



Engine Mechanical System

General Information



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	(63.7 ~ 73.5) + (105 + 115°)	(6.5 ~ 7.5) + (105 + 115°)	(47.0 ~ 54.2) + (105 + 115°)
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	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
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



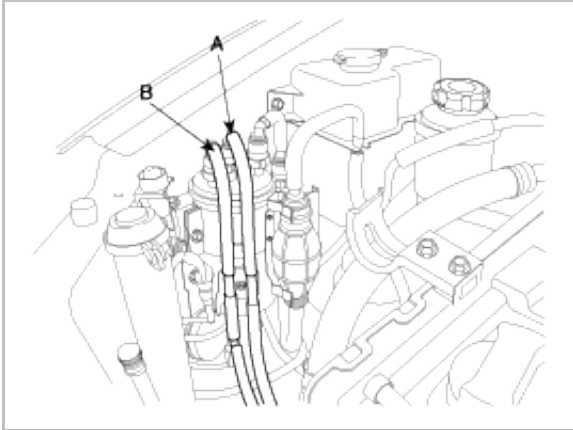
INSPECTION

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/cm², 440.92psi) (325 rpm)
 Minimum pressure :
 2745.85kPa (28kg/cm², 398.25psi)
 Difference between each cylinder :
 294.20kPa (3.0kg/cm², 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

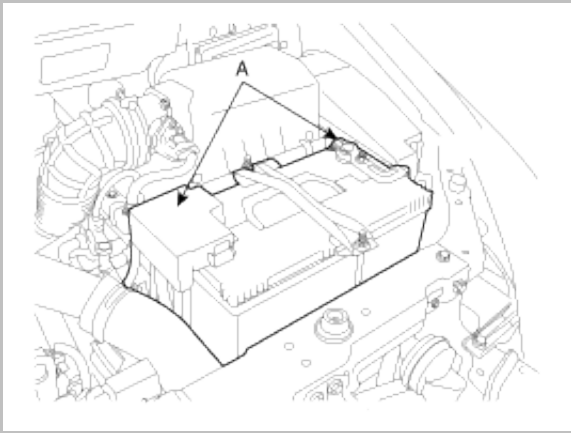
gasket can be the cause.

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.

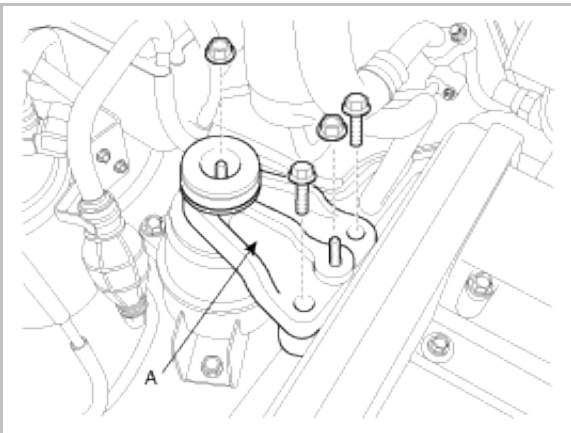
TIMING BELT TENSION ADJUSTMENT

1. Remove the battery terminals (A).

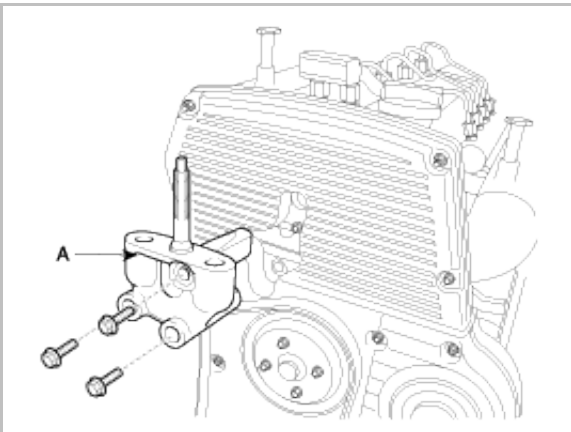


2. Install the jack for oil pan.

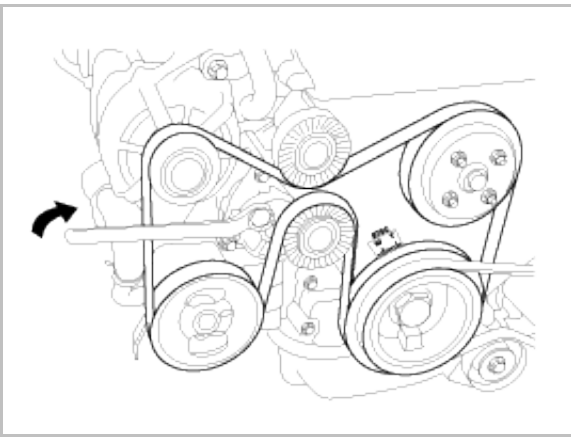
3. Remove the engine mounting (A).



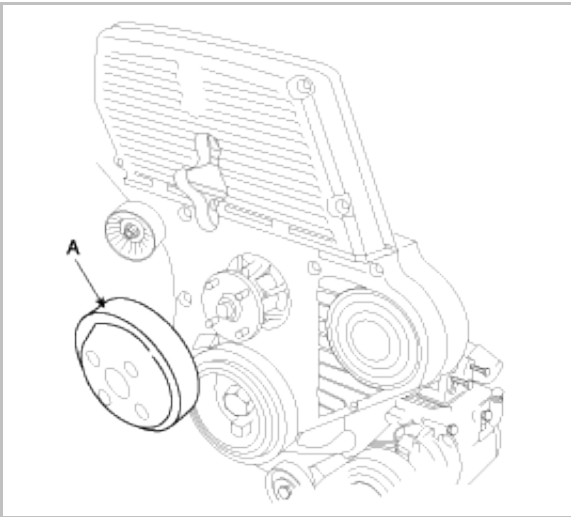
4. Remove the engine support bracket(A).



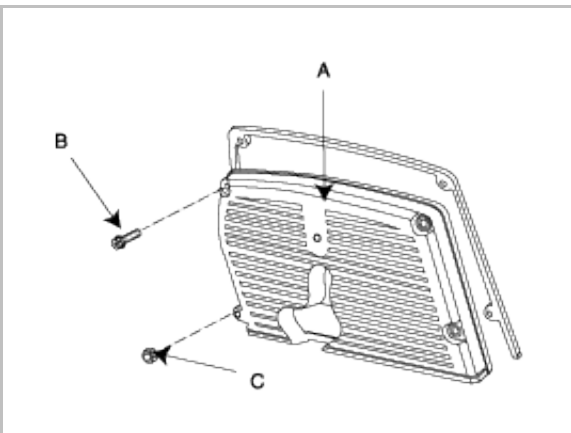
5. Remove the drive belt.



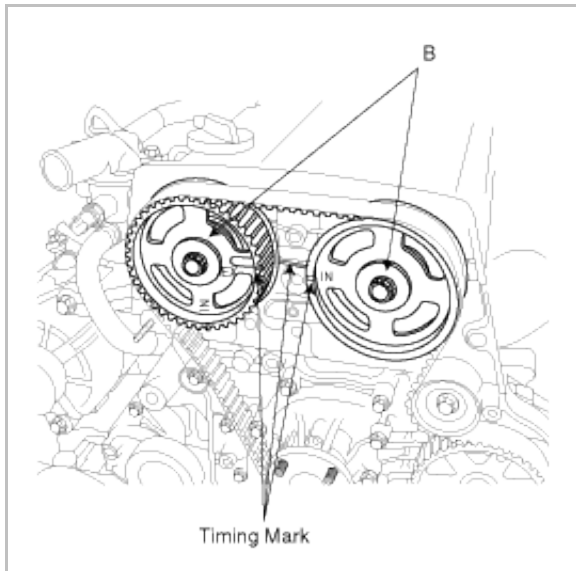
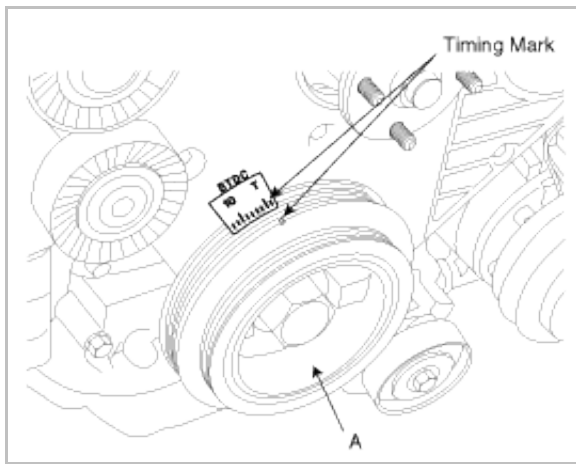
6. Remove the water pump pulley.



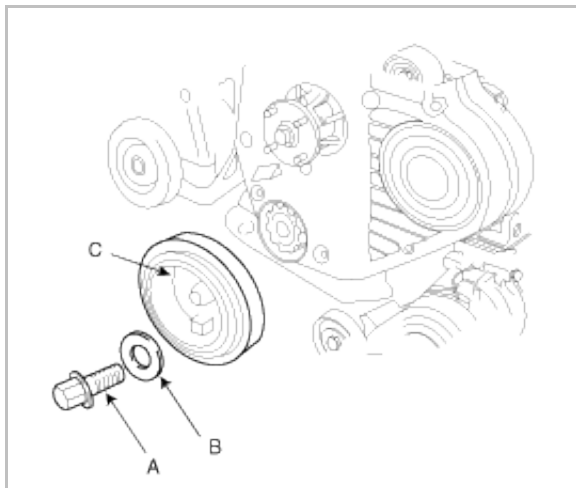
7. Remove the bolts(B), nut(C) and timing belt upper cover (A).



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)



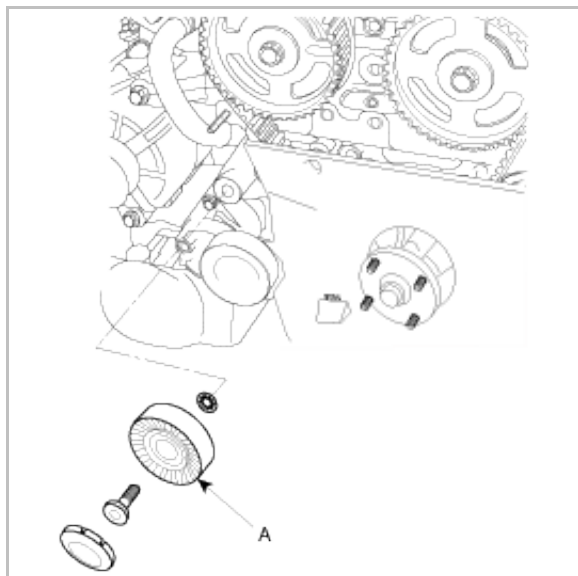
9. Remove the crankshaft pulley bolt(A), washer(B) and crankshaft pulley(C).



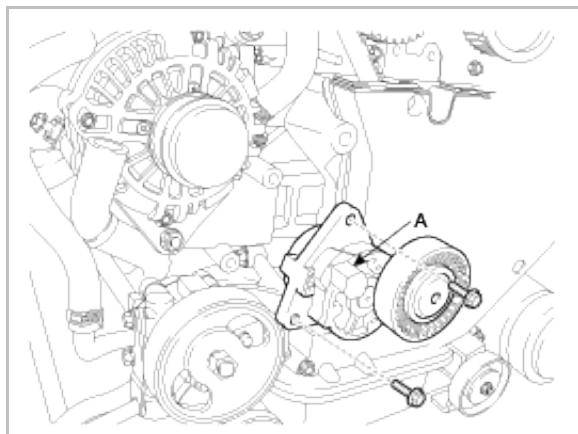
NOTICE

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

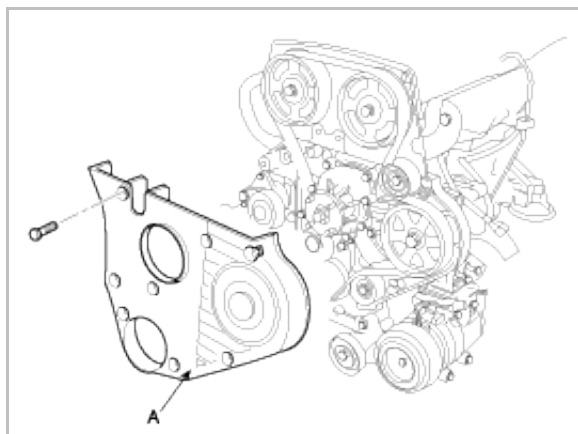
10. Remove the drive belt idler(A).



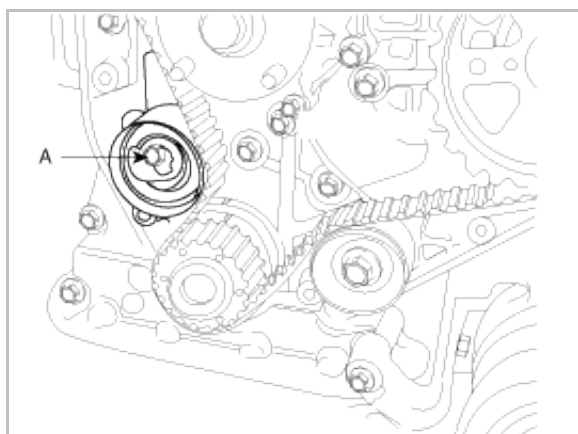
11. Remove the drive belt auto-tensioner (A).



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

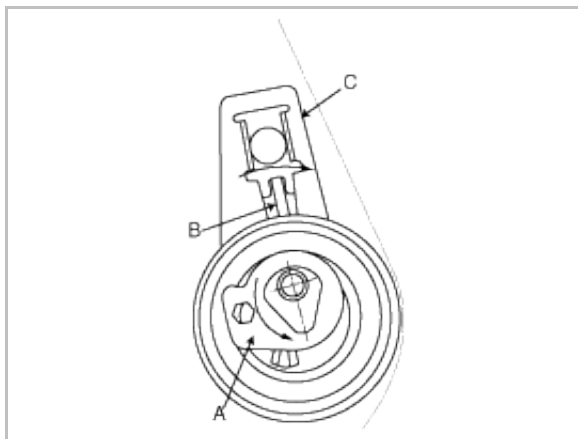


13. Loosen the auto-tensioner fixing bolt(A).



14. Adjust tension of the timing belt.

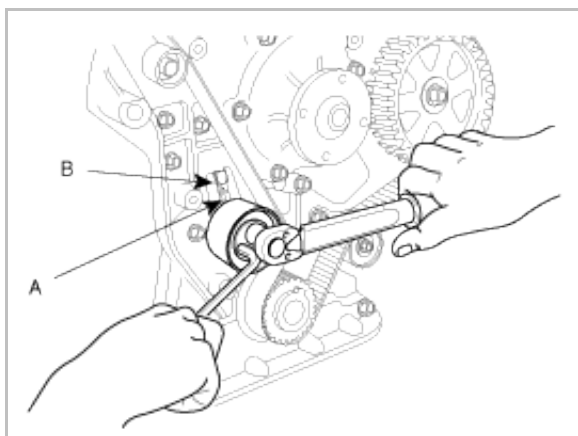
- (1) Align the pointer(B) with the tensioner fork(back plate)(C) as shown below by turning the special washer(A) counterclockwise with a hexagonal wrench.



- (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)



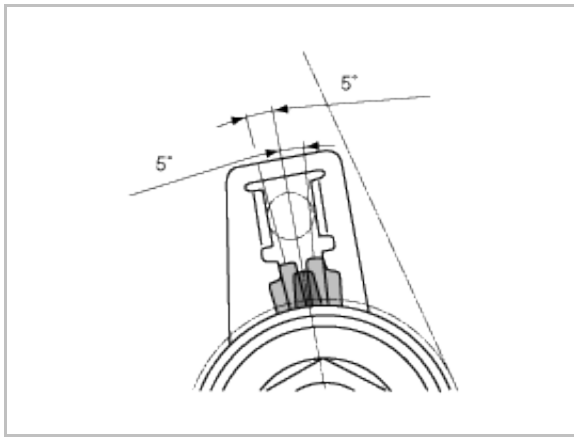
- (3) Remove the hexagonal wrench.

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).

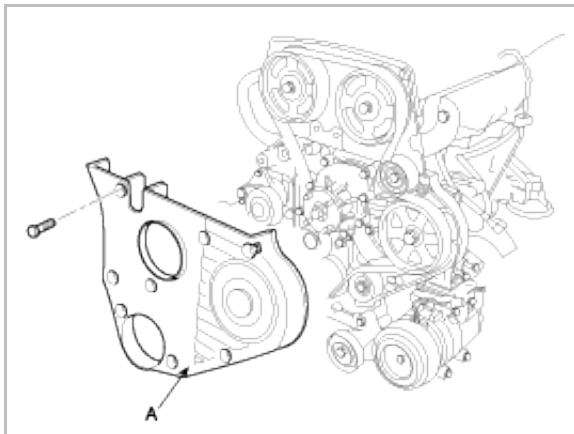
The margin of error : $\pm 5^\circ$



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

Tightening torque :

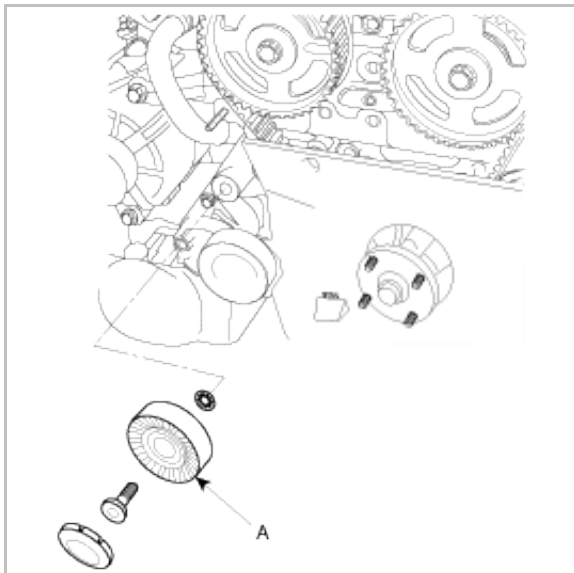
6.9~9.8Nm (0.7 ~ 1.0kgf.m, 5.1 ~ 7.2lb-ft)



18. Install the drive belt idler(A).

Tightening torque :

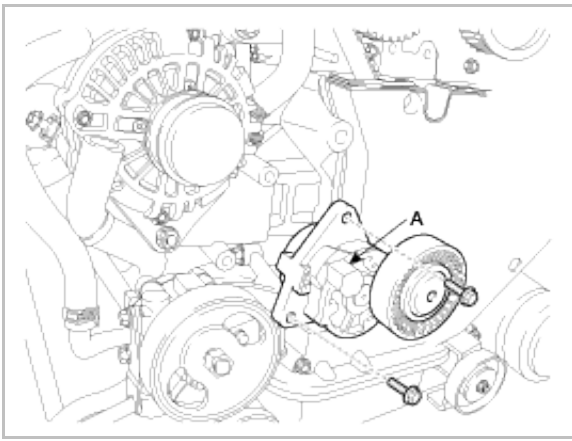
37.3Nm (3.8kgf.m, 27.5lb-ft)



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

Tightening torque :

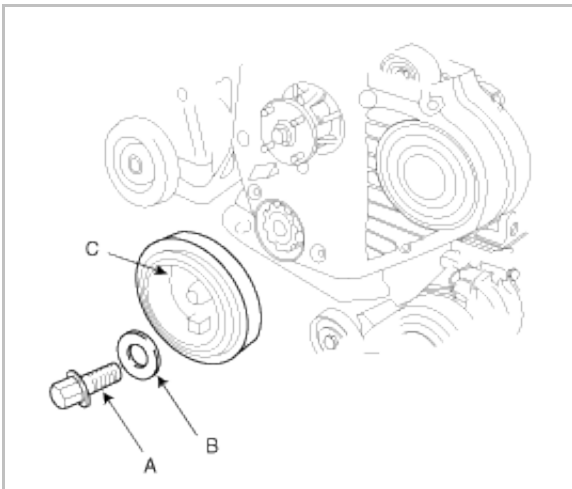
15.7~22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)



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)



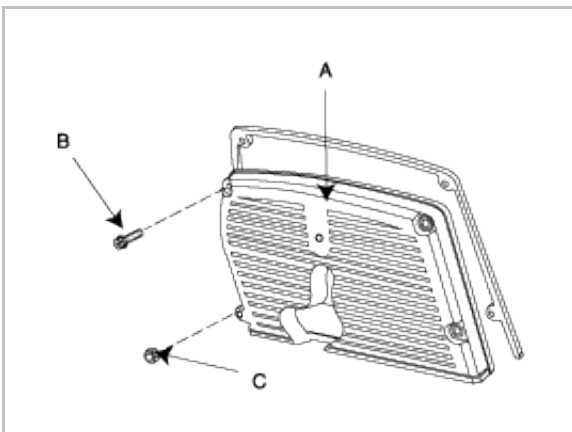
NOTICE

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 :

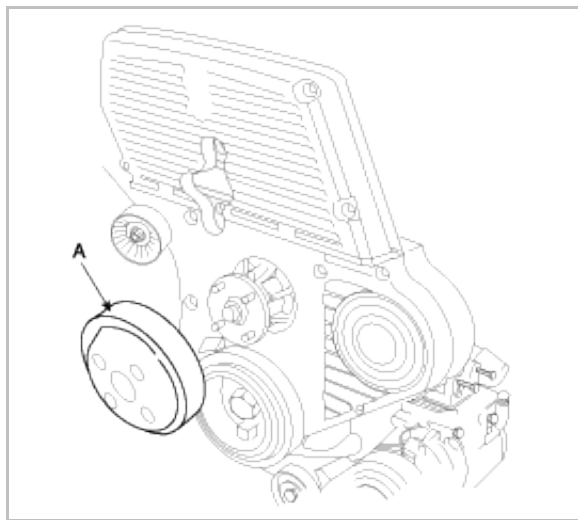
6.9~9.8Nm (0.7 ~ 1.0kgf.m, 5.1 ~ 7.2lb-ft)



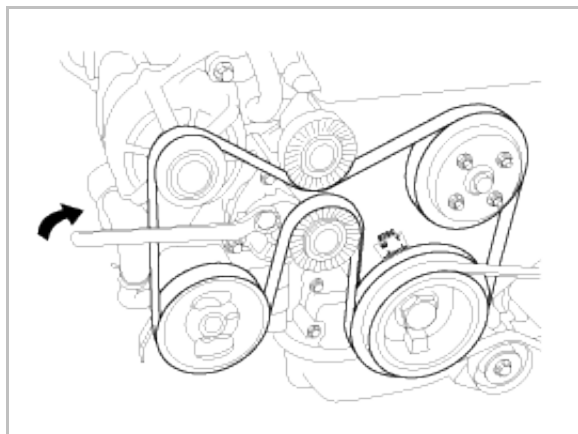
22. Install the water pump pulley.

Tightening torque :

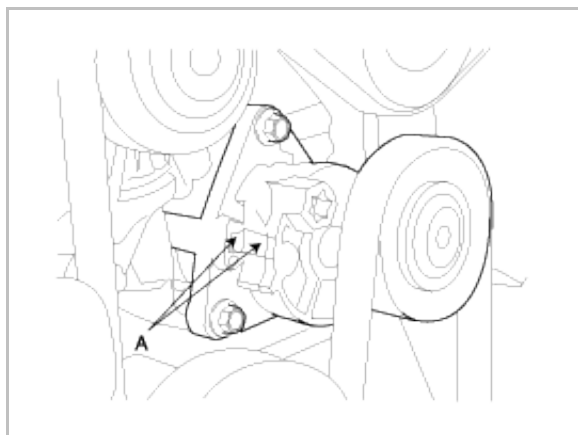
5.9~9.8Nm (0.6 ~ 1.0kgf.m, 4.3 ~ 7.2lb-ft)



23. Install the drive belt.



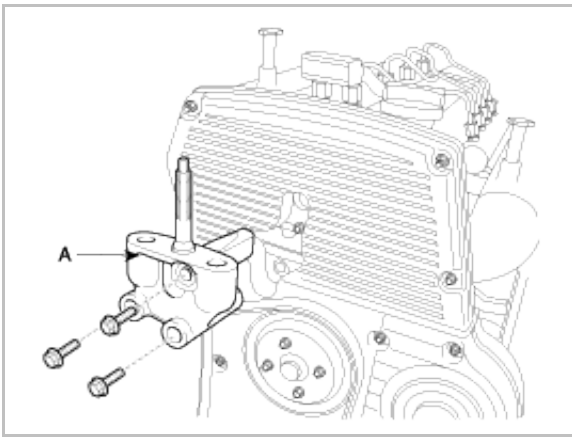
24. Confirm that the 'A' part of the drivebelt auto-tensioner is positioned as shown below. If not, replace the belt.



25. Install the engine support bracket(A).

Tightening torque :

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



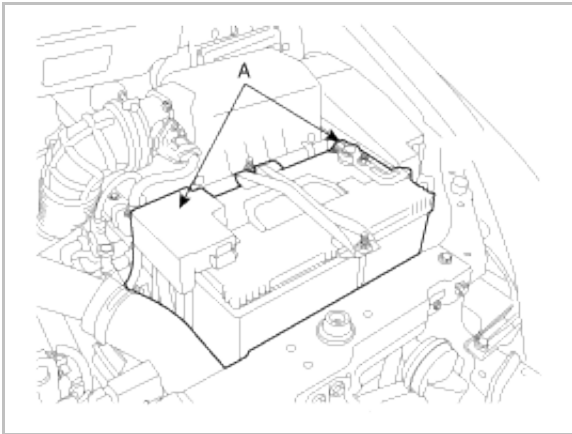
26. Install the engine mounting (A).

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).





TROUBLESHOOTING

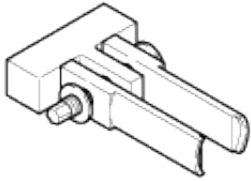
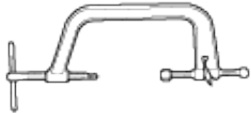
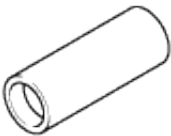
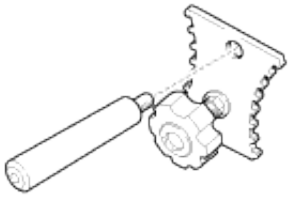
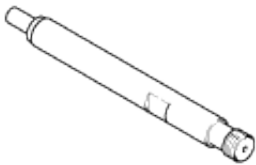
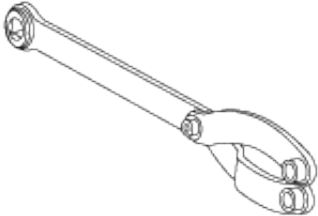
Symptom	Suspect area	Remedy
Engine misfire with abnormal internal lower engine noises.	Loose or improperly installed engine flywheel.	Repair or replace the flywheel as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire.)	Inspect the cylinder for a loss of compression . 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	- Faulty cylinder head gasket and/or cracking or other damage to the cylinder head and engine block cooling system . - Coolant consumption may or may not cause the engine to overheat.	- Inspect the cylinder head and engine block for damage to the coolant passages and/or a faulty head gasket. - 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)	Inspect 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. • The connecting rod bearings. • The connecting rods. • The crankshaft. • The crankshaft journal.
	Excessive crankshaft bearing clearance.	Inspect the following components and repair as required. • The crankshaft bearings. • 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. • The connecting rod bearings. • The connecting rods. • The crankshaft.
	Excessive crankshaft bearing clearance.	Inspect the following components and repair as required. • The crankshaft bearings. • The crankshaft journals. • The cylinder block crankshaft bearing bore.
Engine will not crank. (crankshaft will not rotate)	Hydraulically locked cylinder. • Coolant/antifreeze in cylinder. • Oil in cylinder. • 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. • Broken valve. • Piston material. • Foreign material.	Inspect cylinder for damaged components and/or foreign materials. Repair or replace as required.

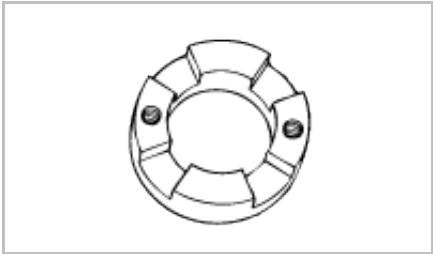
	Seized crankshaft or connecting rod bearings.	Inspect crankshaft and connecting rod bearing. Repair or replace as required.
	Bent or broken connecting rod.	Inspect connecting rods. Repair or replace as required.
	Broken crankshaft.	Inspect crankshaft.Repair or replace as required.



SPECIAL SERVICE TOOLS

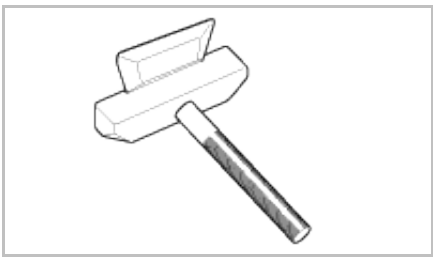
Tool (Number and name)	Illustration	Use
Valve spring lifter pivot. (0K993 120 004)		Removal or installation of the valve spring
Valve spring lifter arm. (0K993 120 001)		Removal or installation of the valve spring
Valve seal installer. (09222-22001)		Installation of the valve seal
Camshaft pulley holder. (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)

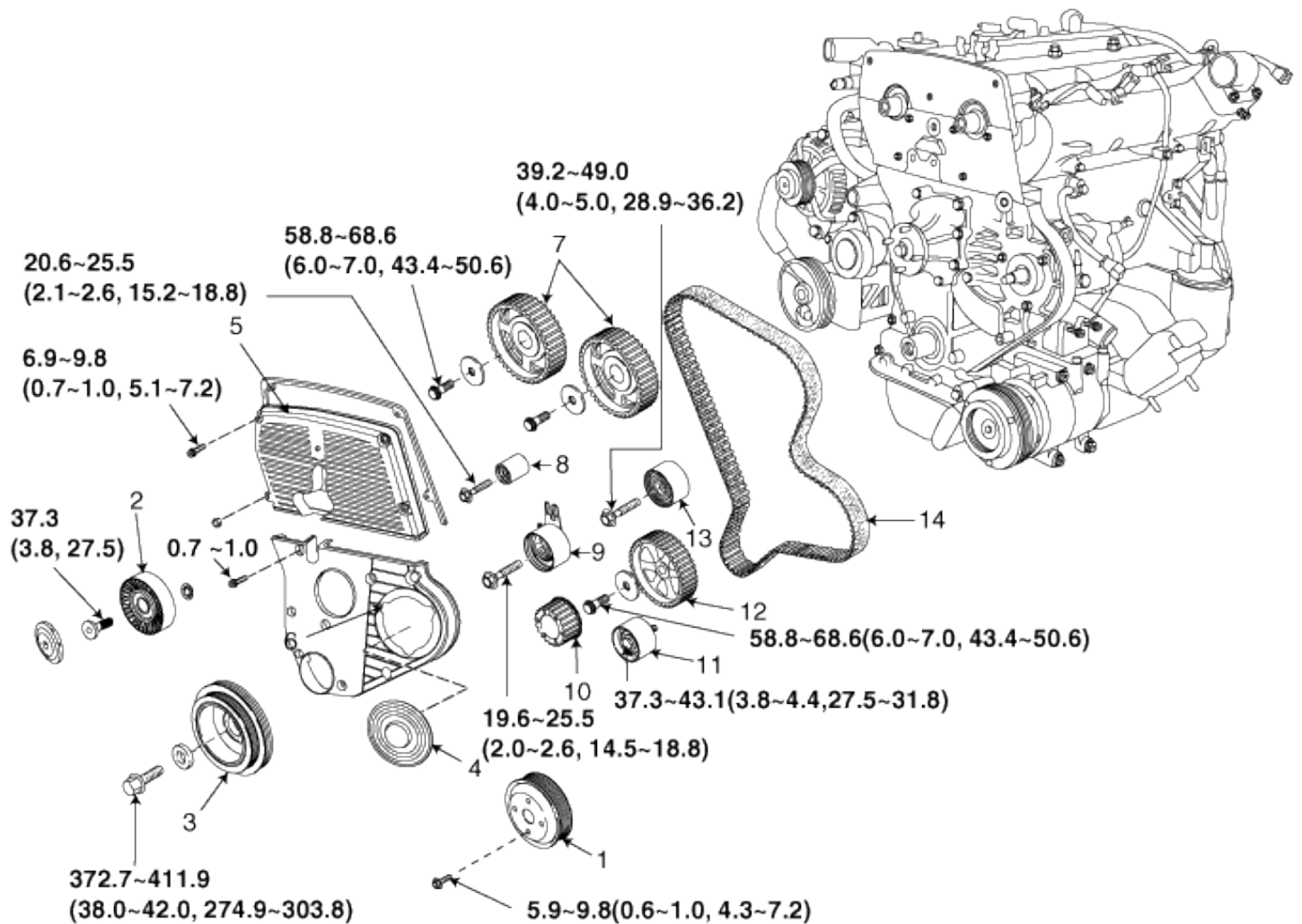


Removal of the oil pan

Engine Mechanical System

Timing System - Timing Belt

COMPONENTS



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

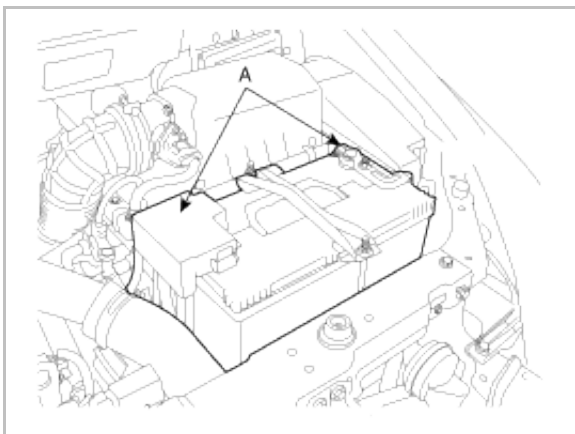
- | | |
|----------------------------|-------------------------------|
| 1. Water pump pulley | 8. Touch idler |
| 2. Drive belt idler | 9. Timing belt auto tensioner |
| 3. Crank shaft pulley | 10. Crankshaft sprocket |
| 4. Service cover | 11. No.2 idler |
| 5. Timing belt upper cover | 12. High pressure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



REMOVAL

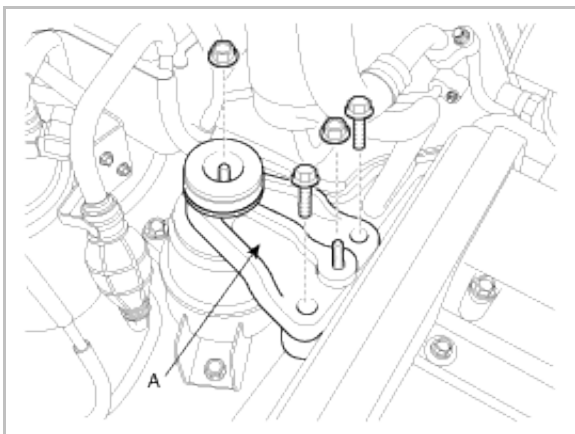
Engine removal is not required for this procedure.

1. Remove the battery terminals (A).

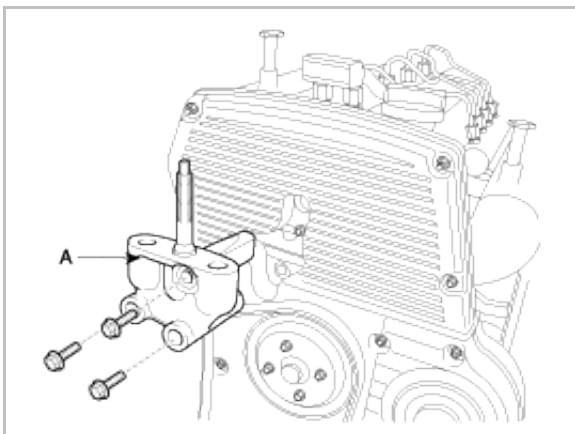


2. Install the jack for oil pan.

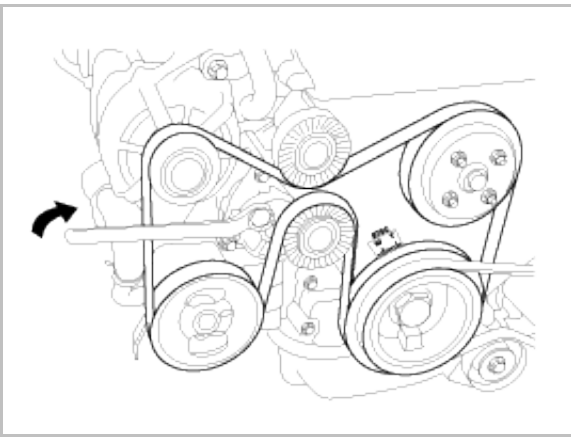
3. Remove the engine mounting (A).



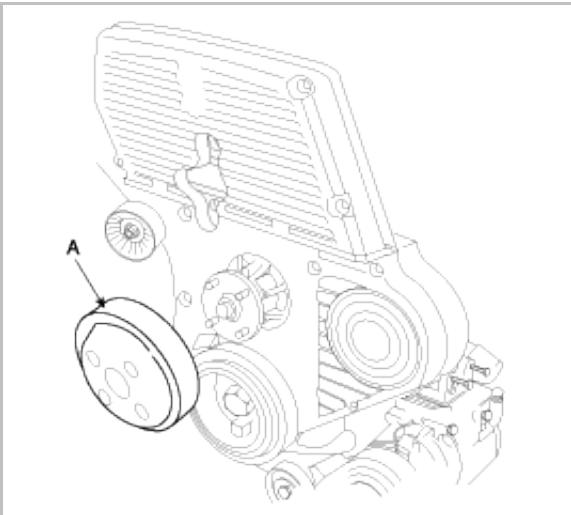
4. Remove the engine support bracket(A).



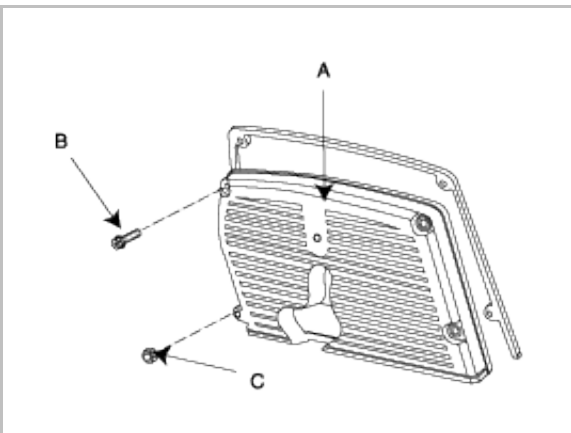
5. Remove the drive belt.



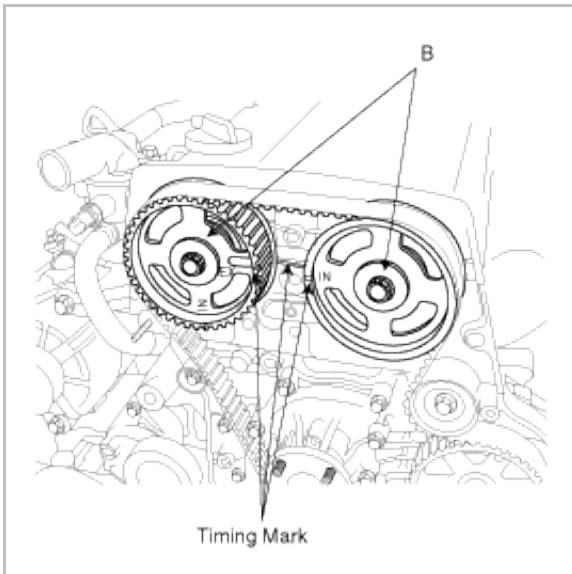
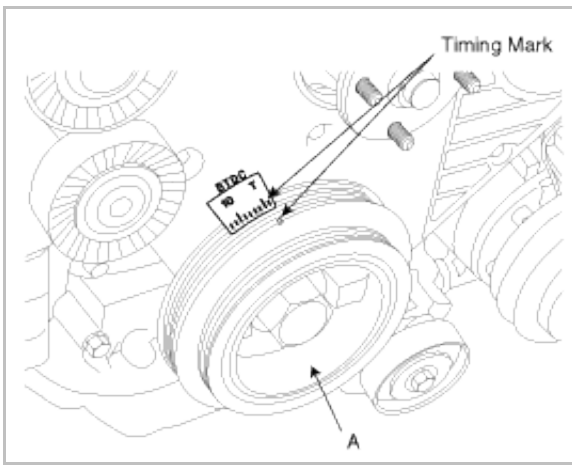
6. Remove the water pump pulley.



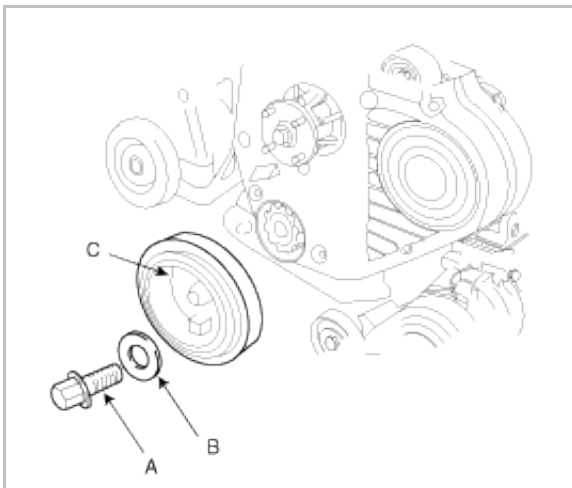
7. Remove the bolts(B), nut(C) and timing belt upper cover (A).



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)



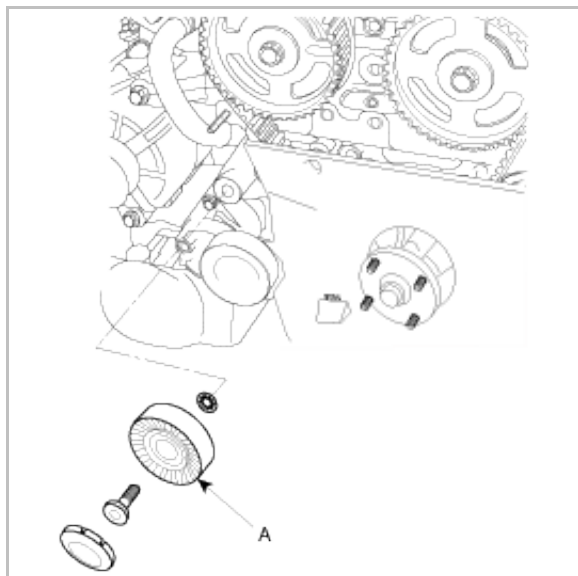
9. Remove the crankshaft pulley bolt(A), washer(B) and crankshaft pulley (C).



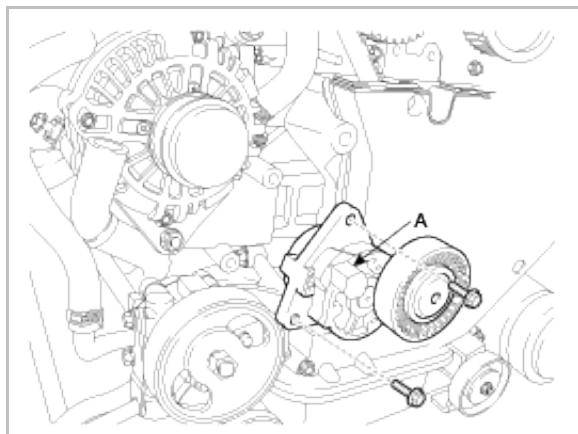
NOTICE

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

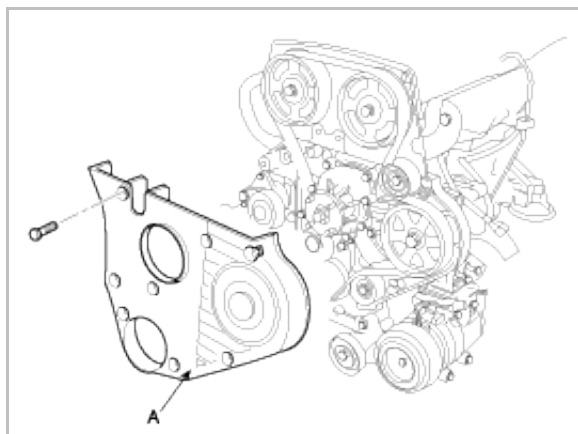
10. Remove the drive belt idler(A).



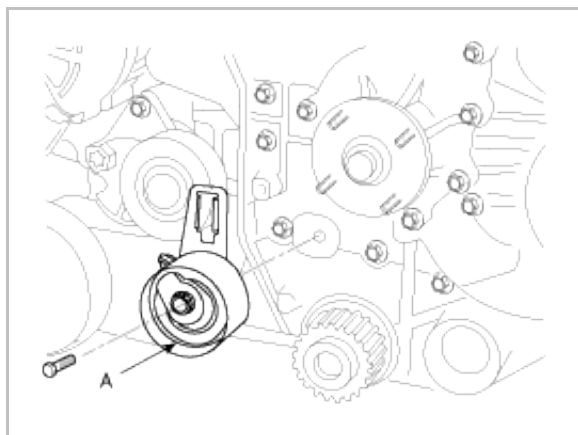
11. Remove the drive belt auto-tensioner (A).



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



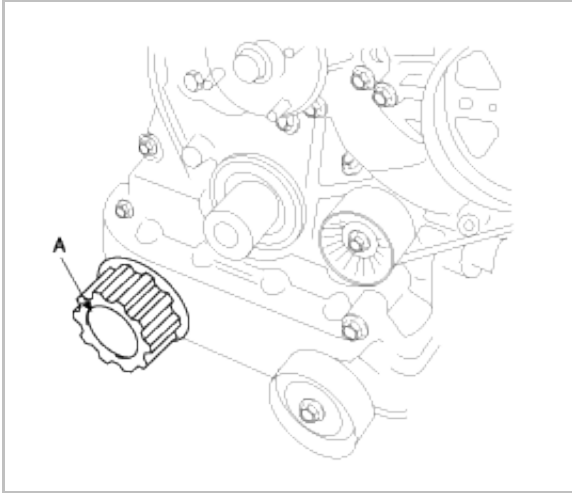
13. Remove the auto-tensioner(A) with the timing belt.



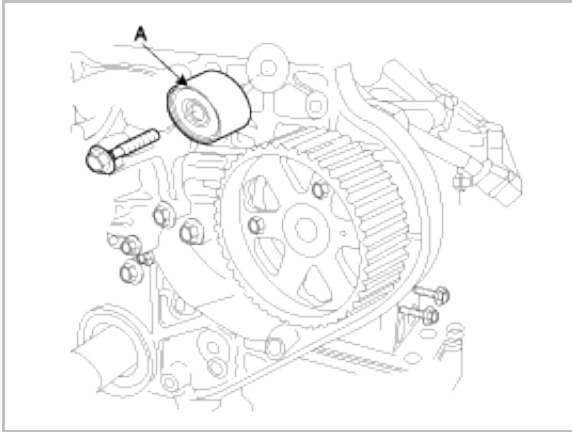
NOTICE

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

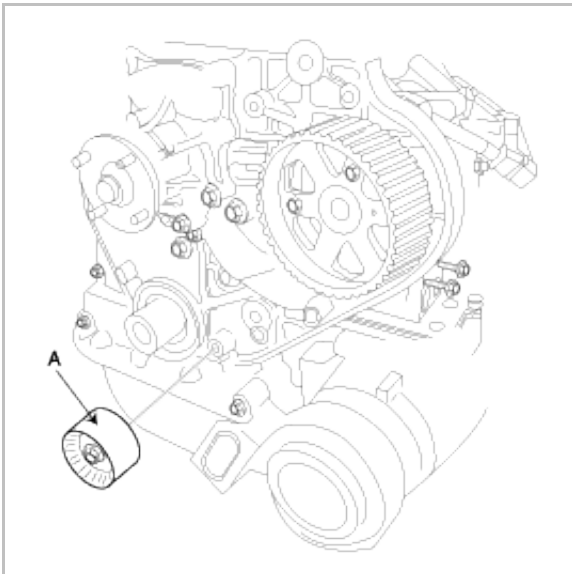
14. Remove the timing belt sprocket(A).



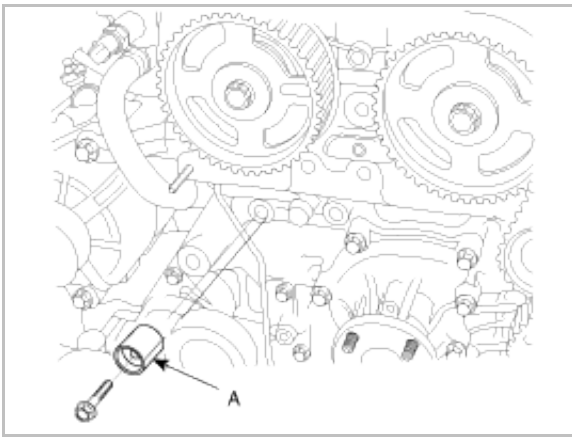
15. Remove the timing belt No.1 idler(A).



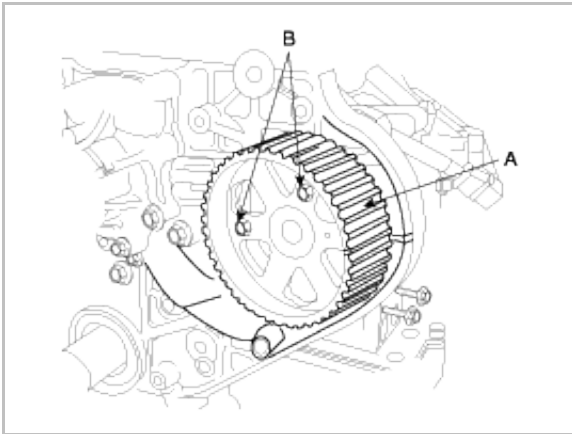
16. Remove the timing belt No.2 idler(A).



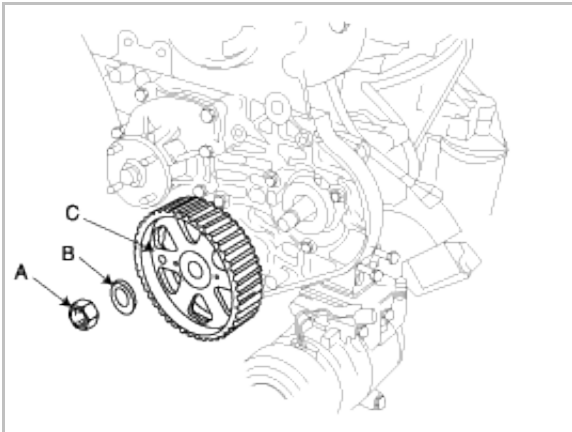
17. Remove the touch idler(A).



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



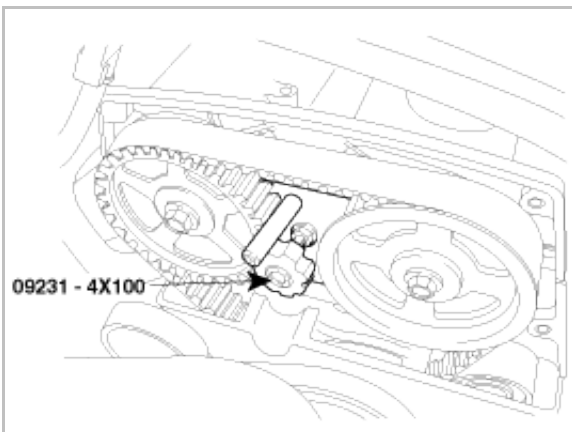
19. Remove the high pressure pump pulley nut(A), with the washer(B), pulley(C).



NOTICE

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

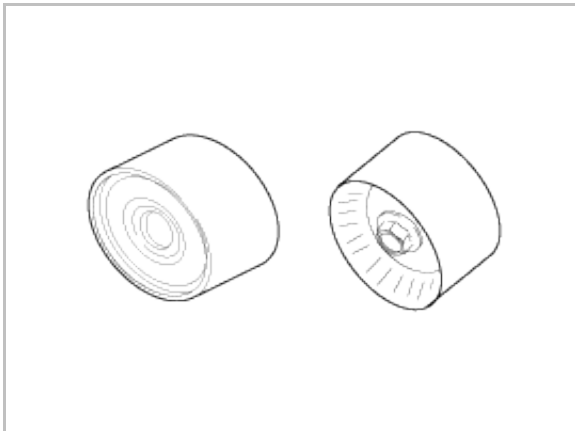
20. Using SST(09231-4X100), remove the camshaft pulley.



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

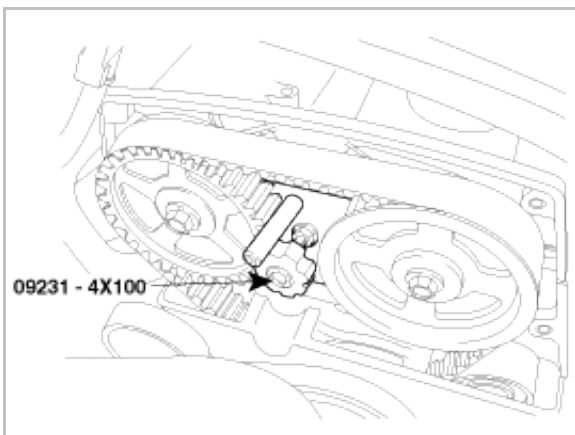
- Do not bend, twist or turn the timing belt inside out.
- Do not allow timing belt to come into contact with oil, water and steam.

INSTALLATION

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

Tightening torque :

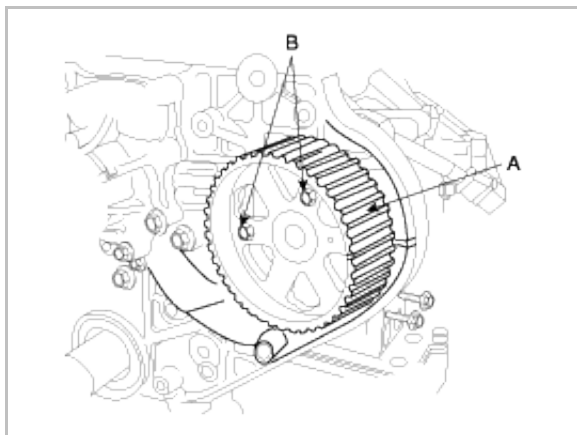
58.8~68.6Nm (6.0~7.0kgf.m, 43.4 ~ 50.6lb-ft)



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 :

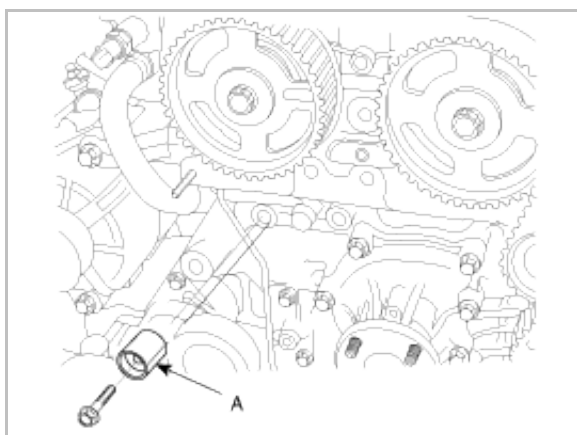
58.8~68.6Nm (6.0~7.0kgf.m, 43.4 ~ 50.6lb-ft)



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 :

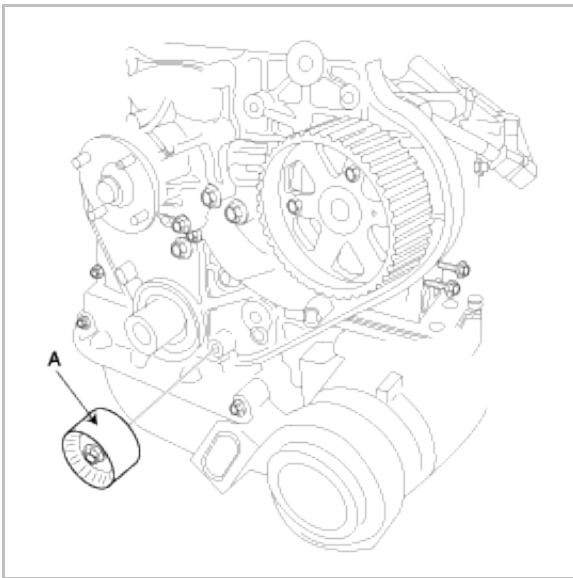
7.8 ~ 9.8Nm (3.8~4.4kgf.m, 5.8 ~ 7.2lb-ft)

CAUTION

Ensure the location of idlers.

No.1 idler : 60mm(2.3622in)

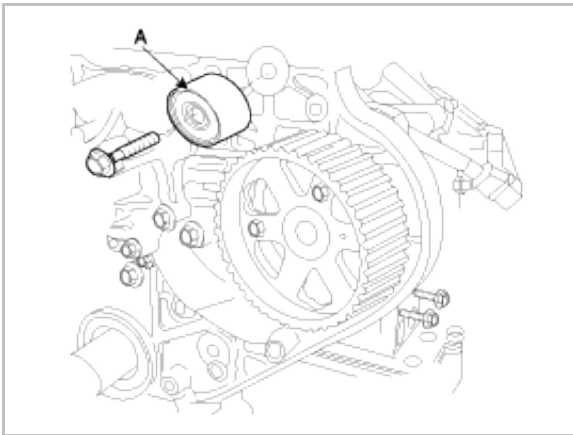
No.2 idler : 55mm(2.1654in)



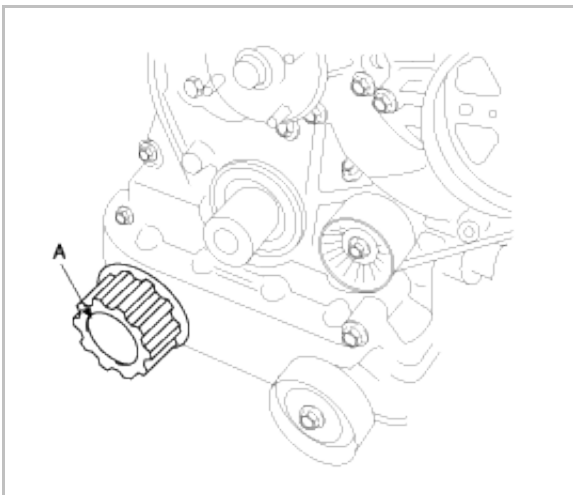
5. Install the timing belt No.1 idler(A).

Tightening torque :

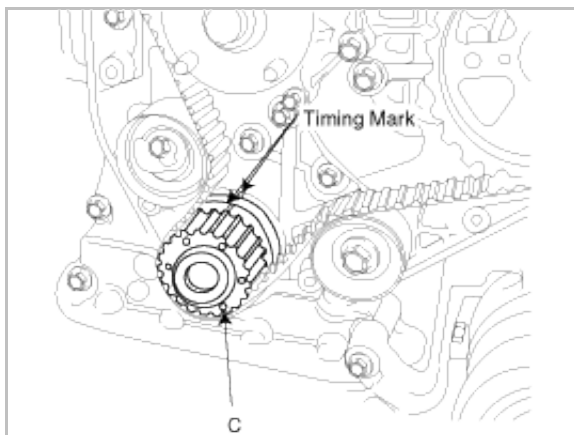
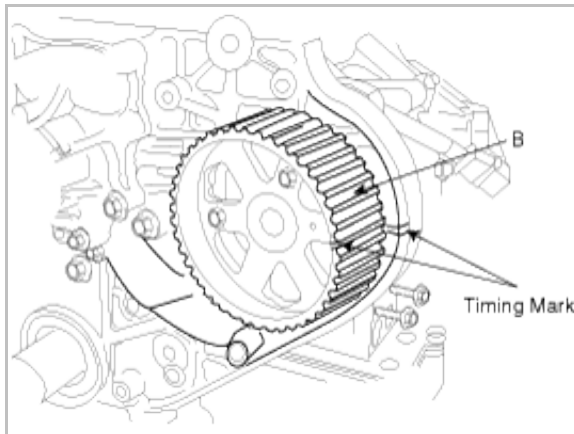
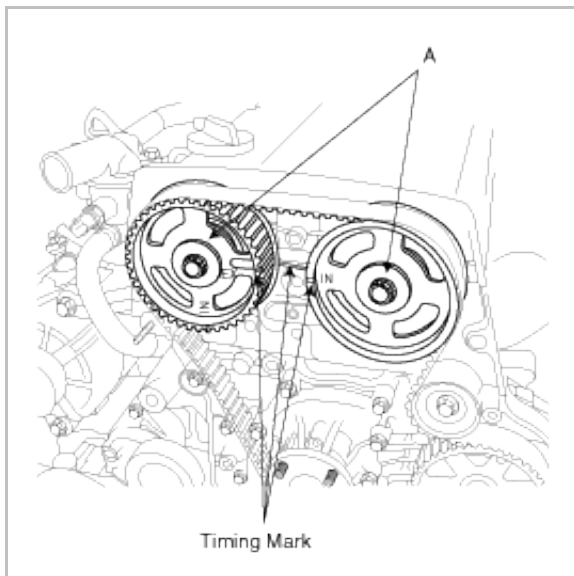
7.8 ~ 9.8Nm (4.0~5.0kgf.m, 5.8 ~ 7.2lb-ft)



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).

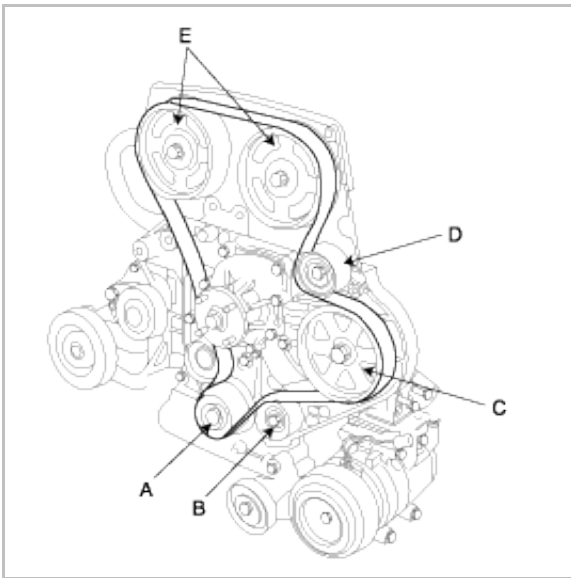


8. Install the timing belt.

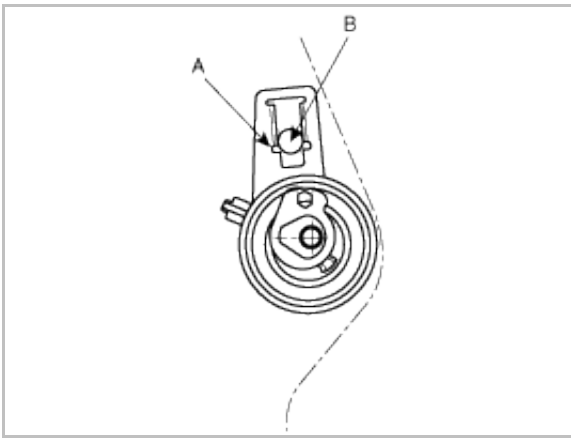
Crankshaft sprocket pulley(A)→No.2 idler(B)→High pressure pump pulley (C) → No.1 idler(D) → camshaft sprocket pulley (E)

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).

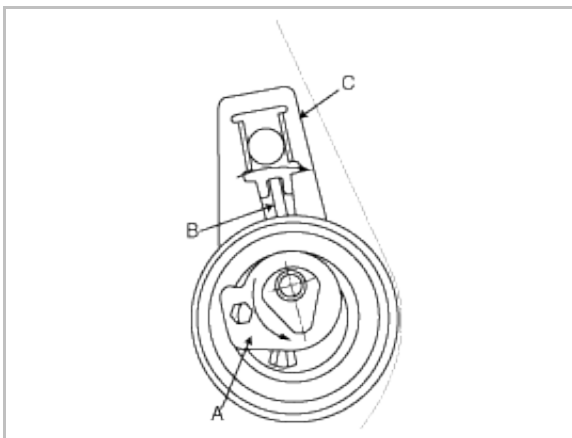


CAUTION

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.

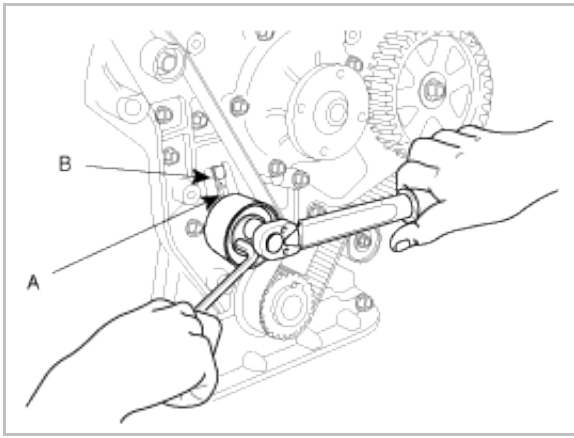
- (1) Adjust the location of the pointer (B) aligning the tensioner fork(back plate)(C) as shown below by turning the special washer(A) counterclockwise with a hexagonal wrench.



- (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)



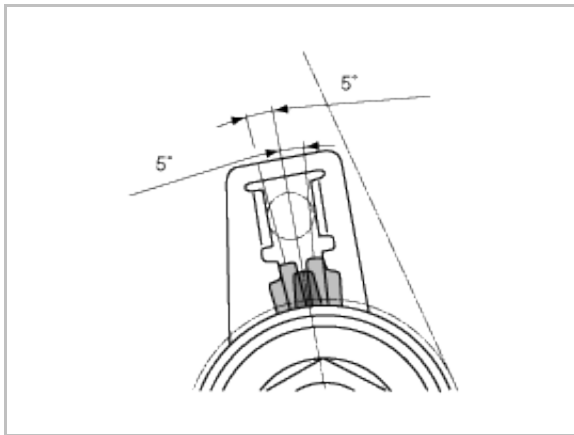
(3) Remove the hexagonal wrench.

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 : $\pm 5^\circ$



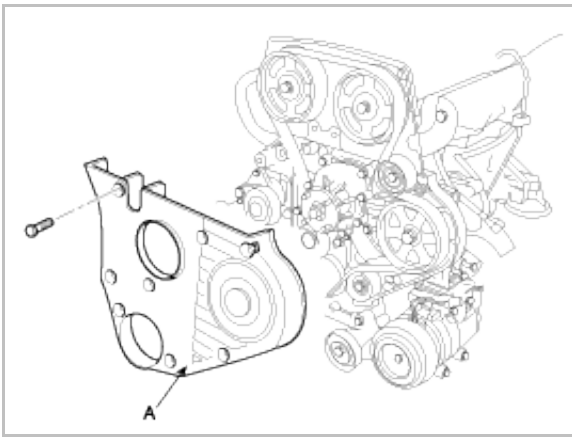
NOTICE

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 :

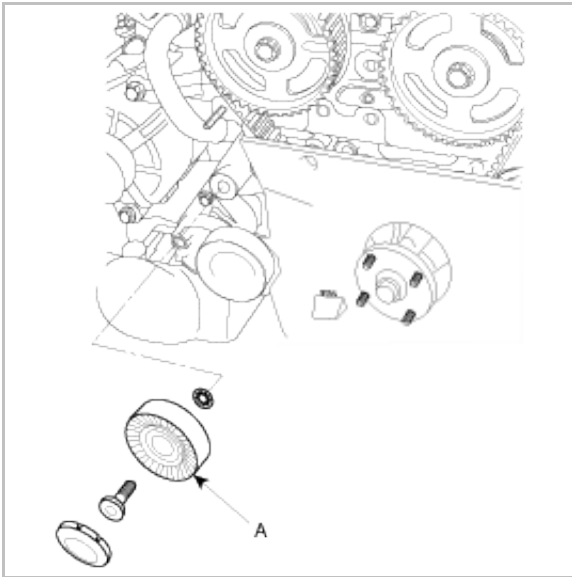
6.9~9.8Nm (0.7 ~ 1.0kgf.m, 5.1 ~ 7.2lb-ft)



14. Install the drive belt idler(A).

Tightening torque :

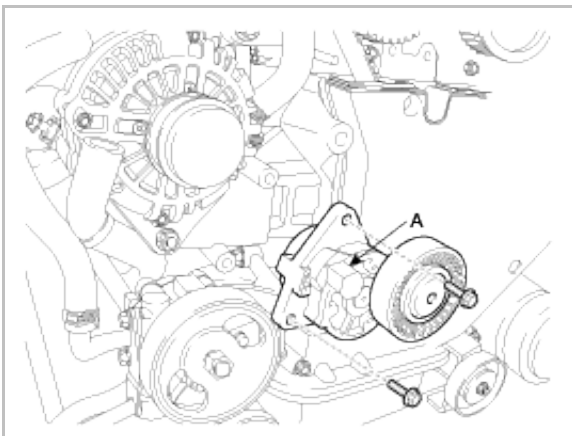
37.3Nm (3.8kgf.m, 27.5lb-ft)



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

Tighting torque :

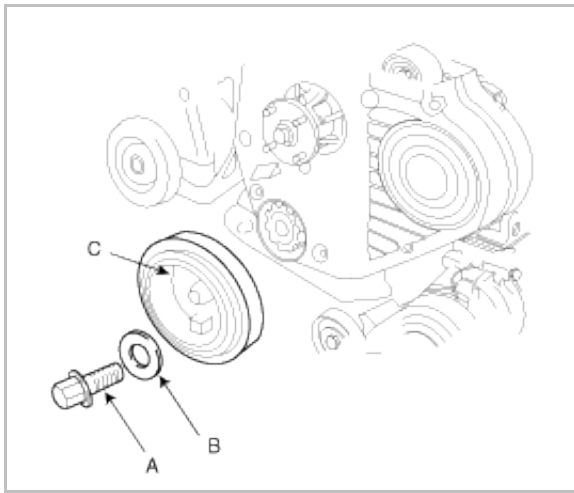
15.7~22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)



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)



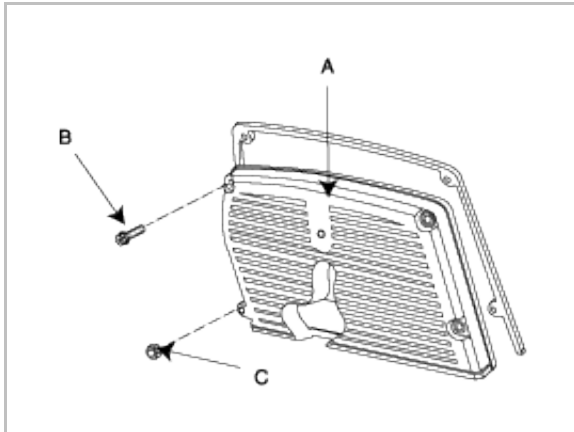
NOTICE

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

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

Tightening torque :

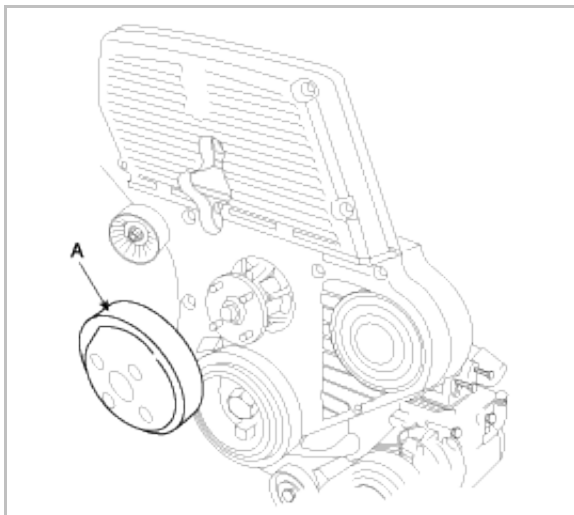
6.9~9.8Nm (0.7 ~ 1.0kgf.m, 5.1 ~ 7.2lb-ft)



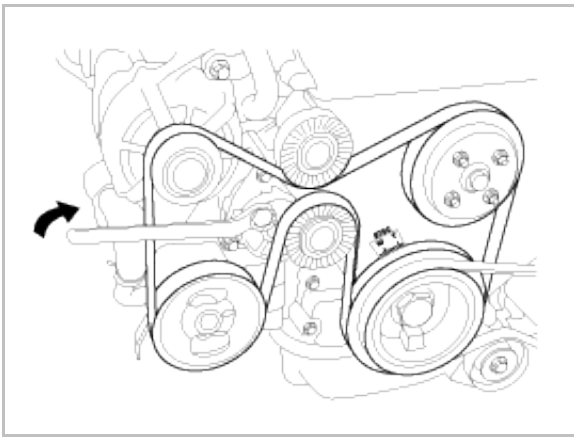
18. Install the water pump pulley.

Tightening torque :

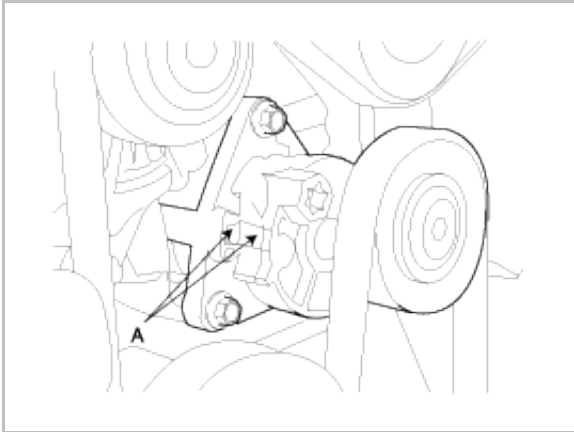
5.9~9.8Nm (0.6 ~ 1.0kgf.m, 4.3 ~ 7.2lb-ft)



19. Install the drive belt.



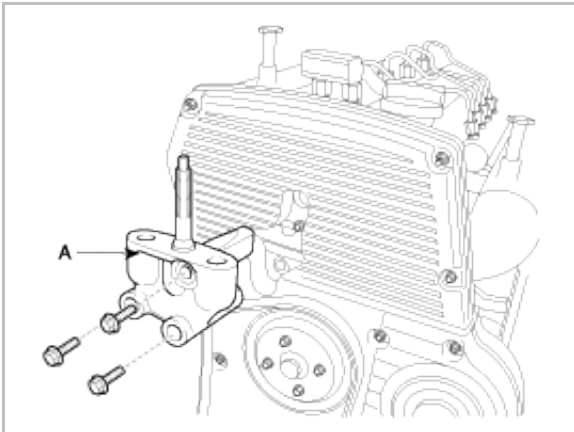
20. Check that the 'A' part of the drivebelt auto-tensioner is aligned as shown below. If not, replace the drivebelt.



21. Install the engine support bracket(A).

Tightening torque :

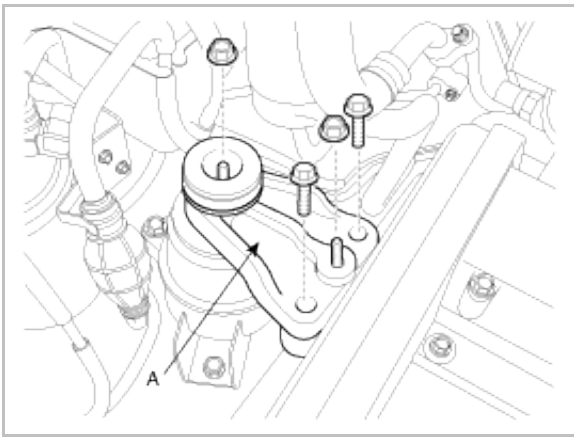
49.0~63.7Nm (5.0 ~ 6.5kgf.m, 36.2 ~ 47.0lb-ft)



22. Install the engine mounting (A).

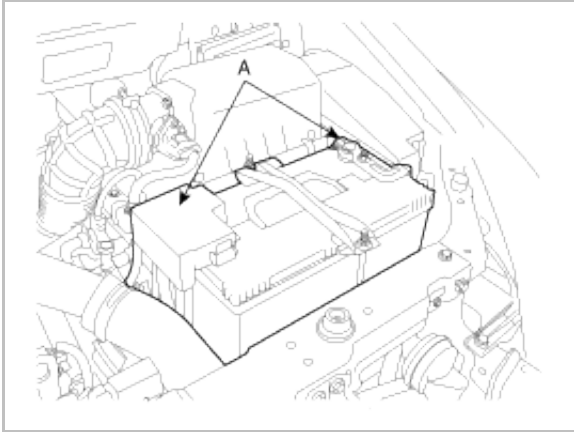
Tightening torque :

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).

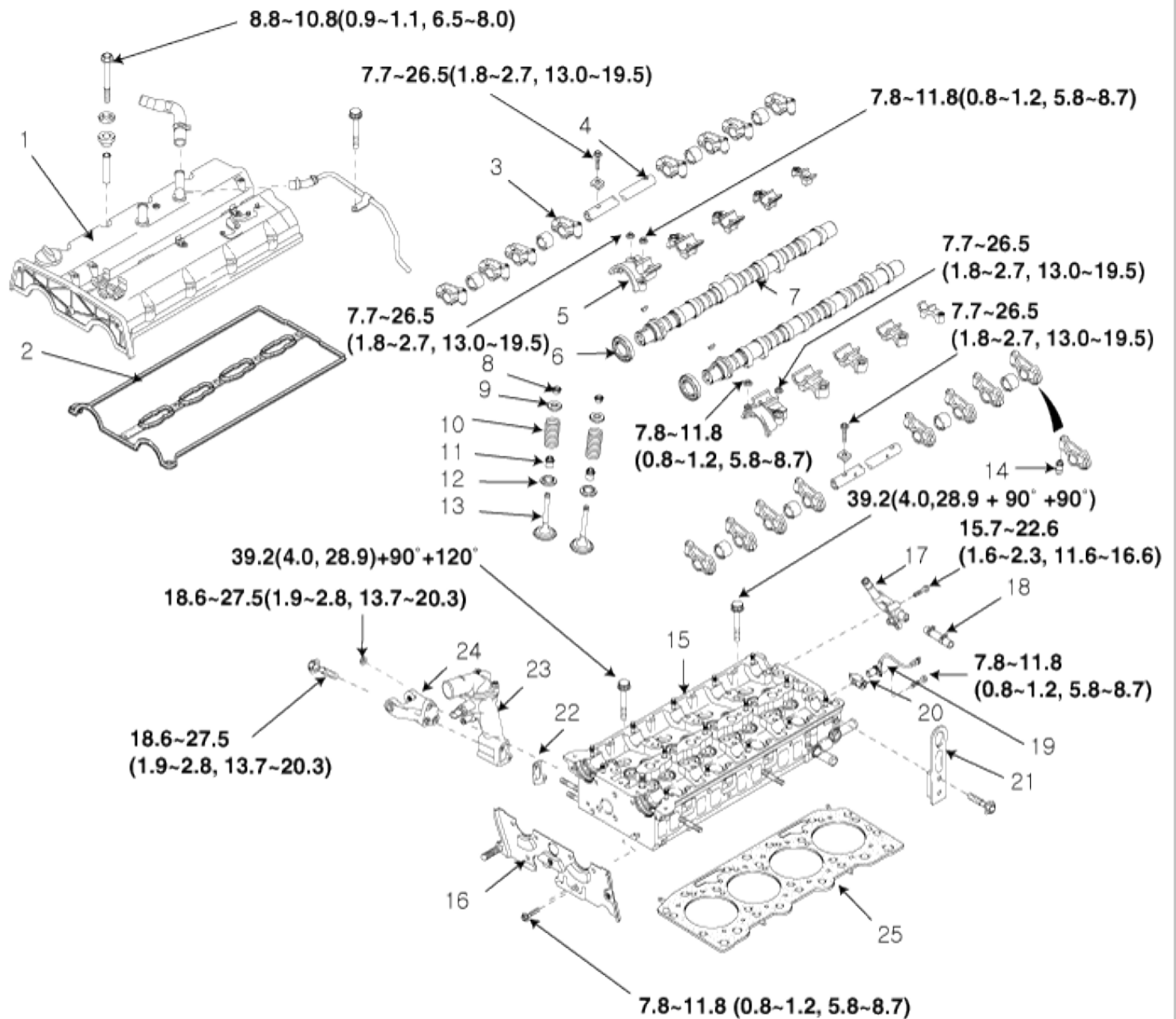




Engine Mechanical System

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.

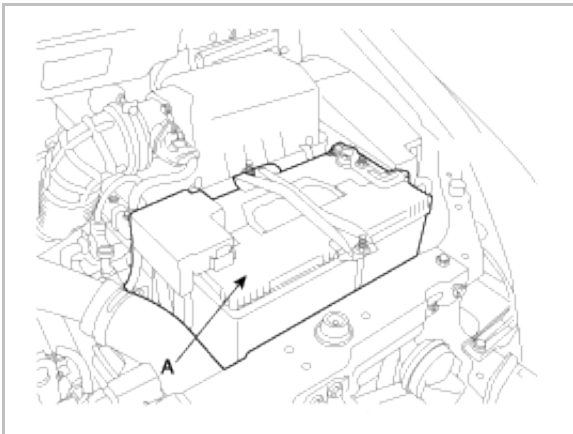
CAUTION

- 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.

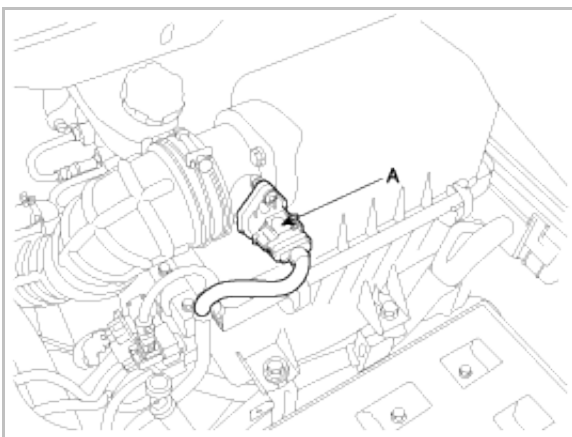
NOTICE

- 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.

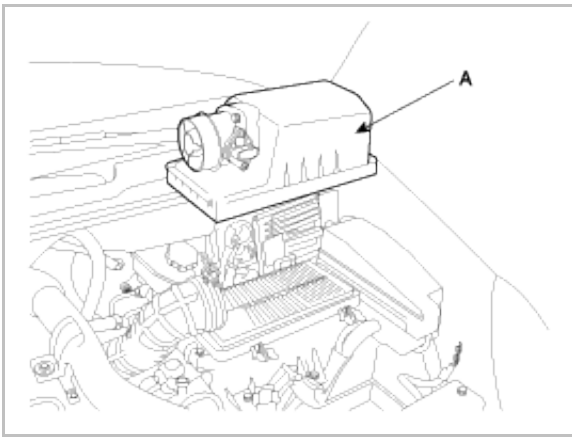
1. Remove the battery(A).



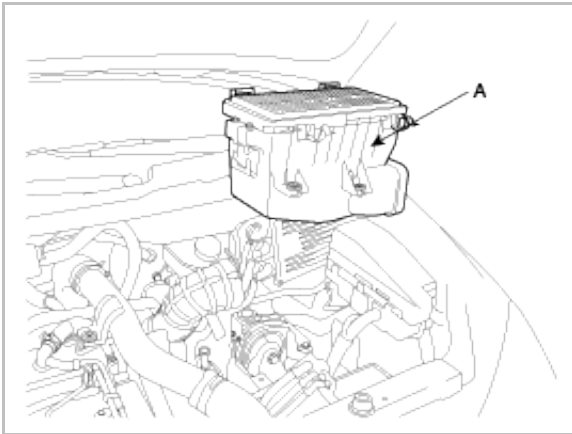
2. Drain the engine coolant.
Remove the radiator cap to speed draining.
3. Remove the intake air hose and air cleaner assembly.
(1) Disconnect the AFS(Air Flow Sensor) connector(A).



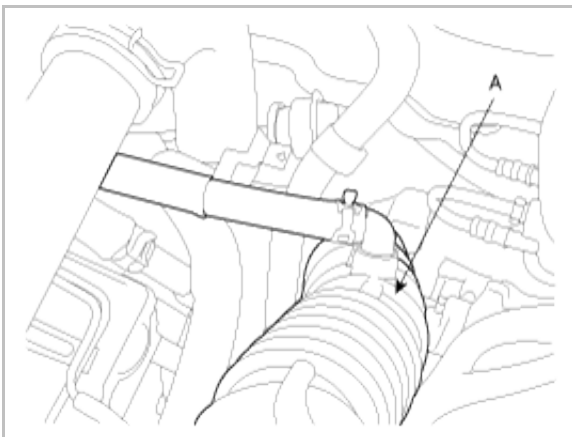
- (2) Disconnect the air cleaner upper cover(A).



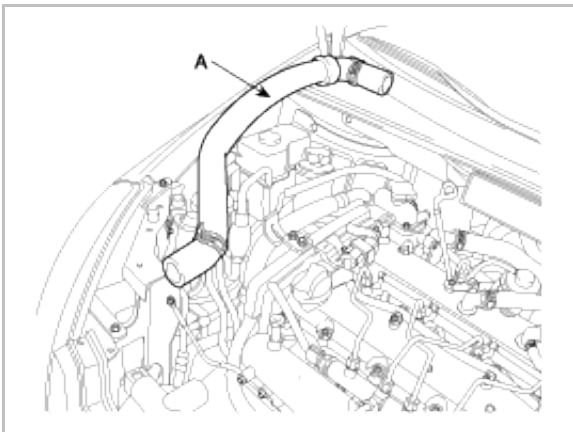
(3) Remove the air cleaner assembly(A).



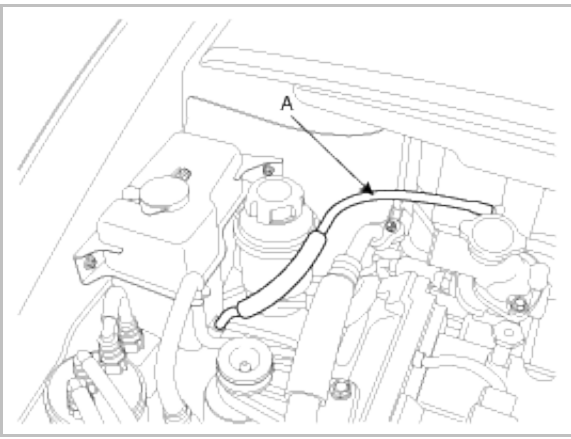
(4) Remove the air intake hose(A).



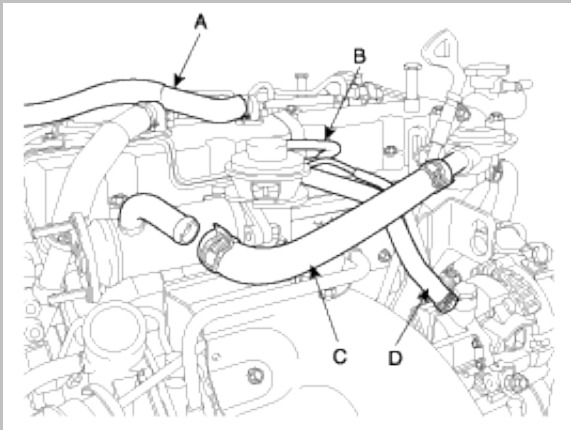
4. Remove the radiator upper hose(A).



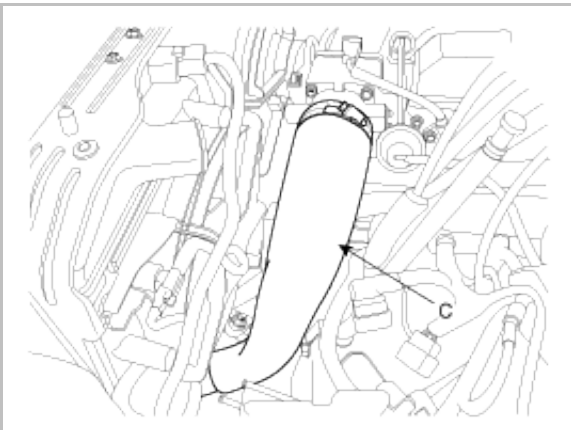
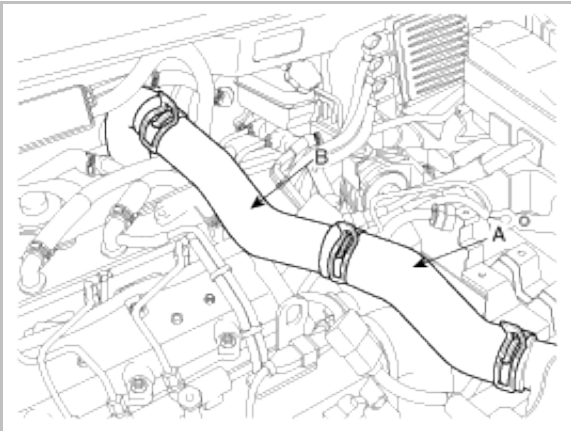
5. Remove the reservoir tank hose(A).



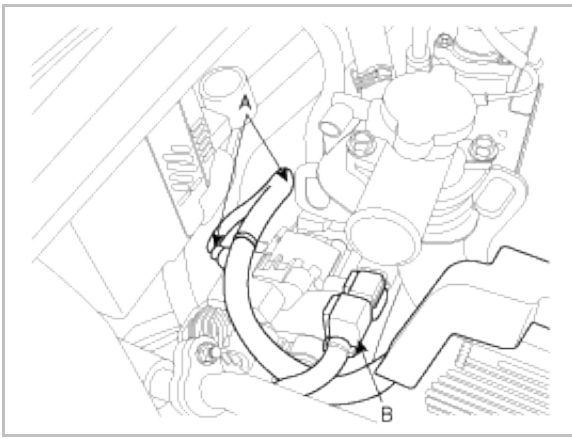
6. Remove the PCV(Positive Crankcase Ventilation) hose(A), EGR valve vacuum hose(B), EGR cooler water hose(C), pump vacuum oil hose(D).



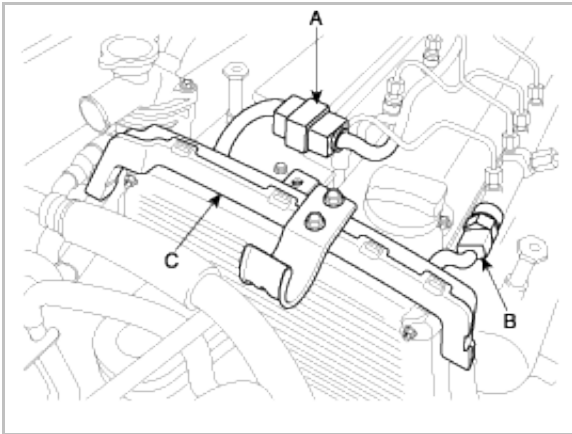
7. Remove the intercooler hose(A,C), pipe(B).



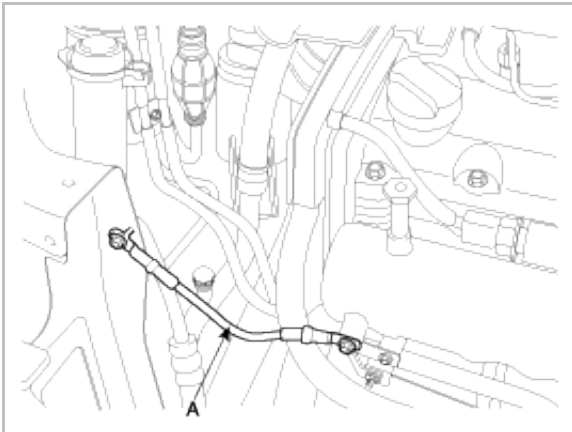
8. Remove the wiring connectors and clamps from cylinder head and intake manifold.
 (1) Remove the generator connector (A) and ETC(Engine Coolant Temperature) sensor connector (B).



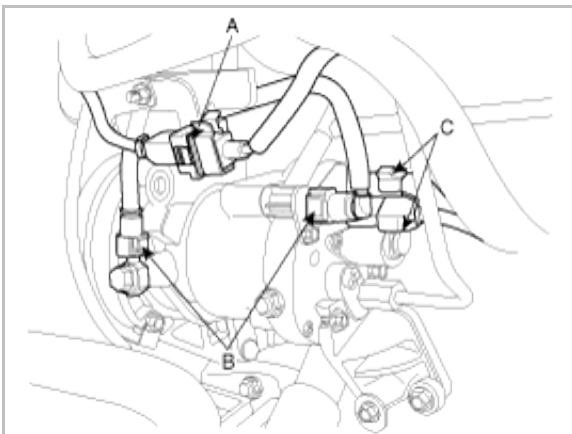
(2) Remove the injector connector(A), common rail pressure sensor connector(B), wire harness protector(C).



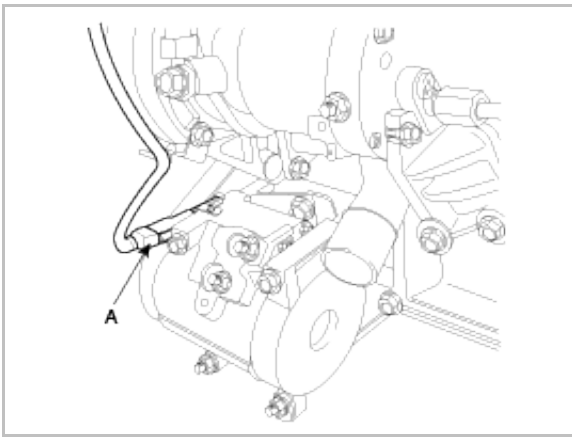
(3) Remove the ground cable(A) from cylinder head.



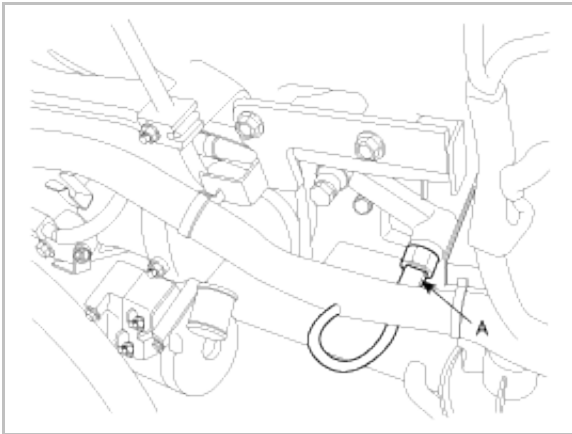
(4) Remove the knock sensor connector (A), high pressure pump fuel hose (B), high pressure pump connector(C).



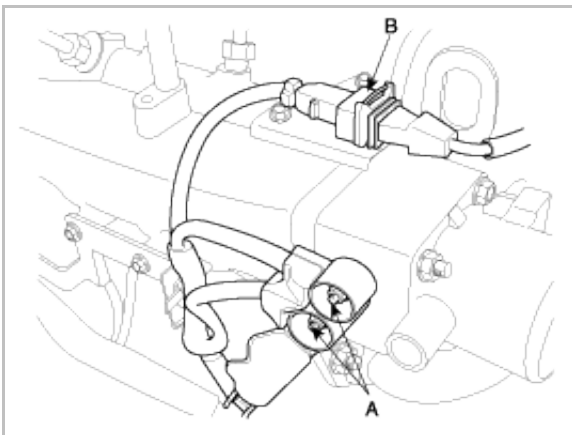
(5) Remove the air conditioner condenser (A).



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



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



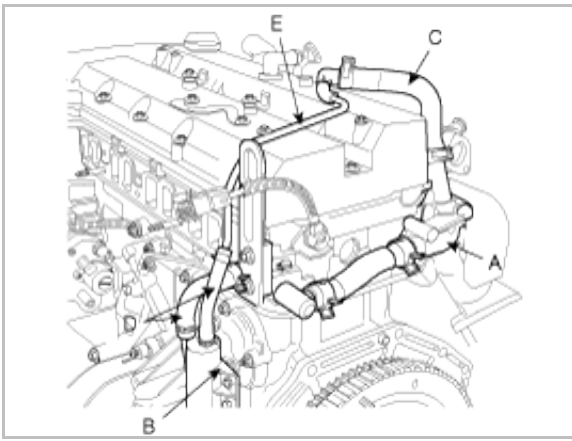
9. Remove the injection pipe, injector. (Refer to FL- injector.)

10. Remove the exhaust manifold.

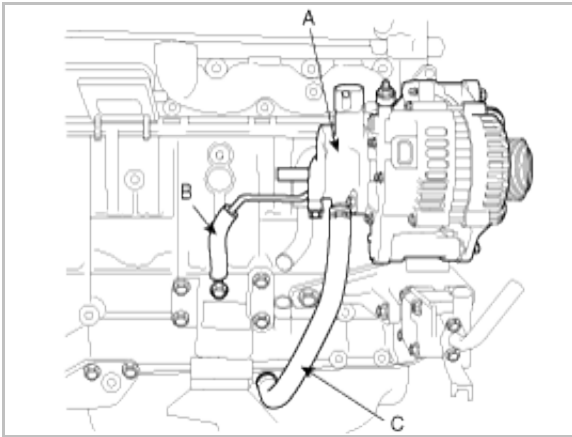
11. Remove the intake manifold.

12. Remove the timing belt.

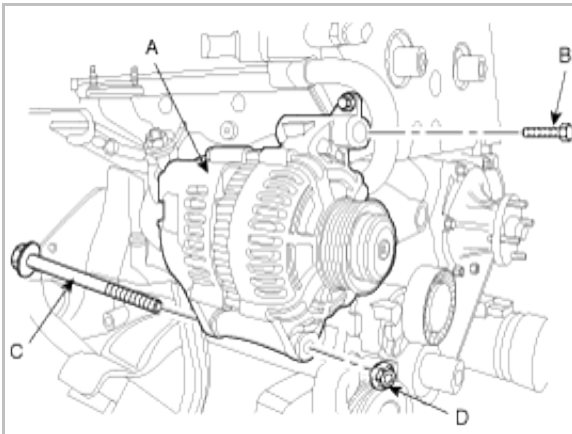
13. Remove the hose(C, D) and pipe (E) from. the ventilation housing(A) and the air separator(B).



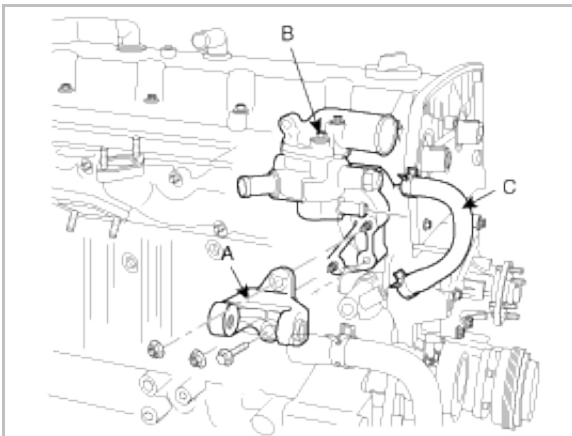
14. Remove the oil pipe (B) and hose(C) from the generator vacuum pump (A).



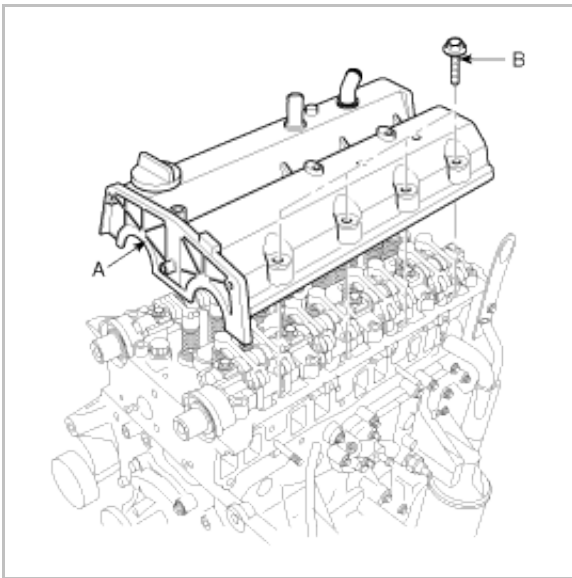
15. Remove the generator fixing bolts(B,C), nuts(D) and then the generator(A).



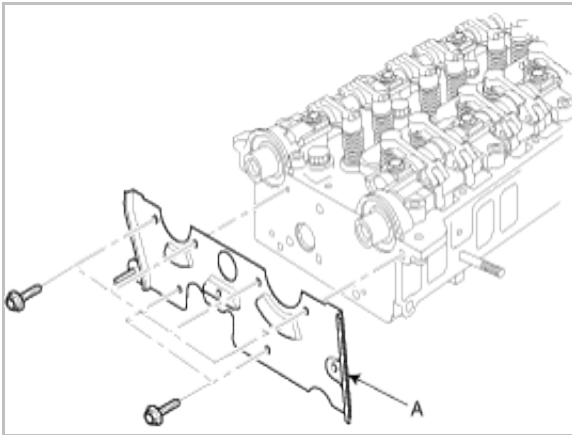
16. After removing the water hose(C) from the thermostat housing (B), remove the generator fixing bracket (A) and the thermostat housing (B).



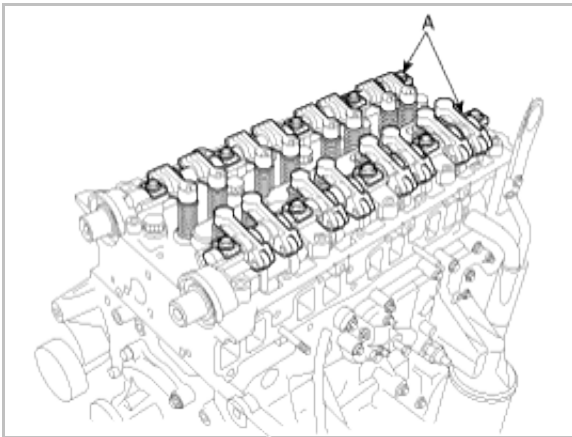
17. Remove the cylinder head cover(A).



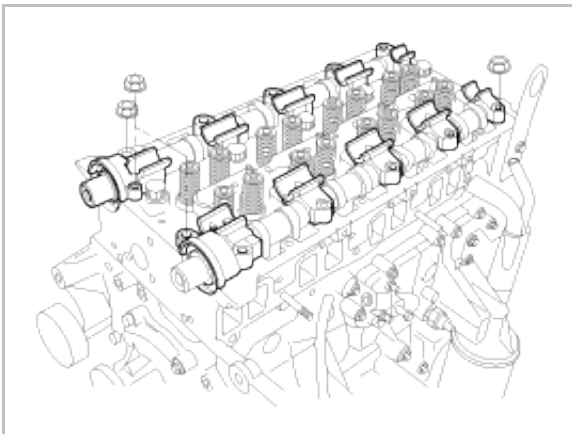
18. Remove the timing belt plate(A).



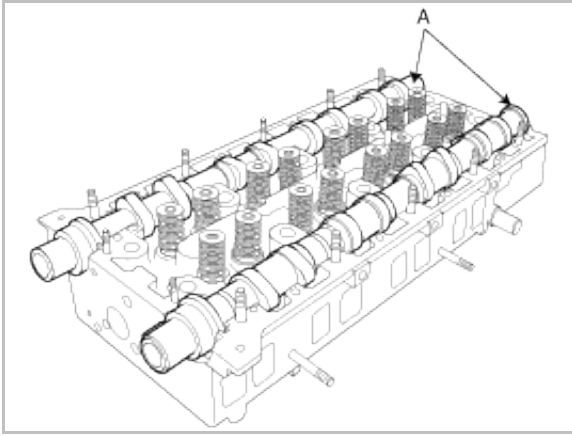
19. Remove the rockerarm shaft(A).



20. Remove the camshaft bearing caps(A).

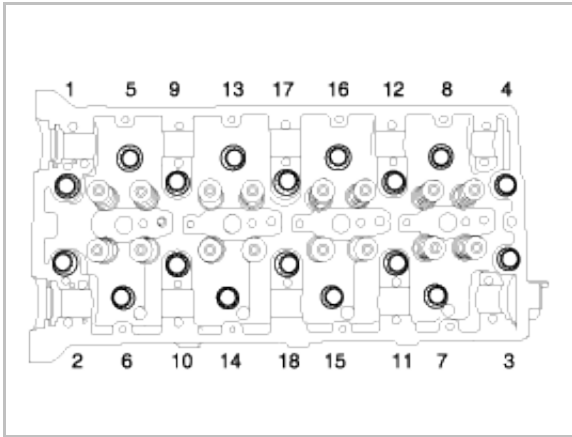


21. Remove the camshaft(A).



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.

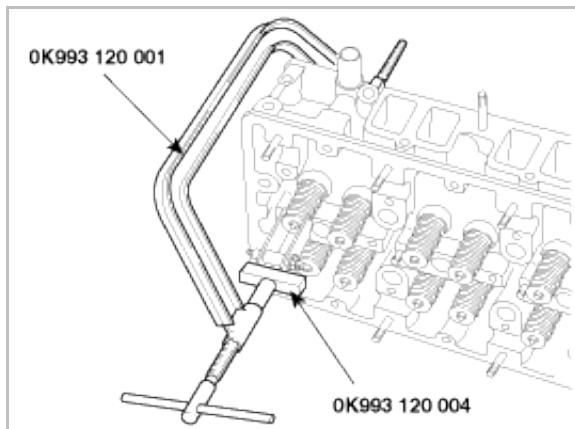
CAUTION

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

DISASSEMBLY

1. Remove the valves.

(1) Using the SST (0K9993 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.

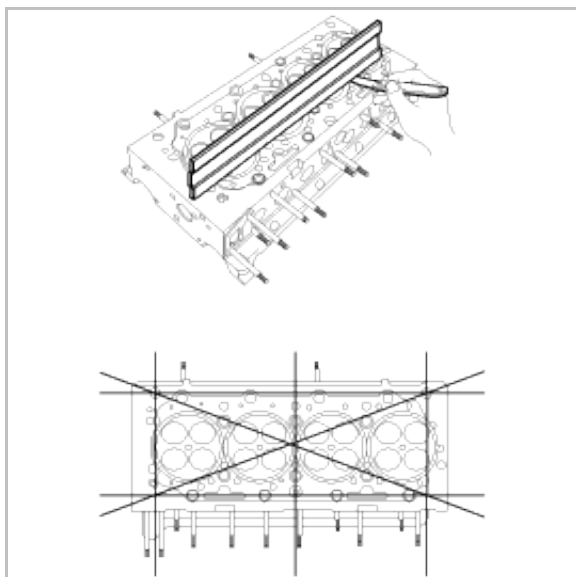
Using a precision straight edge and feeler gauge, measure the surface the contacting the cylinder block and the manifolds for warpage.

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.

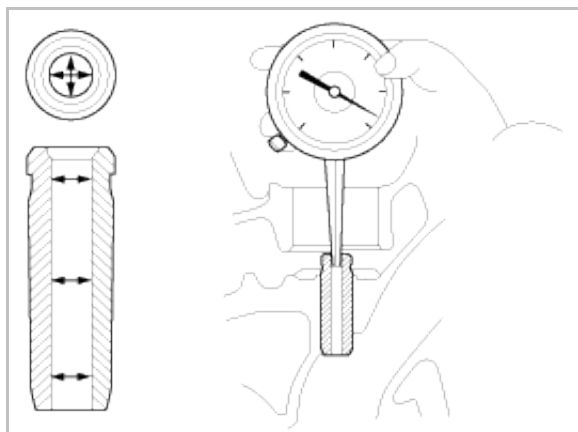
VALVE AND VALVE SPRING

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)

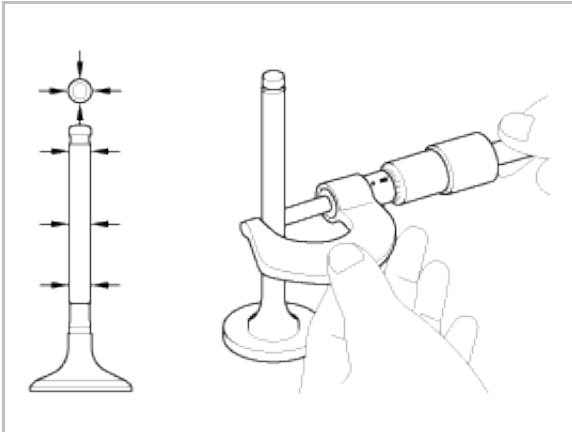


- (2) Using a micrometer, measure the outer diameter of valve stem.

