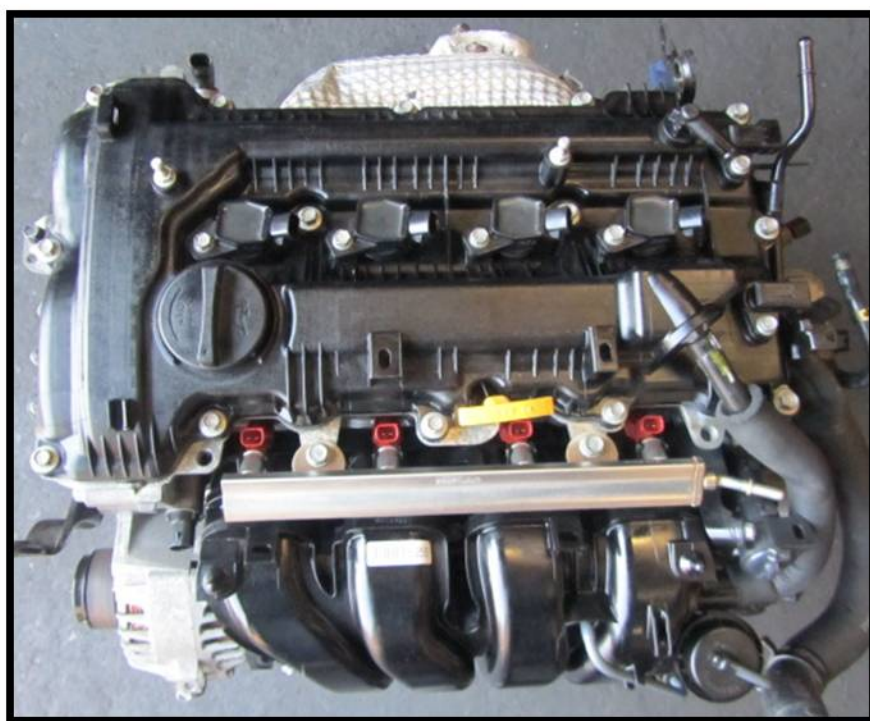


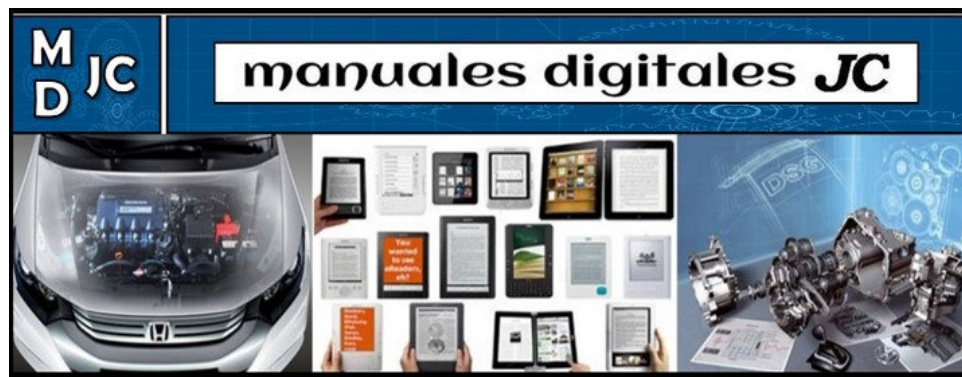


**G4NA
NU 2.0 L / MPI**



Mechanical Repair and Engine Control / Fuel System





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SOUL(AM) > 2013 > G 2.0 DOHC > Engine Mechanical System

Engine Mechanical System > General Information > Specifications - Revised

Specifications

Description		Specifications	Limit
General			
Type		In-line, DOHC	
Number of cylinders		4	
Bore		81.0 mm (3.1890 in.)	
Stroke		97.0 mm (3.8189 in.)	
Total displacement		1999 cc (121.99 cu.in.)	
Compression ratio		10.3±0.2 : 1	
Firing order		1-3-4-2	
Valve timing			
Intake valve	Open	ATDC 10° ~ BTDC 40°	
	Close	ABDC 67° ~ ABDC 17°	
Exhaust valve	Open	BBDC 68° ~ BBDC 28°	
	Close	ATDC 1° ~ ATDC 41°	
Camshaft			
Cam height	Intake	39.0 mm (1.5354 in.)	
	Exhaust	39.0 mm (1.5354 in.)	
Journal outer diameter	Intake	No.1: 35.959 ~ 35.975 mm (1.41571 ~ 1.41634 in.)	
		No.2,3,4,5: 22.959 ~ 22.975 mm (0.90390 ~ 0.90453 in.)	
	Exhaust	No.1: 35.959 ~ 35.975 mm (1.41571 ~ 1.41634 in.)	
		No.2,3,4,5: 22.959 ~ 22.975 mm (0.90390 ~ 0.90453 in.)	
Bearing oil clearance	Intake	No.1: 0.032 ~ 0.062 mm (0.00126 ~ 0.00244 in.)	
		No.2,3,4,5: 0.032 ~ 0.062 mm (0.00126 ~ 0.00244 in.)	
	Exhaust	No.1: 0.032 ~ 0.062 mm (0.00126 ~ 0.00244 in.)	
		No.2,3,4,5: 0.032 ~ 0.062 mm (0.00126 ~ 0.00244 in.)	
End play		0.10 ~ 0.19 mm (0.0039 ~ 0.0075 in.)	

Valve			
Valve length	Intake	102.22 mm (4.0244 in.)	101.97 mm (4.0146 in.)
	Exhaust	104.04 mm (4.0961 in.)	103.79 mm (4.0862 in.)
Stem outer diameter	Intake	5.465 ~ 5.480 mm (0.21516 ~ 0.21575 in.)	
	Exhaust	5.458 ~ 5.470 mm (0.21488 ~ 0.21535 in.)	
Face angle		45.25° ~ 45.75°	
Thickness of valve head (margin)	Intake	1.30 mm (0.0512 in.)	
	Exhaust	1.26 mm (0.0496 in.)	
Valve stem to valve guide clearance	Intake	0.020 ~ 0.047 mm (0.00079 ~ 0.00185 in.)	
	Exhaust	0.030 ~ 0.054 mm (0.00118 ~ 0.00213 in.)	
Valve guide			
Length	Intake	43.8 ~ 44.2 mm (1.7244 ~ 1.7402 in.)	
	Exhaust	43.8 ~ 44.2 mm (1.7244 ~ 1.7402 in.)	
Inner diameter	Intake	5.500 ~ 5.512 mm (0.21654 ~ 0.21701 in.)	
	Exhaust	5.500 ~ 5.512 mm (0.21654 ~ 0.21701 in.)	
Valve seat			
Width of seat contact	Intake	1.05 ~ 1.35 mm (0.0413 ~ 0.0532 in.)	
	Exhaust	1.35 ~ 1.65 mm (0.0532 ~ 0.0650 in.)	
Seat angle	Intake	44° 45' ~ 45° 6'	
	Exhaust	44° 45' ~ 45° 6'	
Valve spring			
Free length		45.93 mm (1.8083 in.)	
Load	19.6 ± 1.0 kg / 37.0 mm (43.21 ± 2.20 lb / 1.4567 in.)		
	45.7 ± 1.8 kg / 27.0 mm (100.75 ± 3.97 lb / 1.0630 in.)		
Out of squareness		Less than 1.5°	
Cylinder head			
		Less than 0.05 mm (0.0020 in.) for total area	

Flatness of gasket surface		Less than 0.02 mm (0.0008 in.) for a section of 100 mm (3.9370 in.) × 100 mm (3.9370 in.)	
Flatness of manifold mounting surface	Intake	Less than 0.10 mm (0.0039 in.)	
	Exhaust	Less than 0.10 mm (0.0039 in.)	
Piston			
Piston outer diameter		80.97 ~ 81.00 mm (3.1878 ~ 3.1890 in.)	
Piston to cylinder clearance		0.02 ~ 0.04 mm (0.0008 ~ 0.0016 in.)	
Ring groove width	No. 1 ring	1.030 ~ 1.050 mm (0.04055 ~ 0.04134 in.)	
	No. 2 ring	1.230 ~ 1.250 mm (0.04843 ~ 0.04921 in.)	
	Oil ring	2.010 ~ 2.025 mm (0.07913 ~ 0.07972 in.)	
Piston ring			
Side clearance	No. 1 ring	0.040 ~ 0.080 mm (0.00157 ~ 0.00315 in.)	
	No. 2 ring	0.040 ~ 0.080 mm (0.00157 ~ 0.00315 in.)	
	Oil ring	0.060 ~ 0.135 mm (0.00236 ~ 0.00532 in.)	
End gap	No. 1 ring	0.15 ~ 0.30 mm (0.0059 ~ 0.0118 in.)	
	No. 2 ring	0.30 ~ 0.45 mm (0.0118 ~ 0.0177 in.)	
	Oil ring	0.20 ~ 0.70 mm (0.0079 ~ 0.0276 in.)	
Piston pin			
Piston pin outer diameter		19.996 ~ 20.000 mm (0.78724 ~ 0.78740 in.)	
Piston pin hole inner diameter		20.004 ~ 20.009 mm (0.78756 ~ 0.78775 in.)	
Piston pin hole clearance		0.004 ~ 0.013 mm (0.00016 ~ 0.00051 in.)	
Connecting rod small end hole inner diameter		20.010 ~ 20.021 mm (0.78779 ~ 0.78823 in.)	
Piston pin-to-connecting rod bushing oil clearance		0.010 ~ 0.025 mm (0.00039 ~ 0.00098 in.)	
Connecting rod			

Connecting rod big end inner diameter		48.000 ~ 48.018 mm (1.88976 ~ 1.89047 in.)	
Connecting rod bearing oil clearance		0.028 ~ 0.046 mm (0.00110 ~ 0.00181 in.)	
Side clearance		0.10 ~ 0.25 mm (0.0039 ~ 0.0098 in.)	
Crankshaft			
Main journal outer diameter		54.942 ~ 54.960 mm (2.16307 ~ 2.16378 in.)	
Pin journal outer diameter		44.954 ~ 44.972 mm (1.76984 ~ 1.77055 in.)	
Main bearing oil clearance		0.016 ~ 0.034 mm (0.00063 ~ 0.00134 in.)	
End play		0.07 ~ 0.25 mm (0.0028 ~ 0.0098 in.)	
Cylinder block			
Cylinder bore		81.00 ~ 81.03 mm (3.1890 ~ 3.1902 in.)	
Flatness of gasket surface		Less than 0.05 mm (0.0020 in.) for total area	
		Less than 0.02 mm (0.0008 in.) for a section of 100 mm (3.9370 in.) × 100 mm (3.9370 in.)	
Engine oil			
Oil quantity	Total	4.5 L (1.19 U.S.gal., 4.76 U.S.qt., 3.96 imp.qt.)	When replacing a short engine or block assembly
	Oil pan	3.7 L (0.98 U.S.gal., 3.91 U.S.qt., 3.26 imp.qt.)	
	Drain and refill	4.0 L (1.06 U.S.gal., 4.23 U.S.qt., 3.52 imp.qt.)	Including oil filter
Oil grade	Recommendation	5W-20/GF4&SM	If not available, refer to the recommended API or ILSAC classification and SAE viscosity number.
	Classification	API SL, SM or above ILSAC GF3, GF4 or above	Satisfy the requirement of the API or ILSAC classification.
	SAE viscosity grade	Recommended SAE viscosity number	Refer to the "Lubrication System".
Oil pressure (at 1,000rpm)		98.07 kPa (1.0 kgf/cm ² , 14.22 psi) or above	Oil temperature (oil pan): 110±2°C (230±35.6°F)
Oil Pump			

Relief valve opening pressure		415 ~ 485 kPa (4.23 ~ 4.95 kgf/cm ² , 60.16 ~ 70.41 psi)	
Side clearance		0.040 ~ 0.090 mm (0.00157 ~ 0.00354 in.)	
Body clearance		0.200 ~ 0.292 mm (0.00787 ~ 0.01150 in.)	
Guide clearance		0.030 ~ 0.075 mm (0.00118 ~ 0.00295 in.)	
Cooling system			
Cooling method		Forced circulation with cooling fan	
Coolant quantity		6.4 L (1.69 U.S.gal., 6.76 U.S.qt., 5.63 Imp.qt.)	
Thermostat	Type	Wax pellet type	
	Opening temperature	88±1.5°C (190.4±34.7°F)	
	Full opening valve lift / temperature	More than 8 mm (0.3 in.) / 100°C (212°F)	
Radiator cap	Main valve opening pressure	93.16 ~ 122.58 kPa (0.95 ~ 1.25 kgf/cm ² , 13.51 ~ 17.78 psi)	
	Vacuum valve opening pressure	0 ~ 6.86 kPa (0 ~ 0.07 kgf/cm ² , 0 ~ 1.00 psi)	

Tightening Torques

Item	Quantity	N.m	kgf.m	lb-ft
Engine mounting				
Engine mounting bracket to body fixing bolt	3	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Engine mounting support bracket to engine mounting insulator fixing nut	1	78.5 ~ 98.1	8.0 ~ 10.0	57.9 ~ 72.3
Engine mounting support bracket to engine support bracket fixing bolt	1	58.8 ~ 73.5	6.0 ~ 7.5	43.4 ~ 54.2
Engine mounting support bracket to engine support bracket fixing nut	2	58.8 ~ 73.5	6.0 ~ 7.5	43.4 ~ 54.2
Transaxle mounting bracket to body fixing bolt	2	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Transaxle mounting bracket to body fixing nut	1	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0

Transaxle mounting support bracket to transaxle	3	88.3 ~ 107.9	9.0 ~ 11.0	65.1 ~ 79.6
Roll rod bracket to sub frame fixing bolt	2	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Roll rod bracket to roll rod support bracket fixing bolt & nut	1	107.9 ~ 127.5	11.0 ~ 13.0	79.6 ~ 94.0
Timing system				
Crankshaft pulley bolt	1	196.1 ~ 205.9	20.0 ~ 21.0	144.7 ~ 151.9
Timing chain cover service plug bolt	1	29.4 ~ 39.2	3.0 ~ 4.0	21.7 ~ 28.9
Timing chain cover bolt (M10×55)	3	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Timing chain cover bolt (M10×85)	2	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Timing chain cover bolt - Seal bolt (M6×38)	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain cover bolt - Seal bolt (M8×50)	1	19.6 ~ 23.5	2.0 ~ 2.4	14.5 ~ 17.4
Timing chain cover bolt (M8×50)	11	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Timing chain cover bolt (M8×28)	5	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Timing chain tensioner bolt	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain tensioner arm bolt	1	18.6 ~ 22.6	1.9 ~ 2.3	13.7 ~ 16.6
Timing chain guide bolt	2	18.6 ~ 22.6	1.9 ~ 2.3	13.7 ~ 16.6
Cylinder head				
Engine cover mounting bolt	2	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Ignition coil bolt	4	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Cylinder head cover bolt	14	[3.9~5.9] + [7.8~9.8]	[0.4~0.6] + [0.8~1.0]	[2.9~4.3] + [5.8~7.2]
Injector & rail assembly bolt	2	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
CVVT bolt (LH/RH)	2	64.7 ~ 76.5	6.6 ~ 7.8	47.7 ~ 56.4
Camshaft bearing cap bolt (M6)	10	11.8 ~ 13.7	1.2 ~ 1.4	8.7 ~ 10.1
Camshaft bearing cap bolt (M8)	15	18.6 ~ 22.6	1.9 ~ 2.3	13.7 ~ 16.6
Cam carrier bolt	2	18.6 ~ 22.6	1.9 ~ 2.3	13.7 ~ 16.6
Cylinder head bolt	10	[32.4~36.3] + [90~95°] + [90~95°]	[3.3~3.7] + [90~95°] + [90~95°]	[23.9~26.8] + [90~95°] + [90~95°]
Engine hanger bolt (Front/Rear)	2	34.3 ~ 39.2	3.5 ~ 4.0	25.3 ~ 28.9
Camshaft position sensor (LH/RH)	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil control valve (OCV) bolt (LH/RH)	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Cylinder block				

Flywheel bolt (M/T)	7	117.7 ~ 127.5	12.0 ~ 13.0	86.8 ~ 93.9
Drive plate bolt (A/T)	7	117.7 ~ 127.5	12.0 ~ 13.0	86.8 ~ 93.9
Connecting rod bearing cap bolt	8	[17.7~21.6] + [88~92°]	[1.8~2.2] + [88~92°]	[13.0~15.9] + [88~92°]
Lower crankcase bolt	11	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Main bearing cap bolt	10	[27.5~31.4] + [120~125°]	[2.8~3.2] + [120~125°]	[20.3~23.1] + [120~125°]
Crankshaft position sensor bolt	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Knock sensor	1	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Lubrication system				
Oil drain plug	1	34.3 ~ 44.1	3.5 ~ 4.5	25.3 ~ 32.5
Oil filter	1	11.8 ~ 15.7	1.2 ~ 1.6	8.7 ~ 11.6
Oil pan bolt	16	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil screen bolt	1	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Oil screen nut	2	11.8 ~ 13.7	1.2 ~ 1.4	8.7 ~ 10.1
Oil pressure switch	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Cooling system				
Water pump pulley bolt	4	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Water pump bolt	5	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Water inlet fitting nut	2	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Water temperature control assembly bolt	3	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Heater pipe bolt	2	19.6 ~ 23.5	2.0 ~ 2.4	14.5 ~ 17.4
Intake and exhaust system				
Air intake hose clamp bolt	2	2.9 ~ 4.9	0.3 ~ 0.5	2.2 ~ 3.6
Air cleaner assembly bolt	3	3.9 ~ 5.9	0.4 ~ 0.6	2.9 ~ 4.3
Electronic throttle control (ETC) module bolt	4	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Intake manifold stay bolt	2	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Intake manifold bolt	3	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Intake manifold nut	2	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Oxygen sensor (Front/Rear)	2	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Exhaust manifold heat protector bolt	3	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Exhaust manifold stay bolt	3	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Exhaust manifold nut	5	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
Catalytic converter / muffler nut	6	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4

Specifications

Description		Specifications	Limit
General			
Type		In-line, DOHC	
Number of cylinders		4	
Bore		81.0 mm (3.1890 in.)	
Stroke		97.0 mm (3.8189 in.)	
Total displacement		1999 cc (121.99 cu.in.)	
Compression ratio		10.3±0.2 : 1	
Firing order		1-3-4-2	
Valve timing			
Intake valve	Open	ATDC 10° ~ BTDC 40°	
	Close	ABDC 67° ~ ABDC 17°	
Exhaust valve	Open	BBDC 68° ~ BBDC 28°	
	Close	ATDC 1° ~ ATDC 41°	
Camshaft			
Cam height	Intake	39.0 mm (1.5354 in.)	
	Exhaust	39.0 mm (1.5354 in.)	
Journal outer diameter	Intake	No.1: 35.959 ~ 35.975 mm (1.41571 ~ 1.41634 in.)	
		No.2,3,4,5: 22.959 ~ 22.975 mm (0.90390 ~ 0.90453 in.)	
	Exhaust	No.1: 35.959 ~ 35.975 mm (1.41571 ~ 1.41634 in.)	
		No.2,3,4,5: 22.959 ~ 22.975 mm (0.90390 ~ 0.90453 in.)	
Bearing oil clearance	Intake	No.1: 0.032 ~ 0.062 mm (0.00126 ~ 0.00244 in.)	
		No.2,3,4,5: 0.032 ~ 0.062 mm (0.00126 ~ 0.00244 in.)	
	Exhaust	No.1: 0.032 ~ 0.062 mm (0.00126 ~ 0.00244 in.)	
		No.2,3,4,5: 0.032 ~ 0.062 mm (0.00126 ~ 0.00244 in.)	
End play		0.10 ~ 0.19 mm (0.0039 ~ 0.0075 in.)	
Valve			

Valve length	Intake	102.22 mm (4.0244 in.)	101.97 mm (4.0146 in.)
	Exhaust	104.04 mm (4.0961 in.)	103.79 mm (4.0862 in.)
Stem outer diameter	Intake	5.465 ~ 5.480 mm (0.21516 ~ 0.21575 in.)	
	Exhaust	5.458 ~ 5.470 mm (0.21488 ~ 0.21535 in.)	
Face angle		45.25° ~ 45.75°	
Thickness of valve head (margin)	Intake	1.30 mm (0.0512 in.)	
	Exhaust	1.26 mm (0.0496 in.)	
Valve stem to valve guide clearance	Intake	0.020 ~ 0.047 mm (0.00079 ~ 0.00185 in.)	
	Exhaust	0.030 ~ 0.054 mm (0.00118 ~ 0.00213 in.)	
Valve guide			
Length	Intake	43.8 ~ 44.2 mm (1.7244 ~ 1.7402 in.)	
	Exhaust	43.8 ~ 44.2 mm (1.7244 ~ 1.7402 in.)	
Inner diameter	Intake	5.500 ~ 5.512 mm (0.21654 ~ 0.21701 in.)	
	Exhaust	5.500 ~ 5.512 mm (0.21654 ~ 0.21701 in.)	
Valve seat			
Width of seat contact	Intake	1.05 ~ 1.35 mm (0.0413 ~ 0.0532 in.)	
	Exhaust	1.35 ~ 1.65 mm (0.0532 ~ 0.0650 in.)	
Seat angle	Intake	44° 45' ~ 45° 6'	
	Exhaust	44° 45' ~ 45° 6'	
Valve spring			
Free length		45.93 mm (1.8083 in.)	
Load	19.6 ± 1.0 kg / 37.0 mm (43.21 ± 2.20 lb / 1.4567 in.)		
	45.7 ± 1.8 kg / 27.0 mm (100.75 ± 3.97 lb / 1.0630 in.)		
Out of squareness		Less than 1.5°	
Cylinder head			
		Less than 0.05 mm (0.0020 in.) for total area	

Flatness of gasket surface		Less than 0.02 mm (0.0008 in.) for a section of 100 mm (3.9370 in.) × 100 mm (3.9370 in.)	
Flatness of manifold mounting surface	Intake	Less than 0.10 mm (0.0039 in.)	
	Exhaust	Less than 0.10 mm (0.0039 in.)	
Piston			
Piston outer diameter		80.97 ~ 81.00 mm (3.1878 ~ 3.1890 in.)	
Piston to cylinder clearance		0.02 ~ 0.04 mm (0.0008 ~ 0.0016 in.)	
Ring groove width	No. 1 ring	1.030 ~ 1.050 mm (0.04055 ~ 0.04134 in.)	
	No. 2 ring	1.230 ~ 1.250 mm (0.04843 ~ 0.04921 in.)	
	Oil ring	2.010 ~ 2.025 mm (0.07913 ~ 0.07972 in.)	
Piston ring			
Side clearance	No. 1 ring	0.040 ~ 0.080 mm (0.00157 ~ 0.00315 in.)	
	No. 2 ring	0.040 ~ 0.080 mm (0.00157 ~ 0.00315 in.)	
	Oil ring	0.060 ~ 0.135 mm (0.00236 ~ 0.00532 in.)	
End gap	No. 1 ring	0.15 ~ 0.30 mm (0.0059 ~ 0.0118 in.)	
	No. 2 ring	0.30 ~ 0.45 mm (0.0118 ~ 0.0177 in.)	
	Oil ring	0.20 ~ 0.70 mm (0.0079 ~ 0.0276 in.)	
Piston pin			
Piston pin outer diameter		19.996 ~ 20.000 mm (0.78724 ~ 0.78740 in.)	
Piston pin hole inner diameter		20.004 ~ 20.009 mm (0.78756 ~ 0.78775 in.)	
Piston pin hole clearance		0.004 ~ 0.013 mm (0.00016 ~ 0.00051 in.)	
Connecting rod small end hole inner diameter		20.010 ~ 20.021 mm (0.78779 ~ 0.78823 in.)	
Piston pin-to-connecting rod bushing oil clearance		0.010 ~ 0.025 mm (0.00039 ~ 0.00098 in.)	
Connecting rod			

Connecting rod big end inner diameter		48.000 ~ 48.018 mm (1.88976 ~ 1.89047 in.)	
Connecting rod bearing oil clearance		0.028 ~ 0.046 mm (0.00110 ~ 0.00181 in.)	
Side clearance		0.10 ~ 0.25 mm (0.0039 ~ 0.0098 in.)	
Crankshaft			
Main journal outer diameter		54.942 ~ 54.960 mm (2.16307 ~ 2.16378 in.)	
Pin journal outer diameter		44.954 ~ 44.972 mm (1.76984 ~ 1.77055 in.)	
Main bearing oil clearance		0.016 ~ 0.034 mm (0.00063 ~ 0.00134 in.)	
End play		0.07 ~ 0.25 mm (0.0028 ~ 0.0098 in.)	
Cylinder block			
Cylinder bore		81.00 ~ 81.03 mm (3.1890 ~ 3.1902 in.)	
Flatness of gasket surface		Less than 0.05 mm (0.0020 in.) for total area	
		Less than 0.02 mm (0.0008 in.) for a section of 100 mm (3.9370 in.) × 100 mm (3.9370 in.)	
Engine oil			
Oil quantity	Total	4.5 L (1.19 U.S.gal., 4.76 U.S.qt., 3.96 imp.qt.)	When replacing a short engine or block assembly
	Oil pan	3.7 L (0.98 U.S.gal., 3.91 U.S.qt., 3.26 imp.qt.)	
	Drain and refill	4.0 L (1.06 U.S.gal., 4.23 U.S.qt., 3.52 imp.qt.)	Including oil filter
Oil grade	Recommendation	5W-20/GF4&SM	If not available, refer to the recommended API or ILSAC classification and SAE viscosity number.
	Classification	API SL, SM or above ILSAC GF3, GF4 or above	Satisfy the requirement of the API or ILSAC classification.
	SAE viscosity grade	Recommended SAE viscosity number	Refer to the "Lubrication System".
Oil pressure (at 1,000rpm)		98.07 kPa (1.0 kgf/cm ² , 14.22 psi) or above	Oil temperature (oil pan): 110±2°C (230±35.6°F)
Oil Pump			

Relief valve opening pressure		415 ~ 485 kPa (4.23 ~ 4.95 kgf/cm ² , 60.16 ~ 70.41 psi)	
Side clearance		0.040 ~ 0.090 mm (0.00157 ~ 0.00354 in.)	
Body clearance		0.200 ~ 0.292 mm (0.00787 ~ 0.01150 in.)	
Guide clearance		0.030 ~ 0.075 mm (0.00118 ~ 0.00295 in.)	
Cooling system			
Cooling method		Forced circulation with cooling fan	
Coolant quantity		6.4 L (1.69 U.S.gal., 6.76 U.S.qt., 5.63 Imp.qt.)	
Thermostat	Type	Wax pellet type	
	Opening temperature	88±1.5°C (190.4±34.7°F)	
	Full opening valve lift / temperature	More than 8 mm (0.3 in.) / 100°C (212°F)	
Radiator cap	Main valve opening pressure	93.16 ~ 122.58 kPa (0.95 ~ 1.25 kgf/cm ² , 13.51 ~ 17.78 psi)	
	Vacuum valve opening pressure	0 ~ 6.86 kPa (0 ~ 0.07 kgf/cm ² , 0 ~ 1.00 psi)	

Tightening Torques

Item	Quantity	N.m	kgf.m	lb-ft
Engine mounting				
Engine mounting bracket to body fixing bolt	3	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Engine mounting support bracket to engine mounting insulator fixing nut	1	78.5 ~ 98.1	8.0 ~ 10.0	57.9 ~ 72.3
Engine mounting support bracket to engine support bracket fixing bolt	1	78.5 ~ 98.1	8.0 ~ 10.0	57.9 ~ 72.3
Engine mounting support bracket to engine support bracket fixing nut	2	78.5 ~ 98.1	8.0 ~ 10.0	57.9 ~ 72.3
Transaxle mounting bracket to body fixing bolt	2	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Transaxle mounting bracket to body fixing nut	1	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0

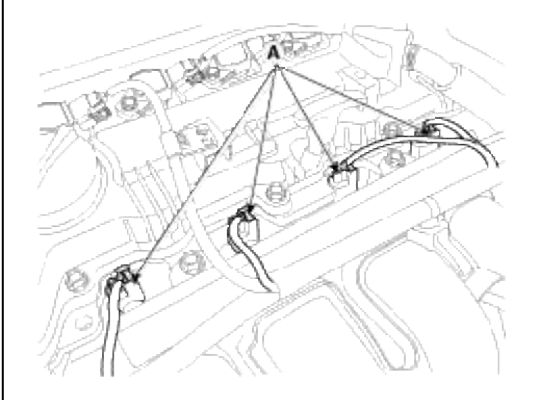
Transaxle mounting support bracket to transaxle	3	88.3 ~ 107.9	9.0 ~ 11.0	65.1 ~ 79.6
Roll rod bracket to sub frame fixing bolt	2	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Roll rod bracket to roll rod support bracket fixing bolt & nut	1	107.9 ~ 127.5	11.0 ~ 13.0	79.6 ~ 94.0
Timing system				
Crankshaft pulley bolt	1	196.1 ~ 205.9	20.0 ~ 21.0	144.7 ~ 151.9
Timing chain cover service plug bolt	1	29.4 ~ 39.2	3.0 ~ 4.0	21.7 ~ 28.9
Timing chain cover bolt (M10×55)	3	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Timing chain cover bolt (M10×85)	2	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Timing chain cover bolt - Seal bolt (M6×38)	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain cover bolt - Seal bolt (M8×50)	1	19.6 ~ 23.5	2.0 ~ 2.4	14.5 ~ 17.4
Timing chain cover bolt (M8×50)	11	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Timing chain cover bolt (M8×28)	5	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Timing chain tensioner bolt	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing chain tensioner arm bolt	1	18.6 ~ 22.6	1.9 ~ 2.3	13.7 ~ 16.6
Timing chain guide bolt	2	18.6 ~ 22.6	1.9 ~ 2.3	13.7 ~ 16.6
Cylinder head				
Engine cover mounting bolt	2	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Ignition coil bolt	4	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Cylinder head cover bolt	14	[3.9~5.9] + [7.8~9.8]	[0.4~0.6] + [0.8~1.0]	[2.9~4.3] + [5.8~7.2]
Injector & rail assembly bolt	2	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
CVVT bolt (LH/RH)	2	64.7 ~ 76.5	6.6 ~ 7.8	47.7 ~ 56.4
Camshaft bearing cap bolt (M6)	10	11.8 ~ 13.7	1.2 ~ 1.4	8.7 ~ 10.1
Camshaft bearing cap bolt (M8)	15	18.6 ~ 22.6	1.9 ~ 2.3	13.7 ~ 16.6
Cam carrier bolt	2	18.6 ~ 22.6	1.9 ~ 2.3	13.7 ~ 16.6
Cylinder head bolt	10	[32.4~36.3] + [90~95°] + [90~95°]	[3.3~3.7] + [90~95°] + [90~95°]	[23.9~26.8] + [90~95°] + [90~95°]
Engine hanger bolt (Front/Rear)	2	34.3 ~ 39.2	3.5 ~ 4.0	25.3 ~ 28.9
Camshaft position sensor (LH/RH)	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil control valve (OCV) bolt (LH/RH)	2	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Cylinder block				

Flywheel bolt (M/T)	7	117.7 ~ 127.5	12.0 ~ 13.0	86.8 ~ 93.9
Drive plate bolt (A/T)	7	117.7 ~ 127.5	12.0 ~ 13.0	86.8 ~ 93.9
Connecting rod bearing cap bolt	8	[17.7~21.6] + [88~92°]	[1.8~2.2] + [88~92°]	[13.0~15.9] + [88~92°]
Lower crankcase bolt	11	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Main bearing cap bolt	10	[27.5~31.4] + [120~125°]	[2.8~3.2] + [120~125°]	[20.3~23.1] + [120~125°]
Crankshaft position sensor bolt	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Knock sensor	1	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Lubrication system				
Oil drain plug	1	34.3 ~ 44.1	3.5 ~ 4.5	25.3 ~ 32.5
Oil filter	1	11.8 ~ 15.7	1.2 ~ 1.6	8.7 ~ 11.6
Oil pan bolt	16	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil screen bolt	1	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Oil screen nut	2	11.8 ~ 13.7	1.2 ~ 1.4	8.7 ~ 10.1
Oil pressure switch	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Cooling system				
Water pump pulley bolt	4	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Water pump bolt	5	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Water inlet fitting nut	2	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Water temperature control assembly bolt	3	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Heater pipe bolt	2	19.6 ~ 23.5	2.0 ~ 2.4	14.5 ~ 17.4
Intake and exhaust system				
Air intake hose clamp bolt	2	2.9 ~ 4.9	0.3 ~ 0.5	2.2 ~ 3.6
Air cleaner assembly bolt	3	3.9 ~ 5.9	0.4 ~ 0.6	2.9 ~ 4.3
Electronic throttle control (ETC) module bolt	4	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Intake manifold stay bolt	2	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Intake manifold bolt	3	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Intake manifold nut	2	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Oxygen sensor (Front/Rear)	2	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Exhaust manifold heat protector bolt	3	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Exhaust manifold stay bolt	3	39.2 ~ 49.0	4.0 ~ 5.0	28.9 ~ 36.2
Exhaust manifold nut	5	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
Catalytic converter / muffler nut	6	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4

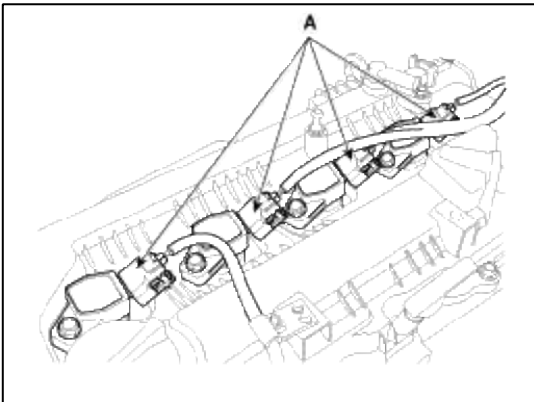
Engine Mechanical System > General Information > Repair procedures**Compression Pressure Inspection****NOTE**

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

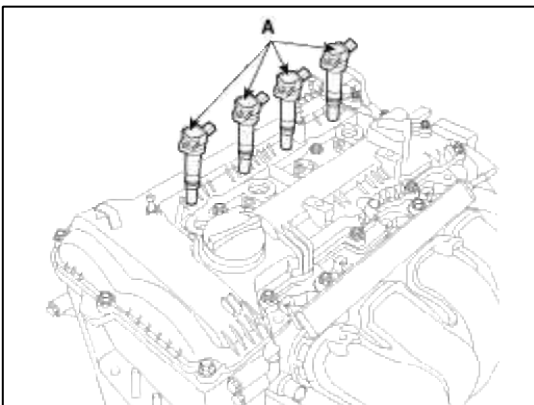
1. Warm up and stop engine.
Allow the engine to warm up to normal operating temperature.
2. Disconnect the injector connectors (A).



3. Disconnect the ignition coil connectors (A).

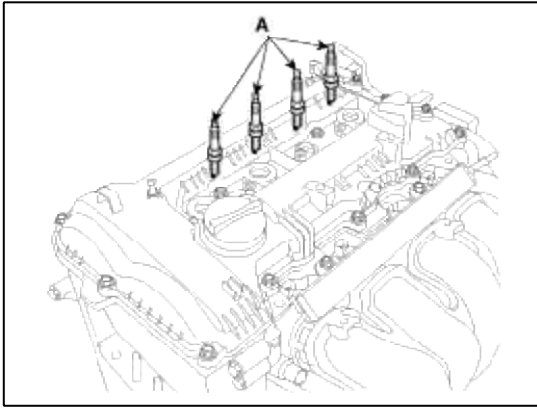


4. Remove ignition coils (A).



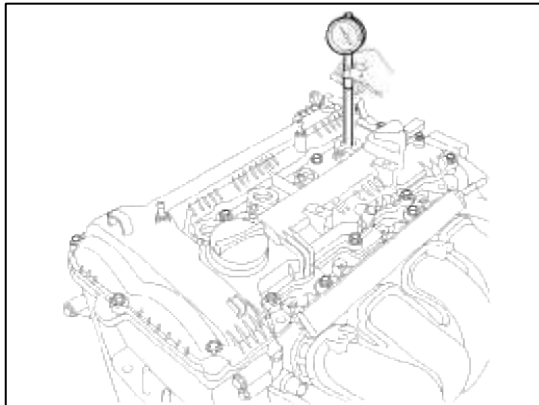
5. Remove spark plugs (A).

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



6. Check cylinder compression pressure.

(1) Insert a compression gauge into the spark plug hole.



(2) Fully open the throttle.

(3) While cranking the engine, measure the compression pressure.

NOTE

Always use a fully charged battery to obtain engine speed of 200 rpm or more.

(4) Repeat steps (1) through (3) for each cylinder.

NOTE

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

Compression pressure:

1,275 kPa (13.0 kgf/cm², 185 psi)

Minimum pressure:

1,128 kPa (11.5 kgf/cm², 164 psi)

Difference between each cylinder:

100 kPa (1.0 kgf/cm², 15 psi) or less

(5) If the cylinder compression in 1 or more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat steps (1) through (3) for cylinders with low compression.

A. If adding oil helps the compression, it is likely that the piston rings and/or cylinder bore are worn or damaged.

B. If pressure stays low, a valve may be sticking or seating is improper, or there may be leakage past the gasket.

7. Reinstall spark plugs.

Tightening torque:

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

8. Install ignition coils.

Tightening torque:

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

9. Connect the injector connectors and ignition coil connectors.

10. Some DTCs may exist after the inspection test and may need to be manually cleared with GDS.

Engine Mechanical System > General Information > Troubleshooting

Troubleshooting

Symptom	Suspect area	Remedy
Engine misfire with abnormal internal lower engine noises	- Worn crankshaft bearings - Loose or out of specification engine flywheel	- Replace the crankshaft and bearings as required. - 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)	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.
Engine misfire with coolant consumption	- Faulty cylinder head gasket 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, 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.

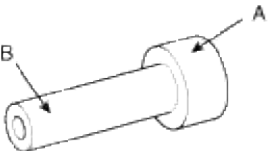
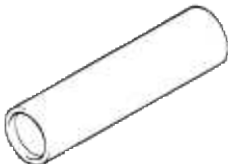
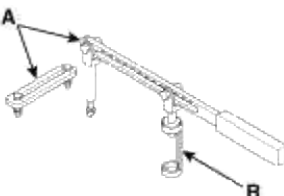
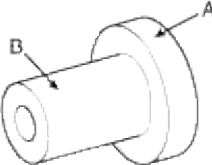
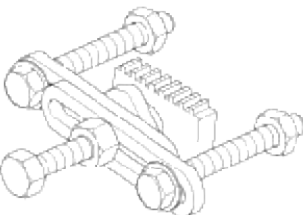
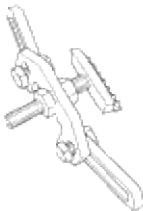
(Check and compare with known good vehicle to determine normal condition.)	Worn crankshaft thrust bearing	• Inspect the thrust bearing and crankshaft. • Repair or replace as required.
Upper engine noise, regardless of engine speed	Low oil pressure	Repair or replace as required.
	Broken valve spring	Replace 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 as required.
	Worn valve guides or valve stems	Inspect the valves and valve guides, then repair or replace 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 or replace as required.
	Worn drive belt, idler, tensioner and bearing	Replace as required.
Lower engine noise, regardless of engine speed	Low oil pressure	Repair or 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, piston pin and cylinder bore. • Repair or replace as required.
	Excessive piston pin-to-piston 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 or replace as required. • The connecting rod bearings. • The connecting rods. • The crankshaft pin journals.
	Excessive crankshaft bearing clearance	Inspect the following components, and repair or replace as required. • The crankshaft bearings. • The crankshaft main journals. • The cylinder block

	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 or replace as required: • The connecting rod bearings • The connecting rods • The crankshaft
	Excessive crankshaft bearing clearance	Inspect the following components, and repair or replace as required: • The crankshaft bearings • The crankshaft main journals • The cylinder block
Engine is not cranked. Crankshaft does not rotate.	Hydraulically locked cylinder • Coolant/antifreeze in cylinder • Oil in cylinder • Fuel in cylinder	1. Remove spark plugs and check for fluid. 2. Inspect for broken head gasket. 3. Inspect for cracked engine block or cylinder head. 4. Inspect for a sticking fuel injector and/or leaking fuel regulator.
	Broken timing chain and/or timing chain gears	1. Inspect timing chain and gears. 2. Repair as required.
	Material in cylinder • Broken valve • Piston material • Foreign material	1. Inspect cylinder for damaged components and/or foreign materials. 2. Repair or replace as required.
	Seized crankshaft or connecting rod bearings	1. Inspect crankshaft and connecting rod bearing. 2. Repair as required.
	Bent or broken connecting rod	1. Inspect connecting rods. 2. Repair as required.
	Broken crankshaft	1. Inspect crankshaft. 2. Repair as required.

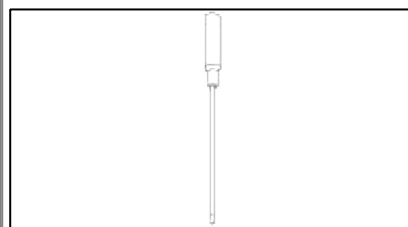
Engine Mechanical System > General Information > Special Service Tools

Special Service Tools

Tool (Number and name)	Illustration	Use

Crankshaft front oil seal installer (09231-2E000) (09231-H1100)		Installation of the front oil seal A : 09231-2E000 (installer) B : 09231-H1100 (handle)
Valve stem seal installer (09222-2E000)		Installation of the valve stem oil seal
Valve spring compressor (09222-3K000) (09222-3K100)		Removal and installation of the intake or exhaust valve A : 09222-3K000 (compressor) B : 09222-3K100 (holder)
Crankshaft rear oil seal installer (09214-2E000) (09231-H1100)		Installation of the rear oil seal A : 09214-2E000 (installer) B : 09231-H1100 (handle)
Ring gear stopper (09231-2B100)		Holding ring gear so that engine doesn't turn/move after the starter is removed
Ring gear stopper (09231-3D100)		Holding ring gear so that engine doesn't turn/move after the service cover is removed
Torque angle adapter (09221-4A000)		Installation of bolts & nuts needing an angular method of adjustment
Oil pan remover (09215-3C000)		• Removal of oil pan • Must use this tool to separate the oil pan from the lower crankcase assembly without damage to the sealing surfaces

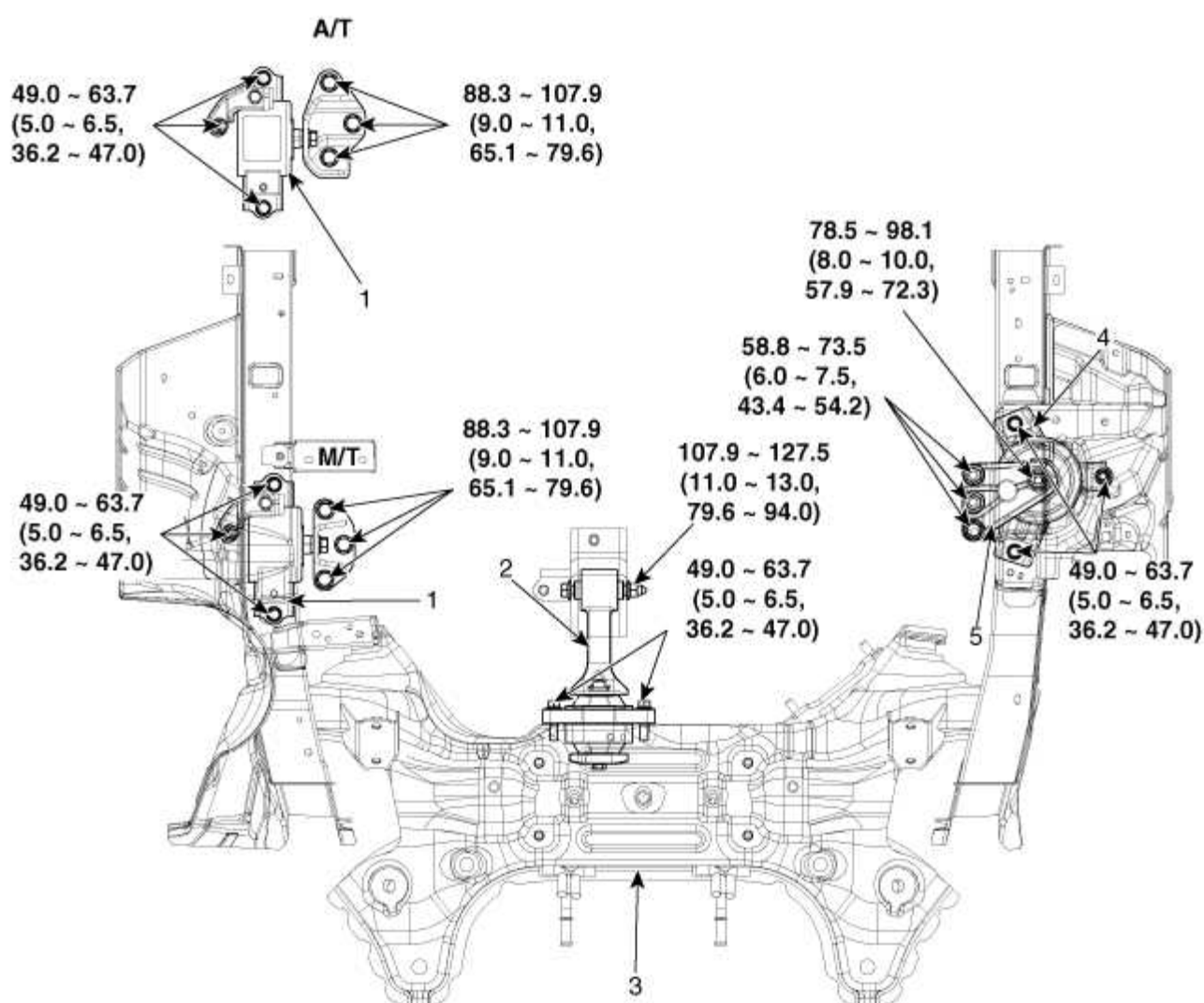
Tensioner stopper pin
(09240-2E100)



Holding compressed piston of tensioner

Engine Mechanical System > Engine And Transaxle Assembly > Engine Mounting > Components and Components Location - Revised

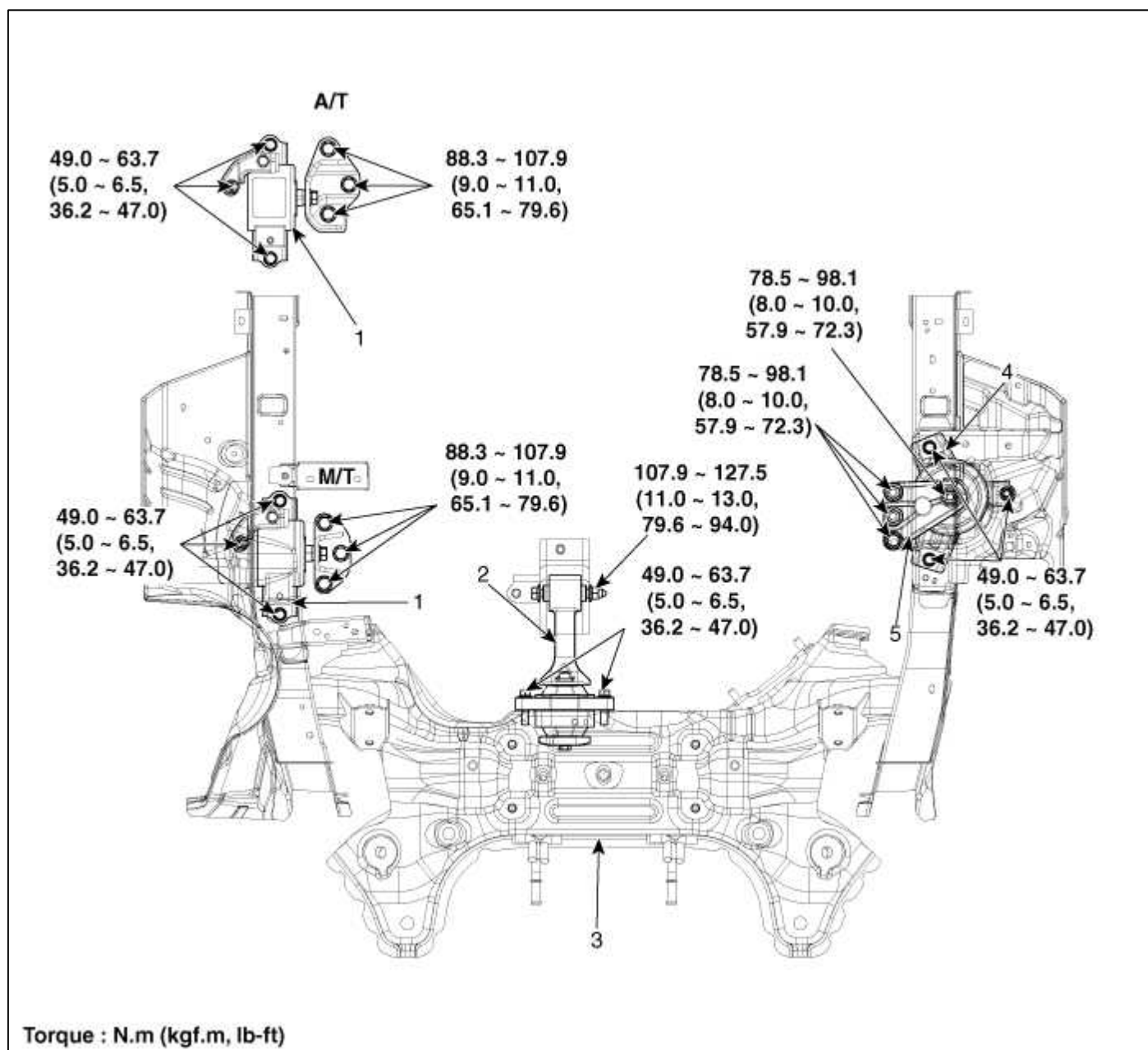
Components



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

1. Transaxle mounting bracket	4. Engine mounting bracket
2. Roll rod bracket	5. Engine mounting support bracket
3. Sub frame	

Components



1. Transaxle mounting bracket	4. Engine mounting bracket
2. Roll rod bracket	5. Engine mounting support bracket
3. Sub frame	

Engine Mechanical System > Engine And Transaxle Assembly > Engine And Transaxle Assembly > Repair procedures - Revised

Removal

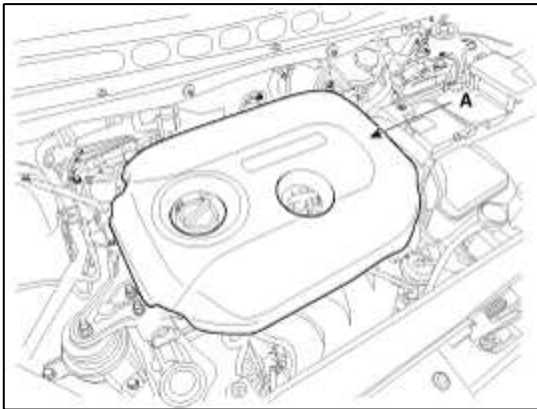
CAUTION

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

NOTE

- Mark all wiring and hoses to avoid misconnection.
- To release the fuel system pressure before removing the engine assembly, start the engine with the fuel pump relay removed. And then turn off the ignition switch after engine stops.

1. Remove the engine cover (A).

**NOTE**

- To avoid damage, remove the engine cover on room temperature.
- To avoid damage of the engine cover, do not disengage both front and rear mounting point at the same time.

2. Disconnect the battery terminals (A). The negative terminal first.

Tightening torque

(+) terminal:

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

(-) terminal:

3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 3.0 ~ 4.4 lb-ft)

3. Remove the air cleaner assembly.

(1) Remove the air duct (B).

(2) Disconnect the breather hose (C).

(3) Disconnect the air intake hose and then remove the air cleaner assembly (D).

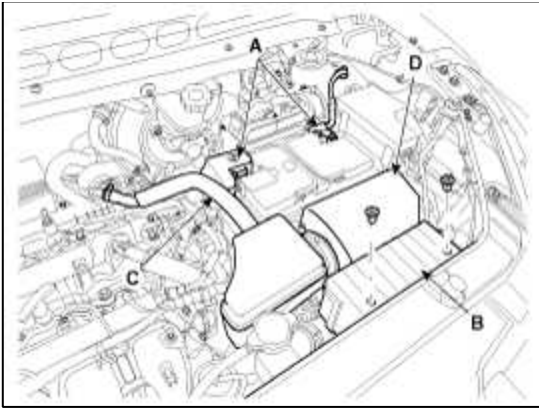
Tightening torque

Hose clamp bolt:

2.9 ~ 4.9 N.m (0.3 ~ 0.5 kgf.m, 2.2 ~ 3.6 lb-ft)

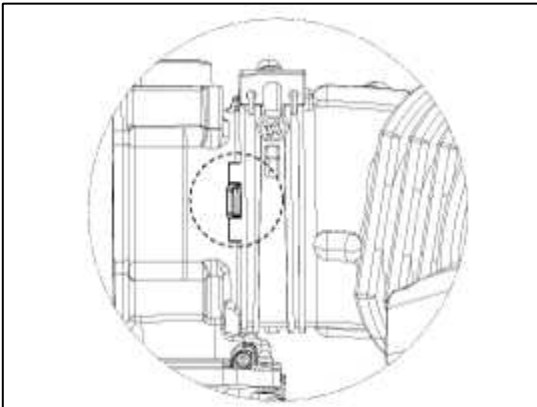
Air cleaner assembly bolts:

3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft)

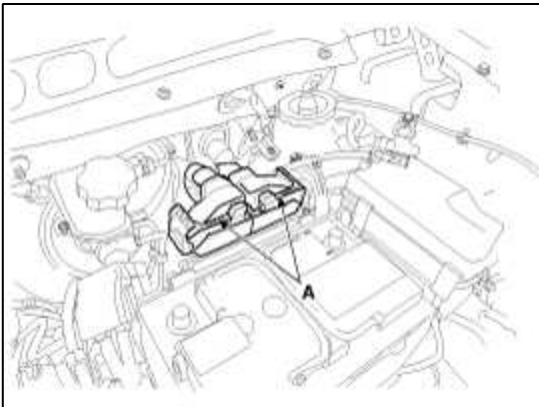


NOTE

- Install the air intake hose while the center of the mark of hose must be in line with the throttle body rib.



4. Disconnect the ECM connectors (A).



5. Remove the ECM (A).

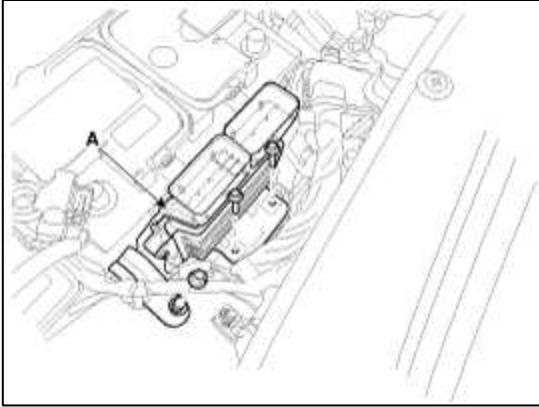
Tightening torque

Bolts :

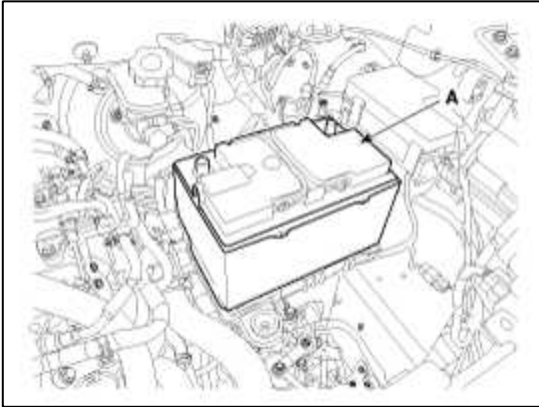
19.6 ~ 29.4N.m (2.0 ~ 3.0kgf.m, 14.5 ~ 21.7lb-ft)

Nut :

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



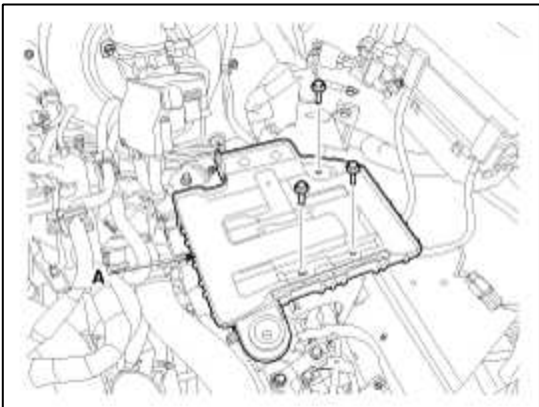
6. Remove the battery (A).



7. Remove the battery tray (A).

Tightening torque:

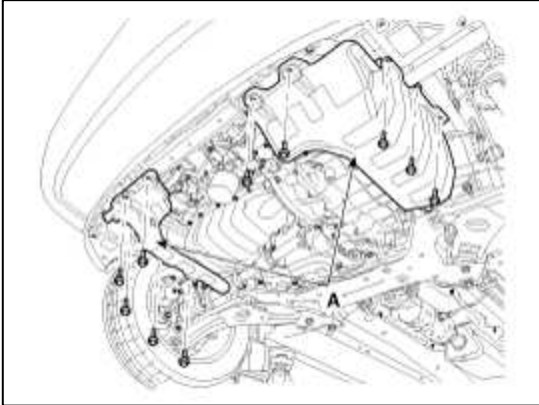
8.8 ~ 13.7N.m (0.9 ~ 1.4kgf.m, 6.5 ~ 10.1lb-ft)



8. Remove the under covers (A).

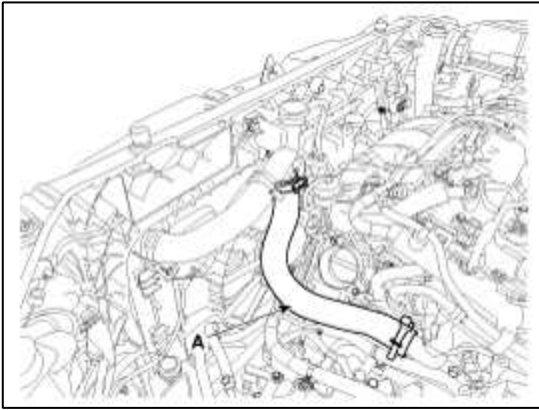
Tightening torque:

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

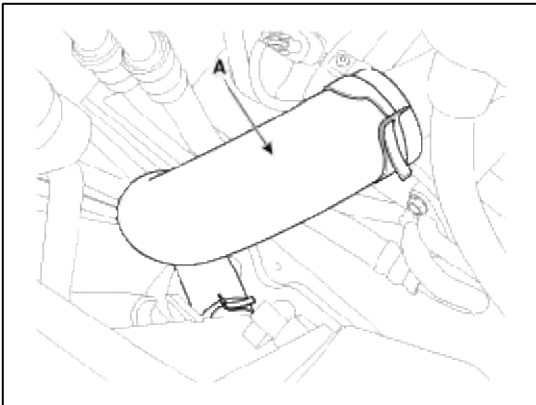


9. Loosen the drain plug, and drain the engine coolant. Remove the radiator cap to help drain the coolant faster.
(Refer to Cooling system in this group)

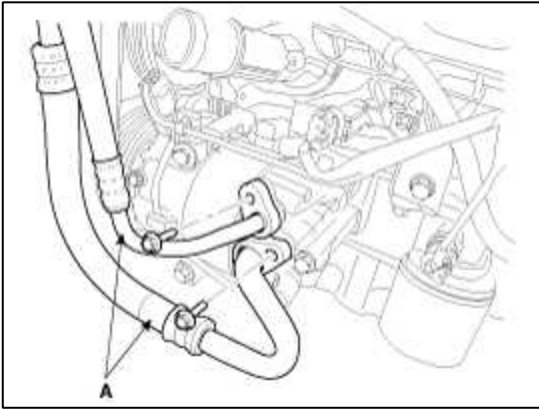
10. Disconnect the radiator upper hose (A).



11. Disconnect the radiator lower hose (A).

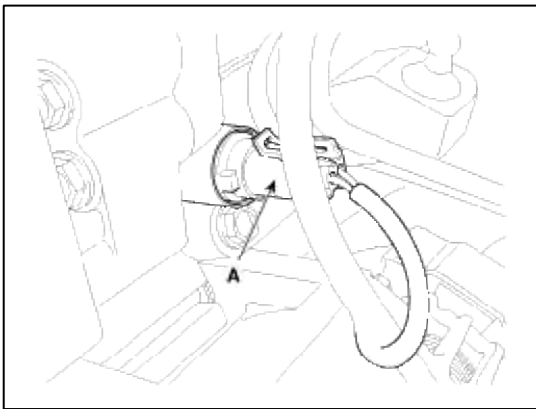


12. Recover the refrigerant and then remove the high pressure pipe and the low pressure pipe (A). (Refer to Air conditioning system in HA Group.)

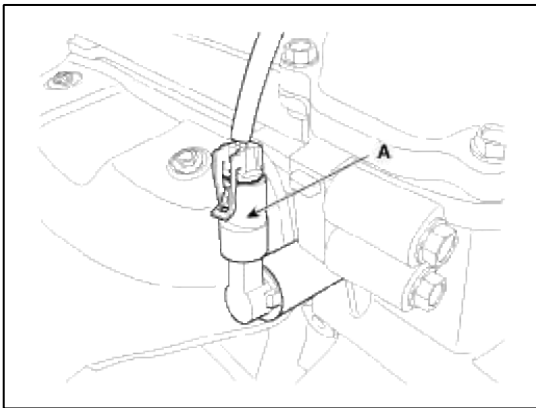


13. Disconnect the wiring connectors and harness clamps, and then remove the wiring and protectors from the cylinder head and the intake manifold.

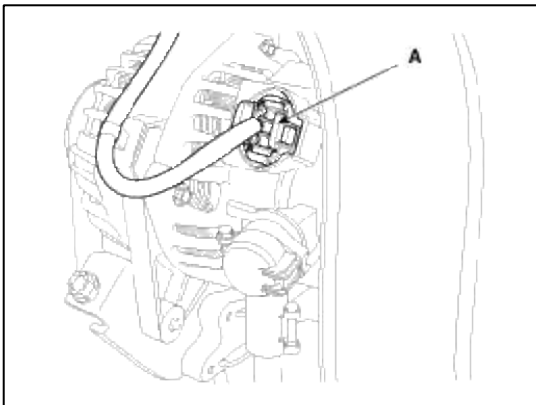
(1) The intake OCV (Oil control valve) connector (A)



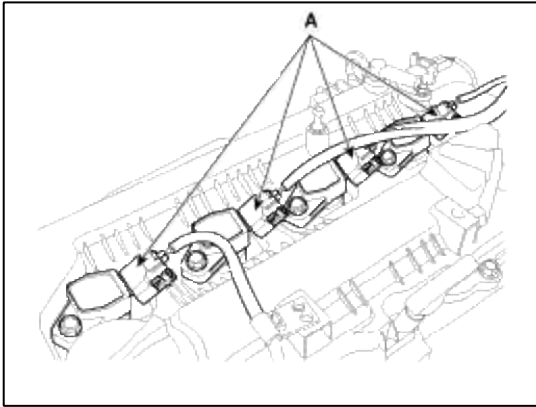
(2) The exhaust OCV (Oil control valve) connector (A)



(3) The alternator connector (A)

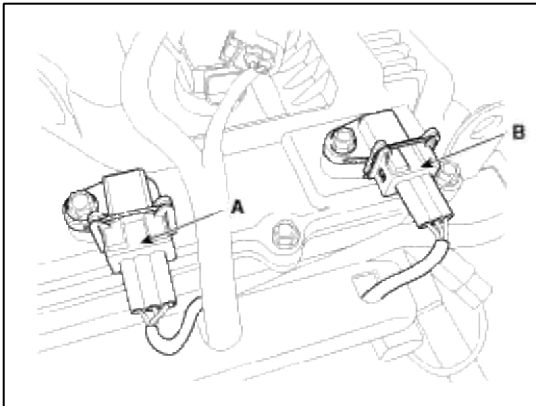


(4) The ignition coil connectors (A)

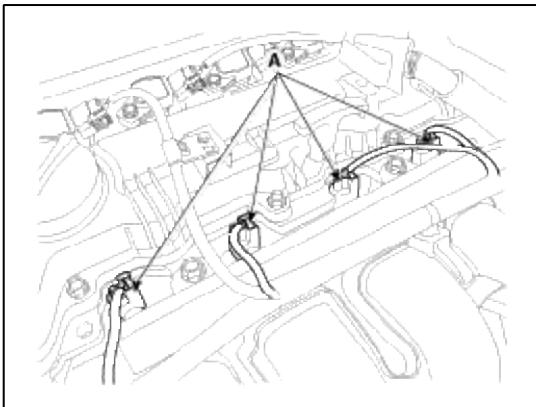


(5) The intake CMPS (Camshaft position sensor) connector (A)

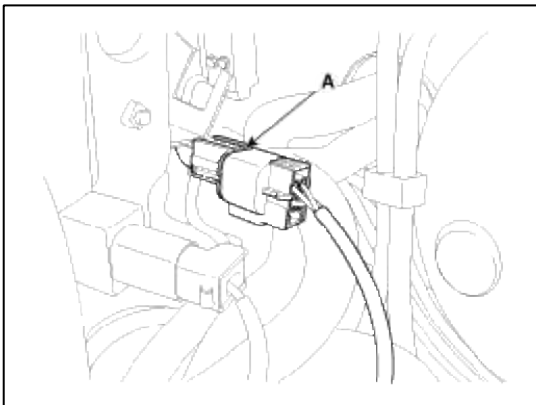
(6) The exhaust CMPS (Camshaft position sensor) connector (B)



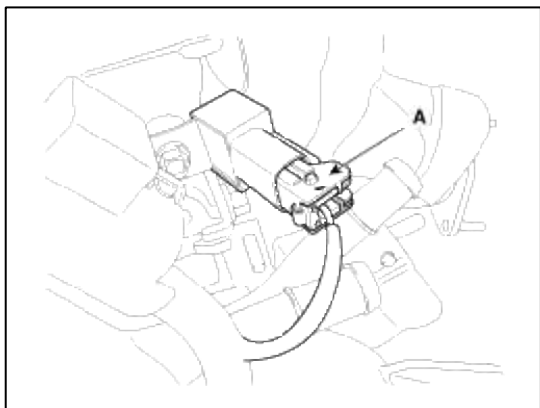
(7) The injector connectors (A)



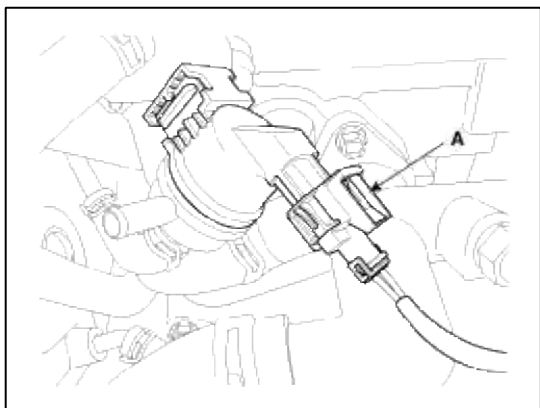
(8) The front and/or rear HO2S (Heated oxygen sensor connectors) (A)



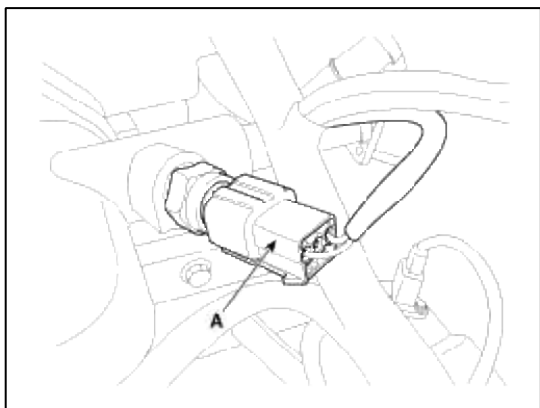
(9) The condenser connector (A)



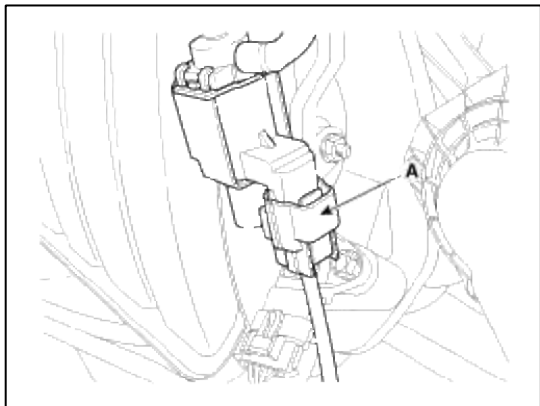
(10) The PCSV (Purge control solenoid valve) connector (A)



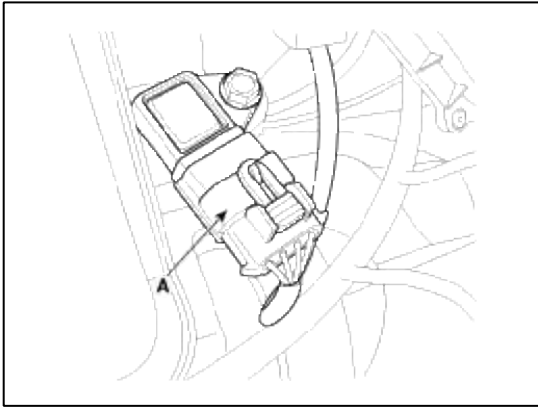
(11) The ECTS (Engine coolant temperature sensor) connector (A)



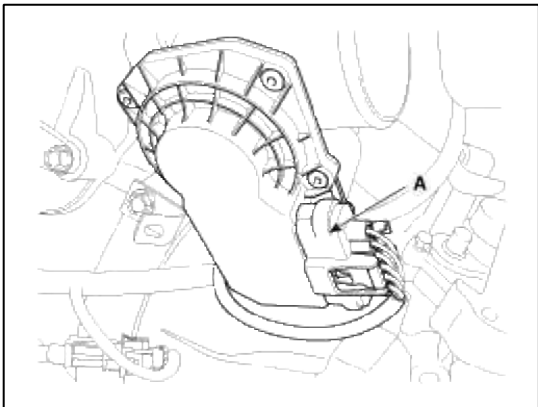
(12) The VIS (Variable Intake System) connector (A)



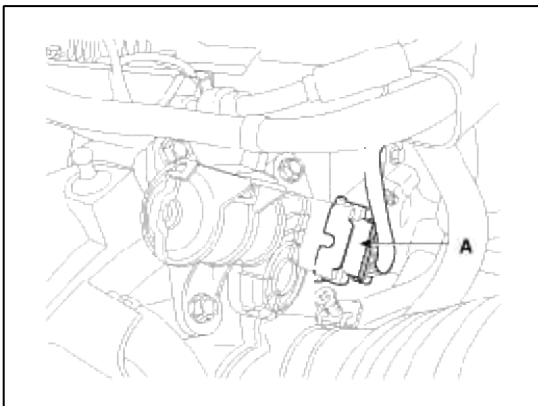
(13) The MAPS (Manifold absolute pressure sensor) & IATS (Intake air temperature sensor) connector (A)



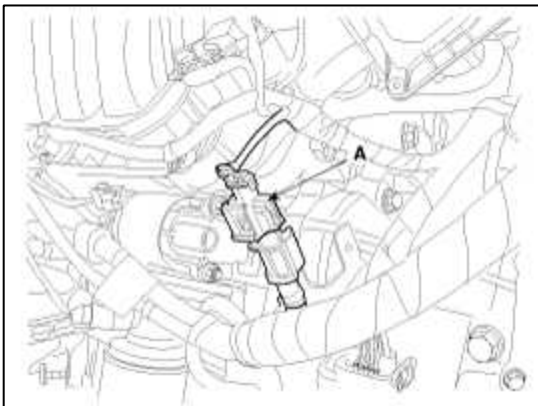
(14) The ETC (Electronic throttle control) connector (A)



(15) The VCMA (Variable charge motion actuator) connector (A)



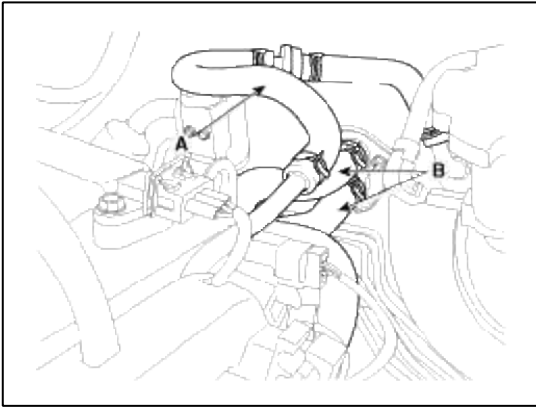
(16) The CKPS(Crankshaft position sensor) connector (A)



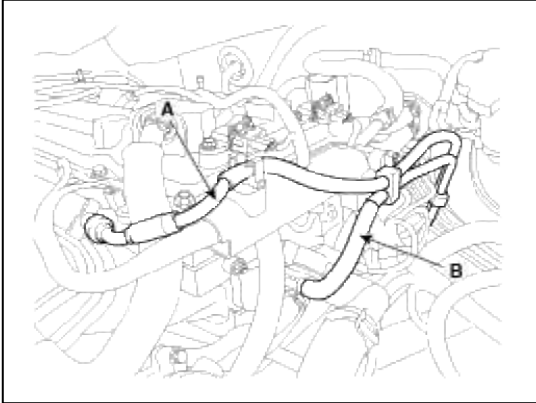
14. Remove the transaxle wire harness connectors, control cable and hoses from the transaxle. (Refer to AT or MT group).

15. Disconnect the ATF cooler hoses. (Refer to AT group)

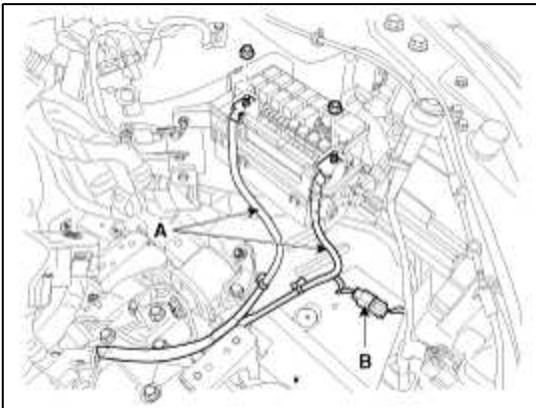
16. Disconnect the brake booster vacuum hose (A) and the heater hoses (B).



17. Disconnect the fuel hose (A) and the PCSV (Purge control solenoid valve) hose (B).



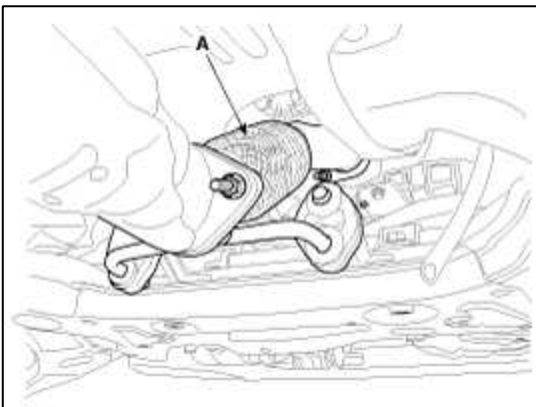
18. Disconnect the "+" cable (A) and the front connector (B).



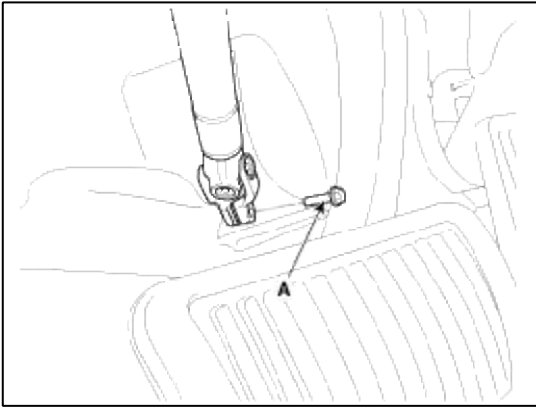
19. Remove the front muffler (A).

Tightening torque:

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

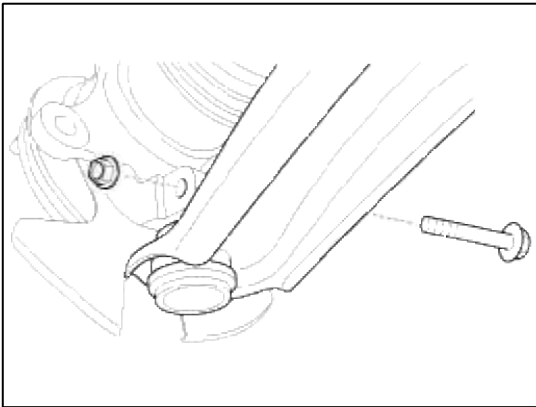


20. Remove the steering u-joint mounting bolt (A). (Refer to ST group – “Steering gear box”)

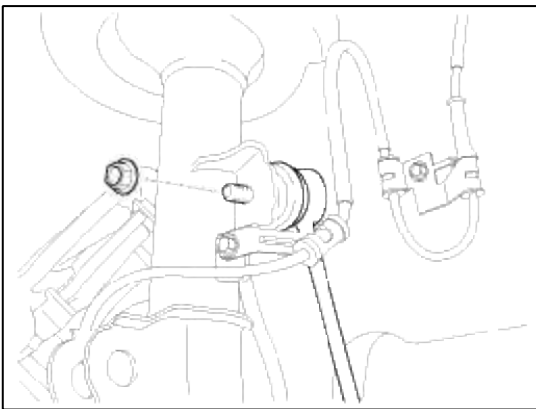


21. Remove the front wheels. (Refer to SS group)

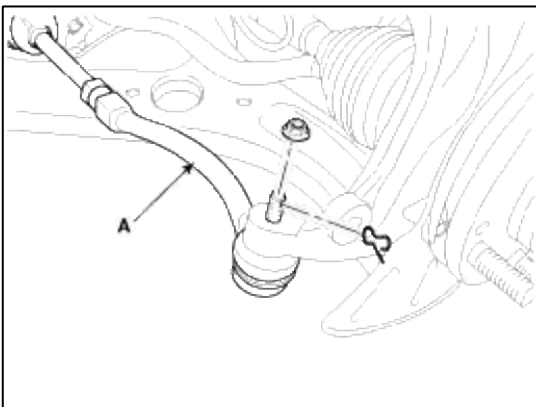
22. Remove the lower arms. (Refer to SS group – “Front lower arm”)



23. Remove the stabilizer bar links. (Refer to SS group – “Front stabilizer bar”)



24. Remove the tie rod ends (A). (Refer to ST group – “Steering gear box”)



25. Disconnect the drive shafts from the axle hubs. (Refer to DS group – “Front driveshaft”)

26. Remove the roll rod bracket (A).

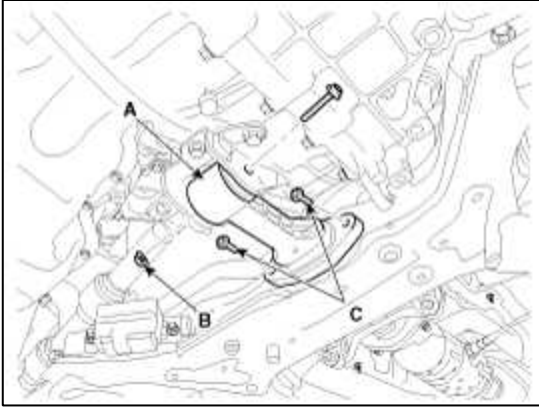
Tightening torque

Nut (B):

107.9 ~ 127.5 N.m (11.0 ~ 13.0 kgf.m, 79.6 ~ 94.0 lb-ft)

Bolt (C):

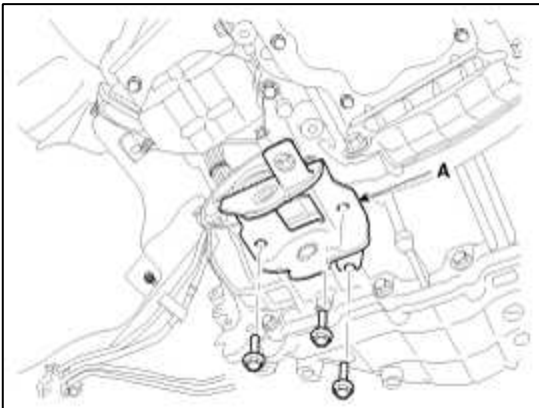
49.0 ~ 63.7 N.m (5.0 ~ 6.5 kgf.m, 36.2 ~ 47.0 lb-ft)



27. Remove the roll rod mounting support bracket (A).

Tightening torque:

49.0 ~ 68.6 N.m (5.0 ~ 7.0 kgf.m, 36.2 ~ 50.6 lb-ft)

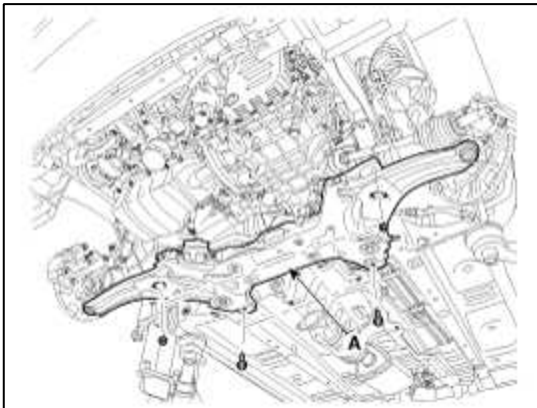


28. Support the sub frame (A) with a floor jack, and then remove the sub frame mounting bolts and nuts.

Tightening torque

Sub frame mounting bolts & nuts:

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



CAUTION

- After removing the sub frame mounting bolts and nuts, the engine and transaxle assembly may fall down, so support them securely with floor jack.
- Verify that the hoses and connectors are disconnected before removing the engine and transaxle assembly.

29. Disconnect the ground line (A), and then remove the engine mounting support bracket (B).

Tightening torque

Ground line bolt (A):

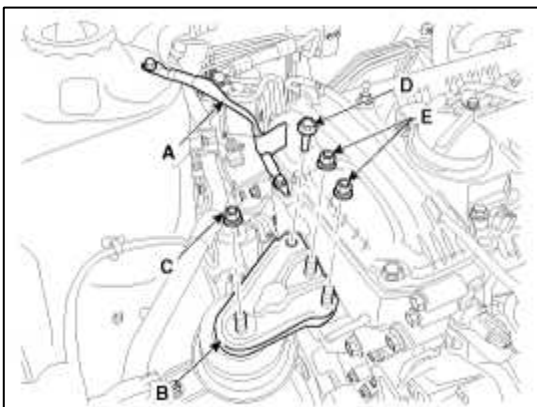
10.8 ~ 13.7 N.m (1.1 ~ 1.4 kgf.m, 8.0 ~ 10.1 lb-ft)

Nut (C):

78.5 ~ 98.1 N.m (8.0 ~ 10.0 kgf.m, 57.9 ~ 72.3 lb-ft)

Bolt (D) and nuts (E):

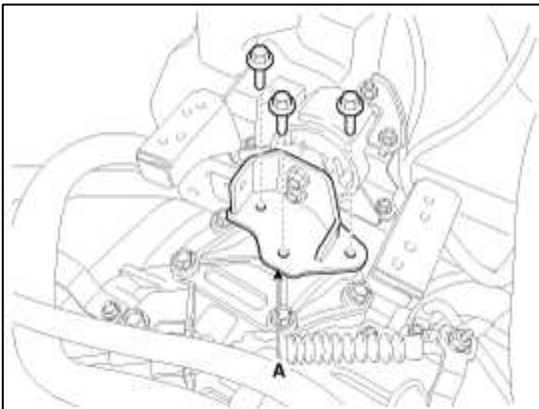
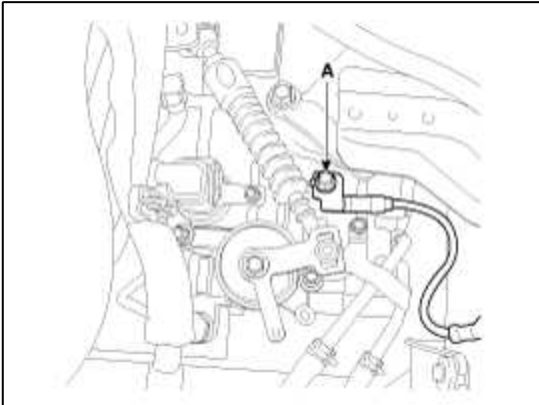
58.8 ~ 73.5 N.m (6.0 ~ 7.5 kgf.m, 43.4 ~ 54.2 lb-ft)



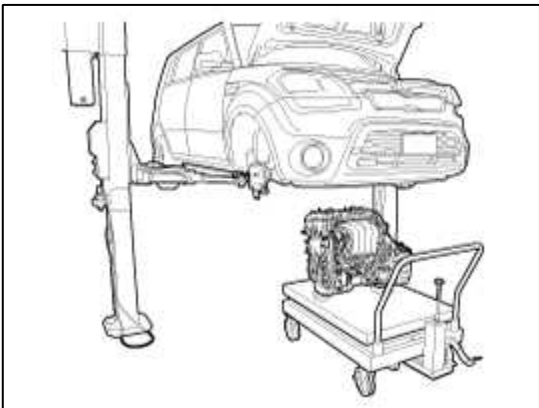
30. Disconnect the ground line (A), and then slowly loosen the transaxle mounting bolts (B).

Tightening torque:

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



31. Lower the engine and transaxle assembly using a floor jack and then remove the engine and transaxle assembly by lifting vehicle.



CAUTION

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

Removal

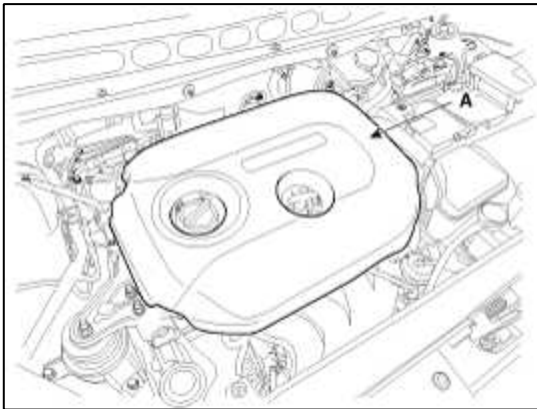
CAUTION

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

NOTE

- Mark all wiring and hoses to avoid misconnection.
- To release the fuel system pressure before removing the engine assembly, start the engine with the fuel pump relay removed. And then turn off the ignition switch after engine stops.

1. Remove the engine cover (A).

**NOTE**

- To avoid damage, remove the engine cover on room temperature.
- To avoid damage of the engine cover, do not disengage both front and rear mounting point at the same time.

2. Disconnect the battery terminals (A). The negative terminal first.

Tightening torque

(+) terminal:

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

(-) terminal:

3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 3.0 ~ 4.4 lb-ft)

3. Remove the air cleaner assembly.

(1) Remove the air duct (B).

(2) Disconnect the breather hose (C).

(3) Disconnect the air intake hose and then remove the air cleaner assembly (D).

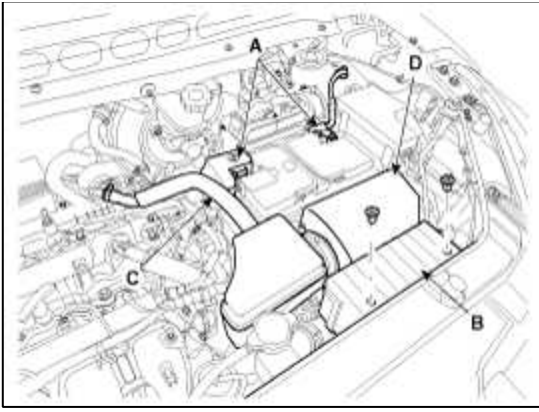
Tightening torque

Hose clamp bolt:

2.9 ~ 4.9 N.m (0.3 ~ 0.5 kgf.m, 2.2 ~ 3.6 lb-ft)

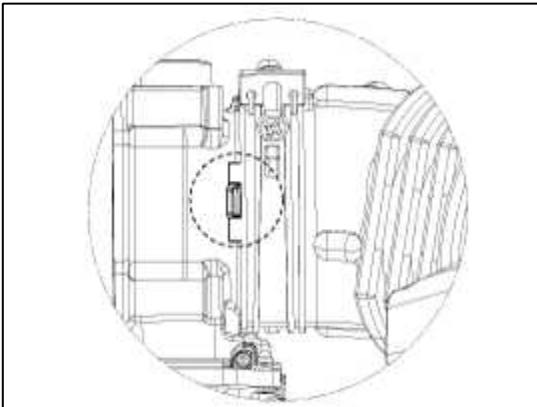
Air cleaner assembly bolts:

3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft)

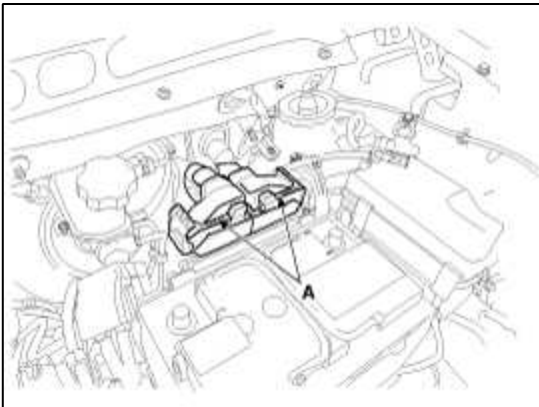


NOTE

- Install the air intake hose while the center of the mark of hose must be in line with the throttle body rib.



4. Disconnect the ECM connectors (A).



5. Remove the ECM (A).

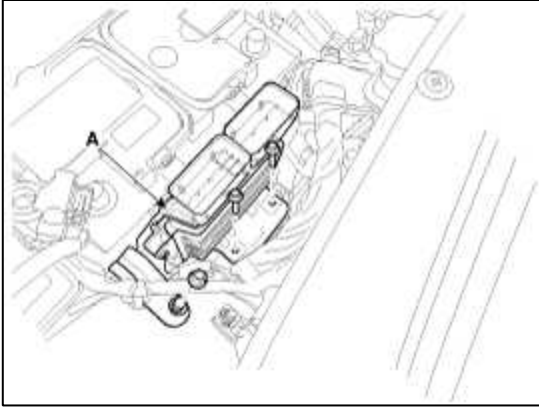
Tightening torque

Bolts :

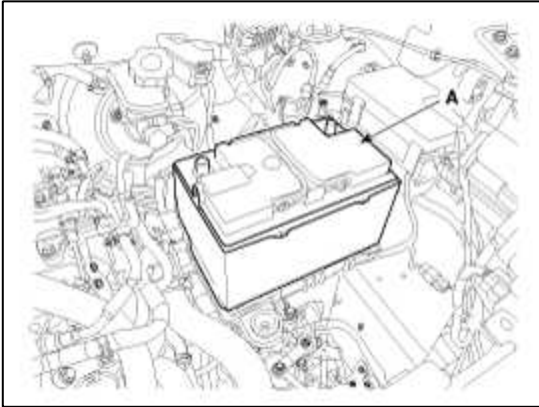
19.6 ~ 29.4N.m (2.0 ~ 3.0kgf.m, 14.5 ~ 21.7lb-ft)

Nut :

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



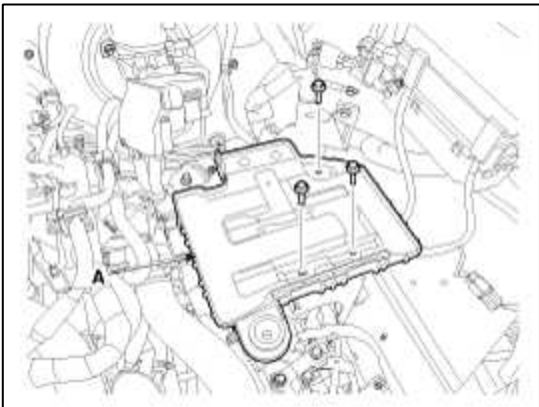
6. Remove the battery (A).



7. Remove the battery tray (A).

Tightening torque:

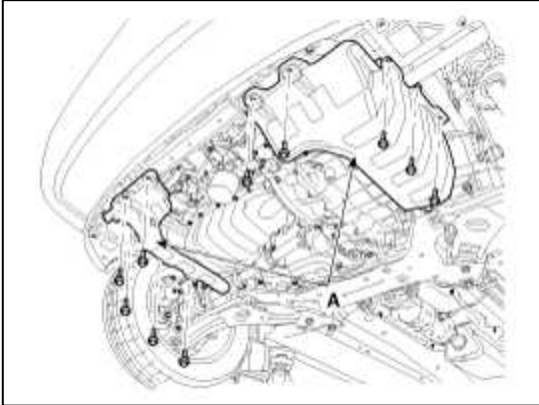
8.8 ~ 13.7N.m (0.9 ~ 1.4kgf.m, 6.5 ~ 10.1lb-ft)



8. Remove the under covers (A).

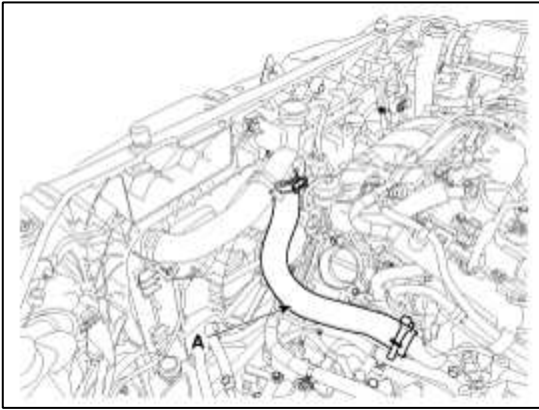
Tightening torque:

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

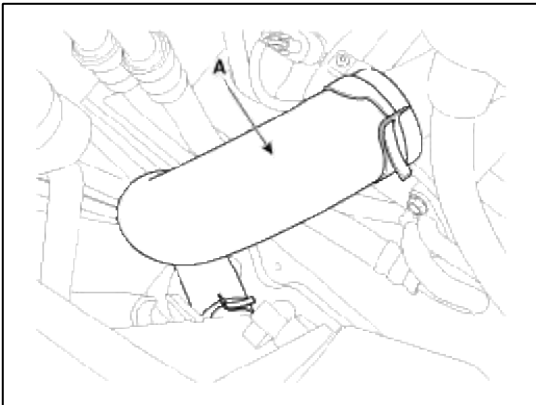


9. Loosen the drain plug, and drain the engine coolant. Remove the radiator cap to help drain the coolant faster.
(Refer to Cooling system in this group)

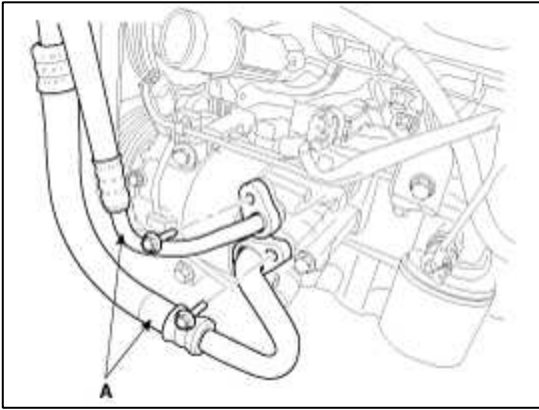
10. Disconnect the radiator upper hose (A).



11. Disconnect the radiator lower hose (A).

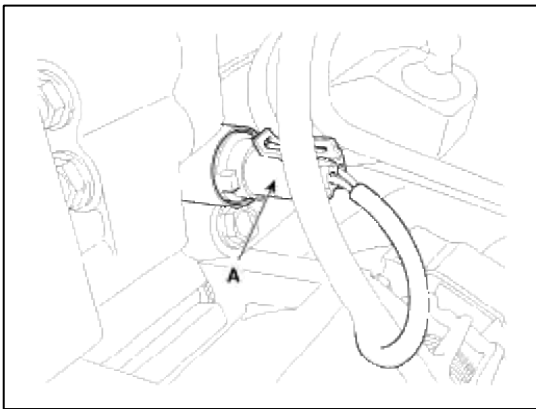


12. Recover the refrigerant and then remove the high pressure pipe and the low pressure pipe (A). (Refer to Air conditioning system in HA Group.)

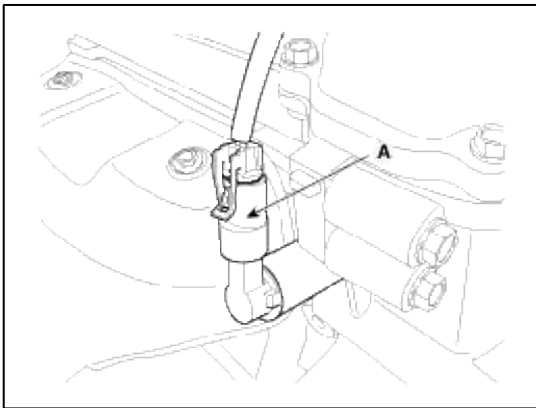


13. Disconnect the wiring connectors and harness clamps, and then remove the wiring and protectors from the cylinder head and the intake manifold.

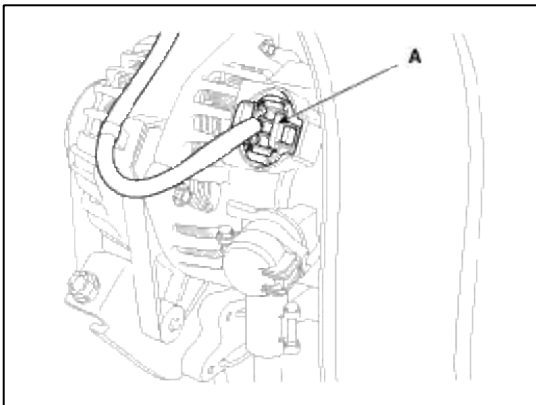
(1) The intake OCV (Oil control valve) connector (A)



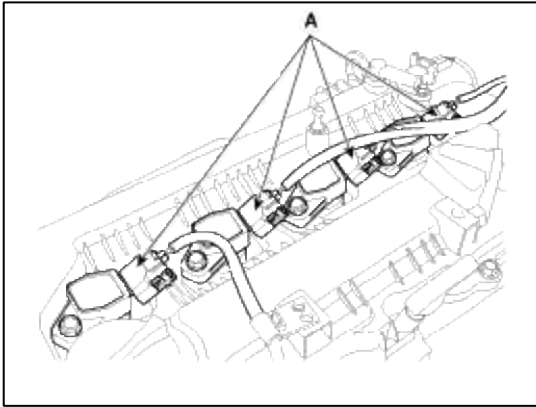
(2) The exhaust OCV (Oil control valve) connector (A)



(3) The alternator connector (A)

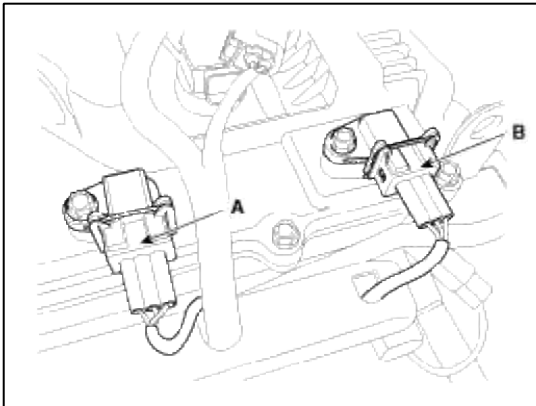


(4) The ignition coil connectors (A)

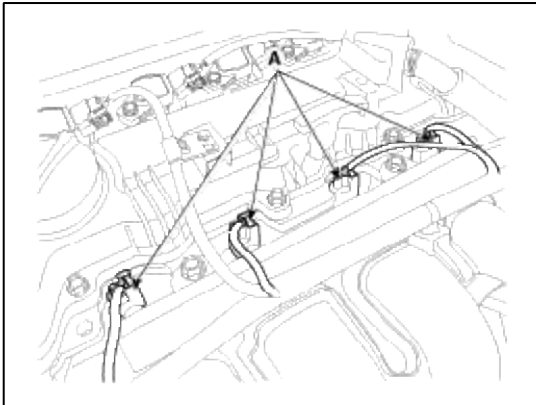


(5) The intake CMPS (Camshaft position sensor) connector (A)

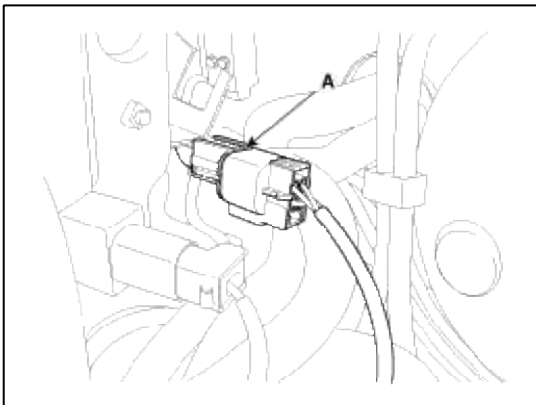
(6) The exhaust CMPS (Camshaft position sensor) connector (B)



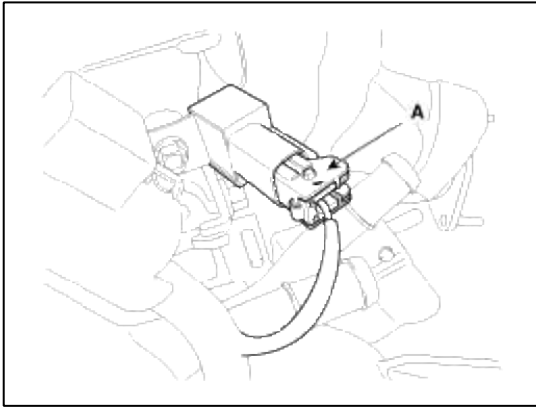
(7) The injector connectors (A)



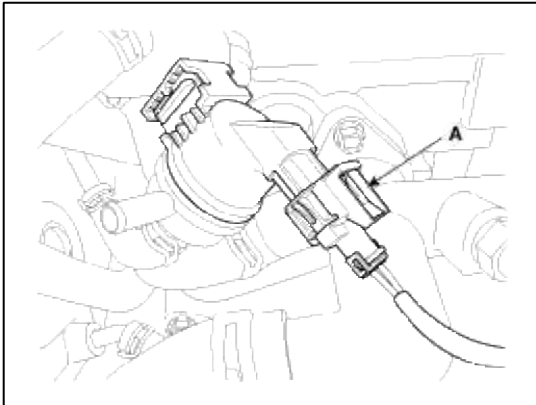
(8) The front and/or rear HO2S (Heated oxygen sensor connectors) (A)



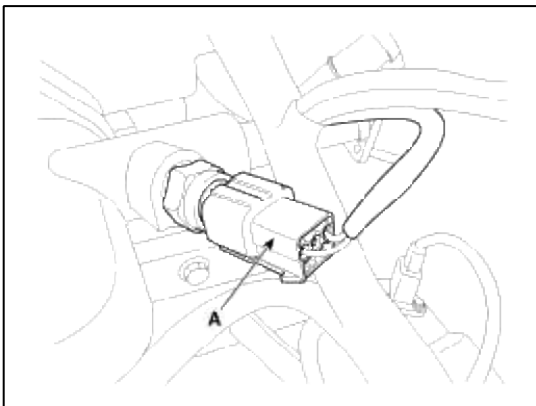
(9) The condenser connector (A)



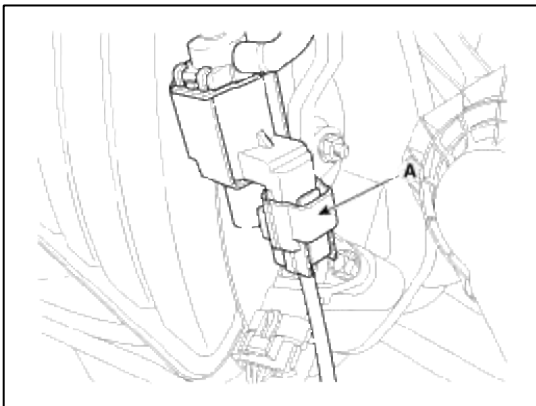
(10) The PCSV (Purge control solenoid valve) connector (A)



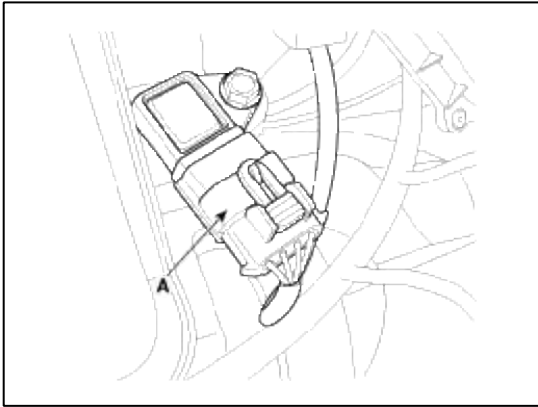
(11) The ECTS (Engine coolant temperature sensor) connector (A)



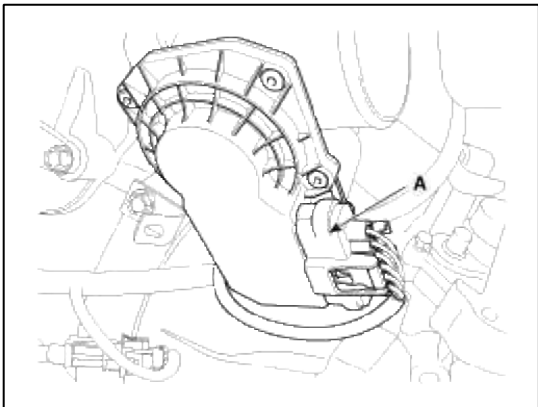
(12) The VIS (Variable Intake System) connector (A)



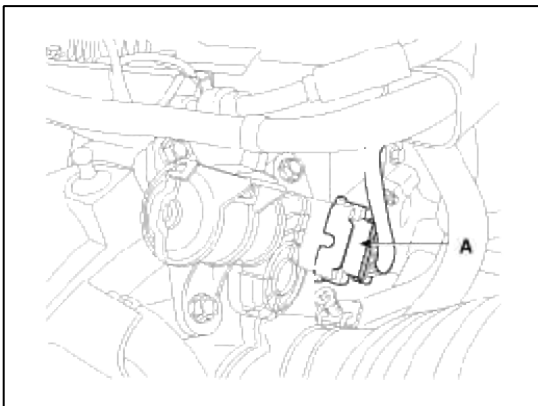
(13) The MAPS (Manifold absolute pressure sensor) & IATS (Intake air temperature sensor) connector (A)



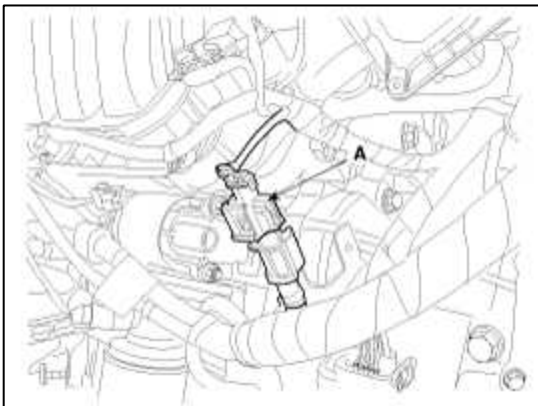
(14) The ETC (Electronic throttle control) connector (A)



(15) The VCMA (Variable charge motion actuator) connector (A)



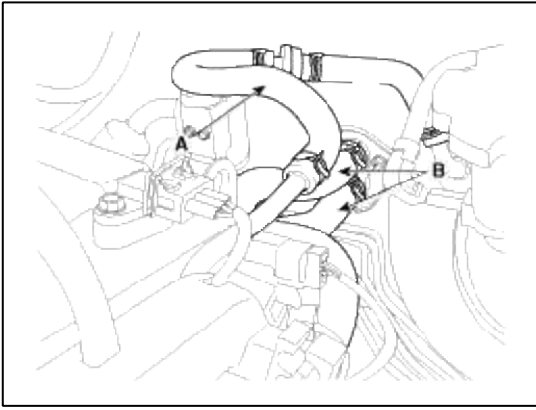
(16) The CKPS(Crankshaft position sensor) connector (A)



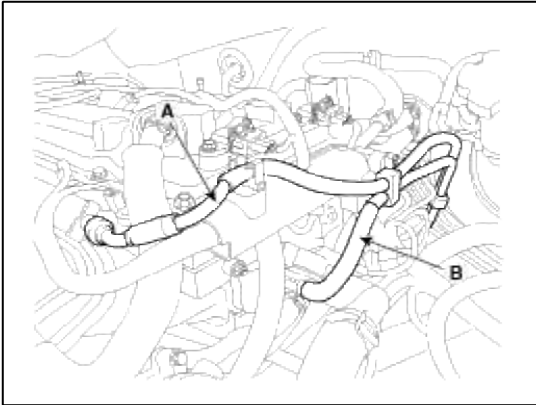
14. Remove the transaxle wire harness connectors, control cable and hoses from the transaxle. (Refer to AT or MT group).

15. Disconnect the ATF cooler hoses. (Refer to AT group)

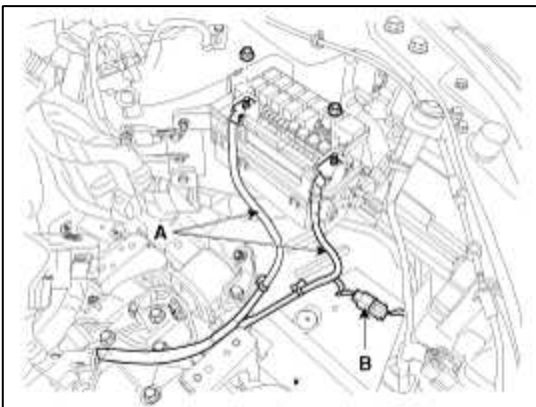
16. Disconnect the brake booster vacuum hose (A) and the heater hoses (B).



17. Disconnect the fuel hose (A) and the PCSV (Purge control solenoid valve) hose (B).



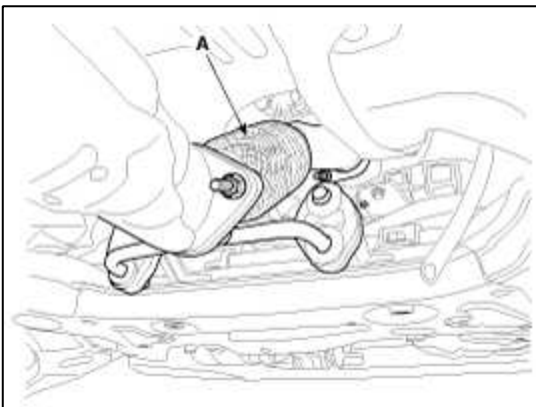
18. Disconnect the "+" cable (A) and the front connector (B).



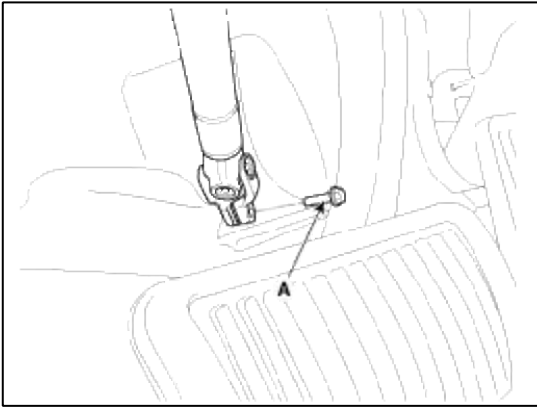
19. Remove the front muffler (A).

Tightening torque:

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

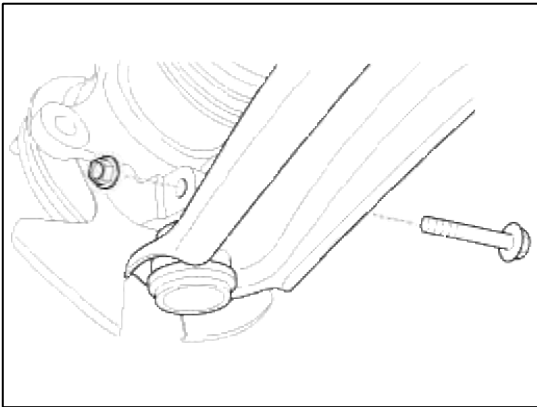


20. Remove the steering u-joint mounting bolt (A). (Refer to ST group – “Steering gear box”)

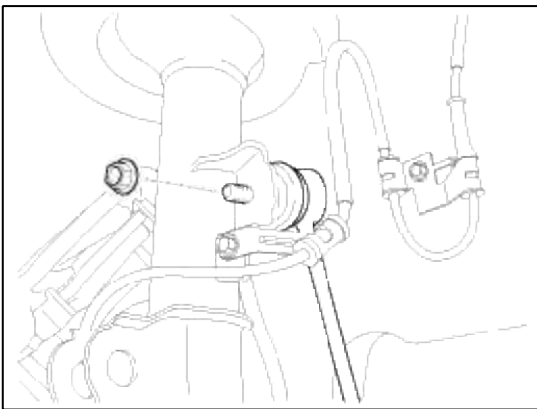


21. Remove the front wheels. (Refer to SS group)

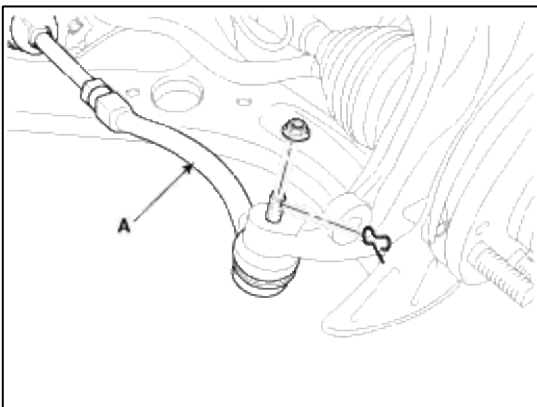
22. Remove the lower arms. (Refer to SS group – “Front lower arm”)



23. Remove the stabilizer bar links. (Refer to SS group – “Front stabilizer bar”)



24. Remove the tie rod ends (A). (Refer to ST group – “Steering gear box”)



25. Disconnect the drive shafts from the axle hubs. (Refer to DS group – “Front driveshaft”)

26. Remove the roll rod bracket (A).

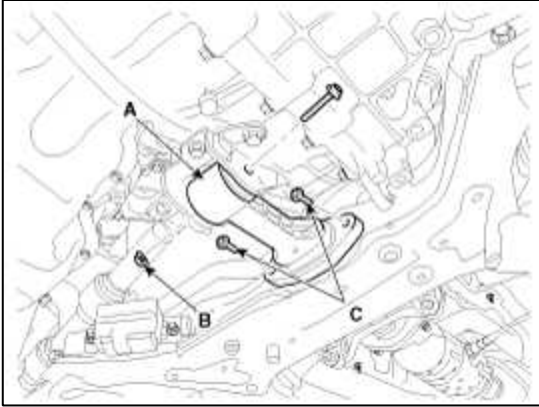
Tightening torque

Nut (B):

107.9 ~ 127.5 N.m (11.0 ~ 13.0 kgf.m, 79.6 ~ 94.0 lb-ft)

Bolt (C):

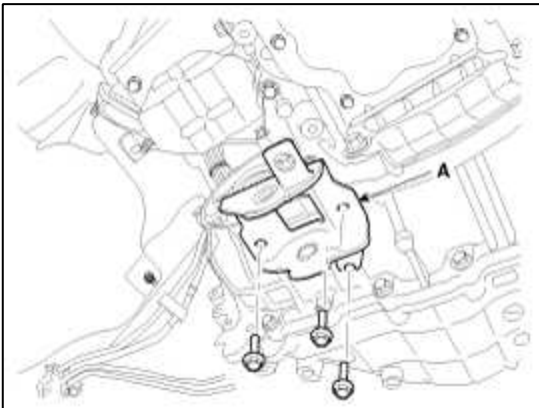
49.0 ~ 63.7 N.m (5.0 ~ 6.5 kgf.m, 36.2 ~ 47.0 lb-ft)



27. Remove the roll rod mounting support bracket (A).

Tightening torque:

49.0 ~ 68.6 N.m (5.0 ~ 7.0 kgf.m, 36.2 ~ 50.6 lb-ft)

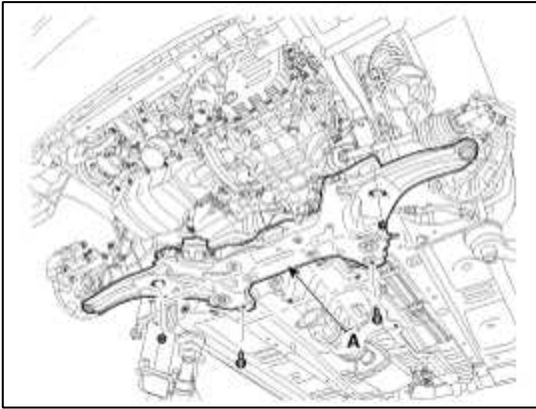


28. Support the sub frame (A) with a floor jack, and then remove the sub frame mounting bolts and nuts.

Tightening torque

Sub frame mounting bolts & nuts:

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



CAUTION

- After removing the sub frame mounting bolts and nuts, the engine and transaxle assembly may fall down, so support them securely with floor jack.
- Verify that the hoses and connectors are disconnected before removing the engine and transaxle assembly.

29. Disconnect the ground line (A), and then remove the engine mounting support bracket (B).

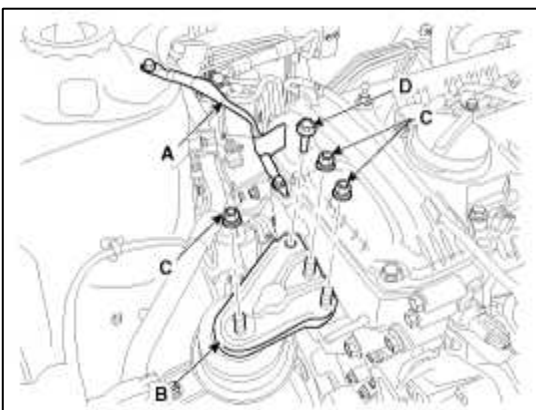
Tightening torque

Ground line bolt (A):

10.8 ~ 13.7 N.m (1.1 ~ 1.4 kgf.m, 8.0 ~ 10.1 lb-ft)

Nuts (C) and bolt (D) :

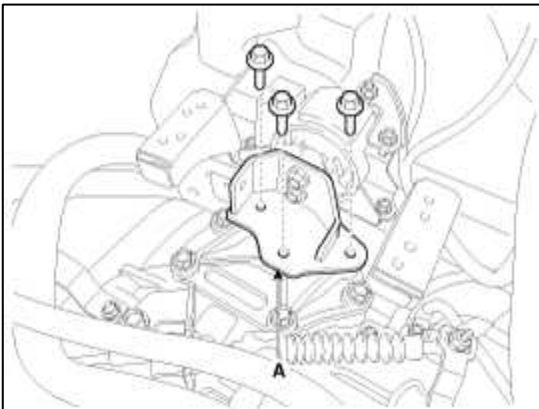
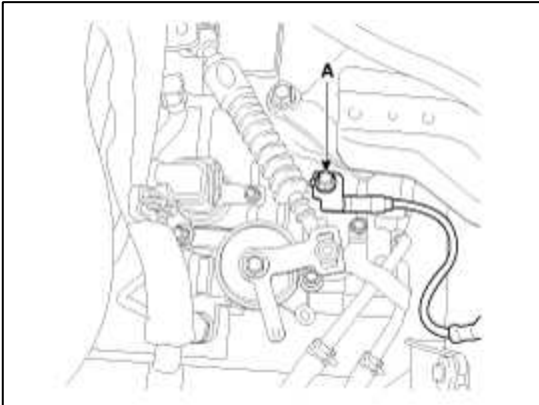
78.5 ~ 98.1 N.m (8.0 ~ 10.0 kgf.m, 57.9 ~ 72.3 lb-ft)



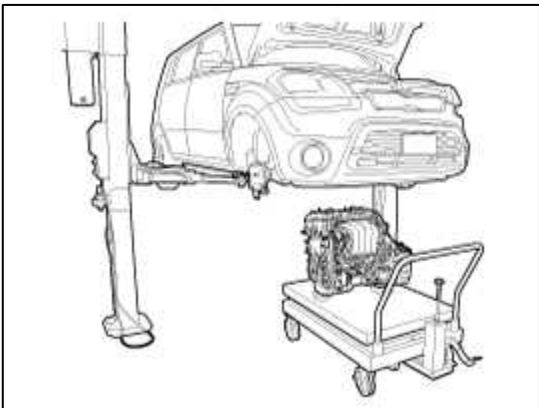
30. Disconnect the ground line (A), and then slowly loosen the transaxle mounting bolts (B).

Tightening torque:

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



31. Lower the engine and transaxle assembly using a floor jack and then remove the engine and transaxle assembly by lifting vehicle.

**CAUTION**

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.

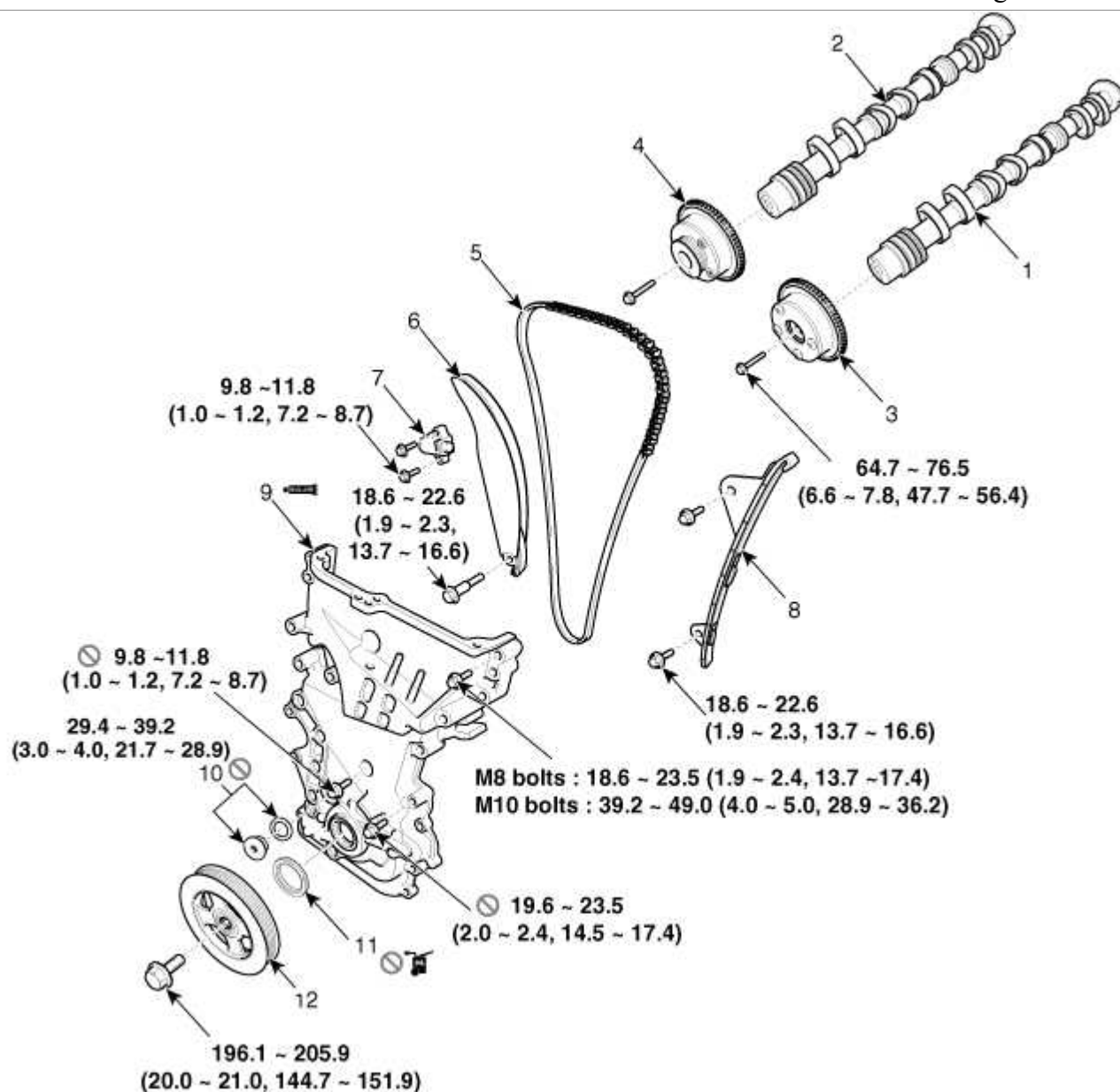
NOTE

Perform the following:

- Adjust a shift cable.
- Refill engine with engine oil.
- Refill a transaxle with fluid.
- Refill a radiator and a reservoir tank with engine coolant.
- Clean battery posts and cable terminals and assemble.
- Inspect for fuel leakage.
- After assembling 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.
- 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 radiator cap on tightly, then run the engine again and check for leaks.

Engine Mechanical System > Timing System > Timing Chain > Components and Components Location

Components



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

1. Intake camshaft	5. Timing chain	9. Timing chain cover
2. Exhaust camshaft	6. Timing chain tensioner arm	10. Service plug bolt & gasket
3. Intake CVVT assembly	7. Timing chain tensioner	11. Front oil seal
4. Exhaust CVVT assembly	8. Timing chain guide	12. Crankshaft damper pulley

Engine Mechanical System > Timing System > Timing Chain > Repair procedures - Revised

Removal

Engine removal is not required for this procedure.

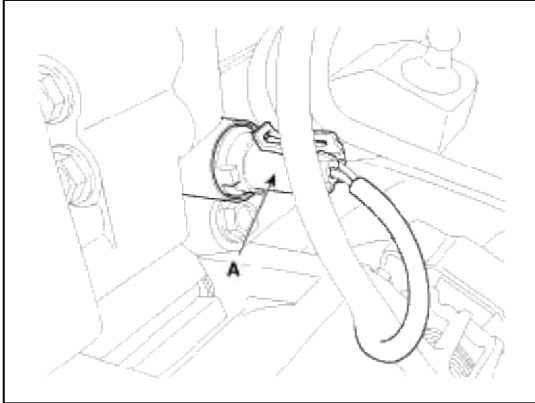
CAUTION

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

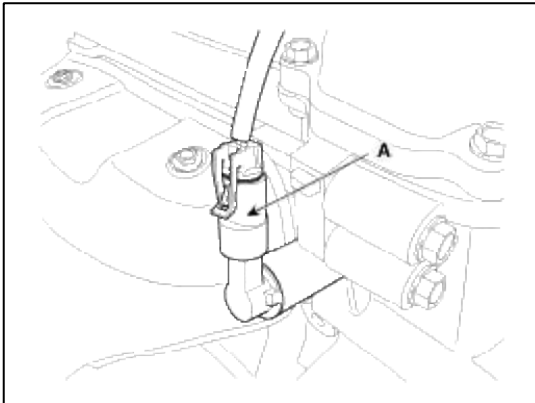
NOTE

Mark all wiring and hoses to avoid misconnection.

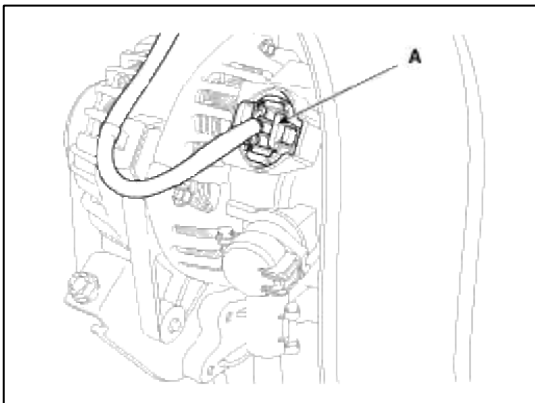
1. Disconnect the battery negative terminal. (Refer to Engine and transaxle assembly in this group)
2. Remove the engine cover. (Refer to Engine and transaxle assembly in this group)
3. Remove the RH front wheel. (Refer to SS group – “Wheel”)
4. Remove the under cover. (Refer to Engine and transaxle assembly in this group)
5. Disconnect the wiring connectors and harness clamps, and then remove the wiring and protectors from the cylinder head cover.
 - (1) The intake OCV (Oil control valve) connector (A)



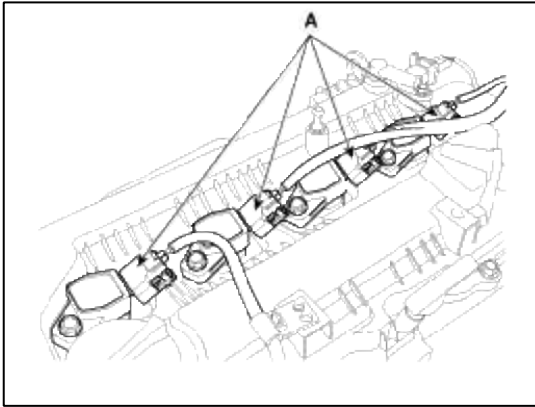
- (2) The exhaust OCV (Oil control valve) connector (A)



- (3) The alternator connector (A)

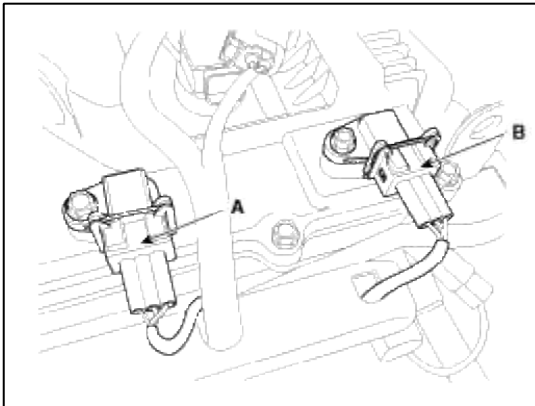


(4) The ignition coil connectors (A)

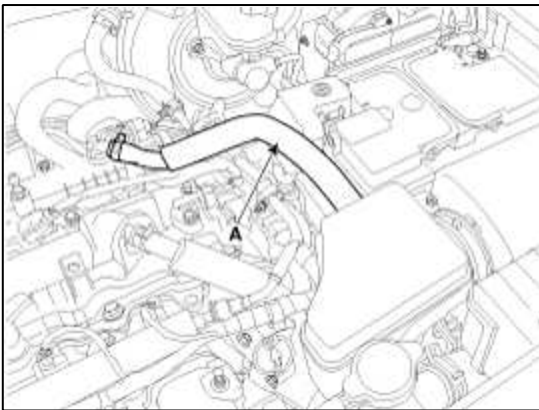


(5) The intake CMPS (Camshaft position sensor) connector (A)

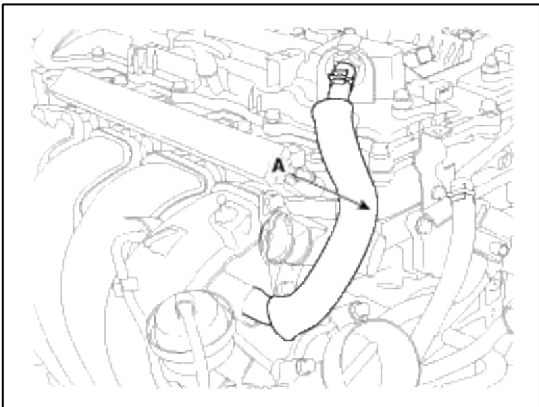
(6) The exhaust CMPS (Camshaft position sensor) connector (B)



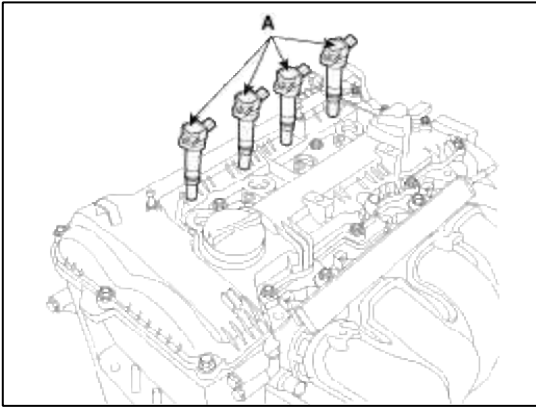
6. Disconnect the breather hose (A).



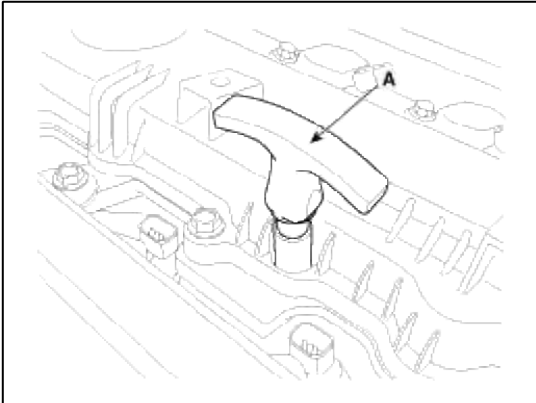
7. Disconnect the PCV (Positive crankcase ventilation) hose (A).



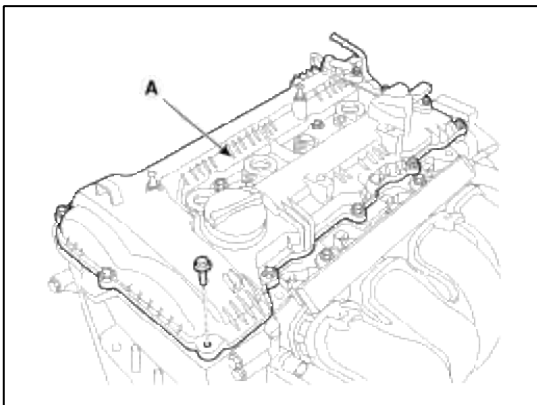
8. Remove the ignition coils (A).



9. Remove the engine oil level gauge (A).

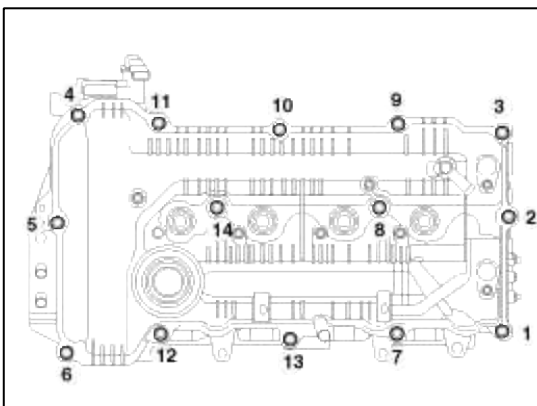


10. Remove the cylinder head cover (A).



NOTE

Unfasten the bolts in the sequence as shown.



11. Drain engine oil and remove the oil pan. (Refer to Lubrication system in this group)

12. Remove the engine mounting support bracket.

- (1) Set the jack to the edge of the lower crankcase.

NOTE

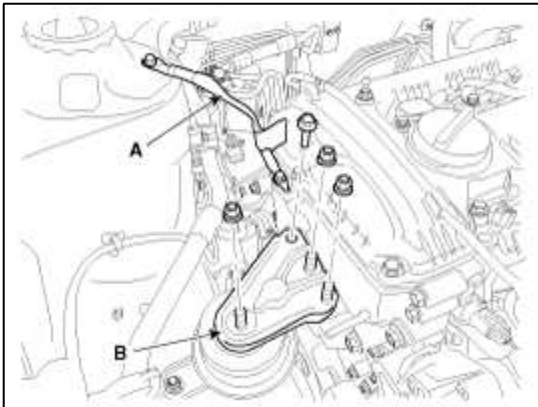
Put the wooden block between lower crankcase and jack.

CAUTION

Be careful not to damage the oil screen.

- (2) Disconnect the engine ground line (A).

- (3) Remove the engine mounting support bracket (B).

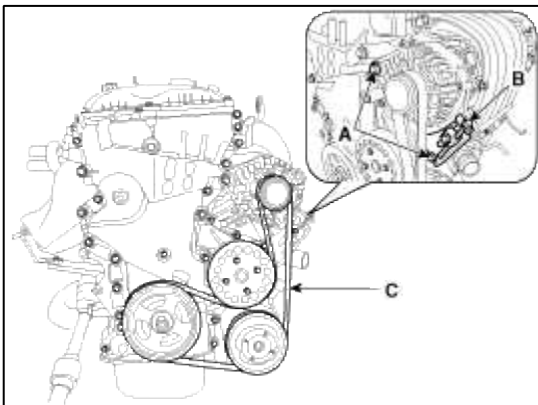


13. Remove the drive belt.

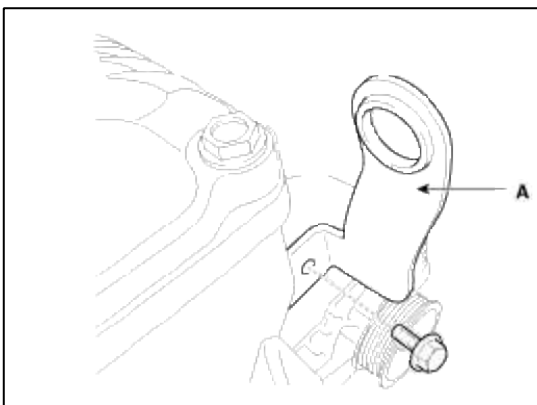
- (1) Loosen the alternator mounting bolts (A).

- (2) Loosen the tension by turning the tension adjusting bolt (B) counterclockwise.

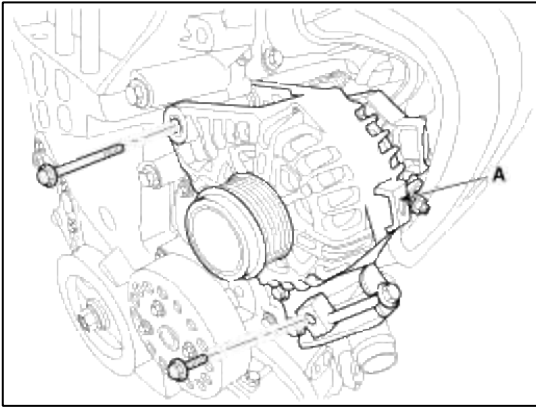
- (3) Remove the drive belt (C).



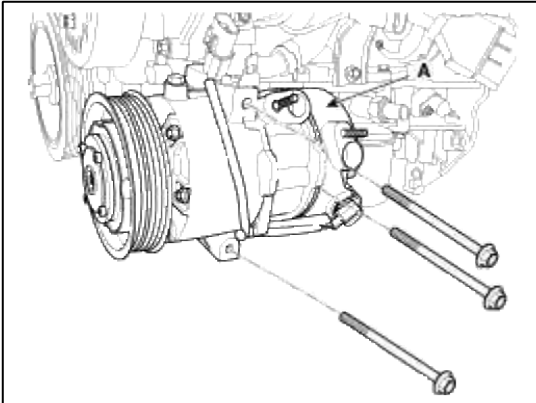
14. Remove the front engine hanger (A).



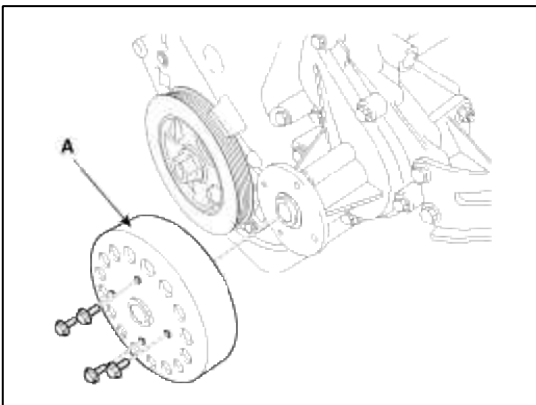
15. Remove the alternator (A). (Refer to EE group – “Alternator”)



16. Remove the A/C compressor (A). (Refer to HA group - "A/C compressor")

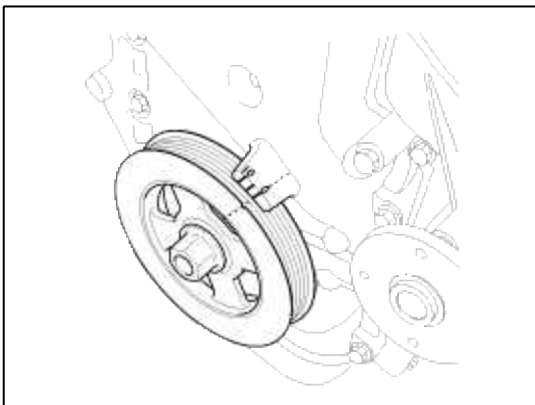


17. Remove the water pump pulley (A).

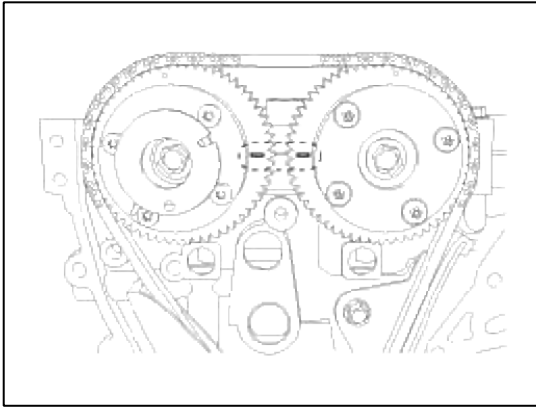


18. Set No.1 cylinder to TDC (Top dead center) on compression stroke.

(1) Turn the crankshaft pulley and align its groove with the timing mark of the timing chain cover.



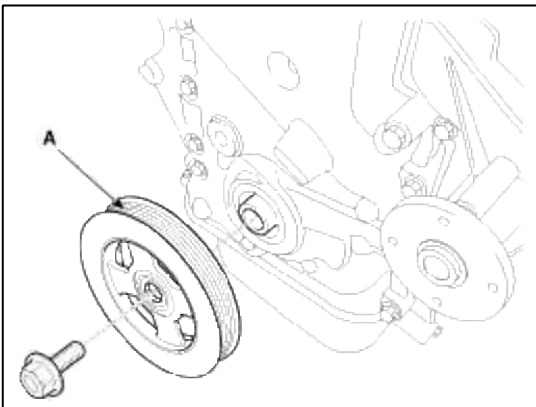
- (2) Check that the TDC marks of the intake and exhaust CVVT sprockets are in straight line on the cylinder head surface as shown in the illustration. If not, turn the crankshaft by one revolution (360°) more.



NOTE

Do not turn the crankshaft pulley counterclockwise.

19. Remove the crankshaft damper pulley (A).



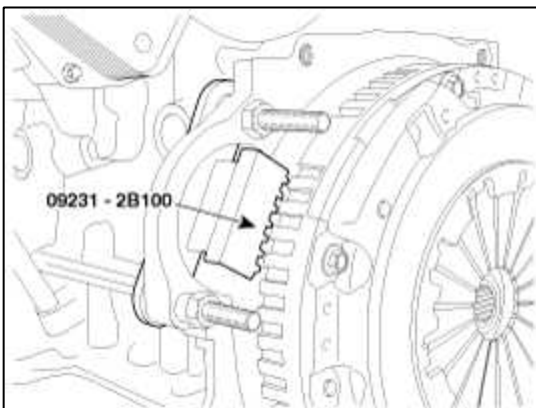
CAUTION

Do not press the pulley or apply the excessive force to prevent the rubber part from being deformed.

NOTE

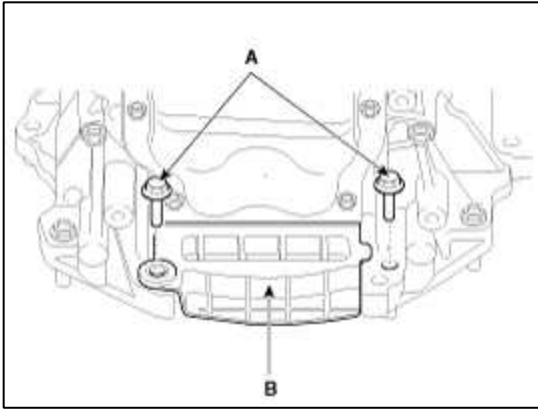
There are two methods to hold the ring gear when removing the crankshaft damper pulley.

- Install the SST (09231-2B100) to hold the ring gear after removing the starter.

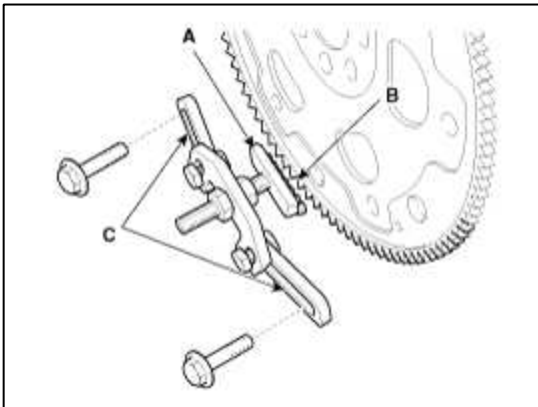


- Install the SST (09231-3D100) to hold the ring gear after removing the service cover.

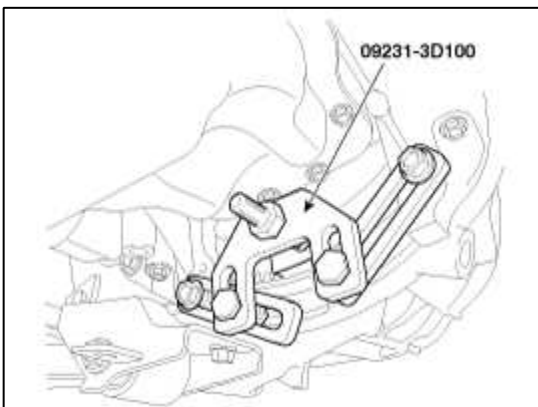
1. Remove the two transaxle mounting bolts (A) and the service cover (B) on the bottom of the lower crankcase.



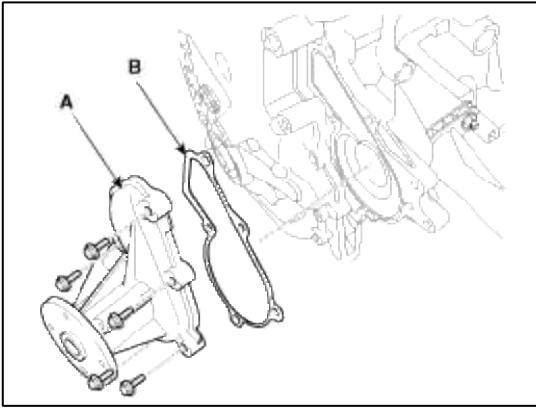
2. Adjust the length of the holder (A) so that the grooves of the holder puts into the ring gears (B) at the closest position.
3. Adjust the angle and length of the links (C) so that the two transaxle mounting bolts can be fastened into the original mounted holes.



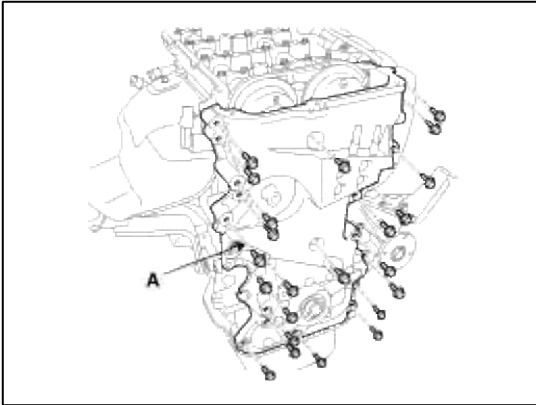
4. Install the SST using the two transaxle mounting bolts. Tighten the bolts and nuts of the holder and links securely.



20. Remove the water pump assembly (A) with the gasket (B).



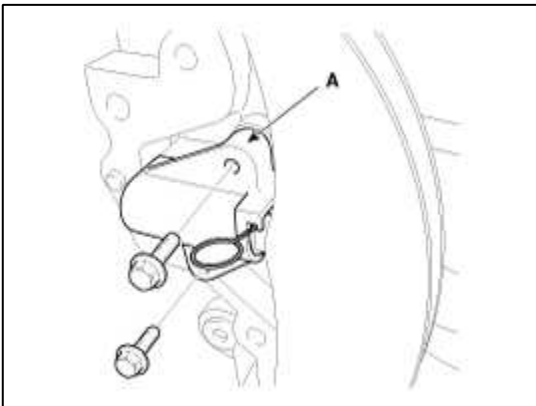
21. Remove the timing chain cover (A) by gently prying the gaps between the cylinder head and cylinder block.



CAUTION

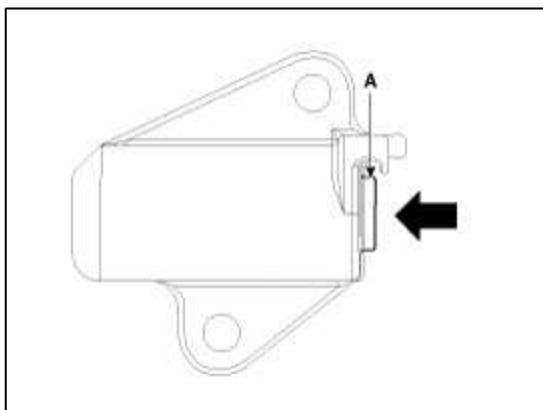
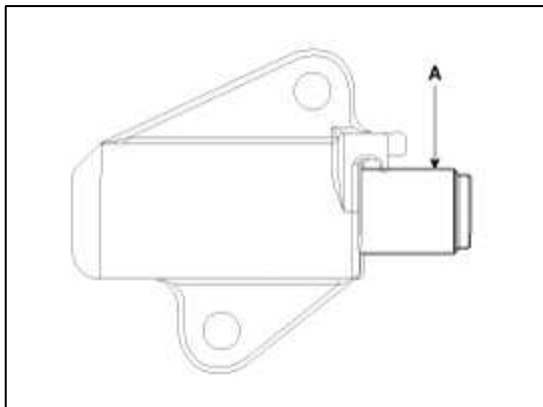
Be careful not to damage the contact surfaces of cylinder block, cylinder head and timing chain cover.

