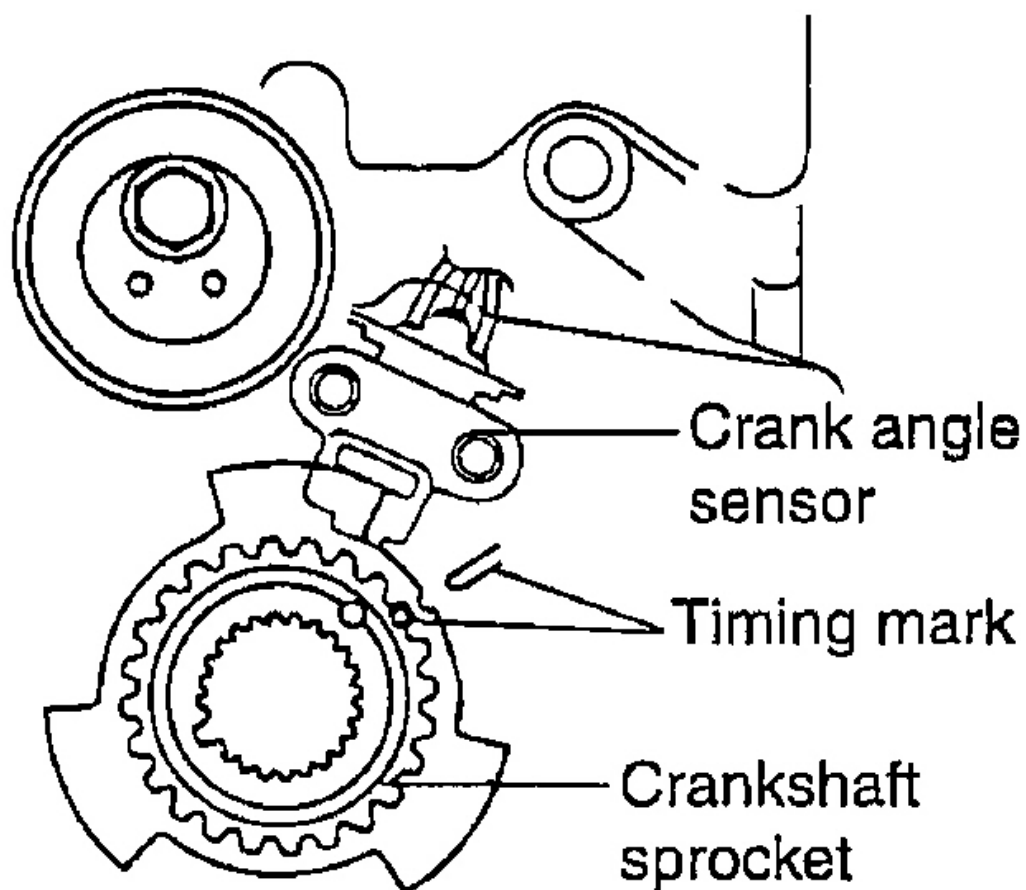
Tightening torque: 35-55 N.m (350-550 kg. cm, 25-40 lb. ft)



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Fig. 127: Installing Tensioner Arm Shaft & Plane Washer
 Courtesy of KIA MOTORS AMERICA, INC.