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.

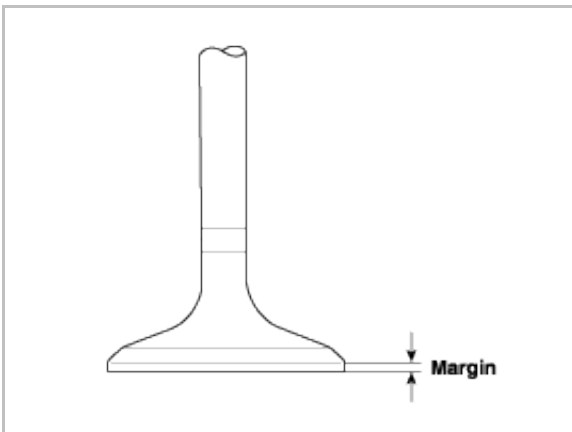
2. Inspect the valves.

- (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)



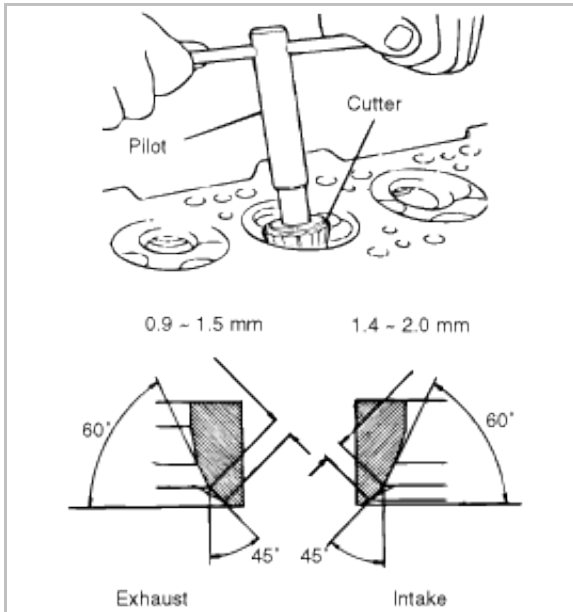
- (4) Check the surface of valve stem tip for wear.
If the valve stem tip is worn, replace the valve.

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

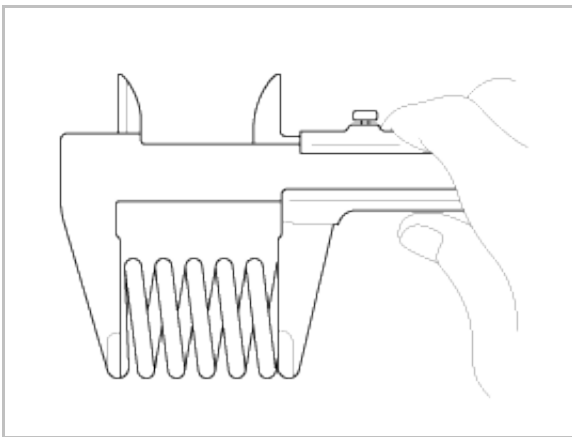
Free height : 52.477mm (2.0660in)

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°



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

CAMSHAFT

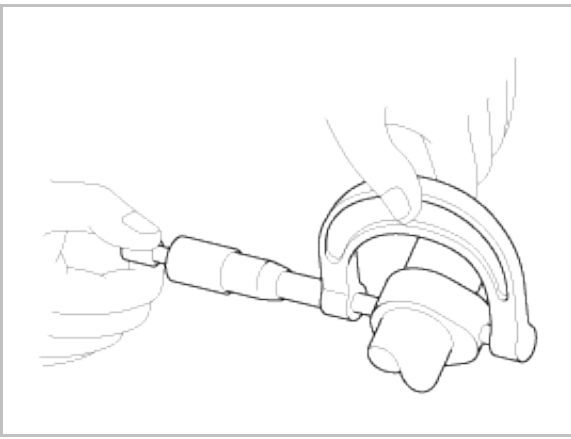
1. Inspect the cam lobes.

Using a micrometer, measure the cam lobe height.

Cam height

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

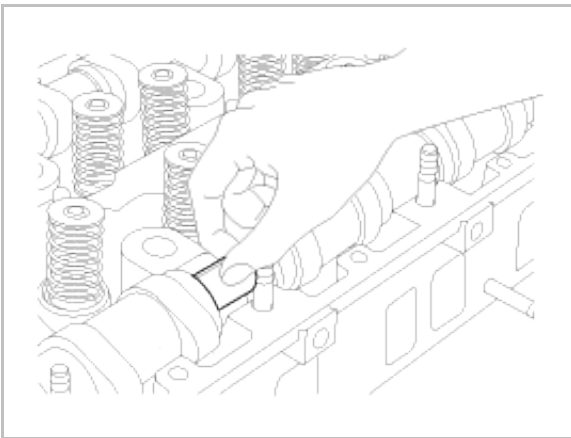
Exhaust : 39.4932~39.6932mm (1.5548~1.5627in)



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.

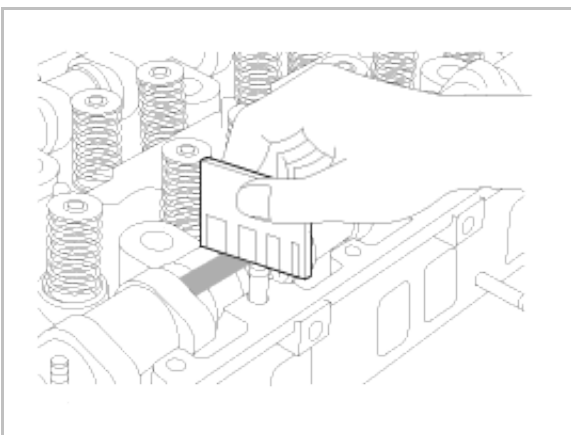
CAUTION

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)

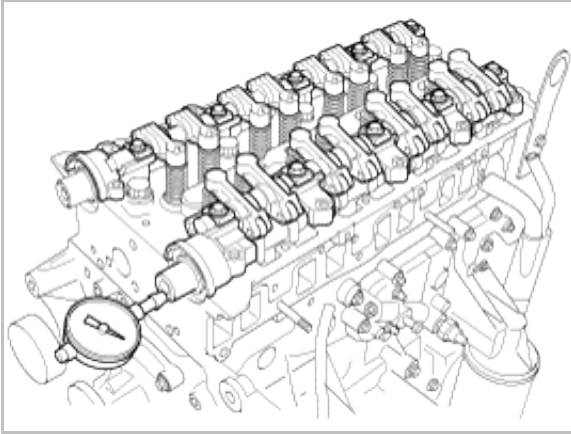


If the oil clearance is greater than maximum, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

- (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)



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)

- (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)

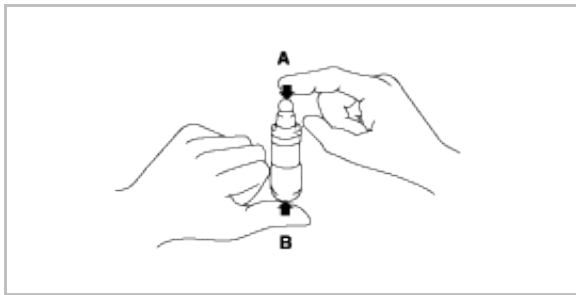
Calculate the clearance between the rocker arm and the rocker arm shaft by the difference between the inner and outer diameter of the rocker arm.

Rockerarm and rockerarm shaft clearance
0.020~0.068mm (0.0008~0.0027in)
Rockerarm shaft outer diameter
19.959~19.980mm (0.7858~0.7866in)

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.	CAUTION Do not run engine at a speed higher than 3,000 rpm, as this may damage the HLA.
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.	
Continuous noise when the engine is running after changing the HLA.	Insufficient oil in 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

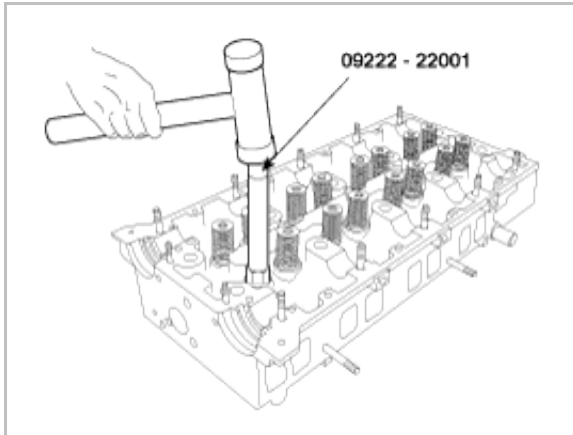
- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surface.
- Replace oil seals with new ones.

1. Install the valves.

- (1) Install the spring seats.
- (2) 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.

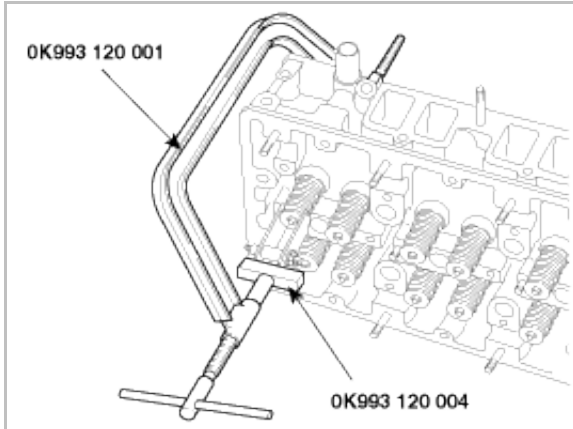


- (3) Install the valve, valve spring and spring retainer.

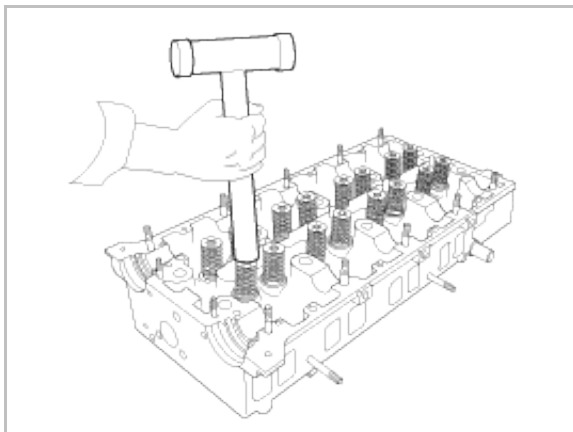
NOTICE

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

- (4) 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.



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



INSTALLATION

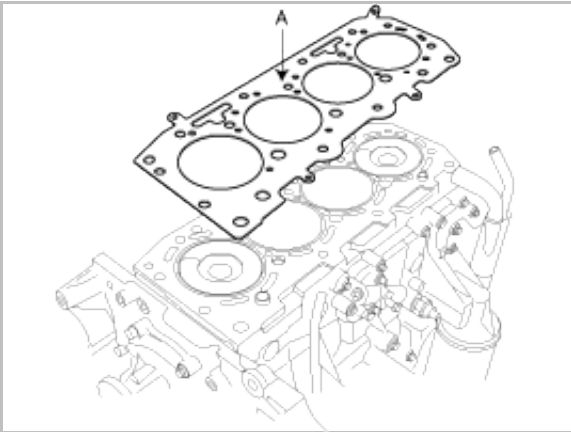
NOTICE

- 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.

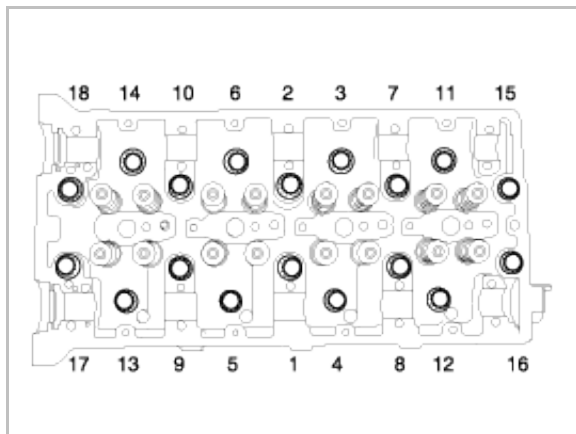
Tightening torque :

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

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

CAUTION

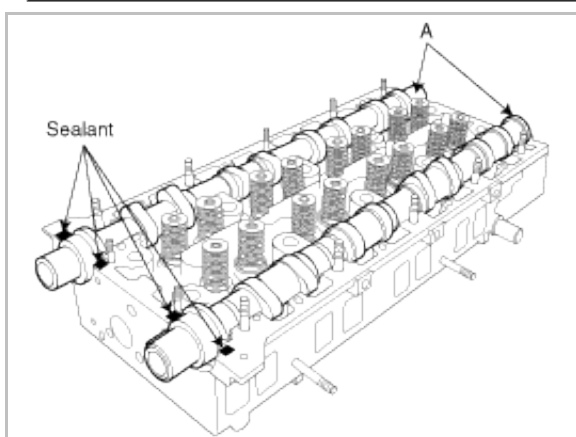
Always use new cylinder head bolts.



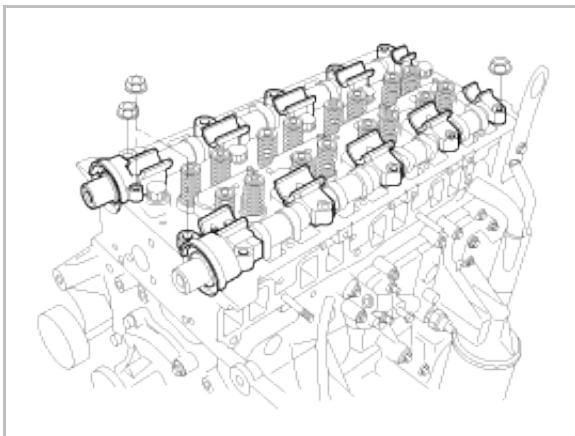
4. Install the camshaft(A) on the cylinder head.

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 rockerarm shaft assembly(A) after bearing cap.

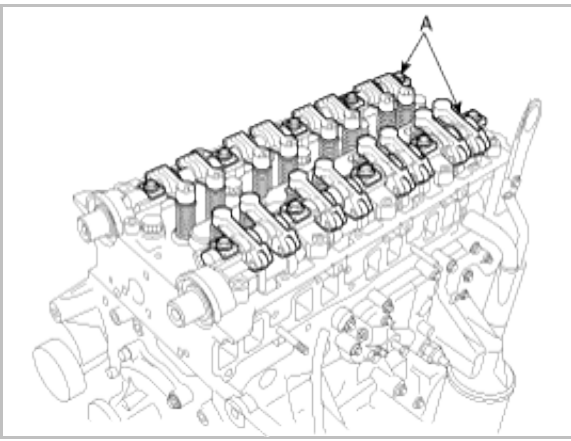
Tightening torque :

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

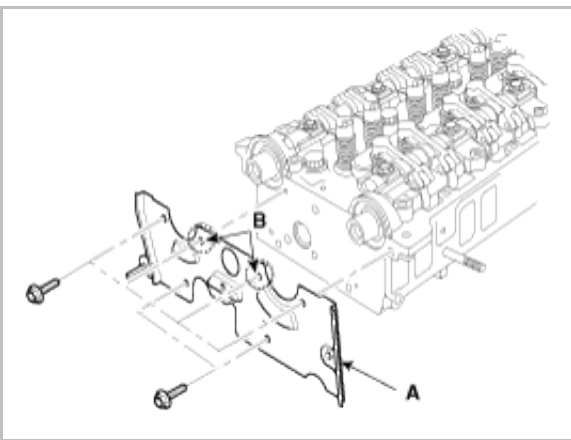
Distinguish between the intake and the exhaust rocker arm shaft (Intake: yellow, exhaust: black).



7. Install the camshaft oil seal.
8. Install the timing belt plate(A).

Tightening torque :

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

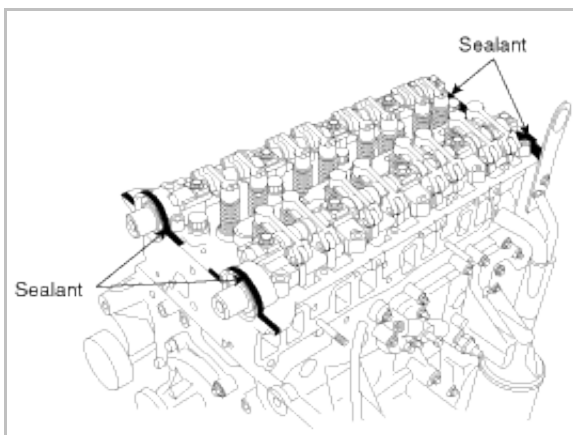


CAUTION

When assembling upper plate to the cylinder head assembly, be sure to use including solid sealant bolts at marked 2ea point (B).

An upper plate mounting bolt can not be reused once it is removed and never use normal flange bolt with applying anaerobic or liquid sealant to it. If not, the bolts may be loosened or damaged. In this case, replace them with including solid sealant bolts.

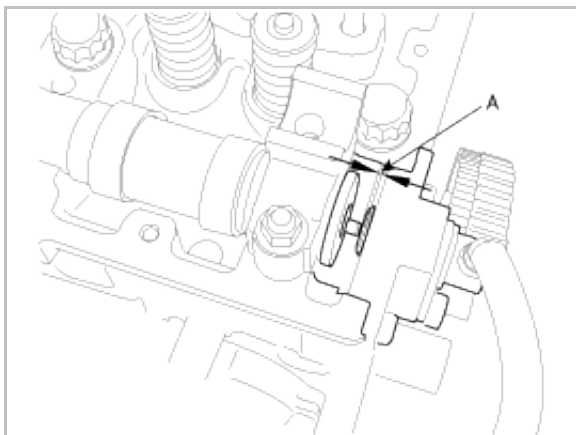
9. Install the cylinder head cover.
 - (1) Apply sealant on the cylinder head as shown below.



- (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) :

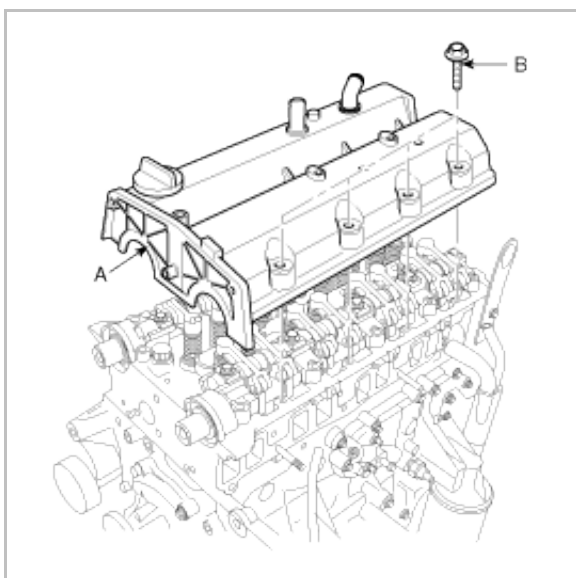
0.5 ~ 1.5mm (0.0197 ~ 0.0591in.)



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

Tightening torque :

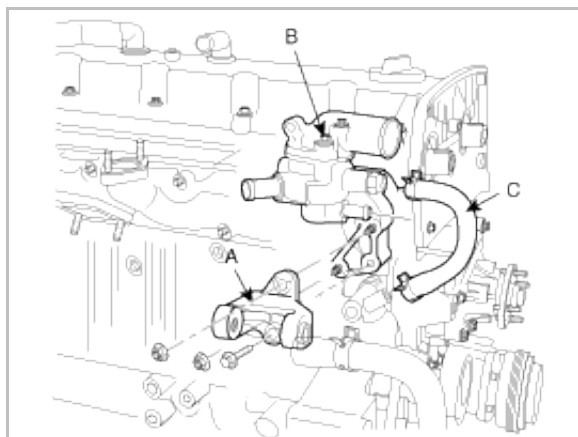
8.8~10.8Nm (0.9~1.1kgf.m, 6.5~8.0lb-ft)



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

Tightening torque :

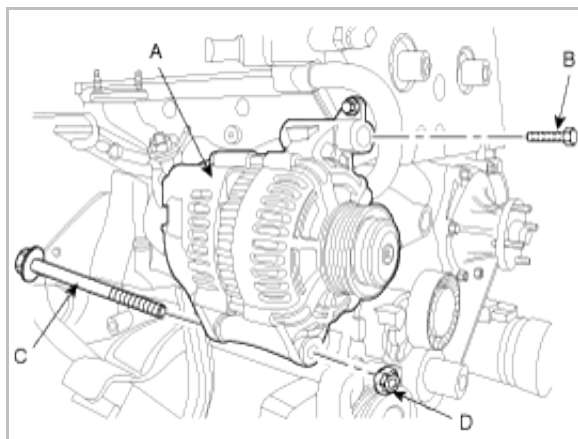
18.6~27.5Nm (1.9~2.8kgf.m, 13.7~20.3lb-ft)



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)

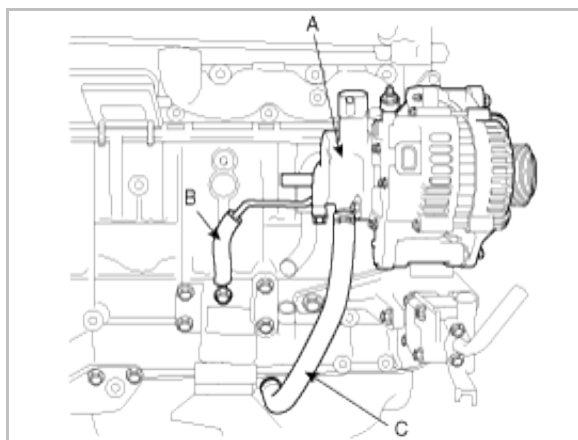


12. Install the oil pipe(B), hose(C) to generator pressure pump(A).

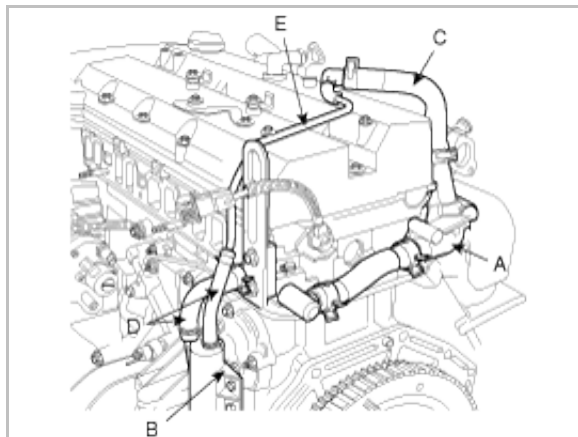
Oil pipe eyd bolt

Tightening torque :

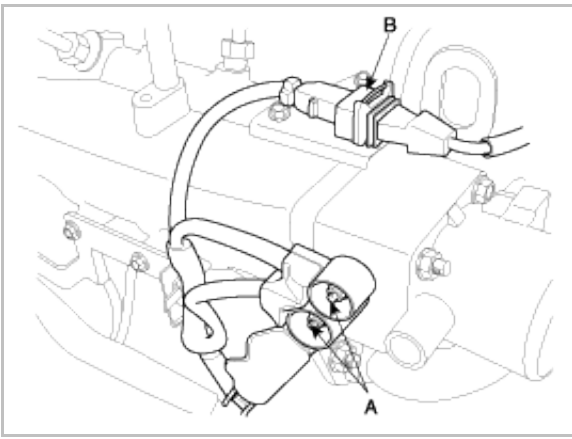
19.6~24.5Nm (2.0~2.5kgf.m, 14.5~18.1lb-ft)



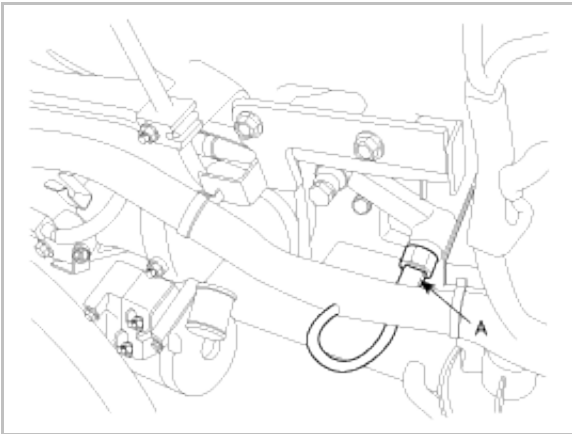
13. Install the hose(C,D) and the pipe(E) to the ventilation housing(A) and the air separator(B).



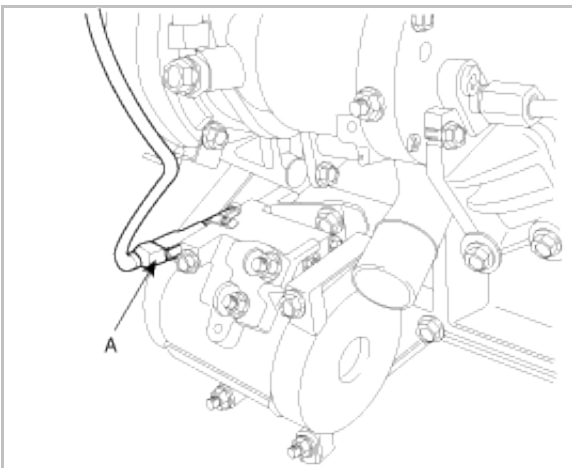
14. Install the timing belt.
15. Install the intake manifold.
16. Install the exhaust manifold.
17. Install the injection pipe, injector. (Refer to FL- injector.)
18. Install the wire harness and the clamp to the cylinder head and the intake manifold.
- (1) Install the air heater(A), CMP (Camshaft Position Sensor) connector(B).



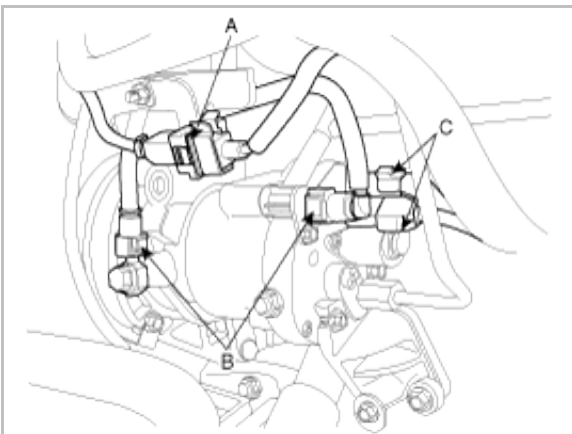
(2) Install the oil pressure switch connector(A).



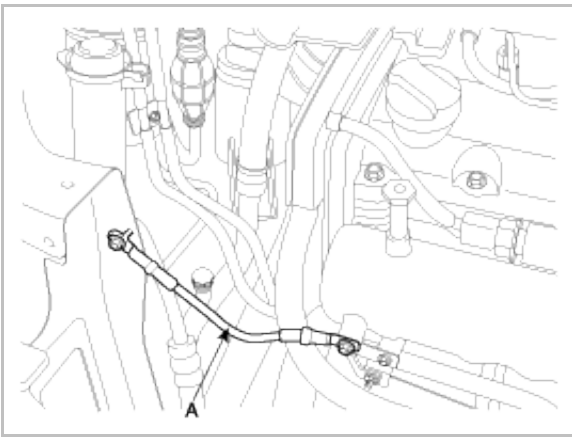
(3) Install the air conditioner condenser(A).



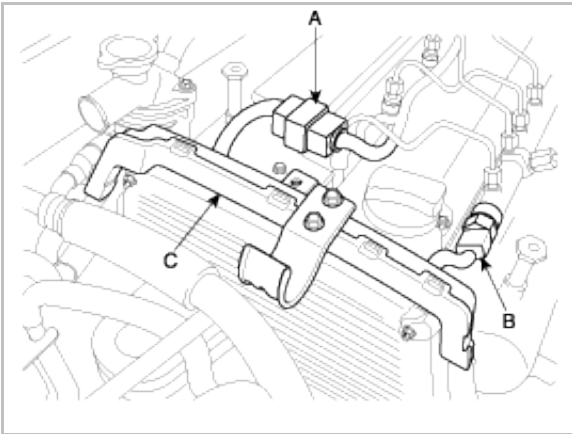
(4) Install the knock sensor connector(A), high pressure pump fuel hose(B), high pressure pump connector(C).



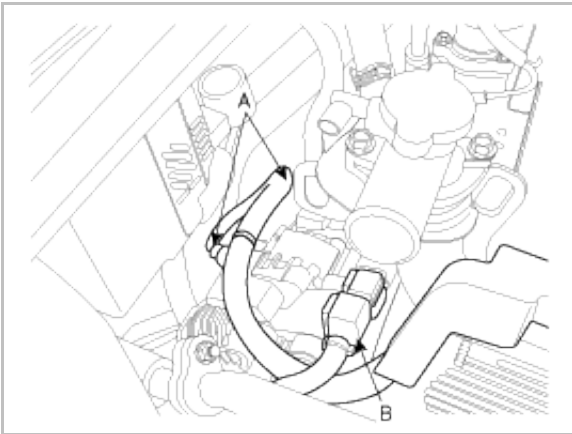
(5) Install the ground cable(A) from cylinder head.



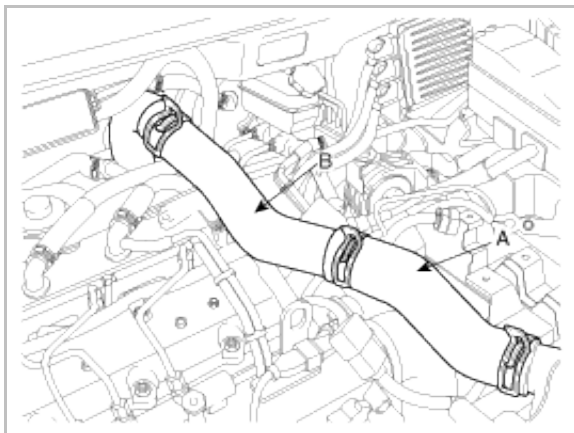
(6) Install the injector connector(A), common rail pressure sensor connector(B), wire harness protector(C).

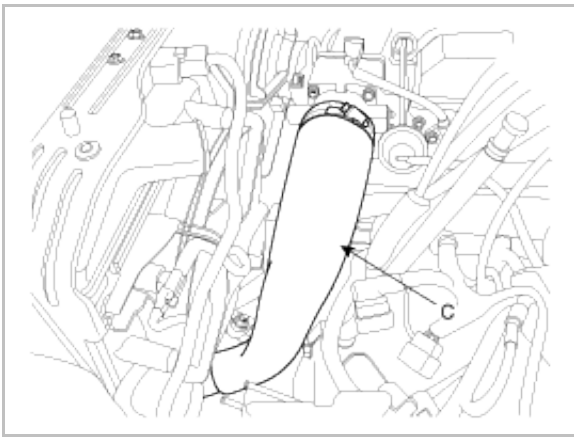


(7) Install the generator connector(A) and the ETC(Engine Coolant Temperature) sensor connector(B).

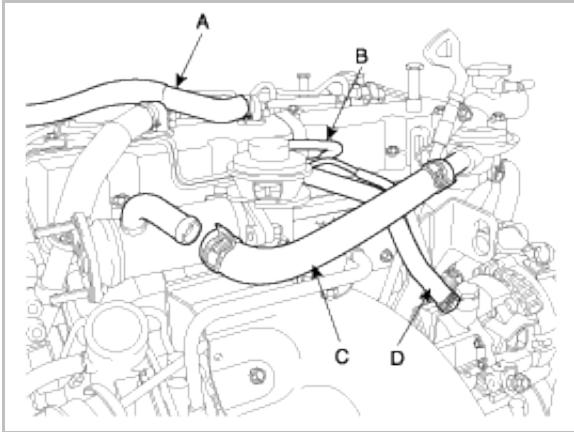


19. Install the intercooler hose(A,C), pipe(B).

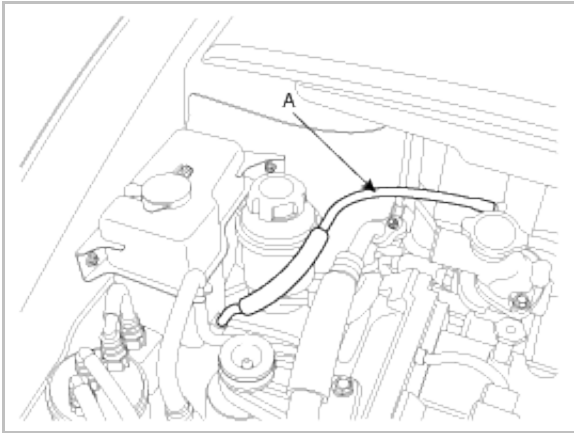




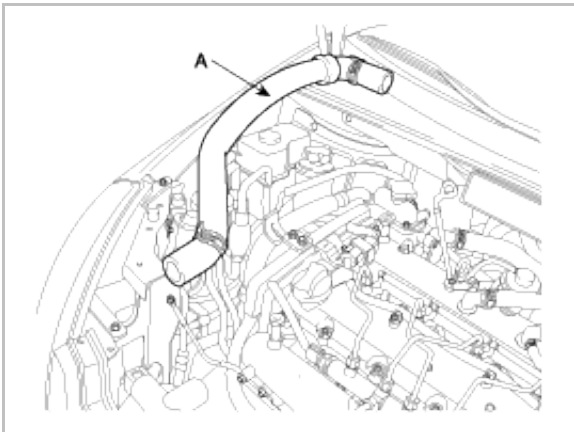
20. Install the PCV(Positive Crankcase Ventilation) hose(A), EGR valve vacuum hose(B), EGR cooler water hose(C), pump vacuum oil hose(D).



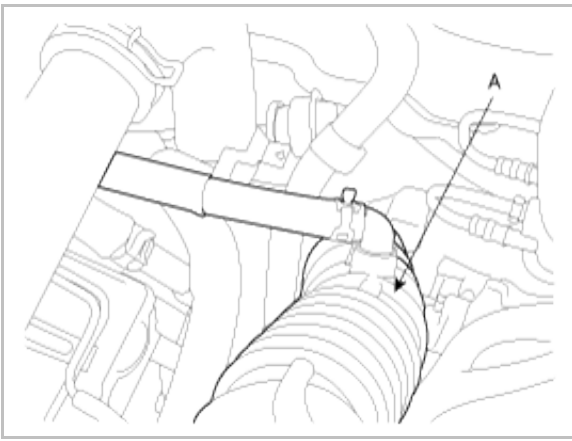
21. Install the reservoir tank hose(A).



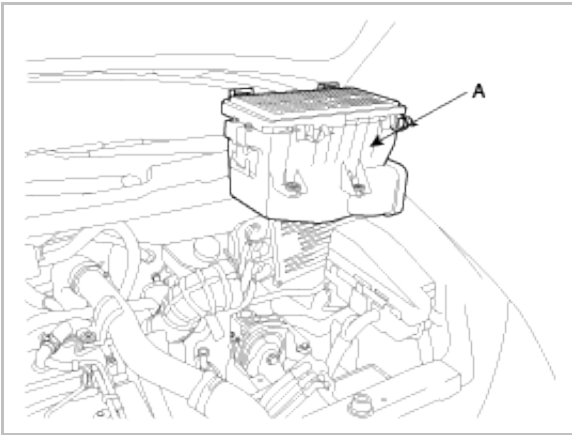
22. Install the radiator upper hose(A).



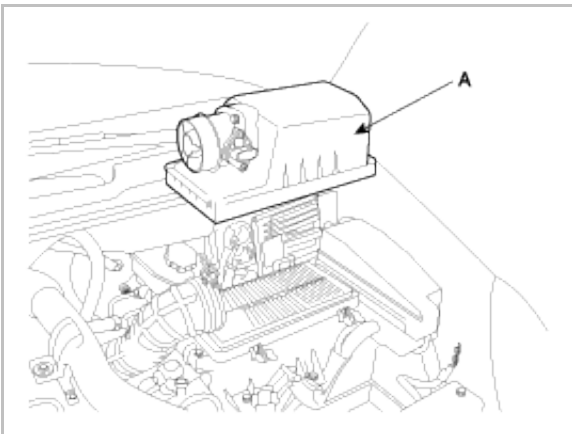
23. Install the intake air hose and air cleaner assembly.
(1) Install the air intake hose(A).



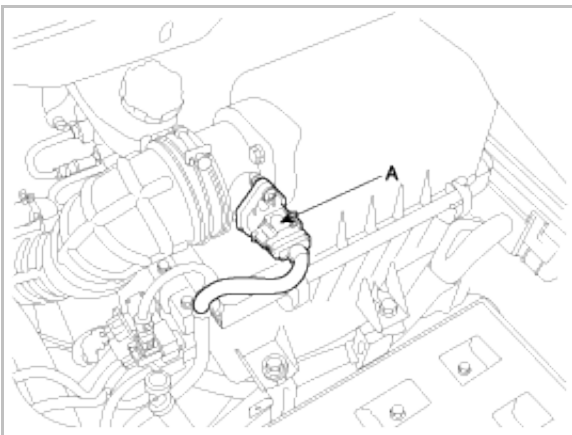
(2) Install the air cleaner assembly(A).



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

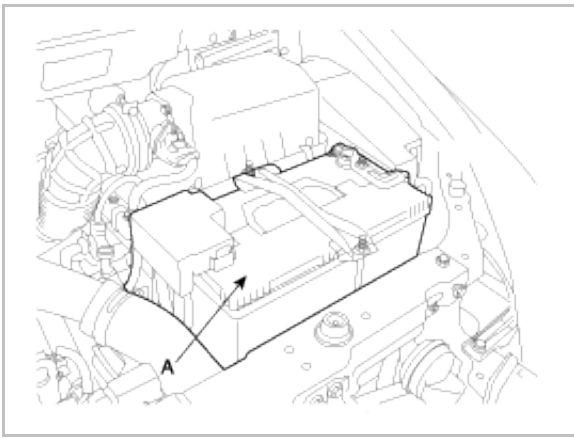


(4) Install the AFS(Air Flow Sensor) connector(A).



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.



Engine Mechanical System

Engine And Transaxle Assembly



REMOVAL

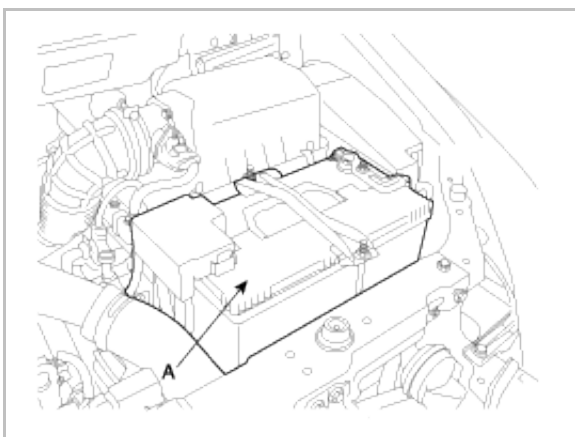
CAUTION

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

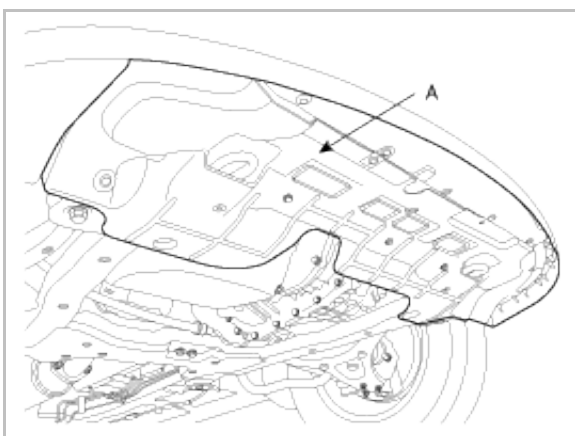
NOTICE

- Mark all wiring and hoses to avoid misconnection.

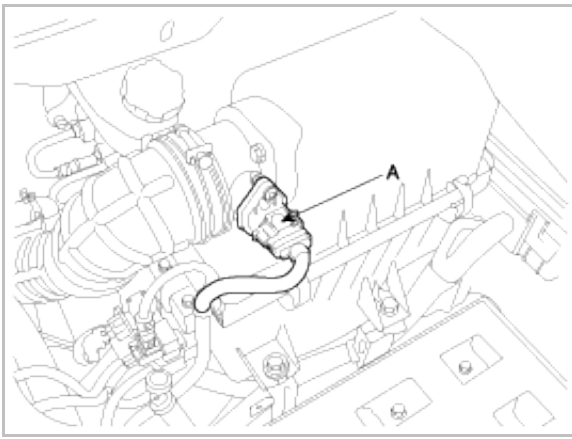
1. Remove the battery(A).



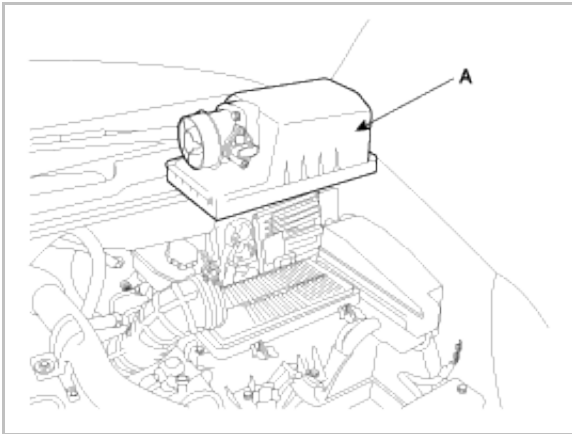
2. Remove the under cover(A).



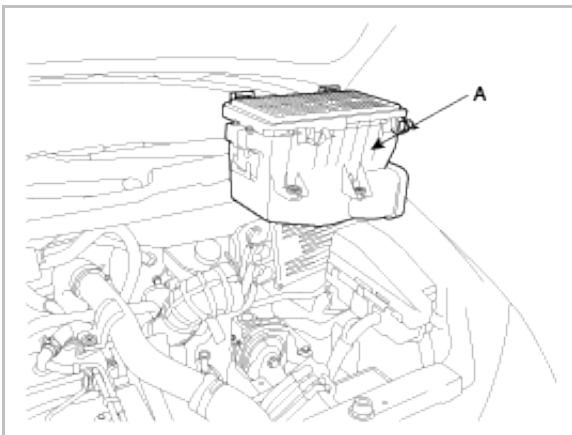
3. Drain the engine coolant.
Remove the radiator cap to speed draining.
4. Drain the engine oil.
Remove the oil filler cap to speed draining.
5. Remove the intake air hose and air cleaner assembly.
(1) Disconnect the AFS(Air Flow Sensor) connector(A).



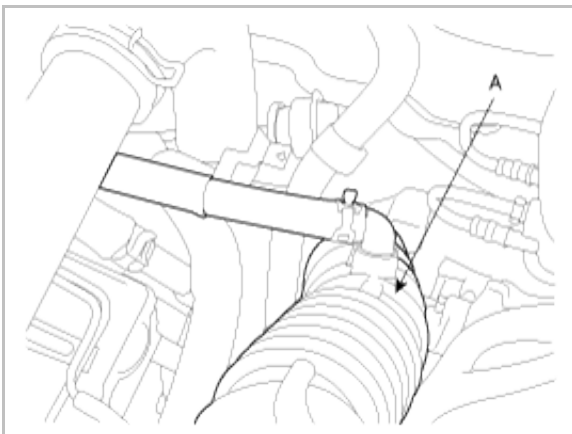
(2) Disconnect the air cleaner upper cover(A).



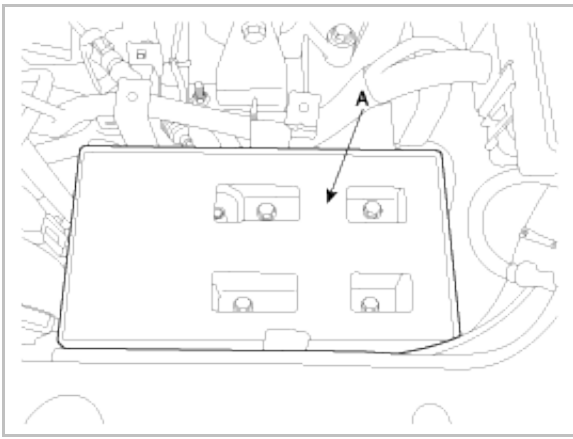
(3) Remove the air cleaner assembly(A).



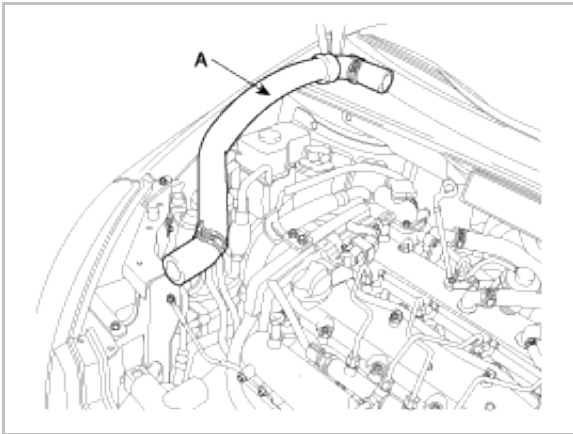
(4) Remove the air intake hose(A).



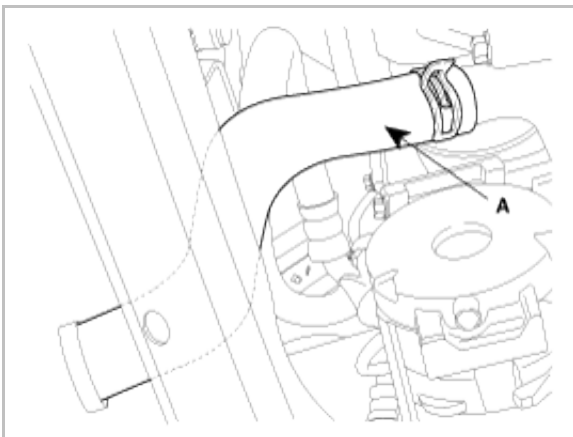
6. Remove the batter tray(A).



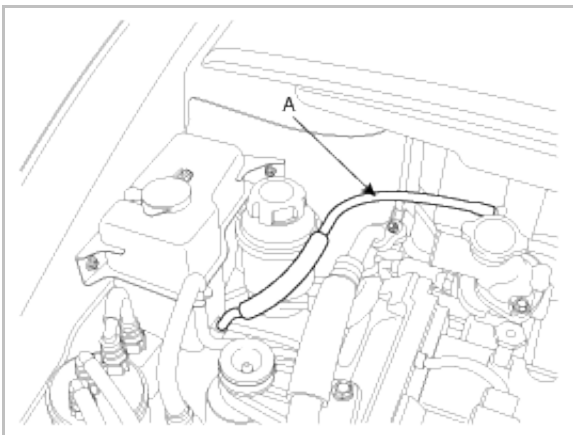
7. Remove the radiator upper hose(A).



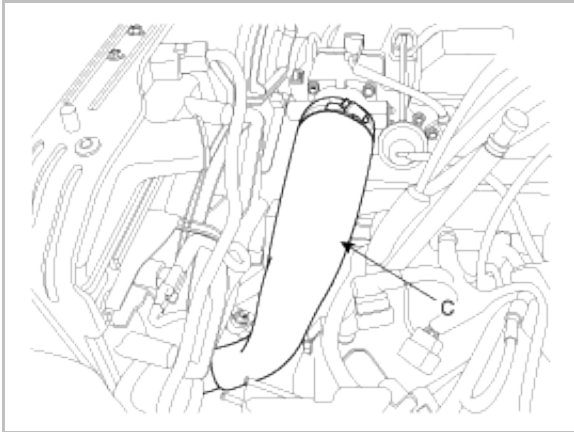
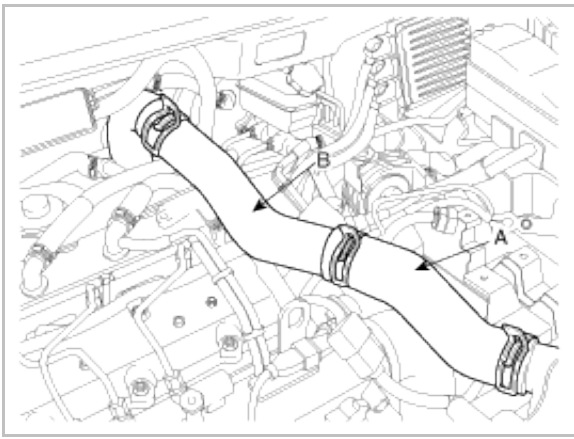
8. Remove the radiator lower hose(A).



9. Remove the reservoir tank hose(A).

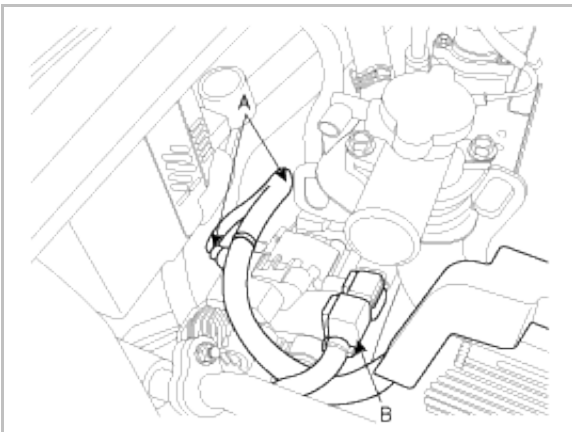


10. Remove the intercooler hose(A,C), pipe(B).

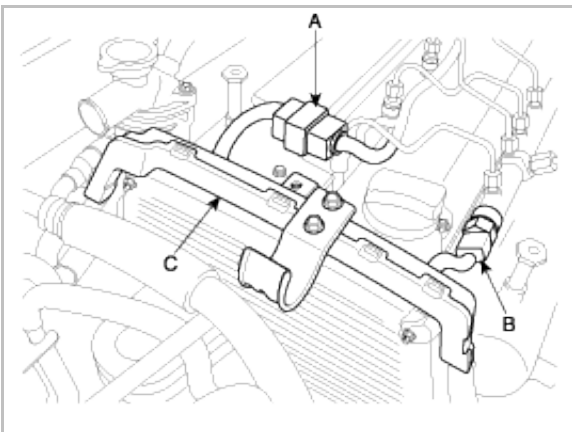


11. Remove the wire harness and the clamp from the cylinder head and the intake manifold.

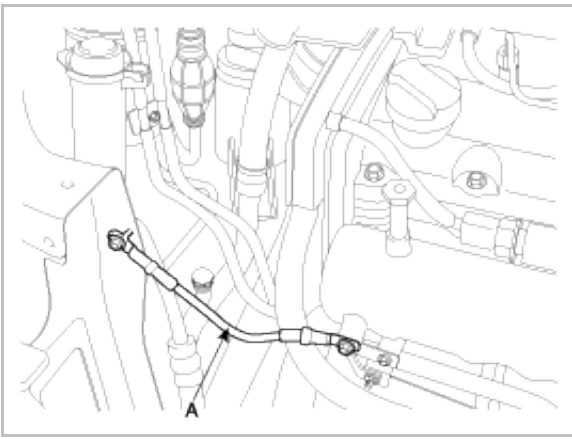
(1) Remove the generator connector(A) and the ETC(Engine Coolant Temperature) sensor connector(B).



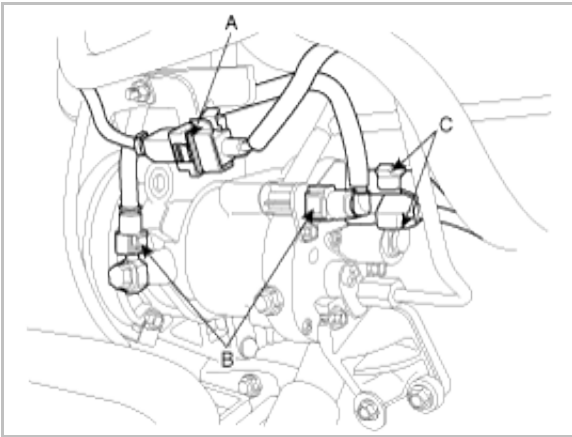
(2) Remove the injector connector(A), common rail pressure sensor connector(B), wire harness protector(C).



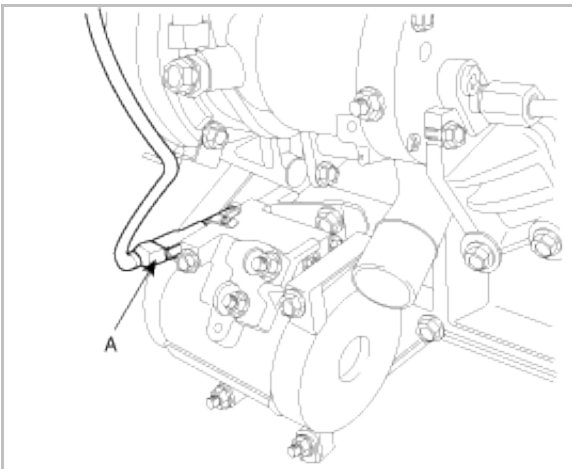
(3) Remove the ground cable(A) from cylinder head.



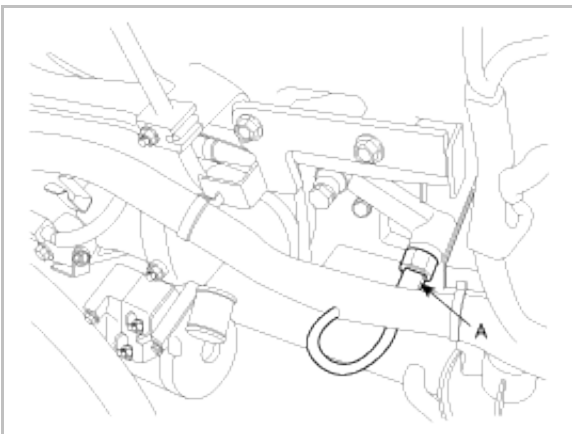
(4) Remove the knock sensor connector(A), high pressure pump fuel hose(B), high pressure pump connector(C).



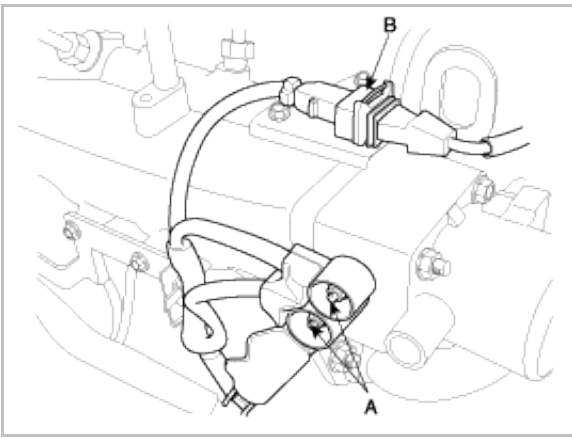
(5) Remove the air conditioner condenser(A).



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

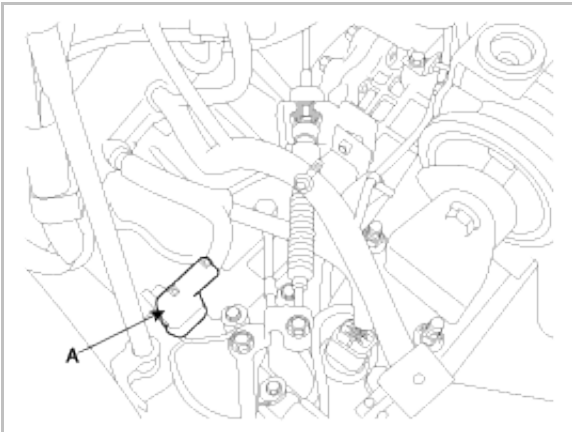


(7) Remove the air heater(A), CMP (Camshaft Position Sensor) connector(B).

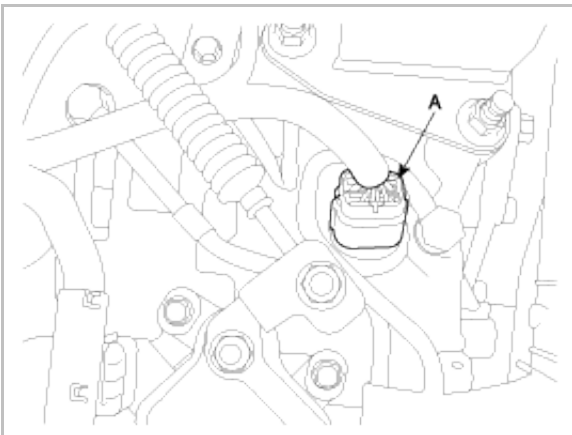


12. Remove the transaxle wire harness connectors and control cable.

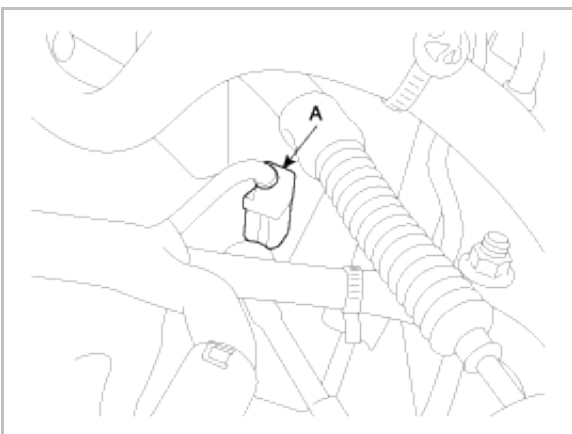
(1) Remove the inhibitor switch connector(A).



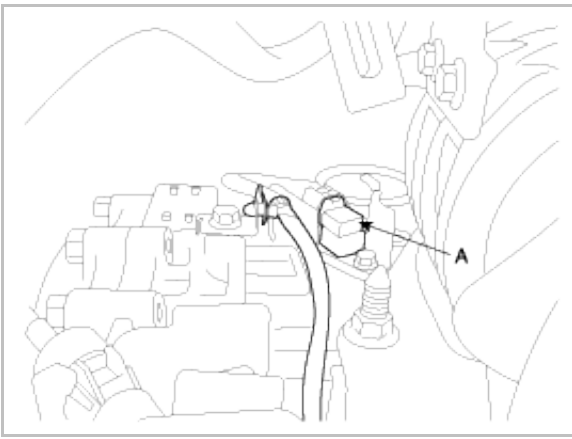
(2) Remove the solenoid valve connector(A).



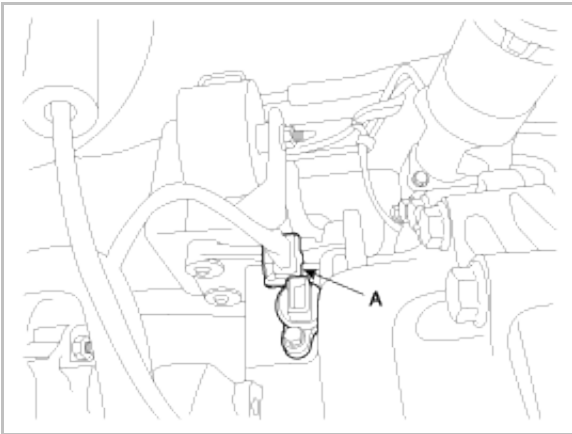
(3) Remove the input shaft speed sensor connector(A).



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



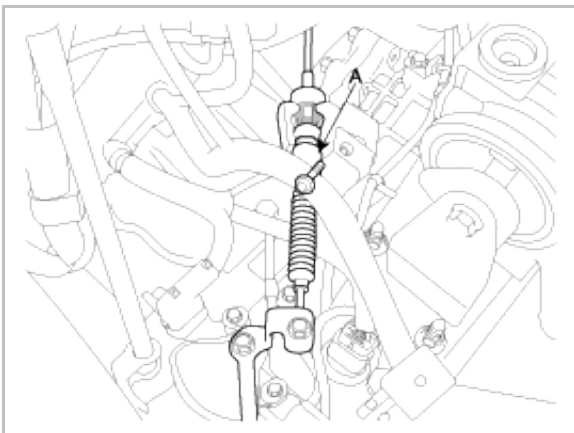
(5) Remove the vehicle speed sensor connector(A).



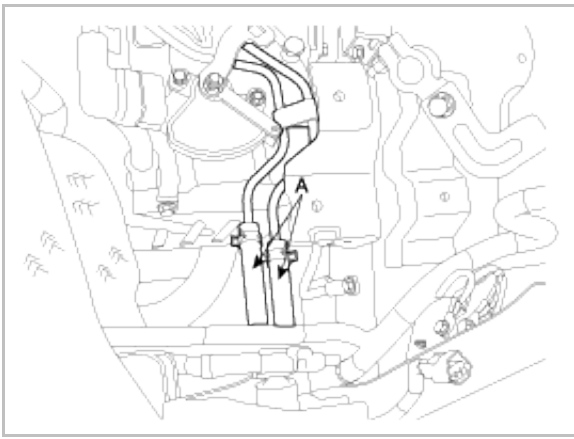
(6) Remove the CKP(Crankshaft position sensor) connector(A).



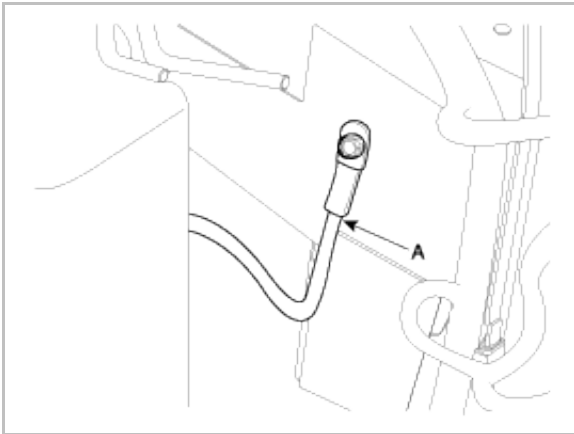
13. Remove the shift cable(A).



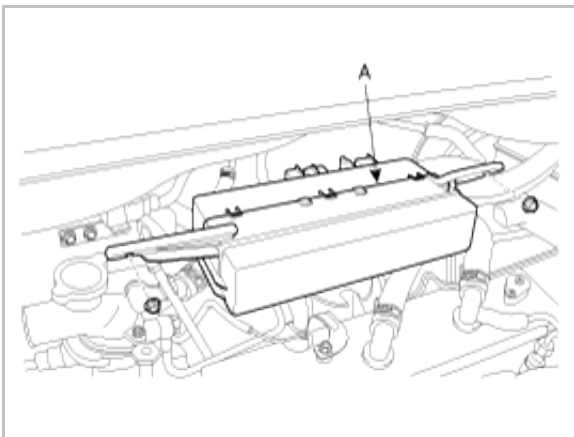
14. Remove the transaxle oil cooler hoses(A).



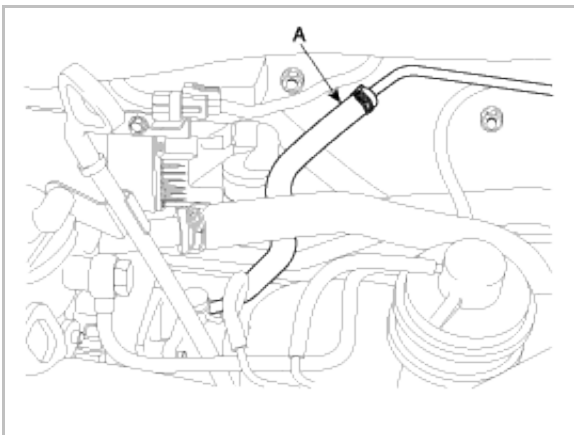
15. Remove the ground cable(A) from transaxle.



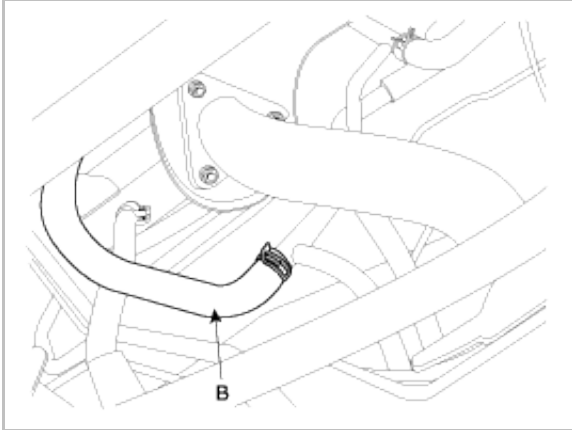
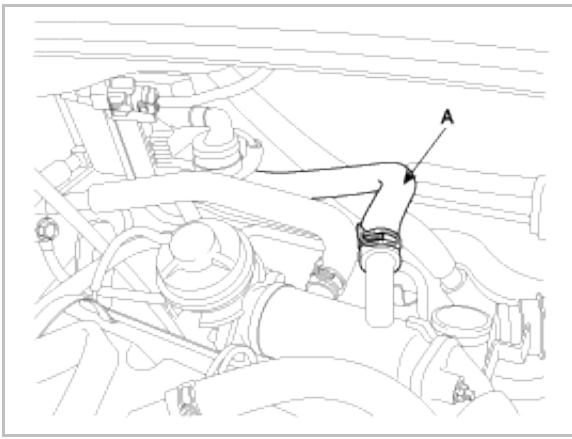
16. Remove the fuse box.(A).



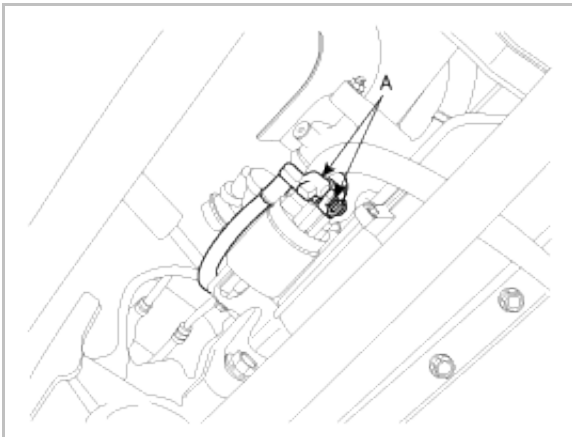
17. Remove the vacuum hose (A) from the generator.



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



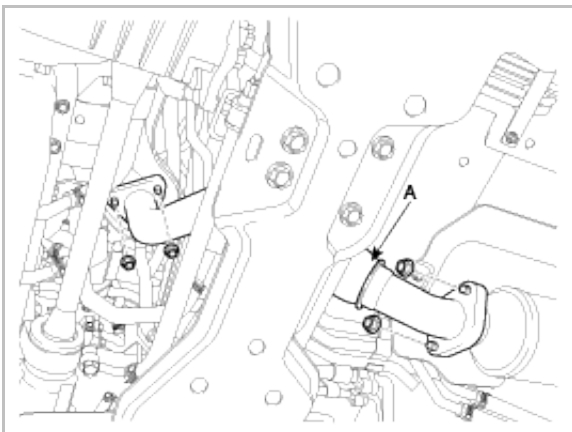
19. Remove the starter motor connector(A).



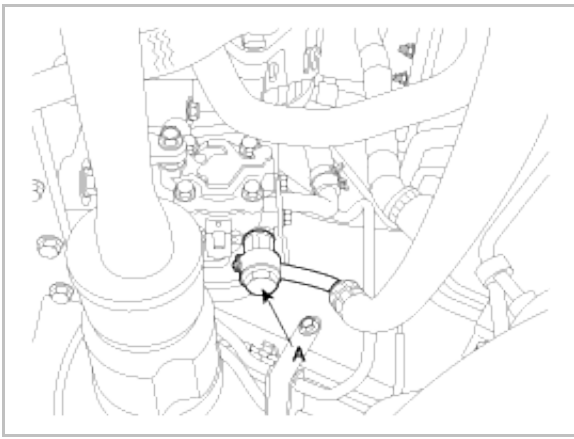
20. Remove the front exhaust manifold(A).

Tightening torque :

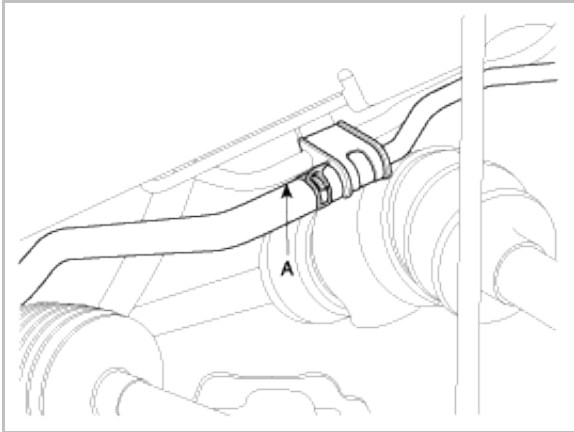
39.2~58.8Nm (4.0~6.0kgf.m, 28.9~43.4lb-ft)



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



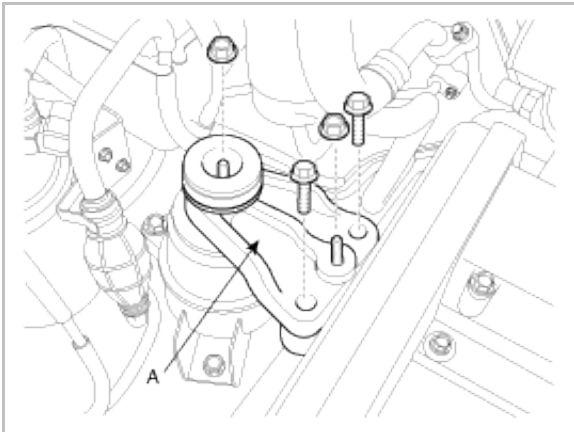
22. Remove the power steering return hose(A).



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

Tightening torque :

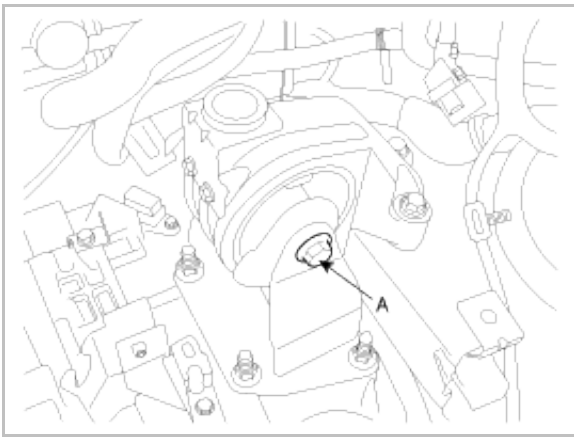
88.3~107.9N.m (9.0~11.0kgf.m, 65.1~79.6lb-ft)



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

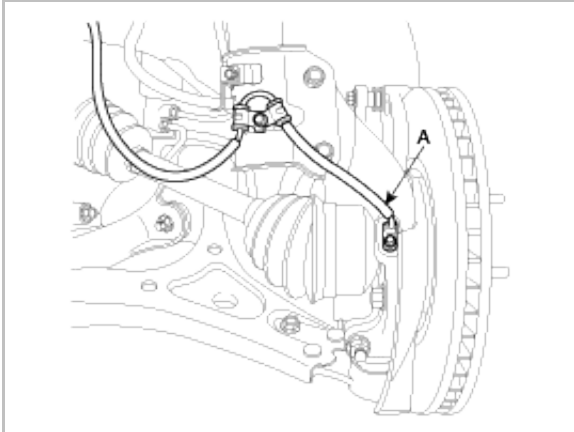
Tightening torque :

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



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

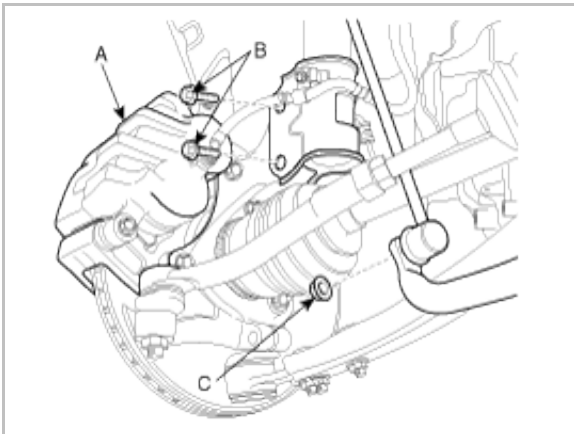
26. Remove the ABS wheel speed sensors(A).(Refer to BR group).



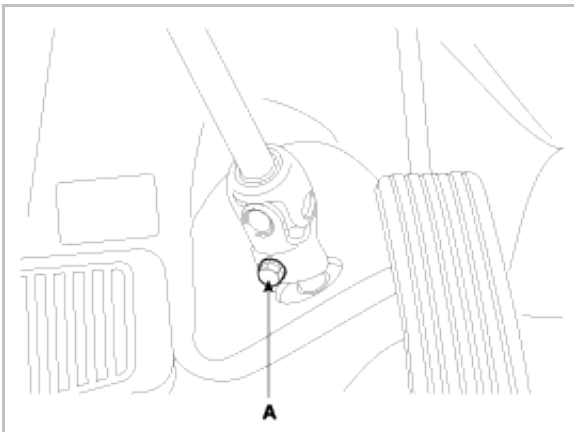
27. Remove the caliper and hang the caliper assembly(A).(Refer to BR group).

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

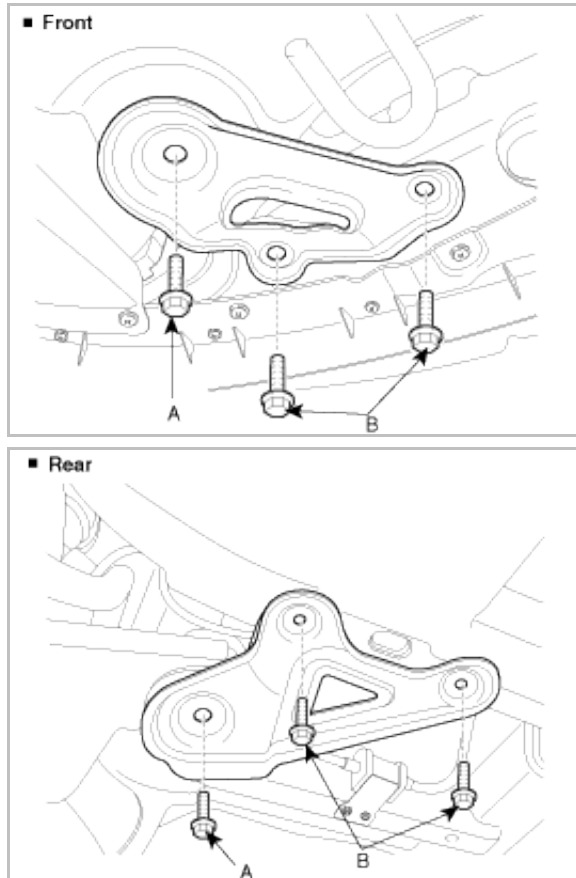
Support the assembly safely because the engine and transaxle assembly can be dropped down after removal of the sub frame.

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.

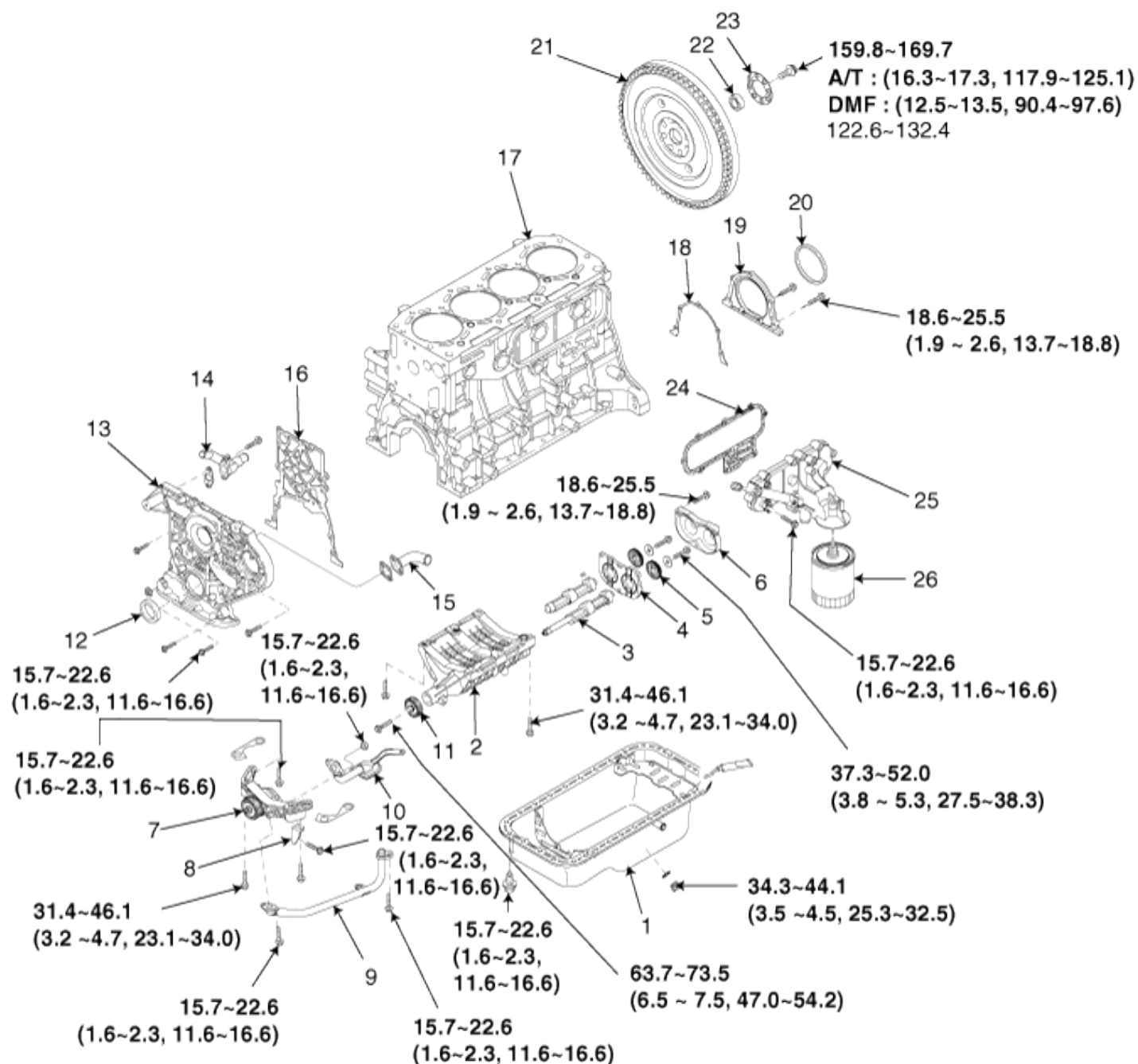
- Put the radiator cap on tightly, then run the engine again and check for leaks.
- Clean the battery posts and cable terminals with sandpaper assemble them, then apply grease to prevent corrosion.
- Inspect for fuel leakage.
 - After assemble the fuel line, turn on the ignition switch (do not operate the starter) so that the fuel pump runs for approximately two seconds and fuel line pressurizes.
 - Repeat this operation two or three times, then check for fuel leakage at any point in the fuel line.



Engine Mechanical System

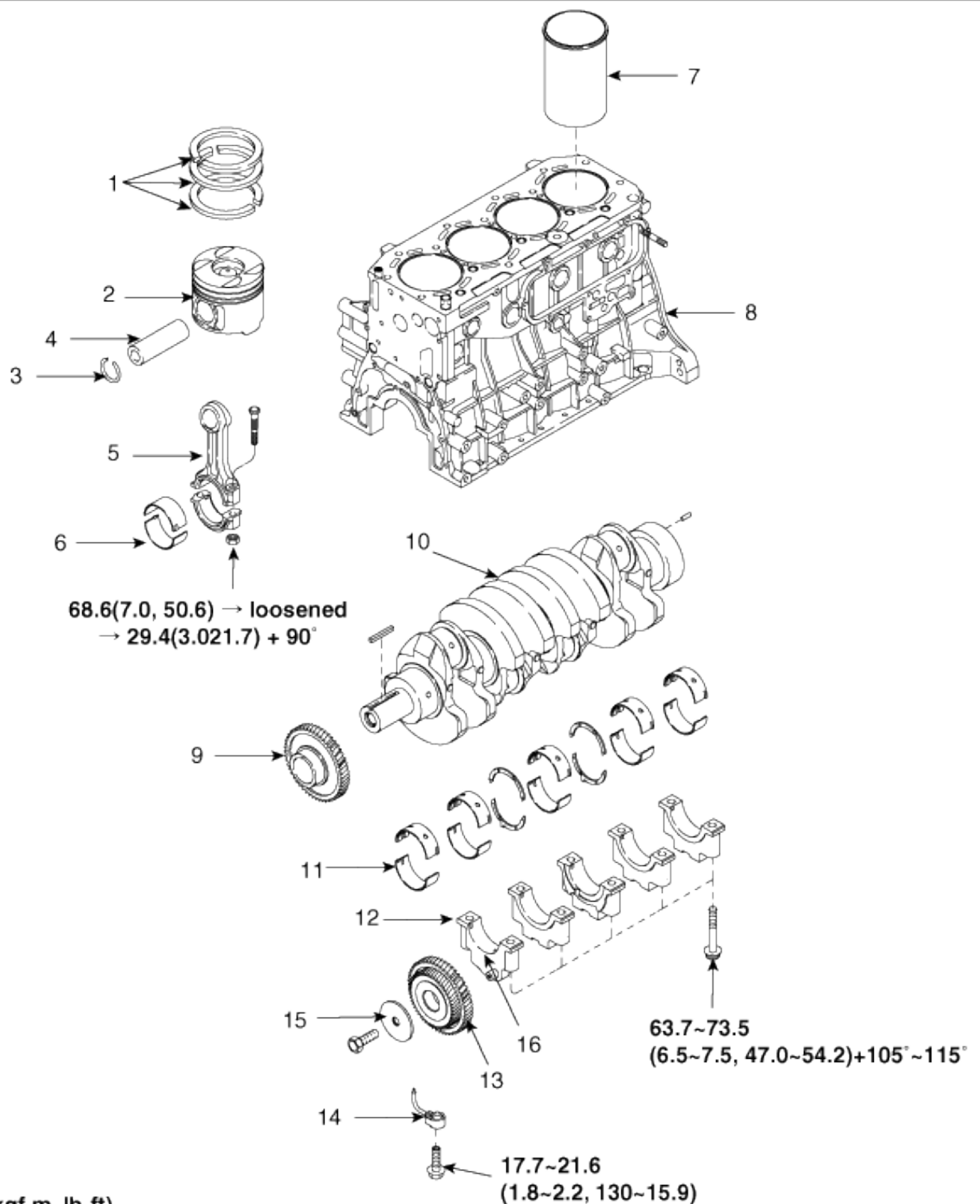
Cylinder Block

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 | |



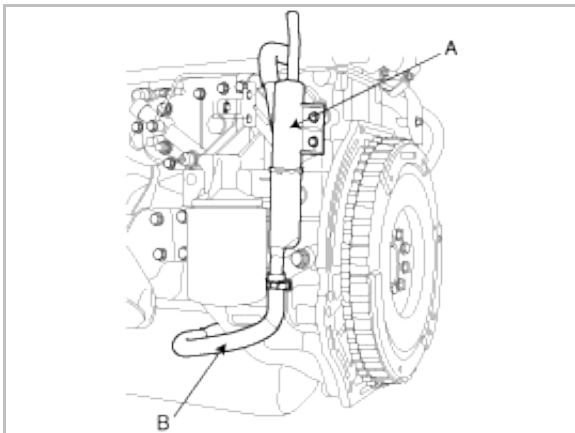
TORQUE : N.m(kgf.m, lb-ft)

1. Piston ring
2. Piston
3. Snap ring
4. Piston pin
5. Connecting rod
6. Connecting rod bearing
7. Cylinder liner
8. Cylinder block

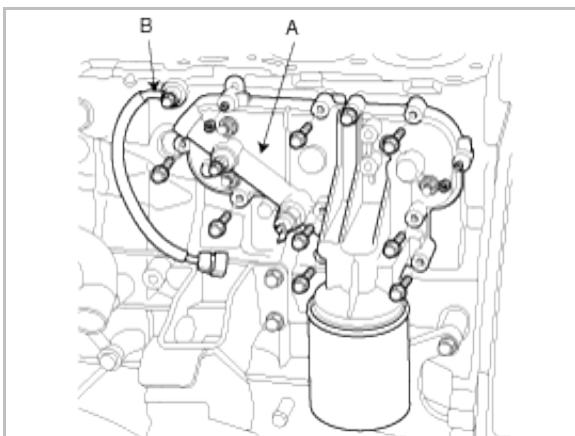
9. Crankshaft gear
10. Crankshaft
11. Crankshaft main bearing
12. Main bearing cap
13. Idle gear
14. Oil jet
15. Idle gear washer
16. Idle gear spindle

DISASSEMBLY

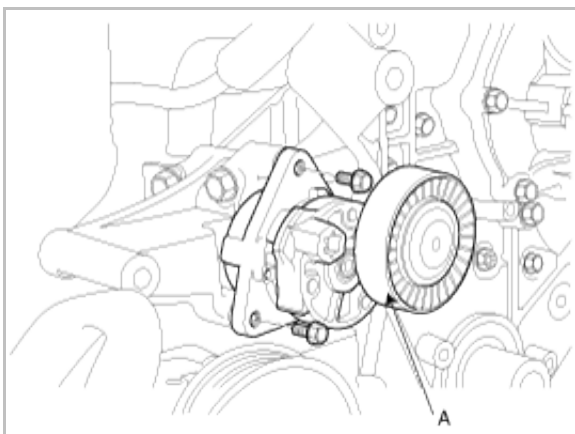
1. Install the engine to engine stand for disassembly.
2. Remove the timing belt.
3. Remove the cylinder head.
4. Remove the water pump.
5. Remove the air separator(A), hose(B).



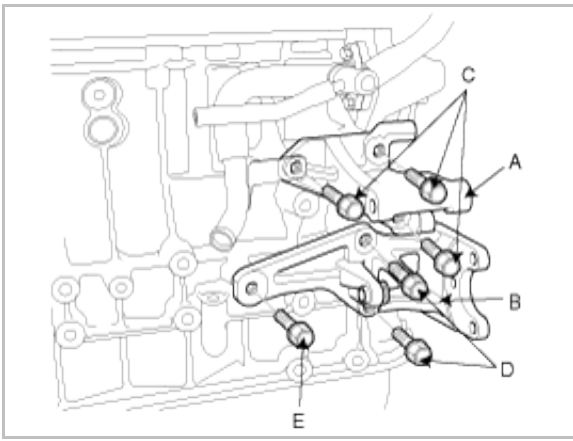
6. Remove the oil cooler assembly(A), knock sensor(B).



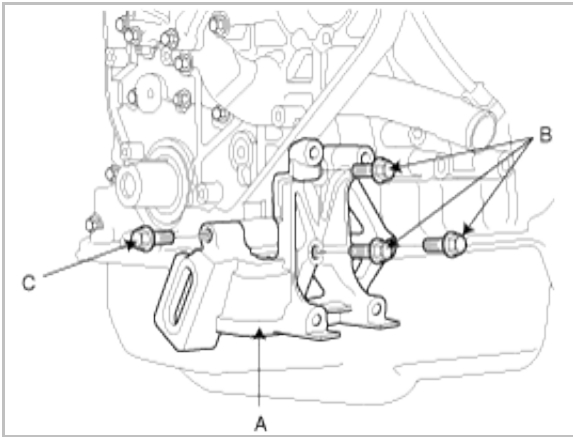
7. Remove the drive belt auto-tensioner (A).



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



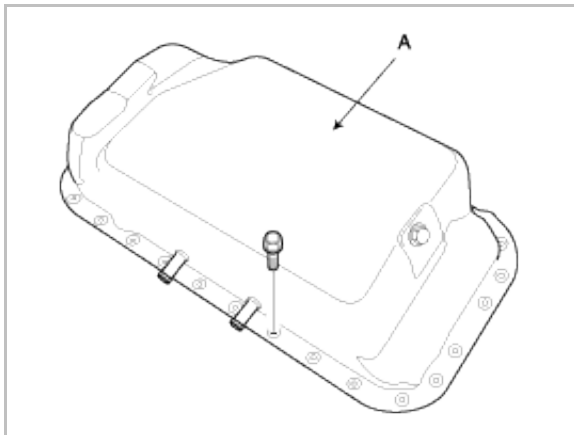
9. Remove the A/C compressor bracket(A).



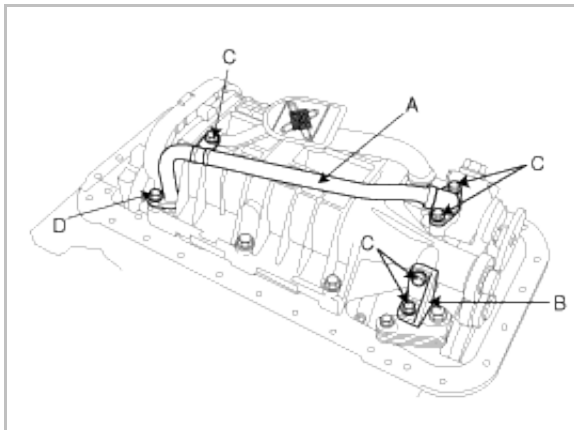
10. M/T : remove flywheel.

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

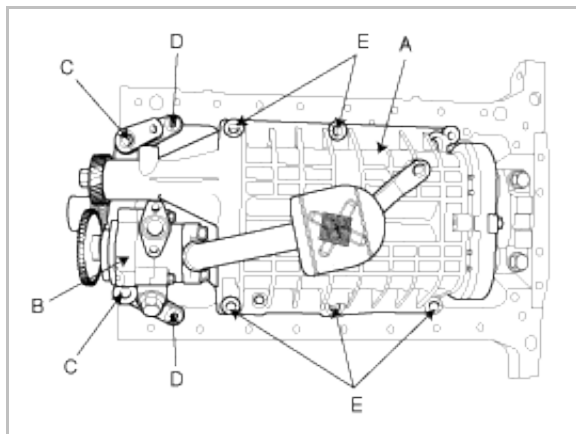
12. Using the SST(09215 - 3C000) remove the oil pan(A).



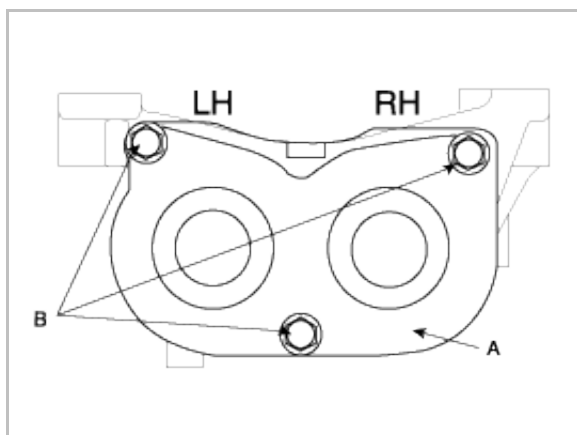
13. Remove the oil pump feed pipe(A) and the ladder frame bracket(B).



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



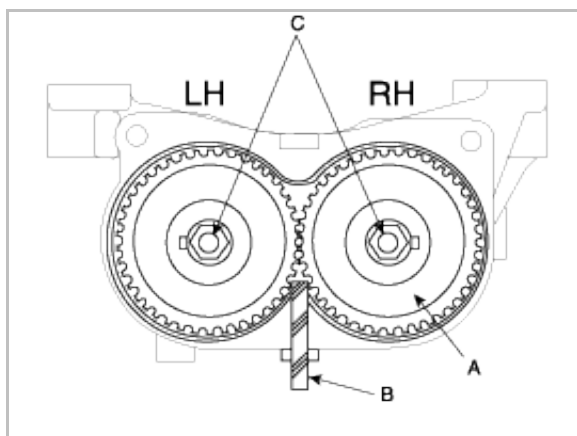
15. Remove the balancer shaft(A) to the ladder frame.
 (1) Remove the gear cover(A) to the ladder frame.



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

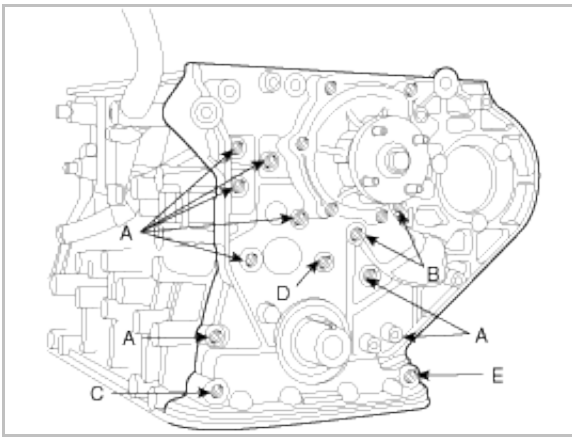
NOTICE

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).



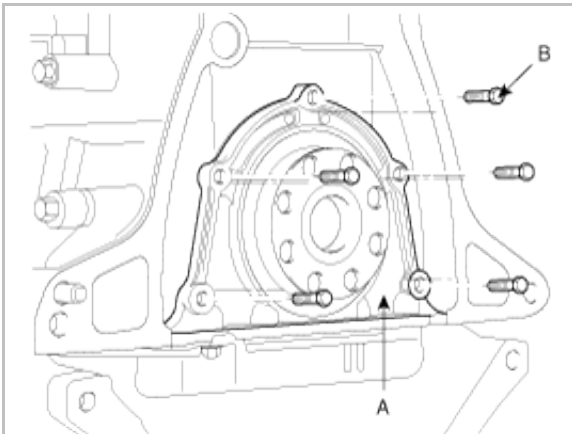
17. Check the connecting rod end play.
18. Remove the connecting rod caps and check oil clearance.
19. Remove the piston and connecting rod assemblies.
 - (1) Using a ridge reamer, remove all the carbon from the top of the cylinder.
 - (2) Push the piston, connecting rod assembly and upper bearing through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

NOTICE

- Keep the bearings, connecting rod and cap together.
- 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.

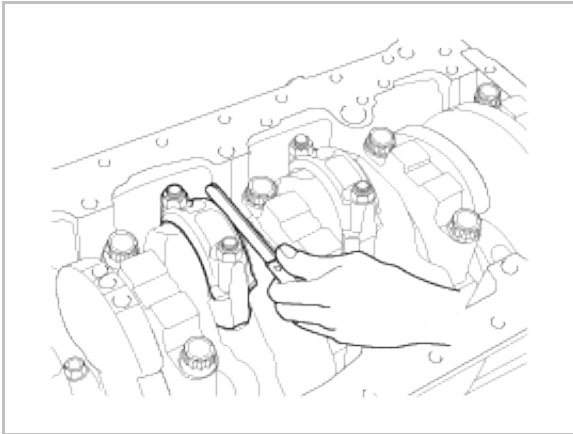
INSPECTION

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.

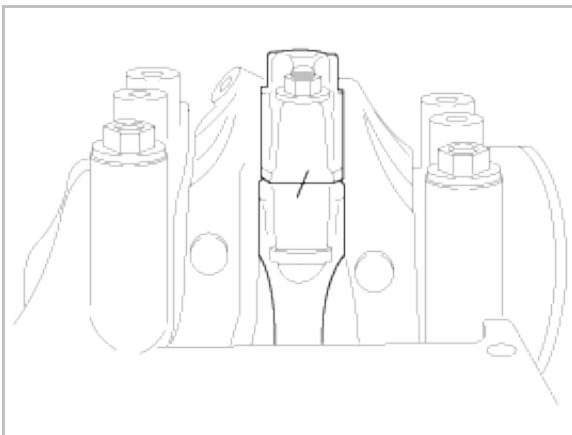
End play

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

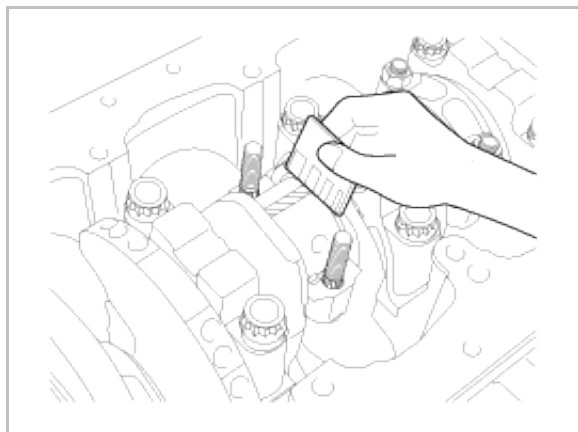
Do not turn the crankshaft.

- (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.

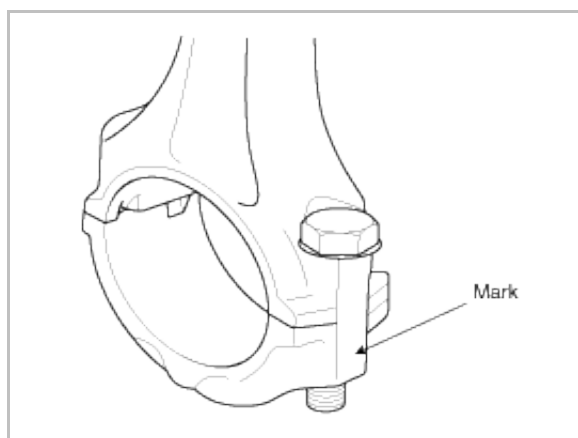
NOTICE

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

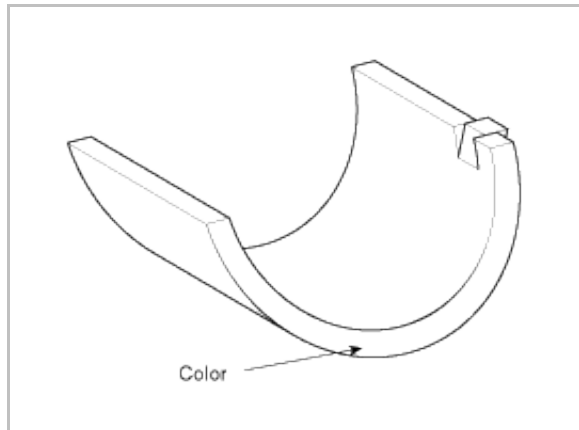


Discrimination of connecting rod

Mark	Connecting rod big-end inner 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.

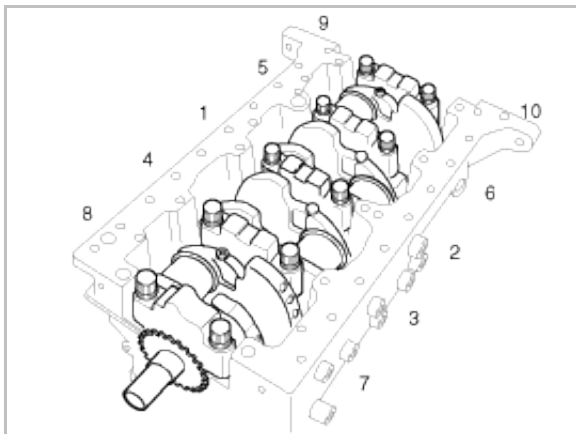
- (2) Clean each main journal and lower bearing with a clean shop towel.
- (3) Place one strip of plastigage across each main journal.
- (4) Reinstall the lower bearings and caps, then tighten the bolts.

Tightening torque :

63.7~73.5Nm(6.5~7.5kgf.m, 47.0~54.2lb-ft)+105°~115°

NOTICE

Do not turn the crankshaft.

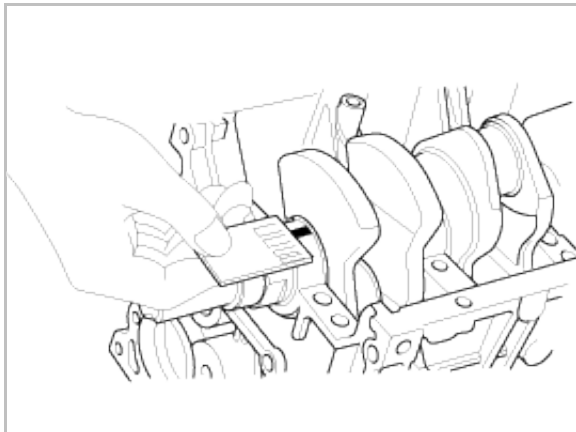


- (5) Remove the cap and lower bearing again, and measure the widest part of the plastigage.

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

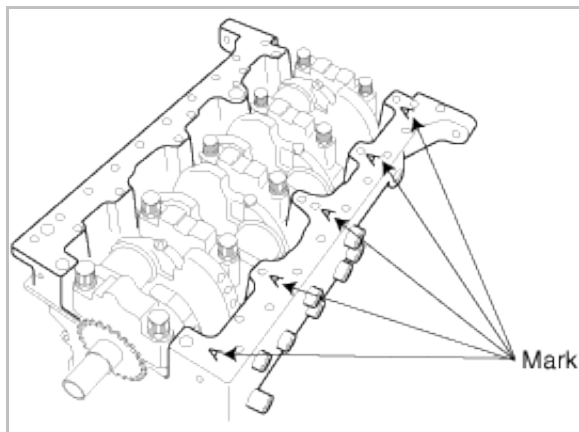
If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start over.

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

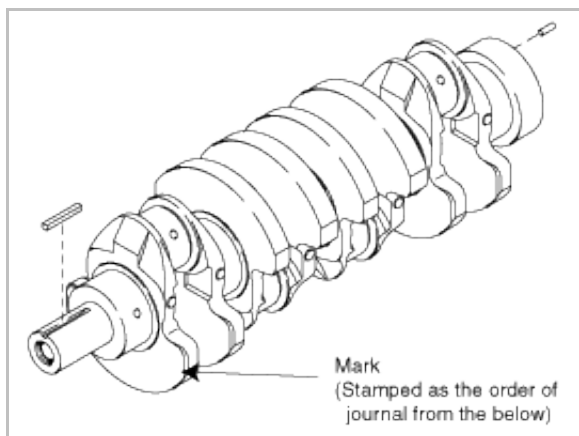
Letters have been stamped on the end of the block as a mark for the size of each of the 5 main journal bores. Use them, and the numbers or letters stamped on the crank (marks for main journal size), to choose the correct bearings.



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)

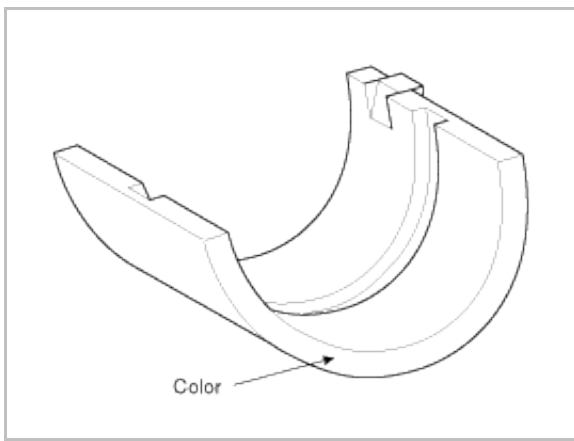
Crankshaft main journal mark location



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

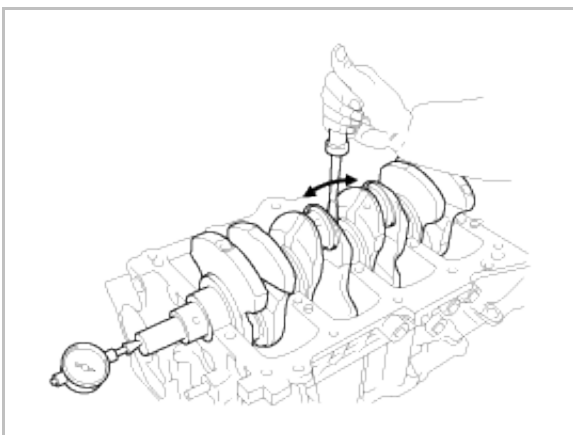
		Cylinder block crankshaft journal bore mark		
		A	None	C
Crank shaft main journal mark	A	(Green)	(Brown)	(Black)
	*	(Yellow)	(Green)	(Brown)
	C	(Yellow)	(Yellow)	(Green)

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.

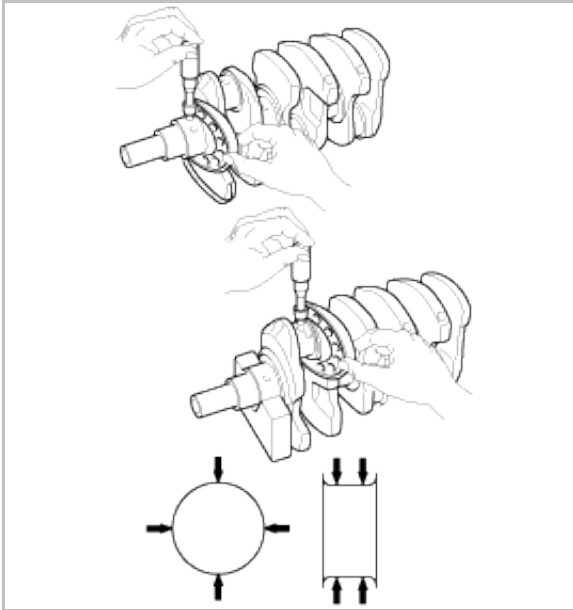
Main journal outer diameter :

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)



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

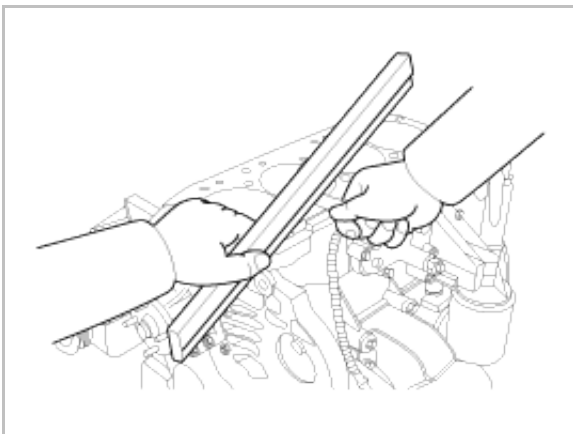
Using a soft brush and solvent, thoroughly clean the cylinder block.

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.

Flatness of cylinder block gasket surface Standard:

Less than 0.05mm (0.0020in)



4. Inspect the cylinder bore.

Visually check the cylinder for vertical scratches.

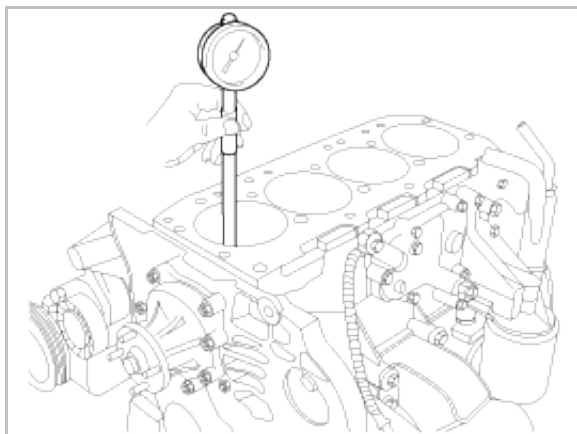
If deep scratches are present, replace the cylinder block.

5. Inspect the cylinder bore diameter.

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

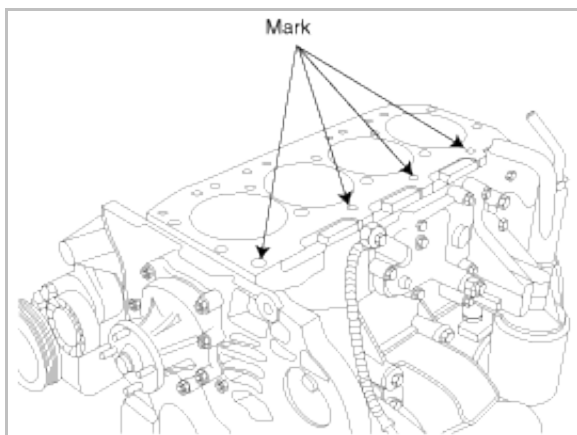
Standard diameter :

97.100~97.126mm (3.8228~3.8239in)



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

Cylinder bore inner diameter mark location



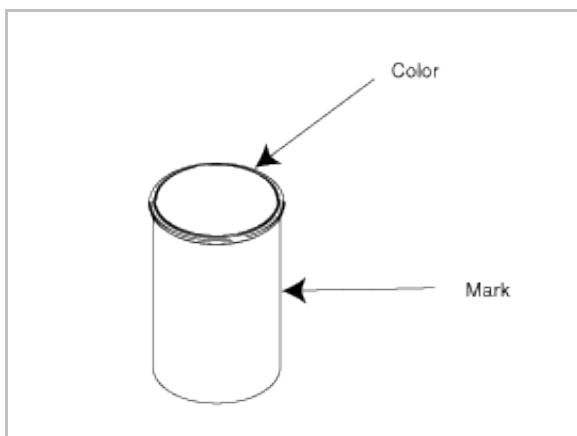
Discrimination of cylinder bore inner diameter

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.

