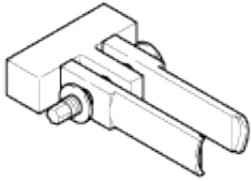
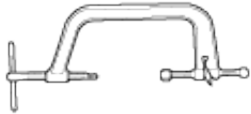
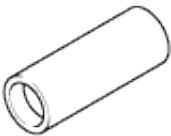
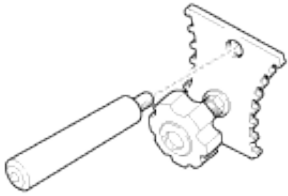
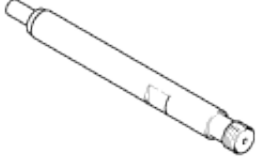
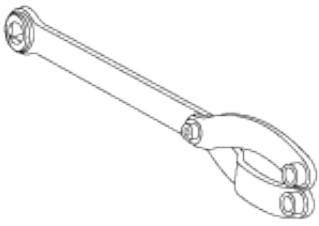


## **CHAPTER 2:**

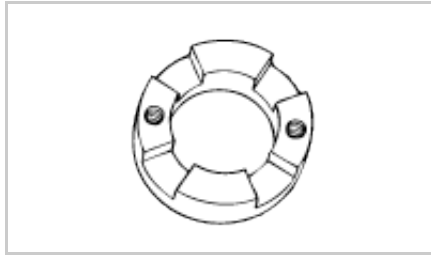
# **Engine Mechanical System**



## SPECIAL SERVICE TOOLS

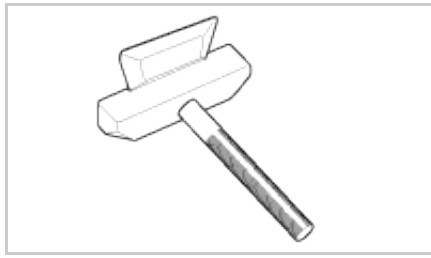
Tool (Number and name)	Illustration	Use
Valve spring lifter pivot. (0K993 120 004)		Removal or installation of the valve spring
Valve spring lifter arm. (0K993 120 001)		Removal or installation of the valve spring
Valve seal installer. (09222-22001)		Installation of the valve seal
Camshaft pulley holder. (09231 - 4X100)		Installation of the camshaft
Pressure gauge adapter. (0K552 131 002)		Measurement of compression pressure
End yolk holder. (09517-21700)		Removal or installation of the crankshaft pulley bolt (used with 09231-H1000)

Crankshaft pulley adapter.  
(09231-H1000)



Removal or installation of the crankshaft  
pulley bolt  
(used with 09517-21700)

Oil pan remover.  
(09215-3C000)



Removal of the oil pan



## TROUBLESHOOTING

Symptom	Suspect area	Remedy
Engine misfire with abnormal internal lower engine noises.	Loose or improperly installed engine flywheel.	Repair or replace the flywheel as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire.)	Inspect the cylinder for a loss of compression . Repair or replace as required.
	Worn crankshaft thrust bearings.	Replace the crankshaft and bearings as required.
Engine misfire with abnormal valve train noise.	Stuck valves. (Carbon buildup on the valve stem can cause the valve not to close properly.)	Repair or replace as required.
	Excessive worn or mis-aligned timing chain.	Replace the timing chain and sprocket as required.
	Worn camshaft lobes.	Replace the camshaft and valve lifers.
Engine misfire with coolant consumption	a. Faulty cylinder head gasket and/or cracking or other damage to the cylinder head and engine block cooling system . b. Coolant consumption may or may not cause the engine to overheat.	a. Inspect the cylinder head and engine block for damage to the coolant passages and/or a faulty head gasket. b. Repair or replace as required.
Engine misfire with excessive oil consumption	Worn valves, valve 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)	Inspection the cylinder for a loss of compression Repair or replace as required.
Engine noise on start-up, but only lasting a few seconds.	Incorrect oil viscosity.	Drain the oil. Install the correct viscosity oil.
	Worn crankshaft thrust bearing.	Inspect the thrust bearing and crankshaft. Repair or replace as required.
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.	Inspect the camshaft lobes. Replace the camshaft and valve lifters as required.
	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.



Lower engine noise, regardless of engine speed.	Low oil pressure.	Repair or replace damaged components as required.
	Loose or damaged flywheel.	Repair or replace the flywheel.
	Damaged oil pan, contacting the oil pump screen.	Inspect the oil pan. Inspect the oil pump screen. Repair or replace as required.
	Oil pump screen loose, damaged or restricted.	Inspect the oil pump screen . Repair or replace as required.
	Excessive piston-to-cylinder bore clearance.	Inspect the piston and cylinder bore. Repair as required.
	Excessive piston pin-to-bore clearance.	Inspect the piston, piston pin and the connecting rod. Repair or replace as required.
	Excessive connecting rod bearing clearance.	Inspect the following components and repair as required. a. The connecting rod bearings. b. The connecting rods. c. The crankshaft. d. The crankshaft journal.
	Excessive crankshaft bearing clearance.	Inspect the following components and repair as required. a. The crankshaft bearings. b. The crankshaft journals.
	Incorrect piston, piston pin and connecting rod installation.	Verify the piston pins and connecting rods are installed correctly. Repair as required.
Engine noise under load.	Low oil pressure.	Repair or replace as required.
	Excessive connecting rod bearing clearance.	Inspect the following components and repair as required. a. The connecting rod bearings. b. The connecting rods. c. The crankshaft.
	Excessive crankshaft bearing clearance.	Inspect the following components and repair as required. a. The crankshaft bearings. b. The crankshaft journals. c. The cylinder block crankshaft bearing bore.
Engine will not crank. (crankshaft will not rotate)	Hydraulically locked cylinder. a. Coolant/antifreeze in cylinder. b. Oil in cylinder. c. Fuel in cylinder.	Remove spark plugs and check for fluid. Inspect for broken head gasket. Inspect for cracked engine block or cylinder head. Inspect for a sticking fuel injector and/or leaking fuel regulator.
	Broken timing chain and/or timing chain gears.	Inspect timing chain and gears. Repair as required.
	Foreign material in cylinder. a. Broken valve. b. Piston material. c. Foreign material.	Inspect cylinder for damaged components and/or foreign materials. Repair or replace as required.

	Seized crankshaft or connecting rod bearings.	Inspect crankshaft and connecting rod bearing. Repair or replace as required.
	Bent or broken connecting rod.	Inspect connecting rods. Repair or replace as required.
	Broken crankshaft.	Inspect crankshaft.Repair or replace as required.

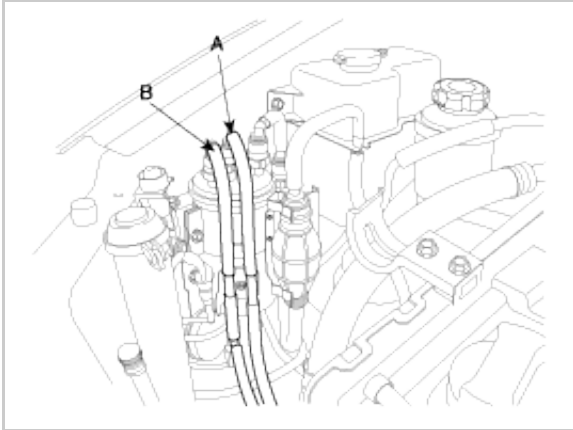
## INSPECTION

### COMPESSION PRESSURE

#### NOTICE

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

1. Warm up the engine until the coolant temperature becomes 80~95°C(176~203°F).
2. Remove the fuel inlet(A) and the return hose(B) from the fuel filter.



3. Crank the engine in order to exhaust fuel in the high pressure pump.

#### NOTICE

Gather residual fuel by putting the return hose into a proper vessel.

4. Remove the injection pipe, injector and washer.(Refer to FL group).
5. Measure the cylinder compression pressure.
  - (1) Insert the SST(OK552 131 002) into the injector hole.
  - (2) Cranking the engine, measure the pressure.

#### NOTICE

Use the complete charging battery for the engine to crank at the speed of 350rpm or more.

- (3) Do the above step 1)~2) again for each cylinder.

#### NOTICE

This work must be done in as short time as possible.

Compression pressure :  
 3040.05kPa (31kg/cm<sup>2</sup>, 440.92psi) (325 rpm)  
 Minimum pressure :  
 2745.85kPa (28kg/cm<sup>2</sup>, 398.25psi)  
 Difference between each cylinder :  
 294.20kPa (3.0kg/cm<sup>2</sup>, 42.67psi)

- (4) If, in one or more cylinders, the measured value is below the limit, fill a little engine oil into the injector holes of the cylinders, repeat the step 1)~2) and measure the compression pressure again.
  - a. If the re-measured pressure becomes higher, wear or damage of the piston ring or cylinder surface can be the cause.
  - b. If the re-measured pressure does not become higher, adherence or poor contact of the valves or inferior

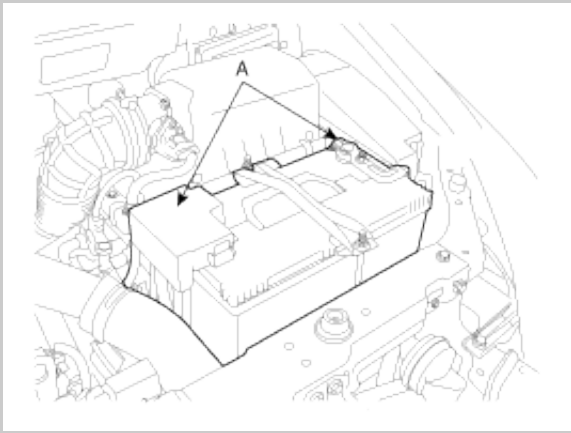
gasket can be the cause.

6. Install the injectors, washers and the injector pipes.(Refer to FL group).

7. Install the inlet and the return hoses to the fuel filter.

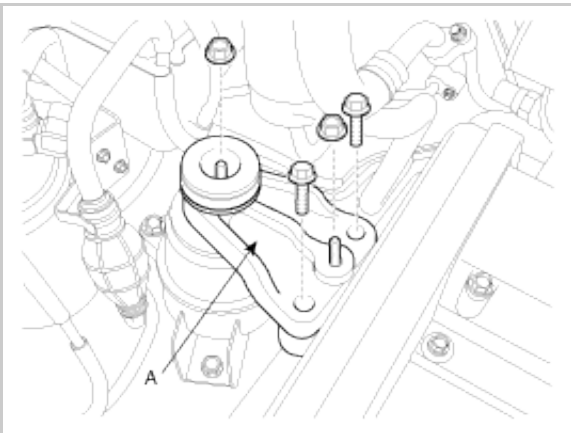
## **TIMING BELT TENSION ADJUSTMENT**

1. Remove the battery terminals (A).

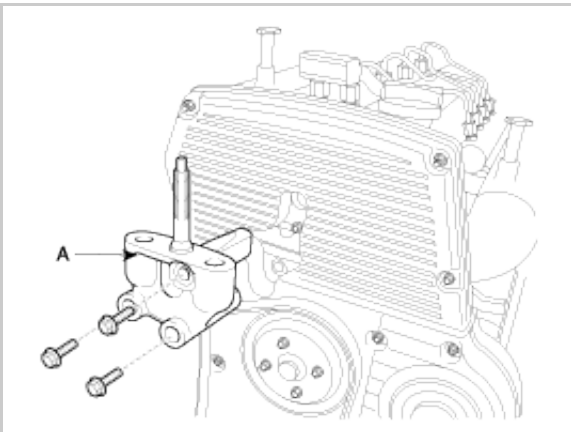


2. Install the jack for oil pan.

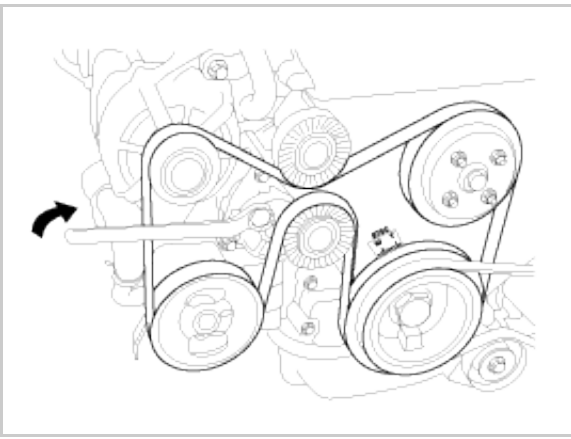
3. Remove the engine mounting (A).



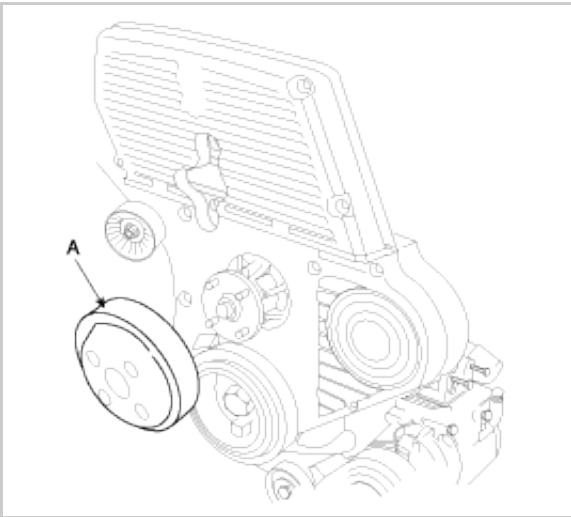
4. Remove the engine support bracket(A).



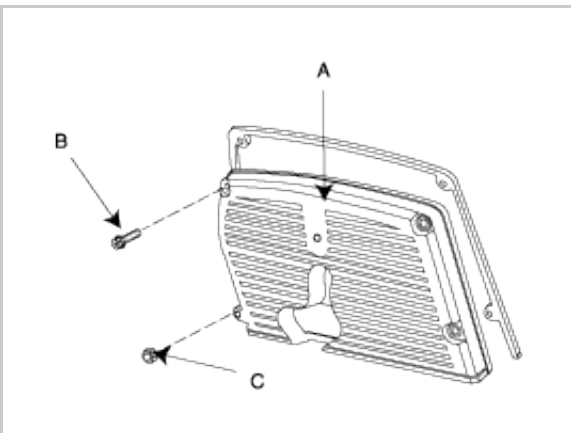
5. Remove the drive belt.



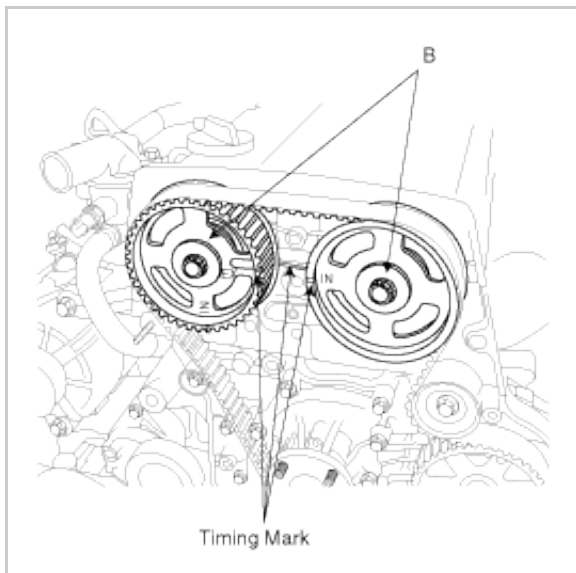
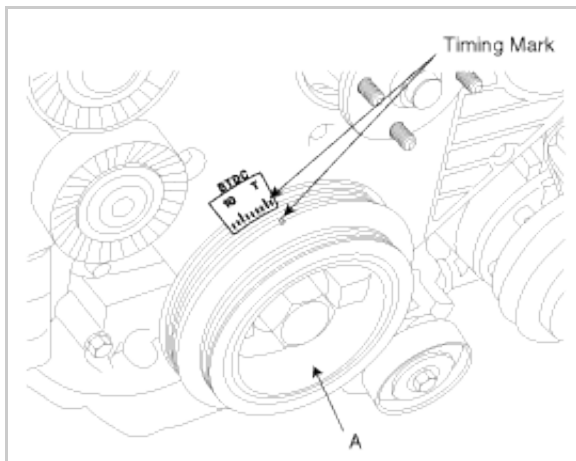
6. Remove the water pump pulley.



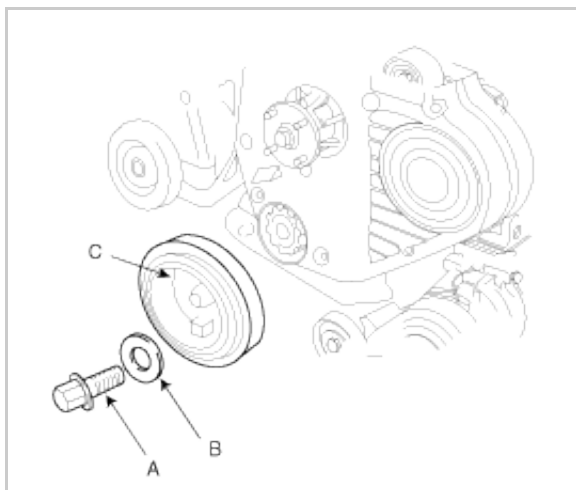
7. Remove the bolts(B), nut(C) and timing belt upper cover (A).



8. Turn the crankshaft pulley(A) and align its groove with the timing mark "T" of the timing belt cover. Check that the timing mark of camshaft sprocket(B) is aligned with that of the cylinder head cover. (No.1 cylinder positioned at the TDC position)



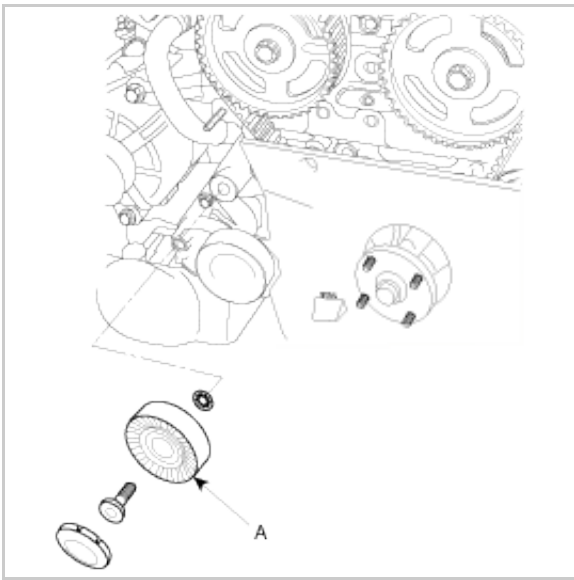
9. Remove the crankshaft pulley bolt(A), washer(B) and crankshaft pulley(C).



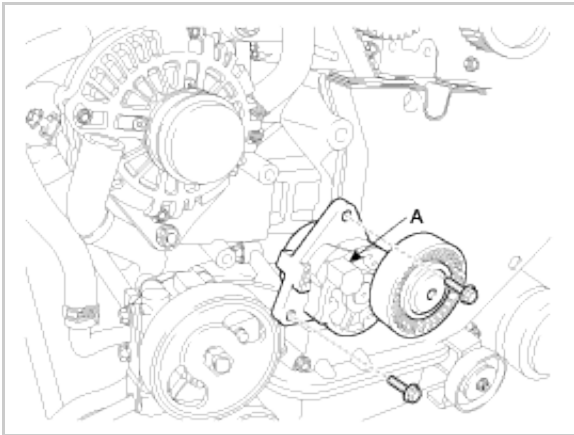
#### NOTICE

Using the special tool(09517-21700, 09231-H1000), fix the crankshaft pulley and loosen the bolt(A).

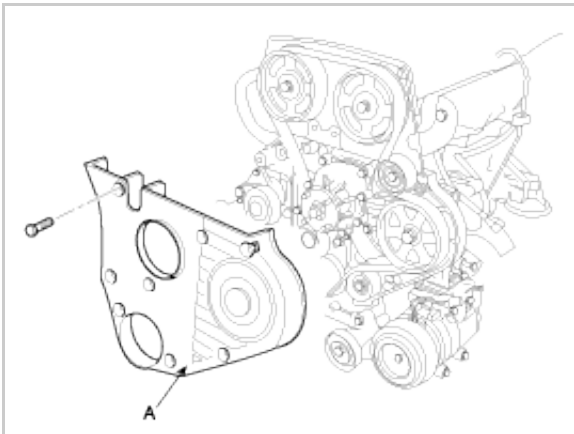
10. Remove the drive belt idler(A).



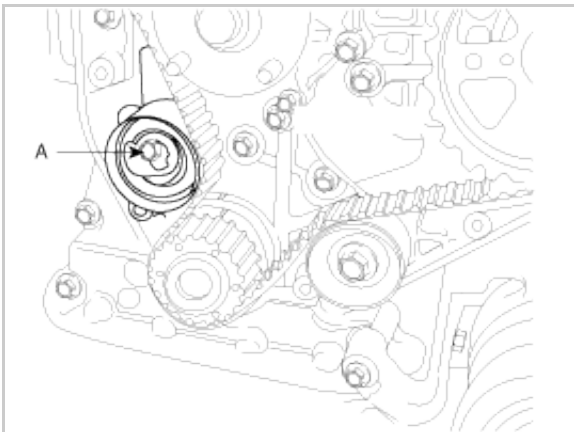
11. Remove the drive belt auto-tensioner (A).



12. Remove the timing belt lower cover(A).

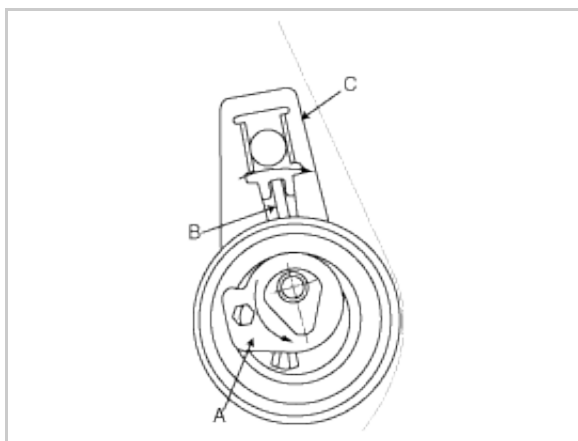


13. Loosen the auto-tensioner fixing bolt(A).



14. Adjust tension of the timing belt.

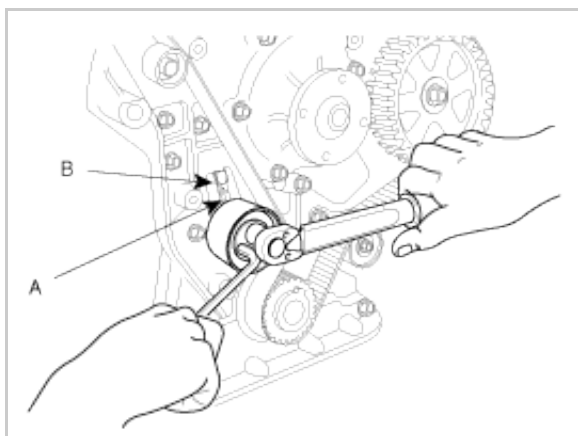
- (1) Align the pointer(B) with the tensioner fork(back plate)(C) as shown below by turning the special washer(A) counterclockwise with a hexagonal wrench.



- (2) When the pointer(A) is aligned with the tensioner fork(back plate)(B), tighten the tensioner mounting bolts with the special bolt fixed by a hexagonal wrench.

Tightening torque :

19.6~25.5Nm (2.0~2.6kgf.m, 14.5~18.8lb-ft)



- (3) Remove the hexagonal wrench.

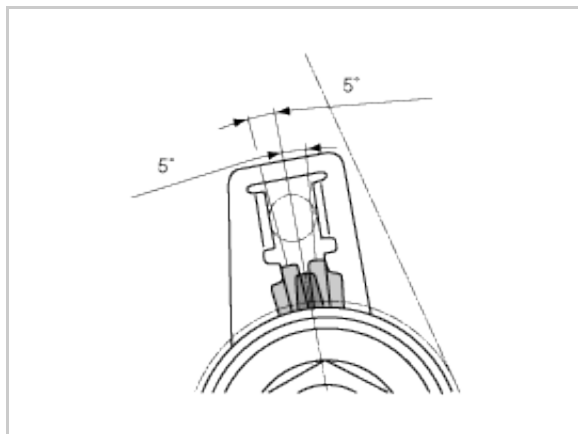
**NOTICE**

When the pointer (A) can not be aligned with the tensioner fork(back plate)(B), replace a new belt and repeat the steps.

15. Rotate the crankshaft clockwise two revolutions in order to align the timing marks on the crankshaft sprocket, the camshaft sprocket and high pressure pump pulley.
16. Confirm that the location of the pointer is aligned with tensioner fork (back plate).

The margin of error :  $\pm 5^\circ$

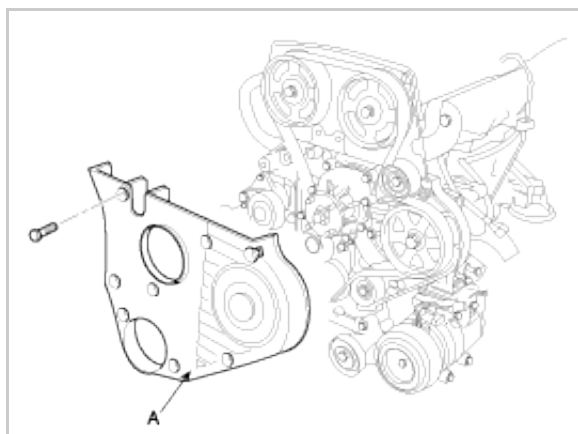




17. Install the timing belt lower cover(A).

Tightening torque :

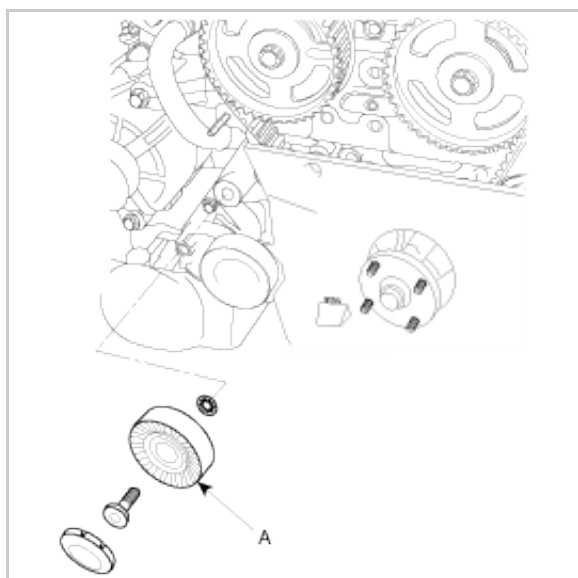
6.9~9.8Nm (0.7 ~ 1.0kgf.m, 5.1 ~ 7.2lb-ft)



18. Install the drive belt idler(A).

Tightening torque :

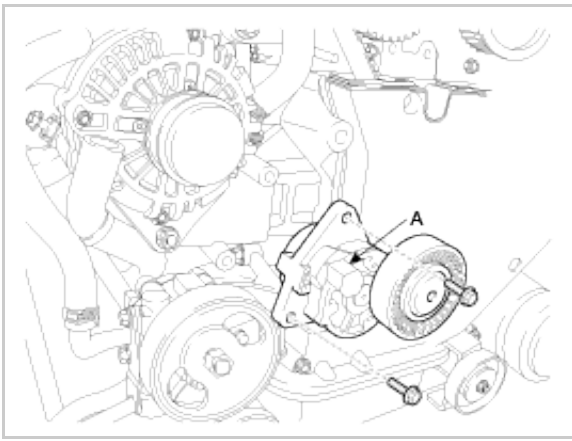
37.3Nm (3.8kgf.m, 27.5lb-ft)



19. Install the drive belt auto-tensioner (A).

Tightening torque :

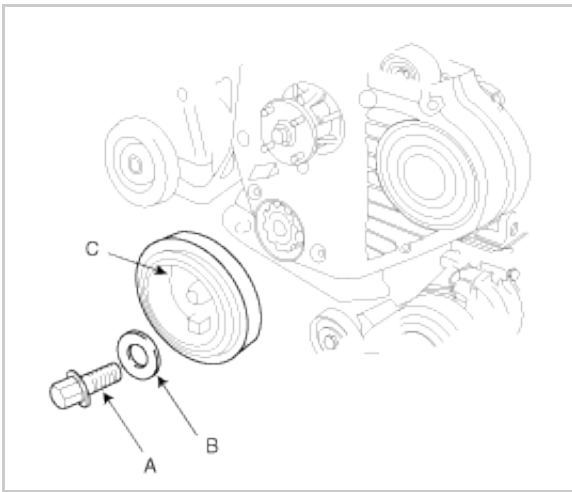
15.7~22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)



20. Install the crankshaft pulley bolt(A), washer(B) and crankshaft pulley (A).

Tightening torque :

376.6~411.9Nm (38.4~42.0kgf.m, 277.7~303.8lb-ft)



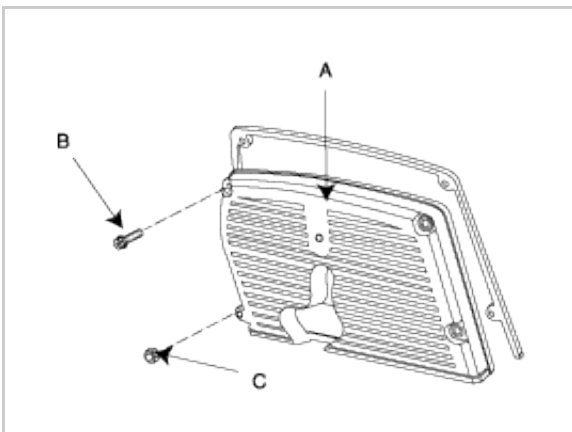
#### NOTICE

Using the special tool(09517-21700, 09231-H1000), tighten the bolt(A).

21. Install the bolts(B), nut(C) and timing belt upper cover (A).

Tightening torque :

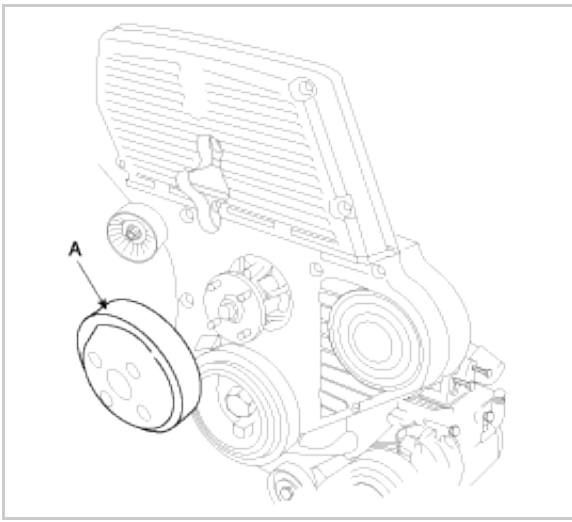
6.9~9.8Nm (0.7 ~ 1.0kgf.m, 5.1 ~ 7.2lb-ft)



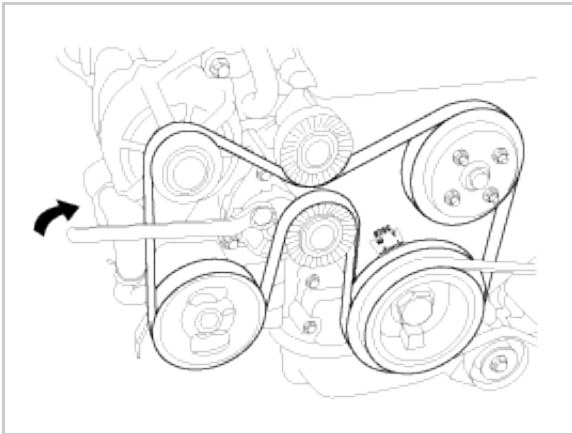
22. Install the water pump pulley.

Tightening torque :

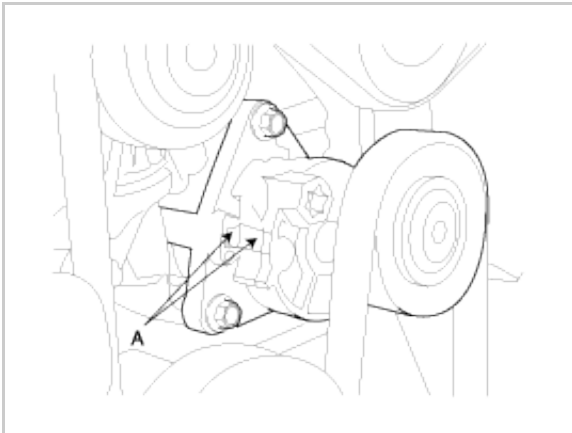
5.9~9.8Nm (0.6 ~ 1.0kgf.m, 4.3 ~ 7.2lb-ft)



23. Install the drive belt.



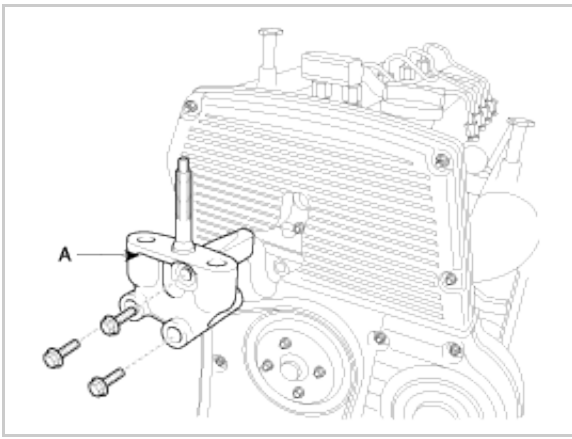
24. Confirm that the 'A' part of the drivebelt auto-tensioner is positioned as shown below. If not, replace the belt.



25. Install the engine support bracket(A).

Tightening torque :

49.0~63.7Nm (5.0 ~ 6.5kgf.m, 36.2 ~ 47.0lb-ft)



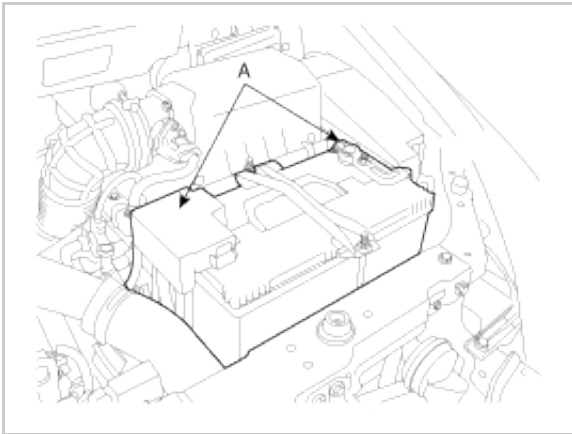
26. Install the engine mounting (A).

Tightening torque :

88.3~107.9Nm (9.0 ~ 11.0kgf.m, 65.1 ~ 79.6lb-ft)

27. Remove the jack for oil pan.

28. Install the battery terminals (A).





## SPECIFICATIONS

Description		Specifications(J3 - ENG)	Limit
General			
Type		In-line, DOHC	
Number of cylinders		4	
Bore		101.5~101.526mm (3.9961~3.9971in)	
Stroke		98mm (8.8583in)	
Total displacement		2,902 cc (177.08 cu.in)	
Compression ratio		18.4 : 1	
Firing order		1-3-4-2	
Valve timing			
Intake valve	Opens (ATDC)	26°	
	Closes (ABDC)	50°	
Exhaust valve	Opens (BBDC)	72°	
	Closes (ATDC)	32°	
Cylinder head			
Flatness of gasket surface		Less than 0.05mm (0.0020in)	
Flatness of manifold mounting surface	Intake	Less than 0.15mm (0.0059in)	
	Exhaust	Less than 0.15mm (0.0059in)	
Camshaft			
Cam height	Intake	39.397 ~ 39.597mm (1.5511 ~ 1.5589in)	
	Exhaust	39.4932 ~ 39.6932mm (1.5548 ~ 1.5627in)	
Journal outer Diameter (Intake, Exhaust)		27.941 ~ 27.960mm (1.1000 ~ 1.1008in)	
Bearing oil clearance		0.040 ~ 0.080mm (0.0016 ~ 0.0031in)	
End play		0.08 ~ 0.17mm (0.0031 ~ 0.0067in)	
Valve			
Valve length	Intake	126.24mm (4.9701in)	
	Exhaust	126.24mm (4.9701in)	
Stem outer diameter	Intake	6.965 ~ 6.980mm (0.2742 ~ 0.2748in)	
	Exhaust	6.945 ~ 6.960mm (0.2734 ~ 0.2740in)	
Face angle		45°	
Thickness of valve head (margin)	Intake	1.7mm (0.0669in)	
	Exhaust	1.6mm (0.0630in)	
Valve stem to valve guide clearance	Intake	0.030 ~ 0.065mm (0.0012 ~ 0.0026in)	
	Exhaust	0.050 ~ 0.085mm ( 0.0020~ 0.0033in)	
Valve guide			
Length	Intake	52.5mm (2.0669in)	
	Exhaust	52.5mm (2.0669in)	
Valve seat			

Width of seat contact	Intake	1.4 ~ 2.0mm (0.0551 ~ 0.0787in)	
	Exhaust	0.9 ~ 1.5mm (0.0354 ~0.0591 in)	
Seat angle		45°	
Valve spring			
Free length		52.477mm (2.0660in)	
Load(Intake)	Installed	23.45±1.87kg/40.0mm(51.7±4.1lb/1.5748 in)	
	Valve opened	39.15±3.13kg/31.65mm(86.3±6.9 lb/1.2461 in)	
Load(Exhaust)	Installed	23.45±1.87kg/40.0mm(51.7±4.1lb/1.5748 in)	
	Valve opened	39.43±3.15kg/31.50mm(86.9±6.9 lb/1.2402 in)	
Out of squareness		Less than 2°	3°
Rocker arm and rocker arm shaft			
Rocker arm inner diameter		20.000 ~ 20.027mm (0.7874 ~ 0.7885in)	
Rocker arm shaft outer diameter		19.959 ~ 19.980mm (0.7858 ~ 0.7866in)	
Cylinder block			
Cylinder bore		101.500 ~ 101.526mm (3.9961 ~3.9971 in)	
Liner inner diameter		97.100 ~ 97.126mm (3.8228~ 3.8239in)	
Liner outer diameter		101.480 ~ 101.526mm ( 3.9953~ 3.9971in)	
Flatness of gasket surface		Less than 0.05mm (0.0020in)	
Piston			
Piston outer diameter		97.015 ~ 97.030mm ( 3.8195~ 3.8201in)	
Piston to cylinder clearance		0.070 ~ 0.098mm (0.0028 ~ 0.0039in)	
Ring groove width	No. 1 ring groove	2.397 ~ 2.417mm ( 0.0944~0.0952 in)	
	No. 2 ring groove	2.05 ~ 2.07mm ( 0.0807~ 0.0815in)	
	Oil ring groove	3.02 ~ 3.04mm (0.1189 ~ 0.1197in)	
Piston ring			
Side clearance			
	No. 2 ring	0.06 ~ 0.10mm (0.0024~0.0039 in)	
	Oil ring	0.03 ~ 0.07mm (0.0012~0.0028 in)	
End gap	No. 1 ring	0.25 ~ 0.40mm (0.0098~ 0.0157in)	
	No. 2 ring	0.40 ~ 0.55mm (0.0157~0.0217in)	
	Oil ring	0.20 ~ 0.40mm (0.0079 ~ 0.0157in)	
Piston pin			
Piston pin outer diameter		31.994 ~ 32.000mm (1.2596 ~ 1.2598 in)	
Piston pin hole inner diameter		32.015 ~ 32.025mm (1.2604 ~ 1.2608 in)	
Piston pin hole clearance		0.015 ~ 0.031mm (0.0006 ~ 0.0012 in)	
Connecting rod small end inner diameter		32.012 ~ 32.033mm (1.2603 ~ 1.2611 in)	
Connecting rod small end hole clearance		0.012 ~ -0.039mm (0.0005 ~ 0.0015 in)	
Connecting rod			
Connecting rod big end inner diameter		60.833 ~ 60.846mm (2.3950 ~ 2.3955 in)	
Connecting rod bearing oil clearance		0.043 ~ 0.077mm (0.0017 ~ 0.0030 in)	
End play		0.239~0.39 (0.0094 ~ 0.0154 in)	

Crankshaft			
Main journal outer diameter	NO 1, 2, 4, 5	69.995 ~ 70.015mm (2.7557 ~2.7565 in)	
	NO 3	69.973~69.993mm (2.7548 ~2.7556 in)	
Pin journal outer diameter		57.106~57.124mm (2.2483~2.2490 in)	
Main bearing oil clearance	NO 1, 2, 4, 5	0.045 ~ 0.079mm (0.0018 ~0.0031 in)	
	NO 3	0.067~0.101 mm (0.0026 ~0.0040 in)	
End play		0.14 ~ 0.39mm (0.0055 ~0.0154 in)	
Flywheel			
Runout		0.10mm (0.0039in)	0.13mm (0.0051in)
Oil pump			
Relief valve opening pressure		588.40±49.0kpa(6.0±0.5kg/cm²,85.34±7.1psi)	
Discharge volume		75L/min(79.25 US qt/min, 65.99 Imp qt/min) (engine3,800rpm)	
Engine oil			
Oil quantity (Total)		8.0 L (8.45 US qt, 7.03 Imp qt)	
Oil quantity (Oil pan)		6.0 L (6.34 US qt, 5.27 Imp qt)	
Oil quantity (Drain and refill including oil filter)		6.6 L (6.97 US qt, 5.08 Imp qt)	
Oil quality		ABOVE API CH-4 or ABOVE ACEA B4	
Oil pressure (Idle)		78.45 kpa (0.8 kg/cm², 11.38 psi)	
Cooling system			
Cooling method		Forced circulation with cooling fan	
Thermostat	Type	Wax pellet type	
	Opening temperature	88±1.5 °C (190.4 ±34.7 °F)	
	Pull opening temperature	100 °C (212.0 °F)	
Radiator cap	Main valve opening pressure	93.16 ~ 122.58kpa(0.95 ~ 1.25kg/cm², 13.51 ~ 17.78psi)	
Water temperature sensor			
Type		Thermister type	
Resistance	20°C (68°F)	2.27~2.64 kΩ	
	80°C (176°F)	0.31~0.33 kΩ	

## TIGHTENING TORQUE

Item	Quan- tity	Tightening torque		
		N.m	kgf.m	lb-ft
Cylinder block				
Engine support bracket bolts	8	36.3 ~ 53.9	3.7 ~ 5.5	26.8 ~ 39.8
Engine mounting				
Engine mounting insulator and engine mounting bracket fixing nuts	4	36.3 ~ 53.9	3.7 ~ 5.5	26.8 ~ 39.8
Engine support bracket and engine mounting insulator fixing nuts	2	36.3 ~ 53.9	3.7 ~ 5.5	26.8 ~ 39.8

Transaxle mounting bracket and body fixing bolts	4	36.3 ~ 53.9	3.7 ~ 5.5	26.8 ~ 39.8
Transaxle mounting insulator and transaxle mounting bracket fixing bolt	1	62.8 ~ 93.2	6.4 ~ 9.5	46.3 ~ 68.7
Transaxle and transaxle mounting insulator fixing nuts	4	36.3 ~ 53.9	3.7 ~ 5.5	26.8 ~ 39.8
Main moving system				
Connecting rod cap nuts	8	68.6→Unfasten bolts→29.4+90°	7.0 → Unfasten bolts→3.0+ 90°	50.6→ Unfasten bolts→21.7+ 90°
Crankshaft main bearing cap bolts	10	69.6~79.4+55°~65°	7.1 ~ 8.1+55°~65°	51.4~58.6+55°~65°
Flywheel (DMF) bolts (M/T)	8	122.6 ~ 132.4	12.5 ~ 13.5	90.4 ~ 97.6
Drive plate bolts (A/T)	8	159.8 ~ 169.7	16.3 ~ 17.3	117.9 ~ 125.1
Timing belt				
Timing belt upper cover bolts	5	6.9 ~ 9.8	0.7 ~ 1.0	5.1 ~ 7.2
Timing belt upper cover nut	1	6.9 ~ 9.8	0.7 ~ 1.0	5.1 ~ 7.2
Timing belt lower cover bolts	8	6.9 ~ 9.8	0.7 ~ 1.0	5.1 ~ 7.2
Crankshaft pulley bolt	1	372.7 ~ 411.9	38.0 ~ 42.0	274.9 ~ 303.8
Camshaft sprocket bolts	2	58.8 ~ 68.6	6.0 ~ 7.0	43.4 ~ 50.6
Timing belt tensioner bolt	1	20.6 ~ 25.5	2.1 ~ 2.6	15.2 ~ 18.8
Timing belt NO. 1 idler bolt	1	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Timing belt NO. 2 idler bolt	1	37.3 ~ 43.1	3.8 ~ 4.4	27.5 ~ 31.8
Touch idler bolt	1	20.6 ~ 25.5	2.1 ~ 2.6	15.2 ~ 18.8
High pressure pump puli nut	1	58.8 ~ 68.6	6.0 ~ 7.0	43.4 ~ 50.6
High pressure pump and Timing belt case fixing bolts	3	21.6 ~ 25.5	2.2 ~ 2.6	15.9 ~ 18.8
High pressure pump bracket bolts (Pump)	2	21.6 ~ 25.5	2.2 ~ 2.6	15.9 ~ 18.8
High pressure pump bracket bolts (Cylinder block)	2	34.3 ~ 40.2	3.5 ~ 4.1	25.3 ~ 29.7
Timing belt plate bolts	6	6.9 ~ 9.8	0.7 ~ 1.0	5.1 ~ 7.2
Timing belt case bolts (8 X 25)	8	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Timing belt case bolts (8 X 45)	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Timing belt case bolts (8 X 50)	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Timing belt case nut	1	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Balancer gear bolt	1	63.7 ~ 73.5	6.5 ~ 7.5	47.0 ~ 54.2
Oil pump gear bolt	1	33.3 ~ 39.2	3.4 ~ 4.0	24.6 ~ 28.9
Idler gear bolt	1	33.3 ~ 39.2	3.4 ~ 4.0	24.6 ~ 28.9
Cylinder head				
Cylinder head cover bolts	15	8.8 ~ -10.8	0.9 ~ -1.1	6.5 ~ -8.0
Rocker arm shaft And camshaft bearing cap bolts	10	17.7 ~ 26.5	1.8 ~ 2.7	13.0 ~ 19.5
Camshaft bearing cap nuts	10	17.7 ~ 26.5	1.8 ~ 2.7	13.0 ~ 19.5
Front camshaft bearing cap nuts(Small nuts)	2	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7



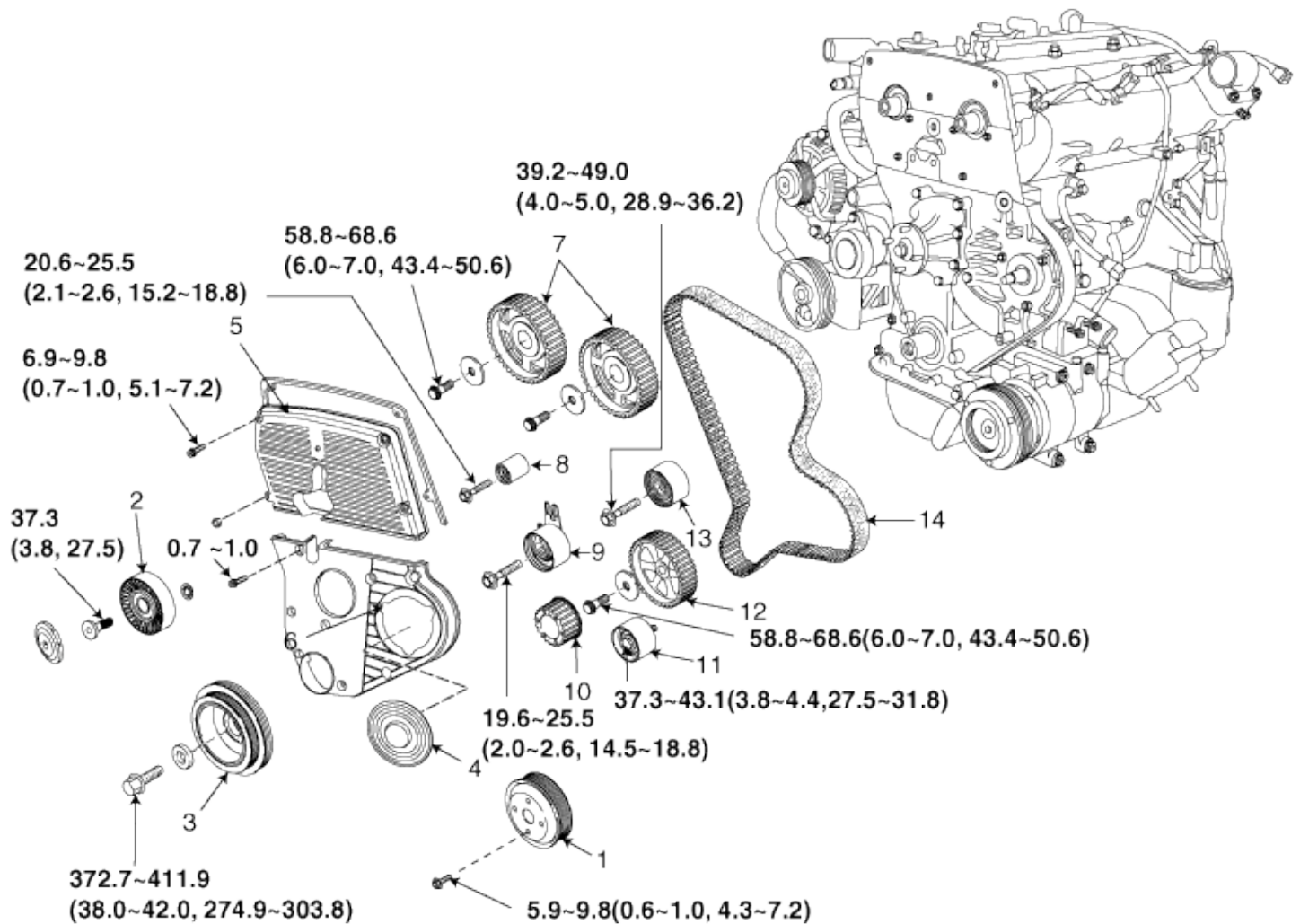
Cylinder head bolt (Long bolts)	10	39.2 + 90° + 120°	4.0 + 90° + 120°	28.9 + 90° + 120°
Cylinder head bolt (Short bolts)	8	39.2 + 90°+ 90°	4.0 + 90° + 90°	28.9 + 90°+ 90°
Cooling system				
Cooling fan water pump pulley bolts	4	5.9 ~ 9.8	0.6 ~ 1.0	4.3 ~ 7.2
Water pump bolt (Long bolts)	3	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Water pump bolt (Short bolts)	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Water pump and generator brace fixing bolts (8 X 45)	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Thermostat housing and generator strip nuts	2	18.6 ~ 22.6	1.9 ~ 2.3	13.7 ~ 16.6
Thermostat case cover bolts	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Lubrication system				
Oil filter	1	21.6 ~ 24.5	2.2 ~ 2.5	15.9 ~ 18.1
Oil cooler bolts (8 X 35)	4	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Oil cooler bolts (8 X 50)	4	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Oil cooler nuts	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Oil pan nuts	29	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Oil pan drain plug	1	34.3 ~ 44.1	3.5 ~ 4.5	25.3 ~ 32.5
Ladder frame bolts (10 X 45)	5	31.4 ~ 46.1	3.2 ~ 4.7	23.1 ~ 34.0
Ladder frame and oil supplying pipe bolt (8X 50)	1	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Ladder frame bracket (Oil pump and ladder frame fixing) bolts	2	31.4 ~ 46.1	3.2 ~ 4.7	23.1 ~ 34.0
Oil supplying pipe and oil pump fixing bolts (8 X16)	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Oil supplying pipe and Ladder frame fixing bolts (8 X 16)	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Oil pump bolts(10 X 60)	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Oil pump bolt(8 X 30)	1	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Oil screen nuts	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Oil pressure switch	1	14.7 ~ 46.1	1.5 ~ 2.2	10.8 ~ 34.0
Intake and exhaust system				
Intake manifold and cylinder head fixing bolts(8 X 45)	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Intake manifold and cylinder head fixing bolts(8 X 95)	4	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Intake manifold and cylinder head fixing nuts	2	15.7 ~ 22.6	1.6 ~ 2.3	11.6 ~ 16.6
Intake manifold and cylinder head fixing hexagonal wrench bolt	1	17.7 ~ 26.5	1.8 ~ 2.7	13.0 ~ 19.5
Exhaust manifold and cylinder head fixing nut	9	26.5 ~ 34.3	2.7 ~ 3.5	19.5 ~ 25.3
Exhaust manifold heat cover and exhaust manifold fixing bolts(6X12)	3	8.8 ~ 12.7	0.9 ~ 1.3	6.5 ~ 9.4
Engine hanger bracket and exhaust manifold fixing bolts (8 X 18)	2	17.7 ~ 26.5	1.8 ~ 2.7	13.0 ~ 19.5
Exhaust manifold and front muffler fixing nut	2	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4

Front muffler CPF(Catalyzed Particulate Filter) fixing nuts	2	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
CPF(Catalyzed Particulate Filter) main muffler fixing nuts	2	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Main muffler and tail pipe fixing nuts	2	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4

**Timing system**

**Timing belt**

## COMPONENTS



**TORQUE : N.m(kgf.m, lb-ft)**

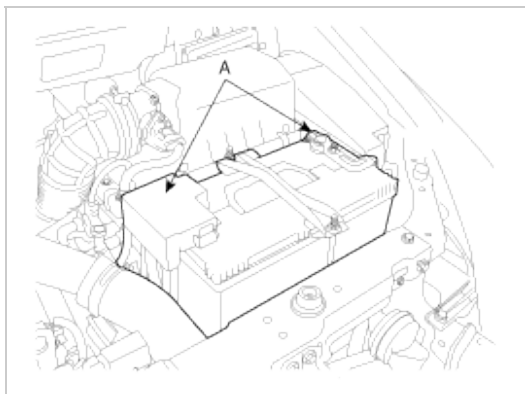
- |                            |                               |
|----------------------------|-------------------------------|
| 1. Water pump pulley       | 8. Touch idler                |
| 2. Drive belt idler        | 9. Timing belt auto tensioner |
| 3. Crank shaft pulley      | 10. Crankshaft sprocket       |
| 4. Service cover           | 11. No.2 idler                |
| 5. Timing belt upper cover | 12. High pressure pump pulley |
| 6. Timing belt lower cover | 13. No.1 idler                |
| 7. Camshaft pulley         | 14. Timing belt               |



## REMOVAL

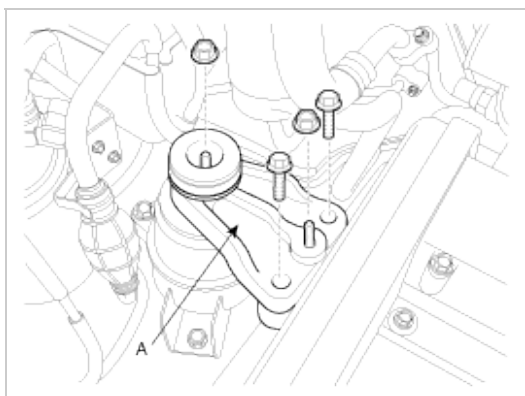
Engine removal is not required for this procedure.

1. Remove the battery terminals (A).

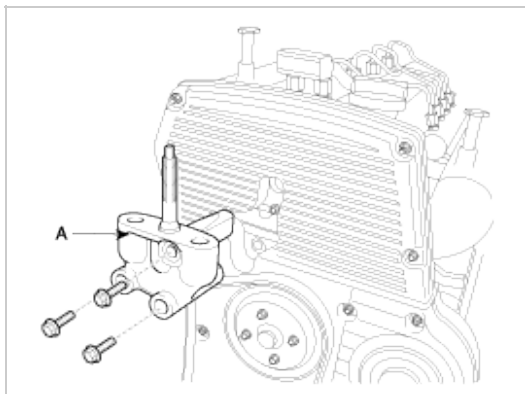


2. Install the jack for oil pan.

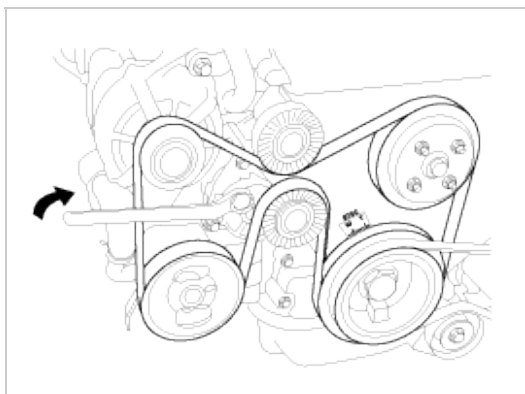
3. Remove the engine mounting (A).



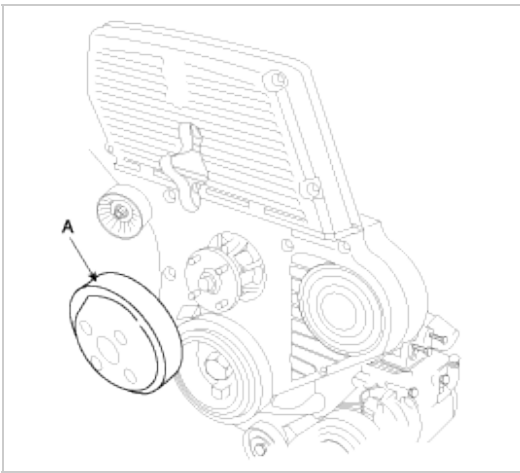
4. Remove the engine support bracket(A).



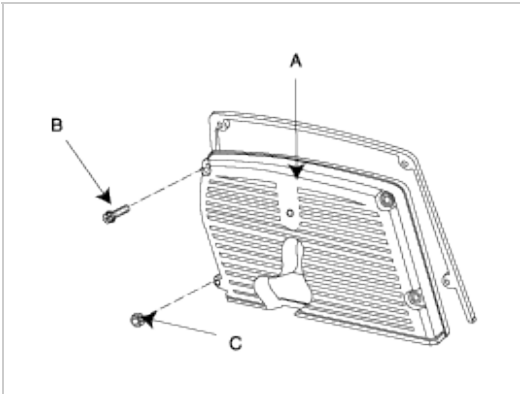
5. Remove the drive belt.



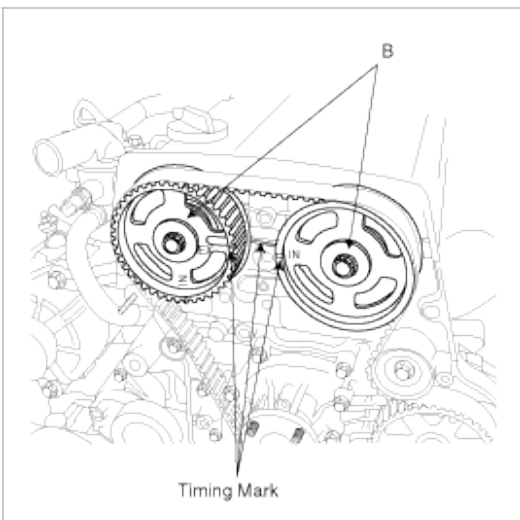
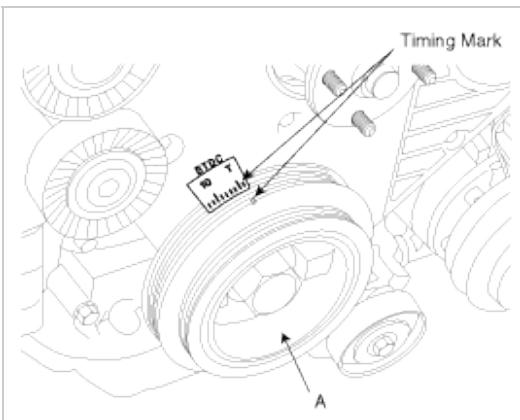
6. Remove the water pump pulley.



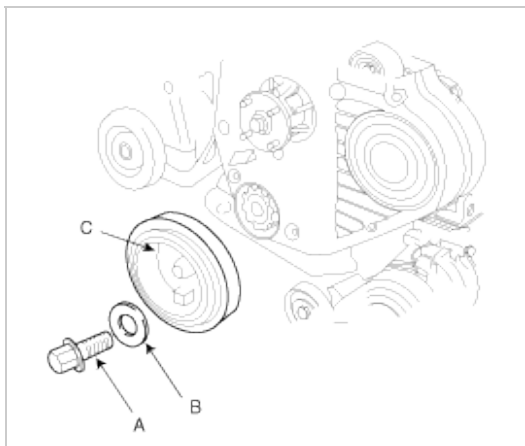
7. Remove the bolts(B), nut(C) and timing belt upper cover (A).



8. Turn the crankshaft pulley(A), and align its groove with timing mark "T" of the timing belt cover. Check that the timing mark of camshaft sprocket(B) is aligned with the timing mark of cylinder head cover. (No.1 cylinder compression TDC position)



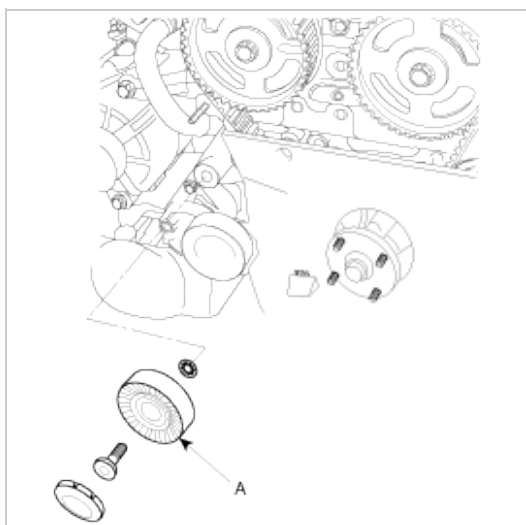
9. Remove the crankshaft pulley bolt(A), washer(B) and crankshaft pulley (C).



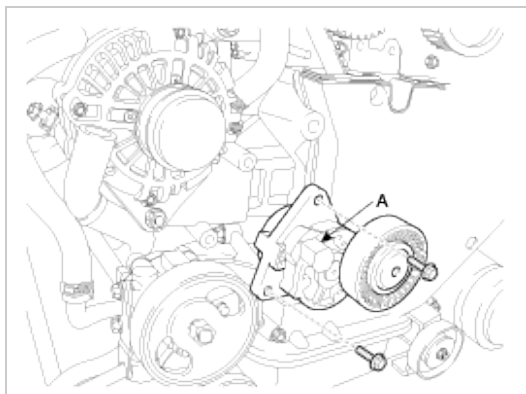
### NOTICE

Using the special tool(09517-21700, 09231-H1000), fix the crankshaft pulley and loosen the bolt(A).

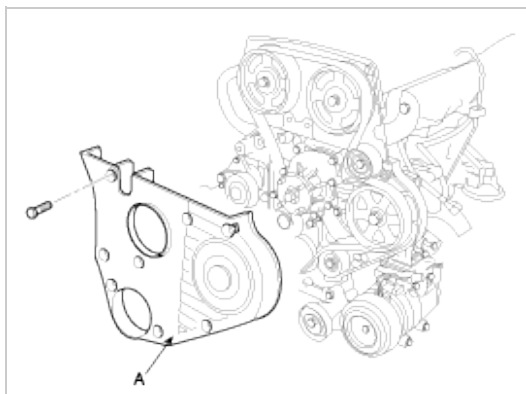
10. Remove the drive belt idler(A).



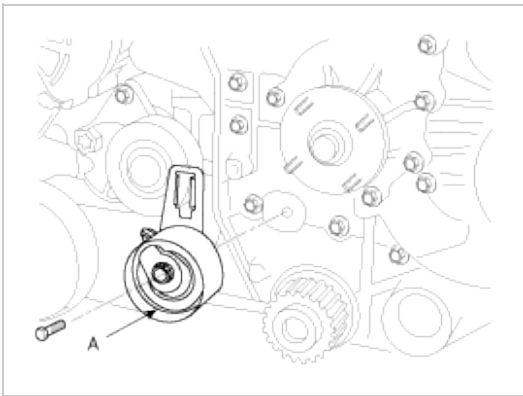
11. Remove the drive belt auto-tensioner (A).



12. Remove the timing belt lower cover(A).



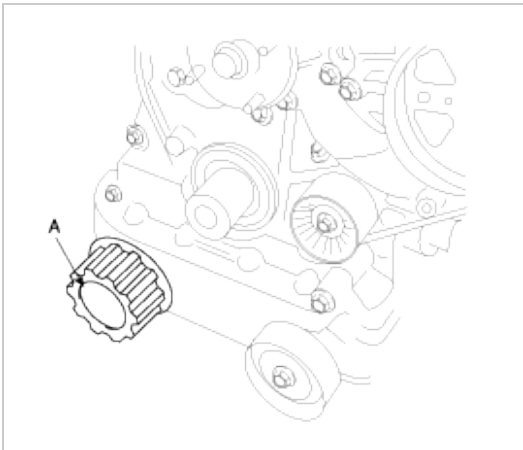
13. Remove the auto-tensioner(A) with the timing belt.



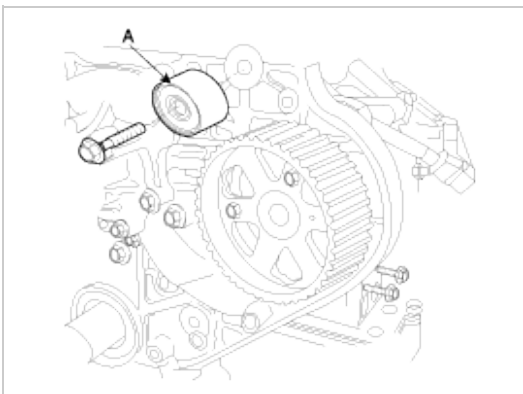
**NOTICE**

In reusing the timing belt, install the belt with the arrow mark facing to rotating direction.

14. Remove the timing belt sprocket(A).

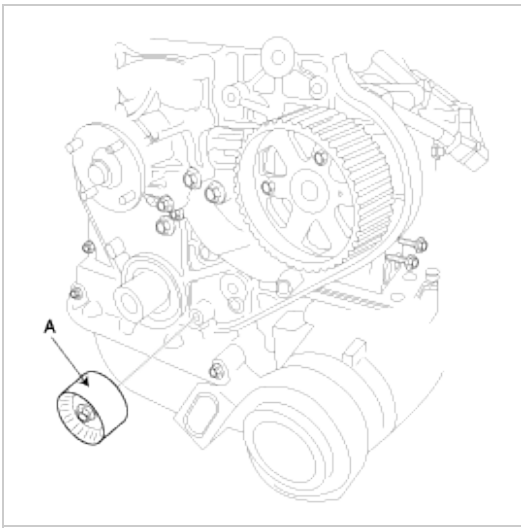


15. Remove the timing belt No.1 idler(A).

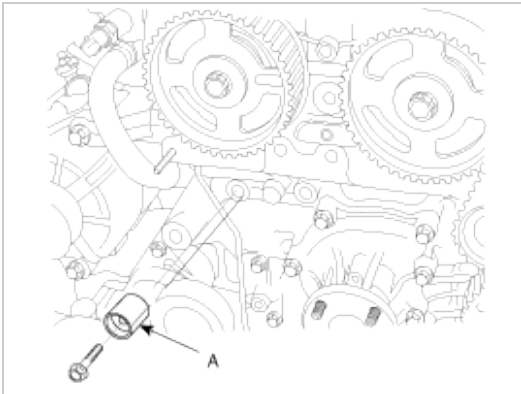


16. Remove the timing belt No.2 idler(A).

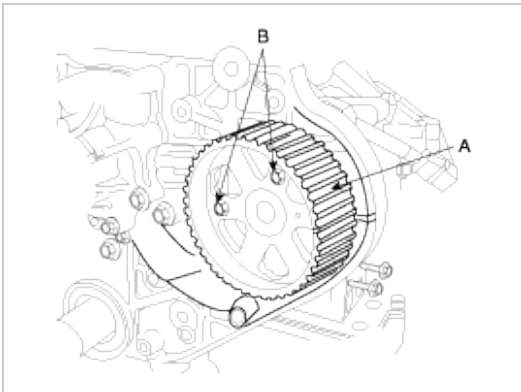




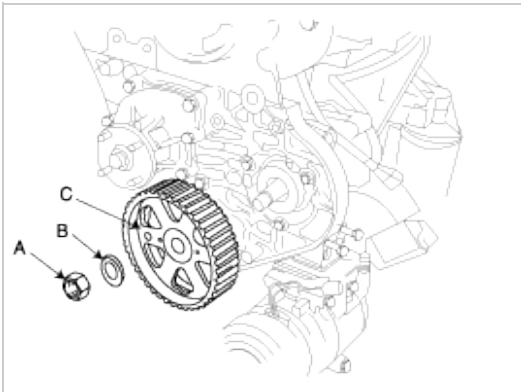
17. Remove the touch idler(A).



18. Fix the high pressure pump pulley, using the setting bolt(B) for the pulley not to be rotated.



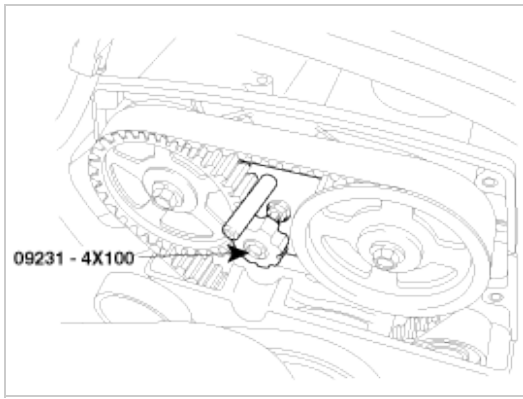
19. Remove the high pressure pulley nut(A), with the washer(B), pulley(C).



#### NOTICE

Using SST, remove the pulley. (Refer to FL group).

20. Using SST(09231-4X100), remove the camshaft pulley.

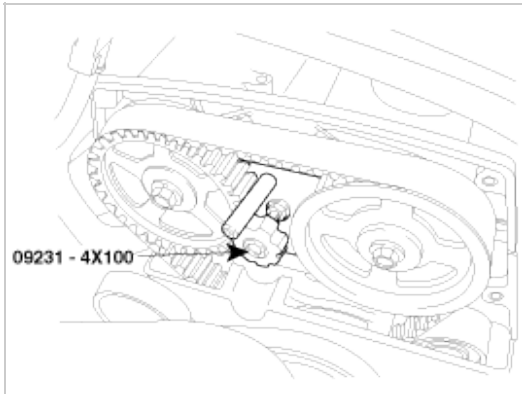


## INSTALLATION

1. Using SST (09231-4X100), install the camshaft pulley.

Tightening torque :

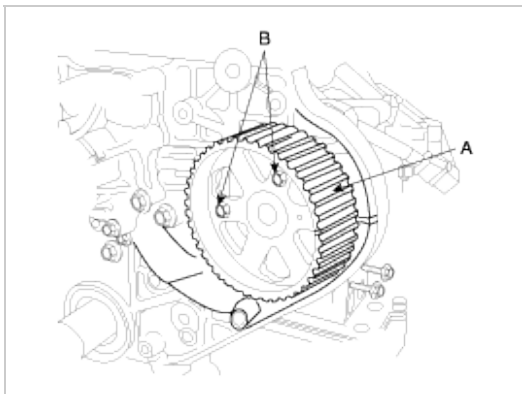
58.8~68.6Nm (6.0~7.0kgf.m, 43.4 ~ 50.6lb-ft)



2. After installing the high pressure pump pulley(A), tighten the high pressure pump pulley nut with the setting bolt(B) for the pulley not to be rotated.

Tightening torque :

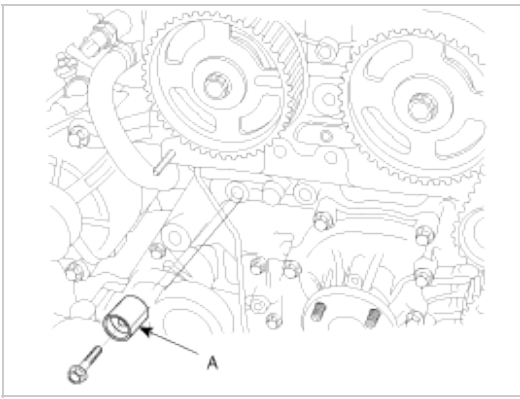
58.8~68.6Nm (6.0~7.0kgf.m, 43.4 ~ 50.6lb-ft)



3. Install the touch idler(A).

Tightening torque :

7.8 ~ 9.8Nm (2.1~2.6kgf.m, 5.8 ~ 7.2lb-ft)



4. Install the timing belt No.2 idler(A).

Tightening torque :

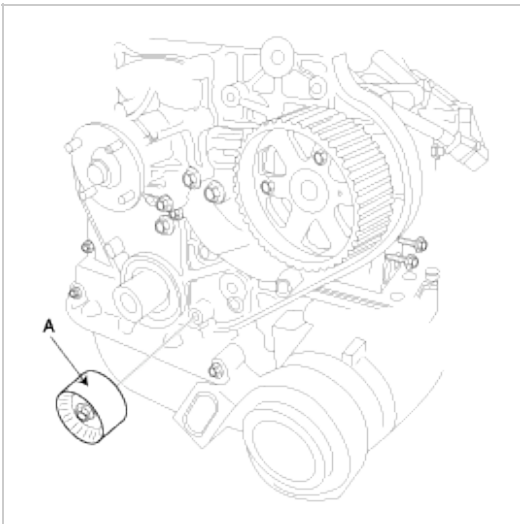
7.8 ~ 9.8Nm (3.8~4.4kgf.m, 5.8 ~ 7.2lb-ft)

#### CAUTION

Ensure the location of idlers.

No.1 idler : 60mm(2.3622in)

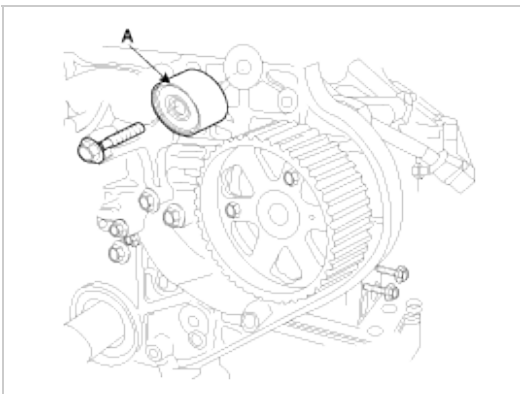
No.2 idler : 55mm(2.1654in)



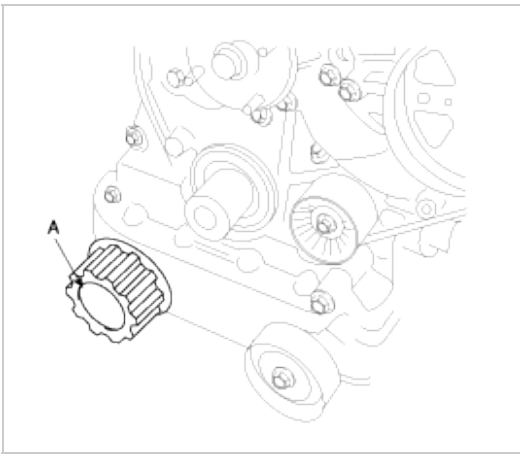
5. Install the timing belt No.1 idler(A).

Tightening torque :

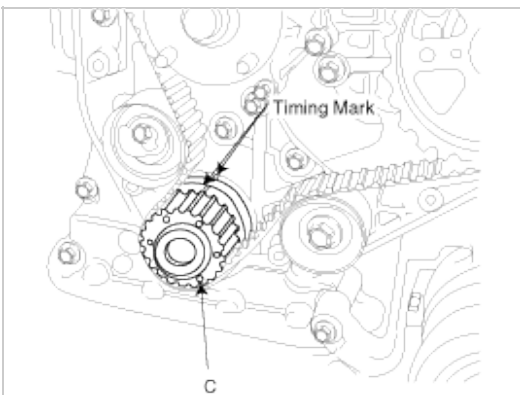
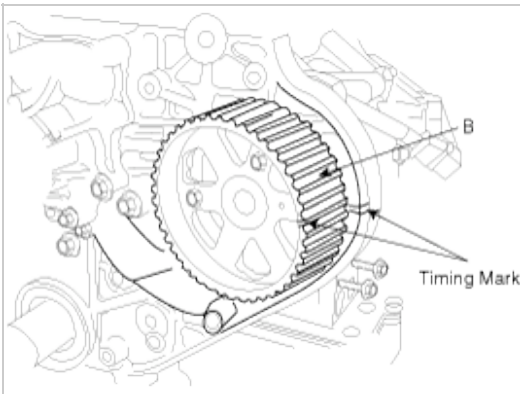
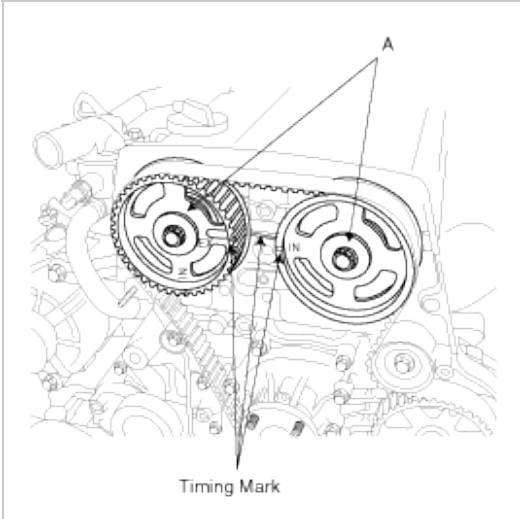
7.8 ~ 9.8Nm (4.0~5.0kgf.m, 5.8 ~ 7.2lb-ft)



6. Install the timing belt sprocket(A).



7. Check that the timing mark of camshaft pulley(A), high pressure pump pulley(B) and crankshaft pulley(c).



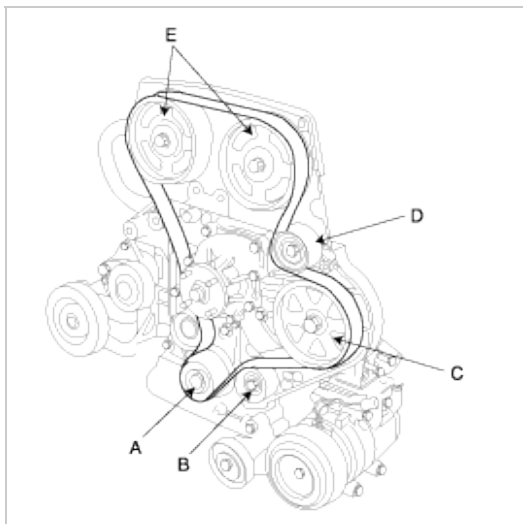
8. Install the timing belt.

Crankshaft sprocket pulley(A)→No.2 idler(B)→High pressure pump pulley (C) → No.1 idler(D) → camshaft sprocket pulley (E)

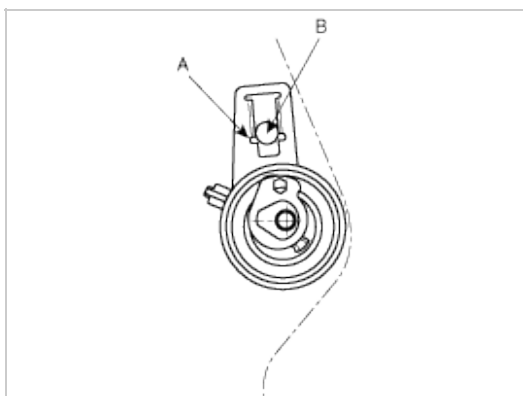
#### CAUTION

Because the auto-tensioner should be installed after the timing belt, be careful about the tension of the belt

before the installation of the auto-tensioner.



9. Install the auto-tensioner as shown below which the tensioner fork(back plate)(A) positioned around the dowel pin(B).

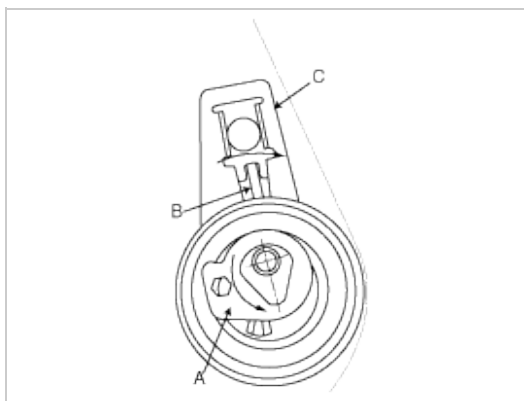


#### CAUTION

Be careful for the auto-tensioner not to be stained with oil. If so, replace the auto-tensioner with a new one. The location of the pointer, the back plate and the special washer is as shown.

10. Adjust the tension of the timing belt.

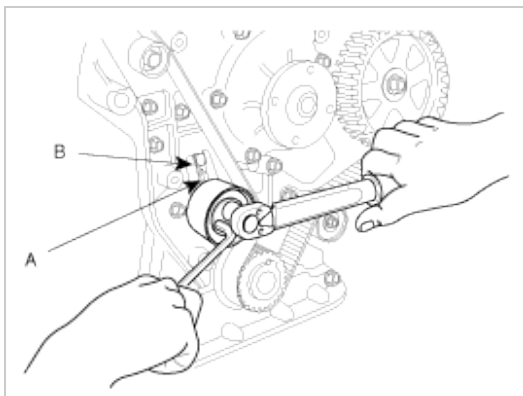
- (1) Adjust the location of the pointer (B) aligning the tensioner fork(back plate)(C) as shown below by turning the special washer(A) counterclockwise with a hexagonal wrench.



- (2) When aligning the pointer(A) with the tensioner fork(back plate)(B), tighten the tensioner mounting bolt with fixing the special washer not to move by a hexagonal wrench.

Tightening torque :

19.6~25.5Nm (2.0~2.6kgf.m, 14.5~18.8lb-ft)



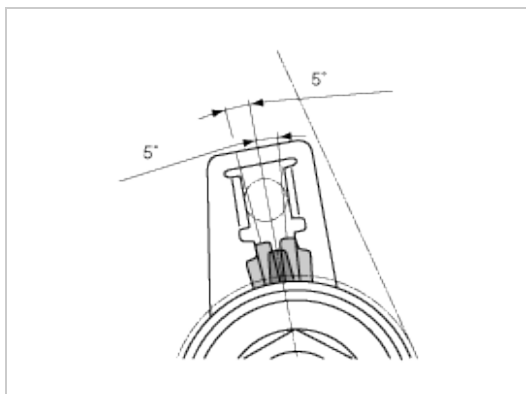
(3) Remove the hexagonal wrench.

