

SPECIFICATIONS

Description	Specification 2.0(D4EA)	Limit
General		
Type	In-line, Single Overhead Camshaft	
Number of cylinders	4	
Bore	83mm (3.27in.)	
Stroke	92mm (3.62in.)	
Total displacement	1991cc (121.5cu.in.)	
Compression ratio	17.3 : 1	
Firing order	1 - 3 - 4 - 2	
Valve timing		
Intake valve		
Opens (BTDC)	7°	
Closes (ABDC)	35°	
Exhaust valve		
Opens (BBDC)	52°	
Closes (ATDC)	6°	
Cylinder head		
Flatness of gasket surface	0.03mm (0.0012in.) for width	
	0.09mm (0.0035in.) for length	
	0.012mm. (0.00047in.) / 51×51mm	
Camshaft		
Cam height		
Intake	34.697mm (1.366in.)	34.197mm (1.346in.)
Exhaust	34.570mm (1.361in.)	34.070mm (1.341in.)
Journal O.D	28mm (1.10in.)	
Bearing oil clearance	0.040 ~ 0.074mm (0.0020 ~ 0.0029in.)	
End play	0.05 ~ 0.15mm (0.002 ~ 0.006in.)	
Valve		
Valve length		
Intake	95.7mm (3.77in.)	
Exhaust	95.4mm (3.76in.)	
Stem O.D.		
Intake	5.953mm (0.234in.)	
Exhaust	5.925mm (0.233in.)	
Face angle	45.5°	
Thickness of valve head (margin)		

Intake	1.6mm (0.063in.)	English ▼
Exhaust	1.3mm (0.0512in.)	
Valve stem to valve guide clearance		
Intake	0.022 ~ 0.067mm (0.00086 ~ 0.00263in.)	0.1mm (0.0039in.)
Exhaust	0.050 ~ 0.095mm (0.0020 ~ 0.0037in.)	0.15mm (0.0059in.)
Valve guide		
Length		
Intake	36.5mm (1.437in.)	
Exhaust	36.5mm (1.437in.)	
Valve seat		
Width of seat contact	1.21 ~ 1.61mm (0.0477 ~ 0.6634in.) (IN/EX)	
Seat angle	44° ~ 44.5°	
Valve spring		
Free length	38.8mm (1.527in.)	
Load	21.25kg/32mm (47.2lb/1.26in.) at installed height	
Cylinder block		
Cylinder bore	83 + 0.03mm (3.27 + 0.0012in.)	
Flatness of head gasket surface	0.042mm (0.00165in.) for width 0.096mm (0.00378in.) for length 0.012mm (0.00047in.) / 50×50mm	
Piston		
O.D	82.92 ~ 82.95mm (3.26 ~ 3.27in.)	
Piston-to-cylinder clearance	0.07 ~ 0.09mm (0.0027 ~ 0.0036in.)	
Ring groove width		
No.1	1.915 ~ 1.945mm (0.075 ~ 0.076in.)	
No.2	2.06 ~ 2.08mm (0.08 ~ 0.082in.)	
Oil	3.02 ~ 3.04mm (0.119 ~ 0.1196in.)	
Service size	0.25mm (0.010in.), 0.5mm (0.020in.) oversize	
Piston ring		
Side clearance		
No.1	0.064 ~ 0.114mm (0.00252 ~ 0.00449in.)	
No.2	0.065 ~ 0.11mm (0.00256 ~ 0.00433in.)	
Oil ring	0.03 ~ 0.07mm (0.00118 ~ 0.00275in.)	
End gap		
No.1	0.2 ~ 0.35mm (0.008 ~ 0.014in.)	
No.2	0.40 ~ 0.50mm (0.016 ~ 0.024in.)	
Oil ring side rail	0.2 ~ 0.45mm (0.0079 ~ 0.0177in.)	
Connecting rod		
Connecting rod pin O.D	28.022 ~ 28.034mm (1.103 ~ 1.104in.)	

Connecting rod bearing oil clearance		0.024 ~ 0.042mm (0.0009 ~ 0.0016in.)	
Crankshaft main bearing oil clearance		0.024 ~ 0.042mm (0.0009 ~ 0.0016in.)	
Crankshaft			
Journal O.D.		60.002 ~ 60.020mm (2.362 ~ 2.363in.)	
Pin O.D.		50.008 ~ 50.026mm (1.9688 ~ 1.9695in.)	
Out-of-round of journal and pin		Less than 0.0035mm (0.0001in.)	
Taper of journal and pin		Less than 0.006mm (0.0002in.)	
End play		0.09 ~ 0.32mm (0.0035 ~ 0.0126in.)	
Flywheel			
Runout		0.45mm/Ø200	0.45mm (0.0170in.)
Engine oil			
Oil quantity	Total	7.4 L (7.81 US qt, 6.51 Imp qt)	When replacing a short engine or a block assembly
	Oil pan	6.2 L (6.55 US qt, 5.45 Imp qt)	
	Drain and refill	6.7 L (7.07 US qt, 5.89 Imp qt)	Including oil filter
Oil grade	Classification	ACEA C3 (with CPF) ACEA B4 (without CPF)	
	SAE viscosity grade	Recommended SAE viscosity number	Refer to the "Lubrication System"
Oil pressure (at idle)		78.45kPa (0.8kg/cm ² , 11.38psi) or above	Oil temperature in oil pan : 80°C (176°F)
Oil pump			
Oil pump performance [Oil temperature is 95 ~ 105°C (203 ~ 221°F, SAE 10W -30)]&Eng rpm 1500		More than 25ℓ/min (0.01471ft ³ /s) 4.0kgf/cm ² (8192lbf/ft ²)	
Tip clearance		0.28 ~ 0.36mm (0.01102 ~ 0.01417in.)	
Radial clearance		0.13 ~ 0.23mm (0.0051 ~ 0.009in.)	
Side clearance		0.02 ~ 0.07mm (0.00078 ~ 0.0027in.)	
Relief spring			
Freen length		47.5mm (1.835in.)	
Opening pressure		570 ± 50kPa (82.67 ± 7.25psi)	
Silent shaft			
Front journal diameter		27.99 ~ 28.01mm (1.102 ~ 1.1027in.)	
Rear journal diameter		41.99 ~ 42.01mm (1.6531 ~ 1.6539in.)	
Oil clearacne			
Front		0.050 ~ 0.09mm (0.0020 ~ 0.0036in.)	
Rear		0.050 ~ 0.091mm (0.0020 ~ 0.0036in.)	
Cooling method			
Cooling system quantity (Radiator)		Forced circulation with electrical fan 7.3L (7.7U.S.qts, 6.42 Imp.qts)	
Thermostat			
Type		Wax pellet type with jiggle valve	
Normal opening temperature		85°C (185°F)	

Opening temperature range	83.5 ~ 86.5°C (182 ~ 188°F)	
Full opening temperature	100°C (212°F)	
Radiator cap	107.9 ± 14.7kPa (1.1±0.15kg/cm ² , 15.64±2.13psi)	
Main valve opening pressure		
Main valve closing pressure	83.4kPa (0.85kg/cm ² , 12.1psi)	
Vacuum valve opening pressure	-6.86kPa (-0.07kg/cm ² , -1.00psi)	
Air cleaner		
Type	Dry type	
Element	Unwoven cloth type	
Exhaust		
Muffler	Expansion resonance type	
Suspension system	Rubber hangers	
Coolant temperature sensor		
Type	Thermister type	
Resistance		
20°C (68°F)	2.45 ± 0.14kΩ	
80°C (176°F)	0.3222kΩ	

SERVICE STANDARDS

Standard value	
Coolant concentration	
Tropical area	40%
Other area	50%

LUBRICANT

Engine oil	ACEA : C3(CPF EQUIPPED VEHICLE) ACEA : B4 or API CH-4 ABOVE(NON CPF VEHICLE)	SAE 15W-40 (ABOVE -15°C)
		SAE 10W-30 (-20°C ~ 40°C)
		SAE 5W-30 (-25°C ~ 40°C)
		SAE 0W-30 (BELOW 10°C)*1 *2

*1. Restricted to driving condition and area

*2. Not recommended for sustained high speed

SEALANT

Engine coolant temperature sensor	3M No.1324 or equivalent
Oil pressure switch	3M ATD No. 8660 or Three bond TB 2403
Bed plate	OMNI FIT FD20, DREIBOND 5105 or HYLOMAR 3000

NOTICE

O.D. = Outer Diameter

I.D. = Inner Diameter

O.S. = Oversize Diameter
U.S. = Undersize Diameter

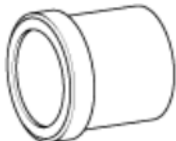
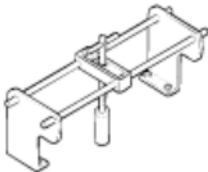
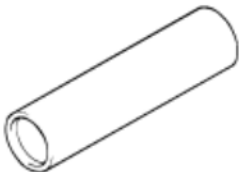
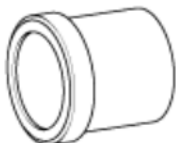
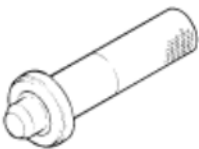
TIGHTENING TORQUE

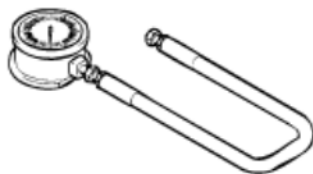
Items	N.m	kgf.m	lbf.ft
Engine system			
High fuel pipe(reil↔pump) mounting nut	24.5 ~ 28.4	2.5 ~ 2.9	18.1 ~ 21.0
Drive plate	68.6 ~ 78.5	7.0 ~ 8.0	50.6 ~ 57.9
Damper pulley mounting bolt	29.4 ~ 33.3	3.0 ~ 3.4	21.7 ~ 24.6
Real roll stopper bracket sub frame bolt	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Real roll mounting insulator bolts	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Relief plug	41.2 ~ 51.0	4.2 ~ 5.2	30.4 ~ 37.6
Balance shaft assembly mounting bolt	52.0 ~ 55.9	5.3 ~ 5.7	38.3 ~ 41.2
Engine support bracket bolt	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8
Starter motor mounting bolt	47.1 ~ 51.0	4.8 ~ 5.2	34.7 ~ 37.6
Cylinder head bolt	49.0 + 120° + 90°	5.0 + 120° + 90°	36.2 + 120° + 90°
Cylinder head cover mounting bolt(10mm)	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Cylinder head cover mounting bolt(12mm)	21.6 ~ 25.5	2.2 ~ 2.6	15.9 ~ 18.8
Air cleaner mounting bolt	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Air cleaner intake hose clamp	2.9 ~ 4.9	0.3 ~ 0.5	2.2 ~ 3.6
Engine mounting bracket bolt & nut	63.7 ~ 83.4	6.5 ~ 8.5	47.0 ~ 61.5
Injector holder bolt	7.8 ~ 10.8	0.8 ~ 1.1	5.8 ~ 8.0
A/T mounting bracket bolt	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
A/T insulator bolt	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Camshaft bearing cap bolt	26.5 ~ 29.4	2.7 ~ 3.0	19.5 ~ 21.7
Camshaft sprocket mounting bolt	122.6 ~ 140.2	12.5 ~ 14.3	90.4 ~ 103.4
Connecting rod cap bolt	24.5 + 90°	2.5 + 90°	18.1 + 90°
Crankshaft bed plate bolt(15mm)	(27.5~31.4) + 120°	(2.8~3.2) + 120°	(20.3~23.1) + 120°
Crankshaft bed plate bolt(12mm)	33.3 ~ 37.3	3.4 ~ 3.8	24.6 ~ 27.5
Crankshaft pulley bolt	196.1 ~ 205.9	20.0 ~ 21.0	144.7 ~ 151.9
Crankshaft position mounting bolt	3.9 ~ 5.9	0.4 ~ 0.6	2.9 ~ 4.3
Front roll stopper bracket sub frame mounting bolt	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Front roll stopper insulator bolt	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Fly wheel	68.6 ~ 78.5	7.0 ~ 8.0	50.6 ~ 57.5
Timing system			
Timing auto tensioner bolt	49.0 ~ 53.9	5.0 ~ 5.5	36.2 ~ 39.8
Upper cover mounting bolt	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Rear cover mounting bolt	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7
Idler mounting bolt	44.1 ~ 48.1	4.5 ~ 4.9	32.5 ~ 35.4
Auto tensiner adjustable bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Lower cover mounting bolt	7.8 ~ 11.8	0.8 ~ 1.2	5.8 ~ 8.7

Lubrication system			
Oil lever gage mounting bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil screen mounting bolt	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil jet mounting bolt	8.8 ~ 12.7	0.9 ~ 1.3	6.5 ~ 9.4
Oil pan drain plug	34.3 ~ 44.1	3.5 ~ 4.5	25.3 ~ 32.5
Oil pan bolt	9.8 ~ 7.8	1.0 ~ 1.2	7.2 ~ 8.7
Oil pump mounting bolt	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Oil pump cover bolt	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Oil pressure switch	14.7 ~ 21.6	1.5 ~ 2.2	10.8 ~ 15.9
Oil filter	22.6 ~ 24.5	2.3 ~ 2.5	16.6 ~ 18.1
Heater & oil cooler return pipe bracket mounting bolt(10mm)	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Heater & oil cooler return pipe bracket mounting bolt(12mm)	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
Cooling system			
Water pump mounting bolt(10mm)	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Water pump mounting bolt(14mm)	47.1 ~ 51.0	4.8 ~ 5.2	34.7 ~ 37.6
Radiator drain plug	7.8 ~ 15.7	0.8 ~ 1.6	5.8 ~ 11.6
Radiator shroud mounting bolt	8.8 ~ 10.8	0.9 ~ 1.1	6.5 ~ 8.0
Radiator upper bracket mounting bolt	8.8 ~ 10.8	0.9 ~ 1.1	6.5 ~ 8.0
Engine water coolant temperature sensor	19.6 ~ 23.5	2.0 ~ 2.4	14.5 ~ 17.4
Thermostat inlet mounting bolt, nut	19.6 ~ 24.5	2.0 ~ 2.5	14.5 ~ 18.1
Intake & exhaust system			
Main muffler and center exhaust pipe nuts	39.2 ~ 58.8	4.0 ~ 6.0	28.9 ~ 43.4
Cylinder head and exhaust manifold nuts	24.5 ~ 37.3	2.5 ~ 3.8	18.1 ~ 27.5
Catalytic convert and center exhaust pipe nuts	29.4 ~ 39.2	3.0 ~ 4.0	21.7 ~ 28.9
Turbo charger support bolt	34.3 ~ 44.1	3.5 ~ 4.5	25.3 ~ 32.5
Intake manifold mounting nuts & bolt	14.7 ~ 21.6	1.5 ~ 2.2	10.8 ~ 15.9



SPECIAL TOOLS

Tool (Number and name)	Illustration	Use
Camshaft oil seal installer (09212-27100)		Installation of the camshaft oil seal
Valve spring compressor (09222-27300)		Removal and installation of intake and exhaust valves
Valve stem oil seal installer (09222-27200)		Installation of valve stem oil seals
Crankshaft rear oil seal installer (09231-27000)		Installation of the crankshaft rear oil seal
Front case oil seal installer (09231-27100)		Installation of the front case oil seal
Injector oil seal installer (09351-27401)		Installation of the injector oil seal
Compression gauge & adapter (09351-27000) (09351-27500)		Checking engine compression pressure



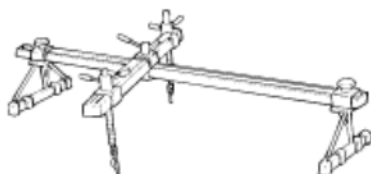
Oil filter wrench
(09263-27000)



Oil filter wrench
(09263-2E000)



Engine support fixture and
adapter
(09200-38001, 09200-1C00)



Removal and installation of oil filter
For the rest area except Europe LHD

Removal and installation of oil filter
For Europe LHD

Engine fixing

TROUBLESHOOTING

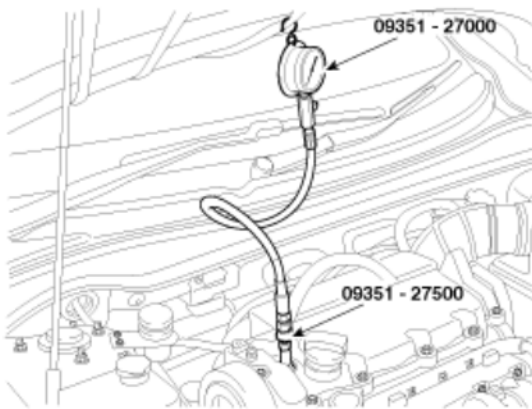
Symptom	Suspect	Remedy
Engine misfire with abnormal internal lower engine noises.	Loose or improperly installed engine flywheel.	Repair or replace the flywheel as required.
	Worn piston rings (Oil consumption may or may not cause the engine to misfire.)	Inspect the cylinder for a loss of compression. Repair or replace as required.
	Worn crankshaft thrust bearings.	Replace the crankshaft and bearings as required.
Engine misfire with abnormal valve train noise.	Stuck valves (Carbon buildup on the valve stem can cause the valve not to close properly.)	Repair or replace as required
	Excessive worn or mis-aligned timing belt	Replace the timing belt and sprocket as required.
	Worn camshaft lobes.	Replace the camshaft and valve lifters.
Engine misfire with coolant consumption.	- Faulty cylinder head gasket and/or cranking or other damage to the cylinder head and engine block cooling system. - Coolant consumption may not cause the engine to overheat.	- Inspect the cylinder head and engine block for damage to the coolant passages and/or a faulty head gasket. - Repair or replace as required.
Engine misfire with excessive oil consumption.	Worn valves, valve guides and/or valve stem oil seals.	Repair or replace as required.
	Worn piston rings. (Oil consumption may or may not cause the engine to misfire)	- Inspect the cylinder for a loss of compression. - Repair or replace as required.
Engine noise on start-up, but only lasting a few seconds.	Incorrect oil viscosity.	- Drain the oil - Install the correct viscosity oil.
	Worn crankshaft thrust bearing.	- Inspect the thrust bearing and crankshaft. - Repair or replace as required.
Upper engine noise, regardless of engine speed.	Low oil pressure.	Repair or replace as required.
	Broken valve spring.	Replace the valve spring
	Worn or dirty valve lifters.	Replace the valve lifters.
	Stretched or broken timing belt and/or damaged sprocket teeth.	Replace the timing belt and sprockets.
	Worn timing chain tensioner, if applicable.	Replace the timing chain tensioner as required.
	Worn camshaft lobes.	- Inspect the camshaft lobes. - Replace the timing camshaft and valve lifters as required.
	Worn valve guides or valve stems.	Inspect the valves and valve guides, then repair as required.
	Stuck valves. (Carbon on the valve stem or valve seat may cause the valve to stay open.)	Inspect the valves and valve guides, then repair as required.

Lower engine noise, regardless of engine speed.	Low oil pressure.	Repair or replace damaged components as required.
	Loose or damaged flywheel.	Repair or replace the flywheel.
	Damaged oil pan, contacting the oil pump screen.	- Inspect the oil pan. - Inspect the oil pump screen. - Repair or replace as required.
	Oil pump screen loose, damage or restricted.	- Inspect the oil pump screen. - Repair or replace as required.
	Excessive piston-to-cylinder bore clearance.	- Inspect the piston and cylinder bore. - Repair as required.
	Excessive piston pin-to bore clearance.	- Inspect the piston, piston pin and the connecting rod. - Repair or replace as required.
	Excessive connecting rod bearing clearance	Inspect the following components and repair as required. - The connecting rod bearings. - The connecting rods. - The crankshaft. - The crankshaft journal.
	Excessive crankshaft bearing clearance	Inspect the following components and repair as required. - The crankshaft bearings. - The crankshaft journals.
	Incorrect piston, piston pin and connecting rod installation	- Verify the piston pins and connecting rods are installed correctly. - Repair as required.
Engine noise under load	Low oil pressure	Repair or replace as required.
	Excessive connecting rod bearing clearance	Inspect the following components and repair as required. - The connecting rod bearings. - The connecting rods. - The crankshaft
	Excessive crankshaft bearing clearance	Inspect the following components, and repair as required. - The crankshaft bearings. - The crankshaft journals. - The cylinder block crankshaft bearing bore.
Engine will not crank- crankshaft will not rotate	Hydraulically cylinder - Coolant/antifreeze in cylinder. - Oil in cylinder.	1) Remove injectors and check for fluid. 2) Inspect for broken head gasket. 3) Inspect for cranked engine block or cylinder

Fuel in 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 cylinder - Broken valve - Piston material - Foreign meterial	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 connectong rods. 2) Repair as required.
Broken crankshaft	1) Inspect crankshaft. 2) Repair as required.

COMPRESSION PRESSURE INSPECTION

1. Check the engine oil, stater motor and the battery normal condition.
2. Warm up the engine until the normal operating temperature becoming 80~95°C(176~203°F).
3. Engine stop, remove the air cleaner assembly.
4. Remove the Electronic Control Module(ECM).
5. Remove the injector.(Refer to Injector in FLC Group).
6. While cranking the engine, remove impurity from the cylinder.
7. Install the pressure gauge(09351-27000 , 09351-27500) to the injector hall.



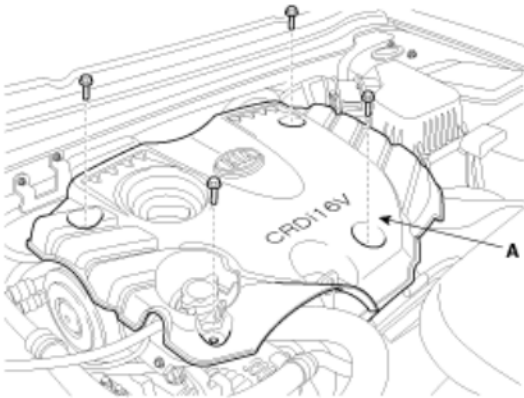
8. While cranking the engine, measure the compression pressure.
 Compression pressure
 Standard pressure :
 2,549kPa (26.0kgf/cm², 369psi) - 270rpm
 Minimum pressure :
 2,255kPa (23.0kgf/cm², 327psi)
9. Check the power balance between all cylinder are within limlt by repeating steps 7) through 8) for each cylinder.
 Limit : each cylinder pressure 294kPa (3.0kgf/cm², 42psi)
10. If the cylinder compression in 1 or more cylinders is low, pour a small amount of engine oil into the cylinderthrough the spark plug hole and repeat steps through for cylinders with low compression. Repeat steps 7) through 9) for each cylinder.
 - (1) If adding oil helps the compression, it is likely that the piston rings and/or cylinder bore are worn or damaged.
 - (2) If pressure stays low, a valve may be sticking or seating is improper, or there may be leakage past the gasket.
11. In case of remove the injection nozzle when measure cylinder compressed pressure replace gasket and holder with new one and tighten them Tightening torque.

REMOVAL

⚠ CAUTION

- Make sure jacks and safety stands are placed properly.
- Make sure the vehicle will not roll off stands and fall while you are working under it.
- Use fender covers to avoid damaging painted surface.
- Unplug the wiring connectors carefully while holding the connector portion to avoid damage.
- Mark all wiring and hoses to avoid misconnection.
Also, be sure that they do not contact other wiring or hoses or interfere with other parts.

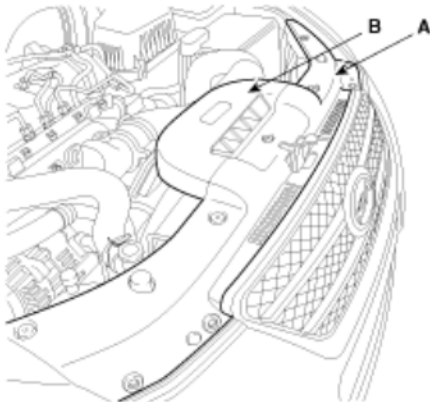
1. Remove the engine cover(A).



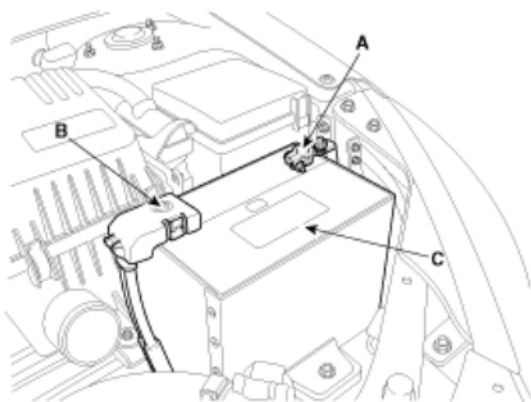
2. Remove the front bumper upper cover (A) and the air duct (B).

Tightening torque :

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



3. Disconnect the battery negative terminal(A) first, then the positive terminal(B) and remove the battery(C).



4. Remove the radiator cap to speed draining.
5. Loosen the radiator drain plug (A) and drain engine coolant.

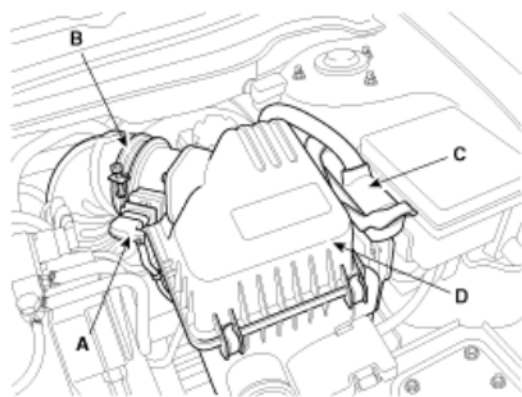


6. Remove the air cleaner.
 - (1) Disconnect the air flow sensor (AFS) connect(A).
 - (2) Remove the air intake hose (B).
 - (3) Disconnect the electric control unit (ECU) connector (C).
 - (4) Remove the air clear assembly(D).