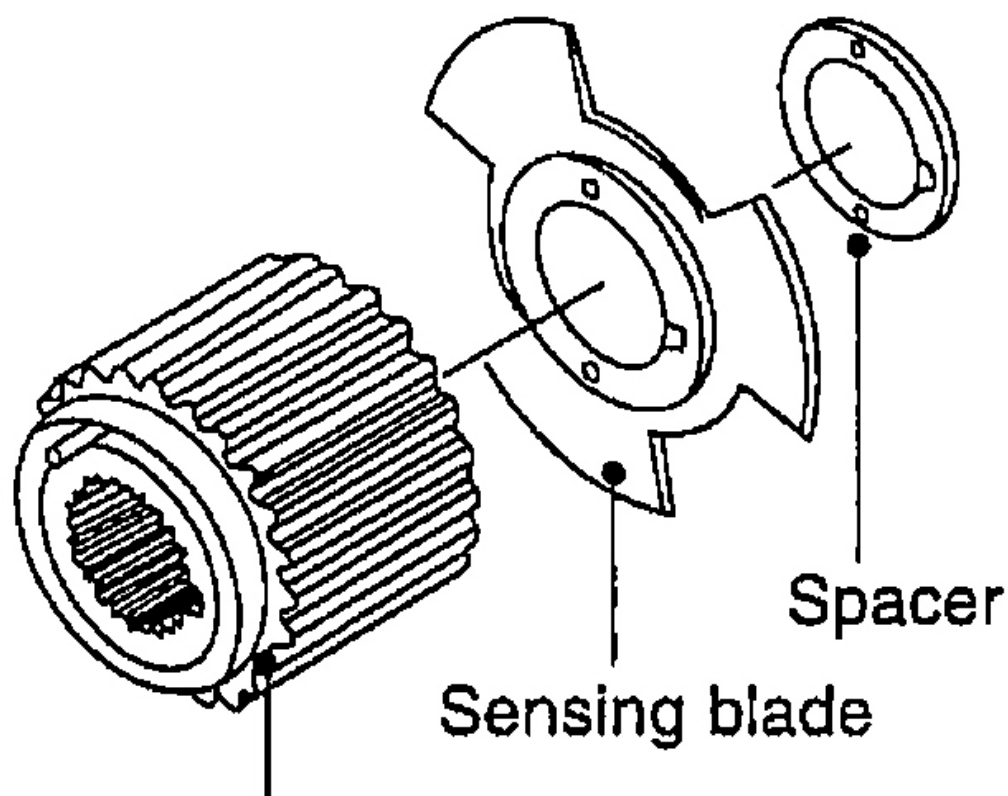
3. Install crankshaft sprocket and align the timing mark.



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Fig. 128: Aligning Crankshaft Gear
Courtesy of KIA MOTORS AMERICA, INC.

CAUTION: Be careful not to bend crankshaft sensing blade.

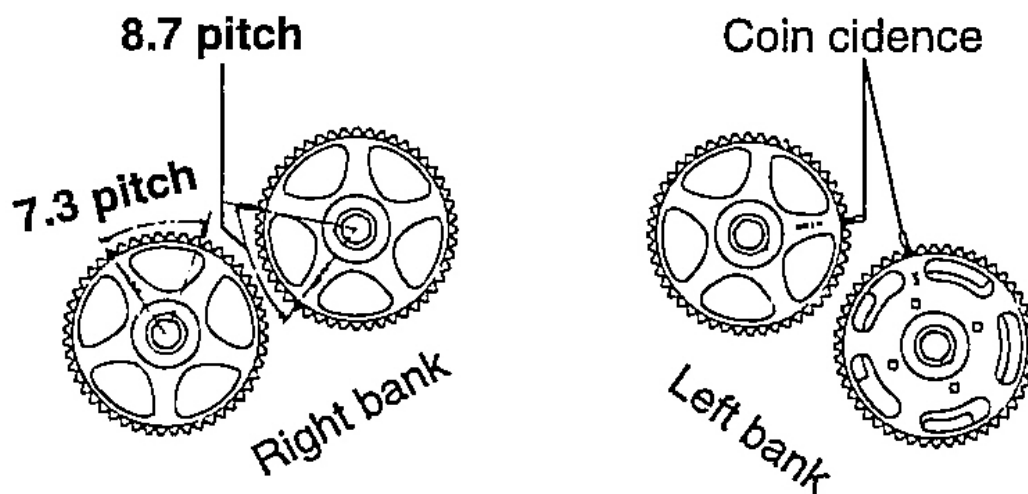


Crankshaft sprocket

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Fig. 129: Identifying Crankshaft Sensing Blade
Courtesy of KIA MOTORS AMERICA, INC.