#### NOTICE

If the pointer is not aligned with the tensioner fork(back plate), replace the belt with a new one and adjust them again.

11. Align the timing marks of the crankshaft sprocket, the camshaft sprocket and the high pressure pump pulley by turning the crankshaft clockwise two revolutions.
12. Check that the location of the pointer is aligned with the tensioner fork (back plate).

The margin of error :  $\pm 5^\circ$

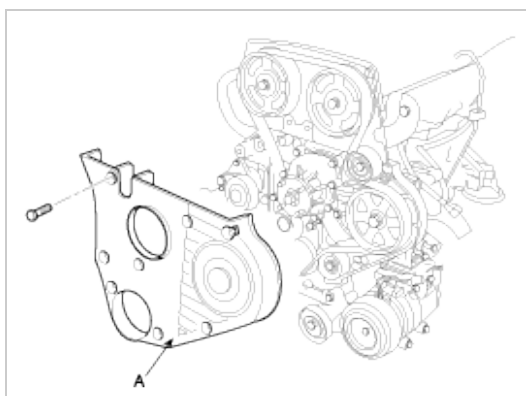


#### NOTICE

If the location of the pointer is not within the margin of error, repeat the steps 10)~12).

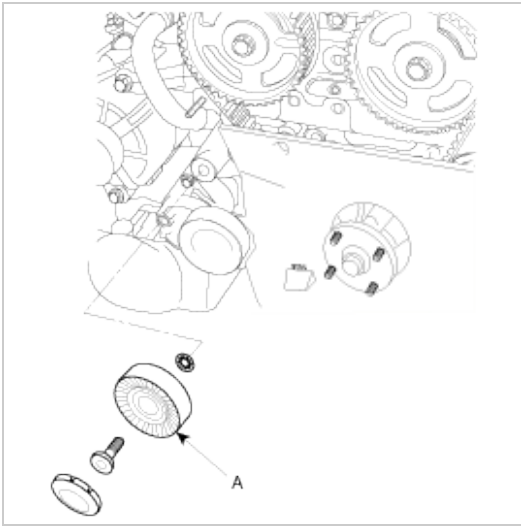
13. Install the timing belt lower cover(A).

Tightening torque :  
6.9~9.8Nm (0.7 ~ 1.0kgf.m, 5.1 ~ 7.2lb-ft)



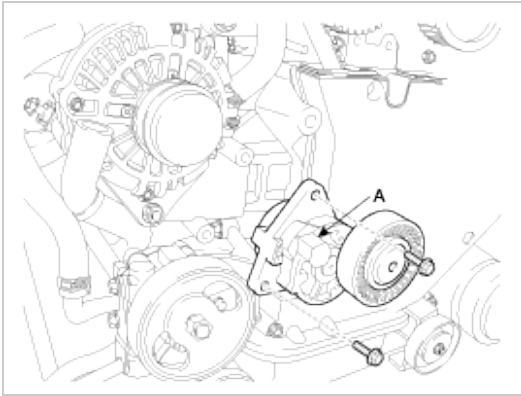
14. Install the drive belt idler(A).

Tightening torque :  
37.3Nm (3.8kgf.m, 27.5lb-ft)



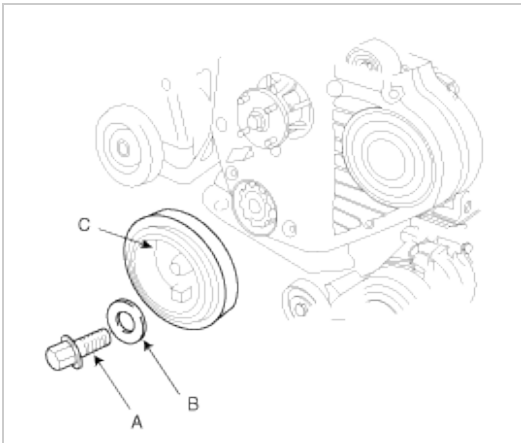
15. Install the drive belt auto-tensioner (A).

Tightening torque :  
15.7~22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)



16. Install the crankshaft pulley bolt(A), washer(B) and crankshaft pulley (A).

Tightening torque :  
376.6~411.9Nm (38.4~42.0kgf.m, 277.7~303.8lb-ft)

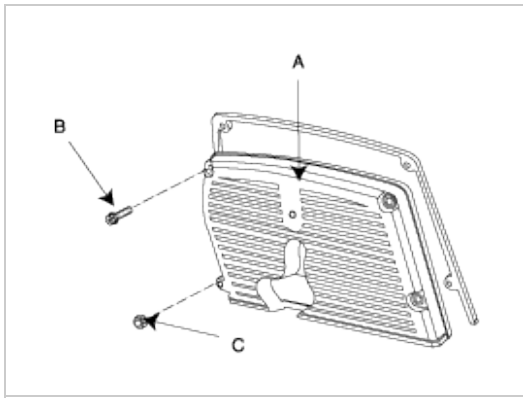


#### NOTICE

Using the special tool(09517-21700, 09231-H1000).

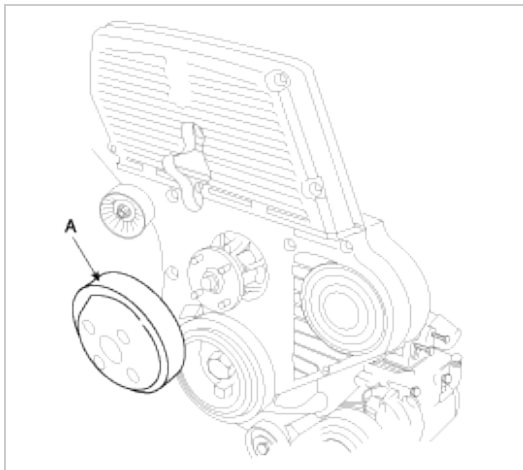
17. Install the bolts(B), nut(C) and timing belt upper cover (A).

Tightening torque :  
6.9~9.8Nm (0.7 ~ 1.0kgf.m, 5.1 ~ 7.2lb-ft)

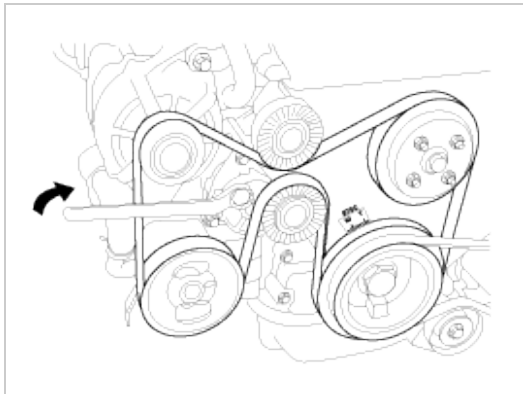


18. Install the water pump pulley.

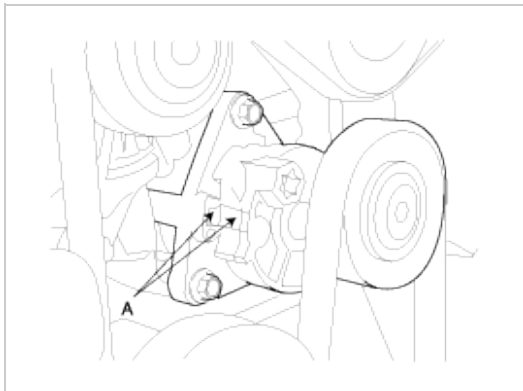
Tightening torque :  
5.9~9.8Nm (0.6 ~ 1.0kgf.m, 4.3 ~ 7.2lb-ft)



19. Install the drive belt.



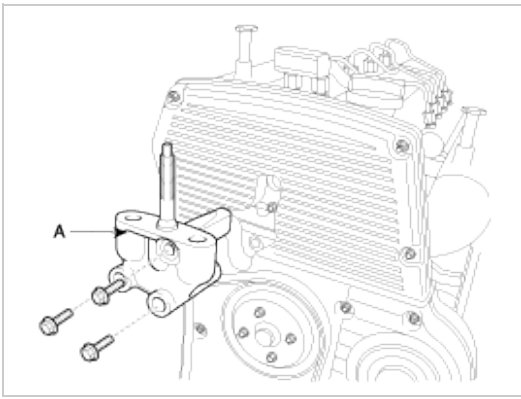
20. Check that the 'A' part of the drivebelt auto-tensioner is aligned as shown below. If not, replace the drivebelt.



21. Install the engine support bracket(A).

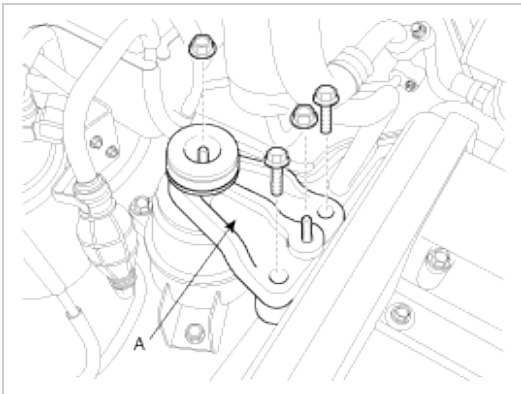
Tightening torque :  
49.0~63.7Nm (5.0 ~ 6.5kgf.m, 36.2 ~ 47.0lb-ft)





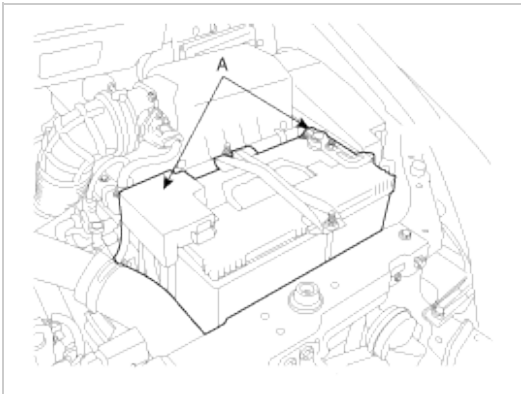
22. Install the engine mounting (A).

Tightening torque :  
88.3~107.9Nm (9.0 ~ 11.0kgf.m, 65.1 ~ 79.6lb-ft)



23. Remove the jack for oil pan.

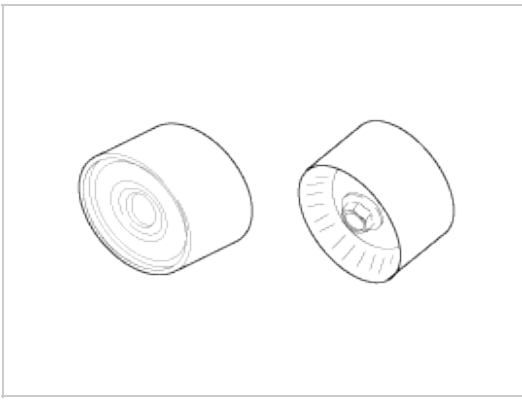
24. Install the battery terminals (A).



## INSPECTION

### SPROCKETS, TENSIONER, IDLER

1. Check the camshaft sprocket, crankshaft sprocket, tensioner pulley, and idler pulley for abnormal wear, cracks, or damage. Replace as necessary.
2. Inspect the tensioner pulley and the idler pulley for easy and smooth rotation and check for play or noise. Replace as necessary.



3. Replace the pulley if there is a grease leak from its bearing.

## **TIMING BELT**

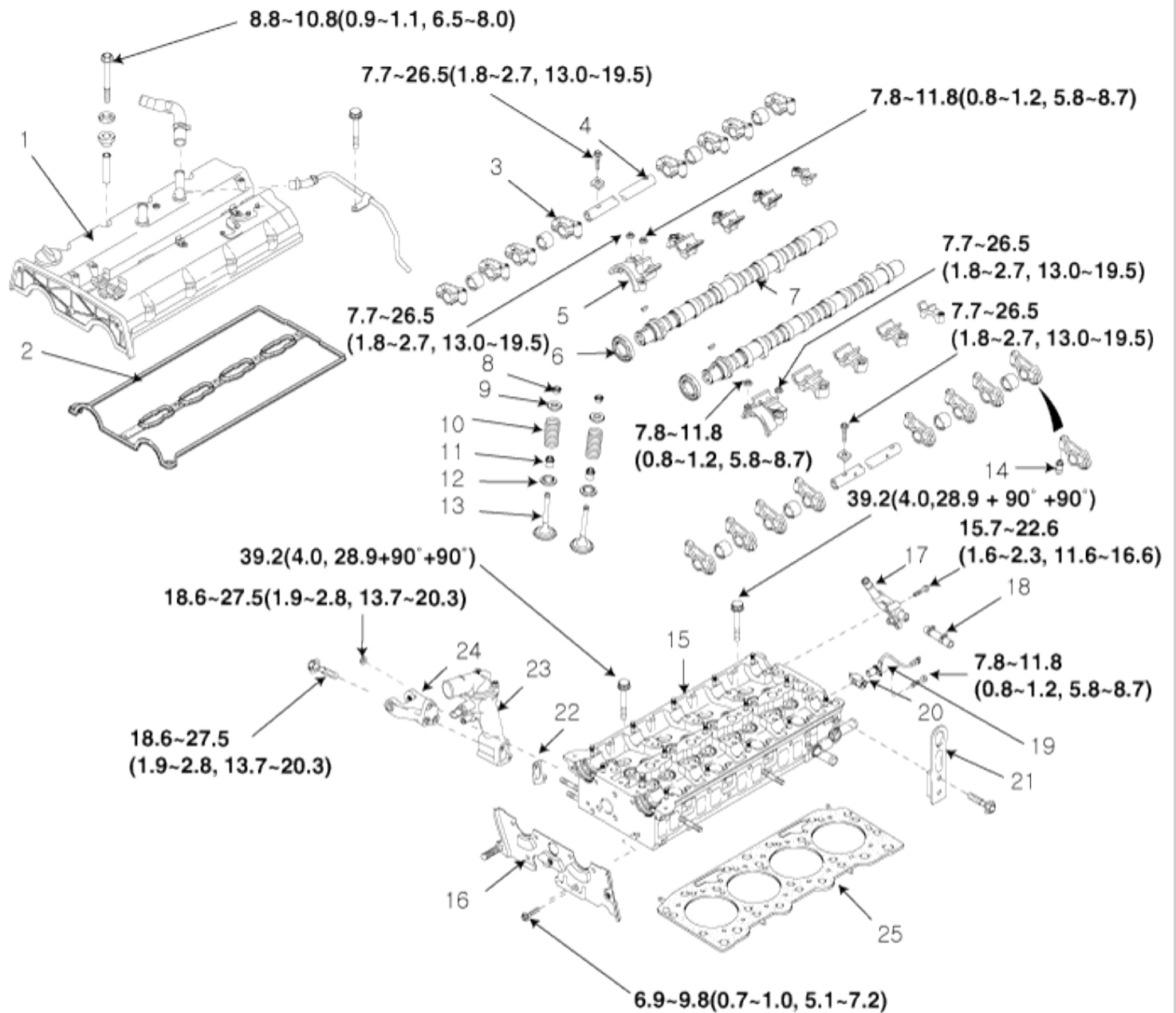
1. Check the belt for oil or dust deposits.  
Replace, if necessary.  
Small deposits should be wiped away with a dry cloth or paper. Do not clean with solvent.
2. When the engine is overhauled or belt tension adjusted, check the carefully. If any of the following flaws are evident, replace the belt.

### **NOTICE**

- a. Do not bend, twist or turn the timing belt inside out.
- b. Do not allow timing belt to come into contact with oil, water and steam.

# Cylinder Head Assembly

## COMPONENTS



### TORQUE : N.m(kgf.m, lb-ft)

1. Cylinder head cover	10. Valve spring	19. Camshaft position sensor
2. Cylinder head cover gasket	11. Valve stem seal	20. Camshaft position sensor housing
3. Rockerarm	12. Spring seat	21. Engine hanger
4. Rockerarm shaft	13. Valve	22. Thermostat case gasket
5. Camshaft bearing cap	14. Hydramlic lash adjuster	23. Thermostat case
6. Camshaft oil seal	15. Cylinder head	24. Generator bracket
7. Camshaft	16. Timing belt plate	25. Cylinder head gasket
8. Retainer lock	17. Ventilation housing	
9. Retainer	18. Ventilation hose	



## REMOVAL

Engine removal is not required for this procedure.

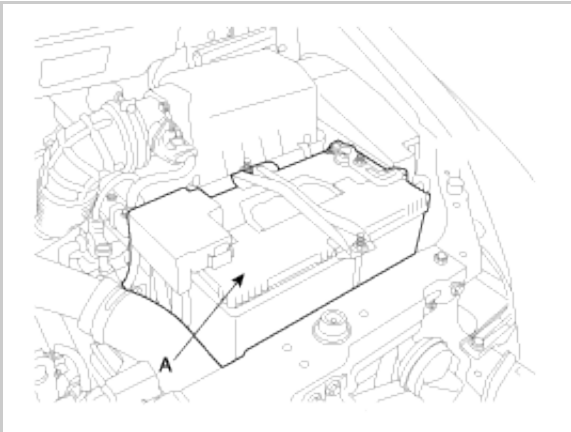
### CAUTION

- 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.

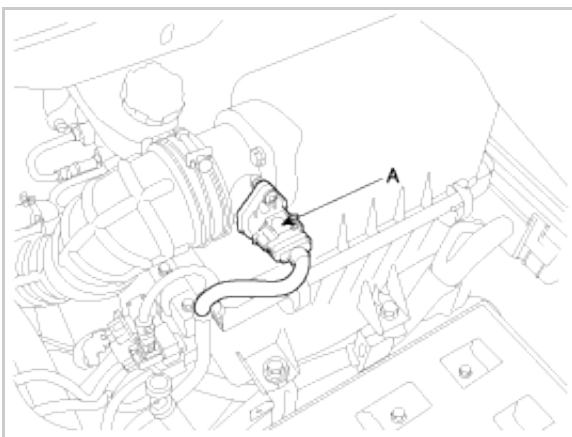
### NOTICE

- 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.

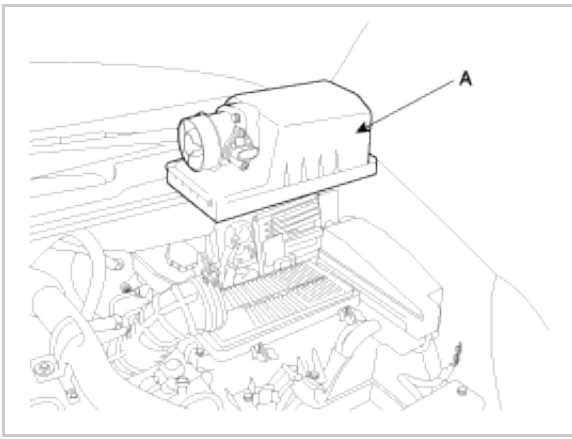
1. Remove the battery(A).



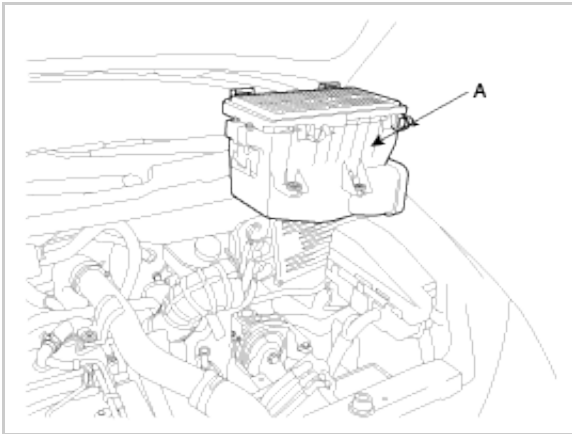
2. Drain the engine coolant.  
Remove the radiator cap to speed draining.
3. Remove the intake air hose and air cleaner assembly.  
(1) Disconnect the AFS(Air Flow Sensor) connector(A).



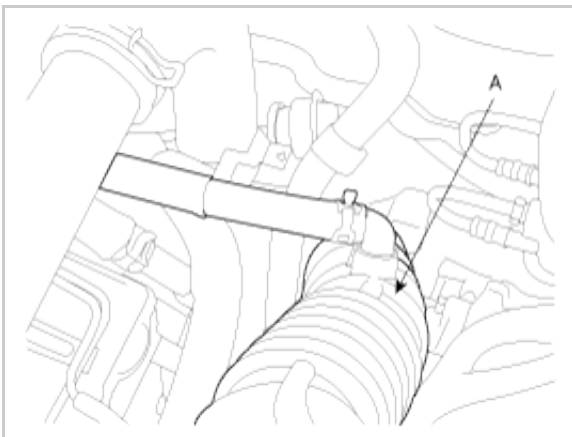
- (2) Disconnect the air cleaner upper cover(A).



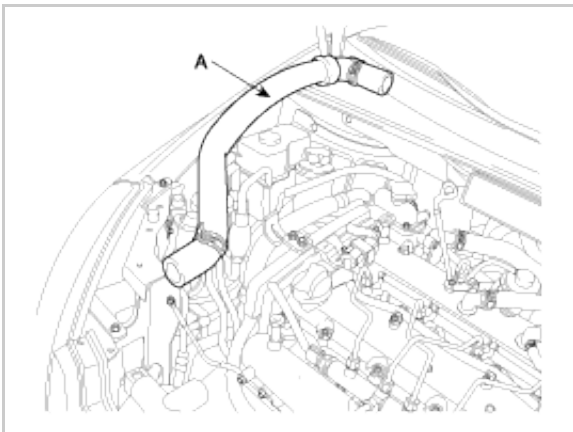
(3) Remove the air cleaner assembly(A).



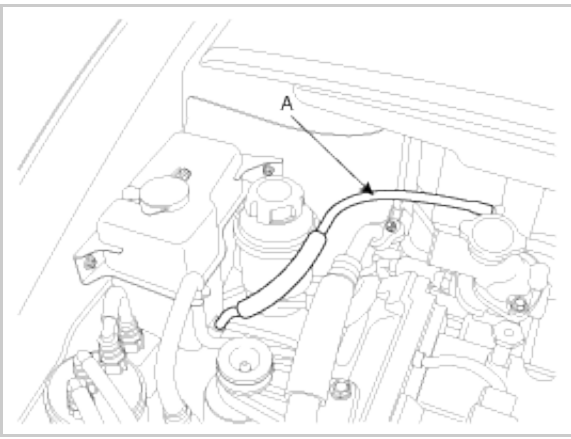
(4) Remove the air intake hose(A).



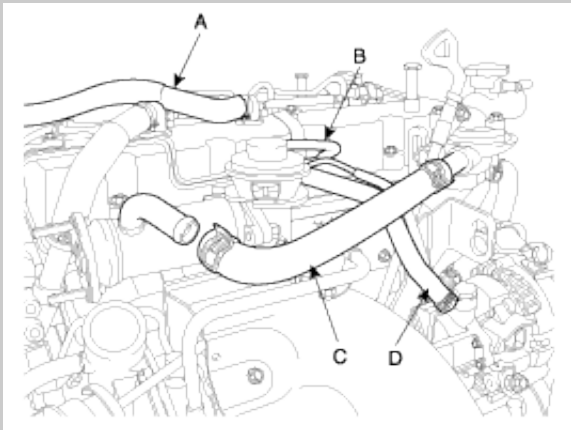
4. Remove the radiator upper hose(A).



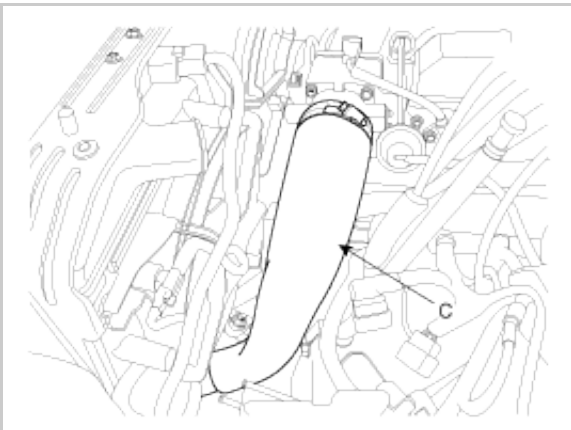
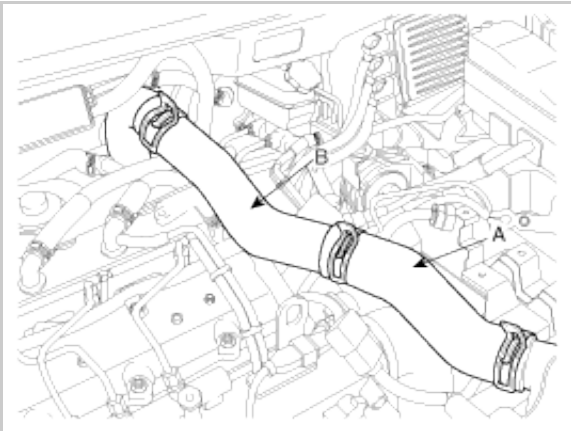
5. Remove the reservoir tank hose(A).



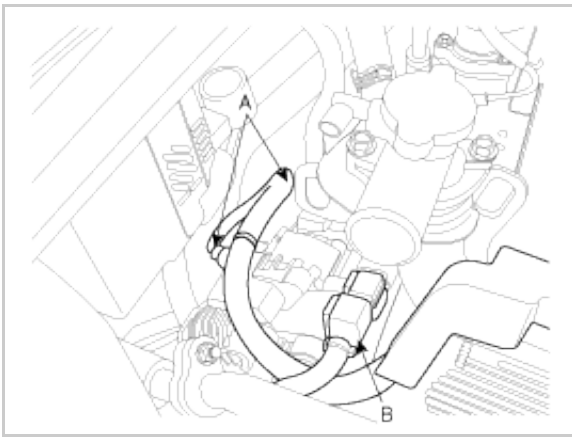
6. Remove the PCV(Positive Crankcase Ventilation) hose(A), EGR valve vacuum hose(B), EGR cooler water hose(C), pump vacuum oil hose(D).



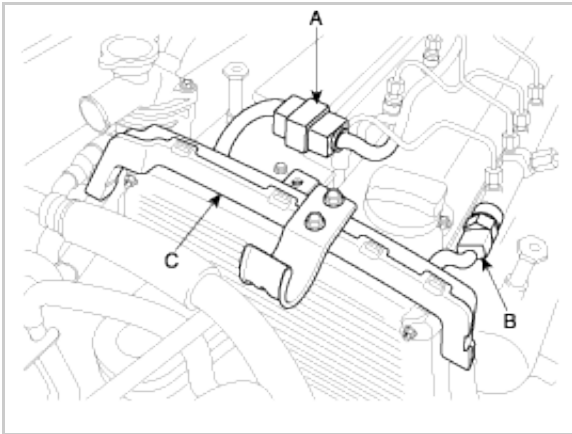
7. Remove the intercooler hose(A,C), pipe(B).



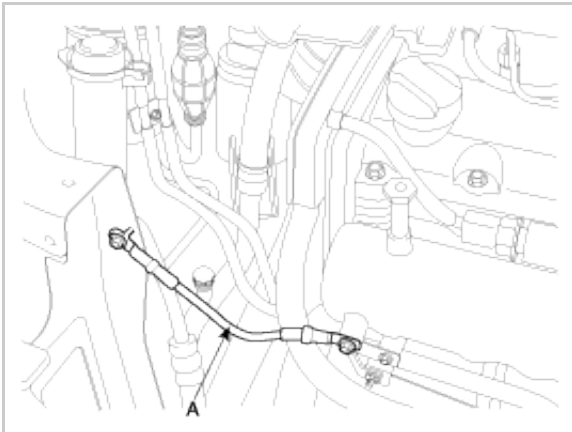
8. Remove the wiring connectors and clamps from cylinder head and intake manifold.  
 (1) Remove the generator connector (A) and ETC(Engine Coolant Temperature) sensor connector (B).



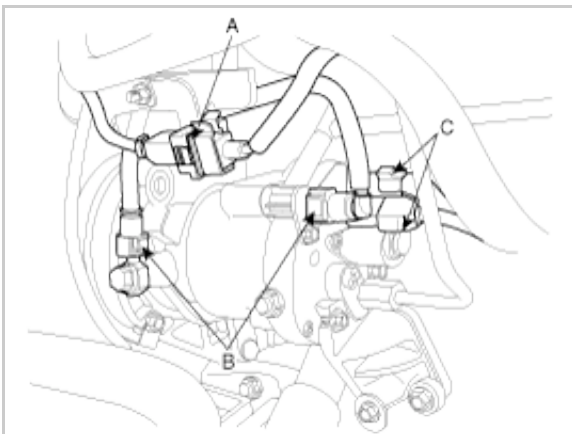
(2) Remove the injector connector(A), common rail pressure sensor connector(B), wire harness protector(C).



(3) Remove the ground cable(A) from cylinder head.

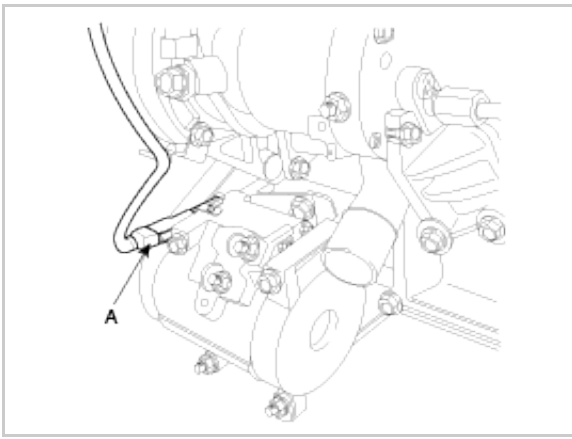


(4) Remove the knock sensor connector (A), high pressure pump fuel hose (B), high pressure pump connector(C).

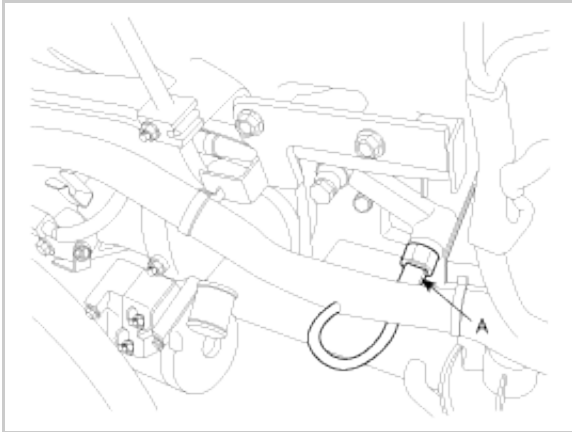


(5) Remove the air conditioner condenser (A).

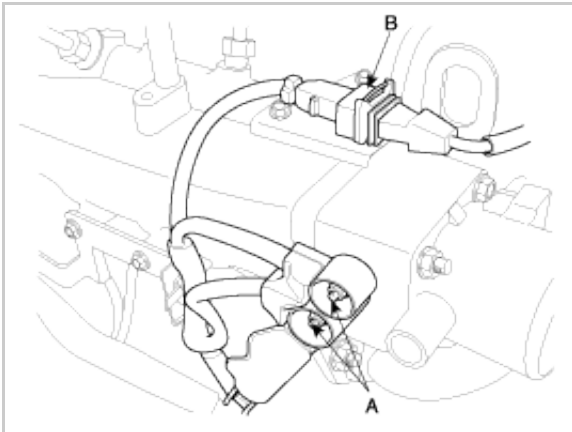




(6) Remove the oil pressure switch connector (A).



(7) Remove the air heater (A), CMP (Camshaft Position Sensor) connector (B).



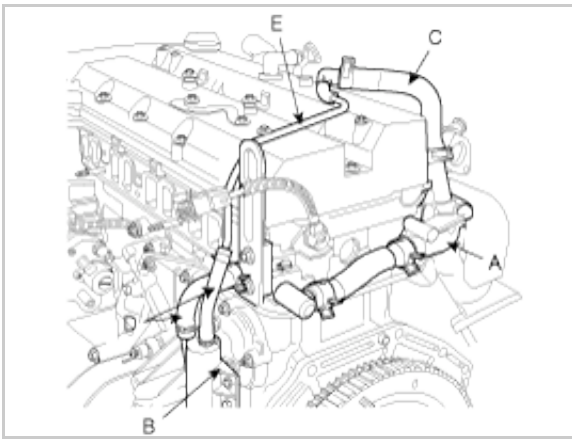
9. Remove the injection pipe, injector. (Refer to FL- injector.)

10. Remove the exhaust manifold.

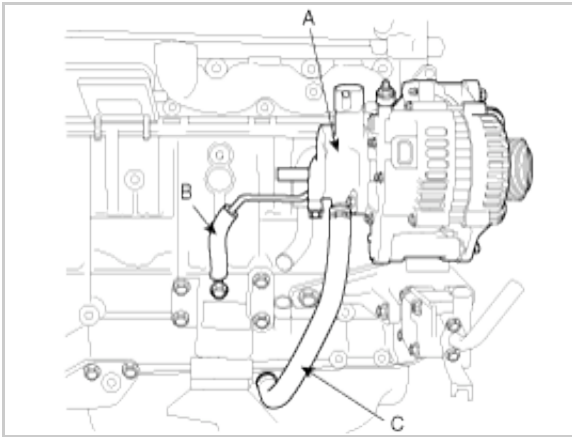
11. Remove the intake manifold.

12. Remove the timing belt.

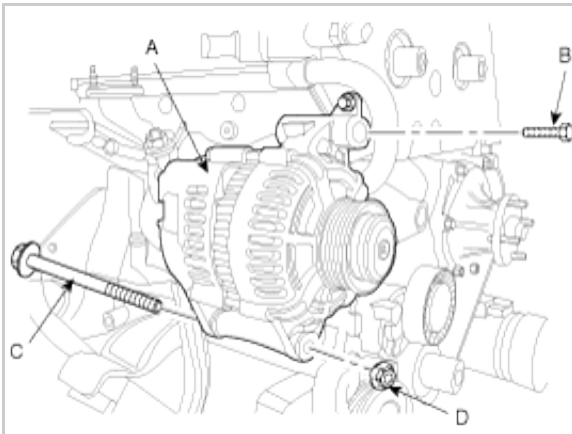
13. Remove the hose(C, D) and pipe (E) from. the ventilation housing(A) and the air separator(B).



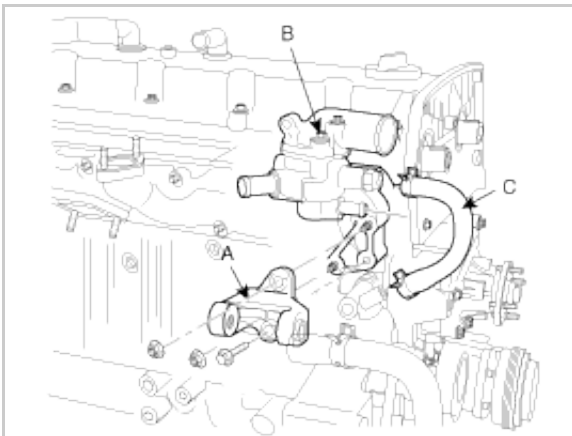
14. Remove the oil pipe (B) and hose(C) from the generator vacuum pump (A).



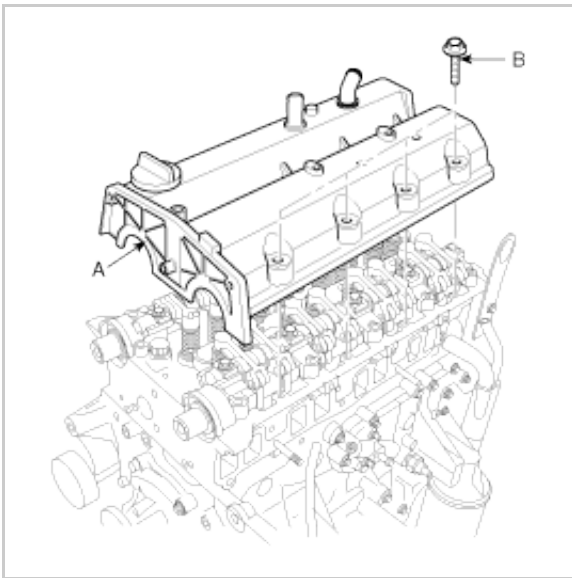
15. Remove the generator fixing bolts(B,C), nuts(D) and then the generator(A).



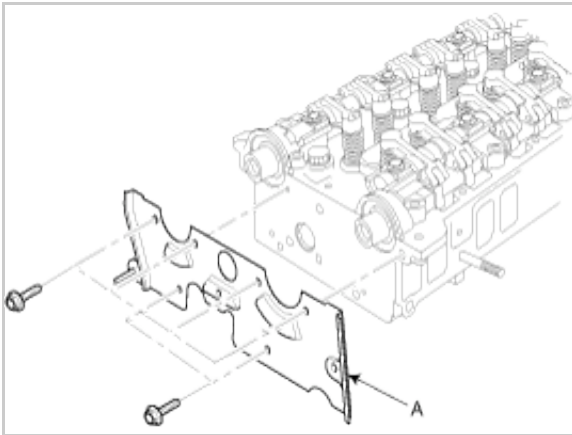
16. After removing the water hose(C) from the thermostat housing (B), remove the generator fixing bracket (A) and the thermostat housing (B).



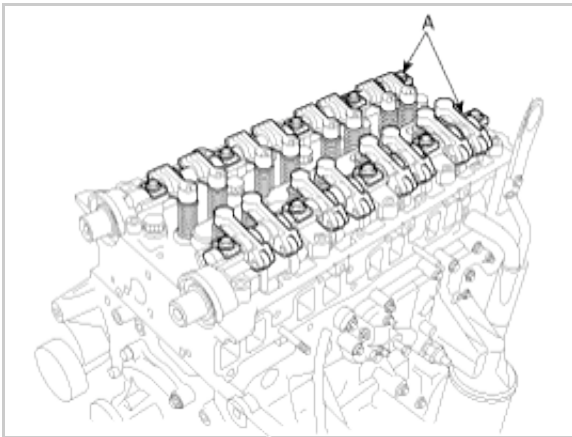
17. Remove the cylinder head cover(A).



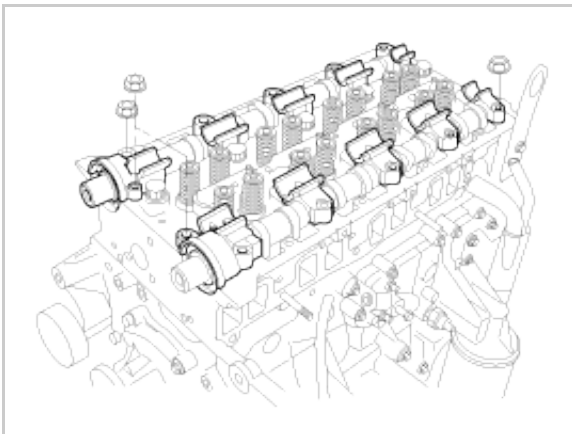
18. Remove the timing belt plate(A).



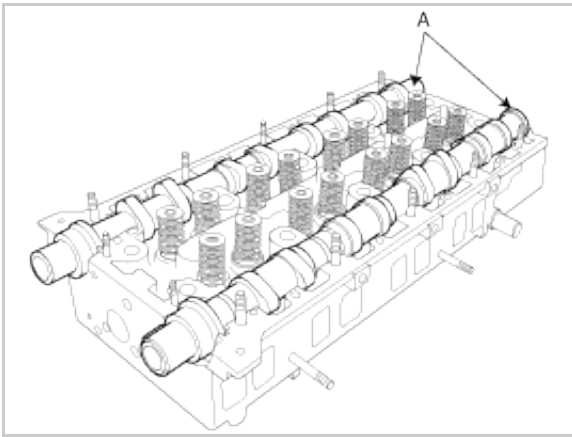
19. Remove the rockerarm shaft(A).



20. Remove the camshaft bearing caps(A).

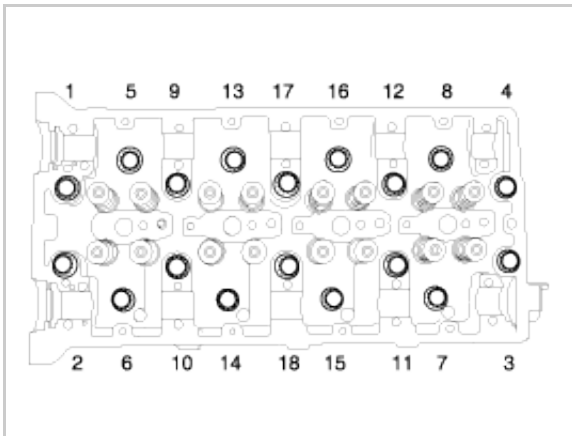


21. Remove the camshaft(A).



22. Remove the cylinder head bolts, then remove the cylinder head.

(1) Remove the 18 cylinder head bolts, in several steps and the sequence shown below.



#### CAUTION

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

(2) 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.

## INSTALLATION

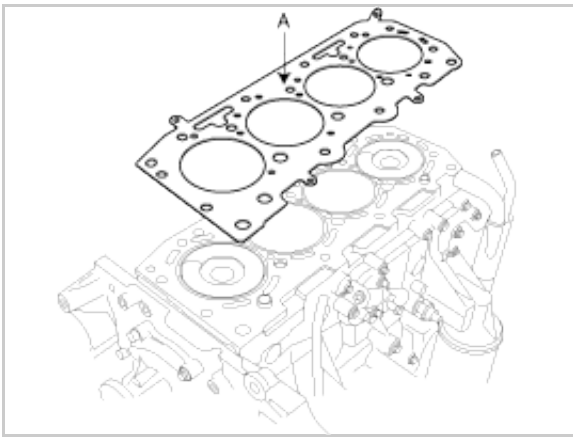
#### NOTICE

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

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

#### NOTICE

Ensure 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 the cylinder head bolts.
  - (1) Apply a light coat of engine oil on the threads and under the heads of the cylinder head bolts.

#### NOTICE

After measuring the length of the cylinder head bolts, replace them, if necessary.

Long bolts : 132mm(5.1968in)

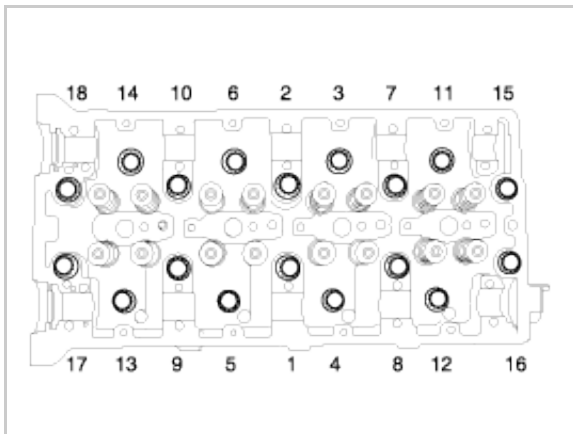
Short bolts : 93mm(3.6614in)

- (2) Install and tighten the 18 cylinder head bolts and plate washers, in several passes, in the sequence shown.

Tightening torque :

Long bolts: 39.2Nm (4.0kgf.m, 28.9lb-ft)+ 90° + 120°

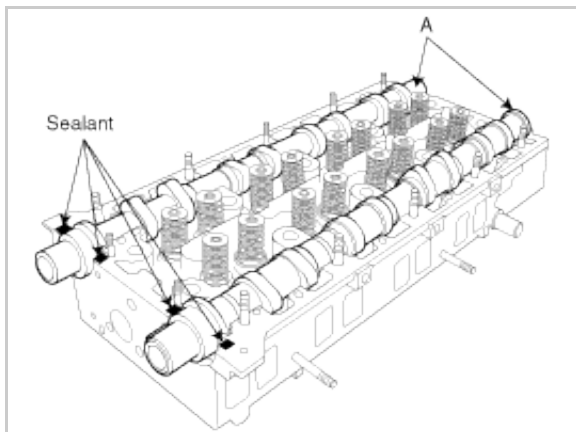
Short bolts: 39.2Nm (4.0kgf.m, 28.9lb-ft)+ 90° + 90°



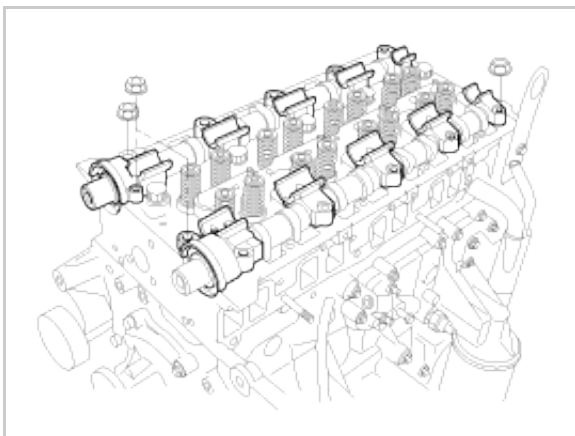
4. Install the camshaft(A) on the cylinder head.

#### CAUTION

Apply sealant before assembling the front bearing caps (LOCTITE NO. 518 or equivalent).



5. Install the bearing caps aligning the cap numbers with the direction of the arrow marks.



6. Install the rocker arm shaft assembly(A) after bearing cap.

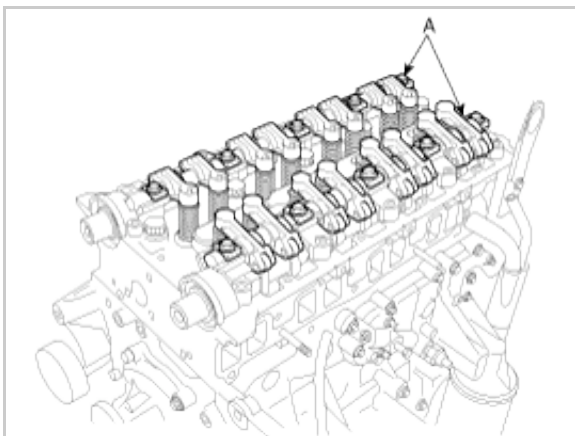
Tightening torque :

Nuts, Bolts: 17.7~26.5Nm (1.8 ~ 2.7kgf.m, 13.0~19.5lb-ft)

Small nuts: 7.8~11.8Nm (0.8 ~ 1.2kgf.m, 5.8~8.7lb-ft)

#### NOTICE

Distinguish between the intake and the exhaust rocker arm shaft (Intake: yellow, exhaust: black).

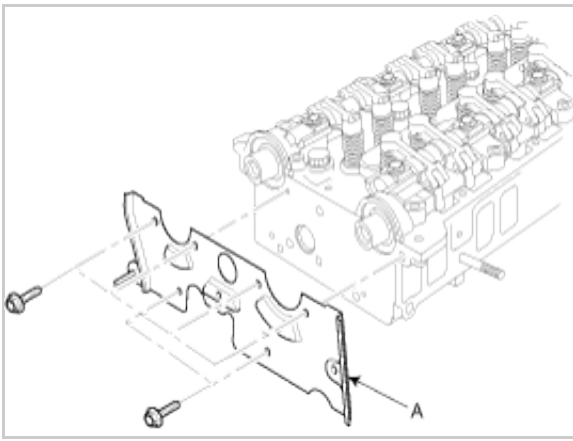


7. Install the camshaft oil seal.

8. Install the timing belt plate(A).

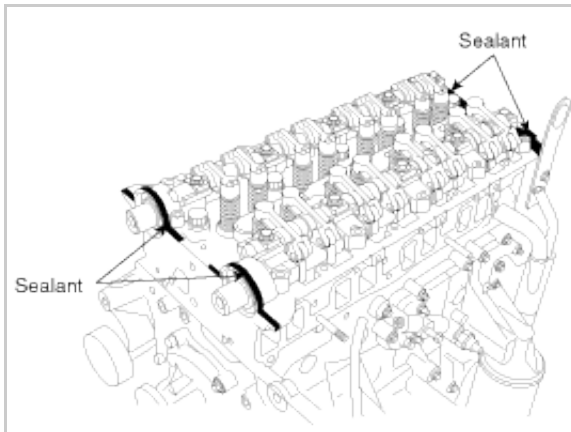
Tightening torque :

6.9~9.8Nm (0.7~1.0kgf.m, 5.1~7.2lb-ft)



9. Install the cylinder head cover.

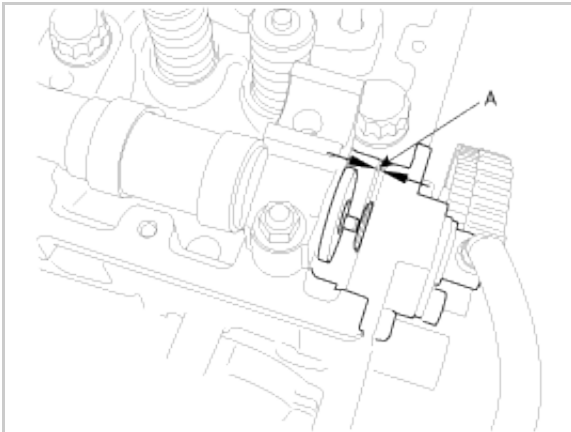
(1) Apply sealant on the cylinder head as shown below.



(2) Before installing the cylinder head cover, check the clearance (A) between dowel pin on the edge of the camshaft and the phase sensor.

Clearance (A) :

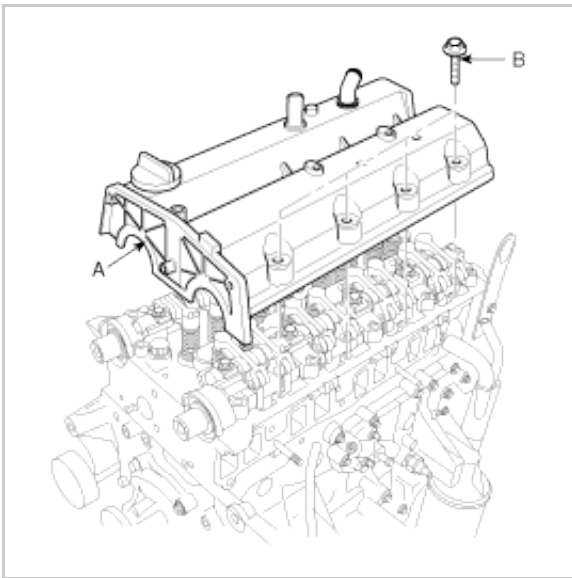
0.5 ~ 1.5mm (0.0197 ~ 0.0591in.)



(3) Install the cover (A) to the cylinder head after the gasket.

Tightening torque :

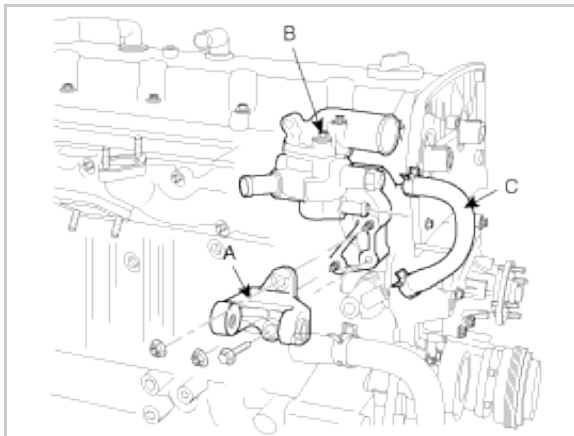
8.8~10.8Nm (0.9~1.1kgf.m, 6.5~8.0lb-ft)



10. Install the thermostat housing (B), the generator fixing bracket (A), and the water hose(C).

Tightening torque :

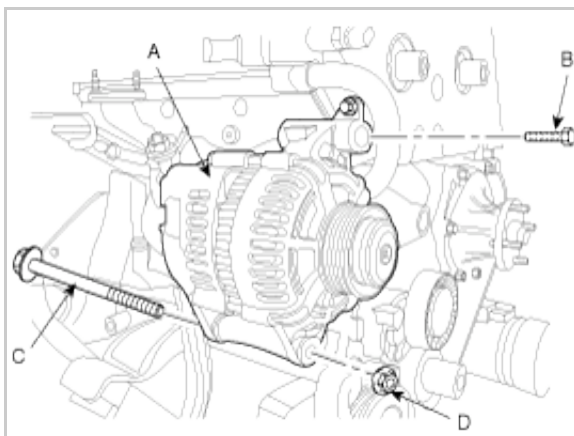
18.6~27.5Nm (1.9~2.8kgf.m, 13.7~20.3lb-ft)



11. Install the generator(A) with the fixing bolts(B,C), nut(D).

Tightening torque :

38.2~58.8Nm (3.9~6.0kgf.m, 28.2~43.4lb-ft)



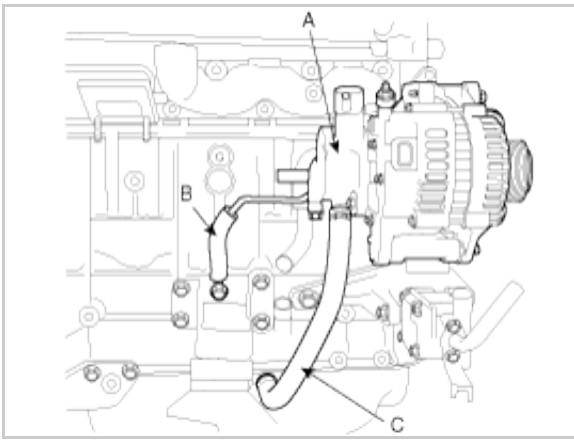
12. Install the oil pipe(B), hose(C) to generator pressure pump(A).

Oil pipe eyd bolt

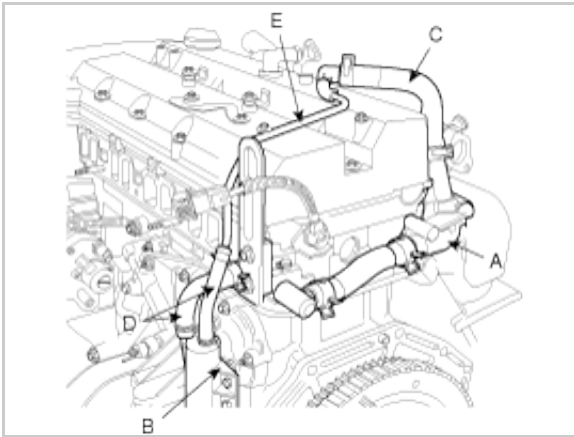
Tightening torque :

19.6~24.5Nm (2.0~2.5kgf.m, 14.5~18.1lb-ft)





13. Install the hose(C,D) and the pipe(E) to the ventilation housing(A) and the air separator(B).



14. Install the timing belt.

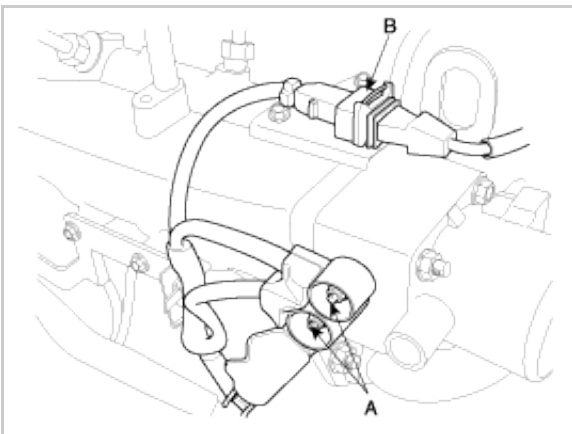
15. Install the intake manifold.

16. Install the exhaust manifold.

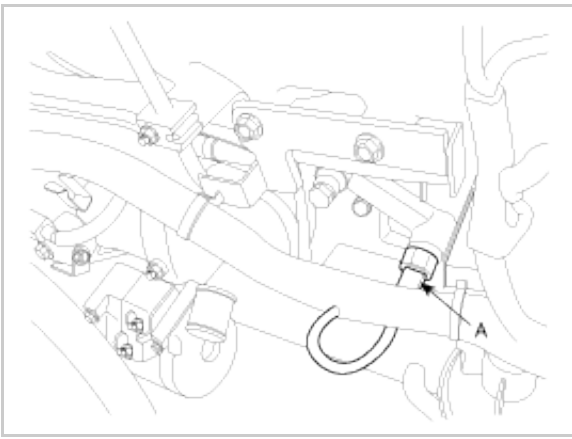
17. Install the injection pipe, injector. (Refer to FL- injector.)

18. Install the wire harness and the clamp to the cylinder head and the intake manifold.

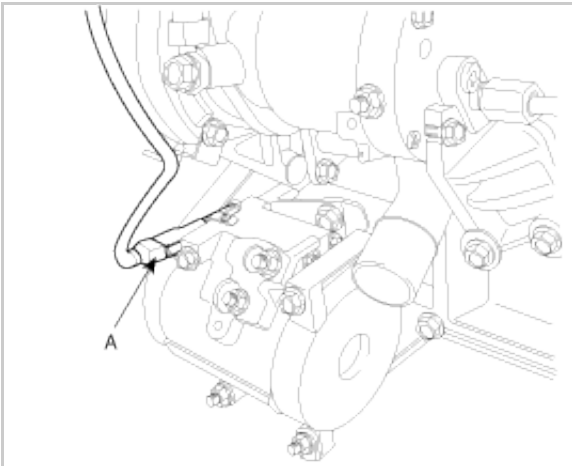
(1) Install the air heater(A), CMP (Camshaft Position Sensor) connector(B).



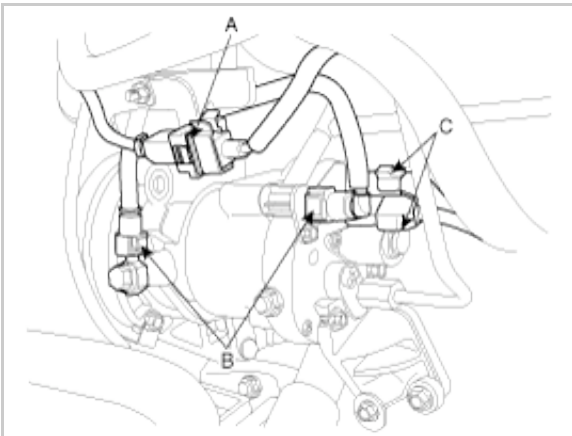
(2) Install the oil pressure switch connector(A).



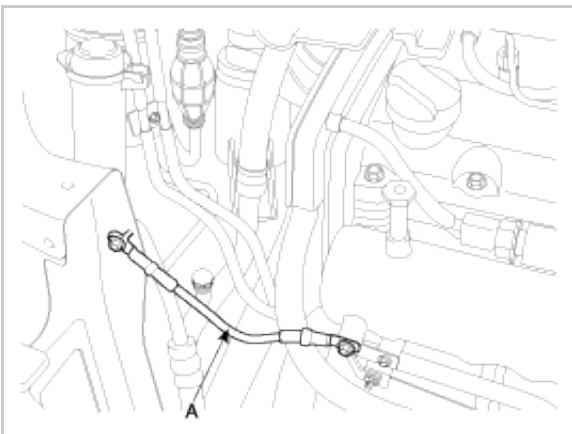
(3) Install the air conditioner condenser(A).



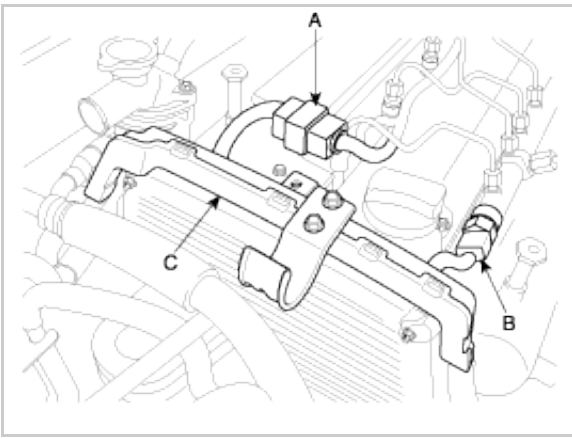
(4) Install the knock sensor connector(A), high pressure pump fuel hose(B), high pressure pump connector(C).



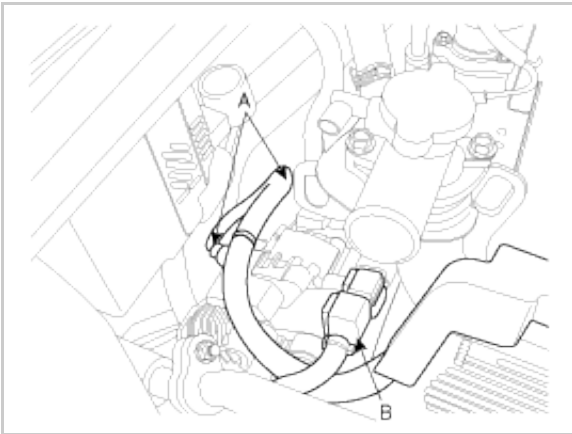
(5) Install the ground cable(A) from cylinder head.



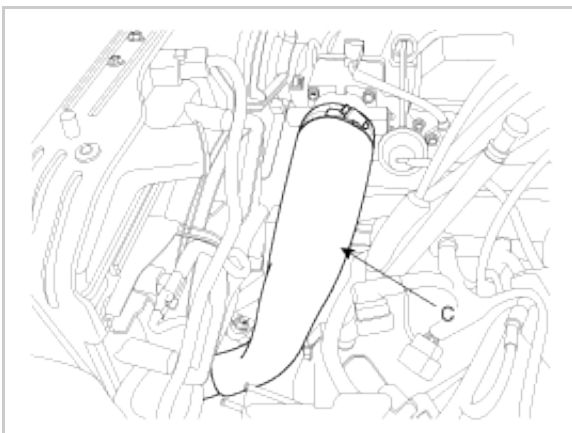
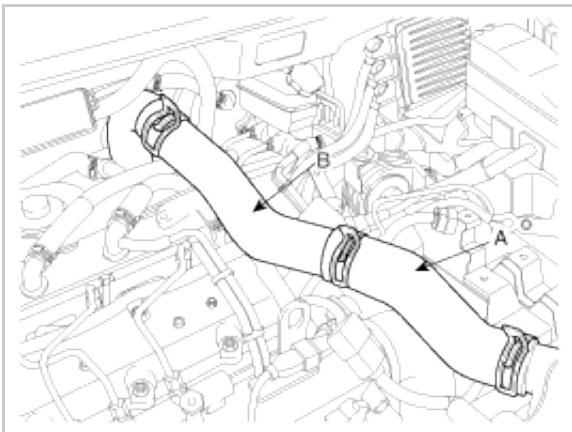
(6) Install the injector connector(A), common rail pressure sensor connector(B), wire harness protector(C).



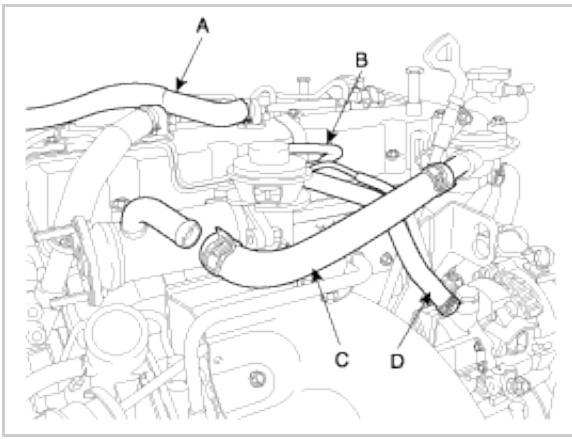
(7) Install the generator connector(A) and the ETC(Engine Coolant Temperature) sensor connector(B).



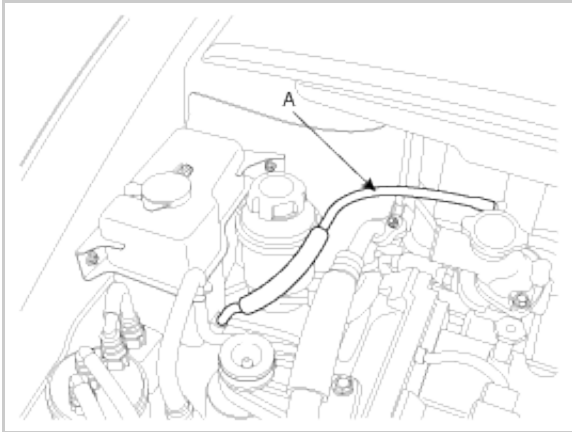
19. Install the intercooler hose(A,C), pipe(B).



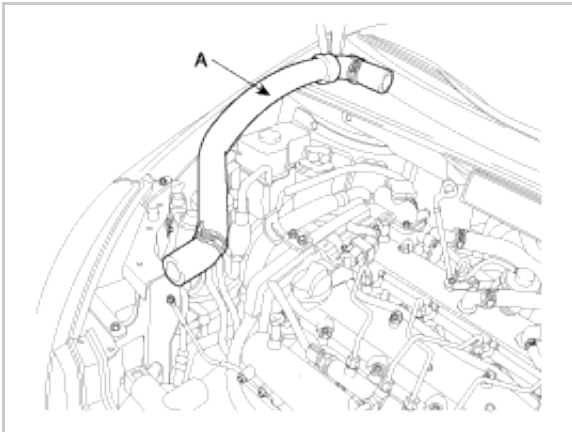
20. Install the PCV(Positive Crankcase Ventilation) hose(A), EGR valve vacuum hose(B), EGR cooler water hose(C), pump vacuum oil hose(D).



21. Install the reservoir tank hose(A).

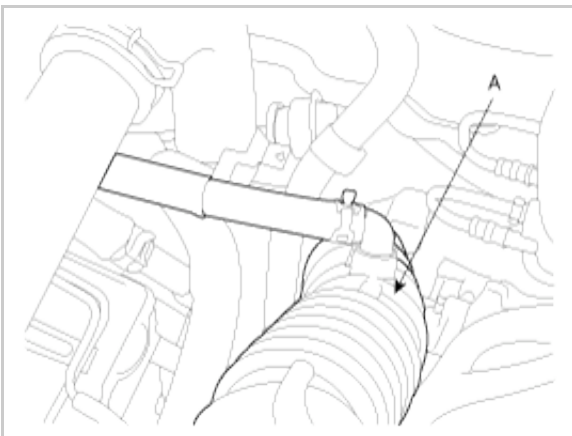


22. Install the radiator upper hose(A).

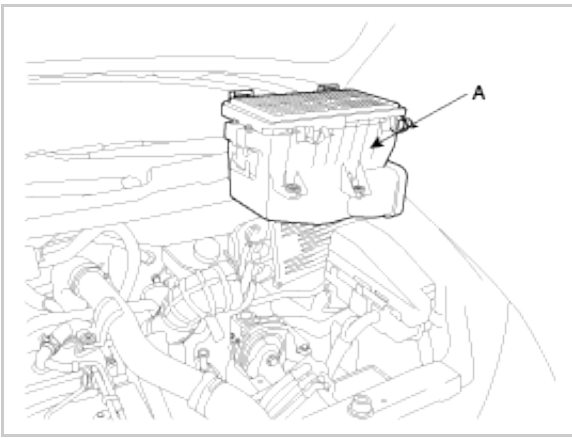


23. Install the intake air hose and air cleaner assembly.

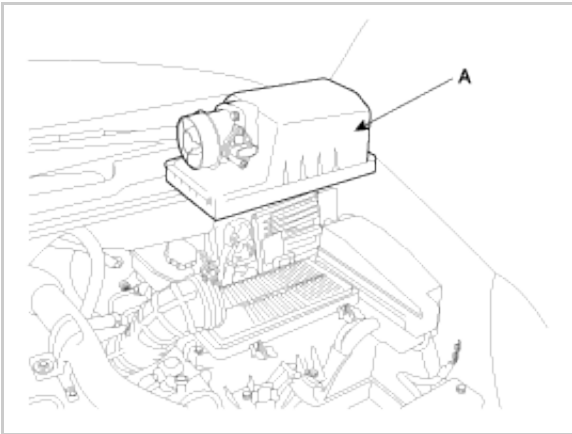
(1) Install the air intake hose(A).



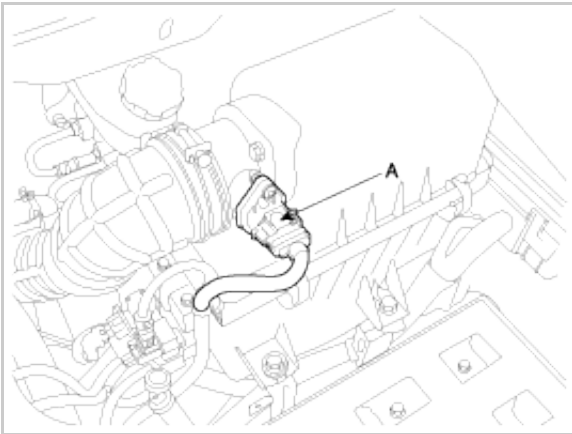
(2) Install the air cleaner assembly(A).



(3) Install the air cleaner upper cover(A).

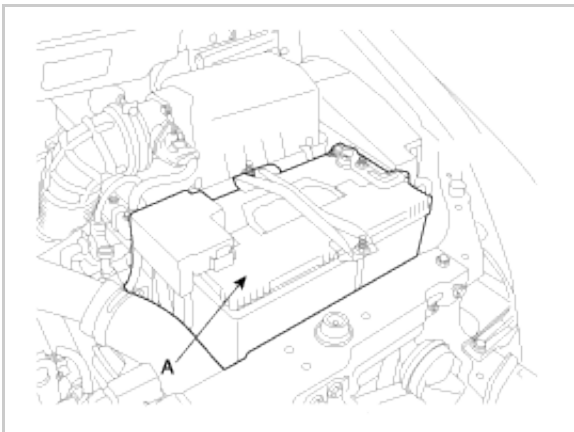


(4) Install the AFS(Air Flow Sensor) connector(A).



24. Fill with engine coolant.

25. Install the battery(A).



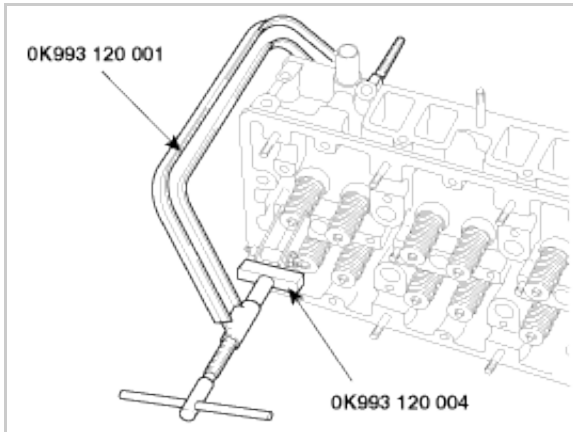
26. Start engine and check for leaks.

27. Check the engine coolant and engine oil level.

## DISASSEMBLY

### 1. Remove the valves.

(1) Using the SST (0K993 120 004, 0K993 120 001), compress the valve spring and remove the retainer lock.



(2) Remove the spring retainer.

(3) Remove the valve spring.

(4) Remove the valve.

(5) Using a needle-nose pliers, remove the oil seal.

(6) Using a magnetic finger, remove the spring seat.

## INSPECTION

### CYLINDER HEAD

#### 1. Inspect for flatness.

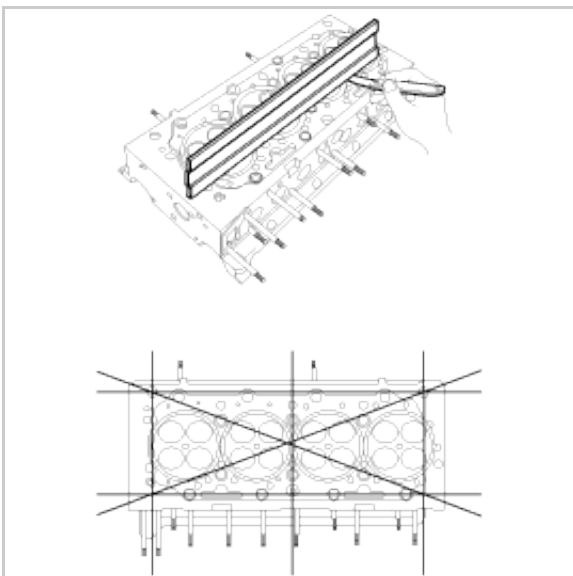
Using a precision straight edge and feeler gauge, measure the surface the contacting the cylinder block and the manifolds for warpage.

Flatness of cylinder head gasket surface

Less than 0.05mm (0.0020in)

Flatness of manifold mating surface

Less than 0.15mm (0.0059in)



#### 2. Inspect for cracks.

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

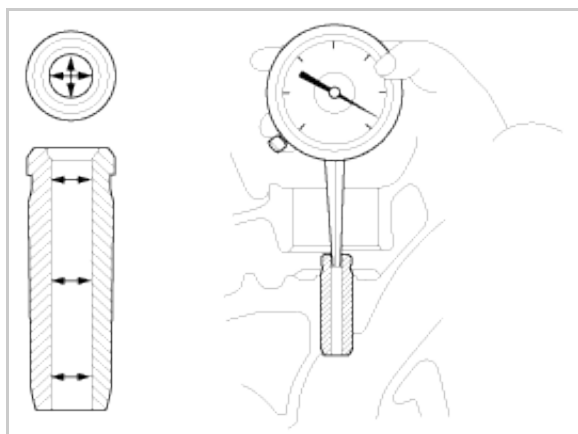
## VALVE AND VALVE SPRING

1. Inspect the valve stems and valve guides.

- (1) Using a caliper gauge, measure the inner diameter of valve guide.

Valve guide inner diameter :

7.010~7.030mm (0.2760~0.2768in)

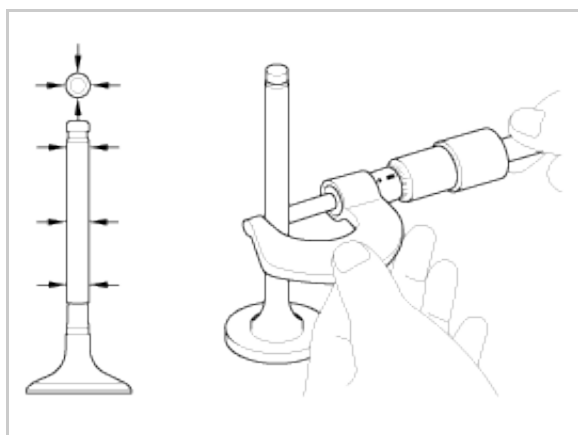


- (2) Using a micrometer, measure the outer diameter of valve stem.

Valve stem outer diameter

Intake : 6.965~6.980mm (0.2742~0.2748in)

Exhaust : 6.945~6.960mm (0.2734~0.2740in)



- (3) Subtract the valve stem outer diameter measurement from the valve guide inner diameter measurement.

Valve stem- to-guide clearance

Intake : 0.030 ~ 0.065mm (0.0012 ~ 0.0026in)

Exhaust : 0.050 ~ 0.085mm (0.0020 ~ 0.0033in)

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

2. Inspect the valves.

- (1) Check the valve is ground to the correct valve face angle.

- (2) Check that the surface of valve for wear.

If the valve face is worn, replace the valve.

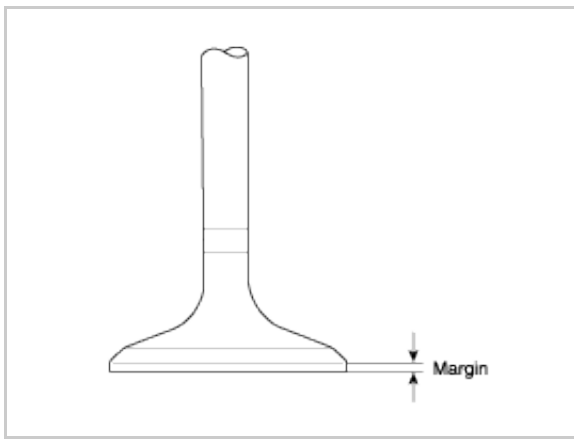
- (3) Check the valve head margin thickness.

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

Margin

Intake : 1.7mm (0.0669in)

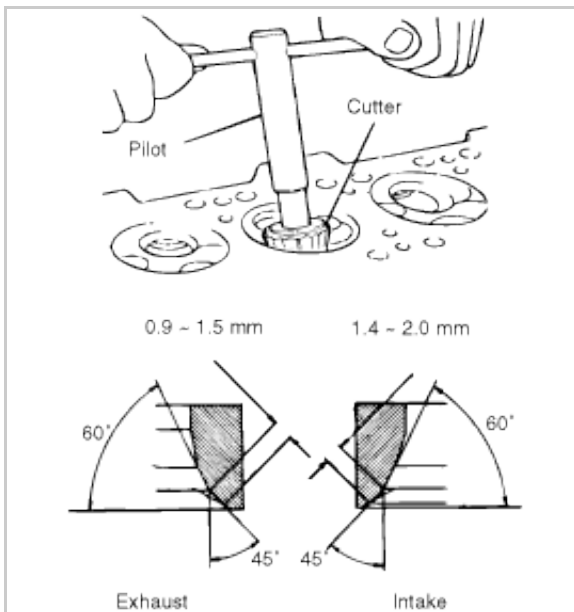
Exhaust : 1.6mm (0.0630in)



- (4) Check the surface of valve stem tip for wear.  
If the valve stem tip is worn, replace the valve.

### 3. Inspect the valve seats.

- (1) Check the valve seat for evidence of overheating and improper contact with the valve face.  
Replace the seat if necessary.
- (2) Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace it, then recondition the seat.
- (3) Recondition the valve seat with a valve seat grinder or cutter. The valve seat contact width should be within



### 4. Inspect the valve springs.

- (1) Using a steel square, measure the out-of-square of valve spring.
- (2) Using a vernier calipers, measure the free length of valve spring.

---

#### Valve spring

Free height : 52.477mm (2.0660in)

Installed load: 51.7±4.1kg/40.0mm(41.4±2.0lb/1.5748in)

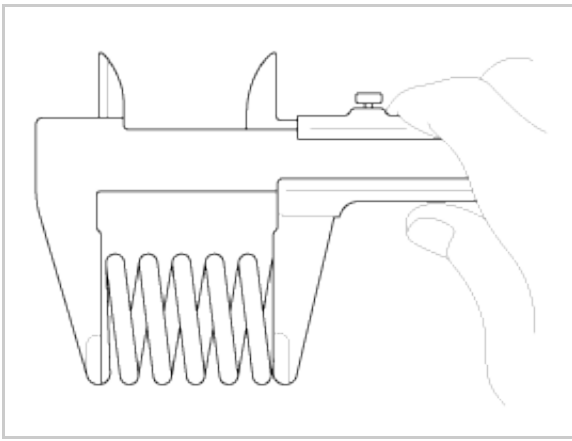
Compressed load:86.3±6.9kg/31.65mm(41.4±2.0lb/1.2461in) (Intake)

86.9±6.9kg/31.50mm(41.4±2.0lb/1.2402in) (Exhaust)

Out of square : Less than 2°

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If the loads is not as specified, replace the valve spring.

## CAMSHAFT

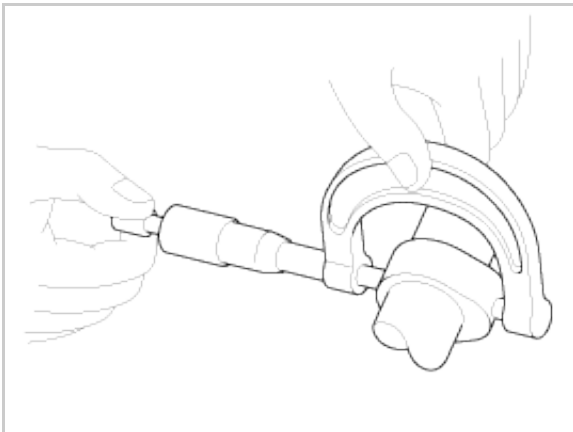
1. Inspect the cam lobes.

Using a micrometer, measure the cam lobe height.

Cam height

Intake : 39.397~39.597mm (1.5511~1.5589in)

Exhaust : 39.4932~39.6932mm (1.5548~1.5627in)



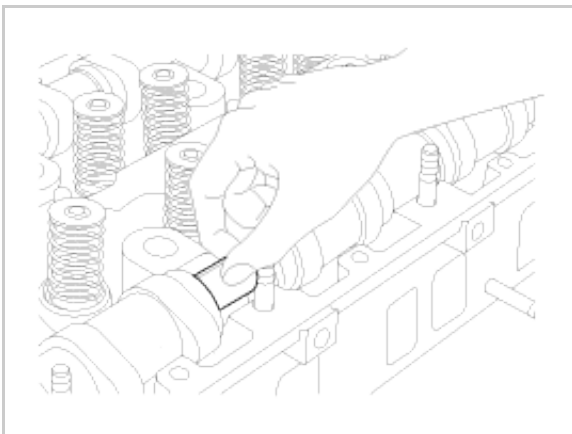
If the cam lobe height is less than minimum, replace the camshaft.

2. Inspect the 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.



- (4) Install the bearing caps and tighten the bolts with specified torque.

### CAUTION

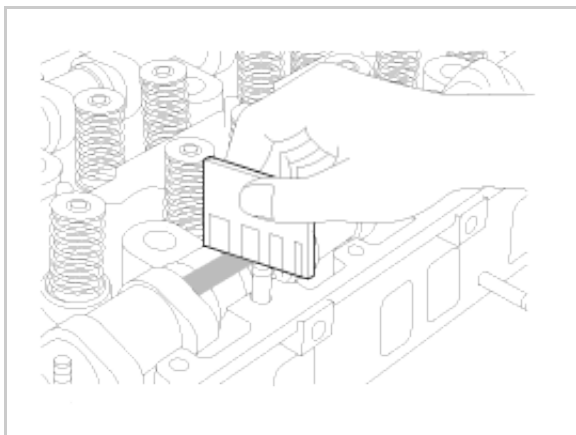
Do not turn the camshaft.

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

Bearing oil clearance

Standard : 0.040 ~ 0.080mm (0.0016 ~ 0.0031in)

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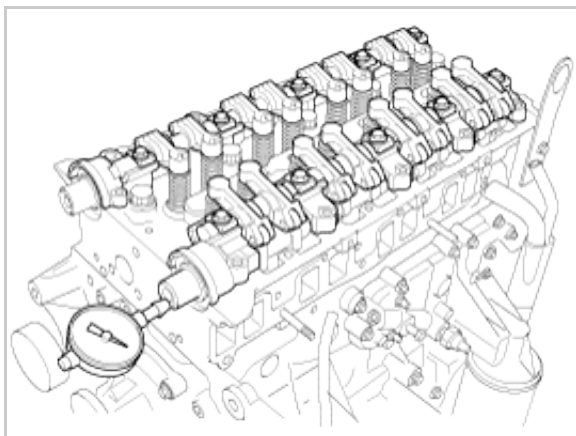
If the oil clearance is greater than maximum, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

- (7) Completely remove the plastigage.
  - (8) Remove the camshafts.
3. Inspect the 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 : 0.08 ~ 0.17mm (0.0031 ~ 0.0067in)

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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.

