2003-05 ENGINES

3.5L V6 - XG350

GENERAL

SPECIFICATIONS

General Engine Specifications

Description	Specification	Limit
General		
Type	V - type, DOHC	
Number of cylinders	6	
Bore	93.0 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	
Valve timing		
Intake valve		
Opens (BTDC)	11.5°	
Closes (ABDC)	60.5°	
Exhaust valve		
Opens (BBDC)	43.5°	
Closes (ATDC)	20.5°	
Valve overlap	32°	
Intake valve duration	252°	
Exhaust valve duration	244°	
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.)	0.05 mm
Flatness of maunting Surface		

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Intake	Max. 0.10 mm (0.0039 in.)	0.10 mm
Exhaust	Max. 0.15 mm (0.0059 in.)	0.15 mm
Valve guide hole diameter		
0.05 (0.002) O.S.	12.05 ~ 12.068 mm (0.474 ~ 0.475 in.)	
0.25 (0.010) O.S.	12.25 ~ 12.268 mm (0.482 ~ 0.483 in.)	
0.50 (0.020) O.S.	12.50 ~ 12.518 mm (0.492 ~ 0.493 in.)	
Intake valve seat ring hole diameter		
0.3 (0.012) O.S.	36.30 ~ 36.325 mm (1.429 ~ 1.430 in.)	
0.6 (0.024) O.S.	36.60 ~ 36.625 mm (1.441 ~ 1.442 in.)	
Exhaust valve seat ring hole diameter		
0.3 (0.012) O.S.	33.30 ~ 33.325 mm (1.311 ~ 1.312 in.)	
0.6 (0.024) O.S.	33.60 ~ 33.625 mm (1.323 ~ 1.324 in.)	
Valve		
Overall length		
Intake	106.28 mm (4.184 in.)	105.78 mm (4.164 in.)
Exhaust	105.4 mm (4.150 in.)	104.9 mm (4.130 in.)
Stem diameter		
Intake	6.565 ~ 6.580 mm (0.258 ~ 0.259 in.)	
Exhaust	6.530 - 6.550 mm (0.257 ~ 0.258 in.)	
Face angle	45° ~ 45.5°	
Margin		
Intake	1.0 mm (0.0394 in.)	0.5 mm (0.0197 in.)
Exhaust	1.5 mm (0.059 in.)	1.0 mm (0.039 in.)
Clearance (stem-to - guide)		
Intake	0.02 ~ 0.05 mm (0.0009 ~ 0.0020 in.)	0.1 mm (0.0039 in.)
Exhaust	0.05 ~ 0.085 mm (0.0020 ~ 0.0033 in.)	0.15 mm (0.0059 in.)
Valve spring		
Free height	46.4 mm (1.8268 in.)	45.4 mm (1.787 in.)
Load	24.0 kg / 37.9 mm (53 lb / 1.492 in.)	
Out of squareness	Max 2°	4°

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Valve guide		
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)	92.96 ~ 92.99 mm (3.659 ~ 3.661 in.)	
Clearance (Piston-to-cylinder)	0.03 ~ 0.05 mm (0.0012 ~ 0.0020 in.)	
Ring groove width		
No. 1	1.503 ~ 1.505 mm (0.0592 ~ 0.05925 in.)	
No. 2	1.501 ~ 1.503 mm (0.0591 ~ 0.0592 in.)	
Oil	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	
No. 2	Taper type, special cast iron	
Oil ring type	3 - piece type	
Ring end gap		
No. 1	0.20 ~ 0.30 mm (0.0078 ~ 0.0118 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 in.)	
Ring side clearance		
No. 1	0.04 ~ 0.08 mm (0.0016 ~ 0.0031	

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	in.)	
No. 2	0.02 ~ 0.06 mm (0.0008 ~ 0.0024 in.)	
Ring for service	0.25 mm (0.010 in.), 0.50 mm (0.020 in.)	
Connecting rod		
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	0.026 ~ 0.044 mm (0.001 ~ 0.0017 in.)	0.1 mm (0.004 in.)
Pin diameter	22.001 ~ 22.004 mm (0.8661 ~ 0.8663 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	0.022 ~ 0.040 mm (0.00086 ~ 0.00157 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		
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 (15.18 lb. / 1.54 in.)	

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Oil filter Type	 Cartridge, full flow	
Engine oil pressure	80 kPa (11.4 psi) or more @700 rpm [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	 8.2 lit (8.61 U.S.qts., 7.2 lmp.qts)	
Thermostat Type Normal opening temperature Opening temperature range Wide open temperature	 Wax pellet type with jiggle valve 82°C (179.6°F) 80°C ~ 84°C (176 ~ 183.2°F) 95°C (203°F)	
Radiator cap Main valve opening pressure Main valve closing pressure Vacuum valve opening pressure	 86.1 ~ 124.5 kPa (0.98 ~ 1.27 kg/cm^2 , 13.94 ~ 18.06 psi) 83.4 kPa (0.85 kg/cm^2 , 12.1 psi) - 6.86 kPa (- 0.07 kg/cm^2 , - 1.00 psi)	
Air cleaner Type Element	 Dry type Unwoven cloth type	
Exhaust pipe Muffler Suspension system	 Expansion resonance type Rubber hangers	

SERVICE STANDARD

Standard value

Coolant concentration

Tropical area: 40%

Other area: 50%

LUBRICANT

Engine coolant: Ethylene glycol base for aluminum radiator

SEALANT

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Engine coolant temperature sensor	Three bond No.2310 or equivalent LOCTITE 962T or equivalent

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Fig. 1: Identifying Engine Coolant Temperature Sensor Sealant
Courtesy of HYUNDAI MOTOR CO.

TIGHTENING TORQUE

TORQUE SPECIFICATIONS

Application	Ft. Lbs (N.m)
Air Intake Tank-To-Manifold Fasteners	11-15 (15-20)
Auto Tensioner Fixed Bolt	15-20 (20-27)
Camshaft Bearing Cap (1)	
Inner	(2)
Outer	14-15 (19-20)
Camshaft Sprocket Bolt	59-74 (80-100)
Connecting Rod Nut	
Step 1	25 (34)
Step 2	Tighten An Additional 90 Degrees
Coolant Inlet Fitting Bolt	13-15 (17-20)
Coolant Pump Bolt (Bolt Head Mark "7")	
M8	11-16 (15-22)
M10	24-37 (33-50)
Coolant Temperature Sensor	15-30 (20-40)
Crankshaft Bolt	133-140 (180-190)
Crankshaft Pulley Bolt	133-140 (180-190)
Cylinder Head Bolt (Cold) (3)	77-85 (105-115)
Drive Belt Pulley Bolt	26-41 (35-55)
Drive Belt Tensioner Nut	24-41 (35-55)
Drive Plate & Adapter Plate Bolt	54-57 (73-77)
Engine Hanger Bracket Bolt	20-28 (27-38)
Engine Mounting Fasteners	
Engine Mounting Bracket Bolt	44-59 (60-80)
Engine Mounting Bracket Nut	44-59 (60-80)
Engine Mounting Insulator Bolt	66-81 (90-110)
Front Roll Stopper Bracket-To-Transaxle Bolt	44-59 (60-80)
Front Roll Stopper Insulator Fasteners	
Front Roll Stopper Bracket-To-Subframe Bolt	44-59 (60-80)
Rear Roll Stopper Bracket-To-Subframe Bolts	44-59 (60-80)
Rear Roll Stopper Bracket-To-Transaxle Bolts	37-41 (50-65)

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Rear Roll Stopper Insulator Bolt & Nut	37-41 (50-65)
Exhaust Components	
Catalytic Converter-To-Center Exhaust Pipe Nut	22-30 (30-40)
Center Exhaust Pipe-To-Main Muffler Nuts	22-30 (30-40)
Exhaust Manifold-To-Cylinder Head Nut	30-37 (40-50)
Exhaust Manifolt-To-Engine	30-33 (40-45)
Front Exhaust Pipe-To-Catalytic Converter Bolt	30-44 (40-60)
Front Exhaust Pipe-To-Exhaust Manifold Bolt	22-30 (30-40)
Generator Mounting Bracket Bolt (All)	15-22 (20-30)
Intake Manifold-To-Cylinder Head Nuts (4)	15-17 (20-23)
Main Bearing Bolt (5)	66-74 (90-100)
Oil Drain Plug	26-33 (35-45)
Oil Filter	9-12 (12-16)
Oil Pump Case Bolt	11-15 (15-20)
Oil Pump Relief Valve Plug	30-37 (40-50)
Oil Screen Bolt	11-16 (15-22)
Oxygen Sensor	30-37 (40-50)
Power Steering Bracket-To-Cylinder Head Bolt	13-15 (17-26)
Power Steering Pump-To-Bracket bolt	13-15 (17-26)
Starter-To-Engine Bolt	20-25 (27-34)
Starter-To-Engine Nut	15-22 (20-30)
Surge Tank Stay Bolt	11-15 (15-20)
Throttle Body-To-Surge Tank Bolts	18-22 (25-30)
Timing Belt Cover Bolt	
M6	(2)
M8	15-20 (20-27)
Timing Belt Idler Pulley Bolt	37-44 (50-60)
Timing Belt Tensioner Arm Fixed Bolt	26-41 (35-55)
Timing Belt Tensioner Bolt	15-20 (20-27)
Timing Belt Tensioner Pulley Bolt	32-41 (43-55)
Transaxle Mounting Fasteners	
Transaxle Mounting Bracket Bolts	44-59 (60-80)
Transaxle Mounting Insulator Bolt	66-81 (90-110)
Transaxle Mounting Sub Bracket Nut	44-59 (60-80)
Upper Oil Pan Bolt (6)	
10x380 mm	22-31 (30-42)
6x18 mm	(7)
6x161.5 mm	(7)
6x152.5 mm	(7)
Water Outlet Fitting Bolt	13-15 (17-20)

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	INCH Lbs. (N.m)
Air Cleaner Body Installation Bolt	71-106 (8-12)
Air Cleaner Mounting Bolt	71-106 (8-12)
Crankshaft Position Sensor Wheel Screw	97-106 (11-12)
Cylinder Head Cover Bolt	44-53 (5-6)
Delivery Pipe Installation Bolt	89-133 (10-15)
Fuel Hose Clamp-To-Engine Bolt	106-133 (12-15)
Generator Inlet Pipe Bolt	106-133 (12-15)
Heat Protector-To-Exhaust Manifold	106-133 (12-15)
Lower Oil Pan Bolt (8)	89-106 (10-12)
Main Muffler Hanger Support Bracket Bolt	89-133 (10-15)
Oil Level Guide-To-Engine	106-133 (12-15)
Oil Pressure Switch	71-133 (8-15)
Oil Pump Cover Screw	71-106 (8-12)
Oil Seal Case	89-106 (10-12)
Rear Plate	89-106 (10-12)
Transaxle Mounting Plate	89-106 (10-12)

(1) Tighten camshaft bearing cap bolts in sequence. See **Fig. 97**.

(2) Tighten to 89-106 INCH Lbs. (10-12).

(3) Tighten cylinder head bolts in sequence. See **Fig. 15**.

(4) Tighten intake manifold nuts in sequence. See **Fig. 151**.

(5) Tighten main bearing bolts in sequence. See **Fig. 116**.

(6) Tighten upper oil pan bolts in sequence. See **Fig. 131**.

(7) Tighten to 44-62 INCH Lbs. (5-7 N.m).

(8) Tighten lower oil pan bolts in sequence. See **Fig. 133**.

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.

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

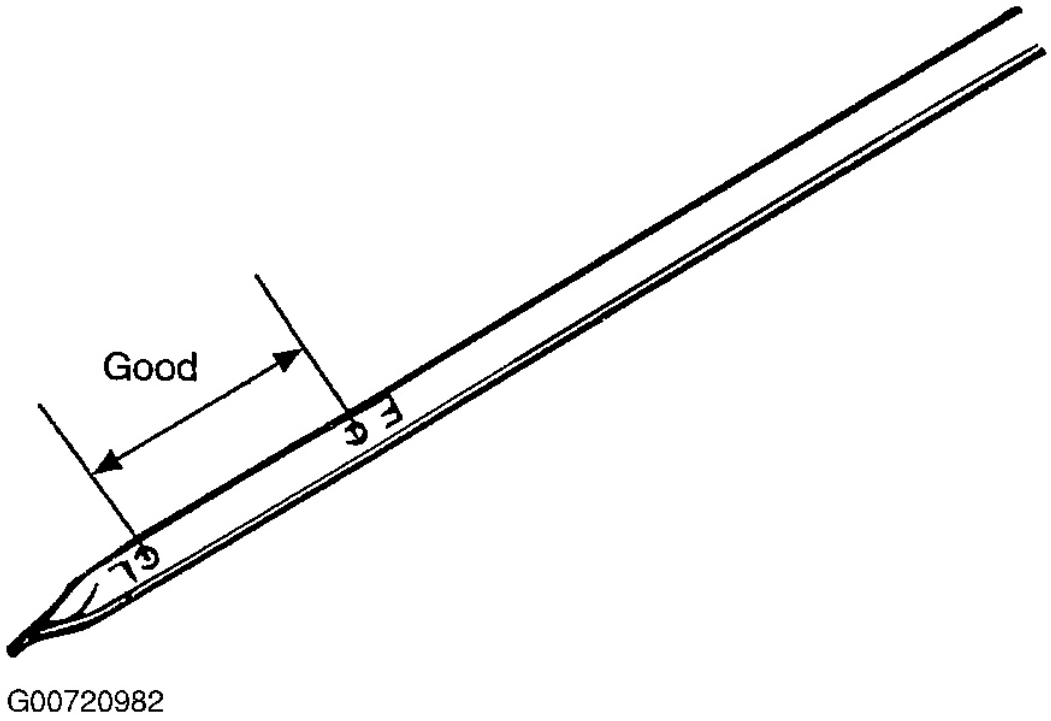


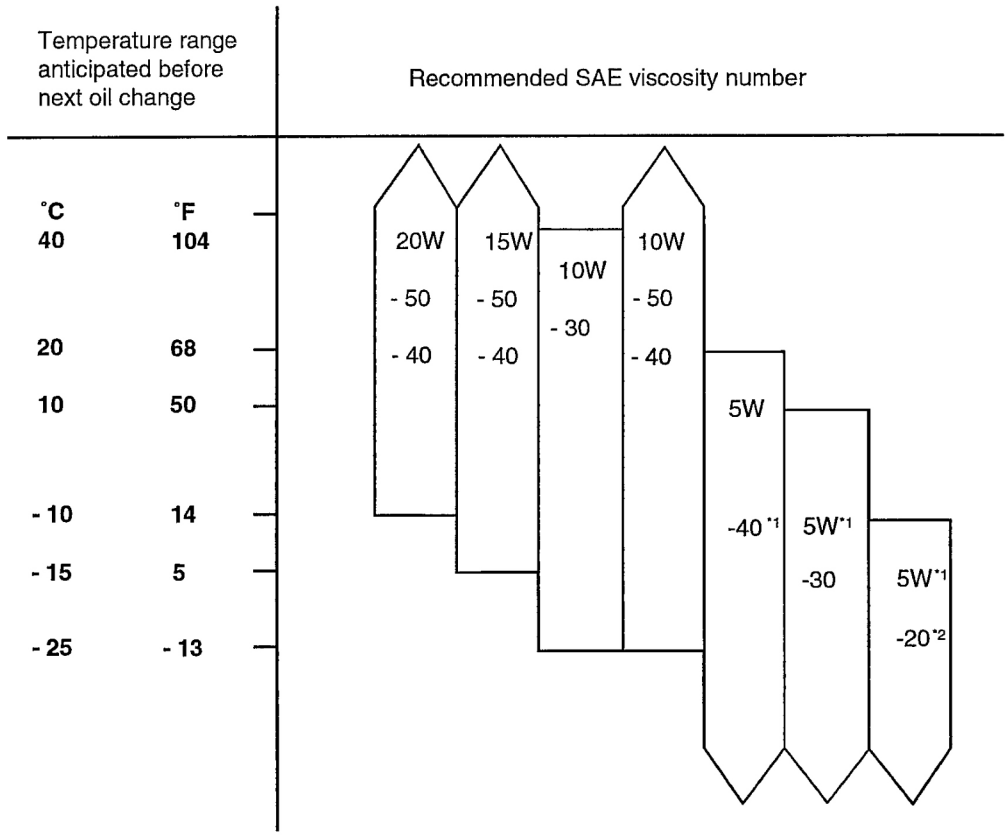
Fig. 2: Identifying Engine Oil Operating Range On Engine Oil Dipstick
Courtesy of HYUNDAI MOTOR CO.

SELECTION OF ENGINE OIL

Recommended API classification: SH OR ABOVE [For EC.]

Recommended SAE viscosity grades:

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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. 3: Identifying Recommended SAE Oil Viscosity Grades
Courtesy of HYUNDAI MOTOR CO.

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

1. **Satisfy the requirements of the API classification.**
2. **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.

CHANGE ENGINE OIL

1. Run the engine until if reaches normal operating temperature.
2. Turn off the engine.

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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.

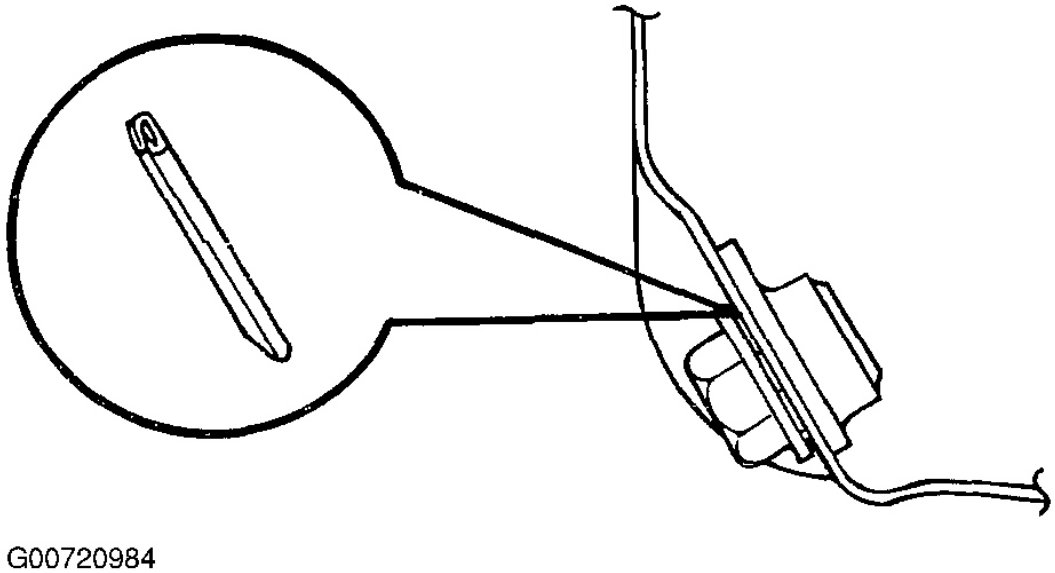


Fig. 4: Identifying Engine Oil Drain Plug & Seal
Courtesy of HYUNDAI MOTOR CO.

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

   Drain and refill

   Oil quantity: 4.3 lit (4.5 U.S. qts., 3.8 lmp. qts.)

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

6. Install the oil filler cap.

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7. Start and run the engine.
8. Turn off the engine and then check the oil level. Add oil it necessary.

REPLACEMENT OIL FILTER

FILTER SELECTION

All Hyundai Motor Company 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 is various 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.

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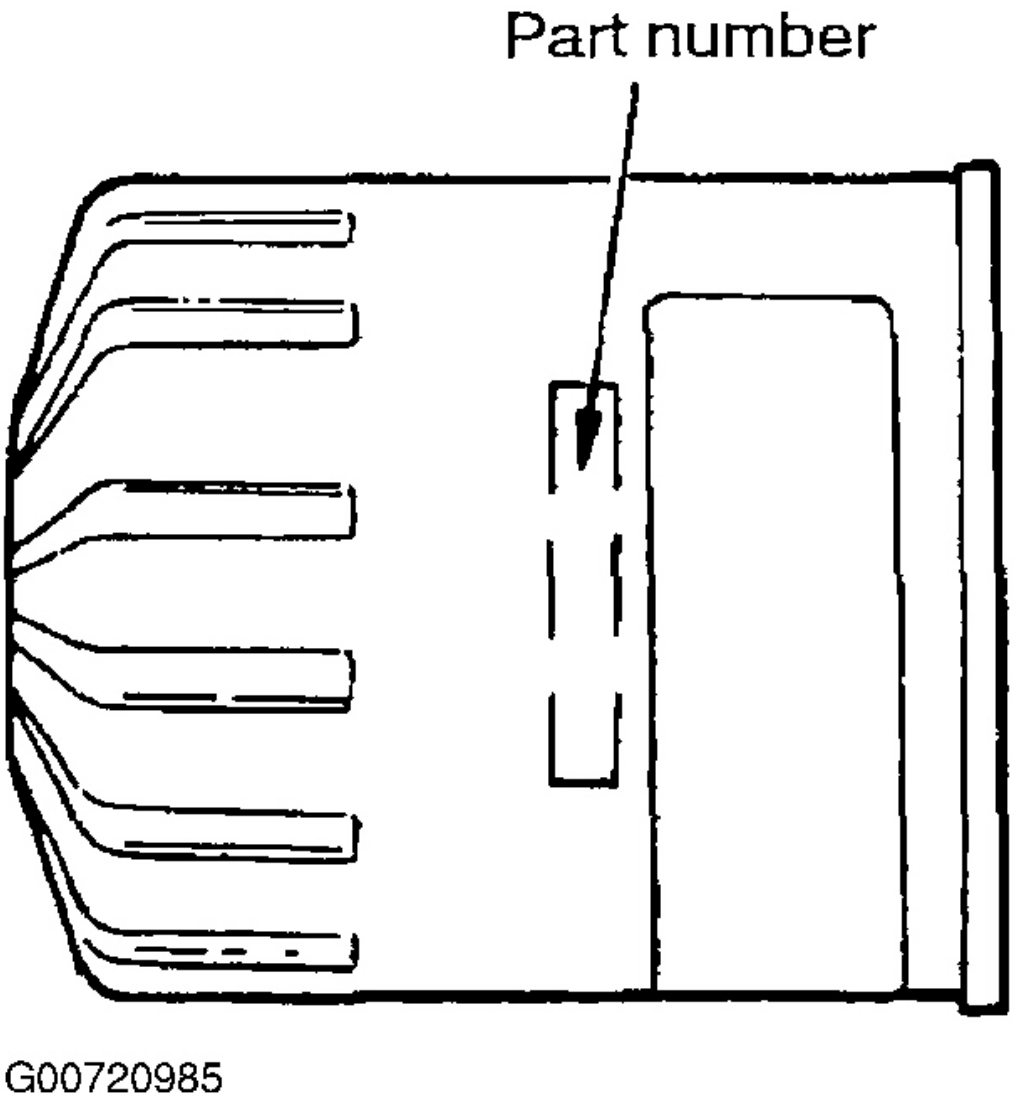


Fig. 5: Identifying Engine Oil Filter Part Number Location
Courtesy of HYUNDAI MOTOR CO.

PROCEDURE FOR REPLACING OIL FILTER

1. Use a filter wrench to remove the oil filter.

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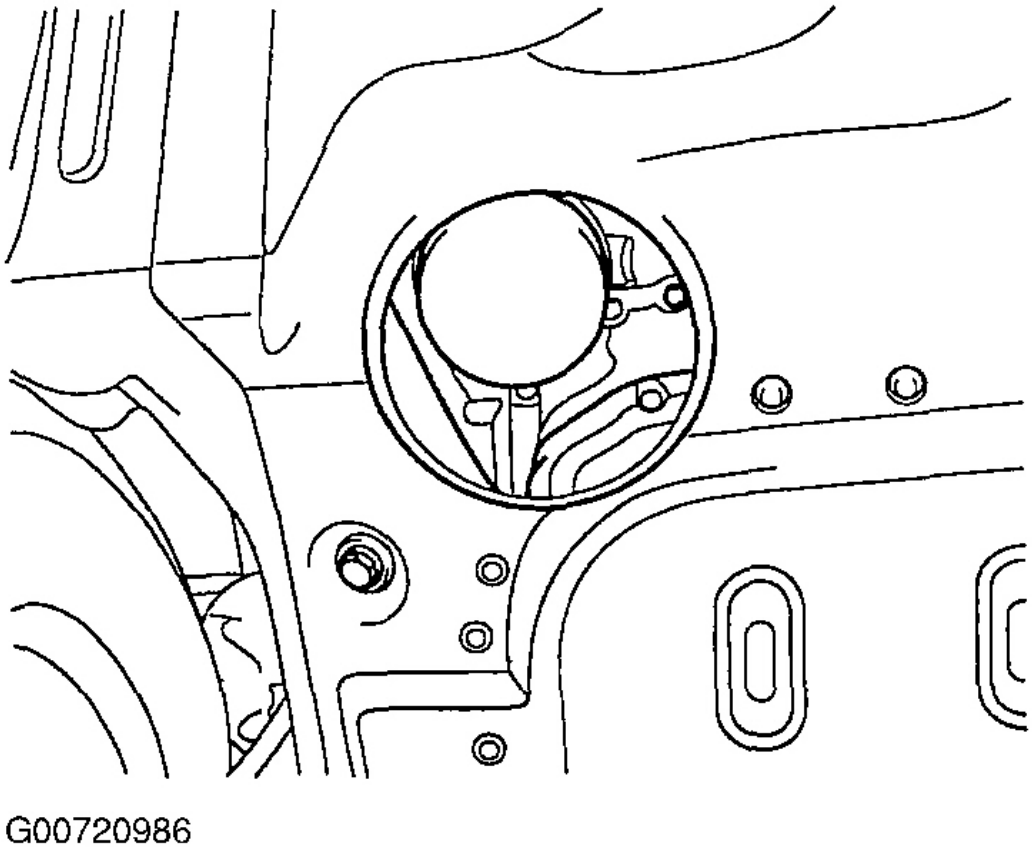


Fig. 6: Locating Engine Oil Filter
Courtesy of HYUNDAI MOTOR CO.

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: 12 ~ 16 Nm (120 ~ 160 kg.cm, 8.7 ~ 11.6 lb. ft)

4. Start and run the engine and check engine oil leaks.
5. After stopping the engine, check the oil level and add oil as necessary.

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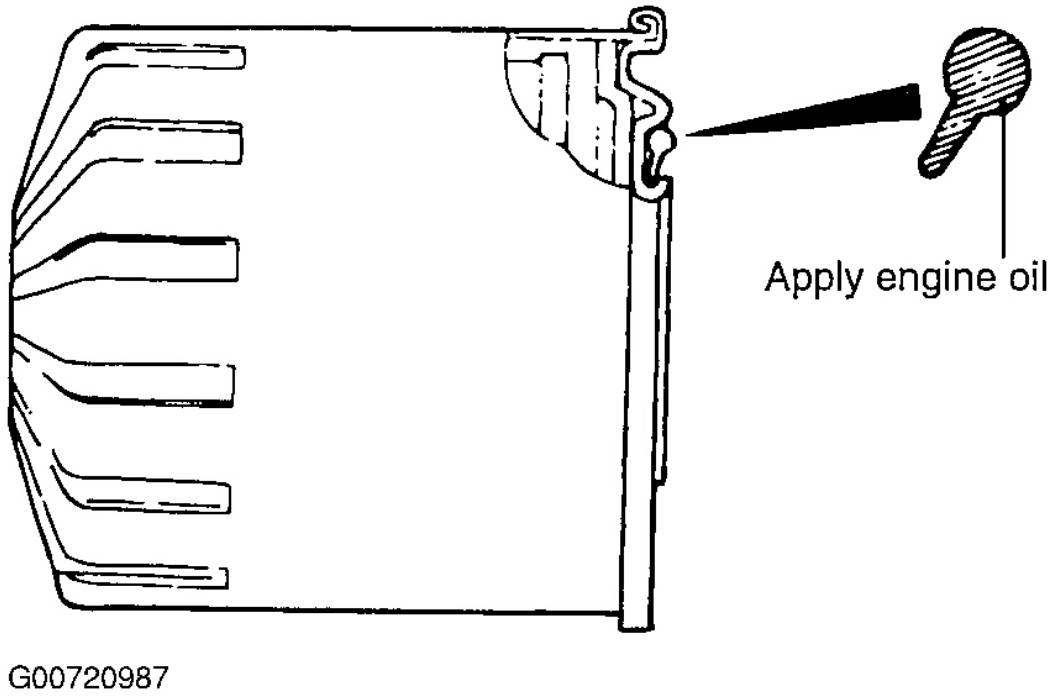


Fig. 7: Identifying & Lubricating Engine Oil Filter Seal
Courtesy of HYUNDAI MOTOR CO.

CHECKING COOLANT LEAK CHECK

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 (21psi, 1.53 kg/cm^2) pressure. Hold for two minutes, then check for leakage from the radiator, hoses or connections.

CAUTION:
1. **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.**
2. **When the tester is removed, be careful not to spill any coolant from it.**
3. **Be sure to clean away completely any coolant from the area.**
4. **Be careful, when installing and removing the tester and when testing, not to deform the filler neck of the radiator.**

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

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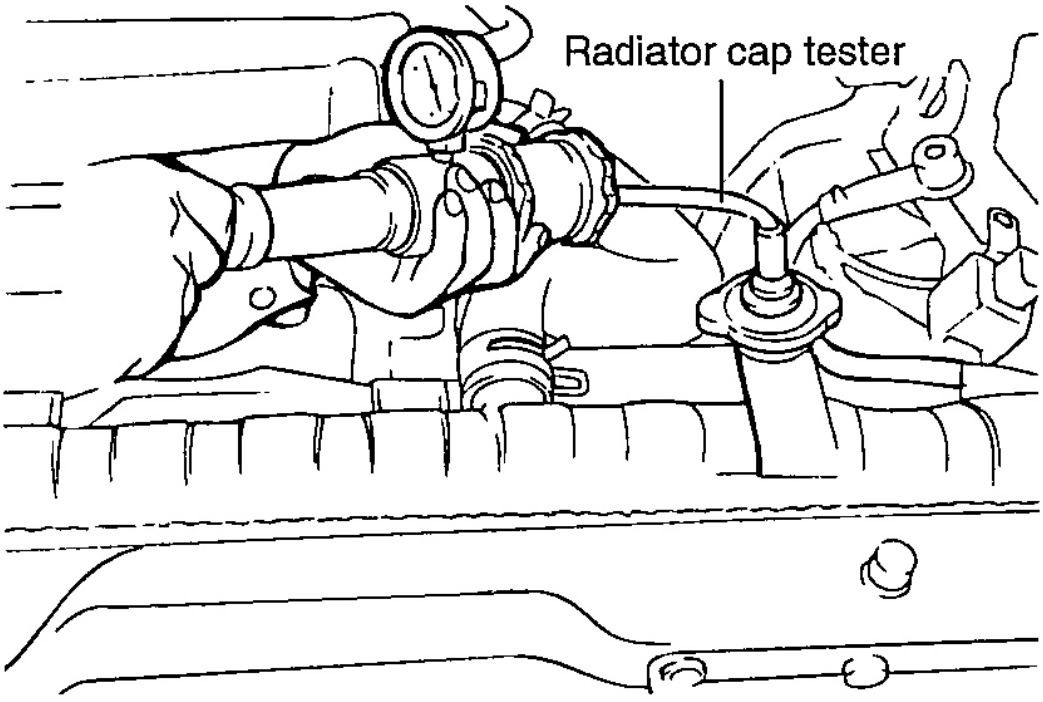


Fig. 8: Pressure Testing Cooling System
Courtesy of HYUNDAI MOTOR CO.

RADIATOR CAP PRESSURE TEST

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

   Main valve opening pressure:

   107.9 +/- 14.7 kPa (1.1 +/- 0.15 kg/cm^2 , 15.64 +/- 2.13 psi)

   Main valve closing pressure:

   83.4 kPa (0.85 kg/cm^2 , 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.

NOTE: Be sure that the cap is clean before testing, since rust or other foreign

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material on the cap seal will cause an incorrect reading.

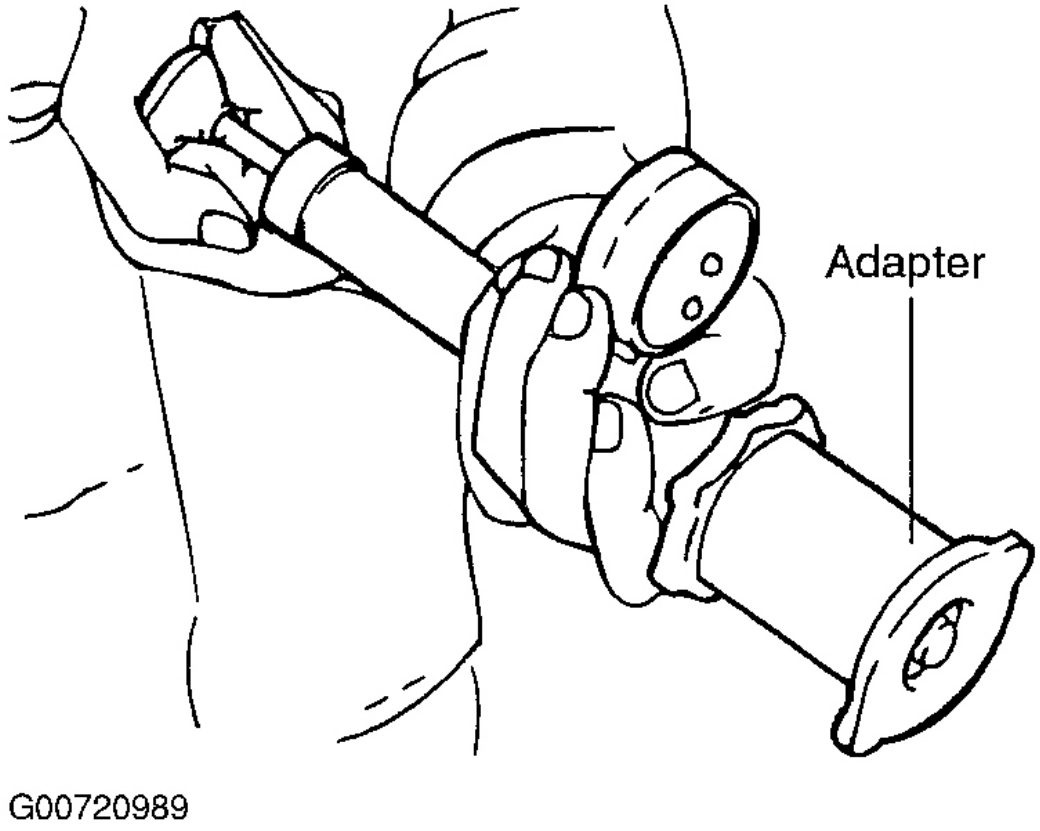


Fig. 9: Pressure Testing Radiator Pressure Cap
Courtesy of HYUNDAI MOTOR CO.

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 table for reference.

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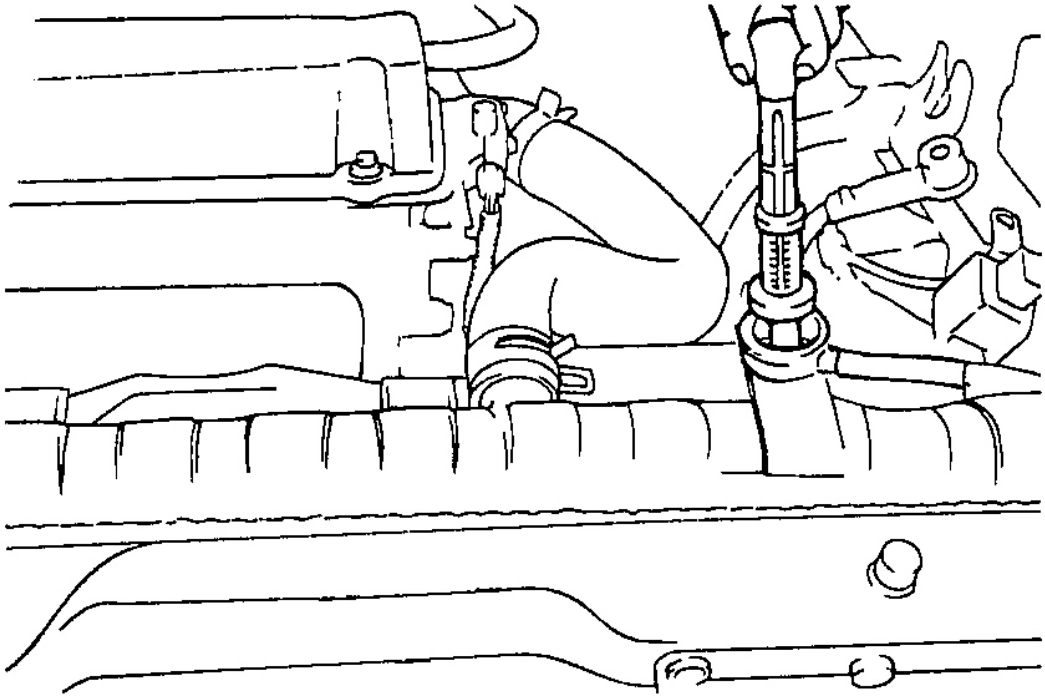


Fig. 10: Measuring Coolant Specific Gravity
Courtesy of HYUNDAI MOTOR CO.

RELATION BETWEEN COOLANT CONCENTRATION AND SPECIFIC GRAVITY

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	1.0544	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	1.0841.	1.076	-50 (-58)	-45 (-49)	60%

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Fig. 11: Identifying Relationship Between Coolant Concentration & Specific Gravity
Courtesy of HYUNDAI MOTOR CO.

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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)

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 anti - freeze.**

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. 12: Identifying Recommended Coolant Mixing Ratios
Courtesy of HYUNDAI MOTOR CO.

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: 1,200 kpa (12.2 kg/cm^2 , 170 psi)

   Limit: 1,050 kpa (10.7 kg/cm^2 , 149 psi)

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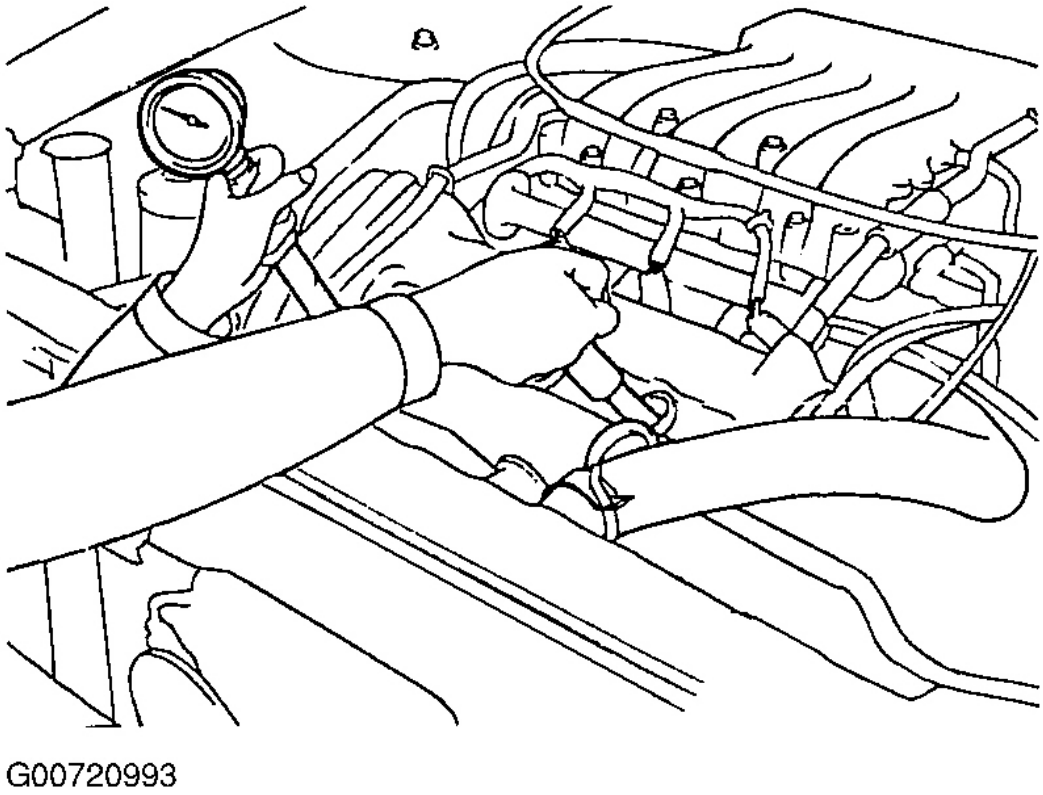


Fig. 13: Checking Engine Compression With Compression Gauge
Courtesy of HYUNDAI MOTOR CO.

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/cm^2 , 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 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 Nm (200 ~ 300 kg.cm, 14 ~ 22 lb. ft)

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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 Nm (1050 ~ 1150 kg.cm, 75 ~ 82 lb. ft.)

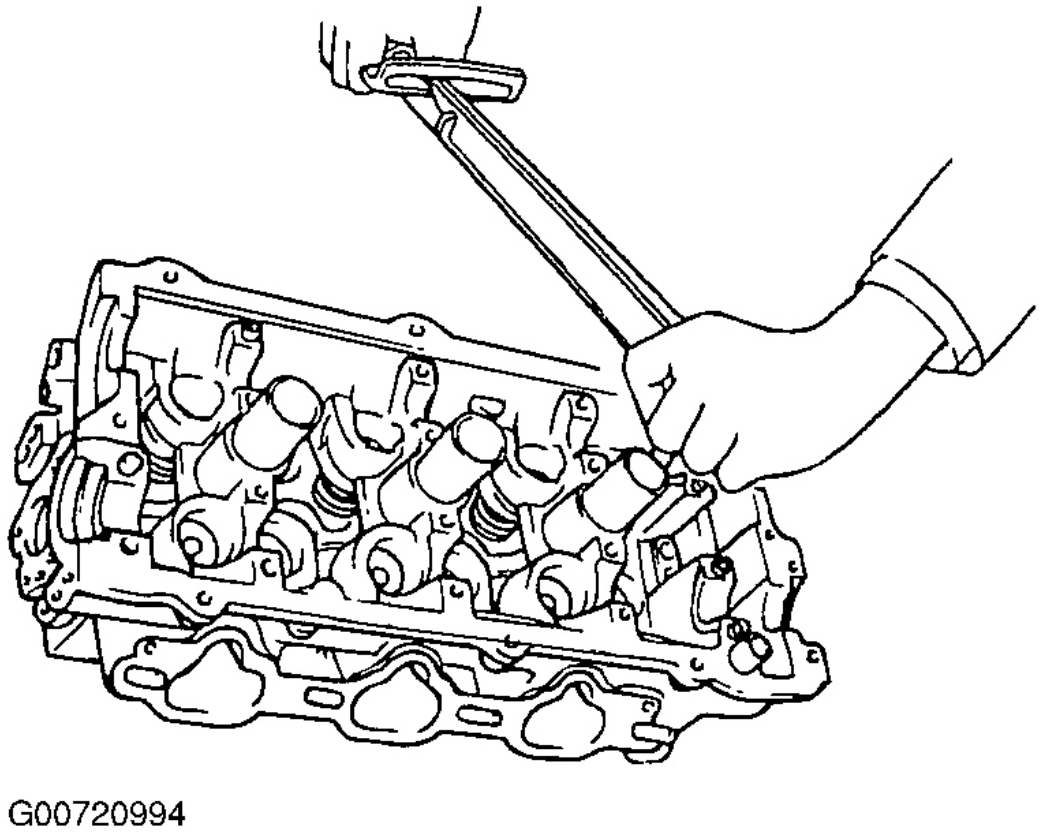


Fig. 14: Tightening Cylinder Head Bolts With Torque Wrench
Courtesy of HYUNDAI MOTOR CO.

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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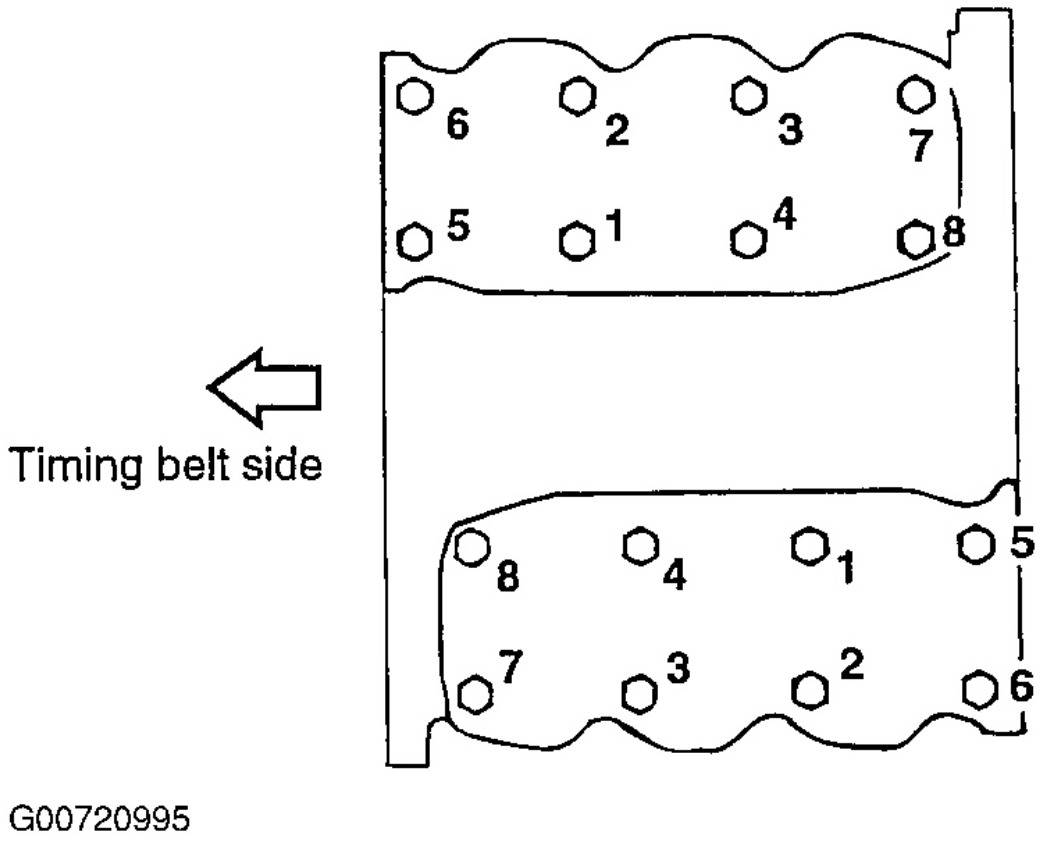


Fig. 15: Identifying Cylinder Head Tightening Sequence
Courtesy of HYUNDAI MOTOR CO.

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 AND TENSIONER

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

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

   Tightening torque

   Tensioner assembly nut:

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35 ~ 55 Nm (350 ~ 550 Kg. cm, 26 ~ 40 lb. ft)

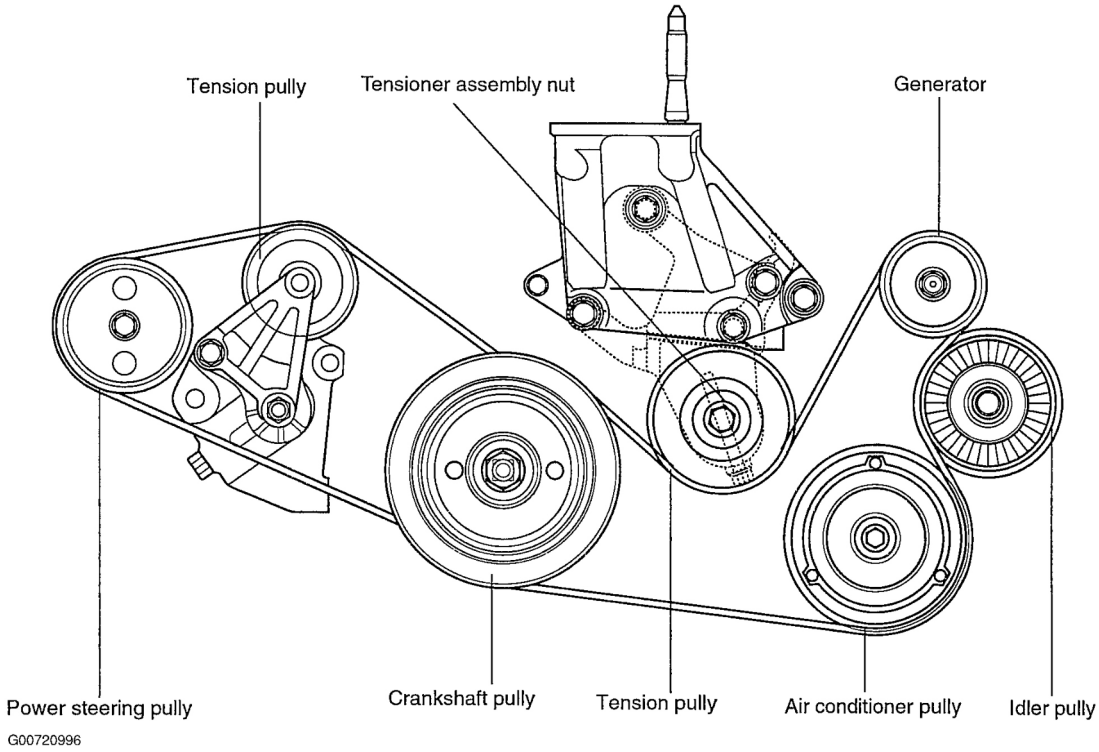
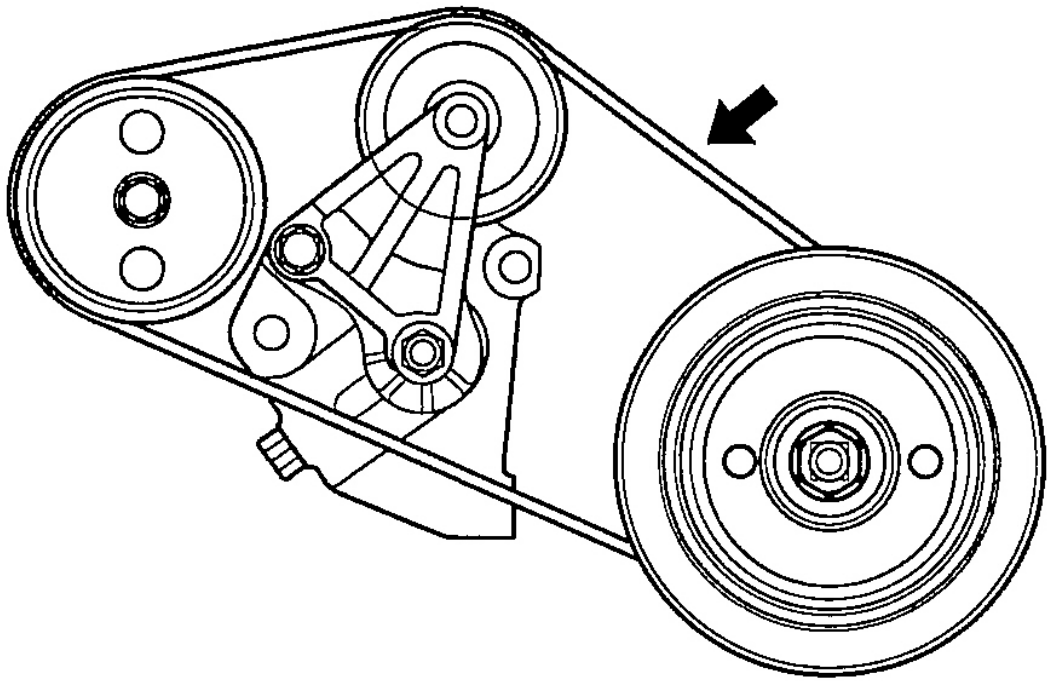


Fig. 16: Identifying Engine & Power Steering Drive Belts & Components
Courtesy of HYUNDAI MOTOR CO.

2. Install power steering belt.

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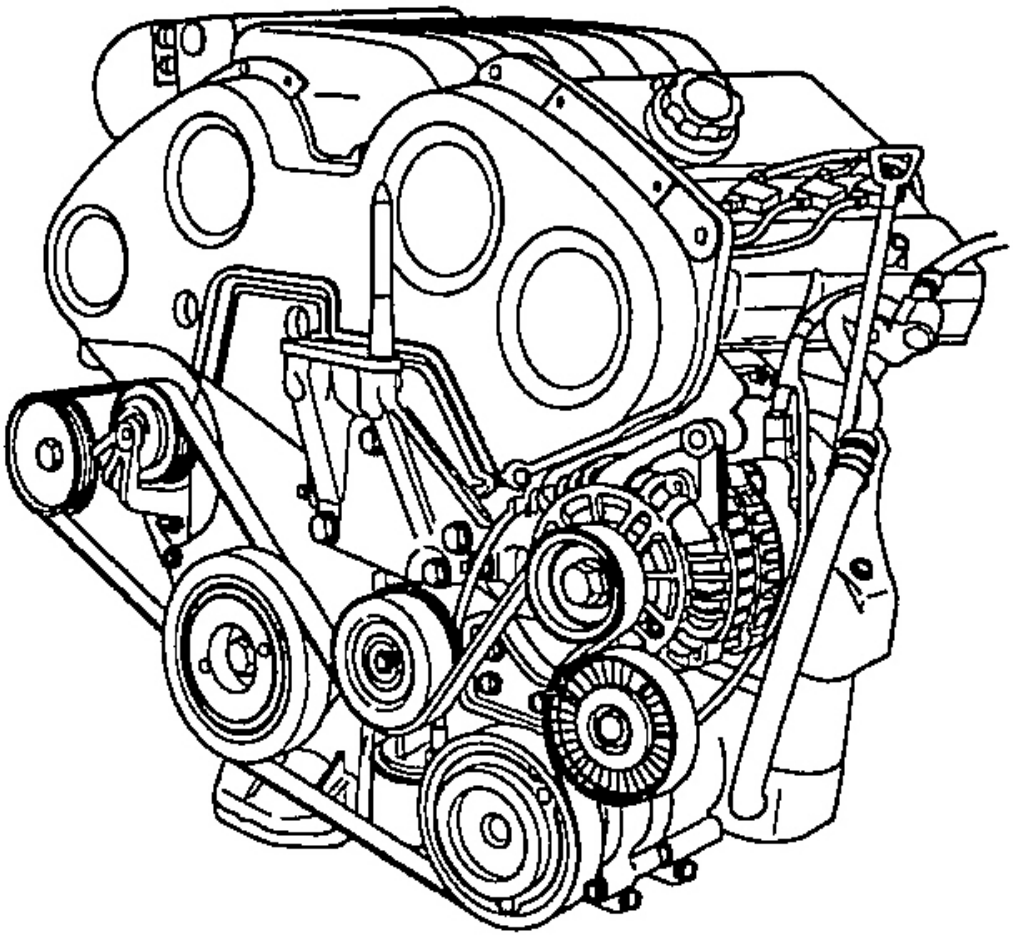


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Fig. 17: Installing Power Steering Belt
Courtesy of HYUNDAI MOTOR CO.

3. Install drive belt.

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Fig. 18: Installing Drive Belt
Courtesy of HYUNDAI MOTOR CO.

4. Adjust the power steering belt tension to specification by turning the adjusting bolt (Q) clockwise or counterclockwise.

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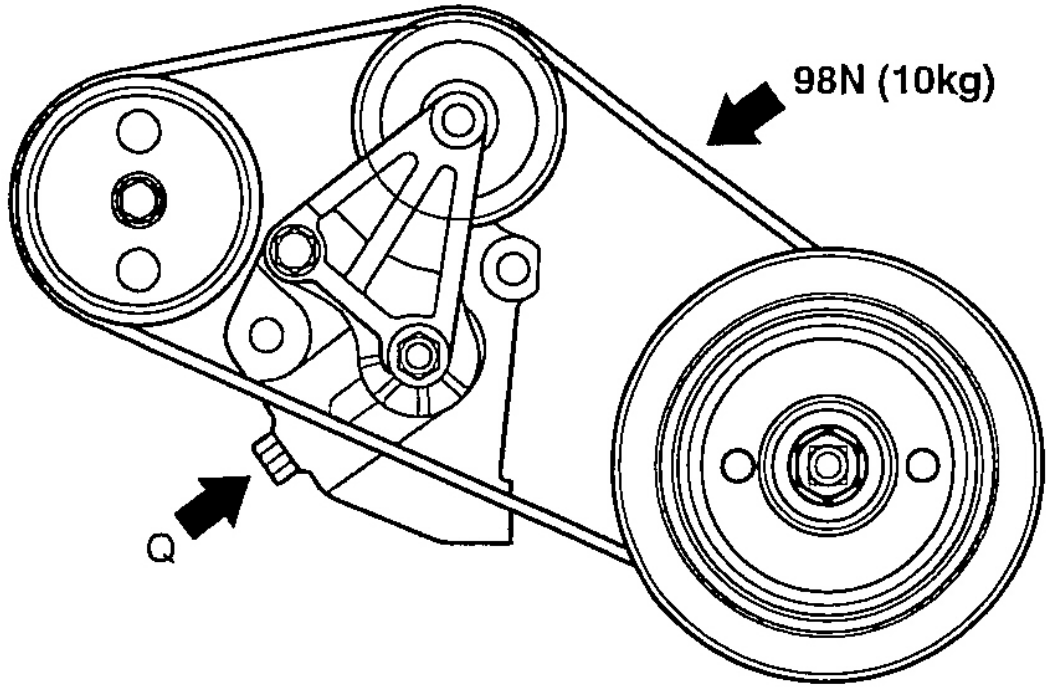


Fig. 19: Adjusting Power Steering Belt
Courtesy of HYUNDAI MOTOR CO.

5. Adjust the drive belt tension to specification by turning the adjusting bolt (Q) clockwise or counterclockwise.

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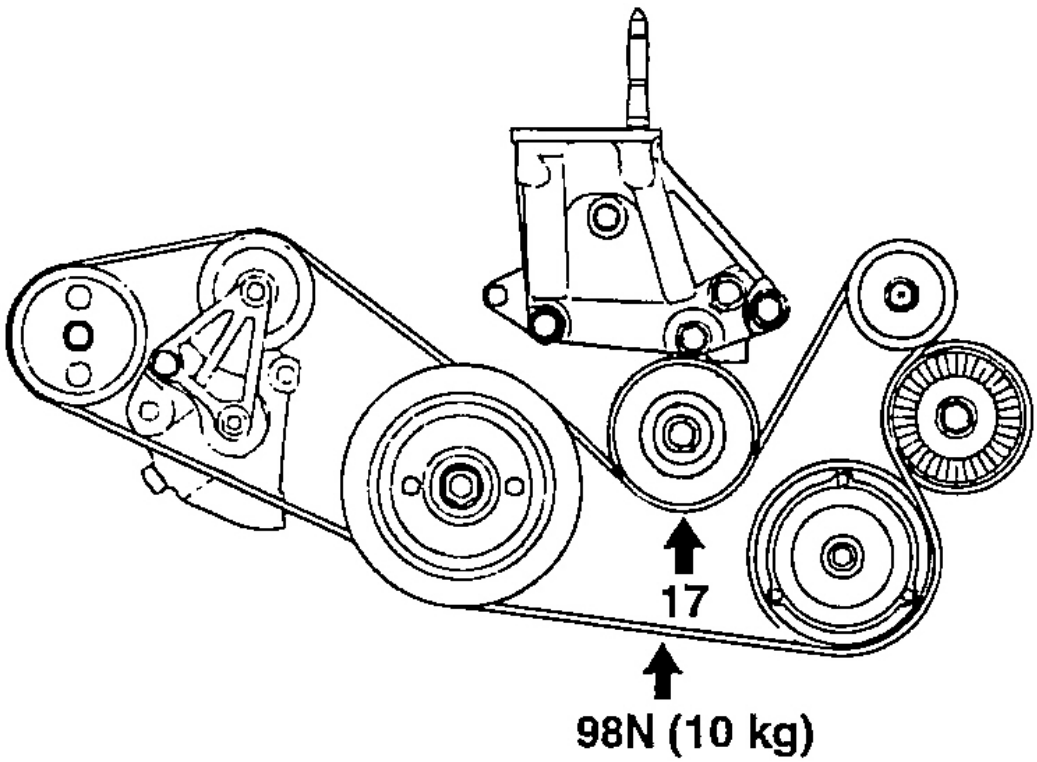


Fig. 20: Adjusting Drive Belt
Courtesy of HYUNDAI MOTOR CO.