4. Install camshaft sprocket and adjust initial installation state as shown in illustration.

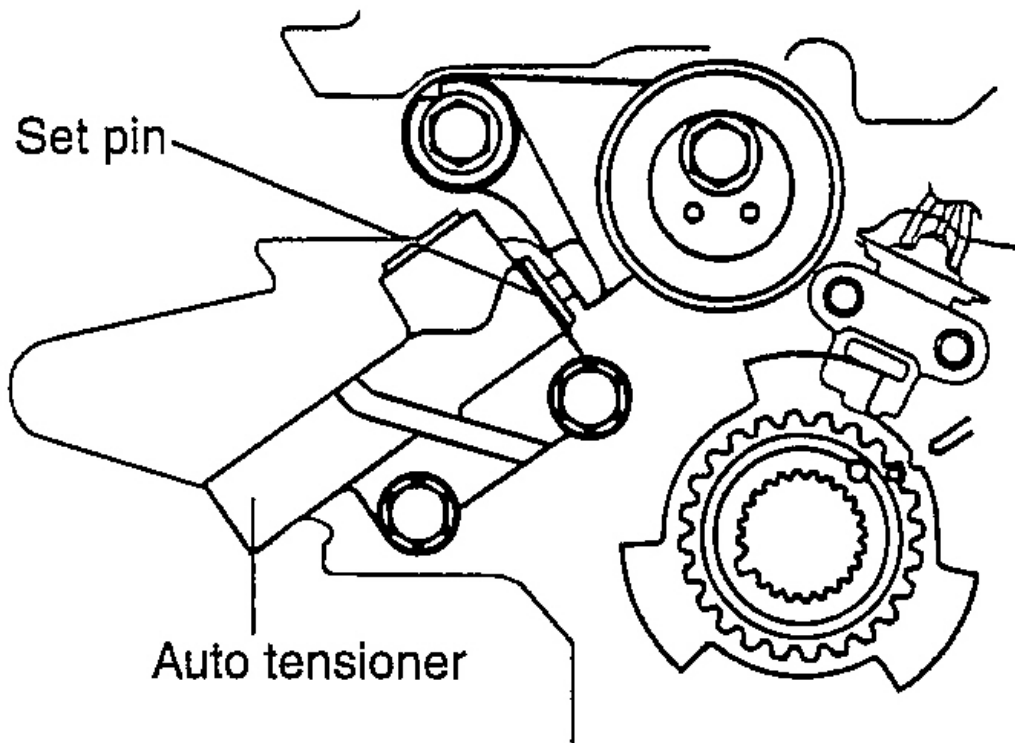


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Fig. 130: Installing Camshaft Sprockets & Adjust To Initial Installation State
Courtesy of KIA MOTORS AMERICA, INC.

5. Install auto tensioner to oil pump case.

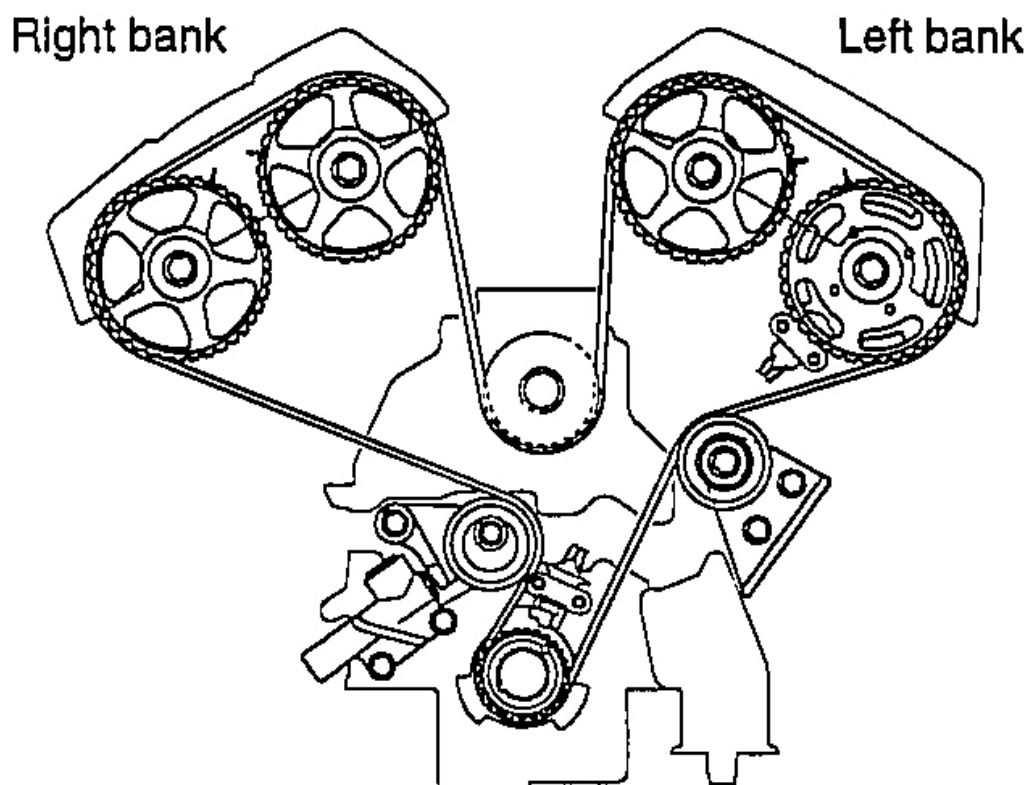
NOTE: At this time auto tensioner's set pin should be assembled completely.