22. Remove the timing chain tensioner (A).

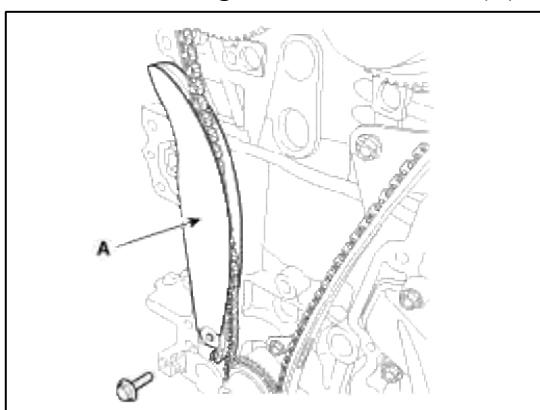


CAUTION

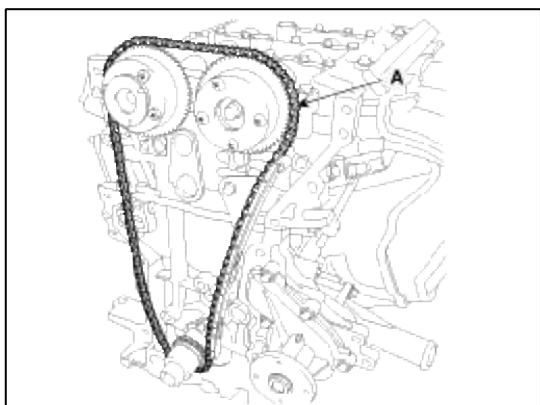
- Do not reuse the detached tensioner.
 - If need to reuse the tensioner, remove the tensioner, make the piston (A) to protrude maximally, push the piston (A) to the end, and then mount the stopper pin.
- At this time, the tensioner fixing pin should be placed in the same way as when the product was first delivered from the factory.



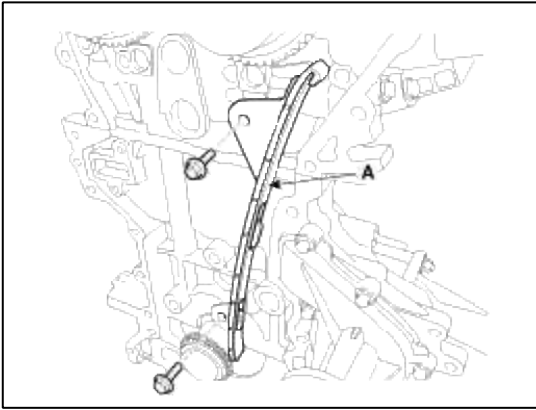
23. Remove the timing chain tensioner arm (A).



24. Remove the timing chain (A).



25. Remove the timing chain guide (A).



Inspection

Sprockets, Chain Tensioner, Chain Guide, Chain Tensioner Arm

1. Check the CVVT sprocket and crankshaft sprocket for abnormal wear, cracks, or damage. Replace if necessary.
2. Inspect the tensioner arm and chain guide for abnormal wear, cracks, or damage. Replace if necessary.
3. Check that the tensioner piston moves smoothly.

Drive belt, Idler, Pulley

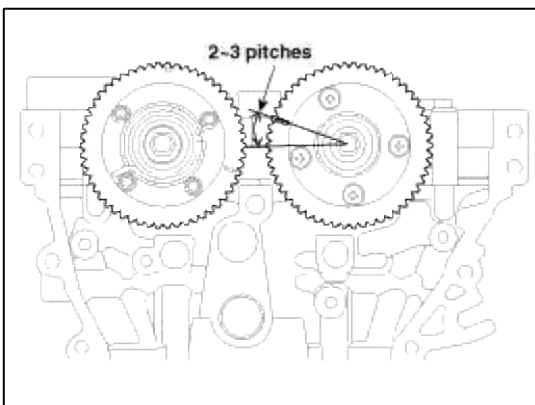
1. Check the idler for excessive oil leakage, abnormal rotation or vibration. Replace if necessary.
2. Check belt for maintenance and abnormal wear of V-ribbed part. Replace if necessary.
3. Check the pulleys for vibration in rotation, oil or dust deposit of V-ribbed part. Replace if necessary.

CAUTION

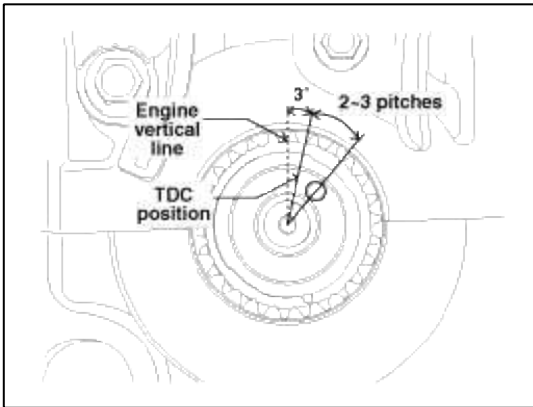
- Do not bend, twist or turn the timing belt inside out.
- Do not allow the timing belt to come into contact with oil, water and steam.

Installation

1. The TDC marks of the intake and exhaust CVVT sprockets are slightly turned from the TDC position as shown when the timing chain is removed.



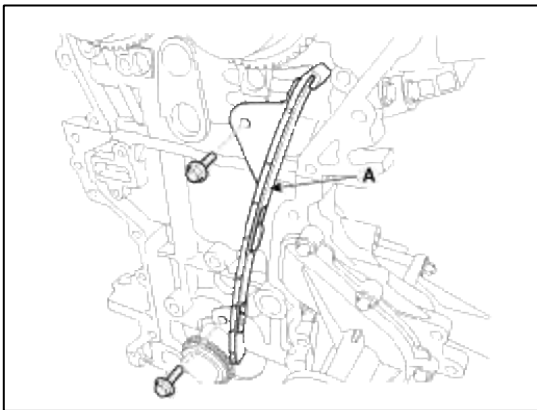
2. Turn the crankshaft clockwise (about 2~3 pitches) from the TDC position (the dowel pin (A) of crankshaft is about 3° with the engine vertical line) as rotation of the intake CVVT sprocket from the TDC position.



3. Install the timing chain guide (A).

Tightening torque:

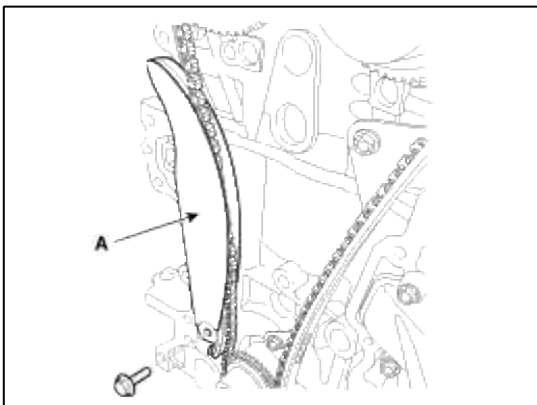
18.6 ~ 22.6 N.m (1.9 ~ 2.3 kgf.m, 13.7 ~ 16.6 lb-ft)



4. Install the timing chain tensioner arm (A).

Tightening torque:

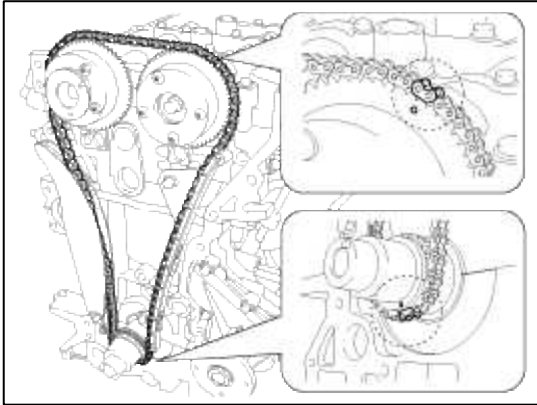
18.6 ~ 22.6 N.m (1.9 ~ 2.3 kgf.m, 13.7 ~ 16.6 lb-ft)



5. Install the timing chain.

Crankshaft sprocket (A) → Timing chain guide (B) → Intake CVVT sprocket (C) → Exhaust CVVT sprocket (D)

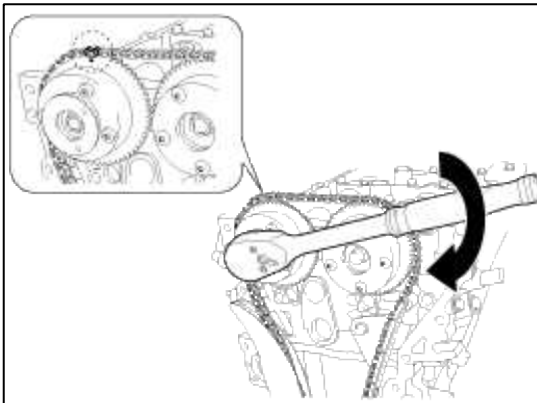
- (1) Install the timing chain with no slack between the crankshaft sprocket and the intake CVVT sprocket.



NOTE

The timing marks of each sprocket should be matched with timing marks (color link) of timing chain when installing the timing chain.

- (2) Install the timing chain on the exhaust CVVT sprocket with no slack while turning the CVVT assembly clockwise.



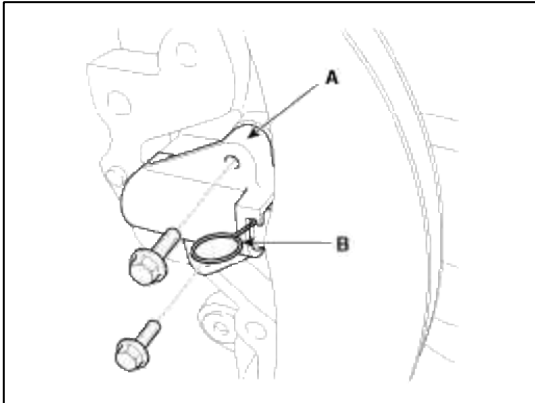
NOTE

- The timing mark of the exhaust CVVT sprocket should be matched with timing mark (color link) of timing chain when installing the timing chain.
- Press down the timing chain links on the exhaust CVVT sprocket to prevent the sprocket from spinning.

6. Install the timing chain auto tensioner (A) and remove the stopper pin (B).

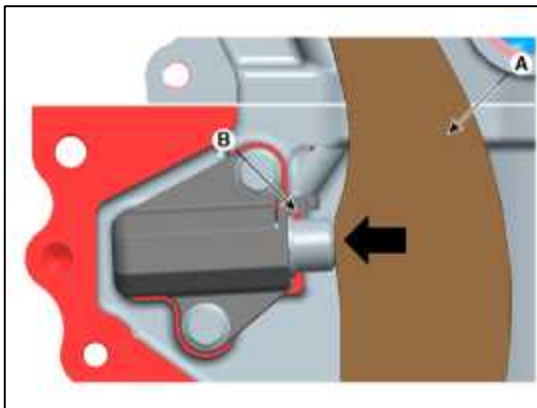
Tightening torque:

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

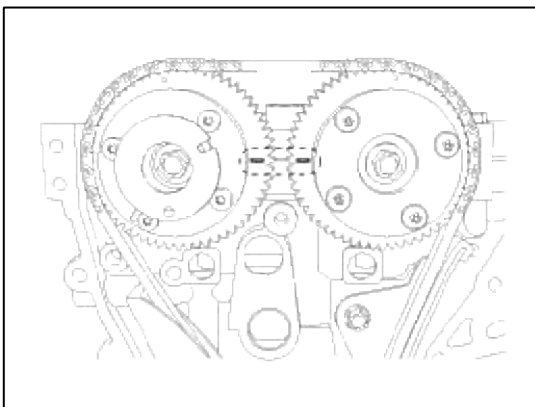


CAUTION

- When reinstall the tensioner, check the ratchet function of the tensioner after removing the fixing pin by retracting the tensioner arm (A) maximally as shown below.
- When maximally retracted, there should be no interference between the tensioner arm (A) and tensioner housing (B).



7. After rotating crankshaft 2 revolutions in regular direction (clockwise viewed from front), confirm that the TDC marks on the intake and exhaust CVVT sprockets are aligned with the top surface of cylinder head.



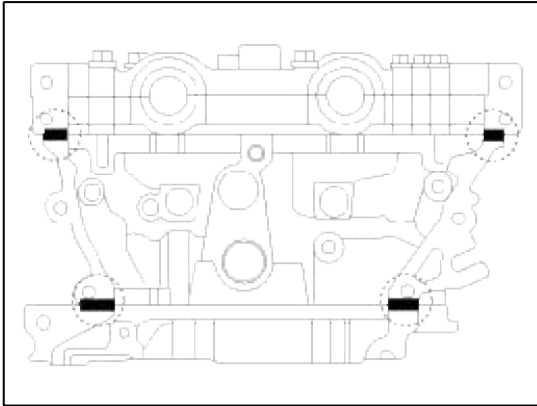
8. Install the timing chain cover.

- (1) Using a gasket scraper, remove all the old packing material from the gasket surfaces.
- (2) The sealant locations on the chain cover and the counter parts (cam carrier, cylinder head, cylinder block, and lower crankcase) must be free of harmful foreign materials, oil, dust and moisture. Spraying cleaner on the surface and wiping with a clean duster.

- (3) Before assembling the timing chain cover, liquid sealant should be applied on the gap between cam carrier, cylinder head and cylinder block.

Bead width: 3.0 ~ 5.0 mm (0.11 ~ 0.20 in.)

Sealant: Threebond 1217H or equivalent



- (4) After applying liquid sealant on the timing chain cover, assemble the cover within 5 minutes after sealant was applied. Continuous bead of sealant should be applied to prevent any path from oil leakage.

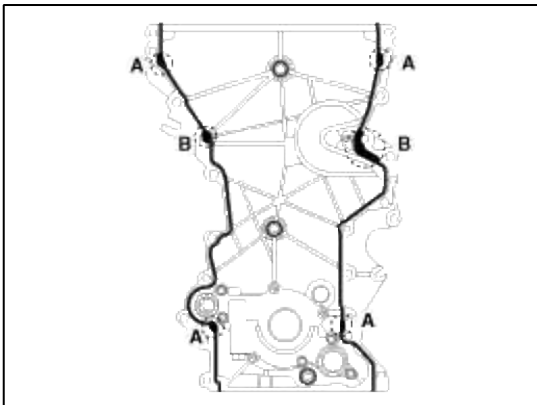
Bead width

Whole section: 2.5 ~ 3.5 mm (0.10 ~ 0.14 in.)

Section A: 4.5 ~ 5.5 mm (0.18 ~ 0.22 in.)

Section B: 8.0 ~ 9.0 mm (0.32 ~ 0.35 in.)

Sealant: Threebond 1217H or equivalent



- (5) Install the timing chain cover. The dowel pins on the cylinder block and holes on the timing chain cover should be used as a reference in order to assemble the timing chain cover in exact position.

Tightening torque

Bolts (A, B):

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

Bolt (C):

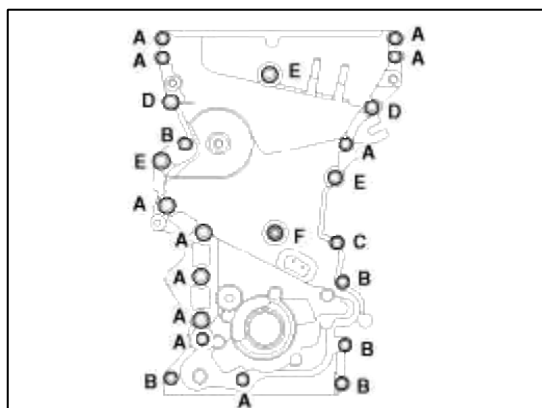
19.6 ~ 23.5 N.m (2.0 ~ 2.4 kgf.m, 14.5 ~ 17.4 lb-ft)

Bolts (D,E):

39.2 ~ 49.0 N.m (4.0 ~ 5.0 kgf.m, 28.9 ~ 36.2 lb-ft)

Bolt (F):

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



CAUTION

Do not reuse the seal bolts (C,F).

CAUTION

The engine running or pressure test should not be performed within 30 minutes after the timing chain cover was assembled.

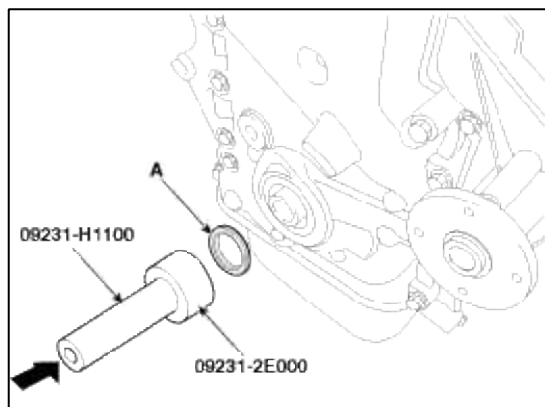
9. Replace the front oil seal if necessary.

- (1) Apply engine oil on the edge of new oil seal.

CAUTION

Remove any debris from the lip portion of the oil seal.

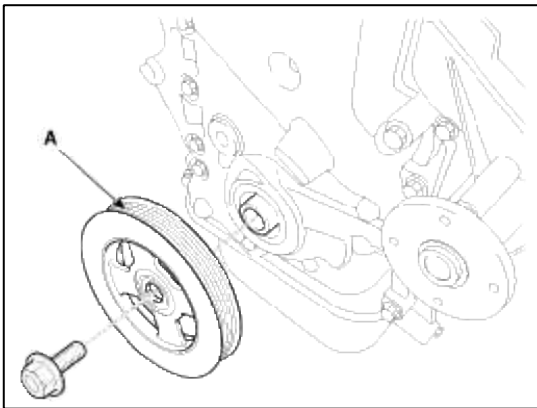
- (2) Install the front oil seal (A) using SST (09231-2E000, 09231-H1100).



10. Install the crankshaft damper pulley (A).

Tightening torque:

196.1 ~ 205.9 N.m (20.0 ~ 21.0 kgf.m, 144.7 ~ 151.9 lb-ft)

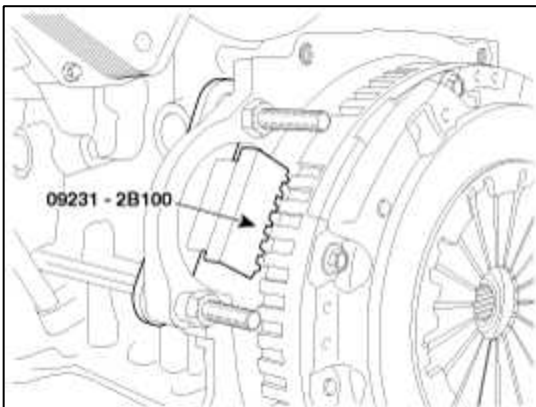
**CAUTION**

Do not press the pulley or apply the excessive force to prevent the rubber part from being deformed.

NOTE

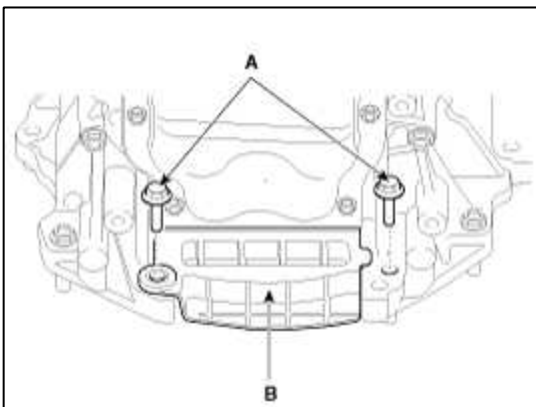
There are two methods to hold the ring gear when installing the crankshaft damper pulley.

- Install the SST (09231-2B100) to hold the ring gear after removing the starter.



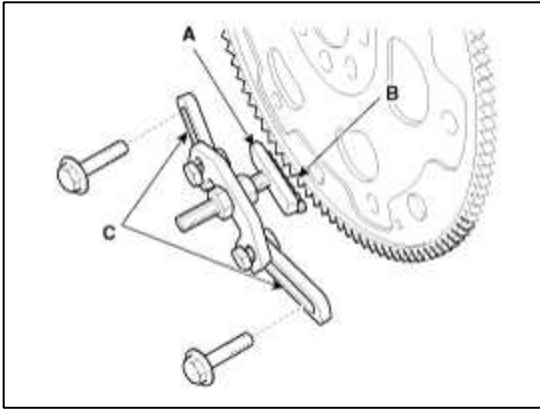
- Install the SST (09231-3D100) to hold the ring gear after removing the service cover.

1. Remove the two transaxle mounting bolts (A) and the service cover (B) on the bottom of the lower crankcase.

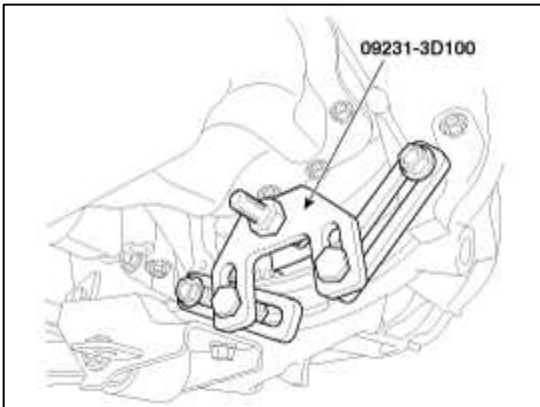


2. Adjust the length of the holder (A) so that the grooves of the holder puts into the ring gears (B) at the closest position.

3. Adjust the angle and length of the links (C) so that the two transaxle mounting bolts can be fastened into the original mounted holes.



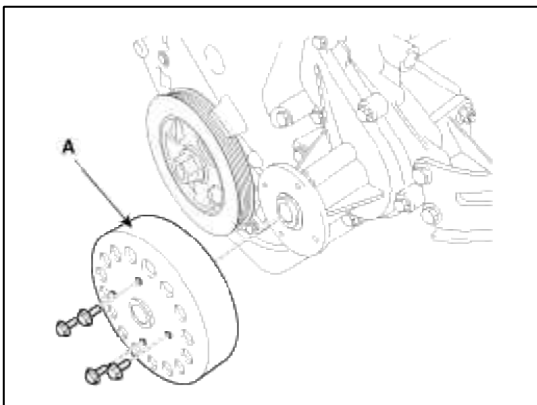
4. Install the SST using the two transaxle mounting bolts. Tighten the bolts and nuts of the holder and links securely.



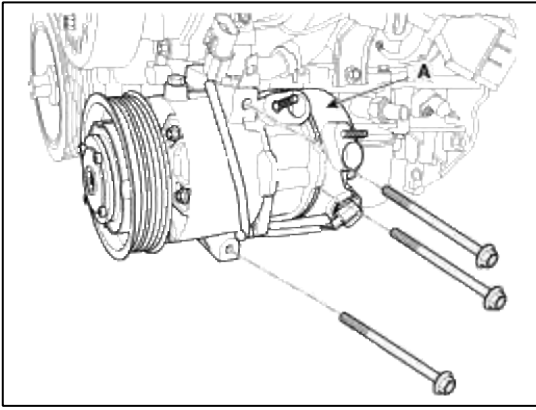
11. Install the water pump pulley (A).

Tightening torque:

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



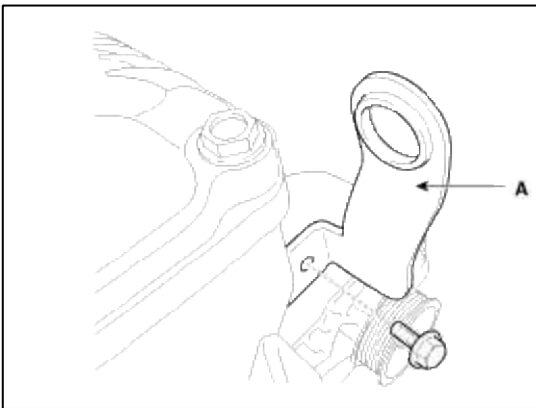
12. Install the A/C compressor (A). (Refer to HA group - "A/C compressor")



13. Install the front engine hanger (A).

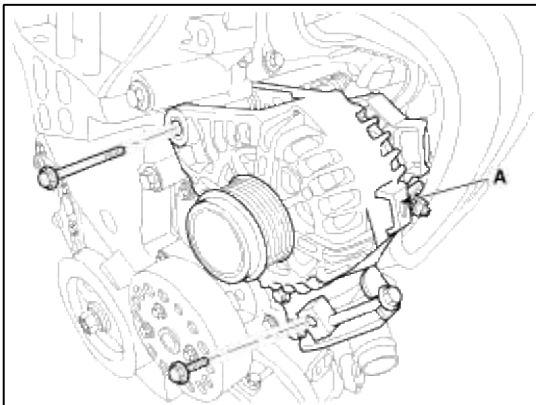
Tightening torque:

34.3 ~ 39.2 N.m (3.5 ~ 4.0 kgf.m, 25.3 ~ 28.9 lb-ft)



14. Install the drive belt.

- (1) Preassemble the alternator (A) temporarily.



- (2) Install the drive belt (C).

- (3) Adjust the tension by turning the tension adjusting bolt (B) clockwise. (Refer to EE group – “Alternator”)

Belt tension

New belt:

637.4 ~ 735.5 N (65 ~ 75 kgf, 143.3 ~ 165.3 lbf)

Used belt:

441.3 ~ 539.4 N (45 ~ 55 kgf, 99.2 ~ 121.3 lbf)

- (4) Tighten the alternator mounting bolts (A) with the specified torque.

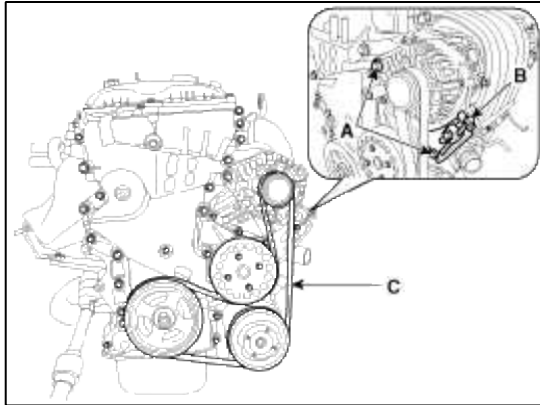
Tightening torque

M10 bolt:

29.4 ~ 41.2 N.m (3.0 ~ 4.2 kgf.m, 21.7 ~ 30.4 lb-ft)

M8 bolt:

21.6 ~ 32.4 N.m (2.2 ~ 3.3 kgf.m, 15.9 ~ 23.9 lb-ft)



15. Install the engine mounting support bracket.

- (1) Install the engine mounting support bracket (B).

Tightening torque

Nut (C):

78.5 ~ 98.1 N.m (8.0 ~ 10.0 kgf.m, 57.9 ~ 72.3 lb-ft)

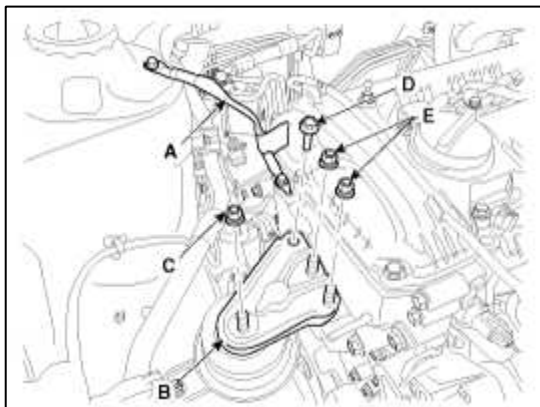
Bolt (D) and Nuts (E):

58.8 ~ 73.5 N.m (6.0 ~ 7.5 kgf.m, 43.4 ~ 54.2 lb-ft)

- (2) Connect the engine ground line (A).

Tightening torque

10.8 ~ 13.7 N.m (1.1 ~ 1.4 kgf.m, 8.0 ~ 10.1 lb-ft)



- (3) Remove the jack from the lower crankcase.

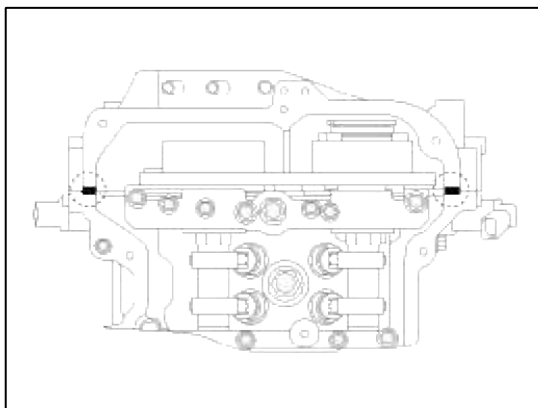
16. Install the oil pan. (Refer to Lubrication system in this group)

17. Install cylinder head cover.

- (1) The hardening sealant located on the cylinder head cover and the gap between the timing chain cover and the cam carrier should be removed before assembling cylinder head cover.
- (2) Apply engine oil on the lip portion of the oil seal on the cover and outer surface of the spark plug pipes.
- (3) After applying sealant on the gap between the timing chain cover and the cam carrier, it should be assembled within 5 minutes.

Bead width: 2.0 ~ 3.0 mm (0.08 ~ 0.12 in.)

Sealant: Threebond 1217H or equivalent

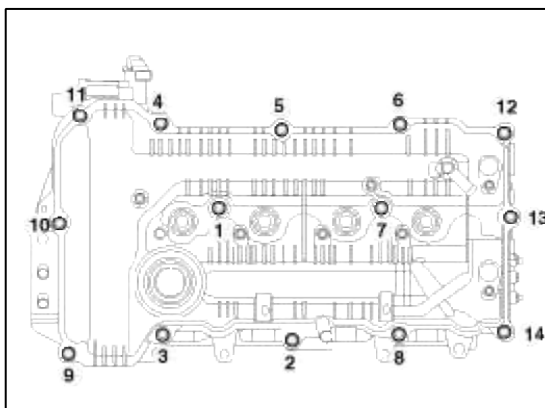


- (4) Install the cylinder head cover (A) by tightening the bolts, in several passes, in the sequence as shown.

Tightening torque

1st step: 3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft)

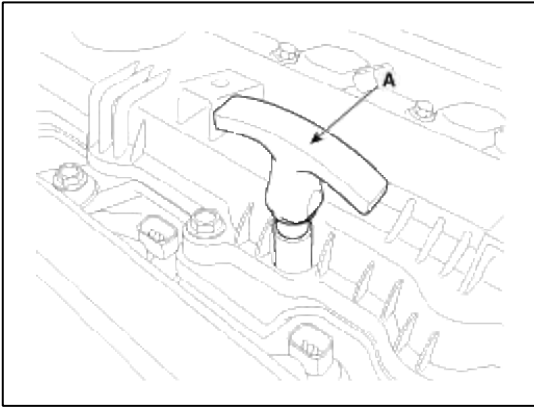
2nd step: 7.8 ~ 9.8 N.m (0.8 ~ 1.0 kgf.m, 5.8 ~ 7.2 lb-ft)



CAUTION

- Do not reuse cylinder head cover gasket.
- Before installing the cylinder head cover, make sure the cylinder head cover gasket is not separated from the cylinder head cover gasket groove.
- The engine running or pressure test should not be performed within 30 minutes after the cylinder head cover was assembled.

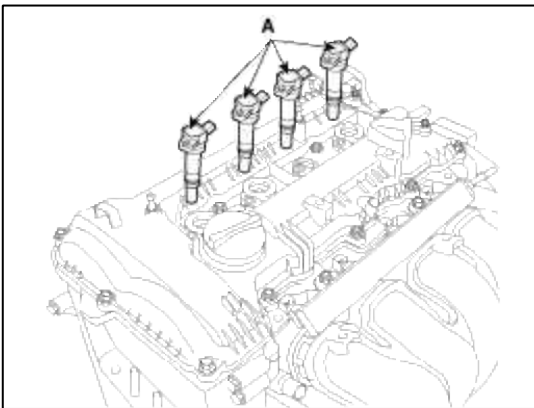
18. Install the oil level gauge (A).



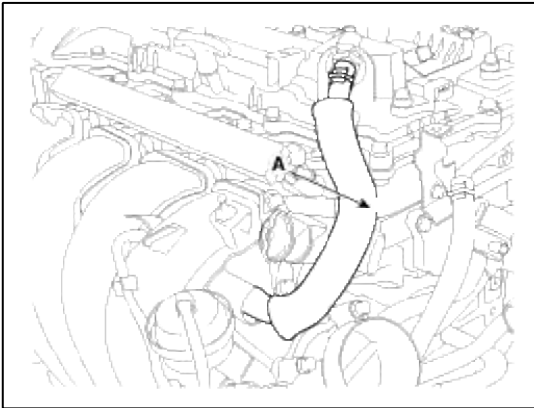
19. Install the ignition coils (A).

Tightening torque :

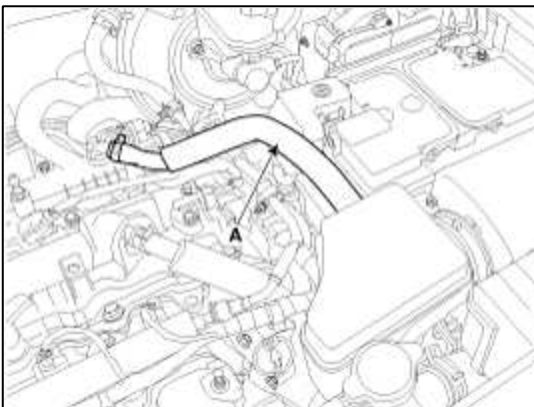
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



20. Connect the PCV (Positive crankcase ventilation) hose (A).



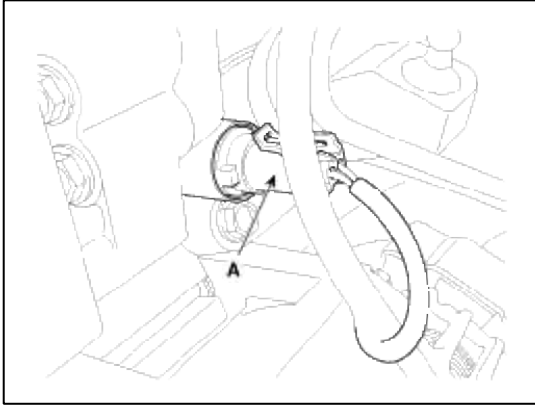
21. Connect the breather hose (A).



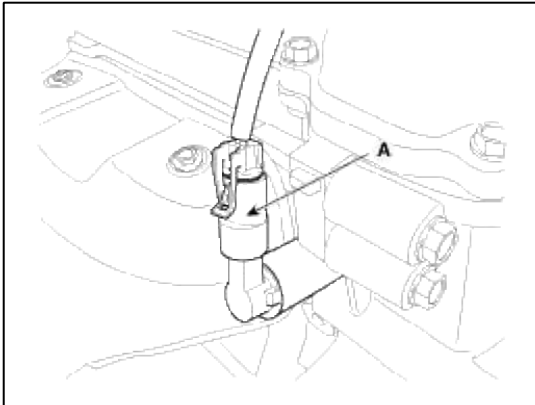
22. Install the wiring and protectors on the cylinder head cover and then connect the wiring connectors and harness

clamps.

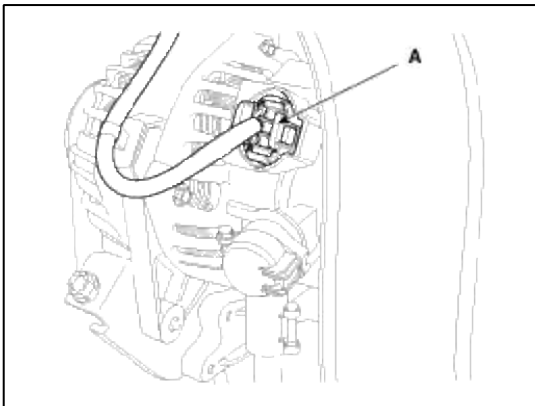
- (1) The intake OCV (Oil control valve) connector (A)



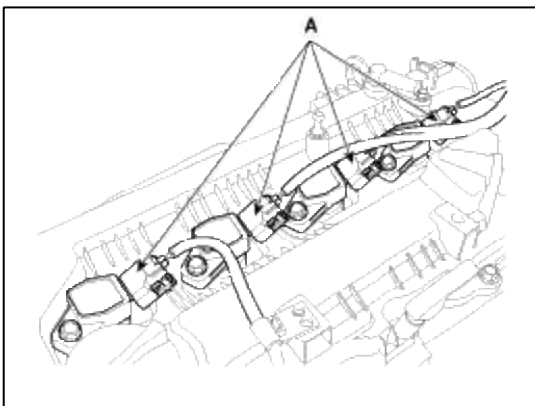
- (2) The exhaust OCV (Oil control valve) connector (A)



- (3) The alternator connector (A)

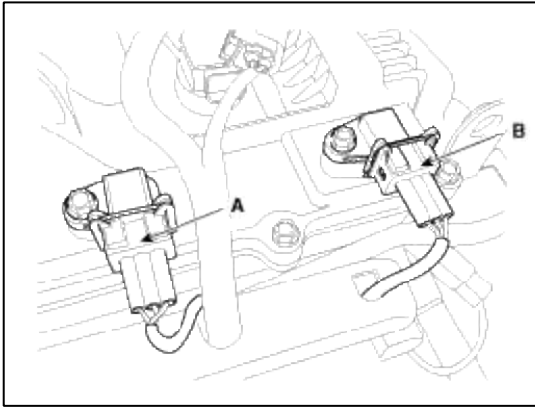


- (4) The ignition coil connectors (A)



- (5) The intake CMPS (Camshaft position sensor) connector (A)

(6) The exhaust CMPS (Camshaft position sensor) connector (B)



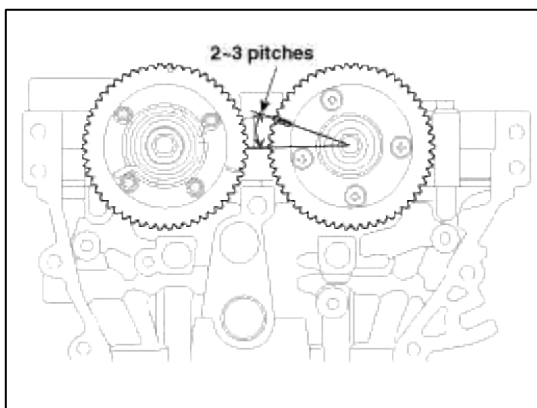
23. Install the under cover. (Refer to Engine and transaxle assembly in this group)
24. Install the RH front wheel. (Refer to SS group – “Wheel”)
25. Connect the battery negative terminal. (Refer to Engine and transaxle assembly in this group)
26. Install the engine cover. (Refer to Engine and transaxle assembly in this group)
27. Add all the necessary fluids and check for leaks. Connect GDS. Check for codes, note, and clear. Recheck.

NOTE

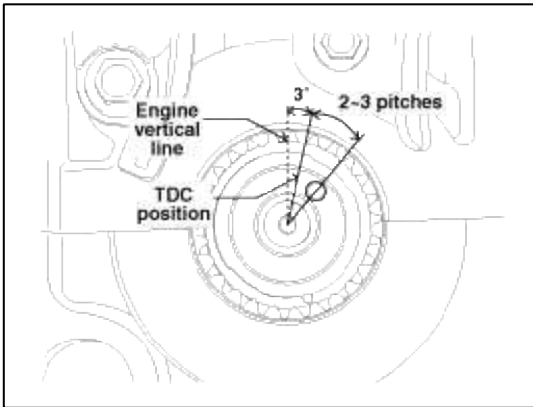
- Refill engine with engine oil.
- Clean battery posts and cable terminals and assemble.
- Inspect for fuel leakage.
 - After assembling the fuel line, turn on the ignition switch (do not operate the starter) so that the fuel pump runs for approximately two seconds and fuel line pressurizes.
 - Repeat this operation two or three times, then check for fuel leakage at any point in the fuel line.

Installation

1. The TDC marks of the intake and exhaust CVVT sprockets are slightly turned from the TDC position as shown when the timing chain is removed.



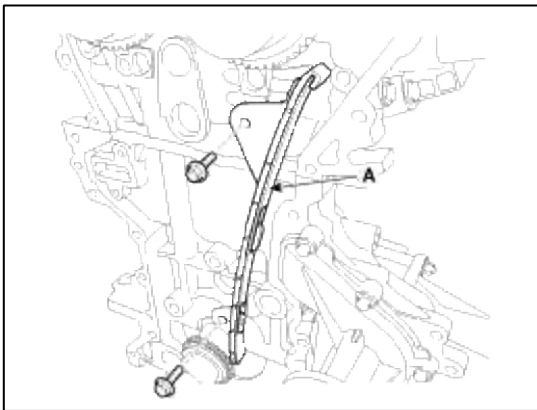
2. Turn the crankshaft clockwise (about 2~3 pitches) from the TDC position (the dowel pin (A) of crankshaft is about 3° with the engine vertical line) as rotation of the intake CVVT sprocket from the TDC position.



3. Install the timing chain guide (A).

Tightening torque:

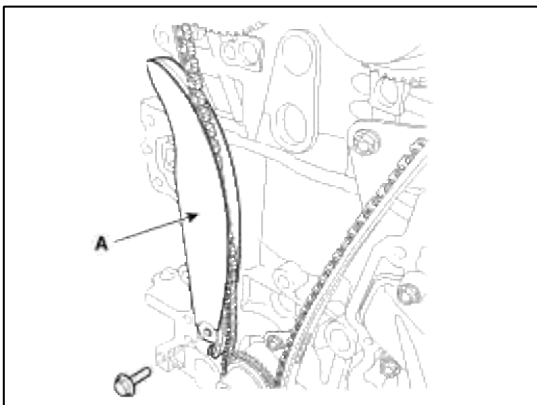
18.6 ~ 22.6 N.m (1.9 ~ 2.3 kgf.m, 13.7 ~ 16.6 lb-ft)



4. Install the timing chain tensioner arm (A).

Tightening torque:

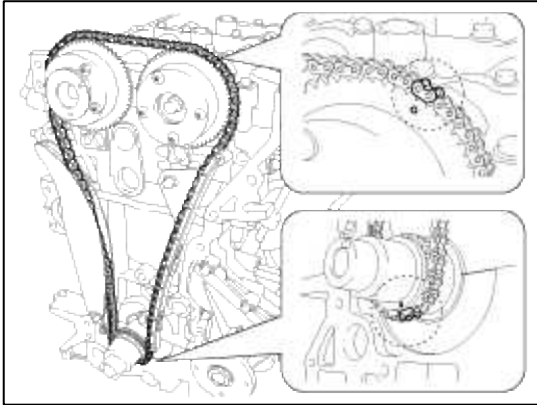
18.6 ~ 22.6 N.m (1.9 ~ 2.3 kgf.m, 13.7 ~ 16.6 lb-ft)



5. Install the timing chain.

Crankshaft sprocket (A) → Timing chain guide (B) → Intake CVVT sprocket (C) → Exhaust CVVT sprocket (D)

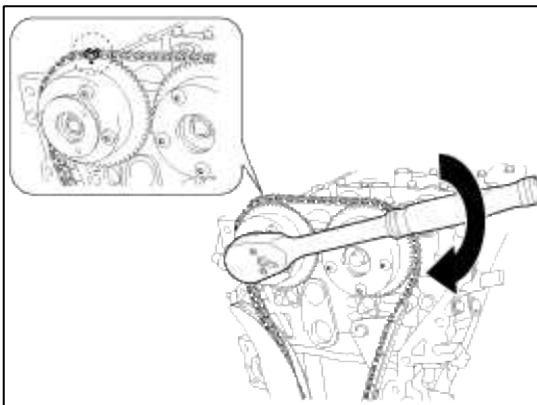
- (1) Install the timing chain with no slack between the crankshaft sprocket and the intake CVVT sprocket.



NOTE

The timing marks of each sprocket should be matched with timing marks (color link) of timing chain when installing the timing chain.

- (2) Install the timing chain on the exhaust CVVT sprocket with no slack while turning the CVVT assembly clockwise.



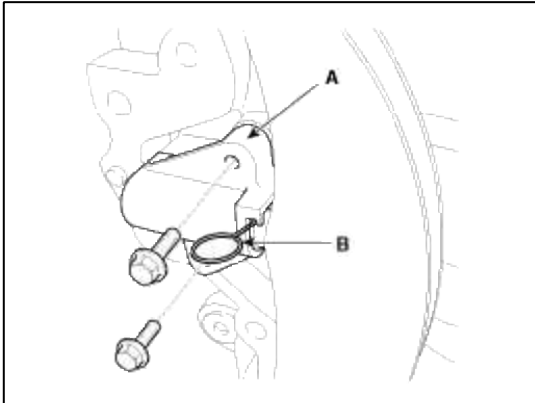
NOTE

- The timing mark of the exhaust CVVT sprocket should be matched with timing mark (color link) of timing chain when installing the timing chain.
- Press down the timing chain links on the exhaust CVVT sprocket to prevent the sprocket from spinning.

6. Install the timing chain auto tensioner (A) and remove the stopper pin (B).

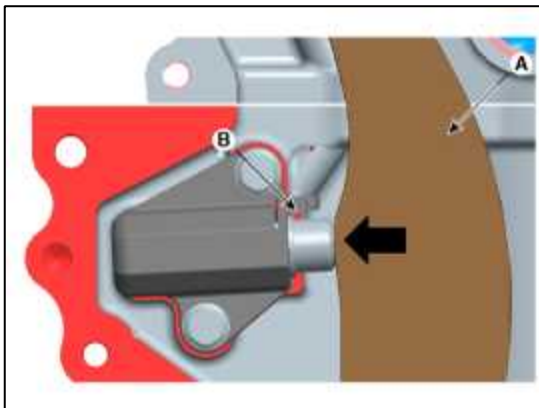
Tightening torque:

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

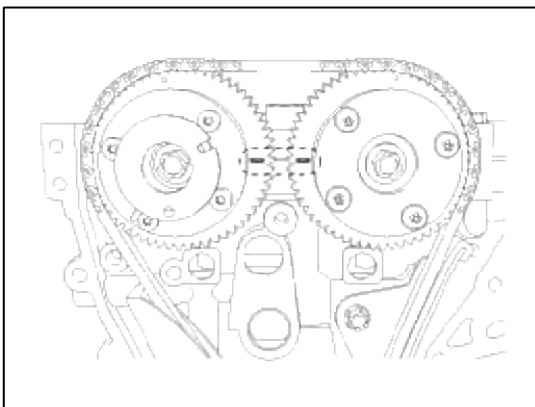


CAUTION

- When reinstall the tensioner, check the ratchet function of the tensioner after removing the fixing pin by retracting the tensioner arm (A) maximally as shown below.
- When maximally retracted, there should be no interference between the tensioner arm (A) and tensioner housing (B).



7. After rotating crankshaft 2 revolutions in regular direction (clockwise viewed from front), confirm that the TDC marks on the intake and exhaust CVVT sprockets are aligned with the top surface of cylinder head.



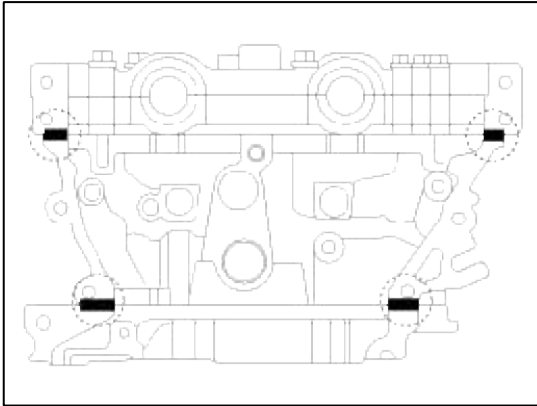
8. Install the timing chain cover.

- (1) Using a gasket scraper, remove all the old packing material from the gasket surfaces.
- (2) The sealant locations on the chain cover and the counter parts (cam carrier, cylinder head, cylinder block, and lower crankcase) must be free of harmful foreign materials, oil, dust and moisture. Spraying cleaner on the surface and wiping with a clean duster.

- (3) Before assembling the timing chain cover, liquid sealant should be applied on the gap between cam carrier, cylinder head and cylinder block.

Bead width: 3.0 ~ 5.0 mm (0.11 ~ 0.20 in.)

Sealant: Threebond 1217H or equivalent



- (4) After applying liquid sealant on the timing chain cover, assemble the cover within 5 minutes after sealant was applied. Continuous bead of sealant should be applied to prevent any path from oil leakage.

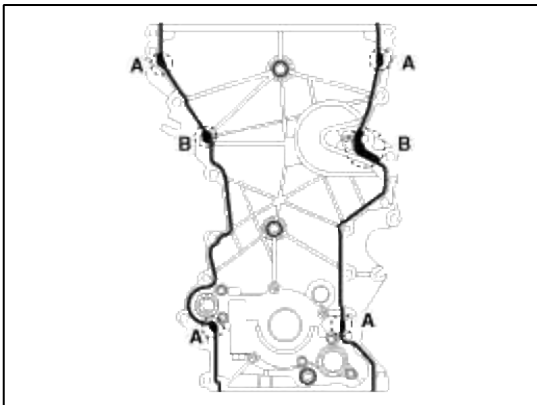
Bead width

Whole section: 2.5 ~ 3.5 mm (0.10 ~ 0.14 in.)

Section A: 4.5 ~ 5.5 mm (0.18 ~ 0.22 in.)

Section B: 8.0 ~ 9.0 mm (0.32 ~ 0.35 in.)

Sealant: Threebond 1217H or equivalent



- (5) Install the timing chain cover. The dowel pins on the cylinder block and holes on the timing chain cover should be used as a reference in order to assemble the timing chain cover in exact position.

Tightening torque

Bolts (A, B):

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

Bolt (C):

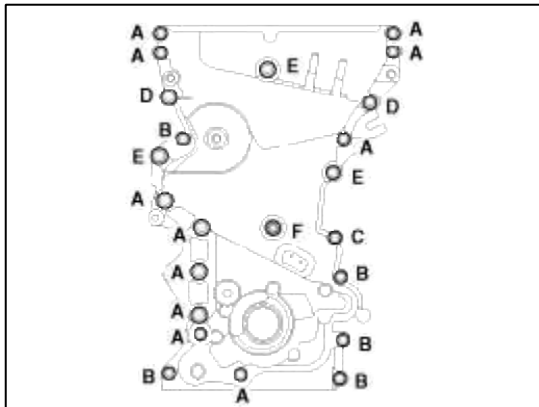
19.6 ~ 23.5 N.m (2.0 ~ 2.4 kgf.m, 14.5 ~ 17.4 lb-ft)

Bolts (D,E):

39.2 ~ 49.0 N.m (4.0 ~ 5.0 kgf.m, 28.9 ~ 36.2 lb-ft)

Bolt (F):

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



CAUTION

Do not reuse the seal bolts (C,F).

CAUTION

The engine running or pressure test should not be performed within 30 minutes after the timing chain cover was assembled.

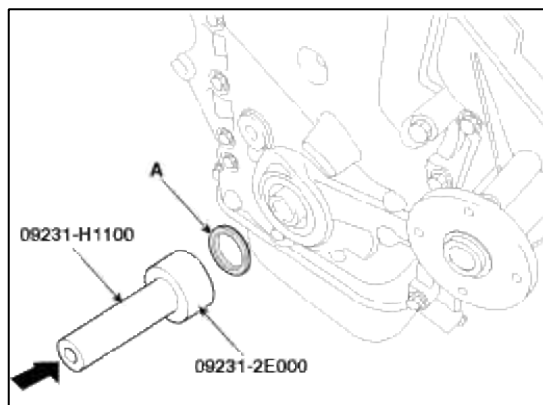
9. Replace the front oil seal if necessary.

- (1) Apply engine oil on the edge of new oil seal.

CAUTION

Remove any debris from the lip portion of the oil seal.

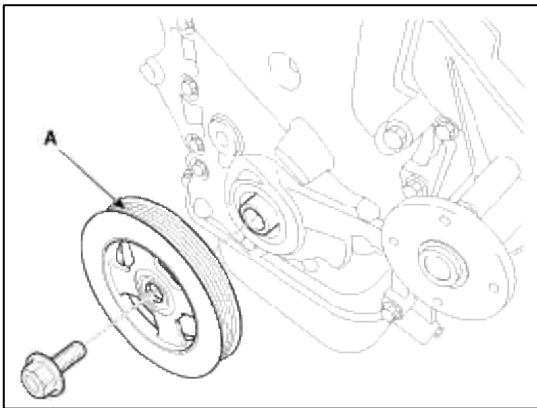
- (2) Install the front oil seal (A) using SST (09231-2E000, 09231-H1100).



10. Install the crankshaft damper pulley (A).

Tightening torque:

196.1 ~ 205.9 N.m (20.0 ~ 21.0 kgf.m, 144.7 ~ 151.9 lb-ft)

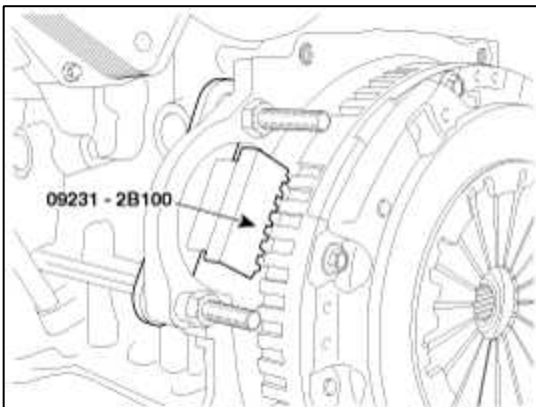
**CAUTION**

Do not press the pulley or apply the excessive force to prevent the rubber part from being deformed.

NOTE

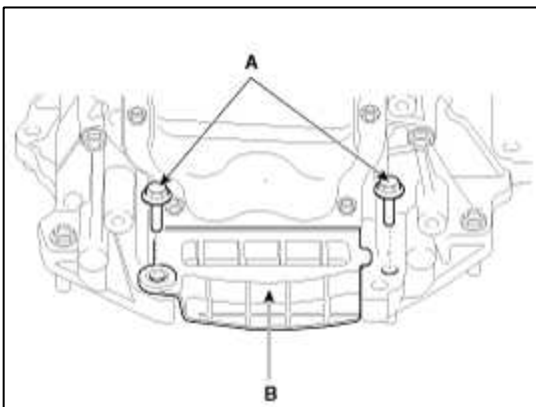
There are two methods to hold the ring gear when installing the crankshaft damper pulley.

- Install the SST (09231-2B100) to hold the ring gear after removing the starter.



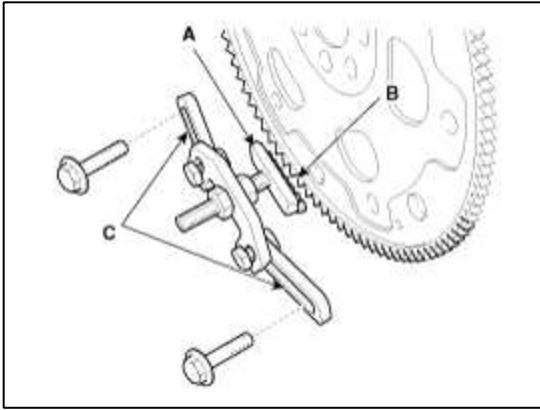
- Install the SST (09231-3D100) to hold the ring gear after removing the service cover.

1. Remove the two transaxle mounting bolts (A) and the service cover (B) on the bottom of the lower crankcase.

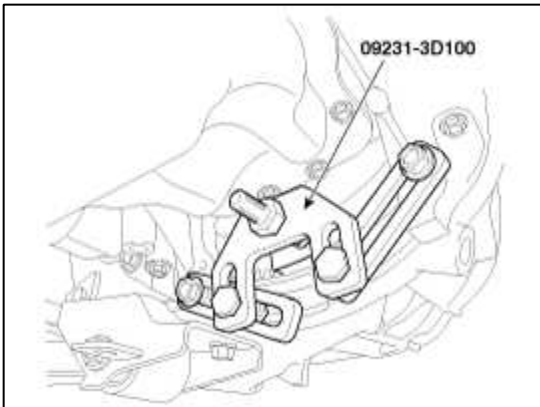


2. Adjust the length of the holder (A) so that the grooves of the holder puts into the ring gears (B) at the closest position.

3. Adjust the angle and length of the links (C) so that the two transaxle mounting bolts can be fastened into the original mounted holes.



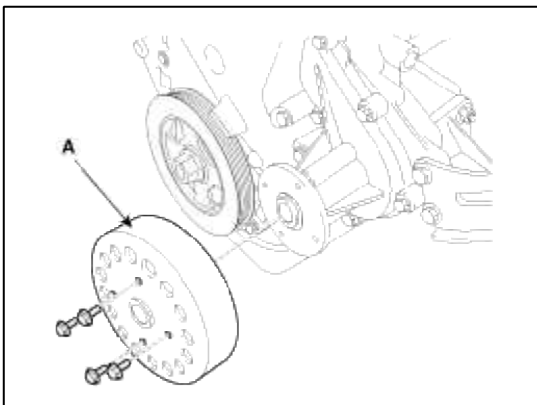
4. Install the SST using the two transaxle mounting bolts. Tighten the bolts and nuts of the holder and links securely.



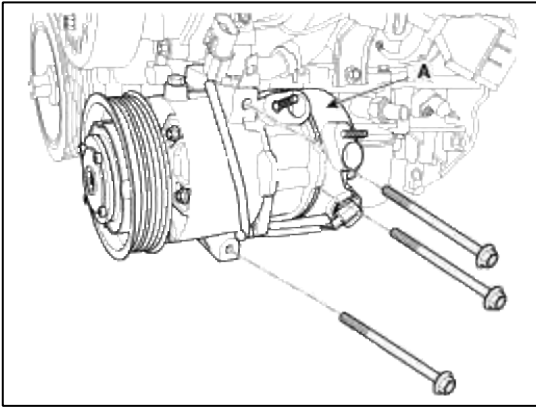
11. Install the water pump pulley (A).

Tightening torque:

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



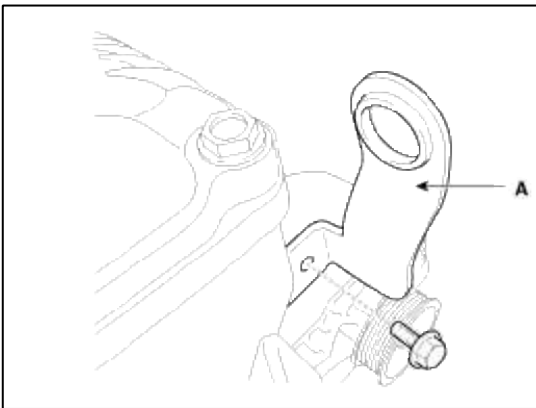
12. Install the A/C compressor (A). (Refer to HA group - "A/C compressor")



13. Install the front engine hanger (A).

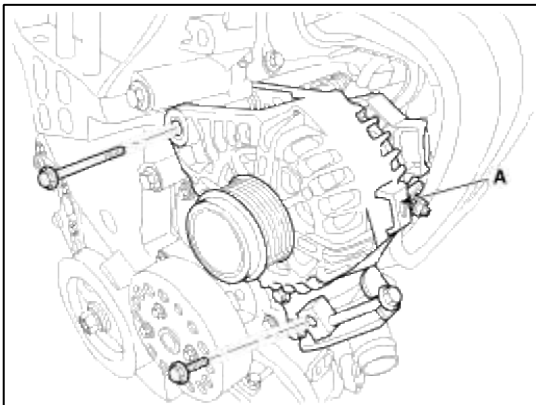
Tightening torque:

34.3 ~ 39.2 N.m (3.5 ~ 4.0 kgf.m, 25.3 ~ 28.9 lb-ft)



14. Install the drive belt.

- (1) Preassemble the alternator (A) temporarily.



- (2) Install the drive belt (C).

- (3) Adjust the tension by turning the tension adjusting bolt (B) clockwise. (Refer to EE group – “Alternator”)

Belt tension

New belt:

637.4 ~ 735.5 N (65 ~ 75 kgf, 143.3 ~ 165.3 lbf)

Used belt:

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- (4) Tighten the alternator mounting bolts (A) with the specified torque.

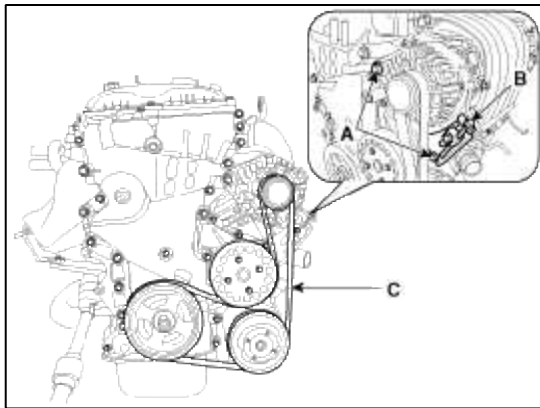
Tightening torque

M10 bolt:

29.4 ~ 41.2 N.m (3.0 ~ 4.2 kgf.m, 21.7 ~ 30.4 lb-ft)

M8 bolt:

21.6 ~ 32.4 N.m (2.2 ~ 3.3 kgf.m, 15.9 ~ 23.9 lb-ft)



15. Install the engine mounting support bracket.

- (1) Install the engine mounting support bracket (B).

Tightening torque

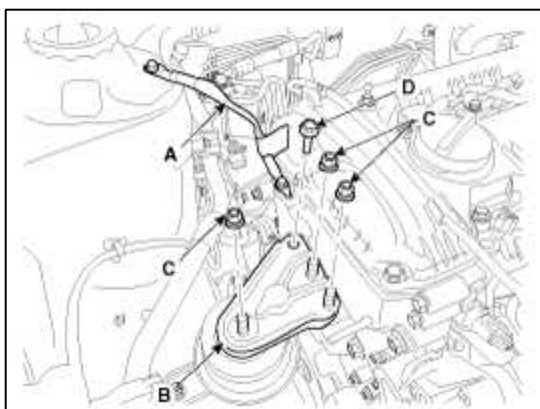
Nuts (C) and bolt (D) :

78.5 ~ 98.1 N.m (8.0 ~ 10.0 kgf.m, 57.9 ~ 72.3 lb-ft)

- (2) Connect the engine ground line (A).

Tightening torque

10.8 ~ 13.7 N.m (1.1 ~ 1.4 kgf.m, 8.0 ~ 10.1 lb-ft)



- (3) Remove the jack from the lower crankcase.

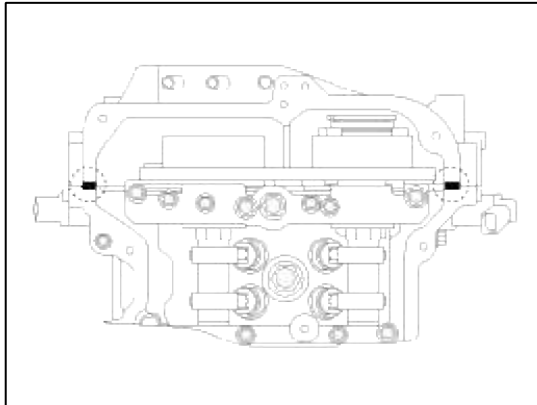
16. Install the oil pan. (Refer to Lubrication system in this group)

17. Install cylinder head cover.

- (1) The hardening sealant located on the cylinder head cover and the gap between the timing chain cover and the cam carrier should be removed before assembling cylinder head cover.
- (2) Apply engine oil on the lip portion of the oil seal on the cover and outer surface of the spark plug pipes.
- (3) After applying sealant on the gap between the timing chain cover and the cam carrier, it should be assembled within 5 minutes.

Bead width: 2.0 ~ 3.0 mm (0.08 ~ 0.12 in.)

Sealant: Threebond 1217H or equivalent

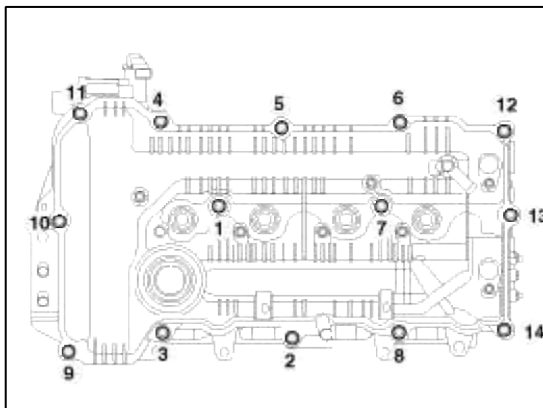


- (4) Install the cylinder head cover (A) by tightening the bolts, in several passes, in the sequence as shown.

Tightening torque

1st step: 3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft)

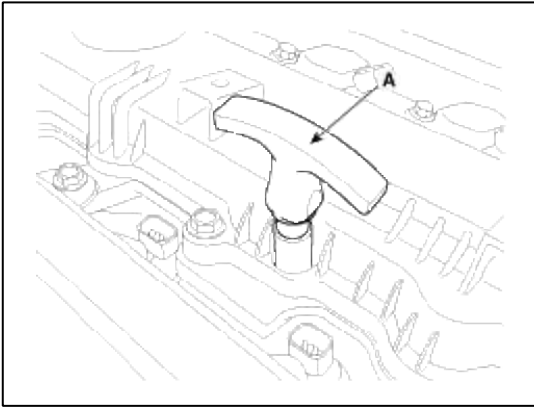
2nd step: 7.8 ~ 9.8 N.m (0.8 ~ 1.0 kgf.m, 5.8 ~ 7.2 lb-ft)



CAUTION

- Do not reuse cylinder head cover gasket.
- Before installing the cylinder head cover, make sure the cylinder head cover gasket is not separated from the cylinder head cover gasket groove.
- The engine running or pressure test should not be performed within 30 minutes after the cylinder head cover was assembled.

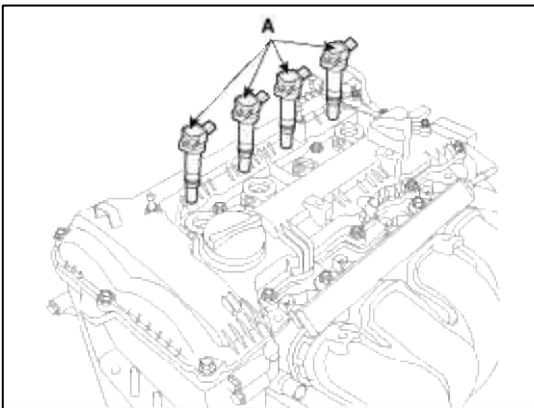
18. Install the oil level gauge (A).



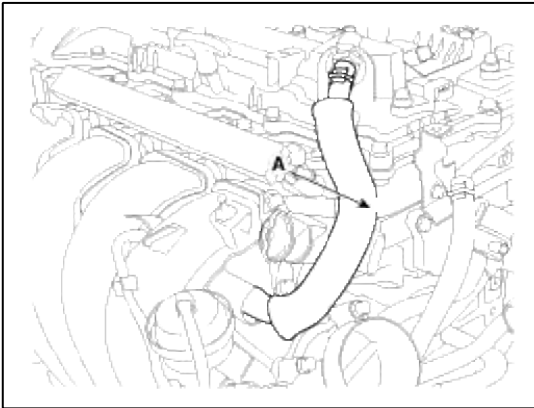
19. Install the ignition coils (A).

Tightening torque :

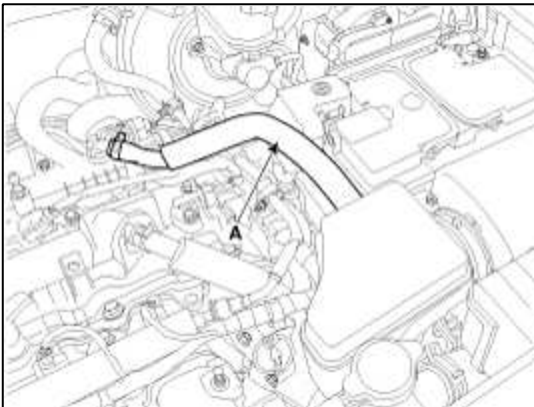
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



20. Connect the PCV (Positive crankcase ventilation) hose (A).



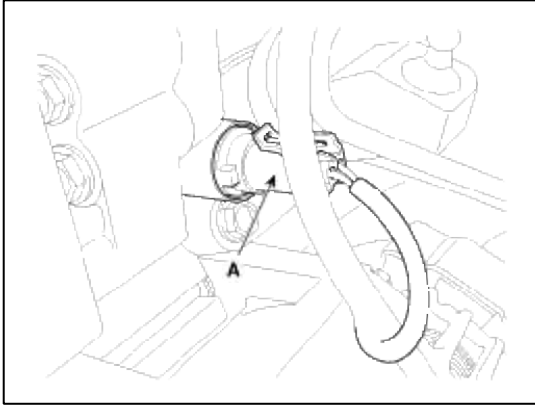
21. Connect the breather hose (A).



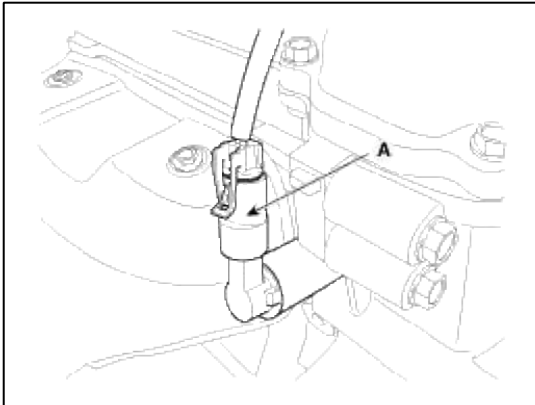
22. Install the wiring and protectors on the cylinder head cover and then connect the wiring connectors and harness

clamps.

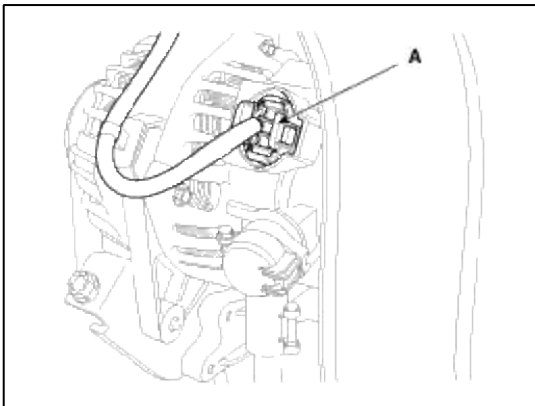
- (1) The intake OCV (Oil control valve) connector (A)



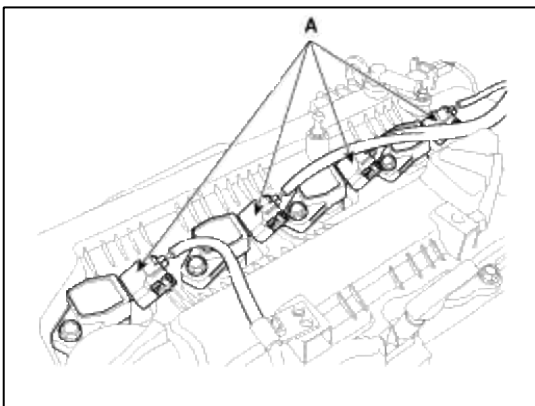
- (2) The exhaust OCV (Oil control valve) connector (A)



- (3) The alternator connector (A)

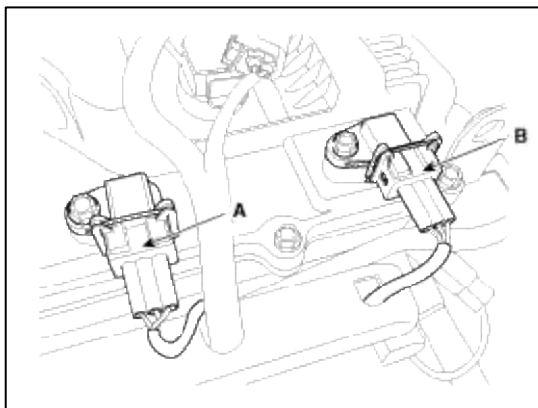


- (4) The ignition coil connectors (A)



- (5) The intake CMPS (Camshaft position sensor) connector (A)

(6) The exhaust CMPS (Camshaft position sensor) connector (B)



23. Install the under cover. (Refer to Engine and transaxle assembly in this group)
24. Install the RH front wheel. (Refer to SS group – “Wheel”)
25. Connect the battery negative terminal. (Refer to Engine and transaxle assembly in this group)
26. Install the engine cover. (Refer to Engine and transaxle assembly in this group)
27. Add all the necessary fluids and check for leaks. Connect GDS. Check for codes, note, and clear. Recheck.

NOTE

- Refill engine with engine oil.
- Clean battery posts and cable terminals and assemble.
- Inspect for fuel leakage.
- After assembling 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 Head Assembly > Camshaft > Repair procedures**Removal**

Timing chain cover removal is not required for this procedure.

CAUTION

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

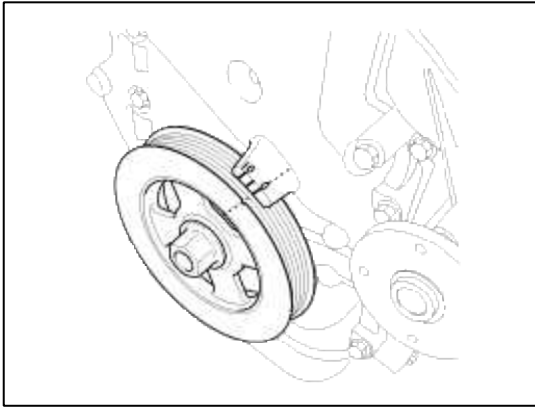
NOTE

- Mark all wiring and hoses to avoid misconnection.
- Turn the crankshaft pulley so that the No. 1 piston is at top dead center.

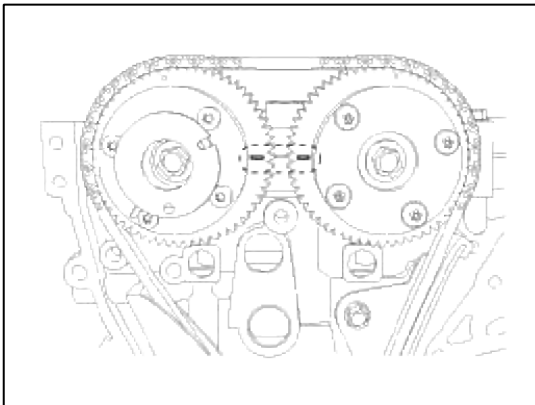
1. Remove the cylinder head cover. (Refer to Timing system in this group)

2. Set No.1 cylinder to TDC (Top dead center) on compression stroke.

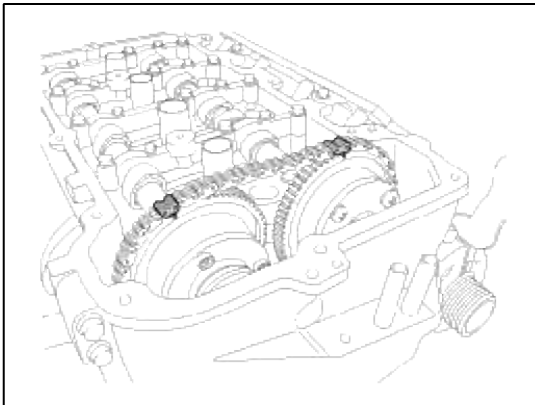
(1) Turn the crankshaft pulley and align its groove with the timing mark of the timing chain cover.



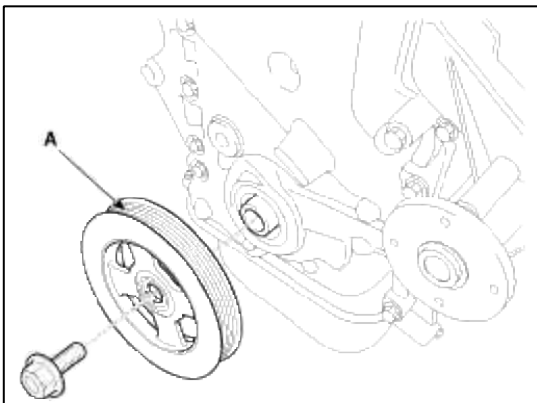
(2) Check that the TDC marks of the intake and exhaust CVVT sprockets are in straight line on the cylinder head surface as shown in the illustration. If not, turn the crankshaft by one revolution (360°) more.



(3) Mark the timing chains corresponding to the timing marks of the CVVT sprockets.



3. Remove the crankshaft damper pulley.



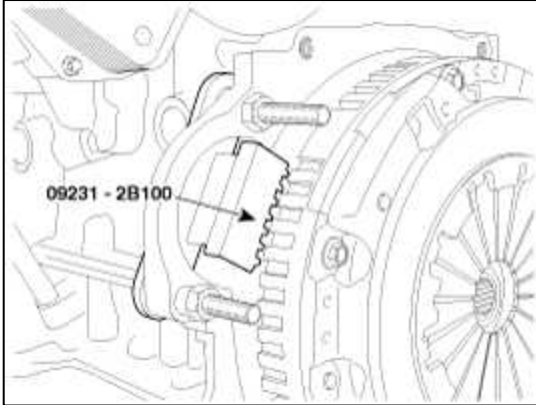
CAUTION

Do not press the pulley or apply the excessive force to prevent the rubber part from being deformed.

NOTE

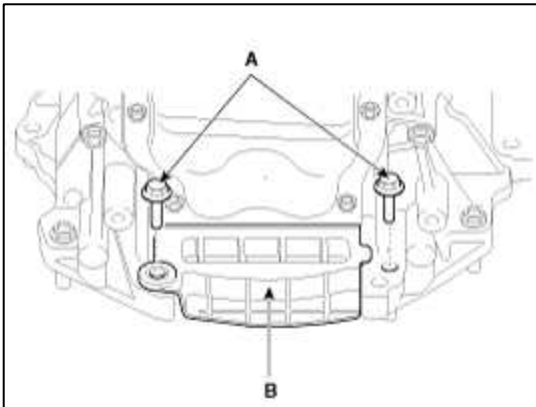
There are two methods to hold the ring gear when removing the crankshaft damper pulley.

- Install the SST (09231-2B100) to hold the ring gear after removing the starter.

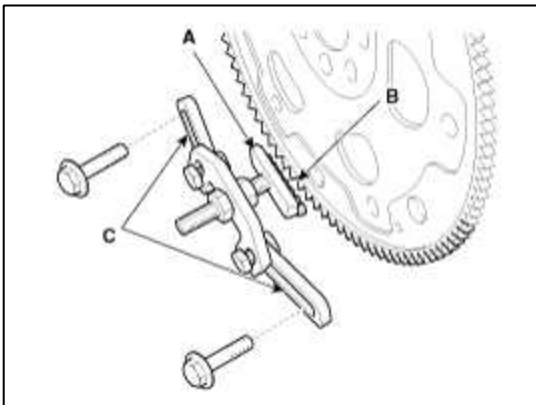


- Install the SST (09231-3D100) to hold the ring gear after removing the service cover.

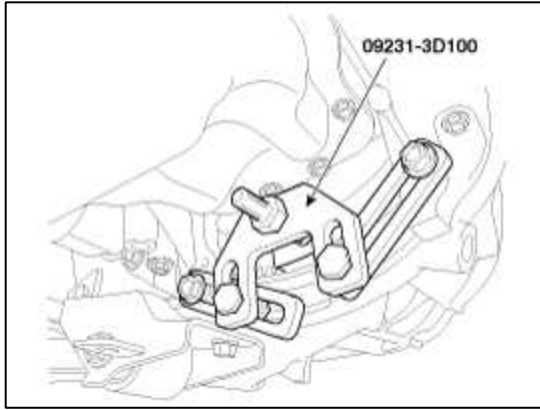
1. Remove the two transaxle mounting bolts (A) and the service cover (B) on the bottom of the lower crankcase.



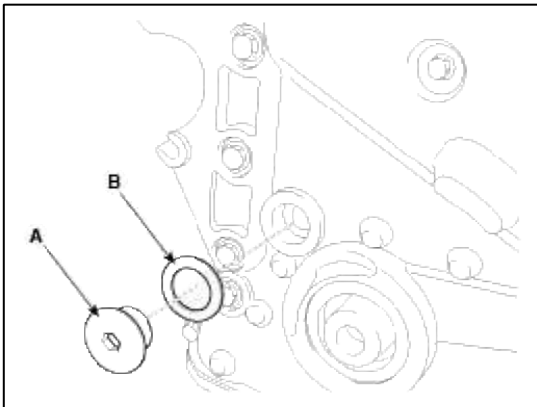
2. Adjust the length of the holder (A) so that the grooves of the holder puts into the ring gears (B) at the closest position.
3. Adjust the angle and length of the links (C) so that the two transaxle mounting bolts can be fastened into the original mounted holes.



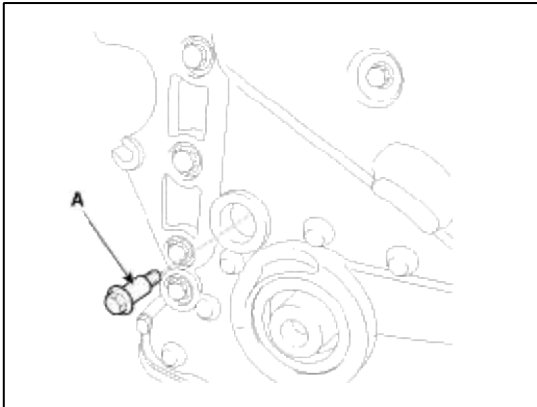
4. Install the SST using the two transaxle mounting bolts. Tighten the bolts and nuts of the holder and links securely.



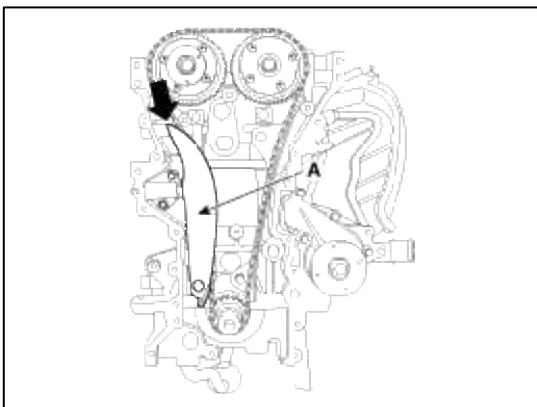
4. Remove the service plug bolt (A) with the gasket (B).



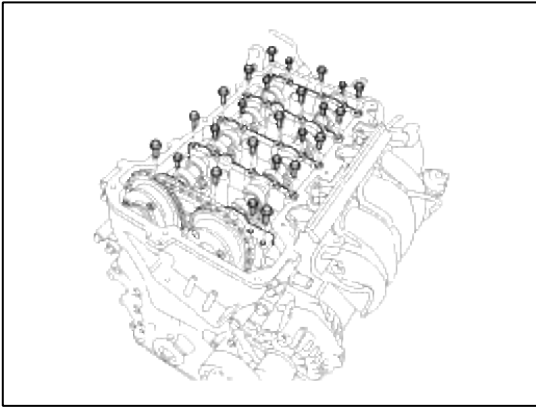
5. Remove the tensioner arm bolt (A).



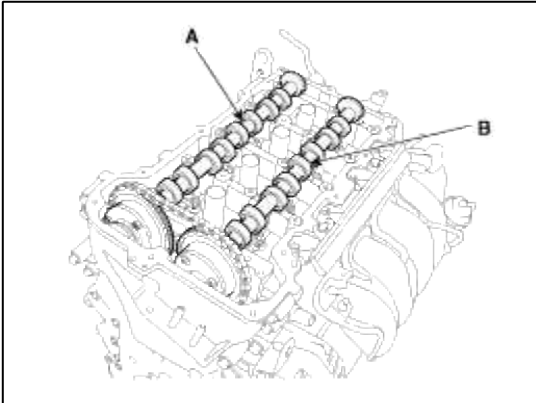
6. Push down the tensioner arm (A).



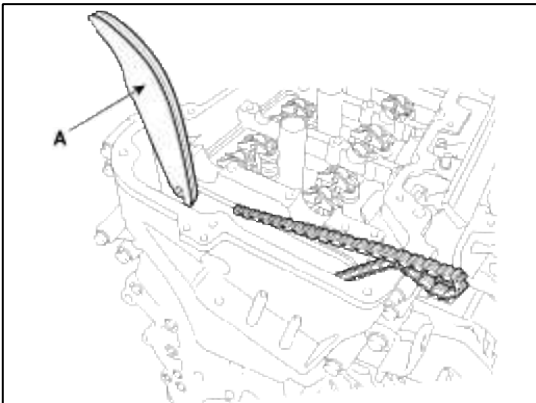
7. Remove the camshaft bearing caps.



8. Remove the exhaust camshaft (A) first, then intake camshaft (B).



9. Remove the tensioner arm (A).

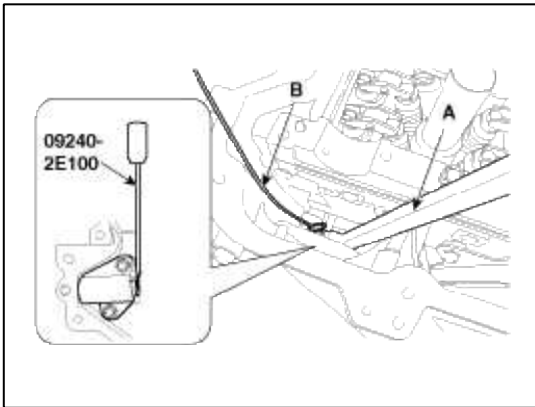


NOTE

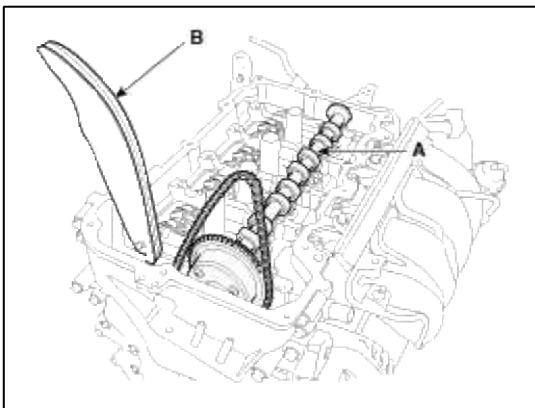
To hold the timing chain, tie it with strap.

Installation

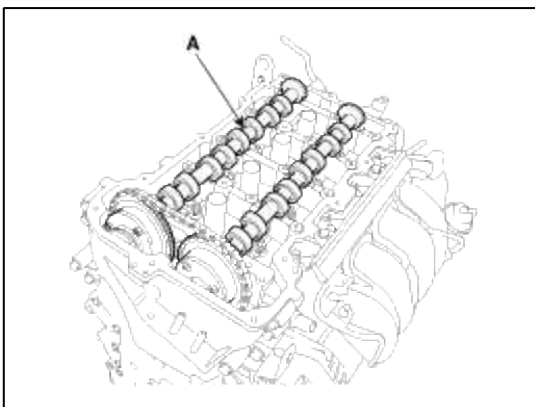
1. Compress the piston of the tensioner using a handy bar (A) and then insert a stopper pin (B) into the hole on the tensioner to hold the compressed piston.



2. Place the intake camshaft (A) and then insert the tensioner arm (B) along the timing chain.

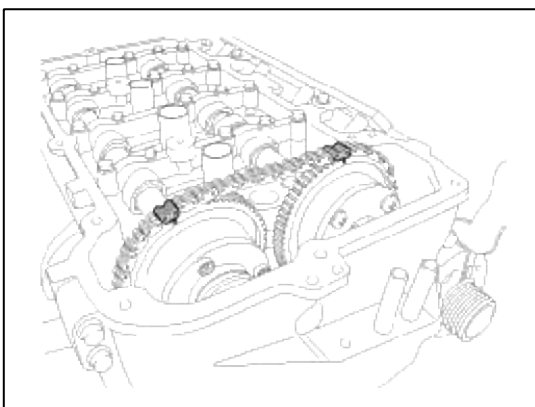


3. Place the exhaust camshaft (A).

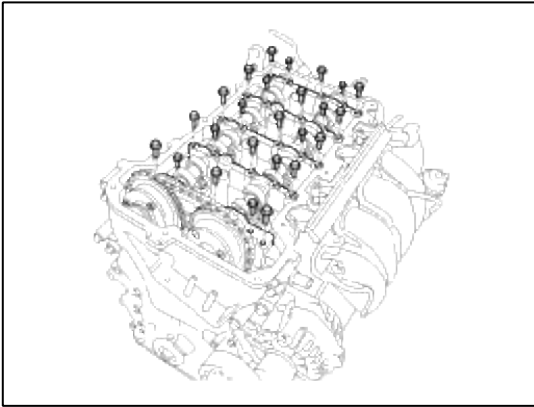


NOTE

The timing marks of each CVVT sprocket should be matched with timing marks (painted link) of timing chain when installing the timing chain.



4. Install the camshaft bearing caps.



Tighten the bolts, in several passes, in the sequence as shown.

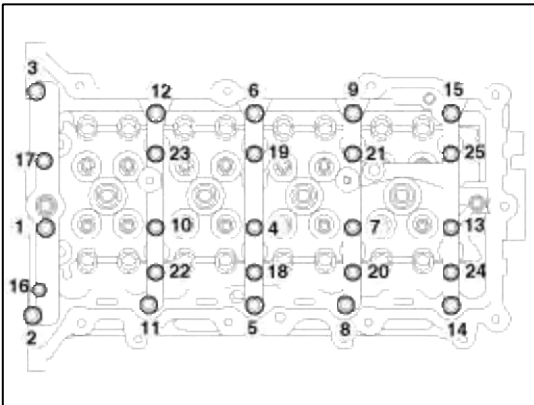
Tightening torque

M6 bolts:

11.8 ~ 13.7 N.m (1.2 ~ 1.4 kgf.m, 8.7 ~ 10.1 lb-ft)

M8 bolts:

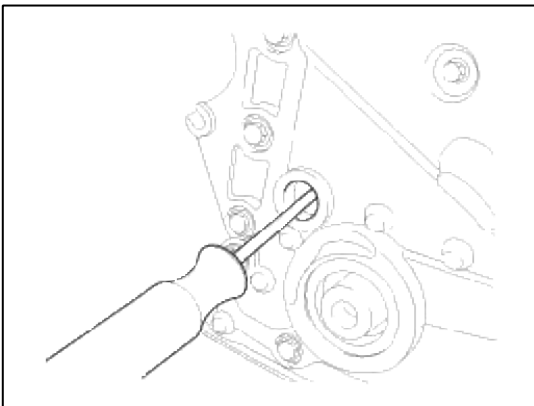
18.6 ~ 22.6 N.m (1.9 ~ 2.3 kgf.m, 13.7 ~ 16.6 lb-ft)



CAUTION

Be careful not to change the position and direction of bearing caps.

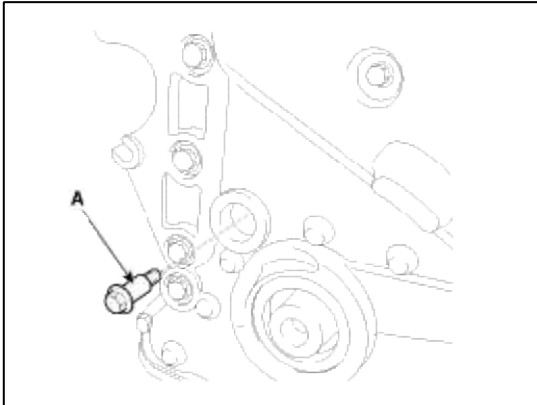
5. Using a suitable tool, move the tensioner arm to align the tensioner bolt hole with the service hole.



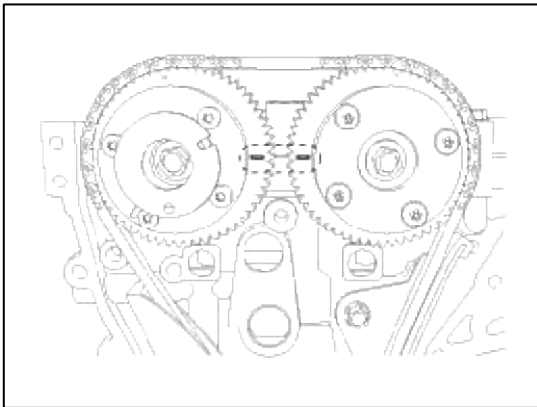
6. Install the tensioner arm bolt (A).

Tightening torque:

18.6 ~ 22.6 N.m (1.9 ~ 2.3 kgf.m, 13.7 ~ 16.6 lb-ft)



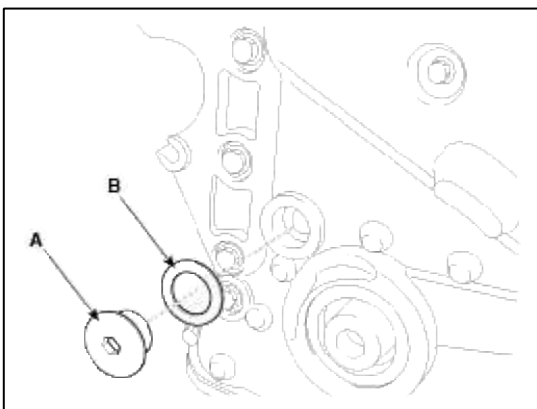
7. Remove the stopper pin from the tensioner.
 8. Turn the crankshaft two turns in the operating direction (clockwise), and then check that the TDC marks of the CVVT sprockets are in straight line on the cylinder head surface.



9. Install a service plug bolt (A) with a gasket.

Tightening torque:

29.4 ~ 39.2 N.m (3.0 ~ 4.0 kgf.m, 21.7 ~ 28.9 lb-ft)



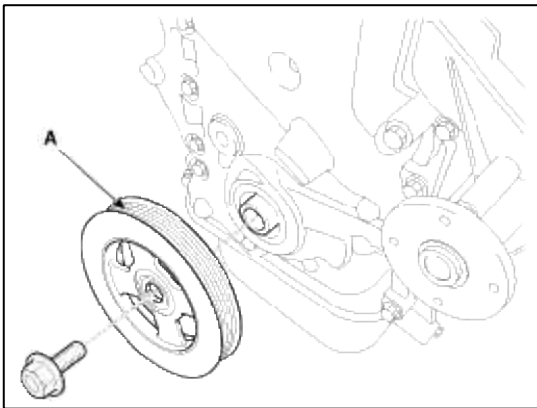
CAUTION

Do not reuse the service plug bolt and gasket.

10. Install the crankshaft damper pulley (A).

Tightening torque:

196.1 ~ 205.9 N.m (20.0 ~ 21.0 kgf.m, 144.7 ~ 151.9 lb-ft)

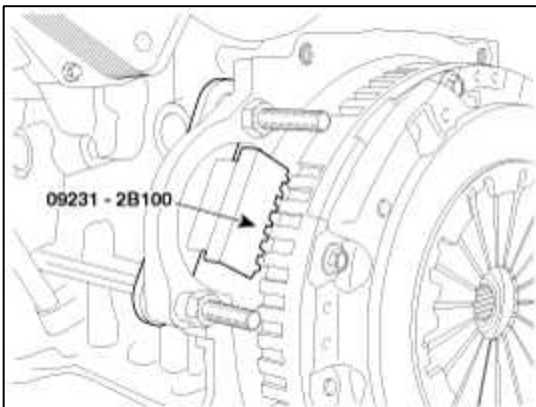
**CAUTION**

Do not press the pulley or apply the excessive force to prevent the rubber part from being deformed.

NOTE

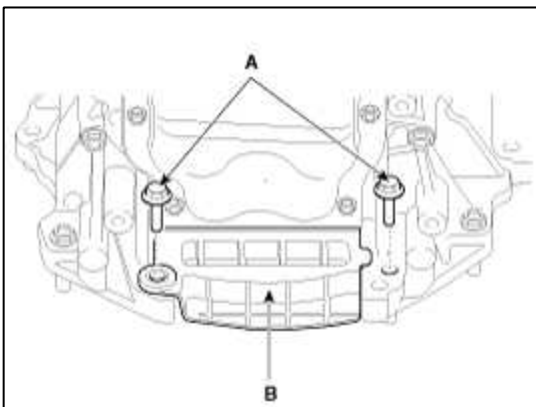
There are two methods to hold the ring gear when installing the crankshaft damper pulley.

- Install the SST (09231-2B100) to hold the ring gear after removing the starter.



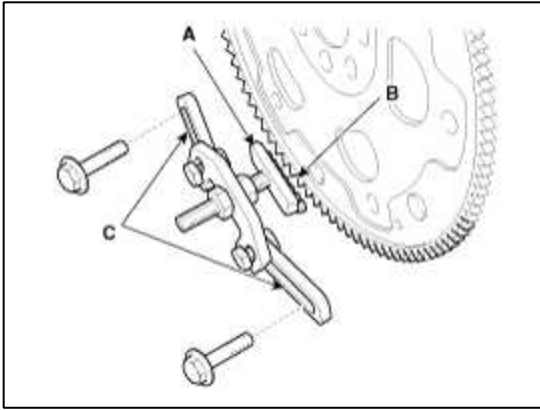
- Install the SST (09231-3D100) to hold the ring gear after removing the service cover.

1. Remove the two transaxle mounting bolts (A) and the service cover (B) on the bottom of the lower crankcase.

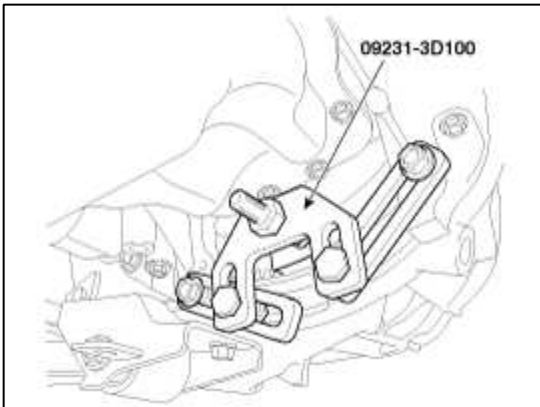


2. Adjust the length of the holder (A) so that the grooves of the holder puts into the ring gears (B) at the closest position.

3. Adjust the angle and length of the links (C) so that the two transaxle mounting bolts can be fastened into the original mounted holes.



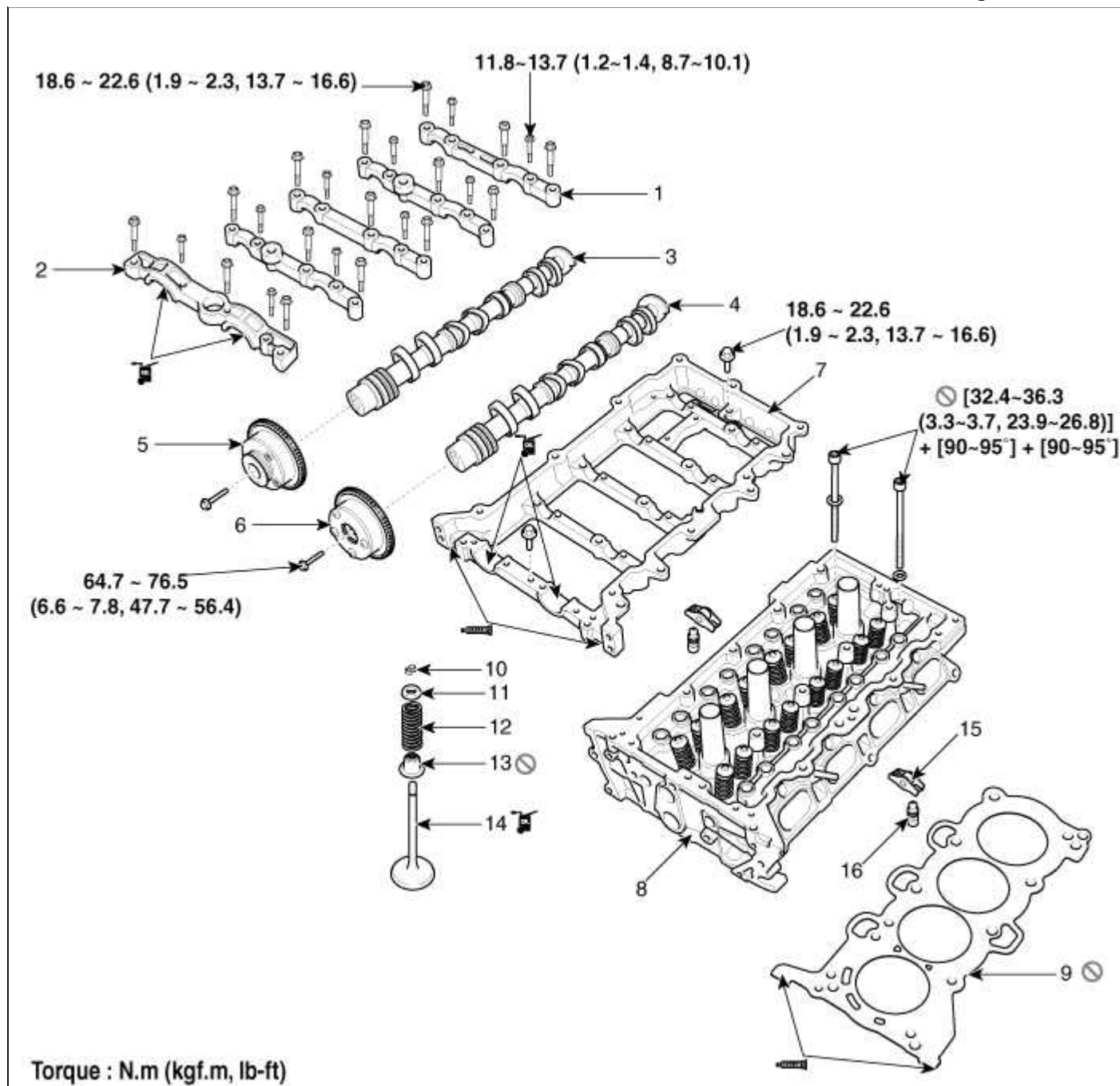
4. Install the SST using the two transaxle mounting bolts. Tighten the bolts and nuts of the holder and links securely.



11. Install the cylinder head cover. (Refer to Timing system in this group)

Engine Mechanical System > Cylinder Head Assembly > Cylinder Head > Components and Components Location

Components



1. Camshaft bearing cap	7. Cam carrier	13. Valve stem seal
2. Camshaft front bearing cap	8. Cylinder head	14. Valve
3. Exhaust camshaft	9. Cylinder head gasket	15. Swing arm
4. Intake camshaft	10. Retainer lock	16. HLA (Hydraulic lash adjuster)
5. Exhaust CVVT assembly	11. Retainer	
6. Intake CVVT assembly	12. Valve spring	

Engine Mechanical System > Cylinder Head Assembly > Cylinder Head > Repair procedures

Removal

Engine removal is not required for this procedure.

CAUTION

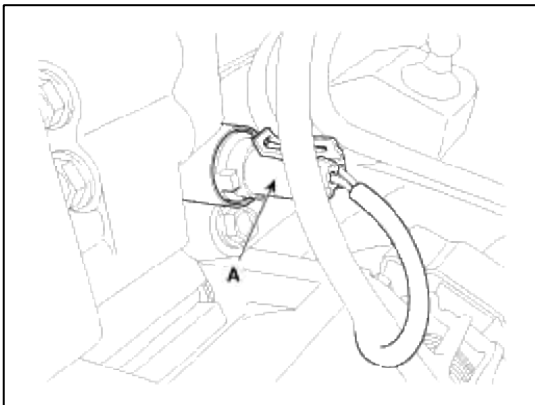
- Use fender covers to avoid damaging painted surfaces.
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature (20°C [68°F]) before removing it.
- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.
- To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

NOTE

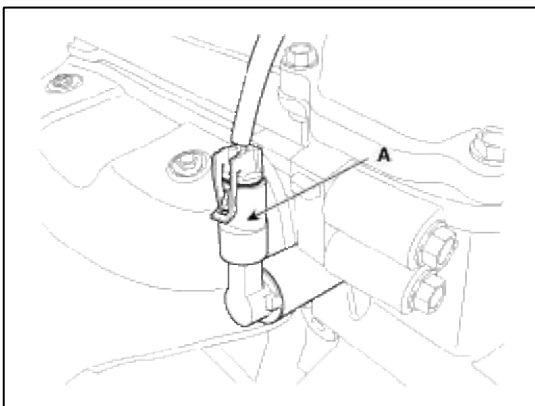
- Mark all wiring and hoses to avoid misconnection.
- Turn the crankshaft pulley so that the No. 1 piston is at TDC (Top dead center).

1. Disconnect the battery negative terminal. (Refer to Engine and transaxle assembly in this group)
2. Remove the RH front wheel. (Refer to SS group – “Wheel”)
3. Remove the under cover. (Refer to Engine and transaxle assembly in this group)
4. Remove the engine cover. (Refer to Engine and transaxle assembly in this group)
5. Remove the air duct and the air cleaner assembly. (Refer to Intake and exhaust system in this group)
6. Loosen the drain plug, and drain the engine coolant. Remove the radiator cap to help drain the coolant faster. (Refer to Cooling system in this group)
7. Disconnect the radiator upper hose and lower hose. (Refer to Cooling system in this group)
8. Disconnect the wiring connectors and harness clamps, and then remove the wiring and protectors from the cylinder head and the intake manifold.

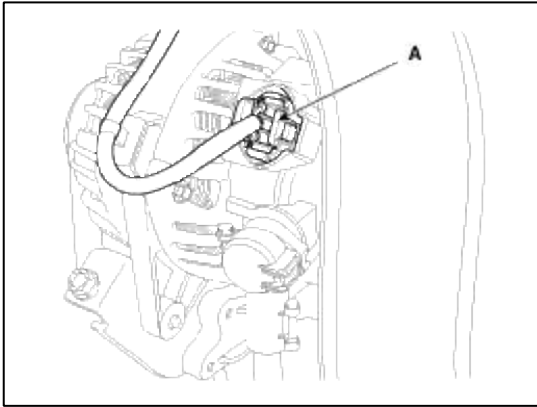
(1) The intake OCV (Oil control valve) connector (A)



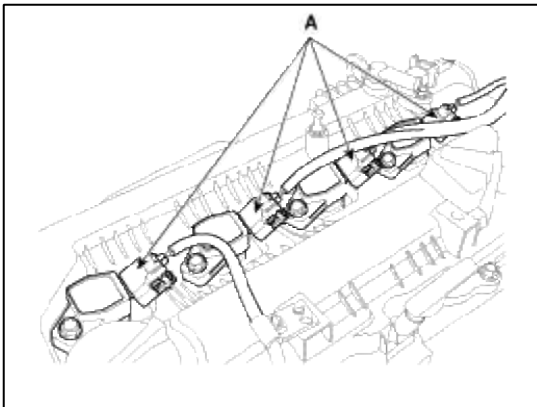
(2) The exhaust OCV (Oil control valve) connector (A)



(3) The alternator connector (A)

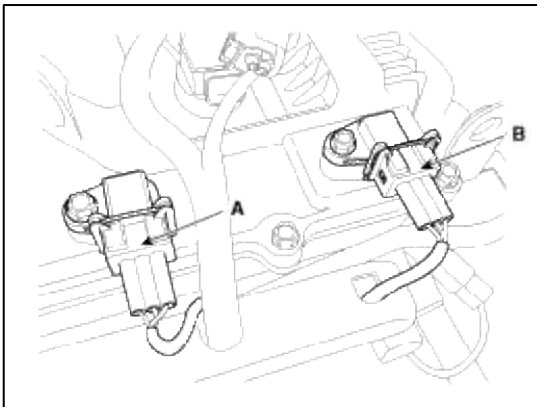


(4) The ignition coil connectors (A)

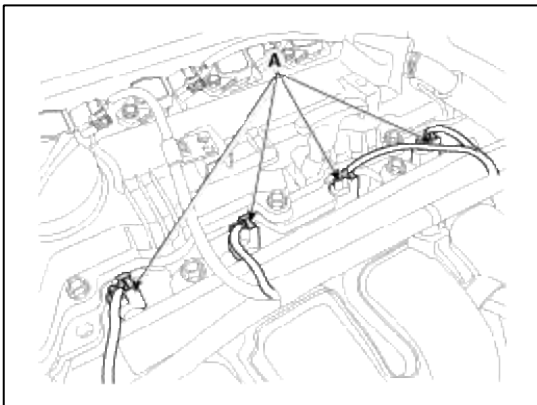


(5) The intake CMPS (Camshaft position sensor) connector (A)

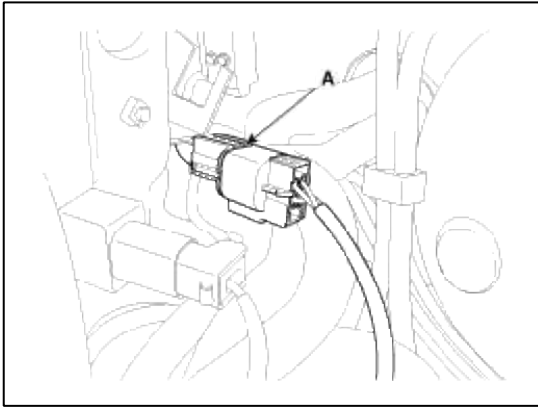
(6) The exhaust CMPS (Camshaft position sensor) connector (B)



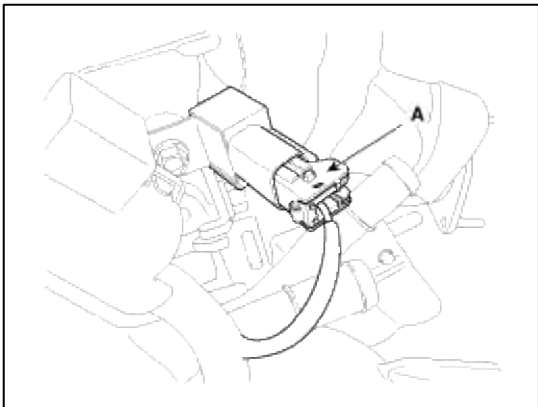
(7) The injector connectors (A)



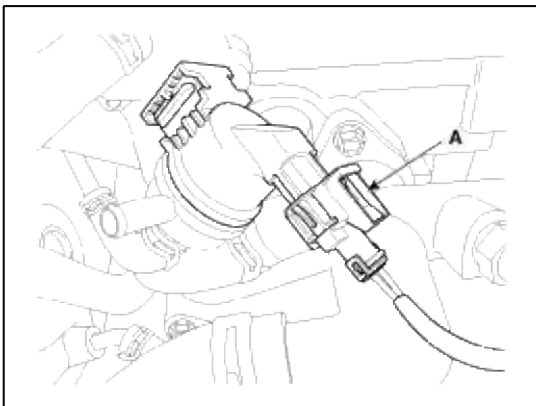
(8) The front HO2S (Heated oxygen sensor connectors (A)



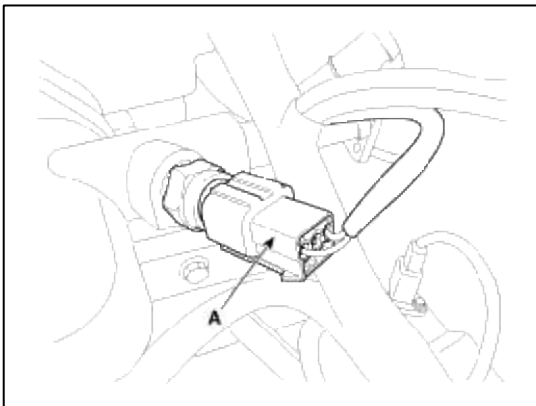
(9) The condenser connector (A)



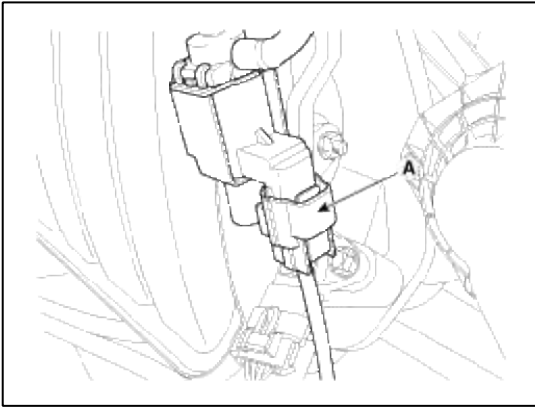
(10) The PCSV (Purge control solenoid valve) connector (A)



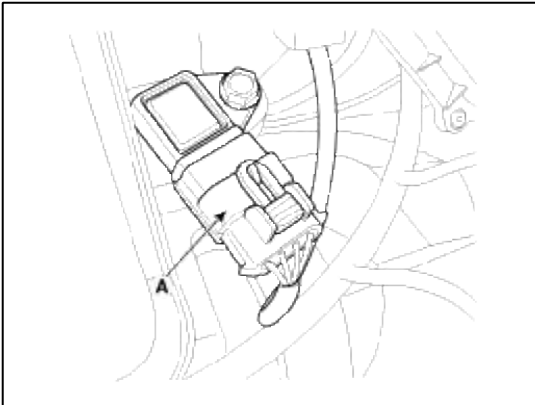
(11) The ECTS (Engine coolant temperature sensor) connector (A)



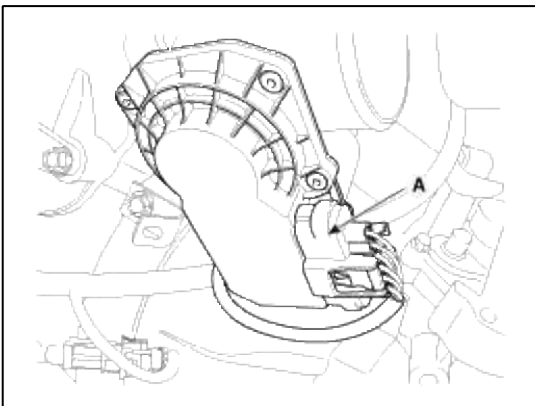
(12) The VIS (Variable Intake System) connector (A)



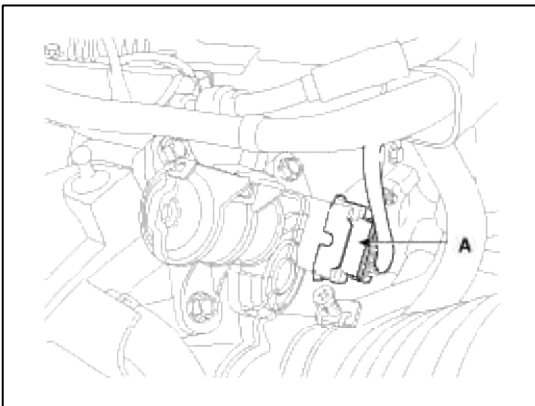
(13) The MAPS (Manifold absolute pressure sensor) & IATS (Intake air temperature sensor) connector (A)



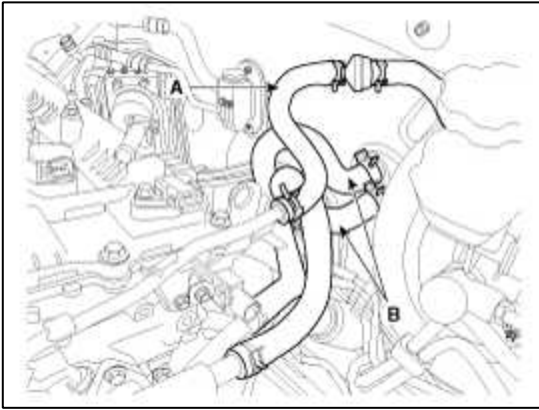
(14) The ETC (Electronic throttle control) connector (A)



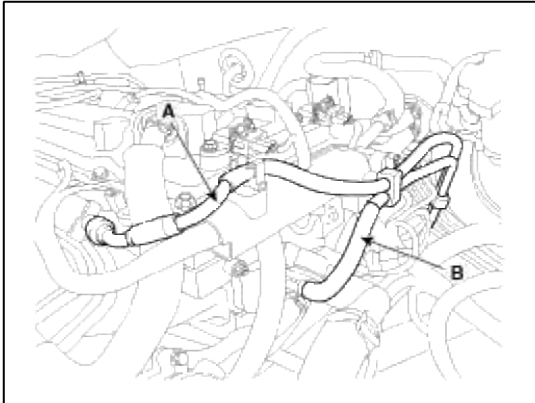
(15) The VCMA (Variable charge motion actuator) connector (A)



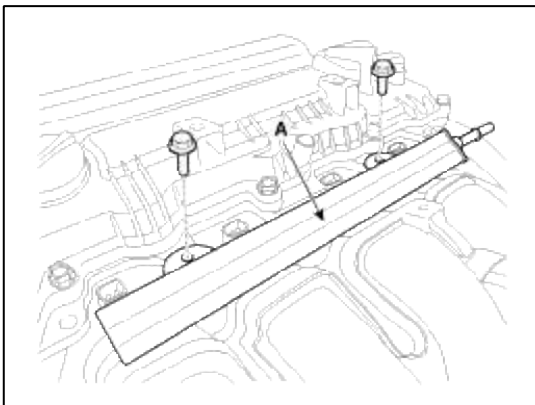
9. Disconnect the brake booster vacuum hose (A) and the heater hoses (B).



10. Disconnect the fuel hose (A) and PCSV (Purge control solenoid valve) hose (B).



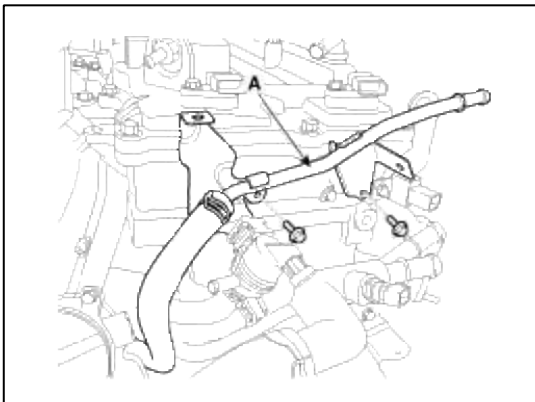
11. Remove the injector & rail assembly (A). (Refer to FL – “Injector”)



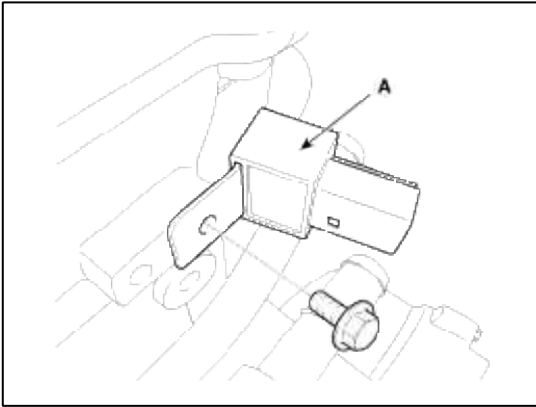
12. Remove the intake and exhaust manifold. (Refer to Intake and exhaust system in this group)

13. Remove the timing chain including the drive belt, the cylinder head cover, the alternator and the timing chain cover. (Refer to Timing system in this group)

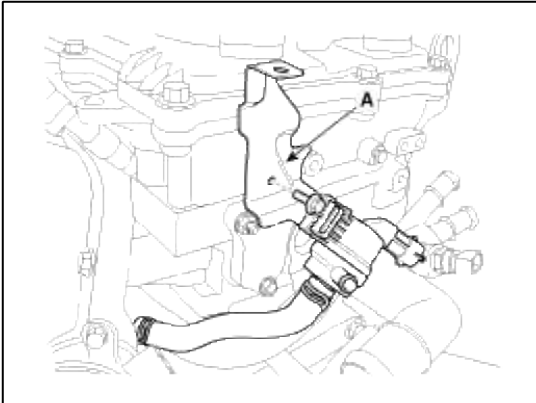
14. Remove the vacuum pipe (A).



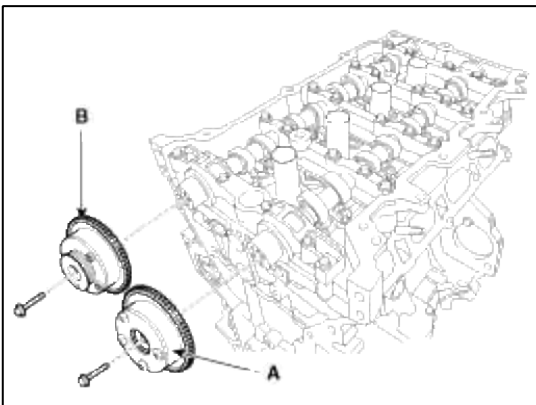
15. Remove the condenser (A).



16. Remove the PCSV bracket (A).

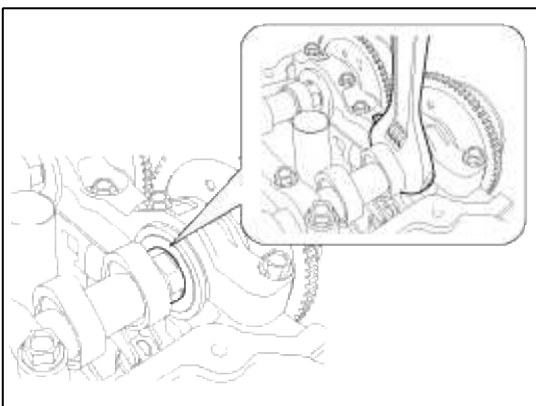


17. Remove the intake CVVT assembly (A) and exhaust CVVT assembly (B).



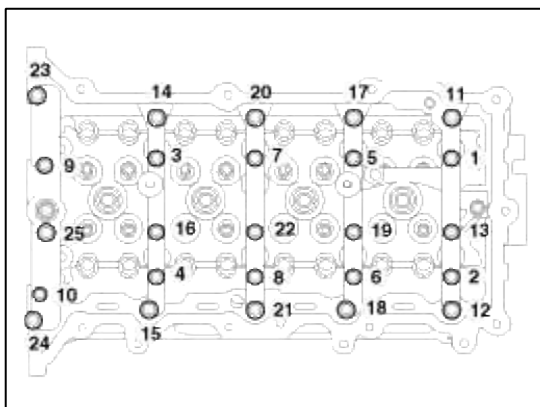
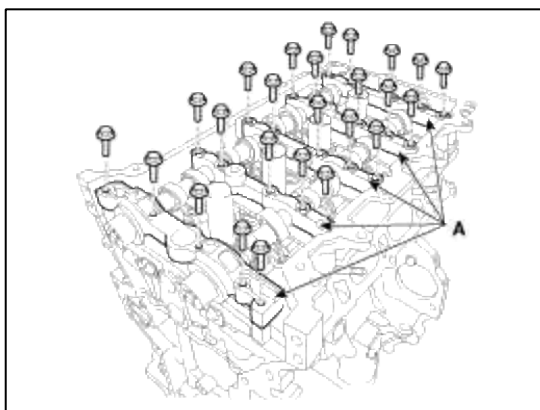
NOTE

When removing the CVVT assembly bolt, hold the camshaft with a wrench to prevent the camshaft from rotating.

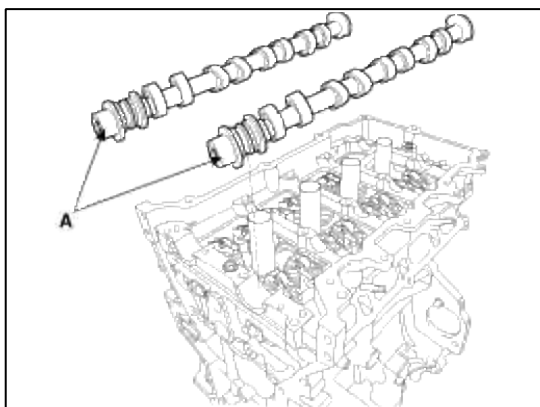


18. Remove the camshaft.

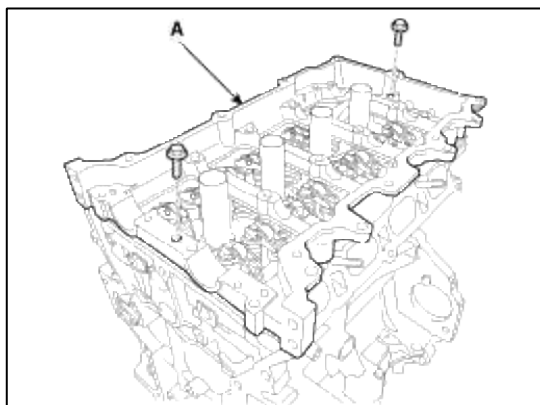
(1) Remove the camshaft bearing cap (A) by loosening the bolts in the sequence as shown.



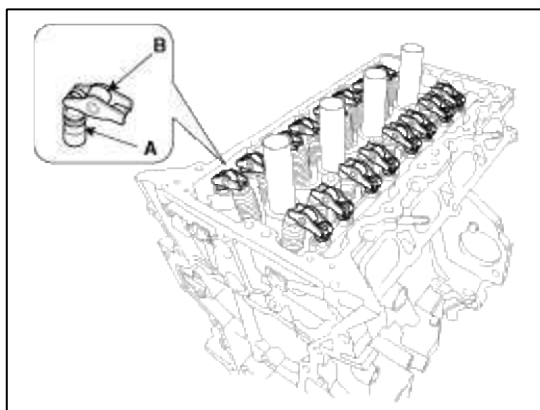
(2) Remove the camshafts (A).



19. Remove the cam carrier (A).



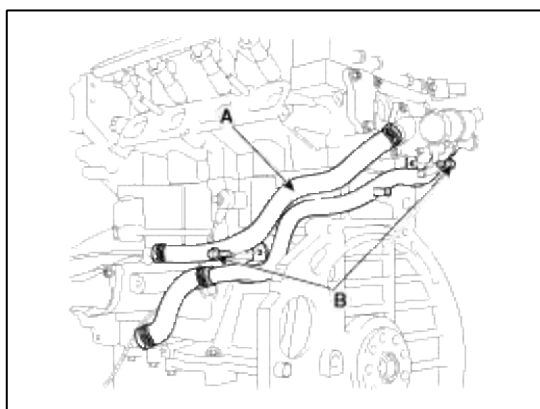
20. Remove the HLA (Hydraulic lash adjuster) (A) and the swing arm (B).



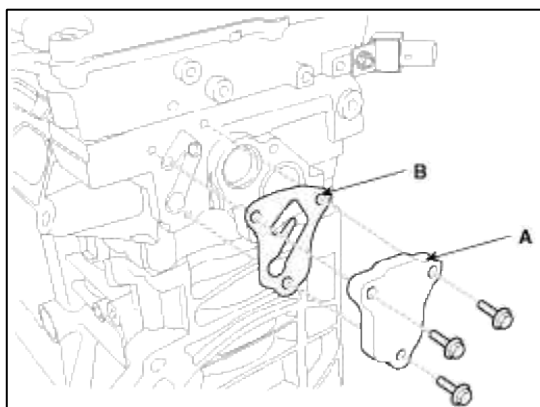
NOTE

The HLA and swing arm should be kept together as pairs during storage after removal and reinstallation.

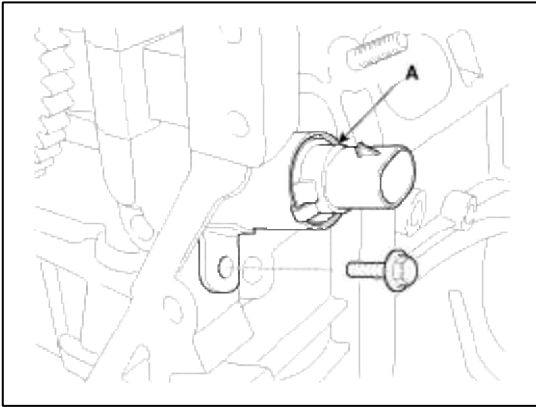
21. Disconnect the bypass hose (A).
 22. Unfasten the heater pipe mounting bolts (B).



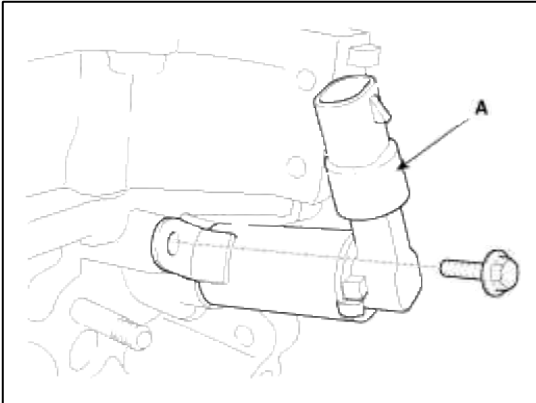
23. Remove the water temperature control assembly.
 (Refer to Cooling system in this group)
 24. Remove the oil control adapter (A) with the gasket (B).



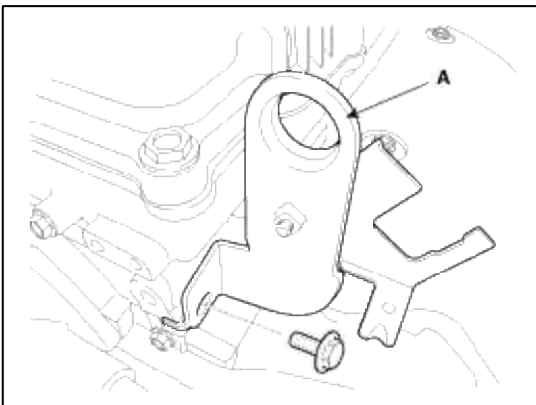
25. Remove the intake OCV (Oil control valve) (A).



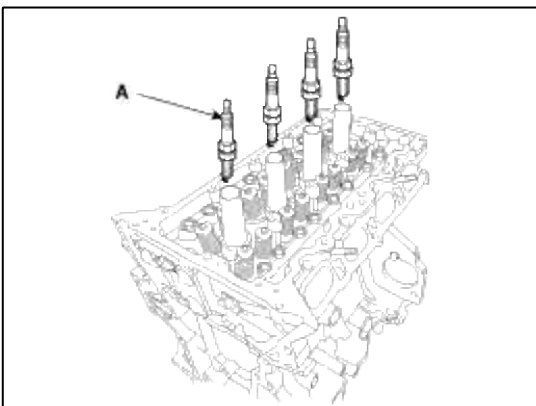
26. Remove the exhaust OCV (Oil control valve) (A).



27. Remove the rear engine hanger (A).

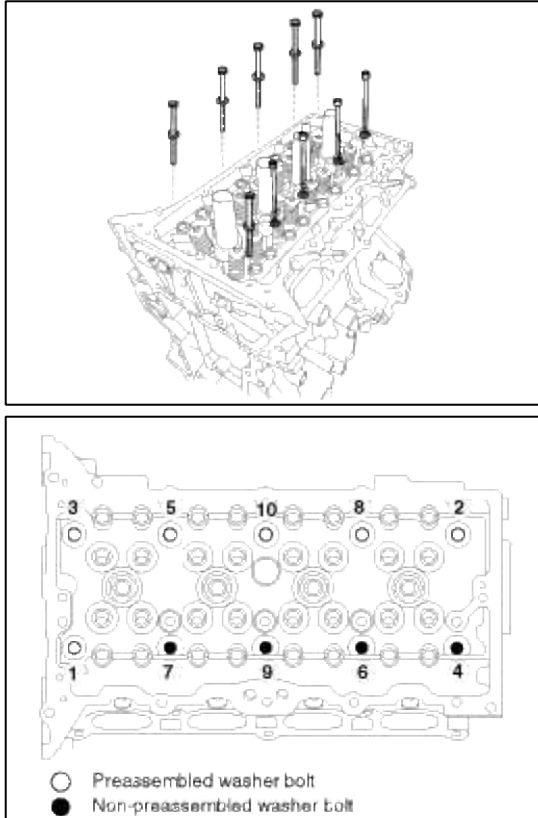


28. Remove the spark plugs (A). (Refer to EE group – “Ignition system”)



29. Remove the cylinder head.

- (1) Using bit socket (12PT), uniformly loosen and remove the cylinder head bolts, in several passes, in the sequence as shown.



CAUTION

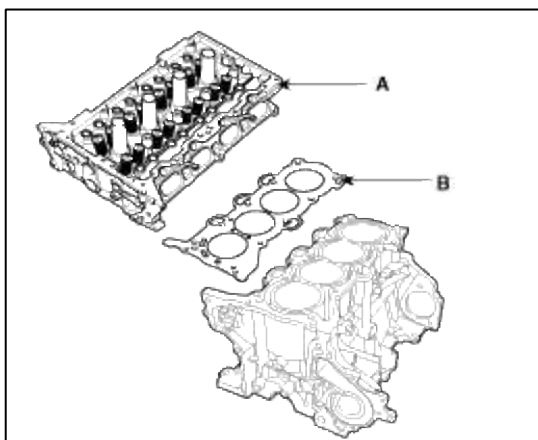
Head warpage or cracking could result from removing bolts in an incorrect order.

- (2) Lift the cylinder head (A) from the dowels on the cylinder block and place 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.

- (3) Remove the cylinder head gasket (B).



NOTE

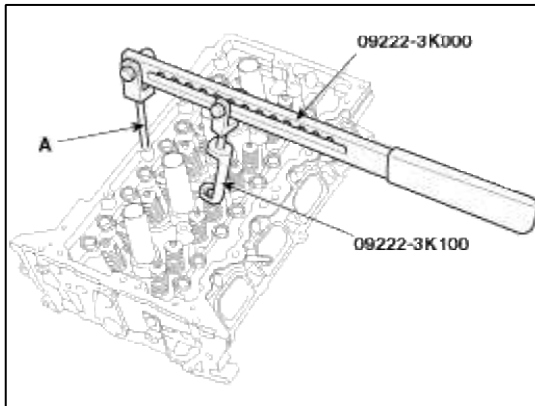
Identify, valves and valve springs as they are removed so that each item can be reinstalled in its original position.

1. Remove the valves.

- (1) Using the SST (09222-3K000, 09222-3K100), compress the valve spring and remove the retainer lock (A).

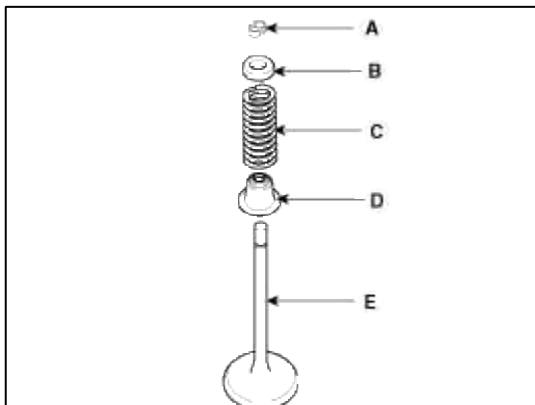
NOTE

When installing the SST, insert the front support (A) directly into the bolt hole on the cylinder head.

**CAUTION**

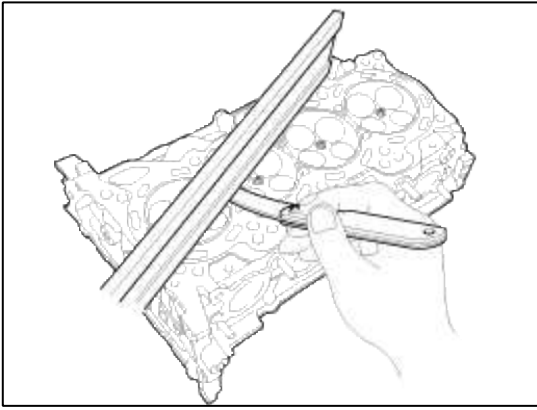
Do not press valve retainer more than 12 mm (0.47 in.).

- (2) Remove the spring retainer (B).
 (3) Remove the valve spring (C).
 (4) Remove the valve (D).
 (5) Using needle-nose pliers, remove the valve stem seal (E).

**NOTE**

Do not reuse the valve stem seals.

1. Inspect for flatness.

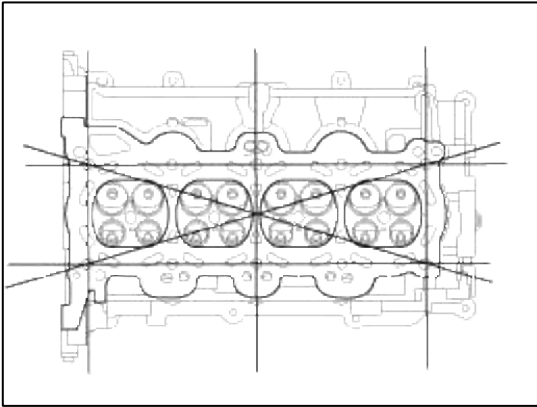


Using a precision straight edge and feeler gauge, measure the contacting surface of the cylinder block and the manifolds for warpage.

Flatness of cylinder head gasket surface:

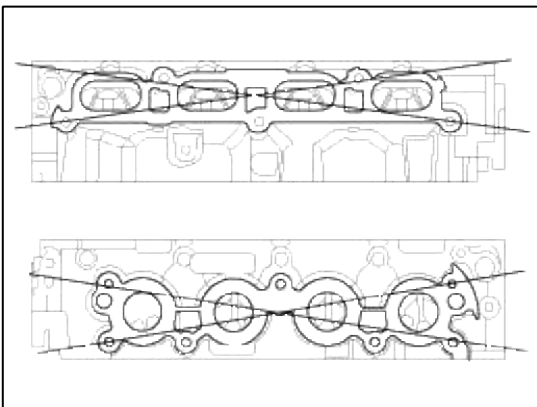
Less than 0.05 mm (0.0020 in.) for total area

Less than 0.02 mm (0.0008 in.) for a section of 100 mm (3.9370 in.) X 100 mm (3.9370 in.)



Flatness of manifold mounting surface:

Less than 0.10 mm (0.0039 in.)



2. Inspect for cracks.

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

Valve And Valve Spring

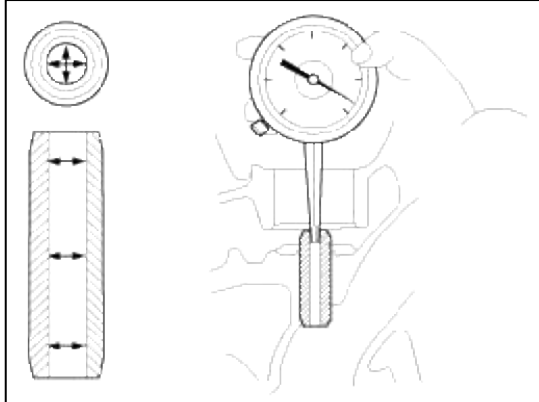
1. Inspect valve stems and valve guides.

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

Valve guide inner diameter

Intake: 5.500 ~ 5.512 mm (0.21654 ~ 0.21701 in.)

Exhaust: 5.500 ~ 5.512 mm (0.21654 ~ 0.21701 in.)

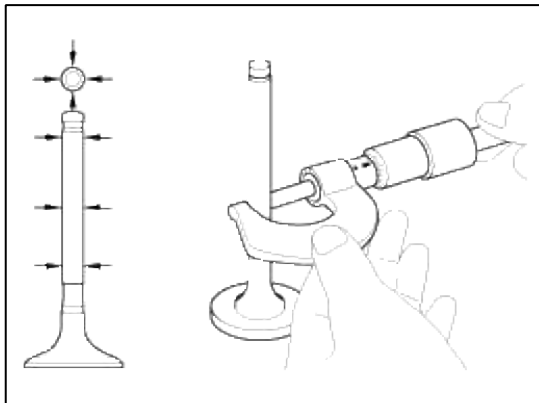


- (2) Using a micrometer, measure the diameter of the valve stem.

Valve stem outer diameter

Intake: 5.465 ~ 5.480 mm (0.21516 ~ 0.21575 in.)

Exhaust: 5.458 ~ 5.470 mm (0.21488 ~ 0.21535 in.)



- (3) Subtract the valve stem diameter measurement from the valve guide inside diameter measurement.
If the clearance is greater than specification, replace the valve or the cylinder head.

Valve stem-to-guide clearance

[Standard]

Intake : 0.020 ~ 0.047 mm (0.00079 ~ 0.00185 in.)

Exhaust : 0.030 ~ 0.054 mm (0.00118 ~ 0.00213 in.)

2. Inspect the valves.

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

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

If the valve face is worn, replace the valve.

(3) Check the valve head margin thickness.

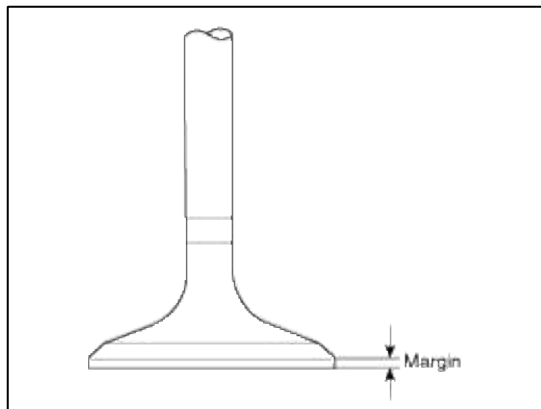
If the margin thickness is less than specification, replace the valve.

Margin

[Standard]

Intake: 1.30 mm (0.0512 in.)

Exhaust: 1.26 mm (0.0496 in.)



(4) Check the valve length.

Valve length

[Standard]

Intake: 102.22 mm (4.0244 in.)

Exhaust: 104.04 mm (4.0961 in.)

[Limit]

Intake: 101.97 mm (4.0146 in.)

Exhaust: 103.79 mm (4.0862 in.)

(5) Check the surface of the valve stem tip for wear.

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

3. Inspect the valve seats and the valve guides.

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

If the valve seat is worn, replace the cylinder head.

(2) Check the valve guide for wear. If the valve guide is worn, replace the cylinder head.

4. Inspect the valve springs.

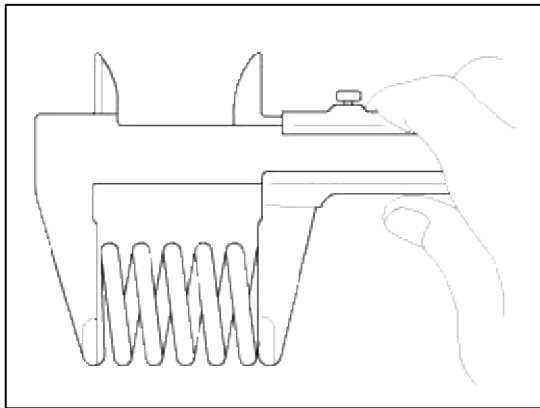
- (1) Using a steel square, measure the out-of-square of valve spring.
- (2) Using a vernier calipers, measure the free length of valve spring.
If the free length is not as specified, replace the valve spring.

Valve spring

[Standard]

Free height: 45.93 mm (1.8083 in.)

Out-of-square : Less than 1.5°



Camshaft

1. Inspect the cam lobes.

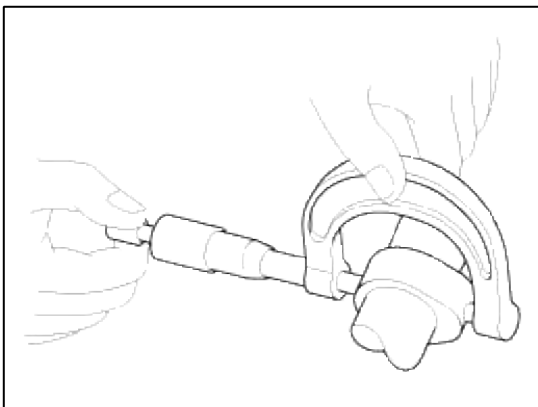
Using a micrometer, measure the cam lobe height.

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

Cam height

Intake: 39.0 mm (1.5354 in.)

Exhaust: 39.0 mm (1.5354 in.)

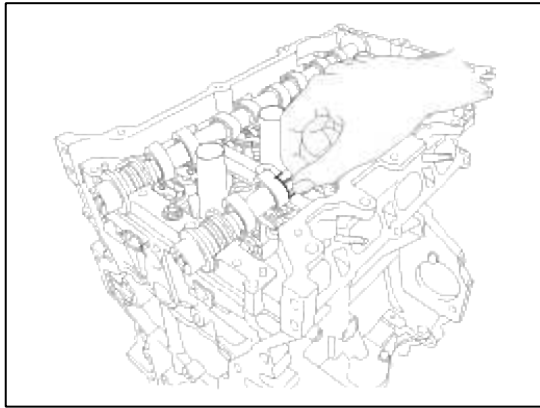


2. Check the surface of the camshaft journal for wear.

If the journal is worn excessively, replace the camshaft.

3. 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.

Tightening torque

M6 bolts:

11.8 ~ 13.7 N.m (1.2 ~ 1.4 kgf.m, 8.7 ~ 10.1 lb-ft)

M8 bolts:

18.6 ~ 22.6 N.m (1.9 ~ 2.3 kgf.m, 13.7 ~ 16.6 lb-ft)

CAUTION

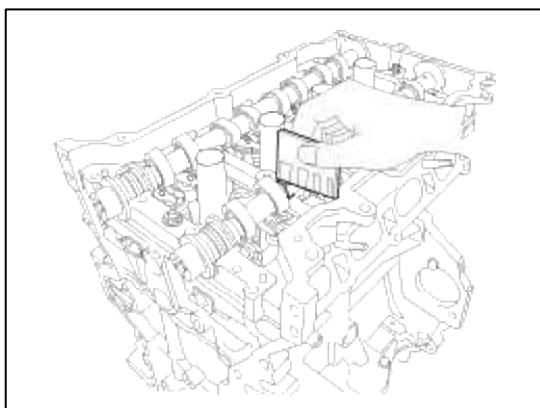
Do not turn the camshaft.

- (5) Remove the bearing caps.
- (6) Measure the plastigage at its widest point.
If the oil clearance is greater than specification, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

Bearing oil clearance

Standard:

0.032 ~ 0.062 mm (0.00126 ~ 0.00244 in.)



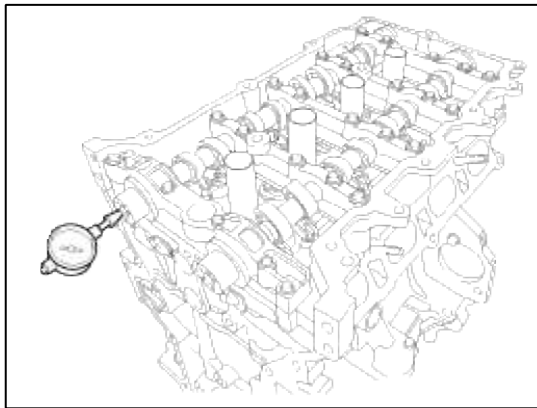
4. Inspect the camshaft end play.

- (1) Install the camshaft bearing caps.
- (2) Using a dial indicator, measure the end play while moving the camshaft back and forth.
If the end play is greater than specification, replace the camshaft.
If necessary, replace the bearing caps and cylinder head as a set

Camshaft end play

Standard:

0.10 ~ 0.19mm (0.0039 ~ 0.0075 in.)

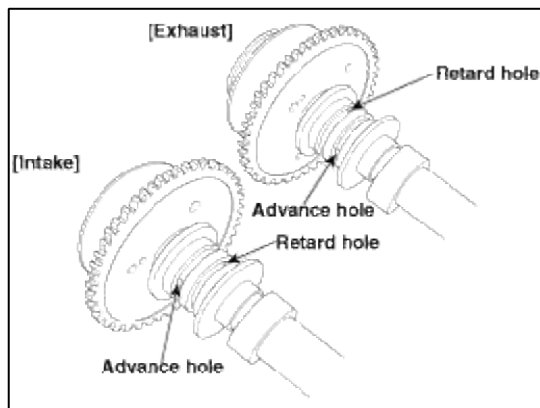


- (3) Remove the camshafts.

CVVT (Continuous Variable Valve Timing) Assembly

1. Inspect CVVT assembly.

- (1) Fix the camshaft using a vise.
Be careful not to damage the cam lobe and journal.
- (2) Check that the CVVT assembly will not turn.
- (3) Apply vinyl tape to the retard hole like the one indicated by the arrow in the illustration.
Verify that the tape holds and put air through the port of the camshaft.



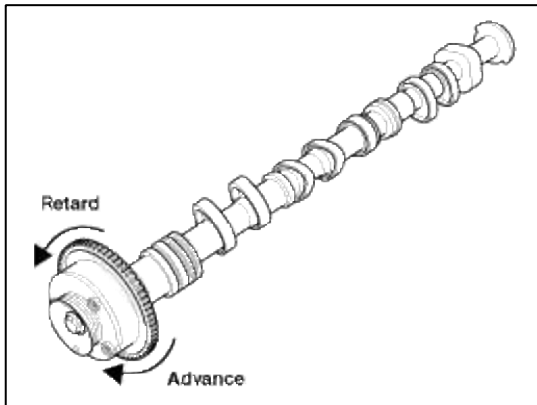
- (4) Wind tape around the tip of the air gun and apply air of approx. 150 kPa (1.5 kgf/cm², 21 psi) to the port of the camshaft.
Perform this in order to release the lock pin for the maximum delay angle locking.

NOTE

Wrap around it with a shop rag and the likes to prevent oil from splashing.

- (5) With air applied, as in step (3), turn the CVVT assembly to the advance angle side (the arrow marked direction in the illustration) with your hand.

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



- (6) Turn the CVVT assembly back and forth and check the movable range and that there is no disturbance.

Standard:

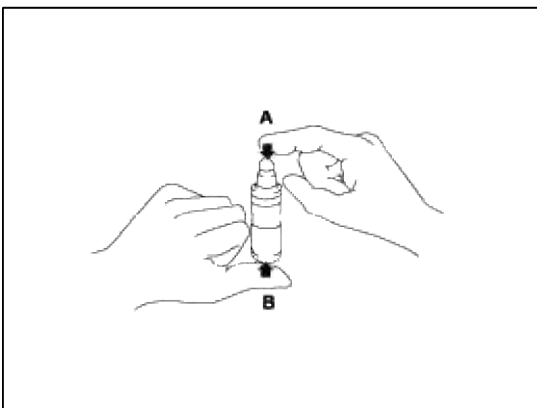
Should move smoothly in a range from about
 25.0° (Intake) / 20.0° (Exhaust)

- (7) Turn the intake CVVT assembly with your hand and lock it at the maximum retard angle position (counter clockwise).
- (8) Turn the exhaust CVVT assembly with your hand and lock it at the maximum advance angle position (clockwise).