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

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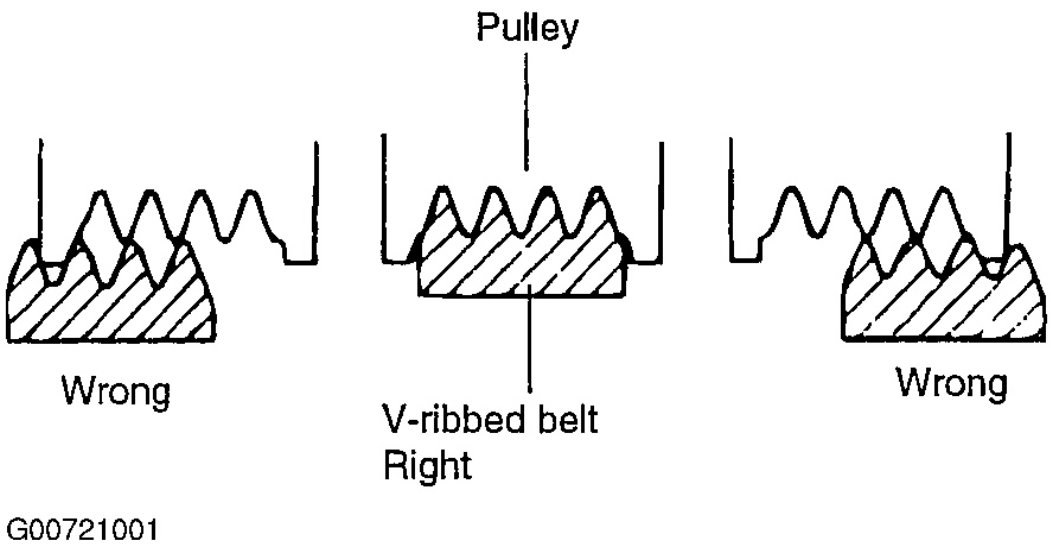


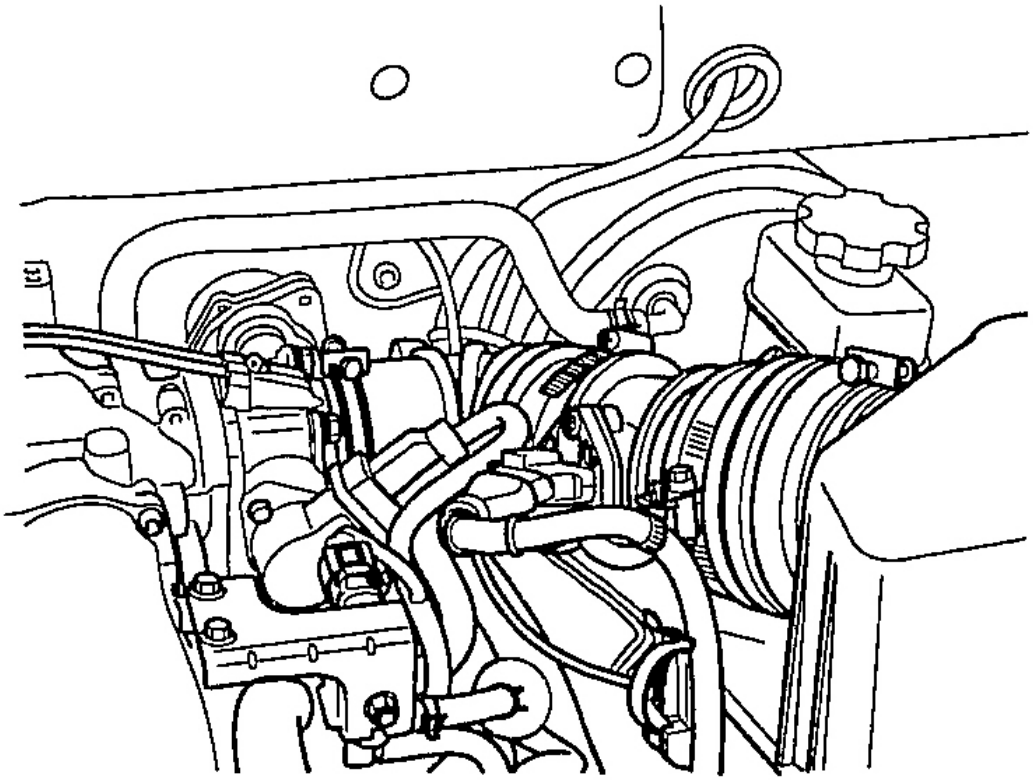
Fig. 21: Identifying Proper Belt-To-Pulley Fit
Courtesy of HYUNDAI MOTOR CO.

ENGINE AND TRANSAXLE ASSEMBLY

REMOVAL

1. Remove the battery and engine cover.
2. Remove the battery stay.
3. Detach the air cleaner.
4. Disconnect the connectors from the engine harness.

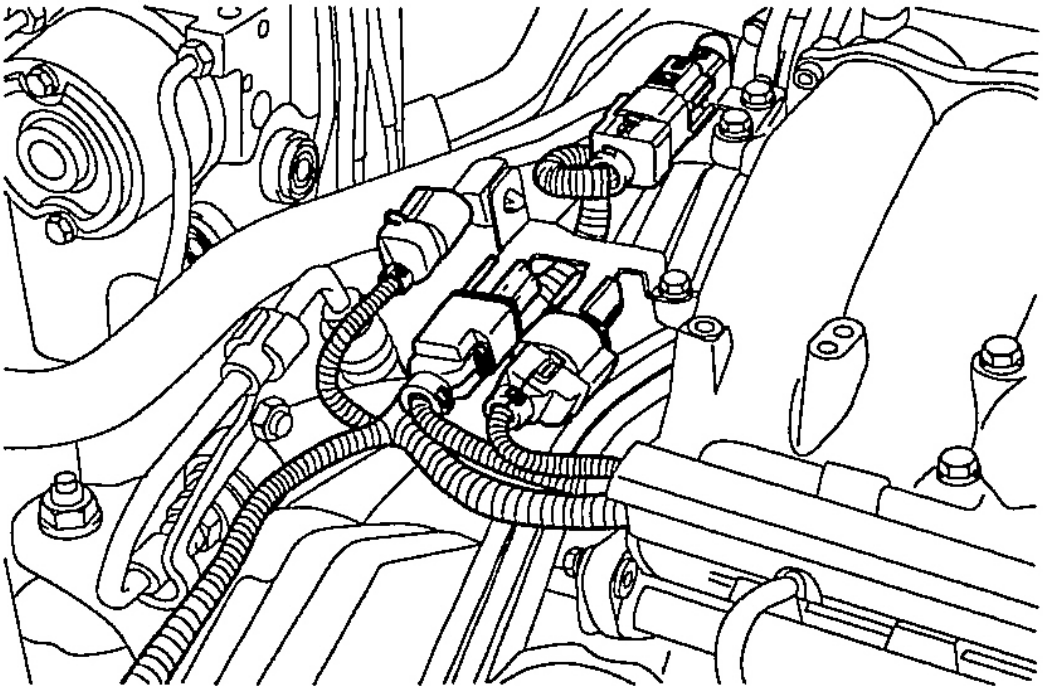
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Fig. 22: Disconnecting Air Cleaner
Courtesy of HYUNDAI MOTOR CO.

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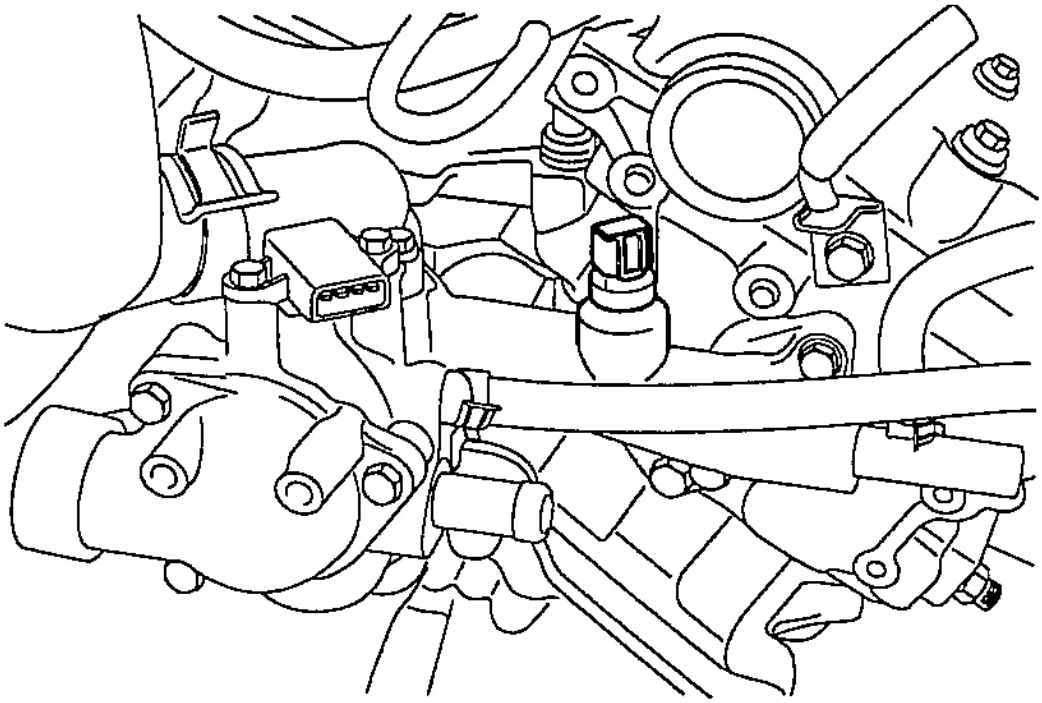


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Fig. 23: Disconnecting Engine Electrical Connectors
Courtesy of HYUNDAI MOTOR CO.

1. Alternator, starter
2. Power steering switch connector, oil pressure gauge connector, air conditioner switch
3. Injector connectors
4. Back up lamp switch connector
5. A/T solenoid, inhibitor switch connector.
6. Coolant temperature

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G00721004

Fig. 24: Identifying Engine Coolant Temperature (ETC) Sensor
Courtesy of HYUNDAI MOTOR CO.

7. Ignition coils, power TR connector
8. Idle speed control valve (ISC) connector
9. AFS and ATS connectors
10. Oxygen sensor connector etc.

5. Disconnect the transaxle oil cooler hoses (A/T).

NOTE: When disconnecting hoses, make identification marks to avoid making any mistake when installing them again.

CAUTION: Be careful not to spill any of the oil or fluid from the hoses. Plug the openings to prevent the entry of foreign material.

6. Disconnect the radiator upper and lower hoses on the engine side.

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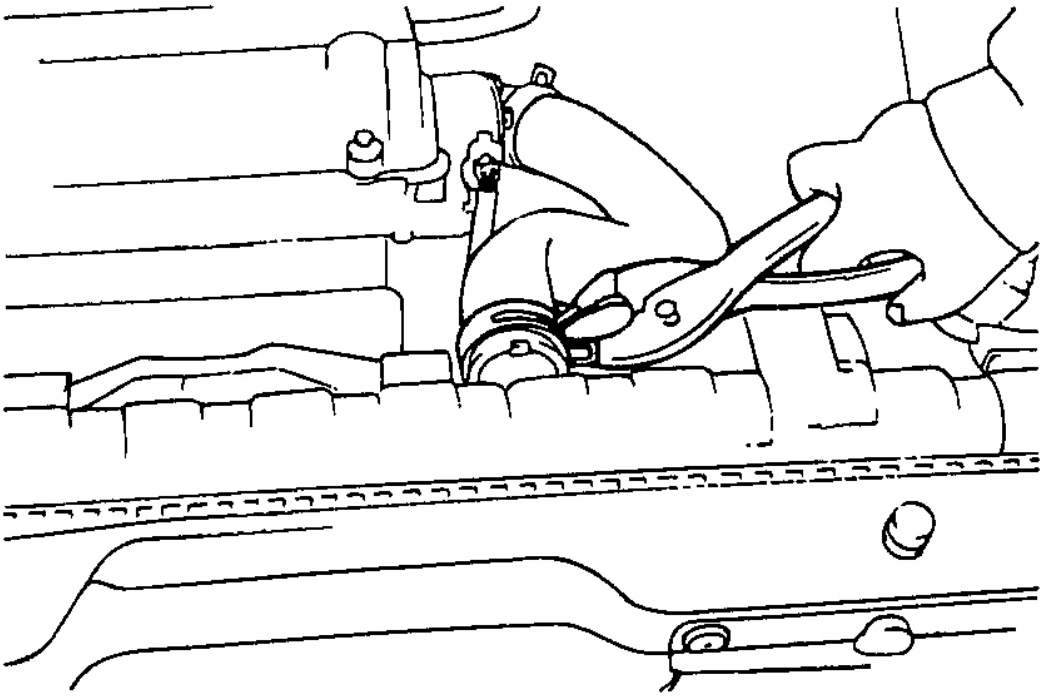
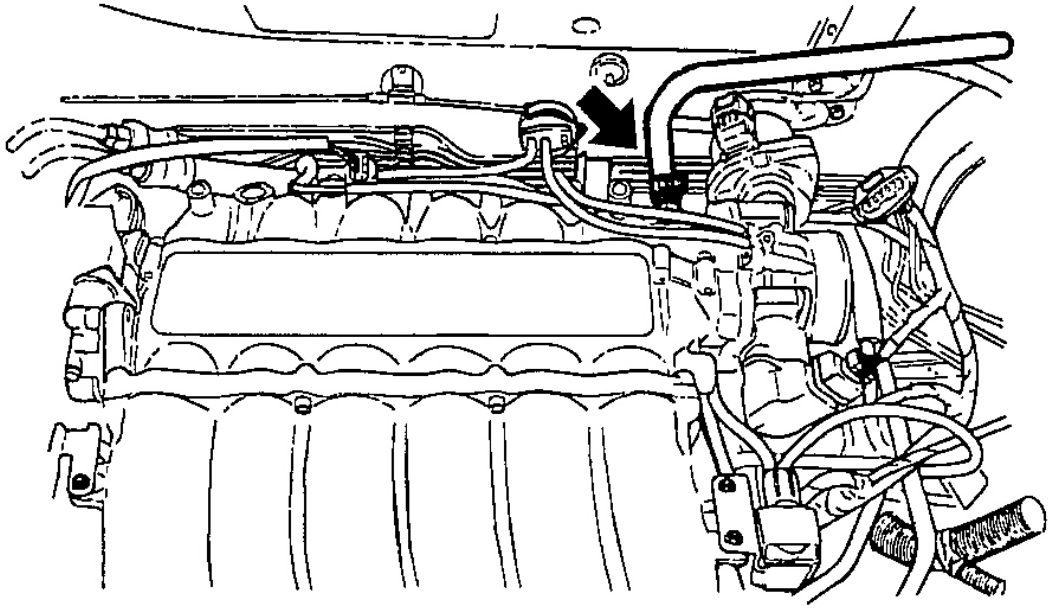


Fig. 25: Disconnecting Radiator Hoses
Courtesy of HYUNDAI MOTOR CO.

7. Disconnect the engine ground and transaxle ground.
8. Disconnect the brake booster vacuum hose.

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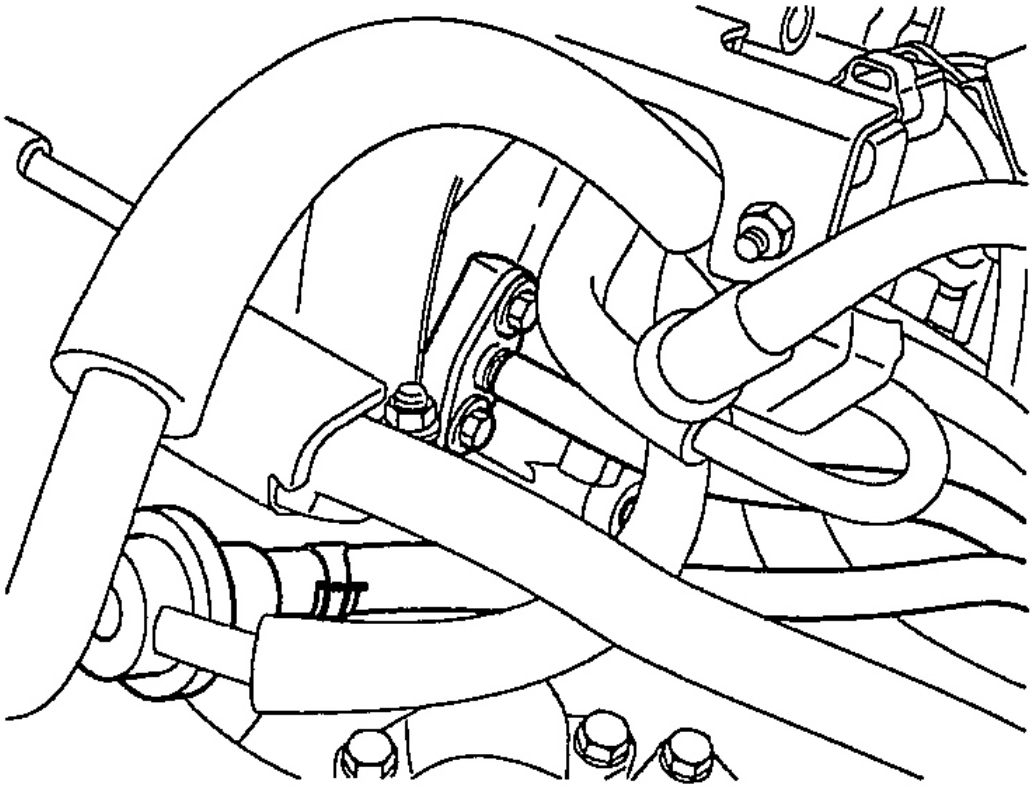


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Fig. 26: Disconnecting Brake Booster Hose
Courtesy of HYUNDAI MOTOR CO.

9. Disconnect the heater hoses (inlet and outlet) on the engine side.
10. Remove the main fuel line (supply and return) at the delivery pipe.

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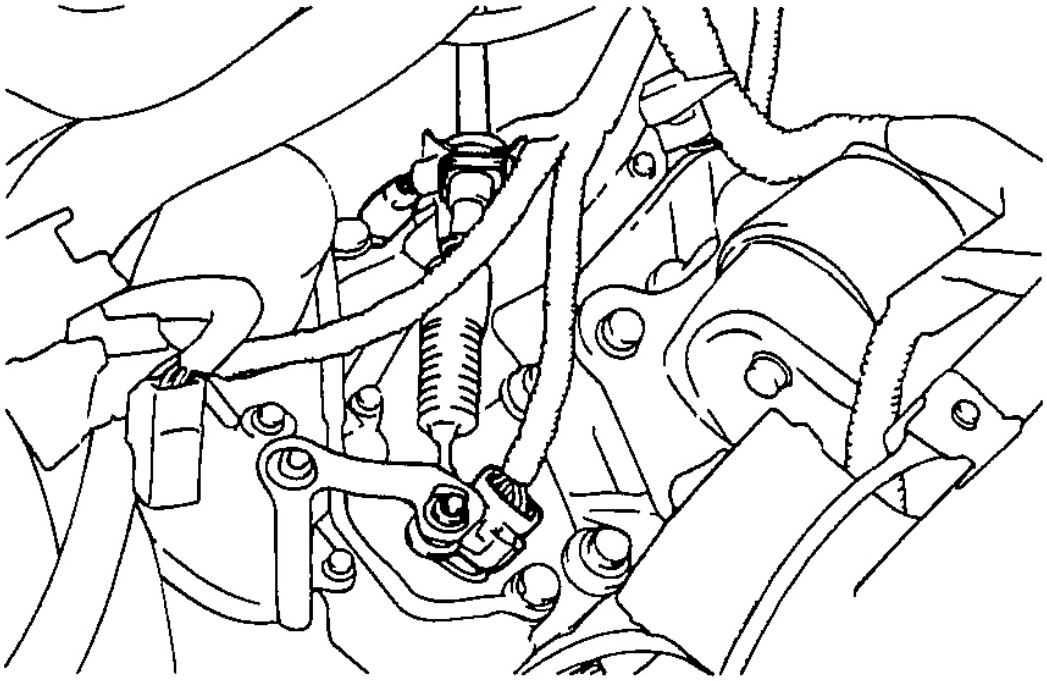


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Fig. 27: Disconnecting Fuel Lines At Delivery Pipe
Courtesy of HYUNDAI MOTOR CO.

11. Disconnect the speedometer cable from the transaxle.
12. Disconnect the control cable from the transaxle.

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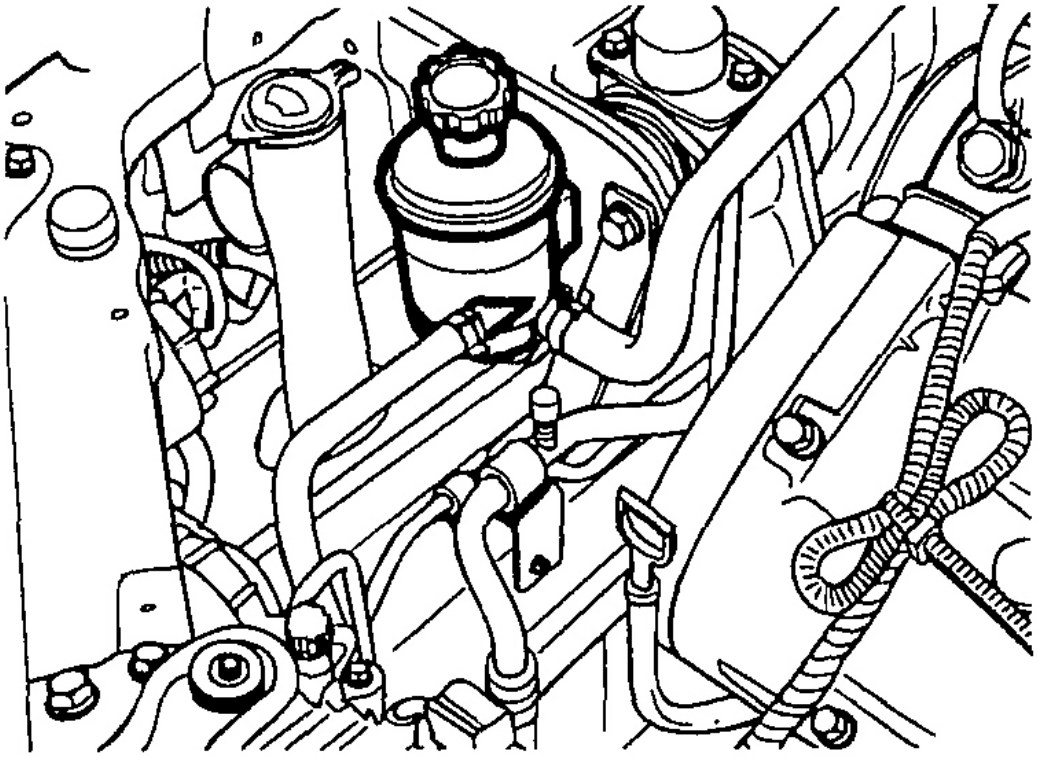


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Fig. 28: Disconnecting Transmission Control Cable
Courtesy of HYUNDAI MOTOR CO.

13. Remove the power steering oil pump.

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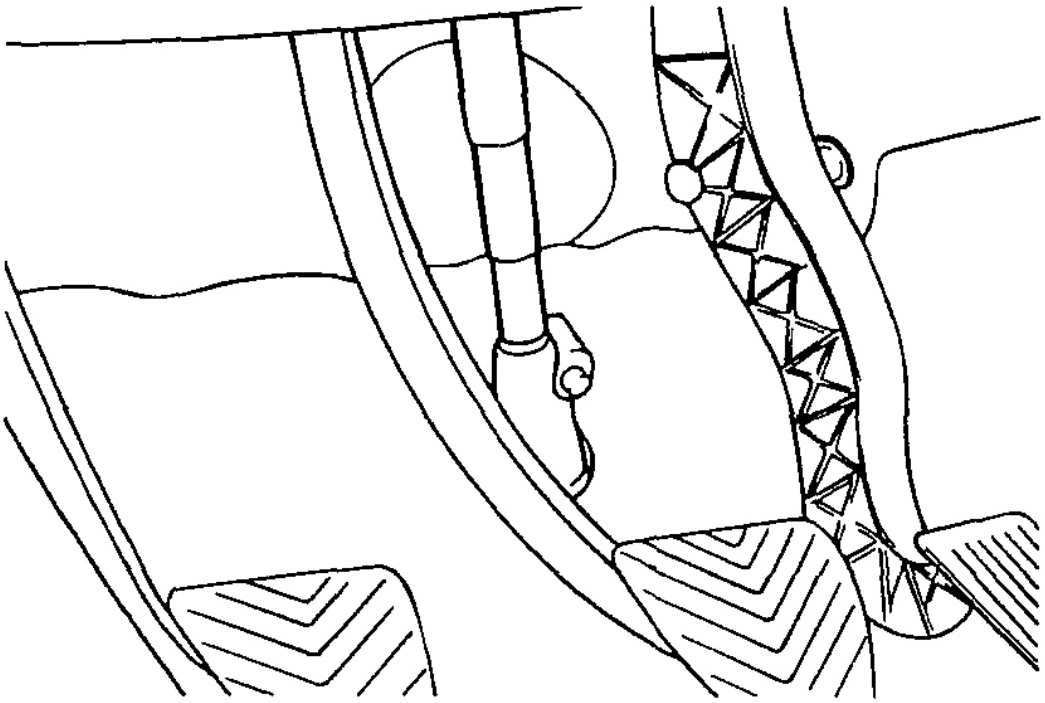
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Fig. 29: Removing Power Steering Oil Pump
Courtesy of HYUNDAI MOTOR CO.

14. Detach the steering dust cover in the engine compartment and then disconnect the gear box universal joint bolt.

NOTE: Make sure to make identification marks between the universal joint and the gear box for reassembly.

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G00721010

Fig. 30: Disconnection Steering Gear Box Universal Joint
Courtesy of HYUNDAI MOTOR CO.

15. Raise the vehicle and then remove the front tire.
16. Remove the caliper assembly from knuckle and hold the upper side.

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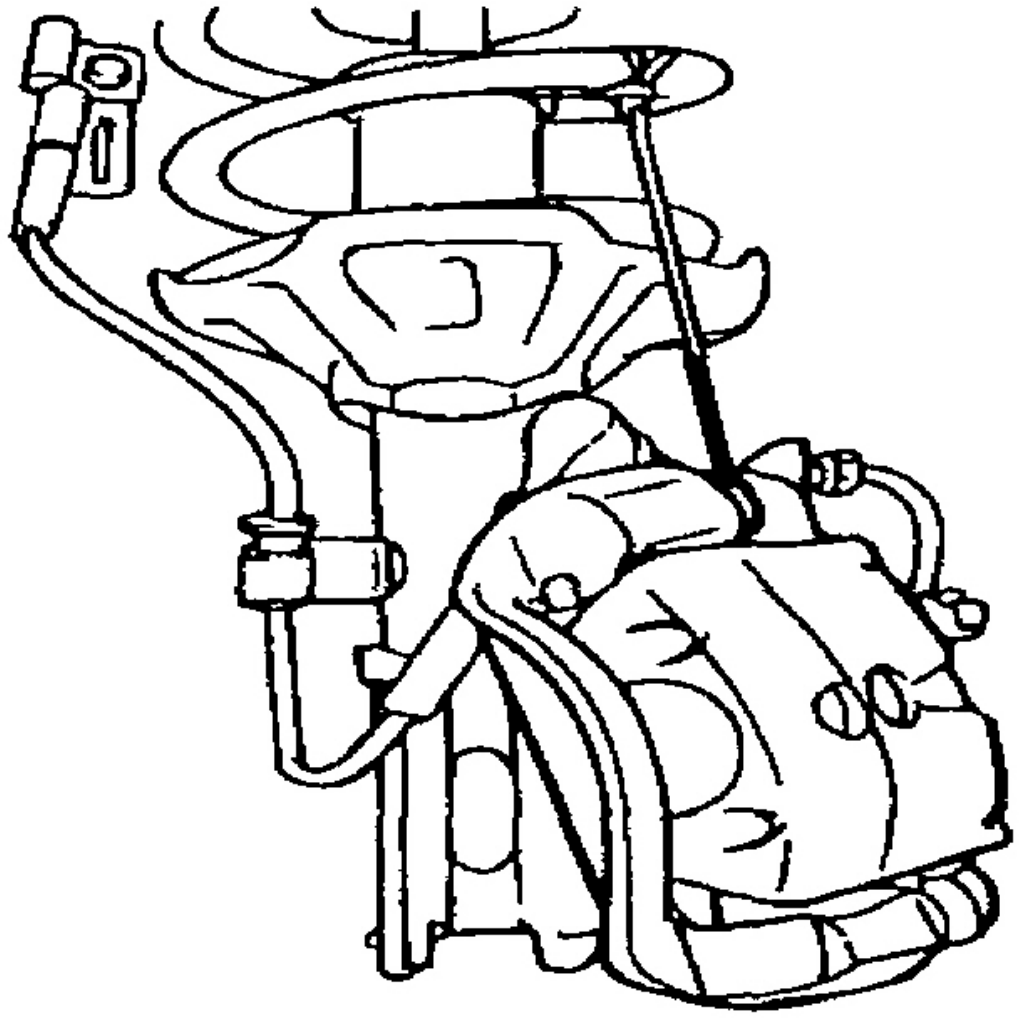
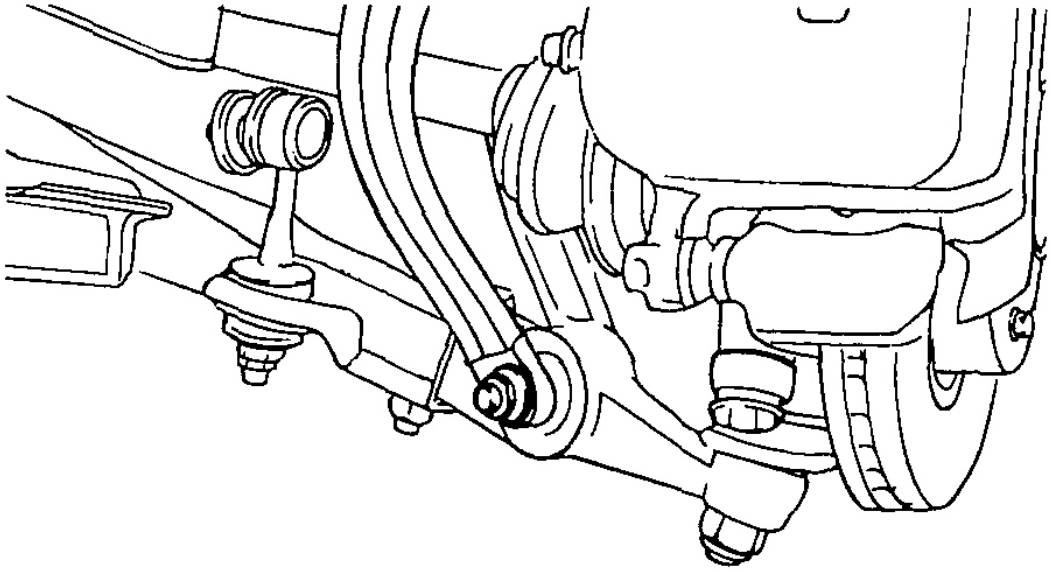


Fig. 31: Supporting Brake Caliper Assembly
Courtesy of HYUNDAI MOTOR CO.

17. Remove the lower arm ball joint bolts and upper arm bolt from the knuckle.

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Fig. 32: Removing Lower Arm Ball Joint Bolts From Knuckle
Courtesy of HYUNDAI MOTOR CO.

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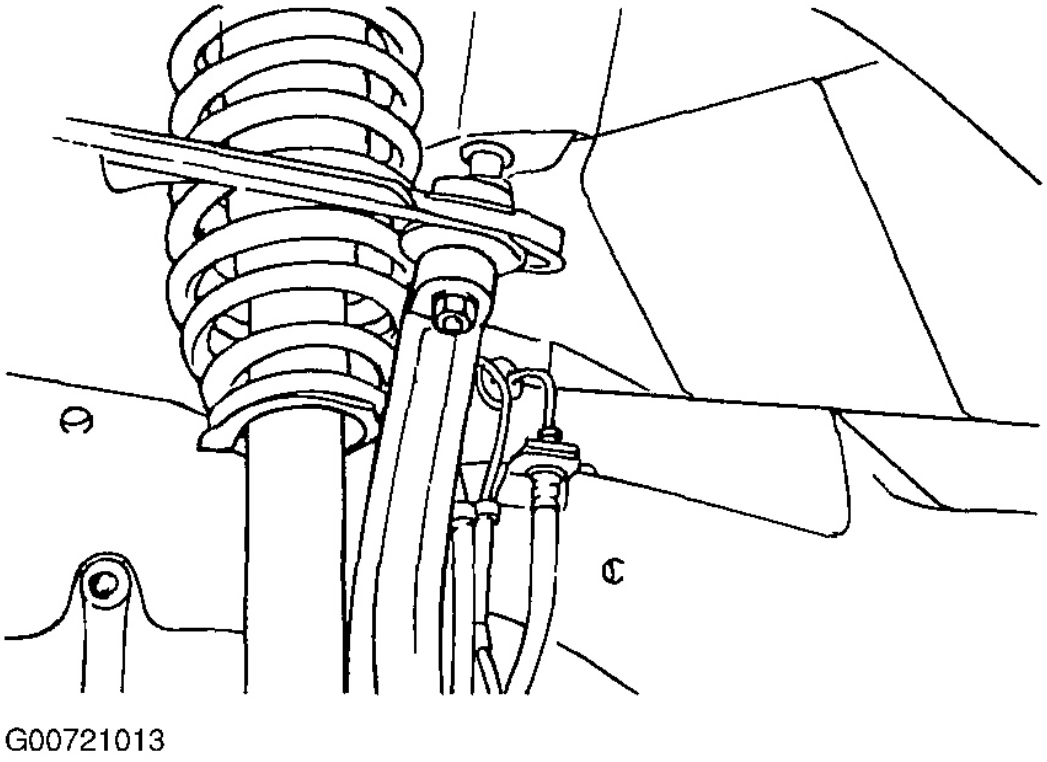
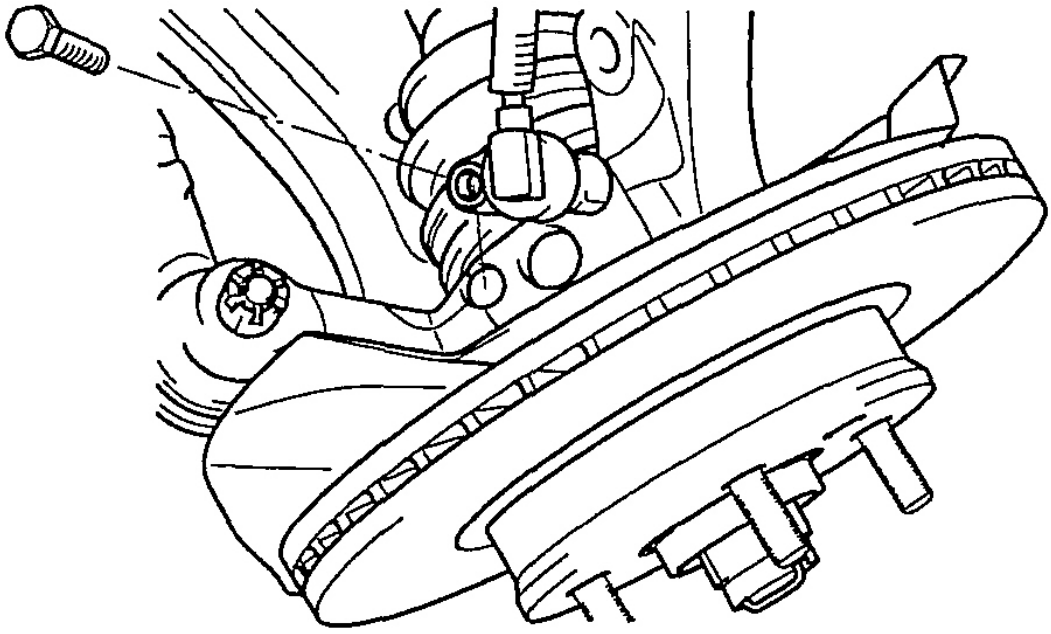


Fig. 33: Removing Upper Arm Bolts From Knuckle
Courtesy of HYUNDAI MOTOR CO.

18. Remove the wheel speed sensor from the knuckle.

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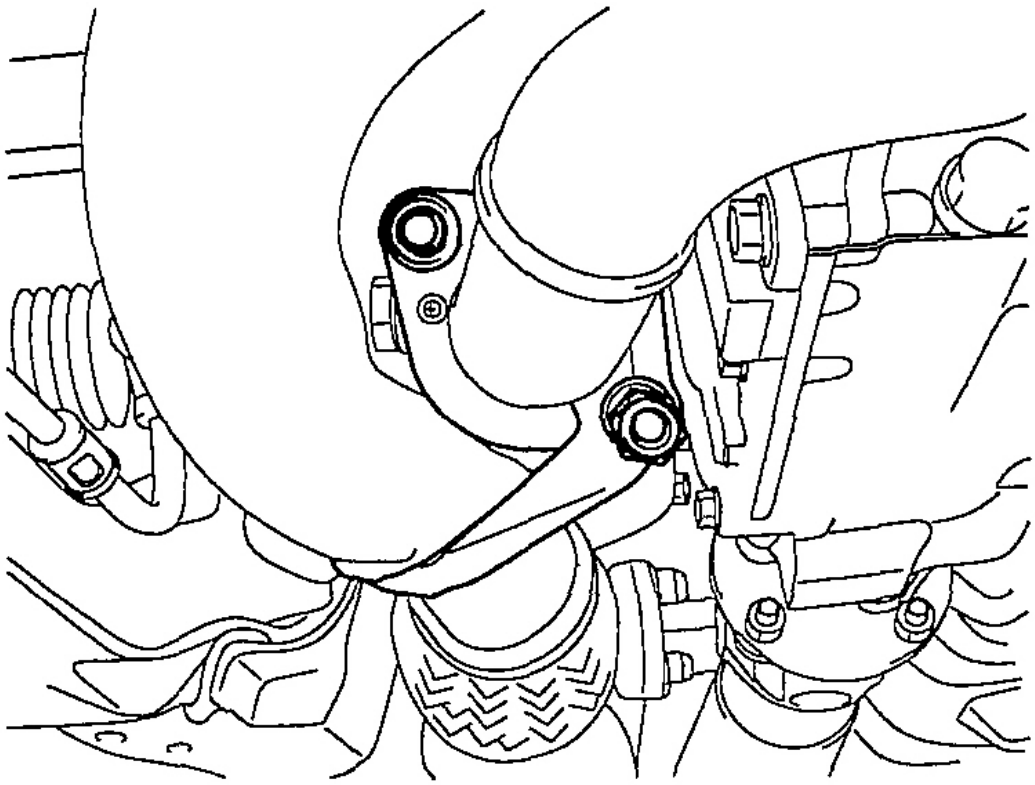


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Fig. 34: Removing Wheel Speed Sensor
Courtesy of HYUNDAI MOTOR CO.

19. Remove the front muffler bolts.

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Fig. 35: Removing Front Muffler Bolts (1 Of 2)
Courtesy of HYUNDAI MOTOR CO.

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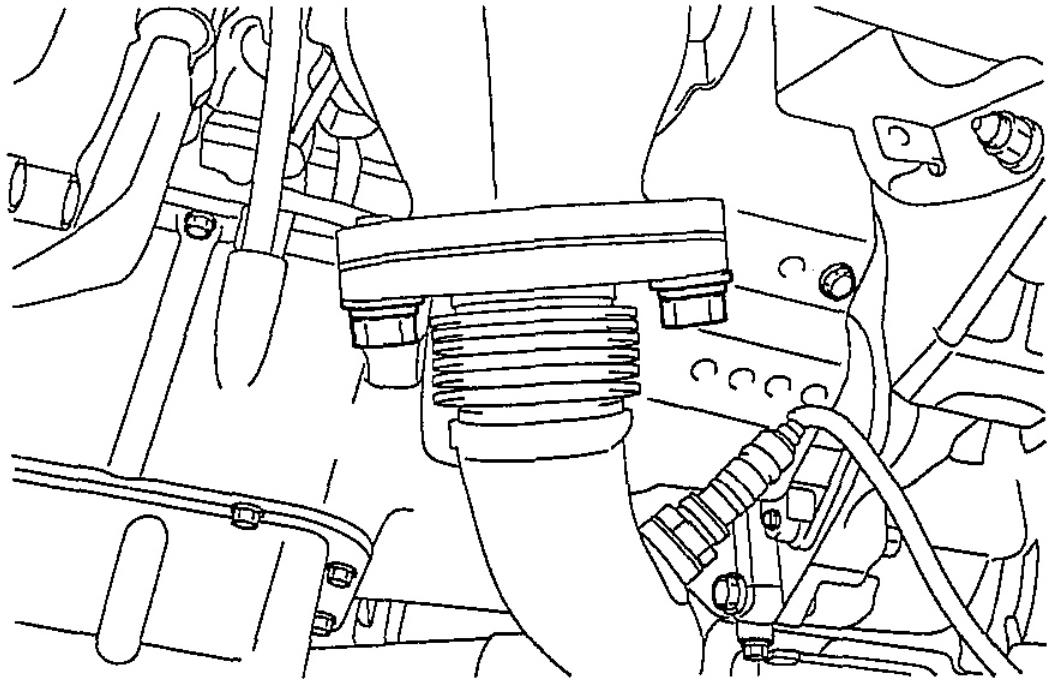
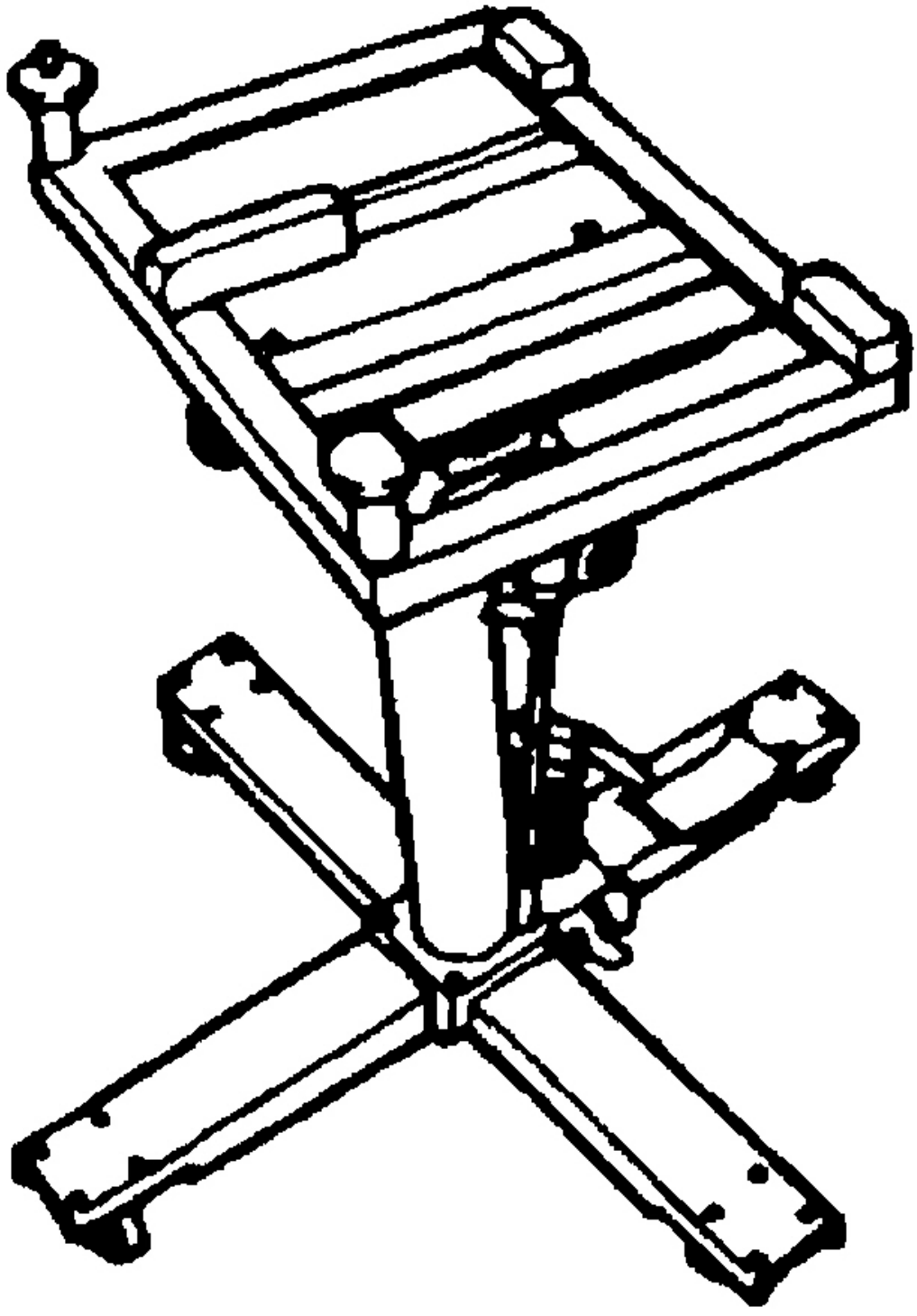


Fig. 36: Removing Front Muffler Bolts (2 Of 2)
Courtesy of HYUNDAI MOTOR CO.

20. Put the special fixture on the T/M jack and then adjust it to the sub - frame.

NOTE: Check that all the cables, harness connector and hoses are disconnected from the engine and transaxle assembly.

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Fig. 37: Identifying T/M Jack
Courtesy of HYUNDAI MOTOR CO.

21. Remove the engine mount bolts.

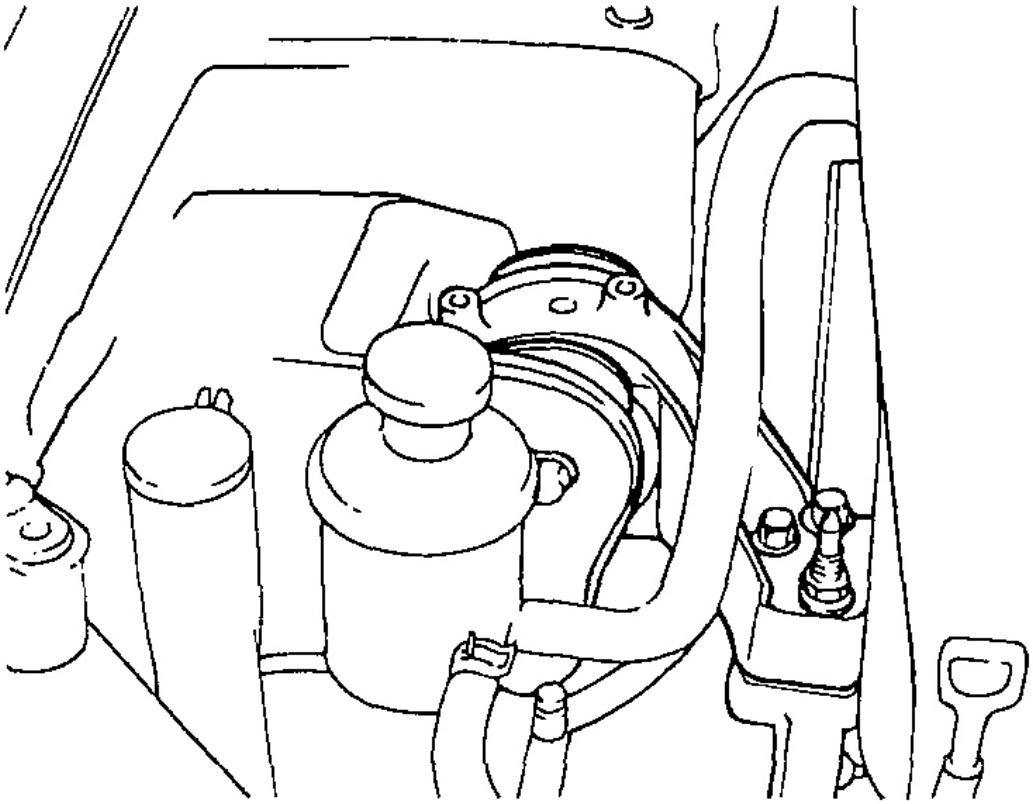
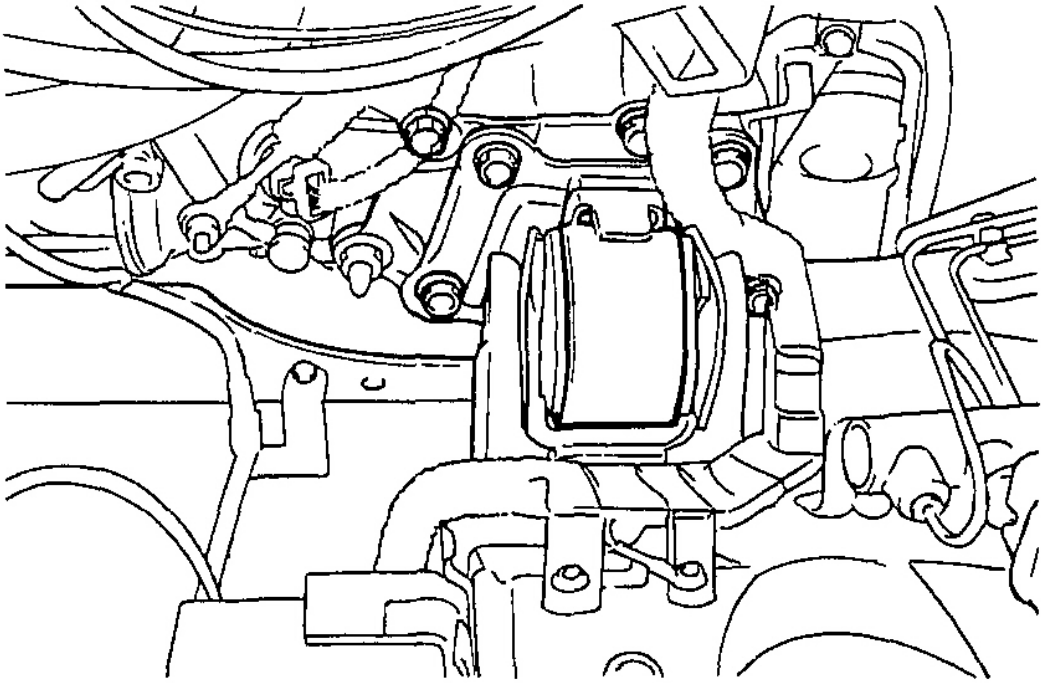


Fig. 38: Removing Engine Mount Bolts
Courtesy of HYUNDAI MOTOR CO.

22. Remove the transaxle mounting bracket bolts.

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Fig. 39: Removing Transaxle Bracket Mounting Bolts
Courtesy of HYUNDAI MOTOR CO.

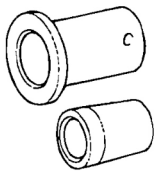
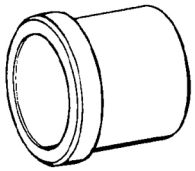
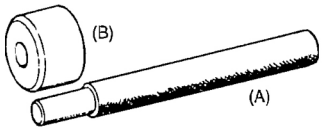
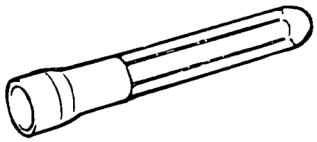
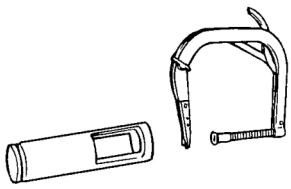
23. Remove the cross member fixing bolts.
24. While directing the transaxle side downward, lift the engine and transaxle assembly down and out of the vehicle.

INSTALLATION

Installation is the reverse order of removal.

SPECIAL TOOLS

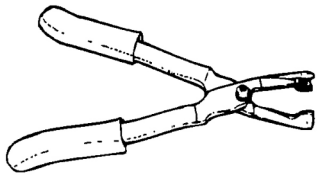
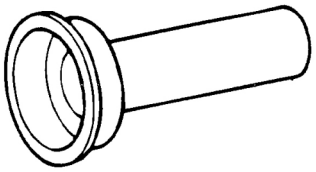
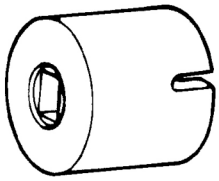
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Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09214 - 33000)		Installation of the crankshaft front oil seal
Camshaft oil seal installer (09221 - 21000)		Installation of the camshaft oil seal
Valve guide installer (09222 - 22000 (B)) (09221 - 29000 (A))		Removal and installation of the valve guide
Valve stem oil seal installer (09222 - 22001)		Installation of the valve stem oil seal
Valve spring compressor (09222 - 28000)		Removal and installation of the intake or exhaust valve

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Fig. 40: Special Tools (1 Of 2)
Courtesy of HYUNDAI MOTOR CO.

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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. 41: Special Tools (2 Of 2)
Courtesy of HYUNDAI MOTOR CO.

TROUBLE SHOOTING

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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 beaing 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. 42: Trouble Shooting Table (1 Of 2)
Courtesy of HYUNDAI MOTOR CO.

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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. 43: Trouble Shooting Table (2 Of 2)
Courtesy of HYUNDAI MOTOR CO.

TIMING SYSTEM

TIMING BELT

COMPONENTS

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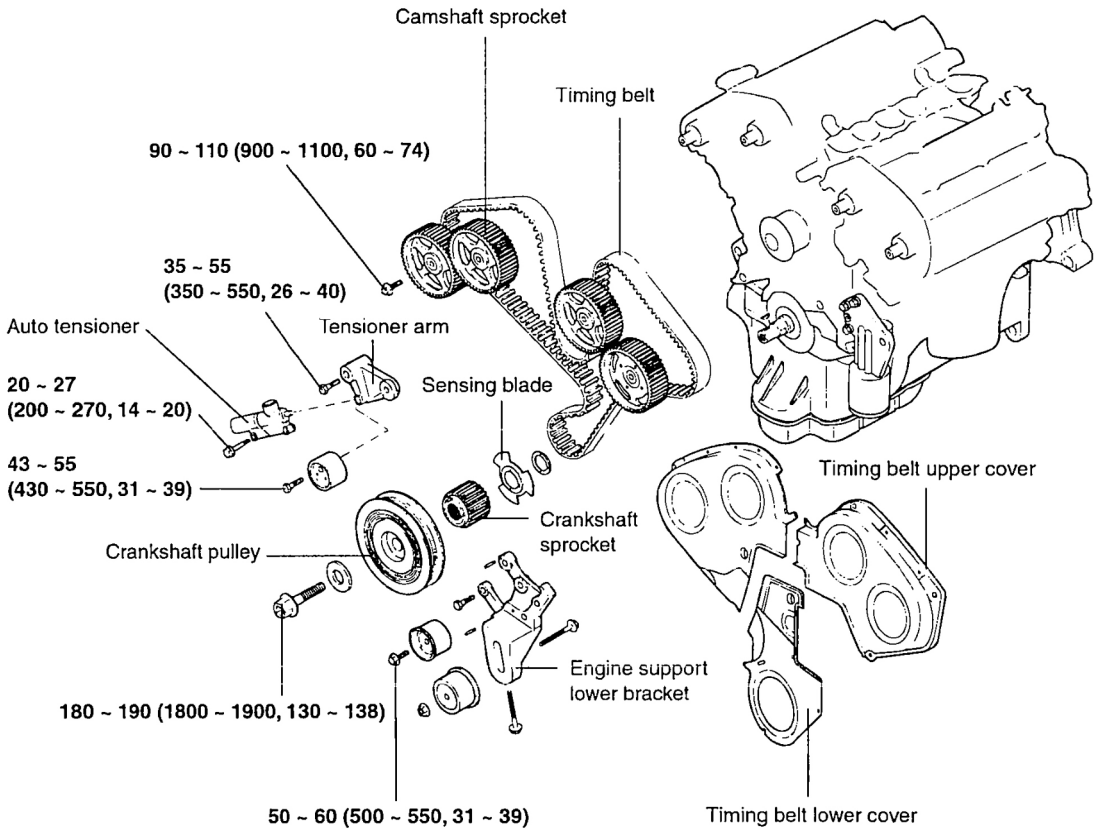


Fig. 44: Identifying Timing Belt & Related Components
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

1. Remove the wheel of passenger side.
2. Remove the side cover.
3. Remove the engine cover.
4. Disconnect the power steering hose fixing on the engine mounting bracket.
5. Remove the engine mounting bracket.

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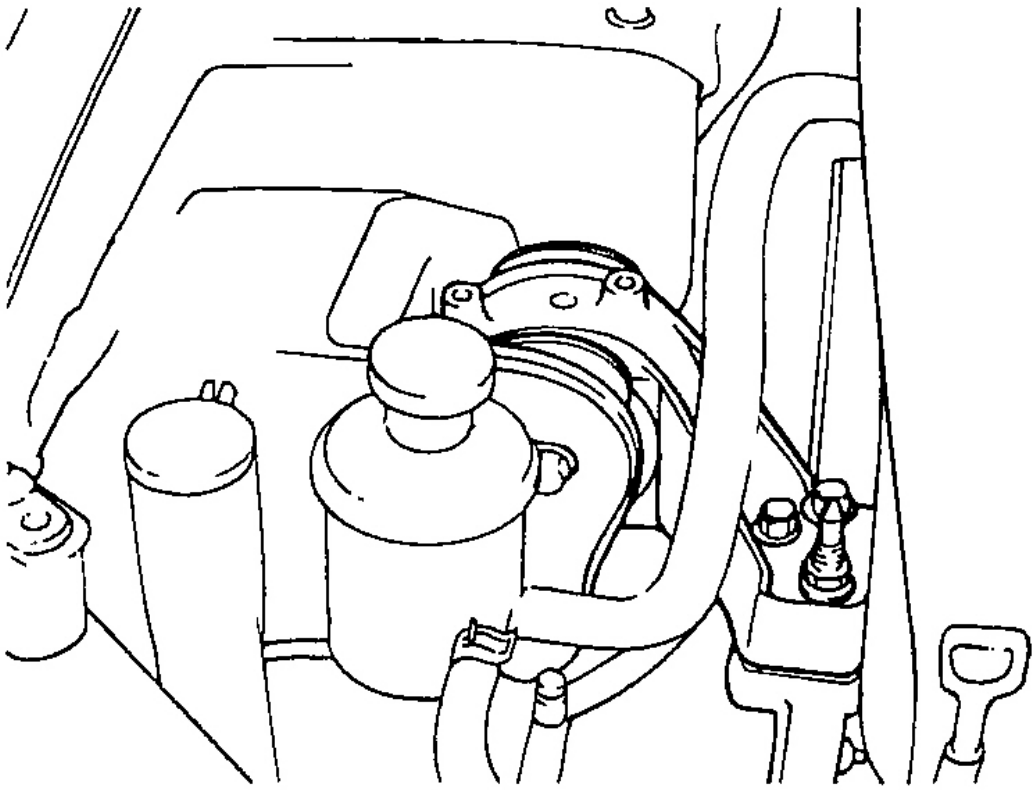


Fig. 45: Removing Engine Mounting Bracket
Courtesy of HYUNDAI MOTOR CO.