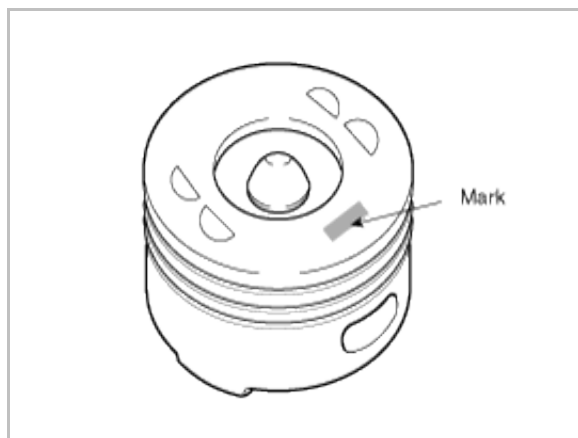


Discrimination of cylinder liner

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.

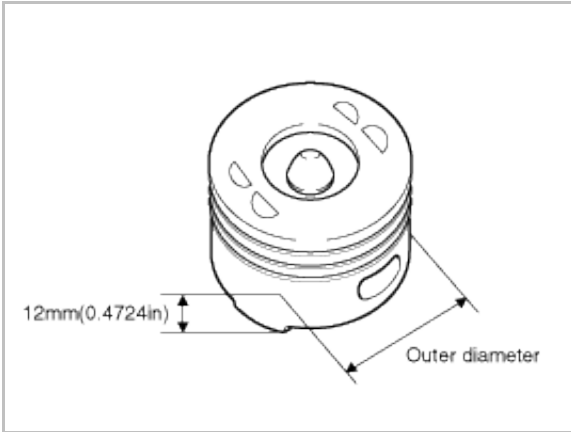
NOTICE

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)

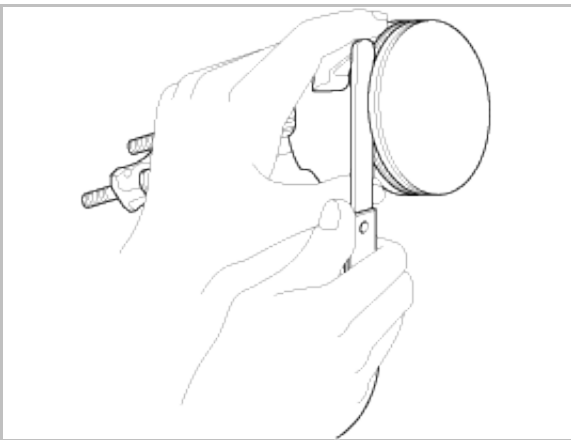
4. Inspect the piston ring side clearance.

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.

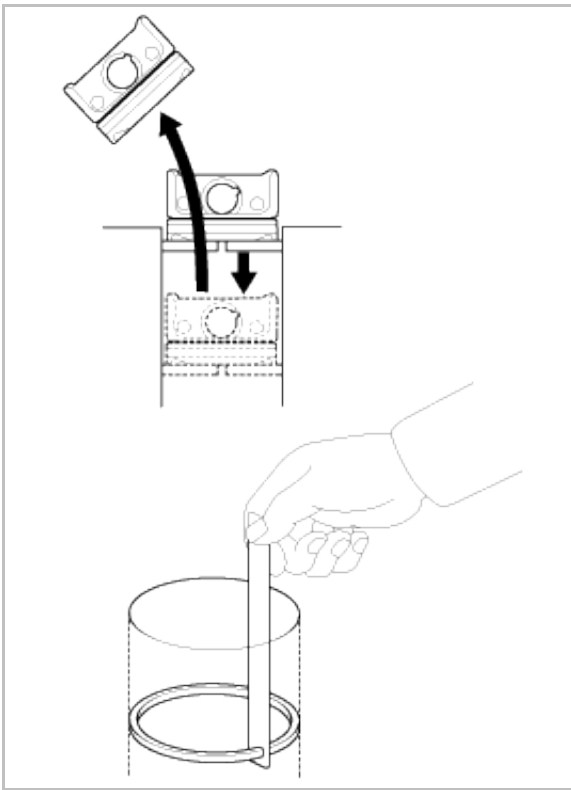
Piston ring end gap

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)

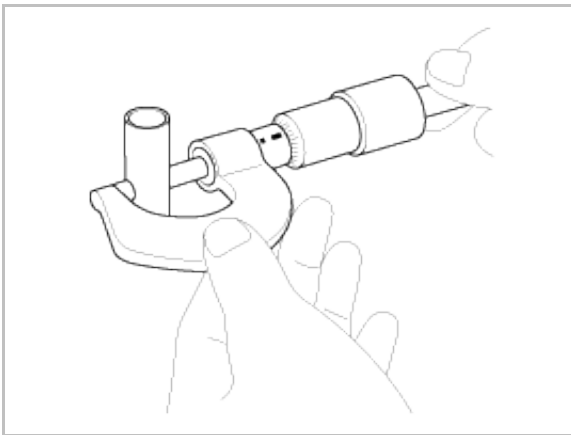


PISTON PINS

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)

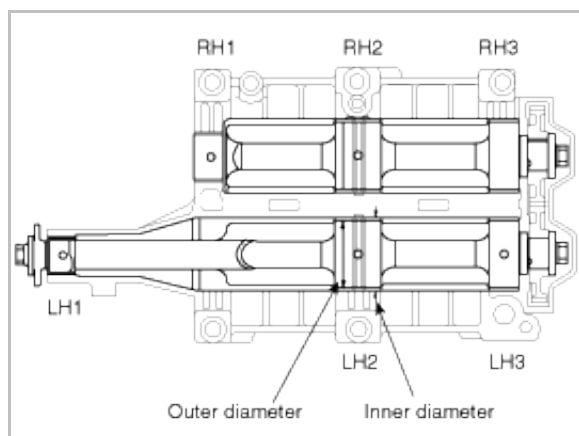
0.012~0.039 mm(0.0005~0.0015 in)

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.

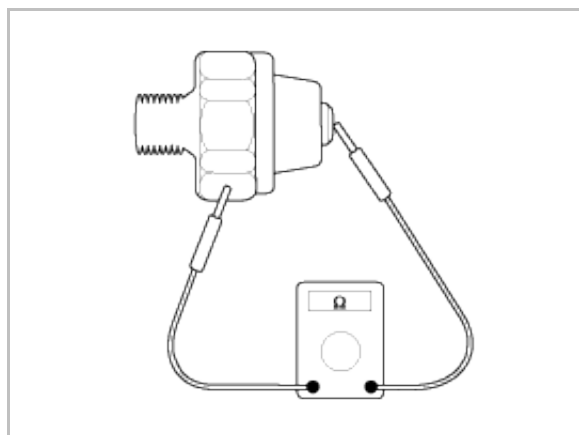
Balance shaft outer diameter	
LH1	24.939 ~ 24.960 mm(0.9818~0.9827in)
LH2	53.910 ~ 53.940 mm(2.1224~2.1236in)
LH3	55.910 ~ 55.940 mm(2.2012~2.2024in)
RH1	34.925 ~ 34.950 mm(1.3750~1.3760in)
RH2	53.910 ~ 53.940 mm(2.1224~2.1236in)
RH3	55.910 ~ 55.940 mm(2.2012~2.2024in)

3. Measure the end play of the balance shaft.

0.10~0.25mm (0.0036~0.0098in)

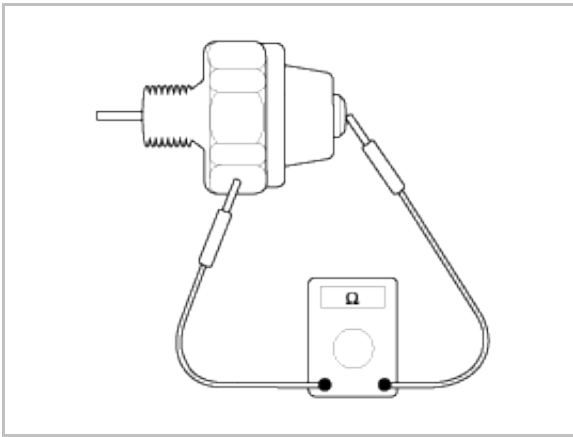
OIL PRESSURE SWITCH

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/cm², 7.1psi) 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

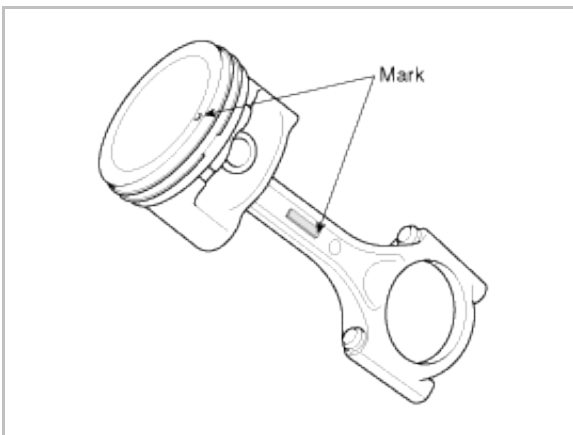
NOTICE

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

1. Assemble 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.

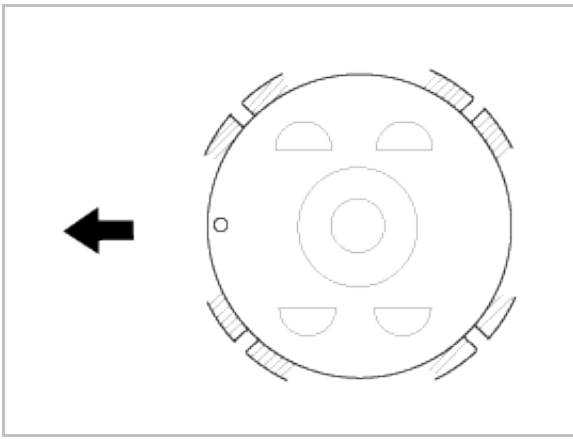


2. Install the piston rings.

(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.

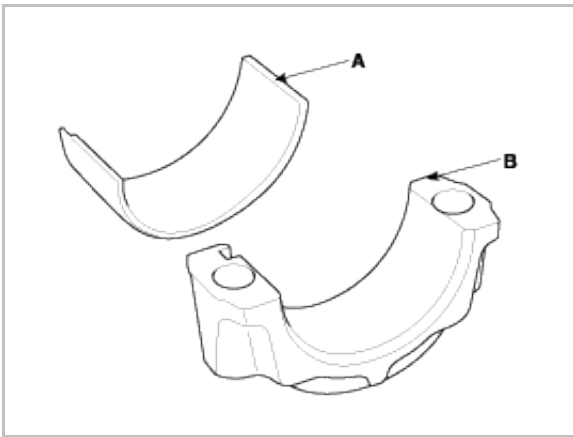
(3) Position the piston rings so that the ring ends are as shown.



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).

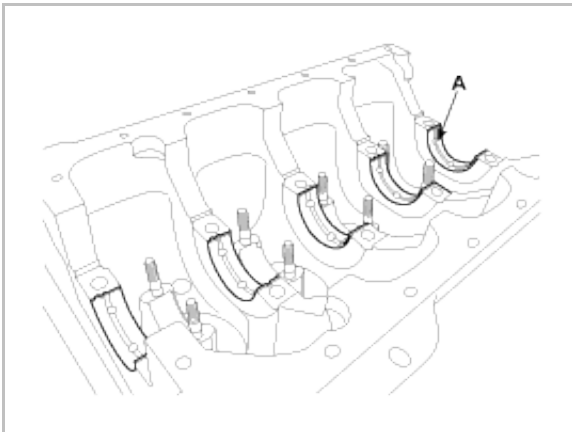


4. Install the crankshaft main bearings.

NOTICE

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

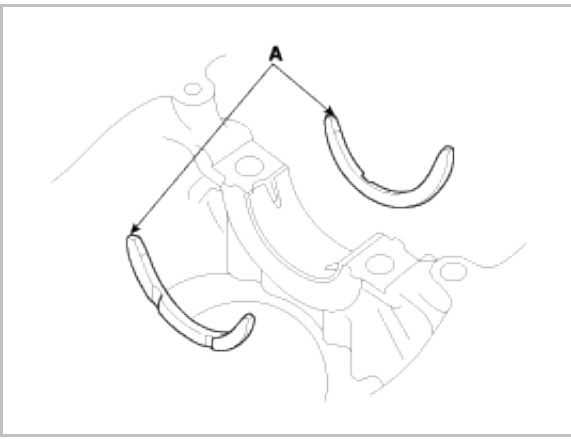
(1) Aligning the bearing protrusions with the grooves of the cylinder block, push in the 5 upper bearings (A).



(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.

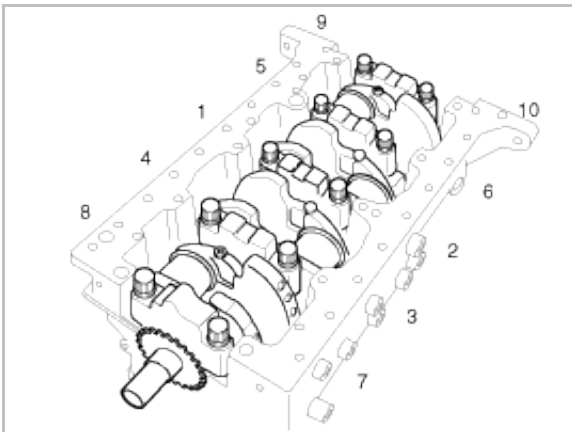
NOTICE

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

- (1) Apply a light coat of engine oil on the threads 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 :

63.7~73.5Nm(6.5~7.5kgf.m, 47.0~54.2lb-ft)+105°~115°



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

NOTICE

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

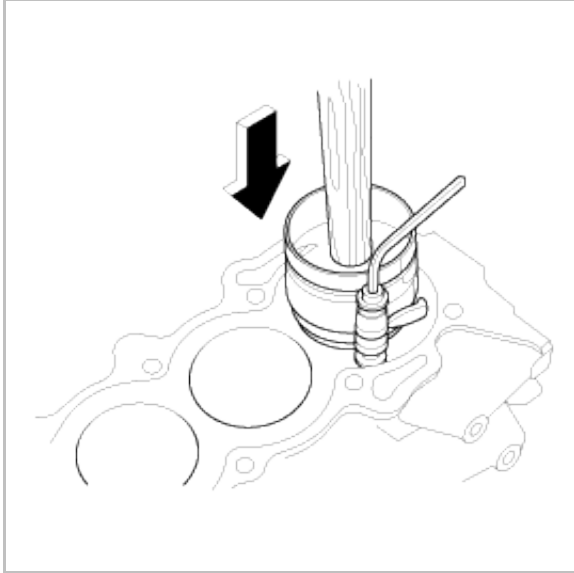
and tighten the nuts.

Tightening torque :

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

NOTICE

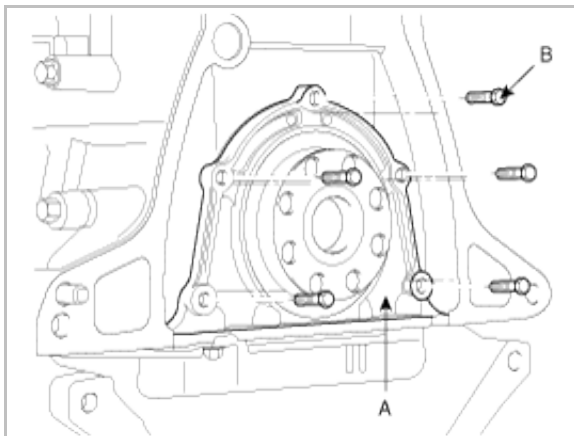
Maintain downward force on the ring compressor to prevent the rings from expanding before entering the cylinder bore.



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.

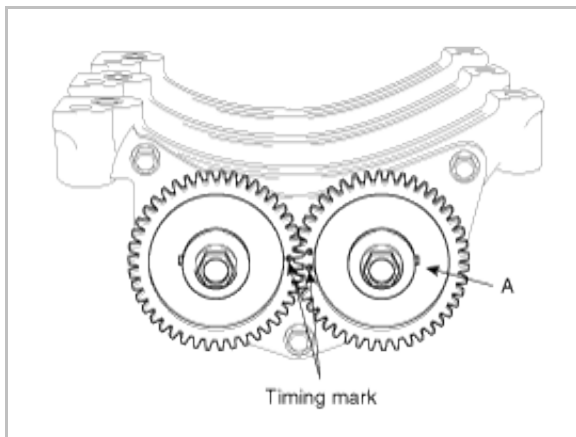
(1) Apply engine oil to a new oil seal lip.

(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)-

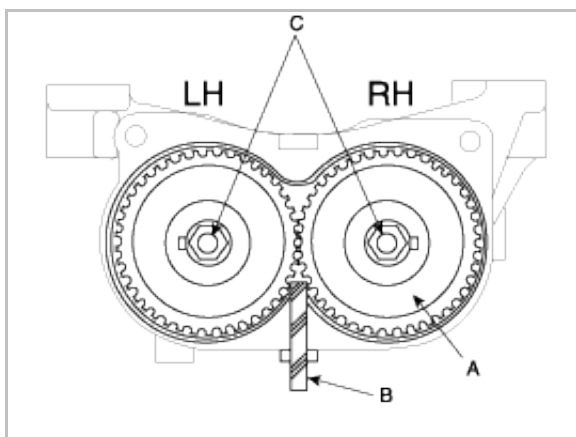
37.3 ~ 52.0Nm (3.8 ~ 5.3kgf.m, 27.5 ~ 38.3lb-ft)

Front balance gear bolt-

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

NOTICE

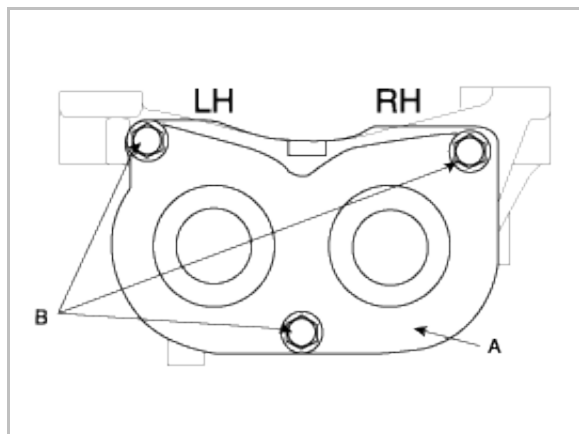
Not to make the balance shaft be rotated, insert the 5mm-thickness urethane rubber (B) in the balance gear (A) for protection.



(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)

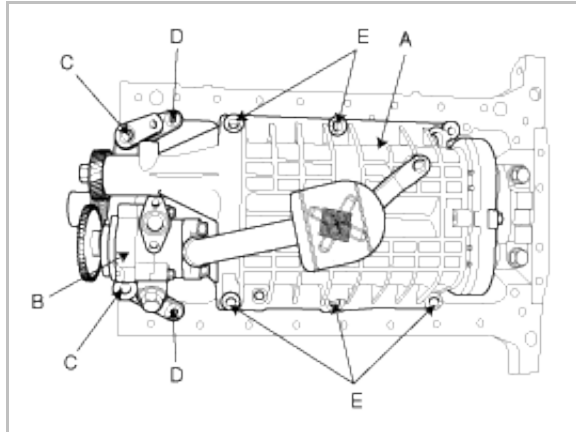
15. Install the ladder frame(A) and pump assembly(B) and tighten the bolts(C,D,E).
-

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)

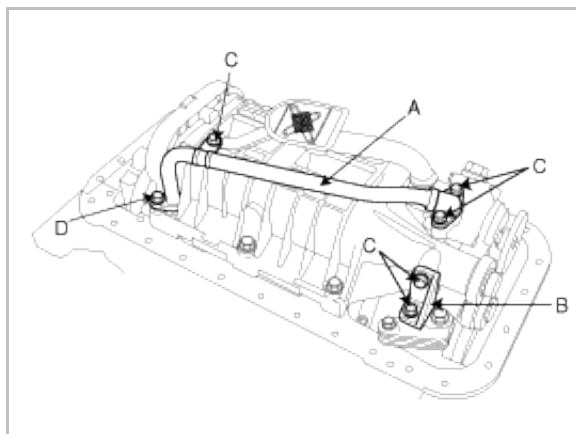
**NOTICE**

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)



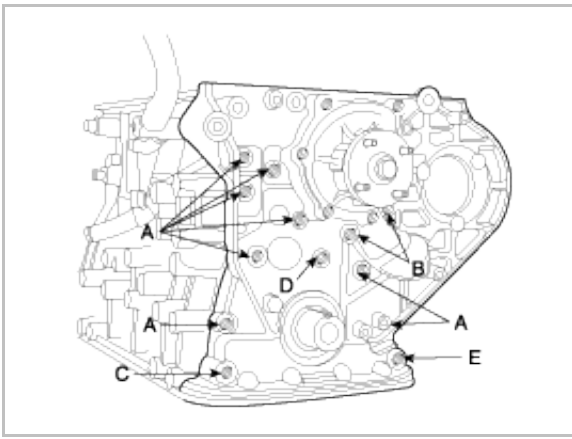
17. Install the timing belt case.
-

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.

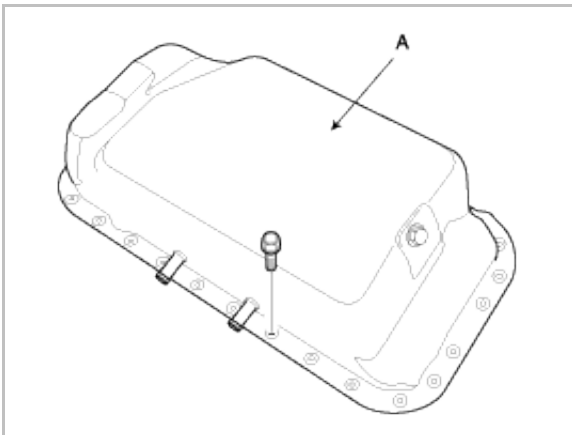
NOTICE

- 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).

Tighting torque :

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

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

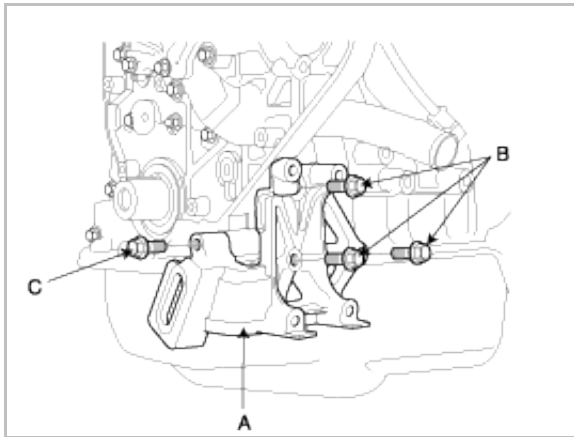
Tightening torque :

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):

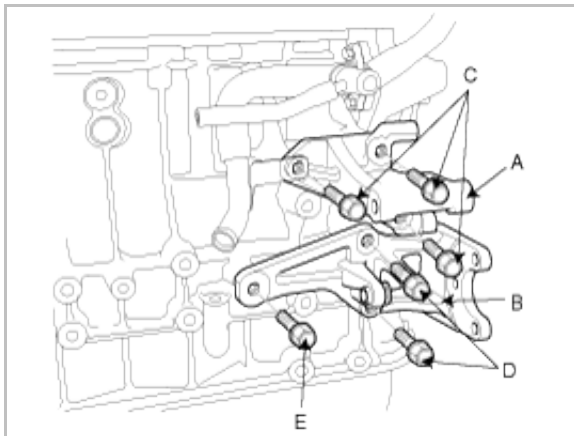
38.2 ~ 58.8Nm (3.9 ~ 6.0kgf.m, 28.2 ~ 43.4lb-ft)

BOLT (D):

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

BOLT (E):

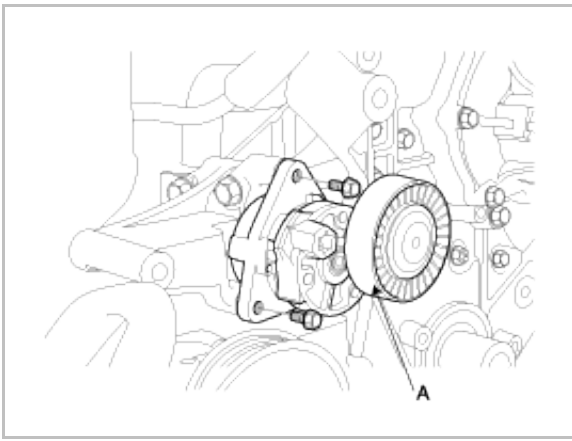
68.6 ~ 93.2Nm (7.0 ~ 9.5kgf.m, 50.6 ~ 68.7lb-ft)



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).

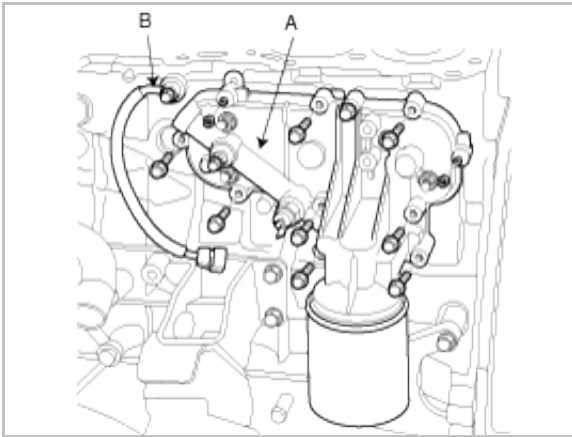
Tightening torque :

Oil cooler bolts:

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

Knock sensor bolts:

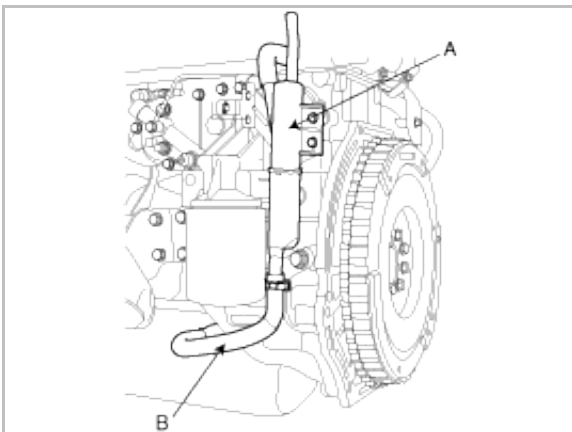
14.7 ~ 24.5Nm (1.5 ~ 2.5kgf.m, 10.8 ~ 18.1lb-ft)



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.



Engine Mechanical System

Cooling System

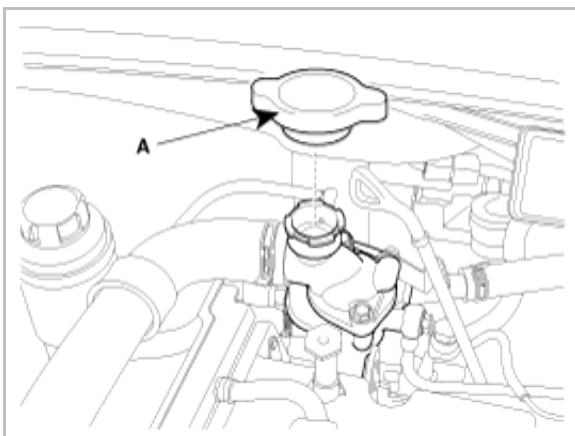


ENGINE COOLANT REFILLING AND BLEEDING

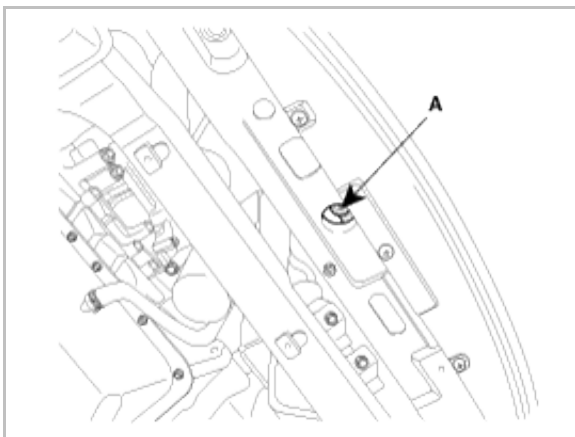
CAUTION

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

- Use only genuine antifreeze/coolant.
- 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.
- Coolant concentrations greater than 60% will impair cooling efficiency and are not recommended.

CAUTION

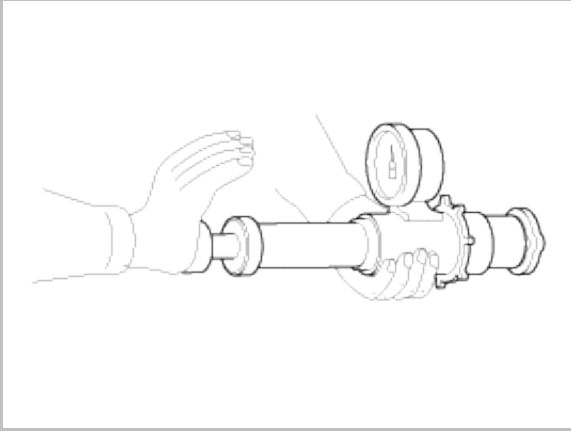
- Do not mix different brands of antifreeze/coolants.
- Do not use additional rust inhibitors or antirust products; they may not be compatible with the coolant.

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

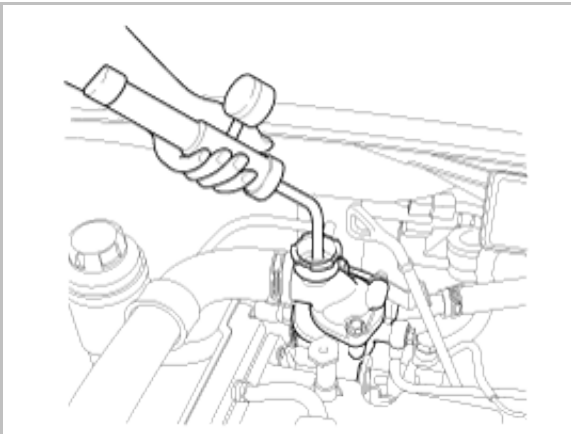
1. Remove the radiator cap, wet its seal with engine coolant, then install it no pressure tester.



2. Apply a pressure of 93.16 ~ 122.58kpa (0.95 ~ 1.25kg/cm², 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/cm², 13.51 ~ 17.78psi).

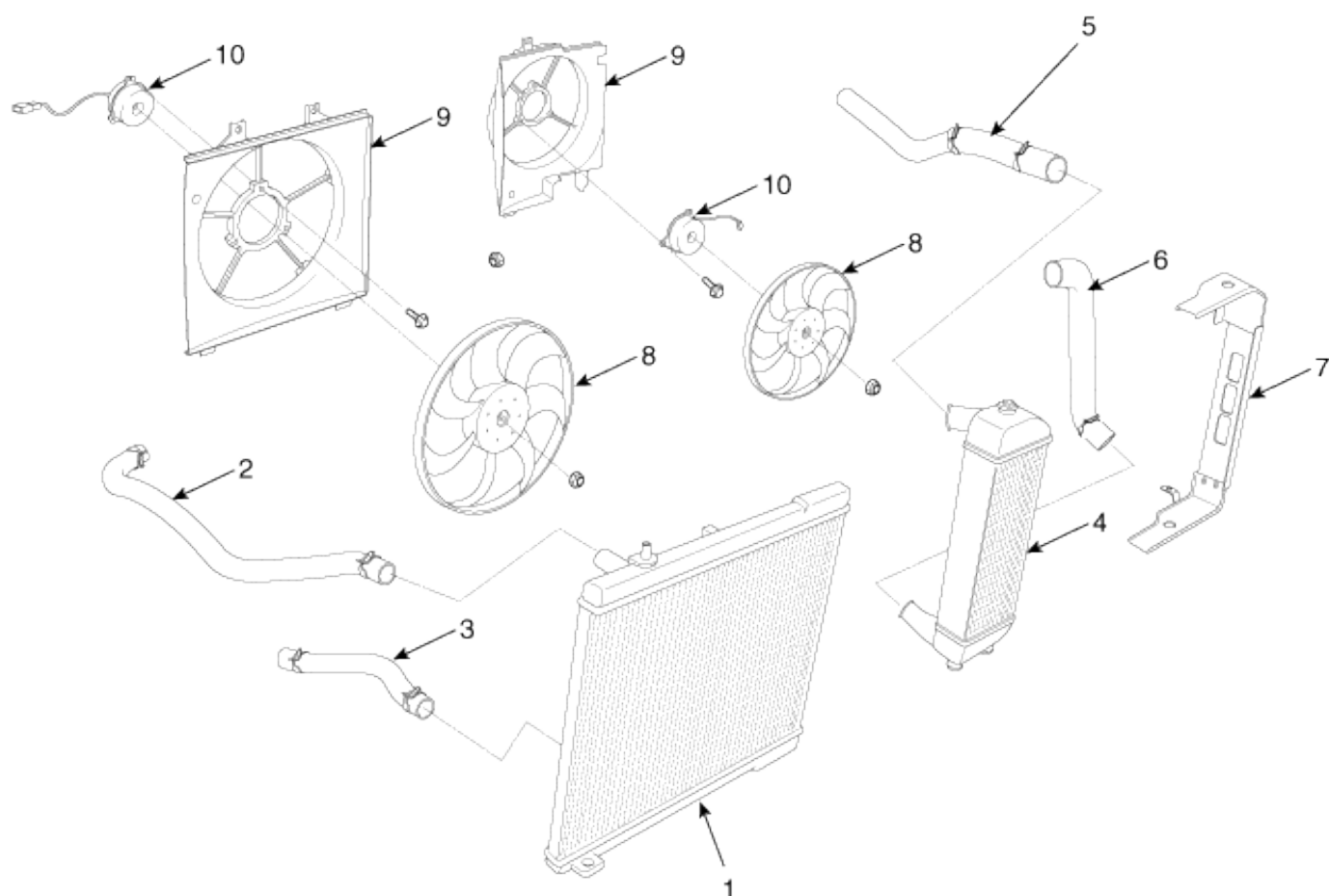


3. Inspect for engine coolant leaks and a drop in pressure.
4. Remove the tester and reinstall the radiator cap.

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

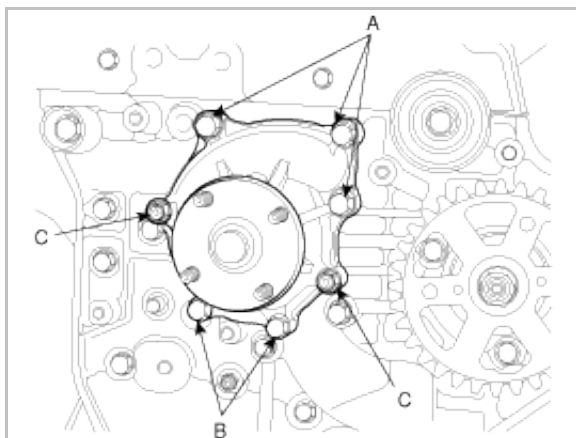
WATER PUMP

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.

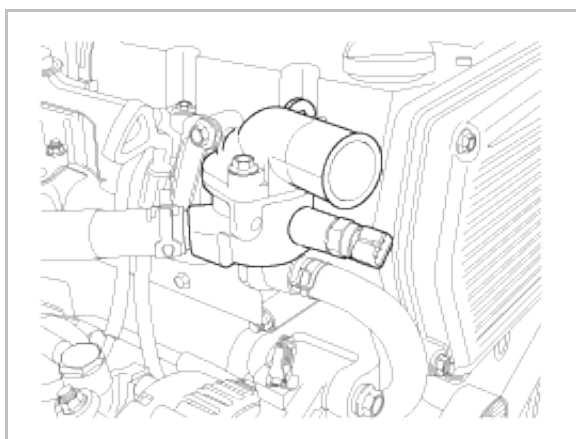


THRMOSTAT

NOTICE

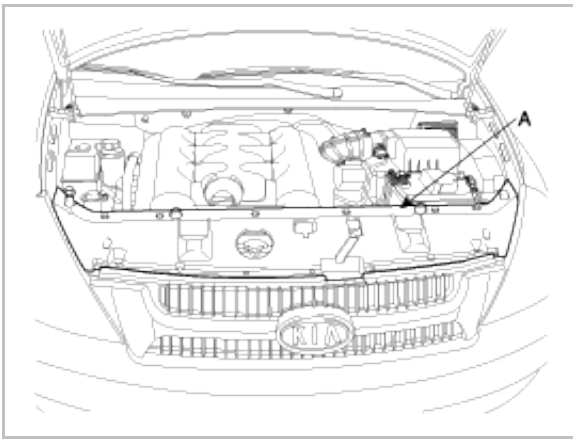
Disassembly of the thermostat would have an adverse effect, causing a lowering of cooling efficiency.

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

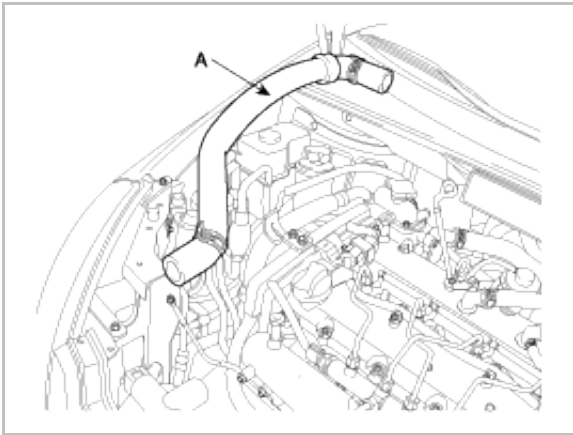


RADIATOR

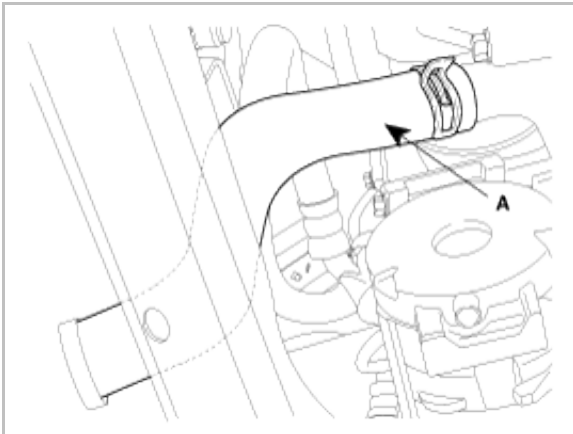
1. Drain the engine coolant.
2. Remove the radiator upper cover(A).



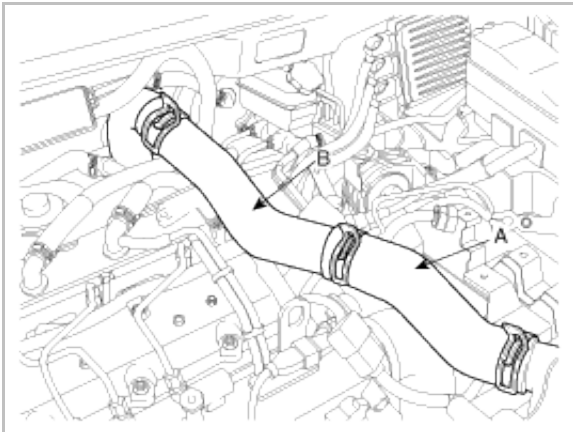
3. Remove the radiator upper hose(A).

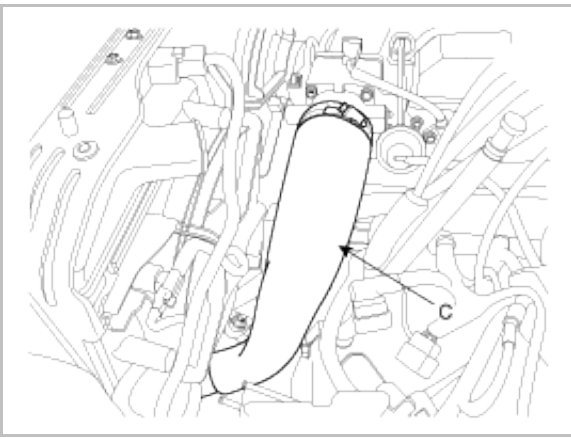


4. Remove the radiator lower hose(A).

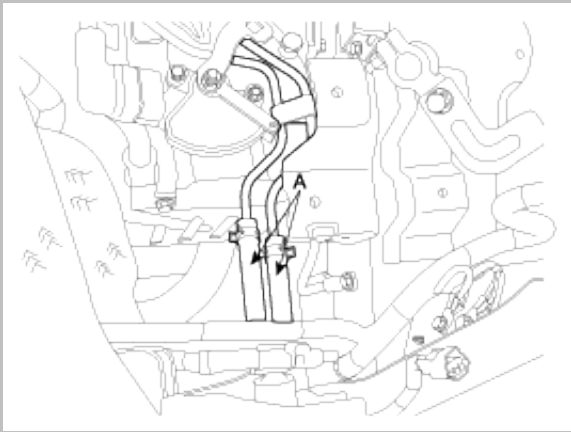


5. Remove the intercooler hose(A,C), pipe(B).

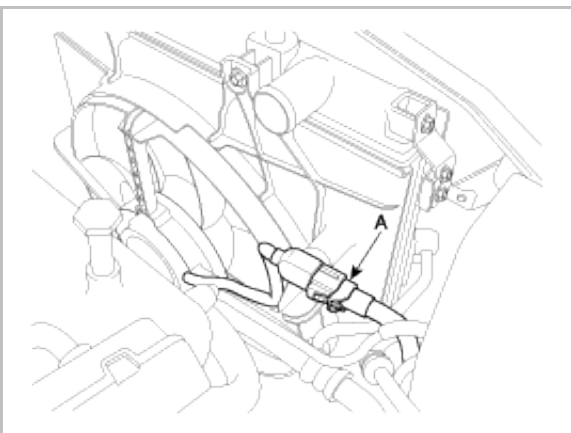
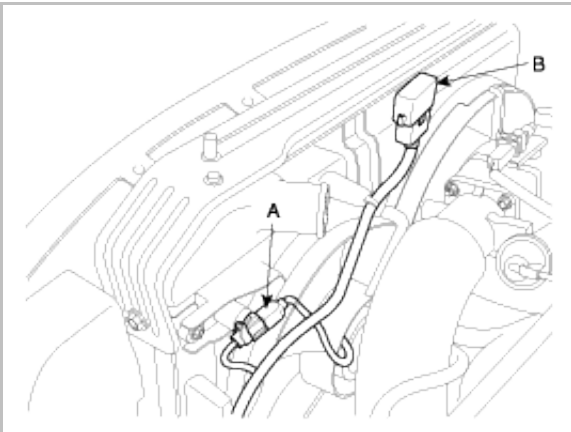




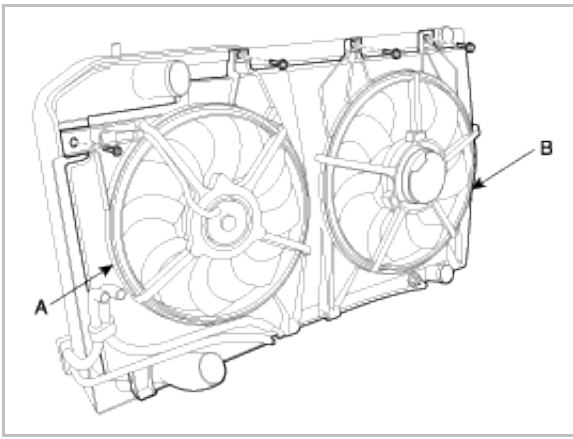
6. Remove the transaxle oil cooler hose(A).



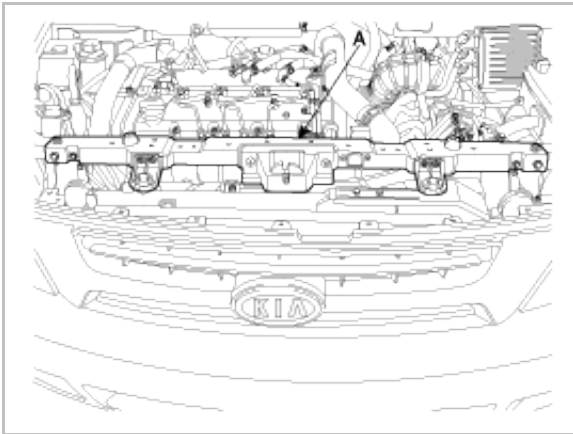
7. Remove the cooling fan motor connector(A) diagnosis connector(B).



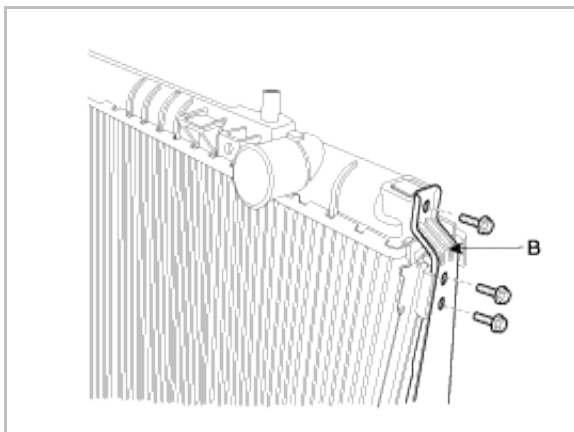
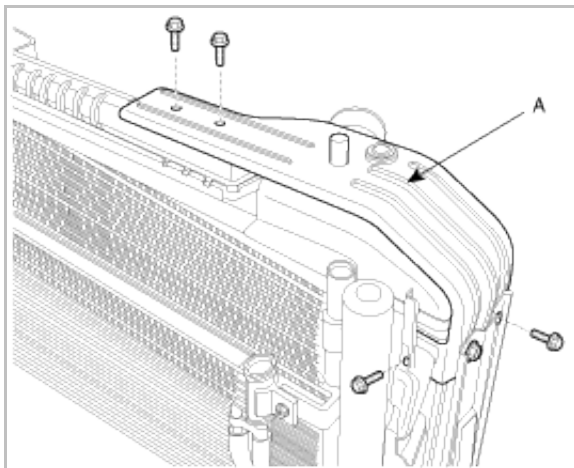
8. Remove the cooling fan motor assembly(A).



9. Remove the radiator upper bracket(A).



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



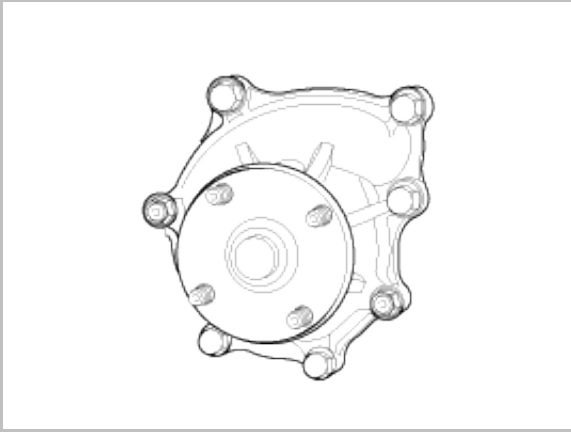
11. Remove the intercooler.

12. Remove the radiator.

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.



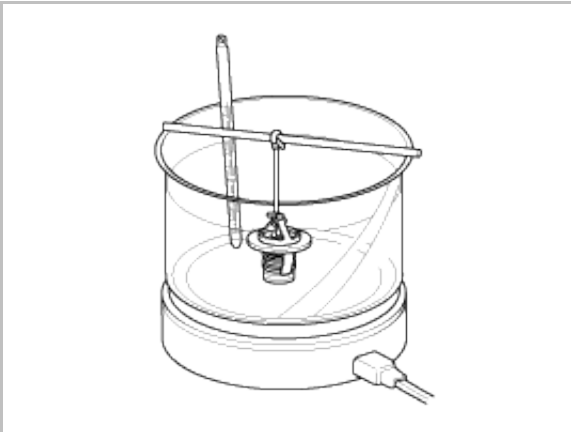
3. Check for coolant leakage. If coolant leaks from hole, the seal is defective. Replace the coolant pump assembly.

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.

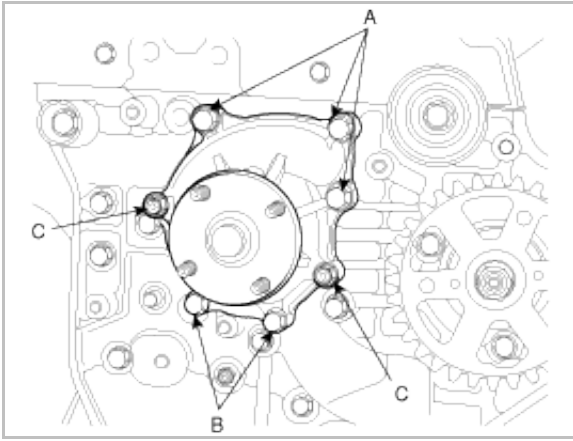
INSTALLATION

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

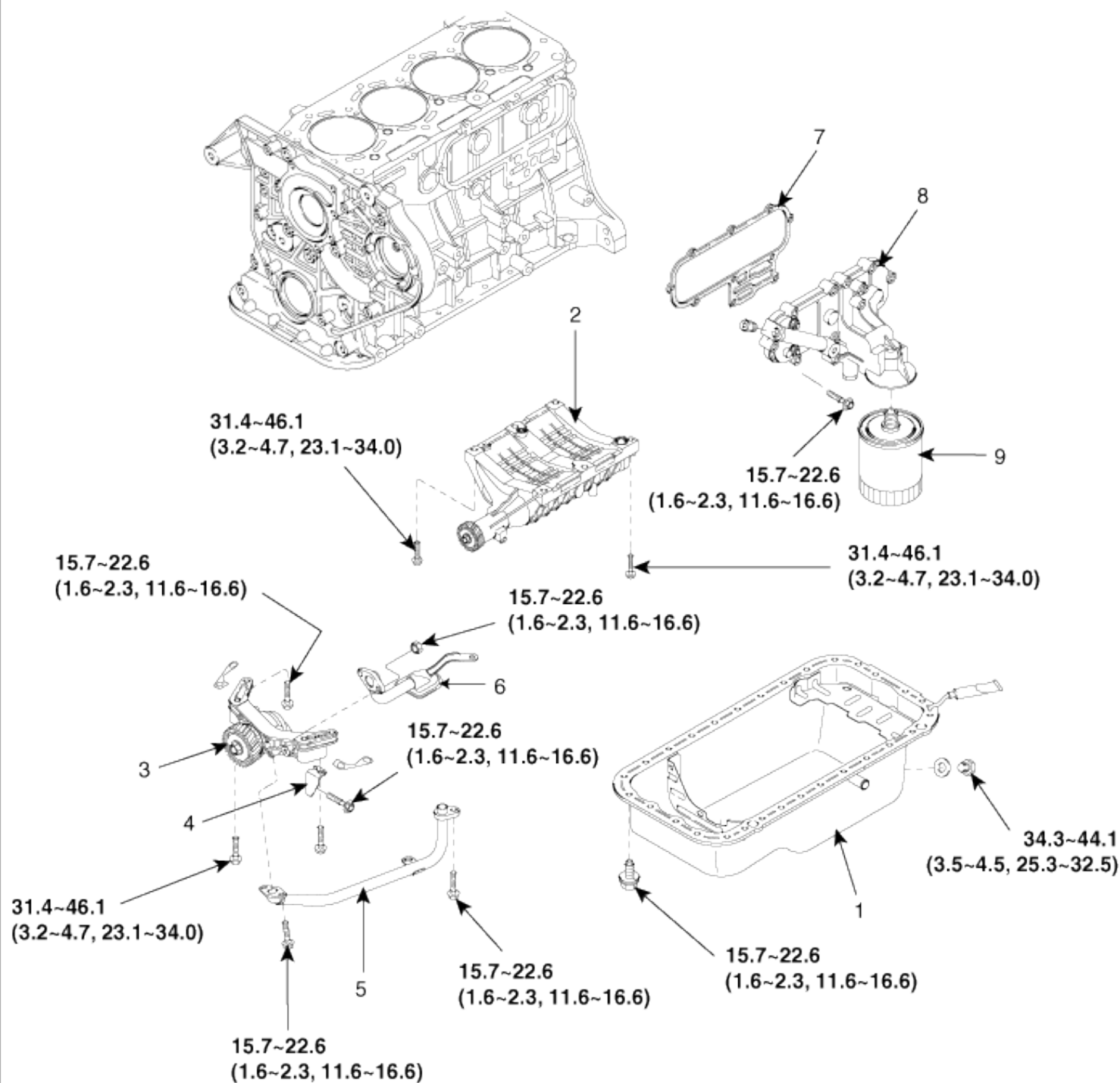
1. Install the radiator. Installation is in the reverse order of removal.
2. Install the air conditioner condenser. (Refer to HA- air conditioner condenser).
3. Install the upper and lower radiator hoses.
4. Refill with engine coolant.
5. Start engine and check for leaks.



Engine Mechanical System

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



REPLACEMENT

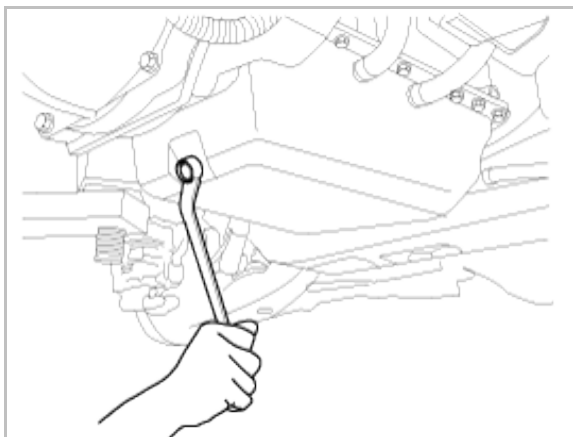
OIL AND FILTER

CAUTION

- 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.
- 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.
- 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)

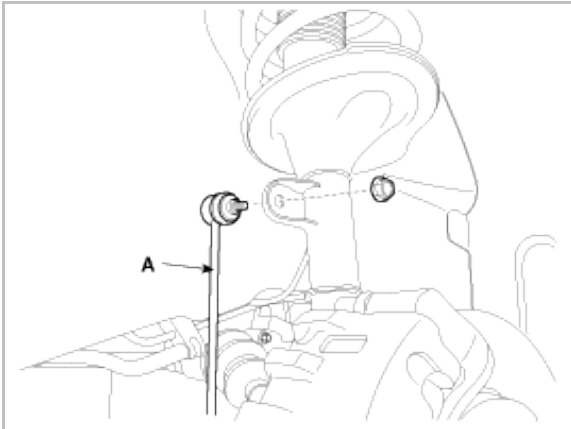
(3) Install the oil filler cap.

4. Start engine and check for oil leaks.
5. Recheck the engine oil level.

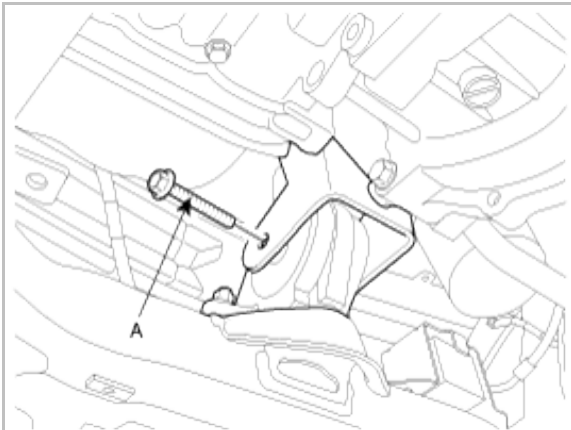
REMOVAL

OIL PAN

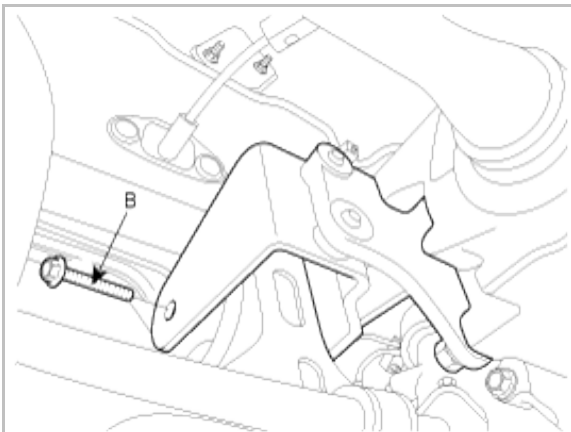
1. Drain the engine oil.
2. Remove the RH tires.
3. Remove the RH stabilizer bar link(A).



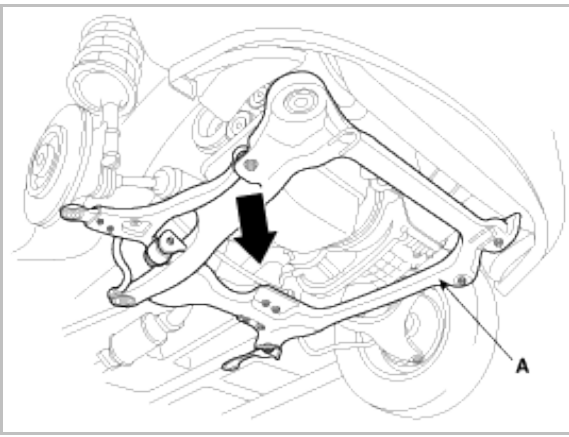
4. Remove the front roll stopper insulator mounting bolt(A).



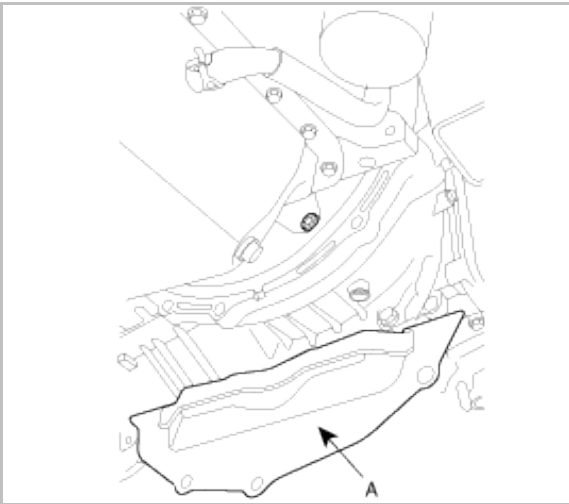
5. Remove the rear roll stopper insulator mounting bolt(B).



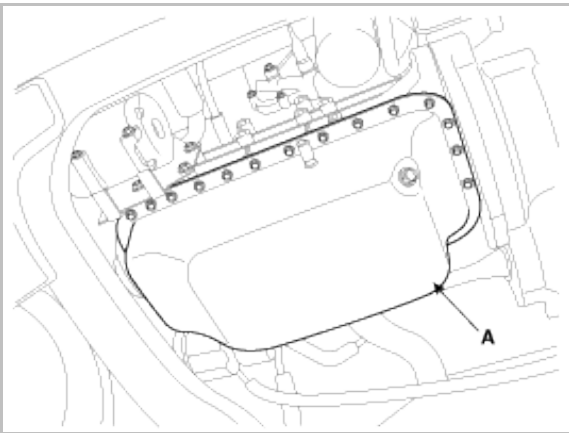
6. Remove the RH sub frame mounting bolts.
7. Tilt the sub frame(A) sideways by loosening the RH sub frame mounting bolts only.



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

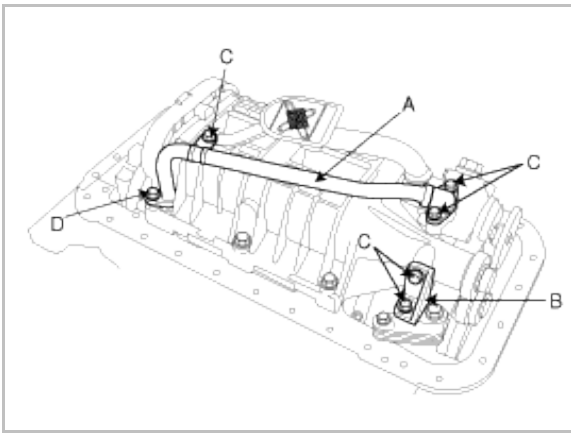


9. Using the SST(09215-3C000), remove the oil pan(A).

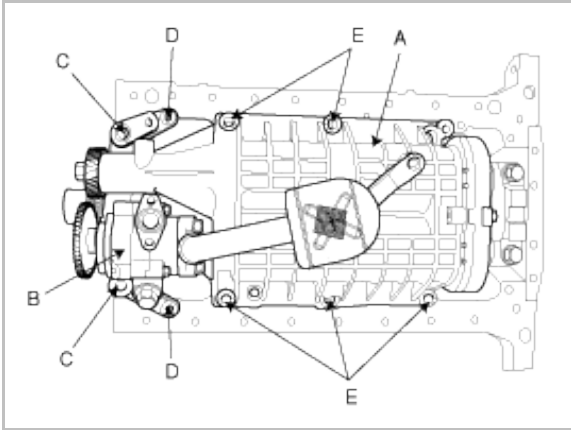


OIL PUMP

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).



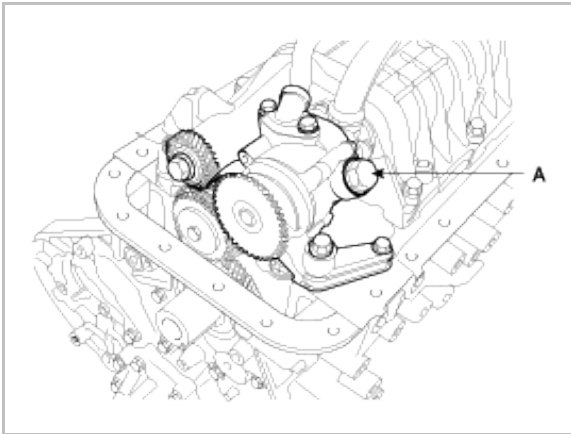
5. Remove the ladder frame(A), oil pump assembly(B).



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.

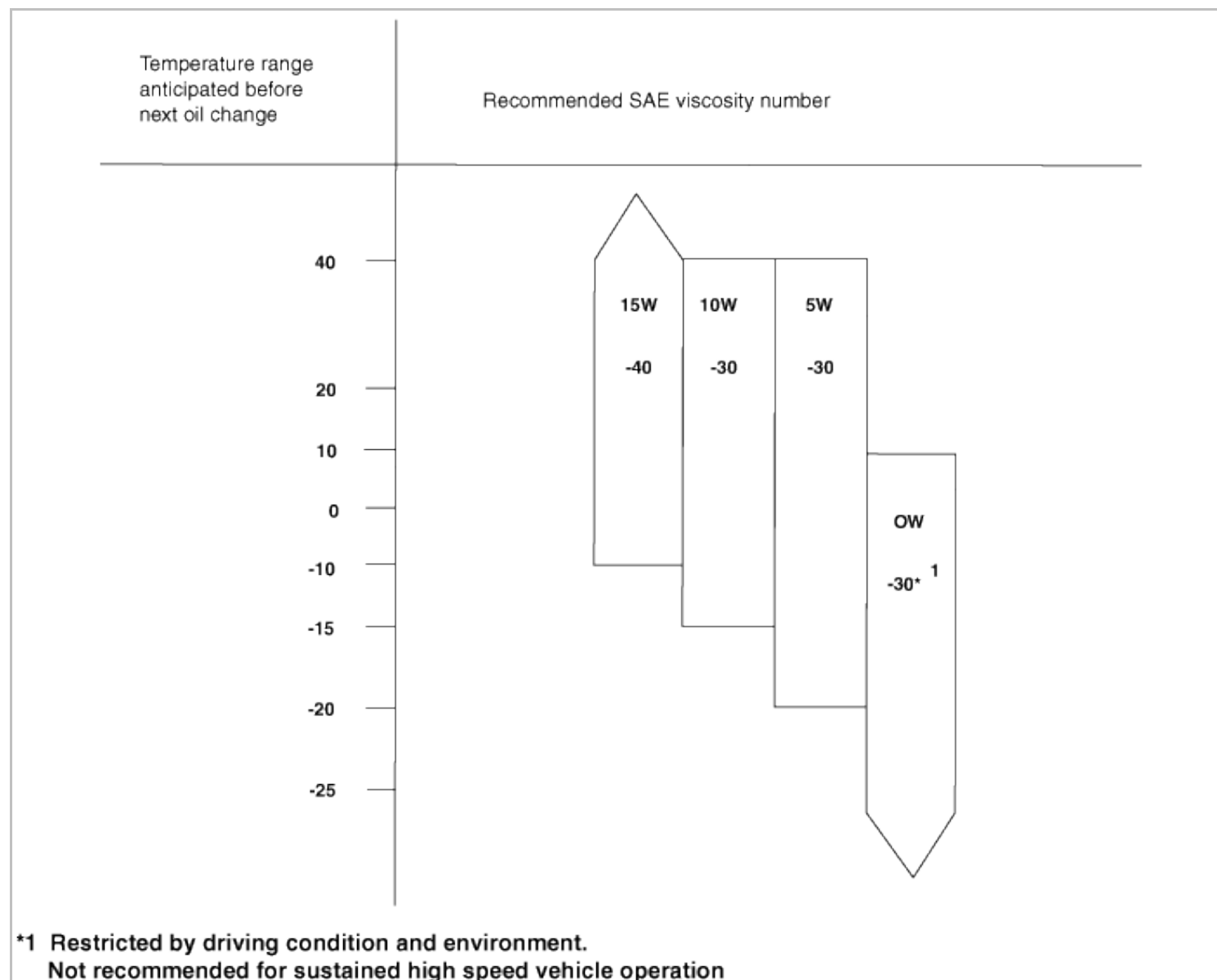
NOTICE

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

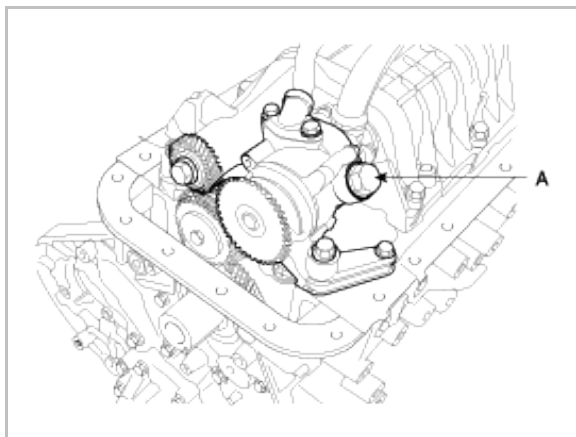
RELIEF PLUNGER

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)



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)

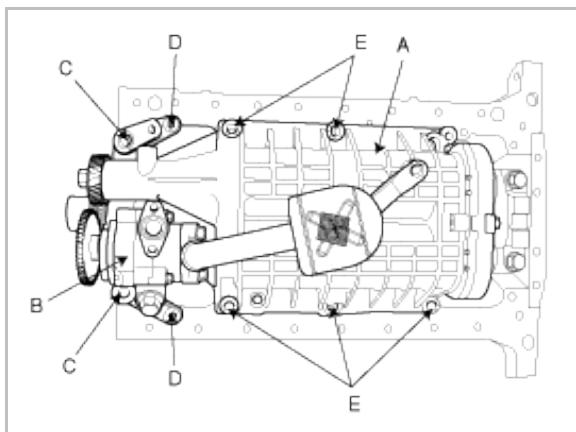
2. Install the ladde frame(A), oil pump assembly(B) with the bolts(C,D,E).

Tightening torque :

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

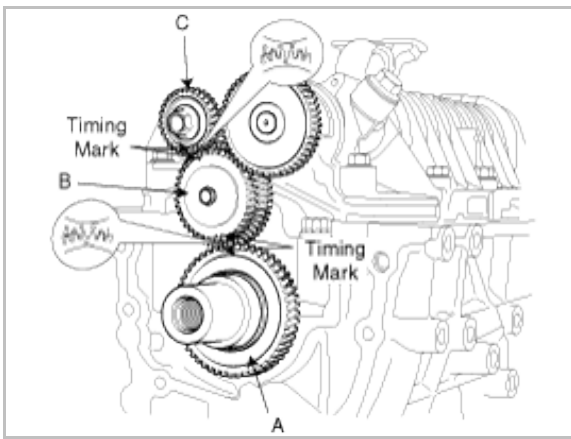
Bolts(D): 15.7~22.6Nm (1.6~2.3kgf.m, 11.6~16.6lb-ft)

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



NOTICE

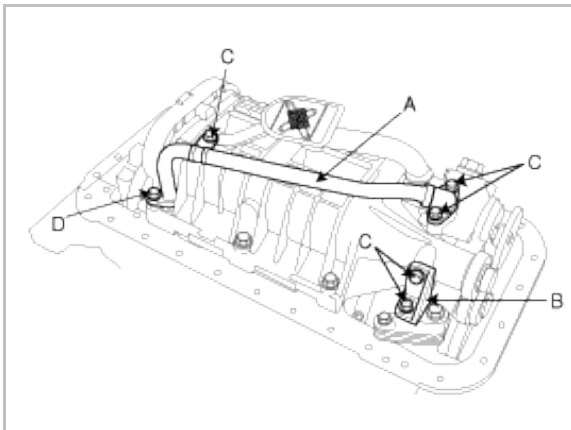
Align the timing marks on the crankshaft sprocket(A), idler(B) and balancer sprocket(C).



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

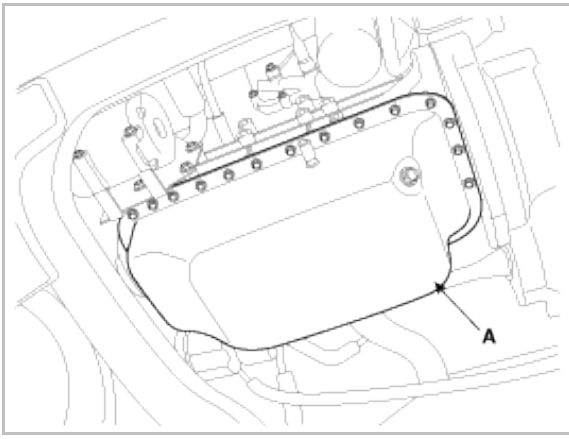
NOTICE

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

- (3) Install the oil pan(A) with the bolts.
Uniformly tighten the bolts in several passes.

Tightening torque :

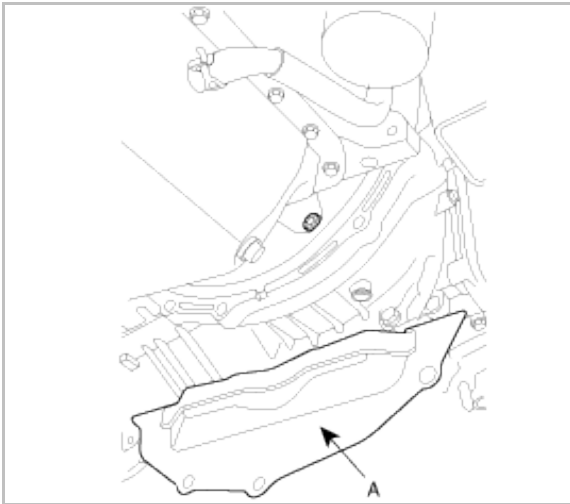
15.7~22.6Nm (1.6~2.3kgf.m, 11.6~16.6lb-ft)



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)

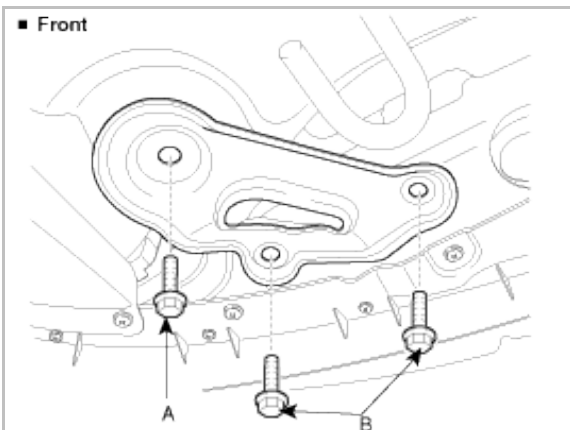


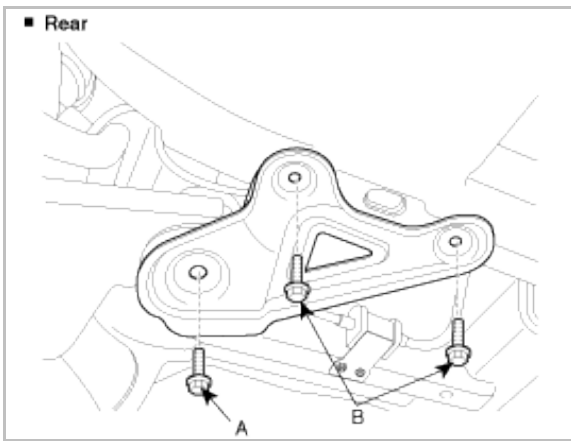
3. Install the RH, LH sub frame mounting bolts(A,B).

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)

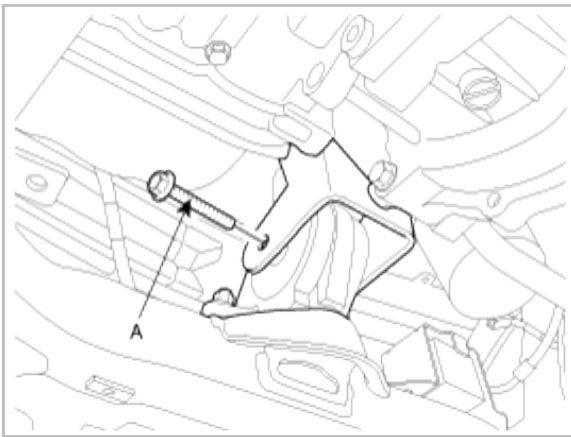




4. Install the front roll stopper insulator mounting bolt(A).

Tightening torque :

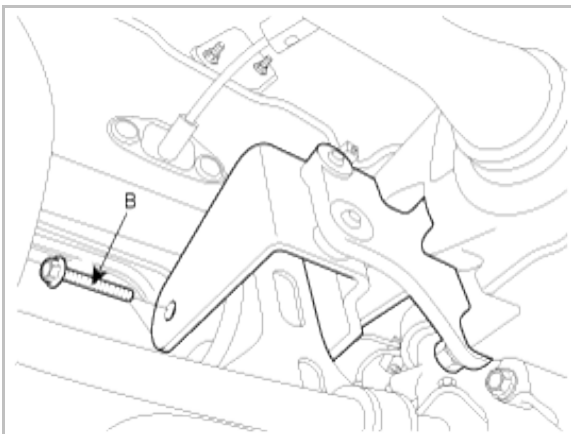
88.3~107.9Nm (9.0~11.0kgf.m, 65.1~79.6lb-ft)



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

Tightening torque :

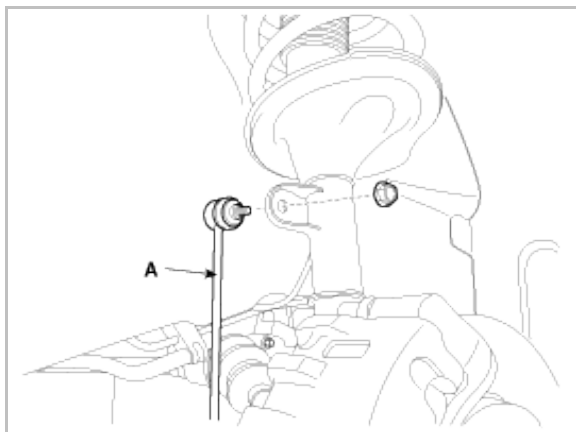
88.3~107.9Nm (9.0~11.0kgf.m, 65.1~79.6lb-ft)



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)

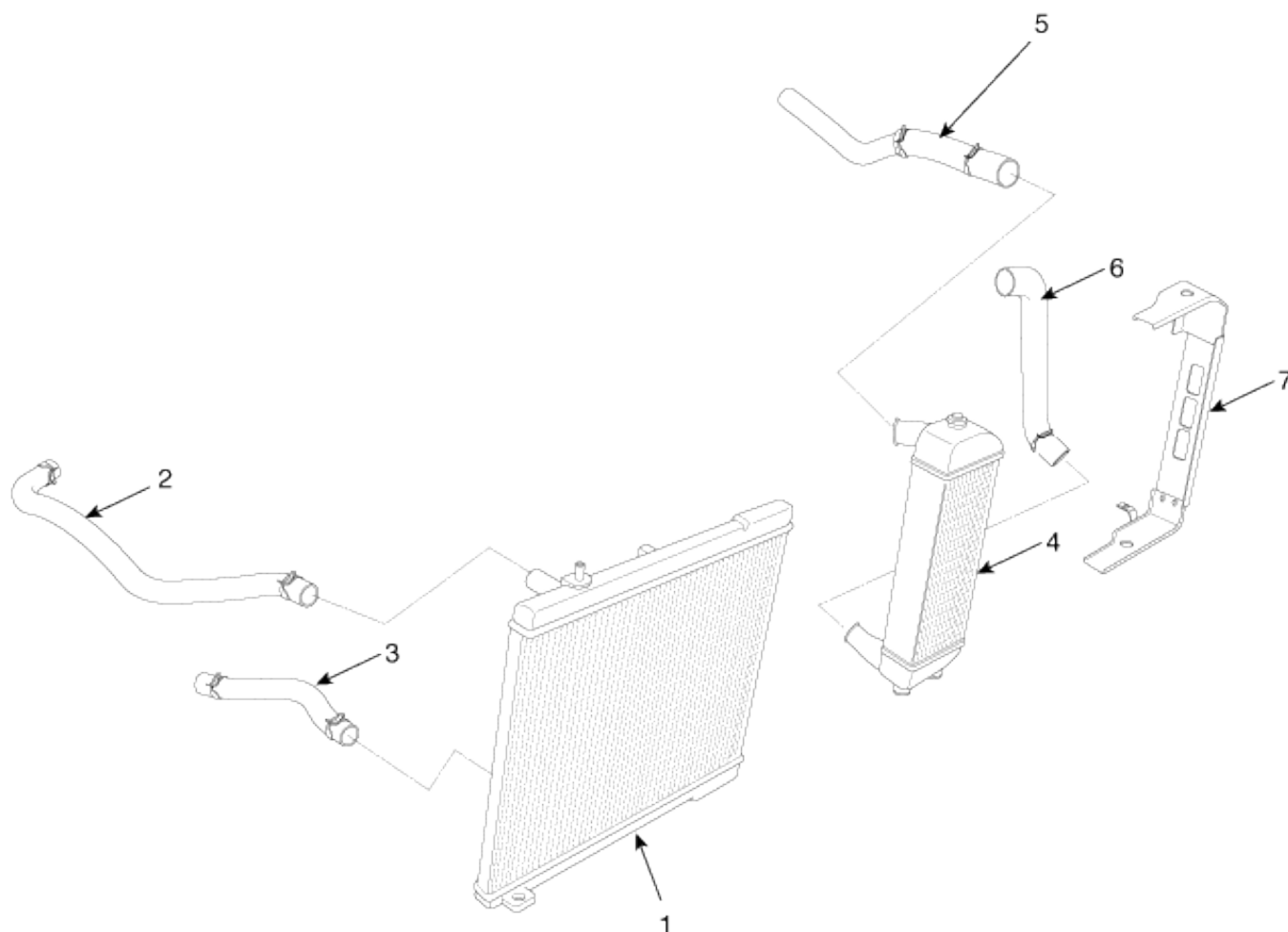
8. Fill with engine oil



Engine Mechanical System

Intake and Exhaust System - Intercooler

COMPONENTS



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

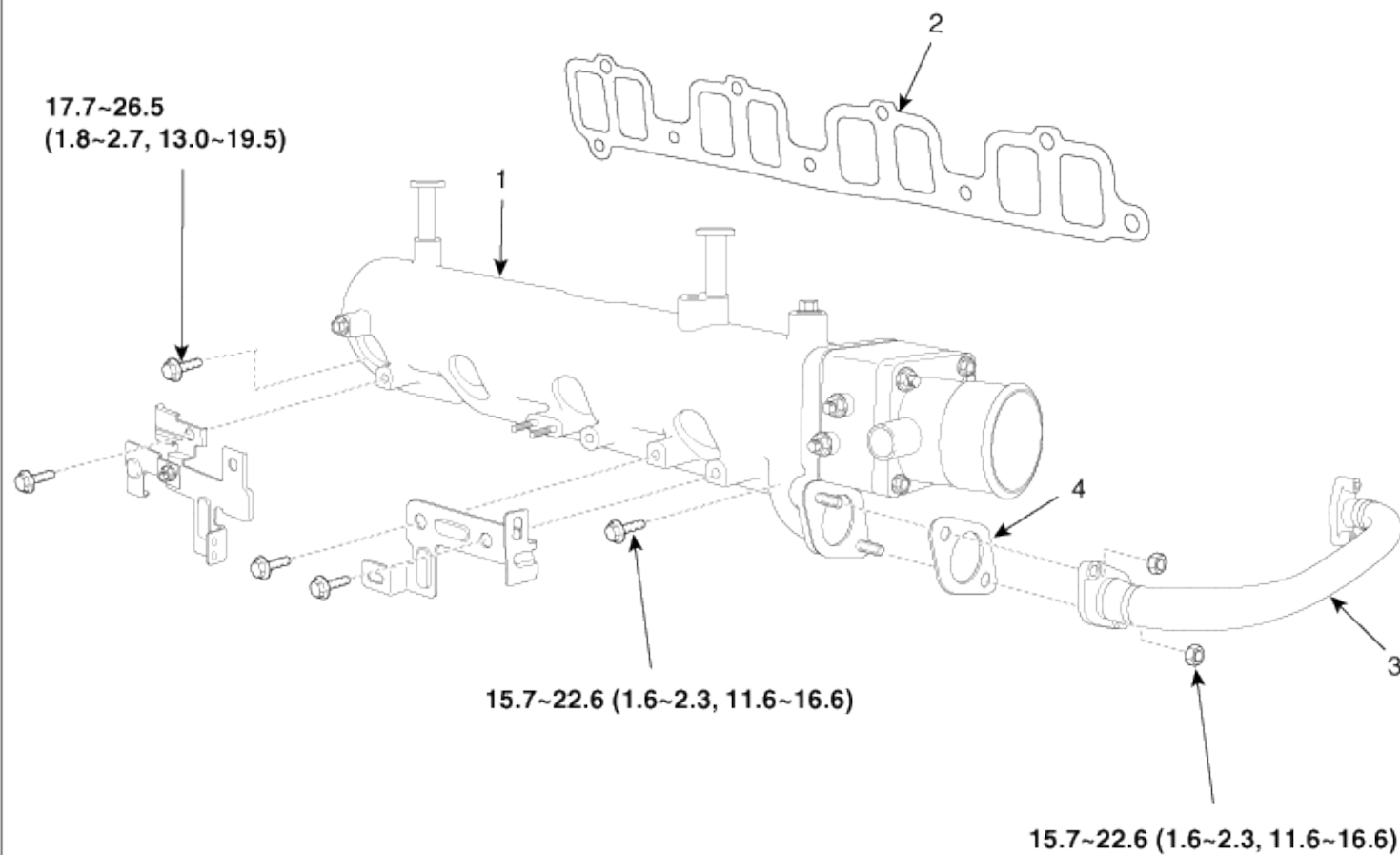
- 5. Intercooler upper hose
- 6. Intercooler lower hose
- 7. Intercooler bracket



Engine Mechanical System

Intake and Exhaust System - Intake Manifold

COMPONENTS



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

1. Intake manifold

2. Intake manifold gasket

3. EGR pipe

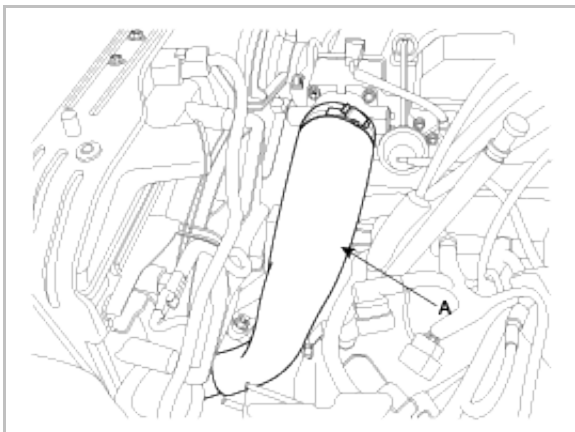
4. EGR pipe gasket



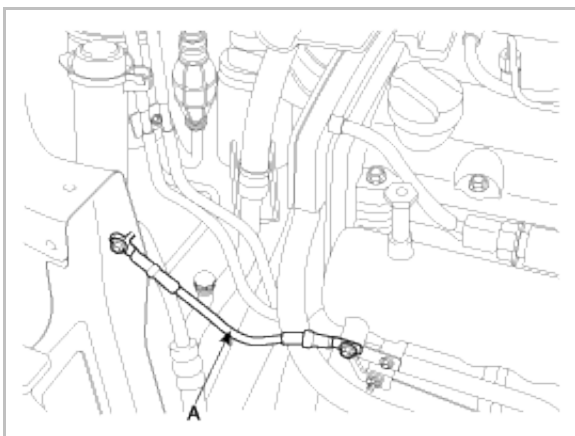
REMOVAL

INTAKE MANIFOLD

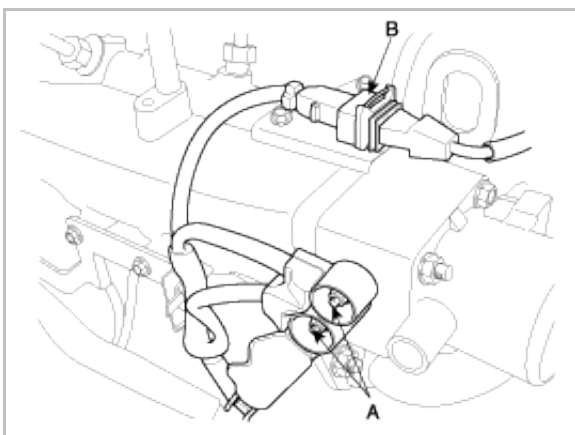
1. Remove the air intake hose, air cleaner assembly.
2. Remove the intercooler hoses(A).



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



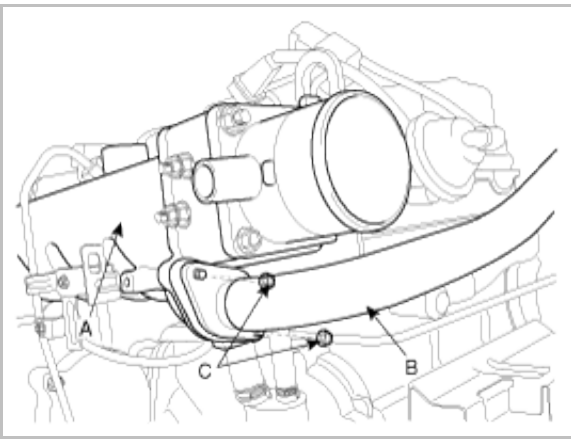
4. Remove the air heater terminals(A) CMP(Crankshaft position sensor) connector(B).



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

Tightening torque :

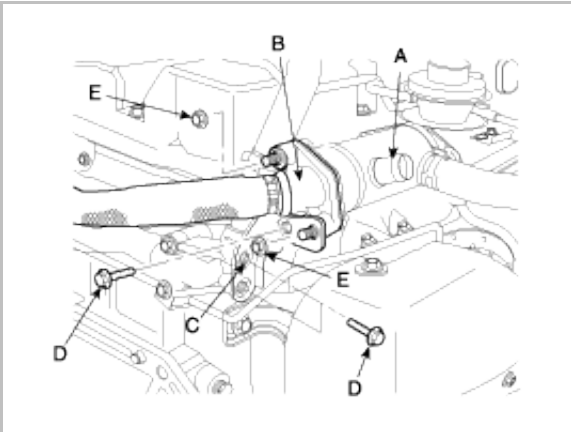
15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)



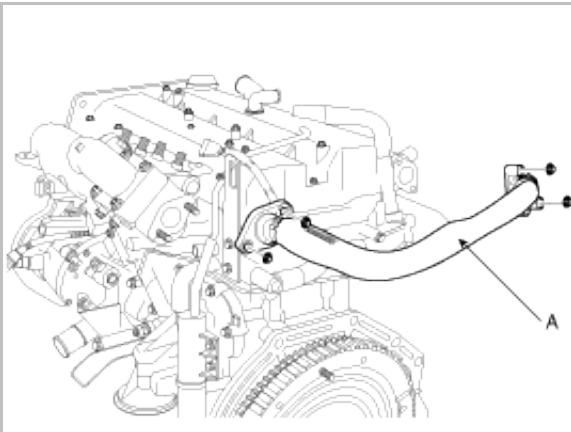
7. Remove the EGR pipe

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).

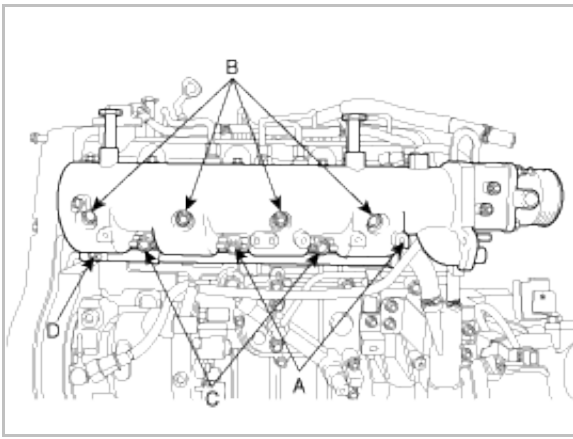


9. Remove the intake manifold.

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)



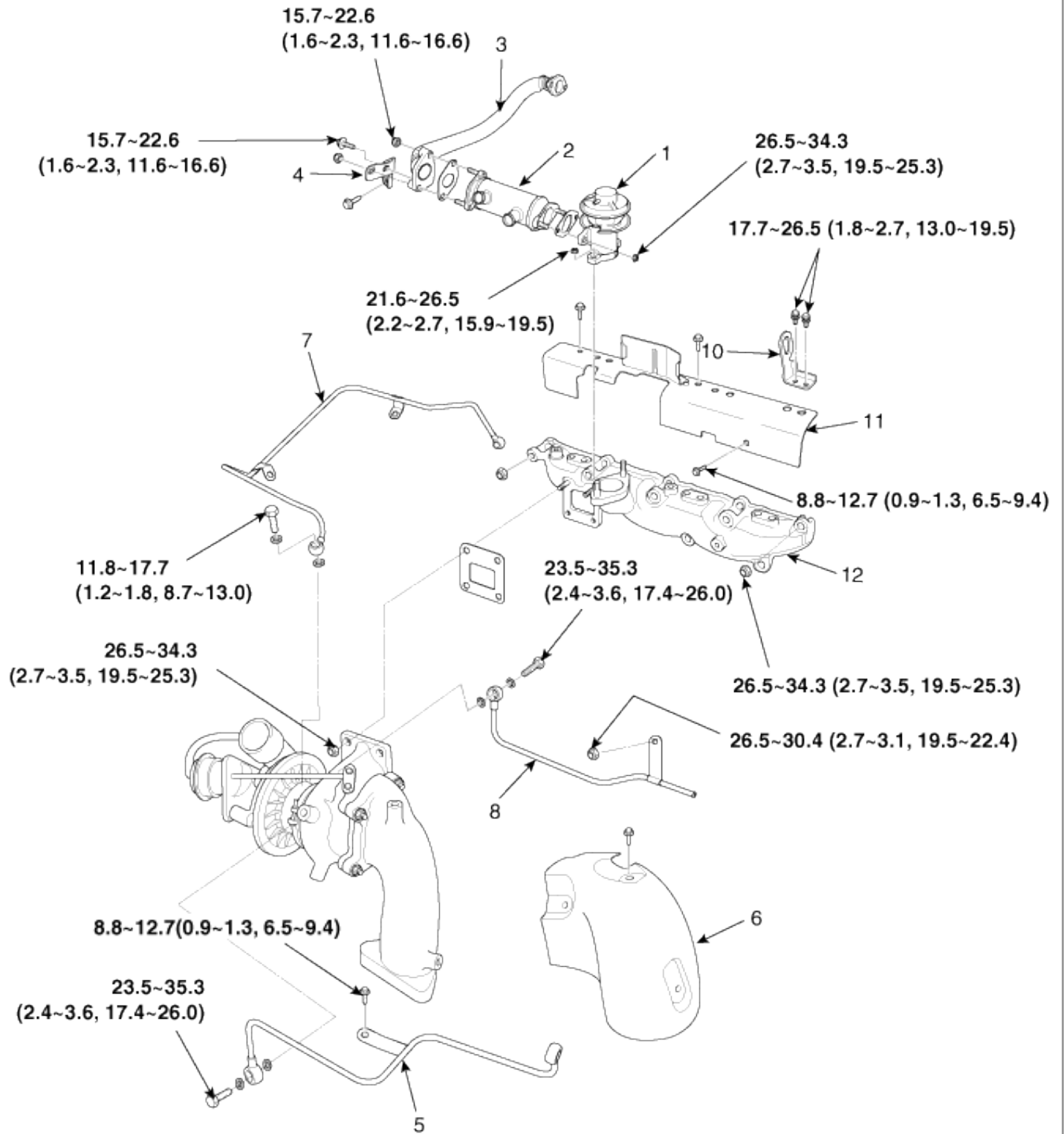
10. Installation is in the reverse order of removal with new gasket.



Engine Mechanical System

Intake and Exhaust System - Exhaust
Manifold

COMPONENTS



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

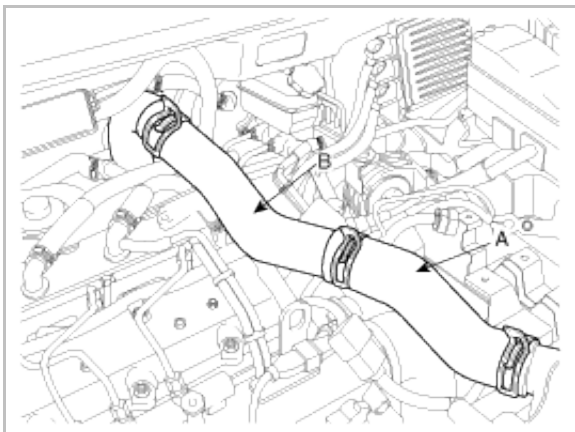
- | | | |
|----------------------|-------------------------------------|--------------------------------|
| 1. EGR valve | 5. Turbo chargers water inlet pipe | 9. Turbo charger assembly |
| 2. EGR cooler | 6. Heat protector | 10. Engine hanger |
| 3. EGR pipe | 7. Turbo chargers oil inlet pipe | 11.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



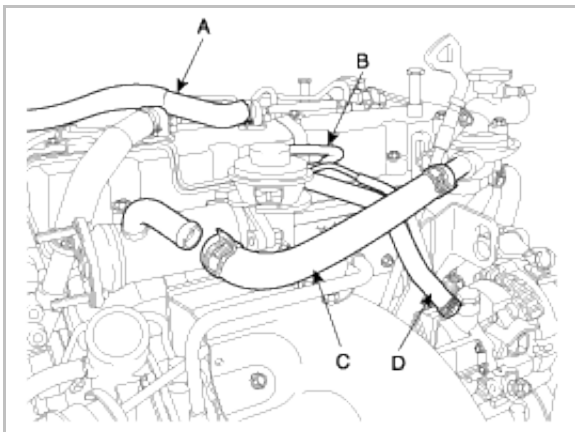
REMOVAL

EXHAUST MANIFOLD

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



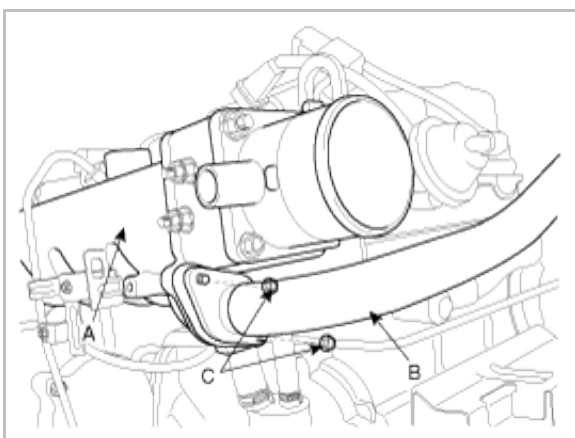
3. Remove the PCV(Positive Crankcase Ventilation) hose(A), EGR valve vacuum hose(B), EGR cooler water hose(C), vacuum pump oil hose(D).



4. Remove the EGR pipe(B).

Tightening torque :

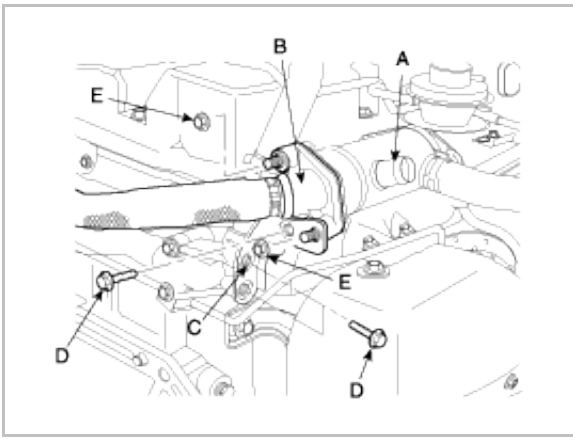
15.7 ~ 22.6Nm (1.6 ~ 2.3kgf.m, 11.6 ~ 16.6lb-ft)



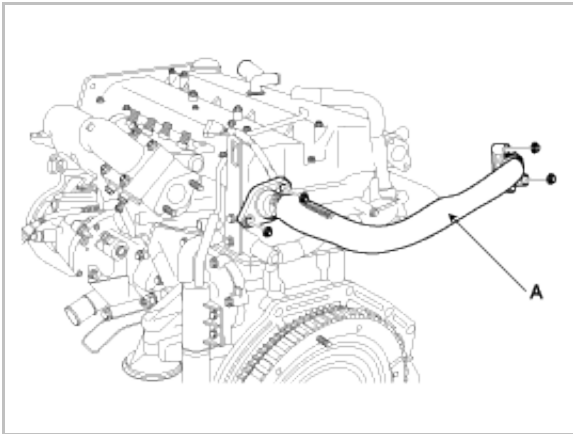
5. Remove the EGR pipe

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).

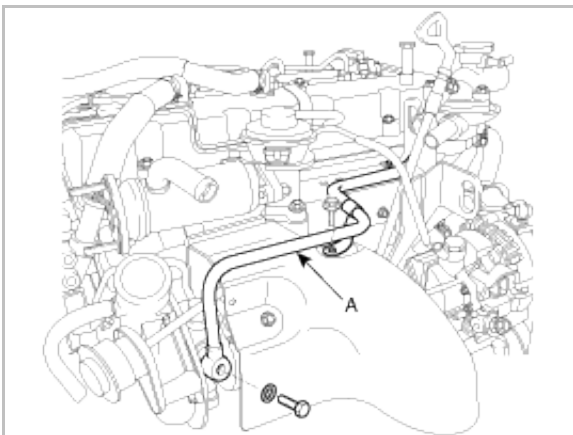


7. Remove the turbo chargers water inlet pipe(A).

Tightening torque :

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

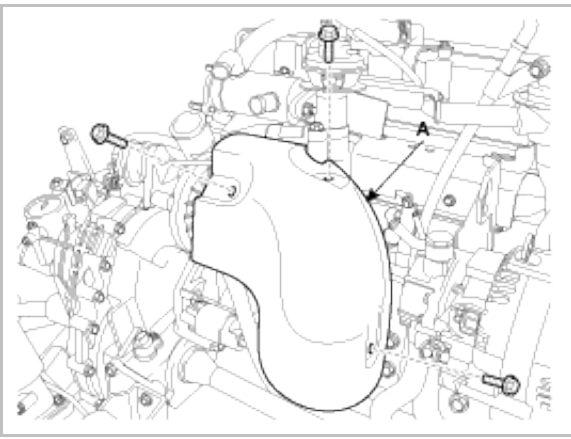
Bolt(C): 8.8~12.7Nm (0.9~1.3kgf.m, 6.5~9.4lb-ft)



8. Remove the heat protector(A).

Tightening torque :

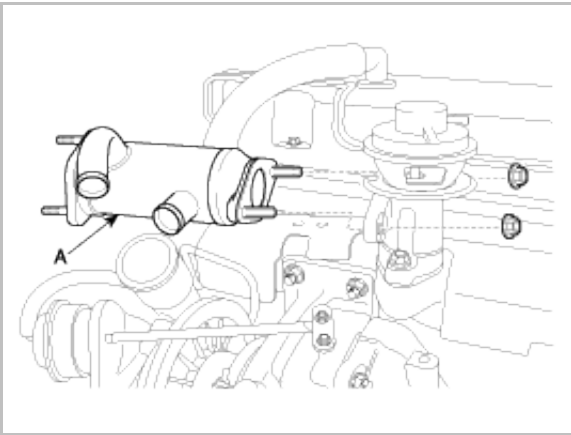
8.8~12.7Nm (0.9~1.3kgf.m, 6.5~9.4lb-ft)



9. Remove the EGR cooler(A).

Tightening torque :

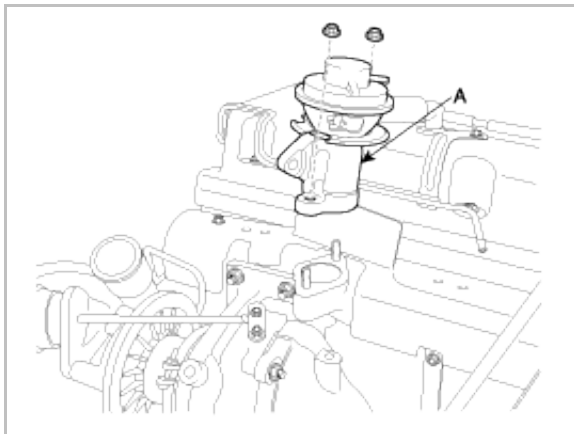
26.5~34.3Nm (2.7~3.5kgf.m, 19.5~25.3lb-ft)



10. Remove the EGR valve(A).

Tightening torque :

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

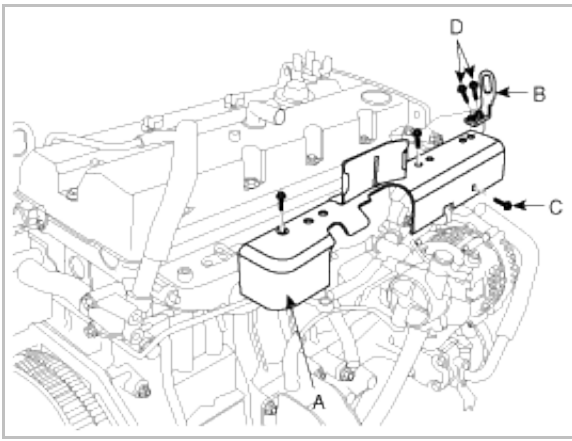


11. Remove the exhaust manifold insulator(A), engine hanger(B).

Tightening torque :

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

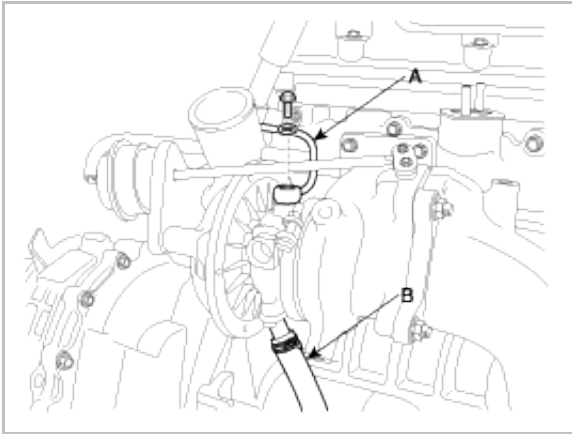
Bolts(D): 17.7 ~ 26.5Nm (1.8 ~ 2.7kgf.m, 13.0 ~ 19.5lb-ft)



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

Tightening torque :

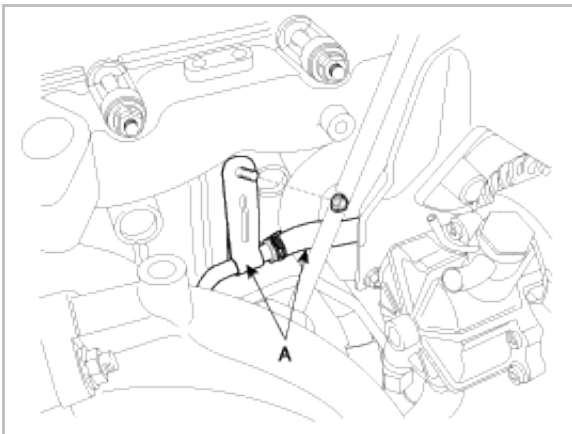
11.8~17.7Nm (1.2~1.8kgf.m, 8.7~13.0lb-ft)



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

Tightening torque :

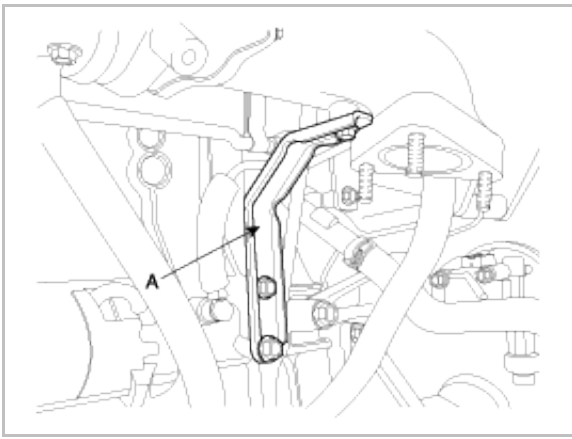
23.5~35.3Nm (2.4~3.6kgf.m, 17.4~26.0lb-ft)



14. Remove the turbo charger stay(A).

Tightening torque :

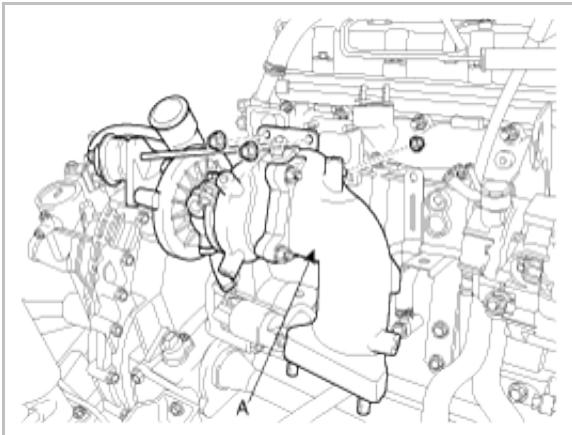
30.4~36.3Nm (3.1~3.7kgf.m, 22.4~26.8lb-ft)



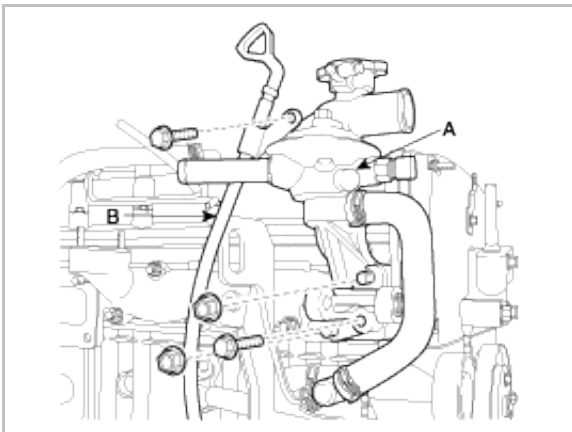
15. Remove the turbo charger assembly(A).