HLA (Hydraulic Lash Adjuster)

With the HLA filled with engine oil, hold A and press B by hand.

If B moves, replace the HLA.



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

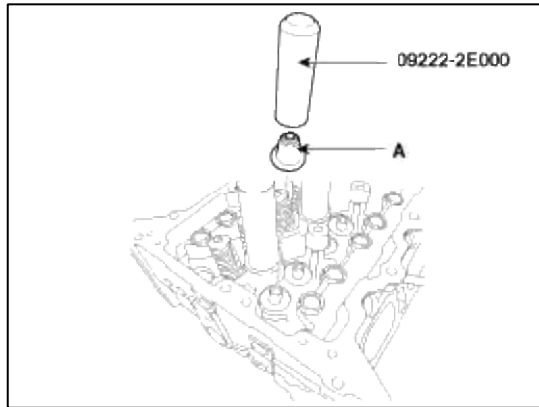
Reassembly

NOTE

- 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) Using the SST (09222-2E000), push in a new stem seal (A).

**NOTE**

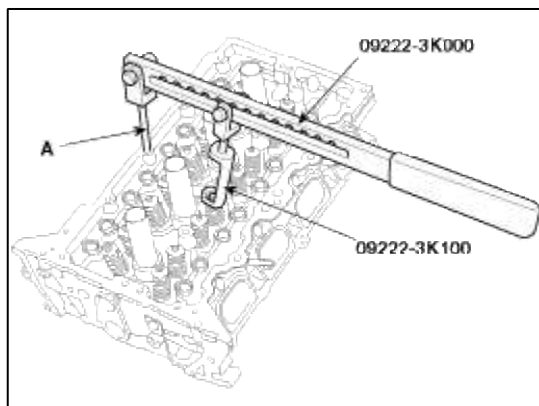
- Do not reuse old valve stem seals.
- Incorrect installation of the seal could result in oil leakage past the valve guides.

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

NOTE

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

- (3) Using the SST (09222-3K000, 09222-3K100), compress the spring and install the retainer locks.
- Before releasing the valve spring compressor, ensure that the retainer locks are correctly in place after pushing down and releasing the compressor handle 2 ~ 3 times.

**NOTE**

When installing the SST, insert the front support (A) directly into the bolt hole on the cylinder head.

CAUTION

Do not press valve retainer more than 12 mm (0.47 in.).

NOTE

- Thoroughly clean all parts to be assembled.
- Always use new cylinder head and manifold gaskets.
- Always use new cylinder head bolts.
- The cylinder head gasket is a metal gasket. Take care not to bend it.
- Rotate the crankshaft to set the No.1 piston at TDC (Top dead center) on compression stroke.

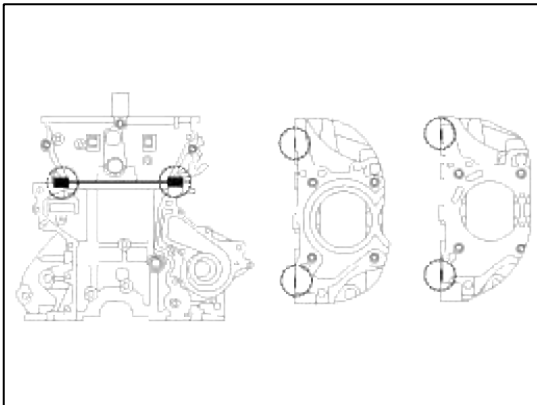
1. Install the cylinder head gasket (B) on the cylinder block.

- (1) Remove hardening sealant, oil, dust, moisture and harmful foreign materials from the cylinder block and the cylinder head.
- (2) Apply liquid gasket on the edge of the cylinder block.
- (3) Install the cylinder head gasket with the dowel pins of the cylinder block.
- (4) Apply liquid gasket on the edge of the cylinder head gasket.

NOTE

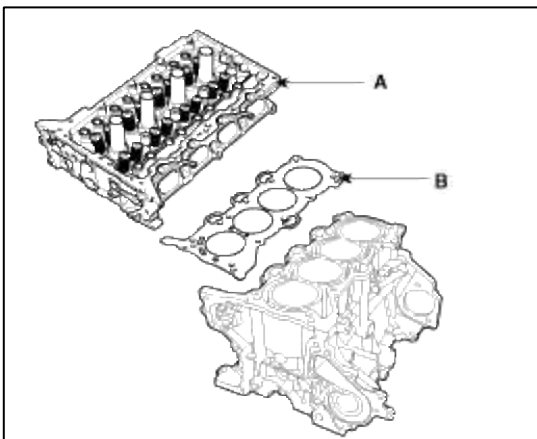
Apply liquid gasket on the edge of the cylinder block and cylinder head gasket.

Sealant: Threebond 1217H or equivalent

**CAUTION**

Assemble the cylinder head gasket and the cylinder head within 5 minutes after applying sealant.

2. Place the cylinder head (A) carefully to protect damage to the head gasket during installation.



3. Install the cylinder head bolts with washers.

Using SST (09221-4A000), install and tighten the 10 cylinder head bolts, in several passes, in the sequence as shown.

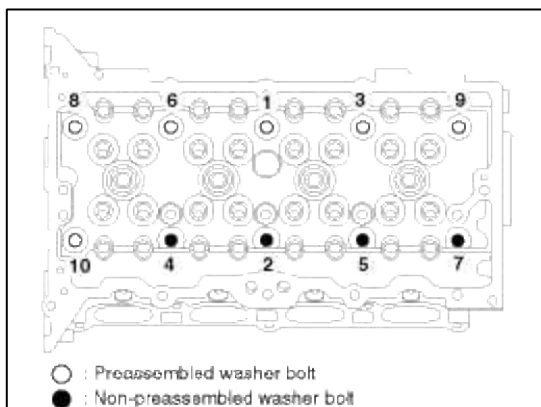
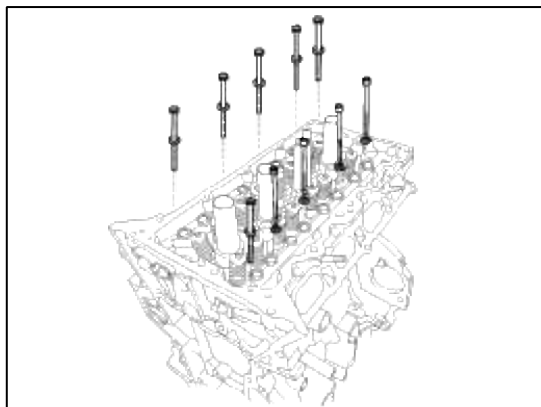
Tightening torque

1st step:

32.4 ~ 36.3 N.m (3.3 ~ 3.7 kgf.m, 23.9 ~ 26.8 lb-ft)

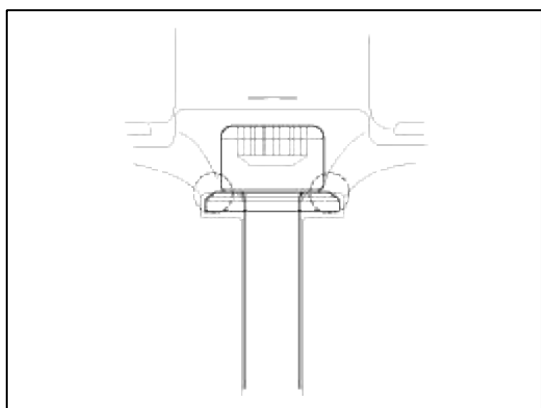
2nd step: 90~95°

3rd step: 90~95°



CAUTION

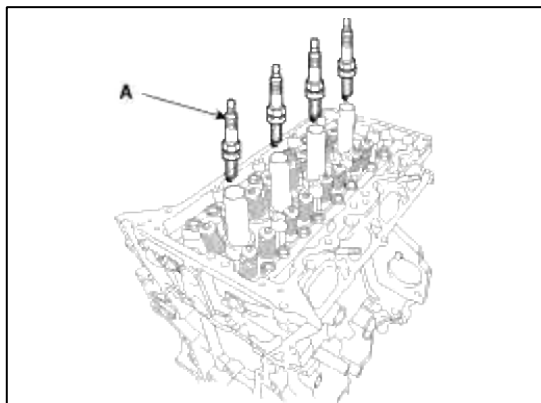
- Do not reuse the cylinder head bolts.
- Do not apply engine oil on the bolt threads to achieve correct torque.
- Remove the extruded sealant within 5 minutes after installing cylinder head bolts.
- The engine running or pressure test should not be performed within 30 minutes after installing cylinder head bolts.
- Be careful not to change the installing position of the preassembled washer bolts and non-preassembled washer bolts.
- When installing the washer of the non-preassembled washer bolts, the round and chamfer of washers should be faced up.



4. Install the spark plugs (A). (Refer to EE group – “Ignition system”)

Tightening torque:

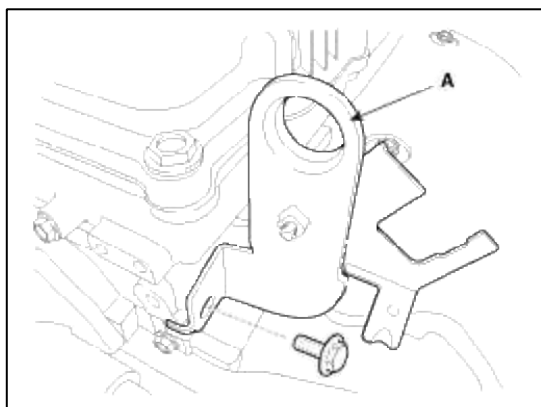
14.7 ~ 24.5 N.m (1.5 ~ 2.5 kgf.m, 10.8 ~ 18.1 lb-ft)



5. Install the rear engine hanger (A).

Tightening torque:

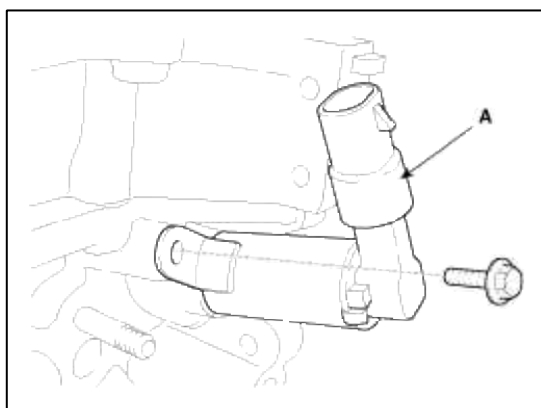
34.3 ~ 39.2 N.m (3.5 ~ 4.0 kgf.m, 25.3 ~ 28.9 lb-ft)



6. Install the exhaust OCV (Oil control valve) (A).

Tightening torque:

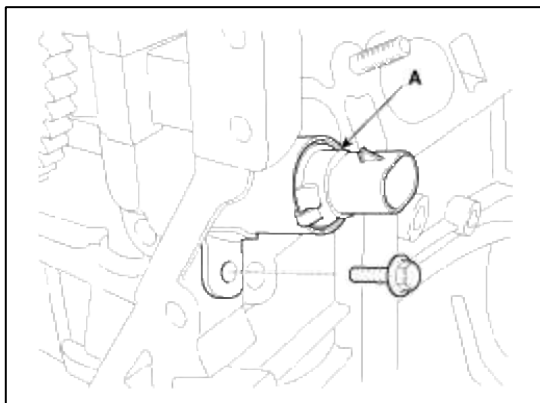
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



7. Install the intake OCV (Oil control valve) (A).

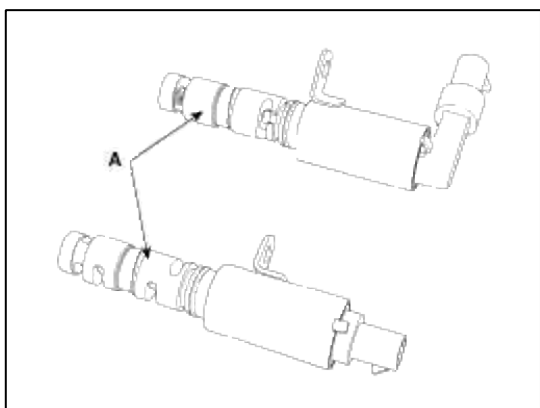
Tightening torque:

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



CAUTION

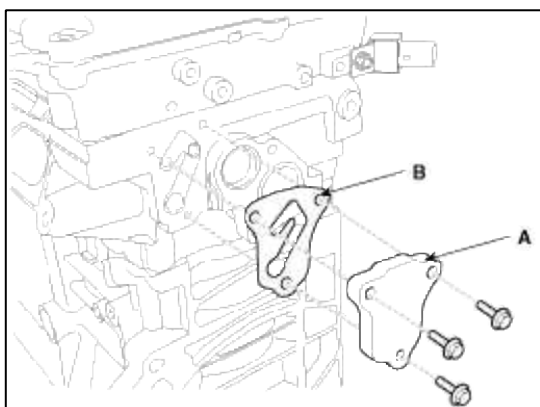
- Do not reuse the OCV when dropped.
- Keep the OCV filter clean.
- Do not hold the OCV sleeve (A) during servicing.
- When the OCV is installed on the engine, do not move the engine with holding the OCV yoke.



8. Install the oil control adapter (A) with a new gasket (B).

Tightening torque:

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



9. Install the water temperature control assembly.
(Refer to Cooling system in this group)
10. Fasten the heater pipe mounting bolts (B).

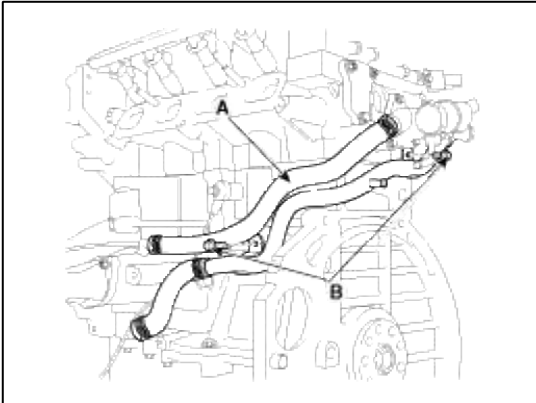
Tightening torque:

19.6 ~ 23.5 N.m (2.0 ~ 2.4 kgf.m, 14.5 ~ 17.4 lb-ft)

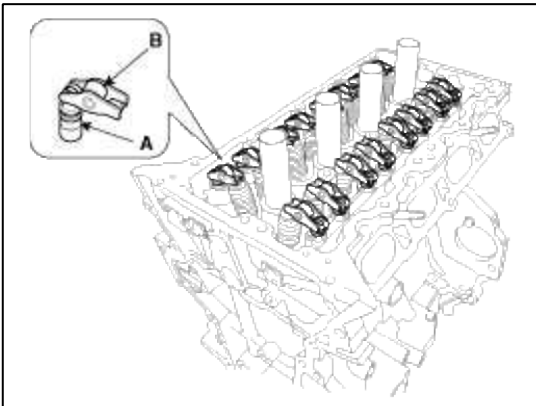
CAUTION

Do not reuse the seal bolts.

11. Connect the bypass hose (A).



12. Install the HLA (Hydraulic lash adjuster)(A) and the swing arm (B).

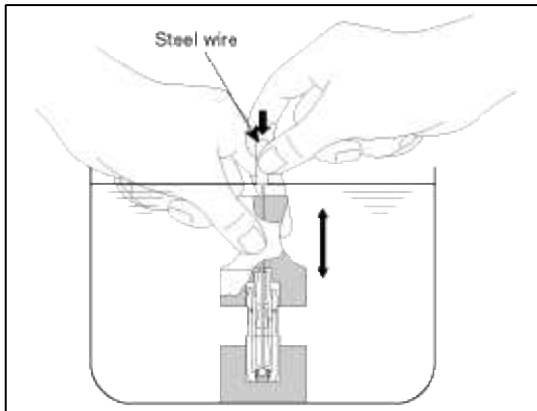


- (1) When installing HLA, it should be held upright so that engine oil in HLA may not spill and assured that dust does not adhere to HLA.

- (2) HLA should be inserted carefully to the cylinder head not to spill engine oil.

CAUTION

In case of spilling, air bleed should be done in accordance with the air bleed procedure. Stroke HLA in diesel oil 4 ~ 5 times by pushing its cap while pushing the ball down slightly with a hard steel wire. (Take care not to severely push a hard steel wire down since ball is several grams.)

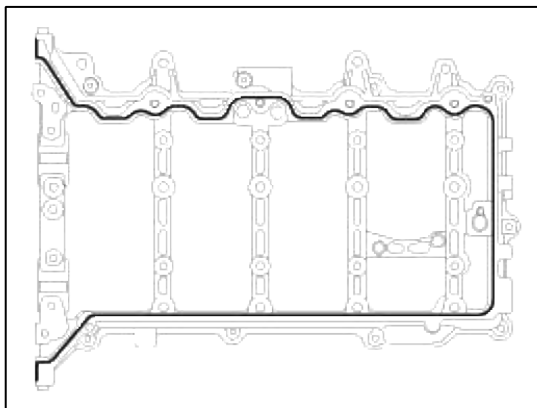


13. Install the cam carrier.

- (1) Using a gasket scraper, remove all the old packing material from the gasket surfaces.
- (2) The sealant locations on the cam carrier and the cylinder head must be free of harmful foreign materials, oil, dust and moisture. Spray cleaner on the surface and wipe with a clean duster.
- (3) After applying liquid sealant on the bottom surface of the cam carrier, assemble the cam carrier. Continuous bead of sealant should be applied to prevent any path from oil leakage.

Bead width: 2.5 ~ 3.5 mm (0.10 ~ 0.14 in.)

Sealant: Threebond 1217H or equivalent

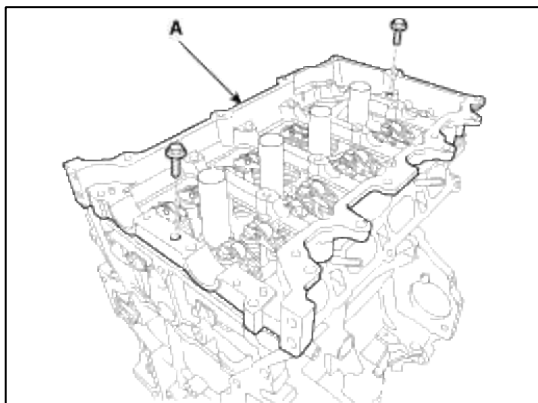


- (4) Place the cam carrier (A) on the cylinder head. The dowel pins on the cam carrier and holes on the cylinder head should be used as a reference in order to assemble the cam carrier in exact position.

(5) Fasten the cam carrier bolts.

Tightening torque:

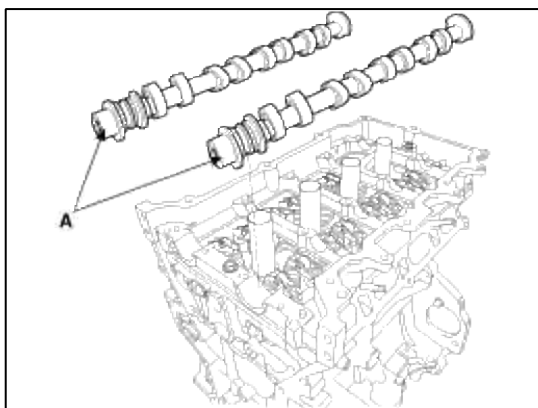
18.6 ~ 22.6 N.m (1.9 ~ 2.3 kgf.m, 13.7 ~ 16.6 lb-ft)

**CAUTION**

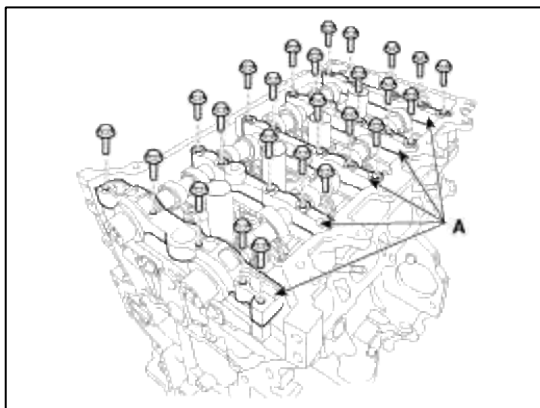
- Assemble the cam carrier within 5 minutes after applying sealant.
- Assemble the camshaft bearing cap within 5 minutes after assembling the cam carrier.
- The engine running or pressure test should not be performed within 30 minutes after assembling the cam carrier.

14. Install the camshafts.

(1) Place the intake and exhaust camshafts (A) on the cam carrier.



(2) Install the camshaft bearing cap (A).



Tighten the bolts, in several passes, in the sequence as shown.

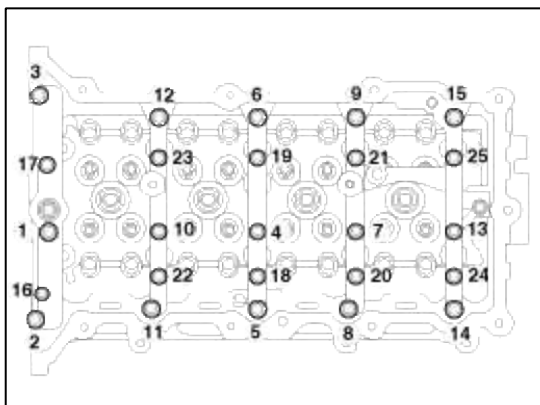
Tightening torque

M6 bolts:

11.8 ~ 13.7 N.m (1.2 ~ 1.4 kgf.m, 8.7 ~ 10.1 lb-ft)

M8 bolts:

18.6 ~ 22.6 N.m (1.9 ~ 2.3 kgf.m, 13.7 ~ 16.6 lb-ft)



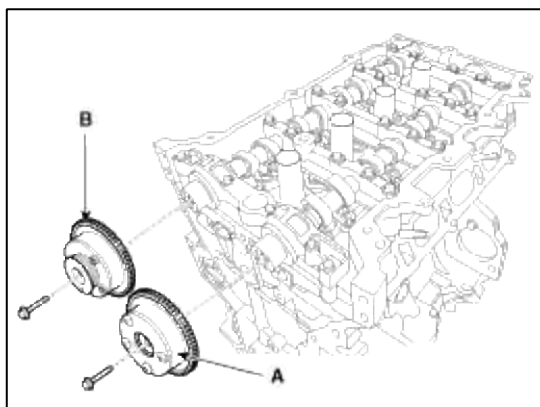
CAUTION

Be careful not to change the position and direction of bearing caps.

15. Install the intake CVVT assembly (A) and exhaust CVVT assembly (B).

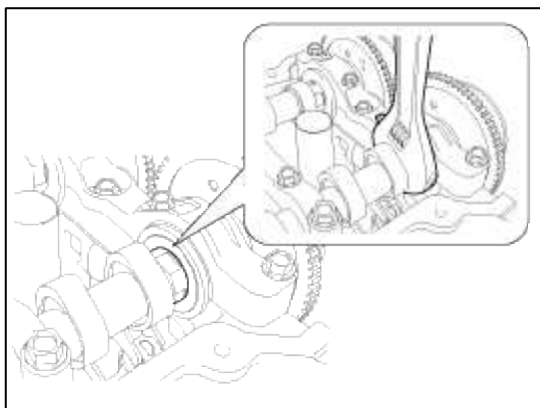
Tightening torque:

64.7 ~ 76.5 N.m (6.6 ~ 7.8 kgf.m, 47.7 ~ 56.4 lb-ft)



NOTE

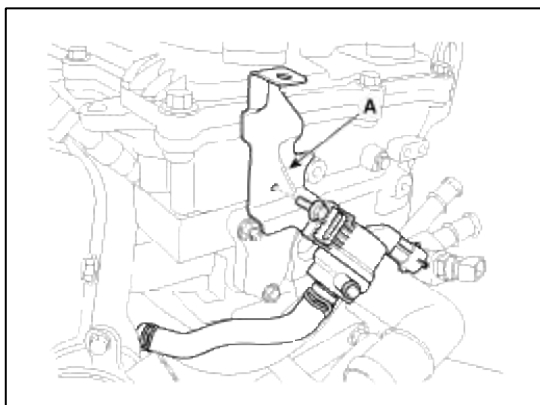
When installing the CVVT assembly bolt, hold the camshaft with a wrench to prevent the camshaft from rotating.



16. Install the PCSV bracket (A).

Tightening torque:

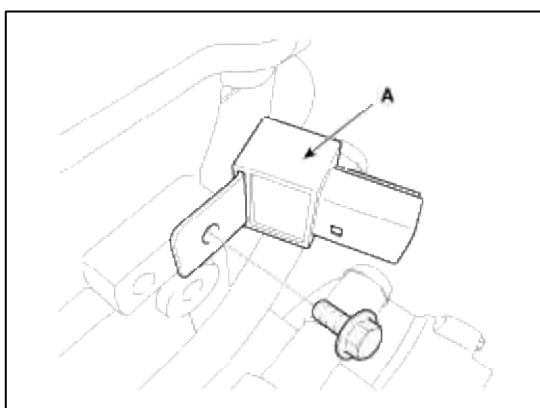
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



17. Install the condenser (A).

Tightening torque:

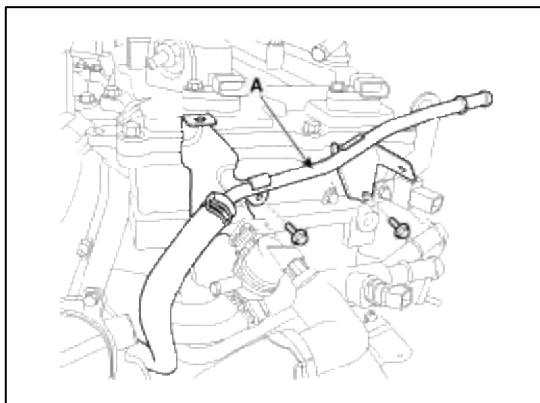
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



18. Install the vacuum pipe (A).

Tightening torque:

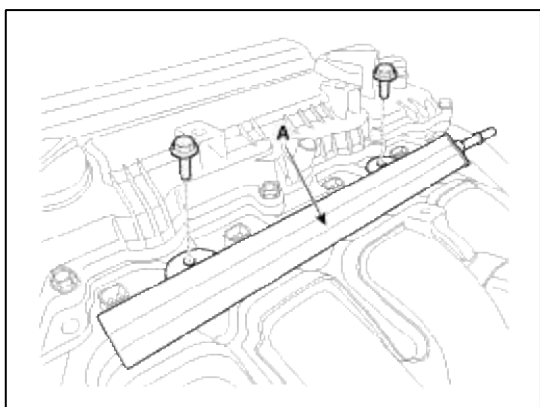
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



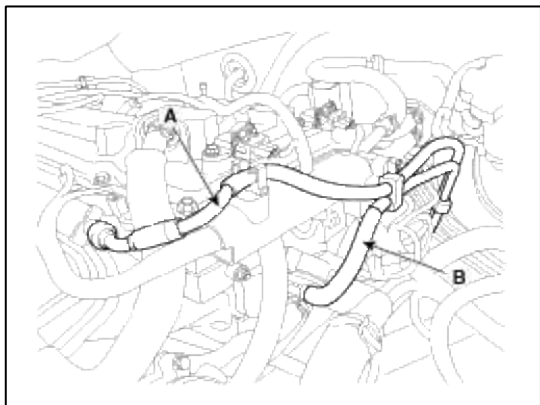
19. Install the timing chain including the drive belt, the cylinder head cover, the alternator and the timing chain cover.
(Refer to Timing system in this group)
20. Install the intake and exhaust manifold.
(Refer to Intake and exhaust system in this group)
21. Install the injector & rail assembly (A). (Refer to FL – “Injector”)

Tightening torque:

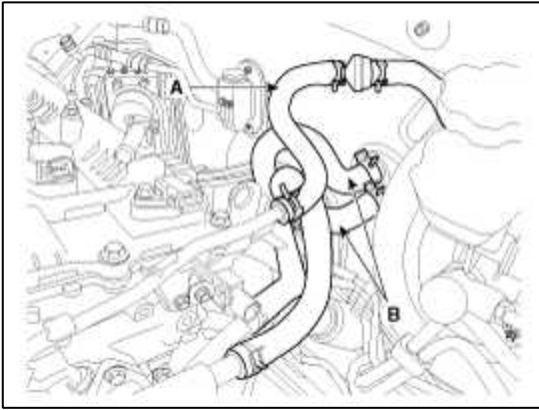
18.6 ~ 23.5 N.m (1.9 ~ 2.4 kgf.m, 13.7 ~ 17.4 lb-ft)



22. Connect the fuel hose (A) and PCSV (Purge control solenoid valve) hose (B).



23. Connect the brake booster vacuum hose (A) and the heater hoses (B).

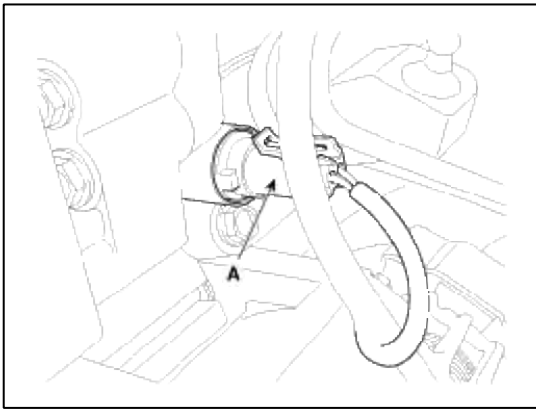


NOTE

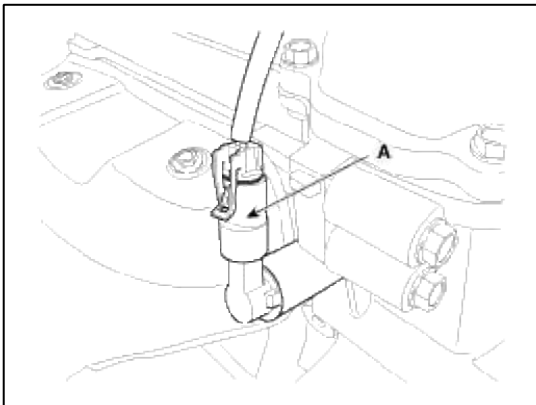
When installing the heater hoses, install as shown in illustrations.

24. Install the wiring and protectors on the cylinder head and the intake manifold and then connect the wiring connectors and harness clamps.

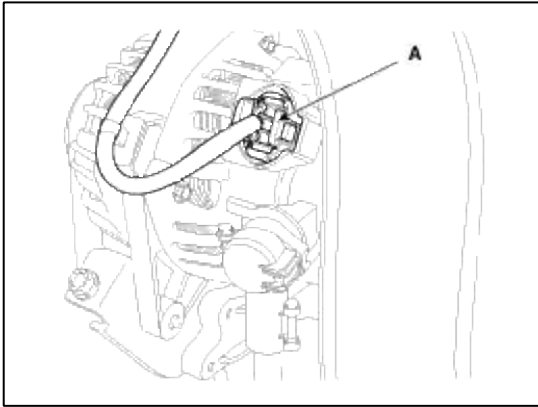
(1) The intake OCV (Oil control valve) connector (A)



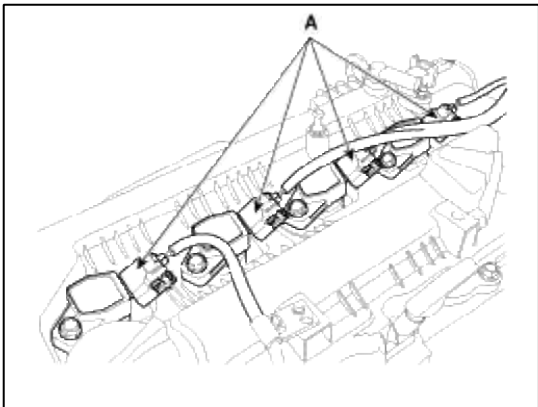
(2) The exhaust OCV (Oil control valve) connector (A)



(3) The alternator connector (A)

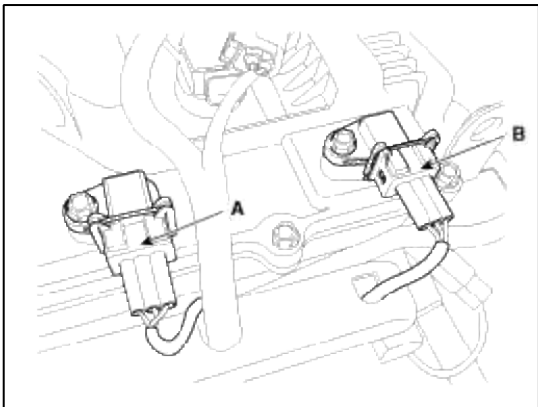


(4) The ignition coil connectors (A)

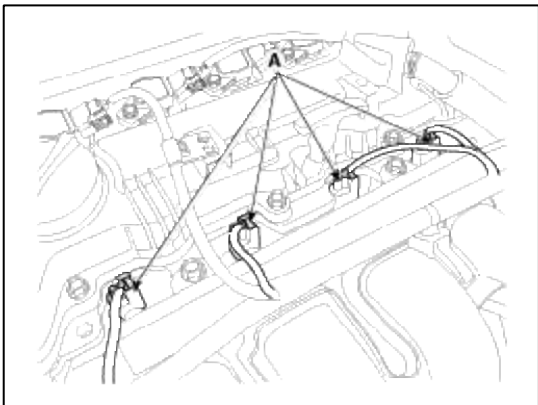


(5) The intake CMPS (Camshaft position sensor) connector (A)

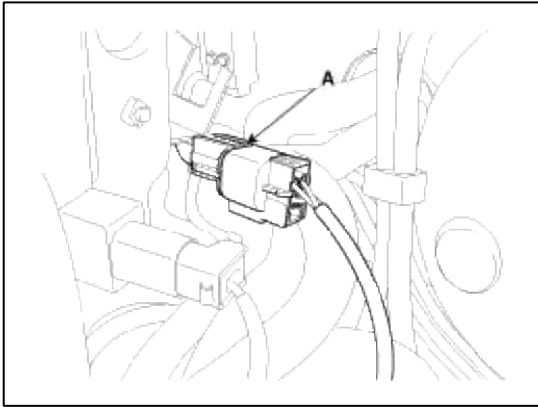
(6) The exhaust CMPS (Camshaft position sensor) connector (B)



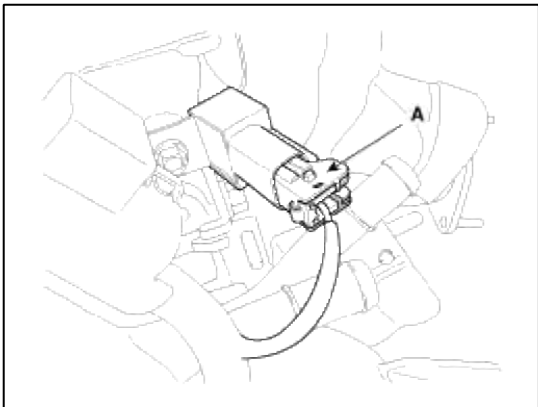
(7) The injector connectors (A)



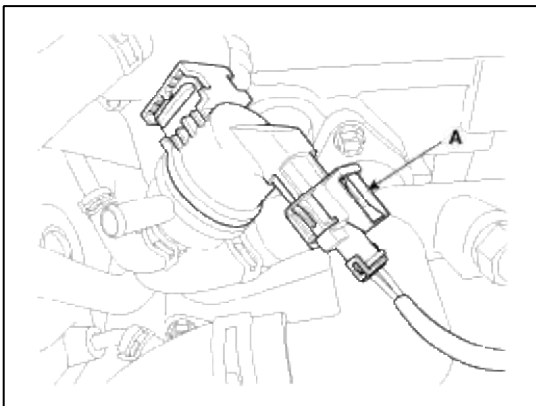
(8) The front HO2S (Heated oxygen sensor connector (A)



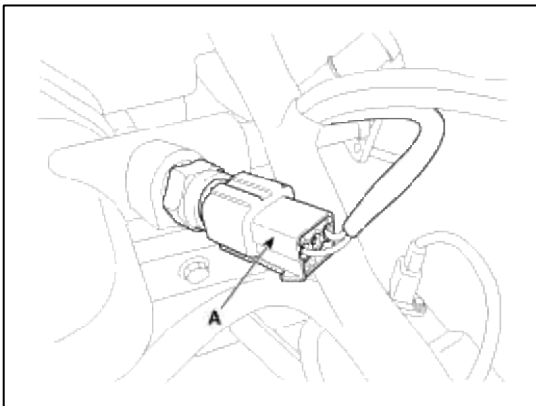
(9) The condenser connector (A)



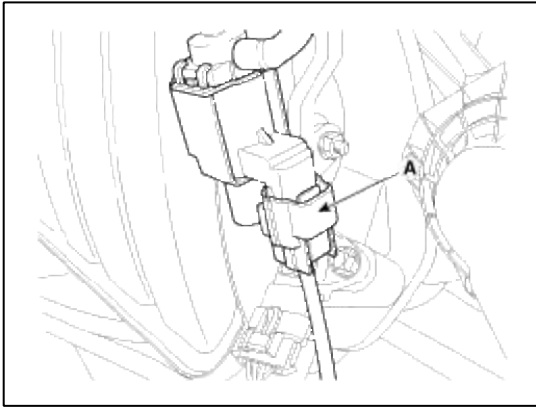
(10) The PCSV (Purge control solenoid valve) connector (A)



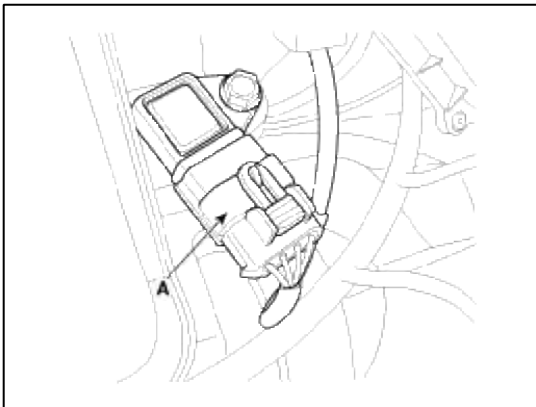
(11) The ECTS (Engine coolant temperature sensor) connector (A)



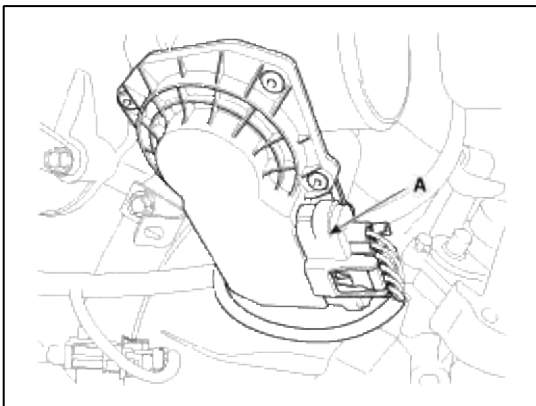
(12) The VIS (Variable Intake System) connector (A)



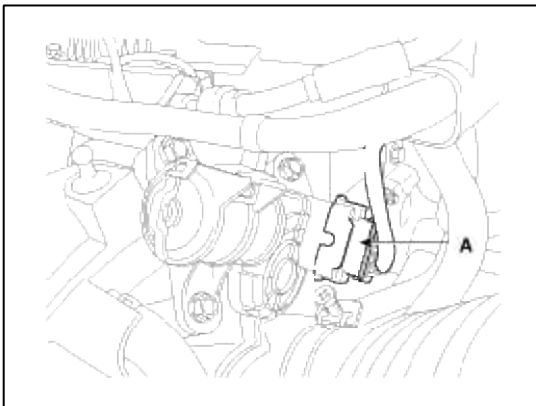
(13) The MAPS (Manifold absolute pressure sensor) & IATS (Intake air temperature sensor) connector (A)



(14) The ETC (Electronic throttle control) connector (A)



(15) The VCMA (Variable charge motion actuator) connector (A)



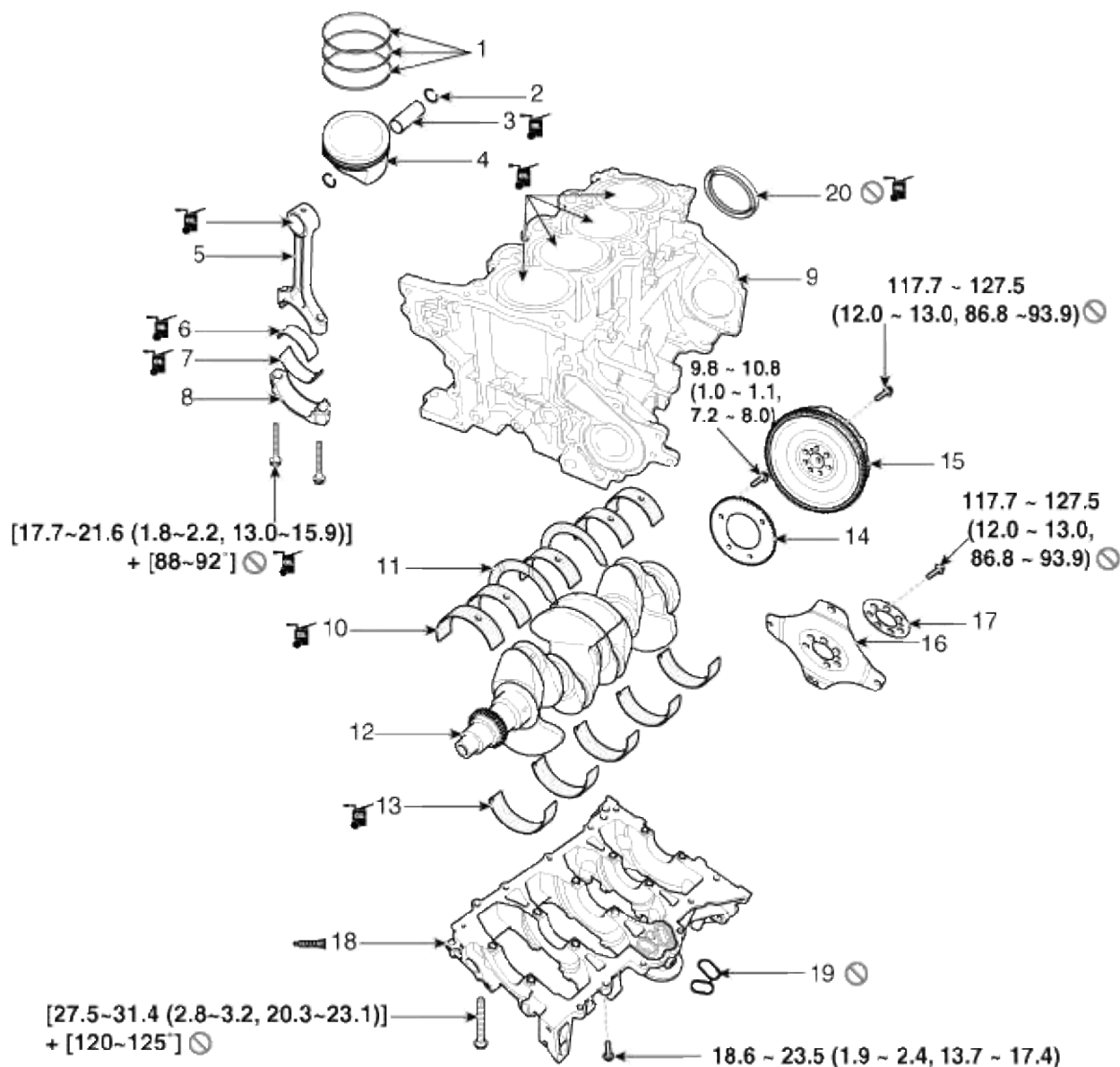
25. Connect the radiator upper hose and lower hose. (Refer to Cooling system in this group)
26. Install the air duct and the air cleaner assembly. (Refer to Intake and exhaust system in this group)
27. Install the engine cover. (Refer to Engine and transaxle assembly in this group)
28. Install the under cover. (Refer to Engine and transaxle assembly in this group)

29. Install the RH front wheel. (Refer to SS group – “Wheel”)
30. Connect the battery negative terminal. (Refer to Engine and transaxle assembly in this group)
31. Add all the necessary fluids and check for leaks.
Connect GDS. Check for codes, note, and clear. Recheck.

NOTE

- Refill engine with engine oil.
- Refill a radiator and a reservoir tank with engine coolant.
- Clean battery posts and cable terminals and assemble.
- Inspect for fuel leakage.
- After assembling 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.
- 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 radiator cap on tightly, then run the engine again and check for leaks.

Engine Mechanical System > Cylinder Block > Cylinder Block > Components and Components Location
Components



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

1. Piston ring	8. Connecting rod bearing cap	15. Flywheel
2. Snap ring	9. Cylinder block	16. Drive plate
3. Piston pin	10. Crankshaft upper bearing	17. Adapter plate
4. Piston	11. Crankshaft thrust bearing	18. Lower crankcase
5. Connecting rod	12. Crankshaft	19. Gasket
6. Connecting rod upper bearing	13. Crankshaft lower bearing	20. Rear oil seal
7. Connecting rod lower bearing	14. CKPS (Crankshaft position sensor) wheel	

Engine Mechanical System > Cylinder Block > Cylinder Block > Repair procedures

Disassembly

Engine removal is required for this procedure.

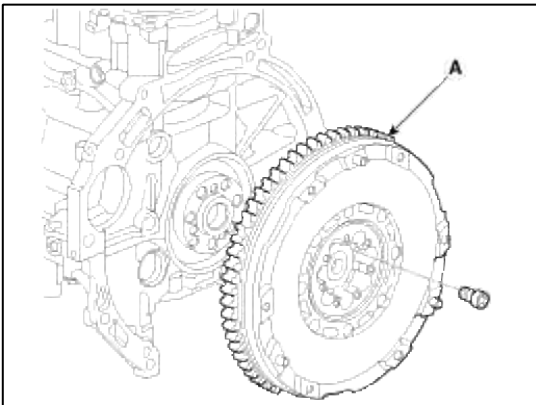
CAUTION

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

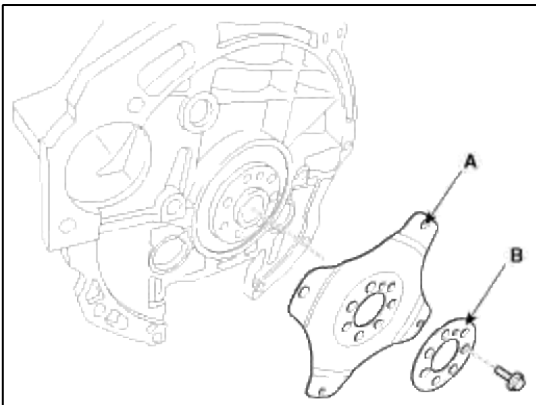
NOTE

- Mark all wiring and hoses to avoid misconnection.
- Turn the crankshaft pulley so that the No.1 piston is at TDC (Top dead center).

1. Remove the engine assembly from the vehicle. (Refer to Engine and transaxle assembly in this group)
2. Remove the transaxle assembly from the engine assembly. (Refer to MT or AT group)
3. Manual transaxle: Remove the flywheel (A).

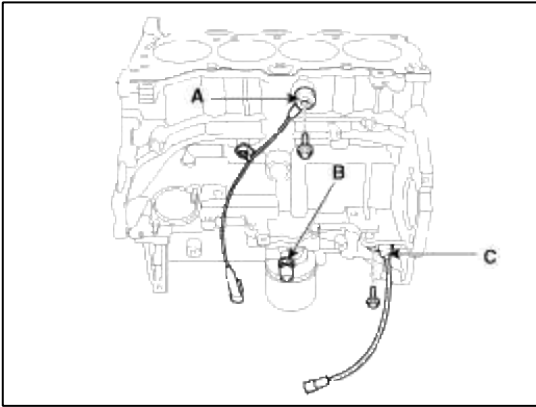


Automatic transaxle: Remove the drive plate (A) and the adapter plate (B).

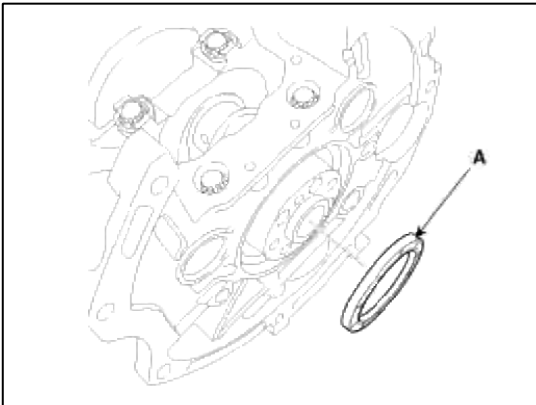


4. Fix the engine to an engine stand for disassembly.
5. Remove the intake manifold and exhaust manifold. (Refer to Intake and exhaust system in this group)
6. Remove the timing chain including the drive belt, the cylinder head cover, the alternator and the timing chain cover. (Refer to Timing system in this group)
7. Remove the cylinder head assembly. (Refer to Cylinder head in this group)
8. Remove the A/C compressor. (Refer to HA group - "A/C compressor")
9. Remove the water pump assembly. (Refer to Cooling system in this group)
10. Remove the water inlet fitting and the thermostat assembly. (Refer to Cooling system in this group)
11. Remove the knock sensor (A).
12. Remove the OPS (Oil pressure switch) (B).

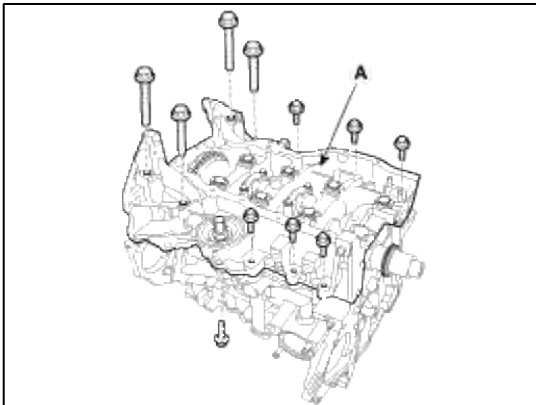
13. Remove the CKPS (Crankshaft position sensor) (C).



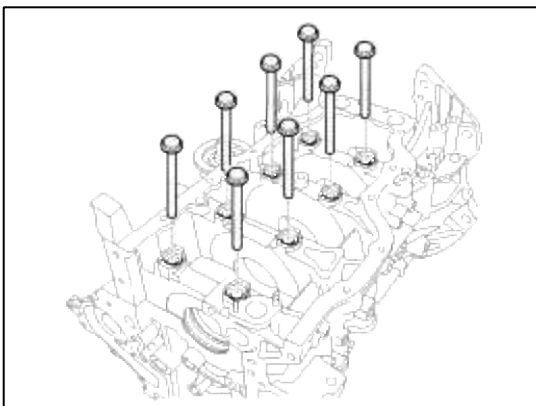
14. Remove the oil filter. (Refer to Lubrication system in this group)
 15. Remove the oil screen. (Refer to Lubrication system in this group)
 16. Remove the rear oil seal (A).



17. Remove the lower crankcase.
 (1) Remove the lower crankcase mounting bolts.



- (2) Remove the main bearing cap bolts.



18. Check the connecting rod side clearance.
 19. Check the connecting rod bearing oil clearance.

20. Remove piston and connecting rod assemblies.

(1) Using a ridge reamer, remove all the carbon from the top of the cylinder.

(2) Push the piston and connecting rod assembly with upper bearing through the top of the cylinder block.

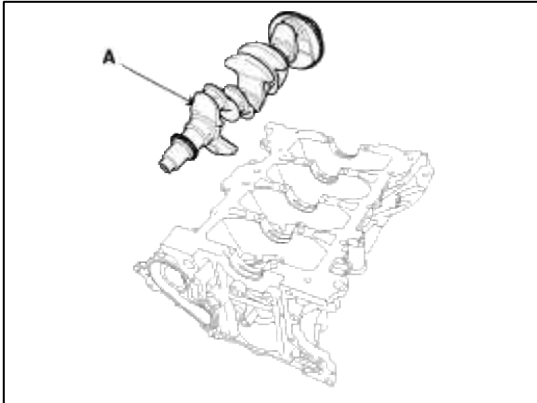
NOTE

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

21. Check the crankshaft bearing oil clearance.

22. Check the crankshaft end play.

23. Lift the crankshaft (A) out of the engine, being careful not to damage journals.



NOTE

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

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

25. Remove piston rings.

(1) Using a piston ring expander, remove the 2 compression rings.

(2) Remove 2 side rails and the oil ring by hand.

NOTE

Arrange the piston rings in the correct order.

26. Remove the snap rings and then disassemble the connecting rod from the piston.

Inspection

Connecting Rod

1. Check the connecting rod side clearance.

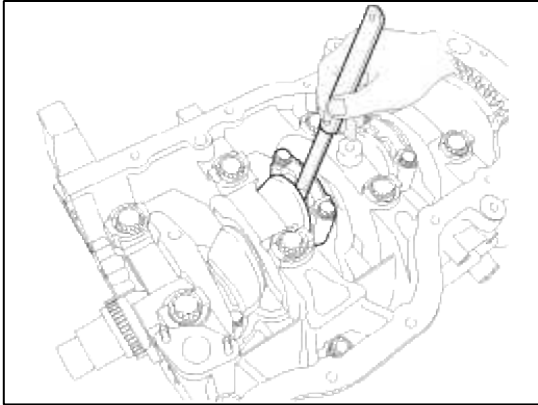
Using a feeler gauge, measure the end play while moving the connecting rod back and forth.

A. If out-of-tolerance, install a new connecting rod.

B. If still out-of-tolerance, replace the crankshaft.

Side clearance

Standard: 0.10~ 0.25 mm (0.0039 ~ 0.0098 in.)



2. Check the connecting rod bearing oil clearance.

(1) Check the matchmarks on the connecting rod and cap are aligned to ensure correct reassembly.

(2) Remove 2 connecting rod cap bolts.

(3) Remove the connecting rod cap and lower bearing.

(4) Clean the crank pin and bearing.

(5) Place a plastigage across the crankshaft pin journal.

(6) Reinstall the lower bearing and cap, and torque the bolts.

Tightening torque

1st step:

17.7 ~ 21.6 N.m (1.8 ~ 2.2 kgf.m, 13.0 ~ 15.9 lb-ft)

2nd step: 88 ~ 92°

NOTE

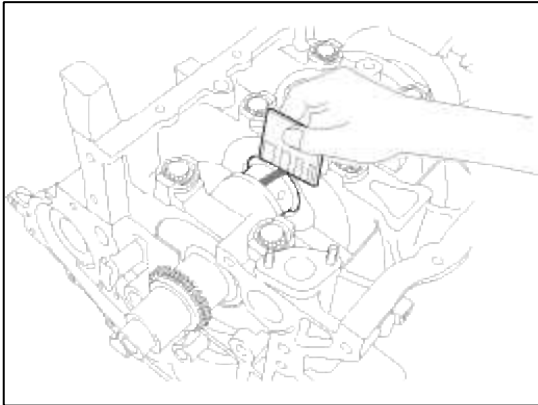
Do not turn the crankshaft.

(7) Remove the connecting rod cap and lower bearing.

- (8) Measure the width of the plastigage at its widest point.

Oil clearance:

0.028 ~ 0.046 mm (0.00110 ~ 0.00181 in.)



- (9) If the measurement from the plastigage is too wide or too narrow, remove the upper and lower bearing and then install new bearings with the same color mark. 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. Recheck the oil clearance.

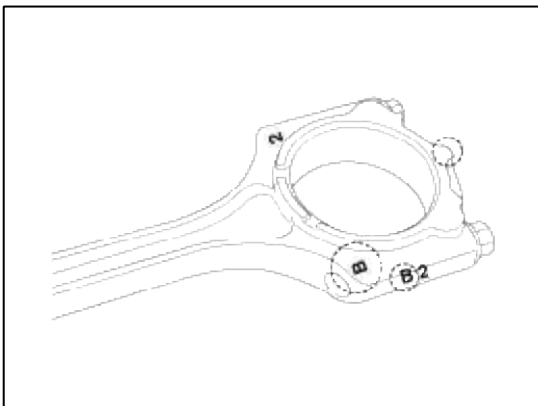
NOTE

If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and repeat the check procedure.

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.

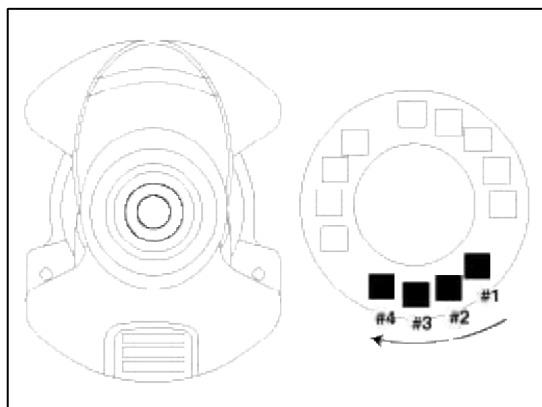
Connecting Rod Identification Mark



Connecting Rod Specifications

Class	Mark	Inside Diameter
0	A	48.000 ~ 48.006 mm (1.88976 ~ 1.89000 in.)
1	B	48.006 ~ 48.012 mm (1.89000 ~ 1.89023 in.)
2	C	48.012 ~ 48.018 mm (1.89023 ~ 1.89047 in.)

Crankshaft Pin Identification Mark



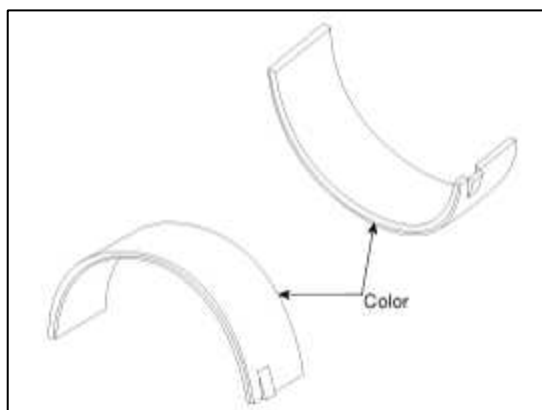
NOTE

Conform to read stamping order as shown arrow direction from #1.

Crankshaft Specifications

Class	Mark	Outside Diameter Of Pin
I	1	44.966 ~ 44.972 mm (1.77031 ~ 1.77055 in.)
II	2	44.960 ~ 44.966 mm (1.77008 ~ 1.77031 in.)
III	3	44.954 ~ 44.960 mm (1.76984 ~ 1.77008 in.)

Connecting Rod Bearing Identification Mark



Connecting Rod Bearing Specifications

Class	Mark	Thickness Of Bearing
A	Blue	1.509 ~ 1.512 mm (0.05941 ~ 0.05953 in.)
B	Black	1.506 ~ 1.509 mm (0.05929 ~ 0.05941 in.)
C	None	1.503 ~ 1.506 mm (0.05917 ~ 0.05929 in.)
D	Green	1.500 ~ 1.503 mm (0.05906 ~ 0.05917 in.)
E	Yellow	1.497 ~ 1.500 mm (0.05894 ~ 0.05906 in.)

(11) Select a connecting rod bearing using selection chart.

Selection Chart For Connecting Rod Bearings

Assembling Classification Of Bearing		Connecting Rod Identification Mark		
		0 (A)	1 (B)	2(C)
Crankshaft Identification Mark	I (1)	E (Yellow)	D (Green)	C (None)
	II (2)	D (Green)	C (None)	B (Black)
	III (3)	C (None)	B (Black)	A (Blue)

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:

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

Allowable twist of connecting rod:

0.10 mm (0.0039 in.) or less for 100 mm (3.94 in.)

NOTE

When the connecting rods are installed without bearings, there should be no difference on side surface.

Crankshaft

1. Check the crankshaft bearing oil clearance.

- (1) To check main bearing-to-journal oil clearance, remove the lower crankcase and lower bearings.
- (2) Clean each main journal and bearing with a clean shop towel.

- (3) Place one strip of plastigage across each main journal.
- (4) Reinstall the lower crankcase and lower bearings, and then tighten the main bolts.

Tightening torque

1st step:

27.5 ~ 31.4 N.m (2.8~3.2 kgf.m, 20.3 ~ 23.1 lb-ft)

2nd step: 120 ~ 125°

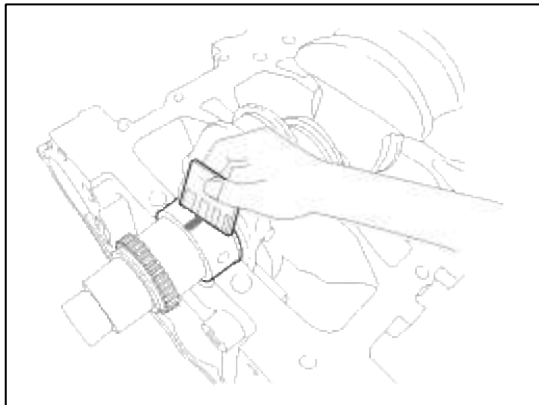
NOTE

Do not turn the crankshaft.

- (5) Remove the lower crankcase and lower bearings.
- (6) Measure the width of the plastigage at its widest point.

Oil clearance:

0.016 ~ 0.034 mm (0.00063 ~ 0.00134 in.)



- (7) 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. Recheck the oil clearance.

CAUTION

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

- (8) If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing. Recheck the oil clearance.

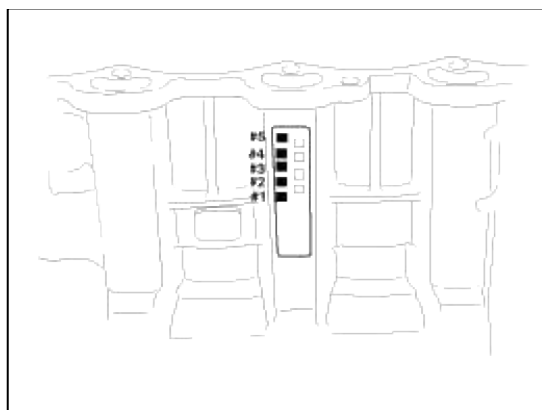
NOTE

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

CAUTION

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

Crankshaft Bore Identification Mark



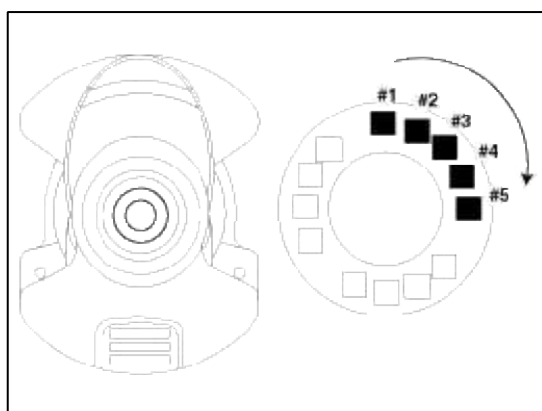
Letters have been stamped on the block as a mark for the size of each of the 5 main journal bores.

Use them, and the numbers or bar stamped on the crank (marks for main journal size), to choose the correct bearings.

Cylinder Block Specifications

Class	Mark	Inside Diameter
a	A	59.000 ~ 59.006 mm (2.32283 ~ 2.32307 in.)
b	B	59.006 ~ 59.012 mm (2.32307 ~ 2.32330 in.)
c	C	59.012 ~ 59.018 mm (2.32330 ~ 2.32354 in.)

Crankshaft Journal Identification Mark



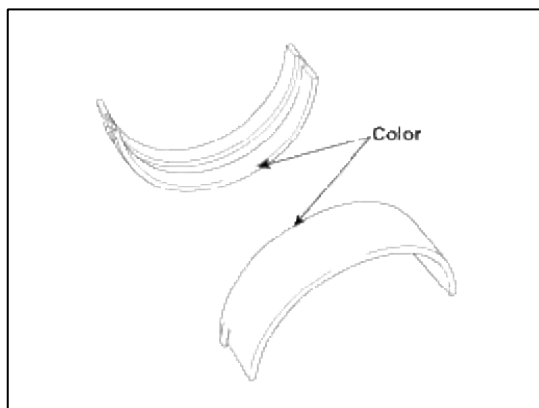
NOTE

Conform to read stamping order as shown arrow direction from #1.

Crankshaft Specifications

Class	Mark	Outside Diameter Of Journal
I	1	54.954 ~ 54.960 mm (2.16354 ~ 2.16378 in.)
II	2	54.948 ~ 54.954 mm (2.16330 ~ 2.16354 in.)
III	3	54.942 ~ 54.948 mm (2.16307 ~ 2.16330 in.)

Crankshaft Bearing Identification Mark



Crankshaft Bearing Specifications

Class	Mark	Thickness Of Bearing
A	Blue	2.021 ~ 2.024 mm (0.07957 ~ 0.07968 in.)
B	Black	2.018 ~ 2.021 mm (0.07945 ~ 0.07957 in.)
C	None	2.015 ~ 2.018 mm (0.07933 ~ 0.07945 in.)
D	Green	2.012 ~ 2.015 mm (0.07921 ~ 0.7933 in.)
E	Yellow	2.009 ~ 2.012 mm (0.07909 ~ 0.07921 in.)

(9) Select a crankshaft bearing using the selection chart.

Selection Chart For Crankshaft Bearings

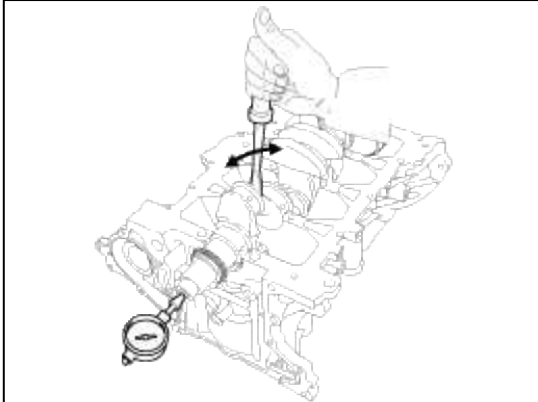
Assembling Classification Of Bearing		Crankshaft Bore Identification Mark		
		a (A)	b (B)	c (C)
Crankshaft Identification Mark	I (1)	E (Yellow)	D (Green)	C (None)
	II (2)	D (Green)	C (None)	B (Black)
	III (3)	C (None)	B (Black)	A (Blue)

2. Check crankshaft end play.

Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver. If the end play is greater than maximum, replace the center bearing.

End play

Standard: 0.07 ~ 0.25 mm (0.0028 ~ 0.0098 in.)



3. Inspect main journals and crank pins.

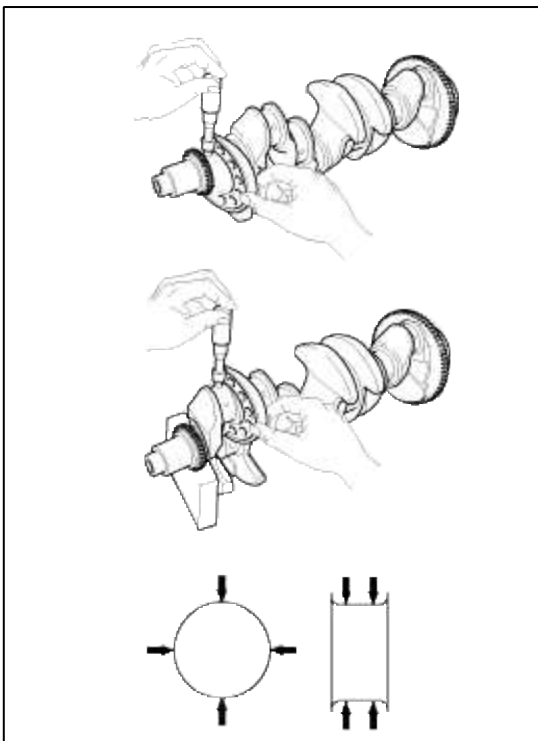
Using a micrometer, measure the diameter of each main journal and crank pin.

Main journal diameter:

54.942 ~ 54.960 mm (2.16307 ~ 2.16378 in.)

Crank pin diameter:

44.954 ~ 44.972 mm (1.76984 ~ 1.77055 in.)



Cylinder Block

1. Remove gasket material.

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

2. Clean cylinder block

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

3. Inspect top surface of cylinder block for flatness.

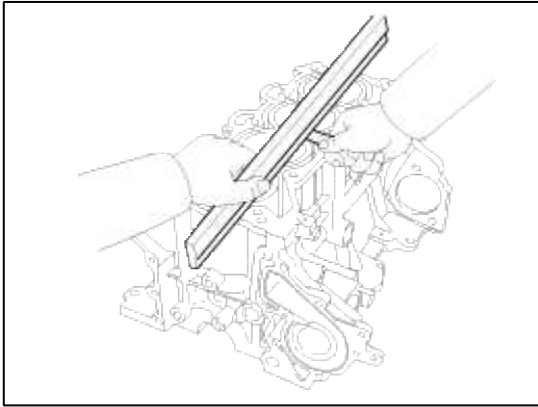
Using a precision straight edge and feeler gauge, measure the surface contacting the cylinder head gasket for warpage.

Flatness of cylinder block gasket surface

Standard:

Less than 0.05 mm (0.0020 in.) for total area

Less than 0.02 mm (0.0008 in.) for a section of 100 mm (3.9370 in.) X 100 mm (3.9370 in.)



4. Inspect the cylinder bore

Visually check the cylinder for vertical scratches.

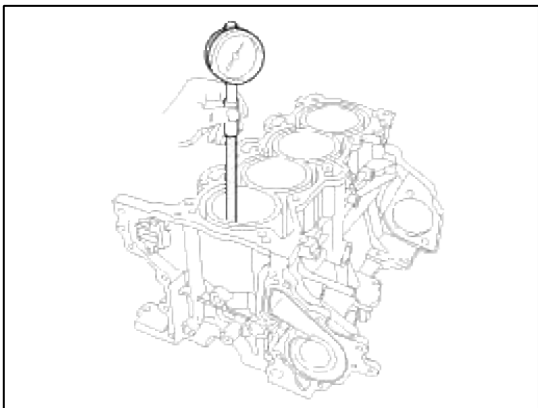
If deep scratches are present, replace the cylinder block.

5. Inspect the cylinder bore diameter.

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

Cylinder bore diameter:

81.00 ~ 81.03 mm (3.1890 ~ 3.1902 in.)

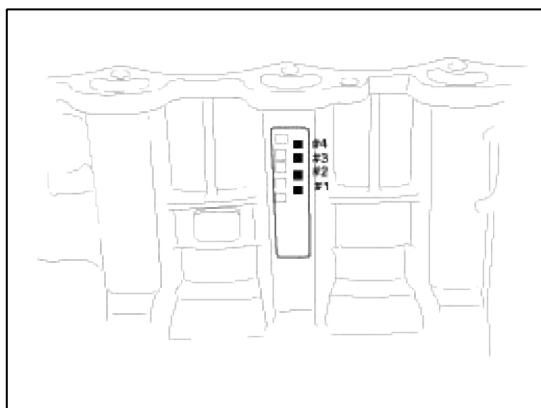


NOTE

Measure position points (from the top of the cylinder block):

30 mm (1.1811 in.) / 60 mm (2.3622 in.) / 90 mm (3.5433 in.)

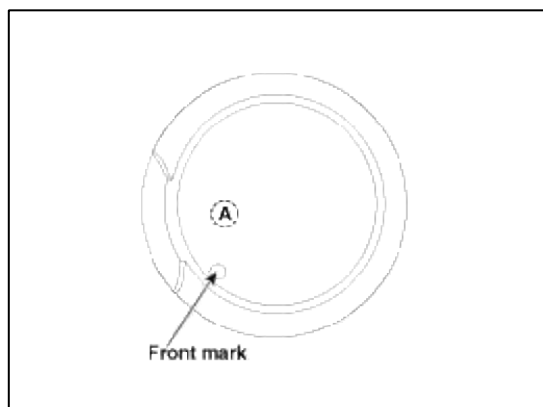
6. Check the cylinder bore size code on the cylinder block side surface.



Cylinder Bore Inner Diameter

Size Code	Cylinder Bore Inner Diameter
A	81.00 ~ 81.01 mm (3.1890 ~ 3.1894 in.)
B	81.01 ~ 81.02 mm (3.1894 ~ 3.1898 in.)
C	81.02 ~ 81.03 mm (3.1898 ~ 3.1902 in.)

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



Piston Outer Diameter

Size Code	Piston Outer Diameter
A	80.97 ~ 80.98 mm (3.1878 ~ 3.1882 in.)
B	80.98 ~ 80.99 mm (3.1882 ~ 3.1886 in.)
C	80.99 ~ 81.00 mm (3.1886 ~ 3.1890 in.)

8. Select the piston related to cylinder bore class.

Piston-to-cylinder clearance:

0.02 ~ 0.04 mm (0.0008 ~ 0.0016 in.)

Piston And Piston Rings

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

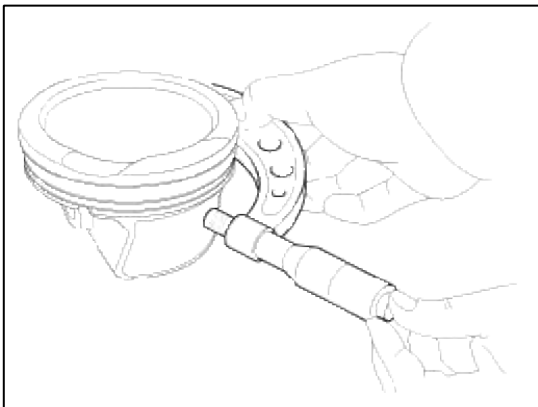
NOTE

Do not use a wire brush.

2. The standard measurement of the piston outside diameter is taken 35 mm (1.3780 in.) from top land of the piston.

Piston outside diameter:

80.97 ~ 81.00 mm (3.1878 ~ 3.1890 in.)



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

Piston-to-cylinder clearance:

0.02 ~ 0.04 mm (0.0008 ~ 0.0016 in.)

4. Inspect the piston ring side clearance.
Using a feeler gauge, measure the clearance between new piston ring and the wall of ring groove.
If the clearance is greater than maximum, replace the piston.

Piston ring side clearance

[Standard]

No.1 ring:

0.040 ~ 0.080 mm (0.00157 ~ 0.00315 in.)

No.2 ring:

0.040 ~ 0.080 mm (0.00157 ~ 0.00315 in.)

Oil ring:

0.060 ~ 0.135 mm (0.00236 ~ 0.00532 in.)



5. Inspect piston ring end gap.

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

If the gap exceeds the service limit, replace the piston 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 replaced.

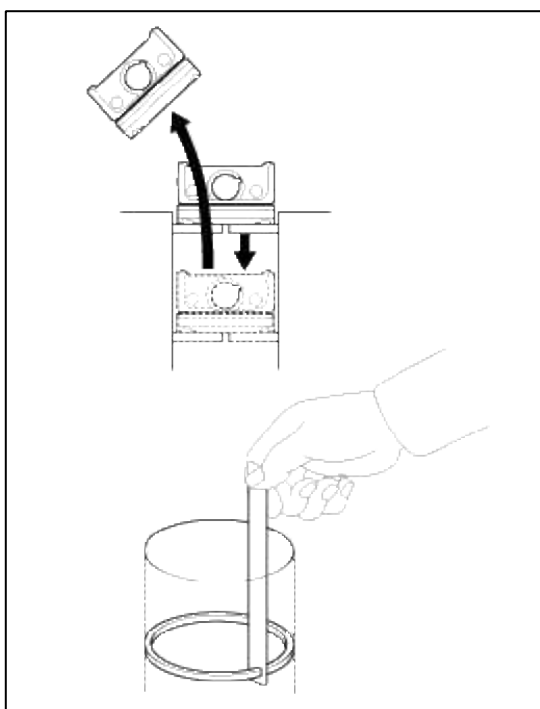
Piston ring end gap

[Standard]

No.1 ring: 0.15 ~ 0.30 mm (0.0059 ~ 0.0118 in.)

No.2 ring: 0.30 ~ 0.45 mm (0.0118 ~ 0.0177 in.)

Oil ring : 0.20 ~ 0.70 mm (0.0079 ~ 0.0276 in.)

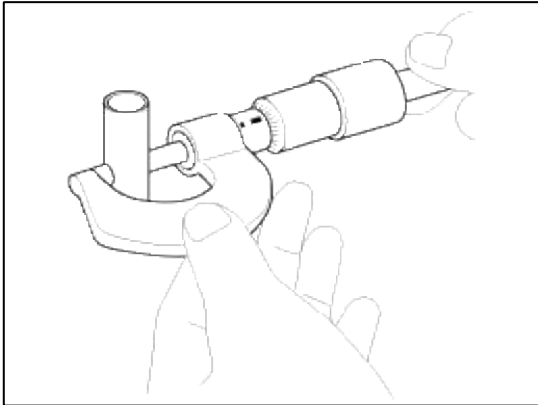


Piston Pins

1. Measure the diameter of the piston pin.

Piston pin diameter:

19.996 ~ 20.000 mm (0.78724 ~ 0.78740 in.)



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

Piston pin-to-piston clearance:

0.004 ~ 0.013 mm (0.00016 ~ 0.00051 in.)

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

Piston pin-to-connecting rod clearance:

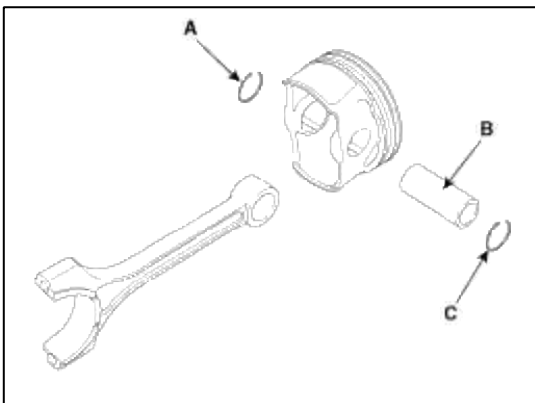
0.010 ~ 0.025 mm (0.00039 ~ 0.00098 in.)

Reassembly

NOTE

- Thoroughly clean all parts to be 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 the connecting rod.
 - (1) Install the snap ring (A) in one side of the piston pin hole.
 - (2) Align the piston front mark and the connecting rod front mark.
 - (3) Insert the piston pin (B) into the piston pin hole and the small end bore of connecting rod.
 - (4) Install the snap ring (C) in the other side after inserting the piston pin.



NOTE

Apply a sufficient amount of engine oil to outer surface of the piston, inner surface of piston pin hole and small end bore of the connecting rod before inserting the piston pin.

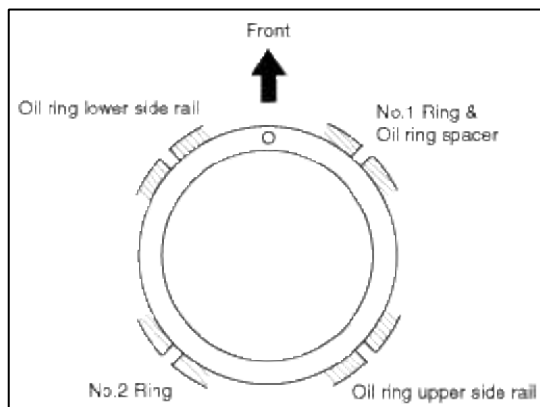
CAUTION

- Be careful not to damage and scratch the small end bore, piston pin hole and piston pin when inserting the piston pin.
- Set the snap ring firmly so that the snap ring can contact with the whole groove of the piston pin hole.

2. Install the piston rings.

- (1) Install the oil ring spacer and 2 side rails by hand.
- (2) Using a piston ring expander, install the 2 compression rings with the maker mark facing upward.
- (3) Position the piston rings so that the ring ends are as shown. (The No.1 ring should be on the opposite side of the No.2 ring.)

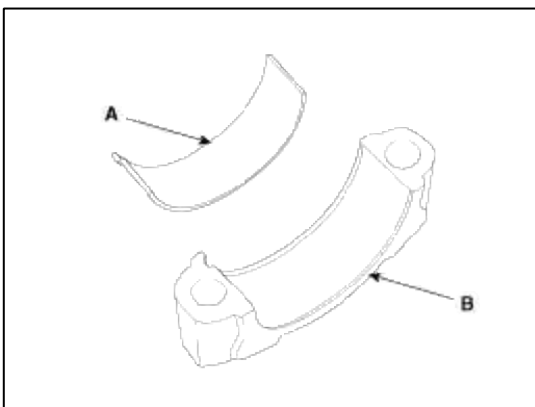
Example)

**CAUTION**

Check to ensure that the oil ring can be turned smoothly.

3. Install the connecting rod bearings.

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

**CAUTION**

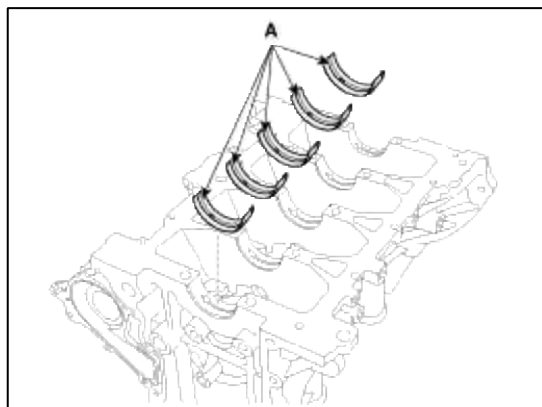
Be careful not to change the position of bearing caps.

4. Install the crankshaft main bearings.

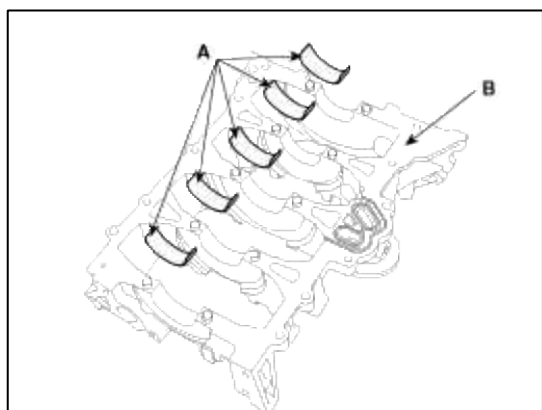
NOTE

Upper bearings have an oil groove of oil holes; Lower bearings do not.

- (1) Align the bearing claw with the groove of the cylinder block, and push in the 5 upper bearings (A).

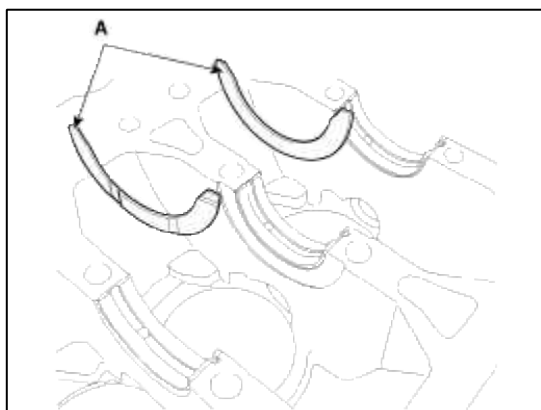


- (2) Align the bearing claw with the groove of the lower crankcase (B), and push in the 5 lower bearings (A).

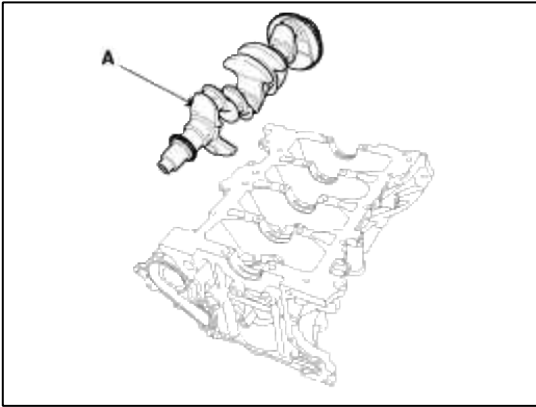


5. Install the thrust bearings.

Install the 2 thrust bearings (A) on both sides of the No.3 journal of the cylinder block with the oil groove facing out.

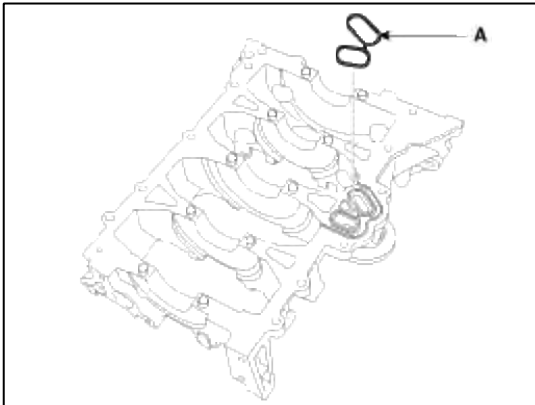


6. Place the crankshaft (A) on the cylinder block.



7. Apply liquid sealant on the top surface of the lower crankcase.

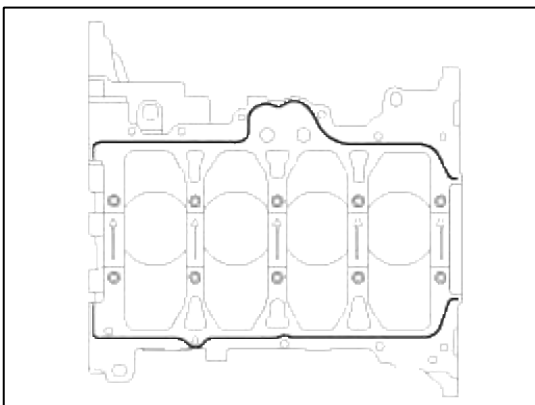
- (1) Using a gasket scraper, remove all the old packing material from the gasket surfaces.
- (2) The sealant locations on the lower crankcase and the cylinder block must be free of harmful foreign materials, oil, dust and moisture. Spraying cleaner on the surface and wiping with a clean duster.
- (3) Assemble a new rubber gasket (A) on the top of lower crankcase.



- (4) Apply liquid sealant on the bottom of the cylinder block. Continuous bead of sealant should be applied to prevent any path from oil leakage.

Bead width: 2.5 ~ 3.5 mm (0.10 ~ 0.14 in.)

Sealant: Threebond 1217H or equivalent

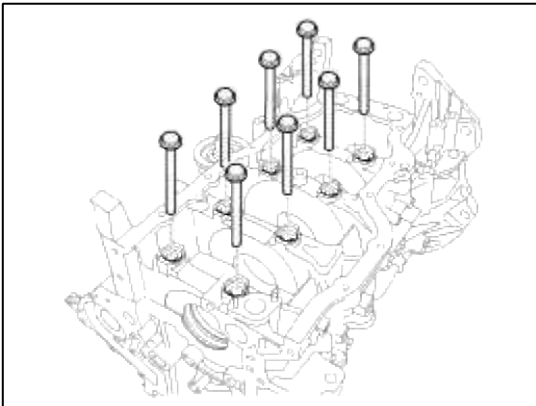


CAUTION

- Assemble the lower crankcase within 5 minutes after applying sealant.
- The engine running or pressure test should not be performed within 30 minutes after assembling the lower crankcase.
- Excess sealant on application surface of sealant of following process should be removed before hardening.
- If the sealant is applied to the top surface of the lower crankcase, it should be the same position as the cylinder block.
- To prevent leakage of oil, apply sealant gasket on the inner threads of the bolt holes.

8. Place the lower crankcase on the cylinder block.

9. Install the main bearing cap bolts.



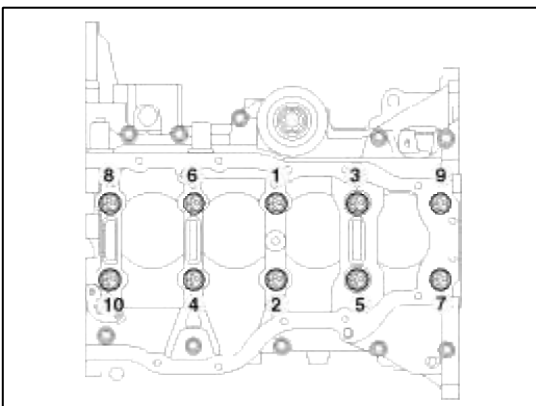
Using SST (09221-4A000), install and tighten the 10 main bearing cap bolts, in several passes, in the sequence as shown.

Tightening torque

1st step:

27.5 ~ 31.4 N.m (2.8 ~ 3.2 kgf.m, 20.3 ~ 23.1 lb-ft)

2nd step: 120 ~ 125°

**CAUTION**

- Do not reuse the bearing cap bolts.
- Do not apply engine oil on the bolt threads to achieve correct torque.

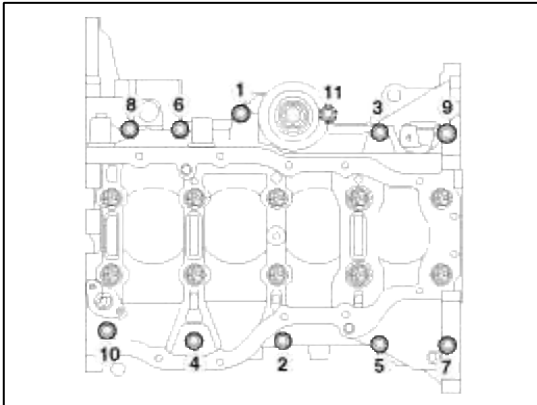
NOTE

- The main bearing cap bolts are tightened in 2 progressive steps.
- If any of the bearing cap bolts is broken or deformed, replace it.
- Be sure to assemble the main bearing cap bolts in correct order.

10. Install the lower crankcase bolts, in several passes, in sequence as shown.

Tightening torque:

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



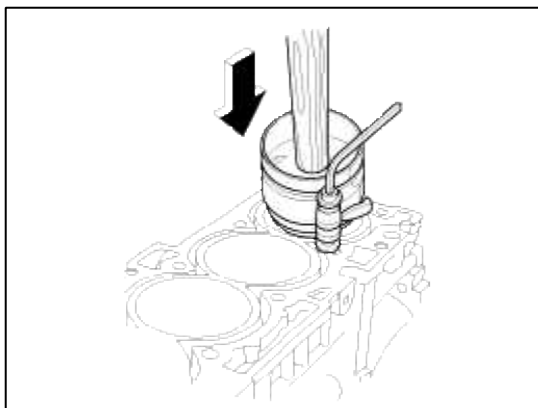
Check that the crankshaft turns smoothly.

11. Check the crankshaft end play.
12. Install the piston and connecting rod assemblies.

NOTE

- Before installing the piston, apply a coat of engine oil to the ring grooves and cylinder bores.
- Install the piston and connecting rod assembly with the front marks facing the front of the engine.

- (1) Install the ring compressor, check that the rings are securely in place, and then position the piston in the cylinder, and tap it in using the wooden handle of a hammer.



- (2) Stop after the ring compressor pops free, and check the connecting rod-to-crank journal alignment before pushing the piston into place.

(3) Apply engine oil to the bolt threads. Install the rod caps with bearings, and tighten the bolts.

Tightening torque

1st step :

17.7 ~ 21.6 Nm (1.8 ~ 2.2 kgf.m, 13.0 ~ 15.9 lb-ft)

2nd step : 88 ~ 92°

CAUTION

Do not reuse the connecting rod cap bolts.

NOTE

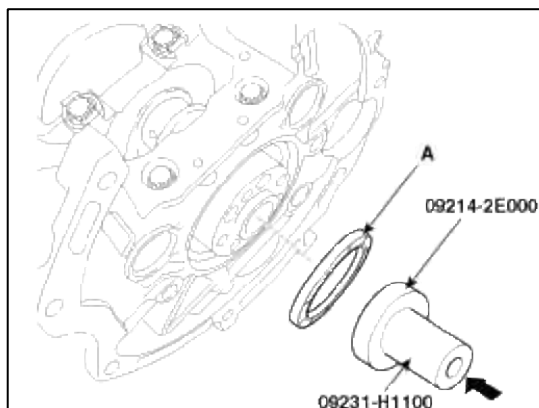
- Using the SST (09221-4A000), tighten the bolts.
- Maintain downward force on the ring compressor to prevent the rings from expending before entering the cylinder bore.

13. Check the connecting rod end play.

14. Install a new rear oil seal.

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

(2) Using SST (09231-H1100, 09214-2E000) and a hammer, tap in the oil seal (A) until the rear oil seal face is aligned with the cylinder block assembly rear face.



15. Install the oil screen. (Refer to Lubrication system in this group)

16. Install the oil filter. (Refer to Lubrication system in this group)

17. Install the CKPS (Crankshaft position sensor) (C).

Tightening torque:

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

18. Install the OPS (Oil pressure switch) (B).

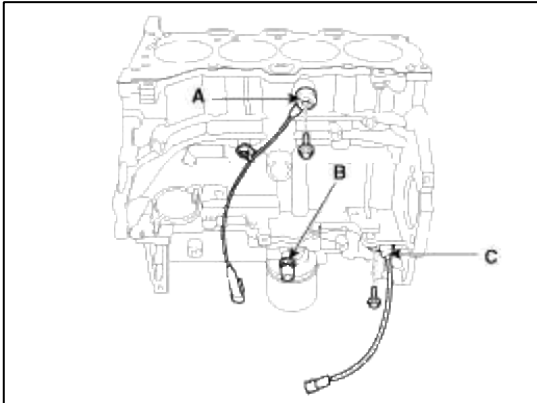
Tightening torque:

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

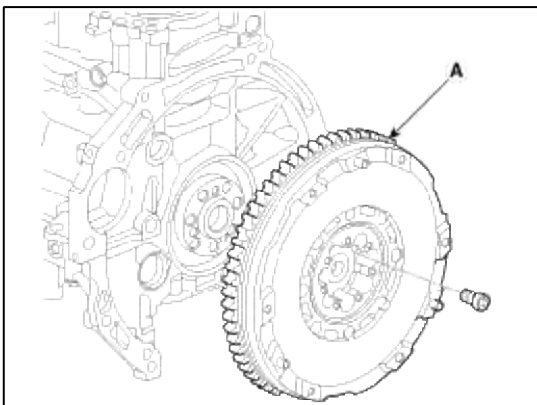
19. Install the knock sensor (A).

Tightening torque:

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



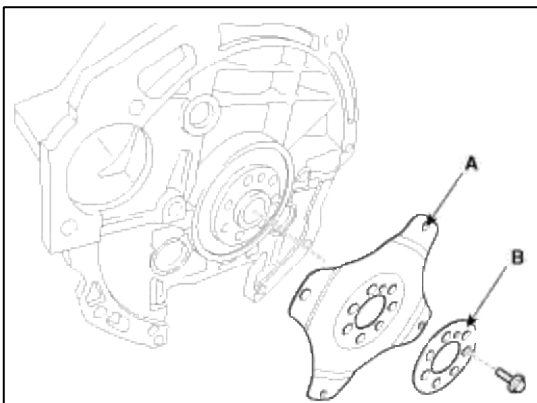
20. Install the water inlet fitting and the thermostat assembly. (Refer to Cooling system in this group)
 21. Install the water pump assembly. (Refer to Cooling system in this group)
 22. Install the A/C compressor. (Refer to HA group - "A/C compressor")
 23. Install the cylinder head assembly. (Refer to Cylinder head in this group)
 24. Install the timing chain including the drive belt, the cylinder head cover, the alternator and the timing chain cover.
 (Refer to Timing system in this group)
 25. Install the intake manifold and exhaust manifold. (Refer to Intake and exhaust system in this group)
 26. Remove the engine from an engine stand for assembly.
 27. Manual transaxle: Install the flywheel (A).



Automatic transaxle: Install the drive plate (A) and the adapter plate (B).

Tightening torque:

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



CAUTION

Do not reuse the bolts.

28. Assemble the transaxle assembly to the engine assembly. (Refer to MT or AT group)
29. Install the engine and transaxle assembly to the vehicle. (Refer to Engine and transaxle assembly in this group)

Engine Mechanical System > Cooling System > Coolant > Repair procedures

Refilling And Bleeding

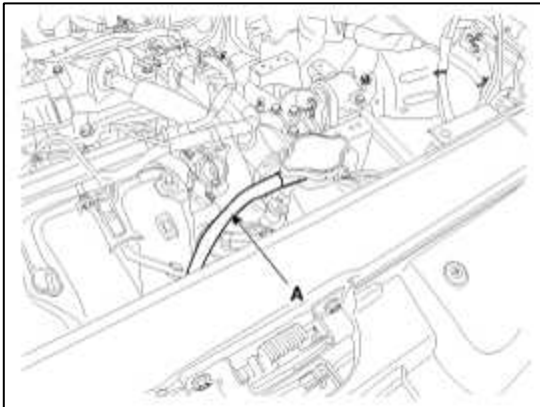
WARNING

Never remove the radiator cap when the engine is hot. Serious scalding could be caused by hot fluid under high pressure escaping from the radiator.

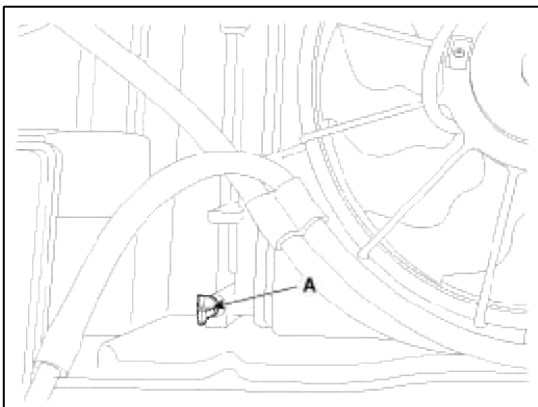
CAUTION

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

1. Make sure the engine and radiator are cool to the touch.
2. Remove radiator cap (A).



3. Remove the under cover. (Refer to Engine and transaxle assembly in this group)
4. Loosen the drain plug (A) and drain the coolant.



5. Tighten the radiator drain plug securely.
6. After draining engine coolant in the reservoir tank, clean the tank.
7. Fill the radiator with water through the radiator cap and tighten the cap.

NOTE

To most effectively bleed the air, pour the water slowly and press on the upper/lower radiator hoses.

8. Start the engine and allow to come to normal operating temperature. Wait for the cooling fans to turn on several times. Accelerate the engine to aid in purging trapped air. Shut engine off.
9. Wait until the engine is cool.
10. Repeat step 1 to 9 until the drained water runs clear.
11. Fill fluid mixture with coolant and water (55~60%) (except for North America, Europe and China: 45~50%) slowly through the radiator cap. Push the upper/lower hoses of the radiator so as bleed air easily.

NOTE

- Use only genuine antifreeze/coolant.
- For best corrosion protection, the coolant concentration must be maintained year-round at 55% (except for North America, Europe and China: 45%) minimum. Coolant concentrations less than 55% (except for North America, Europe and China: 45%) may not provide sufficient protection against corrosion or 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.

12. Start the engine and run until coolant circulates. When the cooling fan operates and coolant circulates, refill coolant through the radiator cap.
13. Repeat step 12 until the cooling fan 3 ~ 5 times and bleed air sufficiently out of the cooling system.
14. Install the radiator cap and fill the reservoir tank to the "MAX" (or "FULL") line with coolant.
15. Run the vehicle under idle until the cooling fan operates 2 ~ 3 times.
16. Stop the engine and wait coolant gets cool.
17. Repeat step 11 to 16 until the coolant level doesn't fall any more, bleed air out of the cooling system.

NOTE

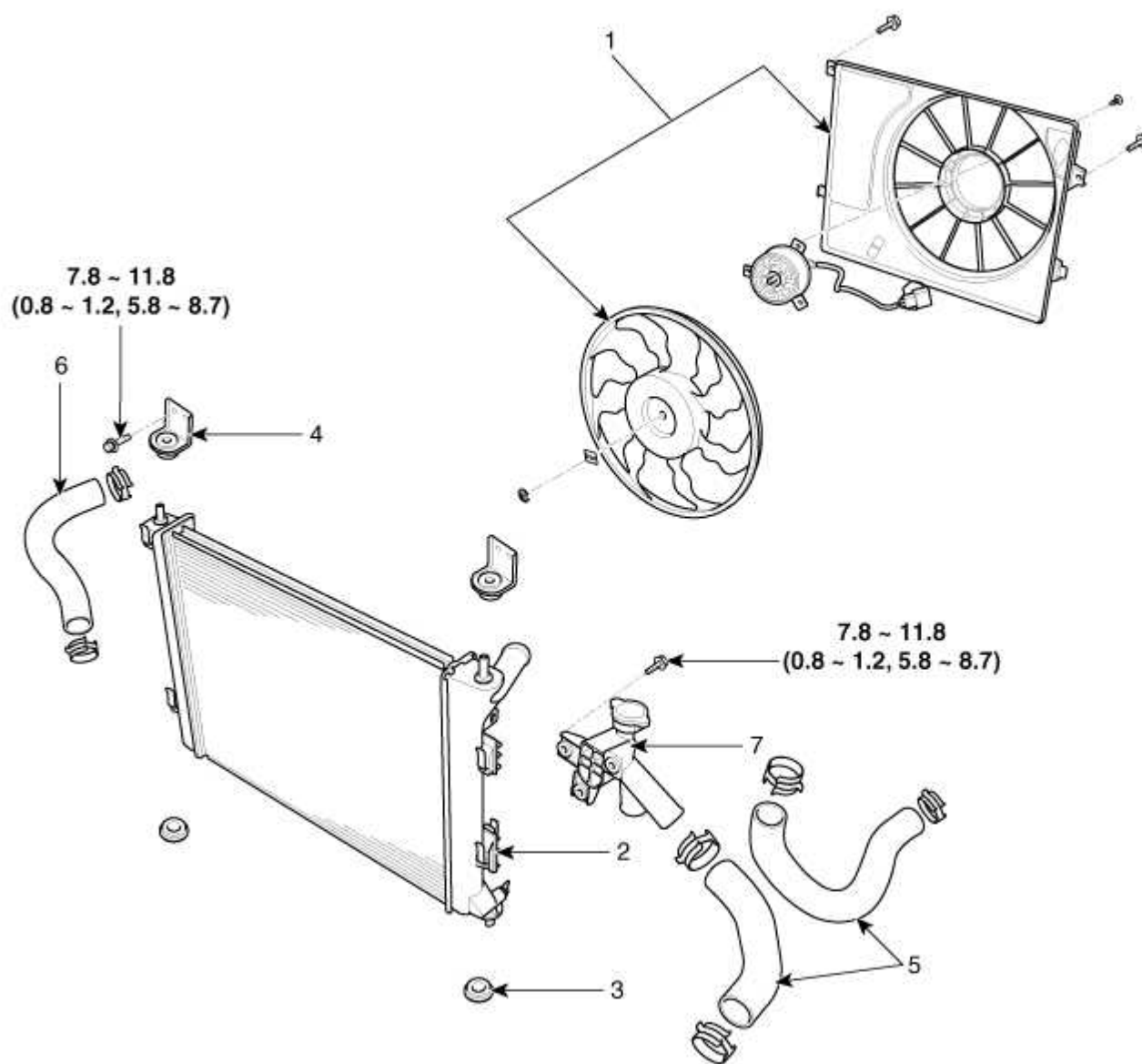
It takes time to bleed out all the air in the cooling system. Refill coolant when coolant gets cool completely, then recheck the coolant level in the reservoir tank for 2~3 days after replacing coolant.

Coolant capacity:

6.4 L (1.69 U.S.gal., 6.76 U.S.qt., 5.63 Imp.qt.)

Engine Mechanical System > Cooling System > Radiator > Components and Components Location

Components



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

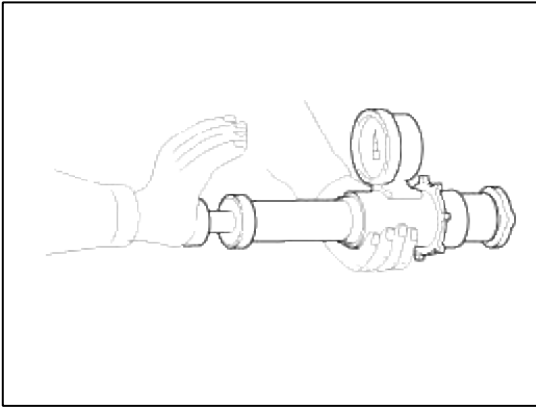
1. Cooling fan assembly	5. Radiator upper hose
2. Radiator	6. Radiator lower hose
3. Mounting insulator	7. Filler neck assembly
4. Radiator upper mounting bracket	

Engine Mechanical System > Cooling System > Radiator > Repair procedures

Inspection

Radiator Cap Testing

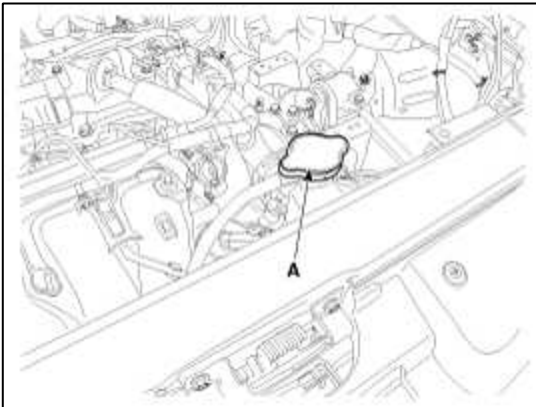
1. Remove the radiator cap, wet its seal with engine coolant, and then install it on a pressure tester.



2. Apply a pressure of 93.16 ~ 122.58 kPa (0.95 ~ 1.25 kgf/cm², 13.51 ~ 17.78 psi).
3. Check for a drop in pressure.
4. If the pressure drops, replace the cap.

Radiator Leakage 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 (A).



2. Apply a pressure tester to the radiator and apply a pressure of 93.16 ~ 122.58 kPa (0.95 ~ 1.25 kgf/cm², 13.51 ~ 17.78 psi).
3. Inspect for engine coolant leaks and a drop in pressure.
4. Remove the tester and reinstall the radiator cap.

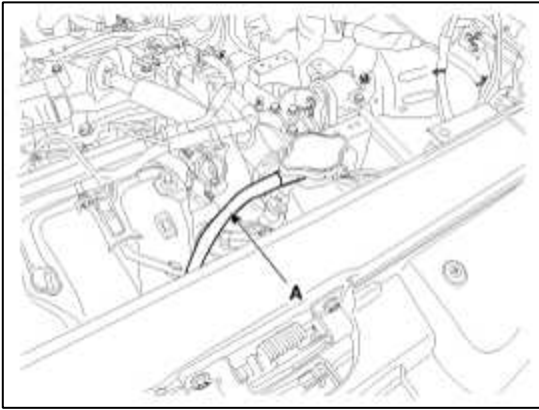
NOTE

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

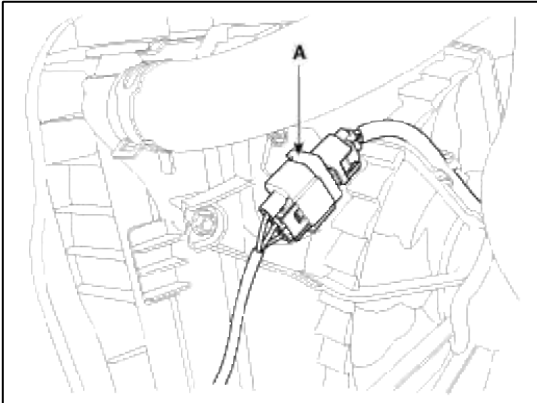
Removal and Installation

1. Disconnect the battery negative terminals. (Refer to Engine and transaxle assembly in this group)
2. Remove the air cleaner assembly. (Refer to Engine and transaxle assembly in this group)
3. Remove the front bumper. (Refer to BD group - "Front bumper")

4. Disconnect the over flow hose (A) from the filler neck.

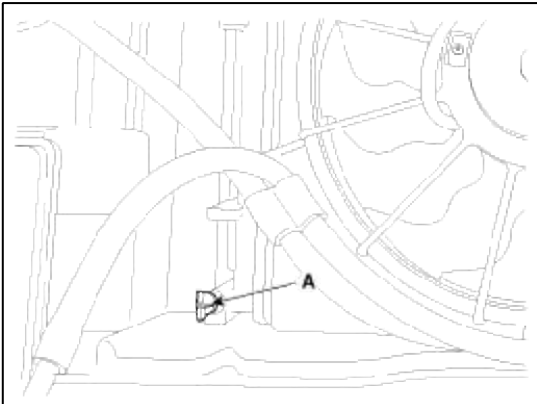


5. Disconnect the fan motor connector (A)

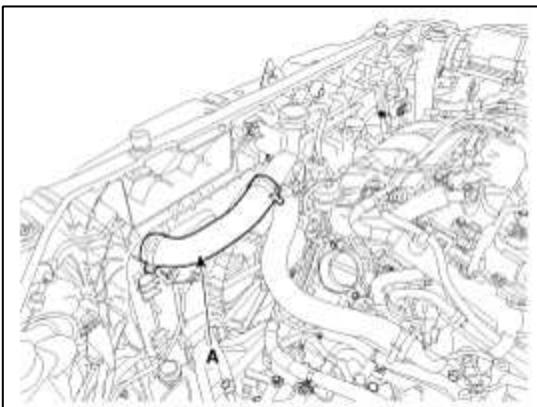


6. Remove the under cover. (Refer to Engine and transaxle assembly in this group)

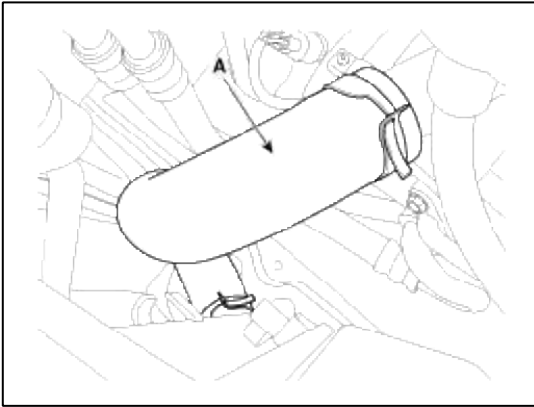
7. Loosen the drain plug (A) and drain the engine coolant. Remove the radiator cap to help drain the coolant faster.



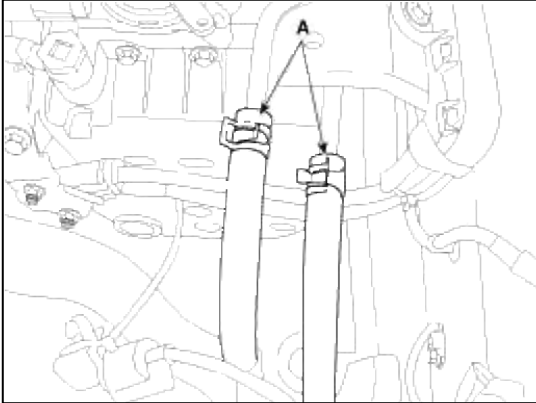
8. Disconnect the radiator upper hose (A).



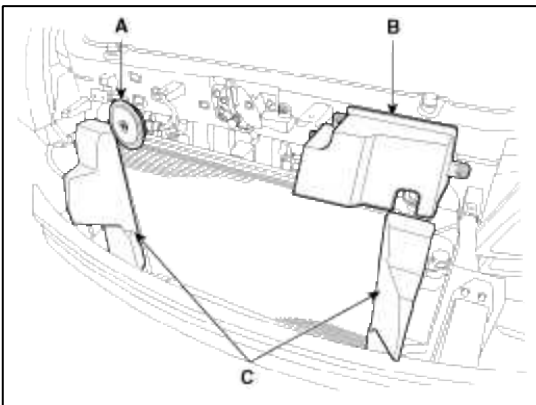
9. Disconnect the radiator lower hose (A).



10. Disconnect the ATF cooler hoses (A) (A/T only). (Refer to AT group - "Automatic transaxle")



11. Remove the horn (A), the intake shield cover (B) and the air guard (C).

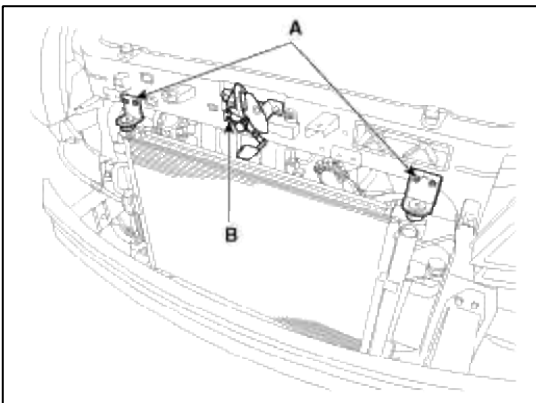


12. Remove the radiator upper mounting bracket (A).

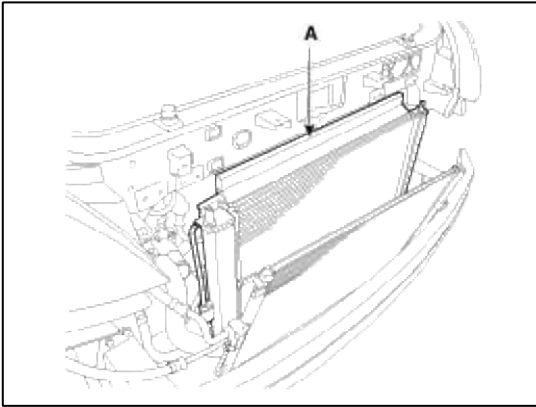
Tightening torque:

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

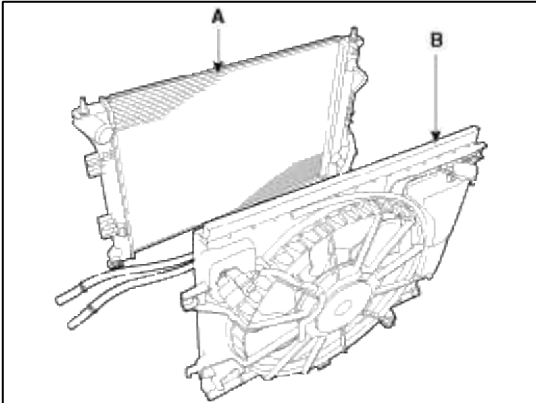
13. Remove the hood latch (B). (Refer to BD group - "Hood")



14. Separate the condenser from the radiator and then remove the radiator assembly (A).



15. Remove the cooling fan (B) from the radiator (A).



16. Installation is the reverse order of removal.

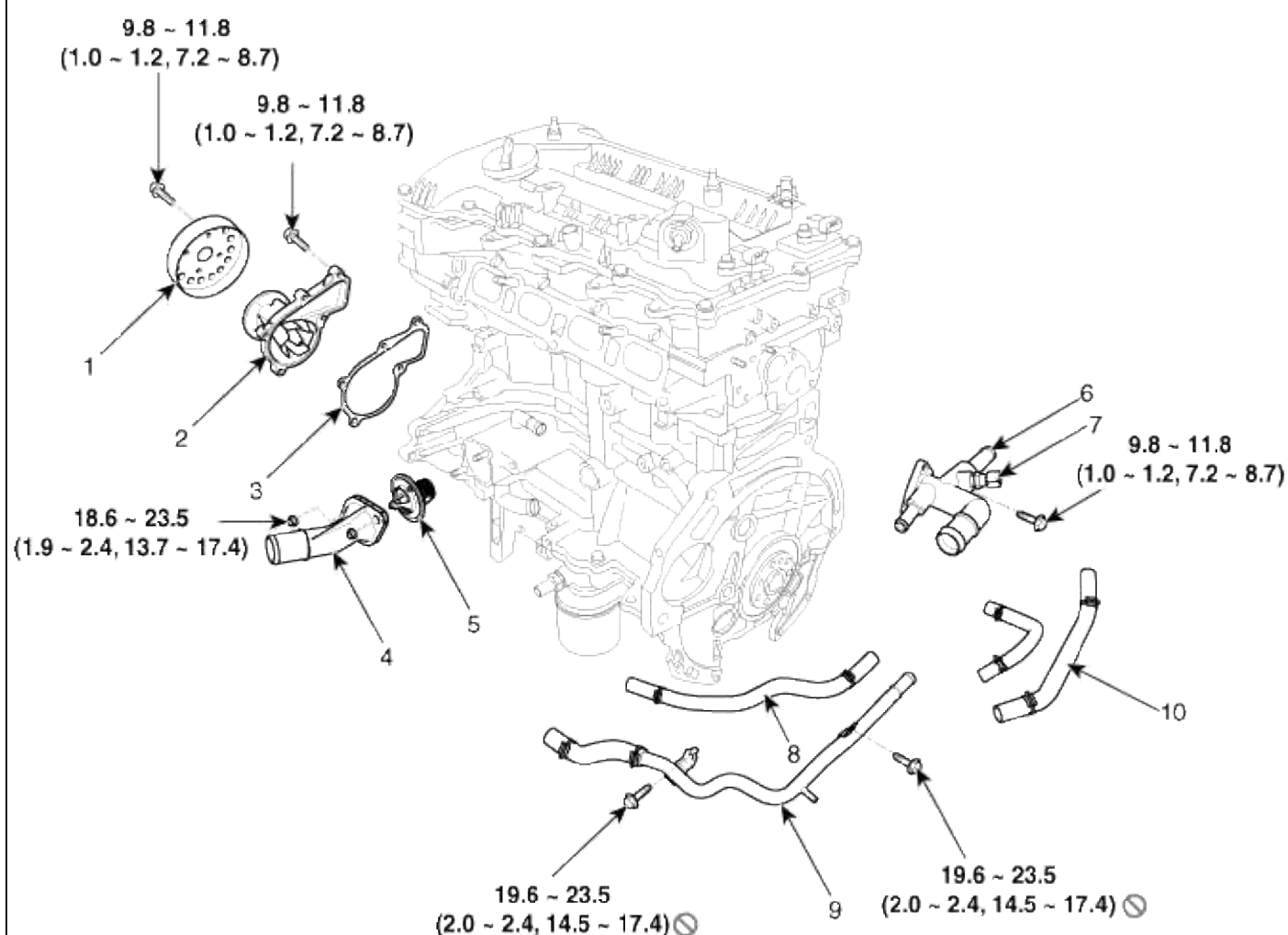
17. Fill the radiator with coolant and check for leaks.

NOTE

- 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 engine. Check the coolant level and add coolant if needed. This will allow trapped air to be removed from the cooling system.
- Put the radiator cap on tightly, then run engine again and check for leaks.

Engine Mechanical System > Cooling System > Water pump > Components and Components Location

Components



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

1. Water pump pulley	5. Thermostat	
2. Water pump	6. Water temperature control assembly	9. Heater pipe & hose assembly
3. Water pump gasket	7. Engine coolant temperature sensor	10. Throttle body coolant hose (if equipped)
4. Water inlet fitting	8. Bypass hose	

Engine Mechanical System > Cooling System > Water pump > Repair procedures

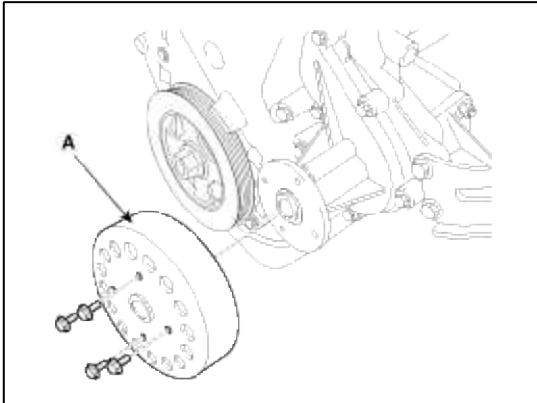
Removal and Installation

1. Loosen the drain plug, and then drain the engine coolant. Remove the radiator cap to help drain the coolant faster.
2. Remove the drive belt. (Refer to Timing system in this group)

3. Remove the water pump pulley (A).

Tightening torque:

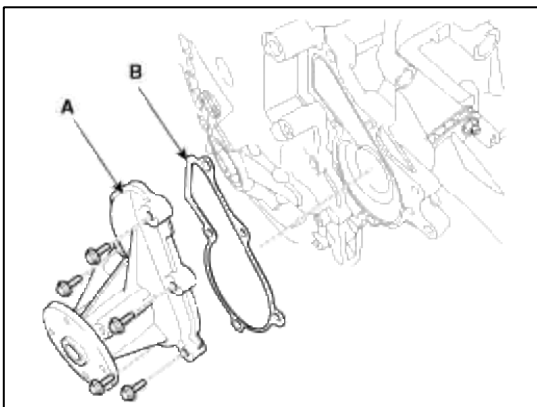
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



4. Remove the water pump assembly (A) with the gasket (B).

Tightening torque:

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



5. Installation is reverse order of removal

NOTE

Install a new water pump gasket.

6. Fill the engine coolant.
7. Start the engine and check for leaks.
8. Recheck the coolant level.

Inspection

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.

NOTE

A small amount of "weeping" from the bleed hole is normal.

Engine Mechanical System > Cooling System > Water pump > Troubleshooting
Troubleshooting
Water Pump

Symptoms		Possible Causes		Remedy
Coolant leakage	From the bleed hole of the water pump	Visually check	Check leaks after about ten-minute warming up.	If coolant still leaks, replace a water pump.
	From gaskets or bolts		Check the tightening of the water pump mounting bolts.	- If leakage stops, reuse the water pump (Do not replace the pump with a new one). - Retighten the mounting bolts.
	From outer surface of water pump		Check damage of gaskets or inflow of dust.	Replace the gasket and clean dust off.
	From outer surface of water pump		Check the material or any cracks of the water pump.	Poor material. If any crack found, replace the water pump.
Noise	- From bearings - From mechanical seals - Impeller interference	Inspection with a stethoscope	After starting the engine, check noise with a stethoscope.	If there is no noise, reuse the water pump (do not replace it).
		Inspection after removing a drive belt	After removing a water pump and a drive belt, check noise again.	If there is any noise from the water pump, remove the drive belt and recheck.
				- If there is noise, reuse the water pump. Check other drive line parts. - If there is no noise, replace the water pump with a new one.
		Inspection after removing a water pump	After removing a water pump and a drive belt, check noise again.	If there is any interference between them, replace the water pump with a new one.
Overheating	- Damaged impeller - Loosened impeller	Loosened impeller	Corrosion of the impeller wing	- Check engine coolant. - Poor coolant quality / Maintenance check

- Impeller separation from the shaft

- Replace the water pump.

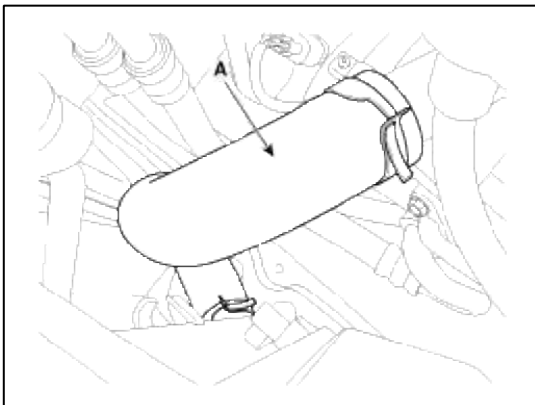
Engine Mechanical System > Cooling System > Thermostat > Repair procedures

Removal and Installation

NOTE

Disassembly of the thermostat would have an adverse effect, causing a lowering of cooling efficiency. Do not remove the thermostat, even if the engine tends to overheat.

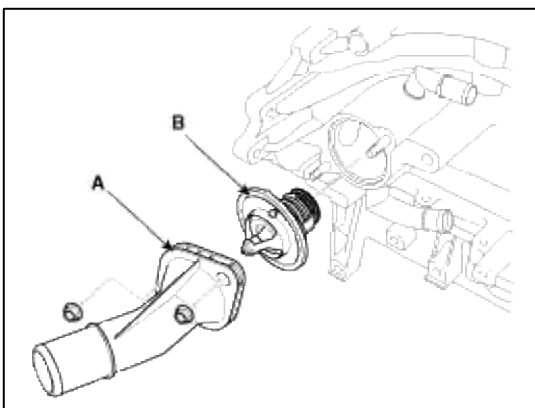
1. Drain engine coolant so its level is below thermostat.
2. Disconnect the radiator lower hose (A).



3. Remove water inlet fitting (A) and thermostat (B).

Tightening torque :

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



4. Installation is reverse order of removal.

CAUTION

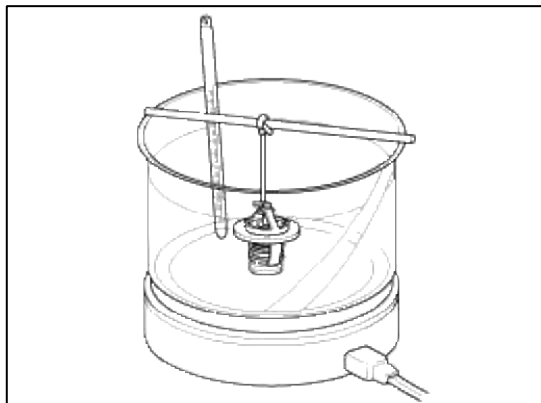
- Install the thermostat with the jiggle valve upward.
- When assembling the thermostat, place the thermostat on the housing with a protrusion of thermostat matching with a groove of the housing and install the inlet fitting. Be careful the thermostat doesn't get out of the groove on the housing.
- Clean surface on the rubber packing contact surface.

5. Fill the engine coolant.

6. Start the engine and check for leaks.
7. Recheck the coolant level.

Inspection

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



2. Check the valve opening temperature.

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

Valve opening temperature:

$88 \pm 1.5^{\circ}\text{C}$ ($190.4 \pm 34.7^{\circ}\text{F}$)

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

3. Check the valve lift.

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

Valve lift : 8 mm (0.3 in.) or more at 100°C (212°F)

Engine Mechanical System > Cooling System > Thermostat > Troubleshooting

Troubleshooting

Symptoms		Possible Causes		Remedy
Coolant leakage	From the thermostat gasket	Check the mounting bolts	Check the torque of the mounting bolts	Retighten the bolts and check leakage again.
		Check the gasket for damage	Check gasket or seal for damage	Replace gaskets and reuse the thermostat.
Cooled excessively	- Low heater performance (cool air blows-out) - Thermogauge indicates 'LOW'	Visually check after removing the radiator cap.	Insufficient coolant or leakage.	After refilling coolant, recheck.
		GDS check&Starting engine	- Check DTCs - Check the fan motor performance as temperature varies. - Check connection of the fan clutch or the fan motor. If the fan clutch is always connected, there	- Check the engine coolant sensor, wiring and connectors. - Check the fan motor, the relay and the connector. - Replace the components.

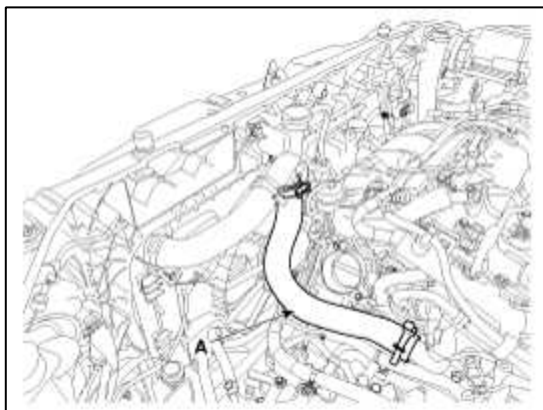
			will be a noise at idle.	
		Remove the thermostat and inspect	• Check if there are dusts or chips in the thermostat valve. • Check adherence of the thermostat.	• Clean the thermostat valve and reuse the thermostat. • Replace the thermostat, if it doesn't work properly.
Heated excessively	• Engine overheated • Thermogauge indicates 'HI'	Visually check after removing the radiator cap.	• Insufficient coolant or leakage. Be careful when removing a radiator cap of the overheated vehicle. • Check air in cooling system.	• After refilling coolant, recheck. • Check the cylinder head gaskets for damage and the tightening torque of the mounting bolts.
		GDS check&Starting engine	• Check DTCs • Check the fan motor performance as temperature varies. • Check if the fan clutch slips. • Check the water pump adherence or impeller damaged.	• Check the engine coolant sensor, wiring and connectors. • Check the fan motor, the relay and the connector. • Replace the fan clutch, if it doesn't work properly. • Replace the water pump, if it doesn't work properly.
		Immerse the thermostat in boiling water and inspection.	• After removing the thermostat, check it works properly. Check the thermostat opens at the valve opening temperature.	• Replace the thermostat, if it doesn't work properly.

Engine Mechanical System > Cooling System > Water Temperature Control Assembly > Repair procedures

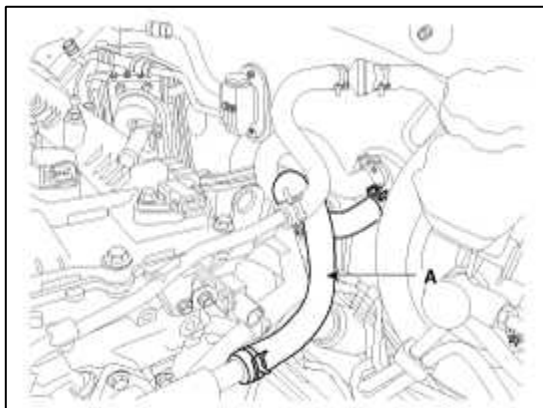
Removal and Installation

1. Drain engine coolant so its level is below water temperature control assembly.
2. Remove the air cleaner assembly. (Refer to Engine transaxle assembly in this group)

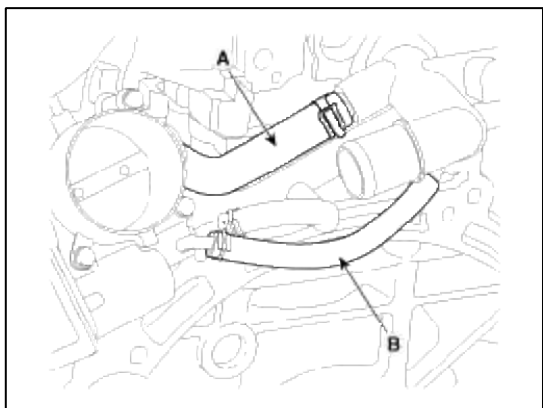
3. Disconnect the radiator upper hose (A).



4. Disconnect the heater hose (A).



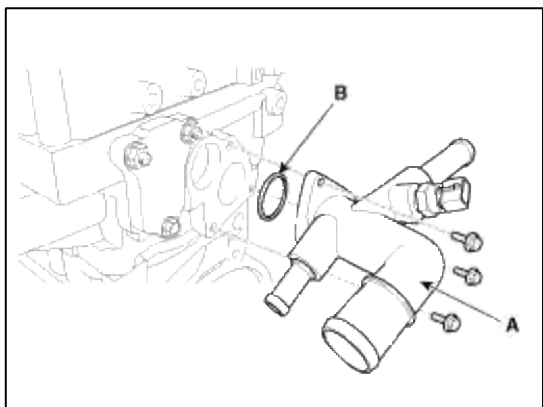
5. Disconnect the bypass hose (A) and the throttle body coolant hose (B).



6. Remove the water temperature control assembly (A) with the O-ring (B).

Tightening torque:

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



7. Installation is reverse order of removal.

NOTE

- Install a new O-ring.
- Clean surface on the O-ring and install the O-ring after wetting with water.

Engine Mechanical System > Lubrication System > Engine Oil > Repair procedures

Oil And Filter Replacement

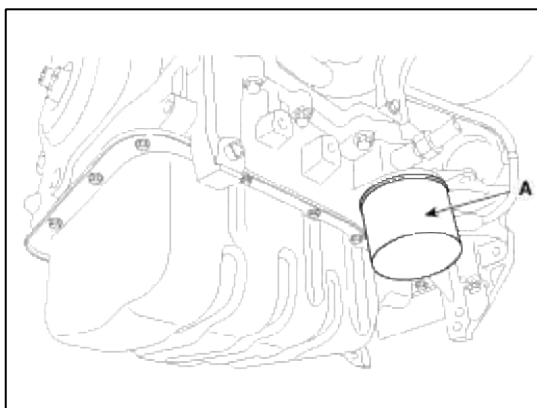
CAUTION

- 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. Park the car on level ground.
2. Drain engine oil.
 - (1) Remove the oil filler cap.
 - (2) After lifting the car, remove the oil drain plug and drain oil into a container.
3. Replace the oil filter (A).
 - (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 with the torque below.

Tightening torque :

11.8 ~ 15.7 N.m (1.2 ~ 1.6 kgf.m, 8.7 ~ 11.6 lb-ft)



4. Install the oil drain plug with a new gasket.

Tightening torque :

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

5. Fill with new engine oil, after removing the engine oil level gauge.

Capacity

Total:

4.5 L (1.19 U.S.gal., 4.76 U.S.qt., 3.96 Imp.qt.)

Oil pan: 3.7 L (0.98 U.S.gal., 3.91 U.S.qt., 3.26 Imp.qt.)

Drain and refill including oil filter:

4.0 L (1.06 U.S.gal., 4.23 U.S.qt., 3.52 Imp.qt.)

6. Install the oil filler cap.
7. Start engine and check for oil leaks and check the oil gauge or light for an indication of oil pressure.
8. Recheck the engine oil level.

Inspection

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 engine warm up stop the engine wait 5 minutes then check the oil level. Oil level should be between the "L" and "F" marks on the dipstick. If low check for leakage and add oil up to the "F" mark.

NOTE

Do not fill with engine oil above the "F" mark.

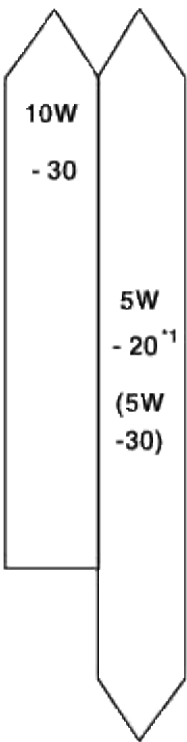
Selection Of Engine Oil

Recommendation: 5W-20/GF4&SM (If not available, refer to the recommended API or ILSAC classification.)

API classification: SL, SM or above

ILSAC classification: GF3, GF4 or above

SAE viscosity grade: Refer to the recommended SAE viscosity number

Temperature range anticipated before next oil change	Recommended SAE viscosity number
- 18°C - 0.4°F	
	*1 If 5W-20 / GF4 engine oil is not available, 5W-30 or secondary recommended engine oil for corresponding temperature range can be used.

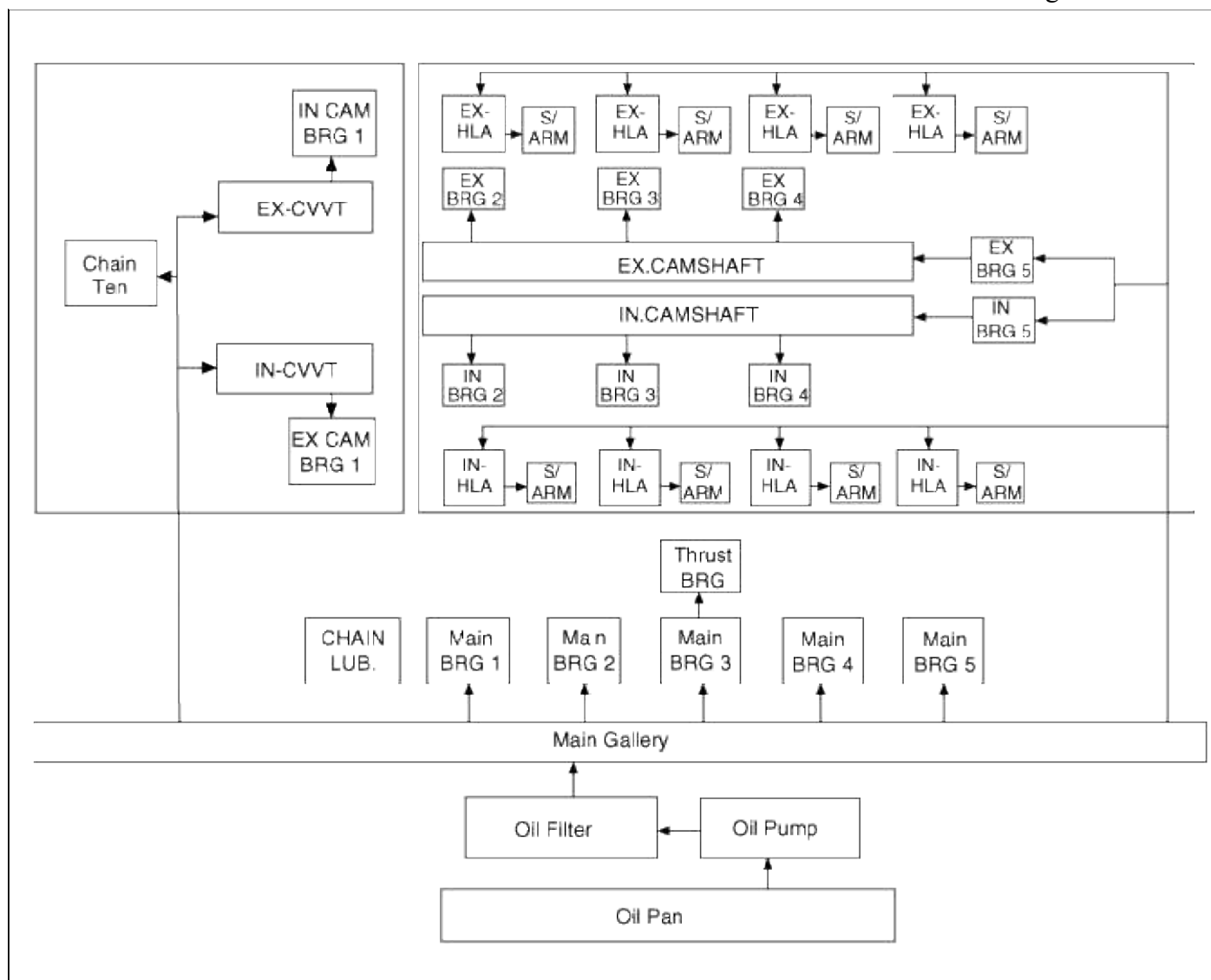
NOTE

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

1. Satisfy the requirement of the API or ILSAC classification.
2. Have proper SAE grade number for expected ambient temperature range.
3. Lubricants that do not have both an SAE grade number and API or ILSAC service classification on the container should not be used.

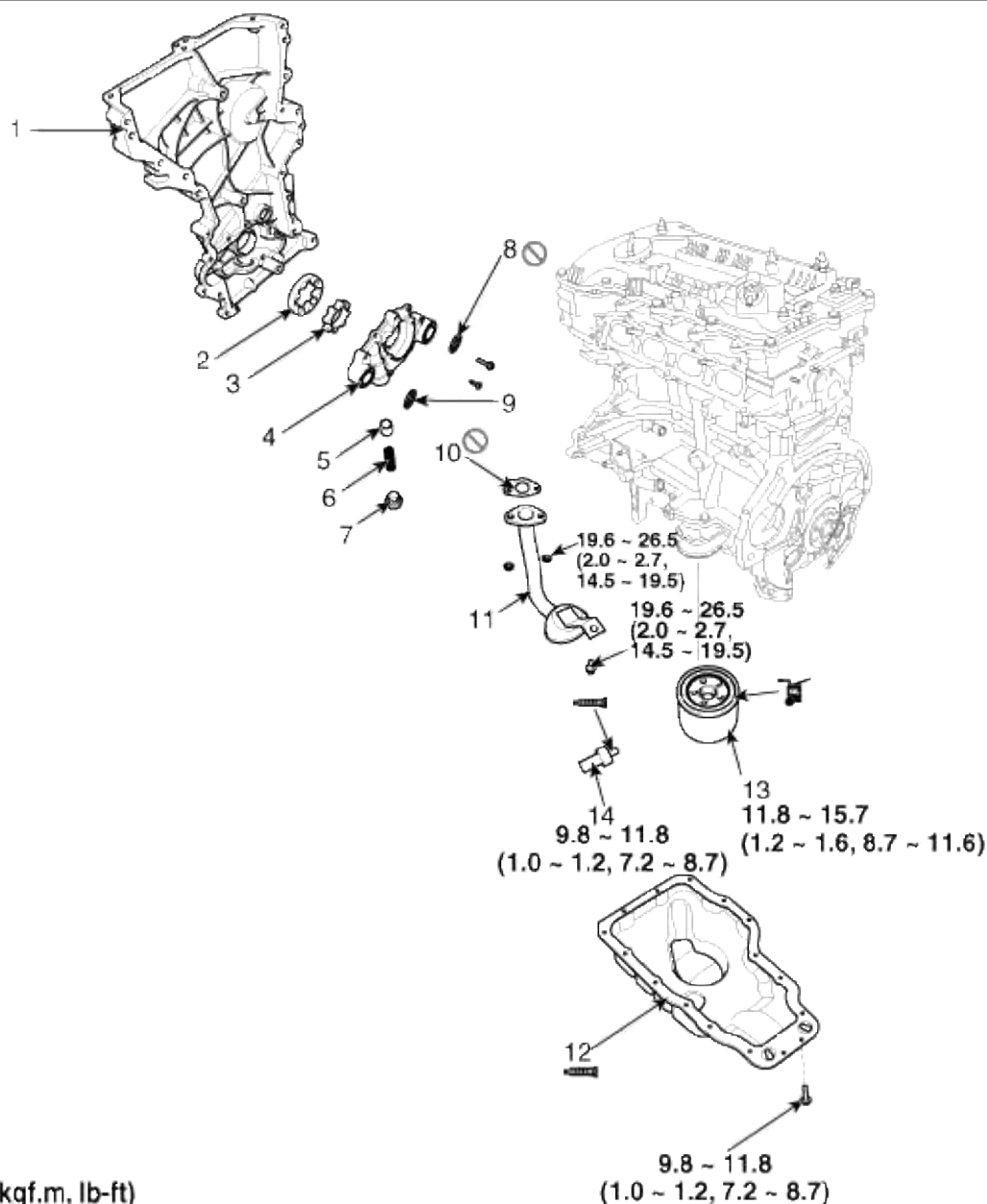
Engine Mechanical System > Lubrication System > Engine Oil > Flow Diagram

Engine Oil Schemetics



Engine Mechanical System > Lubrication System > Oil Pump > Components and Components Location

Components



1. Timing chain cover	8. O-ring (suction side)
2. Outer rotor	9. O-ring (discharge side)
3. Inner rotor	10. Oil screen gasket
4. Oil pump cover	11. Oil screen
5. Relief plunger	12. Oil pan
6. Relief spring	13. Oil filter
7. Relief plug	14. OPS (Oil pressure switch)

Engine Mechanical System > Lubrication System > Oil Pump > Repair procedures

Removal and Installation

1. Remove the timing chain cover. (Refer to Timing system in this group)

2. Remove the oil pump cover (A).

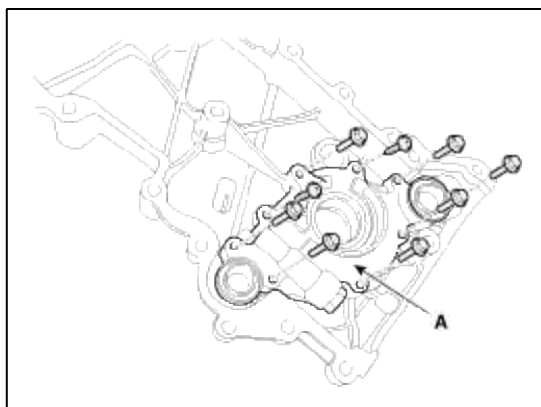
Tightening torque

Screws :

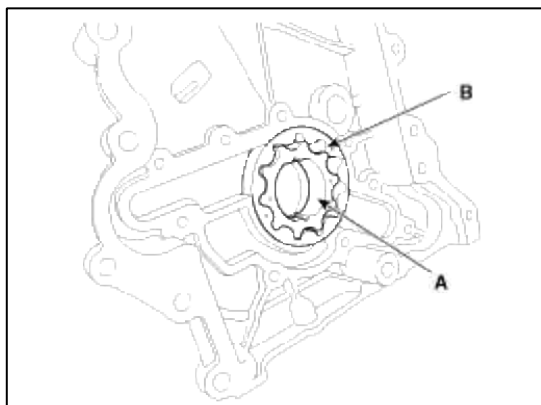
5.9 ~ 8.8 N.m (0.6 ~ 0.9 kgf.m, 4.3 ~ 6.5 lb-ft)

Bolts :

8.8 ~ 13.7 N.m (0.9 ~ 1.4 kgf.m, 6.5 ~ 10.1 lb-ft)



3. Remove the inner rotor (A) and outer rotor (B).



4. Installation is the reverse order of removal.

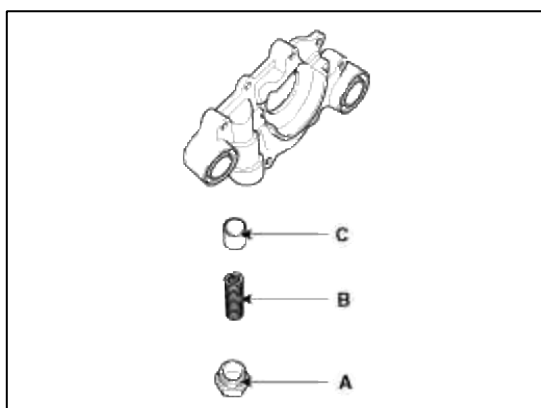
Inspection

1. Remove the relief plunger.

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

Tightening torque :

39.2 ~ 49.0 N.m (4.0 ~ 5.0 kgf.m, 28.9 ~ 36.2 lb-ft)



2. 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 necessary, replace timing chain cover.

3. Inspect the relief valve spring.

Inspect for distortion or breakdown of the relief valve spring.

4. Inspect the rotor side clearance.

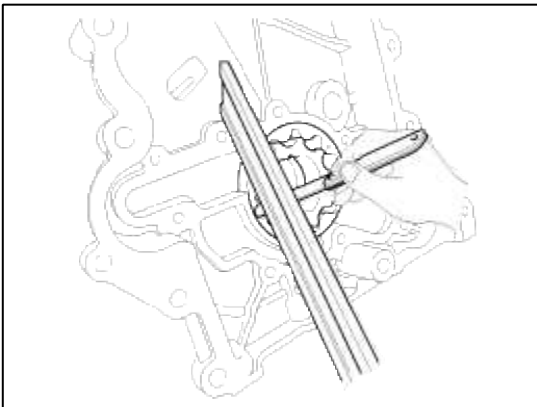
Using a feeler gauge and precision straight edge, measure the clearance between the inner rotors and precision straight edge.

If the side clearance is greater than maximum, replace the rotors as a set.

If necessary, replace the timing chain cover.

Side clearance:

0.040 ~ 0.090 mm (0.00157 ~ 0.00354 in.)



5. Inspect the rotor body clearance.

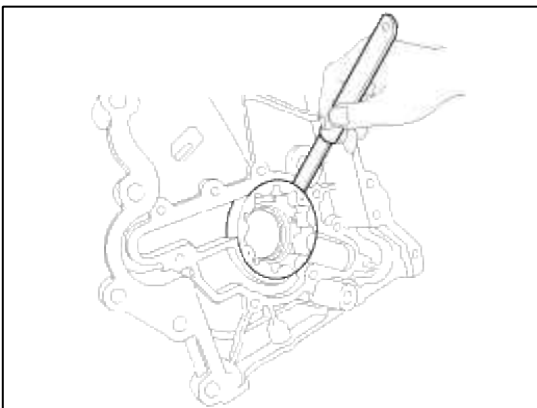
Using a feeler gauge, measure the clearance between the outer rotor and body.

If the body clearance is greater than maximum, replace the rotors as a set.

If necessary, replace the timing chain cover.

Body clearance:

0.200 ~ 0.292 mm (0.00787 ~ 0.01150 in.)



6. Inspect the rotor guide clearance.

- (1) Measure the outer diameter of the inner rotor guide.

Inner rotor diameter:

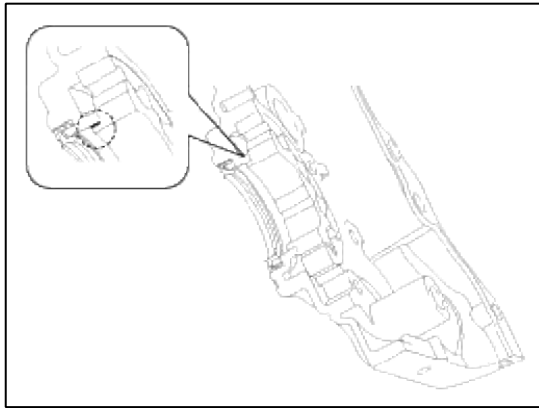
41.550 ~ 41.570 mm (1.63582 ~ 1.63661 in.)

- (2) Measure the inner diameter of the timing chain cover hole.

Timing chain cover hole diameter:

41.600 ~ 41.625 mm (1.63779 ~ 1.63878 in.)

- (3) Check the clearance between the timing chain cover hole inner diameter and the inner rotor guide outer diameter.



Guide clearance:

0.030 ~ 0.075 mm (0.00118 ~ 0.00295 in.)

Engine Mechanical System > Lubrication System > Oil Pan > Repair procedures

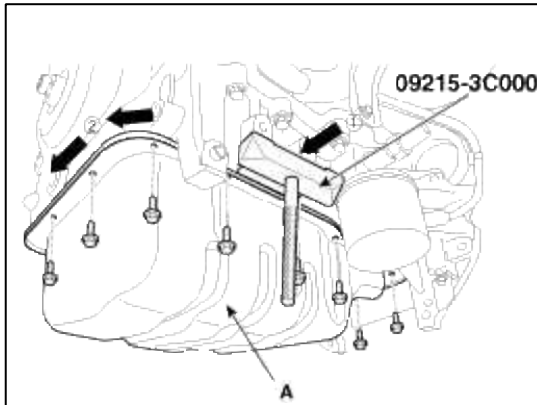
Removal

1. Remove the under covers. (Refer to Engine and transaxle assembly)
2. Drain engine oil.

3. Remove the oil pan (A).

(1) Unfasten the bolts.

(2) Insert the blade of SST (09215-3C000) between the lower crankcase and the oil pan. Separate the applied sealer and remove the oil pan.



