

**2010 Hyundai Elantra GLS**

2010 ENGINE General Information - Engine Mechanical - Elantra

**2010 ENGINE****General Information - Engine Mechanical - Elantra****SPECIFICATIONS****ENGINE MECHANICAL SYSTEM SPECIFICATIONS**

Description		Specifications	Limit
<b>General</b>			
Type	In-line, Double Overhead Camshaft		
Number of cylinder	4		
Bore	82mm (3.228in)		
Stroke	93.5mm (3.681in)		
Total displacement	1975cc (120.52cu.in)		
Compression ratio	10.1 : 1		
Firing order	1 - 3 - 4 - 2		
<b>Valve timing</b>			
Intake valve	Opens	ATDC 11° ~ BTDC 29°	
	Closes	ABDC 59° ~ 19°	
Exhaust	Opens	BBDC 42°	
	Closes	ATDC 6°	
<b>Valve</b>			
Valve length	Intake	114.34mm (4.5016in)	
	Exhaust	116.8mm (4.598in)	
Stem outer diameter	Intake	5.965 ~ 5.98mm (0.2348 ~ 0.2354in)	
	Exhaust	5.950 ~ 5.965mm (0.2343 ~ 0.2348in)	
<b>Face angle thickness of valve head (Margin)</b>			
Intake	1.6±0.15mm (0.0630±0.0059in)		0.8mm (0.031in)
Exhaust	1.8±0.15mm (0.0709±0.0059in)		1.0mm (0.039in)
<b>Valve stem to valve guide clearance</b>			
Intake	0.02 ~ 0.05mm (0.0008 ~ 0.0019in)		0.10mm (0.0039in)
Exhaust	0.035 ~ 0.065mm (0.0014 ~ 0.0026in)		0.13mm (0.0051in)
<b>Valve guide</b>			
Installed dimension outer diameter	Intake	45.8~46.2mm (1.8031~1.8189in)	
		52.8~53.2mm	

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	Exhaust	(2.0787~2.0945in)	
Service oversize		0.05, 0.25, 0.50mm (0.002, 0.010, 0.020in) oversize	
<b>Valve seat</b>			
Width of seat contact	Intake	1.1 ~ 1.5mm (0.043 ~ 0.059in)	
	Exhaust	1.3 ~ 1.7mm (0.051 ~ 0.066in)	
Oversize		0.3, 0.6mm (0.012, 0.024in) oversize	
<b>Valve spring</b>			
Free length		48.86mm (1.9236in)	
Load		18.8k±0.9kg/39.0mm (41.4±2.0lb/1.5354in) 41.0±1.5kg/30.5mm (90.4±3.3lb/1.2008in)	
Squareness		1.5° or less	
<b>Valve clearance</b>			
Cold (20°C [68°F])	Intake	0.20mm (0.0079in)	0.17~0.23mm (0.0067~0.0091in)
	Exhaust	0.28mm (0.0110in)	0.25~0.31mm (0.0098~0.0122in)
Hot (80°C [176°F]) : only for reference	Intake	0.29mm (0.0114in)	
	Exhaust	0.34mm (0.0134in)	
<b>Cylinder head</b>			
Flatness of gasket surface		Max. 0.03mm (0.0012in)	0.06mm (0.0024in)
Flatness of manifold mounting surface		Max. 0.15mm (0.0059in)	0.03mm (0.0012in)
Oversize rework dimensions of valve seat hole			
Intake	0.3mm (0.012in) O.S.	33.300 ~ 33.325mm (1.3110 ~ 1.3120in)	
	0.6mm (0.024in) O.S.	33.600 ~ 33.625mm (1.3228 ~ 1.3238in)	
Exhaust	0.3mm (0.012in) O.S.	28.800 ~ 28.821mm (1.1338 ~ 1.1346in)	
	0.6mm (0.024in) O.S.	29.100 ~ 29.121mm (1.1456 ~ 1.1465in)	
Oversize rework dimensions of valve guide hole (both intake and exhaust)			
0.05mm (0.002in) O.S		11.05 ~ 11.068mm (0.435 ~ 0.4357in)	
0.25mm (0.010in) O.S		11.25 ~ 11.268mm (0.443 ~ 0.4436in)	
0.50mm (0.020in) O.S		11.50 ~ 11.518mm (0.453 ~ 0.4535in)	
<b>Cylinder block</b>			

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Cylinder bore		82.00 ~ 82.03mm (3.2283 ~ 3.2295in)	
Out-of-round and taper of cylinder bore		Less than 0.01mm (0.0004in)	
Clearance with piston (To set limits to new parts)		0.02 ~ 0.04mm (0.0008 ~ 0.0016in)	
<b>Piston</b>			
Outer diameter (To set limits to new parts)		81.97 ~ 82.00mm (3.2271 ~ 3.2283in)	
Service oversize		0.25, 0.50mm (0.010, 0.020in) oversize	
<b>Piston ring</b>			
Side clearance	No. 1	0.04 ~ 0.08mm (0.0015 ~ 0.0031in)	0.1mm (0.004in)
	No. 2	0.03 ~ 0.07mm (0.0012 ~ 0.0027in)	
End gap	No. 1	0.20 ~ 0.35mm (0.0079 ~ 0.0138in)	1mm (0.039in)
	No. 2	0.37 ~ 0.52mm (0.0146 ~ 0.0205in)	1mm (0.039in)
Oil ring side rail		0.20 ~ 0.60mm (0.0078 ~ 0.0236in)	1mm (0.039in)
Service oversize		0.25, 0.50mm (0.010, 0.020in.) oversize	
<b>Piston pin</b>			
Outer diameter		20.001 ~ 20.006mm (0.7874 ~ 0.7876in)	
Hole inner diameter		20.016 ~ 20.021mm (0.7880 ~ 0.7882in)	
Hole clearance		0.010 ~ 0.020mm (0.0004 ~ 0.0008in)	
Connecting rod small end inner diameter		19.974 ~ 19.985mm (0.7864 ~ 0.7868in)	
<b>Connecting rod</b>			
Bend		0.05mm (0.0020in) or less	
Twist		0.1mm (0.004in) or less	
Connecting rod big end to crankshaft side clearance		0.100 ~ 0.250mm (0.0039 ~ 0.010in)	0.4mm (0.0157in)
<b>Connecting rod bearing</b>			
Oil clearance (To seat limits to new parts)		0.024 ~ 0.042mm (0.0009 ~ 0.0017in)	
Undersize		0.25mm (0.01in)	
<b>Camshaft</b>			
	Intake	44.618mm (1.7566in)	44.518mm (1.7527in)

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Cam height	Exhaust	44.518mm (1.7527in)	44.418mm (1.7487in)
Journal outer diameter		28mm (1.1023in)	
Bearing oil clearance		0.02 ~ 0.061mm (0.0008 ~ 0.0024in)	0.1mm (0.0039in)
End play		0.1 ~ 0.2mm (0.0040 ~ 0.0079in)	
<b>Crankshaft</b>			
Pin outer diameter		44.946 ~ 44.966mm (1.7695 ~ 1.7703in)	
Journal outer diameter		56.942 ~ 56.962mm (2.2418 ~ 2.2426in)	
Bend		0.03mm (0.0012in) or less	
Out-of-round, taper of journal and pin		0.01mm (0.0004in) or less	0.030mm (0.0012in)
End play		0.06 ~ 0.260mm (0.0023 ~ 0.010in)	
Undersize rework dimension of pin	0.25mm (0.010in)	44.725 ~ 44.740mm (1.7608 ~ 1.7614in)	
Undersize rework dimension of journal	0.25mm (0.010in)	56.727 ~ 56.742mm (2.2333 ~ 2.2339in)	
<b>Crankshaft bearing</b>			
Oil clearance		0.028 ~ 0.046mm (0.0011 ~ 0.0018in)	
<b>Flywheel</b>			
Runout		0.1mm (0.0039in)	0.13mm (0.0051in)
<b>Cooling method</b>		Water-cooled, pressurized. Forced circulation with electrical fan	
<b>Coolant</b>			
Quantity		6.5~6.6liter (6.87~6.97U.S qts, 5.72~5.81mp. qts)	
<b>Radiator</b>			
Type		Pressurized corrugated fin type	
<b>Radiator cap</b>			
Main valve opening pressure		93.16 ~ 122.58kpa (0.95 ~ 1.25kg/cm <sup>2</sup> , 13.51 ~ 17.78psi)	
Vacuum valve opening pressure		MAX. 6.86 kpa (0.07kg/cm <sup>2</sup> , 1.00 psi)	
<b>Thermostat</b>			
Type		Wax pellet type with jiggle valve	

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Valve opening temperature	82°C (177°F)		
Valve closing temperature	77°C (170.6°F)		
Full-opening temperature	95°C (201°F)		
<b>Coolant pump</b>	Centrifugal type impeller		
<b>Drive belt</b>			
Type	V-ribbed belt		
<b>Engine coolant temperature sensor</b>			
Type	Heat-sensitive thermistor type		
Resistance	2.31 ~ 2.59kohms at 20°C (68°F) 0.3222kohms at 80°C (176°F)		
<b>Oil pump</b>			
Clearance between outer circumference and front case.	0.120 ~ 0.185mm (0.0049 ~ 0.0073in)		
Front case tip clearance	0.025 ~ 0.069mm (0.0009 ~ 0.0027in)		
Side clearance			
Inner gear	0.04 ~ 0.085mm (0.0016 ~ 0.0033in)		
Outer gear	0.04 ~ 0.09mm (0.0016 ~ 0.0035in)		
Engine oil pressure at 1500 RPM [Oil temperature is 90 to 110°C 194 to 230°F]	245KPa (2.5kg/cm <sup>2</sup> , 35.5psi)		
<b>Engine oil</b>			
Oil quantity	Total	4.1L (4.33US qt, 3.60lmp qt)	When replacing a short engine or a block assembly
	Oil pan	3.7L (3.91US qt, 3.26lmp qt)	
	Drain and refill	4.0L (4.23US qt, 3.52lmp qt)	Including oil filter
Oil grade	Recommendation	5W-20/GF4 & SM	If not available, refer to the recommended API or ILSAC classification and SAE viscosity number.
	Classification	API SL, SM or above ILSAC GF3, GF4 or above	Satisfy the requirement of the API or ILSAC classification.
	SAE viscosity grade	Recommended SAE viscosity number	Refer to the " <b>LUBRICATION SYSTEM</b> " article "
Oil pressure (at 800rpm)	100kPa (1.0kg/cm <sup>2</sup> , 14.5psi) or above	Oil temperature in oil pan : 90 ~ 100°C (194 ~ 212°F)	
<b>Relief spring</b>			
Free height	43.8mm (1.725in.)		
Load	3.7±0.4kg at 40.1mm (3.15lb/1.578in)		

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### Air cleaner

Type	Dry type	
Element	Unwoven cloth type	

### Exhaust pipe

Muffler	Expansion resonance type	
Suspension system	Rubber hangers	

## SERVICE STANDARDS

### ENGINE MECHANICAL SYSTEM SERVICE SPECIFICATIONS

Standard value	
Antifreeze	Mixture ratio of anti-freeze in coolant
Ethylene glycol base for aluminum	50%

## TIGHTENING TORQUES

### TIGHTENING TORQUES SPECIFICATIONS

Item	Nm	kgf.m	lb-ft
<b>Cylinder Block</b>			
Front engine support bracket bolt and nut	34.3 ~ 49.0	3.5 ~ 5.0	25.3 ~ 36.2
Front roll stopper bracket bolt	68.6 ~ 88.3	7.0 ~ 9.0	50.6 ~ 65.1
Rear roll stopper bracket bolt	68.6 ~ 88.3	7.0 ~ 9.0	50.6 ~ 65.1
Rear engine stopper bracket bolt	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
<b>Engine Mounting</b>			
Right mounting insulator (large) nut	88.3 ~ 107.9	9.0 ~ 11.0	65.1 ~ 79.6
Right mounting insulator (small) nut	44.1 ~ 58.8	4.5 ~ 6.0	32.5 ~ 43.4
Right mounting bracket to engine nuts and bolts	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Transmission mount insulator nut	88.3 ~ 107.9	9.0 ~ 11.0	65.1 ~ 79.6
Transmission insulator bracket to side member bolt	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Rear roll stopper insulator nut	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Rear roll stopper bracket to center member bolts	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Front roll stopper insulator nut	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Front roll stopper bracket to center member bolts.	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
<b>Main Moving</b>			
Connecting rod cap nut	49.0 ~ 52.0	5.0 ~ 5.3	36.2 ~ 38.3
Crankshaft bearing cap bolt	27.5~31.4 + (60°~64°)	2.8~3.2 + (60°~64°)	20.3~23.1 + (60°~64°)

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Fly wheel M/T bolt	117.7 ~ 127.5	12.0 ~ 13.0	86.8 ~ 94.0
Drive plate A/T bolt	117.7 ~ 127.5	12.0 ~ 13.0	86.8 ~ 94.0
Engine cover	3.9 ~ 5.9	0.4 ~ 0.6	2.9 ~ 4.3
Heat protector	14.7 ~	19.6 1.5 ~	2.0 10.8 ~14.5
Water pipe bracket bolts	11.8 ~ 14.7	1.2 ~ 1.5	8.7 ~ 10.8
<b>Cooling system</b>			
Alternator support bolt and nut	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
Alternator lock bolt	11.8 ~ 14.7	1.2 ~ 1.5	8.7 ~ 10.8
Alternator brace mounting bolt	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Coolant pump pulley bolts	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Coolant pump bolts	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Coolant temperature sensor	19.6 ~ 39.2	2.0 ~ 4.0	14.5 ~ 28.9
Coolant inlet fitting nuts	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Thermostat housing bolts and nuts	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
<b>Lubrication system</b>			
Oil filter	11.8 ~ 15.7	1.2 ~ 1.6	8.7 ~ 11.6
Oil pan bolts	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pan drain plug (Aluminum)	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Oil pan drain plug (Steel)	34.3 ~ 44.1	3.5 ~ 4.5	25.3 ~ 32.5
Oil screen bolts	14.7 ~	21.6 1.5 ~	2.2 10.8 ~15.9
Oil pressure switch	12.7 ~	14.7 1.3 ~	1.5 9.4 ~10.8
<b>Intake and Exhaust system</b>			
Air cleaner body mounting bolts	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Resonator mounting bolts	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Intake manifold to cylinder head nuts and bolts	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Intake manifold stay to cylinder block bolts	17.7 ~ 24.5	1.8 ~ 2.5	13.0 ~ 18.1
Throttle body to surge tank nuts	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Exhaust manifold to cylinder head nuts	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8
Exhaust manifold cover to exhaust manifold bolts	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Oxygen sensor to front muffler	49.0 ~ 58.8	5.0 ~ 6.0	36.2 ~ 43.4
Oxygen sensor to exhaust manifold	49.0 ~ 58.8	5.0 ~ 6.0	36.2 ~ 43.4
Front exhaust pipe to exhaust manifold nuts	29.4 ~ 39.2	3.0 ~ 4.0	21.7 ~ 28.9
Front exhaust pipe bracket bolts	29.4 ~ 39.2	3.0 ~ 4.0	21.7 ~ 28.9
Front exhaust pipe to catalytic converter bolts	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Main muffler hanger support	9.8 ~ 14.7	1.0 ~ 1.5	7.2 ~ 10.8

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bracket bolts			
<b>Cylinder head</b>			
Cylinder head bolts - M10	22.6~26.5+(60°~65°) + (60°~65°)	2.3~2.7+(60°~65°) + (60°~65°)	16.6~19.5+(60°~65°)+ (60°~65°)
Cylinder head bolts - M12	27.5~31.4+(60°~65°) + (60°~65°)	2.8~3.2+(60°~65°) + (60°~65°)	20.3~33.1+(60°~65°)+ (60°~65°)
Intake manifold nuts	17.7 ~ 24.5	1.8 ~ 2.5	13.0 ~ 18.1
Exhaust manifold nuts	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8
Cylinder head cover bolts	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Camshaft bearing cap bolts	13.7 ~ 14.7	1.4 ~ 1.5	10.1 ~ 10.8
Oil control valve bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
OCV Filter	40.2 ~ 50.0	4.1 ~ 5.1	29.7 ~ 36.9
CVVT unit to exhaust camshaft bolt	64.7 ~	76.5 6.6 ~	7.8 47.7~ 56.4
Rear plate bolts	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
<b>Timing Belt</b>			
Crankshaft pulley bolt	156.9 ~ 166.7	16.0 ~ 17.0	115.7 ~ 123.0
Camshaft sprocket bolt	98.1 ~ 117.7	10.0 ~ 12.0	72.3 ~ 86.8
Timing belt auto tensioner bolts	22.6 ~ 28.4	2.3 ~ 2.9	16.6 ~ 21.0
Timing belt cover bolts	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Front case bolts	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Timing belt idler bolt	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8

M/T : Manual Transmission

A/T : Automatic Transmission

## REPAIR PROCEDURES

### INSPECTION

#### Compression Pressure

**NOTE:** If the there is lack of power, excessive oil consumption or poor fuel economy, measure the compression pressure.

1. Warm up and stop engine.

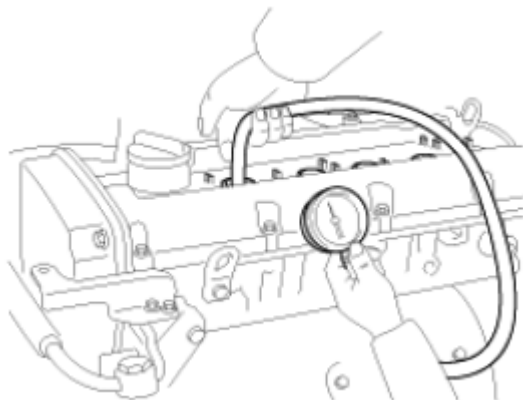
Allow the engine to warm up to normal operating temperature.

2. Remove ignition coils.
3. Remove spark plugs.

Using a 16mm plug wrench, remove the 4 spark plugs.



4. Check cylinder compression pressure
  - A. Insert a compression gauge into the spark plug hole.



**Fig. 1: Checking Cylinder Compression Pressure**  
Courtesy of HYUNDAI MOTOR CO.

- B. Fully open the throttle.
- C. while cranking the engine, measure the compression pressure.

**NOTE:** Always use a fully charged battery to obtain engine speed of 250 rpm or more.

- D. Repeat steps (A) through (C) for each cylinder.

**NOTE:** This measurement must be done in as short a time as possible.

**Compression pressure:**

1421.96kPa (14.5kgf/cm<sup>2</sup> , 206.24psi)

**Minimum pressure:**

1274.86kPa (13.0kgf/cm<sup>2</sup> , 184.90psi)

**Difference between each cylinder:**

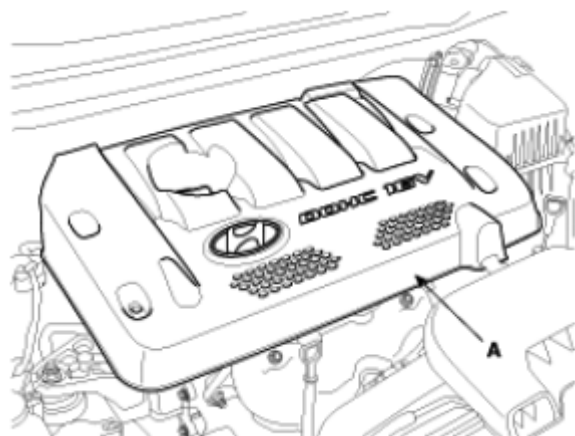
98.07kPa (1.0kgf/cm<sup>2</sup> , 14.22psi) or less

- E. If the cylinder compression in 1 or more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat steps (A) through (C) for cylinders with low compression.
  - If adding oil helps the compression, it is likely that the piston rings and/or cylinder bore are worn or damaged.

- If pressure stays low, a valve may be sticking or seating is improper, or there may be leakage past the gasket.
5. Reinstall spark plugs.
  6. Install ignition coils.

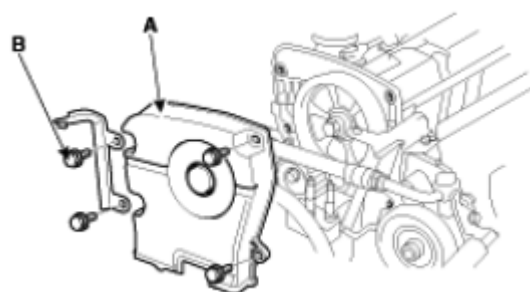
### Timing Belt Tension Adjustment

1. Remove the engine cover (A).



**Fig. 2: Identifying Engine Cover**  
Courtesy of HYUNDAI MOTOR CO.

2. Remove RH front wheel.
3. Remove the 4 bolts (B) and timing belt upper cover (A).



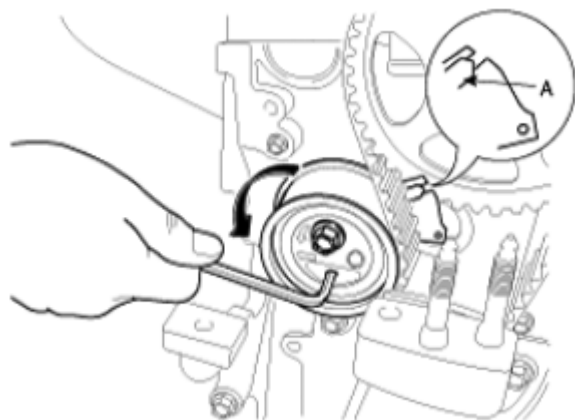
**Fig. 3: Identifying Timing Belt Upper Cover With Bolts**  
Courtesy of HYUNDAI MOTOR CO.