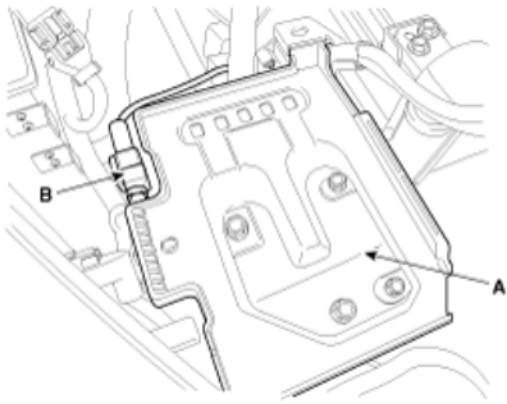
Tightening torque :

Hose clamp (B) : 2.9 ~ 4.9N.m (0.3~0.5kgf.m, 2.2 ~ 2.6lb.ft)

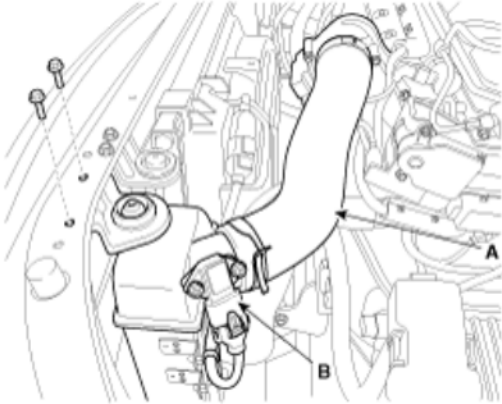
Mounting bolt : : 7.8 ~ 10.8N.m (0.8~1.1kgf.m, 5.8 ~ 8.0lb.ft)



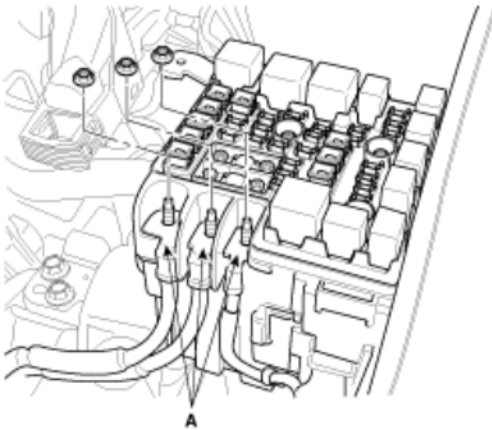
7. Remove the battery tray (A) and disconnect the front connector (B).



8. Remove the intercooler hose (A) and disconnect the booster pressure sensor (BPS) connector (B).

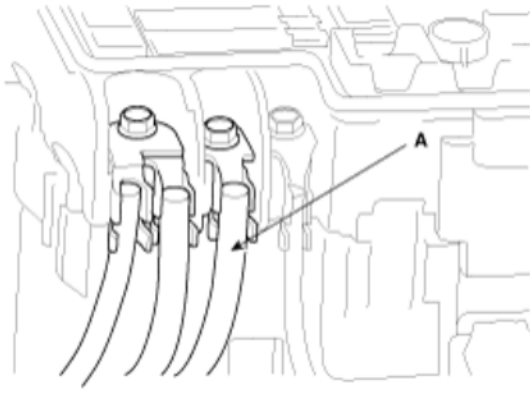


9. Remove the fuse box cover.
10. Disconnect the terminals(A) from the fuse box.
Tightening torque :
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



NOTICE

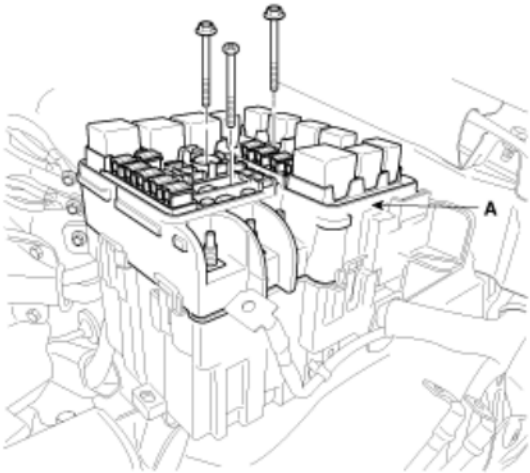
When connecting the alternator B+ cable, refer to the illustration below.



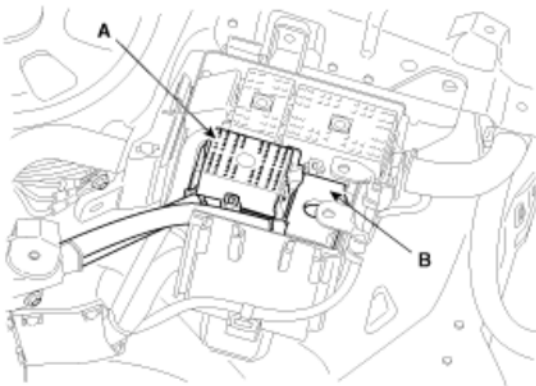
11. After removing the mounting bolts, remove the relay and fuse assembly(A).

Tightening torque :

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



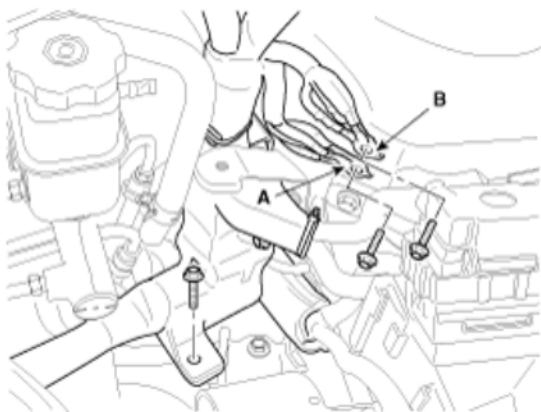
12. Remove the connector wiring(A) and the engine wiring(B).



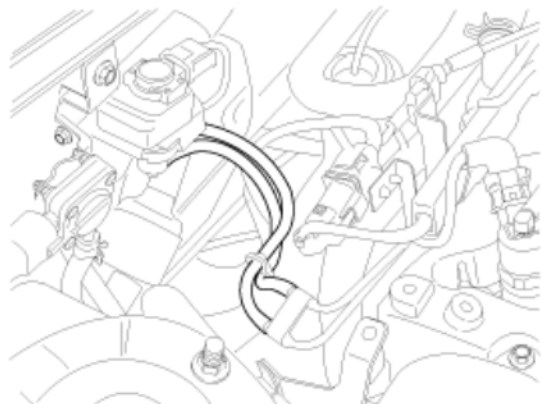
13. Remove the engine control side ground(A) and, the transaxle control side one(B).

Tightening torque :

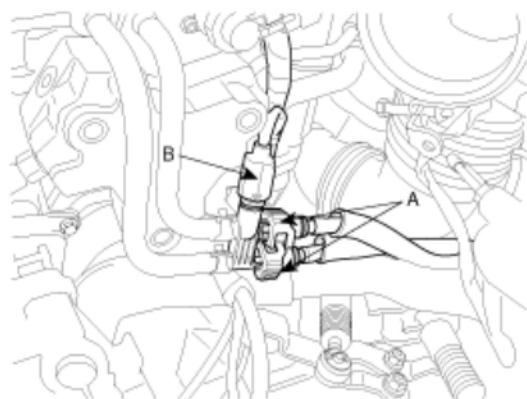
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



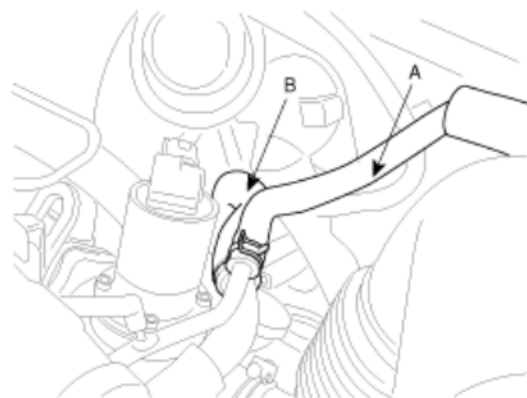
14. Remove the solenoid valve vacuum hose(A).



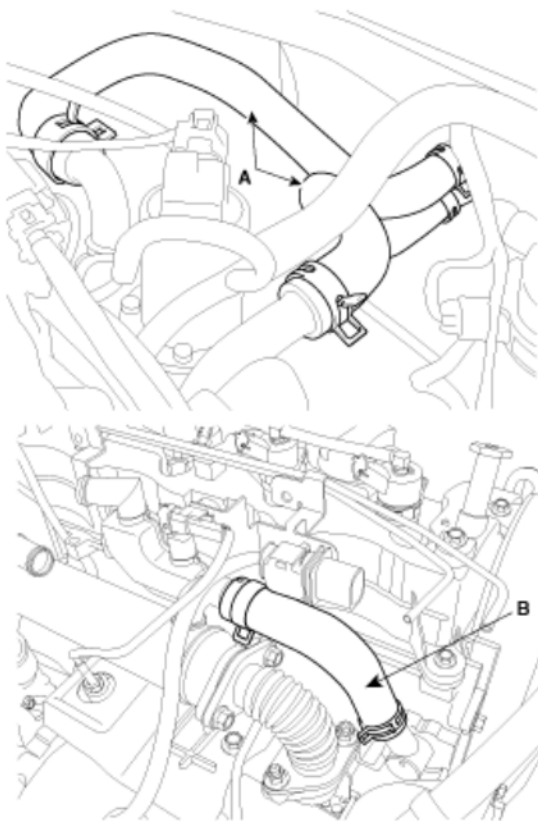
15. Disconnect the fuel hoses(A) and fuel temperature sensor connector(B).



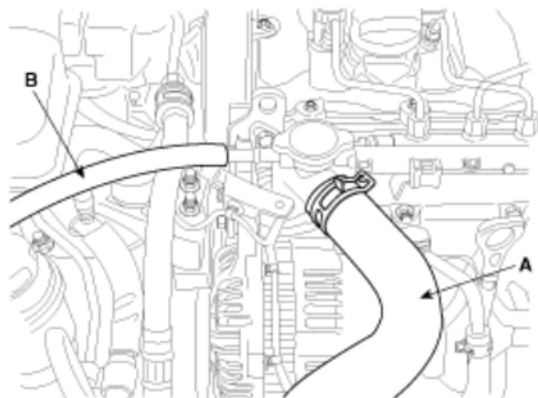
16. Disconnect the brake booster vacuum hose(A) and heater hose(B).



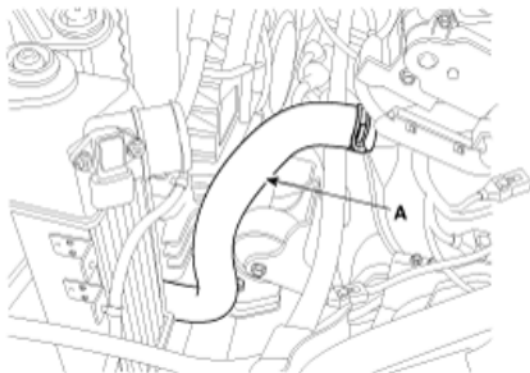
17. Remove the heater hose(A) and EGR cooler hose(B).



18. Remove the radiator upper hoses(A) and the coolant bleed hose(B).



19. Remove the radiator lower hose(A).



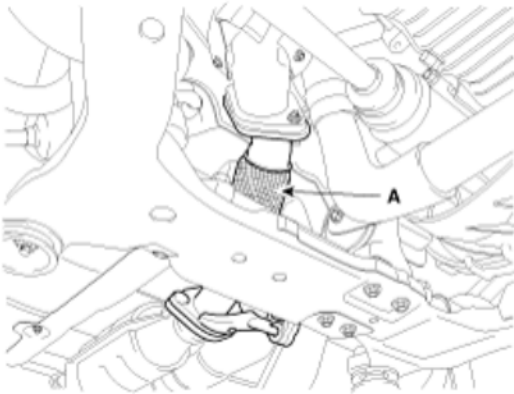
20. Disconnect the transaxle wire harness and the control cable.
(Refer to Transaxle control system in MTC Group).

21. Remove the high & low pressure pipe. (Refer to Air conditioner compressor in HA Group).

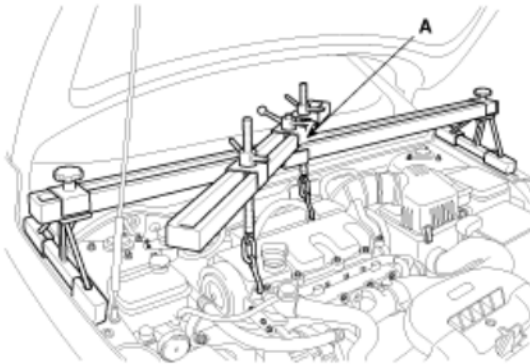
22. Remove the steering column mounting bolt(A), (Refer to Steering column in ST Group).



23. Remove the front wheels and tires.
24. Disconnect the stabilizer bar link and remove the mounting bolts from the lower arm and the front axles.
(Refer to front suspension system in SS Group)
25. Remove the front muffler (A).



26. Install the SST (09200-38001, 09200-1C000), the engine support fixture and the adapter, on the engine and transaxle assembly.

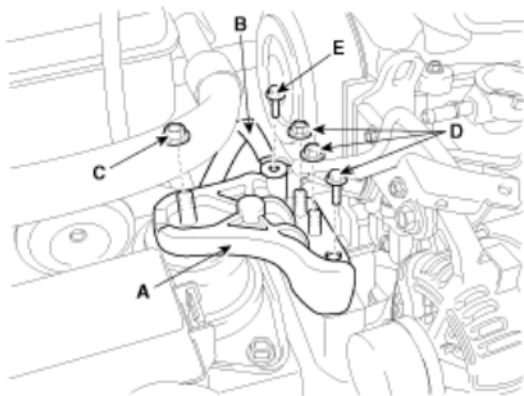


27. Remove the engine mounting bracket (A) and the ground line (B).

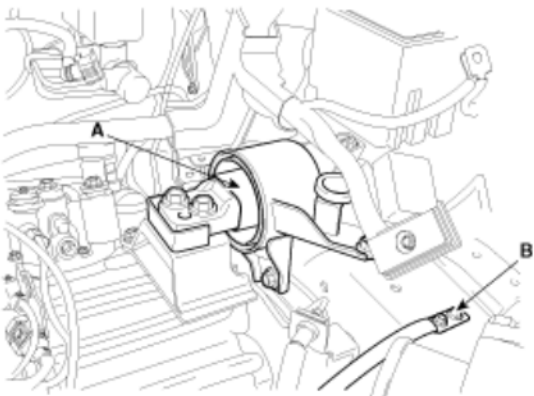
Tightening torque :

63.7 ~ 83.4N.m (6.5 ~ 8.5kgf.m, 47.0 ~ 61.5lb.ft)

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



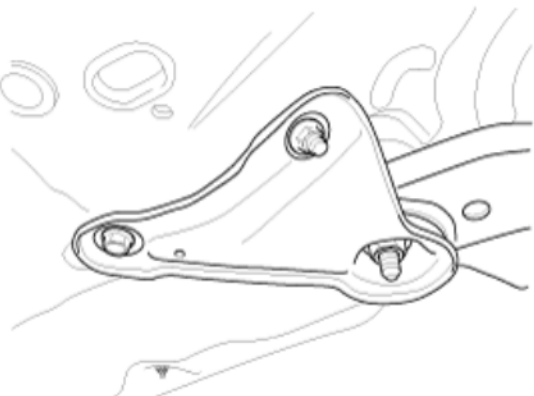
28. Remove the transaxle mounting bracket (A) and the ground line (B).



29. Remove the sub frame mounting bolts and nut.

Tightening torque :

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



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

NOTICE

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

INSTALLATION

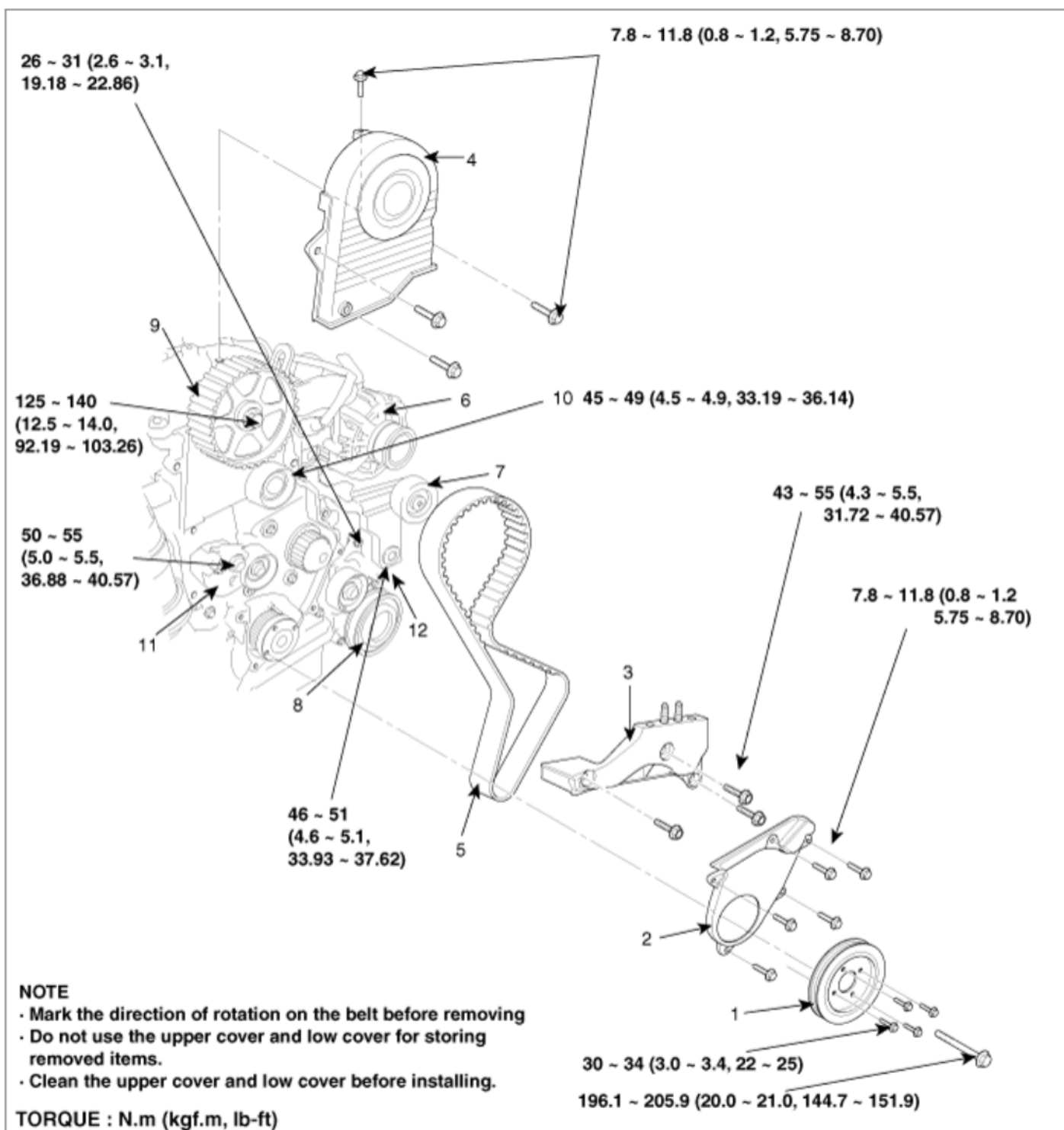
Install the engine in the reverse order of removal.

Reinstall the mount bolts/nuts in the following sequence.

Failure to follow these procedures may cause excessive noise and vibration, and reduce bushing life.

1. Install the sub frame installation bolt.
2. Tighten the engine and transmission mounting bolts.
3. Connect the power steering oil hoses.
4. Install the front muffler.
5. Install the front tires/wheels and splash shield.
6. Connect the air condition hoses.
7. Install the transmission links.
8. Connect the fuel hoses.
9. Connect the engine wire harness connectors.
10. Connect the radiator upper and lower hoses.
11. Connect the heater hoses.
12. Connect the hose to the reservoir tank.
13. Connect the intercooler hoses.
14. Install the air cleaner and the battery.
15. Perform the following :
 - Clean the areas where the driveshaft contact the transmission thoroughly with solvent or carburetor cleaner, and dry with compressed air.
 - Check that the snap rings on the ends of the driveshaft click into place.

COMPONENTS

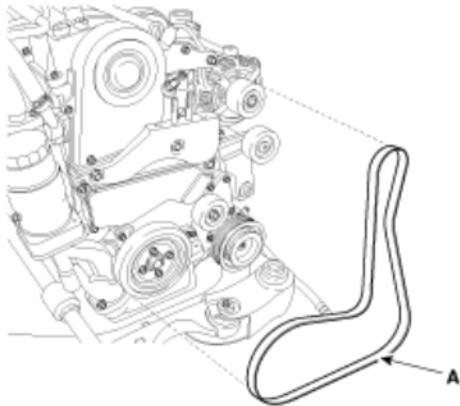


1. Damper pulley
2. Timing belt lower cover
3. Engine support bracket
4. Timing belt upper cover
5. Timing belt
6. Alternator and vacuum pump assembly

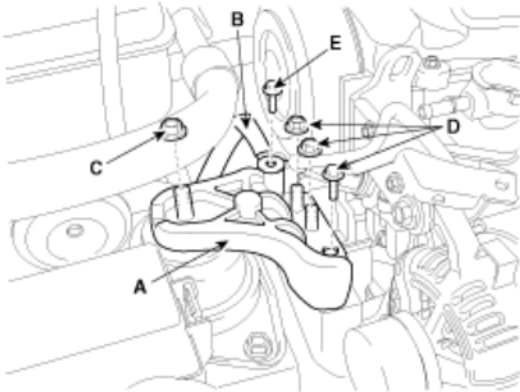
7. Power steering pump
8. Air conditioning compressor
9. Camshaft sprocket
10. Timing belt idler
11. Timing belt tensioner
12. Idler

REMOVAL

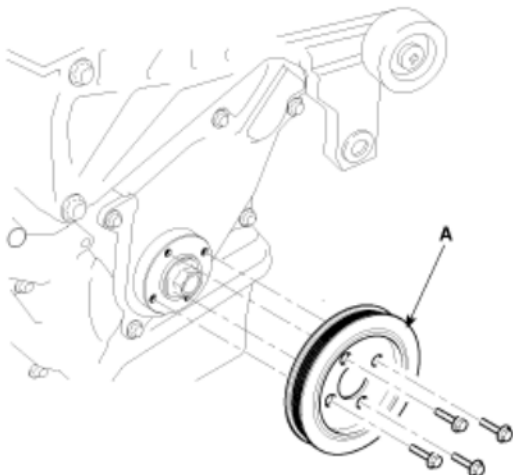
1. Remove the front tires.(RH)
2. Remove the side cover.
3. The tensioner should be lifted up to remove the drive belt(A).



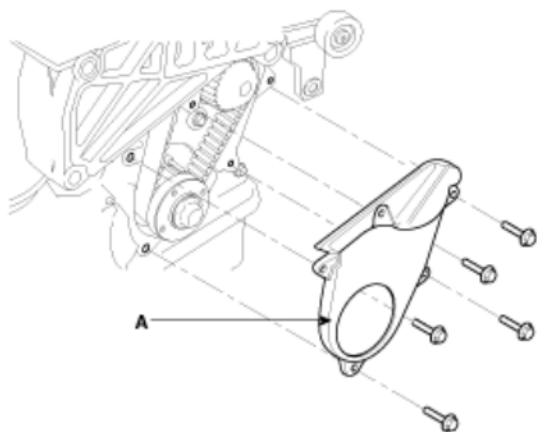
4. Remove the engine mounting bracket(A) and the ground cable(B).



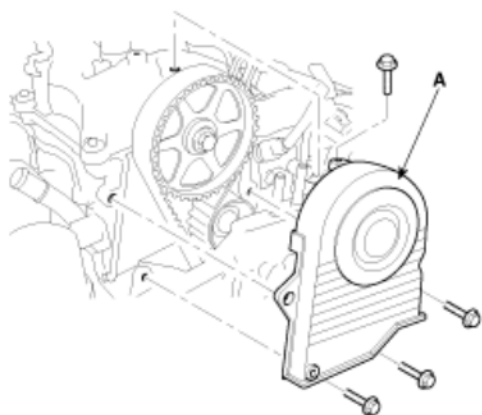
5. Remove the crankshaft pulley(A).



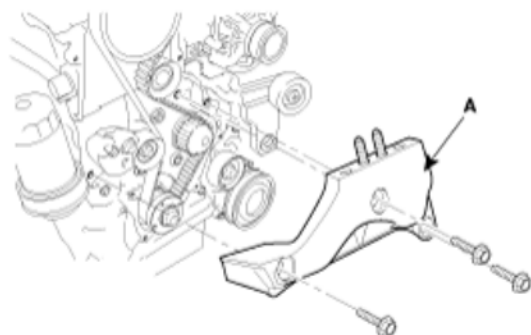
6. Remove the timing belt lower cover(A).



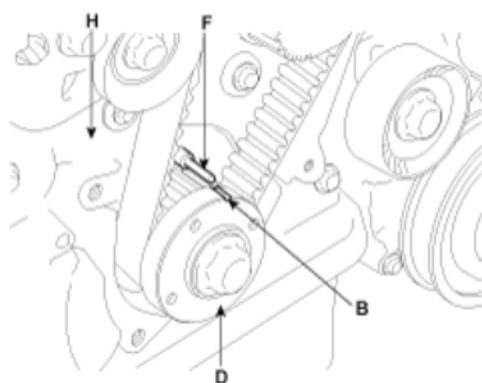
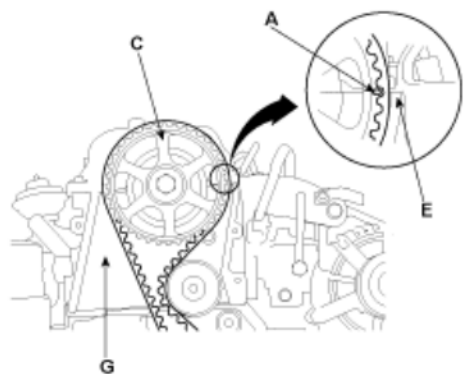
7. Remove the timing belt upper cover(A).



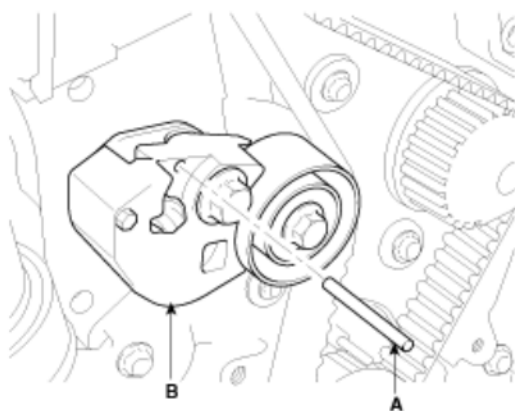
8. Remove the engine support bracket(A).