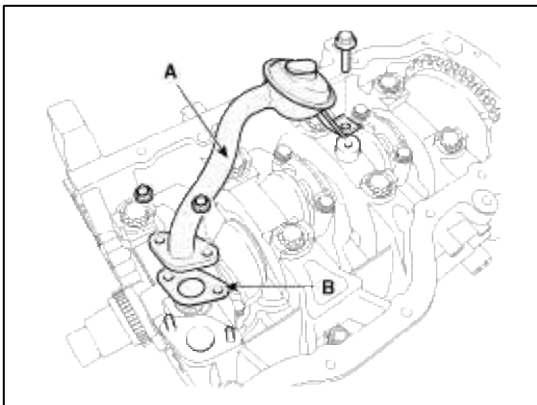
NOTE

Loosen one oil pan bolt near each corner of the oil pan leaving the bolts held in by about 2 threads. Then remove all other pan bolts.

NOTE

- Insert the SST between the oil pan and the lower crankcase by tapping it with a plastic hammer in the direction of ① arrow.
- After tapping the SST with a plastic hammer along the direction of ② arrow around more than 2/3 edge of the oil pan, remove it from the lower crankcase.
- Do not turn over the SST abruptly without tapping. It is result in damage of the SST.
- Be careful not to damage the contact surfaces of the lower crankcase and the oil pan.

4. Remove the oil screen (A) with the gasket (B).



Installation

1. Install the oil screen (A) with a new gasket (B).

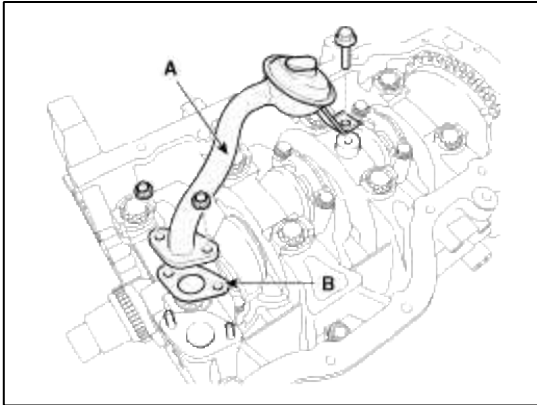
Tightening torque

Bolt :

19.6 ~ 26.5 N.m (2.0 ~ 2.7 kgf.m, 14.5 ~ 19.5 lb-ft)

Nuts :

11.8 ~ 13.7 N.m (1.2 ~ 1.4 kgf.m, 8.7 ~ 10.1 lb-ft)



2. Install the oil pan.

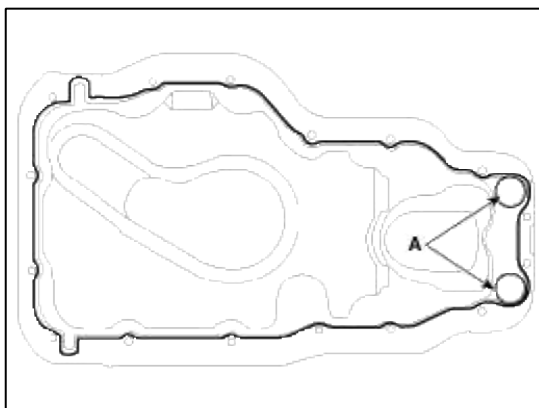
- (1) Using a gasket scraper, remove all the old packing material from the gasket surfaces.
- (2) The sealant locations on the oil pan and the lower crankcase must be free of harmful foreign materials, oil, dust and moisture.
Spraying cleaner on the surface and wiping with a clean duster.
- (3) After applying liquid sealant on the oil pan, assemble it within 5 minutes after sealant was applied. Continuous bead of sealant should be applied to prevent any path of oil leakage.

Bead width

Whole section : 4.0 ~ 5.0 mm (0.16 ~ 0.20 in.)

Section A : 1.5 ~ 2.5 mm (0.06 ~ 0.10 in.)

Sealant: Threebond 1217H



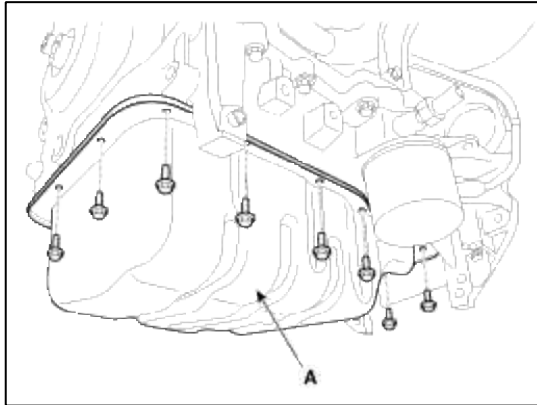
CAUTION

- When applying sealant gasket, sealant must not be protruded into the inside of oil pan.
- To prevent leakage of oil, apply sealant gasket on the inner threads of the bolt holes.
- If the sealant is applied to the bottom surface of the lower crankcase, it should be the same position as the oil pan.

(4) Install the oil pan (A). Uniformly tighten the bolts in several passes.

Tightening torque:

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



CAUTION

After assembly, wait at least 30 minutes before filling the engine with oil.

CAUTION

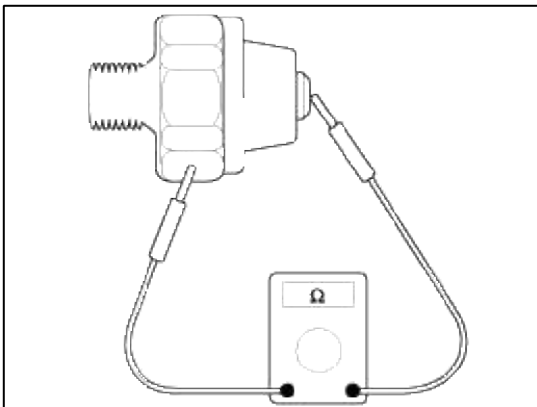
Always use a new drain plug gasket.

3. Refill engine with engine oil.

Engine Mechanical System > Lubrication System > Oil Pressure Switch > Repair procedures

Inspection

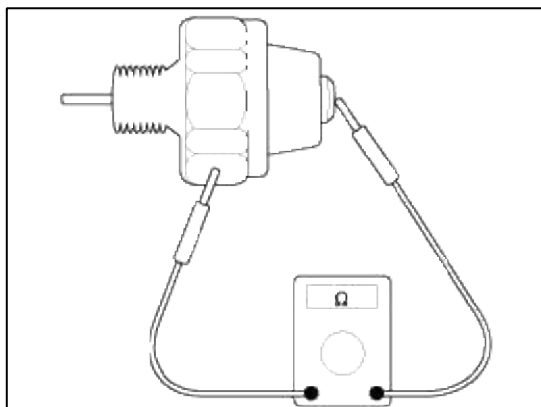
1. Check the continuity between the terminal and the body with an ohmmeter.
If there is no continuity, replace the oil pressure switch.



2. Check the continuity between the terminal and the body when the fine wire is pushed. If there is continuity even when the fine wire is pushed, replace the switch.

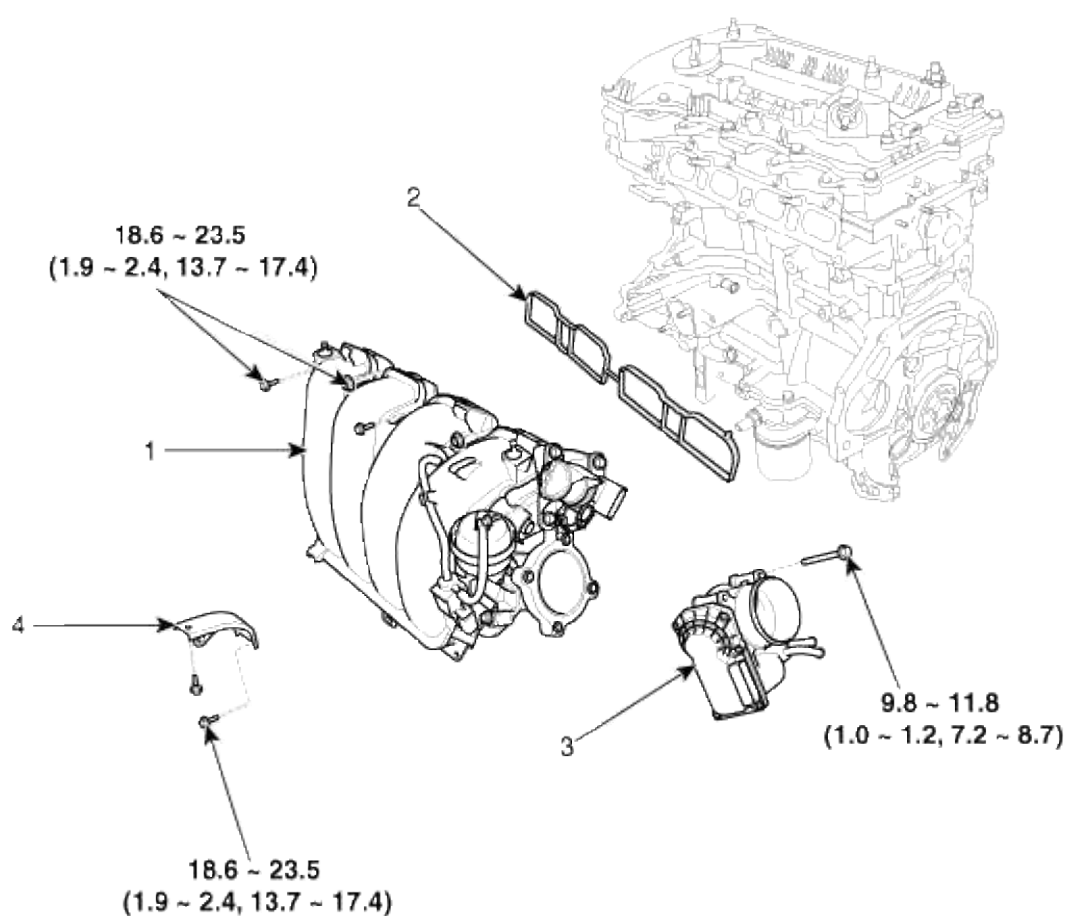
3. If there is no continuity when a 50 kPa (0.50 kgf/cm², 7.25 psi) is applied through the oil hole, the switch is operating properly.

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



Engine Mechanical System > Intake And Exhaust System > Intake Manifold > Components and Components Location

Components



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

1. Intake manifold assembly	3. Electronic throttle body
2. Intake manifold gasket	4. Intake manifold stay

Engine Mechanical System > Intake And Exhaust System > Intake Manifold > Repair procedures**Removal and Installation**

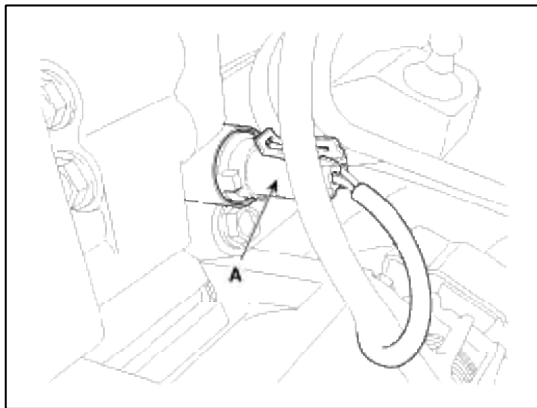
1. Remove the engine cover.
2. Disconnect the battery negative terminal.

Tightening torque:

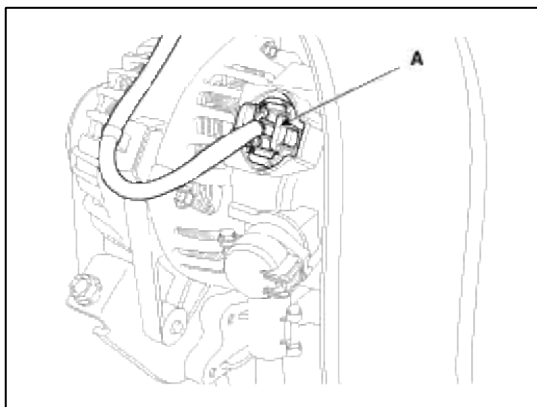
3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 3.0 ~ 4.4 lb-ft)

3. Disconnect the wiring connectors and harness clamps, and then remove the wiring and protectors from the intake manifold.

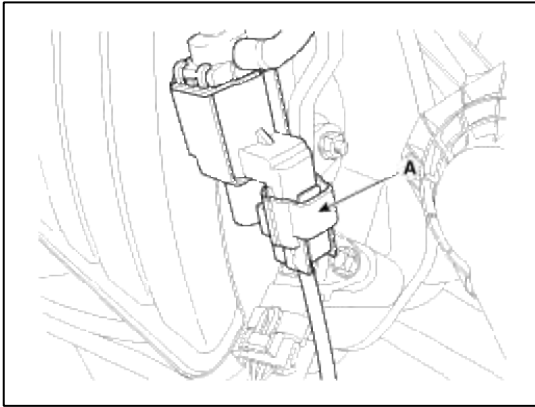
- (1) The intake OCV (Oil control valve) connector (A)



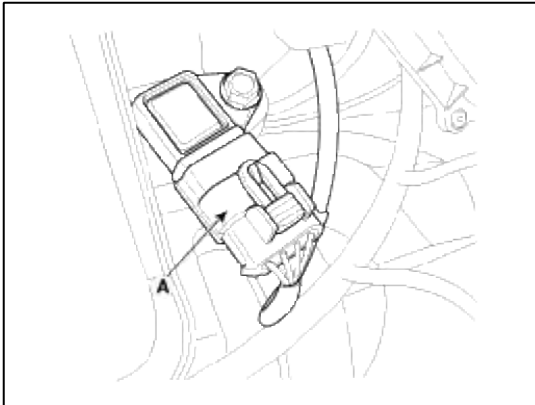
- (2) The alternator connector (A)



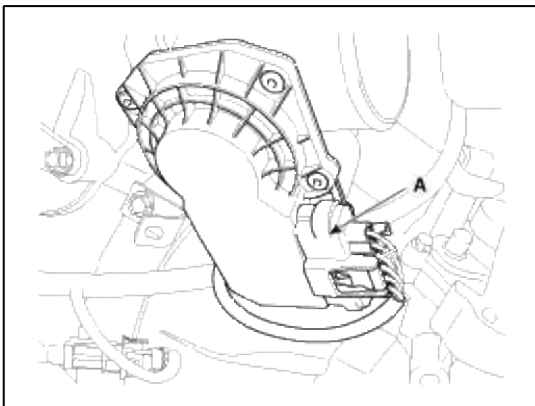
(3) The VIS (Variable Intake System) connector (A)



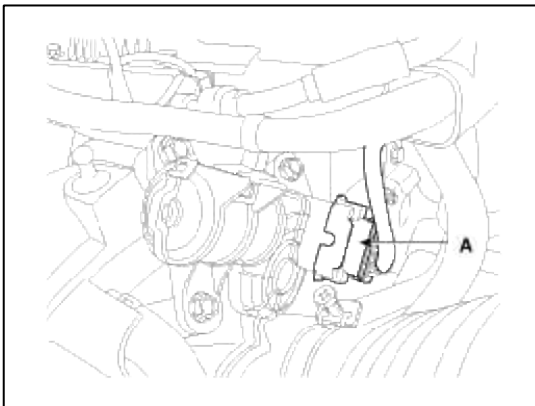
(4) The MAPS (Manifold absolute pressure sensor) & IATS (Intake air temperature sensor) connector (A)



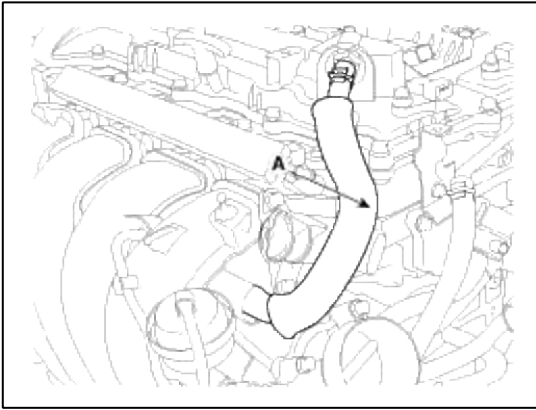
(5) The ETC (Electronic throttle control) connector (A)



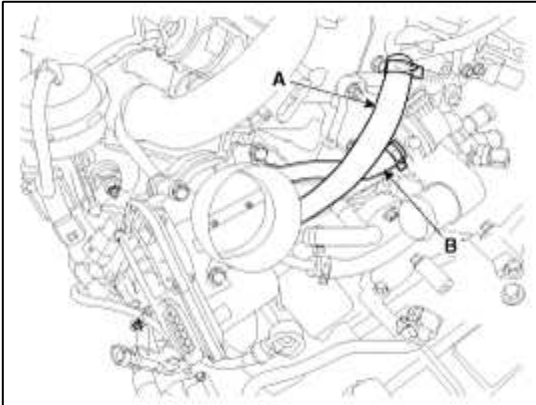
(6) The VCMA (Variable charge motion actuator) connector (A)



4. Disconnect the PCV (Positive crankcase ventilation) hose (A).



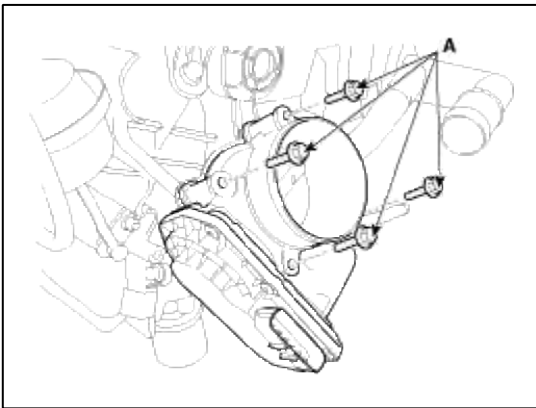
5. Disconnect the vacuum hose (A) and PCSV (Purge control solenoid valve) hose (B).



6. Unfasten the ETC (Electric throttle body control) module bolts (A). (Refer to FL – “ETC system”)

Tightening torque:

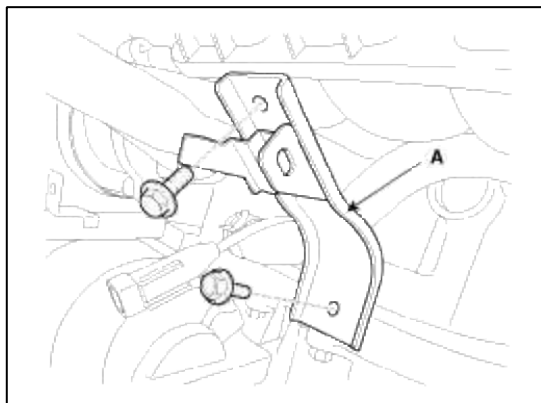
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



7. Remove the intake manifold stay (A).

Tightening torque:

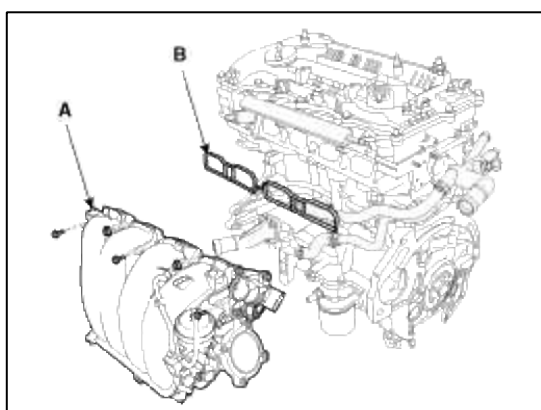
18.6 ~ 23.5 N.m (1.9 ~ 2.4 kgf.m, 13.7 ~ 17.4 lb-ft)



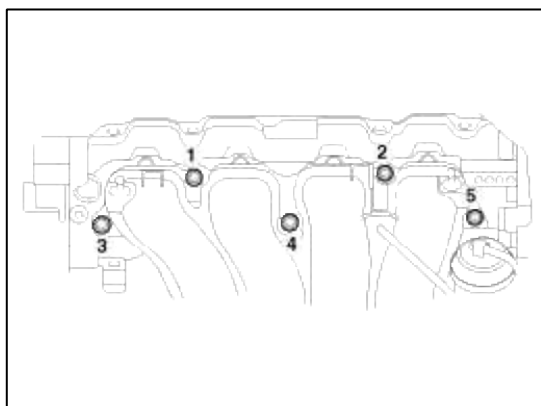
8. Remove the intake manifold (A) with the gasket (B).

Tightening torque:

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

**NOTE**

When installing the intake manifold, tighten the bolts and nuts with pre-torque first, and then tighten the bolts and nuts with specified torque in the sequence shown.



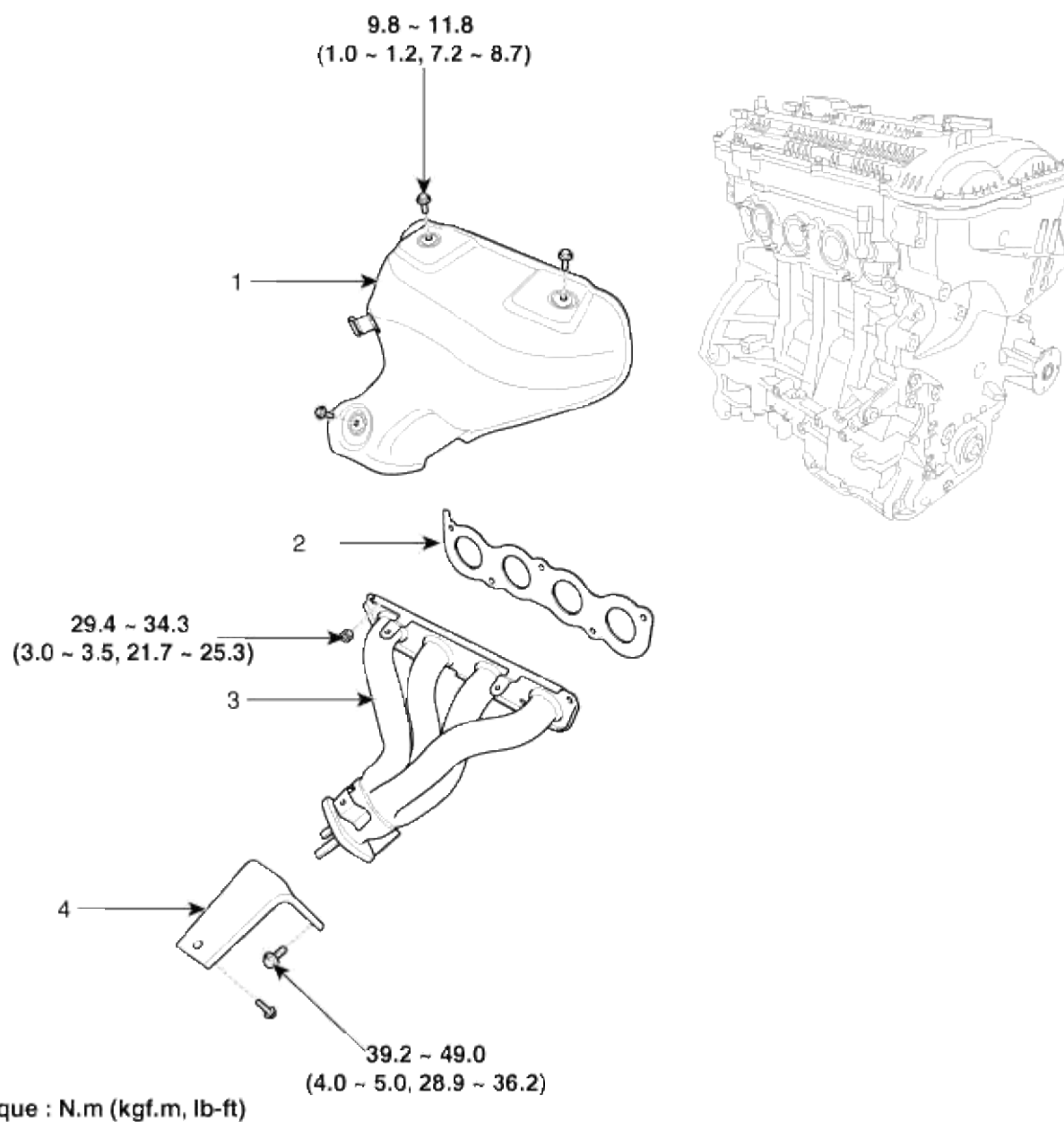
9. Installation is reverse order of removal.

NOTE

When installing, replace with new gaskets.

Engine Mechanical System > Intake And Exhaust System > Exhaust Manifold > Components and Components Location

Components



1. Heat protector
2. Exhaust manifold
gasket

3. Exhaust manifold
4. Exhaust manifold stay

Engine Mechanical System > Intake And Exhaust System > Exhaust Manifold > Repair procedures

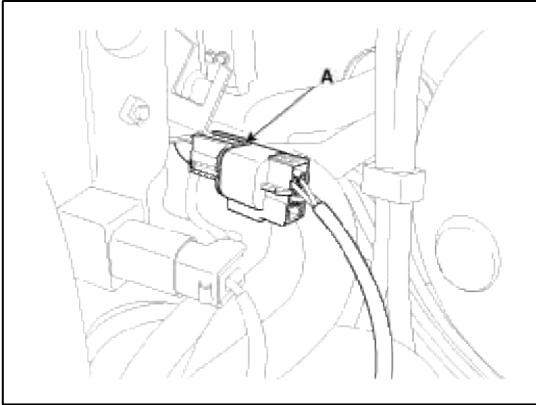
Removal and Installation

1. Remove the engine cover.
 2. Disconnect the battery negative terminal.
-

Tightening torque:

3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 3.0 ~ 4.4 lb-ft)

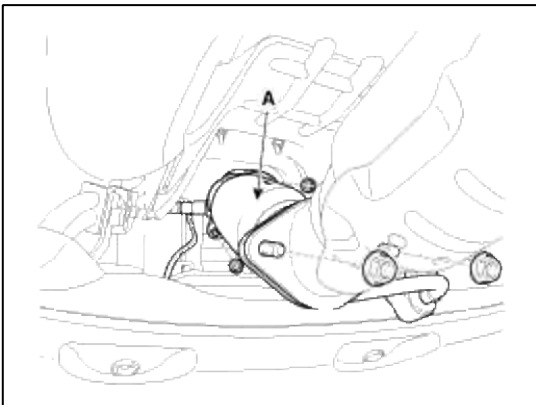
3. Disconnect the front oxygen sensor connector (A) and then remove it from the bracket.



4. Remove the front muffler (A).
-

Tightening torque:

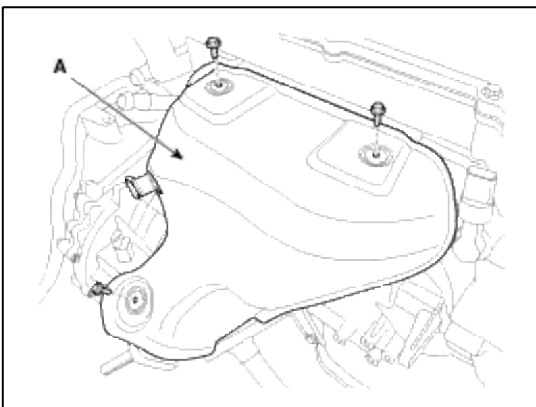
39.2 ~ 58.8 N.m (4.0 ~ 6.0 kgf.m, 28.9 ~ 43.4 lb-ft)



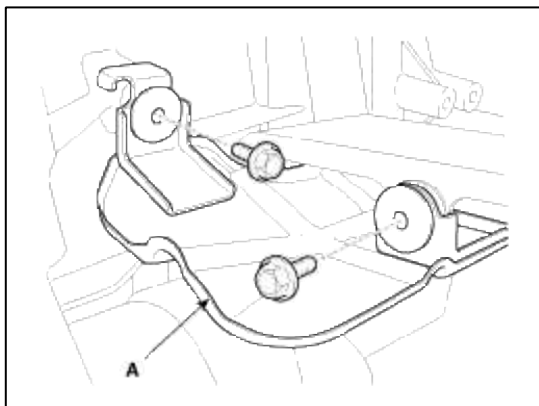
5. Remove the exhaust manifold heat protector (A).
-

Tightening torque:

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



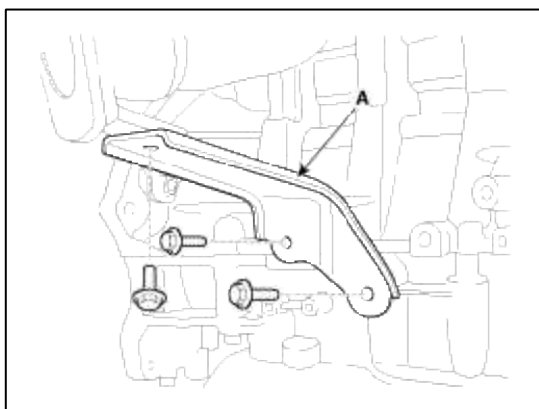
6. Remove the driveshaft heat protector (A).



7. Remove the exhaust manifold stay (A).

Tightening torque:

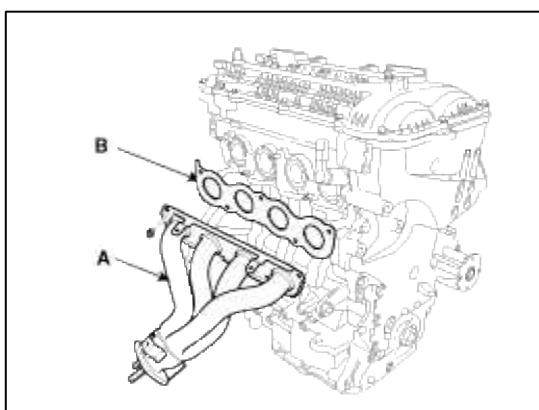
39.2 ~ 49.0 N.m (4.0 ~ 5.0 kgf.m, 28.9 ~ 36.2 lb-ft)



8. Remove the exhaust manifold (A) with the gasket (B).

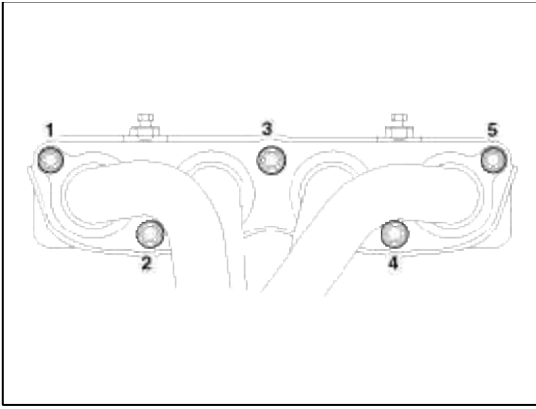
Tightening torque:

29.4 ~ 34.3 N.m (3.0 ~ 3.5 kgf.m, 21.7 ~ 25.3 lb-ft)



NOTE

When installing the intake manifold, tighten the nuts with pre-torque first, and then tighten the nuts with specified torque in the sequence shown.



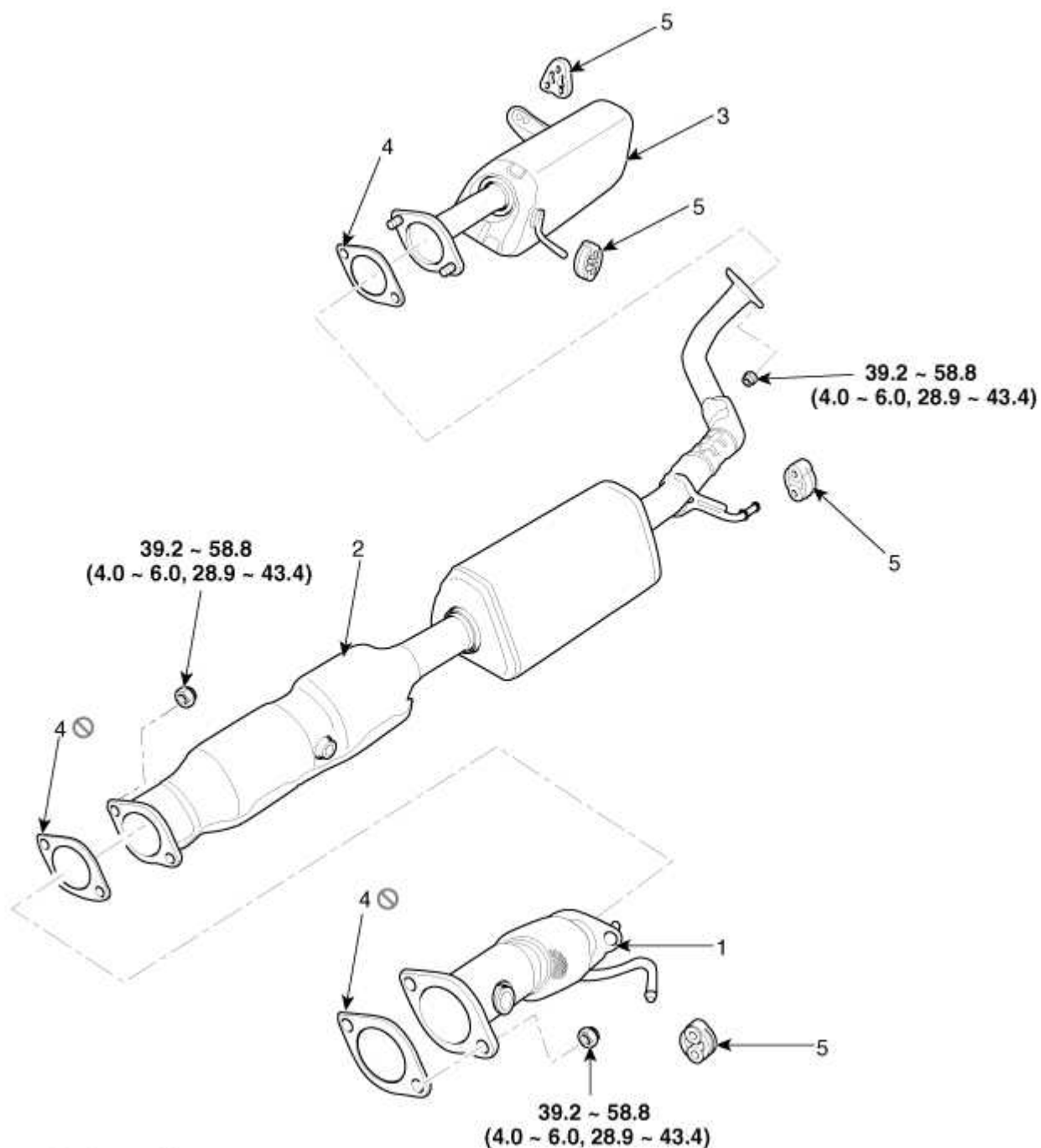
9. Installation is reverse order of removal.

NOTE

When installing, replace with a new gasket.

Engine Mechanical System > Intake And Exhaust System > Muffler > Components and Components Location

Components



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

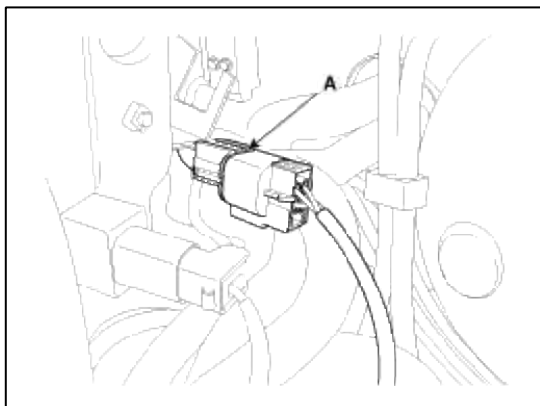
1. Front muffler
2. Catalytic converter & center muffler assembly
3. Main muffler

4. Gasket
5. Hanger

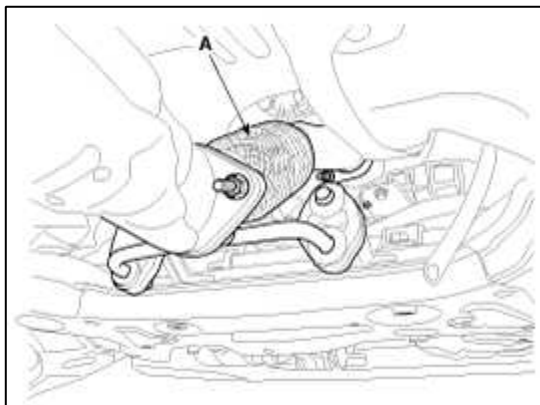
Engine Mechanical System > Intake And Exhaust System > Muffler > Repair procedures

Removal and Installation

1. Disconnect the front oxygen sensor connector (A) and then remove it from the bracket.



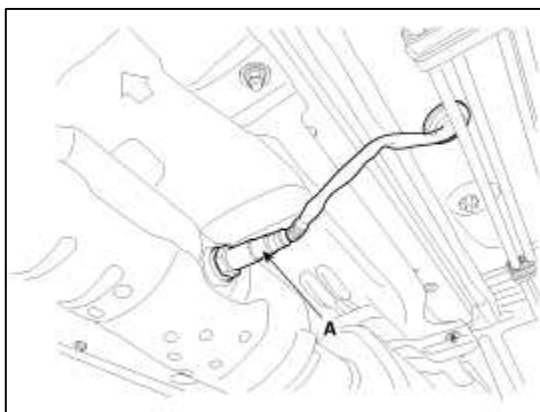
2. Remove the front muffler (A).



3. Remove the rear oxygen sensor (A).

Tightening torque :

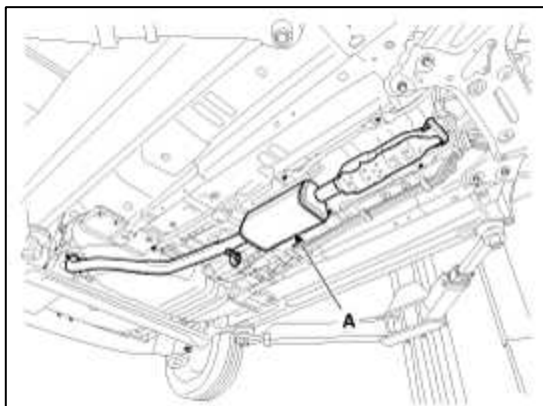
39.2 ~ 49.0 N.m (4.0 ~ 5.0 kgf.m, 28.9 ~ 36.2 lb-ft)



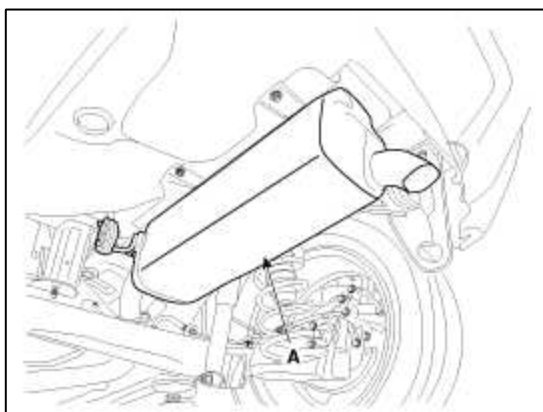
4. Remove the catalytic converter and center muffler assembly (A).

Tightening torque :

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



5. Remove the main muffler (A).



6. Installation is the reverse order of removal.

NOTE

When installing, replace with new gaskets.

SOUL(AM) > 2013 > G 2.0 DOHC > Engine Electrical System

Engine Electrical System > General Information > Specifications

Specifications

Ignition System

Items		Specification
Ignition coil	Primary resistance	0.75 $\Omega \pm 15 \%$
	Secondary resistance	5.9 k $\Omega \pm 15 \%$
Spark plugs	Type	SILZKR7B11
	Gap	1.0 ~ 1.1 mm (0.0394 ~ 0.0433 in.)
Condenser	Rated voltage	DC 250 V
	Capacitance [at 1 KHz]	0.47

Starting System

Items			Specification	
			Non-ISG	ISG
Starter	Rated voltage		12 V, 1.2 kW	12V, 1.4kW
	No. of pinion teeth		11	13
	No-load characteristics	Voltage	11 V	11.5V
		Ampere	70 A, MAX	100A, MAX
		Speed	2,400 rpm, MIN	1,915 rpm, MIN

Charging System

Items			Specification	
			Non-ISG	ISG
Alternator	Rated voltage		13.5 V, 90 A	13.5V, 120A
	Speed in use		1,000 ~ 18,000 rpm	
	Voltage regulator		IC Regulator built-in type, Alternator management system	
	Regulator setting voltage	External mode	ECU control	
		Internal mode	14.55 ± 0.3 V	
	Temperature compensation	External mode	ECU control	
		Internal mode	-3.5 ± 2 mV/ $^{\circ}$ C	
Battery	Type		48-23 GL	56-28GL (AGM)
	Cold cranking amperage [at -18 $^{\circ}$ C (-0.4 $^{\circ}$ F)]		550A	760A
	Reserve capacity		92 min	120 min
	Specific gravity [at 25 $^{\circ}$ C (77 $^{\circ}$ F)]		1.280 ± 0.01	1.310 ± 0.01

Tightening Torques

Item	N.m	kgf.m	lb-ft
Ignition coil bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Spark plug	14.7 ~ 24.5	1.5 ~ 2.5	10.8 ~ 18.1
Condenser bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Alternator B-terminal cable nut	9.8 ~ 14.7	1.0 ~ 1.5	7.2 ~ 10.8
Alternator mounting bolt (M10)	29.4 ~ 41.2	3.0 ~ 4.2	21.7 ~ 30.4
Alternator mounting bolt (M8)	21.6 ~ 32.4	2.2 ~ 3.3	15.9 ~ 23.9
Alternator brace mounting bolt	21.6 ~ 32.4	2.2 ~ 3.3	15.9 ~ 23.9
Battery positive terminal	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Battery negative terminal	3.9 ~ 5.9	0.4 ~ 0.6	3.0 ~ 4.4
ECM & bracket bolt	19.6 ~ 29.4	2.0 ~ 3.0	14.5 ~ 21.7
ECM & bracket nut	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Battery tray mounting bolt	8.8 ~ 13.7	0.9 ~ 1.4	6.5 ~ 10.1
Starter B-terminal cable nut	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Starter mounting bolt	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8

CAUTION

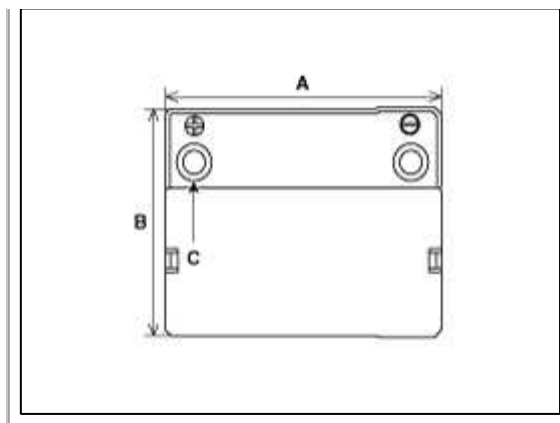
- COLD CRANKING AMPERAGE is the amperage a battery can deliver for 30 seconds and maintain a terminal voltage of 7.2V or greater at a specified temperature.
- RESERVE CAPACITY RATING is amount of time a battery can deliver 25A and maintain a minimum terminal voltage of 10.5V at 26.7°C(80.1°F).

NOTE

• Battery type notation : MF 4 8 - 2 3 G L

① ② ③ ④ ⑤

- ① : Battery type
 - MF : Maintenance Free
- ② : Battery capacity (5HR)
 - 48 : 48A·h
- ③ : Battery length (A)
 - 23 : 230mm (9.06in)
- ④ : Battery width (B)
 - A : 127mm (5.00in)
 - B : 129mm (5.08in)
 - C : 132mm (5.20in)
 - D : 135mm (5.31in)
 - E : 154mm (6.06in)
 - F : 173mm (6.81in)
 - G : 175mm (6.89in)
 - H : 176mm (6.93in) or above
- ⑤ : Terminal location (C)
 - L : Positive terminal is left
 - R : Positive terminal is right



Engine Electrical System > General Information > Troubleshooting

Troubleshooting

Ignition System

Symptom	Suspect area	Remedy
Engine will not start or is hard to start (Crank OK)	Ignition lock switch	Inspect ignition lock switch, or replace as required
	Ignition coil	Inspect ignition coil, or replace as required
	Spark plugs	Inspect spark plugs, or replace as required
	Ignition wiring disconnected or broken	Repair wiring, or replace as required
Rough idle or stalls	Ignition wiring	Repair wiring, or replace as required
	Ignition coil	Inspect ignition coil, or replace as required
Engine hesitates/poor acceleration	Spark plugs and spark plug cables	Inspect spark plugs / cable, or replace as required
	Ignition wiring	Repair wiring, or replace as required
Poor mileage	Spark plugs and spark plug cables	Inspect spark plugs / cable, or replace as required

Charging System

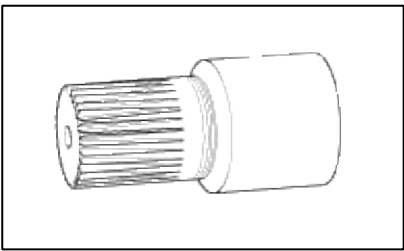
Symptom	Suspect area	Remedy
Charging warning indicator does not light with ignition switch "ON" and engine off.	Fuse blown	Check fuses
	Light burned out	Replace light
	Wiring connection loose	Tighten loose connection
	Electronic voltage regulator	Disconnect the voltage regulator to see if light turns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

Starting System

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

Engine Electrical System > General Information > Special Service Tools

Special Service Tools

Tool (Number and name)	Illustration	Use
Alternator pulley remover wrench		Removal and installation of alternator pulley

Engine Electrical System > Ignition System > Description and Operation

Description

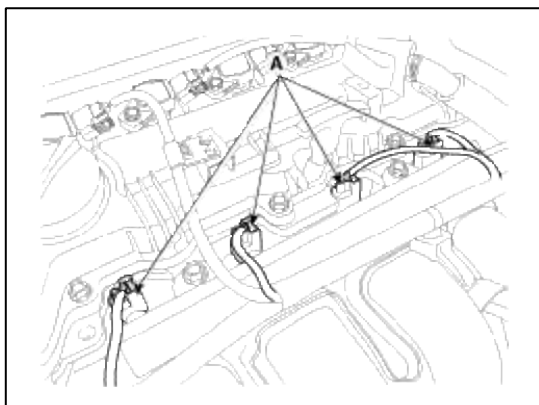
Ignition timing is controlled by the electronic control ignition timing system. The standard reference ignition timing data for the engine operating conditions are preprogrammed in the memory of the ECM (Engine Control Module). The engine operating conditions (speed, load, warm-up condition, etc.) are detected by the various sensors. Based on these sensor signals and the ignition timing data, signals to interrupt the primary current are sent to the ECM. The ignition coil is activated, and timing is controlled.

Engine Electrical System > Ignition System > Repair procedures

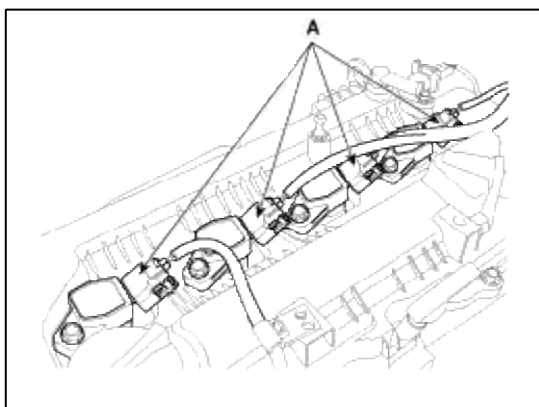
On-vehicle Inspection

Spark Test

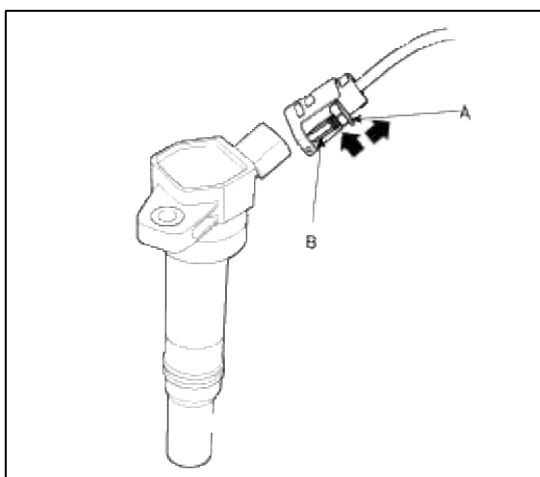
1. Disconnect the injector connectors (A).



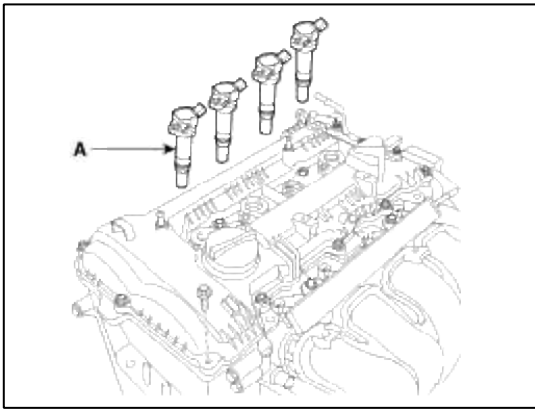
2. Disconnect the ignition coil connectors (A).

**NOTE**

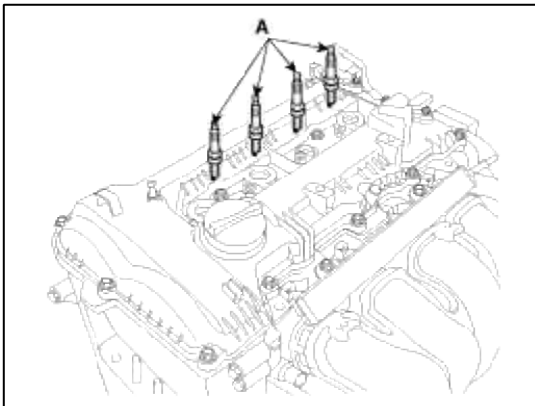
When removing the ignition coil connector, pull the lock pin (A) and push the clip (B).



3. Remove the ignition coils (A).



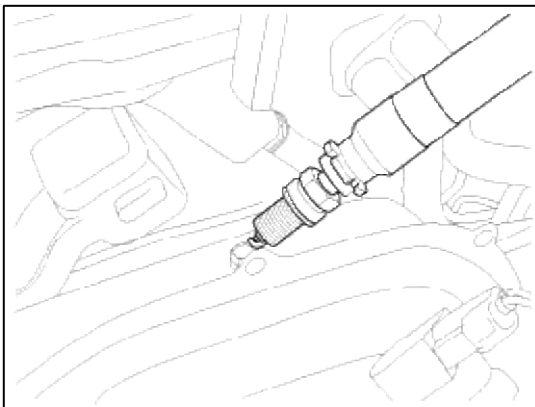
4. Using a spark plug socket, remove the spark plugs (A).



CAUTION

Be careful that no contaminants enter through the spark plug holes.

5. Install the spark plug to the ignition coil.
6. Ground the spark plug to the engine.



7. Check if spark occurs while engine is being cranked.

NOTE

To prevent fuel being injected from injectors while the engine is being cranked, disconnect the injector connectors.

Crank the engine for no more than 5 ~ 10 seconds.

8. Inspect all the spark plugs.

9. Using a spark plug socket, install the spark plugs.
-

Tightening torque:

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

10. Install the ignition coils.
-

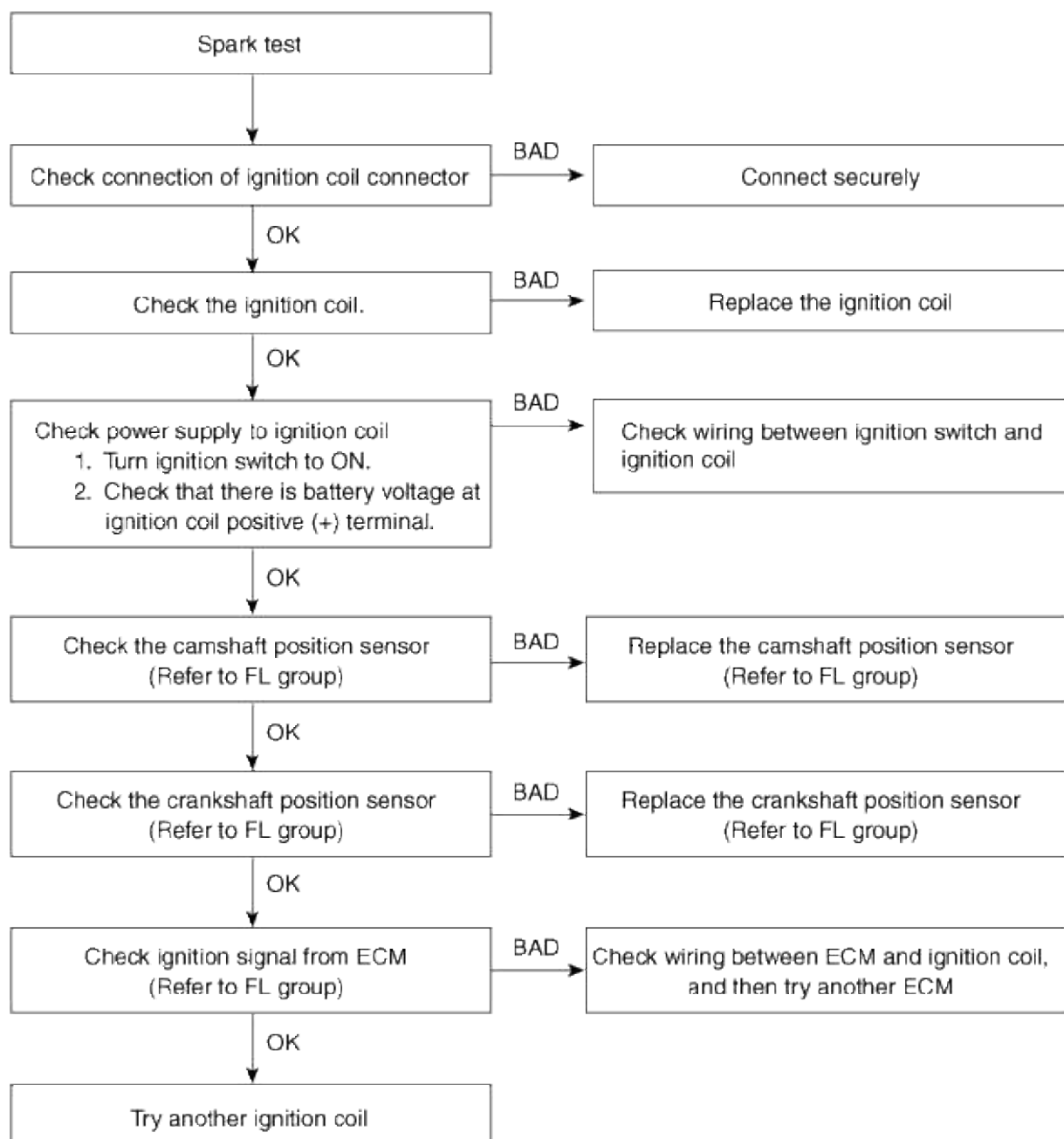
Tightening torque:

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

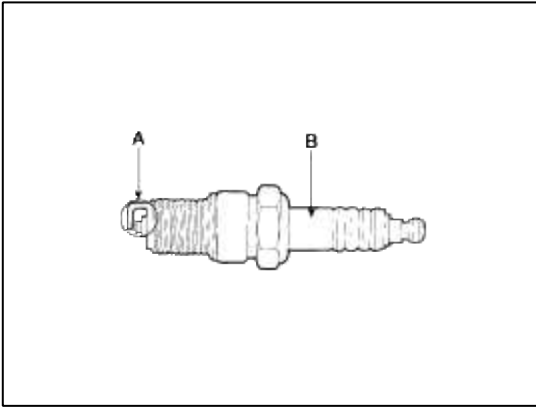
NOTE

When inserting ignition coil into the cylinder head cover for spark plug to be inserting ignition coil, the sealing cap of ignition coil must be mated totally with inner side of cylinder head.

11. Reconnect the ignition coil connectors.
12. Reconnect the injector connectors.



1. Inspect the electrodes (A) and ceramic insulator (B).

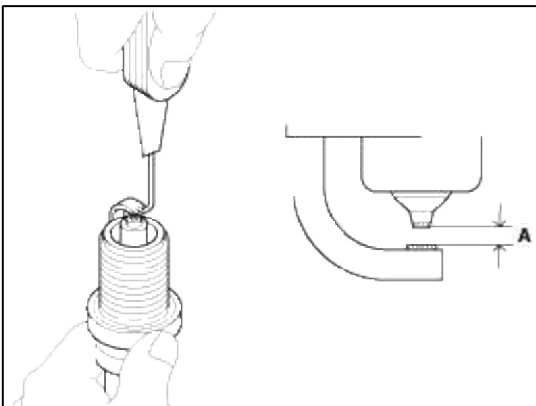


Inspection Of Electrodes

Condition	Dark deposits	White deposits
Description	- Fuel mixture too rich - Low air intake	- Fuel mixture too lean - Advanced ignition timing - Insufficient plug tightening torque

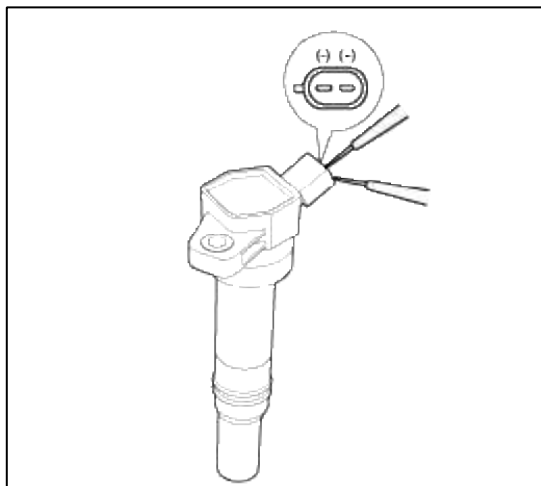
2. Check the electrode gap (A).

Standard : 1.0 ~ 1.1 mm (0.0394 ~ 0.0433 in.)



Inspect Ignition Coil

1. Measure the primary coil resistance between terminals (+) and (-).



Standard value: $0.75 \Omega \pm 15\%$

Engine Electrical System > Charging System > Description and Operation

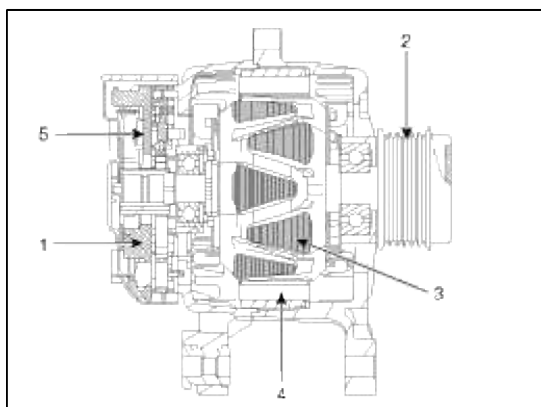
Description

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

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

DC current appears at alternator "B" terminal. The charging voltage of this alternator is regulated by ECM.

The main components of the alternator are the rotor, stator, rectifier, capacitor, brushes, bearings and V-ribbed belt pulley. The brush holder contains a built-in electronic voltage regulator.



1. Brush
2. Drive belt pulley (OAD : Overrunning Alternator Decoupler)
3. Rotor
4. Stator
5. Rectifier

Alternator Management System (AMS)

Alternator management system controls the charging voltage set point in order to improve fuel economy, manage alternator load under various operating conditions, keep the battery charged, and protect the battery from over-charging. ECM controls generating voltage by duty cycle (charging control, discharging control, normal control) based on the battery conditions and vehicle operating conditions.

The system lowers the charging rate when accelerating. Lowering the charging rate will allow more engine power for

accelerating.

The system increases the charging rate when decelerating. The system uses the unused power of the decelerating engine and increases the charging rate.

Engine Electrical System > Charging System > Repair procedures

On-vehicle Inspection

CAUTION

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

Check Battery Voltage

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

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

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

Check The Battery Terminals And Fuses

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

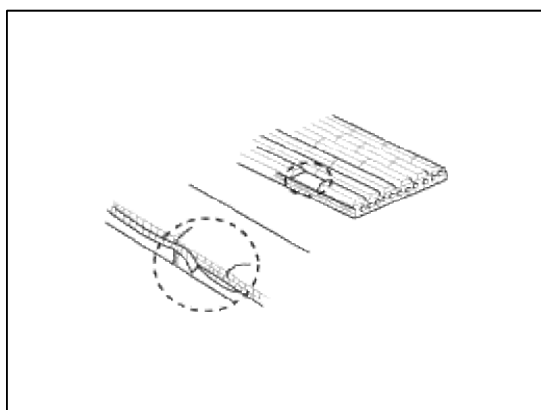
Inspect Drive Belt

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

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

NOTE

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



Drive belt tension measurement and adjustment

Belt tension measurement

Measure the belt tension using a mechanical tension gauge or a sonic tension meter.

Belt tension

New belt:

637.4 ~ 735.5 N (65 ~ 75 kgf, 143.3 ~ 165.3 lbf)

Used belt:

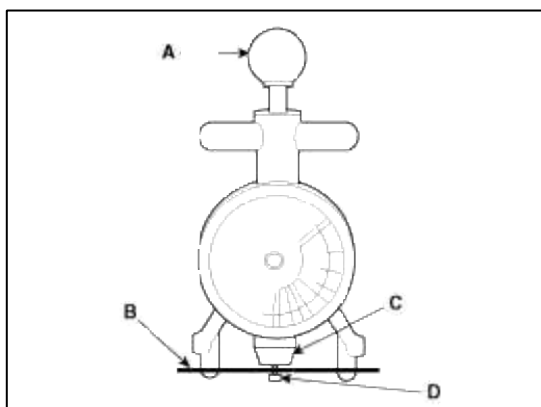
441.3 ~ 539.4 N (45 ~ 55 kgf, 99.2 ~ 121.3 lbf)

CAUTION

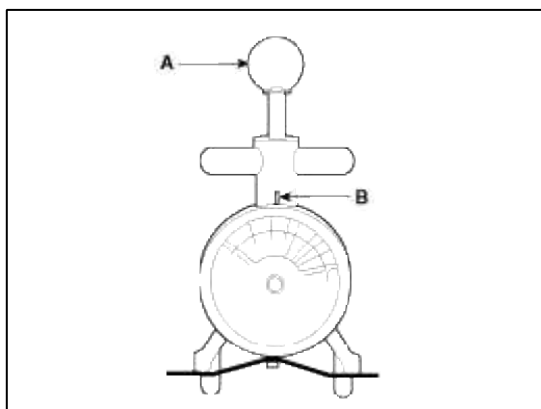
- If the engine has run for 5 minutes or more, the belt tension must be adjusted as a used belt.
- When installing the V-ribbed belt, all grooves on the pulley should be covered with belt ribs.
- A loose belt causes slip noise.
- Too tight belt cause bearing of alternator and water pump to damage.

Using a mechanical tension gauge (BT-33-73F, BTG-2 type)

1. While pressing the handle (A) of the gauge, insert the belt (B) between pulley and pulley (or idler) into the gap between spindle (C) and hook (D).



2. After releasing the handle (A), read a value on the dial pointed by the indicator (B).



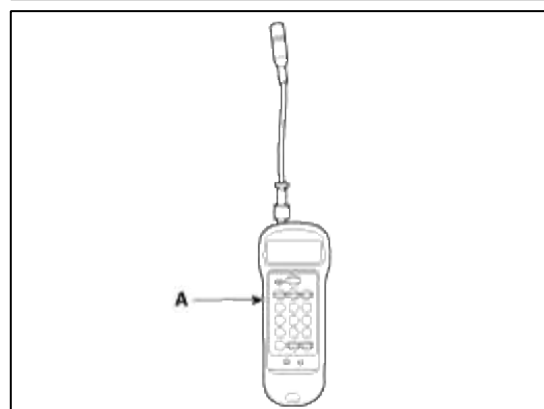
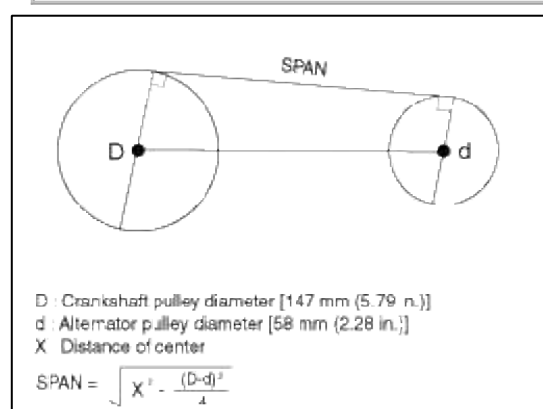
Using a sonic tension meter (U-505/507 type)

1. Input the belt specifications into the tension meter (A).

Belt type	Location of measurement	Input data		
		M (Mass, g/m.rib)	W (Width, rib)	S (Span, mm)
With A/C	Crankshaft pulley to A/C compressor pulley	14.7	006.0	187
Without A/C	Crankshaft pulley to alternator pulley	14.7	006.0	Actual measurement value

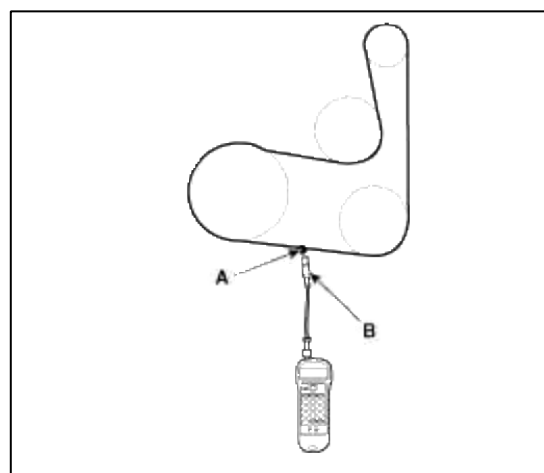
NOTE

Measurement of S (Span): Calculate average value after measuring the distance 3~4 times.

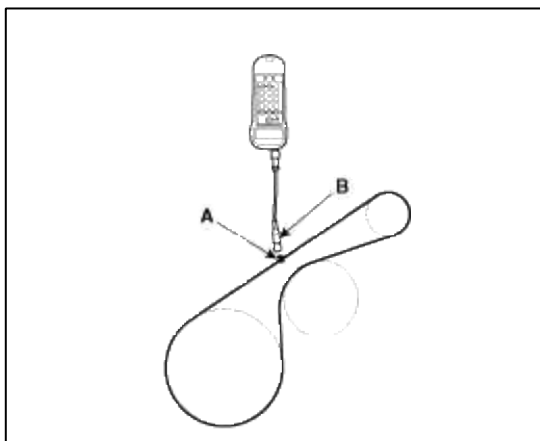


2. Locate the micro phone (B) close to the center of belt span (A) and bounce the belt by finger 2~3 times. Read a value on the display.

[With A/C]

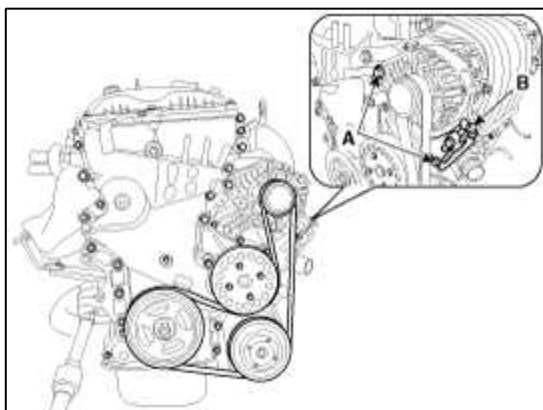


[Without A/C]



If adjustment is necessary:

1. Loosen the mounting bolts (A).
2. Tighten the adjusting bolt (B) counterclockwise in loose tension; fasten the bolt clockwise in high tension.



3. Recheck tension of the belt.
4. After adjusting tension, tighten the mounting bolts.

Tightening torque

M10 bolt:

29.4 ~ 41.2 N.m (3.0 ~ 4.2 kgf.m, 21.7 ~ 30.4 lb-ft)

M8 bolt:

21.6 ~ 32.4 N.m (2.2 ~ 3.3 kgf.m, 15.9 ~ 23.9 lb-ft)

Visually Check Alternator Wiring And Listen For Abnormal Noises

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

Check Discharge Warning Light Circuit

1. Warm up the engine and then turn it off.
2. Turn off all accessories.
3. Turn the ignition switch "ON". Check that the discharge warning light is lit.
4. Start the engine. Check that the light is lit.

If the light does not go off as specified, troubleshoot the discharge light circuit.

Inspect Charging System

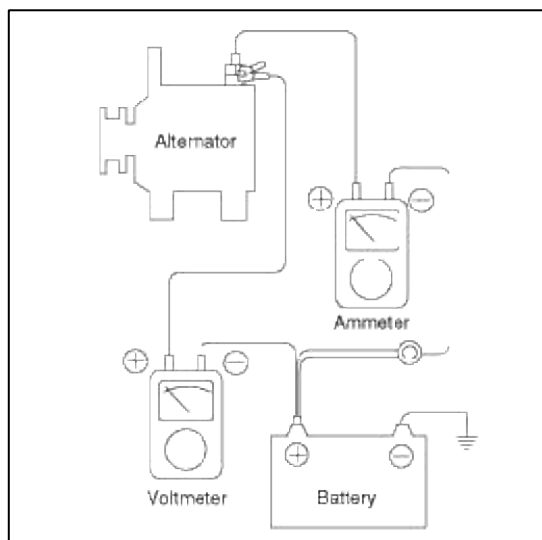
Voltage Drop Test Of Alternator Output Wire

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

Preparation

1. Turn the ignition switch to "OFF".

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



Test

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

Result

1. The voltmeter may indicate the standard value.

Standard value: 0.2V max

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

Output Current Test

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

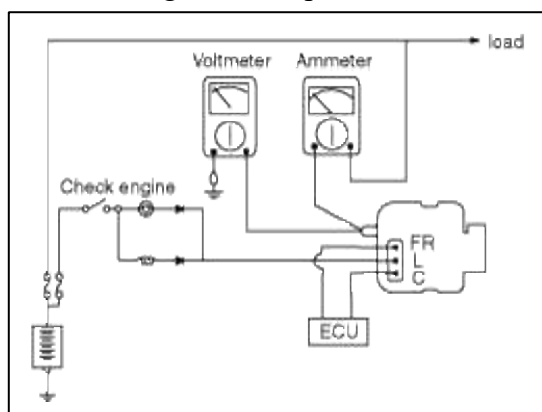
Preparation

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

NOTE

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

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



Test

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

NOTE

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

Result

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

Limit value : 60% of the voltage rate

NOTE

- The maximum 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. Due to temperature the maximum output current may not be obtained. If such is the case, keep the headlamps on to increase the electrical load.
The maximum output current may not be obtained if the temperature of the alternator itself or ambient temperature is too high.
In such a case, reduce the temperature before testing again.

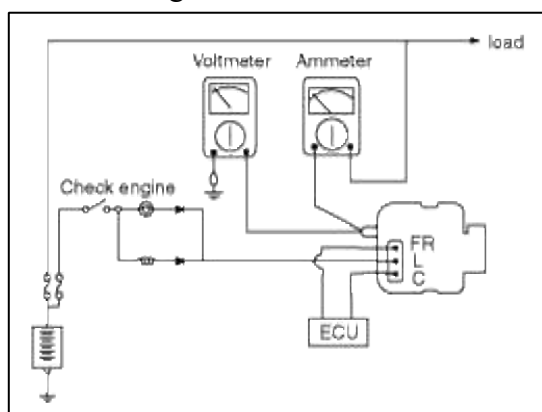
2. Upon completion of the output current test, lower the engine speed to idle and turn off the ignition switch.
3. Disconnect the battery ground cable.
4. Remove the ammeter and voltmeter and the engine tachometer.
5. Connect the alternator output wire to the alternator "B" terminal.
6. Connect the battery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

Regulated Voltage Test

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

Preparation

1. Prior to the test, check the following items and correct if necessary.
Check that the battery installed on the vehicle is fully charged. The battery checking method is described in the section "Battery".
Check the alternator drive belt tension. The belt tension check method is described in the section "Inspect drive belt".
2. Turn ignition switch to "OFF".
3. Disconnect the battery ground cable.
4. Connect a digital voltmeter between the "B" terminal of the alternator and ground. Connect the (+) lead of the voltmeter to the "B" terminal of the alternator. Connect the (-) lead to good ground or the battery (-) terminal.
5. Disconnect the alternator output wire from the alternator "B" terminal.
6. Connect a DC ammeter (0 to 150A) in series between the "B" terminal and the disconnected output wire.
Connect the (-) lead wire of the ammeter to the disconnected output wire.
7. Attach the engine tachometer and connect the battery ground cable.



Test

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

Voltage: Battery voltage

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

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

Result

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

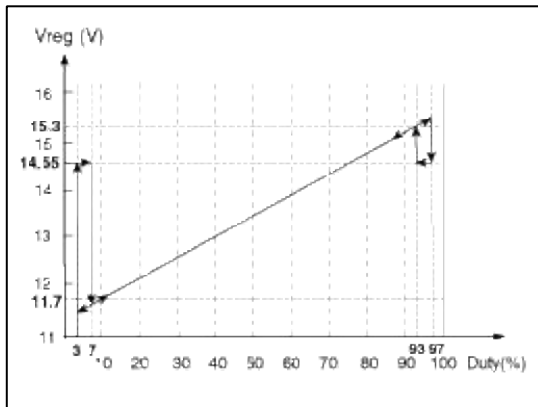
Regulating Voltage Table (Internal mode)

Voltage regulator ambient temperature °C (°F)	Regulating voltage (V)
-30 (-22)	13.4 ~ 14.7
25 (77)	13.5 ~ 14.4
135 (275)	12.9 ~ 14.3

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.

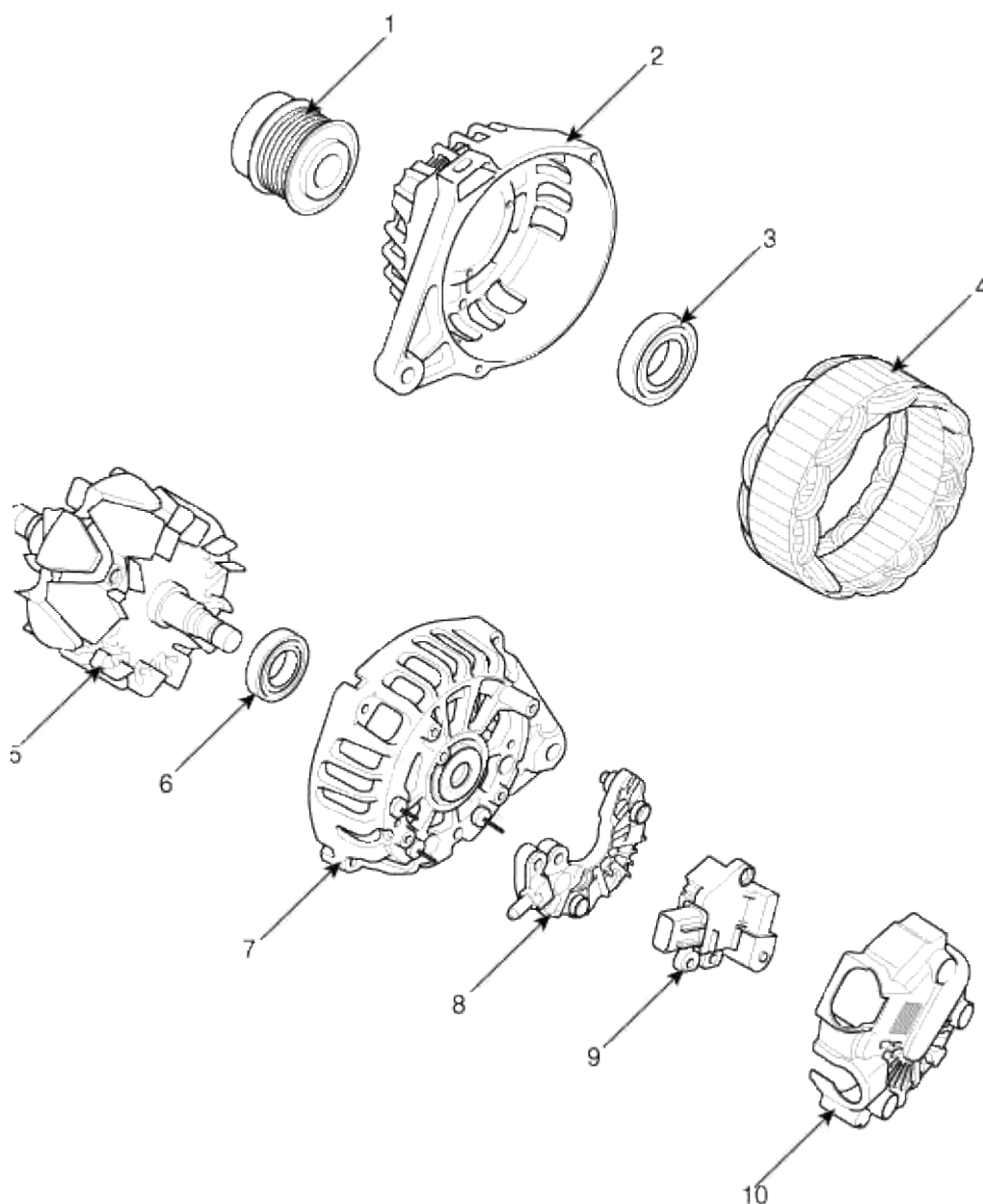
6. Connect the battery ground cable.

Regulating Voltage Table (External mode)



Engine Electrical System > Charging System > Alternator > Components and Components Location

Components



1. OAD pulley	6. Rear bearing
2. Front housing	7. Rear housing
3. Front bearing	8. Rectifier assembly
4. Stator	9. Regulator assembly
5. Rotor	10. Rear cover

Engine Electrical System > Charging System > Alternator > Repair procedures

Removal and installation

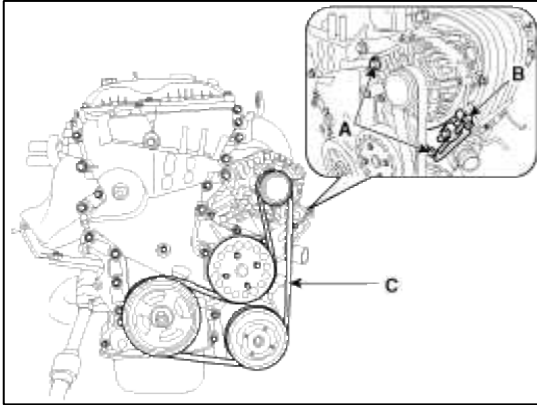
1. Disconnect the battery negative terminal.

Tightening torque :

3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 3.0 ~ 4.4 lb-ft)

2. Remove the drive belt.

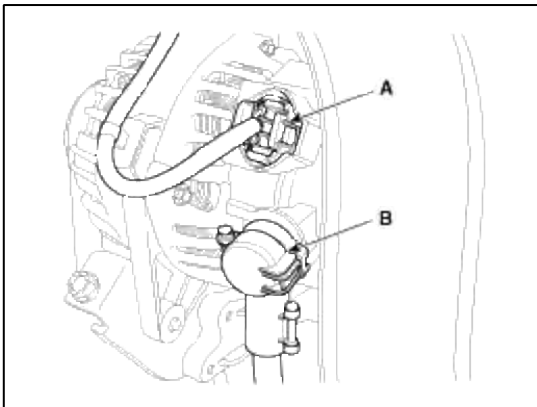
- (1) Loosen the alternator mounting bolts (A).
- (2) Loosen the tension by turning the tension adjusting bolt (B) counterclockwise.
- (3) Remove the drive belt (C).



3. Disconnect the alternator connector (A) and the cable (B) from alternator "B" terminal.

Tightening torque:

9.8 ~ 14.7 N.m (1.0 ~ 1.5 kgf.m, 7.2 ~ 10.8 lb-ft)



4. Pull out the through bolt and then remove the alternator (A).

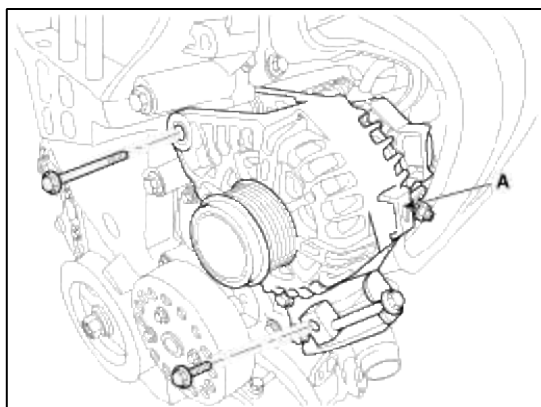
Tightening torque

M10 bolt:

29.4 ~ 41.2 N.m (3.0 ~ 4.2 kgf.m, 21.7 ~ 30.4 lb-ft)

M8 bolt:

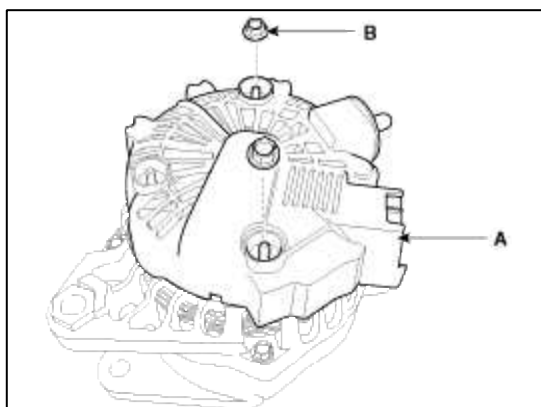
21.6 ~ 32.4 N.m (2.2 ~ 3.3 kgf.m, 15.9 ~ 23.9 lb-ft)



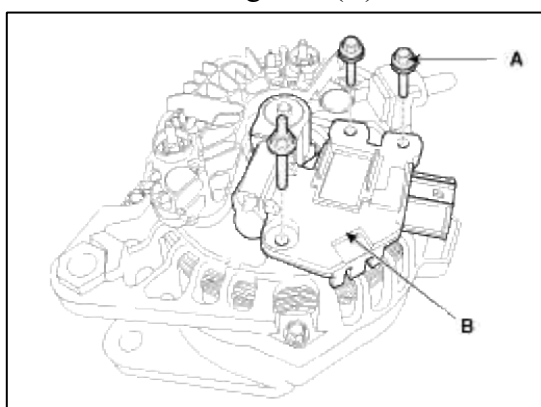
5. Installation is the reverse order of removal.

Disassembly

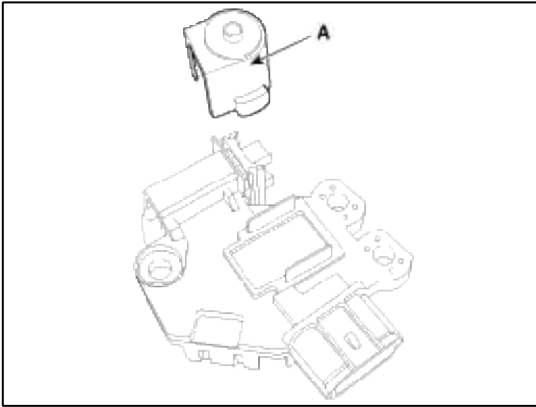
1. Loosen the nuts (B) and then remove the cover (A).



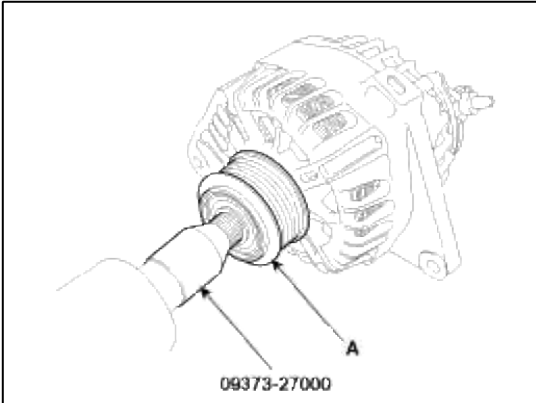
2. Loosen the mounting bolts (A) and remove the regulator assembly (B).



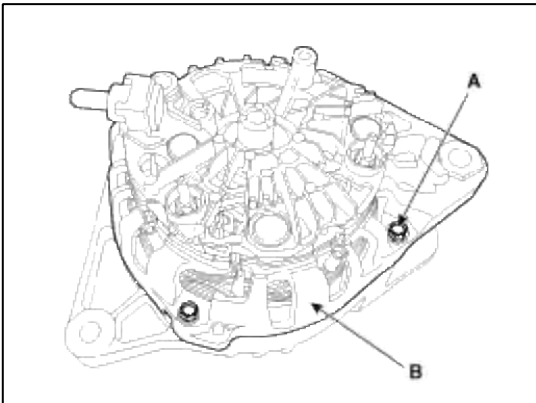
3. Remove the slip ring guide (A).



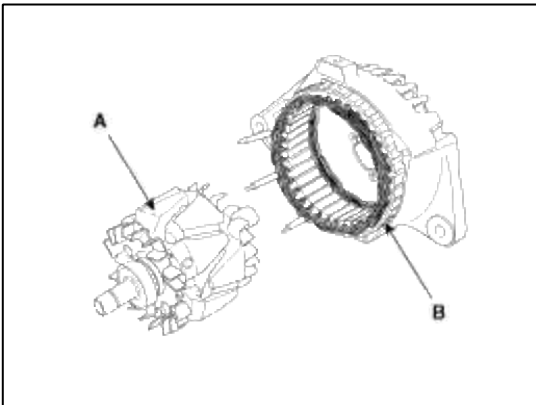
4. Using the SST (09373-27000), remove the pulley (A).



5. Loosen the 4 bolts (A) and then remove the rear housing (B).



6. Disconnect the rotor (A) and the housing (B).



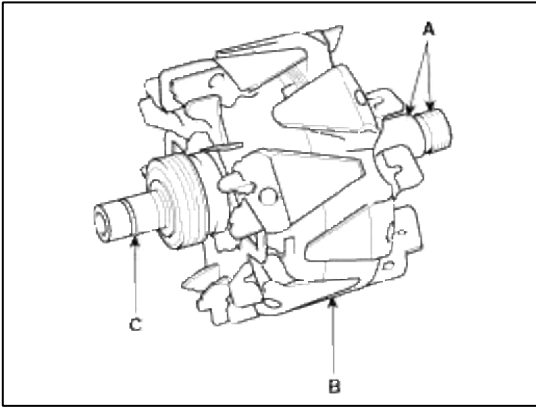
7. Reassembly is the reverse order of disassembly.

Inspection

Inspect Rotor

1. Check that there is continuity between the slip rings (C).

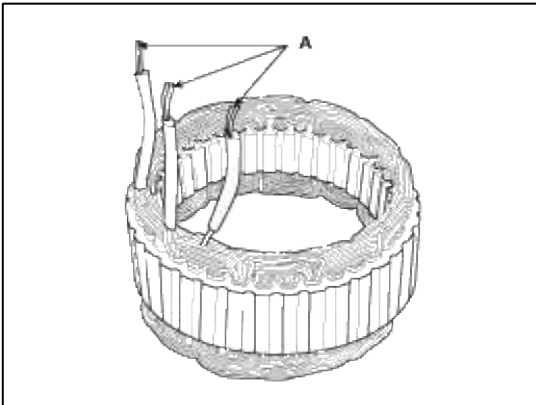
2. Check that there is no continuity between the slip rings and the rotor (B) or rotor shaft (A).



3. If the rotor fails either continuity check, replace the alternator.

Inspect Stator

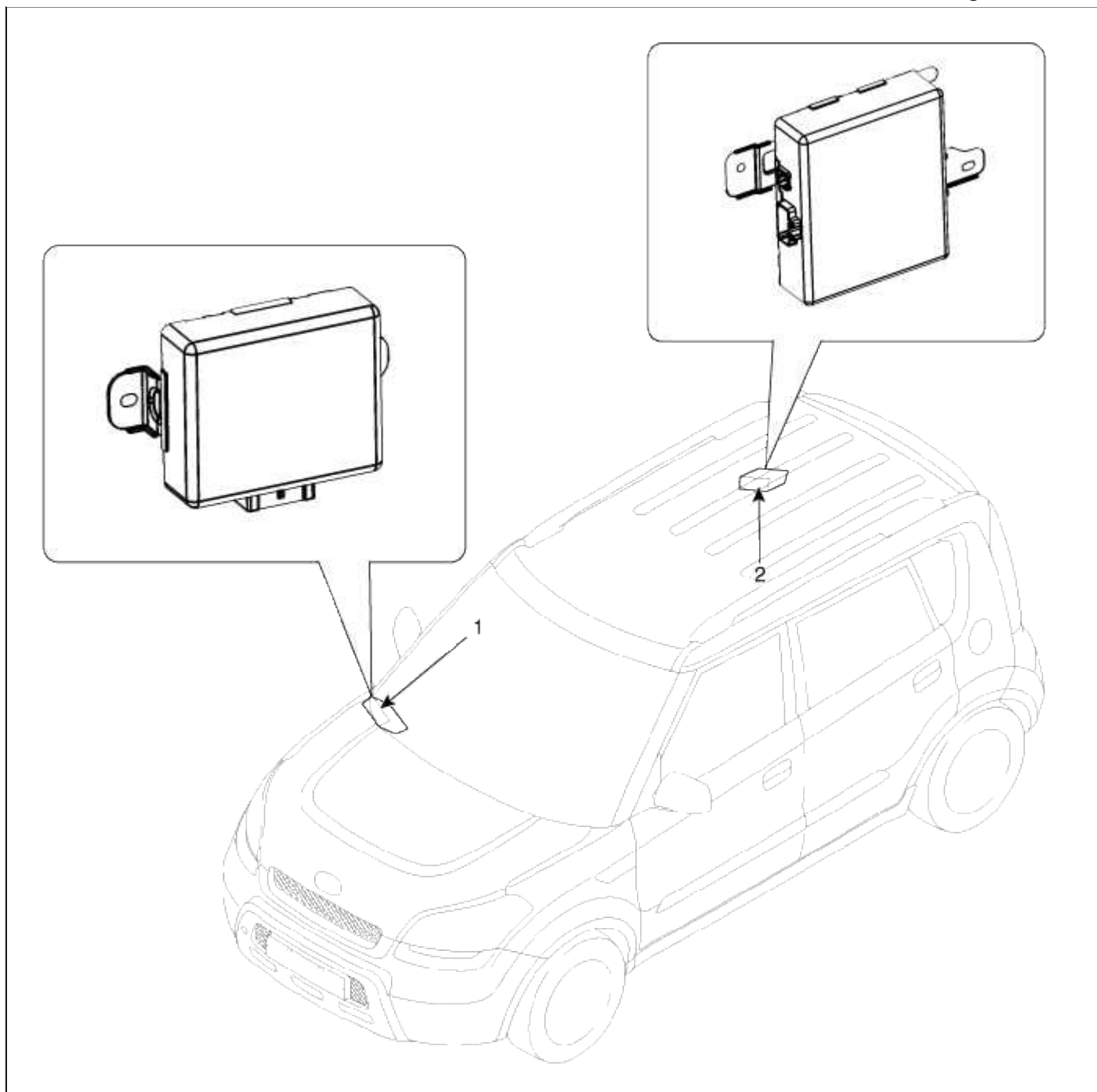
1. Check that there is continuity between each pair of leads (A).



2. Check that there is no continuity between each lead and the coil core.
3. If the coil fails either continuity check, replace the alternator.

Engine Electrical System > Charging System > DC DC converter > Components and Components Location

Component Location

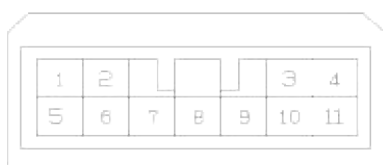
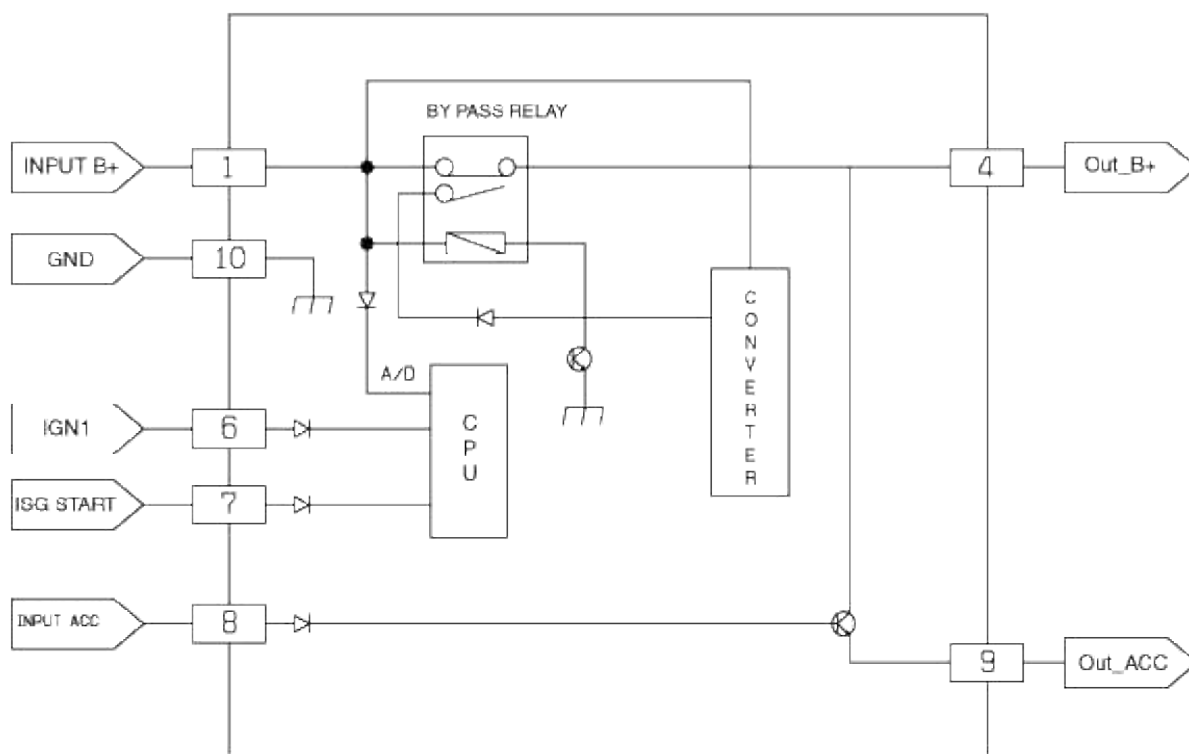


1. DC/DC converter (200W)
2. DC/DC converter (400W)

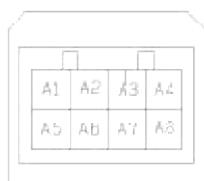
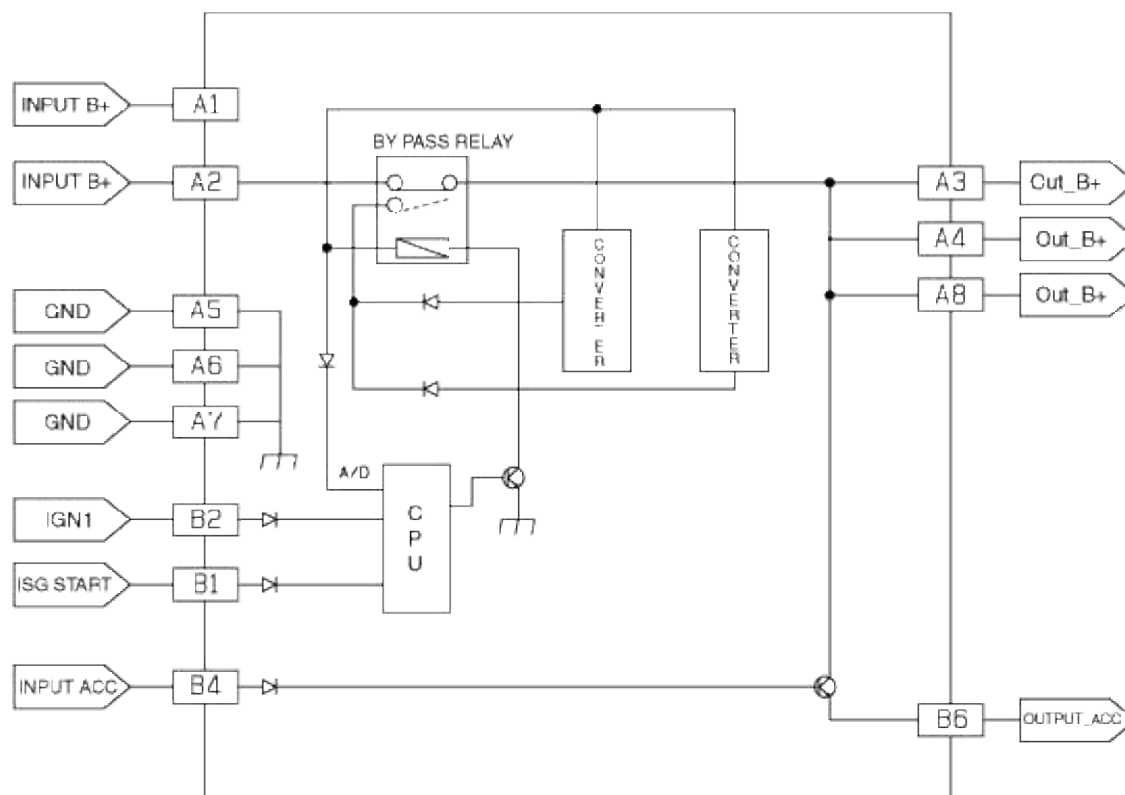
Engine Electrical System > Charging System > DC DC converter > Schematic Diagrams

Circuit Diagram

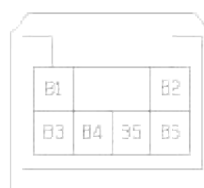
[200W]



PIN NO.	DESCRIPTION
1	INPUT B+
2	-
3	-
4	OUTPUT B+
5	-
6	IGN1
7	ISG START
8	INPUT_ACC
9	OUTPUT_ACC
10	GND
11	-



PIN NO.	DESCRIPTION
A1	INPUT B+
A2	INPUT B+
A3	OUTPUT B+
A4	OUTPUT B+
A5	GND
A6	GND
A7	GND
A8	OUTPUT B+



PIN NO.	DESCRIPTION
B1	ISG START
B2	IGN1
B3	NC
B4	INPUT ACC
B5	NC
B6	OUTPUT_ACC

NOTE

In case of IGN 2 with connecting battery, input the signal 'ISG Start' then BY PASS RELAY will be ON, after boosting voltage ($12\pm0.6V$) of low battery, if the battery voltage is over $12\pm0.5V$ then BY PASS RELAY will be OFF.

In the ISG mode, if the power of an audio system turns OFF by drawdown while "Auto Starting" or "Idle Starting" function operates, replace the DC/DC converter.

Engine Electrical System > Charging System > DC DC converter > Repair procedures

Replacement

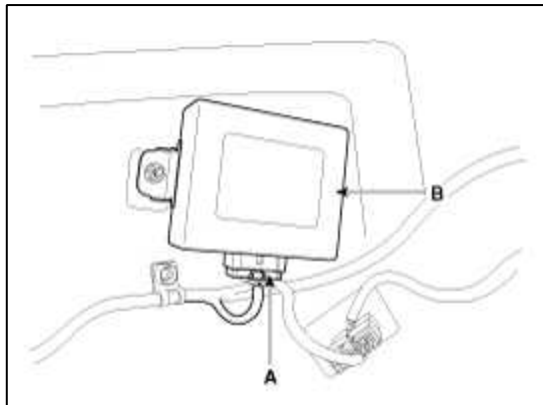
[200W]

1. Disconnect the battery negative terminal.

Tightening torque :

4.0 ~ 6.0N.m (0.4 ~ 0.6kgf.m, 3.0 ~ 4.4lb-ft)

2. Remove the glove box housing. (Refer to BD group – “Crash Pad”)
3. Disconnect the DC/DC converter connector (A) and then remove the DC/DC converter (B).



4. Installation is reverse order of removal.

NOTE

After disconnecting then reconnecting the battery negative cable, the ISG function dose not operates until the system is stabilized, about 4 hours.

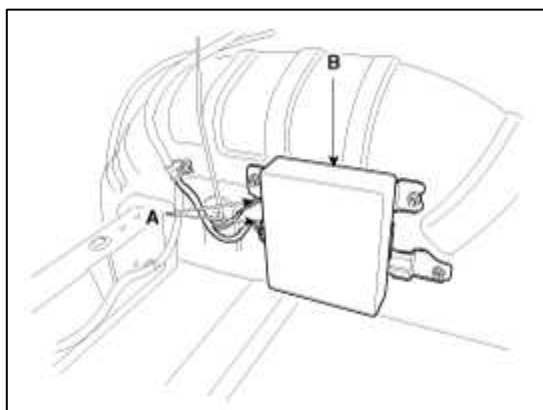
[400W]

1. Disconnect the battery negative terminal.

Tightening torque :

4.0 ~ 6.0N.m (0.4 ~ 0.6kgf.m, 3.0 ~ 4.4lb-ft)

2. Remove the rear seat. (Refer to BD group – “Rear Seat”)
3. Remove the RH luggage side trim. (Refer to BD group – “Interior Trim”)
4. Disconnect the DC/DC converter connector (A) and then remove the DC/DC converter (B).



5. Installation is reverse order of removal.

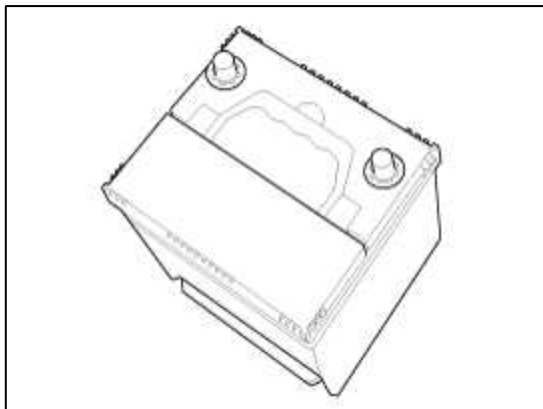
NOTE

After disconnecting then reconnecting the battery negative cable, the ISG function dose not operates until the system is stabilized, about 4 hours.

Engine Electrical System > Charging System > Battery > Description and Operation

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.



NOTE

After disconnecting then reconnecting the battery negative cable, reset some parts that require the reset procedures. (Refer to BE group - "General Information")

[ISG Type]

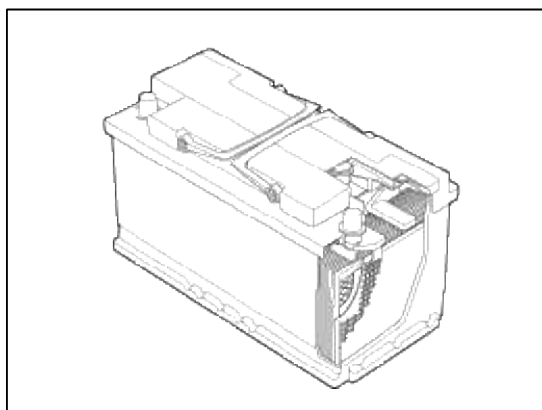
AGM battery is used for especially heavy load on the vehicle network depending on equipment and requirements. AGM stands for Absorbent Glass Material Battery; that is absorbent glass fibre fleece. AGM batteries are fitted in models with electrical loads/consumers which have a high energy demand.

The constantly increasing energy demand of modern vehicle electrical systems calls for ever more powerful battery solutions.

The power consumption is considerable even when the vehicle is parked.

The somewhat higher price compared with a battery of similar size is fully balanced by the following benefits:

- Significantly longer service life
- Increased starting reliability at low temperatures
- 100 % freedom from maintenance
- Low risk in event of an accident (reduced risk to the environment)



Recharging [ISG Type]

Check the battery condition

The battery condition cannot be determined solely on the basis of the battery charge state. If there is a suspicion of a damaged battery, check the battery condition with a battery tester and investigate the cause by means of the test

module. With a low battery charge state, recharge the battery.

Recharging the AGM battery

The battery may be charged using the battery chargers at a constant charge voltage of 14.8V.

If possible, the battery temperature during charging should be between 20°C and 30°C.

Only chargers with voltage clamping (IU or WU curve) may be used or chargers with IUoU curve which have a trickle.

IU or WU charging technique

Optimized charging voltage for IU or WU: 14.7V (at 20°C ~ 30°C) about 24 hours

Min. charging voltage at 20°C: 14.4V

Max. charging voltage at 20°C: 14.8V

10% of capacity is recommended as charging current (e.g. 60Ah : 10 = 6,0A charging current).

WARNING

Do not charge the AGM battery with >15.2V. No quick-charging routines.

CAUTION

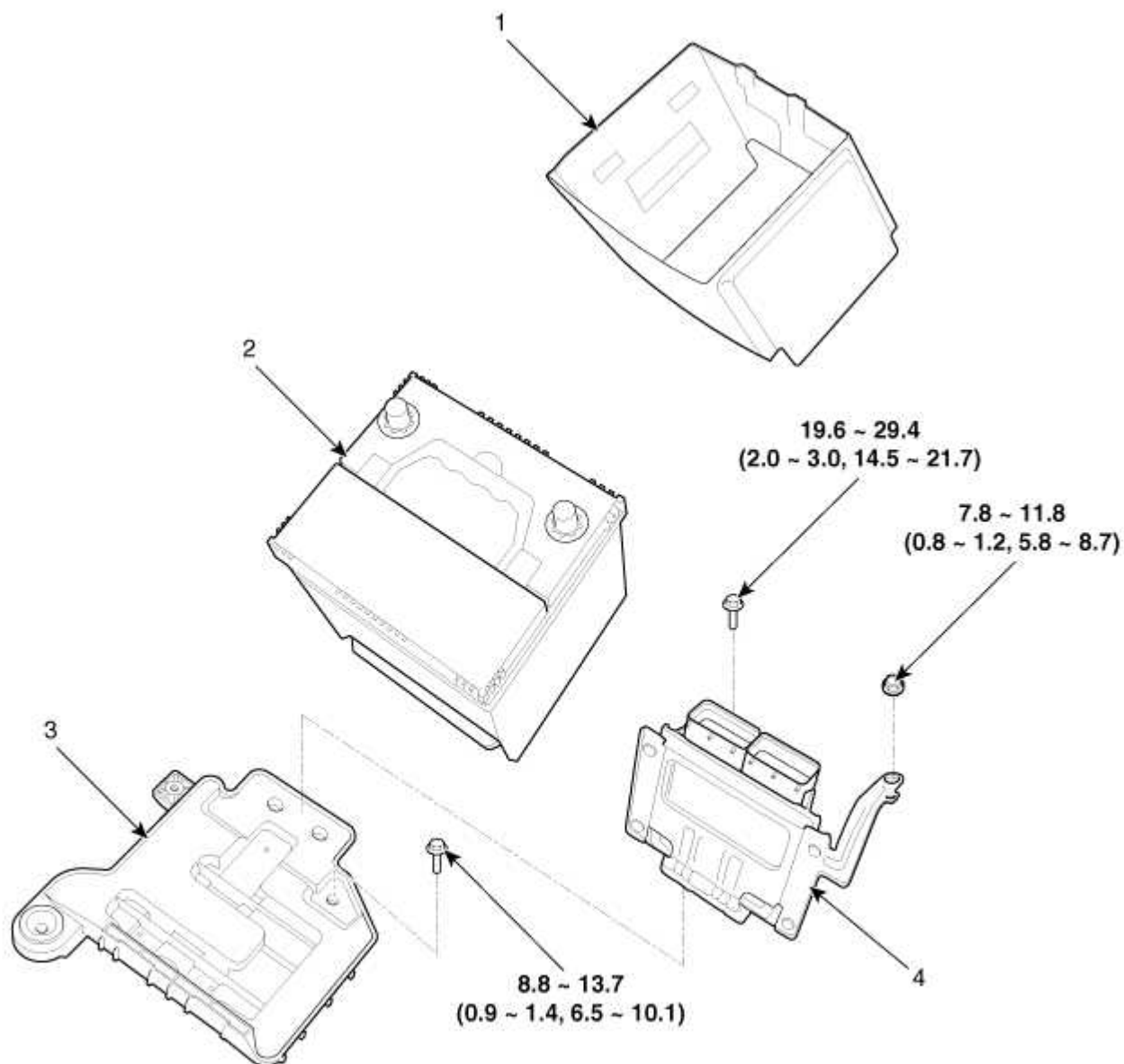
If the battery is charged directly at the battery terminals on vehicles with battery sensor, misinterpretations of battery condition and under certain circumstances also unwanted Check Control messages or fault memory entire can occur.

If the battery is charged directly at the battery (+),(-) terminals on vehicles with battery sensor, the battery sensor should be re-installed and then, battery sensor recalibration procedure should be performed.

Engine Electrical System > Charging System > Battery > Components and Components Location

Components

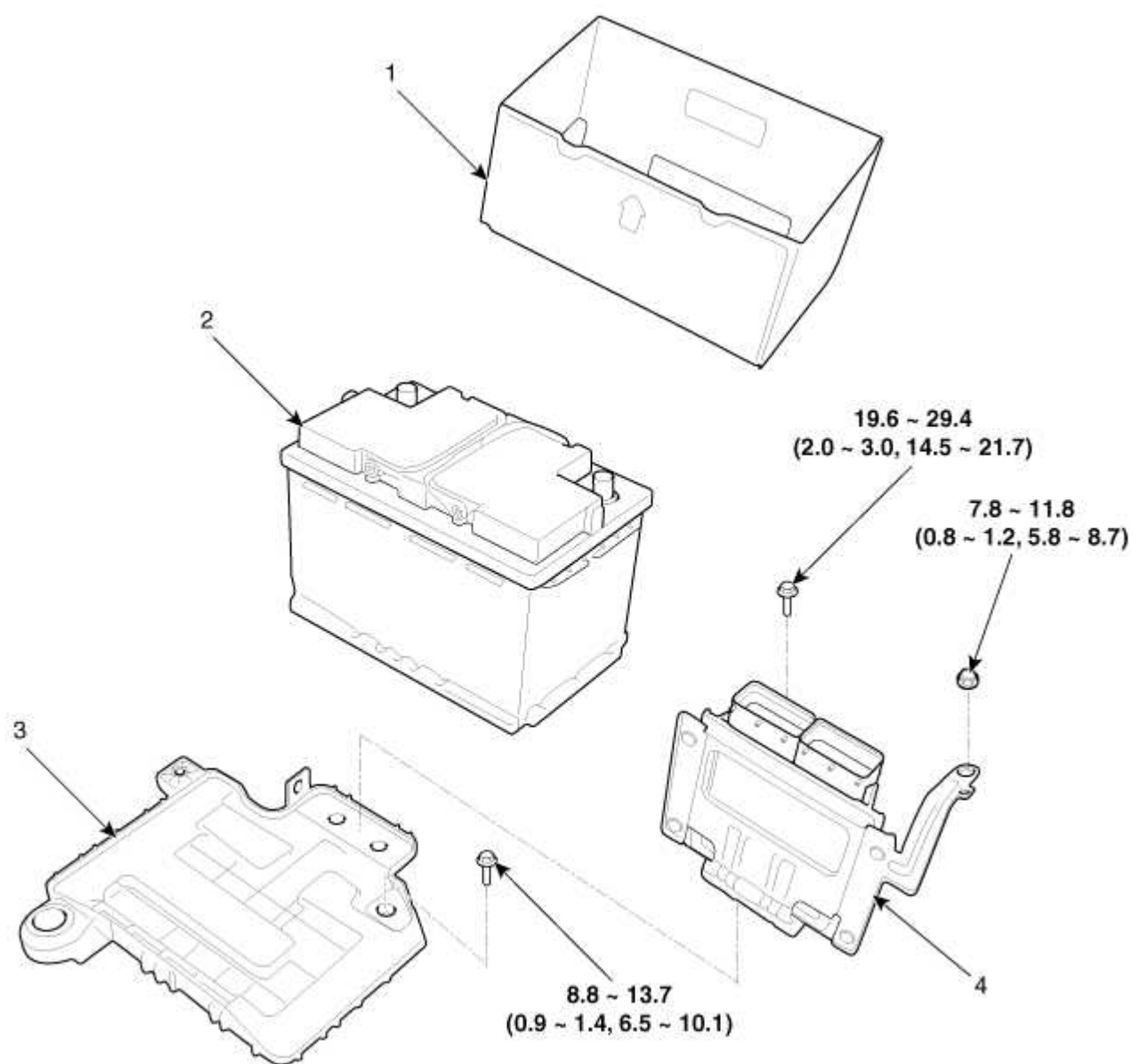
[Non-ISG Type]



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

1. Battery insulation pad	3. Battery tray
2. Battery	4. ECM & bracket assembly

[ISG Type]



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

1. Battery insulation pad	3. Battery tray
2. Battery	4. ECM & bracket assembly

Engine Electrical System > Charging System > Battery > Repair procedures

Removal and Installation

1. Disconnect the battery terminals (A). The negative terminal first.

Tightening torque

(+) terminal:

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

(-) terminal:

3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 3.0 ~ 4.4 lb-ft)

2. Remove the air cleaner assembly.

- (1) Remove the air duct (B).
- (2) Disconnect the breather hose (C).
- (3) Disconnect the air intake hose and then remove the air cleaner assembly (D).

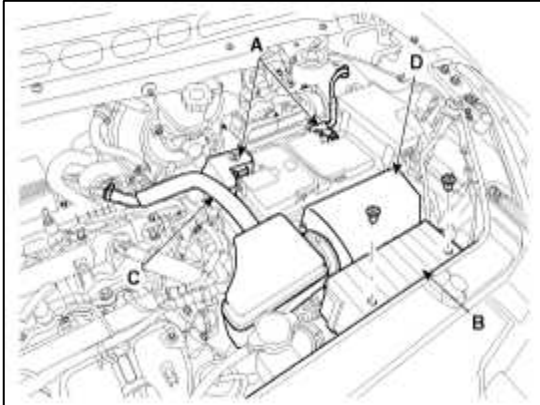
Tightening torque

Hose clamp bolt:

2.9 ~ 4.9 N.m (0.3 ~ 0.5 kgf.m, 2.2 ~ 3.6 lb-ft)

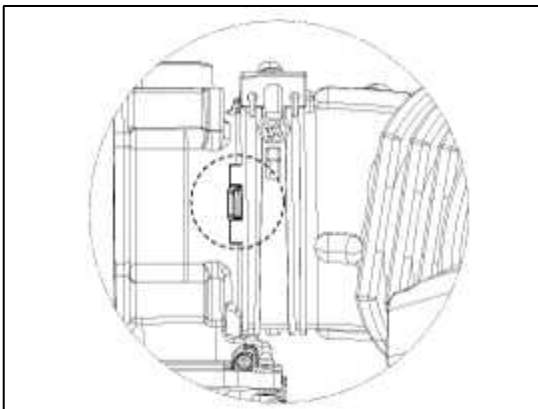
Air cleaner assembly bolts:

3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft)

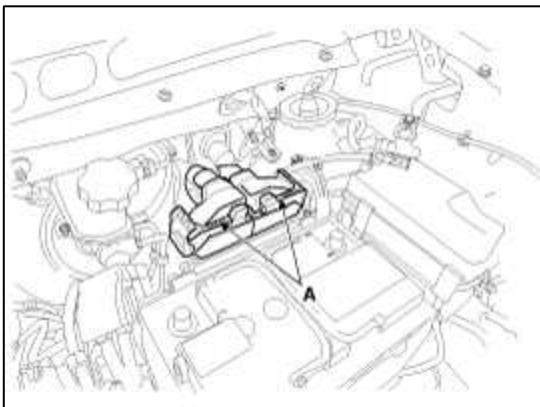


NOTE

Install the air intake hose while the center of the mark of hose must be in line with the throttle body rib.



3. Disconnect the ECM connectors (A).

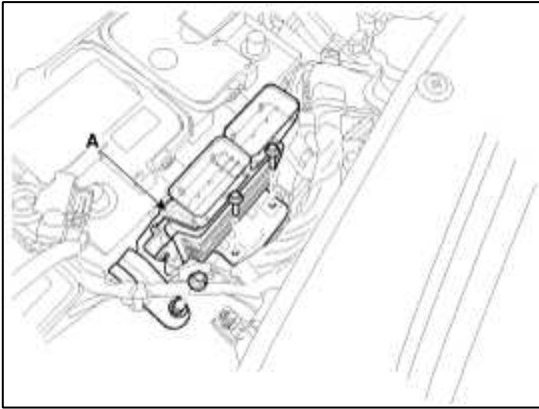


4. Remove the ECM & bracket (A).

Tightening torque

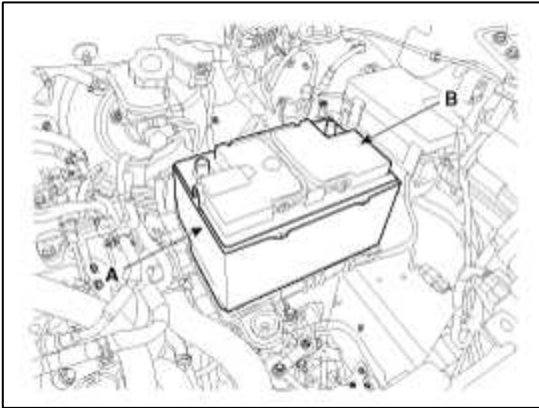
Bolts :19.6 ~ 29.4N.m (2.0 ~ 3.0kgf.m, 14.5 ~ 21.7lb-ft)

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



5. Remove the battery insulation pad (A).

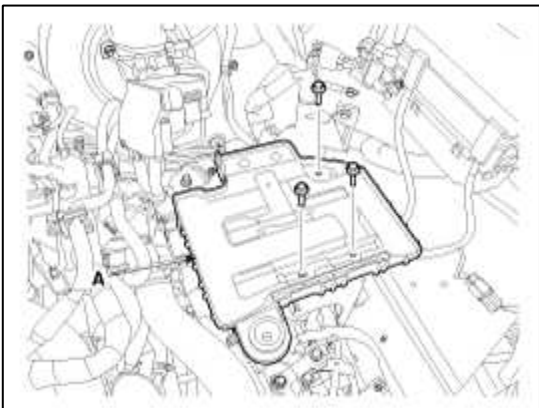
6. Remove the battery (B).



7. Remove the battery tray (A).

Tightening torque:

8.8 ~ 13.7N.m (0.9 ~ 1.4kgf.m, 6.5 ~ 10.1lb-ft)



8. Installation is the reverse order of removal.

CAUTION

When installing the battery, fix the ECM & bracket on the tray correctly.

CAUTION

- ISG (Idle stop & go) system equipped vehicle always use the AGM battery only. If flooded battery has installed, this can potentially lead to engine electrical trouble or ISG system error.
- Replace same capacity of the AGM battery.

NOTE

Ensure the AGM battery is placed correctly on the battery tray.

In all cases, an AGM battery must be installed and the battery sensor calibrated for the ISG system to function.

After the battery has been changed or disconnected, the battery sensor must be recalibrated.

After connecting the battery, start the engine at least once.

Then park the car for at least 4 hours with the ignition off in the ignition switch OFF door closed, hood switch off state.

After the 4 hours, the engine should be started two times.

At this time the battery sensor will be recalibrated. (Refer to "Battery sensor recalibration procedure" in FL group)

But first 25 times, the ISG function can operates regardless of ISG system stability for ISG function operating check.

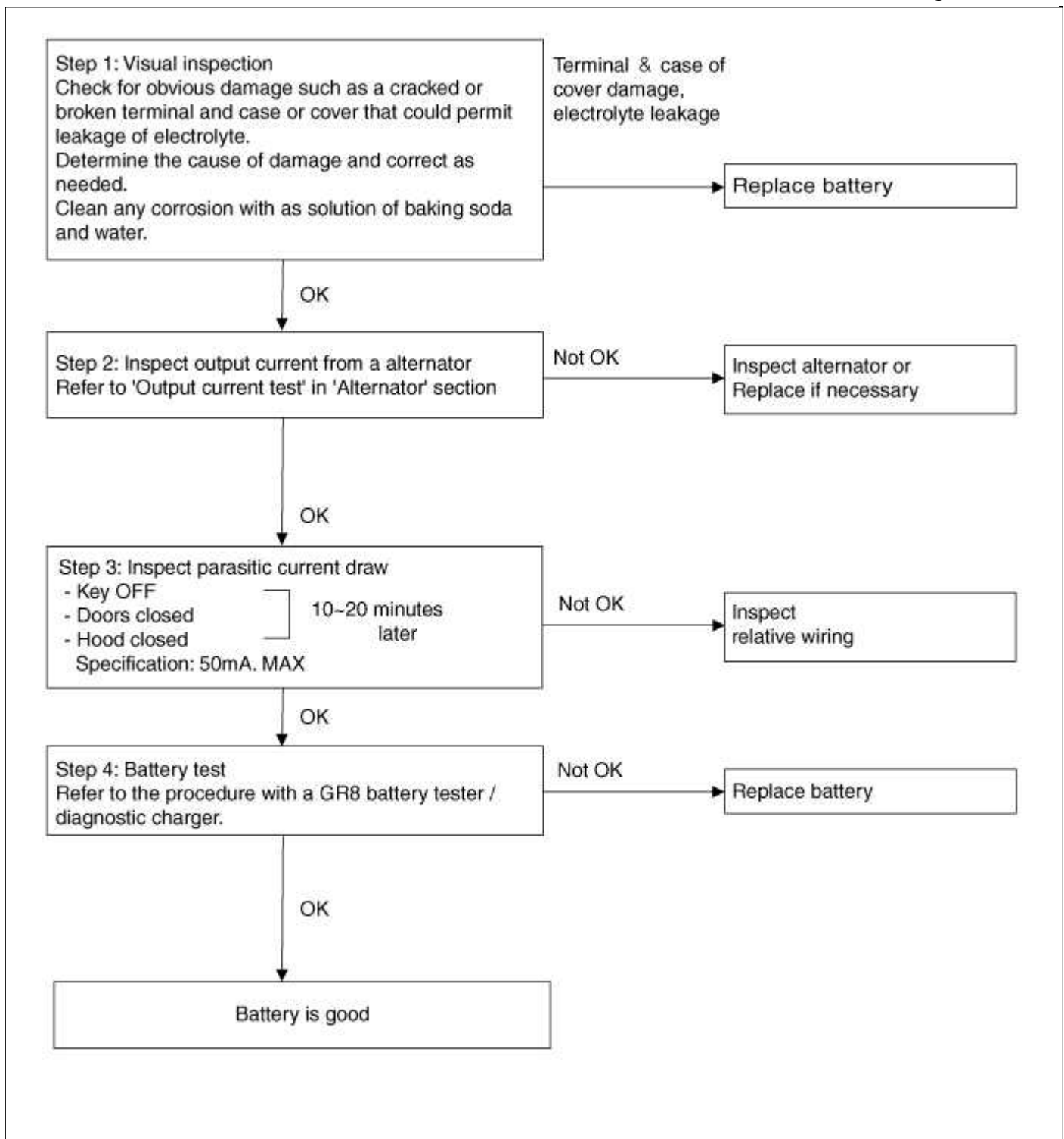
WARNING

Do not open the AGM battery.

The AGM battery must not be opened under any circumstances as the introduction of oxygen from the air will cause the battery to lose its chemical equilibrium and rendered non-operational.

Inspection

Battery Diagnostic Flow



Vehicle parasitic current inspection

1. Turn all the electric devices OFF, and then turn the ignition switch OFF.
2. Close all doors except the engine hood, and then lock all doors.
 - (1) Disconnect the hood switch connector.
 - (2) Close the trunk lid.
 - (3) Close the doors or remove the door switches.

3. Wait a few minutes until the vehicle's electrical systems go to sleep mode.

NOTE

For an accurate measurement of a vehicle parasitic current, all electrical systems should go to sleep mode. (It takes at least one hour or at most one day.) However, an approximate vehicle parasitic current can be measured after 10~20 minutes.

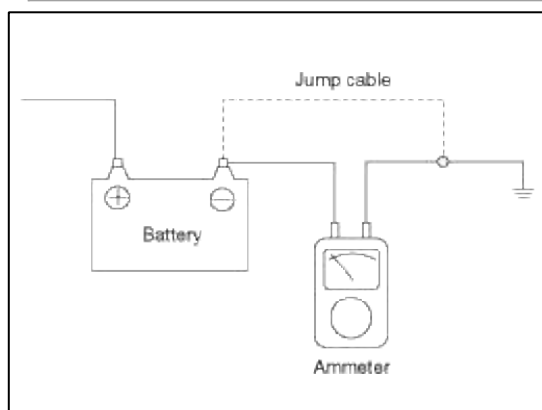
4. Connect an ammeter in series between the battery (-) terminal and the ground cable, and then disconnect the clamp from the battery (-) terminal slowly.

CAUTION

Be careful that the lead wires of an ammeter do not come off from the battery (-) terminal and the ground cable to prevent the battery from being reset. In case the battery is reset, connect the battery cable again, and then start the engine or turn the ignition switch ON for more than 10 sec. Repeat the procedure from No. 1.

To prevent the battery from being reset during the inspection,

- 1) Connect a jump cable between the battery (-) terminal and the ground cable.
- 2) Disconnect the ground cable from the battery (-) terminal.
- 3) Connect an ammeter between the battery (-) terminal and the ground cable.
- 4) After disconnecting the jump cable, read the current value of the ammeter.



5. Read the current value of the ammeter.

- A. If the parasitic current is over the limit value, search for abnormal circuit by removing a fuse one by one and checking the parasitic current.
- B. Reconnect the suspected parasitic current draw circuit fuse only and search for suspected unit by removing a component connected with the circuit one by one until the parasitic draw drops below limit value.

Limit value (after 10~20 min.): Below 50 mA

Cleaning

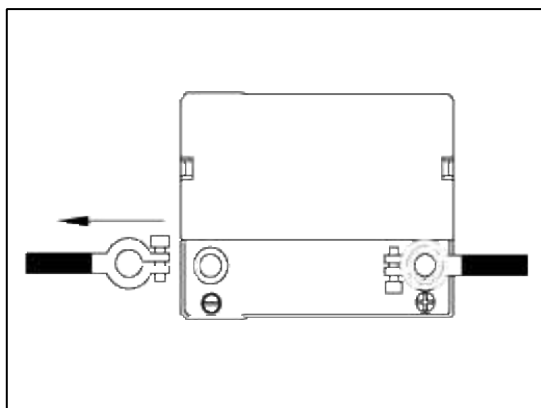
1. Make sure the ignition switch and all accessories are in the OFF position.
2. Disconnect the battery cables (negative first).

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 tray for damage caused by the loss of electrolyte. If acid damage is present, it will be necessary to clean the area with a solution of clean warm water and baking soda. Scrub the area with a stiff brush and wipe off with a cloth moistened with baking soda and water.
5. Clean the top of the battery with the same solution as described above.
6. Inspect the battery case and cover for cracks. If cracks are present, the battery must be replaced.
7. Clean the battery posts with a suitable battery post tool.
8. Clean the inside surface of the terminal clamps with a suitable battery cleaning tool. Replace damaged or frayed cables and broken terminal clamps.
9. Install the battery in the vehicle.
10. Connect the cable terminals to the battery post, making sure tops of the terminals are flush with the tops of the posts.
11. Tighten the terminal nuts securely.
12. Coat all connections with light mineral grease after tightening.

CAUTION

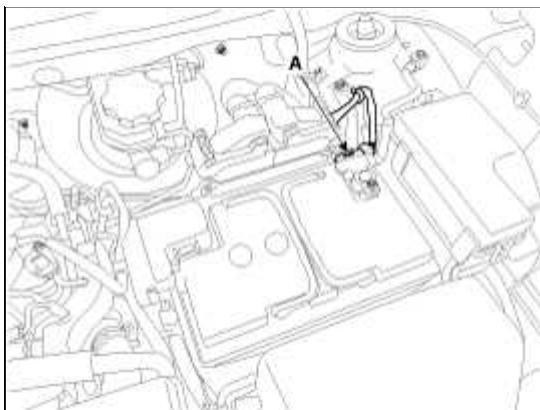
When batteries are being charged, an explosive gas forms beneath the cover of each cell. Do not smoke near batteries being charged or which have recently been charged. Do not break live circuit at the terminals of batteries being charged.

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

Engine Electrical System > Charging System > Battery Sensor > Description and Operation

Description

Vehicles have many control units that use more electricity. These units control their own system based on information from diverse sensors. It is important to have a stable power supply as there diverse sensors giving a variety of information. Battery sensor (A) is mounted on battery (-) terminal. It transmits battery voltage, current, temperature information to ECM. ECM controls generating voltage by duty cycle based on these signals.

**CAUTION**

When battery sensor signal fault occurs, inspect the vehicle parasitic draw in advance after inspecting the sensor because the sensor will behave abnormally when the parasitic draw is more than 100mA. (Refer to vehicle parasitic current inspection)

NOTE

It takes a few hours for a new battery sensor to detect the battery state correctly. Perform the following process after replacing the battery sensor. (Refer to "Battery sensor recalibration procedure" in FL group)

1. Ignition switch ON/OFF.
2. Park the vehicle about 4 hours.
3. After 4 hours later, check that the SOC (State of charge) of battery is displayed on GDS properly.
4. After engine start ON/OFF 2 times or more, check the SOF (State of function) of battery using GDS.

CAUTION

For the vehicle equipped with a battery sensor, be careful not to damage the battery sensor when the battery is replaced or recharged.

- When replacing the battery, it should be same one (type, capacity and brand) that is originally installed on your vehicle. If a battery of a different type is replaced, the battery sensor may recognize the battery to be abnormal.
- When installing the ground cable on the negative post of battery, tighten the clamp with specified torque of 3.9~5.9N.m (0.4~0.6kgf.m, 3.0~4.4lb-ft). An excessive tightening torque can damage the PCB internal circuit of battery sensor or the negative post of battery.
- When recharging the battery, ground the negative terminal of the booster battery to the vehicle body.

Engine Electrical System > Starting System > Description and Operation

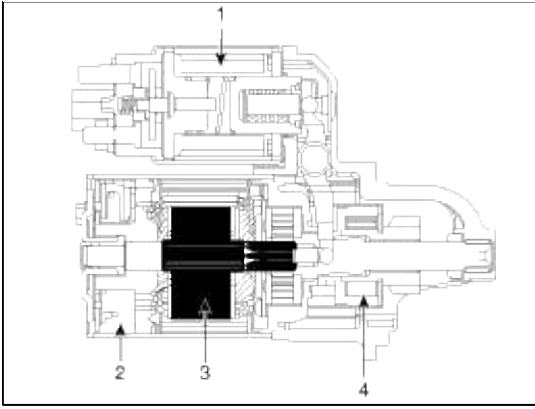
Description

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

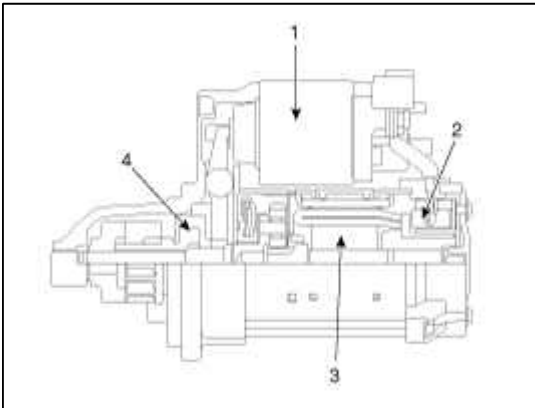
When the ignition key is turned to the start position, current flows and energizes the starter motor's solenoid coil. The solenoid plunger and clutch shift lever are activated, and the clutch pinion engages the ring gear.

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

[Non-ISG Type]



[ISG Type]



1. Solenoid
2. Brush
3. Armature
4. Overrun clutch

[ISG Type]

In conjunction with the ISG function, the starter motor must do a great deal more work. The starter motor is therefore configured for a significantly higher number of start cycles. The components of the starter motor have been adapted to the higher requirements.

NOTE

There are two kinds of starter, ISG type starter and the other.
When replace the starter, confirm that the part number and connector shape.

CAUTION

ISG (Idle stop & go) system equipped vehicle always use the ISG type starter only. If the other starter has installed, this can potentially lead to engine electrical trouble or ISG system error.

WARNING

Do not disassemble the ISG type starter.
If the starter troubles occur, replace the starter.

Engine Electrical System > Starting System > Repair procedures

Troubleshooting Starter Circuit

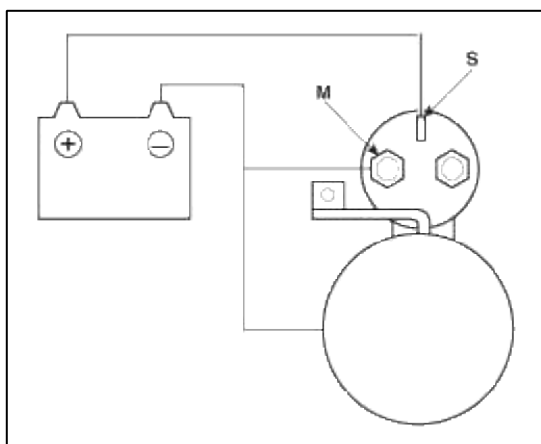
NOTE

The battery must be in good condition and fully charged.

1. Disconnect the injector connectors.
2. 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.
3. 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 the engine normally, 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.
4. 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.
5. 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 ignition system in BE Group).
 - C. Check the transaxle range switch connector or ignition lock switch connector.
 - D. Inspect the starter relay.

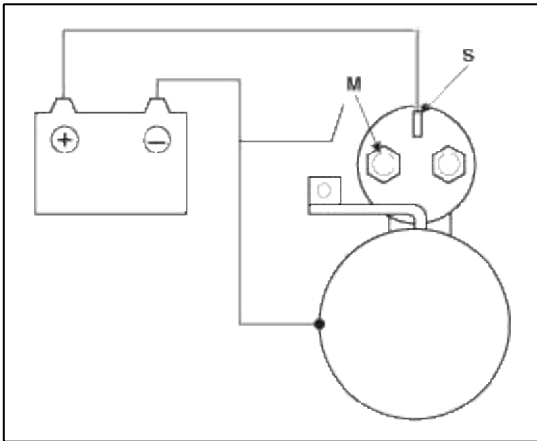
Starter Solenoid Test

1. Disconnect the field coil wire from the M-terminal of solenoid switch.
2. Connect the battery as shown. If the starter pinion pops out (engages), it is working properly. To avoid damaging the starter, do not leave the battery connected for more than 10 seconds.

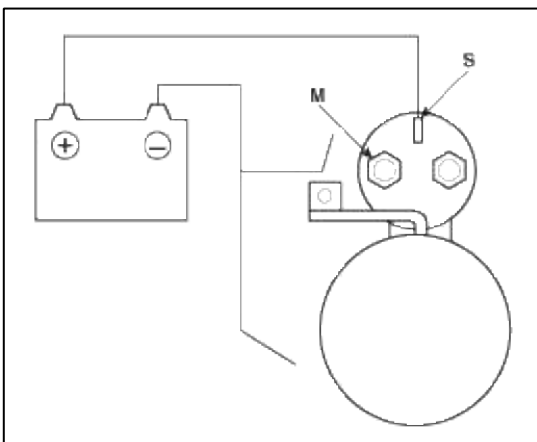


3. Disconnect the battery from the M terminal.

If the pinion does not retract, the hold-in coil is working properly. To avoid damaging the starter, do not leave the battery connected for more than 10 seconds.

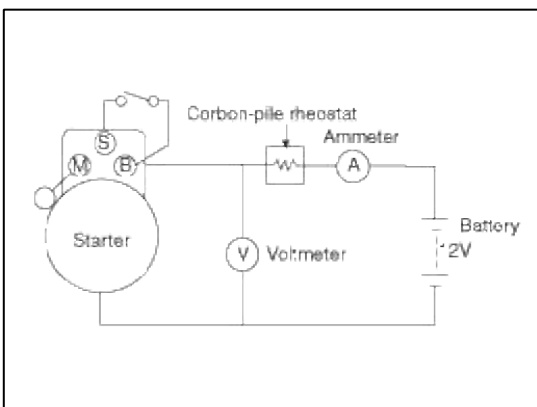


4. Disconnect the battery also from the body. If the pinion retracts immediately, it is working properly. To avoid damaging the starter, do not leave the battery connected for more than 10 seconds.



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 (150-ampere scale) and carbon pile rheostats as shown in 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 11.5 volts.
7. Confirm that the maximum amperage is within the specifications and that the starter motor turns smoothly and freely.

Max. Current

Non-ISG : 60A

ISG : 100A

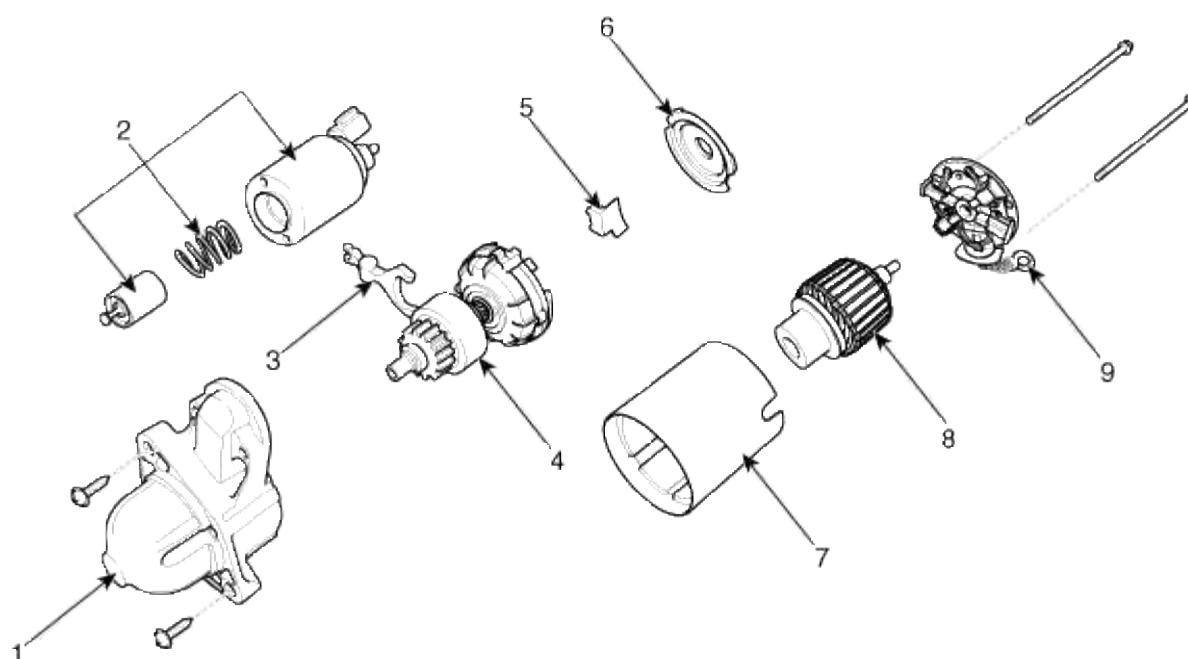
Min. Speed

Non-ISG : 2,400 rpm

ISG : 1,915 rpm

Engine Electrical System > Starting System > Starter > Components and Components Location

Components



1. Front bracket assembly
2. Magnet switch
assembly
3. Lever
4. Reducer assembly
5. Lever stop

6. Gasket sheet
7. Yoke assembly
8. Armature assembly
9. Brush holder assembly

Engine Electrical System > Starting System > Starter > Repair procedures**Removal and Installation**

1. Disconnect the battery negative cable.

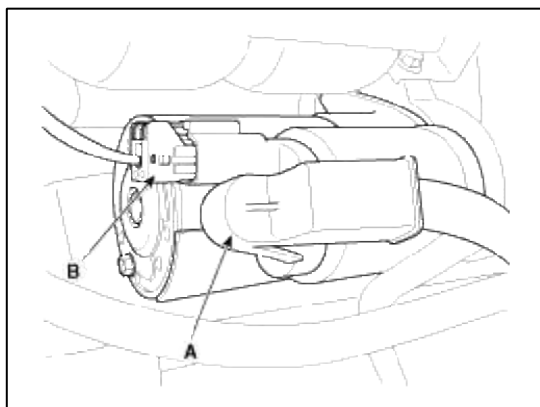
Tightening torque:

3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 3.0 ~ 4.4 lb-ft)

2. Remove the air duct and air cleaner assembly. (Refer to EM group - "Engine and transaxle assembly")
3. Disconnect the starter cable (A) from the B - terminal on the solenoid and the connector (B) from the S terminal.

Tightening torque:

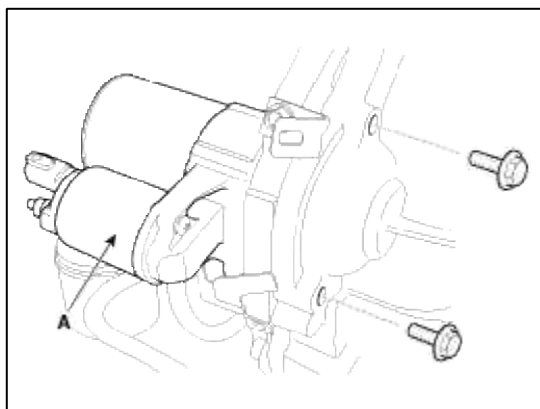
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



4. Remove the starter (A).

Tightening torque:

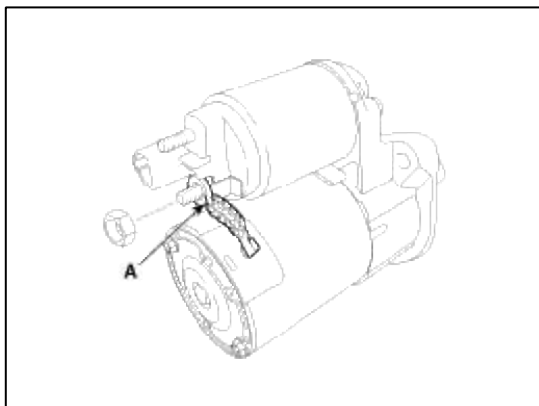
42.2 ~ 53.9 N.m (4.3 ~ 5.5 kgf.m, 31.1 ~ 39.8 lb-ft)



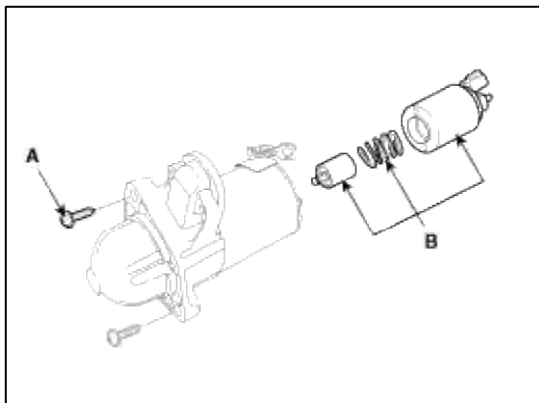
5. Installation is the reverse of removal.

Disassembly

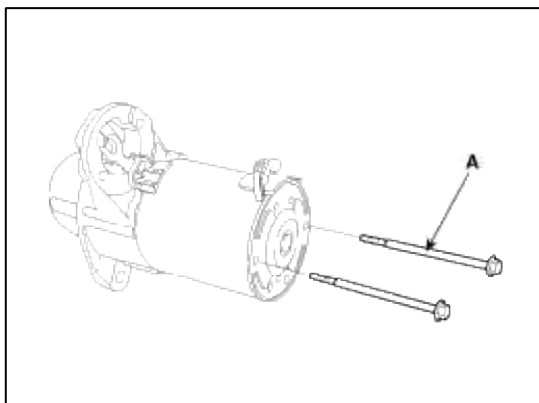
1. Disconnect the M-terminal (A) on the magnet switch assembly.



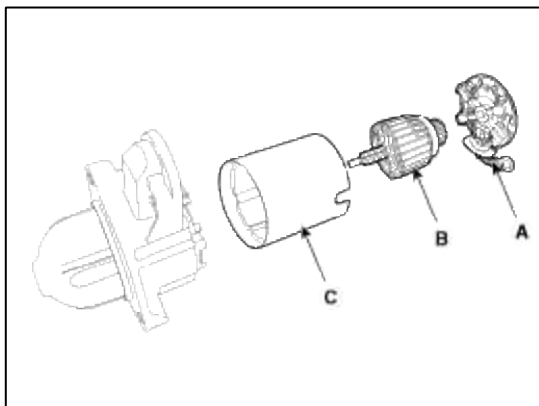
2. After loosening the screws (A), detach the magnet switch assembly (B).



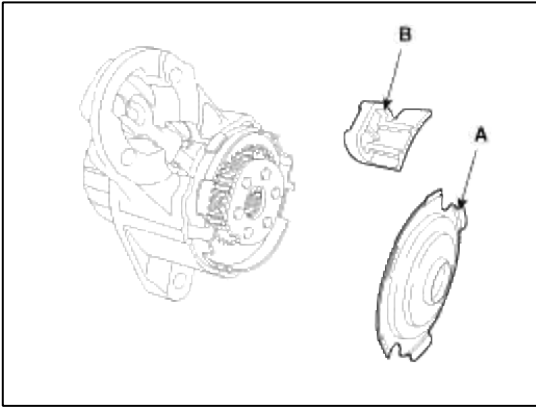
3. Loosen the through bolts (A).



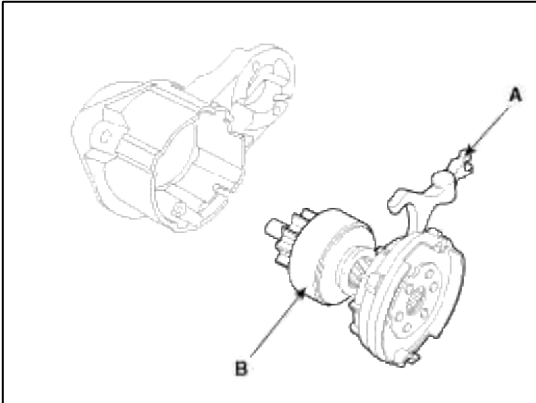
4. Remove the brush holder assembly (A), armature assembly (B) and yoke assembly (C).



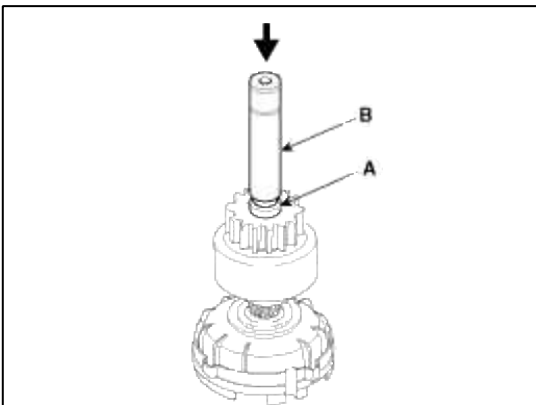
5. Remove the gasket sheet (A) and lever stop (B).



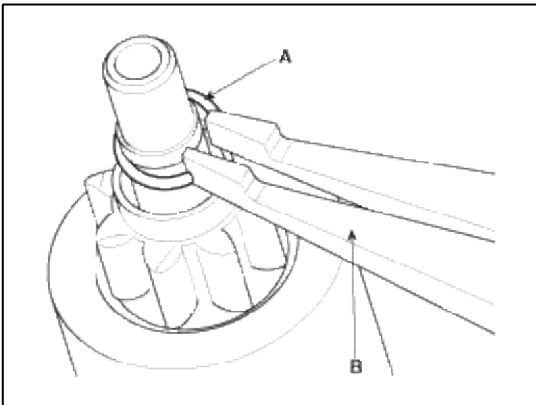
6. Remove the reducer assembly (A) and lever (B).



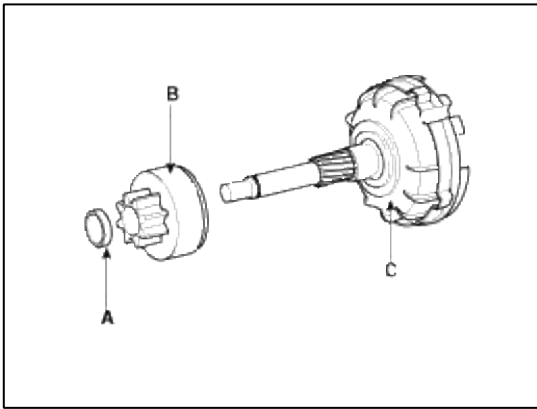
7. Press the stopper (A) using a socket (B).



8. After removing the stop ring (A) using stop ring pliers (B).

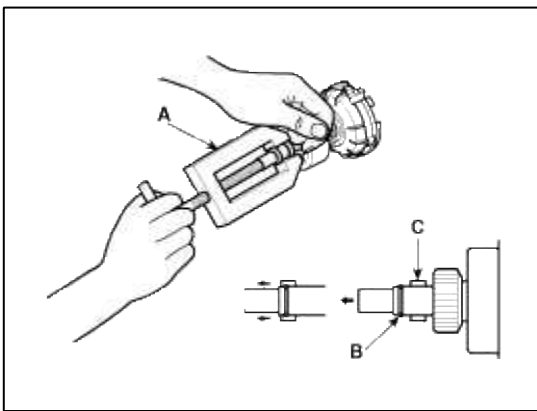


9. Disconnect the stopper (A), overrunning clutch (B) and internal gear (C).



NOTE

Using a suitable pulling tool (A), pull the overrunning clutch stopper (C) over the stop ring (B).