CAUTION: Before removing the engine mounting bracket support the engine oil pan with a jack or equivalent so as not to go down the engine.

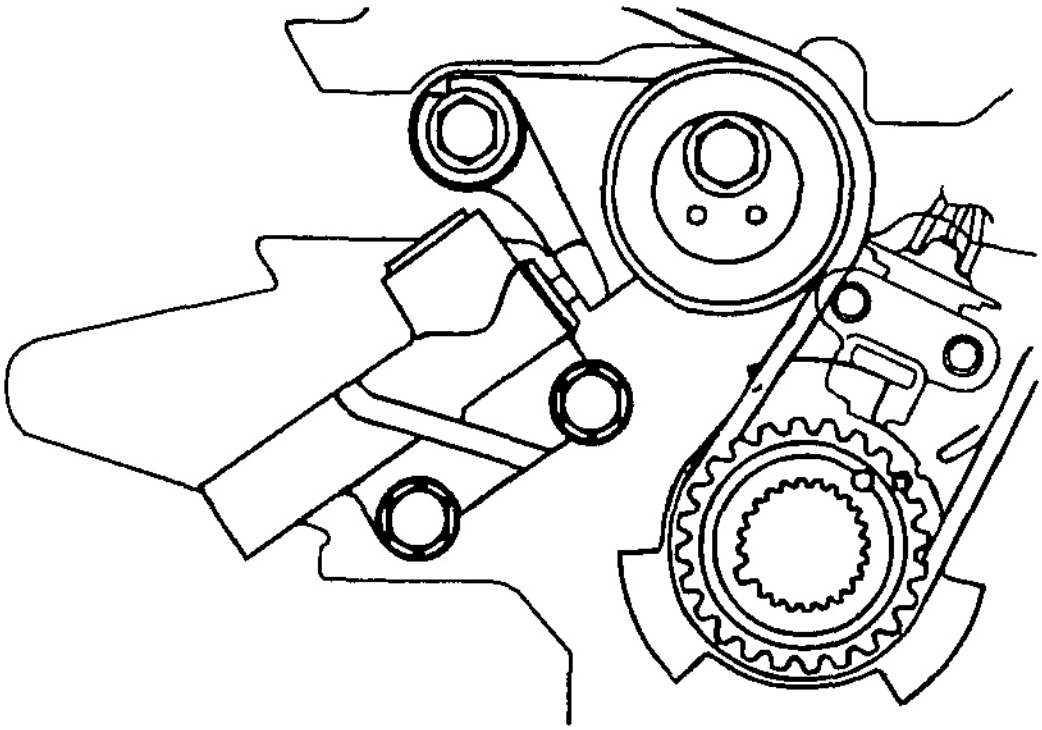
6. Disconnect the connectors from the timing belt upper cover and remove the upper cover.
7. Remove the drive belt and loosen the 2 alternator mounting nuts (14 mm) and 2 bolts (12 mm) connecting the engine support bracket.
8. Loosen the 5 engine support bracket bolts.

CAUTION: To loosen the bolt shown in the forward of engine, first disconnect the alternator.

9. Remove the engine support bracket bolt by moving the engine up and down slightly and remove the bracket upward.

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10. Remove the auto tensioner.

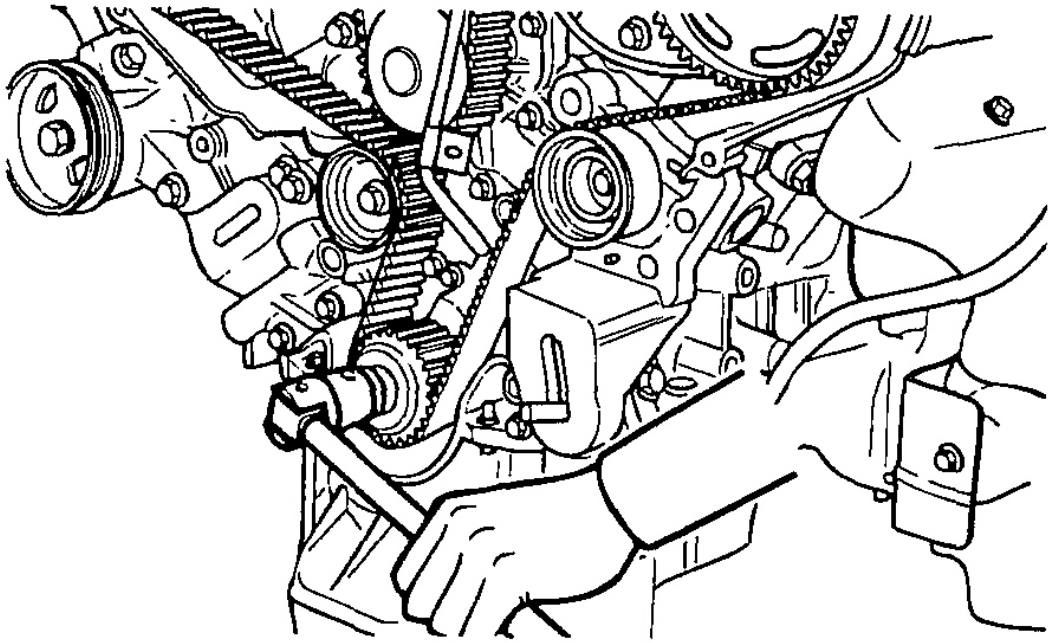


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Fig. 46: Removing The Timing Belt Auto Tensioner
Courtesy of HYUNDAI MOTOR CO.

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.

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Fig. 47: Rotating Engine To Align Timing Marks
Courtesy of HYUNDAI MOTOR CO.

11. 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 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 glossy, non-elastic and so hard that when the nail of your finger is pressed into it, no mark is produced.

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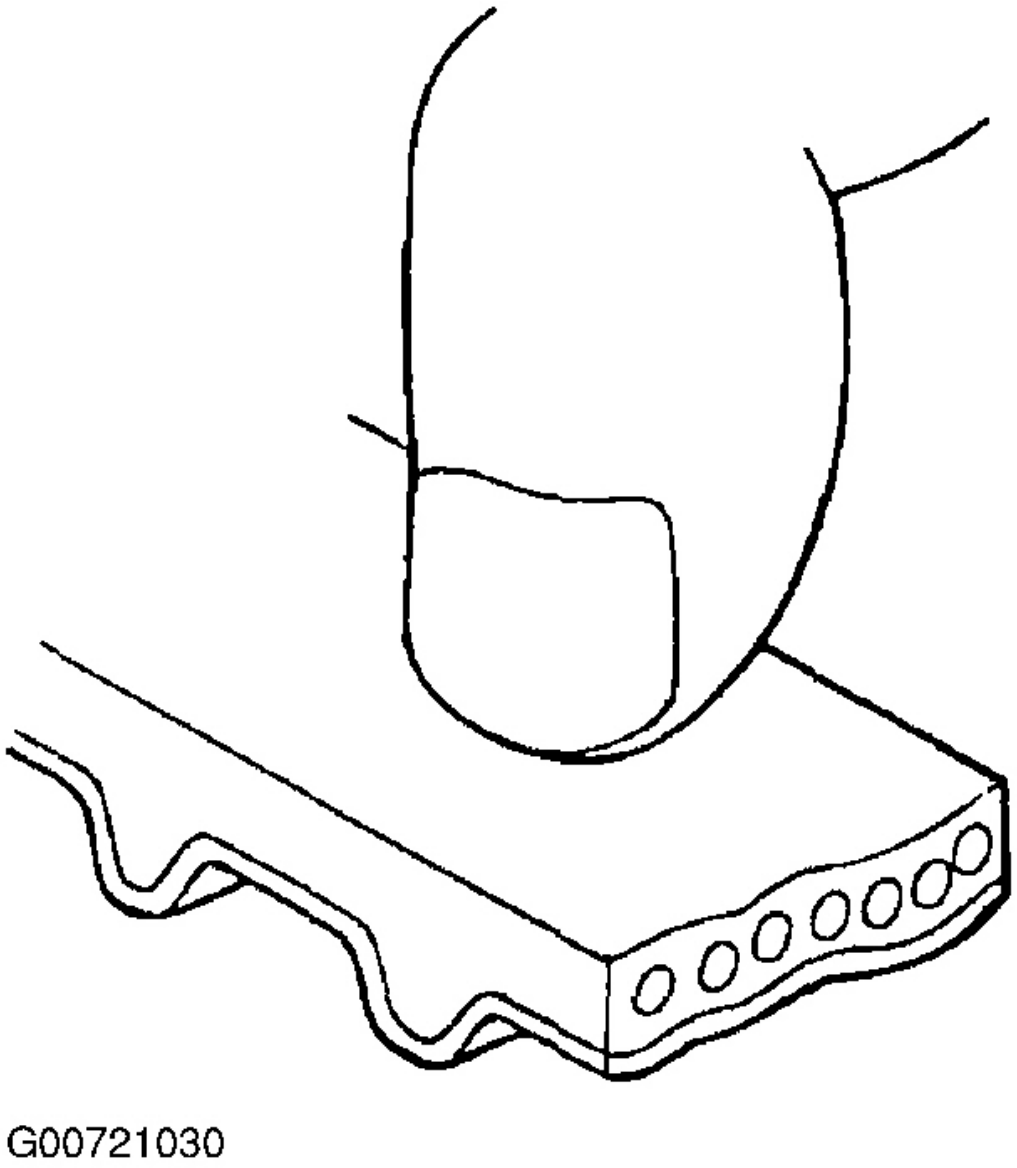


Fig. 48: Checking Timing Belt Hardness
Courtesy of HYUNDAI MOTOR CO.

2. Cracked back surface of rubber.

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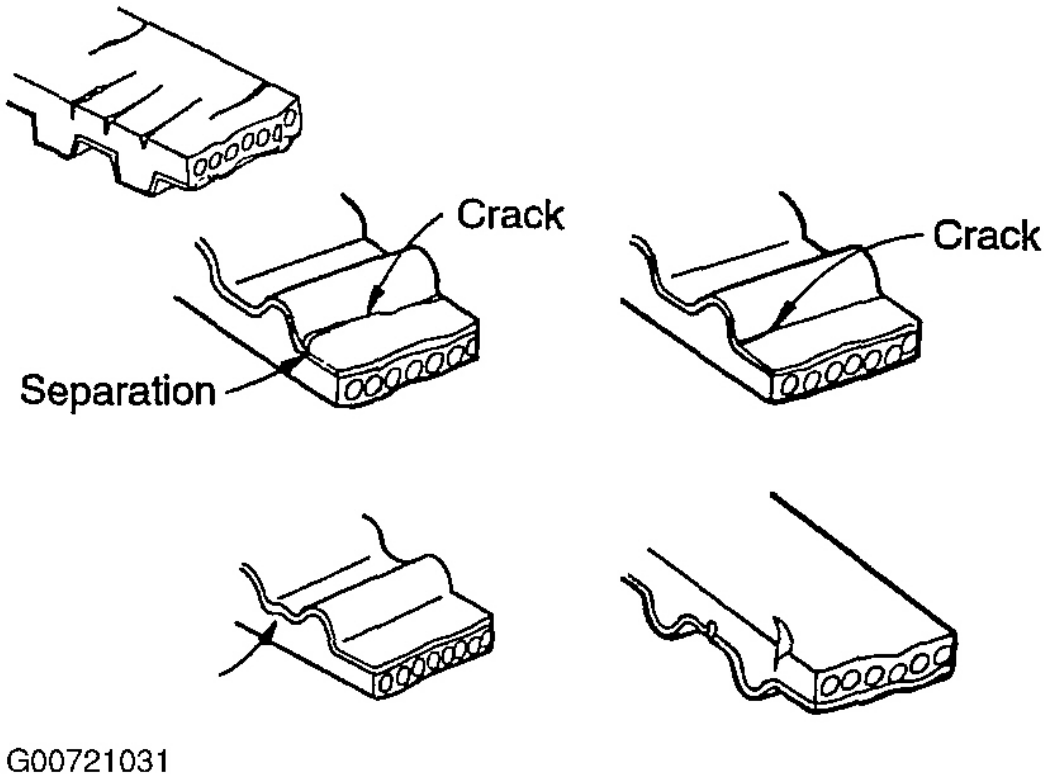


Fig. 49: Checking Timing Belt For Cracks
Courtesy of HYUNDAI MOTOR CO.

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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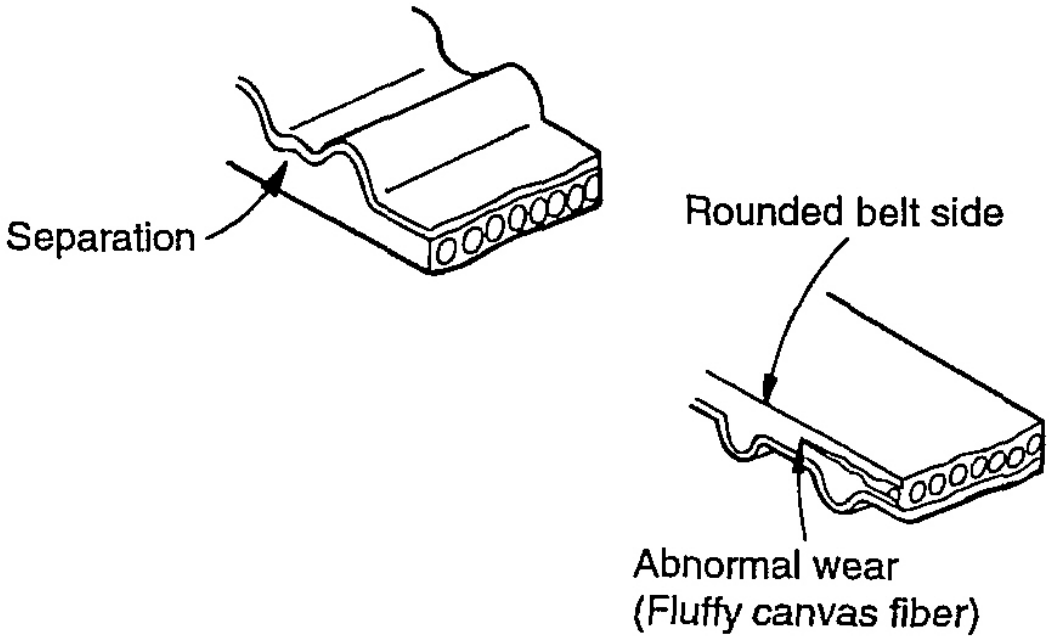


Fig. 50: Checking Timing Belt Condition
Courtesy of HYUNDAI MOTOR CO.

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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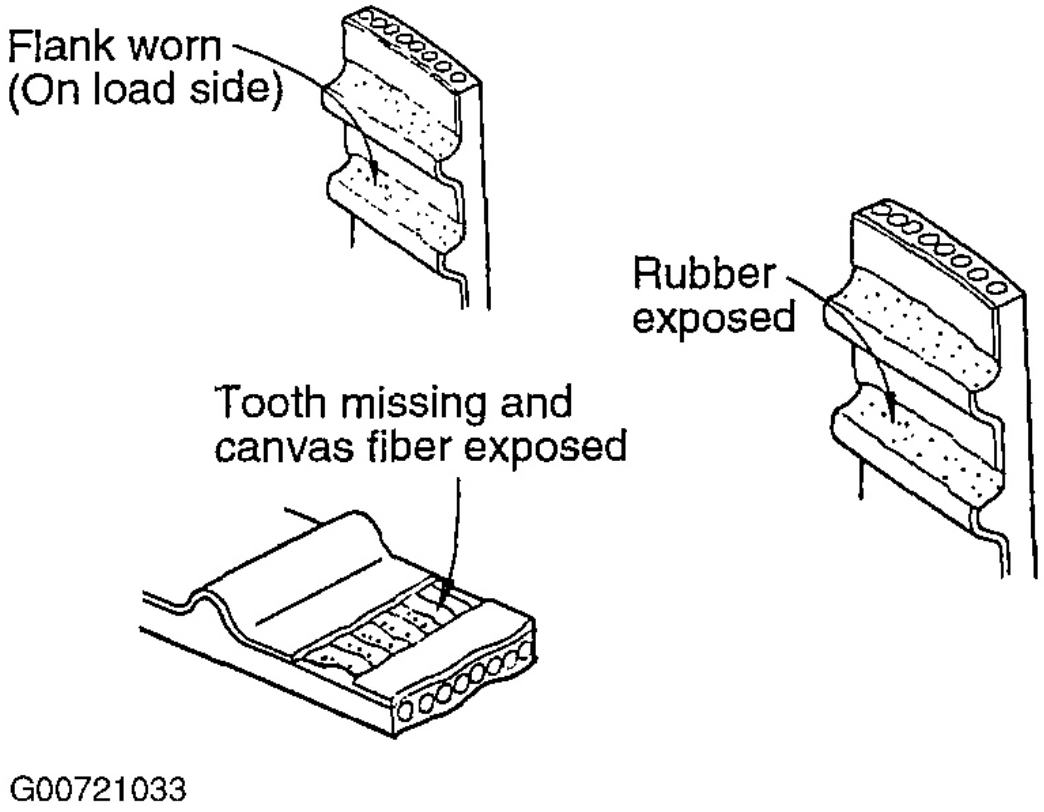


Fig. 51: Checking Timing Belt For Tooth Wear
Courtesy of HYUNDAI MOTOR CO.

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

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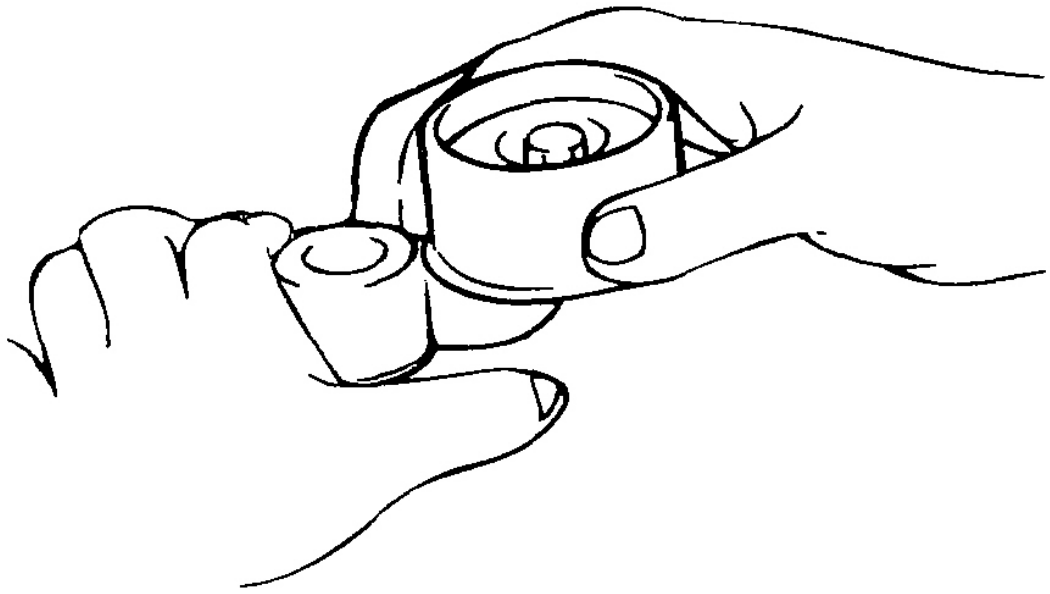


Fig. 52: Checking Timing Belt Tensioner Condition
Courtesy of HYUNDAI MOTOR CO.

COMPONENTS

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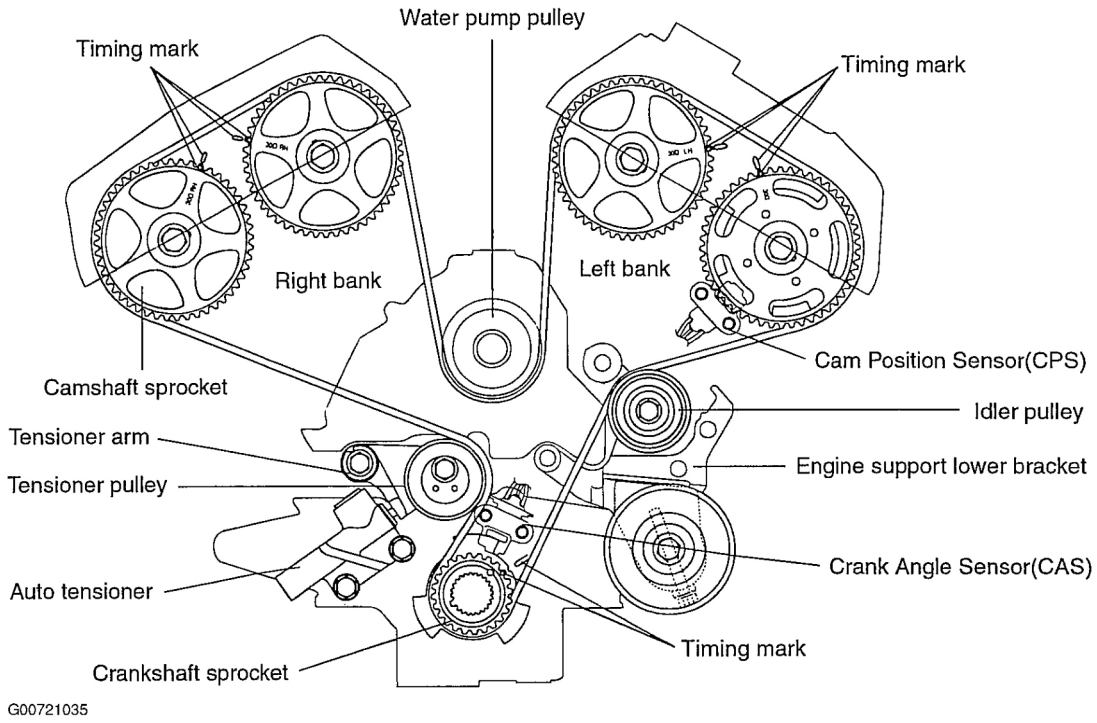


Fig. 53: Identifying Timing System Components & Timing Mark Alignment
Courtesy of HYUNDAI MOTOR CO.

INSTALLATION

The method of installing timing belt and auto tensioner.

1. Install idler pulley to engine support lower bracket.

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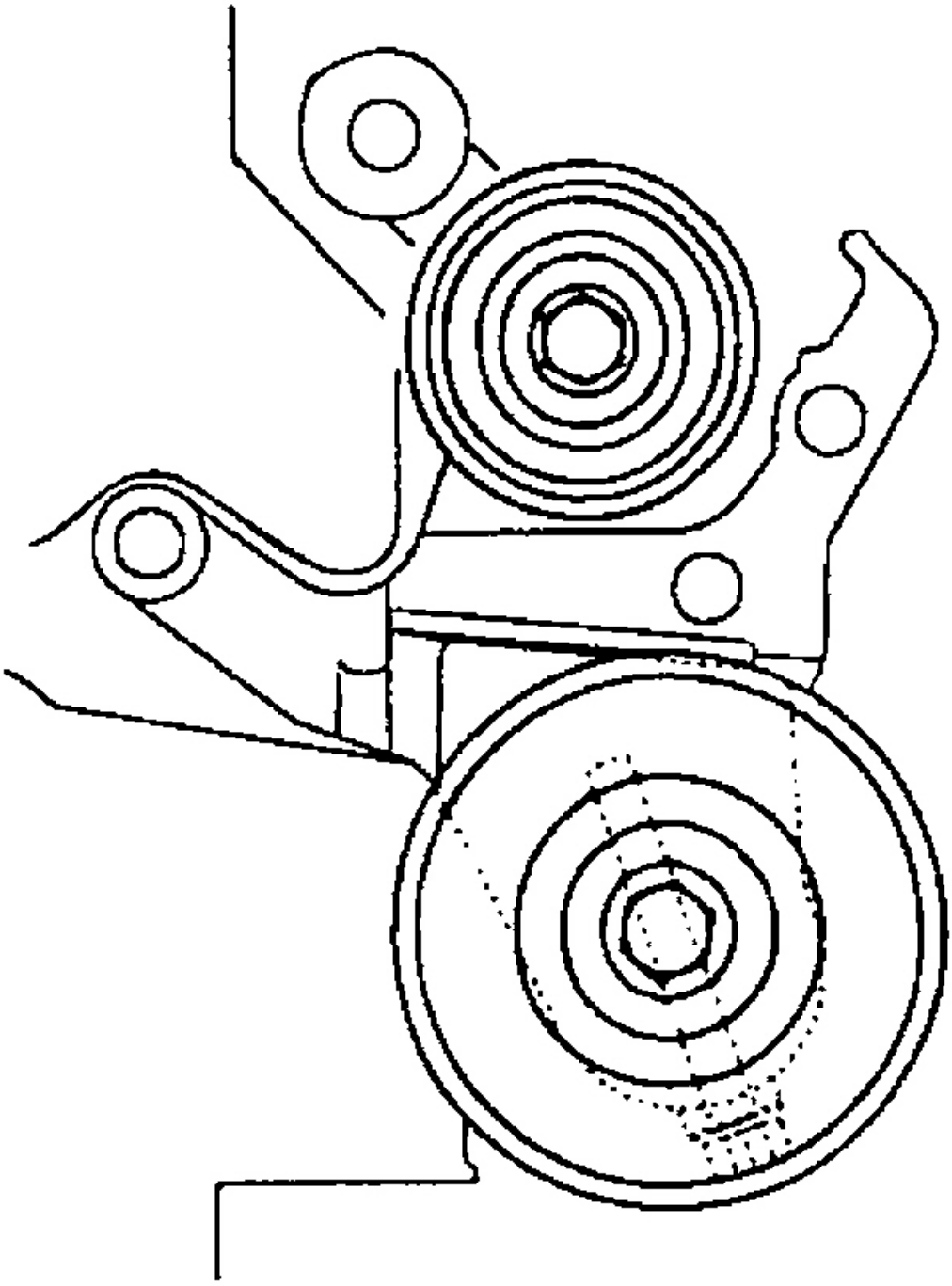


Fig. 54: Installing Idler Pulley To Engine Support Lower Bracket

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Courtesy of HYUNDAI MOTOR CO.

2. Install tensioner arm, shaft and plane washer to cylinder block.

   Tightening torque: 35 ~ 55 Nm (350 ~ 550 kg.cm)

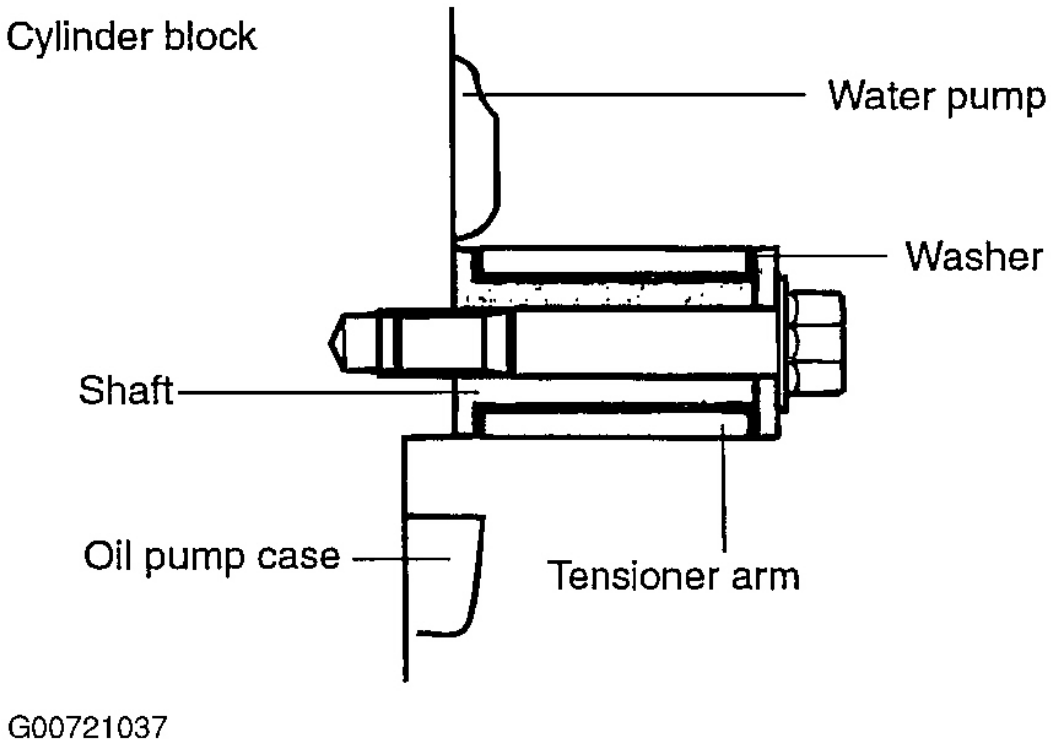


Fig. 55: Installing Tensioner Arm Shaft & Plane Washers
Courtesy of HYUNDAI MOTOR CO.

3. Install crankshaft sprocket and align the timing mark.

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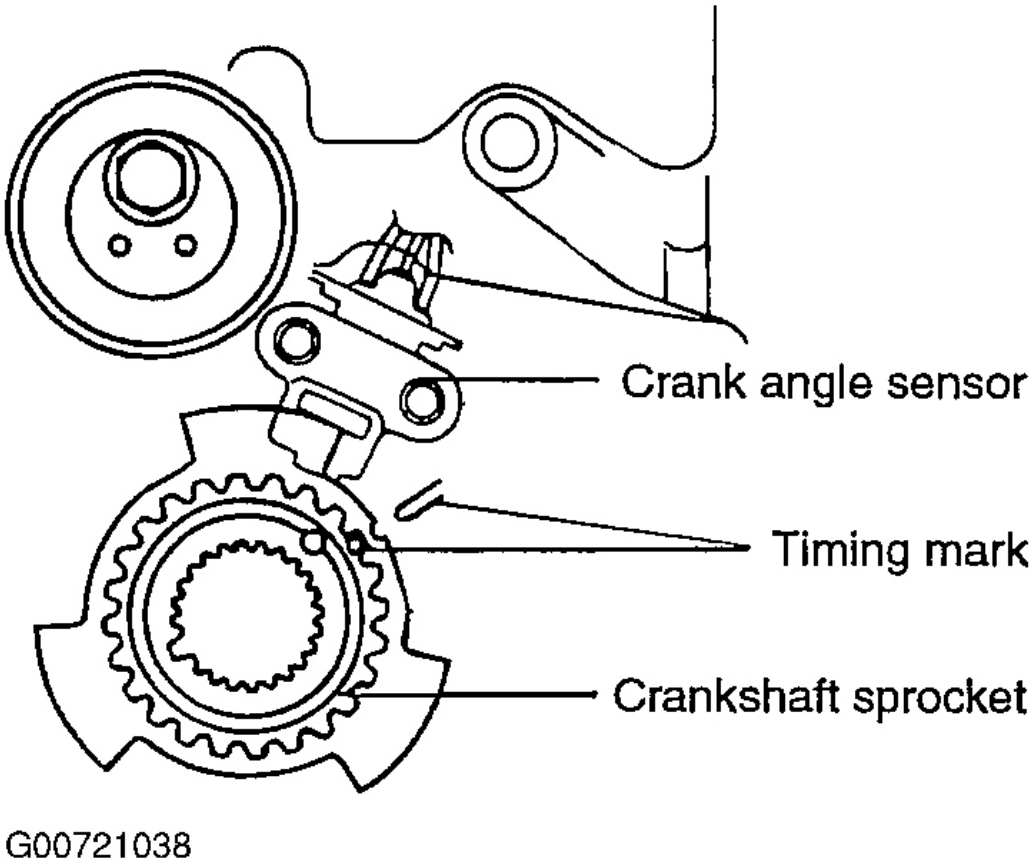


Fig. 56: Identifying Crankshaft Sprocket Timing Marks
Courtesy of HYUNDAI MOTOR CO.

CAUTION: Be careful not to bend crankshaft sensing blade.

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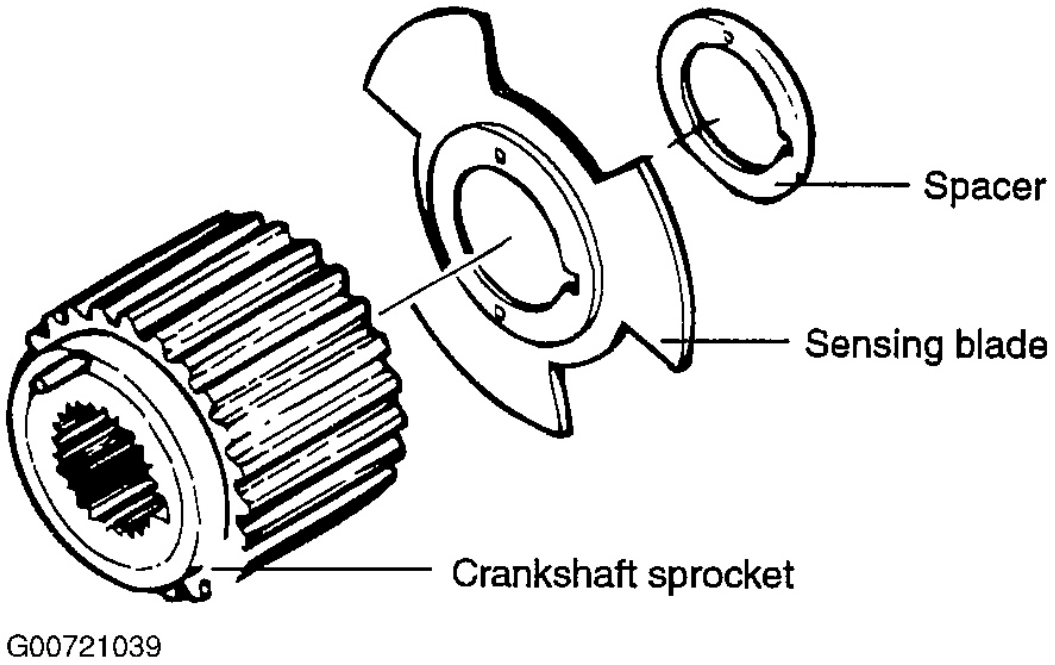


Fig. 57: Installing Crankshaft Sprocket, Sensing Blade & Spacer
Courtesy of HYUNDAI MOTOR CO.

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

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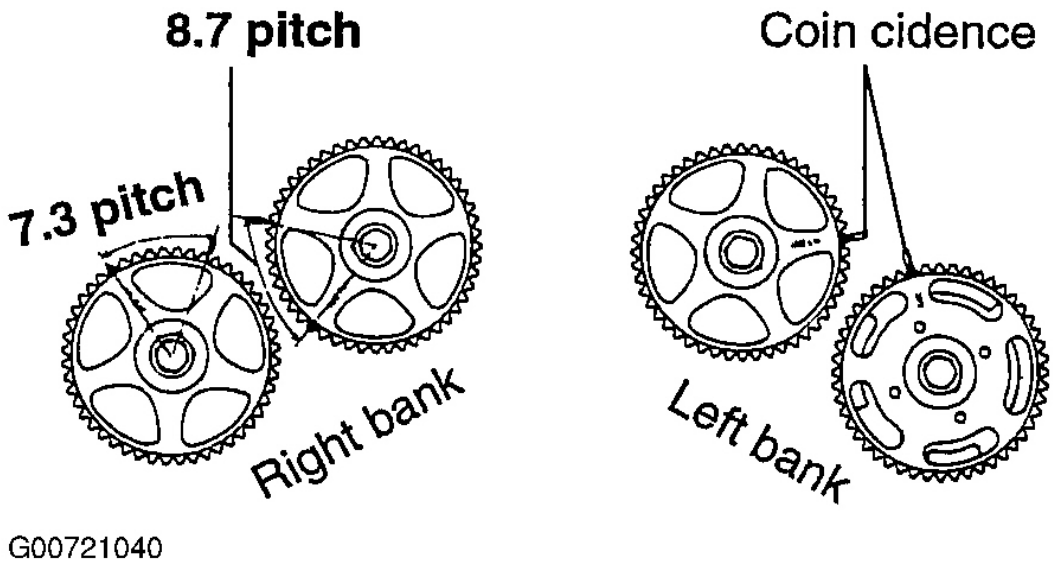


Fig. 58: Identifying Initial Camshaft Installation Positions
Courtesy of HYUNDAI MOTOR CO.

5. Install auto tensioner to oil pump case.

NOTE: If the auto tensioner rod is in its fully extended position, reset it as follows.

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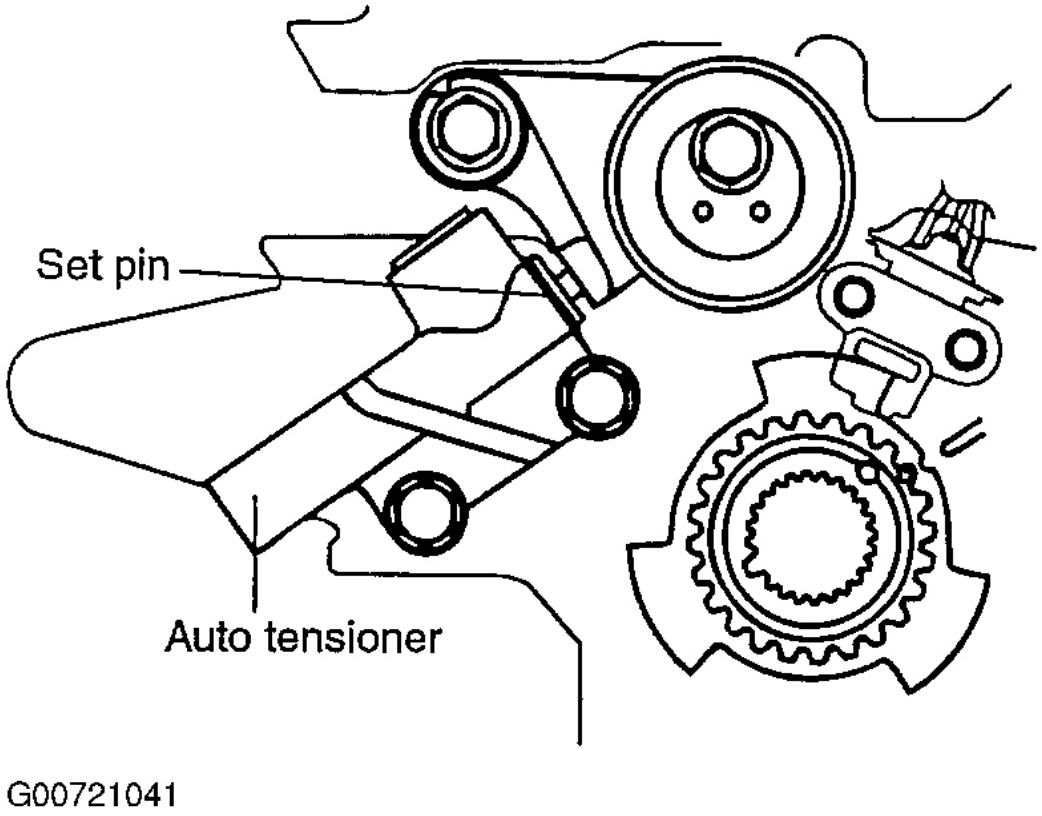


Fig. 59: Installing Timing Belt Auto-Tensioner To Oil Pump Case
Courtesy of HYUNDAI MOTOR CO.

1. Clamp it in a vise equipped with soft jaws, in a level position. Use a plain washer if there is a plug at the bottom of the auto tensioner.
2. Compress the rod slowly with the vise until the set hole in the rod is aligned with set hole in the cylinder.

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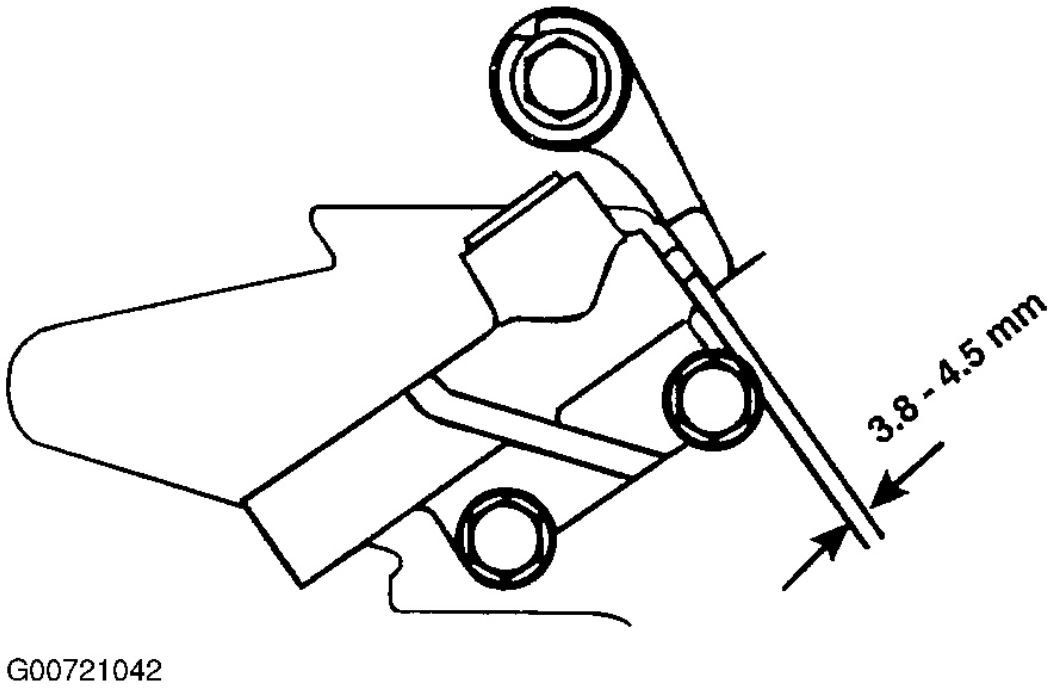


Fig. 60: Aligning Timing Belt Tensioner Set Hole In Rod With Set Hole In Tensioner Body
Courtesy of HYUNDAI MOTOR CO.

3. Insert a set pin through the auto tensioner body and rod.

CAUTION: Leave the set pin installed in the auto tensioner.

6. Align the timing marks of each sprocket and install the timing belt in this order.

   Crankshaft sprocket --> Idler pulley --> Exhaust camshaft sprocket (LH) --> Intake camshaft sprocket (RH) --> Exhaust camshaft sprocket (RH) --> Tensioner pulley.

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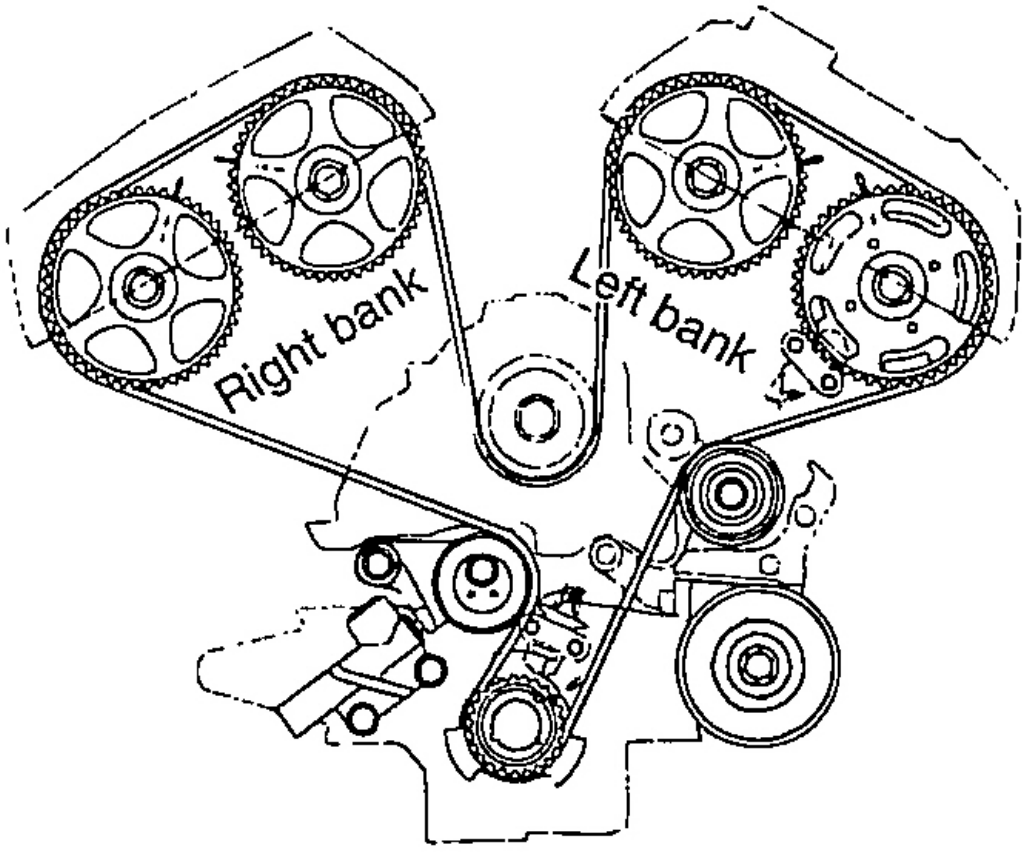


Fig. 61: Installing Timing Belt To Pulleys & Sprockets
Courtesy of HYUNDAI MOTOR CO.

NOTE:

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

7. After installing the timing belt, reconfirm the timing mark.
8. Pull out the set pin of auto tensioner.

NOTE:

1. **Rotate the crankshaft 2 rotation clockwise and measure the projected load of auto tensioner in the TDC (# 1 compression stroke) after 5 minutes.**
2. **Check the projected length is 3.8 ~ 4.5 mm.**

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3. Check again if the timing marks of each sprocket is with in specified position.

9. Install the engine support bracket.
10. Install the timing belt cover.
11. Install the alternator and drive belt.
12. Install the engine mounting bracket.
13. Install the side cover.
14. Install the wheel of passenger side.

CYLINDER HEAD ASSEMBLY

CYLINDER HEAD

COMPONENTS

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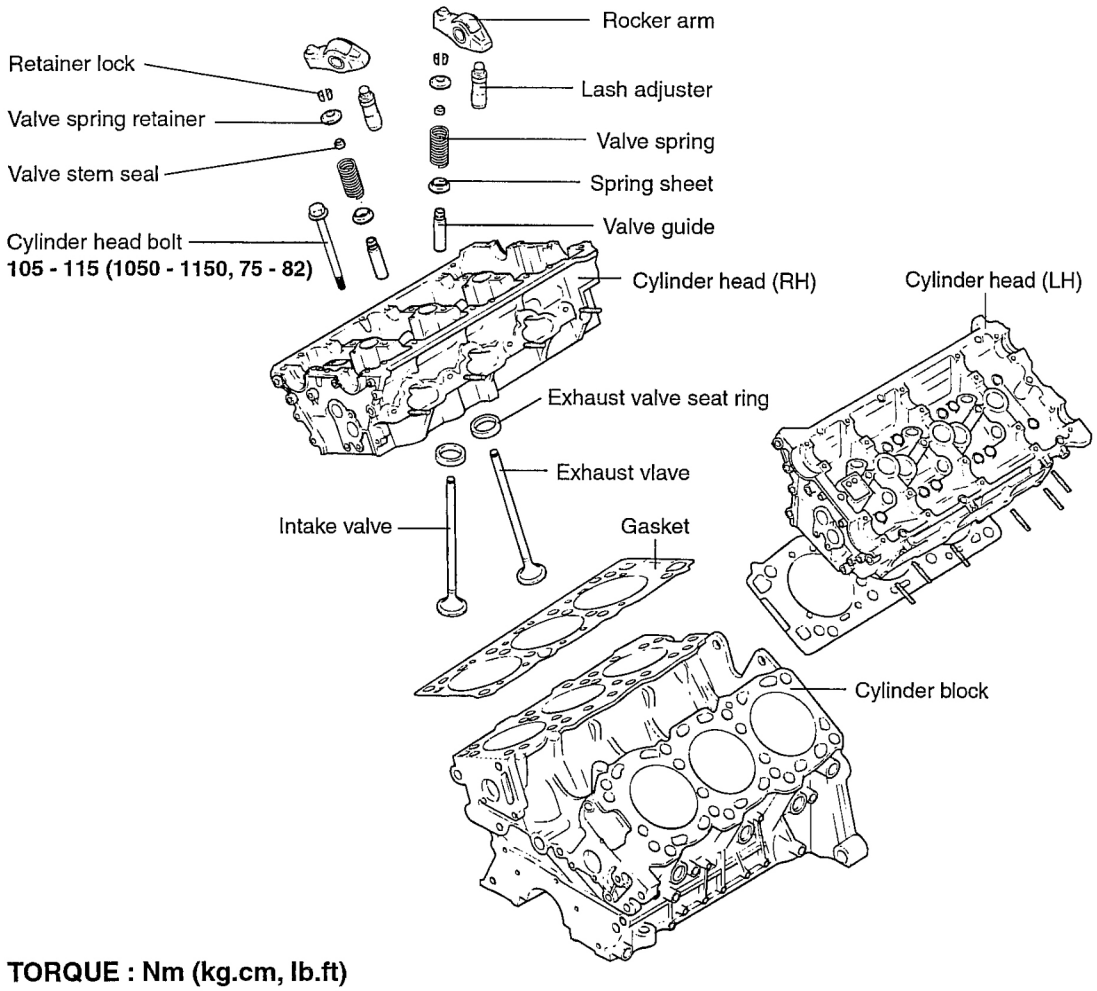


Fig. 62: Identifying Cylinder Head Components
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY

1. Remove the engine. For additional information, refer to**ENGINE AND TRANSAXLE ASSEMBLY**.
2. For additional information, refer to **INTAKE MANIFOLD**.
3. Remove the cables from the spark plugs. The cables should be removed by holding the boot portion.
4. Remove the ignition coil.
5. Remove the upper and lower timing belt cover.

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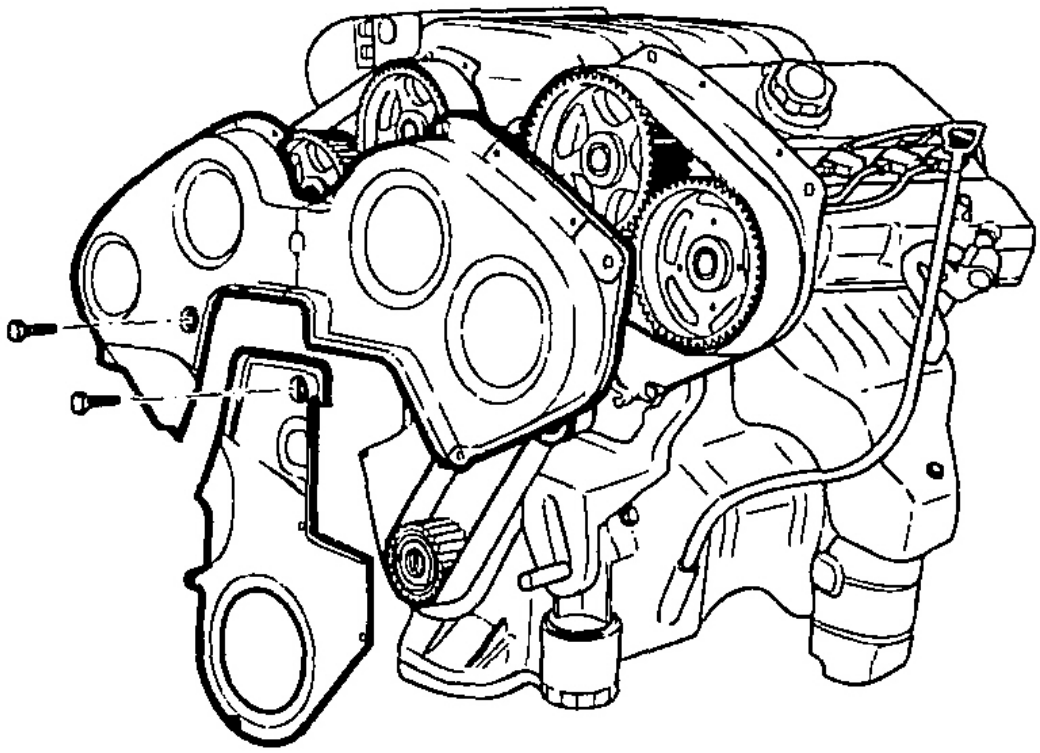


Fig. 63: Removing Upper & Lower Timing Belt Covers
Courtesy of HYUNDAI MOTOR CO.

6. Remove the timing belt and camshaft sprockets. For additional information, refer to **TIMING BELT**.

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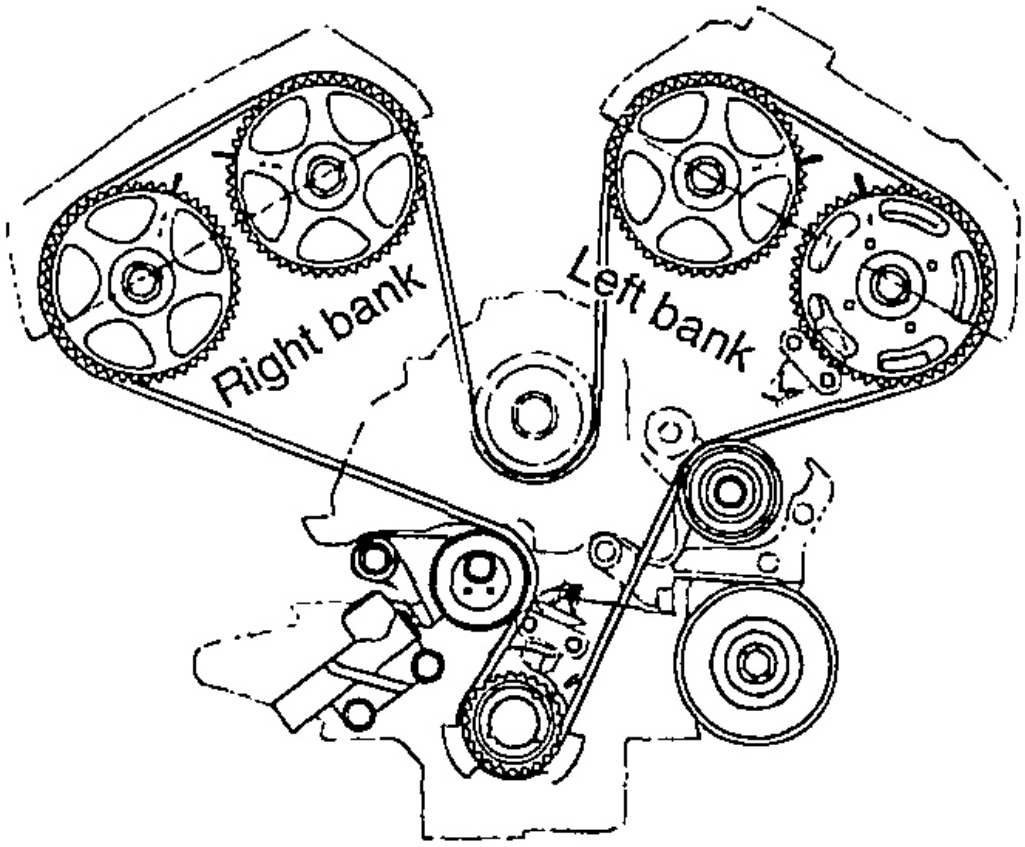
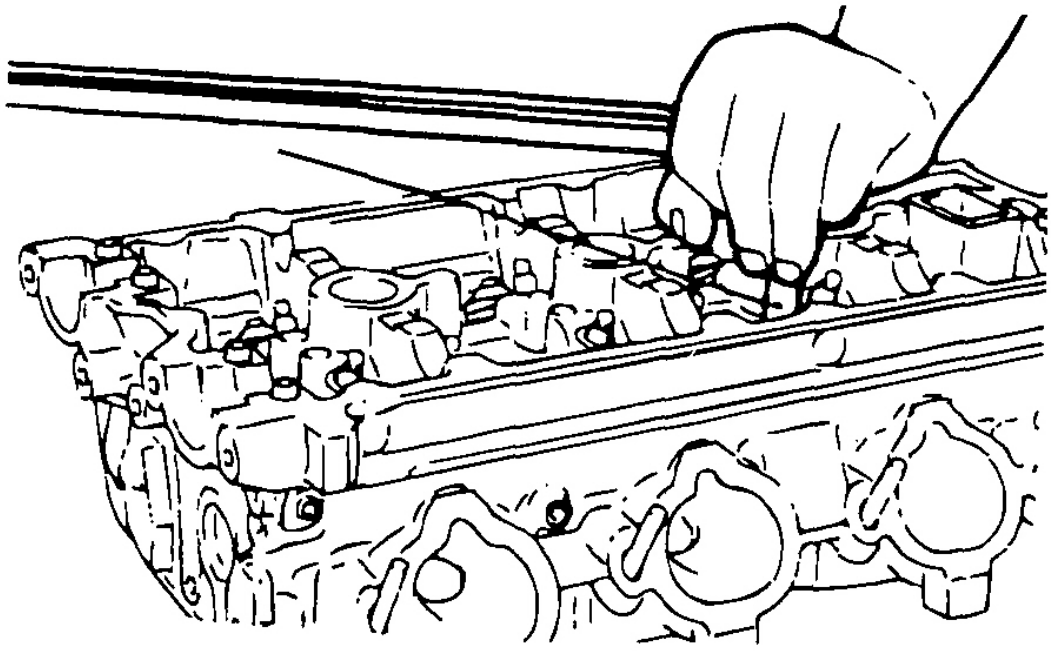


Fig. 64: Removing Timing Belt
Courtesy of HYUNDAI MOTOR CO.