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Fig. 131: Install Auto Tensioner Set Pin & Tensioner To Oil Pump Case
Courtesy of KIA MOTORS AMERICA, INC.

6. Align the timing marks of each sprocket and install the timing belt in this order.
 1. Crankshaft sprocket
 2. Idler pulley
 3. Exhaust camshaft sprocket (LH)
 4. Intake camshaft sprocket (LH)
 5. Water pump pulley
 6. Intake camshaft sprocket (RH)
 7. Exhaust camshaft sprocket (RH)
 8. Tensioner pulley

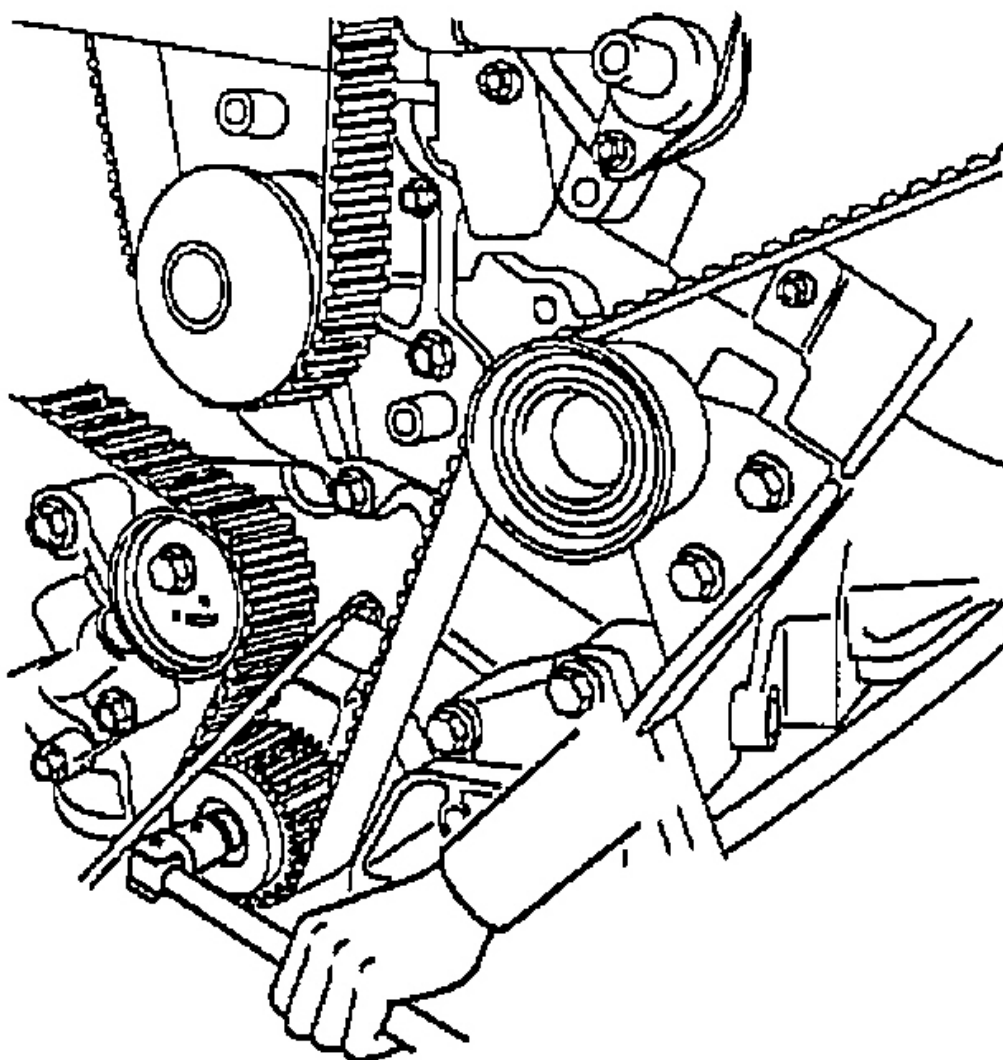


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Fig. 132: Identifying Timing System Assembled
Courtesy of KIA MOTORS AMERICA, INC.