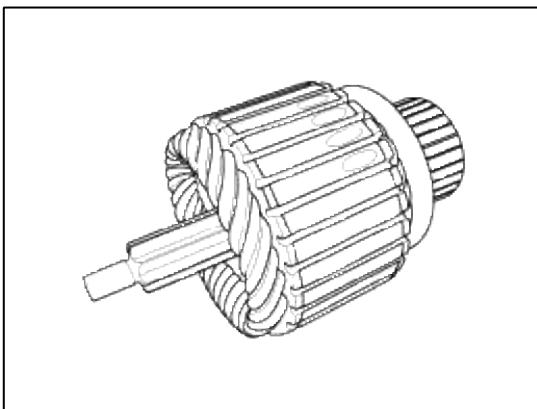


10. Reassembly is the reverse of disassembly.

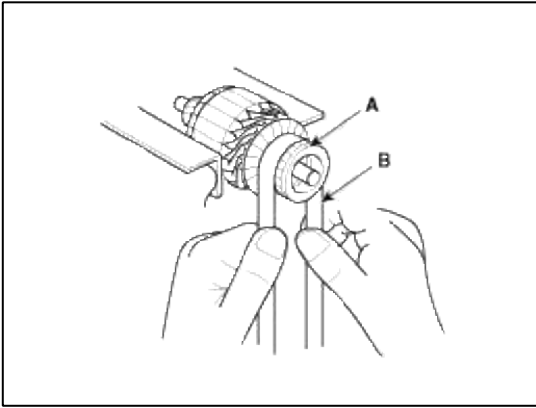
Inspection

Armature Inspection And Test

1. Remove the starter.
2. Disassemble the starter as shown at the beginning of this procedure.
3. Inspect the armature for wear or damage from contact with the permanent magnet. If there is wear or damage, replace the armature.



4. Check the commutator (A) surface. If the surface is dirty or burnt, resurface with emery cloth or a lathe within the following specifications, or recondition with #500 or #600 sandpaper (B).

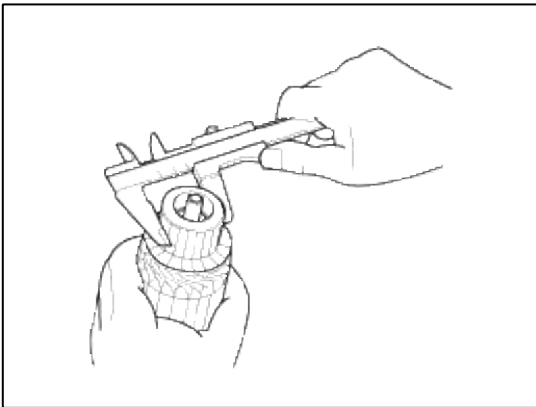


5. Check the commutator diameter. If the diameter is below the service limit, replace the armature.

Commutator diameter

Standard (New): 27.0 mm (1.06 in.)

Service limit: 26.0 mm (1.02 in.)



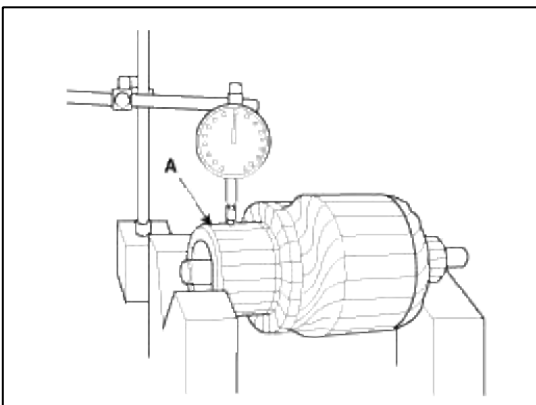
6. Measure the commutator (A) runout.

- A. If the commutator runout is within the service limit, check the commutator for carbon dust or brass chips between the segments.
- B. If the commutator run out is not within the service limit, replace the armature.

Commutator runout

Standard (New): 0.05 mm (0.0019 in.) max

Service limit: 0.08 mm (0.0031 in.)

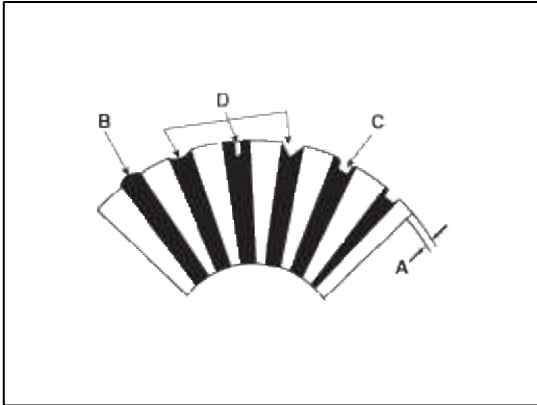


7. Check the mica depth (A). If the mica is too high (B), undercut the mica with a hacksaw blade to the proper depth. Cut away all the mica (C) between the commutator segments. The undercut should not be too shallow, too narrow, or v-shaped (D).

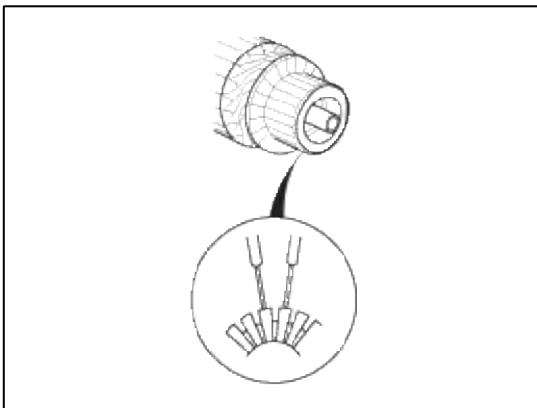
Commutator mica depth

Standard (New): 0.8 mm (0.0314 in.)

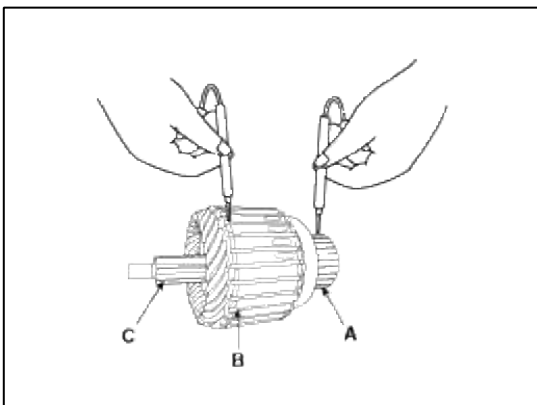
Limit: 0.2 mm (0.0079 in.)



8. Check for continuity between the segments of the commutator. If an open circuit exists between any segments, replace the armature.

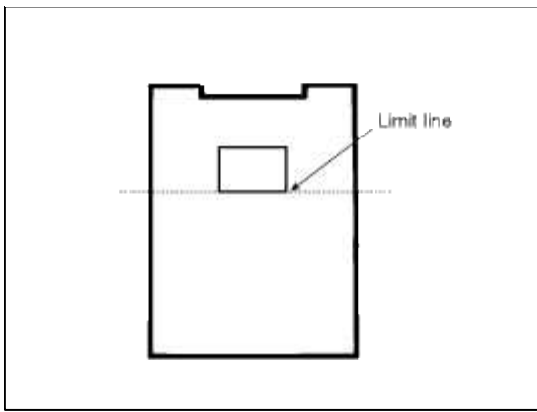


9. Check with an ohmmeter that no continuity exists between the commutator (A) and armature coil core (B), and between the commutator and armature shaft (C). If continuity exists, replace the armature.



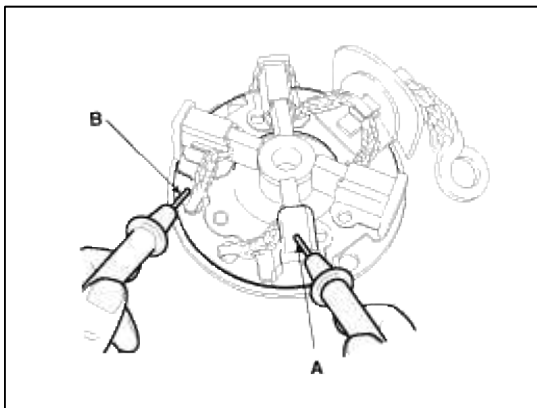
Inspect Starter Brush

Brushes that are worn out, or oil-soaked, should be replaced.



Starter Brush Holder Test

Make sure there is no continuity between the (+) brush holder (A) and (-) plate (B). If there is continuity, replace the brush holder assembly.

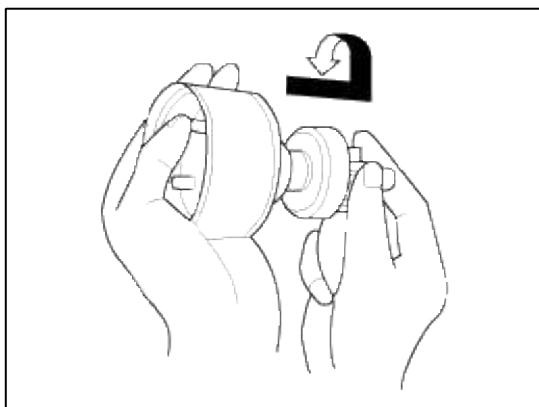


Overrunning Clutch

1. Slide the overrunning clutch along the shaft.
Replace it if it does not slide smoothly.

2. Rotate the overrunning clutch both ways.

Does it lock in one direction and rotate smoothly in reverse? If it does not lock in either direction or it locks in both directions, replace it.



3. If the starter drive gear is worn or damaged, replace the overrunning clutch assembly. (the gear is not available separately).

Check the condition of the flywheel or torque converter ring gear if the starter drive gear teeth are damaged.

Cleaning

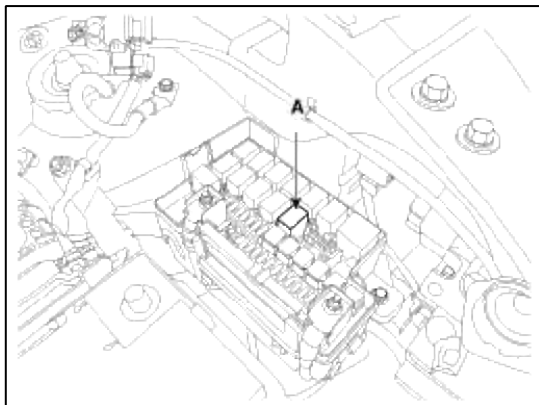
1. Do not immerse parts in cleaning solvent. Immersing the yoke assembly and/or armature will damage the insulation. Wipe these parts with a cloth only.
2. Do not immerse the drive unit in cleaning solvent. The overrun clutch is pre-lubricated at the factory and solvent will wash lubrication from the clutch.

3. The drive unit may be cleaned with a brush moistened with cleaning solvent and wiped dry with a cloth.

Engine Electrical System > Starting System > Starter Relay > Repair procedures

Inspection

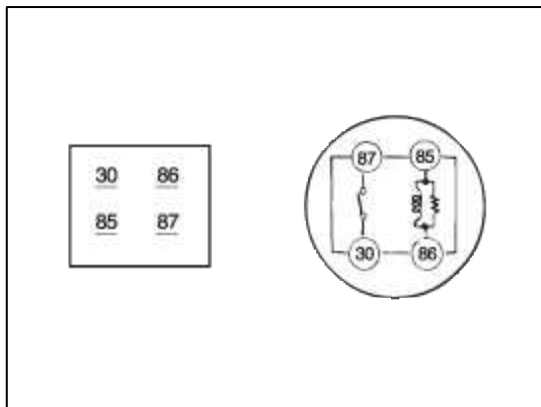
1. Remove the fuse box cover.
2. Remove the starter relay (A).



3. Using an ohmmeter, check that there is continuity between each terminal.

Terminal	Continuity
30 - 87	NO
85 - 86	YES

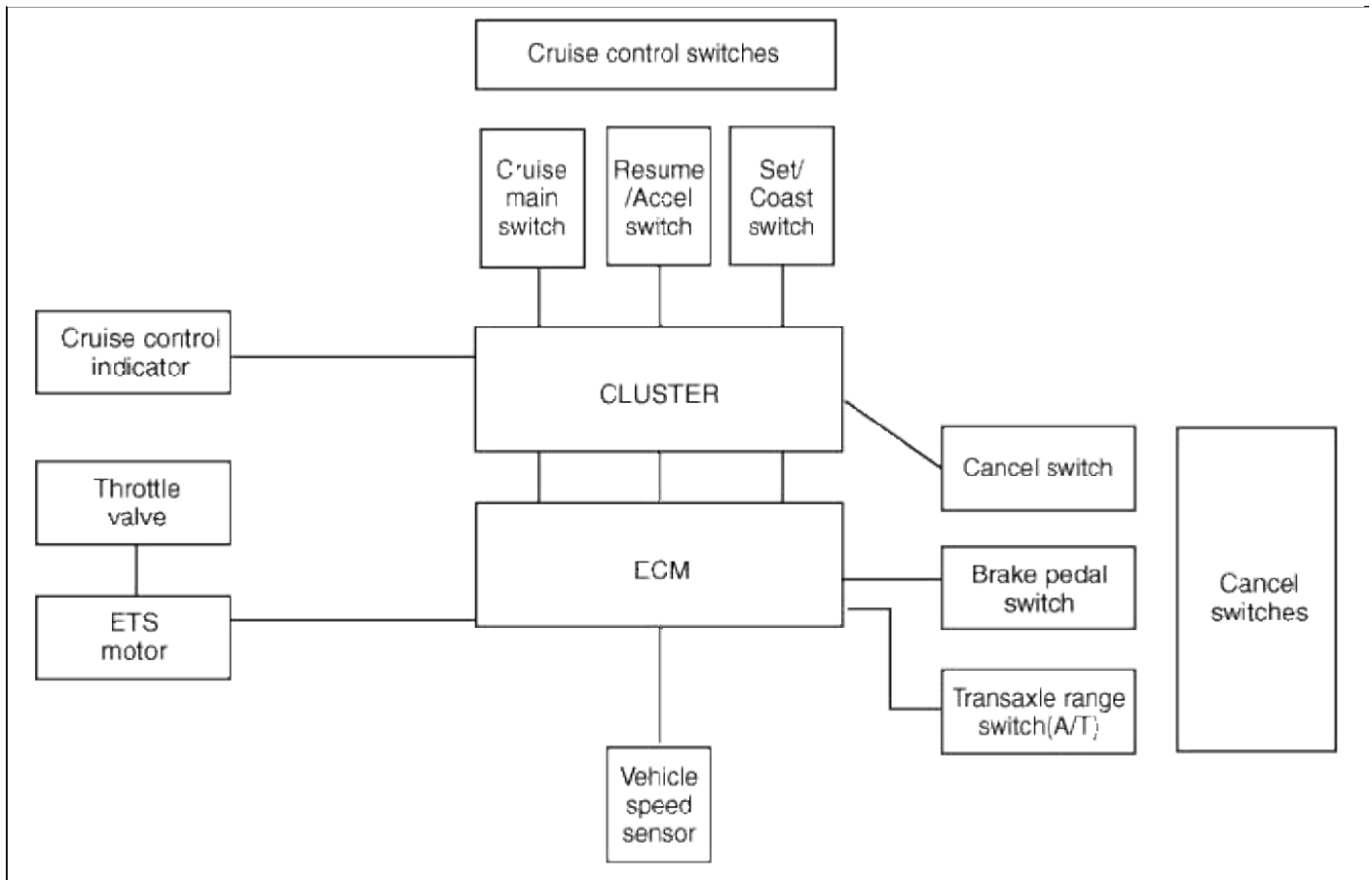
4. Apply 12V to terminal 85 and ground to terminal 86.
Check for continuity between terminals 30 and 87.



5. If there is no continuity, replace the starter relay.
6. Install the starter relay.
7. Install the fuse box cover.

Engine Electrical System > Cruise Control System > Schematic Diagrams

System Block Diagram



Component Parts And Function Outline

Component part		Function
Vehicle-speed sensor		Converts vehicle speed to pulse.
ECM		Receives signals from sensor and control switches.
Cruise control indicator		Illuminate when CRUISE main switch is ON (Built into cluster)
Cruise Control switches	ON/OFF switch	Switch for automatic speed control power supply.
	Resume/Accel switch	Controls automatic speed control functions by Resume/Accel switch (Set/Coast switch)
	Set/Coast switch	
Cancel switches	Cancel switch	Sends cancel signals to ECM.
	Brake-pedal switch	
	Transaxle range switch (A/T)	
ETS motor		Regulates the throttle valve to the set opening by ECM.

* ETS : Electronic Throttle System

Engine Electrical System > Cruise Control System > Description and Operation

Cruise Control

The cruise control system is engaged by the cruise "ON/OFF" main switch located on right of steering wheel column. The system has the capability to cruise, coast, accelerate and resume speed. It also has a safety interrupt, engaged upon depressing brake or shifting select lever.

The ECM is the control module for this system. The main components of cruise control system are mode control switches, transmission range switch, brake switch, vehicle speed sensor, ECM and ETS motor that connect throttle body.

The ECM contains a low speed limit which will prevent system engagement below a minimum speed of 40km/h (25mph).

The operation of the controller is controlled by mode control switches located on steering wheel.

Transmission range switch and brake switch are provided to disengage the cruise control system. The switches are on brake pedal bracket and transmission. When the brake pedal is depressed or select lever shifted, the cruise control system is electrically disengaged and the throttle is returned to the idle position.

Cruise main switch (ON/OFF)

The cruise control system is engaged by pressing the cruise "ON/OFF" main switch. Pressing the cruise "ON/OFF" main switch again releases throttle, clears cruise memory speed, and puts vehicle in a non-cruise mode.

Set/Coast switch (SET/-)

The "SET/-" switch located on right of steering wheel column has two functions.

The set function - Push the "SET/-" switch and release it at the desired speed. The SET indicator light in the instrument cluster will illuminate. Release the accelerator pedal. The desired speed will automatically be maintained.

The coast function - Push the "SET/-" switch and hold it when the cruise control is on. The vehicle will gradually slow down. Release the switch at the desired speed. The desired speed will be maintained.

Push the "SET/-" switch and release it quickly. The cruising speed will decrease by 2km/h or 1mph.

Resume/Accel switch (RES/+)

The "RES/+" switch located on right of steering wheel column has two functions.

The resume function - If any method other than the cruise "ON/OFF" main switch was used to cancel cruising speed temporarily and the system is still activated, the most recent set speed will automatically resume when the "RES/+" switch is pushed. It will not resume, however, if the vehicle speed has dropped below approximately 40km/h (25mph).

The accel function - Push the "RES/+" switch and hold it when the cruise control is on. The vehicle will gradually accelerate. Release the switch at the desired speed. The desired speed will be maintained.

Push the "RES/+" switch and release it quickly. The cruising speed will increase by 2km/h or 1mph.

Cancel switch (CANCEL)

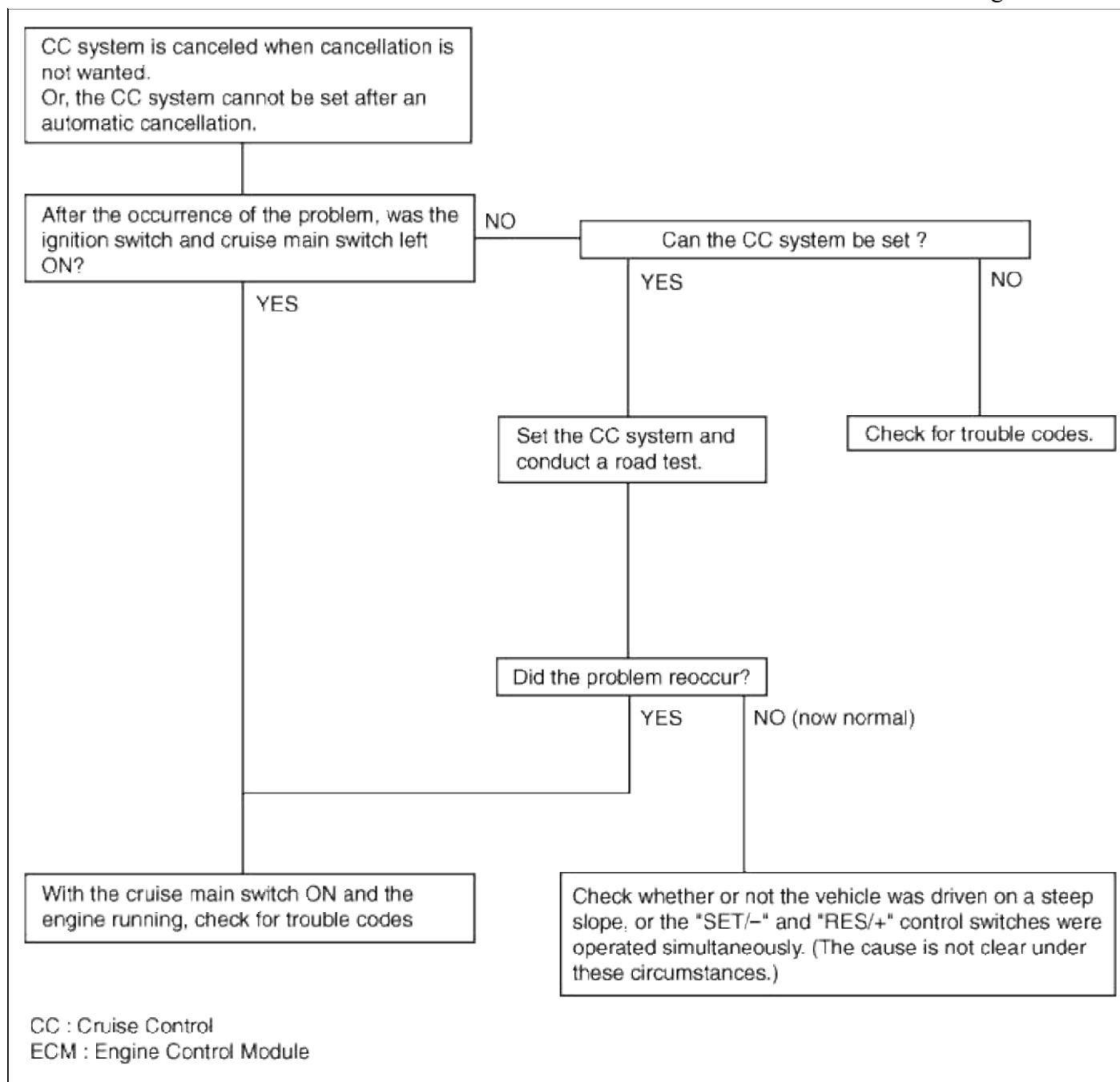
The cruise control system is temporarily disengaged by pushing the "CANCEL" switch.

Cruise speed canceled by this switch can be recovered by pushing the "RES/+" switch.

Engine Electrical System > Cruise Control System > Troubleshooting

Trouble Symptom Charts

Trouble Symptom 1



Trouble Symptom 2

Trouble symptom	Probable cause	Remedy
The set vehicle speed varies greatly upward or downward "Surging" (repeated alternating acceleration and deceleration) occurs after setting	Malfunction of the vehicle speed sensor circuit	Repair the vehicle speed sensor system, or replace the part
	Malfunction of ECM	Check input and output signals at ECM

Trouble Symptom 3

Trouble symptom	Probable cause	Remedy
The CC system is not canceled when the brake pedal is depressed	Damaged or disconnected wiring of the brake pedal switch	Repair the harness or replace the brake pedal switch
	Malfunction of the ECM signals	Check input and output signals at ECM

Trouble Symptom 4

Trouble symptom	Probable cause	Remedy
The CC system is not canceled when the shift lever is moved to the "N" position (It is canceled, however, when the brake pedal is depressed)	Damaged or disconnected wiring of inhibitor switch input circuit	Repair the harness or repair or replace the inhibitor switch
	Improper adjustment of inhibitor switch	
	Malfunction of the ECM signals	Check input and output signals at ECM

Trouble Symptom 5

Trouble symptom	Probable cause	Remedy
Cannot decelerate (coast) by using the "SET/—" switch	Temporary damaged or disconnected wiring of "SET/—" switch input circuit	Repair the harness or replace the "SET/—" switch
	Malfunction of the ECM signals	Check input and output signals at ECM
	Malfunction of the cluster signals	Check input and output signals at cluster

Trouble Symptom 6

Trouble symptom	Probable cause	Remedy
Cannot accelerate or resume speed by using the "RES/+" switch	Damaged or disconnected wiring, or short circuit, or "RES/+" switch input circuit	Repair the harness or replace the "RES/+" switch
	Malfunction of the ECM signals	Check input and output signals at ECM
	Malfunction of the cluster signals	Check input and output signals at cluster

Trouble Symptom 7

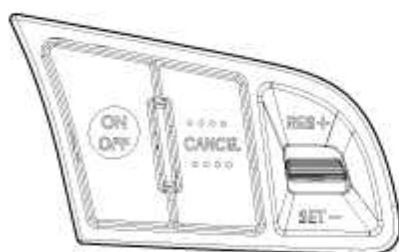
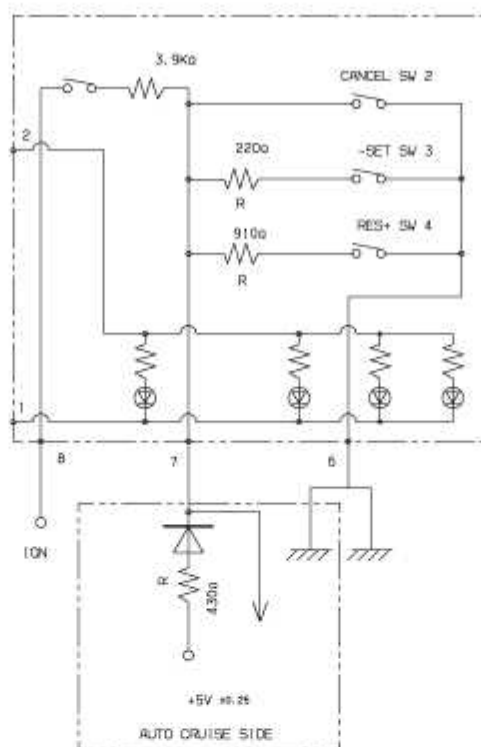
Trouble symptom	Probable cause	Remedy
CC system can be set while driving at a vehicle speed of less than 40km/h (25mph), or there is no automatic cancellation at that speed	Malfunction of the vehicle-speed sensor circuit	Repair the vehicle speed sensor system, or replace the part
	Malfunction of the ECM signals	Check input and output signals at ECM
	Malfunction of the cluster signals	Check input and output signals at cluster

Trouble Symptom 8

Trouble symptom	Probable cause	Remedy
The cruise main switch indicator lamp does not illuminate (But CC system is normal)	Signal faulty	Check output signal at ECM
	Communication error	Check input signal at cluater

Engine Electrical System > Cruise Control System > Cruise Control Switch > Schematic Diagrams

Circuit Diagram



[Cruise Control Switch]

Pin	Connector
1	ILL (-)
2	ILL (+)
3	-
4	-
5	-
6	ACC (-)
7	ACC (+)
8	ACC ON/PFF

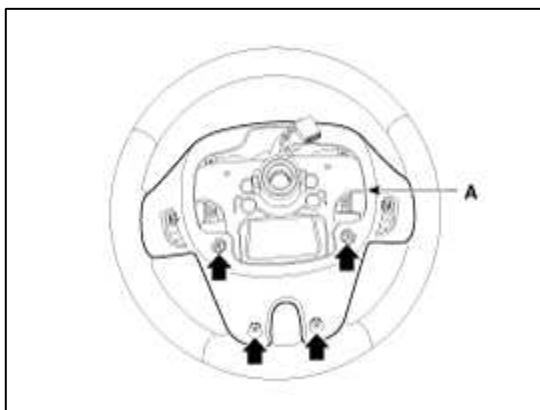
Engine Electrical System > Cruise Control System > Cruise Control Switch > Repair procedures**Removal and Installation**

1. Disconnect the battery negative terminal.

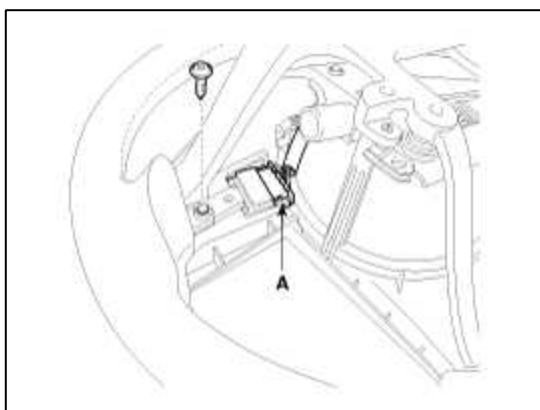
Tightening torque:

4.0 ~ 6.0 N.m (0.4 ~ 0.6 kgf.m, 3.0 ~ 4.4 lb-ft)

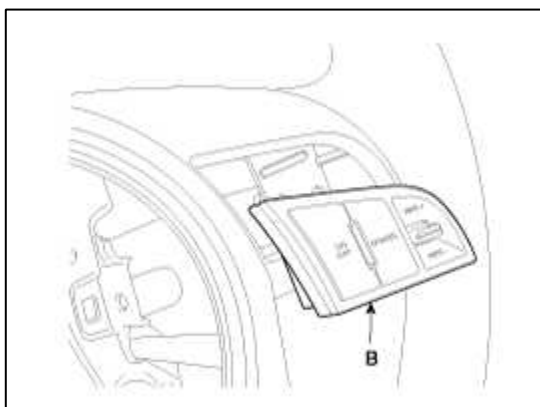
2. Remove the air-bag module from the steering wheel. (Refer to RT group - "Driver airbag module")
3. Remove the steering wheel. (Refer to ST group - "Steering column and shaft")
4. Remove the rear cover (A) after unfastening the screws.



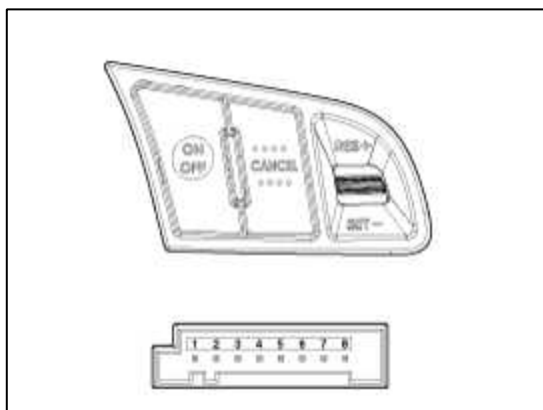
5. Disconnect the cruise control switch connector(A).



6. Remove the cruise control switch(B).

**Inspection****Measuring Resistance**

1. Disconnect the cruise control switch connector from the control switch.



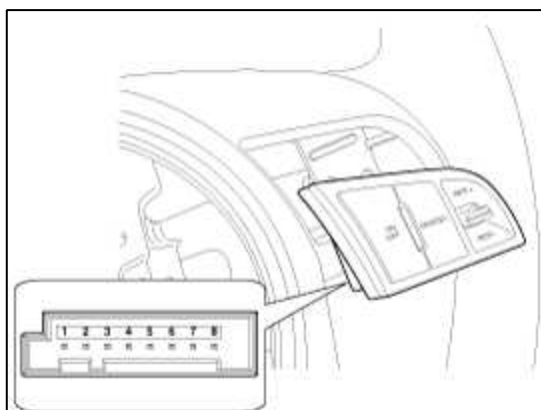
2. Measure resistance between terminals on the control switch when each function switch is ON (switch is depressed).

Function switch	Terminal	Resistance
CANCEL	6 – 7	$0\text{ k}\Omega \pm 1\%$
SET/–	6 – 7	$220\ \Omega \pm 1\%$
RES/+	6 – 7	$910\ \Omega \pm 1\%$
ON/OFF	7 – 8	$3.9\text{ k}\Omega \pm 1\%$

3. If not within specification, replace switch.

Measuring Voltage

1. Connect the cruise control switch connector to the control switch.



2. Measure voltage between terminals on the harness side connector when each function switch is ON (switch is depressed).

Function switch	Terminal	Voltage
CANCEL	6 – 7	$0\text{V} \pm 0.22\text{V}$
SET/–	6 – 7	$1.5\text{V} \pm 0.22\text{V}$
RES/+	6 – 7	$3.0\text{V} \pm 0.22\text{V}$
ON/OFF	7 – 8	-

3. If not within specification, inspect the control switch resistance. The measuring resistance value is not within specification, replace the switch and measure the voltage again.
4. If resistance is OK but, measuring voltage is not within specification, inspect the wiring harness and connectors between the switch and the ECM.

SOUL(AM) > 2013 > G 2.0 DOHC > Emission Control System

Emission Control System > General Information > Description and Operation

Description

Emissions Control System consists of three major systems.

- The Crankcase Emission Control System prevents blow-by gas from releasing into the atmosphere. This system recycles gas back into the intake manifold (Closed Crankcase Ventilation Type).
- The Evaporative Emission Control System prevents evaporative gas from releasing into the atmosphere. This system burns gas at appropriate engine operating condition after gathering it in the canister.
- The Exhaust Emission Control System converts the three pollutants [hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx)] into harmless substances by using the 3-way catalytic converter.

Emission Control System > General Information > Specifications

Specifications

Purge Control Solenoid Valve (PCSV)

Specification

Item	Specification
Coil Resistance (Ω)	22.0 ~ 26.0 [20°C(68°F)]

Fuel Tank Pressure Sensor (FTPS)

Type: Piezo-Resistive Pressure Sensor

Specification

Pressure [kPa (kgf/cm², in H2O)]	Output Voltage (V)
-6.67 (-0.068, -26.8)	0.5
0	2.5
+6.67 (0.068, 26.8)	4.5

Canister Close Valve (CCV)

Specification

Item	Specification
Coil Resistance (Ω)	15.5 ~ 18.5 [20°C(68°F)]

Tightening Torques

Item		kgf.m	N.m	lb-ft
Positive crankcase ventilation valve installation	1.6 GDI	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
	2.0 MPI	0.2 ~ 0.3	1.96 ~ 2.94	1.45 ~ 2.17
Fuel tank air filter installation bolt		0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3

Emission Control System > General Information > Troubleshooting

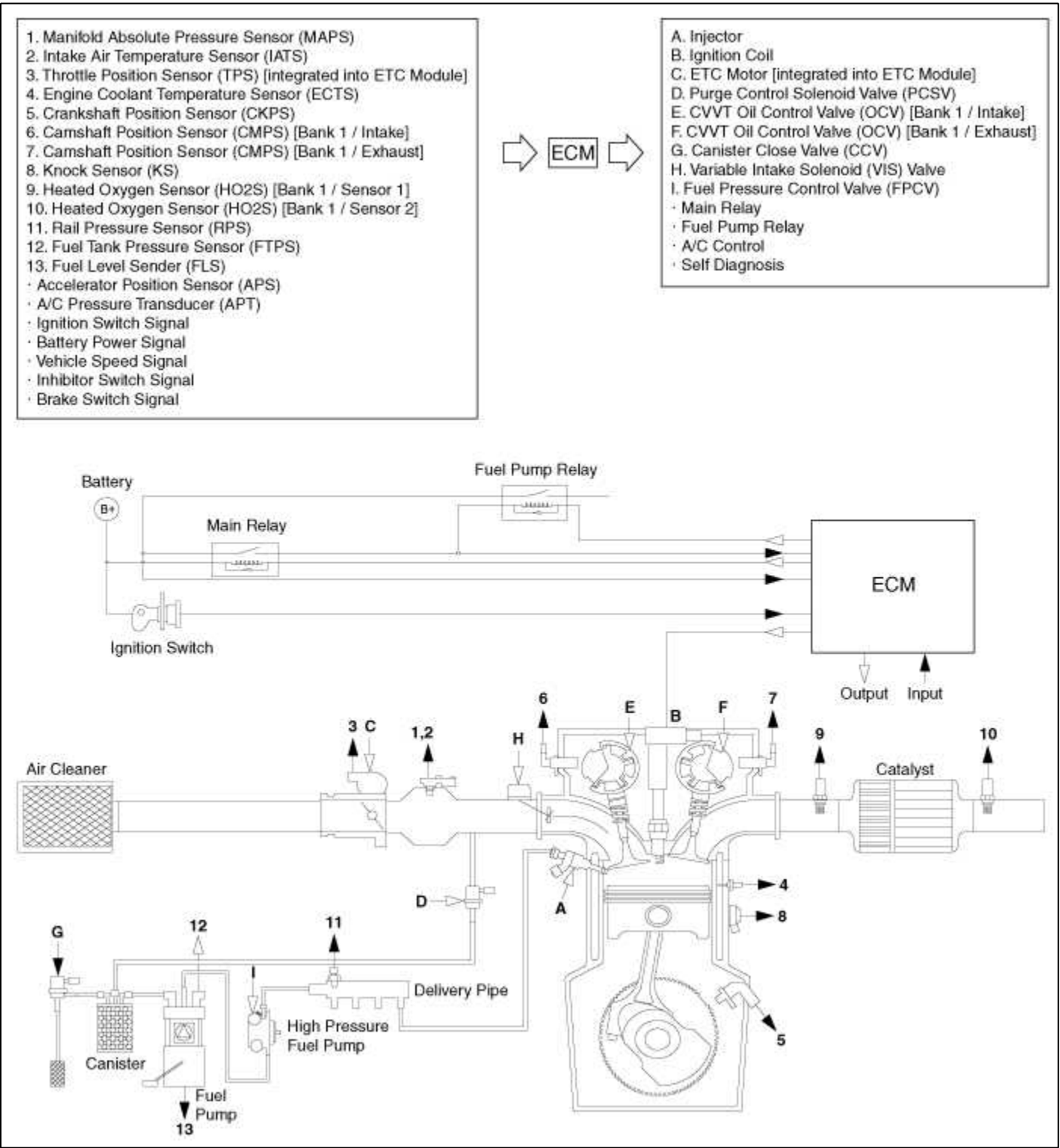
Troubleshooting

Symptom	Suspect area
Engine will not start or struggle to start	Vapor hose damaged or disconnected
Engine struggles to start	Malfunction of the Purge Control Solenoid Valve
Rough idle or engine stalls	Vapor hose damaged or disconnected
	Malfunction of the PCV valve
Rough idle	Malfunction of the Evaporative Emission Control System
Excessive oil consumption	Positive crankcase ventilation line clogged

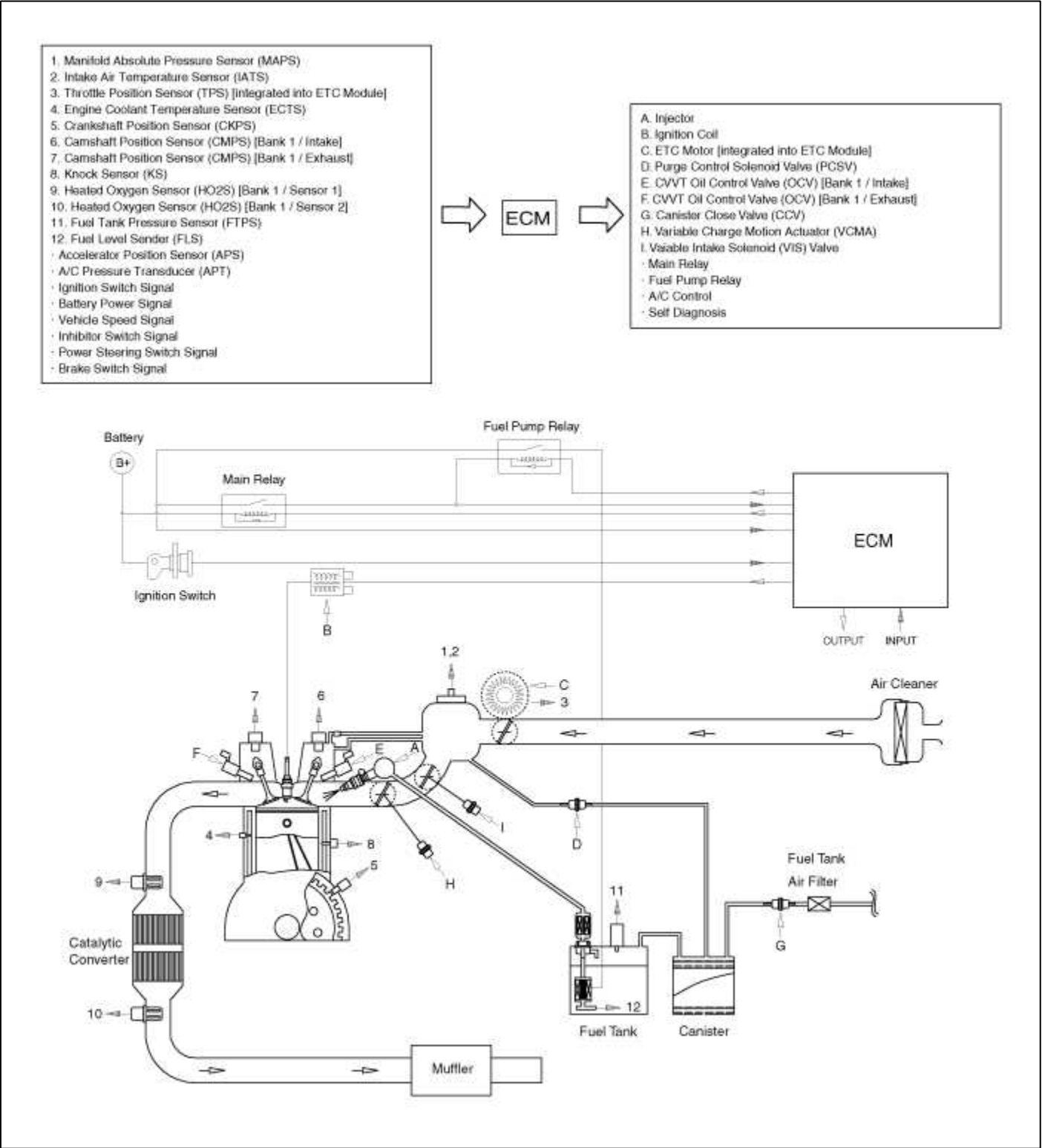
Emission Control System > General Information > Schematic Diagrams

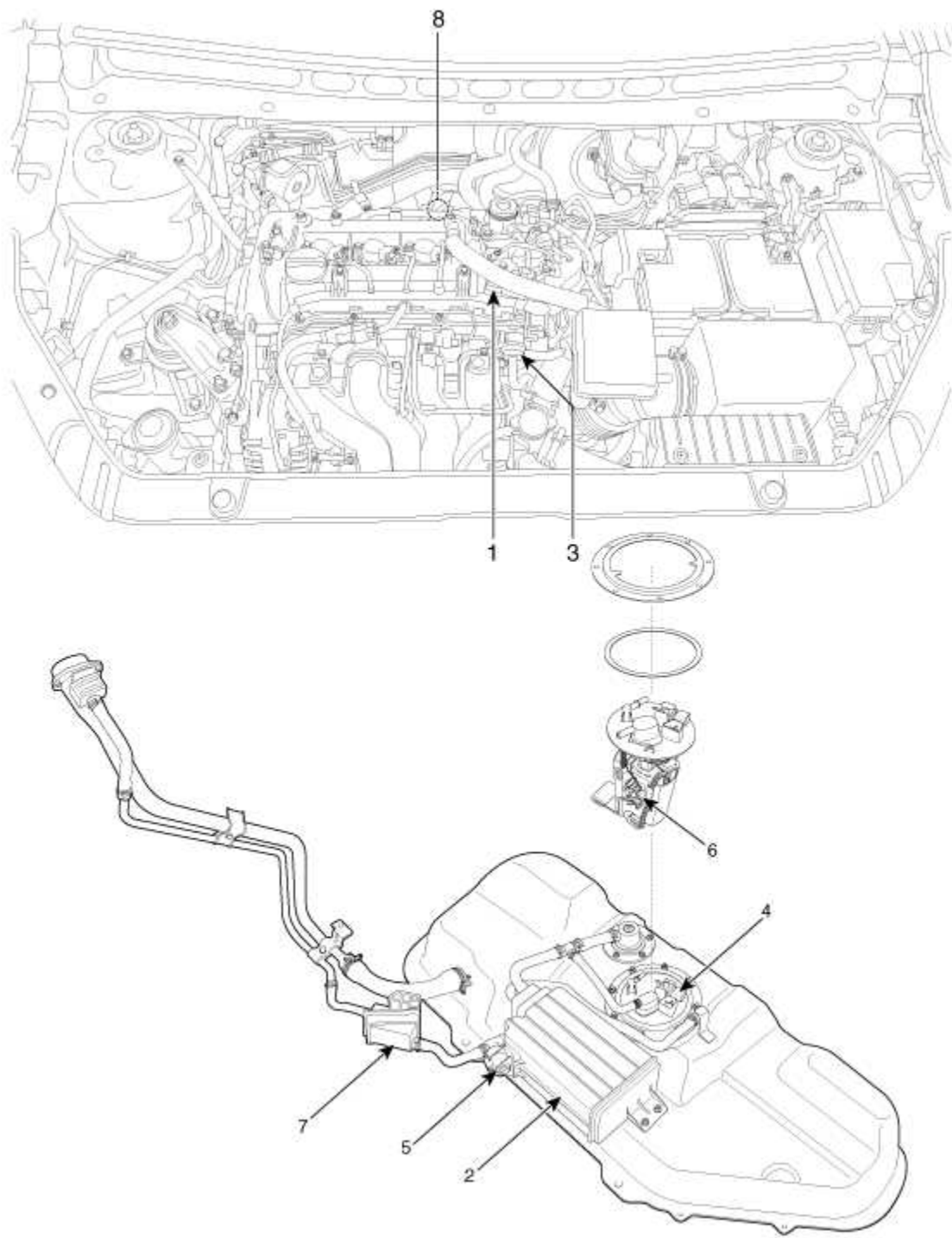
Schematic Diagram

[1.6 GDI]



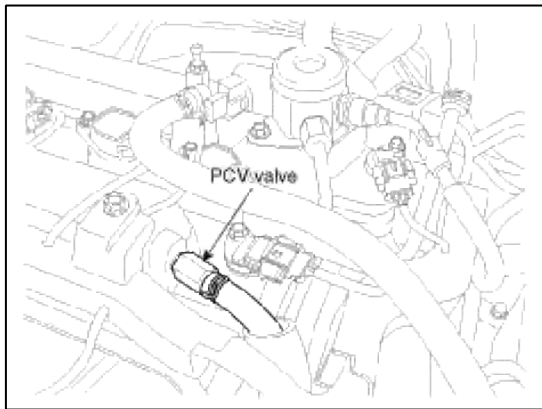
[2.0 MPI]



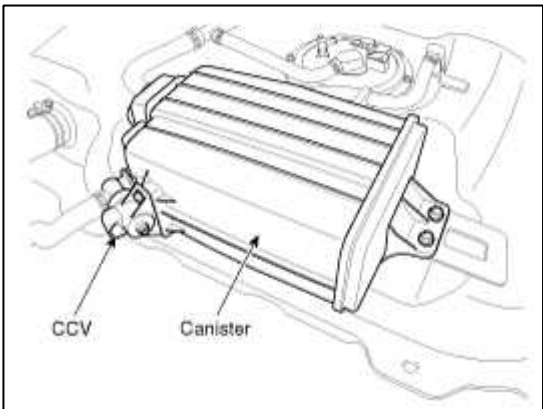


1. PCV valve	5. Canister close valve (CCV)
2. Canister	6. Fuel level sender (FLS)
3. Purge control solenoid valve (PCSV)	7. Fuel tank air filter
4. Fuel tank pressure sensor (FTPS)	8. Catalytic converter (WCC + UCC)

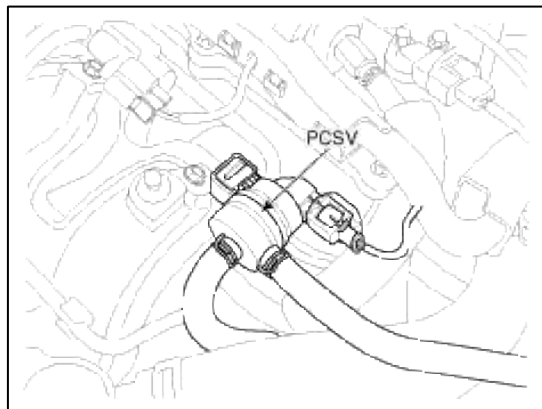
1. PCV valve



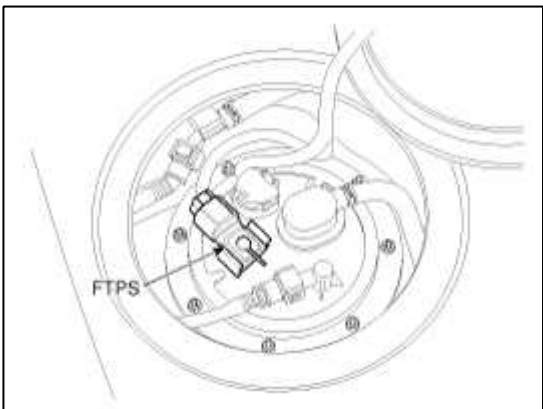
2. Canister
5. Canister close valve (CCV)



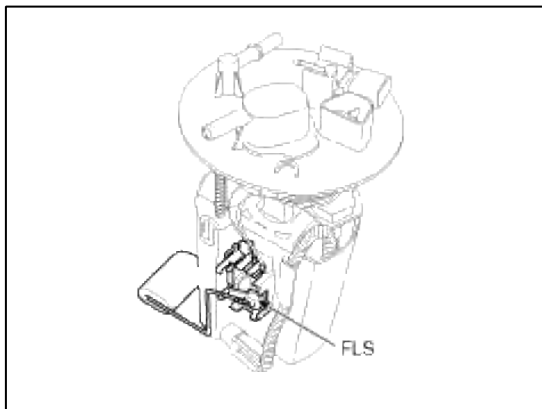
3. Purge control solenoid valve (PCSV)



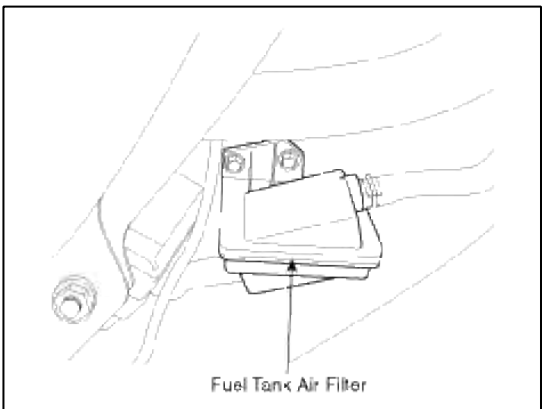
4. Fuel tank pressure sensor (FTPS)



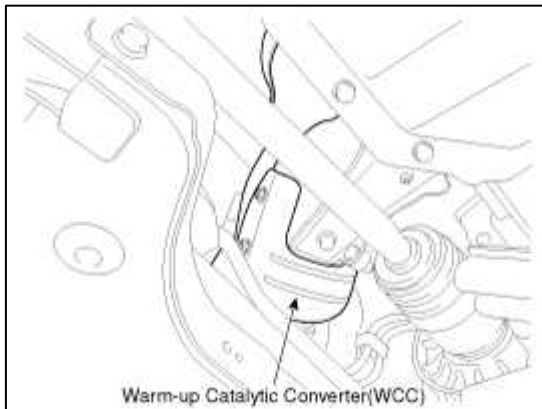
6. Fuel level sender (FLS)



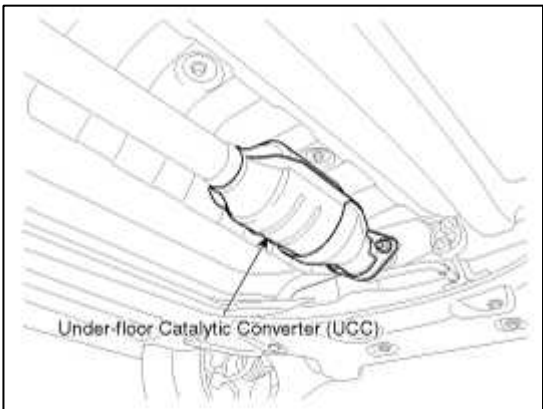
7. Fuel tank air Filter

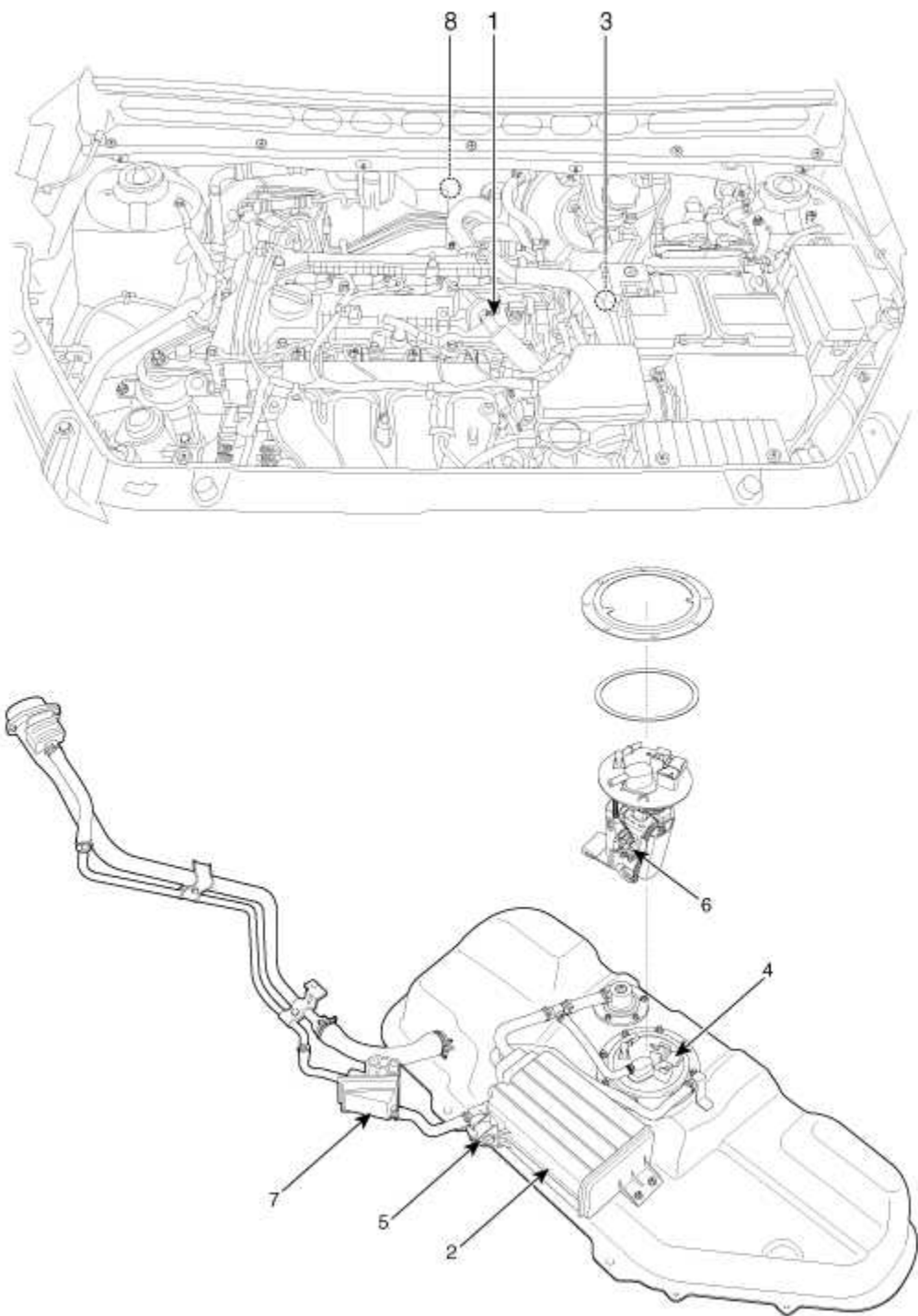


8. Catalytic converter (WCC)



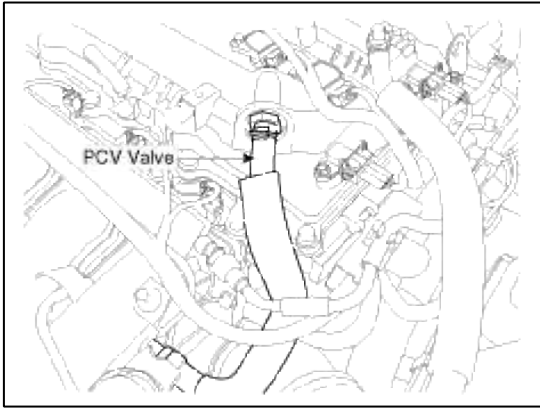
8. Catalytic converter (UCC)



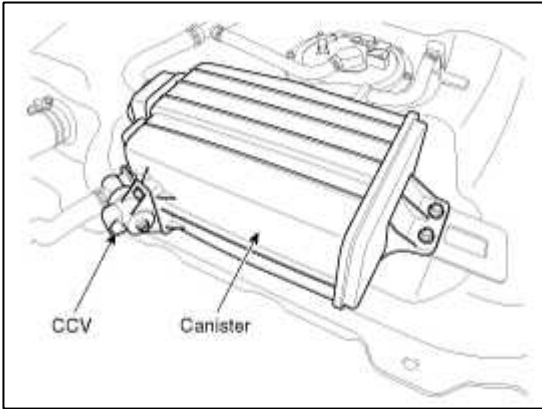


1. PCV valve	5. Canister close valve (CCV)
2. Canister	6. Fuel level sensor (FLS)
3. Purge control solenoid valve (PCSV)	7. Fuel tank air filter
4. Fuel tank pressure sensor (FTPS)	8. Catalytic converter (CCC)

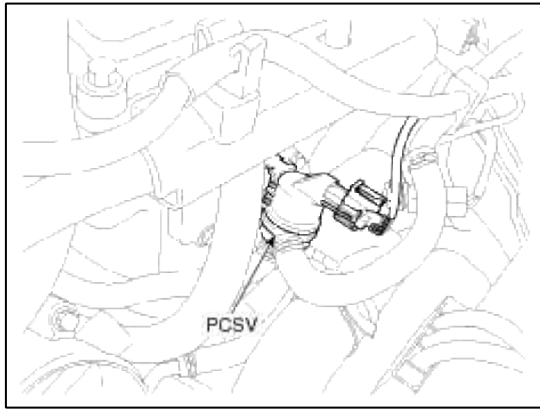
1. PCV valve



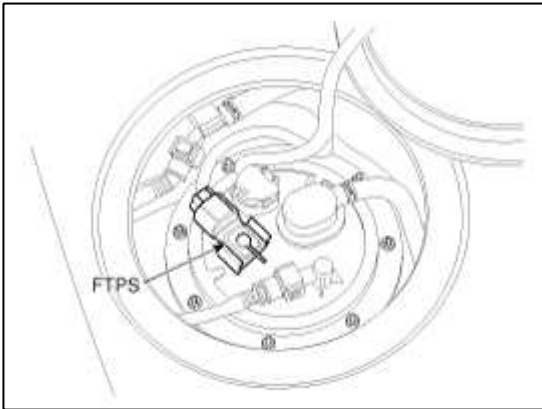
2. Canister
5. Canister close valve (CCV)



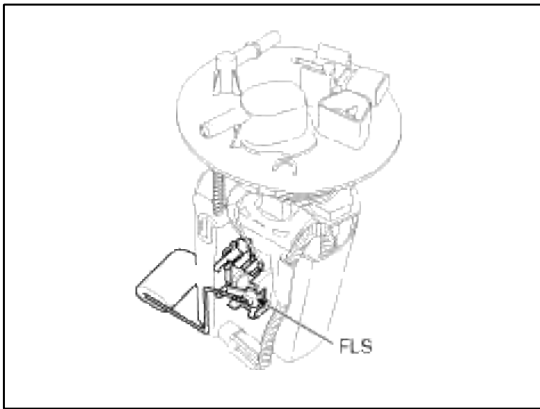
3. Purge control solenoid valve (PCSV)



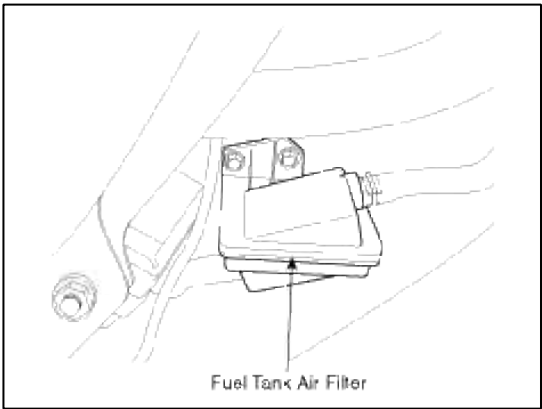
4. Fuel tank pressure sensor (FTPS)



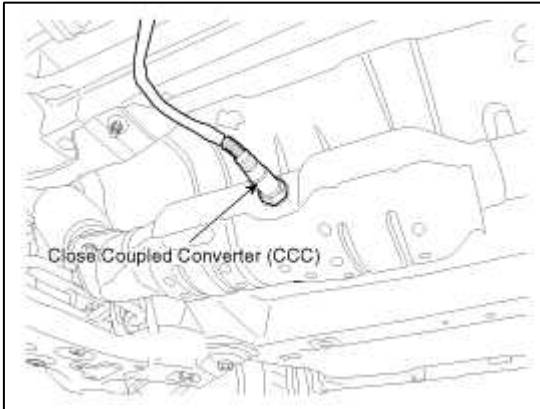
6. Fuel level sender (FLS)

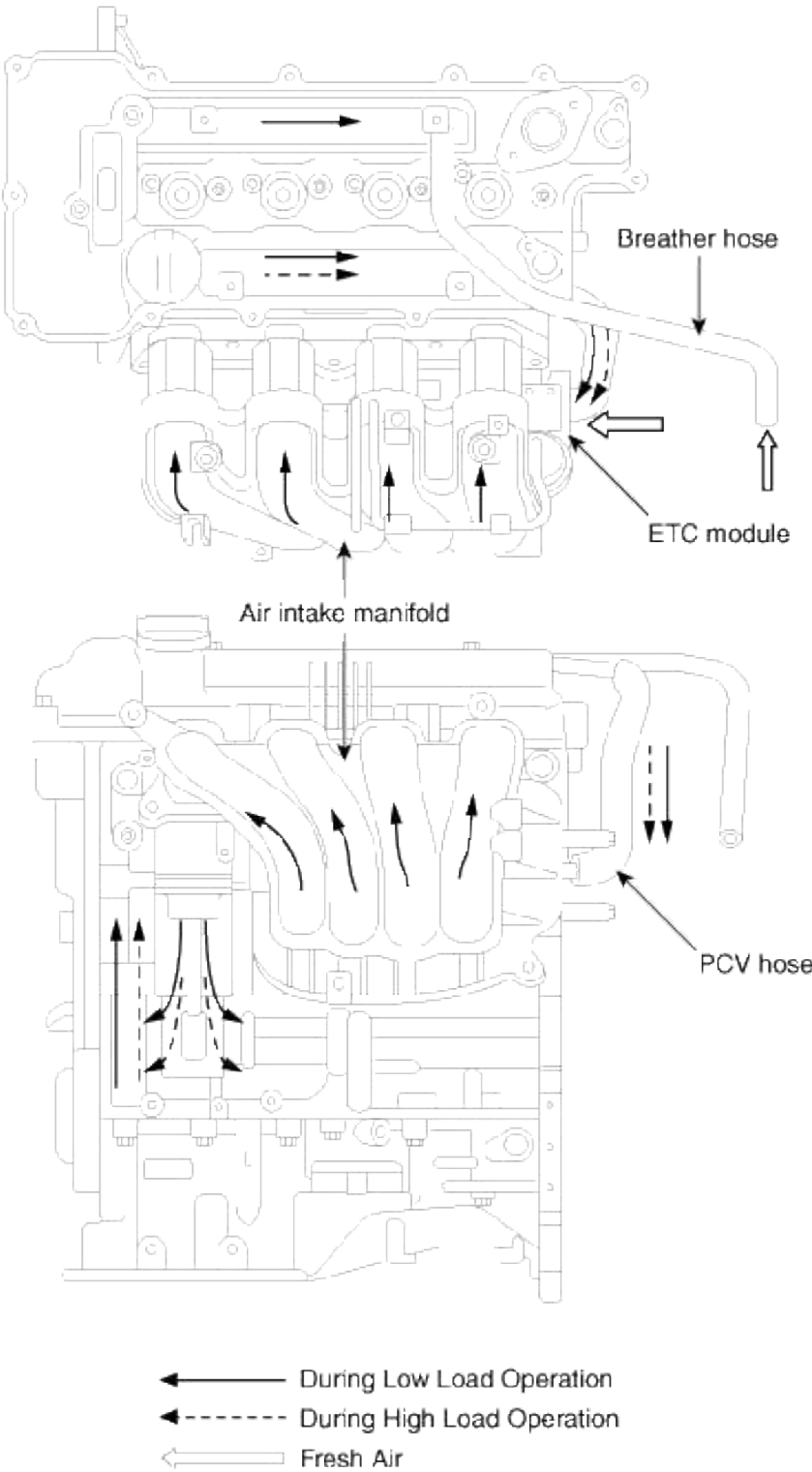


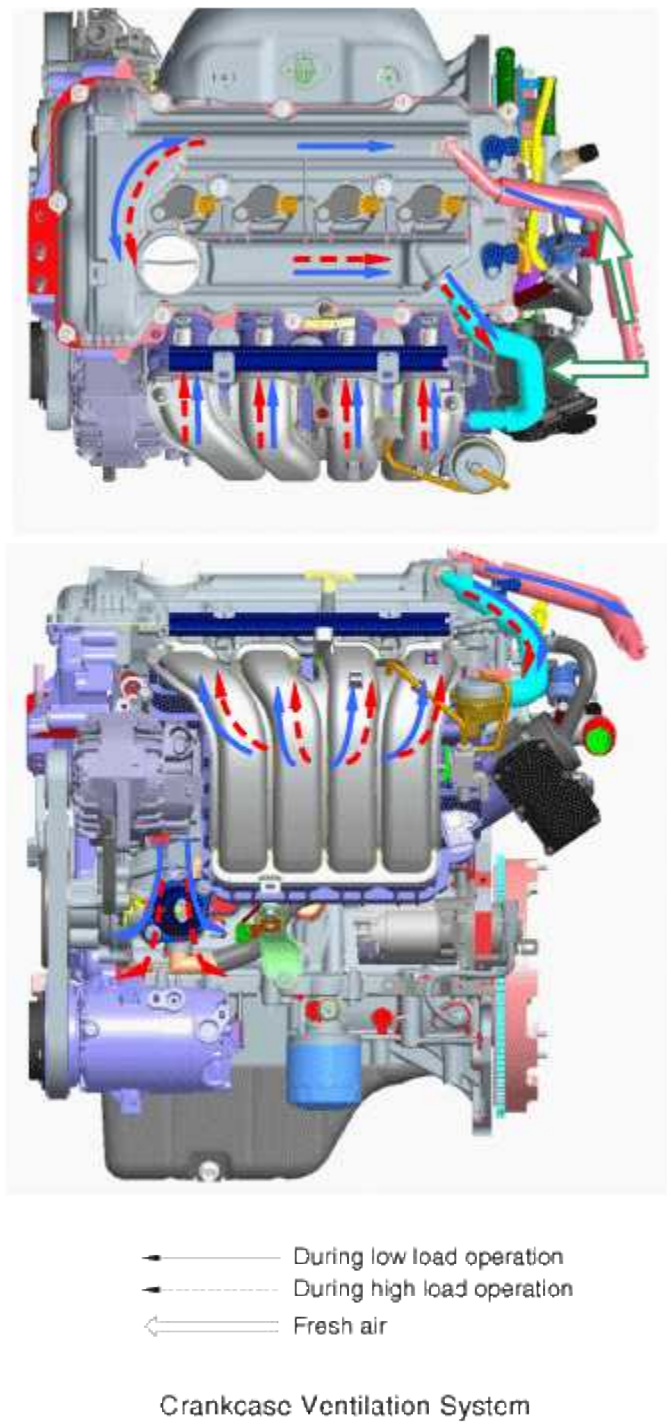
7. Fuel tank air filter



8. Catalytic converter (CCC)







Emission Control System > Crankcase Emission Control System > Repair procedures

Inspection

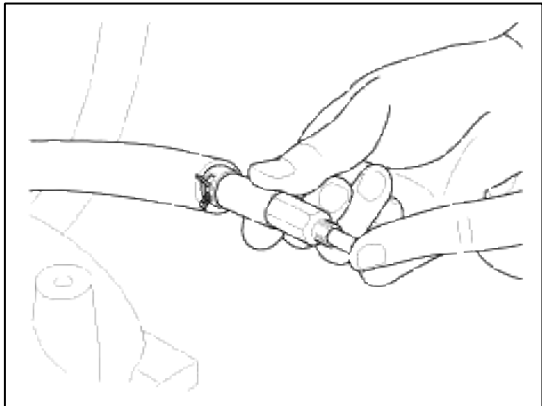
1. After disconnecting the vapor hose from the PCV valve, remove the PCV valve.
2. Reconnect the PCV valve to the vapor hose.

3. Run the engine at idle, then put a finger over the open end of the PCV valve and make sure that intake manifold vacuum can be felt.

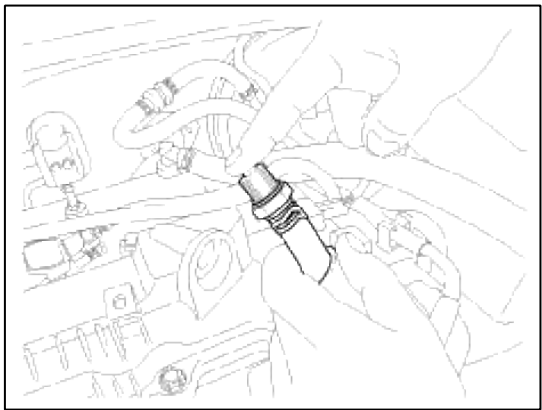
NOTE

The plunger inside the PCV valve will move back and forth at vacuum.

[1.6 GDI]



[2.0 MPI]

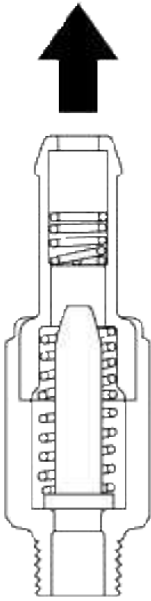
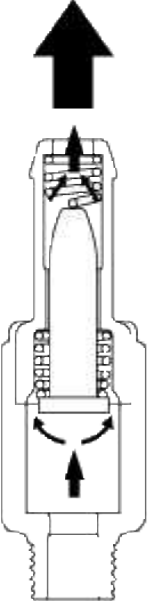
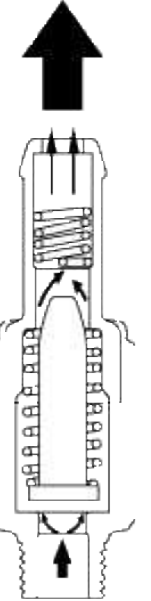
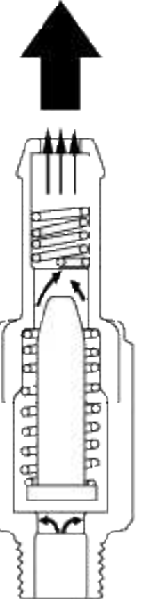


4. If the vacuum is not felt inspect PCV operation, if operating correctly clean or replace the vapor hose.

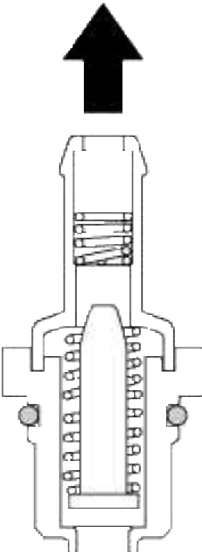
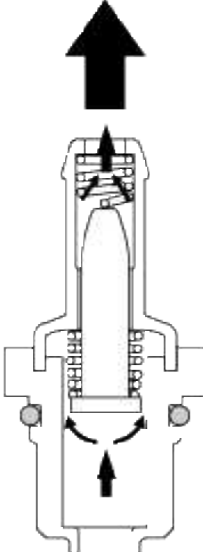
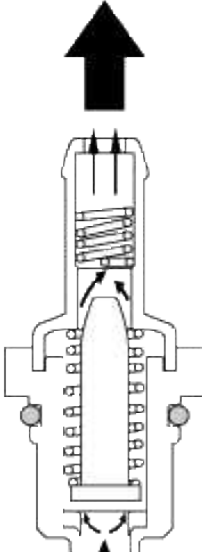
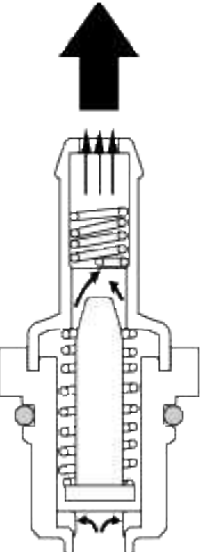
Emission Control System > Crankcase Emission Control System > Positive Crankcase Ventilation (PCV) Valve > Description and Operation

Operation Principle

[1.6 GDI]

Engine Condition	Not Running	Idling or Decelerating	Normal Operation	Accelerating and High Load
Vacuum in Intake Manifold	0	High	Moderate	Low
PCV Valve	Close	Slightly Open	Properly Open	Fully Open
Blow-by Gas Flow	0	Small	Medium	Large
Schematic Diagram	Intake Manifold 	Intake Manifold 	Intake Manifold 	Intake Manifold 

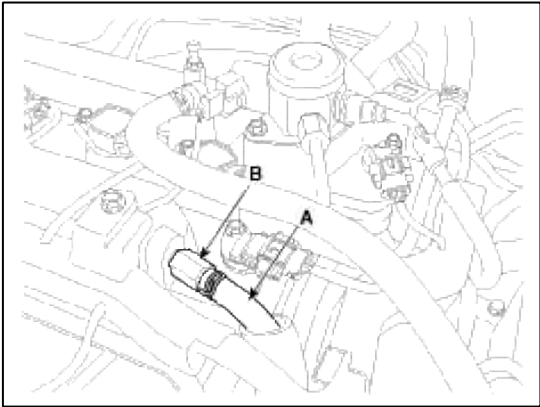
[2.0 MPI]

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Vacuum in Intake Manifold	0	High	Moderate	Low
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Blow-by Gas Flow	0	Small	Medium	Large
Schematic Diagram	Intake Manifold 	Intake Manifold 	Intake Manifold 	Intake Manifold 

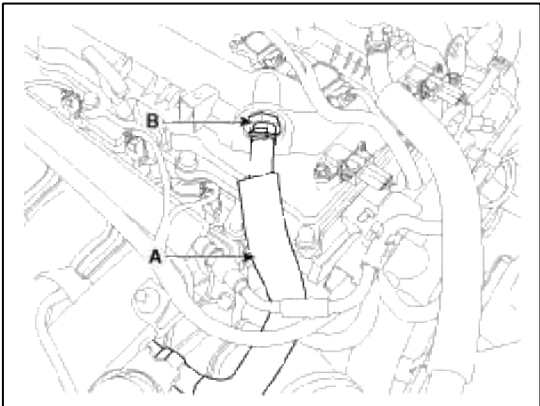
Removal

- 1. Disconnect the vapor hose (A).
- 2. Remove the PCV valve (B).

[1.6 GDI]



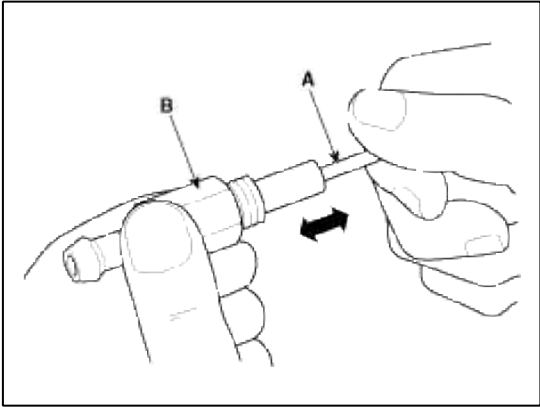
[2.0 MPI]



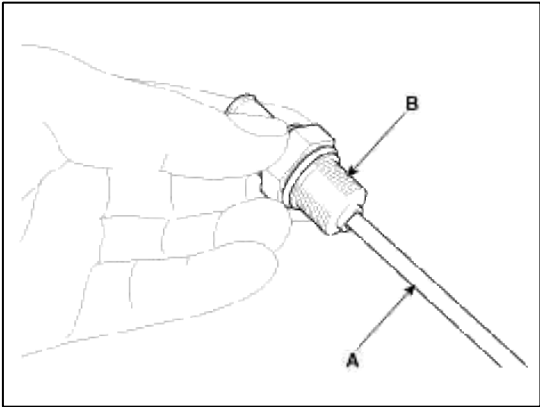
Inspection

- 1. Insert a thin stick (A) into the PCV valve (B) from the threaded side to check that the plunger movement.

[1.6 GDI]



[2.0 MPI]



NOTE

If the plunger does not move (PCV valve is clogged), clean or replace the valve.

Installation

- 1. Installation is reverse of removal.

PCV Valve installation:

[1.6 GDI]

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

[2.0 MPI]

1.96 ~ 2.94 N.m (0.2 ~ 0.3 kgf.m, 1.45 ~ 2.17 lb-ft)

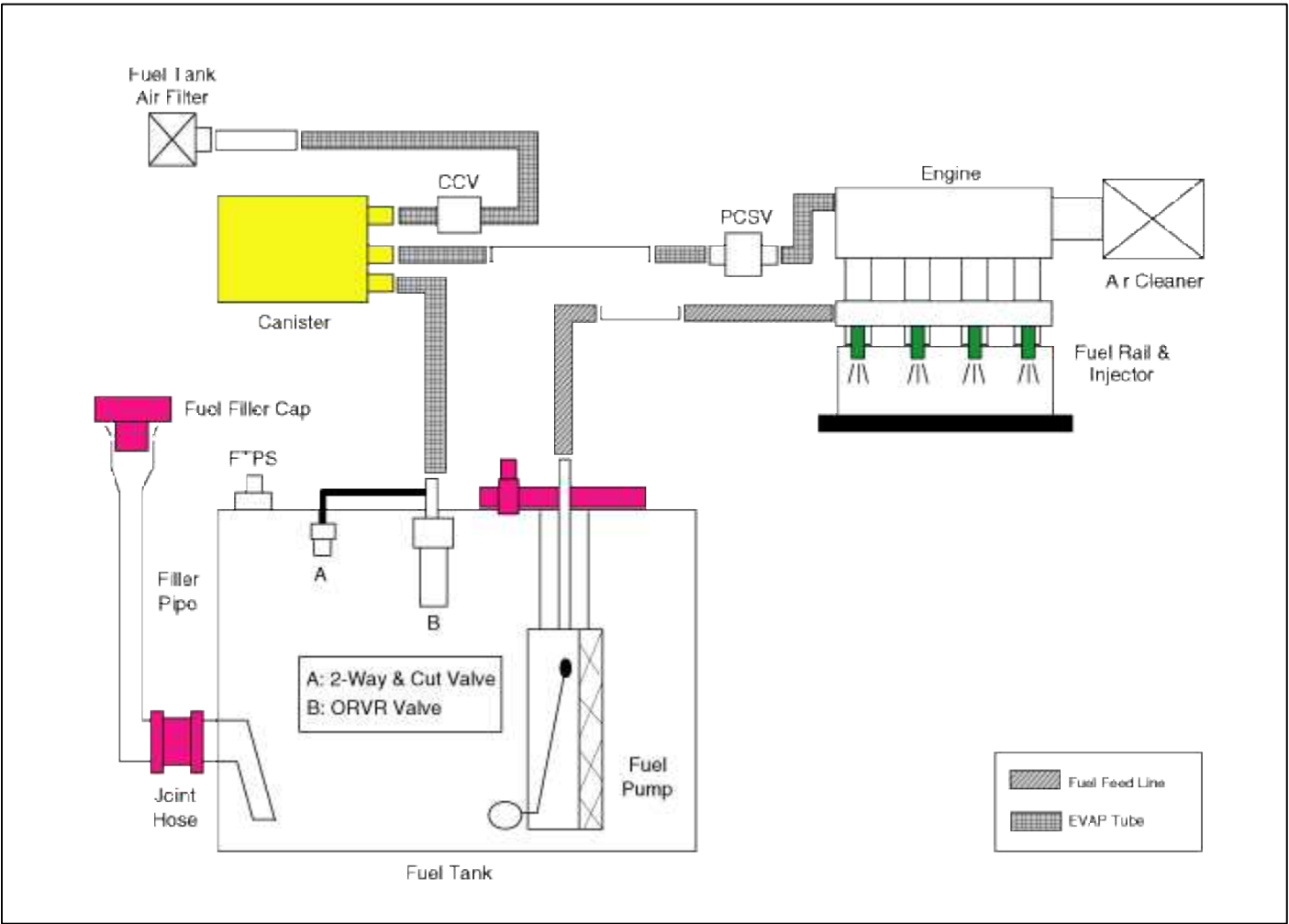
Emission Control System > Evaporative Emission Control System > Description and Operation

Description

The Evaporative Emission Control System prevents fuel vapor stored in fuel tank from vaporizing into the atmosphere. When the fuel evaporates in the fuel tank, the vapor passes through vent hoses or tubes to a canister filled with charcoal. The canister temporarily holds the vapor in the charcoal. The ECM will control the system in order to draw the gathered vapor into the combustion chambers during certain operating conditions. Engine manifold vacuum is used to draw the vapor into intake manifold.

Emission Control System > Evaporative Emission Control System > Schematic Diagrams

Schematic Diagram



Canister

The Canister is filled with charcoal and absorbs evaporated fuel vapor from the fuel tank. The gathered fuel vapor in canister is drawn into the intake manifold by the ECM/PCM when appropriate conditions are set.

Purge Control Solenoid Valve (PCSV)

The Purge Control Solenoid Valve (PCSV) is installed in the passage connecting the canister to the intake manifold.

It is a duty type solenoid valve and is operated by ECM/PCM signal.

To draw the absorbed vapor into the intake manifold, the ECM/PCM will open the PCSV, otherwise the passage remains closed.

Fuel Filler Cap

A ratchet tightening device in the threaded fuel filler cap reduces the chances of incorrect installation, when sealing the fuel filler. After the gasket on the fuel filler cap and the fill neck flange make contact, the ratchet produces a loud clicking noise indicating the seal has been set.

Fuel Tank Pressure Sensor (FTPS)

The Fuel Tank Pressure Sensor (FTPS) is an integral part of the monitoring system. The FTPS checks Purge Control Solenoid Valve (PCSV) operation and leaks in the Evaporative Emission Control System by monitoring pressure and vacuum level in the fuel tank during PCSV operating cycles.

Canister Close Valve (CCV)

The Canister Close Valve (CCV) is located between the canister and the fuel tank air filter. It closes off the air inlet to the canister for the Evaporative Emissions System and also prevents fuel vapors from escaping from the Canister when the vehicle is not operating.

Evaporative System Monitoring

The Evaporative Emission Control Monitoring System monitors fuel vapor generation, evacuation, and a leakage check step. At first, the OBD-II system checks if vapor generation due to fuel temperature is small enough to start monitoring. Then it evacuates the evaporative system by means of PCSV with ramp in order to maintain a certain vacuum level. The final step is to check if there is vacuum loss by any leakage of the system.

Vapor Generation Checking

During the stabilization period, the PCSV and the CCV are closed. The system pressure is measured as starting pressure (DP_A). After a certain defined period (T1), the system pressure (DP_B) is measured again and the difference from the starting pressure is calculated. If this difference (DP_B - DP_A) is bigger than the threshold, there should be excessive vapor pressure and the monitor is aborted for next check. On the contrary, if the difference is lower than the negative threshold, the PCSV is regarded as having a malfunction such as clogged at open position.

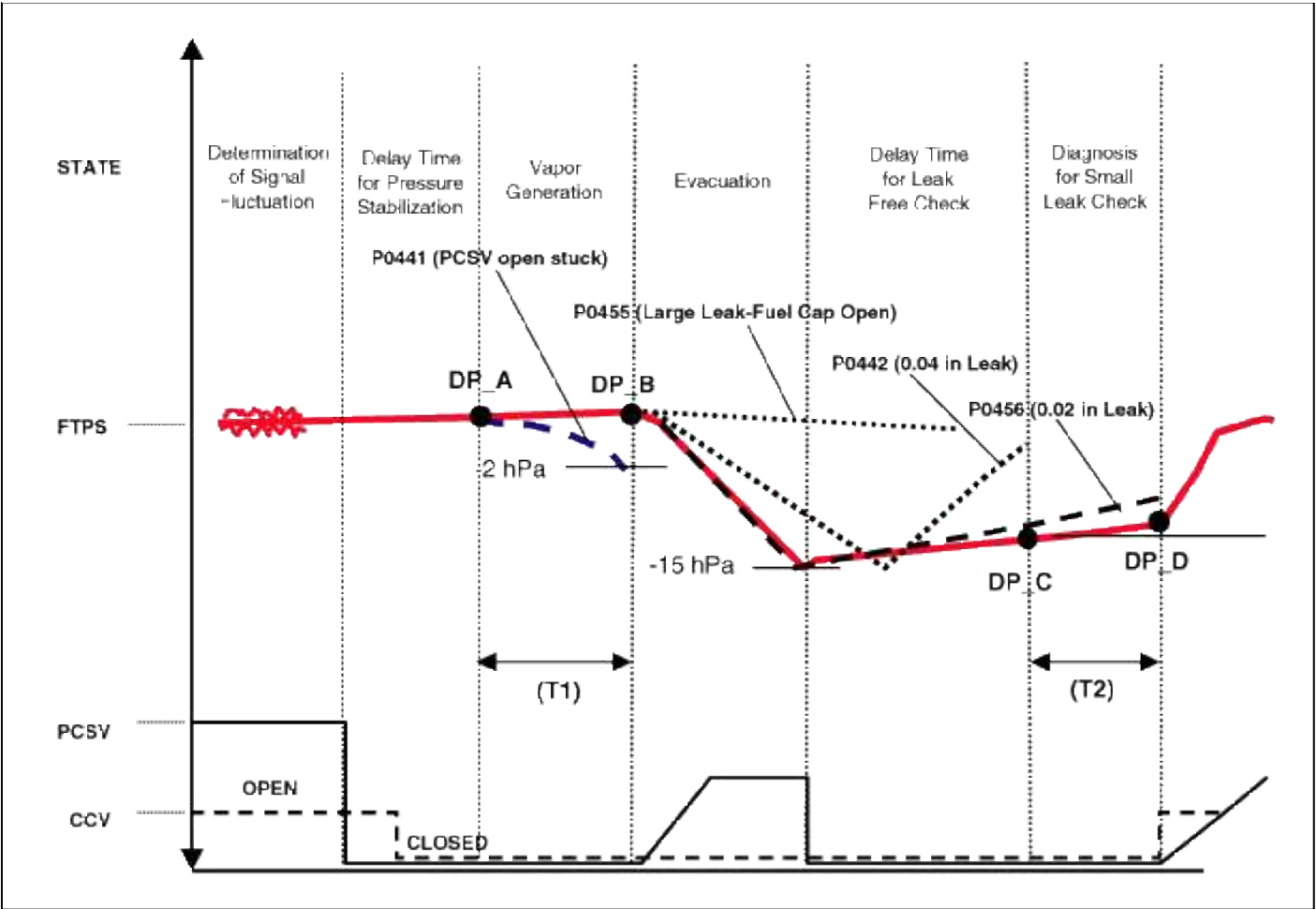
Large EVAP Leak Detection

The PCSV is opened with a certain ramp for the pressure to reach down to a certain level. If the pressure can't be lowered below a threshold, the system is regarded as having a fuel cap-open or having a large leak.

Leaking Checking

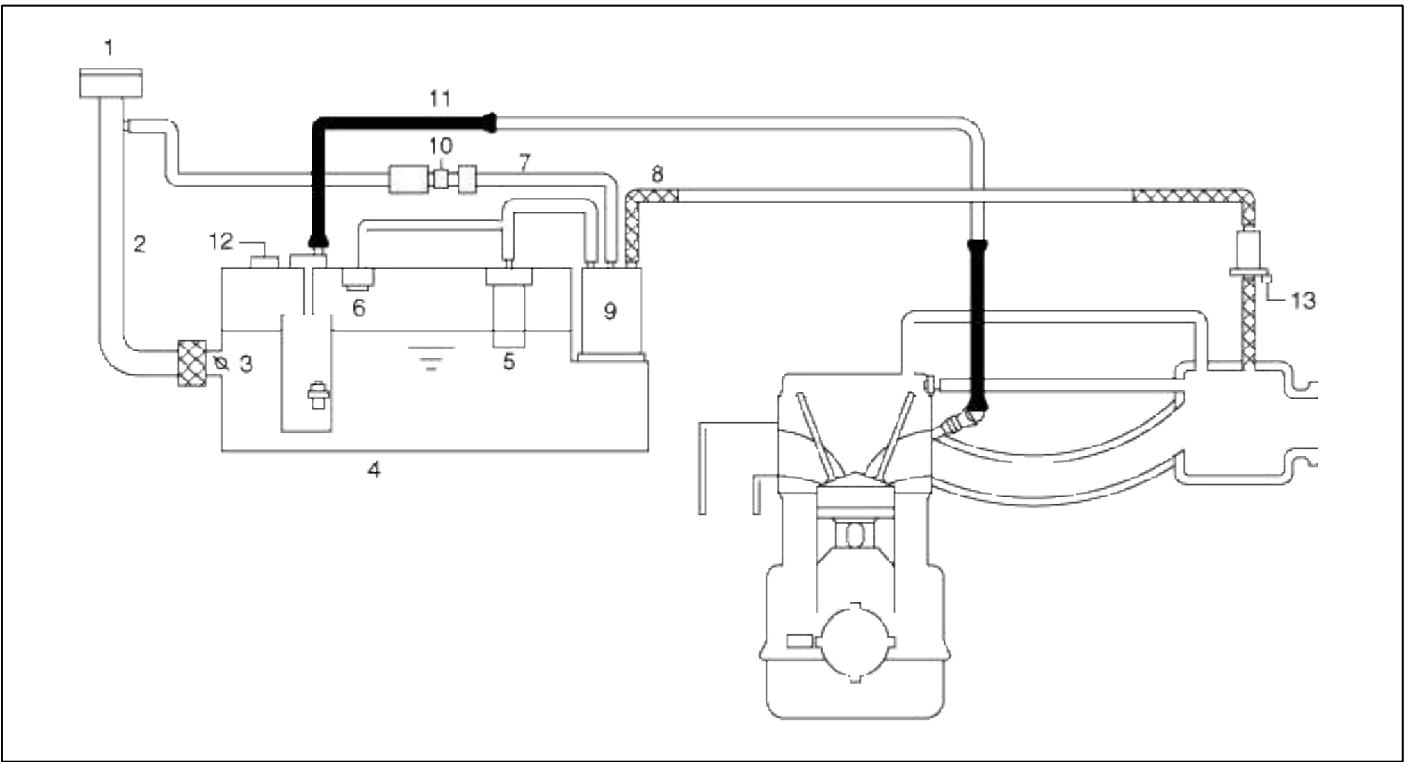
The PCSV is closed and the system waits for a period to get stabilized pressure. During checking period (T2), the system measures the beginning and the end of the system pressure (DP_C, DP_D). The diagnosis value is the pressure difference corrected by the natural vapor generation (DP_B - DP_A) rate from the vapor generation check step.

Evaporative System Monitoring



Evaporative And ORVR Emission Control System

This system consists of a fill vent valve, fuel shut-off valve, fuel cut valve (for roll over), two way valve (pressure/vacuum relief), fuel liquid/vapor separator which is installed beside the filler pipe, charcoal canister which is mounted under the rear floor LH side member and protector, tubes and miscellaneous connections. While refueling, ambient air is drawn into the filler pipe so as not to emit fuel vapors in the air. The fuel vapor in the tank is then forced to flow into the canister via the fill vent valve. The fuel liquid/vapor separator isolates liquid fuel and passes the pure vapor to the charcoal canister. While the engine is operating, the trapped vapor in the canister is drawn into the intake manifold and then into the engine combustion chamber. Using this purge process, the charcoal canister is purged and recovers its absorbing capability.



1. Fuel Filler Cap	8. Evaporative Hose
2. Fuel Filler Pipe	9. Canister
3. Fuel Shut-OFF Valve	10. Canister Close Valve (CCV)
4. Fuel Tank	11. Fuel Feed Line
5. ORVR Valve	12. Fuel Tank Pressure Sensor (FTPS)
6. 2-Way & Cut Valve	13. Purge Control Solenoid Valve (PCSV)
7. Evaporative Hose	

Emission Control System > Evaporative Emission Control System > Repair procedures

Inspection

[System Inspection]

1. Disconnect the vapor hose from the intake manifold and connect a vacuum pump to the nipple on the intake manifold.
- At Cold Engine [Engine Coolant Temperature < 60°C(140°F)]

Engine Operating Condition	Applied Vacuum	Result
Idle	Min. 20 inHg (Min. 0.7 kgf/cm², Min. 67.7 kPa)	Vacuum is held
3,000rpm		

2. Check the following points with applied vacuum at the purge control solenoid valve (PCSV).
- At Warmed Engine [Engine Coolant Temperature > 80°C(176°F)]

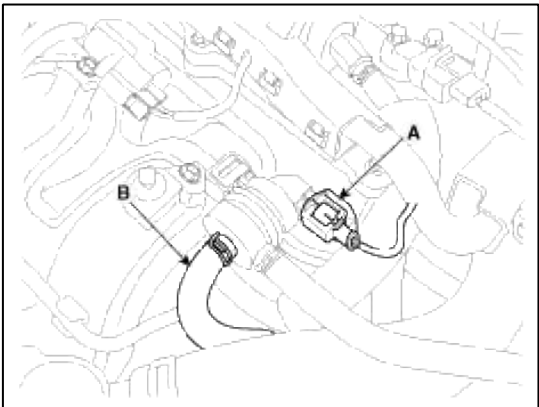
Engine Operating Condition	Applied Vacuum	Result
Idle	Min. 20 inHg (Min. 0.7 kgf/cm², Min. 67.7 kPa)	Vacuum is held
Within 3 minutes after engine start at 3,000 rpm	Try to apply vacuum	Vacuum is released
In 3 minutes after engine start at 3,000 rpm	Min. 20 inHg (Min. 0.7 kgf/cm², Min. 67.7 kPa)	Vacuum will be held momentarily, after which, it will be released

[PCSV Inspection]

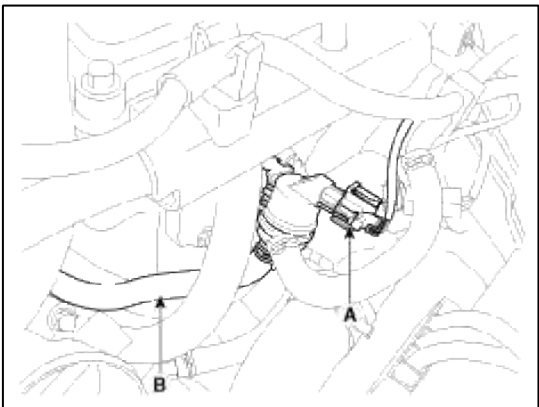
1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Disconnect the PCSV connector (A).

3. Disconnect the vapor hose (B) which is connected to the intake manifold from the PCSV.

[1.6 GDI]



[2.0 MPI]



4. After connecting a vacuum pump to the nipple, apply vacuum.
5. With the PCSV control line grounded, check the valve operation with battery voltage applied to the PCSV(Open) and removed(Closed).

Battery Voltage	Valve	Vacuum
Connected	Open	Released
Disconnected	Close	Maintained

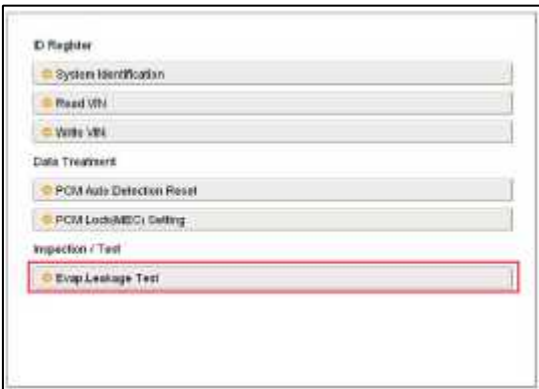
6. Measure the coil resistance of the PCSV.

Specifications:

22.0 ~ 26.0Ω [20°C(68°F)]

[EVAP. Leakage Test]

1. Select "Evap. Leakage Test".



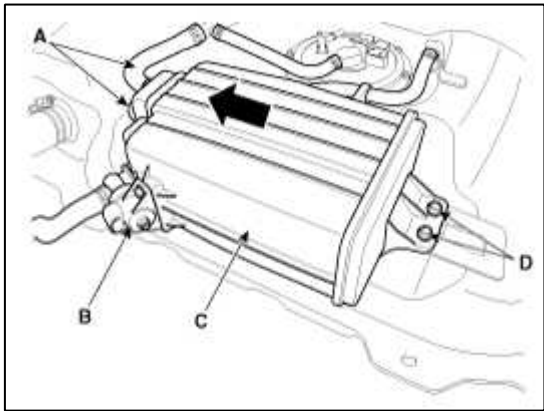
2. Proceed with the test according to the screen introductions.



Emission Control System > Evaporative Emission Control System > Canister > Repair procedures

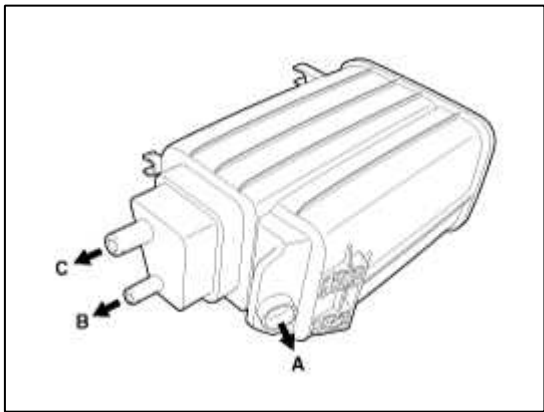
Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the vapor hoses (A).
3. Remove the canister close valve (B) after removing the installation bolts.
4. Remove the canister assembly (C) in the direction of the arrow after removing the installation bolts (D).



Inspection

1. Check for the following items visually.
 - Cracks or leakage of the canister
 - Loose connection, distortion, or damage of the vapor hose/tube



- A: Canister ↔ Atmosphere
- B: Canister ↔ Intake manifold
- C: Canister ↔ Fuel tank

Installation

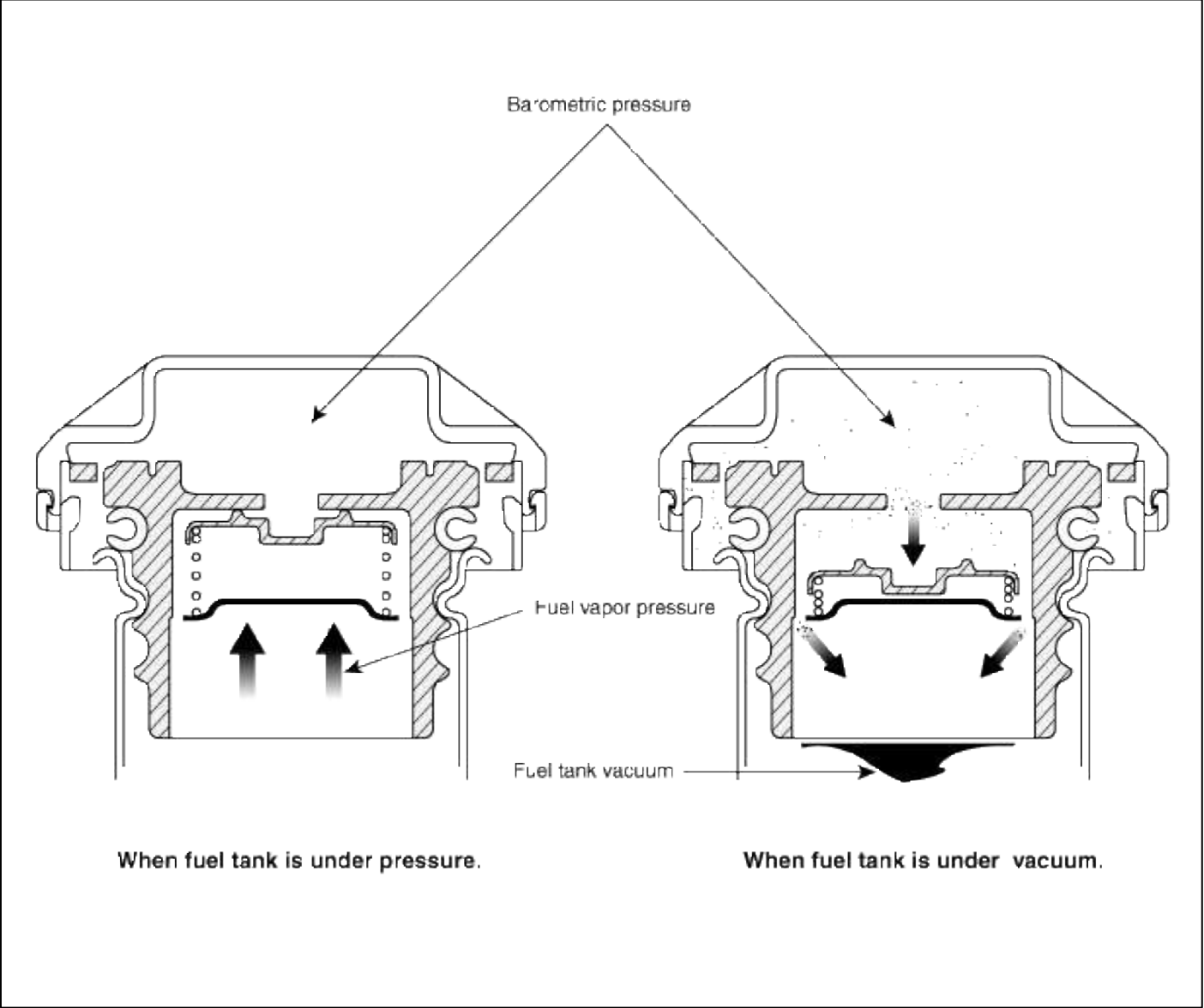
1. Installation is the reverse of removal.

Emission Control System > Evaporative Emission Control System > Fuel Filler Cap > Description and Operation

Description

A ratchet tightening device on the threaded fuel filler cap reduces the chances of incorrect installation, which seals the

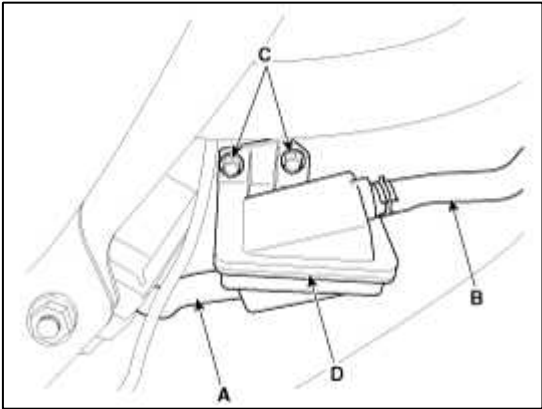
fuel filler. After the gasket on the fuel filler cap and the filler neck flange contact each other, the ratchet produces a loud clicking noise indicating the seal has been set.



Emission Control System > Evaporative Emission Control System > Fuel Tank Air Filter > Repair procedures

Removal

- 1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
- 2. Disconnect the ventilation hoses (A,B) from the fuel tank air filter.
- 3. After removing the installation bolt (C), remove the fuel tank air filter (D).



Installation

1. Installation is the reverse of removal.

Fuel tank air filter installation bolt :
3.9 ~ 5.9 N.m (0.4~0.6 kgf.m, 2.9 ~ 4.3 lb-ft)

Emission Control System > Exhaust Emission Control System > Description and Operation

Description

Exhaust emissions (CO, HC, NOx) are controlled by a combination of engine modifications and the addition of special control components. Modifications to the combustion chamber, intake manifold, camshaft and ignition system form the basic control system. These items have been integrated into a highly effective system which controls exhaust emissions while maintaining good drivability and fuel economy.

Air/Fuel Mixture Control System [Multiport Fuel Injection (MFI) System]

The MFI system uses signals from the heated oxygen sensor to activate and control the injector installed in the manifold for each cylinder, thus precisely regulating the air/fuel mixture ratio and reducing emissions. This in turn allows the engine to produce exhaust gas of the proper composition to permit the use of a three way catalyst. The three way catalyst is designed to convert the three pollutants [hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx)] into harmless substances. There are two operating modes in the MFI system.

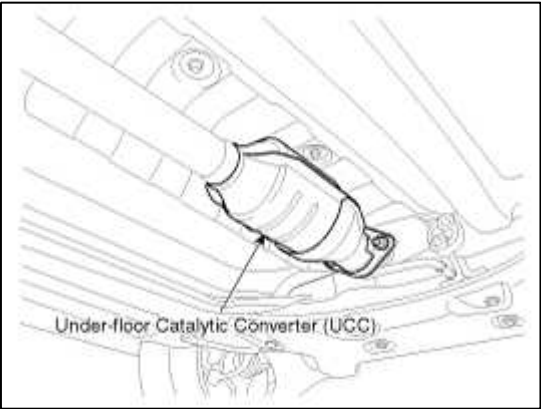
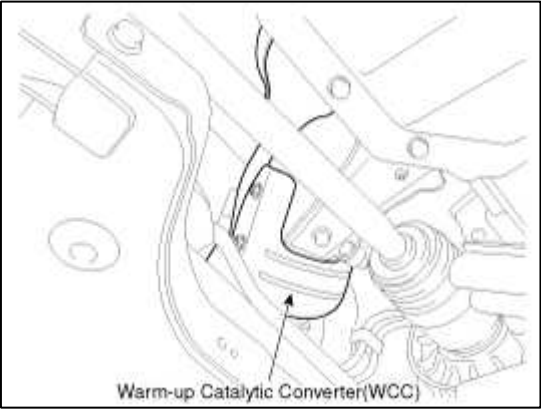
- 1. Open Loop air/fuel ratio is controlled by information pre-programmed into the ECM.
- 2. Closed Loop air/fuel ratio is constantly adjusted by the ECM based on information supplied by the oxygen sensor.

Emission Control System > Exhaust Emission Control System > Catalytic Converter > Description and Operation

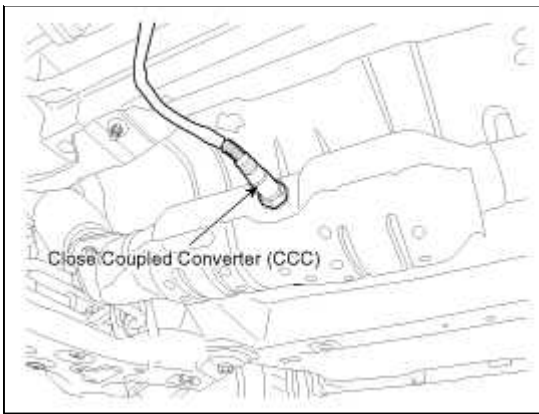
Description

The catalytic converter of the gasoline engine is a three way catalyst. It oxidizes carbon monoxide and hydrocarbons (HC), and separates oxygen from the oxides of nitrogen (NOx).

[1.6 GDI]



[2.0 MPI]



Emission Control System > Exhaust Emission Control System > CVVT (Continuously Variable Valve Timing) System > Description and Operation

Description

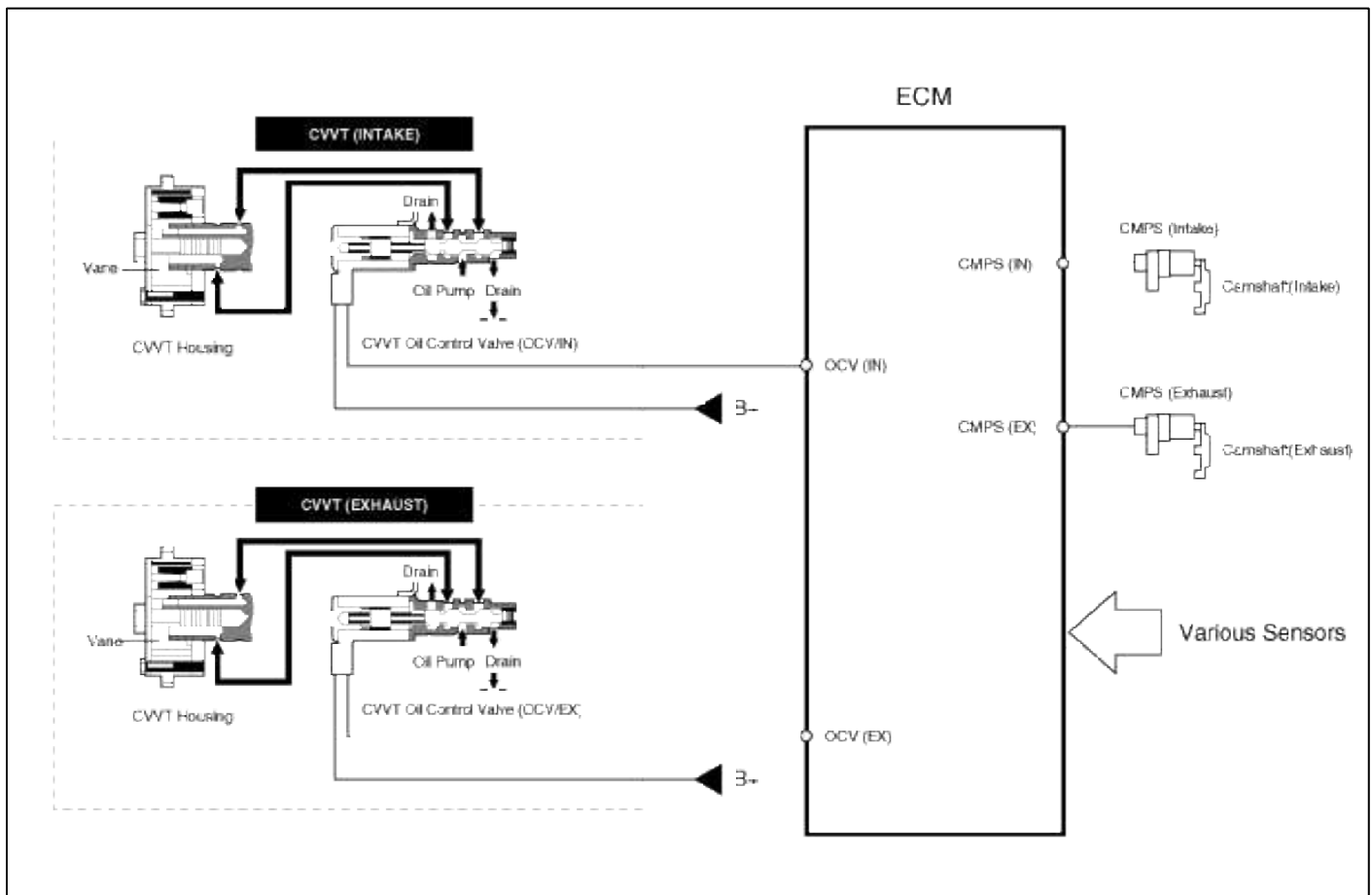
Continuous Variable Valve Timing (CVVT) system advances or retards the valve timing of the intake and exhaust valve in accordance with the ECM control signal which is calculated by the engine speed and load.

By controlling CVVT, the valve over-lap or under-lap occurs, which makes better fuel economy and reduces exhaust gases (NO_x, HC) and improves engine performance through reduction of pumping loss, internal EGR effect, improvement of combustion stability, improvement of volumetric efficiency, and increase of expansion work.

This system consist of

- the CVVT Oil Control Valve (OCV) which regulates engine oil to and from the cam phaser in accordance with the ECM PWM (Pulse With Modulation) control signal,
- and the Cam Phaser which varies the cam phase by using the hydraulic force of the engine oil.

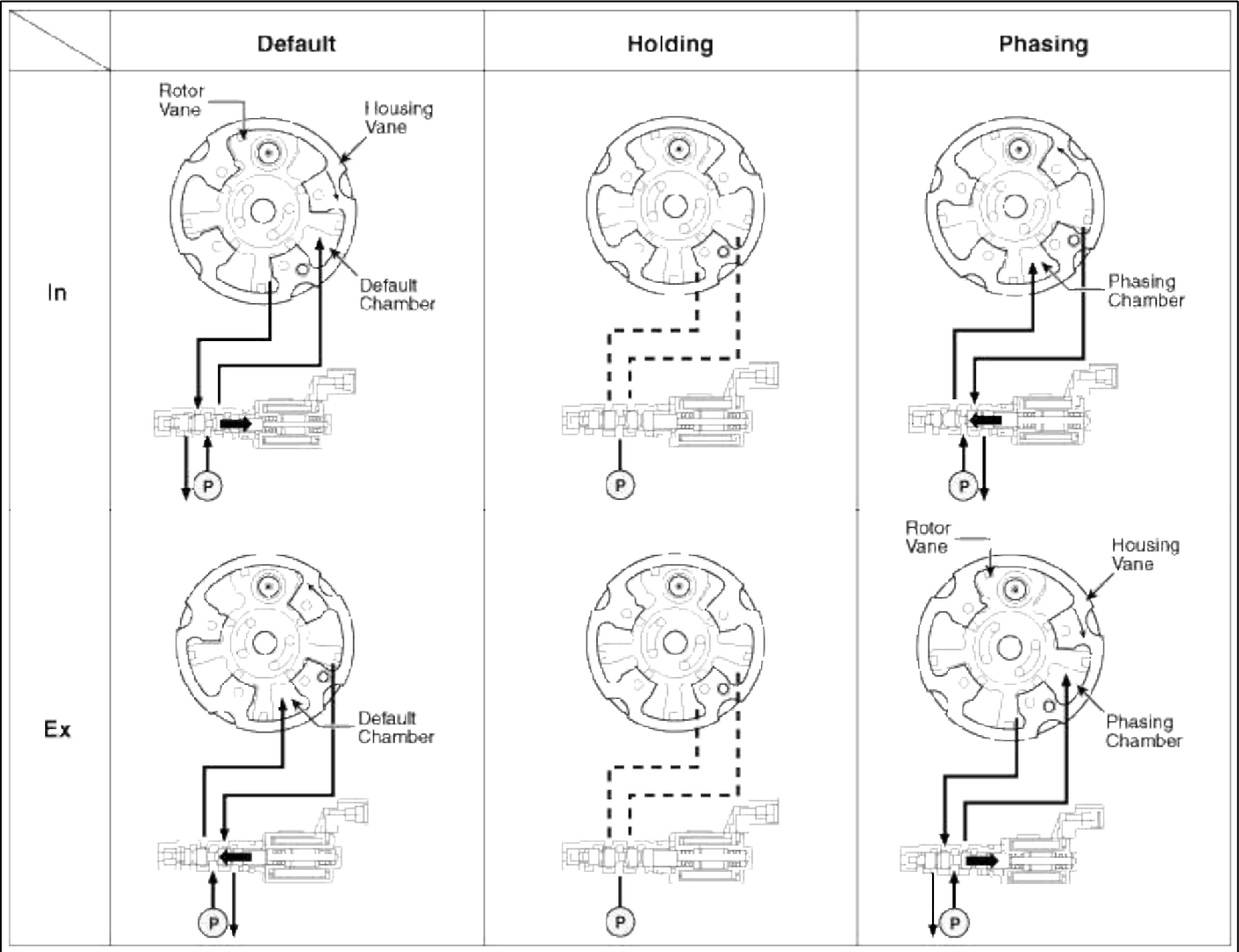
The engine oil getting out of the CVVT oil control valve varies the cam phase in the direction (Intake Advance/Exhaust Retard) or opposite direction (Intake Retard/Exhaust Advance) of the engine rotation by rotating the rotor connected with the camshaft inside the cam phaser.



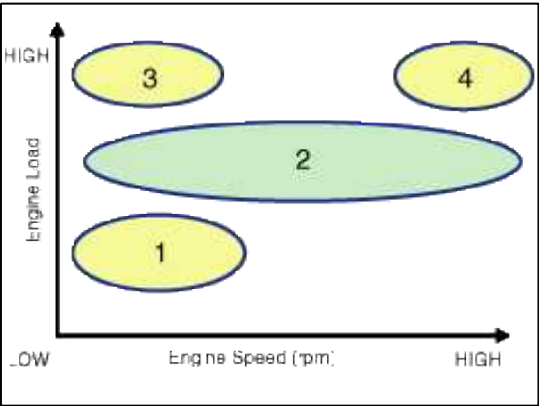
Operation Principle

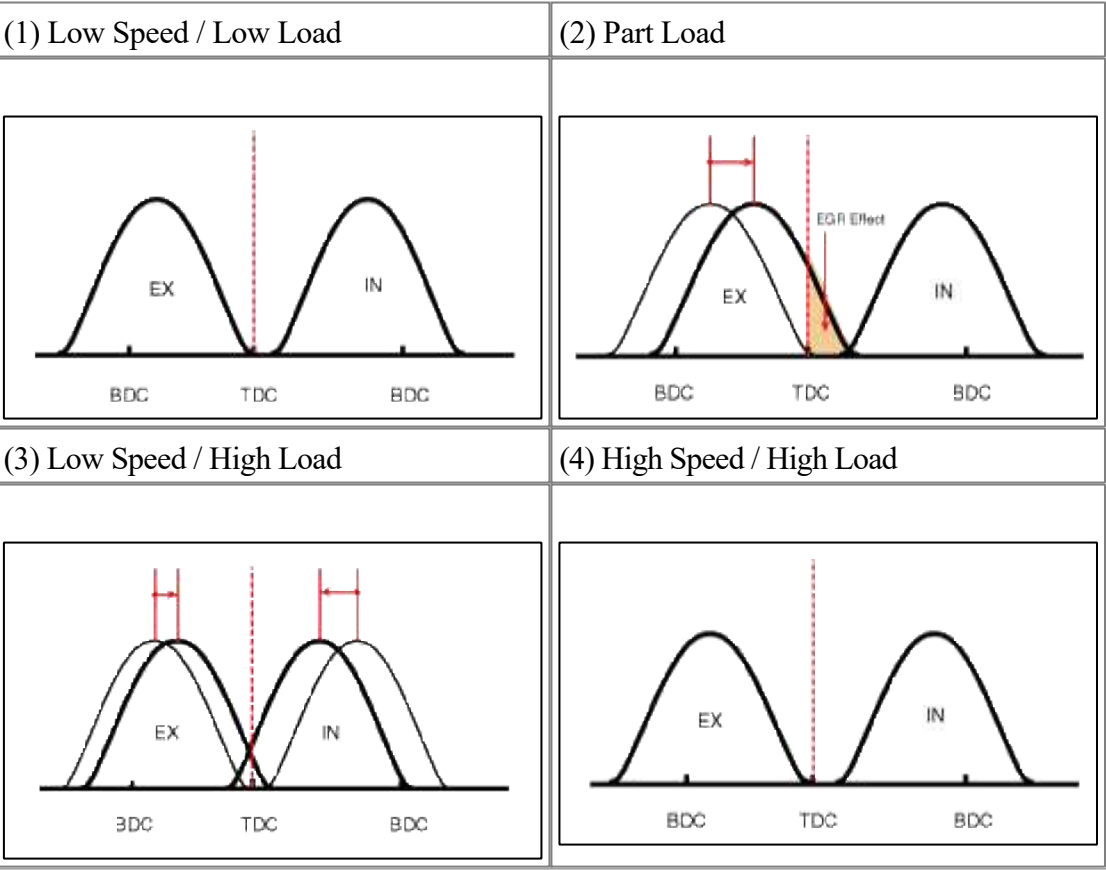
The CVVT has the mechanism rotating the rotor vane with hydraulic force generated by the engine oil supplied to the

advance or retard chamber in accordance with the CVVT oil control valve control.



[CVVT System Mode]





Driving Condition	Exhaust Valve		Intake Valve	
	Valve Timing	Effect	Valve Timing	Effect
(1) Low Speed /Low Load	Completely Advance	* Valve Under-lap * Improvement of combustion stability	Completely Retard	* Valve Under-lap * Improvement of combustion stability
(2) Part Load	Retard	* Increase of expansion work * Reduction of pumping loss * Reduction of HC	Retard	* Reduction of pumping loss
(3) Low Speed /High Load	Retard	* Increase of expansion work	Advance	* Prevention of intake back flow (Improvement of volumetric efficiency)
(4) High Speed /High Load	Advance	* Reduction of pumping loss	Retard	* Improvement of volumetric efficiency

SOUL(AM) > 2013 > G 2.0 DOHC > Fuel System

Fuel System > General Information > Specifications

Specifications

Fuel Delivery System

Items	Specification	
Fuel Tank	Capacity	48 lit. (12.6 U.S.gal., 50.7 U.S.qt., 42.2 Imp.qt.)
Fuel Filter	Type	Paper type
Fuel Pressure Regulator	Regulated Fuel Pressure	338 ~ 348 kPa (3.45 ~ 3.55 kgf/cm ² , 49.0 ~ 50.5 psi)
Fuel Pump	Type	Electrical, in-tank type
	Driven by	Electric motor

Sensors

Manifold Absolute Pressure Sensor (MAPS)

Type: Piezo-resistive pressure sensor type

Specification

Pressure [kPa (kgf/cm ² , psi)]	Output Voltage (V)
20.0 (0.20, 2.9)	0.79
46.7 (0.47, 6.77)	1.84
101.3 (1.03, 14.7)	4.0

Intake Air Temperature Sensor (IATS)

Type: Thermistor type

Specification

Temperature [°C(°F)]	Resistance (kΩ)
-40(-40)	40.93 ~ 48.35
-20(-4)	13.89 ~ 16.03
0(32)	5.38 ~ 6.09
10(50)	3.48 ~ 3.90
20(68)	2.31 ~ 2.57
40(104)	1.08 ~ 1.21
50(122)	0.76 ~ 0.85
60(140)	0.54 ~ 0.62
80(176)	0.29 ~ 0.34

Engine Coolant Temperature Sensor (ECTS)

Type: Thermistor type

Specification

Temperature [°C(°F)]	Resistance (kΩ)
-40(-40)	48.14
-20(-4)	14.13 ~ 16.83
0(32)	5.79
20(68)	2.31 ~ 2.59
40(104)	1.15
60(140)	0.59
80(176)	0.32

Throttle Position Sensor (TPS) [integrated into ETC module]

Type : Hall IC Non-contact sensor type

Specification

Throttle angle (°)	Output voltage (V) [Vref = 5.0V]	
	TPS1	TPS2
0	0.5	4.5
10	0.96	4.05
20	1.41	3.59
30	1.87	3.14
40	2.32	2.68
50	2.78	2.23
60	3.23	1.77
70	3.69	1.32
80	4.14	0.86
90	4.6	0.41
98	4.65	0.35
C.T (0)	0.5	4.5
W.O.T (86)	4.41	0.59

Crankshaft Position Sensor (CKPS)

Type: Magnetic field sensitive Type

Item	Specification
Coil Resistance (Ω)	774 ~ 946 [20°C (68°F)]

Camshaft Position Sensor (CMPS)

Type: Hall effect type

Knock Sensor (KS)

Type: Piezo-electricity type

Specification

Item	Specification
Capacitance (pF)	850 ~ 1,150

Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]

Type: Zirconia (ZrO₂) [Linear] type

Specification

Item	Specification
Heater Resistance (Ω)	2.4 ~ 4.0 [20°C(69.8°F)]

Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]

Type: Zirconia (ZrO₂) [Binary] type

Specification

A/F Ratio (λ)	Output Voltage(V)
RICH	0.6 ~ 1.0
LEAN	0 ~ 0.4

Item	Specification
Heater Resistance (Ω)	Approx. 9.0 [20°C(68°F)]

Accelerator Position Sensor (APS)

Type: Variable resistor type

Specification

Accelerator Position	Output Voltage (V)	
	APS1	APS2
C.T	0.7 ~ 0.8	0.275 ~ 0.475
W.O.T	3.85 ~ 4.35	1.75 ~ 2.35

Fuel Tank Pressure Sensor (FTPS)

Type: Piezo - Resistivity type

Specification

Pressure [kPa (kgf/cm ² , in H ₂ O)]	Output Voltage (V)
-6.67 (-0.068, -26.8)	0.5
0	2.5
+6.67 (0.068, 26.8)	4.5

Actuators

Injector

Specification

Item	Specification
Coil Resistance (Ω)	13.8 ~ 15.2 [20°C(68°F)]

ETC Motor [integrated into ETC Module]

Specification

Item	Specification
Coil Resistance (Ω)	0.3 ~ 100 [20°C(68°F)]

Purge Control Solenoid Valve (PCSV)

Specification

Item	Specification
Coil Resistance (Ω)	22.0 ~ 26.0 [20°C(68°F)]

CVVT Oil Control Valve (OCV)

Specification

Item	Specification
Coil Resistance (Ω)	9,4 ~ 10,4 [20°C(68°F)]

Variable Intake Solenoid (VIS) Valve

Specification

Item	Specification
Coil Resistance (Ω)	30.0 ~ 35.0 [20°C(68°F)]

Variable Charge Motion Actuator (VCMA)

Specification

[Motor]

Item	Specification
Coil Resistance (Ω)	3.4 ~ 4.4 [20°C(68°F)]

[Position Sensor]

Item	Specification
Coil Resistance (k Ω)	3.44 ~ 5.16 [20°C(68°F)]

Ignition Coil

Type: Stick type

Specification

Item	Specification
Primary Coil Resistance (Ω)	0.75 ± 15 [20°C(68°F)]
Secondary Coil Resistance (k Ω)	5.9 ± 15 [20°C(68°F)]

Canister Close Valve (CCV)

Specification

Item	Specification
Coil Resistance (Ω)	15.5 ~ 18.5 [20°C(68°F)]

Service Standard

Item		Specification	
Ignition Timing (°)		BTDC 5 ± 10	
Idle Speed (rpm)	A/C OFF	Neutral, N, P-range	630 ± 100
		D-range	630 ± 100
	A/C ON	Neutral, N, P-range	720 ± 100
		D-range	720 ± 100

Tightening Torques

Engine Control System

Item	kgf.m	N.m	lb-ft
ECM installation nut	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
ECM bracket installation nut	0.8 ~ 1.2	7.8 ~ 11.8	5.8 ~ 8.7
ECM bracket installation bolt	2.0 ~ 3.0	19.6 ~ 29.4	14.5 ~ 21.7
Manifold absolute pressure sensor installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Intake air temperature sensor installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Engine coolant temperature sensor installation	3.0 ~ 4.0	29.4 ~ 39.2	21.7 ~ 28.9
Crankshaft position sensor installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Camshaft position sensor (Bank 1 / Intake) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Camshaft position sensor (Bank 1 / Exhaust) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Knock sensor installation bolt	1.9 ~ 2.4	18.6 ~ 23.5	13.7 ~ 17.4

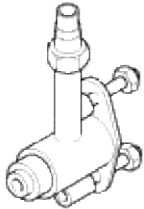
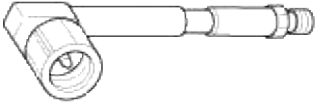
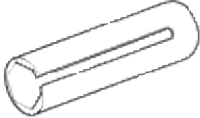
Heated oxygen sensor (Bank 1 / sensor 1) installation	4.0 ~ 5.0	39.2 ~ 49.1	28.9 ~ 36.2
Heated oxygen sensor (Bank 1 / sensor 2) installation	4.0 ~ 5.0	39.2 ~ 49.1	28.9 ~ 36.2
Electronic throttle body installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Purge control solenoid valve bracket installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
CVVT oil control valve (Bank 1 / Intake) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
CVVT oil control valve (Bank 1 / Exhaust) installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Variable intake solenoid valve bracket installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Ignition coil installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7
Variable charge motion actuator installation bolt	1.0 ~ 1.2	9.8 ~ 11.8	7.2 ~ 8.7

Fuel Delivery System

Item	kgf.m	N.m	lb-ft
Fuel tank installation bolt	4.0 ~ 5.5	39.2 ~ 53.9	28.9 ~ 39.8
Fuel tank installation nut	4.0 ~ 5.5	39.2 ~ 53.9	28.9 ~ 39.8
Fuel pump plate cover installation nut	0.2 ~ 0.3	2.0 ~ 2.9	1.4 ~ 2.2
Filler-neck assembly bracket installation bolt	0.4 ~ 0.6	3.9 ~ 5.9	2.9 ~ 4.3
Filler-neck assembly installation screw	0.6 ~ 0.7	5.6 ~ 6.9	4.3 ~ 5.1
Accelerator pedal installation nut	1.7 ~ 2.6	16.7 ~ 25.5	12.3 ~ 18.8
Delivery pipe installation bolt	1.9 ~ 2.4	18.6 ~ 23.5	13.7 ~ 17.4

Fuel System > General Information > Special Service Tools

Special Service Tools

Tool (Number and Name)	Illustration	Application
Fuel Pressure Gauge (09353-24100)		Measuring the fuel line pressure
Fuel Pressure Gauge Adapter (09353-38000)		Connection between the delivery pipe and the fuel feed line
Fuel Pressure Gauge Connector (09353-24000)		Connection between the Fuel Pressure Gauge (09353-24100) and the Fuel Pressure Gauge Adapter (09353-38000)
Heated Oxygen Sensor Socket Wrench (09392-2H100)		Removal and installation of the heated oxygen sensor

Fuel System > General Information > Troubleshooting

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 the GDS 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 of 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

1. VEHICLE INFORMATION

VIN No.		Transmission	☐ M/T ☐ A/T ☐ CVT ☐ etc.
Production date		Driving type	☐ 2WD (FF) ☐ 2WD (FR) ☐ 4WD
Odometer Reading	_____ km/mile	DPF (Diesel Engine)	☐ With DPF ☐ Without DPF

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

5. FCM/PCM INFORMATION

ECM/PCM Part No.	
ROM ID	

Basic Inspection Procedure

Measuring Condition of Electronic Parts' Resistance

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 stated otherwise.

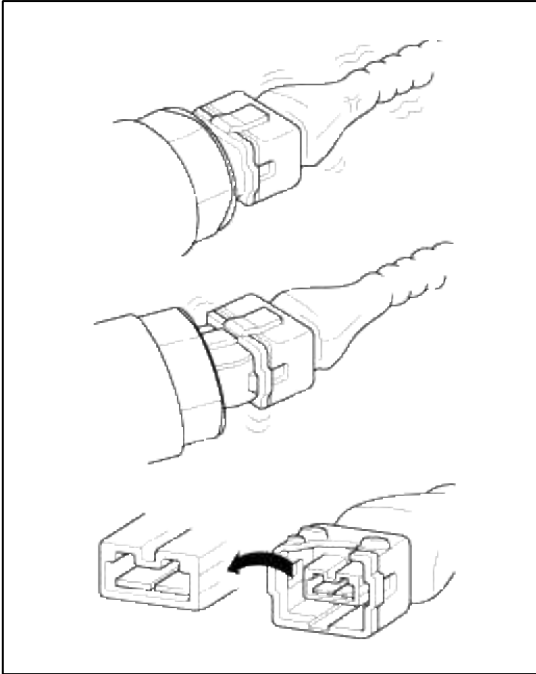
NOTE

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

Intermittent Problem Inspection Procedure

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, the 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.

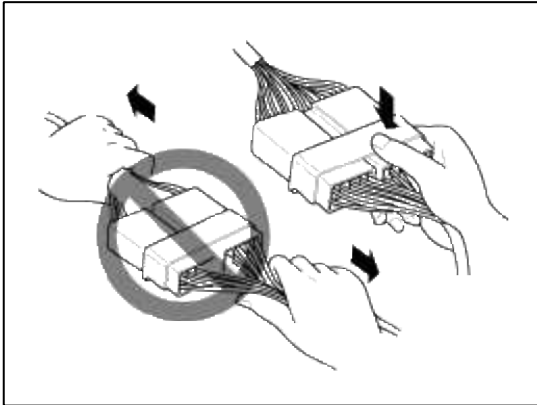
- Simulating Electrical Load

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

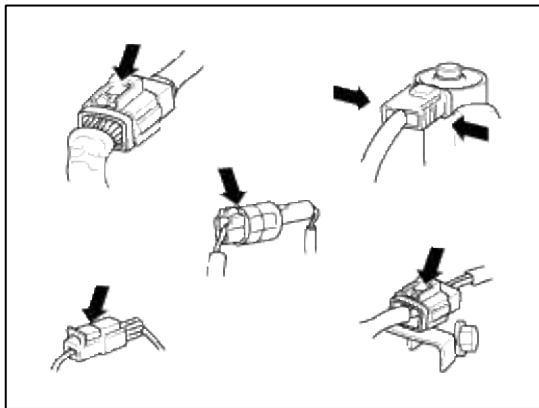
Connector Inspection Procedure

1. Handling of Connector

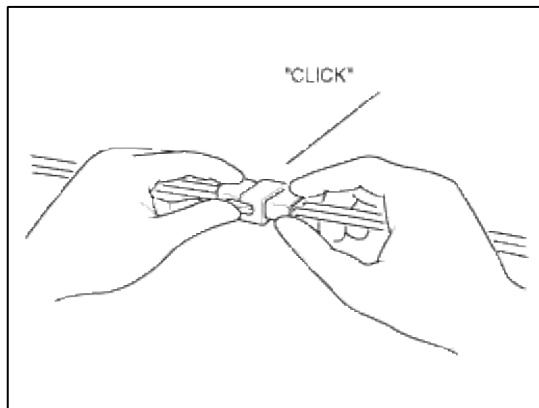
- A. Never pull on the wiring harness when disconnecting connectors.



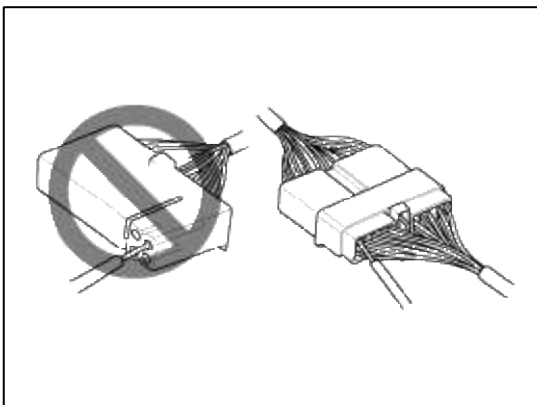
- B. When removing the connector with a lock, press or pull locking lever.



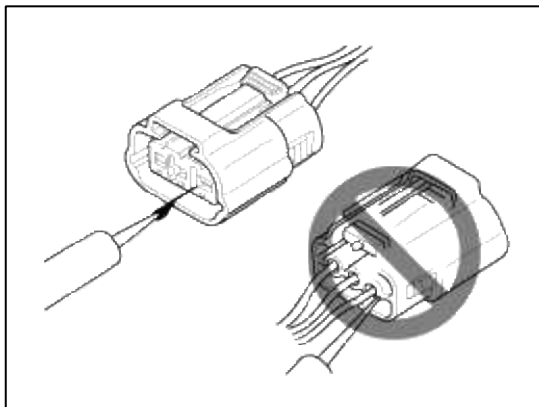
- C. Listen for a click when locking connectors. This sound indicates that they are securely locked.



- 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.



NOTE

- 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.

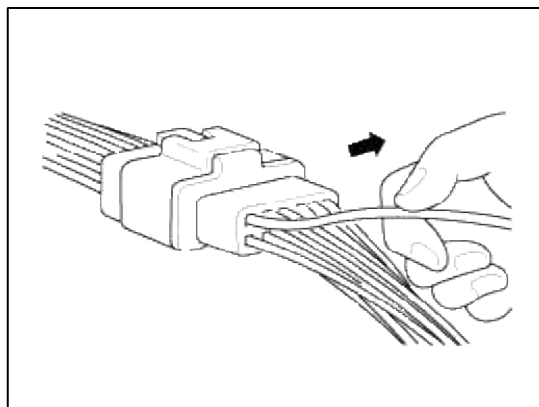
B. When the connector is disconnected:

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.

NOTE

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

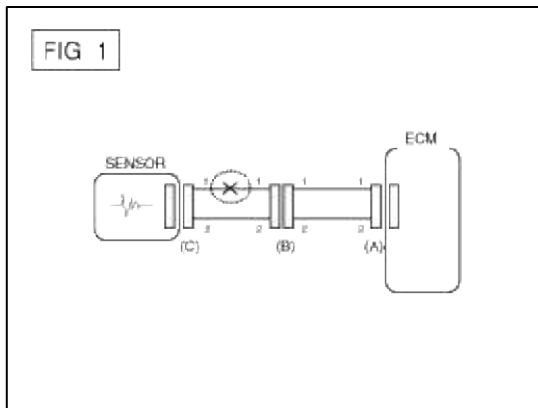
● Check Open Circuit

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

NOTE

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

Specification (Resistance)

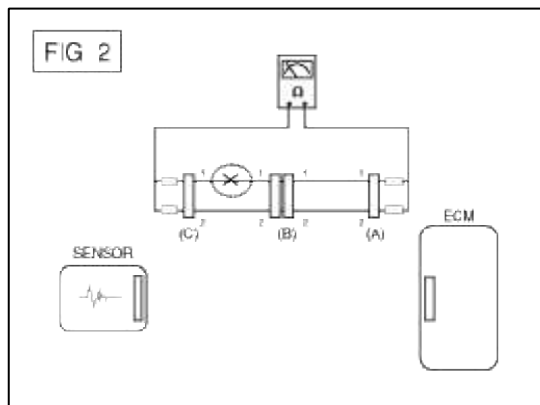
1Ω or less → Normal Circuit

$1M\Omega$ or Higher → Open Circuit

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

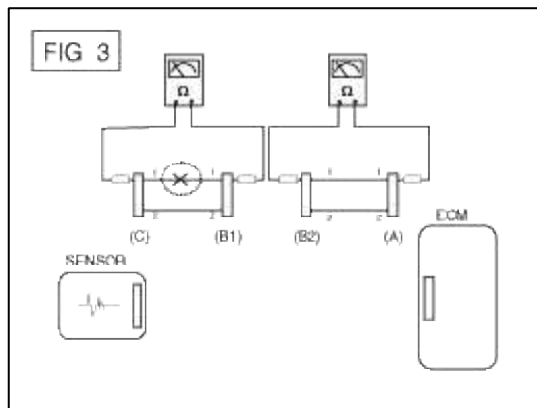
In [FIG.2.] the measured resistance of line 1 and 2 is higher than $1M\Omega$ and below 1Ω respectively.

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].

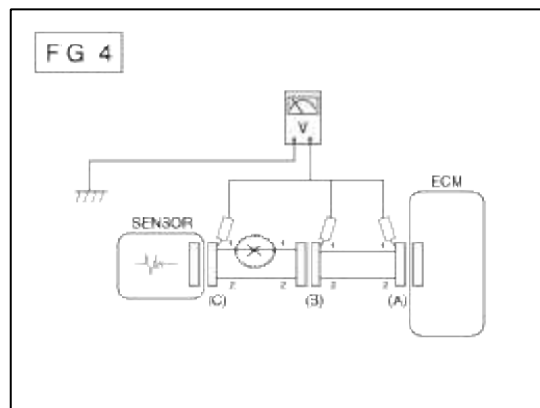
In this case the measured resistance between connector (C) and (B1) is higher than $1\text{M}\Omega$ and the open circuit is between terminal 1 of connector (C) and terminal 1 of connector (B1).



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).

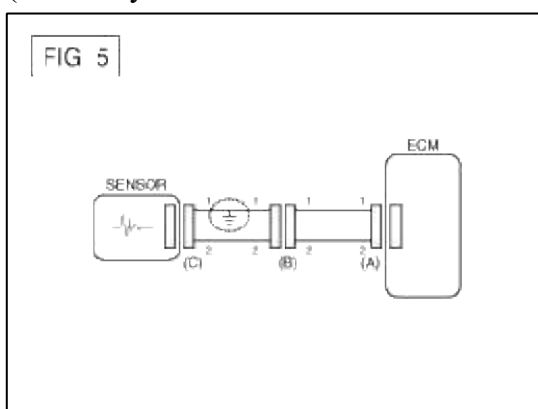


● Check Short Circuit

1. Test Method for Short to Ground Circuit

A. Continuity Check with Chassis Ground

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



2. Continuity Check Method (with Chassis Ground)

NOTE

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

Specification (Resistance)

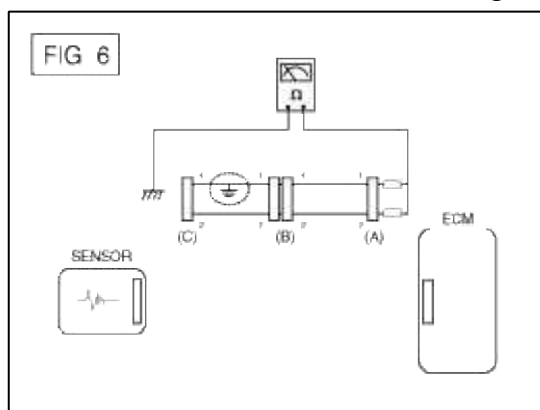
1Ω or less → Short to Ground Circuit

$1M\Omega$ or Higher → Normal Circuit

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

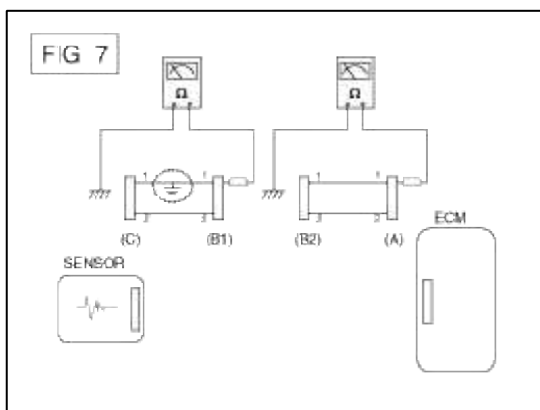
The measured resistance of line 1 and 2 in this example is below 1Ω and higher than $1M\Omega$ respectively.

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.



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

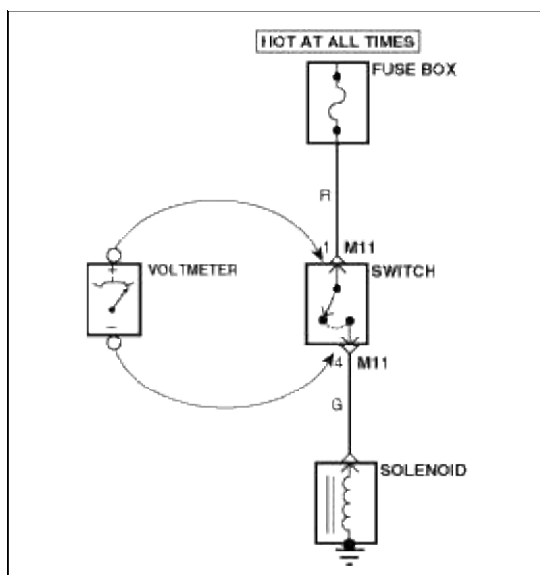
The measured resistance between connector (B1) and chassis ground is 1Ω or less. The short to ground circuit is between terminal 1 of connector (C) and terminal 1 of connector (B1).



● Testing For Voltage Drop

This test checks for voltage drop along a wire, or through a connection or switch.

- 1) Connect the positive lead of a voltmeter to the end of the wire (or to the side of the connector or switch) closest to the battery.
- 2) Connect the negative lead to the other end of the wire. (or the other side of the connector or switch)
- 3) Operate the circuit.
- 4) The voltmeter will show the difference in voltage between the two points. A difference, or drop of more than 0.1 volts (50mV in 5V circuits), may indicate a problem. Check the circuit for loose or dirty connections.



Symptom Troubleshooting Guide Chart

Main symptom	Diagnostic procedure	Also check for
Unable to start (Engine does not turn over)	1. Test the battery 2. Test the starter 3. Inhibitor switch (A/T) or clutch start switch (M/T)	
Unable to start (Incomplete combustion)	1. Test the battery 2. Check the fuel pressure 3. Check the ignition circuit 4. Troubleshooting the immobilizer system (In case of immobilizer lamp flashing)	• DTC • Low compression • Intake air leaks • Slipped or broken timing belt • Contaminated fuel
Difficult to start	1. Test the battery 2. Check the fuel pressure 3. Check the ECT sensor and circuit (Check DTC) 4. Check the ignition circuit	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Poor idling (Rough, unstable or incorrect Idle)	1. Check the fuel pressure 2. Check the Injector 3. Check the long term fuel trim and short term fuel trim (Refer to CUSTOMER DATASTREAM) 4. Check the idle speed control circuit (Check DTC) 5. Inspect and test the Throttle Body 6. Check the ECT sensor and circuit (Check DTC)	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Engine stall	1. Test the Battery 2. Check the fuel pressure 3. Check the idle speed control circuit (Check DTC) 4. Check the ignition circuit 5. Check the CKPS Circuit (Check DTC)	• DTC • Intake air leaks • Contaminated fuel • Weak ignition spark
Poor driving (Surge)	1. Check the fuel pressure 2. Inspect and test Throttle Body	• DTC

	3. Check the ignition circuit 4. Check the ECT Sensor and Circuit (Check DTC) 5. Test the exhaust system for a possible restriction 6. Check the long term fuel trim and short term fuel trim (Refer to CUSTOMER DATASTREAM)	• Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Knocking	1. Check the fuel pressure 2. Inspect the engine coolant 3. Inspect the radiator and the electric cooling fan 4. Check the spark plugs	• DTC • Contaminated fuel
Poor fuel economy	1. Check customer's driving habits • A/C on full time or the defroster mode on? • Are tires at correct pressure? • Is excessively heavy load being carried? • Is acceleration too much, too often? 2. Check the fuel pressure 3. Check the injector 4. Test the exhaust system for a possible restriction 5. Check the ECT sensor and circuit	• DTC • Low compression • Intake air leaks • Contaminated fuel • Weak ignition spark
Hard to refuel (Overflow during refueling)	1. Test the canister close valve 2. Inspect the fuel filler hose/pipe • Pinched, kinked or blocked? • Filler hose is torn 3. Inspect the fuel tank vapor vent hose between the EVAP. canister and air filter 4. Check the EVAP. canister	• Malfunctioning gas station filling nozzle (If this problem occurs at a specific gas station during refueling)

Fuel System > Engine Control System > Description and Operation

OBD-II review

1. Overview

The California Air Resources Board (CARB) began regulation of On Board Diagnostics (OBD) for vehicles sold in California beginning with the 1988 model year. The first phase, OBD-I, required monitoring of the fuel metering system, Exhaust Gas Recirculation (EGR) system and additional emission related components. The Malfunction Indicator Lamp (MIL) was required to light and alert the driver of the fault and the need for repair of the emission control system. Associated with the MIL was a fault code or Diagnostic Trouble Code (DTC) identifying the specific area of the fault.

The OBD system was proposed by CARB to improve air quality by identifying vehicle exceeding emission standards. Passage of the Federal Clean Air Act Amendments in 1990 has also prompted the Environmental Protection Agency (EPA) to develop On Board Diagnostic requirements. CARB OBD-II regulations were followed until 1999 when the federal regulations were used.

The OBD-II system meets government regulations by monitoring the emission control system. When a system or component exceeds emission threshold or a component operates outside tolerance, a DTC will be stored and the MIL illuminated.

The diagnostic executive is a computer program in the Engine Control Module (ECM) or PowertrainControl Module (PCM) that coordinates the OBD-II self-monitoring system. This program controls all the monitors and interactions, DTC and MIL operation, freeze frame data and scan tool interface.

Freeze frame data describes stored engine conditions, such as state of the engine, state of fuel control, spark, RPM,

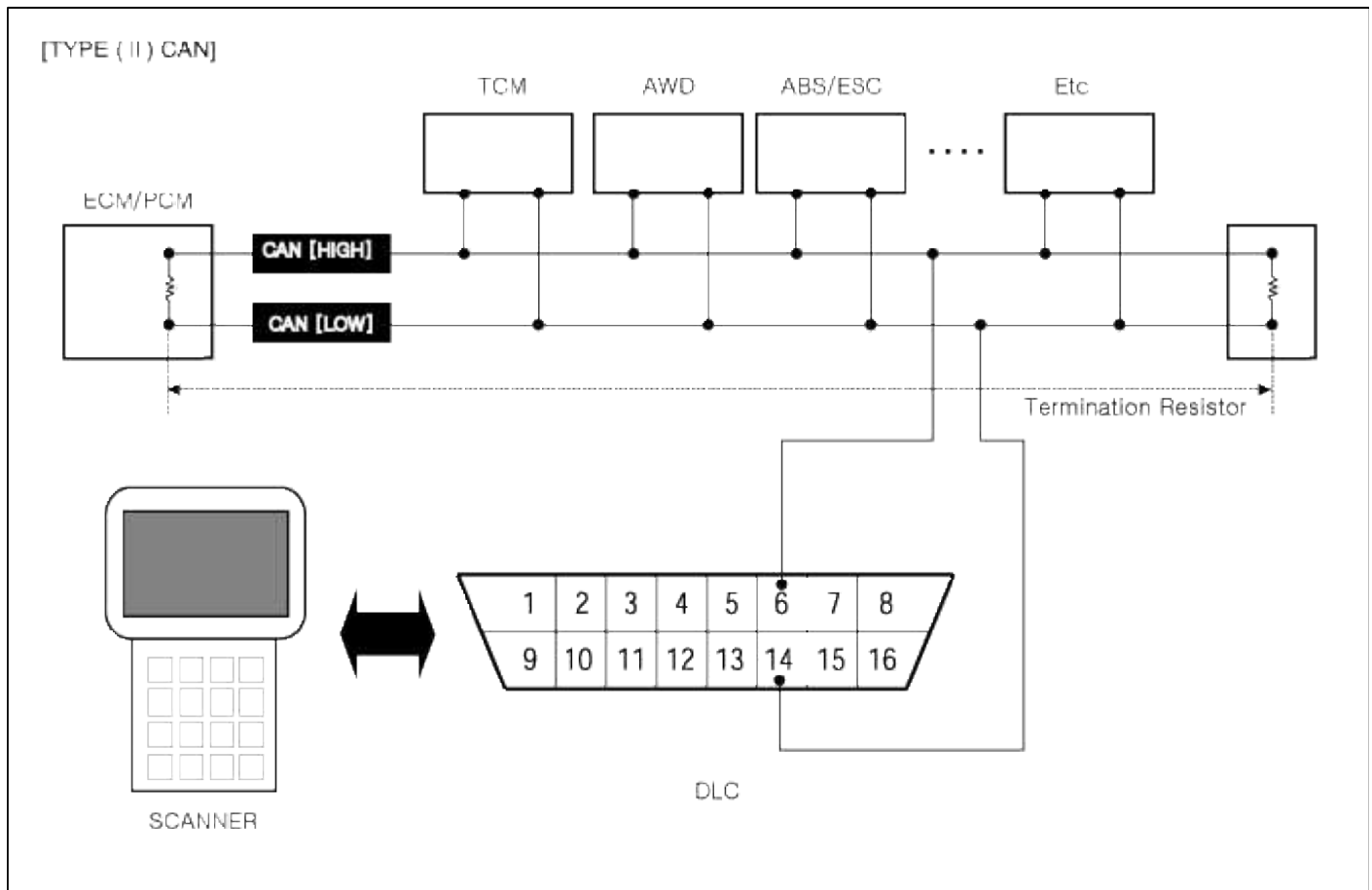
load and warm status at the point the first fault is detected. Previously stored conditions will be replaced only if a fuel or misfire fault is detected. This data is accessible with the scan tool to assist in repairing the vehicle.