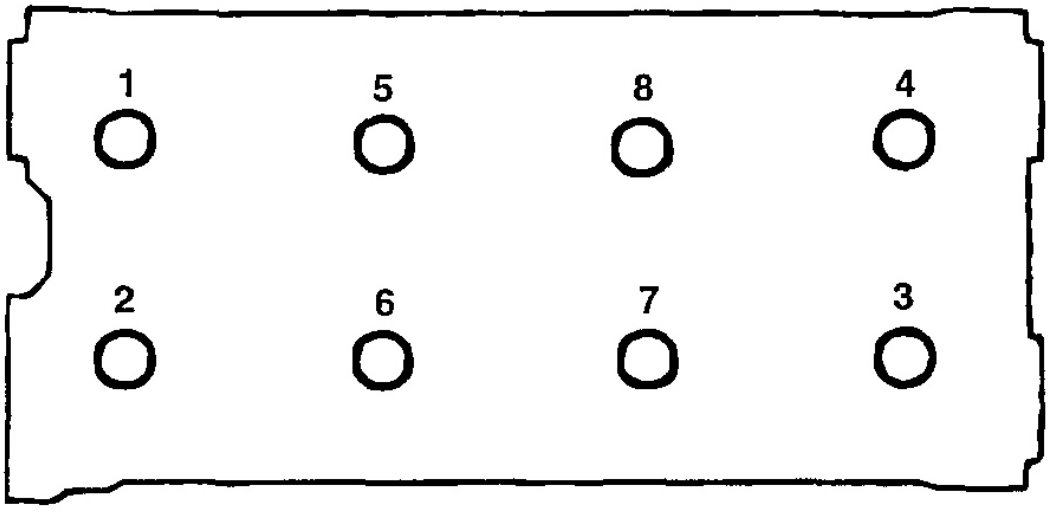
7. Remove the heat protector and exhaust manifold assembly.
8. Remove the coolant pump pulley and head cover.
9. Remove the intake and exhaust camshaft. For additional information, refer to **CAM SHAFT**.
10. Remove the cylinder head assembly. The cylinder head bolts should be removed using the 12 mm socket, in two or three steps.

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Fig. 65: Removing Cylinder Head Bolts
Courtesy of HYUNDAI MOTOR CO.



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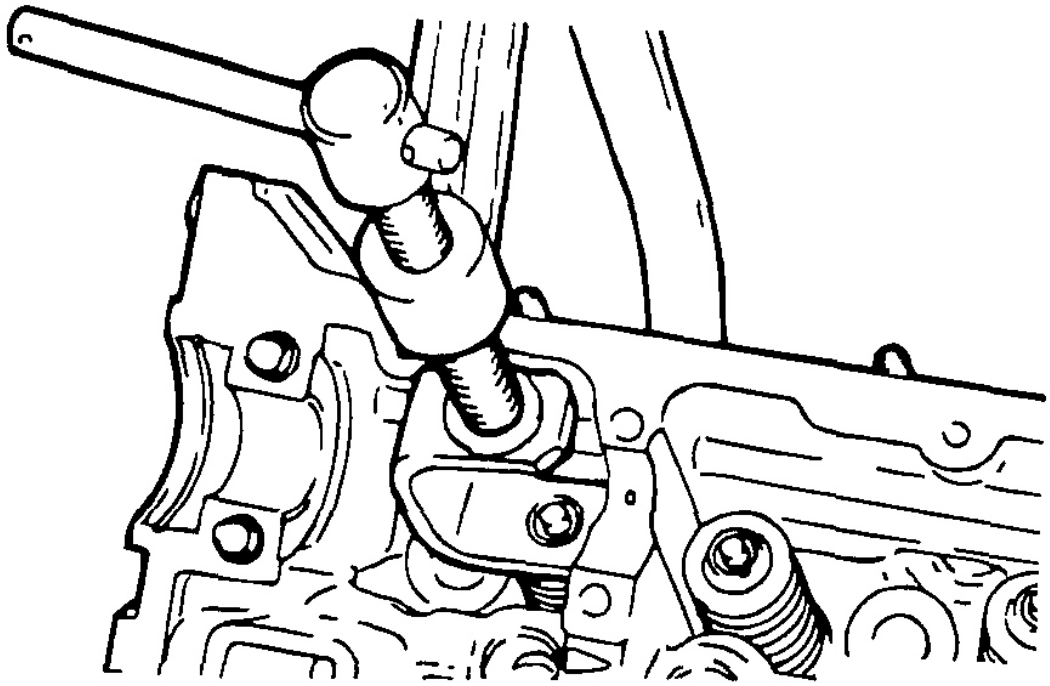
Fig. 66: Cylinder Head Bolt Removal Sequence
Courtesy of HYUNDAI MOTOR CO.

11. 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.



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Fig. 67: Compressing Valve Springs & Removing Retainers
Courtesy of HYUNDAI MOTOR CO.

3. Remove the valve spring, valve spring retainer valve spring sheet and valve.

INSPECTION

CYLINDER HEAD

1. Remove scale, sealing compound and carbon deposits. After cleaning oil passages, apply compressed air

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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.)

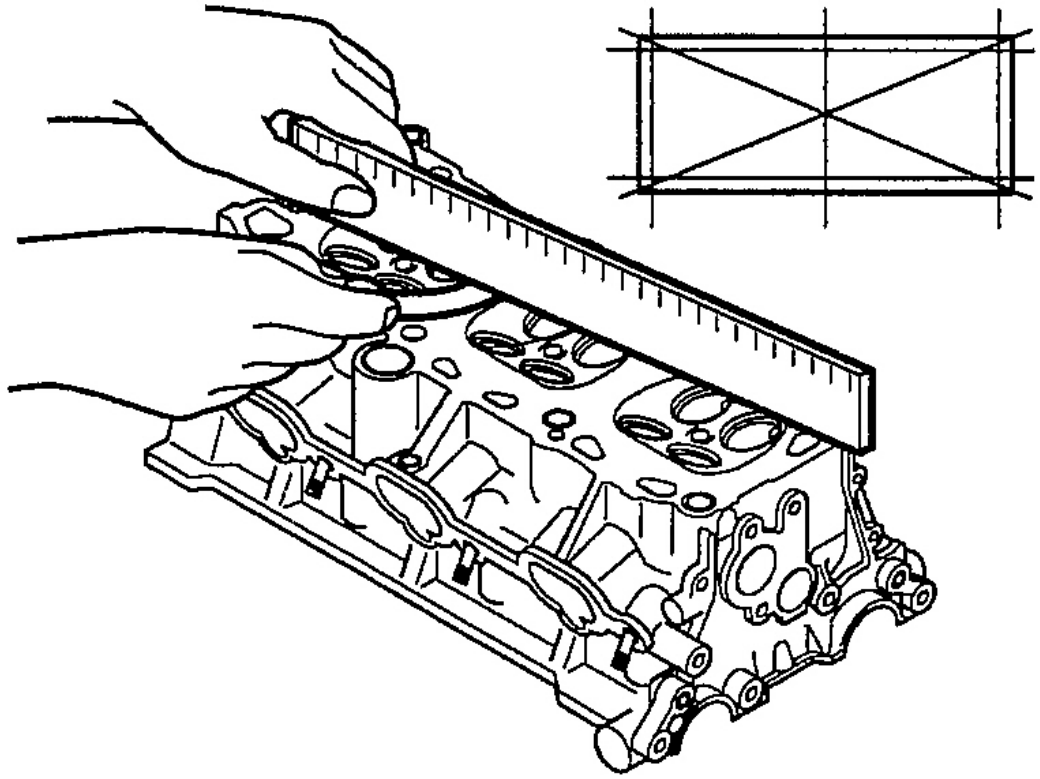


Fig. 68: Checking Cylinder Head Surface For Flatness
Courtesy of HYUNDAI MOTOR CO.

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.

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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.)

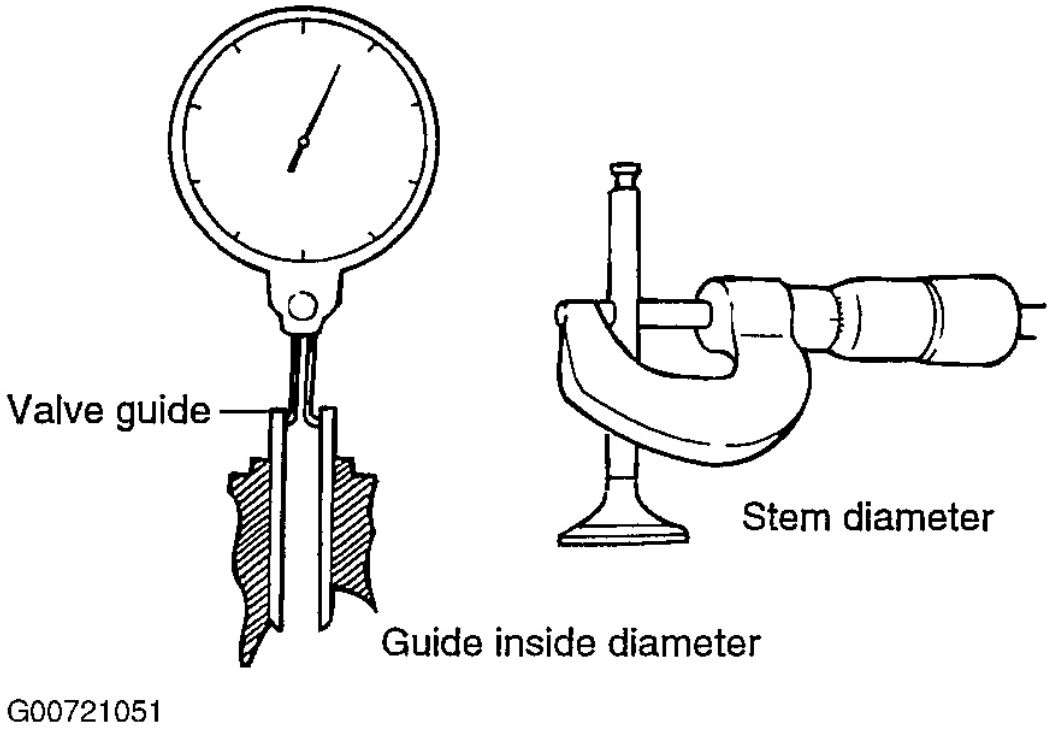
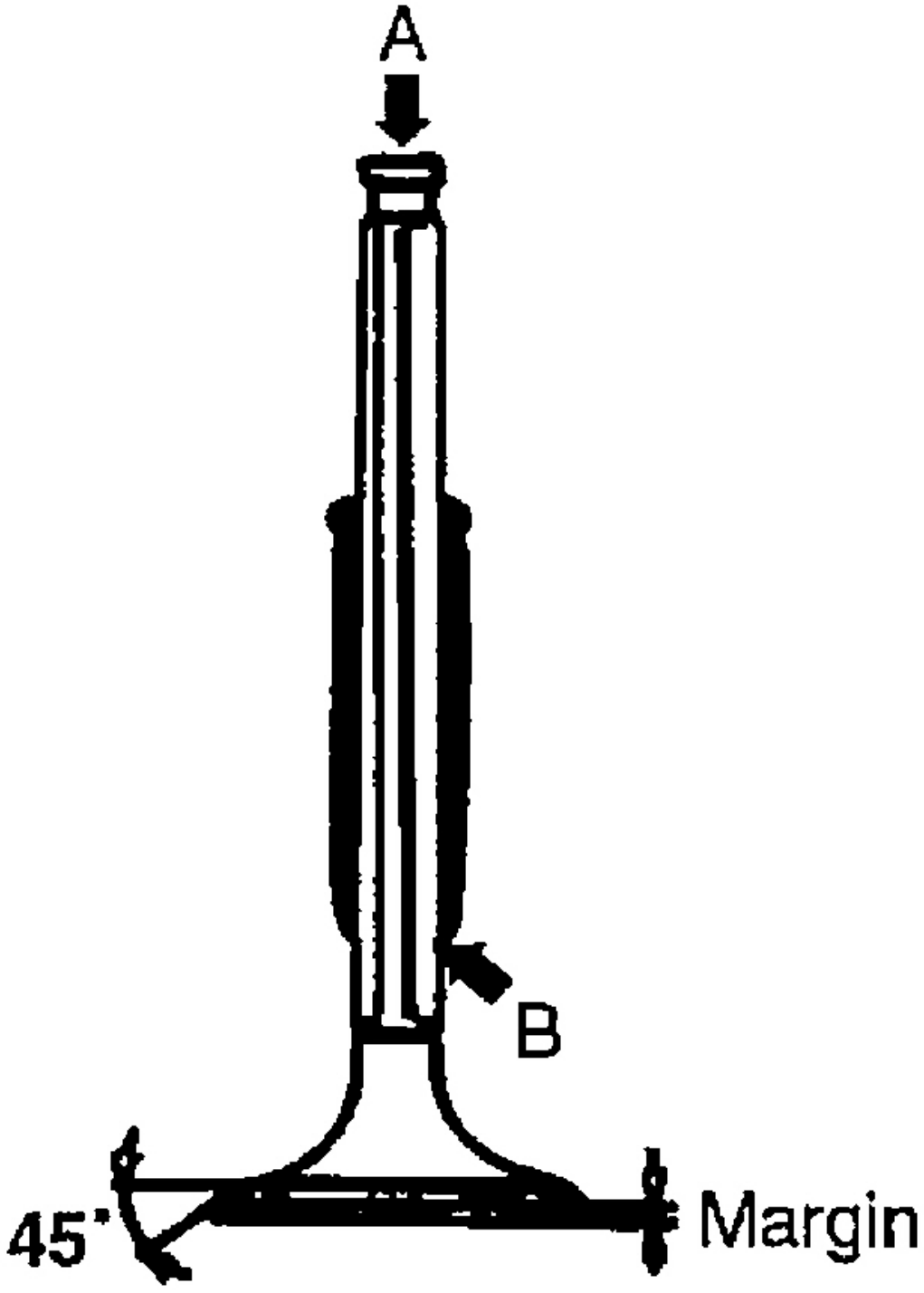


Fig. 69: Measuring Valve Stem Clearance
Courtesy of HYUNDAI MOTOR CO.

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.

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Fig. 70: Inspecting Valve For Straightness, Wear & Damage
Courtesy of HYUNDAI MOTOR CO.

3. Replace the valve if the width of the margin (thickness of the valve head) is less than the minimum specified.

Valve margin

Standard value

Intake: 1.0 mm (0.0394 in.)

Exhaust: 1.3 mm (0.0512 in.)

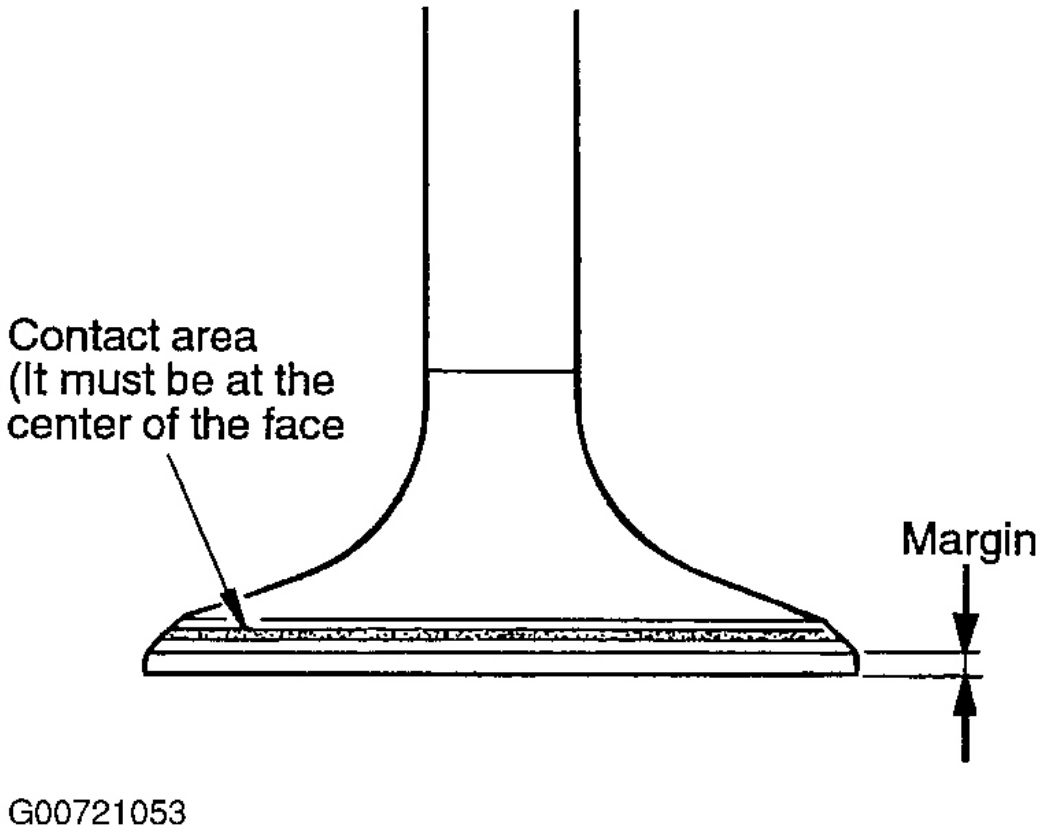


Fig. 71: Inspecting Valve Margin
Courtesy of HYUNDAI MOTOR CO.

VALVE SPRING

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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.)

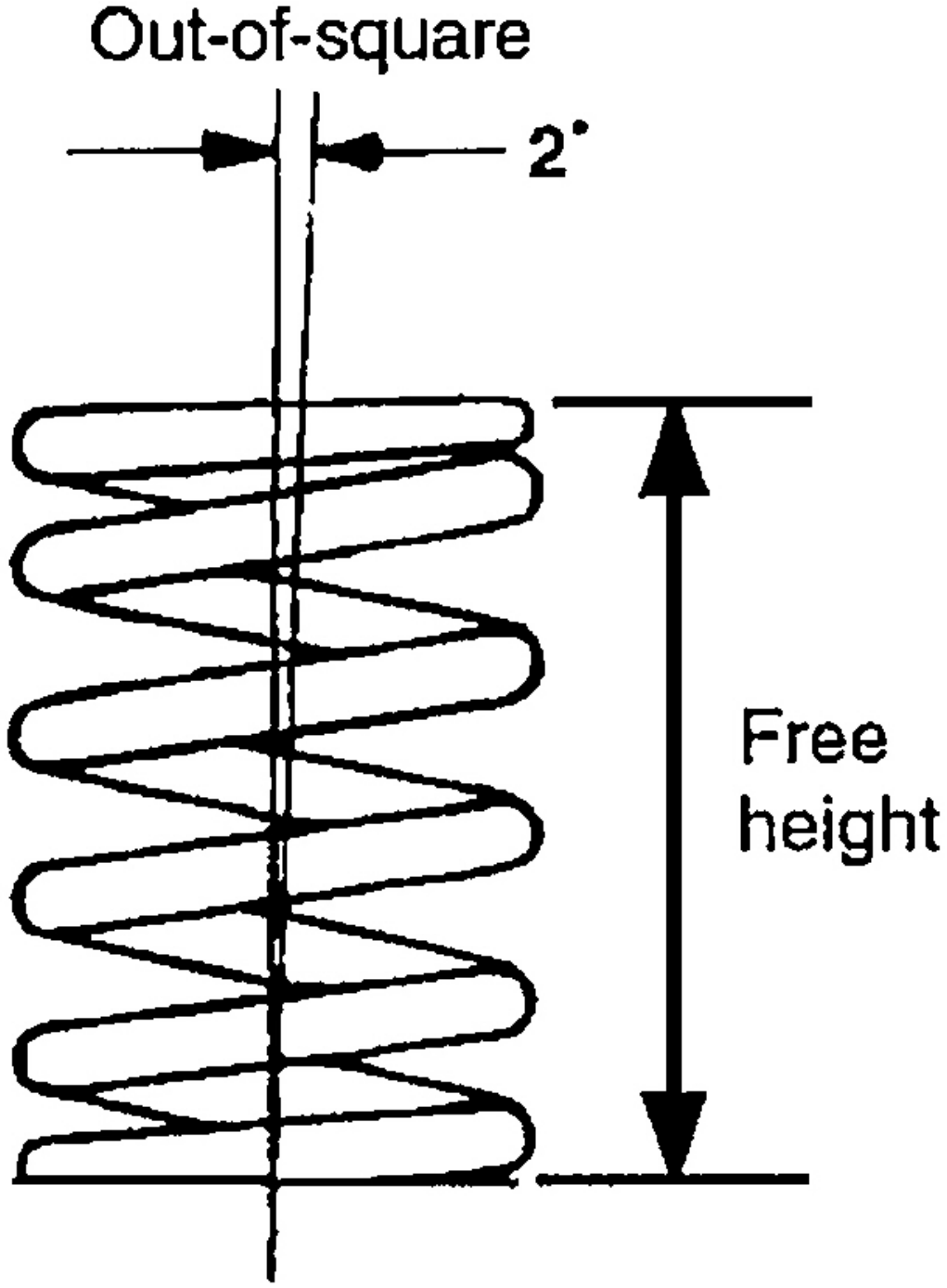
Out - of - square: Max. 2°

Service limit

Free height: .45.4 mm (1.787 in.)

Out - of - square: Max. 4°

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Fig. 72: Checking Valve Spring Squareness & Free Height
Courtesy of HYUNDAI MOTOR CO.

REPLACING VALVE GUIDE

1. Using the special tool (09222-22000 B), 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.

   VALVE GUIDE OVERSIZES

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)

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Fig. 73: Oversized Valve Guide Table
Courtesy of HYUNDAI MOTOR CO.

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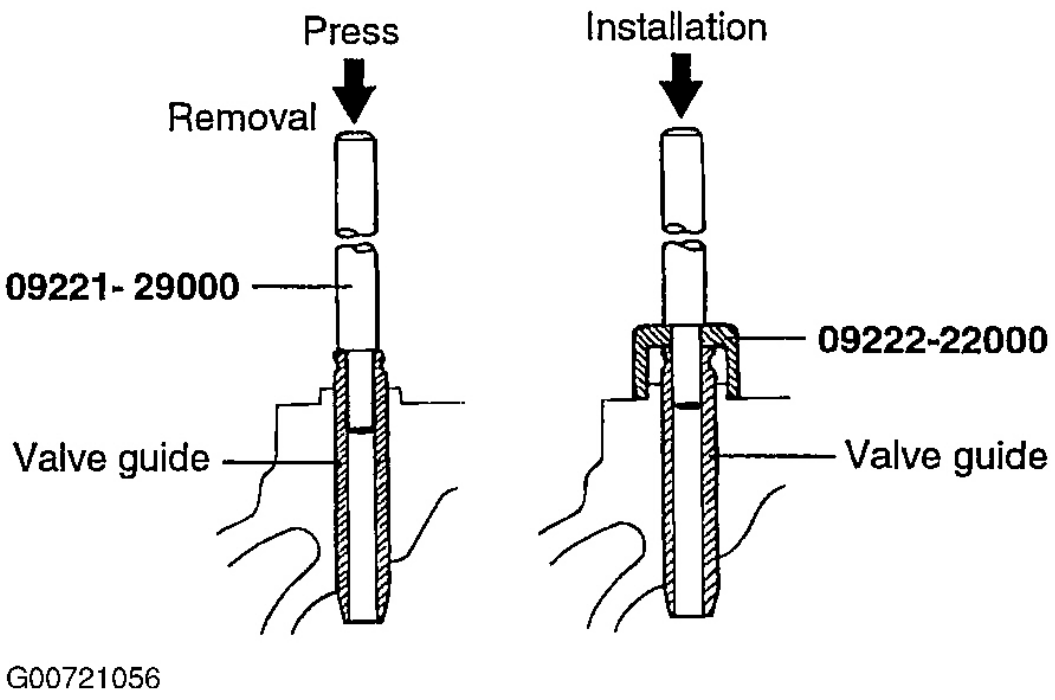


Fig. 74: Press Fitting Valve Guide Into Position
Courtesy of HYUNDAI MOTOR CO.

3. Using the special tool (09221-29000(A), 09222-22000(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.

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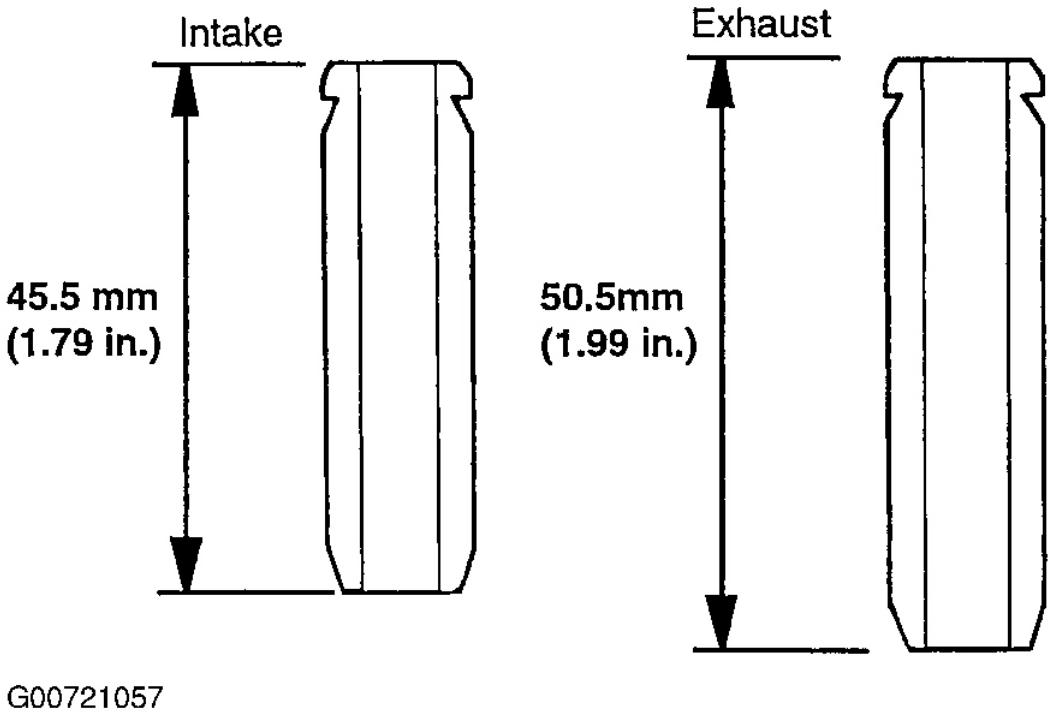


Fig. 75: Identifying Exhaust & Intake Valve Guides
Courtesy of HYUNDAI MOTOR CO.

REPLACING VALVE SEAT RING

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

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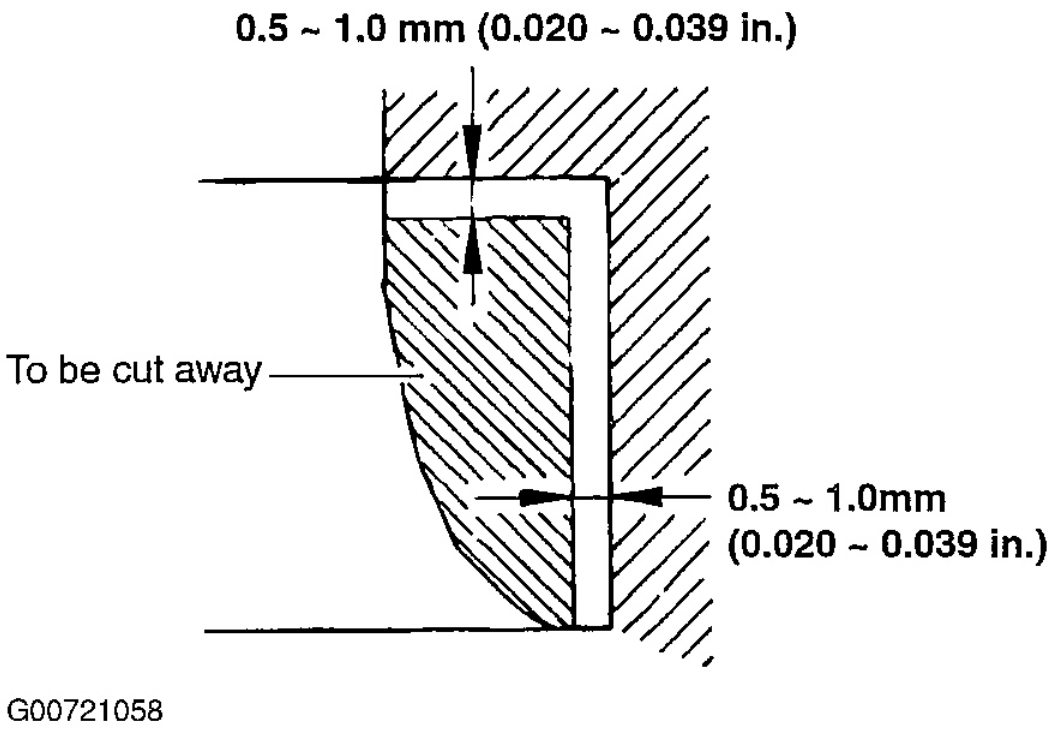


Fig. 76: Identifying Area To Be Cut Away For Valve Seat Ring Replacement
Courtesy of HYUNDAI MOTOR CO.

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

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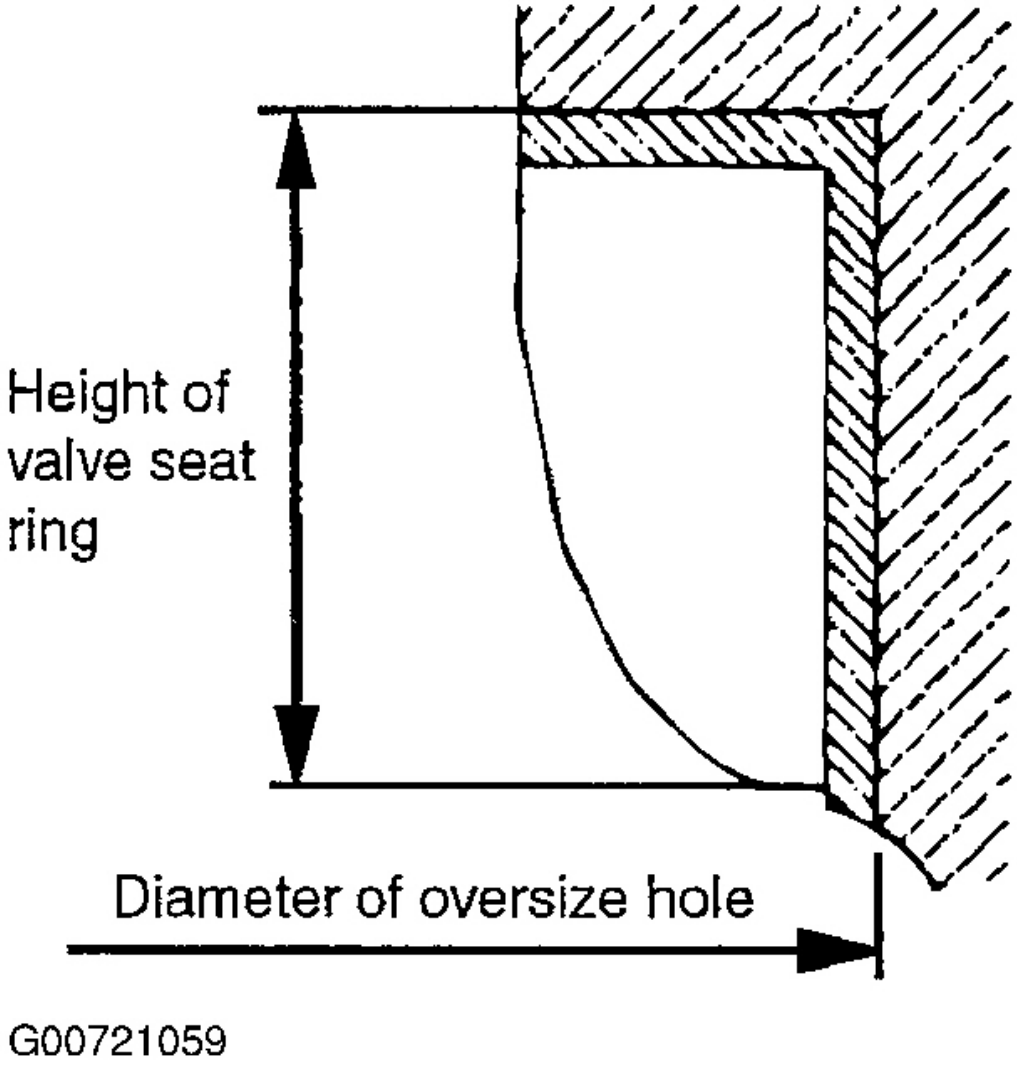


Fig. 77: Matching Valve Seat Ring Replacement To Hole Size
Courtesy of HYUNDAI MOTOR CO.

VALVE SEAT RING OVERSIZES

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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. 0.6 (0.024) O.S.	30 60	7.9 ~ 8.1 (0.311 ~ 0.319) 8.2 ~ 8.4 (0.323 ~ 0.331)	36.300 ~ 36.325 (1.429 ~ 1.430) 36.600 ~ 36.625 (1.441 ~ 1.442)
Exhaust valve seat ring	0.3 (0.012) O.S. 0.6 (0.024) O.S.	30 60	7.9 ~ 8.1 (0.311 ~ 0.319) 8.2 ~ 8.4 (0.323 ~ 0.331)	33.30 ~ 33.325 (1.311 ~ 1.312) 33.600 ~ 33.625 (1.323 ~ 1.324)

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Fig. 78: Valve Seat Ring Oversize Table
Courtesy of HYUNDAI MOTOR CO.

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 of from the valve guides.**

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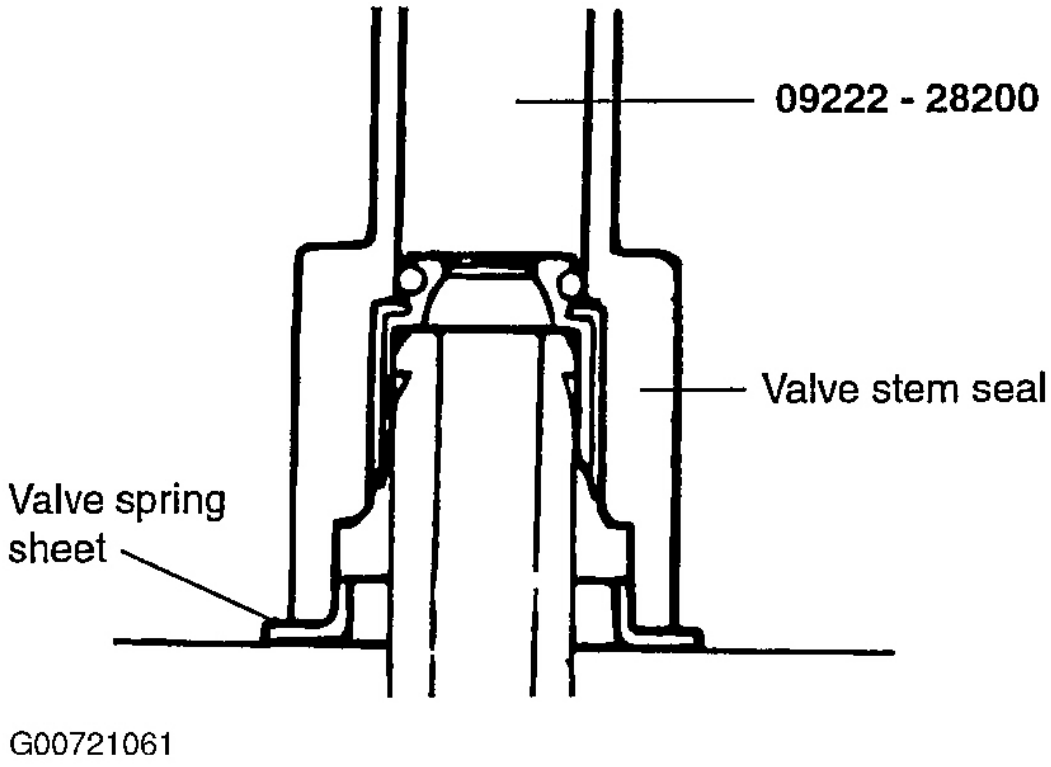


Fig. 79: Identifying Valve Stem Seal
Courtesy of HYUNDAI MOTOR CO.

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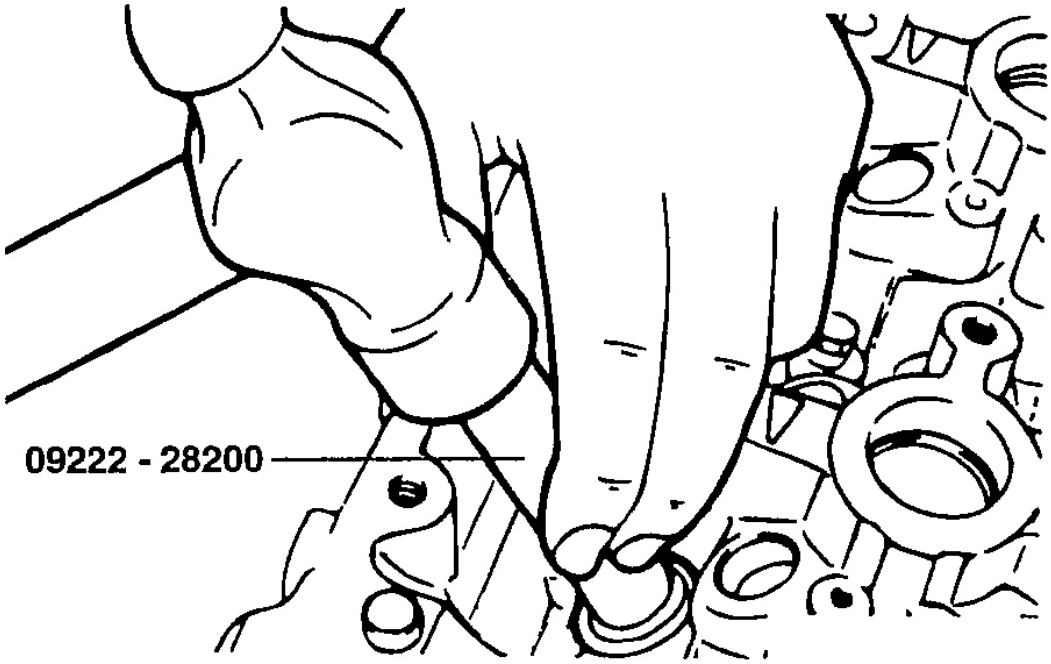


Fig. 80: Installing Valve Spring Seal
Courtesy of HYUNDAI MOTOR CO.

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.

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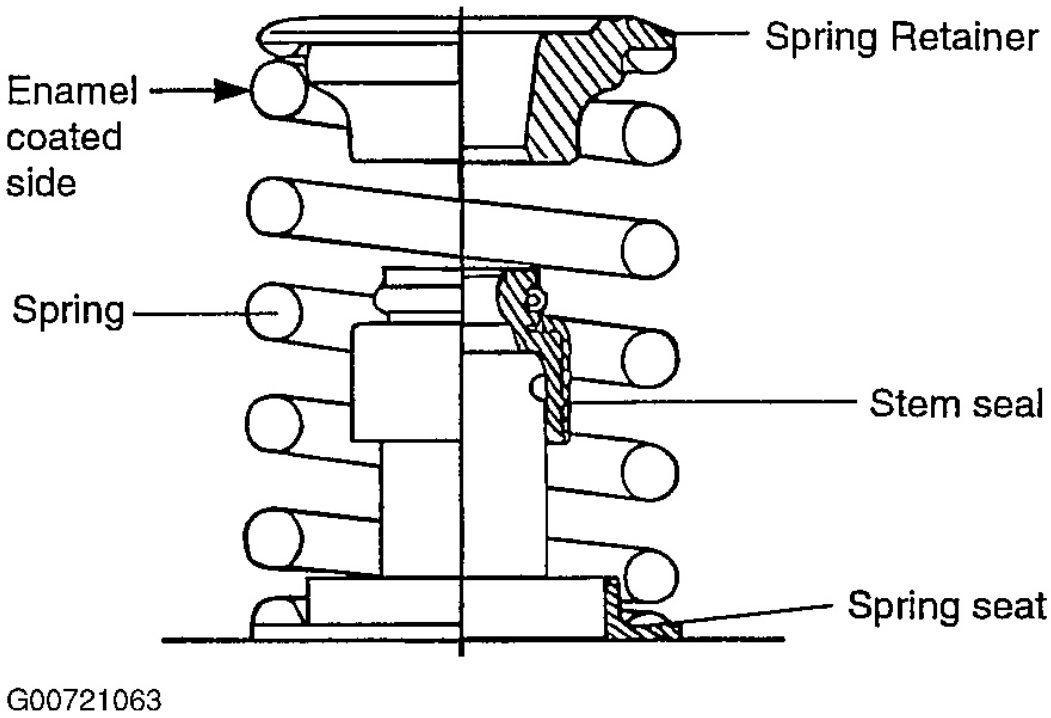


Fig. 81: Identifying Valve Spring Positioning
Courtesy of HYUNDAI MOTOR CO.

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.

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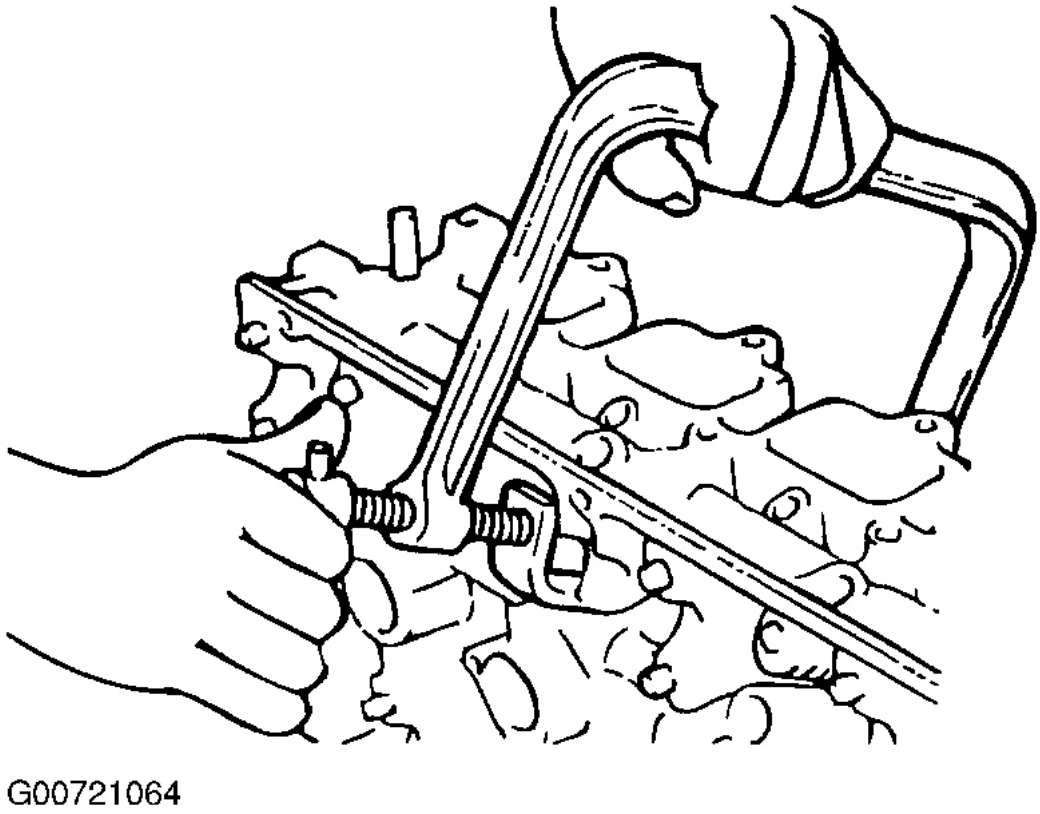
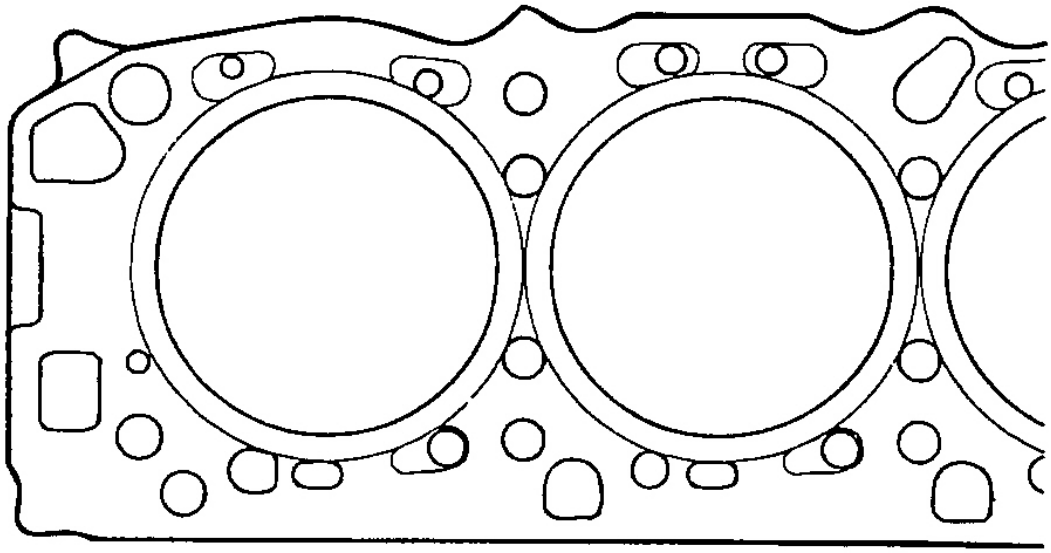


Fig. 82: Installing Valve Assembly
Courtesy of HYUNDAI MOTOR CO.

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.

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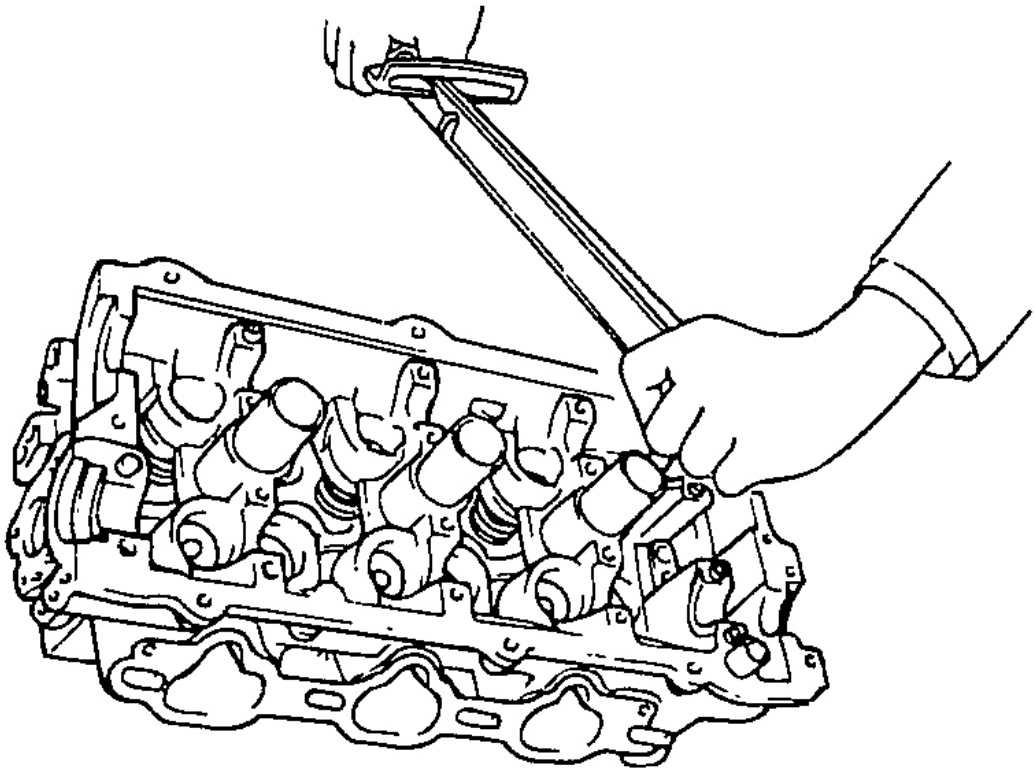


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Fig. 83: Identifying Cylinder Head Gasket
Courtesy of HYUNDAI MOTOR CO.

9. Tighten the cylinder head bolts in the sequence shown in the illustration with a torque wrench.

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Fig. 84: Tightening Cylinder Head Bolts
Courtesy of HYUNDAI MOTOR CO.

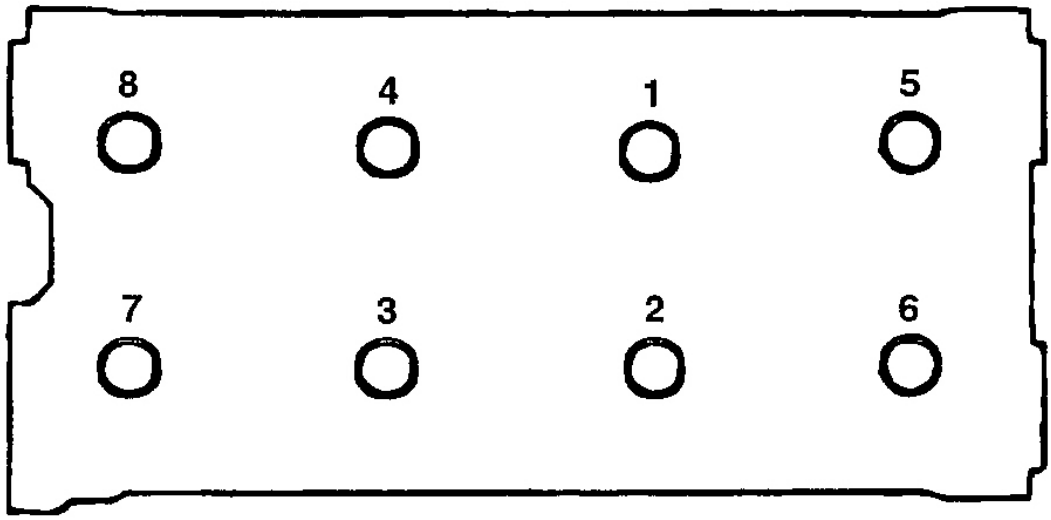
10. Tighten the cylinder head bolts. Starting at top center, tighten all cylinder head bolts in sequence as shown in the illustration, using the 12 mm socket.

Tightening procedure

Cylinder head bolt:

105 ~ 115 Nm (1050 ~ 1150 kg.cm, 75 ~ 82 lb. ft)

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Fig. 85: Cylinder Head Bolt Tightening Sequence
Courtesy of HYUNDAI MOTOR CO.

MAIN MOVING SYSTEM

CAM SHAFT

COMPONENTS

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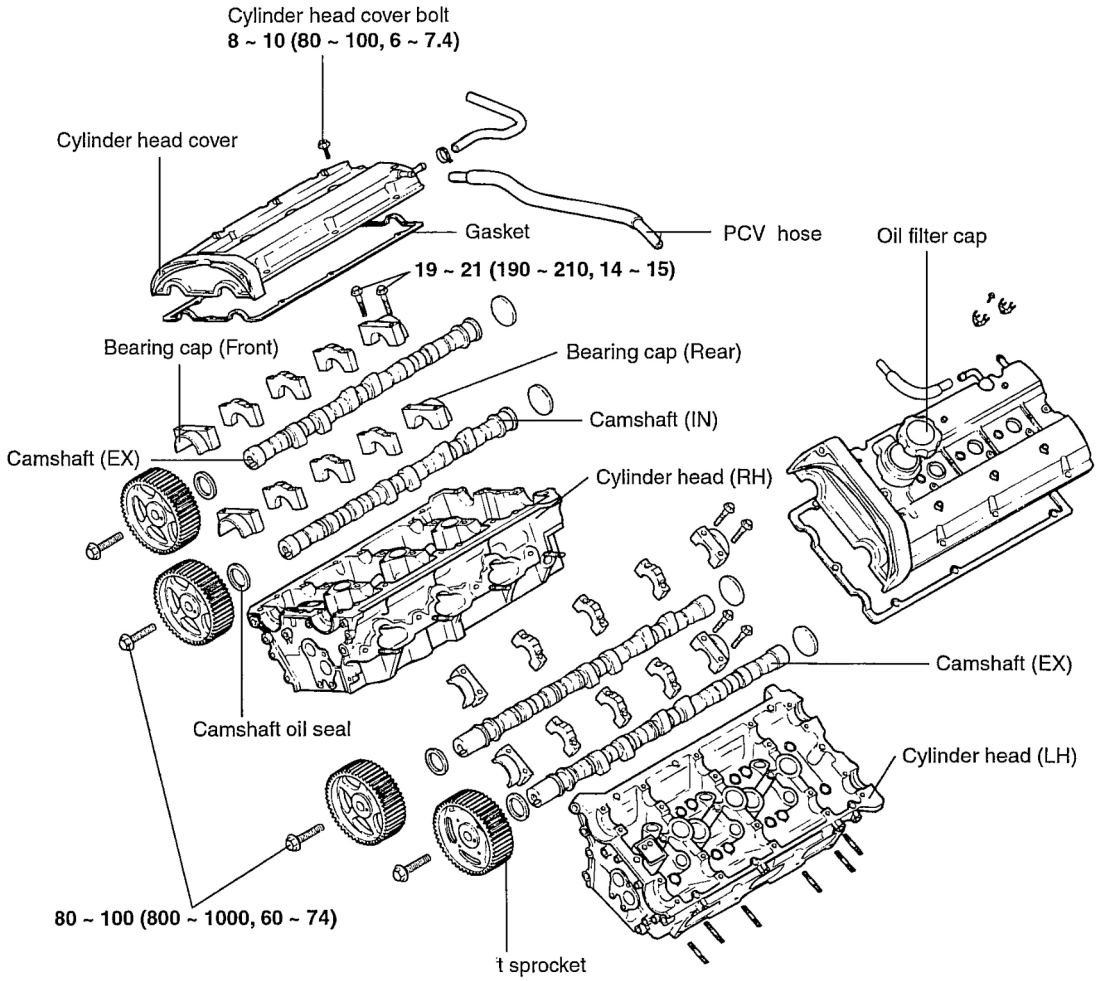


Fig. 86: Identifying Camshaft Components
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY

1. Remove the engine cover and intake manifold

   For additional information, refer to the **INTAKE MANIFOLD**.

2. Disconnect the breather hose and the engine harness.

   For additional information, refer to the **ENGINE AND TRANSAXLE ASSEMBLY**.

3. Remove the timing belt.

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For additional information, refer to the **TIMING BELT**.

4. Remove the spark plug cables.
5. Loosen the cylinder head cover bolts and then remove it.

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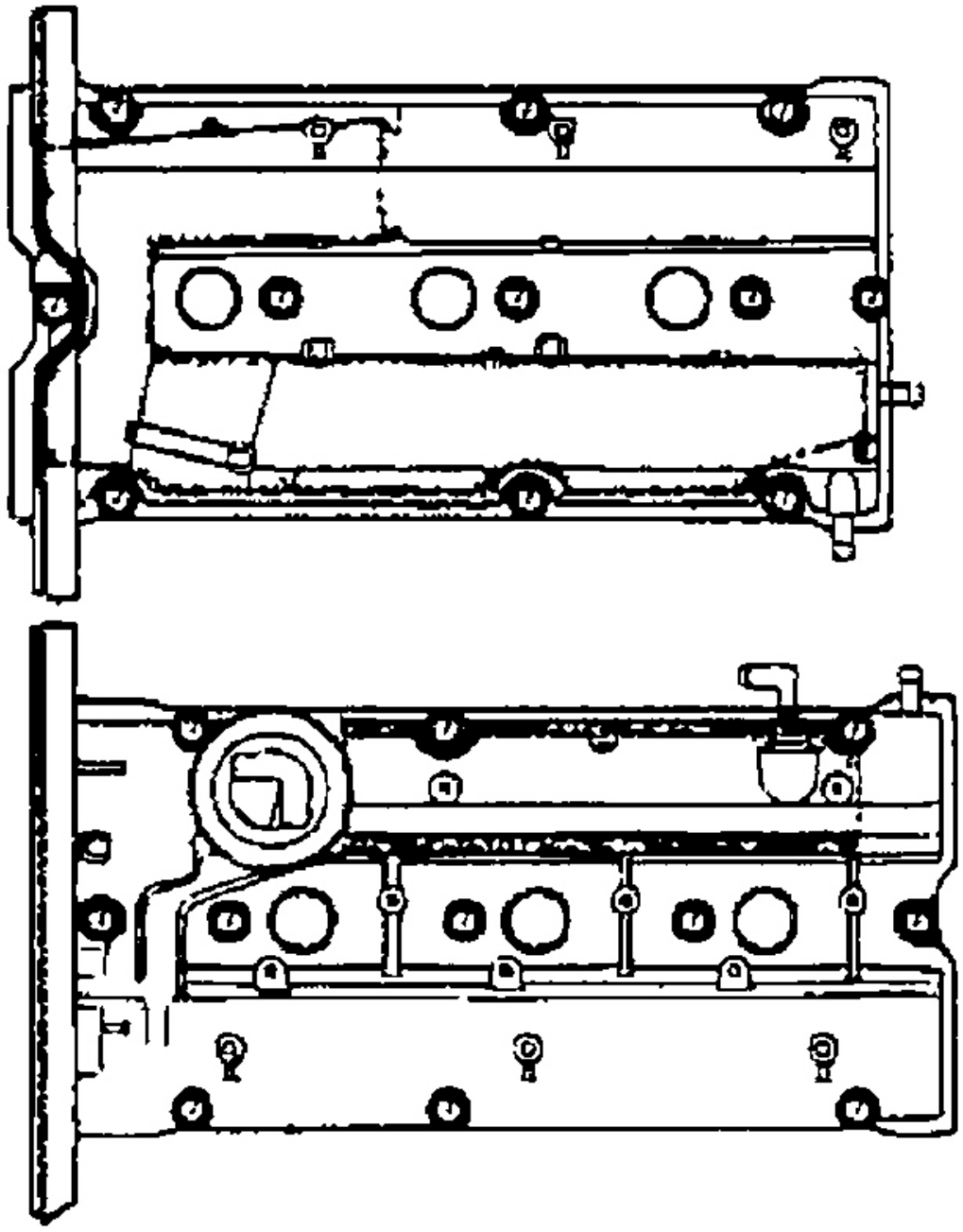


Fig. 87: Identifying Cylinder Head Cover Bolts
Courtesy of HYUNDAI MOTOR CO.

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6. Remove the camshaft sprockets.
7. Remove the camshaft bearing caps.

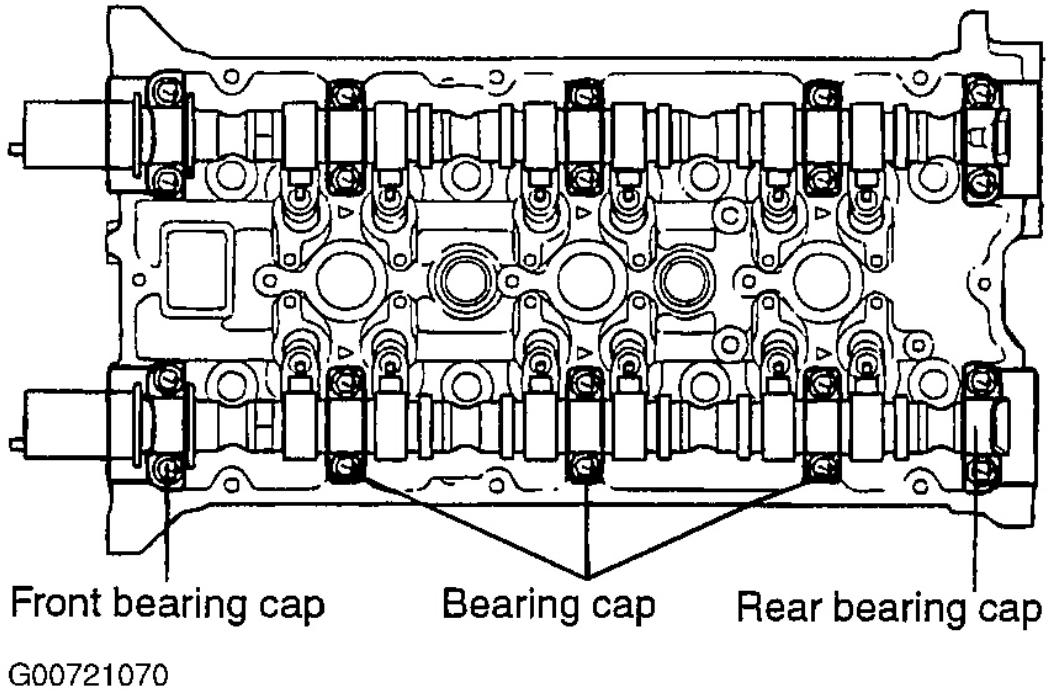


Fig. 88: Removing Camshaft Bearing Caps
Courtesy of HYUNDAI MOTOR CO.