4. Slacken the tensioner bolt.

**NOTE:** When check the timing belt tension or install the timing belt tensioner, must it the engine oil temperature is between 15°C (59°F) and 25°C (77°F).

5. Using a hex wrench, turn the adjuster counterclockwise to make the indicator of the arm (A) located at the

center of the base notch.



**Fig. 4: Turning Adjuster Using Hex Wrench**  
Courtesy of HYUNDAI MOTOR CO.

**CAUTION: Do not rotate the adjuster clockwise.  
It will result in auto tensioner's functional problem.**

6. Tightening tensioner bolt with fixing the indicator not to move.

#### **Tightening torque**

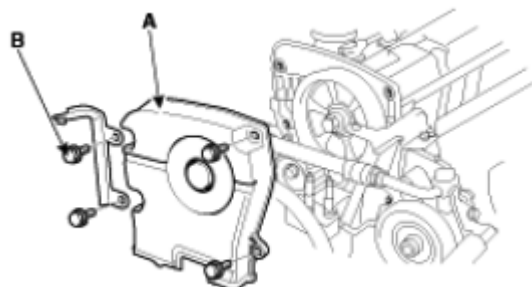
Tensioner bolt:

22.6 ~ 28.4Nm (2.3 ~ 2.9kgf.m, 16.6 ~ 21.0lb-ft)

7. Turn the crankshaft two revolutions in the operating direction (clockwise) and check that the indicator is in the center of base.
8. If the indicator is not located at the center of base, slacken the bolt and repeat the above procedure.
9. Install the timing belt upper cover (A) with the four bolts (B).

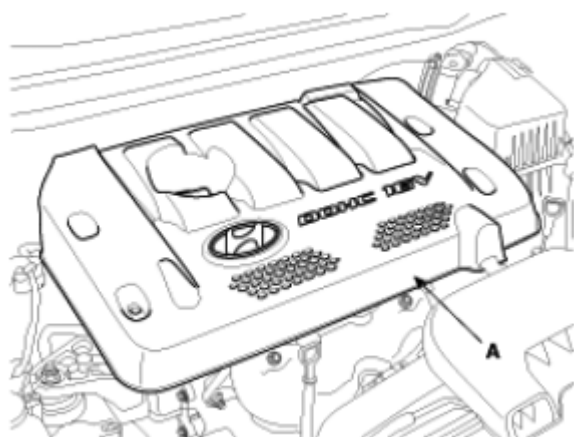
#### **Tightening torque:**

7.8 ~ 9.8Nm (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)



**Fig. 5: Identifying Timing Belt Upper Cover With Bolts**  
 Courtesy of HYUNDAI MOTOR CO.

10. Install RH front wheel.
11. Install engine cover (A) with the four bolts.



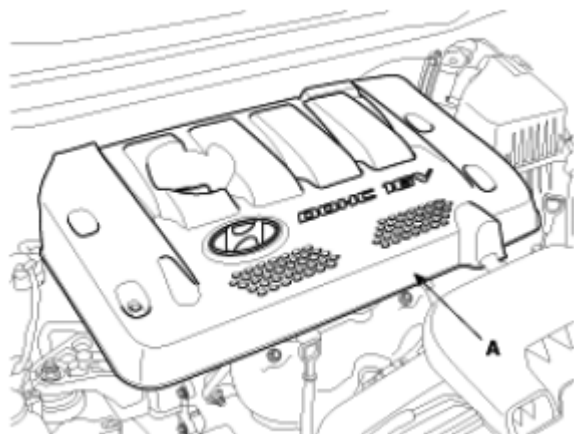
**Fig. 6: Identifying Engine Cover**  
 Courtesy of HYUNDAI MOTOR CO.

#### Valve Clearance Inspection And Adjustment

MLA (Mechanical Lash Adjuster)

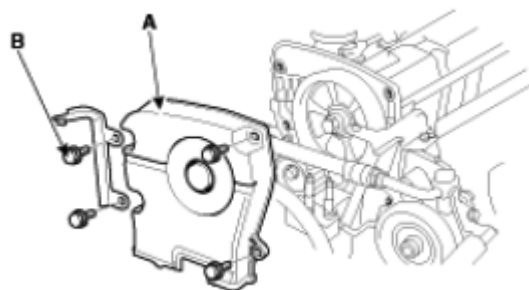
**NOTE:** Inspect and adjust the valve clearance when the engine is cold (Engine coolant temperature : 20°C) and cylinder head is installed on the cylinder block.

1. Remove the engine cover (A).



**Fig. 7: Identifying Engine Cover**  
Courtesy of HYUNDAI MOTOR CO.

2. Remove the upper timing belt cover (A).

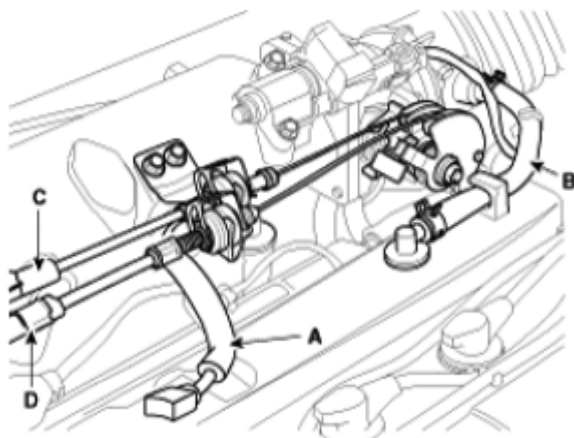


**Fig. 8: Identifying Upper Timing Belt Cover With Bolt**  
Courtesy of HYUNDAI MOTOR CO.

- A. Loosen the upper timing cover bolts and then remove the cover.
3. Remove the cylinder head cover.
  - A. Disconnect the spark plug cables and do not pull on the spark plug by force.

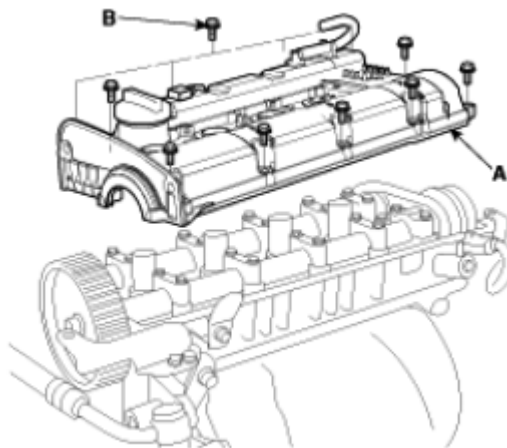
**NOTE:** Pulling on or bending the cables may damage the conductor inside.

- B. Disconnect the P.C.V hose (A) and the breather hose (B) from the cylinder head cover.
- C. Disconnect the accelerator cable (C) and the auto-cruise cable (D) from the cylinder head cover.



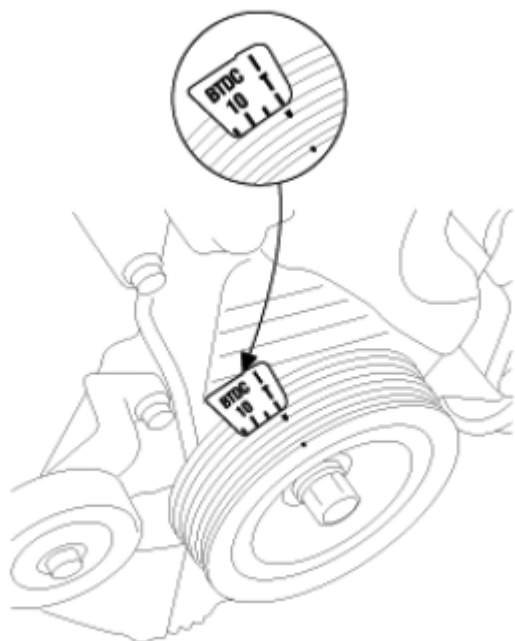
**Fig. 9: Identifying Accelerator Cable, Auto-Cruise Cable, P.C.V And Breather Hoses**  
 Courtesy of HYUNDAI MOTOR CO.

- D. Loosen the cylinder head cover bolts (B) and then remove the cover (A) and gasket.



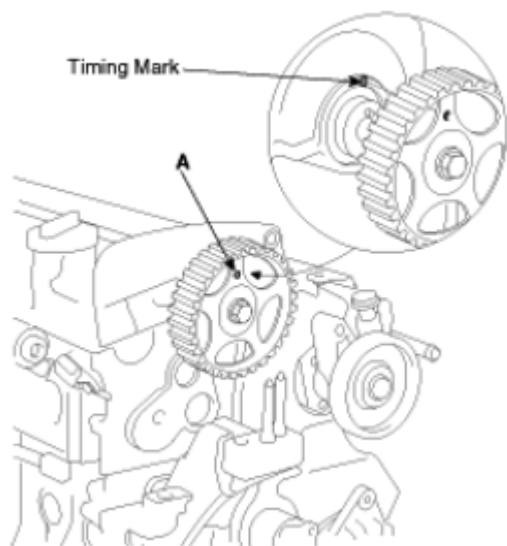
**Fig. 10: Identifying Cylinder Head Cover With Bolts**  
 Courtesy of HYUNDAI MOTOR CO.

- 4. Set No. 1 cylinder to TDC/compression.
  - A. Turn the crankshaft pulley and align its groove with the timing mark "T" of the lower timing belt cover.



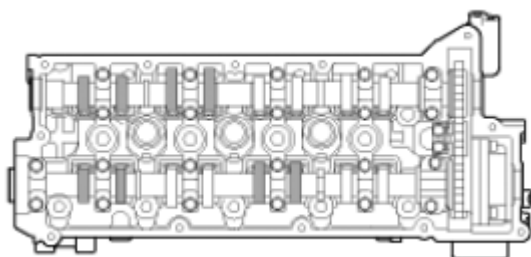
**Fig. 11: Identifying Timing Mark On Crankshaft Pulley**  
Courtesy of HYUNDAI MOTOR CO.

- B. Check that the hole of the camshaft timing pulley (A) is aligned with the timing mark of the bearing cap. If not, turn the crankshaft one revolution (360°)



**Fig. 12: Identifying Timing Mark And Hole Of Camshaft Timing Pulley**  
Courtesy of HYUNDAI MOTOR CO.

5. Inspect the valve clearance
- A. Check only the valve indicated as shown. [No. 1 cylinder : TDC/Compression] measure the valve clearance.



**Fig. 13: Identifying Cylinder Valves**  
 Courtesy of HYUNDAI MOTOR CO.

- Using a thickness gauge, measure the clearance between the tappet shim and the base circle of camshaft.
- Record the out-of-specification valve clearance measurements. They will be used later to determine the required replacement adjusting shim.

### Valve clearance

#### Specifications

Engine coolant temperature : 20°C [68°F]

Intake : 0.20mm (0.0079in.)

Exhaust : 0.28mm (0.0110in.)

Engine coolant temperature : 80°C [176°F]

Intake : 0.29mm (0.0114in.)

Exhaust : 0.34mm (0.0134in.)

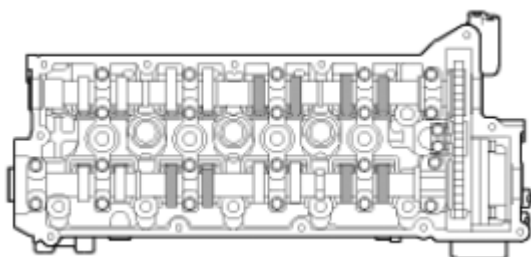
#### Limit

Intake : 0.17 ~ 0.23mm (0.0067 ~ 0.091in.)

Exhaust : 0.25 ~ 0.31mm (0.0098 ~ 0.0122in.)

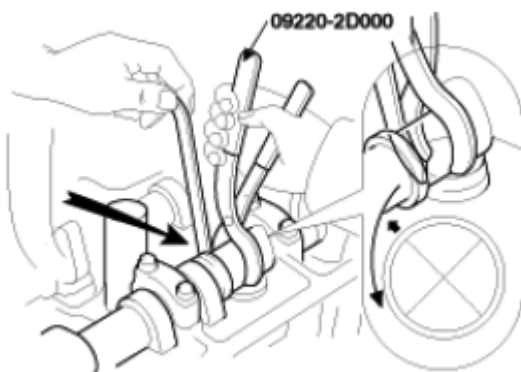
- Turn the crankshaft pulley one revolution (360°) and align the groove with timing mark "T" of the lower timing belt cover.
- Check only valves indicated as shown. [NO. 4 cylinder : TDC/compression]. Measure the valve clearance.





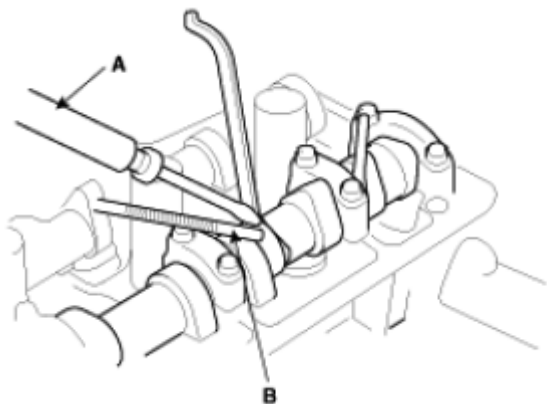
**Fig. 14: Identifying Cylinder Valves**  
Courtesy of HYUNDAI MOTOR CO.

6. Adjust the intake and exhaust valve clearance.
  - A. Turn the crankshaft so that the cam lobe of the camshaft on the adjusting valve is upward.
  - B. Using the SST (09220 - 2D000), press down the valve lifter and place the stopper between the camshaft and valve lifter and remove the special tool.



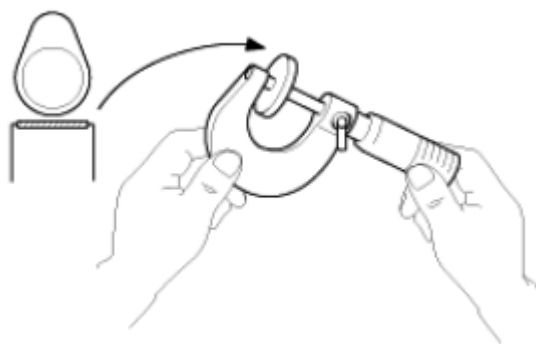
**Fig. 15: Pressing Valve Lifter Using SST (09220 - 2D000)**  
Courtesy of HYUNDAI MOTOR CO.

- C. Remove the adjusting shim with a small screw driver (A) and magnet (B).



**Fig. 16: Removing Adjusting Shim Using Screw Driver And Magnet**  
Courtesy of HYUNDAI MOTOR CO.

- D. Measure the thickness of the removed shim using a micrometer.



**Fig. 17: Measuring Adjusting Shim Thickness Using Micrometer**  
 Courtesy of HYUNDAI MOTOR CO.

- E. Calculate the thickness of a new shim so that the valve clearance comes within the specified value.

**Valve clearance (Engine coolant temperature : 20°C)**

T : Thickness of removed shim

A : Measured valve clearance

N : Thickness of new shim

Intake :  $N = T + [A - 0.20\text{mm (0.0079in.)}]$

Exhaust :  $N = T + [A - 0.28\text{mm (0.0110in.)}]$

- F. Select a new shim with a thickness as close as possible to the calculated value. [Refer to **Fig. 18** or **Fig. 19** ]

**NOTE:** Shims are available in 20 size increments of 0.04mm (0.0016in.) from 2.00mm (0.079in.) to 2.76mm (0.1087in.)

- G. Place a new adjusting shim on the valve lifter.  
 H. Using the SST (09220 - 2D000), press down the valve lifter and remove the stopper.  
 I. Recheck the valve clearance.

**Valve clearance (Engine coolant temperature : 20°C)**

[Specification]

Intake : 0.20mm (0.0079in.)

Exhaust : 0.28mm (0.0110in.)





## 2010 Hyundai Elantra GLS

2010 ENGINE General Information - Engine Mechanical - Elantra

Engine misfire with coolant consumption.	<p>cylinder head and engine block cooling system.</p> <ul style="list-style-type: none"> <li>Coolant consumption may or may not cause the engine to overheat.</li> </ul>	<p>engine block for damage to the coolant passages and/or a faulty head gasket.</p> <ul style="list-style-type: none"> <li>Repair or replace as required.</li> </ul>
Engine misfire with excessive oil consumption	Worn valves, guides and/or valve stem oil seals.	Repair or replace as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire)	<ul style="list-style-type: none"> <li>Inspect the cylinder for a loss of compression.</li> <li>Repair or replace as required.</li> </ul>
Engine noise on start-up, but only lasting a few seconds.	Incorrect oil viscosity	<ul style="list-style-type: none"> <li>Drain the oil.</li> <li>Install the correct viscosity oil.</li> </ul>
	Worn crankshaft thrust bearing.	<ul style="list-style-type: none"> <li>Inspect the thrust bearing and crankshaft.</li> <li>Repair or replace as required.</li> </ul>
Upper engine noise, regardless of engine speed.	Low oil pressure	Repair or replace as required.
	Broken valve spring.	Replace the valve spring.
	Worn or dirty valve lifters.	Replace the valve lifters.
	Stretched or broken timing chain and/or damaged sprocket teeth.	Replace the timing chain and sprockets.
	Worn timing chain tensioner, if applicable.	Replace the timing chain tensioner as required.
	Worn camshaft lobes.	<ul style="list-style-type: none"> <li>Inspect the camshaft lobes.</li> <li>Replace the timing camshaft and valve lifters as required.</li> </ul>
	Worn valve guides or valve stems.	Inspect the valves and valve guides, then repair as required.
	Stuck valves. (Carbon on the valve stem or valve seat may cause the valve to stay open.	Inspect the valves and valve guides, then repair as required.
Low oil pressure.	Low oil pressure.	Repair or required.
	Loose or damaged flywheel.	Repair or replace the flywheel.
	Damaged oil pan, contacting the oil pump screen.	<ul style="list-style-type: none"> <li>Inspect the oil pan.</li> <li>Inspect the oil pump screen.</li> <li>Repair or replace as required.</li> </ul>
	Oil pump screen loose, damaged or restricted.	<ul style="list-style-type: none"> <li>Inspect the oil pump screen.</li> <li>Repair or replace as required.</li> </ul>
	Excessive piston-to-cylinder bore clearance.	<ul style="list-style-type: none"> <li>Inspect the piston, piston pin and cylinder bore.</li> <li>Repair as required.</li> </ul>
	Excessive piston pin-to-clearance	<ul style="list-style-type: none"> <li>Inspect the piston, piston pin and the connecting rod.</li> </ul>

## 2010 Hyundai Elantra GLS

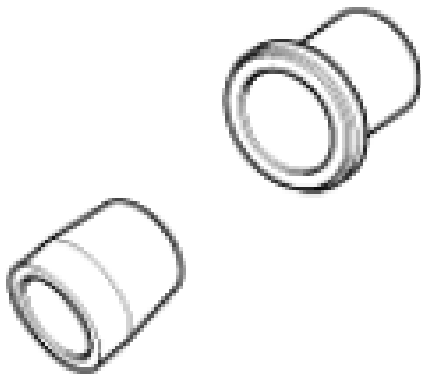
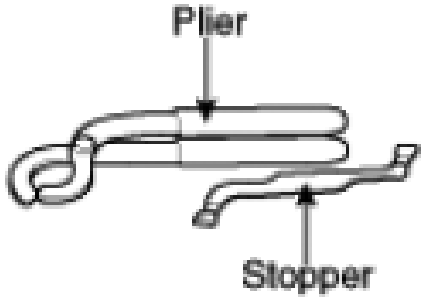
2010 ENGINE General Information - Engine Mechanical - Elantra