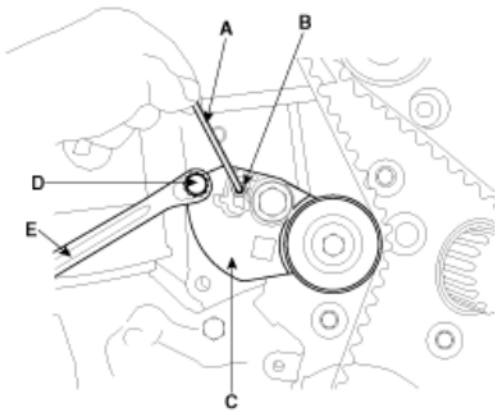
9. Align the timing marks(A, B) on the camshaft sprocket(C) and the crankshaft sprocket(D) with the marks(E, F) on the cylinder head(G) and the oil pump housing(H) with rotating the engine.



10. Insert a pin(A) into the aligned holes in the auto-tensioner(B).



11. Using a hexagonal wrench (5mm)(A), loosen the stop bolt(B). And then, turning the auto-tensioner(C) clockwise fully with the boss bolt(D) and 12mm spanner(E), retighten the stop bolt(B).



12. Remove the timing belt.

NOTICE

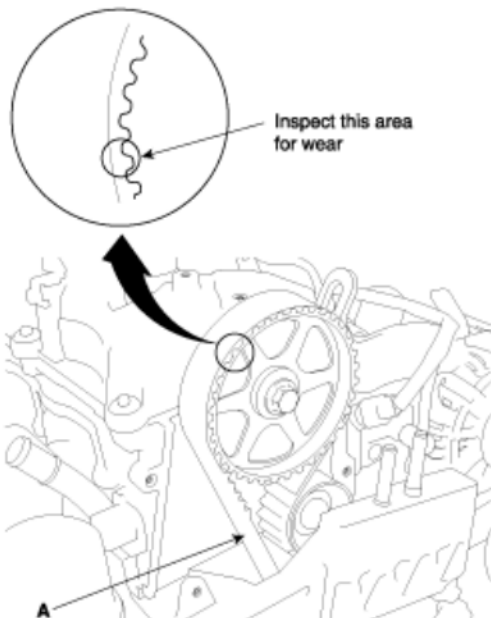
To be prepared in case the removed belt is used, mark an arrow on the timing belt in the direction of rotation before removing it.

INSPECTION

1. Remove the upper cover.
2. Inspect the timing belt(A) for cracks and oil or coolant soaking.

NOTICE

- Replace the belt if oil or coolant soaked.
- Remove any oil or solvent that gets on the belt.

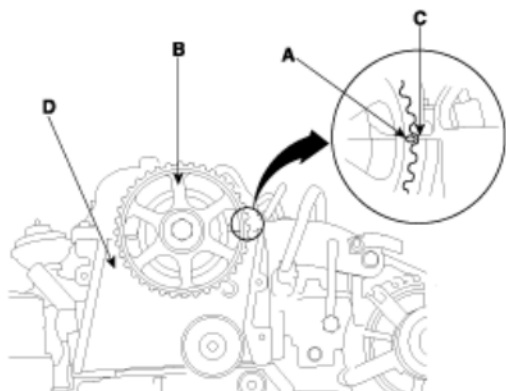


SPROCKETS, TENSIONER, IDLER

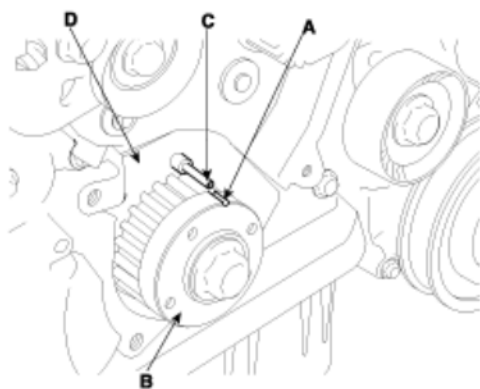
1. Check the camshaft sprocket.
Camshaft sprocket, crankshaft, tensioner pulley and idler pulley for abnormal wear, cracks or damage. Replace as necessary.
2. Inspect the tensioner pulley and the idler pulley for easy and smooth rotation and check for play or noise. Replace as necessary.
3. Replace the pulley if there is a grease leak from its bearing.

INSTALLATION

1. Align the timing mark(A) on the camshaft sprocket(B) with the mark(C) on the cylinder head(D).



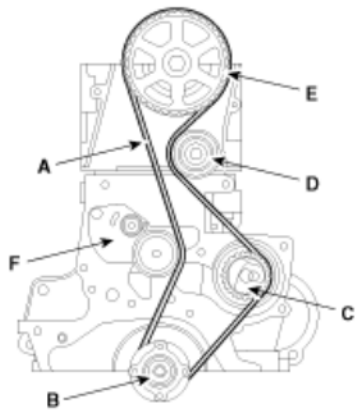
2. Align the timing mark(A) on the crankshaft sprocket(B) with the pin(C) press fitted in the oil pump housing(D).



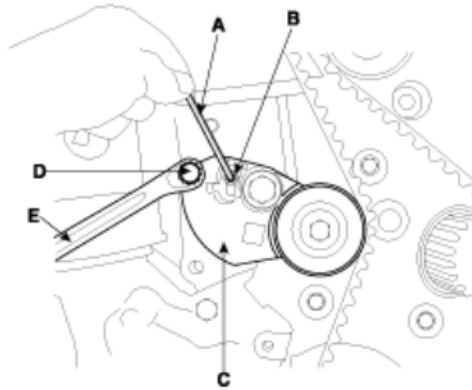
3. Install the timing belt.

(1) Install the timing belt(A) tightly in the sequence shown.

① Timing belt drive pulley(B) (crankshaft) → ② Water pump pulley(C) ③ Timing belt idler(D) → ④ Camshaft sprocket(E) → ⑤ Timing belt tensioner(F).



(2) Turn the auto-tensioner(C) counterclockwise fully to install the timing belt using the boss bolt(D) and spanner(E).



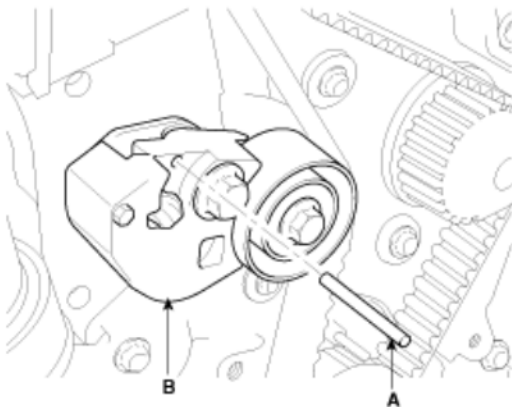
(3) Rotate the crankshaft by hand 2 complete revolutions (clockwise) to take up any slack and set to TDC(Top Dead Center).

(4) Using a hexagonal wrench, install the stop bolt.

Tightening torque :

10 ~ 12N.m (1.0 ~ 1.2 kgf.m, 7 ~ 9lb-ft)

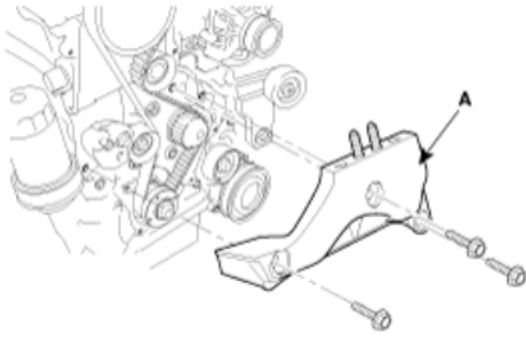
(5) Remove the fixing pin(A)



4. Install the engine support bracket(A).

Tightening torque :

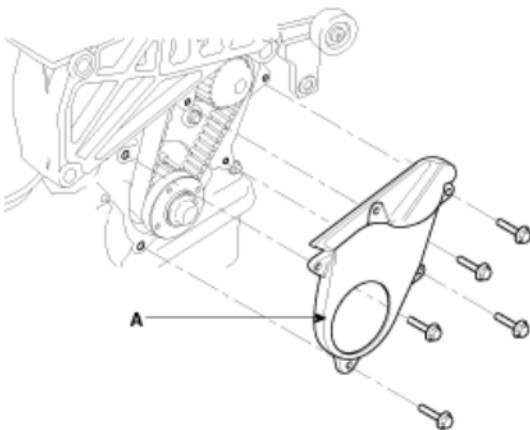
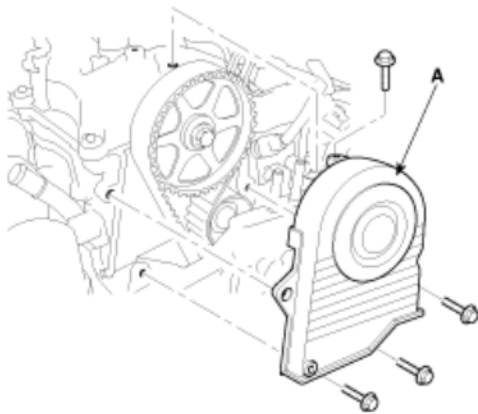
43 ~ 55N.m (4.3 ~ 5.5kgf.m, 31.72 ~ 40.57lb-ft)



5. Install the timing belt upper cover(A) and lower cover(B).

Tightening torque :

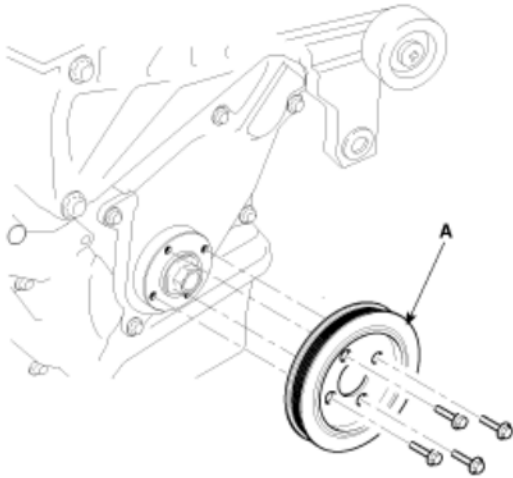
7.8 ~ 11.8N.m (0.8 ~ 1.2kgf.m, 5.75 ~ 8.70lb-ft)



6. Install the crankshaft pulley(A).

Tightening torque :

30 ~ 34N.m (3.0 ~ 3.4kgf.m, 22 ~ 25lb-ft)



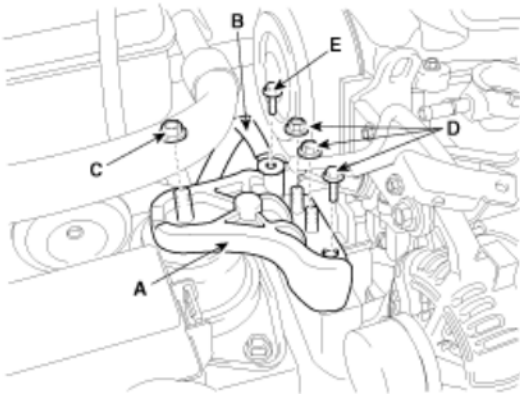
7. Install the engine mounting bracket(A) and the ground cable(B).

Tightening torque :

Nut(C) : 63.7 ~ 83.4N.m(6.5 ~ 8.5kgf.m, 47.0 ~ 61.5lb-ft)

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

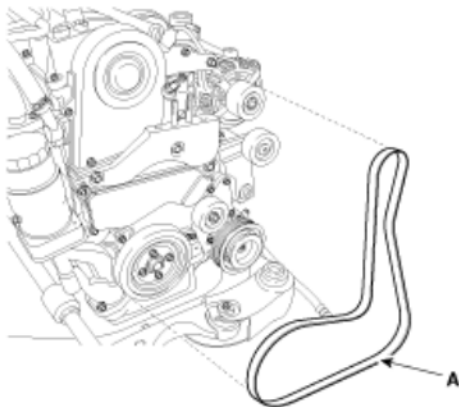
Bolt(E) : 7.8 ~ 9.8N.m (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)



8. Install the drive belt(A), following the sequence below.

1.Alternator → 2.Idler → 3.Air compressor → 4.Crankshaft pulley → 5.Tensioner.

The tensioner should be lifted up to install the drive belt(A).



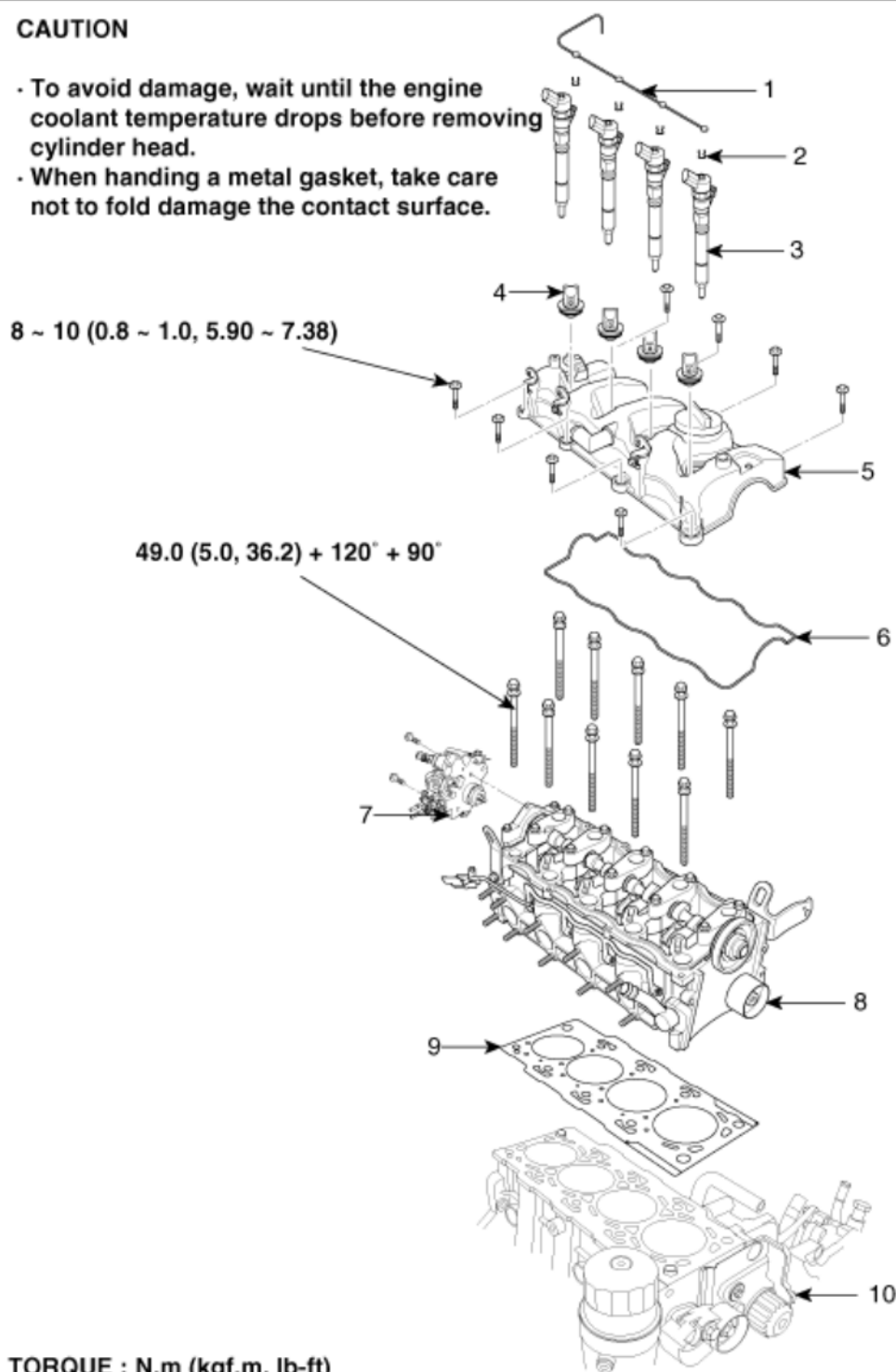
9. Install the side cover.

10. Install the front tires.(RH)

COMPONENTS

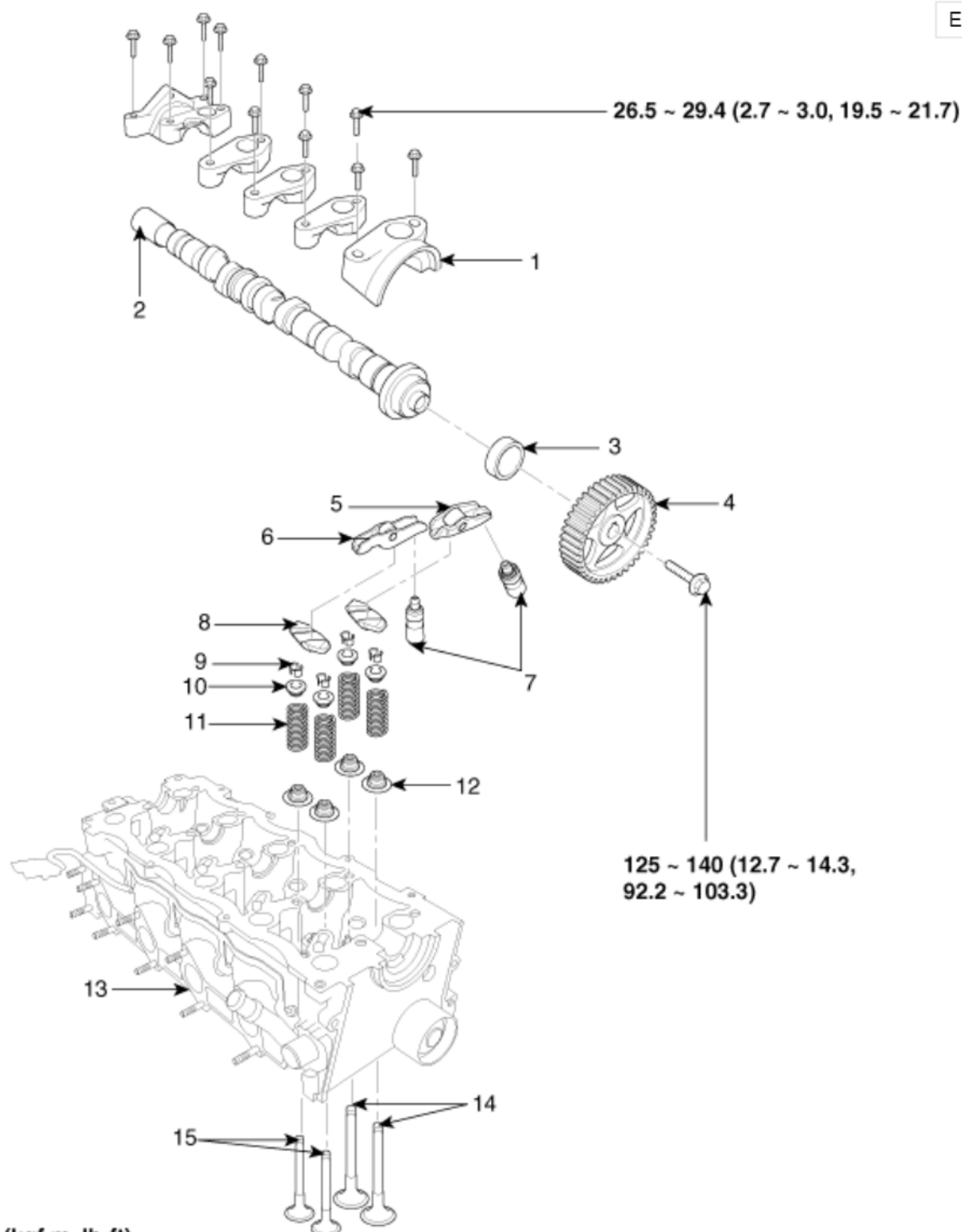
CAUTION

- To avoid damage, wait until the engine coolant temperature drops before removing cylinder head.
- When handling a metal gasket, take care not to fold damage the contact surface.



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

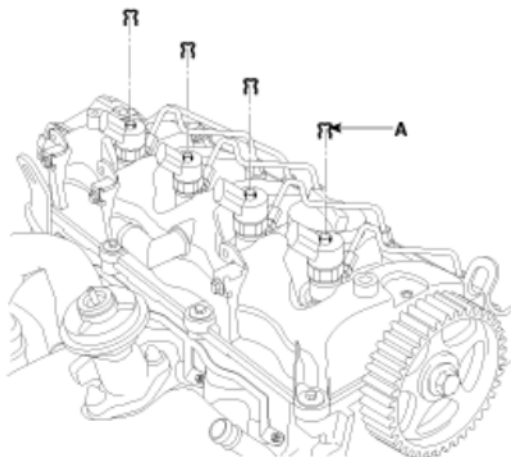
- | | |
|-------------------------------|-------------------------------|
| 1. Fuel return hose | 6. Cylinder head cover gasket |
| 2. Cilp | 7. Fuel pump |
| 3. Injector | 8. Cylinder head |
| 4. Injector installation plug | 9. Cylinder head gasket |
| 5. Cylinder head cover | 10. Cylinder block assembly |


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

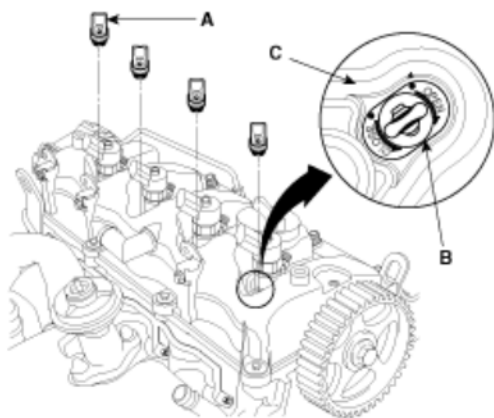
- | | | |
|-------------------------|-------------------------------|---------------------|
| 1. Camshaft bearing cap | 6. Exhaust cam follower | 11. Valve spring |
| 2. Camshaft | 7. Lash adjuster | 12. Valve stem seal |
| 3. Oil seal | 8. Valve cap | 13. Cylinder head |
| 4. Camshaft sprocket | 9. Valve spring retainer lock | 14. Intake valves |
| 5. Intake cam follower | 10. Valve spring retainer | 15. Exhaust valves |

REMOVAL

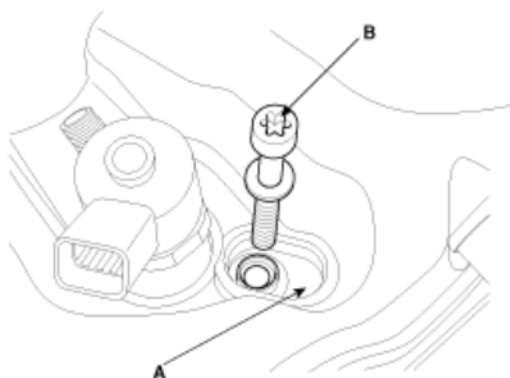
1. Before removing the cylinder head, the timing belt should be removed first. Refer to the timing belt 'removal' step.
2. Remove injector connector.
3. Disconnect the fuel return hose after removing the clips(A).



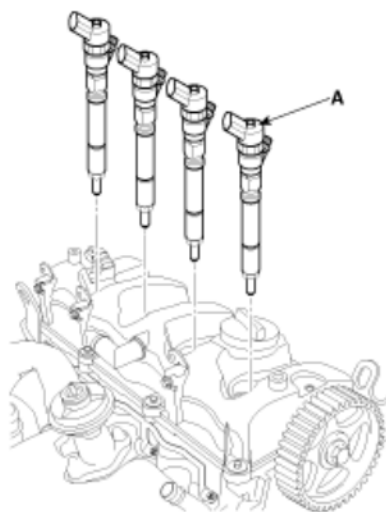
4. Remove the fuel tube. (Refer to Fuel pump in FLC group)
5. Remove the plugs(A).
 - a. Pull the plug up slightly. (more than 1mm)
 - b. Rotate the plug 90° clockwise.
 - c. Remove the plug with inserting a (-)driver between the plug assy(B) and the cylinder head cover(C).



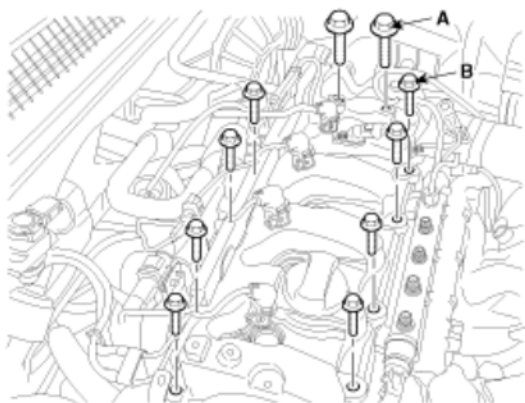
6. Remove the injector holder bolt using the torx wrench.



7. Pull the injector holders with the bolts.
8. Remove the injectors(A).

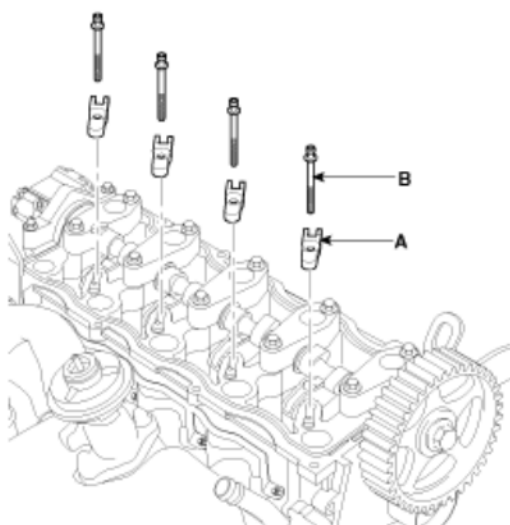


- a. Disconnect the position sensor.
 - b. Remove the wiring bracket.
 - c. Remove the pipe between the oil pan.
 - d. Remove the fuel line hose bolt.
9. Remove the cylinder head cover mounting bolts(A,B).