NOTE:

- In this step, No. 1 is in TDC (Compression stroke).
- Do not insert fingers.



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Fig. 133: Turning Engine Over To Reconfirm Timing Marks
Courtesy of KIA MOTORS AMERICA, INC.

7. After installing the timing belt, reconfirm the timing mark.
8. Install the tensioner pulley.

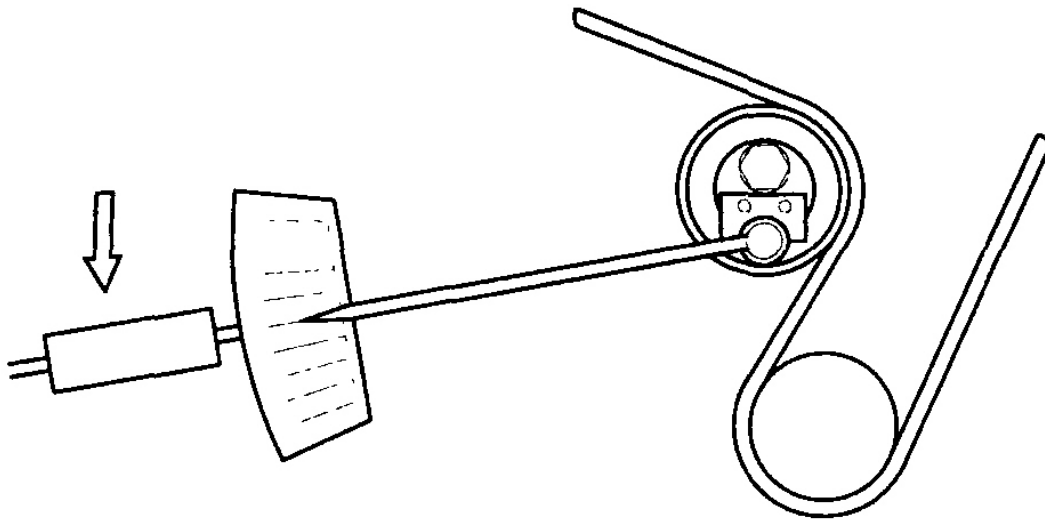
CAUTION: Crankshaft pulley bolt is a "one-time" use and must be replaced whenever it is removed.

9. Install the crankshaft pulley. Tighten crankshaft pulley bolt to specification. See **Fig. 119**.
10. Pull out the auto tensioner set pin after adjusting timing belt tension. See ADJUSTING TIMING BELT TENSION.

ADJUSTING TIMING BELT TENSION

ADJUSTMENT WHILE AUTO TENSIONER IS NOT OPERATING AND FIXING PIN BEING KEPT INSTALLED

NOTE: The following procedure is a tension setting (While auto tensioner is not operating: And fixing pin being kept installed.).



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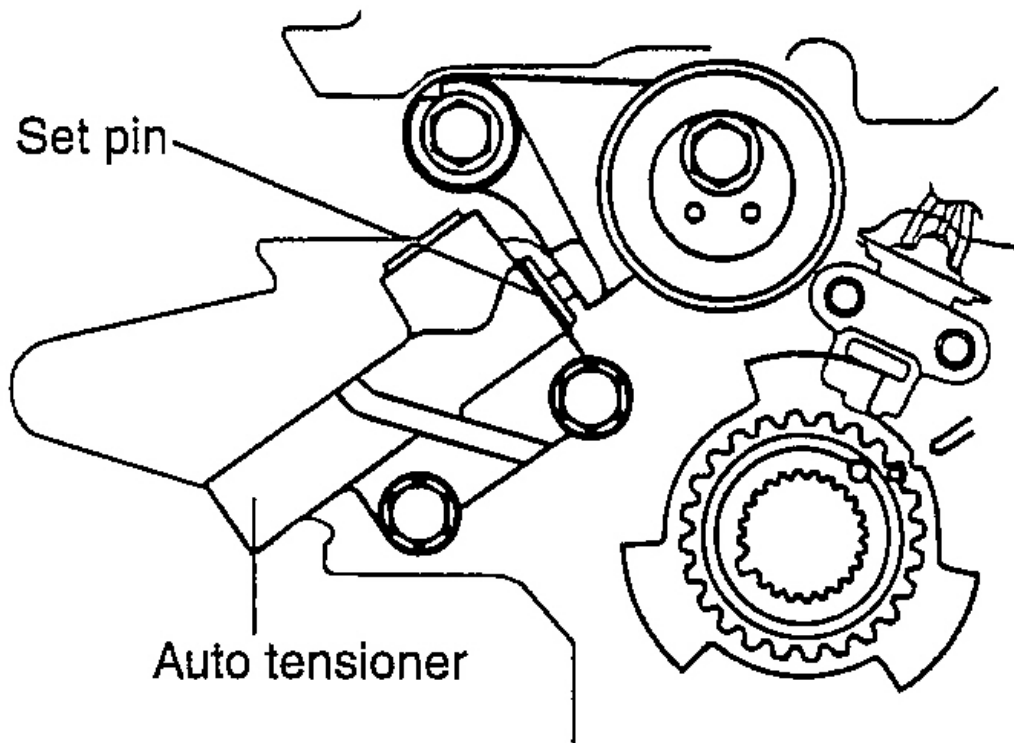
Fig. 134: Adjusting Timing Belt Tension
Courtesy of KIA MOTORS AMERICA, INC.