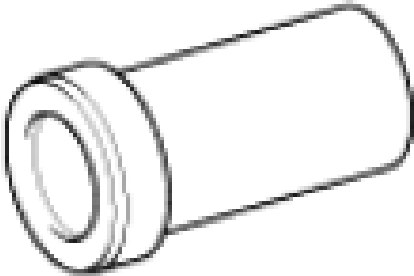
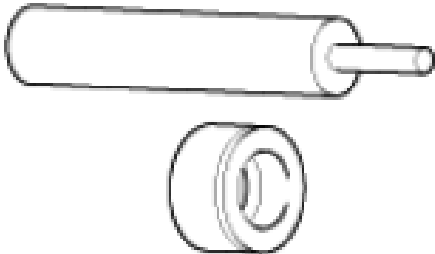
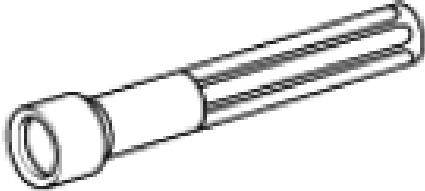
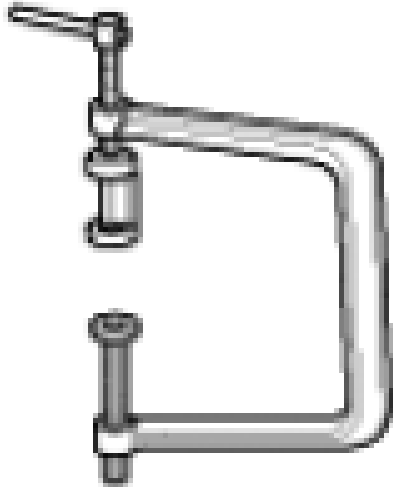
Lower engine noise, regardless of engine speed		<ul style="list-style-type: none"> <li>• Repair or replace as required.</li> </ul>
	Excessive connecting rod bearing rod clearance	<p>Inspect the following components and repair as required.</p> <ul style="list-style-type: none"> <li>• The connecting rod bearings.</li> <li>• The connecting rods.</li> <li>• The crankshaft.</li> <li>• The crankshaft journal.</li> </ul>
	Excessive crankshaft bearing clearance	<p>Inspect the following components, and repair as required.</p> <ul style="list-style-type: none"> <li>• The crankshaft bearing.</li> <li>• The crankshaft journals.</li> </ul>
	Incorrect piston, piston pin and connecting rod installation	<ul style="list-style-type: none"> <li>• Verify the piston pins and connecting rods are installed correctly.</li> <li>• Repair as required.</li> </ul>
Engine noise under load	Low oil pressure	Repair or replace as required.
	Excessive connecting rod bearing clearance	<p>Inspect the following components and repair as required:</p> <ul style="list-style-type: none"> <li>• The connecting rod bearings.</li> <li>• The connecting rods.</li> <li>• The crankshaft</li> </ul>
	Excessive crankshaft bearing clearance	<p>Inspect the following components, and repair as required.</p> <ul style="list-style-type: none"> <li>• The crankshaft bearings.</li> <li>• The crankshaft journals.</li> <li>• The cylinder block crankshaft</li> </ul>
Engine will not crank	<p>Hydro-locked cylinder</p> <ul style="list-style-type: none"> <li>• Coolant/antifreeze in cylinder.</li> <li>• Oil in cylinder.</li> <li>• Fuel in cylinder</li> </ul>	<ol style="list-style-type: none"> <li>1. Remove spark plugs and check for fluid.</li> <li>2. Inspect for broken head gasket.</li> <li>3. Inspect for cracked engine block or cylinder head.</li> <li>4. Inspect for a sticking fuel injector and/or leaking fuel regulator.</li> </ol>
	Broken timing chain and/or timing chain and/or timing chain gears.	<ol style="list-style-type: none"> <li>1. Inspect timing chain and gears.</li> <li>2. Repair as required.</li> </ol>
	Material cylinder	<ol style="list-style-type: none"> <li>1. Inspect cylinder for damaged</li> </ol>

shaft will not rotate	<ul style="list-style-type: none"> <li>• Broken valve</li> <li>• Piston material</li> <li>• Foreign material</li> </ul>	components and/or foreign materials. 2. Repair or replace as required.
	Seized crankshaft or connecting rod bearings.	1. Inspect crankshaft and connecting rod bearing. 2. Repair as required.
	Bent or broken connecting rod.	1. Inspect connecting rods. 2. Repair as required.
	Broken crankshaft	1. Inspect crankshaft. 2. Repair as required.

## SPECIAL SERVICE TOOLS

### SPECIAL TOOLS DESCRIPTION CHART

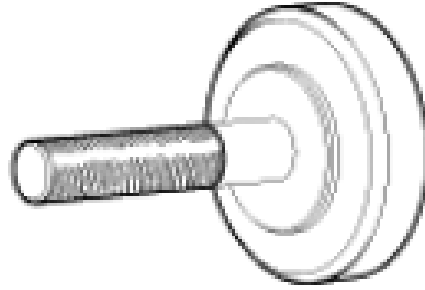
Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09231-23100)		Installation of the front oil seal
Valve clearance adjust tool set (09220-2D000)		Removal and installation of the tappet shim
Camshaft oil seal installer (09221-21000)		Installation of the camshaft oil seal

		
<p>Valve guide installer (09221-3F100 A/B)</p>		<p>Remove and installation of the valve guide</p>
<p>Valve stem oil seal installer (09222-22001)</p>		<p>Installation of the valve stem oil seal</p>
<p>Valve spring compressor &amp; adaptor (09222-28000, 09222-28100)</p>		<p>Removal and installation of the intake or exhaust valve</p>
<p>Crankshaft rear oil seal installer (09231-23200, 09231-H1100)</p>		<p>Installation of the crankshaft rear oil seal</p>



**2010 Hyundai Elantra GLS**

2010 ENGINE General Information - Engine Mechanical - Elantra

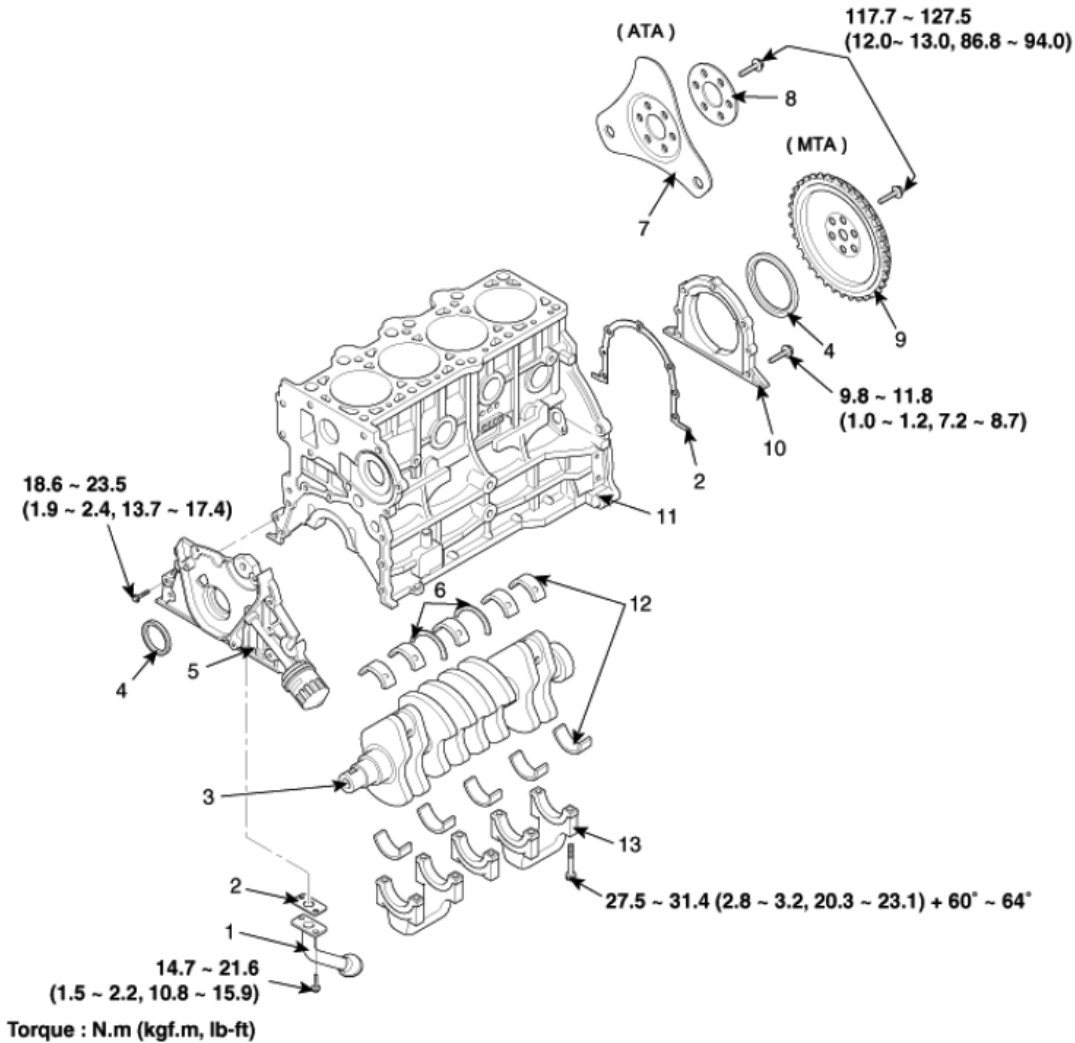


2010 ENGINE

Cylinder Block - Elantra

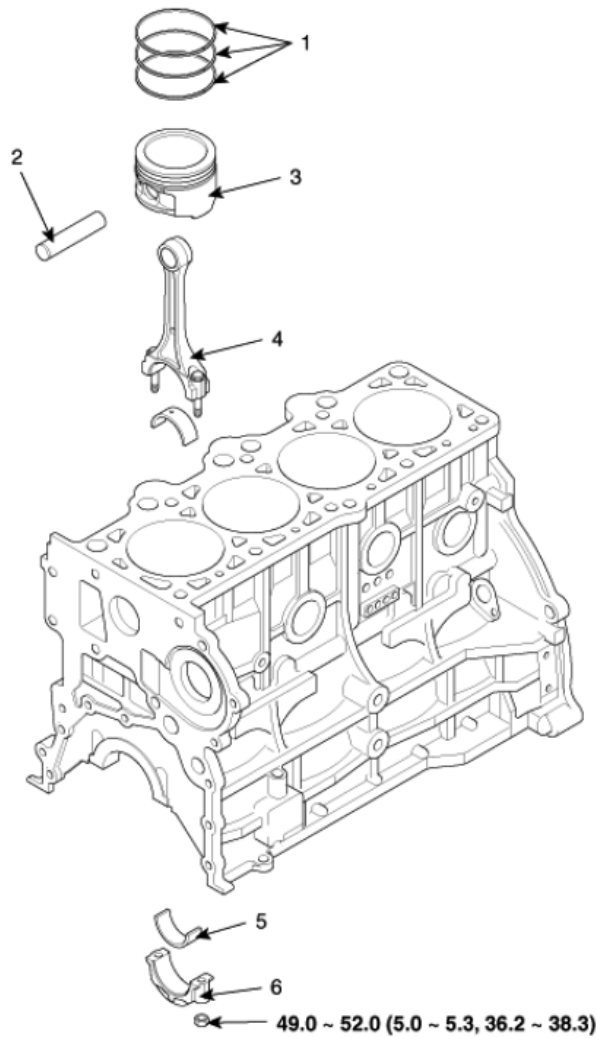
COMPONENTS AND COMPONENTS LOCATION

COMPONENTS



1. Oil screen	6. Thrust bearing	10. Rear oil seal case
2. Gasket	7. Drive plate	11. Cylinder block
3. Crankshaft	8. Washer	12. Main bearing
4. Oil seal	9. Adapter plate	13. Main bearing cap
5. Front case		

Fig. 1: Identifying Cylinder Block Components With Torque Specifications (1 Of 2)  
Courtesy of HYUNDAI MOTOR CO.



Torque : N.m (kgf.m, lb-ft)

1. Piston ring	4. Connecting rod
2. Piston pin	5. Connecting rod bearing
3. Piston	6. Connecting rod bearing cap

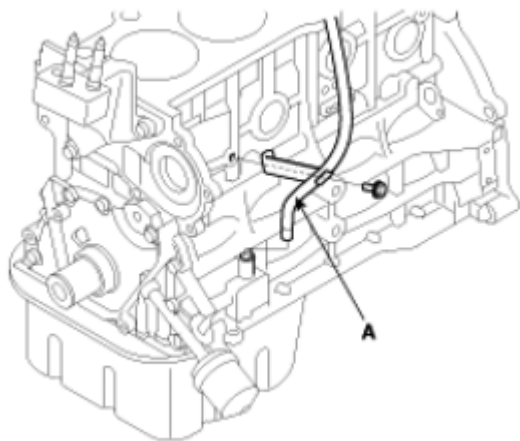
**Fig. 2: Identifying Cylinder Block Components With Torque Specifications (2 Of 2)**  
 Courtesy of HYUNDAI MOTOR CO.

## REPAIR PROCEDURES

### DISASSEMBLY

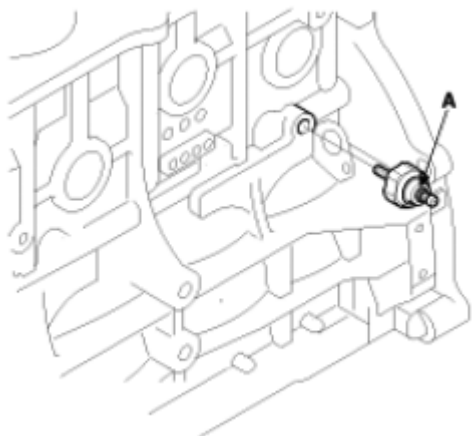
1. M/T : remove flywheel.
2. A/T : remove drive plate.
3. Install engine to engine stand for disassembly.
4. Remove timing belt.
5. Remove cylinder head.

6. Remove oil level gauge assembly (A).



**Fig. 3: Identifying Oil Level Gauge Assembly**  
Courtesy of HYUNDAI MOTOR CO.

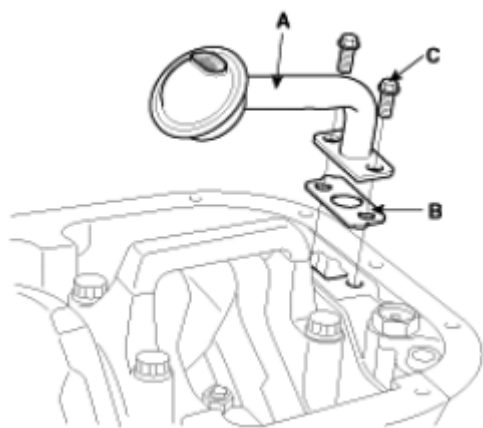
7. Remove knock sensor.
8. Remove oil pressure sensor (A).



**Fig. 4: Identifying Oil Pressure Sensor**  
Courtesy of HYUNDAI MOTOR CO.

9. Remove water pump.
10. Remove oil pan.
11. Remove oil screen.

Remove the 2 bolts (C), oil screen (A) and gasket (B).



**Fig. 5: Identifying Oil Screen, Bolts And Gasket**  
Courtesy of HYUNDAI MOTOR CO.

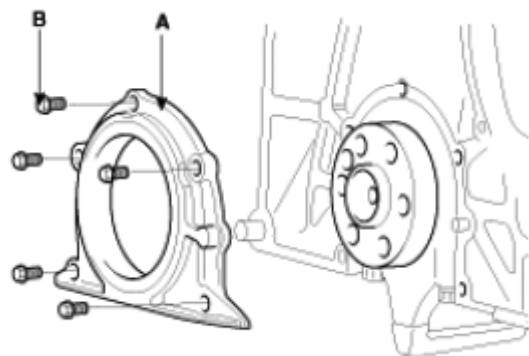
12. Check the connecting rod end play.
13. Remove the connecting rod caps and check oil clearance.
14. Remove piston and connecting rod assemblies.
  1. Using a ridge reamer, remove all the carbon from the top of the cylinder.
  2. Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

**NOTE:**

- **Keep the bearings, connecting rod and cap together.**
- **Arrange the piston and connecting rod assemblies in the correct order.**

15. Remove front case.
16. Remove rear oil seal case.

Remove the 5 bolts (B) and rear oil seal case (A).

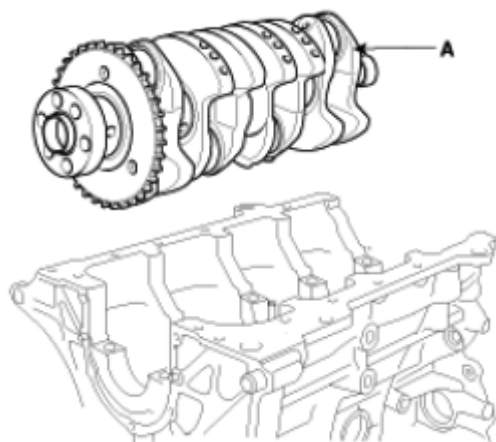


**Fig. 6: Identifying Rear Oil Seal Case And Bolts**  
Courtesy of HYUNDAI MOTOR CO.

17. Remove crankshaft bearing cap and check oil clearance.

18. Check the crankshaft end play.
19. Lift the crankshaft (A) out of the engine, being careful not to damage journals.

**NOTE:** Arrange the main bearings and trust washers in the correct order.



**Fig. 7: Identifying Crankshaft**  
Courtesy of HYUNDAI MOTOR CO.

20. Check fit between piston and piston pin.

Try to move the piston back and forth on the piston pin. If any movement is felt, replace the piston and pin as a set.

21. Remove piston rings.
  1. Using a piston ring expander, remove the 2 compression rings.
  2. Remove the 2 side rails and oil ring by hand.

**NOTE:** Arrange the piston rings in the correct order only.

22. Disconnect connecting rod from piston.

## INSPECTION

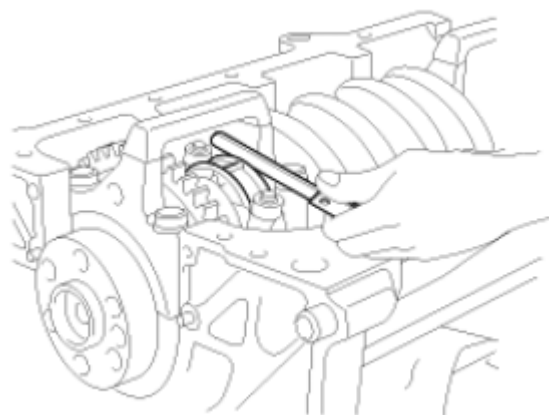
### Connecting Rod And Crankshaft

1. Check the connecting rod end play.

Using a feeler gauge, measure the end play while moving the connecting rod back and forth.

**Standard end play :** 0.1 ~ 0.25mm (0.004 ~ 0.010in)

**Maximum end play :** 0.4mm (0.016in)



**Fig. 8: Measuring End Play Connecting Rod Using Feeler Gauge**  
Courtesy of HYUNDAI MOTOR CO.

- A. If out-of-tolerance, install a new connecting rod.
- B. If still out-of-tolerance, replace the crankshaft.
2. Check the connecting rod bearing oil clearance.
  1. Check the matchmarks on the connecting rod and cap are aligned to ensure correct reassembly.
  2. Remove the 2 connecting rod cap nuts.
  3. Remove the connecting rod cap and bearing half.
  4. Clean the crank pin and bearing.
  5. Place plastigage across the crank pin.
  6. Reinstall the bearing half and cap, and torque the nuts.

#### **Tightening torque**

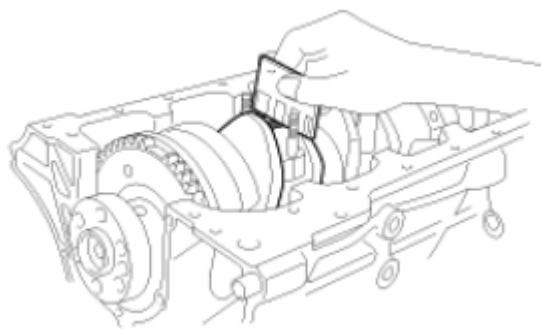
49.0 ~ 52.0 Nm (5.0 ~ 5.3kgf.m, 36.2 ~ 38.3lb-ft)

**NOTE: Do not turn the crankshaft.**

7. Remove the 2 nuts, connecting rod cap and bearing half.
8. Measure the plastigage at its widest point.

#### **Standard oil clearance**

0.024 ~ 0.042mm (0.0009 ~ 0.0017in)



**Fig. 9: Measuring Plastigage**  
Courtesy of HYUNDAI MOTOR CO.

9. If the plastigage measures too wide or too narrow, remove the upper half of the bearing, install a new, complete bearing with the same color mark (select the color as shown in the next column), and recheck the clearance.