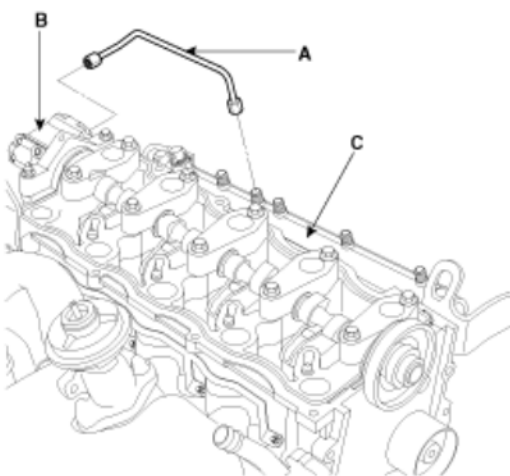


10. Remove the cylinder head cover.

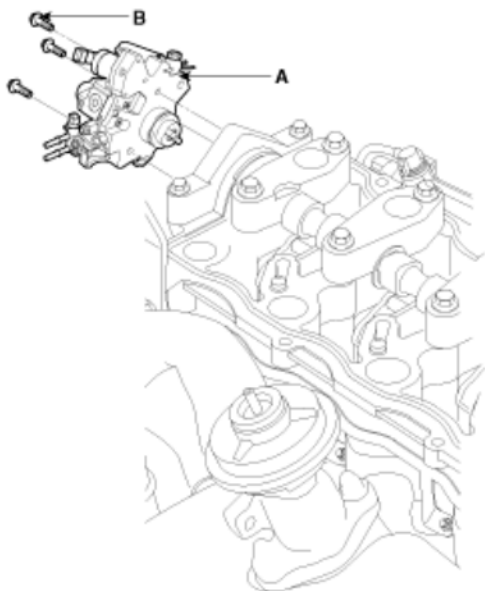
11. Remove the injector holders(A) with the bolts(B).



12. Remove the metal tube(A) between the fuel pump(B) and the common rail(C).



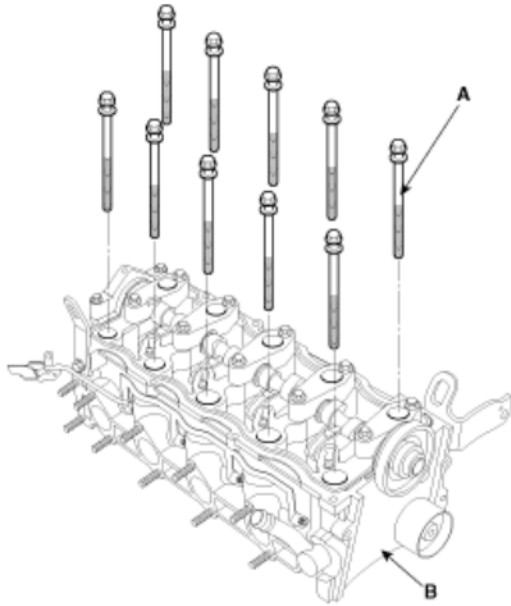
13. Remove the fuel pump(A) after removing the three bolts(B).



14. Remove the exhaust manifold.

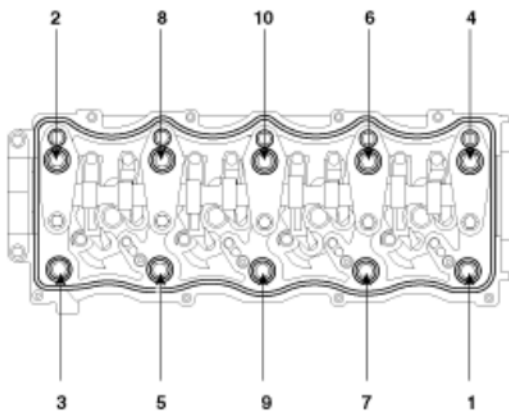
15. Remove the intake manifold.

16. Remove the cylinder head bolts(A), then remove the cylinder head(B).



CAUTION

To prevent warpage, unscrew the bolts in sequence 1/3 turn at a time: repeat the sequence until all bolts are loosened.



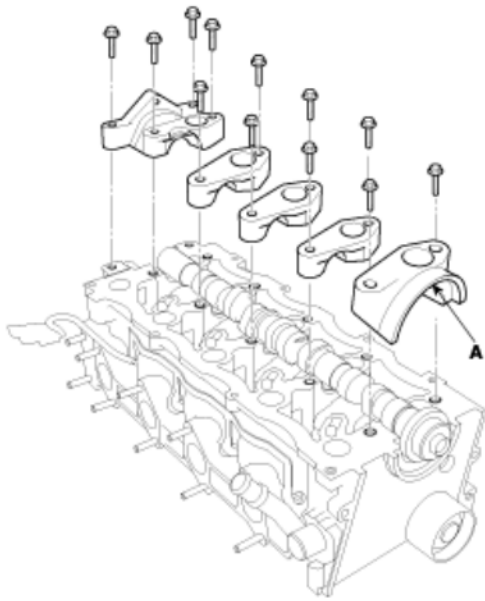
DISASSEMBLY

NOTICE

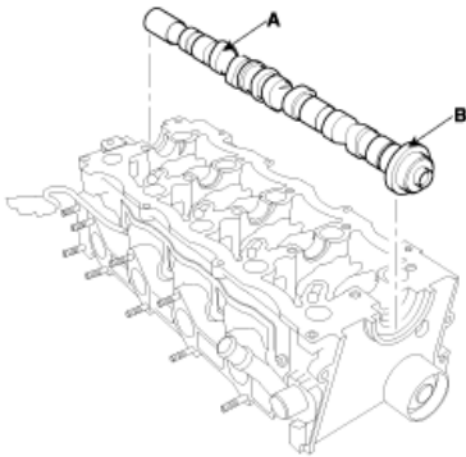
- Identify parts as they are removed to ensure reinstallation in original locations.
- Inspect camshafts.

1. Remove the engine hangers, the knock bushes and the studs.

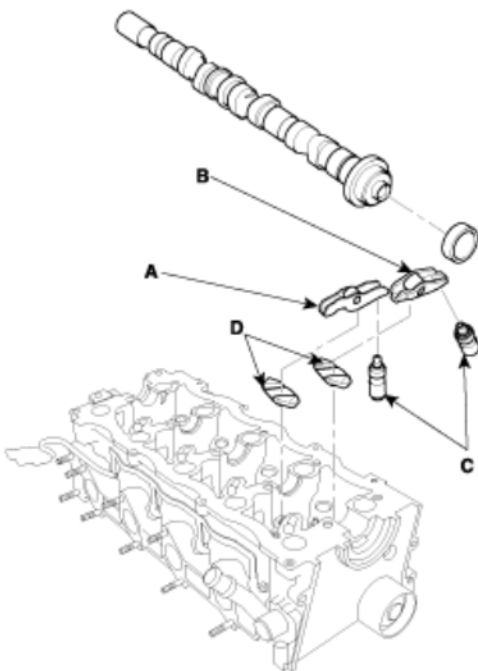
2. Remove the camshaft bearing caps(A).



3. Remove the camshaft(A) with the oil seal(B).



4. Remove the Intake/Exhaust cam followers(A, B).



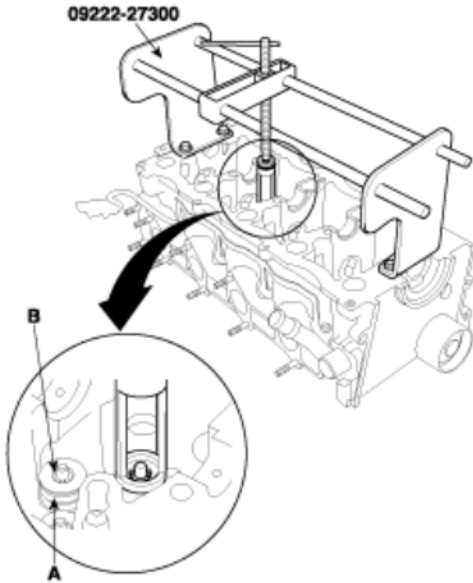
5. Remove the lash adjusters(C).

6. Remove the valve caps(D).
7. Using an appropriate-sized socket and plastic mallet, lightly tap the valve retainer to loosen the valve retainer locks before installing the valve spring compressor.

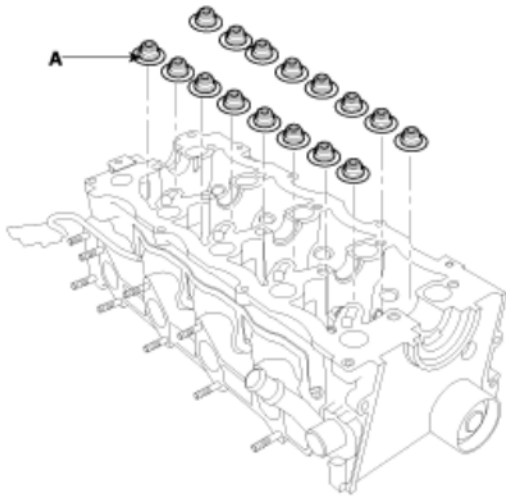
NOTICE

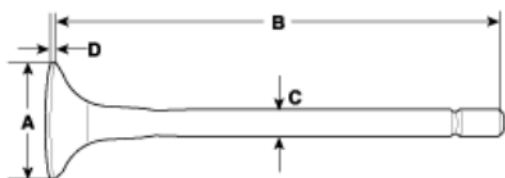
Identify valves and valve springs as they are removed so that each item can be reinstalled in its original position.

8. Using the SST(09222-27300), compress the valve spring(A) in order to remove the valve spring retainer locks(B).



9. Remove the valve stem seals(A).





Intake Valve Dimensions

A Standard (New) :

28.5 ~ 28.7mm (1.1220 ~ 1.1299in.)

B Standard (New) :

94.0 ~ 94.2mm (3.7008 ~ 3.7087in.)

C Standard (New) :

5.933~5.953mm (0.2336~0.0669in.)

D Standard (New) :

1.5 ~ 1.7mm (0.0591 ~ 0.0669in.)

Exhaust Valve Dimensions

A Standard (New) :

24.3 ~ 24.5mm (0.9567 ~ 0.9646in.)

B Standard (New) :

94.0 ~ 94.2mm (3.7008 ~ 3.7087in.)

C Standard (New) :

5.905~5.925mm (0.2325~0.2333in.)

D Standard (New) :

1.2 ~ 1.4mm (0.0472 ~ 0.0551in.)

INSPECTION

CAMSHAFT

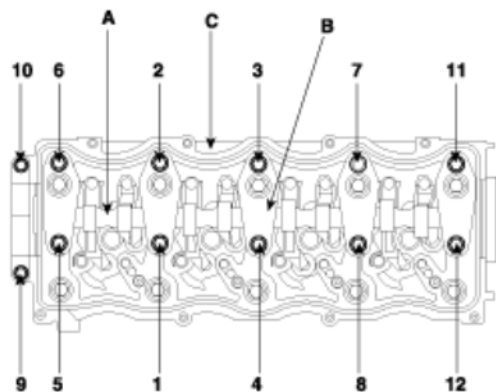
NOTICE

Do not rotate the camshaft during inspection.

1. Put the camshaft(A) and the camshaft bearing caps(B) on the cylinder head(C), then tighten the bolts to the specified torque with the following sequence below.

Specified torque

26.5 ~ 29.4N.m (2.7 ~ 3.0kgf.m, 19.5 ~ 21.7lb-ft)

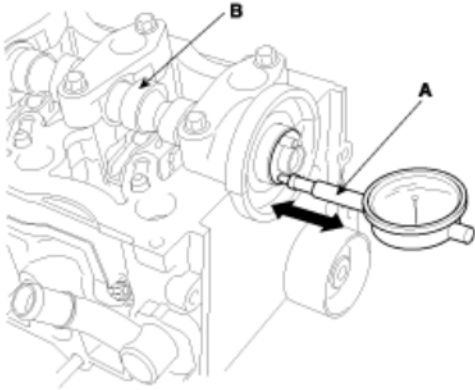


2. Seat the camshaft by pushing it toward the rear of the cylinder head.

3. Zero the dial indicator(A) against the end of the camshaft(B).
Push the camshaft(B) back and forth, and read the end play.

Camshaft End Play

Standard (New) : 0.05 ~ 0.15mm (0.002 ~ 0.006in.)



4. Remove the bolts, then remove the camshaft bearing caps from the cylinder head(A).

- Lift the camshaft(B) out of the cylinder head(A), wipe it clean. Replace the camshaft if any lobes are pitted, scored, or excessively worn.
- Clean the camshaft bearing surfaces in the cylinder head, then set the camshaft back in place.
- Place a plastigauge strip(C) across each journal.

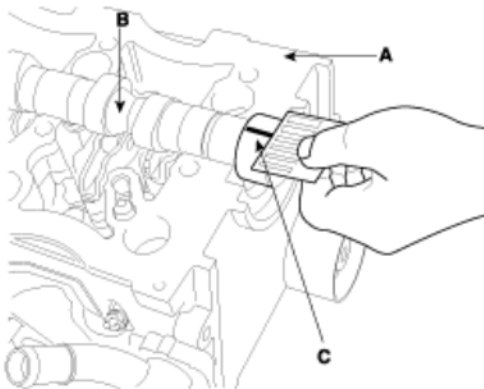
5. Install the camshaft bearing caps and tighten the bolts to the specified torque.

6. Remove the camshaft bearing caps, then measure the widest portion of the plastigauge(C) on each journal.

Camshaft-to-Camshaft bearing cap oil clearance

Standard (New)

0.040 ~ 0.074mm (0.0020 ~ 0.0029in.)



7. If the camshaft-to-camshaft bearing cap oil clearance is out of tolerance :

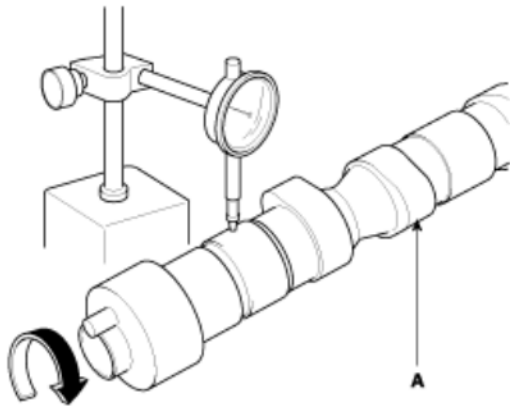
- And the camshaft(A) has already been replaced, you must replace the cylinder head.
- If the camshaft has not been replaced, first check the total runout with the camshaft supported on V-blocks.

Camshaft Total Runout

Standard (New)

0.035mm (0.0014in.) for No.2 and 4

0.050mm (0.0019in.) for No.3



- If the total runout of the camshaft is within tolerance, replace the cylinder head.
- If the total runout is out of tolerance, replace the camshaft and recheck the camshaft-to-camshaft bearing cap oil clearance. If the oil clearance is still out of tolerance, replace the cylinder head.

8. Check the cam height wear.

[Standard]

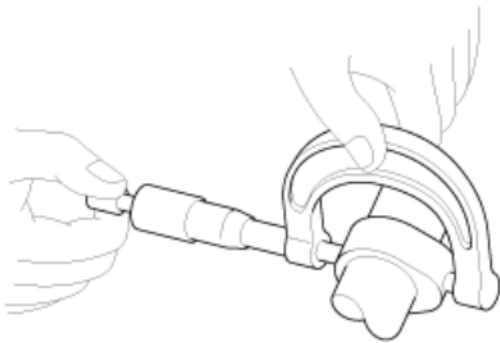
Intake : 34.697mm (1.366in.)

Exhaust : 34.570mm (1.361in.)

[Limit]

Intake : 34.197mm (1.346in.)

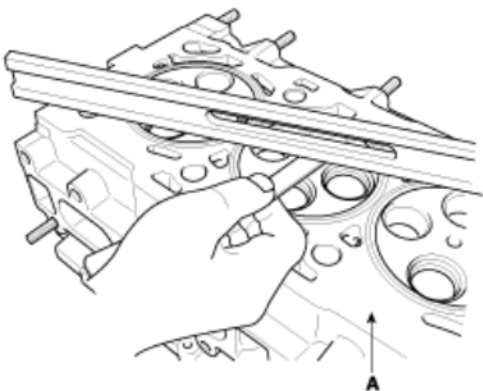
Exhaust : 34.070mm (1.341in.)



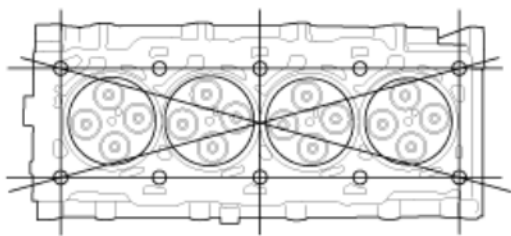
CYLINDER HEAD

Check the cylinder head(A) for warpage.

- If warpage is less than 0.03mm (0.0012in.) for width, 0.09mm (0.0035in.) for length and 0.012mm (0.0005in.) for 51mm × 51mm, cylinder head is in good condition.
- If warpage is over the standard value, replace the cylinder head.



Measure along edges, and three ways across center.



REASSEMBLY

NOTICE

Prior to reassembling, cylinder head assembly shall be cleaned sufficiently to remove scrap and clust. (Clean holes with special care.)

1. Using the SST(09222-27200) insert the valve stem seals(A).

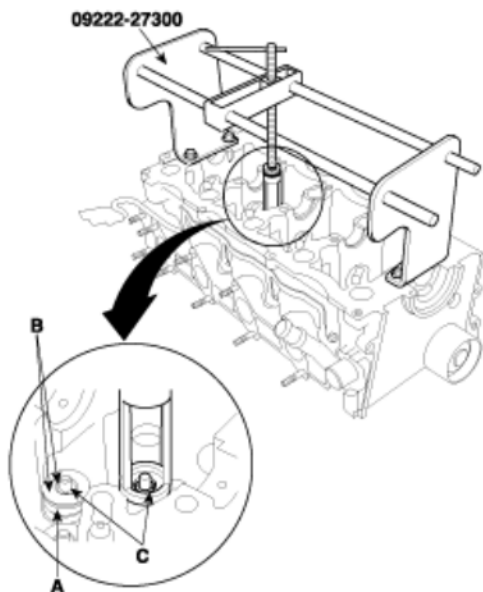


2. Insert the valves through the valve stem seals.

NOTICE

Make sure the valves move up and down smoothly.

3. Install the valve spring(A) and valve spring retainer(B), then install the SST (09222-27300, the valve spring compressor). Compress the spring(A) and install the valve spring retainer lock(C).



4. Lightly tap the end of each valve stem two or three times with a plastic mallet to ensure proper seating of the valve and valve spring retainer locks.

NOTICE

Tap the valve stem only along its axis so you do not bend the stem.

5. Assembly of lash adjuster.

- (1) Until installing, lash adjuster shall be held upright so that gas oil in lash adjuster should not spill and assured that dust does not adhere to adjuster.
- (2) Lash adjust shall be inserted tenderly to the cylinder head not to spill gas oil from lash adjuster. In case of spilling air bent shall be done in accordance with the air bent procedure below.

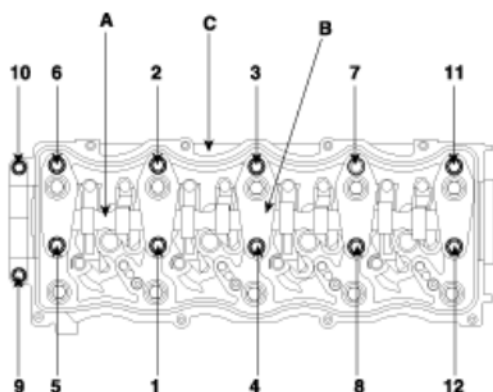
NOTICE

Air bent procedure

- 1) In case of lash adjuster alone.
Stroke lash adjuster in gas oil 4~5 times by pushing its cap while pushing the ball down slightly by hard steel wire.
Take care not to severely push hard steel wire down since ball is several grams.
- 2) After installed on engine
Lash adjuster might give out unusual noise if air is mingled. Apply slow racing from idle to 3,000rpm (Approximately one minute per one racing) and the air shall be removed from adjuster.
Therefore noise can be extinguished.

6. Install the valve-caps.
7. Put the cam followers on the lash adjusters and valve caps.
8. After wiping down the camshaft and camshaft seal in the cylinder head, lubricate both surfaces and install the camshaft with engine oil.
9. Confirm that cam followers are located on lash adjusters and their rollers are in touch with camshaft.
10. In assembly camshaft bearing cap, to the cylinder head with the cylinder block, all pistons should be in the middle position between TDC(Top Dead Center) and BDC(Bottom ead Center) because valves come out of the bottom surface of the cylinder head.

11. Install the bolts loosely.
12. Tighten each bolt two turns at a time in the sequence shown below to ensure that the cam followers do not bind on the valves.
Tightening torque
26.5 ~ 29.4N.m (2.7 ~ 3.0kgf.m, 19.5 ~ 21.7lb-ft)



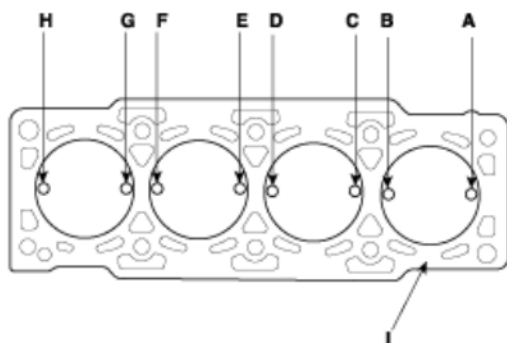
INSTALLATION

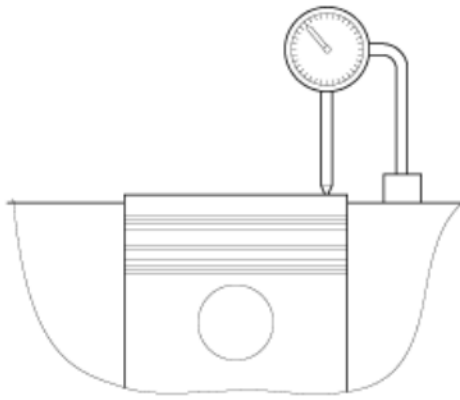
Install the cylinder head in the reverse order of removal :

NOTICE

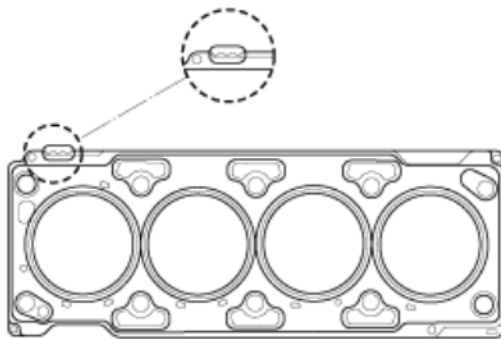
- Always use a new head gasket.
- Cylinder head and cylinder block surface must be clean.
- Turn the crankshaft so the No.1 piston is at TDC(Top Dead Center).

1. Cylinder head dowel pins must be aligned.
2. Select the cylinder head gasket.
 - (1) Measure the piston protrusion from the upper cylinder block face (I) on 8 places (A ~ H) at T.D.C. Measure on the crankshaft center line considering the piston migration.



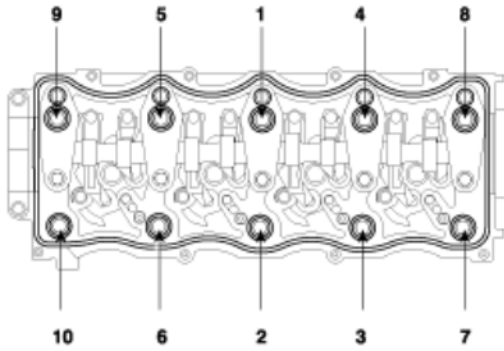


- (2) Install the gasket so that the identification mark faces toward the flywheel side.
- (3) Select the gasket in the table below using the average value of piston protrusions.
Although even the only 1 point is over than the each rank limit, use 1 rank upper gasket than specified in the table below.



Displacement	2.0 L		
Average of piston protrusion	0.194 ~ 0.337mm (0.0079 ~ 0.013in.)	0.337 ~ 0.440mm (0.013 ~ 0.017in.)	0.440 ~ 0.542mm (0.017 ~ 0.021in.)
Gasket thickness	1.13 ± 0.05mm (0.0445 ± 0.0019in.)	1.23 ± 0.05mm (0.0484 ± 0.0019in.)	1.33 ± 0.05mm (0.0523 ± 0.0019in.)
Limit of each rank extant	0.43mm (0.0169in.)	0.53mm (0.0208in.)	-
Identification code			

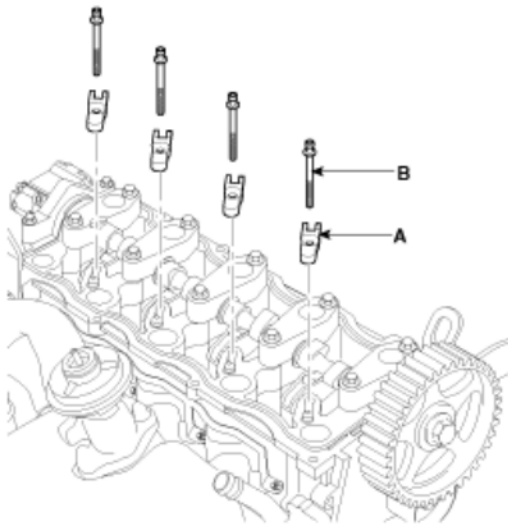
3. Position the cylinder head assembly over the gasket.
4. Tighten the cylinder head bolts slightly.
5. Install the camshaft sprocket, aligning the timing mark.
Tightening torque
124.5 ~ 144.2N.m (12.7 ~ 14.7kgf.m, 91.9 ~ 106.3lb-ft)
6. Tighten the bolts to the specified torque
Tightening torque
49.0Nm (5.0kgf.m, 36.2lb-ft) + 120° + 90°



NOTICE

- Tightening sequence of cylinder head bolt should be confirmed to the upper drawing.
- Cylinder head bolt must be replaced.

7. Install the fuel pump assembly.
8. Install the intake/exhaust manifold assemblies.
9. Install the hose between the vacuum pump and the cylinder head.
10. If it is necessary to replace the oil seals on the cylinder head cover for injectors, use the SST(09351-27401).
11. Install the camshaft oil seal with use the SST(09212 - 27100)
12. Install the injector holder(A).



13. Install the head cover gasket in the groove of the cylinder head cover.

NOTICE

- Cylinder head cover gasket must be replaced.
- Before installing the head cover gasket, thoroughly clean the seal and the groove.

14. Apply liquid gasket to the head cover gasket at the four corners of the recesses.

NOTICE

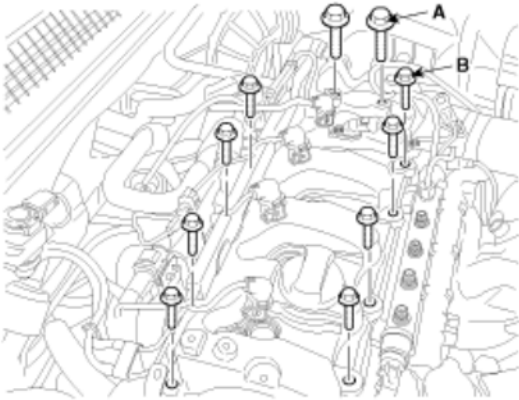
- Use liquid gasket LOCTITE 5699 or TH1212D.
- Check that the mating surface are clean and dry before applying liquid gasket.
- Do not install the parts if five minutes or more have elapsed since applying liquid gasket. Instead, reapply liquid gasket after removing old residue.
- After assembly, wait at least 30 minutes before filling the engine with oil.