The center of the OBD-II system is a microprocessor called the Engine Control Module (ECM) or Powertrain Control Module (PCM).

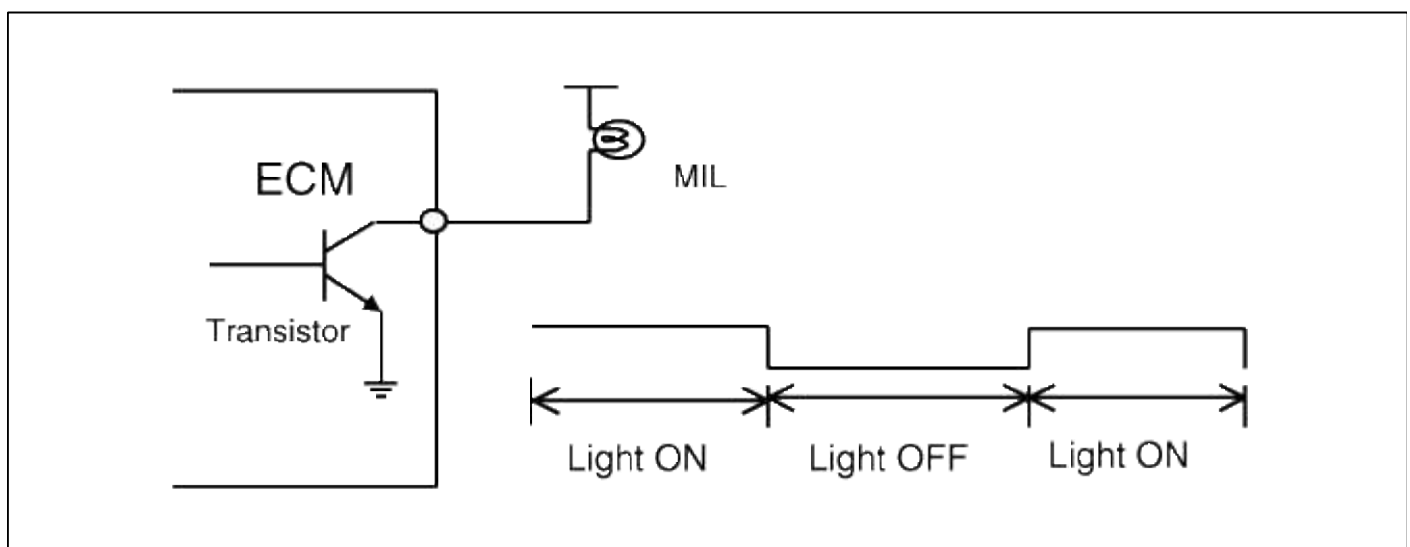
The ECM or PCM receives input from sensors and other electronic components (switches, relays, and others) based on information received and programmed into its memory (keep alive random access memory, and others), the ECM or PCM generates output signals to control various relays, solenoids and actuators.

2. Configuration of hardware and related terms

1) GST (Generic scan tool)



2) MIL (Malfunction indication lamp) - MIL activity by transistor



The Malfunction Indicator Lamp (MIL) is connected between ECM or PCM-terminal Malfunction Indicator Lamp

and battery supply (open collector amplifier).

In most cars, the MIL will be installed in the instrument panel. The lamp amplifier can not be damaged by a short circuit.

Lamps with a power dissipation much greater than total dissipation of the MIL and lamp in the tester may cause a fault indication.

At ignition ON and engine revolution (RPM) < MIN. RPM, the MIL is switched ON for an optical check by the driver.

3) MIL illumination

When the ECM or PCM detects a malfunction related emission during the first driving cycle, the DTC and engine data are stored in the freeze frame memory. The MIL is illuminated only when the ECM or PCM detects the same malfunction related to the DTC in two consecutive driving cycles.

4) MIL elimination

• Misfire and Fuel System Malfunctions:

For misfire or fuel system malfunctions, the MIL may be eliminated if the same fault does not reoccur during monitoring in three subsequent sequential driving cycles in which conditions are similar to those under which the malfunction was first detected.

• All Other Malfunctions:

For all other faults, the MIL may be extinguished after three subsequent sequential driving cycles during which the monitoring system responsible for illuminating the MIL functions without detecting the malfunction and if no other malfunction has been identified that would independently illuminate the MIL according to the requirements outlined above.

5) Erasing a fault code

The diagnostic system may erase a fault code if the same fault is not re-registered in at least 40 engine warm-up cycles, and the MIL is not illuminated for that fault code.

6) Communication Line (CAN)

- Bus Topology : Line (bus) structure
- Wiring : Twisted pair wire
- Off Board DLC Cable Length : Max. 5m
- Data Transfer Rate
 - Diagnostic : 500 kbps
 - Service Mode (Upgrade, Writing VIN) : 500 or 1Mbps)

7) Driving cycle

A drive cycle is when a vehicle is operation (following an engine-off period) for a duration and driving mode such that all components and systems are monitored at least once by the diagnostic system except catalyst efficiency or evaporative system monitoring when a steady-speed check is used, subject to the limitation that the manufacturer-defined trip monitoring conditions shall all be encountered at least once during the first engine start portion of the applicable FTP cycle.

8) Warm-up cycle

A warm-up cycle means sufficient vehicle operation such that the engine coolant temperature has risen by at least 40 degrees Fahrenheit from engine starting and reaches a minimum temperature of at least 160 degrees Fahrenheit.

9) Trip cycle

A trip cycle is when a vehicle is driven under the conditions for one or more of the monitors is completed. After repairing the vehicle for an emission related fault, driving the vehicle under the conditions to run the monitor for the system is considered a Trip.

10) DTC format

- Diagnostic Trouble Code (SAE J2012)
- DTCs used in OBD-II vehicles will begin with a letter and are followed by four numbers.

The letter of the beginning of the DTC identifies the function of the monitored device that has failed. A "P" indicates a powertrain device, "C" indicates a chassis device. "B" is for body device and "U" indicates a network or data link code. The first number indicates if the code is generic (common to all manufacturers) or if it is manufacturer specific.

A "0" & "2" indicates generic, "1" indicates manufacturer-specific. The second number indicates the system that is affected with a number between 1 and 7.

The following is a list showing what numbers are assigned to each system.

1. Fuel and air metering
2. Fuel and air metering(injector circuit malfunction only)
3. Ignition system or misfire
4. Auxiliary emission controls
5. Vehicle speed controls and idle control system
6. Computer output circuits
7. Transmission

The last two numbers of the DTC indicates the component or section of the system where the fault is located.

11) Freeze frame data

When a freeze frame event is triggered by an emission related DTC, the ECM or PCM stores various vehicle information as it existed the moment the fault occurred. The DTC number along with the engine data can be useful in aiding a technician in locating the cause of the fault. Once the data from the 1st driving cycle DTC occurrence is stored in the freeze frame memory, it will remain there even when the fault occurs again (2nd driving cycle) and the MIL is illuminated.

- Freeze Frame List

- 1) Calculated Load Value
 - 2) Engine RPM
 - 3) Fuel Trim
 - 4) Fuel Pressure (if available)
 - 5) Vehicle Speed (if available)
 - 6) Coolant Temperature
 - 7) Intake Manifold Pressure (if available)
 - 8) Closed-or Open-loop operation
 - 9) Fault code
3. OBD-II system readiness tests
- 1) Catalyst monitoring

The catalyst efficiency monitor is a self-test strategy within the ECM or PCM that uses the downstream Heated Oxygen Sensor (HO2S) to determine when a catalyst has fallen below the minimum level of effectiveness in its ability to control exhaust emission.

2) Misfire monitoring

Misfire is defined as the lack of proper combustion in the cylinder due to the absence of spark, poor fuel metering, or poor compression. Any combustion that does not occur within the cylinder at the proper time is also a misfire. The misfire detection monitor detects fuel, ignition or mechanically induced misfires. The intent is to protect the catalyst from permanent damage and to alert the customer of an emission failure or an inspection maintenance failure by illuminating the MIL . When a misfire is detected, special software called freeze frame data is enabled. The freeze frame data captures the operational state of the vehicle when a fault is detected from misfire detection monitor strategy.

3) Fuel system monitoring

The fuel system monitor is a self-test strategy within the ECM or PCM that monitors the adaptive fuel table The fuel control system uses the adaptive fuel table to compensate for normal variability of the fuel system components caused by wear or aging. During normal vehicle operation, if the fuel system appears biased lean or rich, the adaptive value table will shift the fuel delivery calculations to remove bias.

4) Engine cooling system monitoring

The cooling system monitoring is a self-test strategy within the ECM or PCM that monitors ECTS (Engine Coolant Temperature Sensor) and thermostat about circuit continuity, output range, rationality faults.

5) O2 sensor monitoring

OBD-II regulations require monitoring of the upstream Heated O₂ Sensor (H₂OS) to detect if the deterioration of the sensor has exceeded thresholds. An additional HO₂S is located downstream of the Warm-Up Three Way Catalytic Converter (WU-TWC) to determine the efficiency of the catalyst.

Although the downstream H₂OS is similar to the type used for fuel control, it functions differently. The downstream HO₂S is monitored to determine if a voltage is generated. That voltage is compared to a calibrated acceptable range.

6) Evaporative emission system monitoring

The EVAP. monitoring is a self-test strategy within the ECM or PCM that tests the integrity of the EVAP. system.

The complete evaporative system detects a leak or leaks that cumulatively are greater than or equal to a leak caused by a 0.040 inch and 0.020 inch diameter orifice.

7) Air conditioning system monitoring

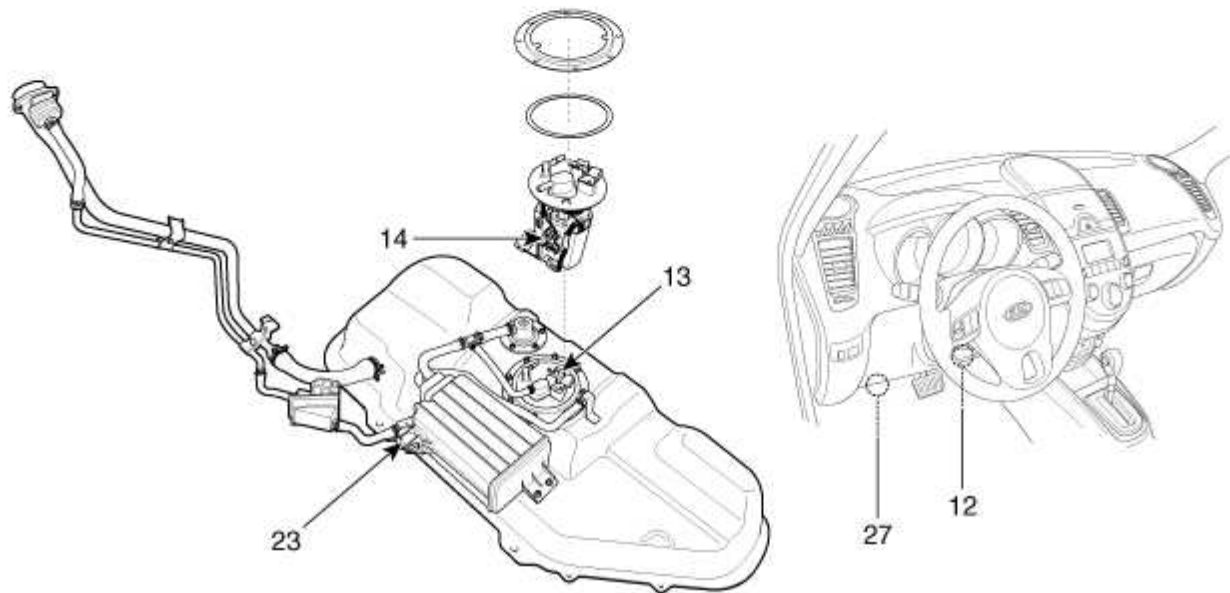
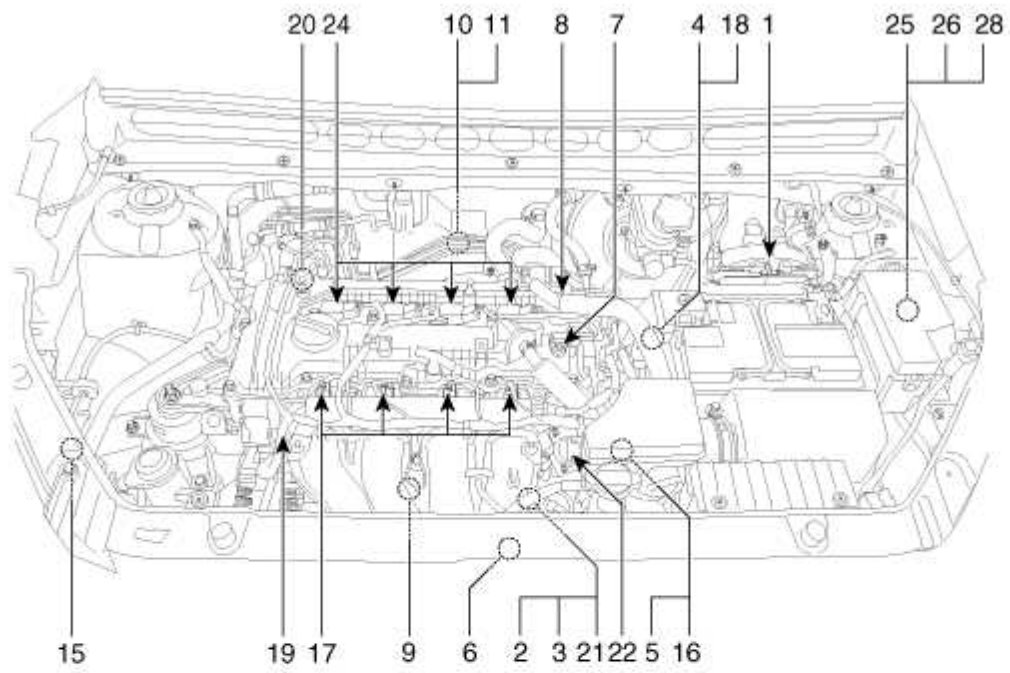
The A/C system monitoring is a self-test strategy within the ECM or PCM that monitors malfunction of all A/C system components at A/C ON.

8) Comprehensive components monitoring

The comprehensive components monitoring is a self-test strategy within the ECM or PCM that detects fault of any electronic powertrain components or system that provides input to the ECM or PCM and is not exclusively an input to any other OBD-II monitor.

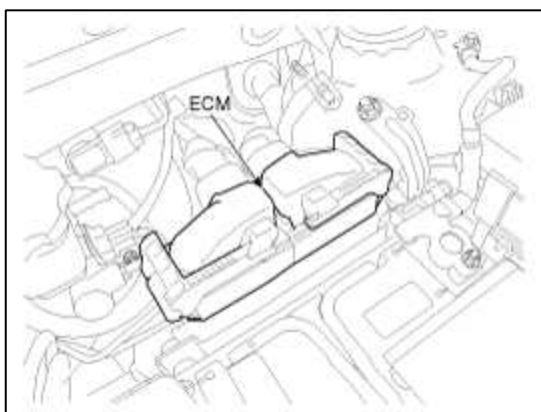
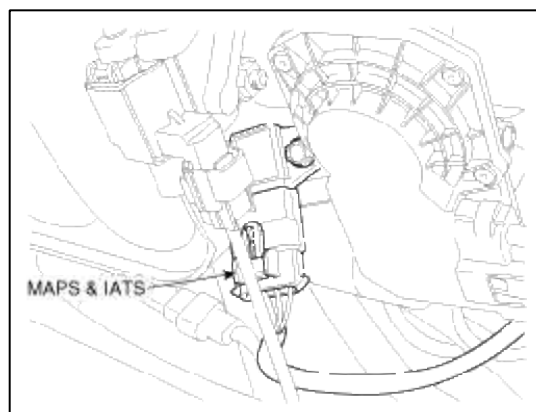
Fuel System > Engine Control System > Components and Components Location

Components Location

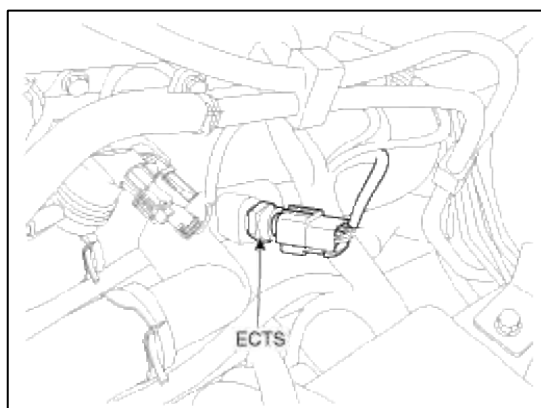
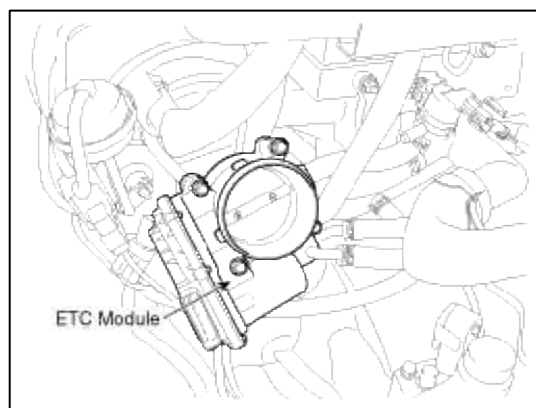


1. Engine Control Module (ECM) 2. Manifold Absolute Pressure Sensor (MAPS) 3. Intake Air Temperature Sensor (IATS) 4. Engine Coolant Temperature Sensor (ECTS) 5. Throttle Position Sensor (TPS) [integrated into ETC Module] 6. Crankshaft Position Sensor (CKPS) 7. Camshaft Position Sensor (CMPS) [Bank 1 / Intake] 8. Camshaft Position Sensor (CMPS) [Bank 1 / Exhaust] 9. Knock Sensor (KS) 10. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 1] 11. Heated Oxygen Sensor (HO2S) [Bank 1 / Sensor 2] 12. Accelerator Position Sensor (APS) 13. Fuel Tank Pressure Sensor (FTPS) 14. Fuel Level Sender (FLS)	15. A/C Pressure Transducer (APT) 16. ETC Motor [integrated into ETC Module] 17. Injector 18. Purge Control Solenoid Valve (PCSV) 19. CVVT Oil Control Valve (OCV) [Bank 1 / Intake] 20. CVVT Oil Control Valve (OCV) [Bank 1 / Exhaust] 21. Variable Intake Solenoid (VIS) Valve 22. Variable Charge Motion Actuator (VCMA) 23. Canister Close Valve (CCV) 24. Ignition Coil 25. Main Relay 26. Fuel Pump Relay 27. Data Link Connector (DLC) [16-Pin] 28. Multi-Purpose Check Connector [20-Pin]

1. Engine Control Module (ECM)

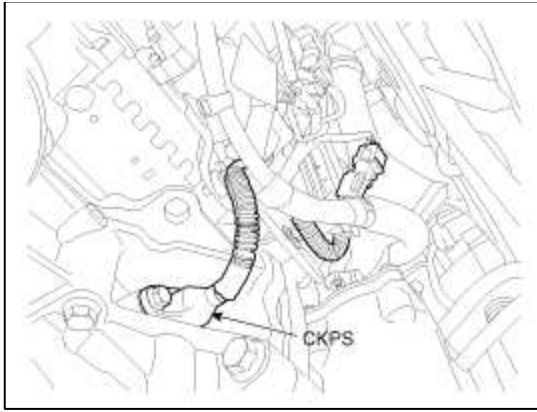

2. Manifold Absolute Pressure Sensor (MAPS)
3. Intake Air Temperature Sensor (IATS)


4. Engine Coolant Temperature Sensor (ECTS)

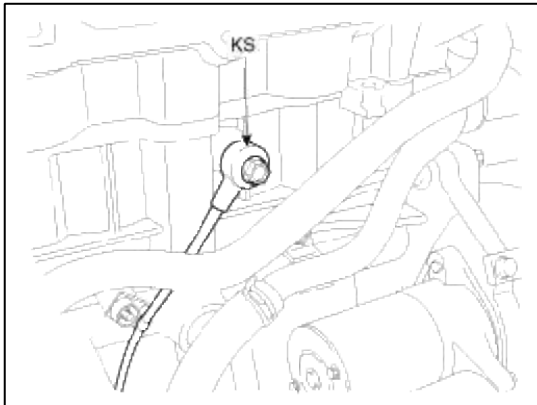

5. Throttle Position Sensor (TPS)
16. ETC Motor


6. Crankshaft Position Sensor (CKPS)

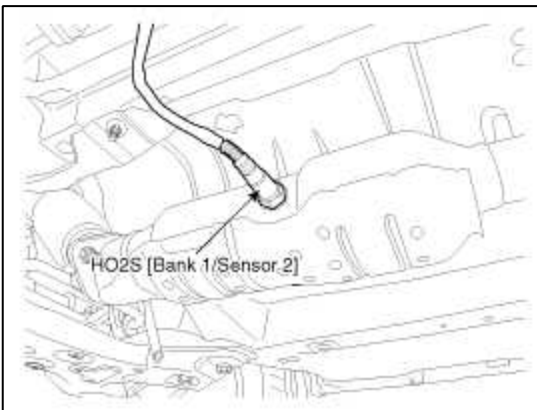
7. Camshaft Position Sensor (CMPS) [Bank 1 / Intake]
8. Camshaft Position Sensor (CMPS) [Bank 1 / Exhaust]



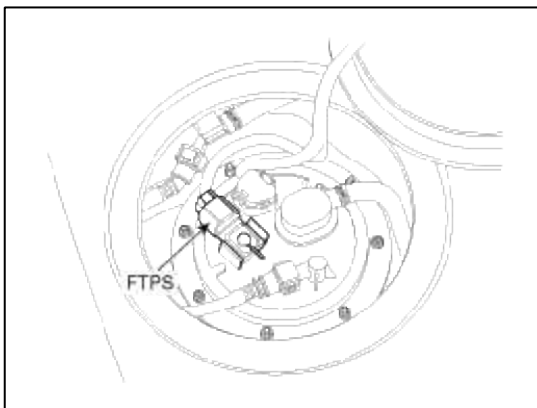
9. Knock Sensor (KS)



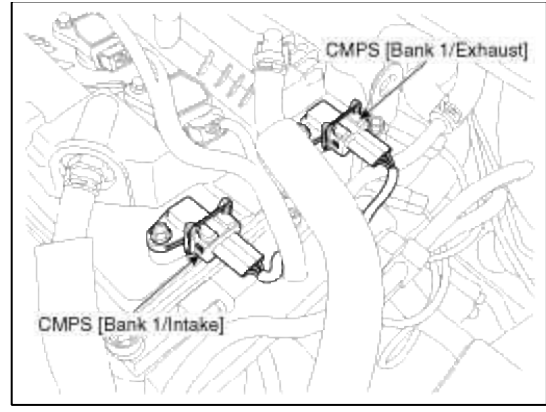
11. Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]



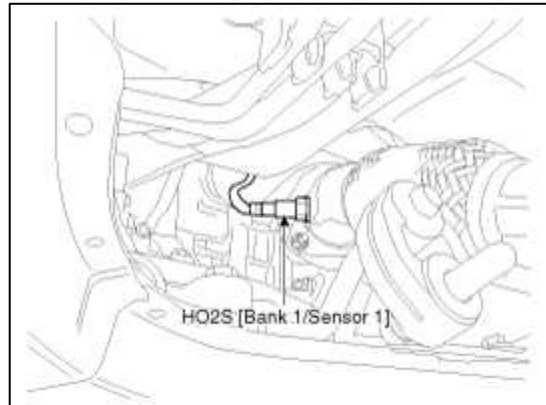
13. Fuel Tank Pressure Sensor (FTPS)



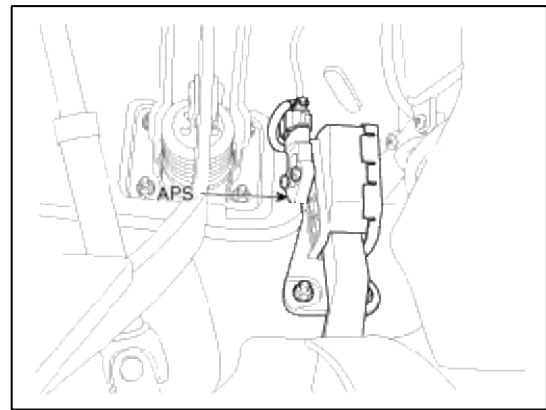
15. A/C Pressure Transducer (APT)



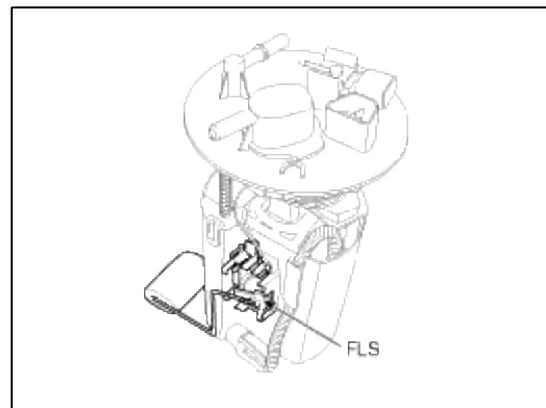
10. Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]



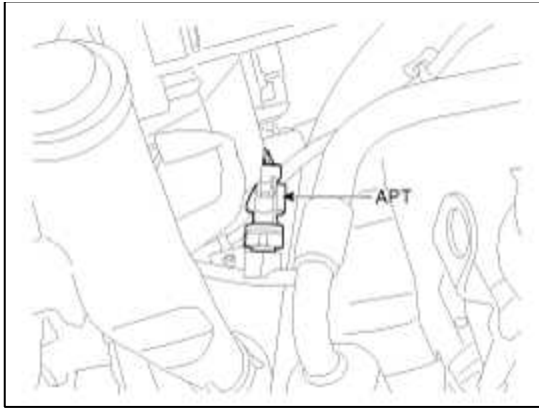
12. Accelerator Position Sensor (APS)



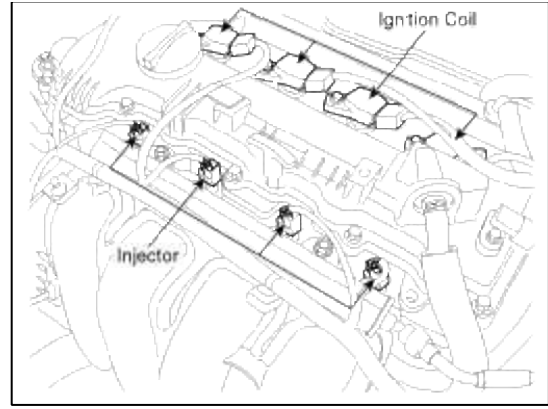
14. Fuel Level Senderr (FLS)



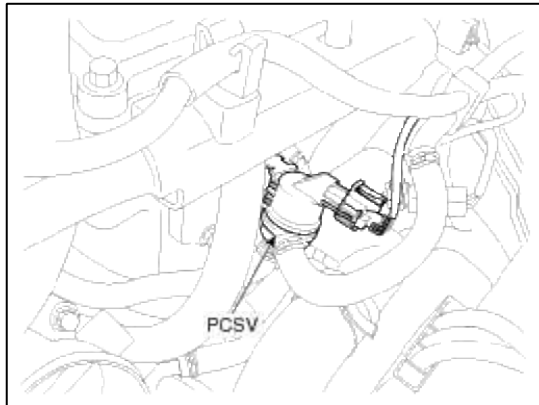
17. Injector
24. Ignition Coil



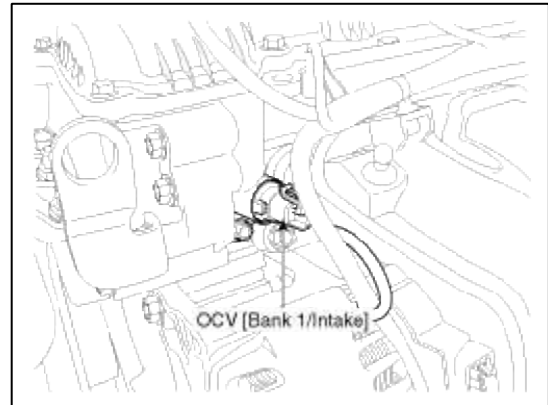
18. Purge Control Solenoid Valve (PCSV)



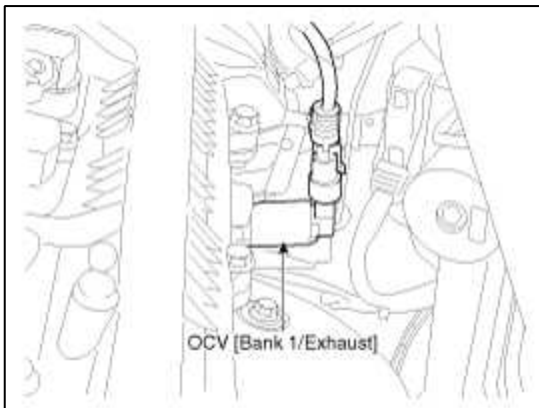
19. CVVT Oil Control Valve (OCV) [Bank 1 / Intake]



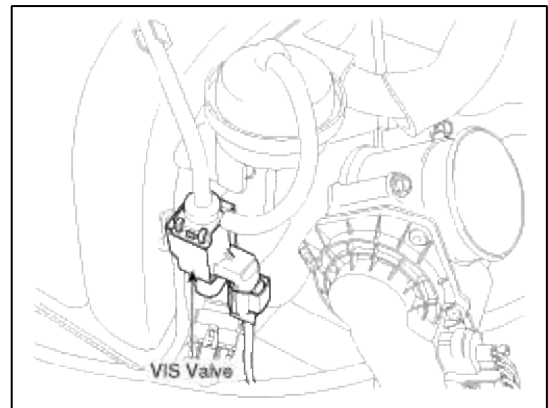
20. CVVT Oil Control Valve (OCV) [Bank 1 / Exhaust]



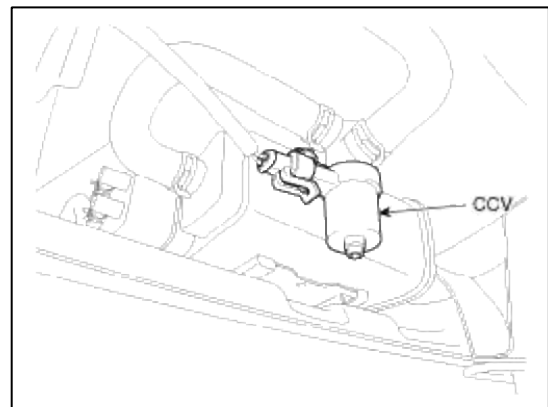
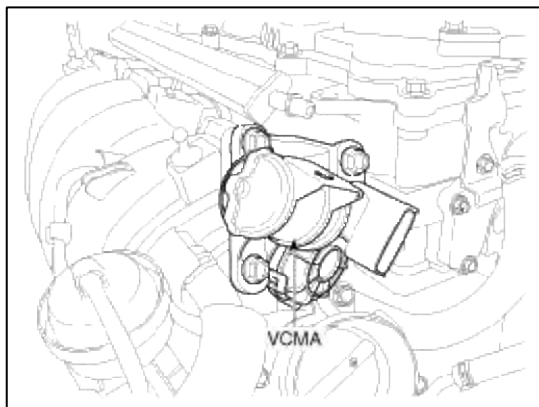
21. Variable Intake Solenoid (VIS) Valve



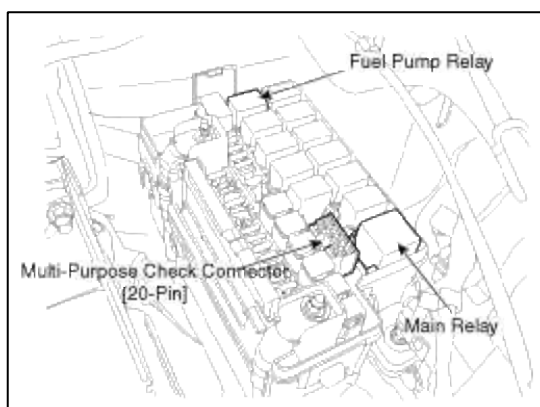
22. Variable Charge Motion Actuator (VCMA)



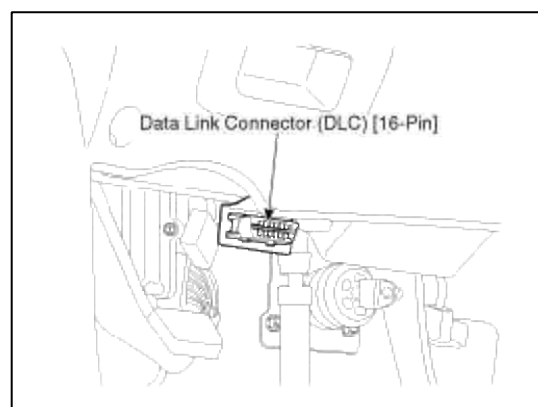
23. Canister Close Valve (CCV)



25. Main Relay
 26. Fuel Pump Relay
 28. Multi-Purpose Check Connector [20-Pin]

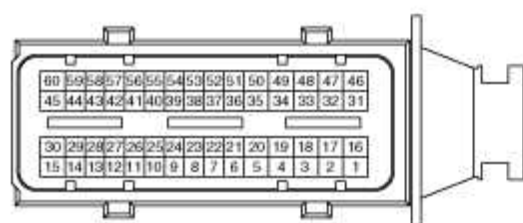


27. Data Link Connector (DLC) [16-Pin]

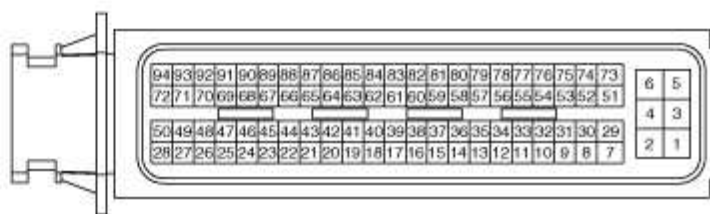


Fuel System > Engine Control System > Engine Control Module (ECM) > Schematic Diagrams

ECM Terminal And Input/Output signal (M/T)



ENGM-A



ENGM-K

ECM Terminal Function

Connector [ENGM-A]

Pin No.	Description	Connected to
1	Ignition Coil (Cylinder #1) control output	Ignition Coil (Cylinder #1) [Without Immobilizer]
	Ignition Coil (Cylinder #4) control output	Ignition Coil (Cylinder #4) [With Immobilizer]
2	Injector (Cylinder #1) control output	Injector (Cylinder #1)
3	-	
4	-	
5	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
6	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
7	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] signal input	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
8	Knock Sensor (KS) signal input	Knock Sensor (KS)
9	Intake Air Temperature Sensor (IATS) signal input	Intake Air Temperature Sensor (IATS)
10	Start Motor control switch	Power Distribution Module (PDM)

11	Electrical load signal input	Alternator
12	Engine Coolant Temperature Sensor (ECTS) signal input	Engine Coolant Temperature Sensor (ECTS)
13	Throttle Position Sensor (TPS) 1 signal input	Throttle Position Sensor (TPS) 1
14	Sensor power (+5V)	Throttle Position Sensor (TPS) 1,2
15	ETC Motor [+] control output	ETC Motor
16	Ignition Coil (Cylinder #3) control output	Ignition Coil (Cylinder #3) [Without Immobilizer]
	Ignition Coil (Cylinder #2) control output	Ignition Coil (Cylinder #2) [With Immobilizer]
17	Injector (Cylinder #3) control output	Injector (Cylinder #3)
18	Purge Control Solenoid Valve (PCSV) control output	Purge Control Solenoid Valve (PCSV)
19	Variable Intake Solenoid (VIS) Valve control output	Variable Intake Solenoid (VIS) Valve
20	-	
21	-	
22	Sensor shield ground	Knock Sensor (KS)
23	Sensor ground	Knock Sensor (KS)
24	Sensor ground	Manifold Absolute Pressure Sensor (MAPS)
25	-	
26	-	
27	Sensor ground	Engine Coolant Temperature Sensor (ECTS)
28	Throttle Position Sensor (TPS) 2 signal input	Throttle Position Sensor (TPS) 2
29	Sensor ground	Throttle Position Sensor (TPS) 1,2
30	ETC Motor [-] control output	ETC Motor
31	Ignition Coil (Cylinder #4) control output	Ignition Coil (Cylinder #4) [Without Immobilizer]
	Ignition Coil (Cylinder #1) control output	Ignition Coil (Cylinder #1) [With Immobilizer]
32	Injector (Cylinder #4) control output	Injector (Cylinder #4)
33	CVVT Oil Control (OCV) Valve [Bank 1/Intake] control output	CVVT Oil Control Valve (OCV) [Bank 1/Intake]
34	CVVT Oil Control (OCV) Valve [Bank 1/Exhaust] control output	CVVT Oil Control Valve (OCV) [Bank 1/Exhaust]
35	Sensor power (+5V)	Variable Charge Motion Actuator (VCMA)
36	VG (Virtual Ground)	Heated Oxygen Sensor [Bank 1/Sensor 1]
37	VIP (Current Pump)	Heated Oxygen Sensor [Bank 1/Sensor 1]
38	VRC (Current Adjust)	Heated Oxygen Sensor [Bank 1/Sensor 1]
39	Manifold Absolute Pressure Sensor (MAPS) signal input	Manifold Absolute Pressure Sensor (MAPS)
40	-	
41	Sensor ground	Crankshaft Position Sensor (CKPS)

42	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust]
43	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 1/Intake]
44	Sensor ground	Variable Charge Motion Actuator (VCMA)
45	Motor [+] control output	Variable Charge Motion Actuator (VCMA)
46	Ignition Coil (Cylinder #2) control output	Ignition Coil (Cylinder #2) [Without Immobilizer]
	Ignition Coil (Cylinder #3) control output	Ignition Coil (Cylinder #3) [With Immobilizer]
47	Injector (Cylinder #2) control output	Injector (Cylinder #2)
48	-	
49	Alternator PWM control output	Alternator
50	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]
51	-	
52	VN (NERNST Cell Voltage)	Heated Oxygen Sensor [Bank 1/Sensor 1]
53	-	
54	Sensor power (+5V)	Manifold Absolute Pressure Sensor (MAPS)
55	-	
56	Crankshaft Position Sensor (CKPS) signal input	Crankshaft Position Sensor (CKPS)
57	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust] signal input	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust]
58	Camshaft Position Sensor (CMPS) [Bank 1/Intake] signal input	Camshaft Position Sensor (CMPS) [Bank 1/Intake]
59	Sensor feedback signal input	Variable Charge Motion Actuator (VCMA)
60	Motor [-] control output	Variable Charge Motion Actuator (VCMA)

Connector [ENGM-K]

Pin No.	Description	Connected to
1	Power ground	Chassis Ground
2	Battery power (B+)	Main Relay
3	Power ground	Chassis Ground
4	Battery power (B+)	Main Relay
5	Power ground	Chassis Ground
6	Battery power (B+)	Main Relay
7	-	
8	-	
9	-	
10	-	

11	A/C Compressor Relay control output	A/C Compressor Relay
12	Engine speed signal output	Power Distribution Module (PDM)
13	-	
14	-	
15	Fuel Tank Pressure Sensor (FTPS) signal input	Fuel Tank Pressure Sensor (FTPS)
16	-	
17	-	
18	-	
19	-	
20	-	
21	-	
22	Auto cruise control switch signal input	Auto cruise control switch
23	-	
24	-	
25	Fuel Level Sensor (FLS) signal input	Fuel Level Sensor (FLS)
26	-	
27	-	
28	-	
29	-	
30	-	
31	-	
32	-	
33	-	
34	Immobilizer Lamp control output	Immobilizer Lamp
35	-	
36	Canister Close Valve (CCV) control output	Canister Close Valve (CCV)
37	Sensor ground	Fuel Tank Pressure Sensor (FTPS)
38	-	
39	-	
40	-	
41	-	
42	-	
43	-	
44	Auto cruise control switch ground	Auto cruise control switch
45	Sensor ground	A/C Pressure Transducer (APT)
46	-	

47	-	-
48	-	
49	Sensor ground	Accelerator Position Sensor (APS) 1
50	Sensor ground	Accelerator Position Sensor (APS) 2
51	Battery power (B+)	Ignition Switch
52	Start Motor relay control output	Start Motor relay
53	Cooling Fan Relay [High] control output	Cooling Fan Relay [High]
54	Cooling Fan Relay [Low] control output	Cooling Fan Relay [Low]
55	-	
56	-	
57	-	
58	-	
59	-	
60	-	
61	-	
62	Brake Test Switch signal input	Brake Switch
63	-	
64	-	
65	-	
66	-	
67	A/C Pressure Transducer (APT) signal input	A/C Pressure Transducer (APT)
68	-	
69	Immobilizer communication line	Immobilizer control module
70	-	
71	Accelerator Position Sensor (APS) 1 signal input	Accelerator Position Sensor (APS) 1
72	Accelerator Position Sensor (APS) 2 signal input	Accelerator Position Sensor (APS) 2
73	-	
74	Main Relay control output	Main Relay
75	Fuel Pump Relay control output	Fuel Pump Relay
76	-	
77	C-CAN [High]	Other control module, Data Link Connector (DLC),
78	C-CAN [Low]	Other control module, Data Link Connector (DLC),
79	Clutch switch signal input	Clutch switch
80	Vehicle speed signal input	ABS/ESC Control Unit
81	-	

82	-	
83	-	
84	Brake Light Switch signal input	Brake Switch
85	-	
86	-	
87	-	
88	Sensor power (+5V)	Fuel Tank Pressure Sensor (FTPS)
		A/C Pressure Transducer (APT)
		Auto cruise control switch
89	-	
90	A/C request switch signal output	Heater & A/C Control module
91	-	
92	-	
93	Sensor power (+5V)	Accelerator Position Sensor (APS) 1
94	Sensor power (+5V)	Accelerator Position Sensor (APS) 2

ECM Terminal Input/ Output signal

Connector [ENGM-A]

Pin No.	Description	Condition	Type	Level
1	Ignition Coil (Cylinder #1) control output	Idle	Pulse	Turn on: Max. 1.6V Turn off: Battery voltage
	Ignition Coil (Cylinder #4) control output			
2	Injector (Cylinder #1) control output	Idle	DC	Hi: Battery voltage
				LO: Max. 0.5V
				48~50V
3	-			
4	-			
5	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] Heater control output	Relay OFF	DC	Battery voltage
		Relay ON		Max. 0.5V
6	Sensor ground	Idle	DC	Max. 0.5V
7	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] signal input	Idle	Analog DC	Min. 0.6V ~ Max. 1.0V
8	Knock Sensor (KS) signal input	Idle	Analog / Frequency	Freq.: Min. 8KHz ~ Max. 12KHz Level: Min. 180 ~ Max. 300mVpp
9	Intake Air Temperature Sensor (IATS) signal input	Idle	Analog	Min. 0.1V ~ Max. 4.7V

10	Start Motor control switch	Switch ON	Digital	Battery voltage
		Switch OFF		Min. -0.3V ~ Max. 0.5V
11	Electrical load signal input	Idle	PWM	Freq.: 125Hz or 200Hz or 60Hz Duty rate 0% ~ 100%
12	Engine Coolant Temperature Sensor (ECTS) signal input	Idle	Analog	Min. 0.1V ~ Max. 4.7V
13	Throttle Position Sensor (TPS) 1 signal input	Idle	Analog	Min. 0.4V ~ Max. 4.5V
14	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		Min. 4.75V ~ Max. 5.25V
15	ETC Motor [+] control output	Idle	PWM	Operating freq.: 1000Hz (estimated)
				Forward direction Turn on: Battery voltage Frewheeling: Max. 0.1V
				Reverse direction Turn on: Max. 0.1V Frewheeling: Max. 0.1V
16	Ignition Coil (Cylinder #3) control output	Idle	Pulse	Turn on: Max. 1.6V Turn off: Battery voltage
	Ignition Coil (Cylinder #2) control output			
17	Injector (Cylinder #3) control output	Idle	DC	Hi: Battery voltage
				LO: Max. 0.5V
				48~50V
18	Purge Control Solenoid Valve (PCSV) control output	Relay OFF	DC	Battery voltage
		Relay ON		Max. 1.76V
19	Variable Intake Solenoid (VIS) Valve control output	Relay OFF	DC	Battery voltage
		Relay ON		Max. 1.76V
20	-			
21	-			
22	Sensor shield ground	Idle	DC	Max. 0.5V
23	Sensor ground	Idle	DC	Max. 0.5V
24	Sensor ground	Idle	DC	Max. 0.5V
25	-			
26	-			
27	Sensor ground	Idle	DC	Max. 0.5V
28	Throttle Position Sensor (TPS) 2 signal input	Idle	Analog	Min. 0.4V ~ Max. 4.5V
29	Sensor ground	Idle	DC	Max. 0.5V
				Operating freq.: 1000Hz

(estimated)				
30	ETC Motor [-] control output	Idle	PWM	Forward direction Turn on: max 0.1V Frewheeling: max 0.1V
				Reverse directon Turn on: Battery voltage Frewheeling: max 0.1V
31	Ignition Coil (Cylinder #4) control output	Idle	Pulse	Turn on: Max. 1.6V Turn off: Battery voltage
	Ignition Coil (Cylinder #1) control output			
32	Injector (Cylinder #4) control output	Idle	DC	Hi: Battery voltage
				LO: Max. 0.5V
				48~50V
33	CVVT Oil Control (OCV) Valve [Bank 1/Intake] control output	Idle	PWM	Operating freq. range: 300Hz Duty rate: 0% ~ 100%
34	CVVT Oil Control (OCV) Valve [Bank 1/Exhaust] control output	Idle	PWM	Operating freq. range: 300Hz Duty rate: 0% ~ 100%
35	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		Min. 4.75V ~ Max. 5.25V
36	VG (Virtual Ground)	Idle	Analog	Min. 0.2V ~ Max. 5.2V
37	VIP (Current Pump)	Idle	Analog	Min. 0.2V ~ Max. 5.2V
38	VRC (Current Adjust)	Idle	Analog	Min. 0.2V ~ Max. 5.2V
39	Manifold Absolute Pressure Sensor (MAPS) signal input	Idle	Analog	Min. 0.8V ~ Max. 4.2V
40	-			
41	Crankshaft Position Sensor (-) signal input	Idle	Frequency	Vpp Min. : 18V at Idle (for 1 rail) Vpp Max. : 90V at 5000rpm (for 1 rail)
42	Sensor ground	Idle	DC	Max. 0.5V
43	Sensor ground	Idle	DC	Max. 0.5V
44	Sensor ground	Idle	DC	Max. 0.5V
45	Motor [+] control output	Idle	PWM	Operating freq.: 1000Hz (estimated)
				Forward direction Turn on: Battery voltage Frewheeling: Max. 0.1V
				Reverse direction Turn on: Max. 0.1V Frewheeling: Max. 0.1V

46	Ignition Coil (Cylinder #2) control output	Idle	Pulse	Turn on: Max. 1.6V Turn off: Battery voltage
	Ignition Coil (Cylinder #3) control output			
47	Injector (Cylinder #2) control output	Idle	DC	Hi: Battery voltage
				LO: Max. 0.5V
				48~50V
48	-			
49	Alternator PWM control output	IG OFF	PWM	Battery voltage
		IG ON		Max. 0.5V
50	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] Heater control output	Relay OFF	DC	Battery voltage
		Relay ON		Max. 0.5V
51	-			
52	VN (NERNST Cell Voltage)	Idle	Analog	Min. 0.2V ~ Max. 5.2V
53	-			
54	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		Min. 4.75V ~ Max. 5.25V
55	-			
56	Crankshaft Position Sensor (+) signal input	Idle	Frequency	Vpp Min. : 18V at Idle (for 1 rail) Vpp Max. : 90V at 5000rpm (for 1 rail)
57	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust] signal input	Idle	Pulse	Around 7Hz at 850rpm
				Around 25Hz at 3000rpm
58	Camshaft Position Sensor (CMPS) [Bank 1/Intake] signal input	Idle	Pulse	Around 7Hz at 850rpm
				Around 25Hz at 3000rpm
59	Sensor feedback signal input	Idle	Analog	Min. 0.1V ~ Max. 4.6V
60	Motor [-] control output	Idle	PWM	Operating freq.: 1000Hz (estimated)
				Forward direction Turn on: max 0.1V Frewheeling: max 0.1V
				Reverse direciton Turn on: Battery voltage Frewheeling: max 0.1V

Connector [ENGM-K]

Pin No.	Description	Condition	Type	Level
1	Power ground	Idle	DC	Max. 50mV

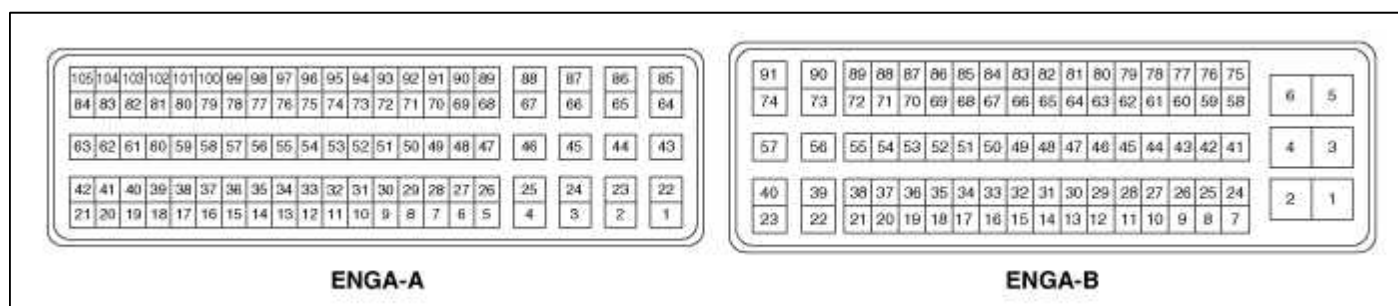
2	Battery power (B+)	IG OFF	DC	Max. 0.5V
		IG ON		Battery Voltage
3	Power ground	Idle	DC	Max. 50mV
4	Battery power (B+)	IG OFF	DC	Max. 0.5V
		IG ON		Battery Voltage
5	Power ground	Idle	DC	Max. 50mV
6	Battery power (B+)	IG OFF	DC	Max. 0.5V
		IG ON		Battery Voltage
7	-			
8	-			
9	-			
10	-			
11	A/C Compressor Relay control output	Relay OFF	DC	Battery voltage
		Relay ON		Min. -0.3V ~Max. 1.2V
12	Engine speed signal output	Idle	Frequency	Around 26Hz at 850rpm, idle
				Around 16Hz at 3000rpm
13	-			
14	-			
15	Fuel Tank Pressure Sensor (FTPS) signal input	Idle	Analog	Min. 0.4V ~Max. 4.6V
16	-			
17	-			
18	-			
19	-			
20	-			
21	-			
22	-			
23	-			
24	-			
25	Fuel Level Sensor (FLS) signal input	Idle	Analog	Min. 0.2V ~Max. 4.7V
26	-			
27	-			
28	-			
29	-			

30	-			
31	-			
32	-			
33	-			
34	Immobilizer Lamp control output	Lamp ON	DC	Min. -0.3V ~ Max. 1.2V
		Lamp OFF		Battery voltage
35	-			
36	Canister Close Valve (CCV) control output	Inactive	DC	Min. -0.3V ~ Max. 1.2V
		Active		Battery voltage
37	Sensor ground	Idle	DC	Max. 50mV
38	-			
39	-			
40	-			
41	-			
42	-			
43	-			
44	Auto cruise control switch ground			
45	Sensor ground	Idle	DC	Max. 50mV
46	-			
47	-			
48	-			
49	Sensor ground	Idle	DC	Max. 50mV
50	Sensor ground	Idle	DC	Max. 50mV
51	Battery power (B+)	IG OFF	DC	Max. 0.5V
		IG ON		Battery Voltage
52	Start Motor relay control output	IG OFF	DC	Battery voltage
		IG ON		Min. -0.3V ~Max. 1.2V
53	Cooling Fan Relay [High] control output	IG OFF	DC	Battery voltage
		IG ON		Min. -0.3V ~Max. 1.2V
54	Cooling Fan Relay [Low] control output	IG OFF	PWM	Battery voltage
		IG ON		Min. -0.3V ~Max. 1.2V
55	-			
56	-			

57	-			
58	-			
59	-			
60	-			
61	-			
62	Brake Test Switch signal input	Swich ON	Digital	Battery voltage
		Switch OFF		Min. -0.3V ~Max. 0.5V
63	-			
64	-			
65	-			
66	-			
67	A/C Pressure Transducer (APT) signal input	Idle	Analog	Min. 0.4V ~Max. 4.6V
68	-			
69	Immobilizer communication line	When communicating after IG ON	Pulse	Hi: Min. 8.5V
				Lo: Max. 3.5V
70	-			
71	Accelerator Position Sensor (APS) 1 signal input	Idle	Analog	Min. 0.6V ~Max. 4.3V
72	Accelerator Position Sensor (APS) 2 signal input	Idle	Analog	Min. 0.3V ~Max. 2.1V
73	-			
74	Main Relay control output	IG OFF	DC	Min. -.03V ~Max. 1.2V
		IG ON		Battery Voltage
75	Fuel Pump Relay control output	Relay OFF	DC	Battery Voltage
		Relay ON		Min. -.03V ~Max. 1.2V
76	-			
77	C-CAN [High]	RECESSIVE	Pulse	2.0~3.0V
		DOMINANT		2.75~4.5V
78	C-CAN [Low]	RECESSIVE	Pulse	2.0~3.0V
		DOMINANT		0~0.5V
79	Clutch switch signal input	Swich ON	Digital	Min. -0.3V ~Max. 0.5V
		Switch OFF		Battery voltage
80	Vehicle speed signal input	Idle	Frequency	Duty rate 40% ~ 60%

81	-			
82	-			
83	-			
84	Brake Light Switch signal input	Swich ON	Digital	Battery voltage
		Switch OFF		Min. -0.3V ~Max. 0.5V
85	-			
86	-			
87	-			
88	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.75 ~ 5.25V
89	-			
90	A/C request switch signal output	Swich ON	Digital	Battery voltage
		Switch OFF		Min. -0.3V ~Max. 0.5V
91	-			
92	-			
93	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.75 ~ 5.25V
94	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		4.75 ~ 5.25V

ECM Terminal And Input/Output signal (A/T)



ECM Terminal Function

Connector [ENGA-A]

Pin No.	Description	Connected to
1	Ignition Coil (Cylinder #2) control output	Ignition Coil (Cylinder #2) [Without Immobilizer]
	Ignition Coil (Cylinder #3) control output	Ignition Coil (Cylinder #3) [With Immobilizer]
2	-	
3	-	

4	-	
5	-	
6	-	
7	-	
8	-	
9	-	
10	-	
11	Camshaft Position Sensor (CMPS) [Bank 1/Intake] signal input	Camshaft Position Sensor (CMPS) [Bank 1/Intake]
12	Sensor power (+5V)	Variable Charge Motion Actuator (VCMA)
		Auto cruise control switch
13	-	
14	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] signal input	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
15	Auto cruise control switch signal input	Auto cruise control switch
16	Sensor feedback signal input	Variable Charge Motion Actuator (VCMA)
17	-	
18	-	
19	-	
20	Sensor ground	Crankshaft Position Sensor (CKPS)
21	Motor [-] control output	Variable Charge Motion Actuator (VCMA)
22	Ignition Coil (Cylinder #4) control output	Ignition Coil (Cylinder #4) [Without Immobilizer]
	Ignition Coil (Cylinder #1) control output	Ignition Coil (Cylinder #1) [With Immobilizer]
23	-	
24	-	
25	-	
26	-	
27	-	
28	-	
29	-	
30	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust]
31	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust] signal input	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust]
32	Sensor ground	Camshaft Position Sensor (CMPS) [Bank 1/Intake]
33	Sensor power (+5V)	Throttle Position Sensor (TPS) 1,2
34	-	

35	Sensor ground	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
36	Auto cruise control switch ground	Auto cruise control switch (ACC)
37	Sensor ground	Variable Charge Motion Actuator (VCMA)
38	-	
39	-	
40	-	
41	Crankshaft Position Sensor (CKPS) signal input	Crankshaft Position Sensor (CKPS)
42	Motor [+] control output	Variable Charge Motion Actuator (VCMA)
43	-	
44	-	
45	-	
46	-	
47	-	
48	-	
49	-	
50	-	
51	-	
52	-	
53	-	
54	Sensor ground	Throttle Position Sensor (TPS) 1, 2
55	-	
56	Sensor shield ground	Knock Sensor (KS)
57	Immobilizer communication line	Immobilizer control module
58	Sensor ground	Battery Sensor
59	Intake Air Temperature Sensor (IATS) signal input	Intake Air Temperature Sensor (IATS)
60	-	
61	Sensor ground	Manifold Absolute Pressure Sensor (MAPS)
62	Sensor ground	Engine Coolant Temperature Sensor (ECTS)
63	Engine Coolant Temperature Sensor (ECTS) signal input	Engine Coolant Temperature Sensor (ECTS)
64	Ignition Coil (Cylinder #3) control output	Ignition Coil (Cylinder #3) [Without Immobilizer]
	Ignition Coil (Cylinder #2) control output	Ignition Coil (Cylinder #2) [With Immobilizer]
65	-	
66	-	
67	-	
68	-	

69	-	
70	-	
71	-	
72	-	
73	-	
74	-	
75	Throttle Position Sensor (TPS) 2 signal input	Throttle Position Sensor (TPS) 2
76	-	
77	Sensor ground	Knock Sensor (KS)
78	-	
79	-	
80	-	
81	-	
82	Manifold Absolute Pressure Sensor (MAPS) signal input	Manifold Absolute Pressure Sensor (MAPS)
83	VIP (Current Pump)	Heated Oxygen Sensor [Bank 1/Sensor 1]
84	VG (Virtual Ground)	Heated Oxygen Sensor [Bank 1/Sensor 1]
85	Ignition Coil (Cylinder #1) control output	Ignition Coil (Cylinder #1) [Without Immobilizer]
	Ignition Coil (Cylinder #4) control output	Ignition Coil (Cylinder #4) [With Immobilizer]
86	-	
87	-	
88	-	
89	-	
90	-	
91	-	
92	-	
93	-	
94	-	
95	-	
96	Throttle Position Sensor (TPS) 1 signal input	Throttle Position Sensor (TPS) 1
97	-	
98	Knock Sensor (KS) signal input	Knock Sensor (KS)
99	-	
100	-	
101	-	
102	-	

103	Sensor power (+5V)	Manifold Absolute Pressure Sensor (MAPS)
104	VRC (Current Adjust)	Heated Oxygen Sensor [Bank 1/Sensor 1]
105	VN (NERNST Cell Voltage)	Heated Oxygen Sensor [Bank 1/Sensor 1]

Connector [ENGA-B]

Pin No.	Description	Connected to
1	Power ground	Chassis Ground
2	Power ground	Chassis Ground
3	Battery power (B+)	Main Relay
4	Power ground	Chassis Ground
5	Battery power (B+)	Main Relay
6	Battery power (B+)	Main Relay
7	-	
8	-	
9	-	
10	Brake Test Switch signal input	Brake Switch
11	-	
12	-	
13	Sensor power (+5V)	Brake Booster Vacuum Pressure Sensor (BBVPS) [with ISG]
		Fuel Tank Pressure Sensor (FTPS)
		A/C Pressure Transducer (APT)
14	Head lamp switch signal input	Multi-function switch [with ISG]
15	Electrical load signal input	Alternator
16	Alternator PWM control output	Alternator
17	-	
18	Cooling Fan Relay [High] control output	Cooling Fan Relay [High]
19	Immobilizer Lamp control output	Immobilizer Lamp [Without Button Engine Start System]
20	ETC Motor [+] control output	ETC Motor
21	ETC Motor [-] control output	ETC Motor
22	Electrical load [Wiper] signal input	Wiper [Low] Relay
23	Injector (Cylinder #1) control output	Injector (Cylinder #1)
24	-	
25	-	
26	-	
27	Brake Light Switch signal input	Brake Switch

28	-	
29	Sensor power (+5V)	Accelerator Position Sensor (APS) 1
30	Sensor power (+5V)	Accelerator Position Sensor (APS) 2
31	-	
32	LIN communication signal input	Battery sensor
33	Cooling Fan Relay [Low] control output	Cooling Fan Relay [Low]
34	-	
35	Brake Booster Vacuum Pressure Sensor signal input	Brake Booster Vacuum Pressure Sensor (BBVPS) [with ISG]
36	Sensor ground	Brake Booster Vacuum Pressure Sensor (BBVPS) [with ISG]
37	-	
38	-	
39	ISG OFF switch signal input	ISG OFF switch [with ISG]
40	Injector (Cylinder #3) control output	Injector (Cylinder #3)
41	Battery power (B+)	Ignition Switch
42	-	
43	-	
44	Sensor ground	A/C Pressure Transducer (APT)
45	A/C Pressure Transducer (APT) signal input	A/C Pressure Transducer (APT)
46	Sensor ground	Accelerator Position Sensor (APS) 1
47	Sensor ground	Accelerator Position Sensor (APS) 2
48	-	
49	-	
50	-	
51	-	
52	Start Motor relay control output	Start Motor relay
53	Main Relay control output	Main Relay
54	-	
55	-	
56	-	
57	Injector (Cylinder #4) control output	Injector (Cylinder #4)
58	-	
59	-	
60	C-CAN [Low]	Other control module, Data Link Connector (DLC)
61	-	
62	-	

63	Accelerator Position Sensor (APS) 1 signal input	Accelerator Position Sensor (APS) 1
64	Accelerator Position Sensor (APS) 2 signal input	Accelerator Position Sensor (APS) 2
65	-	
66	-	
67	A/C Compressor Relay control output	A/C Compressor Relay
68	Variable Intake Solenoid (VIS) Valve control output	Variable Intake Solenoid (VIS) Valve
69	Start relay control output	Start relay [with ISG]
70	Fuel Pump Relay control output	Fuel Pump Relay
71	Engine speed signal output	Power Distribution Module (PDM)
72	-	
73	ISG OFF lamp signal output	ISG OFF switch [with ISG]
74	Injector (Cylinder #2) control output	Injector (Cylinder #2)
75	Battery power (B+)	Main Relay
76	-	
77	C-CAN [High]	
78	Vehicle speed signal input	ABS/ESC Control Unit
79	-	
80	Sensor ground	Fuel Tank Pressure Sensor (FTPS)
81	Fuel Tank Pressure Sensor (FTPS) signal input	Fuel Tank Pressure Sensor (FTPS)
82	Start Motor control switch	Power Distribution Module (PDM)
83	Fuel Level Sensor (FLS) signal input	Fuel Level Sensor (FLS)
84	CVVT Oil Control (OCV) Valve [Bank 1/Exhaust] control output	CVVT Oil Control Valve (OCV) [Bank 1/Exhaust]
85	CVVT Oil Control (OCV) Valve [Bank 1/Intake] control output	CVVT Oil Control Valve (OCV) [Bank 1/Intake]
86	Purge Control Solenoid Valve (PCSV) control output	Purge Control Solenoid Valve (PCSV)
87	Canister Close Valve (CCV) control output	Canister Close Valve (CCV)
88	-	
89	-	
90	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2]
91	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] Heater control output	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1]

ECM Terminal Input/Output signal (AT)

Connector [ENGA-A]

Pin No.	Description	Condition	Type	Level

1	Ignition Coil (Cylinder #2) control output	Idle	Pulse	Turn on: Max. 1.6V Turn off: Battery voltage
	Ignition Coil (Cylinder #3) control output			
2	-			
3	-			
4	-			
5	-			
6	-			
7	-			
8	-			
9	-			
10	-			
11	Camshaft Position Sensor (CMPS) [Bank 1/Intake] signal input	Idle	Pulse	Around 7Hz at 850rpm
				Around 25Hz at 3000rpm
12	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		Min. 4.75V ~ Max. 5.25V
13	-			
14	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] signal input	Idle	Analog DC	Min. 0.6V ~ Max. 1.0V
15	Auto cruise control switch signal input			
16	Sensor feedback signal input	Idle	Analog	Min. 0.1V ~ Max. 4.6V
17	-			
18	-			
19	-			
20	Sensor ground	Idle	DC	Max. 50mV
21	Motor [-] control output	Idle	PWM	Operating freq.: 1000Hz (estimated)
				Forward direction Turn on: max 0.1V Frewheeling: max 0.1V
				Reverse direciton Turn on: Battery voltage Frewheeling: max 0.1V
22	Ignition Coil (Cylinder #4) control output	Idle	Pulse	Turn on: Max. 1.6V Turn off: Battery voltage
	Ignition Coil (Cylinder #1) control output			

23	-			
24	-			
25	-			
26	-			
27	-			
28	-			
29	-			
30	Sensor ground	Idle	DC	Max. 50mV
31	Camshaft Position Sensor (CMPS) [Bank 1/Exhaust] signal input	Idle	Pulse	Around 7Hz at 850rpm
				Around 25Hz at 3000rpm
32	Sensor ground	Idle	DC	Max. 50mV
33	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		Min. 4.75V ~ Max. 5.25V
34	-			
35	Sensor ground	Idle	DC	Max. 50mV
36	Auto cruise control switch ground			
37	Sensor ground	Idle	DC	Max. 50mV
38	-			
39	-			
40	-			
41	Crankshaft Position Sensor (+) signal input	Idle	Frequency	Vpp Min. : 18V at Idle (for 1 rail) Vpp Max. : 90V at 5000rpm (for 1 rail)
42	Motor [+] control output	Idle	PWM	Operating freq.: 1000Hz (estimated)
				Forward direction Turn on: Battery voltage Frewheeling: Max. 0.1V
				Reverse direction Turn on: Max. 0.1V Frewheeling: Max. 0.1V
43	-			
44	-			
45	-			
46	-			
47	-			

48	-			
49	-			
50	-			
51	-			
52	-			
53	-			
54	Sensor ground	Idle	DC	Max. 50mV
55	-			
56	Sensor shield ground	Idle	DC	Max. 50mV
57	Immobilizer communication line	When communicating after IG ON	Pulse	Hi: Min. 8.5V
				Lo: Max. 3.5V
58	Sensor ground	Idle	DC	Max. 50mV
59	Intake Air Temperature Sensor (IATS) signal input	Idle	Analog	Min. 0.1V ~ Max. 4.7V
60	-			
61	Sensor ground	Idle	DC	Max. 50mV
62	Sensor ground	Idle	DC	Max. 50mV
63	Engine Coolant Temperature Sensor (ECTS) signal input	Idle	Analog	Min. 0.1V ~ Max. 4.7V
64	Ignition Coil (Cylinder #3) control output	Idle	Pulse	Turn on: Max. 1.6V Turn off: Battery voltage
	Ignition Coil (Cylinder #2) control output			
65	-			
66	-			
67	-			
68	-			
69	-			
70	-			
71	-			
72	-			
73	-			
74	-			
75	Throttle Position Sensor (TPS) 2 signal input	Idle	Analog	Min. 0.4V ~ Max. 4.5V
76	-			
77	Sensor ground	Idle	DC	Max. 50mV
78	-			

79	-			
80	-			
81	-			
82	Manifold Absolute Pressure Sensor (MAPS) signal input	Idle	Analog	Min. 0.8V ~ Max. 4.2V
83	VIP (Current Pump)	Idle	Analog	Min. 0.2V ~ Max. 5.2V
84	VG (Virtual Ground)	Idle	Analog	Min. 0.2V ~ Max. 5.2V
85	Ignition Coil (Cylinder #1) control output	Idle	Pulse	Turn on: Max. 1.6V Turn off: Battery voltage
	Ignition Coil (Cylinder #4) control output			
86	-			
87	-			
88	-			
89	-			
90	-			
91	-			
92	-			
93	-			
94	-			
95	-			
96	Throttle Position Sensor (TPS) 1 signal input	Idle	Analog	Min. 0.4V ~ Max. 4.5V
97	-			
98	Knock Sensor (KS) signal input	Idle	Analog / Frequency	Freq.: Min. 8KHz ~ Max. 12KHz Level: Min. 180 ~ Max. 300mVpp
99	-			
100	-			
101	-			
102	-			
103	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		Min. 4.75V ~ Max. 5.25V
104	VRC (Current Adjust)	Idle	Analog	Min. 0.2V ~ Max. 5.2V
105	VN (NERNST Cell Voltage)	Idle	Analog	Min. 0.2V ~ Max. 5.2V

Pin No.	Description	Condition	Type	Level
1	Power ground	Idle	DC	Max. 50mV
2	Power ground	Idle	DC	Max. 50mV
3	Battery power (B+)	IG OFF	DC	Max. 0.5V
		IG ON		Battery Voltage
4	Power ground	Idle	DC	Max. 50mV
5	Battery power (B+)	IG OFF	DC	Max. 0.5V
		IG ON		Battery Voltage
6	Battery power (B+)	IG OFF	DC	Max. 0.5V
		IG ON		Battery Voltage
7	-			
8	-			
9	-			
10	Brake Test Switch signal input	Switch ON	Digital	Battery voltage
		Switch OFF		Min. -0.3V ~Max. 0.5V
11	-			
12	-			
13	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		Min. 4.75V ~ Max. 5.25V
14	Head lamp switch signal input			
15	Electrical load signal input	Idle	PWM	Battery voltage
16	Alternator PWM control output	IG OFF	PWM	Battery voltage
		IG ON		Max. 0.5V
17	-			
18	Cooling Fan Relay [High] control output	IG OFF	DC	Battery voltage
		IG ON		Min. -0.3V ~Max. 1.2V
19	Immobilizer Lamp control output	Lamp ON	DC	Min. -0.3V ~ Max. 1.2V
		Lamp OFF		Battery voltage
20	ETC Motor [+] control output	Idle	PWM	Operating freq.: 1000Hz (estimated)
				Forward direction Turn on: Battery voltage Frewheeling: Max. 0.1V
				Reverse direction Turn on: Max. 0.1V Frewheeling: Max. 0.1V
				Operating freq.: 1000Hz

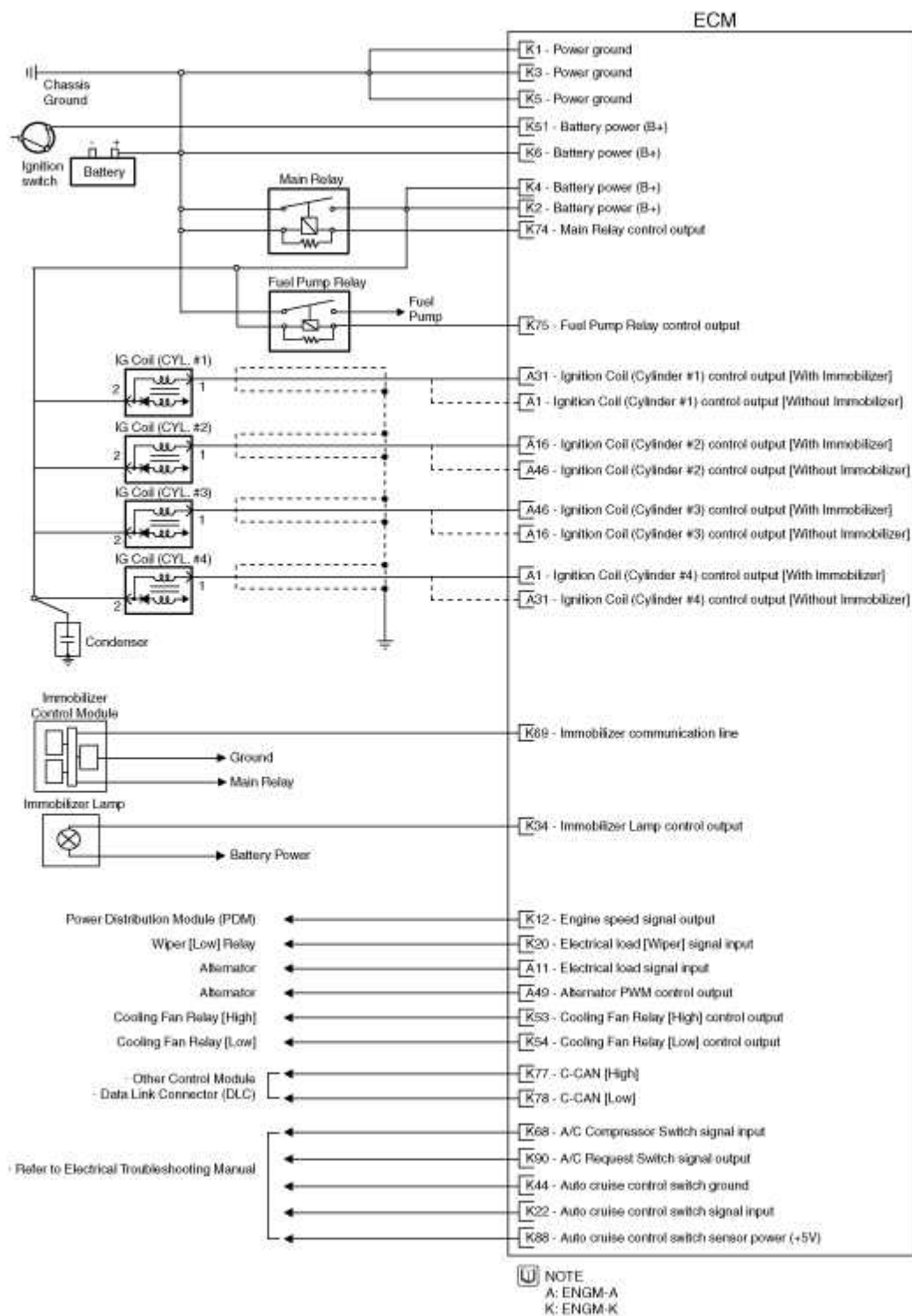
(estimated)				
21	ETC Motor [-] control output	Idle	PWM	Forward direction Turn on: max 0.1V Frewheeling: max 0.1V
				Reverse direciton Turn on: Battery voltage Frewheeling: max 0.1V
22	Electrical load [Wiper] signal input	Idle	PWM	Battery voltage
23	Injector (Cylinder #1) control output	Idle	DC	Hi: Battery voltage
				LO: Max. 0.5V
				48~50V
24	-			
25	-			
26	-			
27	Brake Light Switch signal input	Swich ON	Digital	Battery voltage
		Switch OFF		Min. -0.3V ~Max. 0.5V
28	-			
29	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		Min. 4.75V ~ Max. 5.25V
30	Sensor power (+5V)	IG OFF	DC	Max. 0.5V
		IG ON		Min. 4.75V ~ Max. 5.25V
31	-			
32	LIN communication signal input			
33	Cooling Fan Relay [Low] control output	IG OFF	PWM	Battery voltage
		IG ON		Min. -0.3V ~Max. 1.2V
34	-			
35	Brake Booster Vaccum Pressure Sensor (BBVPS) signal input			
36	Sensor ground	Idle	DC	Max. 50mV
37	-			
38	-			
39	ISG OFF switch signal input			
40	Injector (Cylinder #3) control output	Idle	DC	Hi: Battery voltage
				LO: Max. 0.5V
				48~50V
41	Battery power (B+)	IG OFF	DC	Max. 0.5V
		IG ON		Battery Voltage
42	-			

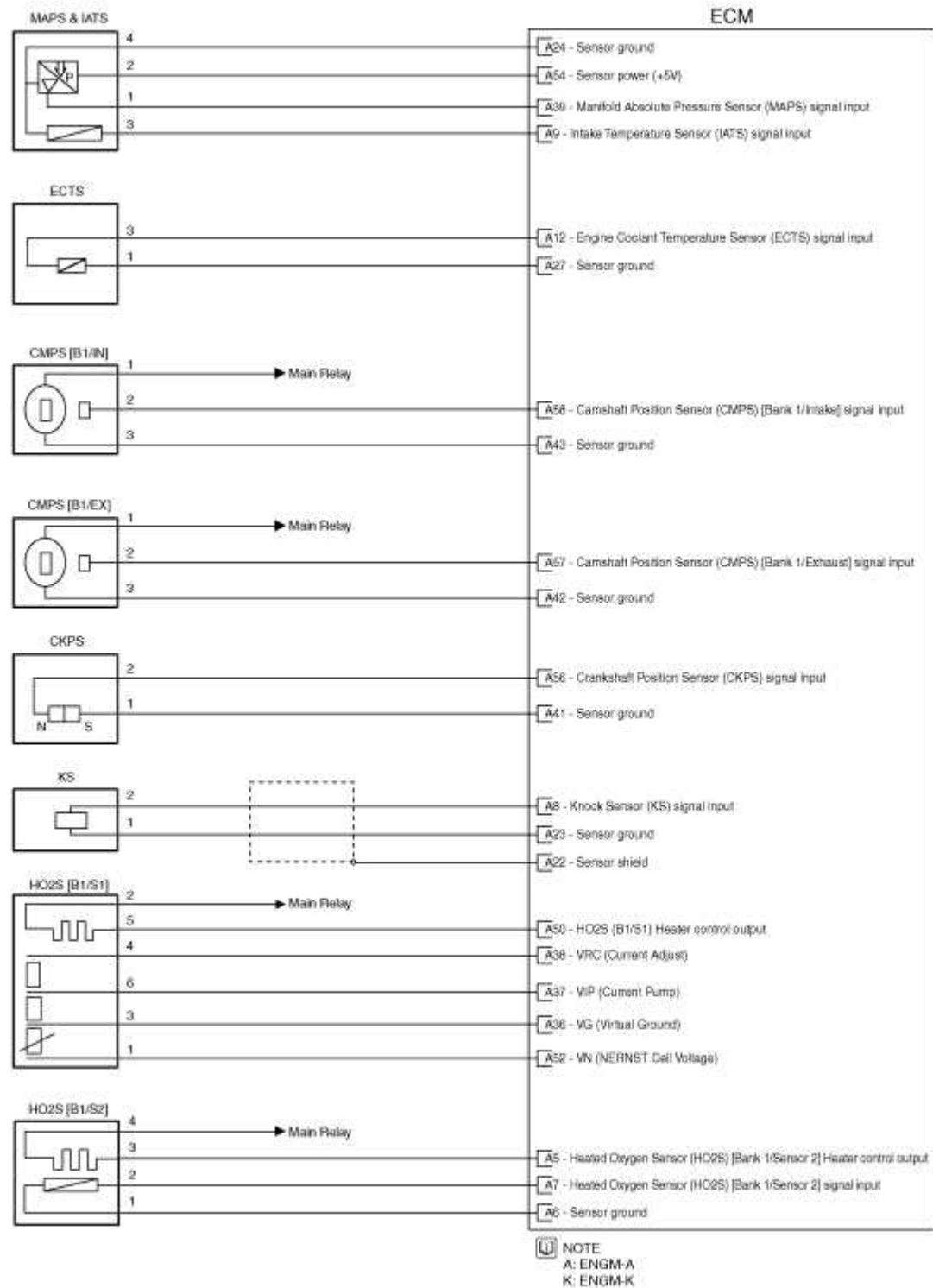
43	-			
44	Sensor ground	Idle	DC	Max. 50mV
45	A/C Pressure Transducer (APT) signal input			
46	Sensor ground	Idle	DC	Max. 50mV
47	Sensor ground	Idle	DC	Max. 50mV
48	-			
49	-			
50	-			
51	-			
52	Start Motor control switch	Switch ON	Digital	Battery voltage
		Switch OFF		Min. -0.3V ~ Max. 0.5V
53	Main Relay control output	IG OFF	DC	Min. -.03V ~Max. 1.2V
		IG ON		Battery Voltage
54	-			
55	-			
56	-			
57	Injector (Cylinder #4) control output	Idle	DC	Hi: Battery voltage
				LO: Max. 0.5V
				48~50V
58	-			
59	-			
60	C-CAN [Low]	RECESSIVE	Pulse	2.0~3.0V
		DOMINANT		0~0.5V
61	-			
62	-			
63	Accelerator Position Sensor (APS) 1 signal input	Idle	Analog	Min. 0.6V ~Max. 4.3V
64	Accelerator Position Sensor (APS) 2 signal input	Idle	Analog	Min. 0.3V ~Max. 2.1V
65	-			
66	-			
67	A/C Compressor Relay control output	Relay OFF	DC	Battery voltage
		Relay ON		Min. -0.3V ~Max. 1.2V
68	Variable Intake Solenoid (VIS) Valve control output			
69	Start relay control output			
70	Fuel Pump Relay control output	Relay OFF	DC	Battery Voltage
		Relay ON		Min. -.03V ~Max. 1.2V

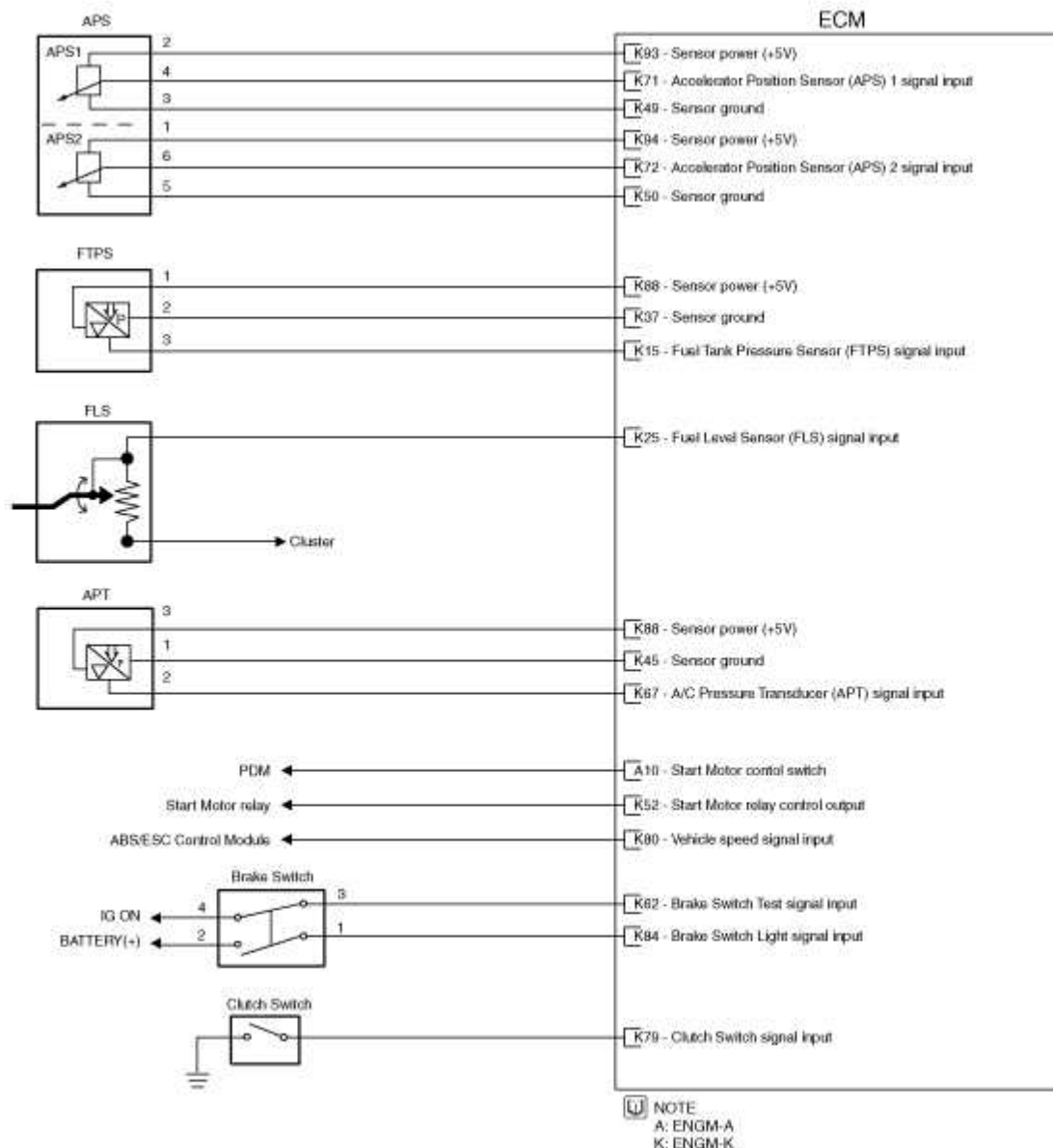
71	Engine speed signal output	Idle	Frequency	Around 26Hz at 850rpm, idle Around 16Hz at 3000rpm
72	-			
73	ISG OFF lamp signal output			
74	Injector (Cylinder #2) control output	Idle	DC	Hi: Battery voltage LO: Max. 0.5V 48~50V
75	Battery power (B+)	IG OFF IG ON	DC	Max. 0.5V Battery Voltage
76	-			
77	C-CAN [High]	RECESSIVE DOMINANT	Pulse	2.0~3.0V 2.75~4.5V
78	Vehicle speed signal input	Idle	Frequency	Duty rate 40% ~ 60%
79	-			
80	Sensor ground	Idle	DC	Max. 50mV
81	Fuel Tank Pressure Sensor (FTPS) signal input	Idle	Analog	Min. 0.4V ~Max. 4.6V
82	Start Motor control switch	Switch ON Switch OFF	Digital	Battery voltage Min. -0.3V ~ Max. 0.5V
83	Fuel Level Sensor (FLS) signal input	Idle	Analog	Min. 0.2V ~Max. 4.7V
84	CVVT Oil Control (OCV) Valve [Bank 1/Exhaust] control output	Idle	PWM	Operating freq. range: 300Hz Duty rate: 0% ~ 100%
85	CVVT Oil Control (OCV) Valve [Bank 1/Intake] control output	Idle	PWM	Operating freq. range: 300Hz Duty rate: 0% ~ 100%
86	Purge Control Solenoid Valve (PCSV) control output	Relay OFF Relay ON	DC	Battery voltage Max. 1.76V
87	Canister Close Valve (CCV) control output	Inactive Active	DC	Min. -0.3V ~ Max. 1.2V Battery voltage
88	-			
89	-			
90	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 2] Heater control output	Relay OFF Relay ON	DC	Battery voltage Max. 0.5V
91	Heated Oxygen Sensor (HO2S) [Bank 1/Sensor 1] Heater control output	Relay OFF Relay ON	DC	Battery voltage Max. 0.5V

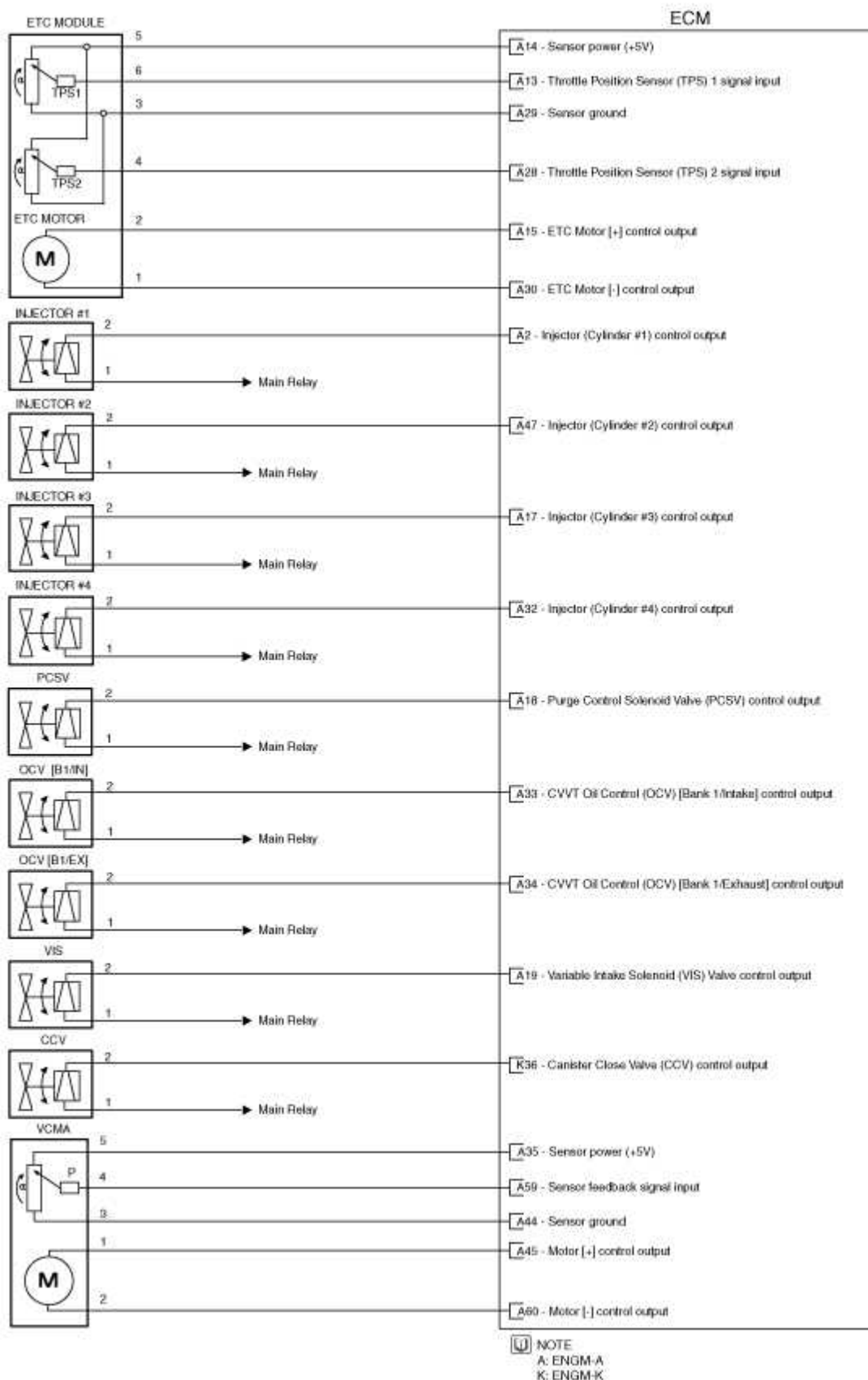
Circuit Diagram

(M/T)

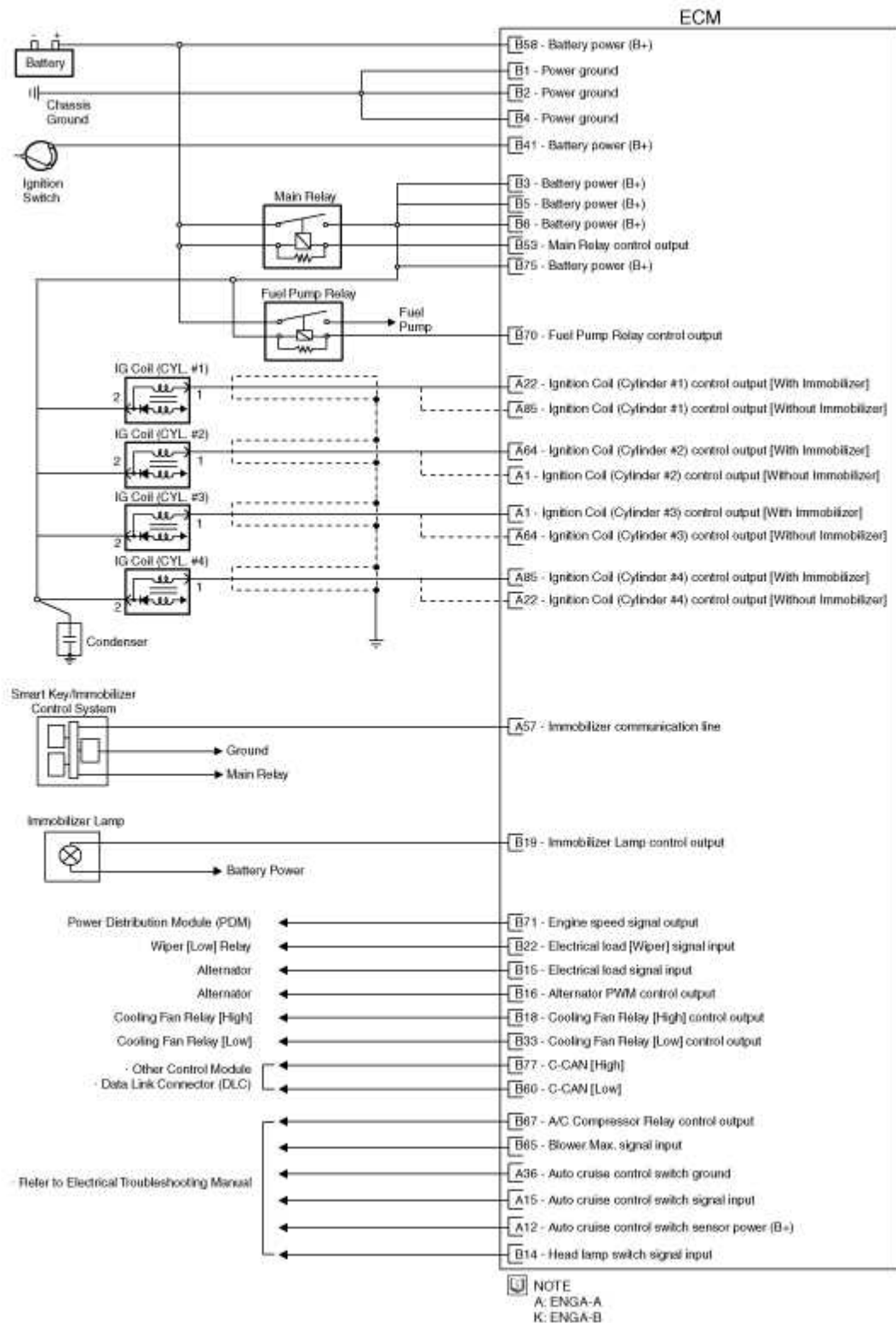


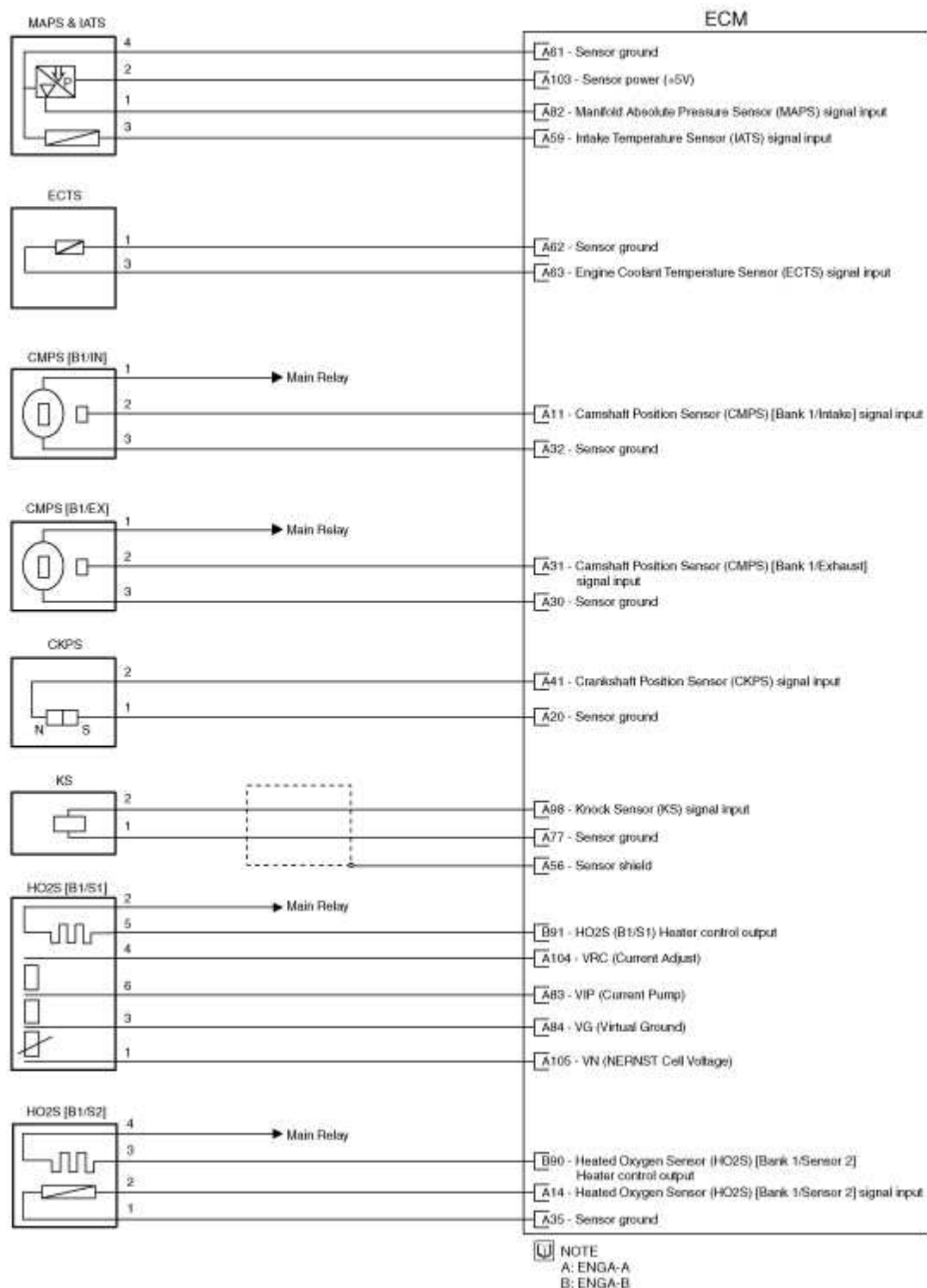


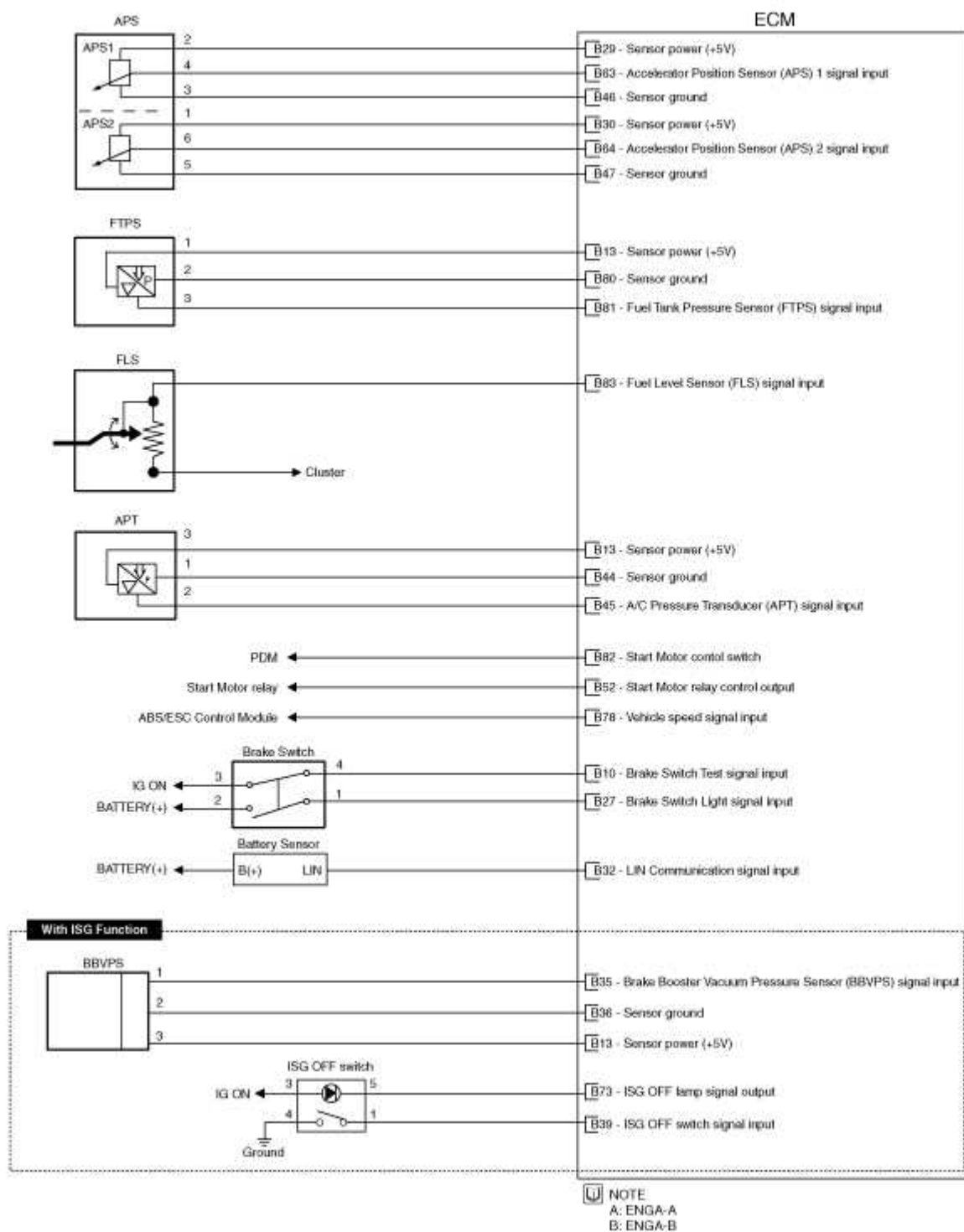


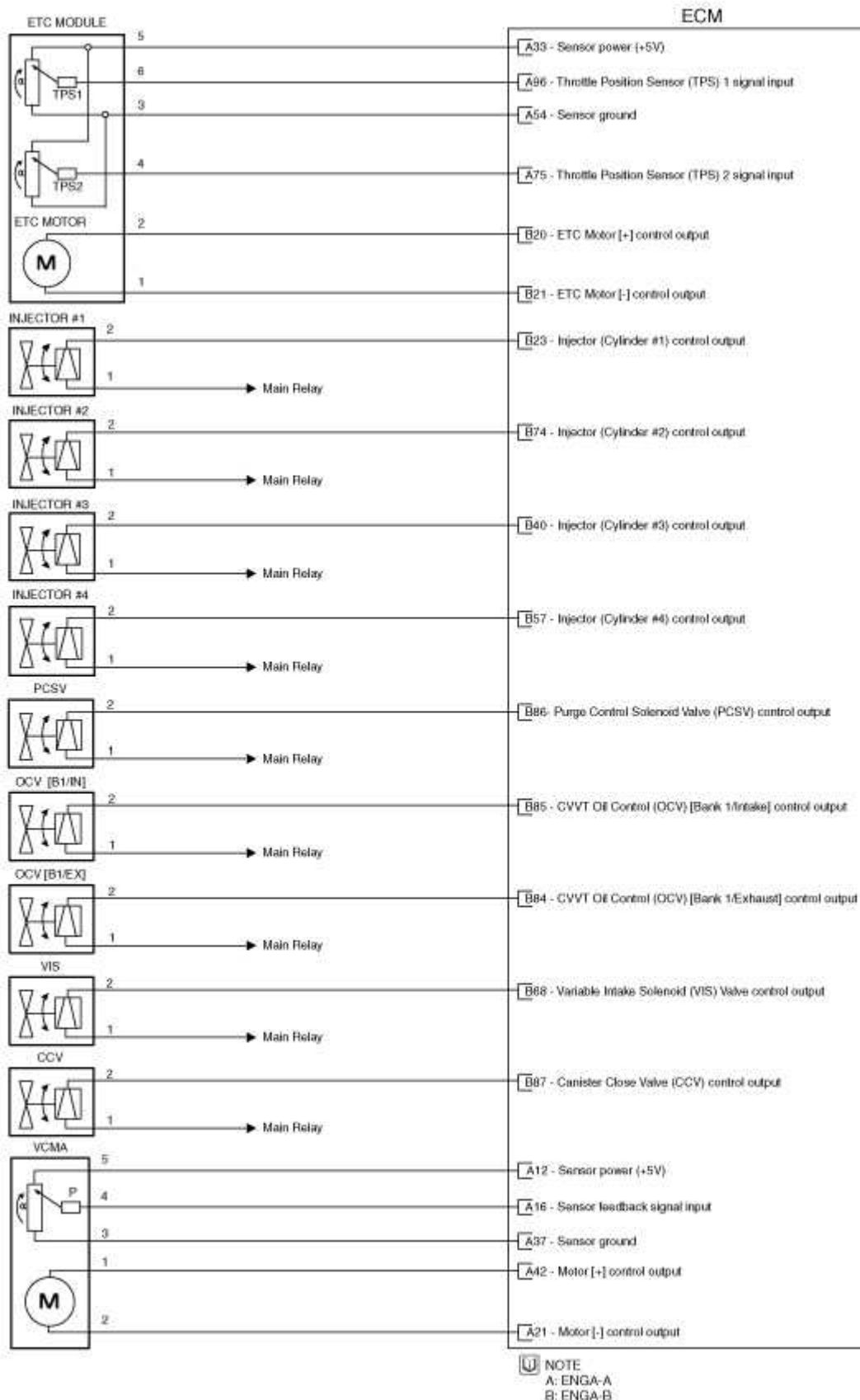


(A/T)









Fuel System > Engine Control System > Engine Control Module (ECM) > Repair procedures

Removal

CAUTION

When replacing the ECM, the vehicle equipped with the immobilizer must be performed procedure as below.

[In the case of installing used ECM]

- 1) Perform "ECM Neutral mode" procedure with GDS. (Refer to "Immobilizer" in BE group)
- 2) After finishing "ECM Neutral mode", perform "Key teaching" procedure with GDS. (Refer to "Immobilizer" in BE group)

[In the case of installing new ECM]

Perform "Key teaching" procedure with GDS. (Refer to "Immobilizer" in BE group)

CAUTION

When replacing the ECM, the vehicle equipped with the smart key system (Button start) must be performed procedure as below.

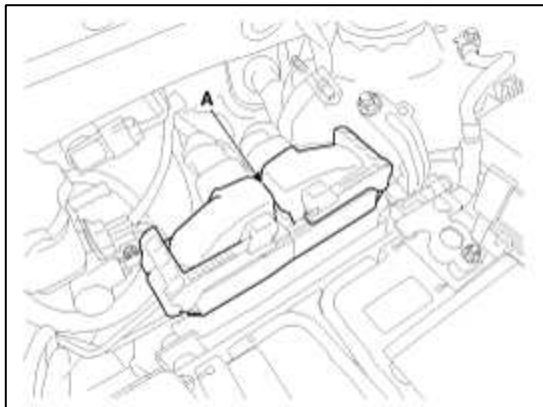
[In the case of installing used ECM]

- 1) Perform "ECM Neutral mode" procedure with GDS. (Refer to "Smart key" in BE group)
- 2) After finishing "ECM Neutral mode", insert the key (or press the start button) and turn it to the IGN ON and OFF position. Then the ECM learns the smart key information automatically.

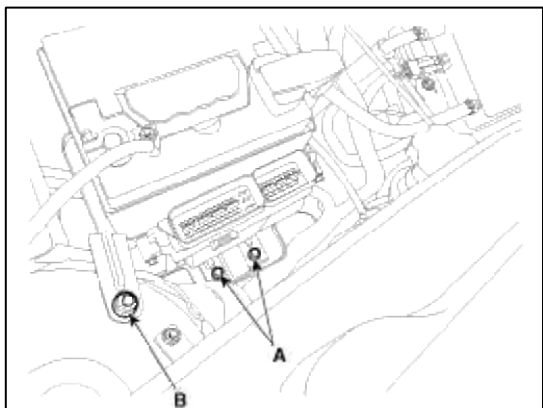
[In the case of installing new ECM]

Insert the key (or press the start button) and turn it to the IGN ON and OFF position. Then the ECM learns the smart key information automatically.

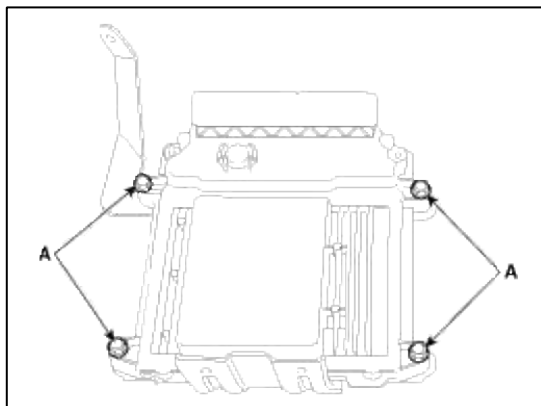
1. Turn ignition switch OFF and disconnect the negative (-) battery cable.
2. Disconnect the ECM Connector (A).



3. Remove the mounting bolts (A) and a nut (B), and then remove the ECM.



4. Remove the installation bolts (A), and then remove the ECM from the bracket.



Installation

CAUTION

When replacing the ECM, the vehicle equipped with the immobilizer must be performed procedure as below.

[In the case of installing used ECM]

- 1) Perform "ECM Neutral mode" procedure with GDS. (Refer to "Immobilizer" in BE group)
- 2) After finishing "ECM Neutral mode", perform "Key teaching" procedure with GDS. (Refer to "Immobilizer" in BE group)

[In the case of installing new ECM]

Perform "Key teaching" procedure with GDS. (Refer to "Immobilizer" in BE group)

CAUTION

When replacing the ECM, the vehicle equipped with the smart key system (Button start) must be performed procedure as below.

[In the case of installing used ECM]

- 1) Perform "ECM Neutral mode" procedure with GDS. (Refer to "Smart key" in BE group)
- 2) After finishing "ECM Neutral mode", insert the key (or press the start button) and turn it to the IGN ON and OFF position. Then the ECM learns the smart key information automatically.

[In the case of installing new ECM]

Insert the key (or press the start button) and turn it to the IGN ON and OFF position. Then the ECM learns the smart key information automatically.

1. Installation is reverse of removal.

ECM installation nut:

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

ECM bracket installation nut:

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

ECM bracket installation bolt:

19.6 ~ 29.4 N.m (2.0 ~ 3.0 kgf.m, 14.5 ~ 21.7 lb-ft)

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: Below 1Ω

2. TEST ECM CONNECTOR: Disconnect the ECM connector and visually check the ground terminals 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, make sure there were no DTC's before swapping the ECM with a new one, and then check the vehicle again. If DTC's were found, examine this first before swapping 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 Inspection Procedure" in Basic Inspection Procedure).

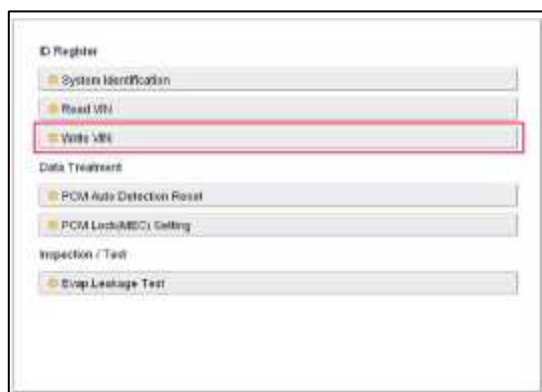
VIN Programming Procedure

VIN (Vehicle Identification Number) is a number that has the vehicle's information (Maker, Vehicle Type, Vehicle Line/Series, Body Type, Engine Type, Transmission Type, Model Year, Plant Location and so forth. For more information, please refer to the group "GI" in this SERVICE MANUAL). When replacing an ECM, the VIN must be programmed in the ECM. If there is no VIN in ECM memory, the fault code (DTC P0630) is set.

CAUTION

The programmed VIN cannot be changed. When writing the VIN, confirm the VIN carefully

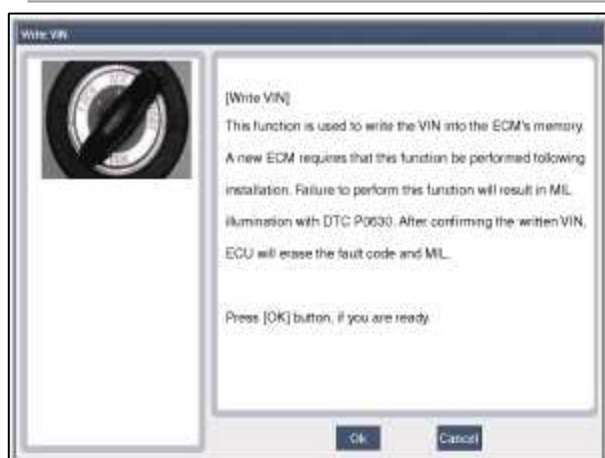
1. Select "VIN Writing" function in "Vehicle S/W Management".
2. Select "Write VIN" in "ID Register".



3. Input the VIN.

WARNING

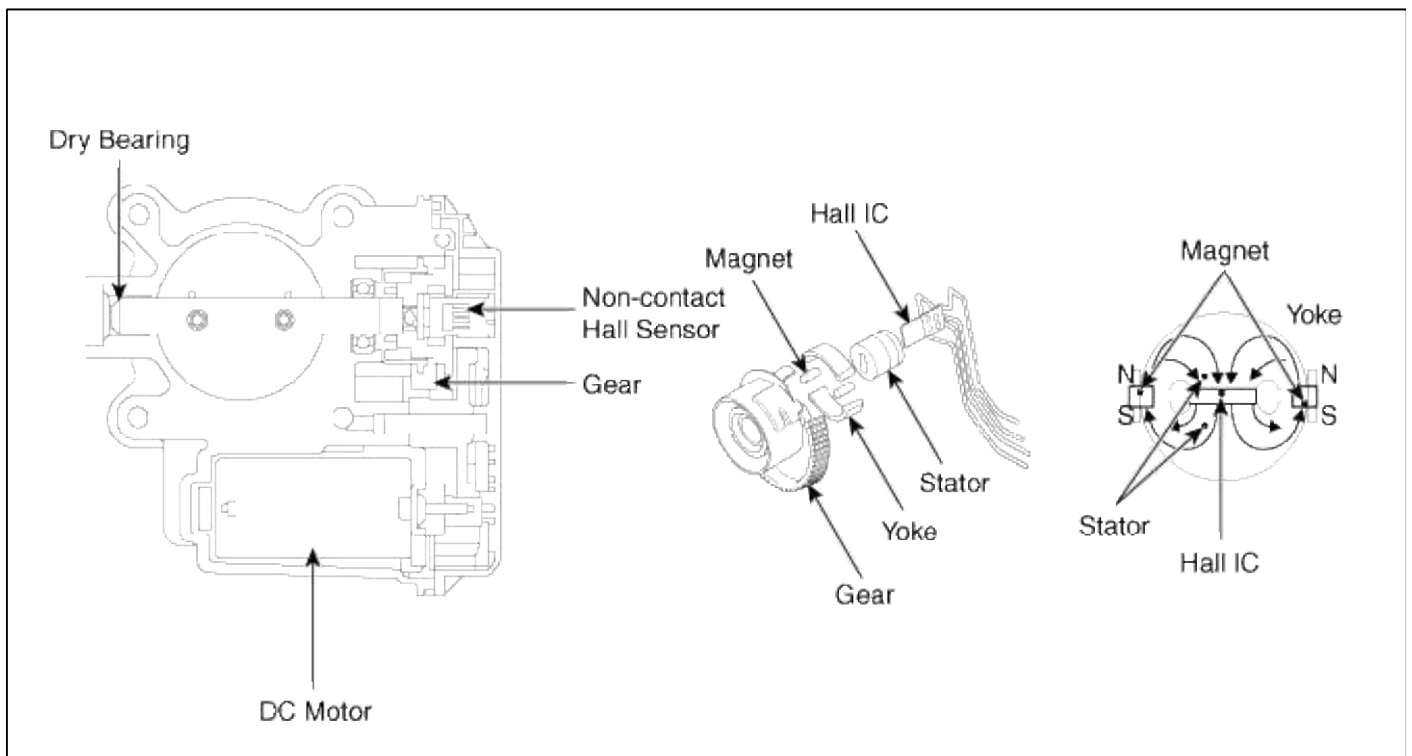
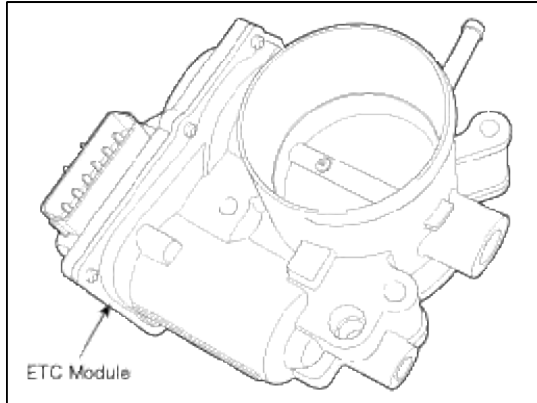
Before inputting the VIN, confirm the VIN again because the programmed VIN cannot be changed.



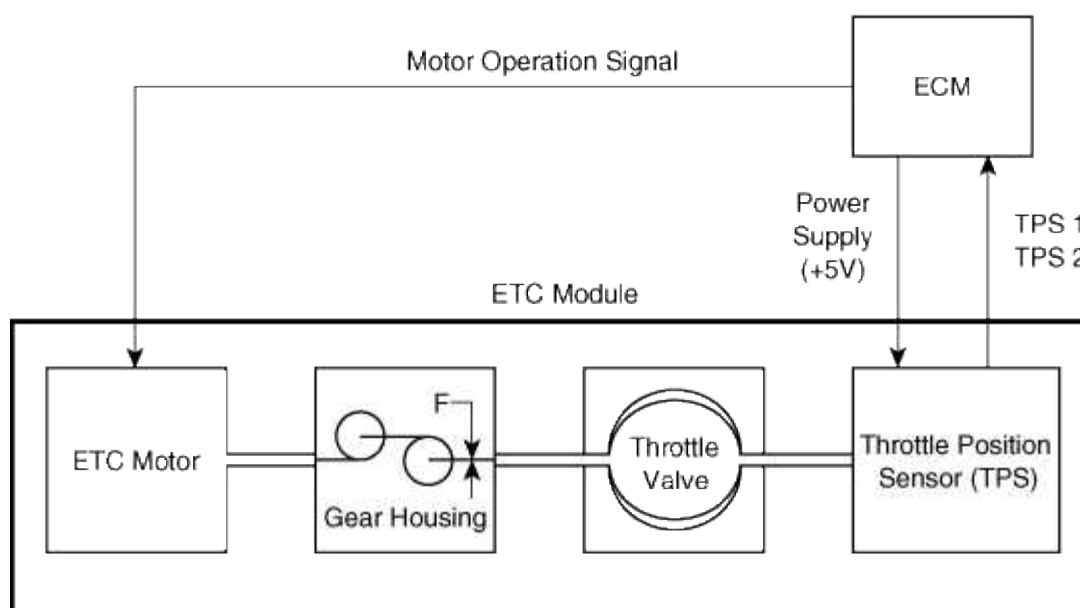
4. Turn the ignition switch OFF, then back ON.

Description

The Electronic Throttle Control (ETC) System consists of a throttle body with an integrated control motor and throttle position sensor (TPS). Instead of the traditional throttle cable, an Accelerator Position Sensor (APS) is used to receive driver input. The ECM uses the APS signal to calculate the target throttle angle; the position of the throttle is then adjusted via ECM control of the ETC motor. The TPS signal is used to provide feedback regarding throttle position to the ECM. Using ETC, precise control over throttle position is possible; the need for external cruise control modules/cables is eliminated.



Schematic Diagram



Fuel System > Engine Control System > ETC (Electronic Throttle Control) System > Troubleshooting

Fail-Safe Mode

Item	Fail-Safe	
ETC Motor	Throttle valve stuck at 7°	
TPS	TPS 1 fault	Replace it with TPS 2
	TPS 2 fault	Replace it with TPS 1
	TPS 1,2 fault	Throttle valve stuck at 7°
APS	APS 1 fault	Replace it with APS 2
	APS 2 fault	Replace it with APS 1
	APS 1,2 fault	Engine idle state

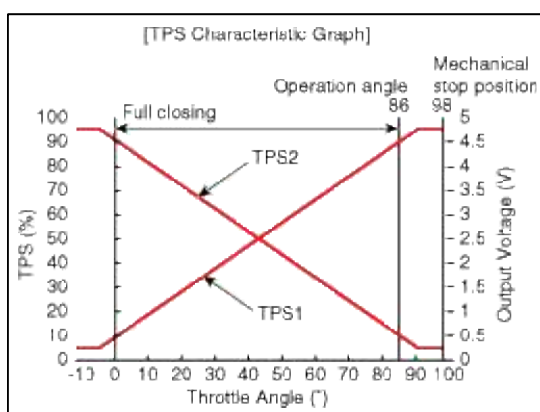
NOTE

When throttle value is stuck at 7°, engine speed is limited at below 1,500rpm and vehicle speed at maximum 40 ~ 50 km/h (25 ~ 31 mph)

Fuel System > Engine Control System > ETC (Electronic Throttle Control) System > Specifications

Specification

Throttle angle (°)	Output voltage (V) [Vref = 5.0V]	
	TPS1	TPS2
0	0.5	4.5
10	0.96	4.05
20	1.41	3.59
30	1.87	3.14
40	2.32	2.68
50	2.78	2.23
60	3.23	1.77
70	3.69	1.32
80	4.14	0.86
90	4.6	0.41
98	4.65	0.35
C.T (0)	0.5	4.5
W.O.T (86)	4.41	0.59



[ETC Motor]

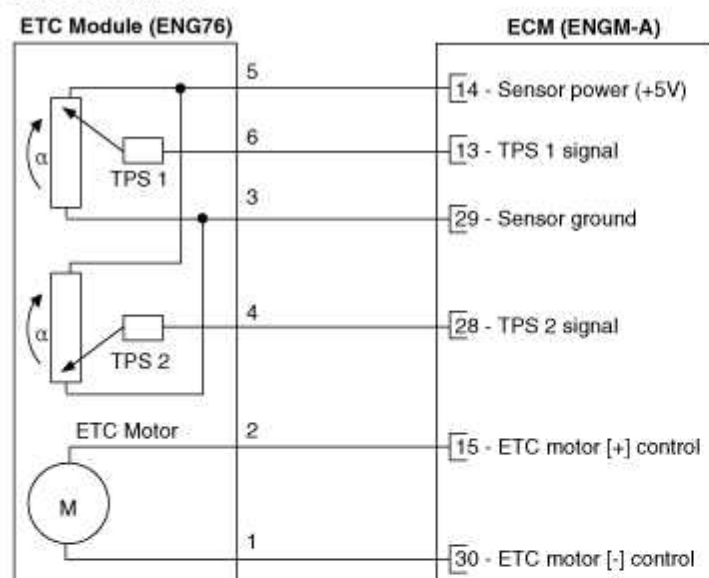
Item	Specification
Coil Resistance (Ω)	0.3 ~ 100 [20°C(68°F)]

Fuel System > Engine Control System > ETC (Electronic Throttle Control) System > Schematic Diagrams

Circuit Diagram

(M/T)

[Circuit Diagram]



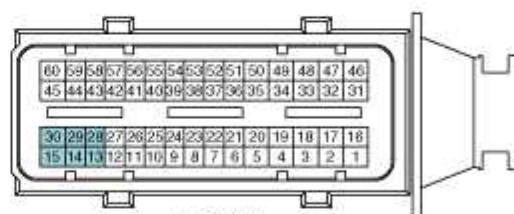
[Connection Information]

Terminal	Connected to	Function
1	ECM ENGM-A (30)	ETC Motor [-] control
2	ECM ENGM-A (15)	ETC Motor [+] control
3	ECM ENGM-A (29)	Sensor ground
4	ECM ENGM-A (28)	TPS 2 signal
5	ECM ENGM-A (14)	Sensor power (+5V)
6	ECM ENGM-A (13)	TPS 1 signal

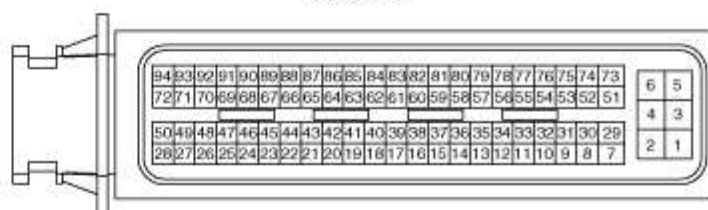
[Harness Connector]



ENG76
ETC Module



ENGM-A

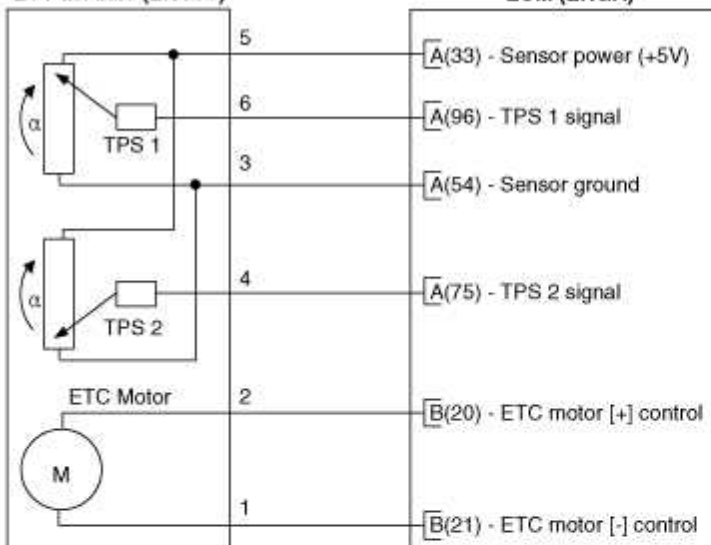


ENGM-K
ECM

(A/T)

[Circuit Diagram]

ETC Module (ENG76)



[Connection Information]

Terminal	Connected to	Function
1	ECM ENGA-B (21)	ETC Motor [-] control
2	ECM ENGA-B (20)	ETC Motor [+] control
3	ECM ENGA-A (54)	Sensor ground
4	ECM ENGA-A (75)	TPS 2 signal
5	ECM ENGA-A (33)	Sensor power (+5V)
6	ECM ENGA-A (96)	TPS 1 signal

[Harness Connector]



ENG76
ETC Module

106	104	103	102	101	100	99	98	97	96	95	94	93	92	91	90	89	88	87	86	85
84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65	64
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43
42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22
21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

ENG A-A

91	90	89	88	87	86	85	84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65	64	63	62	61	60	59	58
57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24
23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1											

ENG A-B
ECM

Fuel System > Engine Control System > ETC (Electronic Throttle Control) System > Repair procedures

Inspection

Throttle Position Sensor (TPS)

1. Connect the GDS on the Data Link Connector (DLC).
2. Start the engine and measure the output voltage of TPS 1 and 2 at C.T. and W.O.T.

Throttle Angle	Output Voltage (V)	
	TPS 1	TPS 2
C.T	0.5	4.5
W.O.T	4.41	0.59

ETC Motor

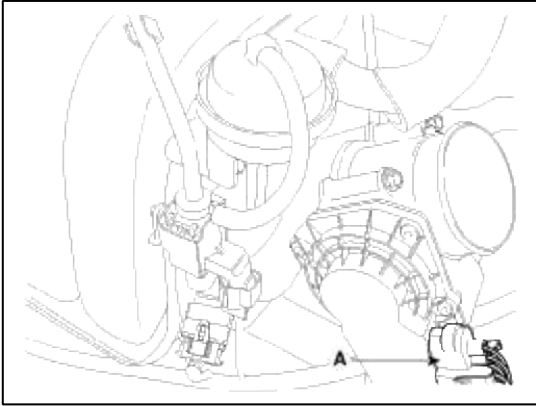
1. Turn the ignition switch OFF.
2. Disconnect the ETC module connector.
3. Measure resistance between the ETC module terminals 1 and 2.

4. Check that the resistance is within the specification.

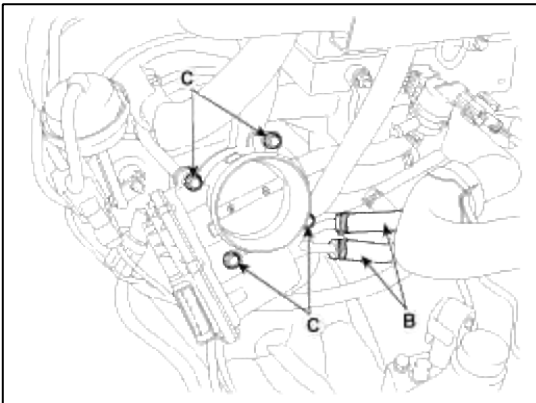
Specification: Refer to “Specification”

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Remove the resonator and the air intake hose (Refer to “Intake And Exhaust System” in EM group).
3. Disconnect the ETC module connector (A).



4. Disconnect the coolant hoses (B).
5. Remove the installation bolts (C), and then remove the ETC module from the engine.



Installation

CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.

1. Installation is reverse of removal.

Electronic throttle body Installation bolt:

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

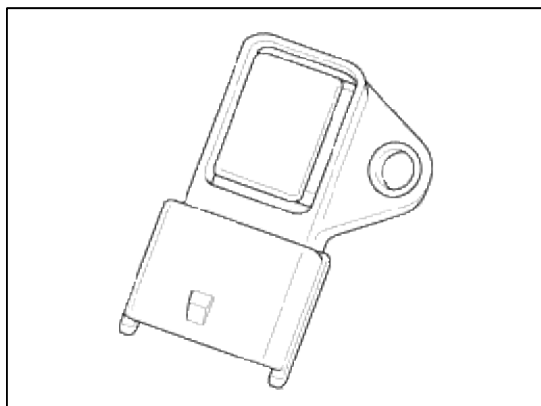
Fuel System > Engine Control System > Manifold Absolute Pressure Sensor (MAPS) > Description and Operation

Description

Manifold Absolute Pressure Sensor (MAPS) is a speed-density type sensor and is installed on the surge tank. It senses absolute pressure of the surge tank and transfers the analog signal proportional to the pressure to the ECM.

By using this signal, the ECM calculates the intake air quantity and engine speed.

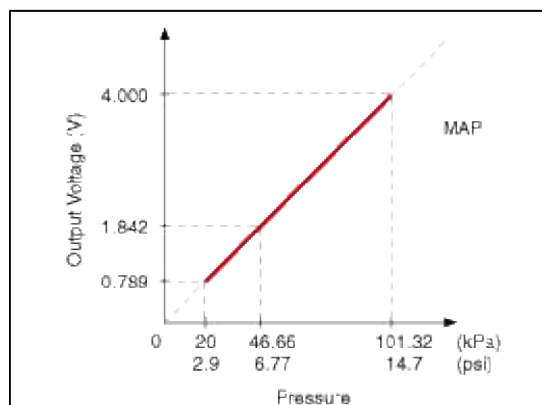
The MAPS consists of a piezo-electric element and a hybrid IC amplifying the element output signal. The element is silicon diaphragm type and adapts pressure sensitive variable resistor effect of semi-conductor. Because 100% vacuum and the manifold pressure apply to both sides of the sensor respectively, this sensor can output analog signal by using the silicon variation proportional to pressure change.



Fuel System > Engine Control System > Manifold Absolute Pressure Sensor (MAPS) > Specifications

Specification

Pressure [kPa (kgf/cm ² , psi)]	Output Voltage (V)
20.0 (0.20, 2.9)	0.79
46.7 (0.47, 6.77)	1.84
101.3 (1.03, 14.7)	4.0



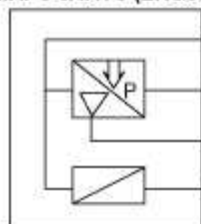
Fuel System > Engine Control System > Manifold Absolute Pressure Sensor (MAPS) > Schematic Diagrams

Circuit Diagram

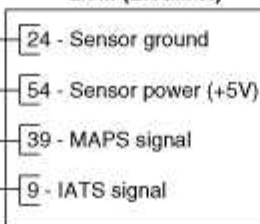
(M/T)

[Circuit Diagram]

MAPS & IATS (ENG37)



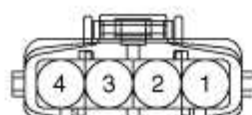
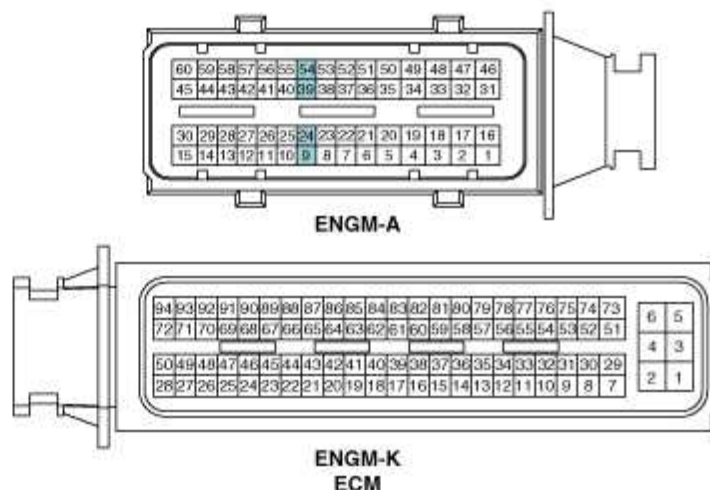
ECM (ENGM-A)



[Connection Information]

Terminal	Connected to	Function
1	ECM ENGM-A (39)	MAPS #1 signal
2	ECM ENGM-A (54)	Sensor power (+5V)
3	ECM ENGM-A (9)	IATS signal
4	ECM ENGM-A (24)	Sensor ground

[Harness Connector]

ENG37
MAPS & IATS

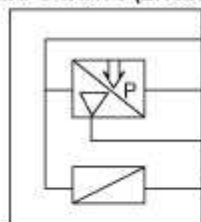
ENGM-A

ENGM-K
ECM

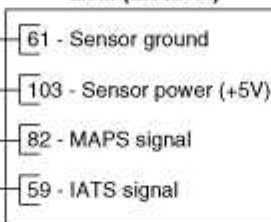
(A/T)

[Circuit Diagram]

MAPS & IATS (ENG37)



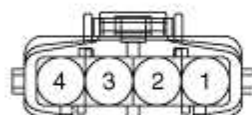
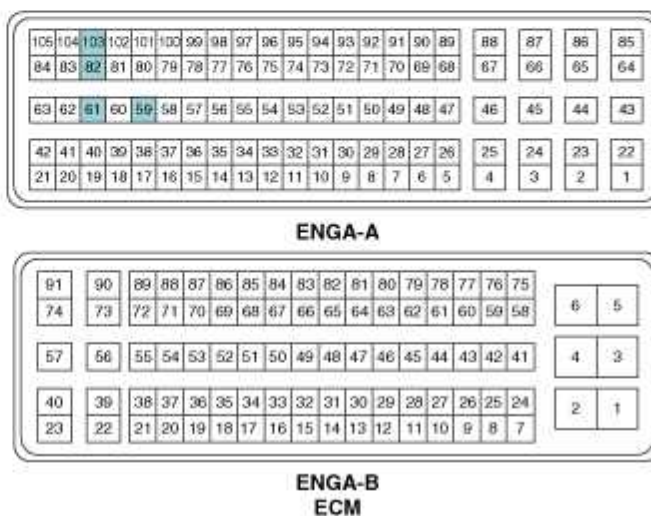
ECM (ENGA-A)



[Connection Information]

Terminal	Connected to	Function
1	ECM ENGA-A (82)	MAPS #1 signal
2	ECM ENGA-A (103)	Sensor power (+5V)
3	ECM ENGA-A (59)	IATS signal
4	ECM ENGA-A (61)	Sensor ground

[Harness Connector]

ENG37
MAPS & IATS

ENGA-A

ENGA-B
ECM

Fuel System > Engine Control System > Manifold Absolute Pressure Sensor (MAPS) > Repair procedures

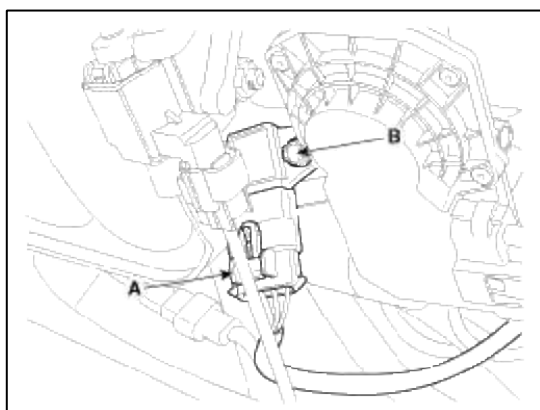
Inspection

1. Connect the GDS on the Data Link Connector (DLC).
2. Measure the output voltage of the MAPS at idle and IG ON.

Condition	Output Voltage (V)
IG ON	3.9 ~ 4.1
Idle	0.8 ~ 1.6

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the manifold absolute pressure sensor connector (A).
3. Remove the installation bolt (B), and then remove the sensor from the intake manifold.



Installation

CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.

CAUTION

- Insert the sensor in the installation hole and be careful not to damage when installation.

1. Installation is reverse of removal.

Manifold absolute pressure sensor installation bolt:

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

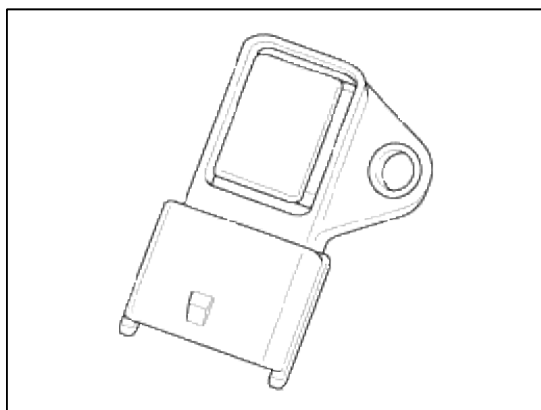
Fuel System > Engine Control System > Intake Air Temperature Sensor (IATS) > Description and Operation

Description

Intake Air Temperature Sensor (IATS) is included inside Manifold Absolute Pressure Sensor and detects the intake air temperature.

To calculate precise air quantity, correction of the air temperature is needed because air density varies according to the temperature. So the ECM uses not only MAPS signal but also IATS signal. This sensor has a Negative

Temperature Coefficient (NTC) Thermister and it's resistance changes in reverse proportion to the temperature.



Fuel System > Engine Control System > Intake Air Temperature Sensor (IATS) > Specifications

Specification

Temperature [°C(°F)]	Resistance (kΩ)
-40(-40)	40.93 ~ 48.35
-20(-4)	13.89 ~ 16.03
0(32)	5.38 ~ 6.09
10(50)	3.48 ~ 3.90
20(68)	2.31 ~ 2.57
40(104)	1.08 ~ 1.21
50(122)	0.76 ~ 0.85
60(140)	0.54 ~ 0.62
80(176)	0.29 ~ 0.34

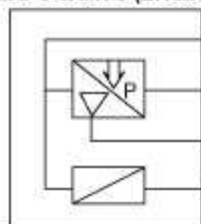
Fuel System > Engine Control System > Intake Air Temperature Sensor (IATS) > Schematic Diagrams

Circuit Diagram

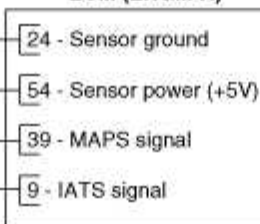
(M/T)

[Circuit Diagram]

MAPS & IATS (ENG37)



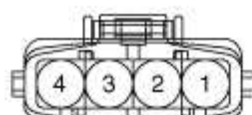
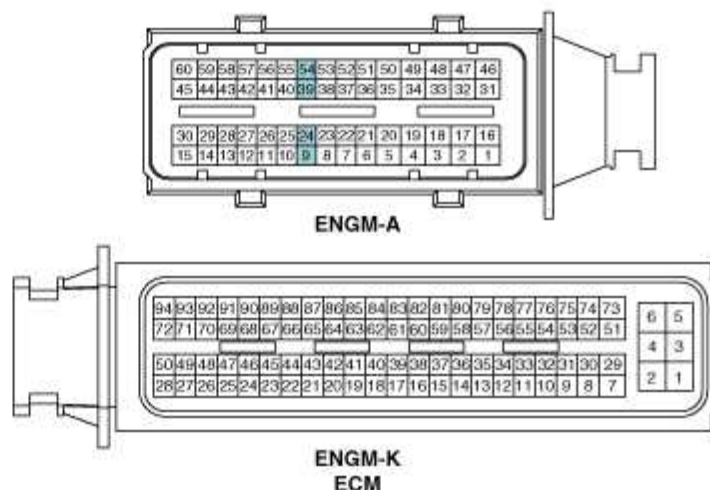
ECM (ENGM-A)



[Connection Information]

Terminal	Connected to	Function
1	ECM ENGM-A (39)	MAPS #1 signal
2	ECM ENGM-A (54)	Sensor power (+5V)
3	ECM ENGM-A (9)	IATS signal
4	ECM ENGM-A (24)	Sensor ground

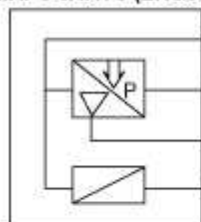
[Harness Connector]

ENG37
MAPS & IATS

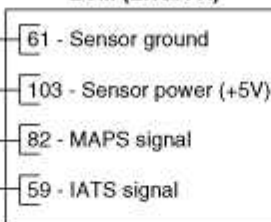
(A/T)

[Circuit Diagram]

MAPS & IATS (ENG37)



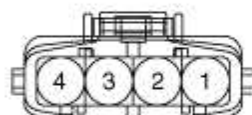
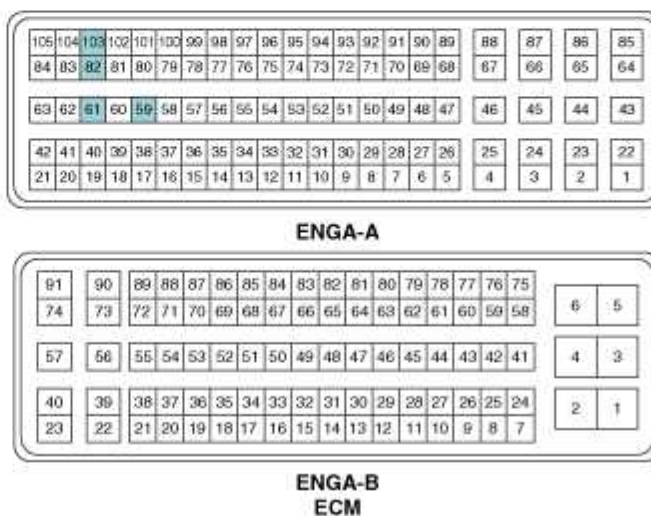
ECM (ENGA-A)



[Connection Information]

Terminal	Connected to	Function
1	ECM ENGA-A (82)	MAPS #1 signal
2	ECM ENGA-A (103)	Sensor power (+5V)
3	ECM ENGA-A (59)	IATS signal
4	ECM ENGA-A (61)	Sensor ground

[Harness Connector]

ENG37
MAPS & IATS

Inspection

1. Turn the ignition switch OFF.
2. Disconnect the IATS connector.
3. Measure resistance between the IATS terminals 3 and 4.
4. Check that the resistance is within the specification.

Specification: Refer to “Specification”

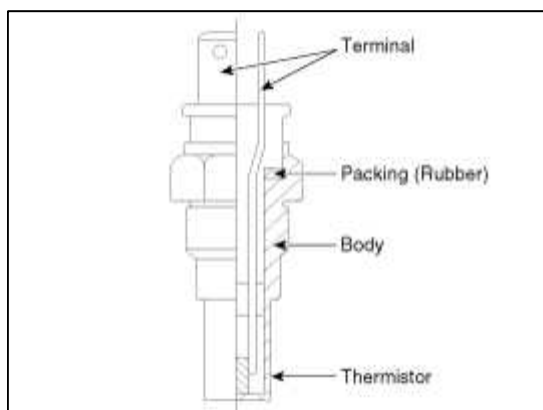
Fuel System > Engine Control System > Engine Coolant Temperature Sensor (ECTS) > Description and Operation

Description

Engine Coolant Temperature Sensor (ECTS) is located in the engine coolant passage of the cylinder head for detecting the engine coolant temperature. The ECTS uses a thermistor whose resistance changes with the temperature.

The electrical resistance of the ECTS decreases as the temperature increases, and increases as the temperature decreases. The reference +5V is supplied to the ECTS via a resistor in the ECM. That is, the resistor in the ECM and the thermistor in the ECTS are connected in series. When the resistance value of the thermistor in the ECTS changes according to the engine coolant temperature, the output voltage also changes.

During cold engine operation, the ECM increases the fuel injection duration and controls the ignition timing using the information of engine coolant temperature to avoid engine stalling and improve drivability.



Fuel System > Engine Control System > Engine Coolant Temperature Sensor (ECTS) > Specifications

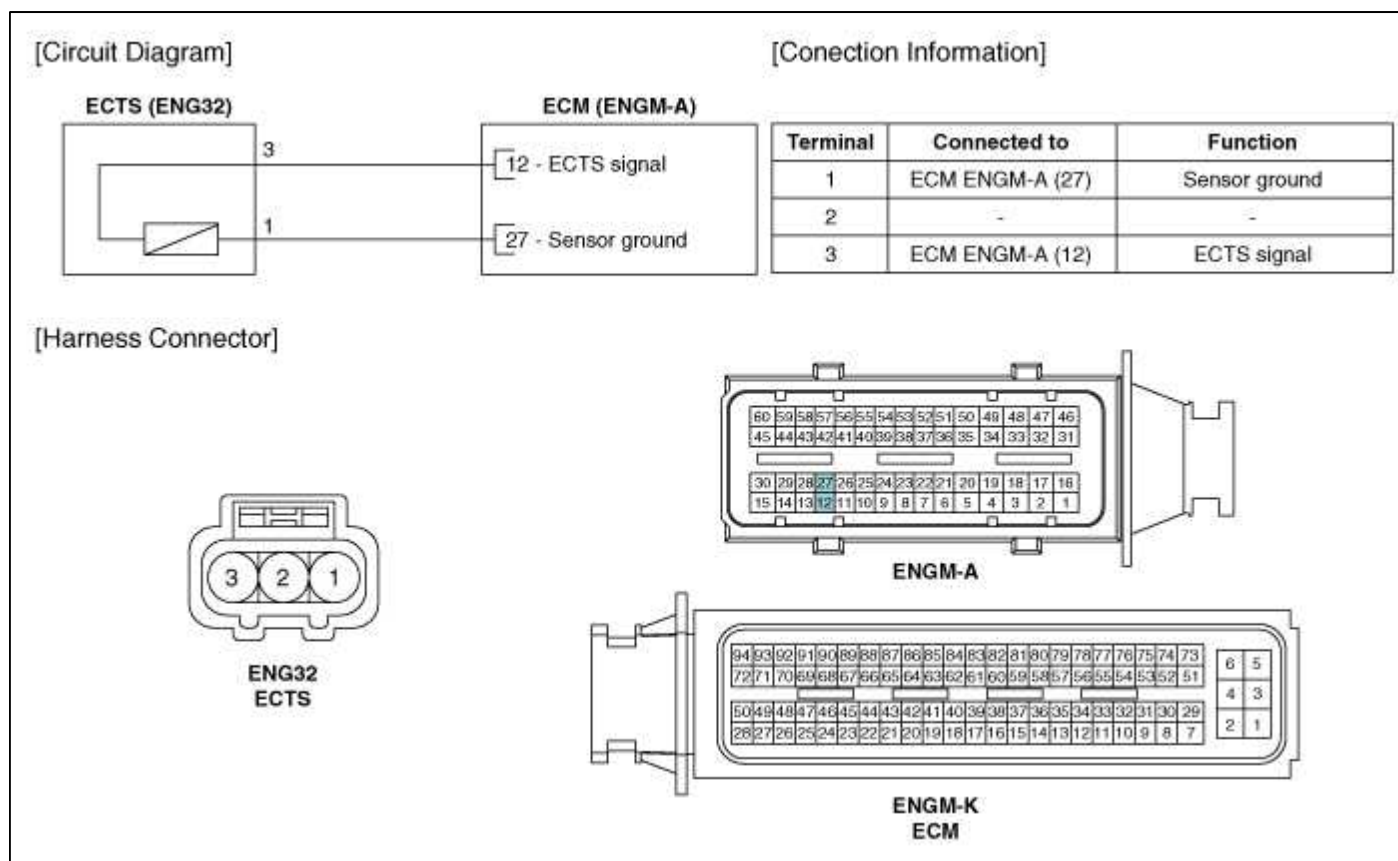
Specification

Temperature		Resistance (kΩ)
°C	°F	
-40	-40	48.14
-20	-4	14.13 ~ 16.83
0	32	5.79
20	68	2.31 ~ 2.59
40	104	1.15
60	140	0.59
80	176	0.32

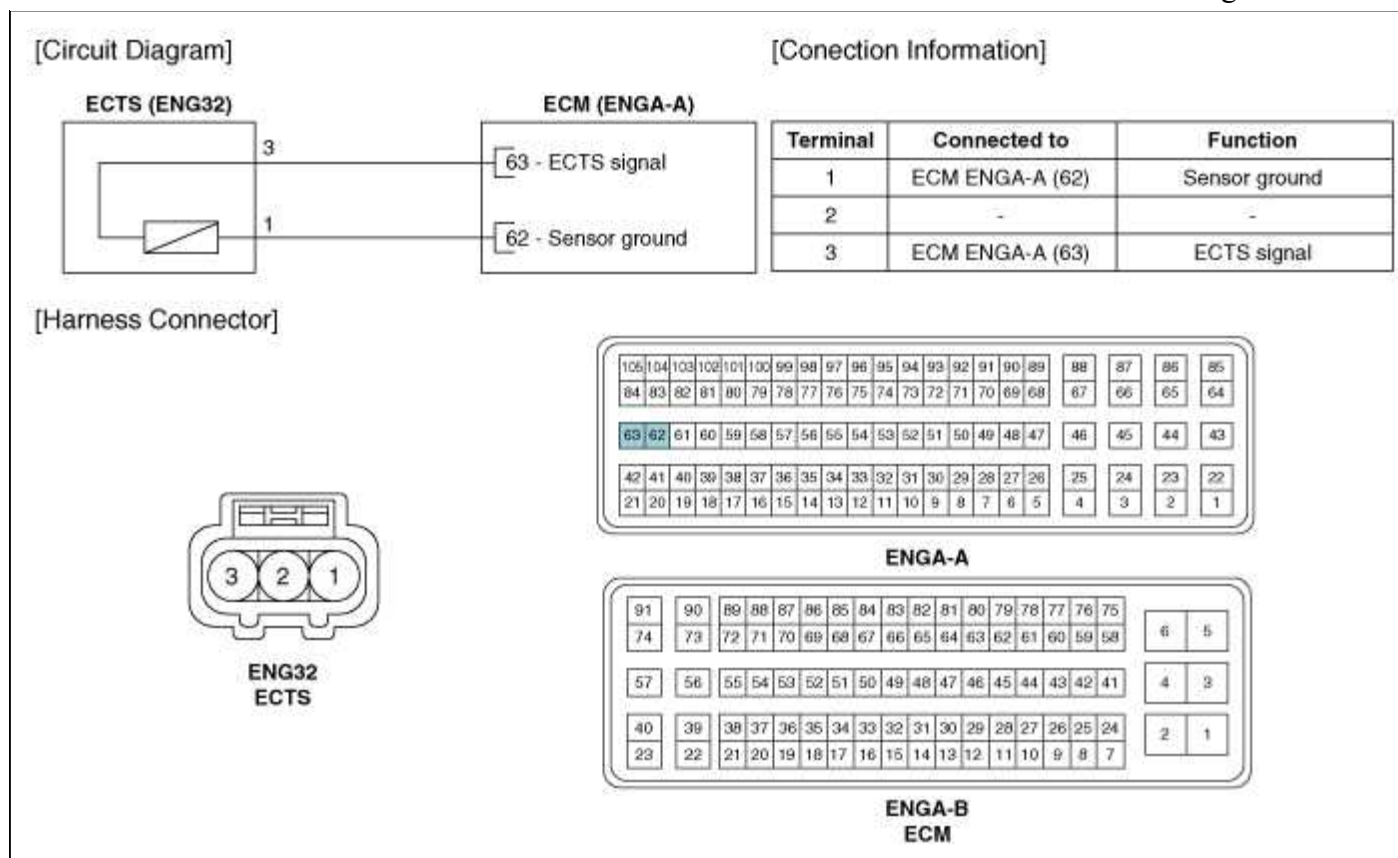
Fuel System > Engine Control System > Engine Coolant Temperature Sensor (ECTS) > Schematic Diagrams

Circuit Diagram

(M/T)



(A/T)



Fuel System > Engine Control System > Engine Coolant Temperature Sensor (ECTS) > Repair procedures

Inspection

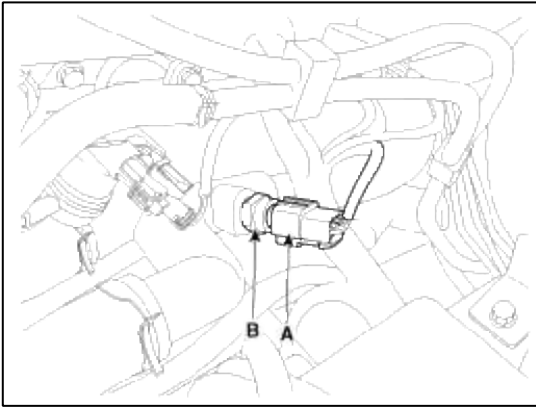
1. Turn the ignition switch OFF.
2. Disconnect the ECTS connector.
3. Remove the ECTS.
4. After immersing the thermistor of the sensor into engine coolant, measure resistance between the ECTS terminals 1 and 3.
5. Check that the resistance is within the specification.