Tightening torque :

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



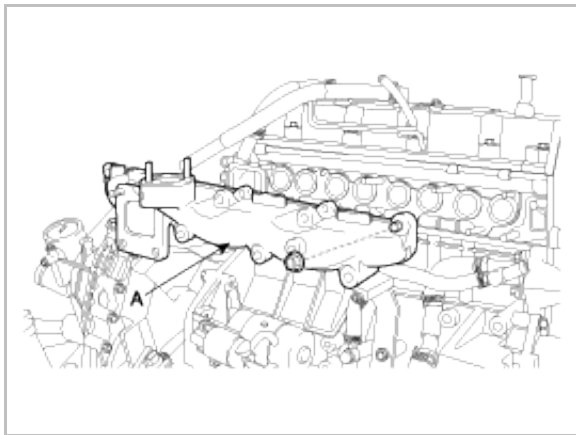
16. Remove the generator. (Refer to EE group).
17. Remove the thermostat case(A), oil level gauge tube(B).



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	- Leakage from the intake or exhaust system - Inferior turbocharger
Pressure is above the standard. (630~670mmHg/3,800rpm)	- Leakage from the inferior actuator hose - 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

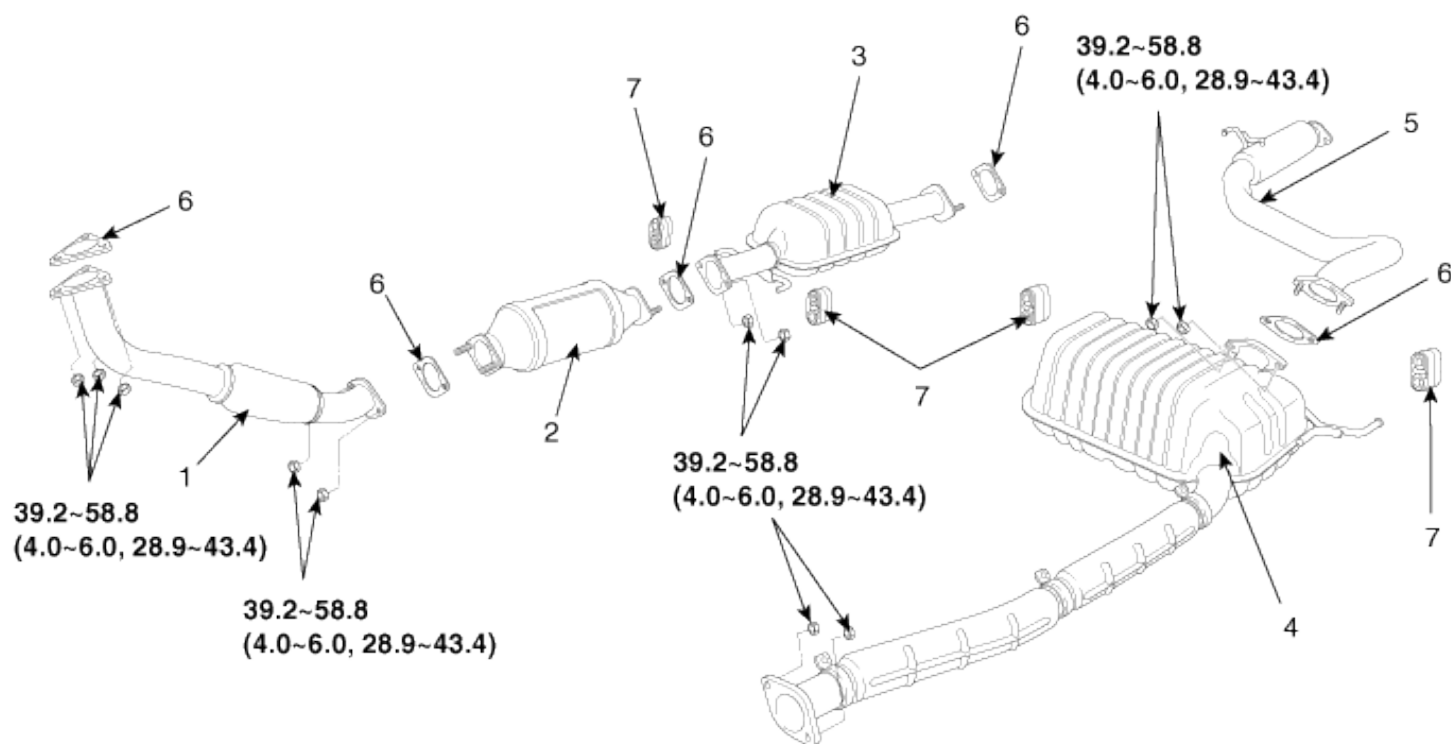
If the pressure more than 1.7 kg/cm²(1,250mmHg) is applied, there is a danger which the actuator will be damaged.

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

Engine Mechanical System

Intake and Exhaust System - 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 | |

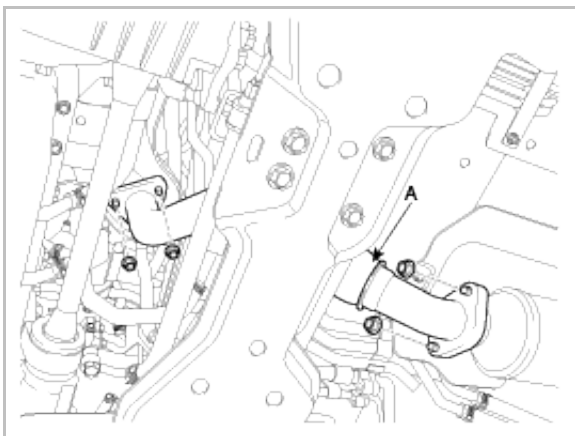


REMOVAL

1. Remove the front muffler(A).

Tightening torque:

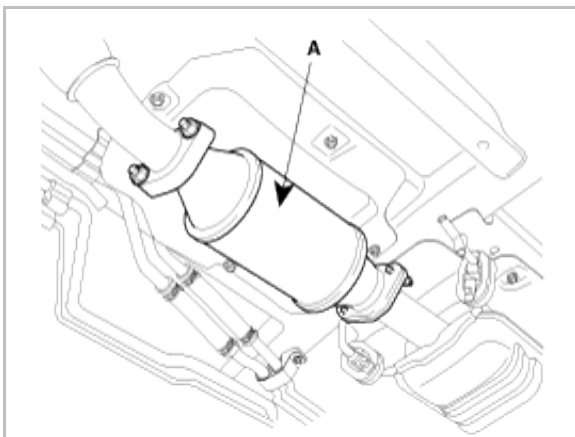
39.2~58.8Nm (4.0~6.0kgf.m, 28.9~43.4lb-ft)



2. Remove the catalytic converter(A).

Tightening torque :

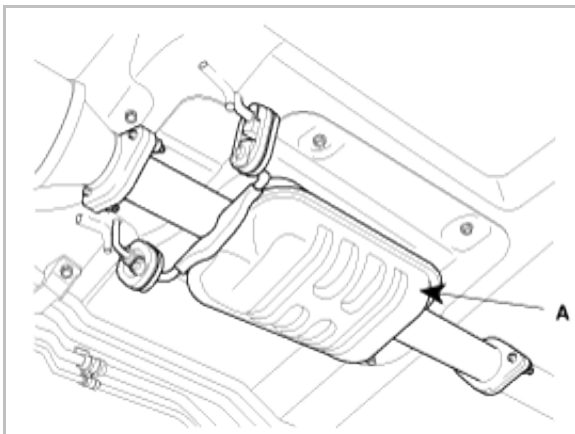
39.2~58.8Nm (4.0~6.0kgf.m, 28.9~43.4lb-ft)



3. Remove the center muffler(A).

Tightening torque :

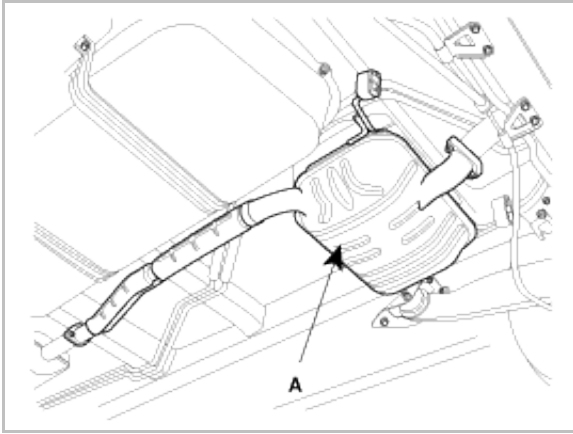
39.2~58.8Nm (4.0~6.0kgf.m, 28.9~43.4lb-ft)



4. Remove the main muffler(A).
-

Tightening torque :

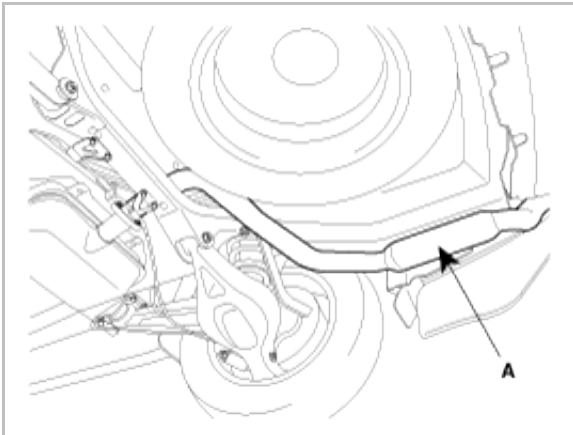
39.2~58.8Nm (4.0~6.0kgf.m, 28.9~43.4lb-ft)



5. Remove the tail pipe(A).
-

Tightening torque :

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





Engine Electrical System

General Information



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)



TROUBLESHOOTING

CHARGING SYSTEM

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

STARTING SYSTEM

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



Engine Electrical System

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

- Check that the battery cables are connected to the correct terminals.
- Do not perform tests with a high voltage insulation resistance tester.
- Never disconnect the battery while the engine is running.

CHECK BATTERY TERMINALS, FUSIBLE LINK AND FUSES

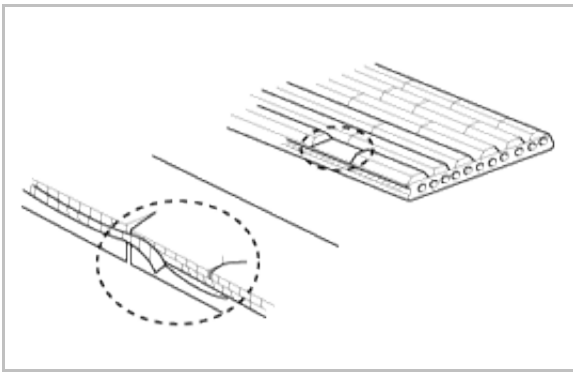
1. Check that the battery terminals are not loose or corroded.
2. Check the fusible link and fuses for continuity.

INSPECT DRIVE BELT

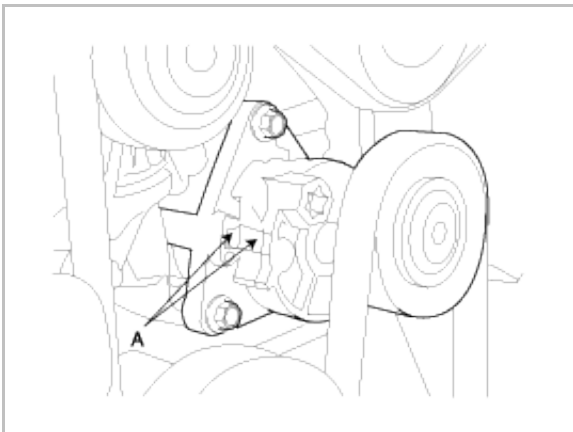
1. Visually check the belt for excessive wear, frayed cords etc.
If any defect has been found, replace the drive belt.

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.



2. Inspect drive belt tension(J3 common rail).
If the marks(A) in the auto-tensioner are aligned as shown below, the tensioner is installed in good position.



NOTICE

- "New belt" refers to a belt which has been used less than 5 minutes on a running engine.
- "Used belt" refers to a belt which has been used on a running engine for 5 minutes or more.
- After installing a belt, check that it fits properly in the ribbed grooves.
- Check with your hand to confirm that the belt has not slipped out of the groove on the bottom of the pulley.
- After installing a new belt, run the engine for about 5 minutes and recheck the belt tension.

INSPECT CHARGING SYSTEM

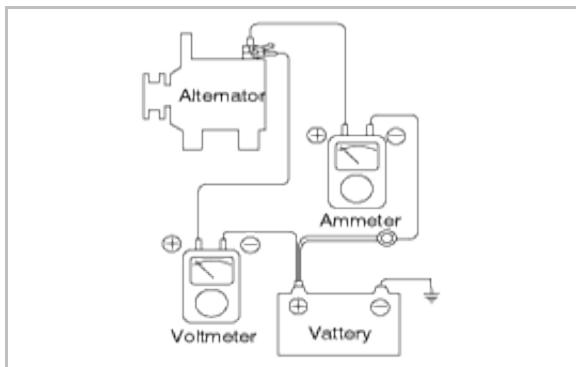
PREPARATION

1. Turn the ignition switch to "OFF".

NOTICE

To find abnormal conditions of the connection, actions should not be taken on the two terminals and each connection during the test.

2. Connect a digital voltmeter between the alternator "B" terminal and battery (+) lead wire to the battery (+) terminal. Connect the (+) lead wire of the voltmeter to the "B" terminal and the (-) lead wire to the battery (+) terminal.



CONDITIONS FOR THE TEST

1. Start the engine.
2. Switch on the headlamps, blower motor and so on. And then, read the voltmeter under this condition.

RESULT

1. The voltmeter may indicate the 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 fusible link to the battery (+) terminal. Check for loose connections, color change due to an overheated harness, etc. Correct them before testing again.
3. Upon completion of the test, set the engine speed at idle. Turn off the head lamps, blower motor and the ignition switch.

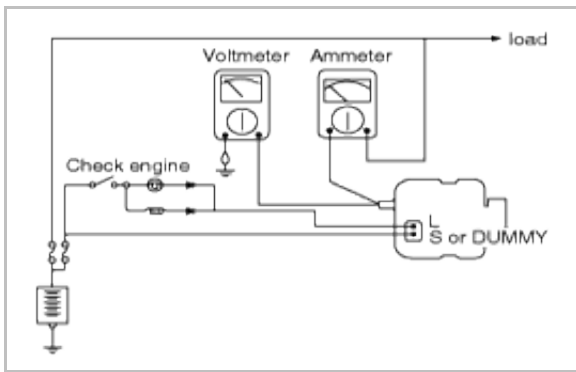
PREPARATION

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 in good condition. The battery checking method is described in "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.
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 the alternator "B" terminal and battery (-) terminal, a blown fusible link or poor grounding is suspected.
2. Start the engine and turn on the headlights.
3. Set the headlights 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 starts 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 : Rated current 70%

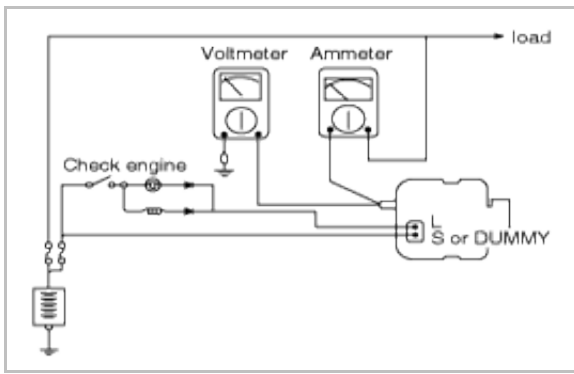
NOTICE

- The nominal output current value is shown on the nameplate affixed to the alternator body.
- 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 headlights 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.

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. For battery checking method, see "BATTERY".
Check the alternator drive belt tension.
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.

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 (-), or the fusible link is blown.

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)
-00 (-40)	14.2 ~ 15.4
20 (68)	14.0 ~ 15.0
60 (140)	13.7 ~ 14.9
80(176)	13.5 ~ 14.7

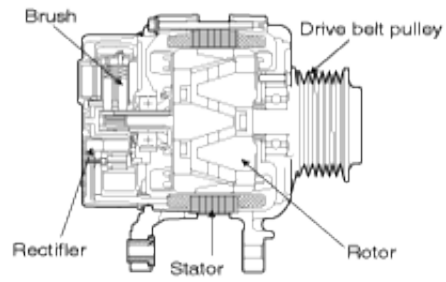
2. Upon completion of the test, reduce the engine speed to idle, and turn off the ignition switch.
3. Disconnect the battery ground cable.
4. Remove the voltmeter and ammeter and the engine tachometer.
5. Connect the alternator output wire to the alternator "B" terminal.
6. Connect the battery ground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

Engine Electrical System

Charging System - Alternator



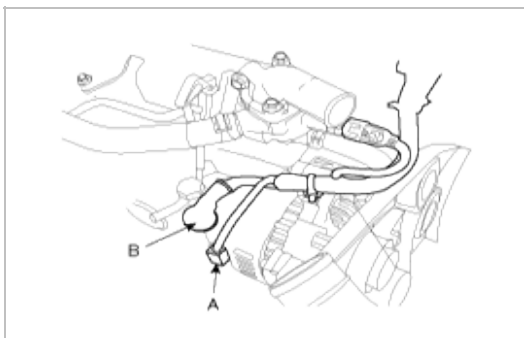
COMPONENT



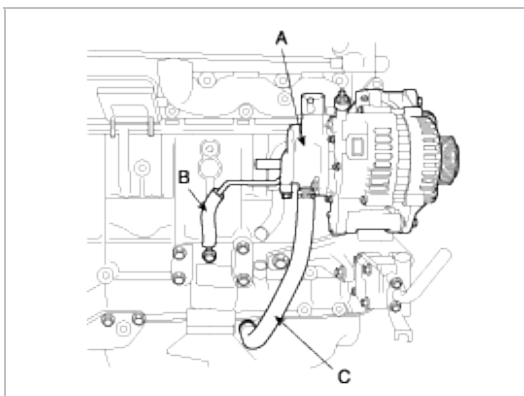


REPLACEMENT

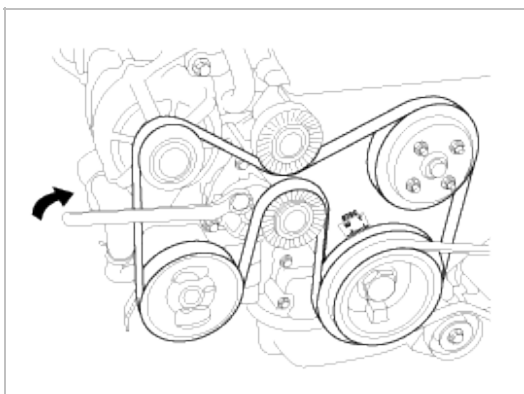
1. Disconnect the battery negative terminal first, then the positive terminal.
2. Disconnect the alternator connector(A) and "B" terminal cable(B).



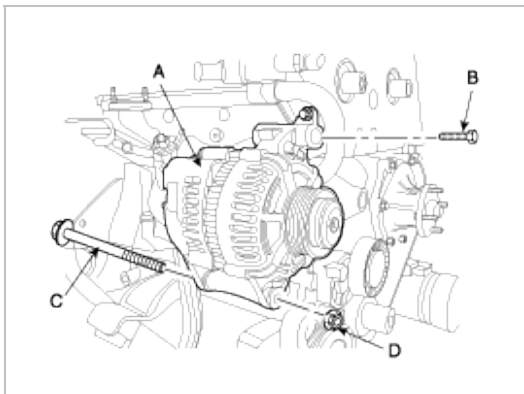
3. Remove the oil pipe(B), oil hose(C) from the vacuum pump(A).



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.

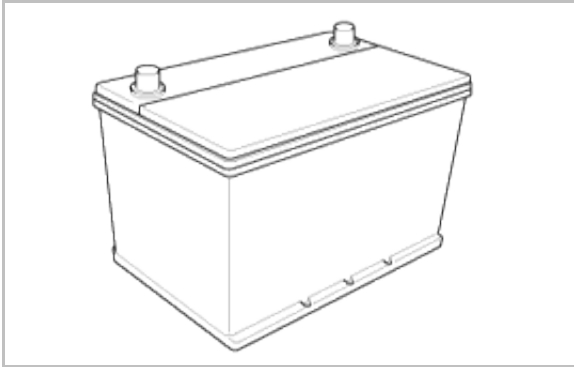
Engine Electrical System

Charging System - Battery



DESCRIPTION

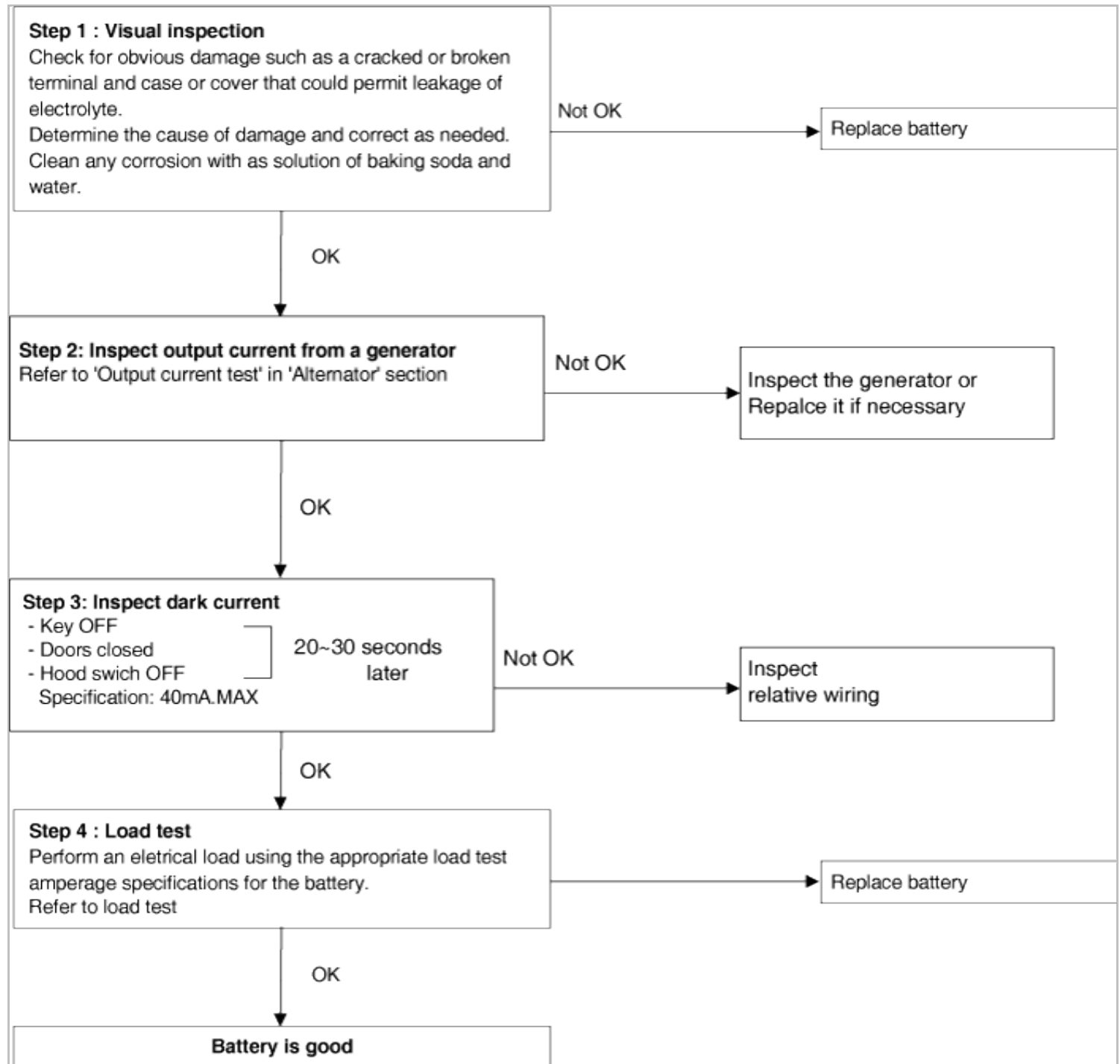
1. The maintenance-free battery is, as the name implies, totally maintenance free and has no removable battery cell caps.
2. Water never needs to be added to the maintenance-free battery.
3. The battery is completely sealed, except for small vent holes in the cover.





INSPECTION

BATTERY DIAGNOSTIC 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 :
 - A. If the battery has been on charge, remove the surface charge by connect a 300 ampere load for 15 seconds.
 - B. Connect the voltmeter and apply the specified load.
 - C. Read the voltage after the load has been applied for 15 seconds.
 - D. Disconnect the load.
 - E. 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
9.6	20°C (70°F)

9.5	16 °C (60 °F)
9.4	10 °C (50 °F)
9.3	4 °C (40 °F)
9.1	-1 °C (30 °F)
8.9	-7 °C (20 °F)
8.7	-12 °C (10 °F)
8.5	-18 °C (0 °F)

NOTICE

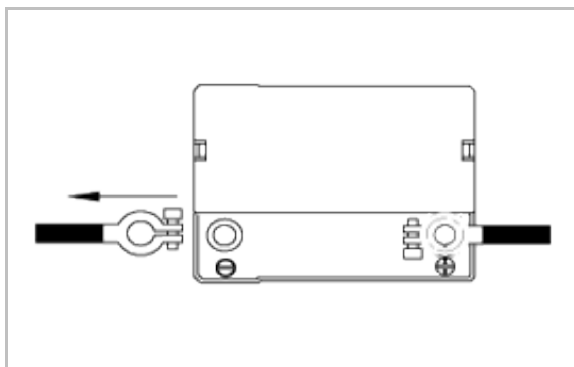
- If the voltage is less than shown in the table, the battery is good.
- If the voltage is greater than shown in the table, replace the battery.

CLEANING

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 worn when removing the battery.

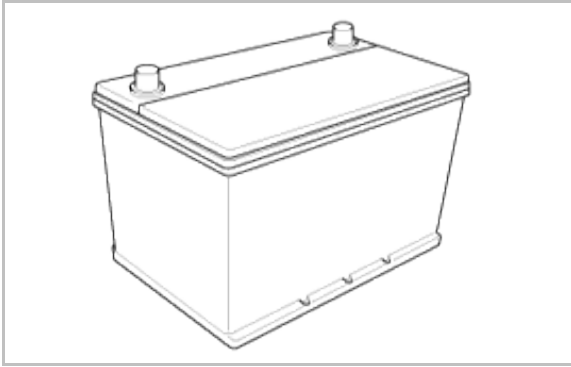


4. Inspect the battery carrier for damage caused by the loss of electrolyte. If acid damage is present, it will be necessary to clean the area with a solution of clean warm water and baking soda. Scrub the area with a stiff brush and wipe off with a cloth moistened with baking soda and water.
5. Clean the top of the battery with the same solution as described in Step(3).
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 the 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 circuits at the terminals of batteries being charged. A spark will occur when the circuit is broken. Keep open flames away from the battery.





Engine Electrical System

Starting System



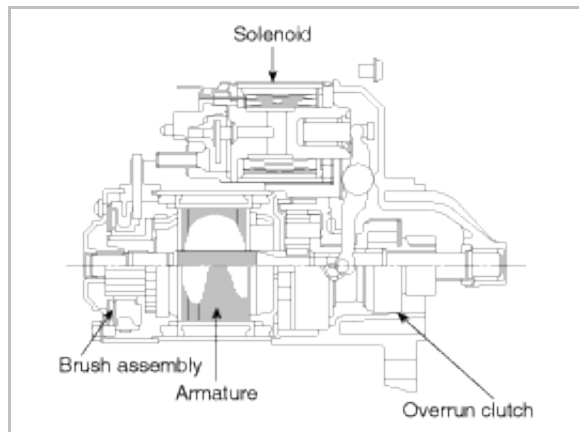
DESCRIPTION

The starting system includes the battery, starter motor, 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

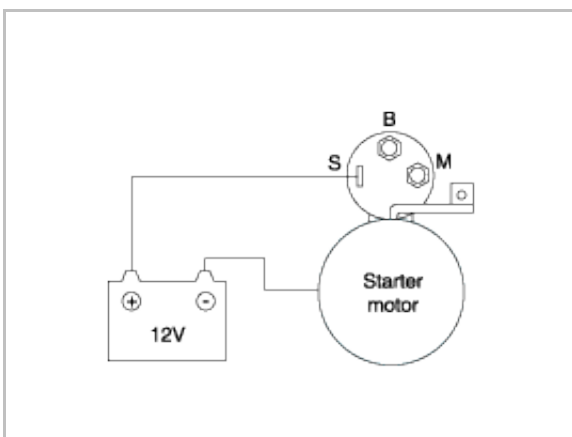
NOTICE

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

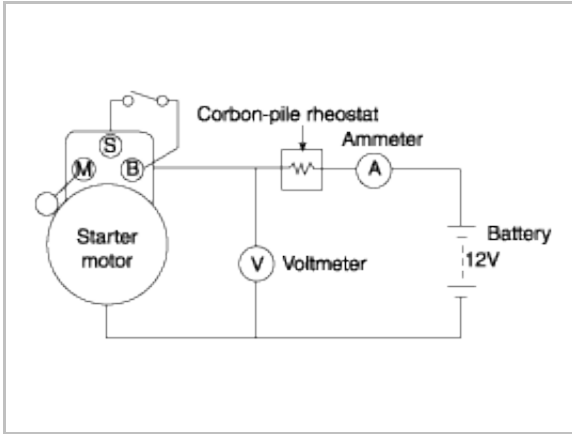
This test must be performed quickly (in less than 10 seconds) to prevent the coil from burning.

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.

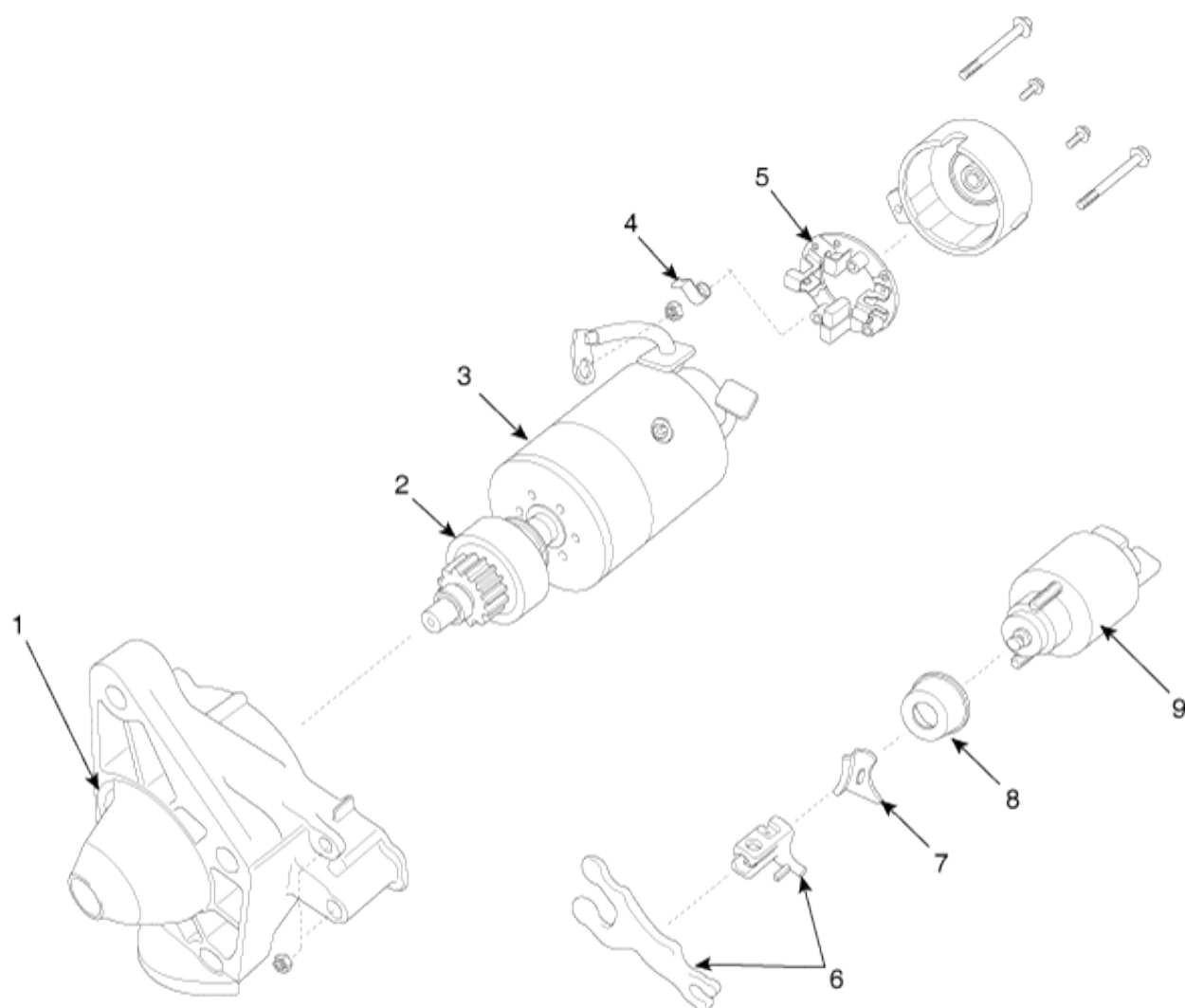
Current : Max.190 Amps

Speed : Min. 3,000 Rpm

Engine Electrical System

Starting System - Starter

COMPONENT

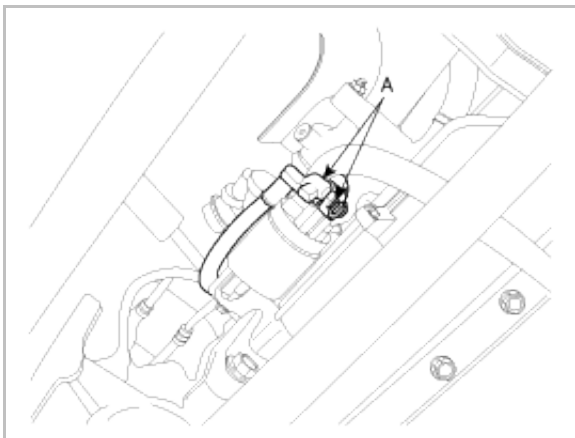


- | | |
|-------------------------------|-----------------------------|
| 1. Front bracket | 6. Shift pork assembly |
| 2. Overrun clutch assembly | 7. Shim |
| 3. Yoke assembly and armature | 8. Dust cover |
| 4. Spring brush | 9. Magnetic switch assembly |
| 5. Brush holder assembly | |



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.



Engine Electrical System

Preheating System



INSPECT

Conditions before inspection :

Battery voltage : 12V

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

(Disconnect the water temperature sensor connector).

CAUTION

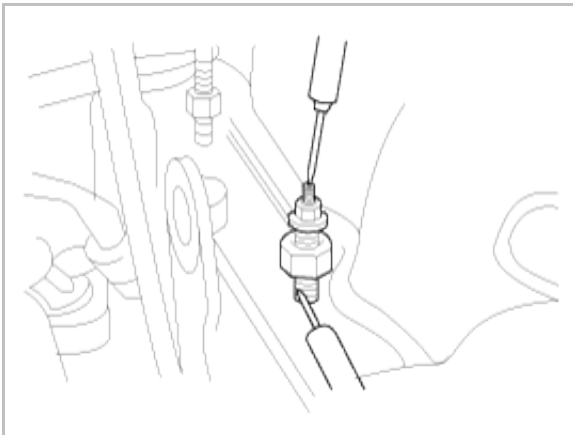
Reconnect the water temperature sensor connector after inspection.

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

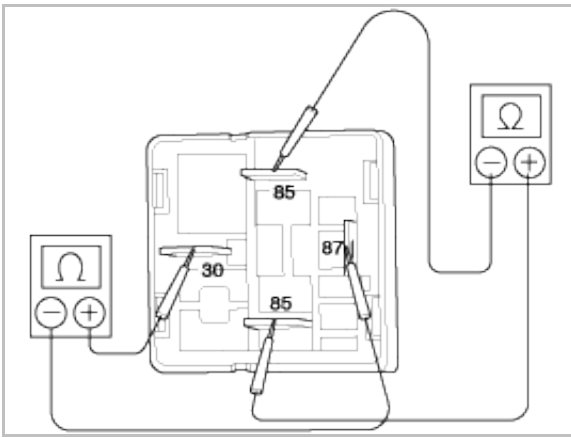
Continuity time varies depending upon cooling water temperature.

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.

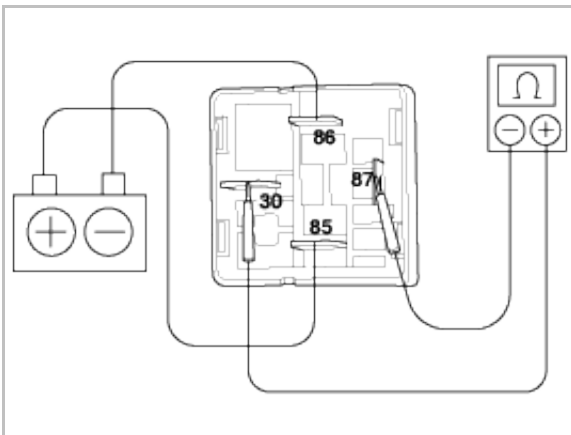


3. Inspect the relay operation.

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.

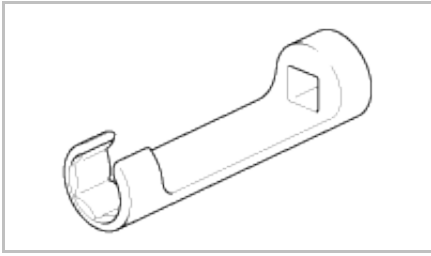
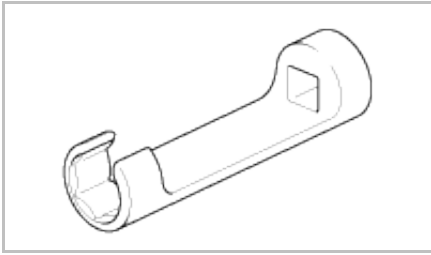
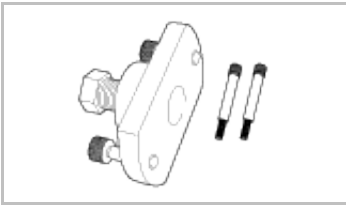


Fuel System

General Information



SPECIAL SERVICE TOOLS

Tool (Number and name)	Illustration	Application
Torque Wrench Socket (17mm) 09314-27120		Installing the high pressure pipe
Torque Wrench Socket (19mm) 09314-27130		Installing the high pressure pipe
High pressure pump pulley puller (OK552-131-003)		Removing the high pressure pump pulley

**SPECIFICATION****FUEL DELIVERY SYSTEM**

Items	Specification	
Fuel tank	Capacity	80ℓ
Fuel pump	Type	High Pressure Pump(Volume metric-blade type)
Fuel Filter	Type	High Pressure Type
Fuel Pressure	Regulated Fuel Pressure	1,600 bar (1,631.5 kgf/cm ²)

SENSOR**MASS AIR FLOW SENSOR (MAFS)**

▷ Type: Hot-film type

▷ Specification

Air Flow (kg/h)	Voltage (V)
10.0	1.23
15.0	1.37
30.0	1.70
60.0	2.18
120.0	2.75
250.0	3.47
370.0	3.92
480.0	4.23
640.0	4.61

INTAKE AIR TEMPERATURE SENSOR (IATS)

▷ Type: Thermistor type

▷ Specification

Temperature		Resistance (kΩ)
°C	°F	
-40	-40	35.14 ~ 43.76
-20	-4	12.66 ~ 15.12
0	32	5.12 ~ 5.89
20	68	2.29 ~ 2.55
40	104	1.10 ~ 1.24
60	140	0.57 ~ 0.65
80	176	0.31 ~ 0.37

ENGINE COOLANT TEMPERATURE SENSOR (ECTS)

▷ Type: Thermistor type

▷ Specification

Temperature		Resistance (kΩ)
°C	°F	

-40	-40	44.4
-20	-4	13.44 ~ 16.83
0	2	5.74
20	68	2.27 ~ 2.64
40	104	1.15
60	140	0.58
80	176	0.31 ~ 0.33

ACCELERATOR POSITION SENSOR (APS)

▷ Type: Variable resistor type

▷ Specification

Accelerator Position	Output Voltage (V) [Vref = 5.0V]	
	APS1	APS2
C.T	0.64 ~ 0.86V	0.275 ~ 0.475V
W.O.T	3.8 ~ 4.4V	1.75 ~ 2.35V

Item	Sensor Resistance (kΩ)
APS1	0.7 ~ 1.3kΩ [20°C(68°F)]
APS2	0.7 ~ 1.3kΩ [20°C(68°F)]

CAMSHAFT POSITION SENSOR (CMPS)

▷ Type: Hall effect type

CRANKSHAFT POSITION SENSOR (CKPS)

▷ Type: Magnetic field sensitive type

▷ Specification

Item	
Coil Resistance (Ω)	774 ~ 946Ω [20°C(68°F)]
Air Gap (mm)	0.5 ~ 1.5

KNOCK SENSOR (KS)

▷ Type: Piezo-electricity type

▷ Specification

Item	Specification
Capacitance (pF)	800 ~ 1,600pF

Rail Pressure Sensor (RPS)

▷ Specification

Rail Pressure (bar)	Output Voltage (V)
0	0.46 ~ 0.54
230	1.00 ~ 1.01
400	1.37 ~ 1.40
600	1.81 ~ 1.85
800	2.25 ~ 2.3
1,000	2.69 ~ 2.75

1,200	3.12 ~ 3.22
1,400	3.55 ~ 3.67
1,600	3.93 ~ 4.18

Fuel Temperature Sensor (FTS)

▷ Type: Thermistor type

▷ Specification

Temperature		Resistance (kΩ)
°C	°F	
-40	-40	82.78 ~ 68.78
-20	-4	24.03 ~ 19.71
0	32	7.97 ~ 6.74
20	68	2.98 ~ 2.65
40	104	1.26 ~ 1.14
60	140	0.59 ~ 0.54
80	176	0.29 ~ 0.28

ACTUATORS

INJECTOR

▷ Number: 4

▷ Specification

Item	Specification
Minimum Operation Pressure	100 bar

Inlet Metering Valve (IMV)

▷ Specification

Item	Specification
Coil Resistance (Ω)	5.5Ω [20°C(68°F)]

EGR Solenoid Valve

▷ Specification

Item	Specification
Coil Resistance (Ω)	14.7 ~ 16.1Ω[20°C(68°F)]

Throttle Control Solenoid Valve

▷ Specification

Item	Specification
Coil Resistance (Ω)	28.3 ~ 31.1Ω [20°C(68°F)]

SERVICE STANDARD

Idle Speed	800±100 rpm
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TIGHTENING TORQUES

Engine Control System

Items	Kgf·m	N·m	lbf·ft
ECM installation bolts (On bracket)	0.7 ~ 1.0	5.9 ~ 9.8	4.3 ~ 7.2
ECM installation nuts (On bracket)	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
ECM Bracket installation nuts	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Knock sensor installation	0.15 ~ 0.25	1.5 ~ 2.5	1.1 ~ 1.8
Solenoid assembly bracket installation bolts	0.7 ~ 0.9	6.9 ~ 8.8	5.1 ~ 6.5
Crankshaft Position Sensor (CKPS) installation bolts	0.9 ~ 1.0	8.8 ~ 9.8	6.5 ~ 7.2
Mass Air Flow Sensor (MAFS) clamp installation bolts	0.3 ~ 0.5	2.9 ~ 4.9	2.2 ~ 3.6

Fuel Delivery System

Items	Kgf·m	N·m	lbf·ft
High Pressure Pipe (Injector ↔ Common Rail) installation flange nuts	3.65 ~ 4.35	35.8 ~ 42.7	26.4 ~ 31.5
High Pressure Pipe (Common Rail ↔ High pressure pump) installation flange nuts	3.65 ~ 4.35	35.8 ~ 42.7	26.4 ~ 31.5
Common Rail installation nuts	1.9 ~ 2.3	18.6 ~ 22.6	13.7 ~ 16.6
High Pressure Pipe (Common Rail ↔ High pressure pump) clamp installation bolts	0.3	2.9	2.2
High pressure pump installation bolts (Timing case)	2.2 ~ 2.6	21.6 ~ 25.5	15.9 ~ 18.8
High pressure pump installation bolts (Bracket)	2.2 ~ 2.6	21.6 ~ 25.5	15.9 ~ 18.8
High pressure pump bracket installation bolts (Cylinder block)	3.5 ~ 4.1	34.3 ~ 40.2	25.3 ~ 29.7
Injector clamp installation bolts	2 ~ 2.2	19.6 ~ 21.6	14.5 ~ 15.9
Fuel tank band installation bolts	4.5 ~ 6	44.1 ~ 58.9	32.6 ~ 43.4
Fuel filter bracket installation bolts	1.9 ~ 2.8	18.6 ~ 27.5	13.7 ~ 20.3
Fuel Sender installation bolts	0.2 ~ 0.3	2 ~ 2.9	1.4 ~ 2.2
Accelerator Pedal Module installation bolts	0.8 ~ 1.0	7.8 ~ 9.8	5.8 ~ 7.2

**BASIC TROUBLESHOOTING****BASIC TROUBLESHOOTING GUIDE**

1	Bring Vehicle to Workshop
2	Analyze Customer's Problem
	Ask the customer about the conditions and environment relative to the issue (Use CUSTOMER PROBLEM ANALYSIS SHEET).
3	Verify Symptom, and then Check DTC and Freeze Frame Data
	- Connect Hi-Scan (Pro) to Diagnostic Link Connector (DLC). - Record the DTC and freeze frame data.  NOTE <i>To erase DTC and freeze frame data, refer to Step 5.</i>
4	Confirm the Inspection Procedure for the System or Part
	Using the SYMPTOM TROUBLESHOOTING GUIDE CHART, choose the correct inspection procedure for the system or part to be checked.
5	Erase the DTC and Freeze Frame Data
	 WARNING NEVER erase DTC and freeze frame data before completing Step 2 MIL/DTC in "CUSTOMER PROBLEM ANALYSIS SHEET".
6	Inspect Vehicle Visually
	Go to Step 11, if you recognize the problem.
7	Recreate (Simulate) Symptoms the DTC
	- Try to recreate or simulate the symptoms and conditions of the malfunction as described by customer. - If DTC(s) is/are displayed, simulate the condition according to troubleshooting procedure for the DTC.
8	Confirm Symptoms of Problem
	- If DTC(s) is/are not displayed, go to Step 9. - If DTC(s) is/are displayed, go to Step 11.
9	Recreate (Simulate) Symptom
	Try to recreate or simulate the condition of the malfunction as described by the customer.
10	Check the DTC
	- If DTC(s) does(do) not occur, refer to INTERMITTENT PROBLEM PROCEDURE in BASIC INSPECTION PROCEDURE. - If DTC(s) occur(s), go to Step 11.
11	Perform troubleshooting procedure for DTC
12	Adjust or repair the vehicle
13	Confirmation test
14	END

CUSTOMER PROBLEM ANALYSIS SHEET**1. VEHICLE INFORMATION**

(I) VIN:

(II) Production Date:

(III) Odometer Reading: (mile/km)

2. SYMPTOMS

☐ Unable to start	☐ Engine does not turn over ☐ Incomplete combustion ☐ Initial combustion does not occur
☐ Difficult to start	☐ Engine turns over slowly ☐ Other _____
☐ Poor idling	☐ Rough idling ☐ Incorrect idling ☐ Unstable idling (High: _____ rpm, Low: _____ rpm) ☐ Other _____
☐ Engine stall	☐ Soon after starting ☐ After accelerator pedal depressed ☐ After accelerator pedal released ☐ During A/C ON ☐ Shifting from N to D-range ☐ Other _____
☐ Others	☐ Poor driving (Surge) ☐ Knocking ☐ Poor fuel economy ☐ Back fire ☐ After fire ☐ Other _____

3. ENVIRONMENT

Problem frequency	☐ Constant ☐ Sometimes (_____) ☐ Once only ☐ Other _____
Weather	☐ Fine ☐ Cloudy ☐ Rainy ☐ Snowy ☐ Other _____
Outdoor temperature	Approx. _____ °C/°F
Place	☐ Highway ☐ Suburbs ☐ Inner City ☐ Uphill ☐ Downhill ☐ Rough road ☐ Other _____
Engine temperature	☐ Cold ☐ Warming up ☐ After warming up ☐ Any temperature
Engine operation	☐ Starting ☐ Just after starting (____ min) ☐ Idling ☐ Racing ☐ Driving ☐ Constant speed ☐ Acceleration ☐ Deceleration ☐ A/C switch ON/OFF ☐ Other _____

4. MIL/DTC

MIL (Malfunction Indicator Lamp)		☐ Remains ON ☐ Sometimes lights up ☐ Does not light
DTC	Normal Check (Pre-check)	☐ Normal ☐ DTC (_____) ☐ Freeze Frame Data
	Check mode	☐ Normal ☐ DTC (_____) ☐ Freeze Frame Data

BASIC INSPECTION PROCEDURE

The measured resistance at high temperature after vehicle running may be high or low. So all resistance must be measured at ambient temperature (20°C, 68°F), unless there is any notice.

NOTICE

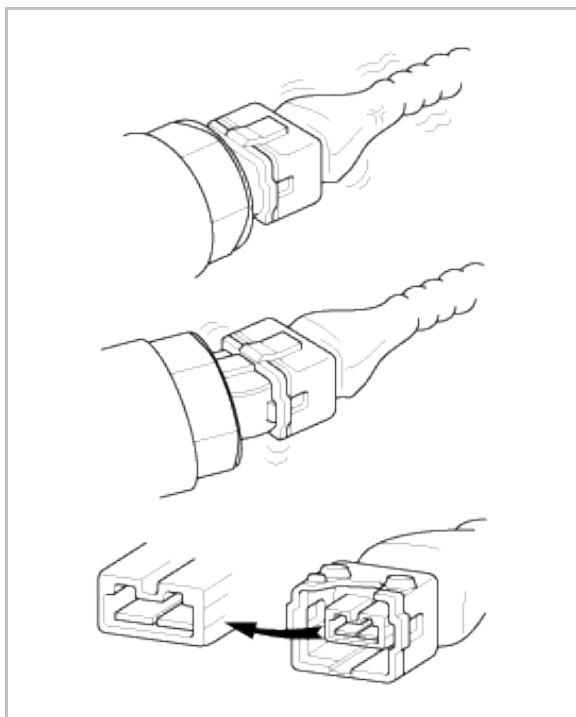
The measured resistance in except for ambient temperature (20°C, 68°F) is reference value.

Sometimes the most difficult case in troubleshooting is when a problem symptom occurs but does not occur again during testing. An example would be if a problem appears only when the vehicle is cold but has not appeared when warm. In this case, technician should thoroughly make out a "CUSTOMER PROBLEM ANALYSIS SHEET" and recreate (simulate) the environment and condition which occurred when the vehicle was having the issue.

1. Clear Diagnostic Trouble Code (DTC).

2. Inspect connector connection, and check terminal for poor connections, loose wires, bent, broken or corroded pins,

and then verify that the connectors are always securely fastened.



3. Slightly shake the connector and wiring harness vertically and horizontally.
4. Repair or replace the component that has a problem.
5. Verify that the problem has disappeared with the road test.

- **SIMULATING VIBRATION**

- 1) Sensors and Actuators

: Slightly vibrate sensors, actuators or relays with finger.

WARNING

Strong vibration may break sensors, actuators or relays

- 2) Connectors and Harness

: Lightly shake the connector and wiring harness vertically and then horizontally.

- **SIMULATING HEAT**

- 1) Heat components suspected of causing the malfunction with a hair dryer or other heat source.

WARNING

- DO NOT heat components to the point where they may be damaged.
- DO NOT heat the ECM directly.

- **SIMULATING WATER SPRINKLING**

- 1) Sprinkle water onto vehicle to simulate a rainy day or a high humidity condition.

WARNING

DO NOT sprinkle water directly into the engine compartment or electronic components.

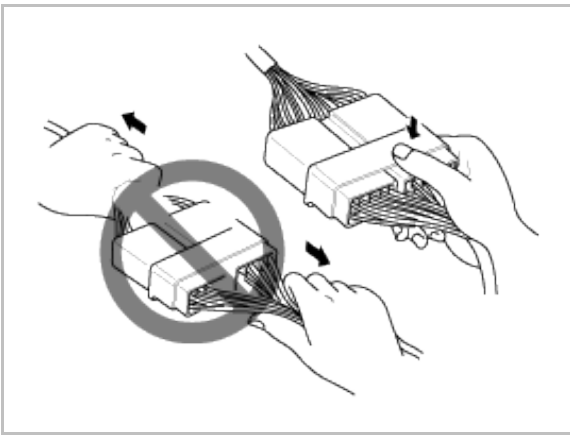
- **SIMULATING ELECTRICAL LOAD**

- 1) Turn on all electrical systems to simulate excessive electrical loads (Radios, fans, lights, etc.).

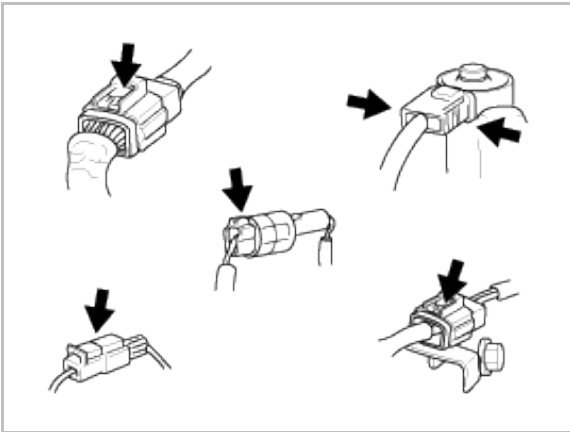
CONNECTOR INSPECTION PROCEDURE

1. Handling of Connector

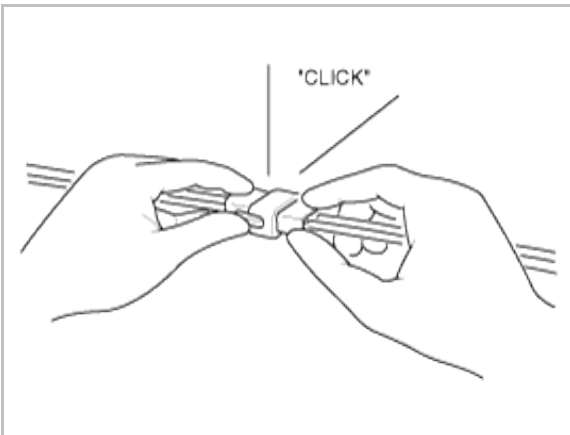
A. Never pull on the wiring harness when disconnecting connectors.



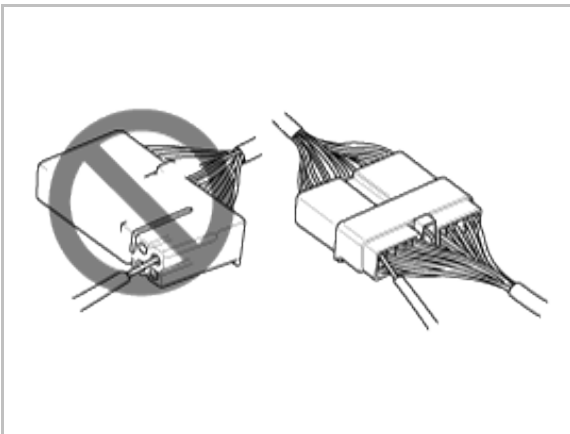
B. When removing the connector with a lock, press or pull locking lever.



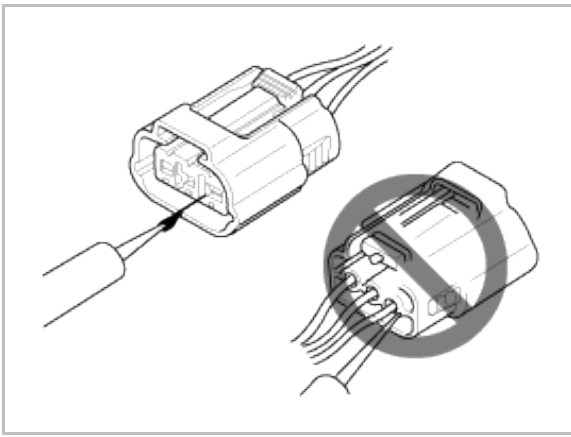
C. Listen for a click when locking connectors. This sound indicates that they are securely locked.



D. When a tester is used to check for continuity, or to measure voltage, always insert tester probe from wire harness side.



E. Check waterproof connector terminals from the connector side. Waterproof connectors cannot be accessed from harness side.



NOTICE

- Use a fine wire to prevent damage to the terminal.
- Do not damage the terminal when inserting the tester lead.

2. Checking Point for Connector

A. While the connector is connected:

Hold the connector, check connecting condition and locking efficiency.

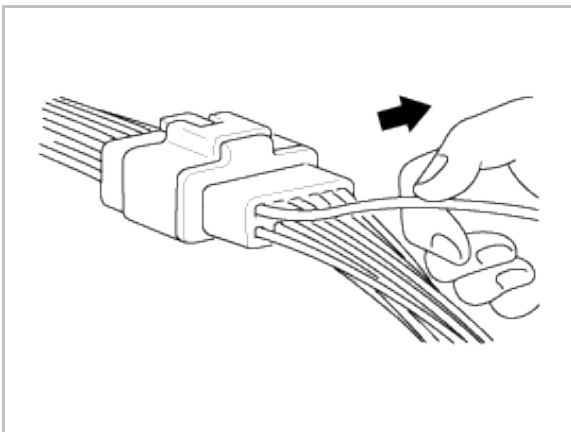
B. When the connector is disconnected:

Check missed terminal, crimped terminal or broken core wire by slightly pulling the wire harness. Visually check for rust, contamination, deformation and bend.

C. Check terminal tightening condition:

Insert a spare male terminal into a female terminal, and then check terminal tightening conditions.

D. Pull lightly on individual wires to ensure that each wire is secured in the terminal.



3. Repair Method of Connector Terminal

A. Clean the contact points using air gun and/or shop rag.

NOTICE

Never use sand paper when polishing the contact points, otherwise the contact point may be damaged.

B. In case of abnormal contact pressure, replace the female terminal.

WIRE HARNESS INSPECTION PROCEDURE

1. Before removing the wire harness, check the wire harness position and crimping in order to restore it correctly.
2. Check whether the wire harness is twisted, pulled or loosened.
3. Check whether the temperature of the wire harness is abnormally high.
4. Check whether the wire harness is rotating, moving or vibrating against the sharp edge of a part.
5. Check the connection between the wire harness and any installed part.
6. If the covering of wire harness is damaged; secure, repair or replace the harness.

ELECTRICAL CIRCUIT INSPECTION PROCEDURE

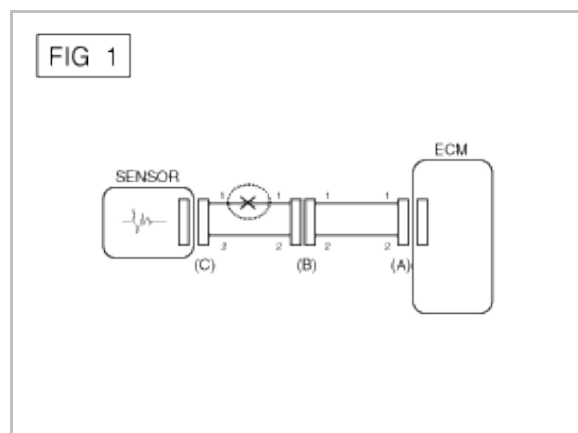
• CHECK OPEN CIRCUIT

1. Procedures for Open Circuit

A. Continuity Check

B. Voltage Check

If an open circuit occurs (as seen in [FIG. 1]), it can be found by performing Step 2 (Continuity Check Method) or Step 3 (Voltage Check Method) as shown below.



2. Continuity Check Method

NOTICE

When measuring for resistance, lightly shake the wire harness above and below or from side to side.

Specification (Resistance)

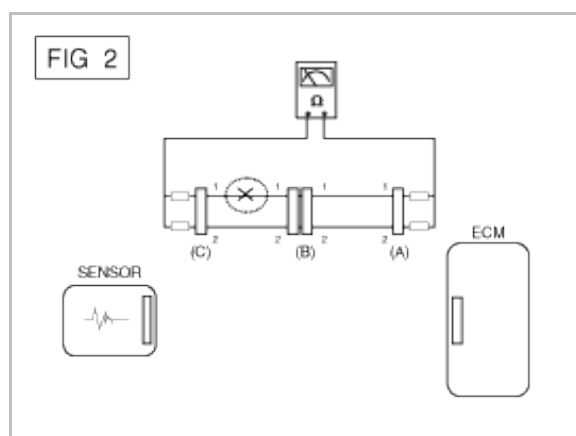
1 Ω or less → Normal Circuit

1 M Ω or Higher → Open Circuit

A. Disconnect connectors (A), (C) and measure resistance between connector (A) and (C) as shown in [FIG. 2].

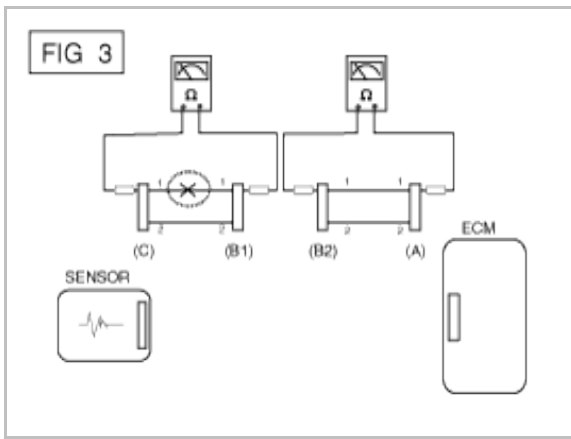
In [FIG.2.] the measured resistance of line 1 and 2 is higher than 1 Ω M Ω and below 1 Ω respectively.

Specifically the open circuit is line 1 (Line 2 is normal). To find exact break point, check sub line of line 1 as described in next step.



B. Disconnect connector (B), and measure for resistance between connector (C) and (B1) and between (B2) and (A) as shown in [FIG. 3].

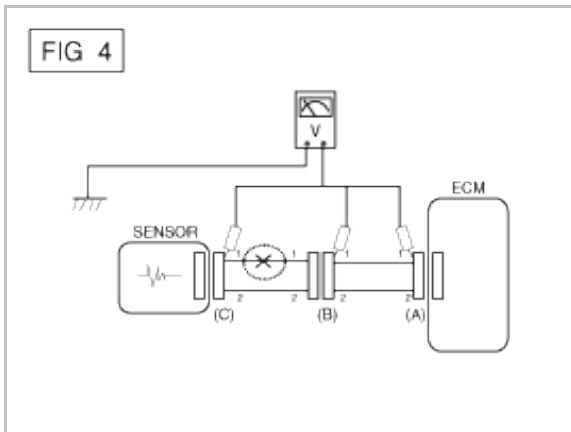
In this case the measured resistance between connector (C) and (B1) is higher than 1M Ω and the open circuit is between terminal 1 of connector (C) and terminal 1 of connector (B1).



3. Voltage Check Method

A. With each connector still connected, measure the voltage between the chassis ground and terminal 1 of each connectors (A), (B) and (C) as shown in [FIG. 4].

The measured voltage of each connector is 5V, 5V and 0V respectively. So the open circuit is between connector (C) and (B).

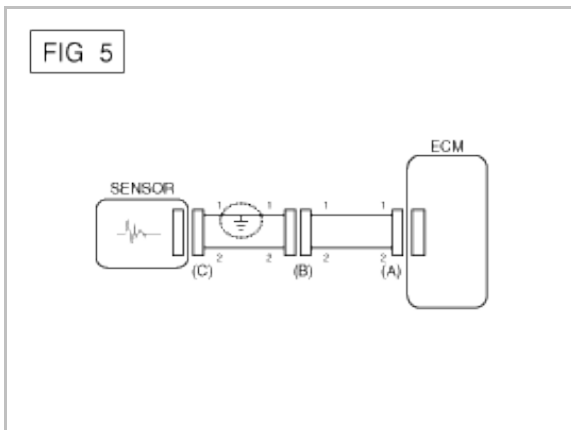


• CHECK SHORT CIRCUIT

1. Test Method for Short to Ground Circuit

• Continuity Check with Chassis Ground

If short to ground circuit occurs as shown in [FIG. 5], the broken point can be found by performing below Step 2 (Continuity Check Method with Chassis Ground) as shown below.



2. Continuity Check Method (with Chassis Ground)

NOTICE

Lightly shake the wire harness above and below, or from side to side when measuring the resistance.

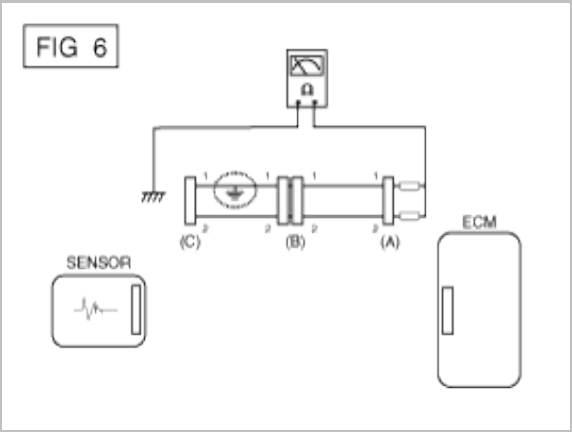
Specification (Resistance)

1Ω or less → Short to Ground Circuit

1MΩ or Higher → Normal Circuit

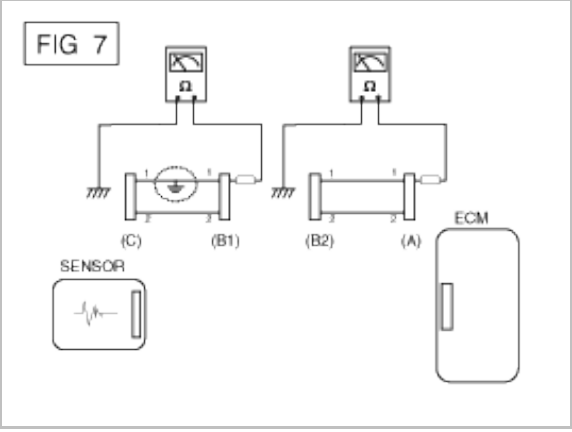
1) Disconnect connectors (A), (C) and measure for resistance between connector (A) and Chassis Ground as shown in [FIG. 6].

The measured resistance of line 1 and 2 in this example is below 1 Ω and higher than 1MΩ respectively. Specifically the short to ground circuit is line 1 (Line 2 is normal). To find exact broken point, check the sub line of line 1 as described in the following step.



2) Disconnect connector (B), and measure the resistance between connector (A) and chassis ground, and between (B1) and chassis ground as shown in [FIG. 7].

The measured resistance between connector (B1) and chassis ground is 1Ω or less. The short to ground circuit is between terminal 1 of connector (C) and terminal 1 of connector (B1).



SYMPTOM TROUBLESHOOTING GUIDE TABLE

(SYMPTOM 1) ENGINE DOES NOT START

Possible Cause	
• Run out of fuel • Starter faulty • Fuel pump hose supply cut • High pressure leakage • Fuse out of order • The compensation of individual injector not adapted • Drift of the rail pressure sensor not detected • Cam and Crank signals missing simultaneously • Battery voltage too low • Faulty immobilizer • EGR valve blocked open • Inlet metering valve contaminated, stuck, jammed • Fuel quality / presence of water	• Inversion of low pressure fuel connections • Fuel filter not adapted • Low pressure fuel circuit sealed • Sealed fuel filter • Intermittent fault connection • Air ingress in the low pressure fuel circuit • Fuel return circuit of the pump sealed • Engine compression too low • Leakage at the injector • Low pressure fuel pump faulty • High pressure fuel pump faulty • Injector jammed open • Bug software or hardware fault not detected

(SYMPTOM 2) ENGINE STARTS WITH DIFFICULTY OR STARTS AND STALLS

Possible Cause

- Run out of fuel
- Fuel return hose of injector cut
- High pressure leakage
- Fuse faulty
- Air filter sealed
- Alternator or voltage regulator faulty
- The compensation of individual injector not adapted
- Drift of the engine coolant temperature sensor not detected
- Drift of the rail pressure sensor not detected
- Battery voltage too low
- EGR valve blocked open
- Inlet metering valve contaminated, stuck, jammed
- Fuel quality / presence of water
- Inversion of low pressure fuel connections

- Low pressure fuel circuit sealed
- Sealed fuel filter
- Oil level too high/too low
- Catalytic converter sealed or damaged
- Intermittent fault connection
- Air ingress in the low pressure fuel circuit
- Fuel return circuit of the pump sealed
- Glow system faulty
- Engine compression too low
- Fuel return hose of injector sealed
- Carbon deposit on the injector (sealed holes)
- Needle stuck (injection possible over a certain pressure)
- Gasoline in fuel
- Bug software or hardware fault not detected

(SYMPTOM 3) POOR STARTING WHEN HOT

Possible Cause	
• The compensation of individual injector not adapted • Drift of the rail pressure sensor not detected • EGR valve blocked open • Inlet metering valve contaminated, stuck, jammed • Air filter sealed • Air ingress in the low pressure fuel circuit • Fuel quality / presence of water • Bug software or hardware fault not detected	• Fuel return circuit of the pump sealed • Sealed fuel filter • Engine compression too low • Intermittent fault connection • Carbon deposit on the injector (sealed holes) • Needle stuck (injection possible over a certain pressure) • Gasoline in fuel

(SYMPTOM 4) UNSTABLE IDLING

Possible Cause	
• Fuel return hose of injector cut • The compensation of individual injector not adapted • Drift of the rail pressure sensor not detected • Harness resistance increased • Air ingress in the low pressure fuel circuit • Fuel quality / presence of water • Sealed fuel filter • Air filter sealed • Fuel return hose of injector sealed	• High pressure leakage • Glow system faulty • Engine compression too low • Bad flanging of the injector • High pressure pump out of order • Injector not adapted • Carbon deposit on the injector (sealed holes) • Needle stuck (injection possible over a certain pressure) • Injector jammed open

(SYMPTOM 5) IDLE SPEED TOO HIGH OR TOO LOW

Possible Cause	
• Drift of the engine coolant temperature sensor not detected • Incorrect state of the electrical pack devices • Alternator or voltage regulator faulty	• Clutch not well set • Bug software or hardware fault not detected

(SYMPTOM 6) BLUE, WHITE, OR BLACK SMOKES

Possible Cause

• The compensation of individual injector not adapted • Drift of the engine coolant temperature sensor not detected • Drift of the rail pressure sensor not detected • EGR valve blocked open • Inlet metering valve contaminated, stuck, jammed • Oil level too high/too low • Fuel quality / presence of water • Catalytic converter sealed or damaged • Air filter sealed	• Oil suction (engine racing) • Glow system faulty • Engine compression too low • Bad flanging of the injector • Injector washer not adapted, forgotten, doubled • Injector not adapted • Carbon deposit on the injector (sealed holes) • Injector jammed open • Gasoline in fuel
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(SYMPTOM 7) ENGINE RATTLING, NOISY ENGINE

Possible Cause	
• The compensation of individual injector not adapted • EGR valve blocked closed (noisy engine) • EGR valve blocked open • Drift of the engine coolant temperature sensor not detected • Glow system faulty • Engine compression too low • Fuel return hose of injector sealed	• Drift of the rail pressure sensor not detected • Injector washer not adapted, forgotten, doubled • Injector not adapted • Carbon deposit on the injector (sealed holes) • Needle stuck (injection possible over a certain pressure) • Injector jammed open

(SYMPTOM 8) BURST NOISE

Possible Cause	
• The compensation of individual injector not adapted • Intermittent fault connection • Exhaust system sealed	• Drift of the rail pressure sensor not detected • Inlet metering valve contaminated, stuck, jammed • Bug software or hardware fault not detected

(SYMPTOM 9) UNTIMELY ACCELERATION/DECELERATION AND ENGINE RACING

Possible Cause	
• Accelerator position sensor blocked • EGR valve blocked open • Intermittent fault connection	• Oil suction (engine racing) • Drift of the rail pressure sensor not detected • Bug software or hardware fault not detected

(SYMPTOM 10) GAP WHEN ACCELERATING AND AT RE-COUPLING (RESPONSE TIME)

Possible Cause	
• Air inlet circuit open • Incorrect state of the electrical pack devices • Accelerator position sensor blocked • EGR valve blocked open • Turbo charger damaged • Sealed fuel filter	• Engine compression too low • High pressure leakage • Inlet metering valve contaminated, stuck, jammed • Needle stuck (injection possible over a certain pressure) • Bug software or hardware fault not detected

(SYMPTOM 11) ENGINE STOP OR STALLING

Possible Cause	
• Run out of fuel • Fuel pump hose supply cut	• Inlet metering valve contaminated, stuck, jammed • Alternator or voltage regulator faulty

- High pressure leakage
- Fuse faulty
- Fuel quality / presence of water
- Low pressure fuel circuit sealed
- Sealed fuel filter
- Cam and Crank signals missing simultaneously
- EGR valve blocked open
- Bug software or hardware fault not detected

- Intermittent fault connection
- Catalytic converter sealed or damaged
- Oil suction (engine racing)
- Low pressure fuel pump faulty
- High pressure pump faulty
- Faulty ignition key
- Gasoline in fuel

(SYMPTOM 12) ENGINE JUDDER

Possible Cause	
• Run out of fuel • Fuel return hose of injector cut • Incorrect state of the electrical pack devices • The compensation of individual injector not adapted • EGR valve blocked open • Fuel filter not adapted • Air ingress in the low pressure fuel circuit • Fuel quality / presence of water • Sealed fuel filter • Intermittent fault connection • Harness resistance increased	• Glow system faulty • Engine compression too low • Fuel return hose of injector sealed • Valve clearance • Low pressure fuel pump faulty • Injector washer not adapted, forgotten, doubled • Carbon deposit on the injector (sealed holes) • Needle stuck (injection possible over a certain pressure) • Injector jammed open • Gasoline in fuel • Bug software or hardware fault not detected

(SYMPTOM 13) LACK OF POWER

Possible Cause	
• The compensation of individual injector not adapted • Accelerator position sensor blocked • Incorrect state of the electrical pack devices • EGR valve blocked open • Air inlet circuit open • Air filter sealed • Oil level too high/too low • Catalytic converter sealed or damaged • Turbo charger damaged	• Sealed fuel filter • Leakage at the injector • Fuel return circuit of the pump sealed • Fuel return hose of injector sealed • Engine compression too low • Injector not adapted • Carbon deposit on the injector (sealed holes) • Valve clearance

(SYMPTOM 14) TOO MUCH POWER

Possible Cause	
• EGR valve blocked closed (noisy engine) • The compensation of individual injector not adapted	• Oil suction (engine racing) • Bug software or hardware fault not detected

(SYMPTOM 15) EXCESSIVE FUEL CONSUMPTION

Possible Cause	
• Fuel return hose of injector cut • Leakage at the Inlet metering valve • Leakage at fuel temperature sensor • Leakage at the spacers • High pressure leakage	• Incorrect state of the electrical pack devices • Oil level too high/too low • Fuel quality / presence of water • Catalytic converter sealed or damaged • Turbo charger damaged

- Air inlet circuit open
- Air filter sealed
- The compensation of individual injector not adapted
- EGR valve blocked open

- Engine compression too low
- Injector not adapted
- Bug software or hardware fault not detected

(SYMPTOM 16) OVER SPEED ENGINE WHEN CHANGING THE GEAR BOX RATIO

Possible Cause	
• Accelerator position sensor blocked • The compensation of individual injector not adapted • Intermittent fault connection • Clutch not well set	• Oil suction (engine racing) • Turbo charger damaged • Injector not adapted • Bug software or hardware fault not detected

(SYMPTOM 17) EXHAUST SMELLS

Possible Cause	
• EGR valve blocked open • Oil suction (engine racing) • Turbo charger damaged • Oil level too high/too low • The compensation of individual injector not adapted • Catalytic converter sealed or damaged • Bad flanging of the injector	• Injector washer not adapted, forgotten, doubled • Injector not adapted • Carbon deposit on the injector (sealed holes) • Needle stuck (injection possible over a certain pressure) • Injector jammed open • Bug software or hardware fault not detected

(SYMPTOM 18) SMOKES (BLACK, WHITE, BLUE) WHEN ACCELERATING

Possible Cause	
• The compensation of individual injector not adapted • EGR valve blocked open • Air filter sealed • Fuel quality / presence of water • Oil level too high/too low • Turbo charger damaged • Catalytic converter sealed or damaged • Oil suction (engine racing) • Air heaters out of order • Engine compression too low	• High pressure leakage • Intermittent fault connection • Bad flanging of the injector • Injector washer not adapted, forgotten, doubled • Injector not adapted • Carbon deposit on the injector (sealed holes) • Needle stuck (injection possible over a certain pressure) • Injector jammed open • Gasoline in fuel • Bug software or hardware fault not detected

(SYMPTOM 19) FUEL SMELLS

Possible Cause	
• Fuel pump hose supply cut • Fuel return hose of injector cut • Leakage at the Inlet metering valve	• Leakage at fuel temperature sensor • Leakage at the spacers • High pressure leakage

(SYMPTOM 20) THE ENGINE COLLAPSES AT TAKE OFF

Possible Cause	
• Accelerator position sensor blocked • Incorrect state of the electrical pack devices • Air filter sealed	• Catalytic converter sealed or damaged • Clutch not well set • Intermittent fault connection

- Inversion of low pressure fuel connections
- Fuel filter not adapted
- Fuel quality/presence of water
- Air ingress in the low pressure fuel circuit
- Sealed fuel filter

- Drift of the rail pressure sensor not detected
- Inlet metering valve contaminated, stuck, jammed
- Gasoline in fuel
- Bug software or hardware fault not detected

(SYMPTOM 21) THE ENGINE DOES NOT STOP

Possible Cause
• Faulty ignition key • Oil suction (engine racing) • Bug software or hardware fault not detected

(SYMPTOM 22) DIFFERENT MECHANICAL NOISES

Possible Cause	
• Buzzer noise (discharge by the injectors) • Clip broken (vibrations, resonance, noises) • Incorrect state of the electrical pack devices • Catalytic converter sealed or damaged • Air inlet circuit open	• Bad flanging of the injector • Clutch not well set • Turbo charger damaged • Valve clearance

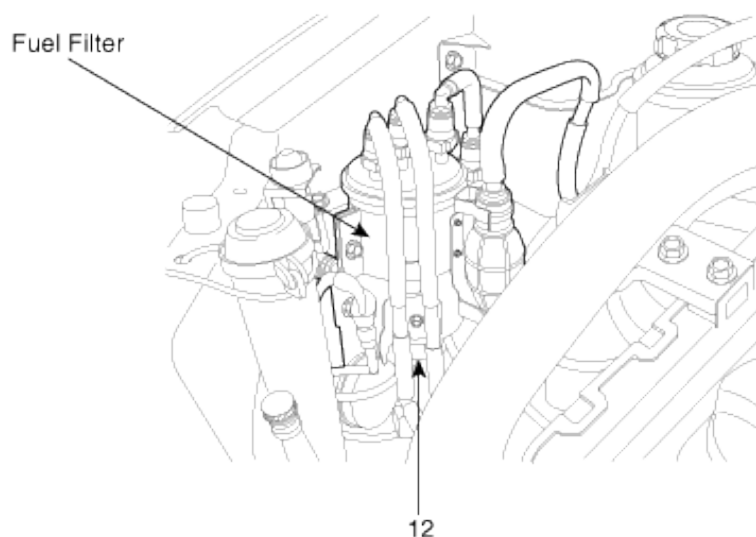
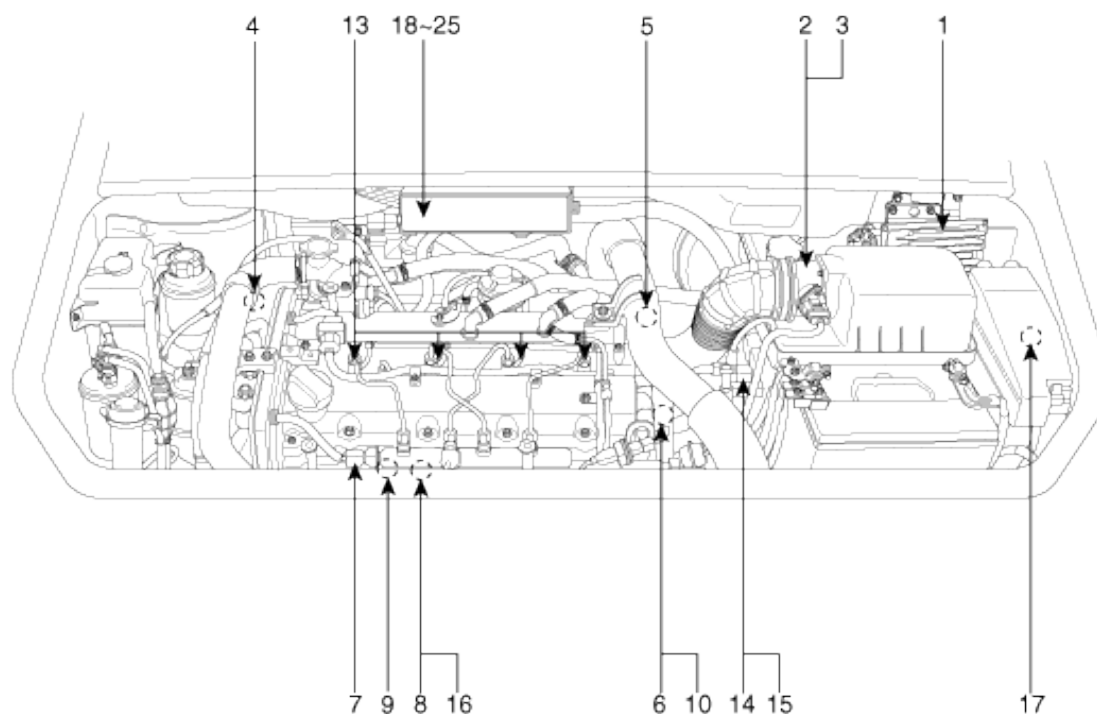


Fuel System

Engine Control System



COMPONENT LOCATION

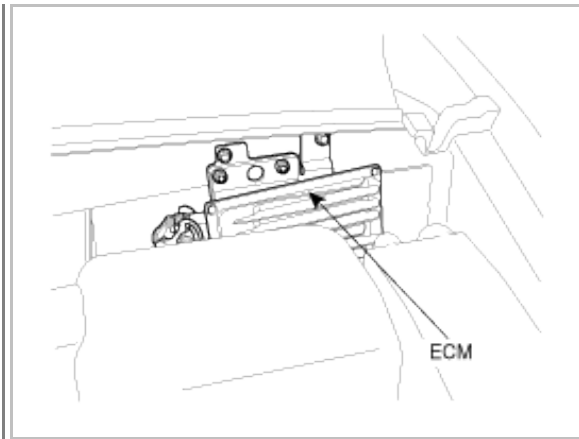


1. ECM (Engine Control Module)
2. Mass Air Flow Sensor (MAFS)
3. Intake Air Temperature Sensor (IATS)
4. Engine Coolant Temperature Sensor (ECTS)
5. Camshaft Position Sensor (CMPS)
6. Crankshaft Position Sensor (CKPS)
7. Rail Pressure Sensor (RPS)
8. Fuel Temperature Sensor (FTS)
9. Knock Sensor (KS)
10. Vehicle Speed Sensor (VSS)
11. Accelerator Position Sensor (APS)
12. Water Sensor
13. Injector

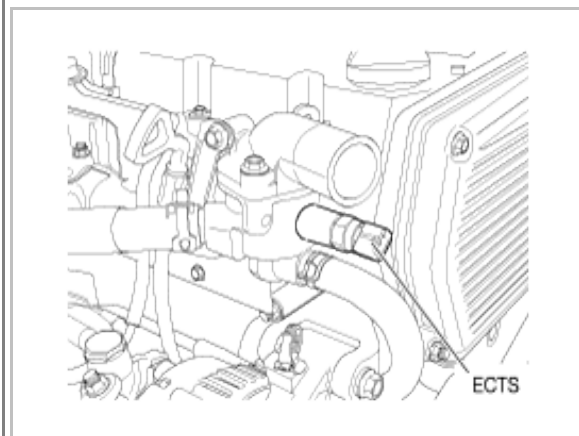
14. Throttle Control Solenoid valve
15. EGR Solenoid valve
16. Inlet Metering Valve (IMV)
17. Main relay
18. Air Heater relay #1
19. Air Heater relay #2
20. PTC Heater relay #1
21. PTC Heater relay #2
22. PTC Heater relay #3
23. Cooling Fan relay (High) #1
24. Cooling Fan relay (High) #2
25. Cooling Fan relay (Low)

1. ECM (Engine Control Module)

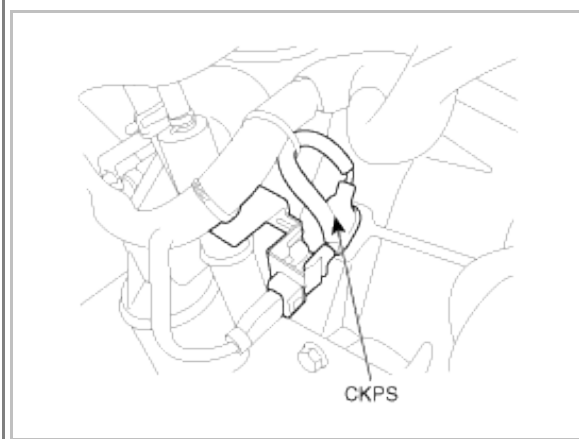
2. Mass Air Flow Sensor (MAFS)
3. Intake Air Temperature Sensor (IATS)



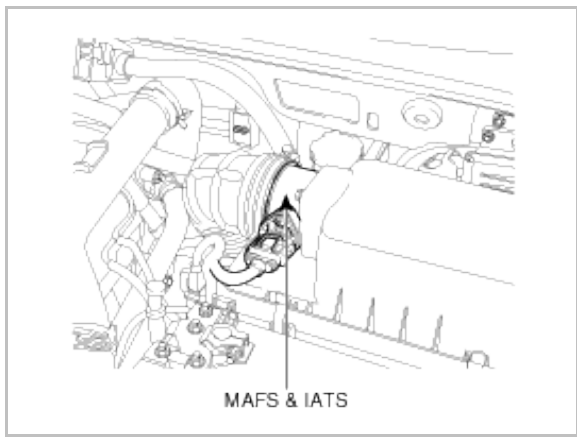
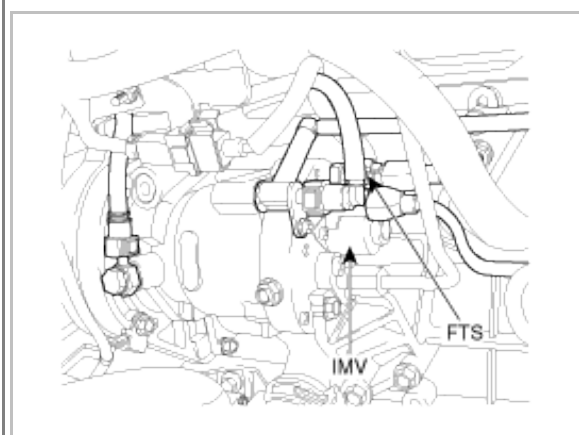
4. Engine Coolant Temperature Sensor (ECTS)



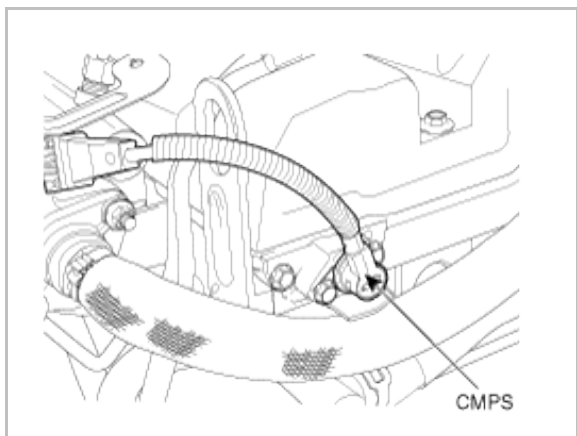
6. Crankshaft Position Sensor (CKPS)



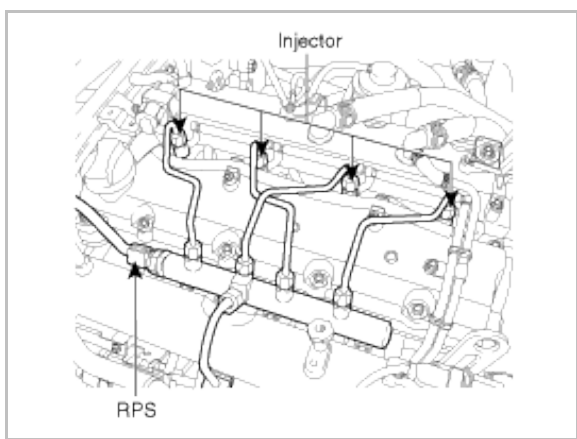
8. Fuel Temperature Sensor (FTS)
16. Inlet Metering Valve (IMV)



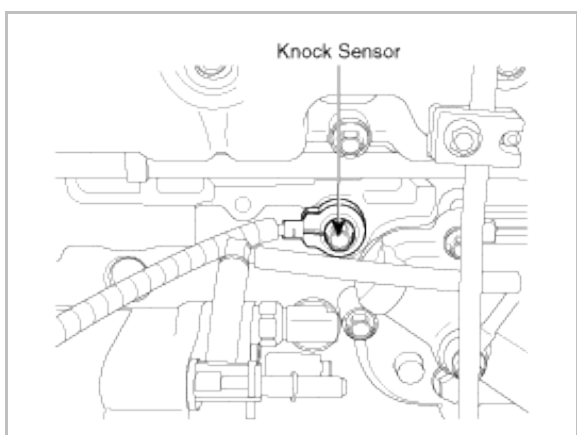
5. Camshaft Position Sensor (CMPS)



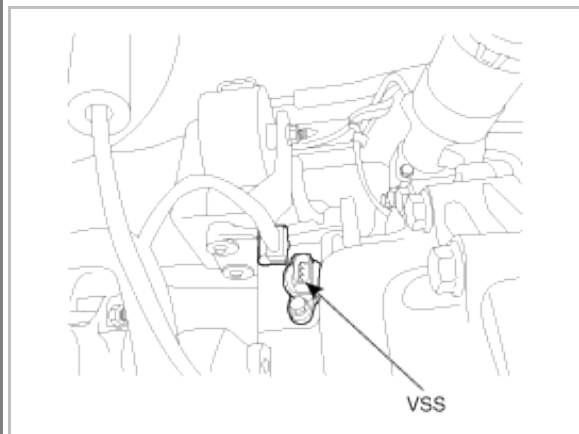
7. Rail Pressure Sensor (RPS)
13. Injector



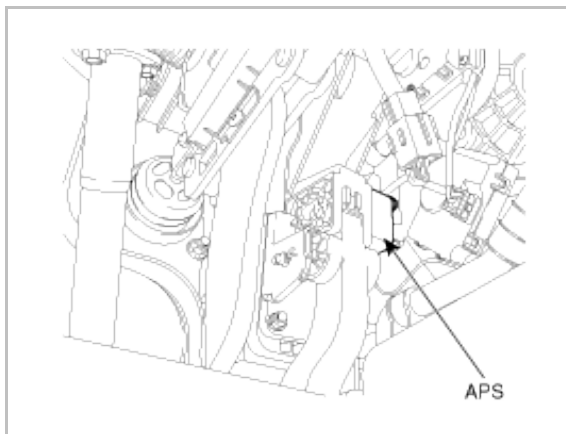
9. Knock Sensor(KS)



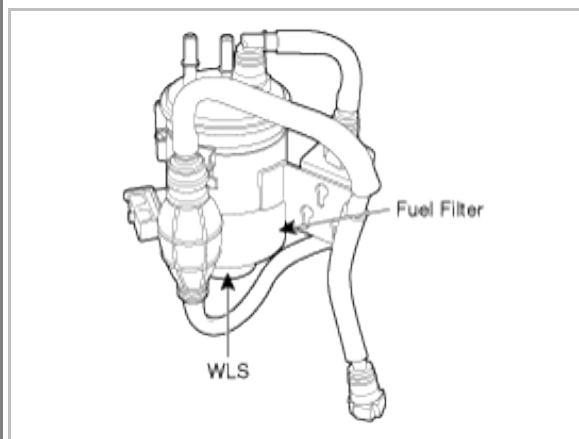
10. Vehicle Speed Sensor (VSS)



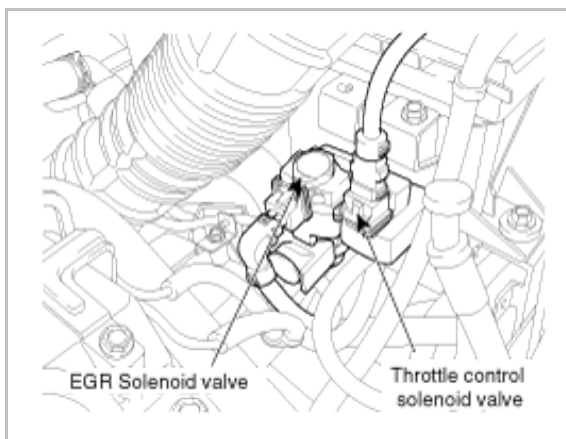
11. Accelerator Position Sensor (APS)



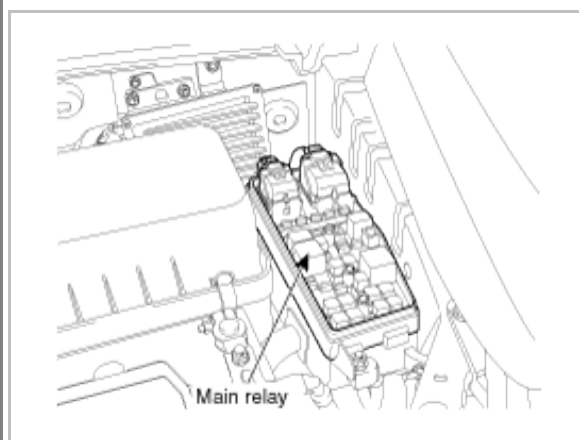
12. Water Sensor (WS)



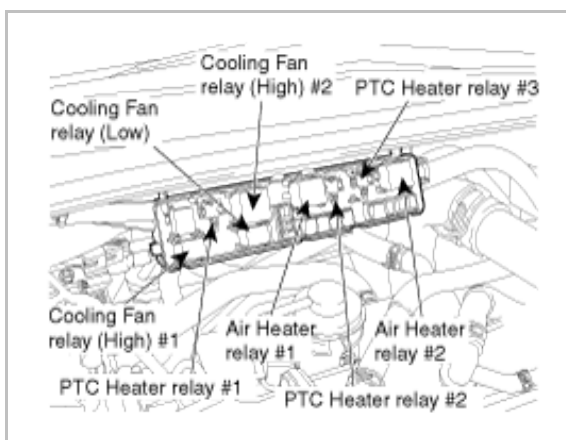
14. Throttle Control Solenoid valve
15. EGR Solenoid valve



17. Mail relay



18. Air Heater relay #1
19. Air Heater relay #2
20. PTC Heater relay #1
21. PTC Heater relay #2
22. PTC Heater relay #3
23. Cooling Fan relay (High) #1
24. Cooling Fan relay (High) #2
25. Cooling Fan relay (Low)



Fuel System

Engine Control System - Engine Control
Module (ECM)



ECM PROBLEM INSPECTION PROCEDURE

1. TEST ECM GROUND CIRCUIT: Measure resistance between ECM and chassis ground using the backside of ECM harness connector as ECM side check point. If the problem is found, repair it.

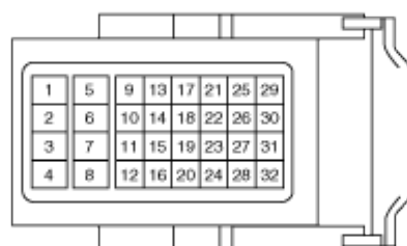
Specification (Resistance): 1Ω or less

2. TEST ECM CONNECTOR: Disconnect the ECM connector and visually check the ground terminal on ECM side and harness side for bent pins or poor contact pressure. If the problem is found, repair it.
3. If problem is not found in Step 1 and 2, the ECM could be faulty. If so, replace the ECM with a new one, and then check the vehicle again. If the vehicle operates normally then the problem was likely with the ECM.
4. RE-TEST THE ORIGINAL ECM: Install the original ECM (may be broken) into a known-good vehicle and check the vehicle. If the problem occurs again, replace the original ECM with a new one. If problem does not occur, this is intermittent problem (Refer to INTERMITTENT PROBLEM PROCEDURE in BASIC INSPECTION PROCEDURE).

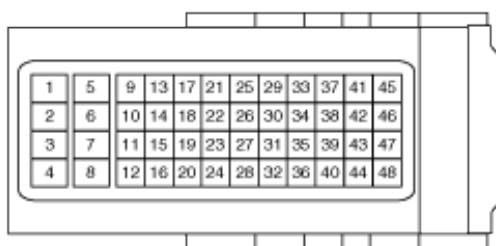


ECM (ENGINE CONTROL MODULE)

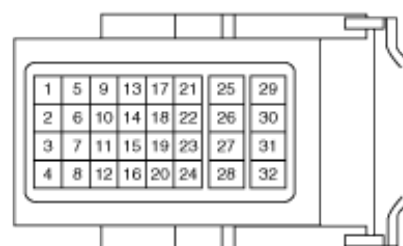
1. ECM HARNESS CONNECTOR



Connector [C06-1]



Connector [C06-2]



Connector [C06-3]

2. ECM TERMINAL FUNCTION

CONNECTOR [C06-1]

Pin	Description	Connected to
1	-	
2	Accelerator Position Sensor (APS) 1 signal input	Accelerator Position Sensor (APS) 1
3	Sensor ground	Accelerator Position Sensor (APS) 1
4	Power ground	Chassis Ground
5	Battery power	Main Relay
6	Reference voltage (+5V)	Accelerator Position Sensor (APS) 1
7	-	
8	Power ground	Chassis Ground
9	Malfunction Indicator Lamp (MIL) control output	Malfunction Indicator Lamp (MIL) in Cluster
10	Reference voltage (+5V)	Accelerator Position Sensor (APS) 2
11	Accelerator Position Sensor (APS) 2 signal input	Accelerator Position Sensor (APS) 2
12	Sensor ground	Accelerator Position Sensor (APS) 2
13	-	
14	Immobilizer Lamp control output	Immobilizer Lamp (Cluster)
15	-	
16	Brake Switch 1 signal input	Brake Switch
17	Battery power	
18	-	
19	-	
20	Fuel consumption signal output	Trip computer
21	Cruise control "MAIN" lamp control output	Cruise control "MAIN" lamp (Cluster)
22	-	
23	Water Sensor signal input	Water Sensor in Fuel Filter
24	[M/T only] Clutch Switch signal input	Clutch Switch
25	-	
26	Engine speed signal output	Tachometer (Cluster)

27	Immobilizer Communication Line	Immobilizer Control Module
28	Diagnostic K-Line	Data Link Connector (DLC)
29	Glow Time Indicator Lamp control output	Glow Time Indicator Lamp (Cluster)
30	[A/T only] P/N switch signal input	Inhibitor Switch
	[M/T Only] Gear Neutral Switch signal input	Gear Neutral Switch
31	CAN [LOW]	TCM, ESP Control Module
32	CAN [HIGH]	TCM, ESP Control Module

CONNECTOR [C06-2]

Pin	Description	Connected to
1	Sensor shield	Knock Sensor (KS)
2	-	
3	Throttle Control Solenoid valve control output	Throttle Control Solenoid Valve
4	Inlet Metering Valve (IMV) control output	Inlet Metering Valve (IMV)
5	Sensor shield	Crankshaft Position Sensor (CKPS)
6	-	
7	EGR Solenoid Valve control output	
8	-	
9	-	
10	Intake Air Temperature Sensor (IATS) signal input	Intake Air Temperature Sensor (IATS)
11	-	
12	-	
13	-	
14	Air heater Relay 2 diagnosis line	Glow Relay
15	-	
16	-	
17	-	
18	Engine Coolant Temperature Sensor (ECTS) signal input	Engine Coolant Temperature Sensor (ECTS)
19	Sensor ground	Engine Coolant Temperature Sensor (ECTS)
20	Injector (Cylinder #4) [LOW] control output	Injector (Cylinder #4)
21	Knock Sensor (KS) signal input	Knock Sensor (KS)
22	Fuel Temperature Sensor (FTS) signal input	Fuel Temperature Sensor (FTS)
23	Sensor ground	Fuel Temperature Sensor (FTS)
24	Injector (Cylinder #4) [HIGH] control output	Injector (Cylinder #4)
25	Sensor ground	Knock sensor (KS)
26	Crankshaft Position Sensor (CKPS) [+] signal input	Crankshaft Position Sensor (CKPS)
27	Crankshaft Position Sensor (CKPS) [-] signal input	Crankshaft Position Sensor (CKPS)
28	Injector (Cylinder #3) [LOW] control output	Injector (Cylinder #3)
29	Reference voltage (+5V)	Camshaft Position Sensor (CMPS)
30	Camshaft Position Sensor (CMPS) signal input	Camshaft Position Sensor (CMPS)
31	Sensor ground	Camshaft Position Sensor (CMPS)

32	Injector (Cylinder #3) [HIGH] control output	Injector (Cylinder #3)
33	Reference voltage (+5V)	Rail Pressure Sensor (RPS)
34	Rail Pressure Sensor (RPS) signal input	Rail Pressure Sensor (RPS)
35	Sensor ground	Rail Pressure Sensor (RPS)
36	Injector (Cylinder #2) [LOW] control output	Injector (Cylinder #2)
37	-	
38	-	
39	-	
40	Injector (Cylinder #2) [HIGH] control output	Injector (Cylinder #2)
41	-	
42	-	
43	-	
44	Injector (Cylinder #1) [LOW] control output	Injector (Cylinder #1)
45	Reference voltage (+5V)	Mass Air Flow Sensor (MAFS)
46	Mass Air Flow Sensor (MAFS) signal input	Mass Air Flow Sensor (MAFS)
47	Sensor ground	Mass Air Flow Sensor (MAFS), Intake Air Temperature Sensor (IATS)
48	Injector (Cylinder #1) [HIGH] control output	Injector (Cylinder #1)

CONNECTOR [C06-3]

Pin	Description	Connected to
1	-	
2	-	
3	-	
4	A/C Compressor Fan Relay control output	A/C Compressor Fan Relay
5	-	
6	Brake Switch 2 signal input	Brake Switch
7	Cooling Fan Relay [HIGH] control output	Cooling Fan Relay [HIGH]
8	Cooling Fan Relay [LOW] control output	Cooling Fan Relay [LOW]
9	Cruise Control "MAIN" signal input	Cruise Control Switch
10	PTC Heater Relay diagnosis line	PTC Heater Relay
11	Air heater Relay 1 control	Glow Relay 1
12	-	
13	Blower Switch signal input	Blower Switch
14	Air heater Relay 1 diagnosis line	Glow Relay 1
15	Air heater Relay 2 control	Glow Relay 2
16	-	
17	M/T, A/T switch signal input	A/T: Chassis Ground, M/T: Not used
18	-	
19	A/C Switch "ON" signal input	A/C Switch
20	Vehicle speed sensor (VSS) signal input	Vehicle speed sensor (VSS)
21	-	

22	-	
23	-	
24	Main Relay control output	Main Relay
25	A/C Relay control output	A/C Relay
26	-	
27	Battery power	Main Relay
28	Power ground	Chassis GroundChassis Ground
29	PTC Heater Relay control output	PTC Heater Relay
30	-	
31	Battery power	Main Relay
32	Power ground	Chassis Ground

3. ECM TERMINAL IN/OUT SIGNAL CONNECTOR [C06-1]

PinNo.	Description	Condition	Type	Level
1	-			
2	Accelerator Position Sensor (APS) 1 signal input	C.T	Analog	0.3 ~ 0.9V
		W.O.T		4.0 ~ 4.8V
3	Sensor ground	Idle	DC	Max. 50mV
4	Power ground	Idle	DC	Max. 50mV
5	Battery power	IG OFF	DC	Max. 1.0V
		IG ON		Battery Voltage
6	Reference voltage (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.9 ~ 5.1V
7	-			
8	Power ground	Idle	DC	Max. 50mV
9	Malfunction Indicator Lamp (MIL) control output	Lamp OFF	DC	Battery Voltage
		Lamp ON		Max. 1.0V
10	Reference voltage (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.2 ~ 5.2V
11	Accelerator Position Sensor (APS) 2 signal input	C.T	Analog	0.3 ~ 0.9V
		W.O.T		1.5 ~ 3.0V
12	Sensor ground	Idle	DC	Max. 50mV
13	-			
14	Immobilizer Lamp control output	Lamp OFF	DC	Battery Voltage
		Lamp ON		Max. 1.0V
15	-			
16	Brake Switch 1 signal input	Release	DC	Max. 0.5V
		Push		Battery Voltage
17	Battery power	IG OFF	DC	Max. 0.5V
		IG ON		Battery Voltage
18	-			

19	-			
20	Fuel consumption signal output	Vehicle Run	Pulse	HI: Battery Voltage LO: Max. 1.0V
21	-			
22	-			
23	Water Sensor signal input	Indicator ON	DC	Battery Voltage
		Indicator OFF		Max. 0.5V
24	[M/T only] Clutch Switch signal input	Release	DC	Max. 0.5V
		Push		Battery Voltage
25	-			
26	Engine speed signal output	Idle	Pulse	HI: Battery Voltage LO: Max. 0.5V Idle: 40 ~ 50Hz
27	Immobilizer Communication Line	IG ON 후 통신	Pulse	[Transmitting] HI: Min. Vbatt × 80% LO: Max. Vbatt × 20% [Receiving] HI: Min. Vbatt × 70% LO: Max. Vbatt × 30%
28	Diagnostic K-Line	GST Communication	Pulse	[Transmitting] HI: Min. Vbatt × 80% LO: Max. Vbatt × 20% [Receiving] HI: Min. Vbatt × 70% LO: Max. Vbatt × 30%
29	Glow Time Indicator Lamp control output	Lamp OFF	DC	Battery Voltage
		Lamp ON		Max. 1.0V
30	[A/T only] P/N switch signal input [M/T Only] Gear Neutral Switch signal input	Neutral	DC	Battery Voltage
				Max. 1.0V
		Except Neutral	DC	Max. 1.0V
				Battery Voltage
31	CAN [LOW]	RECESSIVE	Pulse	2.0 ~ 3.0V
		DOMINANT		0.5 ~ 2.25V
32	CAN [HIGH]	RECESSIVE	Pulse	2.0 ~ 3.0V
		DOMINANT		2.75 ~ 4.5V

CONNECTOR [C06-2]

PinNo.	Description	Condition	Type	Level
1	Sensor shield	Idle	DC	Max. 50mV
2	-			
3	Throttle Control Solenoid valve control output	Active/Inactive	DC	HI: Battery Voltage LO: Max. 1.0V
4	Inlet Metering Valve (IMV) control output	Vehicle Run	PULSE	HI: Battery Voltage LO: Max. 1.0V
5	Sensor shield	Idle	DC	Max. 50mV
6	-			

7	EGR Solenoid Valve control output	Vehicle Run	PULSE	Min. Battery voltage LO: Max. 1.0V Vpeak: Max. 70V
8	-			
9	-			
10	Intake Air Temperature Sensor (IATS) signal input	Idle	Analog	0 ~ 5V
11	-			
12	-			
13	-			
14	Air heater Relay 2 diagnosis line	Relay OFF	DC	Max. 1.0V
		Relay ON		Battery Voltage
15	-			
16	-			
17	-			Max. 50mV
18	Engine Coolant Temperature Sensor (ECTS) signal input	Idle	Analog	0.5 ~ 4.5V
19	Sensor ground	Idle	DC	Max. 50mV
20	Injector (Cylinder #4) [LOW] control output	Idle	PULSE	[HI] PULL: 22.0 ~ 26.5A HOLD: 5.9 ~ 8.0A [LO] PULL: 6.4~8.8A HOLD: 4.4 ~ 6.3A
21	Knock Sensor (KS) signal input	Knocking	Variable Frequency	
		Normal		
22	Fuel Temperature Sensor (FTS) signal input	IG ON	DC	0.5 ~ 4.5V
23	Sensor ground	Idle	DC	Max. 50mV
24	Injector (Cylinder #4) [HIGH] control output	Idle	PULSE	[HI] PULL: 22.0 ~ 26.5A HOLD: 5.9 ~ 8.0A [LO] PULL: 6.4~8.8A HOLD: 4.4 ~ 6.3A
25	Sensor ground	Idle	DC	Max. 50mV
26	Crankshaft Position Sensor (CKPS) [+] signal input	Idle	SINE WAVE	Vp-p: Min. 1.0V
27	Crankshaft Position Sensor (CKPS) [-] signal input	Idle	DC	Max. 50mV
28	Injector (Cylinder #3) [LOW] control output	Idle	PULSE	[HI] PULL: 22.0 ~ 26.5A HOLD: 5.9 ~ 8.0A [LO] PULL: 6.4~8.8A HOLD: 4.4 ~ 6.3A
29	Reference voltage (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.9 ~ 5.1V

30	Camshaft Position Sensor (CMPS) signal input	Idle	PULSE	HI: Vcc or B+
				LO: Max. 0.6V
31	Sensor ground	Idle	DC	Max. 50mV
32	Injector (Cylinder #3) [HIGH] control output	Idle	PULSE	[HI] PULL: 22.0 ~ 26.5A HOLD: 5.9 ~ 8.0A [LO] PULL: 6.4~8.8A HOLD: 4.4 ~ 6.3A
33	Reference voltage (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.9 ~ 5.1V
34	Rail Pressure Sensor (RPS) signal input	IG ON	Analog	Max. 1.0V
		Idle		1.0 ~ 2.0V
		3000 RPM		2.0 ~ 5.0V
35	Sensor ground	Idle	DC	Max. 50mV
36	Injector (Cylinder #2) [LOW] control output	Idle	PULSE	[HI] PULL: 22.0 ~ 26.5A HOLD: 5.9 ~ 8.0A [LO] PULL: 6.4~8.8A HOLD: 4.4 ~ 6.3A
37	-			
38	-			
39	-			
40	Injector (Cylinder #2) [HIGH] control output	Idle	PULSE	[HI] PULL: 22.0 ~ 26.5A HOLD: 5.9 ~ 8.0A [LO] PULL: 6.4~8.8A HOLD: 4.4 ~ 6.3A
41	-			
42	-			
43	-			
44	Injector (Cylinder #1) [LOW] control output	Idle	PULSE	[HI] PULL: 22.0 ~ 26.5A HOLD: 5.9 ~ 8.0A [LO] PULL: 6.4~8.8A HOLD: 4.4 ~ 6.3A
45	Reference voltage (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.9 ~ 5.1V
46	Mass Air Flow Sensor (MAFS) signal input	Idle	Analog	0 ~ 2.0V
		3000RPM		1.0 ~ 4.5V
47	Sensor ground	Idle	DC	Max. 50mV
48	Injector (Cylinder #1) [HIGH] control output	Idle	PULSE	[HI] PULL: 22.0 ~ 26.5A HOLD: 5.9 ~ 8.0A [LO] PULL: 6.4~8.8A

CONNECTOR [C06-3]

PinNo.	Description	Condition	Type	Level
1	-			
2	-			
3	-			
4	A/C Compressor Fan Relay control output	Relay OFF	DC	Battery Voltage
		Relay ON		Max. 1.0V
5	-			
6	Brake Switch 2 signal input	RELEASE	DC	Max. 0.5V
		PUSH		Battery Voltage
7	Cooling Fan Relay [HIGH] control output	Relay OFF	DC	Battery Voltage
		Relay ON		Max. 1.0V
8	Cooling Fan Relay [LOW] control output	Relay OFF	DC	Battery Voltage
		Relay ON		Max. 1.0V
9	-			
10	PTC Heater Relay diagnosis line	Relay OFF	DC	Max. 1.0V
		Relay ON		Battery Voltage
11	Air heater Relay 1 control	Relay OFF	DC	Battery Voltage
		Relay ON		Max. 1.0V
12	-			
13	Blower Switch signal input	Blower OFF	DC	Battery Voltage
		Blower ON		Max. 1.0V
14	Air heater Relay 1 diagnosis line	Relay OFF	DC	Max. 1.0V
		Relay ON		Battery Voltage
15	Air heater Relay 2 control	Relay OFF	DC	Battery Voltage
		Relay ON		Max. 1.0V
16	-			
17	M/T, A/T switch signal input	IG ON	DC	M/T: Battery Voltage
				A/T: Ground
18	-			
19	A/C Switch "ON" signal input	A/C SW OFF	DC	Battery Voltage
		A/C SW ON		Max. 1.0V
20	Vehicle speed sensor (VSS) signal input	Vehicle Run	PULSE	HI: Min. 5.0V
				LO: Max. 1.0V
21	-			
22	-			
23	-			
24	Main Relay control output	Relay OFF	DC	Battery Voltage
		Relay ON		Max. 1.0V
		Relay OFF		Battery Voltage

25	A/C Relay control output	Relay OFF	DC	Battery Voltage
		Relay ON		Max. 1.0V
26	-			
27	Battery power	IG OFF	DC	Max. 1.0V
		IG ON		Battery Voltage
28	Power ground	Idle	DC	Max. 50mV
29	PTC Heater Relay control output	Relay OFF	DC	Battery Voltage
		Relay ON		Max. 1.0V
30	-			
31	Battery power	IG OFF	DC	Max. 1.0V
		IG ON		Battery Voltage
32	Power ground	Idle	DC	Max. 50mV

Fuel System

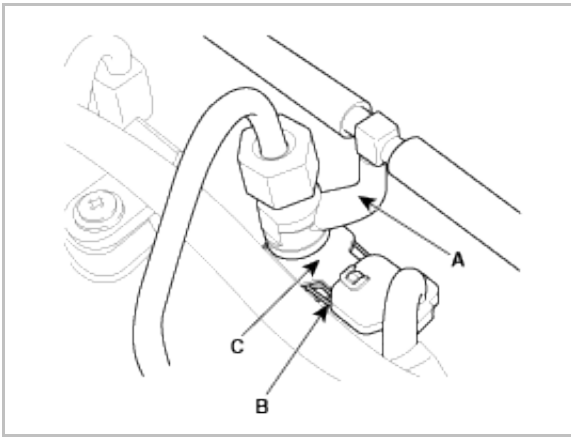
Engine Control System - Injector

REMOVAL

CAUTION

- Common Rail Fuel Injection System is subject to extremely high pressure (Approximately 1,600 bar)
- Never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Always pay attention to safety precaution.
- Ensure the absolute cleanliness.
- It is not recommended to remove the injectors without any notice.
- Take care that the foreign material does not enter to the components when you remove or install the Fuel system.
- Clean the connction parts of injector and replace the O-ring when you remove or install the injector.
- Insert the O-ring in the Cylinder head after pasting Diesel oil to the O-ring gasket.
- Avoid damaging the injector when you insert the injector into the cylinder.
- High pressure fuel pipe should not be reused.
- Mount the flare nut and the component vertically when you install the high pressure fuel pipe.