15. Install the cylinder head cover bolts(A, B).

Tighten torque

(A) : 21 ~ 25N.m (2.2 ~ 2.6kgf.m, 15.9 ~ 18.8lb-ft)

(B) : 8 ~ 10N.m (0.8 ~ 1.0kgf.m, 5.9 ~ 7.38lb-ft)



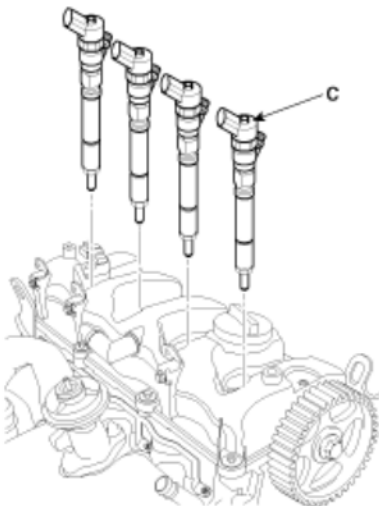
NOTICE

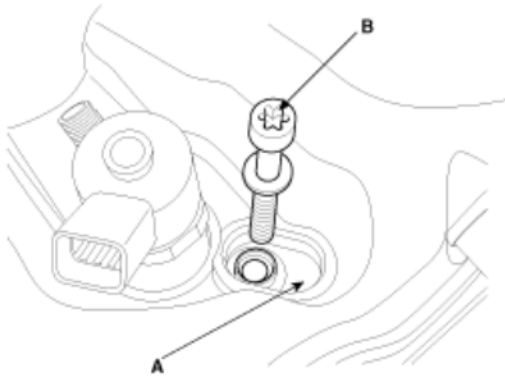
After assembly, wait at least 30 minutes before filling the engine with oil.

16. Insert the injectors(C), moving back the injector holders(A) with the bolts(B).

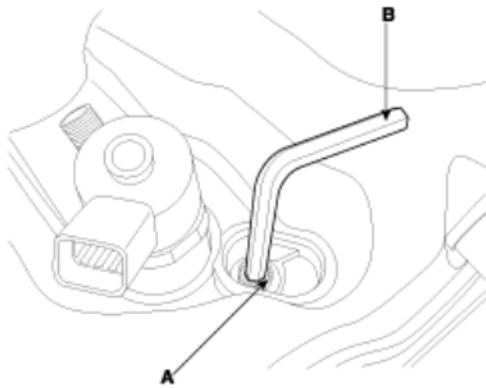
Tighten torque :

24.5 ~ 28.4N.m (2.5 ~ 2.9kgf.m, 18.1 ~ 21.0lb-ft)

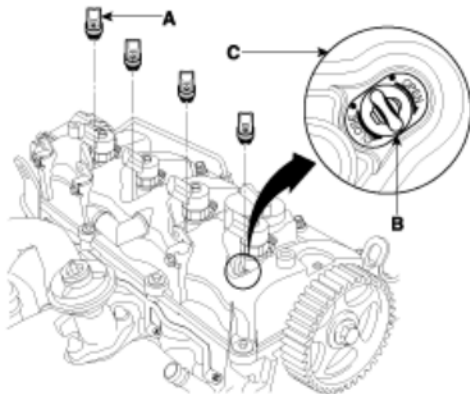




17. Install the injector holder bolts(A) using the torx wrench(B).



18. Install the injector plug(A).



- Make sure that the stopper of the plug faces 'OPEN' side. Otherwise pull and rotate the plug clockwise so the stopper should face 'OPEN' side.
- Apply the engine oil on the head cover mating surface or the gasket of the plug.
- Insert the plugs in the head cover.
- Rotate the plug inserted counterclockwise 90°.
- After installation, rotate the plug clockwise. If it is rotated, repeat the step a ~ d.

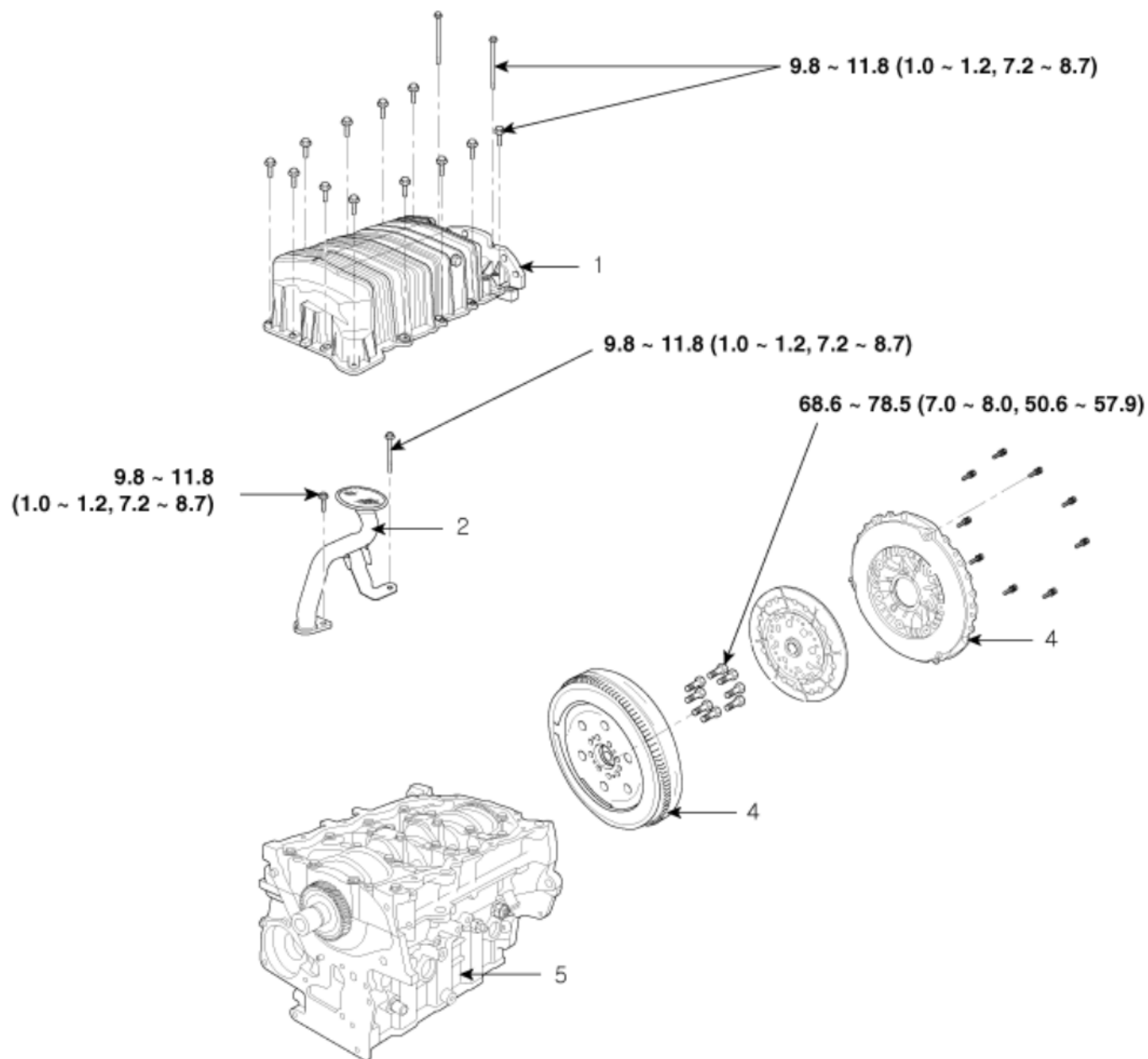
NOTICE

Plug gasket must be replaced.

19. Install the fuel tube.(Refer to Injector in FLC group)

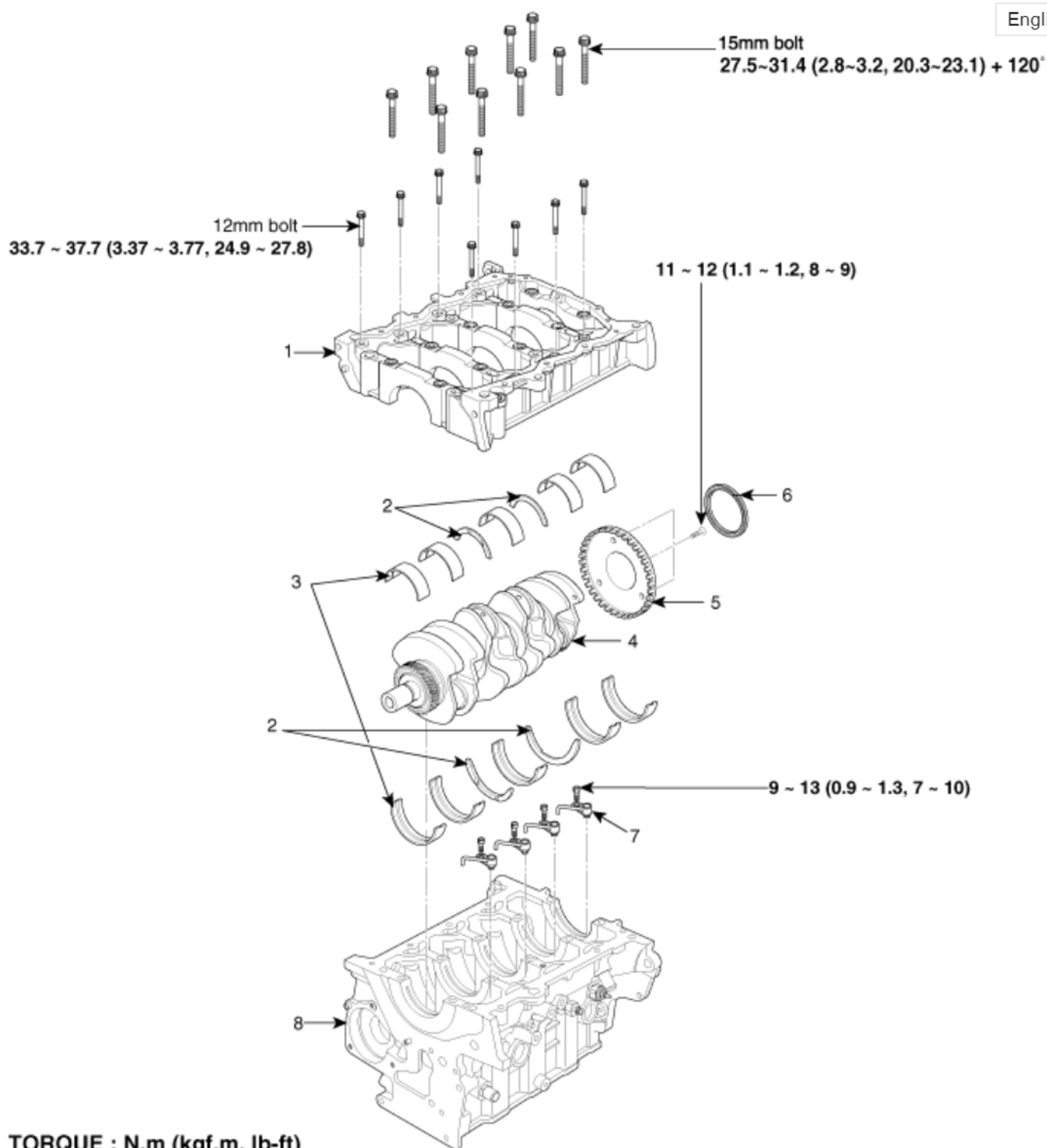
20. Install the timing belt.

COMPONENTS



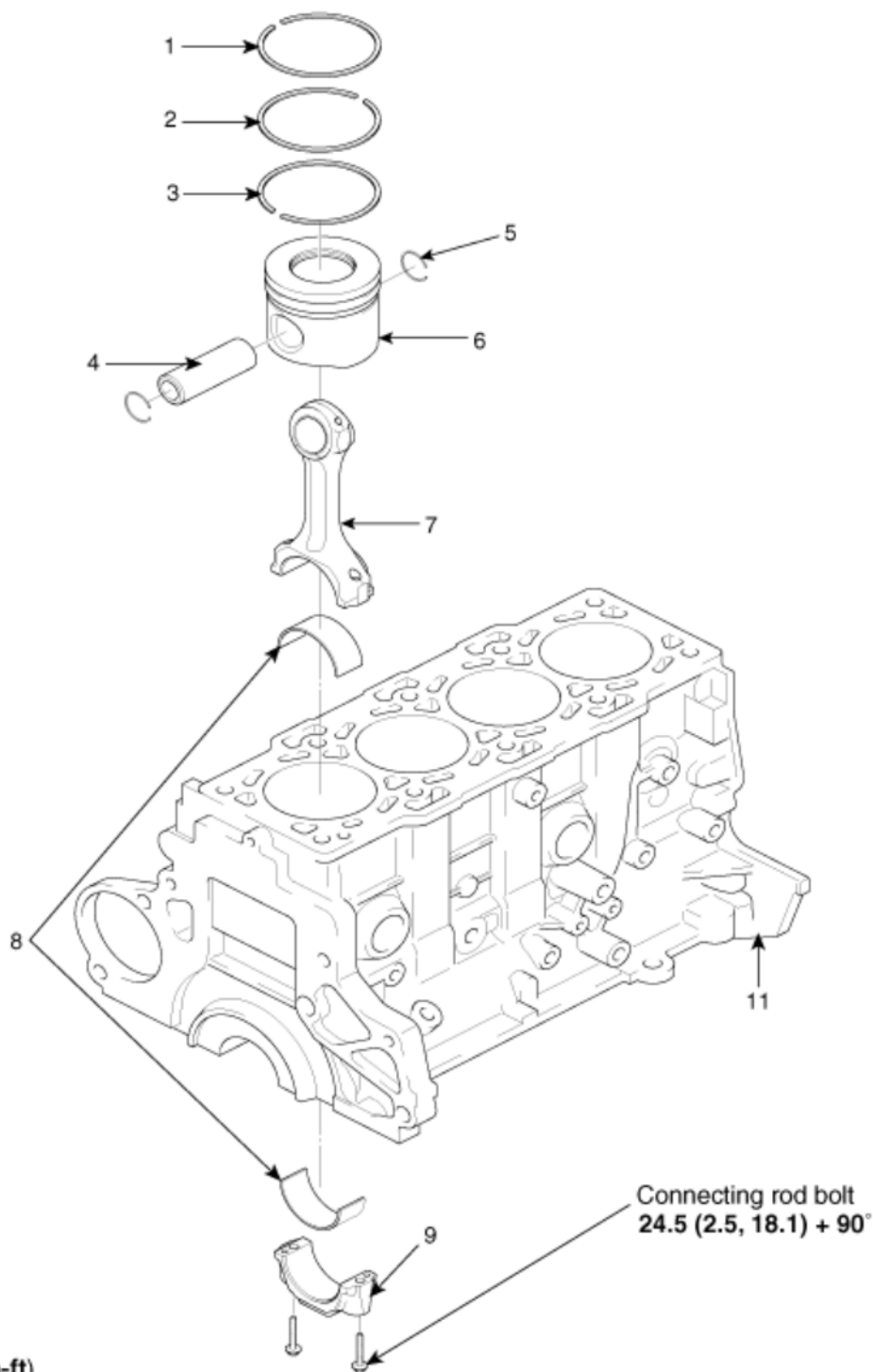
1. Oil pan
2. Oil screen

3. Dual mass flywheel
4. Cylinder block assembly



1. Badplate assembly
2. Center bearings
3. Main bearings
4. Crankshaft

5. Crankshaft position sensor wheel
6. Crankshaft rear oil seal
7. Piston cooling jet (Oil jet)
8. Cylinder block assembly



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

1. Piston ring No. 1
2. Piston ring No. 2
3. Oil ring
4. Piston pin
5. Snap ring

6. Piston
7. Connecting rod
8. Connecting rod bearings
9. Connecting rod bearing cap
10. Cylinder block assembly

Connecting rod bolt
24.5 (2.5, 18.1) + 90°

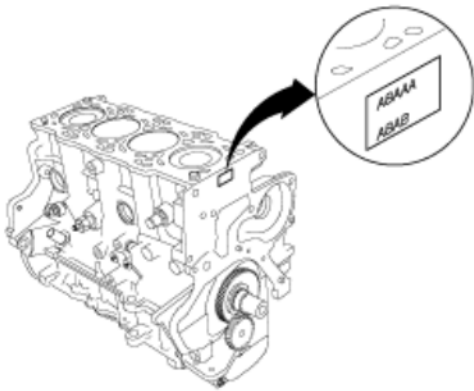
REPLACEMENT

MAIN BEARING SELECTION

Crankshaft Bore Code Location

- Letters have been stamped on the end of the block as a code for the size of each of the 5 main journal bores. Write down the crank bore codes.

If you can't read the codes because of accumulated dirt and dust, do not scrub them with a wire brush or scraper. Clean them only with solvent or detergent.

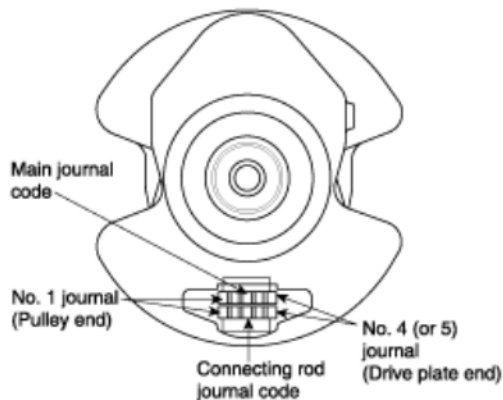


Discrimination of cylinder block

Discrimination		SIZE (Inside diameter of crank bore)
Class	Mark	
A	A	Ø64mm(2.5197in) (0 ~ +0.006in)(0 ~ +0.0002in)
B	B	Ø64mm(2.5197in) (+0.006 ~ +0.012in)(+0.0002~0.0005in)
C	C	Ø64mm(2.5197in) (+0.012 ~ +0.018in)(+0.0005~0.0007in)

Main Journal Code Locations

- The main Journal Codes are stamped on the No.1 web.



Discrimination of crank shaft

Discrimination		SIZE (Outside diameter of main journal)
Class	Mark	
I	A	Ø60mm(2.3622in)

		(+0.014 ~ +0.020in)(+0.0006~+0.0008in)	English ▼
II	B	Ø60mm(2.3622in) (+0.008 ~ +0.014in)(+0.0003~0.0006in)	
III	C	Ø60mm(2.3622in) (+0.002 ~ +0.008in)(+0.0001~+0.0003in)	

2. Use the crank bore codes and crank journal codes to select the appropriate replacement bearings from the following table.

NOTICE

- Color code is on the edge of the bearing. Refer to the table in the step 6 of the main bearing clearance inspection.
- When using bearing halves of different colors, it dose not matter which color is used in the top or bottom.

Installing procedure of bearing

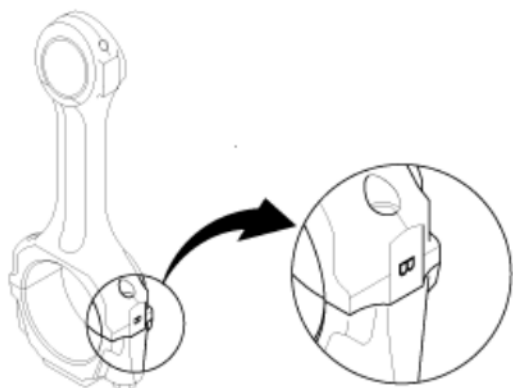
Shaft bore combination		Bearing mark	Oil clearance
Shaft mark	Bore mark		
I (A)	A (A)	A (BLUE)	0.024 ~ 0.042mm (0.0009 ~ 0.0017in)
	B (B)	B (BLACK)	
	C (C)	C (-)	
II (B)	A (A)	B (BLACK)	
	B (B)	C (-)	
	C (C)	D (GREEN)	
III (C)	A (A)	C (-)	
	B (B)	D (GREEN)	
	C (C)	E (YELLOW)	

Rod Bearing Selection

1. Inspect each connecting rod for cracks and heat damage.

Connecting Rod Big End Bore Code Locations

1. Each rod has tolerance range from 0 to 0.018mm (0.0007in.), in 0.006mm (0.0002in.) increments, depending on the size of its big end bore. It's then stamped with a letter (A, B or C) indicating the range. You may find any combination of letters in any engine.



NOTICE

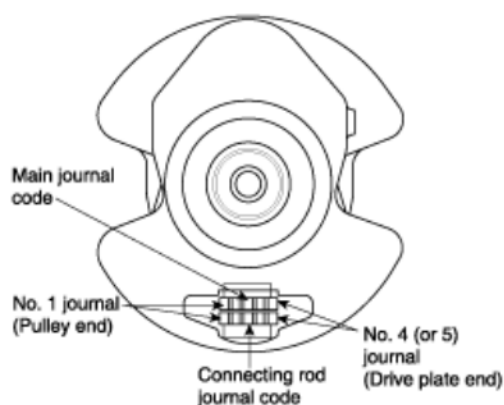
Discrimination connecting rod

Discrimination		SIZE (Inside diameter of connecting rod big end bore)
Class	Mark	
A	A	Ø 53mm(2.0866in) (0 ~ +0.006in)(0~+0.0002in)
B	B	Ø 53mm(2.0866in) (+0.006 ~ +0.012in)(+0.0002~0.0005in)
C	C	Ø 53mm(2.0866in) (+0.012 ~ +0.018in)(0.0005~0.0007in)

Connecting Rod Journal Code Locations

1. The connecting Rod Journal Codes are stamped on the No. 1 web.

)

**NOTICE**

Discrimination of crank shaft pin

Discrimination		SIZE (Outside diameter of pin)
Class	Mark	
I	A	Ø50mm(1.9685in) (+0.020 ~ +0.026in)(+0.0008~0.0010in)
II	B	Ø50mm(1.9685in) (+0.014 ~ +0.020in)(+0.0006~0.0008in)
III	C	Ø50mm(1.9685in) (+0.008 ~ +0.014in)(+0.0003~0.0006in)

2. Use the big end bore codes and rod journal codes to select appropriate replacement bearings from the following table.

NOTICE

Color code is on the edge of the bearing.

Refer to the table in the step 5 of rod bearing clearance inspection.

Shaft bore combination		Bearing mark	Oil clearance
Shaft mark	Bore mark		

I	A (A)	A (BLUE)	0.024 ~ 0.042mm (0.0009~0.0017in)
	B (B)	B (BLACK)	
	C (C)	C (WHITE)	
II	A (A)	B (BLACK)	
	B (B)	C (WHITE)	
	C (C)	D (GREEN)	
III	A (A)	C (WHITE)	
	B (B)	D (GREEN)	
	C (C)	E (YELLOW)	

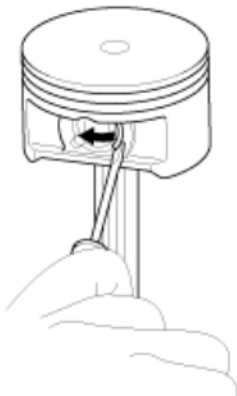
Piston, Pin and Connecting Rod

1. Apply engine oil to the piston pin snap rings and turn them in the ring grooves.

NOTICE

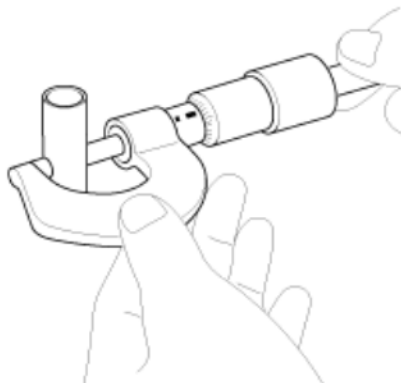
Take care not to damage the ring grooves.

2. Remove both snap rings(A) carefully so they do not go flying or get lost. Wear eye protection.



3. Remove the piston pin and the connecting rod assembly.
4. Measure the diameter of the piston pin.

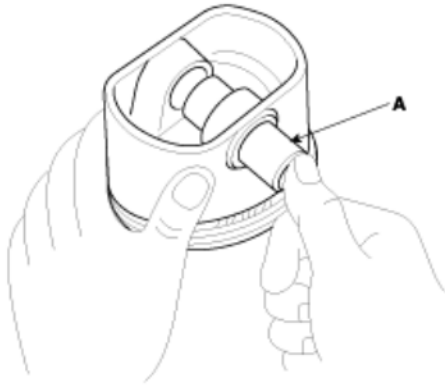
Piston Pin Diameter
 Standard (New)
 27.995 ~ 28.000mm (1.1022 ~ 1.1024in.)



NOTICE

Inspect the piston, piston pin and connecting rod when they are at room temperature.

5. Zero the dial indicator to the piston pin diameter.
6. Check the difference between the piston pin diameter and piston pin hole diameter in the piston.
Piston Pin-to-Piston Clearance
Standard (New)
0.015 ~ 0.030mm (0.00059 ~ 0.00118in.)
7. Measure the piston pin-to-connecting rod clearance.
Piston Pin-to-Connecting Rod Clearance
Standard (New)
0.022 ~ 0.039mm (0.00087 ~ 0.00154in.)
8. Set a snap ring in one side of piston pin hole.
9. Before inserting the piston pin, apply a sufficient amount of the lubricant oil to the outer surface of the piston, the inner surface of the piston pin hole and the small end bore of the connecting rod.
10. Insert the piston pin(A). Assembly the piston and connecting rod with the embossed front marks on the same side.



NOTICE

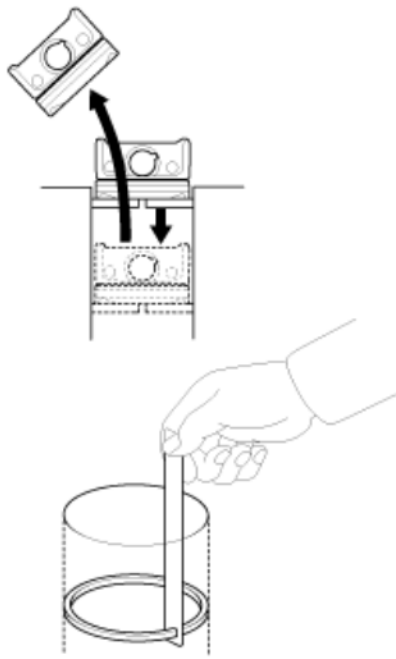
The front mark of the piston is embossed on the piston whereas some letters are located on a side surface of the connecting rod as the front mark.