## **Rockerarm and rockerarm shaft**

1. Inspect the rockerarm and rockerarm shaft.
    - (1) Measure the inner diameter of the rocker arm, using a caliper gauge.
- 

Rockerarm inner diameter

20.000~20.027mm (0.7874~0.7885in)

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- (2) Measure the inner diameter of the rocker arm, using a micro meter.
-

Rockerarm shaft outer diameter  
19.959~19.980mm (0.7858~0.7866in)

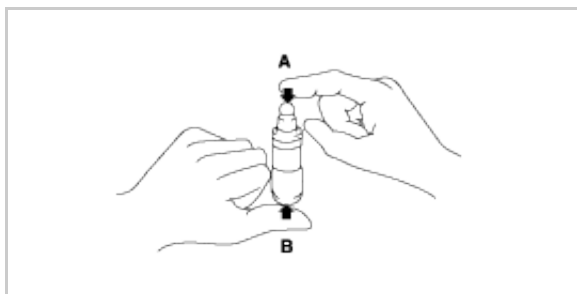
Calculate the clearance between the rocker arm and the rocker arm shaft by the difference between the inner and outer diameter of the rocker arm.

Rockerarm and rockerarm shaft clearance  
0.020~0.068mm (0.0008~0.0027in)

If the clearance is out of the specification above, replace the rocker arm and rocker arm shaft.

## HLA (HYDRAULIC LASH ADJUSTER)

Sieze the 'A' part of the HLA filled with engine oil. If it is moved when pushed the 'B' part by hand, replace it.



Problem	Possible cause	Action
Temporary noise when starting a cold engine	Normal	This noise will disappear after the oil in the engine reaches the normal pressure.
Continuous noise when the engine is started after parking more than 48 hours.	Oil leakage of the high pressure chamber on the HLA, allowing air to get in.	Noise will disappear within 15 minutes when engine runs at 2,000~3,000 rpm. If it doesn't disappear, refer to step 7 below.
Continuous noise when the engine is first started after rebuilding cylinder head.	Insufficient oil in cylinder head oil gallery.	<div><b>CAUTION</b></div> <div>Do not run engine at a speed higher than 3,000 rpm, as this may damage the HLA.</div>
Continuous noise when the engine is started after excessively cranking the engine by the starter motor.	Oil leakage of the high-pressure chamber in the HLA, allowing air to get in. Insufficient oil in the HLA.	
Continuous noise when the engine is running after changing the HLA.		
Continuous noise during idle after high engine speed.	Engine oil level too high or too low.	Check oil level. Drain or add oil as necessary.
	Excessive amount of air in the oil at high engine speed.	Check oil supply system
Noise continues for more than 15 minutes.	Deteriorated oil.	Check oil quality. If deteriorated, replace with specified type.
	Low oil pressure	Check oil pressure and oil supply system of each part of engine.
	Faulty HLA.	Remove the cylinder head cover and press HLA down by hand. If it moves, replace the HLA.

**CAUTION**

Be careful with the hot HLAs.

## REASSEMBLY

**NOTICE**

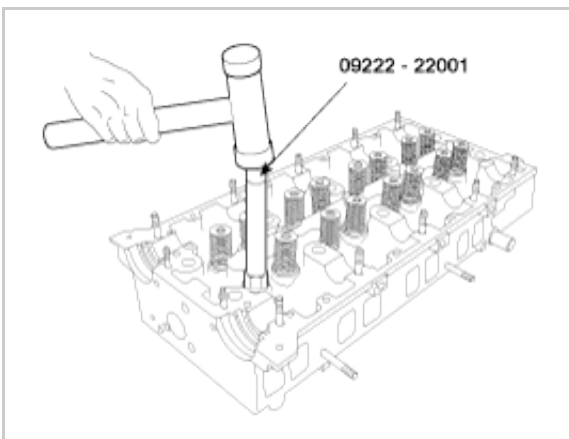
- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surface.
- Replace oil seals with new ones.

1. Install the valves.

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

**NOTICE**

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

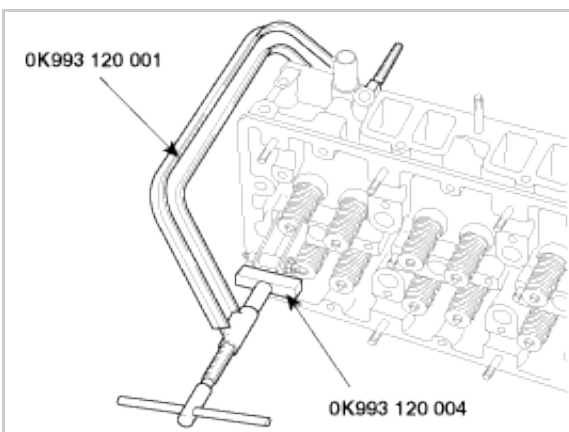


- Install the valve, valve spring and spring retainer.

**NOTICE**

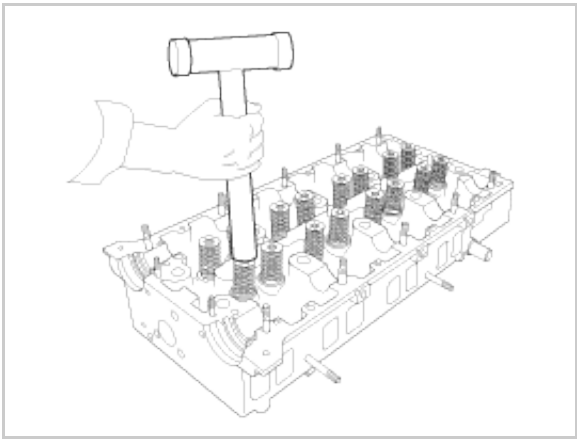
Place the valve springs so that the side coated with enamel faces toward the valve spring retainer and then installs the retainer.

- Using the SST (0K993 120 004, 0K993 120 001), 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.



- 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.



# **Engine And Transaxle Assembly**



## REMOVAL

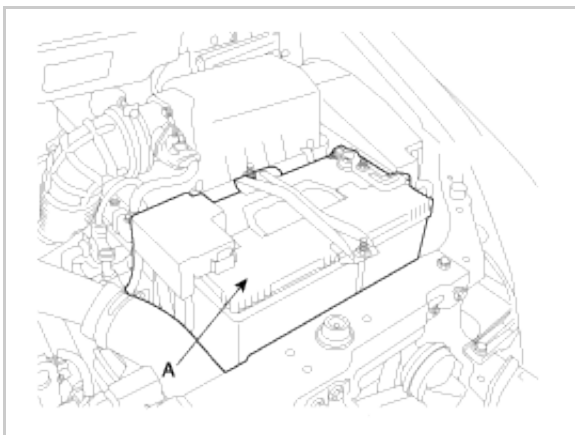
### CAUTION

- a. Use fender covers to avoid damaging painted surfaces.
- b. To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

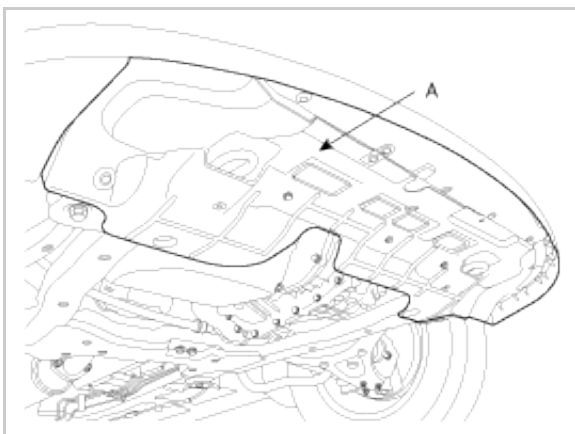
### NOTICE

- a. Mark all wiring and hoses to avoid misconnection.

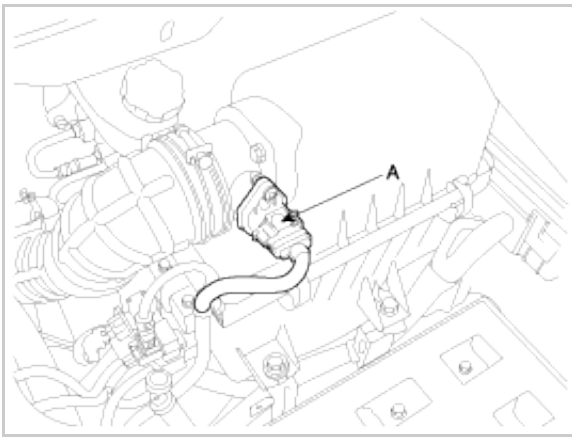
1. Remove the battery(A).



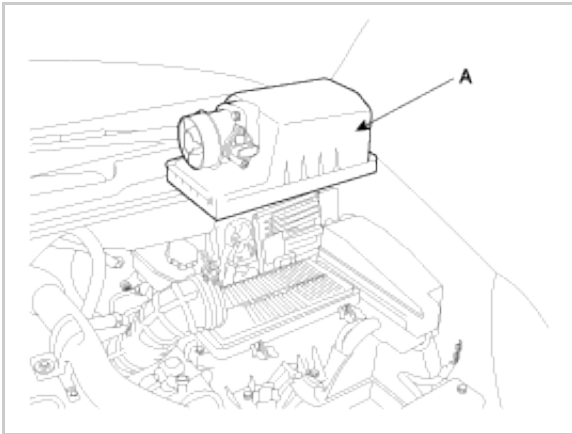
2. Remove the under cover(A).



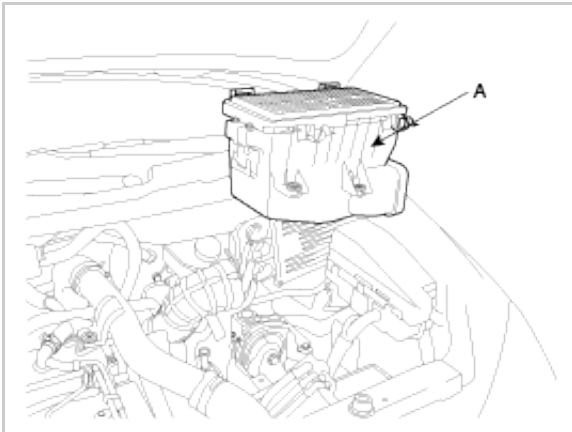
3. Drain the engine coolant.  
Remove the radiator cap to speed draining.
4. Drain the engine oil.  
Remove the oil filler cap to speed draining.
5. Remove the intake air hose and air cleaner assembly.  
(1) Disconnect the AFS(Air Flow Sensor) connector(A).



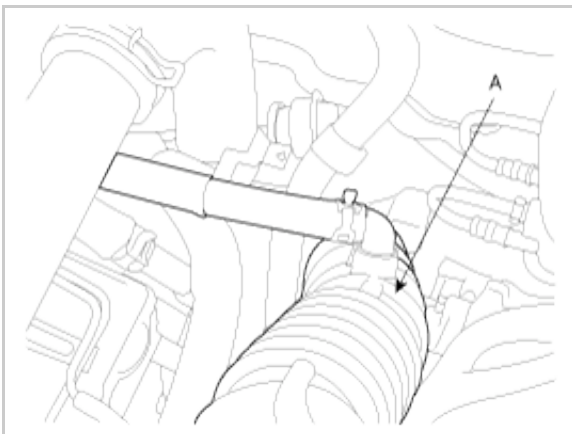
(2) Disconnect the air cleaner upper cover(A).



(3) Remove the air cleaner assembly(A).

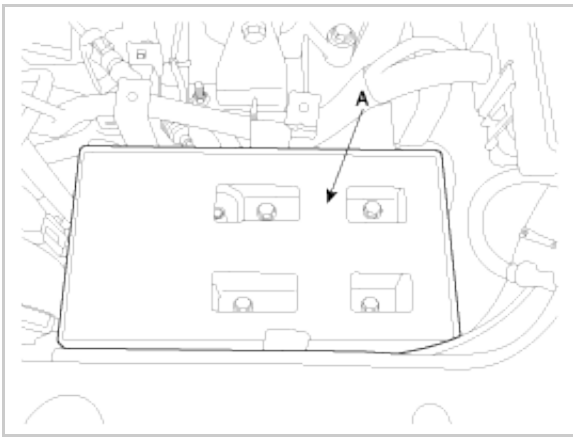


(4) Remove the air intake hose(A).

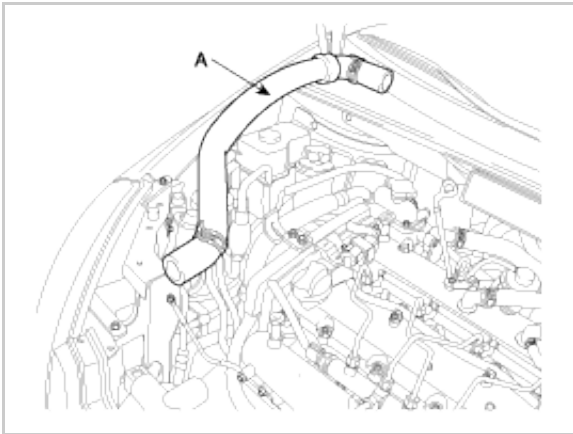


6. Remove the batter tray(A).

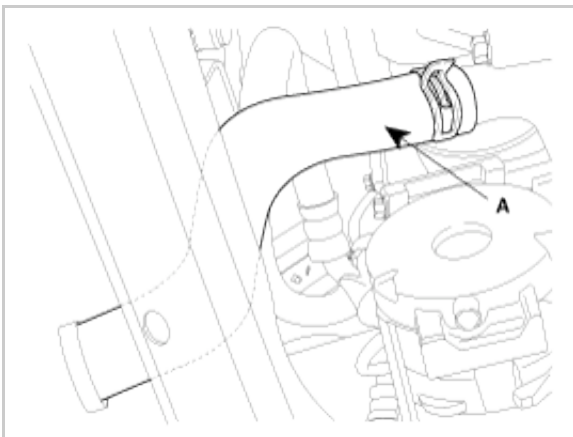




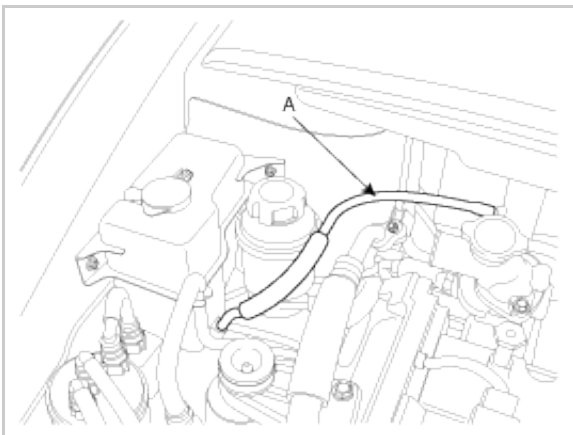
7. Remove the radiator upper hose(A).



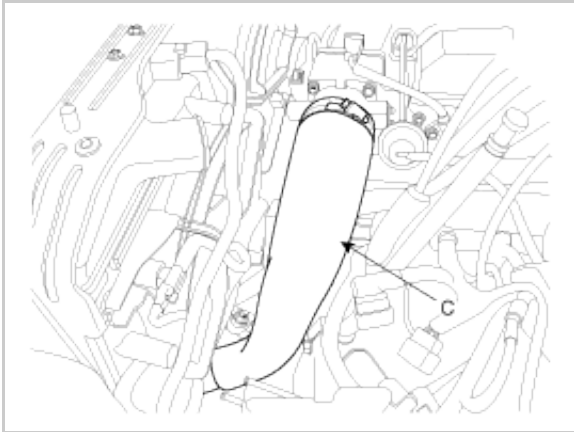
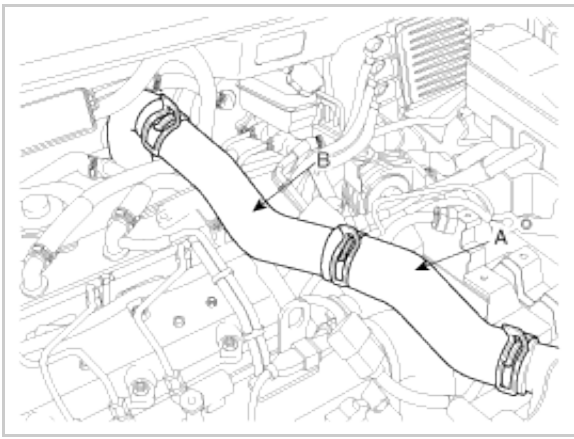
8. Remove the radiator lower hose(A).



9. Remove the reservoir tank hose(A).

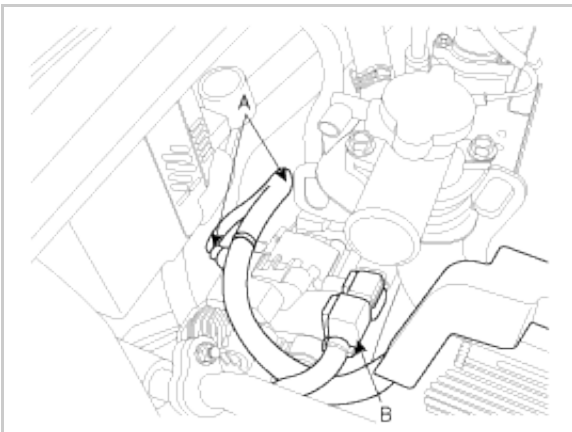


10. Remove the intercooler hose(A,C), pipe(B).

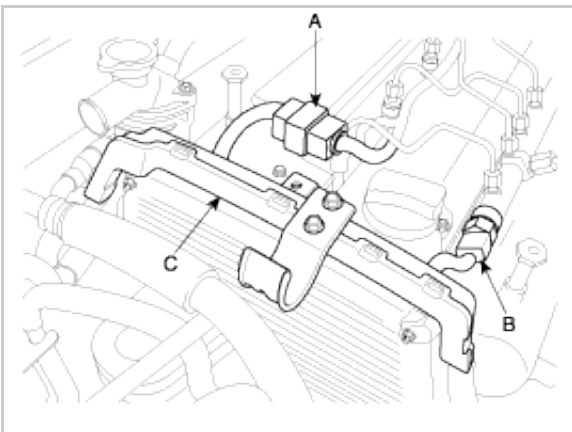


11. Remove the wire harness and the clamp from the cylinder head and the intake manifold.

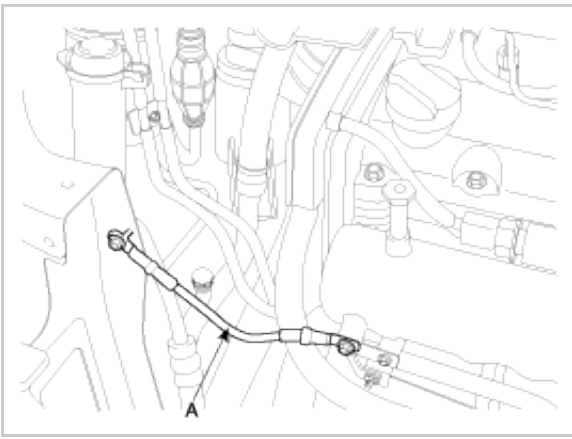
(1) Remove the generator connector(A) and the ETC(Engine Coolant Temperature) sensor connector(B).



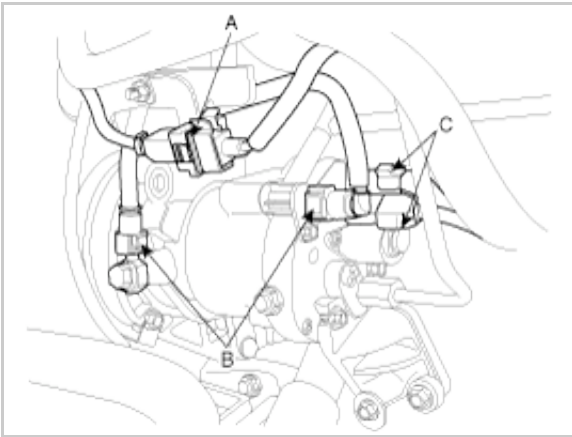
(2) Remove the injector connector(A), common rail pressure sensor connector(B), wire harness protector(C).



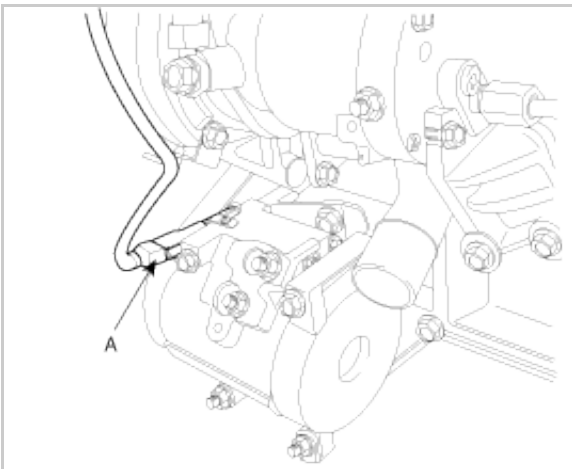
(3) Remove the ground cable(A) from cylinder head.



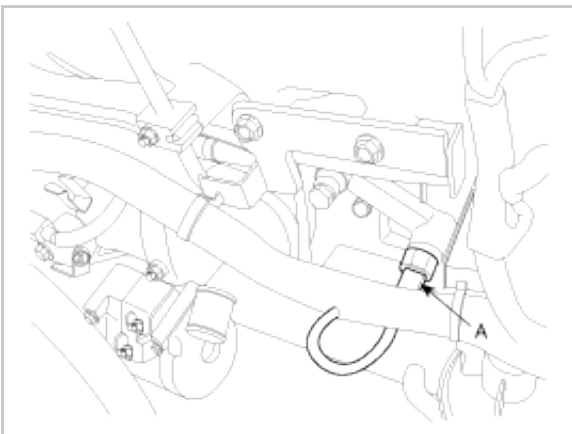
(4) Remove the knock sensor connector(A), high pressure pump fuel hose(B), high pressure pump connector(C).



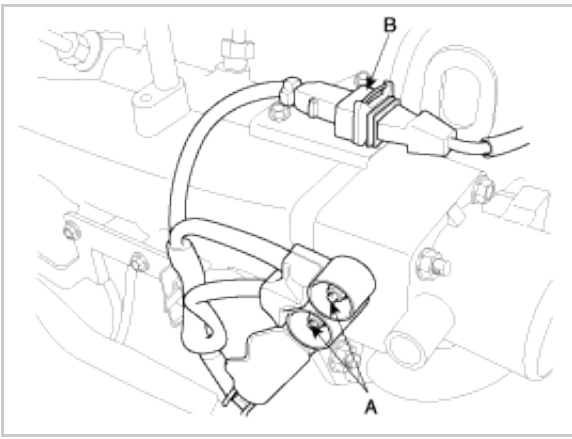
(5) Remove the air conditioner condenser(A).



(6) Remove the oil pressure switch connector(A).

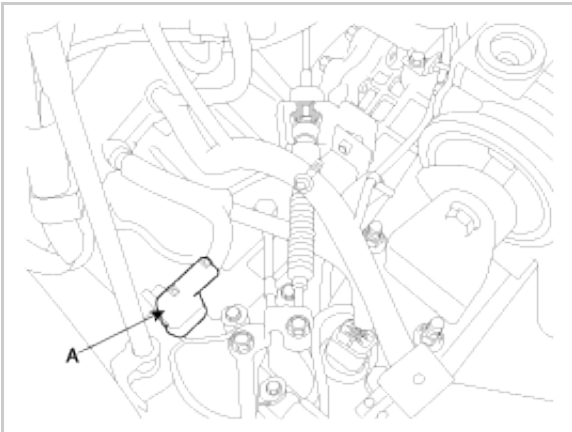


(7) Remove the air heater(A), CMP (Camshaft Position Sensor) connector(B).

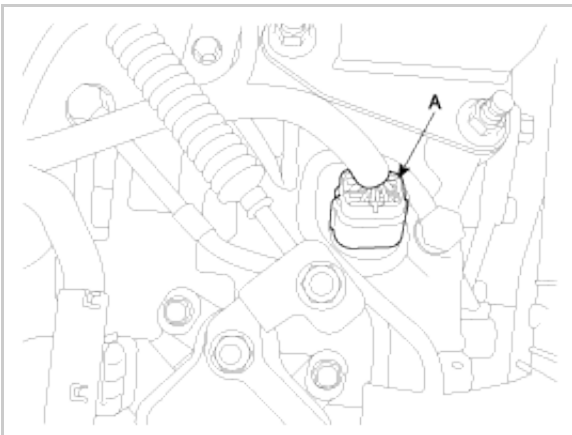


12. Remove the transaxle wire harness connectors and control cable.

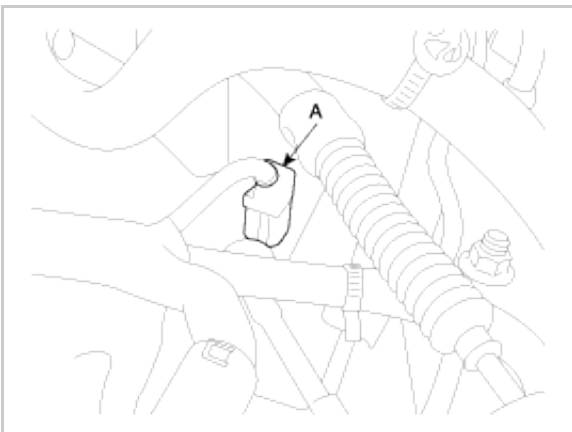
(1) Remove the inhibitor switch connector(A).



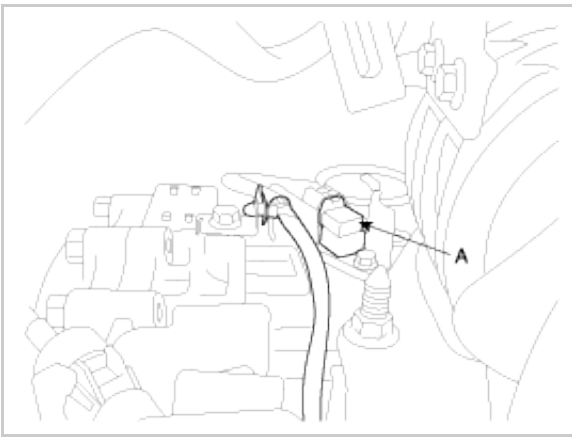
(2) Remove the solenoid valve connector(A).



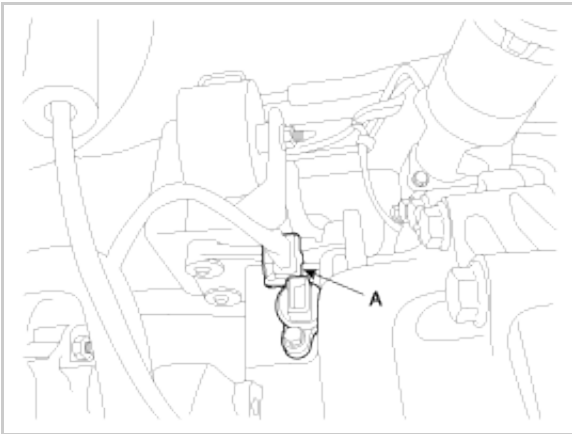
(3) Remove the input shaft speed sensor connector(A).



(4) Remove the output shaft speed sensor connector(A).



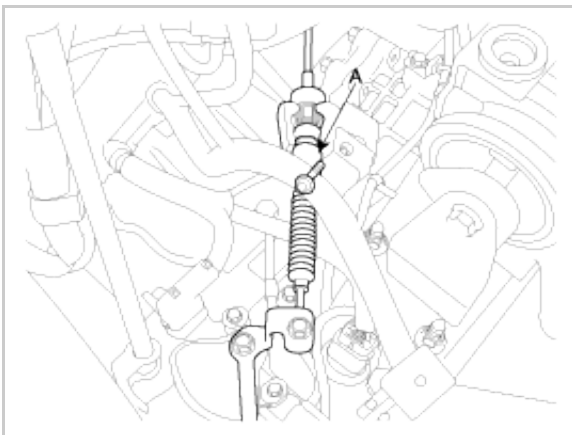
(5) Remove the vehicle speed sensor connector(A).



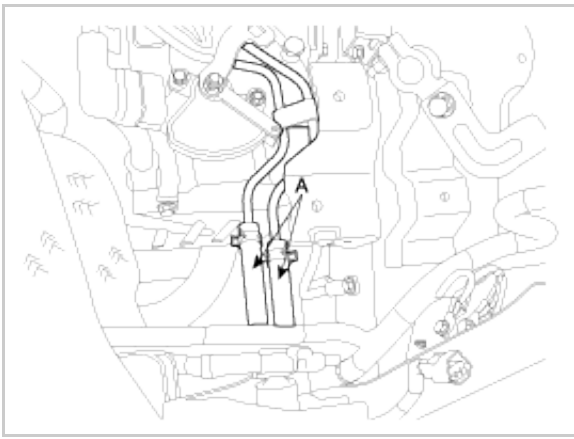
(6) Remove the CKP(Crankshaft position sensor) connector(A).



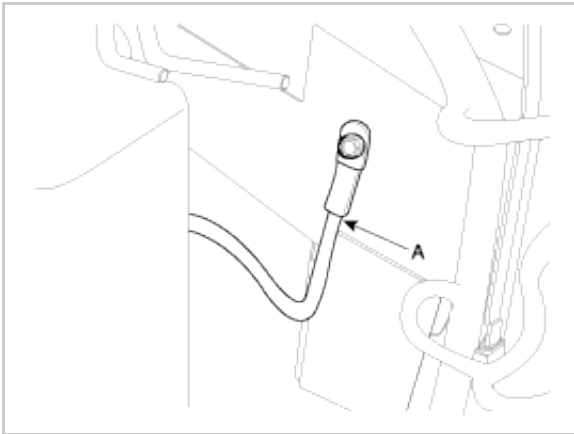
13. Remove the shift cable(A).



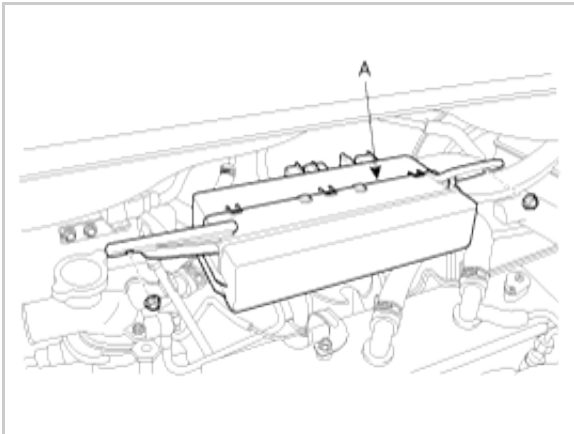
14. Remove the transaxle oil cooler hoses(A).



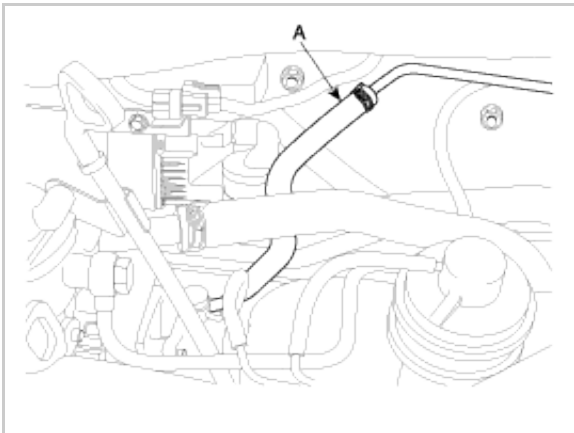
15. Remove the ground cable(A) from transaxle.



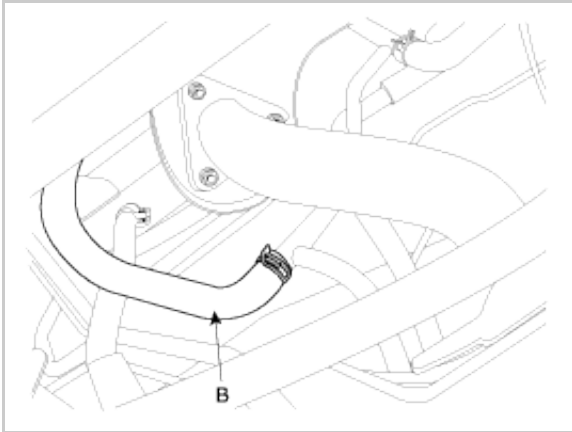
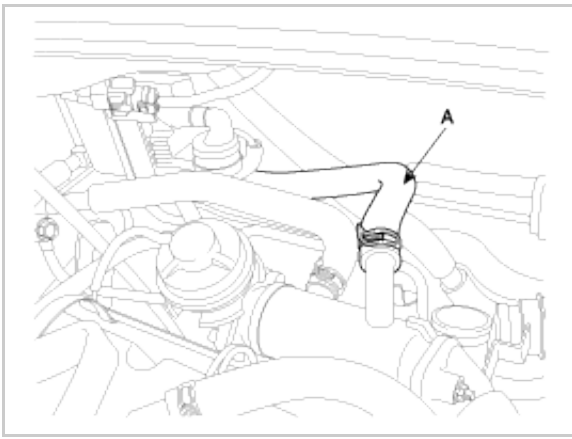
16. Remove the fuse box.(A).



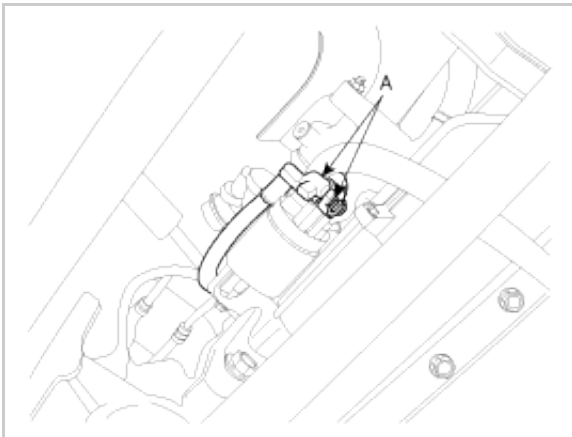
17. Remove the vacuum hose (A) from the generator.



18. Remove the heater hose(A,B).



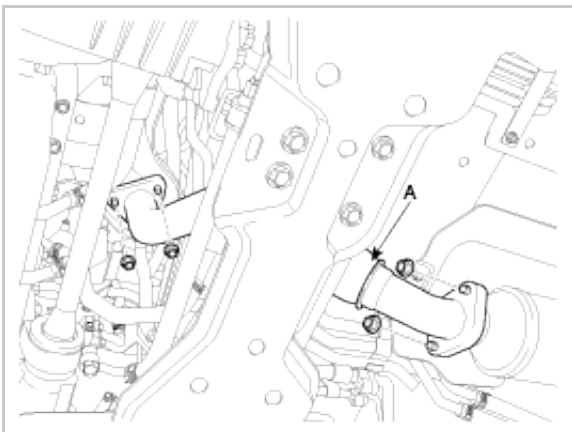
19. Remove the starter motor connector(A).



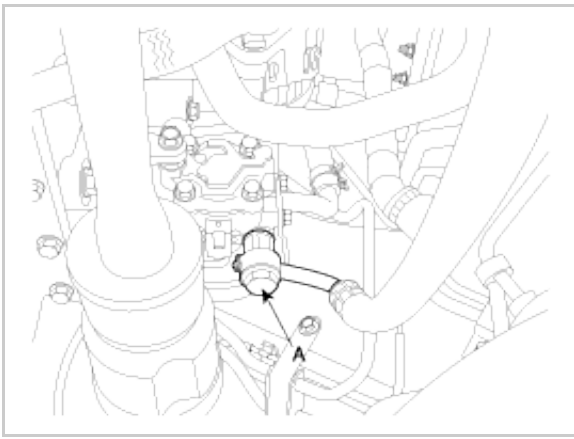
20. Remove the front exhaust manifold(A).

Tightening torque :

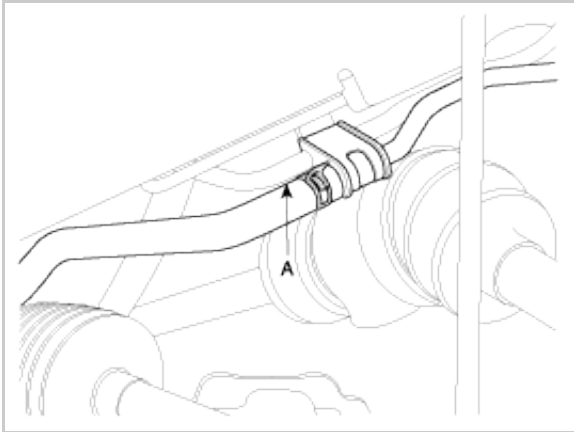
39.2~58.8Nm (4.0~6.0kgf.m, 28.9~43.4lb-ft)



21. Remove the power steering pump bolt(A).



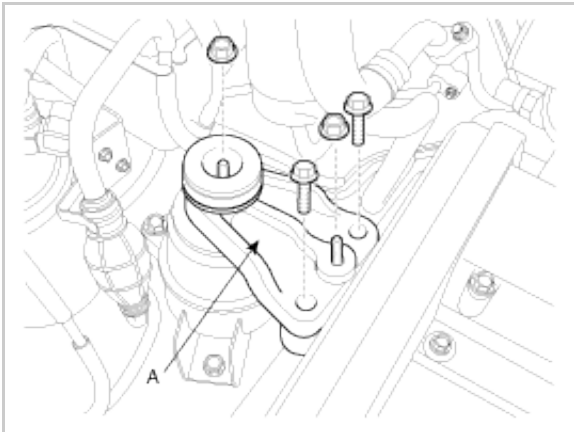
22. Remove the power steering return hose(A).



23. Remove the engine mounting support bracket(A).

Tightening torque :

88.3~107.9N.m (9.0~11.0kgf.m, 65.1~79.6lb-ft)

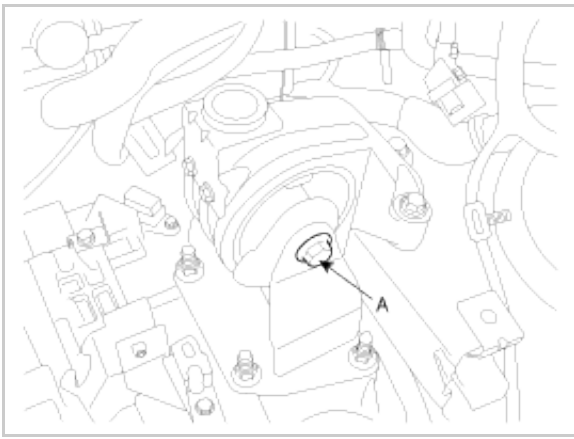


24. Remove the transaxle insulator mounting bolt(A).

Tightening torque :

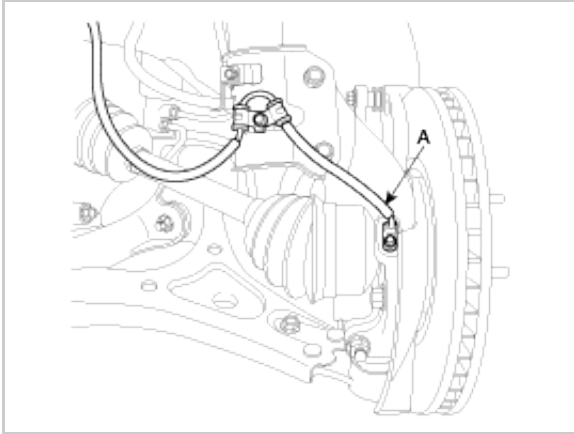
88.3~107.9N.m (9.0~11.0kgf.m, 65.1~79.6lb-ft)





25. Remove the front tires.(Refer to DS group).

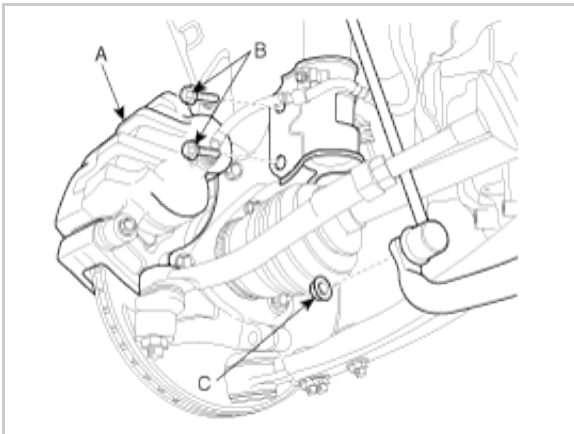
26. Remove the ABS wheel speed sensors(A).(Refer to BR group).



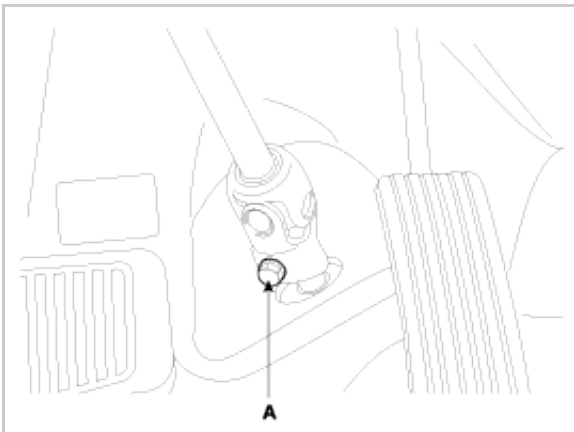
27. Remove the caliper and hang the caliper assembly(A).(Refer to BR group).

28. Remove the knuckle mounting bolts(B).(Refer to SS group).

29. Remove the stabilizer link fixing nut(A).(Refer to SS group).



30. Remove the steering u-joint mounting bolt(A).



31. Install the jack for supporting engine and transaxle assembly.

#### NOTICE

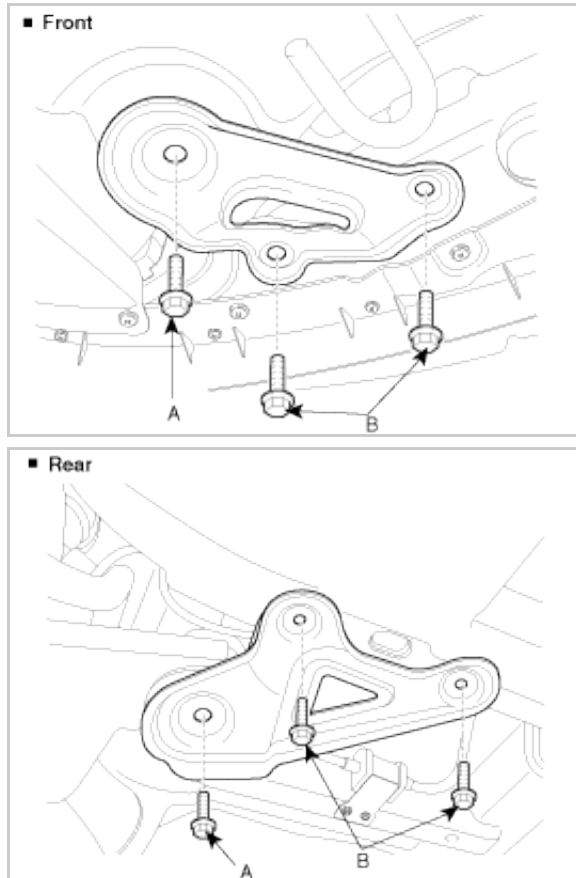
Support the assembly safely because the engine and transaxle assembly can be dropped down after removal of the sub frame.

32. Remove the sub frame mounting bolts(A).

Tightening torque :

Bolt(A): 156.9~ 176.5Nm (16.0~18.0kgf.m, 115.7~ 130.2lb-ft)

Bolts(B) :44.1~58.8Nm (4.5~6.0kgf.m, 32.5~43.4lb-ft)



33. Remove the engine and transaxle assembly by lifting vehicle.

#### NOTICE

When remove the engine and transaxle assembly, be careful not to damage any surrounding parts or body components.

## INSTALLATION

Installation is in the reverse order of removal.

Perform the following :

- Adjust the shift cable.
  - Adjust the throttle cable.
  - Refill the engine with engine oil.
  - Refill the transaxle with fluid.
  - Refill the radiator and reservoir tank with engine coolant.
  - Place the heater control knob on "HOT" position.
  - Bleed air from the cooling system.
- Start engine and let it run until it warms up. (until the radiator fan operates 3 or 4 times.)
  - Turn Off the engine. Check the level in the radiator, add coolant if needed. This will allow trapped air to be

removed from the cooling system.

c. Put the radiator cap on tightly, then run the engine again and check for leaks.

h. Clean the battery posts and cable terminals with sandpaper assemble them, then apply grease to prevent corrosion.

i. Inspect for fuel leakage.

a. After assemble the fuel line, turn on the ignition switch (do not operate the starter) so that the fuel pump runs for approximately two seconds and fuel line pressurizes.

b. Repeat this operation two or three times, then check for fuel leakage at any point in the fuel line.

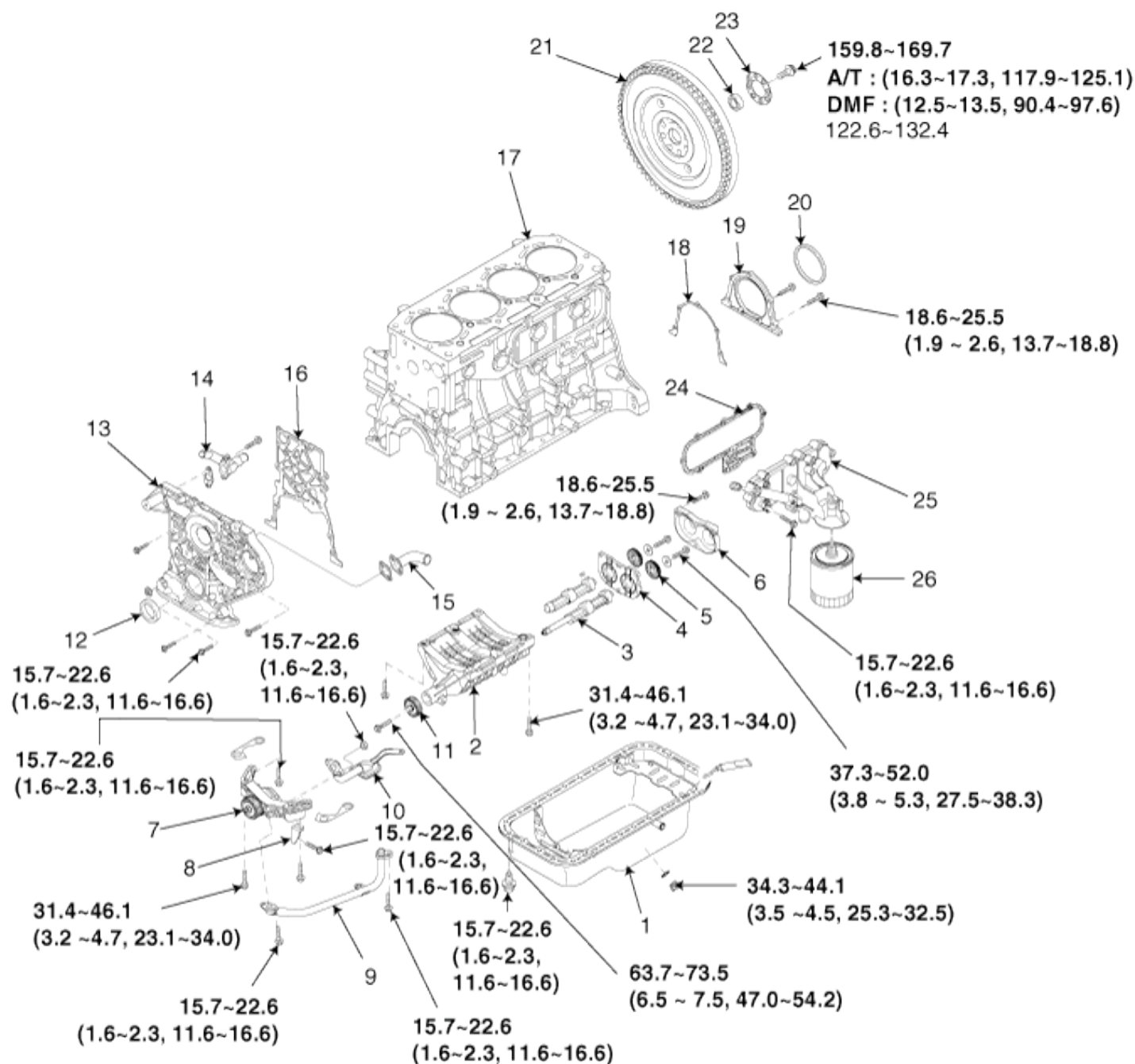
**Cylinder Block**

.

**D]ghc b`UbX`**

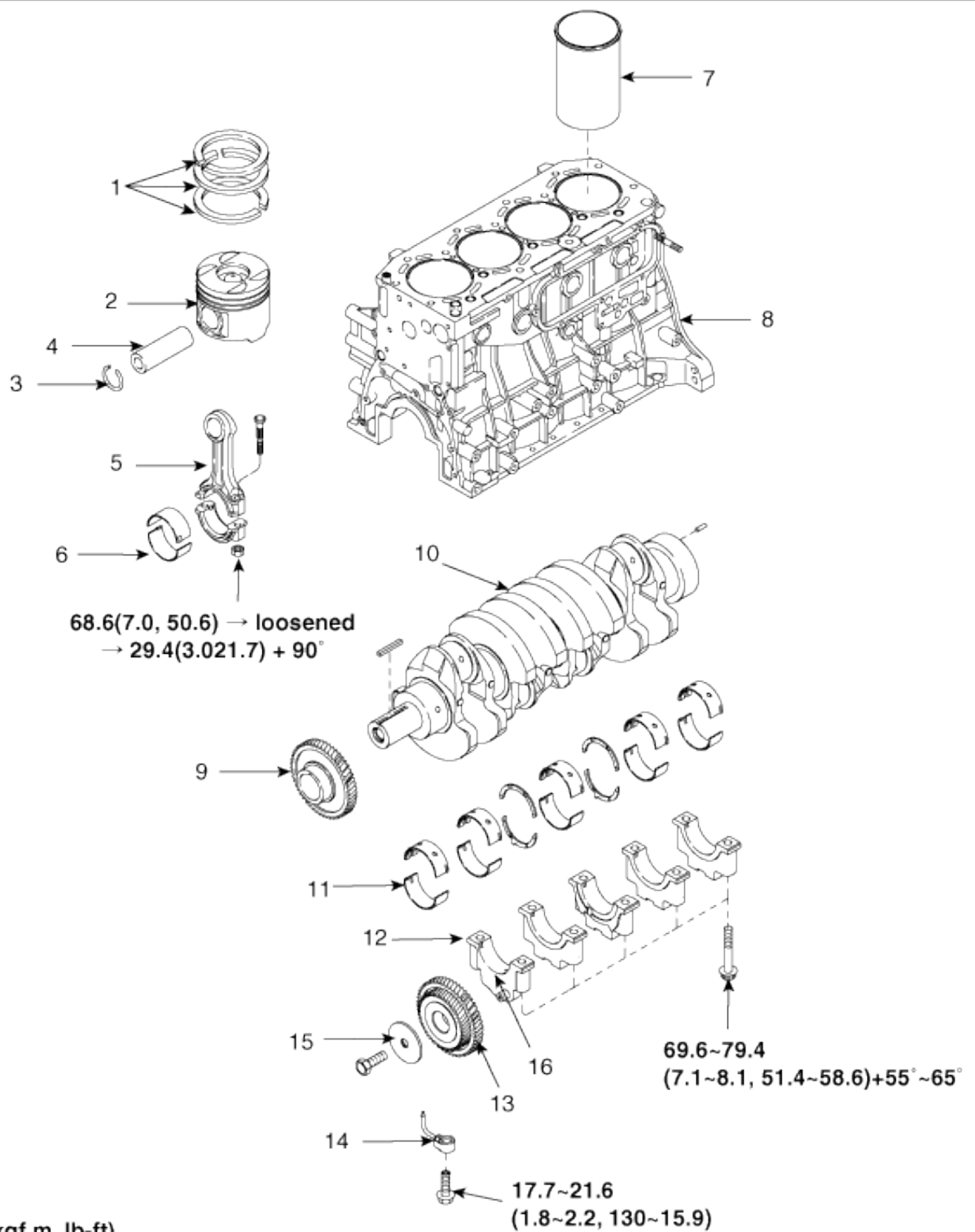
**7 cbbYW]b[ `F cX**

## COMPONENTS



**TORQUE : N.m(kgf.m, lb-ft)**

- |                            |                               |                                |
|----------------------------|-------------------------------|--------------------------------|
| 1. Oil pan                 | 10. Oil screen                | 19. Rear oil seal case         |
| 2. Ladder frame            | 11. Idle gear                 | 20. Rear oil seal              |
| 3. Balance shaft           | 12. Crankshaft front oil seal | 21. Flywheel                   |
| 4. Thrust plate            | 13. Timing belt case          | 22. Bearing                    |
| 5. Balance gear            | 14. Coolant bypass pipe       | 23. Washer                     |
| 6. Gear cover              | 15. Coolant inlet pipe        | 24. Oil cooler assembly gasket |
| 7. Oil pump assembly       | 16. Timing belt case gasket   | 25. Oil cooler assembly        |
| 8. Ladder frame bracket    | 17. Cylinder block            | 26. Oil filter                 |
| 9. Oil pump supplying pipe | 18. Rear oil seal case gasket |                                |

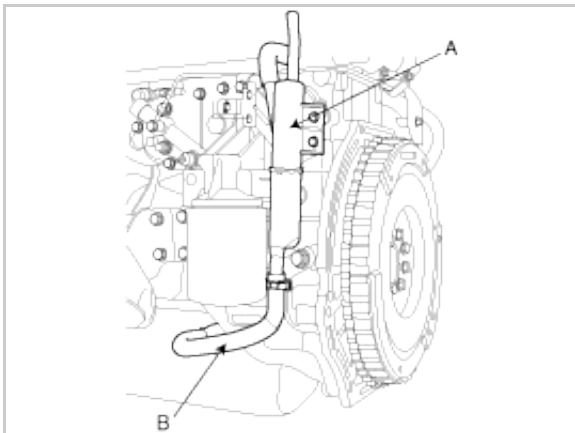


**TORQUE : N.m(kgf.m, lb-ft)**

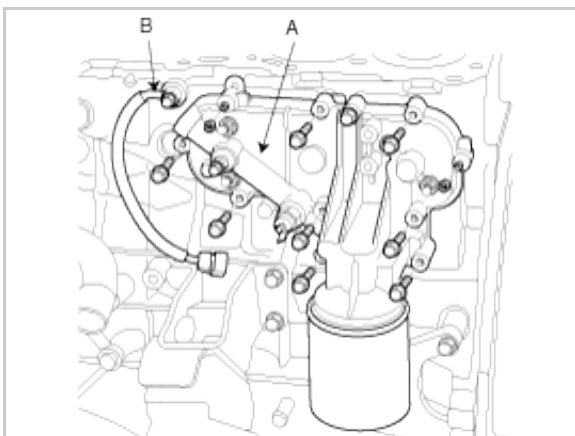
- |                           |                             |
|---------------------------|-----------------------------|
| 1. Piston ring            | 9. Crankshaft gear          |
| 2. Piston                 | 10. Crankshaft              |
| 3. Snap ring              | 11. Crankshaft main bearing |
| 4. Piston pin             | 12. Main bearing cap        |
| 5. Connecting rod         | 13. Idle gear               |
| 6. Connecting rod bearing | 14. Oil jet                 |
| 7. Cylinder liner         | 15. Idle gear washer        |
| 8. Cylinder block         | 16. Idle gear spindle       |

## DISASSEMBLY

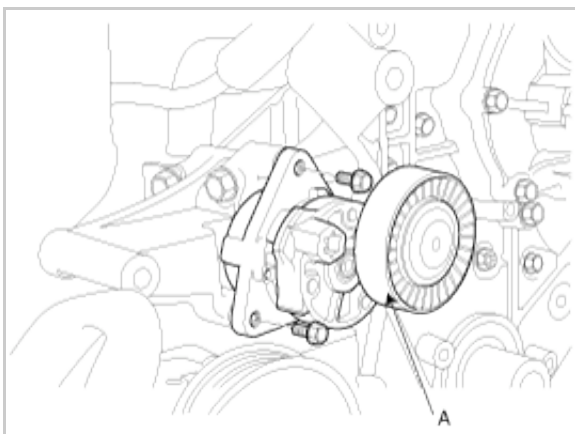
1. Install the engine to engine stand for disassembly.
2. Remove the timing belt.
3. Remove the cylinder head.
4. Remove the water pump.
5. Remove the air separator(A), hose(B).



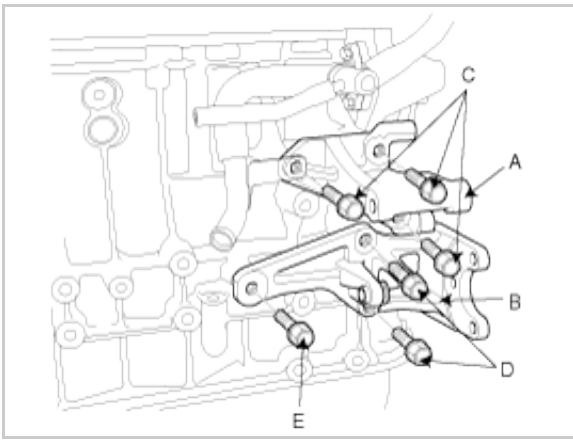
6. Remove the oil cooler assembly(A), knock sensor(B).



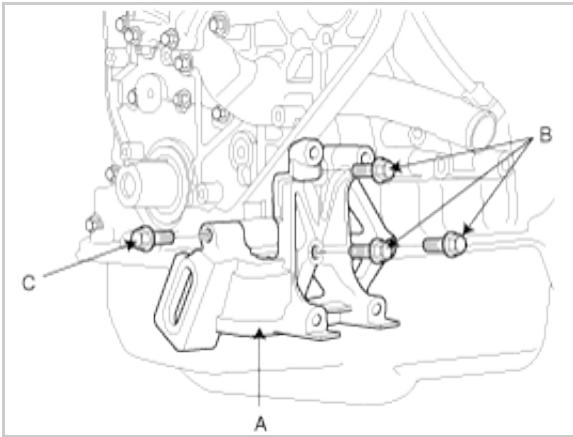
7. Remove the drive belt auto-tensioner (A).



8. Remove the generator mounting bracket(A), power steering pump bracket(B).



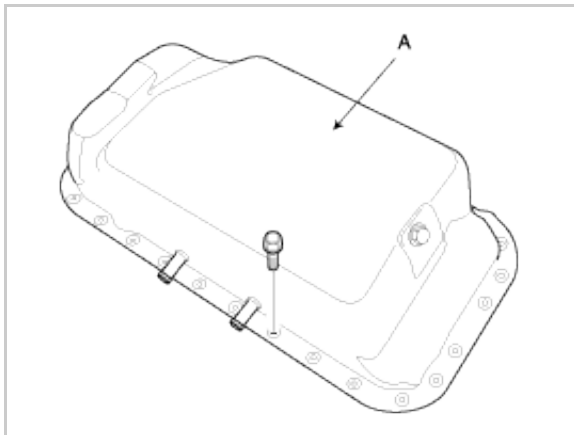
9. Remove the A/C compressor bracket(A).



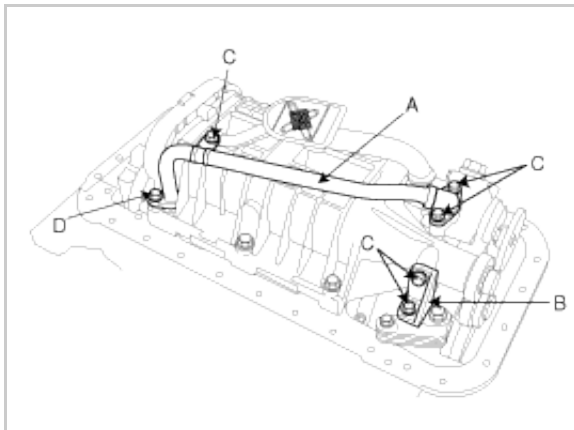
10. M/T : remove flywheel.

11. A/T : remove drive plate and mass wheel.

12. Using the SST(09215 - 3C000) remove the oil pan(A).

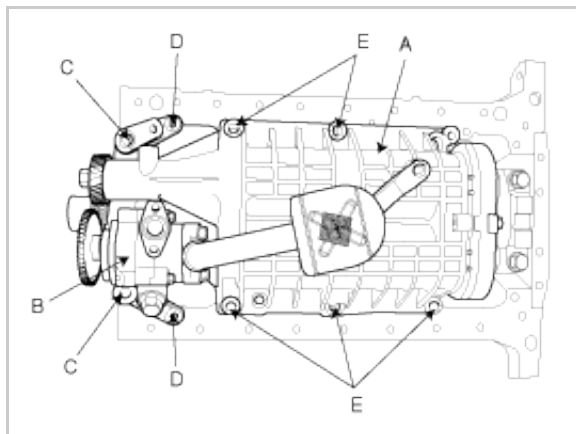


13. Remove the oil pump feed pipe(A) and the ladder frame bracket(B).

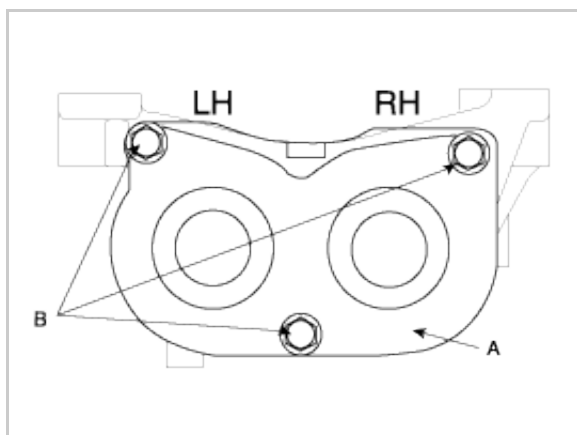


14. Remove the ladder frame(A) and the oil pump assembly(B).





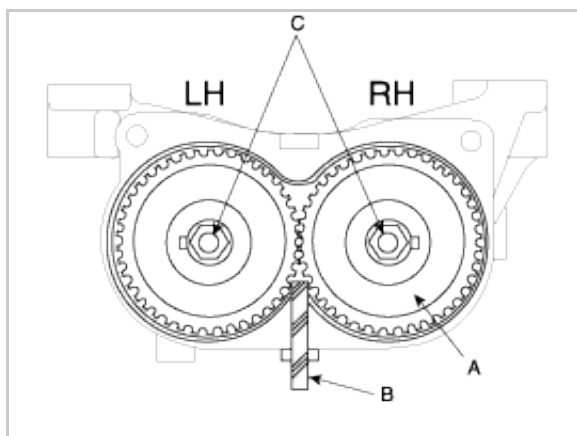
15. Remove the balancer shaft(A) to the ladder frame.  
 (1) Remove the gear cover(A) to the ladder frame.



- (2) Remove the balancer sprocket and the balancer gear by loosening the bolts(B).

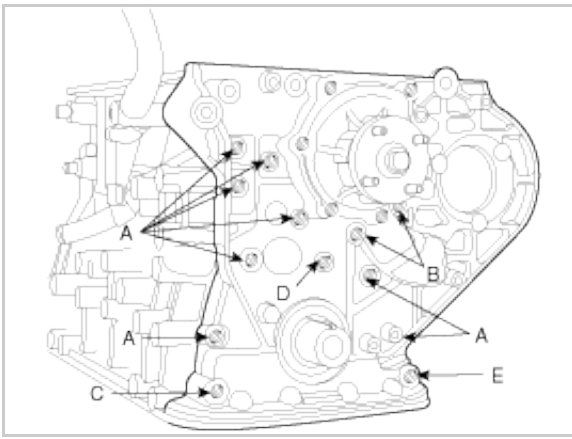
#### NOTICE

Not to make the balance shaft be rotated, insert the 5mm-thickness urethane rubber (B) in the balance gear (A) for protection.



- (3) Remove the thrust plate and the balance shaft.

16. Remove the timing belt case(A).



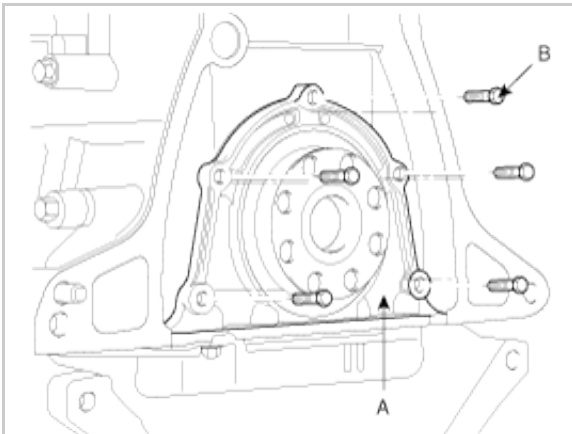
17. Check the connecting rod end play.
18. Remove the connecting rod caps and check oil clearance.
19. Remove the piston and connecting rod assemblies.
  - (1) Using a ridge reamer, remove all the carbon from the top of the cylinder.
  - (2) Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

#### NOTICE

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

20. Remove the rear oil seal case.
 

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



21. Remove the crankshaft bearing cap and check oil clearance.
22. Check the crankshaft end play.
23. Lift the crankshaft(A) out of the engine, being careful not to damage journals.

#### NOTICE

Arrange the main bearings and thrust bearings in the correct order.

24. Check fit between piston and piston pin.
25. Remove the piston rings.
  - (1) Using a piston ring expander, remove the 2 compression rings.
  - (2) Remove the 2 side rails and oil ring by hand.

#### NOTICE

Arrange the piston rings in the correct order only.

26. Remove the connecting rod from the piston.  
Using a press, remove the piston pin from piston.

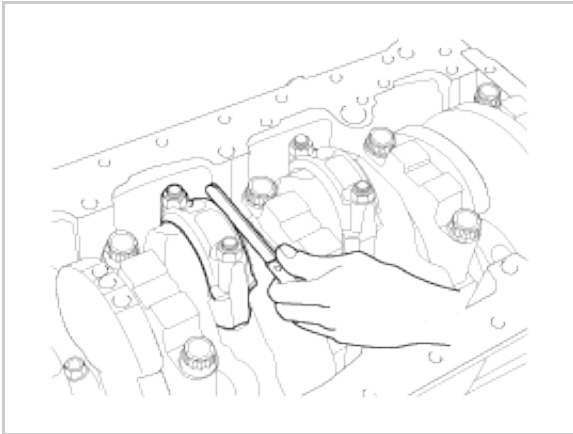
## INSPECTION

### CONNECTING ROD AND CRANKSHAFT

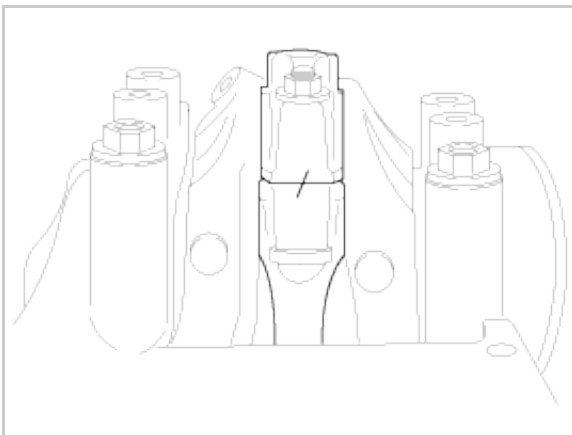
1. Check the connecting rod end play.  
Using feeler gauge, measure the end play while moving the connecting rod back and forth.

End play

0.239 ~ 0.39mm (0.0094 ~ 0.0154in)



- 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 match marks 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 lower bearing.
- (4) Clean the crankshaft pin journal and bearing.
- (5) Place a plastigage across the crankshaft pin journal.
- (6) Reinstall the lower bearing and cap, and tighten the nuts.

Tightening torque :

68.6Nm (7.0 kgf.m, 50.6lb-ft) → Unfasten bolts→29.4Nm (3.0kgf.m, 21.7lb-ft) + 90°

#### NOTICE

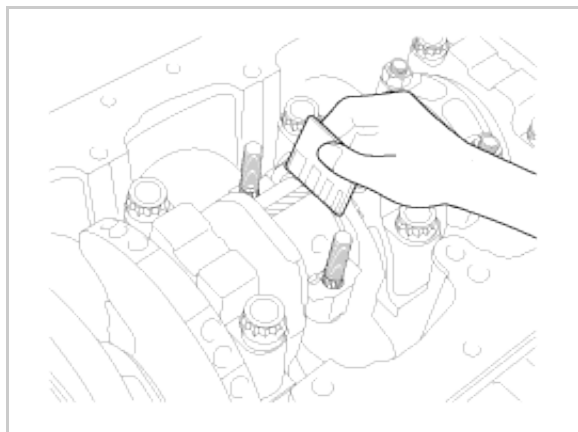
Do not turn the crankshaft.

- (7) Remove the 2nuts, connecting rod cap and lower bearing .

(8) Measure the plastigage at its widest point.

Standard oil clearance

0.043 ~ 0.077mm (0.0017 ~ 0.0030in)



(9) If the plastigage measures too wide or too narrow, remove the upper and lower bearing and then install a new bearings with the same color mark. (Refer to connecting rod bearing selection table)  
Recheck the oil 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. ( Refer to connecting rod bearing selection table))  
Recheck the oil clearance.

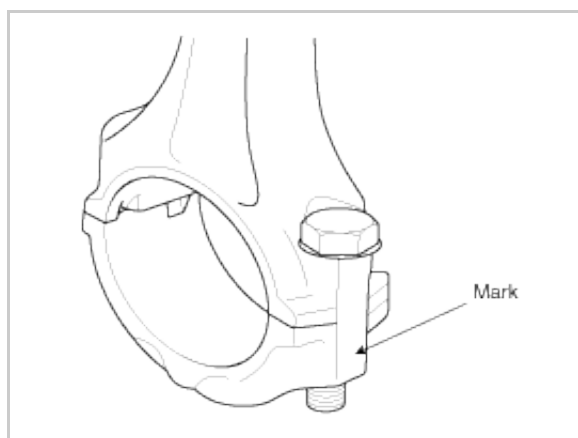
#### NOTICE

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



### Discrimination of connecting rod

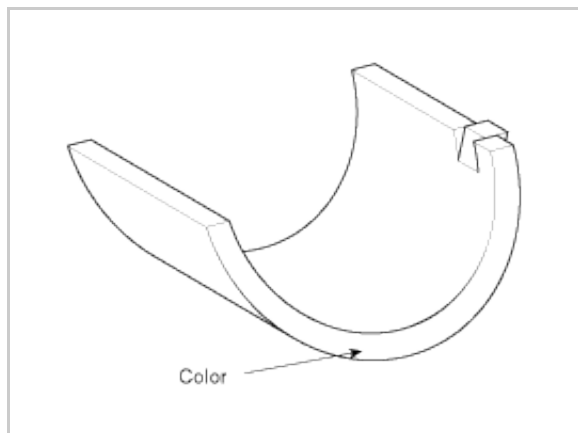
Mark	Connecting rod big-endinner diameter
1	60.833 ~ 60.839mm (2.3950 ~ 2.3952 in)

## CRANKSHAFT PIN JOURNAL

Journal outer diameter

57.106~57.124mm (2.2483~2.2490in)

## CONNECTING ROD BEARING MARK LOCATION



## Discrimination of crankshaft pin journal

Color	Connecting rod bearing thickness
Blue	1.0828~1.832mm (0.0720~0.0721in)
Red	1.832~1.836mm (0.0721~0.0723in)

(11) Select the bearing by using the selection table.

## Connecting rod bearing selection table

Connecting rod mark	Connecting rod bearing thickness	Oil clearance
1	Blue	0.045~0.077mm(0.0018~0.0030in)
2	Red	0.043~0.076mm(0.0017~0.0030in)

## 3. Check the 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 :

0.04mm / 50mm (0.0016in / 1.9685in ) or less

Allowable twist of connecting rod :

0.1mm / 50mm (0.0039in / 1.9685in) or less

## 4. Check the crankshaft bearing oil clearance.

- (1) To check main bearing-to-journal oil clearance, remove the main bearing caps and lower bearings.

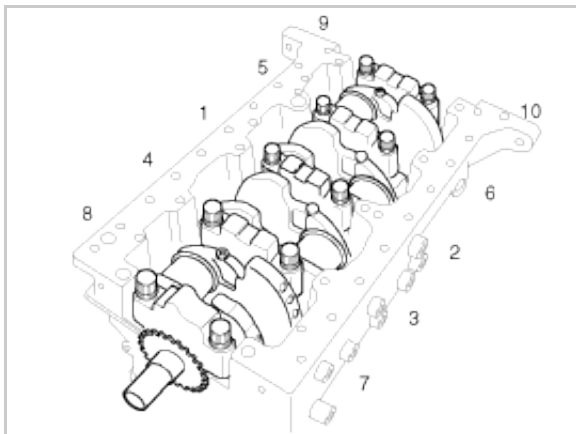
- (2) Clean each main journal and lower bearing with a clean shop towel.
- (3) Place one strip of plastigage across each main journal.
- (4) Reinstall the lower bearings and caps, then tighten the bolts.

Tightening torque :

69.6~79.4Nm(7.1~8.1kgf.m, 51.4~58.6lb-ft)+55°~ 65°

#### NOTICE

Do not turn the crankshaft.

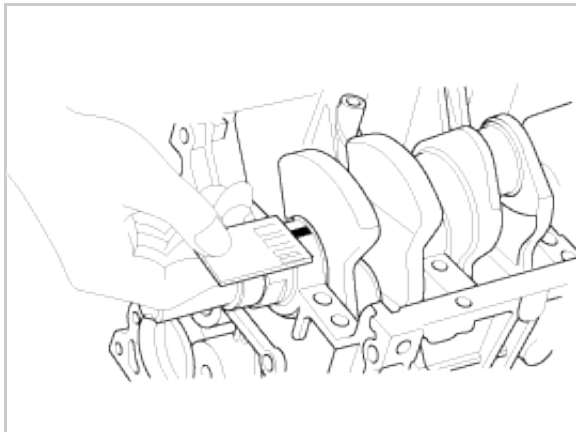


- (5) Remove the cap and lower bearing again, and measure the widest part of the plastigage.

Standard oil clearance :

No.1, 2, 3, 5: 0.045~0.079mm (0.0018 ~0.0031 in)

No.3: 0.067~0.101 mm (0.0026 ~0.0040 in)



- (6) If the plastigage measures too wide or too narrow, remove the upper and lower bearing and then install a new bearings with the same color mark. (Refer to crankshaft main bearing selection table).  
Recheck the oil clearance.

#### CAUTION

Do not file, shim, or scrape the bearings or the cap to adjust clearance.

- (7) If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing. (Refer to crankshaft main bearing selection table).  
Recheck the oil clearance.

#### NOTICE

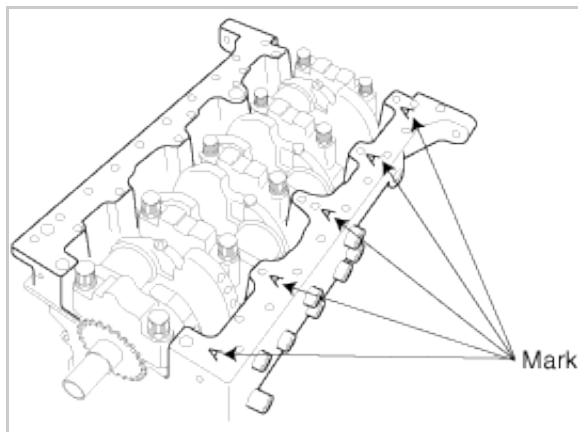
If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start over.

### 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.

### CYLINDER BLOCK CRANKSHAFT JOURNAL BORE MARK LOCATION

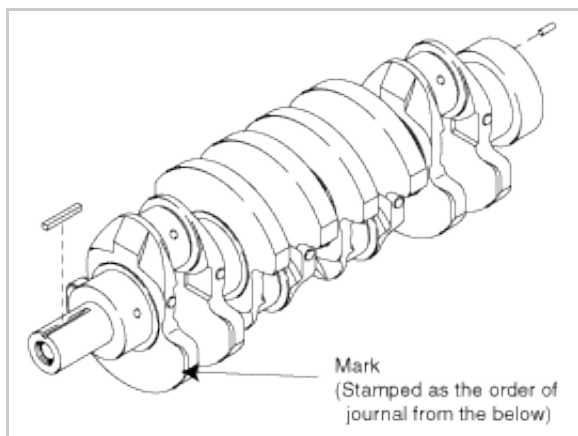
Letters have been stamped on the end of the block as a mark for the size of each of the 5 main journal bores. Use them, and the numbers or letters stamped on the crank (marks for main journal size), to choose the correct bearings.



### Discrimination of cylinder block crankshaft journal bore

Mark	Cylinder block crankshaft journal bore inner diameter
A	74.066~74.075mm (2.9160~2.9163in)
None	74.075~74.084mm (2.9163~2.9167in)
C	74.084~74.092mm (2.9167~2.9170in)

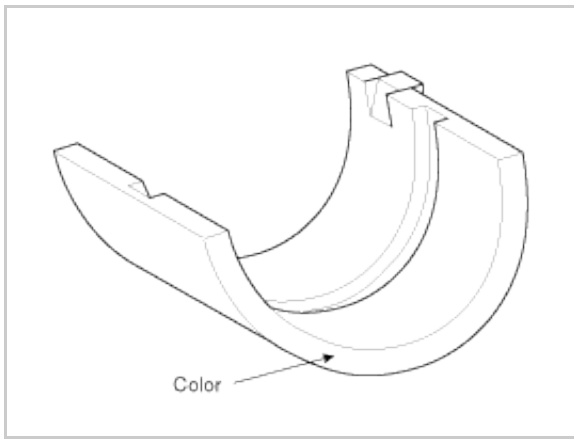
### Crankshaft main journal mark location



### Discrimination of crankshaft main journal

Mark	Crankshaft main journal outer diameter	
	No.1, 2, 3, 5 journal	No.3 journal
1	69.995~70.002mm(2.7557~2.7560in)	69.973~69.980mm(2.7548~2.7551in)
*	70.002~70.009mm(2.7560~2.7563in)	69.980~69.987mm(2.7551~2.7554in)
3	70.009~70.015mm(2.7563~2.7565in)	69.987~69.993mm(2.7554~2.7556in)

### Crankshaft main bearing mark location



#### Discrimination of crankshaft bearing

Color	Crankshaft bearing thickness
Black	2.013 ~ 2.018mm(0.0793~0.0794in)
Brown	2.008 ~ 2.013mm(0.0791~0.0793in)
Green	2.003 ~ 2.008mm(0.0789~0.0791in)
Yellow	1.998 ~ 2.003mm(0.0787~0.0789in)

(8) Select the bearing by using selection table.

#### Crankshaft main bearing selection table

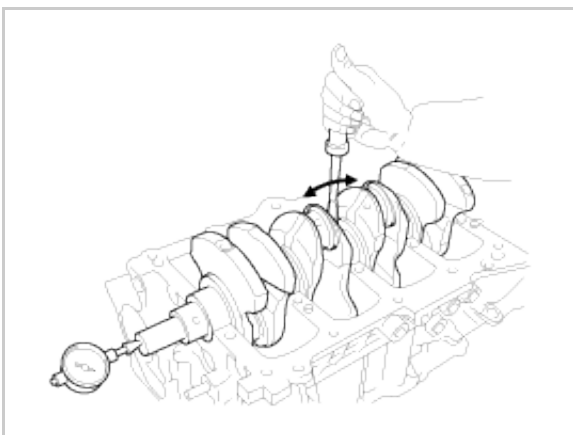
		Cylinder block crankshaft journal bore mark		
		A	None	C
Crank shaft main journal mark	A	(Green)	(Brown)	(Black)
	*	(Yellow)	(Green)	(Brown)
	C	(Yellow)	(Yellow)	(Green)

5. Check the crankshaft end play.

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

End play

Standard: 0.14~ 0.39mm (0.0055 ~ 0.0154in)



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

6. Inspect the crankshaft main journals and pin journals.

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

Main journal outer diameter :

NO.1, 2, 3, 5: 69.995 ~ 70.015mm (2.7557 ~2.7565 in)

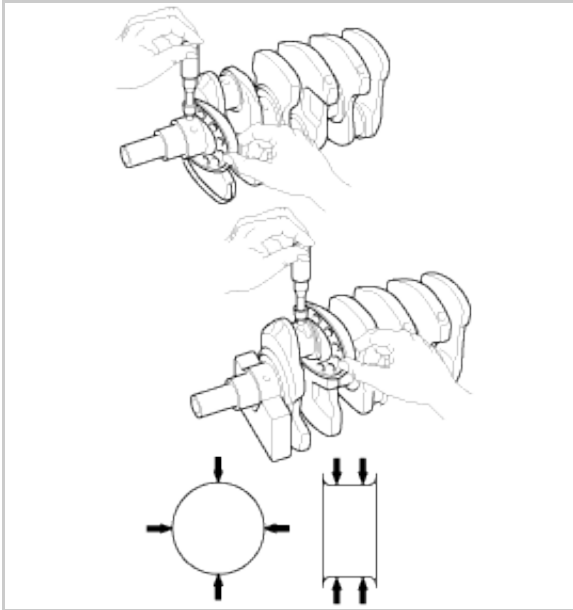


NO.3: 69.973~69.993 mm (2.7548 ~2.7556 in)

Pin journal outer diameter :

57.106 ~ 57.124mm (2.2483 ~2.2490 in)

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## CYLINDER BLOCK

1. Remove the gasket material.

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

2. Clean the cylinder block

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

3. Inspect the top surface of cylinder block for flatness.

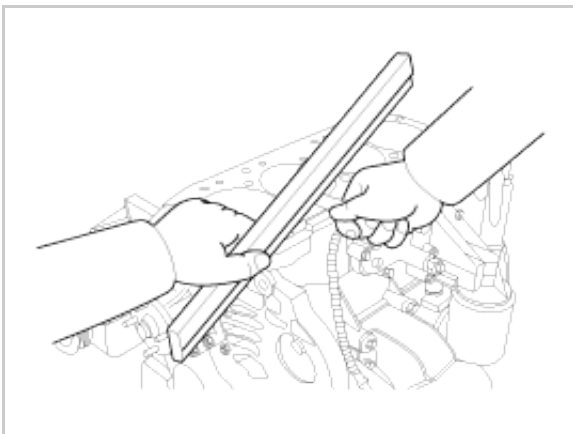
Using a precision straight edge and feeler gauge, measure the surface contacting the cylinder head gasket for warpage.

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Flatness of cylinder block gasket surface Standard:

Less than 0.05mm (0.0020in)

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4. Inspect the cylinder bore.

Visually check the cylinder for vertical scratches.

If deep scratches are present, replace the cylinder block.