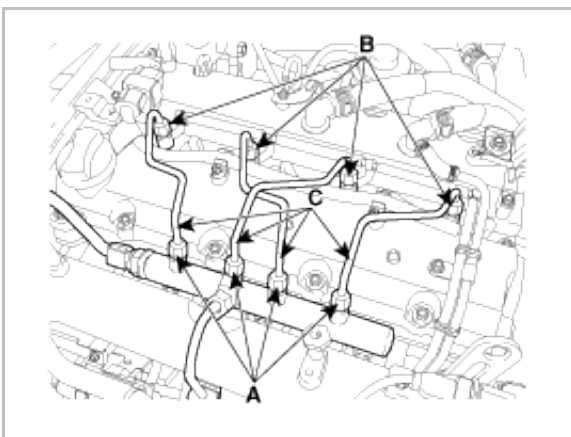
1. Remove the fuel return hose (A).



2. Remove the fixing clip (B) and disconnect the injector connector (C).

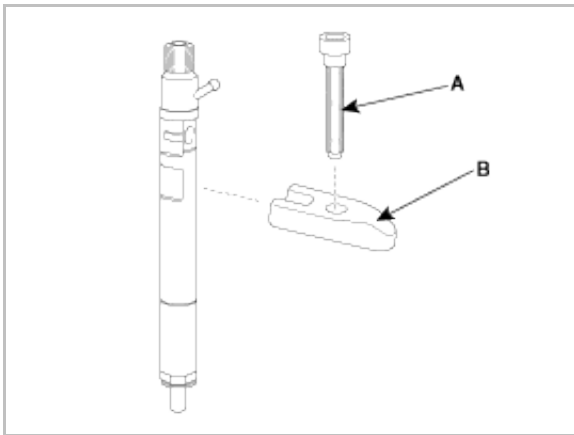
3. High pressure pipe (Common rail ↔ Injector) Removal

- (1) Unscrews the flange nut (A) at the common rail.



- (2) Unscrews the flange nuts (B) of injectors and remove the high pressure pipe (C).

4. Remove the injector clamp (B) after unscrewing the clamp mounting bolt (A).



5. Remove the injector from the cylinder.

INSTALLATION

CAUTION

- Common Rail Fuel Injection System is subject to extremely high pressure (Approximately 1,600 bar)
- Never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Always pay attention to safety precaution.
- Ensure the absolute cleanliness.
- It is not recommended to remove the injectors without any notice.
- Take care that the foreign material does not enter to the components when you remove or install the Fuel system.
- Clean the connction parts of injector and replace the O-ring when you remove or install the injector.
- Insert the O-ring in the Cylinder head after pasting Diesel oil to the O-ring gasket.
- Avoid damaging the injector when you insert the injector into the cylinder.
- High pressure fuel pipe should not be reused.
- Mount the flare nut and the component vertically when you install the high pressure fuel pipe.

1. Install the Injector according to the reverse order to REMOVAL procedure.

NOTICE

1. Install the flange nut (Injector & Common rail side) with SST as following specification.

Classification	SPEC	SST No.
Flange nut (Common rail)	19mm (0.74 in.)	09314-27130
Flange nut (Injector)	17mm (0.67 in.)	09314-27120

Tightening torque:

Flange nut (Common rail): 35.8 ~ 42.7 N.m (3.65 ~ 4.35 kgf·m, 26.4 ~ 31.5 lbf.ft)

Flange nut (Injector): 35.8 ~ 42.7 N.m (3.65 ~ 4.35 kgf·m, 26.4 ~ 31.5 lbf.ft)

Injector clamp mounting bolt : 19.6 ~ 21.6 N.m (2.0 ~ 2.2 kgf·m, 14.5 ~ 15.9 lbf.ft)

REPLACEMENT

1. Remove the injector according to the removal procedure.
2. Install new injector according to the installation.
3. Eliminate injector characteristic data in the ECM using the diagnosis tool.

NOTICE

Refer to "Injector characteristic data elimination" procedure.

4. Input the characteristic data elimination of new injector using diagnosis tool.

NOTICE

Refer to "Injector characteristic data input" procedure.

INSPECTION

INJECTOR CHARACTERISTIC DATA INFORMATION CHECK

1. Select " J2.9 WGT(DIESEL)".

KIA VEHICLE DIAGNOSIS	
MODEL	: CARNIVAL(06MY~)
SYSTEM	: ENGINE CONTROL
01. 3.3/3.8L(LAMBDA)	
02. J2.9 WGT(DIESEL)	

2. Select " ENGINE CONTROL".

KIA VEHICLE DIAGNOSIS ▼	
MODEL	: CARNIVAL(06MY~)
01. ENGINE CONTROL	
02. AUTOMATIC TRANSAXLE	
03. ANTI-LOCK BRAKE SYSTEM	
04. SRS-AIRBAG	
05. FULL AUTO AIR/CON.	
06. FUEL FIRED HEATER	
07. POWER SLIDING / TAIL GATE	
08. BODY CONTROL MODULE	

3. Select "INDIVIDUAL INJECTOR CORRECTION".

1. KIA VEHICLE DIAGNOSIS ▲	
MODEL	: CARNIVAL(06MY~)
SYSTEM	: 2006
ENGINE CONTROL	
03. DUAL DISPLAY	
04. FLIGHT RECORD	
05. ACTUATION TEST	
06. SIMU-SCAN	
07. ECU INFORMATION	
08. FUEL LEAK CHECK TEST	
09. INDIVIDUAL INJECTOR CORRECTION	
10. ECU INITIALIZATION	

4. Select "INFO" tab using F5 key.

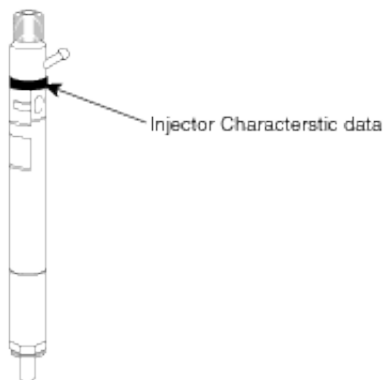
✖ CONDITION : IG.ON (ENGINE OFF)
 ✖ METHOD -1
 1. INJECTOR BARCODE DATA 17 CHARACTER
 1ST CHAR. 1 ==> INJ1,
 1ST CHAR. 2 ==> INJ2,
 1ST CHAR. 3 ==> INJ3,
 1ST CHAR. 4 ==> INJ4,
 2. PLEASE , PRESS [FUNCTION KEY]
 INJ1 INJ2 INJ3 INJ4 INFO CLR

5. Check whether the characteristic data displayed on the diagnosis tool screen (ECM data) and the real injector characteristic data are same or not. If they are different, eliminate the characteristic data in the ECM data and input again.

NOTICE

Refer to "Injector characteristic data elimination & input" procedure.

INJECTOR 1 E2 04 EA 55 8A 13 DA 16
 INJECTOR 2 C5 78 A7 62 18 D4 1E C8
 INJECTOR 3 27 DF A4 D8 22 DA 91 E0
 INJECTOR 4 0C 52 C0 4D A3 C0 09 FA



INJECTOR CHARACTERISTIC DATA ELIMINATION

1. Select " J2.9 WGT(DIESEL)".

KIA VEHICLE DIAGNOSIS	
MODEL	: CARNIVAL(06MY~)
SYSTEM	: ENGINE CONTROL
01.	3.3/3.8L(LAMBDA)
02.	J2.9 WGT(DIESEL)

2. Select " ENGINE CONTROL".

KIA VEHICLE DIAGNOSIS ▼	
MODEL	: CARNIVAL(06MY~)
01.	ENGINE CONTROL
02.	AUTOMATIC TRANSAXLE
03.	ANTI-LOCK BRAKE SYSTEM
04.	SRS-AIRBAG
05.	FULL AUTO AIR/CON.
06.	FUEL FIRED HEATER
07.	POWER SLIDING / TAIL GATE
08.	BODY CONTROL MODULE

3. Select "INDIVIDUAL INJECTOR CORRECTION".

1. KIA VEHICLE DIAGNOSIS ▲	
MODEL	: CARNIVAL(06MY~)
SYSTEM	: 2006
ENGINE CONTROL	
03.	DUAL DISPLAY
04.	FLIGHT RECORD
05.	ACTUATION TEST
06.	SIMU-SCAN
07.	ECU INFORMATION
08.	FUEL LEAK CHECK TEST
09.	INDIVIDUAL INJECTOR CORRECTION
10.	ECU INITIALIZATION

4. Select "CLR" tab "using" F6 key.

✖ CONDITION : IG.ON (ENGINE OFF)	
✖ METHOD -1	
1. INJECTOR BARCODE DATA 17 CHARACTER	
1ST CHAR. 1 ==> INJ1,	

PLASE ,ARE YOU SURE? [Y/N]	

1ST CHAR. 4 ==> INJ4,	
2. PLEASE , PRESS [FUNCTION KEY]	
INJ1	INJ2
INJ3	INJ4
INFO	CLR

5. Select "ENTER"

NOTICE

If you want to cancel data elimination, select "ESC".

INJECTOR CHARACTERISTIC DATA ELIMINATION

1. Select " J2.9 WGT(DIESEL)".

KIA VEHICLE DIAGNOSIS	
MODEL	: CARNIVAL(06MY~)
SYSTEM	: ENGINE CONTROL
01.	3.3/3.8L(LAMBDA)
02.	J2.9 WGT(DIESEL)

2. Select " ENGINE CONTROL".

KIA VEHICLE DIAGNOSIS ▼	
MODEL	: CARNIVAL(06MY~)
01.	ENGINE CONTROL
02.	AUTOMATIC TRANSAXLE
03.	ANTI-LOCK BRAKE SYSTEM
04.	SRS-AIRBAG
05.	FULL AUTO AIR/CON.
06.	FUEL FIRED HEATER
07.	POWER SLIDING / TAIL GATE
08.	BODY CONTROL MODULE

3. Select "INDIVIDUAL INJECTOR CORRECTION".

1. KIA VEHICLE DIAGNOSIS ▲	
MODEL	: CARNIVAL(06MY~)
SYSTEM	: 2006
ENGINE CONTROL	
03.	DUAL DISPLAY
04.	FLIGHT RECORD
05.	ACTUATION TEST
06.	SIMU-SCAN
07.	ECU INFORMATION
08.	FUEL LEAK CHECK TEST
09.	INDIVIDUAL INJECTOR CORRECTION
10.	ECU INITIALIZATION

4. Select the cylinder using F1 ~ F4 (Each cylinder 1,2,3,4) key.

✕ CONDITION : IG.ON (ENGINE OFF)					
✕ METHOD -1					
1. INJECTOR BARCODE DATA 17 CHARACTER					
1ST CHAR. 1 ==> INJ1,					
1ST CHAR. 2 ==> INJ2,					
1ST CHAR. 3 ==> INJ3,					
1ST CHAR. 4 ==> INJ4,					
2. PLEASE , PRESS [FUNCTION KEY]					
INJ1	INJ2	INJ3	INJ4	INFO	CLR

5. Input "Injector characteristic data" 16 unit using the direction key and press "ENTER".

INJECTOR 1

READ INJECTOR DATA

<<<< E2 04 EA 55 8A 13 DA 16 >>>>

* METHOD -2

3. INPUT BARCODE DATA 2ND ~17TH DATA

4. PLEASE [ENTER] KEY

ABCADD0541230463

A

B

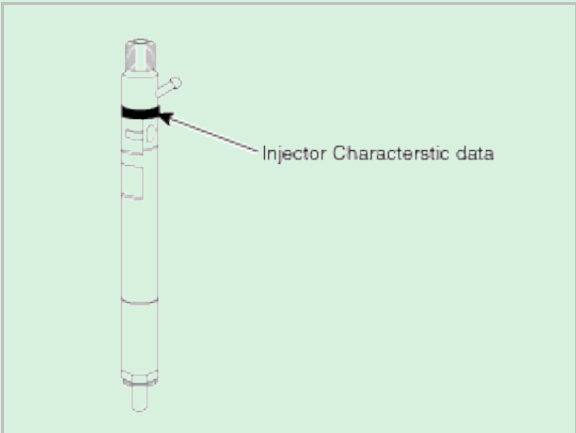
C

D

E

F

NOTICE

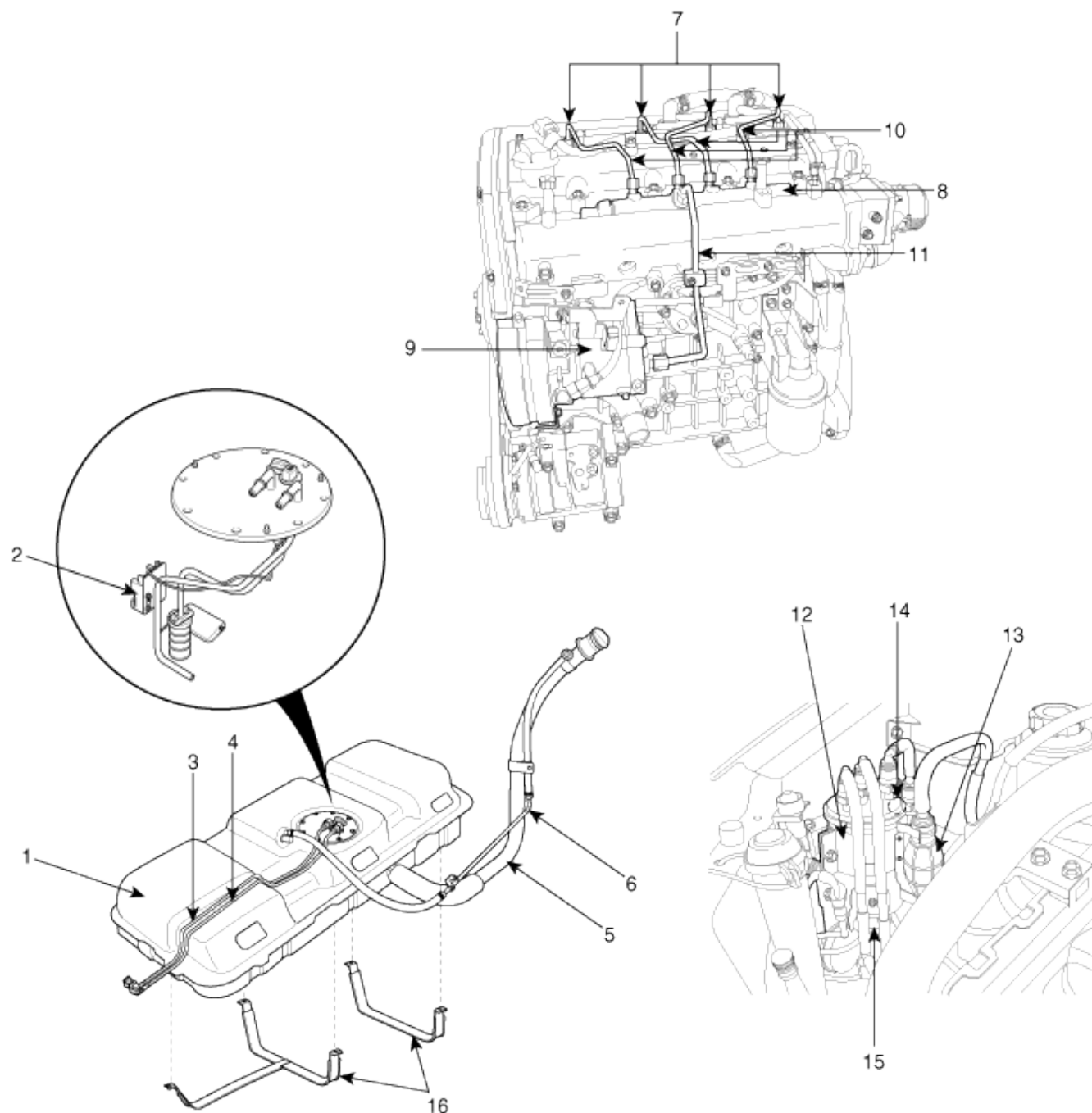




Fuel System

Fuel Delivery System

COMPONENT LOCATION



1. Fuel tank
2. Fuel sender
3. Fuel feed hose
4. Fuel return hose
5. Fuel filler pipe
6. Leveling Hose
7. Injector
8. Common Rail

9. High Pressure Pump
10. High Pressure Pipe (Injector ↔ Common Rail)
11. High Pressure Pipe (Common Rail ↔ High Pressure Pump)
12. Fuel Filter
13. Priming Pump
14. Fuel Heater
15. Water Sensor
16. Fuel tank band

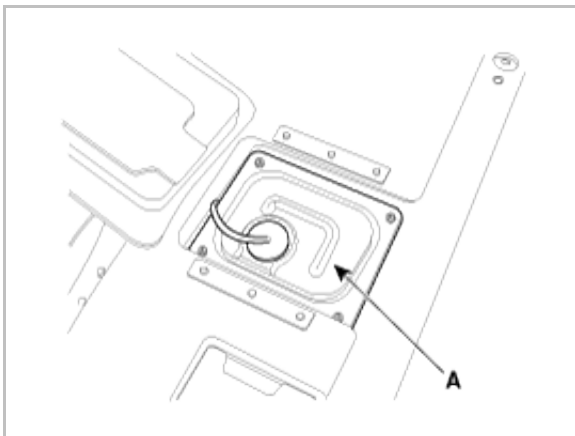
Fuel System

Fuel Delivery System - Fuel Tank

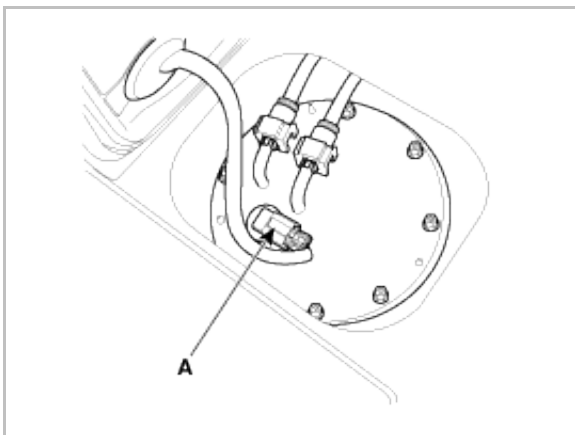


REMOVAL

1. Remove the second seat (Refer to "BD" group in this WORKSHOP MANUAL).
2. Remove the Service cover (A).



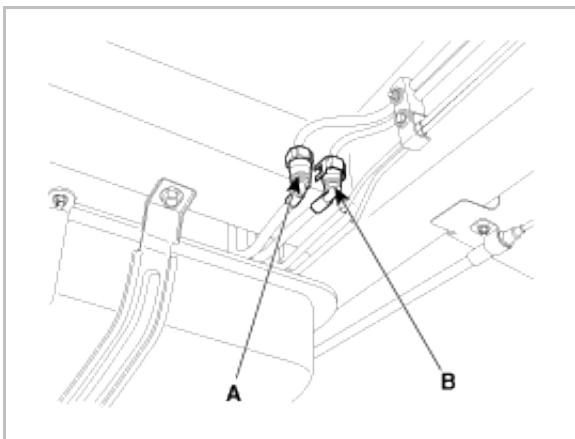
3. Disconnect the Fuel sender connector (A).



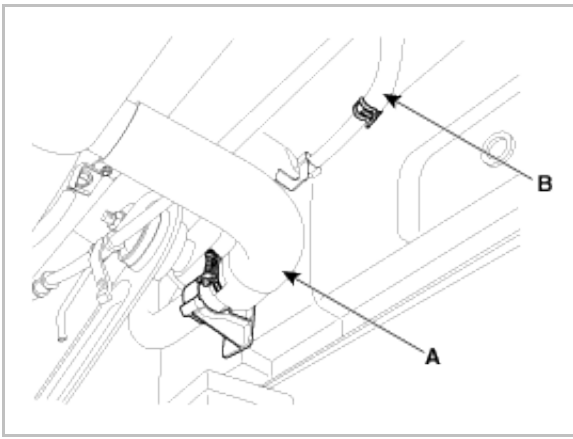
4. Disconnect the Fuel supply hose Quick - connector (A) and the Fuel return hose Quick - connector (B).

NOTICE

When you disconnect the Fuel supply & Return hose quick - connector , you should disconnect the connector from the lower part first before the fuel sender side.

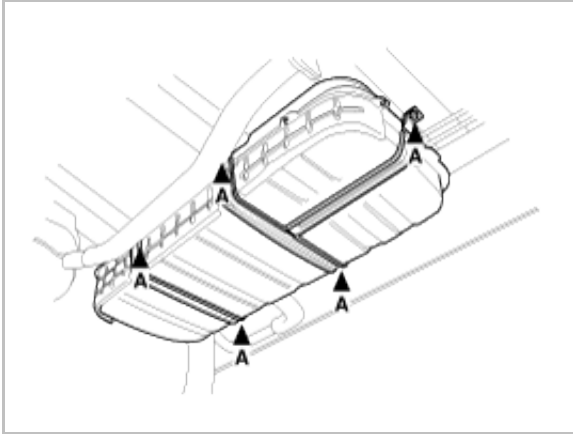


5. Disconnect the fuel feed hose (A), the leveling hose (B).



6. Support the Fuel tank with the jack.

7. Unscrew the fuel tank mounting nuts (A) and then remove the fuel tank.

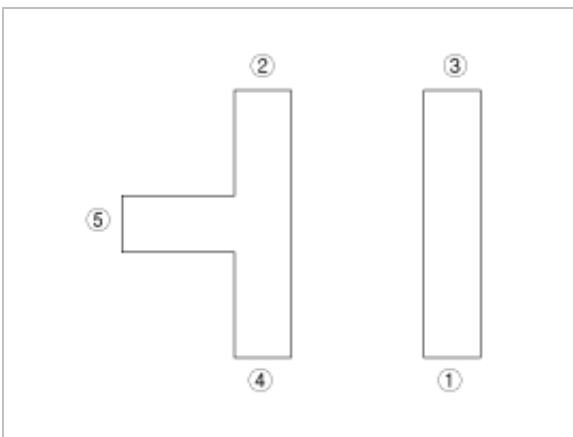


INSTALLATION

1. Install the Fuel Tank according to the reverse order to REMOVAL procedure.

Tightening Torques

Fuel tank installation bolts: 44.1 ~ 58.9 N·m (4.5 ~ 6.0 kg·m, 32.6 ~ 43.4 lb·ft)



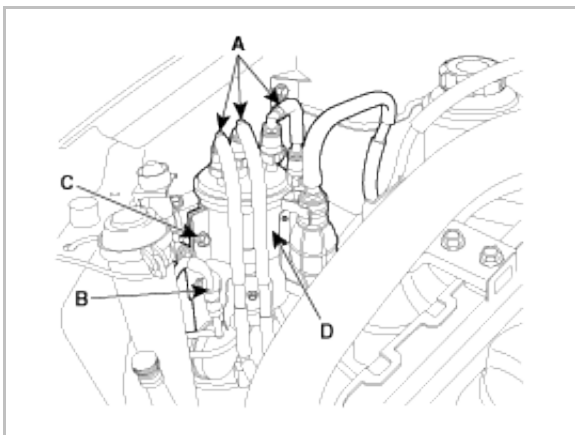
Fuel System

Fuel Delivery System - Fuel Filter

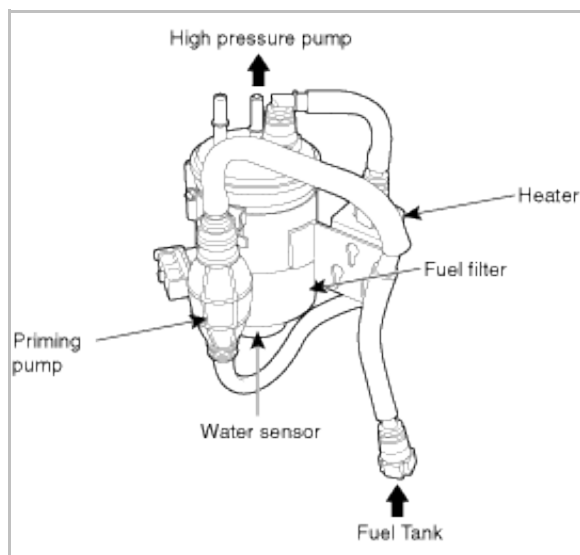


REMOVAL

1. Disconnect the fuel tube (A,B,C).



2. Disconnect the water sensor connector (B).
3. Remove the fuel filter (D) after unscrewing the mounting bolt (C).



INSTALLATION

1. Install the Fuel filter according to the reverse order to REMOVAL procedure.

NOTICE

Take care that the foreign material does not enter to the hose and the filter when you remove or install the hose and filter.

Fuel System

Fuel Delivery System - Common Rail

REMOVAL

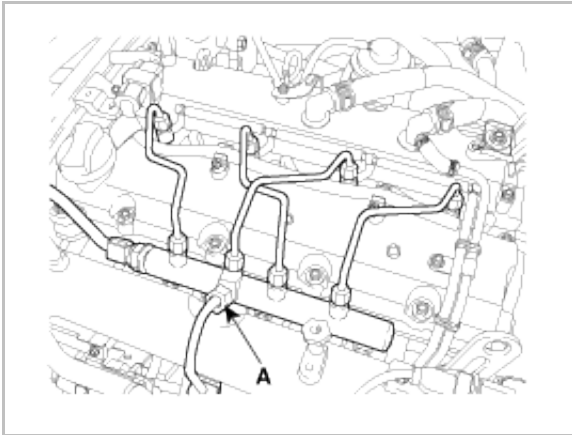
CAUTION

- Common Rail Fuel Injection System is subject to extremely high pressure (Approximately 1,600 bar)
- Never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Always pay attention to safety precaution.
- Ensure the absolute cleanliness.
- It is not recommended to remove the injectors without any notice.
- Take care that the foreign material does not enter to the components when you remove or install the Fuel system.
- Clean the connction parts of injector and replace the O-ring when you remove or install the injector.
- Insert the O-ring in the Cylinder head after pasting Diesel oil to the O-ring gasket.
- Avoid damaging the injector when you insert the injector into the cylinder.
- High pressure fuel pipe should not be reused.
- Mount the flare nut and the component vertically when you install the high pressure fuel pipe.

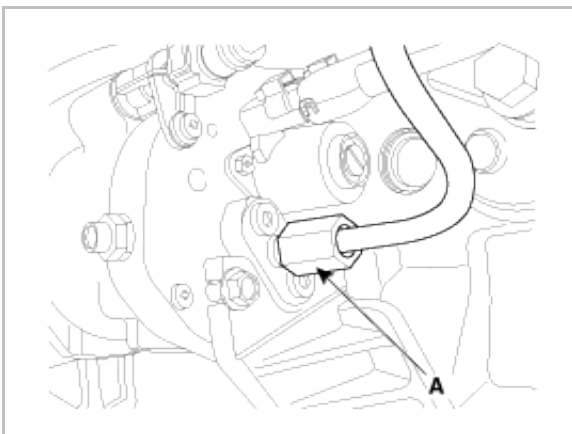
1. Remove the cooling fan (Refer to "EM" group in this WORKSHOP MANUAL)

2. Remove the high pressure pipe (High pressure pump ↔ Common rail).

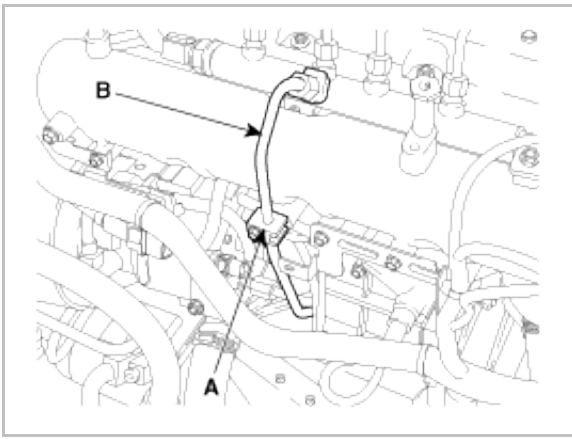
(1) Unscrews the flange nut (A) on the common rail.



(2) Unscrews the flange nut (A) at the side of the high pressure pump.

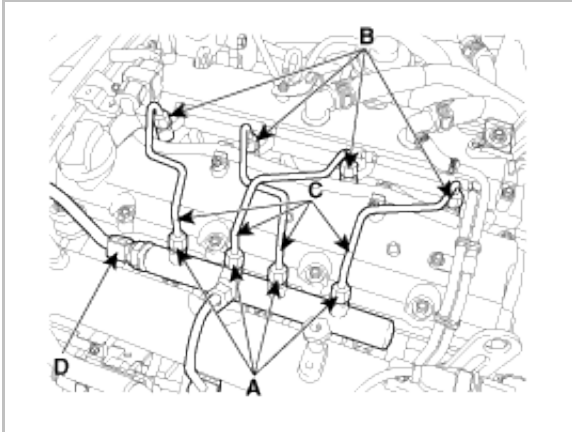


(3) Remove the high pressure pipe clamp (A) and high pressure pipe (B).



3. High pressure pipe (Common rail ↔ Injector) Removal

(1) Unscrews the flange nut (A) at the common rail.

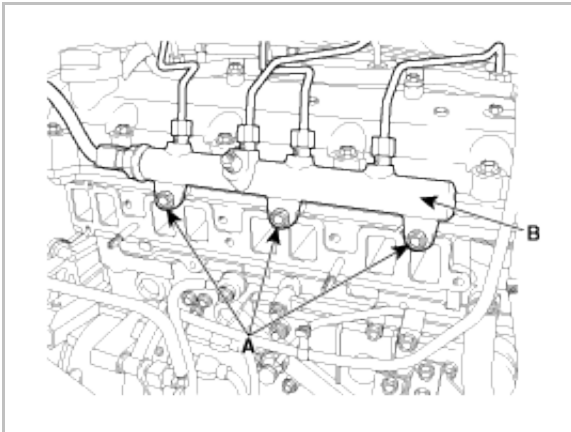


(2) Unscrews the flange nuts (B) of injectors and remove the high pressure pipe (C).

4. Disconnect the rail pressure sensor connector (A).

5. Remove the intake manifold. (Refer to "EM" group)

6. Remove the common rail (B) after unscrewing 3 mounting bolts (A).



INSTALLATION

CAUTION

- Common Rail Fuel Injection System is subject to extremely high pressure (Approximately 1,600 bar)
- Never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Always pay attention to safety precaution.
- Ensure the absolute cleanliness.
- It is not recommended to remove the injectors without any notice.
- Take care that the foreign material does not enter to the components when you remove or install the Fuel system.

- Clean the connection parts of injector and replace the O-ring when you remove or install the injector.
- Insert the O-ring in the Cylinder head after pasting Diesel oil to the O-ring gasket.
- Avoid damaging the injector when you insert the injector into the cylinder.
- High pressure fuel pipe should not be reused.
- Mount the flare nut and the component vertically when you install the high pressure fuel pipe.

1. Install the Common rail according to the reverse order to REMOVAL procedure.

NOTICE

Install the flange nut (High pressure pump & Common rail side) with SST as following specification.

Classification	SPEC	SST No.
Flange nut (Common rail)	19mm (0.74 in.)	09314-27130
Flange nut (High pressure pump)	19mm (0.74 in.)	09314-27130
Flange nut (Injector)	17mm (0.67 in.)	09314-27120

Tightening torque:

Flange nut (Common rail): 35.8 ~ 42.7 N.m (3.65 ~ 4.35 kgf·m, 26.4 ~ 31.5 lbf.ft)

Flange nut (Common rail): 35.8 ~ 42.7 N.m (3.65 ~ 4.35 kgf·m, 26.4 ~ 31.5 lbf.ft)

Flange nut (Injector): 35.8 ~ 42.7 N.m (3.65 ~ 4.35 kgf·m, 26.4 ~ 31.5 lbf.ft)

High pressure pipe(Common rail ↔High pressure pump) clamp mounting bolt: 2.9 N.m (0.3 kgf·m, 2.2 lbf.ft)

Common rail mounting bolt : 18.6 ~ 22.6 N.m (1.9 ~ 2.3 kgf·m, 13.7 ~ 16.6 lbf.ft)

Fuel System

Fuel Delivery System - High Pressure Pump

REMOVAL

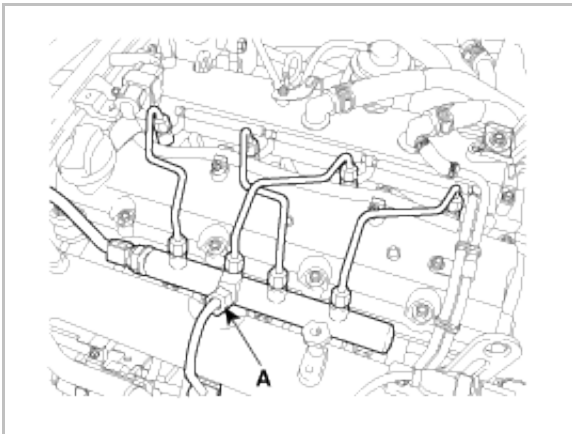
CAUTION

- Common Rail Fuel Injection System is subject to extremely high pressure (Approximately 1,600 bar)
- Never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Always pay attention to safety precaution.
- Ensure the absolute cleanliness.
- It is not recommended to remove the injectors without any notice.
- Take care that the foreign material does not enter to the components when you remove or install the Fuel system.
- Clean the connction parts of injector and replace the O-ring when you remove or install the injector.
- Insert the O-ring in the Cylinder head after pasting Diesel oil to the O-ring gasket.
- Avoid damaging the injector when you insert the injector into the cylinder.
- High pressure fuel pipe should not be reused.
- Mount the flare nut and the component vertically when you install the high pressure fuel pipe.

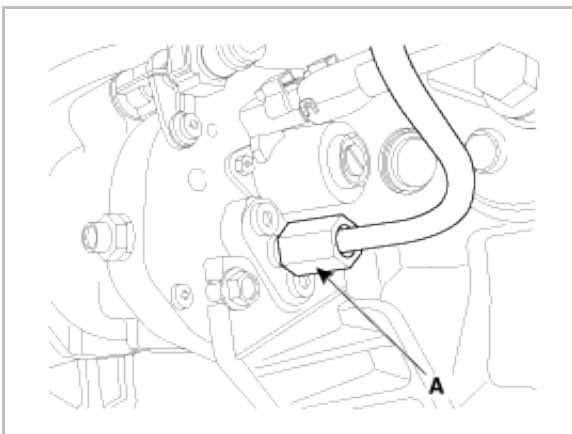
1. Remove the cooling fan (Refer to "EM" group in this WORKSHOP MANUAL)

2. Remove the high pressure pipe (High pressure pump ↔ Common rail).

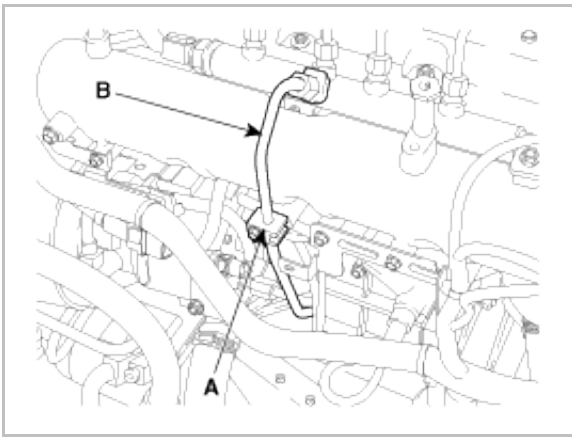
(1) Unscrews the flange nut (A) at the common rail.



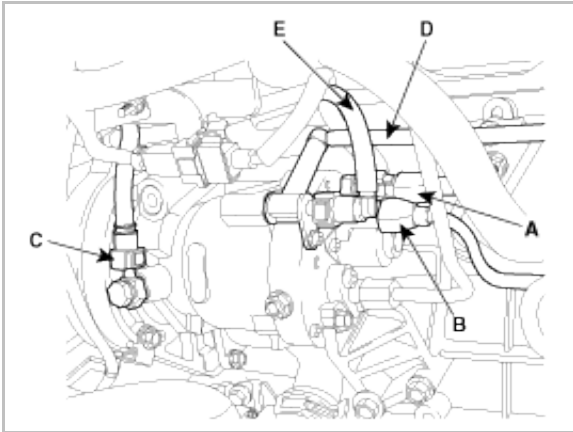
(2) Unscrews the flange nut (A) at the side of the high pressure pump.



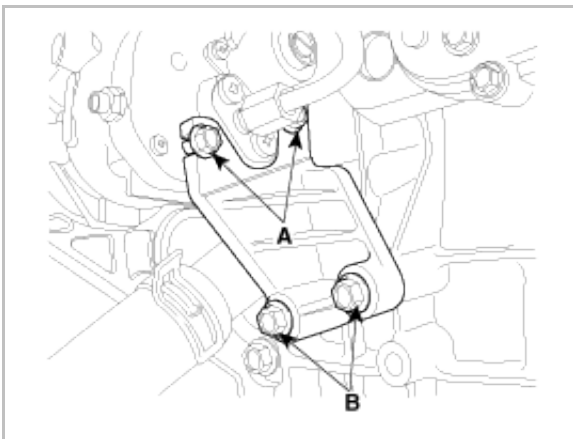
(3) Remove the high pressure pipe clamp (A) and high pressure pipe (B).



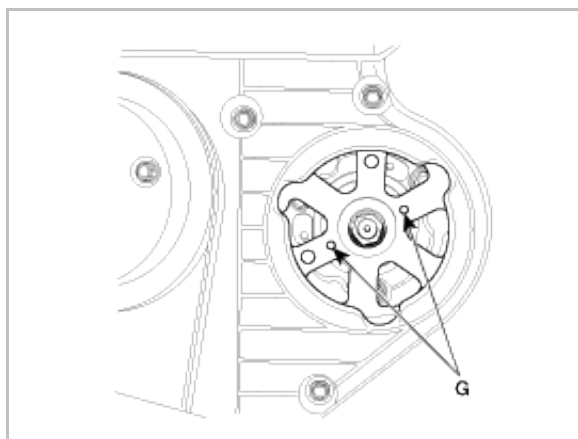
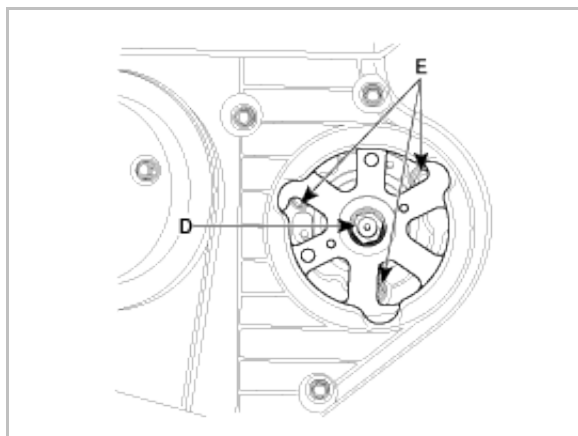
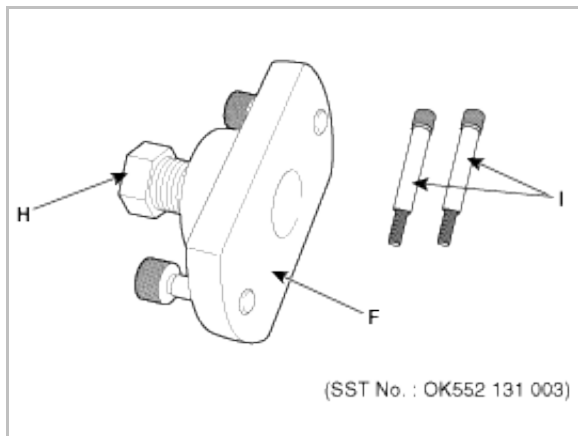
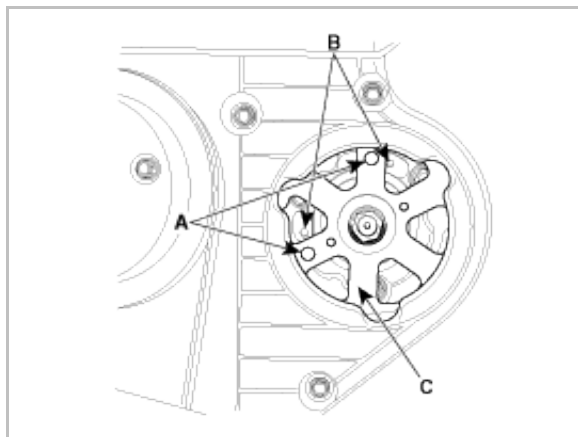
3. Disconnect the fuel temperature sensor connector (A) and the inlet metering valve connector (B).



4. Remove the fuel feed hose (C).
5. Remove the return hose (D) connected with the injector.
6. Remove the return hose (E) connected with the fuel filter.
7. Unscrew 2 mounting bolts (A) at the side of the high pressure pump bracket.



8. Unscrew 2 mounting bolts (B) at the side of the cylinder block .
 9. Remove the rubber cover (B) from the high pressure pump sprocket.
 10. Rotate the sprocket (C) in order to meet the fixing hole of the sprocket (A) and the fixing hole (B) of the timing case.
- Fix the sprocket (C) to the timing case by using 2 bolts(I) of the SST (No.:OK552 131 003)



11. Unscrews the timing case mounting bolt (E) after unscrewing the high pressure pump mounting nut (D).
12. Install the SST (No.: OK552 131 003) (F) to the hole (G) of the sprocket.
13. Push the high pressure pump from the timing case by using the tightening bolts (H).

INSTALLATION

CAUTION

- Common Rail Fuel Injection System is subject to extremely high pressure (Approximately 1,600 bar)
- Never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Always pay attention to safety precaution.
- Ensure the absolute cleanliness.
- It is not recommended to remove the injectors without any notice.
- Take care that the foreign material does not enter to the components when you remove or install the Fuel system.
- Clean the connection parts of injector and replace the O-ring when you remove or install the injector.
- Insert the O-ring in the Cylinder head after pasting Diesel oil to the O-ring gasket.
- Avoid damaging the injector when you insert the injector into the cylinder.
- High pressure fuel pipe should not be reused.
- Mount the flare nut and the component vertically when you install the high pressure fuel pipe.

1. Install the High pressure pump according to the reverse order to REMOVAL procedure.

NOTICE

1. When you install the high pressure pump bracket mounting bolt, Install the bracket as following order.
Cylinder block side -> High pressure pump side

2. Remove the sprocket fixing bolt (SST: OK552 131 003) after the high pressure pump set to the timing case completely.

NOTICE

Install the flange nut (High pressure pump & Common rail side) with SST as following specification.

Classification	SPEC	SST No.
Flange nut (Common rail)	19mm (0.74 in.)	09314-27130
Flange nut (High pressure pump)	19mm (0.74 in.)	09314-27130

Tightening torque:

Flange nut (Common rail): 35.8 ~ 42.7 N.m (3.65 ~ 4.35 kgf·m, 26.4 ~ 31.5 lbf.ft)

Flange nut (High pressure pump): 35.8 ~ 42.7 N.m (3.65 ~ 4.35 kgf·m, 26.4 ~ 31.5 lbf.ft)

High pressure pipe clamp mounting bolt: 2.9 N.m (0.3 kgf·m, 2.2 lbf.ft)

Bracket mounting bolt (Cylinder block): 34.3 ~ 40.2 N.m (3.5 ~ 4.1 kgf·m, 25.3 ~ 29.7 lbf.ft)

Bracket mounting bolt (High pressure pump): 21.6 ~ 25.5 N.m (2.2 ~ 2.6 kgf·m, 15.9 ~ 18.8 lbf.ft)

High pressure pump mounting bolt (Timing case): 21.6 ~ 25.5 N.m (2.2 ~ 2.6 kgf·m, 15.9 ~ 18.8 lbf.ft)

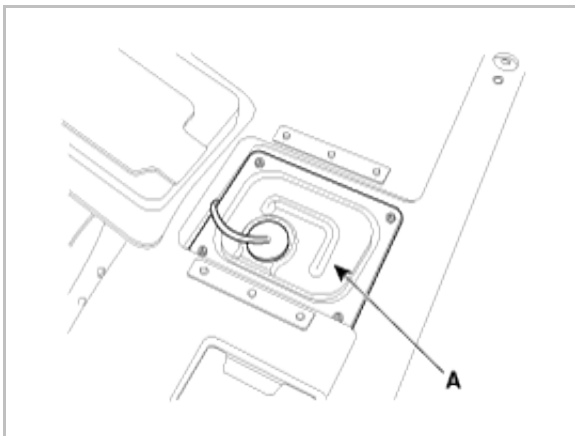
Fuel System

Fuel Delivery System - Fuel Sender

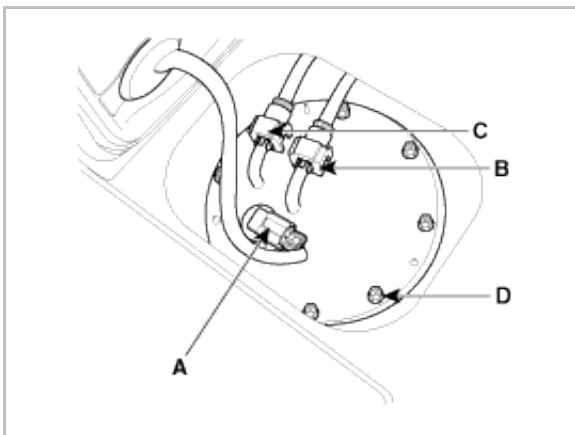


REMOVAL

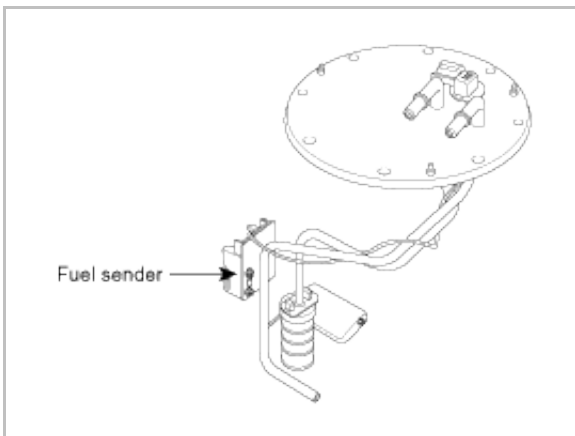
1. Remove the second seat (Refer to "BD" group in this WORKSHOP MANUAL).
2. Remove the Service cover (A).



3. Disconnect the Fuel sender connector (A), the Fuel supply hose Quick - connector (B) and the Fuel return hose Quick - connector (C).



4. Unscrew the fuel sender mounting bolt (D) and then remove the fuel sender.



INSTALLATION

1. Install the Fuel Sender according to the reverse order to REMOVAL procedure.

Tightening Torques

Fuel tank installation bolts: 2 ~ 2.9 N·m (0.2 ~ 0.3 kg·m, 1.4 ~ 2.2 lb·ft)



Manual Transaxle System

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



Manual Transaxle System

Manual Transaxle System



DESCRIPTION

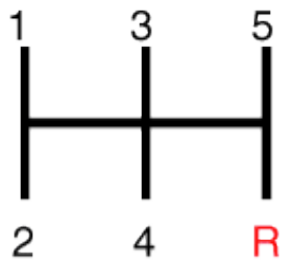
VQ Diesel (J2.9) model has the manual transaxle (M5HF2).

IMPROVEMENT

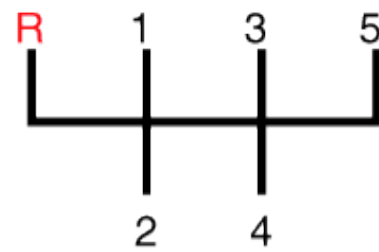
ITEM	Improvement
Better shift feeling	1. New shift pattern 2. Multi cone synchronizer system 3. Module of control system 4. New type of poppet ball
Better duability	1. Optimizing strength of shift control system 2. Optimizing strength of housing and cases (for NVH) 3. Carbonized material for synchronized rings
Cost saving&Convenience	1. 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).

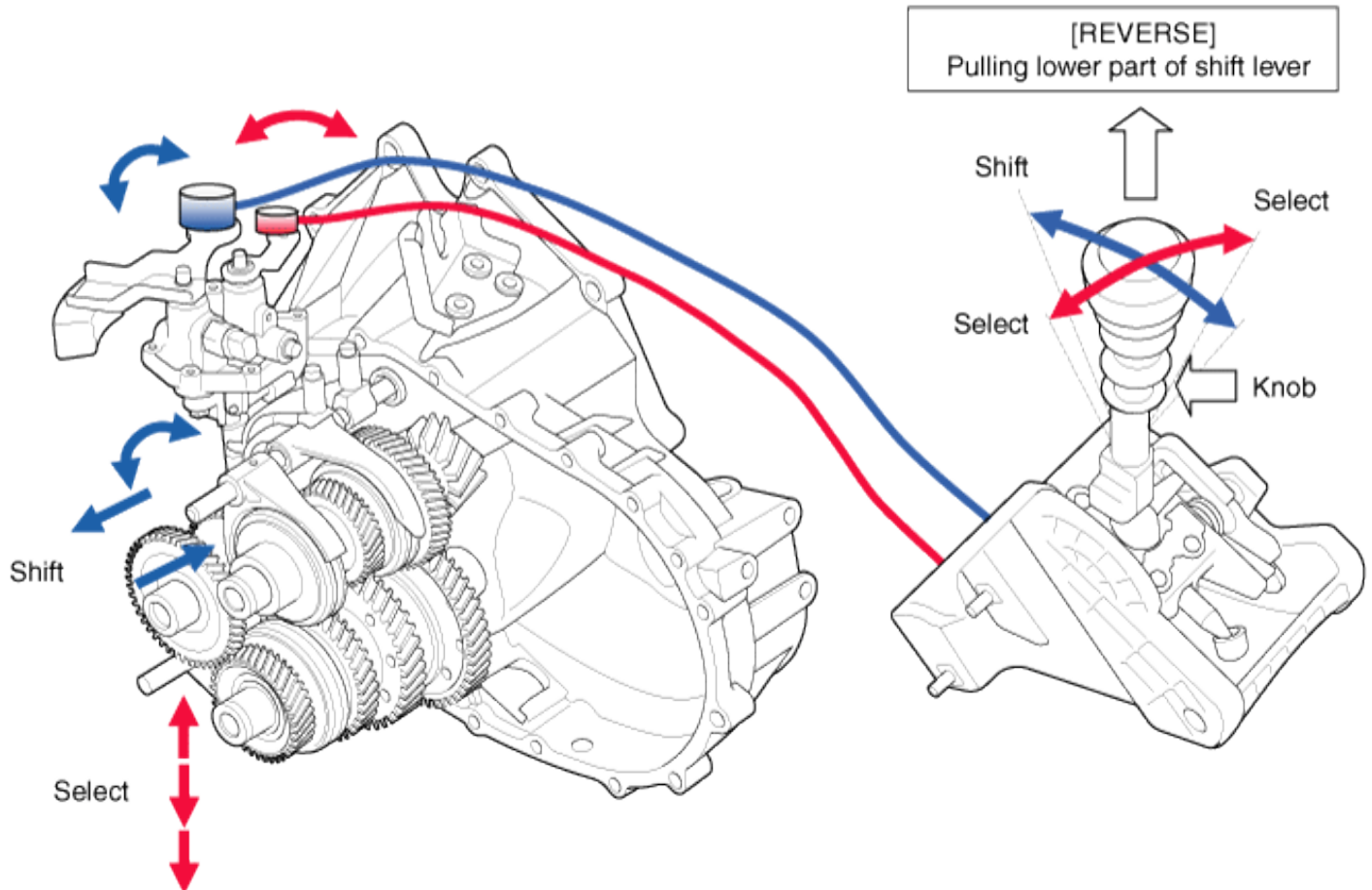
You should pull the lower part of the shift lever to shift in reverse.



<OLD PATTERN>



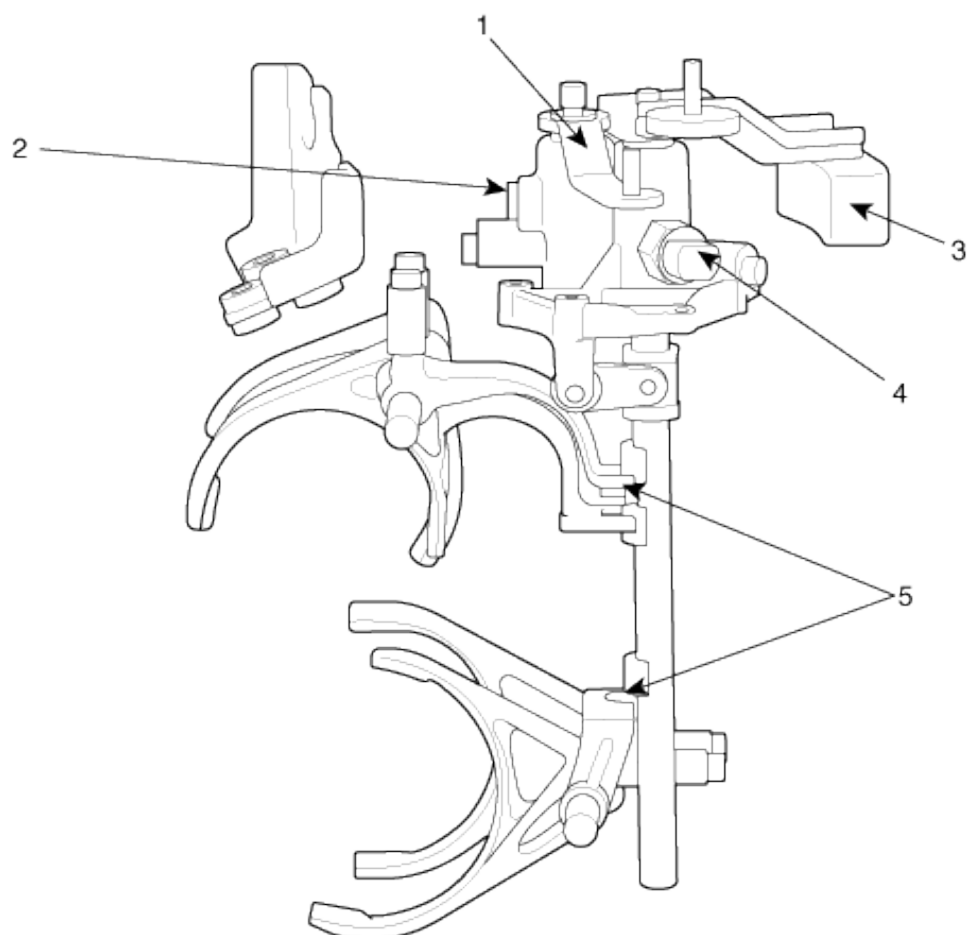
<NEW PATTERN>



SHIFT CONTROL SYSTEM

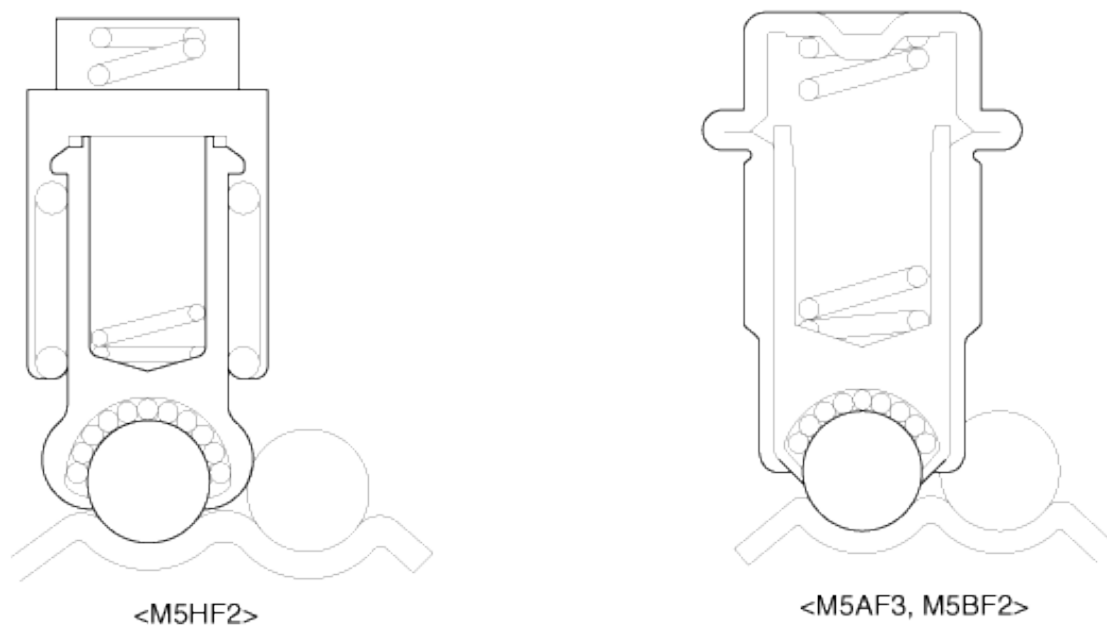
- SHIFT CONTROL SYSTEM

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 | |

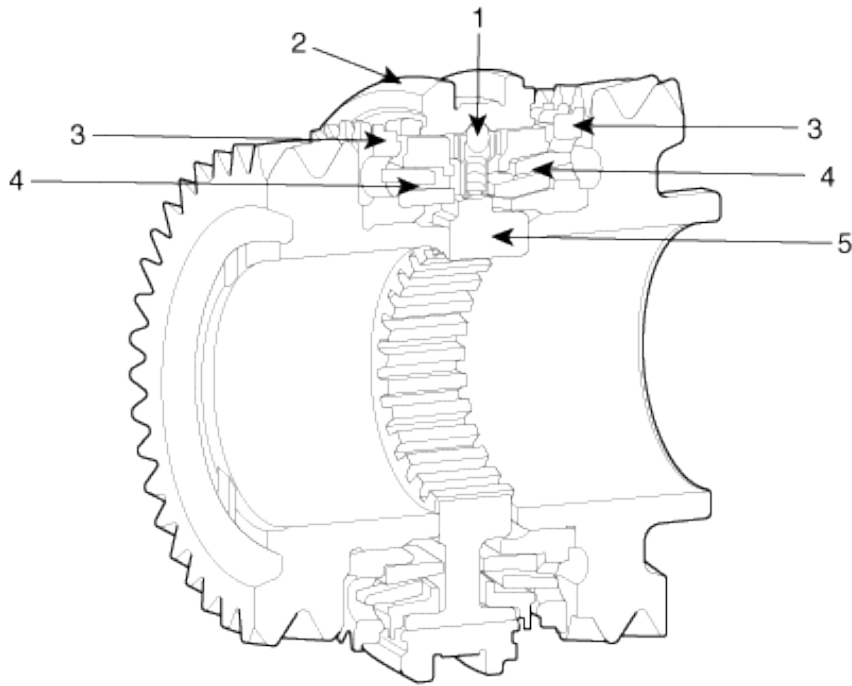
New type of poppet ball



Items	M5HF2	M5AF3, M5BF2
Character	Easy shifting	Medium shifting

SYNCHRONIZER SYSTEM

COMPONENTS

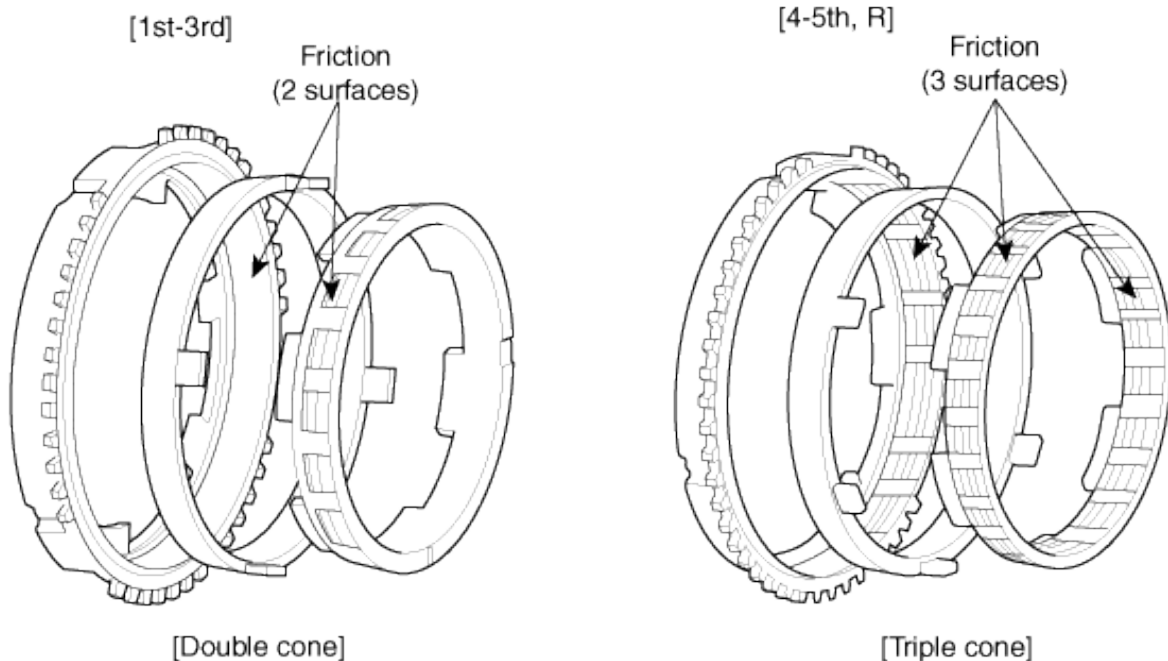


- 1. Synchronizer key
- 2. Synchronizer sleeve
- 3. Clutch gear

- 4. Synchronizer ring
- 5. Synchronizer hub

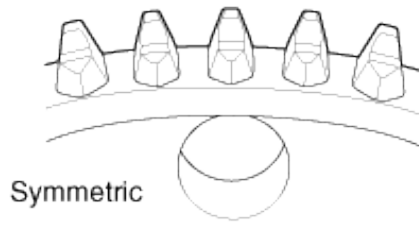
SYNCHRONIZER TYPE

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

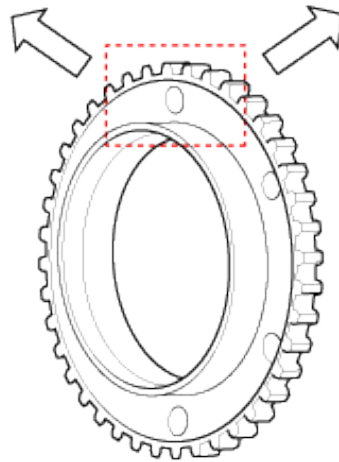
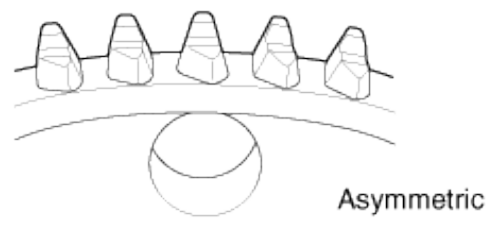


CLUTCH GEAR CHAMFER

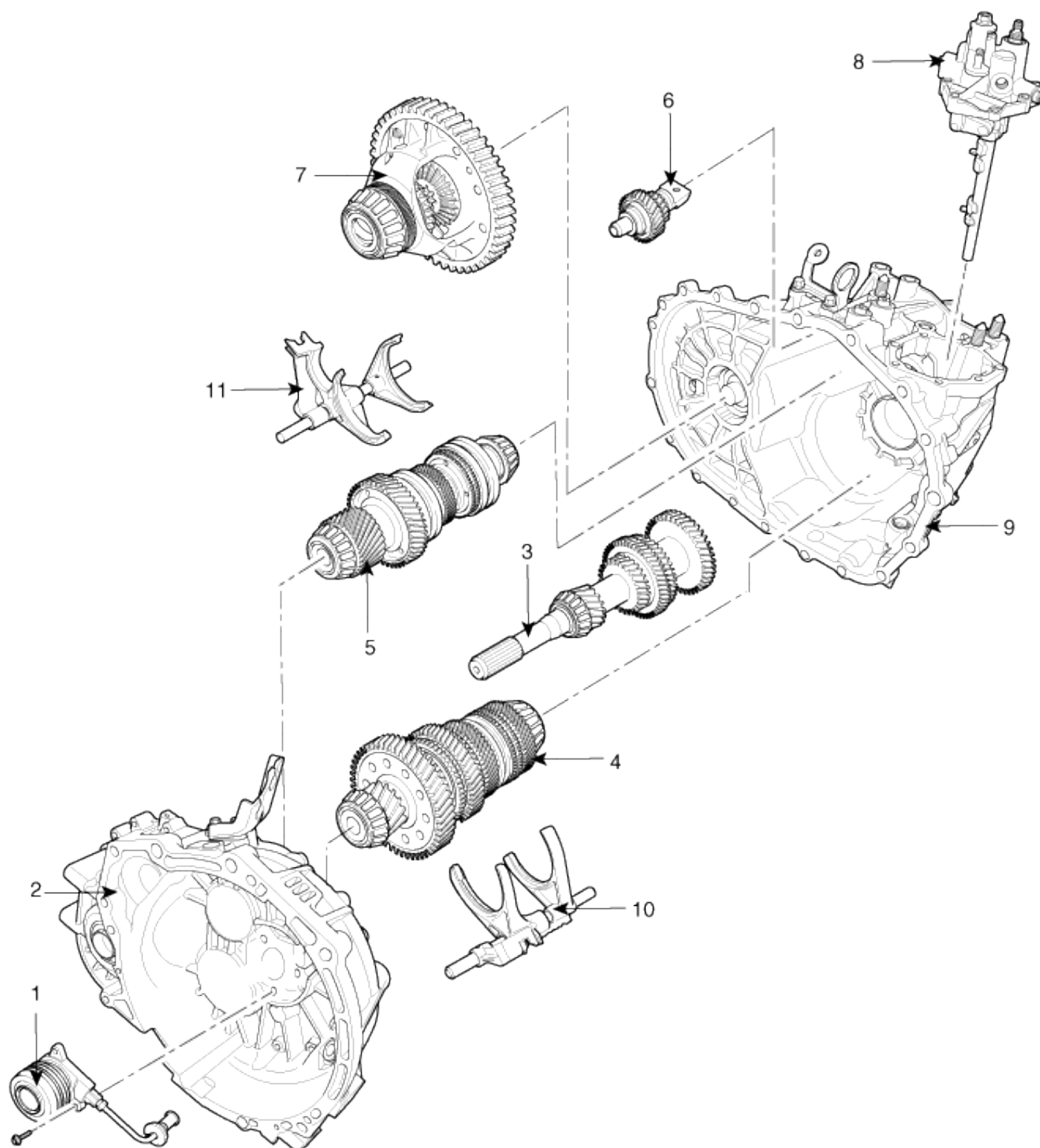
[1st & R]



[2-5th]



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

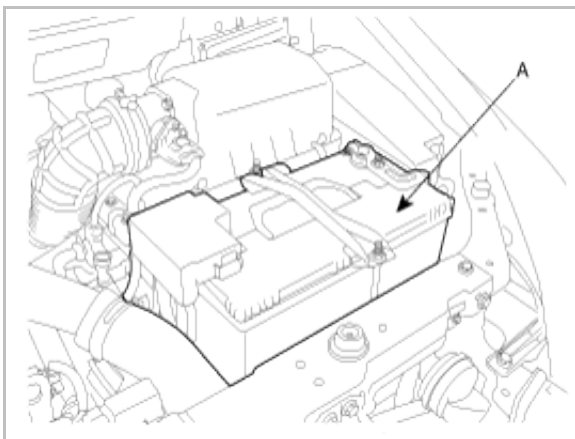
CAUTION

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

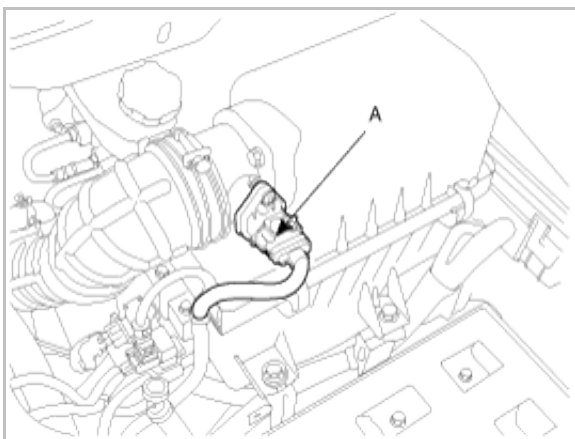
NOTICE

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

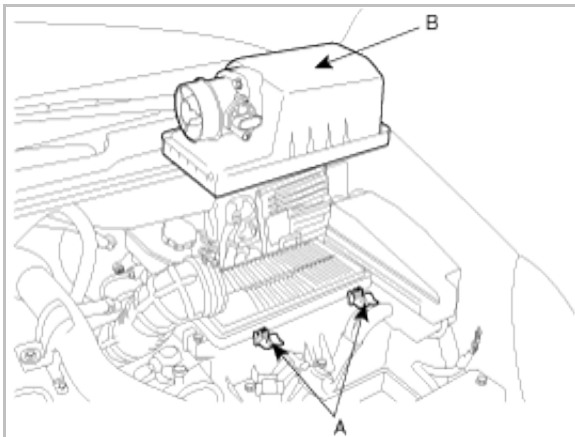
1. Remove the battery (A).



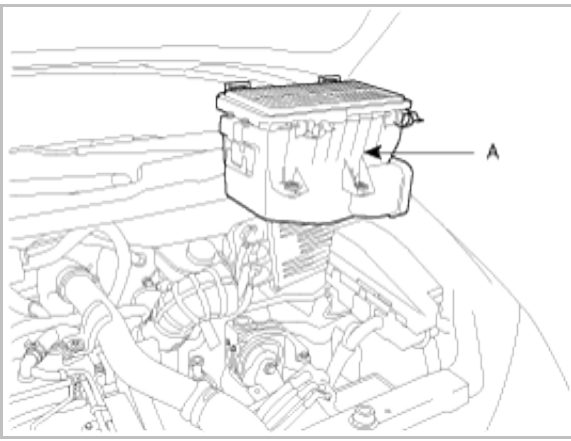
2. Disconnect the AFS connector (A).



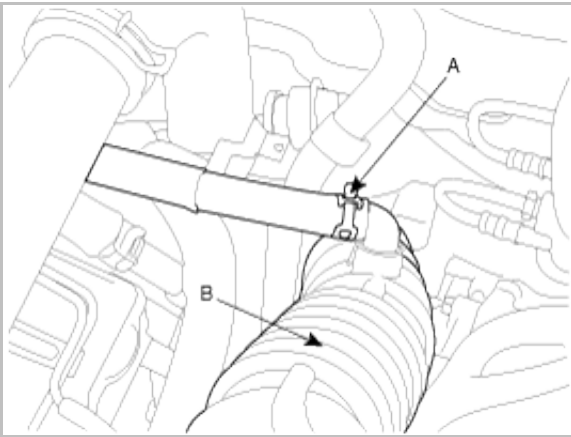
3. Remove the air cleaner upper cover (B) by loosening the clips (A).



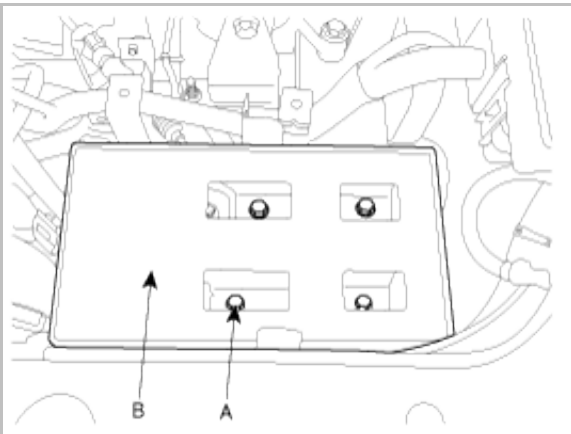
4. Remove the air cleaner assembly (A) by removing the two mounting bolts.



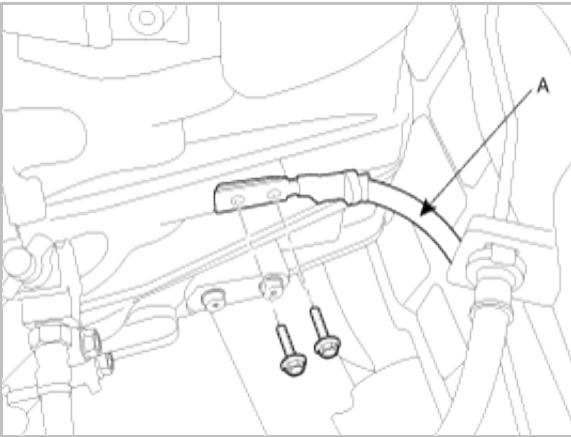
5. Disconnect the air cleaner hose (B) by loosening the clamp (A).



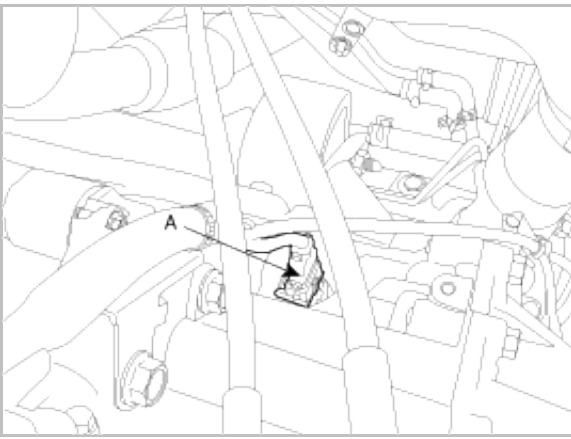
6. Remove the battery tray (B) by removing the four mounting bolts (A).



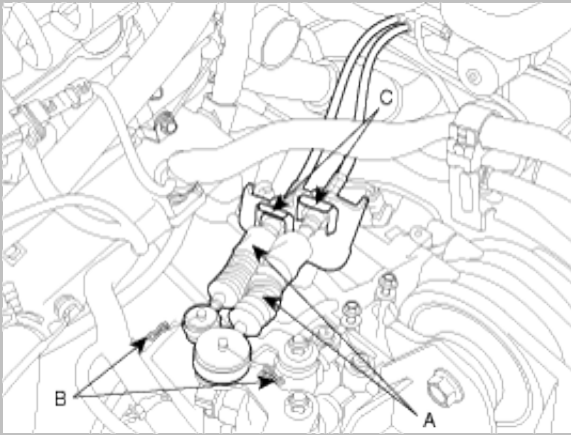
7. Remove the ground wire (A) from the transaxle case.



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.



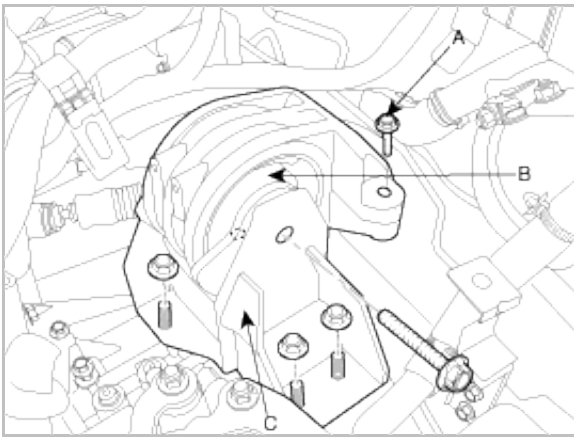
11. Remove C.S.C (Concentric Slave Cylinder) tube which is being clamped.

12. Remove the CKP sensor from the clutch housing assembly.

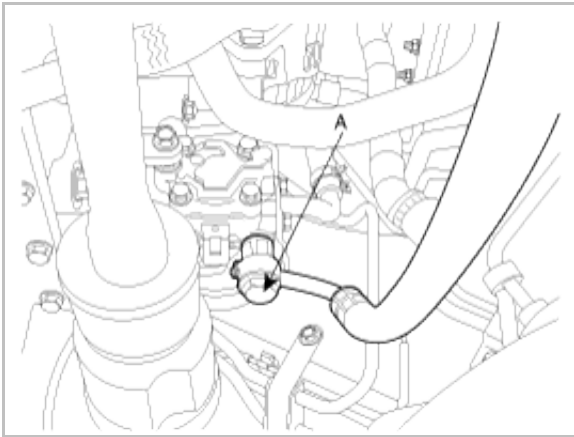
13. Remove the mounting bolts of upper part of the transaxle.

14. Support the engine and transaxle by using the special tool (09200-38001).

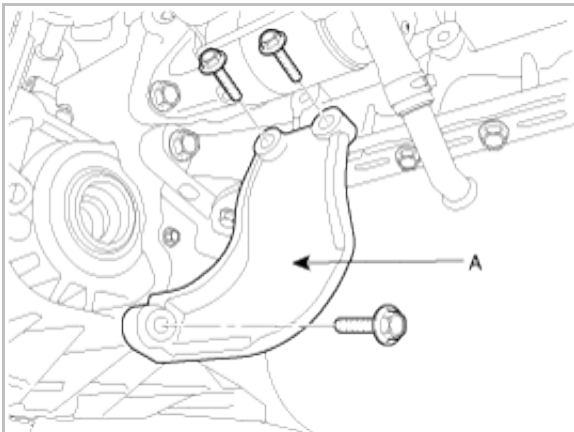
15. Remove the transaxle insulator (B) and the bracket (C) by removing the bolts (A).

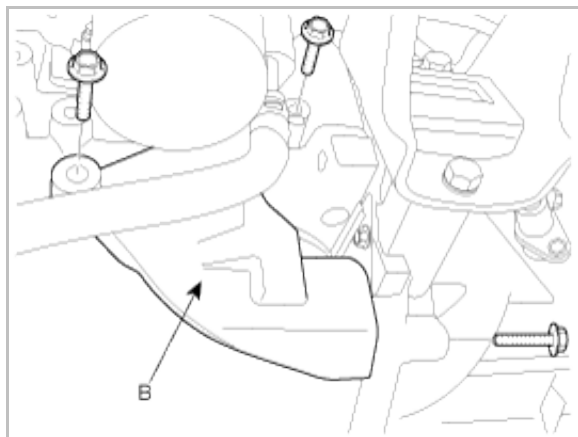


16. Remove the front wheels and tires. (see SS group)
17. Remove the steering column joint bolt. (see ST group)
18. Lift up the vehicle.
19. Remove the under cover.
20. Drain power steering oil through the return tube. (see ST group)
21. Disconnect the power steering pressure hose (A) from the power 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 :

- Adjust the shift cable.
- Refill the transaxle with fluid.
- Refill the radiator with engine coolant.
- Bleed air from the cooling system with the heater valve open.
- 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 plate between the engine and transaxle.

TORQUE :

8~11 Nm(80~110 kgf.cm, 5.8~8.0 lb-ft)

4. Install the brackets.

TORQUE :

19~26 or 38~53Nm (190~260 or 380~530kgf.cm, 13.8~18.9 or 27.3~38.5lb-ft)

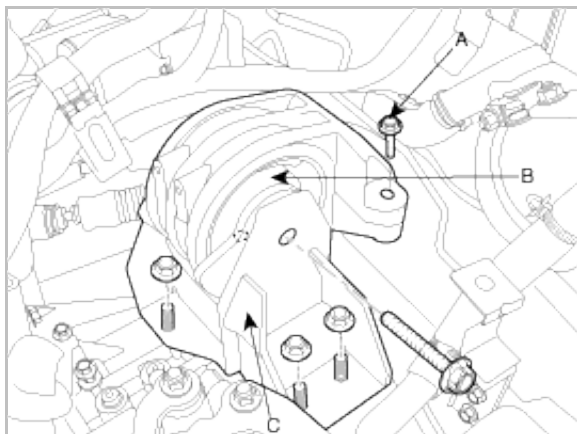
5. Install the starter motor and connect the starter motor connector. (see EE group)

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).

TORQUE:

60~80 Nm (600~800 kgf.cm, 43.6~58.2 lb-ft)

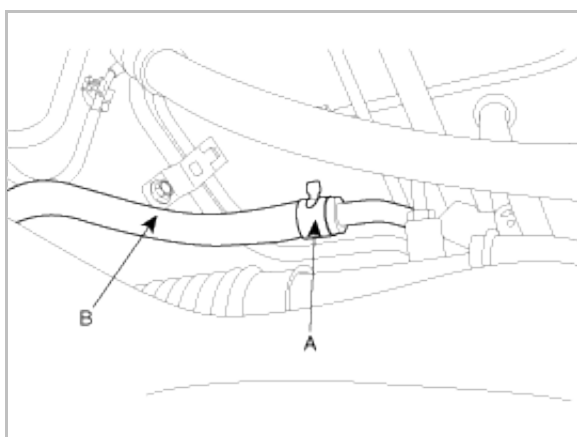


8. Install the sub frame. (see SS group)

TORQUE:

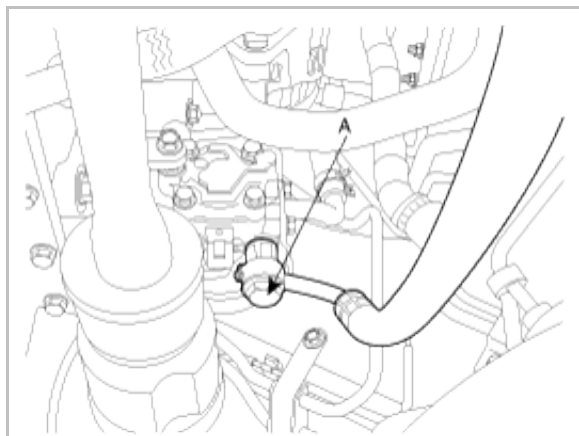
60~80 Nm(600~800 kgf.cm, 65.1~79.5 lb-ft)

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.



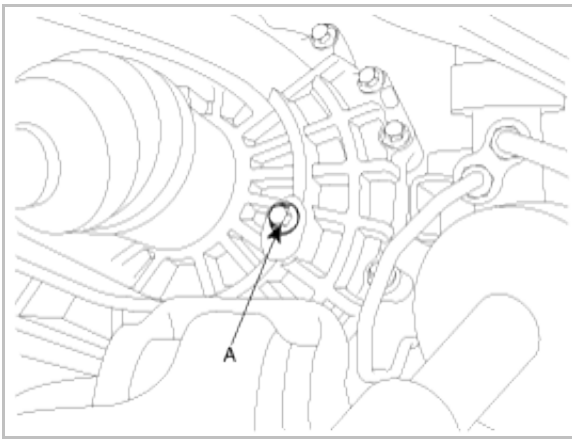
12. Install the under cover.

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

14. Refill transaxle oil through the inlet hole (A).

TORQUE:

30~35 Nm(300~350 kgf.cm, 21.8~25.4 lb-ft)



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:

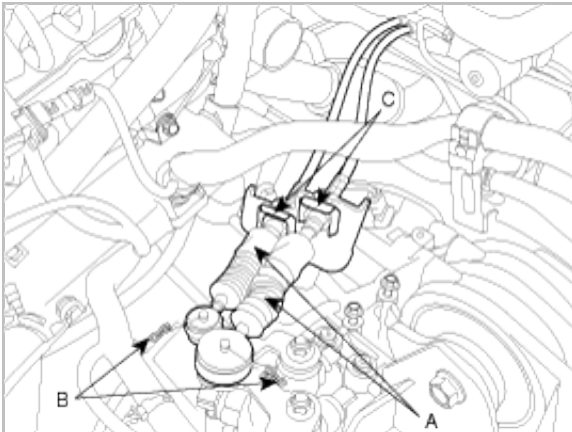
9~10 Nm(90~100 kgf.cm, 6.5~7.3 lb-ft)

18. Install the C.S.C (Concentric Slave Cylinder) tube and loosen the tube.

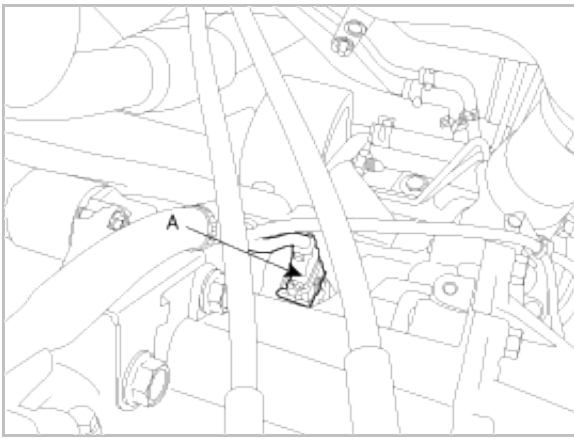
19. Connect the "N" (A) and the "R" (B) position switch.



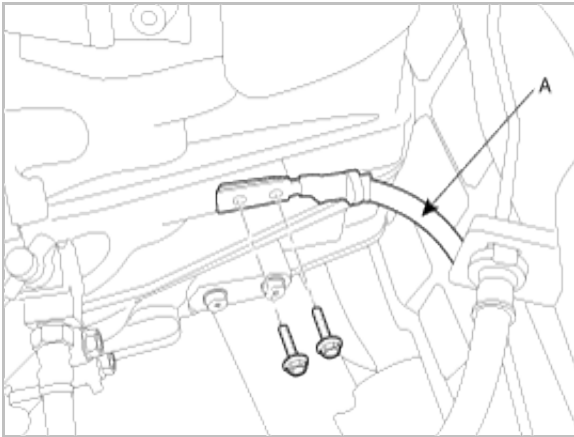
20. Install the shift cable(A) by tightening the clip (C) and pin (B).



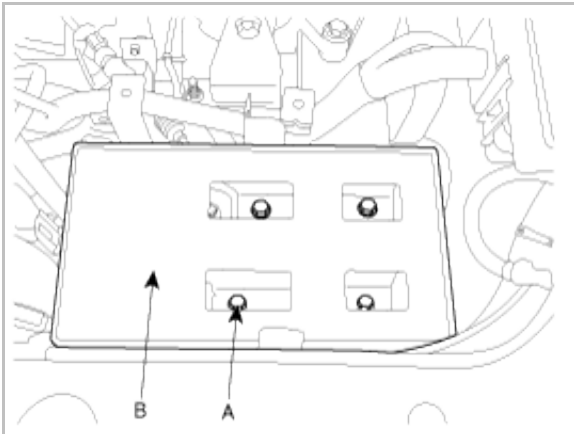
21. Install the vehicle speed sensor connector (A).



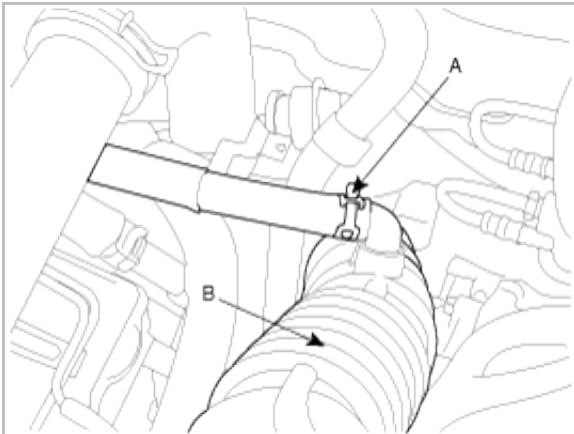
22. Install the ground wire (A) from the transaxle case.



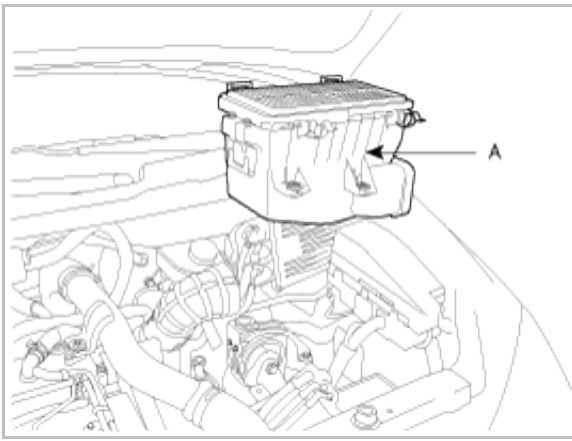
23. Install the battery tray (B) by removing the four mounting bolts (A).



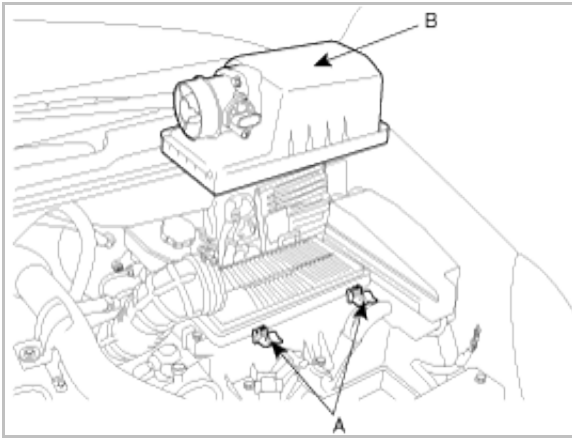
24. Connect the air cleaner hose (B) by tightening the clamp (A).



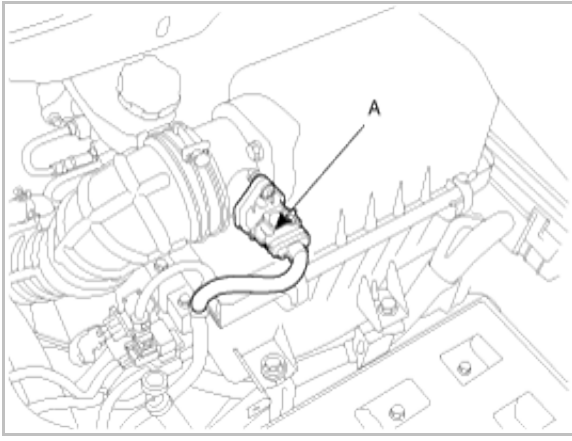
25. Install the air cleaner assembly (A) by tightening the two mounting bolts.



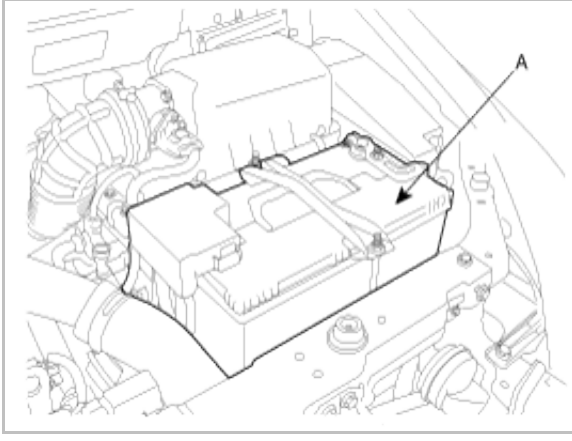
26. Install the air cleaner upper cover (B) by tightening the clips (A).



27. Connect the AFS connector (A).



28. Install the battery (A).

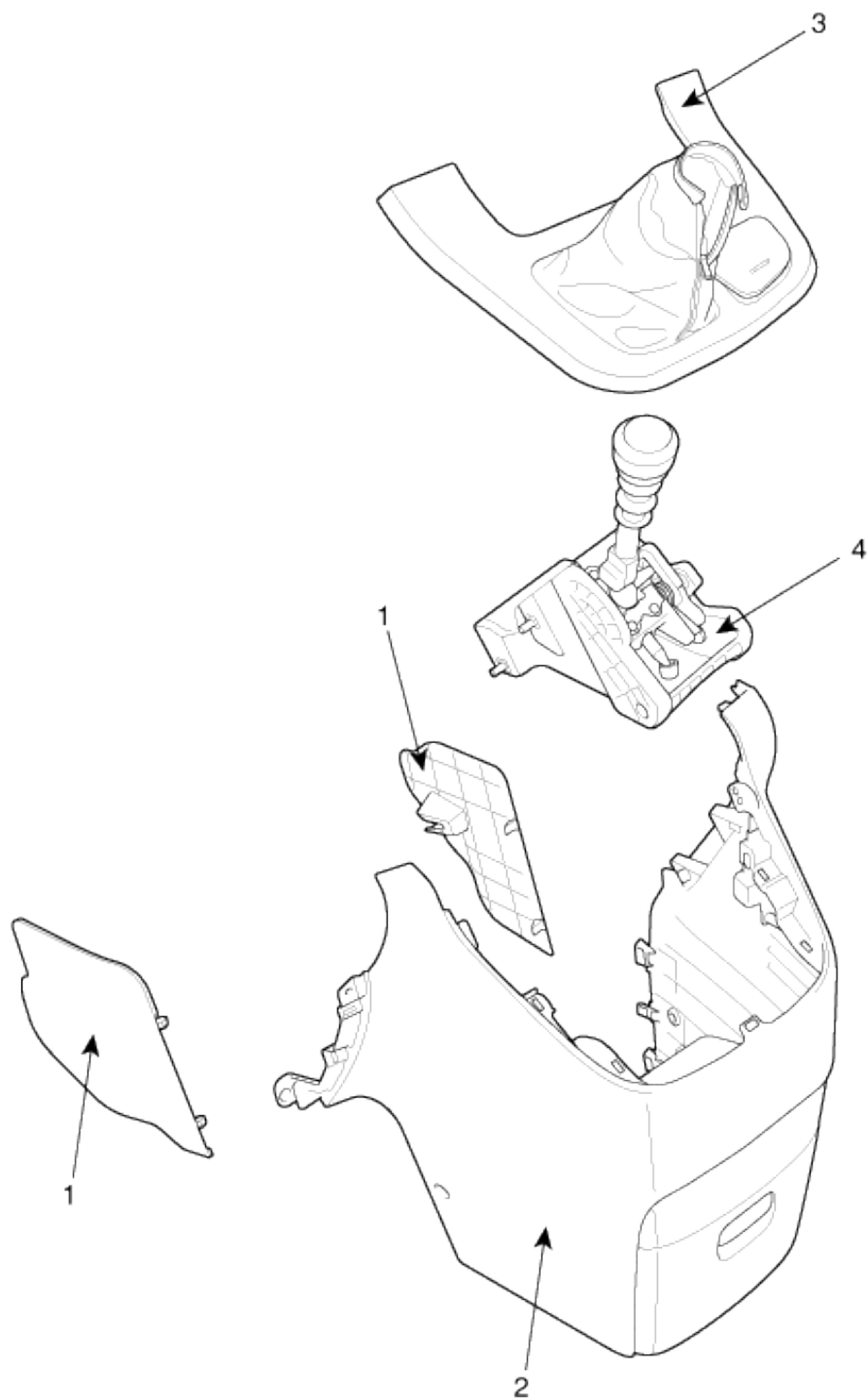




Manual Transaxle System

Manual Transaxle System - Shift Lever

COMPONENTS



- 1. Under cover
- 2. Center console

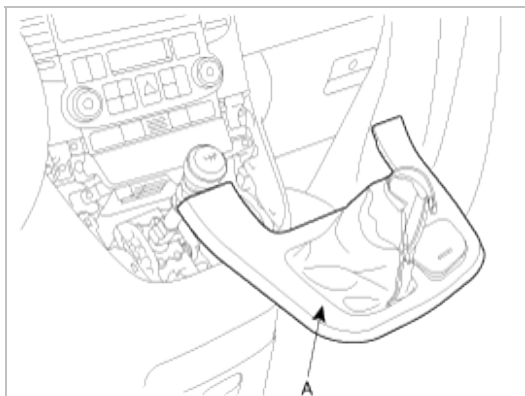
- 3. Shift lever cover
- 4. Shift lever assembly



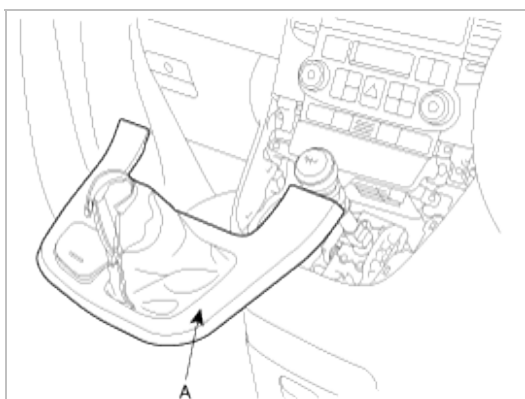
REMOVAL

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

[LHD]

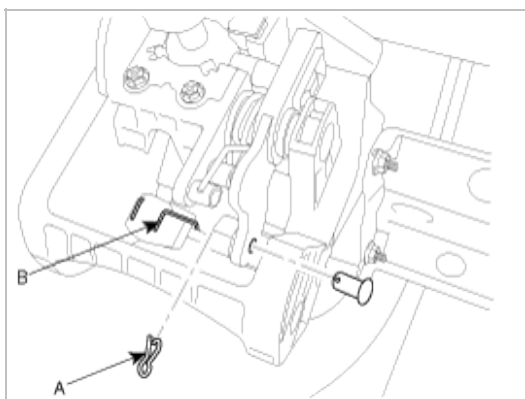


[RHD]

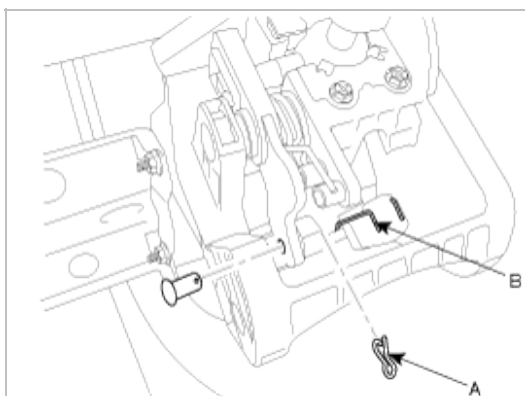


2. Remove the front console cover. (see BD group)
3. Remove the shift cable and the select cable by removing the pin (A) and clip (B).