CAUTION

- Be sure to keep the small end bore, piston pin hole and piston pin undamaged and unscratched when inserting the piston pin.
- Set the snap rings to be sure for contacting with the groove of the piston pin hole.

Piston Ring

1. Using a piston, push a new ring into the cylinder bore.



2. Measure the piston ring end-gap(B) with a feeler gauge :

- If the gap is too small, check to see if you have the proper rings for your engine.
- If the gap is too large, recheck the cylinder bore diameter against the wear limits. If the bore is over the service limit, the cylinder block must be rebored.

Piston Ring End-Gap

Top ring

Standard (New) : 0.20 ~ 0.35mm (0.008 ~ 0.014in.)

Second Ring

Standard (New) : 0.40 ~ 0.50mm (0.016 ~ 0.024in.)

Oil Ring

Standard (New) : 0.20 ~ 0.40mm (0.008 ~ 0.016in.)

3. Using a ring expander, remove the old piston rings.

4. Clearance all ring grooves thoroughly with a squared-off broken ring or ring groove cleaner with a blade to fit the piston grooves.

Top ring groove

1.915 ~ 1.945mm (0.07539 ~ 0.07657in.)

2nd ring groove

2.060 ~ 2.080mm (0.08110 ~ 0.08189in.)

Oil ring groove

3.020 ~ 3.040mm (0.11889 ~ 0.12008in.)

File down a blade if necessary.

Do not use a wire brush to clean the ring grooves, or cut the ring grooves deeper with cleaning tools.

NOTICE

If the piston is to be separated from the connecting rod, do not install new rings yet.

5. Install the piston rings.

Piston Ring Dimensions

Top Ring (Standard)

Width : 2.95 ~ 3.25mm (0.116 ~ 0.128in.)

Thickness : 2mm (0.079in.)

Second Ring (Standard)

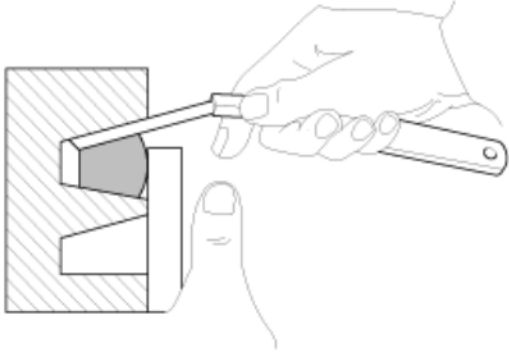
Width : 3.60 ~ 3.90mm (0.142 ~ 0.154in.)
Thickness : 1.970 ~ 1.995mm (0.078 ~ 0.079in.)

6. After installing a new set of rings, measure the ring-to-groove clearances :

Top Ring Clearance

Standard (New)

0.083 ~ 0.137mm (0.00327 ~ 0.00529in.)



Second Ring Clearance

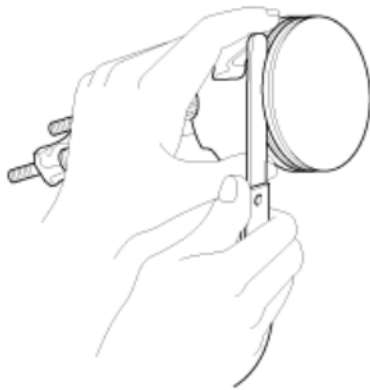
Standard (New)

0.065 ~ 0.110mm (0.00256 ~ 0.00433in.)

Oil Ring Clearance

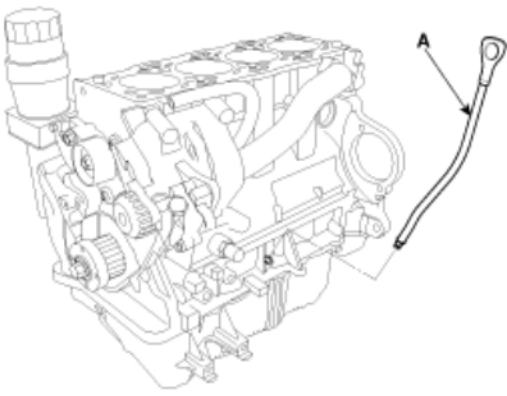
Standard (New)

0.03 ~ 0.07mm (0.00118 ~ 0.00275in.)

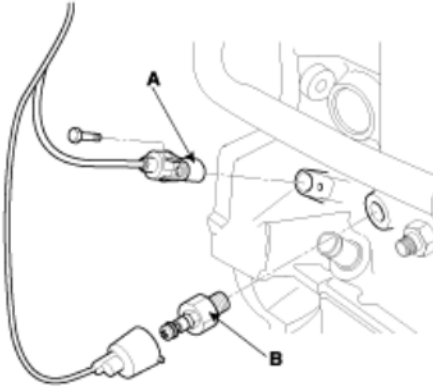


REMOVAL

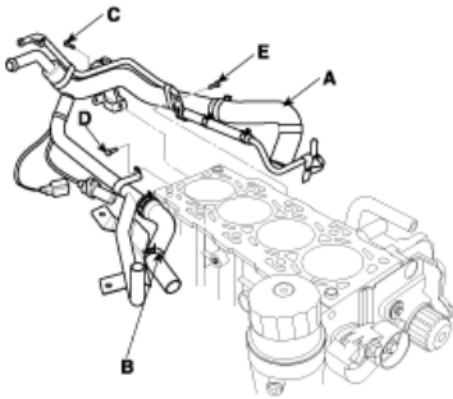
1. Remove the engine and transaxle assembly from the vehicle.(Refer to Engine and transaxle assembly in this Group)
2. Remove the timing belt assembly.(Refer to Timing system in this Group)
3. Remove the intake and the exhaust manifold.(Refer to Cylinder head assembly in this Group)
4. Remove the cylinder head assembly.
5. Remove the alternator. (Refer to Alternator in EEC Group)
6. Remove the engine oil level gauge(A).



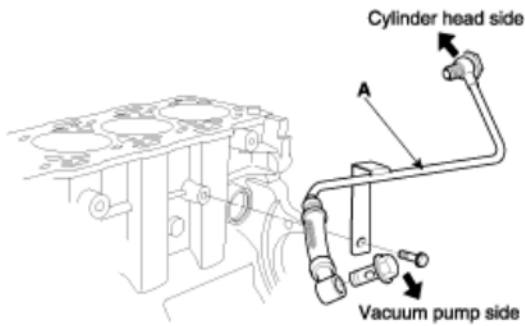
7. Remove the Crankshaft Position Sensor(CKP)(A) and the oil pressure switch(B).



8. Remove the heater and oil cooler return pipe assembly(A) after loosening the hose clamps(B) and the bolts(C, D, E).

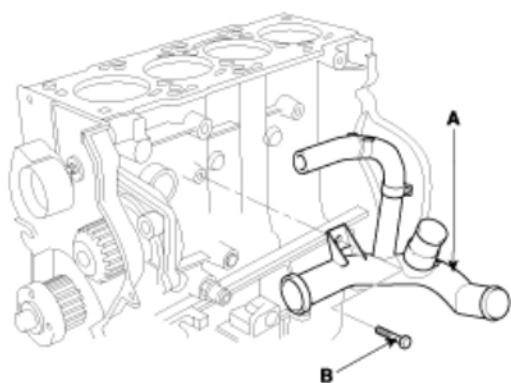


9. Remove the tube(A) between the vacuum pump and the cylinder head.

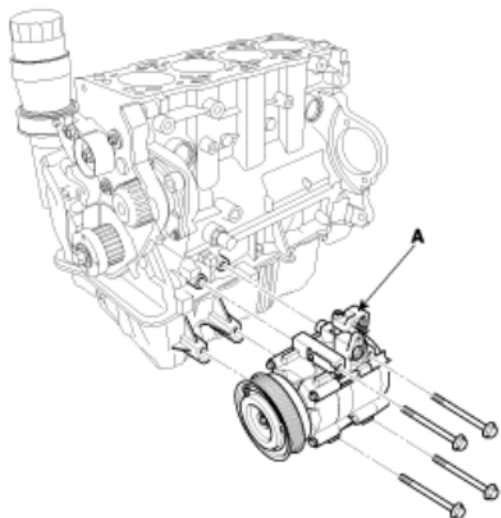


10. Remove alternator lower bracket.

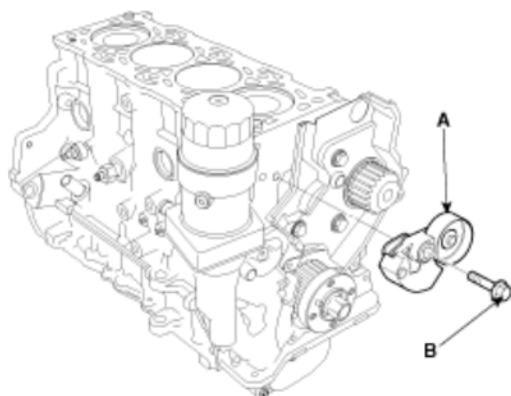
11. Remove the water inlet pipe assembly(A) by loosening a bolt(B) and clamps.



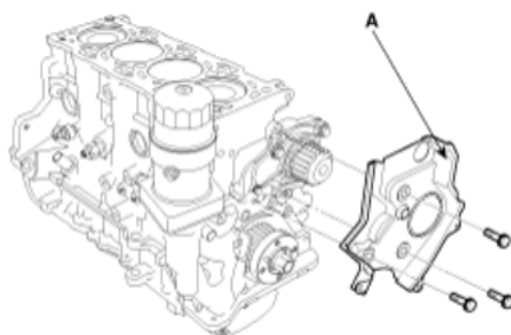
12. Remove the air compressor(A). (See HA group - compressor)



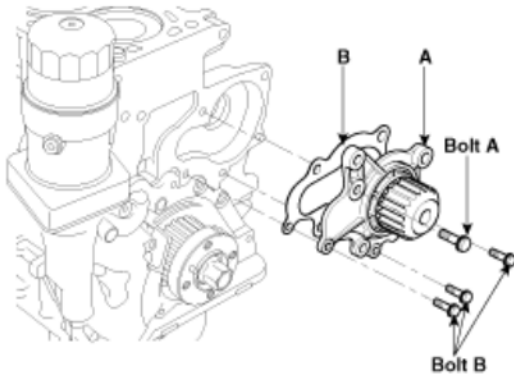
13. Remove the auto-tensioner(A) by loosening the bolt(B).



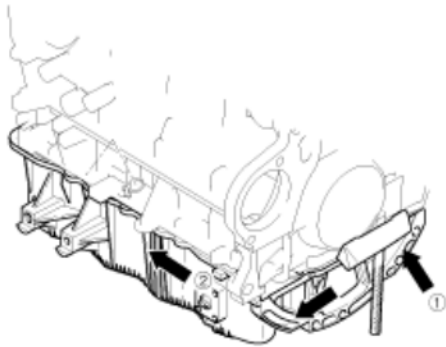
14. Remove the timing belt rear cover(A).



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



16. Remove the oil pan(A).

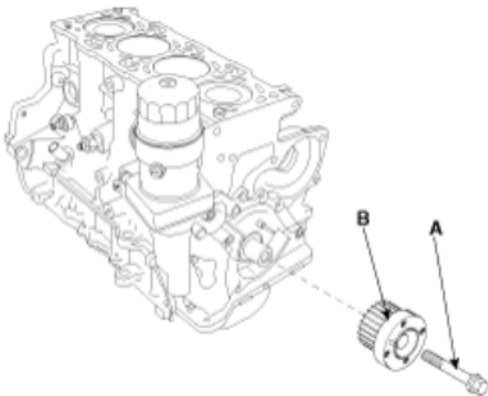


CAUTION

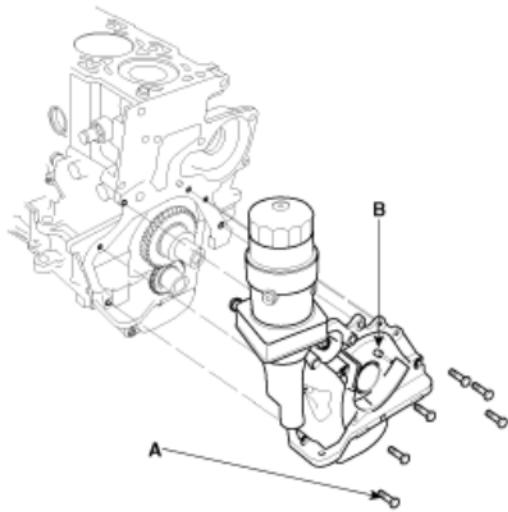
- Insert the SST between the oil pan and the ladder frame by tapping it with a plastic hammer in the direction of ① arrow.
- After tapping the SST with a plastic hammer along the direction of ② arrow around more than 2/3 edge of the oil pan, remove it from the ladder frame.
- Do not turn over the SST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

17. Remove oil screen for removal of oil pump assembly(B).

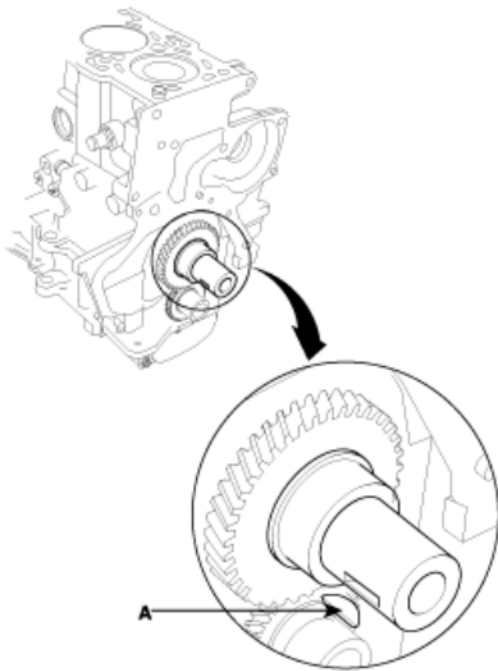
18. Remove the crankshaft bolt(A), then separate the crankshaft sprocket(B).



19. Remove the oil-pump assembly(B) by loosening the bolts(A).



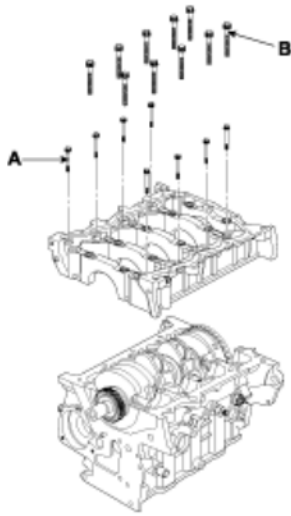
20. Remove the crankshaft key(A).



DISASSEMBLY

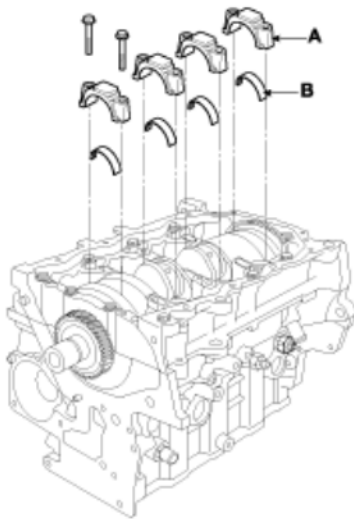
1. Remove the bed plate assembly.

- Remove the bolts(A).
To prevent warpage, unscrew the bolts in sequence 1/3 turn at a time : repeat the sequence until all bolts are loosened.
- Remove the bolts(B).

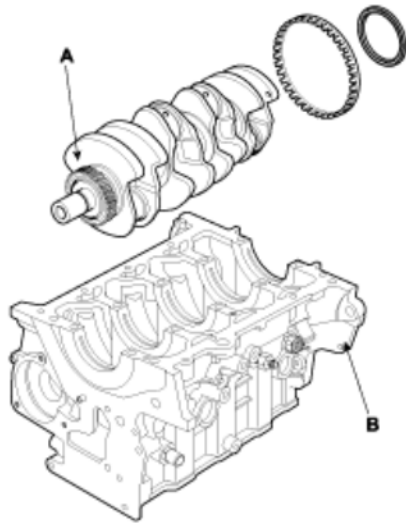


2. Remove the connecting rod bearing caps(A) and bearings(B).

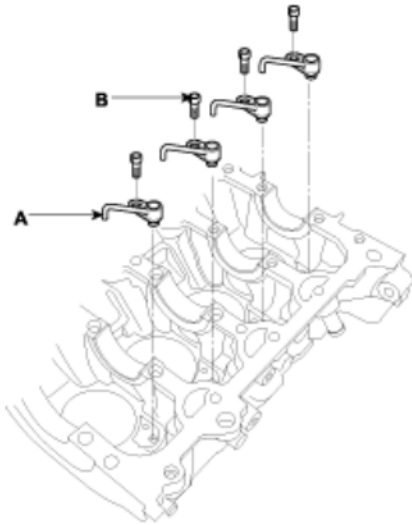
- After removing No. 1 and 4 connecting rod bearing caps and turn the crankshaft No. 2 and 3 crankpins are at the top.
- Remove the rest bearing caps and bearings.
- Keep all caps/bearings in order.



3. If you can feel a ridge of metal or hard carbon around the top of each cylinder, remove it with a ridge reamer. Follow the reamer manufacturer's instructions. If the ridge is not removed, it may damage the pistons as they are pushed out.
4. Drive out the piston assembly from the engine block.
 - a. Reinstall the connecting rod bearings and caps after removing each piston/connecting rod assembly.
 - b. To avoid mixup on reassembly, mark each piston/connecting rod assembly with its cylinder number.
5. Lift the crankshaft(A) out of the cylinder block(B), being careful not to damage the journals.



6. Remove the piston oil jet(A) by loosening the hexagonal bolt(B) with a hexagonal wrench.



INSPECTION

FLYWHEEL

1. Inspect ring gear teeth for wear or damage.
2. Flywheel bolts should be free from detrimental flaws.

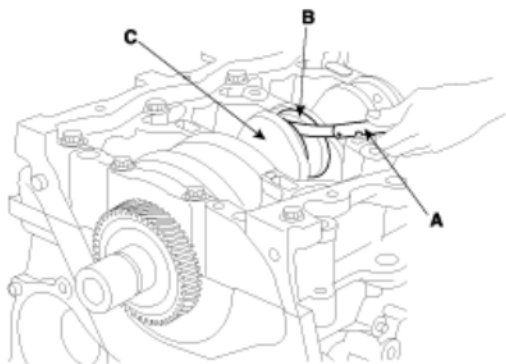
Connecting Rod and Crankshaft End Play

1. Measure the connecting rod end play with a feeler gauge(A) between the connecting rod(B) and crankshaft(C).

Connecting Rod End play

Standard (New) : 0.10 ~ 0.35mm (0.004 ~ 0.014in.)

Service Limit : 0.40mm (0.016in.)



- If the connecting rod end play is out-of-tolerance, install a new connecting rod, and recheck. If it is still out-of-tolerance, replace the crankshaft.
- If the end play is excessive. Replace parts as necessary.

Main Bearing Clearance

- To check main bearing-to-journal oil clearance, remove the bed plate, the crankshaft and the bearing halves.
- Clean each main journal and bearing half with a clean shop towel.
- Cut plastigauge to the same length as the width of the bearing.
- Place one strip of plastigauge across each main journal on the cylinder block and the bed plate, avoiding the oil holes.
- Reinstall the bearings, crankshaft and bed plate then torque the bolts to the specified value.

NOTICE

Do not rotate the crankshaft during inspection.

- Remove the bed plate and bearings again and measure the widest part of the plastigauges with a calibrated scale on which an arrow of marks has been printed.

Main bearing-to-journal Oil Clearance
Standard (valve)
0.024 ~ 0.042mm (0.0009 ~ 0.0017in.)

NOTICE

Discrimination of crankshaft main bearing

Discrimination		SIZE (Thickness of bearing)	Place of identification mark
Class	Mark		
E	YELLOW	1.987~1.990mm (0.0782~0.0783in)	
D	GREEN	1.984~1.987mm (0.0781~0.0782in)	
C	-	1.981~1.984mm (0.0780~0.0781in)	
B	BLACK	1.978~1.981mm (0.0779~0.0780in)	
A	BLUE	1.975~1.978mm (0.0778~0.0779in)	

7. If the plastigauge measure too wide or too narrow, remove the crankshaft, and remove the upper half of the bearing. Install a new, complete bearing with the same color code(s), and recheck the clearance. Do not file, shim, or scrape the bearings to adjust clearance.
8. If the plastigauge shows the clearance is still incorrect, try the next larger or smaller bearing (the color listed above or below that one), and check again. If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start over.

Rod bearing Clearance

1. Remove the connecting rod cap and bearing half.
2. Clean the crankshaft rod journal bearing half with a clean shop towel.
3. Place plastigauge across the rod journal.
4. Reinstall the bearing half and cap, and torque the bolt.

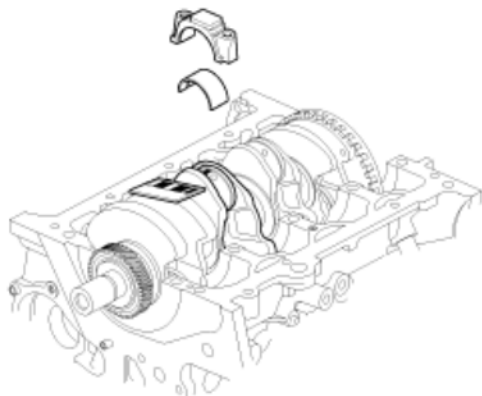
NOTICE

Do not rotate the crankshaft during inspection.

5. Remove the rod cap and bearing half and measure the widest part of the plastigauge.

Connecting Rod Bearing-to-Journal Oil

Clearance : 0.024 ~ 0.042mm (0.0009 ~ 0.0017in.)

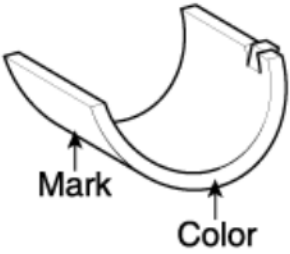


6. If the plastigauge measure too wide or too narrow, remove the upper half of the bearing, install a new, complete bearing with the same color code(s), and recheck the clearance. Do not file, shim, or scrape the bearings or the caps to adjust clearance.

NOTICE

Discrimination of connecting rod bearing

Discrimination		Size (Thickness of bearing)	Place of Identification
Class	Mark		
E	YELLOW	1.484 ~ 1.487mm (0.0584~0.0585in)	
D	GREEN	1.481 ~ 1.484mm (0.0583~0.0584in)	
		1.478 ~ 1.481mm	

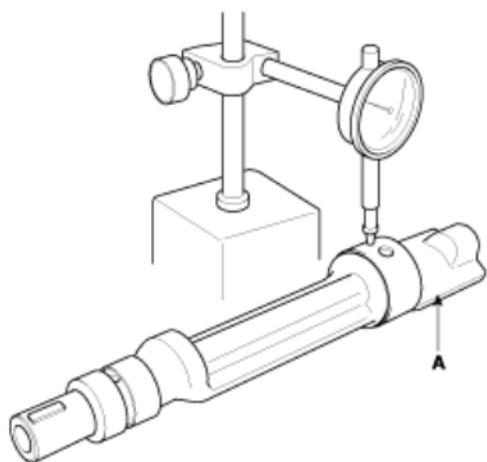
C	WHITE	(0.0582~0.0583in)	
B	BLACK	1.475 ~ 1.478mm (0.0581~0.0582in)	
A	BLUE	1.472 ~ 1.475mm (0.0580~0.0581in)	

7. If the plastigauge shows the clearance is still incorrect, try the next larger or smaller bearings (the color listed above or below that one), and check clearance again. If the proper clearance cannot be obtained by using the appropriate larger or smaller bearing, replace the crankshaft and start over.

Balancer Shafts

1. Measure runout on the journals of each balancer shaft(A) to make sure the balancer shafts are not bent.

Balancer Shaft Total Indicated Runout
Standard (New) : 0.025mm (0.00098in.)



2. Measure the diameters of the journals on the balance shafts(A).

Journal Diameter

Standard (New)

No. 1 journal :

19.980 ~ 19.993mm (0.7866 ~ 0.7871in.)

No. 2 journal :

27.99 ~ 28.01mm (1.1020 ~ 1.1028in.)

No. 3 journal :

41.99 ~ 42.01mm (1.6531 ~ 1.6539in.)



3. Measure the inner diameters of the bearings for the balance shafts.

Bearing Inner Diameter

Standard (New)

No. 1 journal :

20.00 ~ 20.02mm (0.7874 ~ 0.7882in.)

No. 2 journal :

28.06 ~ 28.08mm (1.1047 ~ 1.1055in.)

No. 3 journal :

42.06 ~ 42.08 (1.6559 ~ 1.6567in.)

4. Calculate the shaft-to-bearings oil clearances.

BEARING I.D - JOURNAL O.D = OIL CLEARANCE

Shaft-to-Bearings Oil clearance

Standard (New)

No. 1 journal :

0.007 ~ 0.041mm (0.00028 ~ 0.00161in.)

No. 2 journal :

0.050 ~ 0.090mm (0.00197 ~ 0.00354in.)

No. 3 journal :

0.050 ~ 0.090mm (0.00197 ~ 0.00354in.)

CRANKSHAFT

Straightness

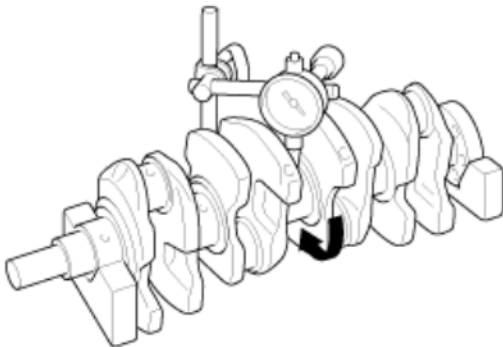
NOTICE

- Clean the crankshaft oil passages with pipe cleaners or a suitable brush.
- Check the keyway and threads.

1. Support the crankshaft with V-blocks.
2. Measure runout on all main journals to make sure the crank is not bent. Rotate the crankshaft two complete revolutions. The difference between measurements on each journal must not be more than the standard value.

Crankshaft Total Indicator Runout

Standard (New) : 0.06mm (0.002in.) max.