5. Inspect the cylinder bore diameter.

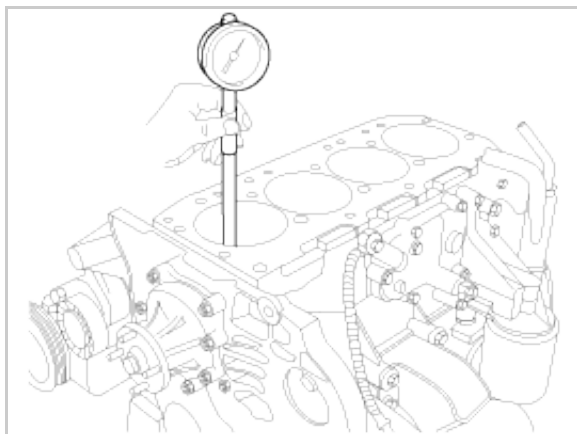
Using a cylinder bore gauge, measure the cylinder bore diameter at position in the thrust and axial direction.

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Standard diameter :

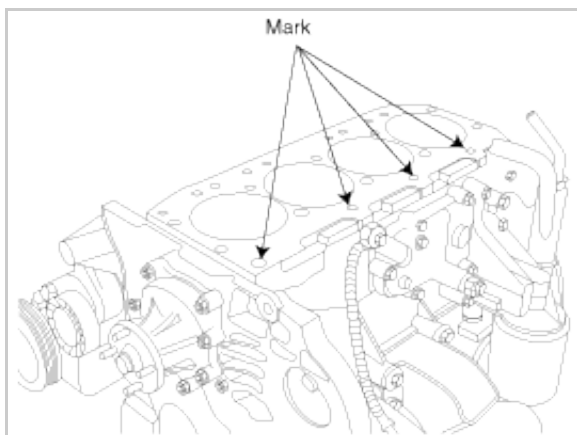
97.100~97.126mm (3.8228~3.8239in)

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

### Cylinder bore inner diameter mark location



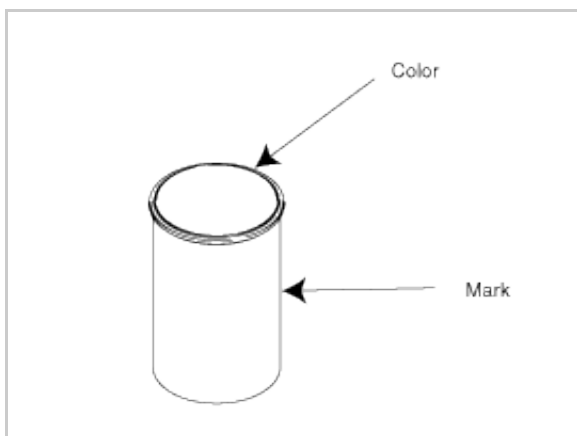
### Discrimination of cylinder bore inner diameter

Mark	Cylinder bore inner diameter
Y	101.513~101.526mm (3.9966~3.9971in)
X	101.500~101.513mm (3.9961~3.9966in)

### Cylinder liner classifying mark location

#### NOTICE

The outer discrimination mark of the cylinder liner is on the outer surface of the liner and the inner mark is on the top surface of it.

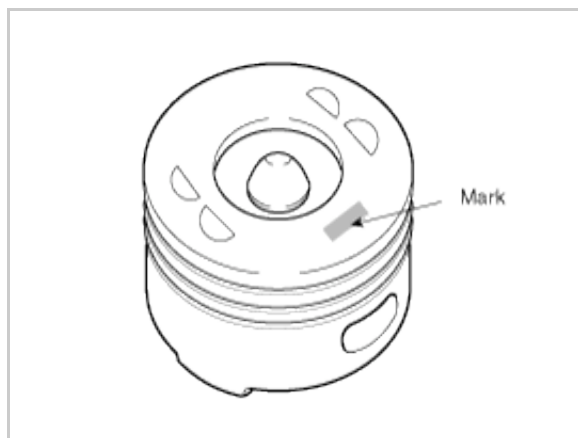


### Discrimination of cylinder liner

Mark	Outer diameter (mm)	Mark	Inner diameter (mm)
------	---------------------	------	---------------------

3Y	101.493~101.506mm(3.9958~3.9963in)	Yellow	97.113~97.126mm(3.8233 ~ 3.8239in)
3Y	101.493~101.506mm(3.9958~3.9963in)	Blue	97.100~97.113mm(3.8228~ 3.8233in)
3X	101.480~101.493mm(3.9953 ~ 3.9958in)	Yellow	97.113~97.126mm(3.8233~3.8239in)
3X	101.480~101.493mm(3.9953 ~ 3.9958in)	Blue	97.100~97.113mm(3.8228~ 3.8233in)

## Piston Outer diameter mark location



## Discrimination of piston outer diameter

Mark	Piston outer diameter
A	97.015~97.030mm(3.8195~3.8201in)
B	97.030~97.045mm(3.8201~3.8207in)

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

## Cylinder liner selection table

Cylinder bore mark	Cylinder liner mark	Oil clearance
Y	3Y- Yellow	0.007~0.033mm(0.0003~0.0013in)
Y	3Y- Blue	0.007~0.033mm(0.0003~0.0013in)
X	3X- Yellow	0.007~0.033mm(0.0003~0.0013in)
X	3X- Blue	0.007~0.033mm(0.0003~0.0013in)

## Piston

Cylinder liner mark	Piston outer diameter mark	Oil clearance
Yellow	B	0.068~0.096mm(0.0027~0.0038in)
Blue	A	0.070~0.098mm(0.0028~0.0039in)

## PISTON AND PISTON RINGS

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

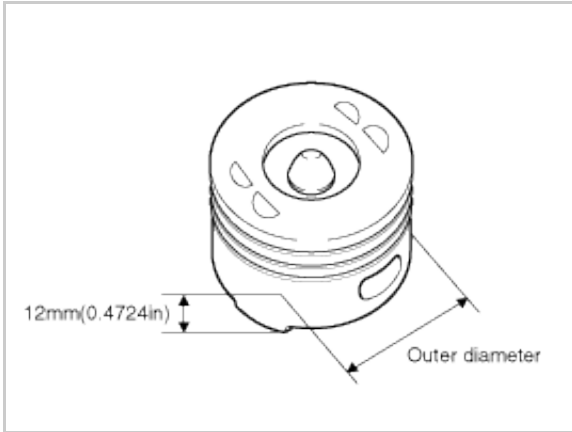
### NOTICE

Do not use a wire brush.

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

Standard diameter :

97.015~97.045mm (3.8195 ~ 3.8207in)



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

Piston-to-cylinder clearance :

0.070 ~ 0.098mm (0.0028 ~ 0.0039in)

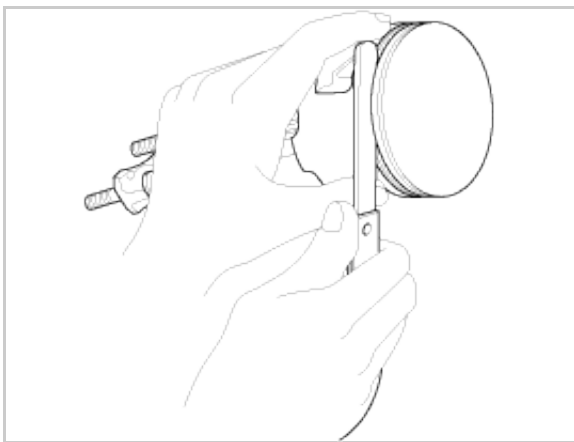
4. Inspect the piston ring side clearance.

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

Piston ring side clearance

No. 2 : 0.06 ~ 0.10mm (0.0024 ~ 0.0039in)

Oil ring : 0.03 ~ 0.07mm (0.0012 ~ 0.0028in)



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

5. Inspect the 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 rings. If the gap is too large, recheck the cylinder bore inner diameter. If the bore is over the service limit, the cylinder block must be rebored.

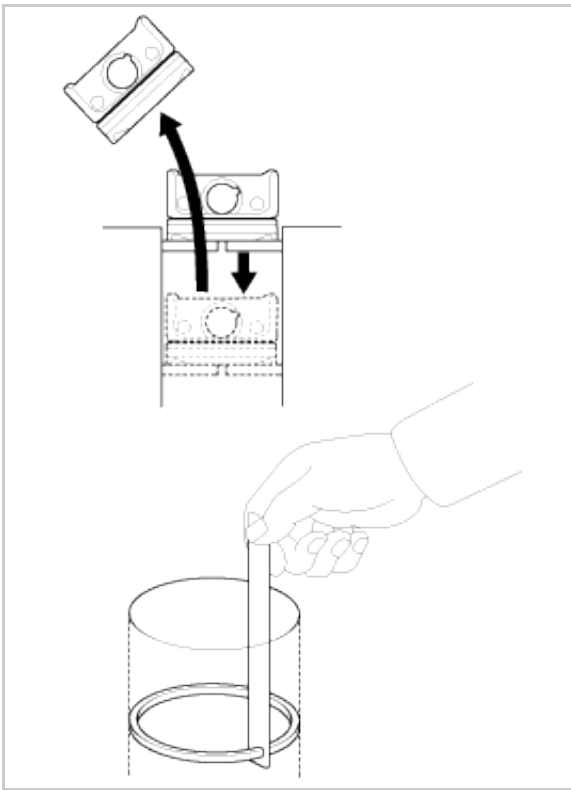
Piston ring end gap

Standard

No.1 : 0.25~ 0.40mm (0.0098 ~ 0.0157in)

No.2 : 0.40 ~ 0.55mm (0.0157 ~ 0.0217in)

Oil ring : 0.20 ~ 0.40mm(0.0079 ~ 0.0157in)

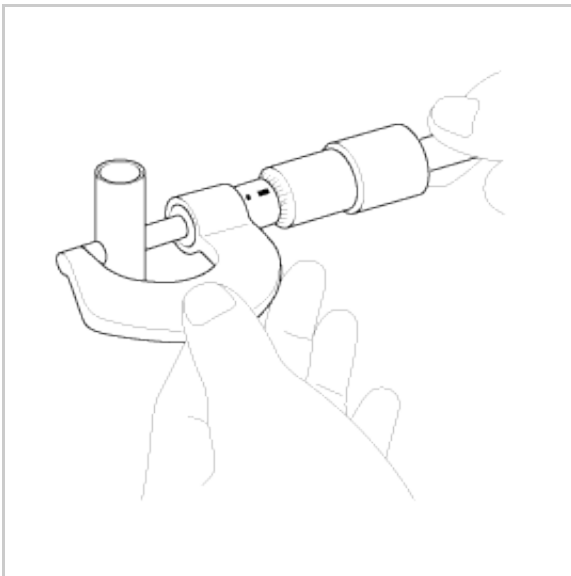


## PISTON PINS

1. Measure the outer diameter of piston pin.

Piston pin diameter :

31.994~32.000mm (1.2596 ~ 1.2598in)



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

Piston pin hole inner diameter:

32.015~32.025 mm (1.2604~1.2608 in)

0.015~0.031 mm(0.0003~0.0012 in)

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

Inside diameter of connecting rod small end bore:

32.012~32.033mm (1.2603~1.2611 in)

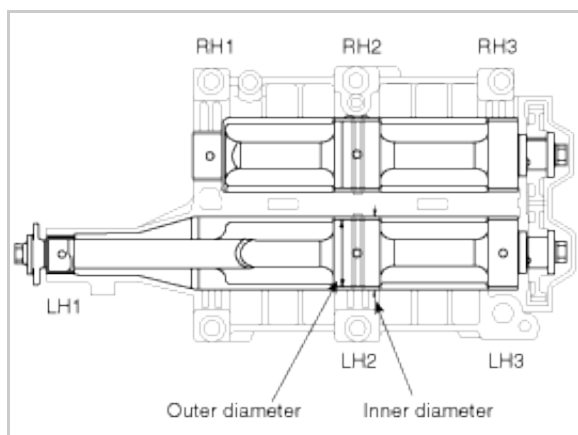
0.012~0.039 mm(0.0005~0.0015 in)

4. Apply oil on the piston pin when assembling.

## LADDER FRAME AND BALANCE SHAFT

1. Measure the ladder frame inner diameter.

Ladder frame inner diameter	
LH1	25.000 ~ 25.021 mm(0.9843~0.9851in)
LH2	54.000 ~ 54.030 mm(2.1260~2.1272in)
LH3	56.000 ~ 56.030 mm(2.2047~2.2059in)
RH1	35.000 ~ 35.025 mm(1.3780~1.3789in)
RH2	54.000 ~ 54.030 mm(2.1260~2.1272in)
RH3	56.000 ~ 56.030 mm(2.2047~2.2059in)



2. Measure the balance shaft outer diameter.

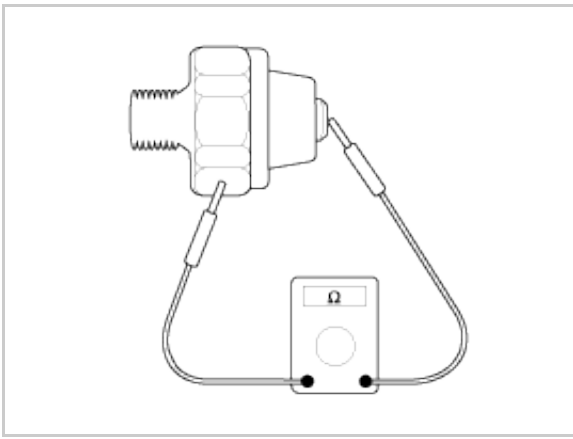
Balance shaft outer diameter	
LH1	24.939 ~ 24.960 mm(0.9818~0.9827in)
LH2	53.910 ~ 53.940 mm(2.1224~2.1236in)
LH3	55.910 ~ 55.940 mm(2.2012~2.2024in)
RH1	34.925 ~ 34.950 mm(1.3750~1.3760in)
RH2	53.910 ~ 53.940 mm(2.1224~2.1236in)
RH3	55.910 ~ 55.940 mm(2.2012~2.2024in)

3. Measure the end play of the balance shaft.

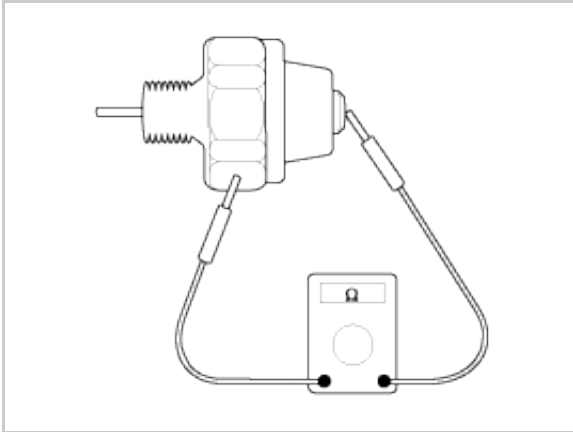
0.10~0.25mm (0.0036~0.0098in)

## OIL PRESSURE SWITCH

1. Check the continuity between the terminal and the body with an ohmmeter. If there is no continuity, replace the oil pressure switch.



2. Check the continuity between the terminal and the body when the oil hole is blocked with a fine stick. If there is continuity with a fine stick is pushed, replace the switch.



3. If there is no continuity when a 49.0kpa (0.5kg/cm<sup>2</sup>, 7.1psi) pressure is applied through the oil hole, the switch is operating properly.  
Check for air leakage. If air leaks, the diaphragm is broken. Replace it.

## REASSEMBLY

### NOTICE

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

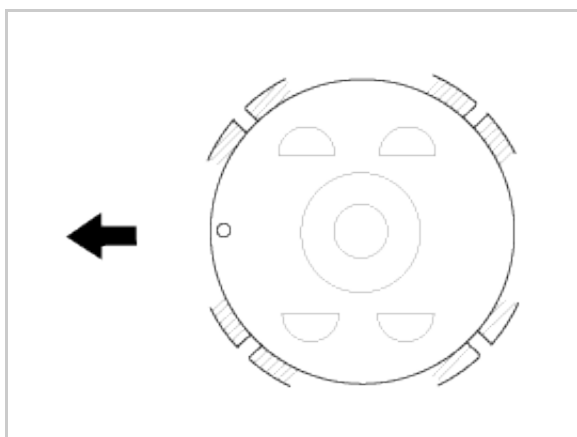
1. Assemble the piston and connecting rod.
  - (1) Insert the piston pin and fix the piston pin clip.
  - (2) The piston front mark and the connecting rod front mark must face the timing belt side of the engine.



2. Install the piston rings.
  - (1) Install the oil ring expander and two side rails by hand.

(2) Using a piston ring expander, install the two compression rings with the code mark facing upward.

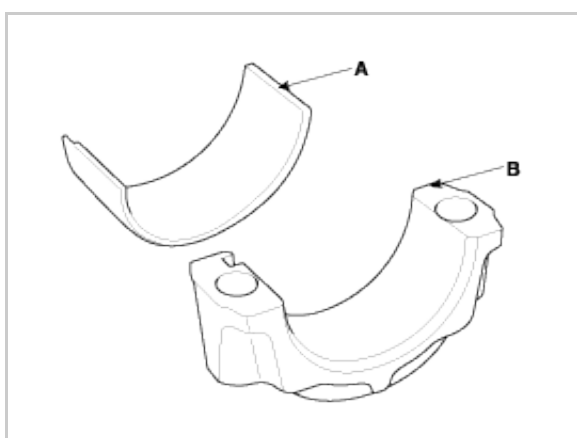
(3) Position the piston rings so that the ring ends are as shown.



3. Install the connecting rod bearings.

(1) Align the bearing (A) claw with the groove of the connecting rod and bearing cap (B).

(2) Install the bearings (A) in the connecting rod and bearing cap (B).

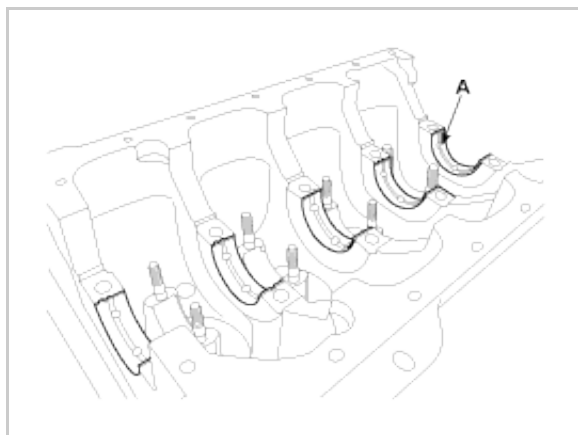


4. Install the crankshaft main bearings.

#### NOTICE

Upper bearings have oil grooves of the oil holes; Lower bearings do not.

(1) Aligning the bearing protrusions with the grooves of the cylinder block, push in the 5 upper bearings (A).

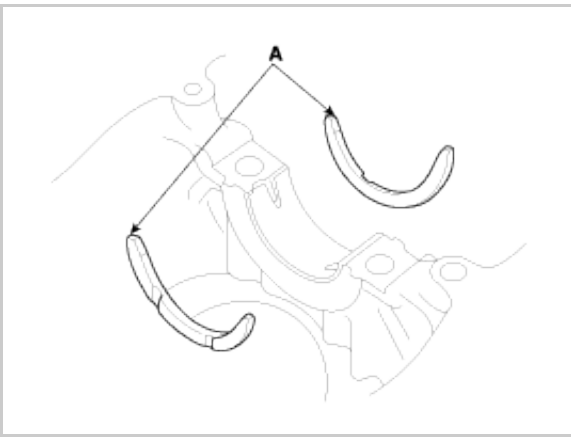


(2) Aligning the bearing protrusions with the grooves of the main bearing cap, and push in the 5 lower bearings.

5. Install the thrust bearings.

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





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

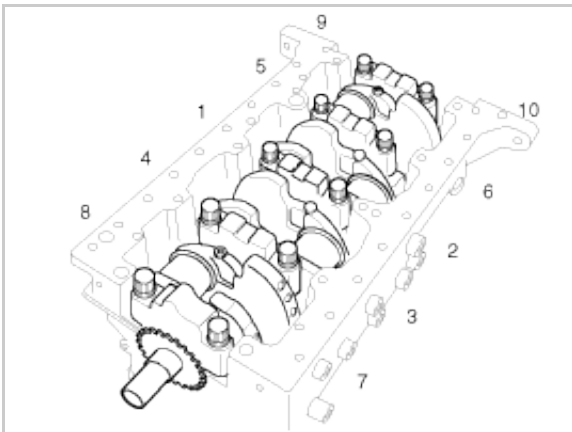
#### NOTICE

- a. The main bearing cap bolts are tightened in 2 progressive steps.
- b. If any of the bearing cap bolts is broken or deformed, replace it.

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

Tightening torque :

69.6 ~ 79.4Nm (7.1 ~ 8.1kgf.m, 51.4 ~ 58.6lb-ft) + 55° ~ 65°



- (3) Check that the crankshaft turns smoothly.
9. Check the crankshaft end play.
  10. Install the piston and connecting rod assemblies.

#### NOTICE

- a. Before installing the piston, apply a coat of engine oil to the piston ring grooves and the cylinder bores.
- b. When installing the piston pin to the piston, apply engine oil sufficiently

- (1) Remove the connecting rod bearing caps and insert short sections of rubber hose over the threaded ends of the connecting rod bolts.
- (2) Install the ring compressor, checking that the rings are securely in place and positioning the piston in the cylinder, tap it in using the wooden handle of a hammer.
- (3) Stop inserting after the ring inserted in the cylinder, and check the connecting rod to crank journal alignment before complete inserting.
- (4) Apply engine oil to the bolt threads after removing rubber hose. Install the connecting rod caps with bearings,

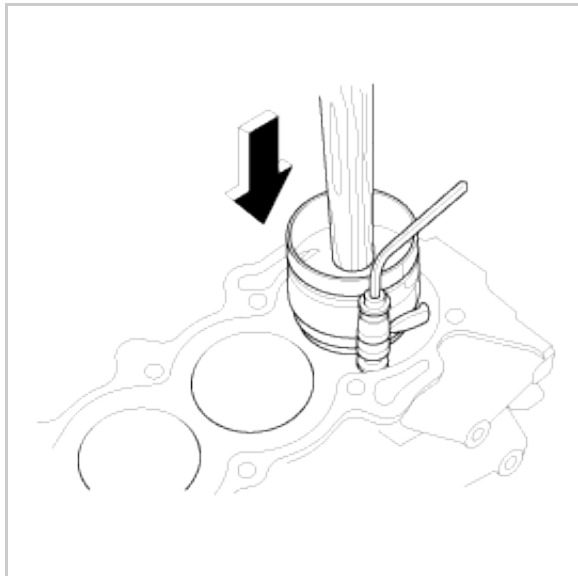
and tighten the nuts.

Tightening torque :

68.9Nm (7.0kgf.m, 50.6lb-ft) → Loosened → 29.4Nm (3.0kgf.m, 21.7lb-ft) + 90°

#### NOTICE

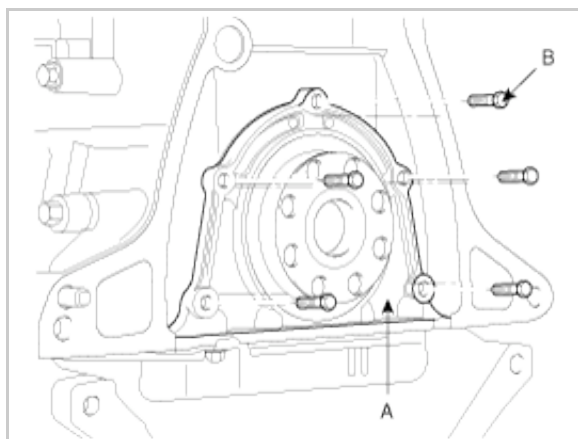
Maintain downward force on the ring compressor to prevent the rings from expanding before entering the cylinder bore.



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

Tightening torque :

7.8 ~ 10.8Nm (0.8 ~ 1.1kgf.m, 5.8 ~ 8.0lb-ft)



#### NOTICE

Check that the mating surfaces are clean and dry.

12. Install the rear oil seal.

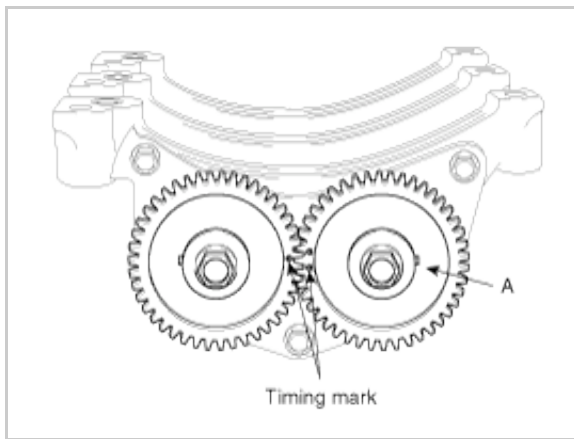
(1) Apply engine oil to a new oil seal lip.

(2) Tap in the rear oil seal until its surface is flush with the rear oil seal retainer edge.

13. Install the balance shaft to the ladder frame.

(1) Install the thrust plate and balance shaft to the ladder frame.

(2) Aligning the timing marks on the balance gear(A), install the balance sprocket.



(3) Tighten the balance sprocket bolt and balance gear bolt(C).

Tightening torque :

Rear balance gear bolt(C)-

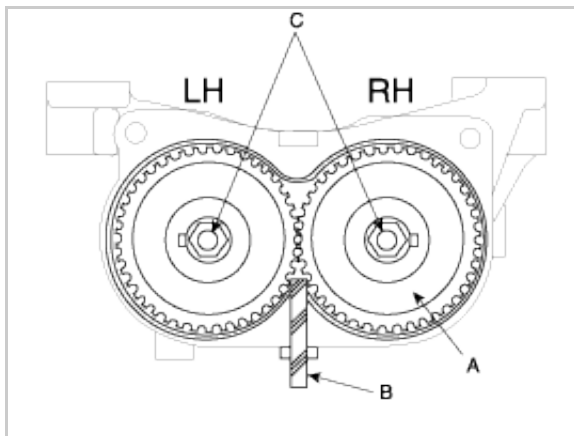
37.3 ~ 52.0Nm (3.8 ~ 5.3kgf.m, 27.5 ~ 38.3lb-ft)

Front balance gear bolt-

63.7 ~ 73.5Nm (6.5 ~ 7.5kgf.m, 47.0 ~ 54.2lb-ft)

#### NOTICE

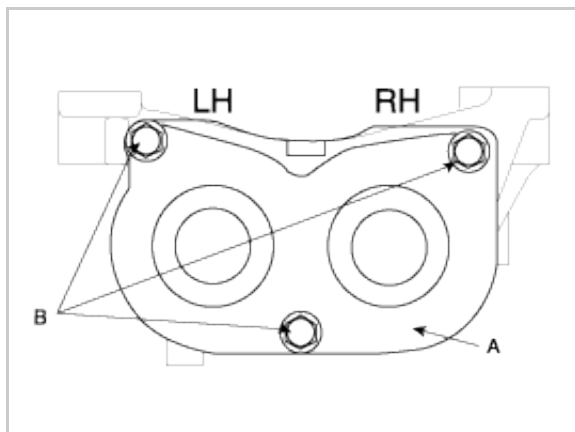
Not to make the balance shaft be rotated, insert the 5mm-thickness urethane rubber (B) in the balance gear (A) for protection.



(4) Install the gear cover (A) to the ladder frame and tighten the bolts (B).

Tightening torque :

18.6 ~ 25.5Nm (1.9 ~ 2.6kgf.m, 13.7 ~ 18.8lb-ft)



14. Install the oil screen with a new gasket to the oil pump.

Tightening torque :

15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)

---

15. Install the ladder frame(A) and pump assembly(B) and tighten the bolts(C,D,E).
- 

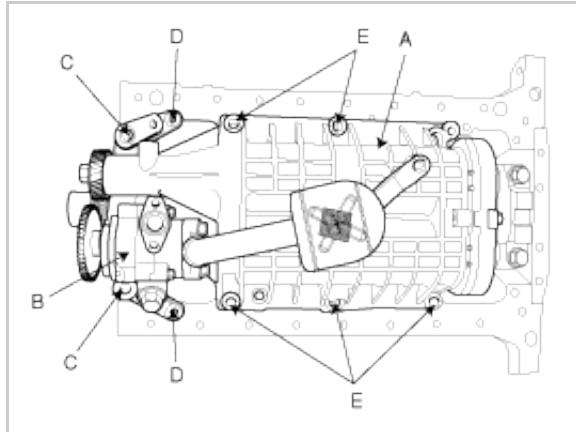
Tightening torque :

Bolts (C): 31.4 ~ 46.1Nm (3.2 ~ 4.7kgf.m, 23.1 ~ 34.0lb-ft)

Bolts (D): 15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)

Bolts (E): 31.4 ~ 46.1Nm (3.2 ~ 4.7kgf.m, 23.1 ~ 34.0lb-ft)

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#### NOTICE

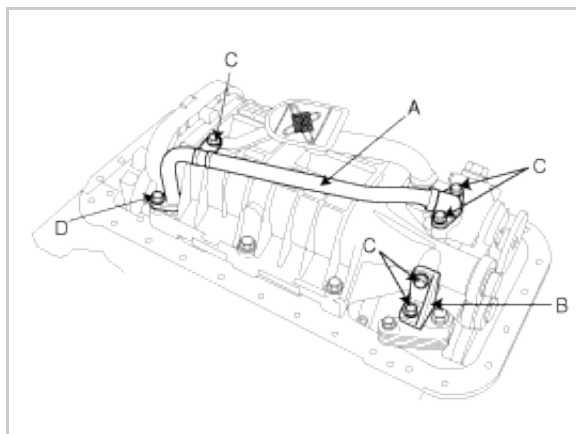
Check that the timing marks on the crankshaft sprocket(A), idler(B) and balance sprocket(C) are aligned.

16. Install the oil pump supplying pipe(A) and ladder frame bracket(B) and tighten the bolts(C,D) as shown below.
- 

Tightening torque :

15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)

---



17. Install the timing belt case.
- 

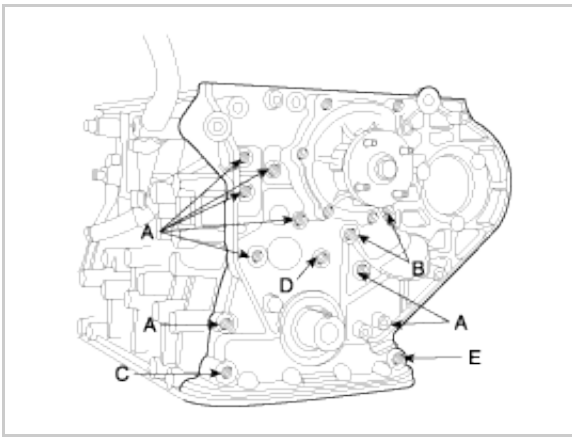
Length of the bolts :

(A): 25mm, (B): 45mm, (C):50mm, (D): nut

Tightening torque :

15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)

---



18. Install the oil pan.

(1) Remove the gasket from the surface of the oil pan by using a knife or a scraper.

**NOTICE**

After checking that the contact surface is clean and dry, apply liquid gasket.

(2) Apply liquid gasket on the surface of the oil pan.

Liquid gasket: LOCTITE 5900 or equivalent.

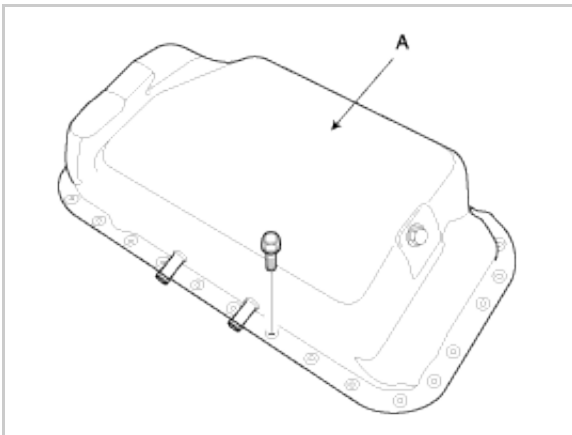
**NOTICE**

- Apply liquid gasket on the thread of the bolts in order to prevent oil from being leaked.
- If the time, five minutes, passes after applying, remove the applied gasket before. Apply it again and install it.
- After the minimum 30 minutes passing from assembly, refill engine oil.

(3) Install the oil pan (A) and tighten the oil pan bolts uniformly in several steps.

Tightening torque :

15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)



19. Install the fly wheel (manual transaxle vehicles only).

Tightening torque :

122.6 ~ 132.4Nm (12.5 ~ 13.5kgf.m, 90.4 ~ 97.6lb-ft)

20. Install the mass wheel and drive plate (automatic transaxle vehicles only).

Tightening torque :

159.8 ~ 169.7Nm (16.3 ~ 17.3kgf.m, 117.9 ~ 125.1lb-ft)

21. Install the air conditioning compressor bracket (A).

---

Tightening torque :

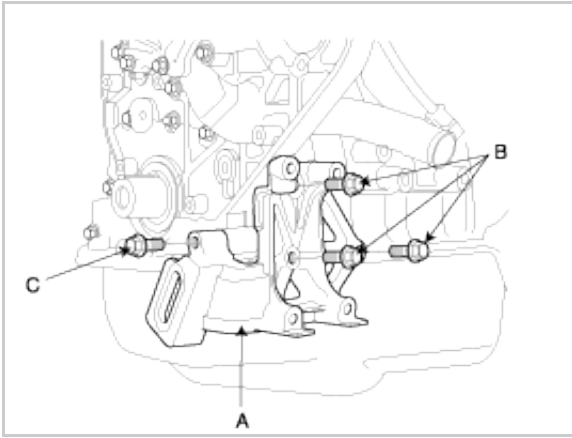
BOLT (B):

38.2 ~ 58.8Nm (3.9 ~ 6.0kgf.m, 28.2 ~ 43.4lb-ft)

BOLT (C):

18.6 ~ 27.5Nm (1.9 ~ 2.8kgf.m, 13.7 ~ 20.3lb-ft)

---



22. Install the generator mounting bracket (A) and the power steering pump bracket (B).

---

Tightening torque :

BOLT (C):

38.2 ~ 58.8Nm (3.9 ~ 6.0kgf.m, 28.2 ~ 43.4lb-ft)

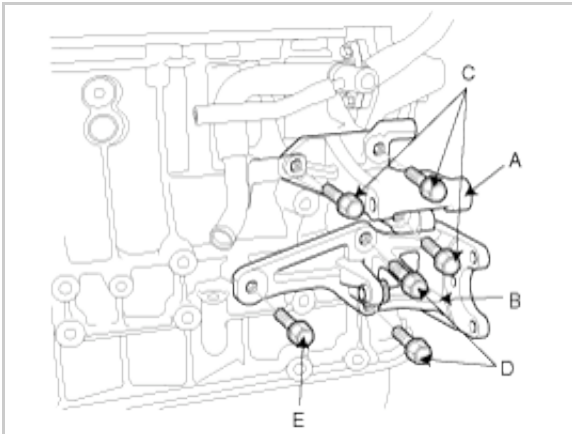
BOLT (D):

34.3 ~ 53.9Nm (3.5 ~ 5.5kgf.m, 25.3 ~ 39.8lb-ft)

BOLT (E):

68.6 ~ 93.2Nm (7.0 ~ 9.5kgf.m, 50.6 ~ 68.7lb-ft)

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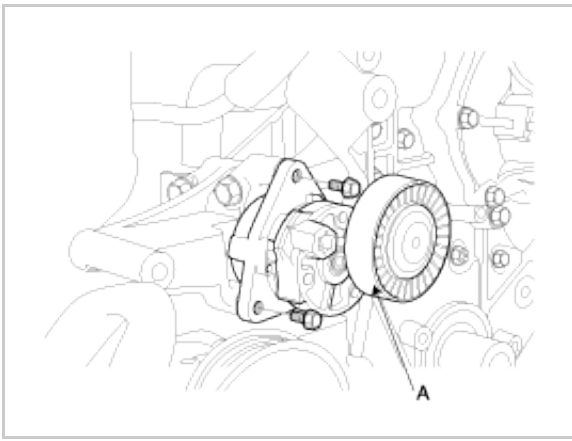
23. Install the drive belt auto-tensioner (A).

---

Tightening torque :

15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)

---



24. Install the oil cooler assembly (A) and the knock sensor (B).

---

Tightening torque :

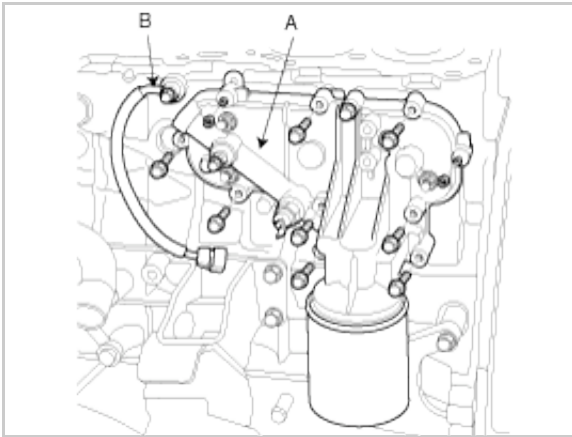
Oil cooler bolts:

15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)

Knock sensor bolts:

14.7 ~ 24.5Nm (1.5 ~ 2.5kgf.m, 10.8 ~ 18.1lb-ft)

---



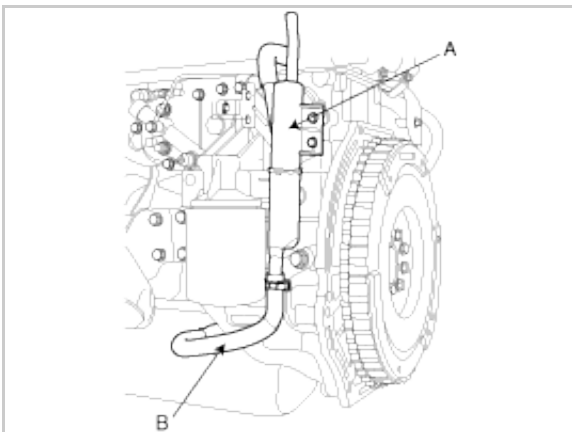
25. Install the air separator (A) and hose (B).

---

Tightening torque :

15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)

---



26. Install the water pump, cylinder head and timing belt in order.

27. Remove the engine stand.

# Cooling system

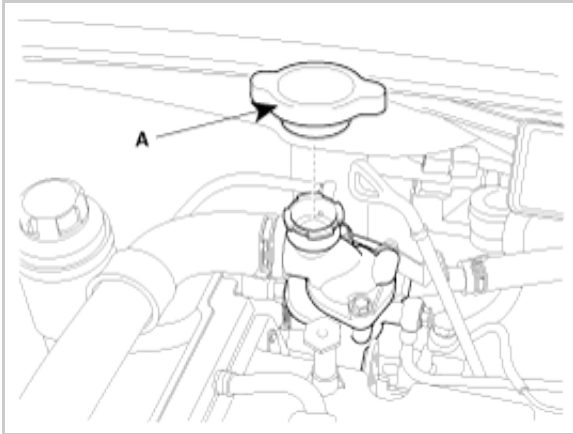


## ENGINE COOLANT REFILLING AND BLEEDING

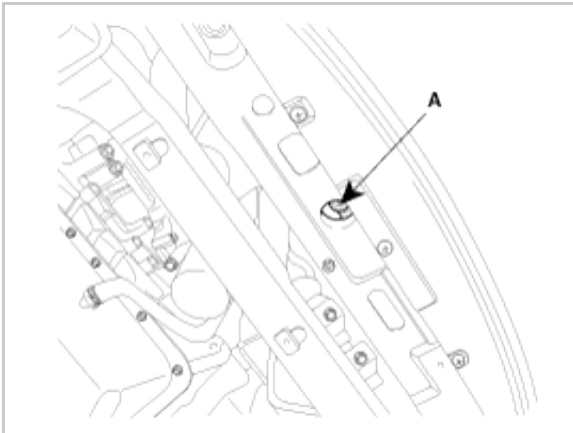
### CAUTION

When pouring engine coolant, be sure to shut the relay box lid and not to let coolant spill on the electrical parts of the paint. If any coolant spills, rinse it off immediately.

1. Slide the heater temperature control lever to maximum heat. Make sure the engine and radiator are cool to the touch.
2. Remove the radiator cap(A).



3. Loosen the drain plug(A), and drain the coolant.



4. Tighten the radiator drain plug securely.
5. Remove the coolant reservoir tank. Drain the coolant and reinstall the coolant reservoir tank. Fill the coolant reservoir tank to the MAX mark with the coolant.
6. Mix the recommended antifreeze with an equal amount of water in a clean container.

### NOTICE

- a. Use only genuine antifreeze/coolant.
- b. For best corrosion protection, the coolant concentration must be maintained year-round at 50% minimum. Coolant concentrations less than 50% may not provide sufficient protection against corrosion of freezing.
- c. Coolant concentrations greater than 60% will impair cooling efficiency and are not recommended.

### CAUTION

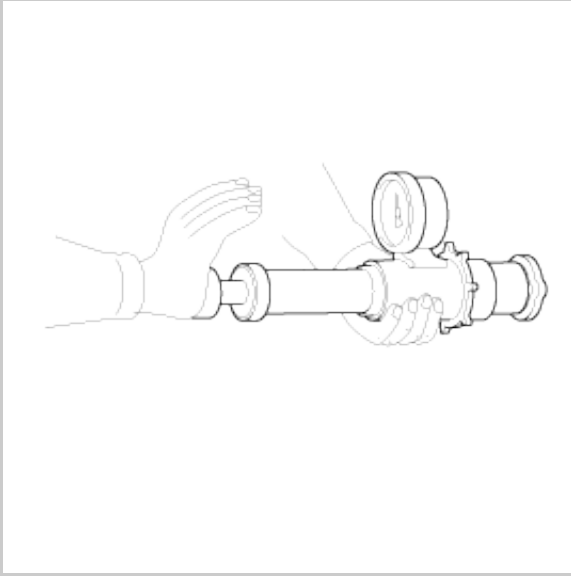
- a. Do not mix different brands of antifreeze/coolants.
- b. Do not use additional rust inhibitors or antirust products; they may not be compatible with the coolant.

7. Pour the coolant into the radiator to the base of the filler neck, and install the radiator cap loosely.

8. Start the engine and let it run until it warms up. ( until the radiator fan operates 3 or 4 times.)
9. Turn off the engine. Check the level in the radiator, add coolant if needed. This will allow trapped air to be removed from the cooling system.
10. Put the radiator cap on tightly, then run the engine again and check for leaks.

## RADIATOR CAP TESTING

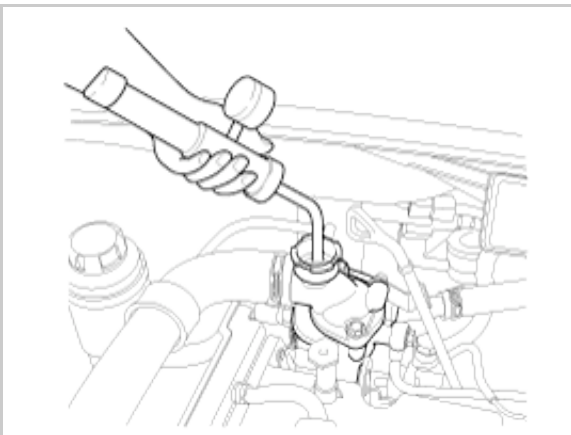
1. Remove the radiator cap, wet its seal with engine coolant, then install it no pressure tester.



2. Apply a pressure of 93.16 ~ 122.58kpa (0.95 ~ 1.25kg/cm<sup>2</sup>, 13.51 ~ 17.78psi).
3. Check for a drop in pressure.
4. If the pressure drops, replace the cap.

## RADIATOR LEAKGE TEST

1. Wait until engine is cool, then carefully remove the radiator cap and fill the radiator with engine coolant, then install it on the pressure tester.
2. Apply a pressure tester to the radiator and apply a pressure of 93.16 ~ 122.58kpa (0.95 ~ 1.25kg/cm<sup>2</sup>, 13.51 ~ 17.78psi).

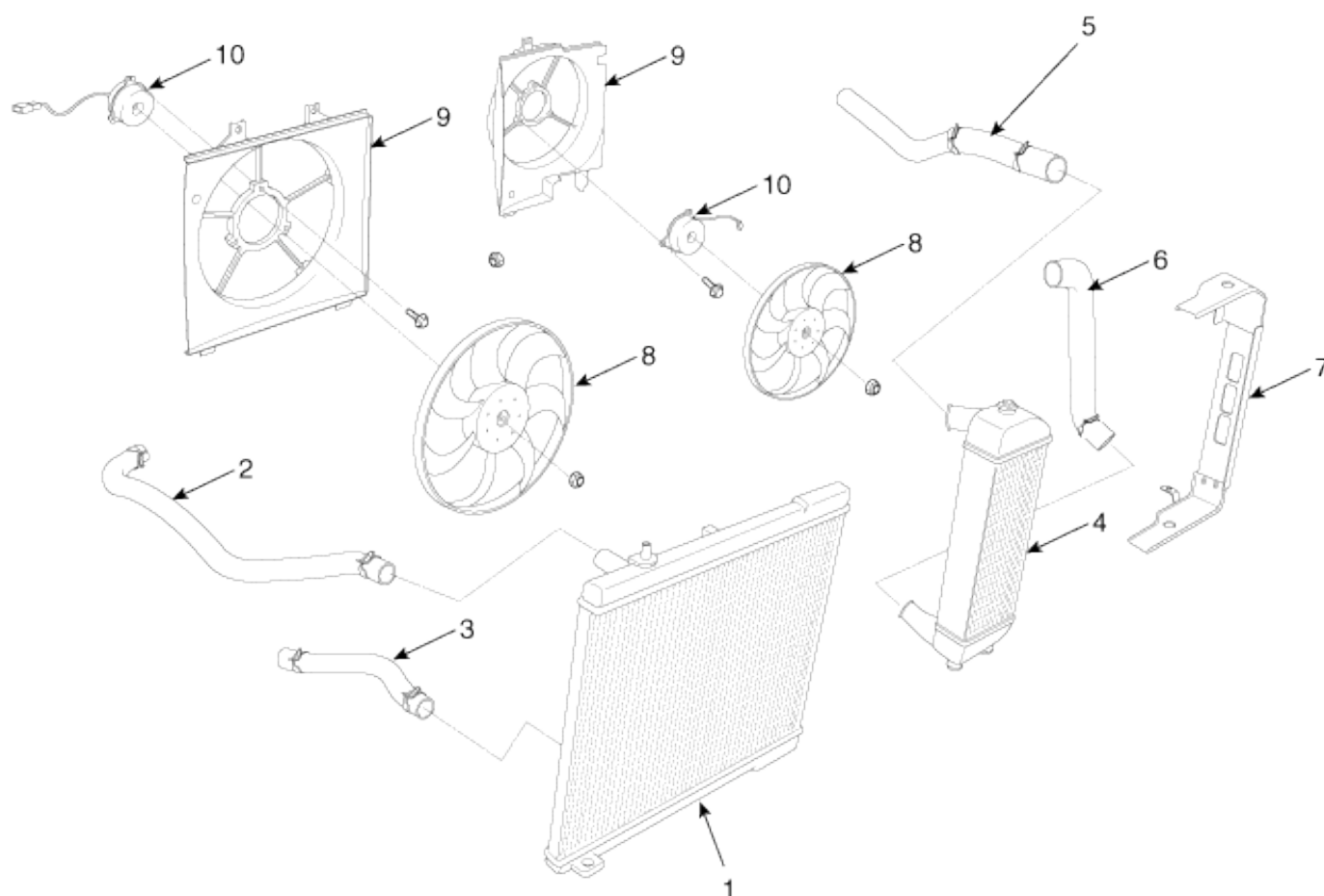


3. Inspect for engine coolant leaks and a drop in pressure.
4. Remove the tester and reinstall the radiator cap.

### NOTICE

Check for engine oil in the coolant and/or coolant in the engine oil.

## COMPONENTS



1. Radiator
2. Radiator upper hose
3. Radiator lower hose
4. Intercooler
5. Intercooler upper hose

6. Intercooler lower hose
7. Intercooler bracket
8. Cooling fan
9. Cooling fan shroud
10. Cooling fan motor



## REMOVAL

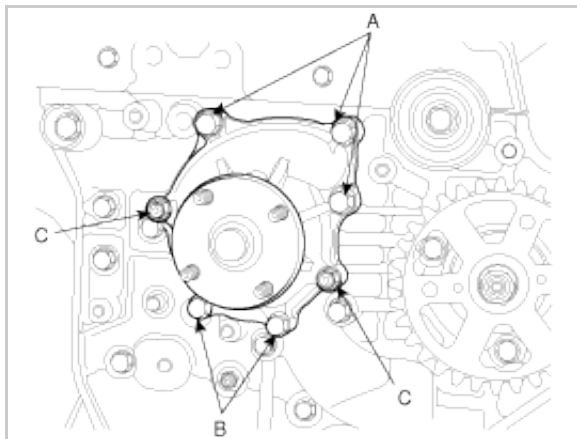
### WATER PUMP

1. Drain the engine coolant.

#### WARNING

System is under high pressure when the engine is hot. To avoid danger of releasing scalding engine coolant, remove the cap only when the engine is cool.

2. Remove the drive belts.
3. Remove the timing belt.
4. Remove the water pump.

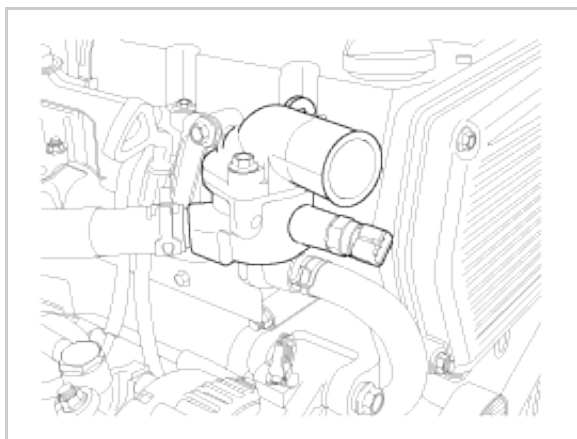


### THRMOSTAT

#### NOTICE

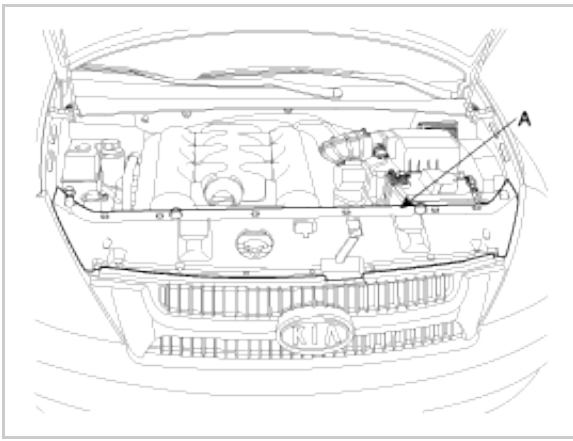
Disassembly of the thermostat would have an adverse effect, causing a lowering of cooling efficiency.

1. Drain the engine coolant so its level is below thermostat.
2. Remove the thermostat housing, gasket and thermostat.

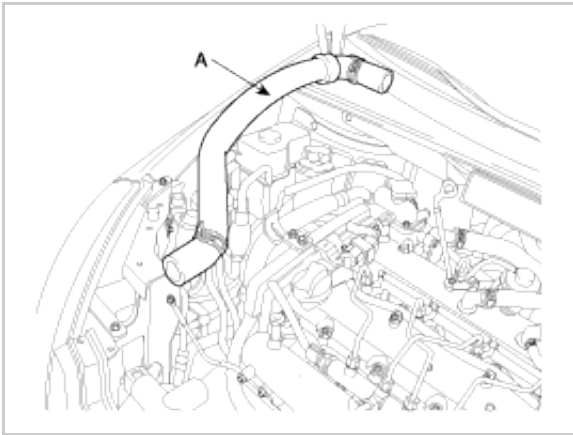


### RADIATOR

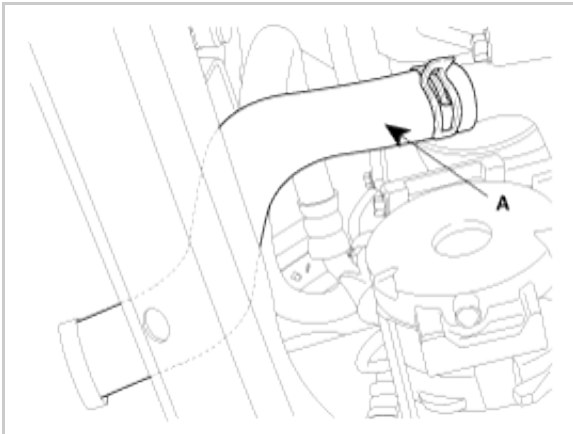
1. Drain the engine coolant.
2. Remove the radiator upper cover(A).



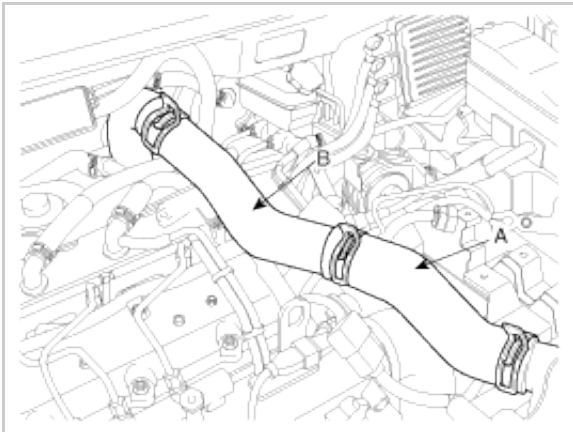
3. Remove the radiator upper hose(A).

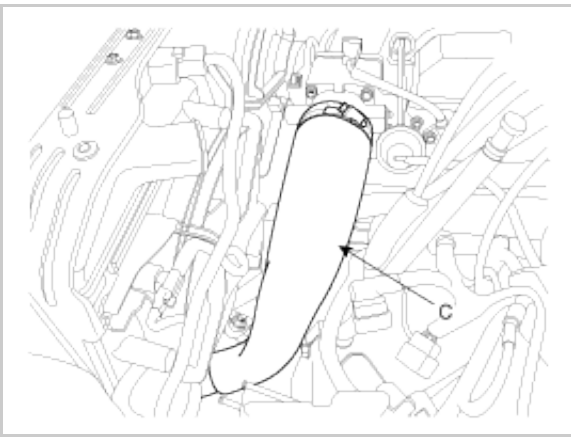


4. Remove the radiator lower hose(A).

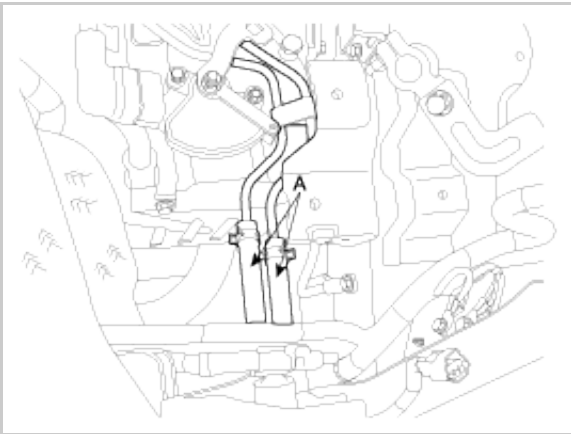


5. Remove the intercooler hose(A,C), pipe(B).

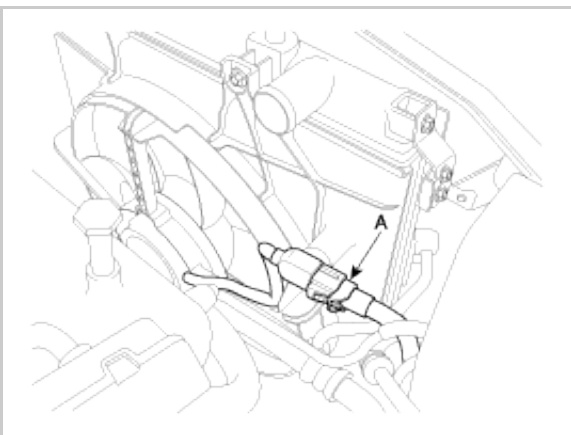
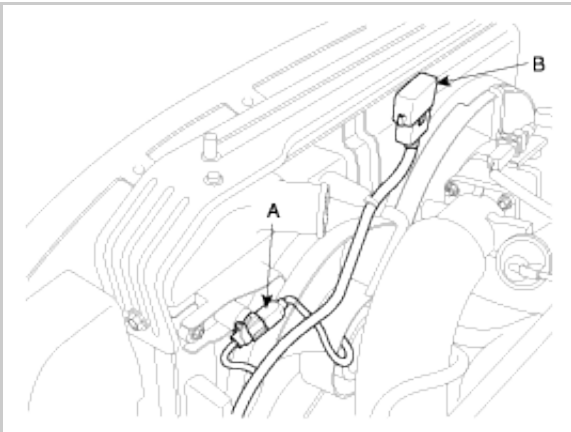




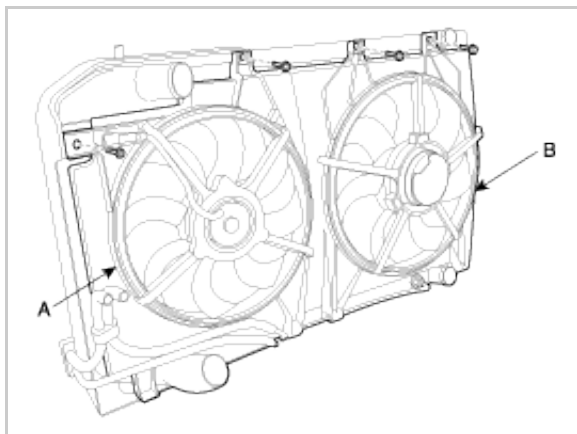
6. Remove the transaxle oil cooler hose(A).



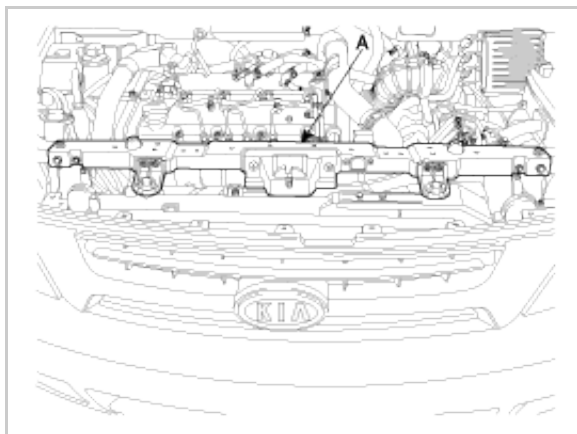
7. Remove the cooling fan motor connector(A) diagnosis connector(B).



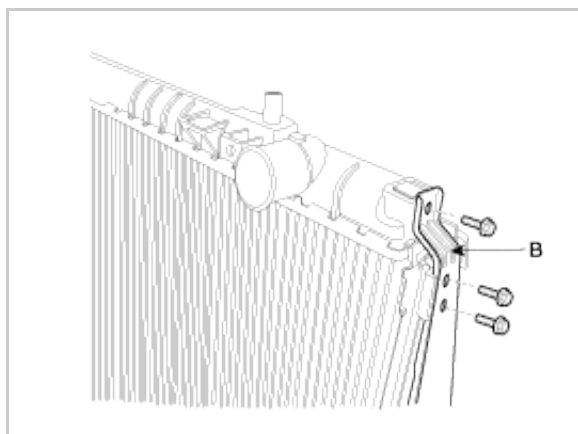
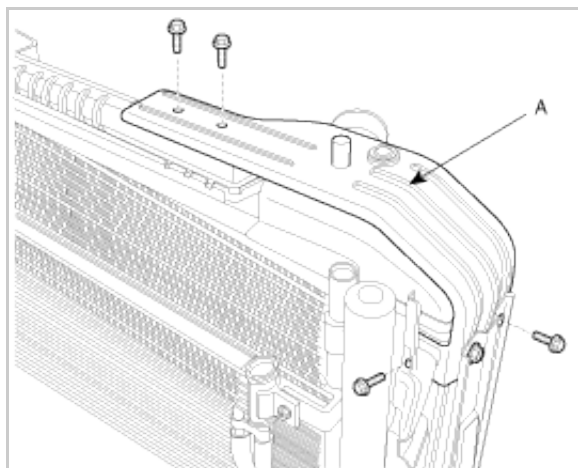
8. Remove the cooling fan motor assembly(A).



9. Remove the radiator upper bracket(A).



10. Remove the radiator bracket(A,B).



11. Remove the intercooler.

12. Remove the radiator.

## INSTALLATION

## WATER PUMP

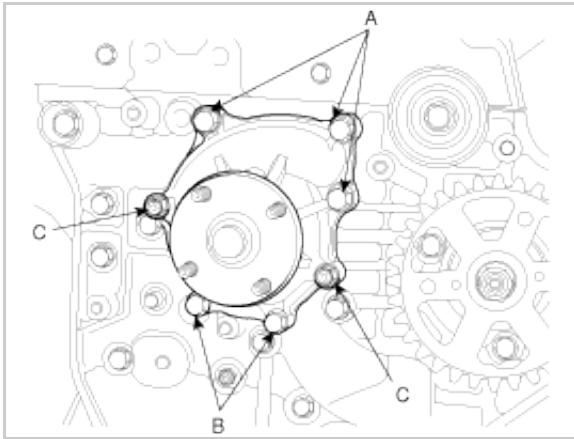
1. Install the water pump.  
(1) Install the water pump and a new gasket with the bolts, nuts(A,B,C).

---

Tightening torque :

15.7~22.6Nm (1.6 ~ 2.3kg-m, 11.6~16.6lb-ft)

---



2. Install the timing belt.
3. Install the water pump pulley, cooling fan.
4. Install the drive belt.
5. Fill with engine coolant.
6. Start engine and check for leaks.
7. Recheck engine coolant level.

## THERMOSTAT

1. Install the thermostat housing, thermostat.
2. Install the thermostat bolts.

---

Tightening torque :

15.7~22.6Nm (1.6 ~ 2.3kgf.m, 11.6~16.6lb-ft)

---

3. Fill with engine coolant.
4. Start engine and check for leaks.

## RADIATOR

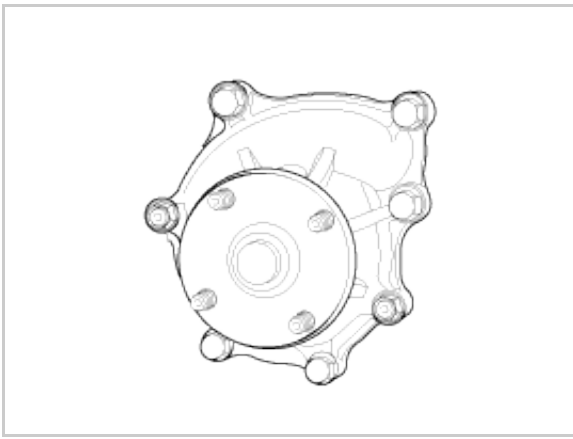
1. Install the radiator. Installation is in the reverse order of removal.
2. Install the air conditioner condenser. (Refer to HA- air conditioner condenser).
3. Install the upper and lower radiator hoses.
4. Refill with engine coolant.
5. Start engine and check for leaks.

## INSPECTION

### WATER PUMP

1. Check each part for cracks, damage or wear, and replace the coolant pump assembly if necessary.
2. Check the bearing for damage, abnormal noise and sluggish rotation, and replace the coolant pump assembly if necessary.





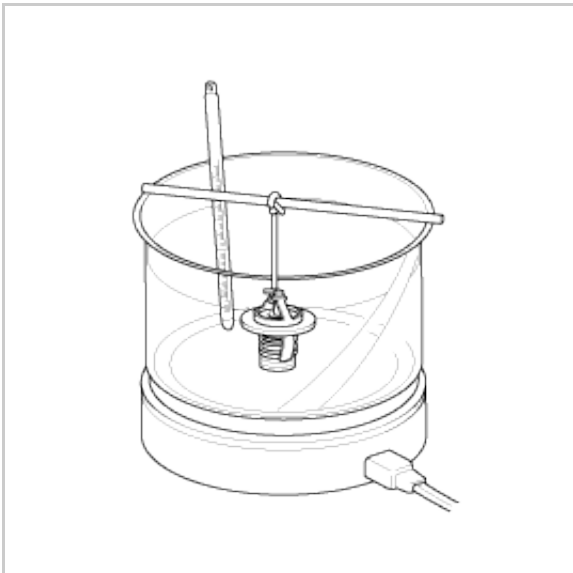
3. Check for coolant leakage. If coolant leaks from hole, the seal is defective. Replace the coolant pump assembly.

#### NOTICE

A small amount of "engine coolant" from the bleed hole can be weeped.

## THERMOSTAT

1. Immerse the thermostat in water and gradually heat the water.



2. Check the valve opening temperature.

---

Valve opening temperature : 86.5~89.5°C (187.7~193.1°F)

Full opening temperature : 100°C (212°F)

---

If the valve opening temperature is not as specified, replace the thermostat.

3. Check the valve lift.

---

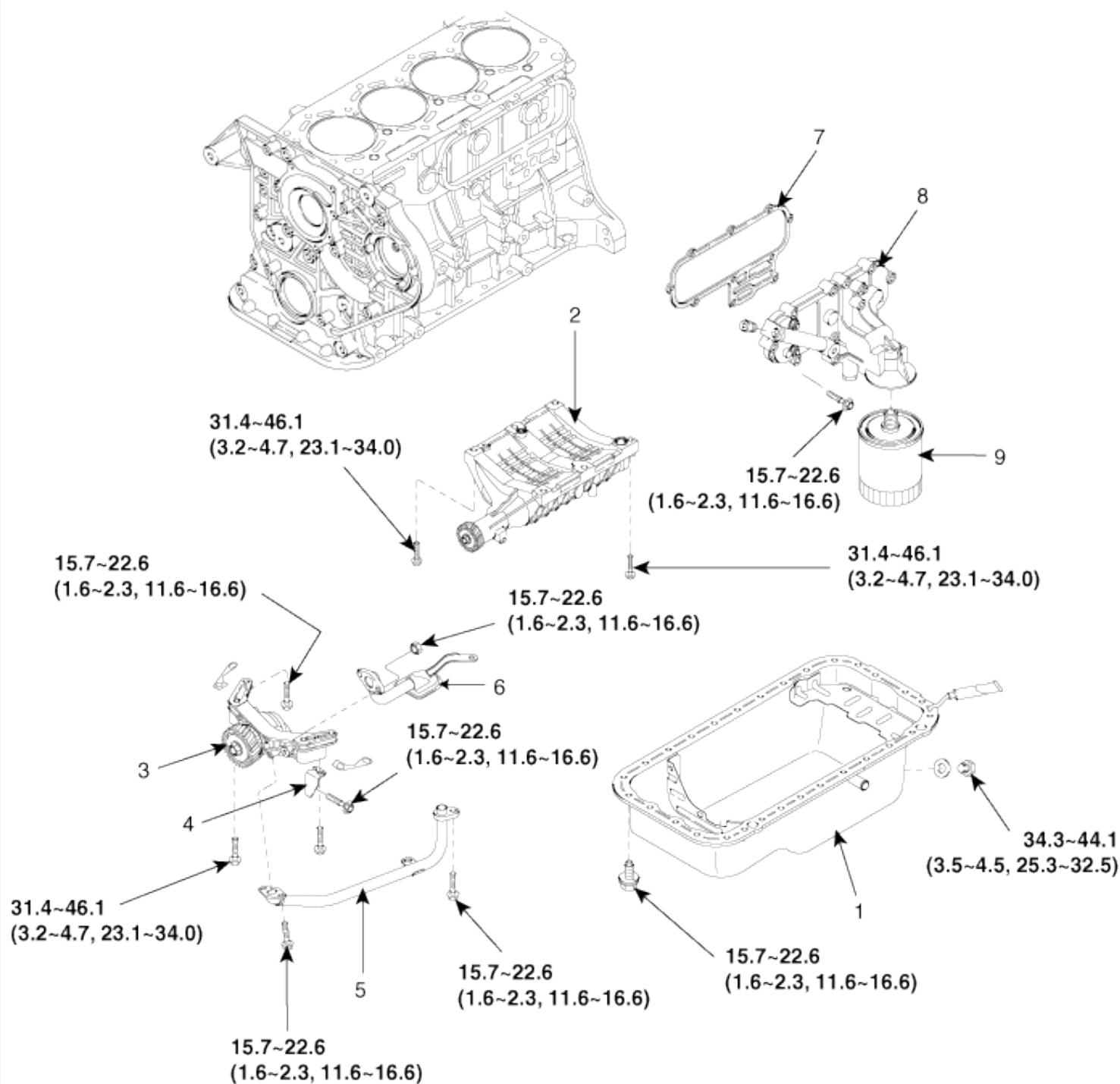
Valve lift : 8.5mm(0.3346in) or more at 100°C (212°F)

---

If the valve lift is not as specified, replace the thermostat.

# **Lubrication system**

## COMPONENTS



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

1. Oil pan
2. Ladde frame assembly
3. Oil pump assembly
4. Ladde frame bracket
5. Oil pump supply pipe

6. Oil screen
7. Oil cooler gasket
8. Oil cooler assembly
9. Oil filter

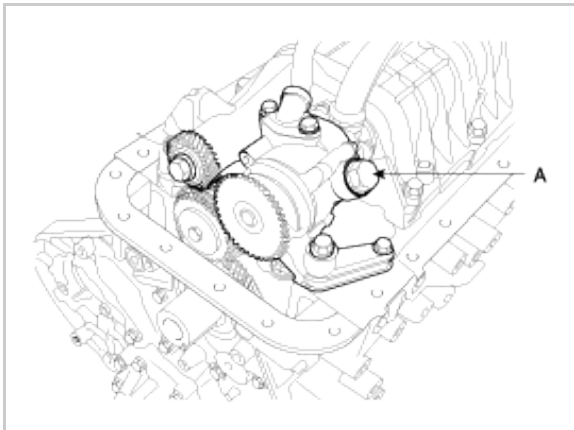


## DISASSEMBLY

### RELIEF PLUNGER

1. Remove the relief plunger.

Remove the plug(A), spring and relief plunger.



## INSPECTION

### RELIEF PLUNGER

1. Inspect the relief plunger.

Coat the plunger with engine oil and check that it falls smoothly into the plunger hole by its own weight. If it does not, replace the relief plunger. If necessary, replace the front case.

2. Inspect the relief valve spring.

Inspect for distorted or broken relief valve spring.

---

Standard value

Free height : 46.3mm (1.8228in)

Load : 6.13±5% kgf/38.05mm (13.5±1.1% lb/1.4980in)

---

### ENGINE OIL

1. Check the engine oil quality.

Check the oil deterioration, entry of water, discoloring or thinning.

If the quality is visibly poor, replace the oil.

2. Check the engine oil level.

After warming up the engine and then 5 minutes after the engine stop, oil level should be between the “L” and “F” marks in the dipstick.

If low, check for leakage and add oil up to the “F” mark.

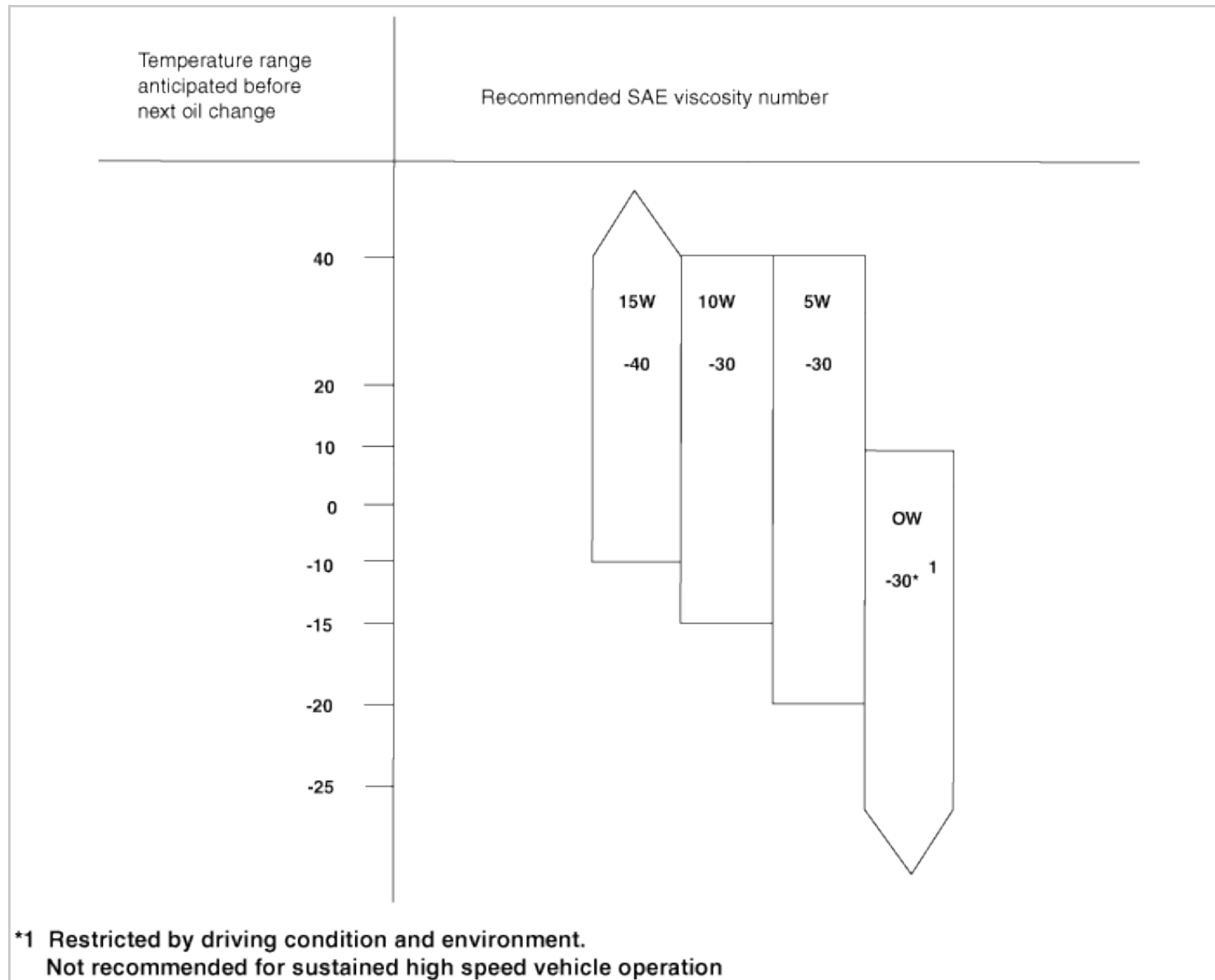
#### NOTICE

Do not fill with engine oil above the “F” mark.

### SELECTION OF ENGINE OIL

Recommended API classification : CH- 4 OR ABOVE(5W-30)

Recommended SAE viscosity grades :



#### NOTICE

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

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

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

## REASSEMBLY

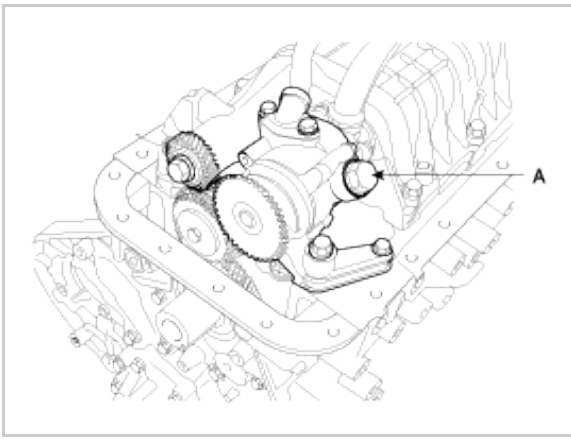
### RELIEF PLUNGER

1. Install the relief plunger.

Install relief plunger and spring into the front case hole, and install the plug(A).

Tightening torque :

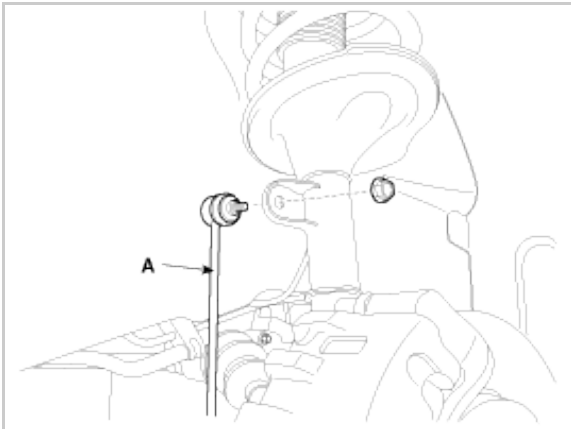
32.4~42.2Nm (3.3~4.3kgf.m, 23.9~31.1lb-ft)



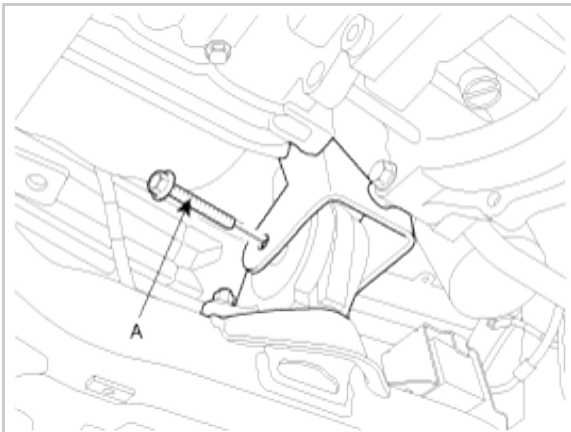
## REMOVAL

### OIL PAN

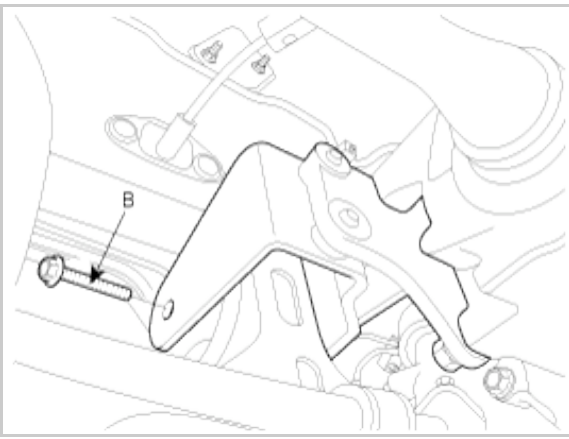
1. Drain the engine oil.
2. Remove the RH tires.
3. Remove the RH stabilizer bar link(A).



4. Remove the front roll stopper insulator mounting bolt(A).

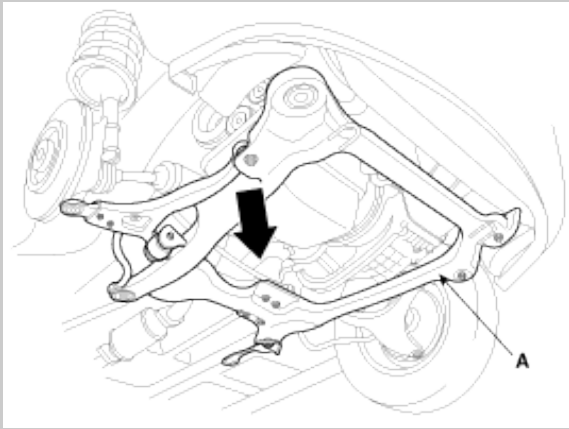


5. Remove the rear roll stopper insulator mounting bolt(B).

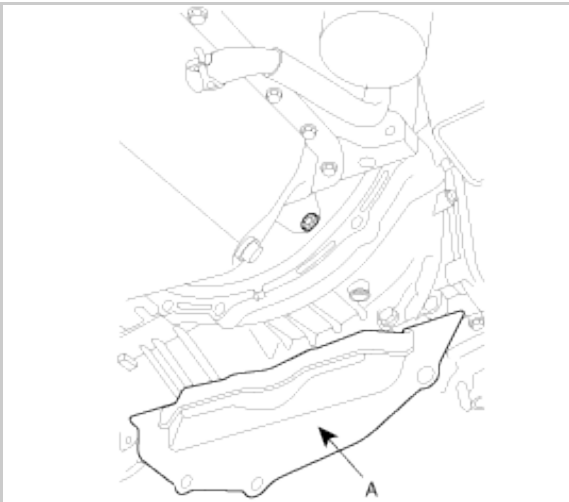


6. Remove the RH sub frame mounting bolts.

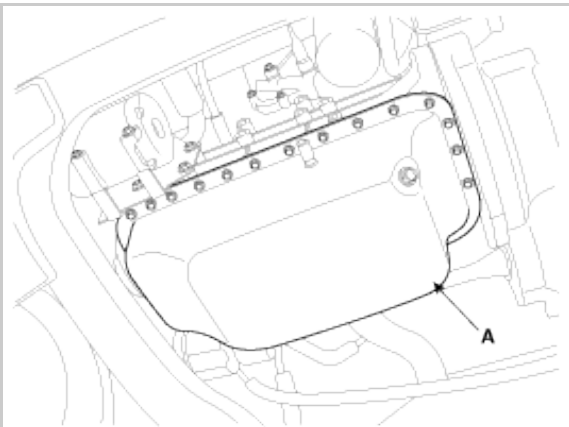
7. Tilt the sub frame(A) sideways by loosening the RH sub frame mounting bolts only.



8. Remove the plate(A) between the engine and the transaxle.

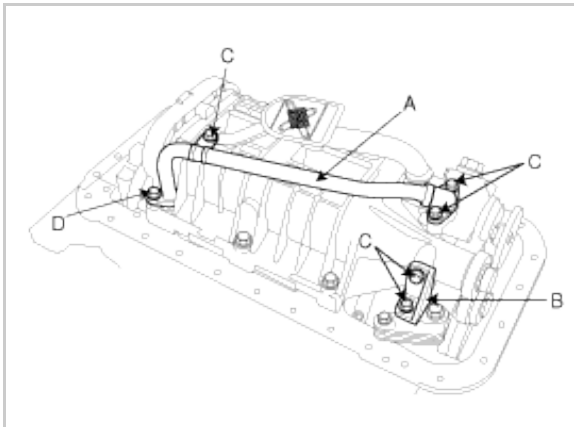


9. Using the SST(09215-3C000), remove the oil pan(A).

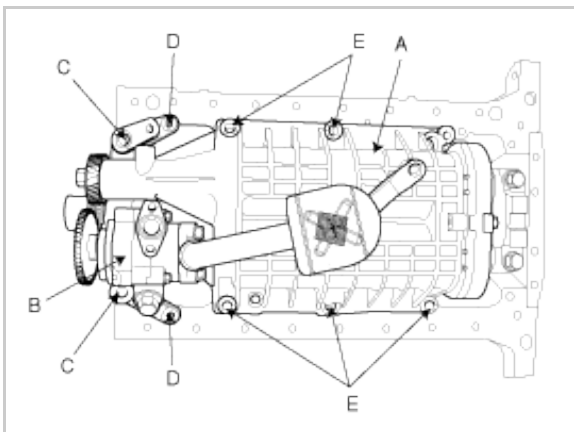


## OIL PUMP

1. Drain the engine oil.
2. Turn the crankshaft pulley, and align its groove with timing mark "T" of the timing belt cover.
3. Remove the oil pan.
4. Remove the oil supply pipe(A), ladde frame bracket(B).