1. After rotating crankshaft 1/4 revolution reversely, rotate it clockwise to position No. 1 cylinder at TDC. Then, loosen the center bolt and give the belt 50 kg-cm of tension with tensioner pulley socket (Two pins are attached) and torque wrench. While maintaining this state, tighten the center bolt to the standard torque.

Center bolt standard torque:

43 - 55 N.m (430 - 550 kgcm, 31.72 - 40.57 lb. ft.)

2. Pull out the auto tensioner fixing (set) pin.



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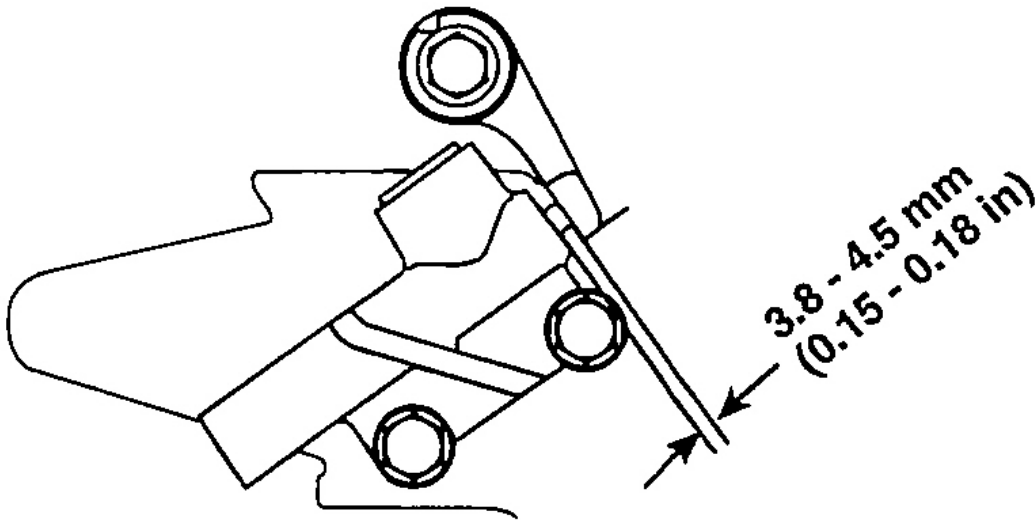
Fig. 135: Install Auto Tensioner Set Pin & Tensioner To Oil Pump Case
Courtesy of KIA MOTORS AMERICA, INC.

ADJUSTMENT WITH AUTO TENSIONER OPERATING, AND FIXING PIN IS NOT INSTALLED

NOTE: The following procedure is performed while auto tensioner is operating, and fixing pin is not installed.

1. After rotating crankshaft 2 revolutions clockwise to position No. 1 cylinder at TDC, wait for about 5 minutes, and measure the amount of protruding of the auto tensioner rod.

CAUTION: This is "leak down" time for the auto tensioner rod to protrude 1mm when tension caused by rotation of the crankshaft has changed.



G00340331

Fig. 136: Checking Projected Length Of Auto Tensioner
Courtesy of KIA MOTORS AMERICA, INC.

2. Check if the amount of rod protruding is in the range of 3.8-4.5 mm (0.15-0.18 in.).
3. Check again if the timing marks of each sprocket is with in specified position.

NOTE: If not within specified position, repeat from step 6 in the method of installing timing belt and auto tensioner.