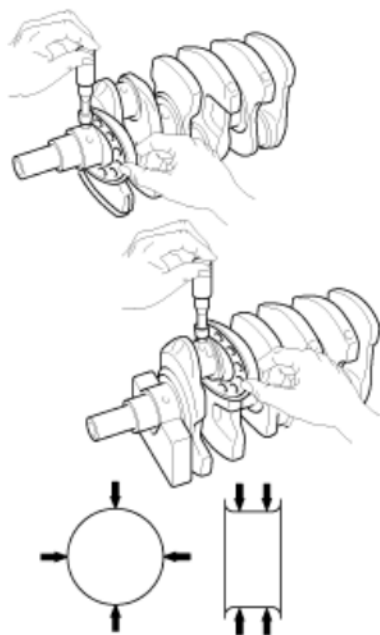


Out-of-Round and Taper

- 1) Measure out-of-round at the middle of each rod and main journal in two places. The difference between measurements on each journal must not be more than the service limit.

Journal Out-of-Round

Standard (New) : 0.0035mm (0.0001in.) max.



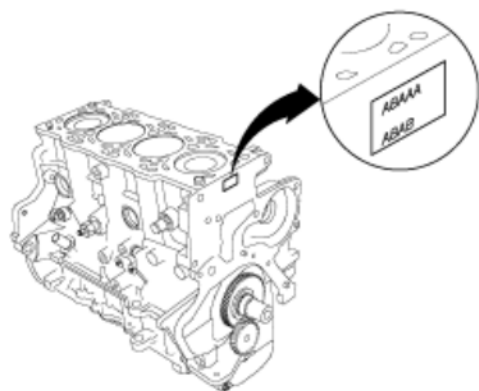
- 2) Measure taper at the edge of each rod and main journal. The difference between measurements on each journal must not be more than the serive limit.

Journal Taper

Standard (New) : 0.006mm (0.0002in.) max.

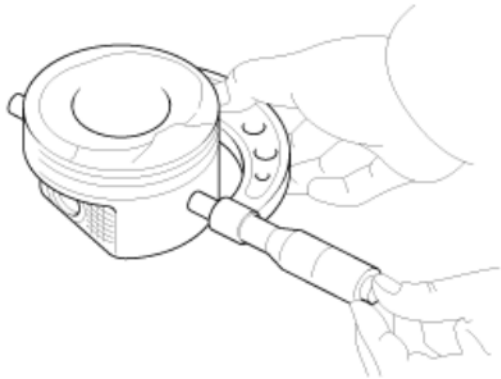
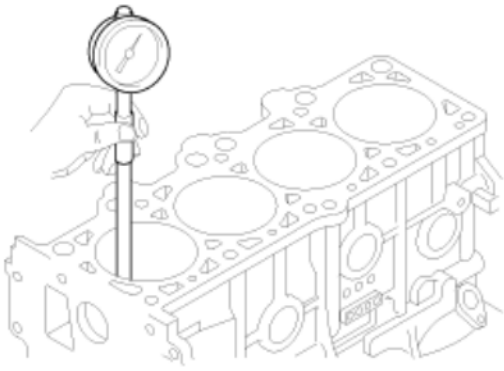
Block and Piston

1. Check the piston for distortion or cracks.
2. Measure the piston diameter at a point 10mm (0.4in) from the bottom of the skirt. There are three standard-size pistons (A, B and C). The letter is stamped on the top of the piston. Letters are also stamped on the block as cylinder bore sizes.



Piston Diameter and Cylinder Bore
Standard value :

Grade	A	B	C
Piston Outer Diameter	82.92 ~ 82.93mm (3.2646~3.2650in)	82.93 ~ 82.94mm (3.2650~3.2653in)	82.94 ~ 82.95mm (3.2650~3.2657in)
Cylinder Bore	83.00 ~ 83.01mm (3.2677~3.2681in)	83.01 ~ 83.02mm (3.2681~3.2685in)	83.02 ~ 83.03mm (3.2685~3.2686in)
Clearance	0.070 ~ 0.090mm(0.0028~0.0035in)		



3. Measure wear and taper in direction X and Y at three levels in each cylinder as shown. If measurements in any cylinder are beyond the cylinder bore standard value (Refer to the previous page), replace the block. If the block is to be rebored, refer to step 6 after reboring.

Oversize

0.25 : 83.250 ~ 83.280mm (3.2776 ~ 3.2787in.)

0.50 : 83.500 ~ 83.530mm (3.2874 ~ 3.2886in.)

Bore Taper

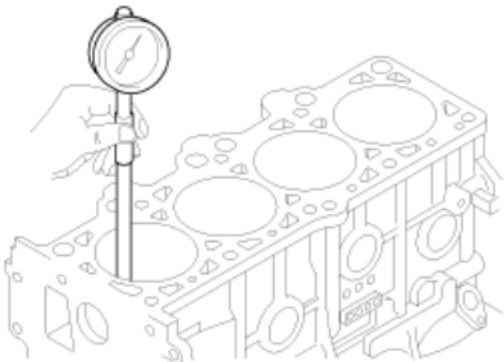
Limit : (Difference between first and third measurement)

0.01mm (0.0004in.) MAX.

Level 1 : No. 1 piston ring position at TDC(Top Dead Center).

Level 2 : Center of cylinder.

Level 3: Bottom of cylinder.



4. Scored or scratched cylinder bores must be honed.
5. Check the top of the block for warpage. Measure along the edges and across the center.

Engine Block Warpage

Standard (New)

0.042mm (0.00165in.) for width

0.096mm (0.00378in.) for length

0.012mm (0.00047in.)/50×50mm
Service Limit : 0.10mm (0.004in.)

6. Calculate the difference between the cylinder bore diameter and the piston diameter. If the clearance is near or exceeds the standard value, inspect the piston and cylinder block for excessive wear.

Piston-to-Cylinder Clearance

Standard (New) :

0.070 ~ 0.090mm (0.0028 ~ 0.0035in.)

Oversize Piston Diameter :

0.25 : 83.170 ~ 83.200mm (3.2744 ~ 3.2756in.)

0.50 : 83.420 ~ 83.450mm (3.2882 ~ 3.2881in.)

Cylinder Honing

Only a scored or scratched cylinder bore must be honed.

1. Measure the cylinder bores.

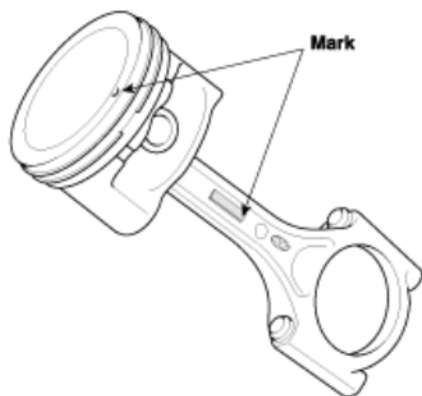
If the block is to be reused, hone the cylinders and remeasure the bores.

2. Hone the cylinder bores with honing oil and a fine stone. Do not use stones that are worn or broken.
3. When honing is complete, thoroughly clean the engine block of all metal particles. Wash the cylinder bores with hot soapy water, then dry and oil them immediately to prevent rusting. Never use solvent, it will redistribute the grit on the cylinder walls.
4. If scoring or scratches are still present in the cylinder bores after honing to the service limit, rebore the cylinder block. Some light vertical scoring and scratching is acceptable if it is not deep enough to catch your fingernail and does not run the full length of the bore.

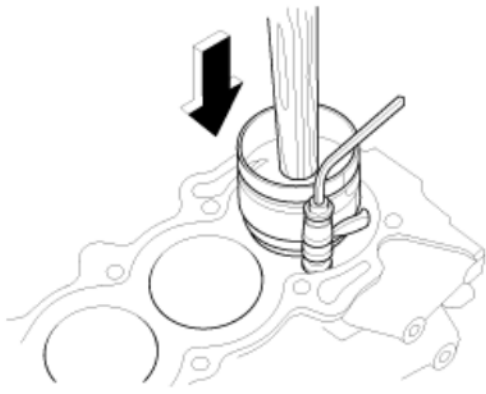
REASSEMBLY

PISTON

1. Remove the connecting rod caps then install the ring compressor and check that the bearing is securely in place.
2. Position the marks facing the timing belt side of the engine.



3. Position the piston in the cylinder and tap it in using the wooden handle of hammer. Maintain downward force on the ring compressor to prevent the rings from expanding before entering the cylinder bore.



4. Stop after the ring compressor pops free, and check the connecting rod-to-crank journal alignment before pushing the piston into place.
5. Check the connecting rod bearing clearance with plastigauge.
6. Apply engine oil to the bolt threads, then install the rod caps with bearings.

CRANKSHAFT AND BALANCER

1. Install the oil jets, tightening the hexagon socket head bolts with the torque 9 ~ 13Nm (0.9 ~ 1.3kgf.m, 6.5 ~ 9.4lb-ft)
2. Apply a coat of engine oil to the main bearings.
3. Install the bearing halves in the engine block.
4. Hold the crankshaft so rod journal No. 2 and rod journal No. 3 are straight up.
5. Lower the crankshaft into the block.
6. Install the bearing halves in the bed plate after applying a coat of engine oil.
7. Install the bed plate(C) to the cylinder block after applying the sealant (omniFIT FD2.0, DREIBOND 5105 or HYLOMAR 3000).

Tightening torque

15mm(B)

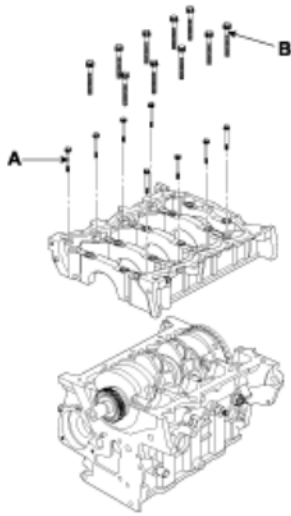
27.5 ~ 31.4N.m + (2.8 ~ 3.2kgf.m, 20.3 ~23.1lb-ft) + 120°

12mm(A)

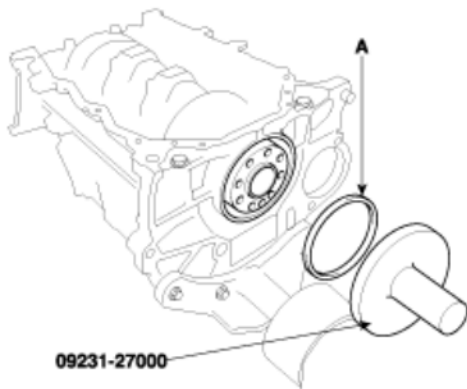
33.3 ~ 37.3N.m (3.4 ~ 3.8kgf.m, 24.6 ~27.5lb-ft)

CAUTION

Always use new cylinder head bolts.



8. Rotate the crankshaft clockwise to be seated properly.
9. Check the main bearing clearance with plastigauge.
10. Install the piston and connecting rod assemblies.
 - a. Apply coat of engine oil to the connecting rod bearings.
 - b. Install the bearing halves in the connecting rods.
 - c. Insert the assemblies into the cylinder bores.
 - d. Install the connecting rod caps and bolts finger tight
 - e. Rotate the crankshaft clockwise, seat the journals into connecting rod No.2 and connecting rod No.3. Install the connecting rod caps and bolts finger tight. Install caps so the bearing recess is on the same side as the recess in the rod.
 - f. Check the connecting rod bearing clearance with plastigage.
 - g. Apply engine oil to the bolt threads, then install the rod caps within bearings and torque the bolts to 24.5N.m + 90° (2.5kgf.m + 90°, 18.1lb-ft + 90°).
11. Using the SST(09231-27000), install the crankshaft oil seal(A) squarely.



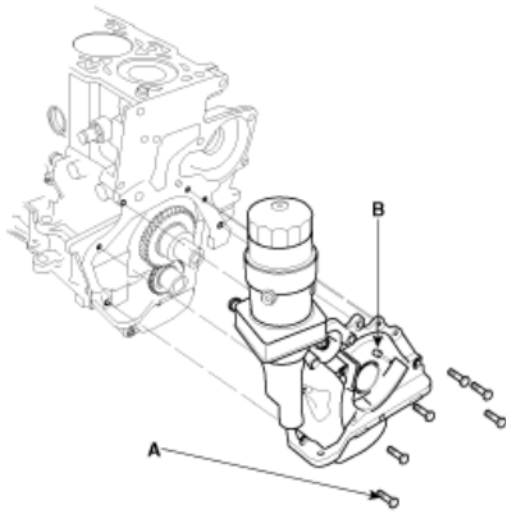
12. Clean and dry the mating surfaces.
Apply a light coat of oil to the crankshaft and to the lip of the seal.

INSTALLATION

1. Clean and dry the oil pump mating surface.

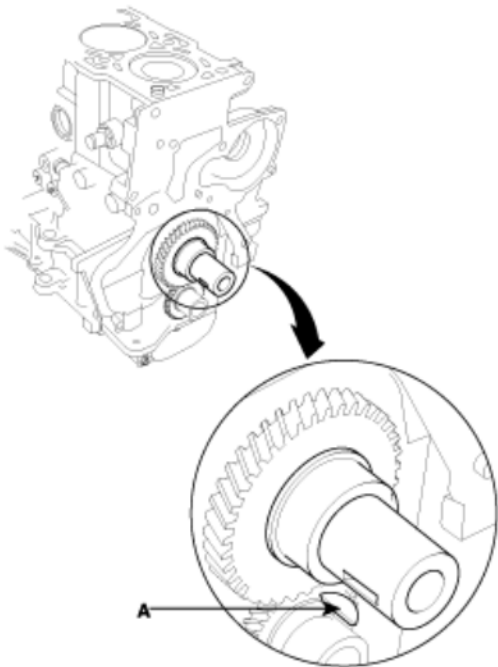
2. Install the oil pump

- a. Install a new crankshaft oil seal in the oil pump.
- b. Apply liquid gasket evenly to the block mating surface of the oil pump.
Standard liquid gaskets (or sealants)
LOCTITE5900 or TB1217H
 - Apply liquid gasket in a wide bead : $2.5 \pm 0.5\text{mm}$
 - Apply the liquid gasket without stoping.
 - Assemble the oil pump within 5 minutes after applying.
- c. Grease the lips of the oil seals.
- d. Align the oil pump gear with the crankshaft drive gear and install the oil pump(B).
Tightening torque(A)
 $19.6 \sim 26.5\text{N.m}$ ($2.0 \sim 2.7\text{kgf.m}$, $14.5 \sim 19.51\text{lb-ft}$)



- e. Clean the excess grease off the crankshaft and check the seals for distortion.

3. Install the crankshaft key(A) on the crankshaft assembly.

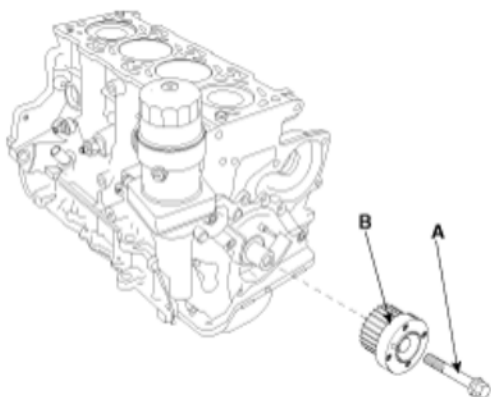


4. Insert the crankshaft sprocket(B) then tighten the crankshaft bolt(A).

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

NOTICE

Align the timing mark on the sprocket.



5. Install oil screen.

NOTICE

The bolt B should be tightened after the installation of the bolt A.

6. Clean and dry the bed plate and the oil pan mating surfaces.

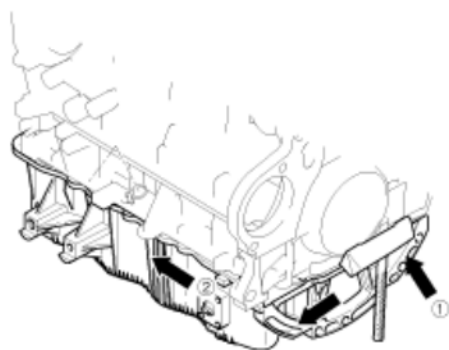
7. Apply liquid gasket evenly to the bed plate mating surface of the oil pan. Install the oil pan.

NOTICE

- Standard liquid gasket : LOCTITE 5900 or TB1217H
- Assemble the oil pan in 5 minutes after applying the liquid gasket.
- Apply liquid gasket in a 3mm wide bead without stopping.
- The clearance between the liquid gasket end and the flange inner end at T-joint should be 2~3mm(2places)

8. Tighten the bolt in two or three steps. In the final step, tighten all bolts.

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



NOTICE

After installing the oil pump assembly and the oil pan, remove the oil cooler and fill the 50cc engine oil.

9. Install water pump(A) with new gasket(B).

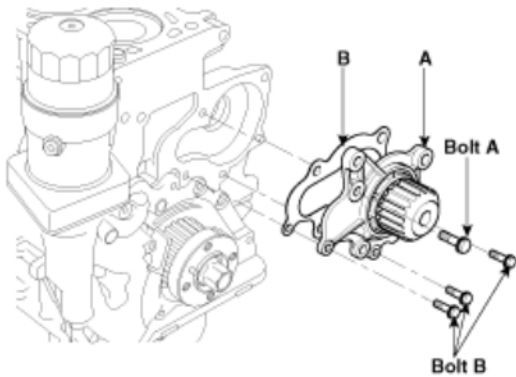
Tighten torque

Bolt A

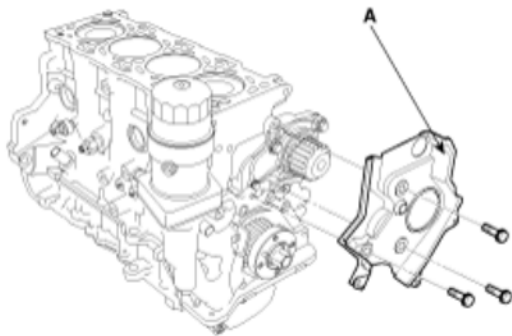
47.1 ~ 51.0N.m (4.8 ~ 5.2kgf.m, 34.7 ~ 37.6lb-ft)

Bolt B

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



10. Install the timing belt rear cover(A).



11. Install the auto-tensioner(A).

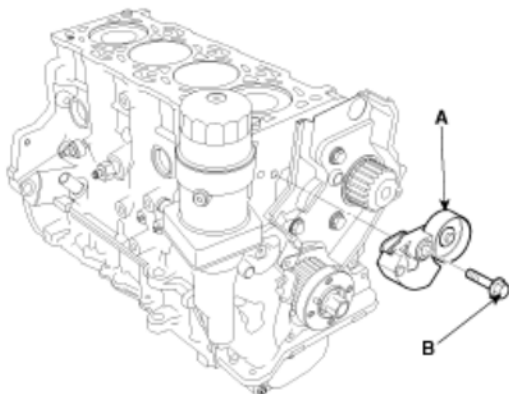
Tightening torque

Pivot bolt(B)

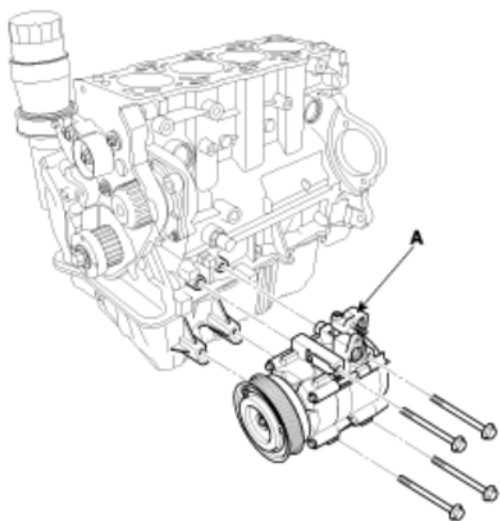
49.0 ~ 53.9N.m (5.0 ~ 5.5kgf.m, 36.2 ~ 39.8lb-ft)

Stop bolt

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



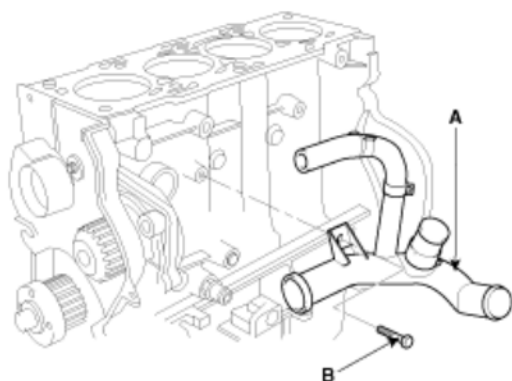
12. Install the air compressor(A). (Refer to Compressor in HA Group)



13. Install the water inlet pipe assembly(A), tightening the bolt(B).

Tightening torque

19.6 ~ 26.5N.m (2.0 ~ 2.5kgf.m, 14.5 ~ 19.5lb-ft)



14. Install the heater and oil cooler return pipe(A) assembly.

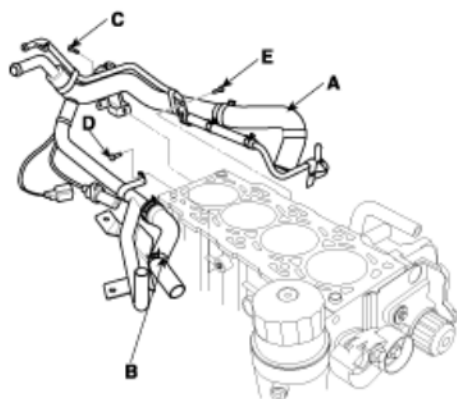
Tightening torque

Rear side bolt and left side bolt(C, D)

19.6 ~ 26.5N.m (2.0 ~ 2.5kgf.m, 14.5 ~ 19.5lb-ft)

Right side bolt(E)

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

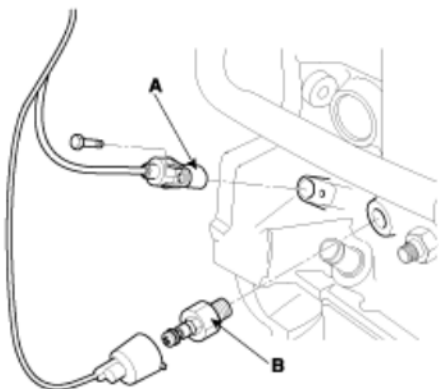


15. Install the Crankshaft Position Sensor(CKP)(A) and the oil pressure switch(B).

Tightening torque

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

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



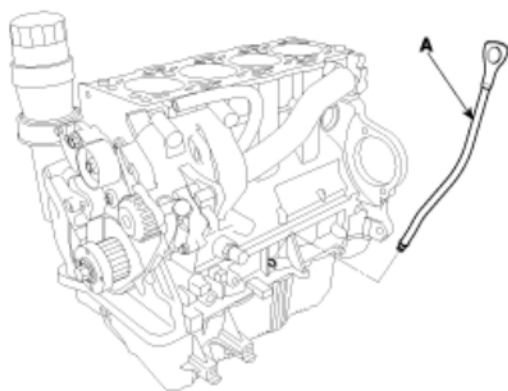
16. Install the cylinder head assembly.

17. Install the intake/exhaust manifold assemblies.

18. Install the oil level gauge(A).

Tightening torque

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

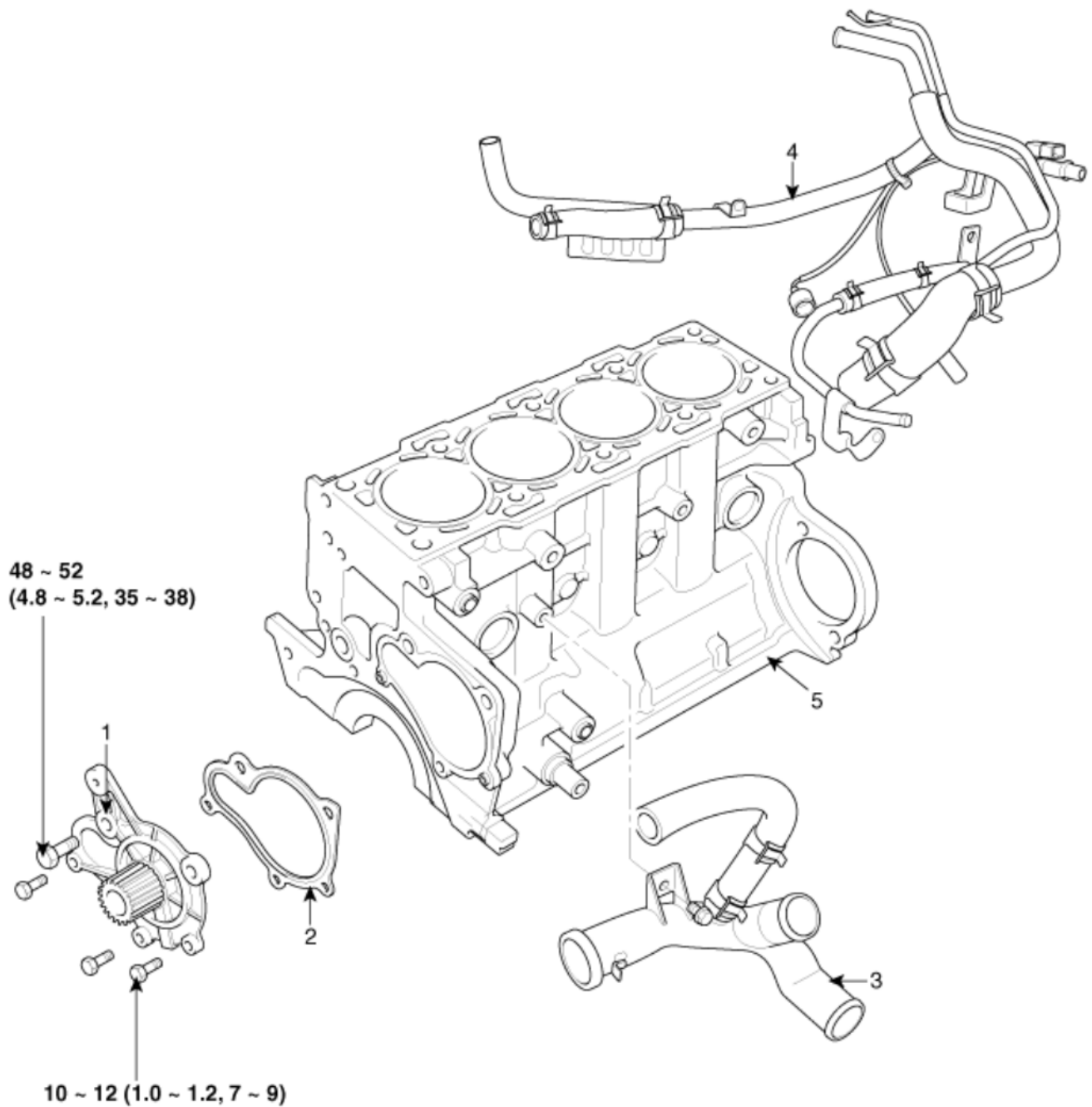


NOTICE

Apply engine oil to O-ring before assembly.