[LHD]

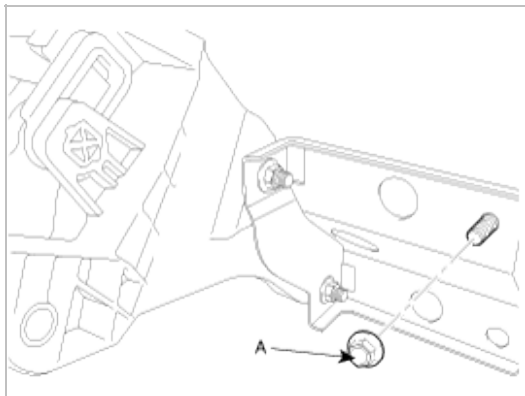
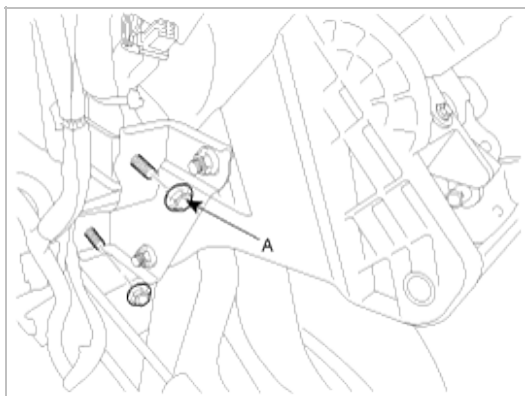


[RHD]

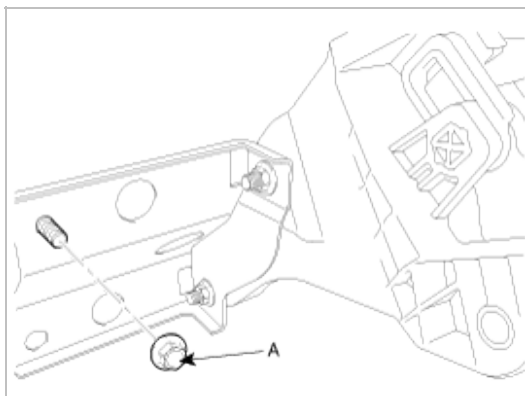


4. Remove the shift lever assembly mounting nuts (A).

[LHD]



[RHD]



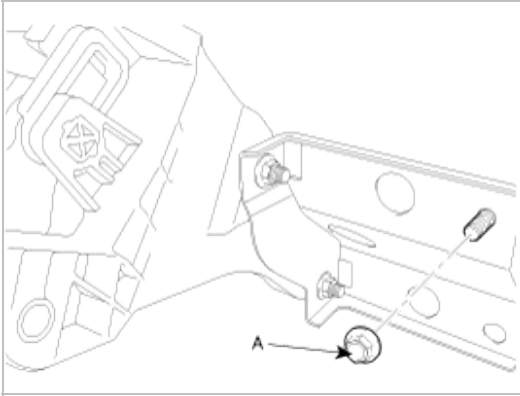
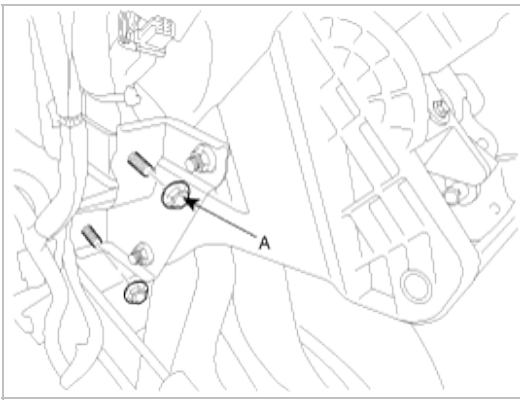
INSTALLATION

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

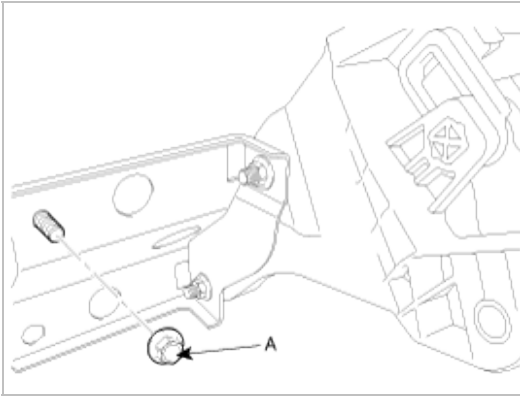
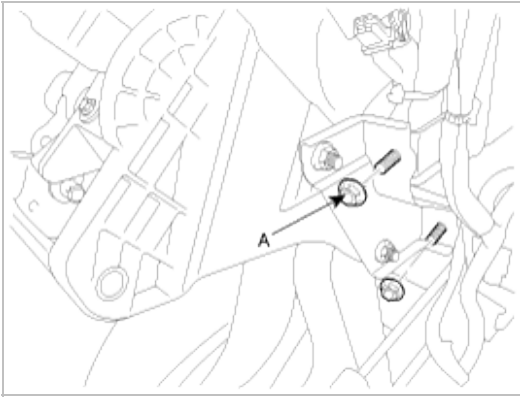
TORQUE:

18~27 Nm(180~270 kgf.cm, 13.1~19.6 lb-ft)

[LHD]

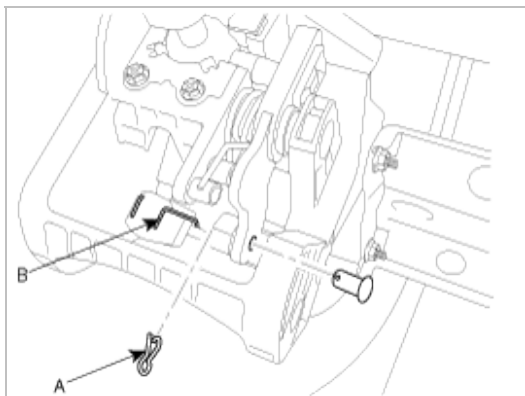


[RHD]

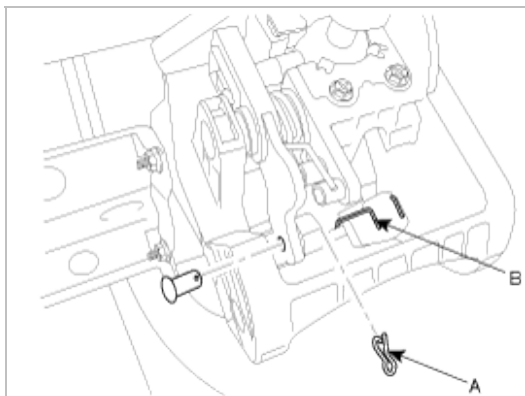


2. Install the shift cable and the select cable by installing the pin (A) and clip (B).

[LHD]



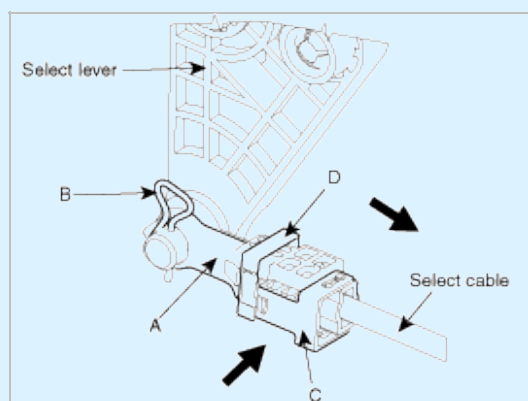
[RHD]



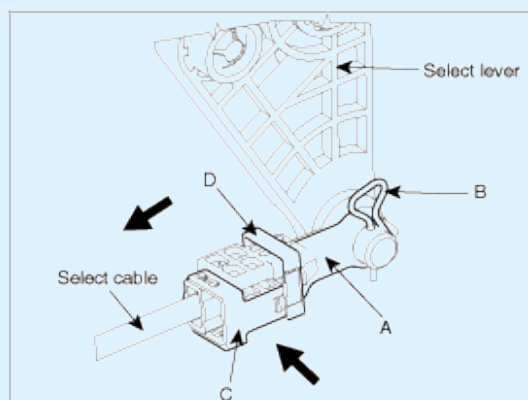
CAUTION

When adjusting the cable, follow the instruction as :

[LHD]



[RHD]

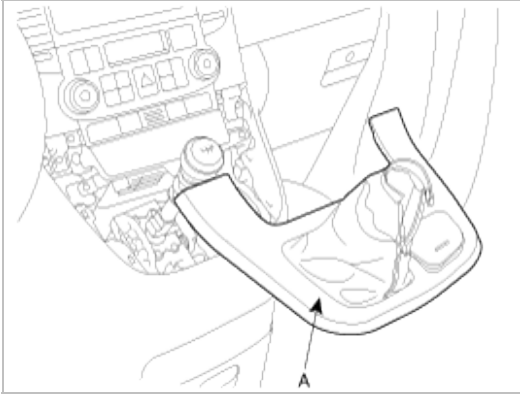


Place the shift lever in "N" position.

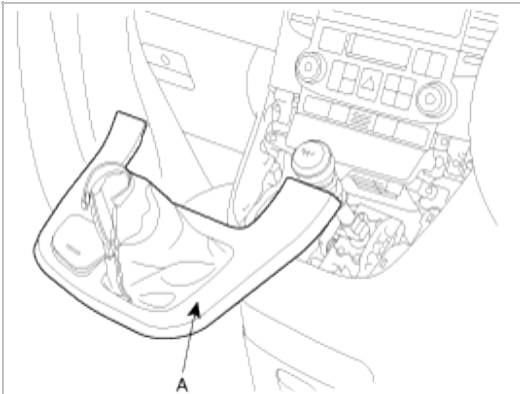
1. Insert the eye end (A).
2. Install the snap pin (B).
3. Insert the lock piece (C).
4. Clamp the locking clamp (D).

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

[LHD]



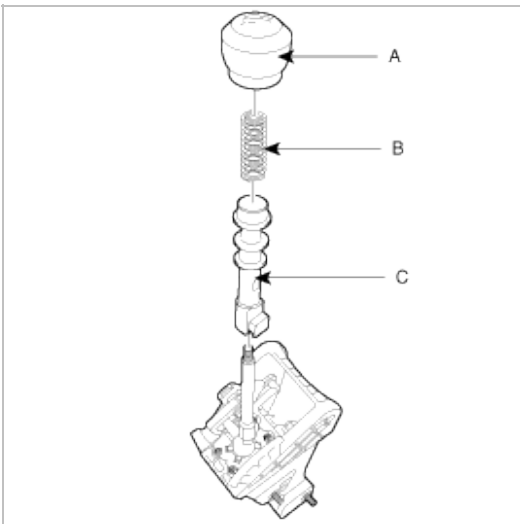
[RHD]



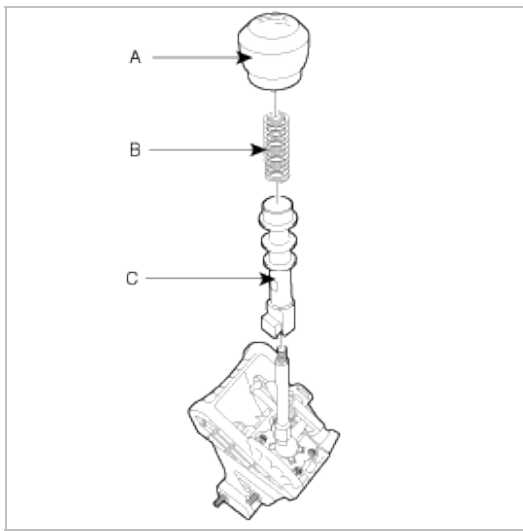
DISASSEMBLY

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):

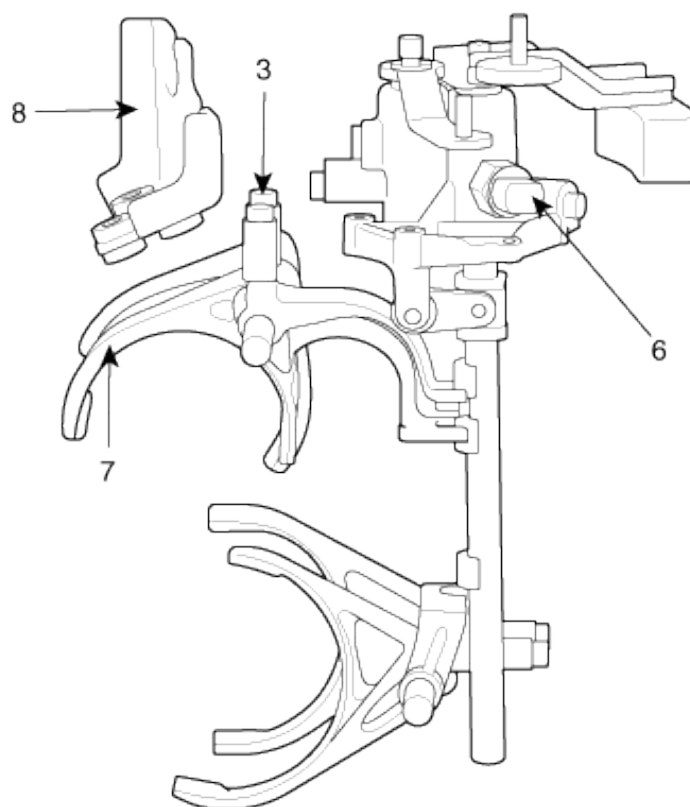
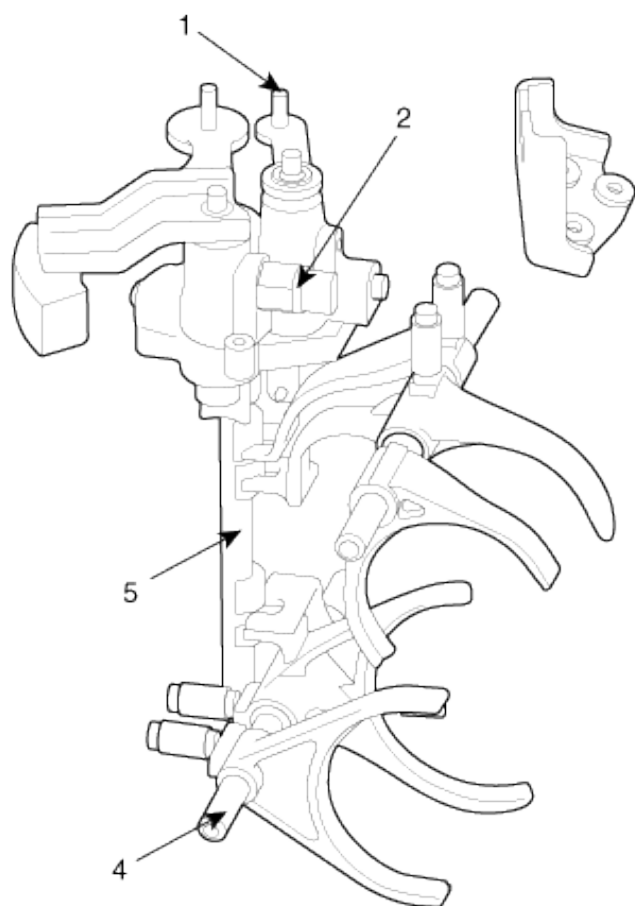
18~27 Nm(180~270 kgf.cm, 13.1~19.6 lb-ft)



Manual Transaxle System

Manual Transaxle Control System - Shift
Control

COMPONENTS



- 1. Shift/select lever
- 2. Neutral sensing switch
- 3. Detent pin
- 4. Shift rail

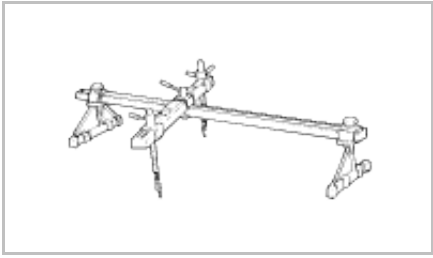
- 5. Control shaft
- 6. Reverse shift switch
- 7. Shift fork/lug
- 8. Cable bracket



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.



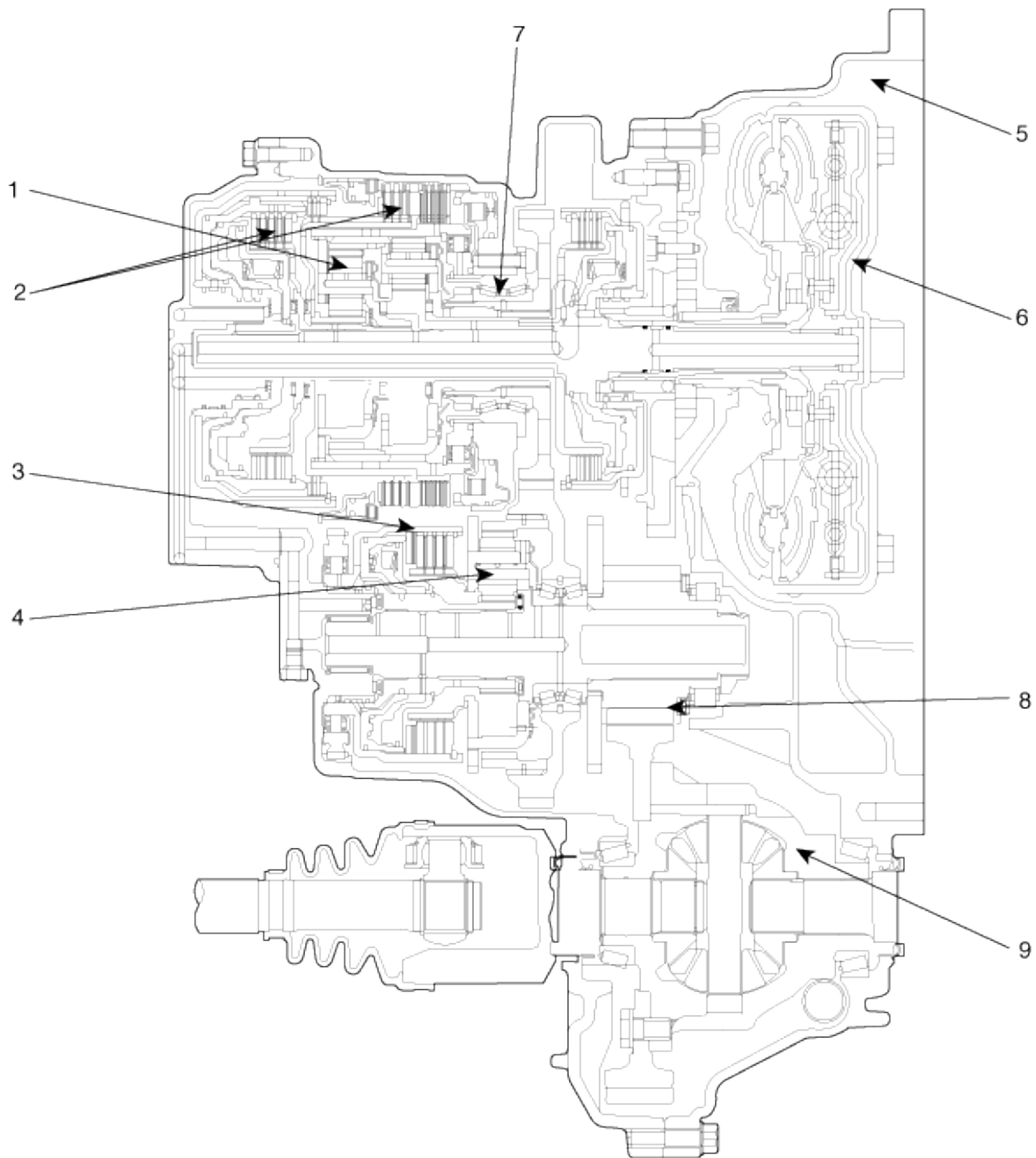
Automatic Transaxle System

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) | 6. High capacity torque converter |
| -Overdrive clutch | 7. Bearing outer diameter increased ($\Phi 5$ mm) |
| -2ND brake | 8. Differential gear (Increased width by 2mm) |
| 3. Reduction band (Piston increased) | 9. Differential capacity increased (6.1→7) |
| 4. Direct planetary gear (3→4 pinions) | |

2. Variable Line Pressure Control

A. Description

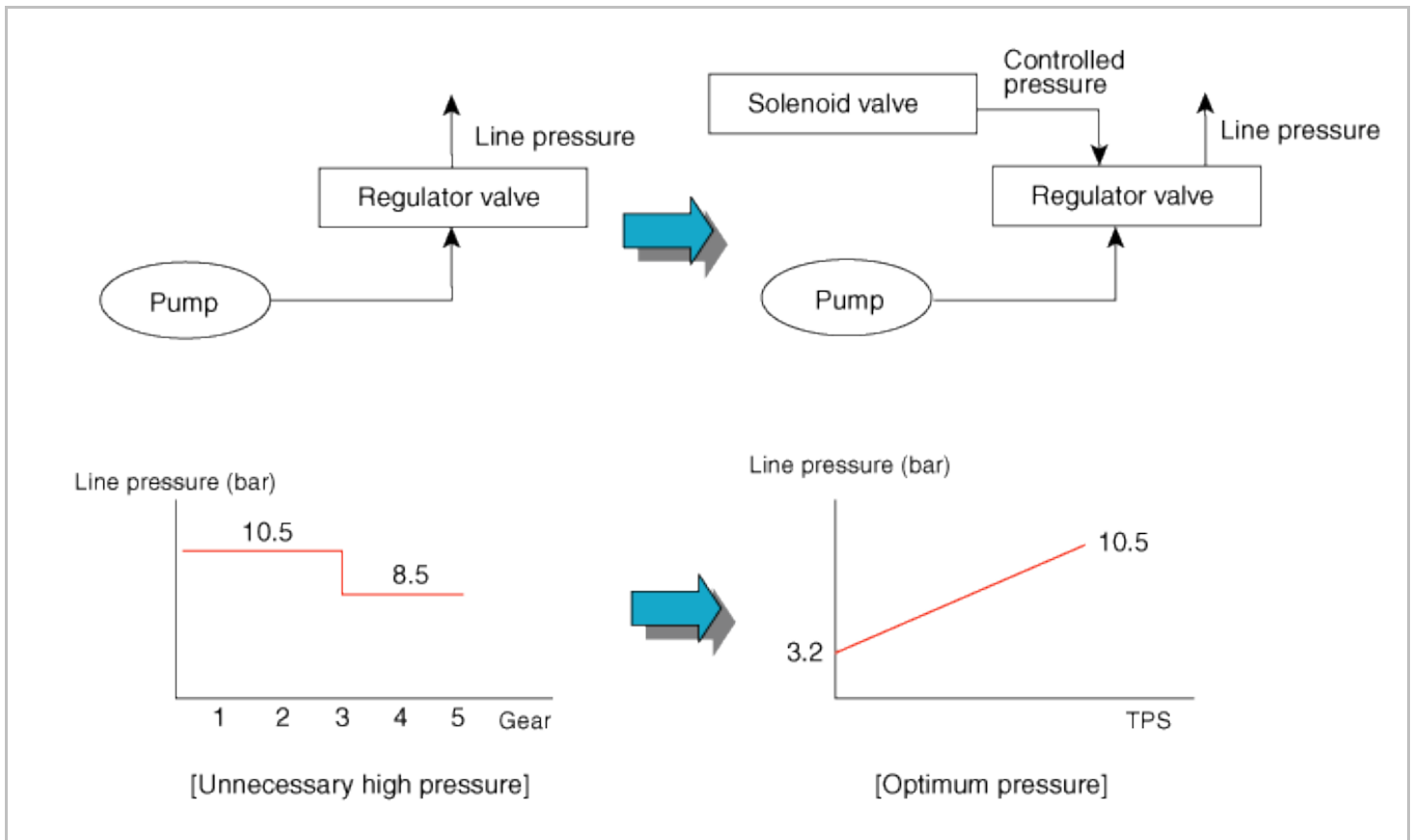
- Form the most suitable line pressure according to the vehicle driving condition

B. Special Features

- VFS (Variable Force Solenoid) valve (For varying line pressure)
- Reducing valve added (Stabilize control pressure in shiftings)

C. Effects

- Improved power transmission efficiency and fuel consumption



3. Gear durability improvement and less-noisy gear development

A. Description

- Optimal gear transmission ratio design from analyzing gears

B. Special Features

- Apply High-strength gear material
- Gear teeth width increased
- Planetary gear (3 pinions → 4 pinions)
- Less-noisy gear development

C. Effects

- Durability improvement
- Reduction of noise level

4. Case/Housing intensity reinforced

A. Description

- Case/Housing intensity reinforced

B. Special Features

- Converter housing intensity reinforced(Ribs added and thickness increased)
- Most suitable stiff reinforcement through analyzing

C. Effects

- Intensity increased and banding vibration decreased
- NVH Performance improvement

5. New frictional material

A. Description

- Apply new frictional material for capacity and durability improvement

B. Special Features

- SSP (Single Sided Plate) applied only on overdrive clutch and 2nd brake
- Apply the next generation frictional material(BWA 6100/D 0880-88)

C. Effects

- Thermal absorption capacity improvement
- 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	-	-

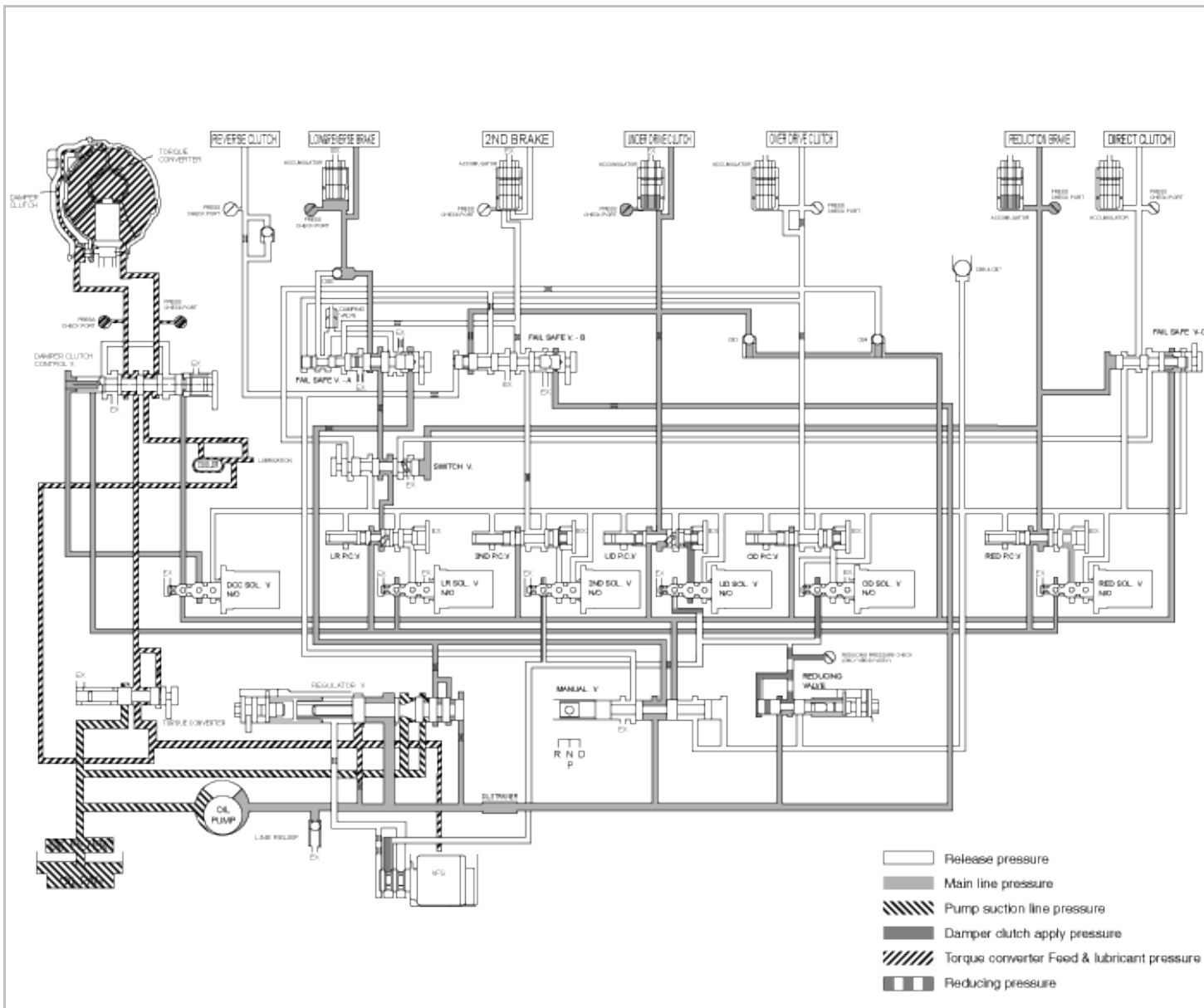
(• : Locked when driving)

FUNCTIONS OF CLUTCHES AND BRAKES

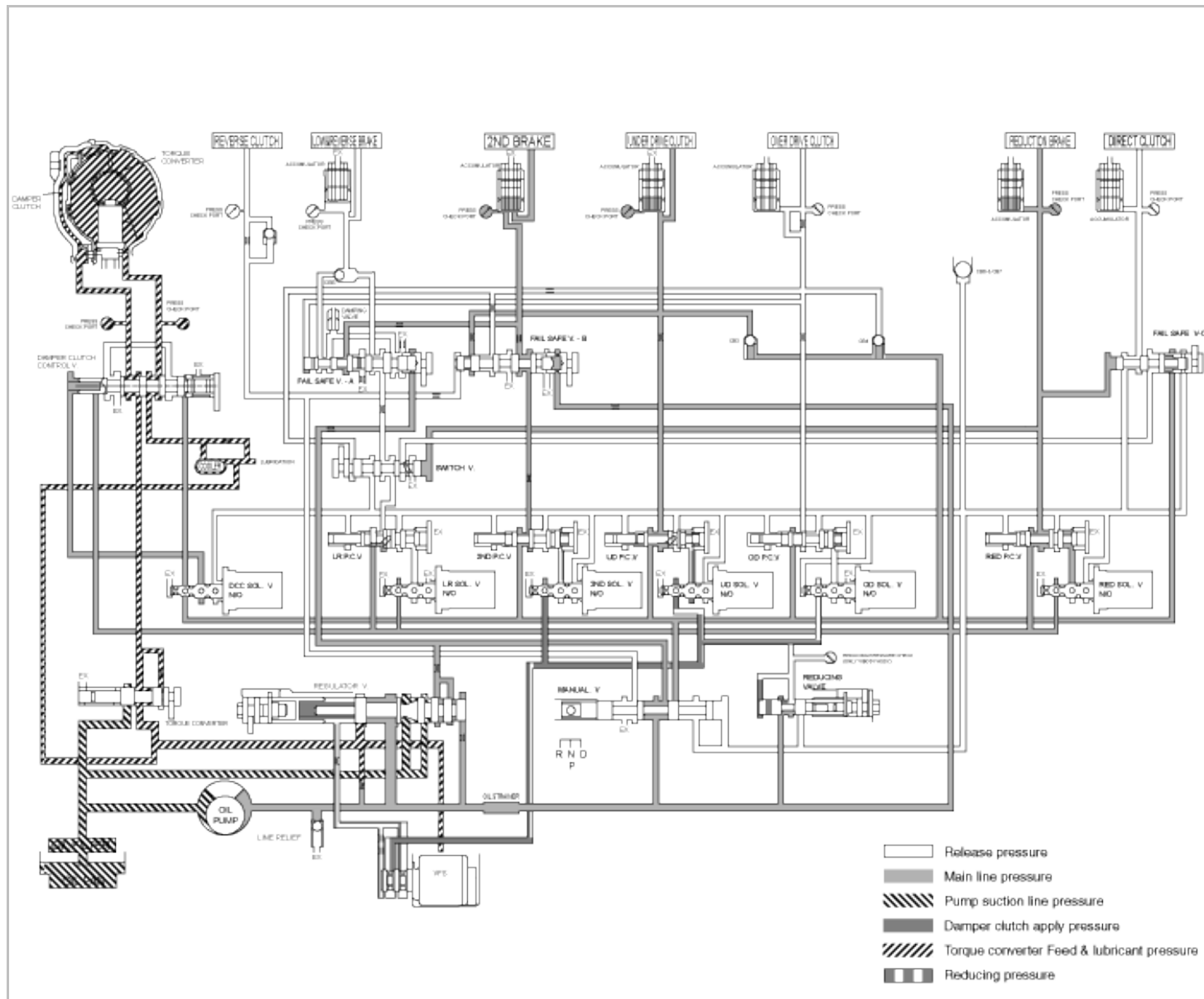
Element	Sign	Function
Underdrive clutch	UD	Connect the input shaft with the underdrive sun gear
Reverse clutch	REV	Connect the input shaft with the reverse sun gear
Overdrive clutch	OD	Connect the input shaft with the overdrive carrier
Direct clutch	DIR	Connect the direct sun gear with the direct carrier
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

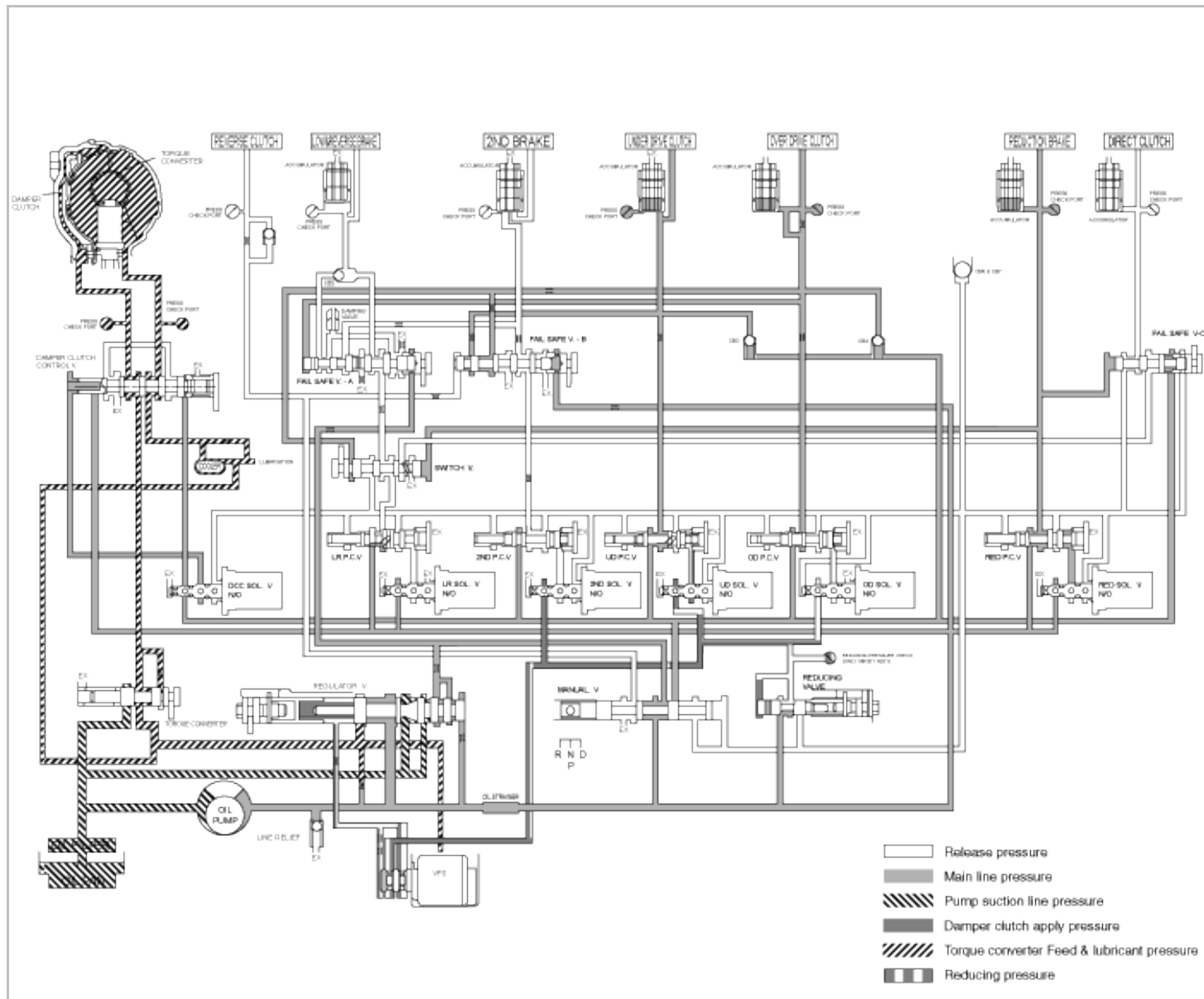
P/N



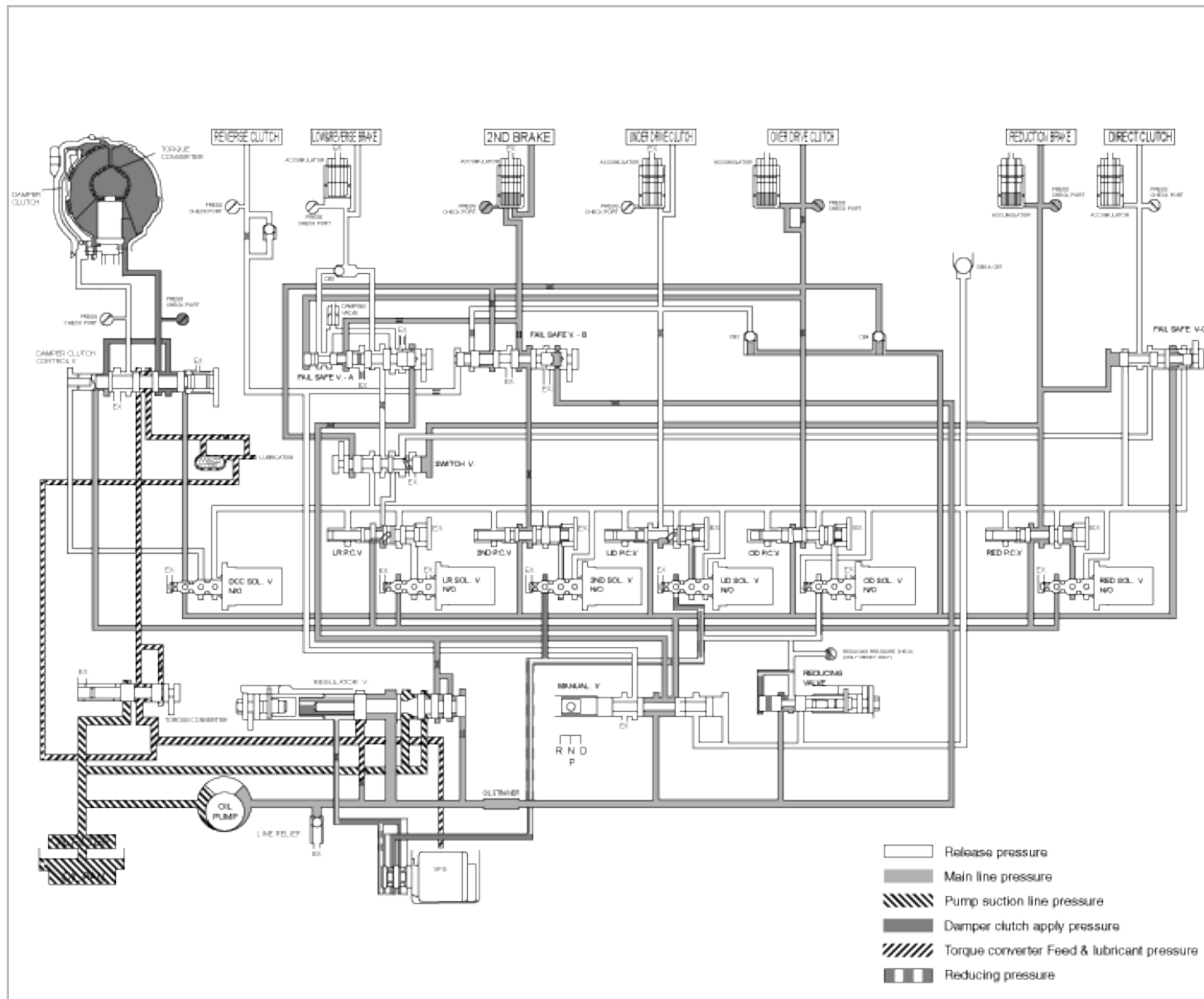
D(2 RANGE)



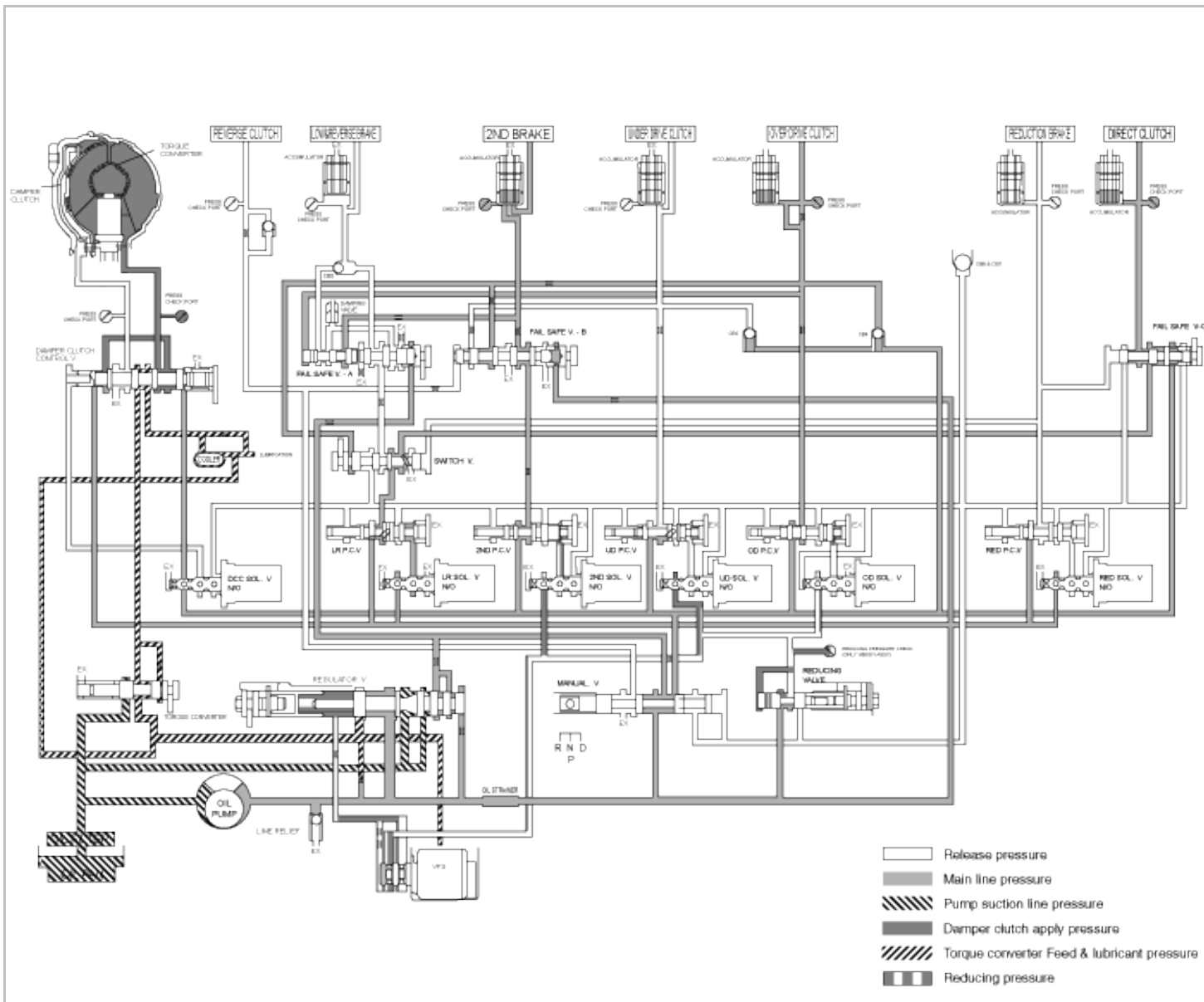
D(3 RANGE)



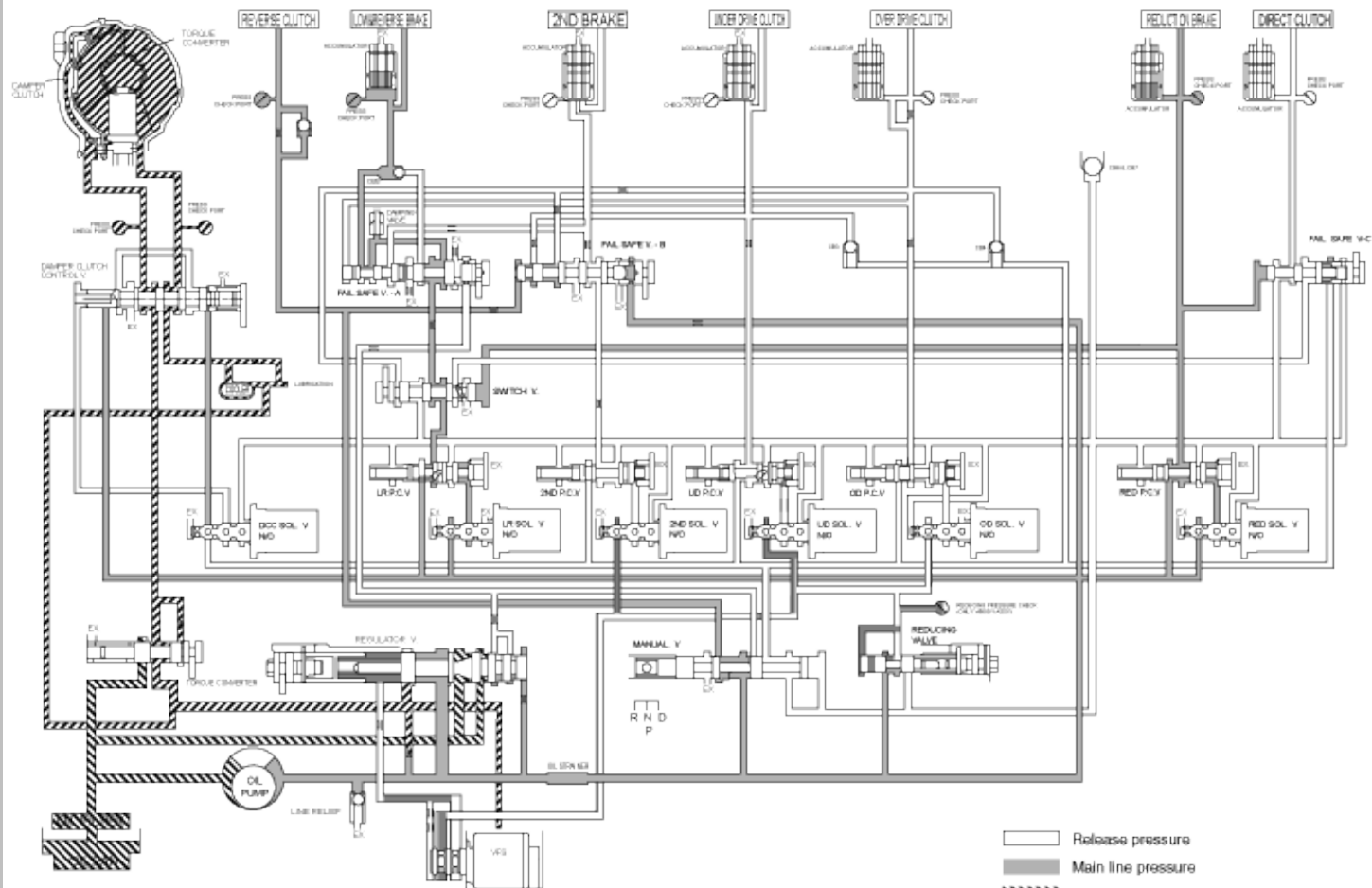
D(4 RANGE)



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.

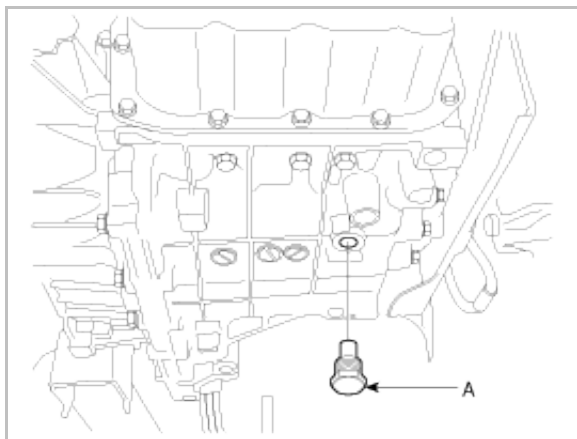
Running conditions : "N" range with engine idling.

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

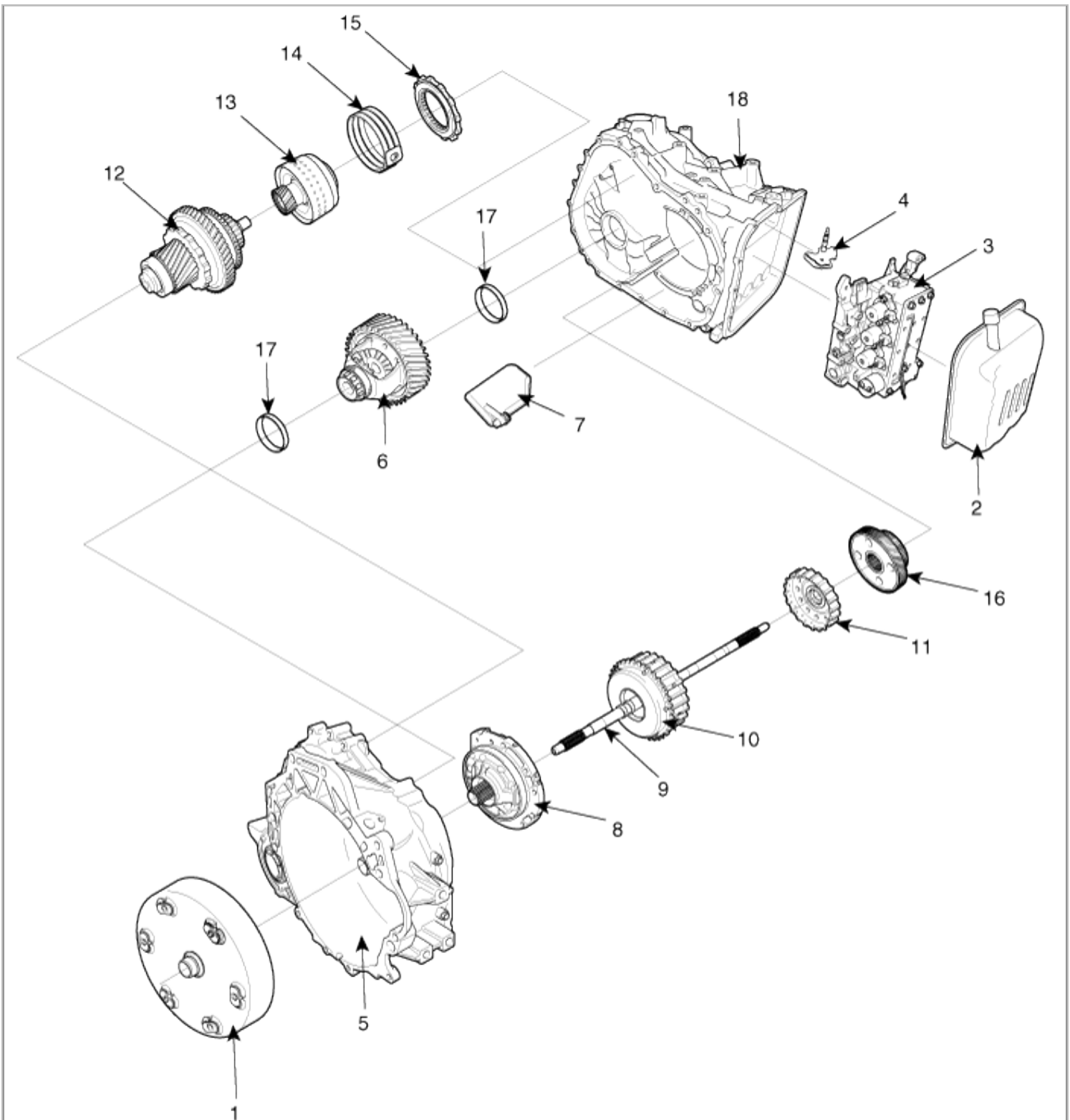
Stop pouring if the full volume of fluid cannot be poured in.

6. Repeat the procedure in step (2).

NOTICE

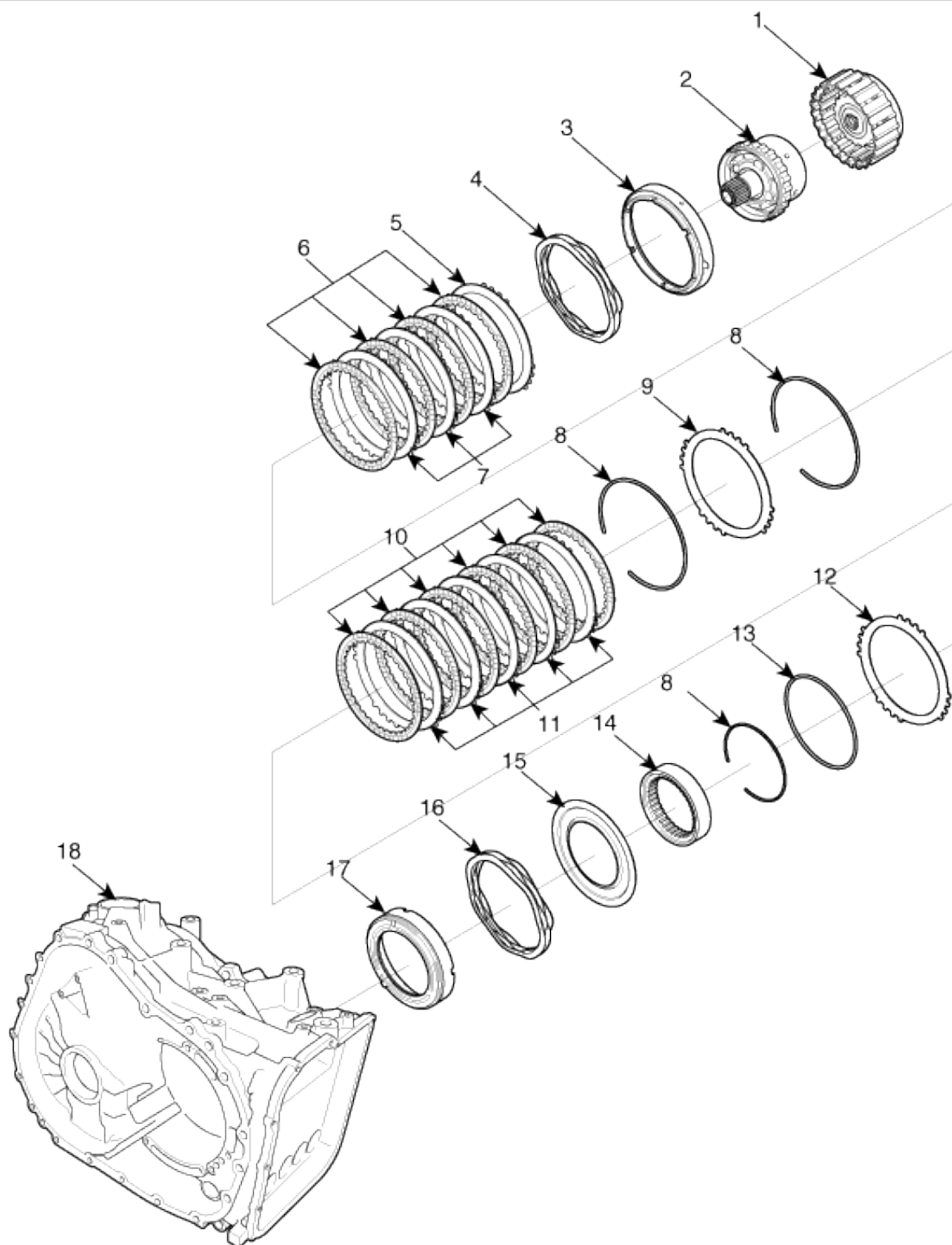
Check the old fluid for contamination. If it has been contaminated, repeat the steps (5) and (6).

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.

COMPONENTS (1)

- | | | |
|----------------------------------|---------------------------------------|-------------------------------|
| 1. Torque converter | 7. Main oil filter | 13. Direct clutch assembly |
| 2. Valve body cover | 8. Oil pump | 14. Reduction brake band |
| 3. Valve body assembly | 9. Input shaft | 15. One way clutch |
| 4. Manual control shaft assembly | 10. Underdrive clutch assembly | 16. Transfer drive gear |
| 5. Converter housing | 11. Underdrive clutch hub | 17. Differential bearing case |
| 6. Differential assembly | 12. Direct planetary carrier assembly | 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

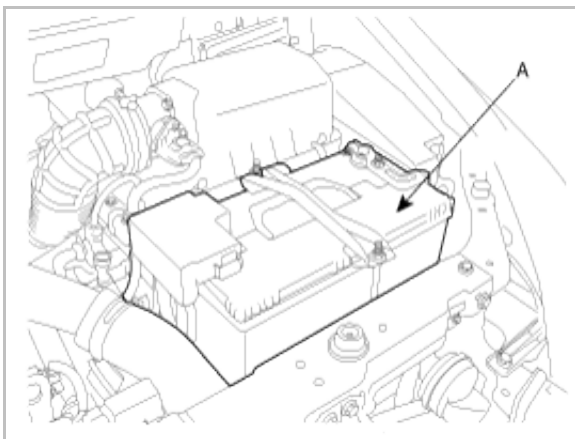
CAUTION

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

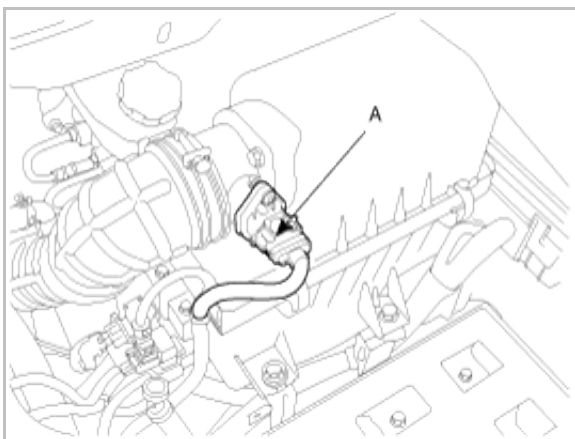
NOTICE

- Mark wires or hoses for identification.

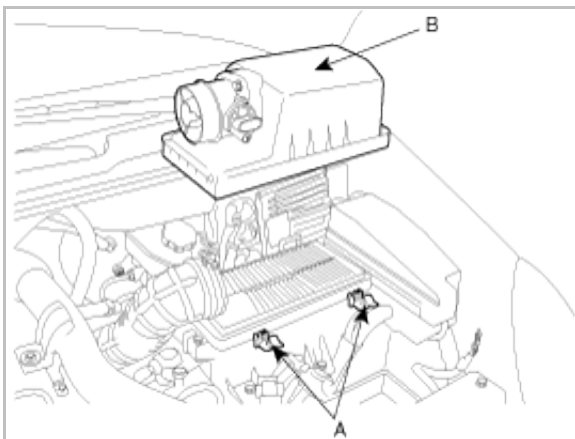
1. Remove the battery (A).



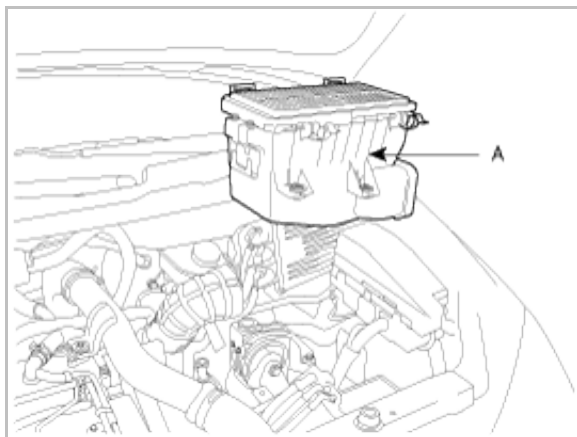
2. Disconnect the AFS connector (A).



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

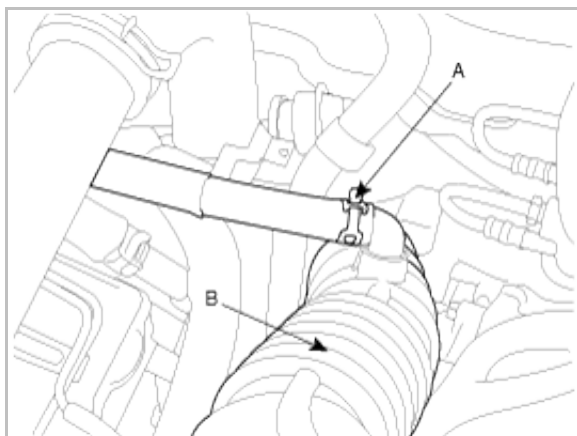


4. Remove the air cleaner assembly (A).

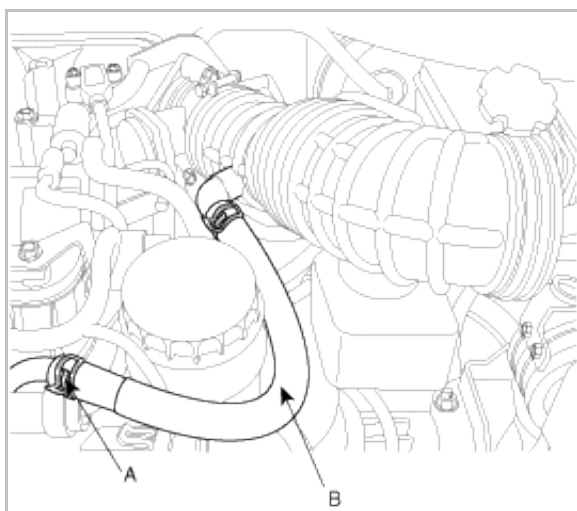


5. Disconnect the air cleaner hose (B) by loosening the clamp (A).

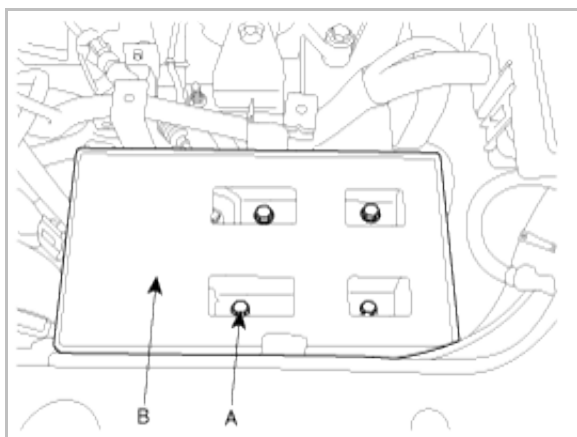
[2.9 DSL]



[3.8 GSL]

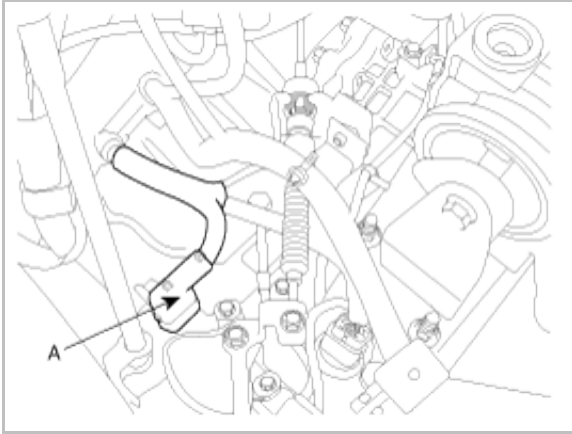


6. Remove the battery tray (B) by removing the four mounting bolts (A).



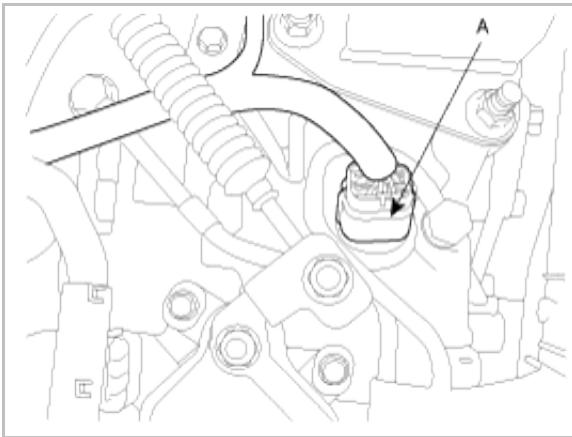
7. Disconnect the transaxle wire harness connectors.

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

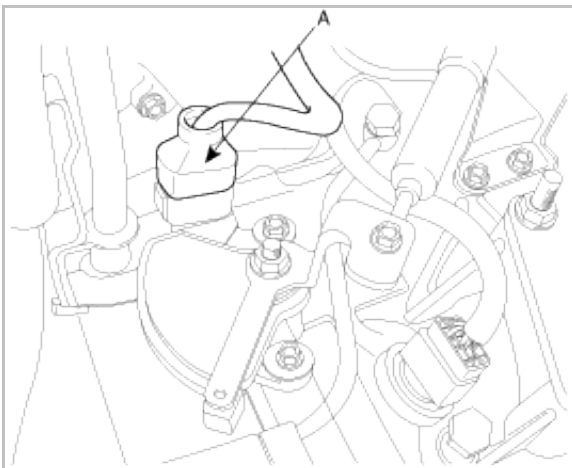


(2) Remove the solenoid valve connector (A).

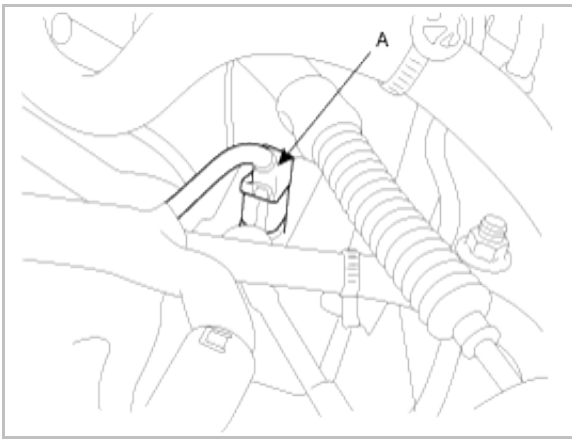
[2.9 DSL]



[3.8 DSL]



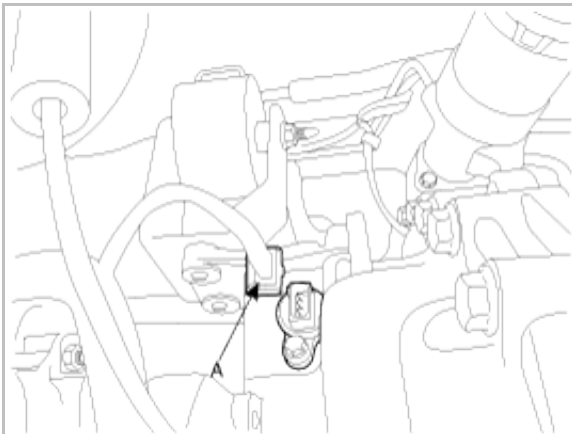
(3) Remove the input speed sensor connector (A).



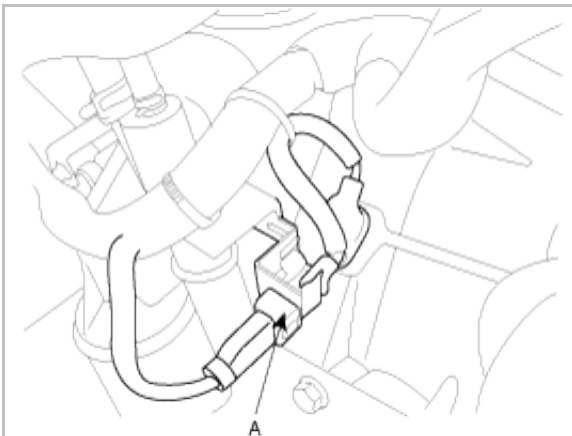
(4) Remove the output speed sensor connector (A).



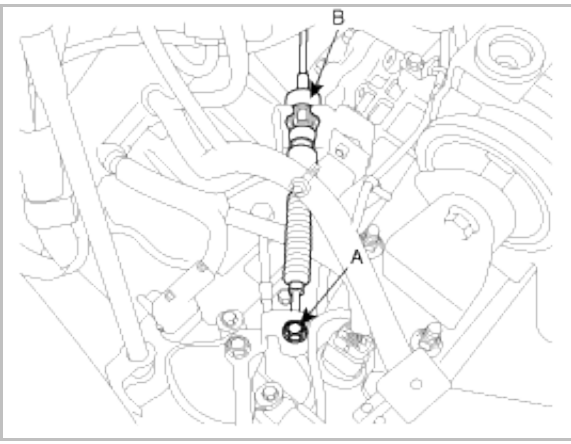
(5) Remove the vehicle speed sensor connector (A).



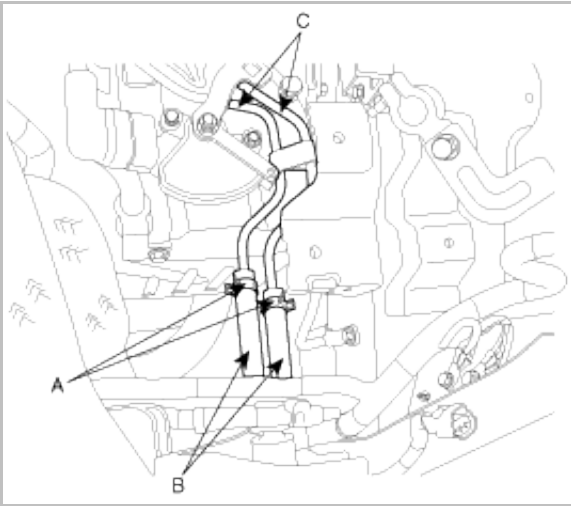
(6) Remove the CKP sensor connector (A).



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

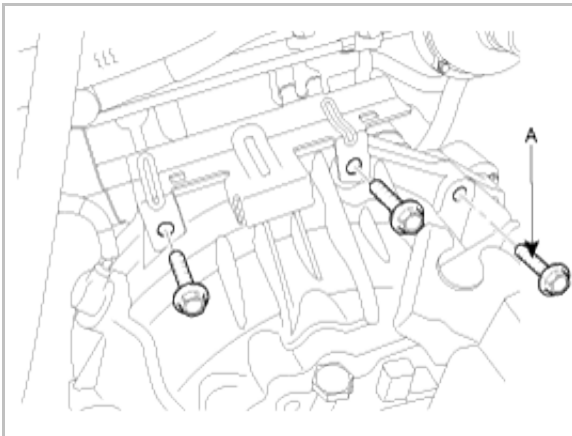


9. Disconnect the transaxle oil cooler hoses (A) from the tubes (C) by loosening the clamps (B).

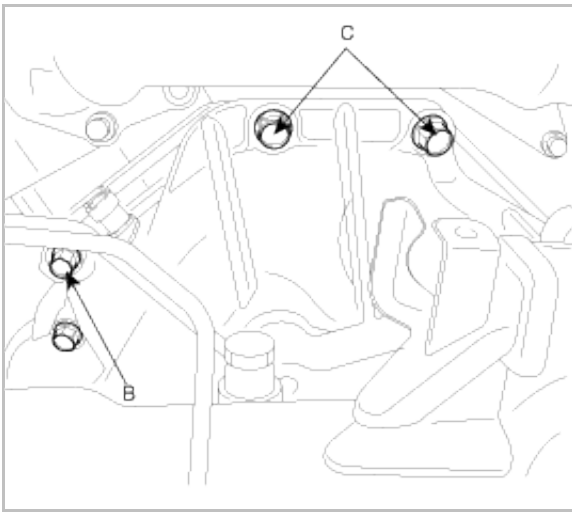


10. Remove the transaxle mounting bolts (A).

[2.9 DSL]

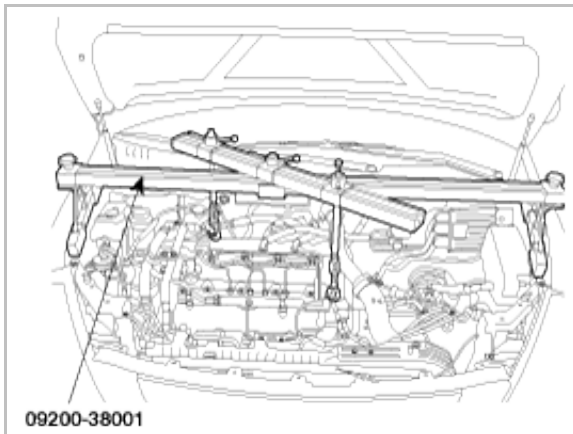


[3.8 GSL]

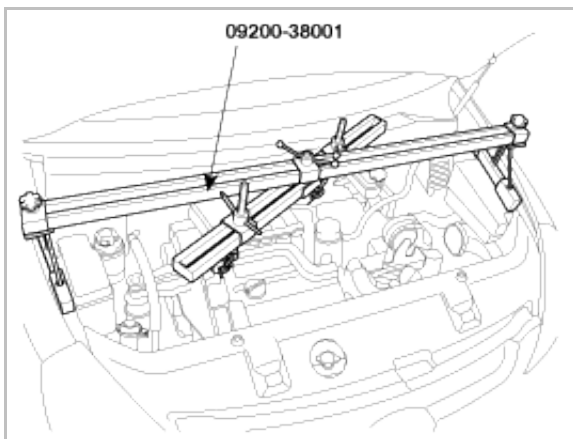


11. Using the SST(09200-38001), hold the engine and transaxle assembly safely.

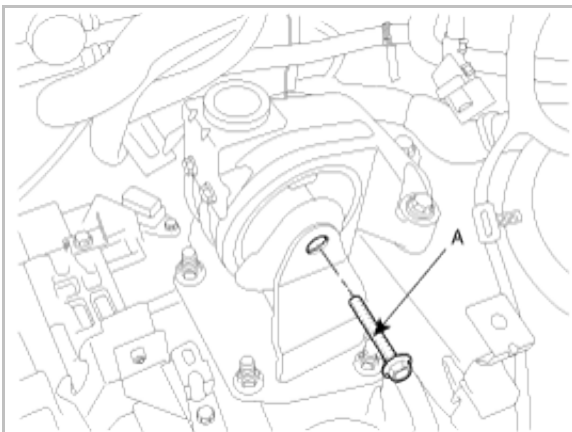
[2.9 DSL]



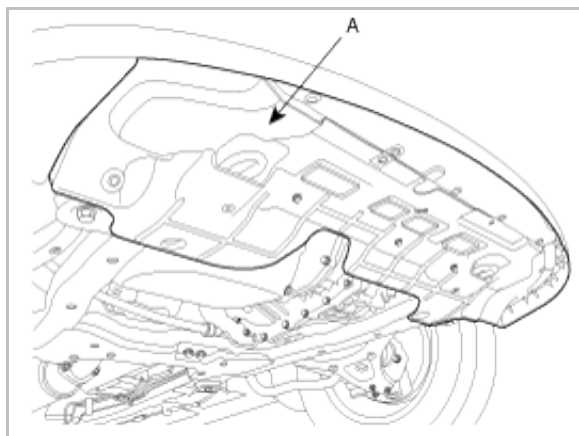
[3.8 GSL]



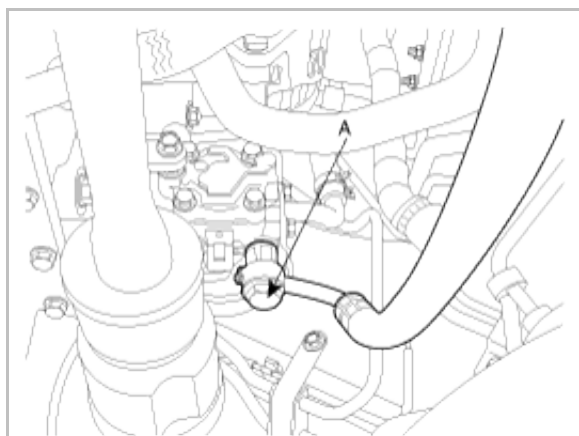
12. Remove the transaxle insulator mounting bolt (A).



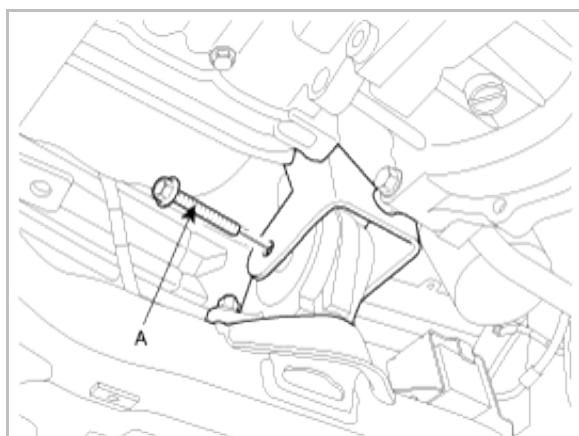
13. Remove the front wheels.
14. Remove the power steering column joint bolt. (see ST group)
15. Lift up the vehicle.
16. Remove the under cover (A).

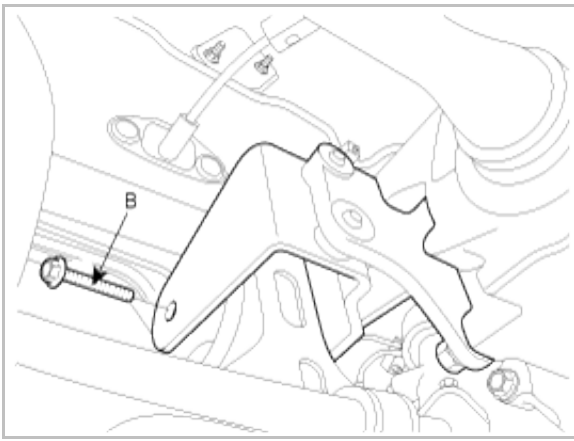


17. Drain transaxle oil.
18. Drain power steering oil through the return tube. (see ST group)
19. Disconnect the power steering pressure tube (A) from the power steering oil pump.



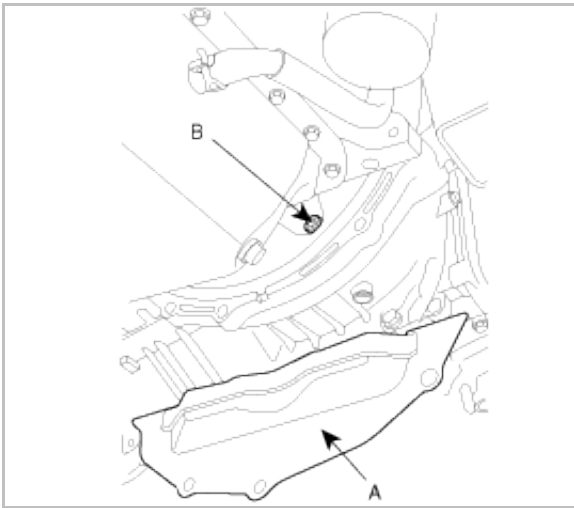
20. Disconnect the lower arm, the tie rod end ball joint, the stabilizer bar link from the front knuckle. (see SS group)
21. Remove the roll stopper mounting bolts (A,B).



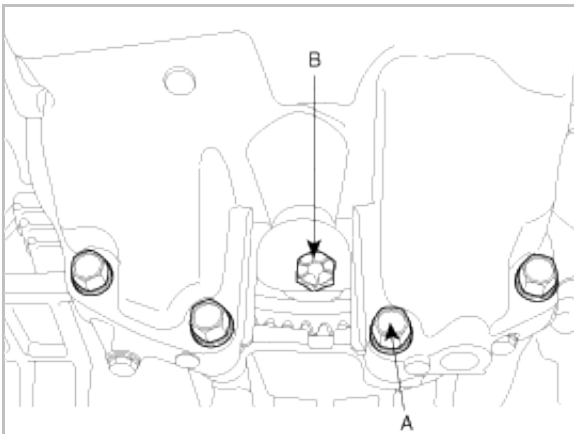


22. Remove the mounting bolts from the sub frame by supporting the sub frame with a jack. (see SS group)
23. Remove drive shaft from transaxle. (See DS group).
24. Install a jack for supporting the transaxle assembly.
25. Remove the plate (A) and the drive plate bolts (B).

[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 :

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

- 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).

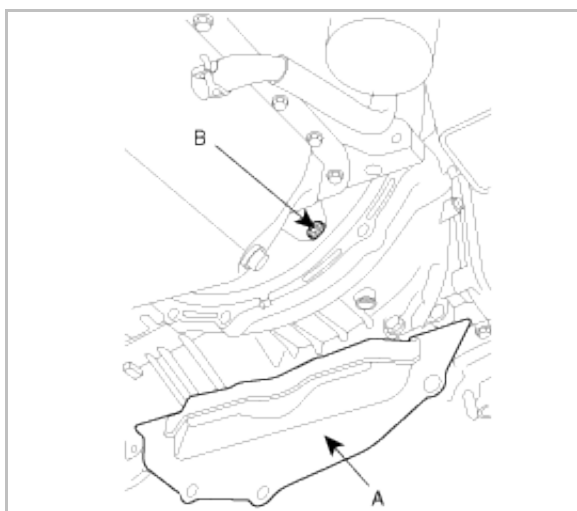
TORQUE:

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

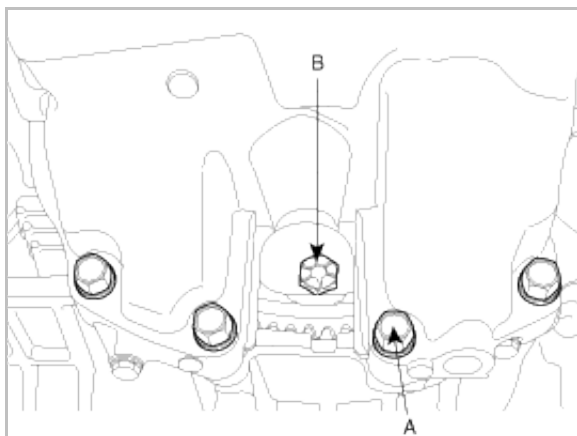
4. Install the drive plate bolts (B) by turning the timing gear and the plate (A).

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

[2.9 DSL]



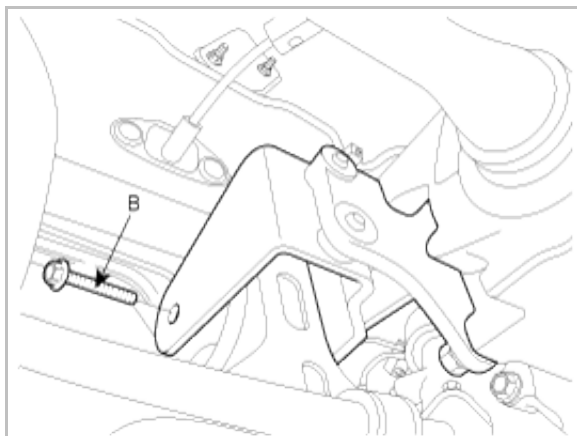
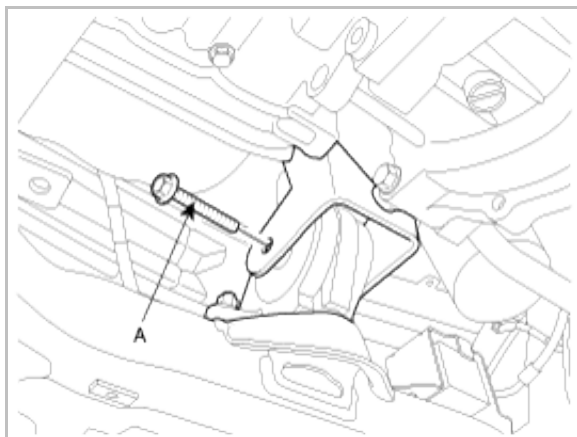
[3.8 GSL]



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)

TORQUE:

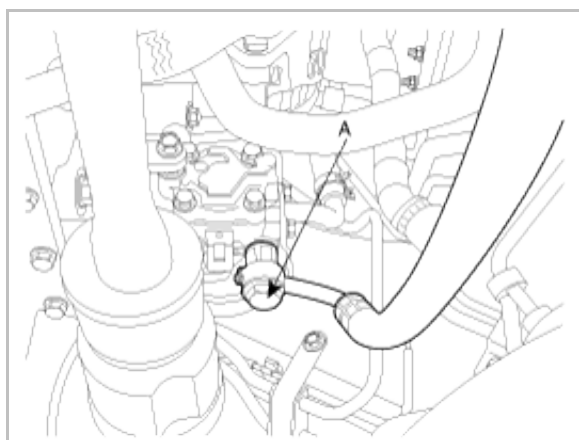
90~110 Nm(900~1100 kgf.cm, 65.1~79.5 lb-ft)



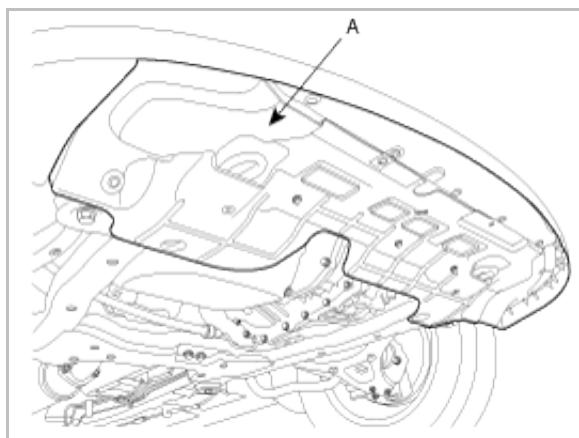
8. Connect the return tube with a clamp. (see ST group)

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).



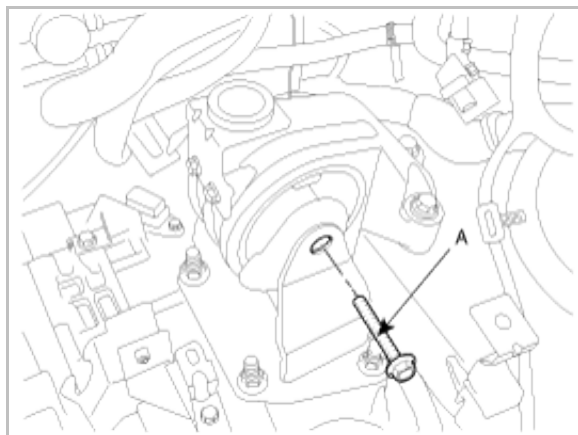
12. Install the steering column joint bolt. (see ST group).

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)

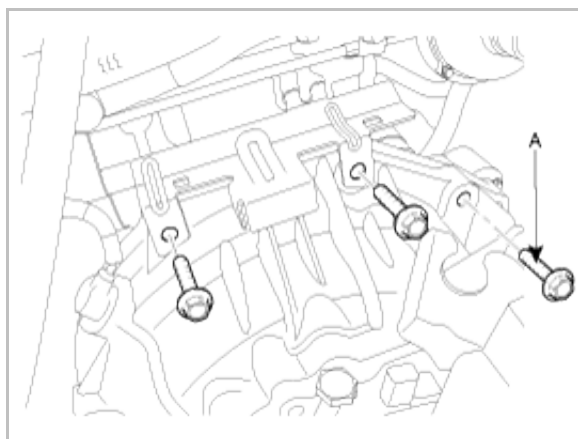


15. Tighten the transaxle mounting bolts (A).

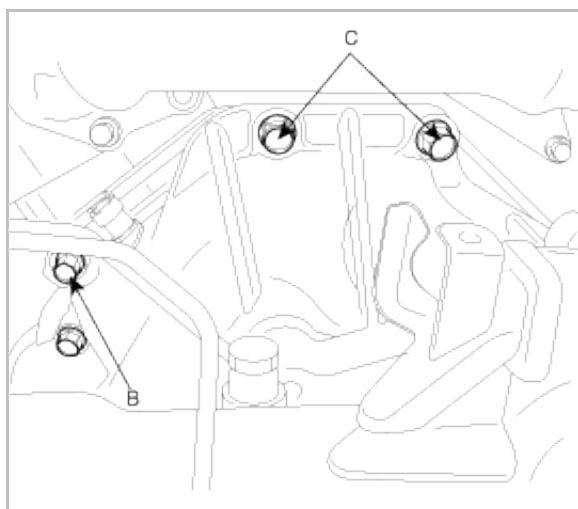
TORQUE:

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

[2.9 DSL]

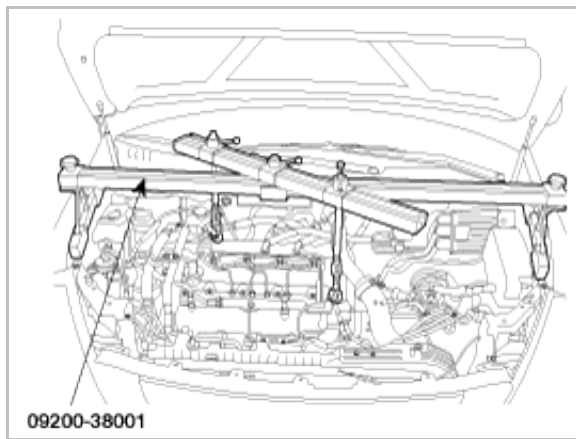


[3.8 GSL]

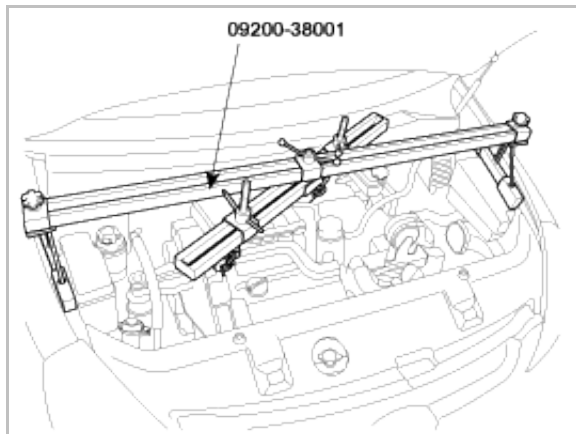


16. Remove the SST (09200-38001) holding the engine and transaxle assembly.

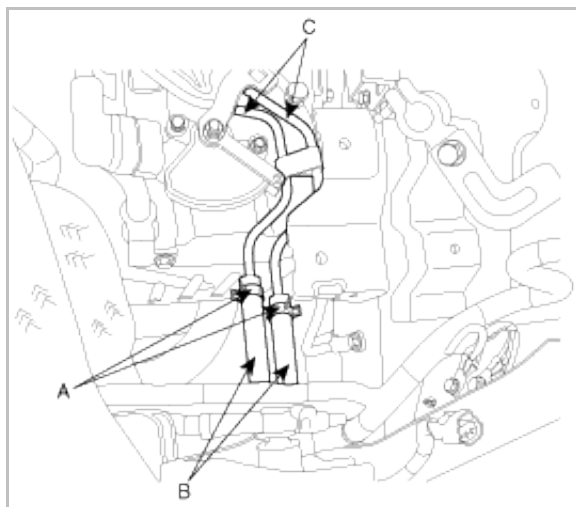
[2.9 DSL]



[3.8 GSL]



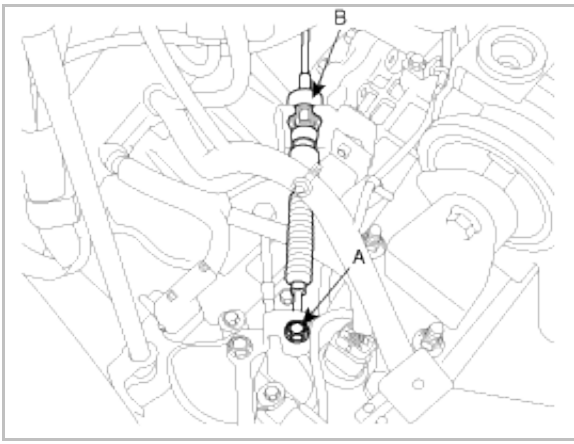
17. Connect the transaxle oil cooler hoses (A) to the tubes (C) by fastening the clamps (B).



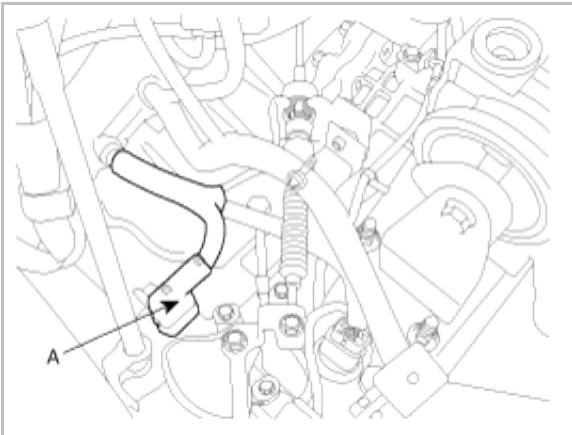
18. Install the shift cable by tightening the bolt (A) and clip (B).

TORQUE:

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

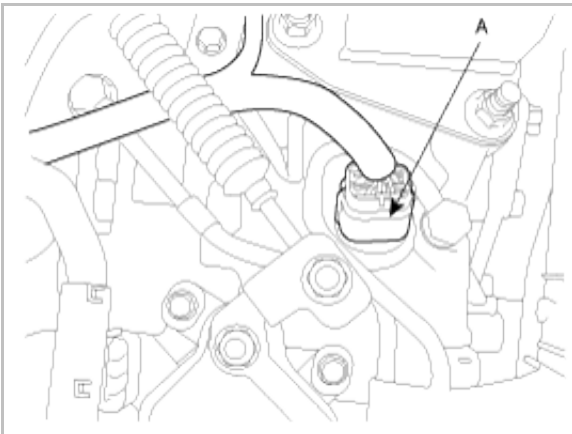


19. Connect the transaxle wire harness connectors.
 (1) Install the inhibitor switch connector (A).

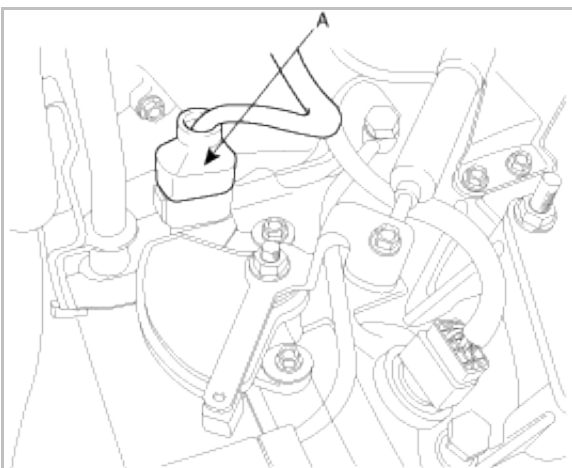


- (2) Install the solenoid valve connector (A).

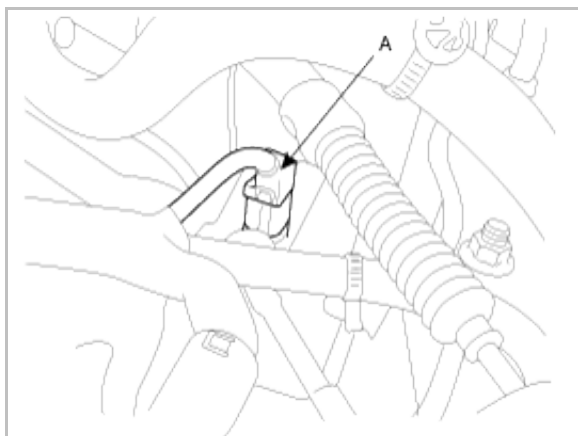
[2.9 DSL]



[3.8 GSL]



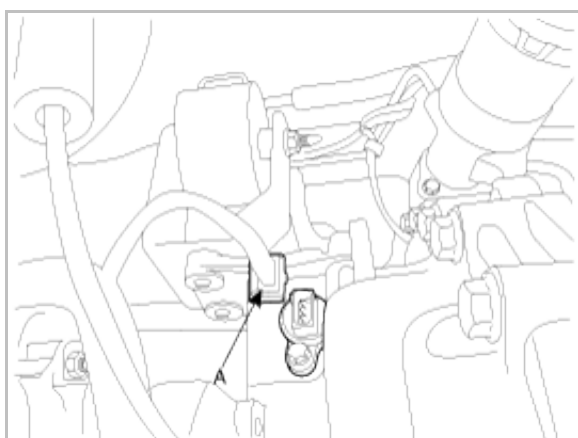
(3) Install the input speed sensor connector (A).



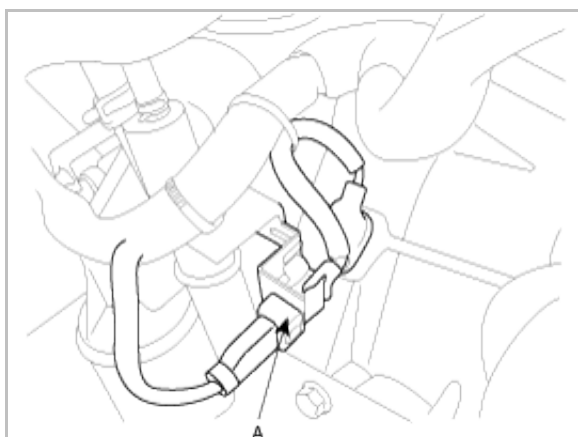
(4) Install the output speed sensor connector (A).



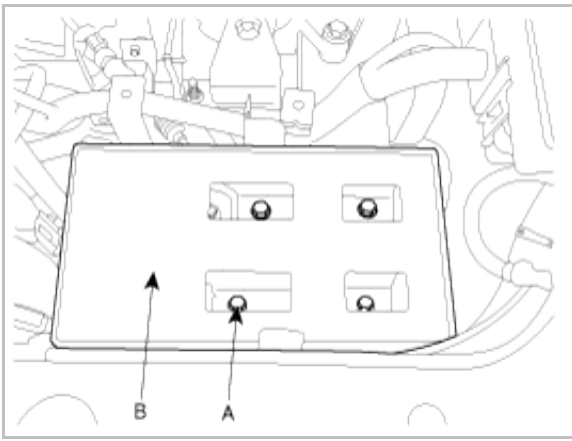
(5) Install the vehicle speed sensor connector (A).



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

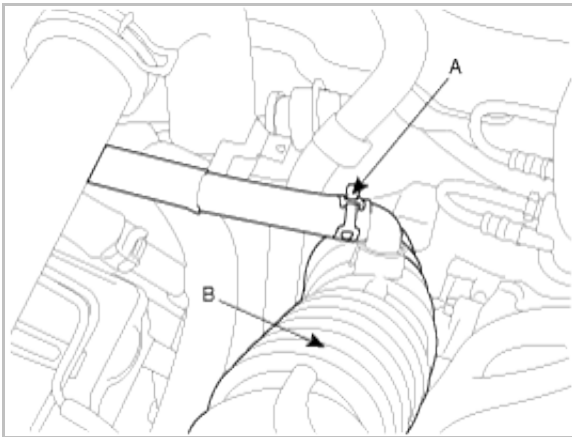


20. Install the battery tray (B) by tightening the four mounting bolts (A).

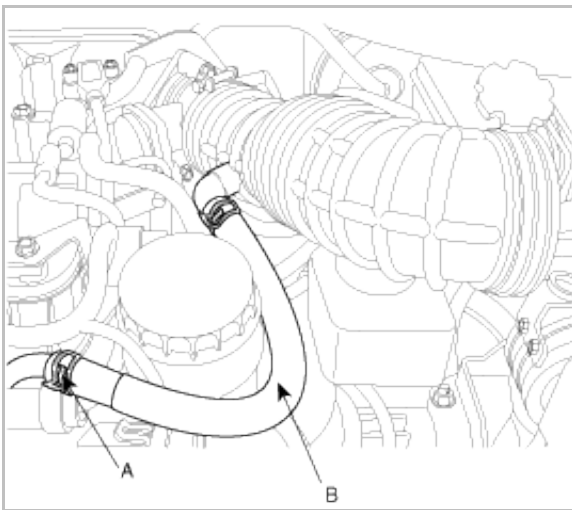


21. Connect the air cleaner hose (B) by fastening the clamp (A).

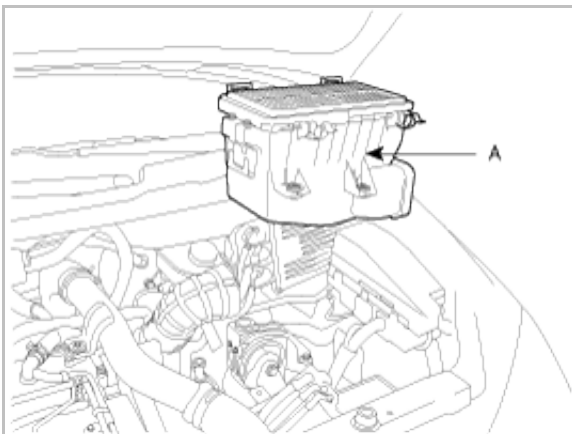
[2.9 DSL]



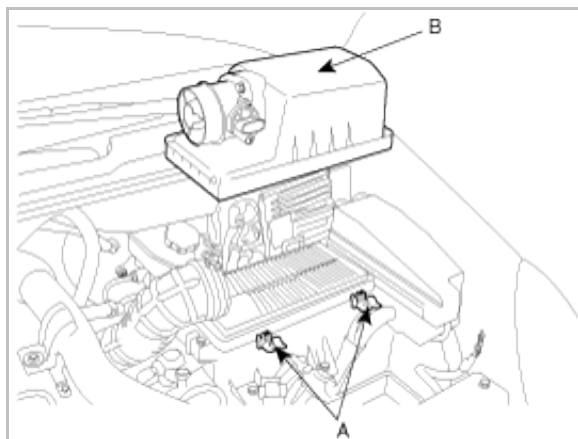
[3.8 GSL]



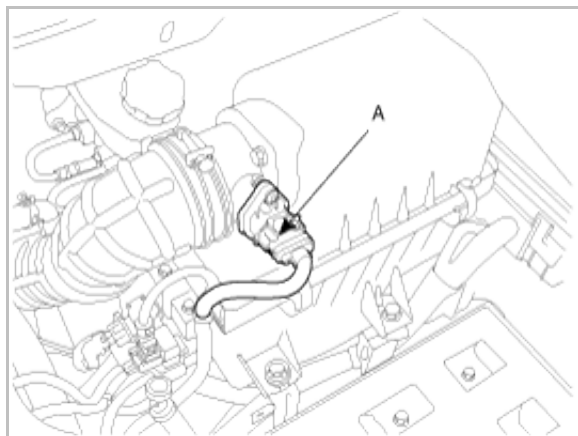
22. Install the air cleaner assembly (A).



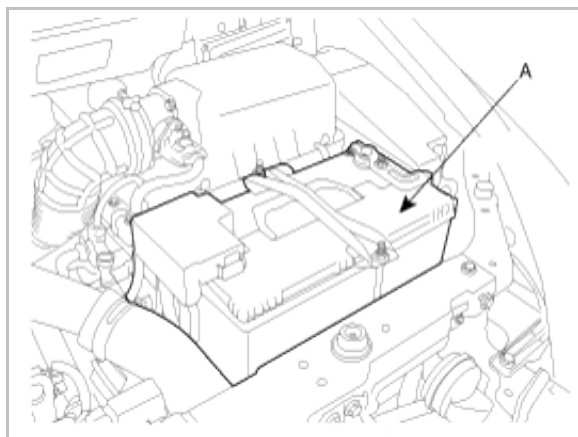
23. Install the air cleaner upper cover (B) by fastening the clips (A).