Specification: Refer to “Specification”

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the engine coolant temperature sensor connector (A).

3. Remove the sensor (B).

**CAUTION**

Note that engine coolant may be flowed out from the water temperature control assembly when removing the sensor.

4. Supplement the engine coolant (Refer to “Cooling System” in EM group).

Installation

CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped.

CAUTION

- Apply the engine coolant to the O-ring.

CAUTION

- Insert the sensor in the installation hole and be careful not to damage.

1. Installation is reverse of removal.

Engine coolant temperature sensor installation:

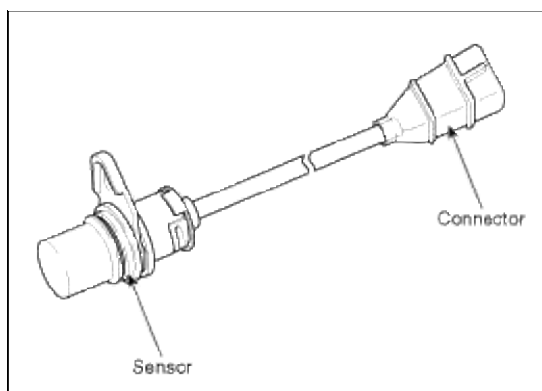
29.4 ~ 39.2 N.m (3.0 ~ 4.0 kgf.m, 21.7 ~ 28.9 lb-ft)

Fuel System > Engine Control System > Crankshaft Position Sensor (CKPS) > Description and Operation

Description

Crankshaft Position Sensor (CKPS) detects the crankshaft position and is one of the most important sensors of the engine control system. If there is no CKPS signal input, the engine may stop because of CKPS signal missing. This sensor is installed on the cylinder block or the transaxle housing and generates alternating current by magnetic flux field which is made by the sensor and the target wheel when engine runs.

The target wheel consists of 58 slots and 2 missing slots on 360 degrees CA (Crank Angle).



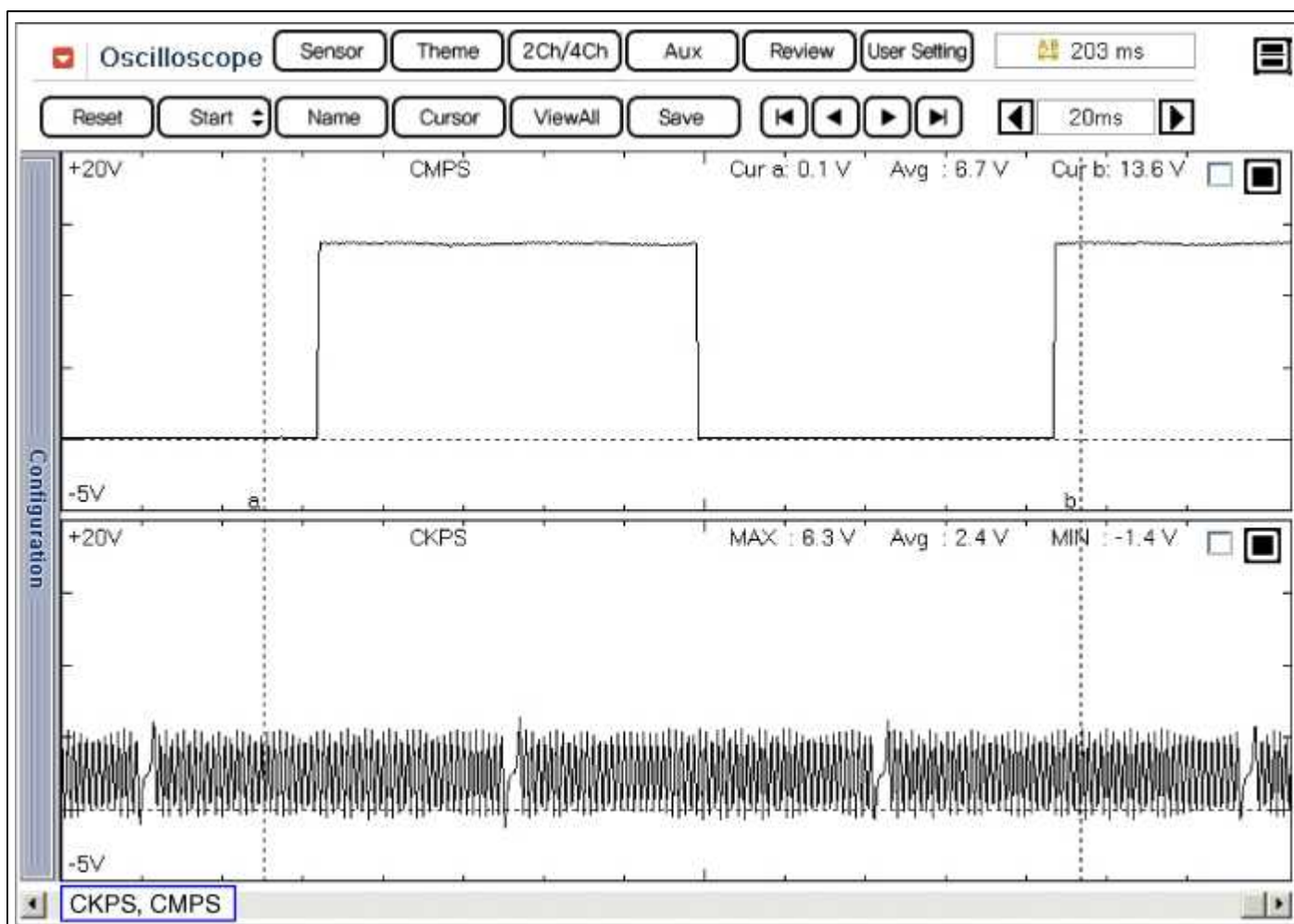
Fuel System > Engine Control System > Crankshaft Position Sensor (CKPS) > Specifications

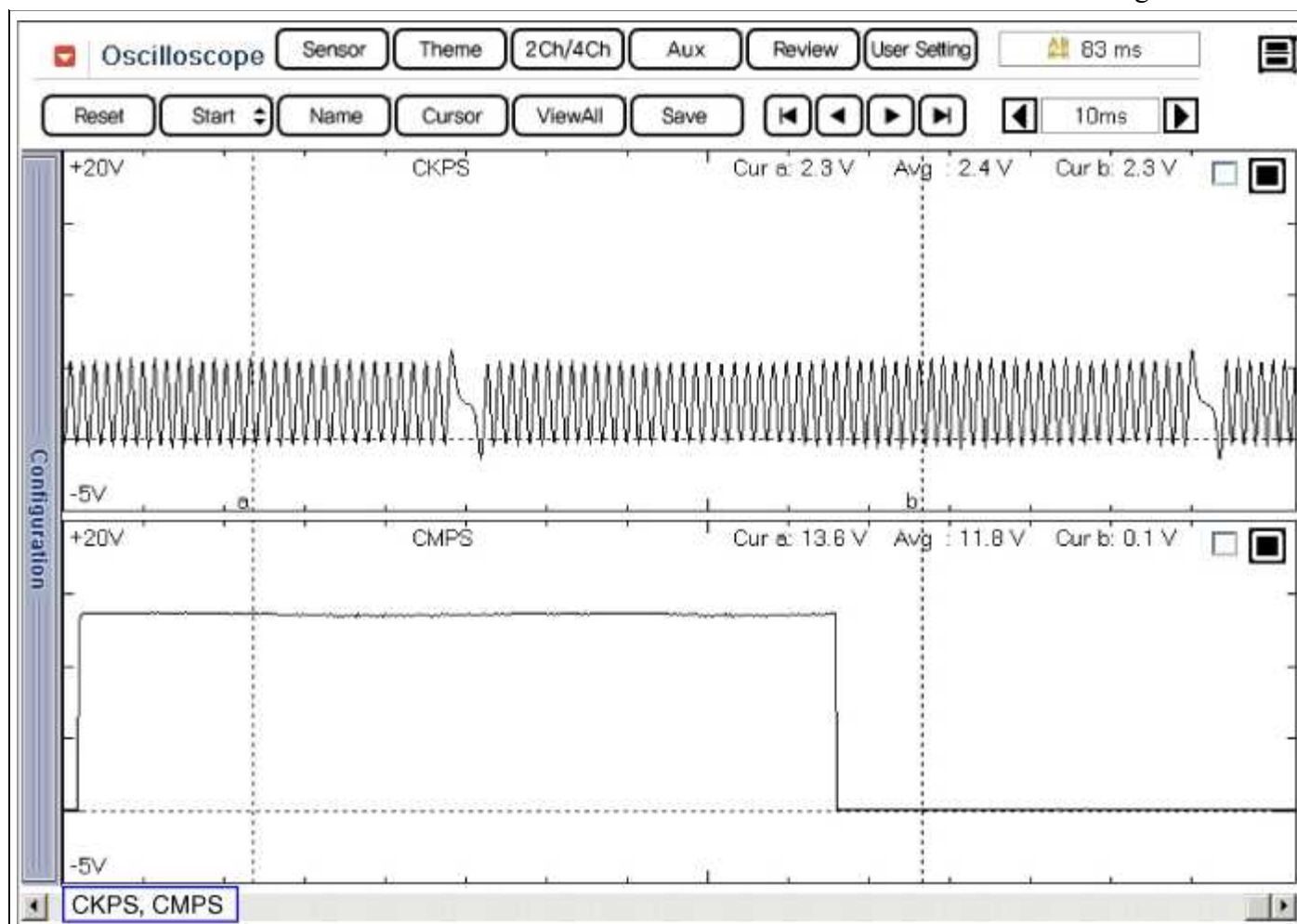
Specification

Item	Specification
Coil Resistance(Ω)	774 ~ 946 [20°C (68°F)]

Fuel System > Engine Control System > Crankshaft Position Sensor (CKPS) > Troubleshooting

Waveform

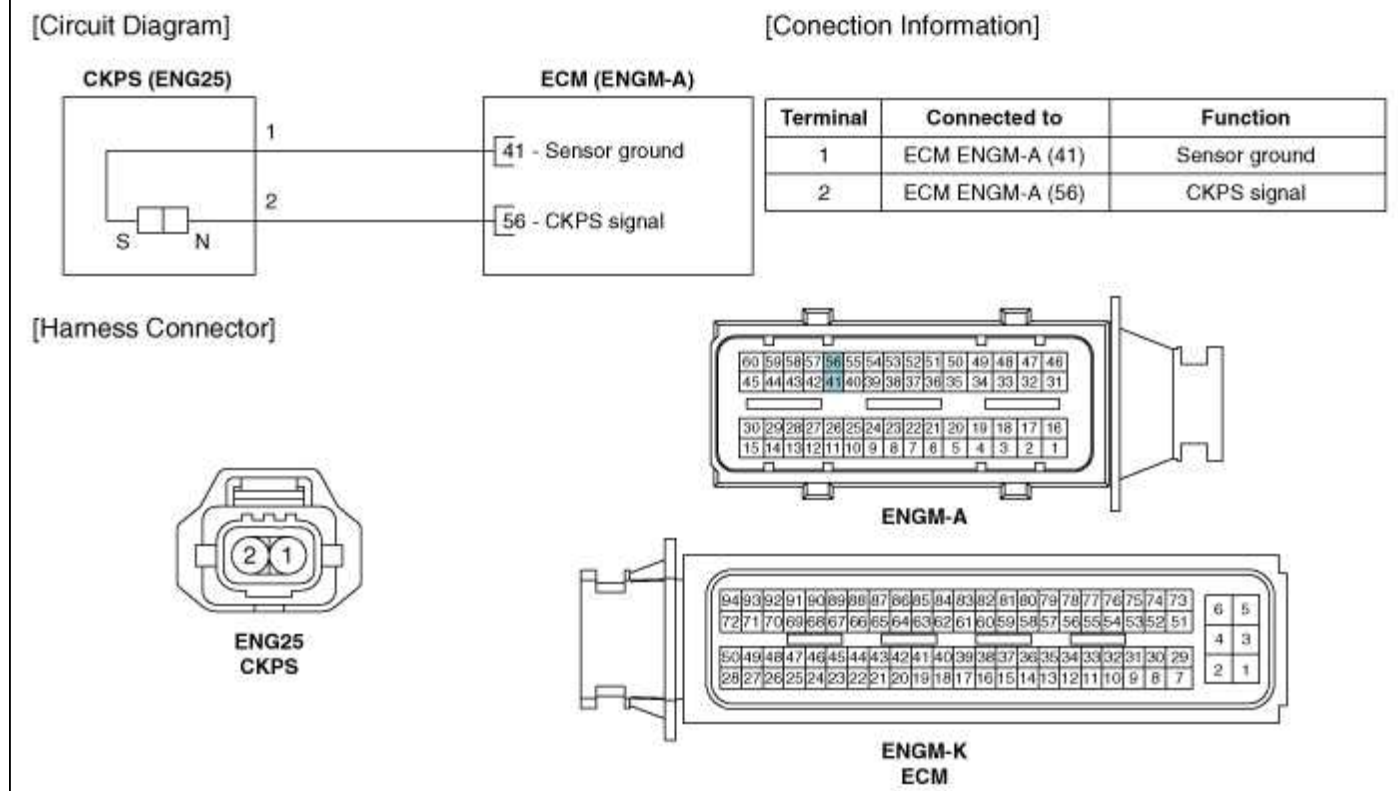




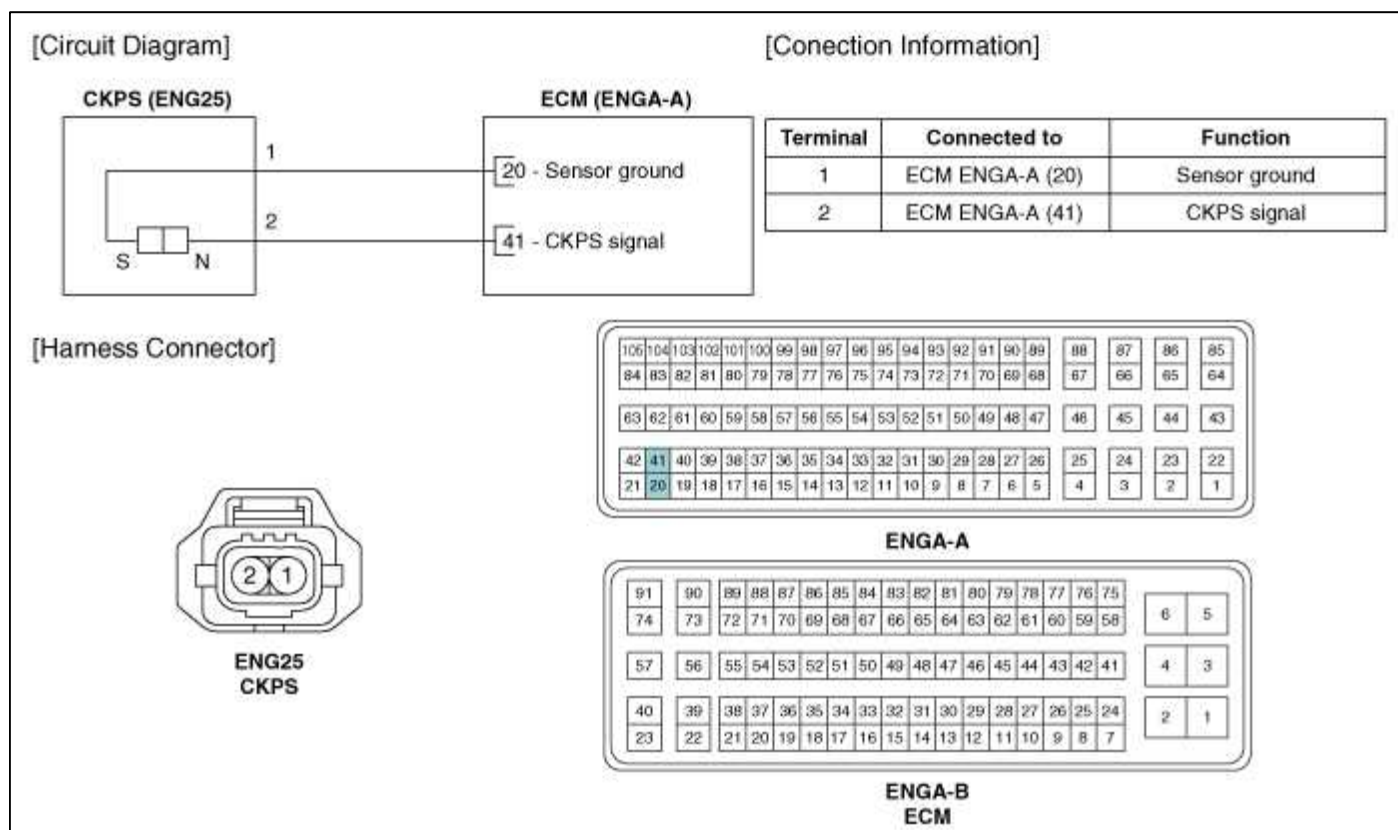
Fuel System > Engine Control System > Crankshaft Position Sensor (CKPS) > Schematic Diagrams

Circuit Diagram

(M/T)



(A/T)



Fuel System > Engine Control System > Crankshaft Position Sensor (CKPS) > Repair procedures

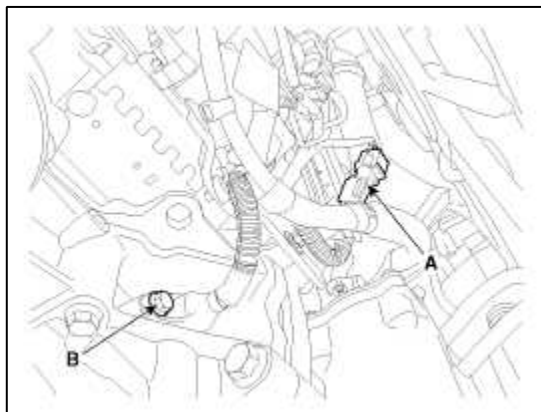
Inspection

1. Check signal waveform of CKPS and CMPS using a scan tool.

Specification: Refer to “Waveform”

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the crankshaft position sensor connector (A) and remove the sensor after removing the installation bolt (B).



Installation

CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. If the component has been dropped, inspect before installing.

CAUTION

- Apply the engine oil to the O-ring.
- Insert the sensor in the installation hole and be careful not to damage.

1. Installation is reverse of removal.

Crankshaft position sensor installation bolt:

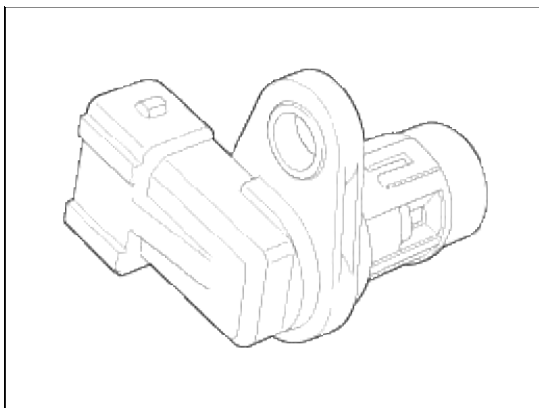
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

Fuel System > Engine Control System > Camshaft Position Sensor (CMPS) > Description and Operation

Description

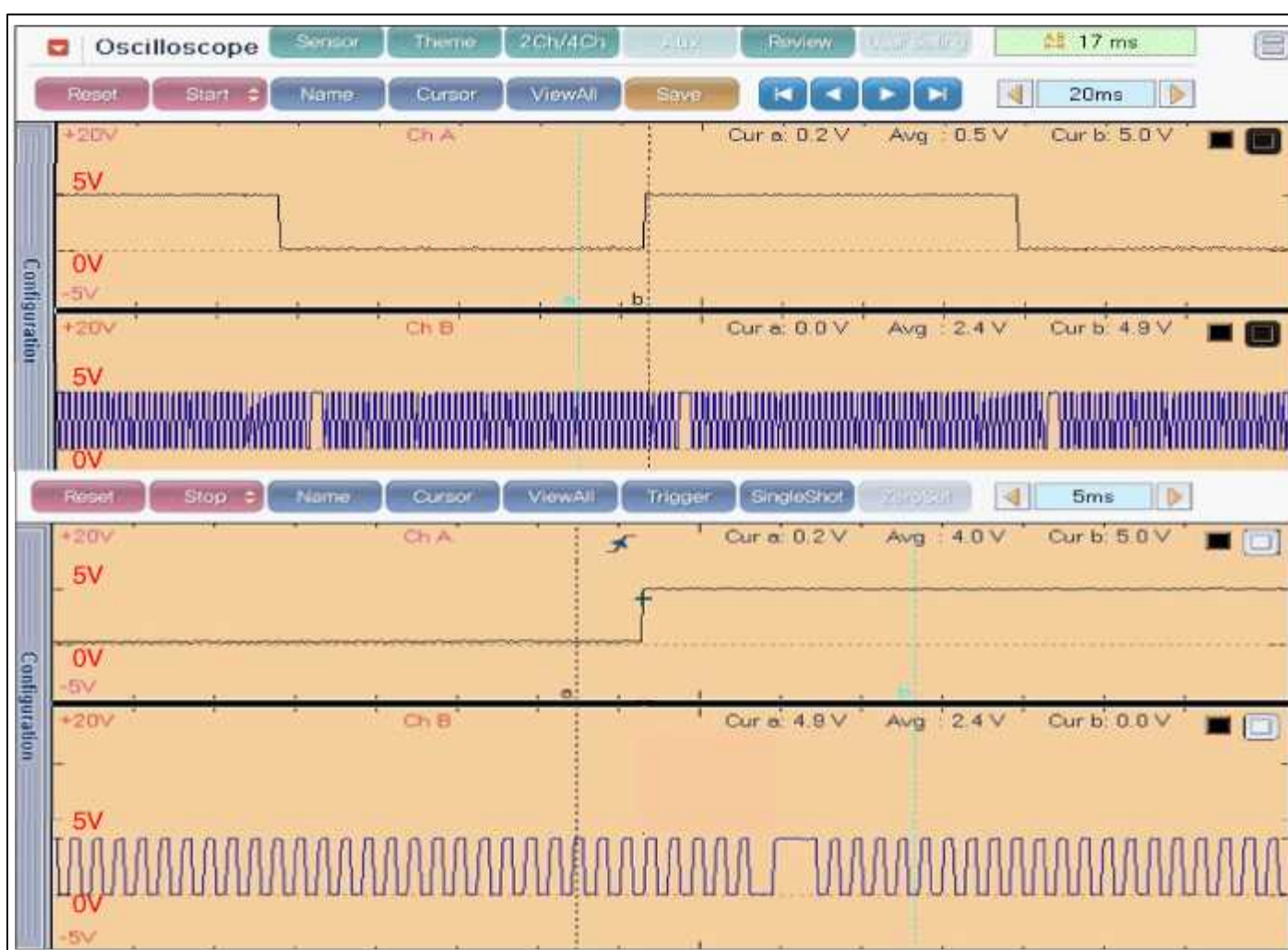
Camshaft Position Sensor (CMPS) is a hall sensor and detects the camshaft position by using a hall element. It is related with Crankshaft Position Sensor (CKPS) and detects the piston position of each cylinder which the CKPS can't detect.

The CMPS is installed on engine head cover and uses a target wheel installed on the camshaft. The Cam Position sensor is a hall-effect type sensor. As the target wheel passes the Hall sensor, the magnetic field changes in the sensor. The sensor then switches a signal which creates a square wave.



Fuel System > Engine Control System > Camshaft Position Sensor (CMPS) > Troubleshooting

Wave Form

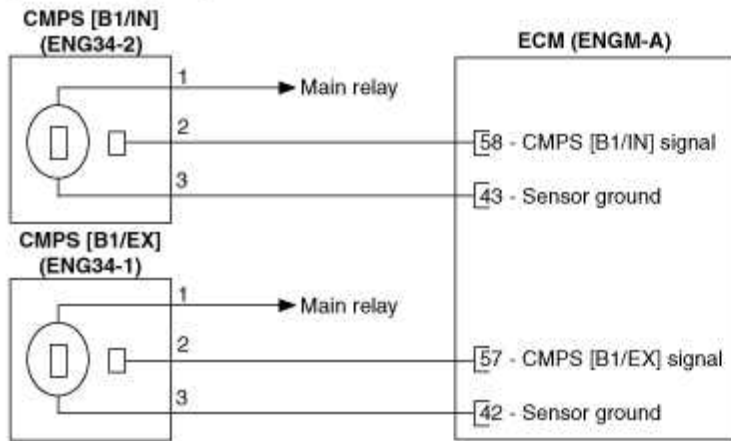


Fuel System > Engine Control System > Camshaft Position Sensor (CMPS) > Schematic Diagrams

Circuit Diagram

(M/T)

[Circuit Diagram]



[Connection Information]

CMPS [B1/IN] (ENG34-2)

Terminal	Connected to	Function
1	Main relay	Battery power (B+)
2	ECM ENGM-A (58)	CMPS [B1/IN] signal
3	ECM ENGM-A (43)	Sensor ground

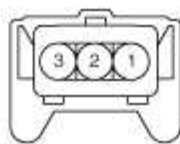
CMPS [B1/EX] (ENG34-1)

Terminal	Connected to	Function
1	Main relay	Battery power (B+)
2	ECM ENGM-A (57)	CMPS [B1/EX] signal
3	ECM ENGM-A (42)	Sensor ground

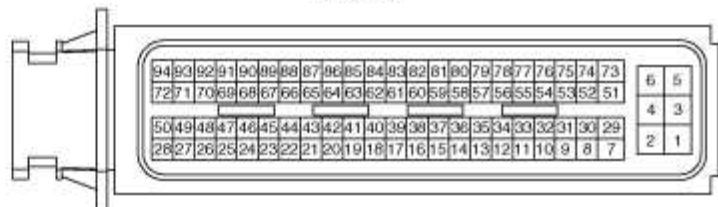
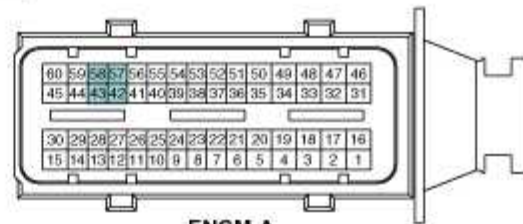
[Harness Connector]



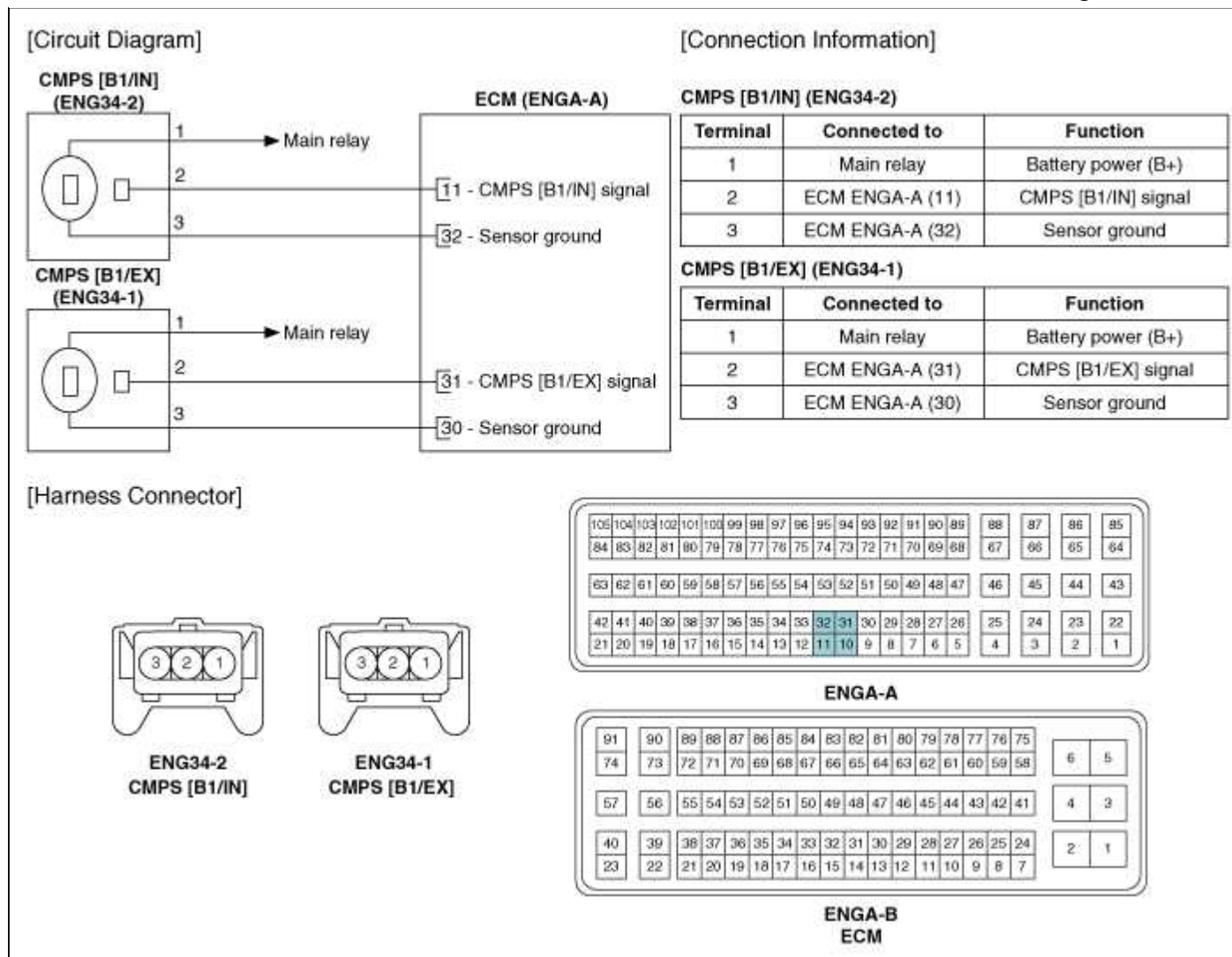
ENG34-2
CMPS [B1/IN]



ENG34-1
CMPS [B1/EX]



(A/T)



Fuel System > Engine Control System > Camshaft Position Sensor (CMPS) > Repair procedures

Inspection

1. Check the signal waveform of the CMPS and CKPS using the GDS.

Specification: Refer to “Wave Form”

Removal

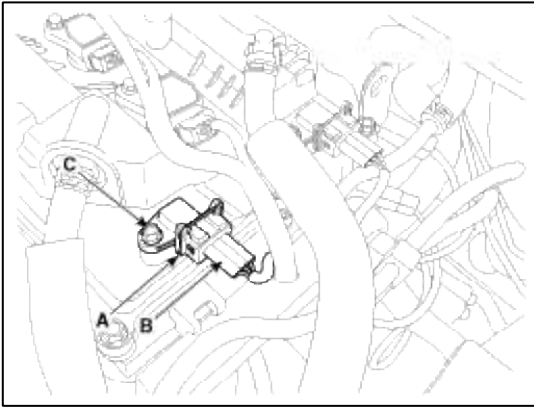
WARNING

- DON'T remove the camshaft position sensor during engine running or right after engine stops, or a scald by the flowed out engine oil may occur.

[Bank 1 / Intake]

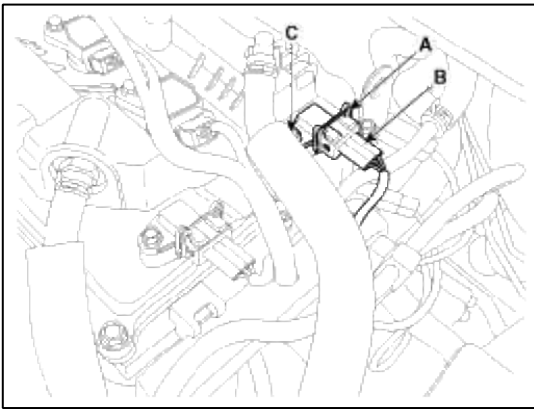
1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the camshaft position sensor connector (B) after removing the clip (A).

3. Remove the installation bolt (C), and then remove the sensor.



[Bank 1 / Exhaust]

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the camshaft position sensor connector (B) after removing the clip (A).
3. Remove the installation bolt (C), and then remove the sensor.



Installation

CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.

CAUTION

- Apply the engine oil to the O-ring.

CAUTION

- Insert the sensor in the installation hole and be careful not to damage when installation.

CAUTION

- Be careful not to damage the sensor housing and the connector.
- Be careful not to damage the O-ring.

1. Installation is reverse of removal.

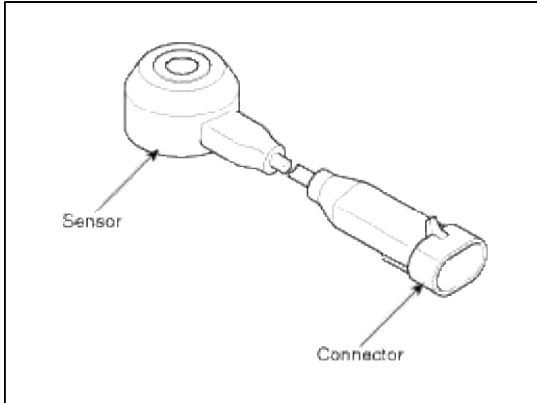
Camshaft position sensor installation bolt:

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

Description

Knocking is a phenomenon characterized by undesirable vibration and noise and can cause engine damage. Knock Sensor (KS) is installed on the cylinder block and senses engine knocking.

When knocking occurs, the vibration from the cylinder block is applied as pressure to the piezoelectric element. When a knock occurs, the sensor produces voltage signal. The ECM retards the ignition timing when knocking occurs. If the knocking disappears after retarding the ignition timing, the ECM will advance the ignition timing. This sequential control can improve engine power, torque and fuel economy.



Fuel System > Engine Control System > Knock Sensor (KS) > Specifications

Specification

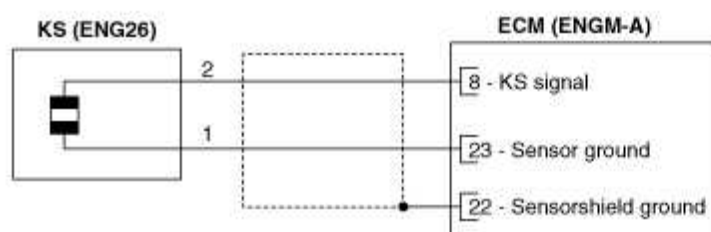
Item	Specification
Capacitance (pF)	850 ~ 1,150

Fuel System > Engine Control System > Knock Sensor (KS) > Schematic Diagrams

Circuit Diagram

(M/T)

[Circuit Diagram]



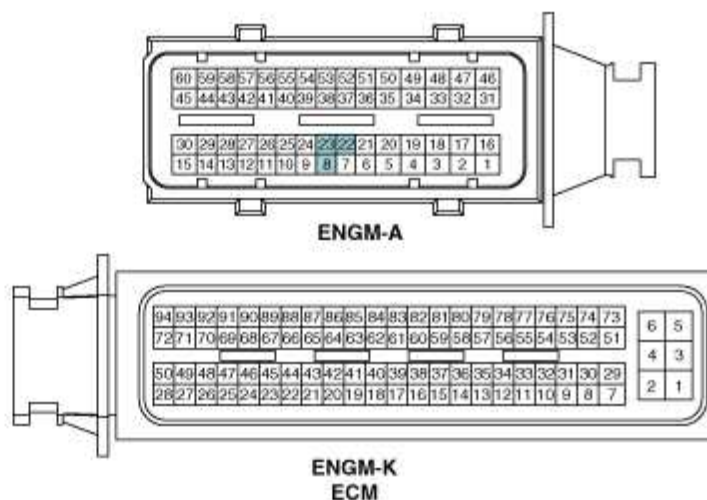
[Connection Information]

Terminal	Connected to	Function
1	ECM ENGM-A (23)	KS signal
2	ECM ENGM-A (8)	Sensor ground

[Harness Connector]

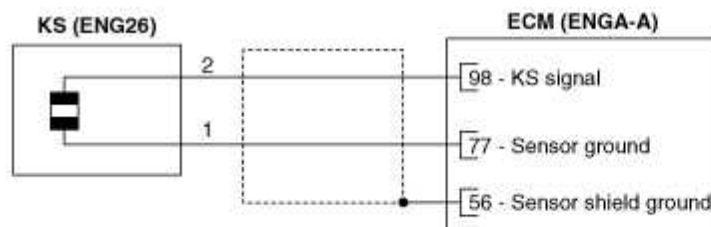


ENG26
Knock sensor



(A/T)

[Circuit Diagram]



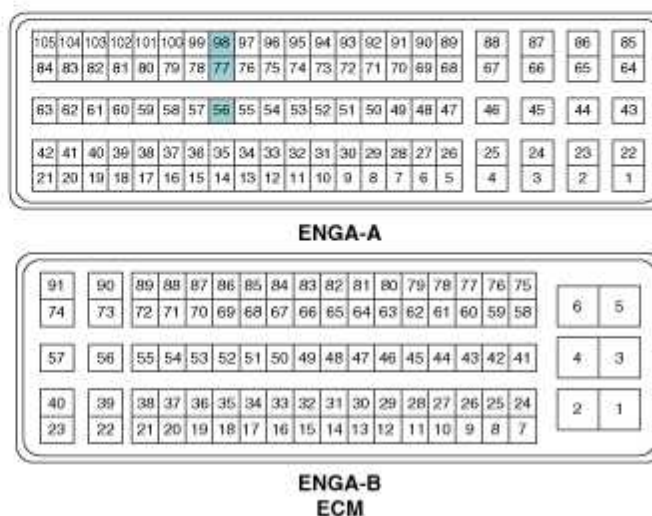
[Connection Information]

Terminal	Connected to	Function
1	ECM ENGA-A (77)	KS signal
2	ECM ENGA-A (98)	Sensor ground

[Harness Connector]



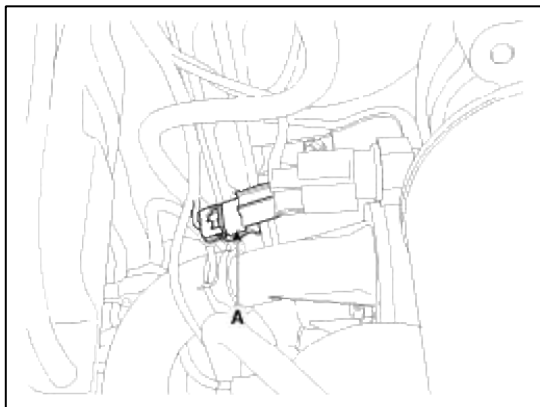
ENG26
Knock sensor



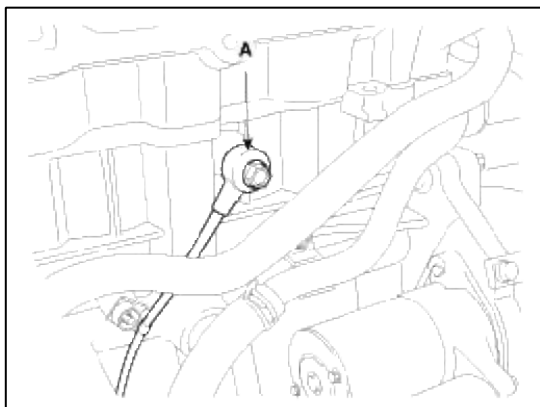
Fuel System > Engine Control System > Knock Sensor (KS) > Repair procedures

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the knock sensor connector (A).



3. Remove the intake manifold (Refer to “Intake And Exhaust System” in EM group).
4. Remove the installation bolt (A), and then remove the sensor from the cylinder block.



Installation

CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.

1. Installation is reverse of removal.

Knock sensor installation bolt:

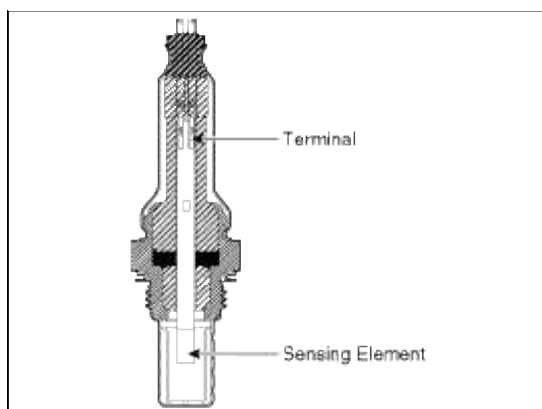
18.6 ~ 23.5 N.m (1.9 ~ 2.4 kgf.m, 13.7 ~ 17.4 lb-ft)

Fuel System > Engine Control System > Heated Oxygen Sensor (HO2S) > Description and Operation

Description

Heated Oxygen Sensor (HO2S) consists of zirconium and alumina and is installed both upstream and downstream of the Catalytic Converter. It varies in accordance with the air/fuel ratio.

The sensor must be hot in order to operate normally. To keep it hot, the sensor has a heater which is controlled by the ECM via a duty cycle signal. When the exhaust gas temperature is lower than the specified value, the heater warms the sensor tip.



Fuel System > Engine Control System > Heated Oxygen Sensor (HO2S) > Specifications

Specification

HO2S [Bank 1/Sensor 1] (Linear type)

Item	Specification
Heater Resistance (Ω)	2.4 ~ 4.0 [20°C(68°F)]

HO2S [Bank 1/Sensor 2] (Binary type)

A/F Ratio (λ)	Output Voltage(V)
RICH	0.6 ~ 1.0
LEAN	0 ~ 0.4

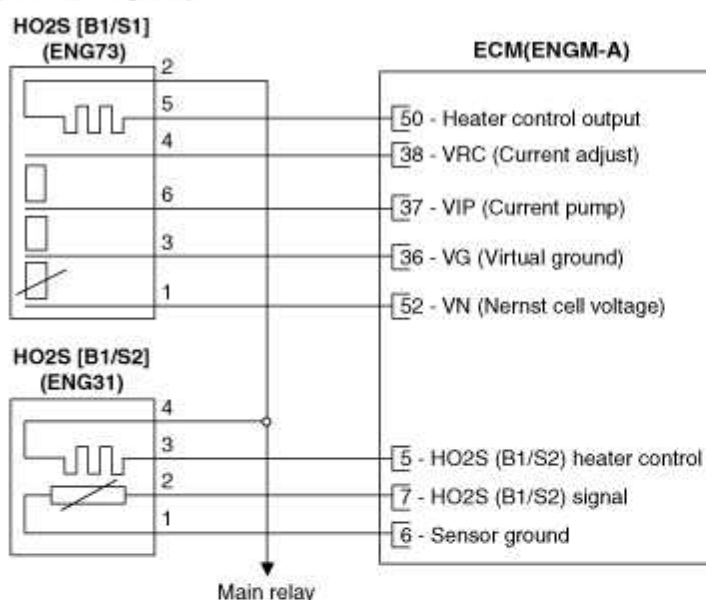
Item	Specification
Heater Resistance (Ω)	Approx. 9.0 [20°C(68°F)]

Fuel System > Engine Control System > Heated Oxygen Sensor (HO2S) > Schematic Diagrams

Circuit Diagram

(M/T)

[Circuit Diagram]



[Connection Information]

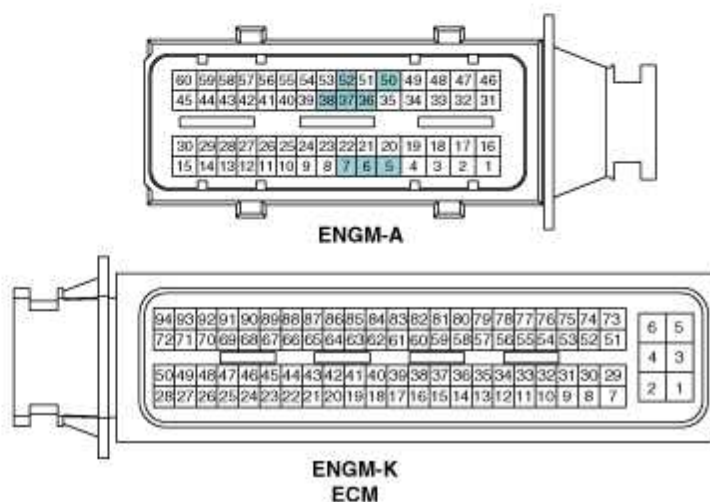
HO2S [B1/S1] (ENG73)

Terminal	Connected to	Function
1	ECM CNGM-A (52)	VN (Nernst cell voltage)
2	Main relay	Power supply (B+)
3	ECM CNGM-A (36)	VG (Virtual ground)
4	ECM CNGM-A (38)	VRC (Current adjust)
5	ECM CNGM-A (50)	Heater control
6	ECM CNGM-A (37)	VIP (Current pump)

HO2S [B1/S2] (ENG31)

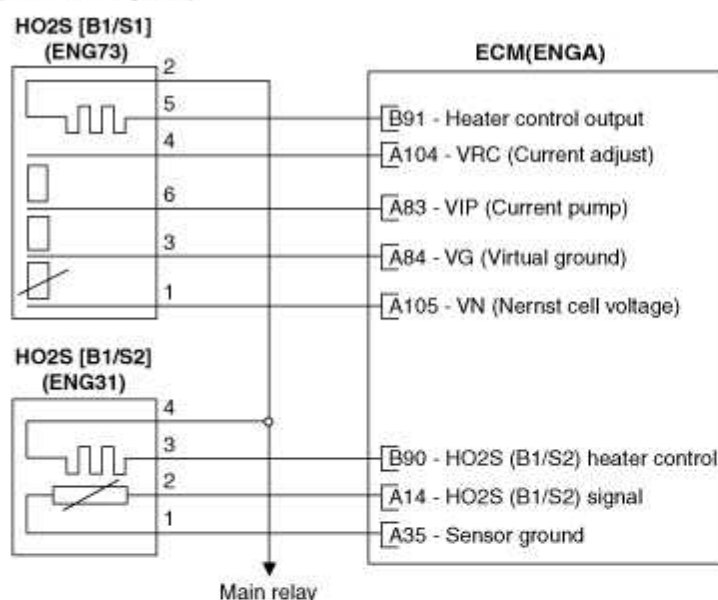
Terminal	Connected to	Function
1	ECM CNGM-A (6)	Sensor ground
2	ECM CNGM-A (7)	HO2S (B1/S2) signal
3	ECM CNGM-A (5)	Heater control
4	Main relay	Power supply (B+)

[Harness Connector]



(A/T)

[Circuit Diagram]



[Connection Information]

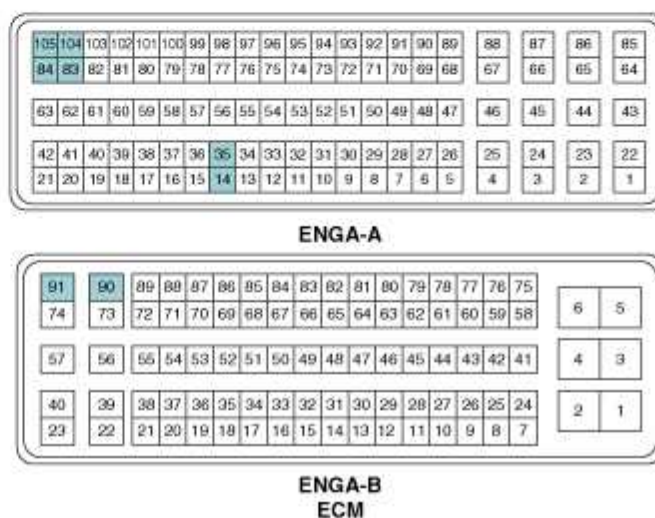
HO2S [B1/S1] (ENG73)

Terminal	Connected to	Function
1	ECM ENGA-A (105)	VN (Nernst cell voltage)
2	Main relay	Power supply (B+)
3	ECM ENGA-A (84)	VG (Virtual ground)
4	ECM ENGA-A (104)	VRC (Current adjust)
5	ECM ENGA-B (91)	Heater control
6	ECM ENGA-A (83)	VIP (Current pump)

HO2S [B1/S2] (ENG31)

Terminal	Connected to	Function
1	ECM ENGA-A (35)	Sensor ground
2	ECM ENGA-A (14)	HO2S (B1/S2) signal
3	ECM ENGA-B (90)	Heater control
4	Main relay	Power supply (B+)

[Harness Connector]



Fuel System > Engine Control System > Heated Oxygen Sensor (HO2S) > Repair procedures

Inspection

1. Turn the ignition switch OFF.
2. Disconnect the HO2S connector.
3. Measure resistance between the HO2S terminals 2 and 5 [B1/S1].
Measure resistance between the HO2S terminals 3 and 4 [B1/S2].
4. Check that the resistance is within the specification.

Specification: Refer to “Specification”

Removal

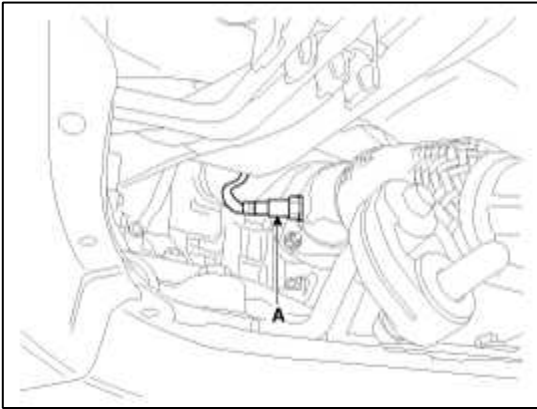
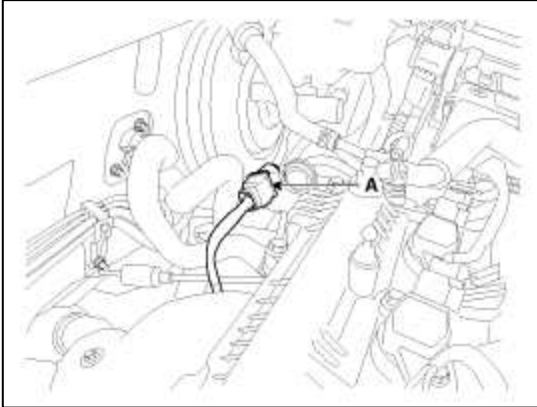
[Bank 1 / Sensor 1]

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.

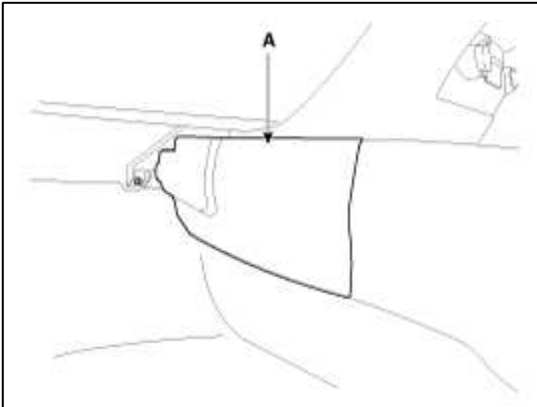
2. Disconnect the connector (A), and then remove the sensor (B).

NOTE

Note that the SST (Part No.: 09392-2H100) is useful when removing the heated oxygen sensor.

**[Bank 1 / Sensor 2]**

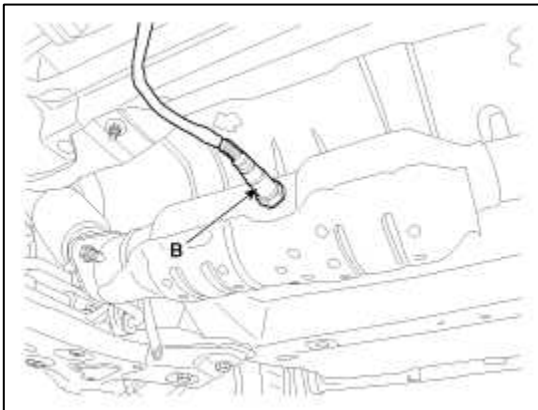
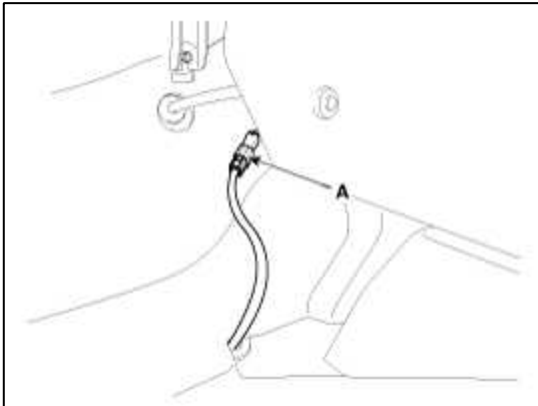
1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Remove the console side cover [LH] (A).



3. Disconnect the connector (A), and then remove the sensor (B).

NOTE

Note that the SST (Part No.: 09392-2H100) is useful when removing the heated oxygen sensor.



Installation

CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.

CAUTION

- DON'T use a cleaner, spray, or grease to sensing element and connector of the sensor because oil component in them may malfunction the sensor performance.
- Sensor and its wiring may be damaged in case of contacting with the exhaust system (Exhaust Manifold, Catalytic Converter, and so on).

1. Installation is reverse of removal.

Heated oxygen sensor installation:

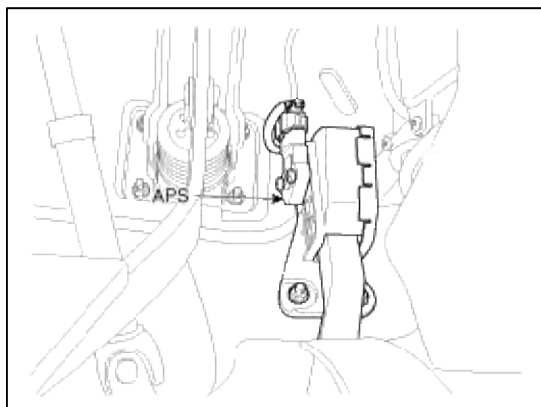
39.2 ~ 49.1 N.m (4.0 ~ 5.0 kgf.m, 28.9 ~ 36.2 lb-ft)

Fuel System > Engine Control System > Accelerator Position Sensor (APS) > Description and Operation

Description

Accelerator Position Sensor (APS) is installed on the accelerator pedal module and detects the rotation angle of the

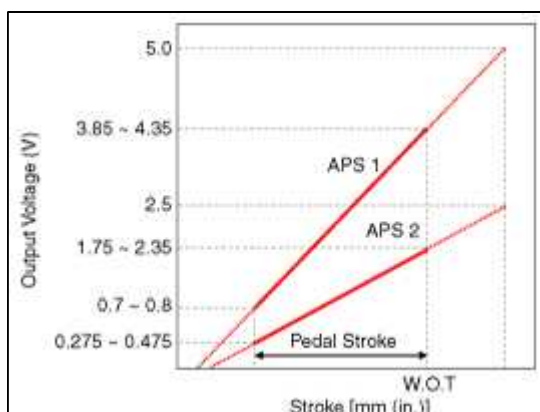
accelerator pedal. The APS is one of the most important sensors in engine control system, so it consists of the two sensors which adapt individual sensor power and ground line. The second sensor monitors the first sensor and its output voltage is half of the first one. If the ratio of the sensor 1 and 2 is out of the range (approximately 1/2), the diagnostic system judges that it is abnormal.



Fuel System > Engine Control System > Accelerator Position Sensor (APS) > Specifications

Specification

Accelerator Position	Output Voltage (V)	
	APS1	APS2
C.T	0.7 ~ 0.8	0.275 ~ 0.475
W.O.T	3.85 ~ 4.35	1.75 ~ 2.35

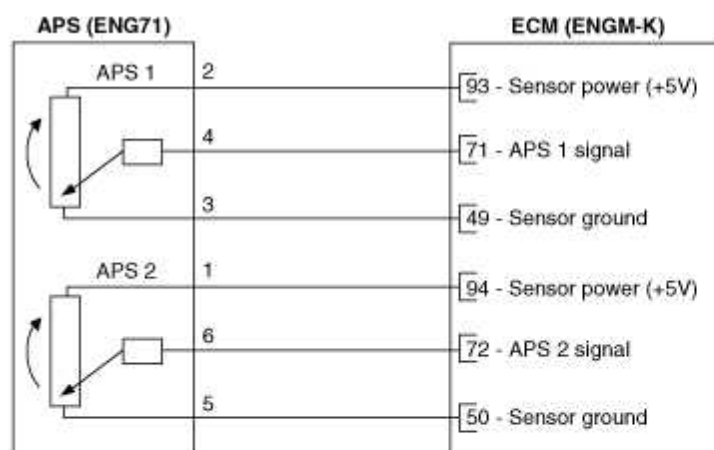


Fuel System > Engine Control System > Accelerator Position Sensor (APS) > Schematic Diagrams

Circuit Diagram

(M/T)

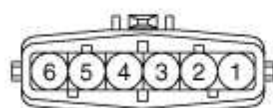
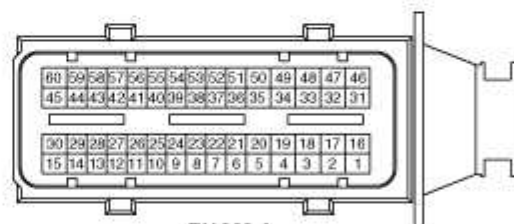
[Circuit Diagram]



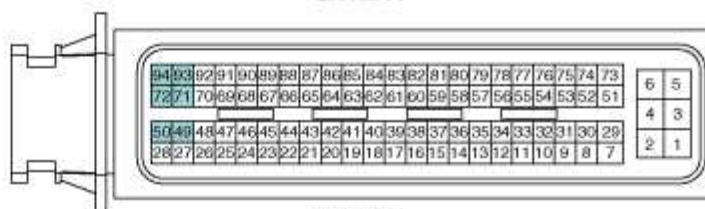
[Connection Information]

Terminal	Connected to	Function
1	ECM ENGM-K (94)	APS 2 sensor power (+5V)
2	ECM ENGM-K (93)	APS 1 sensor power (+5V)
3	ECM ENGM-K (49)	APS 1 sensor ground
4	ECM ENGM-K (71)	APS 1 signal
5	ECM ENGM-K (50)	APS 2 sensor ground
6	ECM ENGM-K (72)	APS 2 signal

[Harness Connector]

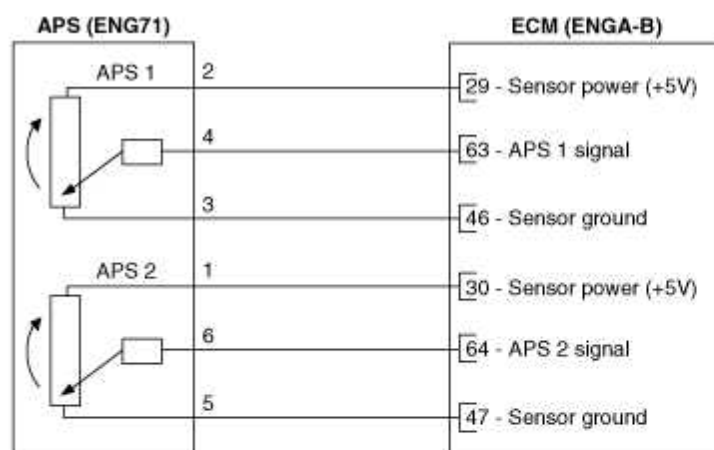
ENG71
APS

ENGM-A

ENGM-K
ECM

(A/T)

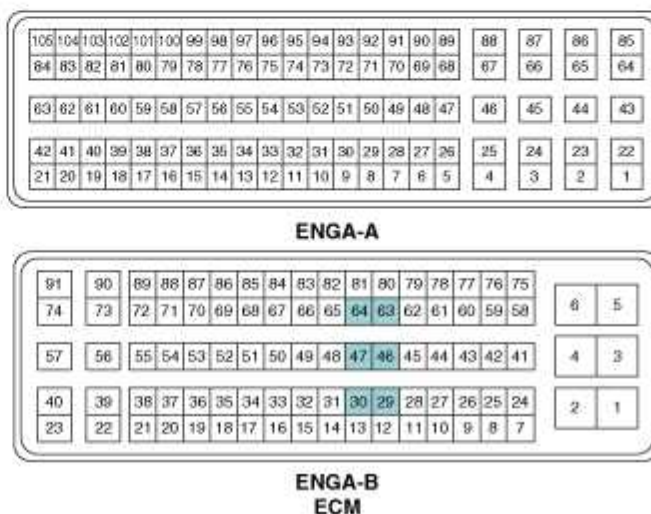
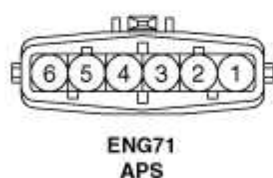
[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	ECM ENGA-B (30)	APS 2 sensor power (+5V)
2	ECM ENGA-B (29)	APS 1 sensor power (+5V)
3	ECM ENGA-B (46)	APS 1 sensor ground
4	ECM ENGA-B (63)	APS 1 signal
5	ECM ENGA-B (47)	APS 2 sensor ground
6	ECM ENGA-B (64)	APS 2 signal

[Harness Connector]



Fuel System > Engine Control System > Accelerator Position Sensor (APS) > Repair procedures

Inspection

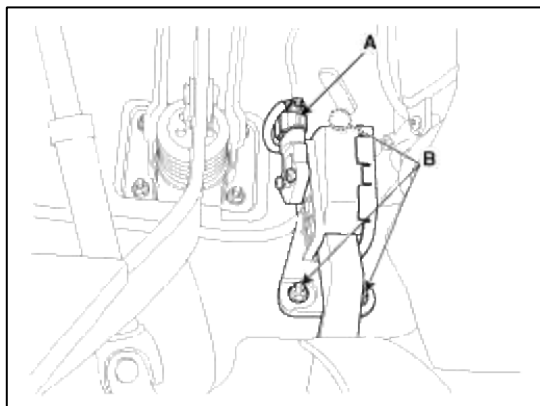
1. Connect the GDS on the Data Link Connector (DLC).
2. Turn the ignition switch ON.
3. Measure the output voltage of the APS 1 and 2 at C.T and W.O.T.

Specification: Refer to “Specification”

Removal

1. Turn the ignition switch OFF and disconnect the negative (-) battery cable.
2. Disconnect the accelerator position sensor connector (A).

3. Remove the installation nuts (B), and then remove the accelerator pedal module.



Installation

1. Installation is reverse of removal.

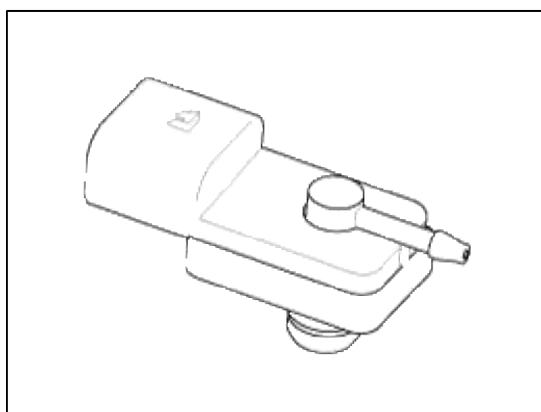
Accelerator pedal module installation nut:

16.7 ~ 25.5 N.m (1.7 ~ 2.6 kgf.m, 12.3 ~ 18.8 lb-ft)

Fuel System > Engine Control System > Fuel Tank Pressure Sensor (FTPS) > Description and Operation

Description

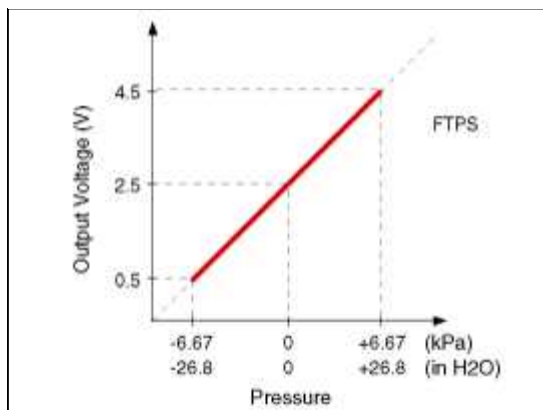
Fuel Tank Pressure Sensor (FTPS) is a component of the evaporative emission control system and is installed on the fuel tank, the fuel pump, or the canister. It checks the purge control solenoid valve operation and detects a leakage of the system.



Fuel System > Engine Control System > Fuel Tank Pressure Sensor (FTPS) > Specifications

Specification

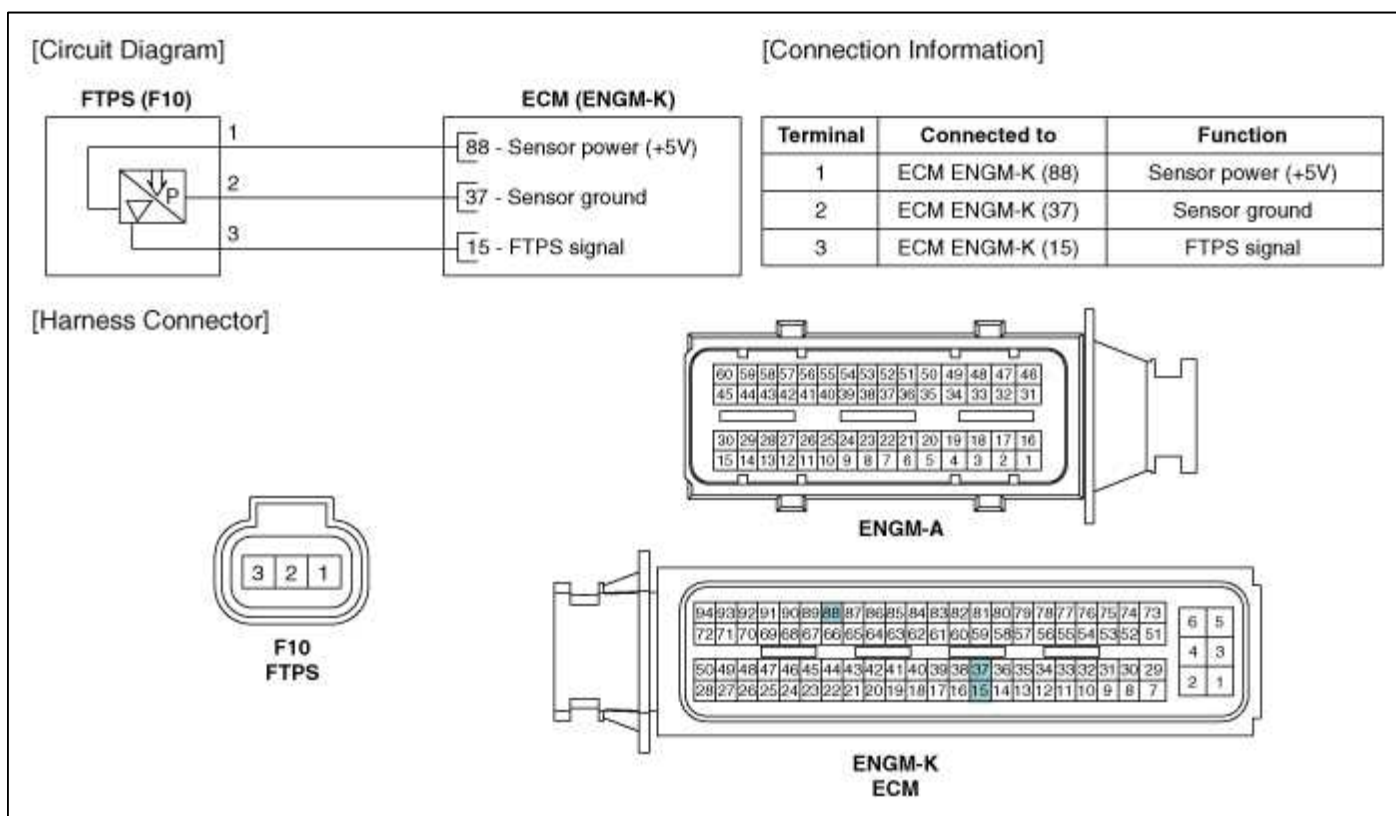
Pressure [kPa (kgf/cm ² , in H ₂ O)]	Output Voltage (V)
-6.67 (-0.068, -26.8)	0.5
0	2.5
+6.67 (0.068, 26.8)	4.5



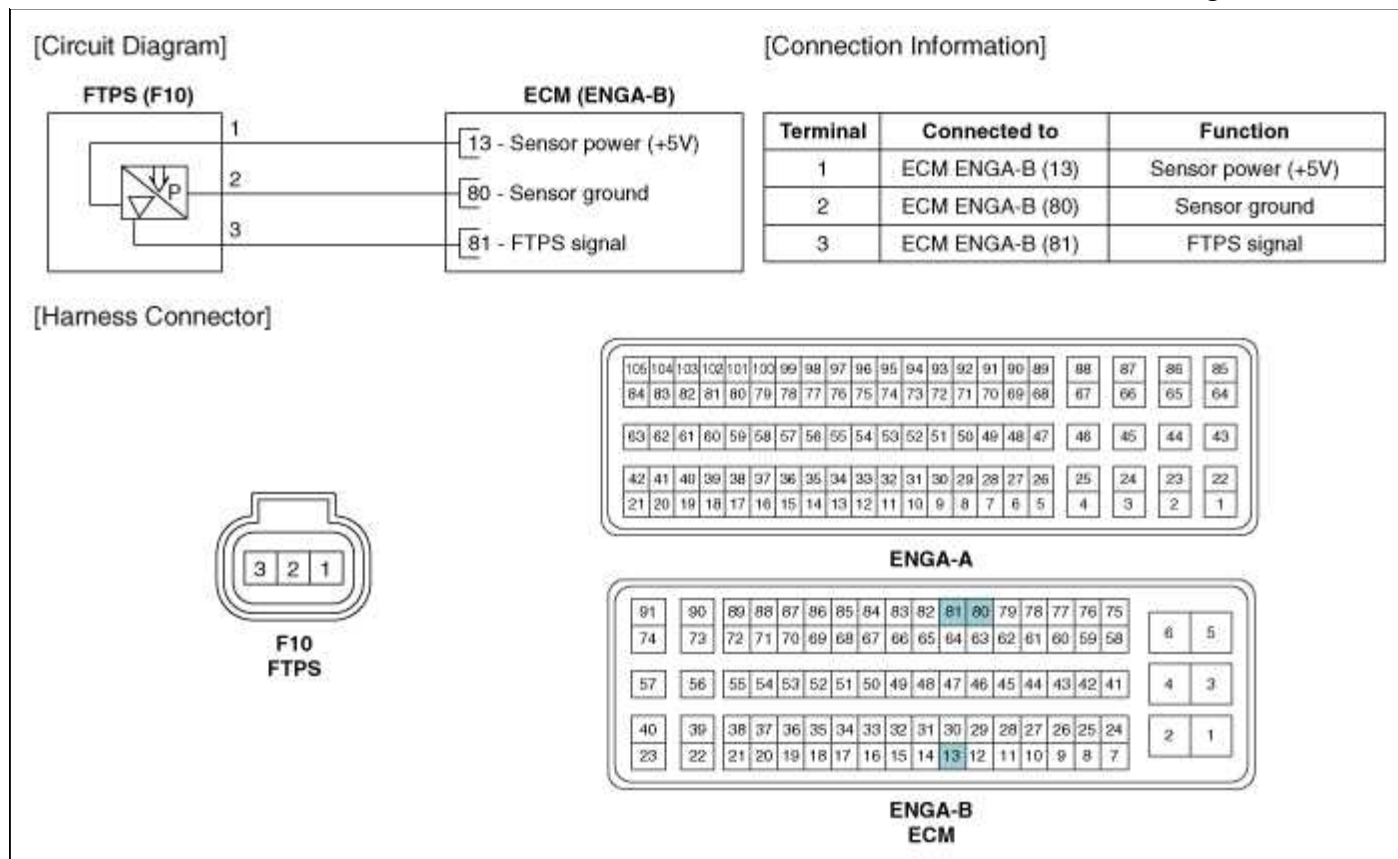
Fuel System > Engine Control System > Fuel Tank Pressure Sensor (FTPS) > Schematic Diagrams

Circuit Diagram

(M/T)



(A/T)



Fuel System > Engine Control System > Fuel Tank Pressure Sensor (FTPS) > Repair procedures

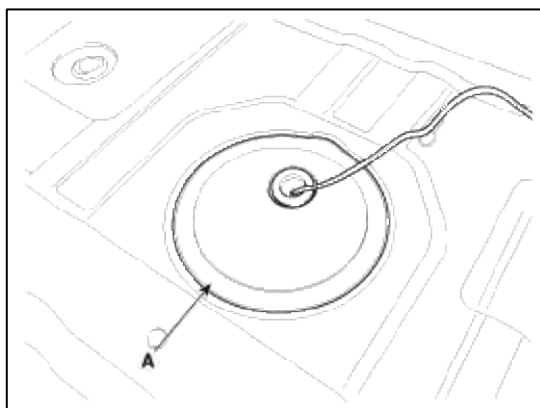
Inspection

1. Connect the GDS on the Data Link Connector (DLC).
2. Measure the output voltage of the FTPS.

Specification: Refer to "Specification"

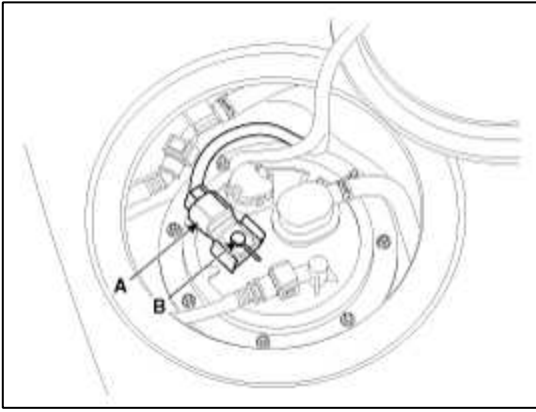
Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Remove the rear seat (Refer to "Seat" in BD group).
3. Remove the fuel pump service cover (A).



4. Disconnect the fuel tank pressure sensor connector (A).

5. Remove the fuel tank pressure sensor (B) after releasing the hooks vertically.



Installation

CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.

CAUTION

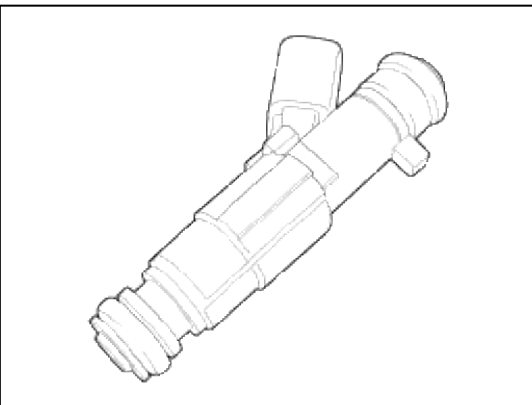
- Insert the sensor in the installation hole and be careful not to damage when installation.

1. Installation is reverse of removal.

Fuel System > Engine Control System > Injector > Description and Operation

Description

Based on information from various sensors, the ECM can calculate the fuel amount to be injected. The fuel injector is a solenoid-operated valve and the fuel injection amount is controlled by length of injection time. The ECM controls each injector by grounding the control circuit. When the ECM energizes the injector by grounding the control circuit, the circuit voltage should be low (theoretically 0V) and the fuel is injected. When the ECM de-energizes the injector by opening control circuit, the fuel injector is closed and circuit voltage should momentarily peak.



Fuel System > Engine Control System > Injector > Specifications

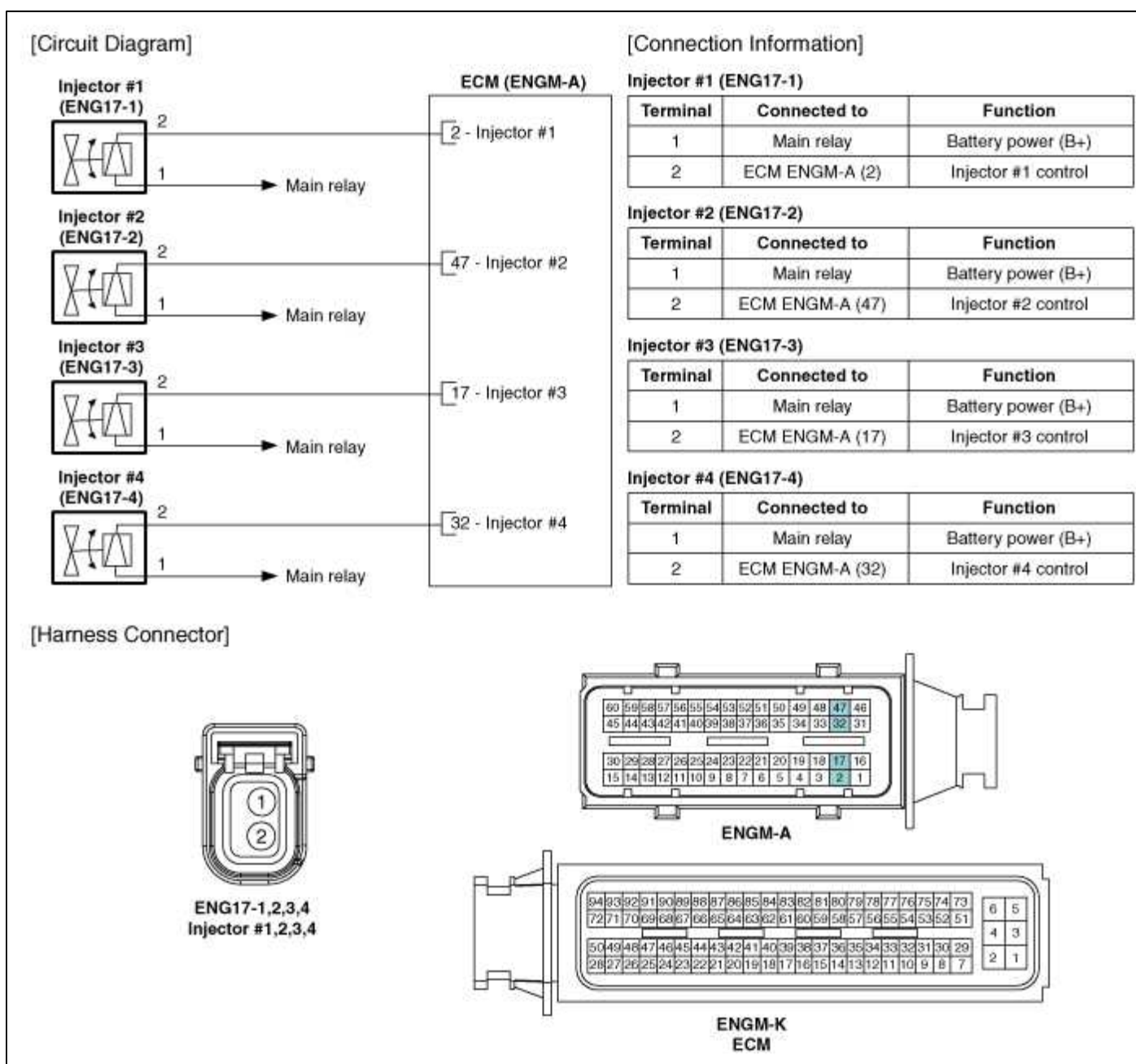
Specification

Item	Specification
Coil Resistance (Ω)	13.8 ~ 15.2 [20°C(68°F)]

Fuel System > Engine Control System > Injector > Schematic Diagrams

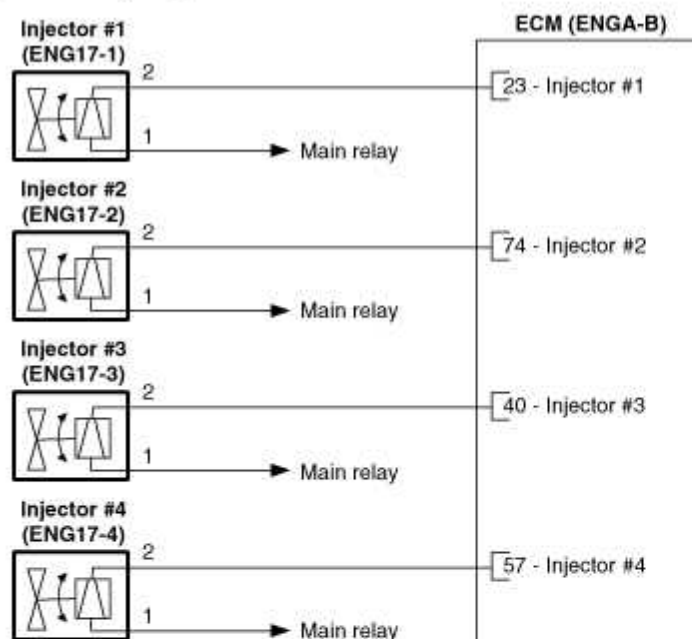
Circuit Diagram

(M/T)



(A/T)

[Circuit Diagram]



[Connection Information]

Injector #1 (ENG17-1)

Terminal	Connected to	Function
1	Main relay	Battery power (B+)
2	ECM ENG-B (23)	Injector #1 control

Injector #2 (ENG17-2)

Terminal	Connected to	Function
1	Main relay	Battery power (B+)
2	ECM ENG-B (74)	Injector #2 control

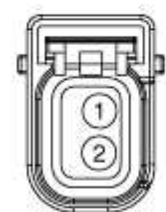
Injector #3 (ENG17-3)

Terminal	Connected to	Function
1	Main relay	Battery power (B+)
2	ECM ENG-B (40)	Injector #3 control

Injector #4 (ENG17-4)

Terminal	Connected to	Function
1	Main relay	Battery power (B+)
2	ECM ENG-B (57)	Injector #4 control

[Harness Connector]



ENG17-1,2,3,4
Injector #1,2,3,4

106	104	103	102	101	100	99	98	97	96	95	94	93	92	91	90	89	88	87	86	85
84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65	64
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43
42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22
21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

ENG-A

91	90	89	88	87	86	85	84	83	82	81	80	79	78	77	76	75		
74	73	72	71	70	69	68	67	66	65	64	63	62	61	60	59	58	6	5
57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	4	3
40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	2	1
23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7		

ENG-B
ECM

Fuel System > Engine Control System > Injector > Repair procedures

Inspection

1. Turn the ignition switch OFF.
2. Disconnect the injector connector.
3. Measure resistance between the injector terminals 1 and 2.
4. Check that the resistance is within the specification.

Specification: Refer to “Specification”

Removal

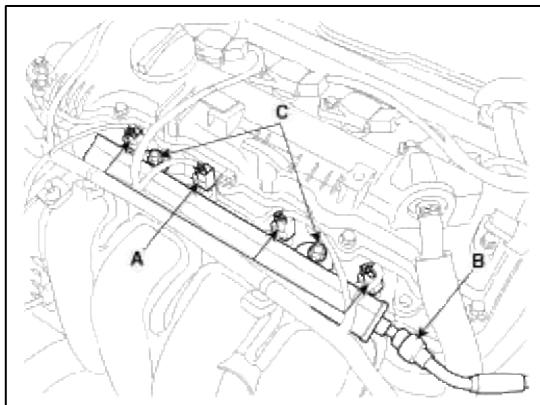
1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.

2. Release the residual pressure in fuel line (Refer to “Release Residual Pressure in Fuel Line” in this group).

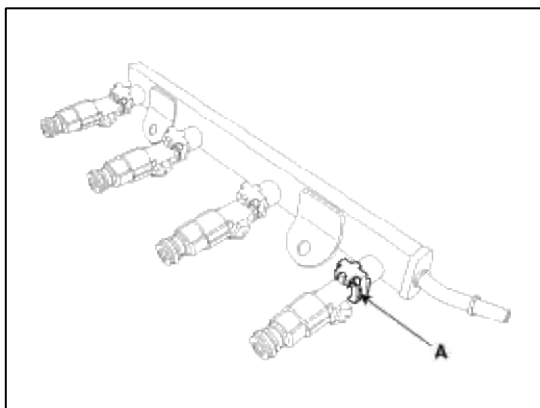
CAUTION

When removing the fuel pump relay, a Diagnostic Trouble Code (DTC) may occur. Delete the code with the GDS after completion of “Release Residual Pressure in Fuel Line” work.

3. Disconnect the injector connector (A).
4. Disconnect the fuel feed tube quick-connector (B).
5. Remove the installation bolt (C), and then remove the delivery pipe & injector assembly from the engine.



6. Remove the fixing clip (A), and then separate the injector from the delivery pipe.



Installation

CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.

CAUTION

- Apply the engine oil to the injector O-ring.

CAUTION

- Inspect the injector O-ring when installing.

1. Installation is reverse of removal.

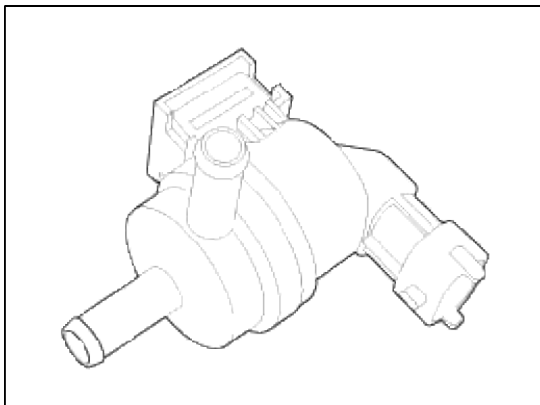
Delivery pipe installation bolt:

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

Fuel System > Engine Control System > Purge Control Solenoid Valve (PCSV) > Description and Operation

Description

Purge Control Solenoid Valve (PCSV) is installed on the intake manifold and controls the evaporative purge between the canister and the intake manifold. It is a normally closed solenoid valve and is open when the ECM grounds the valve control line. When the passage is open (PCSV ON), fuel vapor stored in the canister is transferred to the intake manifold.



Fuel System > Engine Control System > Purge Control Solenoid Valve (PCSV) > Specifications

Specification

Item	Specification
Coil Resistance (Ω)	22.0 ~ 26.0 [20°C(68°F)]

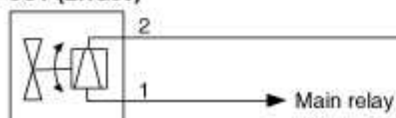
Fuel System > Engine Control System > Purge Control Solenoid Valve (PCSV) > Schematic Diagrams

Circuit Diagram

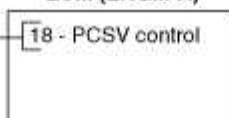
(M/T)

[Circuit Diagram]

PCSV (ENG38)



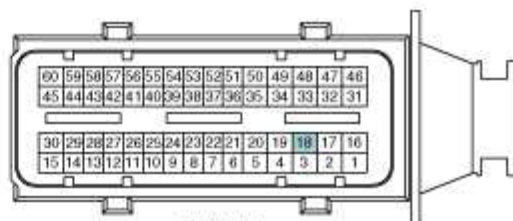
ECM (ENGM-A)



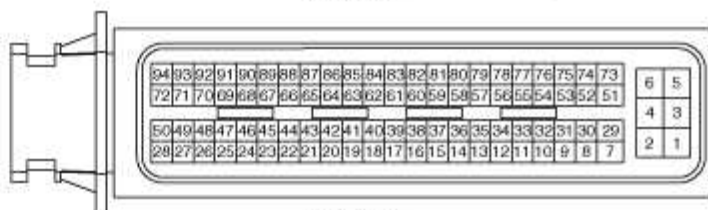
[Connection Information]

Terminal	Connected to	Function
1	Main relay	Battery power (B+)
2	ECM ENGM-A (18)	PCSV control

[Harness Connector]

ENG38
PCSV

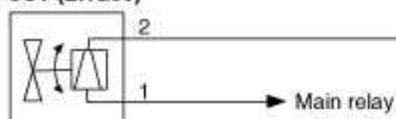
ENGM-A

ENGM-K
ECM

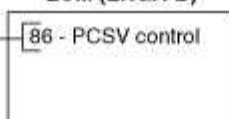
(A/T)

[Circuit Diagram]

PCSV (ENG38)



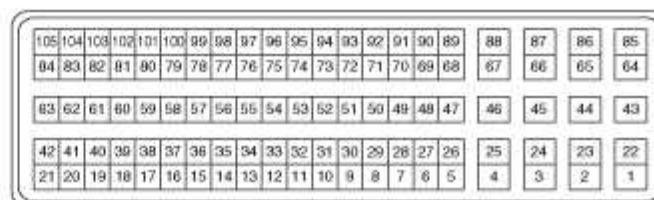
ECM (ENGA-B)



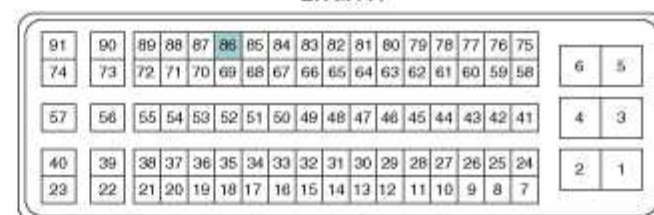
[Connection Information]

Terminal	Connected to	Function
1	Main relay	Battery power (B+)
2	ECM ENGA-B (86)	PCSV control

[Harness Connector]

ENG38
PCSV

ENGA-A

ENGA-B
ECM

Fuel System > Engine Control System > Purge Control Solenoid Valve (PCSV) > Repair procedures

Inspection

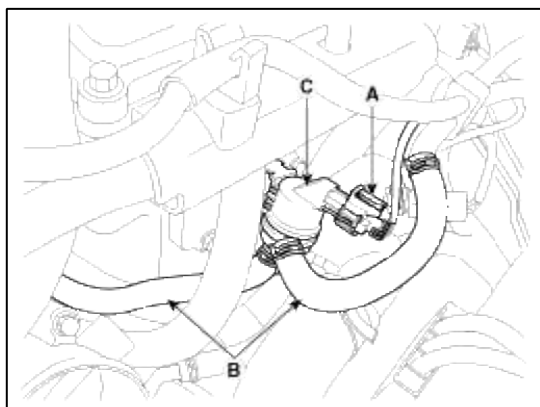
1. Turn the ignition switch OFF.
2. Disconnect the PCSV connector.
3. Measure resistance between the PCSV terminals 1 and 2.

4. Check that the resistance is within the specification.

Specification: Refer to “Specification”

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the purge control solenoid valve connector (A).
3. Disconnect the vapor hoses (B) from the purge control solenoid valve.
4. Remove the valve (C) from the surge tank after pulling it.



Installation

CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.
- Be sure not to apply oil or lubricant to the end of the hoses when connecting the PCSV hose.

CAUTION

- Use care to keep foreign material out of the valve.

1. Installation is reverse of removal.

Purge control solenoid valve bracket installation bolt: 9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

Fuel System > Engine Control System > CVVT Oil Control Valve (OCV) > Description and Operation

Description

Continuous Variable Valve Timing (CVVT) system advances or retards the valve timing of the intake and exhaust valve in accordance with the ECM control signal which is calculated by the engine speed and load.

By controlling CVVT, the valve over-lap or under-lap occurs, which makes better fuel economy and reduces exhaust gases (NOx, HC) and improves engine performance through reduction of pumping loss, internal EGR effect, improvement of combustion stability, improvement of volumetric efficiency, and increase of expansion work.

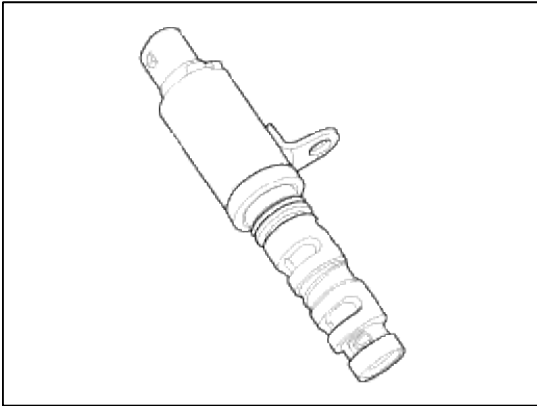
This system consist of

- the CVVT Oil Control Valve (OCV) which regulates the engine oil to and from the cam phaser in accordance with the ECM PWM (Pulse With Modulation) control signal,
- and the Cam Phaser which varies the cam phase by using the hydraulic force of the engine oil.

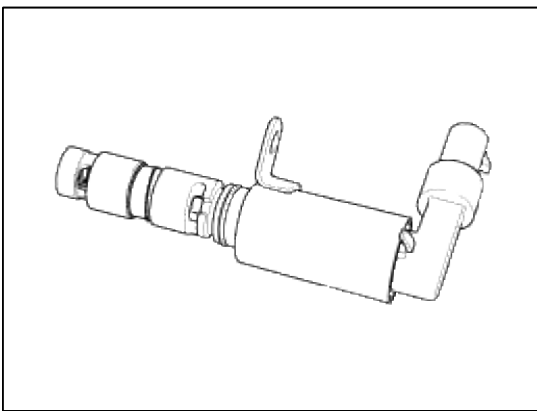
The engine oil getting out of the CVVT oil control valve varies the cam phase in the direction (Intake

Advance/Exhaust Retard) or opposite direction (Intake Retard/Exhaust Advance) of the engine rotation by rotating the rotor connected with the camshaft inside the cam phaser.

[Bank 1/Intake]



[Bank 1/Exhaust]



Fuel System > Engine Control System > CVVT Oil Control Valve (OCV) > Specifications

Specification

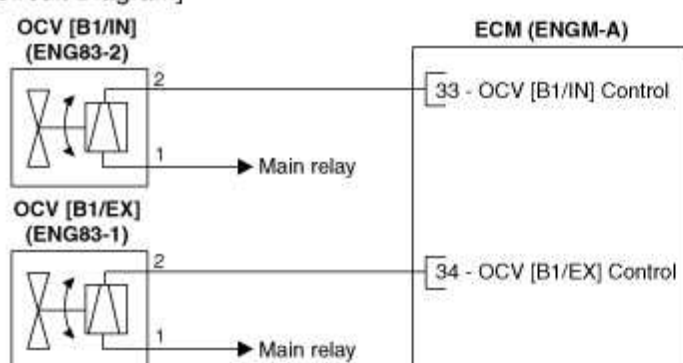
Item	Specification
Coil Resistance (Ω)	9,4 ~ 10,4 [20°C(68°F)]

Fuel System > Engine Control System > CVVT Oil Control Valve (OCV) > Schematic Diagrams

Circuit Diagram

(M/T)

[Circuit Diagram]



[Connection Information]

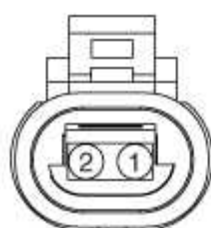
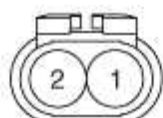
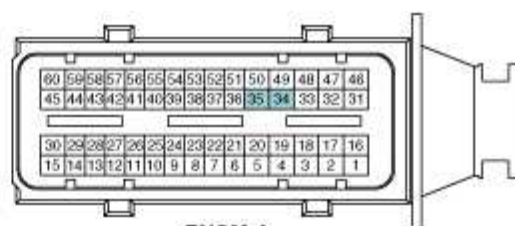
OCV [B1/IN] (ENG83-2)

Terminal	Connected to	Function
1	Main relay	Battery power (B+)
2	ECM ENGM-A (33)	OCV [B1/IN] control

OCV [B1/EX] (ENG83-1)

Terminal	Connected to	Function
1	Main relay	Battery power (B+)
2	ECM ENGM-A (34)	OCV [B1/EX] control

[Harness Connector]

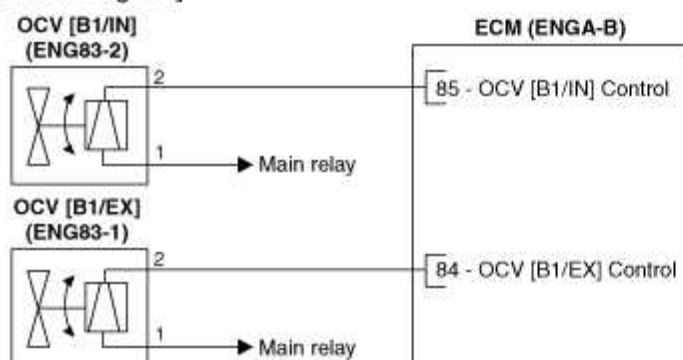
ENG83-2
OCV [B1/IN]ENG83-1
OCV [B1/EX]

ENGM-A

ENGM-K
ECM

(A/T)

[Circuit Diagram]



[Connection Information]

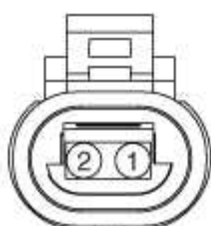
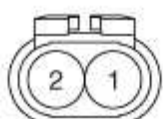
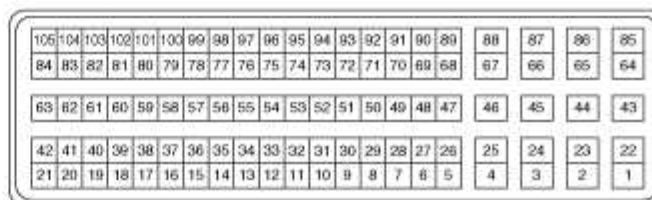
OCV [B1/IN] (ENG83-2)

Terminal	Connected to	Function
1	Main relay	Battery power (B+)
2	ECM ENGA-B (85)	OCV [B1/IN] control

OCV [B1/EX] (ENG83-1)

Terminal	Connected to	Function
1	Main relay	Battery power (B+)
2	ECM ENGA-B (84)	OCV [B1/EX] control

[Harness Connector]

ENG83-2
OCV [B1/IN]ENG83-1
OCV [B1/EX]

ENGA-A

ENGA-B
ECM

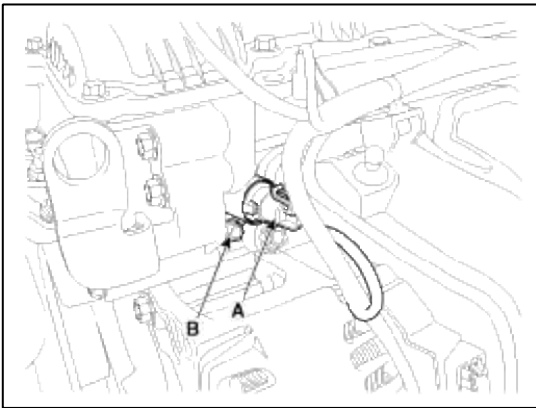
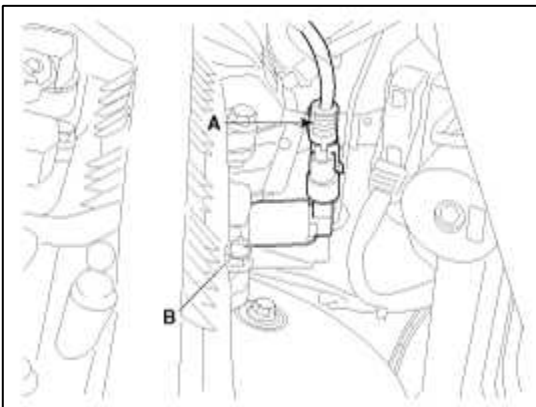
Fuel System > Engine Control System > CVVT Oil Control Valve (OCV) > Repair procedures**Inspection**

1. Turn the ignition switch OFF.
2. Disconnect the OCV connector.
3. Measure resistance between the OCV terminals 1 and 2.
4. Check that the resistance is within the specification.

Specification: Refer to “Specification”

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the CVVT oil control valve connector (A).
3. Remove the installation bolt (B), and then remove the valve from the engine.

[Bank 1 / Intake]**[Bank 1 / Exhaust]****Installation****CAUTION**

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.

CAUTION

- Apply engine oil to the valve O-ring.

1. Installation is reverse of removal.

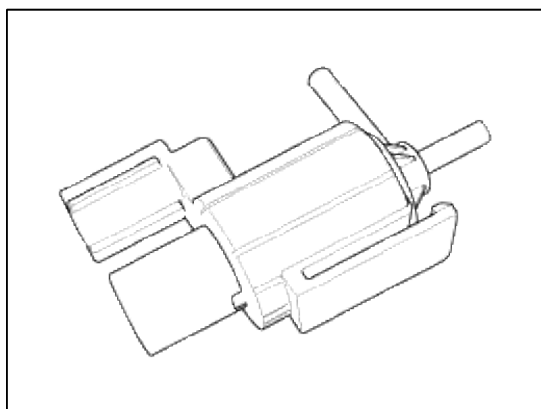
CVVT oil control valve installation bolt:

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

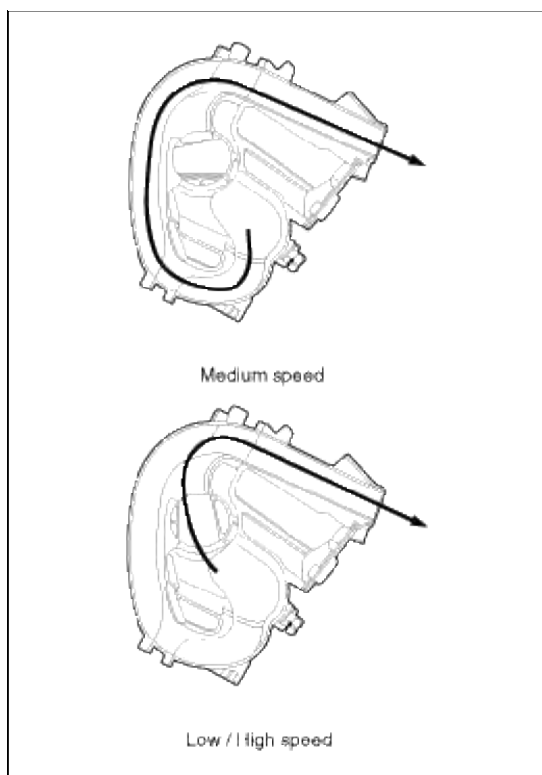
Fuel System > Engine Control System > Variable Intake Solenoid (VIS) Valve > Description and Operation

Description

Variable Intake manifold Solenoid (VIS) valve is installed on the intake manifold. The VIS valve controls the vacuum modulator which activates a valve in the intake manifold. The ECM opens or closes this valve according to engine condition (Refer to below table).



Engine condition	VIS valve	Operation
Medium speed	Closed	Increasing engine performance in low engine speed by reducing intake interference among cylinders
Low / High speed	Open	Minimizing intake resistance by shortening intake manifold length and increasing area of air entrance

**Fuel System > Engine Control System > Variable Intake Solenoid (VIS) Valve > Specifications**

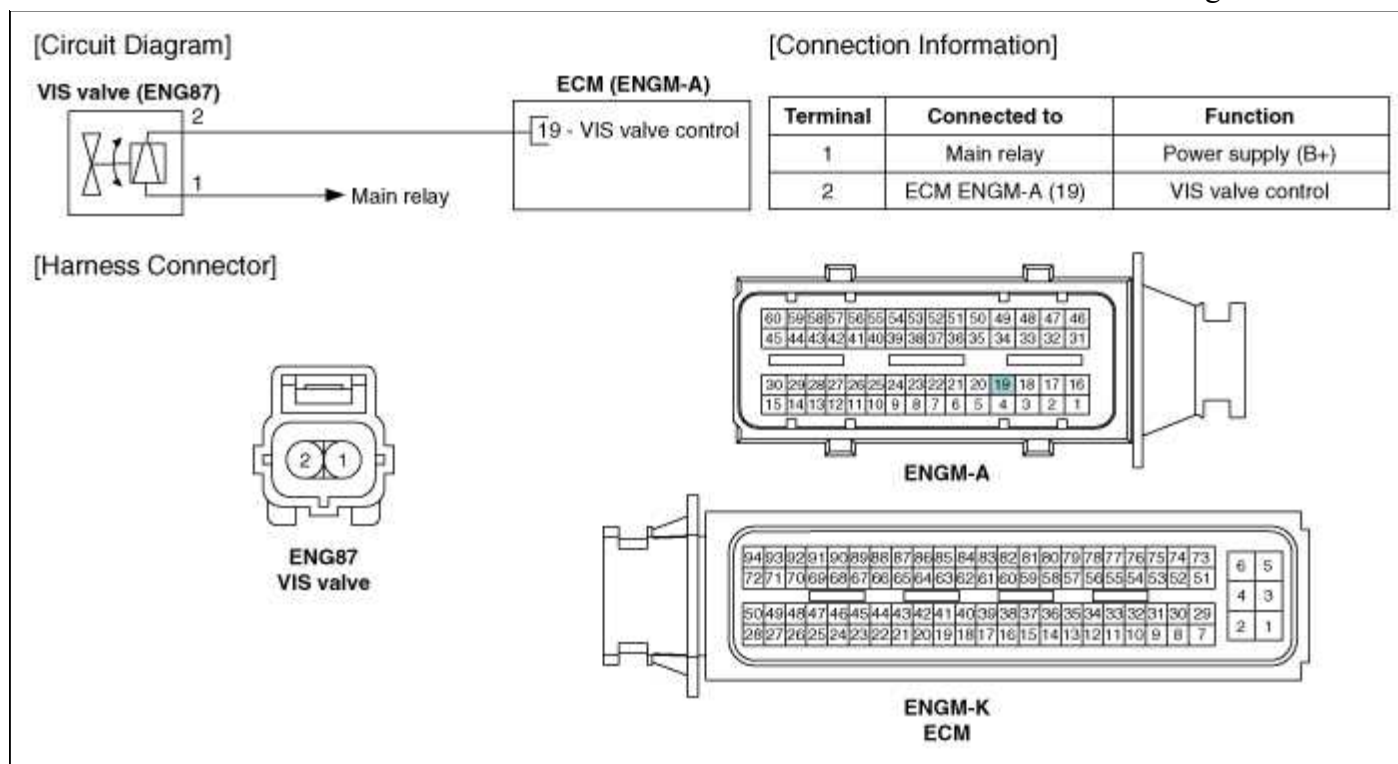
Specification

Item	Specification
Coil resistance (Ω)	30.0 ~ 35.0 [20°C(68°F)]

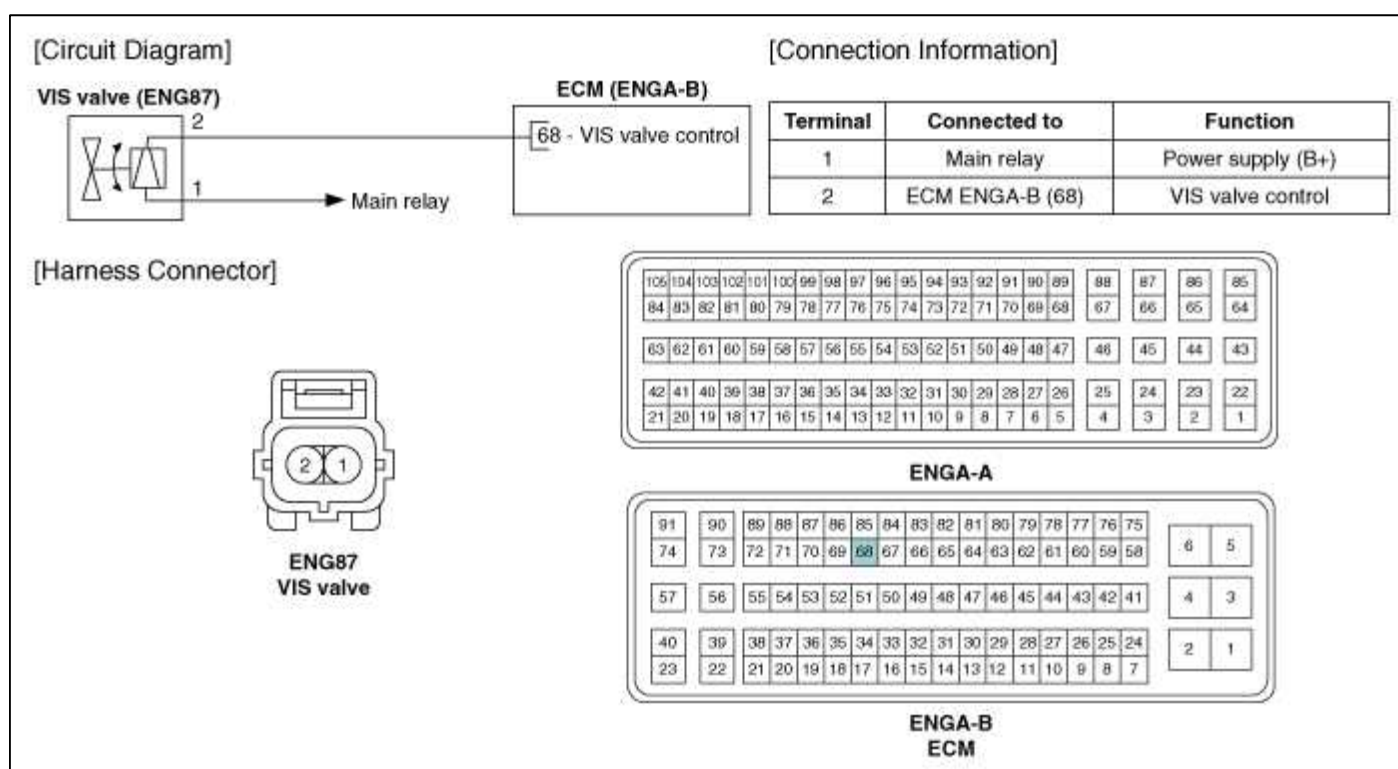
Fuel System > Engine Control System > Variable Intake Solenoid (VIS) Valve > Schematic Diagrams

Circuit Diagram

(M/T)



(A/T)



Fuel System > Engine Control System > Variable Intake Solenoid (VIS) Valve > Repair procedures

Inspection

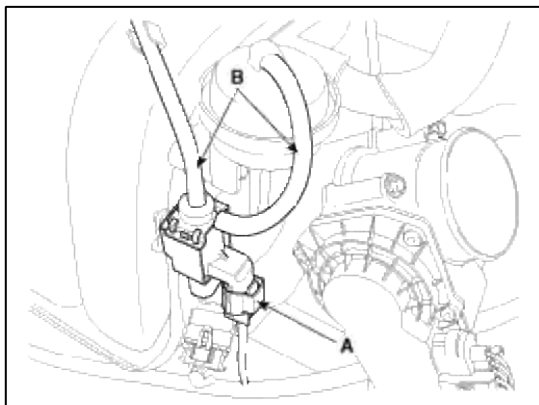
1. Turn the ignition switch OFF.
2. Disconnect the VIS valve connector.

3. Measure resistance between VIS valve terminals 1 and 2.

Specification: Refer to "Specification"

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Disconnect the variable intake solenoid valve connector (A).
3. Disconnect the vacuum hoses (B) from the valve.
4. Remove the installation nut, and then remove the valve from the intake manifold.



Installation

CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.

CAUTION

- Be careful of foreign material not to flow into the valve.

1. Installation is reverse of removal.

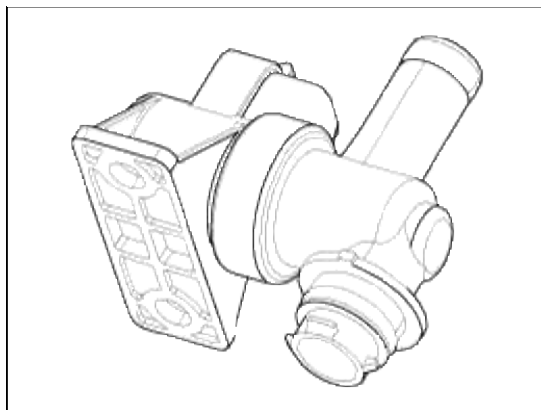
Variable intake solenoid valve bracket installtion bolt:

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

Fuel System > Engine Control System > Canister Close Valve (CCV) > Description and Operation

Description

Canister Close Valve (CCV) is normally open and is installed on the canister ventilation line. It seals evaporative emission control system by shutting the canister from the atmosphere during EVAP leak detection process.



Fuel System > Engine Control System > Canister Close Valve (CCV) > Specifications

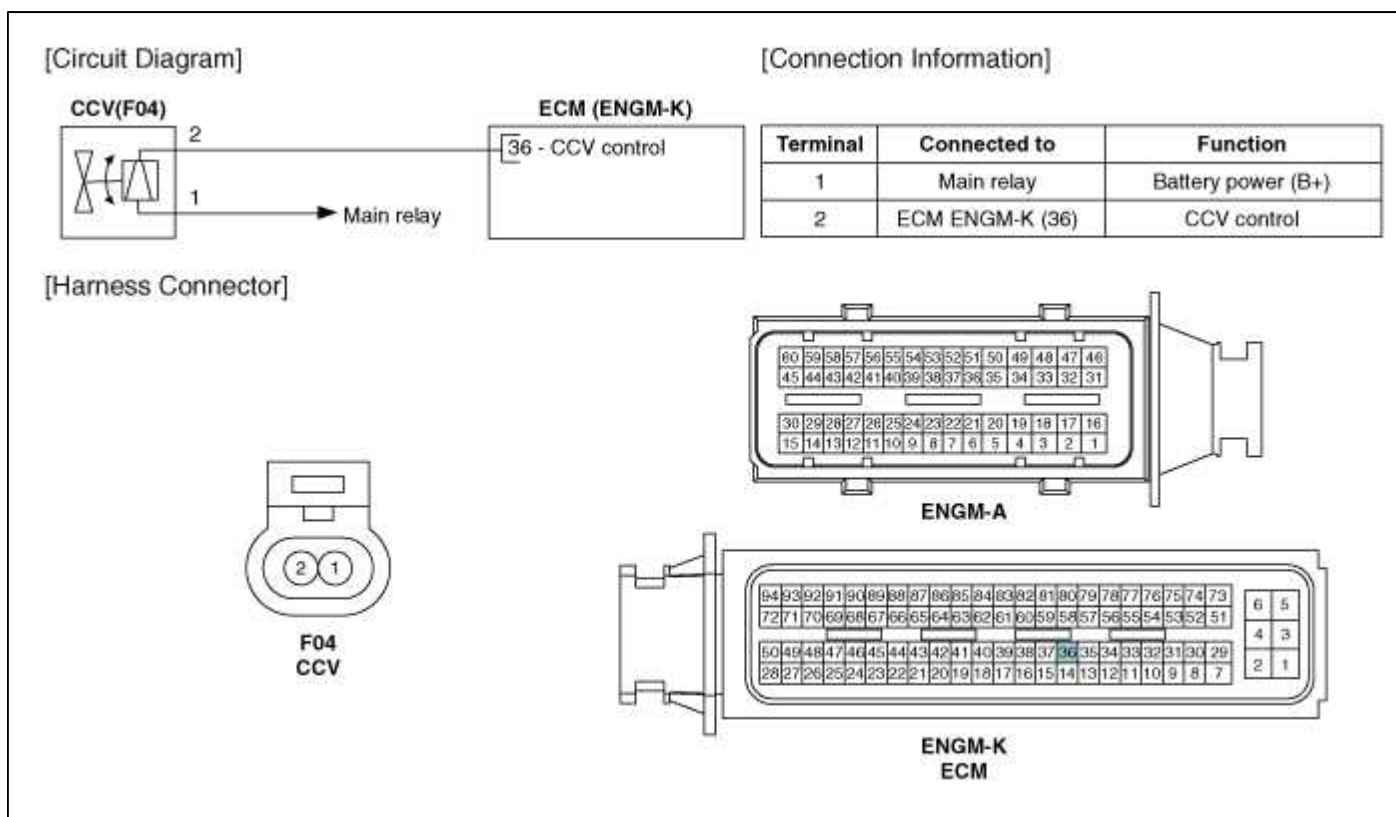
Specification

Item	Specification
Coil Resistance (Ω)	15.5 ~ 18.5 [20°C(68°F)]

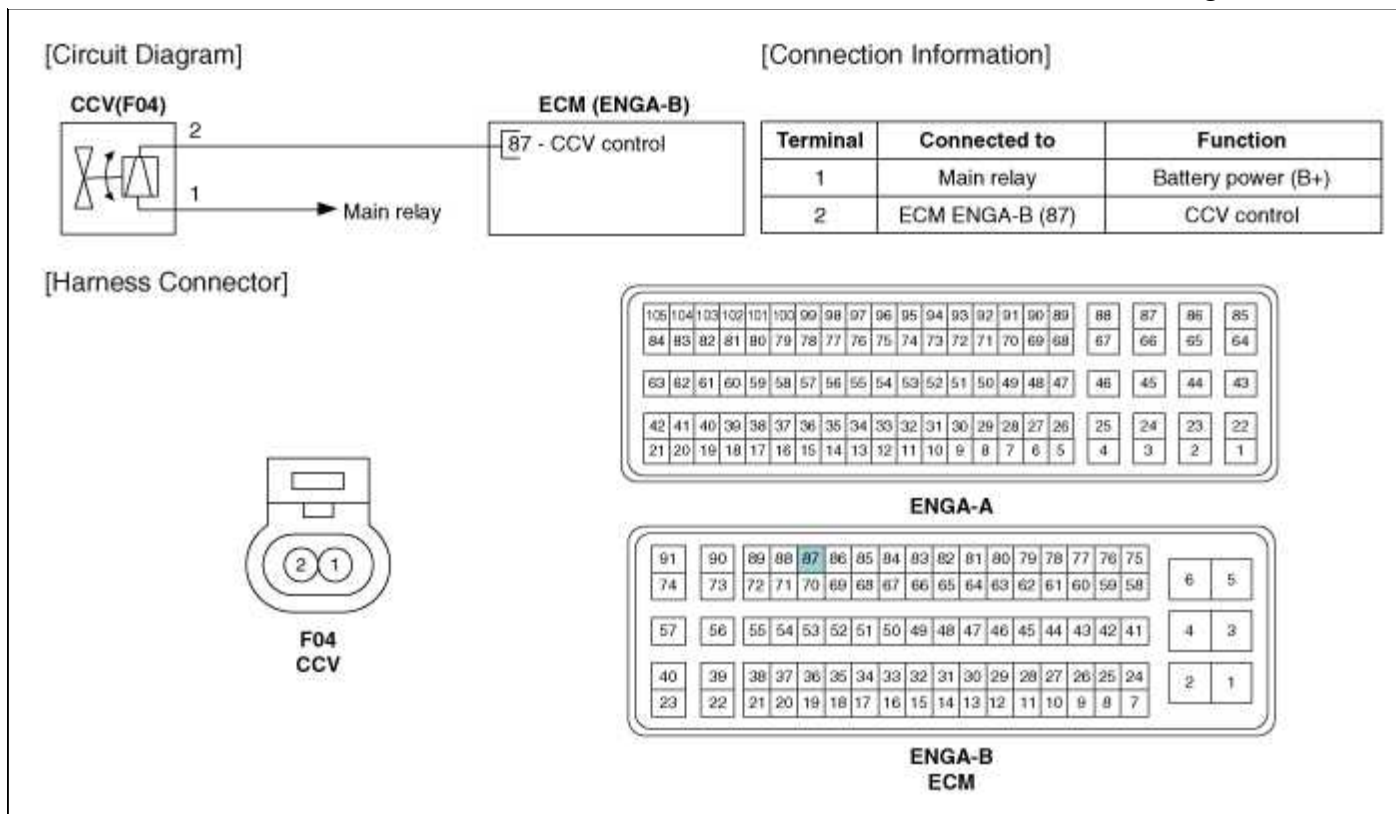
Fuel System > Engine Control System > Canister Close Valve (CCV) > Schematic Diagrams

Circuit Diagram

(M/T)



(A/T)



Fuel System > Engine Control System > Canister Close Valve (CCV) > Repair procedures

Inspection

1. Turn the ignition switch OFF.
2. Disconnect the CCV connector.
3. Measure resistance between the CCV terminal 1 and 2.
4. Check that the resistance is within the specification.

Specification: Refer to "Specification"

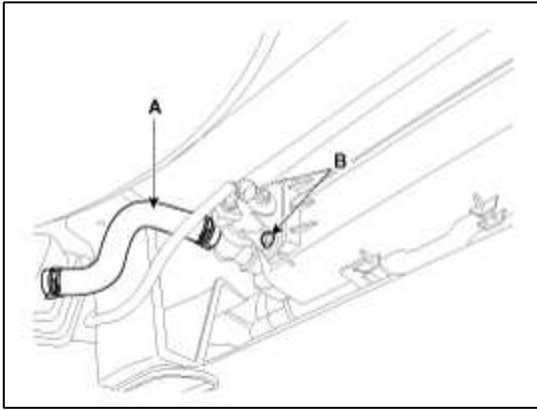
5. Disconnect the vapor hose connected with the canister from the CCV.
6. Connect a vacuum pump to the nipple.
7. Ground the CCV control line and apply battery voltage to the CCV power supply line.
8. Apply vacuum and check the valve operation.

Specification: Vacuum maintained

Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Lift the vehicle.
3. Disconnect the canister close valve connector.
4. Disconnect the ventilation hose (A) from the fuel tank air filter and canister close valve.

5. Remove the installation bolts (B), and then remove the canister close valve.



Installation

CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.

1. Installation is reverse of removal.

Fuel System > Engine Control System > Variable Charge Motion Actuator (VCMA) > Description and Operation

Description

The Variable Charge Motion Actuator (VCMA) is installed on the inlet of the intake manifold.

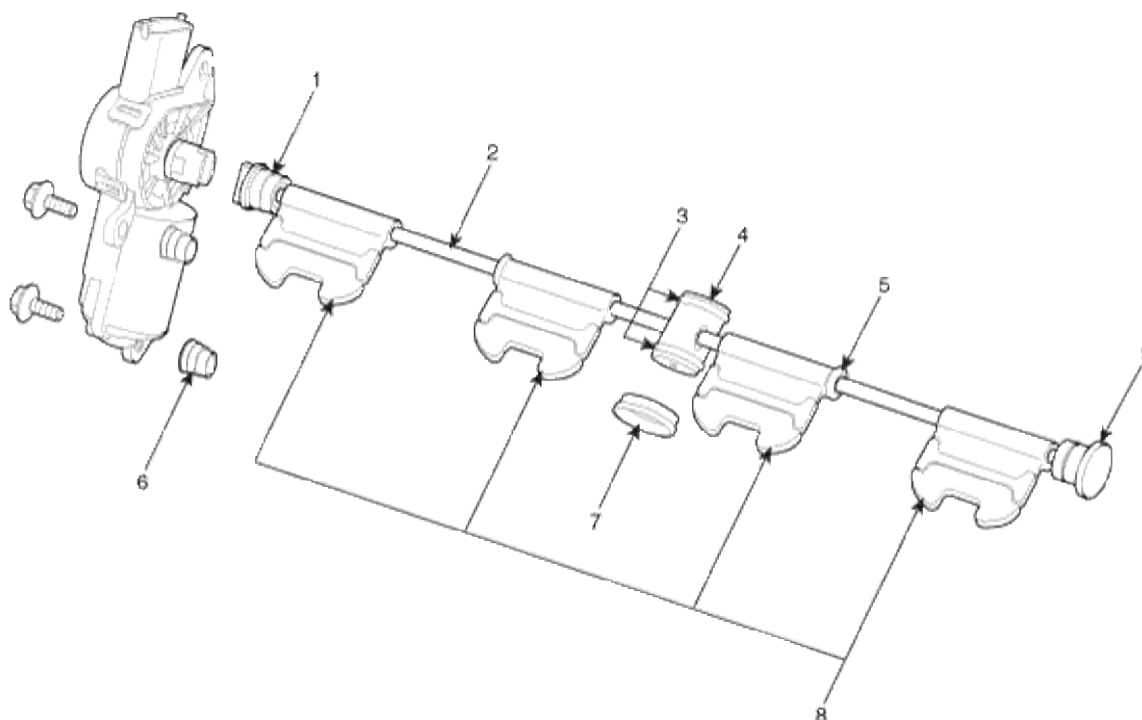
It consists of a DC motor which actuates the VCM valve and a position sensor which detects the position of the VCM valve.

The VCM system tumbles air flow entering into combustion chamber of each cylinder by closing the VCM valve in the cold start conditions.

This tumble effect reduces cold start emissions by improving atomization

Fuel System > Engine Control System > Variable Charge Motion Actuator (VCMA) > Components and Components Location

Components



1. Coupling	6. Insert nut
2. Shaft	7. Stabilizer Cover
3. Stabilizer O-ring	8. Valve
4. Stabilizer	9. Hole cover
5. O-ring	

Fuel System > Engine Control System > Variable Charge Motion Actuator (VCMA) > Specifications

Specification

Motor

Item	Specification
Coil Resistance (Ω)	3.4 ~ 4.4 [20°C(68°F)]

Position sensor

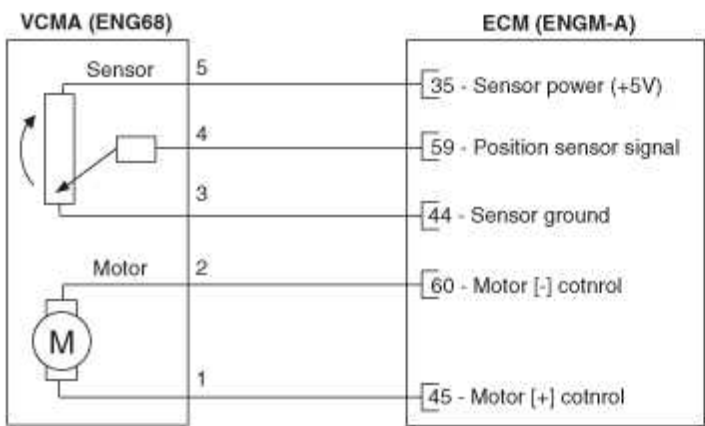
Item	Specification
Coil Resistance (k Ω)	3.44 ~ 5.16 [20°C(68°F)]

Fuel System > Engine Control System > Variable Charge Motion Actuator (VCMA) > Schematic Diagrams

Circuit diagram

(M/T)

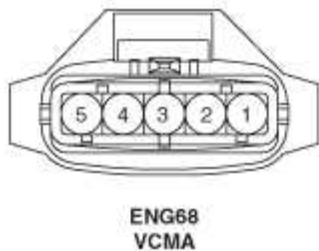
[Circuit Diagram]



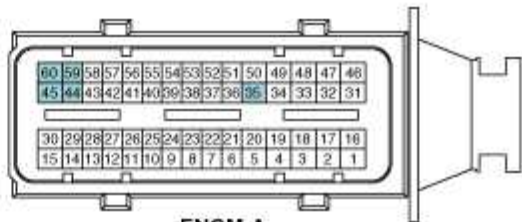
[Connection Information]

Terminal	Connected to	Function
1	ECM ENGM-A (45)	Motor [+] control
2	ECM ENGM-A (60)	Motor [-] control
3	ECM ENGM-A (44)	Sensor ground
4	ECM ENGM-A (59)	Position sensor signal
5	ECM ENGM-A (35)	Sensor power (+5V)

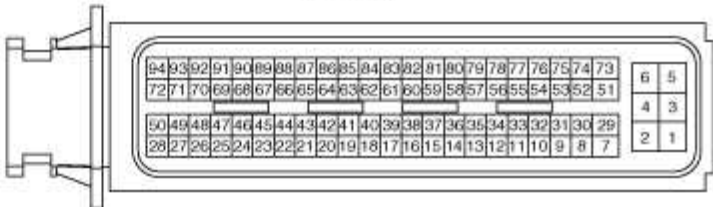
[Harness Connector]



ENG68
VCMA



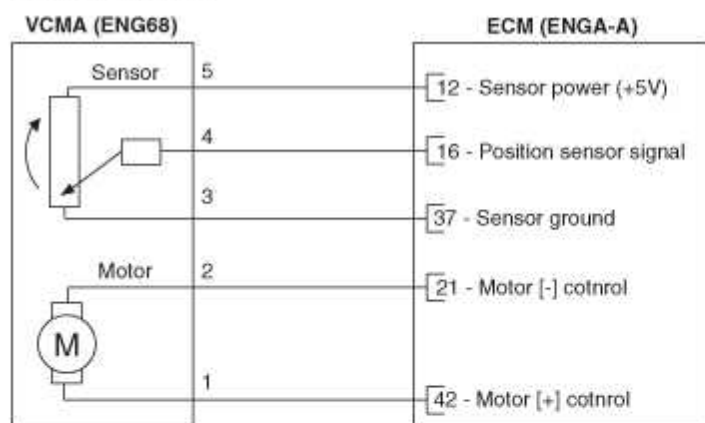
ENGM-A



ENGM-K
ECM

(A/T)

[Circuit Diagram]



[Connection Information]

Terminal	Connected to	Function
1	ECM ENGA-A (42)	Motor [+] control
2	ECM ENGA-A (21)	Motor [-] control
3	ECM ENGA-A (37)	Sensor ground
4	ECM ENGA-A (16)	Position sensor signal
5	ECM ENGA-A (12)	Sensor power (+5V)

[Harness Connector]



105	104	103	102	101	100	99	98	97	96	95	94	93	92	91	90	89	88	87	86	85
84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65	64
63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43
42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22
21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

ENGA-A

91	90	89	88	87	86	85	84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65	64	63	62	61	60	59	58
57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24
23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1											

ENGA-B
ECM

Fuel System > Engine Control System > Variable Charge Motion Actuator (VCMA) > Repair procedures

Inspection

1. Turn ignition switch OFF.
2. Disconnect the VCMA connector.
3. Check that the VCMA is not stuck by foreign material.
4. Measure resistance between motor (+) and (-) control terminals of the motor.
5. Check that the resistance is within the specification.

Specification: Refer to "Specification"

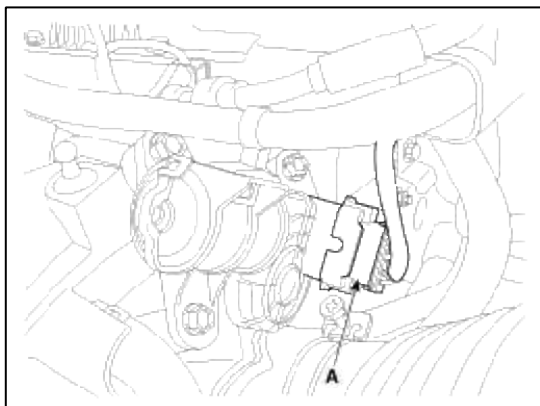
6. Measure resistance between voltage supply terminal and ground terminal of the position sensor.
7. Check that the resistance is within the specification.

Specification: Refer to "Specification"

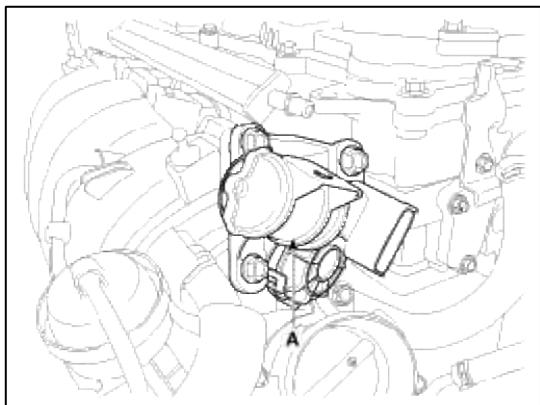
Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.

2. Disconnect the VCMA connector (A).



3. Remove the VCMA (A) after removing 3 installation bolts.



Installation

CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.

CAUTION

The VCM actuator has to be installed at the fully closing position of the VCM valve.
If it doesn't, the VCM coupling of the VCM shaft can't be put in the the VCM actuator.

1. Installation is reverse of removal.

Variable charge motion actuator installation bolt:

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

Fuel System > ISG (Idle Stop & Go) System > Description and Operation

Description

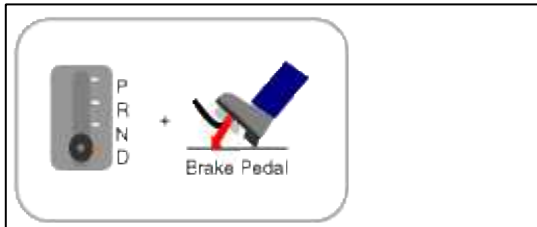
Idle Stop & Go (ISG) function automatically switches off the engine when the car is at a standstill if the and starts it again as soon as the brake pedal is released. This not only reduces fuel consumption, it also lowers emissions. Idle Stop & Go (ISG) function also has a built-in sensitivity to driving safety and comfort.

The engine is not switched off if certain conditions relating to safety and comfort have not been fulfilled (For example, when the engine oil is still cold, when the battery is running low or when the outside temperature is below 3°C). It can be deactivated by pressing the ISG OFF switch on the crash pad lower panel.

Sample scenario: switching off the engine at a standstill at a red traffic light or in stop-and-go traffic.

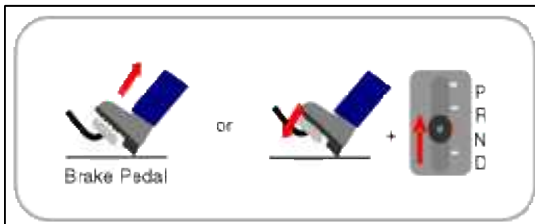
How to use:

1. Engine Auto-Stop: D-range + brake pedal is pressed.

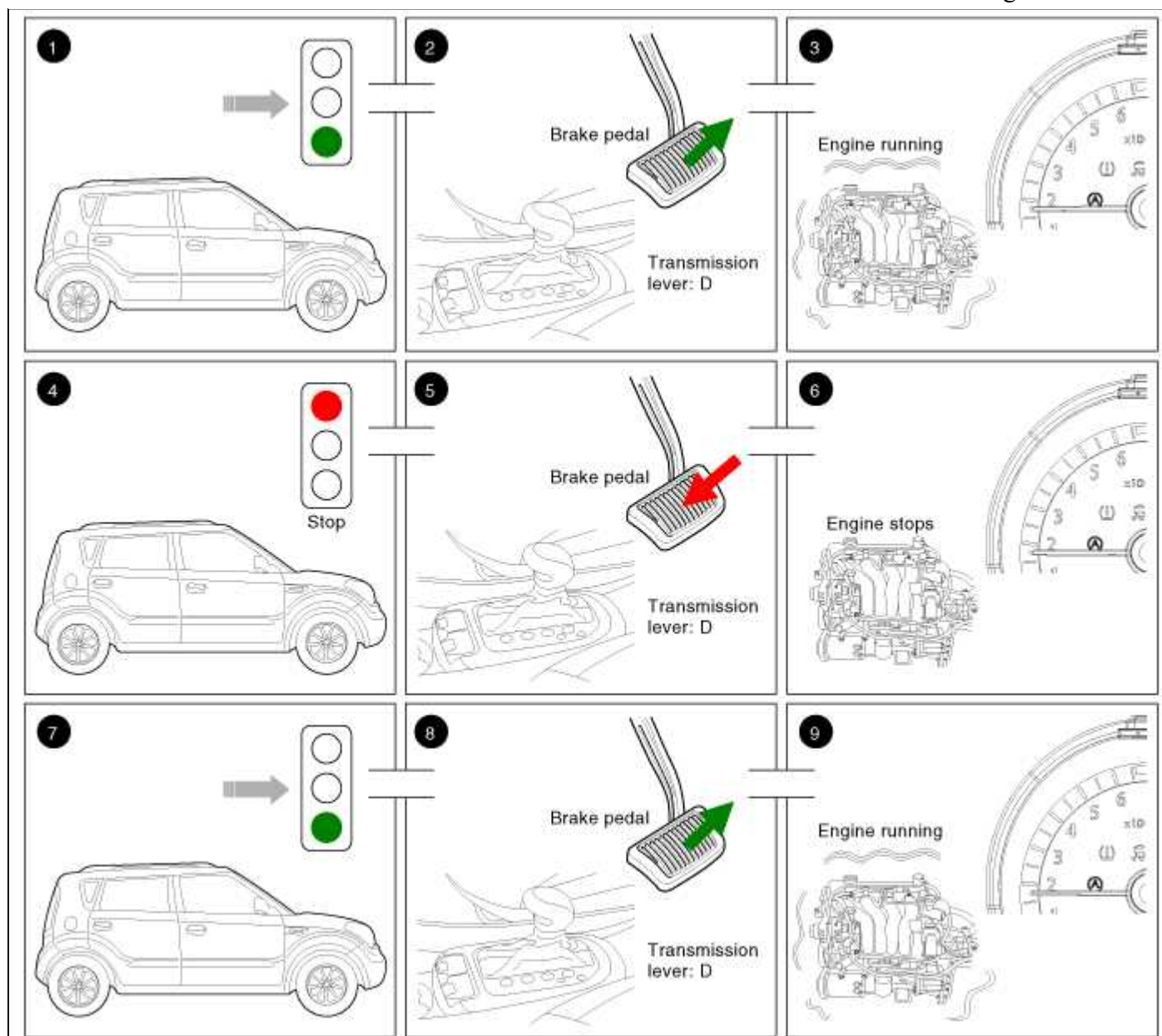


2. Engine Auto-Start:

- Brake pedal is released.
- N-range + brake pedal is pressed.



Operation



1. Vehicle moving.
2. The transmission lever position is D-range. The brake pedal is released.
3. The engine is running. (Vehicle moving).
4. The driver brakes until the vehicle comes to a standstill.
5. The transmission lever position is D-range. The brake pedal is pressed
6. The engine stops. The symbol "AUTO STOP" lights up in the instrument cluster.
7. The driver wants to continue the journey.
8. The transmission lever position is D-range. The brake pedal is released.
9. The engine is running again. The symbol goes out.

Operation Condition for the ISG function

1. Auto stop or Auto start condition (If all of the below condition are satisfied)

Items		State	Remark
Driving conditions	ISG OFF Switch	off	
	Switch (seat/door/hood)	Closed	
	Lever position	D or N range	Prohibit operation on gear 'P, R'
	Brake pedal	Pressed	Auto Stop
		Released	Auto Start
	Vehicle speed	Vehicle speed = 0 Mph	After driving higher than 8kph (5 Mph)
	Air conditioning system	Ambient temperature is between -2 ~ 35 °C (28.4 ~ 95 °F)	
	Engine Coolant Temperature (ECT)	Over 78 °C (172.4 °F)	
	Brake Pressure	Below -35kpa	
Battery conditions	SOC	Over 77%	To protect Battery
	Temperature	2 ~ 55 °C (35.6 ~ 131 °F)	
Steering wheel	Operating angle	Below 180°	
Parking condition	Slope	Up hill <12%, Down hill < 8%	
ISG related part error		Sensor Error	Brake Booster Pressure Sensor
			Brake Master Cylinder Pressure
			Sensor, Brake Pedal Sensor,
			APS, Battery Sensor
		Related System Error	TM Electronic Auxiliary Pump
			ESC System Defect Mode
			CAN Communication Error
			Engine Limp Home Mode

2. Forced re-start conditions (If any of the below condition is not satisfied)

Component	Conditions	State	Remark
Conditions for safety	Low pressure for braking system	Over -35kpa	
	Low battery voltage	Below 12.1V for 180 sec	
	Active defroster of front glass	On	
	When inertial speed reach 1Mph with (down hill)	Over 1Mph (Kph)	Inertial Speed
	Open the door or unfasten driver's seat belt	Open	Brake Pedal Pressed
	Elapsed much of stop time		
	On the steep slope way		
Conditions for convenience	Turn on the air-conditioner or max blower speed or bad performance of air conditioning and heating		
	Active 'ISG OFF' button		
Sign of forced auto re-start	Blinking of lamp for 5 second and indicating on cluster		

3. Restriction conditions for Auto-Stop operation

To protect system and safety auto-stop system is restricted below the conditions

Large steering angle when car is stop
Low brake operating pressure
Turn on the air conditioner with max blower
When battery Condition is poor (low SOC)
Active defroster of front or rear glass
Unfasten driver's seat belt or open the door and hood
On the steep slope way
With ISG system errors, and other diagnosis

4. Restriction condition for auto Re-Start operation

Open hood (have to restart by key for repairman's safety)

5. Restriction condition for OBD Check & Emission control

Auto Stop system will be limited	During Canister purge monitoring
	During OBD check
To restrict continuous Cranking (for Emission Control)	Start Motor can operate for two seconds at the longest (just once)

CAUTION

The ISG system is strongly networked with the power management. In the event of battery replacement, disconnection of the battery terminal or after changing the engine management system, the reference data regarding the battery charge state and battery condition can be lost.

They are only available again a closed-circuit current measurement of approximate 4 hours in which the vehicle may not be wakened. In this time, the ISG system is inactive.

CAUTION

ISG system deactivation by fault.

- Fault in communication line (LIN/CAN)
 - Fault Electric oil pump
 - Fault ESC System
 - Fault Limp home mode
- Fault brake booster vacuum pressure sensor
 - Fault Brake master cylinder pressure sensor
 - Fault Brake pedal switch
 - Fault Battery sensor

When the ISG related sensors or system error occurs, the ISG OFF switch lights up. Especially when the battery sensor is replaced or reinstalled, the vehicle must be placed in the ignition switch OFF for about 4 hours for recalibration.

The ISG function is operated about 4 hours later normally. But in the case of first 25 times, the ISG function can be operated regardless of recalibration.

WARNING

When the engine is in Idle stop mode, it's possible to restart the engine without the driver taking any action.

Before leaving the car or doing anything in the engine room area, stop the engine by turning the ignition key to the LOCK position or removing it.

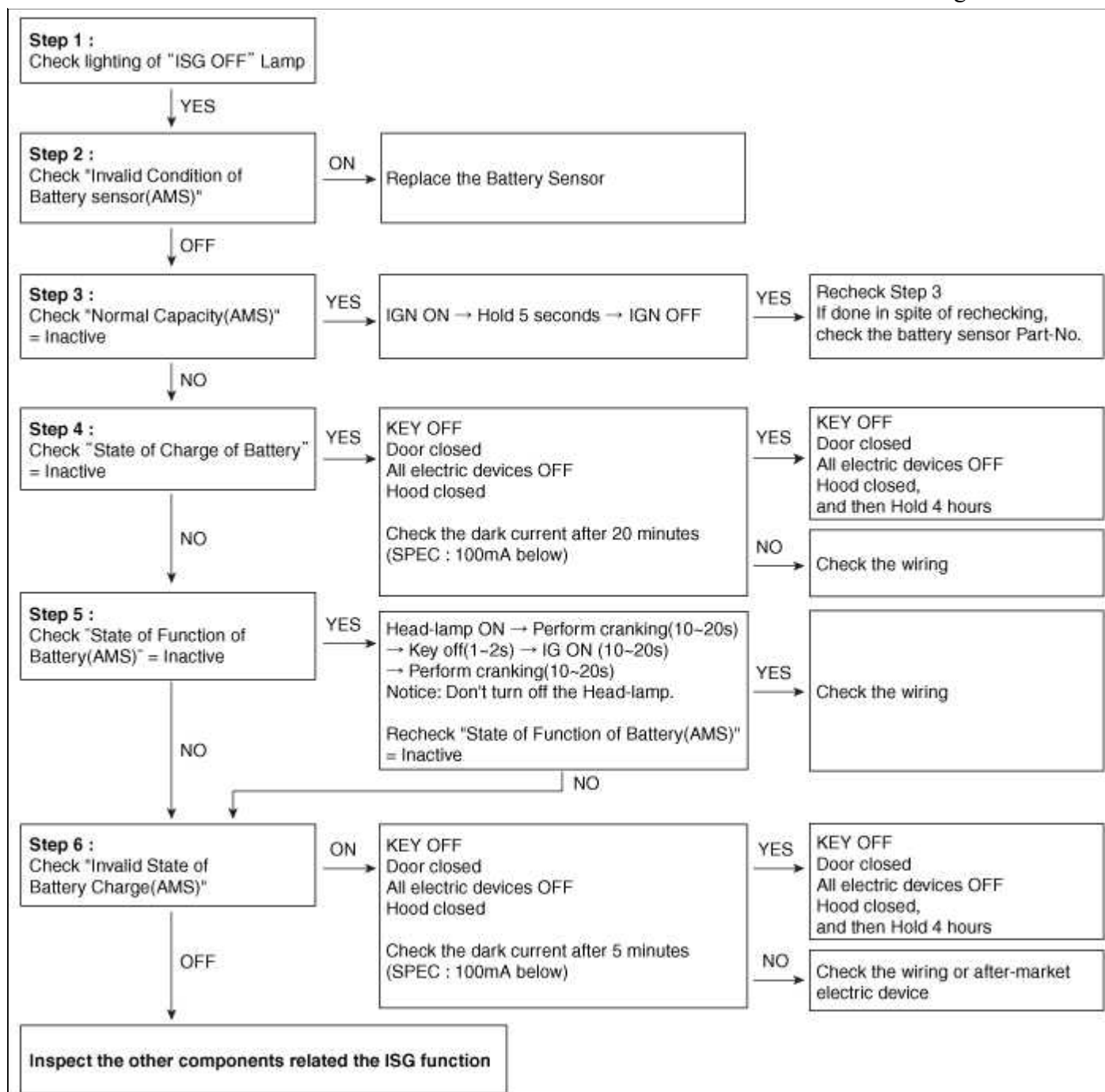
Fuel System > ISG (Idle Stop & Go) System > Troubleshooting

Troubleshooting

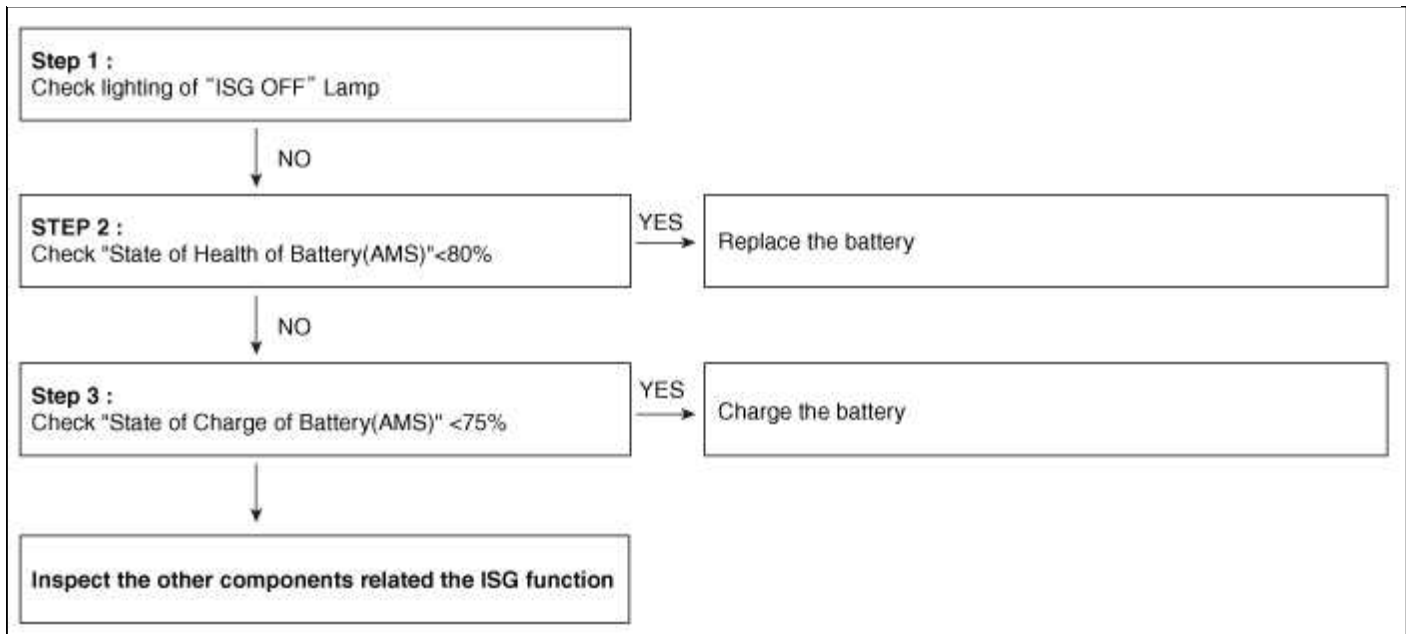
If ISG function is not operated, check the related DTC codes. (Refer to DTC guide.)