5. Remove the ladde frame(A), oil pump assembly(B).



## REPLACEMENT

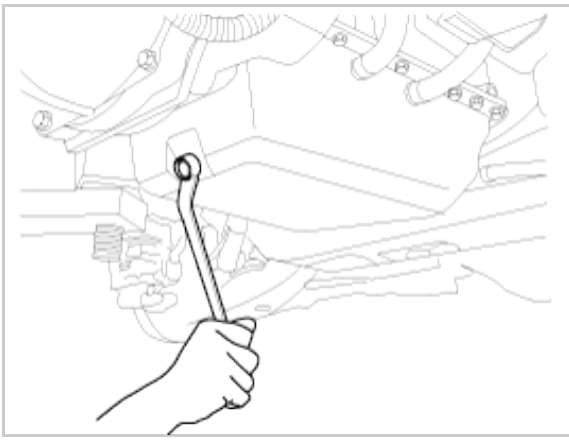
### OIL AND FILTER

#### CAUTION

- a. Prolonged and repeated contact with mineral oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer.
- b. Exercise caution in order to minimize the length and frequency of contact of your skin to used oil. Wear protective clothing and gloves. Wash your skin thoroughly with soap and water, or use water-less hand cleaner, to remove any used engine oil. Do not use gasoline, thinners, or solvents.
- c. In order to preserve the environment, used oil and used oil filter must be disposed of only at designated disposal sites.

1. Drain the engine oil.
  - (1) Remove the oil filler cap.
  - (2) Remove the oil drain plug, and drain the oil into a container.





2. Replace the oil filter.

- (1) Remove the oil filter.
- (2) Check and clean the oil filter installation surface.
- (3) Check the part number of the new oil filter is as same as old one.
- (4) Apply clean engine oil to the gasket of a new oil filter.
- (5) Lightly screw the oil filter into place, and tighten it until the gasket contacts the seat.
- (6) Tighten it an additional 3/4 turn.

---

Tightening torque :

21.6~24.5Nm (2.2~2.5kgf.m, 15.9~18.1lb-ft)

---

3. Refill with engine oil.

- (1) Clean and install the oil drain plug with a new gasket.

---

Tightening torque :

34.3~44.1Nm (3.5~4.5kgf.m, 25.3~32.5lb-ft)

---

- (2) Fill with fresh engine oil.

---

Oil Capacity

Total : 8.0 L (8.45 US qt, 7.03 Imp qt)

Oil pan : 6.0 L (6.34 US qt, 5.27 Imp qt)

Drain and refill including oil filter : 6.6 L (6.97 US qt, 5.08 Imp qt)

Oil quality : ABOVE API CH-4 or ABOVE ACEA B4

---

- (3) Install the oil filler cap.

4. Start engine and check for oil leaks.

5. Recheck the engine oil level.

## INSTALLATION

### OIL PUMP

1. Install the oil screen and new gasket.

---

Tightening torque :

15.7~22.6Nm (1.6~2.3kgf.m, 11.6~16.6lb-ft)

---

2. Install the ladde frame(A), oil pump assembly(B) with the bolts(C,D,E).

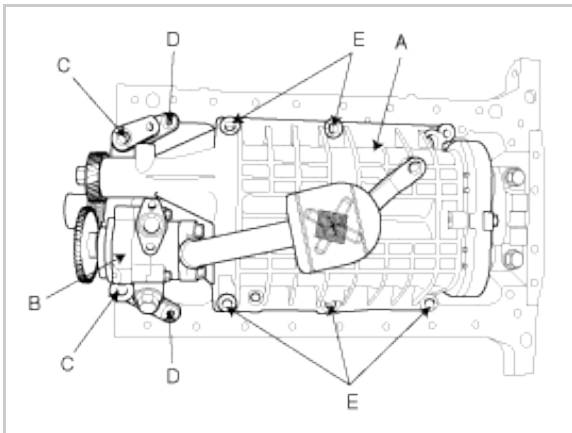
---

Tightening torque :

Bolts(C): 31.4~46.1Nm (3.2~4.7kgf.m, 23.1~34.0lb-ft)

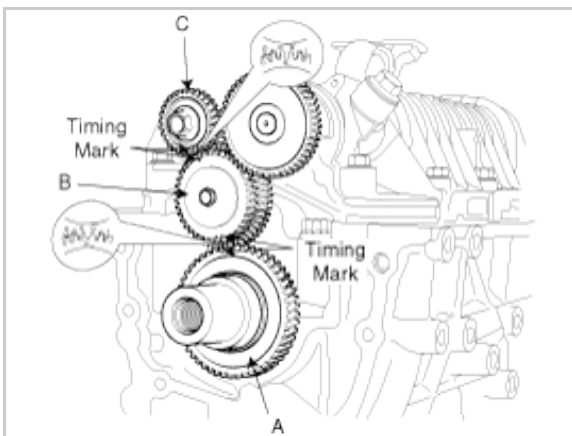
Bolts(D): 15.7~22.6Nm (1.6~2.3kgf.m, 11.6~16.6lb-ft)

Bolts(E): 31.4~46.1Nm (3.2~4.7kgf.m, 23.1~34.0lb-ft)



#### NOTICE

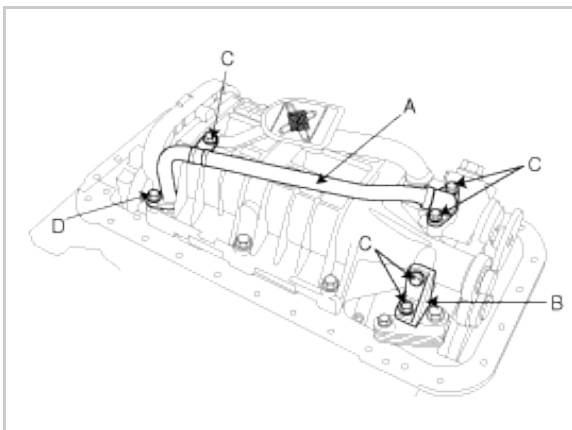
Align the timing marks on the crankshaft sprocket(A), idler(B) and balancer sprocket(C).



3. Install the oil supply pipe(A), ladde frame bracket(B) with the bolts(C,D).

Tightening torque:

15.7~22.6Nm (1.6~2.3kgf.m, 11.6~16.6lb-ft)



4. Install the oil pan.
5. Fill with engine oil.

## OIL PAN

1. Install the oil pan.
  - (1) Using a razor blade and gasket scraper, remove all the old packing material from the gasket surfaces.

#### NOTICE

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

---

(2) Apply liquid gasket as an even bead, centered between the edges of the mating surface.

---

Liquid gasket: LOCTITE 5900 or equivalent

---

**NOTICE**

- a. To prevent leakage of oil, apply liquid gasket to the inner threads of the bolt holes.
- b. 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.
- c. After assembly, wait at least 30 minutes before filling the engine with oil.

(3) Install the oil pan(A) with the bolts.

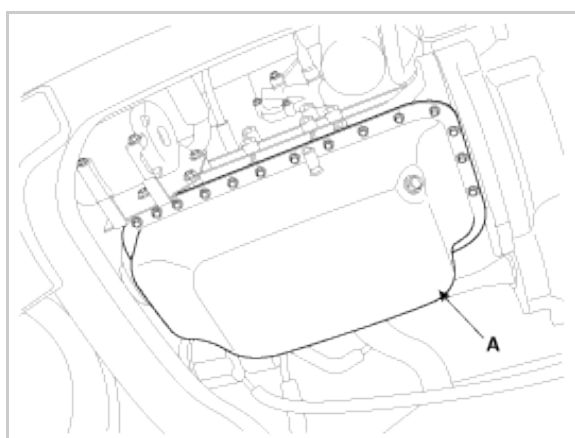
Uniformly tighten the bolts in several passes.

---

Tightening torque :

15.7~22.6Nm (1.6~2.3kgf.m, 11.6~16.6lb-ft)

---



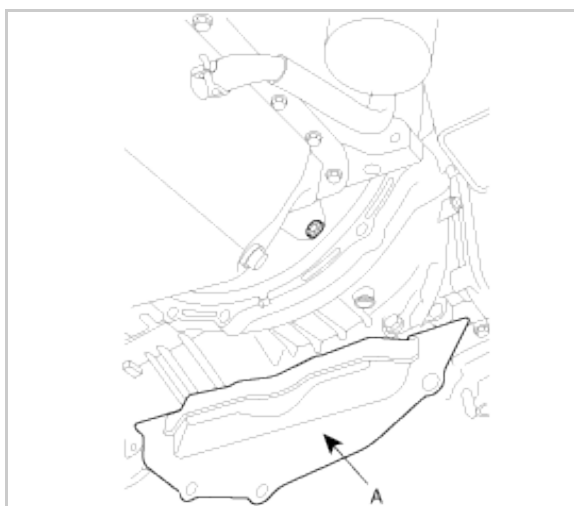
2. Install the plate(A) between the engine and the transaxle assembly.

---

Tightening torque :

15.7~22.6Nm (1.6~2.3kgf.m, 11.6~16.6lb-ft)

---



3. Install the RH, LH sub frame mounting bolts(A,B).

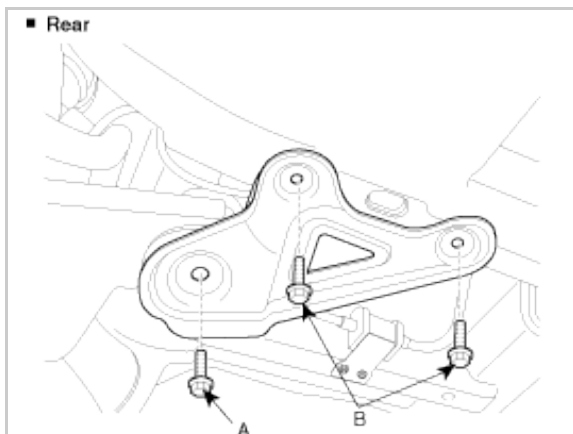
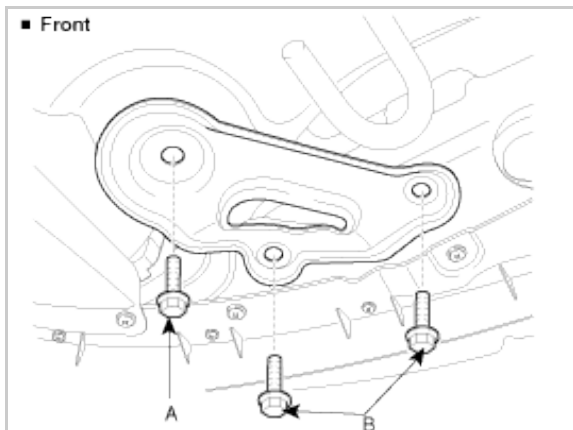
---

Tightening torque :

156.9~176.5Nm (16.0~18.0kgf.m, 115.7~130.2lb-ft)

44.1~58.8Nm (4.5~6.0kgf.m, 32.5~43.4lb-ft)

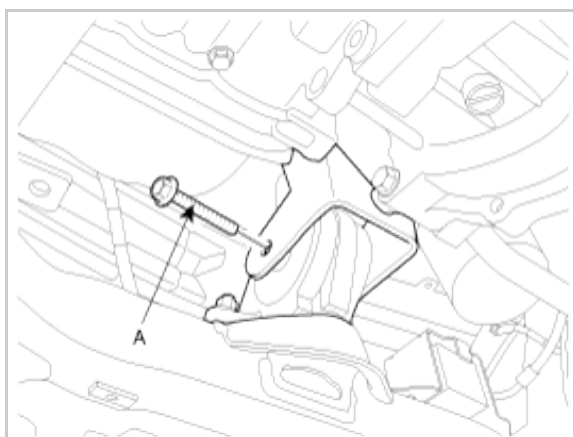
---



4. Install the front roll stopper insulator mounting bolt(A).

Tightening torque :

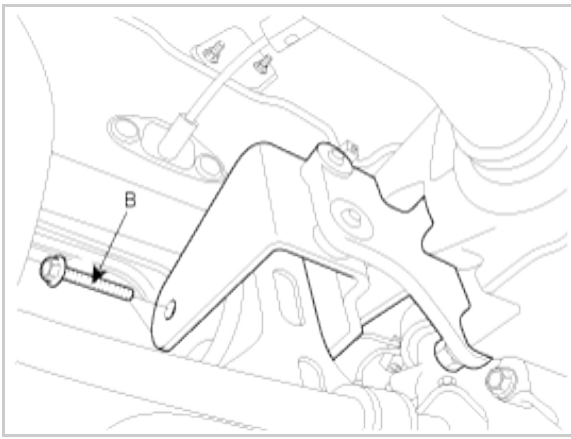
88.3~107.9Nm (9.0~11.0kgf.m, 65.1~79.6lb-ft)



5. Install the rear roll stopper insulator mounting bolt(A).

Tightening torque :

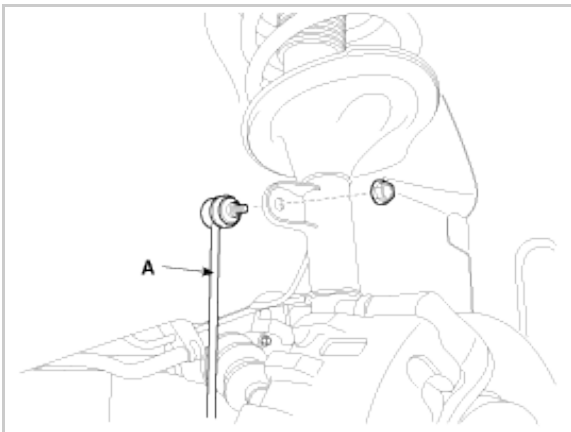
88.3~107.9Nm (9.0~11.0kgf.m, 65.1~79.6lb-ft)



6. Install the RH stabilizer bar link(A).

Tightening torque:

98.1~117.7Nm (10.0~12.0kgf.m, 72.3~86.8lb-ft)



7. Remove the RH tires.

Tightening torque :

88.3~107.9Nm (9.0~11.0kgf.m, 65.1~79.6lb-ft)

8. Fill with engine oil

## INSPECTION

### RELIEF PLUNGER

1. Inspect the relief plunger.

Coat the plunger with engine oil and check that it falls smoothly into the plunger hole by its own weight. If it does not, replace the relief plunger. If necessary, replace the front case.

2. Inspect the relief valve spring.

Inspect for distorted or broken relief valve spring.

Standard value

Free height : 46.3mm (1.8228in)

Load : 6.13±5% kgf/38.05mm (13.5±1.1% lb/1.4980in)

### ENGINE OIL

1. Check the engine oil quality.

Check the oil deterioration, entry of water, discoloring or thinning.

If the quality is visibly poor, replace the oil.

2. Check the engine oil level.

After warming up the engine and then 5 minutes after the engine stop, oil level should be between the “L” and “F” marks in the dipstick.

If low, check for leakage and add oil up to the “F” mark.

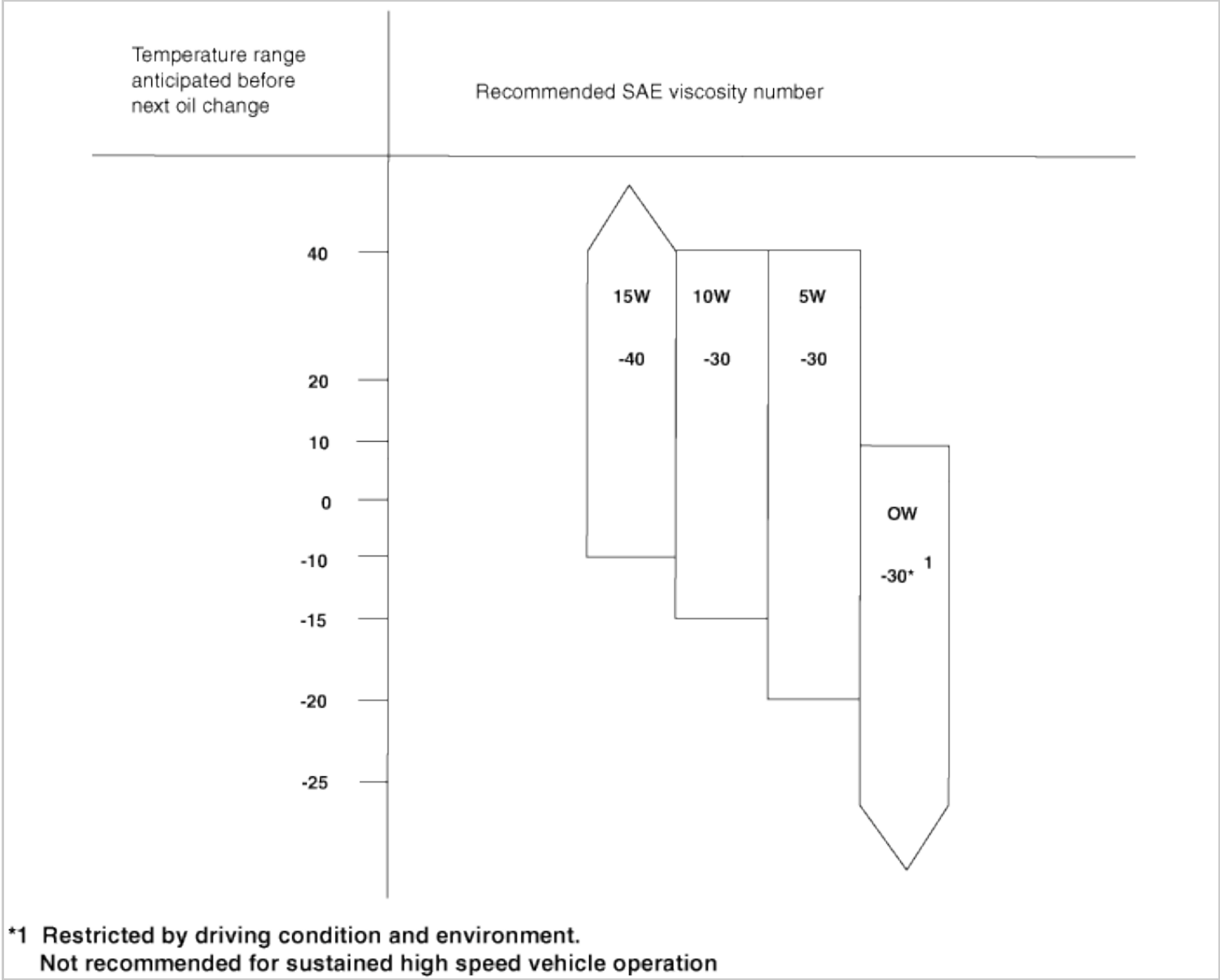
**NOTICE**

Do not fill with engine oil above the “F” mark.

**SELECTION OF ENGINE OIL**

Recommended API classification : CH- 4 OR ABOVE(5W-30)

Recommended SAE viscosity grades :



**NOTICE**

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

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

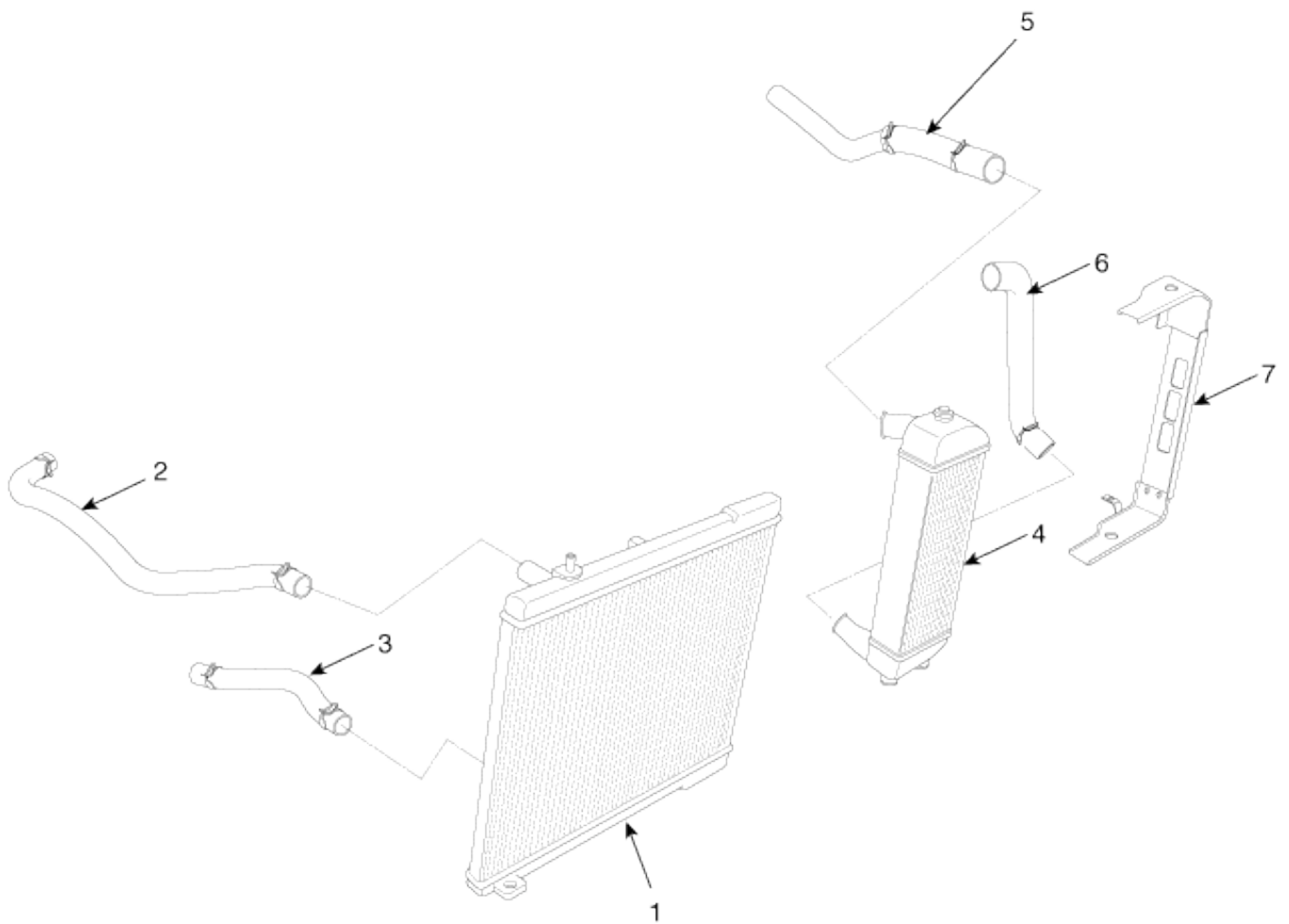
Lubricants that do not have both an SAE grade number and API service classification on the container should not be used.

# **Intake and Exhaust system**

# Intercooler



## COMPONENTS

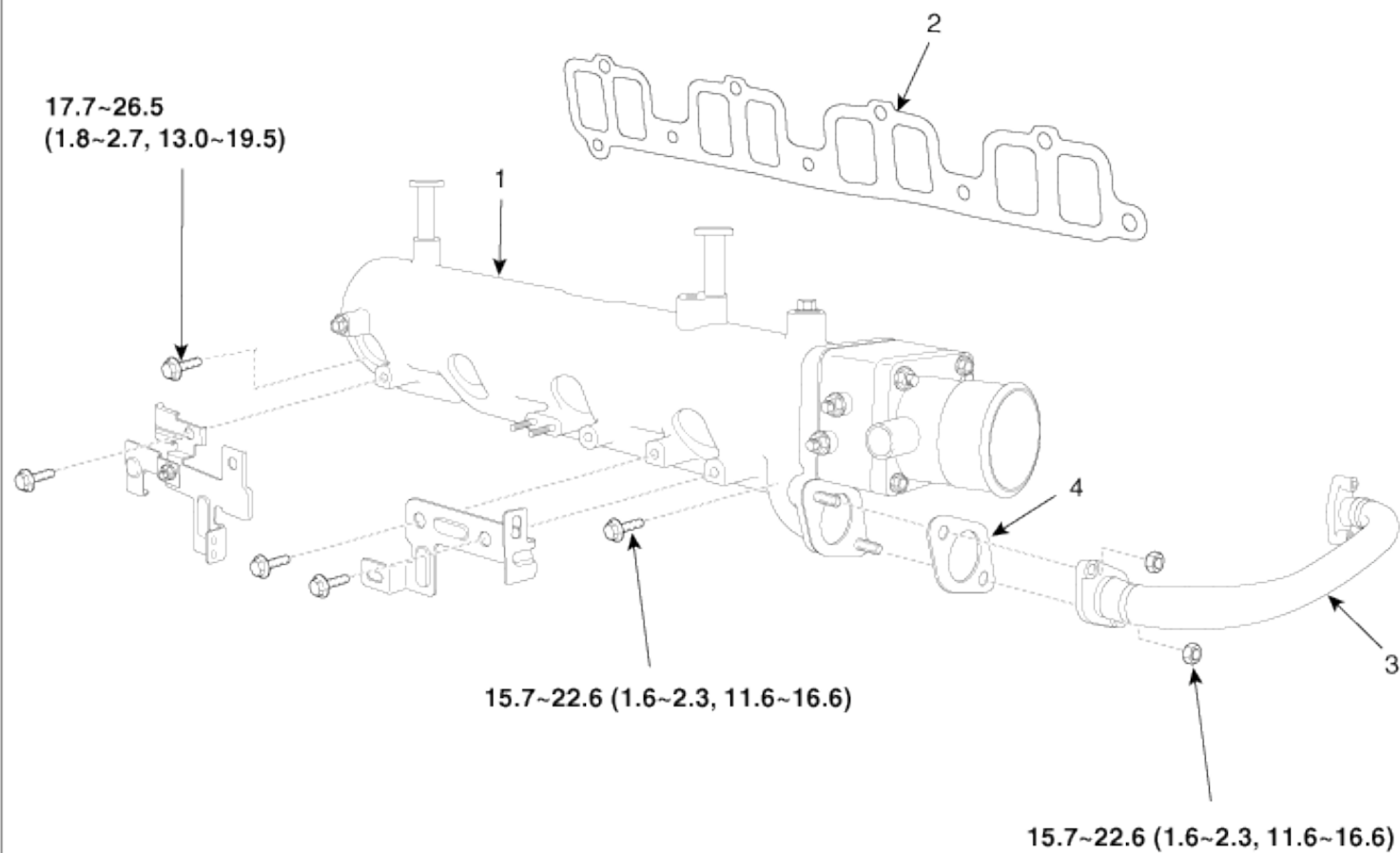


- 1. Radiator
- 2. Radiator upper hose
- 3. Radiator lower hose
- 4. Intercooler

- 5. Intercooler upper hose
- 6. Intercooler lower hose
- 7. Intercooler bracket

# **Intake Manifold**

## COMPONENTS



**TORQUE : N.m (kgf.m, lb-ft)**

1. Intake manifold

2. Intake manifold gasket

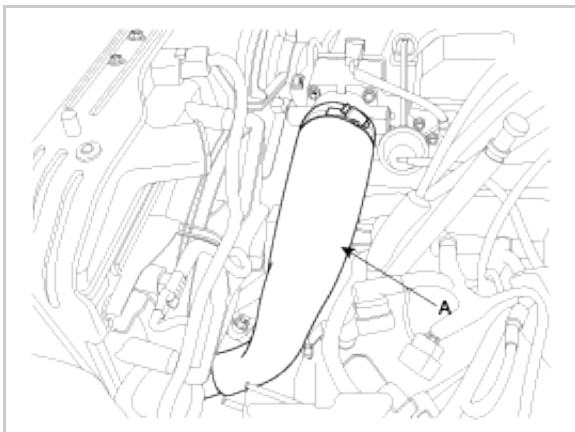
3. EGR pipe

4. EGR pipe gasket

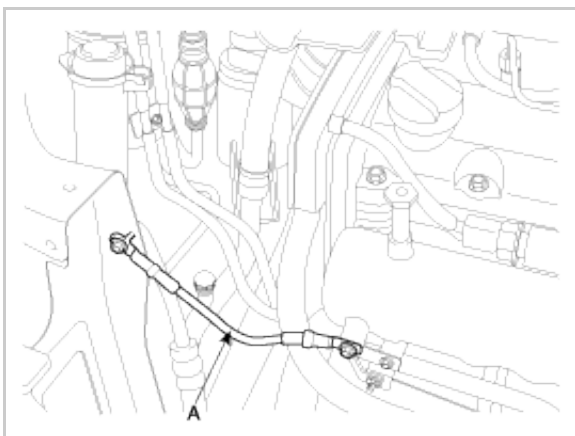
## REMOVAL

### INTAKE MANIFOLD

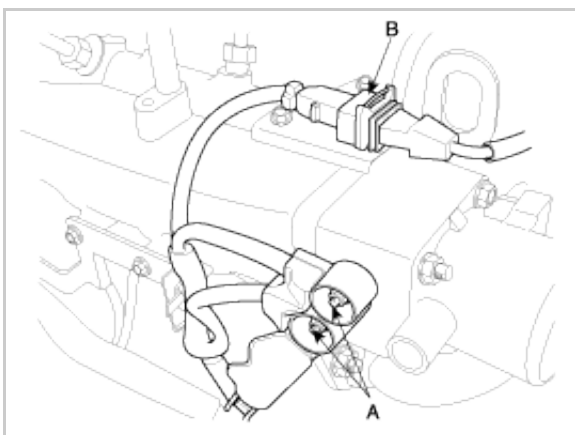
1. Remove the air intake hose, air cleaner assembly.
2. Remove the intercooler hoses(A).



3. Remove the ground cable(A) from cylinder head.



4. Remove the air heater terminals(A) CMP(Crankshaft position sensor) connector(B).



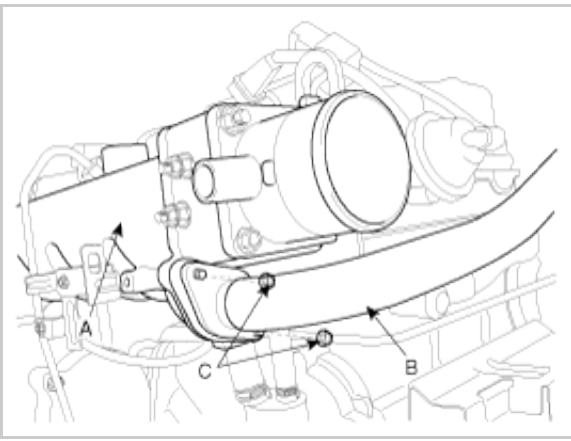
5. Remove the injection high pressure. (Refer to FL group).
6. Remove the EGR pipe(B).

---

Tightening torque :

15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)

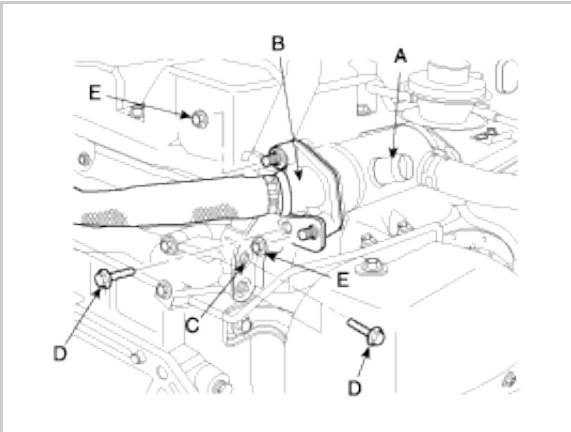
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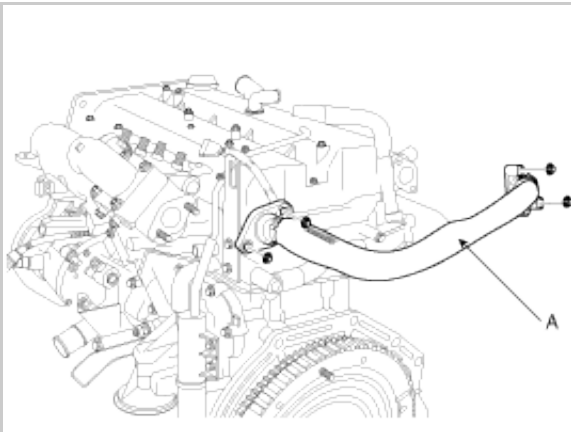
#### 7. Remove the EGR pipe

Tightening torque :

Bolts(D), Nut(E): 15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)



#### 8. Remove the EGR pipe(A).

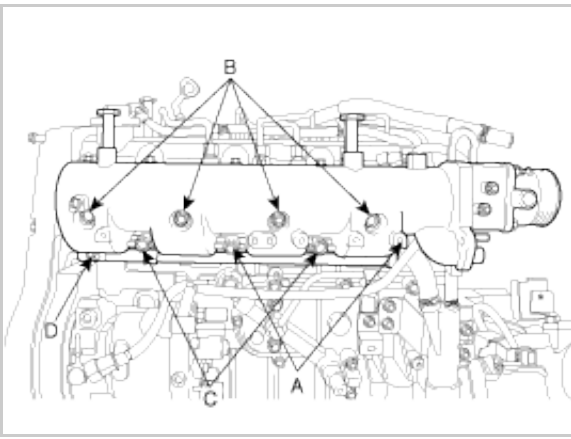


#### 9. Remove the intake manifold.

Tightening torque :

Bolts(A,B), Nut(C): 15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)

Hexagonal wrench bolt (D): 17.7 ~ 26.5Nm (1.8 ~ 2.7kgf.m, 13.0 ~ 19.5lb-ft)



10. Installation is in the reverse order of removal with new gasket.

# Exhaust Manifold

This diagram illustrates the assembly of a vehicle's front suspension and steering components. The parts are numbered 1 through 12, and their respective torque specifications are provided in both metric (Nm) and imperial (ft-lb) units.

- 1**: Upper ball joint assembly. Torque: 26.5~34.3 (2.7~3.5, 19.5~25.3).
- 2**: Lower ball joint assembly. Torque: 21.6~26.5 (2.2~2.7, 15.9~19.5).
- 3**: Steering knuckle. Torque: 15.7~22.6 (1.6~2.3, 11.6~16.6).
- 4**: Lower control arm. Torque: 15.7~22.6 (1.6~2.3, 11.6~16.6).
- 5**: Lower control arm. Torque: 23.5~35.3 (2.4~3.6, 17.4~26.0).
- 6**: Lower control arm. Torque: 26.5~30.4 (2.7~3.1, 19.5~22.4).
- 7**: Lower control arm. Torque: 11.8~17.7 (1.2~1.8, 8.7~13.0).
- 8**: Lower control arm. Torque: 26.5~34.3 (2.7~3.5, 19.5~25.3).
- 9**: Lower control arm. Torque: 26.5~34.3 (2.7~3.5, 19.5~25.3).
- 10**: Lower control arm. Torque: 8.8~12.7 (0.9~1.3, 6.5~9.4).
- 11**: Lower control arm. Torque: 8.8~12.7 (0.9~1.3, 6.5~9.4).
- 12**: Lower control arm. Torque: 8.8~12.7 (0.9~1.3, 6.5~9.4).

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

- |                      |                                     |                                |
|----------------------|-------------------------------------|--------------------------------|
| 1. EGR valve         | 5. Turbo chargers water inlet pipe  | 9. Turbo charger assembly      |
| 2. EGR cooler        | 6. Heat protector                   | 10. Engine hanger              |
| 3. EGR pipe          | 7. Turbo chargers oil inlet pipe    | 11. Exhaust manifold insulator |
| 4. EGR pipe mounting | 8. Turbo chargers water outlet pipe | 12. Exhaust manifold           |

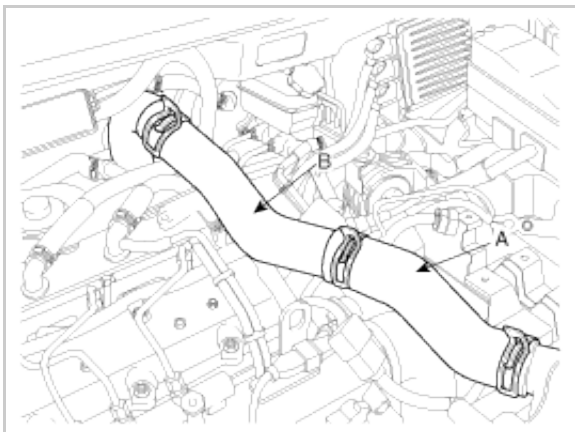




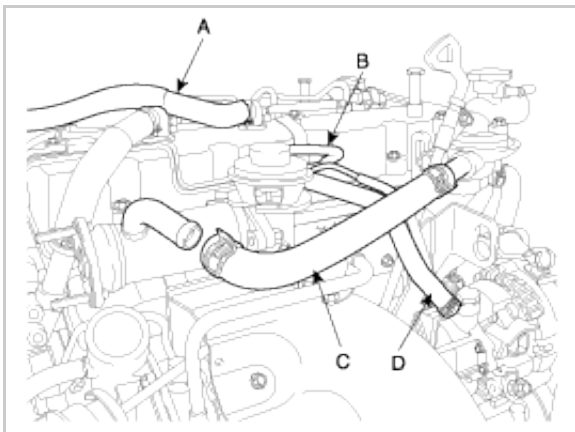
## REMOVAL

### EXHAUST MANIFOLD

1. Remove the air intake hose, air cleaner assembly.
2. Remove the intercooler hoses, pipe(A, B).



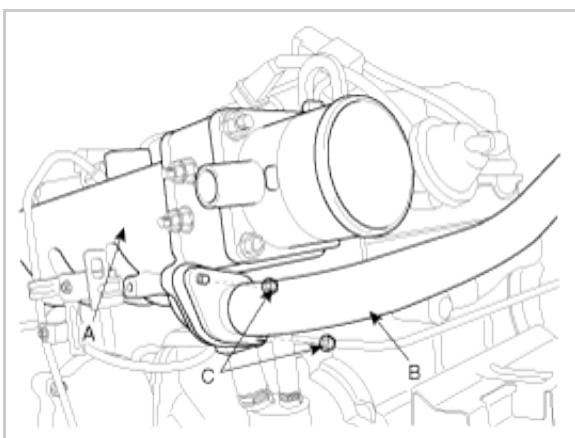
3. Remove the PCV(Positive Crankcase Ventilation) hose(A), EGR valve vacuum hose(B), EGR cooler water hose(C), vacuum pump oil hose(D).



4. Remove the EGR pipe(B).

Tightening torque :

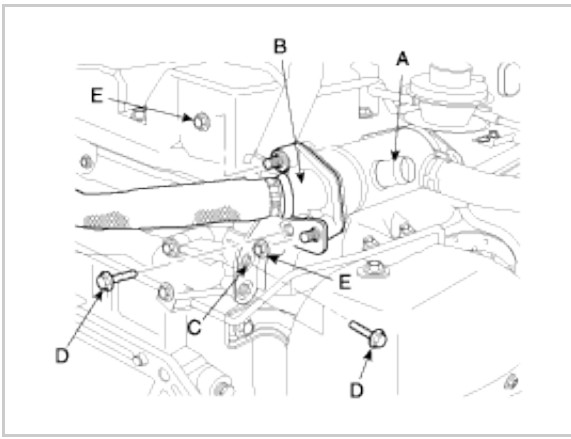
15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)



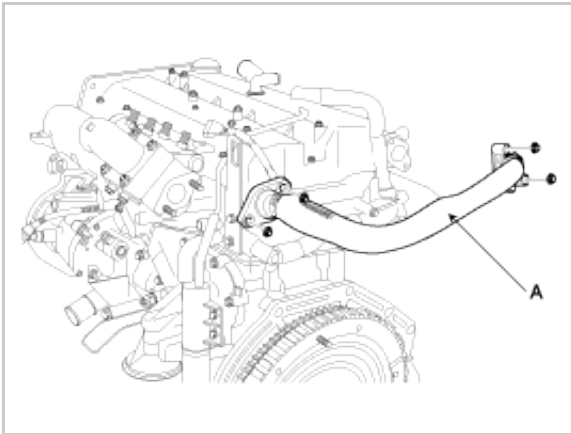
5. Remove the EGR pipe

Tightening torque :

Bolts(D), Nut(E): 15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)



6. Remove the EGR pipe(A).

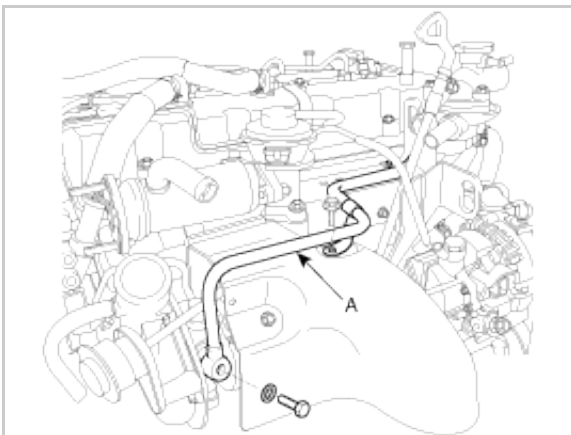


7. Remove the turbo chargers water inlet pipe(A).

Tightening torque :

Eye bolt(B): 23.5~35.3Nm (2.4~3.6kgf.m, 17.4~26.0lb-ft)

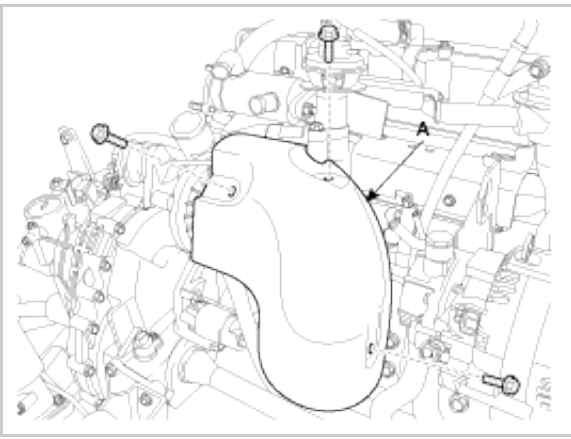
Bolt(C): 8.8~12.7Nm (0.9~1.3kgf.m, 6.5~9.4lb-ft)



8. Remove the heat protector(A).

Tightening torque :

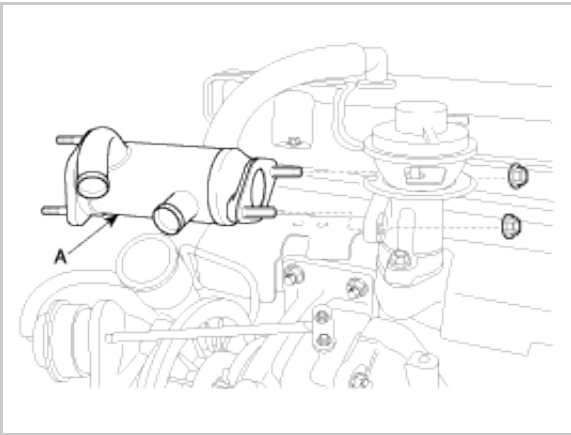
8.8~12.7Nm (0.9~1.3kgf.m, 6.5~9.4lb-ft)



9. Remove the EGR cooler(A).

Tightening torque :

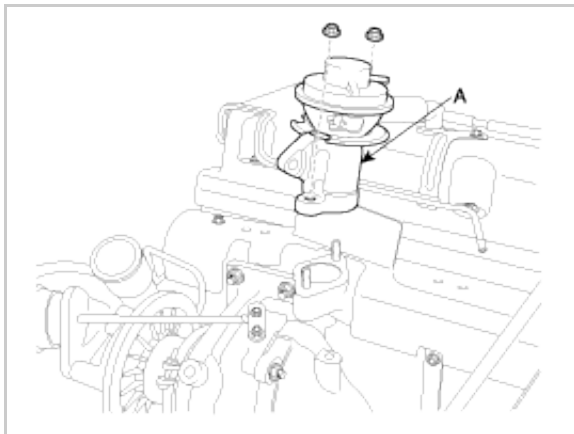
26.5~34.3Nm (2.7~3.5kgf.m, 19.5~25.3lb-ft)



10. Remove the EGR valve(A).

Tightening torque :

21.6~26.5Nm (2.2~2.7kgf.m, 15.9~19.5lb-ft)

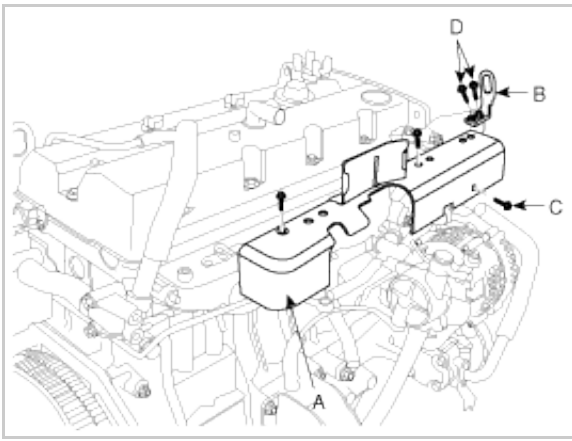


11. Remove the exhaust manifold insulator(A), engine hanger(B).

Tightening torque :

Bolts(C): 8.8~12.7Nm (0.9~1.3kgf.m, 6.5~9.4lb-ft)

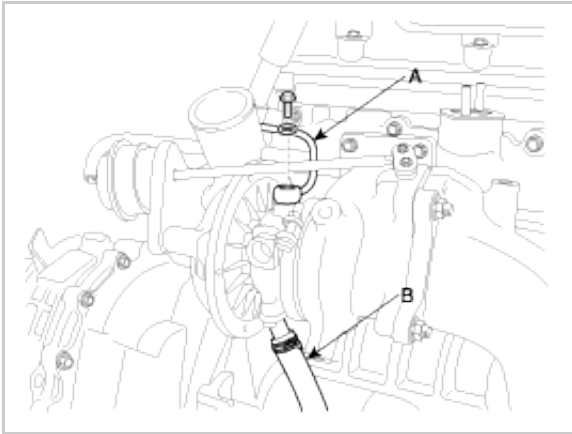
Bolts(D): 17.7 ~ 26.5Nm (1.8 ~ 2.7kgf.m, 13.0 ~ 19.5lb-ft)



12. Remove the turbo charger oil inlet pipe(A), oil outlet hose(B).

Tightening torque :

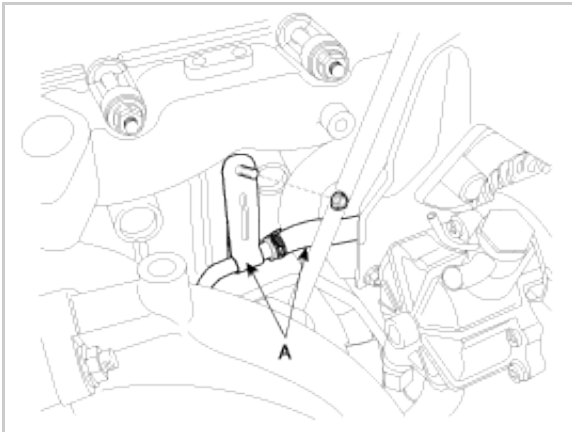
11.8~17.7Nm (1.2~1.8kgf.m, 8.7~13.0lb-ft)



13. Remove the turbo charger water outlet pipe, hose(A).

Tightening torque :

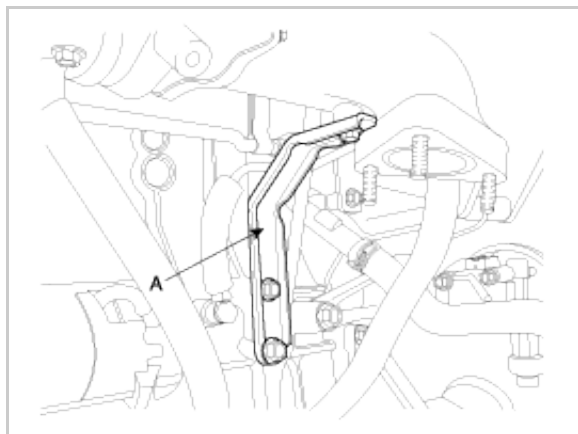
23.5~35.3Nm (2.4~3.6kgf.m, 17.4~26.0lb-ft)



14. Remove the turbo charger stay(A).

Tightening torque :

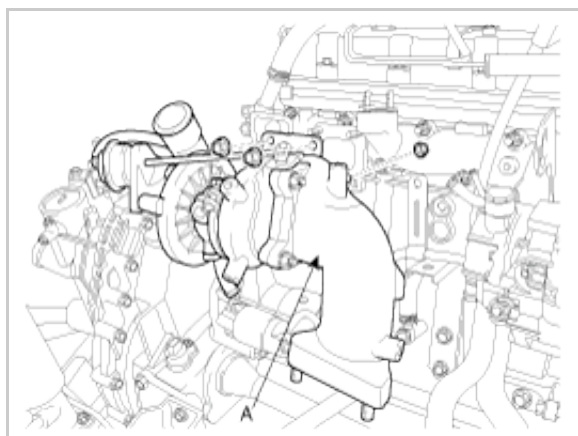
30.4~36.3Nm (3.1~3.7kgf.m, 22.4~26.8lb-ft)



15. Remove the turbo charger assembly(A).

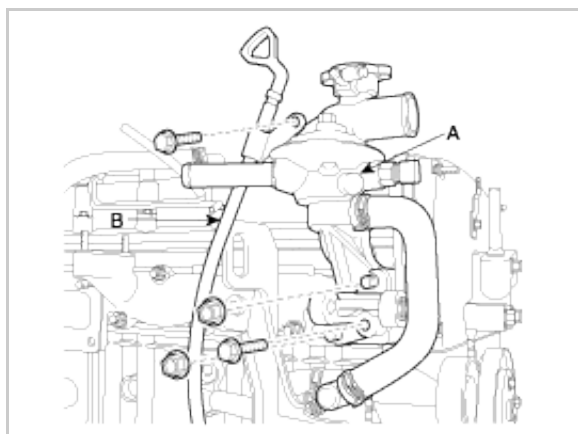
Tightening torque :

26.5~34.3Nm (2.7~3.5kgf.m,19.5~25.3lb-ft)



16. Remove the generator. (Refer to EE group).

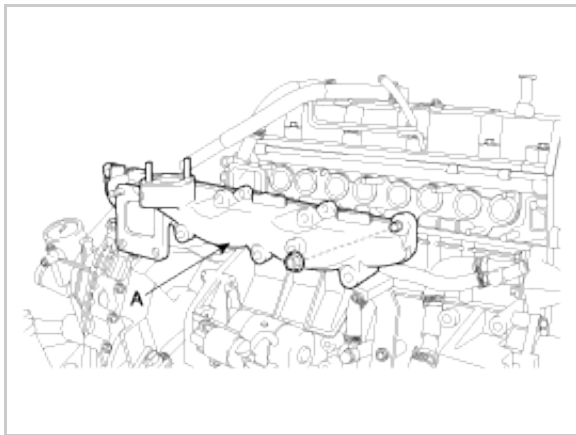
17. Remove the thermostat case(A), oil level gauge tube(B).



18. Remove the exhaust manifold(A).

Tightening torque :

26.5~34.3Nm (2.7~3.5kgf.m,19.5~25.3lb-ft)



## INSPECTION

### TURBO CHARGER

1. Warm up the engine to the normal temperature.
2. After removing the hose between the intake manifold and the intercooler, install the pressure gauge with 3-way connector.
3. Measure the maximum pressure data by starting the engine and raising up the rpm.

PRESSURE GAUGE	INSPECTION
Not fixed pressure or low pressure	a. Leakage from the intake or exhaust system b. Inferior turbocharger
Pressure is above the standard. (630~670mmHg/3,800rpm)	a. Leakage from the inferior actuator hose b. Actuator defect

### ACTUATOR

1. After removing the air hose from the actuator, install the pressure tester.
2. Install the dial gauge in a straight line with the actuator rod.
3. Using the pressure tester, when the pressure, 1,320~1,360Hg is applied, check whether the actuator rod is shifted 2.0mm.

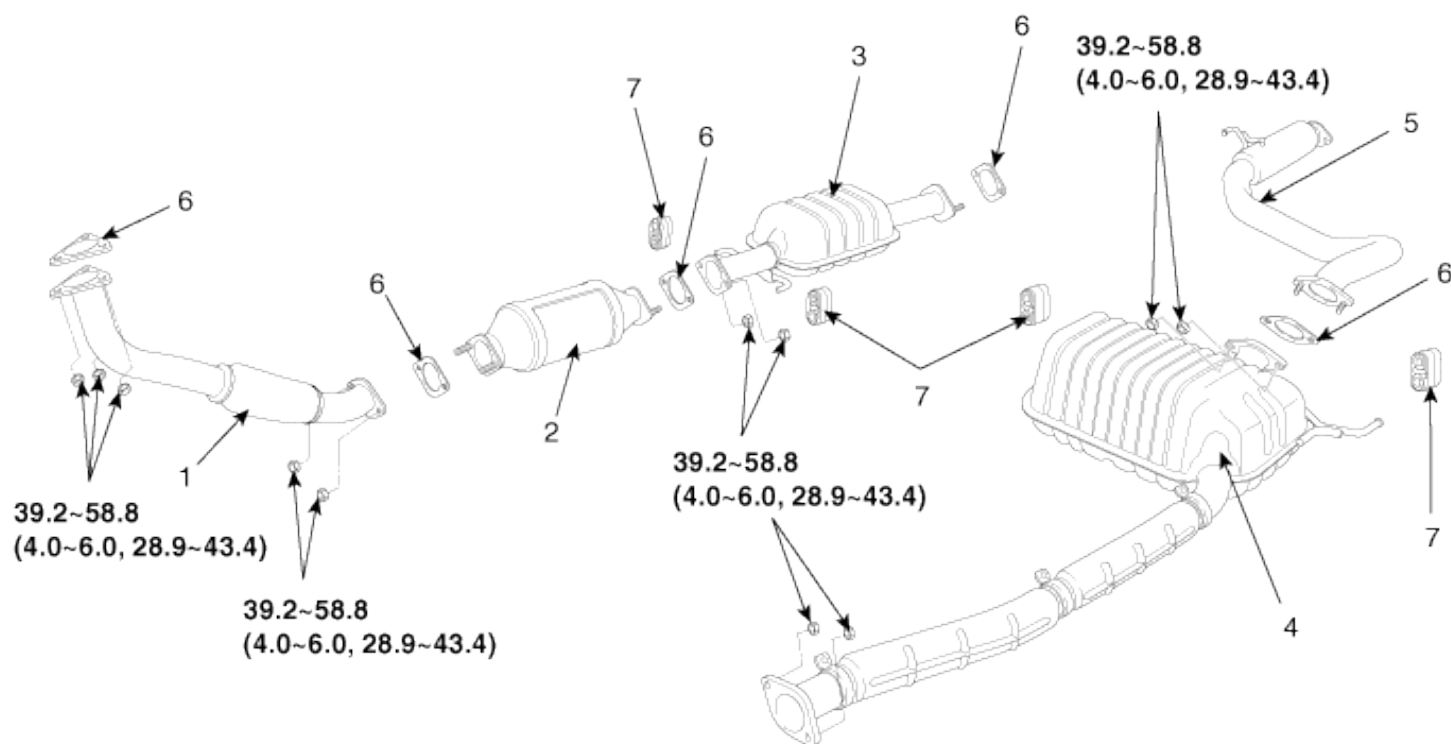
#### CAUTION

If the pressure more than 1.7 kg/cm<sup>2</sup>(1,250mmHg) is applied, there is a danger which the actuator will be damaged.

4. Replace an actuator when it is not working or pressure can not be applied.

# Front Exhaust Pipe

## COMPONENTS



**TORQUE : N.m (kgf.m, lb-ft)**

- |                        |                  |
|------------------------|------------------|
| 1. Front muffler       | 5. Tail pipe     |
| 2. Catalytic converter | 6. Gasket        |
| 3. Center muffler      | 7. Rubber hanger |
| 4. Main muffler        |                  |

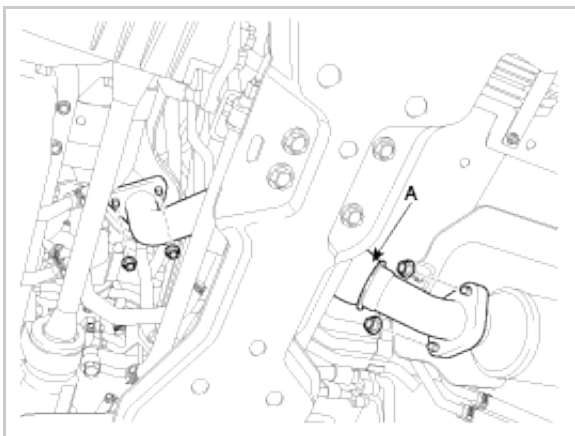


## REMOVAL

1. Remove the front muffler(A).

Tightening torque:

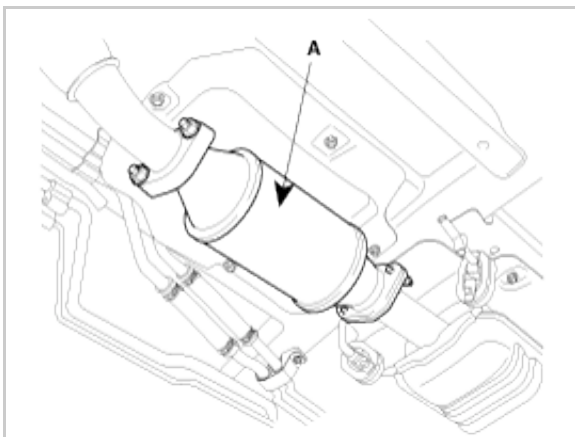
39.2~58.8Nm (4.0~6.0kgf.m, 28.9~43.4lb-ft)



2. Remove the catalytic converter(A).

Tightening torque :

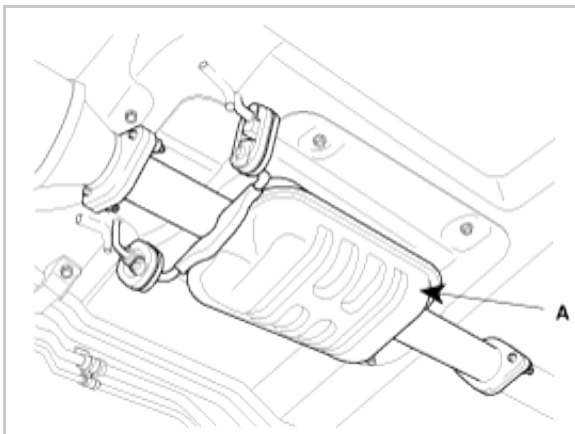
39.2~58.8Nm (4.0~6.0kgf.m, 28.9~43.4lb-ft)



3. Remove the center muffler(A).

Tightening torque :

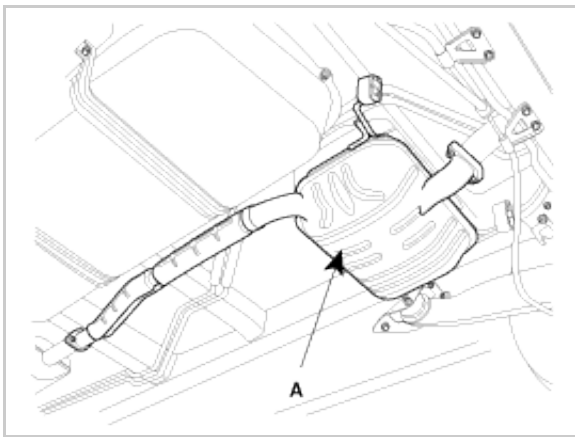
39.2~58.8Nm (4.0~6.0kgf.m, 28.9~43.4lb-ft)



4. Remove the main muffler(A).

Tightening torque :  
39.2~58.8Nm (4.0~6.0kgf.m, 28.9~43.4lb-ft)

---

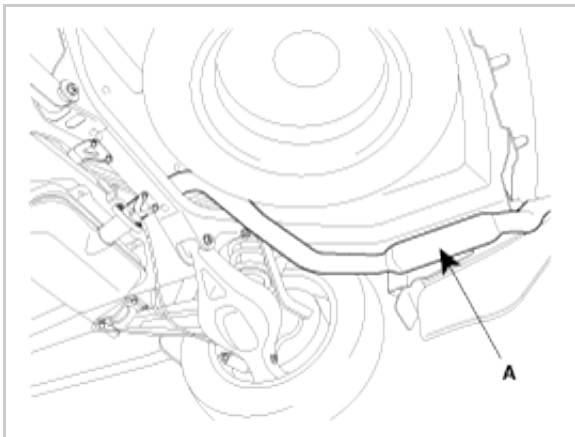


5. Remove the tail pipe(A).

---

Tightening torque :  
39.2~58.8Nm (4.0~6.0kgf.m, 28.9~43.4lb-ft)

---



## **CHAPTER 3:**

# **Engine Electrical System**

# **General information**



## TROUBLESHOOTING

### CHARGING SYSTEM

Symptom	Suspect area	Remedy
Charging warning indicator does not light with ignition switch "ON" and engine off.	a. Fuse blown b. Light burned out c. Poor wiring connection d. Inferior electronic voltage regulator	a. Check fuses b. Replace a lamp c. Tighten loose connection d. Replace voltage regulator
Charging warning indicator does not go out with engine running. (Battery requires frequent recharging)	a. Drive belt loose or worn b. Battery cable loose, corroded or worn c. Inferior electronic voltage regulator or generator d. Bad wiring connection	a. Adjust belt tension or replace belt b. Inspect cable connection, repair or replace cable c. Replace voltage regulator or generator d. Repair or replace wiring
Overcharge	a. Electronic voltage regulator b. Voltage sensing wire	a. Replace voltage regulator b. Repair or replace wiring
Discharge	a. Drive belt loose or worn b. Wiring connection loose or short circuit c. Electronic voltage regulator or generator d. Poor grounding e. Worn battery	a. Adjust belt tension or replace belt b. Inspect wiring connection, repair or replace wiring c. Replace voltage regulator or generator d. Inspect ground or repair e. Replace battery

### STARTING SYSTEM

Symptom	Suspect area	Remedy
Engine will not crank	a. Battery charge low b. Battery cables loose, corroded or worn out c. Transaxle range switch (Vehicle with automatic transaxle only) d. Fuse blown e. Starter motor faulty f. Ignition switch faulty	a. Charge or replace battery b. Repair or replace cables c. Refer to AT group-automatic transaxle d. Replace fuse e. Replace f. Replace
Engine cranks slowly	a. Battery charge low b. Battery cables loose, corroded or worn out c. Starter motor faulty	a. Charge or replace battery b. Repair or replace cables c. Replace
Starter keeps running	a. Starter motor b. Ignition switch	a. Replace b. Replace
Starter spins but engine will not crank	a. Short in wiring b. Pinion gear teeth broken or starter motor c. Ring gear teeth broken	a. Repair wiring or replace b. Replace c. Replace fly wheel or torque converter



## SPECIFICATION

### STARTING SYSTEM

Item			J3 common rail
Starter	Rated voltage		12V, 2.0KW
	No. of pinion teeth		12
	No-load characteristics	Voltage	11.5V
		Amperage	190A, MAX
		Speed	3,000rpm, MIN

### CHARGING SYSTEM

Item			J3 common rail	
Generator	Type		Battery voltage sensing	
	Rated voltage		12V, 120A	
	Voltage regulator type		I.C regulator built-in type	
	Regulator setting voltage		14.4 ± 0.3V	
	Temperature compensation		-10 ± 3mV/°C	
Battery	Type		CMF 100 AH	MF 80AH
	Cold cranking amperage at -18°C (-0.4°F)		900A	660A
	Reserve capacity		182min	145min.
	Specific gravity at 25°C (77°F)		1.280 ± 0.01	←

#### NOTICE

- COLD CRANKING AMPERAGE is the amperage a battery can deliver for 30 seconds and maintain a terminal voltage of 7.2V or greater at a specified temperature.
- REVERSE CAPACITY RATING is amount of time a battery can deliver 25A and maintain a minimum terminal voltage of 10.5V at 26.7°C(80°F)

# Charging System



## DESCRIPTION

The charging system includes a battery, an generator with a built-in regulator, and the charging indicator light and wire.

The generator has eight built-in diodes, each rectifying AC current to DC current.

Therefore, DC current appears at generator "B" terminal.

In addition, the charging voltage of this generator is regulated by the battery voltage detection system in the regulator.

The generator is regulated by the voltage detection system. The main components of the generator are the rotor, stator, rectifier, capacitor, brushes, bearings and overrunning alternator pulley (OAP). The brush holder contains a built-in electronic voltage regulator.





## ON-VEHICLE INSPECTION

### CAUTION

- a. Check that the battery cables are connected to the correct terminals.
- b. Disconnect the battery cables when the battery is given a quick charge.
- c. Never disconnect the battery while the engine is running.

## CHECK BATTERY VOLTAGE

1. If 20 minutes have not passed since the engine was stopped, turn the ignition switch ON and turn on the electrical system (headlamp, blower motor, rear defogger etc.) for 60 seconds to remove the surface charge.
2. Turn the ignition switch OFF and turn off the electrical systems.
3. Measure the battery voltage between the negative (-) and positive (+) terminals of the battery.

Standard voltage : 12.5 ~ 12.9V at 20°C(68°F)

If the voltage is less than specification, charge the battery.

## CHECK THE BATTERY TERMINALS AND FUSES

1. Check that the battery terminals are not loose or corroded.
2. Check the fuses for continuity.

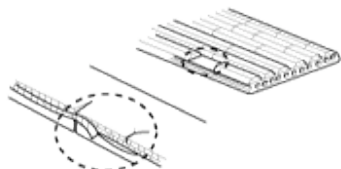
## INSPECT DRIVE BELT

Visually check the belt for excessive wear, frayed cords etc.

If any defect has been found, replace the drive belt.

### NOTICE

Cracks on the rib side of a belt are considered acceptable. If the belt has chunks missing from the ribs, it should be replaced.



## VISUALLY CHECK ALTERNATOR WIRING AND LISTEN FOR ABNORMAL NOISES

1. Check that the wiring is in good condition.
2. Check that there is no abnormal noise from the alternator while the engine is running.

## CHECK DISCHARGE WARNING LIGHT CIRCUIT

1. Warm up the engine and then turn it off.
2. Turn off all accessories.
3. Turn the ignition switch "ON". Check that the discharge warning light is lit.
4. Start the engine. Check that the light is lit.  
If the light does not go off as specified, troubleshoot the discharge light circuit.

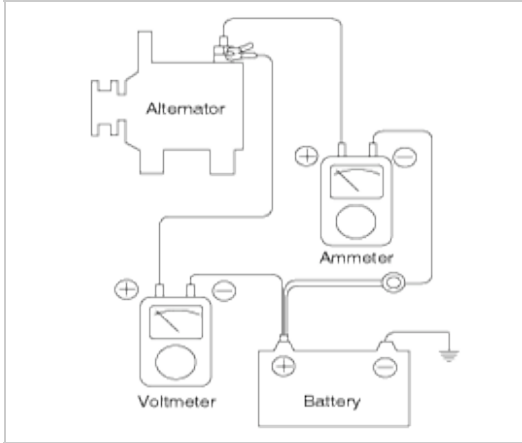
## INSPECT CHARGING SYSTEM

### VOLTAGE DROP TEST OF ALTERNATOR OUTPUT WIRE

This test determines whether or not the wiring between the alternator "B" terminal and the battery (+) terminal is good by the voltage drop method.

## PREPARATION

1. Turn the ignition switch to "OFF".
2. Disconnect the output wire from the alternator "B" terminal. Connect the (+) lead wire of ammeter to the "B" terminal of alternator and the (-) lead wire of ammeter to the output wire. Connect the (+) lead wire of voltmeter to the "B" terminal of alternator and the (-) lead wire of voltmeter to the (+) terminal of battery.



## TEST

1. Start the engine.
2. Turn on the headlamps and blower motor, and set the engine speed until the ammeter indicates 20A. And then, read the voltmeter at this time.

## RESULT

1. The voltmeter may indicate the standard value.

---

Standard value: 0.2V max

---

2. If the value of the voltmeter is higher than expected (above 0.2V max.), poor wiring is suspected. In this case check the wiring from the alternator "B" terminal to the battery (+) terminal. Check for loose connections, color change due to an over-heated harness, etc. Correct them before testing again.
3. Upon completion of the test, set the engine speed at idle. Turn off the headlamps, blower motor and the ignition switch.

## OUTPUT CURRENT TEST

This test determines whether or not the alternator gives an output current that is equivalent to the normal output.

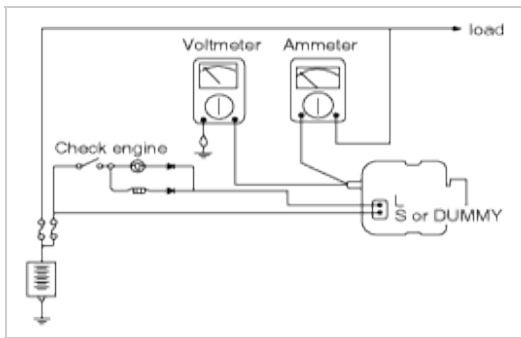
### PREPARATION

1. Prior to the test, check the following items and correct as necessary.  
Check the battery installed in the vehicle to ensure that it is good condition. The battery checking method is described in the section "Battery".  
The battery that is used to test the output current should be one that has been partially discharged. With a fully charged battery, the test may not be conducted correctly due to an insufficient load.  
Check the tension of the alternator drive belt. The belt tension check method is described in the section "Inspect drive belt".
2. Turn off the ignition switch.
3. Disconnect the battery ground cable.
4. Disconnect the alternator output wire from the alternator "B" terminal.
5. Connect a DC ammeter (0 to 150A) in series between the "B" terminal and the disconnected output wire. Be sure to connect the (-) lead wire of the ammeter to the disconnected output wire.

#### NOTICE

Tighten each connection securely, as a heavy current will flow. Do not rely on clips.

6. Connect a voltmeter (0 to 20V) between the "B" terminal and ground. Connect the (+) lead wire to the alternator "B" terminal and (-) lead wire to a good ground.
7. Attach an engine tachometer and connect the battery ground cable.
8. Leave the engine hood open.



## TEST

1. Check to see that the voltmeter reads as the same value as the battery voltage. If the voltmeter reads 0V, and the open circuit in the wire between alternator "B" terminal and battery (-) terminal or poor grounding is suspected.
2. Start the engine and turn on the headlamps.
3. Set the headlamps to high beam and the heater blower switch to HIGH, quickly increase the engine speed to 2,500 rpm and read the maximum output current value indicated by the ammeter.

### NOTICE

After the engine start up, the charging current quickly drops.  
Therefore, the above operation must be done quickly to read the maximum current value correctly.

## RESULT

1. The ammeter reading must be higher than the limit value. If it is lower but the alternator output wire is in good condition, remove the alternator from the vehicle and test it.

---

Limit value : 70% of the rated current

---

### NOTICE

- a. The nominal output current value is shown on the nameplate affixed to the alternator body.
- b. The output current value changes with the electrical load and the temperature of the alternator itself.  
Therefore, the nominal output current may not be obtained. If such is the case, keep the headlamps on the cause discharge of the battery, or use the lights of another vehicle to increase the electrical load.  
The nominal output current may not be obtained if the temperature of the alternator itself or ambient temperature is too high.  
In such a case, reduce the temperature before testing again.

2. Upon completion of the output current test, lower the engine speed to idle and turn off the ignition switch.
3. Disconnect the battery ground cable.
4. Remove the ammeter and voltmeter and the engine tachometer.
5. Connect the alternator output wire to the alternator "B" terminal.
6. Connect the battery ground cable.

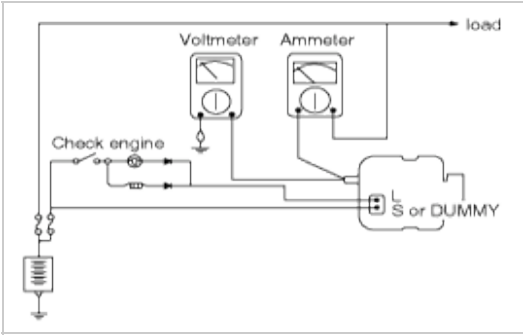
## REGULATED VOLTAGE TEST

The purpose of this test is to check that the electronic voltage regulator controls voltage correctly.

## PREPARATION

1. Prior to the test, check the following items and correct if necessary.  
Check that the battery installed on the vehicle is fully charged. The battery checking method is described in the section "Battery".  
Check the alternator drive belt tension. The belt tension check method is described in the section "Inspect drive belt".
2. Turn ignition switch to "OFF".
3. Disconnect the battery ground cable.
4. Connect a digital voltmeter between the "B" terminal of the alternator and ground. Connect the (+) lead of the voltmeter to the "B" terminal of the alternator. Connect the (-) lead to good ground or the battery (-) terminal.
5. Disconnect the alternator output wire from the alternator "B" terminal.

6. Connect a DC ammeter (0 to 150A) in series between the "B" terminal and the disconnected output wire.  
Connect the (-) lead wire of the ammeter to the disconnected output wire.
7. Attach the engine tachometer and connect the battery ground cable.



TEST

1. Turn on the ignition switch and check to see that the voltmeter indicates the following value.

Voltage: Battery voltage

If it reads 0V, there is an open circuit in the wire between the alternator "B" terminal and the battery and the battery (-) terminal.

2. Start the engine. Keep all lights and accessories off.
3. Run the engine at a speed of about 2,500 rpm and read the voltmeter when the alternator output current drops to 10A or less

RESULT

1. If the voltmeter reading agrees with the value listed in the regulating voltage table below, the voltage regulator is functioning correctly. If the reading is other than the standard value, the voltage regulator or the alternator is faulty.

REGULATING VOLTAGE TABLE

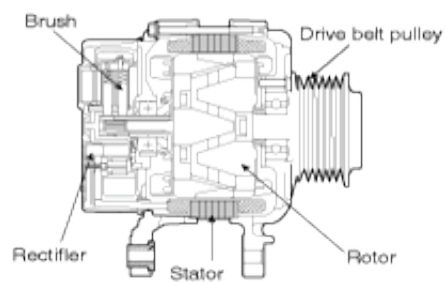
Voltage regulator ambient temperature °C (°F)	Regulating voltage (V)
-20 (-4)	14.2 ~ 15.4
20 (68)	14.0 ~ 15.0
60 (140)	13.7 ~ 14.9
80 (176)	13.5 ~ 14.7

2. Upon completion of the test, reduce the engine speed to idle, and turn off the ignition switch.
3. Disconnect the battery ground cable.
4. Remove the voltmeter and ammeter and the engine tachometer.
5. Connect the alternator output wire to the alternator "B" terminal.
6. Connect the battery ground cable.

# Alternator



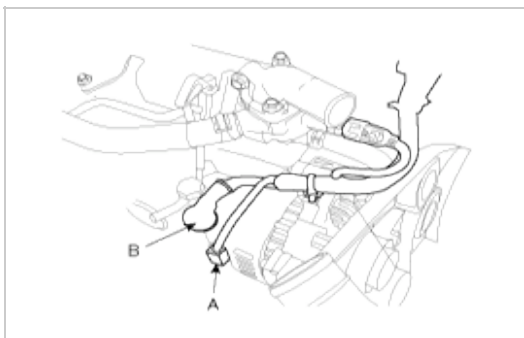
## COMPONENT



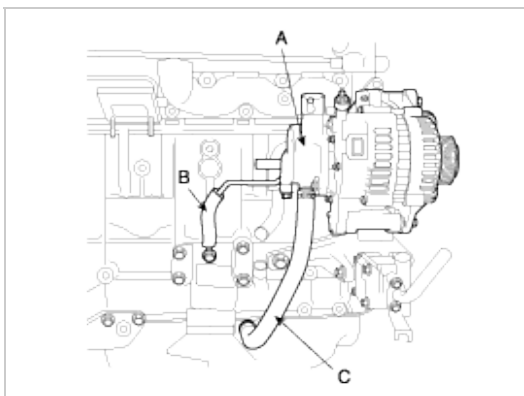


## REPLACEMENT

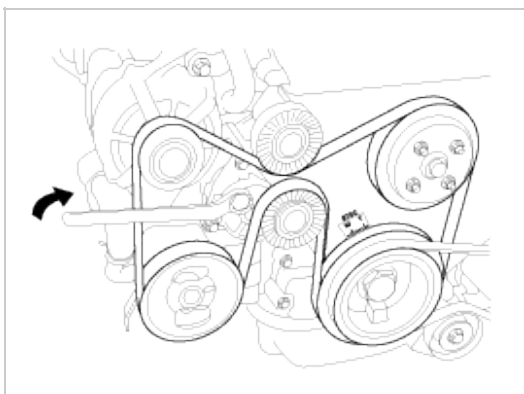
1. Disconnect the battery negative terminal first, then the positive terminal.
2. Disconnect the alternator connector(A) and "B" terminal cable(B).



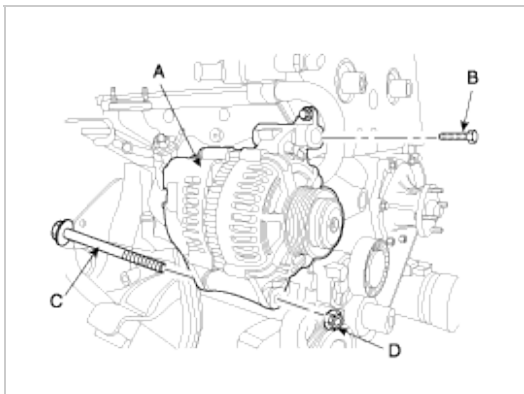
3. Remove the oil pipe(B), oil hose(C) from the vacuum pump(A).



4. Remove the drive belt.



5. Remove the mounting bolts(B,C) and nut(D) then remove the alternator(A).



6. Installation is the reverse of removal.

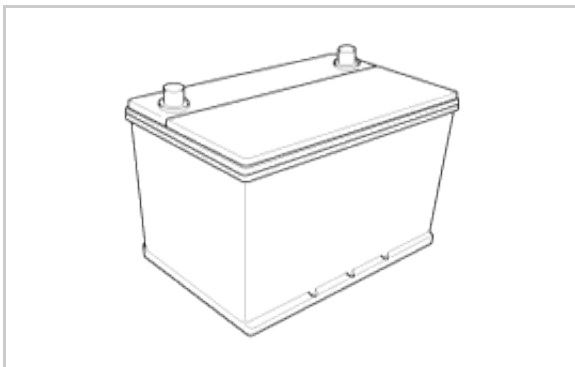
# Battery





## DESCRIPTION

1. The maintenance-free battery is, as the name implies, totally maintenance free and has no removable battery cell caps.
2. Water never needs to be added to the maintenance-free battery.
3. The battery is completely sealed, except for small vent holes in the cover.

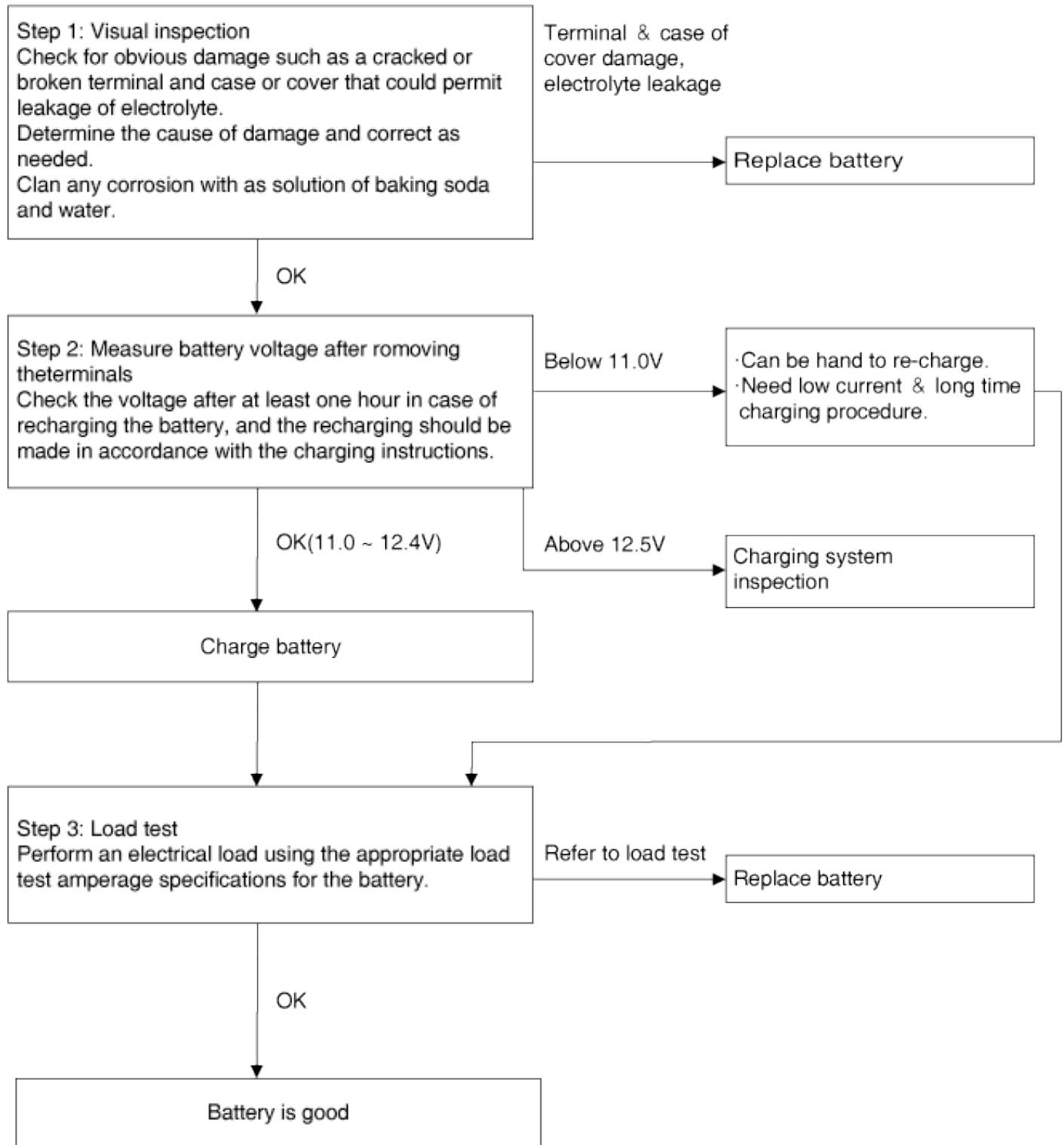




## INSPECTION

### BATTERY DIAGNOSTIC TEST (1)

#### CHECKING FLOW



### LOAD TEST

1. Perform the following steps to complete the load test procedure for maintenance free batteries.
2. Connect the load tester clamps to the terminals and proceed with the test as follow:

- (1) If the battery has been on charge, remove the surface charge by connect a 300ampere load for 15 seconds.
- (2) Connect the voltmeter and apply the specified load.
- (3) Read the voltage after the load has been applied for 15 seconds.
- (4) Disconnect the load.
- (5) Compare the voltage reading with the minimum and replace the battery if battery test voltage is below that shown in the voltage table.