8. Remove the camshafts.

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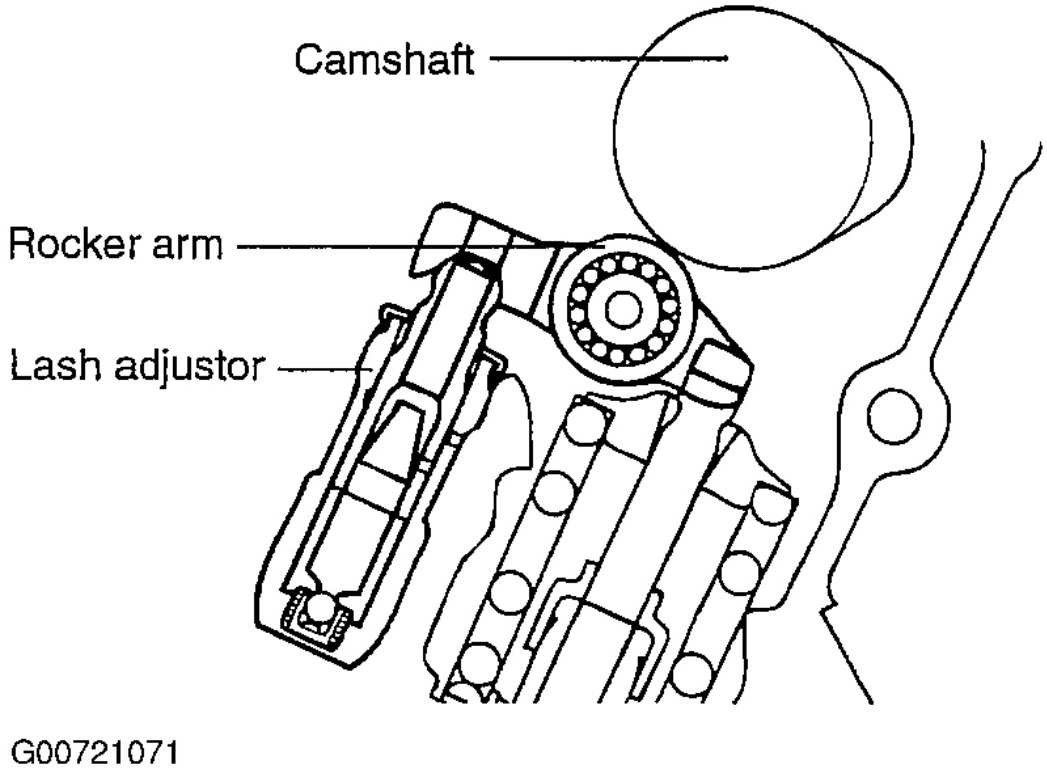


Fig. 89: Removing Camshaft
Courtesy of HYUNDAI MOTOR CO.

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.)

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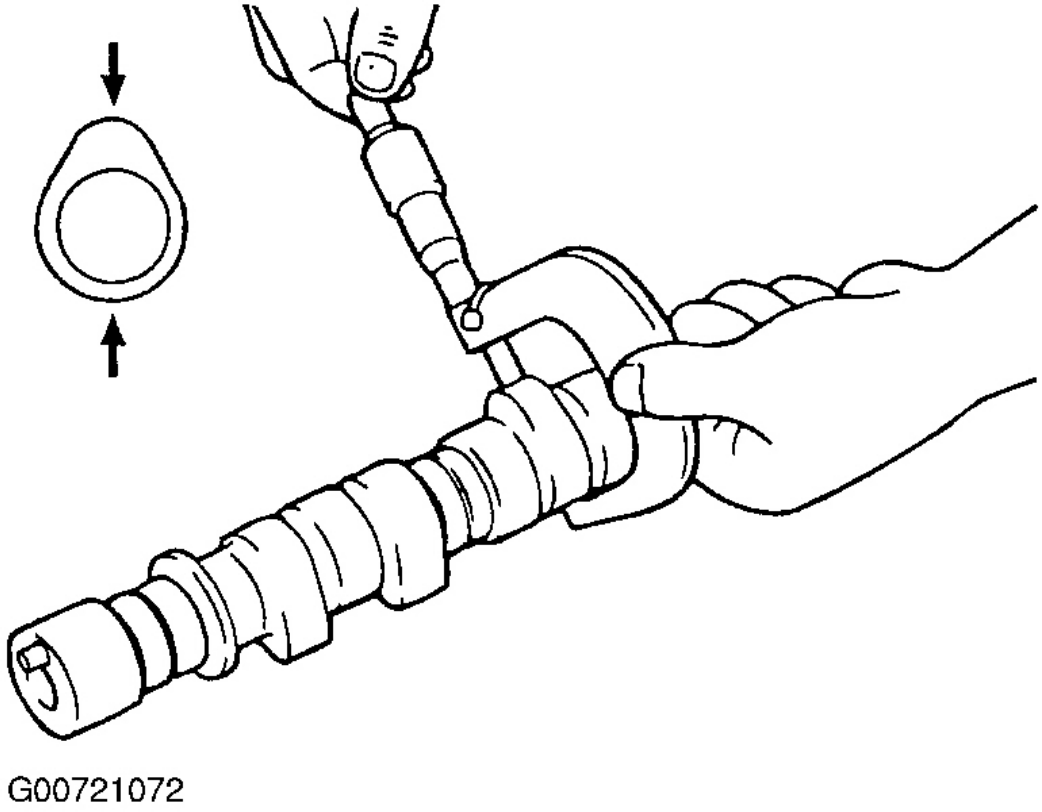


Fig. 90: Measuring Camshaft For Wear
Courtesy of HYUNDAI MOTOR CO.

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. If B moves, replace the HLA.

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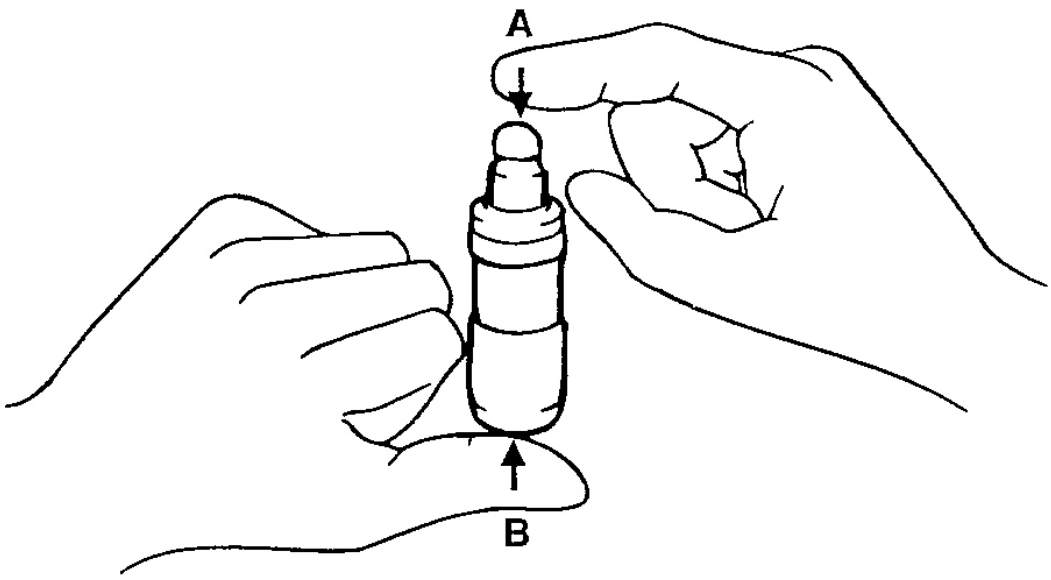


Fig. 91: Checking Hydraulic Lash Adjuster
Courtesy of HYUNDAI MOTOR CO.

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Problem	Possible cause	Action
1. Temporary noise when starting a cold engine	Normal	This noise will disappear atfer 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 excessivly craking the engine by the starter motor or band.	Oil leakagi 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*** ***Do not run engine at a speed higher than 3000 rpm, as this may damage the HLA.***
6. Contiunous 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 specitied 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.

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Fig. 92: Hydraulic Lash Adjuster Symptom Table
Courtesy of HYUNDAI MOTOR CO.

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 autolash 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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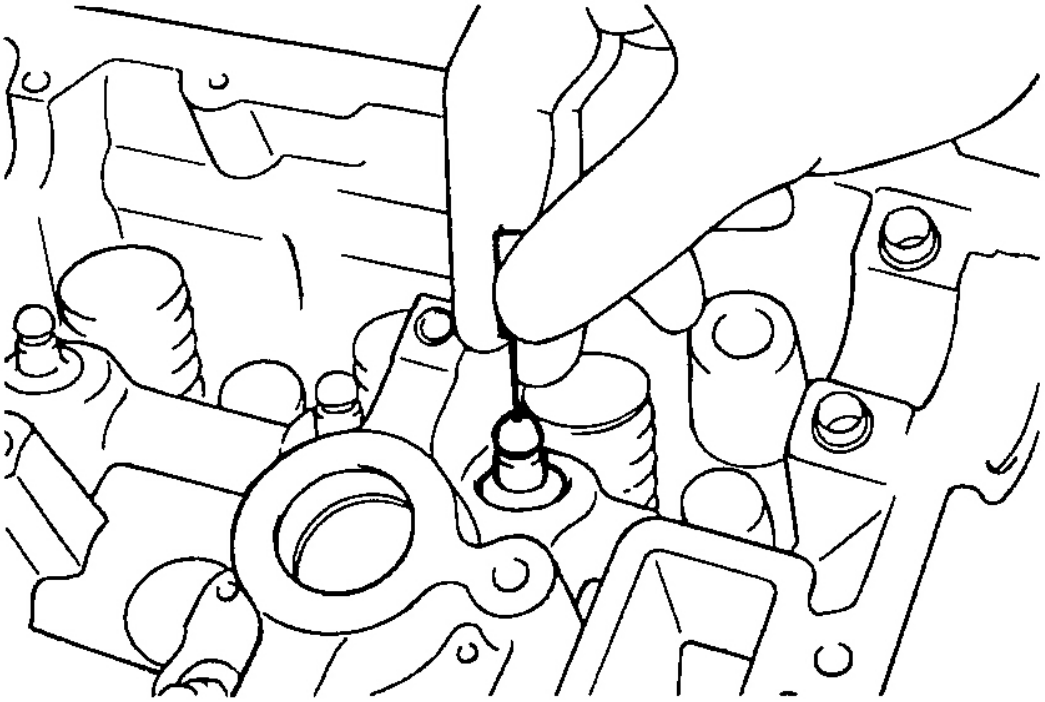


Fig. 93: Checking Hydraulic Lash Adjuster Free Play
Courtesy of HYUNDAI MOTOR CO.

REASSEMBLY

CAMSHAFT AND BEARING CAP

1. Rotate the crankshaft and No. 1 cylinder is in TDC (Compression stroke)
2. Check the position of the rocker arm whether it is exactly installed on the lash adjuster and valve or not.
3. Install the camshaft dowel pin as illustration.

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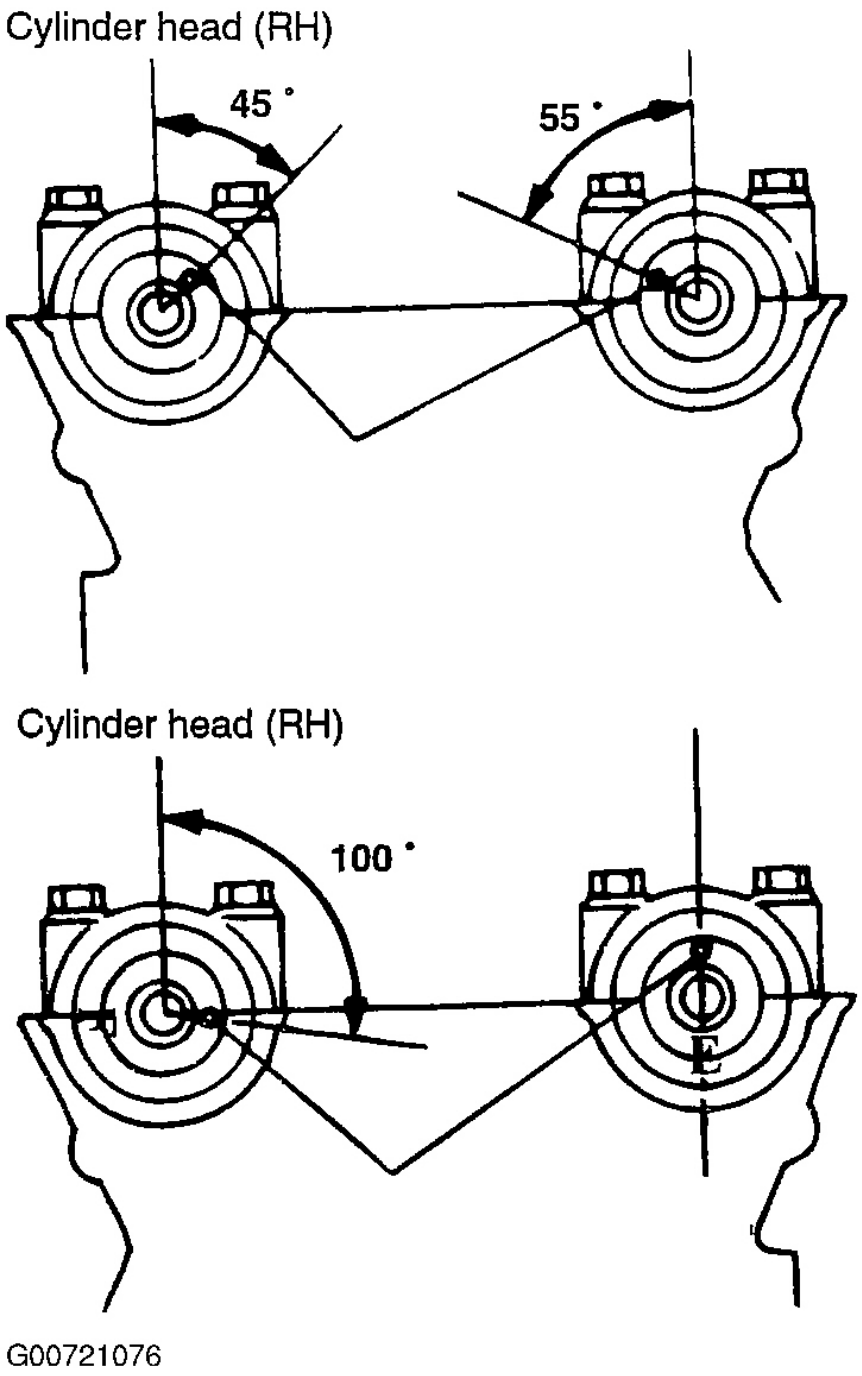


Fig. 94: Camshaft Installation Positions
Courtesy of HYUNDAI MOTOR CO.

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

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Identification signal

Left bank

Intake (IN): F

Exhaust (Ex): E

Right bank

Intake (IN): G

Exhaust (Ex): H

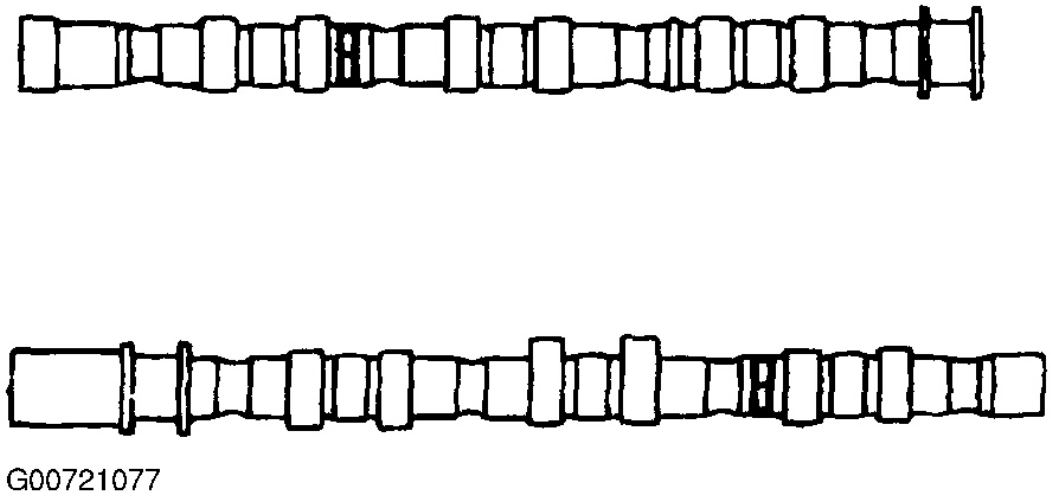


Fig. 95: Identifying Camshaft Size Difference Between Left & Right Cylinder Banks
Courtesy of HYUNDAI MOTOR CO.

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

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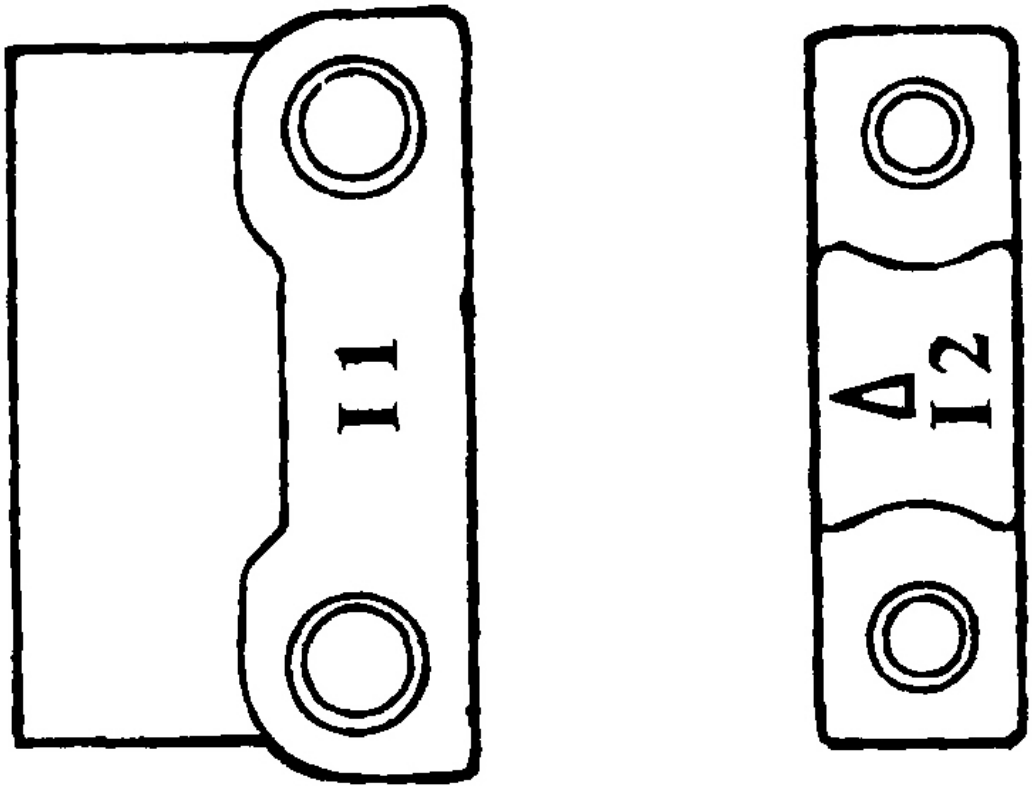


Fig. 96: Identifying Camshaft Bearing Cap Markings
Courtesy of HYUNDAI MOTOR CO.

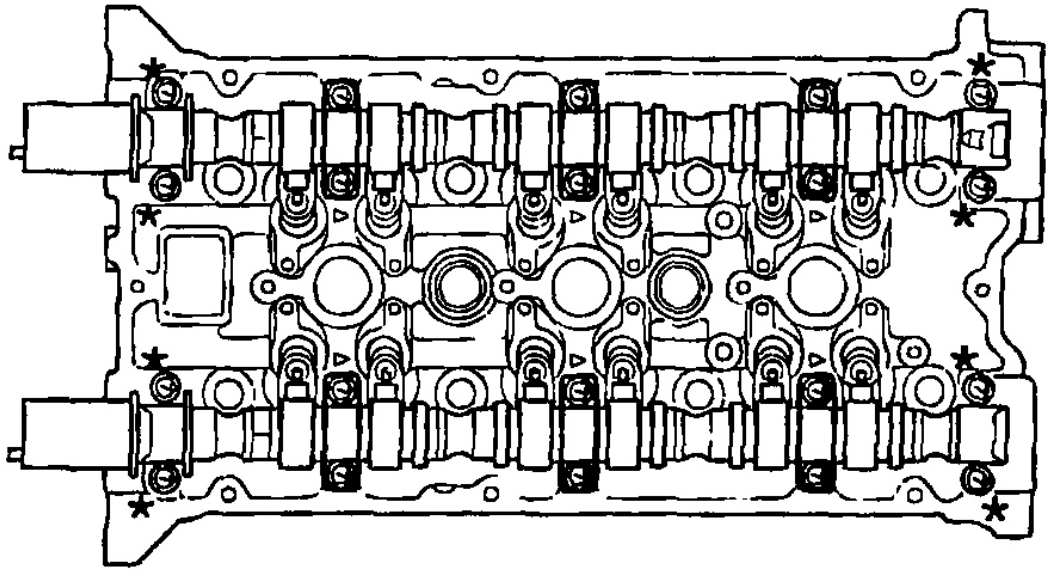
6. Tighten the bearing cap by 2 or 3 steps

   Tightening Torque

   Outer (*) 16 EA: 1.9 ~ 2.1 kg.m

   Inner 24 EA: 1.0 ~ 1.2 kg.m

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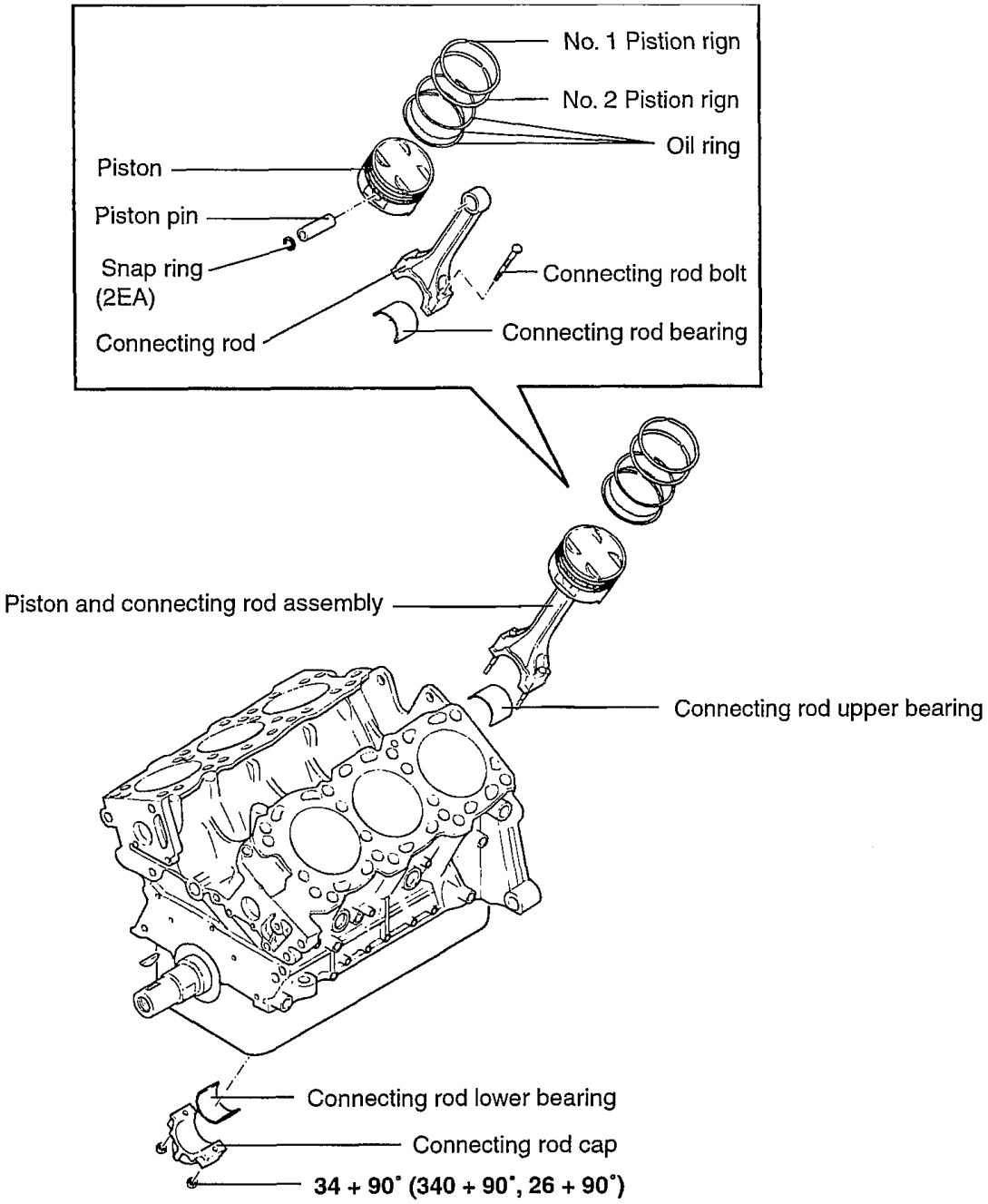
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Fig. 97: Identifying Camshaft Bearing Cap Tightening Sequence
Courtesy of HYUNDAI MOTOR CO.

CONNECTING ROD

COMPONENTS

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TORQUE : Nm (kg.cm, lb.ft)

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Fig. 98: Identifying Connection Rod Components
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

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1. Remove the timing belt.

   For additional information, refer to **TIMING BELT**.

2. Remove the cylinder head.

   For additional information, refer to **CYLINDER HEAD**.

3. Remove the oil pan.
4. Remove the oil screen.
5. Remove the upper baffle plate.

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.

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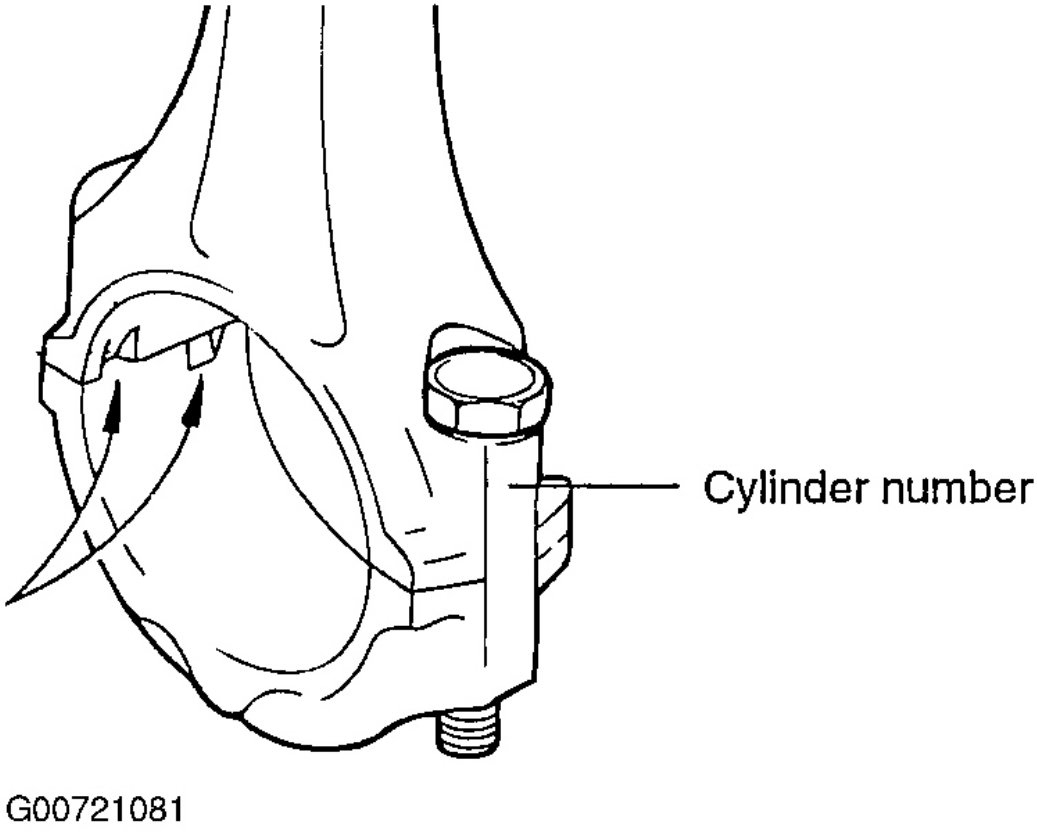


Fig. 99: Identifying Connecting Rod Caps
Courtesy of HYUNDAI MOTOR CO.

INSPECTION

PISTONS AND 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.

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Piston ring side clearance

No. 1: 0.04 ~ 0.08 mm (0.0016 ~ 0.0031 in.)

No. 2: 0.45 ~ 0.60 mm (0.018 ~ 0.024 in.)

Oil ring side rail: 0.2 ~ 0.7 mm (0.0079 ~ 0.0276 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 (0.0078 ~ 0.0118 in.)

No. 2: 0.45 ~ 0.60 mm (0.018 ~ 0.024 in.)

Oil ring side rail: 0.2 ~ 0.7 mm (0.0079 ~ 0.0276 in.)

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 AND MARK

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. 100: Piston Ring Service Size Table
Courtesy of HYUNDAI MOTOR CO.

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

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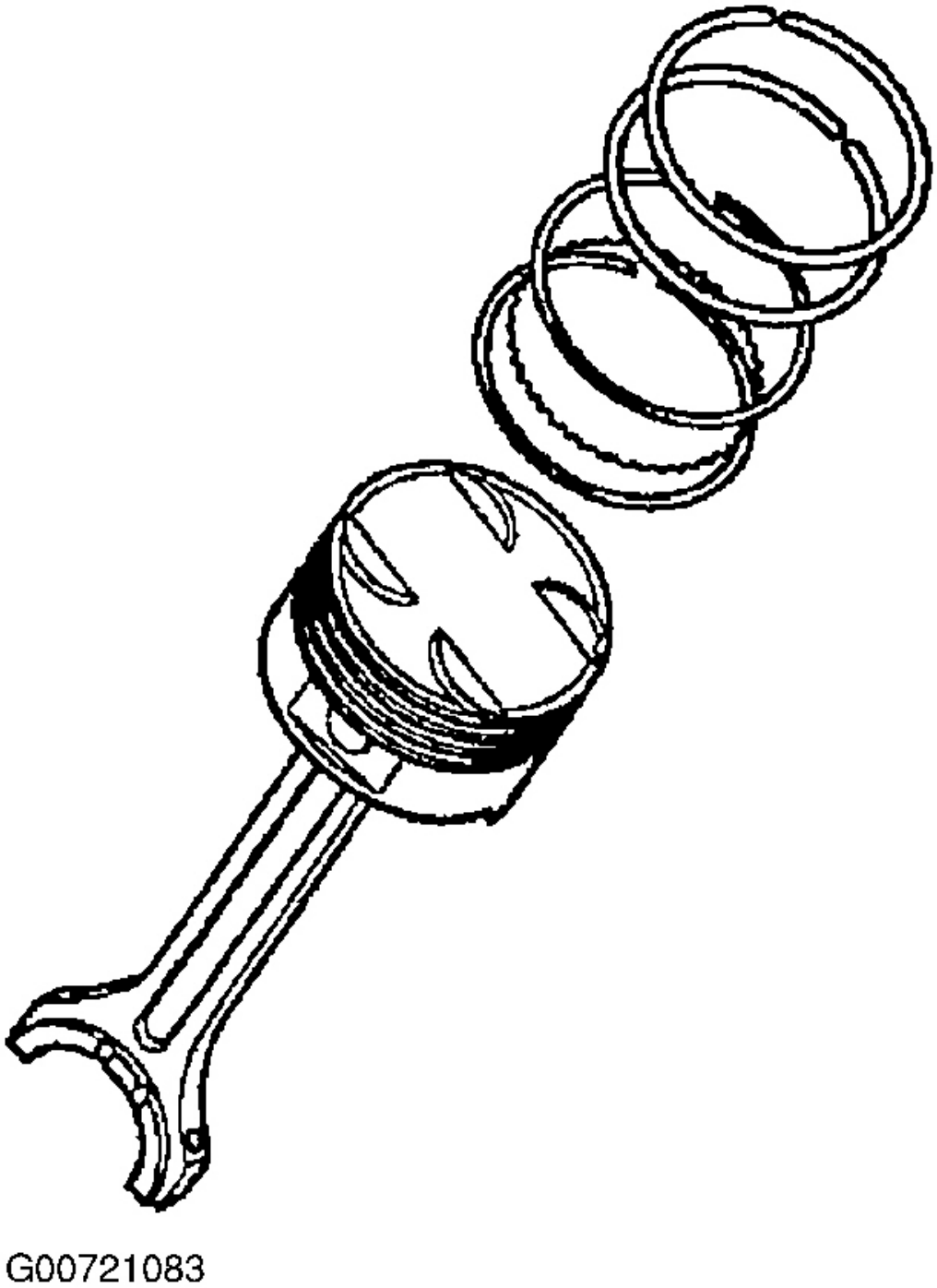


Fig. 101: Piston & Ring Assembly
Courtesy of HYUNDAI MOTOR CO.

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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 bearing 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.

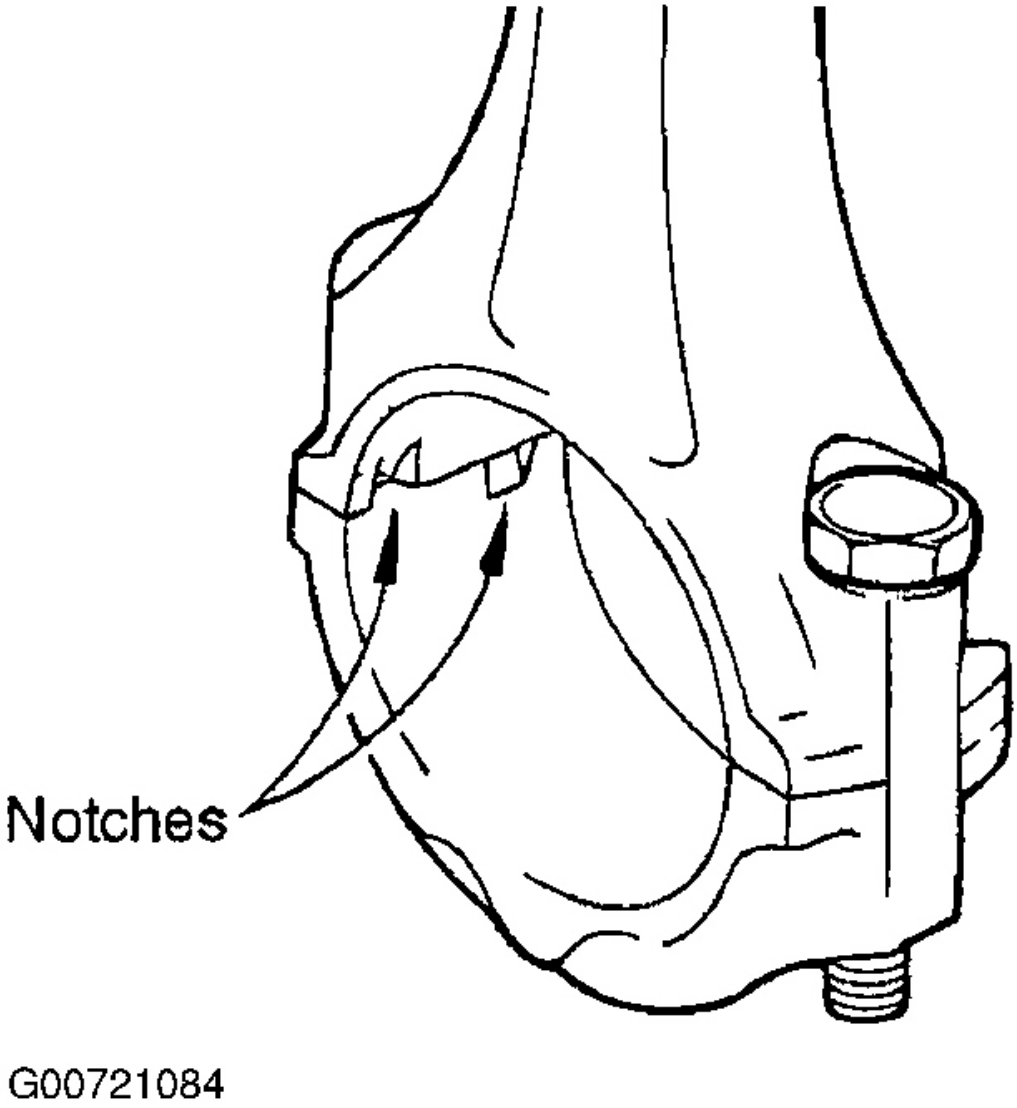


Fig. 102: Identifying Proper Bearing Notch Position
Courtesy of HYUNDAI MOTOR CO.

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REASSEMBLY

1. Install the spacer.

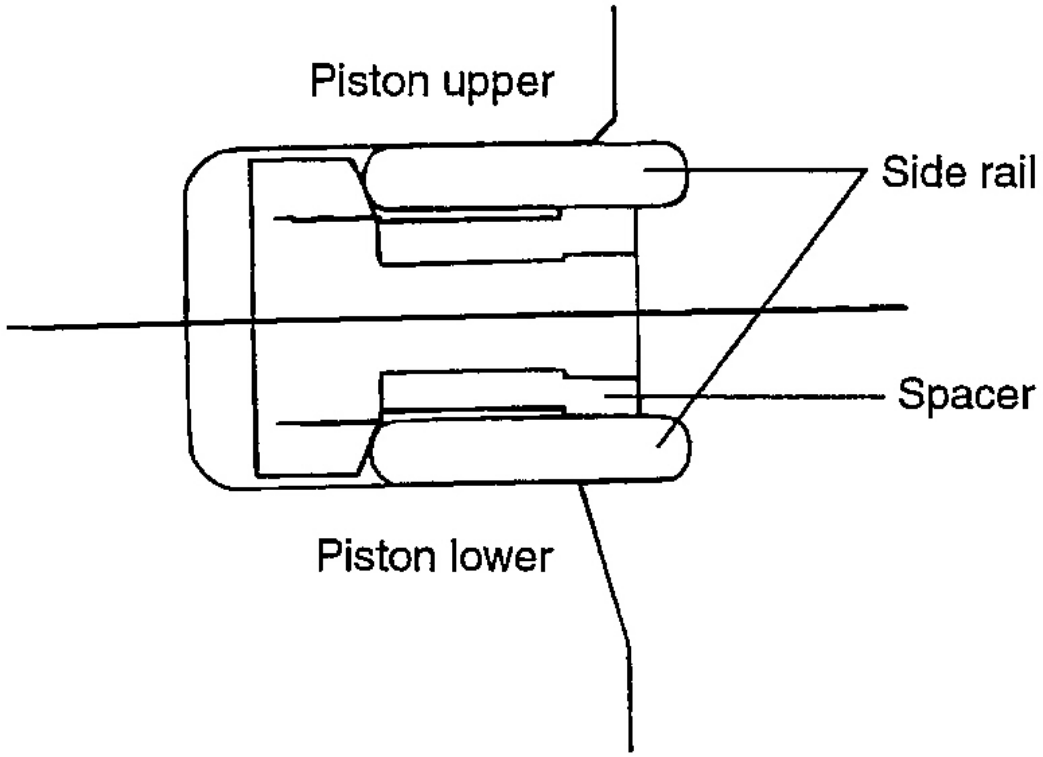


Fig. 103: Identifying Oil Ring Components
Courtesy of HYUNDAI MOTOR CO.

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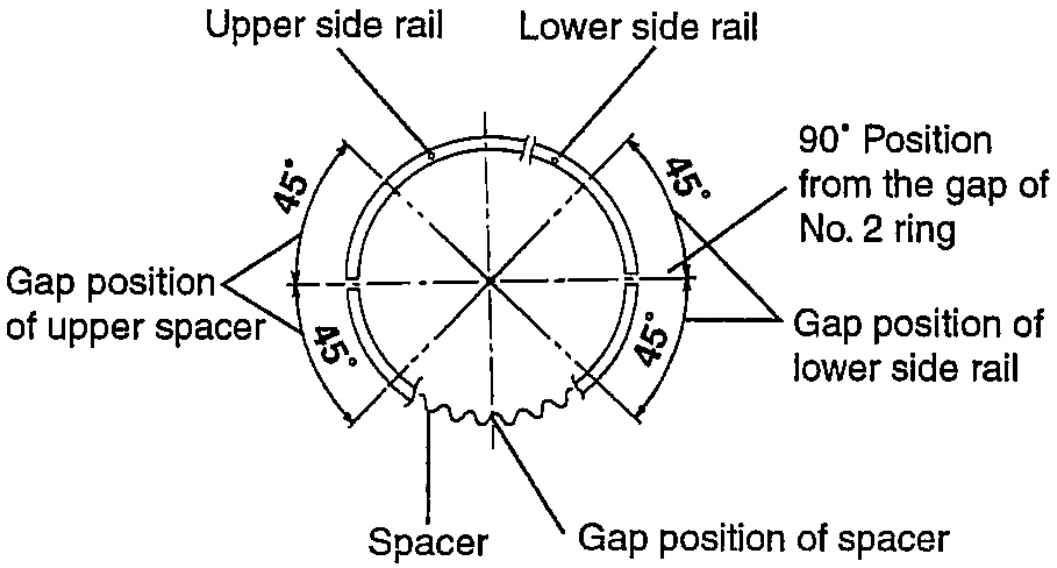


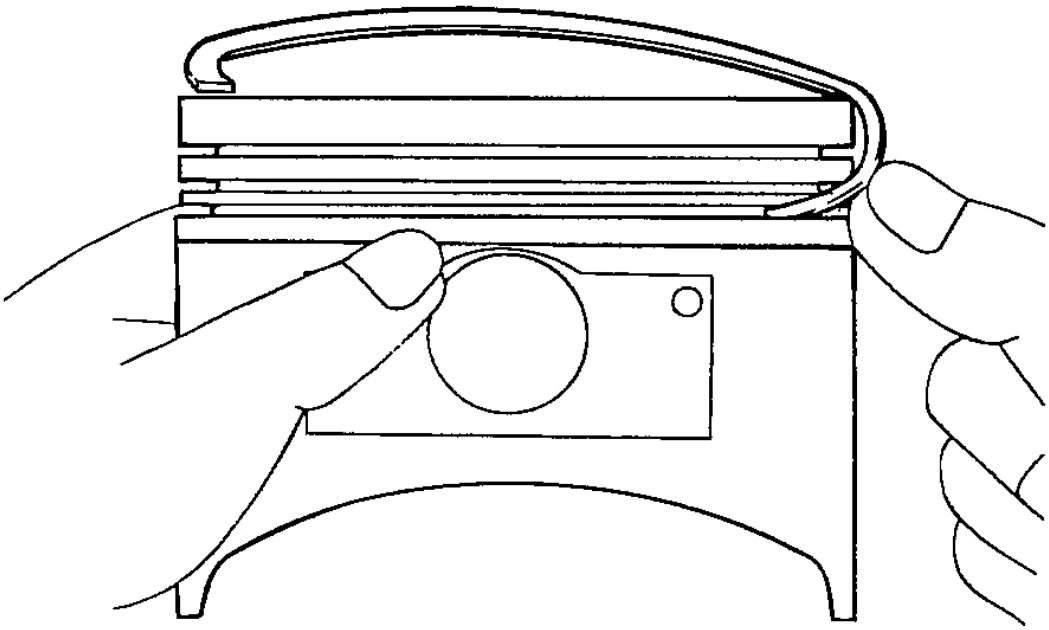
Fig. 104: Identifying Piston Oil Ring End Gap Locations
Courtesy of HYUNDAI MOTOR CO.

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.

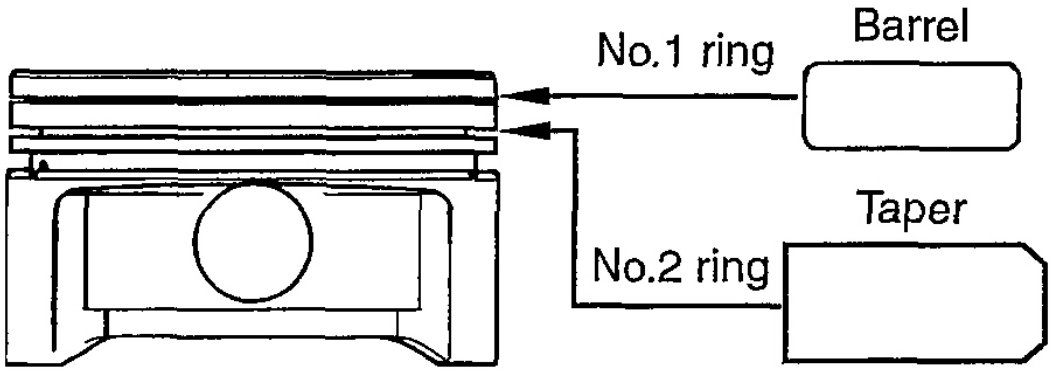
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Fig. 105: Installing Piston Oil Ring Side Rail
Courtesy of HYUNDAI MOTOR CO.

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.



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Fig. 106: Installing Piston Rings No. 1 & 2
Courtesy of HYUNDAI MOTOR CO.

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.

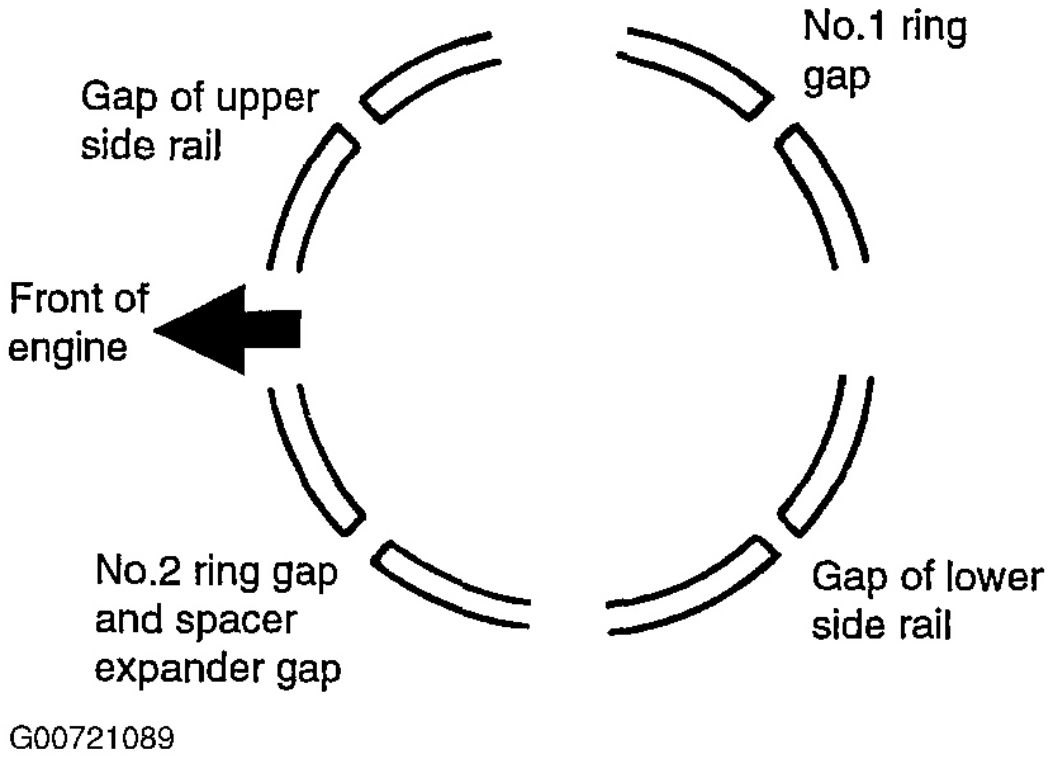
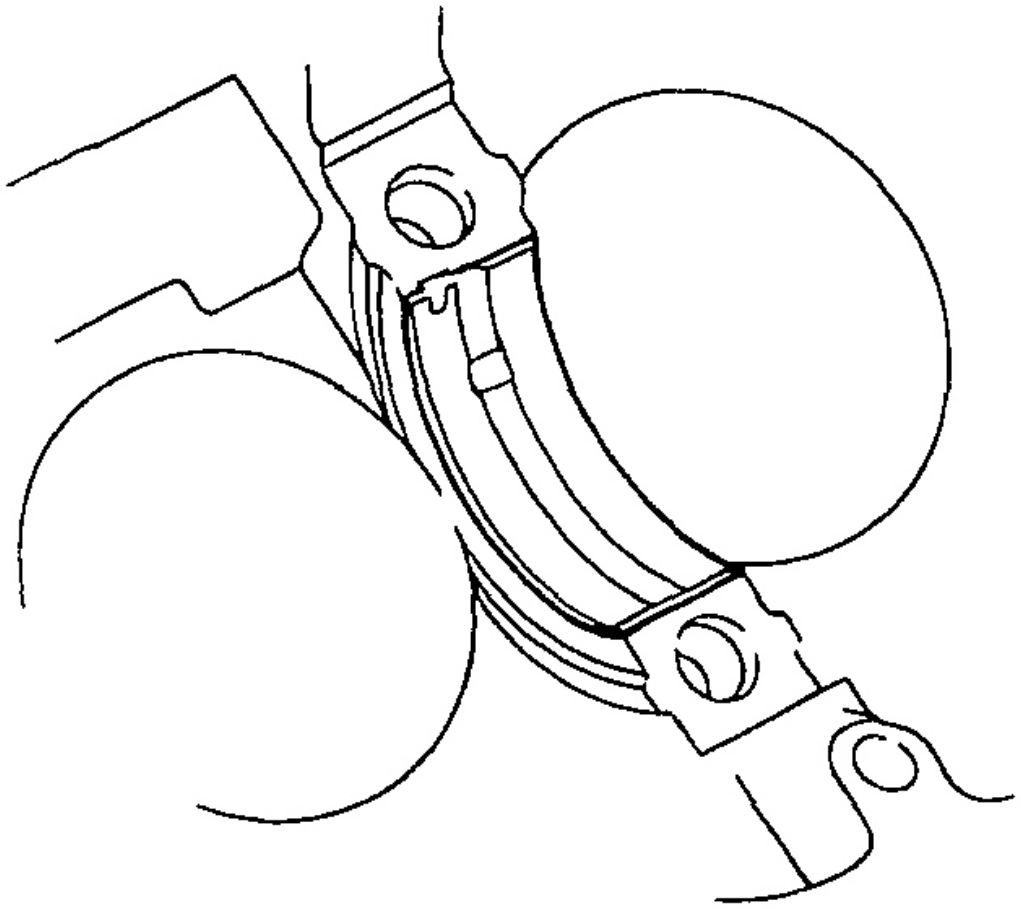


Fig. 107: Identifying Piston Ring End Gap Locations
Courtesy of HYUNDAI MOTOR CO.

9. Install the upper main bearings in the cylinder block.
10. Install the lower main bearings in the main bearing caps.

CAUTION: Install the bearing so it matches the oil hole in the block.

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Fig. 108: Installing Upper Main Bearings
Courtesy of HYUNDAI MOTOR CO.

11. Install the thrust washers in the No. 3 main bearing cap with the oil grooves facing outward.

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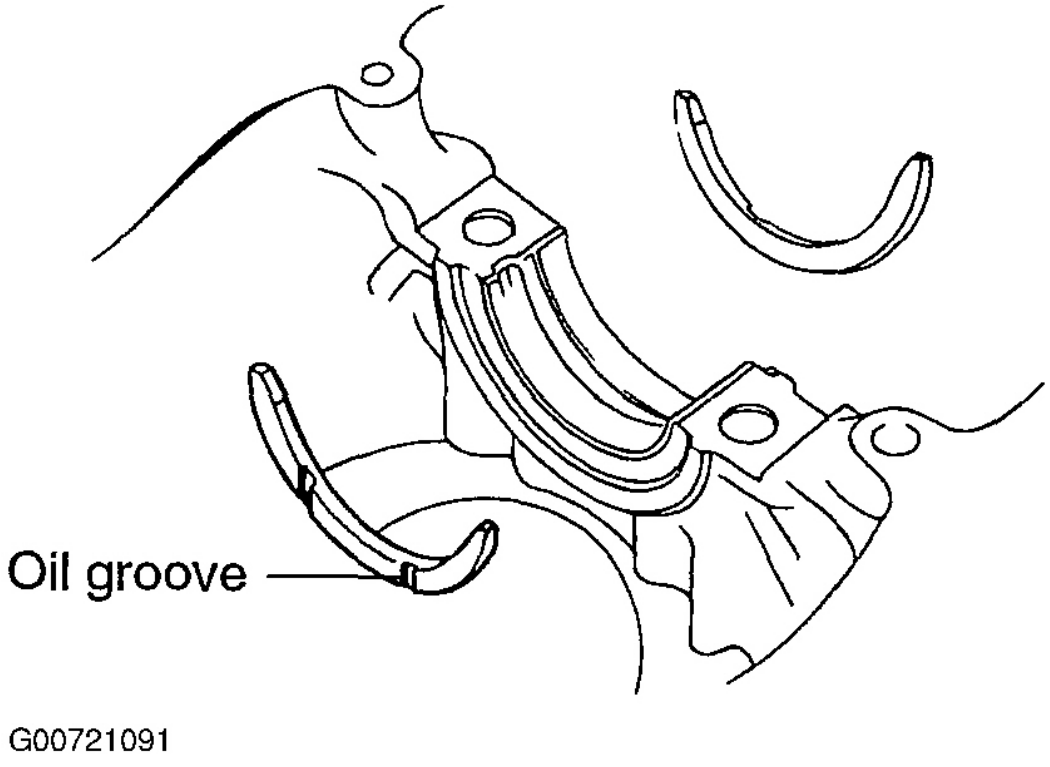


Fig. 109: Installing Main Bearing Thrust Washers
Courtesy of HYUNDAI MOTOR CO.

12. 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.
13. When the connecting rod cap is installed, make sure that any cylinder numbers placed on the rod and cap at disassembly match.
14. When a new connecting rod is installed, make sure that the notches for holding the bearing in place are on the same side.
15. 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 Nm (350 kg.cm, 26 lb. ft) +90°

CAUTION: After removing the connecting rod bolt, do not use it again.

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When using a new bolt, do not tighten the bolt more than 3 times.

16. 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.)

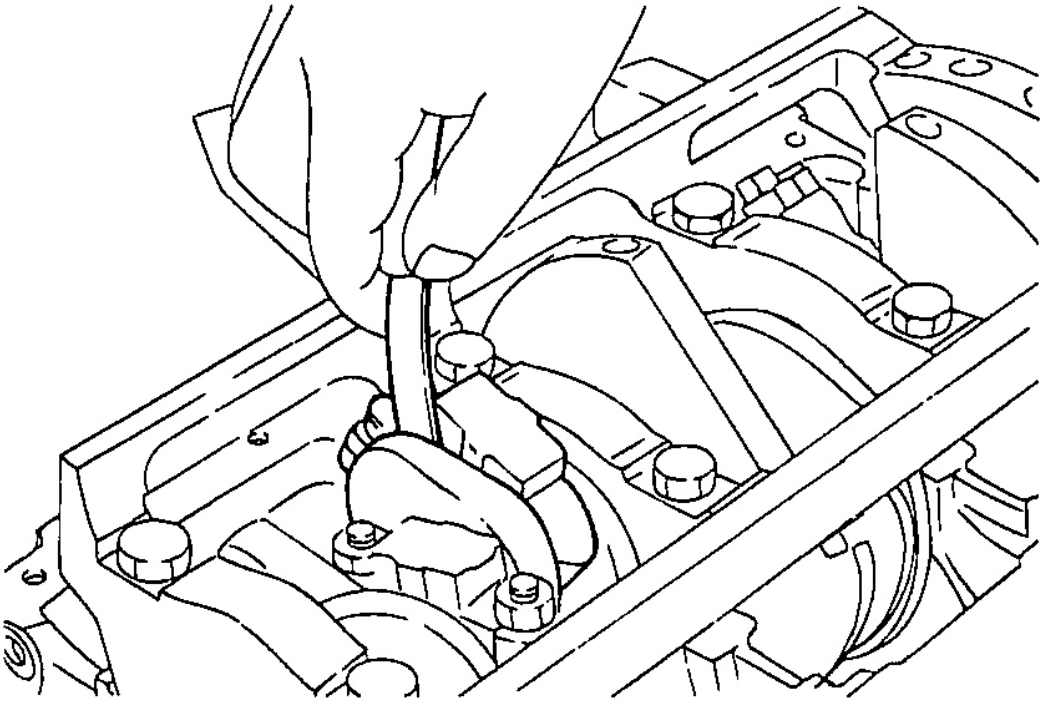


Fig. 110: Checking Connecting Rod Side Clearance
Courtesy of HYUNDAI MOTOR CO.

INSTALLATION

1. Install the upper baffle plate.
2. Install the oil screen.
3. Install the oil pan.

For additional information, refer to **LUBRICATION SYSTEM**.

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4. Install the cylinder head.

   For additional information refer to **CYLINDER HEAD**.

5. Install the timing belt.

   For additional information, refer to **TIMING BELT**.