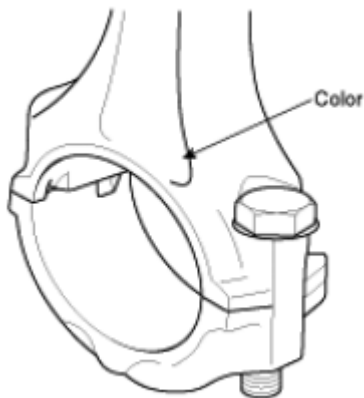
**CAUTION: Do not file, shim, or scrape the bearings or the caps to adjust clearance.**

10. If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing (the color listed above or below that one), and check clearance again.

**NOTE: If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start over.**

**CAUTION: If the marks are indecipherable because of an accumulation of dirt and dust, do not scrub them with a wire brush or scraper. Clean them only with solvent or detergent.**

#### Connecting Rod Mark Location



**Fig. 10: Identifying Connecting Rod Mark Location**  
Courtesy of HYUNDAI MOTOR CO.

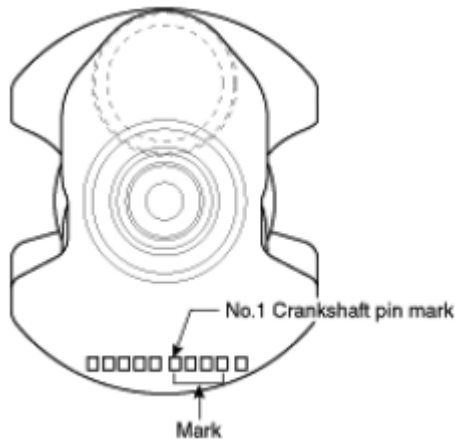


**Discrimination Of Connecting Rod**

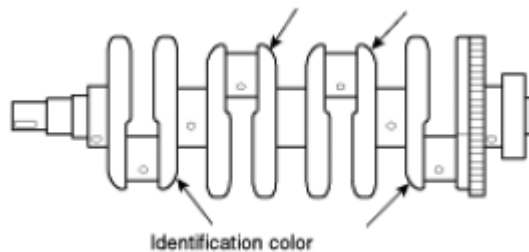
**DISCRIMINATION OF CONNECTING ROD**

Class	Mark	Inside Diameter
A	White	48.00 ~ 48.006mm (1.8896 ~ 1.8899in.)
B	None	48.006 ~ 48.012mm (1.8899 ~ 1.8902in.)
C	Yellow	48.012 ~ 48.018mm (1.8902 ~ 1.8904in.)

**Crankshaft Pin Mark Location**



**Fig. 11: Identifying Crankshaft Pin Mark Location (1 Of 2)**  
 Courtesy of HYUNDAI MOTOR CO.



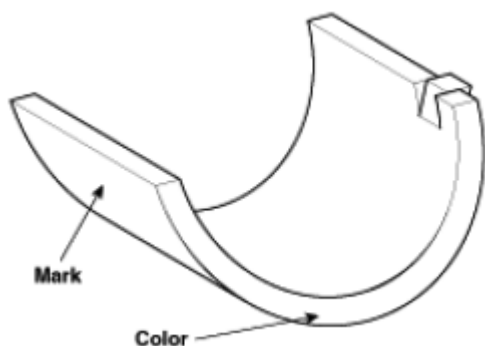
**Fig. 12: Identifying Crankshaft Pin Mark Location (2 Of 2)**  
 Courtesy of HYUNDAI MOTOR CO.

**Discrimination Of Crankshaft**

**DISCRIMINATION OF CRANKSHAFT**

Class	Mark	Outside Diameter Of Pin
I	Yellow	44.960 ~ 44.966mm (1.7700 ~ 1.7703in.)
II	None	44.954 ~ 44.960mm (1.7698 ~ 1.7700in.)
III	White	44.948 ~ 44.954mm (1.7696 ~ 1.7698in.)

**Place Of Identification Mark (Connecting Rod Bearing)**



**Fig. 13: Identifying Connecting Rod Bearing Identification Mark**  
 Courtesy of HYUNDAI MOTOR CO.

**Discrimination Of Connecting Rod Bearing**

**DISCRIMINATION OF CONNECTING ROD BEARING**

Class	Mark	Thickness Of Bearing
AA	Blue	1.514 ~ 1.517mm (0.0596 ~ 0.0597in.)
A	Black	1.511 ~ 1.514mm (0.0595 ~ 0.0596in.)
B	None	1.508 ~ 1.511mm (0.0594 ~ 0.0595in.)
C	Green	1.505 ~ 1.508mm (0.0593 ~ 0.0594in.)
D	Yellow	1.502 ~ 1.505mm (0.0591 ~ 0.0593in.)

11. Selection

**CRANKSHAFT IDENTIFICATION MARK REFERENCE**

Crankshaft Identification Mark	Connecting Rod Identification Mark	Assembling Classification Of Bearing
I (Yellow)	A (White)	D (Yellow)
	B (None)	C (Green)
	C (Yellow)	B (None)
II (None)	A (White)	C (Green)
	B (None)	B (None)
	C (Yellow)	A (Black)
III (White)	A (White)	B (None)
	B (None)	A (Black)
	C (Yellow)	AA (Blue)

3. Check the crankshaft bearing oil clearance.

1. To check main bearing-to-journal oil clearance, remove the main caps and bearing halves.
2. Clean each main journal and bearing half with a clean shop towel.
3. Place one strip of plastigage across each main journal.
4. Reinstall the bearings and caps, then torque the bolts.

**Tightening torque:**

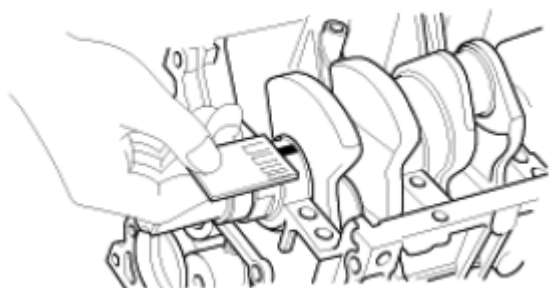
27.5~31.4Nm (2.8~3.2kgf.m, 20.3~23.1lb-ft) + 60° ~ 64°

**NOTE:** Do not turn the crankshaft.

5. Remove the cap and bearing again, and measure the widest part of the plastigage.

**Standard oil clearance:**

0.028 ~ 0.046mm (0.0011 ~ 0.0018in)



**Fig. 14: Measuring Widest Part Of Plastigage**  
Courtesy of HYUNDAI MOTOR CO.

6. If the plastigage measures too wide or too narrow, remove the upper half of the bearing, install a new, complete bearing with the same color mark (select the color as shown in the next column), and recheck the clearance.

**CAUTION: Do not file, shim, or scrape the bearings or the caps to adjust clearance.**

7. If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing (the color listed above or below that one), and check clearance again.

**NOTE:** If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start over.

**CAUTION: If the marks are indecipherable because of an accumulation of dirt and dust, do not scrub them with a wire brush or scraper. Clean them only with solvent or detergent.**

**Connecting rods**

1. When reinstalling, make sure that cylinder numbers put on the connecting rod and cap at disassembly match. When a new connecting rod is installed, make sure that the notches for holding

- the bearing in place are on the same side.
2. Replace the connecting rod if it is damaged on the thrust faces at either end. Also if step wear or a severely rough surface of the inside diameter of the small end is apparent, the rod must be replaced as well.
  3. Using a connecting rod aligning tool, check the rod for bend and twist. If the measured value is close to the repair limit, correct the rod by a press. Any connecting rod that has been severely bent or distorted should be replaced.

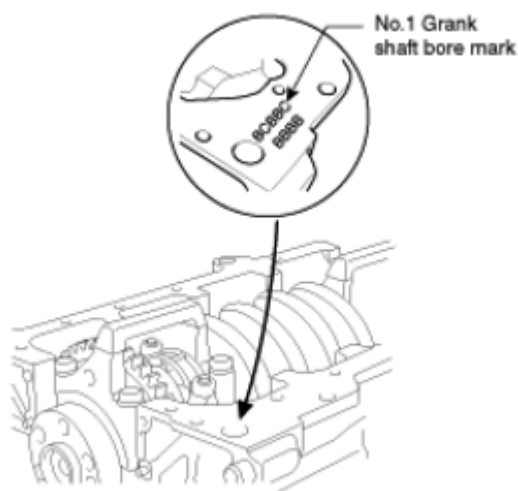
**Allowable bend of connecting rod:**

0.05mm/100mm (0.0020 in./3.94 in) or less

**Allowable twist of connecting rod:**

0.1mm/100mm (0.0039 in./3.94 in) or less

Letters have been stamped on the end of the block as a mark for the size of each of the 5 main journal bores.



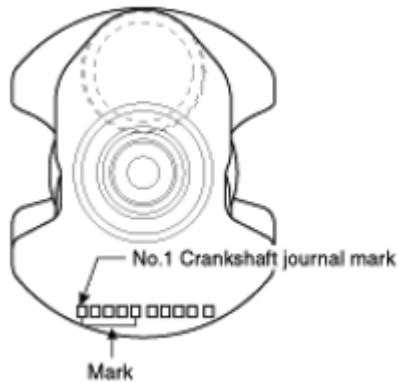
**Fig. 15: Identifying No. 1 Crankshaft Bore Mark**  
 Courtesy of HYUNDAI MOTOR CO.

**Discrimination Of Cylinder Block**

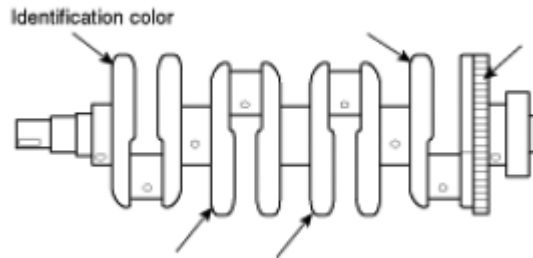
**DISCRIMINATION OF CYLINDER BLOCK**

Class	Mark	Inside Diameter
a	A	59.000 ~ 59.006mm (2.3228 ~ 2.3230in.)
b	B	59.006 ~ 59.012mm (2.3230 ~ 2.3233in.)
c	C	59.012 ~ 59.018mm (2.3233 ~ 2.3235in.)

**Crankshaft Journal Mark Location**



**Fig. 16: Identifying Crankshaft Journal Mark Location (1 Of 2)**  
 Courtesy of HYUNDAI MOTOR CO.



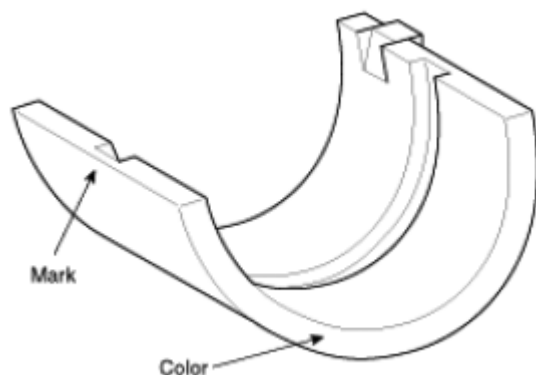
**Fig. 17: Identifying Crankshaft Journal Mark Location (2 Of 2)**  
 Courtesy of HYUNDAI MOTOR CO.

**Discrimination Of Crankshaft**

**DISCRIMINATION OF CRANKSHAFT**

Class	Mark	Outside Diameter Of Journal
I	Yellow	54.956 ~ 54.962mm (2.1636 ~ 2.1638in.)
II	None	54.950 ~ 54.956mm (2.1633 ~ 2.1636in.)
III	White	54.944 ~ 54.950mm (2.1631 ~ 2.1633in.)

**Place Of Identification Mark (Crankshaft Bearing)**



**Fig. 18: Identifying Crankshaft Bearing Identification Mark**  
Courtesy of HYUNDAI MOTOR CO.

### Discrimination Of Crankshaft Bearing

#### DISCRIMINATION OF CRANKSHAFT BEARING

Class	Mark	Thickness Of Bearing
AA	Blue	2.014 ~ 2.017mm (0.0793 ~ 0.0794in.)
A	Black	2.011 ~ 2.014mm (0.0791 ~ 0.0793in.)
B	None	2.008 ~ 2.011mm (0.0790 ~ 0.0791in.)
C	Green	2.005 ~ 2.008mm (0.0789 ~ 0.790in.)
D	Yellow	2.002 ~ 2.005mm (0.0788 ~ 0.0789in.)

#### Selection

#### CRANKSHAFT IDENTIFICATION MARK REFERENCE

Crankshaft Identification Mark	Crankshaft Bore Identification Mark	Assembling Classification Of Bearing
I (Yellow)	a (A)	D (Yellow)
	b (B)	C (Green)
	c (C)	B (None)
II (None)	a (A)	C (Green)
	b (B)	B (None)
	c (C)	A (Black)
III (White)	a (A)	B (None)
	b (B)	A (Black)
	c (C)	AA (Blue)

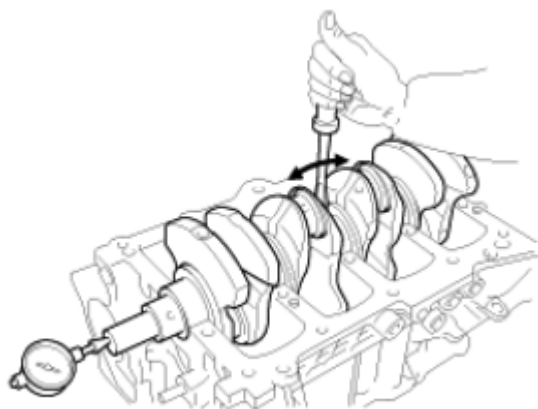
#### 4. Check crankshaft end play.

Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

#### Standard end play:

0.06 ~ 0.26mm (0.0023 ~ 0.010in)

**Limit** : 0.30mm (0.0118in)



**Fig. 19: Measuring Crankshaft End Play Dial Indicator**  
Courtesy of HYUNDAI MOTOR CO.

If the end play is greater than maximum, replace the thrust bearings as a set.

**Thrust bearing thickness:**

2.44 ~ 2.47mm (0.096 ~ 0.097in)

5. Inspect main journals and crank pins

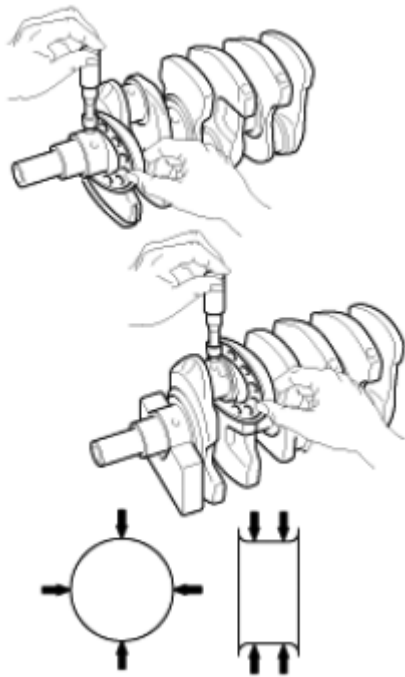
Using a micrometer, measure the diameter of each main journal and crank pin.

**Main journal diameter:**

56.942 ~ 56.962mm (2.2418 ~ 2.2426in)

**Crank pin diameter:**

44.946 ~ 44.966mm (1.7695 ~ 1.7703in)



**Fig. 20: Measuring Main Journal Diameter Using Micrometer**  
Courtesy of HYUNDAI MOTOR CO.

### Cylinder Block

1. Remove gasket material.

Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.

2. Clean cylinder block

Using a soft brush and solvent, thoroughly clean the cylinder block.

3. Inspect top surface of cylinder block for flatness.

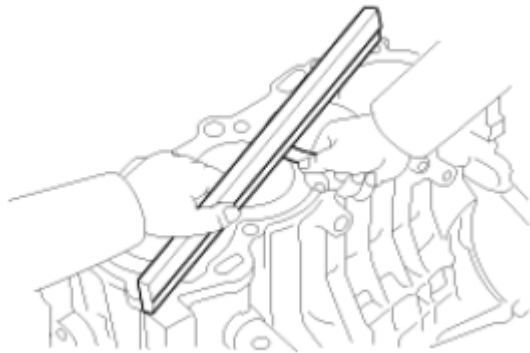
Using a precision straight edge and feeler gauge, measure the surface contacting the cylinder head gasket for warpage.

### Flatness of cylinder block gasket surface

Standard : Less than 0.03mm (0.0012 in)

Limit : 0.05 mm (0.0020 in)





**Fig. 21: Inspecting Surface Of Cylinder Block For Flatness**  
Courtesy of HYUNDAI MOTOR CO.

4. Inspect cylinder bore diameter

Visually check the cylinder for vertical scratch.

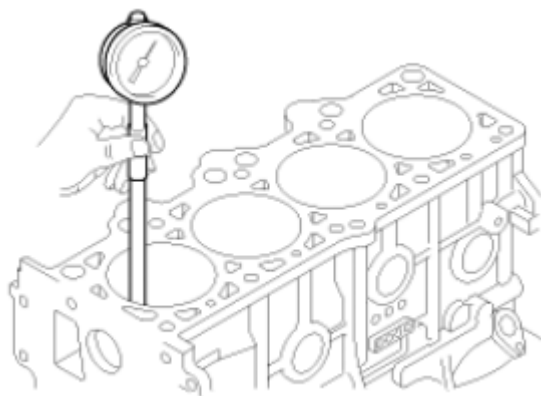
If deep scratches are present, replace the cylinder block.

5. Inspect cylinder bore diameter

Using a cylinder bore gauge, measure the cylinder bore diameter at position in the thrust and axial directions.

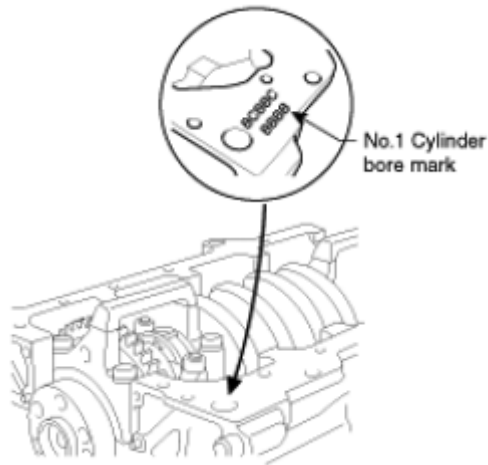
**Standard diameter:**

82.00 ~ 82.03mm (3.2283 ~ 3.2295in)



**Fig. 22: Measuring Cylinder Bore Diameter Using Cylinder Bore Gauge**  
Courtesy of HYUNDAI MOTOR CO.

6. Check the cylinder bore size code on the cylinder block bottom face.

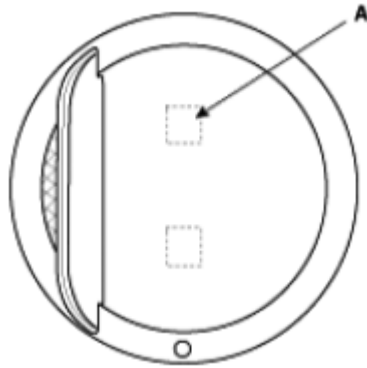


**Fig. 23: Identifying Cylinder Bore Size Code On Cylinder Block Bottom Face**  
 Courtesy of HYUNDAI MOTOR CO.

**CYLINDER BORE INNER DIAMETER**

Class	Cylinder Bore Inner Diameter	Size code
A	82.00 ~ 82.01mm (3.228~ 3.2287in)	A
B	82.01 ~ 82.02mm (3.2287~ 3.2291in)	B
C	82.02 ~ 82.03mm (3.2291~ 3.2295in.)	C

7. Check the piston size code on the piston top face.



**Fig. 24: Identifying Piston Size Code On Piston Top Face**  
 Courtesy of HYUNDAI MOTOR CO.

**NOTE:** Stamp the grade mark of basic diameter with rubber stamp.

**PISTON OUTER DIAMETER REFERENCE**

Class	Piston Outer Diameter	Size code
A	81.97 ~ 81.98mm (3.2271 ~ 3.2275in)	A
-	81.98 ~ 81.99mm (3.2275 ~ 3.2279in)	-

C	81.99 ~ 82.00mm (3.2279 ~ 3.2283in)	C
---	-------------------------------------	---

- Select the piston related to cylinder bore class.

### Clearance

0.02 ~ 0.04mm (0.00078 ~ 0.00157in.)

### Boring cylinder

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

### PISTONS IDENTIFICATION

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

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

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

New bore size = Piston O.D + 0.02 to 0.04 mm

(0.0008 to 0.0016 in.) (clearance between piston and cylinder) - 0.01 mm (0.0004 in.) (honing margin.)

- 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.