Voltage	Temperature
9.6V	20°C (68.0°F) and above
9.5V	16°C (60.8°F)
9.4V	10°C (50.0°F)
9.3V	4°C (39.2°F)
9.1V	-1°C (30.2°F)
8.9V	-7°C (19.4°F)
8.7V	-12°C (10.4°F)
8.5V	-18°C (-0.4°F)

#### NOTICE

- a. If the voltage is greater shown in the table, the battery is good.
- b. If the voltage is less than shown in the table, replace the battery.

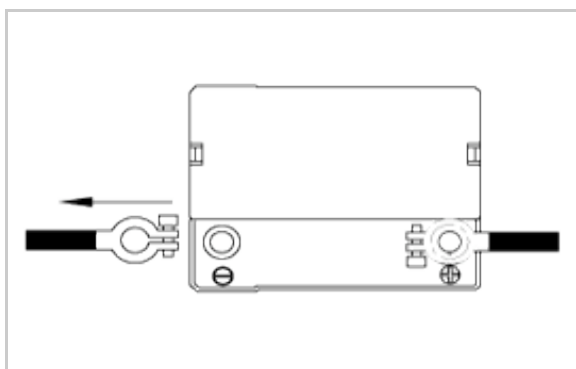
## BATTERY DIAGNOSTIC TEST (2)

1. Make sure the ignition switch and all accessories are in the OFF position.
2. Disconnect the battery cables (negative first).
3. Remove the battery from the vehicle.

#### CAUTION

Care should be taken in the event the battery case is cracked or leaking, to protect your skin from the electrolyte.

Heavy rubber gloves (not the household type) should be wore when removing the battery.



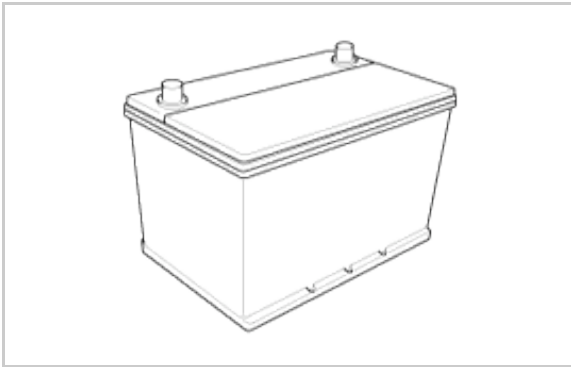
4. Inspect the battery tray for damage caused by the loss of electrolyte. If acid damage is present, it will be necessary to clean the area with a solution of clean warm water and baking soda. Scrub the area with a stiff brush and wipe off with a cloth moistened with baking soda and water.
5. Clean the top of the battery with the same solution as described above.
6. Inspect the battery case and cover for cracks. If cracks are present, the battery must be replaced.
7. Clean the battery posts with a suitable battery post tool.

8. Clean the inside surface of the terminal clamps with a suitable battery cleaning tool. Replace damaged or frayed cables and broken terminal clamps.
9. Install the battery in the vehicle.
10. Connect the cable terminals to the battery post, making sure tops of the terminals are flush with the tops of the posts.
11. Tighten the terminal nuts securely.
12. Coat all connections with light mineral grease after tightening.

#### CAUTION

When batteries are being charged, an explosive gas forms beneath the cover of each cell. Do not smoke near batteries being charged or which have recently been charged. Do not break live circuit at the terminals of batteries being charged.

A spark will occur when the circuit is broken. Keep open flames away from battery.



# Starting System



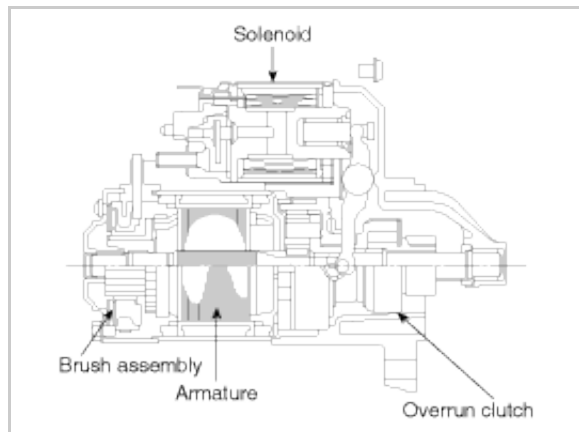
## DESCRIPTION

The starting system includes the battery, starter, solenoid switch, ignition switch, inhibitor switch (A/T), ignition lock switch, connection wires and the battery cable.

When the ignition key is turned to the start position, current flows and energizes the starter motor's solenoid coil.

The solenoid plunger and clutch shift lever are activated, and the clutch pinion engages the ring gear.

The contacts close and the starter motor cranks. In order to prevent damage caused by excessive rotation of the starter armature when the engine starts, the clutch pinion gear overruns.





## TROUBLESHOOTING

### STARTER CIRCUIT

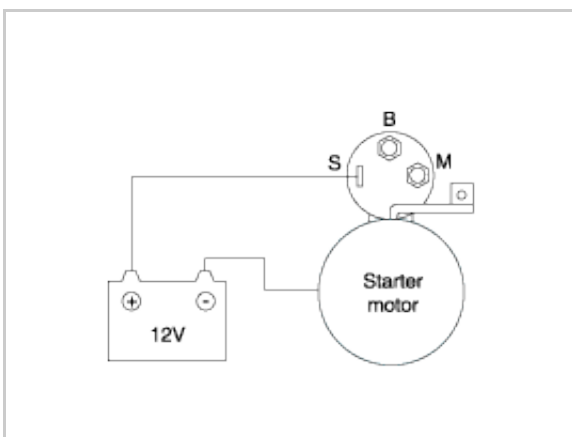
#### NOTICE

The battery must be in good condition and fully charged.

1. With the shift lever in N or P (A/T) or clutch pedal pressed (M/T), turn the ignition switch to "START"  
If the starter normally cranks the engine, starting system is OK. If the starter will not crank the engine at all, go to next step.  
If it won't disengage from the ring gear when you release key, check for the following until you find the cause.
  - a. Solenoid plunger and switch malfunction.
  - b. Dirty pinion gear or damaged overrunning clutch.
2. Check the battery condition. Check electrical connections at the battery, battery negative cable connected to the body, engine ground cables, and the starter for looseness and corrosion. Then try starting the engine again.  
If the starter cranks normally the engine, repairing the loose connection repaired the problem. The starting system is now OK.  
If the starter still does not crank the engine, go to next step.
3. Disconnect the connector from the S-terminal of solenoid. Connect a jumper wire from the B-terminal of solenoid to the S-terminal of solenoid.  
If the starter cranks the engine, go to next step.  
If the starter still does not crank the engine, remove the starter, and repair or replace as necessary.
4. Check the following items in the order listed until you find the open circuit.
  - a. Check the wire and connectors between the driver's under-dash fuse/relay box and the ignition switch, and between the driver's under-dash fuse/relay box and the starter.
  - b. Check the ignition switch (Refer to BE group - ignition system)
  - c. Check the transaxle range switch connector or ignition lock switch connector.
  - d. Inspect the starter relay.

### STATER SOLENOID TEST

1. Disconnect the field coil wire from the M-terminal of solenoid switch.
2. Connect a 12V battery between S-terminal and the starter body.



3. Connect the field coil wire to the M-terminal.

#### CAUTION

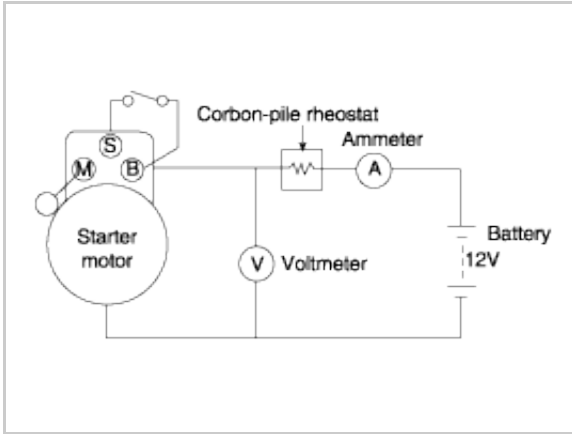
This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.

4. If the pinion moves out, the pull-in coil of solenoid is working properly.  
If the pinion does not move, replace the solenoid.

5. Disconnect the field coil wire from the M-terminal.
6. If the pinion has moved out, the hold-in coil of the solenoid is working properly.  
If the pinion moves in, replace the solenoid.

## FREE RUNNING TEST

1. Place the starter motor in a vise equipped with soft jaws and connect a fully-charged 12-volt battery to starter motor as follows.
2. Connect a test ammeter (100-ampere scale) and carbon pile rheostats shown is the illustration.
3. Connect a voltmeter (15-volt scale) across starter motor.



4. Rotate carbon pile to the off position.
5. Connect the battery cable from battery's negative post to the starter motor body.
6. Adjust until battery voltage shown on the voltmeter reads 11volts.
7. Confirm that the maximum amperage is within the specifications and that the starter motor turns smoothly and freely.

---

Current : Max.190 Amps

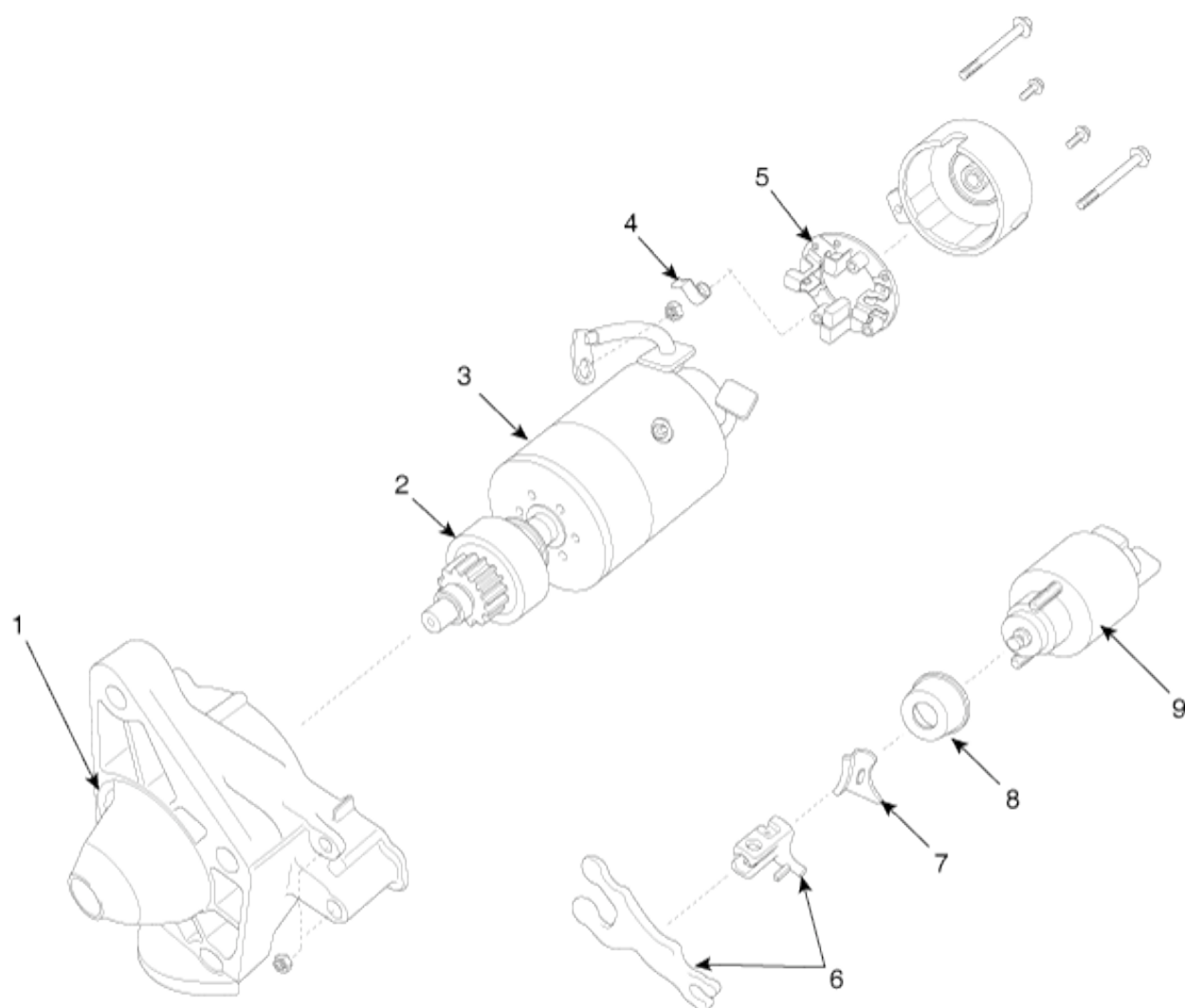
Speed : Min. 3,000 Rpm

---



# Starter

## COMPONENT

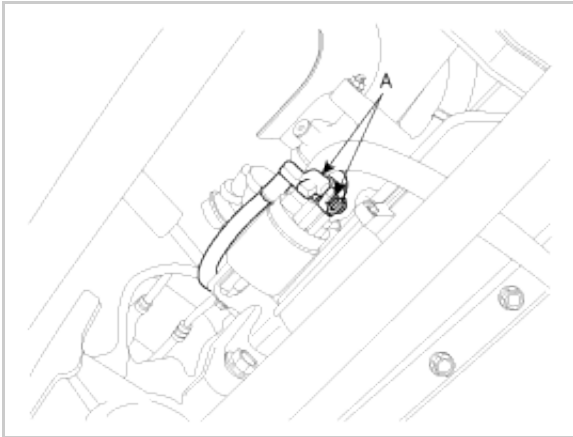


- |                               |                             |
|-------------------------------|-----------------------------|
| 1. Front bracket              | 6. Shift pork assembly      |
| 2. Overrun clutch assembly    | 7. Shim                     |
| 3. Yoke assembly and armature | 8. Dust cover               |
| 4. Spring brush               | 9. Magnetic switch assembly |
| 5. Brush holder assembly      |                             |



## REPLACEMENT

1. Disconnect the battery negative cable.
2. Remove the starter motor cable(A).



3. Remove the 2 bolts holding the starter, then remove the starter.
4. Installation is the reverse of removal.
5. Connect the battery positive cable and negative cable to the battery.

# **Preheating System**



## INSPECT

Conditions before inspection :

Battery voltage : 12V

Cooling water temperature : Below 30°C (86°F)

(Disconnect the water temperature sensor connector).

### CAUTION

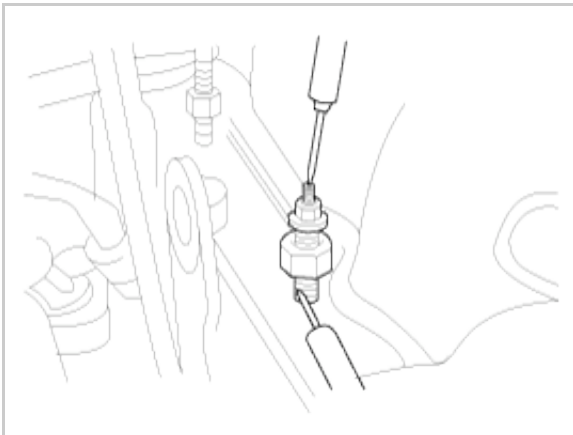
Reconnect the water temperature sensor connector after inspection.

1. Connect voltmeter between glow plug plate and plug body (ground).
2. Check indicated value on voltmeter with ignition switch ON.
3. Check that preheat indication lamp lights for about 6 seconds and indicates battery voltage (about 9V or over) for about 36 seconds immediately after ignition switch is turned on. [At cooling water temperature 20°C (68.0°F)]

### NOTICE

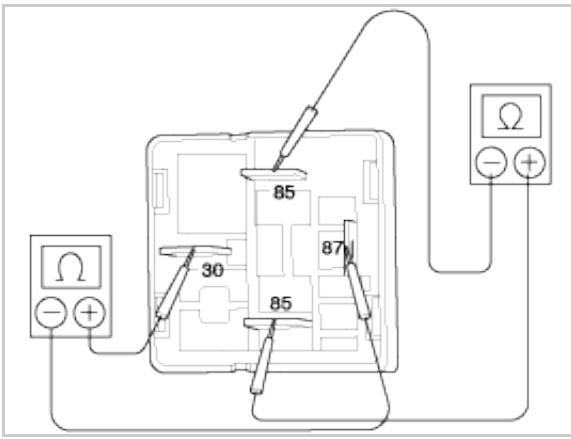
Continuity time varies depending upon cooling water temperature.

4. After checking 3, set ignition switch at START position.
5. The system is normal if battery voltage (about 9V or over) is generated for about 6 seconds during engine cranking and after start operation. [at cooling water temperature 20°C (68.0°F)]
6. When the voltage or continuity time is not normal, check the terminal voltage in glow control unit, and single parts.



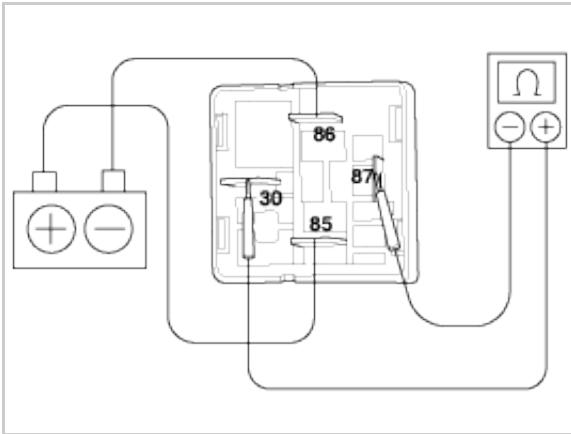
## GLOW PLUG RELAY

1. Remove the glow plug relay.
2. Inspect the relay continuity.
  - a. Using an ohmmeter, check that there is continuity between terminals 86 and 85.  
If there is no continuity, replace the relay.
  - b. Check that there is no continuity between terminals 87 and 30.  
If there is continuity, replace the relay.



3. Inspect the relay operation.

- a. Apply battery positive voltage across terminals 85 and 85.
- b. Using an ohmmeter, check that there is continuity between terminals 87 and 30.  
If there is no continuity, replace the relay.



4. Install the glow plug relay.

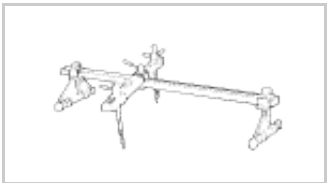
## **CHAPTER 6:**

# **Automatic Transaxle System**

# **General Information**



**SPECIAL TOOLS**

TOOL (Number and name)	Illustration	Use
09200 - 38001 Engine support fixture		Removal and installation of transaxle.



## SPECIFICATIONS

Engine type		DIESEL(J2.9)	GASOLINE(λ-3.8)
Transaxle type		A5HF1	A5HF1
Gear ratio	1ST	4.497	←
	2ND	2.442	←
	3RD	1.686	←
	4TH	1.233	←
	5TH	0.868	←
	REV.	4.586	←
Final gear ratio		3.333	←
T/M oil capacity(ℓ)※		10.7	10.9

※ The quantity in the chart above is for the reference. The actual filling quantity of the automatic transaxle fluid must be set according to 'INSPECTION' or 'REPLACEMENT' procedure of the automatic transaxle fluid.

Recommended transaxle oil			Diamond ATF SP III or SK ATF SP III
Check & Replenishment			Every one year or every 20,000km Every one year or every 15,000km only for European contries
Replacement	Private use	Normal use	No service required Every 100,000km only for Australia Every 90,000km only for European contries
		Severe use(＊)	Every 40,000km Every 45,000km only for European contries
	Business use		

\* Severe use(marked '\*') is defined as:

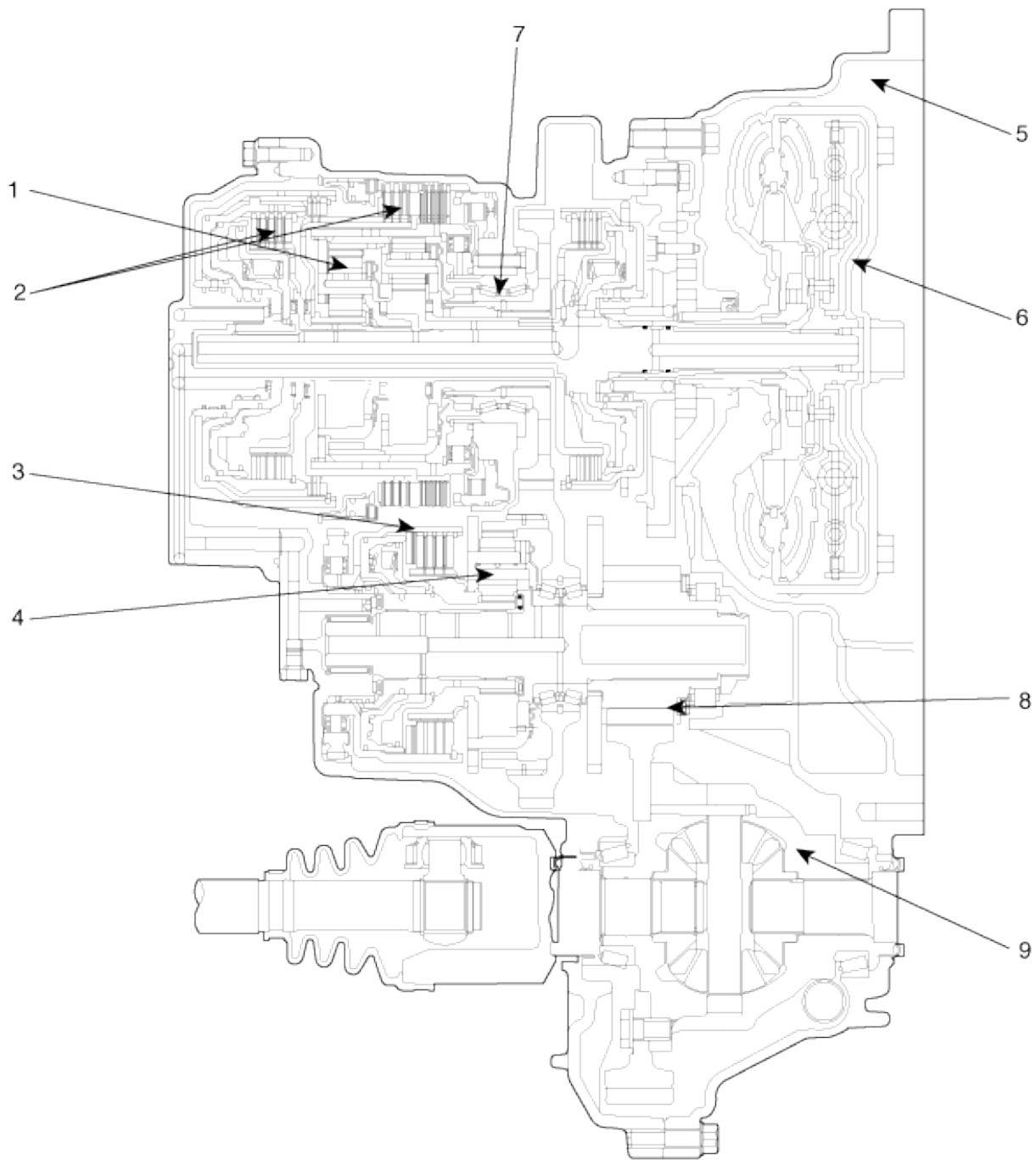
1. Driving on rough road(bumpy road, gravel road, snowy road, unpaved road etc.).
2. Driving on mountain road, ascent/descent.
3. Repetition of short distance driving.
4. More than 50% operation in heavy city traffic during hot weather above 32°C(89.6°F).
5. Police car, Taxi, Commercial type operation or trailer towing, etc.

# **Automatic Transaxle System**



## DESCRIPTION

### 1. Structure & Technical highlights



- |   |  |
|---|--|
| 1. Overdrive planetary gear (3→4 pinions)                     | 5. Case/ Housing intensity reinforced & redesigned |
| 2. SSP(Single sided plate)<br>-Overdrive clutch<br>-2ND brake | 6. High capacity torque converter                  |
| 3. Reduction band (Piston increased)                          | 7. Bearing outer diameter increased ( $\Phi 5$ mm) |
| 4. Direct planetary gear (3→4 pinions)                        | 8. Differential gear (Increased width by 2mm)      |
|   | 9. Differential capacity increased (6.1→7)         |

### 2. Variable Line Pressure Control

#### a. Description

a. Form the most suitable line pressure according to the vehicle driving condition

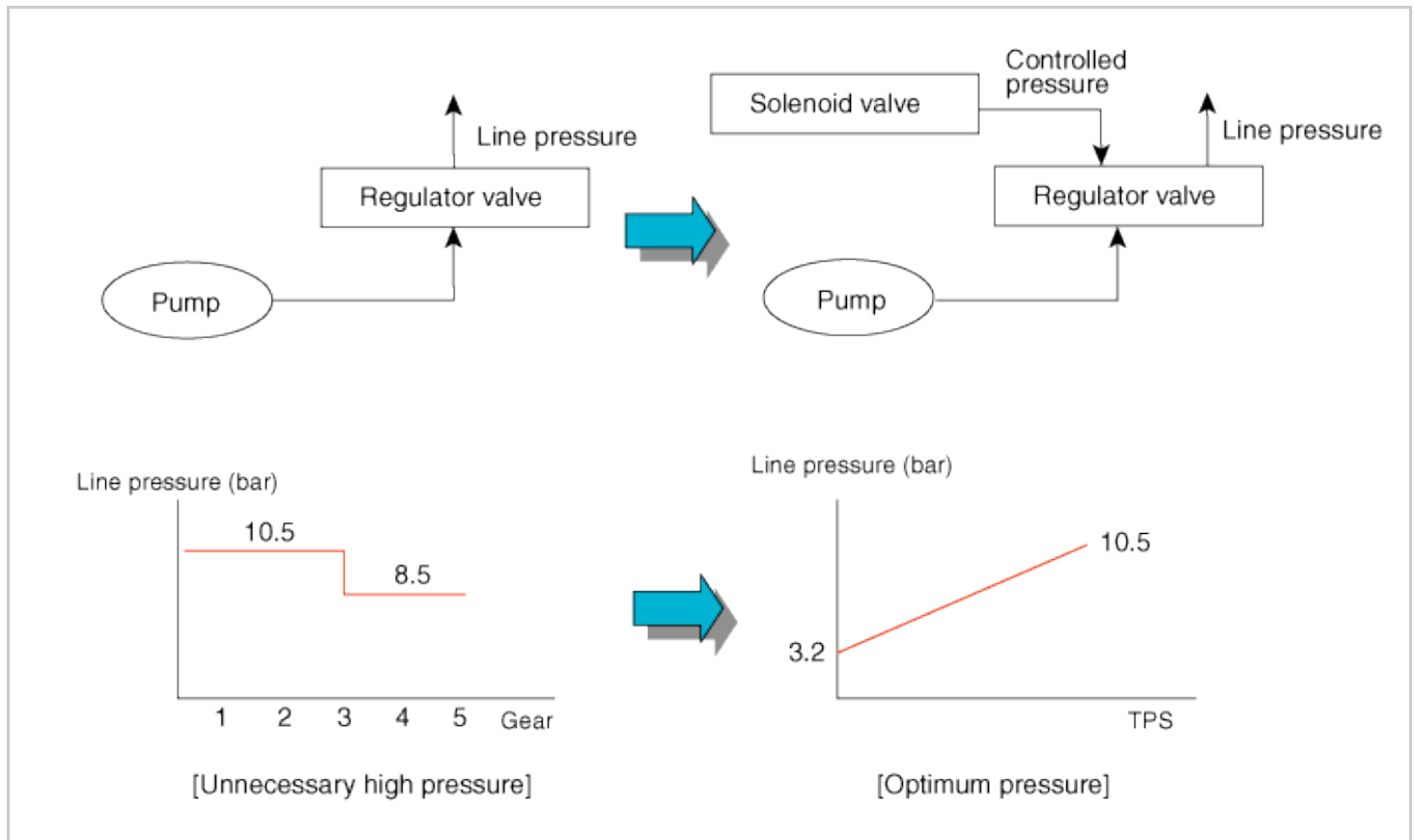
#### b. Special Features

a. VFS (Variable Force Solenoid) valve (For varying line pressure)

b. Reducing valve added (Stabilize control pressure in shiftings)

#### c. Effects

a. Improved power transmission efficiency and fuel consumption



3. Gear durability improvement and less-noisy gear development

a. Description

a. Optimal gear transmission ratio design from analyzing gears

b. Special Features

a. Apply High-strength gear material

b. Gear teeth width increased

c. Planetary gear (3 pinions → 4 pinions)

d. Less-noisy gear development

c. Effects

a. Durability improvement

b. Reduction of noise level

4. Case/Housing intensity reinforced

a. Description

a. Case/Housing intensity reinforced

b. Special Features

a. Converter housing intensity reinforced(Ribs added and thickness increased)

b. Most suitable stiff reinforcement through analyzing

c. Effects

a. Intensity increased and banding vibration decreased

b. NVH Performance improvement

5. New frictional material

a. Description

a. Apply new frictional material for capacity and durability improvement

b. Special Features

a. SSP (Single Sided Plate) applied only on overdrive clutch and 2nd brake

b. Apply the next generation frictional material(BWA 6100/D 0880-88)

c. Effects

a. Thermal absorption capacity improvement

b. Energy capacity and durability improvement

## MECHANICAL SYSTEM

### CLUTCHES AND BRAKES FOR EACH RANGE

		UD Clutch	OD Clutch	2ND Brake	LR Brake	REV Clutch	RED Brake	DIR Clutch	OWC 1	OWC 2
	P	-	-	-	O	-	O	-	-	-
	R	-	-	-	O	O	O	-	-	-
	N	-	-	-	O	-	O	-	-	-
D	1st	O	-	-	O	-	O	-	●	●
	2nd	O	-	O	-	-	O	-	-	●
	3rd	O	O	-	-	-	O	-	-	●
	4th	-	O	O	-	-	O	-	-	●
	5th	-	O	O	-	-	-	O	-	-

(● : Locked when driving)

### FUNCTIONS OF CLUTCHES AND BRAKES

Element	Sign	Function
Underdrive clutch	UD	Connect the input shaft with the underdrive sun gear
Reverse clutch	REV	Connect the input shaft with the reverse sun gear
Overdrive clutch	OD	Connect the input shaft with the overdrive carrier
Direct clutch	DIR	Connect the direct sun gear with the direct carrier
Low& Reverse brake	LR	Fix the planetary gear and the overdrive carrier
2nd brake	2ND	Fix the reverse sun gear
Reduction brake	RED	Fix the direct sun gear
One way clutch 1	OWC 1	Control the rotational direction of the low&reverse ring gear
One way clutch 2	OWC 2	Control the rotational direction of the direct sun gear

### AUTOMATIC TRANSAXLE HYDRAULIC CIRCUIT

P/N

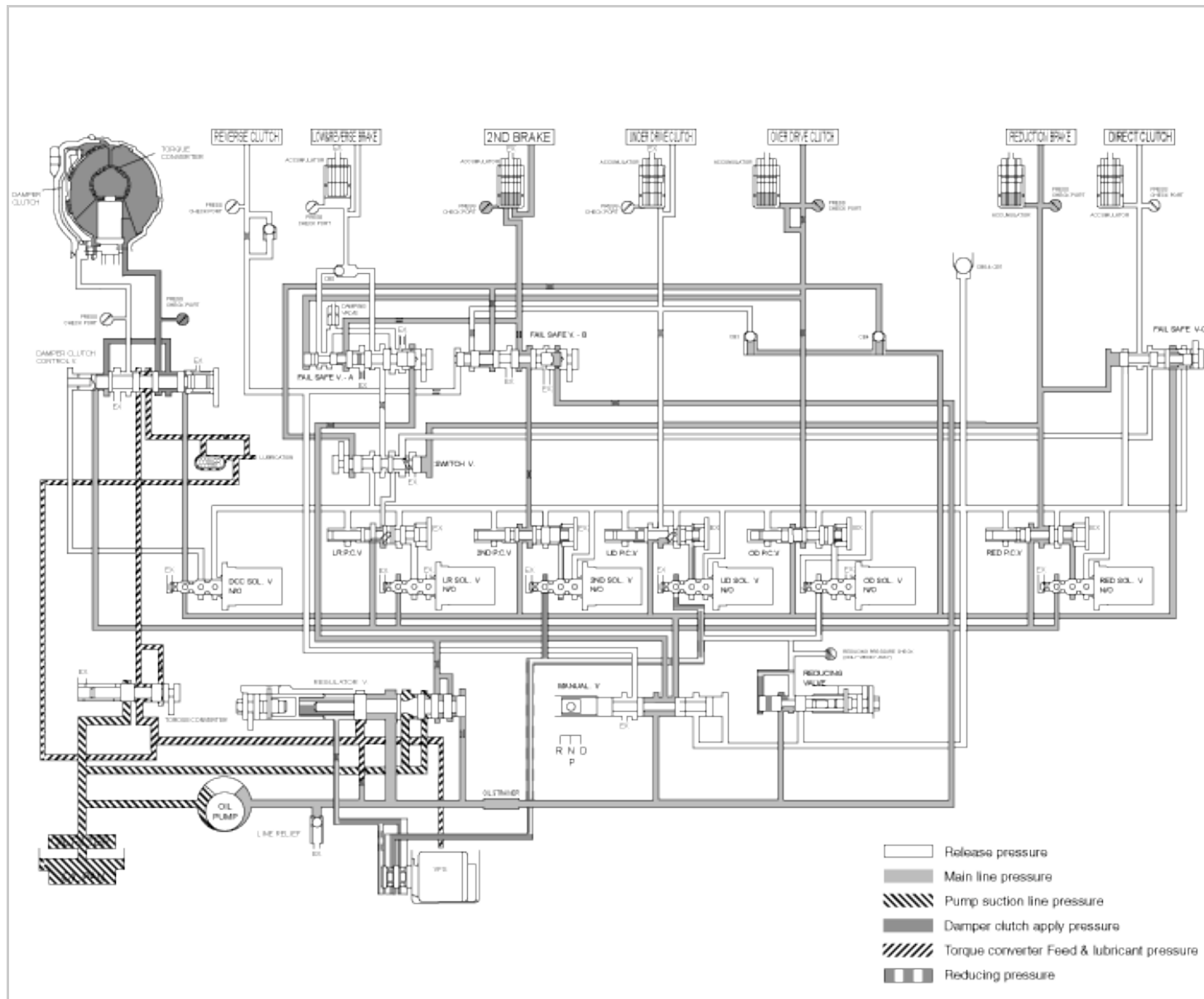




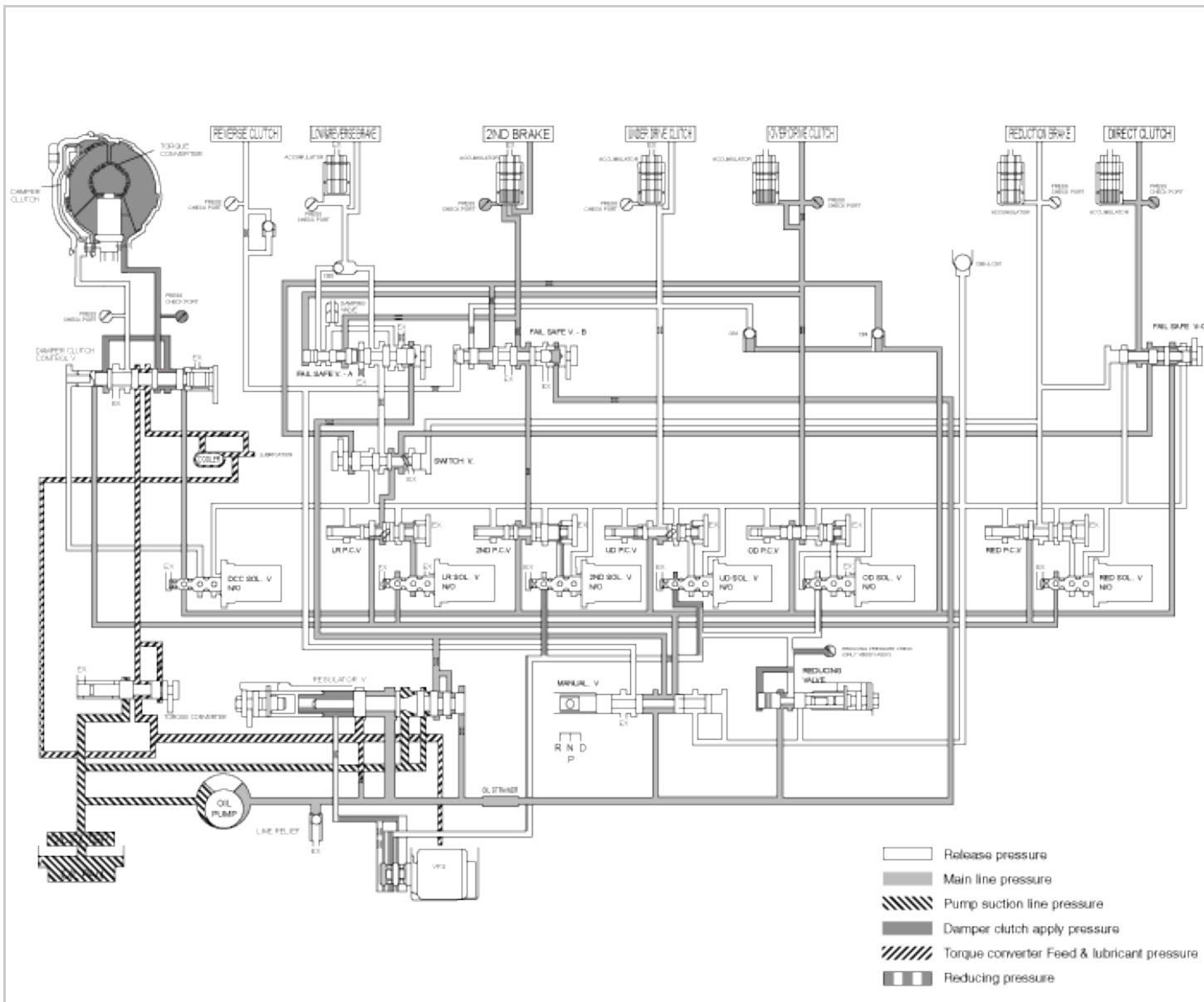




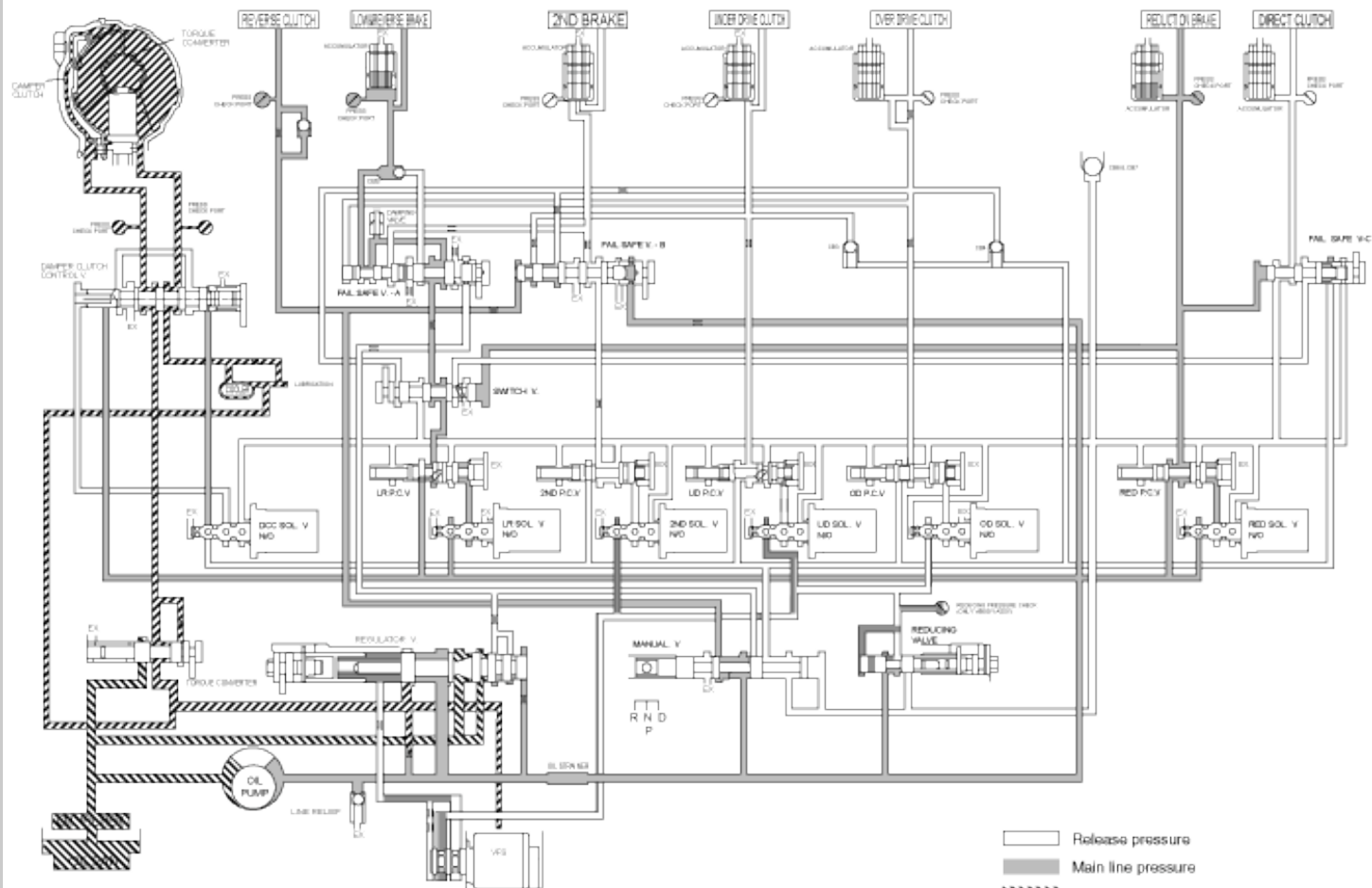




**D(5 RANGE)**



## R RANGE



- Release pressure
- Main line pressure
- Pump suction line pressure
- Damper clutch apply pressure
- Torque converter Feed & lubricant pressure
- Reducing pressure



## SERVICE ADJUSTMENT PROCEDURE

### Automatic transaxle fluid

#### INSPECTION

1. Drive the vehicle until the fluid reaches normal operating temperature [70~80°C].
2. Place the vehicle on a level surface.
3. Move the selector lever through all gear positions. This will fill the torque converter and the hydraulic system with fluid and move the selector lever to the "N" (Neutral) or "P"(Park) position.
4. Before removing the oil level gauge, wipe all contaminants from around the oil level gauge. Then take out the oil level gauge and check the condition of the fluid.

#### NOTICE

If the fluid smells as if it is burning, it means that the fluid has been contaminated by fine particles from the bushes and friction materials, a transaxle overhaul may be necessary.

5. Check that the fluid level is at the HOT mark on the oil level gauge. If the fluid level is low, add automatic transaxle fluid until the level reaches the "HOT" mark.

Auto transaxle fluid:

DIAMOND ATF SP-III, SK ATF SP-III

Quantity : 10.7ℓ(Diesel), 10.9ℓ(Gasoline)

#### NOTICE

Low fluid level can cause a variety of abnormal conditions because it allows the pump to take in air along with fluid. Air trapped in the hydraulic system forms bubbles, which are compressible. Therefore, pressures will be erratic, causing delayed shifting, slipping clutches and brakes, etc. Improper filling can also raise fluid level too high. When the transaxle has too much fluid, gears churn up foam and cause the same conditions which occur with low fluid level, resulting in accelerated deterioration of automatic transaxle fluid. In either case, air bubbles can cause overheating, and fluid oxidation, which can interfere with normal valve, clutch, and brake operation. Foaming can also result in fluid escaping from the transaxle vent where it may be mistaken for a leak.

6. Insert the oil level gauge securely.

#### NOTICE

When new, automatic transmission fluid should be red. The red dye is added so the assembly plant can identify it as transmission fluid and distinguish it from engine oil or antifreeze. The red dye, which is not an indicator of fluid quality, is not permanent. As the vehicle is driven the transmission fluid will begin to look darker. The color may eventually appear light brown.

### REPLACEMENT

If you have a fluid changer, use this changer to replace the fluid. If you do not, replace it using the following procedure.

1. Disconnect the hose which connects the transmission and the oil cooler.
2. Start the engine and let the fluid drain out.

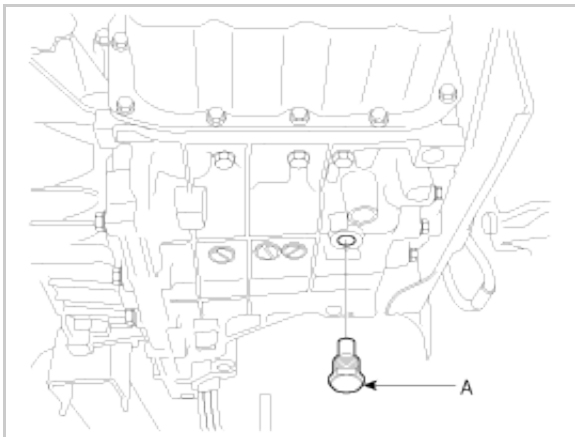
Running conditions : "N" range with engine idling.

#### CAUTION

The engine should be stopped within one minute after it is started. If the fluid has all drained out before then,

the engine should be stopped at that point.

3. Remove the drain plug(A) from the bottom of the transmission case to drain the fluid.



4. Install the drain plug via the gasket, and tighten it to the specified torque.

TORQUE :

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

5. Pour the new fluid in through the oil filler tube.

**CAUTION**

Stop pouring if the full volume of fluid cannot be poured in.

6. Repeat the procedure in step (2).

**NOTICE**

Check the old fluid for contamination. If it has been contaminated, repeat the steps (5) and (6).

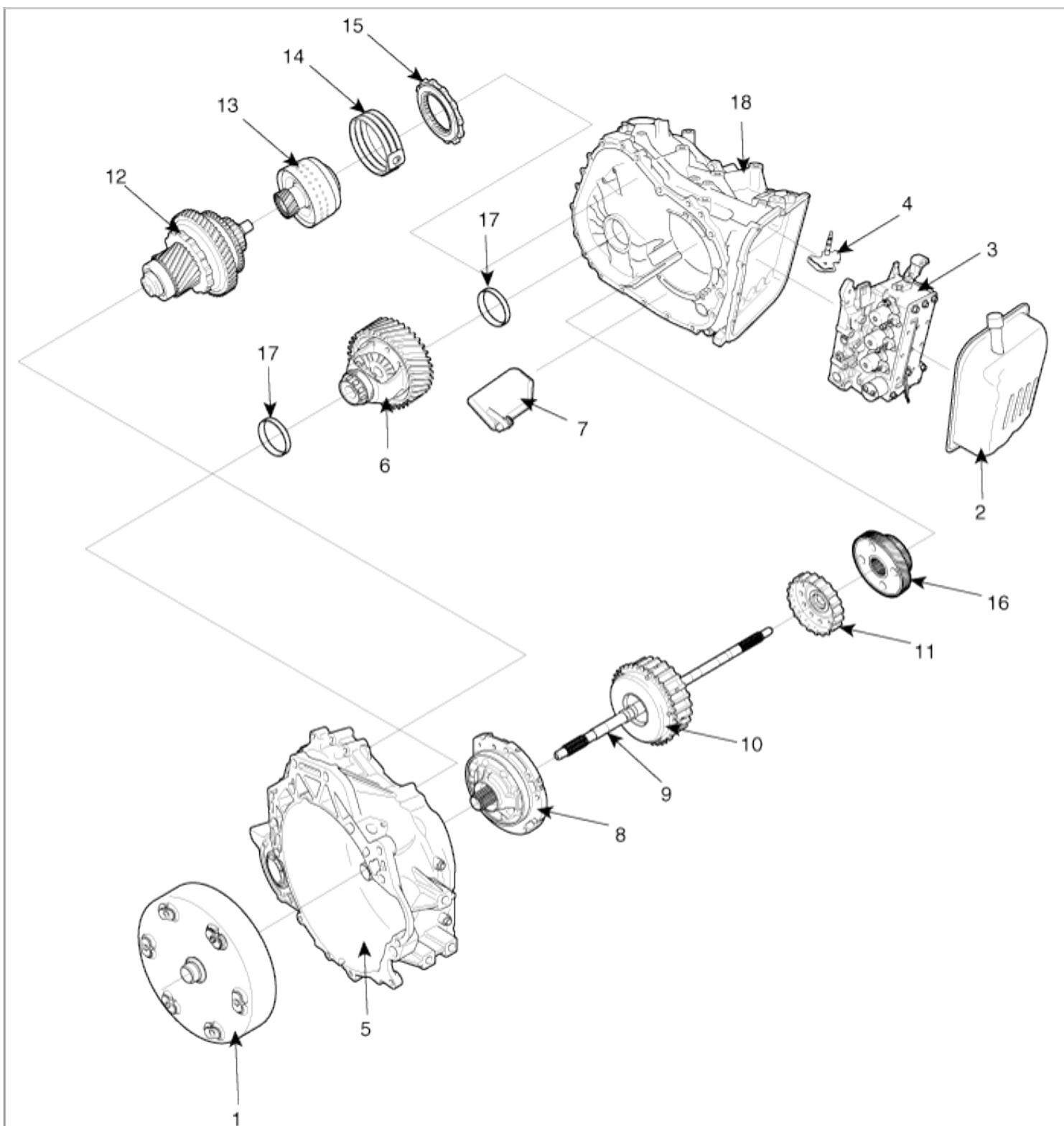
7. Pour the new fluid in through the oil filler tube.
8. Reconnect the hose which was disconnected in step (1) above and firmly replace the oil level gauge.(In case of this "replace", this means after wiping off any dirt around the oil level gauge, insert it into the filler tube.)
9. Start the engine and run it at idle for 1~2 minutes.
10. Move the select lever through all positions, and then move it to the "N" position.
11. Drive the vehicle until the fluid temperature rises to the normal temperature (70~80°C), and then check the fluid level again. The fluid level must be at the HOT mark.
12. Firmly insert the oil level gauge into the oil filler tube.

# **Automatic Transaxle**





## COMPONENTS (1)

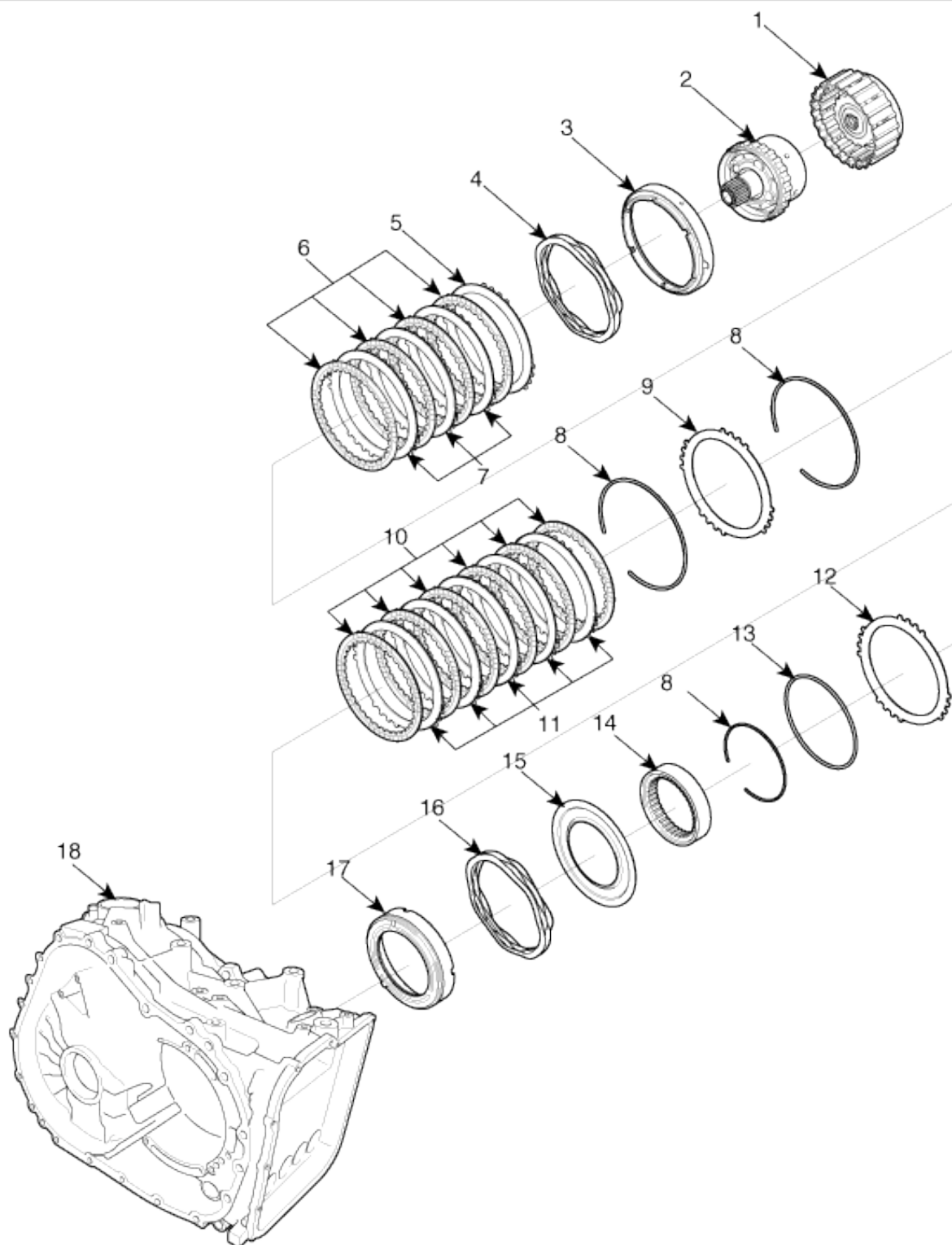


1. Torque converter
2. Valve body cover
3. Valve body assembly
4. Manual control shaft assembly
5. Converter housing
6. Differential assembly

7. Main oil filter
8. Oil pump
9. Input shaft
10. Underdrive clutch assembly
11. Underdrive clutch hub
12. Direct planetary carrier assembly

13. Direct clutch assembly
14. Reduction brake band
15. One way clutch
16. Transfer drive gear
17. Differential bearing case
18. Transaxle case

## COMPONENTS (2)



1. Reverse sun gear
2. Planetary gear assembly
3. 2nd brake retainer
4. 2nd brake return spring
5. 2nd brake pressure plate
6. 2nd brake discs

7. 2nd brake plates
8. Snap ring
9. Brake reaction plate
10. Brake discs
11. Brake plates
12. Low&Reverse brake pressure plate

13. Wave spring
14. Oneway clutch inner race
15. Brake spring retainer
16. Low&Reverse brake return spring
17. Low&Reverse brake piston
18. Transaxle case



## REMOVAL

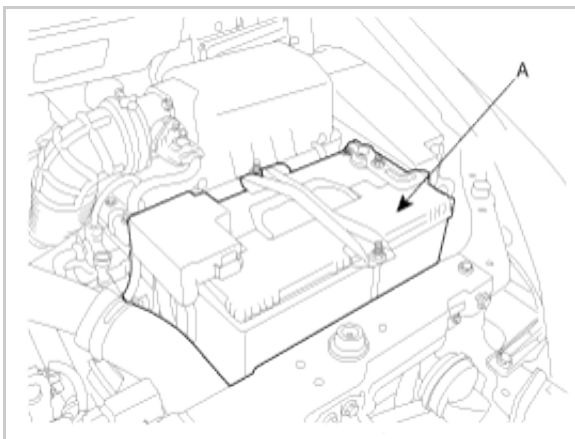
### CAUTION

- a. Use a cover not to damage the vehicle surface.
- b. Disconnect connectors carefully not to be damaged.

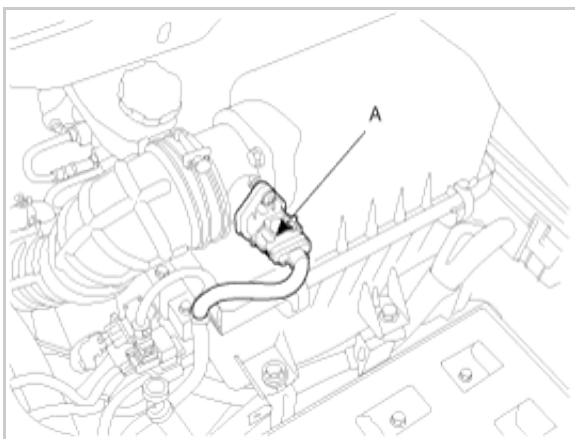
### NOTICE

- a. Mark wires or hoses for identification.

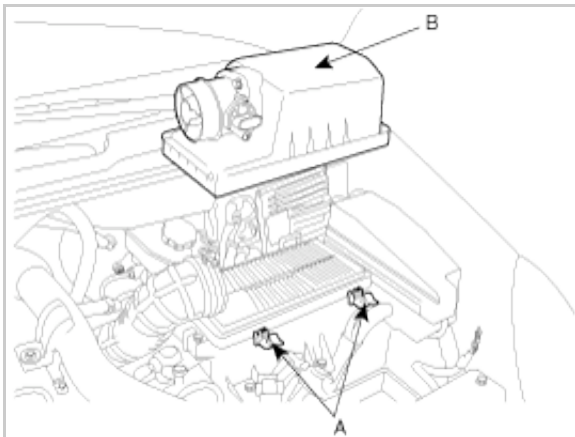
1. Remove the battery (A).



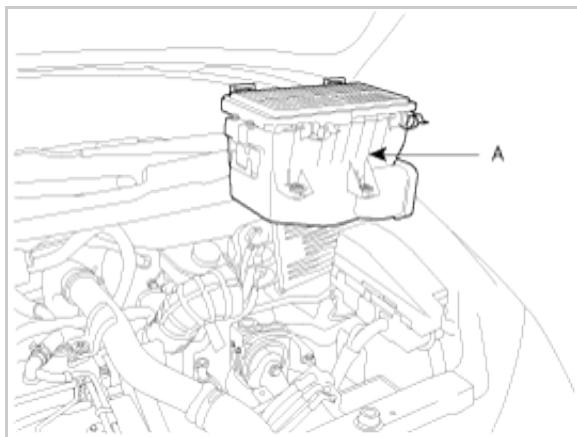
2. Disconnect the AFS connector (A).



3. Remove the air cleaner upper cover (B) by loosening the clips (A).

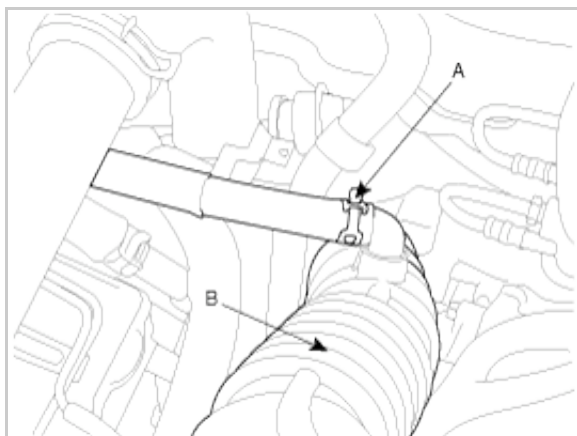


4. Remove the air cleaner assembly (A).

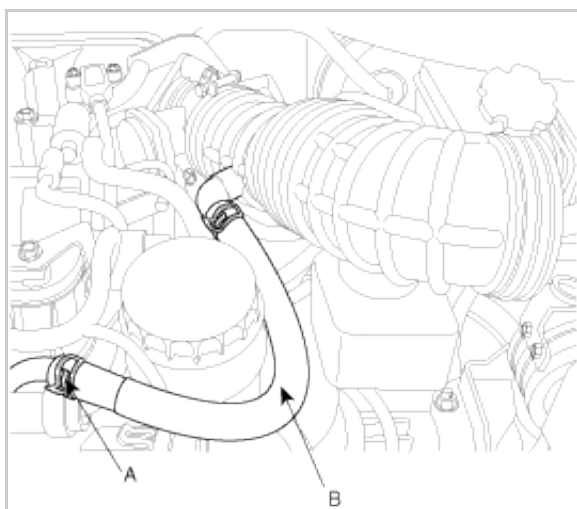


5. Disconnect the air cleaner hose (B) by loosening the clamp (A).

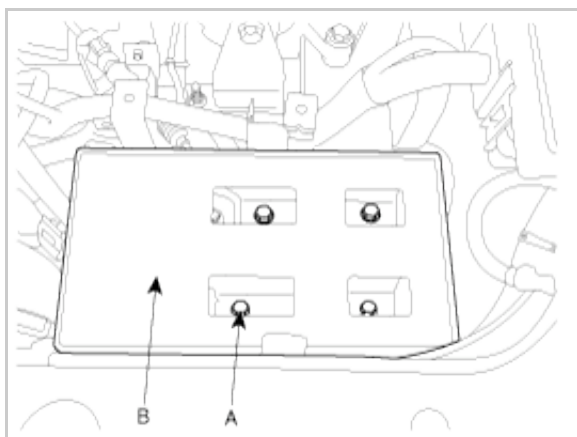
### [2.9 DSL]



### [3.8 GSL]

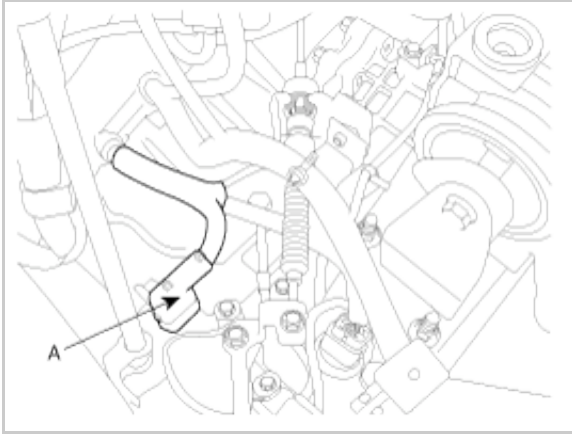


6. Remove the battery tray (B) by removing the four mounting bolts (A).



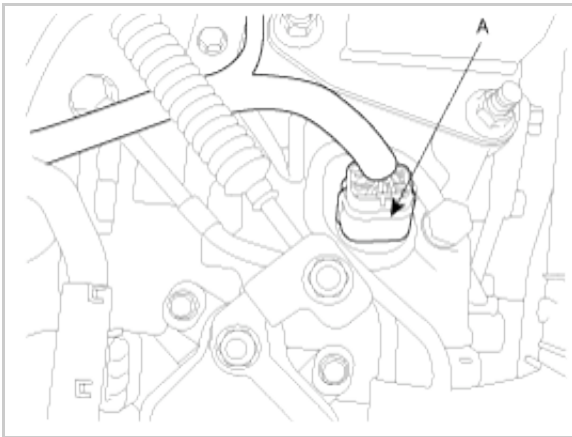
7. Disconnect the transaxle wire harness connectors.

(1) Remove the inhibitor switch connector (A).

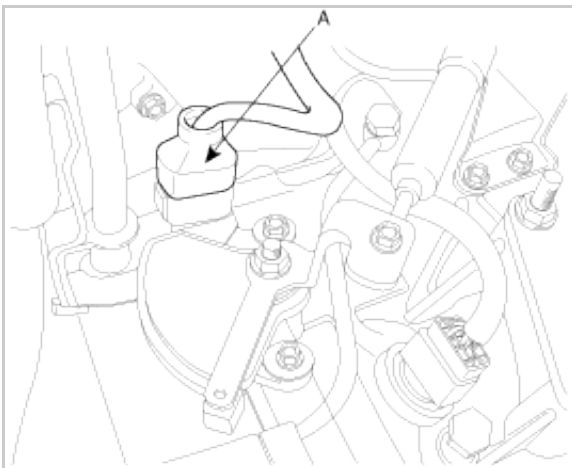


(2) Remove the solenoid valve connector (A).

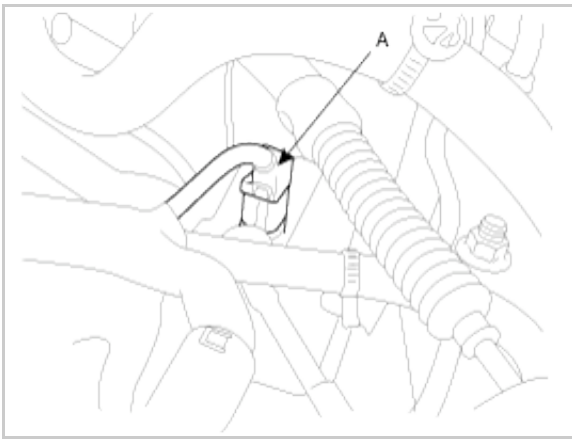
### [2.9 DSL]



### [3.8 DSL]



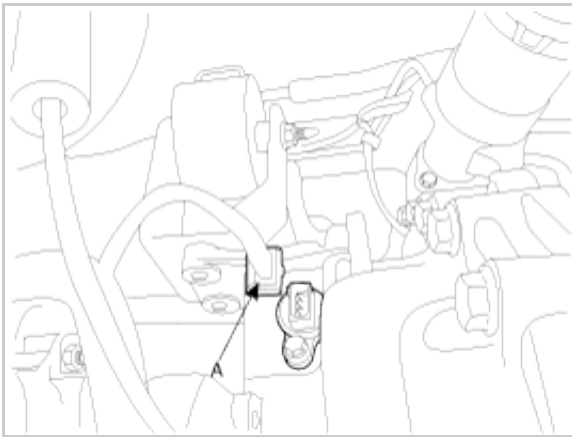
(3) Remove the input speed sensor connector (A).



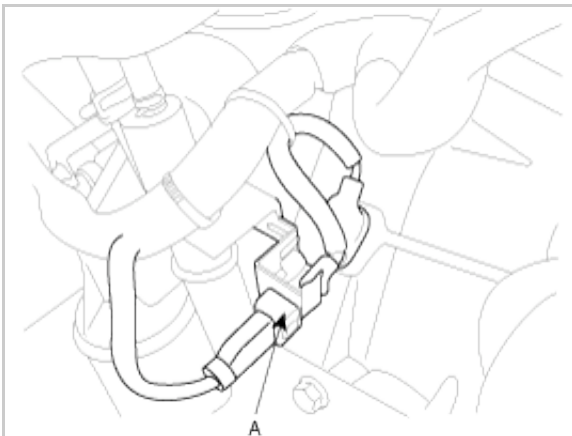
(4) Remove the output speed sensor connector (A).



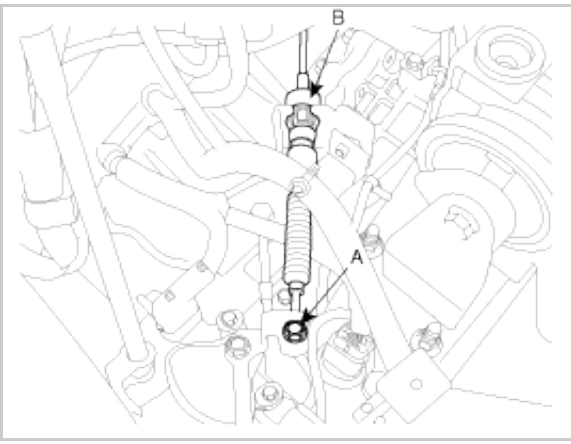
(5) Remove the vehicle speed sensor connector (A).



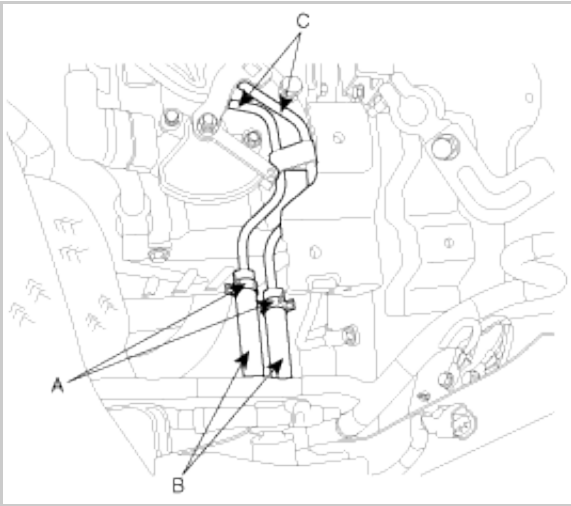
(6) Remove the CKP sensor connector (A).



8. Remove the shift cable by removing the bolt (A) and clip (B).



9. Disconnect the transaxle oil cooler hoses (A) from the tubes (C) by loosening the clamps (B).



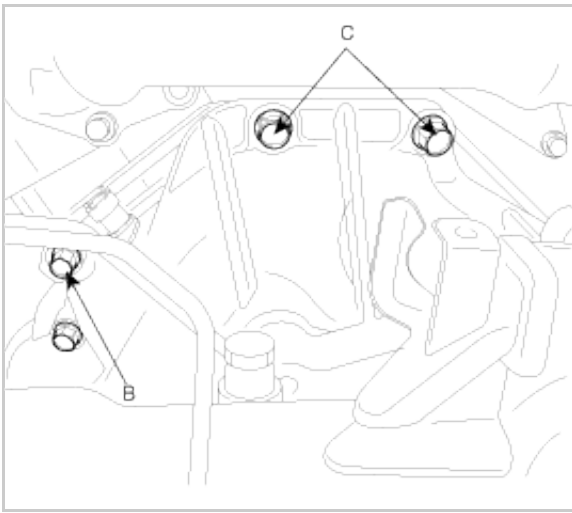
10. Remove the transaxle mounting bolts (A).

### [2.9 DSL]



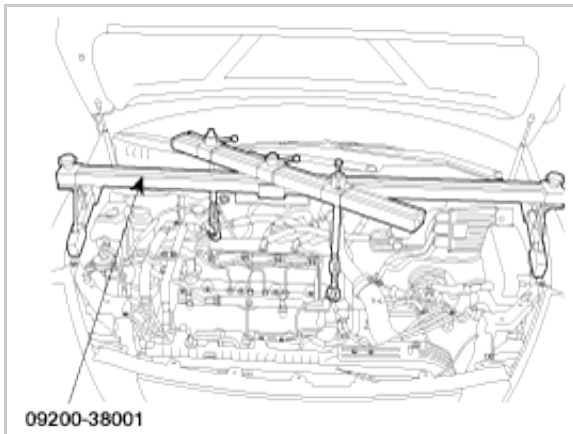
### [3.8 GSL]



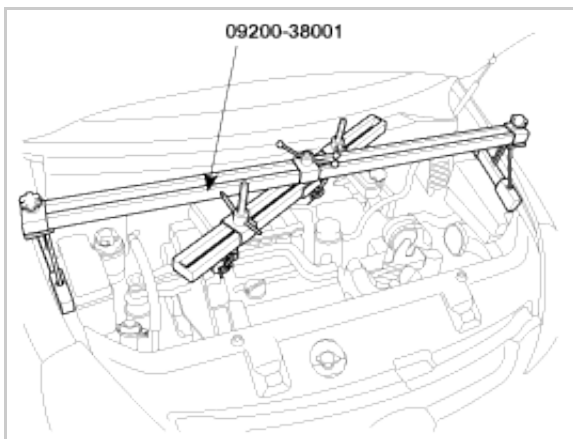


11. Using the SST(09200-38001), hold the engine and transaxle assembly safely.

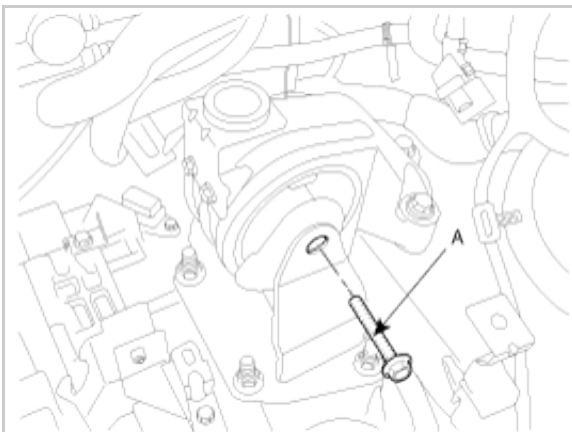
## [2.9 DSL]



## [3.8 GSL]

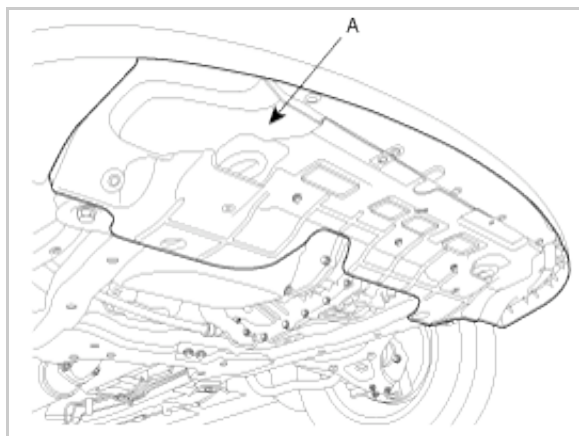


12. Remove the transaxle insulator mounting bolt (A).

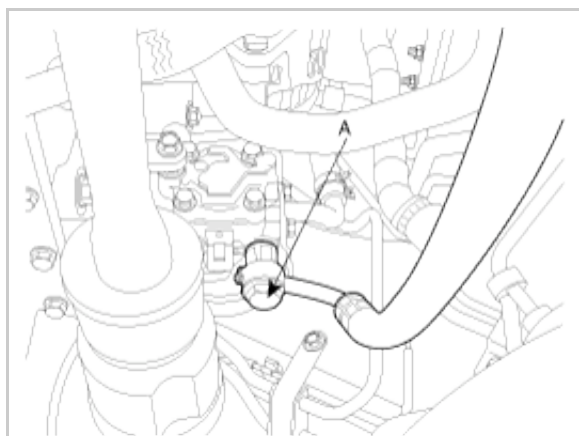




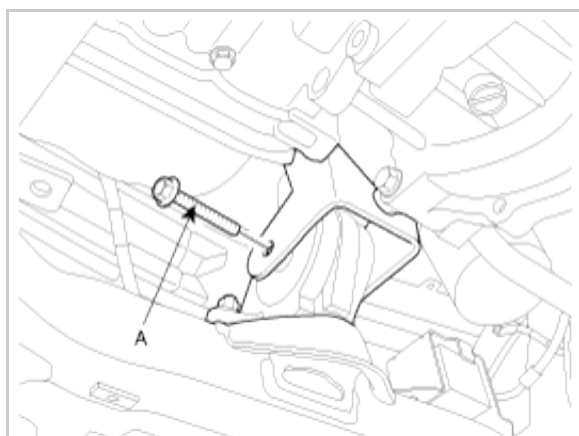
13. Remove the front wheels.
14. Remove the power steering column joint bolt. (see ST group)
15. Lift up the vehicle.
16. Remove the under cover (A).

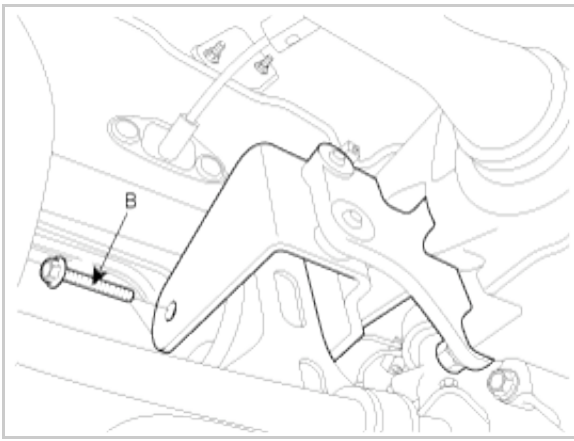


17. Drain transaxle oil.
18. Drain power steering oil through the return tube. (see ST group)
19. Disconnect the power steering pressure tube (A) from the power steering oil pump.



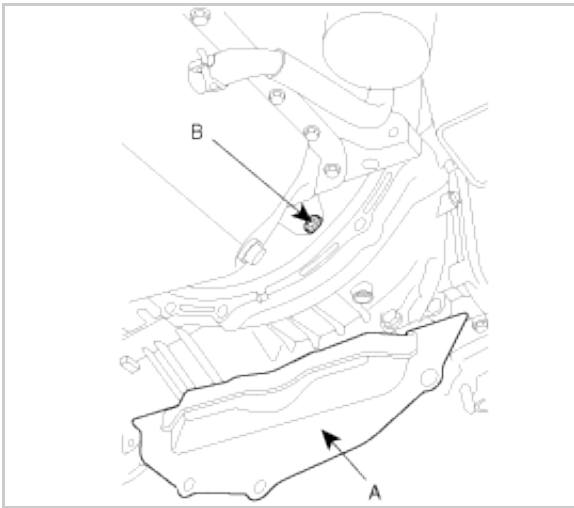
20. Disconnect the lower arm, the tie rod end ball joint, the stabilizer bar link from the front knuckle. (see SS group)
21. Remove the roll stopper mounting bolts (A,B).



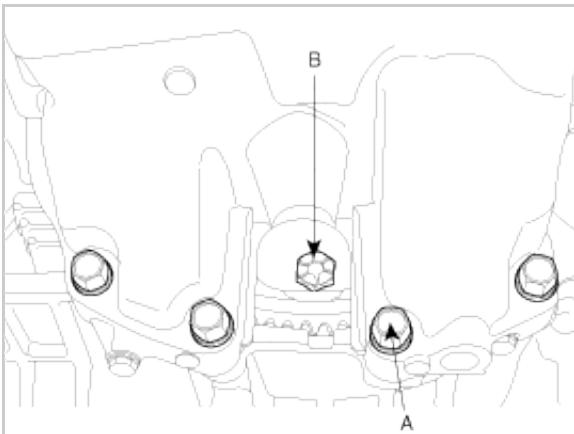


22. Remove the mounting bolts from the sub frame by supporting the sub frame with a jack. (see SS group)
23. Remove drive shaft from transaxle. (See DS group).
24. Install a jack for supporting the transaxle assembly.
25. Remove the plate (A) and the drive plate bolts (B).

### [2.9 DSL]



### [3.8 GSL]



26. Lifting the vehicle up and lowering the jack slowly, remove the transaxle assembly.

## INSTALLATION

Installation is in the reverse order of removal.

Perform the following :

- a. Adjust the shift cable.
- b. Refill the transaxle with fluid.
- c. Refill the radiator with engine coolant.
- d. Bleed air from the cooling system with the heater valve open.

e. Clean the battery posts and cable terminals with sandpaper, assemble them, and apply grease to prevent corrosion.

1. Lowering the vehicle or lifting up a jack, install the transaxle assembly.

2. Tighten the transaxle under mounting bolts.

---

TORQUE:

65~85 Nm(650~850 kgf.cm, 47.0~61.5 lb-ft)

---

3. Install the starter motor. (see EE group).

---

TORQUE:

65~85 Nm(650~850 kgf.cm, 47.0~61.5 lb-ft)

---

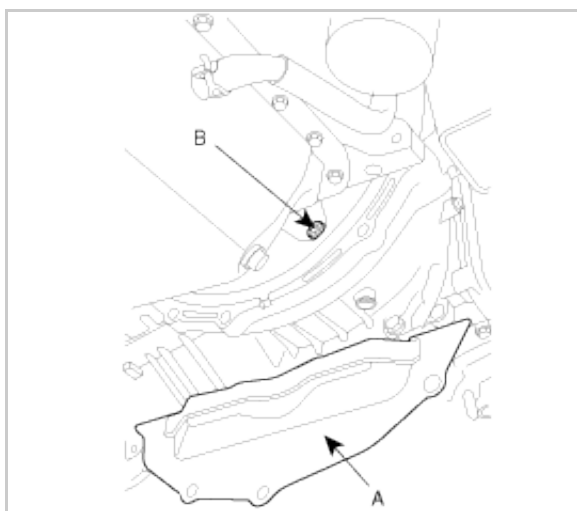
4. Install the drive plate bolts (B) by turning the timing gear and the plate (A).