24. Connect the AFS connector (A).



25. Install the battery (A).





Automatic Transaxle System

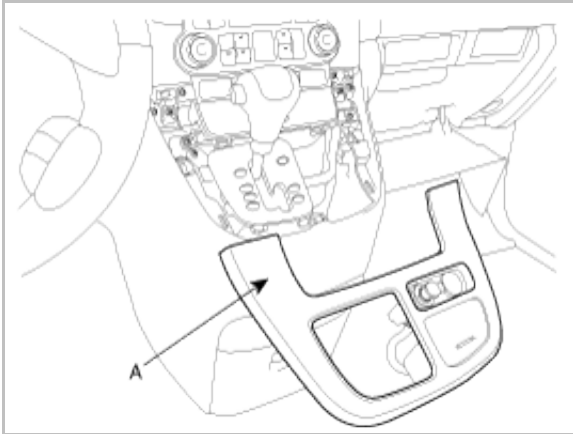
Automatic Transaxle Control System - Shift
Lever



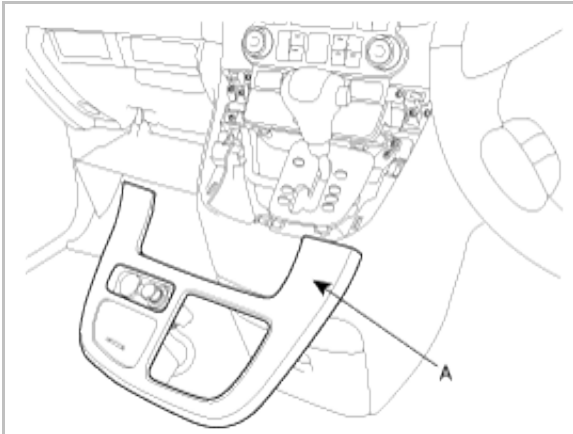
REMOVAL

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

[LHD]

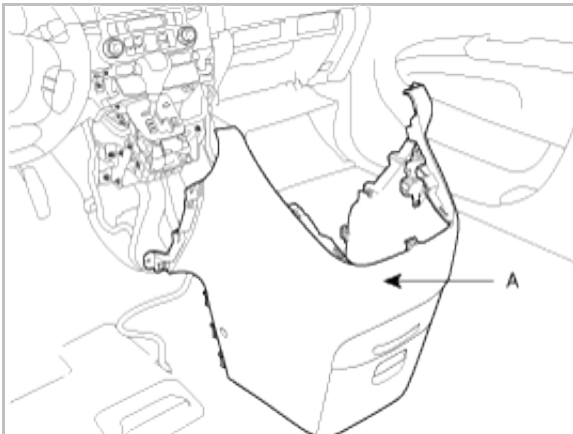


[RHD]

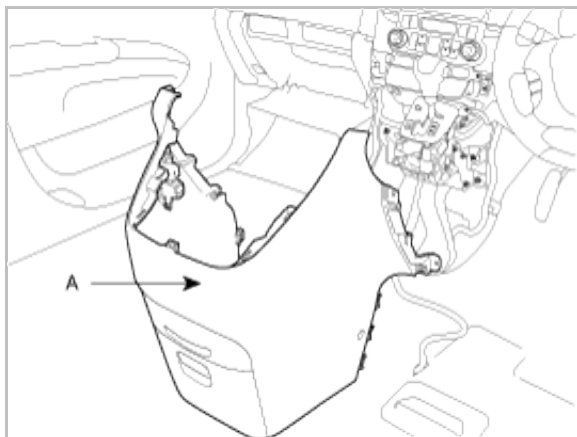


2. Remove the front console cover (A). (see BD group).

[LHD]

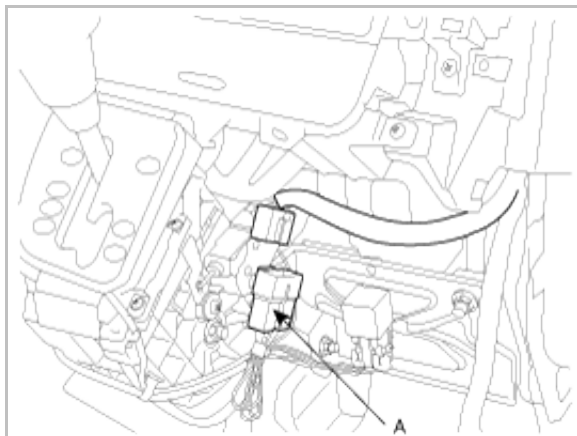


[RHD]

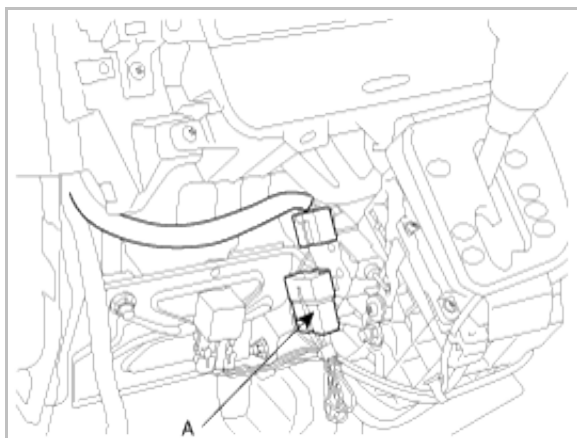


3. Disconnect the connector (A).

[LHD]

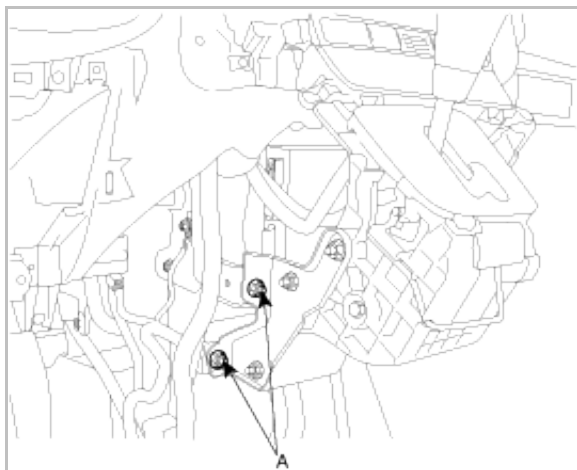


[RHD]

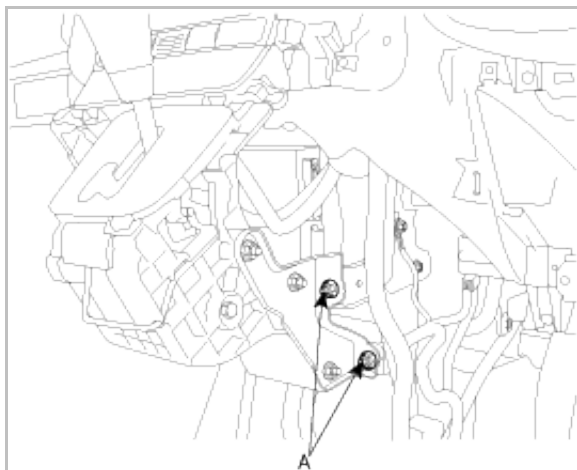


4. Remove the shift lever assembly mounting nuts (A).

[LHD]

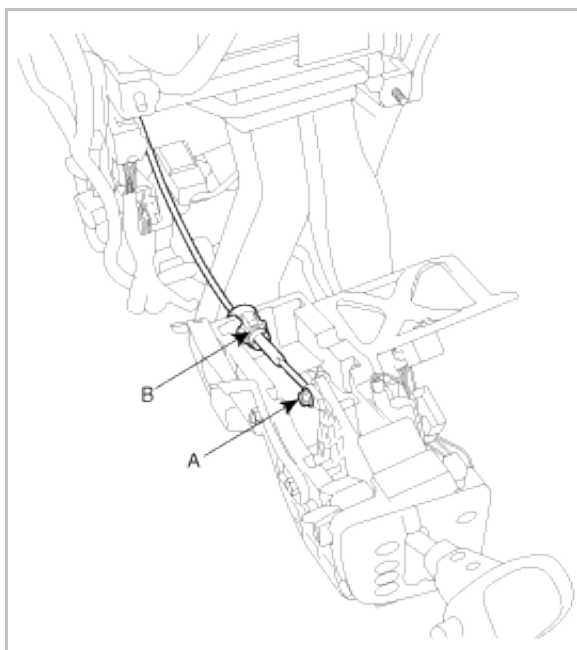


[RHD]

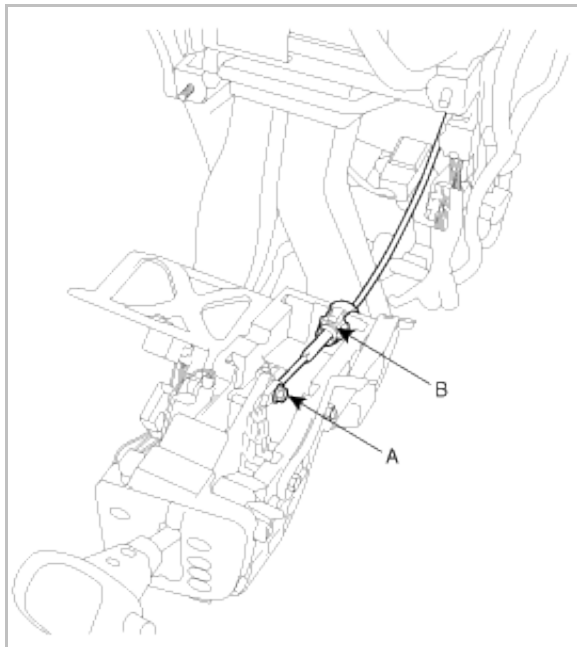


5. Remove the shift cable mounting nut (A) and cap (B).

[LHD]



[RHD]



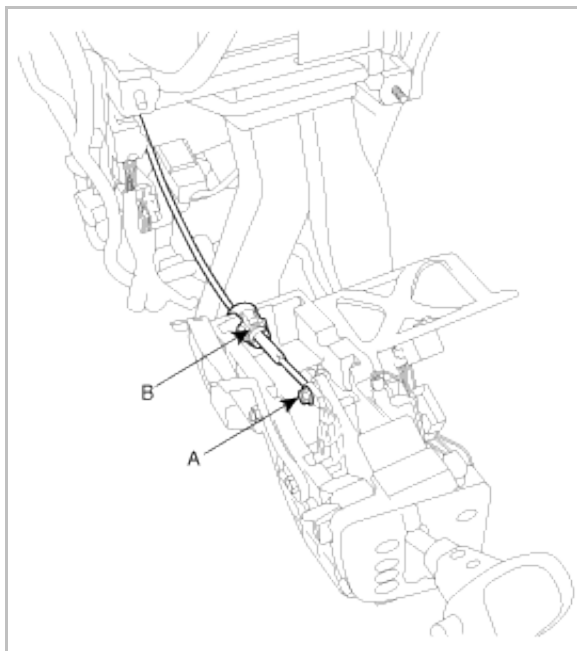
INSTALLATION

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

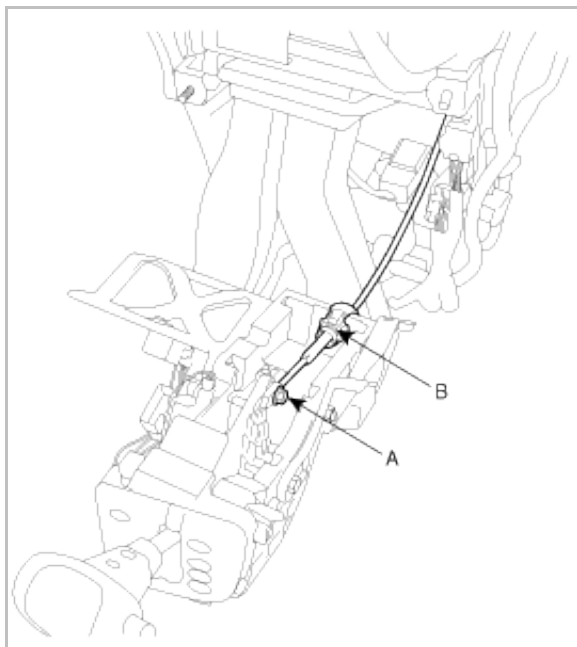
TORQUE:

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

[LHD]



[RHD]

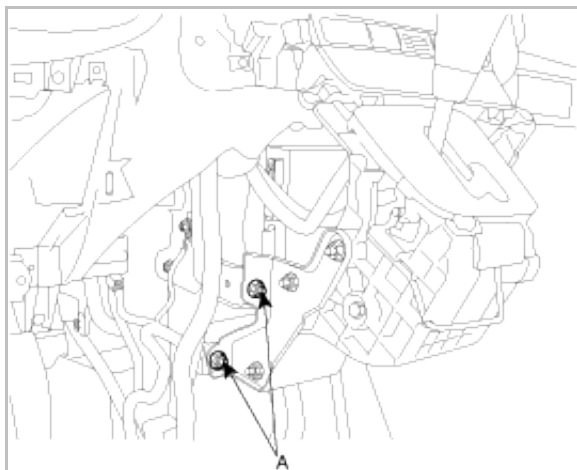


2. Install the shift lever assembly mounting nuts (A).

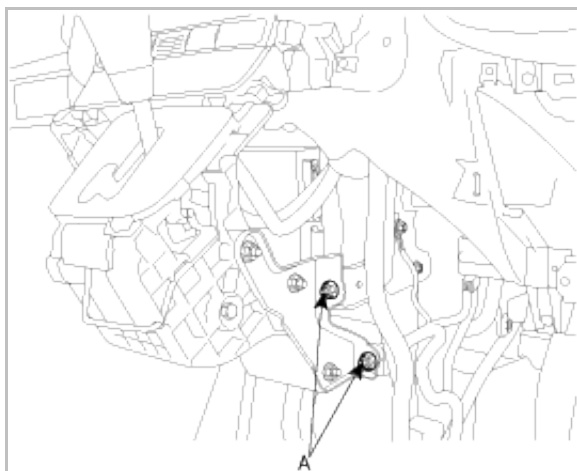
TORQUE:

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

[LHD]

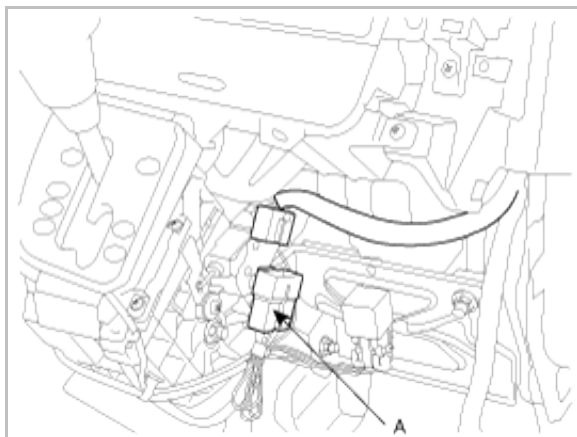


[RHD]

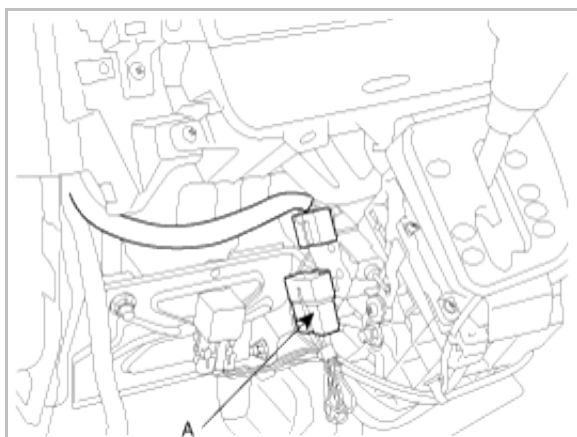


3. Connect the connector (A).

[LHD]

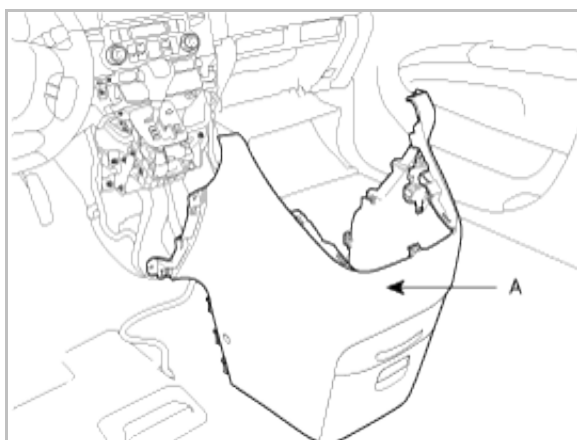


[RHD]

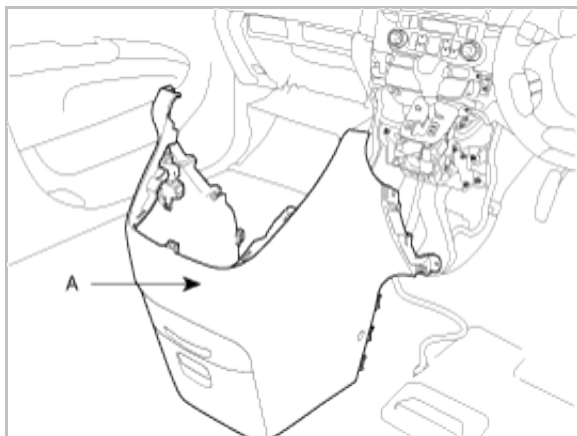


4. Install the front console cover (A). (see BD group)

[LHD]

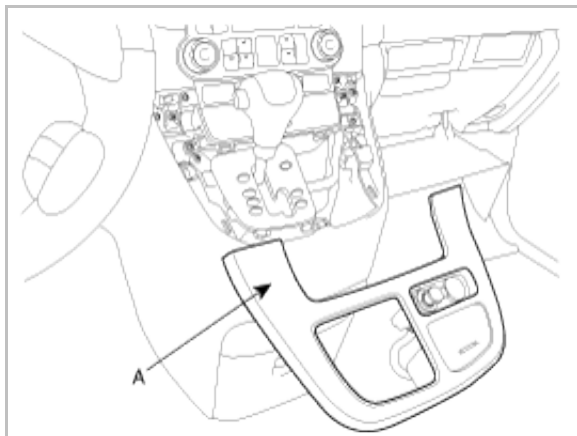


[RHD]

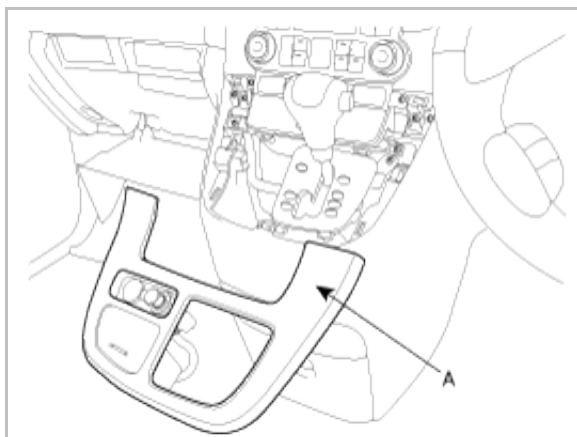


5. Install the console upper cover(A). (see BD group).

[LHD]



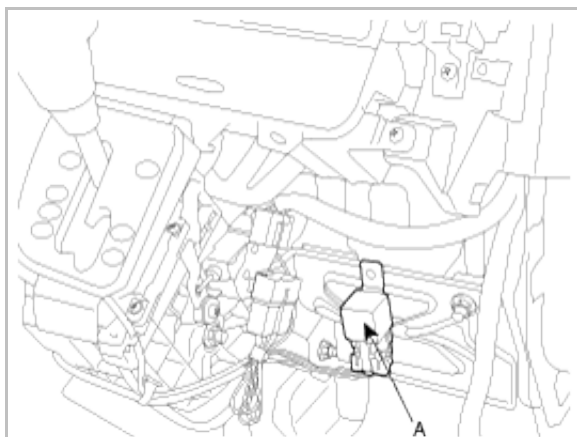
[RHD]



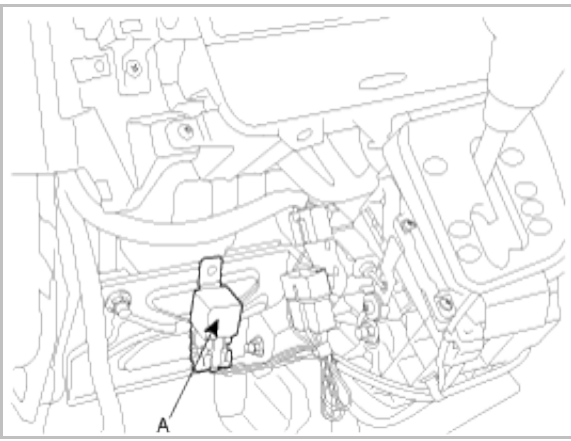
DISASSEMBLY

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

[LHD]

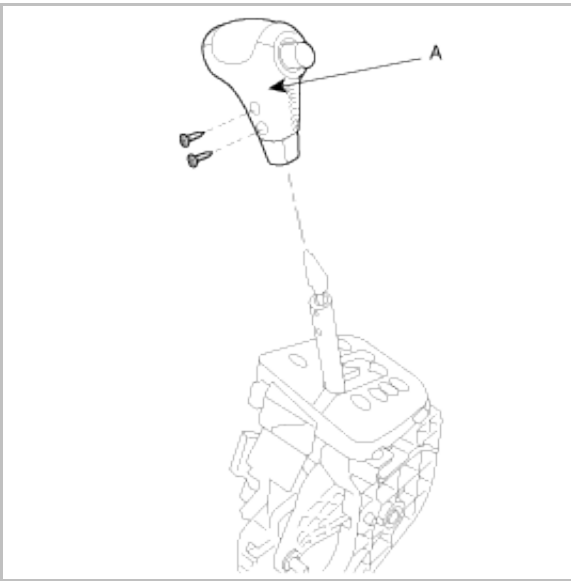


[RHD]

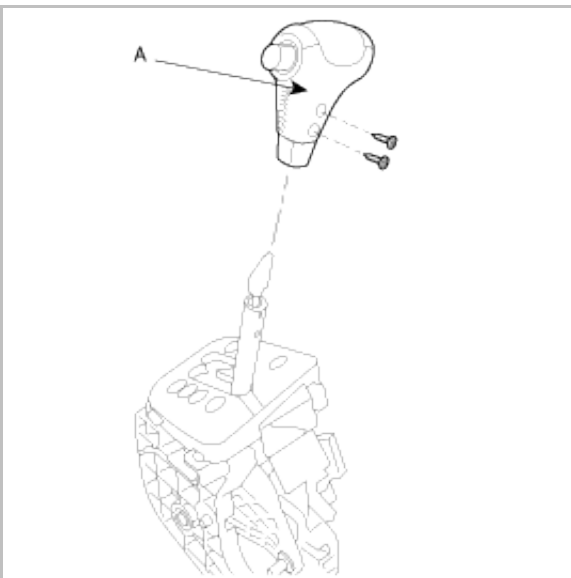


2. Remove both sides of the brackets.
3. Remove the shift lever knob (A) by removing the two screws.

[LHD]

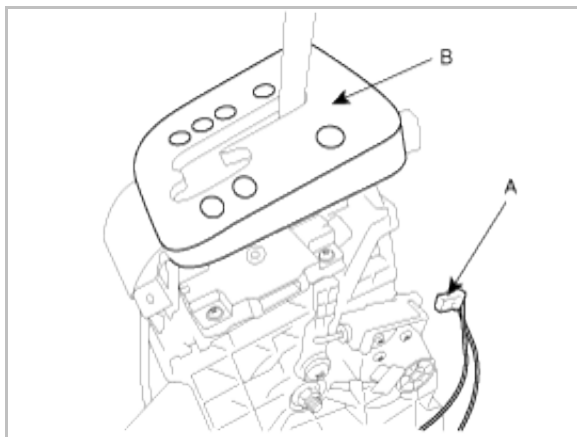


[RHD]

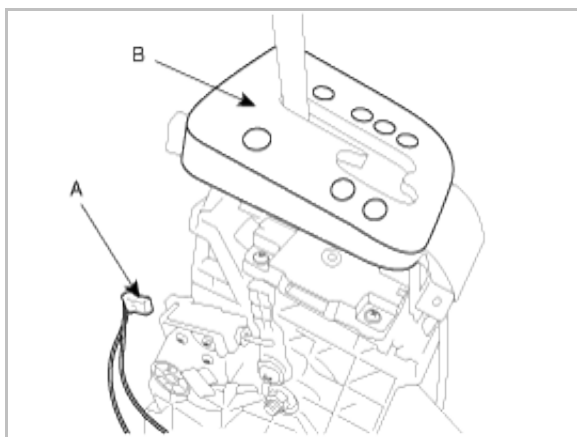


4. Disconnect the solenoid connector (A) and remove the indicator panel (B).

[LHD]

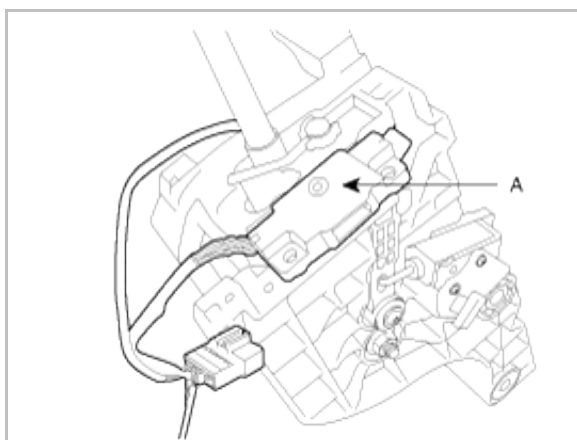


[RHD]

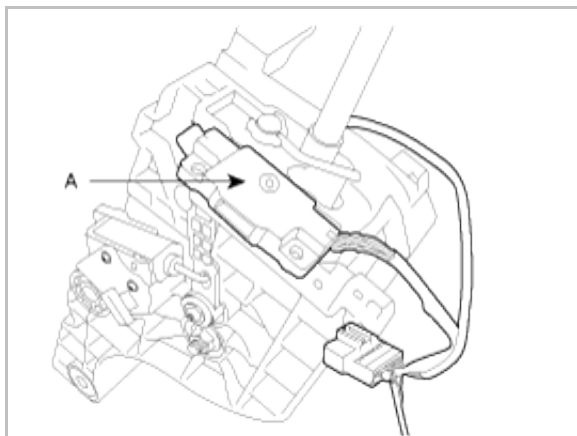


5. Remove the switch assembly (A) and 'P' position switch assembly.

[LHD]

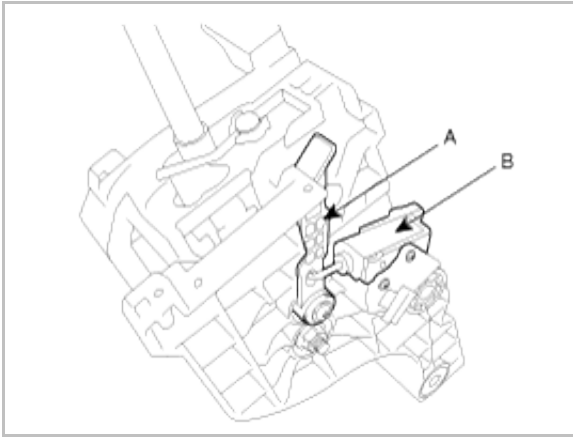


[RHD]

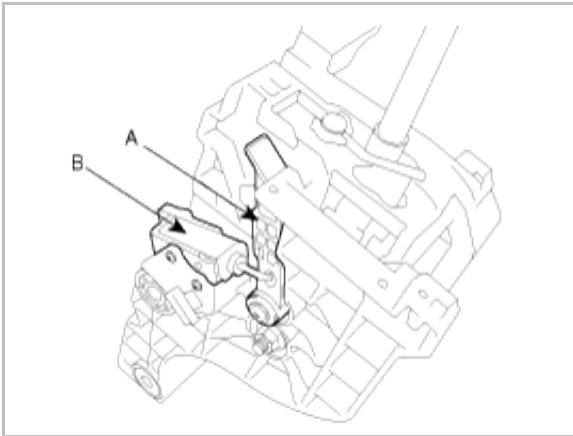


6. Remove the solenoid (B) and solenoid lever (A).

[LHD]

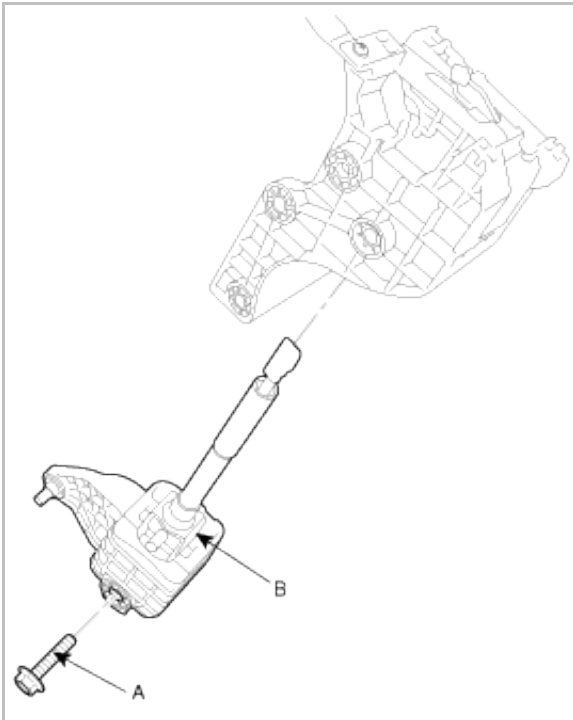


[RHD]

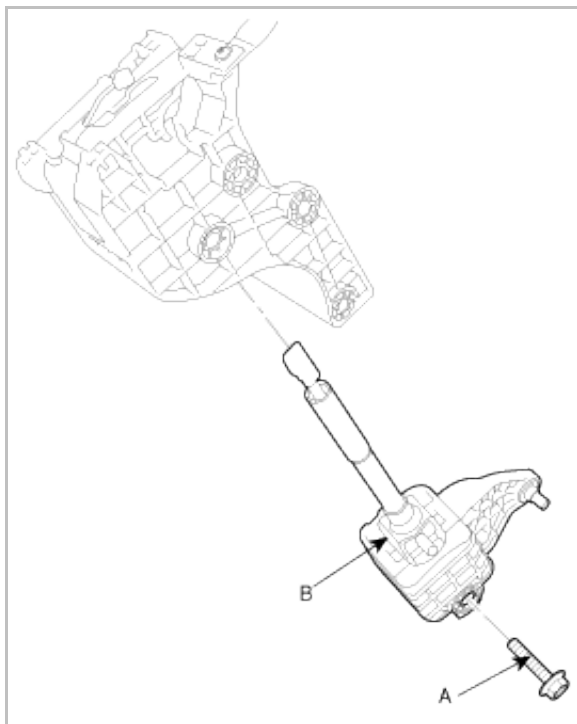


7. Remove the lever assembly (B) by the mounting bolt (A).

[LHD]

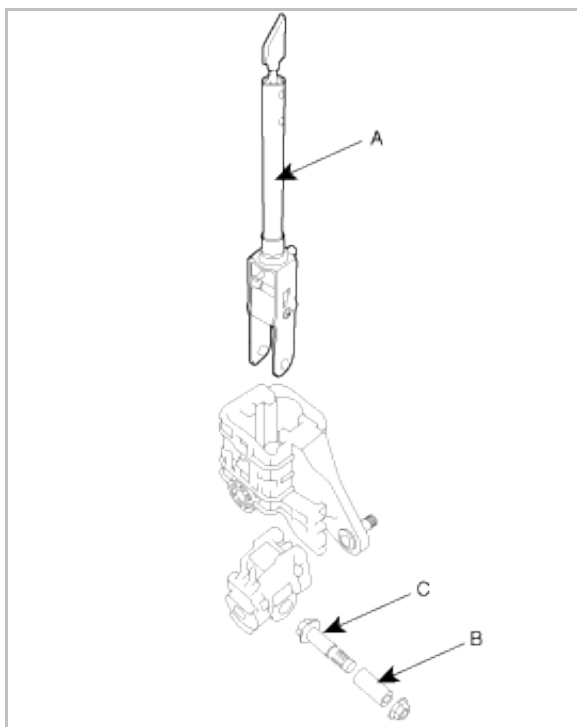


[RHD]

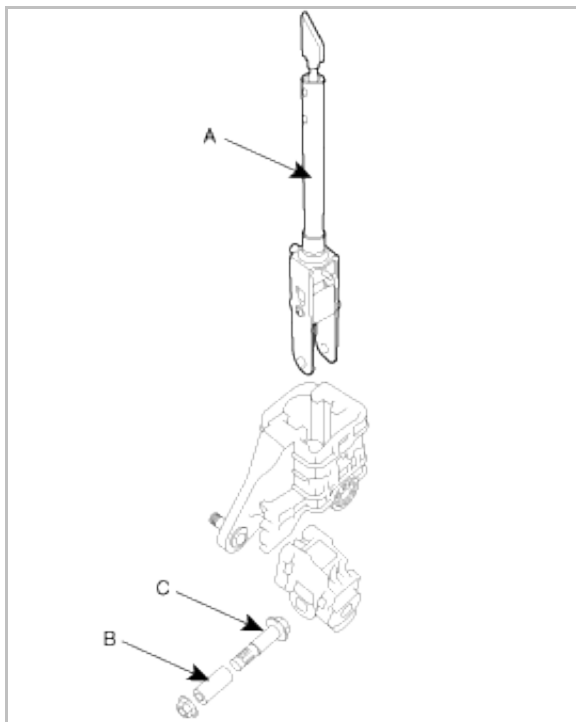


8. Remove the lever (A) and tube (B) by removing the bolt (C).

[LHD]



[RHD]



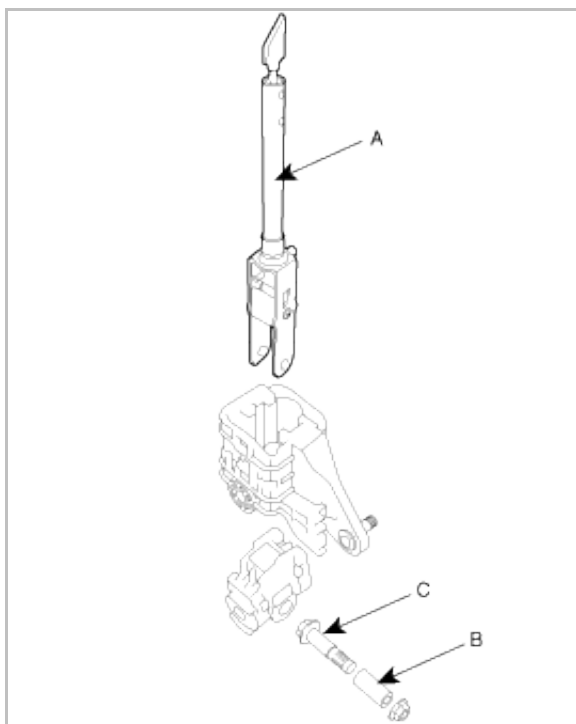
REASSEMBLY

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

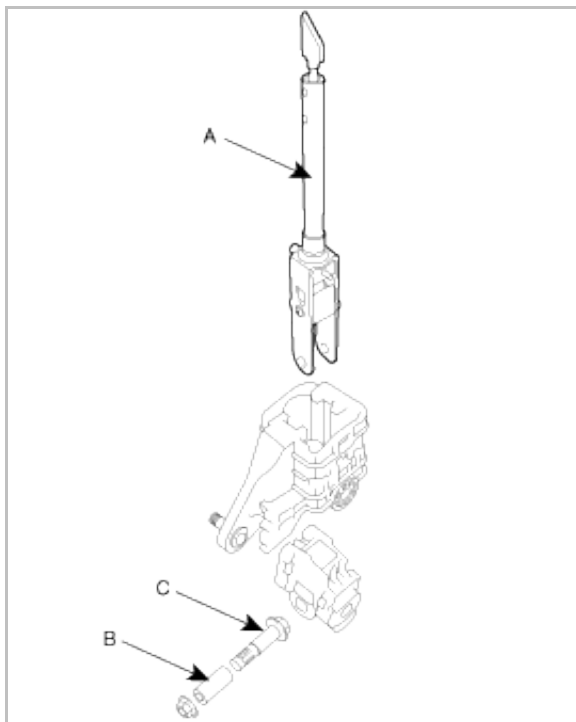
TORQUE:

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

[LHD]



[RHD]

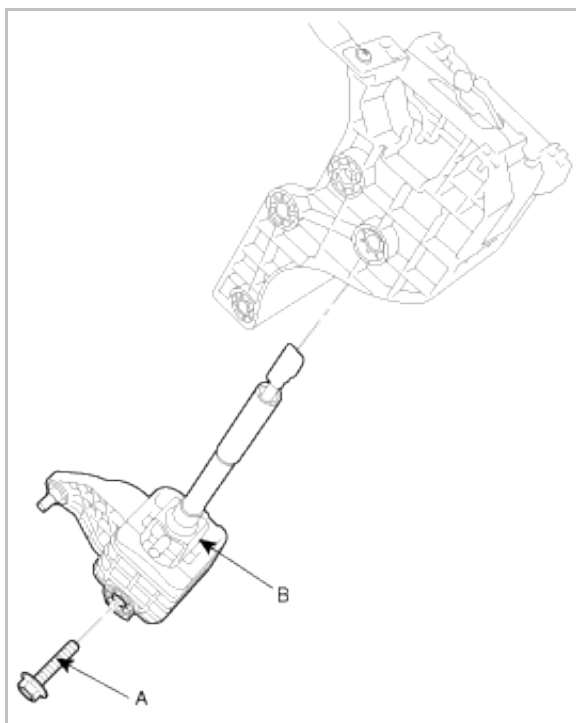


2. Install the lever assembly (B) by tightening the bolt (A).

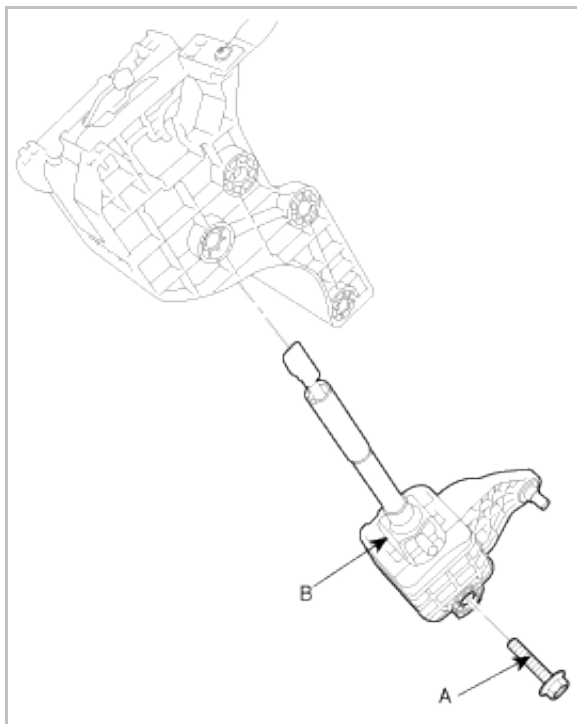
TORQUE:

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

[LHD]

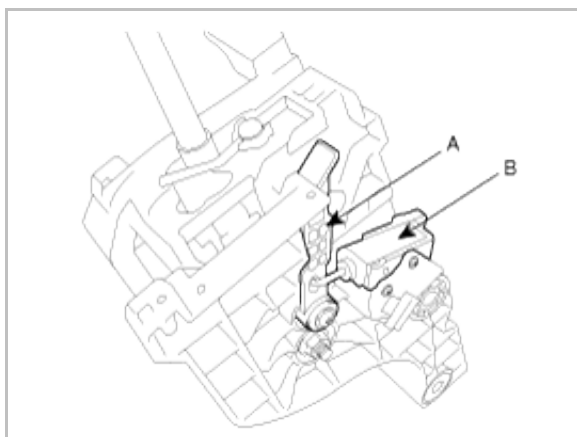


[RHD]

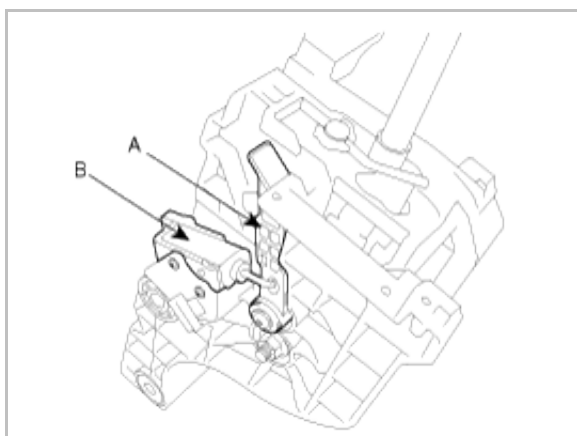


3. Install the solenoid (B) and solenoid lever (A).

[LHD]



[RHD]

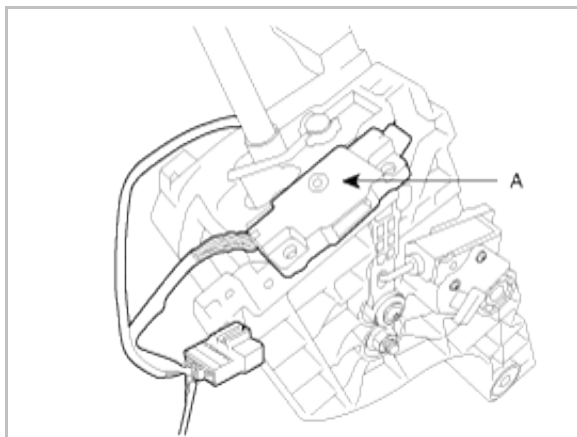


4. Install the switch assembly (A) and 'P' position switch assembly.

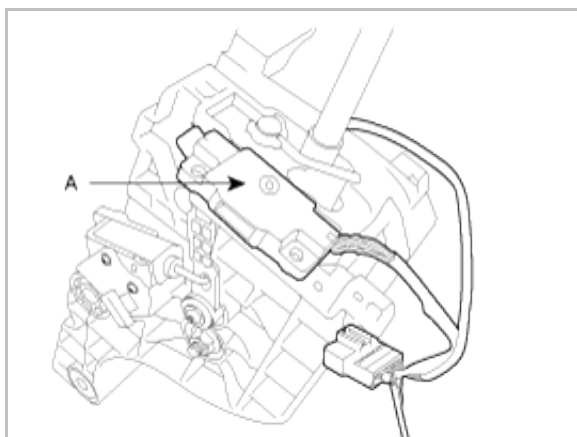
TORQUE:

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

[LHD]

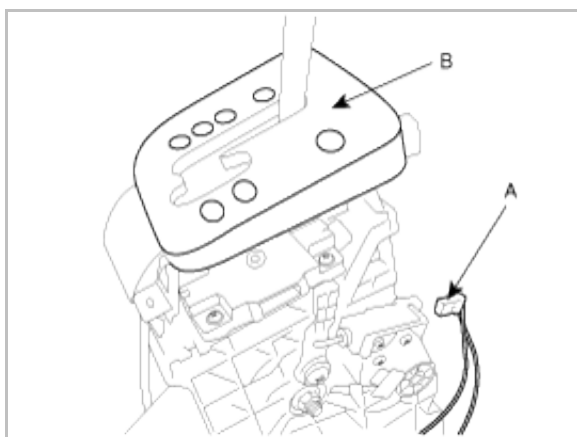


[RHD]

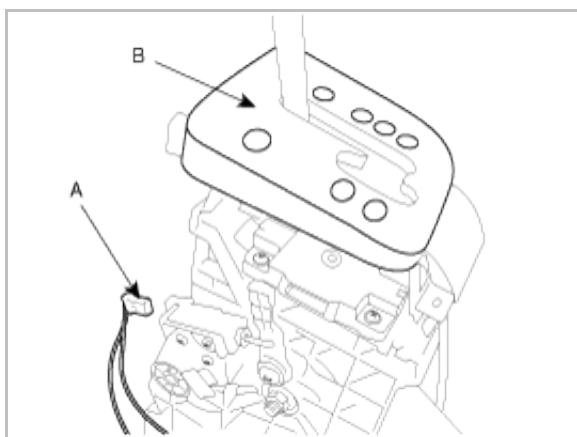


5. Connect the solenoid connector (A) and install the indicator panel (B).

[LHD]



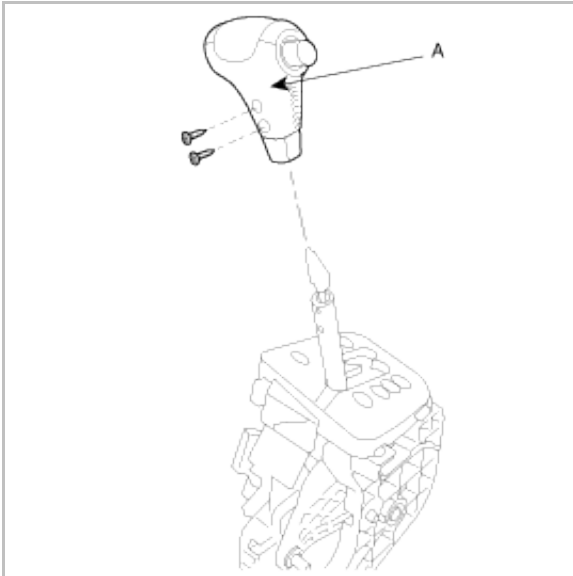
[RHD]



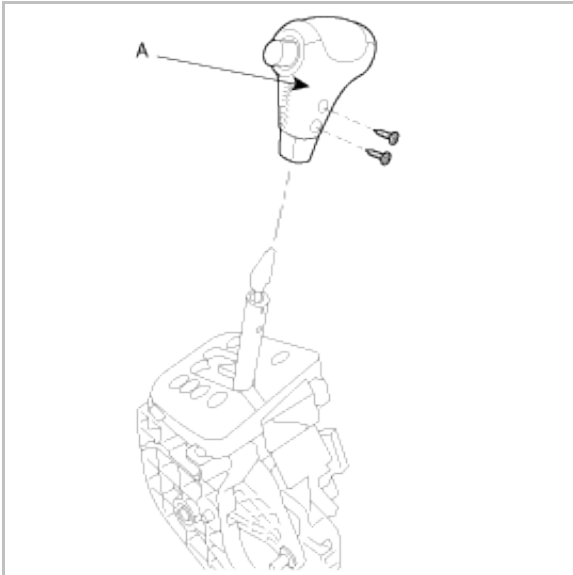
6. Install the shift lever knob (A) by tightening the two screws.

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

[LHD]



[RHD]

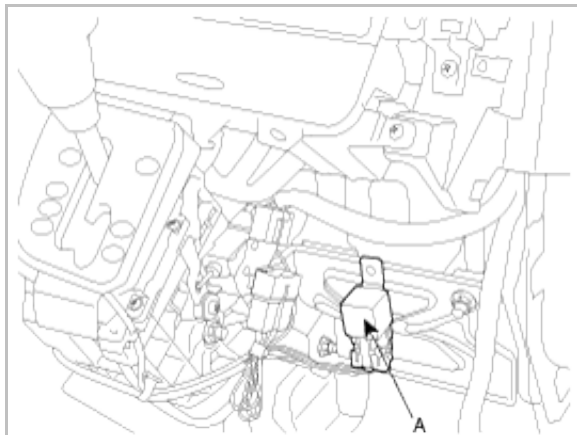


7. Install both sides of the brackets.
-

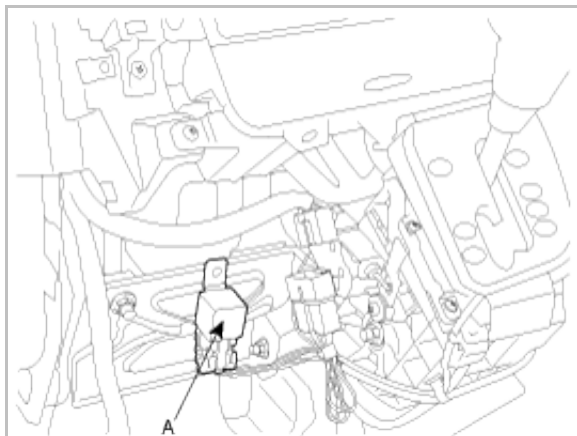
TORQUE:
16~23 Nm(160~230 kgf.cm, 11.6~16.7 lb-ft)

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

[LHD]



[RHD]





Suspension System

General Information



SPECIFICATIONS

FRONT SUSPENSION SYSTEM

Items					Specification	
Type					Macpherson strut	
Shock Absorber	Type				Gas	
	Stroke mm (in)				195.5 (7.70)	
	Expansion mm (in)				595.5 ± 3 (23.44 ± 0.12)	
	Compression mm (in)				400 + 3, -Free (15.75 + 3, Free)	
	I.D. Color			DIESEL	WHITE	
				GASOLINE	RED	
	Damping force (0.3 m/s)	DIESEL	Expansion N(kgf)		1265 ± 186 (129 ± 19)	
			Compression N (kgf)		618 ± 108 (63 ± 11)	
		GASOLINE	Expansion N(kgf)		980 ± 220 (100 ± 15)	
			Compression N (kgf)		588 ± 118 (60 ± 12)	
Spring	DIESEL		Free height mm (in)		418.9 (16.49)	
			Load(kg)	I.D. Color	594.8~606.7	Yellow 2 point
					582.9~594.7	Yellow 1 point
	GASOLINE		Free height mm (in)		415.9 (16.37)	
			Load(kg)	I.D. Color	550.0~561.2	Green 2 point
					538.8~549.9	Green 1 point

REAR SUSPENSION SYSTEM

Items					Specification	
Type					Multi Link	
Shock Absorber	Type				Gas	
	Stroke mm (in)				170 (6.68)	
	Expansion mm (in)				478.0 ± 3 (18.82 ± 0.12)	
	Compression mm (in)				308 + 3, -Free (12.13 + 0.12, -Free)	
	I.D. Color			DIESEL	WHITE	
				GASOLINE	RED	
	Damping force (0.3 m/s)	DIESEL	Expansion N(kgf)		1540 ± 216 (157 ± 22)	
			Compression N (kgf)		647 ± 127 (66 ± 13)	
		GASOLINE	Expansion N(kgf)		1422 ± 206 (145 ± 21)	
			Compression N (kgf)		549 ± 108 (56 ± 11)	
	DIESEL		Free height mm (in)		286.7 (11.29)	
			Load(kg)	I.D. Color	642.2~674.7	Yellow 2 point

Spring	GASOLINE			610.0~642.2	Yellow 1 point
		Free height mm (in)		291.1(11.46)	
		Load(kg)	I.D. Color	623.6~653.0	White 2 point
				594.2~623.6	White 1 point

WHEELS AND TIRES

Items		Specification	
Tire Size		225/70 R16	
		235/60 R17	
Wheel Size	Steel	6.5J×16	
	Aluminium	6.5J×16	
		6.5J×17	
Tire Pressure KPa (kg/cm ² , psi)		Front	Rear
	225/70 R16	2.4(35)	2.4(35)
	235/60 R17	2.4(35)	2.4(35)

WHEEL ALIGNMENT

Items		Front	Rear
Camber		0°±0.5°	0.1°±0.5°
Caster	to Ground	3.77°±0.5°	-
Toe-in	Total	0°±0.2°	0.26°±0.2°
	Individual	0°±0.1°	0.17°±0.1°
King pin angle		12.45°±0.5°	-
Tread mm(in)		1685(66.34)	1685(66.34)

TIGHTENING TORQUE

FRONT SUSPENSION

Items	Nm	kgf.m	lb-ft
Front strut assembly mounting nut(to body)	45 ~ 60	4.5 ~ 6.0	32.5 ~ 43.4
Front strut assembly self-locking nut	60 ~ 70	6 ~ 7	43.4 ~ 50.6
Front strut assembly mounting bolt(to knuckle)	100 ~ 120	10 ~ 12	72.3 ~ 86.8
Front lower arm ball joint mounting bolt(to knuckle)	90 ~ 120	9 ~ 12	65.1 ~ 86.8
Front lower arm bushing(A) mounting bolt(to subframe)	160 ~ 180	16 ~ 18	115.7 ~ 130.2
Front lower arm bushing(G) mounting bolt(to subframe)	160 ~ 180	16 ~ 18	115.7 ~ 130.2
Front stabilizer link self-locking nut	100 ~ 120	10 ~ 12	72.3 ~ 86.8
Front stabilizer bar bracket mounting bolt(to Subframe)	39 ~ 60	3.9 ~ 6.0	28.2 ~ 43.4
Wheel nut	90 ~ 110	9 ~ 11	65.1 ~ 79.5

REAR SUSPENSION

Items	Nm	kgf.m	lb-ft
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Rear shock absorber bracket mounting bolt(to body)	80 ~ 110	8 ~ 11	57.9 ~ 79.5
Rear shock absorber bracket mounting nut(to body)	90 ~ 120	9~ 12	65.1 ~ 86.8
Rear shock absorber nut (to rear knuckle)	140 ~ 160	14 ~ 16	101.2 ~ 115.7
Rear upper arm ball joint nut (to rear knuckle)	90 ~ 110	9 ~ 11	65.1 ~ 79.5
Rear upper arm self-locking nut (to cross member)	160 ~ 180	16 ~ 18	115.7 ~ 130.2
Rear lower arm mounting bolt (to rear knuckle)	160 ~ 180	16 ~ 18	115.7 ~ 130.2
Rear lower arm mounting nut (to cross member)	200 ~ 270	20 ~ 27	144.7 ~ 195.3
Rear assist arm mounting bolt (to rear knuckle)	90 ~ 110	9 ~ 11	65.1 ~ 79.5
Rear assist arm mounting nut (to cross member)	90 ~ 120	9 ~ 12	65.1 ~ 86.8
Trailing arm bracket mounting nut (to body)	80 ~ 110	8 ~ 11	57.9 ~ 79.5
Trailing arm self-locking nut (to rear knuckle)	80 ~ 100	8 ~ 10	57.9 ~ 72.3
Trailing arm mounting bolt(to bracket)	160~ 180	16 ~ 18	115.7 ~ 130.2
Rear stabilizer bar bracket mounting bolt(to cross member)	39 ~ 60	3.9 ~ 6.0	28.2 ~ 43.4
Rear stabilizer link self-locking nut(to trailing arm)	50 ~ 65	5.0 ~ 6.5	36.2 ~ 47.0
Wheel nut	90 ~ 110	9 ~ 11	65.1 ~ 79.5
Rear cross member to body	160 ~ 180	16 ~ 18	115.7~130.2

CAUTION

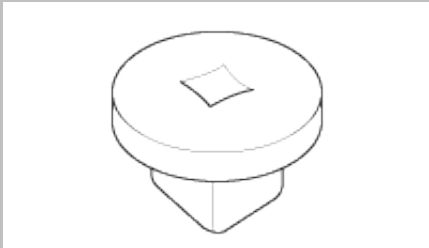
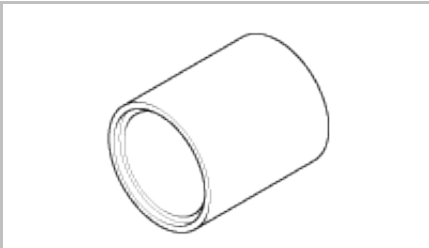
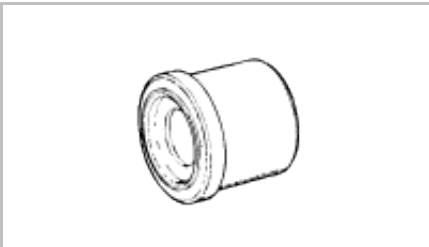
Replace the self-locking nuts with new ones after removal.

LUBRICANTS

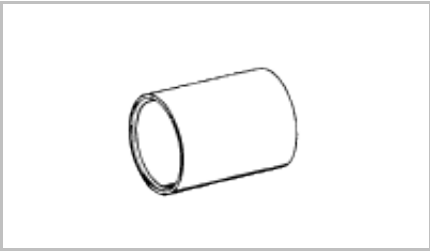
Items	The Recommended	Quantity
Front lower arm ball joint	Boot : CGMS03 (CMS-H006) Ball seat : CGMS02 (CMS-H006)	As required
Rear upper arm ball joint	Boot : CGMS03 (CMS-H006) Ball seat : CGMS01 (CMS-H006)	
Rear assist arm ball joint		
Stabilizer link ball joint(Front Rear)		



SPECIAL SERVICE TOOLS

Tool (Number and Name)	Illustration	Use
09568-4A000 Ball joint remover		Removal of Ball joint (Front upper arm/lower arm, & Rear upper arm)
09532-11600 Preload socket		Measurement of the front lower arm ball joint starting torque. (Use with torque wrench)
09546-26000 Strut spring compressor		Compression of the coil spring
09214-32000 Mount bushing remover and installer		Removal & installation of lower arm bushing(G) (Use with 09216-21100)
09216-21100 Mount bushing remover and installer		Removal & installation of lower arm bushing(G) (Use with 09216-32000)
09216-21600 Mount bushing remover and installer arbor		Removal and installation of trailing arm bushing (Use with 09552-38100)

09552-38100
Rear trailing arm bushing remover
and installer



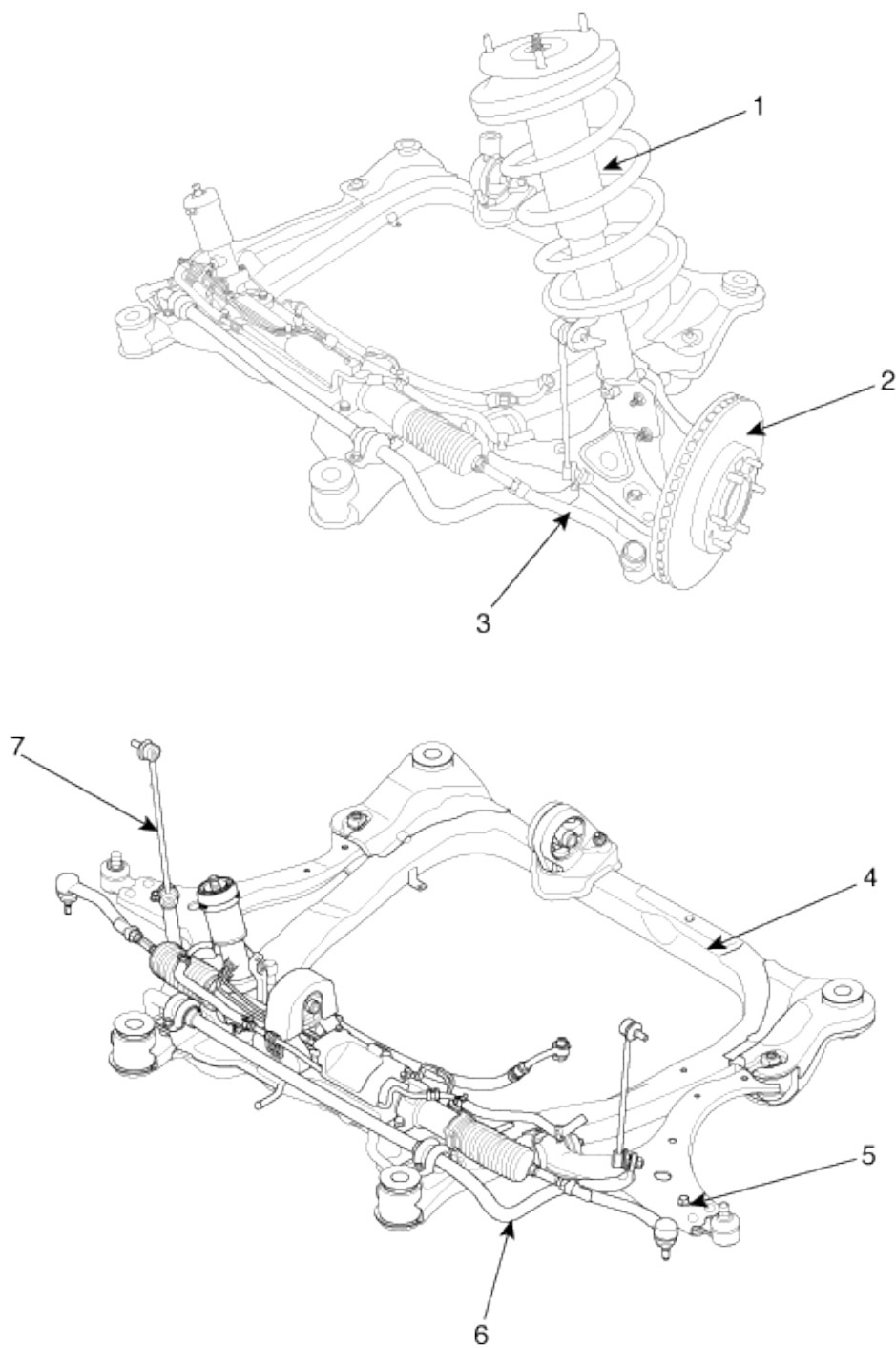
Removal and installation of the rear
trailing arm bushing
(Use with 09216-21600)



Suspension System

Front Suspension System

COMPONENTS



- 1. Front strut assembly
- 2. Front disk
- 3. Tie rod end assembly
- 4. Front subframe

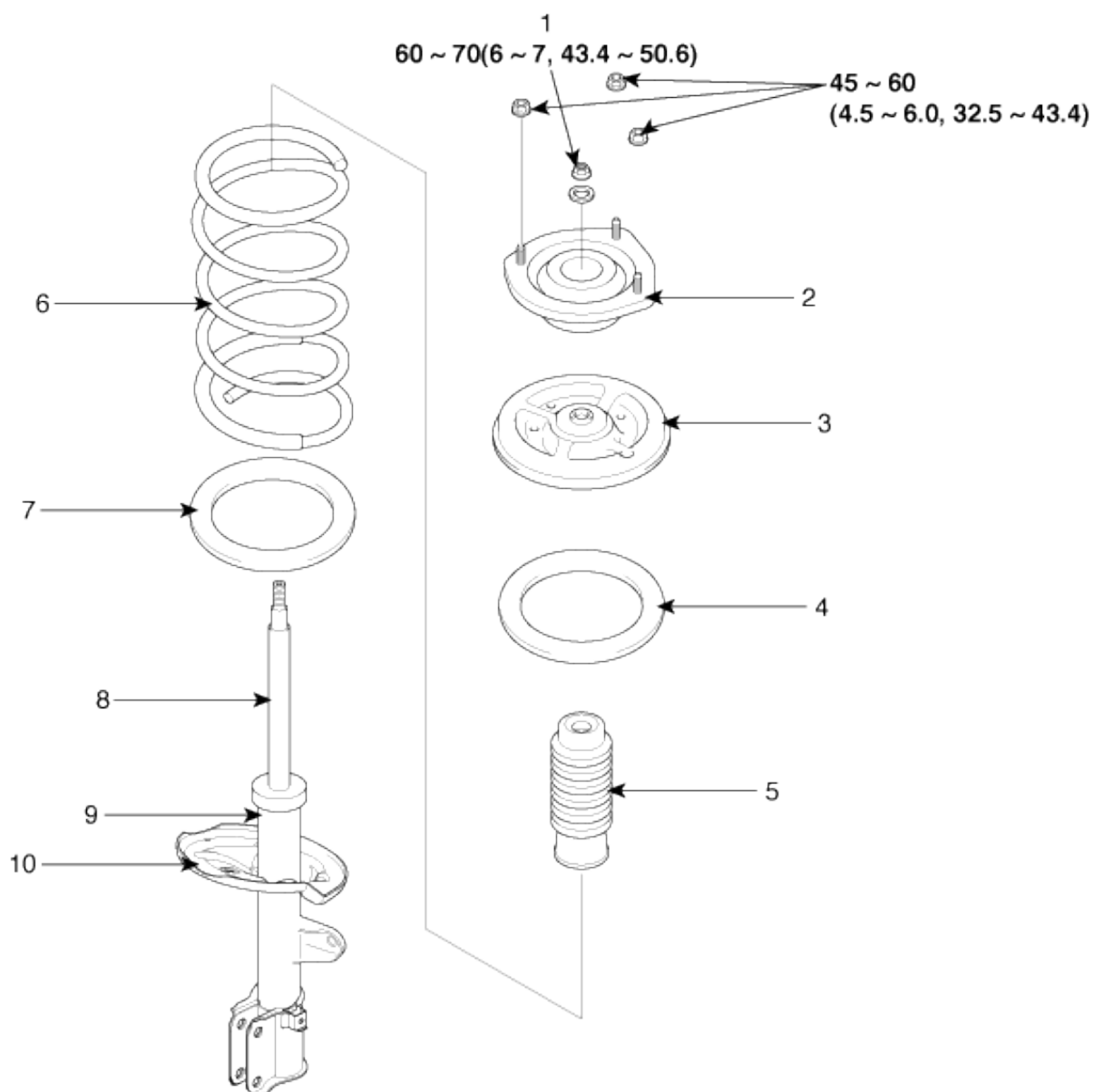
- 5. Front lower arm
- 6. Front stabilizer bar assembly
- 7. Front stabilizer link assembly



Suspension System

Front Suspension System - Front Strut
Assembly

COMPONENTS



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

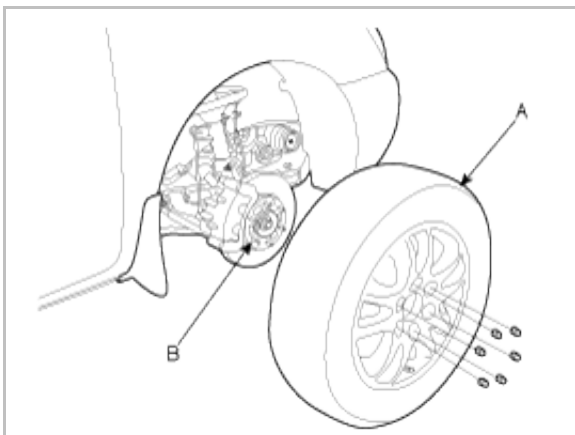
1. Self-locking nut
2. Insulator
3. Spring upper seat
4. Spring upper pad
5. Strut dust cover and Urethane bumper

6. Coil spring
7. Spring lower pad
8. Piston rod
9. Strut assembly
10. Spring lower seat



REMOVAL

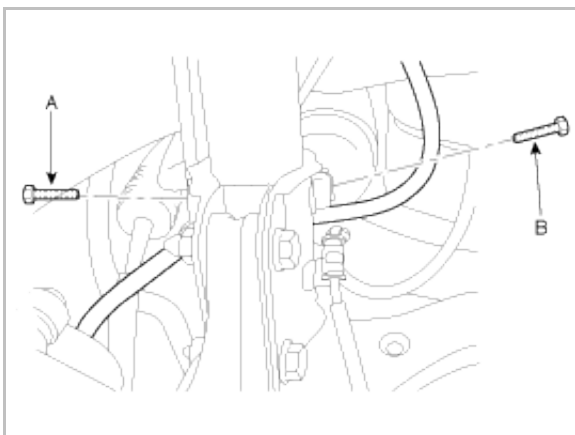
1. Loosen the wheel nuts slightly.
Raise the front of the vehicle, and make sure it is securely supported.
2. Remove the front wheel and tire (A) from front hub (B).



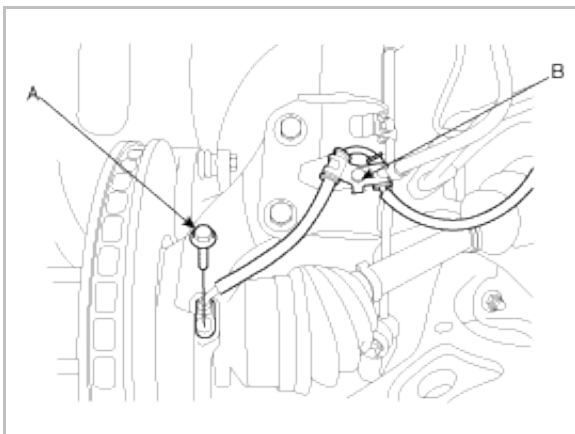
CAUTION

Be careful not to damage to the hub bolts (C) when removing the front wheel and tire (A).

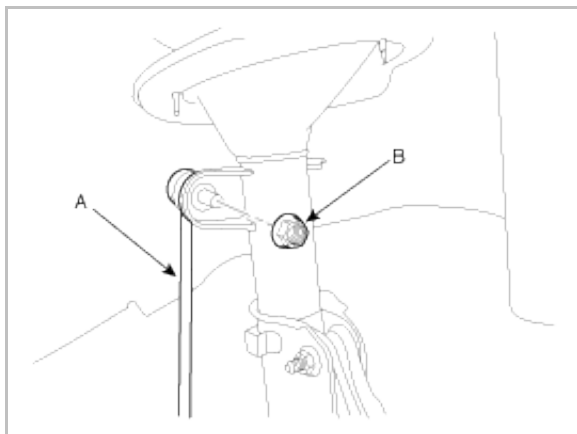
3. Remove the brake hose bracket bolt (A, B) from the front strtu assembly.



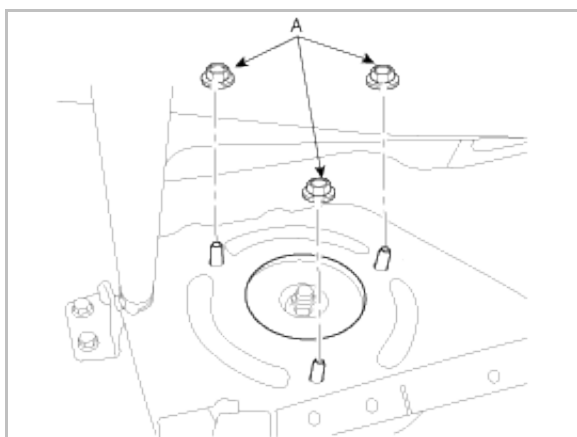
4. Remove the speed sensor (A) and wire (B) bolts from the front knuckle.



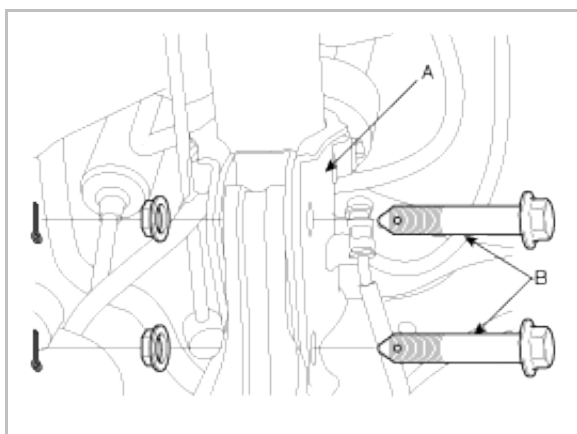
5. Remove the front stabilizer link (A) nut (B) from the strut assembly.



6. Remove the strut upper mounting nuts(A).



7. Remove the front strut assembly (A) bolts (B) from the front knuckle.

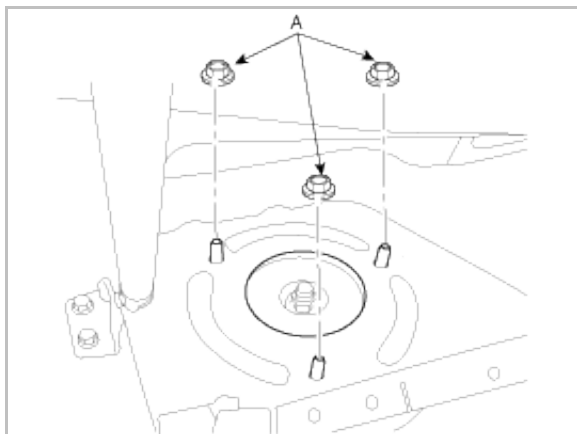


INSTALLATION

1. Install the strut upper mounting nuts (A).

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

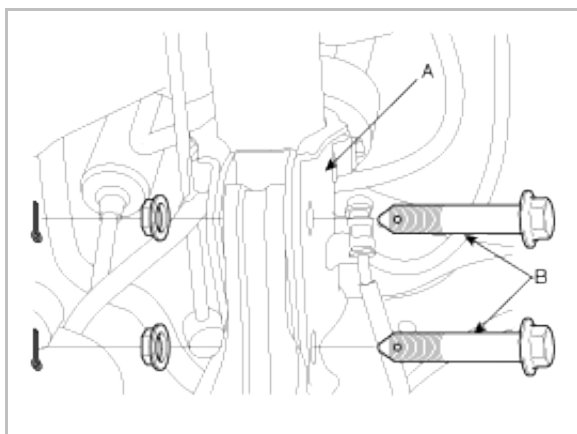
45 ~ 60 (4.5 ~ 6.0, 32.5 ~ 43.4)



2. Install the front strut assembly (A) bolts (B) to the front knuckle.

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

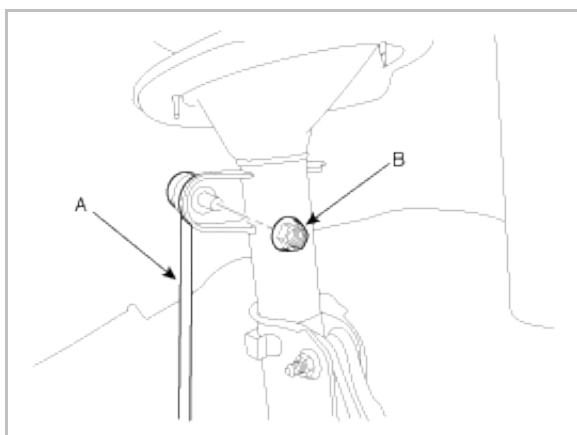
100 ~ 120 (10 ~ 12, 72.3 ~ 86.8)



3. Install the front stabilizer link (A) nut (B) to the strut assembly.

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

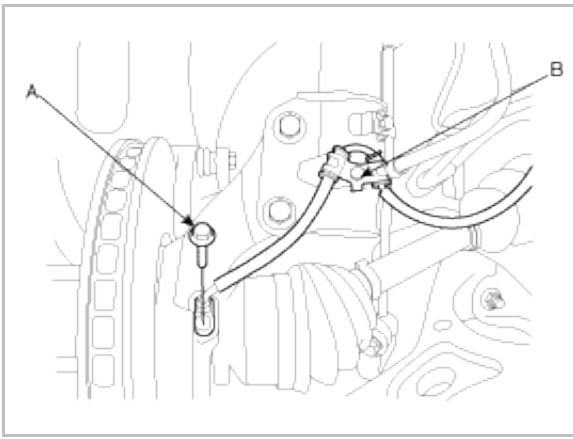
100 ~ 120 (10 ~ 12, 72.3 ~ 86.8)



4. Install the speed sensor (A) and wire (B) bolts.

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

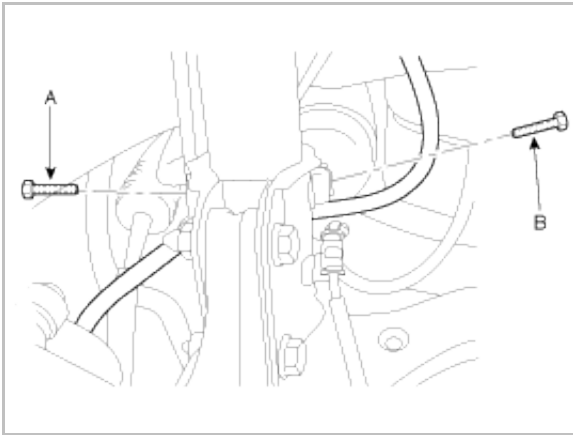
7 ~ 11 (0.7 ~ 1.1, 5.1 ~ 8.0)



5. Install the brake hose bracket bolt (A, B) to the axle assembly.

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

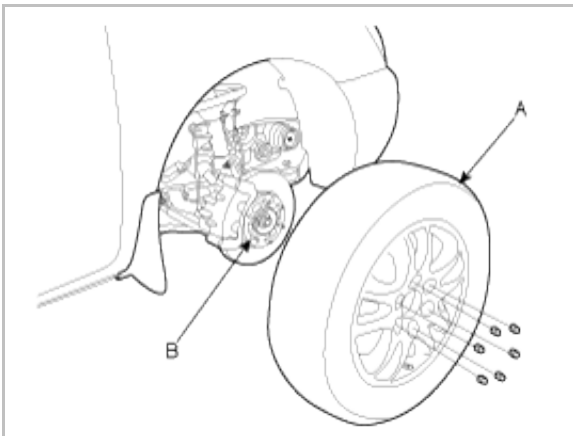
6.9 ~ 11 (0.7 ~ 1.1, 5.1 ~ 8.0)



6. Install the wheel and the tire (A) to the front hub (B).

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

90 ~ 110 (9 ~ 11, 65.1 ~ 79.5)

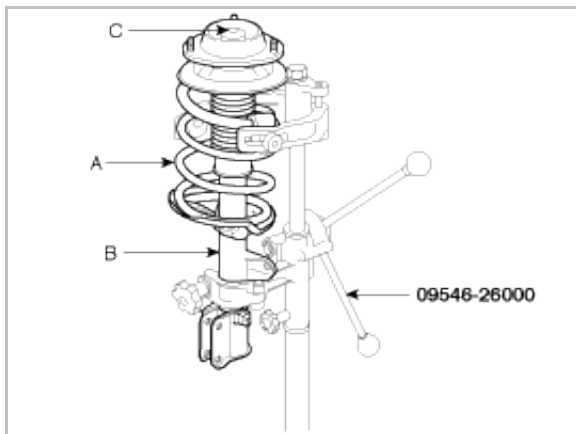


CAUTION

Be careful not to damage the hub bolts(C) when installing the front wheel and tire(A).

DISASSEMBLY

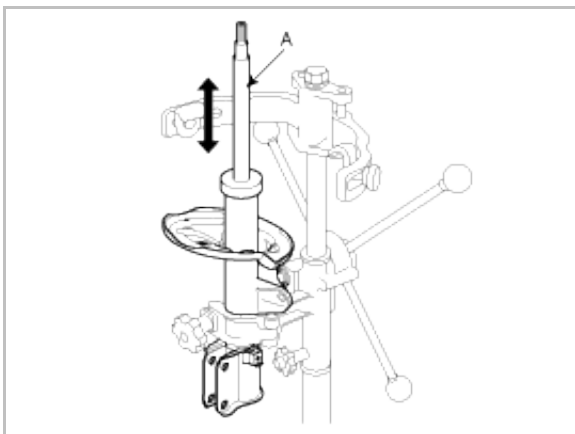
1. Using the special tool (09546-26000), compress the coil spring (A).



2. Remove the self-locking nut (C) from the strut assembly (B).
3. Remove the insulator, spring seat, coil spring and dust cover from the strut assembly.

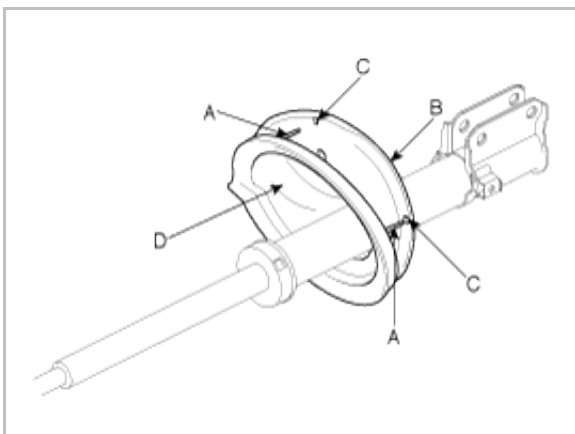
INSPECTION

1. Check the strut insulator for wear or damage.
2. Check rubber parts for damage or deterioration.
3. Compress and extend the piston rod (A) and check that there is no abnormal resistance or unusual sound during operation.



REASSEMBLY

1. Install the spring lower pad (D) so that the protrusions (A) fit in the holes (C) in the spring lower seat (B).



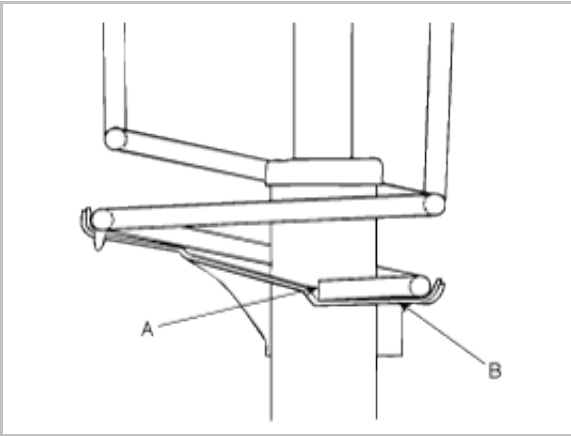
2. Compress coil spring using special tool (09546-26000).
Install compressed coil spring into shock absorber.

NOTICE

- 1) Indicated two identification color marks on the coil spring one follows model option the other follows load classification according to the below.
Pay attention to distinguish between the two marks and then install them.

2) Install the coil spring with the identification mark directed toward the knuckle.

3. After fully extending the piston rod, install the spring upper seat and insulator assembly.
4. After seating the upper and lower ends of the coil spring (A) in the upper and lower spring seat grooves (B) correctly, tighten new self-locking nut temporarily.



5. Remove the special tool (09546-26000).
6. Tighten the self-locking nut to the specified torque.

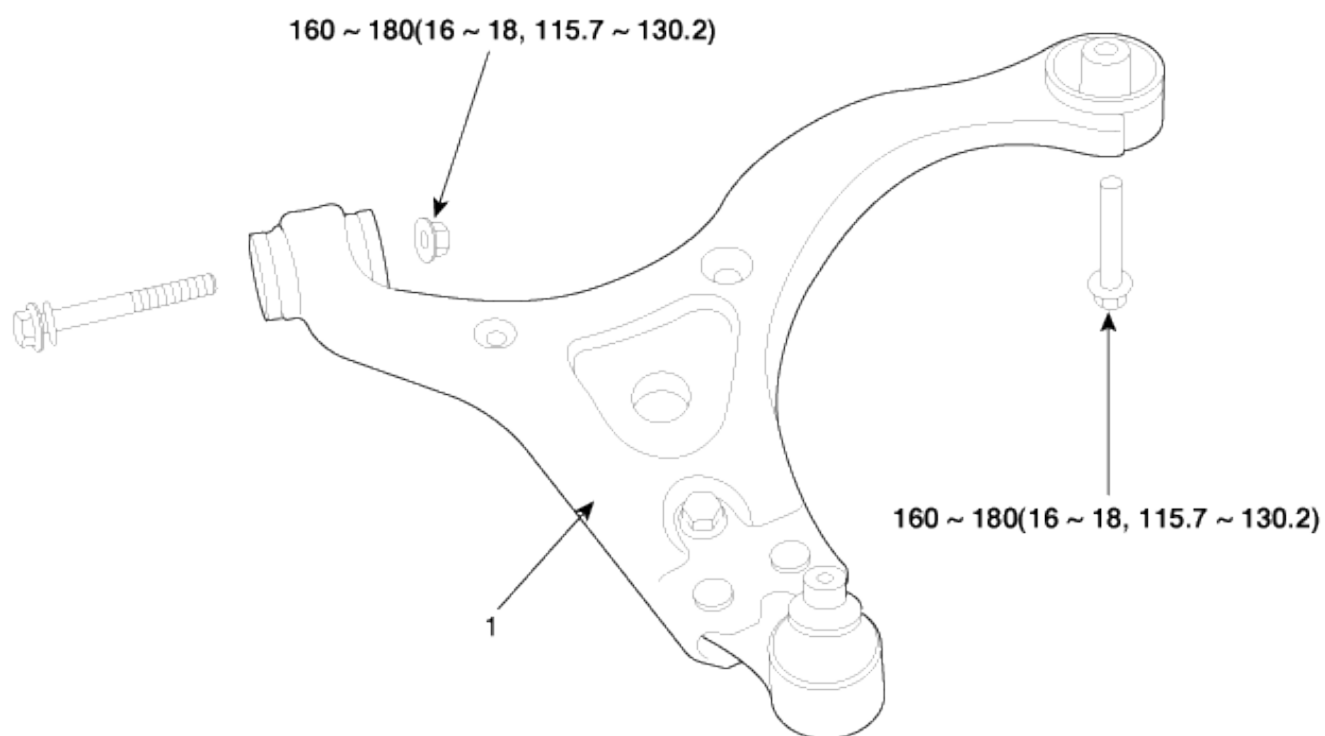
Tightening torque :

60 ~ 70 Nm (6 ~7 kgf.m, 43.4 ~ 50.6 lb-ft)

Suspension System

Front Suspension System - Front Lower Arm

COMPONENTS



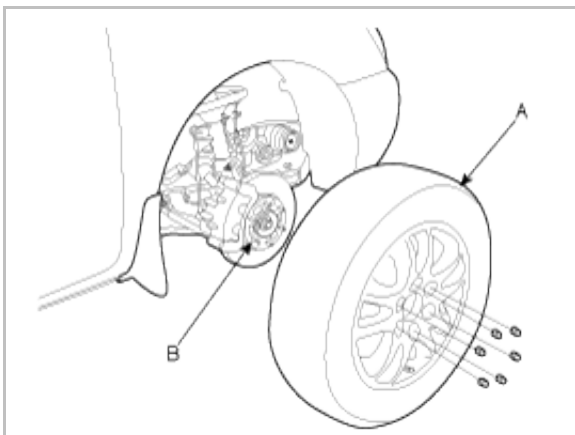
TORQUE : Nm (kgf.m, lb-ft)

1. Front lower arm



REMOVAL

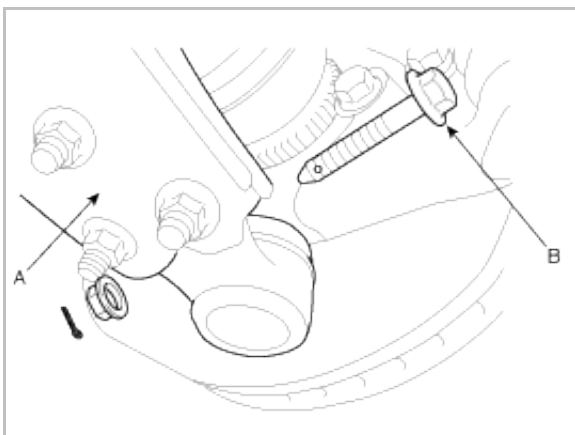
1. Loosen the wheel nuts slightly.
Raise the front of the vehicle, and make sure it is securely supported.
2. Remove the front wheel and tire (A) from front hub (B).



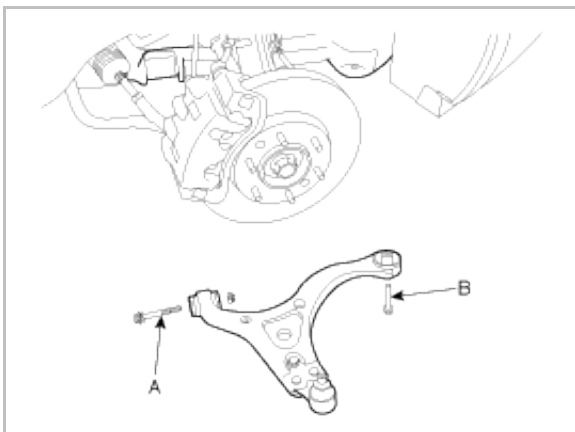
CAUTION

Be careful not to damage the hub bolts(C) when removing the front wheel and tire(A).

3. Remove the front lower arm (A) mounting bolt (B) from the knuckle.

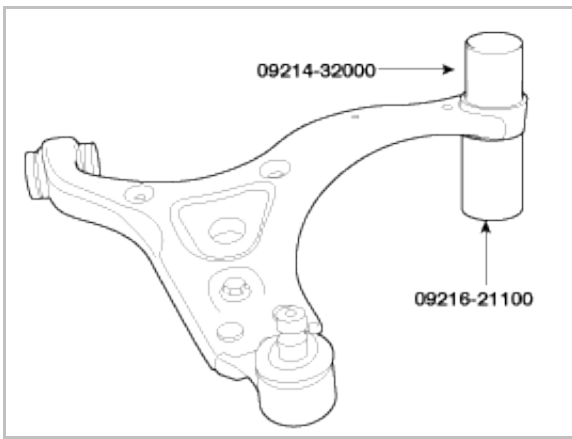


4. Remove the lower arm mounting bolts (A, B).

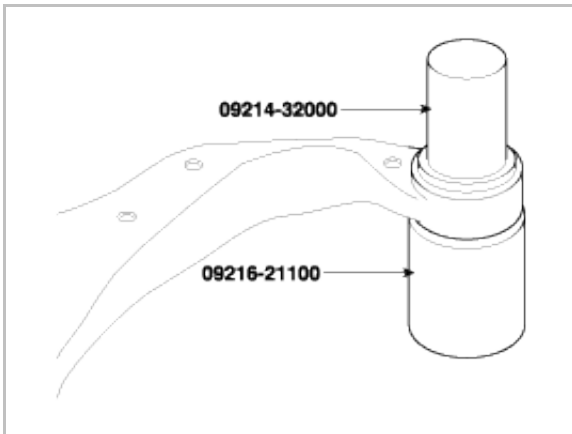


REPLACEMENT

1. Using the special tools(09214-32000 & 09216- 211000), remove the bushing from the lower arm.



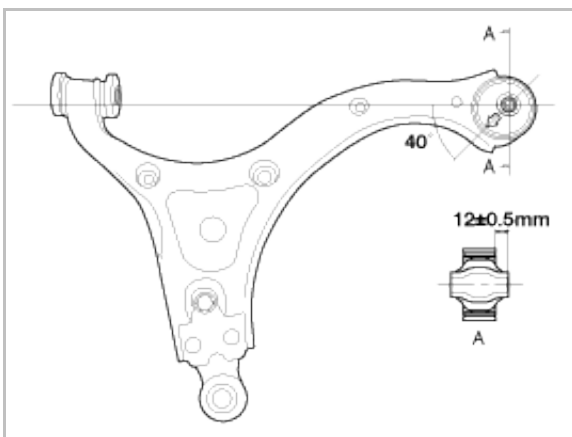
2. Apply soap solution to the following parts.
 - A. Outer surface of the bushing.
 - B. Inner surface of the lower bushing mounting part.
3. Using the special tools(09214-32000 & 09216-21100), install the busing on the lower arm.



CAUTION

Insert bushing in the direction shown in the illustration.

Separation force is over 100 Nm (1000Kgf, 2204 lbf)

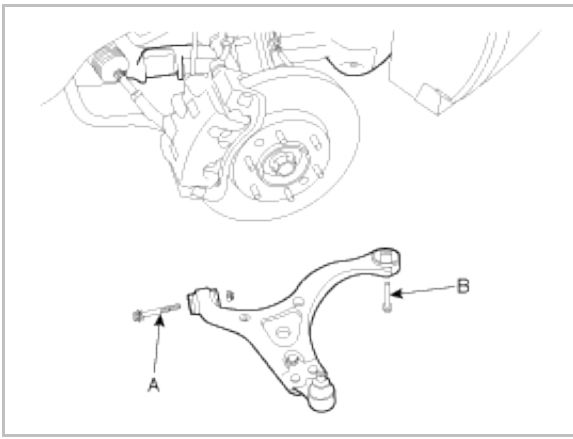


INSTALLATION

1. Install the lower arm mounting bolts (A, B).

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

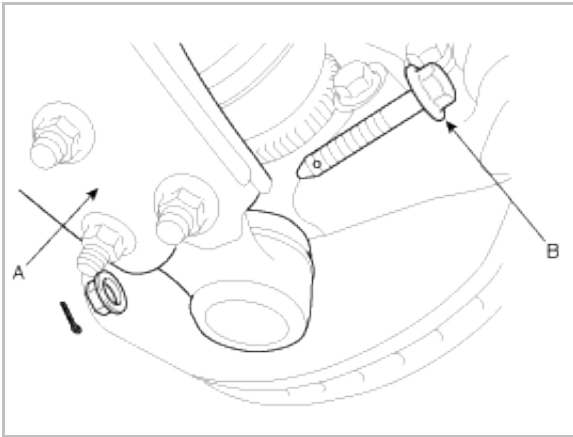
160 ~ 180 (16 ~ 18, 115.7 ~ 130.2)



2. Install the front lower arm (A) ball joint mounting bolt (B) to the knuckle.

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

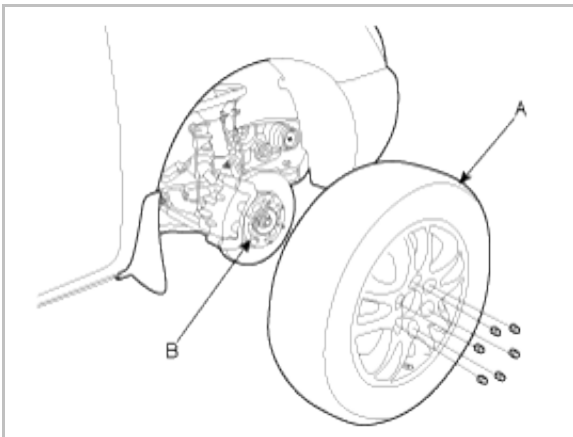
90 ~ 120 (9 ~ 12, 65.1 ~ 86.8)



3. Install the wheel and the tire(A) to the front hub(B).

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

90 ~ 110 (9 ~ 11, 65.1 ~ 79.5)



CAUTION

Be careful not to damage the hub bolts(C) when installing the front wheel and tire(A).

INSPECTION

1. Check the bushing for wear and deterioration.
2. Check the lower arm for bending or breakage.
3. Check the ball joint dust cover for cracks.

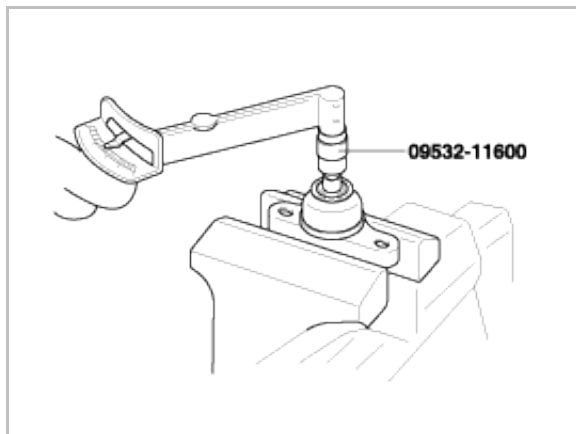
4. Check all bolts.
5. Check the lower arm ball joint for rotating torque.
 - (1) If a crack is noted in the dust cover, replace the ball joint assembly.
 - (2) Move the ball joint stud several times in a circular motion.
 - (3) Measure the ball joint rotating torque.

Standard value :

1 ~ 3.5 Nm (10 ~ 35 kgf.cm, 0.72 ~ 2.53 lb-ft)

NOTICE

Measure torque using the special tool(09532-11600) and torque wrench at the range of 0.5 - 2 rpm after moving the ball joint stud 10 times at room temperature.



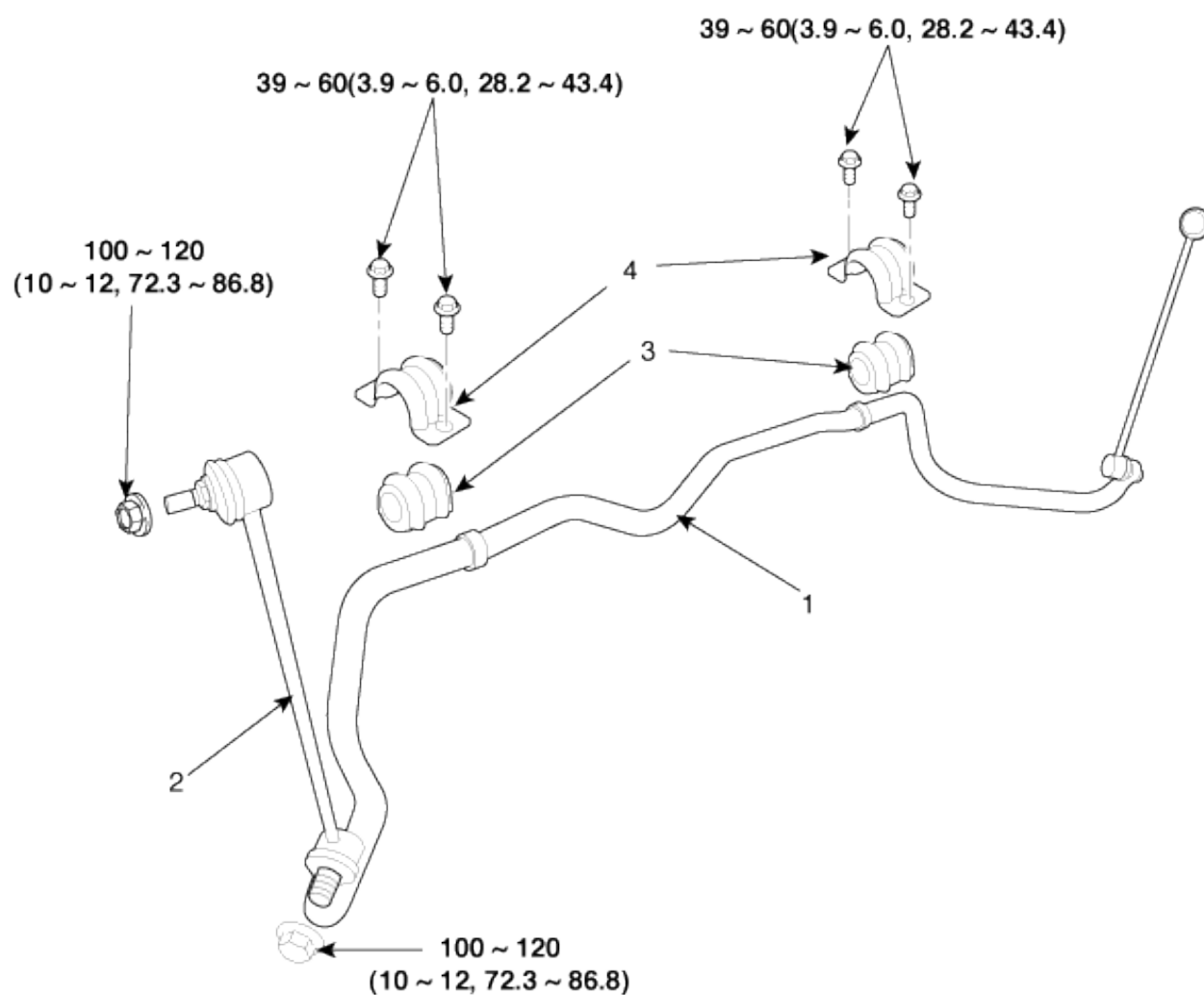
- (4) If the rotating torque is below the lower limit of standard value, replace the ball joint assembly.
- (5) Even if the rotating torque is below the lower limit of the standard value, the ball joint may be reused unless it has drag and excessive play.



Suspension System

Front Suspension System - Front Stabilizer
Bar

COMPONENTS



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

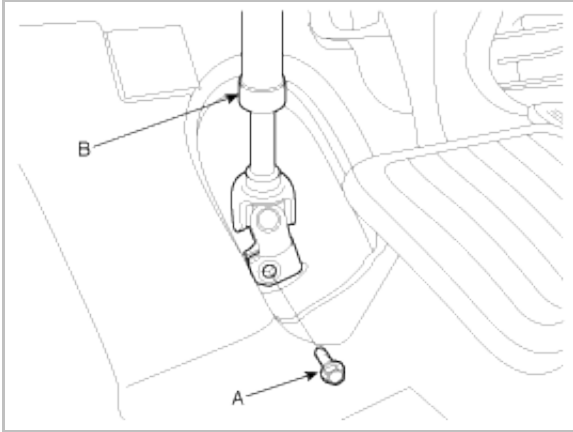
- 1. Front stabilizer bar
- 2. Front stabilizer link

- 3. Bushing
- 4. Bracket



REMOVAL

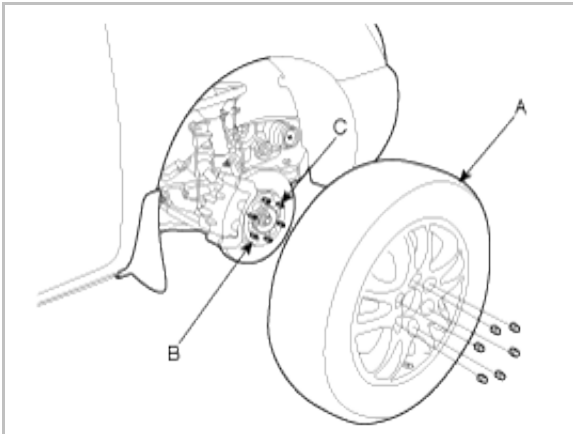
1. Remove the connecting bolt (A) between the steering universal joint assembly (B) and the pinion assembly.



CAUTION

Keep the neutral-range to prevent the damage of the clock spring inner cable when you handle the steering wheel.

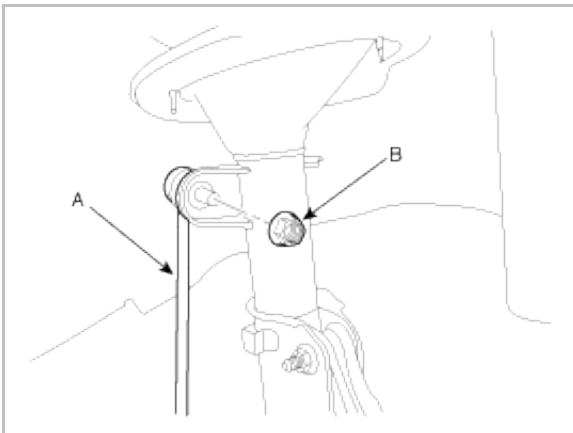
2. Loosen the wheel nuts slightly. Raise the front of the vehicle, and make sure it is securely supported.
3. Remove the front wheel and tire (A) from front hub (B).



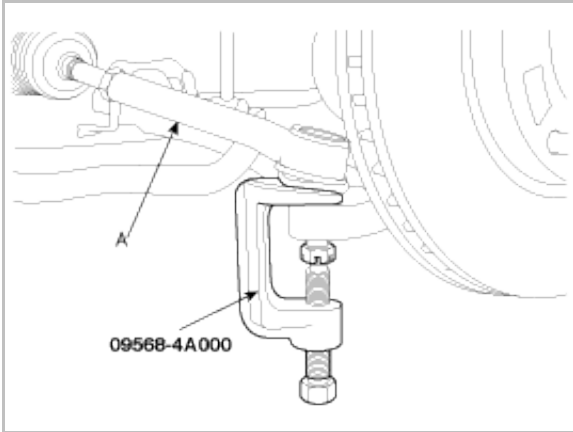
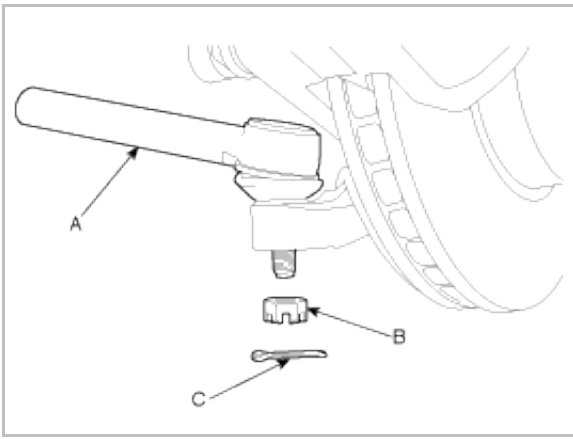
CAUTION

Be careful not to damage the hub bolts (C) when removing the front wheel and tire (A).

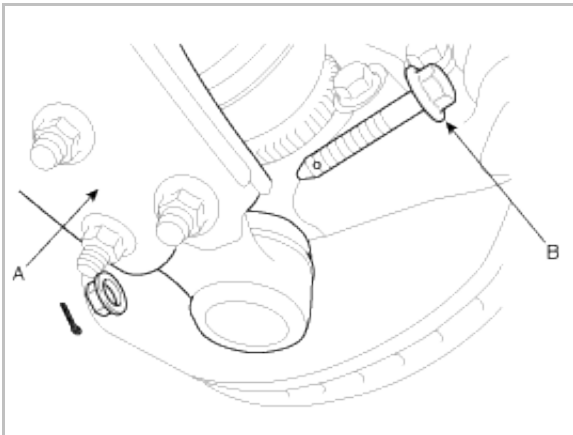
4. Remove the front stabilizer link (A) nut (B) from the strut assembly.



5. After removing both sides of the tie rod end (A) self-locking nuts (B) and cotterpin (C), remove the ball joint by using the special tool (09568-4A000).

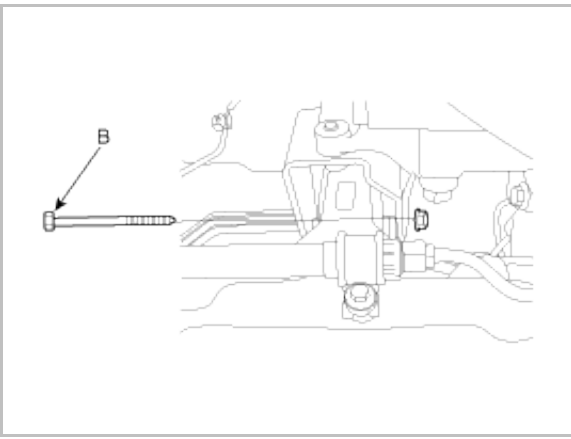


6. Remove both sides of the lower arm (A) mounting bolts (B).

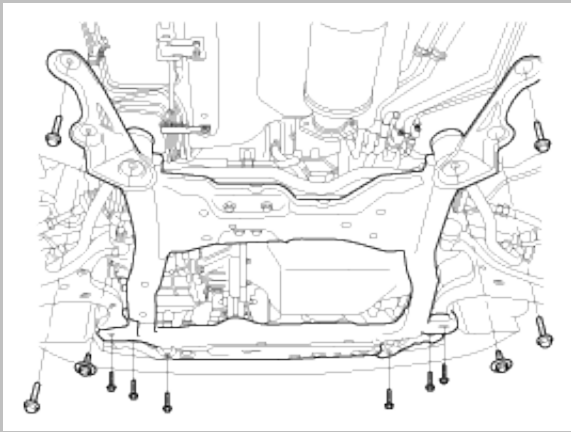


7. Remove the engine mounting bolts (A, B)

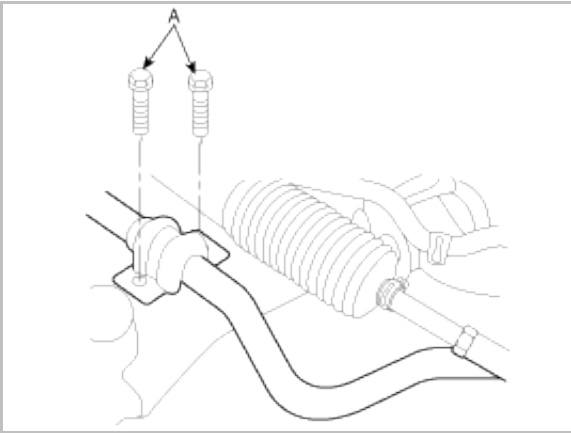




8. Remove the twelve bolts and nuts of the sub frame by supporting it with a jack.



9. After lowering the jack which supports the sub frame in a proper level, remove both sides of the stabilizer bar assembly mounting bolts (A).

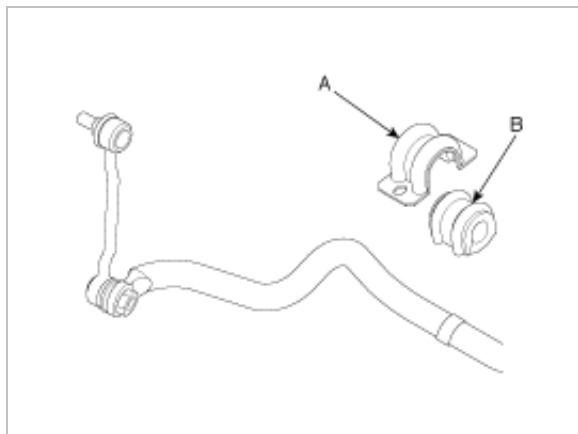


10. Remove the stabilizer bar assembly through the gap between the body and the rear side of the sub frame.

CAUTION

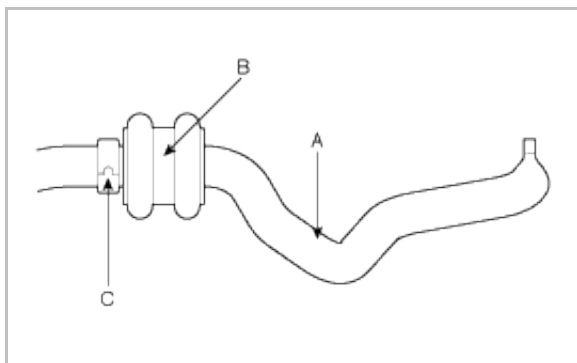
Be careful not to damage to the power steering related tubes.

11. Remove the brackets (A) and the bushings (B).



INSTALLATION

1. Install the bushing (B) on the stabilizer bar (A).



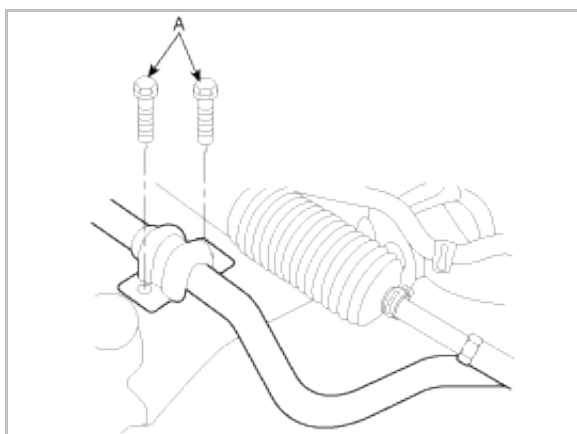
NOTICE

Bring clamp (C) of stabilizer bar (A) into contact with bushing (B).

2. Install the bracket on the bushing (B).
3. After tightening the bolts of the bushing bracket temporarily, install the bushing bracket on the opposite side.
4. Install the stabilizer bar bracket mounting bolts (A) to the sub frame.

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

39 ~ 60 (3.9 ~ 6.0, 28.2 ~ 43.4)

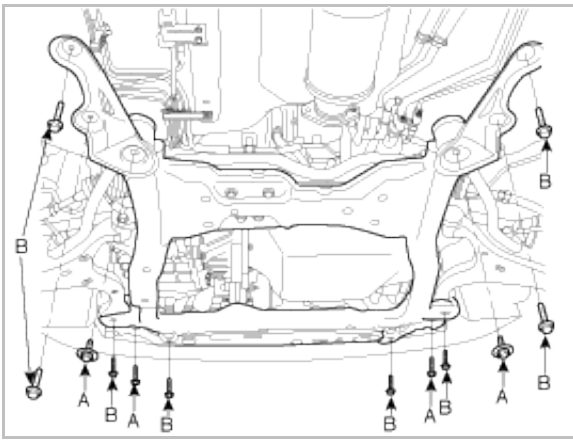


5. After lifting the jack which supports the sub frame, install the four bolts (A) of the sub frame and the eight bolts (B) of the guide bracket.

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

Bolt (A) : 160 ~ 180 (16 ~ 18, 115.7 ~ 130.2)

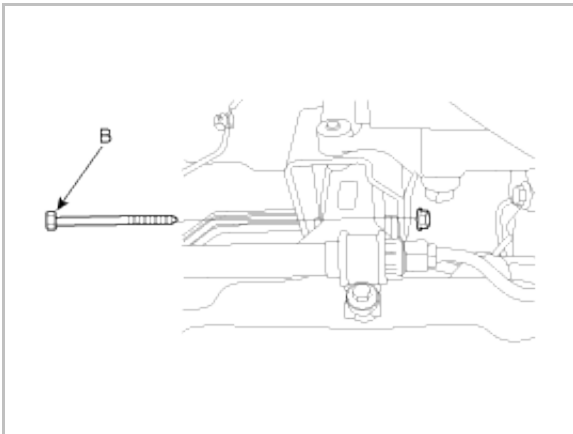
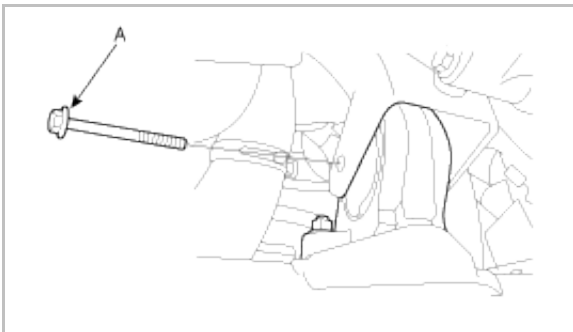
Bolt (B) : 45 ~ 60 (4.5 ~ 6.0, 32.5 ~ 43.4)



6. Install the engine mounting bolts (A, B)

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

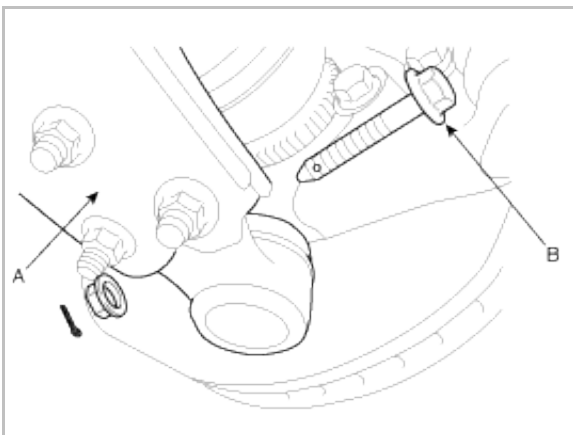
65 ~ 85 (6.5 ~ 8.5, 47.0 ~ 61.5)



7. Install both sides of the lower arm (A) mounting bolts(B).

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

90 ~ 120 (9 ~ 12, 65.1 ~ 86.8)

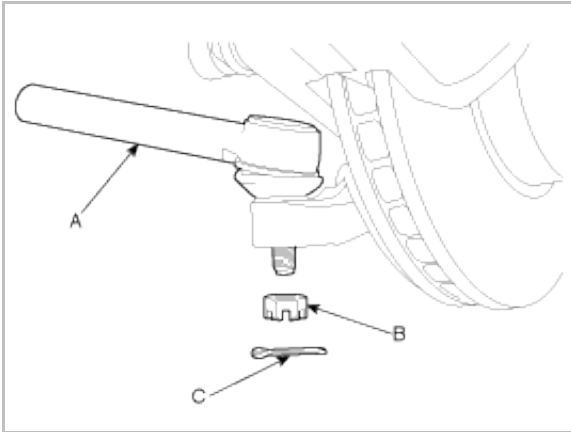


8. Install both sides of the tie rod end (A) self-locking nuts (B). Insert cooter pin (C) after nut is torqued to

specification.

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

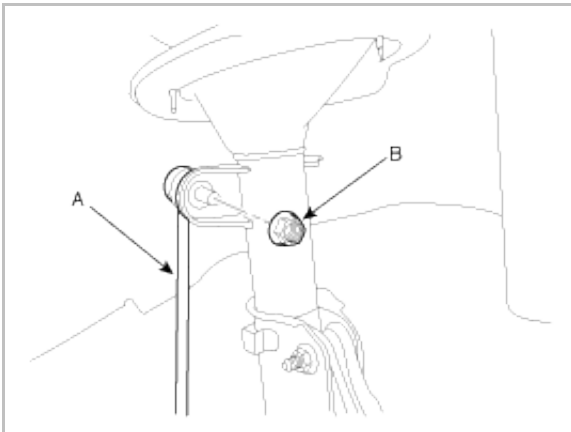
65 ~ 80 (6 ~ 8, 43.4 ~ 57.8)



9. Install the front stabilizer link (A) nut (B) to the strut assembly.

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

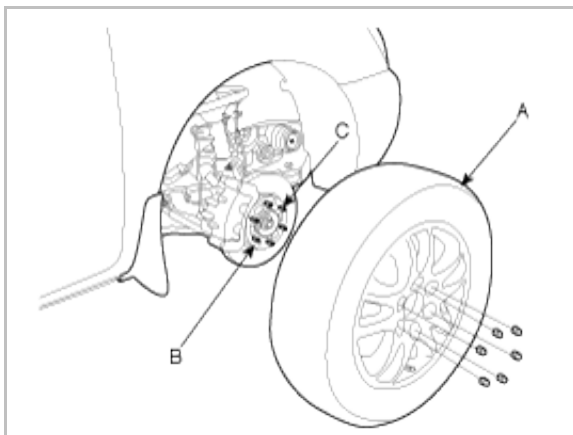
100 ~ 120 (10 ~ 12, 72.3 ~ 86.8)



10. Install the wheel and the tire (A) to the front hub (B).

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

90 ~ 110 (9 ~ 11, 65.1 ~ 79.5)



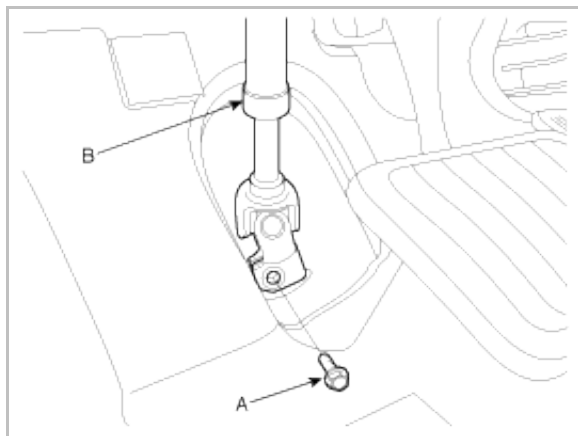
CAUTION

Be careful not to damage the hub bolts(C) when installing the front wheel and tire(A).