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

**Standard :** 0.02-0.04 mm (0.0008-0.0016 in.)

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

### Piston And Rings

- Clean piston

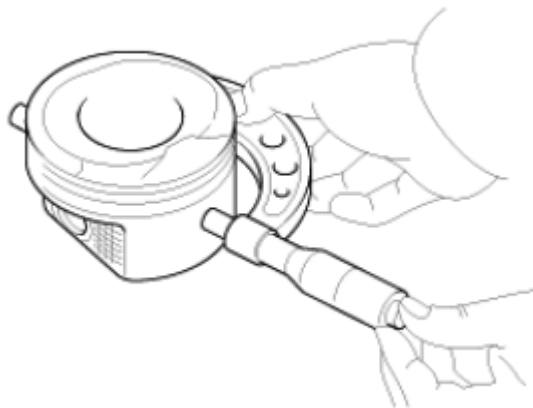
1. Using a gasket scraper, remove the carbon from the piston top.
2. Using a groove cleaning tool or broken ring, clean the piston ring grooves.
3. Using solvent and a brush, thoroughly clean the piston.

**NOTE: Do not use a wire brush.**

2. The standard measurement of the piston outside diameter is taken 47 mm (1.85 in.) from the top land of the piston.

#### **Standard diameter**

81.97 ~ 82.00mm (3.2272 ~ 3.2283in)



**Fig. 25: Measuring Piston Outside Diameter**  
Courtesy of HYUNDAI MOTOR CO.

3. Calculate the difference between the cylinder bore diameter and the piston diameter.

#### **Piston-to-cylinder clearance**

0.02 ~ 0.04mm (0.0008 ~ 0.0016in)

4. Inspect the piston ring side clearance.

Using a feeler gauge, measure the clearance between new piston ring and the wall of the ring groove.

#### **Piston ring side clearance**

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

No. 2 : 0.03 ~ 0.07 mm (0.0012 ~ 0.0028 in)

Oil ring : 0.06 ~ 0.15 mm (0.0024 ~ 0.0059 in)

**Limit**

No. 1 : 0.1mm (0.004in)

No. 2 : 0.1mm (0.004in)

Oil ring : 0.2 mm (0.0079 in)



**Fig. 26: Measuring Piston Ring Side Clearance**  
 Courtesy of HYUNDAI MOTOR CO.

If the clearance is greater than maximum, replace the piston.

5. Inspect piston ring end gap.

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. If the gap is too large, recheck the cylinder bore diameter against the wear limits. If the bore is over the service limit, the cylinder block must be rebored.

**Piston ring end gap****Standard**

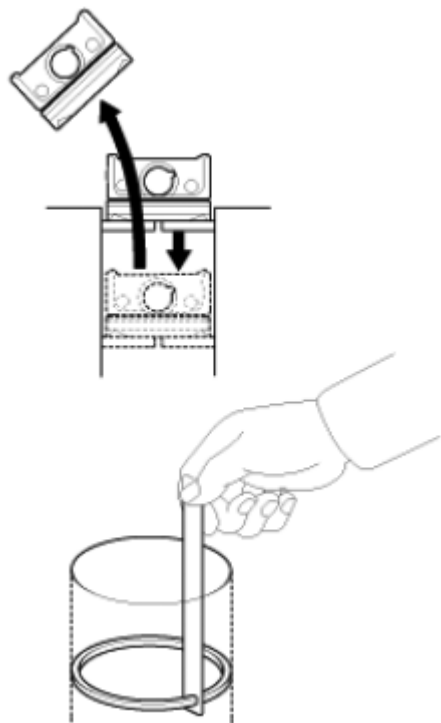
No. 1 : 0.20 ~ 0.35mm (0.0079 ~ 0.0138 in)

No. 2 : 0.37 ~ 0.52mm (0.0146 ~ 0.0205 in)

Oil ring : 0.20 ~ 0.60 mm (0.0079 ~ 0.0236 in)

**Limit**

No. 1, 2, oil ring : 1.0mm (0.039in)



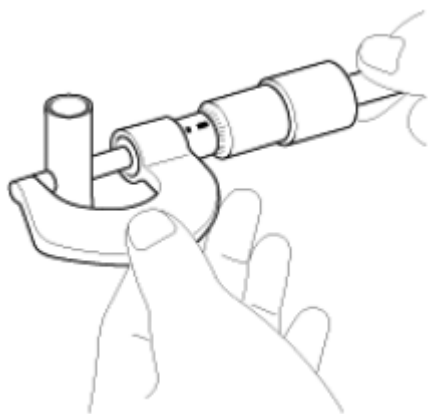
**Fig. 27: Measuring Piston Ring End Gap**  
Courtesy of HYUNDAI MOTOR CO.

**Piston Pins**

1. Measure the diameter of the piston pin.

**Piston pin diameter**

20.001 ~ 20.006mm (0.7874 ~ 0.7876in)



**Fig. 28: Measuring Piston Pin Diameter**  
Courtesy of HYUNDAI MOTOR CO.

2. Measure the piston pin-to-piston clearance.

**Piston pin-to-piston clearance**

0.01 ~ 0.02mm (0.0004 ~ 0.0008in)

3. Check the difference between the piston pin diameter and the connecting rod small end diameter.

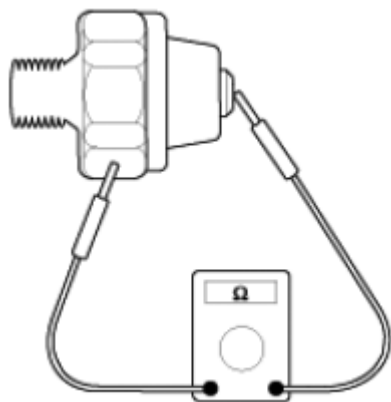
**Piston pin-to-connecting rod interference**

-0.032 ~ -0.016mm (-0.0013 ~ -0.0006in)

**Engine Oil Pressure Switch**

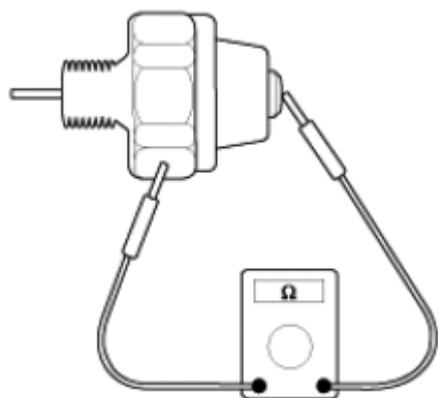
1. Check the continuity between the terminal and the body with an ohmmeter.

If there is no continuity, replace the oil pressure switch.



**Fig. 29: Checking Continuity Between Oil Pressure Switch Terminal And Body With Ohmmeter**  
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 50kpa (7psi) vacuum is applied through the oil hole, the switch is operating properly. Check for air leakage. If air leaks, the diaphragm is broken. Replace it.



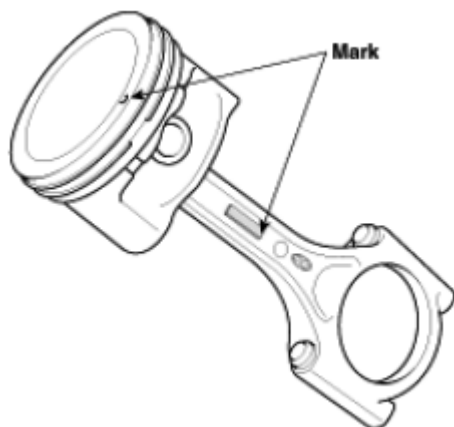
**Fig. 30: Checking Continuity Between Oil Pressure Switch Terminal And Body (Fine Wire Pushed)**  
 Courtesy of HYUNDAI MOTOR CO.

## REASSEMBLY

### NOTE:

- Thoroughly clean all parts to assembled.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.
- Replace all gaskets, O-rings and oil seals with new parts.

1. Assemble piston and connecting rod.
  1. Use a hydraulic press for installation.
  2. The piston front mark and the connecting rod front mark must face the timing belt side of the engine.

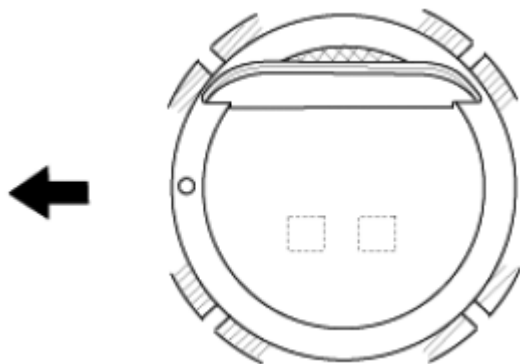


**Fig. 31: Identifying Piston Front Mark**  
 Courtesy of HYUNDAI MOTOR CO.

2. Install piston rings.
  1. Install the oil ring expander and 2 side rails by hand.

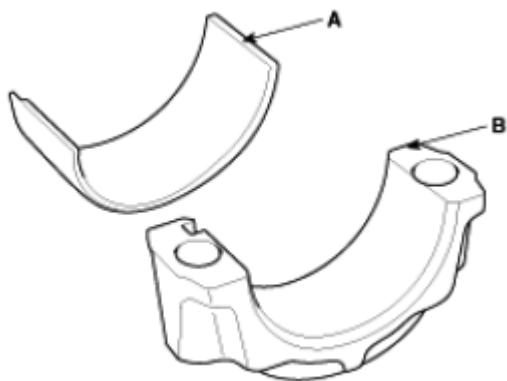


2. Using a piston ring expander, install the 2 compression rings with the code mark facing upward.
3. Position the piston rings so that the ring ends are as shown in illustration.



**Fig. 32: Positioning Piston Rings**  
Courtesy of HYUNDAI MOTOR CO.

3. Install connecting rod bearings.
  1. Align the bearing claw with the groove of the connecting rod or connecting rod cap.
  2. Install the bearings (A) in the connecting rod and connecting rod cap (B).



**Fig. 33: Identifying Connecting Rod Bearings And Connecting Rod Cap**  
Courtesy of HYUNDAI MOTOR CO.

4. Install main bearings.

**NOTE:** Upper 1,2,4,5 bearings have an oil groove of oil holes; Lower bearings do not.

1. Align the bearing claw with the claw groove of the cylinder block, push in the 5 upper bearings (A).
  2. Align the bearing claw with the claw groove of the main bearing cap, and push in the 5 lower bearings.
5. Install thrust bearings.

Install the 2 thrust bearings under the No. 3 journal position of the cylinder block with the oil grooves facing outward.



**Fig. 34: Identifying Thrust Bearings**  
Courtesy of HYUNDAI MOTOR CO.

6. Place crankshaft on the cylinder block.
7. Place main bearing caps on cylinder block.
8. Install main bearing cap bolts.

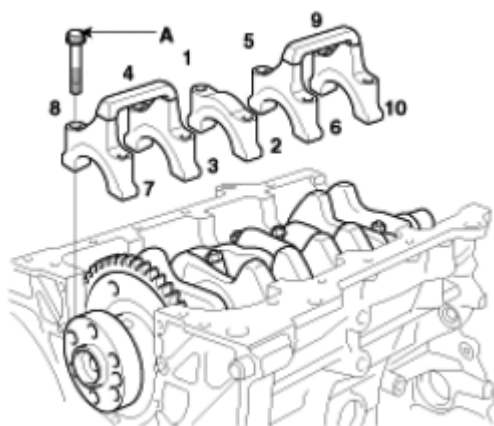
**NOTE:**

- The main bearing cap bolts are tightened in 2 progressive steps.
- Always use new main bearing cap bolts.

1. Apply a light coat of engine oil on the threads and under the bearing cap bolts.
2. Install and uniformly tighten the 10 bearing cap bolts (A), in several passes, in the sequence shown in illustration.

**Tightening torque**

27.5 ~ 31.4 Nm (2.8 ~ 3.2kgf.m, 20.3 ~ 23.1lb-ft) + 60 ~ 64°



**Fig. 35: Identifying Bearing Cap Bolts Tightening Sequence**  
 Courtesy of HYUNDAI MOTOR CO.

- Retighten the bearing cap bolts by 60°~66° in the numerical order shown in illustration.

**Tightening torque**

Main bearing cap bolt:

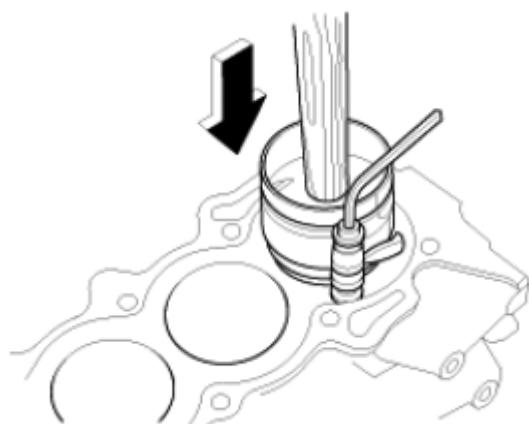
27.5 ~ 31.4 Nm (2.8 ~ 3.2kgf.m, 20.3 ~ 23.1lb-ft) + 60 ~ 64°

- Check that the crankshaft turns smoothly.
- Check crankshaft end play.
- Install piston and connecting rod assemblies.

**NOTE:** Before installing the pistons, apply a coat of engine oil to the ring grooves and cylinder bores.

- Remove the connecting rod caps, and slip short sections of rubber hose over the threaded ends of the connecting rod bolts.
- Install the ring compressor, check that the bearing is securely in place, then position the piston in the cylinder, and tap it in using the wooden handle of a hammer.
- Stop after the ring compressor pops free, and check the connecting rod-to-check journal alignment before pushing the piston into place.
- Apply engine oil to the bolt threads. Install the rod caps with bearings, and torque the nuts : 49.0 ~ 52.0 Nm (5.0 ~ 5.3kgf.m, 36.2 ~ 38.3lb-ft)

**NOTE:** Maintain downward force on the ring compressor to prevent the rings from expanding before entering the cylinder bore.

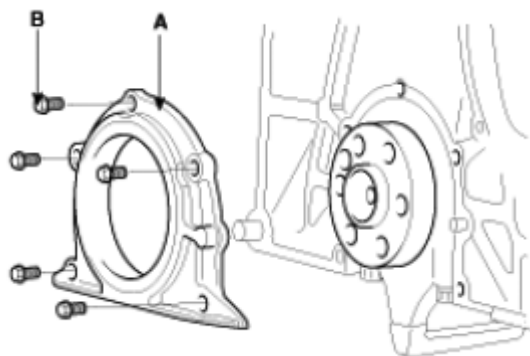


**Fig. 36: Installing Ring Compressor**  
 Courtesy of HYUNDAI MOTOR CO.

11. Install a new gasket and rear oil seal case (A) with 5 bolts (B).

### Tightening torque

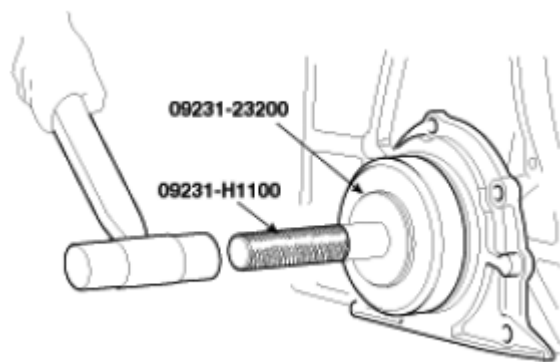
9.8 ~ 11.8 Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



**Fig. 37: Identifying Rear Oil Seal Case And Bolts**  
Courtesy of HYUNDAI MOTOR CO.

**NOTE:** Check that the mating surfaces are clean and dry.

12. Install rear oil seal.
1. Apply engine oil to a new oil seal lip.
  2. Using SST (09231-23200, 09231-H1100) and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.



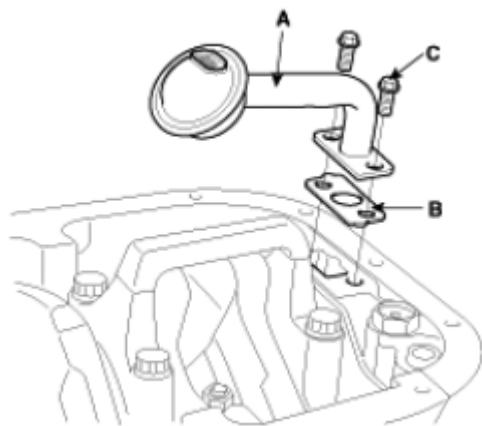
**Fig. 38: Installing Rear Oil Seal**  
Courtesy of HYUNDAI MOTOR CO.

13. Install front case.
14. Install oil screen.

Install a new gasket (A) and oil screen (B) with 2 bolts (C).

**Tightening torque**

14.7 ~ 21.6 Nm (1.5 ~ 2.2kgf.m, 10.8 ~ 15.9lb-ft)



**Fig. 39: Identifying Oil Screen, Gasket And Bolts**  
Courtesy of HYUNDAI MOTOR CO.

## 15. Install oil pan.

- Using a razor blade and gasket scraper, remove all the old packing material from the gasket surfaces.

**NOTE:** Check that the mating surfaces are clean and dry before applying liquid gasket.

- Apply liquid gasket as an even bead, centered between the edges of the mating surface. Use liquid gasket 'TB 1217H' or equivalent.

**NOTE:**

- To prevent leakage of oil, apply liquid gasket to the inner threads of the bolt holes.
- Do not install the parts if five minutes or more have elapsed since applying the liquid gasket. Instead, reapply liquid gasket after removing the residue.
- After assembly, wait at least 30 minutes before filling the engine with oil.

- Install the oil pan with the 19 bolts.

Uniformly tighten the bolts in several passes.

**Tightening torque**

9.8 ~ 11.8 Nm (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

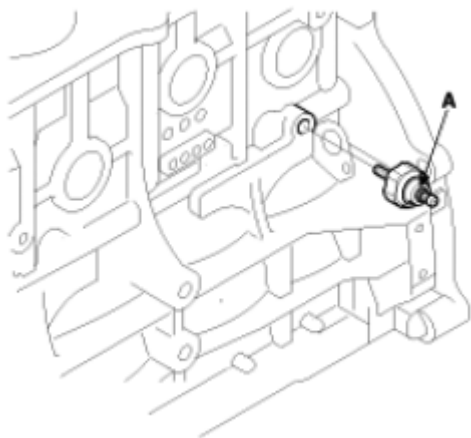
16. Install water pump.
17. Install oil pressure sensor.
  1. Apply adhesive to 2 or 3 threads.

Adhesive : Three bond 2310/2350 or equivalent.

2. Install the oil pressure sensor (A).

#### **Tightening torque**

14.7 ~ 21.6 Nm (1.5 ~ 2.2kgf.m, 10.8 ~ 15.9lb-ft)



**Fig. 40: Identifying Oil Pressure Sensor**  
Courtesy of HYUNDAI MOTOR CO.

18. Install knock sensor.

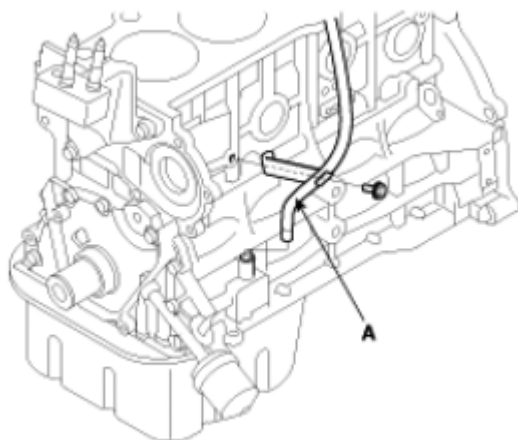
#### **Tightening torque**

16.7 ~ 26.5 Nm (1.7 ~ 2.7kgf.m, 12.3 ~ 19.5lb-ft)

19. Install oil level gauge assembly.
  1. Install a new O-ring on the oil level gauge.
  2. Apply engine oil on the O-ring.
  3. Install the oil level gauge assembly (A) with the bolt.