CRANK SHAFT

COMPONENTS

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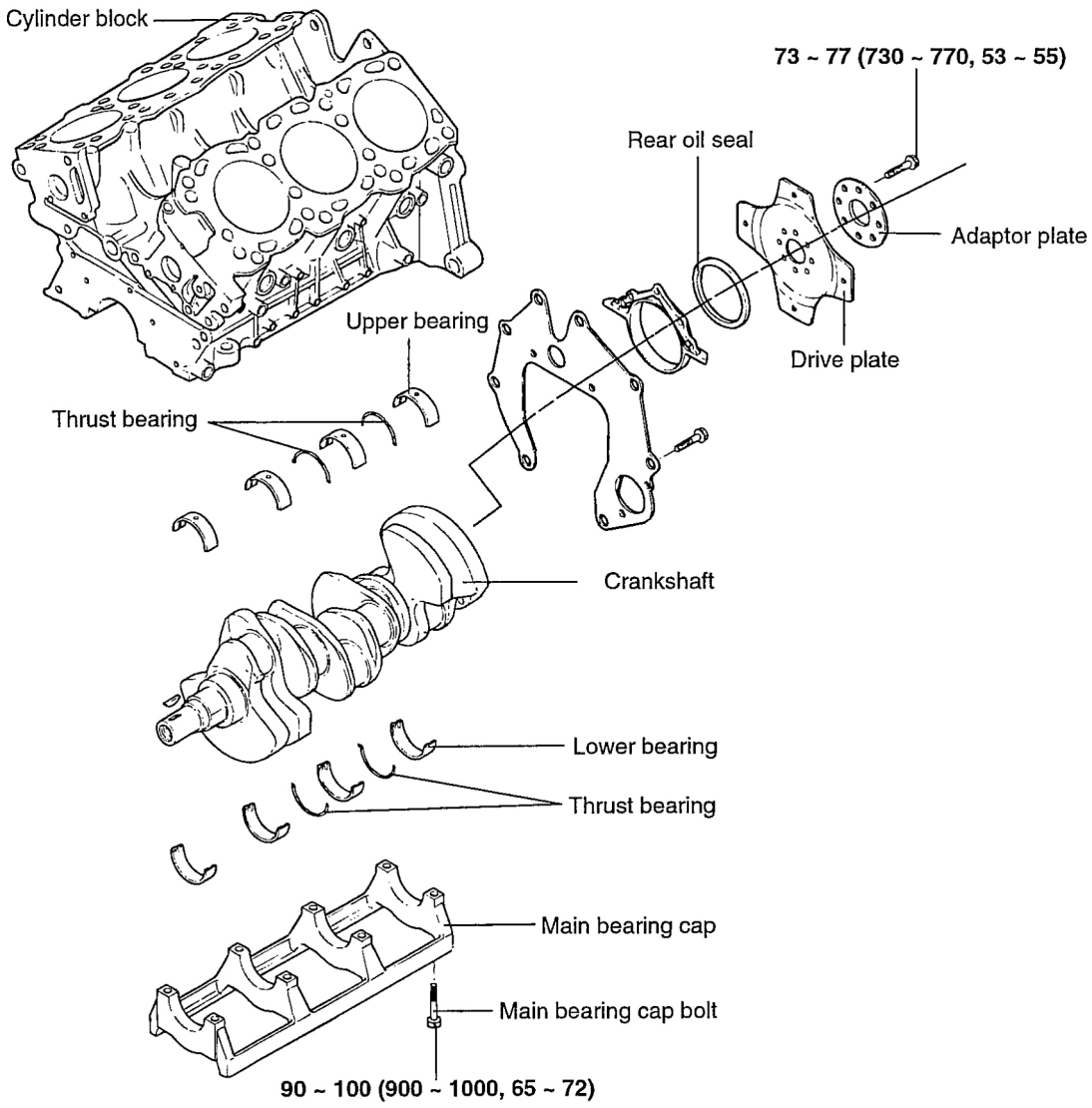


Fig. 111: Identifying Crankshaft Components
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY

1. Remove the **TIMING BELT** train, front case, **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.

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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.)

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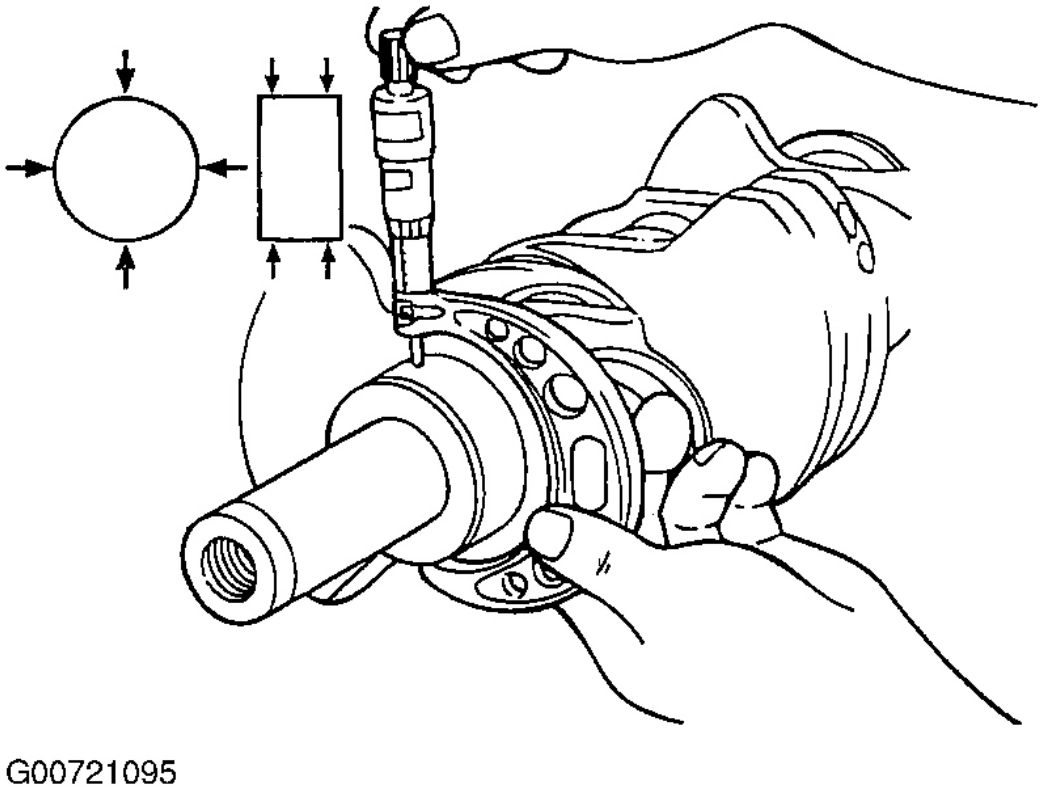


Fig. 112: Measuring Crankshaft Journals
Courtesy of HYUNDAI MOTOR CO.

MAIN BEARINGS AND 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

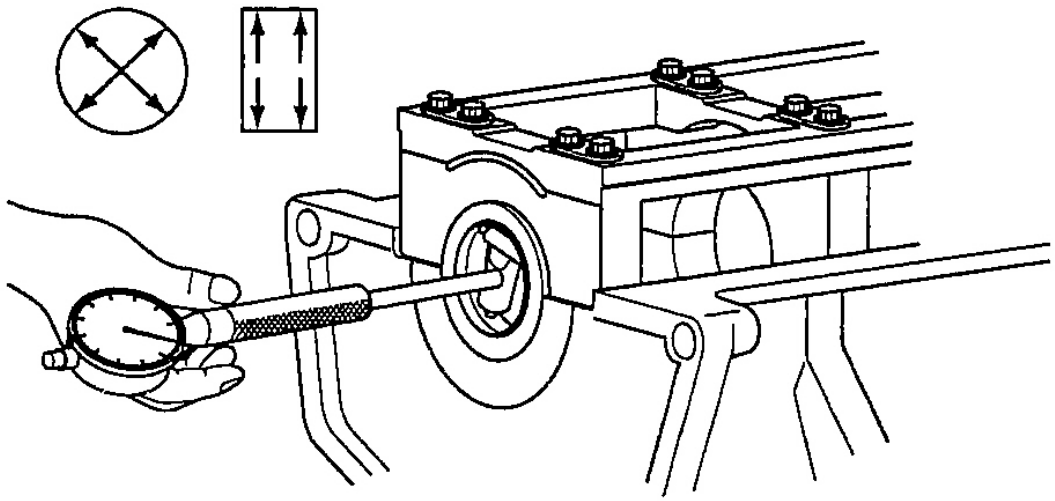
Crankshaft main bearing:

0.022 ~ 0.040 mm (0.0009 ~ 0.0016 in.)

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Connecting ~ rod bearing:

0.026 ~ 0.044 mm (0.001 ~ 0.0017 in.)



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Fig. 113: Measuring Main Bearing Inside Diameter
Courtesy of HYUNDAI MOTOR CO.

PLASTIGAUGE METHOD

Plastigauge may be used to measure the clearance.

1. Remove oil, grease and any other dirt from the bearings and journals.
2. Cut the plastigauge 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 plastigauge 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.

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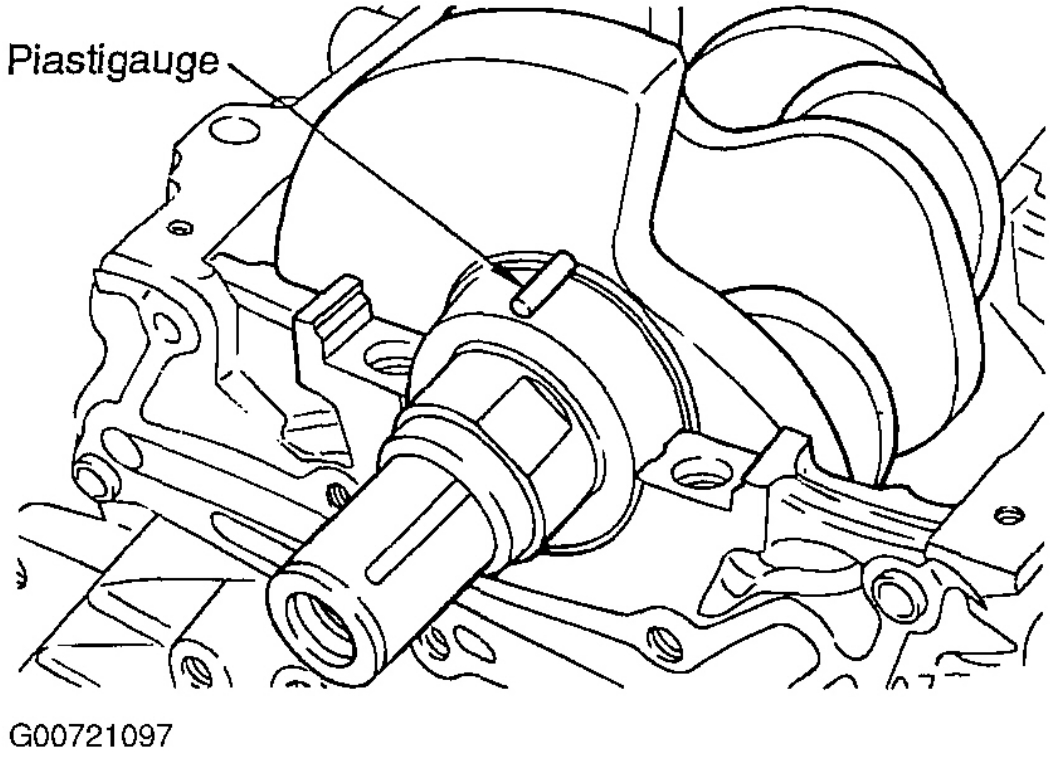


Fig. 114: Using Plastigauge To Determine Main Bearing Clearance
Courtesy of HYUNDAI MOTOR CO.

OIL SEAL

Check the front and rear oil seals for damage or worn surfaces. Replace any seat 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.

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Tightening torque

Main bearing cap bolts:

90 ~ 100 Nm (900 ~ 1000 kg.cm, 65 ~ 72 lb. ft)

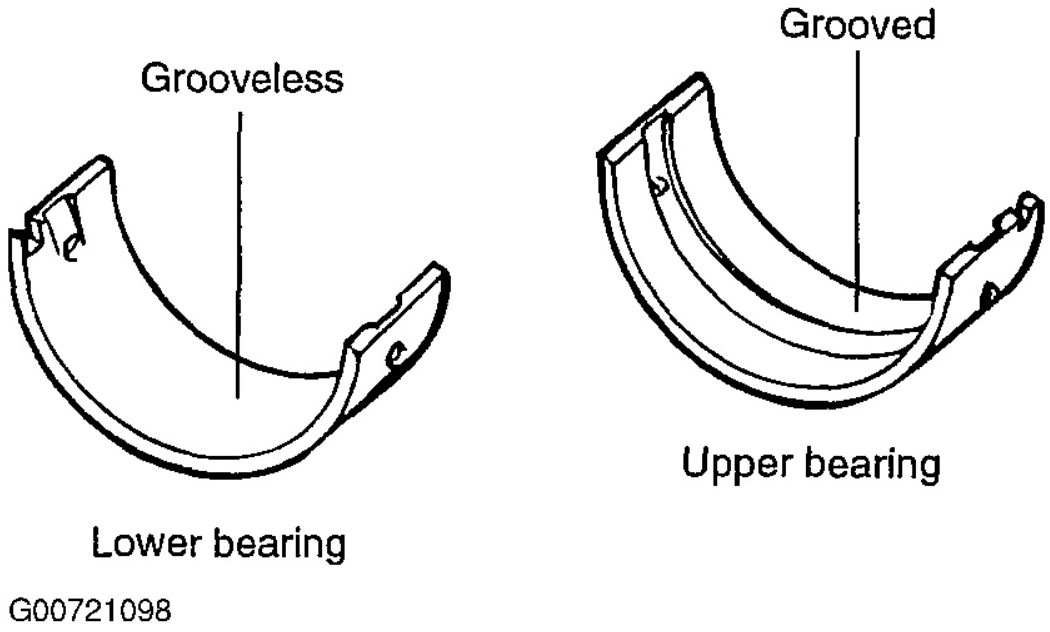


Fig. 115: Identifying Lower & Upper Main Bearings
Courtesy of HYUNDAI MOTOR CO.

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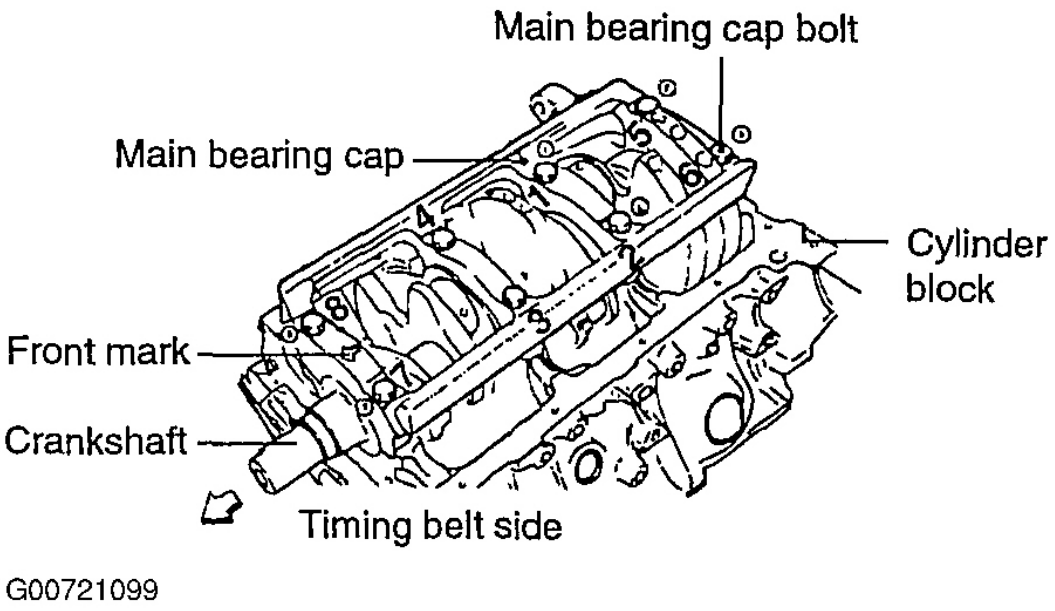


Fig. 116: Identifying Main Bearing Cap Tightening Sequence
Courtesy of HYUNDAI MOTOR CO.

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: 0.050 ~ 0.250 mm (0.002 ~ 0.0098 in.)

Limit: 0.35 mm (0.014 in.)

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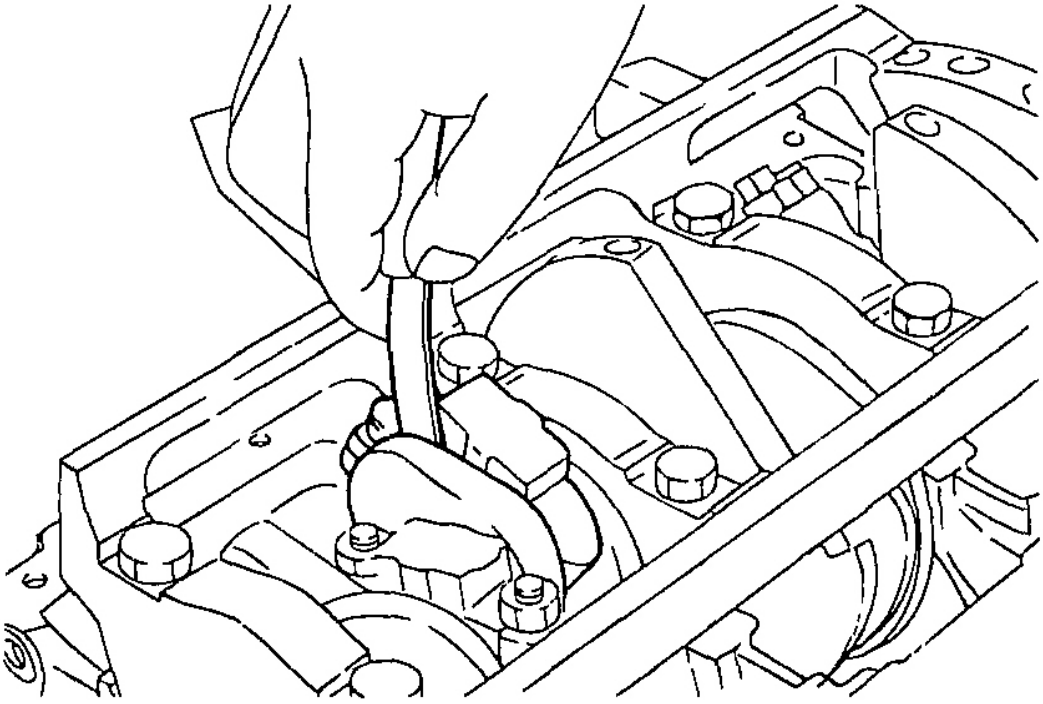


Fig. 117: Measuring Crankshaft End Play
Courtesy of HYUNDAI MOTOR CO.

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 Nm (100 ~ 120 kg.cm, 7 ~ 9 lb. ft)

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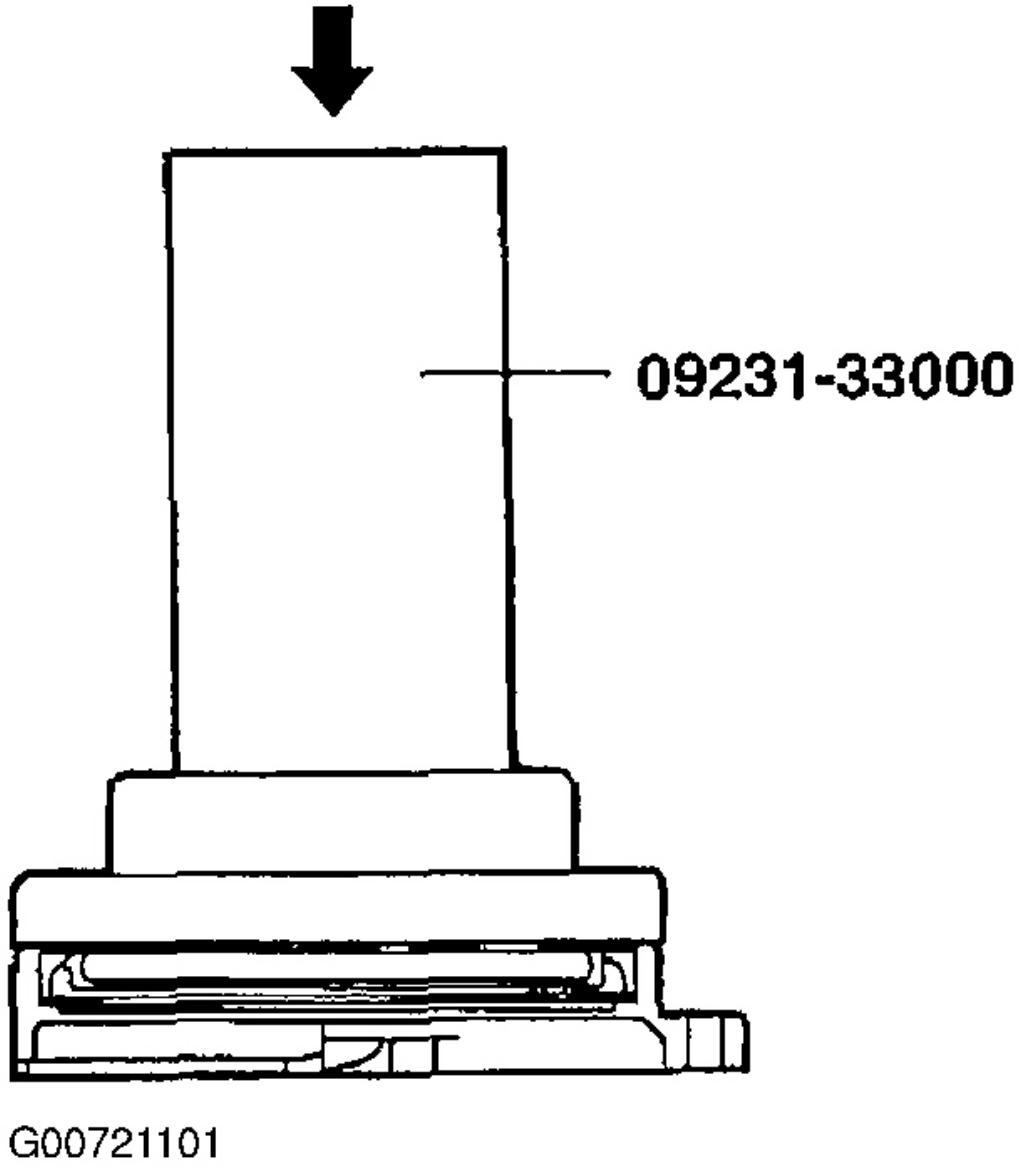


Fig. 118: Identifying Oil Seal Installer
Courtesy of HYUNDAI MOTOR CO.

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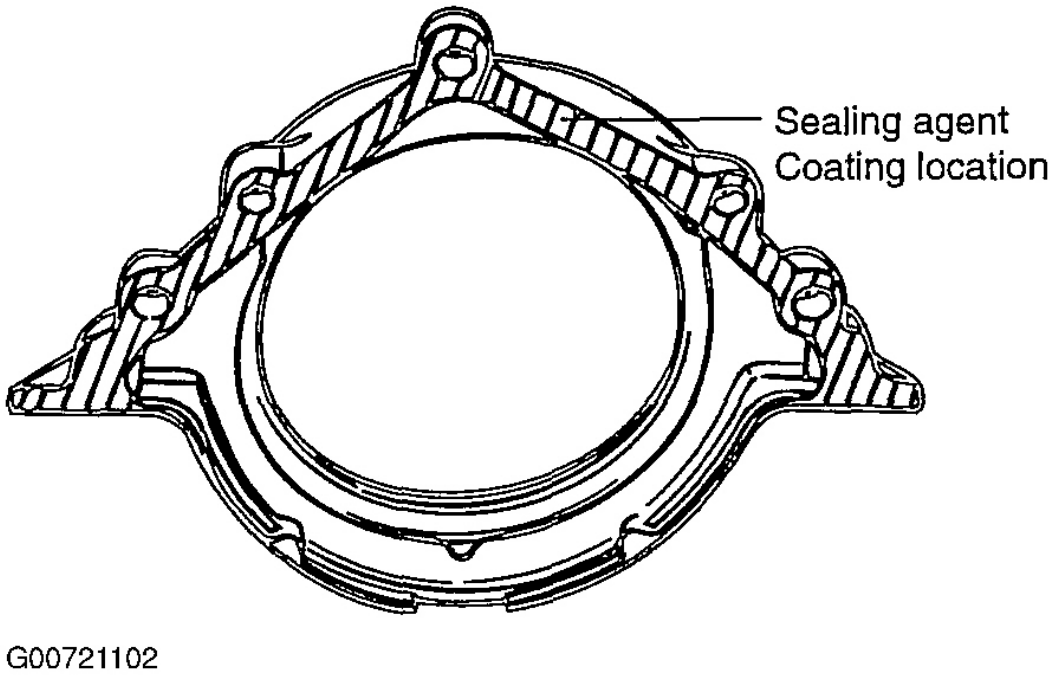


Fig. 119: Identifying Sealing Agent Coating Location
Courtesy of HYUNDAI MOTOR CO.

10. Tighten the rear plate to the specified torque.

    Tightening torque

    Rear plate: 10 ~ 12 Nm (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 Nm (730 ~ 770 kg.cm, 53 ~ 56 lb. ft)

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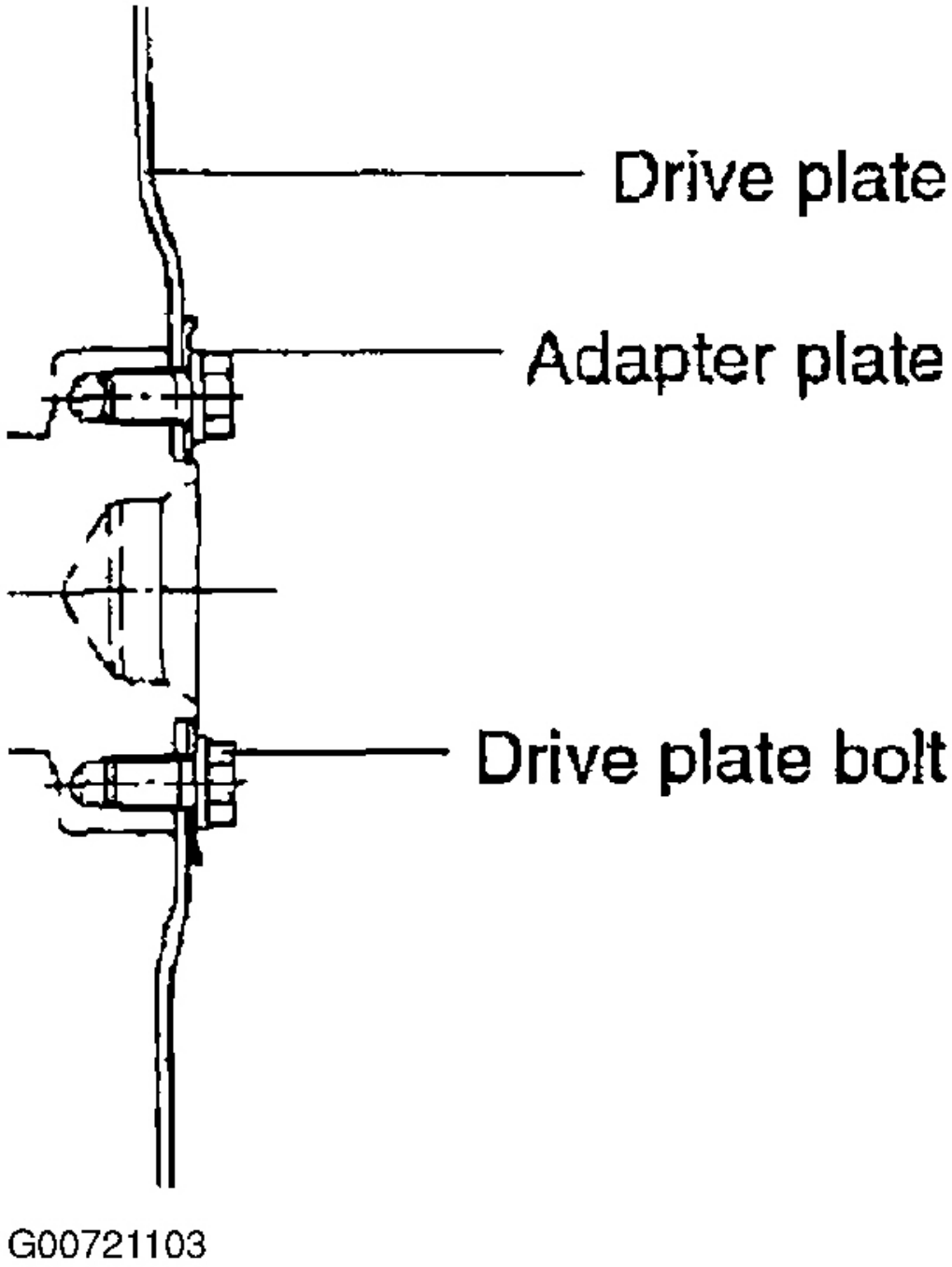


Fig. 120: Identifying Drive Plate, Adaptor Plate & Bolts
Courtesy of HYUNDAI MOTOR CO.

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LUBRICATION SYSTEM

OIL PUMP

COMPONENTS

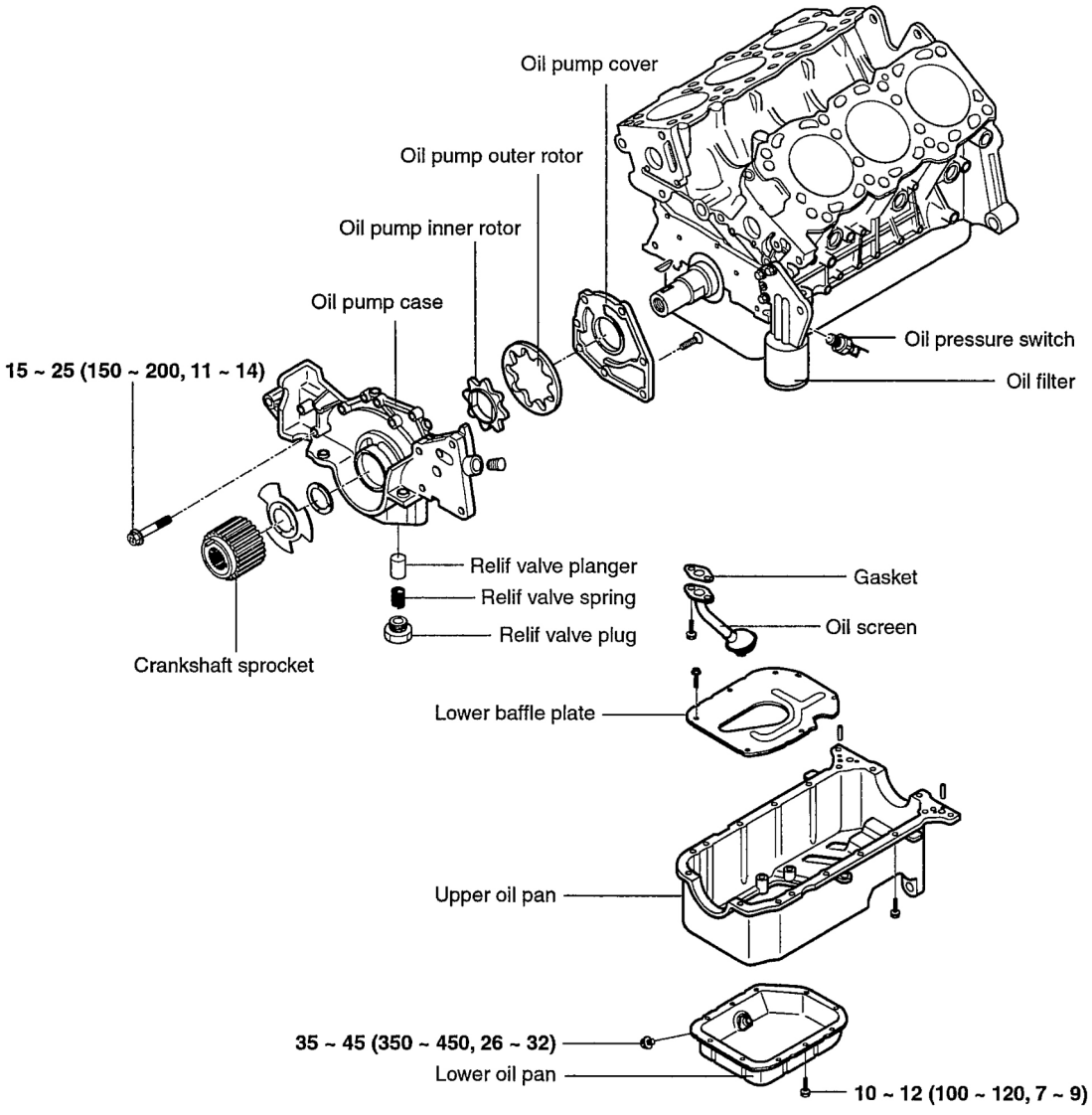


Fig. 121: Identifying Lubrication System Components
Courtesy of HYUNDAI MOTOR CO.

DISASSEMBLY

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

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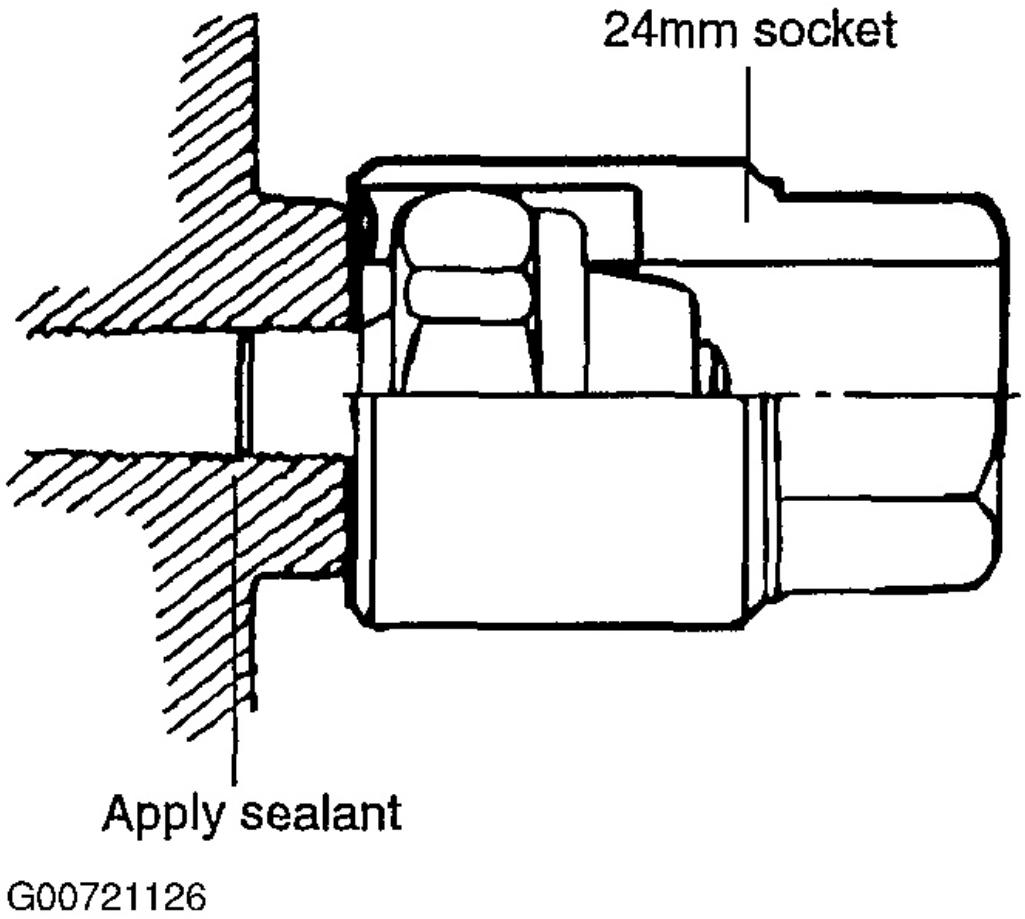


Fig. 122: Removing Oil Pressure Switch
Courtesy of HYUNDAI MOTOR CO.

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 valve plug from the oil pump case.
6. Remove the oil pump case.

INSPECTION

OIL PUMP

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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.)

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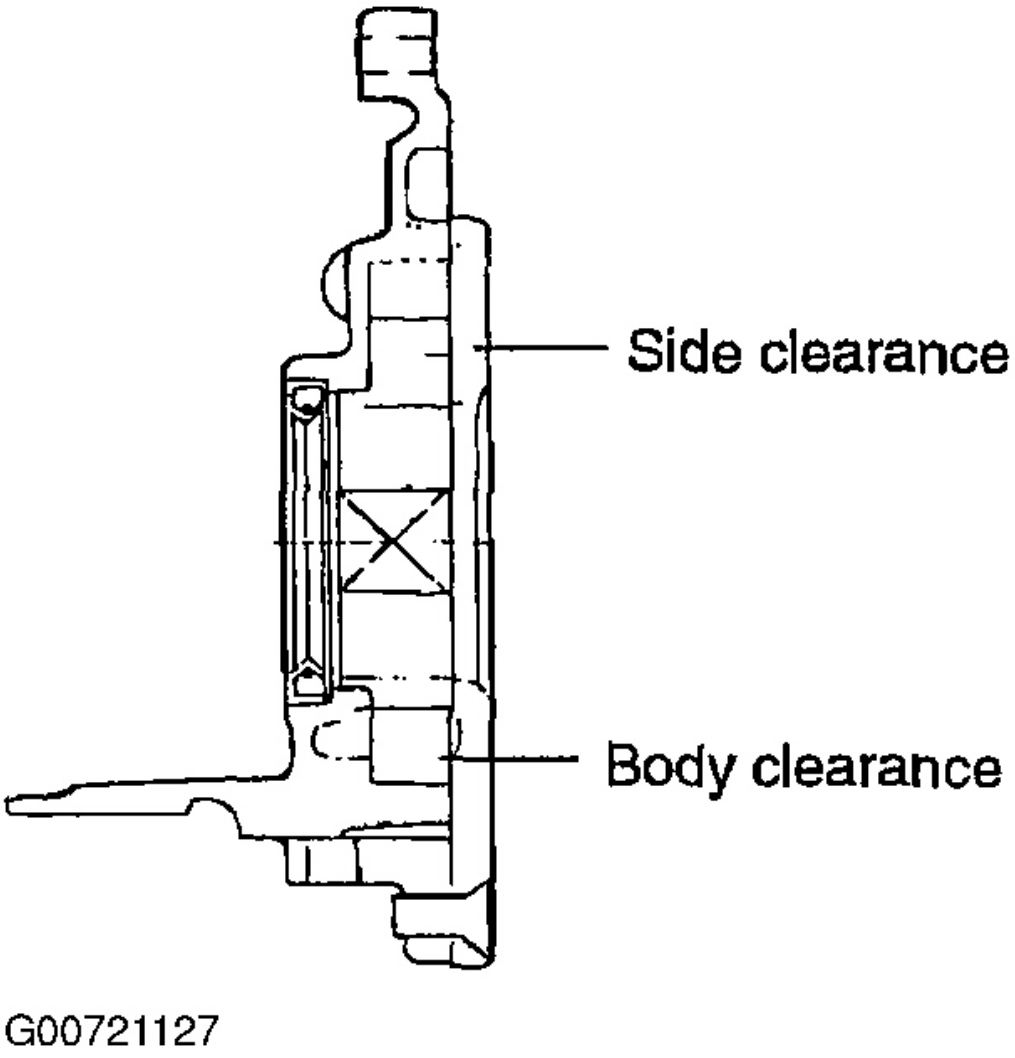


Fig. 123: Identifying Oil Pump Side & Body Clearances
Courtesy of HYUNDAI MOTOR CO.

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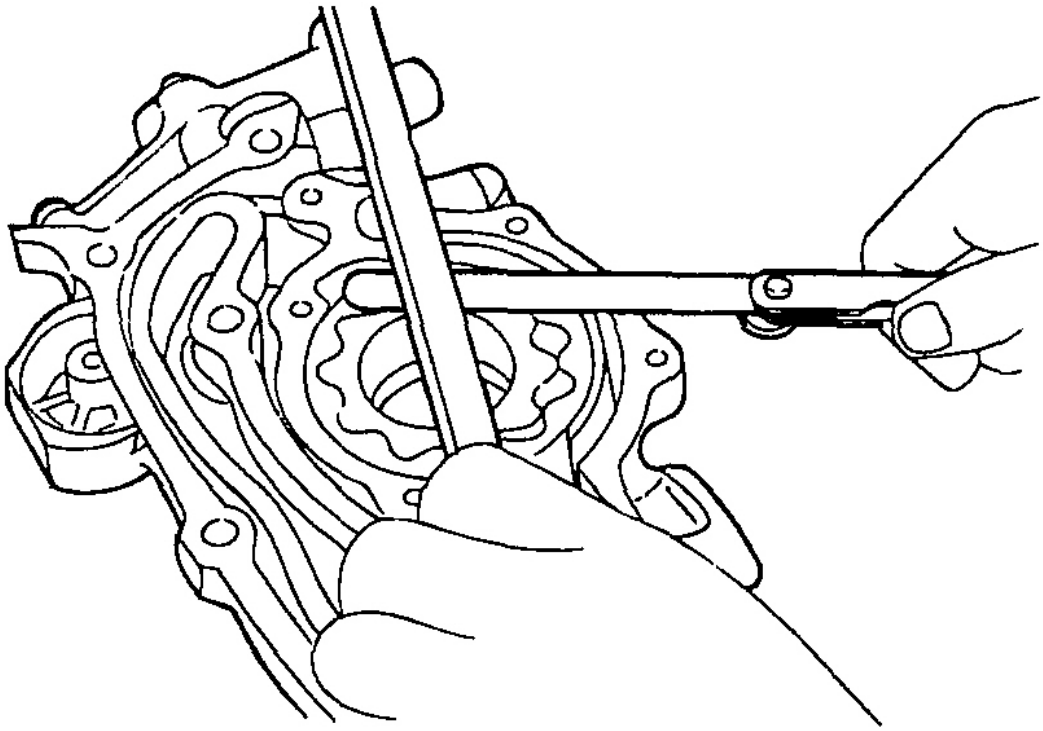


Fig. 124: Measuring Oil Pump Clearance
Courtesy of HYUNDAI MOTOR CO.

RELIEF PLUNGER AND 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 surface that mates with the oil filter.
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.

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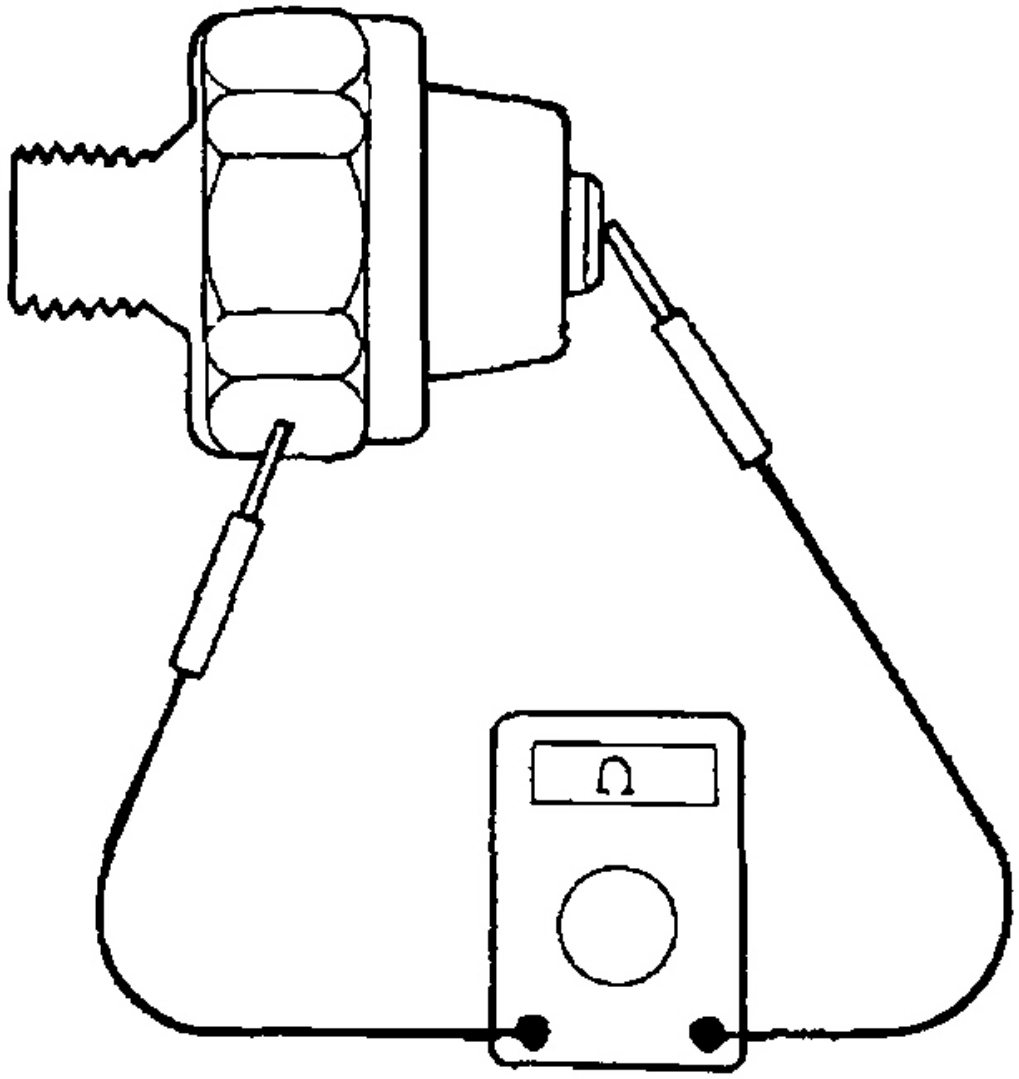


Fig. 125: Checking Oil Pressure Switch Continuity (Static)
Courtesy of HYUNDAI MOTOR CO.

2. Check the continuity between the terminal and the body when the fine wire is pushed. If there is continuity even when the fine wire is pushed, replace the switch.
3. If there is no continuity when a 50 kpa (7 psi) vacuum is applied through the oil hole, the switch is operating properly.

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Check for air leakage. If air leaks, the diaphragm is broken Replace it.

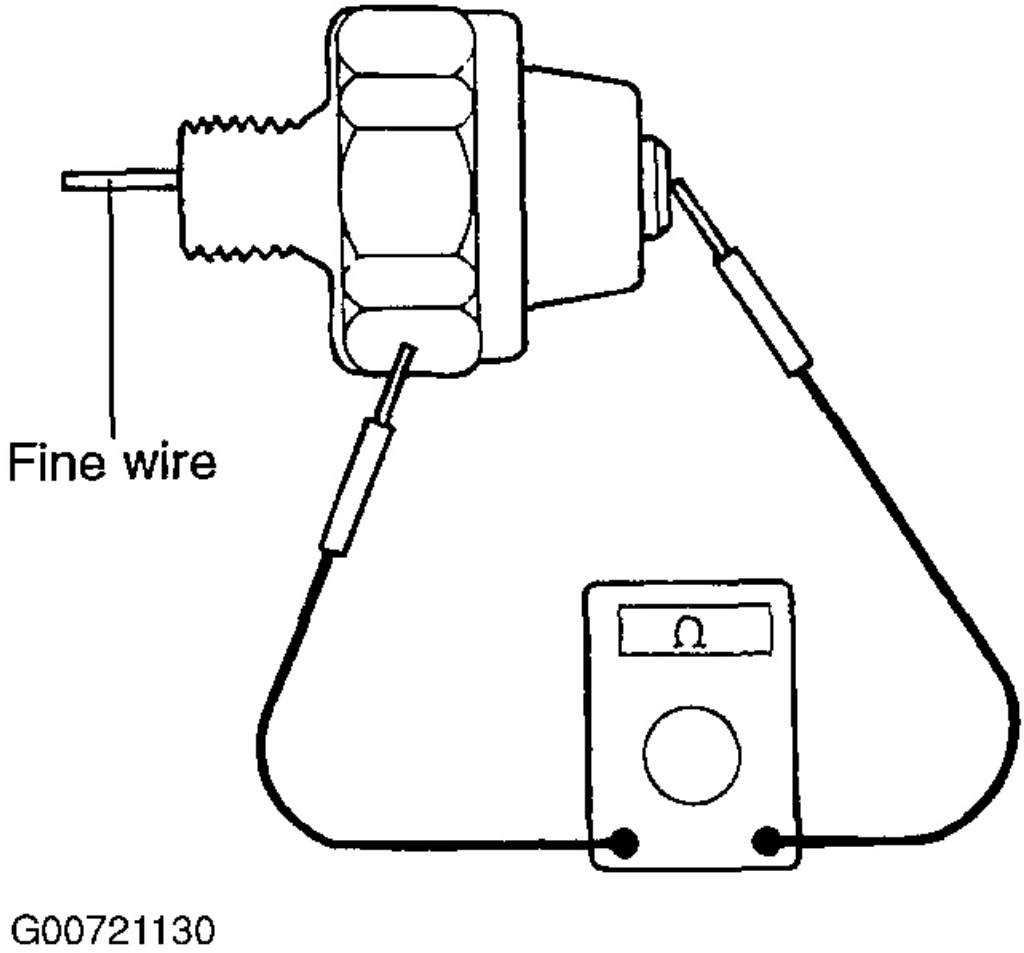


Fig. 126: Checking Oil Pressure Switch Continuity (Using Fine Wire)
Courtesy of HYUNDAI MOTOR CO.

Operation Pressure

Oil pressure switch:

80 kpa (0.8 kg/cm^2 , 11.4 psi) or more @ 700 rpm

REASSEMBLY

1. Install the oil pump case with the gasket.

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Tightening torque

Oil pump case bolt:

15 ~ 20 Nm (150 ~ 200 kg.cm, 11 ~ 14 lb. ft)

Oil pump cover screw:

8 ~ 12 Nm (80 ~ 120 kg.cm, 6 ~ 9 lb. ft)

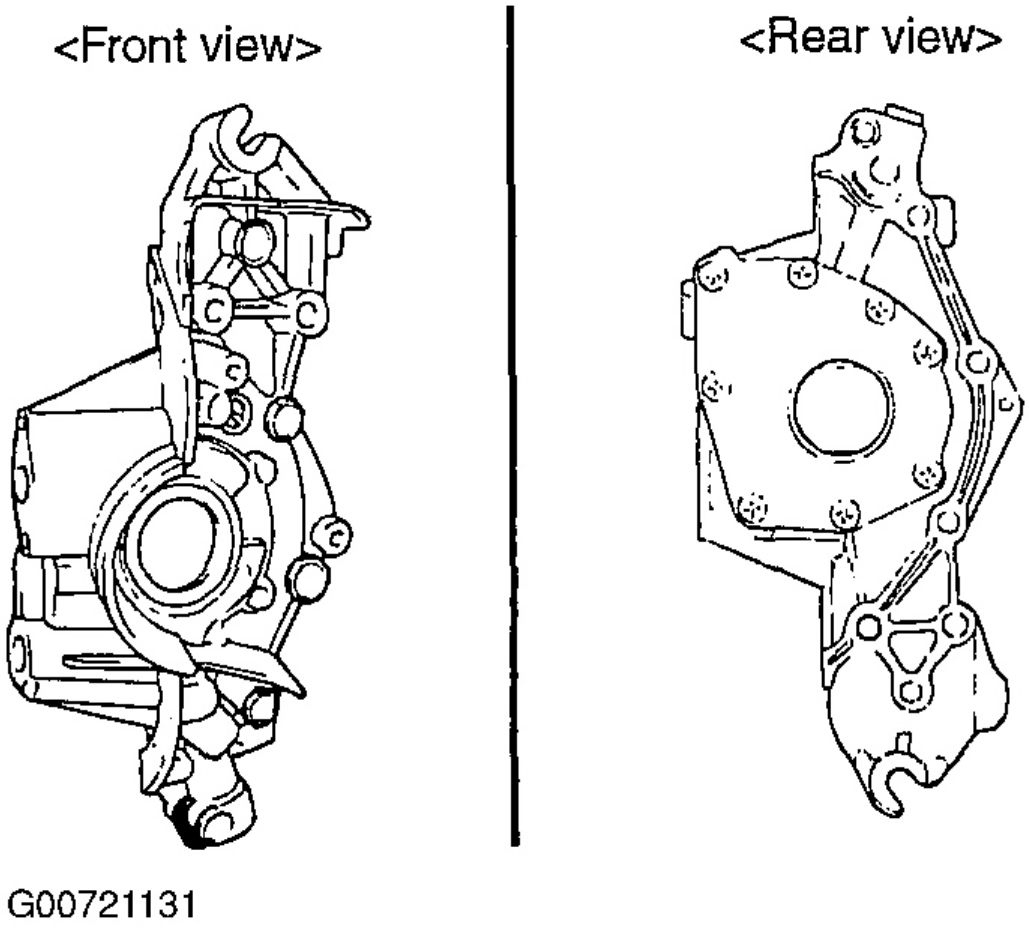


Fig. 127: Identifying Oil Pump
Courtesy of HYUNDAI MOTOR CO.

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

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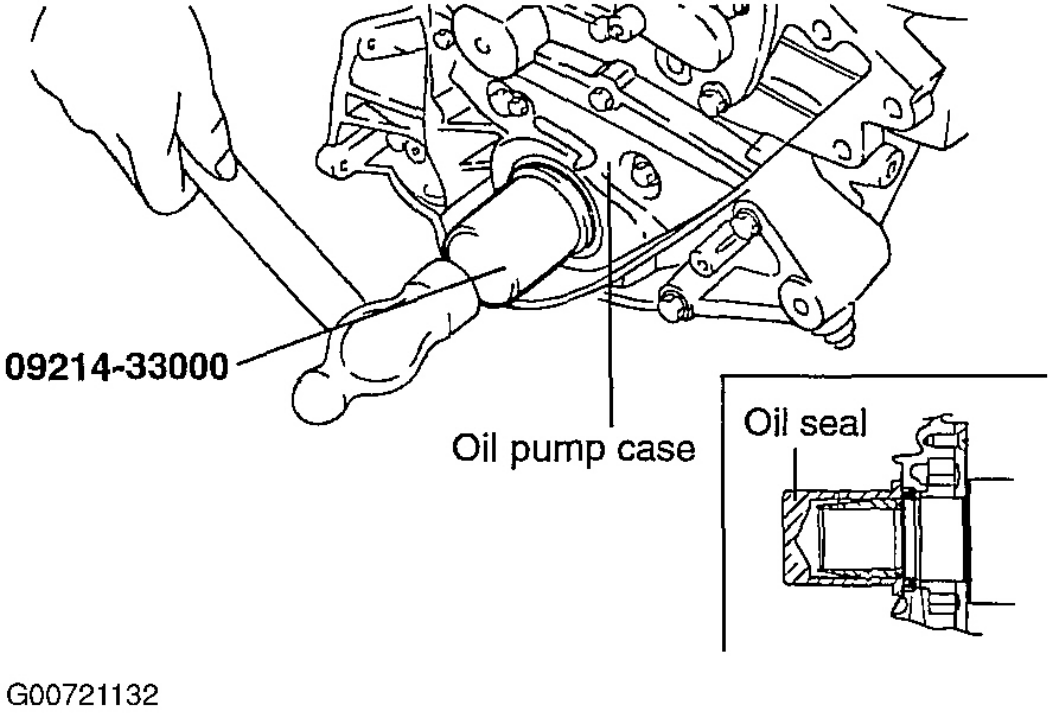


Fig. 128: Installing Oil Seal Into Oil Pump Case
Courtesy of HYUNDAI MOTOR CO.

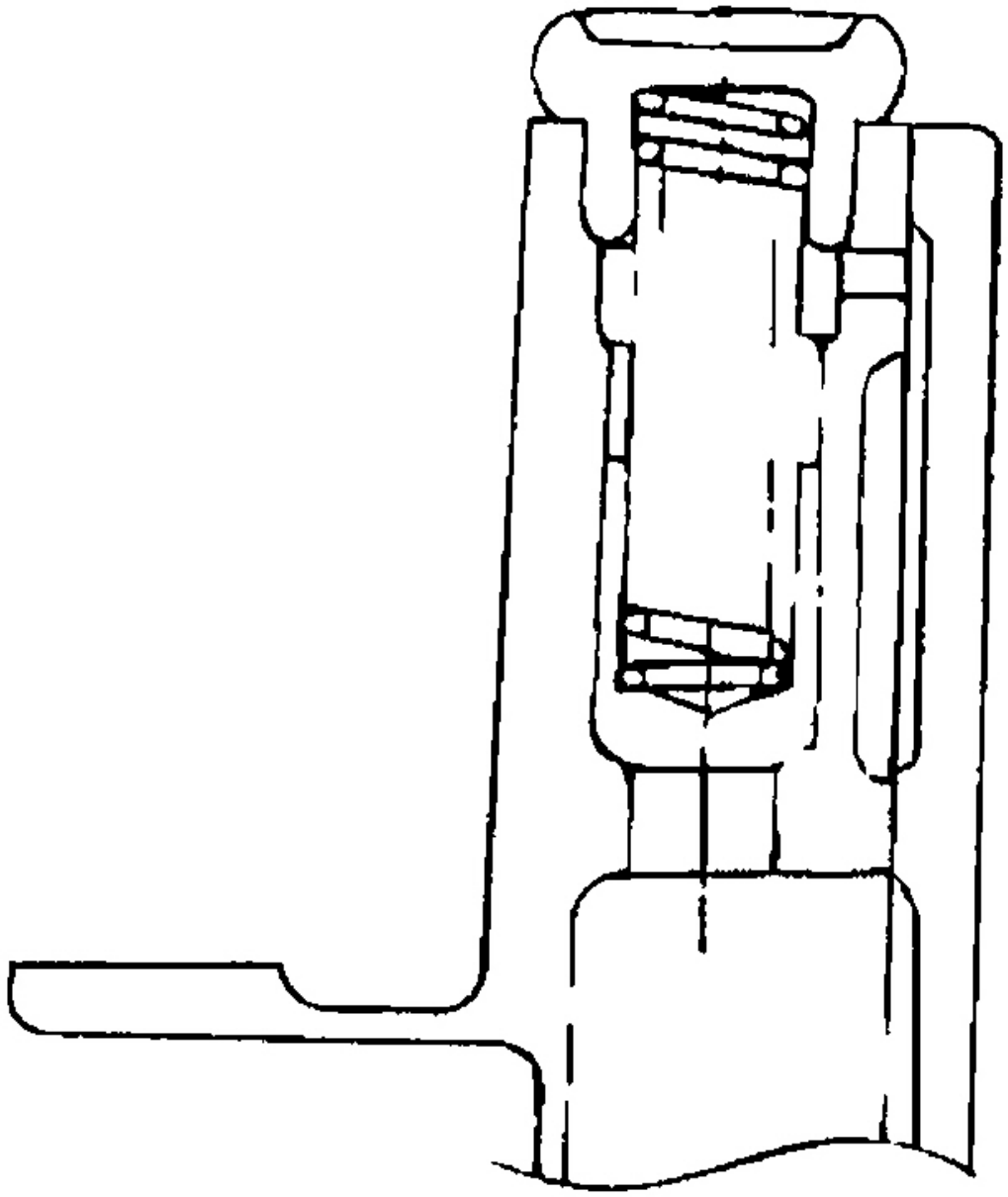
3. Install the relief plunger and spring, and tighten the oil relief valve plug to the specified torque.

   Tightening torque

   Oil relief valve plug:

   40 ~ 50 Nm (400 ~ 500 kg.cm, 29 ~ 36 lb. ft)

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Fig. 129: Installing Relief Valve & Spring
Courtesy of HYUNDAI MOTOR CO.