---

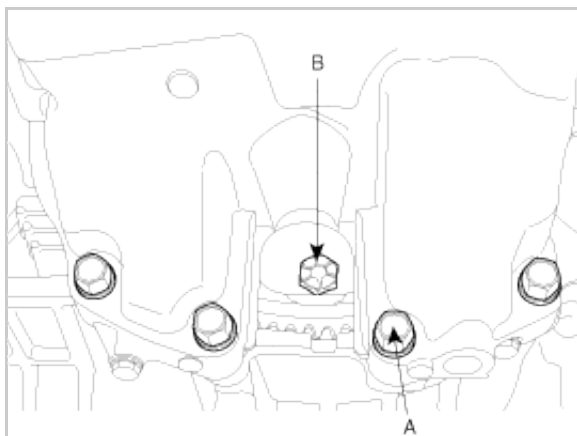
TORQUE:46~53 Nm(460~530 kgf.cm, 33.3~38.3 lb-ft)

---

## [2.9 DSL]



## [3.8 GSL]



5. After removing a jack, insert the drive shafts. (see DS group)

6. Install the sub frame. (see SS group).

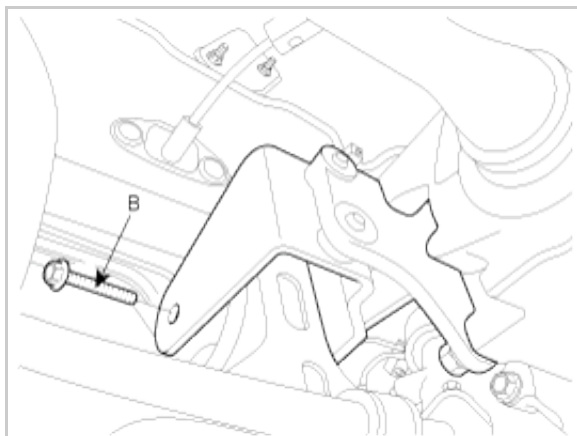
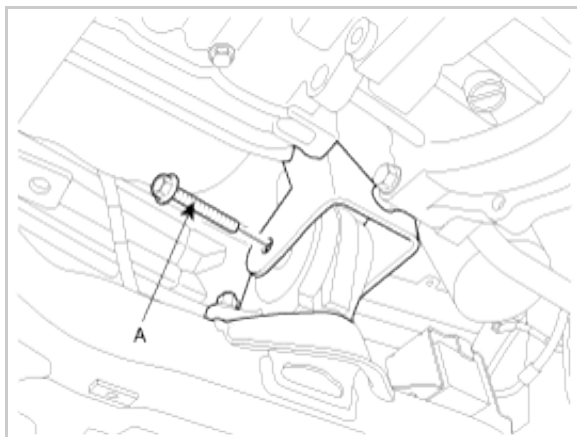
7. Tighten the roll stopper mounting bolts (A,B)

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TORQUE:

90~110 Nm(900~1100 kgf.cm, 65.1~79.5 lb-ft)

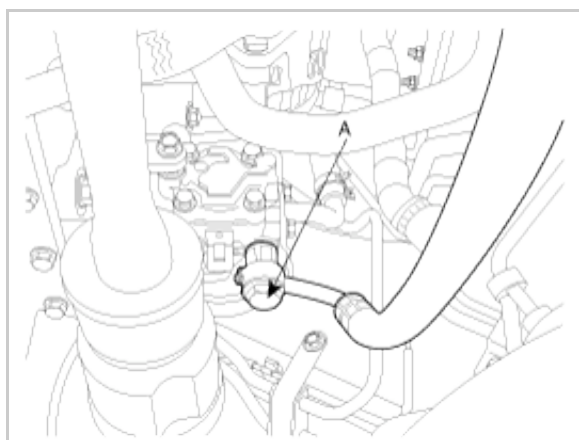
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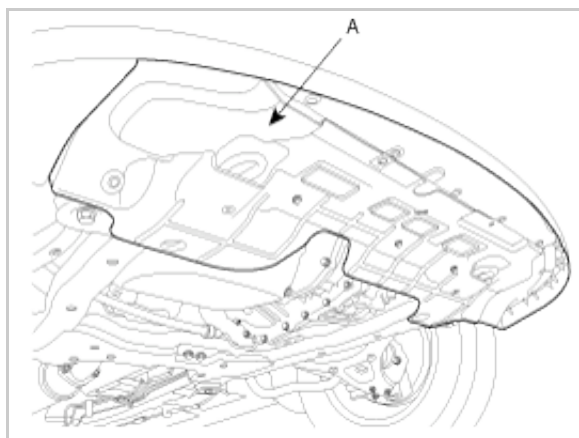
8. Connect the return tube with a clamp. (see ST group)

9. Connect the lower arm, the tie rod end ball joint, the stabilizer bar link to the front knuckle. (see SS group)

10. Connect the power steering pressure tube (A) to the power steering oil pump.



11. Install the under cover (A).



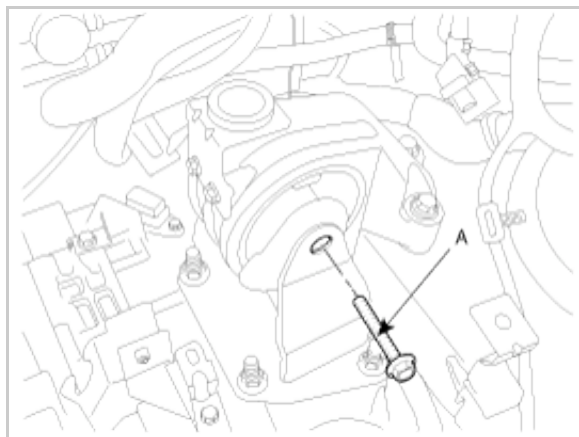
12. Install the steering column joint bolt. (see ST group).

13. Install the front wheels and tires.

14. Tighten the transaxle insulator mounting bolt (A).

TORQUE:

90~110 Nm(900~1100 kgf.cm, 65.1~79.5 lb-ft)



15. Tighten the transaxle mounting bolts (A).

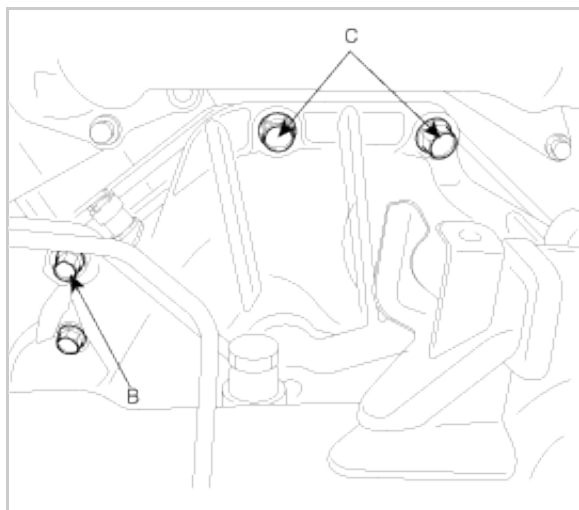
TORQUE:

65~85 Nm(650~850 kgf.cm, 47.0~61.5 lb-ft)

## [2.9 DSL]

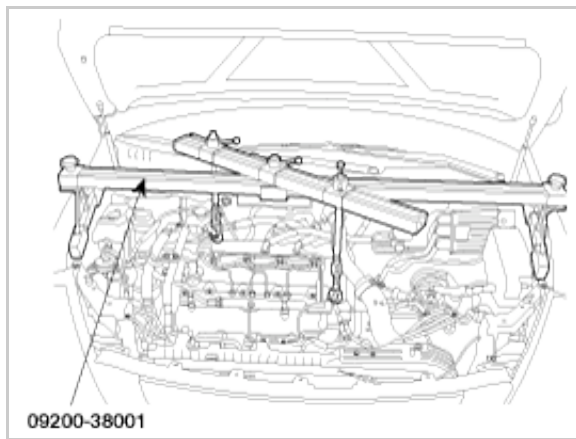


## [3.8 GSL]

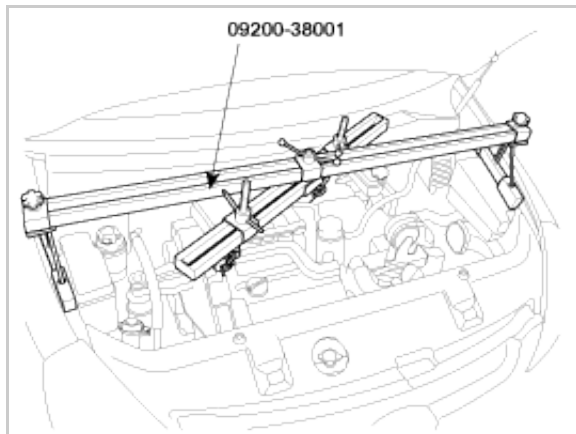


16. Remove the SST (09200-38001) holding the engine and transaxle assembly.

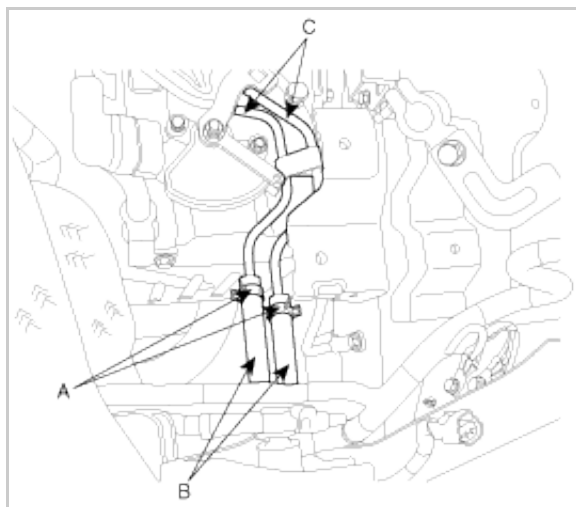
## [2.9 DSL]



### [3.8 GSL]



17. Connect the transaxle oil cooler hoses (A) to the tubes (C) by fastening the clamps (B).



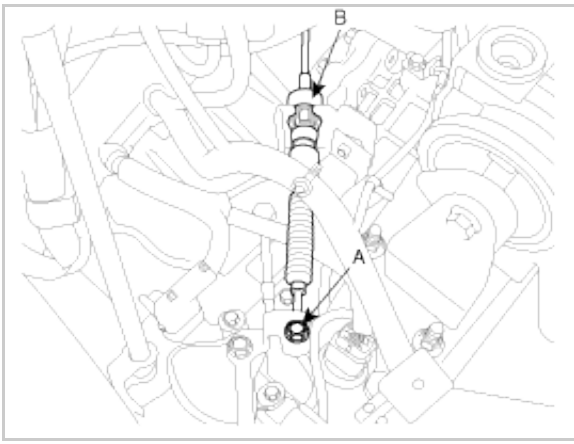
18. Install the shift cable by tightening the bolt (A) and clip (B).

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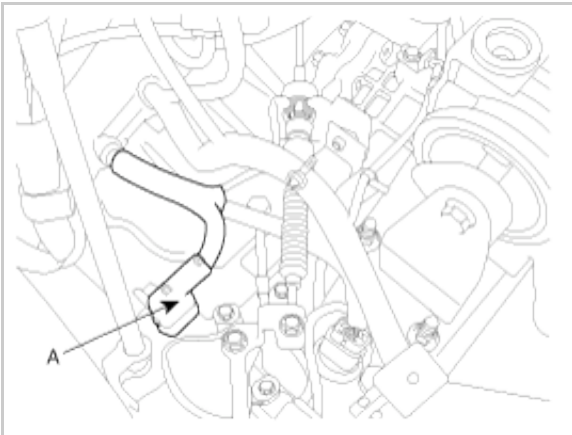
#### TORQUE:

10~14 Nm(100~140 kgf.cm, 7.2~10.1 lb-ft)

---

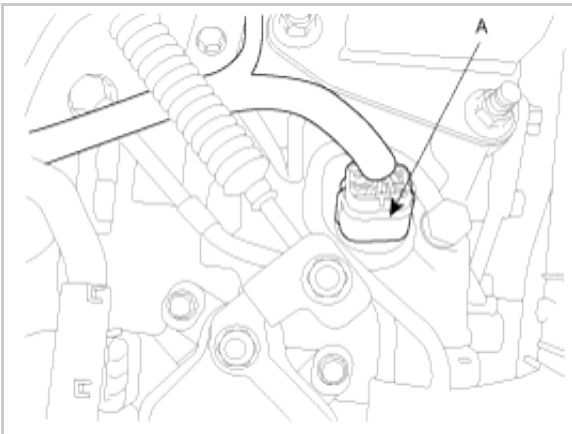


19. Connect the transaxle wire harness connectors.  
 (1) Install the inhibitor switch connector (A).

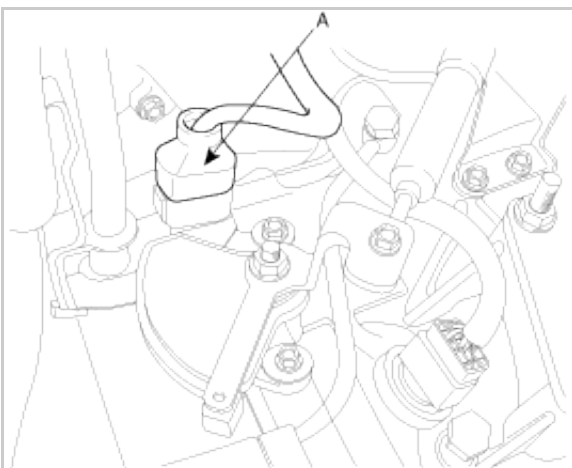


- (2) Install the solenoid valve connector (A).

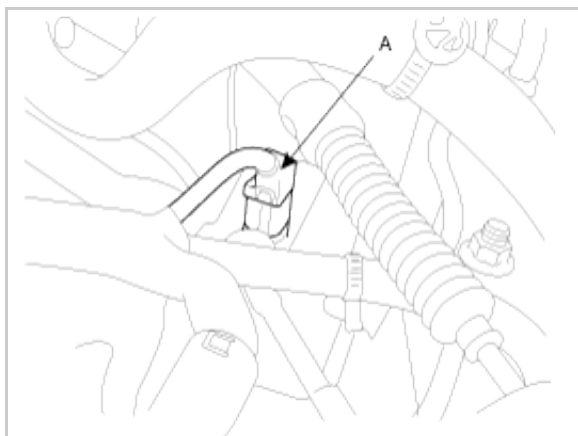
### [2.9 DSL]



### [3.8 GSL]



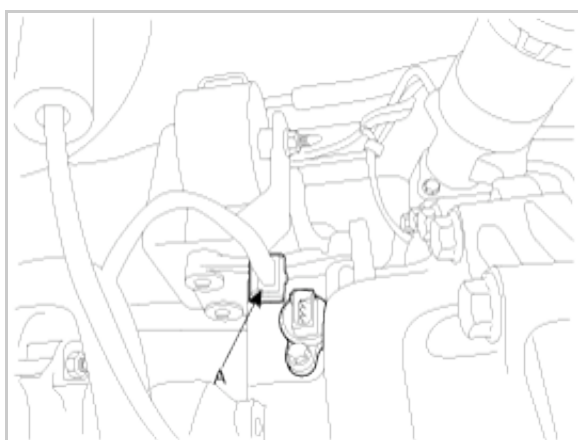
(3) Install the input speed sensor connector (A).



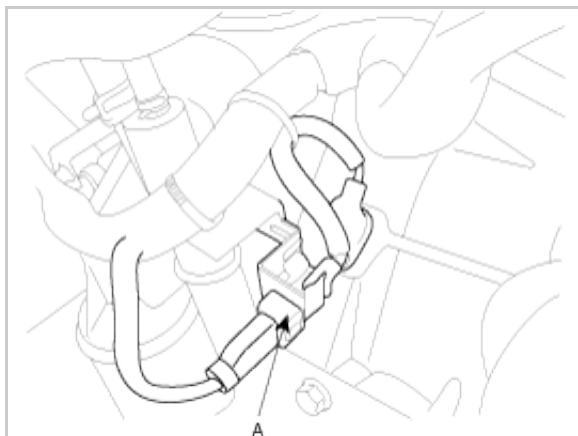
(4) Install the output speed sensor connector (A).



(5) Install the vehicle speed sensor connector (A).

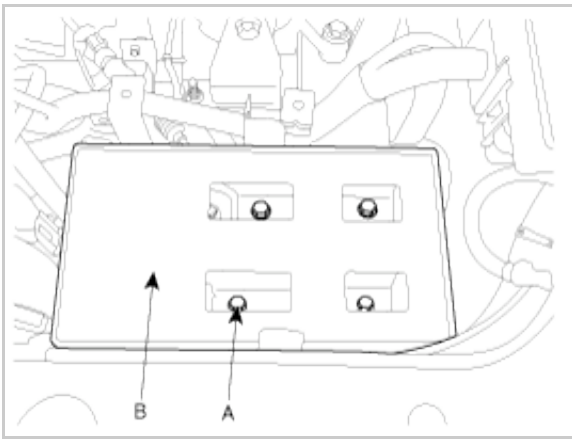


(6) Install the CKP sensor connector (A).



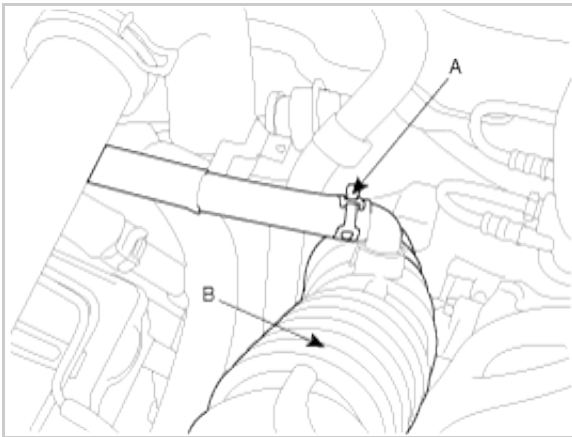
20. Install the battery tray (B) by tightening the four mounting bolts (A).



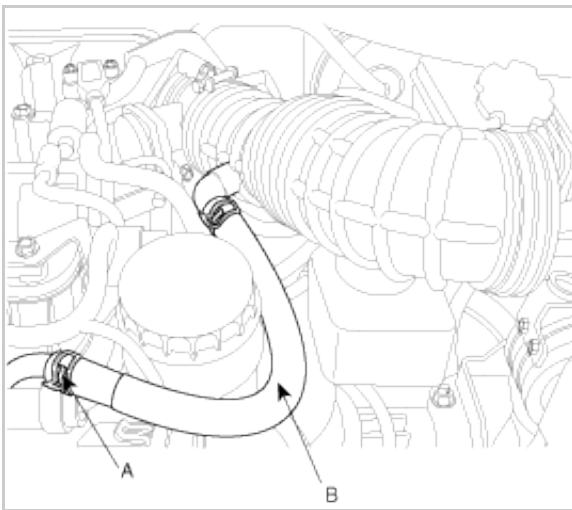


21. Connect the air cleaner hose (B) by fastening the clamp (A).

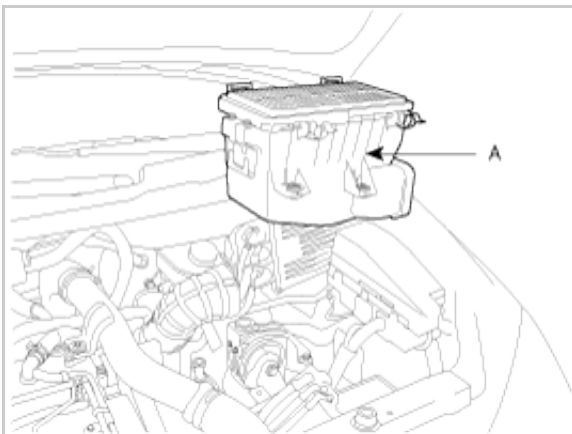
### [2.9 DSL]



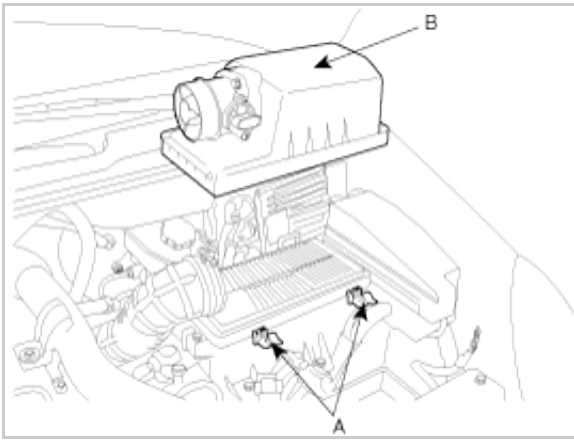
### [3.8 GSL]



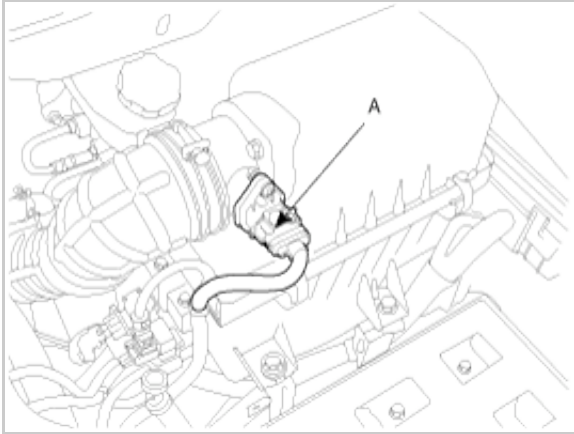
22. Install the air cleaner assembly (A).



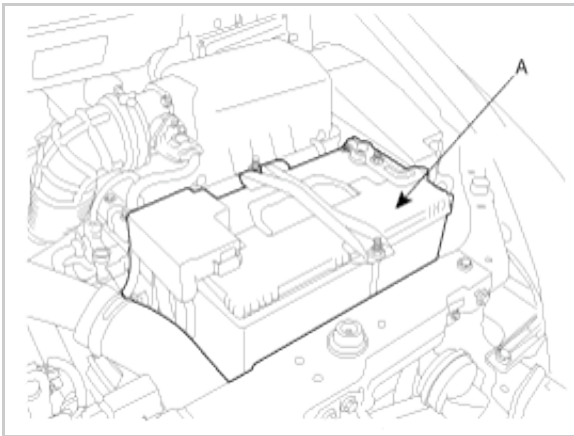
23. Install the air cleaner upper cover (B) by fastening the clips (A).



24. Connect the AFS connector (A).



25. Install the battery (A).



# **Automatic Transaxle Control System**

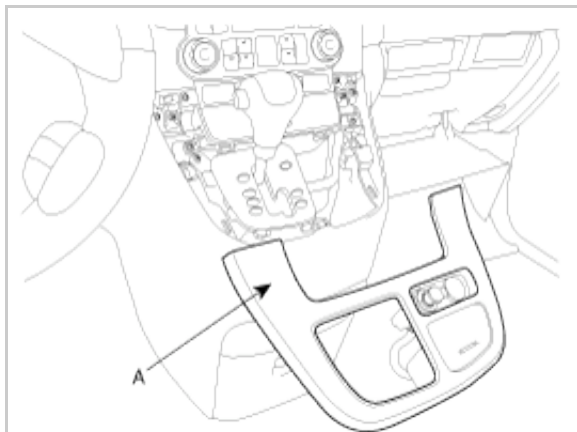
Shift Lever



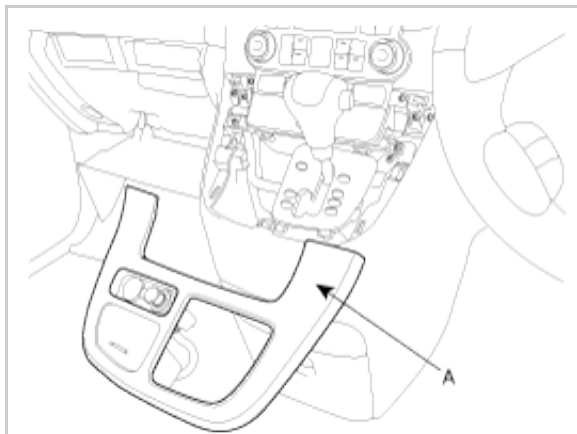
## REMOVAL

1. Remove the console upper cover(A). (see BD group).

### [LHD]

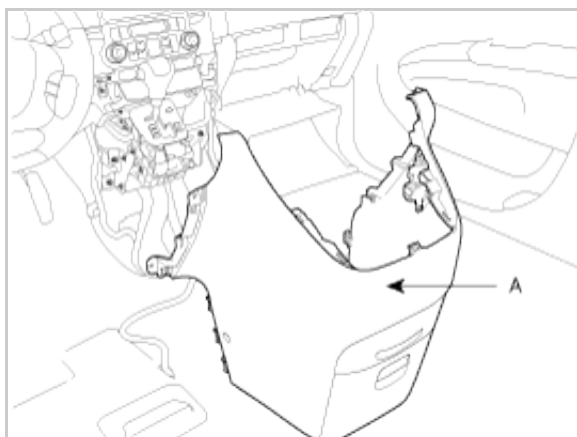


### [RHD]

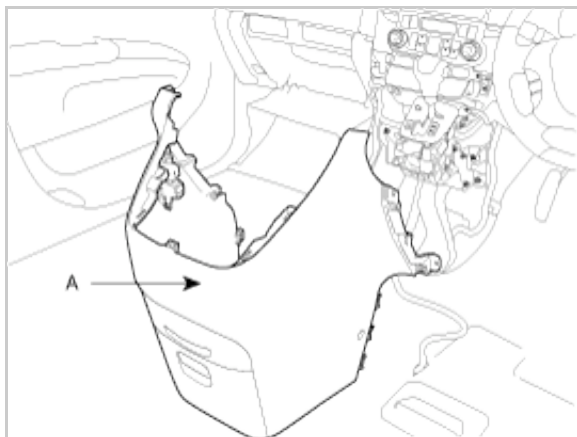


2. Remove the front console cover (A). (see BD group).

### [LHD]

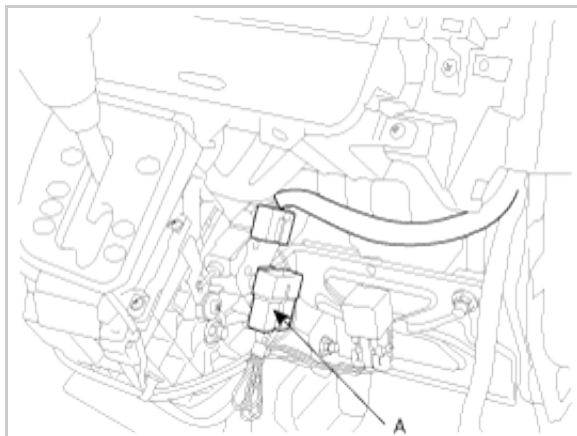


### [RHD]

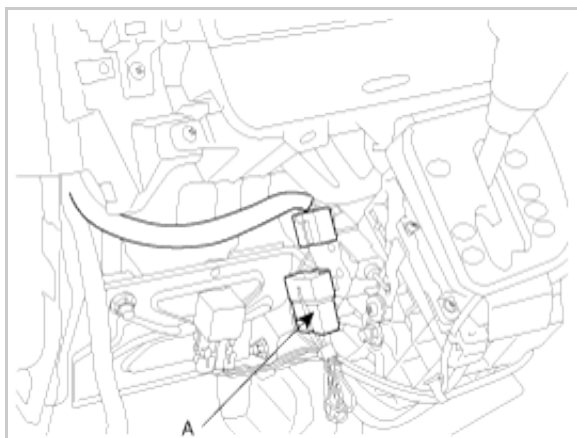


3. Disconnect the connector (A).

**[LHD]**

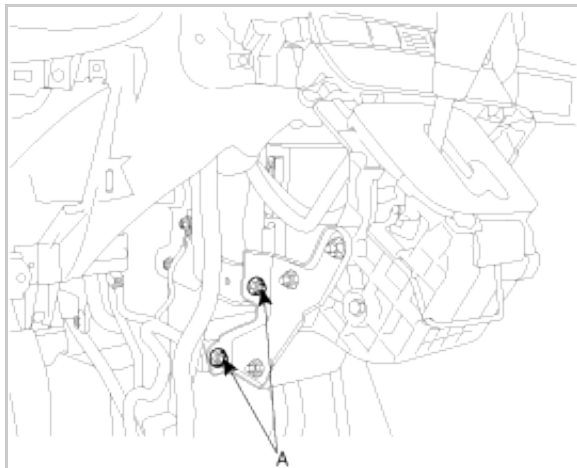


**[RHD]**

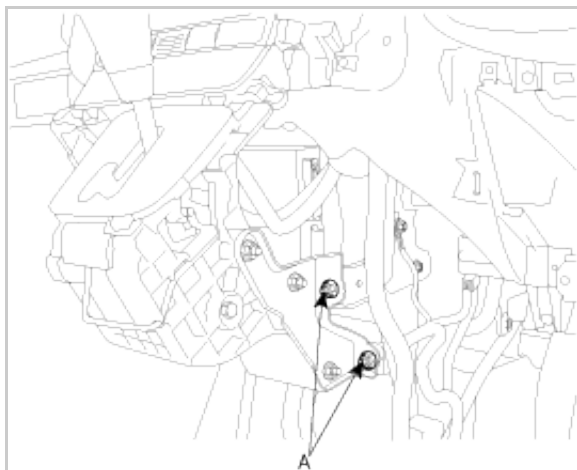


4. Remove the shift lever assembly mounting nuts (A).

**[LHD]**

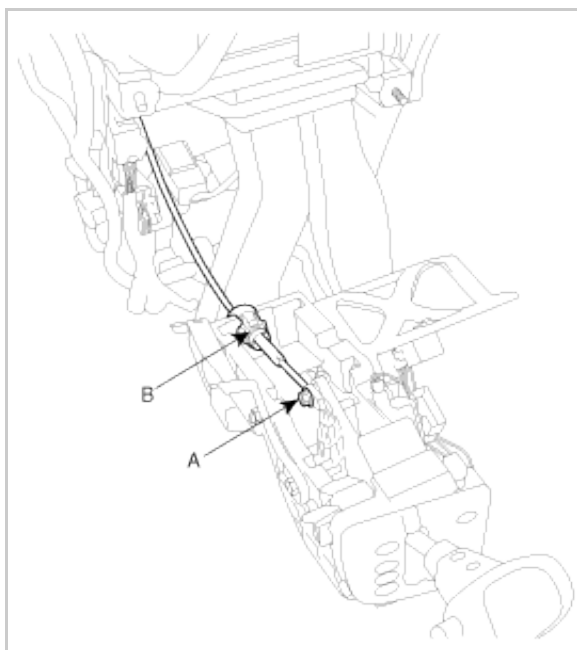


**[RHD]**

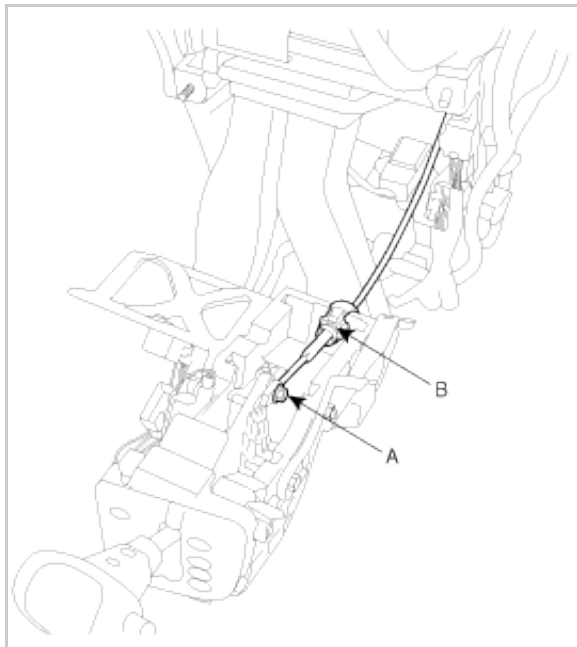


5. Remove the shift cable mounting nut (A) and cap (B).

**[LHD]**



**[RHD]**



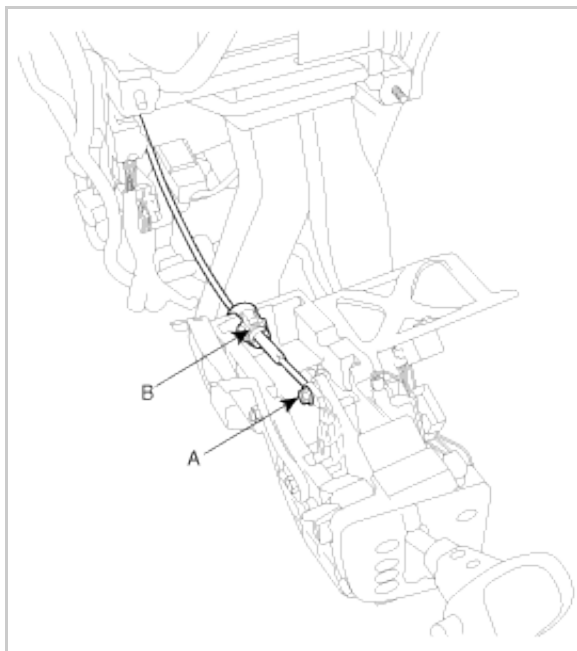
## INSTALLATION

1. Install the shift cable mounting nut (A) and cap (B).

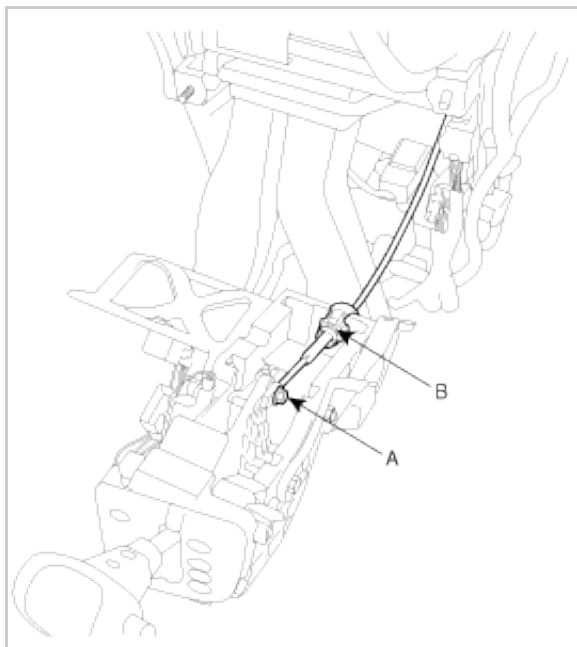
TORQUE:

10~14 Nm(100~140 kgf.cm, 7.3~10.2 lb-ft)

### [LHD]



### [RHD]

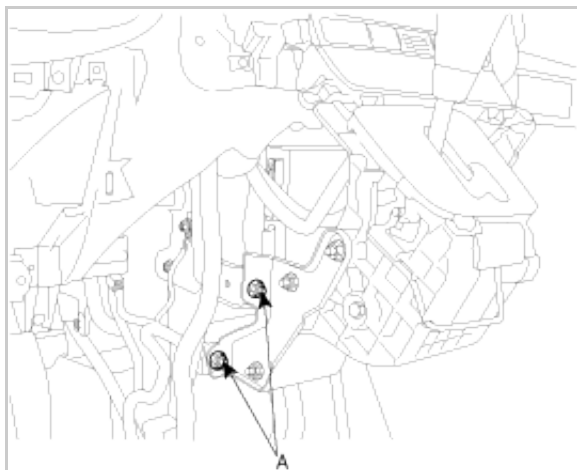


2. Install the shift lever assembly mounting nuts (A).

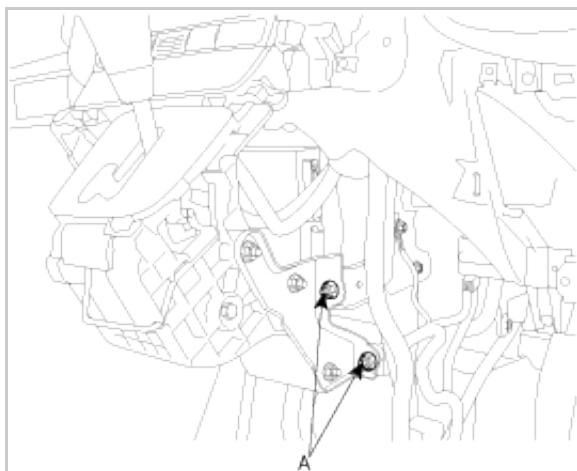
**TORQUE:**

19~24 Nm(190~240 kgf.cm, 13.8~17.5 lb-ft)

**[LHD]**



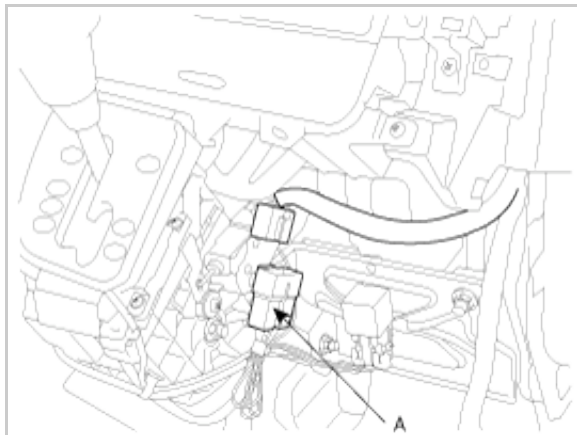
**[RHD]**



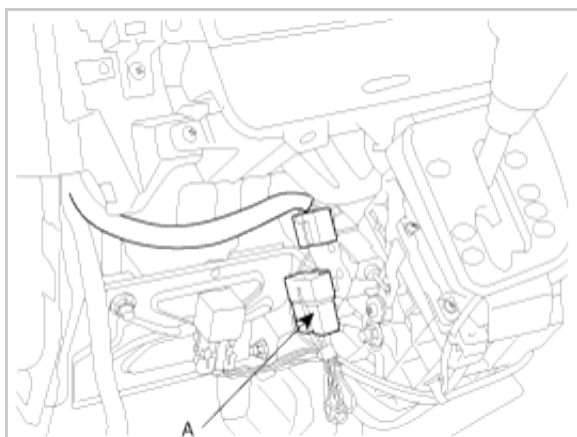
3. Connect the connector (A).

**[LHD]**



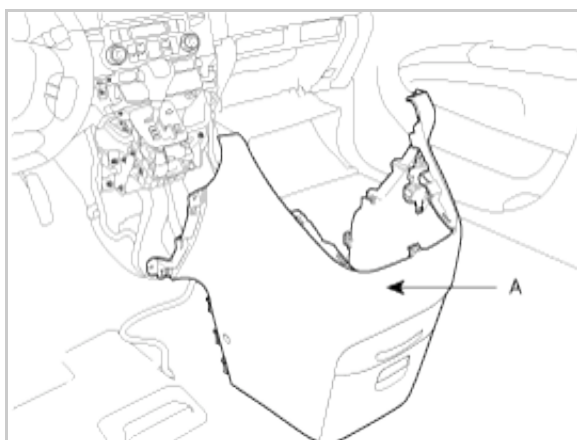


**[RHD]**

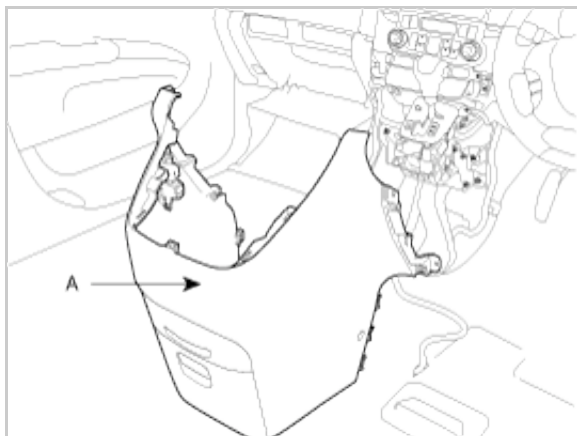


4. Install the front console cover (A). (see BD group)

**[LHD]**

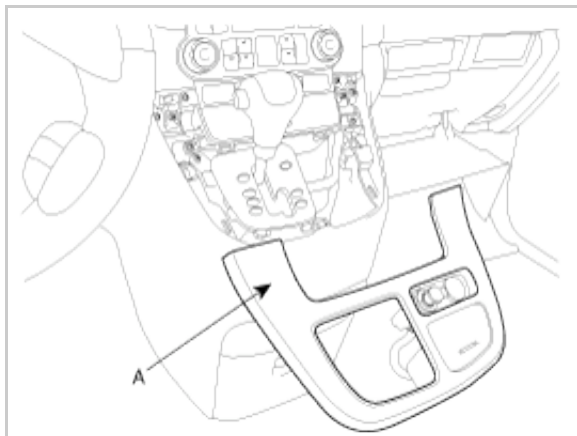


**[RHD]**

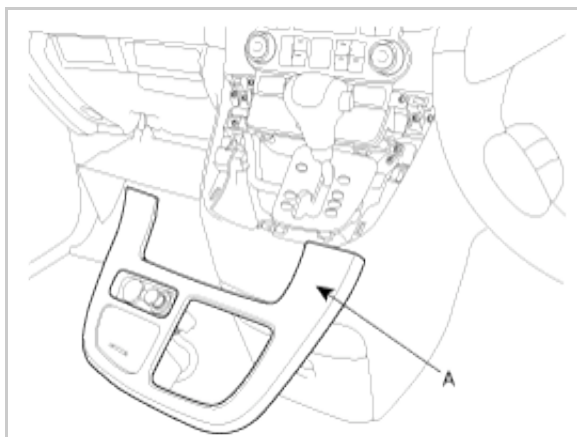


5. Install the console upper cover(A). (see BD group).

**[LHD]**



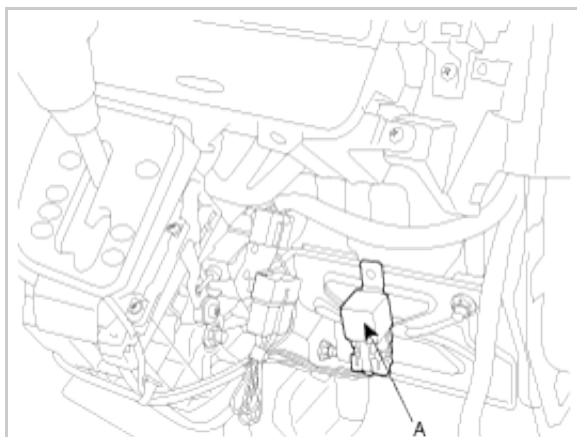
**[RHD]**



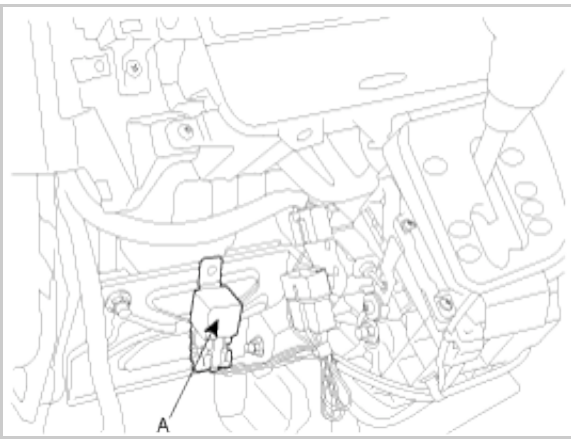
## DISASSEMBLY

1. Remove the power relay (A) from the bracket.

**[LHD]**

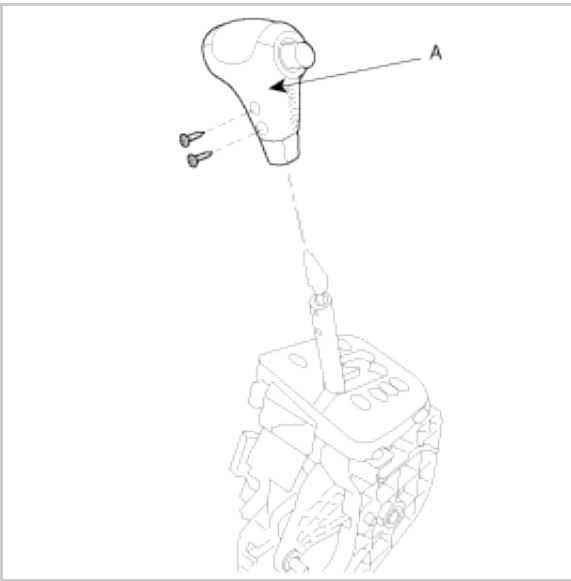


**[RHD]**

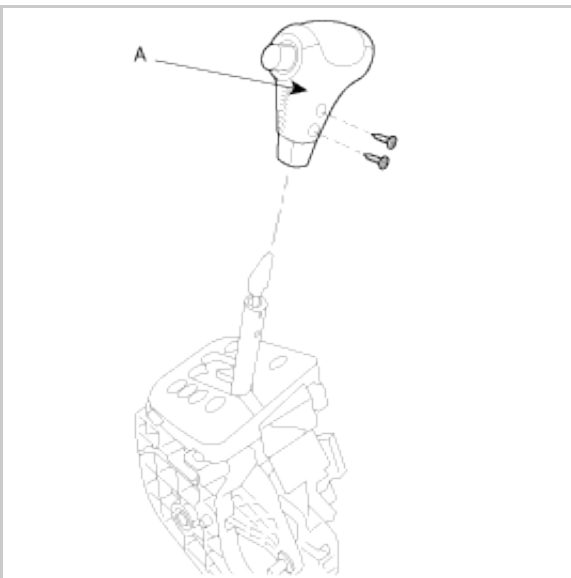


2. Remove both sides of the brackets.
3. Remove the shift lever knob (A) by removing the two screws.

#### [LHD]

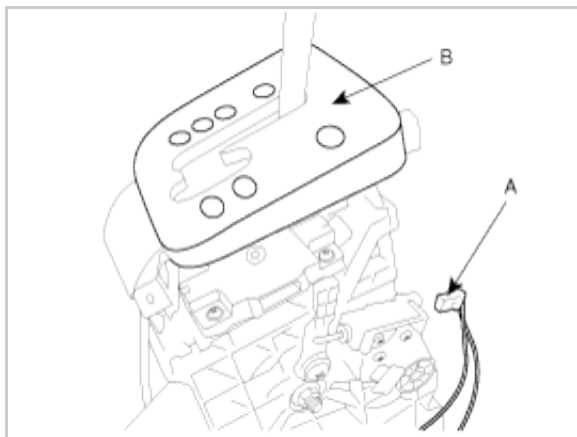


#### [RHD]

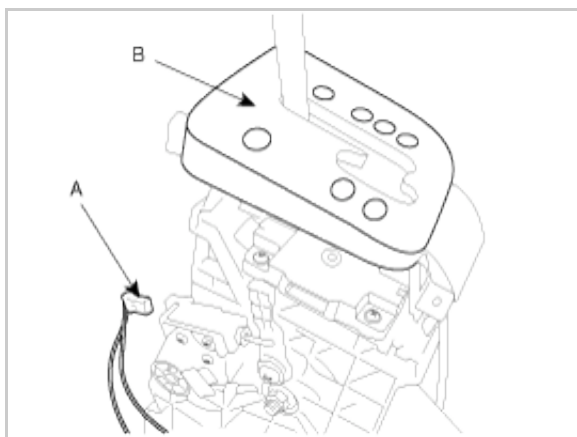


4. Disconnect the solenoid connector (A) and remove the indicator panel (B).

#### [LHD]



**[RHD]**

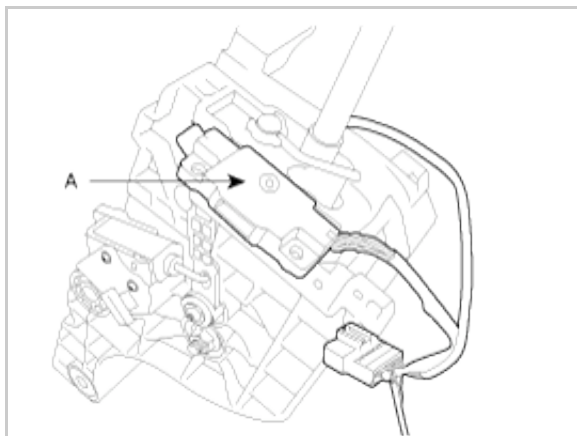


5. Remove the switch assembly (A) and 'P' position switch assembly.

**[LHD]**

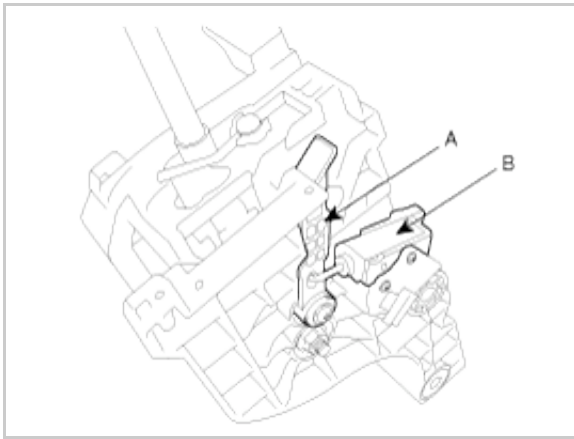


**[RHD]**

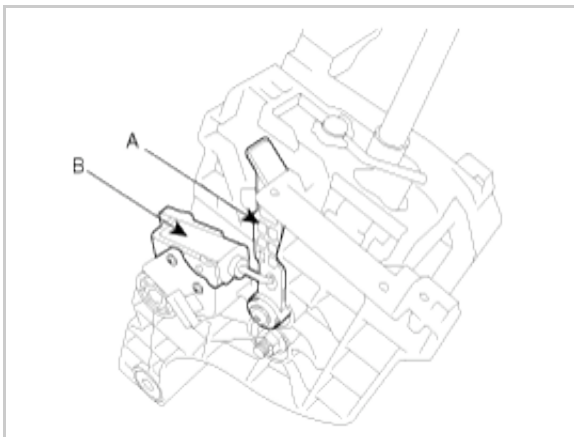


6. Remove the solenoid (B) and solenoid lever (A).

**[LHD]**

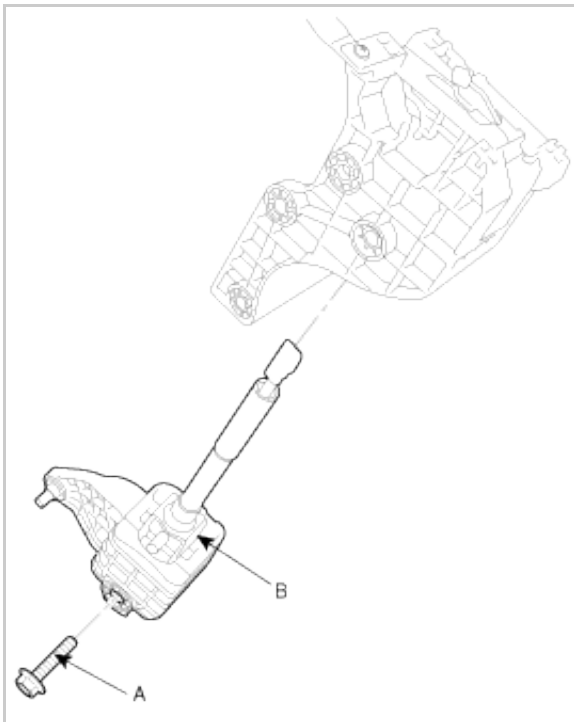


**[RHD]**

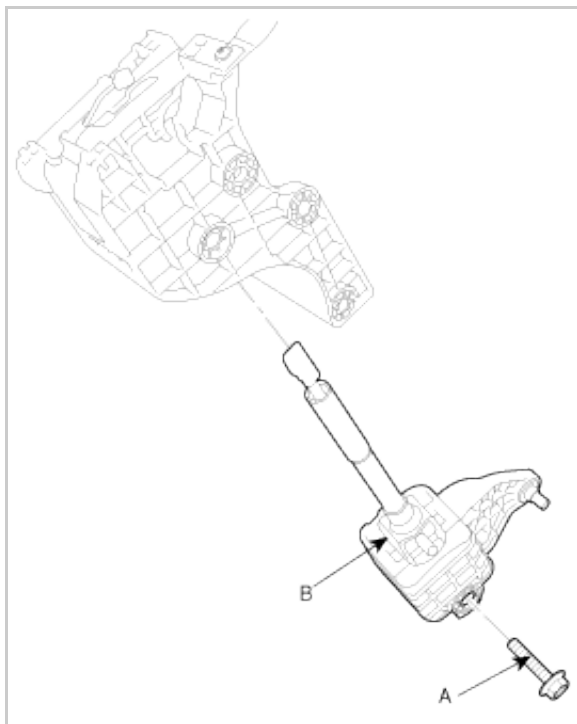


7. Remove the lever assembly (B) by the mounting bolt (A).

**[LHD]**

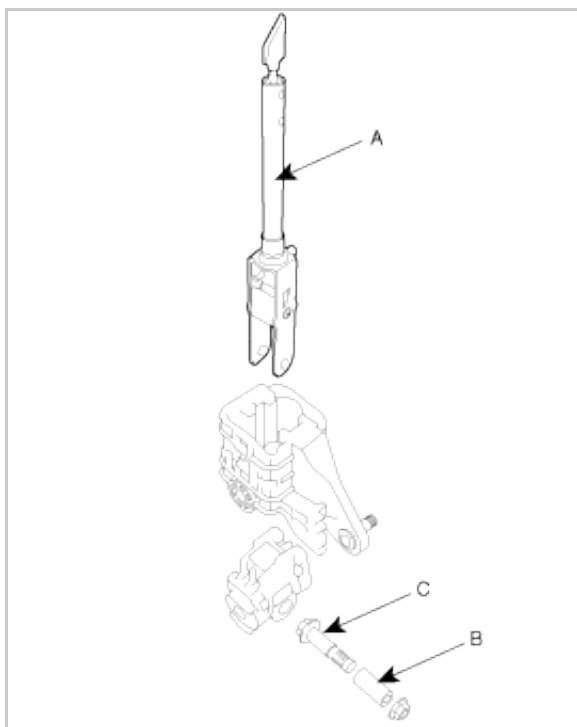


**[RHD]**

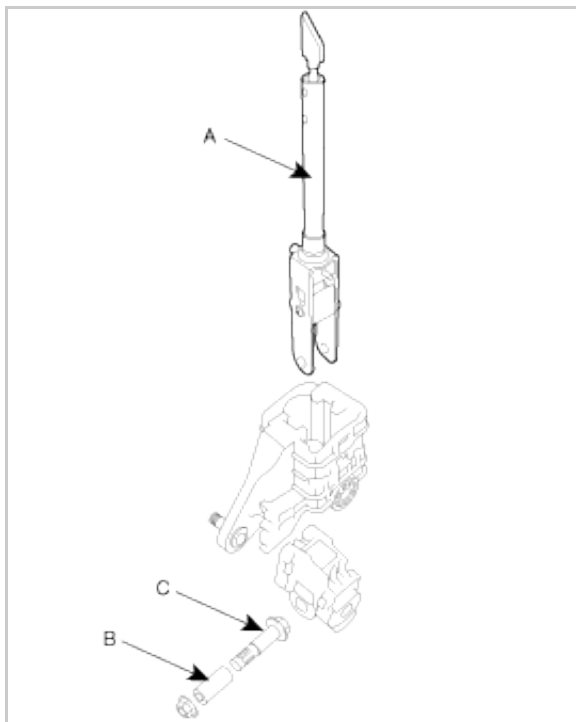


8. Remove the lever (A) and tube (B) by removing the bolt (C).

**[LHD]**



**[RHD]**



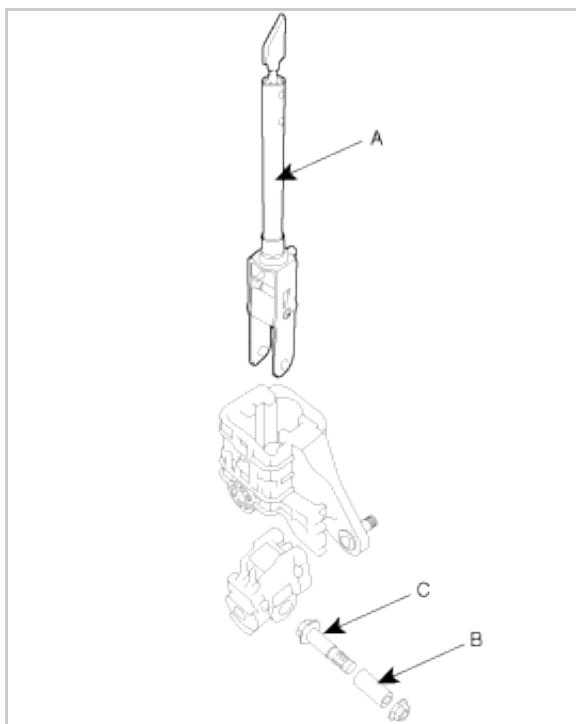
## REASSEMBLY

1. Grease the tube (B) and install the lever (A) by tightening the bolt (C).

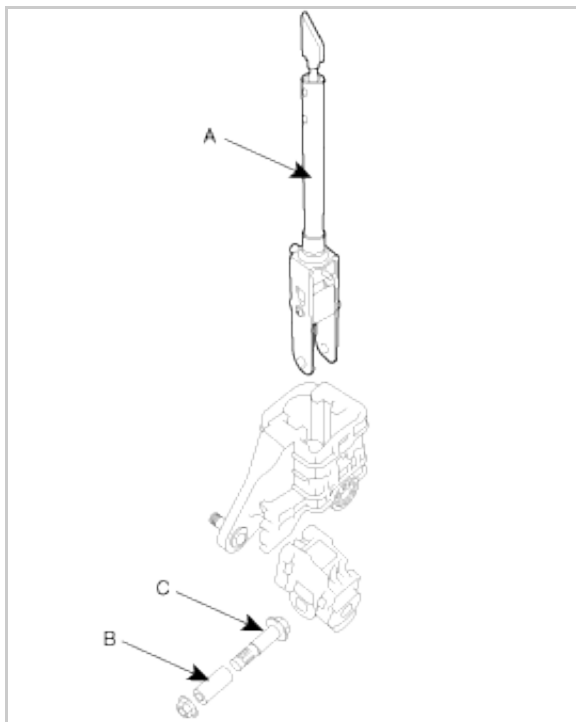
TORQUE:

8~12 Nm(80~120 kgf.cm, 5.8~8.7 lb-ft)

### [LHD]



### [RHD]

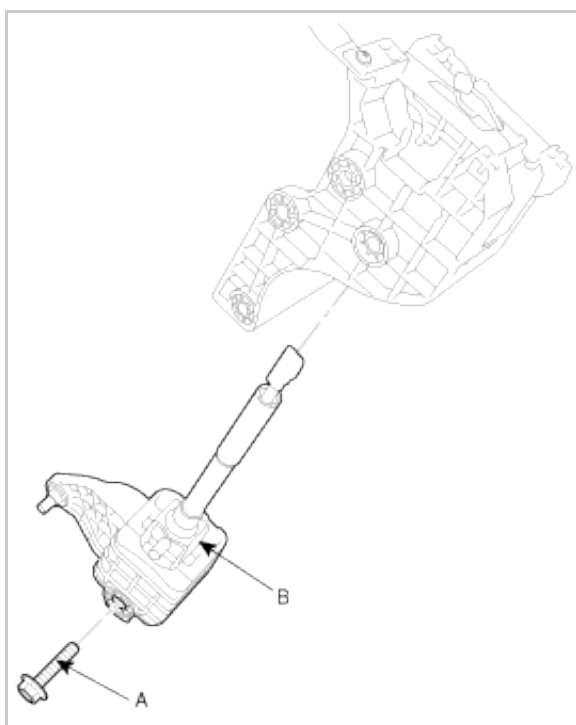


2. Install the lever assembly (B) by tightening the bolt (A).

TORQUE:

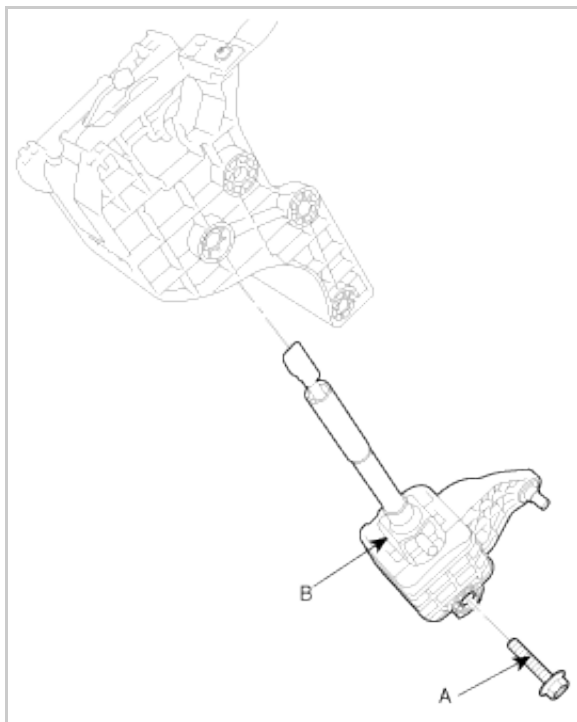
8~12 Nm(80~120 kgf.cm, 5.8~8.7 lb-ft)

**[LHD]**



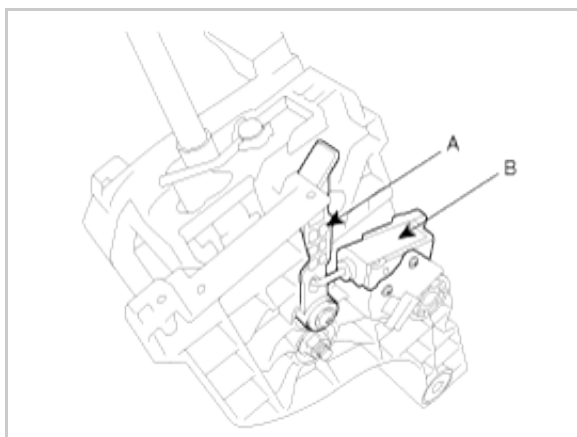
**[RHD]**



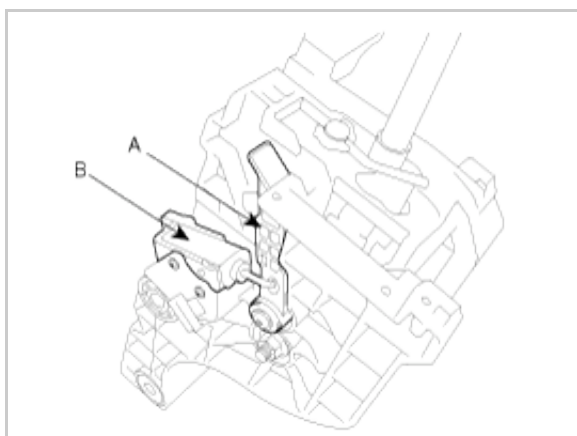


3. Install the solenoid (B) and solenoid lever (A).

**[LHD]**



**[RHD]**

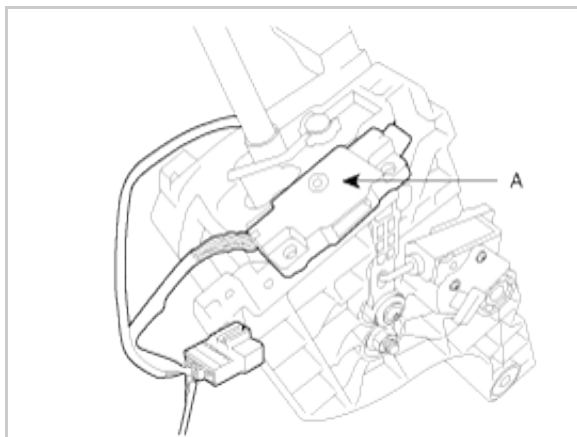


4. Install the switch assembly (A) and 'P' position switch assembly.

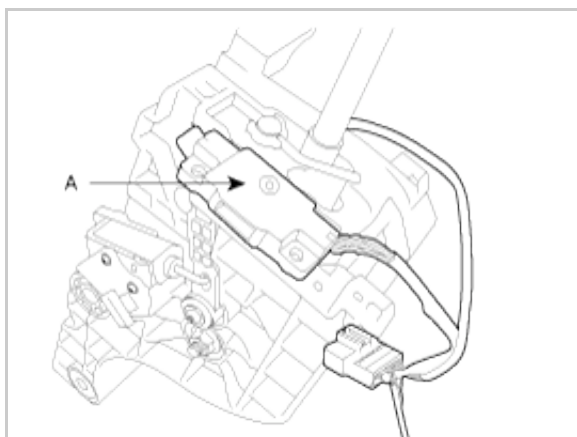
TORQUE:

1.3~1.9 Nm(13~19 kgf.cm, 0.95~1.38 lb-ft)

**[LHD]**

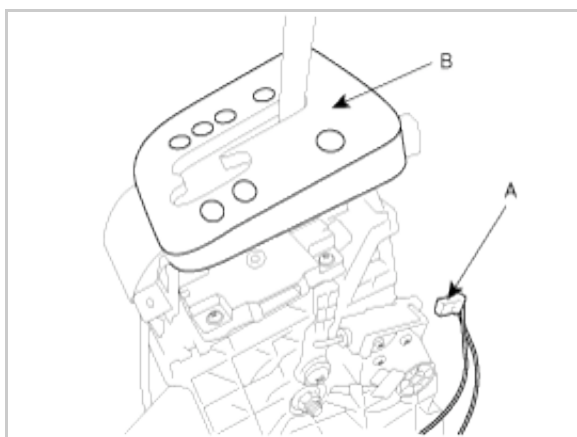


**[RHD]**

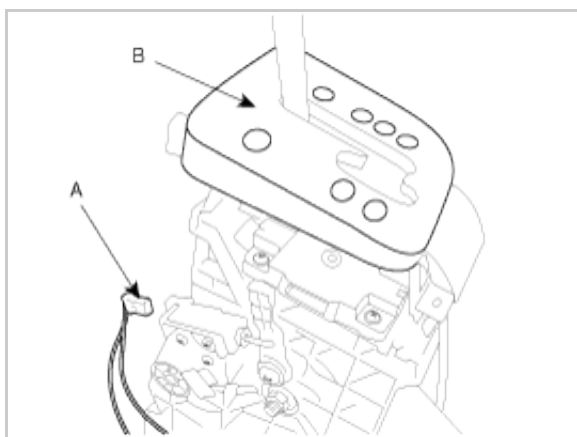


5. Connect the solenoid connector (A) and install the indicator panel (B).

**[LHD]**



**[RHD]**



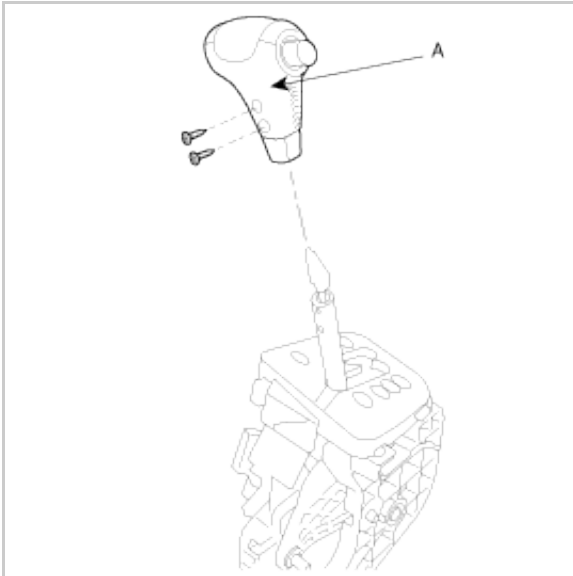
6. Install the shift lever knob (A) by tightening the two screws.

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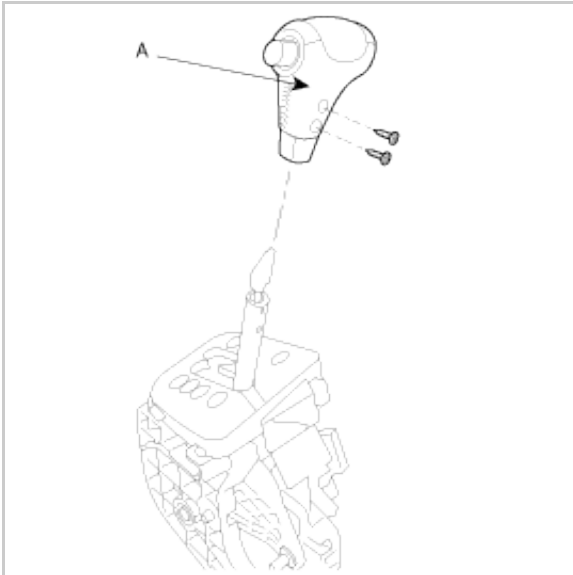
TORQUE:  
2~3 Nm(20~30 kgf.cm, 1.45~2.18 lb-ft)

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**[LHD]**



**[RHD]**



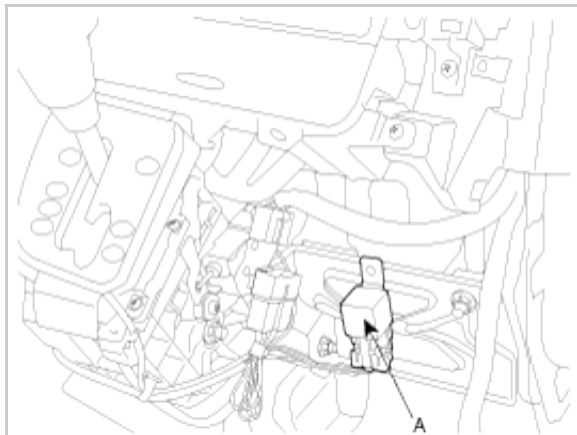
7. Install both sides of the brackets.
- 

TORQUE:  
16~23 Nm(160~230 kgf.cm, 11.6~16.7 lb-ft)

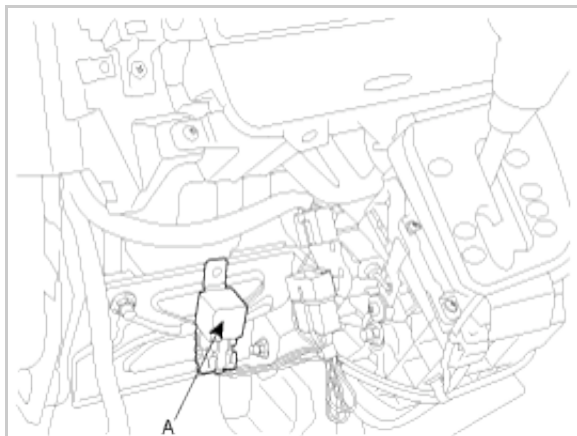
---

8. Install the power relay (A) to the bracket.

**[LHD]**



[RHD]



## **CHAPTER 7:**

# **Manual Transaxle**

# **General Information**



## SPECIFICATIONS

Model			M5HF2	
Related engine			J2.9WGT	J2.9VGT
Torque [Nm (kgf.m, lb-ft)]			350 (35, 253)	
Full length [mm(in)]			392.5 (15.45)	
Weight [N(kgf, lbf)]			673.7 (68.7, 151)	
Oil capacity			1.85ℓ	
Oil replacement	Normal	Private	-	
		Business	100,000 Km	
	Severe use		100,000 Km	
Gear ratio	1st		3.600	3.438
	2nd		1.875	1.800
	3rd		1.205	1.154
	4th		0.818	0.818
	5th		0.768	0.768
	Reverse		4.320	4.050
	Reduction gear ratio		4.500(1-4th gear)/3.706(5,R gear)	
Lubricant			SAE 75W/85, API GL - 4	

## SYNCRONIZED RING ASSEMBLY

	1st	2nd	3rd	4th	5th	Reverse
Type	Triple	←	←	Double	←	←
Material	Brass +Carbon	←	←	Brass	Brass	Brass + Carbon
Key type	Assembly of key, ball and spring	←	←	←	←	←
Hub&Sleeve FITTING	Minor Dia. Fit	←	←	←	←	←
Clutch gear chamfer	Symmetrical chamfer	Asymmetrical chamfer	←	←	←	Symmetrical chamfer



## DESCRIPTION

VQ Diesel (J2.9) model has the manual transaxle (M5HF2).

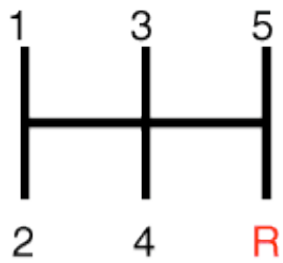
### IMPROVEMENT

ITEM	Improvement
Better shift feeling	a. New shift pattern b. Multi cone synchronizer system c. Module of control system d. New type of poppet ball
Better duability	a. Optimizing strength of shift control system b. Optimizing strength of housing and cases (for NVH) c. Carbonized material for synchronized rings
Cost saving&Convenience	a. Permanent oil (low viscosity)

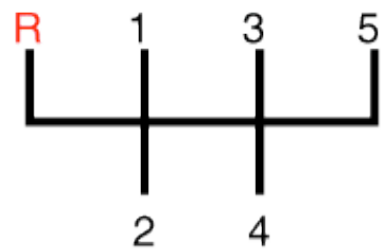
This new shift pattern has the same shift direction for both 1st and Reverse which is convenient when on traffic jam or parking (1↔R).

You should pull the lower part of the shift lever to shift in reverse.

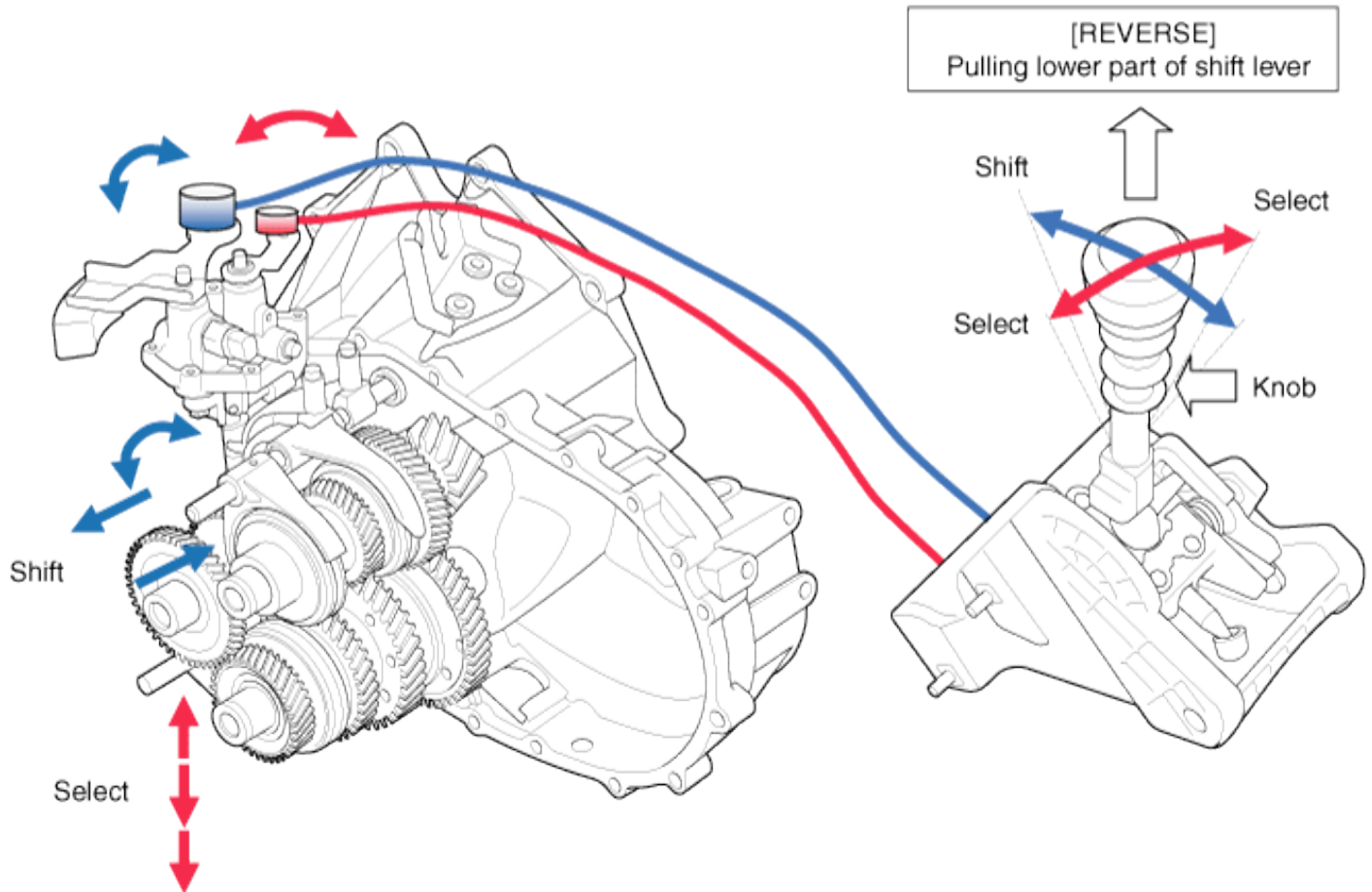




<OLD PATTERN>



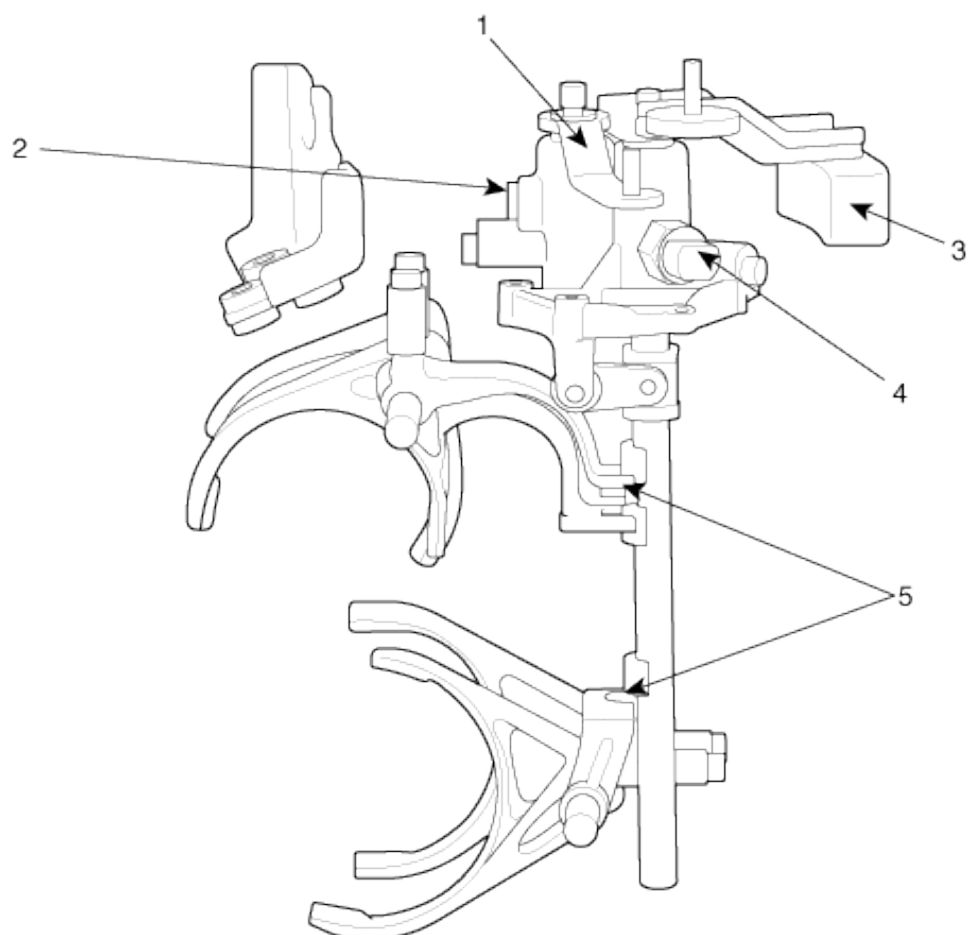
<NEW PATTERN>



## SHIFT CONTROL SYSTEM

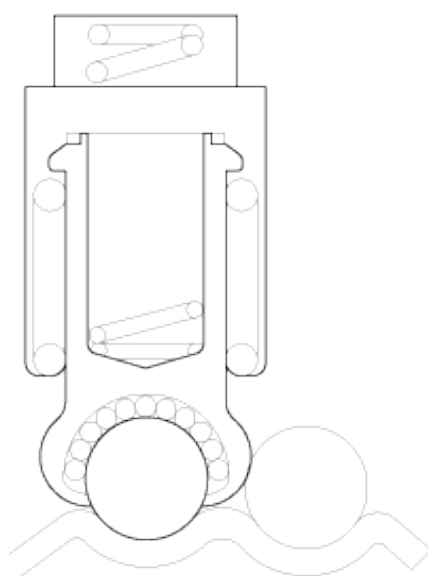
### • SHIFT CONTROL SYSTEM

The module of the shift control system improves shift feeling and quality of the part itself.

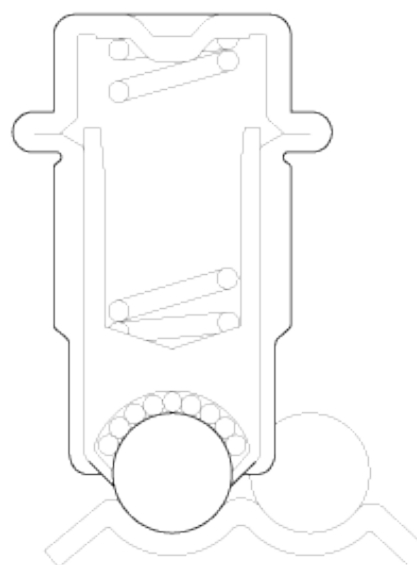


- |                            |                       |
|----------------------------|-----------------------|
| 1. Select lever            | 4. Backup lamp switch |
| 2. Neutral position switch | 5. Control finger     |
| 3. Shift lever             |                       |

## New type of poppet ball



<M5HF2>

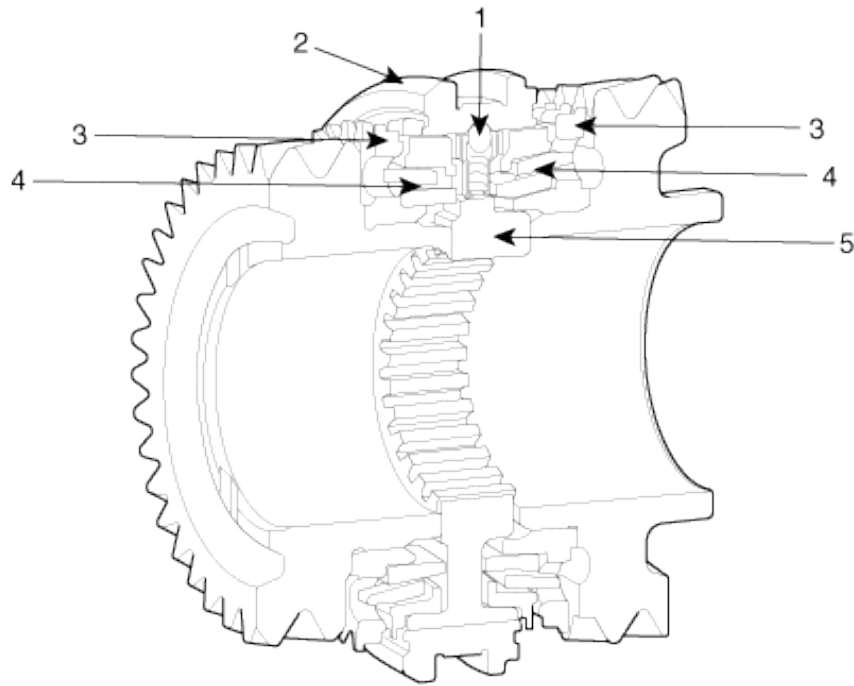


<M5AF3, M5BF2>

Items	M5HF2	M5AF3, M5BF2
Character	Easy shifting	Medium shifting

# SYNCHRONIZER SYSTEM

## COMPONENTS

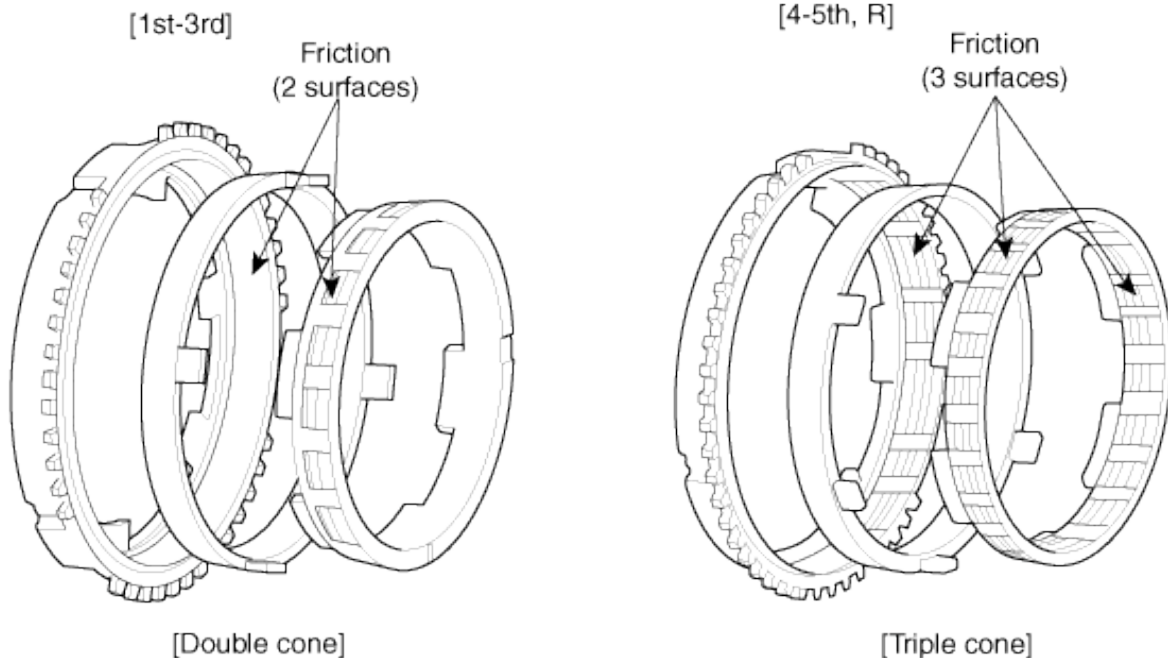


- 1. Synchronizer key
- 2. Synchronizer sleeve
- 3. Clutch gear

- 4. Synchronizer ring
- 5. Synchronizer hub

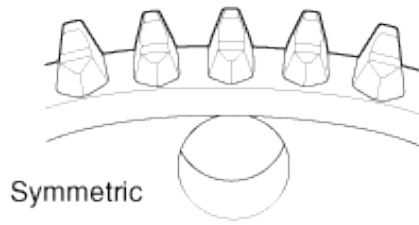
## SYNCHRONIZER TYPE

Both triple cone (1st-3rd) and double cone (4th-R) synchronizer rings, which have more friction surfaces, improve shift feeling.