#### **Tightening torque**

18.6 ~ 23.5 Nm (1.9~ 2.4kgf.m, 13.7 ~ 17.4lb-ft)



**Fig. 41: Identifying Oil Level Gauge Assembly**  
Courtesy of HYUNDAI MOTOR CO.

20. Install cylinder head.
21. Install timing belt.
22. Remove engine stand.
23. A/T : Install drive plate.

**Tightening torque**

117.7 ~ 127.5Nm (12.0 ~ 13.0kgf.m, 86.8 ~ 94.0lb-ft)

24. M/T : Install flywheel.

**Tightening torque**

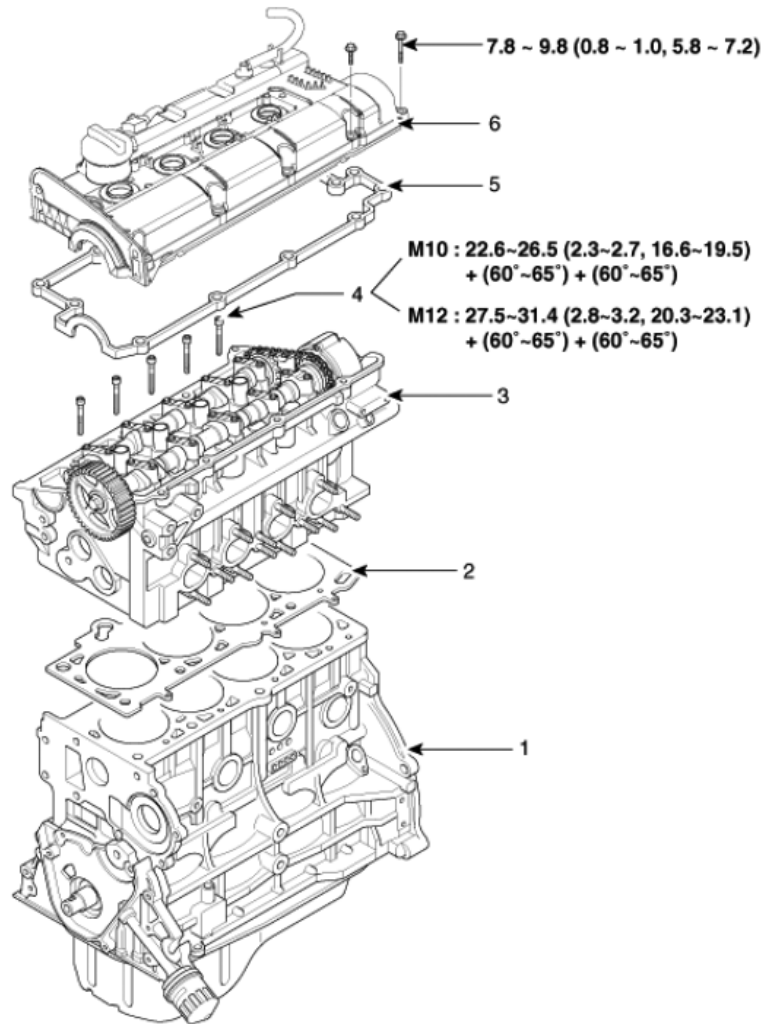
117.7 ~ 127.5Nm (12.0 ~ 13.0kgf.m, 86.8 ~ 94.0lb-ft)

2010 ENGINE

Cylinder Head Assembly - Elantra

COMPONENTS AND COMPONENTS LOCATION

COMPONENTS

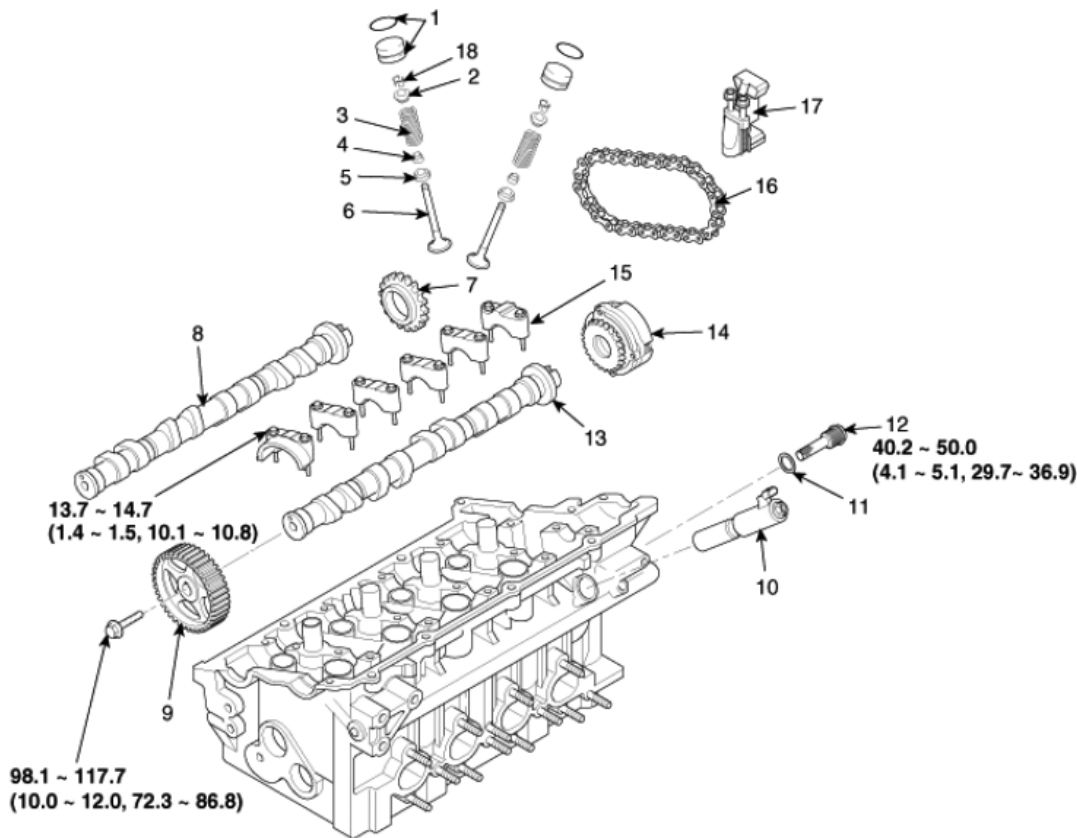


Torque : N.m (kgf.m, lb-ft)

- |                         |                        |
|-------------------------|------------------------|
| 1. Cylinder block       | 4. Cylinder head bolt  |
| 2. Cylinder head gasket | 5. Gasket              |
| 3. Cylinder head        | 6. Cylinder head cover |

**Fig. 1: Identifying Cylinder Head Assembly Components With Torque Specifications (1 Of 2)**  
 Courtesy of HYUNDAI MOTOR CO.





Torque : N.m (kgf.m, lb-ft)

1. Mechanical lash adjuster(MLA)	7. Chain sprocket	13. Exhaust camshaft
2. Retainer	8. Intake camshaft	14. CVVT assembly
3. Valve spring	9. Camshaft sprocket	15. Camshaft bearing cap
4. Stem seal	10. Oil control valve(OCV)	16. Timing chain
5. Spring seat	11. Washer	17. Auto Tensioner
6. Valve	12. OCV filter	18. Retainer lock

**Fig. 2: Identifying Cylinder Head Assembly Components With Torque Specifications (2 Of 2)**  
 Courtesy of HYUNDAI MOTOR CO.

## REPAIR PROCEDURES

### REMOVAL

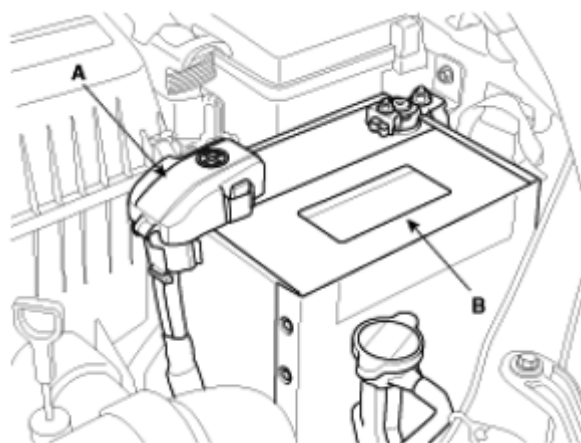
**CAUTION:**

- Use fender covers to avoid damaging painted surfaces.
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature before removing it.
- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

**NOTE:**

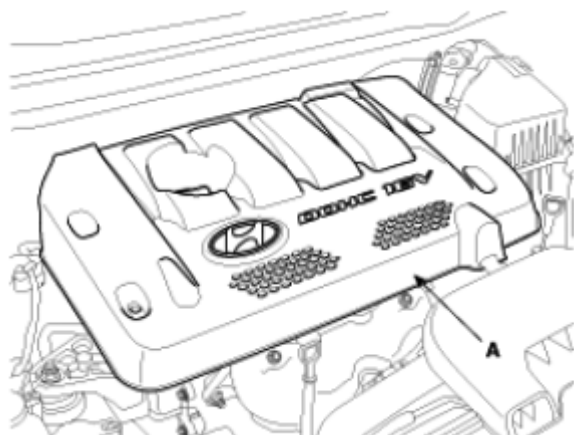
- Mark all wiring and hoses to avoid misconnection.
- Inspect the timing belt before removing the cylinder head.
- Turn the crankshaft pulley so that the No. 1 piston is at top dead center.

1. Disconnect the negative terminal (A) from the battery and remove the battery (B).



**Fig. 3: Identifying Battery And Negative Terminal**  
Courtesy of HYUNDAI MOTOR CO.

2. Remove the engine cover (A).



**Fig. 4: Identifying Engine Cover**  
Courtesy of HYUNDAI MOTOR CO.

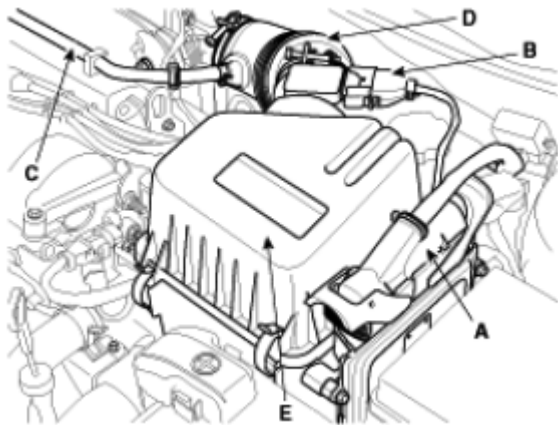
3. Drain the engine coolant.

Remove the radiator cap to speed draining.

4. Remove the intake air hose and air cleaner assembly.

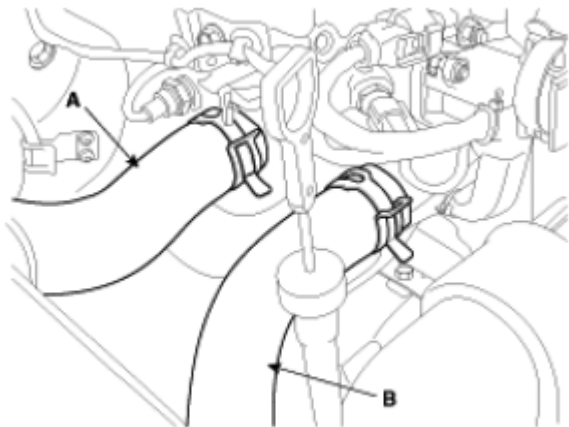
1. Disconnect the PCM connectors (A).

2. Disconnect the MAF connector (B).
3. Disconnect the breather hose (C) from air cleaner hose (D).
4. Remove the intake air hose and air cleaner assembly (E).



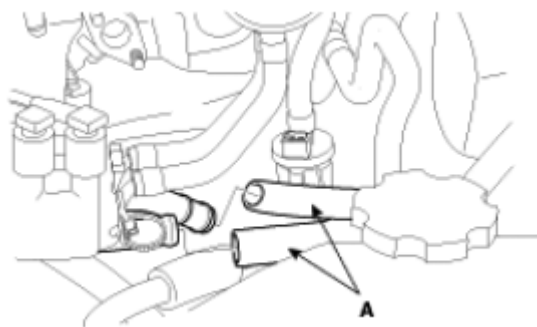
**Fig. 5: Identifying PCM Connectors, MAF Connector, Breather Hose, Air Cleaner Hose And Air Cleaner Assembly**  
Courtesy of HYUNDAI MOTOR CO.

5. Remove the upper radiator hose (A) and lower radiator hose (B).



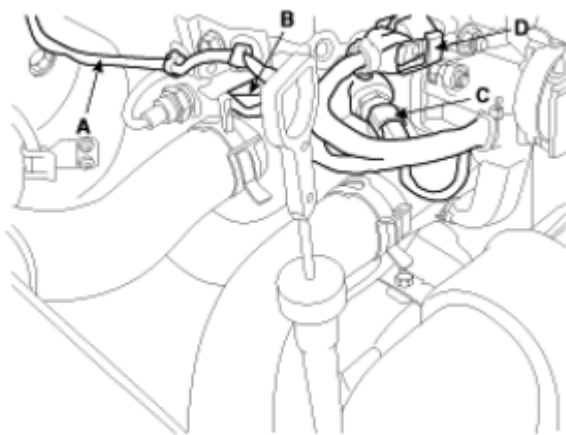
**Fig. 6: Identifying Upper Radiator Hose And Lower Radiator Hose**  
Courtesy of HYUNDAI MOTOR CO.

6. Remove the heater hoses (A).



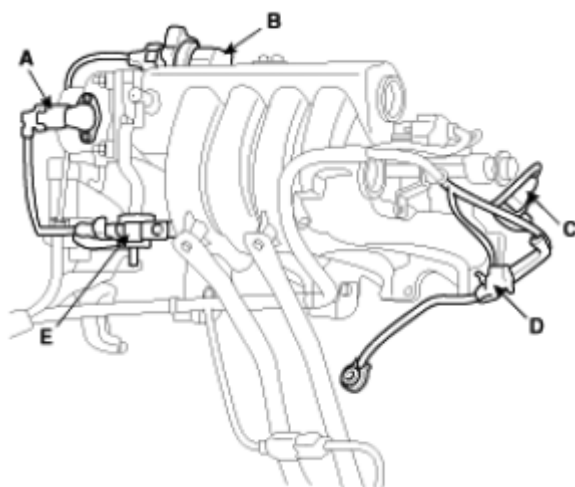
**Fig. 7: Identifying Heater Hoses**  
Courtesy of HYUNDAI MOTOR CO.

7. Remove the engine wire harness connectors and wire harness clamps from the cylinder head and the intake manifold.
  1. OCV (Oil control Valve) connector (A).
  2. Oil temperature sensor (OTS) connector (B).
  3. Engine coolant temperature (ECT) sensor connector (C).
  4. Ignition coil connector (D).



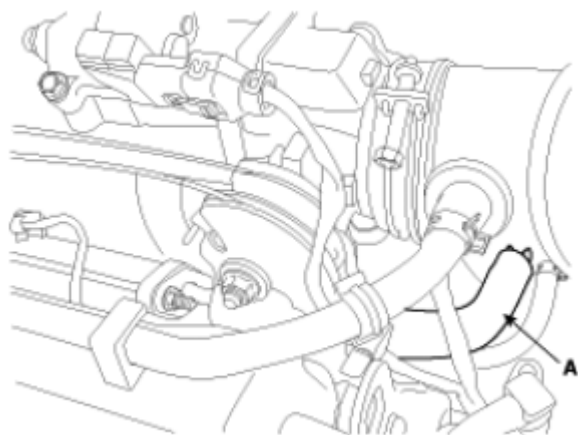
**Fig. 8: Identifying OCV (Oil Control Valve) Connector, Oil Temperature Sensor (OTS) Connector, Engine Coolant Temperature (ECT) Sensor Connector And Ignition Coil Connector**  
Courtesy of HYUNDAI MOTOR CO.

5. TPS (Throttle Position Sensor) connector (A).
6. ISA (Idle Speed Actuator) connector (B).
7. CMP (Camshaft Position Sensor) connector (C).
8. Four fuel injector connectors.
9. Knock sensor connector (D).
10. PCSV (Purge Control Solenoid Valve) connector (E).



**Fig. 9: Identifying TPS Connector, ISA Connector, CMP Connector, Knock Sensor Connector And PCSV Connector**  
 Courtesy of HYUNDAI MOTOR CO.

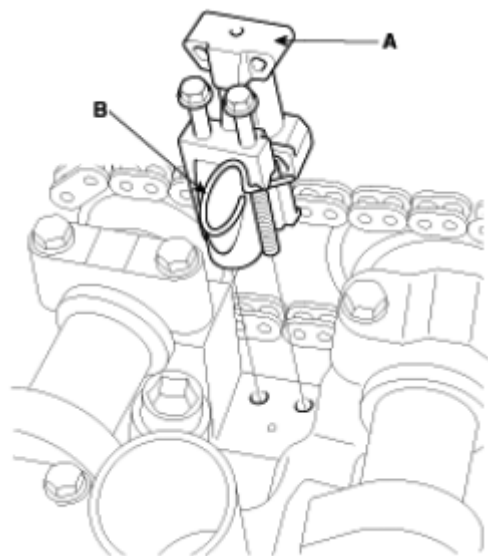
11. Front heated oxygen sensor connector.
8. Remove the fuel inlet hose (A) from delivery pipe.



**Fig. 10: Identifying Fuel Inlet Hose**  
 Courtesy of HYUNDAI MOTOR CO.

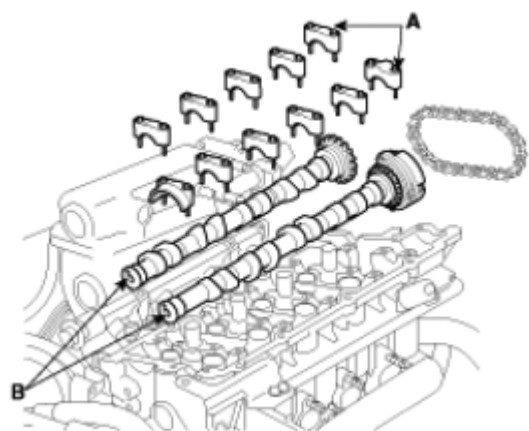
9. Remove the PCSV hose.
10. Remove the brake booster vacuum hose.
11. Remove the accelerator cable and the auto-cruise cable by loosening the locknut, then slip the cable end out of the throttle linkage.
12. Remove the spark plug cable.
13. Remove the PCV hose.
14. Remove the cylinder head cover.
15. Remove the timing belt.

16. Remove the exhaust manifold.
17. Remove the intake manifold.
18. Remove the camshaft sprocket.
19. Remove the timing chain auto tensioner (A).



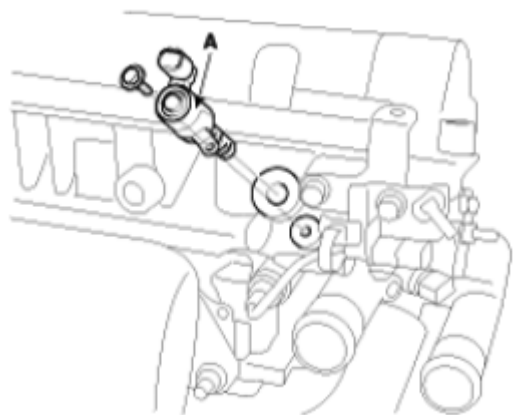
**Fig. 11: Identifying Timing Chain Auto Tensioner**  
Courtesy of HYUNDAI MOTOR CO.

20. Remove the camshaft bearing caps (A) and camshafts (B).



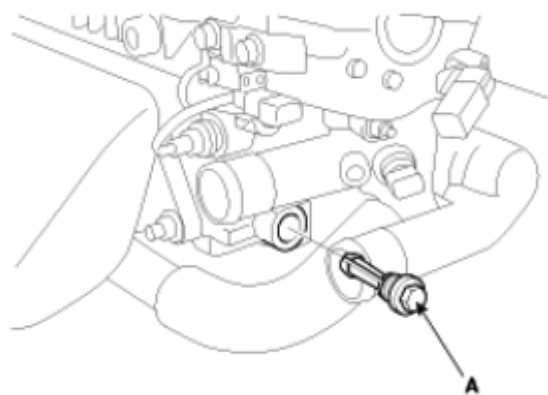
**Fig. 12: Identifying Camshaft Bearing Caps And Camshafts**  
Courtesy of HYUNDAI MOTOR CO.

21. Remove the OCV (oil control valve) (A).



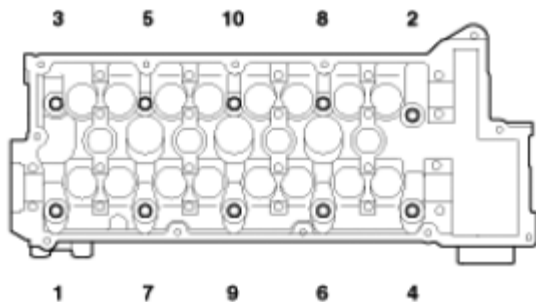
**Fig. 13: Identifying OCV (Oil Control Valve)**  
Courtesy of HYUNDAI MOTOR CO.

22. Remove the OCV (oil control valve) filter (A).



**Fig. 14: Identifying OCV (Oil Control Valve) Filter**  
Courtesy of HYUNDAI MOTOR CO.

23. Remove the cylinder head bolts, then remove the cylinder head.
1. Using 8 mm and 10 mm hexagon wrench, uniformly loosen and remove the 10 cylinder head bolts, in several passes, in the sequence shown in illustration. Remove the 10 cylinder head bolts and plate washers.



**Fig. 15: Identifying Cylinder Head Bolts Loosening Sequence**

Courtesy of HYUNDAI MOTOR CO.