4. Install the oil screen and a new gasket.

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Tightening torque

Oil screen bolt:

15 ~ 22 Nm (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:

1. **Make the first cut approx. 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.**
2. **Make sure that the sealant doesn't enter the inside of the oil pan.**

7. Install the oil pan and tighten the bolts to the specified torque.

Tightening torque

Oil pan bolt

*: 5 ~ 7 Nm (50 ~ 70 kg.cm, 4 ~ 5 lb. ft)

**: 5 ~ 7 Nm (50 ~ 70 kg.cm, 4 ~ 5 lb. ft)

***: 30 ~ 42 Nm (300 ~ 420 kg.cm, 22 ~ 30 lb. ft)

T/M tightening bolt (4EA):

10 ~ 12 Nm (100 ~ 120 kg.cm, 7.2 ~ 9 lb. ft)

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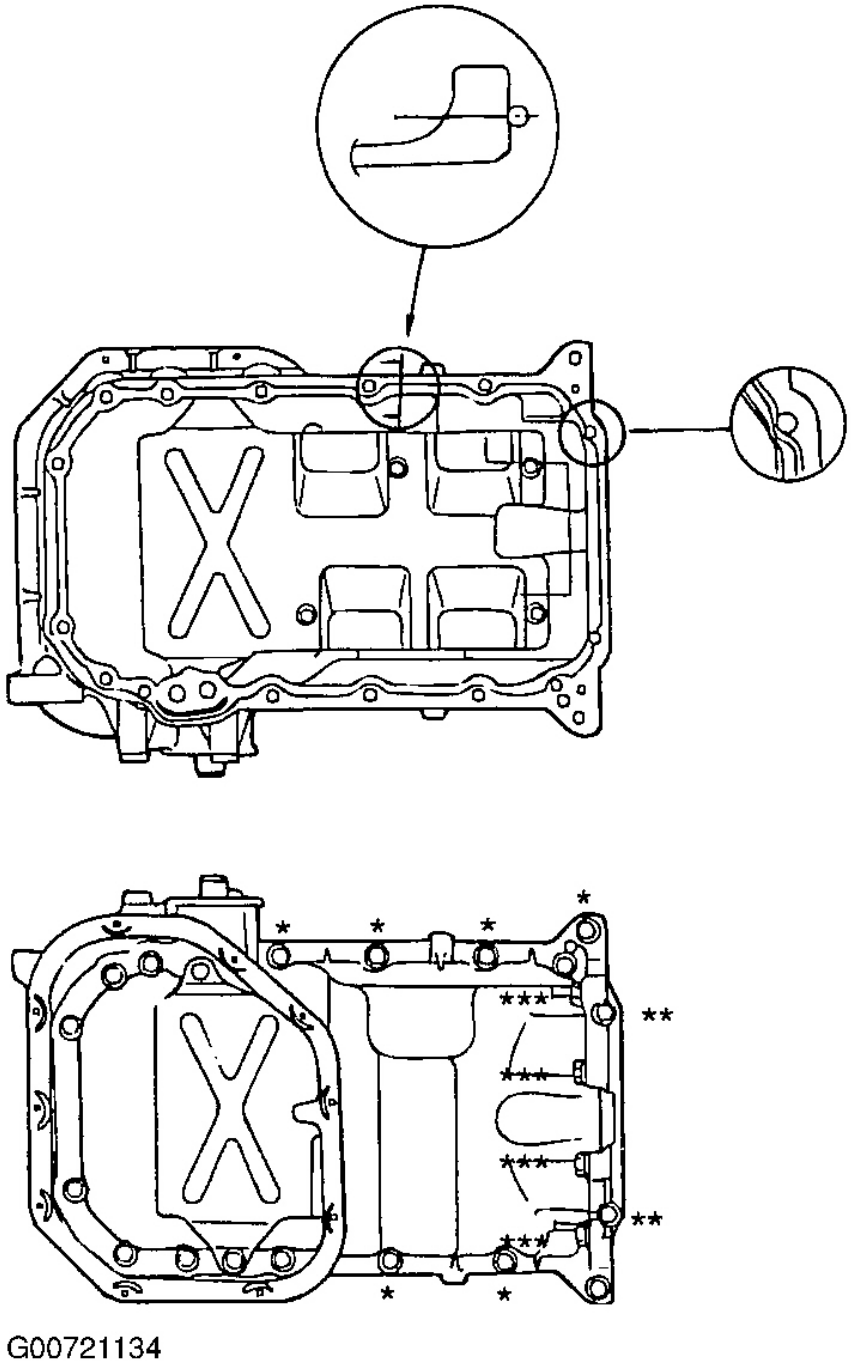


Fig. 130: Upper Oil Pan Sealant Location & Individual Bolt Torque Identification
Courtesy of HYUNDAI MOTOR CO.

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

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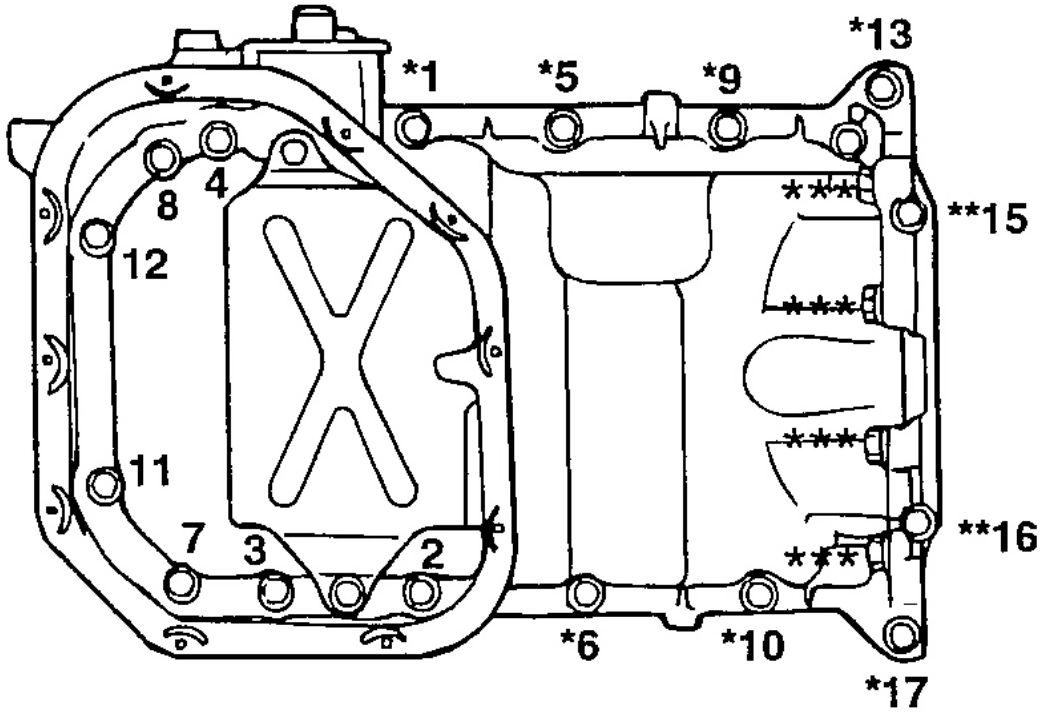


Fig. 131: Upper Oil Pan Bolt Tightening Sequence
Courtesy of HYUNDAI MOTOR CO.

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 Nm (80 ~ 120 kg.cm, 6 ~ 9 lb. ft)

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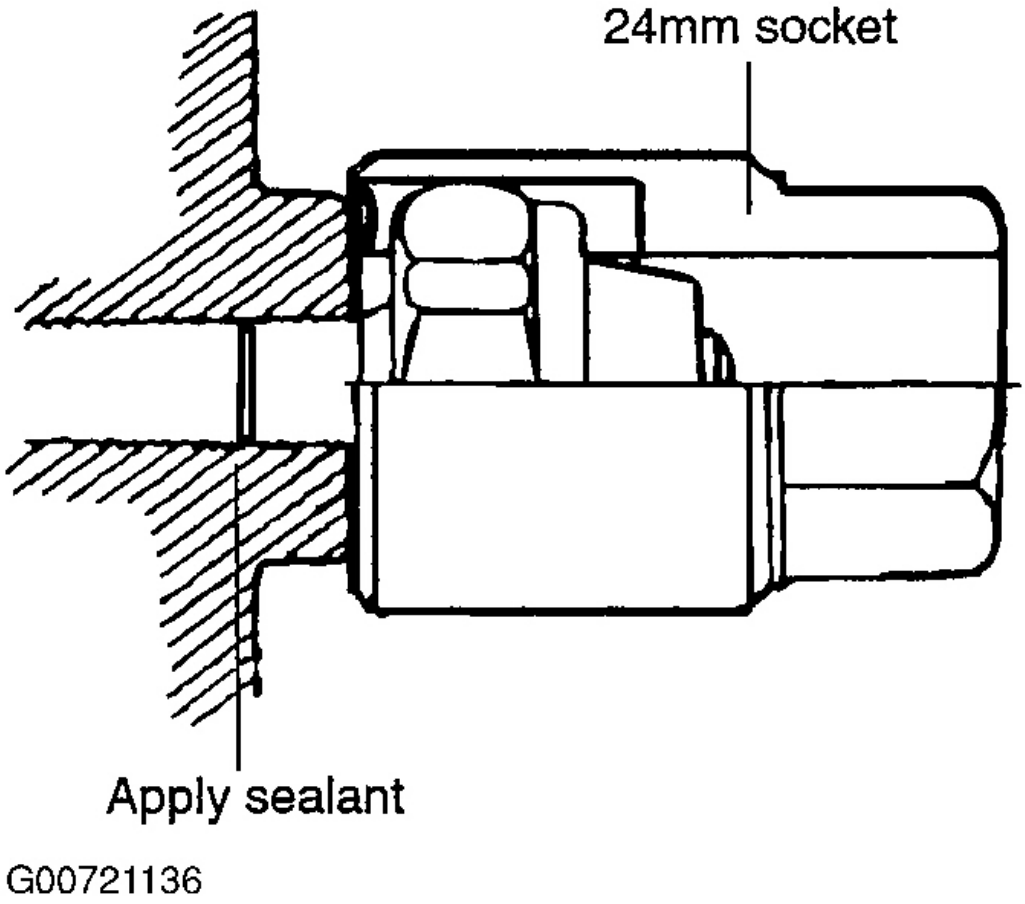


Fig. 132: Installing Oil Pressure Switch
Courtesy of HYUNDAI MOTOR CO.

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

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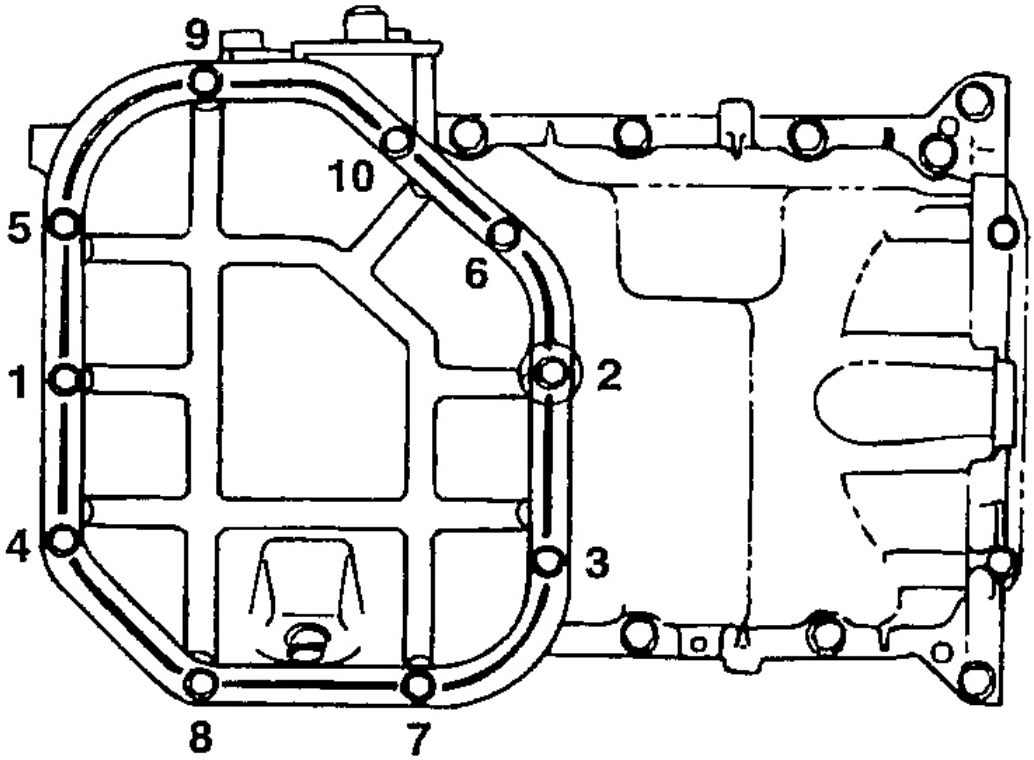


Fig. 133: Lower Oil Pan Tightening Sequence
Courtesy of HYUNDAI MOTOR CO.

INTAKE AND EXHAUST SYSTEM

EXHAUST MANIFOLD

COMPONENTS

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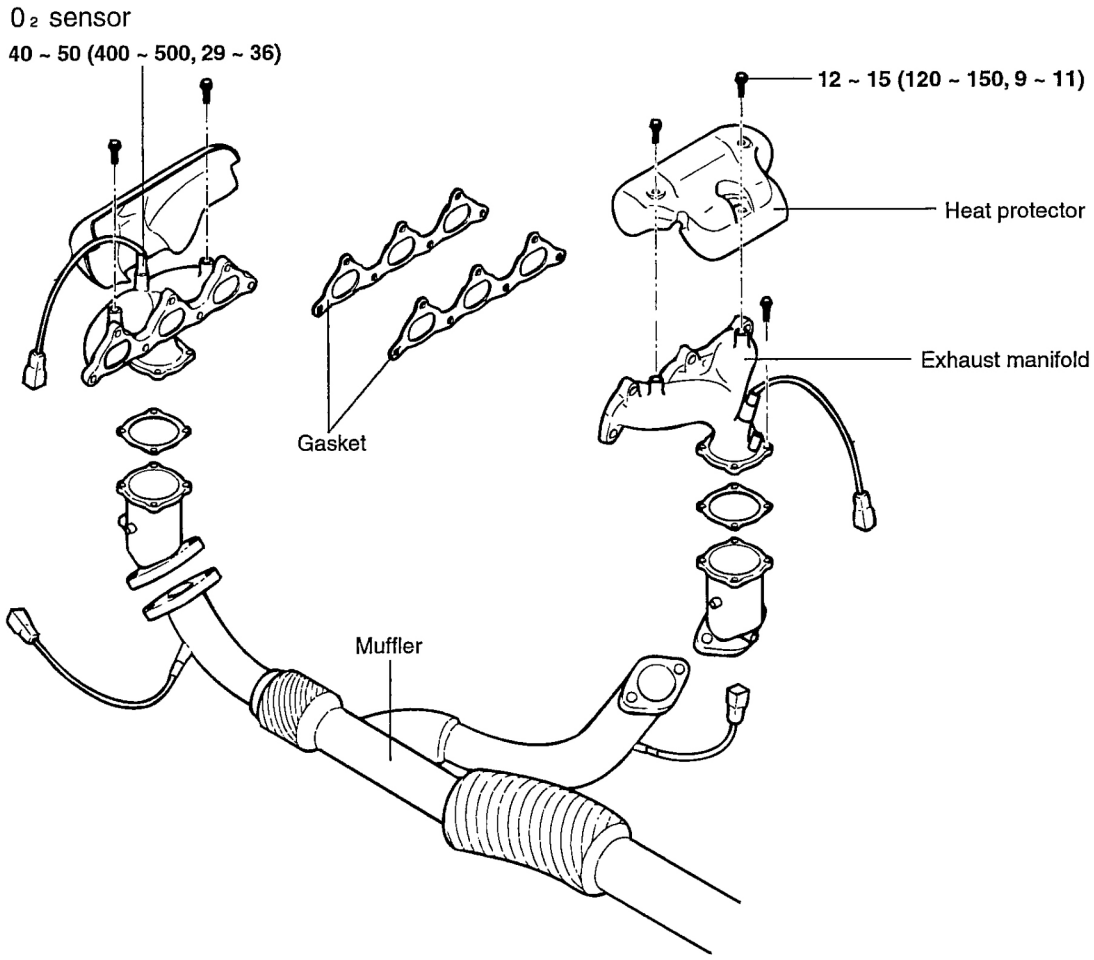
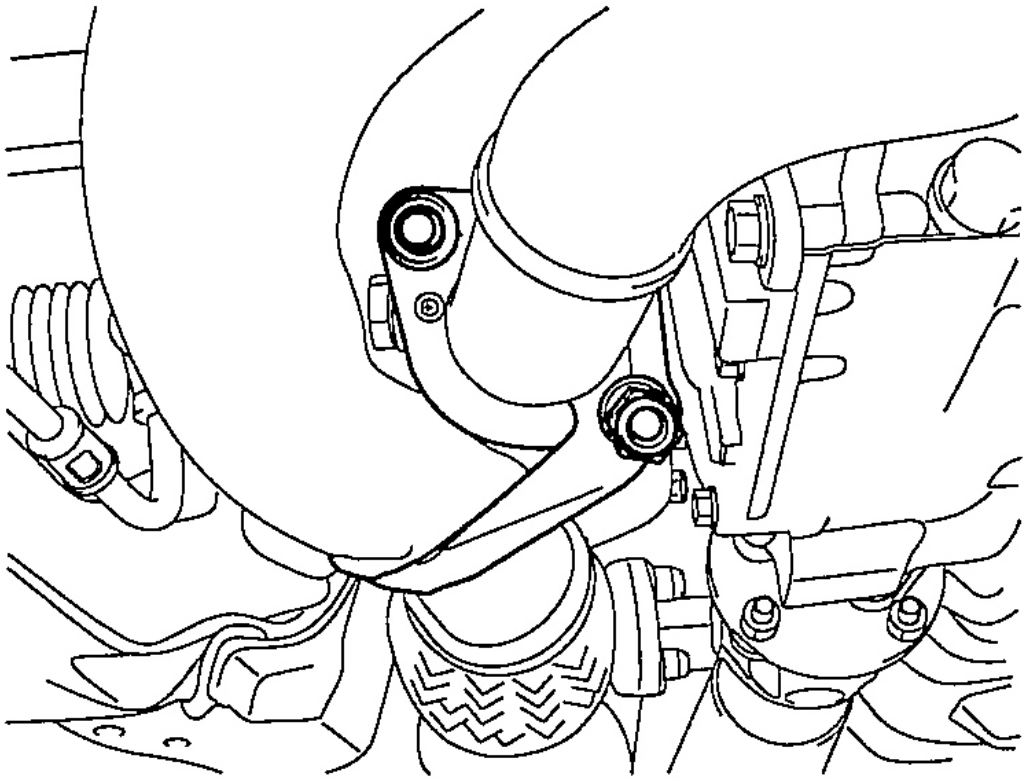


Fig. 134: Identifying Exhaust Manifold Components
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

1. Remove the front muffler.

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Fig. 135: Removing Front Muffler (1 Of 2)
Courtesy of HYUNDAI MOTOR CO.

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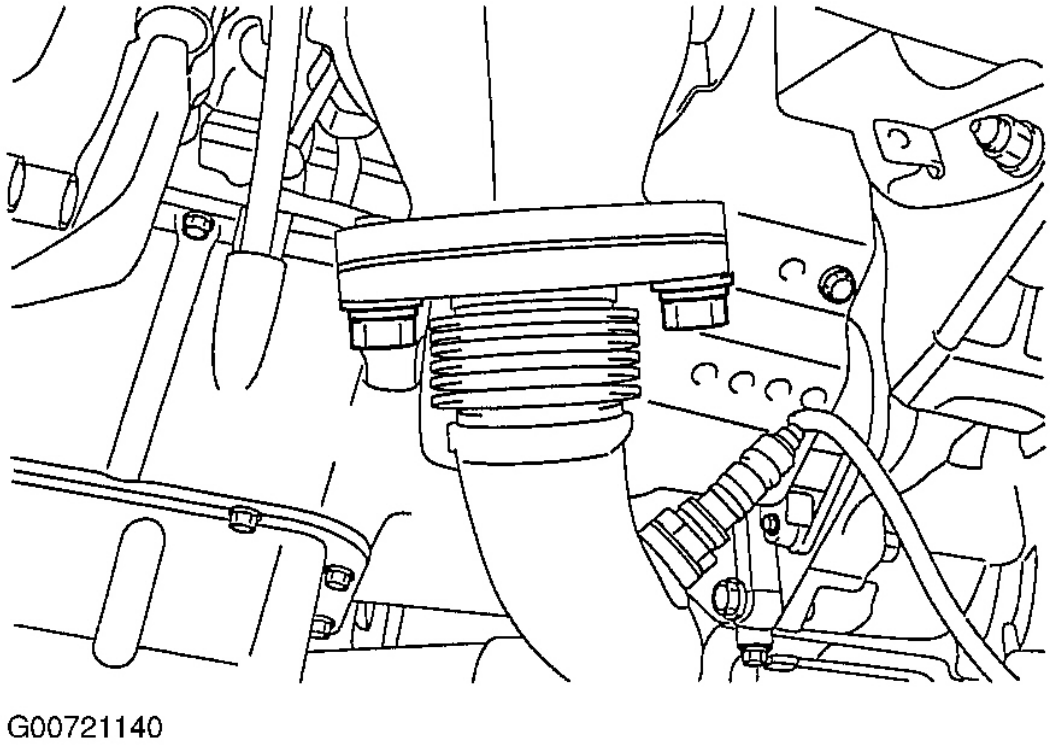
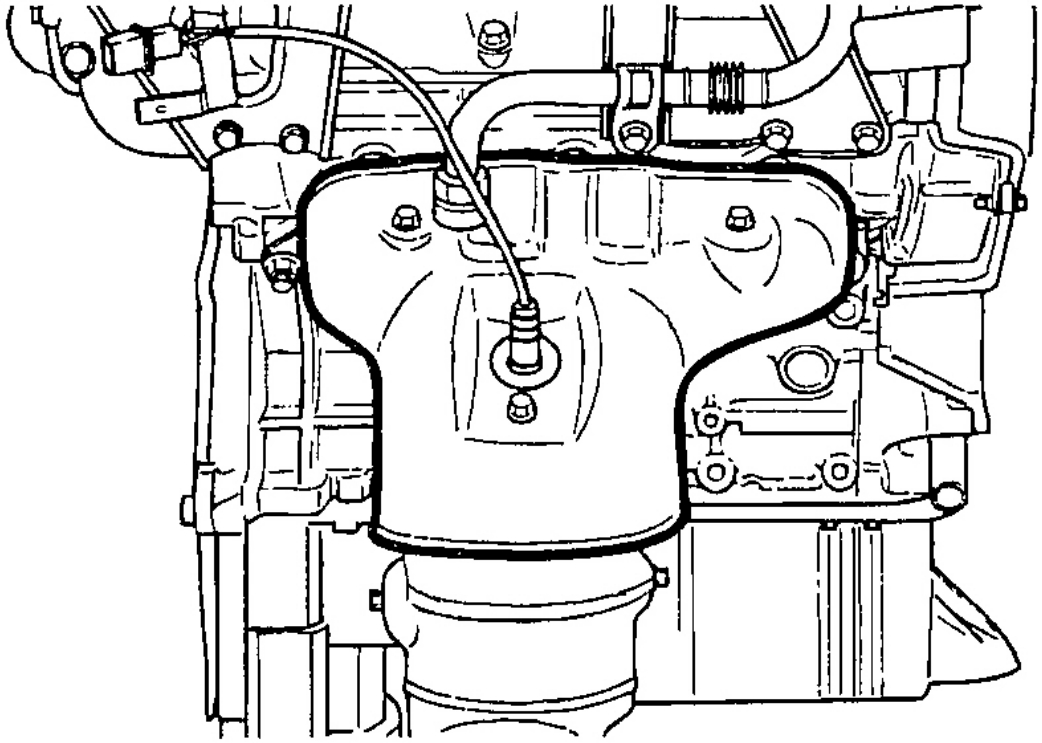


Fig. 136: Removing Front Muffler (2 Of 2)
Courtesy of HYUNDAI MOTOR CO.

2. Remove the heat protector.

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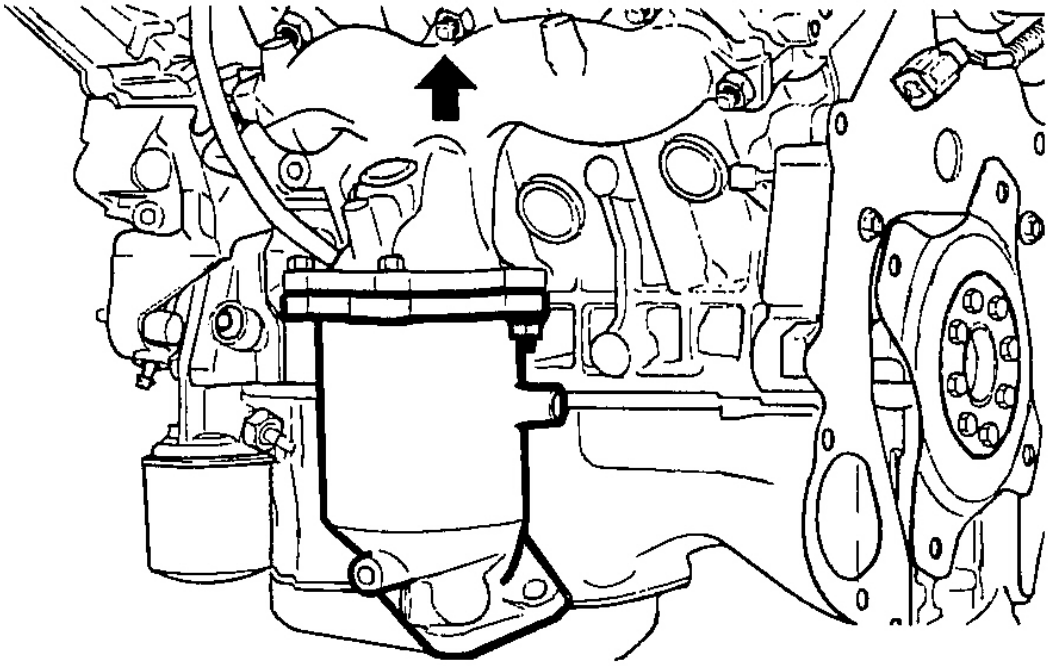


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Fig. 137: Removing Heat Protector
Courtesy of HYUNDAI MOTOR CO.

3. Remove the exhaust manifold.

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Fig. 138: Removing Exhaust Manifold
Courtesy of HYUNDAI MOTOR CO.

4. Remove the exhaust manifold gasket.

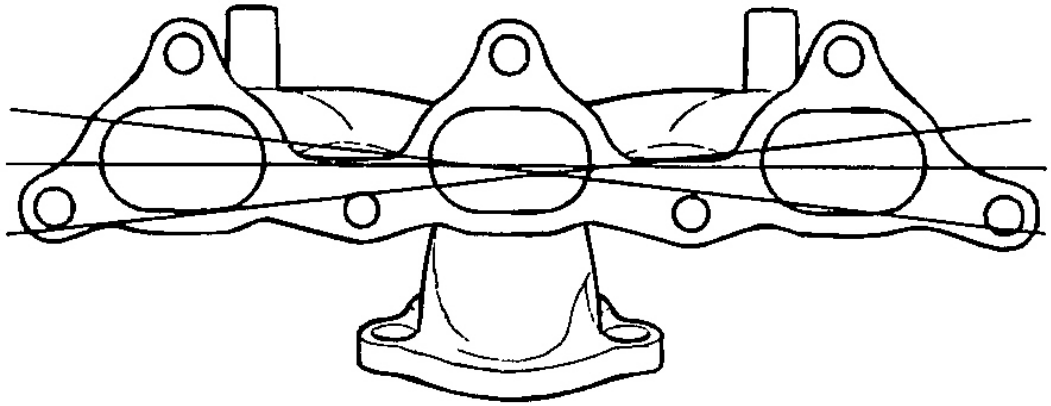
INSPECTION

1. Check for damage or cracks.
2. Using a straight edge and feeler gauge, check for distortion on the cylinder head matching surface.

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

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

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Fig. 139: Checking Exhaust Manifold For Warpage
Courtesy of HYUNDAI MOTOR CO.

3. Check the exhaust manifold for damage and cracks.

INSTALLATION

1. Install the exhaust manifold with gasket.

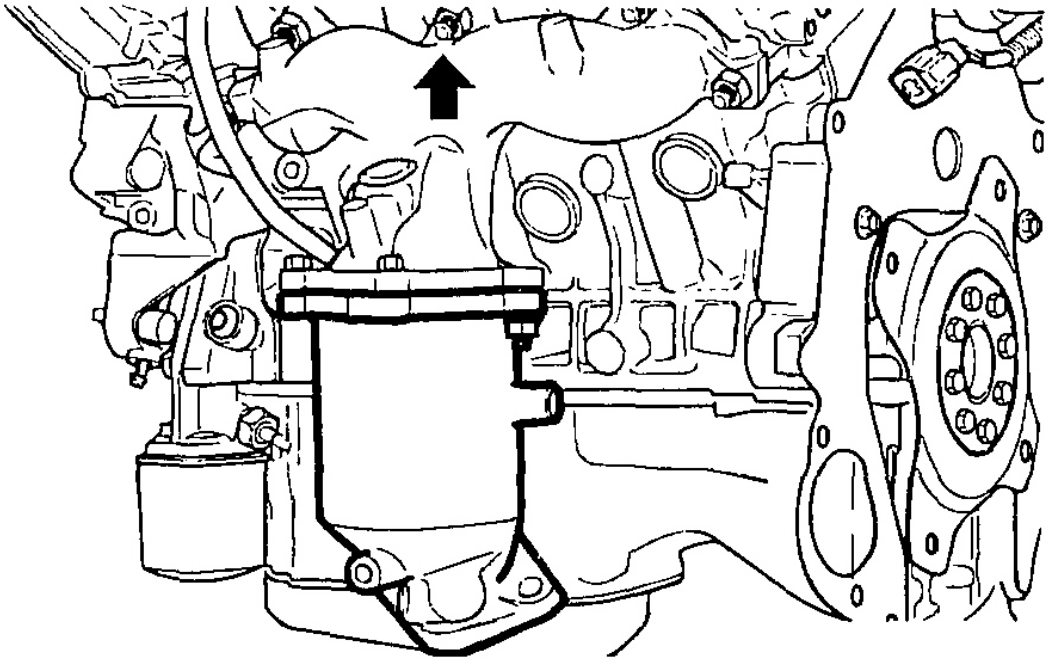
   Tightening torque

   Exhaust manifold:

   40 ~ 45 Nm (400 ~ 450 kg.cm, 29 ~ 33 lb. ft)

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

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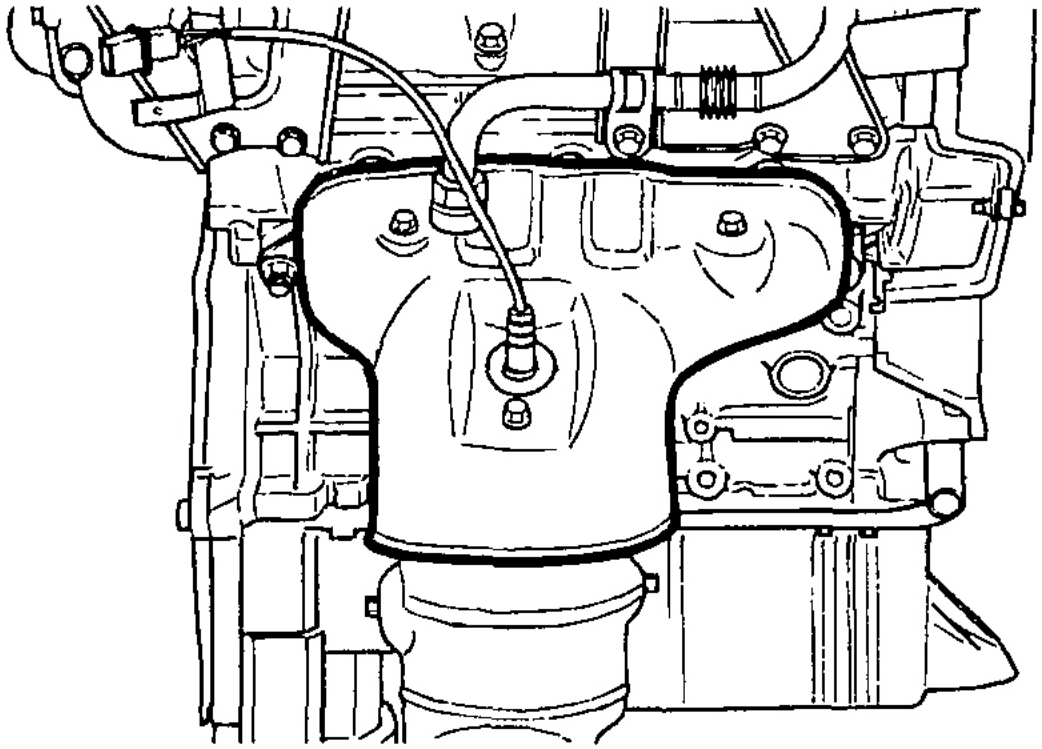


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Fig. 140: Installing Exhaust Manifold
Courtesy of HYUNDAI MOTOR CO.

2. Install the heat protector.

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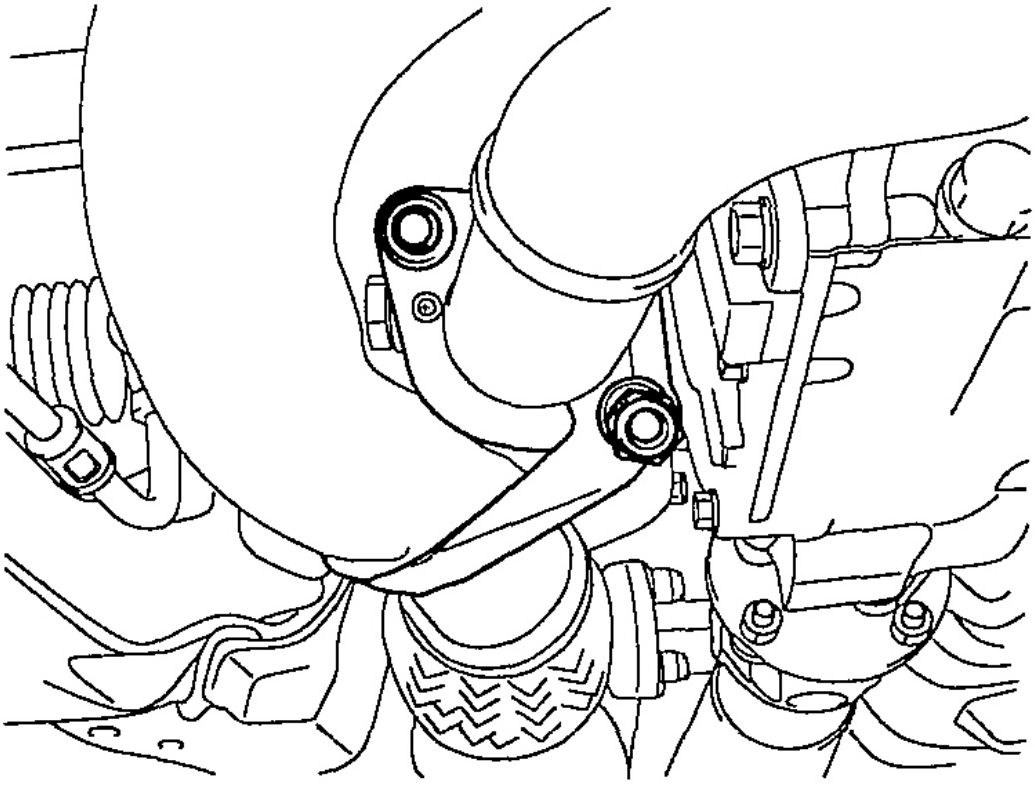


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Fig. 141: Installing Exhaust Manifold Heat Protector
Courtesy of HYUNDAI MOTOR CO.

3. Install the front muffler.

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Fig. 142: Installing Front Muffler (1 Of 2)
Courtesy of HYUNDAI MOTOR CO.

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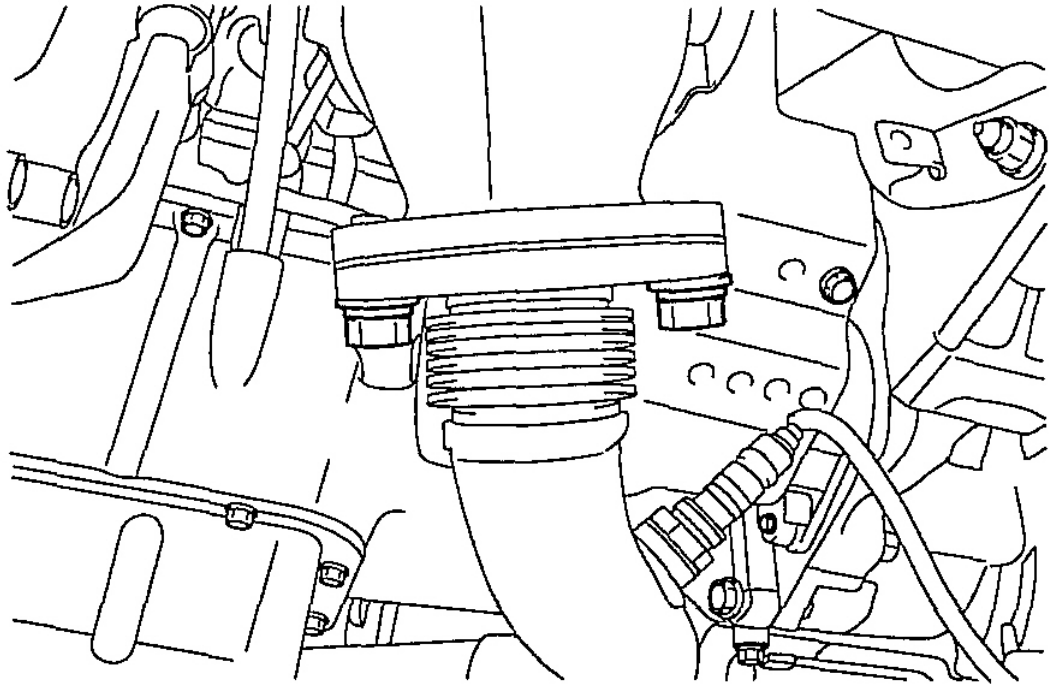


Fig. 143: Installing Front Muffler (2 Of 2)
Courtesy of HYUNDAI MOTOR CO.

INTAKE MANIFOLD

COMPONENTS

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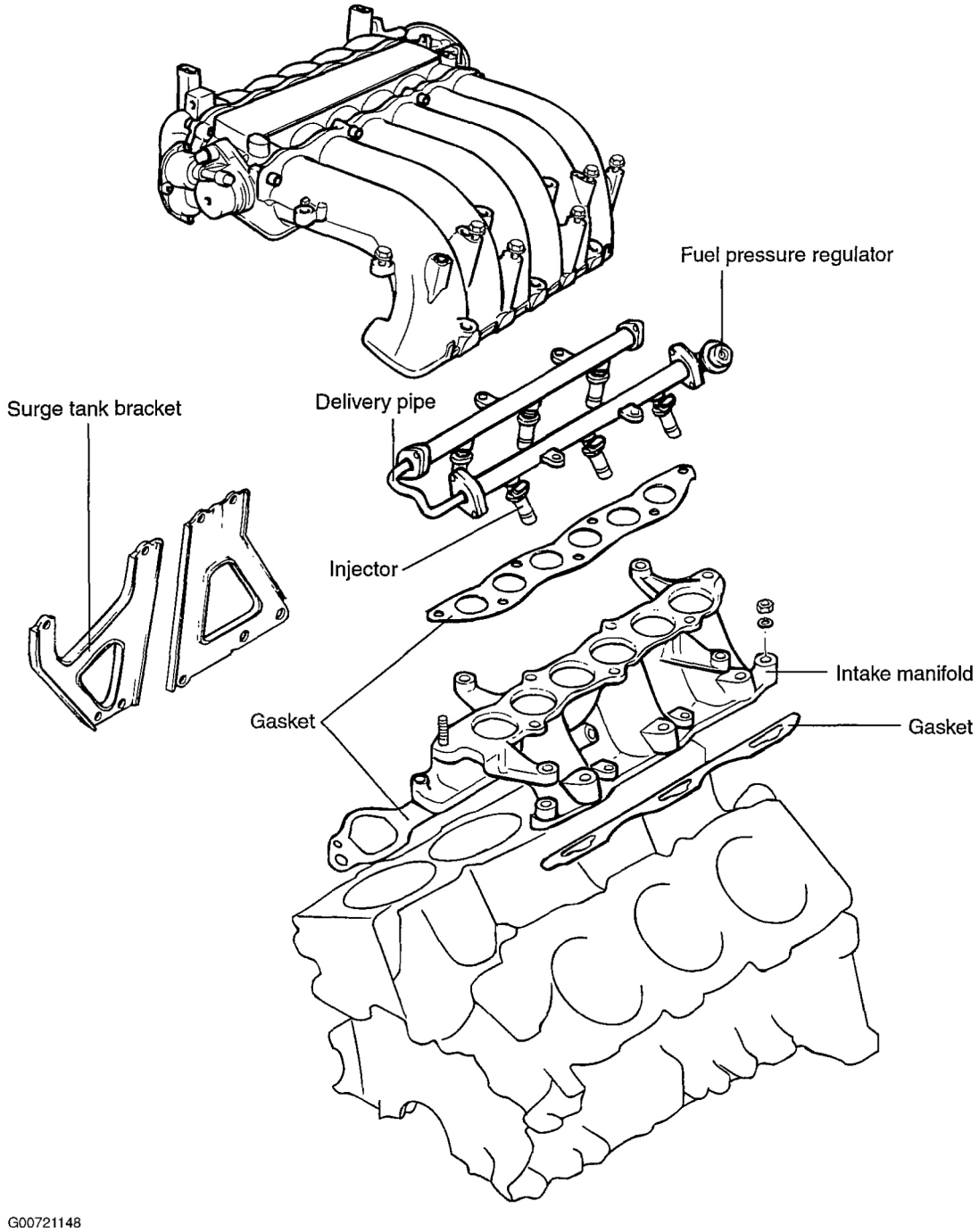
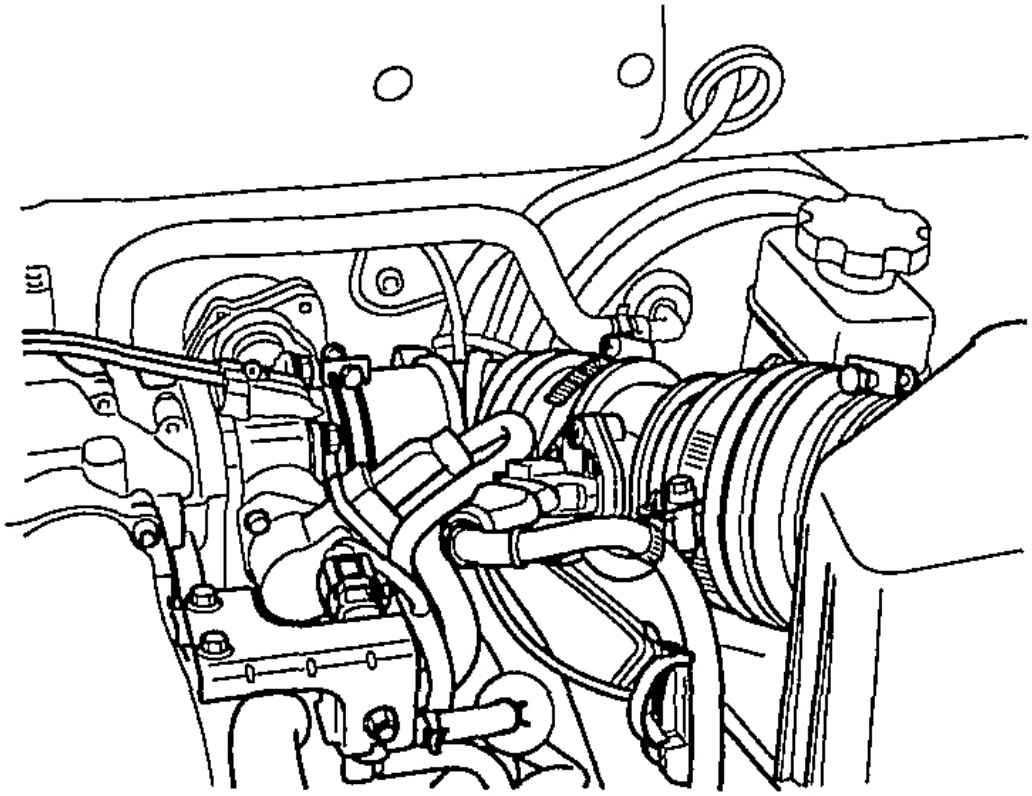


Fig. 144: Identifying Intake Manifold Components
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

1. Remove the air intake hose connected to the throttle body.

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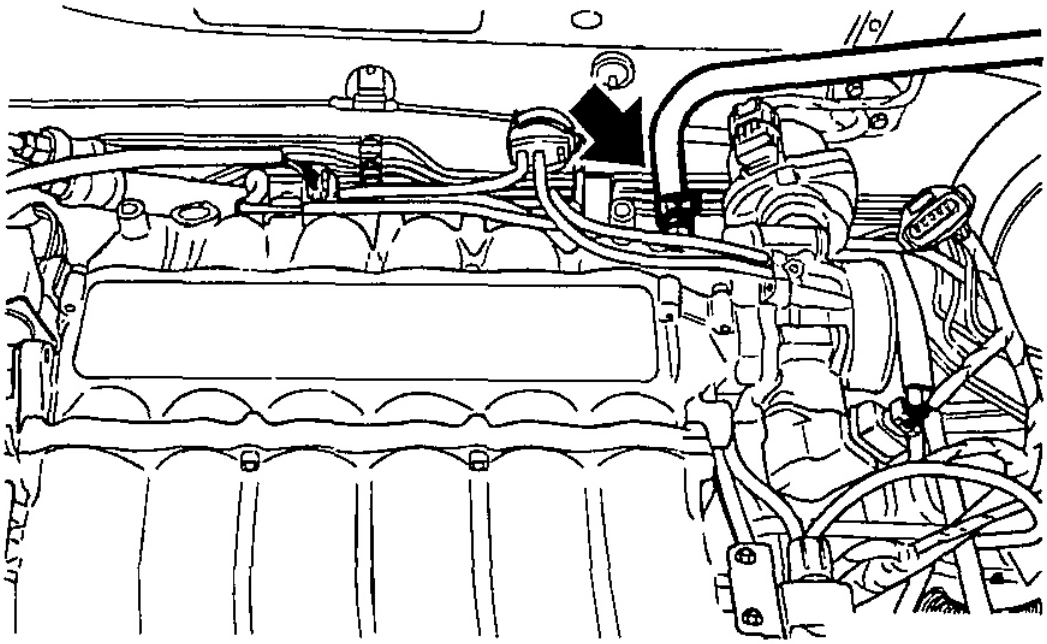


G00721149

Fig. 145: Removing Throttle Body Air Intake Hose
Courtesy of HYUNDAI MOTOR CO.

2. Remove the engine coolant hose and throttle body.
3. Remove the P.C.V. hose and brake booster vacuum hoses.

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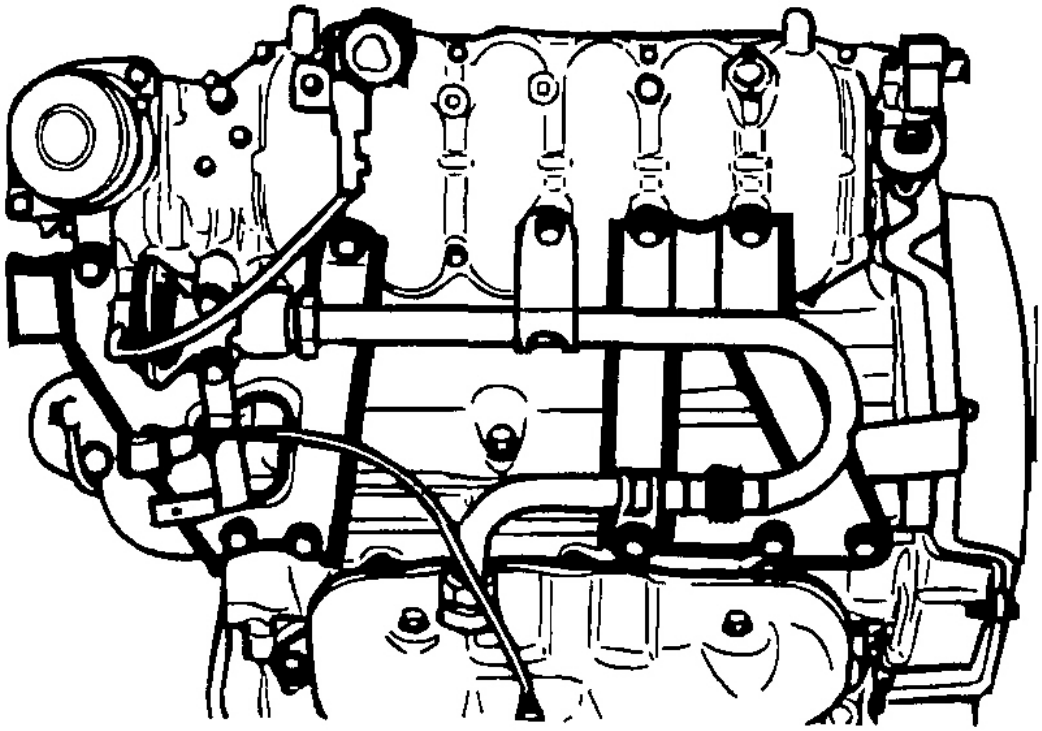


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Fig. 146: Removing PCV & Brake Booster Vacuum Hoses
Courtesy of HYUNDAI MOTOR CO.

4. Disconnect the vacuum hose connections.
5. Remove the surge tank stay.

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Fig. 147: Removing Surge Tank Stay
Courtesy of HYUNDAI MOTOR CO.

6. Remove the surge tank.
7. Remove the surge tank and gasket.

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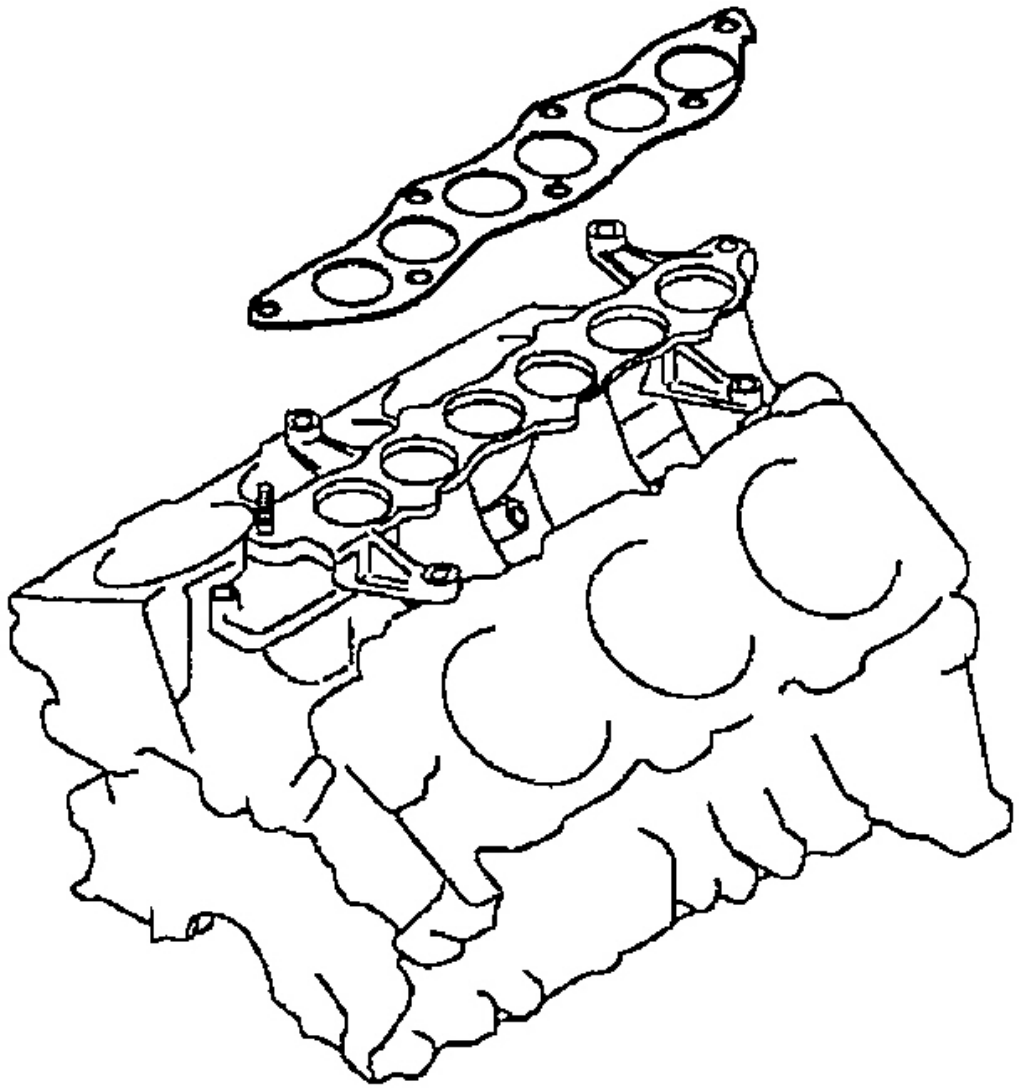


Fig. 148: Removing Surge Tank Gasket
Courtesy of HYUNDAI MOTOR CO.

8. Disconnect the fuel injector harness connector.

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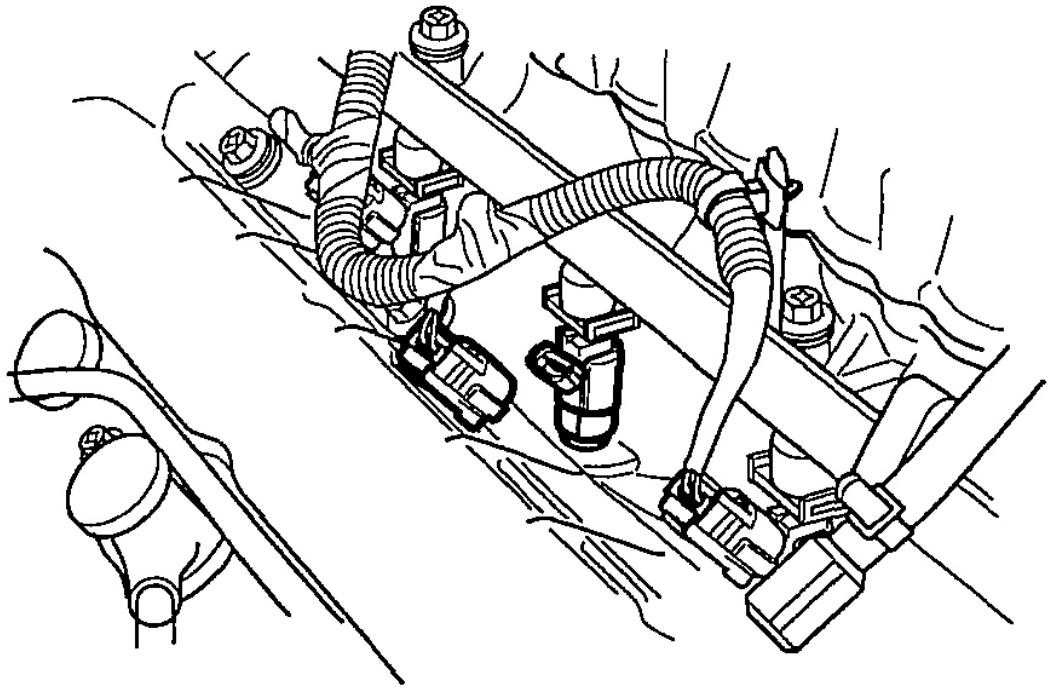


Fig. 149: Disconnecting Fuel Injector Harness Connectors
Courtesy of HYUNDAI MOTOR CO.

9. 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.

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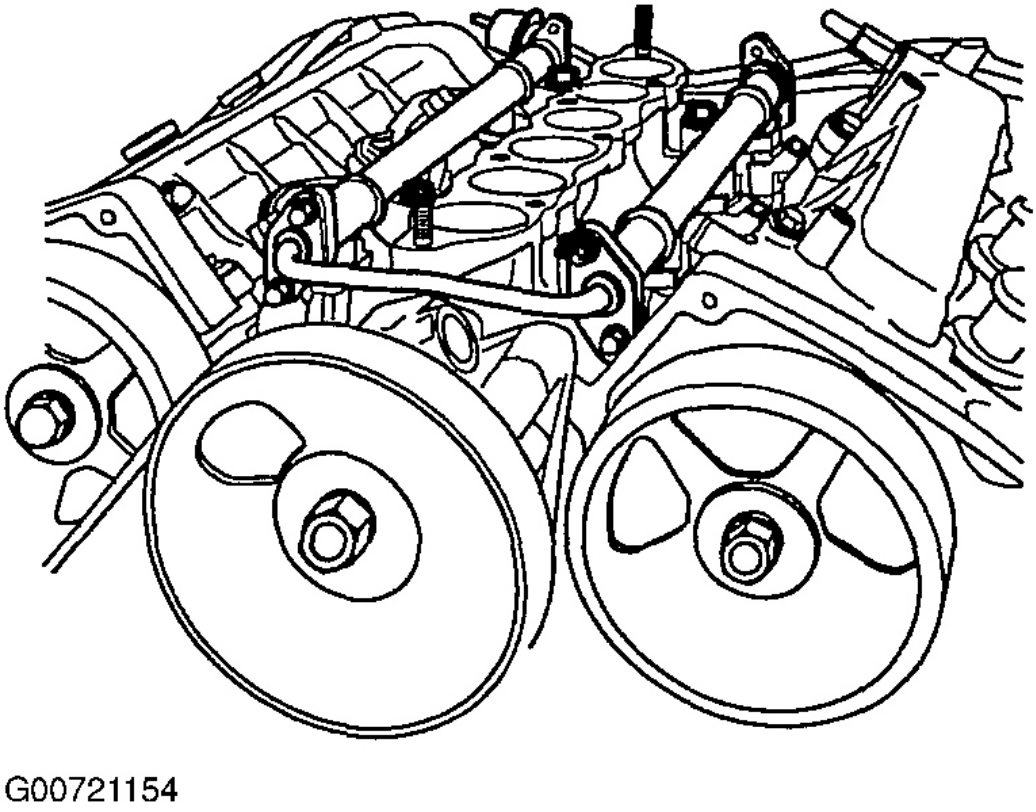


Fig. 150: Removing Fuel Delivery Pipe With Fuel Injectors
Courtesy of HYUNDAI MOTOR CO.

10. Disconnect the wiring harness of the coolant sensor assembly.

INSPECTION

SURGE TANK AND 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.)