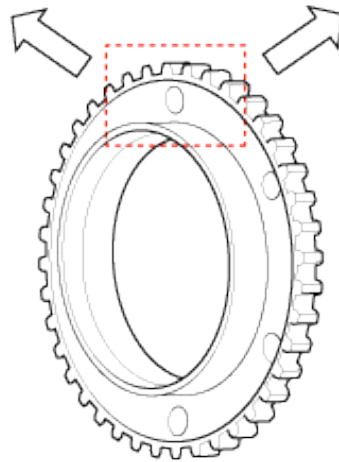
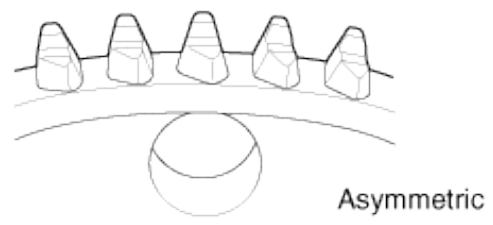


## CLUTCH GEAR CHAMFER

[1st & R]

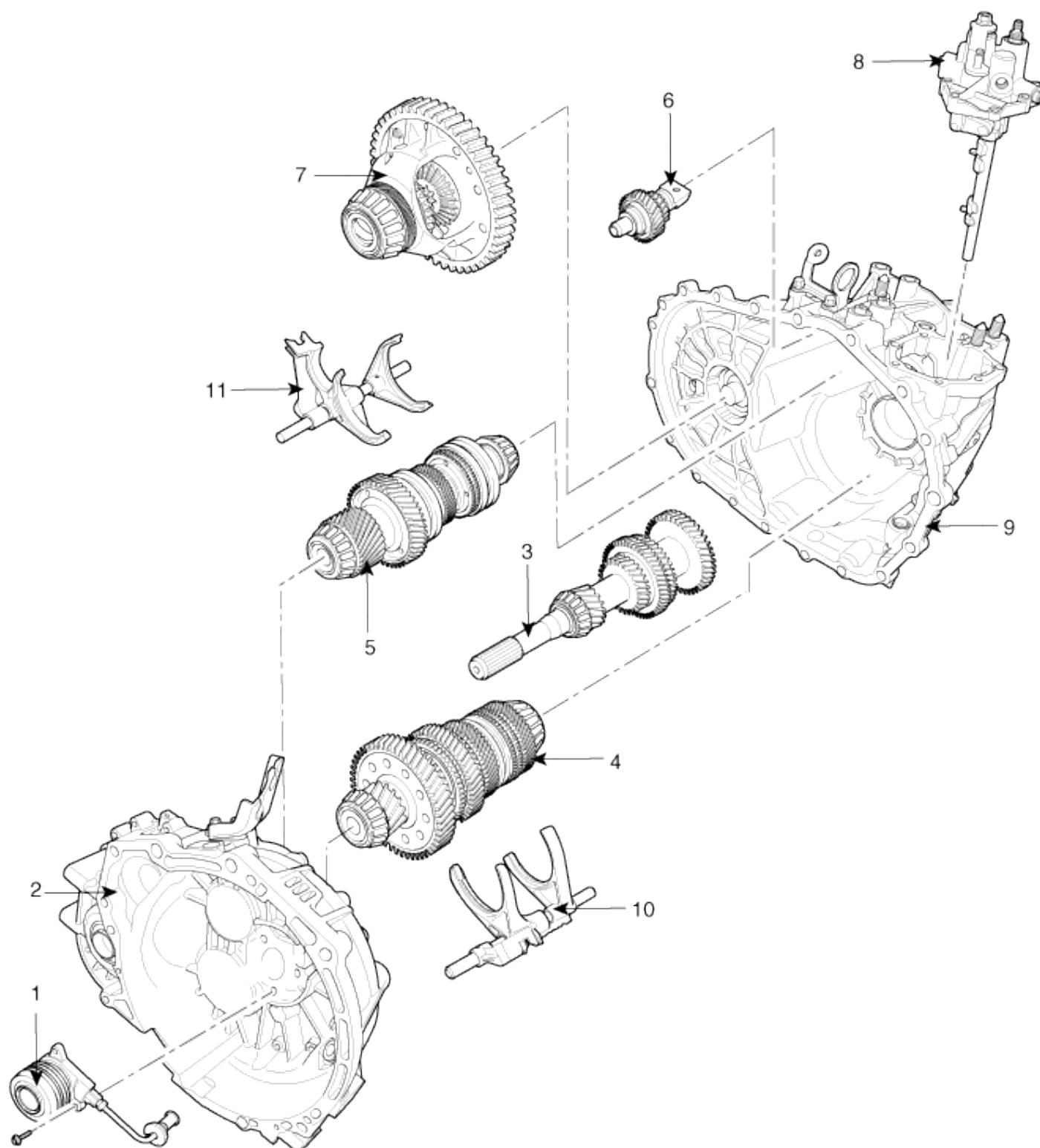


[2-5th]



# **Manual Transaxle System**

## COMPONENTS



1. C.S.C. (Concentric Slave Cylinder)
2. Clutch housing
3. Input shaft
4. 1st output shaft
5. 2nd output shaft
6. Reverse idler gear assembly

7. Differential assembly
8. Control shaft assembly
9. Transaxle case
10. 3rd/4th shift rail sub assembly
11. 5th/Reverse shift rail sub assembly



## REMOVAL

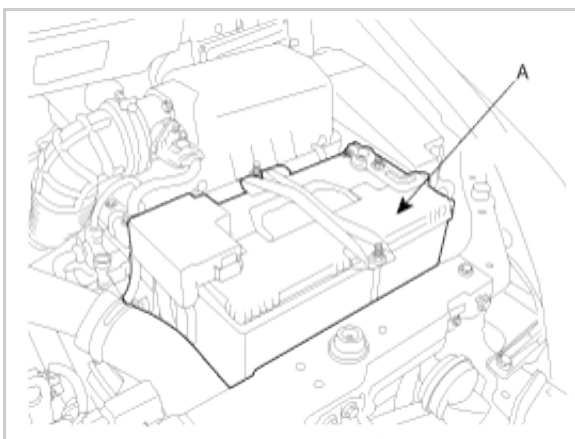
### CAUTION

- a. Use a cover not to damage the vehicle surface.
- b. Disconnect connectors carefully not to be damaged.

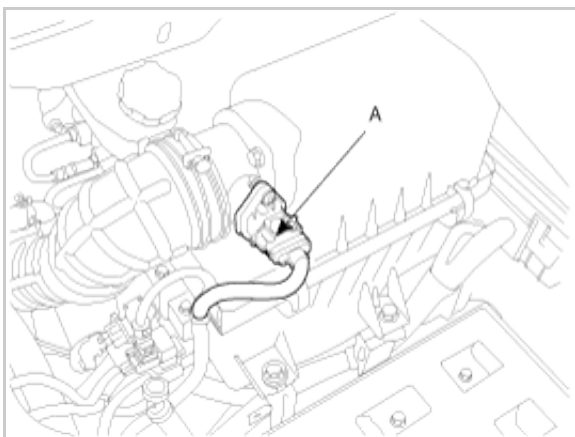
### NOTICE

- a. Mark wires or hoses for identification not to be confused.

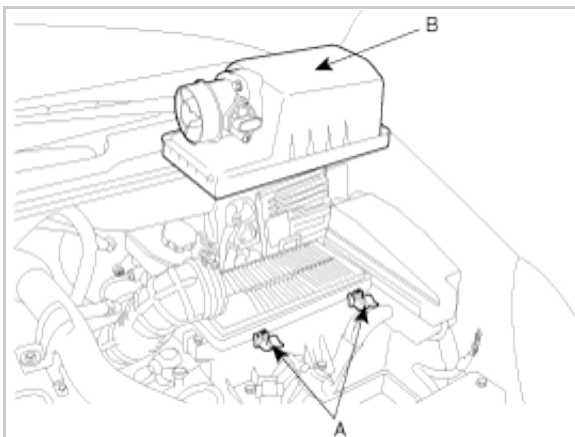
1. Remove the battery (A).



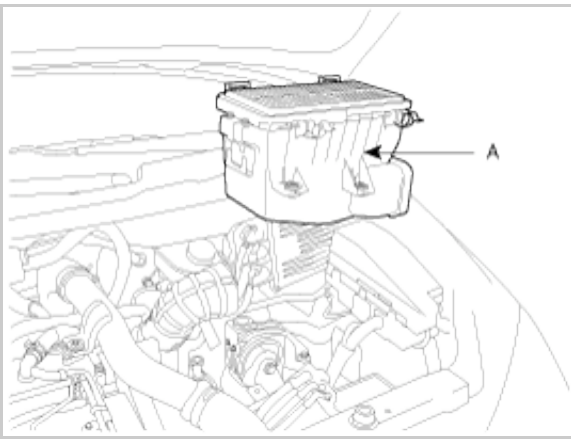
2. Disconnect the AFS connector (A).



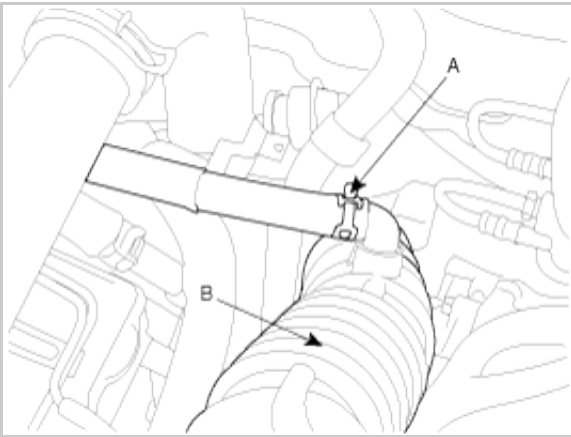
3. Remove the air cleaner upper cover (B) by loosening the clips (A).



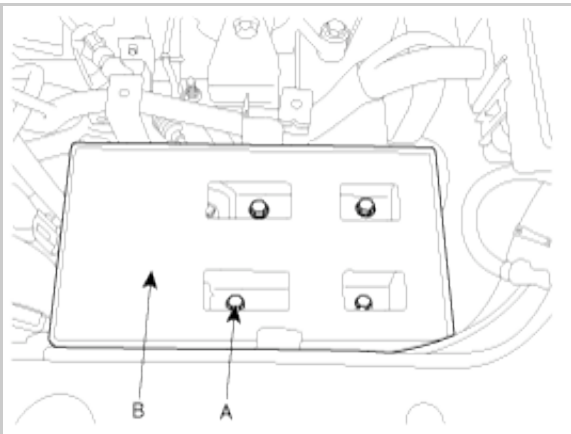
4. Remove the air cleaner assembly (A) by removing the two mounting bolts.



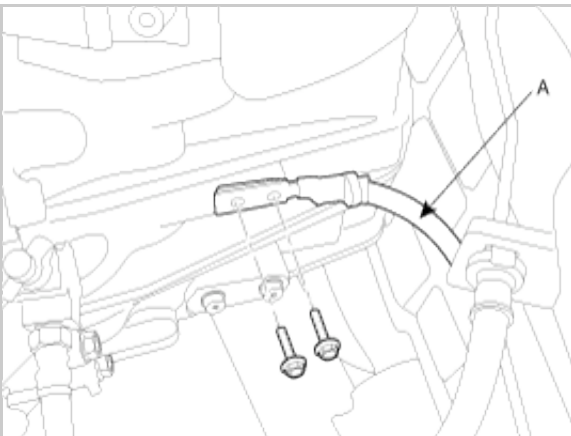
5. Disconnect the air cleaner hose (B) by loosening the clamp (A).



6. Remove the battery tray (B) by removing the four mounting bolts (A).

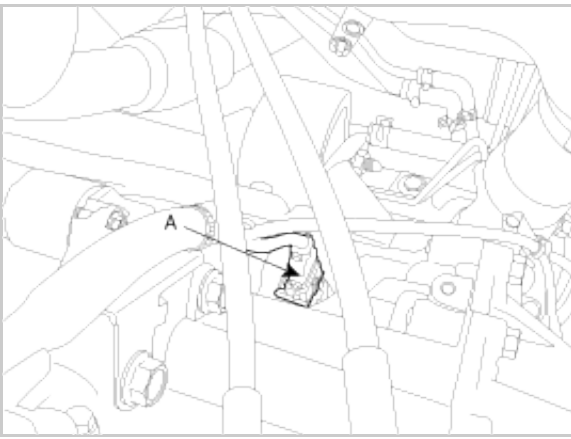


7. Remove the ground wire (A) from the transaxle case.

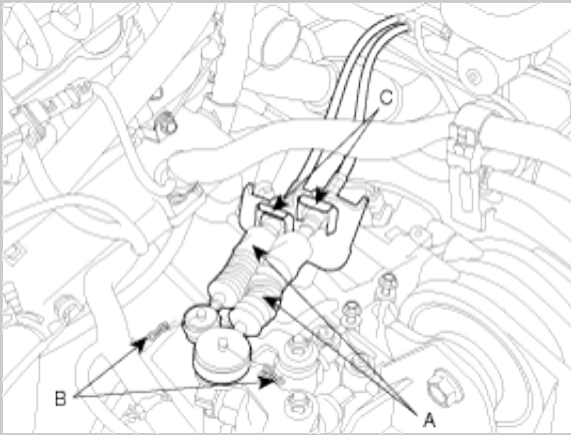


8. Remove the vehicle speed sensor connector (A).





9. Remove the shift cable by removing the bolt (A) and clip (B).



10. Disconnect the "N" (A) and the "R" (B) position switch.



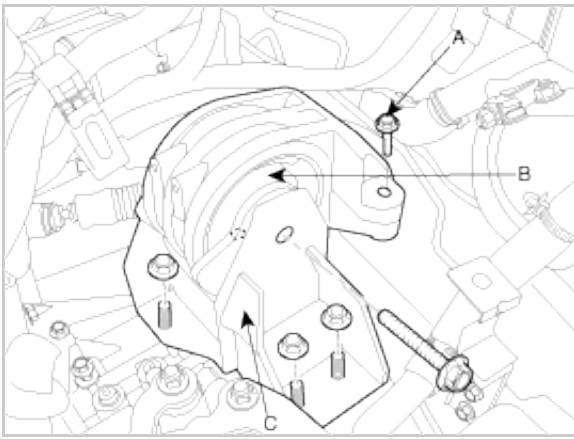
11. Remove C.S.C (Concentric Slave Cylinder) tube which is being clamped.

12. Remove the CKP sensor from the clutch housing assembly.

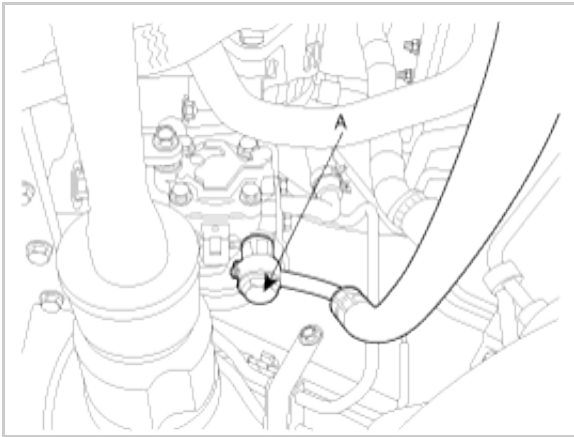
13. Remove the mounting bolts of upper part of the transaxle.

14. Support the engine and transaxle by using the special tool (09200-38001).

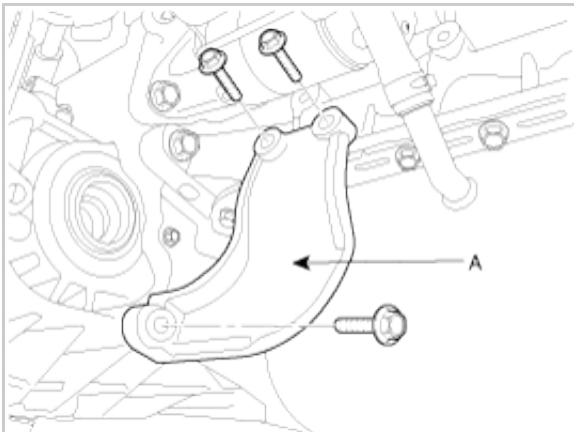
15. Remove the transaxle insulator (B) and the bracket (C) by removing the bolts (A).

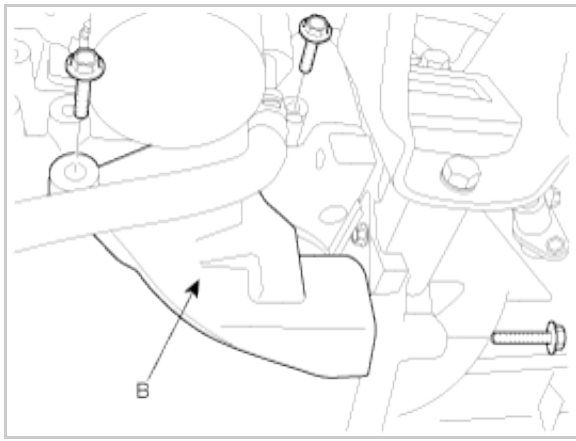


16. Remove the front wheels and tires. (see SS group)
17. Remove the steering column joint bolt. (see ST group)
18. Lift up the vehicle.
19. Remove the under cover.
20. Drain power steering oil through the return tube. (see ST group)
21. Disconnect the power steering pressure hose (A) from the power steering oil pump.



22. Disconnect the lower arm, the tie rod end ball joint, the stabilizer bar link from the front knuckle. (see SS group)
23. Remove the roll stopper mounting bolts.
24. Remove the mounting bolts from the sub frame by supporting the sub frame with a jack. (see SS group)
25. Remove the drive shafts from the transaxle. (see DS group)
26. Remove the plate between the engine and transaxle.
27. Disconnect the starter motor connector and remove the starter motor. (see EE group)
28. Remove the mounting bolts of lower part of the transaxle, brackets (A,B), and the left side cover and remove the transaxle assembly by supporting it with a jack.





## INSTALLATION

Installation is in the reverse order of removal.

Perform the following :

- a. Adjust the shift cable.
  - b. Refill the transaxle with fluid.
  - c. Refill the radiator with engine coolant.
  - d. Bleed air from the cooling system with the heater valve open.
  - e. Clean the battery posts and cable terminals with sandpaper, assemble them, and apply grease to prevent corrosion.
1. Lowering the vehicle or lifting up a jack, install the transaxle assembly.
  2. Tighten the transaxle under mounting bolts.

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TORQUE:

65~85 Nm(650~850 kgf.cm, 47.0~61.5 lb-ft)

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3. Install the plate between the engine and transaxle.

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TORQUE :

8~11 Nm(80~110 kgf.cm, 5.8~8.0 lb-ft)

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4. Install the brackets.

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TORQUE :

19~26 or 38~53Nm (190~260 or 380~530kgf.cm, 13.8~18.9 or 27.3~38.5lb-ft)

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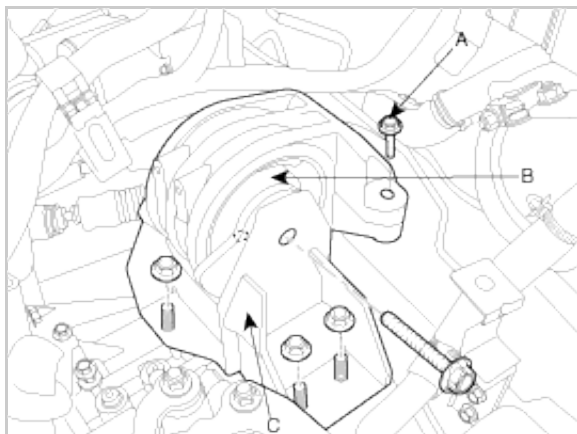
5. Install the starter motor and connect the starter motor connector. (see EE group)
6. Install the drive shafts to the transaxle. (See "DS" group)
7. Install the transaxle insulator (B) and mounting bracket (C) by tightening the bolts (A).

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TORQUE:

60~80 Nm (600~800 kgf.cm, 43.6~58.2 lb-ft)

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8. Install the sub frame. (see SS group)

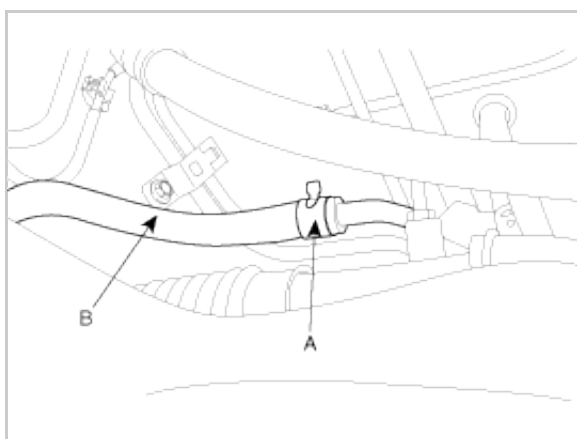
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**TORQUE:**

60~80 Nm(600~800 kgf.cm, 65.1~79.5 lb-ft)

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9. Connect the return tube(B) with a clamp(A). (see ST group)



10. Connect the lower arm, the tie rod end ball joint, the stabilizer bar link to the front knuckle. (see SS group)

11. Connect the power steering pressure hose (A) to the power steering oil pump.



12. Install the under cover.

13. Install the steering column joint bolt. (see ST group)

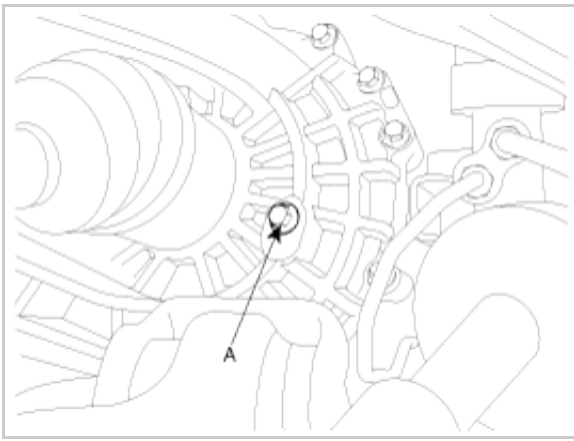
14. Refill transaxle oil through the inlet hole (A).

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**TORQUE:**

30~35 Nm(300~350 kgf.cm, 21.8~25.4 lb-ft)

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15. Install the front wheels and tires. (see SS group)

16. Tighten the transaxle mounting bolts and remove the SST (09200-38001) holding the engine and transaxle assembly.

TORQUE:

70~91 or 38~53Nm(700~910 or 380~530 kgf.cm, 50.9~66.2 or 27.6~38.5 lb-ft)

17. Install the CKP sensor to the clutch housing assembly.

TORQUE:

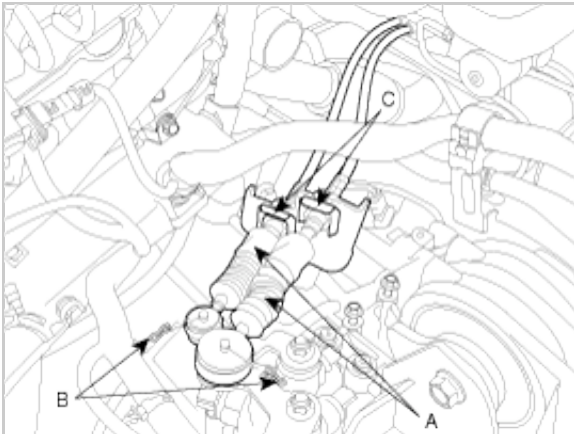
9~10 Nm(90~100 kgf.cm, 6.5~7.3 lb-ft)

18. Install the C.S.C (Concentric Slave Cylinder) tube and loosen the tube.

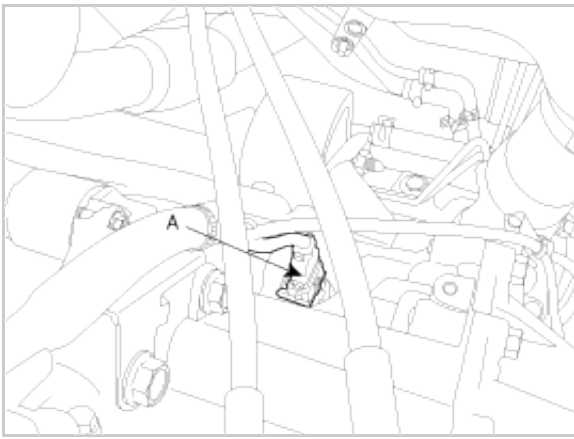
19. Connect the "N" (A) and the "R" (B) position switch.



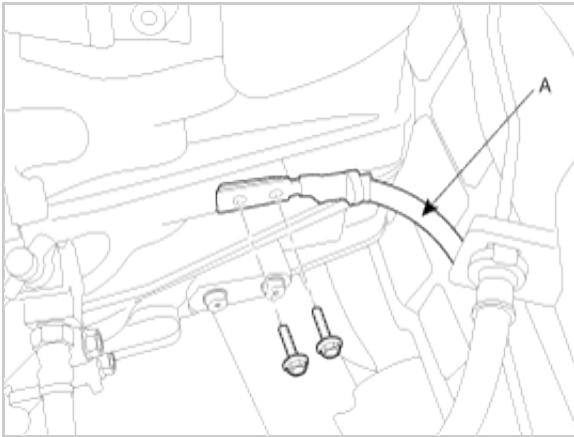
20. Install the shift cable(A) by tightening the clip (C) and pin (B).



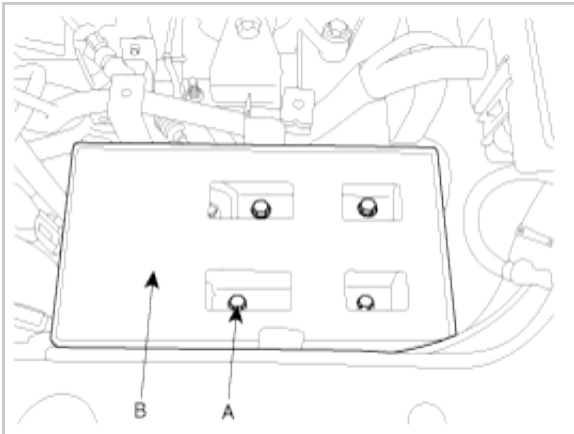
21. Install the vehicle speed sensor connector (A).



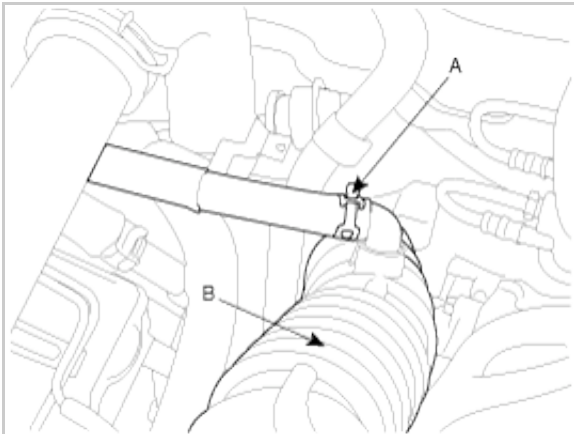
22. Install the ground wire (A) from the transaxle case.



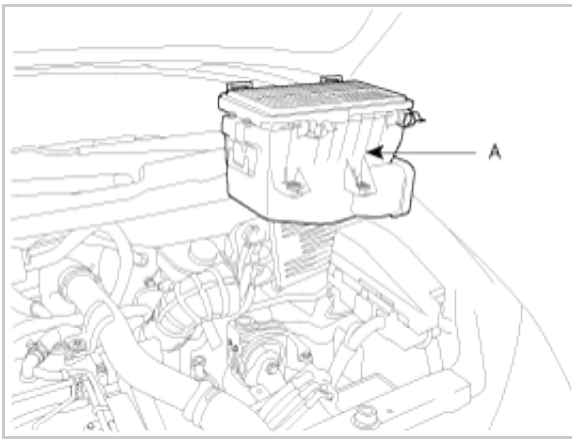
23. Install the battery tray (B) by removing the four mounting bolts (A).



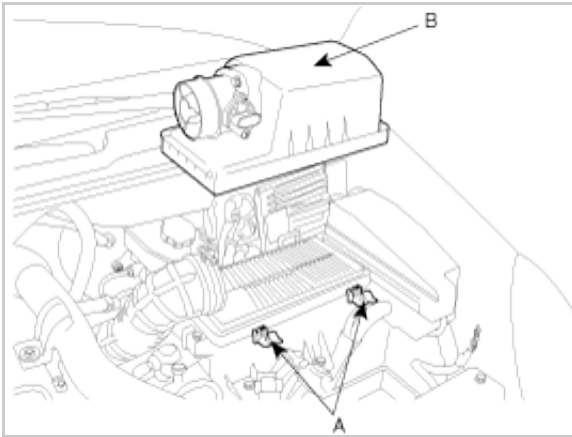
24. Connect the air cleaner hose (B) by tightening the clamp (A).



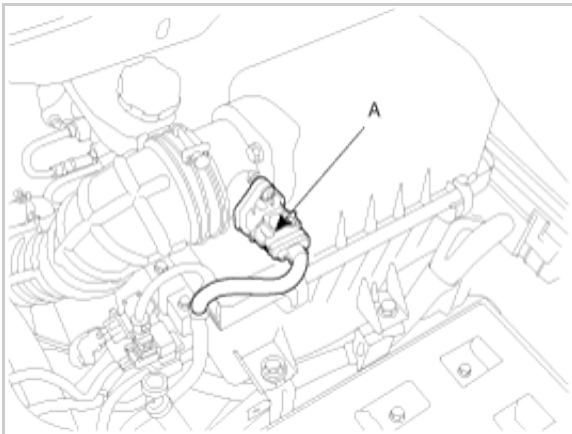
25. Install the air cleaner assembly (A) by tightening the two mounting bolts.



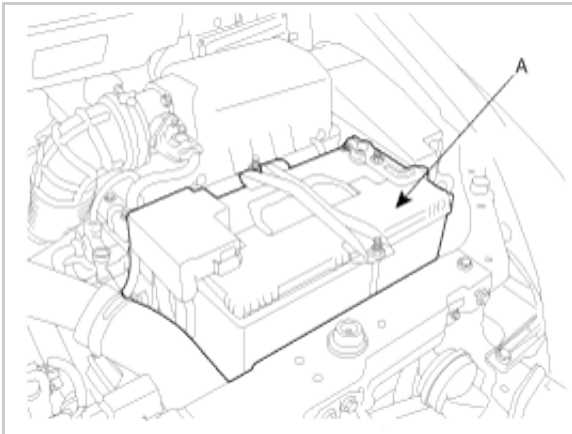
26. Install the air cleaner upper cover (B) by tightening the clips (A).



27. Connect the AFS connector (A).



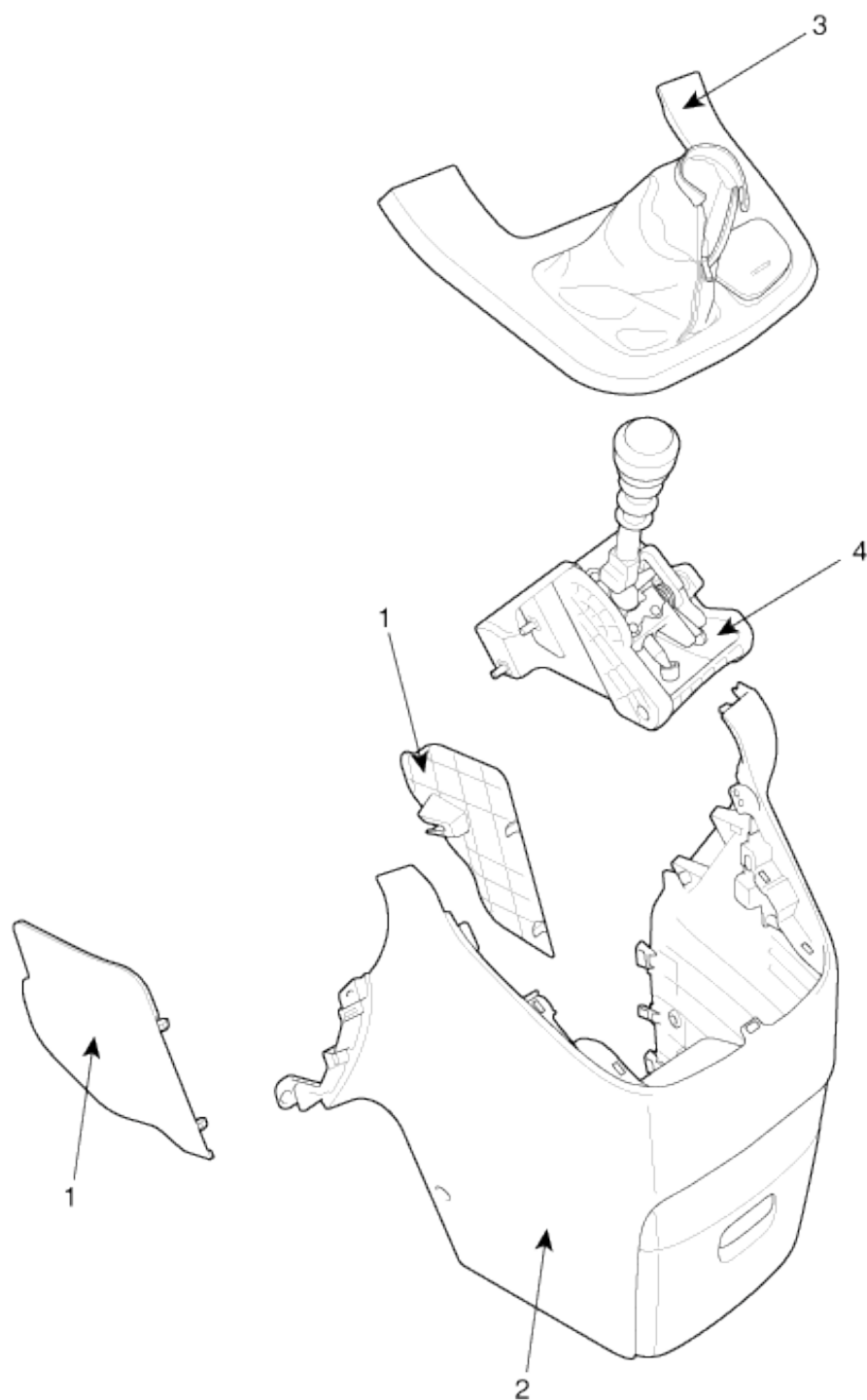
28. Install the battery (A).



# Shift Lever



## COMPONENTS



- 1. Under cover
- 2. Center console

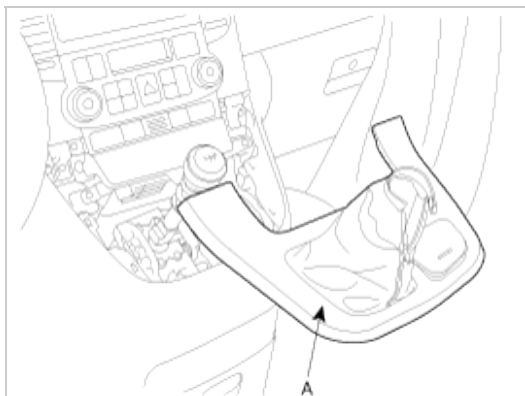
- 3. Shift lever cover
- 4. Shift lever assembly



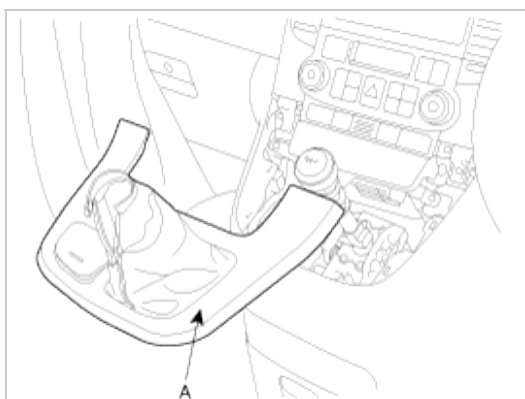
## REMOVAL

1. Remove the console upper cover(A). (see BD group)

### [LHD]

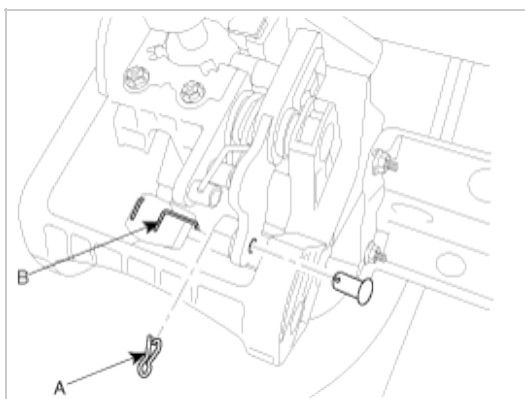


### [RHD]

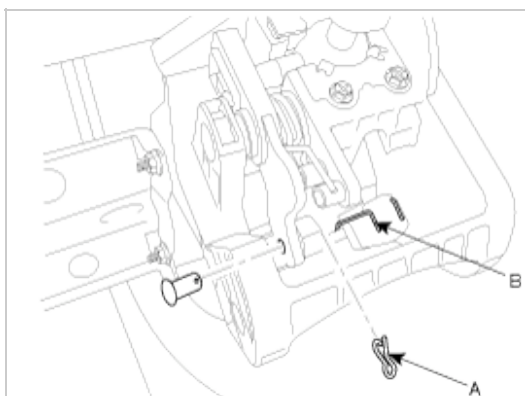


2. Remove the front console cover. (see BD group)
3. Remove the shift cable and the select cable by removing the pin (A) and clip (B).

### [LHD]

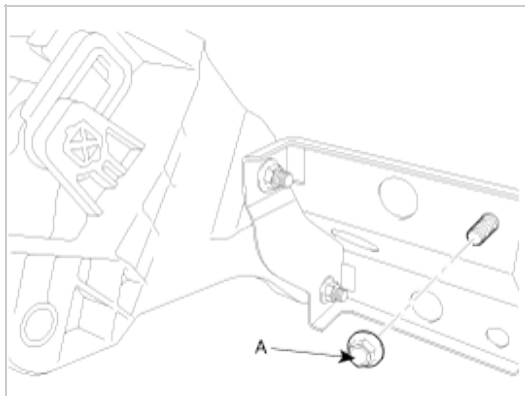


### [RHD]

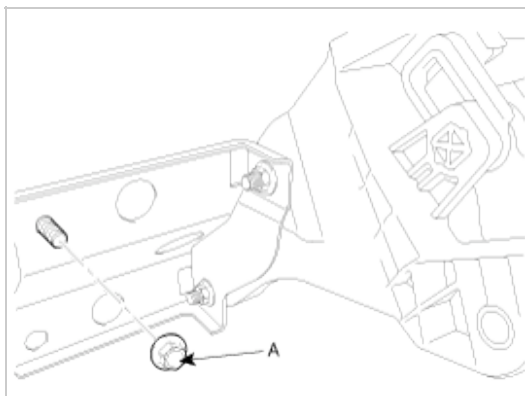


4. Remove the shift lever assembly mounting nuts (A).

#### [LHD]



#### [RHD]



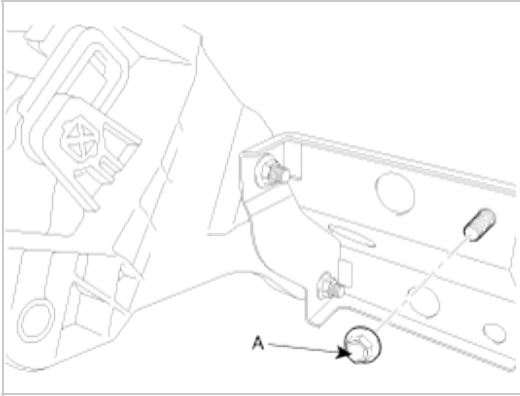
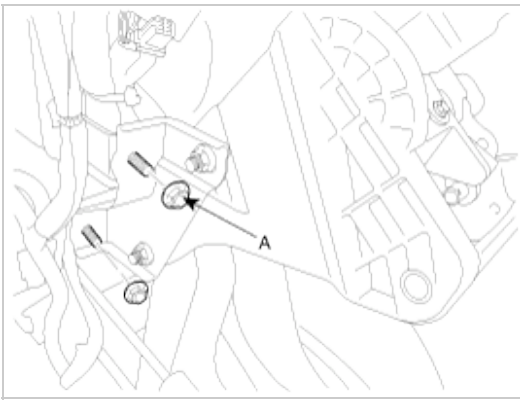
## INSTALLATION

1. Install the shift lever assembly mounting nuts (A).

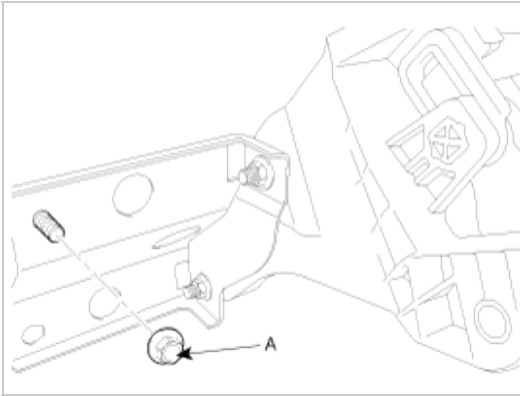
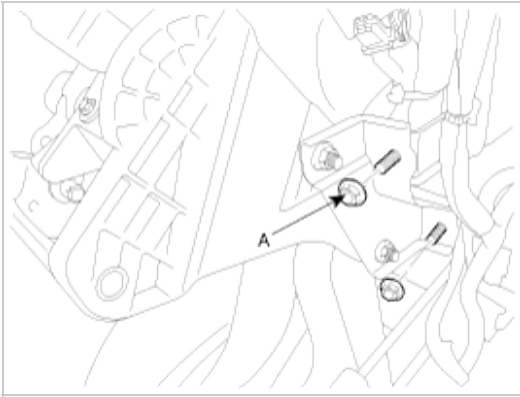
TORQUE:

18~27 Nm(180~270 kgf.cm, 13.1~19.6 lb-ft)

#### [LHD]

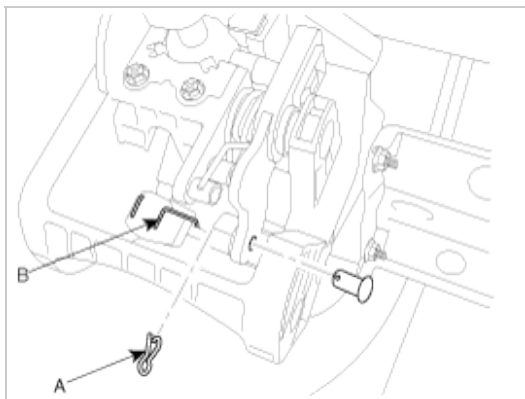


[RHD]

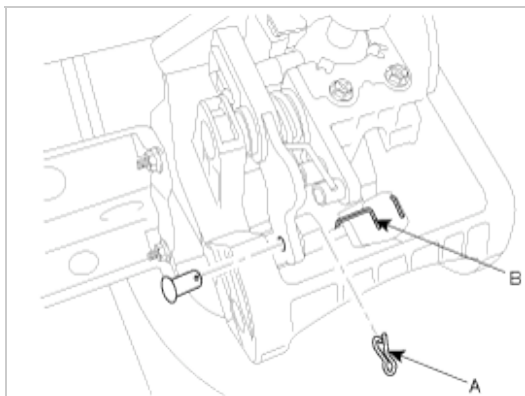


2. Install the shift cable and the select cable by installing the pin (A) and clip (B).

[LHD]



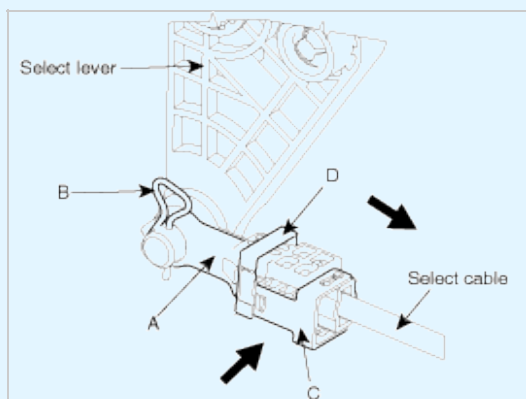
[RHD]



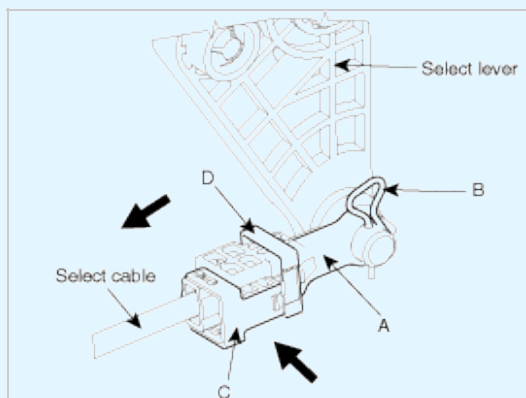
### CAUTION

When adjusting the cable, follow the instruction as :

[LHD]



[RHD]

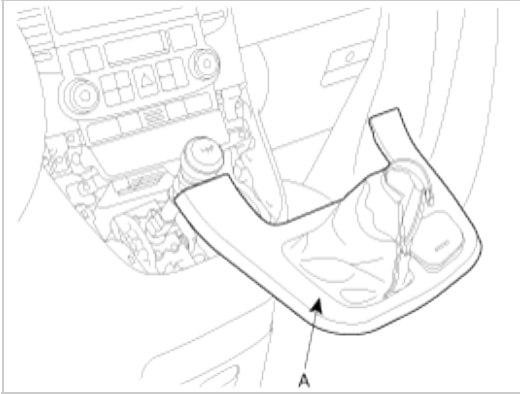


Place the shift lever in "N" position.

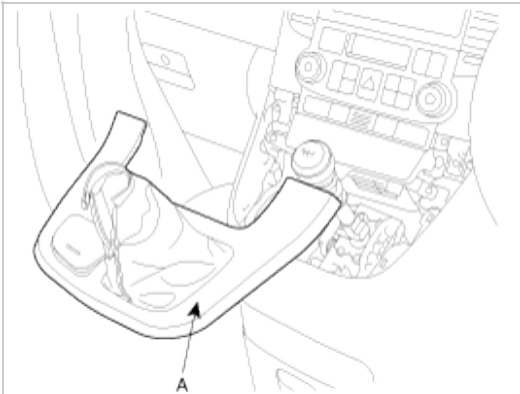
- Insert the eye end (A).
- Install the snap pin (B).
- Insert the lock piece (C).
- Clamp the locking clamp (D).

3. Install the front console cover. (see BD group)
4. Install the console upper cover(A). (see BD group)

#### [LHD]



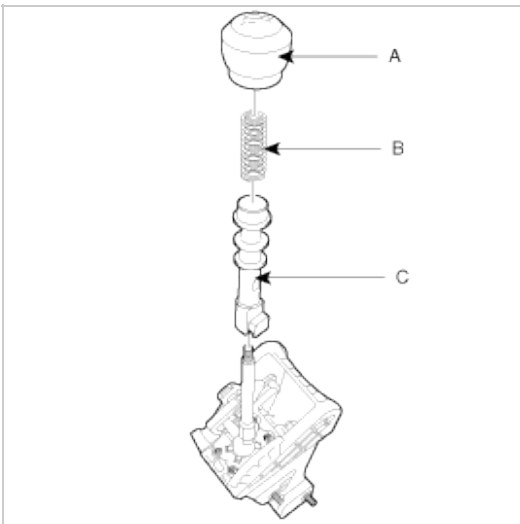
#### [RHD]



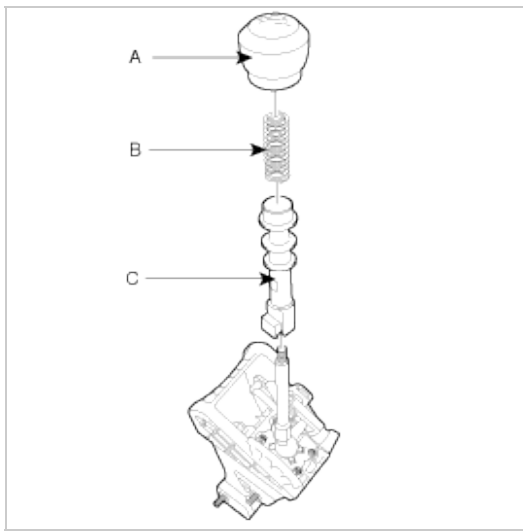
### DISASSEMBLY

1. Remove both sides of the brackets.
2. Remove the shift lever knob (A) by rotating counterclockwise and remove the spring (B), damper, and skirt (C).

#### [LHD]



#### [RHD]



## REASSEMBLY

Reassembling is in reverse order of disassembling.

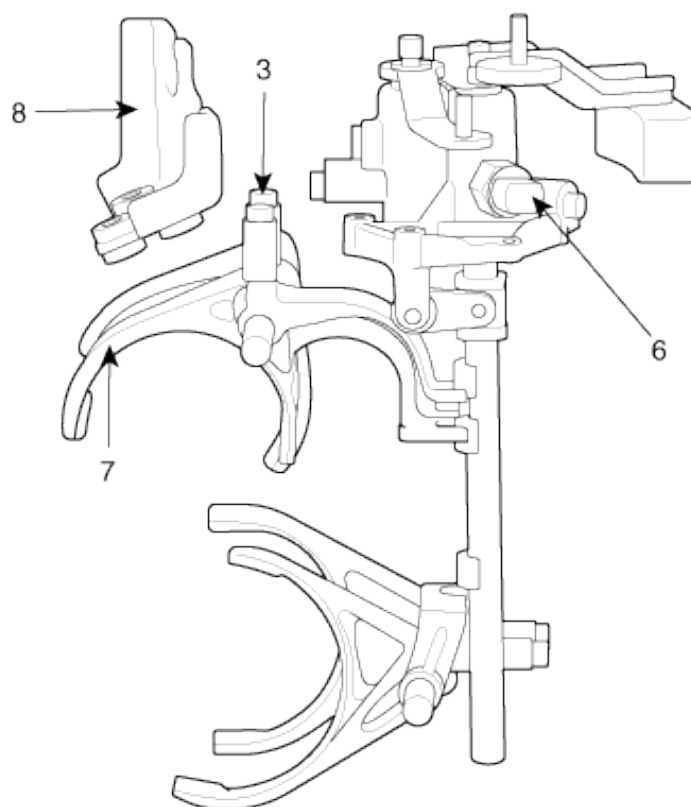
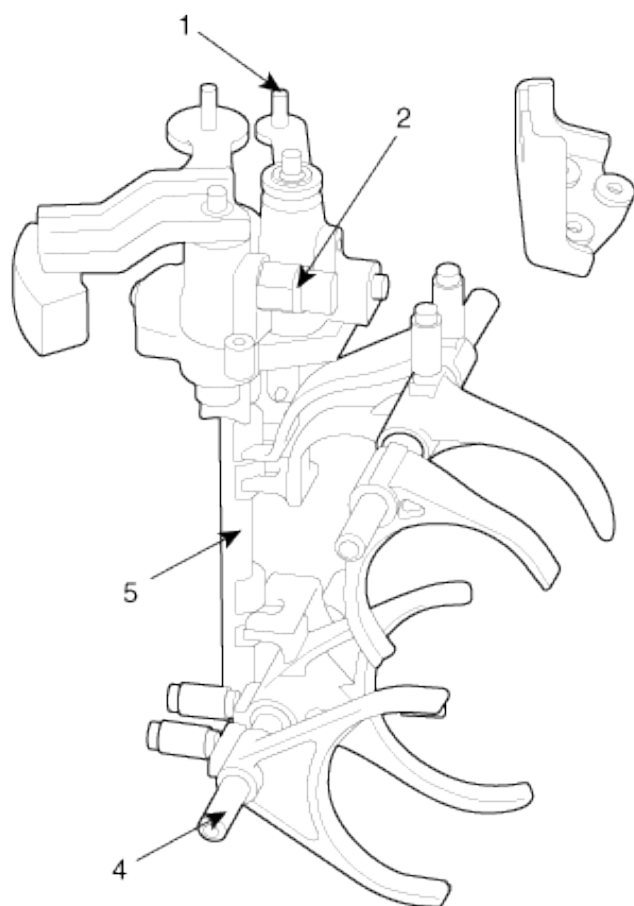
TORQUE(bracket mounting bolts):

18~27 Nm(180~270 kgf.cm, 13.1~19.6 lb-ft)

# **Manual Transaxle Shift Control**



## COMPONENTS

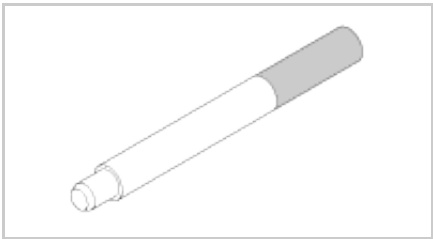


- 1. Shift/select lever
- 2. Neutral sensing switch
- 3. Detent pin
- 4. Shift rail

- 5. Control shaft
- 6. Reverse shift switch
- 7. Shift fork/lug
- 8. Cable bracket

# **General Information**

**SPECIAL TOOLS**

Tool (Number and Name)	Illustration	Use
09411-43000 Clutch disc guide		Installation of the clutch disc



## SPECIFICATION

Item	SPECIFICATION
Engine type	J2.9
Clutch operation	Hydraulic type
Clutch disc	Single dry with diaphragm
Clutch cover assembly	Self Adjusting Clutch

## TIGHTENING TORQUE

Item	Nm	Kgf.cm	lb-ft
Clutch cover (6EA)	25~36	250~360	18.2~26.2
Clutch pedal bracket mounting	19~26	190~260	13.8~18.9
Regulator bolt	28~33	280~330	20.3~24
Connecting rod adjusting bolt	9~14	90~140	6.5~10.1
Clutch master cylinder mounting	12~16	120~160	8.7~11.6
Stopper bolt	8~10 or 14~20	80~100 or 140~200	5.8~7.27 or 10.1~14.5
Clutch pedal bolt/nut	25~34	250~340	18.1~24.7

## SERVICE STANDARD

Item	Standard value
Clutch pedal stroke	150mm (5.91in)
Clutch pedal free play	6~13mm (0.24~0.51in)

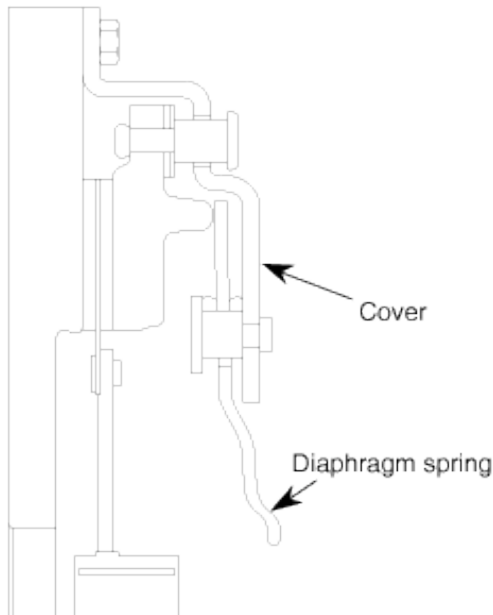
# Clutch System

## DESCRIPTION

### SELF ADJUSTING CLUTCH(S.A.C.) COVER

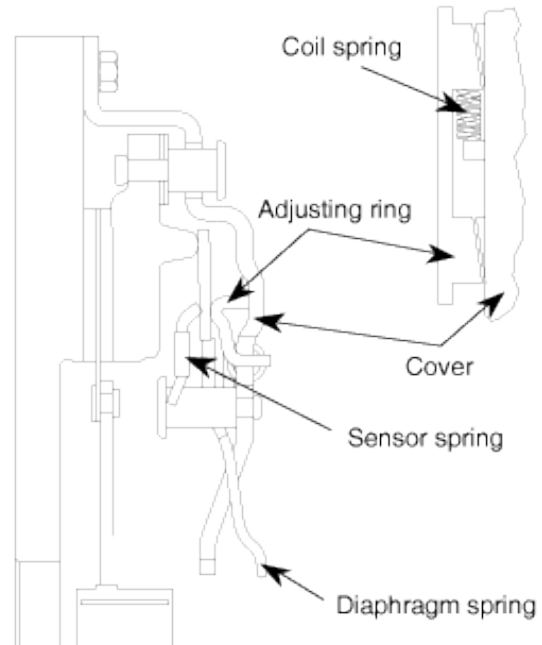
- As a clutch disc facing is worn away according to its durability, a cover weight is increasing and a clutch pedal pressure can be more needed.
- To make up for this defect, the self adjusting clutch system makes the requested pedal pressure minimized so that makes the maintenance cycle longer.

#### GENERAL CLUTCH COVER



- In a general clutch cover, the diaphragm spring increases the weight to the disc in proportion to abrasion.

#### SELF ADJUSTING CLUTCH COVER



- In a self adjusting clutch, the adjusting ring prevents the diaphragm spring from being raised to the transmission side in spite of abrasion.

### CONCENTRIC SLAVE CYLINDER-C.S.C.

It improves working efficiency and lowers the number and the weight of part by unifying clutch release control parts(clutch release bearing ~ clutch release cylinder) in a manual transaxle.

## OPERATION

### CONCENTRIC SLAVE CYLINDER-C.S.C

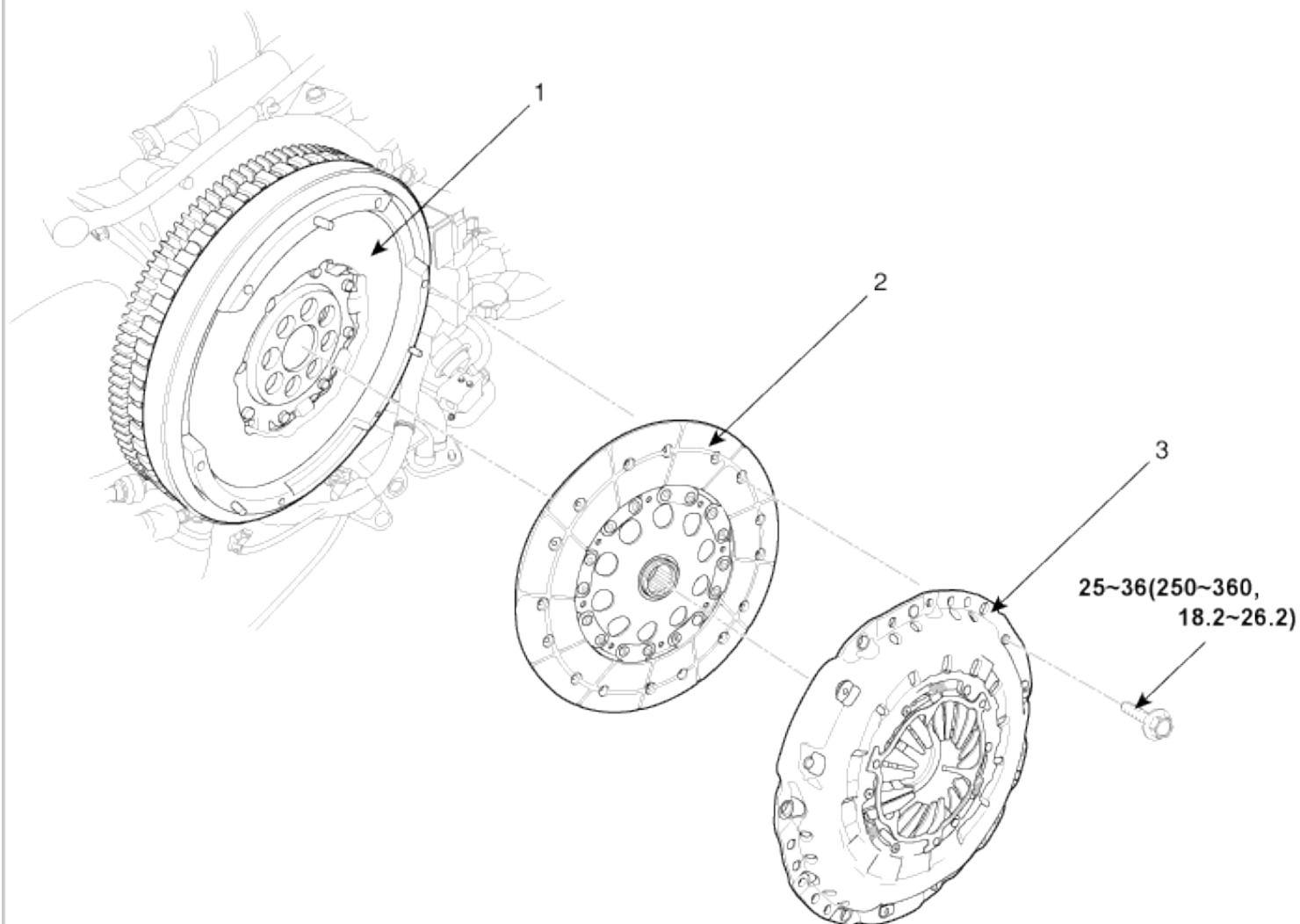
When the clutch pedal is pressed, oil pressure is transmitted along the arrow directions shown below and that moves the clutch slave cylinder and the diaphragm spring of the clutch cover.



# **Clutch Cover and Disc**



## COMPONENTS



TORQUE : Nm (kgf.cm, lb-ft)

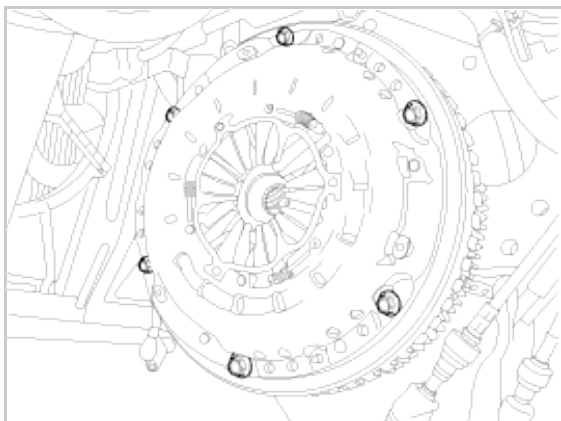
- 1. Engine flywheel
- 2. Clutch disc

- 3. Clutch cover



## REPLACEMENT

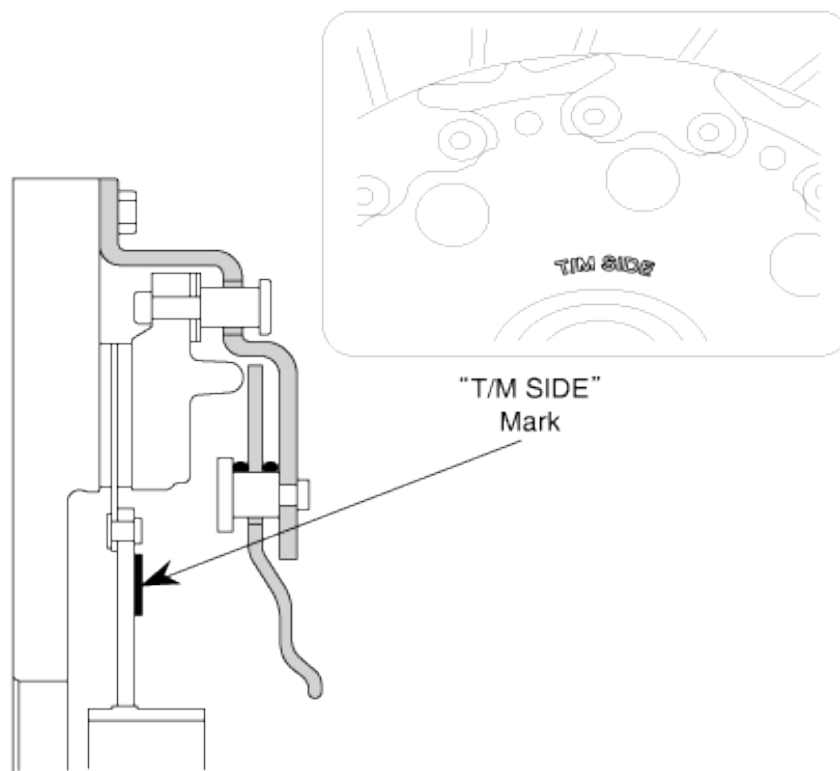
1. Remove a transaxle assembly (refer to 'MT'-group).
2. Remove the clutch cover bolts. Not to be bent or twisted, loosen them in diagonal directions.



3. Remove the clutch cover and disc.
4. Using the SST(09411-43000), install a clutch disc and cover.

### CAUTION

- a. Replace a clutch cover and disc as a set.
  - \* Possible problems when not following the caution
- a. When replacing only a disc, slip problem can occur because of the initial clamp load loss by the adjusting ring's unusual work.
- b. When replacing only a disc, it can be difficult to cut power because the thickness of the disc cannot be permitted.
- b. Apply grease on a disc spline part and transmission input shaft spline part as required.
  - \* Possible problems when not following
- a. When not applying: Excessively wear of splines and bad clutch operation
- b. When excessively applying: Scattered grease by centrifugal force contaminates the clutch disc. Loss of friction force can cause a slip
- c. The 'T/M SIDE' marked surface should face the transaxle.
  - If the surface face the opposite side, there can be an interference between a disc and a flywheel surface.



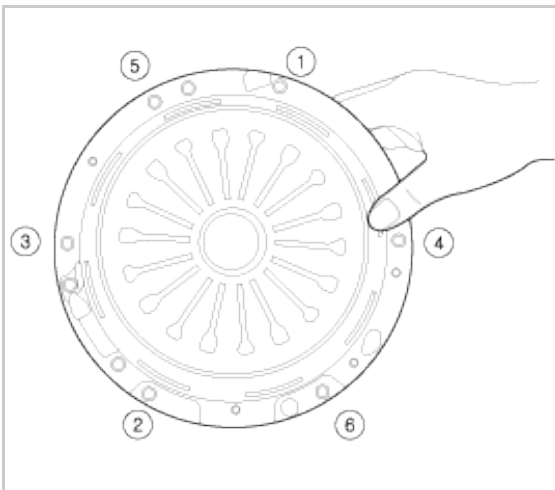
5. Tighten the clutch cover.

TORQUE:

24.5~35.3Nm (250~360kgf.cm, 18.1~26.0lb-ft) (6EA)

#### CAUTION

When installing the clutch cover, tighten the bolts in diagonal directions not to be bent or twisted.



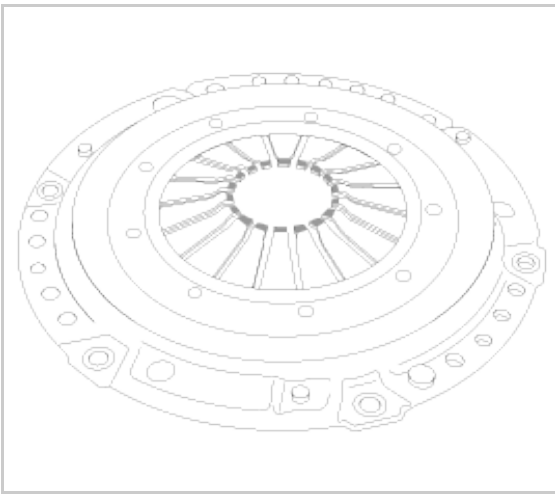
#### CAUTION

\* Possible problems when not following

- When tightening the bolt completely at a time: the clutch cover can be twisted and vibration can occur.
- On vehicles with self adjusting clutches, it is necessary to follow this caution.
- Not following tightening torque: There can be bad torque transmission in clutch and relaxation possibility of bolts.

## INSPECTION

- Inspect diaphragm spring wear which is in contact with a concentric slave cylinder bearing.

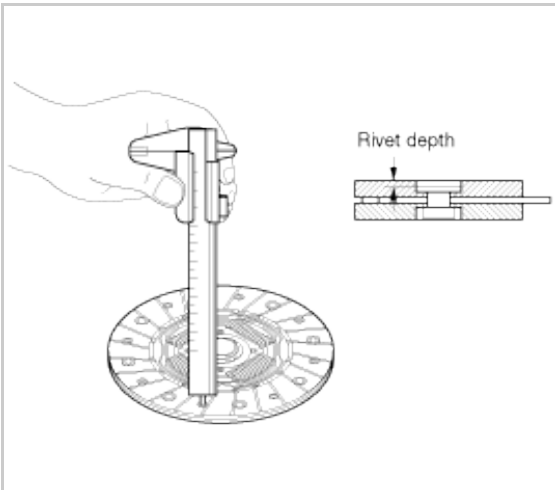


2. Check the clutch cover and disc surface for wear or crack.
3. Check the clutch disc lining for slipping or oil mark.
4. Measure the depth from a clutch lining surface to a rivet. If the measured value is less than the specification below, replace it.

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Specification: 0.3mm(0.0118inch)

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# **Clutch Master Cylinder**

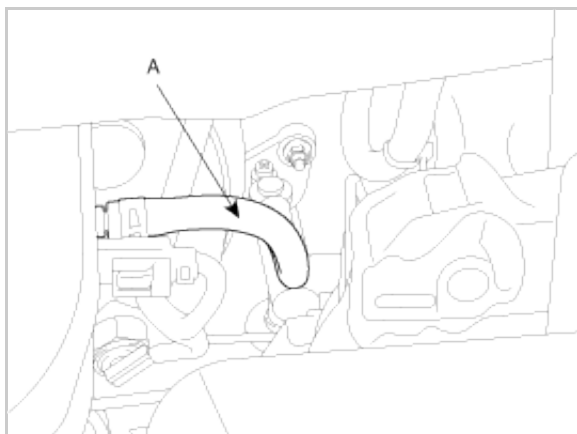


## REMOVAL

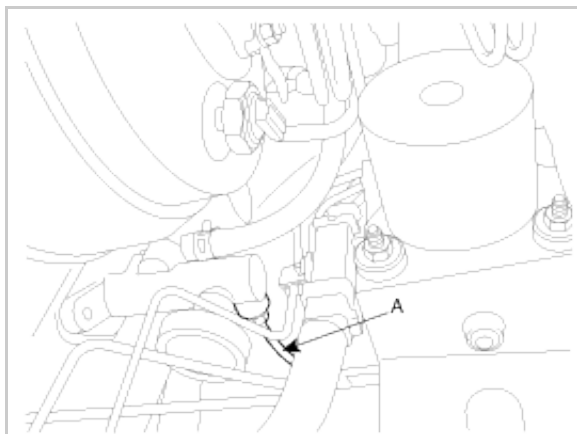
### NOTICE

Do not spill brake fluid on the vehicle; it may damage the paint if brake fluid does contact the paint, wash it off immediately with water.

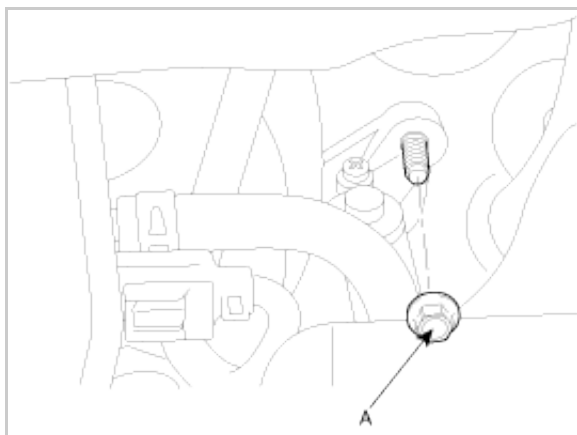
1. Remove the brake fluid from the clutch master cylinder reservoir with a syringe.
2. Clamp the clutch master cylinder hose(A). If there is no enough room for clamping, you can also clamp the hose from the brake master cylinder side.

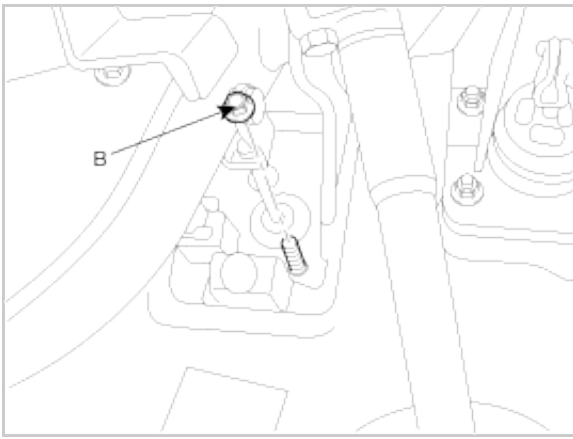


3. Disconnect the hose(A) from the cylinder by releasing the clutch master cylinder clamp.



4. Remove the clutch master cylinder mounting bolts(A,B).  
One is the engine room, the other near the clutch pedal assembly.





5. Remove the pin and washer which connect the clutch pedal with the clutch master cylinder.
6. Remove the clutch master cylinder. It can be helpful to do this step after removing the clutch pedal mounting bracket.

## INSTALLATION

Installation is in the reverse order of removal.

After installation, bleed the clutch hydraulic system.

### CONCENTRIC SLAVE CYLINDER AIR BLEEDING PROCEDURE

1. After disconnecting a cap from the concentric slave cylinder air bleeder, insert a vinyl hose in the plug.
2. Loosening the plug screw, press and release the clutch pedal about 10 times.

#### NOTICE

Hold the air bleeder body not to rotate with a spanner(A). The holding is needed when the plug loosened or tightened.

3. Tighten the plug during the clutch pedal pressed. Afterwards, raise the pedal with a hand.

TORQUE :

25~29Nm (250~290Kgf.cm, 18.2~21.1lb-ft)

4. After pressing the clutch pedal 3 times more, loosen the plug and retighten it with the pedal pressed. Raise it again, then.
5. Repeat the step 4 two or three times. (until there is no bubble in the fluid)

#### CAUTION

- a. Do not clamp the pipe of a concentric slave cylinder.
- b. Be careful not to damage O-rings.

# Clutch Pedal





## ADJUSTMENT PROCEDURE

### IGNITION LOCK SWITCH

1. Disconnect 2P-connector from a ignition lock switch.
2. Disconnect the ignition lock switch. (if you can install a tester with the switch fixed, this step can be omissible)
3. Check for continuity between terminals. (refer to the table below)

Clutch pedal position	Ignition lock switch	Continuity
Released	Released	NO
Pressed	Pressed	YES

If there is difference between what tested and the table above, replace the ignition lock switch with a new one.  
If not, install the ignition lock switch and adjust the clutch pedal.

#### TORQUE :

8~10Nm (80~100kgf.cm, 5.8~7.2lb-ft)

### Clutch pedal and Ignition lock switch

#### NOTICE

- a. Inspect a ignition lock switch.
- b. Remove the driver's seat mat to adjust a clutch pedal.
- c. No gap between a clutch master cylinder piston and push rod can cause clutch slip.

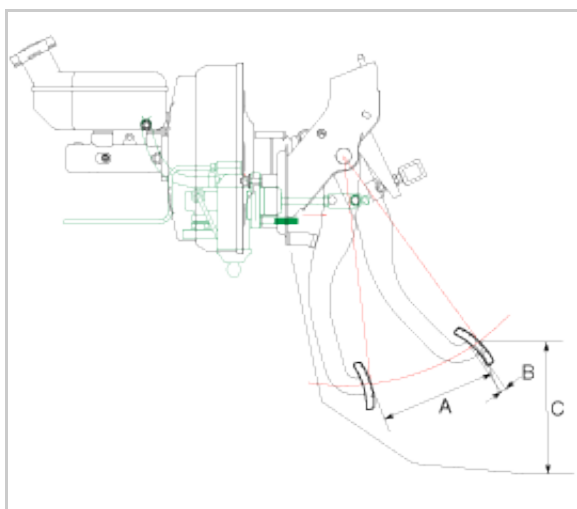
1. Loosen and draw out the bolt until it is off the pedal surface.
2. Push and pull a clutch master cylinder push rod to satisfy the specification below.

#### Specification:

Clutch pedal stroke(A) - 150mm(5.91in)

Clutch pedal free play(B) - 6~13mm(0.24~0.51in)

Clutch pedal distance - 234.7mm(9.24in)



3. With no pressure on a clutch pedal, tighten the bolt until it contacts on the pedal.
4. Fix the bolt with a nut.

#### TORQUE :

14~20Nm (140~200kgf.cm, 10.2~14.5lb-ft)

5. Press the clutch pedal to the seat ground.
6. Adjust the ignition lock switch position with the pedal a little(23~26mm) raised.
7. Install the ignition lock switch firmly.

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**TORQUE:**

8~10Nm (80~100kgf.cm, 5.8~7.2lb-ft)

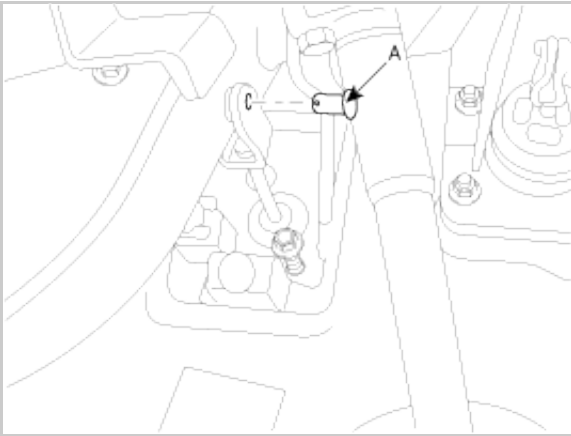
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## REPLACEMENT

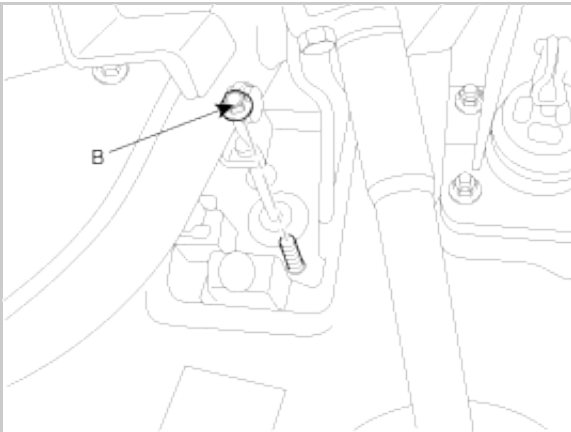
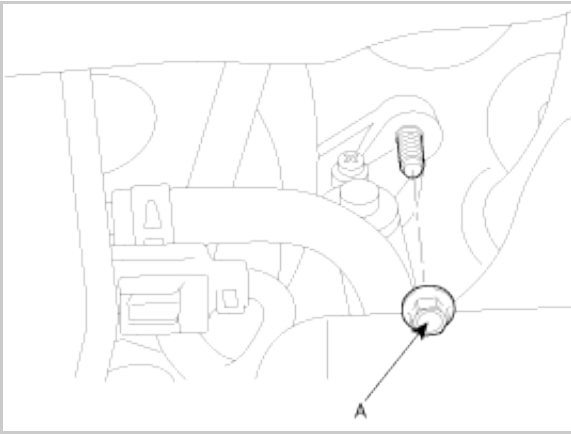
### NOTICE

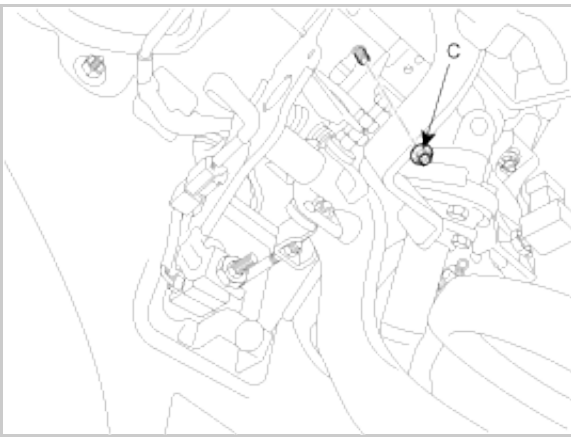
- a. Inspect the continuity of the ignition lock switch.
- b. Remove the floor mat before adjusting the clutch pedal.

1. Remove the ignition lock switch.
2. Remove the snap pin and the clevis pin(A) connecting the clutch master cylinder push rod and the clutch pedal.



3. Remove the clutch master cylinder mounting nut(A,B) and the clutch pedal mounting nut(C).





4. Remove the clutch pedal.
5. Install a new one by tightening the bolts of the clutch pedal bracket and master cylinder .

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**TORQUE :**

19~26 Nm(19~260 kgf.cm, 13.8~18.9 lb-ft)(Clutch pedal bracket)  
12~16 Nm(120~160 kgf.cm, 8.7~11.6 lb-ft)(Clutch master cylinder)

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6. Grease the clevis pin and insert it and the snap pin.
7. Adjust the clutch pedal and the ignition lock switch.