**CAUTION: Head warpage or cracking could result from removing bolts in an incorrect order.**

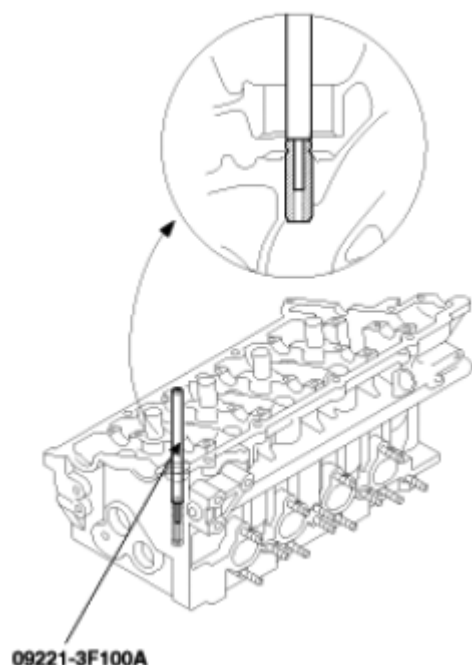
- Lift the cylinder head from the dowels on the cylinder block and replace the cylinder head on wooden blocks on a bench.

**CAUTION: Be careful not to damage the contact surfaces of the cylinder head and cylinder block.**

## REPLACEMENT

### Valve Guide

- Using the SST (09221-3F100A), withdraw the old valve guide toward the bottom of cylinder head.



**Fig. 16: Removing Old Valve Guide Using SST (09221-3F100A)**  
Courtesy of HYUNDAI MOTOR CO.

- Recondition the valve guide hole so that it can match the newly press-fitted oversize valve guide.
- Using the SST (09221-3F100A/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.

### VALVE GUIDES HOLE SIZE REFERENCE

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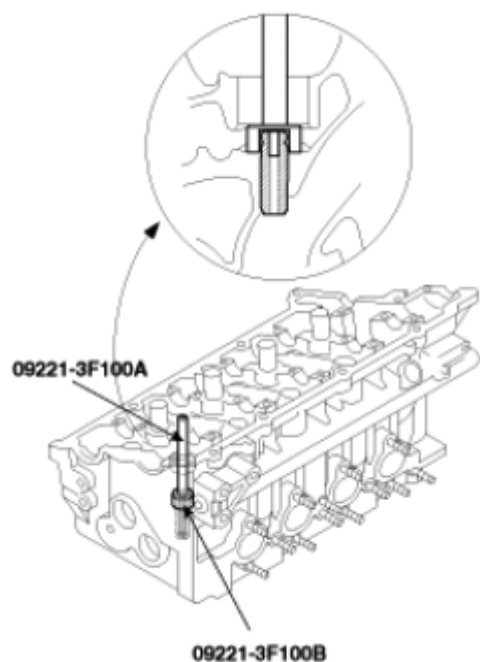


Over size mm (in.)	Size mark	Oversize valve guide hole size mm (in.)
0.05 (0.002)	5	11.05 ~ 11.068 (0.4350 ~ 0.4357)
0.25 (0.010)	25	11.25 ~ 11.268 (0.4429 ~ 0.4436)
0.50 (0.020)	50	11.50 ~ 11.518 (0.4528 ~ 0.4535)

### Valve guide length

Intake : 46 mm (1.8 in.)

Exhaust : 54.5 mm (2.15 in.)



**Fig. 17: Pressing Valve Guide Using SST (09221-3F100A/B)**  
Courtesy of HYUNDAI MOTOR CO.

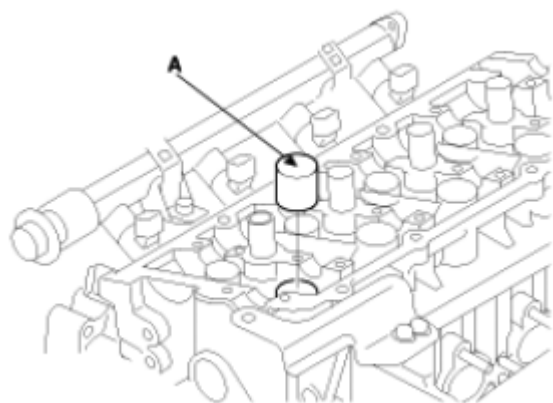
**NOTE:** Before the valve guide is press-fitted using the SST (09221-3F100A/B), remove the valve spring seat to install the valve guide correctly.

4. After the valve guide is press-fitted, insert a new valve and check for proper stem-to-guide clearance.
5. After the valve guide is replaced, check that the valve is seated properly. Recondition the valve seats as necessary.

### DISASSEMBLY

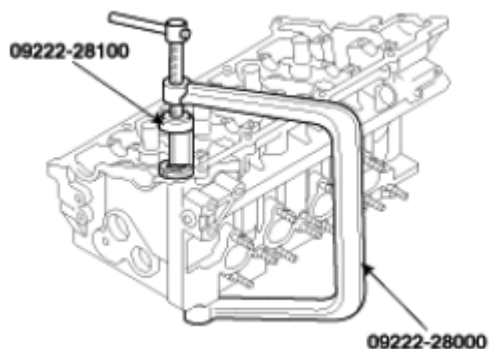
**NOTE:** Identify MLA (Mechanical Lash Adjuster), valves, valve springs as they are removed so that each item can be reinstalled in its original position.

1. Remove MLAs (A).



**Fig. 18: Identifying MLAs**  
Courtesy of HYUNDAI MOTOR CO.

2. Remove valves.
  1. Using SST (09222-28000, 09222-28100), compress the valve spring and remove retainer lock.



**Fig. 19: Compressing Valve Spring Using SST (09222-28000, 09222-28100)**  
Courtesy of HYUNDAI MOTOR CO.

2. Remove the spring retainer.
3. Remove the valve spring.
4. Remove the valve.
5. Remove the using needle-nose pliers, remove the oil seal.
6. Using a magnetic finger, remove the spring seat.

## INSPECTION

### Cylinder Head

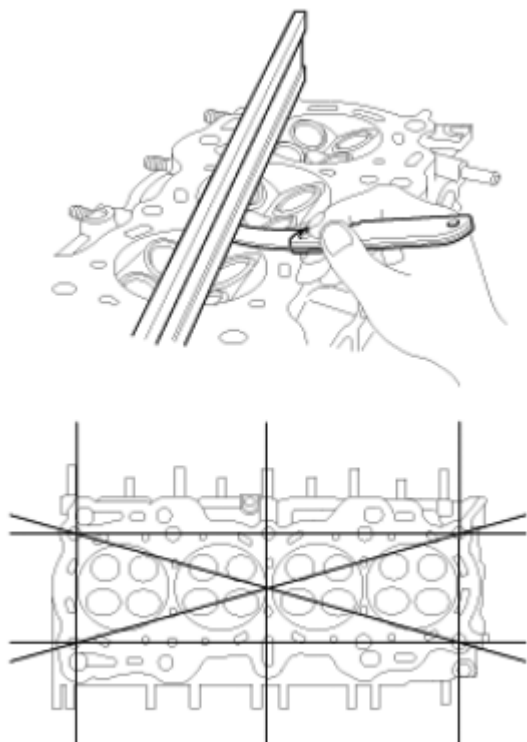
1. Inspect for flatness.

Using a precision straight edge and feeler gauge, measure the surface the contacting the cylinder block and the manifolds for warpage.

### Flatness of cylinder head gasket surface

Standard : Less than 0.03 mm (0.0012 in)

Limit : 0.06 mm (0.0024 in)



**Fig. 20: Measuring Flatness Of Cylinder Head Gasket Surface**  
Courtesy of HYUNDAI MOTOR CO.

### 2. Inspect for cracks.

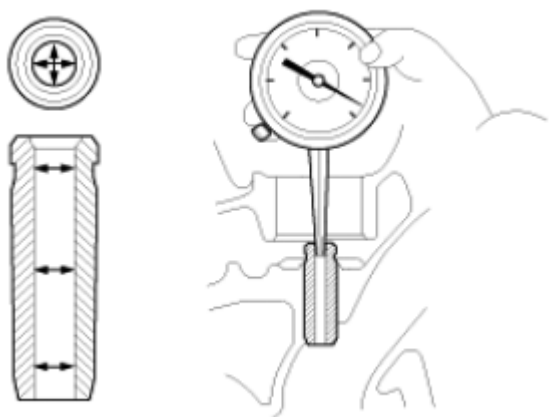
Check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks. If cracked, replace the cylinder head.

### Valve And Valve Spring

#### 1. Inspect valve stems and valve guides.

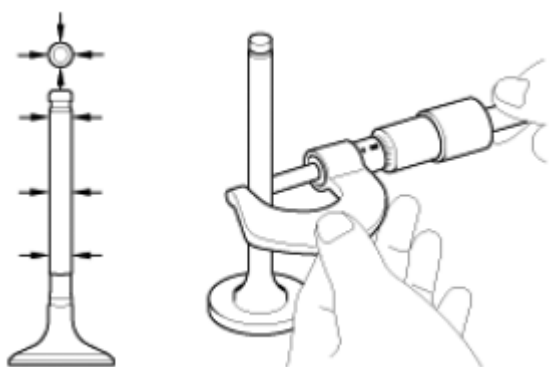
1. Using a caliper gauge, measure the inside diameter of the valve guide.

Valve guide inside.



**Fig. 21: Measuring Inside Diameter Using Caliper Gauge**  
 Courtesy of HYUNDAI MOTOR CO.

2. Using a micrometer, measure the diameter of the valve stem.



**Fig. 22: Measuring Diameter Of Valve Stem Using Micrometer**  
 Courtesy of HYUNDAI MOTOR CO.

3. Subtract the valve stem diameter measurement from the valve guide inside diameter measurement.

Valve stem-to-guide clearance

**[Standard]**

Intake : 0.02 ~ 0.05 mm (0.0008 ~ 0.0020 in)

Exhaust : 0.035 ~ 0.065 mm (0.0014 ~ 0.0026 in)

**[Limit]**

Intake : 0.1 mm (0.0040 in)

Exhaust : 0.13 mm (0.0051 in)

If the clearance is greater than maximum, replace the valve and valve guide.

2. Inspect valves.

1. Check the valve is ground to the correct valve face angle.
2. Check that the surface of the valve for wear.

If the valve face is worn, replace the valve.

3. Check the valve head margin thickness.

If the margin thickness is less than minimum, replace the valve.

**Margin**

[Standard]

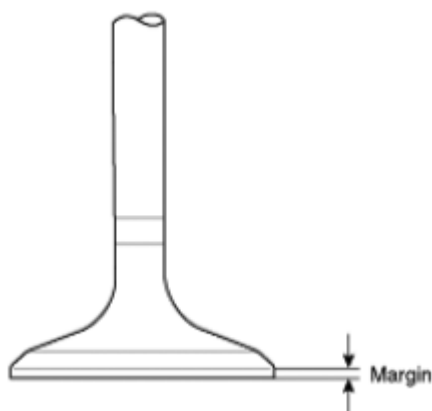
Intake : 1.6 mm (0.0630 in)

Exhaust : 1.8 mm (0.0709 in)

[Limit]

Intake : 1.45 mm (0.0571 in)

Exhaust : 1.65 mm (0.0650 in)



**Fig. 23: Identifying Valve Head Margin Thickness**  
Courtesy of HYUNDAI MOTOR CO.

4. Check the surface of the valve stem tip for wear.

If the valve stem tip is worn, replace the valve.

3. Inspect valve seats

Check the valve seat for evidence of overheating and improper contact with the valve face.

Replace the seat if necessary.

Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace it, then recondition the seat. Recondition the valve seat with a valve seat grinder or cutter. The valve seat contact width should be within specifications and centered on the valve face.

4. Inspect valve springs.
  1. Using a steel square, measure the out-of-square of the valve spring.
  2. Using a vernier calipers, measure the free length of the valve spring.

### Valve spring

[Standard]

Free height : 48.86 mm (1.9236 in)

Load:

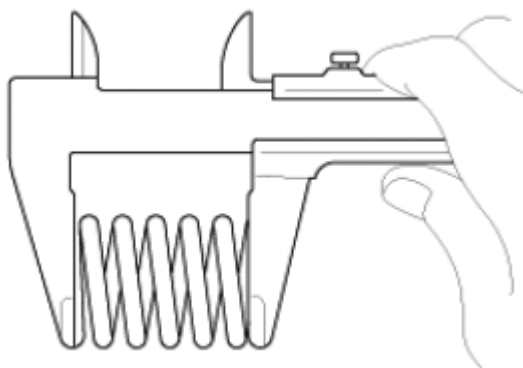
18.8±0.9kg/39.0 mm (41.4±2.0lb/1.5354 in)

41.0±1.5kg/30.5 mm (90.4±3.3lb/1.2008 in)

Out-of-square : 1.5°

[Limit]

Out-of-square : 3°



**Fig. 24: Measuring Free Length Of Valve Spring Using Vernier Calipers**  
Courtesy of HYUNDAI MOTOR CO.

If the free length is not as specified, replace the valve spring.

### Camshaft

1. Inspect cam lobes.

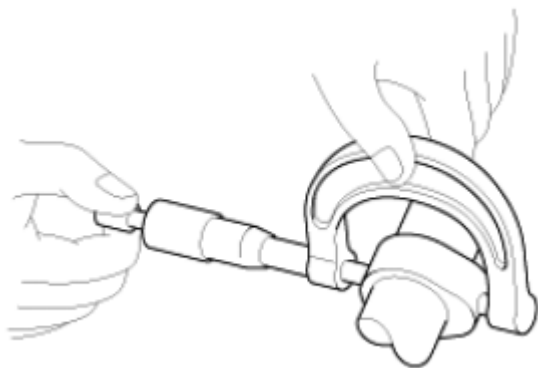
Using a micrometer, measure the cam lobe height.

### Cam height

[Standard value]

Intake : 44.518~44.718 mm (1.7527~1.7605 in)

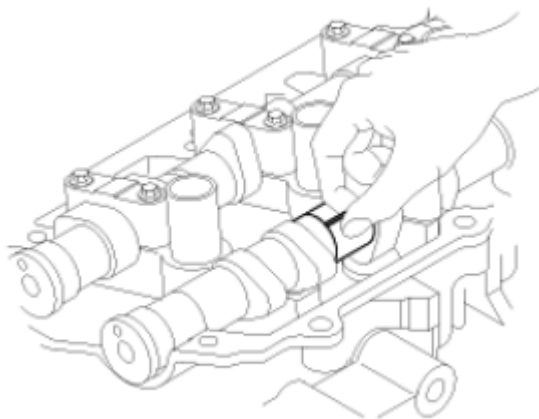
Exhaust : 44.418~44.618 mm (1.7487~1.7566 in)



**Fig. 25: Measuring Cam Lobe Height Using Micrometer**  
Courtesy of HYUNDAI MOTOR CO.

If the cam lobe height is less than minimum, replace the camshaft.

2. Inspect camshaft journal clearance.
  1. Clean the bearing caps and camshaft journals.
  2. Place the camshafts on the cylinder head.
  3. Lay a strip of plastigage across each of the camshaft journal.



**Fig. 26: Laying Strip Of Plastigage Across Of Camshaft Journal**  
Courtesy of HYUNDAI MOTOR CO.

4. Install the bearing caps.

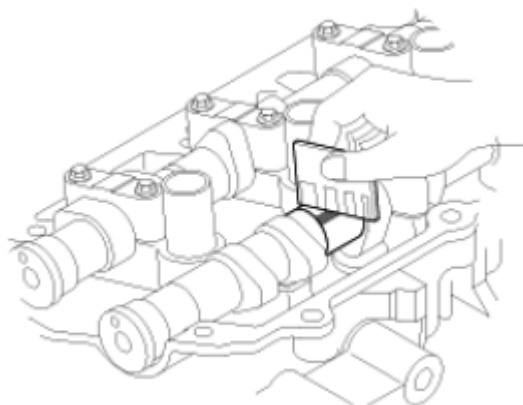
**CAUTION: Do not turn the camshaft.**

5. Remove the bearing caps.
6. Measure the plastigage at its widest point.

**Bearing oil clearance:**

[Standard value] : 0.02 ~ 0.061 mm (0.0008 ~ 0.0024 in)

[Limit] : 0.1 mm (0.0039 in)



**Fig. 27: Measuring Plastigage At Widest Point**  
Courtesy of HYUNDAI MOTOR CO.

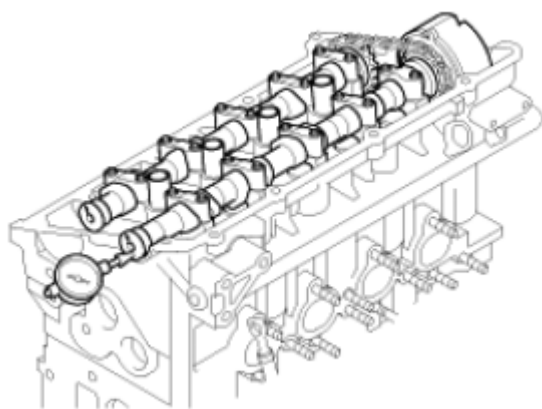
If the oil clearance is greater than maximum, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

7. Completely remove the plastigage.
  8. Remove the camshafts.
3. Inspect camshaft end play.
    1. Install the camshafts.
    2. Using a dial indicator, measure the end play while moving the camshaft back and forth.

**Camshaft end play**

[Standard value] : 0.1 ~ 0.15 mm (0.0039 ~ 0.0059 in)





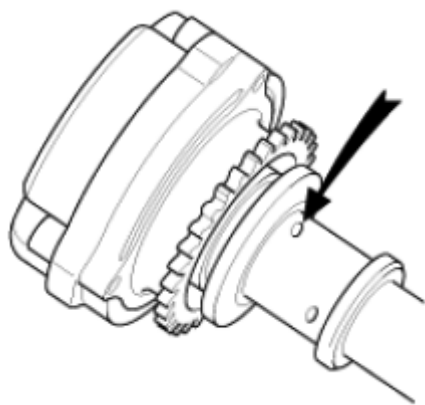
**Fig. 28: Measuring Camshaft End Play Using Dial Indicator**  
 Courtesy of HYUNDAI MOTOR CO.

If the end play is greater than maximum, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

3. Remove the camshafts.

#### CVVT Assembly

1. Inspect CVVT assembly.
  1. Check that the CVVT assembly will not turn.
  2. Apply vinyl tape to all the parts except the one indicated by the arrow shown in the illustration.



**Fig. 29: Applying Vinyl Tape To CVVT Assembly**  
 Courtesy of HYUNDAI MOTOR CO.

3. Wind tape around the tip of the air gun and apply air of approx. 100 kpa (1 kgf/cm<sup>2</sup>, 14psi) to the port of the camshaft. (Perform this order to release the lock pin for the maximum delay angle locking.)

**NOTE:** When the oil splashes, wipe it off with a shop rag and the likes.

4. Under the condition of (3), turn the CVVT assembly to the advance angle side (the arrow marked direction shown in the illustration) with your hand.

Depending on the air pressure, the CVVT assembly will turn to the advance side without applying force by hand. Also, under the condition that the pressure can be hardly applied because of the air leakage from the port, there may be the case that the lock pin could be hardly released.

5. Except the position where the lock pin meets at the maximum delay angle, let the CVVT assembly turn back and forth and check the movable range and that there is no disturbance.

**Standard** : Movable smoothly in the range about 20°

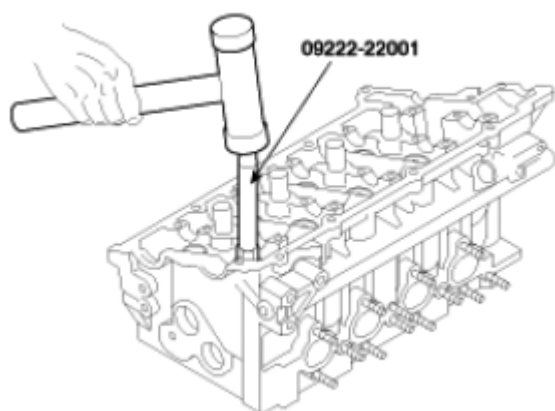
6. Turn the CVVT assembly with your hand and lock it at the maximum delay angle position.

## REASSEMBLY

**NOTE:** Thoroughly clean all parts to be assembled.  
Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.  
Replace oil seals with new ones.

1. Install valves.
  1. Install the spring seats.
  2. Using SST (09222-22001), push in a new oil seal.

**NOTE:** Do not reuse old valve stem seals.  
Incorrect installation of the seal could result in oil leakage past the valve guides.