11. Install the connecting bolt (A) between the steering universal joint assembly (B) and the pinion assembly.

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

13 ~ 18 (1.3 ~ 1.8, 9.4 ~ 13.0)

**CAUTION**

After installation, if necessary, adjust the alignment of the steering wheel and front tires

INSPECTION

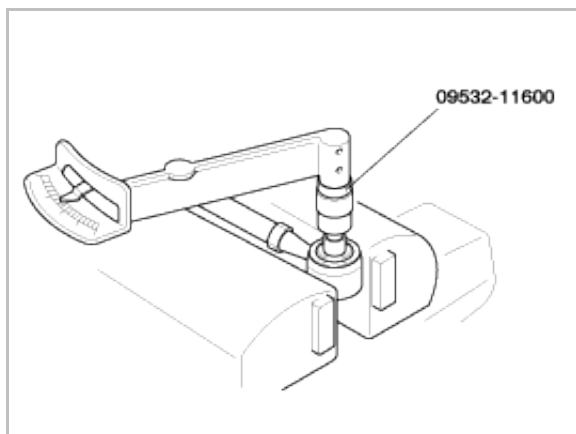
1. Check the bushing for wear and deterioration.
2. Check the stabilizer bar for bending or breakage.
3. Check the ball joint for rotating torque.
 - (1) If there is a crack in the dust cover, replace it and add grease.
 - (2) Move the stabilizer link ball joint stud several times in a circular motion.
 - (3) Mount the self-locking nut on the ball joint, and then measure the ball joint rotating torque.

Standard value :

0.5 ~ 2.5 Nm (5 ~ 25 kgf., 0.36 ~ 1.81 lb-ft)

NOTICE

Measure torque using the special tool(09532-11600) and torque wrench at the range of 0.5 - 2 rpm after moving the ball joint stud 10 times at room temperature.



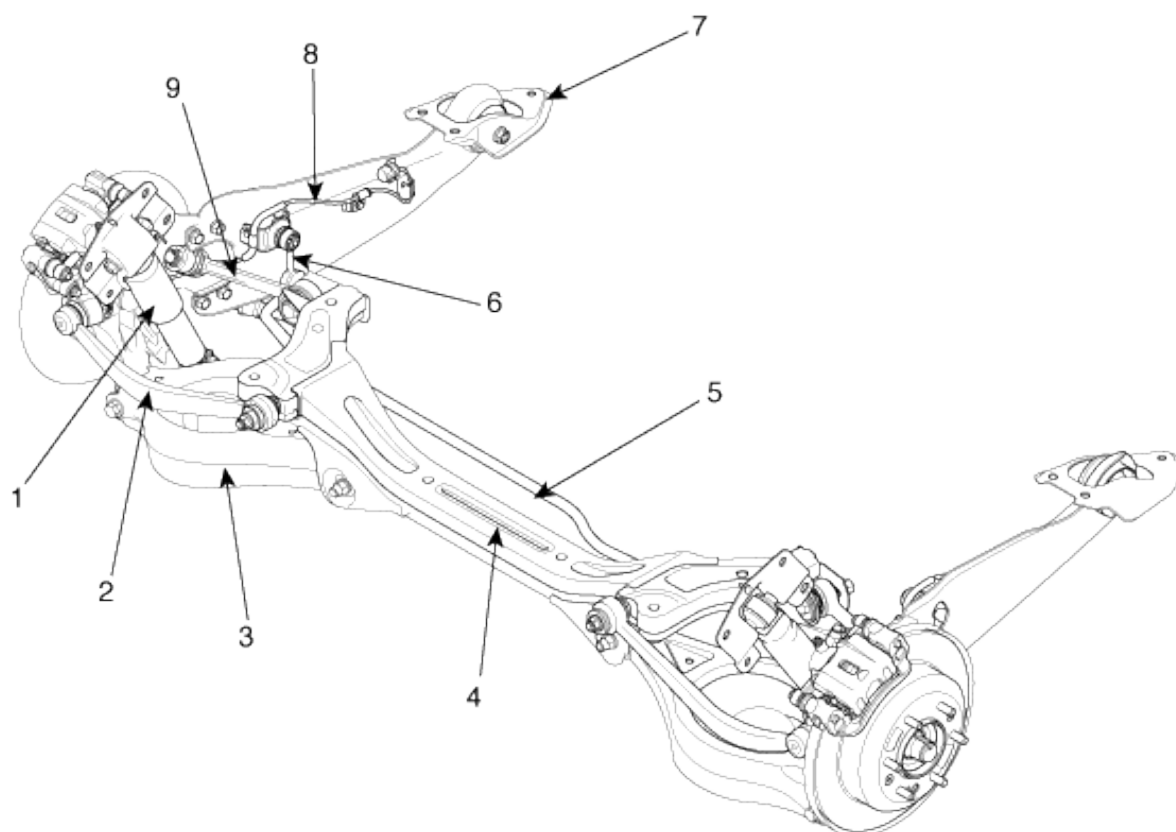
- (4) If the rotating torque exceeds the upper limit of standard value, replace the upper arm assembly.
- (5) Even if the rotating torque is below the lower limit of the standard value, the ball joint may be reused unless it has drag and excessive play.



Suspension System

Rear Suspension System

COMPONENTS



Cross member mounting blot : 160 N.m (16 ~ 18 kgf.m 115.7 ~ 130.2 lb-ft)

- 1. Rear shock absorber assembly
- 2. Rear upper arm
- 3. Rear lower arm
- 4. Rear cross member
- 5. Rear stabilizer bar assembly

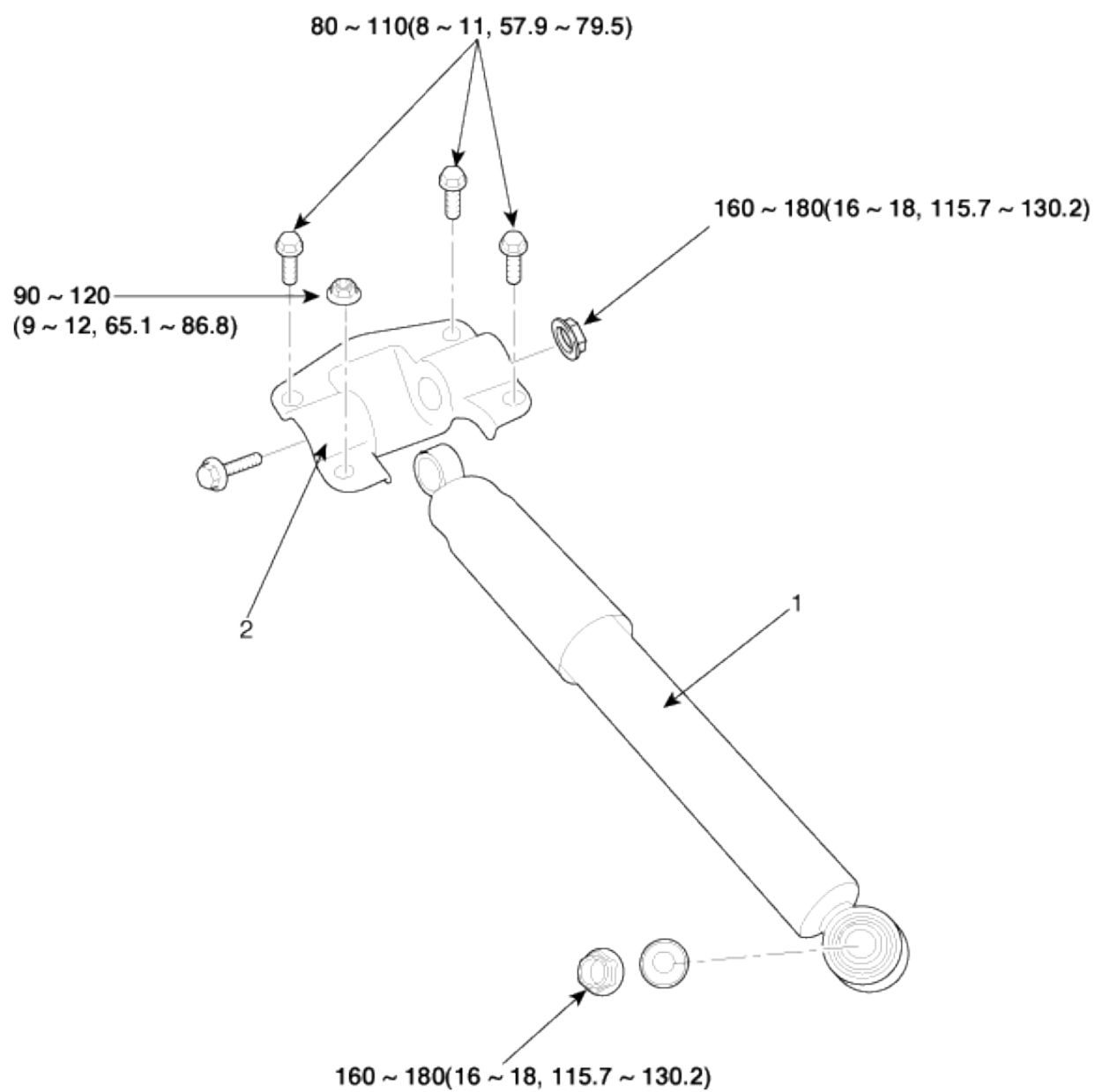
- 6. Rear stabilizer link assembly
- 7. Trailing arm bracket
- 8. Trailing arm
- 9. Rear assist arm



Suspension System

Rear Suspension System - Rear Shock
Absorber

COMPONENTS



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

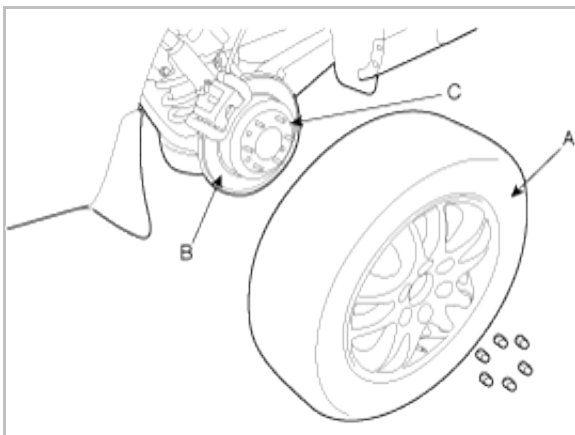
1. Rear shock absorber

2. Rear shock absorber bracket



REMOVAL

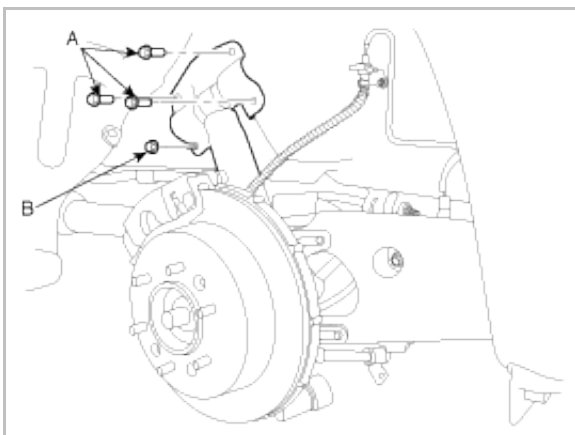
1. Loosen the wheel nuts slightly.
Raise the rear of the vehicle, and make sure it is securely supported.
2. Remove the rear wheel and tire (A) from rear hub (B).



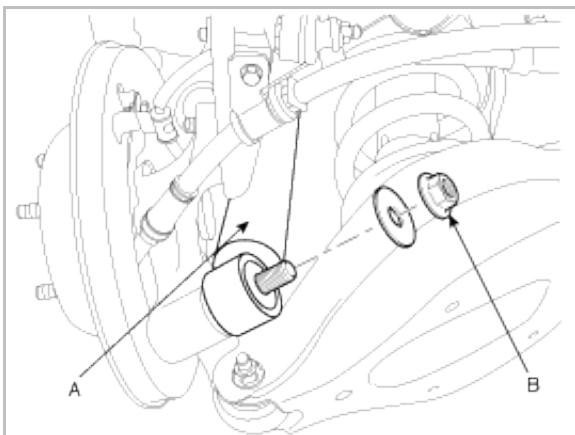
CAUTION

Be careful not to damage the hub bolts (C) when removing the rear wheel and tire (A).

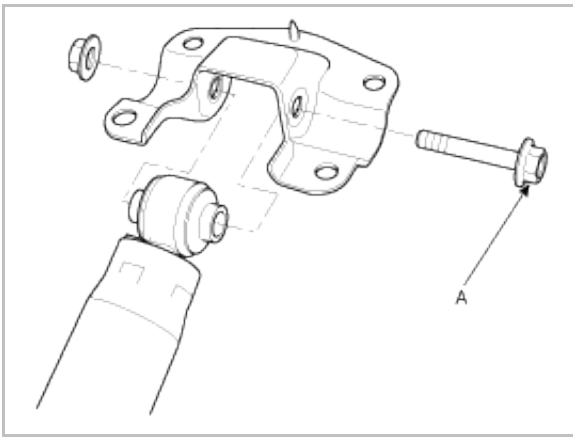
3. Remove the rear shock absorber assembly mounting bolts (A) and nut (B) from the baby.



4. Remove the rear shock absorber assembly nut (B) from the rear knuckle, then remove the shock absorber assembly (A).



5. Remove the rear shock absorber bracket bolt (A).

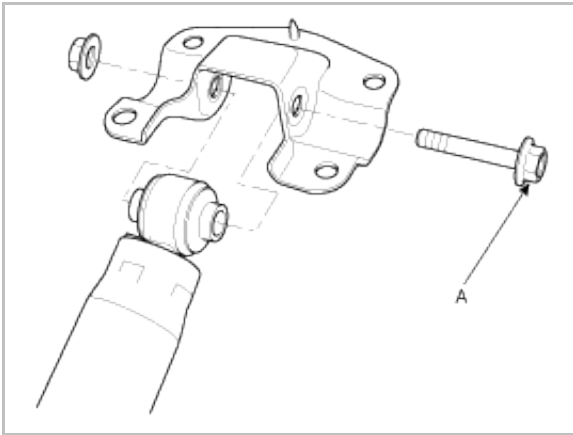


INSTALLATION

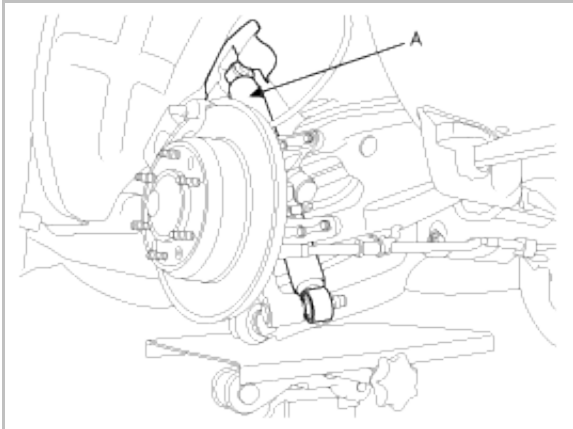
1. Install the connecting bolt (A) between the rear shock absorber and the bracket.

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

160 ~ 180 (16 ~ 18, 115.7 ~ 130.2)



2. Install the rear shock absorber (A) to the knuckle temporarily.

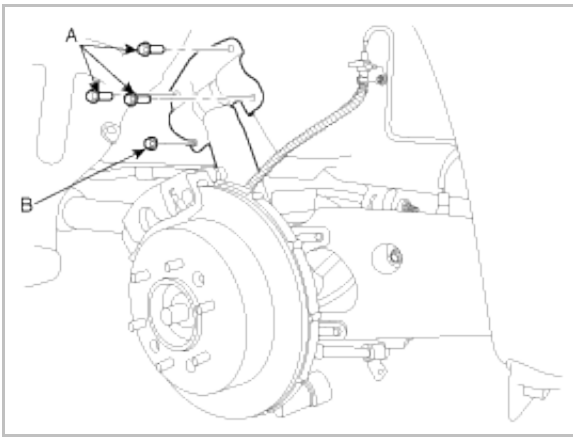


3. Install the rear shock absorber bracket mounting bolts (A) and nut (B).

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

Bolt : 80 ~ 110 (8 ~ 11, 59.7 ~ 79.5)

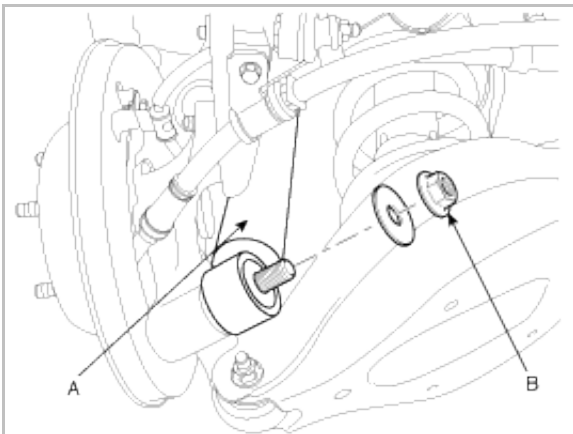
Nut : 90 ~ 120 (9 ~ 12, 65.1 ~ 86.8)



4. Install the rear shock absorber (A) nut (B) to the knuckle.

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

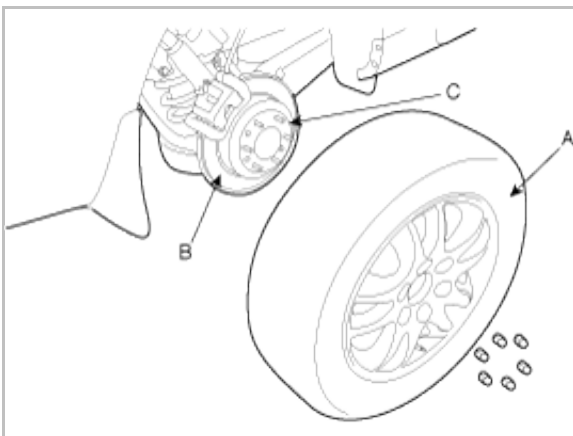
160 ~ 180 (16 ~ 18, 115.7 ~ 130.2)



5. Install the wheel and the tire (A) to the rear hub (B).

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

90 ~ 110 (9 ~ 11, 65.1 ~ 79.5)



CAUTION

Be careful not to damage the hub bolts (C) when installing the rear wheel and tire (A).

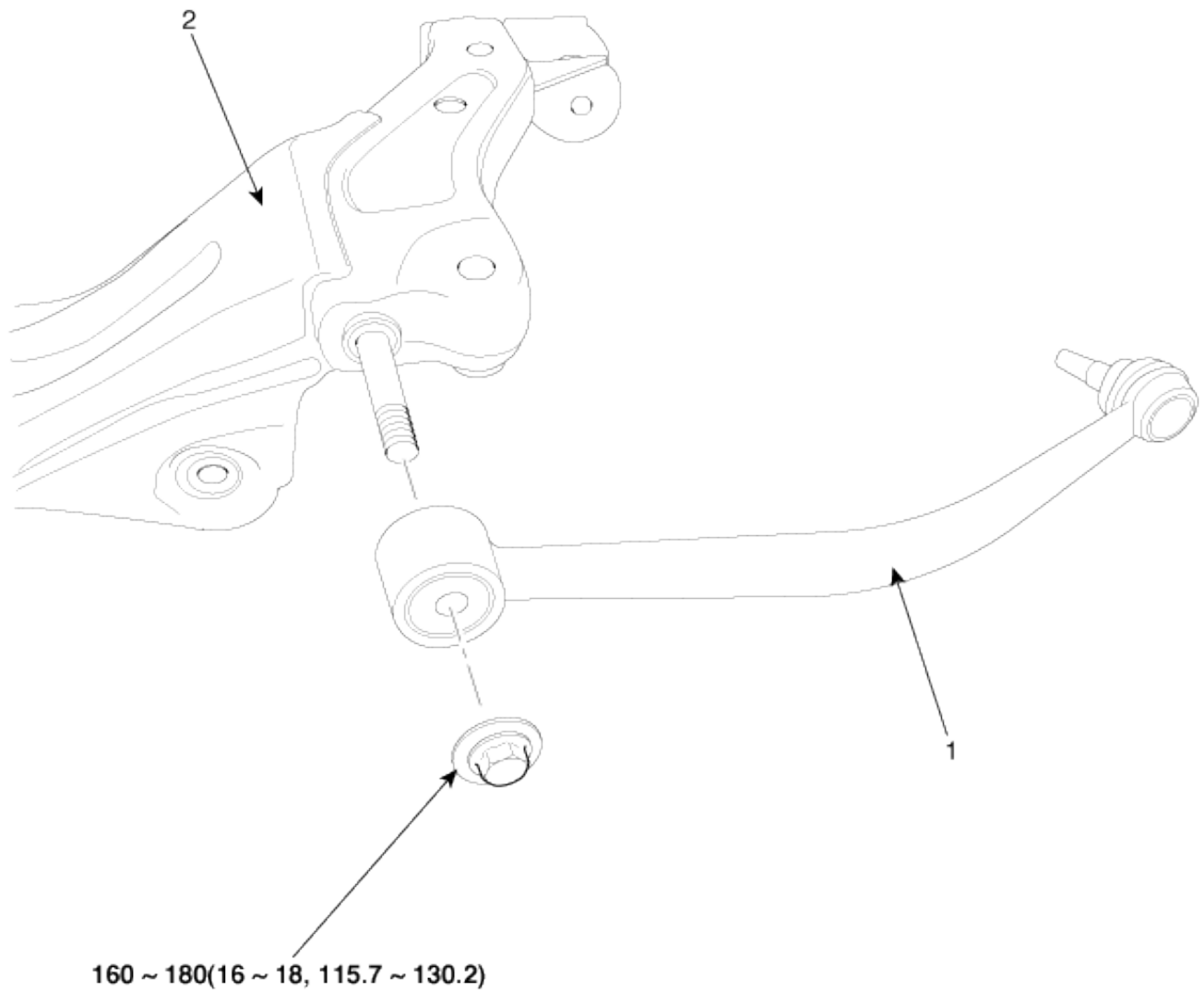
INSPECTION

1. Check the rubber parts for damage or deterioration.
2. Check the shock absorber for abnormal resistance or unusual sounds.



Suspension System

Rear Suspension System - Rear Upper Arm

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

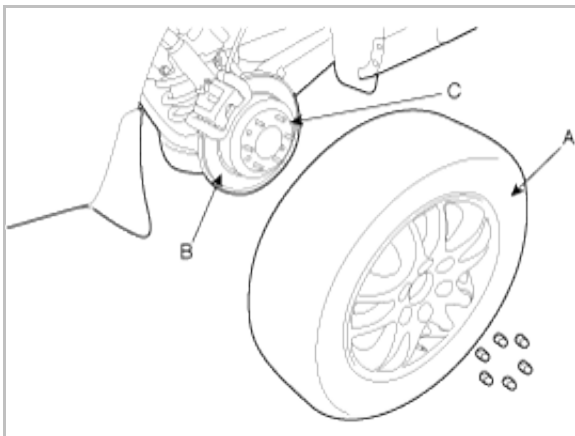
1. Rear upper arm

2. Rear cross member



REMOVAL

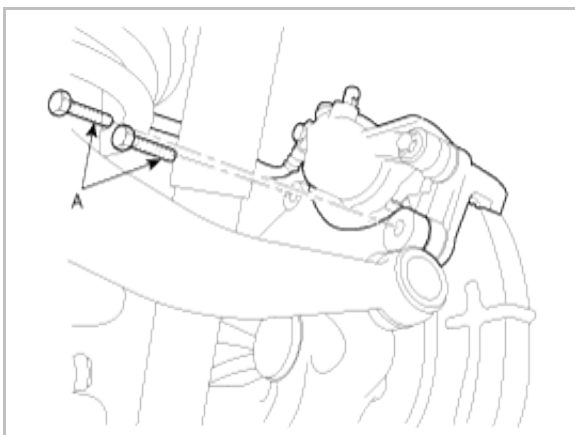
1. Loosen the wheel nuts slightly. Raise the rear of the vehicle, and make sure it is securely supported.
2. Remove the rear wheel and tire (A) from rear hub (B).



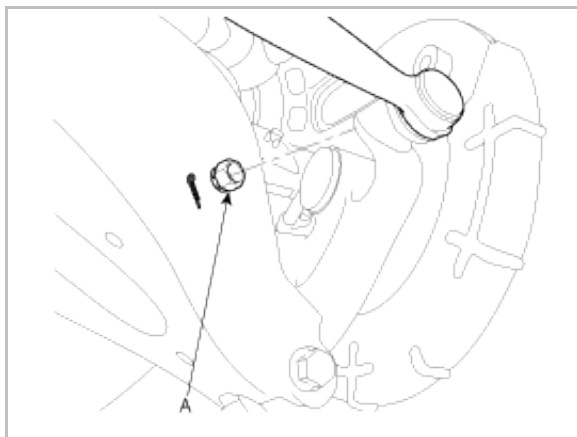
CAUTION

Be careful not to damage the hub bolts (C) when removing the rear wheel and tire (A).

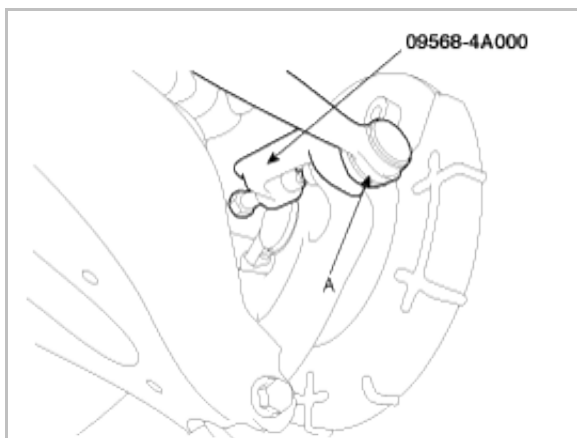
3. Remove the brake caliper mounting bolts (A), and then place the brake caliper assembly (B) with wire as shown in the illustration.



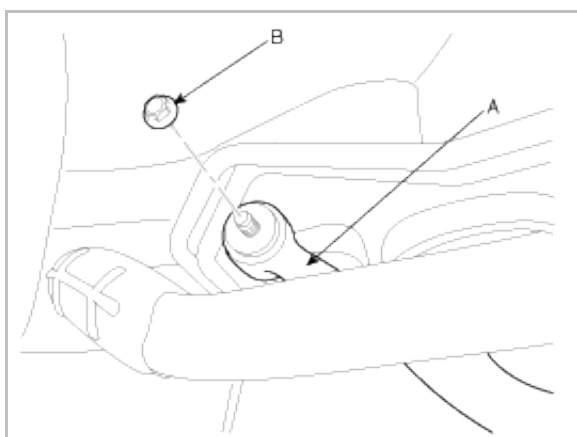
4. Remove the rear upper arm ball joint self-locking nut (A) and the cotter pin.



5. Remove the rear upper arm ball joint (A) by using the special tool(09568-4A000).



6. Remove the rear upper arm (A) mounting nut (B) from the cross member.

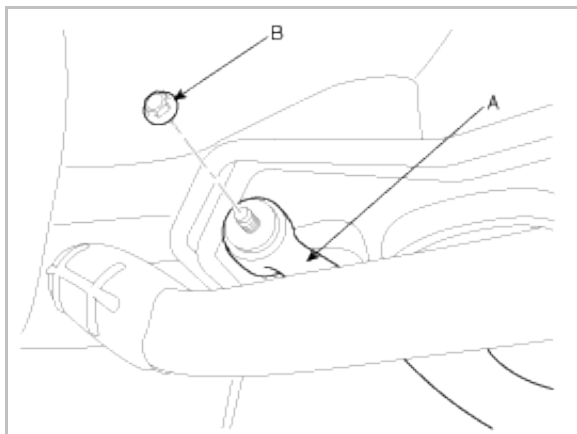


INSTALLATION

1. Install the rear upper arm (A) mounting nut (B) to the cross member.

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

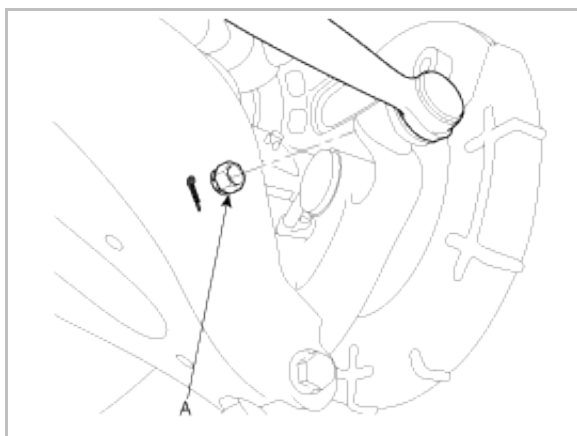
160 ~ 180 (16 ~ 18, 115.7 ~ 130.2)



2. Install the rear upper arm ball joint self-locking nut (A) and the cotter pin.

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

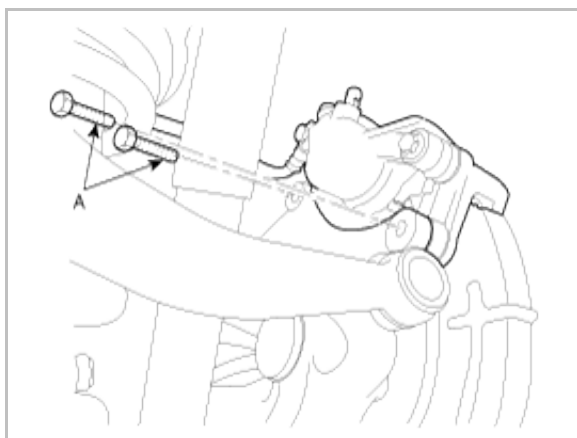
90 ~ 110 (9 ~ 11, 65.1 ~ 79.5)



3. Install the brake caliper mounting bolts (A).

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

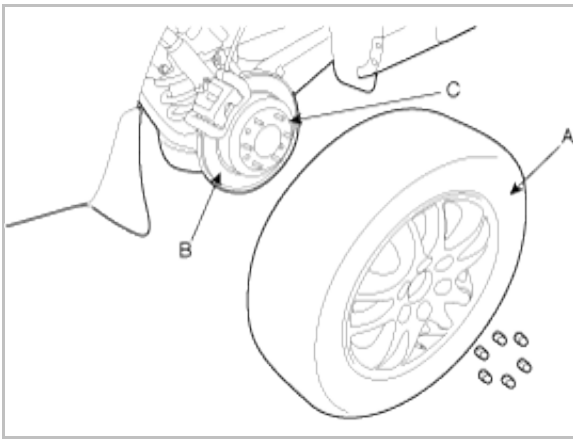
50 ~ 60 (5.0 ~ 6.0, 36.2 ~ 43.4)



4. Install the wheel and the tire (A) to the rear hub (B).

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

90 ~ 110 (9 ~ 11, 65.1 ~ 79.5)



CAUTION

Be careful not to damage the hub bolts (C) when installing the rear wheel and tire (A).

INSPECTION

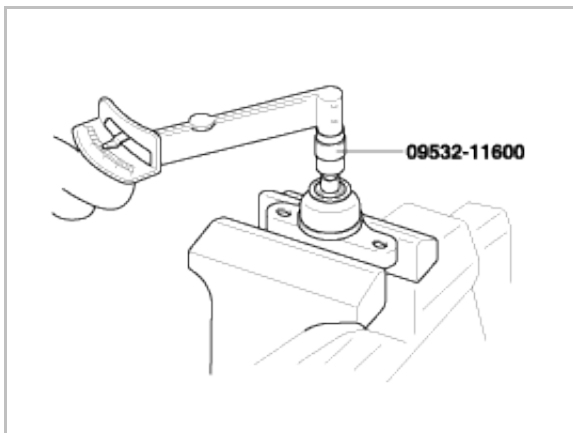
1. Check the bushing for wear and deterioration.
2. Check the upper arm for bending or breakage.
3. Check the ball joint for rotating torque.
 - (1) If there is a crack in the dust cover, replace it and add grease.
 - (2) Move the stabilizer link ball joint stud several times in a circular motion.
 - (3) Mount the self-locking nut on the ball joint, and then measure the ball joint rotating torque.

Specified torque :

1 ~ 3 Nm (10 ~ 30 kgf.cm, 0.72 ~ 2.17 lb-ft)

NOTICE

Measure a torque by using the special tool(09532-11600) and torque wrench, at the range of 0.5 ~ 2 rpm after moving the ball joint stud 10 times at room temperature.



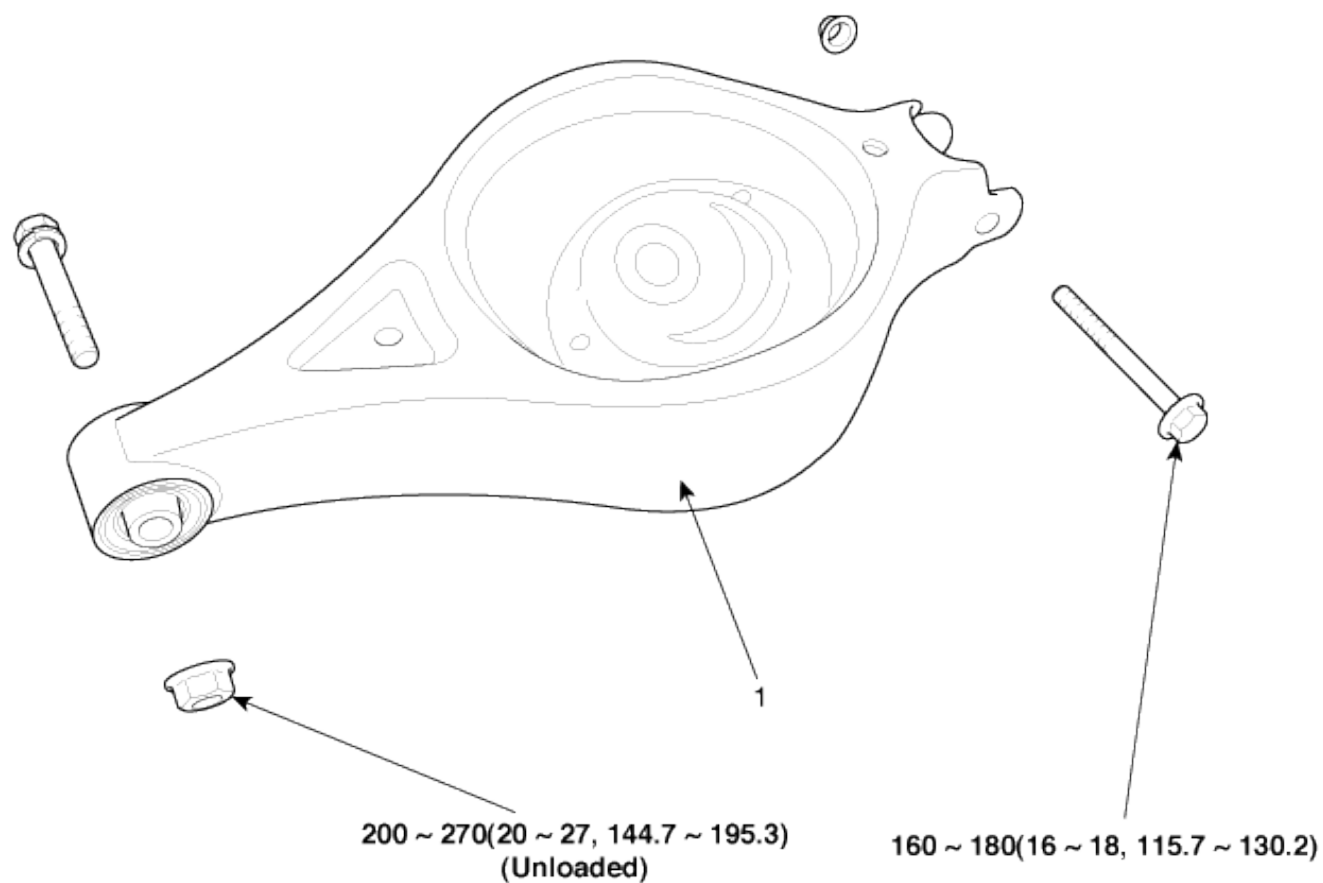
- (4) If the rotating torque exceeds the upper limit of standard value, replace the upper arm assembly.
- (5) Even if the rotating torque is below the lower limit of the standard value, the ball joint may be reused unless it has drag and excessive play.



Suspension System

Rear Suspension System - Rear Lower Arm

COMPONENTS



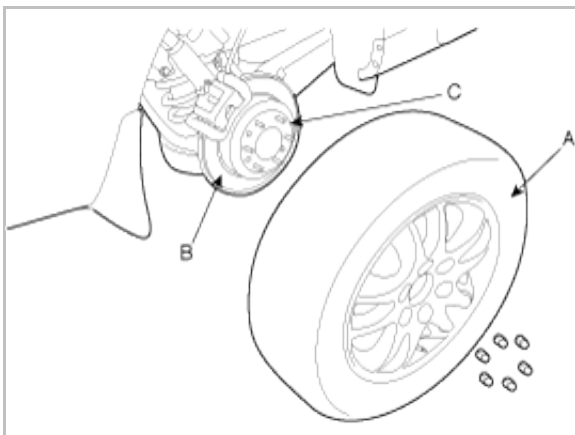
TORQUE : Nm (kgf.m, lb-ft)

1. Rear lower arm



REMOVAL

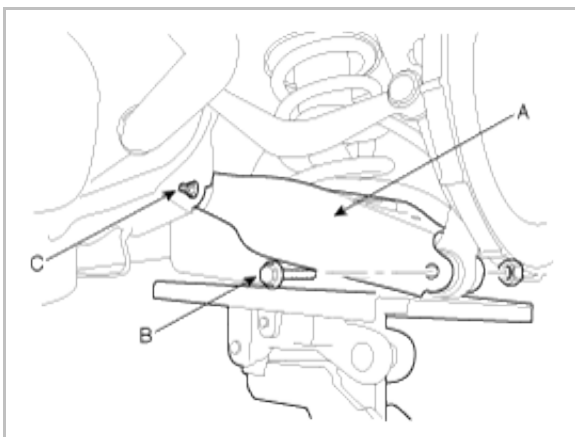
1. Loosen the wheel nuts slightly.
Raise the rear of the vehicle, and make sure it is securely supported.
2. Remove the rear wheel and tire (A) from rear hub (B).



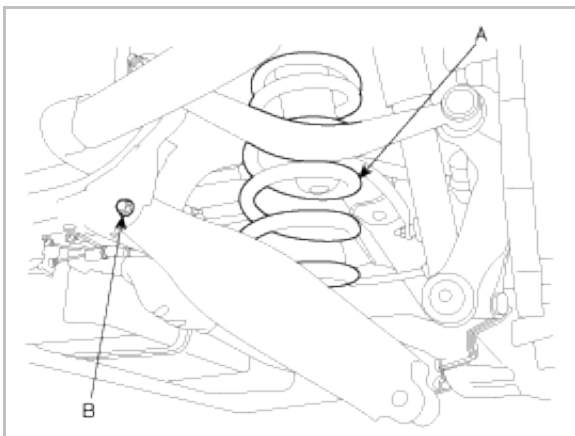
CAUTION

Be careful not to damage the hub bolts (C) when removing the rear wheel and tire (A).

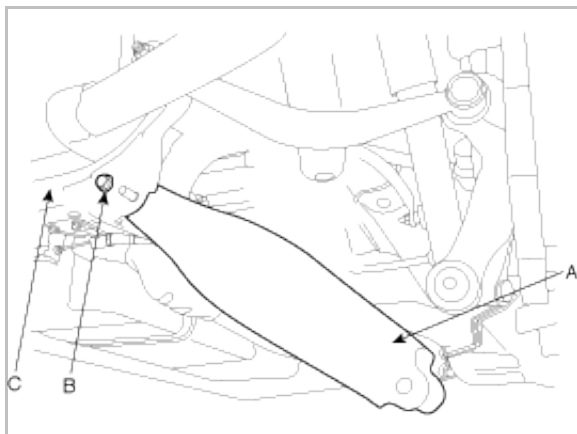
3. Remove the lower arm bolt (B) from the rear knuckle, while supporting the lower arm (A) with a jack as shown in the illustration. Loosen the lower arm bolt (C) from the cross member.



4. Remove the spring (A), the lower seat, and the upper pad.

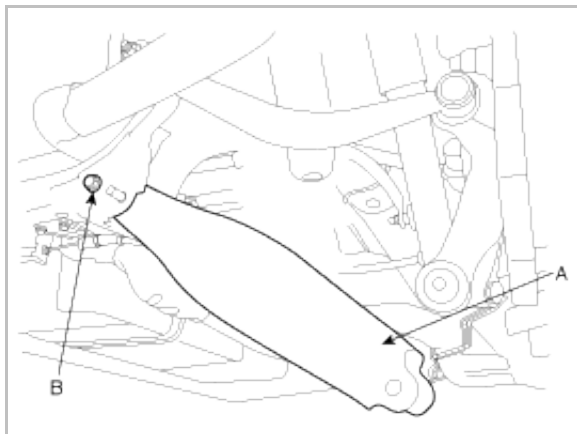


5. Remove the lower arm (A) mounting bolts (B) from the cross member (C).

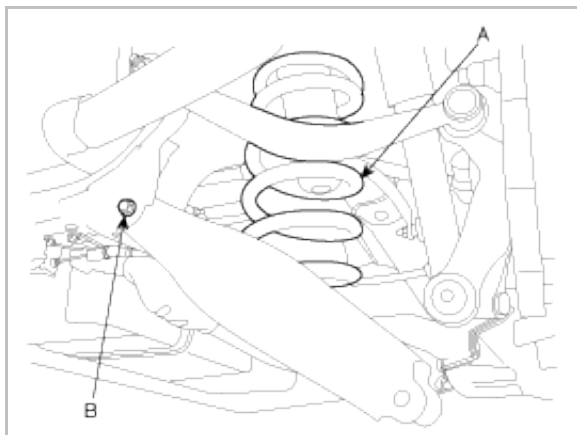


INSTALLATION

1. Pretighten the lower arm (A) mounting bolts (B) to the cross member.



2. Install the spring (A), the lower seat, and the upper pad.

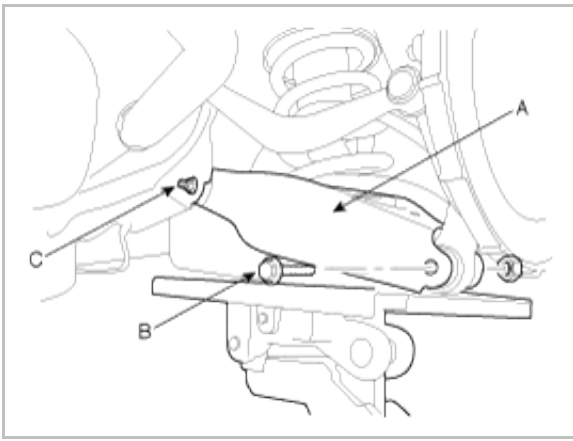


3. Install the lower arm bolt (B) to the rear knuckle and the lower arm bolt (C) to the cross member with a specified torque, while supporting the lower arm (A) with a jack as shown in the illustration.

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

Bolt (B) : 120 ~ 160 (12 ~ 16, 86.8 ~ 115.7)

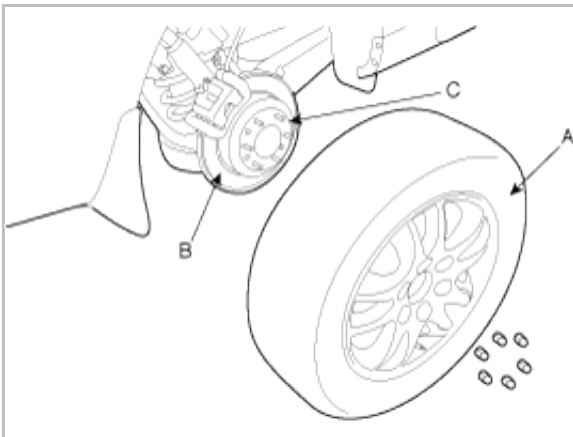
Bolt (C) : 200 ~ 270 (20 ~ 27, 144.7 ~ 195.3)



4. Install the wheel and the tire (A) to the rear hub (B).

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

90 ~ 110 (9 ~ 11, 65.1 ~ 79.5)



CAUTION

Be careful not to damage the hub bolts (C) when installing the rear wheel and tire (A).

INSPECTION

Rear lower arm

1. Check the bushing for wear and deterioration.
2. Check the center arm for bending or breakage.
3. Check the bolts for damage.

Spring

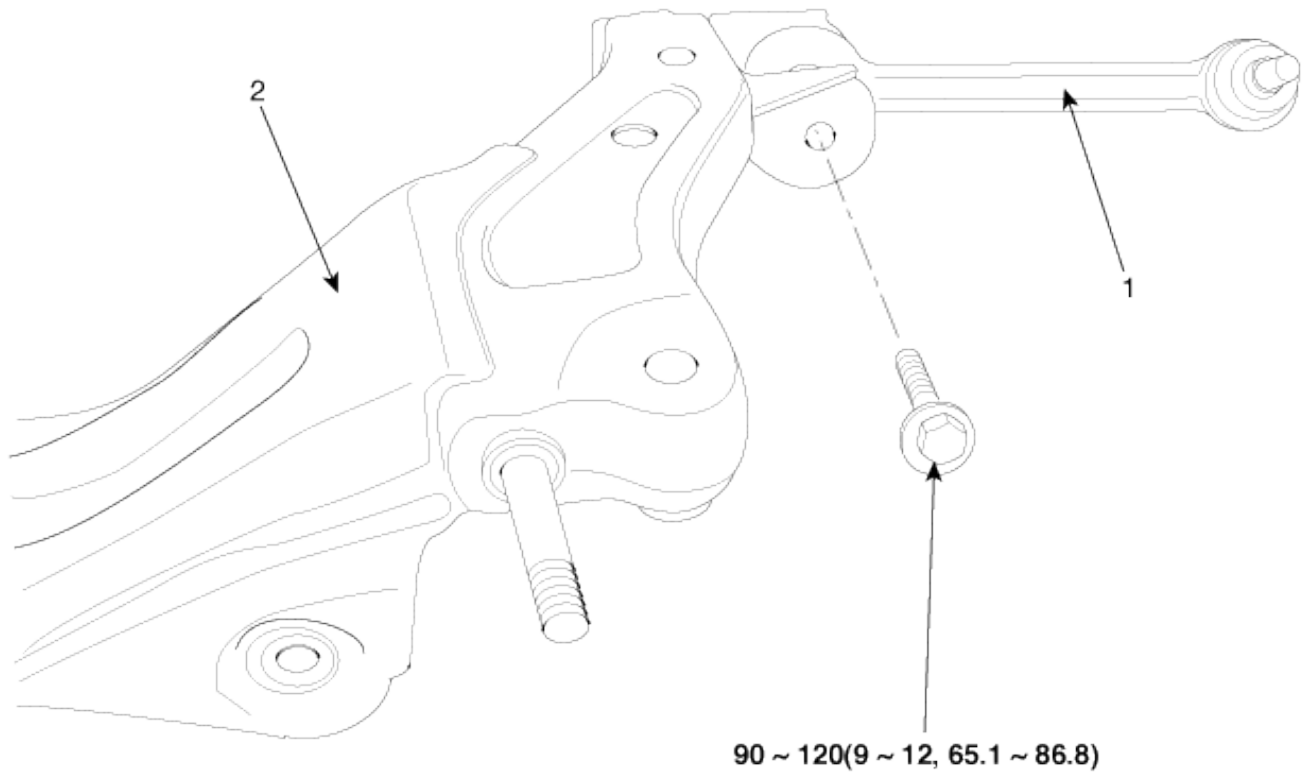
1. Check the spring for distortion, aging or damage.
2. Check the spring upper pad for aging or damage.



Suspension System

Rear Suspension System - Rear Assist Arm

COMPONENTS



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

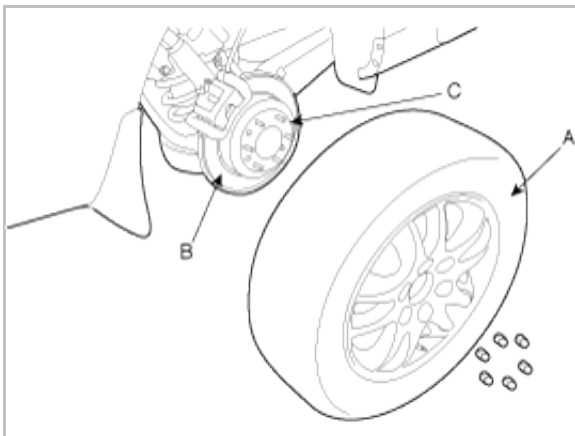
1. Rear assist arm

2. Rear cross member



REMOVAL

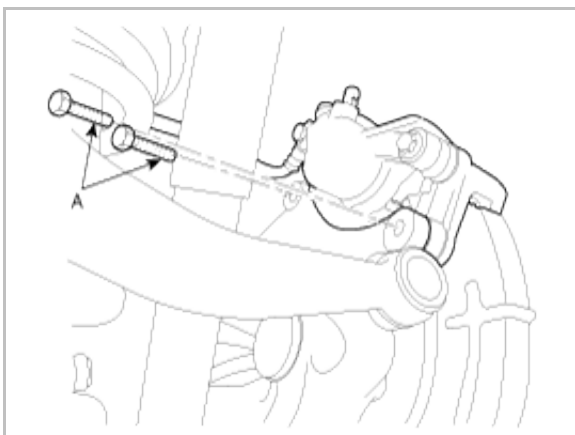
1. Loosen the wheel nuts slightly. Raise the rear of the vehicle, and make sure it is securely supported.
2. Remove the rear wheel and tire (A) from rear hub (B).



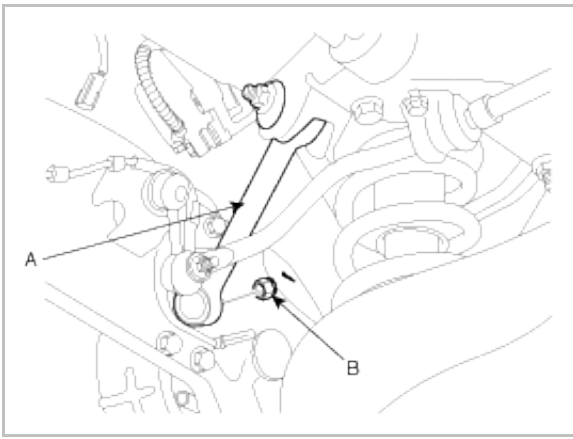
CAUTION

Be careful not to damage the hub bolts (C) when removing the rear wheel and tire (A).

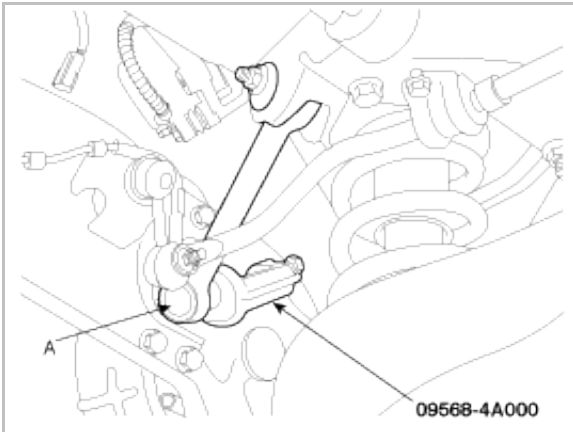
3. Remove the brake caliper mounting bolts (A), and then place the brake caliper assembly (B) with wire as shown in the illustration.



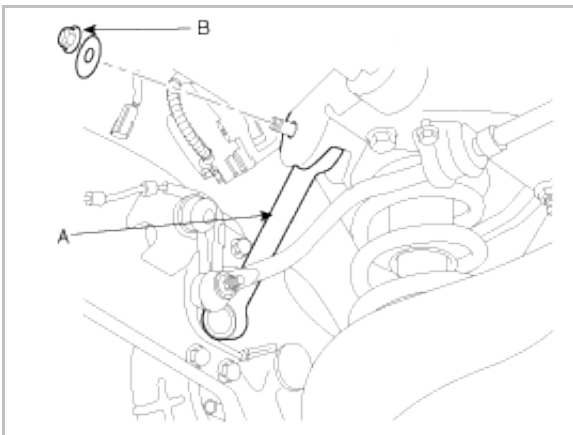
4. Remove the rear assist arm (A) ball joint self-locking nut (B) and the cotter pin.



5. Remove the rear assist arm ball joint (A) by using the special tool(09568-4A000).



6. Remove the rear assist arm (A) mounting nut (B) from the cross member.

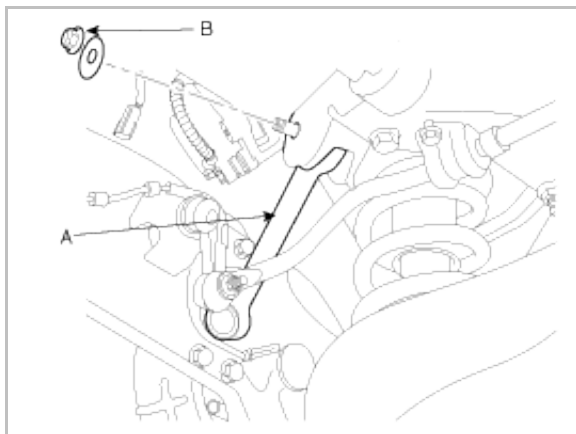


INSTALLATION

1. Install the rear assist arm (A) mounting nut (B) to the cross member.

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

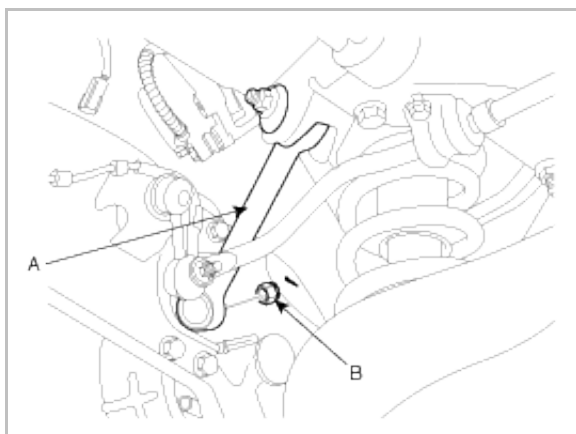
90 ~ 120 (9 ~ 12, 65.1 ~ 86.8)



2. Install the rear assist arm (A) ball joint self-locking nut (B) and the cotter pin.

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

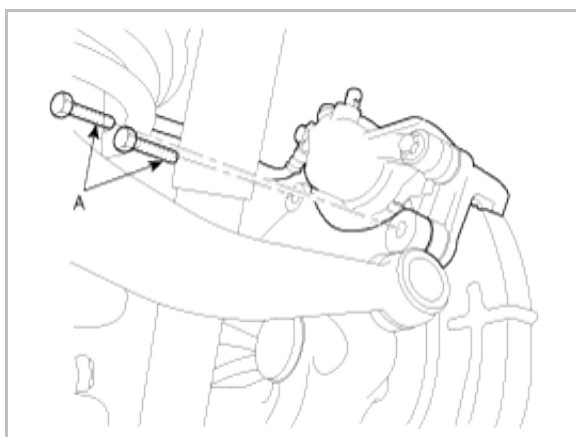
160 ~ 180 (16 ~ 18, 115.7 ~ 130.2)



3. Install the brake caliper mounting bolts (A).

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

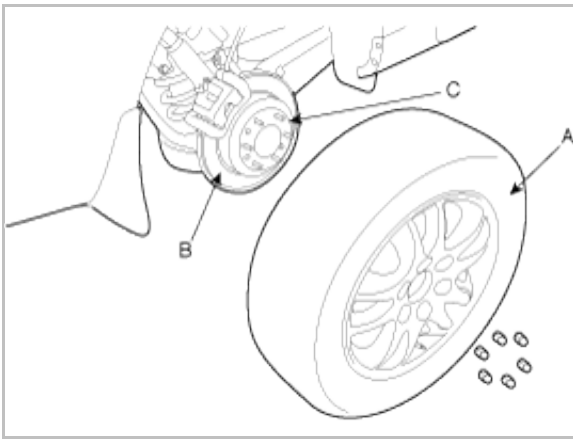
50 ~ 60 (5.0 ~ 6.0, 36.2 ~ 43.4)



4. Install the wheel and the tire (A) to the rear hub (B).

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

90 ~ 110 (9 ~ 11, 65.1 ~ 79.5)



CAUTION

Be careful not to damage the hub bolts (C) when installing the rear wheel and tire (A).

INSPECTION

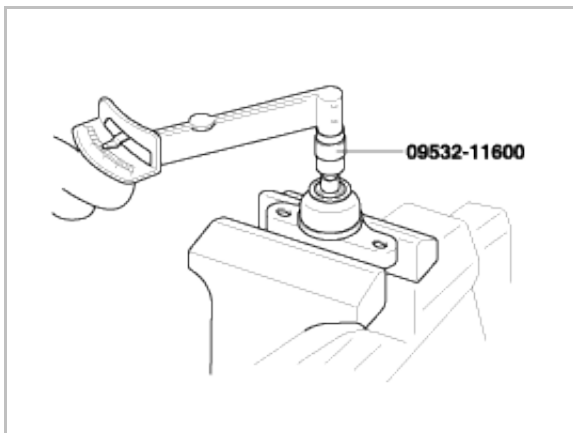
1. Check the bushing for wear and deterioration.
2. Check the upper arm for bending or breakage.
3. Check the ball joint for rotating torque.
 - (1) If there is a crack in the dust cover, replace it and add grease.
 - (2) Move the stabilizer link ball joint stud several times in a circular motion.
 - (3) Mount the self-locking nut on the ball joint, and then measure the ball joint rotating torque.

Specified torque :

1 ~ 3 Nm (10 ~ 30 kgf.cm, 0.72 ~ 2.17 lb-ft)

NOTICE

Measure a torque by using the special tool(09532-11600) and torque wrench, at the range of 0.5-2 rpm after moving the ball joint stud 10 times at room temperature.

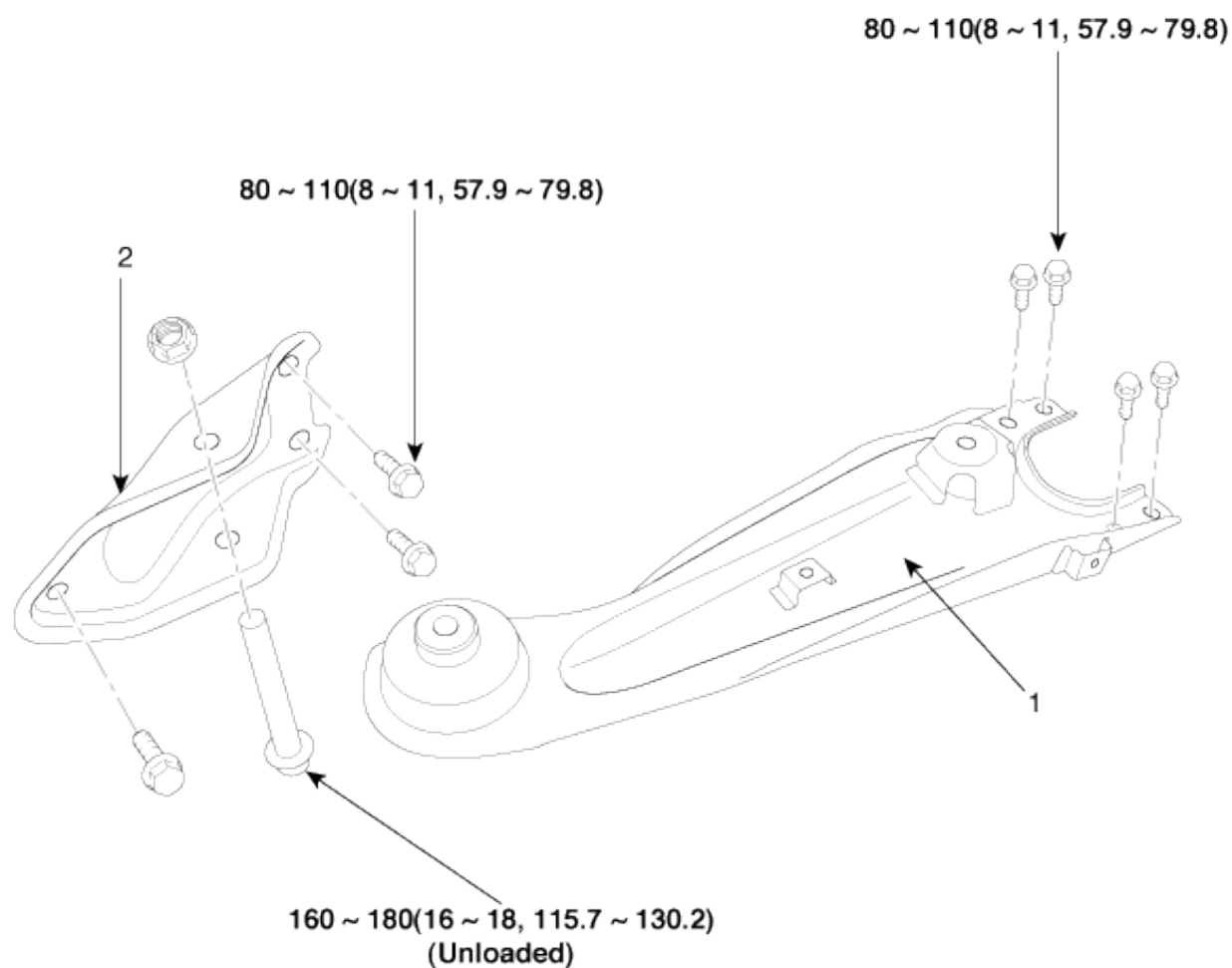


- (4) If the rotating torque exceeds the upper limit of standard value, replace the upper arm assembly.
- (5) Even if the rotating torque is below the lower limit of the standard value, the ball joint may be reused unless it has drag and excessive play.



Suspension System

Trailing Arm

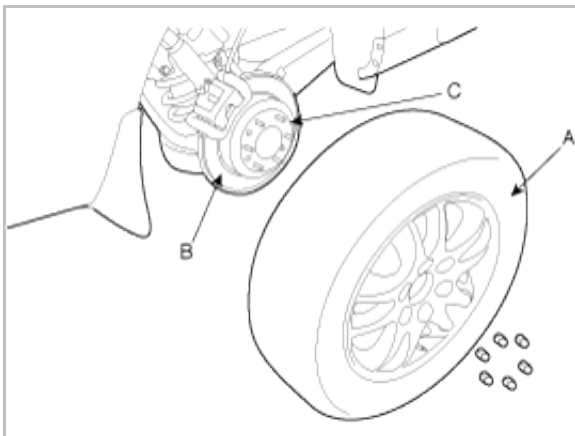
COMPONENTS**TORQUE : Nm (kgf.m, lb-ft)**

- 1. Trailing arm
- 2. Bracket



REMOVAL

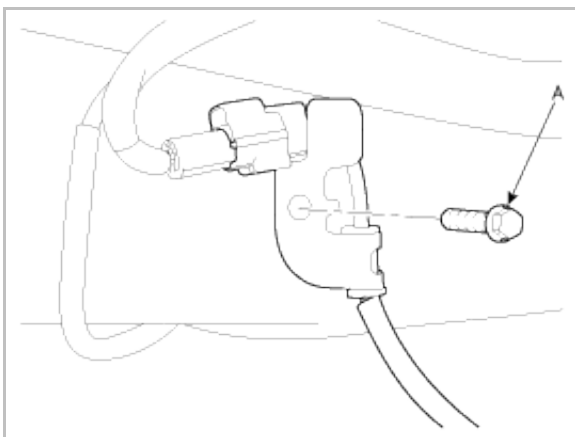
1. Loosen the wheel nuts slightly. Raise the rear of the vehicle, and make sure it is securely supported.
2. Remove the rear wheel and tire (A) from rear hub (B).



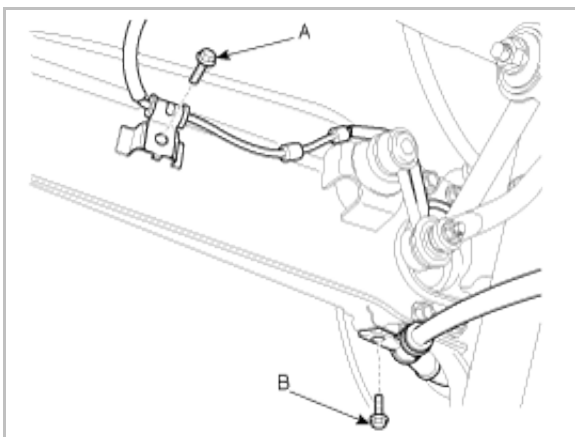
CAUTION

Be careful not to damage the hub bolts (C) when removing the rear wheel and tire (A).

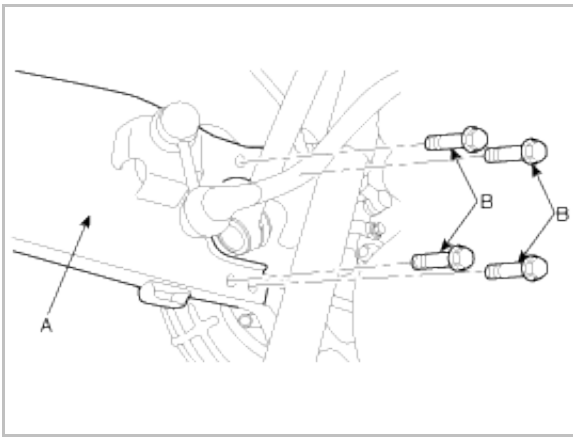
3. Remove the wheel speed sensor wire's bracket bolt (A) from the body and the connector.



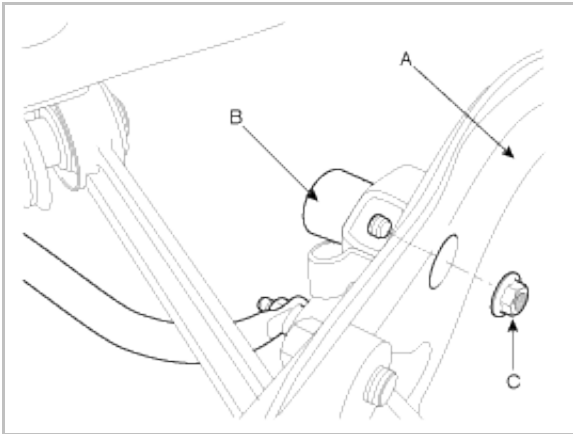
4. Remove the wheel speed sensor wire's bracket bolt (A) and the parking brake wire's bracket bolt (B).



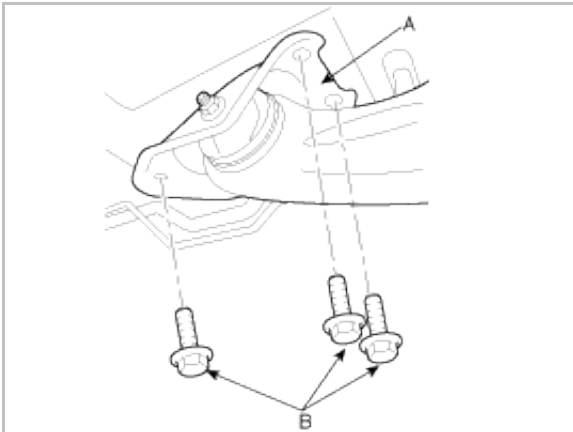
5. Remove the trailing arm (A) mounting nuts (B) from the knuckle.



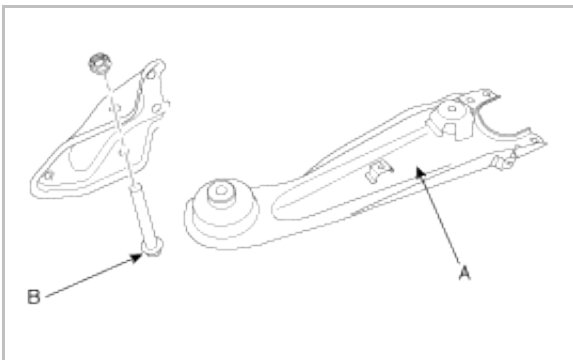
6. Remove the stabilizer link (B) nut (C) from the trailing arm (A).



7. Remove the trailing arm bracket (A) mounting bolts (B) from the body.



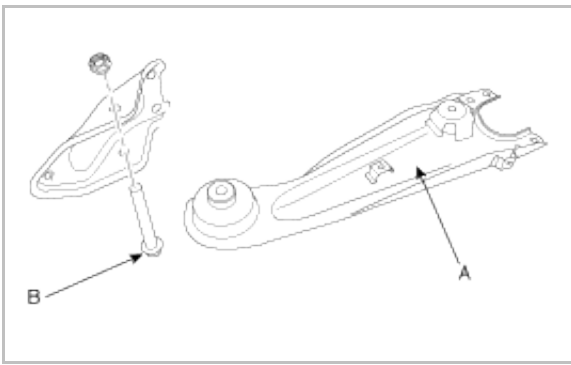
8. Remove the connecting bolt (B) between the trailing arm (A) and the bracket.



INSTALLATION

1. Install the connecting bolt (B) between the trailing arm (A) and the bracket.

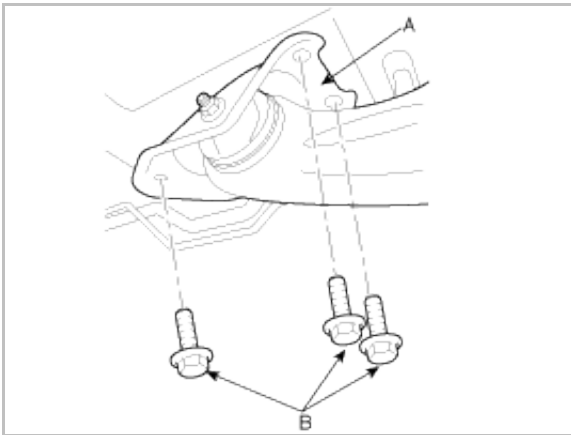
Tightening torque Nm (kgf.m, lb-ft) :
 160 ~ 180 (16 ~ 18, 115.7 ~ 130.2)



2. Install the trailing arm bracket (A) mounting bolts (B) from the body.

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

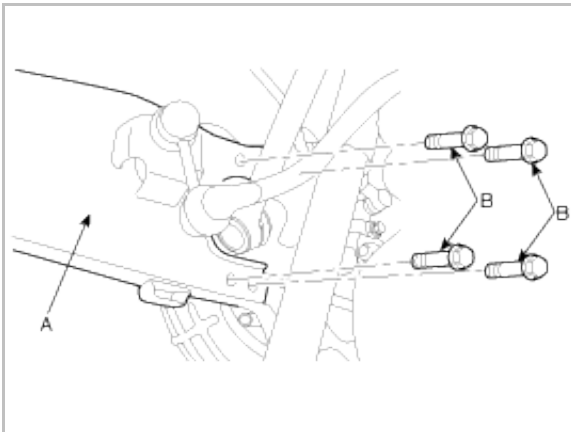
80 ~ 110 (8 ~ 11, 57.9 ~ 79.5)



3. Install the trailing arm (A) mounting nuts (B) from the knuckle.

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

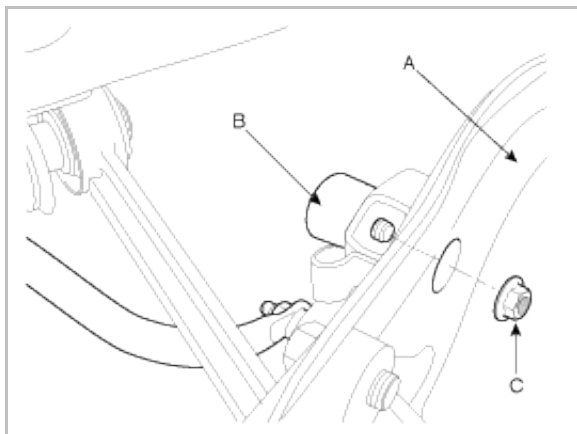
80 ~ 100 (8 ~ 10, 57.9 ~ 72.3)



4. Install the stabilizer link (B) nut (C) to the trailing arm (A).

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

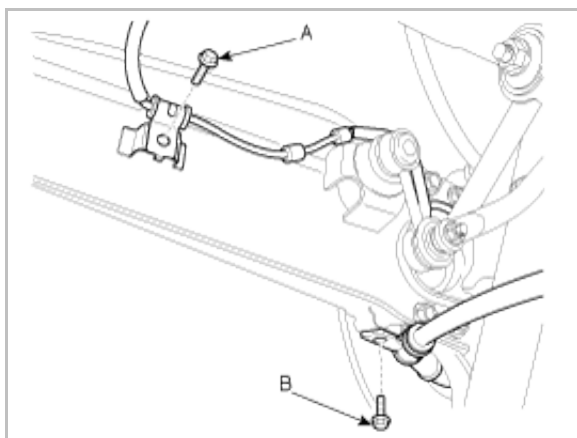
50 ~ 65 (5.0 ~ 6.5, 36.2 ~ 47.0)



5. Remove the wheel speed sensor wire's bracket bolt (A) and the parking brake wire's bracket bolt (B).

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

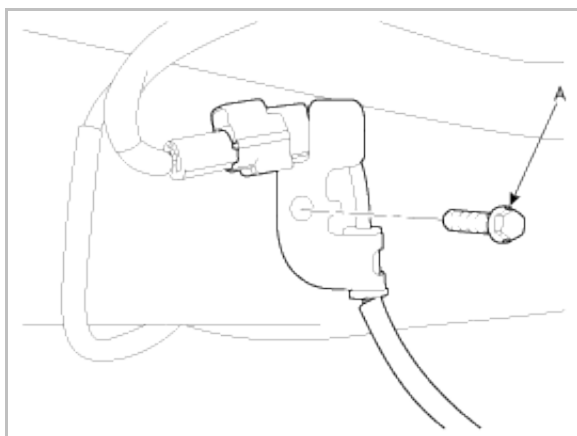
7 ~ 11 (0.7 ~ 1.1, 5.1 ~ 8.0)



6. Install the wheel speed sensor wire's bracket bolt (A) from the body and the connector.

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

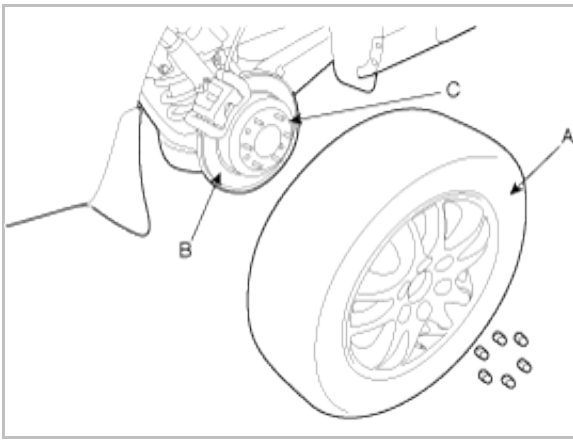
7 ~ 11 (0.7 ~ 1.1, 5.1 ~ 8.0)



7. Install the wheel and the tire (A) to the rear hub (B).

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

90 ~ 110 (9 ~ 11, 65.1 ~ 79.5)



CAUTION

Be careful not to damage the hub bolts (C) when installing the rear wheel and tire (A).

INSPECTION

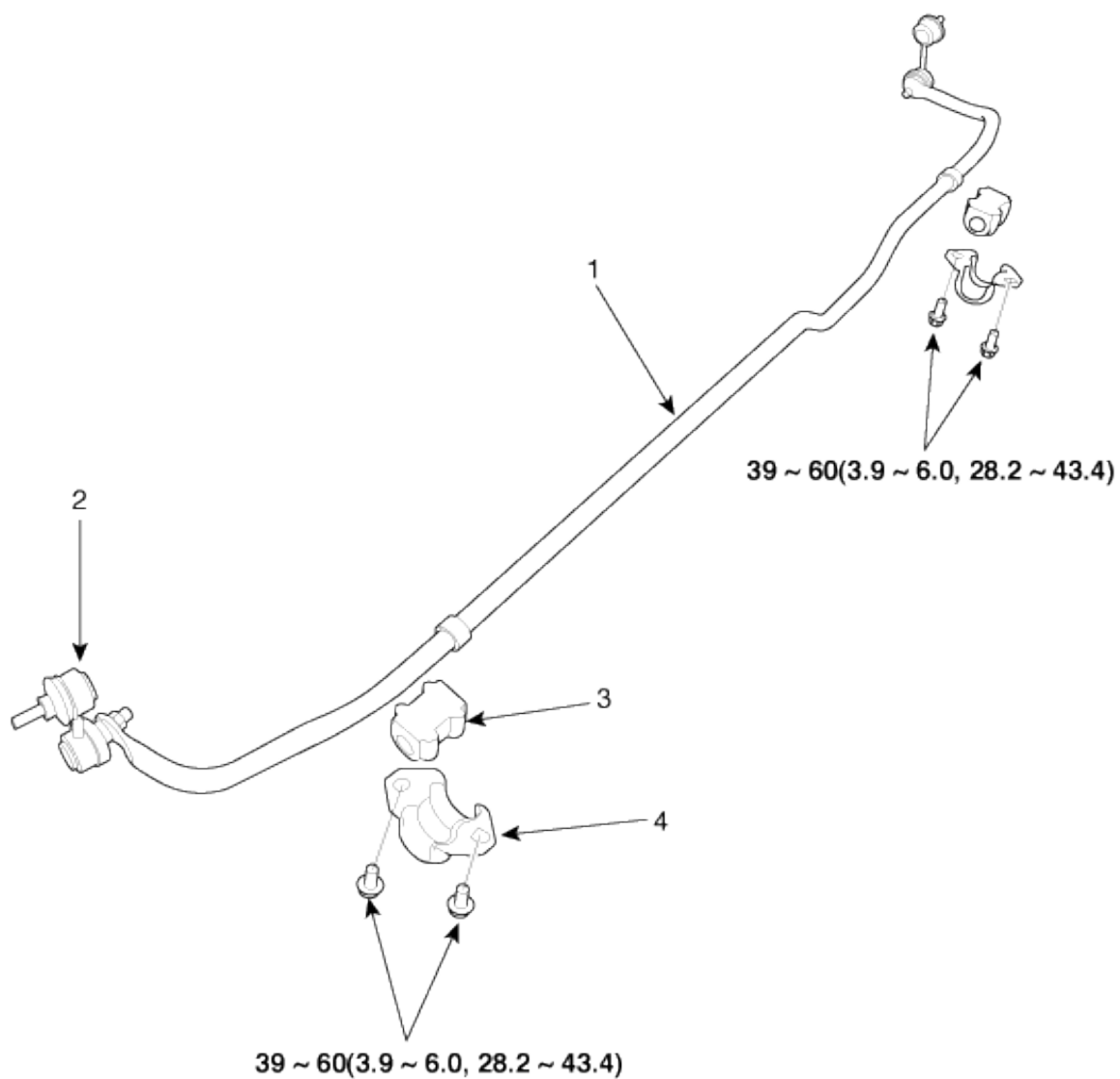
1. Check the bushing for wear and deterioration.
2. Check the trailing arm for bending or breakage.
3. Check all the bolts for damage.



Suspension System

Rear Suspension System - Rear Stabilizer
Bar

COMPONENTS



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

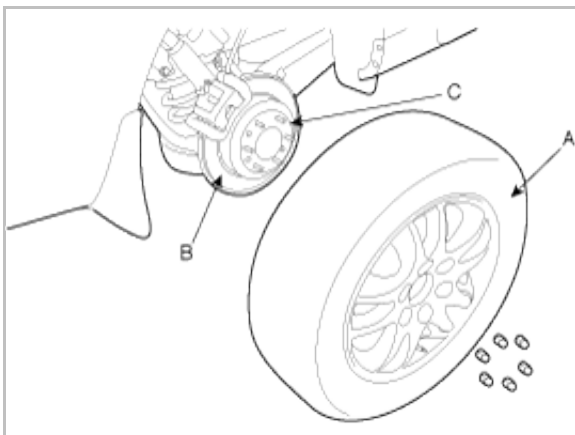
- 1. Rear stabilizer bar
- 2. Rear stabilizer link

- 3. Bushing
- 4. Bracket



REMOVAL

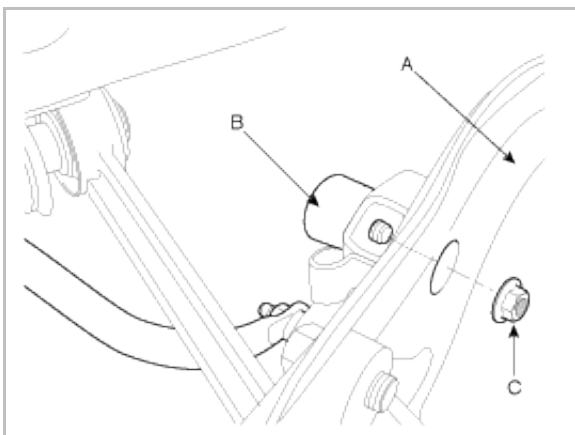
1. Loosen the wheel nuts slightly.
Raise the rear of the vehicle, and make sure it is securely supported.
2. Remove the rear wheel and tire (A) from rear hub (B).



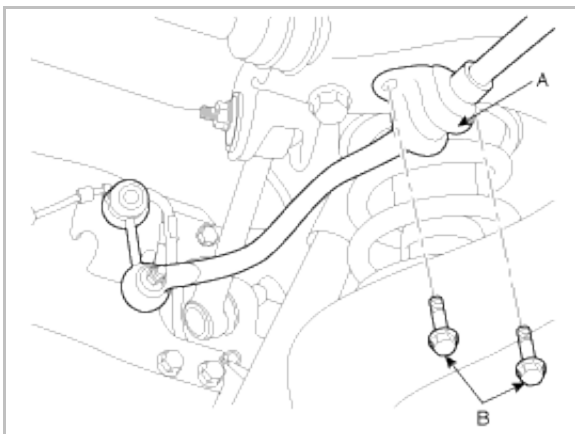
CAUTION

Be careful not to damage the hub bolts (C) when removing the rear wheel and tire (A).

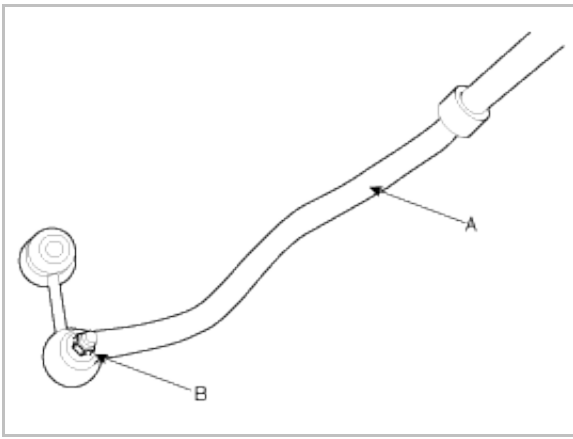
3. Remove the left/right nuts (C) of the rear stabilizer links (B) from the trailing arm (A).



4. Remove the left/right mounting nuts (B) of the rear stabilizer bar brackets (A).



5. Remove the rear stabilizer link (A) nut (B) from the stabilizer bar assembly.

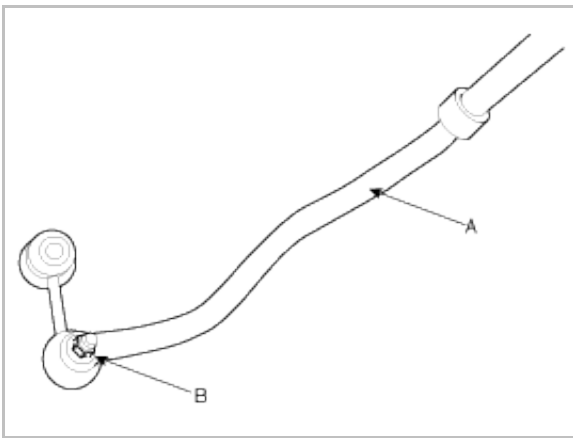


INSTALLATION

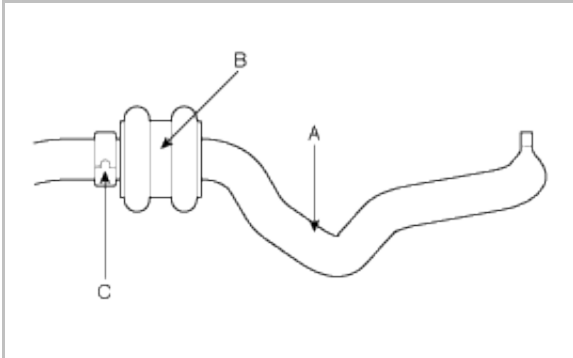
1. Install the rear stabilizer link (A) nut (B) to the stabilizer bar assembly.

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

50 ~ 65 (5.0 ~ 6.5, 36.2 ~ 47.0)



2. Install the bushing (B) on the stabilizer bar (A).



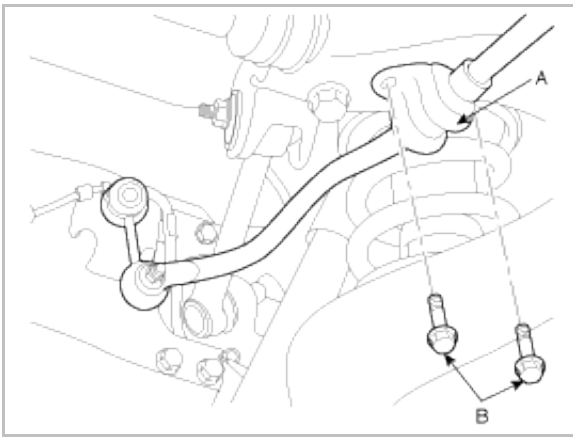
NOTICE

Bring clamp (C) of stabilizer bar (A) into contact with bushing (B).

3. One side bracket should be temporarily tightened, and then install the bushing on the opposite side.
4. Install the stabilizer bracket (A) bolt (B) to the cross member.

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

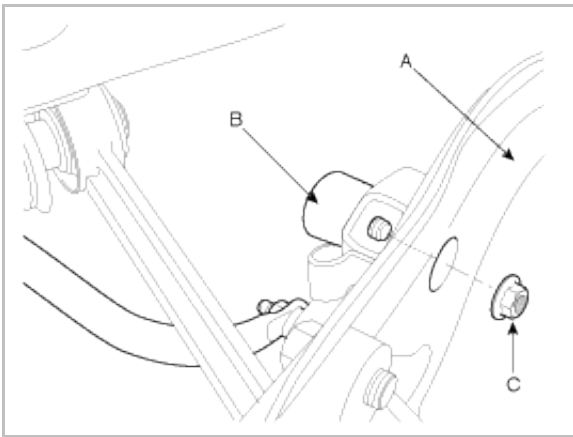
39 ~ 60 (3.9 ~ 6.0, 28.2 ~ 43.4)



5. Install the stabilizer link (B) nut (C) to the trailing arm (A).

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

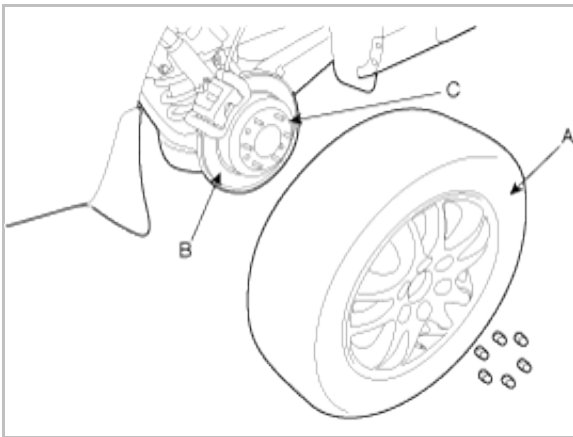
50 ~ 65 (5.0 ~ 6.5, 36.2 ~ 47.0)



6. Repeat step 4 and 5 for the other side.
7. Install the wheel and the tire (A) to the rear hub (B).

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

90 ~ 110 (9 ~ 11, 65.1 ~ 79.5)



CAUTION

Be careful not to damage the hub bolts (C) when installing the rear wheel and tire (A).

INSPECTION

1. Check the bushing for wear and deterioration.
2. Check the stabilizer bar for bending or breakage.

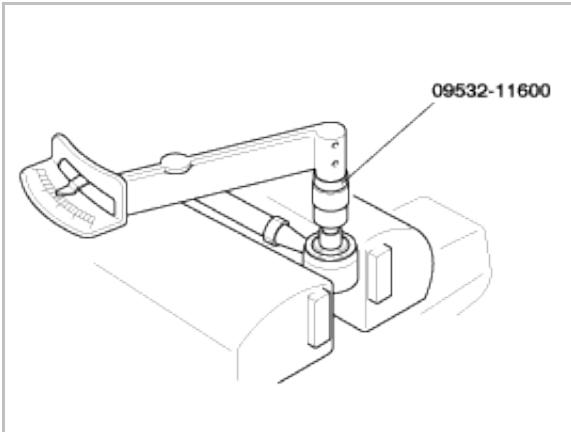
3. Check the ball joint for rotating torque.
 - (1) If there is a crack in the dust cover, replace it and add grease.
 - (2) Shake the stabilizer link ball joint stud several times.
 - (3) Mount the self-locking nut on the ball joint, and then measure the ball joint rotating torque.

Specified torque :

0.5 ~ 2.5 Nm (5 ~ 25 kgf.m, 3.62 ~ 1.81 lb-ft)

NOTICE

Measure torque using the special tool(09532-11600) and torque wrench at the range of 0.5 - 2 rpm after moving the ball joint stud 10 times at room temperature.



- (4) If the rotating torque exceeds the upper limit of standard value, replace the upper arm assembly.
- (5) Even if the rotating torque is below the lower limit of the standard value, the ball joint may be reused unless it has drag and excessive play.



Suspension System

Tires/Wheels - Tires



TIRE WEAR

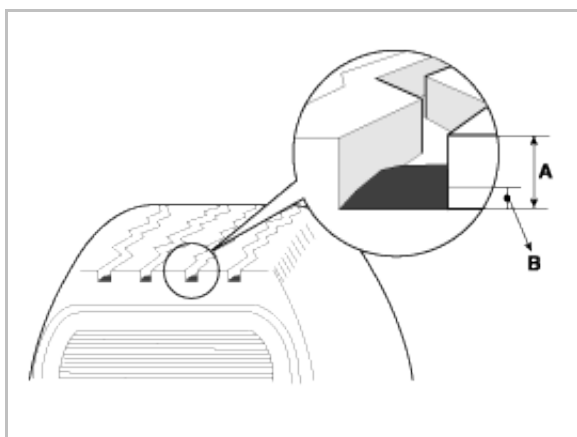
1. Measure the tread depth of the tires.

Tread depth [limit] : 1.6 mm (0.063 in)

2. If the remaining tread(A) depth is less than the limit, replace the tire.

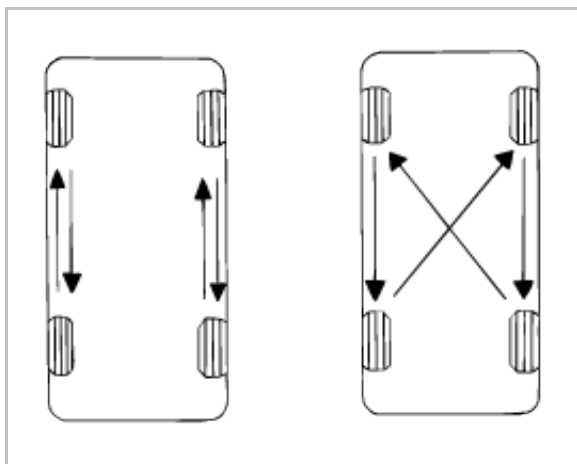
NOTICE

When the tread depth of the tires is less than 1.6 mm (0.063 in), the wear indicators(B) will appear.



TIRE ROTATION

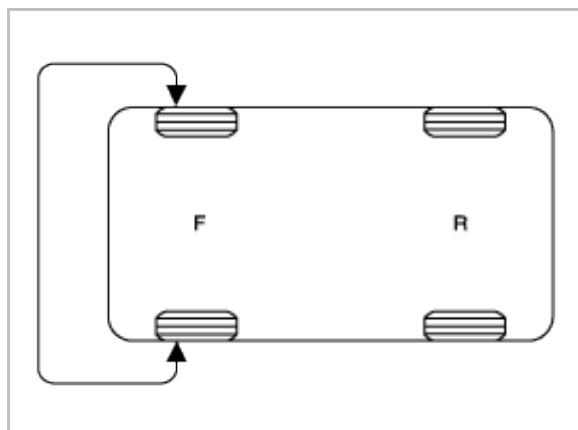
Rotate the tires in the pattern illustrated.



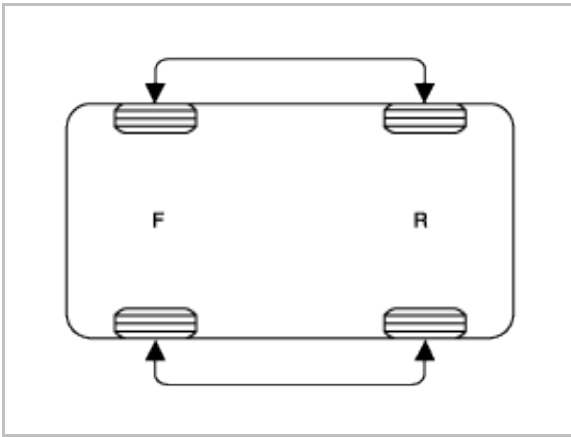
CHECKING FOR PULL AND WANDER

If the steering pulls to one side, rotate the tires according to the following wheel rotation procedure.

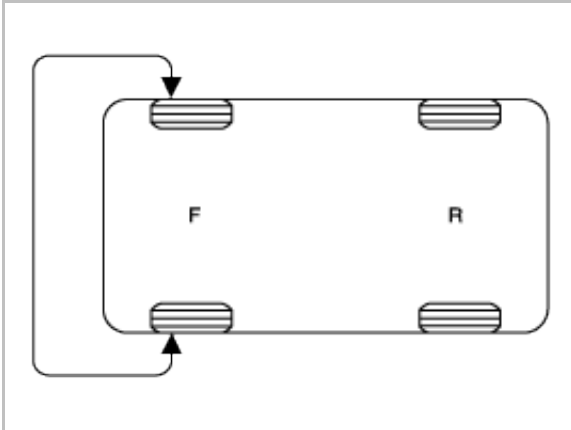
1. Rotate the front right and front left tires, and perform a road test in order to confirm vehicle stability.



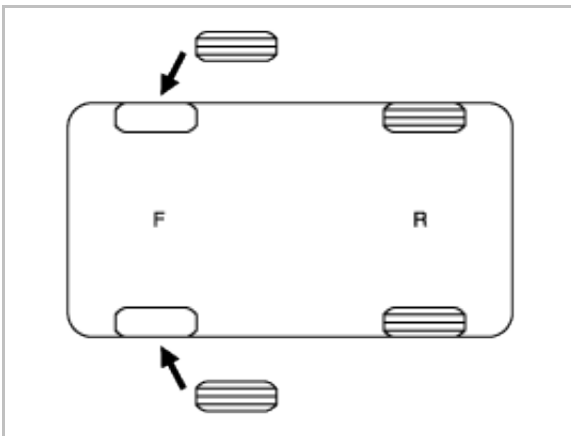
2. If the steering pulls to the opposite side, rotate the front and rear tires, and perform a road test again.



3. If the steering continues to pull to one side, rotate the front right and left tires again, and perform a road test.



4. If the steering continues to pull to the opposite side, replace the front wheels with new ones.



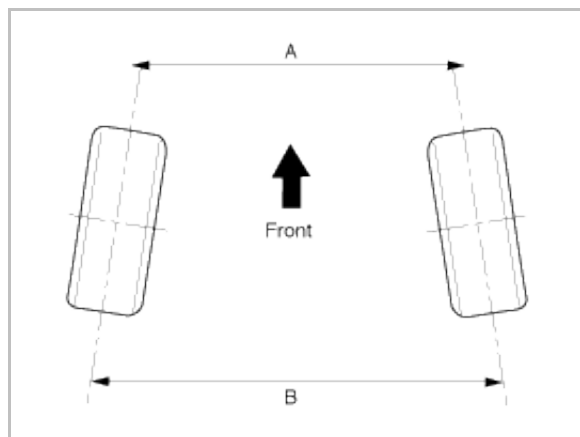


WHEEL ALIGNMENT

When using commercially available computerized four wheel alignment equipment (caster, camber, toe) to inspect the front wheel alignment, always position the car on a level surface with the front wheels facing straight ahead. Prior to inspection, make sure that the front suspension and steering system are in normal operating condition and that the wheels and tires face straight ahead and the tires are inflated to the specified pressure.

TOE

Toe is a measurement of how much the front of the wheels are turned in or out from the straight-ahead position.



Item	Description
$A - B < 0$	Positive (+) toe (toe in)
$A - B > 0$	Negative (-) toe (toe out)

When the wheels are turned in toward the front of the vehicle, toe is positive (+) (toe in). When the wheels are turned out toward the front of the vehicle, toe is negative(-) (toe out). Toe is measured in degrees, from side to side, and totaled.

[FRONT]

Toe-in(B-A or angle a+b) is adjusted by turning the tie rod turnbuckles. Toe-in on the left front wheel can be reduced by turning the tie rod toward the rear of the car. Toe- in change is adjusted by turning the tie rods for the right and left heels simultaneously at the same amount as follows.

Standard value :

Toe-in

Total : $0^\circ \pm 0.2^\circ$

Individual : $0^\circ \pm 0.1^\circ$

NOTICE

- Toe-in adjustment should be made by turning the right and left tie rods at the same amount.
- When adjusting toe-in, loosen the outer bellows clip to prevent twisting the bellows.
- After the adjustment, tighten the tie rod end lock nuts firmly and reinstall the bellows clip.
- Adjust each toe-in to be the range of $\pm 0.1^\circ$.

Tie rod(A) Specified torque Nm (kgf.m, lb-ft) :

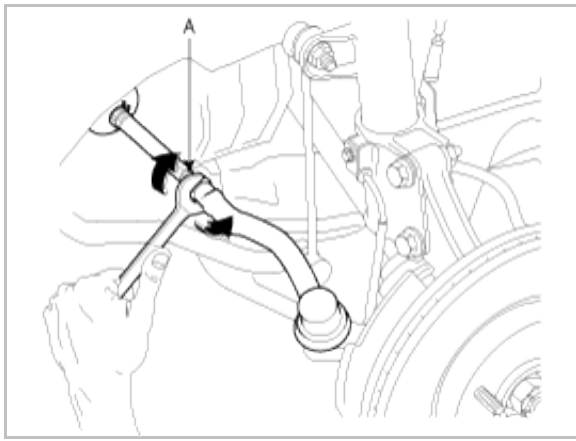
70 ~ 80 (7 ~ 8, 50.6 ~ 57.8)

Standard value :

Toe-in

Total : $0^\circ \pm 0.2^\circ$

Individual : $0^\circ \pm 0.1^\circ$



[REAR]

Standard value :

Toe-in

Total : $0.26^{\circ} \pm 0.2^{\circ}$

Individual : $0.17^{\circ} \pm 0.1^{\circ}$

Adjust the toe-in by turning the cambolt of the assist arm.

Left cambolt : Clockwise → toe-in

Right cambolt : Clockwise → toe-out

The variation of toe by a rotation of the cambolt :

About 0.3°

Standard value :

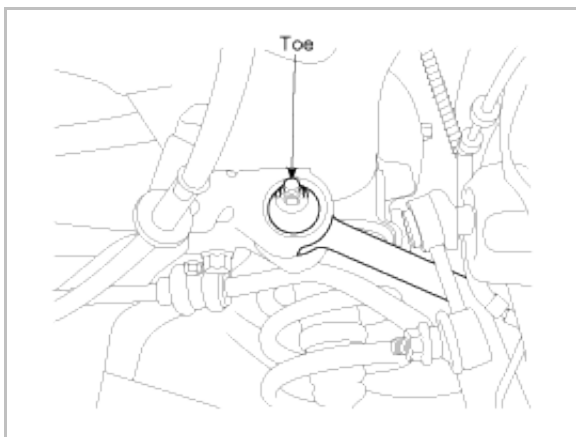
Toe-in

Total : $0.26^{\circ} \pm 0.2^{\circ}$

Individual : $0.17^{\circ} \pm 0.1^{\circ}$

CAUTION

- Each toe should be within $\pm 0.1^{\circ}$.
If the difference between right and left is not within $\pm 0.2^{\circ}$, repeat adjustment.
- After adjusting the cambolt, tighten the nut to the specified torque.



Specified torque

90 ~ 120 Nm (9 ~ 12 kgf.m, 65.1 ~ 86.8 lb-ft)

Standard value :

Toe-in

Total : $0.26^{\circ} \pm 0.2^{\circ}$

Individual : $0.17^{\circ} \pm 0.1^{\circ}$

Left cambolt : Clockwise → toe-in

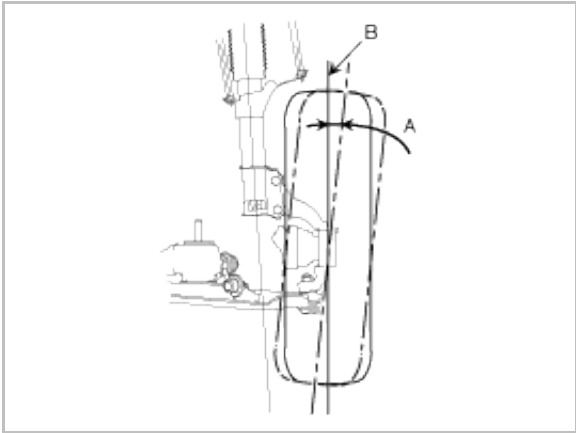
Right cambolt : Clockwise → toe-out

The variation of toe by a rotation of the cambolt :
About 0.3°

CAMBER

[FRONT]

Camber is the inward or outward tilting of the wheels at the top.



Item	Description
A	Positive camber angle
B	True vertical

When the wheel tilts out at the top, then the camber is positive (+).
When the wheel tilts in at the top, then the camber is negative(-).

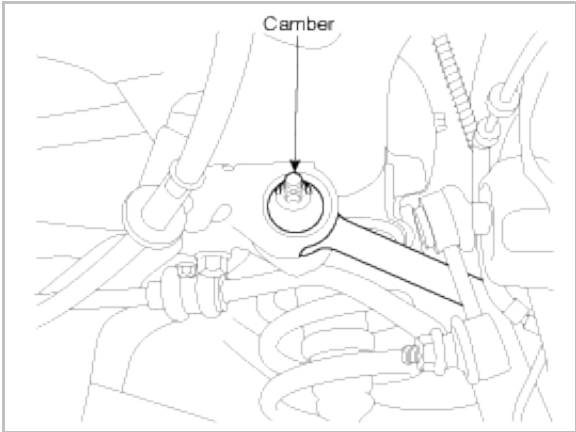
Standard value : 0°±0.5°
Difference between right and left angle is within 0.5°

NOTICE

Camber is pre-set at the factory and doesn't need to be adjusted. If the camber is not within the standard value, replace the bent or damaged parts.

[REAR]

Standard value : 0.1°±0.5°
Difference between right and left angle is within 0.5°



Adjust the camber by turning the cambolt of the rear upper arm.

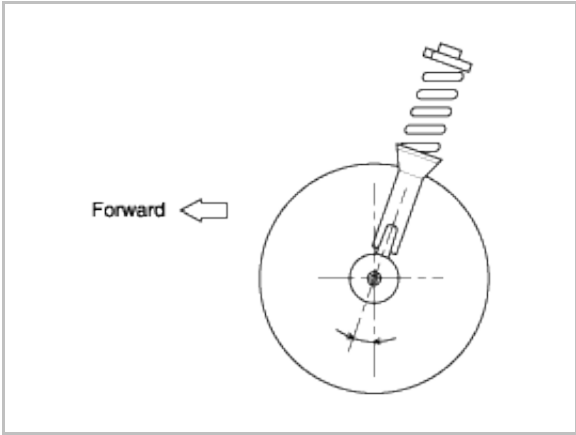
Left cambolt : Clockwise → camber(-)
Right cambolt : Clockwise →camber(+)

The variation of camber by a rotation of the cambolt :
About 0.9°

CASTER

Caster is the tilting of the strut axis either forward or backward from vertical. A backward tilt is positive (+) and a forward tilt is negative (-).
Caster is pre-set at the factory and doesn't need to be adjusted. If the caster is not within the standard value, replace the bent or damaged parts.

Caster : 3.77°±0.5°



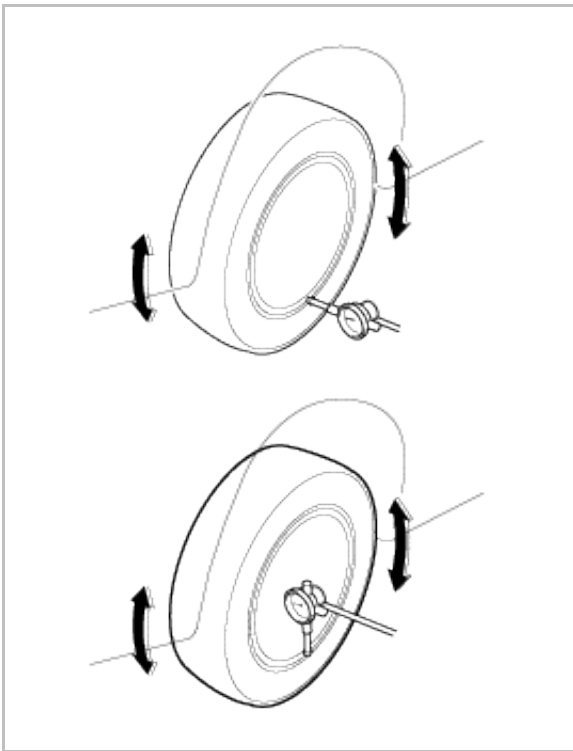
NOTICE

- The worn loose or damaged parts of the front suspension assembly must be replaced prior to measuring front wheel alignment.
- Caster are pre-set to the specified value at the factory and don't need to be adjusted.
- If the caster are not within specifications, replace bent or damaged parts.
- The difference of left and right wheels about the the caster must be within the range of 0±0.5°.

WHEEL RUNOUT

1. Jack up the vehicle and support it with jack stands.
2. Measure the wheel runout with a dial indicator as illustrated.
3. Replace the wheel if the wheel runout exceeds the limit.

Limit		Radial	Axial
Runout mm(in)	Steel	0.7(0.028)	1.1(0.043)
	Aluminium	0.3(0.012)	0.3(0.012)



WHEEL NUT TIGHTENING

1. Tightening torque.

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

90 ~ 110 (9 ~11, 65.1 ~ 79.5)

CAUTION

When using an impact gun, final tightening torque should be checked using a torque wrench.

2. Tightening order.

Check the torque again after tightening the wheel nuts diagonally.