If the ISG function is not operated in spite of no DTC, inspect the ISG system as below. The GDS tool shows the current data about the ISG function for inspection.

[Battery sensor and calibration value inspection]



[Battery status inspection]



Current Data

Current Data 61/177		
Standard Display	Full List	Graph
Items List	Reset Min.Max.	Record
Stop	Filter	
Sensor Name	Value	Unit
☐ VIS Control State	OFF	-
☐ Cooling Fan Relay - Low	OFF	-
☐ Cooling Fan Relay - High	OFF	-
☐ Cruise Control Main Lamp[Option]	OFF	-
☐ Cruise Control Set Lamp[Option]	OFF	-
☐ Cruise Control Active[Option]	OFF	-
☐ O2 Sensor is Ready for Operation-Bank1 Upstream	ON	-
☐ O2 Sensor is Ready for Operation-Bank1 Downstream	ON	-
☐ Lambda Fuel Trim Active Downstream - Bank1	OFF	-
☐ Overheat Protection Active - Bank1	OFF	-
☐ IVVT Controller Active - Intake	ON	-
☐ IVVT Controller Active - Exhaust[Option]	ON	-
☐ Knock Detected - S1B1	OFF	-
☐ AMS Stop Reason - Blower Max Switch[AMS]	OFF	-
☐ AMS Stop Reason - Head Lamp[AMS]	OFF	-
☐ AMS Stop Reason - Wiper[AMS]	OFF	-
☐ Battery Current[AMS]	9.0	A
☐ Battery Voltage[AMS]	14.5	V
☐ Battery Temperature[AMS]	14.5	°C
☐ State of Charge of Battery[AMS]	73	%
☐ State of Health of Battery[AMS]	83	%

Current Data 81/177					
Standard Display ▾			Full List ▾		
Graph ▾			Items List ▾		
Reset Min.Max.			Record		
Stop ▾			Filter		
Sensor Name	Value	Unit			
☐ State of Function of Battery (AMS)	9.5	V			
☐ Desired Alternator Voltage Duty Cycle[AMS]	76.0	%			
☐ Duty Cycle from Alternator PWM Signal[AMS]	75.0	%			
☐ Nominal Capacity[AMS]	70	Ah			
☐ Reference Timer Started at IG ON	254	Sec			
☐ Water Temperature at Start	77.3	°C			
☐ Air Intake Temperature at Start	21.0	°C			
☐ Ignition Output Value - Cyl1	3.0	'CRK			
☐ Ignition Output Value - Cyl2	3.0	'CRK			
☐ Ignition Output Value - Cyl3	1.5	'CRK			
☐ Ignition Output Value - Cyl4	3.8	'CRK			
☐ Engine Operating Status	Idle	-			
☐ Torque Converter Turbine Speed	523	RPM			
☐ Calculated Oil Temperature	61	°C			
☐ Adapted Ambient Pressure	1.0	bar			
☐ ISG System Built-in[ISG]	ON	-			
☐ ISG Status[ISG]	ON	-			
☐ ISG Inhibition Switch[ISG]	OFF	-			
☐ ISG Inhibition Lamp[ISG]	OFF	-			
☐ Start Request from ISG [ISG]	OFF	-			
☐ Stop Request from ISG [ISG]	OFF	-			

Current Data 81/177					
Standard Display ▾			Full List ▾		
Graph ▾			Items List ▾		
Reset Min.Max.			Record		
Stop ▾			Filter		
Sensor Name	Value	Unit			
☐ Canister Shut-off Valve Closed	OFF	-			
☐ Variable Cam Shaft Pack	ON	-			
☐ Condition Camshaft Control	OFF	-			
☐ CAM Phazing Advance Control Active - Bank1 in...	OFF	-			
☐ CAM Phazing Advance Control Active - Bank1 e...	OFF	-			
☐ Lambda Closed Loop Control Active - Upstream...	ON	-			
☐ Lambda Control Active	OFF	-			
☐ Permit Open-Loop Operation by Workshop Tester	OFF	-			
☐ Condition for O2 Sensor Upstream Heating Switc...	ON	-			
☐ Condition for O2 Sensor Downstream Heating Sw...	ON	-			
☐ Power Steering Switch Pressure Sensor Built-in	OFF	-			
☐ VIS 1 Operation Status(Optional)	OFF	-			
☐ Condition High Pressure pump actuator active-B...	ON	-			
☐ ISG System Built-in[ISG]	OFF	-			
☐ Invalid State of Battery Charge(AMS)	OFF	-			
☐ Invalid State of Battery Health-aging(AMS)	OFF	-			
☐ Invalid Status of Battery Function to crank the e...	OFF	-			
☐ Invalid Status of Quiescent current(AMS)	OFF	-			
☐ Invalid Condition of Battery Sensor(AMS)	OFF	-			
☐ Response Error Flag from Battery Sensor(AMS)	OFF	-			
☐ EGR Built-in	OFF	-			
☐ Battery Voltage	14.30	V			

Fuel System > ISG (Idle Stop & Go) System > Repair procedures

Battery Sensor Recalibration Procedure

If disconnecting the negative (-) battery cable from the battery during repair work for the vehicle equipped with ISG function, Battery sensor recalibration procedure should be performed after finishing the repair work.

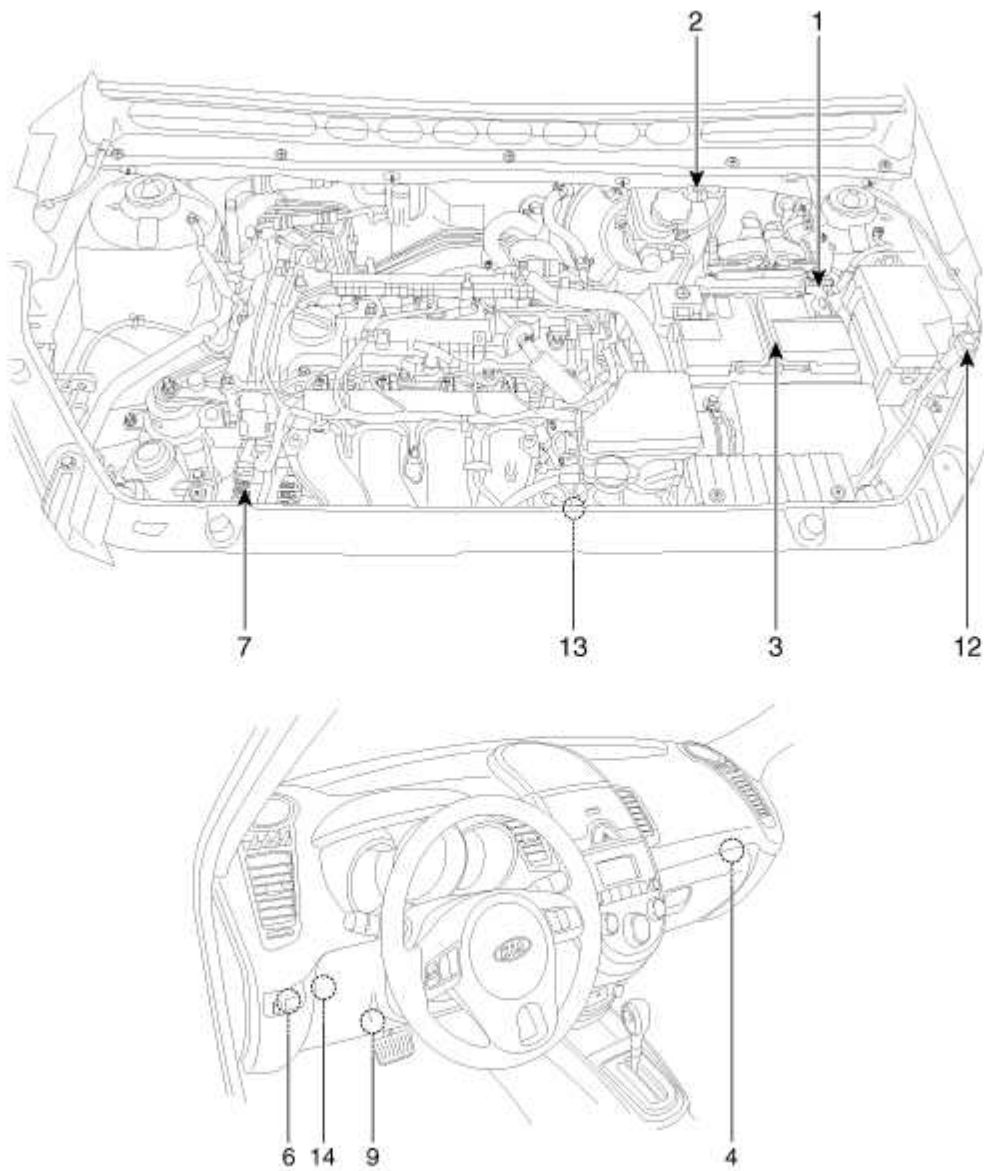
1. Turn the Ignition switch ON and OFF.
2. Park the vehicle about 4 hours under below states.
 - A. Park the vehicle about 4 hours under below states.
 - B. Closing the hood, trunk, and all doors.
3. After 4 hours later, check whether the current datas are displayed normally or not using GDS.
 - A. Nominal capacity(AMS) = 70Ah
 - B. State of Charge of Battery(AMS) = (0~100%)
 - C. State of Health of Battery(AMS) = (0~100%)
4. After cranking the engine 2 times or more, check State of Function of Battery(AMS) =(0~12V).

Current Data 61/177		
Standard Display	Full List	Graph
Items List	Reset Min.Max.	Record
Stop	Filter	
Sensor Name	Value	Unit
☐ VIS Control State	OFF	-
☐ Cooling Fan Relay - Low	OFF	-
☐ Cooling Fan Relay - High	OFF	-
☐ Cruise Control Main Lamp[Option]	OFF	-
☐ Cruise Control Set Lamp[Option]	OFF	-
☐ Cruise Control Active[Option]	OFF	-
☐ O2 Sensor is Ready for Operation-Bank1 Upstream	ON	-
☐ O2 Sensor is Ready for Operation-Bank1 Downstream	ON	-
☐ Lambda Fuel Trim Active Downstream - Bank1	OFF	-
☐ Overheat Protection Active - Bank1	OFF	-
☐ IVVT Controller Active - Intake	ON	-
☐ IVVT Controller Active - Exhaust[Option]	ON	-
☐ Knock Detected - S1B1	OFF	-
☐ AMS Stop Reason - Blower Max Switch[AMS]	OFF	-
☐ AMS Stop Reason - Head Lamp[AMS]	OFF	-
☐ AMS Stop Reason - Wiper[AMS]	OFF	-
☐ Battery Current[AMS]	9.0	A
☐ Battery Voltage[AMS]	14.5	V
☐ Battery Temperature[AMS]	14.5	°C
☐ State of Charge of Battery[AMS]	73	%
☐ State of Health of Battery[AMS]	83	%

Current Data 81/177		
Standard Display	Full List	Graph
Items List	Reset Min.Max.	Record
Stop	Filter	
Sensor Name	Value	Unit
☐ State of Health of Battery[AMS]	83	%
☐ Desired Alternator Voltage Duty Cycle[AMS]	76.0	%
☐ Duty Cycle from Alternator PWM Signal[AMS]	75.0	%
☐ Nominal Capacity[AMS]	70	Ah
☐ Reference Timer Started at IG ON	254	Sec
☐ Water Temperature at Start	77.3	'C
☐ Air Intake Temperature at Start	21.0	'C
☐ Ignition Output Value - Cyl1	3.0	'CRK
☐ Ignition Output Value - Cyl2	3.0	'CRK
☐ Ignition Output Value - Cyl3	1.5	'CRK
☐ Ignition Output Value - Cyl4	3.8	'CRK
☐ Engine Operating Status	Idle	-
☐ Torque Converter Turbine Speed	523	RPM
☐ Calculated Oil Temperature	61	'C
☐ Adapted Ambient Pressure	1.0	bar
☐ ISG System Built-in[ISG]	ON	-
☐ ISG Status[ISG]	ON	-
☐ ISG Inhibition Switch[ISG]	OFF	-
☐ ISG Inhibition Lamp[ISG]	OFF	-
☐ Start Request from ISG [ISG]	OFF	-
☐ Stop Request from ISG [ISG]	OFF	-

Fuel System > ISG (Idle Stop & Go) System > Components and Components Location

Components Location

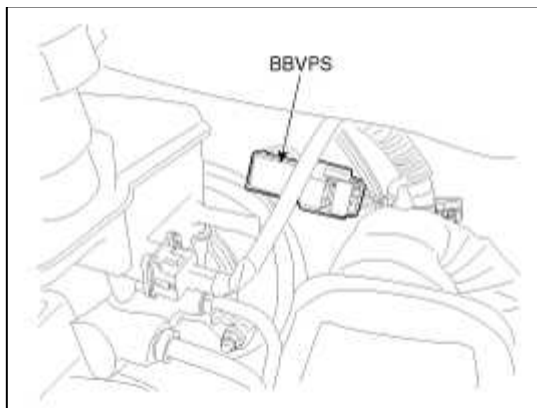
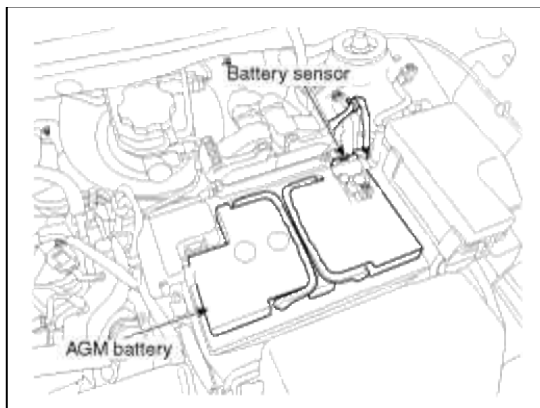


- 1. Battery sensor
- 2. Brake Booster Vacuum Pressure Sensor (BBVPS)
- 3. AGM battery
- 4. DC/ DC Converter (LDC) [200W]
- 5. DC/DC Converter (LDC) [400W]
- 6. ISG OFF Switch
- 7. Alternator

- 8. Starter
- 9. Brake switch
- 10. Door switch
- 11. Seat belt switch
- 12. Hood switch
- 13. Electric Oil Pump (EOP)
- 14. Oil Pump Unit (OPU)

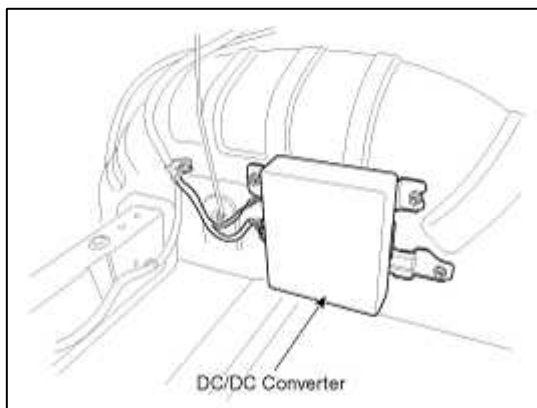
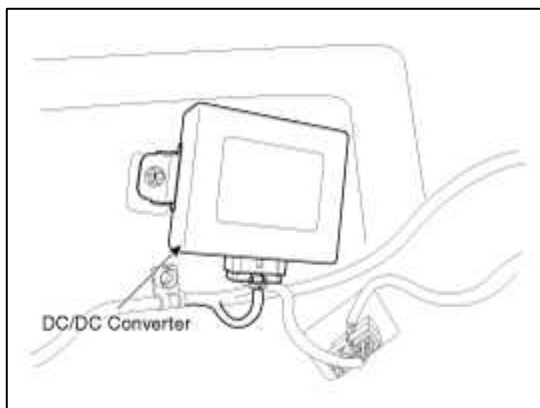
- 1. Battery sensor
- 3. AGM battery

- 2. Brake Booster Vacuum Pressure Sensor (BBVPS)



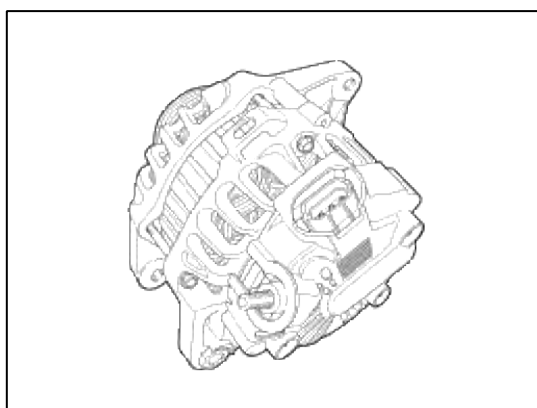
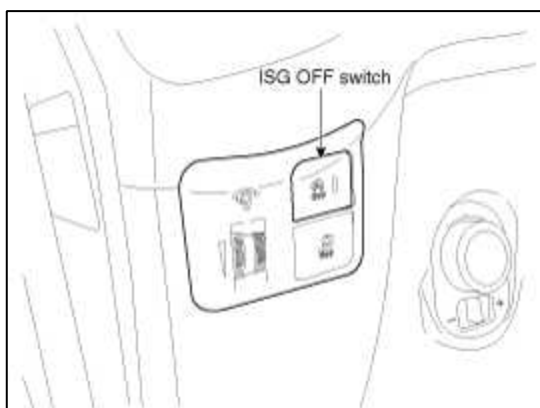
4. DC/DC Converter (LDC) [200W]

5. DC/DC Converter (LDC) [400W]



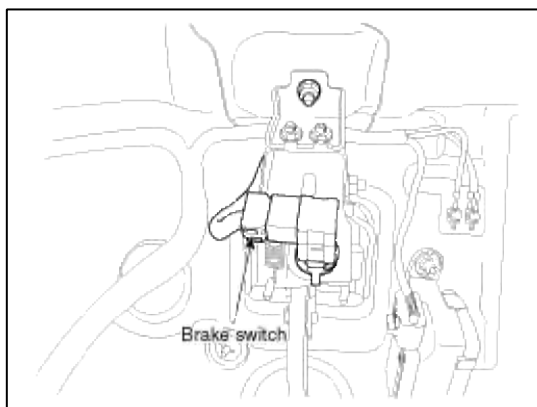
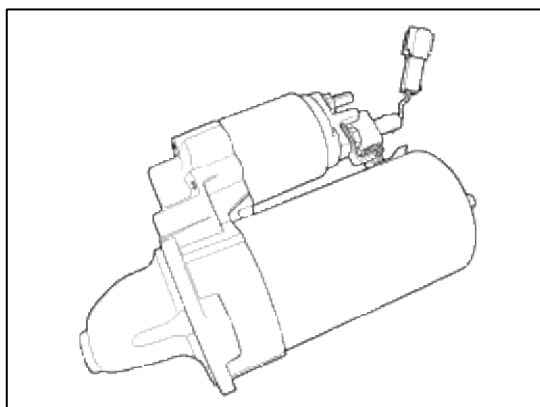
6. ISG OFF Switch

7. Alternator



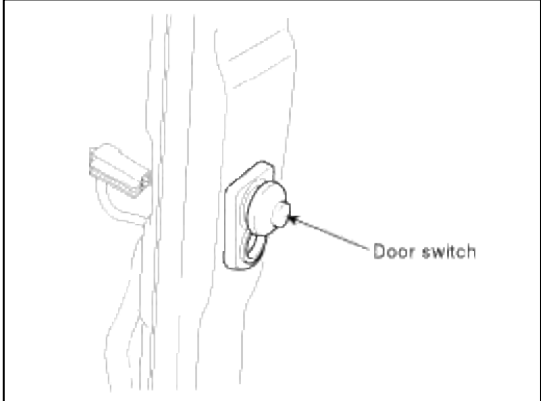
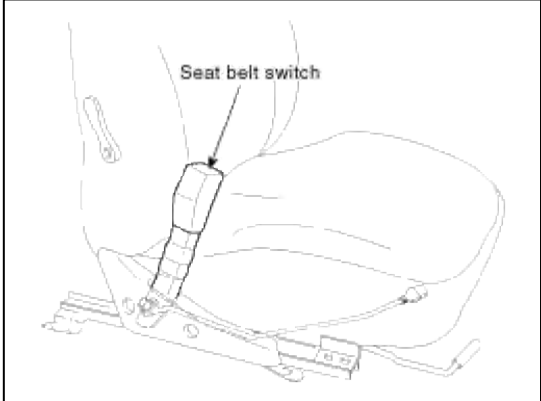
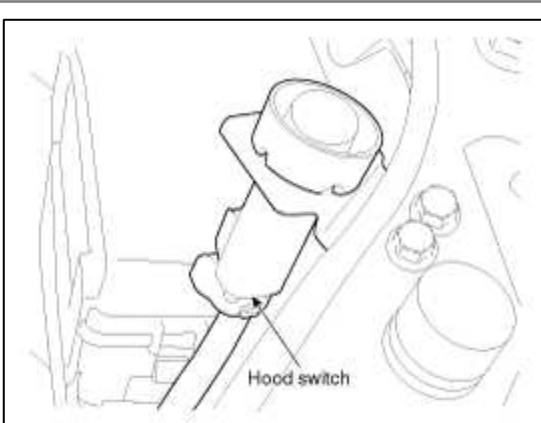
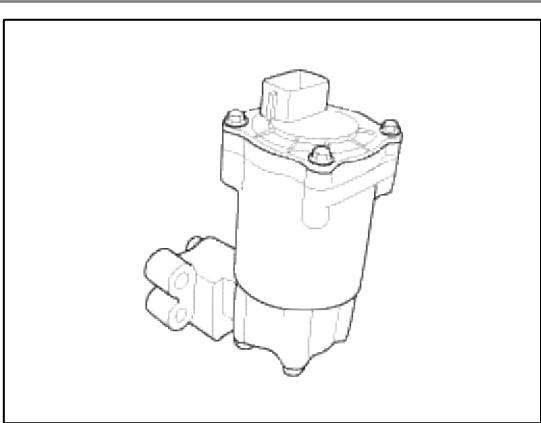
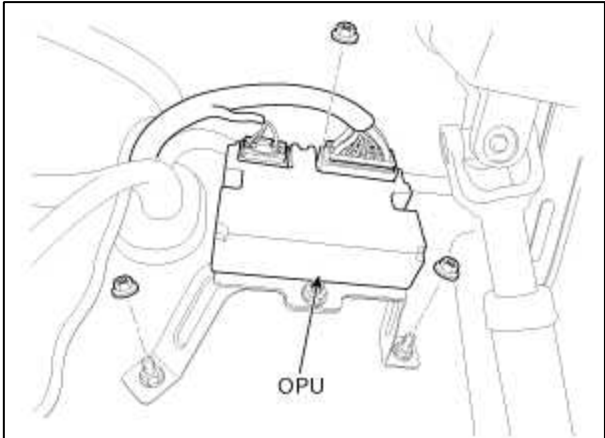
8. Starter

9. Brake switch



10. Door switch

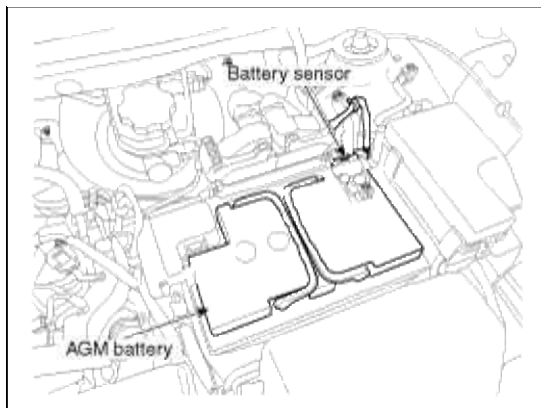
11. Seat belt switch

 Door switch	 Seat belt switch
12. Hood switch	13. Electric Oil Pump (EOP)
 Hood switch	
14. Oil Pump Unit (OPU)	
 OPU	

Fuel System > ISG (Idle Stop & Go) System > Battery Sensor > Description and Operation

Description

Vehicles have many control units that use more electricity. These units control their own system based on information from diverse sensors. It is important to have a stable power supply as there diverse sensors giving a variety of information. Battery sensor is mounted on battery (-) terminal. It transmits battery voltage, current, temperature information to ECM. ECM controls generating voltage by duty cycle based on these signals.

**CAUTION**

When battery sensor signal fault occurs, inspect the vehicle parasitic draw in advance after inspecting the sensor because the sensor will behave abnormally when the parasitic draw is more than 100mA. (Refer to vehicle parasitic current inspection)

NOTE

It takes a few hours for a new battery sensor to detect the battery state correctly. Perform the following process after replacing the battery sensor.

1. Ignition switch ON/OFF.
2. Park the vehicle about 4 hours.
3. After 4 hours later, check that the SOC (State of charge) of battery is displayed on GDS properly.
4. After engine start ON/OFF 2 times or more, check the SOF (State of function) of battery using GDS.

CAUTION

For the vehicle equipped with a battery sensor, be careful not to damage the battery sensor when the battery is replaced or recharged.

- When replacing the battery, it should be same one (type, capacity and brand) that is originally installed on your vehicle. If a battery of a different type is replaced, the battery sensor may recognize the battery to be abnormal.
- When installing the ground cable on the negative post of battery, tighten the clamp with specified torque of 4.0 ~ 6.0 N.m (0.4 ~ 0.6 kgf.m, 3.0 ~ 4.4 lb-ft). An excessive tightening torque can damage the PCB internal circuit and the battery terminal.
- When recharging the battery, ground the negative terminal of the booster battery to the vehicle body.

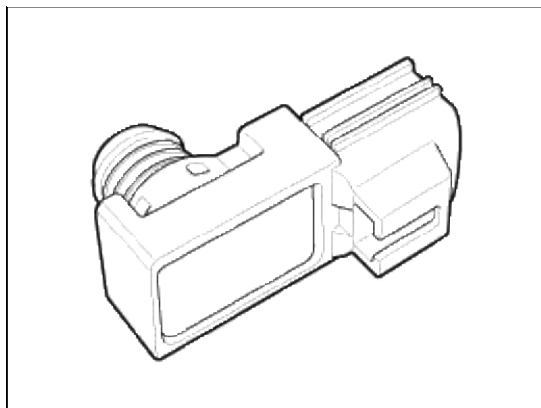
NOTE

- Refer to DTC manual code “U1111, U1112” to inspect the battery sensor.
- Must replace the engine wiring assembly to replace the battery sensor. Battery sensor doesn't be replaced as a part only.

Fuel System > ISG (Idle Stop & Go) System > Brake Booster Vacuum Pressure Sensor > Description and Operation

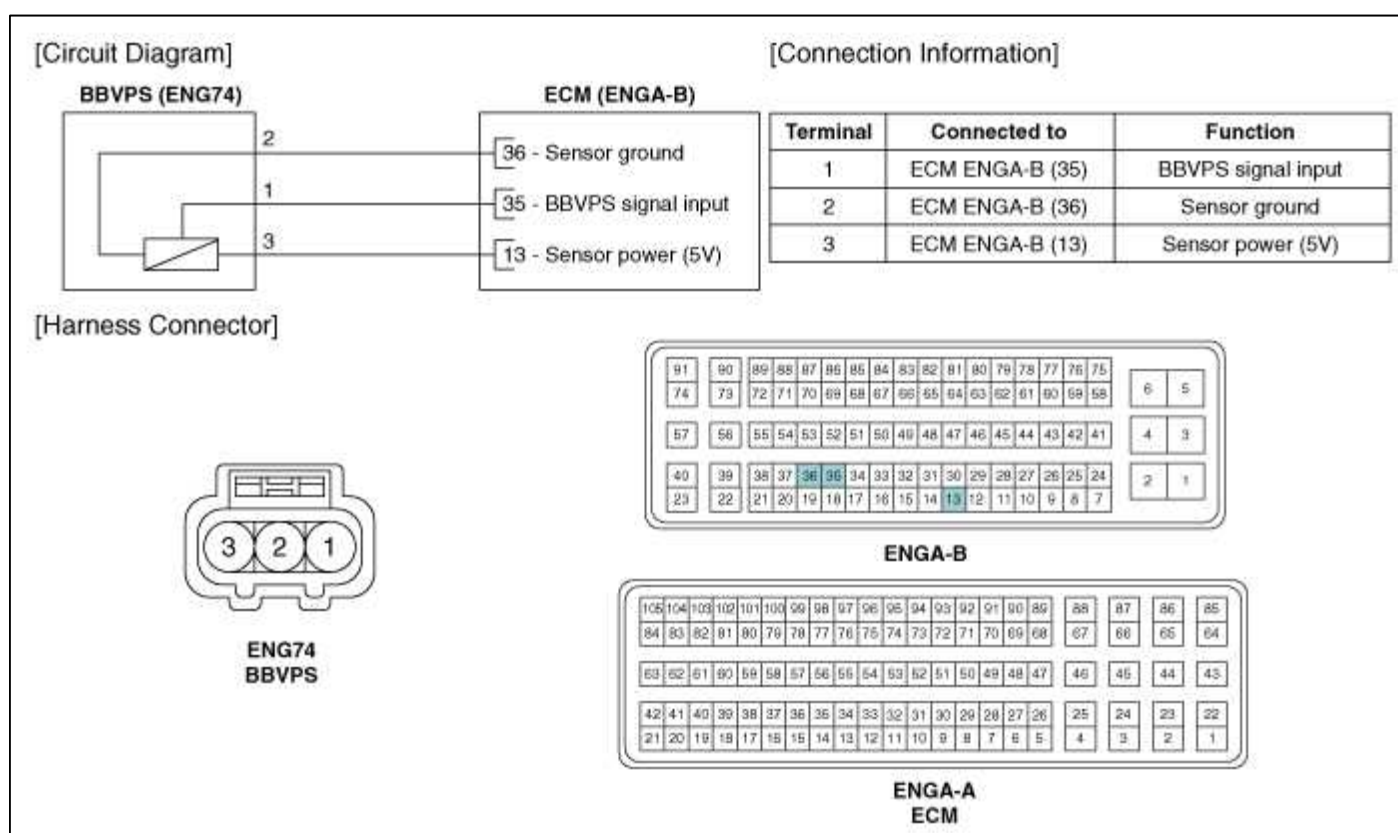
Description

In order to ensure adequate brake power assistance in every situation, the brake booster is equipped with a partial vacuum sensor. The brake booster vacuum pressure sensor is located beside the brake booster.



Fuel System > ISG (Idle Stop & Go) System > Brake Booster Vacuum Pressure Sensor > Schematic Diagrams

Circuit Diagram



Fuel System > ISG (Idle Stop & Go) System > Brake Booster Vacuum Pressure Sensor > Repair procedures

Inspection

1. Check installation status of BBVPS and Vacuum hose or damage of vacuum hose.
2. Connect GDS to DLC (Data Link Cable).
3. Warm up the engine to normal operating temperature.

4. Monitor "BBVPS" parameter on GDS.

Current Data		
Standard Display	Full List	Graph
Items List	Reset Min.Max.	Record
Stop	Filter	
Sensor Name	Value	Unit
☒ ISG Status	ON	-
☒ Clutch Switch	YES	-
☒ Gear is on Neutral Position	YES	-
☒ Brake Boost Vacuum Pressure	-0.8	bar
☒ Brake Boost Vacuum Pressure Voltage	3.667	V
☒ Desired Alternator Voltage Duty Cycle	2.00	%
☒ Duty Cycle from Alternator PWM Signal	39.7	%
☒ Battery Current	1.6	A
☒ Battery Voltage	14.259	V

Fig.1

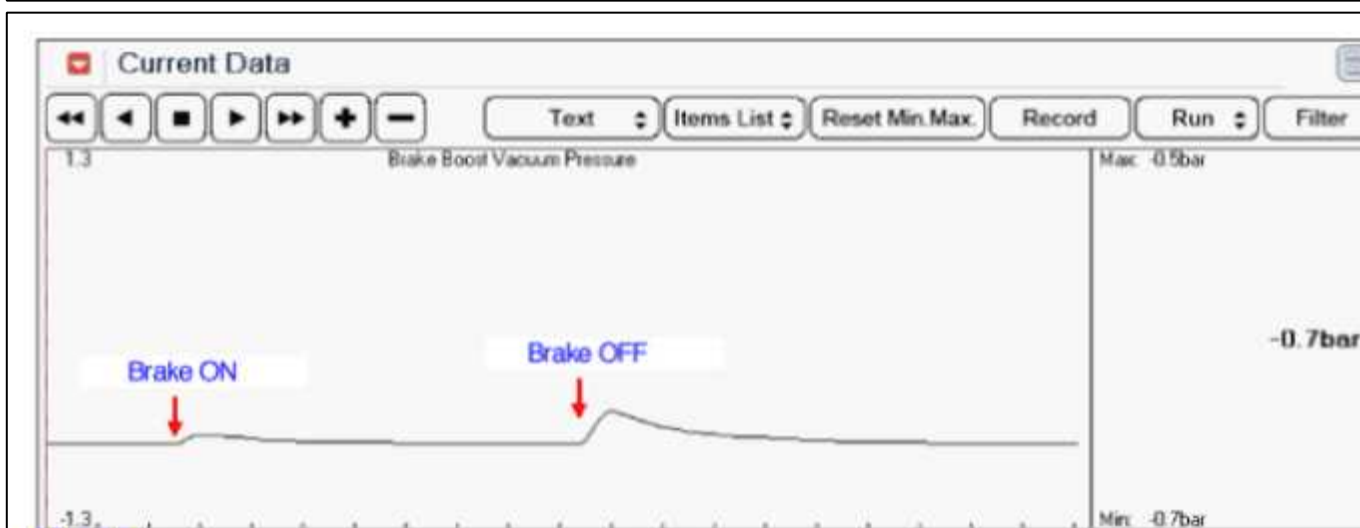


Fig.2

Fig.1) Idle Status

Fig.2) Brake pressure signal

NOTE

With a brake partial vacuum that is too low, the ISG function also starts without activity on the part of the driver.

Insufficient brake partial vacuum can lead to safety risks during braking manoeuvres, when rolling on an incline. To prevent this, the engine is started.

(Refer to "DTC P0557, P0558" in DTC manual)

Fuel System > ISG (Idle Stop & Go) System > AGM Battery > Description and Operation

Description

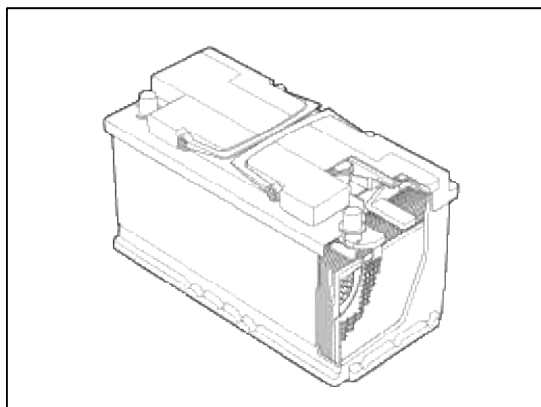
AGM battery is used for especially heavy load on the vehicle network depending on equipment and requirements. AGM stands for Absorbent Glass Material Battery; that is absorbent glass fibre fleece. AGM batteries are fitted in models with electrical loads/consumers which have a high energy demand.

The constantly increasing energy demand of modern vehicle electrical systems calls for ever more powerful battery solutions.

The power consumption is considerable even when the vehicle is parked.

The somewhat higher price compared with a battery of similar size is fully balanced by the following benefits:

- Significantly longer service life
- Increased starting reliability at low temperatures
- 100 % freedom from maintenance
- Low risk in event of an accident (reduced risk to the environment)



Recharging

Check the battery condition

The battery condition cannot be determined solely on the basis of the battery charge state. If there is a suspicion of a damaged battery, check the battery condition with the GR8 battery tester. With a low battery charge state, recharge the battery.

Recharging the AGM battery

The battery may be charged using the battery chargers at a constant charge voltage of 14.8V.

If possible, the battery temperature during charging should be between 68°F and 86°F.

Only chargers with voltage clamping (IU or WU curve) may be used or chargers with IUoU curve which have a trickle.

IU or WU charging technique

Optimized charging voltage for IU or WU: 14.7V (at 68°F ~ 86°F.) about 24 hours

Min. charging voltage at 68°F: 14.4V

Max. charging voltage at 68°F: 14.8V

10% of capacity is recommended as charging current (e.g. 60Ah : 10 = 6,0A charging current).

WARNING

Do not charge the AGM battery with >15.2V. No quick-charging routines.

CAUTION

If the battery is charged directly at the battery terminals on vehicles with battery sensor, misinterpretations of battery condition and under certain circumstances also unwanted Check Control messages or fault memory entire can occur.

After recharging finished, let the battery stand for over 10 hours with normal temperature for battery stabilization.

NOTE

If the battery is charged directly at the battery (+),(-) terminals on vehicles with battery sensor, please battery sensor be re-installed and re-calibration.

Fuel System > ISG (Idle Stop & Go) System > AGM Battery > Specifications

Specification

Items		Specification
AGM Battery	Type	56- 28 GL
		(AGM Battery - 70Ah)
	Cold cranking amperage [at - 18°C (-0.4°F)]	760 A
	Reserve capacity	120 min
	Specific gravity [at 25°C(77°F)]	1.310 ± 0.01

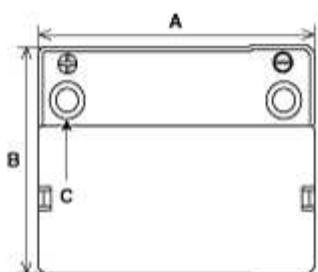
CAUTION

- **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.
- **RESERVE CAPACITY RATING** is amount of time a battery can deliver 25A and maintain a minimum terminal voltage of 10.5V at 26.7°C(80.1°F).

NOTE

Battery type notation : MF 4 8 - 2 3 G L
 ① ② ③ ④ ⑤

- ① : Battery type
 - MF : Maintenance Free
- ② : Battery capacity (5HR)
 - 48 : 48Ah
- ③ : Battery length (A)
 - 23 : 230mm (9.06in)
- ④ : Battery width (B)
 - A : 127mm (5.00in)
 - B : 129mm (5.08in)
 - C : 132mm (5.20in)
 - D : 135mm (5.31in)
 - E : 154mm (6.06in)
 - F : 173mm (6.81in)
 - G : 175mm (6.89in)
 - H : 176mm (6.93in) or above
- ⑤ : Terminal location (C)
 - L : Positive terminal is left
 - R : Positive terminal is right


Fuel System > ISG (Idle Stop & Go) System > AGM Battery > Repair procedures
Removal and Installation

1. Disconnect the battery terminals (A). The negative terminal first.

Tightening torque

(+) terminal:

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

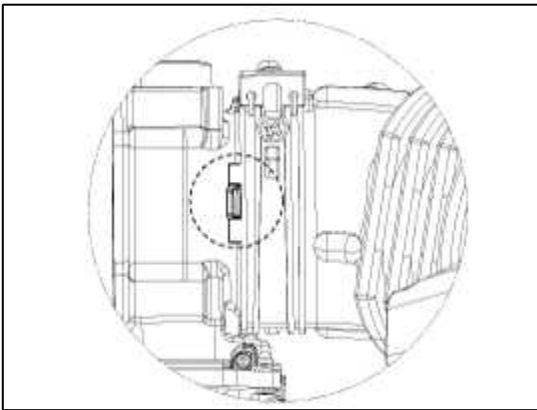
(-) terminal:

3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 3.0 ~ 4.4 lb-ft)

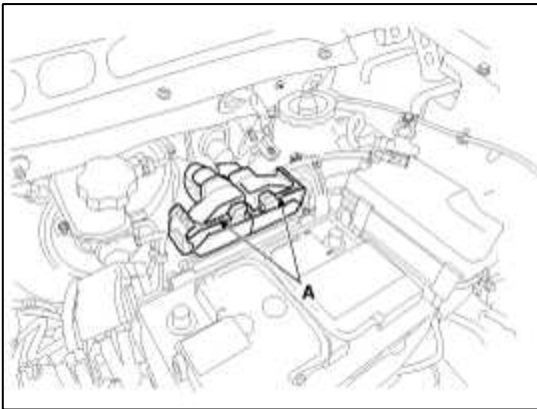
2. Remove the air duct and air cleaner assembly (Refer to "Engine And Transaxle Assembly" in EM group).

NOTE

Install the air intake hose while the center of the mark of hose must be in line with the throttle body rib.



3. Disconnect the ECM connectors (A).



4. Remove the ECM (A).

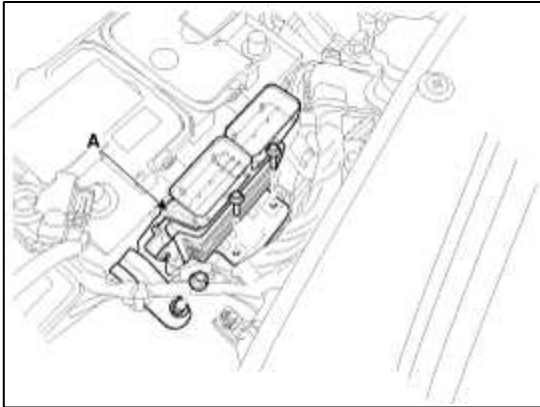
Tightening torque

Bolts :

19.6 ~ 29.4N.m (2.0 ~ 3.0kgf.m, 14.5 ~ 21.7lb-ft)

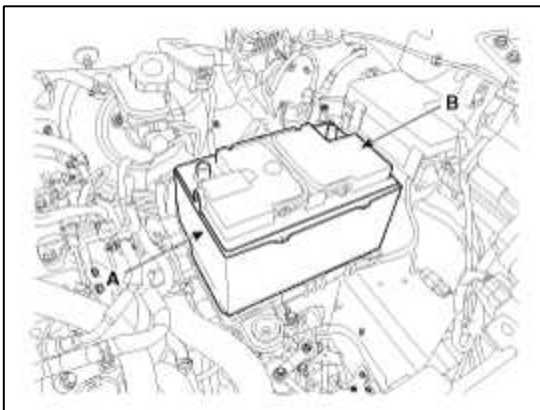
Nut :

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



5. Remove the battery insulation pad (A).

6. Remove the battery (B).



7. Installation is the reverse order of removal.

CAUTION

When installing the battery, fix the mounting bracket on the tray correctly.

CAUTION

- ISG (Idle stop & go) system equipped vehicle always use the AGM battery only. If flooded battery has installed, this can potentially lead to engine electrical trouble or ISG system error.
- Replace same capacity of the AGM battery.

NOTE

Ensure the AGM battery is placed correctly on the battery tray. In all cases, an AGM battery must be installed and the battery sensor calibrated for the ISG system to function. After the battery has been changed or disconnected, the battery sensor must be recalibrated. After connecting the battery, start the engine at least once. Then park the car for at least 4 hours with the ignition off in the ignition switch OFF door closed, hood switch off state. After the 4 hours, the engine should be started two times. At this time the battery sensor will be recalibrated. (Refer to ""Battery sensor recalibration procedure"" in FL group.) But first 25 times, the ISG function can operates regardless of ISG system stability for ISG function operating check.

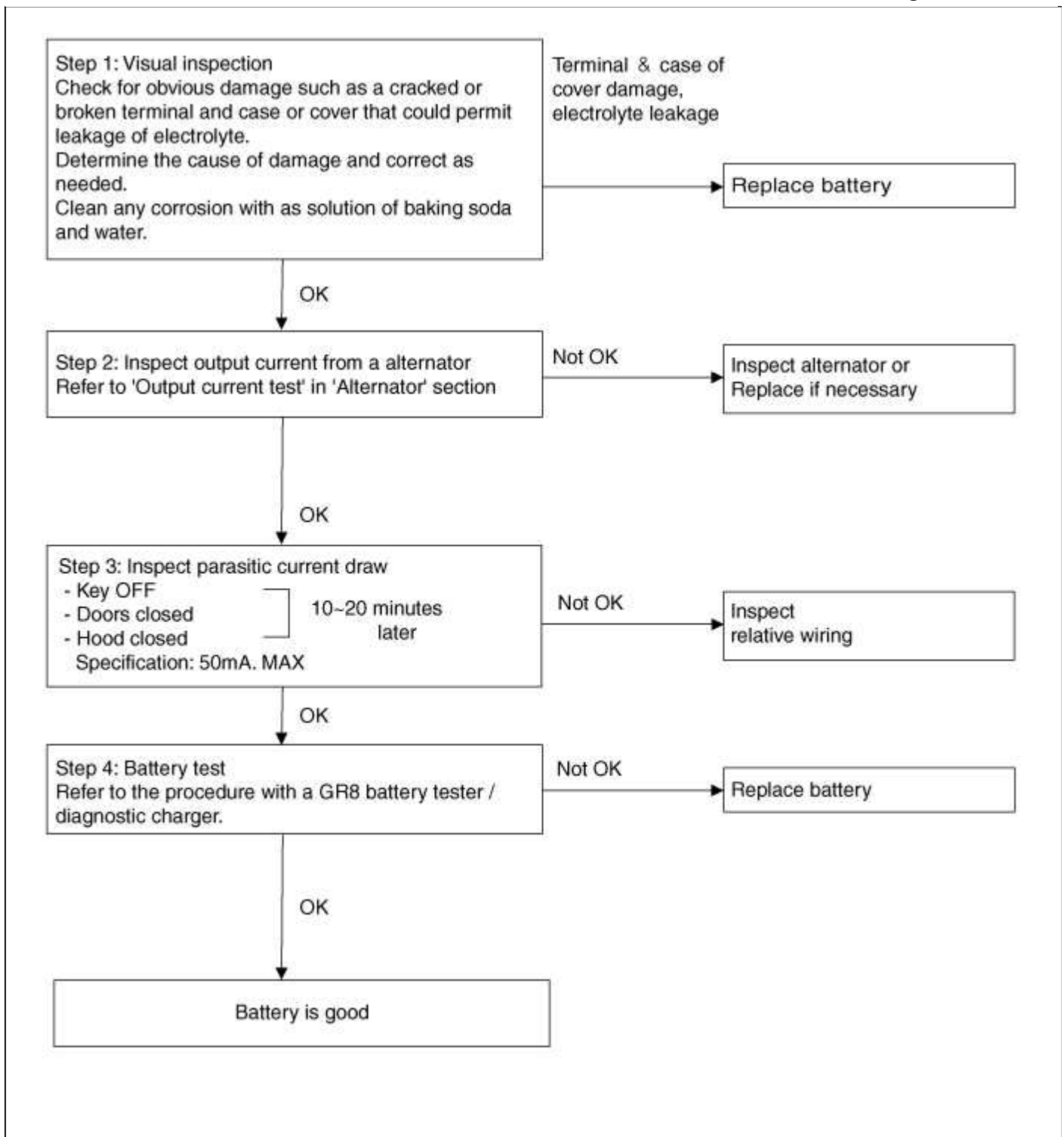
WARNING

Do not open the AGM battery.

The AGM battery must not be opened under any circumstances as the introduction of oxygen from the air will cause the battery to lose its chemical equilibrium and rendered non-operational.

Inspection

Battery Diagnostic Flow



Vehicle parasitic current inspection

1. Turn all the electric devices OFF, and then turn the ignition switch OFF.
2. Close all doors except the engine hood, and then lock all doors.
 - (1) Disconnect the hood switch connector.
 - (2) Close the trunk lid.
 - (3) Close the doors or remove the door switches.

3. Wait a few minutes until the vehicle's electrical systems go to sleep mode.

NOTE

For an accurate measurement of a vehicle parasitic current, all electrical systems should go to sleep mode. (It takes at least one hour or at most one day.) However, an approximate vehicle parasitic current can be measured after 10~20 minutes.

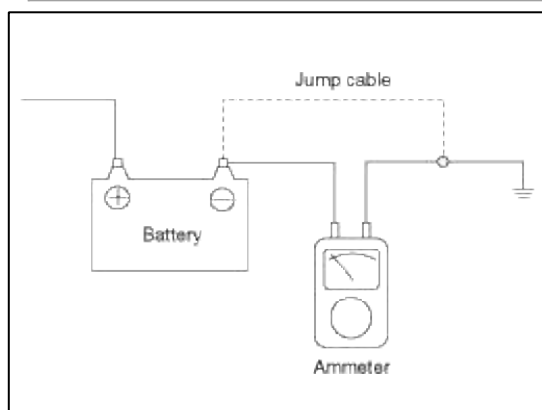
4. Connect an ammeter in series between the battery (-) terminal and the ground cable, and then disconnect the clamp from the battery (-) terminal slowly.

CAUTION

Be careful that the lead wires of an ammeter do not come off from the battery (-) terminal and the ground cable to prevent the battery from being reset. In case the battery is reset, connect the battery cable again, and then start the engine or turn the ignition switch ON for more than 10 sec. Repeat the procedure from No. 1.

To prevent the battery from being reset during the inspection,

- 1) Connect a jump cable between the battery (-) terminal and the ground cable.
- 2) Disconnect the ground cable from the battery (-) terminal.
- 3) Connect an ammeter between the battery (-) terminal and the ground cable.
- 4) After disconnecting the jump cable, read the current value of the ammeter.



5. Read the current value of the ammeter.

- A. If the parasitic current is over the limit value, search for abnormal circuit by removing a fuse one by one and checking the parasitic current.
- B. Reconnect the suspected parasitic current draw circuit fuse only and search for suspected unit by removing a component connected with the circuit one by one until the parasitic draw drops below limit value.

Limit value (after 10~20 min.) : Below 50mA

Cleaning

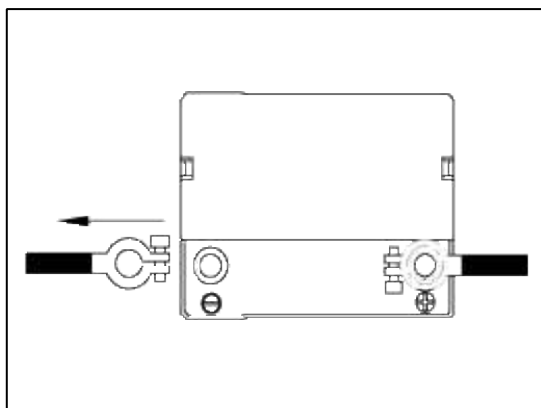
1. Make sure the ignition switch and all accessories are in the OFF position.
2. Disconnect the battery cables (negative first).

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 tray for damage caused by the loss of electrolyte. If acid damage is present, it will be necessary to clean the area with a solution of clean warm water and baking soda. Scrub the area with a stiff brush and wipe off with a cloth moistened with baking soda and water.
5. Clean the top of the battery with the same solution as described above.
6. Inspect the battery case and cover for cracks. If cracks are present, the battery must be replaced.
7. Clean the battery posts with a suitable battery post tool.
8. Clean the inside surface of the terminal clamps with a suitable battery cleaning tool. Replace damaged or frayed cables and broken terminal clamps.
9. Install the battery in the vehicle.
10. Connect the cable terminals to the battery post, making sure tops of the terminals are flush with the tops of the posts.
11. Tighten the terminal nuts securely.
12. Coat all connections with light mineral grease after tightening.

CAUTION

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

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

Fuel System > ISG (Idle Stop & Go) System > DC/DC Converter > Description and Operation

Description

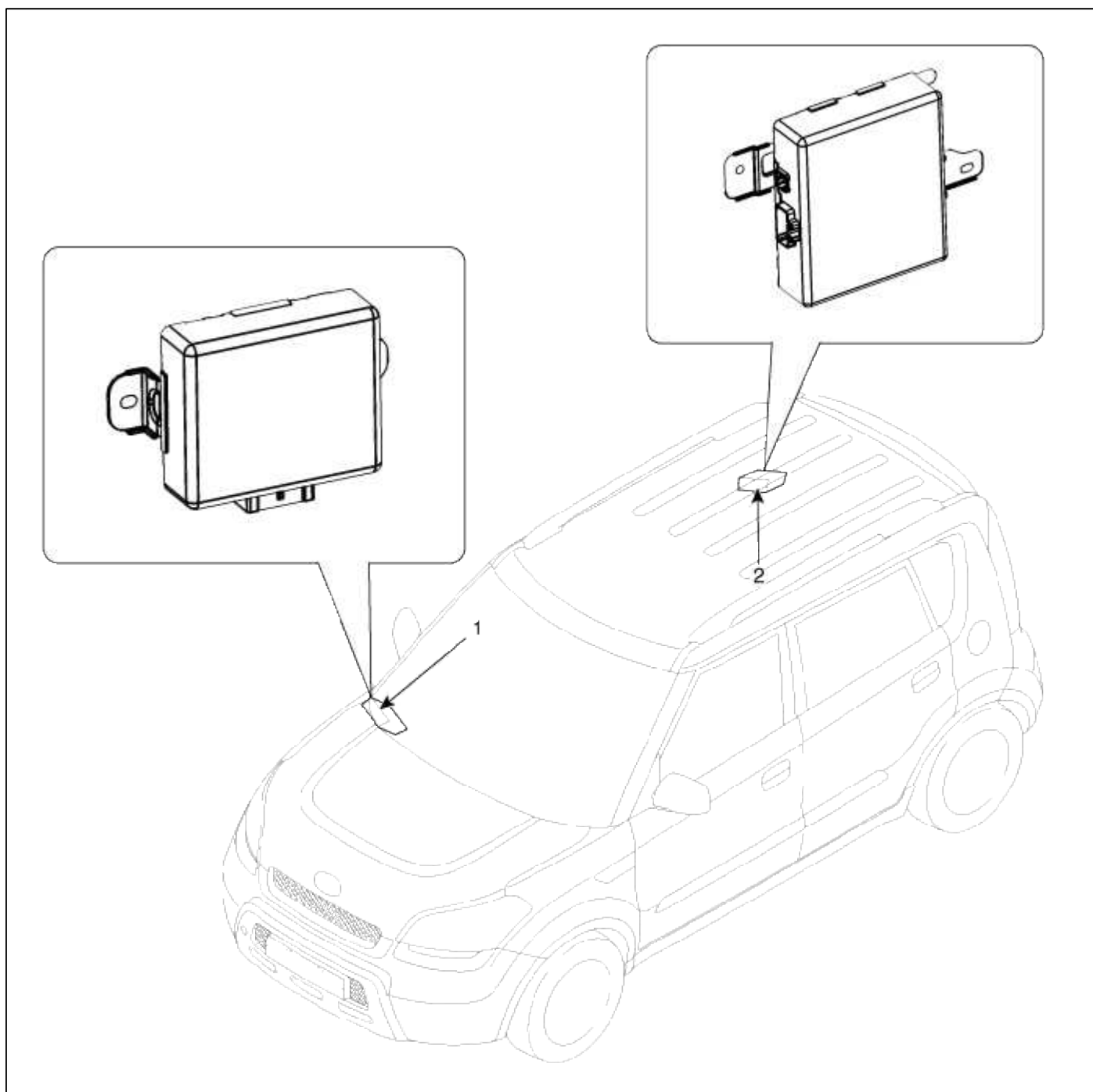
Due to the considerably more frequent occurrence of starting operations, the electrical load that occurs often leads to voltage dips in the vehicle network. In order to stabilize the power supply for certain voltage-sensitive electrical components, a DC/DC converter is used in conjunction with the ISG function.

The DC DC converter supplies the relay with a voltage that also remains constant during the starting operation.

The DC/DC converter is fitted at the behind of the glove box and luggage side trim RH.

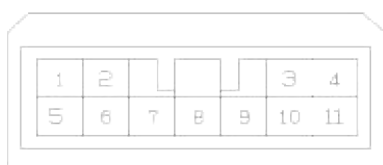
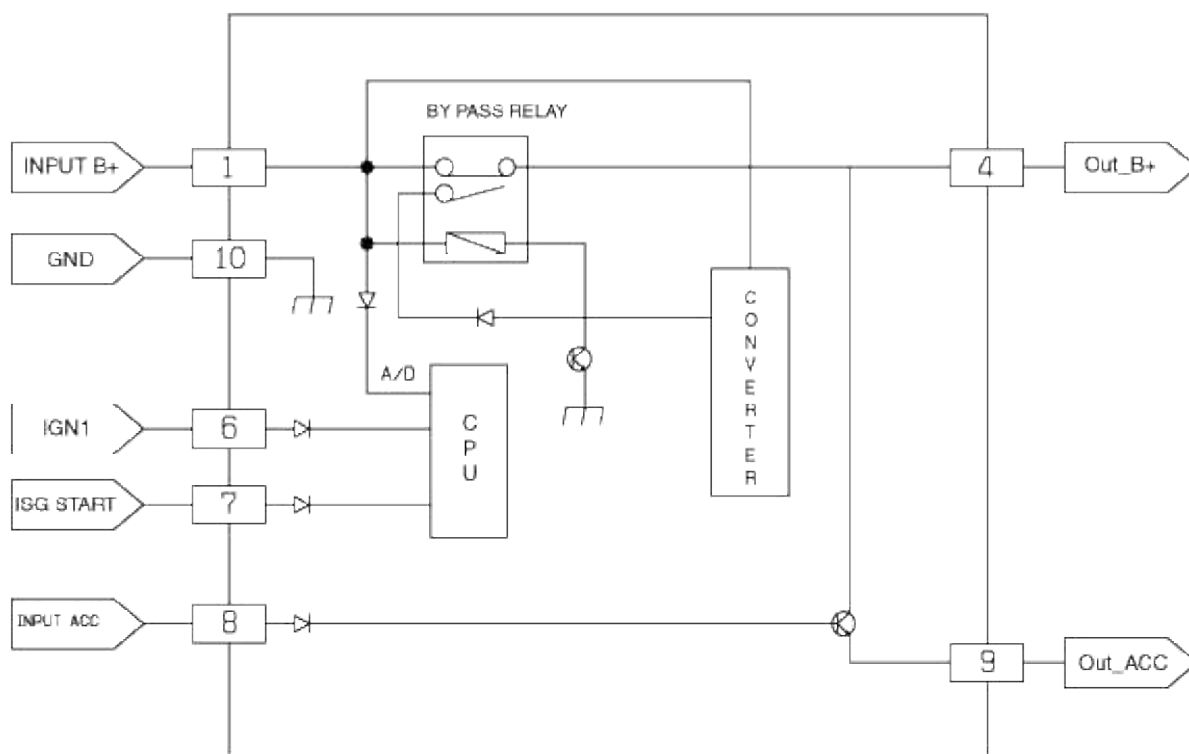
Via the test leads for input voltage and the start relay , the electronics decide whether the power is supplied to the output via the bypass or the DC/DC converter.

In the bypass mode, the on-board supply voltage is not fed across the DC/DC converter, rather is transferred directly to the outputs. In the booster phase, the vehicle voltage is adapted.

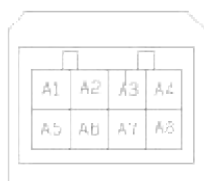
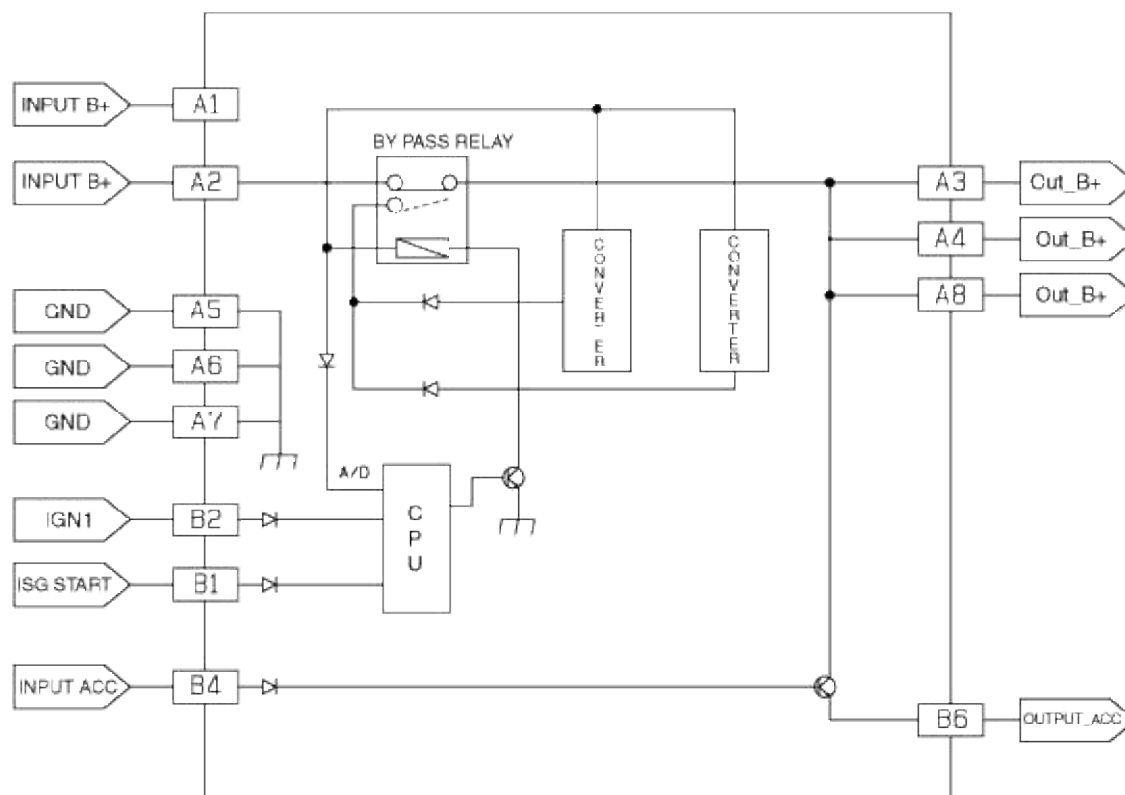
Fuel System > ISG (Idle Stop & Go) System > DC/DC Converter > Components and Components Location**Component Location**

1. DC/DC Converter (200W)
2. DC/DC Converter (400W)

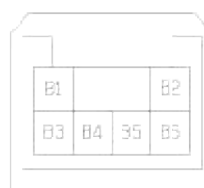
Fuel System > ISG (Idle Stop & Go) System > DC/DC Converter > Schematic Diagrams**Circuit Diagram****[200W]**



PIN NO.	DESCRIPTION
1	INPUT B+
2	-
3	-
4	OUTPUT B+
5	-
6	IGN1
7	ISG START
8	INPUT_ACC
9	OUTPUT_ACC
10	GND
11	-



PIN NO.	DESCRIPTION
A1	INPUT B+
A2	INPUT B+
A3	OUTPUT B+
A4	OUTPUT B+
A5	GND
A6	GND
A7	GND
A8	OUTPUT B+



PIN NO.	DESCRIPTION
B1	ISG START
B2	IGN1
B3	NC
B4	INPUT ACC
B5	NC
B6	OUTPUT_ACC

NOTE

In the ISG mode, if the power of an audio system turns OFF by drawdown while “Auto Starting” or “Idle Starting” function operates, replace the DC/DC converter.

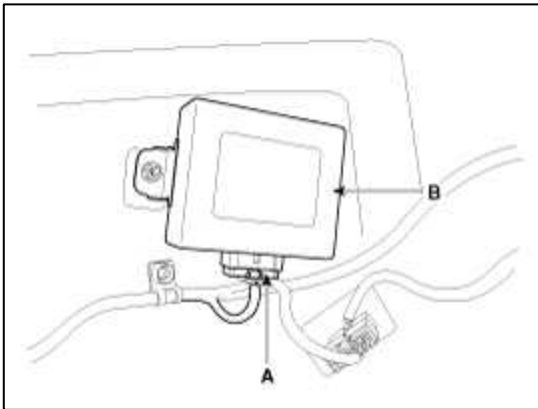
Fuel System > ISG (Idle Stop & Go) System > DC/DC Converter > Repair procedures

Removal

[200W]

1. Disconnect the battery negative terminal.
2. Remove the glove box housing. (Refer to "Crash pad" in BD group)

3. Disconnect the connector (A) and then remove the DC/DC converter (B).

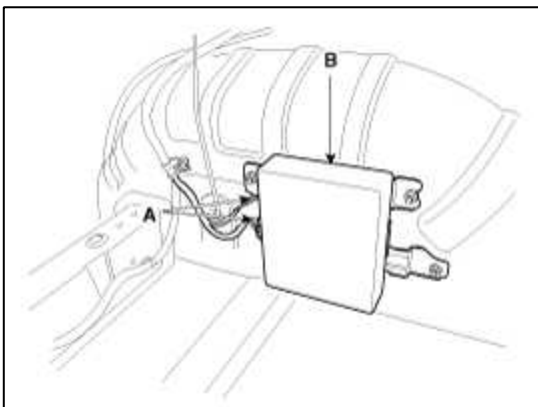


NOTE

After disconnecting then reconnecting the battery negative cable, the ISG function dose not operates until the system is stabilized, about 4 hours.

[400W]

1. Disconnect the battery negative terminal.
2. Remove the rear seat (Refer to "Rear seat" in BD group).
3. Remove the luggage side trim RH (Refer to "Interior trim" in BD group).
4. Disconnect the connector (A) and then remove the DC/DC converter (B).



NOTE

After disconnecting then reconnecting the battery negative cable, the ISG function dose not operates until the system is stabilized, about 4 hours.

Installation

1. Installation is reverse of removal.

Fuel System > ISG (Idle Stop & Go) System > ISG OFF Switch > Description and Operation

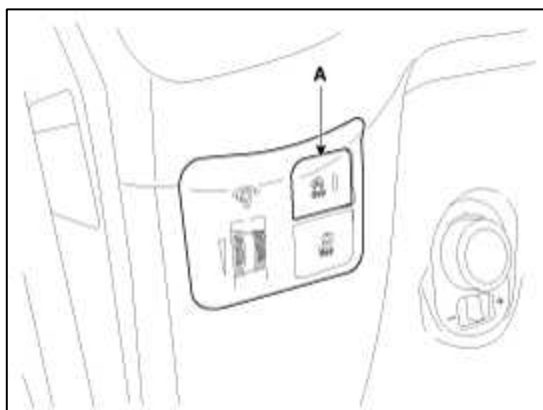
Description

The ISG OFF switch on the crash pad lower panel can be used to deactivate the ISG function.

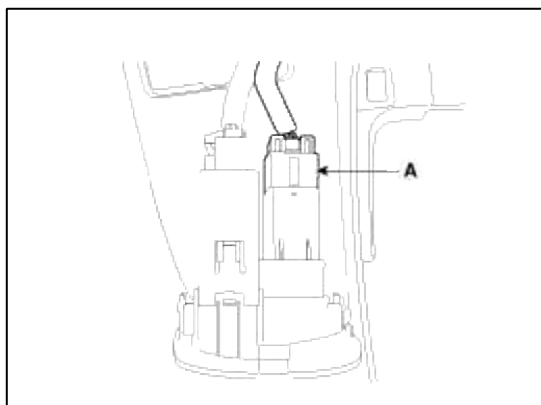
Fuel System > ISG (Idle Stop & Go) System > ISG OFF Switch > Repair procedures

Inspection

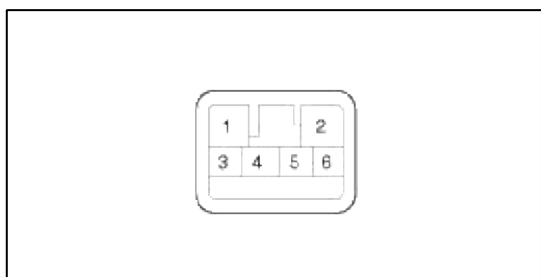
1. Remove the crash pad side switch assembly (A) from the switch panel on the crash pad of the driver's side.



2. Disconnect the ISG OFF switch connector (A).



3. Check the continuity between the switch 1 and 4 terminals as the ISG OFF switch is engaged.



Position Terminal	ON	OFF	Remark
3			Indicator
5			Indicator
4			Switch
1			Switch

Fuel System > ISG (Idle Stop & Go) System > Alternator > Description and Operation

Description

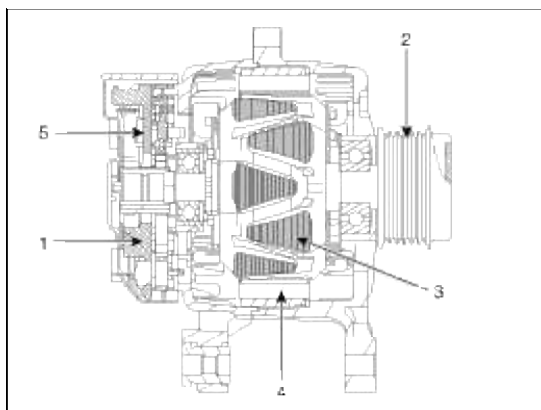
The charging system included a battery, an alternator with a built-in regulator, and the charging indicator light and wire.

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

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

In addition, the charging voltage of this alternator is regulated by the battery voltage detection system.

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



1. Brush
2. Drive belt pulley
(OAD: Overrunning Alternator Decoupler)
3. Rotor
4. Stator
5. Rectifier

Alternator Management System (AMS)

Alternator management system controls the charging voltage set point in order to improve fuel economy, manage alternator load under various operating conditions, keep the battery charged, and protect the battery from over-charging. ECM controls generating voltage by duty cycle (charging control, discharging control, normal control) based on the battery conditions and vehicle operating conditions.

The system conducts discharging control when accelerating a vehicle. Vehicle reduces an alternator load and consumes an electric power from a battery.

The system conducts charging control when decelerating a vehicle. Vehicle increases an alternator load and charges a battery.

Fuel System > ISG (Idle Stop & Go) System > Alternator > Specifications

Specification

Items			Specification
ISG Alternator	Rated voltage		13.5V, 120A
	Speed in use		1,000 ~ 18,000rpm
	Voltage regulator		IC Regulator built-in type
	Regulator setting voltage	External mode	ECU control
		Internal mode	14.55 ± 0.3V
	Temperature compensation	External mode	ECU control
		Internal mode	-3.5 ± 2mV / °C

Fuel System > ISG (Idle Stop & Go) System > Alternator > Repair procedures

On-vehicle Inspection

CAUTION

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

Check Battery Voltage

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

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

Check The Battery Terminals And Fuses

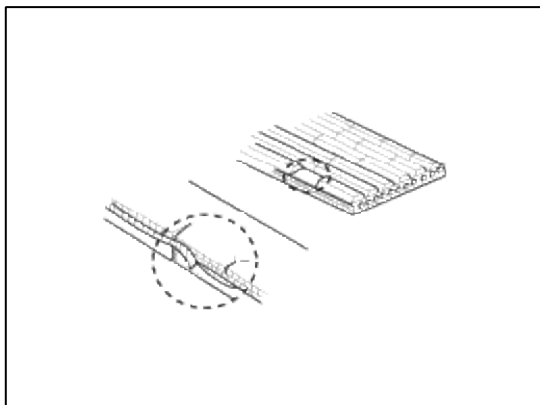
1. Check that the battery terminals are not loose or corroded.
2. Check the fuses for continuity.

Inspect Drive Belt

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

NOTE

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

**Drive belt tension measurement and adjustment****Belt tension measurement**

Measure the belt tension using a mechanical tension gauge or a sonic tension meter.

Tension

New belt: 637.4 ~ 735.5N (65 ~ 75kg, 143.3 ~ 165.3lb)

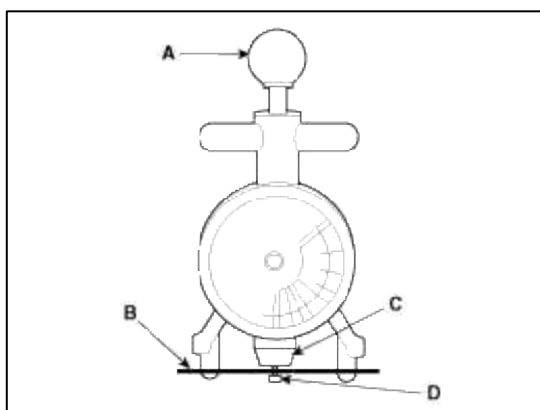
Used belt: 441.3 ~ 539.4N (45 ~ 55kg, 99.2 ~ 121.3lb)

CAUTION

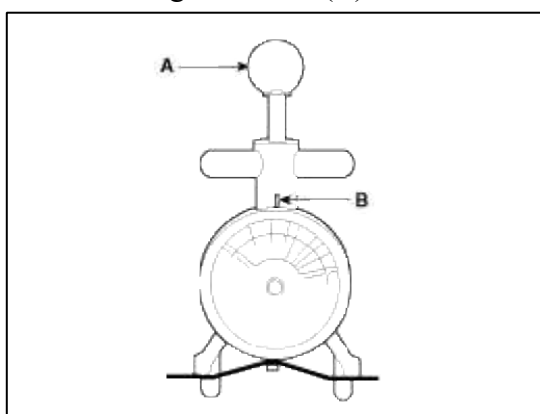
- If the engine has run for 5 minutes or more, the belt tension must be adjusted as a used belt.
- When installing the V-ribbed belt, all grooves on the pulley should be covered with belt ribs.
- A loose belt causes slip noise.
- Too tight belt cause bearing of alternator and water pump to damage.

Using a mechanical tension gauge (BT-33-73F, BTG-2 type)

1. While pressing the handle (A) of the gauge, insert the belt (B) between pulley and pulley (or idler) into the gap between spindle (C) and hook (D).



2. After releasing the handle (A), read a value on the dial pointed by the indicator (B).



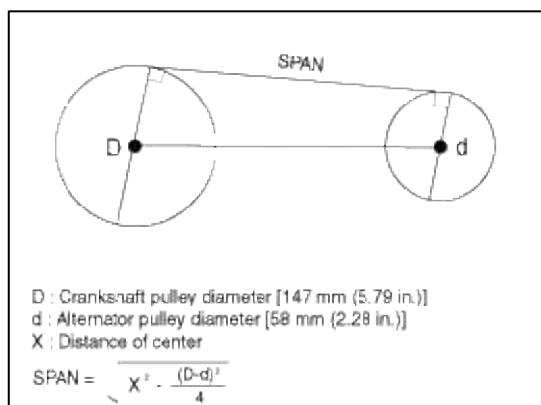
Using a sonic tension meter (U-505/507 type)

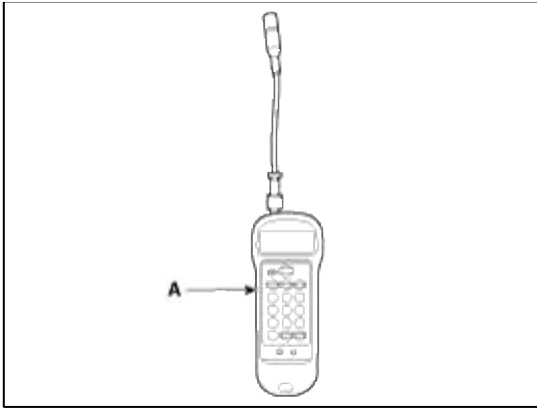
1. Input the belt specifications into the tension meter.

Belt type	Location of measurement	Input data		
		M (Mass, g/m.rib)	W (Width, rib)	S (Span, mm)
With A/C	Crankshaft pulley to A/C compressor pulley	14.7	006.0	187
Without A/C	Crankshaft pulley to alternator pulley	14.7	006.0	Actual measurement value

NOTE

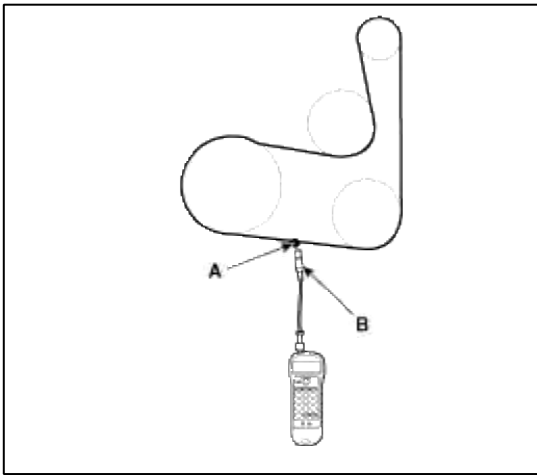
Measurement of S (Span) : Caculate average value after measuring the distance 3~4 times.



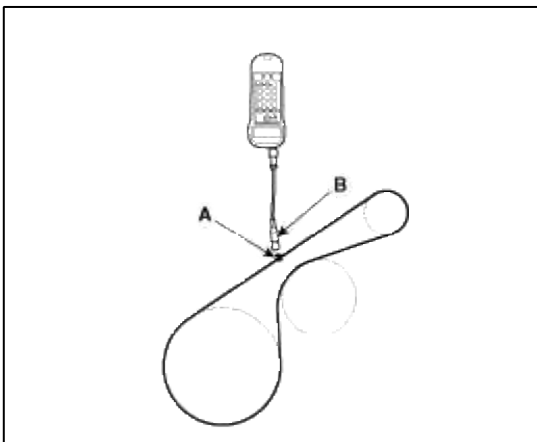


2. Locate the micro phone (B) close to the center of belt span (A) and bounce the belt by finger 2~3 times. Read a value on the display.

[With A/C]



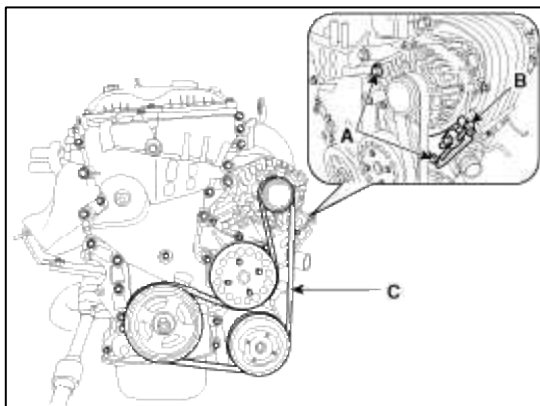
[Without A/C]



If adjustment is necessary :

1. Loosen the mounting bolts (A).

2. Tighten the adjusting bolt(B) clockwise in loose tension ; loosen the bolt counterclockwise in high tension.



3. Recheck tension of the belt.
4. After adjusting tension, tighten the through bolts.

Tightening torque

M8 bolt : 21.6 ~ 32.4 N.m (2.2 ~ 3.3 kgf.m, 15.9 ~ 23.9 lb-ft)

M10 bolt : 29.4 ~ 41.2 Nm (3.0 ~ 4.2 kgf.m, 21.7 ~ 30.4 lb-ft)

Visually Check Alternator Wiring And Listen For Abnormal Noises

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

Check Discharge Warning Light Circuit

1. Warm up the engine and then turn it off.
2. Turn off all accessories.
3. Turn the ignition switch "ON". Check that the discharge warning light is lit.
4. Start the engine. Check that the light is lit.

If the light does not go off as specified, troubleshoot the discharge light circuit.

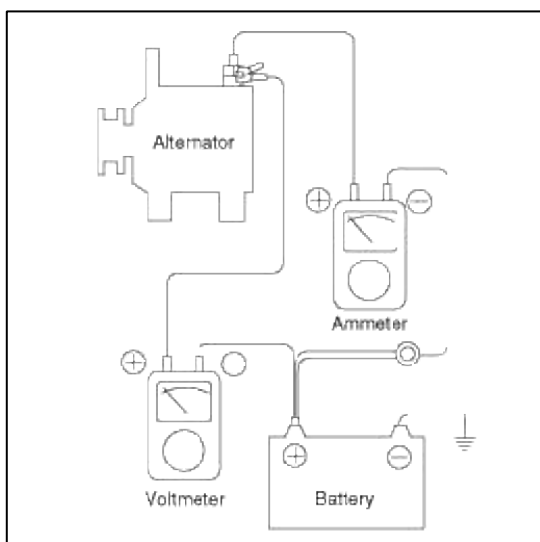
Inspect Charging System

Voltage Drop Test Of Alternator Output Wire

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

Preparation

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



Test

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

Result

1. The voltmeter may indicate the standard value.

Standard value : 0.2V max

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

Output Current Test

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

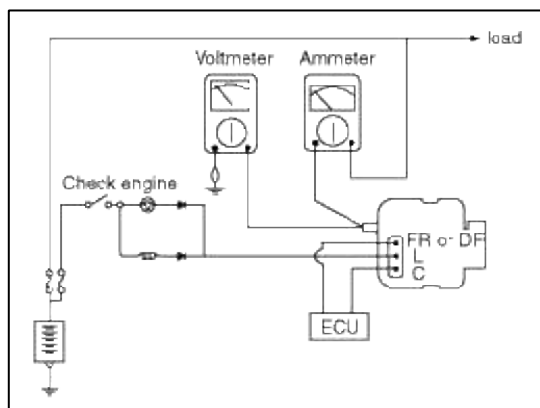
Preparation

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

NOTE

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

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



Test

1. Check to see that the voltmeter reads as the same value as the battery voltage. If the voltmeter reads 0V, and the open circuit in the wire between alternator "B" terminal and battery (+) terminal or poor grounding is suspected.
2. Start the engine and turn on the headlamps.

3. Set the headlamps to high beam and the heater blower switch to HIGH, quickly increase the engine speed to 2,500 rpm and read the maximum output current value indicated by the ammeter.

NOTE

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

Result

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

Limit value : 60% of the voltage rate

NOTE

- 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 headlamps on the cause discharge of the battery, or use the lights of another vehicle to increase the electrical load. The nominal output current may not be obtained if the temperature of the alternator itself or ambient temperature is too high. In such a case, reduce the temperature before testing again.

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

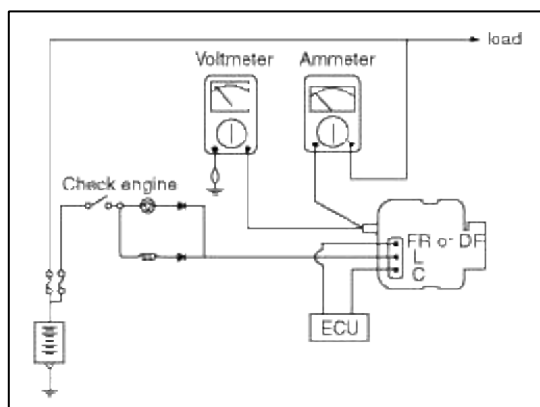
Regulated Voltage Test

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

Preparation

1. Prior to the test, check the following items and correct if necessary.
 - Check that the battery installed on the vehicle is fully charged. The battery checking method is described in the section "Battery".
 - Check the alternator drive belt tension. The belt tension check method is described in the section "Inspect drive belt".
2. Turn ignition switch to "OFF".
3. Disconnect the battery ground cable.
4. Connect a digital voltmeter between the "B" terminal of the alternator and ground. Connect the (+) lead of the voltmeter to the "B" terminal of the alternator. Connect the (-) lead to good ground or the battery (-) terminal.
5. Disconnect the alternator output wire from the alternator "B" terminal.
6. Connect a DC ammeter (0 to 150A) in series between the "B" terminal and the disconnected output wire.
 - Connect the (-) lead wire of the ammeter to the disconnected output wire.

7. Attach the engine tachometer and connect the battery ground cable.



Test

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

Voltage: Battery voltage

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

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

Result

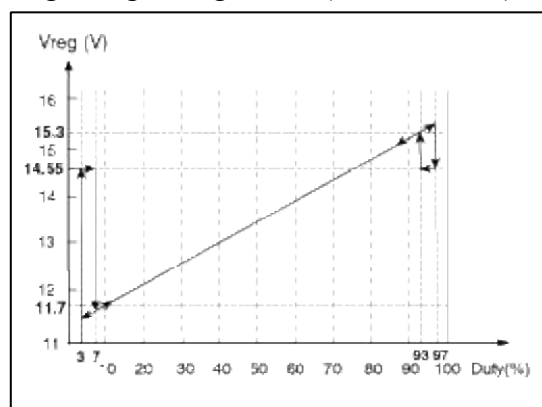
1. If the voltmeter reading doesn't agree with the standard value, the voltage regulator or the alternator is faulty.

Regulating Voltage Table (Internal mode)

Voltage regulator ambient temperature °C (°F)	Regulating voltage (V)
-30 (-22)	13.4 ~ 14.7
25 (77)	13.5 ~ 14.4
135 (275)	12.9 ~ 14.3

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.

Regulating Voltage Table (External mode)



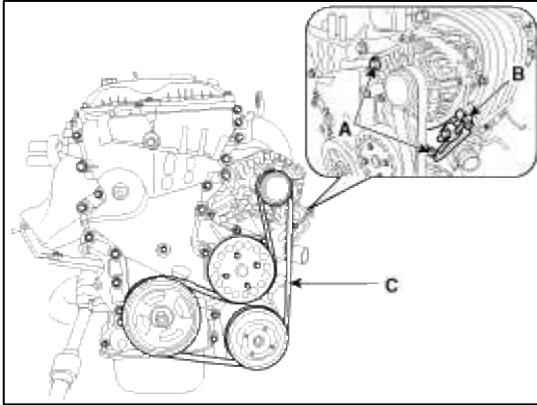
Removal and installation

1. Disconnect the battery negative terminal first, then the positive terminal.
-

Tightening torque :

3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 3.0 ~ 4.4 lb-ft)

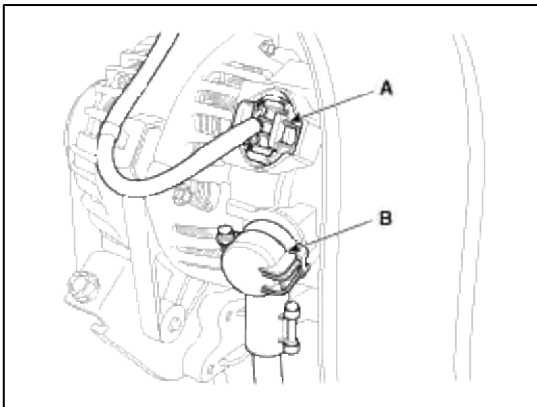
2. Remove the drive belt.
 - (1) Loosen the alternator mounting bolts (A).
 - (2) Loosen the tension by turning the tension adjusting bolt (B) counterclockwise.
 - (3) Remove the drive belt (C).



3. Disconnect the alternator connector (A) and the cable (B) from alternator "B" terminal.
-

Tightening torque:

9.8 ~ 14.7 N.m (1.0 ~ 1.5 kgf.m, 7.2 ~ 10.8 lb-ft)



4. Pull out the through bolt and then remove the alternator (A).

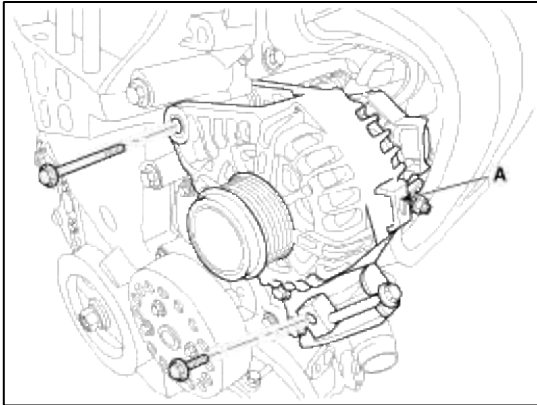
Tightening torque

M10 bolt:

29.4 ~ 41.2 N.m (3.0 ~ 4.2 kgf.m, 21.7 ~ 30.4 lb-ft)

M8 bolt:

21.6 ~ 32.4 N.m (2.2 ~ 3.3 kgf.m, 15.9 ~ 23.9 lb-ft)



5. Installation is the reverse order of removal.

Fuel System > ISG (Idle Stop & Go) System > Starter > Description and Operation

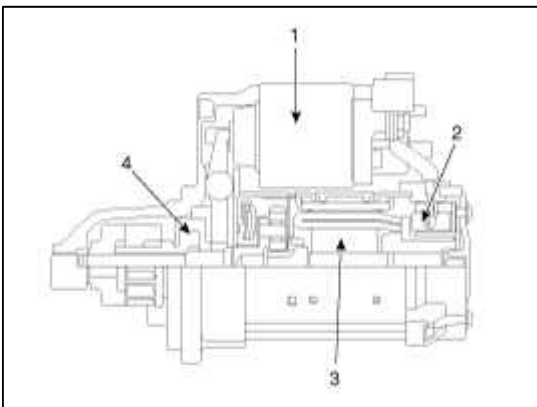
Description

The starting system includes the battery, starter, solenoid switch, inhibitor switch (A/T), ignition switch, 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.



1. Solenoid

2. Brush

3. Armature

4. Overrun clutch

In conjunction with the ISG function, the starter motor must do a great deal more work. The starter motor is therefore configured for a significantly higher number of start cycles. The components of the starter motor have been adapted to the higher requirements.

NOTE

There are two kinds of starter, ISG type starter and the other.
When replace the starter, confirm that the part number and connector shape.

CAUTION

ISG (Idle stop & go) system equipped vehicle always use the ISG type starter only. If the other starter has installed, this can potentially lead to engine electrical trouble or ISG system error.

WARNING

Do not disassemble the ISG type starter.
If the starter troubles occur, replace the starter.

Fuel System > ISG (Idle Stop & Go) System > Starter > Repair procedures

Troubleshooting Starter Circuit

NOTE

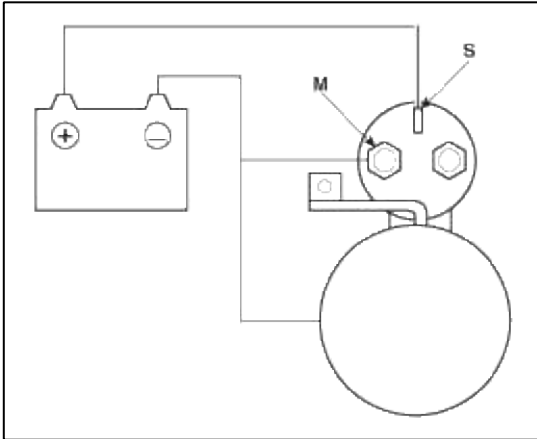
The battery must be in good condition and fully charged.

1. Disconnect the injector connectors.
2. 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.
3. 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 the engine normally, 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.
4. 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.
5. 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 ignition system in BE Group).
 - C. Check the transaxle range switch connector or ignition lock switch connector.
 - D. Inspect the starter relay.

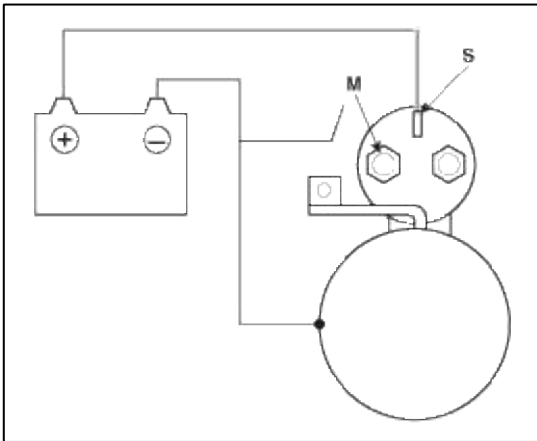
Starter Solenoid Test

1. Disconnect the field coil wire from the M-terminal of solenoid switch.

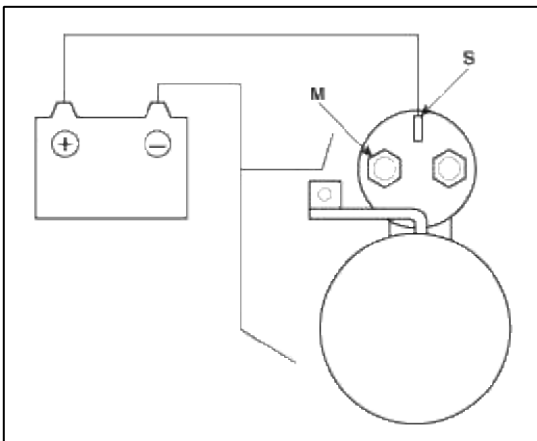
2. Connect the battery as shown. If the starter pinion pops out (engages), it is working properly. To avoid damaging the starter, do not leave the battery connected for more than 10 seconds.



3. Disconnect the battery from the M terminal.
If the pinion does not retract, the hold-in coil is working properly. To avoid damaging the starter, do not leave the battery connected for more than 10 seconds.



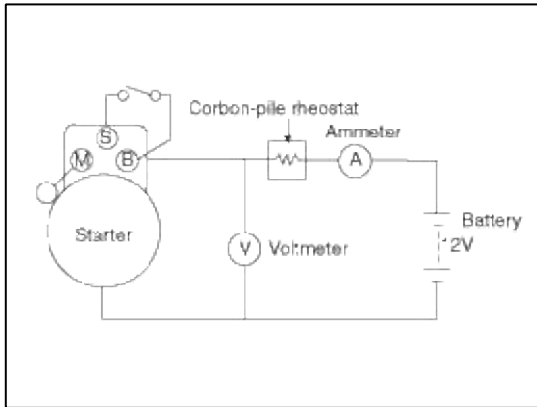
4. Disconnect the battery also from the body. If the pinion retracts immediately, it is working properly. To avoid damaging the starter, do not leave the battery connected for more than 10 seconds.



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 (150-ampere scale) and carbon pile rheostats as shown in 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 11.5 volts.
7. Confirm that the maximum amperage is within the specifications and that the starter motor turns smoothly and freely.

Max. Current: 100A

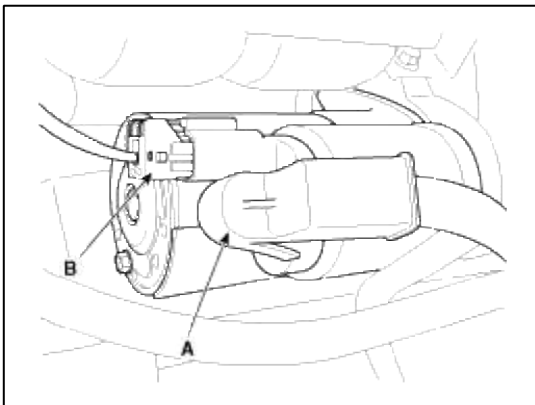
Min. Speed: 1,915 rpm

Removal and Installation

1. Disconnect the battery negative terminal.
2. Remove the air duct and air cleaner assembly. (Refer to EM group)
3. Disconnect the starter cable (A) from the B terminal on the solenoid then disconnect the connector (B) from the S terminal.

Tightening torque:

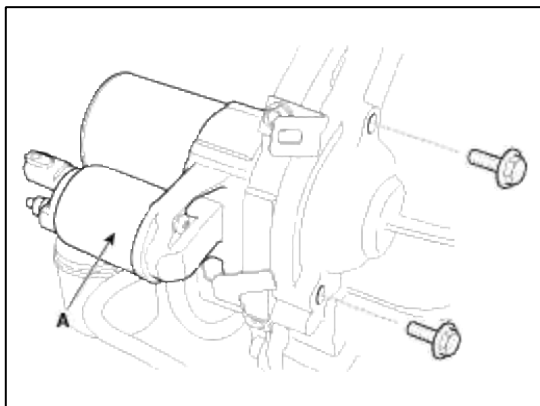
9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



4. Remove the 2 bolts holding the starter, then remove the starter (A).

Tighting torque :

42.2 ~ 53.9 Nm (4.3 ~ 5.5 kgf.m, 31.1 ~ 39.8 lb-ft)



5. Installation is the reverse of removal.

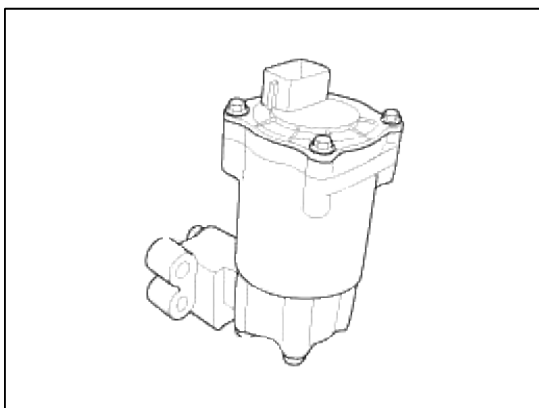
Fuel System > ISG (Idle Stop & Go) System > Electric Oil Pump > Description and Operation

Description

This transaxle has a standard Mechanical Oil Pump (MOP) linked to the input shaft to generate oil pressure when the input shaft rotates.

But, this transaxle equipped with ISG system also has an Electric Oil Pump (EOP). Because the ISG system features Auto-Stop which starts and stops the engine as needed. The Auto-Stop feature prevents the Mechanical Oil Pump (MOP) from operating and building enough pressure for the transaxle to operate. When the vehicle comes to a stop with the engine off, the Mechanical Oil Pump (MOP) cannot generate sufficient oil pressure during the initial startup or during low speed driving.

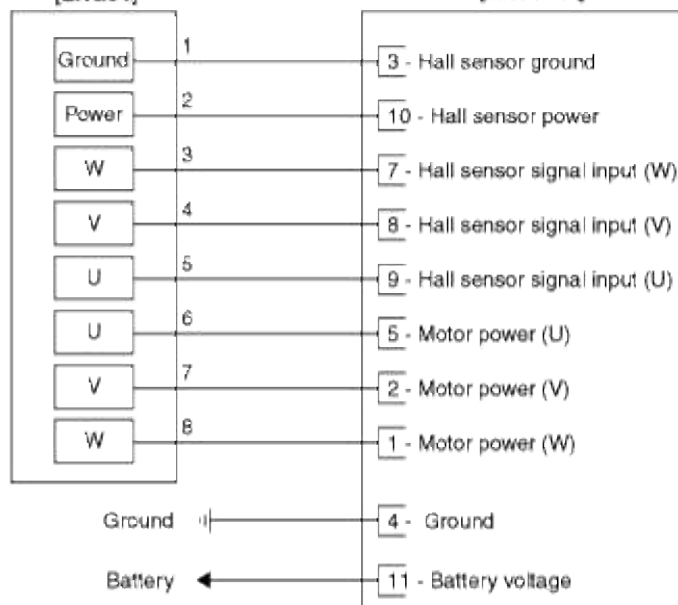
For these reasons, the Electric Oil Pump (EOP) takes on this role as an additional device that can generate the required oil pressure when the vehicle comes to a stop or during low speed driving. The Electric Oil Pump (EOP) supplies oil pressure to the Under Drive Brake (UD/B).



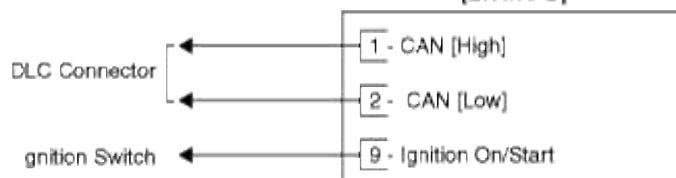
Fuel System > ISG (Idle Stop & Go) System > Electric Oil Pump > Schematic Diagrams

Circuit Diagram

[Circuit Diagram]

Electronic Oil Pump
[ENG84]

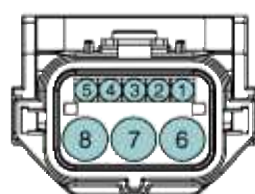
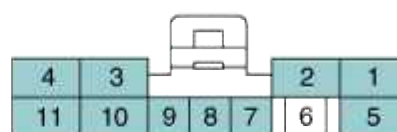
[ENG85-B]



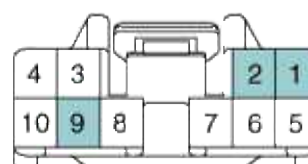
[Connection Information]

Termianl	Connected to	Function
1	OPI ENG85-A (3)	Hall sensor ground
2	OPI ENG85-A (10)	Hall sensor power
3	OPI ENG85-A (7)	Hall sensor signal input (W)
4	OPI ENG85-A (8)	Hall sensor signal input (V)
5	OPI ENG85-A (9)	Hall sensor signal input (U)
6	OPI ENG85-A (5)	Motor power (U)
7	OPI ENG85-A (2)	Motor power (V)
8	OPI ENG85-A (1)	Motor power (W)

[Harness Connector]

ENG84
Electronic Oil Pump

ENG85-A

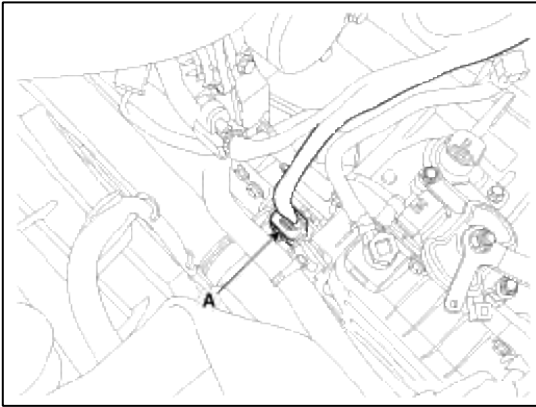
ENG85-B
OPU

Fuel System > ISG (Idle Stop & Go) System > Electric Oil Pump > Repair procedures

Removal

1. Disconnect the negative (-) battery terminal.

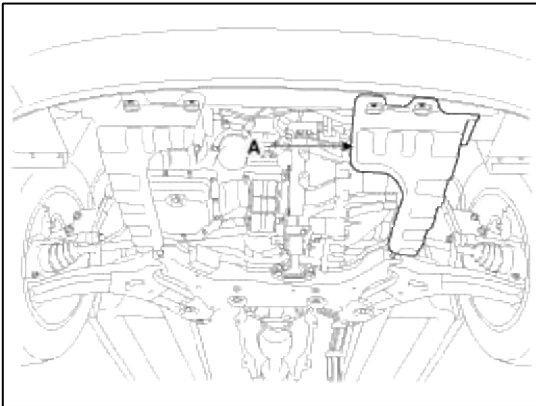
2. Disconnect the Electric Oil Pump (EOP) connector (A).



3. Remove the under cover (A) after lifting the vehicle with lift.

Tightening torque:

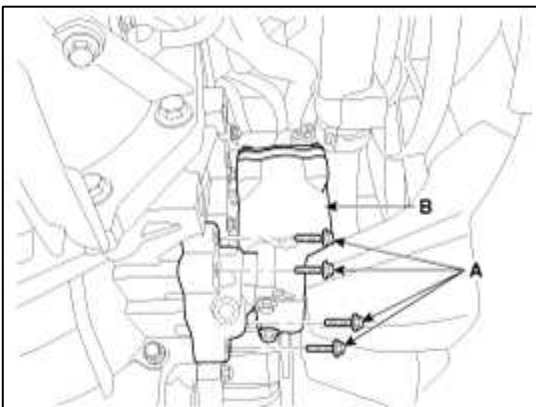
6.9 ~ 10.8 N.m (0.7 ~ 1.1 kgf.m, 5.1 ~ 8.0 lb-ft)



4. Remove the Electric Oil Pump (B) after removing the bolts (A-4ea).

Tightening torque:

19.6 ~ 25.5 N.m (2.0 ~ 2.6 kgf.m, 14.4 ~ 18.8 lb-ft)



Installation

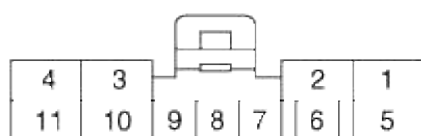
1. Installation is the reverse of removal.

NOTE

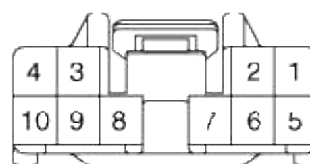
- Must be replaced with new O ring when assembling.
- Adding automatic transaxle fluid.
(Refer to "Hydraulic system(Fluid)" in this group.)

Fuel System > ISG (Idle Stop & Go) System > Oil Pump Unit (OPU) > Schematic Diagrams

Oil Pump Unit (OPU) Connector



[ENG85-A]



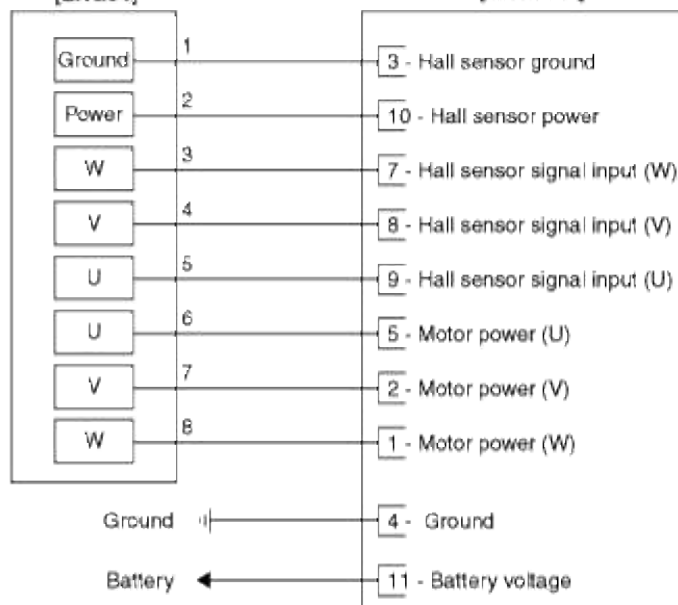
[ENG85-B]

Opu Connector Terminal Function

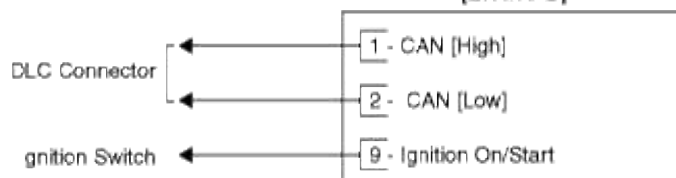
ENG85-A		ENG85-B	
Pin No.	Description	Pin No.	Description
1	Motor power(W)	1	CAN communication (High)
2	Motor power(V)	2	CAN communication (Low)
3	Hall sensor(Ground)	3	-
4	Ground	4	-
5	Motor power(U)	5	-
6	Shield ground	6	-
7	Hall sensor signal input (W)	7	-
8	Hall sensor signal input (V)	8	-
9	Hall sensor signal input (U)	9	Ignition ON / Start
10	Hall sensor power	10	-
11	Battery voltage		

Circuit diagram

[Circuit Diagram]

Electronic Oil Pump
[ENG84]

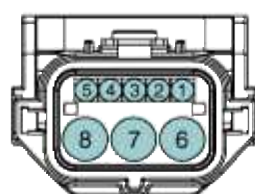
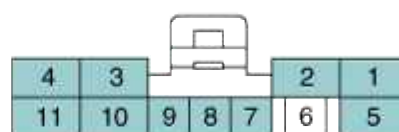
[ENG85-B]



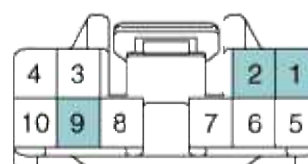
[Connection Information]

Termianl	Connected to	Function
1	OPI ENG85-A (3)	Hal sensor ground
2	OPI ENG85-A (10)	Hall sensor power
3	OPI ENG85-A (7)	Hall sensor signal input (W)
4	OPI ENG85-A (8)	Hall sensor signal input (V)
5	OPI ENG85-A (9)	Hall sensor signal input (U)
6	OPI ENG85-A (5)	Motor power (U)
7	OPI ENG85-A (2)	Motor power (V)
8	OPI ENG85-A (1)	Motor power (W)

[Harness Connector]

ENG84
Electronic Oil Pump

ENG85-A

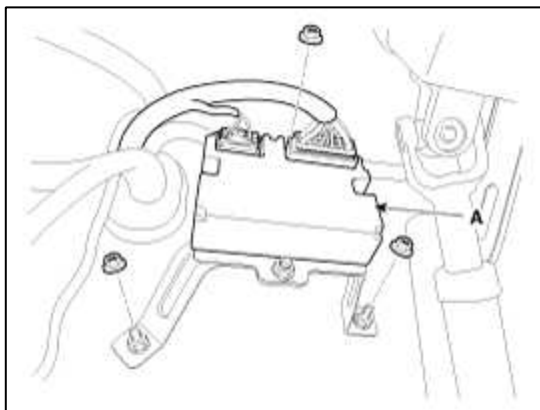
ENG85-B
OPU

Fuel System > ISG (Idle Stop & Go) System > Oil Pump Unit (OPU) > Repair procedures

Removal

1. Remove the negative (-) battery terminal.
2. Remove the crash pad lower panel. (Refer to “Crash pad” in BD group.)
3. Remove the oil pump unit connector to the left side of the brake pedal.

4. Remove the oil pump unit (A) after removing the nuts (3ea).



Installation

1. Installation is the reverse of removal.

Inspection

OPU Problem Inspection Procedure

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

Specification: Below 1Ω

2. TEST OPU CONNECTOR: Disconnect the OPU connector and visually check the ground terminals on OPU 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 OPU could be faulty. If so, make sure there were no DTC's before swapping the OPU with a new one, and then check the vehicle again. If DTC's were found, examine this first before swapping OPU.
4. RE-TEST THE ORIGINAL OPU: Install the original OPU (may be broken) into a known-good vehicle and check the vehicle. If the problem occurs again, replace the original OPU with a new one. If problem does not occur, this is intermittent problem (Refer to "Intermittent Problem Inspection Procedure" in Basic Inspection Procedure

NOTE

Refer to DTC manual code "P1775, P1777" to inspect oil pump unit.

Fuel System > ISG (Idle Stop & Go) System > Brake Switch > Description and Operation

Description

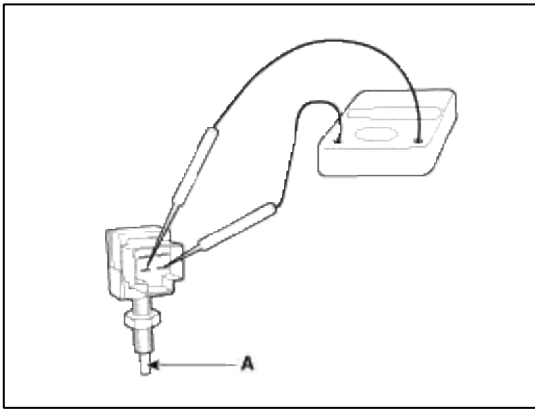
The present brake switch is used as an input variable for the ISG function to detect bracke operation.

Fuel System > ISG (Idle Stop & Go) System > Brake Switch > Repair procedures

Inspection

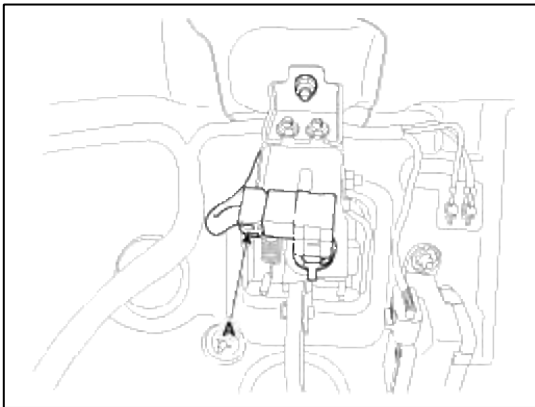
1. Connect a circuit tester to the connector of stop lamp switch, and check whether or not there is continuity when the plunger of the stop lamp switch is pushed in and when it is released.

2. The stop lamp switch is in good condition if there is no continuity when plunger (A) is pushed.



Removal

1. Turn ignition switch OFF.
2. Remove the crash pad lower panel. (Refer to the Body group-"crash pad")
3. Disconnect the stop lamp switch connector (A).



Installation

1. Install is reverse of removal.

Fuel System > ISG (Idle Stop & Go) System > Door Switch > Description and Operation

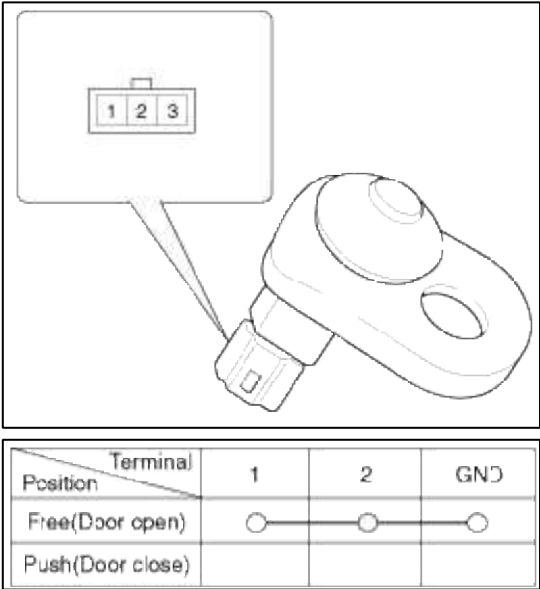
Description

Via the seat belt/Door switch, the ISG function can detect that the driver has fastened the seat belt/door. If the driver has not fastened the seat belt/door, the ISG function reacts as follows. If the seat belt or door is opened, the engine must not be started or stopped by the ISG function for safety reasons.

Fuel System > ISG (Idle Stop & Go) System > Door Switch > Repair procedures

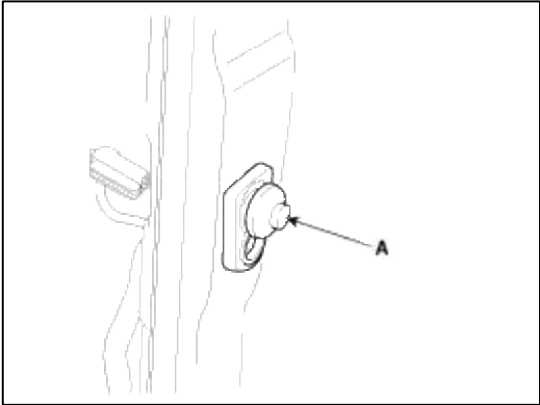
Inspection

1. Remove the door switch and check for continuity between the terminals.



Removal

1. Remove the door switch (A) after loosening the bolt.



Installation

1. Install is reverse of removal.

Fuel System > ISG (Idle Stop & Go) System > Seat Belt Switch > Description and Operation

Description

Via the seat belt/Door switch, the ISG function can detect that the driver has fastened the seat belt/door. If the driver has not fastened the seat belt/door, the ISG function reacts as follows. If the seat belt or door is opened, the engine must not be started or stopped by the ISG function for safety reasons.

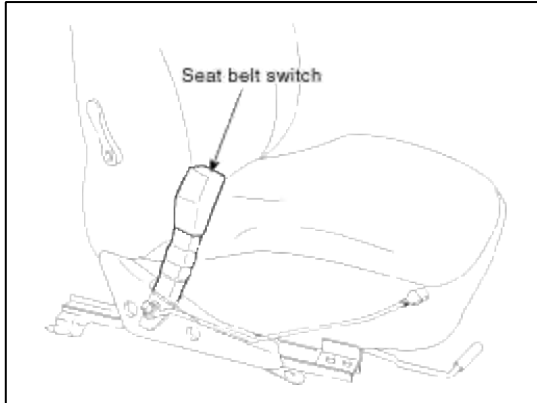
Fuel System > ISG (Idle Stop & Go) System > Seat Belt Switch > Repair procedures

Inspection

1. Remove the connector from the switch.

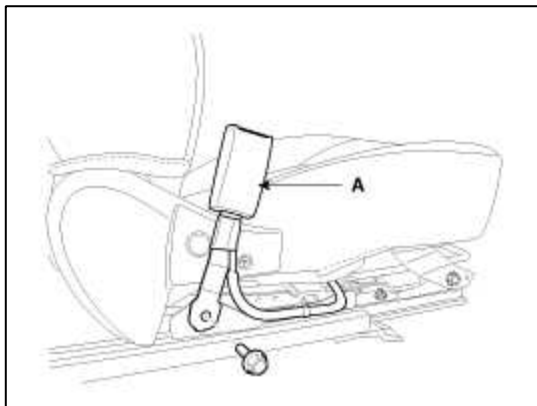
2. Check for continuity between terminals.

Seat belt condition	Continuity
Fastened	Non-conductive ($\infty\Omega$)
Not fastened	Conductive (Ω)



Removal

1. Remove the front seat.
2. After loosening the mounting bolt, then remove the front seat belt buckle (A).



Installation

1. Install is reverse of removal.

Fuel System > ISG (Idle Stop & Go) System > Hood switch > Description and Operation

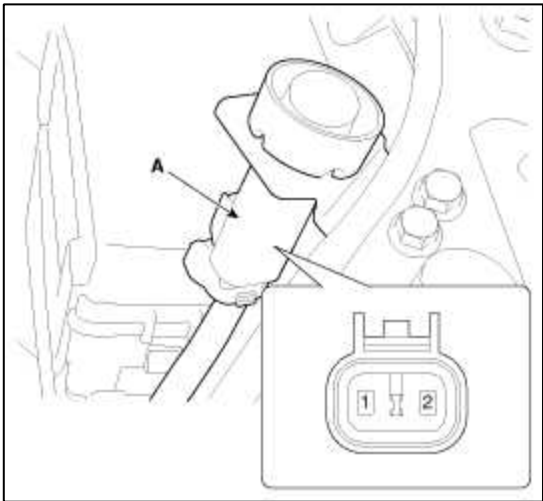
Description

The hood switch is included as the influencing factors in the calculation of the ISG function. If the hood is open, the engine must not be started or stopped by the ISG function for safety reasons.

Fuel System > ISG (Idle Stop & Go) System > Hood switch > Repair procedures

Inspection

1. Disconnect the hood switch connector (A).

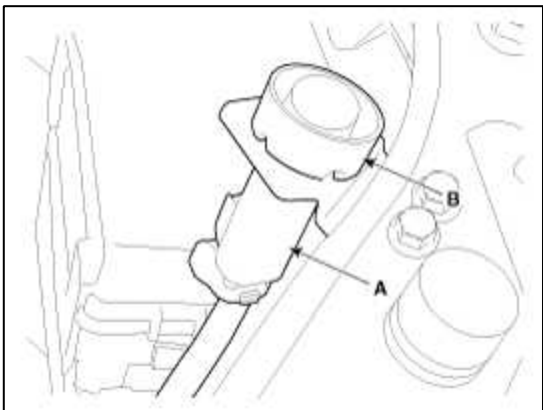


2. Check for continuity between terminals

Terminal Position	1	2
Hood open (Free)	○	○
Hood close (Push)		

Removal

1. After loosening the mounting bolts and connector (A), then remove the hood switch (B).

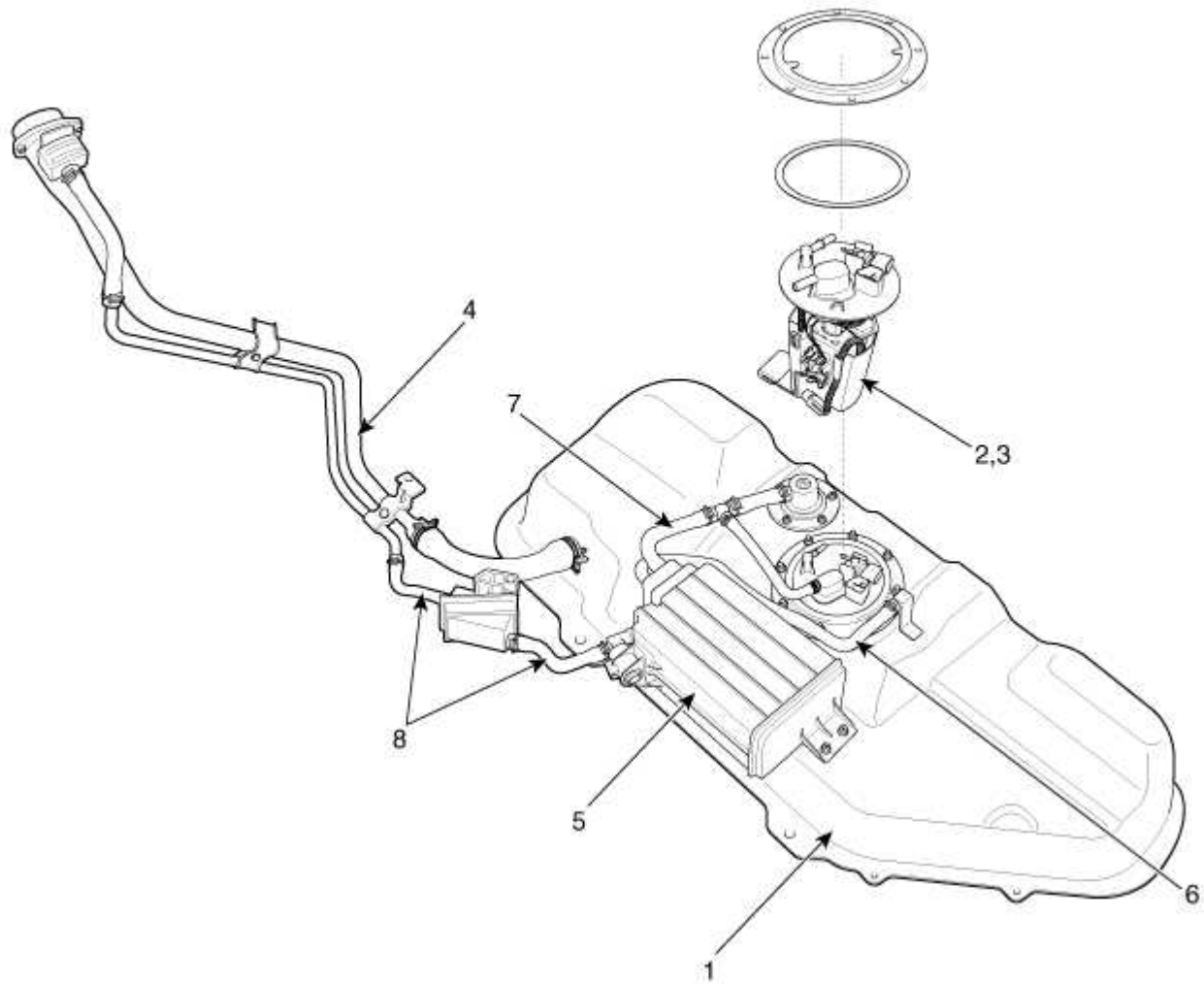


Installation

1. Install is reverse of removal.

Fuel System > Fuel Delivery System > Components and Components Location

Component Location



1. Fuel Tank	5. Canister
2. Fuel Pump (Including Fuel Filter)	6. Vapor Hose (Canister → Intake Manifold)
3. Fuel Pressure Regulator	7. Vapor Hose (Canister ↔ Fuel Tank)
4. Fuel Filler Pipe	8. Ventilation Hose (Canister ↔ Atmosphere)

Fuel System > Fuel Delivery System > Repair procedures

Fuel Pressure Test

1. Release the residual pressure in fuel line (Refer to “Release Residual Pressure in Fuel Line” in this group).

CAUTION

When removing the fuel pump relay, the Diagnostic Trouble Code (DTC) will be occurred. Therefore delete the code with the GDS after “Release Residual Pressure in Fuel Line” work.

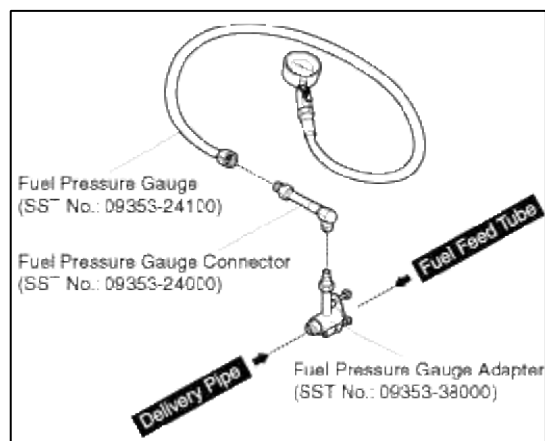
2. Install the Special Service Tool (SST).

- (1) Disconnect the fuel feed tube from the delivery pipe.

CAUTION

There may be some residual pressure even after “Release Residual Pressure in Fuel Line” work, so cover the hose connection with a shop towel to prevent residual fuel from spilling out before disconnecting any fuel connection.

- (2) Install the special service tool for measuring the fuel pressure in between the fuel feed tube and the fuel delivery pipe (Refer to the figure below).



3. Inspect fuel leakage on connections among the fuel feed tube, the delivery pipe, and the SST components with IG ON.

4. Measure Fuel Pressure

- (1) Start the engine and measure the fuel pressure at idle.

Fuel Pressure: 338 ~ 348 kPa (3.45 ~ 3.55 kgf/cm², 49.0 ~ 50.5 psi)

NOTE

If the fuel pressure differs from the standard value, repair or replace the related part (Refer to the table below).

Fuel Pressure	Cause	Related Part
Too Low	Fuel filter clogged	Fuel Filter
	Fuel leakage	Fuel Pressure Regulator
Too High	Fuel pressure regulator valve stuck	Fuel Pressure Regulator

- (2) Stop the engine, and then check for the change in the fuel pressure gauge reading.

Standard Value: The gauge reading should hold for about 5 minutes after the engine stops

NOTE

If the gauge reading should not be held, repair or replace the related part (Refer to the table below).

Fuel Pressure (After Engine Stops)	Cause	Related Part
Fuel Pressure Drops Slowly	Leakage on injector	Injector
Fuel Pressure Drops Immediately	Check valve of fuel pump open stuck	Fuel Pump

- (3) Turn the ignition switch OFF.

5. Release the residual pressure in fuel line (Refer to “Release Residual Pressure in Fuel Line”).

CAUTION

When removing the fuel pump relay, the Diagnostic Trouble Code (DTC) will be occurred. Therefore delete the code with the GDS after “Release Residual Pressure in Fuel Line” work.

6. Test End

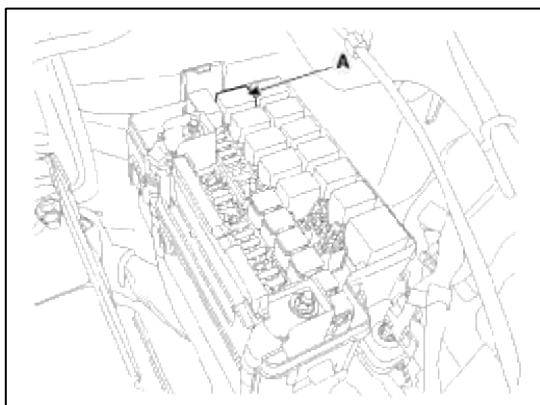
- (1) Remove the Special Service Tool (SST) from the fuel feed tube and the delivery pipe.
- (2) Connect the fuel feed tube and the delivery pipe.

Release Residual Pressure in Fuel Line

CAUTION

There may be some residual pressure even after “Release Residual Pressure in Fuel Line” work, so cover the hose connection with a shop towel to prevent residual fuel from spilling out before disconnecting any fuel connection.

1. Turn the ignition switch OFF and disconnect the battery (-) cable.
2. Remove the fuel pump relay (A).



CAUTION

When removing the fuel pump relay, the Diagnostic Trouble Code (DTC) will be occurred. Therefore delete the code with the GDS after “Release Residual Pressure in Fuel Line” work.

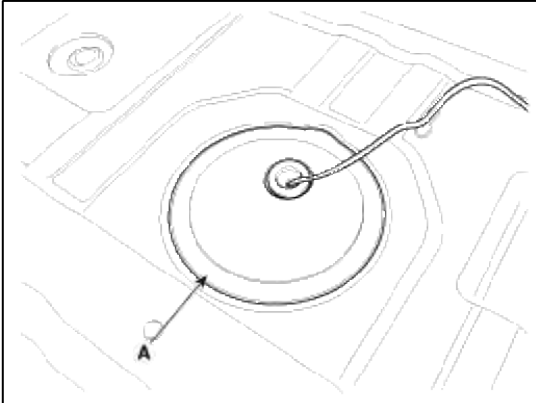
3. Connect the battery (-) cable.
4. Start the engine and let idle, and then turn the ignition switch OFF after the engine has stopped on its own.

5. Disconnect the battery (-) cable, and then install the fuel pump relay (A).
6. Connect the battery (-) cable.
7. Delete the Diagnostic Trouble Code (DTC) related the fuel pump relay with the GDS.

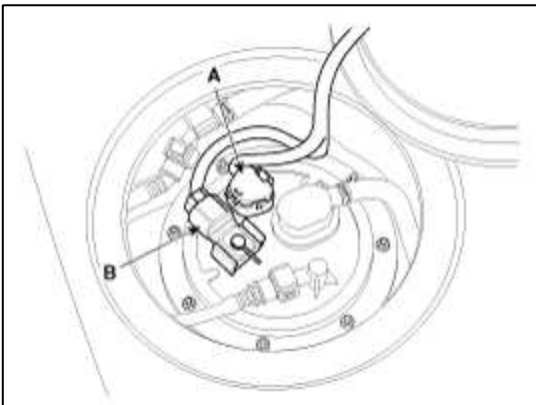
Fuel System > Fuel Delivery System > Fuel Tank > Repair procedures

Removal

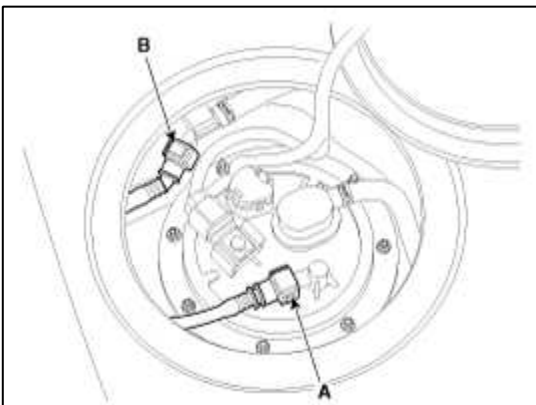
1. Release the residual pressure in fuel line (Refer to "Release Residual Pressure in Fuel Line" in this group).
2. Remove the rear seat cushion (Refer to "Seat" in BD group).
3. Open the service cover (A).



4. Disconnect the fuel pump connector (A) and the fuel tank pressure sensor connector (B).

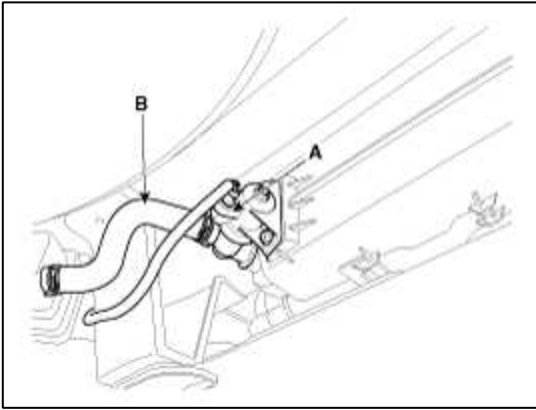


5. Disconnect the fuel feed quick-connector (A) and the vapor tube quick-connector (B).



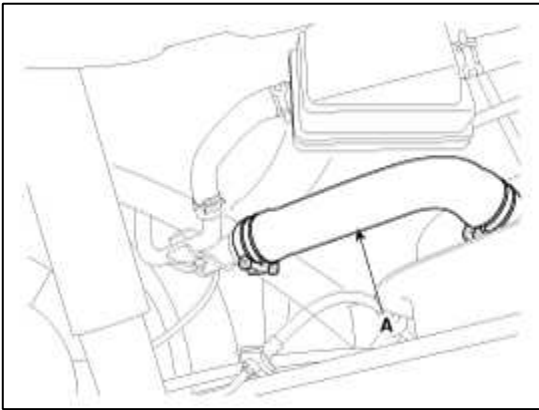
6. Lift the vehicle and support the fuel tank with a jack.
7. Disconnect the canister close valve connector (A).

8. Disconnect the ventilation hose (B).

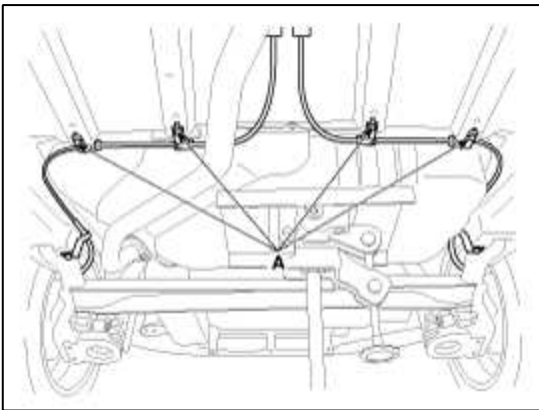


9. Remove the center muffler (Refer to "Intake And Exhaust System" in EM group).

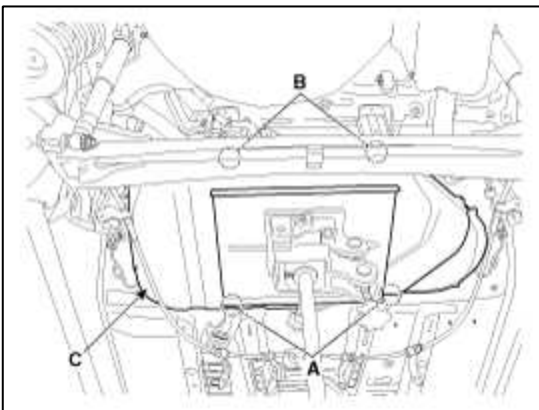
10. Disconnect the fuel filler hose (A).



11. Remove the brake line bracket mounting bolt (A).



12. Remove the fuel tank mounting bolts (A) and nuts (B), and then remove the fuel tank (C).



1. Installation is reverse of removal.

Fuel tank installation bolt:

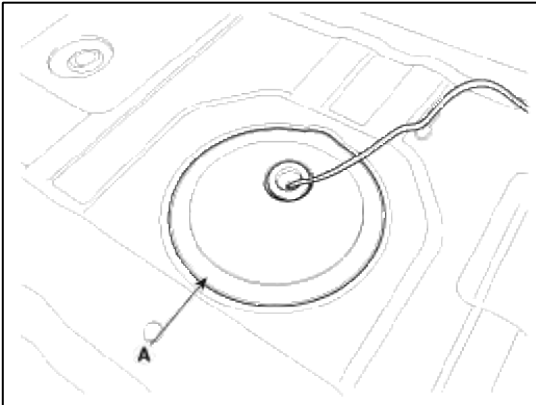
39.2 ~ 53.9 N.m (4.0 ~ 5.5 kgf.m, 28.9 ~ 39.8 lb-ft)

Fuel tank installation nut:

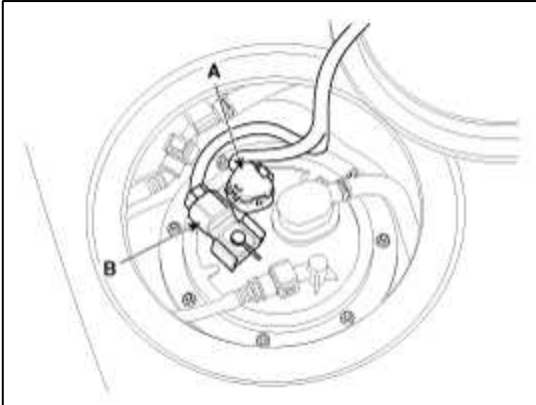
39.2 ~ 53.9 N.m (4.0 ~ 5.5 kgf.m, 28.9 ~ 39.8 lb-ft)

Fuel System > Fuel Delivery System > Fuel Pump > Repair procedures**Removal**

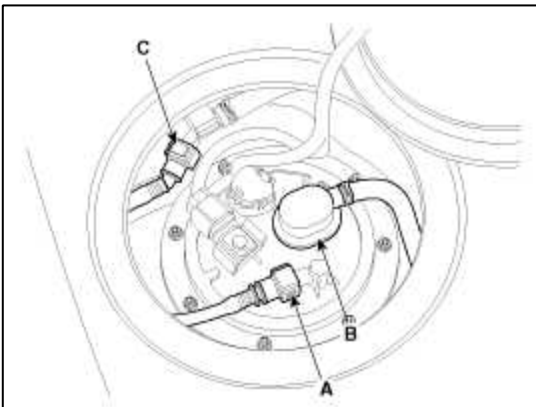
1. Release the residual pressure in fuel line (Refer to "Release Residual Pressure in Fuel Line" in this group).
2. Remove the rear seat cushion (Refer to "Seat" in BD group).
3. Open the service cover (A).



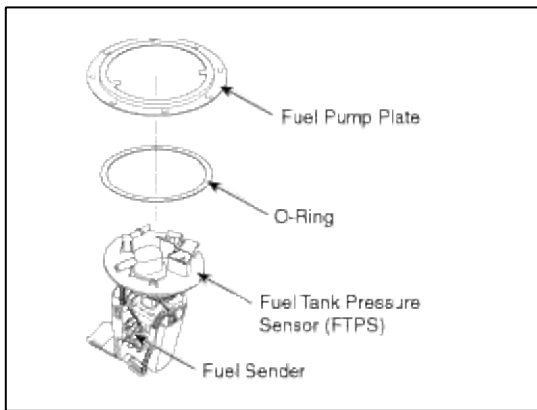
4. Disconnect the fuel pump connector (A) and the fuel tank pressure sensor connector (B).



5. Disconnect the fuel feed tube quick-connector (A), the vapor hose (B) and the vapor tube quick-connector (C).



6. Remove the fuel pump installation nuts and remove the fuel pump assembly.



Installation

1. Installation is reverse of removal.

Fuel pump installation nut: 2.0 ~ 2.9 N.m (0.2 ~ 0.3 kgf.m, 1.4 ~ 2.2 lb-ft)

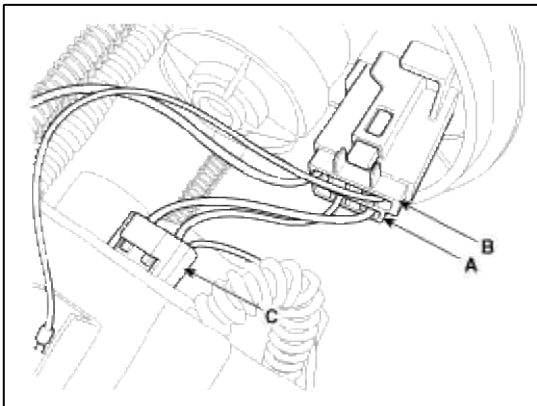
CAUTION

When installing the fuel pump module, be careful not to get the seal-ring entangled.

Fuel System > Fuel Delivery System > Fuel Filter > Repair procedures

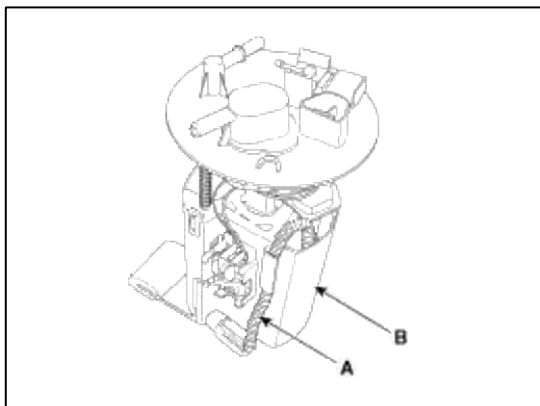
Replacement

1. Remove the fuel pump (Refer to “Fuel Pump” in this group).
2. Disconnect the electric pump wiring connector (A) and the fuel sender wiring connector (B).
3. Disconnect the electric pump wiring connector (C) from the pump.

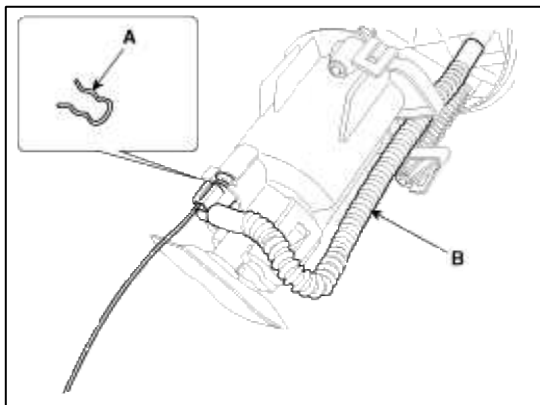


4. Disconnect the fuel tube (A).

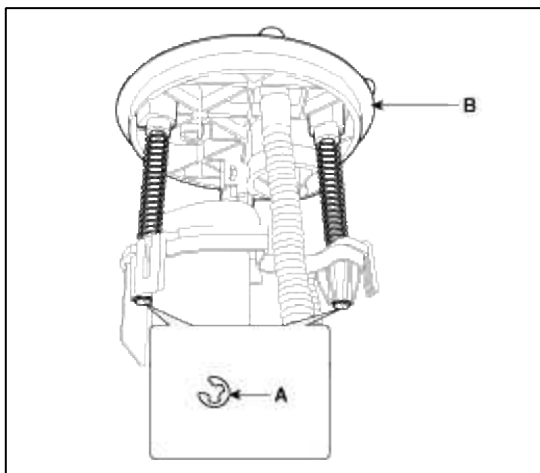
5. Remove the reservoir-cup (B) after releasing the fixing hooks.



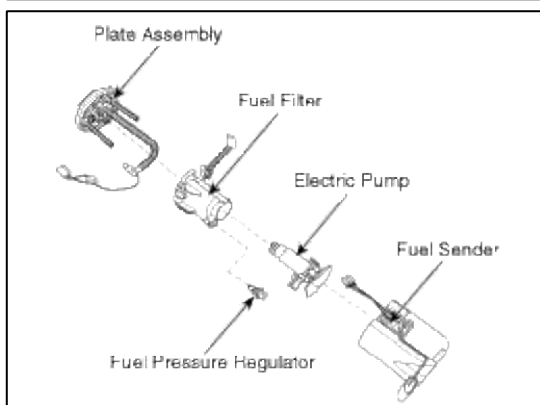
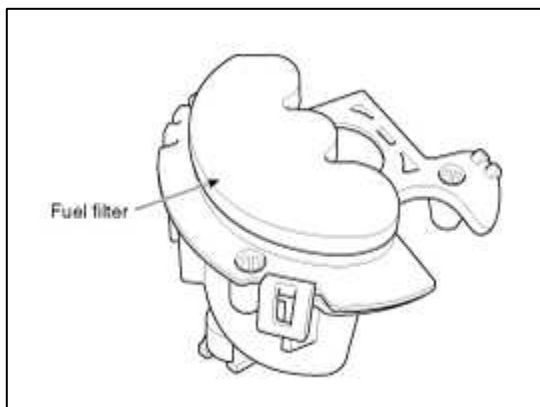
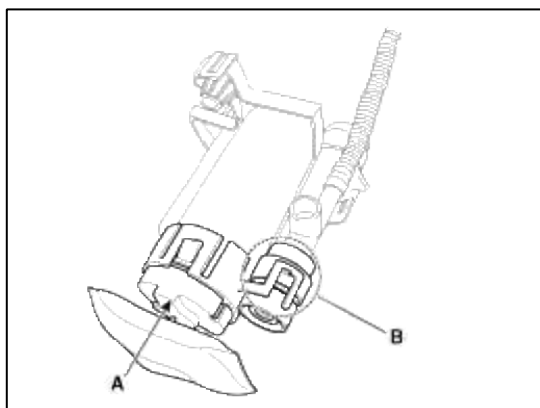
6. Disconnect the fuel tube (B) after removing the fixing clip (A).



7. Remove the plate assembly (B) after removing the cushion pipe fixing clip (A).



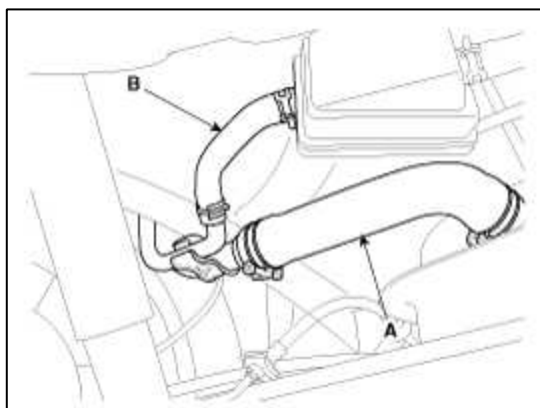
8. Remove the pump & pre-filter assembly (A) and the fuel pressure regulator (B) from the fuel filter.



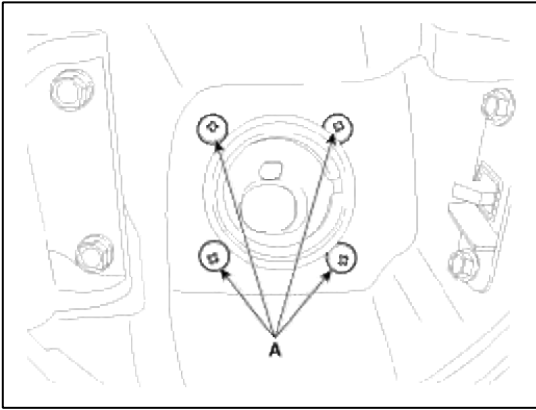
Fuel System > Fuel Delivery System > Filler-Neck Assembly > Repair procedures

Removal

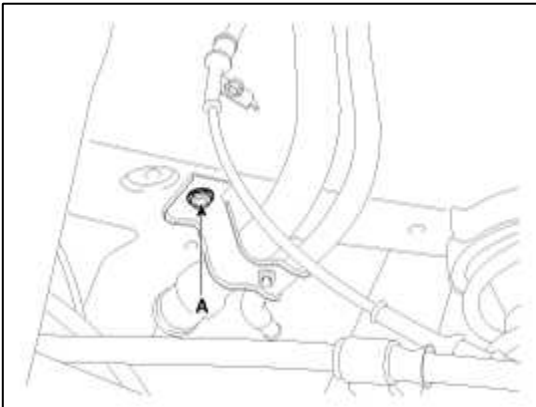
1. Disconnect the fuel filler hose (A) and the ventilation hose (B) from the fuel tank air filter.



2. Open the fuel filler door and unfasten the filler-neck assembly mounting screws (A).



3. Remove the rear-LH wheel, tire, and the inner wheel house.
4. Remove the bracket mounting bolt (A) and remove the filler-neck assembly.



Installation

1. Installation is reverse of removal.

Filler-neck assembly installation bolt:

3.9 ~ 5.9 N.m (0.4 ~ 0.6 kgf.m, 2.9 ~ 4.3 lb-ft)

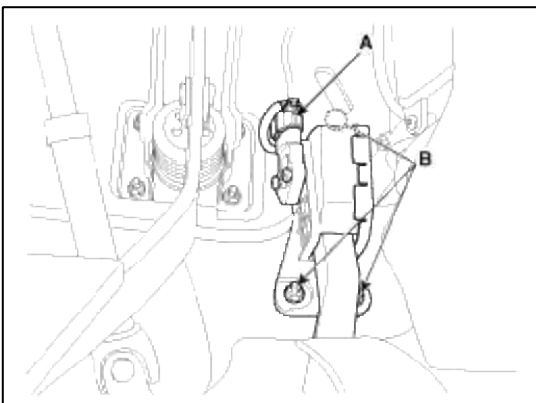
Filler-neck assembly installation screw:

5.6 ~ 6.9 N.m (0.6 ~ 0.7 kgf.m, 4.3 ~ 5.1 lb-ft)

Fuel System > Fuel Delivery System > Accelerator Pedal > Repair procedures

Removal

1. Turn the ignition switch OFF and disconnect the negative (-) battery cable.
2. Disconnect the accelerator position sensor connector (A).
3. Remove the installation nuts (B), and then remove the accelerator pedal module.



Installation

1. Installation is reverse of removal.

Accelerator pedal module installation nut:

16.7 ~ 25.5 N.m (1.7 ~ 2.6 kgf.m, 12.3 ~ 18.8 lb-ft)

Fuel System > Fuel Delivery System > Delivery Pipe > Repair procedures

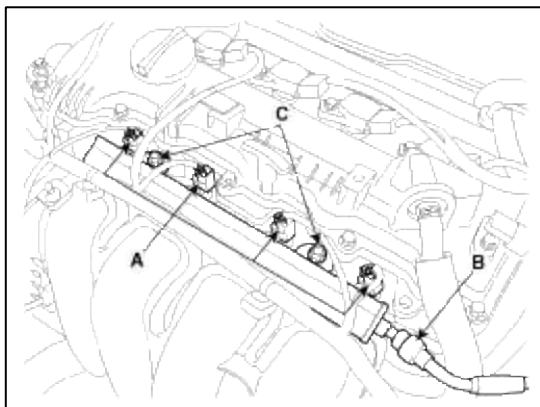
Removal

1. Turn the ignition switch OFF and disconnect the battery negative (-) cable.
2. Release the residual pressure in fuel line (Refer to “Release Residual Pressure in Fuel Line” in this group).

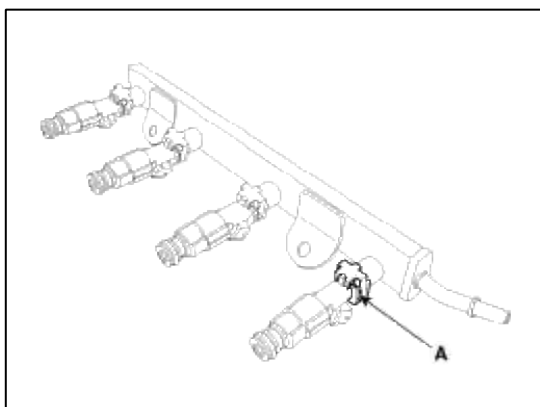
CAUTION

When removing the fuel pump relay, a Diagnostic Trouble Code (DTC) may occur. Delete the code with the GDS after completion of “Release Residual Pressure in Fuel Line” work.

3. Disconnect the injector connector (A).
4. Disconnect the fuel feed tube quick-connector (B).
5. Remove the installation bolt (C), and then remove the delivery pipe & injector assembly from the engine.



6. Remove the fixing clip (A), and then separate the injector from the delivery pipe.



Installation

CAUTION

- Install the component with the specified torques.
- Note that internal damage may occur when the component is dropped. In this case, use it after inspecting.

CAUTION

- Apply the engine oil to the injector O-ring.

CAUTION

- Inspect the injector O-ring when installing.

1. Installation is reverse of removal.

Delivery pipe installation bolt:

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