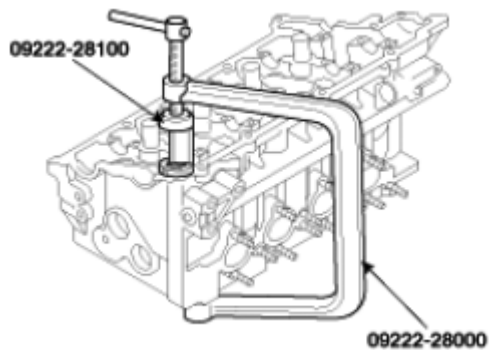


**Fig. 30: Pushing Oil Seal Using SST (09222-22001)**  
Courtesy of HYUNDAI MOTOR CO.

3. Install the valve, valve spring and spring retainer.

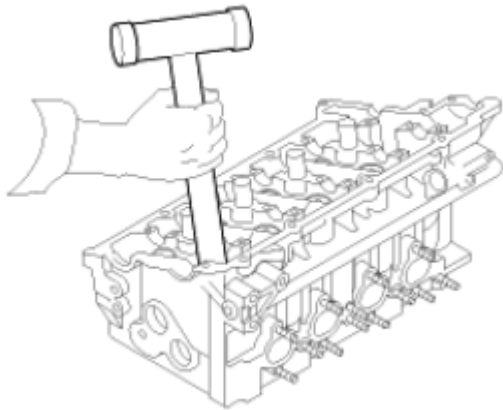
**NOTE:** Place valve springs so that the side coated with enamel faces toward the valve spring retainer and then installs the retainer.

4. Using the SST (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.



**Fig. 31: Compressing Spring Using SST (09222-28000,09222-28100)**  
 Courtesy of HYUNDAI MOTOR CO.

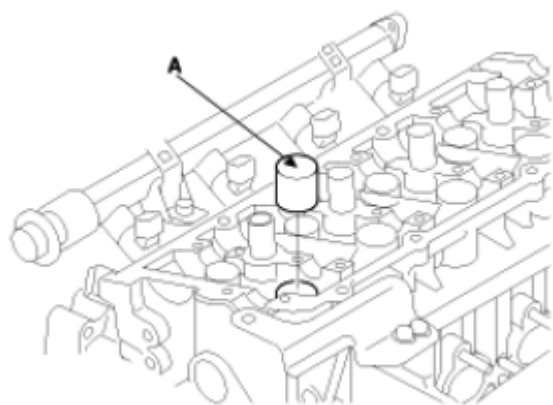
5. Lightly tap the end of each valve stem two or three times with the wooden handle of a hammer to ensure proper seating of the valve and retainer lock.



**Fig. 32: Tapping End Of Valve Stem**  
 Courtesy of HYUNDAI MOTOR CO.

2. Install MLAs.

Check that the MLA rotates smoothly by hand.



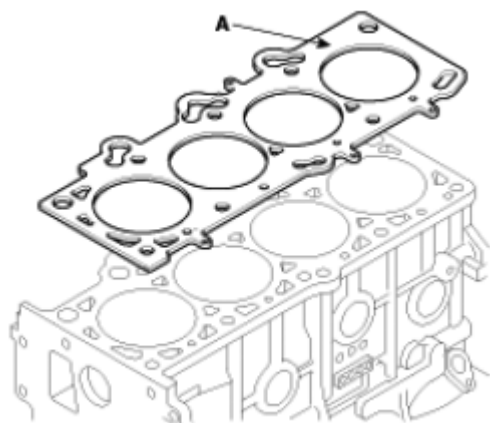
**Fig. 33: Identifying MLAs**  
Courtesy of HYUNDAI MOTOR CO.

## INSTALLATION

### NOTE:

- Thoroughly clean all parts to be assembled.
- Always use a new head and manifold gasket.
- The cylinder head gasket is a metal gasket. Take care not to bend it.
- Rotate the crankshaft, set the No. 1 piston at TDC.

1. Install the cylinder head gasket (A) on the cylinder block.



**Fig. 34: Identifying Cylinder Head Gasket**  
Courtesy of HYUNDAI MOTOR CO.

**NOTE:** Be careful of the installation direction.

2. Place the cylinder head quietly in order not to damage the gasket with the bottom part of the end.
3. Install cylinder head bolts.
  1. Apply a light coat of engine oil on the threads and under the heads of the cylinder head bolts.

- Using 8 mm and 10 mm hexagon wrench, install and tighten the 10 cylinder head bolts and plate washers, in several passes, in the sequence shown in illustration.

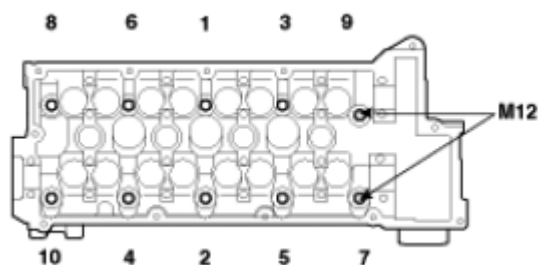
### Tightening torque

M10:

22.6~26.5 (2.3~2.7, 16.6~19.5) + (60° ~ 65°) + (60° ~ 65°)

M12:

27.5~31.4 (2.8~3.2, 20.3~23.1) + (60° ~ 65°) + (60° ~ 65°)

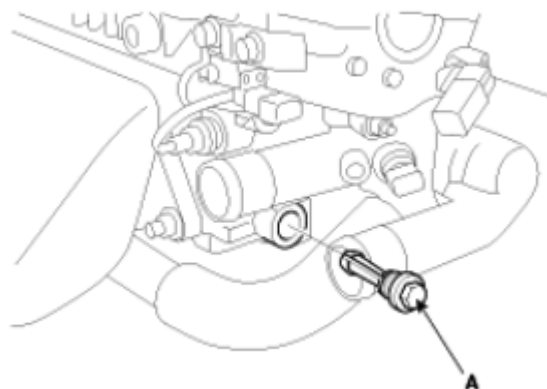


**Fig. 35: Identifying Cylinder Head Bolts And Plate Washers Tightening Sequence**  
Courtesy of HYUNDAI MOTOR CO.

- Install OCV filter (A).

### Tightening torque

40.2 ~ 50.0 Nm (4.1 ~ 5.1 kgf.m, 29.7 ~ 36.9 lb-ft)



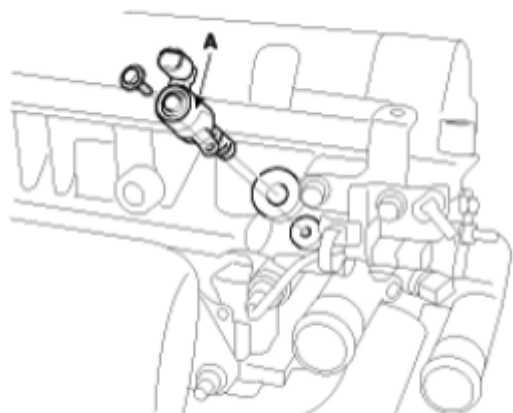
**Fig. 36: Identifying OCV Filter**  
Courtesy of HYUNDAI MOTOR CO.

**NOTE:** Always use a new OCV filter gasket.  
Keep clean the OCV filter.

5. Install OCV (A).

### Tightening torque

9.8 ~ 11.8 Nm (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



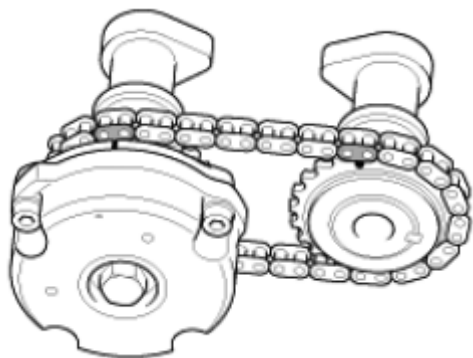
**Fig. 37: Identifying OCV**  
Courtesy of HYUNDAI MOTOR CO.

### CAUTION:

- Do not reuse the OCV when dropped.
- Keep clean the OCV.
- Do not hold the OCV sleeve during servicing.
- When the OCV is installed on the engine, do not move the engine with holding the OCV yoke.

6. Install the camshafts.

1. Align the camshaft timing chain with the intake timing chain sprocket and exhaust timing chain sprocket as shown in illustration.

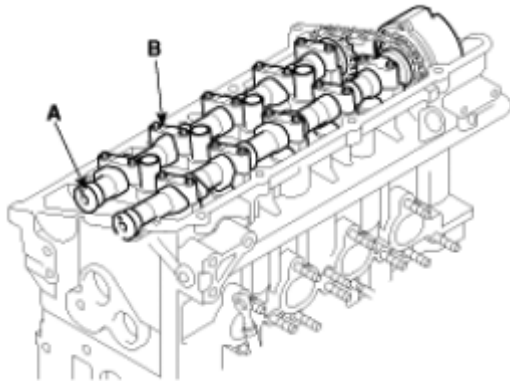


**Fig. 38: Aligning Camshaft Timing Chain With Intake Timing Chain Sprocket And Exhaust Timing Chain Sprocket**  
Courtesy of HYUNDAI MOTOR CO.

2. Install the camshafts (A) and bearing caps (B).

**Tightening torque**

13.7 ~ 14.7 Nm (1.4 ~ 1.5 kgf.m, 10.1 ~ 10.8 lb-ft)

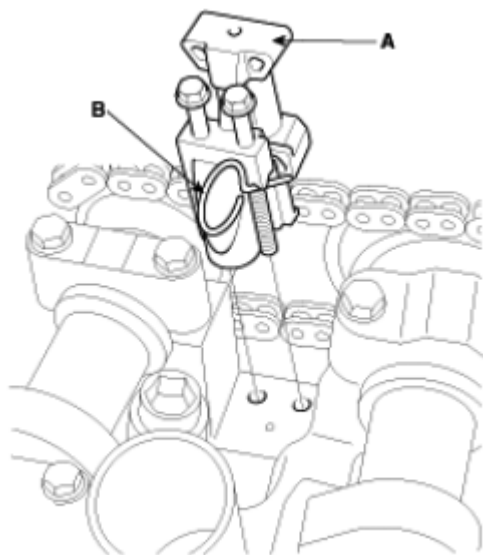


**Fig. 39: Identifying Camshafts And Bearing Caps**  
Courtesy of HYUNDAI MOTOR CO.

3. Install the timing chain auto tensioner (A).

**Tightening torque**

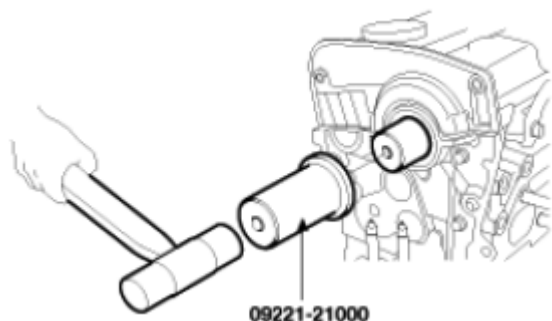
7.8 ~ 9.8 Nm (0.8 ~ 1.0 kgf.m, 5.8 ~ 7.2 lb-ft)



**Fig. 40: Identifying Timing Chain Auto Tensioner And Auto Tensioner Stopper Pin**  
Courtesy of HYUNDAI MOTOR CO.

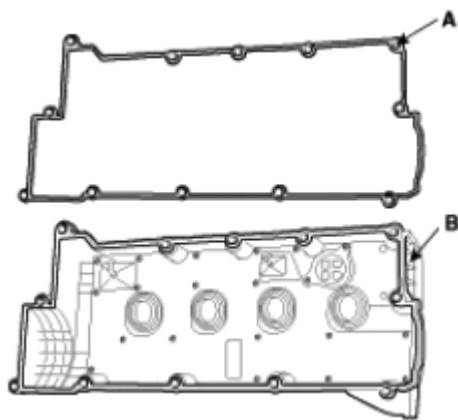
4. Remove the auto tensioner stopper pin (B).

7. Check and adjust valve clearance.
8. Using the SST (09221-21000), install the camshaft bearing oil seal.



**Fig. 41: Installing Camshaft Bearing Oil Seal Using SST (09221-21000)**  
Courtesy of HYUNDAI MOTOR CO.

9. Install the camshaft sprocket.
10. Install the timing belt.
11. Install the cylinder head cover.
  1. Install the cylinder head cover gasket (A) in the groove of the cylinder head cover (B).



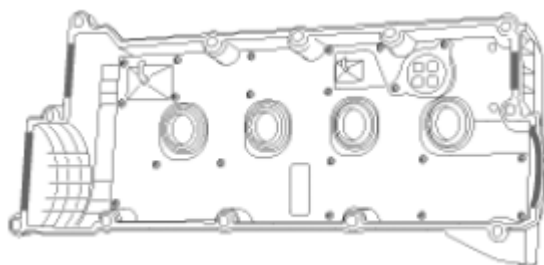
**Fig. 42: Identifying Cylinder Head Cover Gasket And Cylinder Head Cover**  
Courtesy of HYUNDAI MOTOR CO.

**NOTE:**

- Before installing the head cover gasket, thoroughly clean the head cover gasket and the groove.
- When installing, make sure the head cover gasket is seated securely in the corners of the recesses with no gap.

2. Apply liquid gasket to the head cover gasket at the corners of the recess.





**Fig. 43: Identifying Applying Liquid Gasket Area On Head Cover**  
 Courtesy of HYUNDAI MOTOR CO.

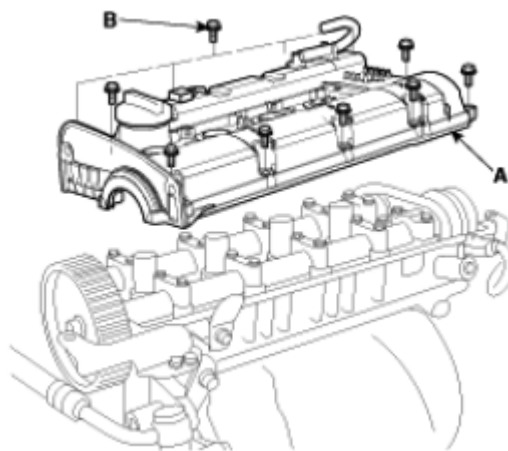
**NOTE:**

- Use liquid gasket, Loctite No. 5999.
- Check that the mating surfaces are clean and dry before applying liquid gasket
- After assembly, wait at least 30 minutes before filling the engine with oil.

3. Install the cylinder head cover (A) with the 12 bolts (B). Uniformly tighten the bolts in several passes.

**Tightening torque**

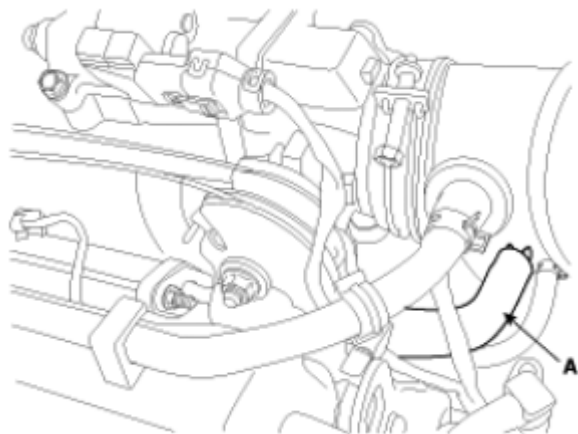
7.8 ~ 9.8 N.m (0.8 ~ 1.0 kgf.m, 5.8 ~ 7.2 lb-ft)



**Fig. 44: Identifying Cylinder Head Cover And Bolts**  
 Courtesy of HYUNDAI MOTOR CO.

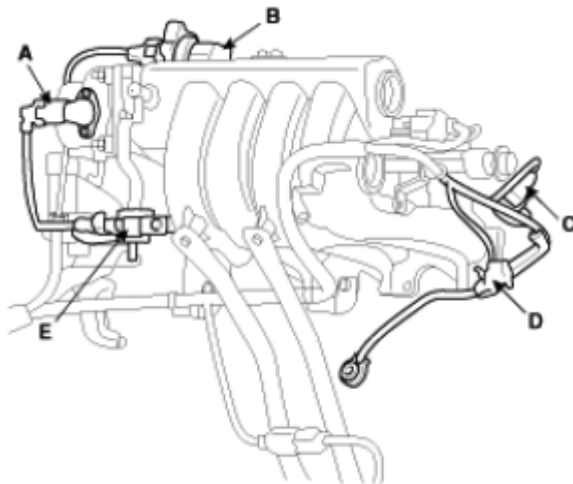
12. Install the intake manifold.
13. Install the exhaust manifold.
14. Install the PCV.
15. Install the spark plug cable. (Refer to **IGNITION SYSTEM** article ).

16. Install the accelerator and the auto-cruise cables.
17. Install the brake booster hose.
18. Install the PCSV hose.
19. Install the fuel inlet hose (A).



**Fig. 45: Identifying Fuel Inlet Hose**  
Courtesy of HYUNDAI MOTOR CO.

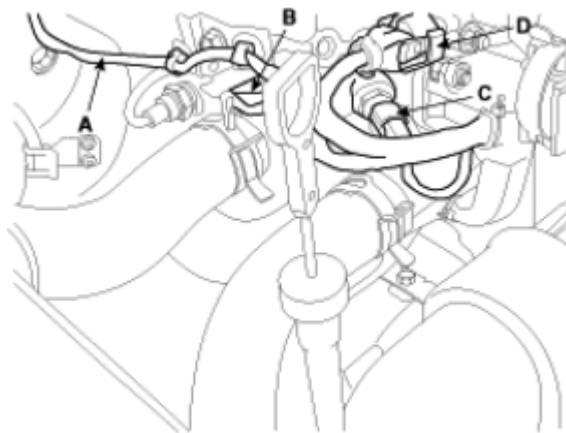
20. Install the engine wire harness connectors and wire harness clamps to the cylinder head and the intake manifold.
  1. Front heated oxygen sensor connector.
  2. Knock sensor connector (D).
  3. Four fuel injector connectors.
  4. CMP connector (C).
  5. PCSV connector (E).
  6. ISA connector (B).
  7. TPS connector (A).



**Fig. 46: Identifying TPS Connector, IPS Connector, CMP Connector, PCSV Connector And Knock Sensor Connector**

Courtesy of HYUNDAI MOTOR CO.

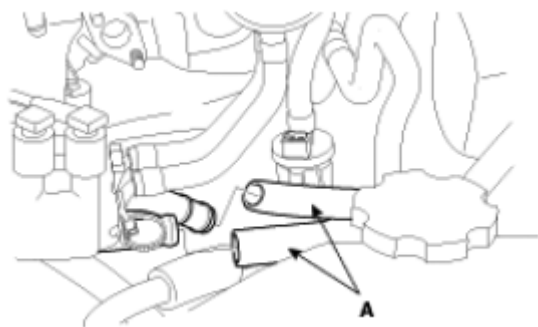
8. Ignition coil connector (D).
9. ECT sensor connector (C).
10. Oil temperature sensor connector (B).
11. OCV connector (A).



**Fig. 47: Identifying OCV Connector, Oil Temperature Sensor Connector, ECT Sensor Connector And Ignition Coil Connector**

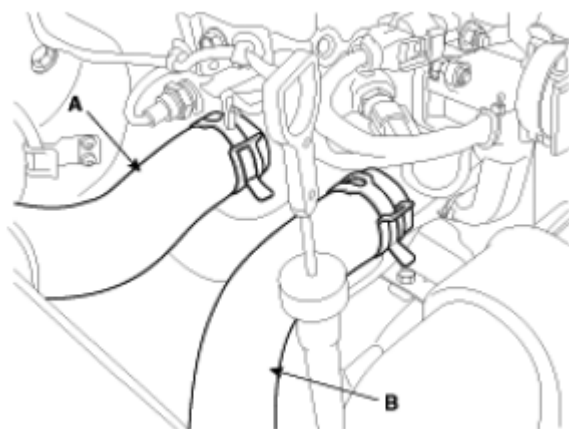
Courtesy of HYUNDAI MOTOR CO.

21. Install the heater hoses (A).



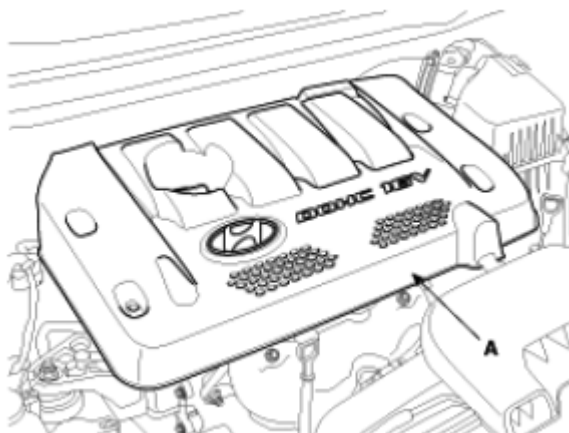
**Fig. 48: Identifying Heater Hoses**  
Courtesy of HYUNDAI MOTOR CO.

22. Install the upper radiator hose (A) and lower radiator hose (B).



**Fig. 49: Identifying Upper Radiator Hose And Lower Radiator Hose**  
Courtesy of HYUNDAI MOTOR CO.

23. Install the intake air hose and air cleaner assembly.
24. Install the engine cover (A).



**Fig. 50: Identifying Engine Cover**  
**Courtesy of HYUNDAI MOTOR CO.**

25. Connect the negative terminal to the battery.
26. Fill with engine coolant.
27. Start the engine and check for leaks.
28. Recheck engine coolant level and oil level.