INSTALLATION

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

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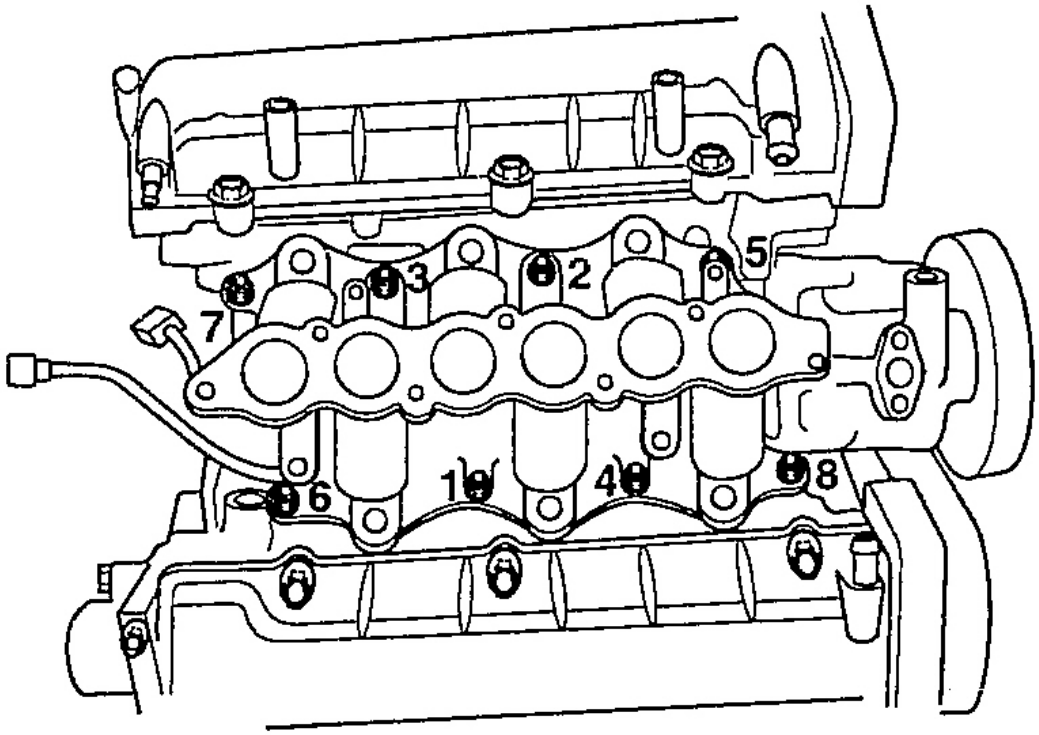
Tightening torque

Intake manifold:

12 ~ 15 Nm (120 ~ 150 kg.cm, 9 ~ 11 lb. ft)

Surge tank stay:

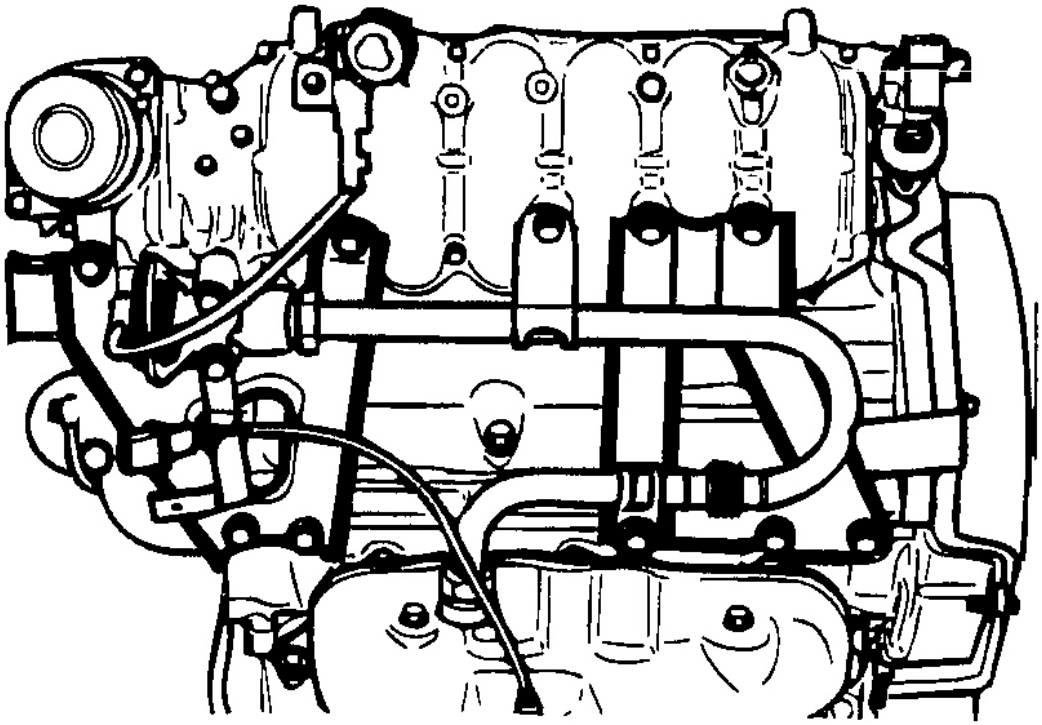
15 ~ 20 Nm (150 ~ 200 kg.cm, 11 ~ 14 lb. ft)



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Fig. 151: Intake Manifold Tightening Sequence
Courtesy of HYUNDAI MOTOR CO.

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Fig. 152: Installing Surge Tank Stay
Courtesy of HYUNDAI MOTOR CO.

MUFFLER

COMPONENTS

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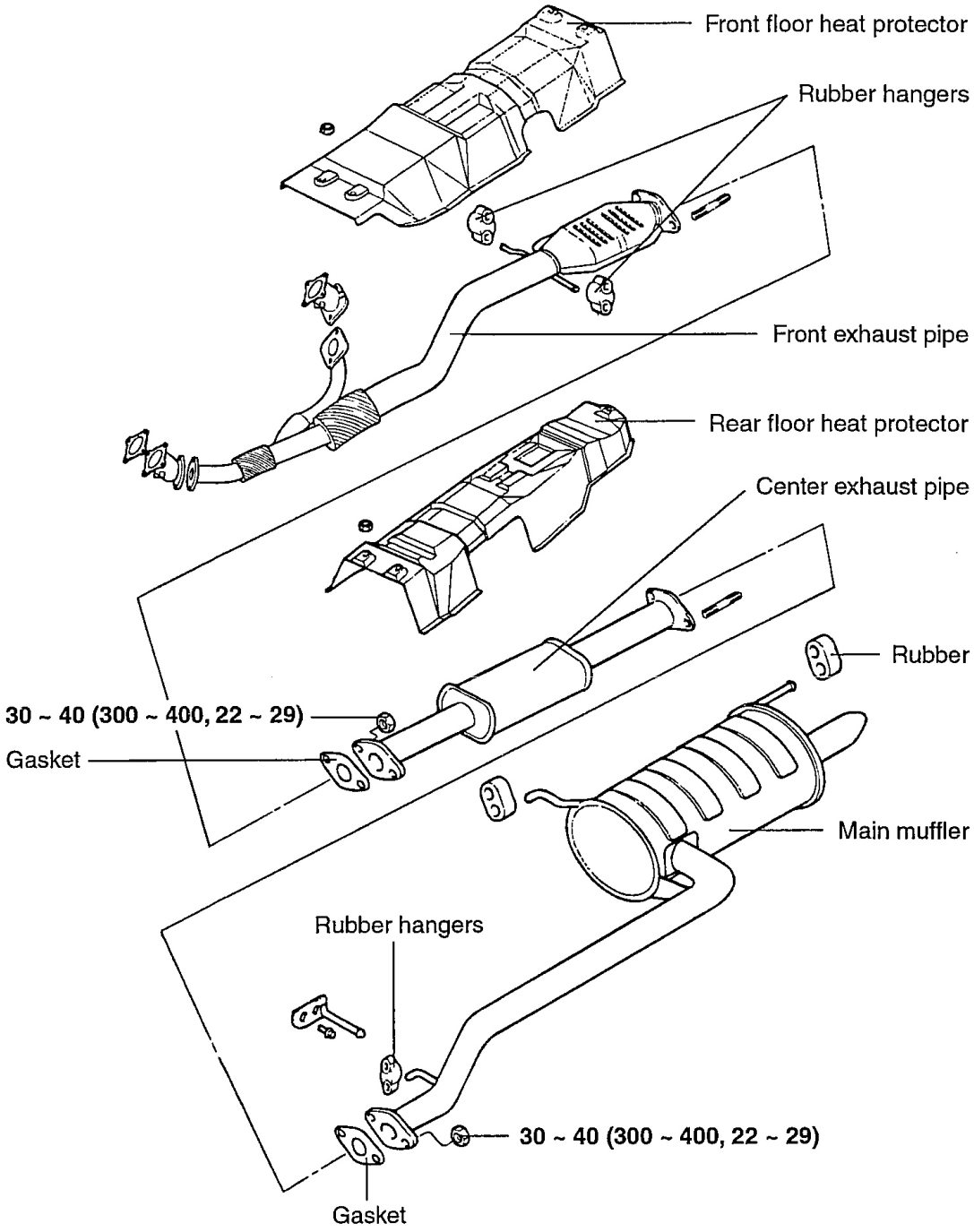


Fig. 153: Muffler/Exhaust System Components
Courtesy of HYUNDAI MOTOR CO.

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REMOVAL

REAR MUFFLER

CAUTION: Before removing or inspecting the exhaust system, ensure that the exhaust system is cool.

1. Disconnect the main muffler from the center exhaust pipe.

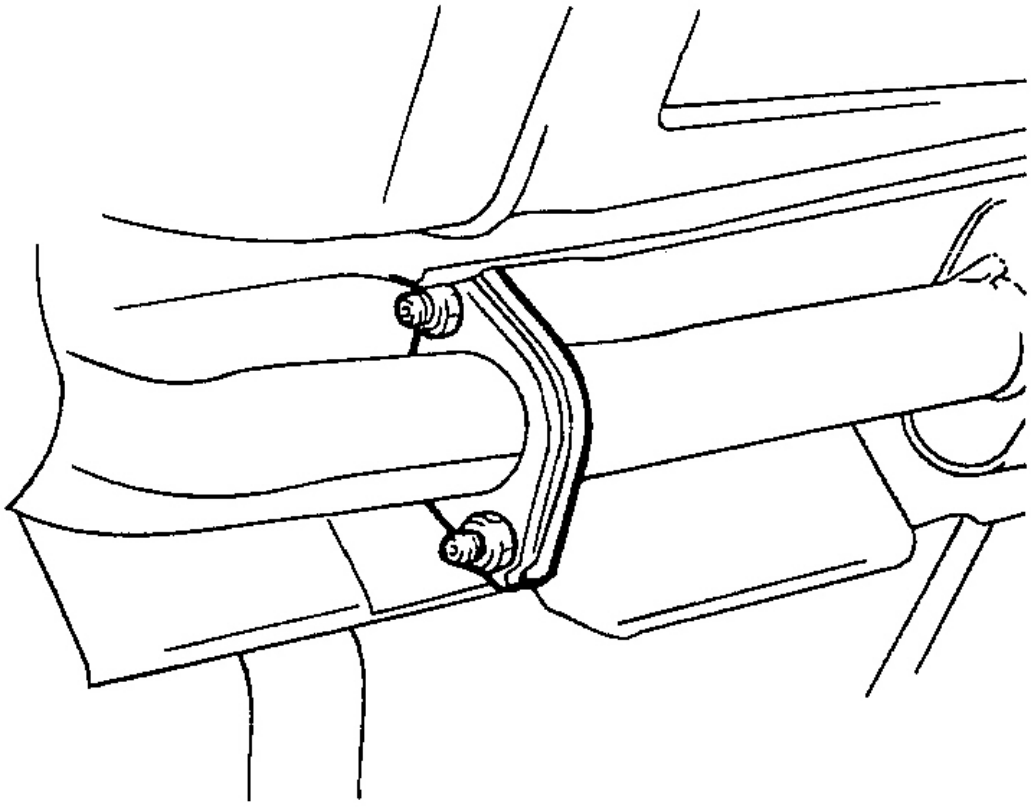
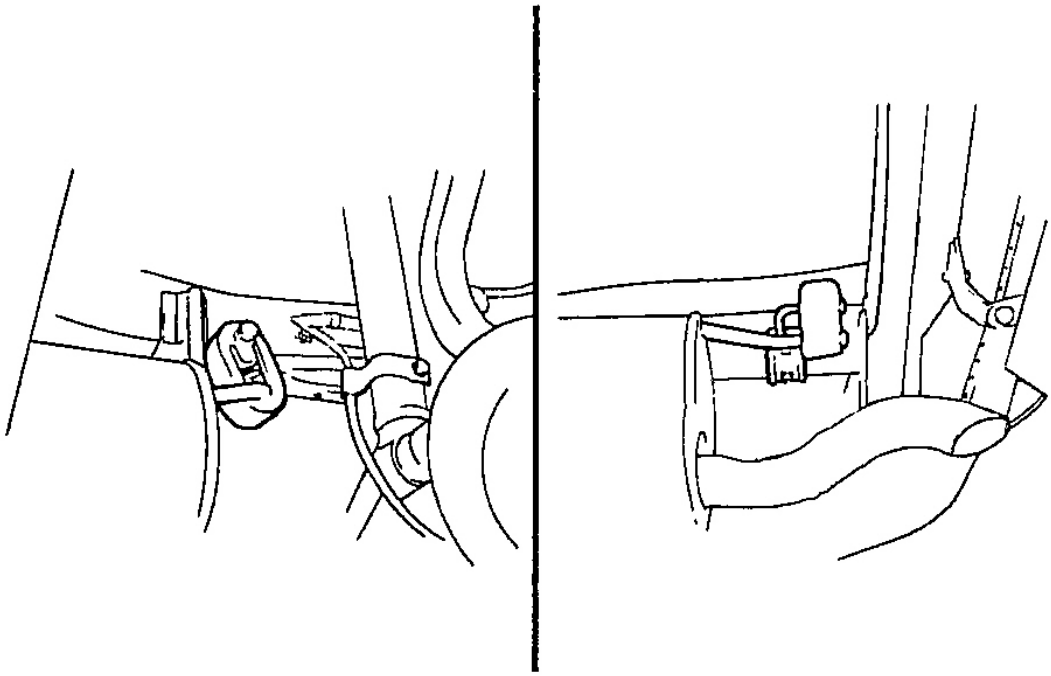


Fig. 154: Disconnecting Main Muffler From Center Exhaust Pipe
Courtesy of HYUNDAI MOTOR CO.

2. Remove the rubber hangers and the rear muffler.

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Fig. 155: Removing Rubber Hangers & Rear Muffler (1 Of 2)
Courtesy of HYUNDAI MOTOR CO.

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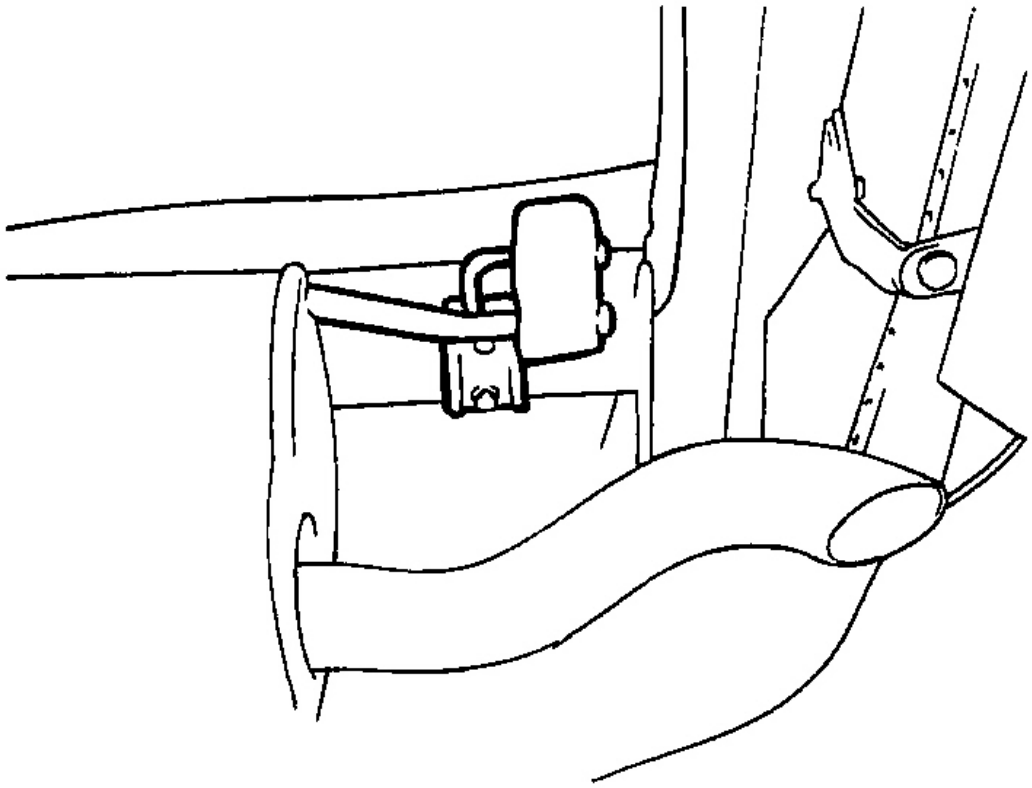
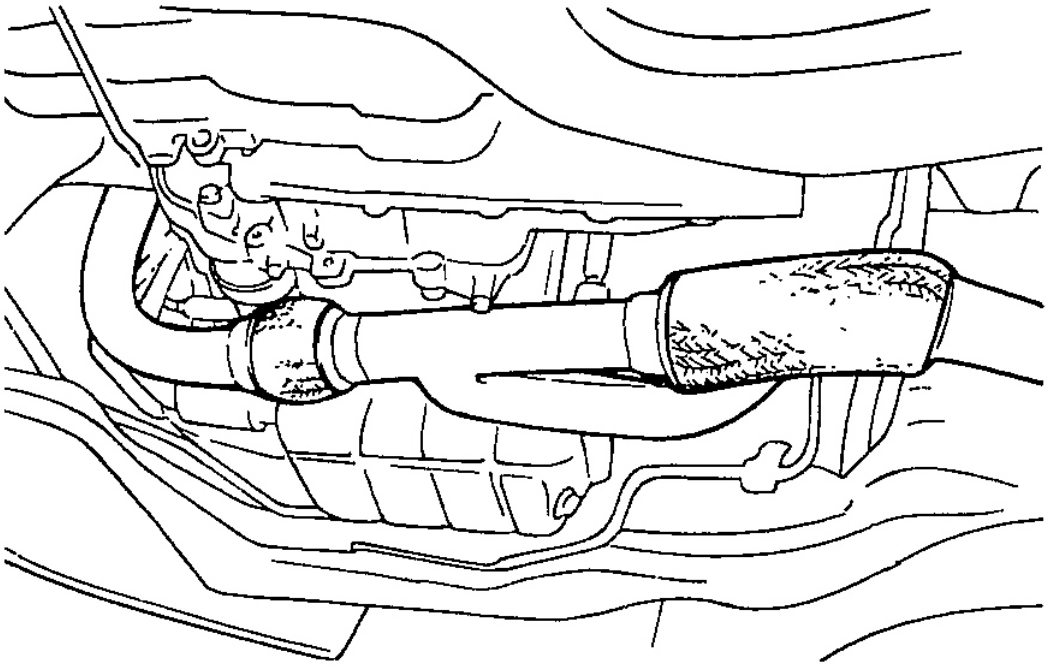


Fig. 156: Removing Rubber Hangers & Rear Muffler (2 Of 2)
Courtesy of HYUNDAI MOTOR CO.

FRONT EXHAUST PIPE (INCLUDING CATALYTIC CONVERTER)

1. Remove the front exhaust pipe from the center exhaust pipe.
2. Remove the front exhaust pipe bolt and the exhaust manifold pipe mounting nuts.

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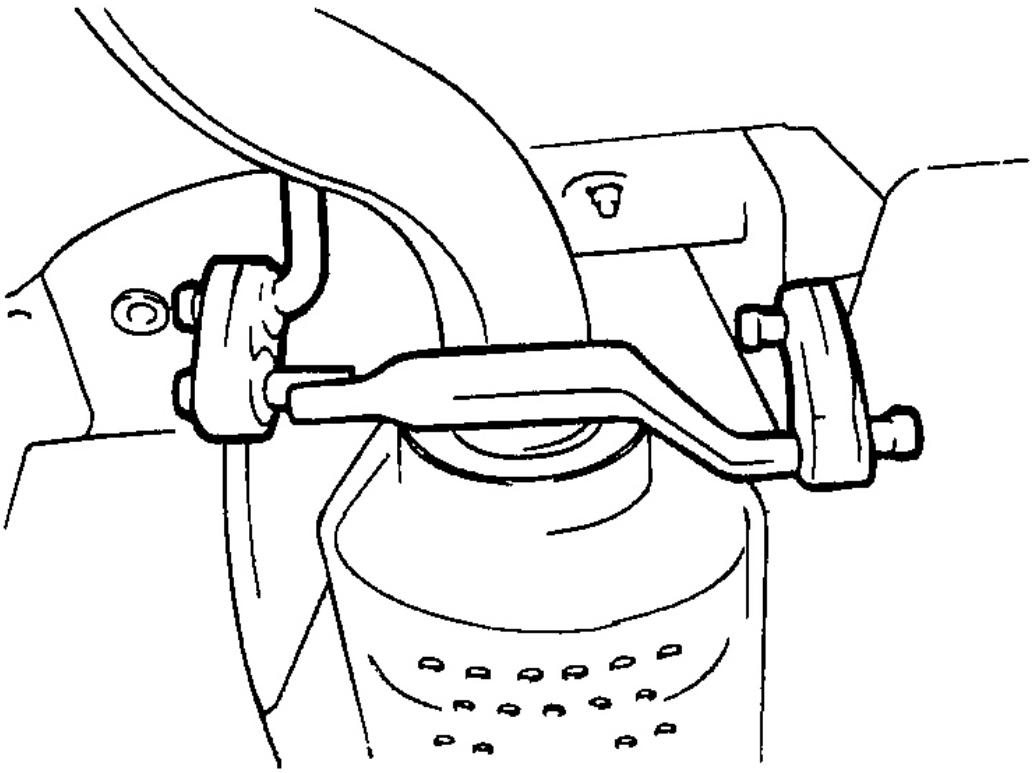


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Fig. 157: Removing Front Exhaust Pipe Bolt & Exhaust Manifold Pipe Mounting Nuts
Courtesy of HYUNDAI MOTOR CO.

3. Remove the front muffler bolts and nuts.

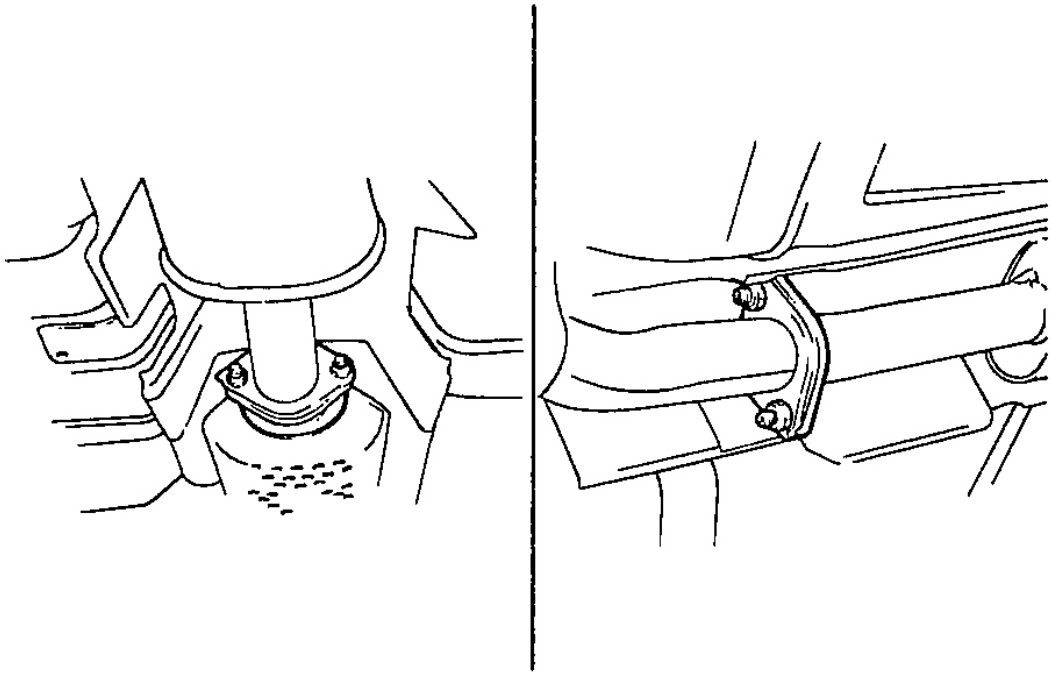
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Fig. 158: Removing Front Exhaust Pipe Hangers
Courtesy of HYUNDAI MOTOR CO.

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Fig. 159: Removing Front Muffler Bolts & Nuts
Courtesy of HYUNDAI MOTOR CO.

INSPECTION

1. Check the mufflers and pipes for leaks, corrosion and damage.
2. Check the rubber hangers for deterioration and cracks.

INSTALLATION

1. Temporarily install the front muffler, the catalytic converter assembly and the rear muffler in this order.
2. Install the rubber hangers so that they hang equally left and right.
3. Tighten the parts securely and then confirm that there is no interference with any components.

Tightening torque

30 ~ 40 Nm (300 ~ 400 kg.cm, 22 ~ 29.5 lb. ft)

AIR CLEANER (ACL)

COMPONENTS

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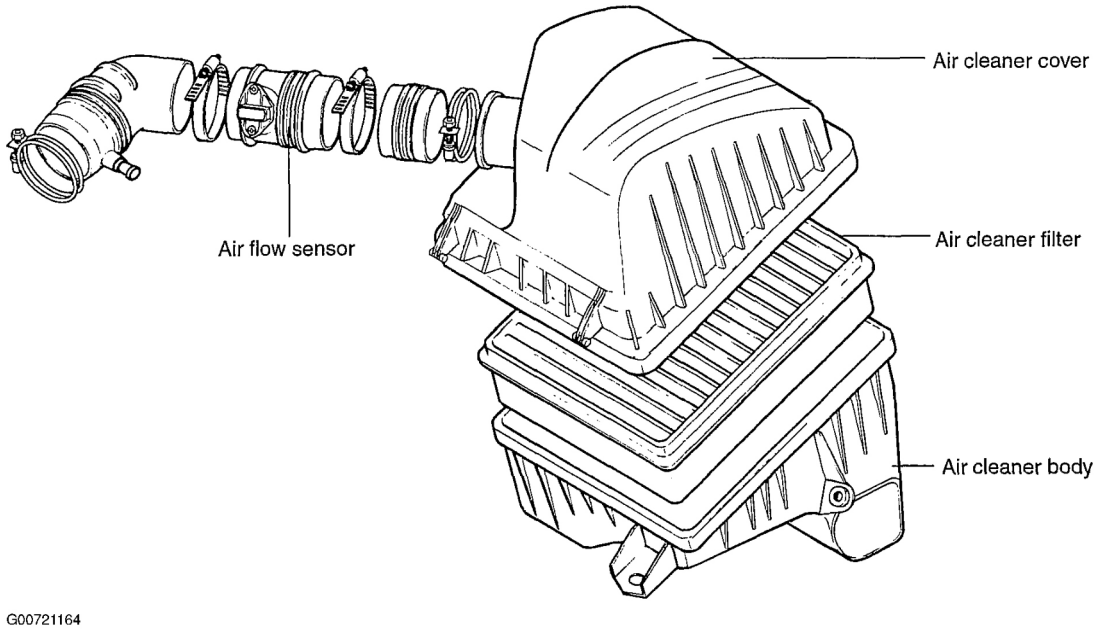
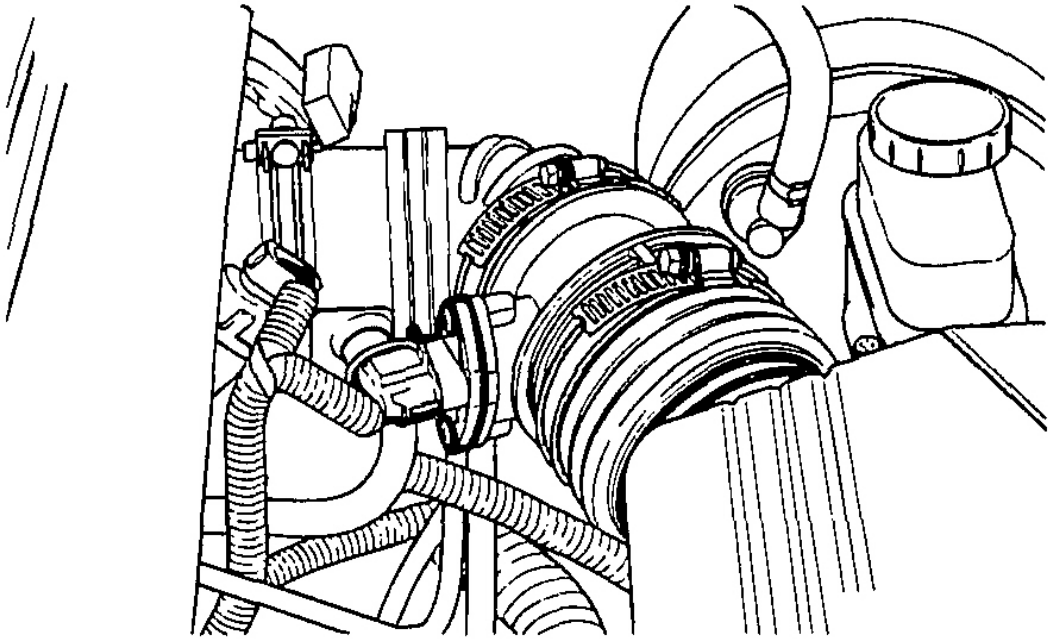


Fig. 160: Identifying Air Cleaner Components
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

1. Disconnect the air flow sensor connector.

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Fig. 161: Disconnecting Airflow Sensor Connector
Courtesy of HYUNDAI MOTOR CO.

2. Remove the air intake hose and air duct connected to the air cleaner.
3. Remove the three bolts attaching the air cleaner mounting brackets.
4. Detach the air cleaner.
5. Remove the air flow sensor from the air intake hose.

CAUTION: Do not pull on the air flow sensor wires.

INSPECTION

1. Check the air intake hose, air cleaner cover for damage.
2. Check the air duct for damage.

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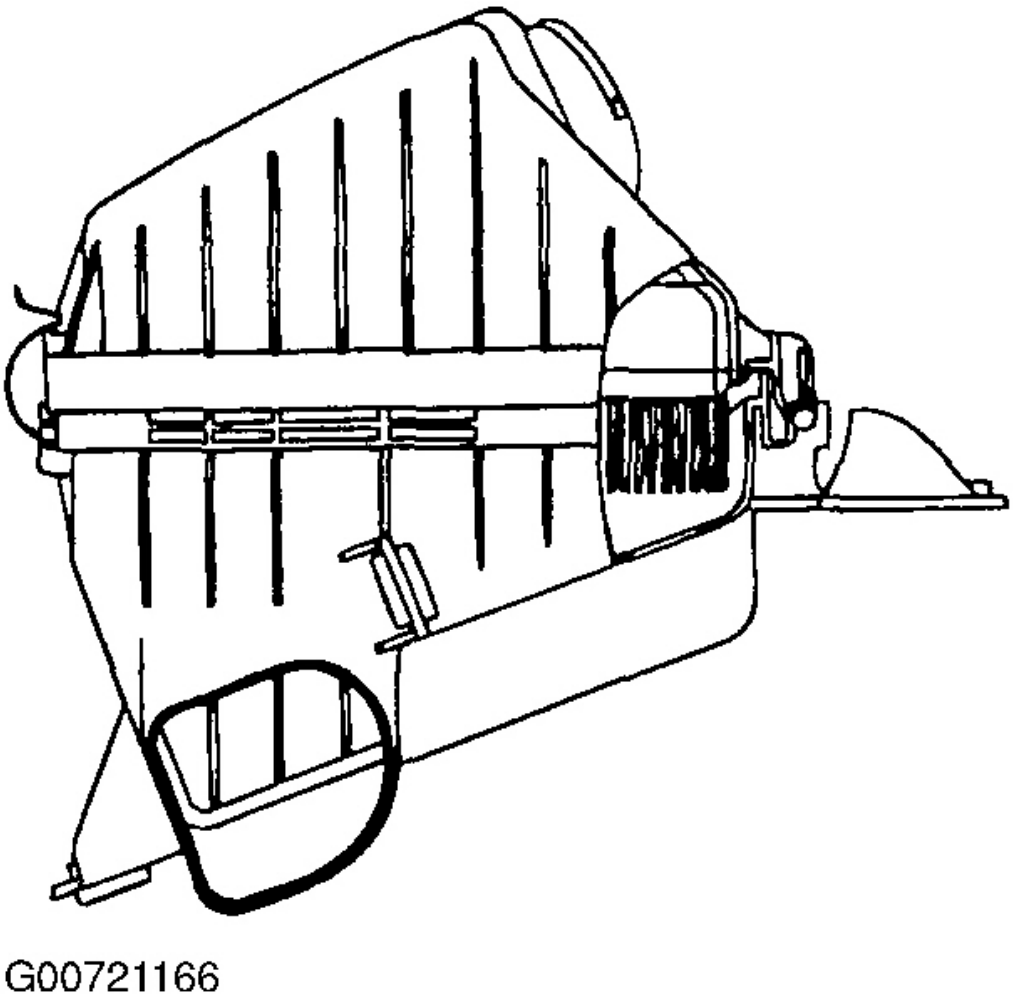


Fig. 162: Inspecting Air Cleaner Assembly For Damage
Courtesy of HYUNDAI MOTOR CO.

3. Check the air cleaner element for restriction, contamination or damage.

   If the element is slightly restricted, remove dust and debris by blowing compressed air from the inside of the element. Replace the element it cannot be cleaned.

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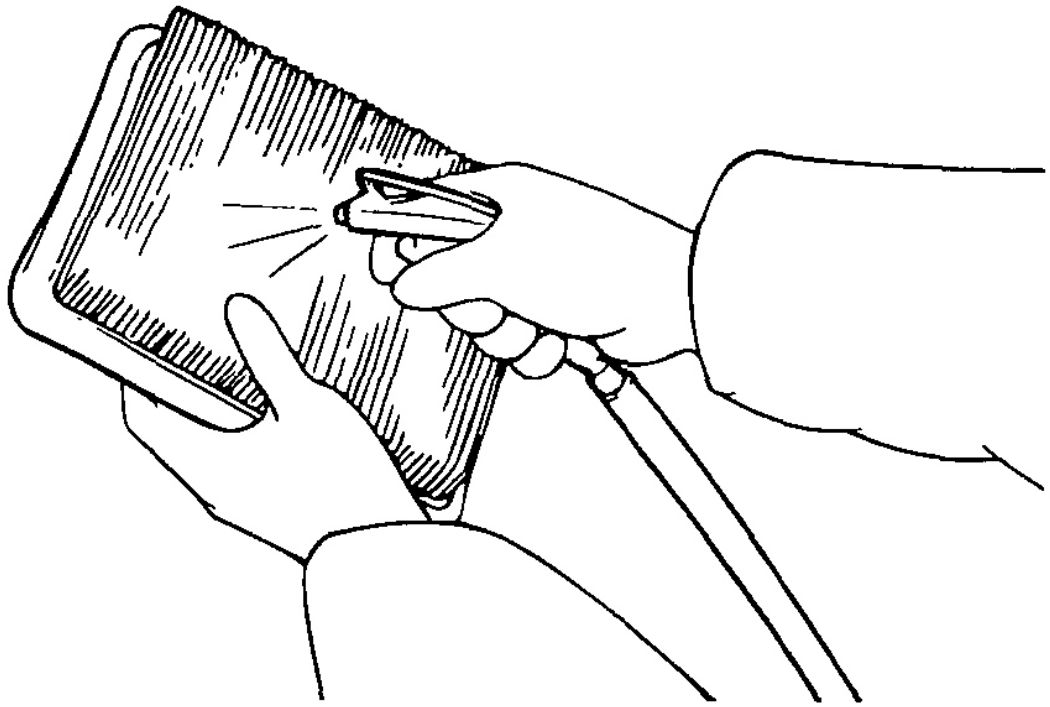


Fig. 163: Cleaning Air Filter Element
Courtesy of HYUNDAI MOTOR CO.

INSTALLATION

Install the air cleaner assembly following the reverse order of removal.

ENGINE BLOCK

ENGINE BLOCK

REMOVAL

Remove the timing belt, cylinder head assembly, drive plate, transaxle mounting plate, oil pan and oil pump case.

INSPECTION

CYLINDER BLOCK

1. Check the cylinder block for scores, rust and corrosion. Also check for cracks or any other defects.

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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.
   Level 1: No. 1 piston ring position at TDC
   Level 2: Center of cylinder
   Level 3: Bottom of cylinder

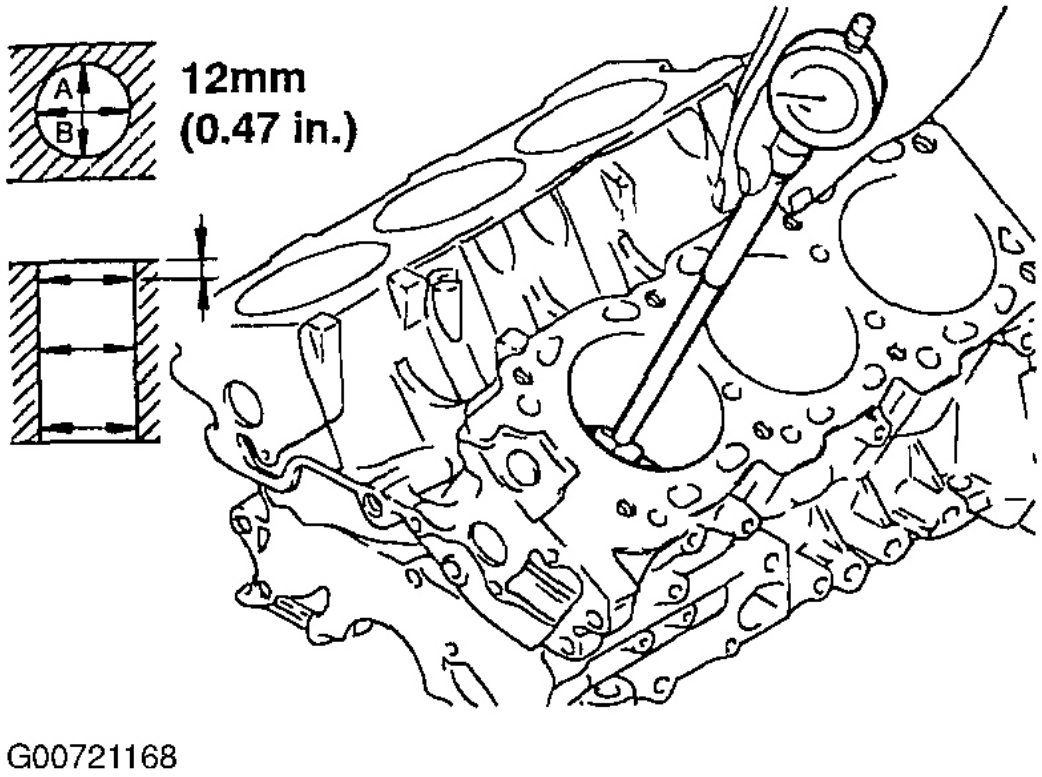


Fig. 164: Measuring Cylinder Bore
Courtesy of HYUNDAI MOTOR CO.

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:

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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 four 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 12 mm (0.47 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.)

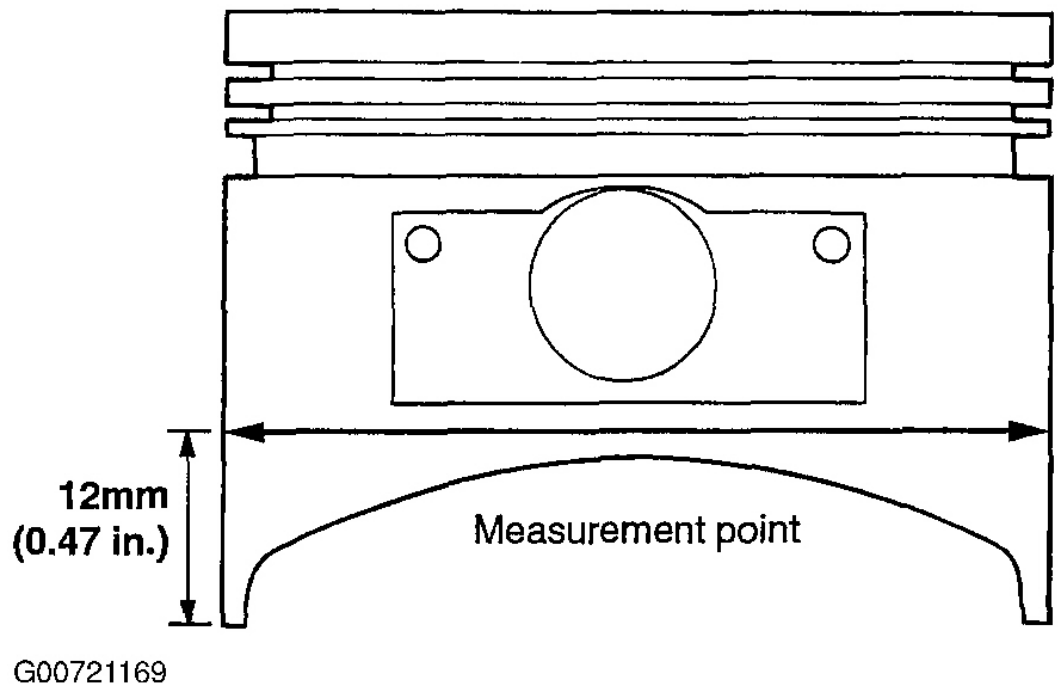


Fig. 165: Identifying Piston Measuring Location
Courtesy of HYUNDAI MOTOR CO.

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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.

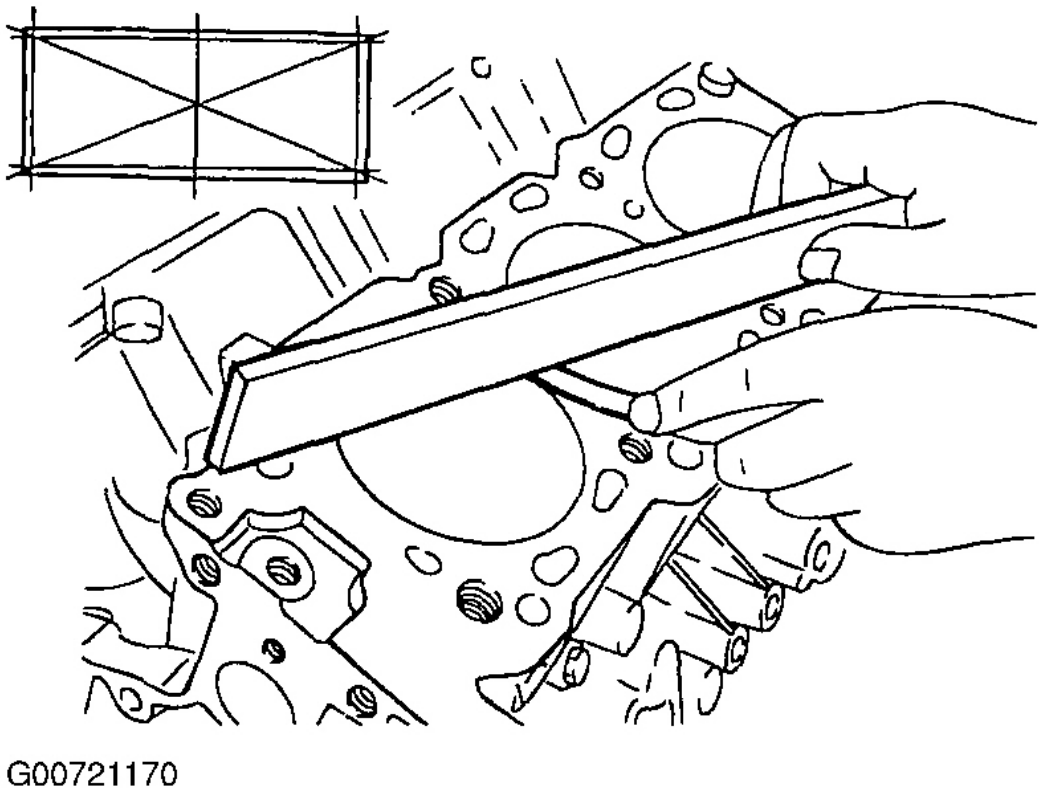


Fig. 166: Checking Cylinder Block Top Surface Flatness
Courtesy of HYUNDAI MOTOR CO.

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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.)

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Fig. 167: Oversize Piston Identification Table
Courtesy of HYUNDAI MOTOR CO.

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 0.0020 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.

INSTALLATION

Install the following parts.

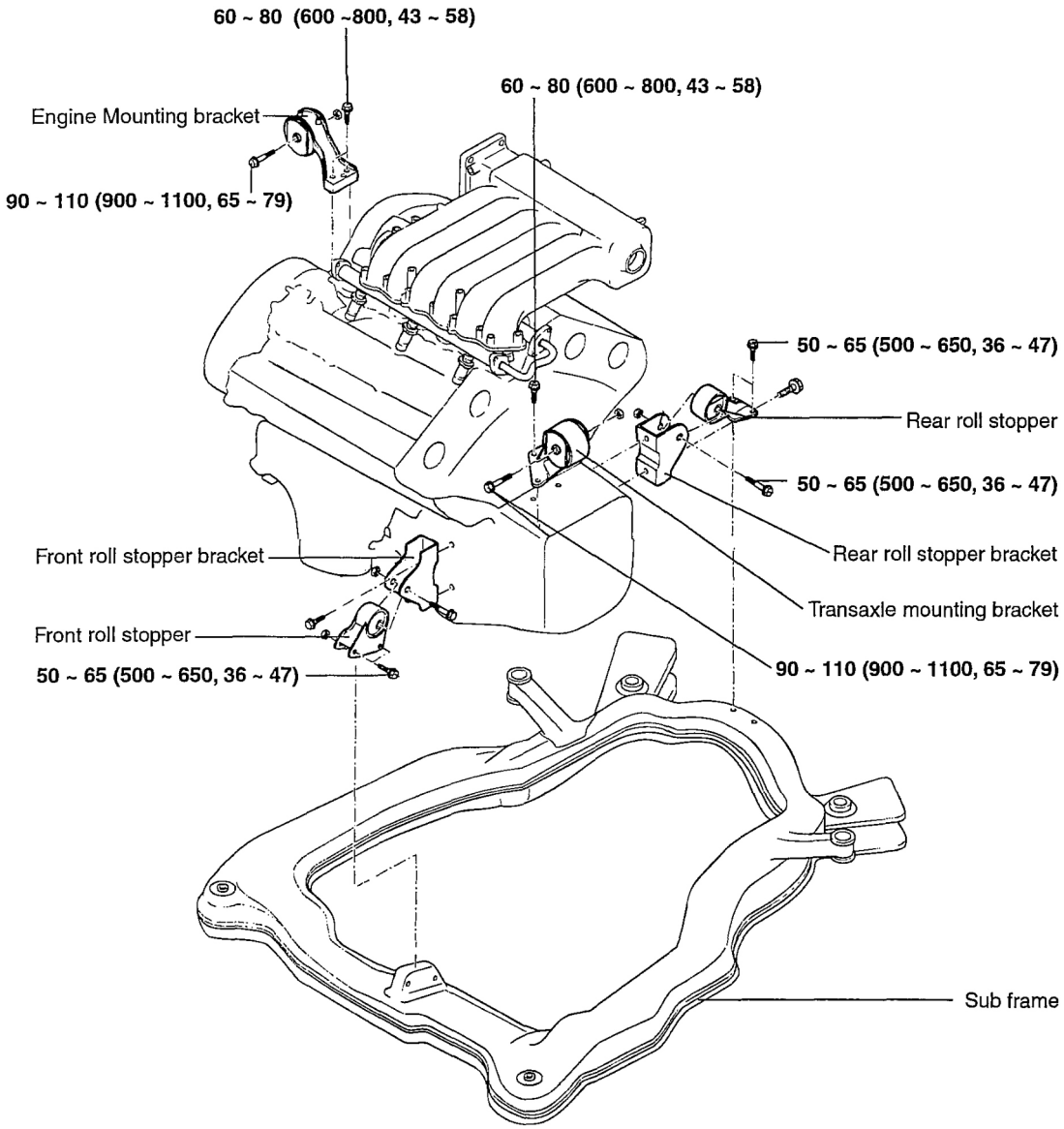
1. Crankshaft
2. Drive plate

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3. Piston
4. Cylinder head
5. Oil pump case
6. Timing belt

ENGINE MOUNTS

COMPONENTS



TORQUE : Nm (kg.dm, lb.ft)

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Fig. 168: Identifying Engine Mount Components
Courtesy of HYUNDAI MOTOR CO.

REMOVAL

Attach a cable or chain to the engine hooks, and then lift enough so that there is no pressure on the insulators.

ENGINE MOUNTING

1. Remove the engine mount bracket bolts and nut.

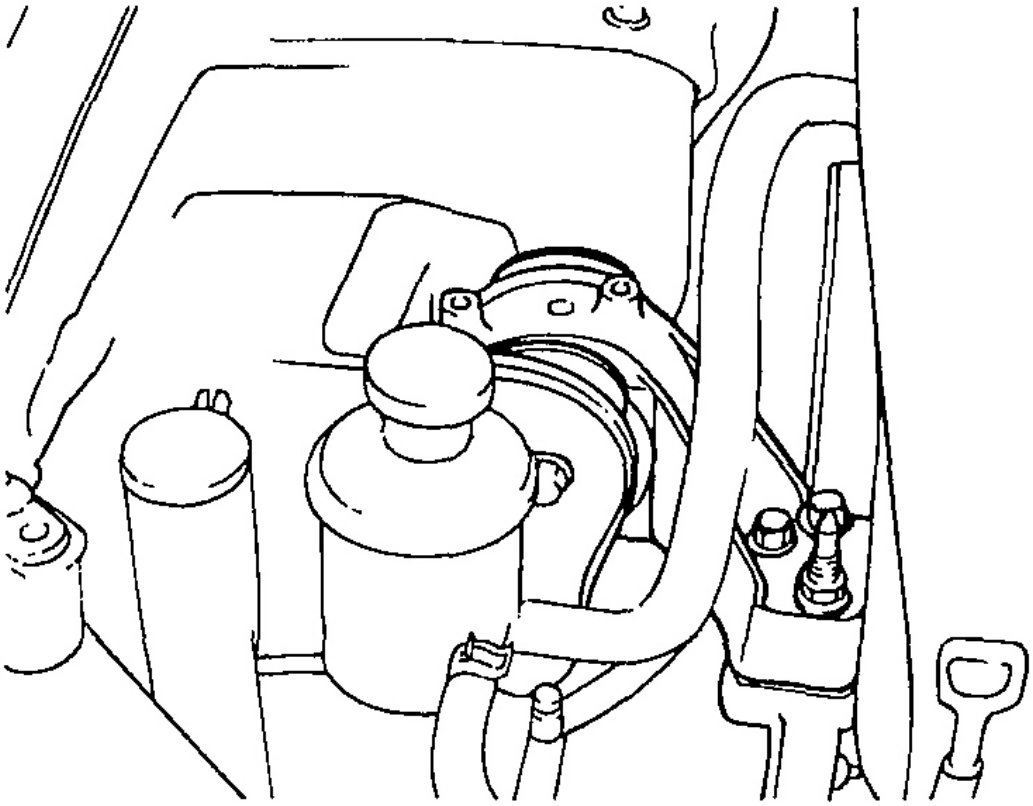


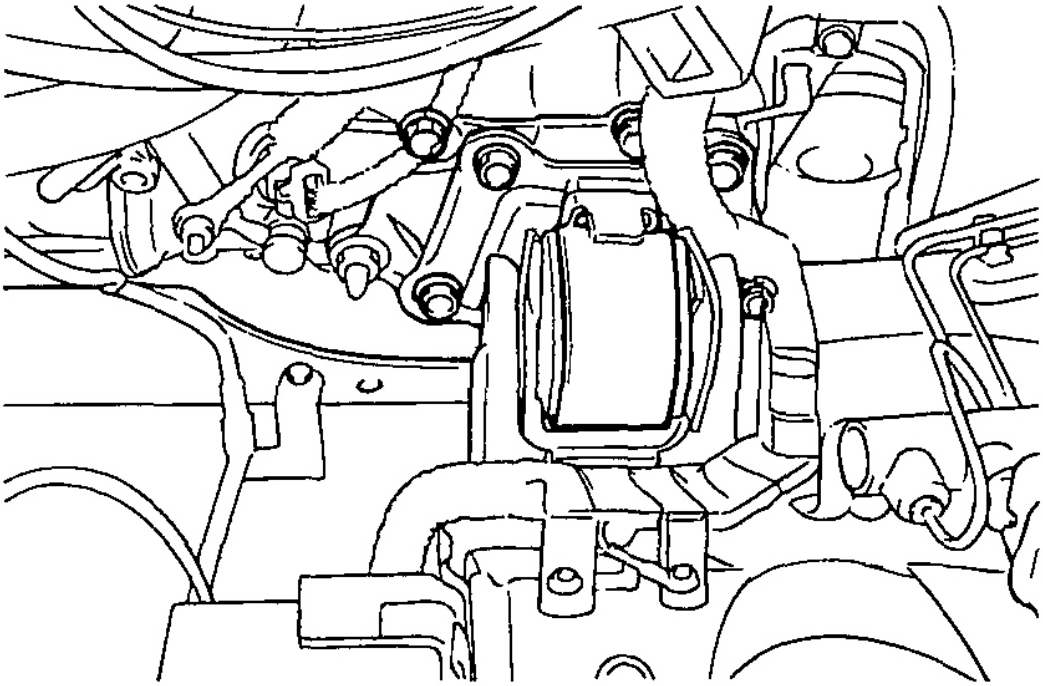
Fig. 169: Removing Engine Mount Bracket Bolt & Nut
Courtesy of HYUNDAI MOTOR CO.

2. Remove the engine mount bracket from the engine.

TRANSAXLE MOUNTING

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1. Remove the air cleaner. For additional information refer to **AIR CLEANER (ACL)**.
2. Remove the transaxle mounting bolt.
3. Remove the transaxle bracket.



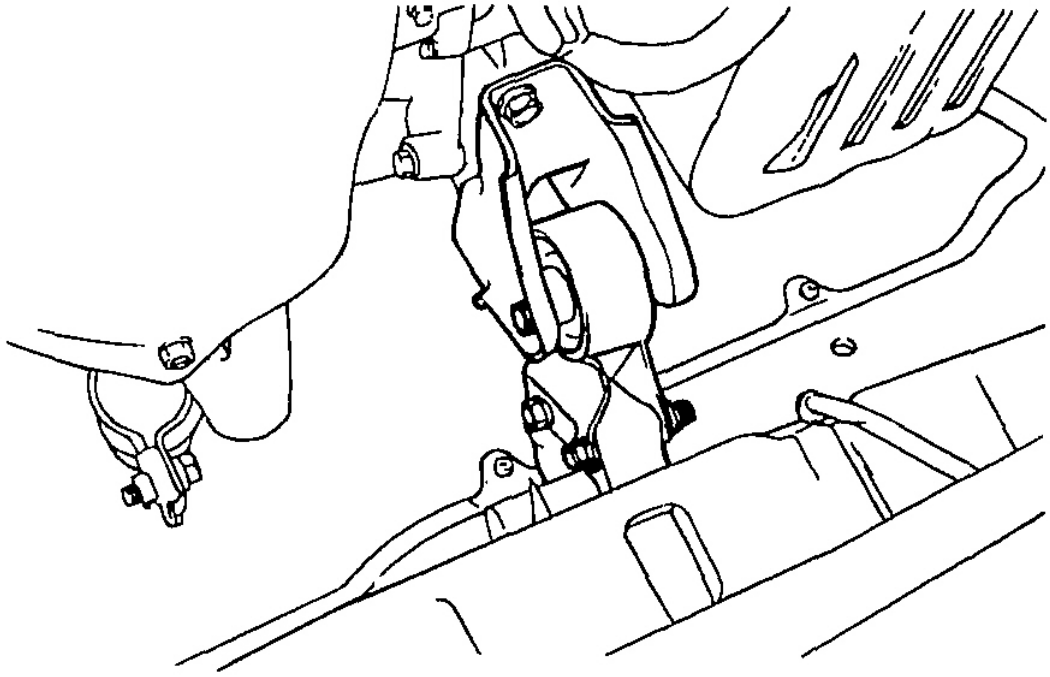
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Fig. 170: Removing Transaxle Bracket
Courtesy of HYUNDAI MOTOR CO.

FRONT ROLL STOPPER

1. Remove the transaxle mounting bolt.
2. Remove the transaxle bracket.

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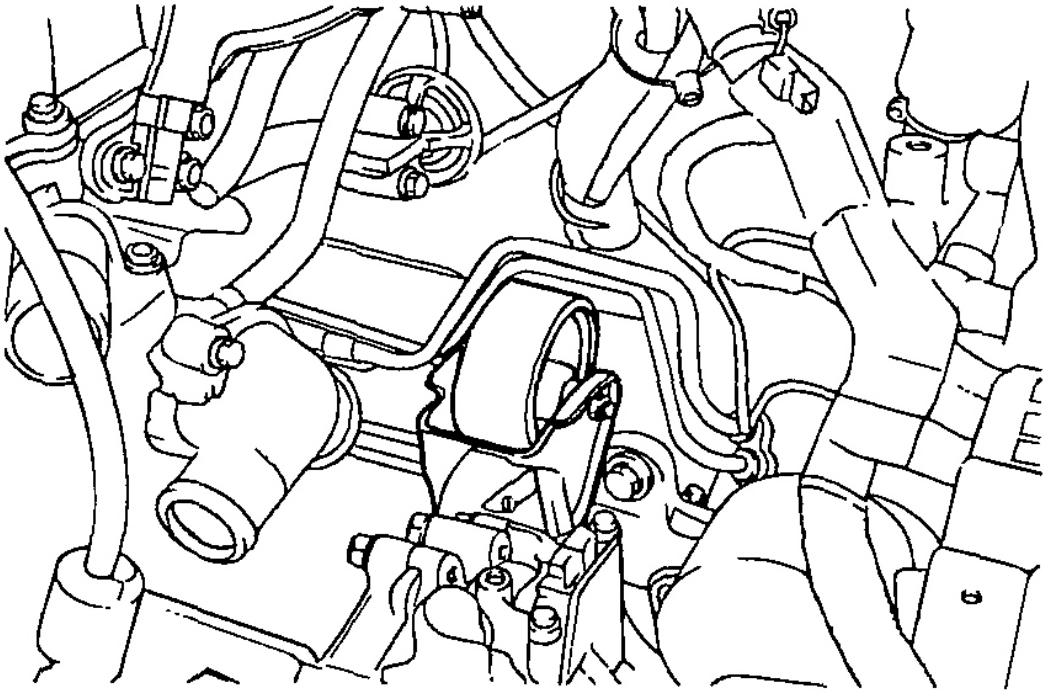
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Fig. 171: Removing Front Roll Stop
Courtesy of HYUNDAI MOTOR CO.

REAR ROLL STOPPER

1. Remove the bolt from the rear roll stopper.
2. Remove the rear roll stopper from the sub - frame.

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Fig. 172: Removing Rear Roll Stop
Courtesy of HYUNDAI MOTOR CO.

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