19. Install the timing belt assembly.

COMPONENTS



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

- 1. Coolant pump
- 2. Gasket
- 3. Coolant inlet pipe
- 4. Coolant hose & pipe
- 5. Cylinder block

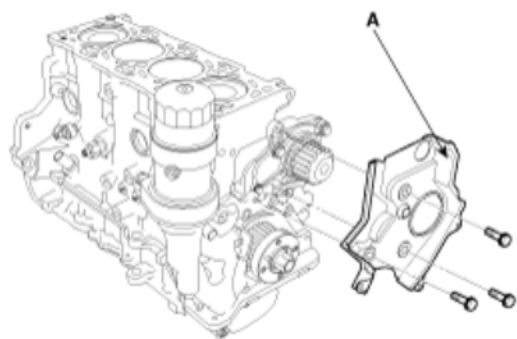
REMOVAL

Water Pump

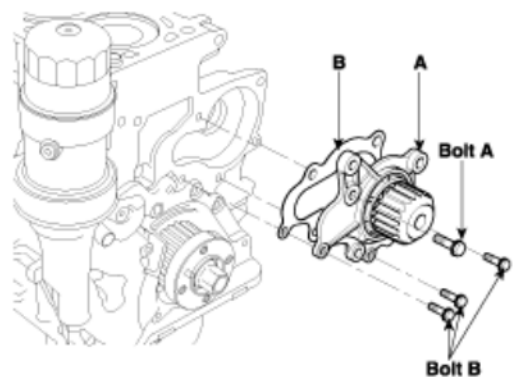
1. Remove radiator cap to speed drain.
2. Drain the engine coolant after removing drain plug(A).



3. Remove the timing belt.
4. Remove the timing belt rear cover(A).



5. Remove the water pump(A) with the gasket(B) by removing four bolts. (One bolt A and three bolt B)



6. Inspect, repair and clean the mating surface on the engine block.
7. Install the water pump, with a new gasket in the reverse order of removal.
Tightening torque
For timing belt rear cover

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

For water pump

Bolt A :

47.1 ~ 51.0N.m (4.8 ~ 5.2kgf.m, 34.7 ~ 37.6lb-ft)

Bolt B :

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

English ▼

8. Clean the spilled engine coolant.

RADIATOR

1. Remove the radiator cap to speed draining.
2. Loosen the radiator drain plug (A) and drain engine coolant.

Tightening torque

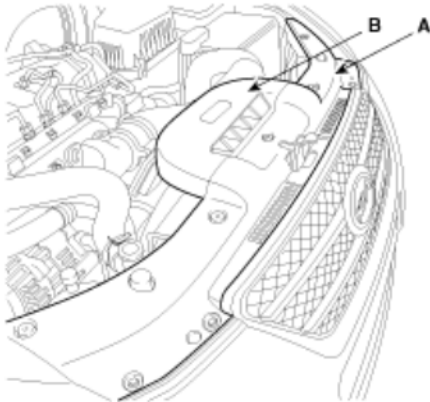
7.8 ~ 15.7N.m (0.8 ~ 1.6kgf.m, 5.8 ~ 11.6lb-ft)



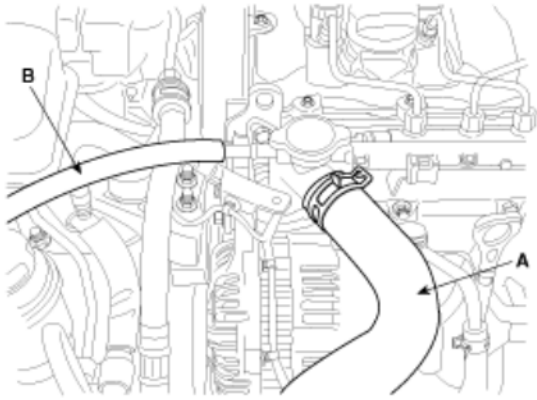
3. Remove the front bumper upper cover (A) and the air duct (B).

Tightening torque

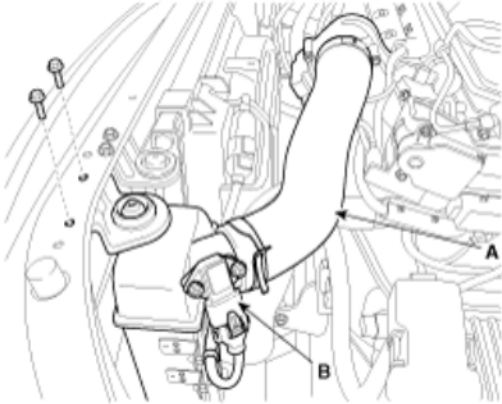
7.8 ~ 9.8N.m (0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)



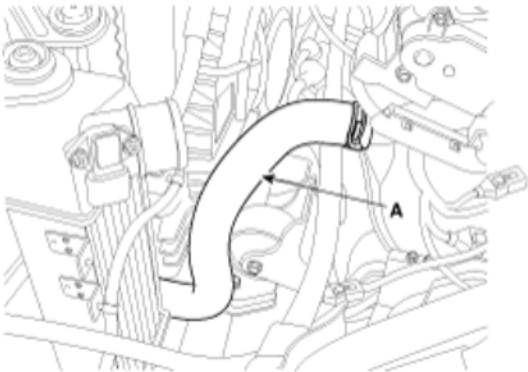
4. Remove the radiator upper hoses(A) and the coolant bleed hose(B).



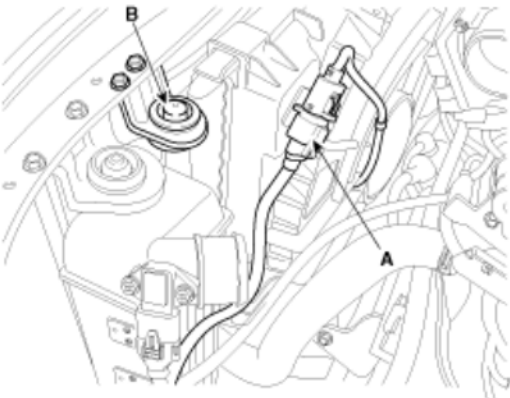
5. Remove the intercooler hose (A).



6. Remove the radiator lower hose(A).



7. Disconnect the fan motor connector (A) and remove the radiator mounting bracket (B).

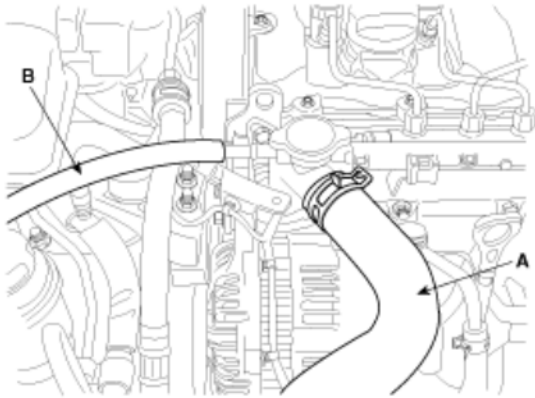


8. Pull radiator upper from engine room.

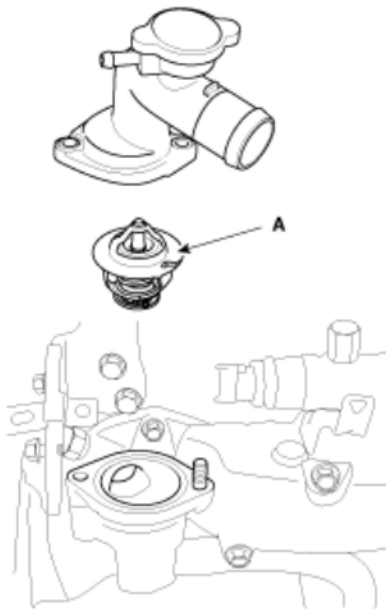
9. Install is in the reverse order of removal.

THERMOSTAT

1. Drain the engine coolant.
2. Remove the radiator upper hose(A) and coolant bleeder hose(B).



3. Remove the coolant inlet fitting.
4. Remove the thermostat(A).



5. To install, reverse the removal order with a new gasket.

INSPECTION

Thermostat

Replace the thermostat if it is open at room temperature.

1. Immerse thermostat in water heated to over 95°C (203°F), then heat for at least 3 minutes to check valve lift.



NOTICE

- Do not use water below 95°C (203°F).
- Do not directly heat unit as this will damage thermostat.

2. Heat the water and check the temperature with the thermometer. Check the temperature at which the thermostat first opens, and at which it is fully open.
3. Measure the lift height of the thermostat when it is fully open.

STANDARD THERMOSTAT

Lift height : above 8.0mm (0.31in.)

Starts opening: $85 \pm 1.5^{\circ}\text{C}$ ($185 \pm 34.7^{\circ}\text{F}$)

Fully open : 100°C (212°F)

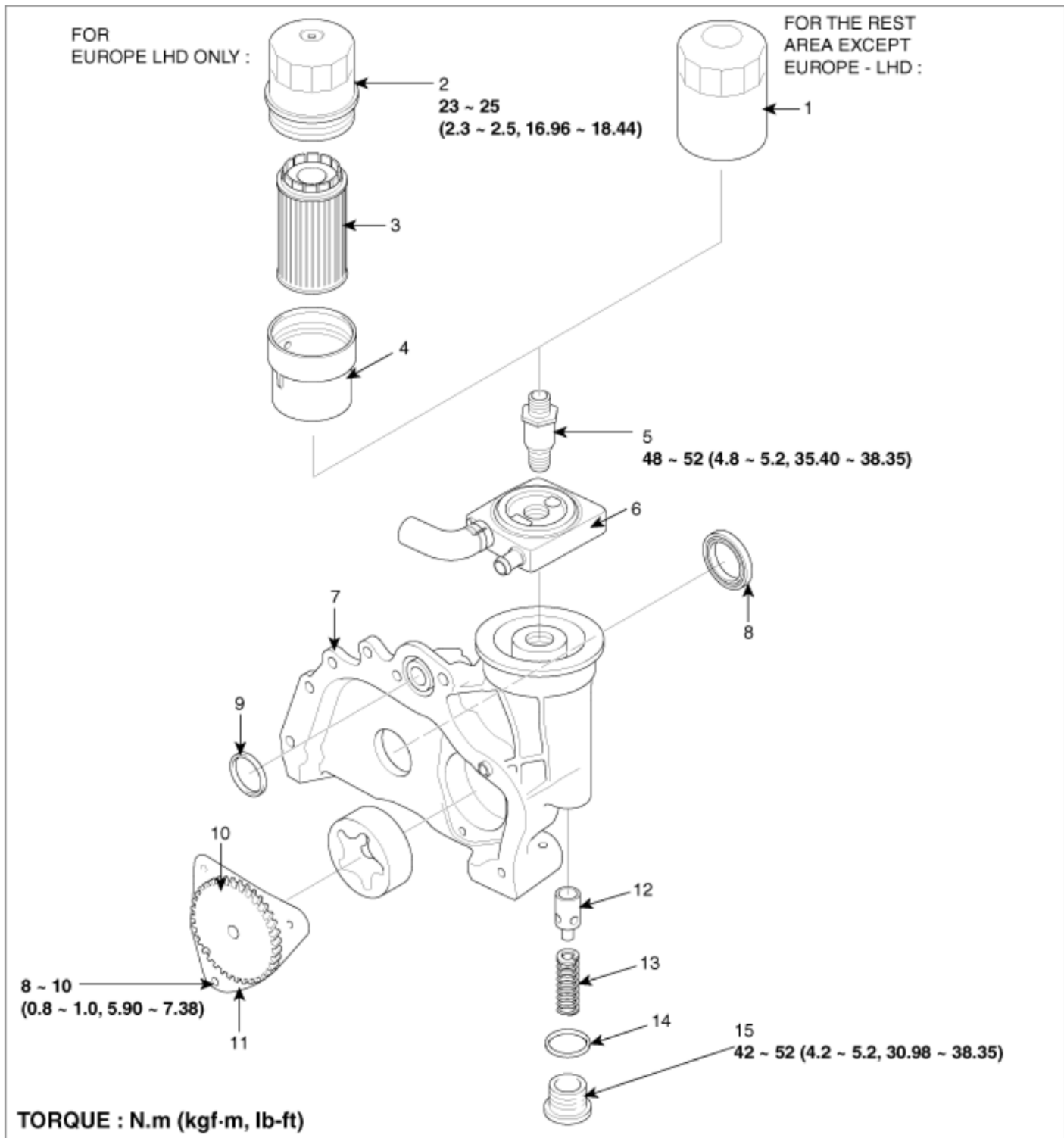
ENGINE OVERHEAT TROUBLESHOOTING

Inspection		Remedy
Visual inspection	Inspect for shortage of coolant in reservoir tank .	Reinspect after replenishing coolant.
	Inspect for coolant pollution after removing radiator cap. ⚠ CAUTION Be careful when removing radiator cap from overheated vehicle.	Reinspect after replacing coolant.
	Inspect for leakage and loose coolant hoses (radiator hose, heater hose, oil cooler hose, etc.).	Reinspect for leakage after reinstalling hoses and clamps.
	Inspect for leakage on water inlet fitting mounting part.	Reinspect for leakage after replacing O-ring. Reinspect for leakage after tightening to the specified torque.
	Inspect drive belt (for normal operation of water pump).	Adjust drive belt tension or replace.
	Inspect for leakage on water pump gasket mounting part.	Reinspect for leakage after replacing gasket. Reinspect for leakage after tightening to the specified torque.
	Inspect for loose coolant temperature sensor, cooling fan connector and pin.	Reinstall loose connector. Replace relevant part if connector pin is damaged.
	Inspect operation status of cooling fan. - Check operation status by switching ON/OFF the heater control A/C. i Information Will not operate in cold ambient temperature.	Check mounting status of ground cable.
	Inspect self-diagnostic code using KDS/GDS.	Check coolant temperature sensor, wiring, connector, etc.
Unit inspection	Inspect water pump impeller.	Replace water pump.
	Inspect for foreign materials and status of thermostat valve.	Inspect unit after removing foreign materials.
	Inspect for stuck thermostat valve. - Immerse thermostat in water heated to over 95°C (203°F), then heat for at least 3 minutes to check valve lift. NOTICE	Check valve lift. - Replace thermostat if valve lift is below specification or valve is stuck.

- Do not use water below 95°C (203°F).
- Do not directly heat unit as this will damage thermostat.

English ▼

COMPONENTS



- | | | |
|--------------------------|-------------------------|-----------------------|
| 1. Oil filter assembly | 6. Oil cooler | 11. Oil pump cover |
| 2. Oil filter upper cap | 7. Oil pump housing | 12. Relief plunger |
| 3. Oil filter | 8. Oil seal | 13. Relief spring |
| 4. Oil filter lower case | 9. O-ring | 14. Relief cap washer |
| 5. Oil filter fitting | 10. Oil pump drive gear | 15. Relief cap |

REPLACEMENT

Engine Oil Filter

NOTICE

There are two kinds of oil filters. One is for Europe LHD and the other is for the rest area except Europe LHD (Left Hand Drive).

For Europe LHD :

1. Remove the oil filter upper cap from lower case with SST(09263-2E000 the oil filter wrench.).
2. Inspect the threads and rubber packing. Wipe off the seat on the oil filter assembly, then apply a light coat of oil to the oil filter assembly upper cap packing.
3. Install the new oil filter by hand to the upper cap.
4. After the rubber seal seats, tighten the oil filter clockwise with the special tool.

Capacity

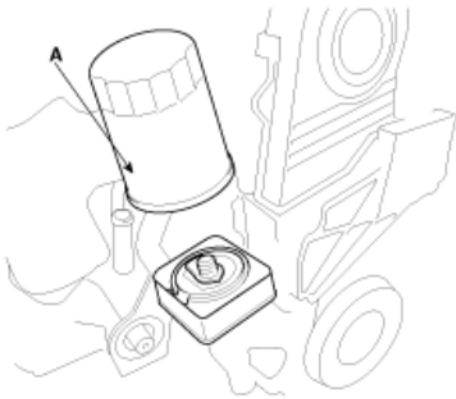
Total : 7.4 L (7.82 US qt, 6.51 Imp qt)

Oil pan : 6.2 L (6.55 US qt, 5.45 Imp qt)

Drain and refill including oil filter : 6.7 L (7.08 US qt, 5.89 Imp qt)

For the rest area except Europe LHD :

- 1) Remove the oil filter(A) with the SST(09263-27000, the oil filter wrench).

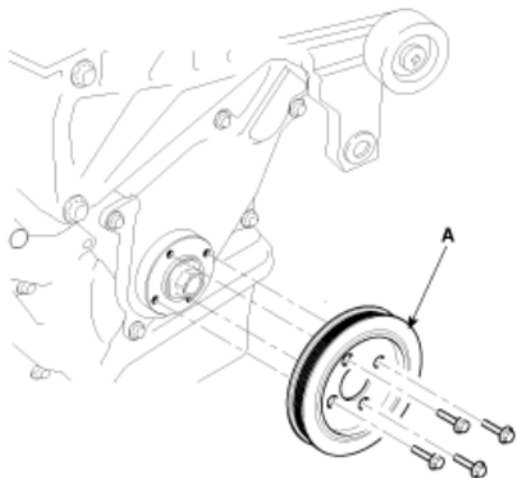


- 2) Inspect the threads and the packing on the apply a light coat of new oil filter. Wipe off the seat.
- 3) Install the new oil filter by hand.
- 4) After the packing seats, tighten the oil filter clockwise with the SST(09263-27000).

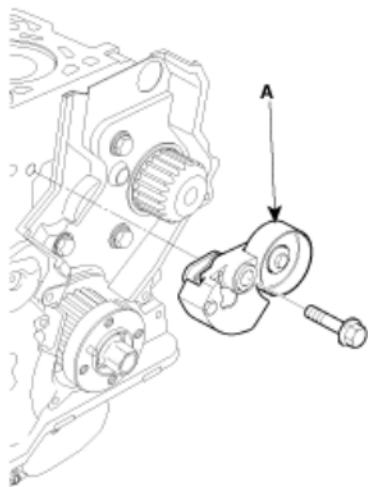
REMOVAL

OIL PUMP

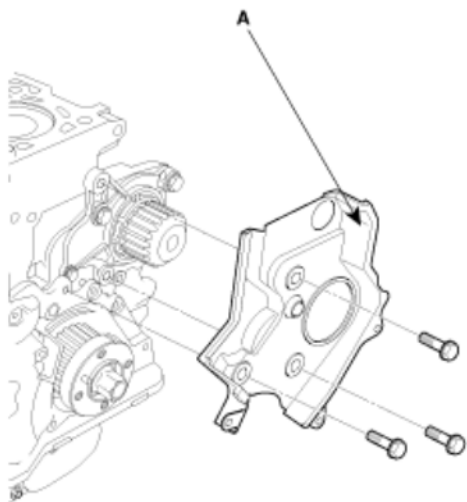
1. Drain the engine oil.
2. Remove the crankshaft pulley(A).



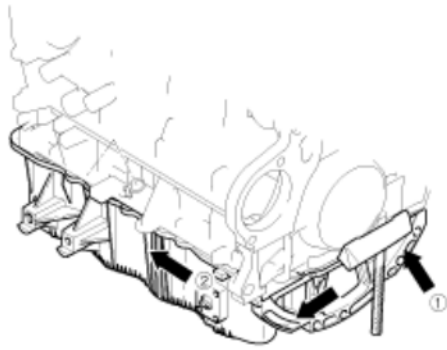
3. Remove the timing belt assembly.
4. Remove the timing belt tensioner(A).



5. Remove the timing rear cover(A).



6. Separate oil pan(A).

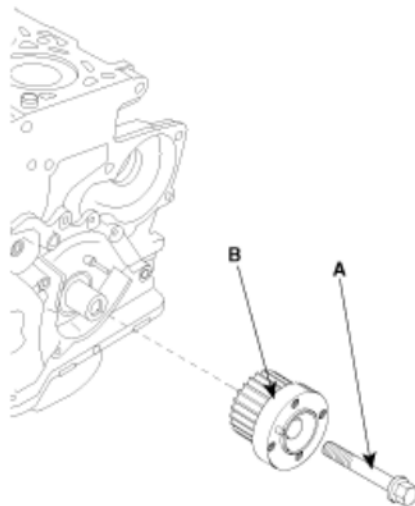


⚠ CAUTION

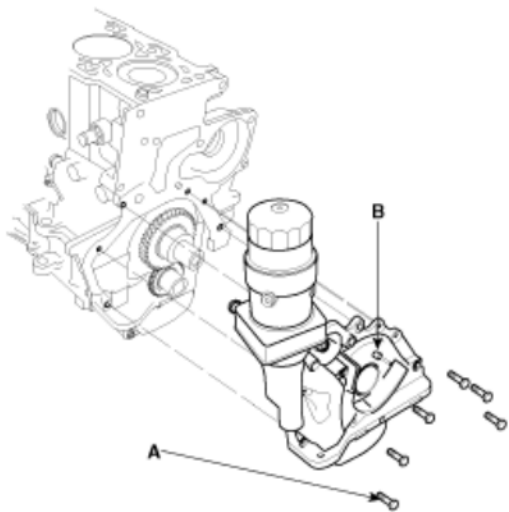
- Insert the SST between the oil pan and the ladder frame by tapping it with a plastic hammer in the direction of ① arrow.
- After tapping the SST with a plastic hammer along the direction of ② arrow around more than 2/3 edge of the oil pan, remove it from the ladder frame.
- Do not turn over the SST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

7. Remove the oil screen.

8. Remove the crankshaft sprocket(B) with bolt(A).



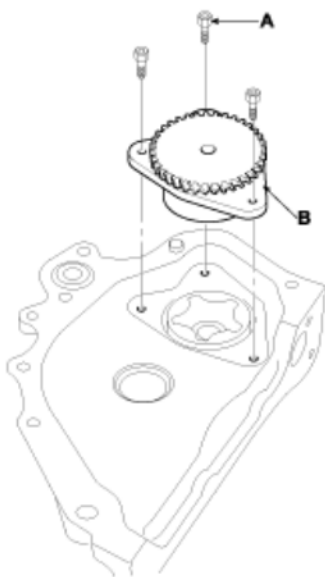
9. Remove the mounting bolts(A) and the oil pump assembly(B).



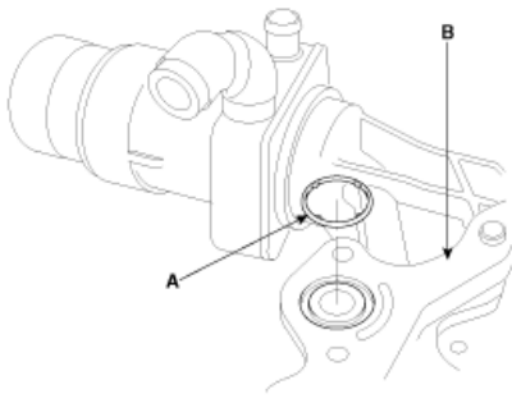
DISASSEMBLY

OIL PUMP

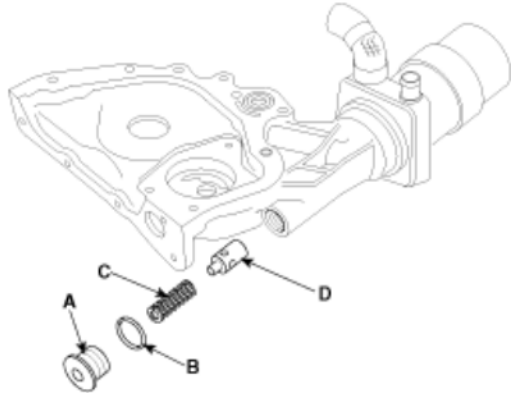
1. Remove the three hexagon socket head bolts(A) from the oil pump cover(B).



2. Remove the out rotor from the oil pump housing.
3. Remove the old oil seals from the oil pump housing.
4. Remove the O ring(A) from the oil pump housing.



5. Remove the relief cap(A), relief cap washer(B), relief spring(C) and relief plunger(D).



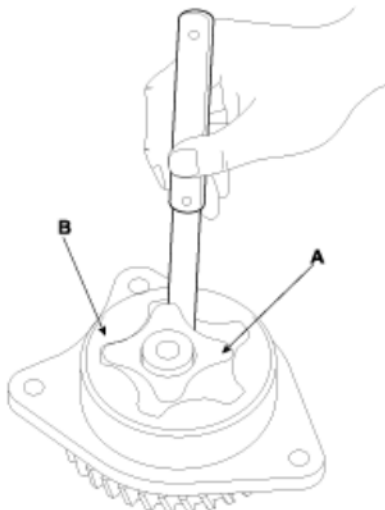
6. Remove the oil filter. Refer to the engine oil filter replacement.
7. Remove the oil cooler and hose assembly after separating the oil filter fitting.

INSPECTION

OIL PUMP

1. Check the inner-to-outer rotor tip clearance between the inner rotor(A) and outer rotor(B). If the inner-to-outer rotor clearance exceeds the service limit, replace the inner and outer rotors.

Inner Rotor-to-Outer Rotor tip Clearance
 Standard (New)
 0.08mm (0.00315in.)



2. Check the housing-to-rotor axial clearance between the rotor and oil pump cover housing. If the housing-to-rotor axial clearance exceeds the service limit, replace the set of inner and outer rotors and/or the pump housing.

Housing-to-Rotor Axial Clearance

Standard (New)

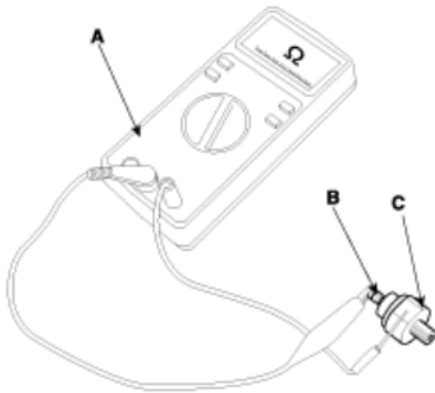
0.020 ~ 0.070mm (0.00079 ~ 0.00276in.)



3. Inspect both rotors and the oil pump cover housing for scoring or other damage. Replace parts if necessary.

OIL PRESSURE SWITCH

1. Remove the oil pressure switch from the engine block.
2. Connect a tester (ohm range) between the terminal and the body of the switch to check for continuity. The switch is normal if there is continuity. If there is no continuity, replace the switch.



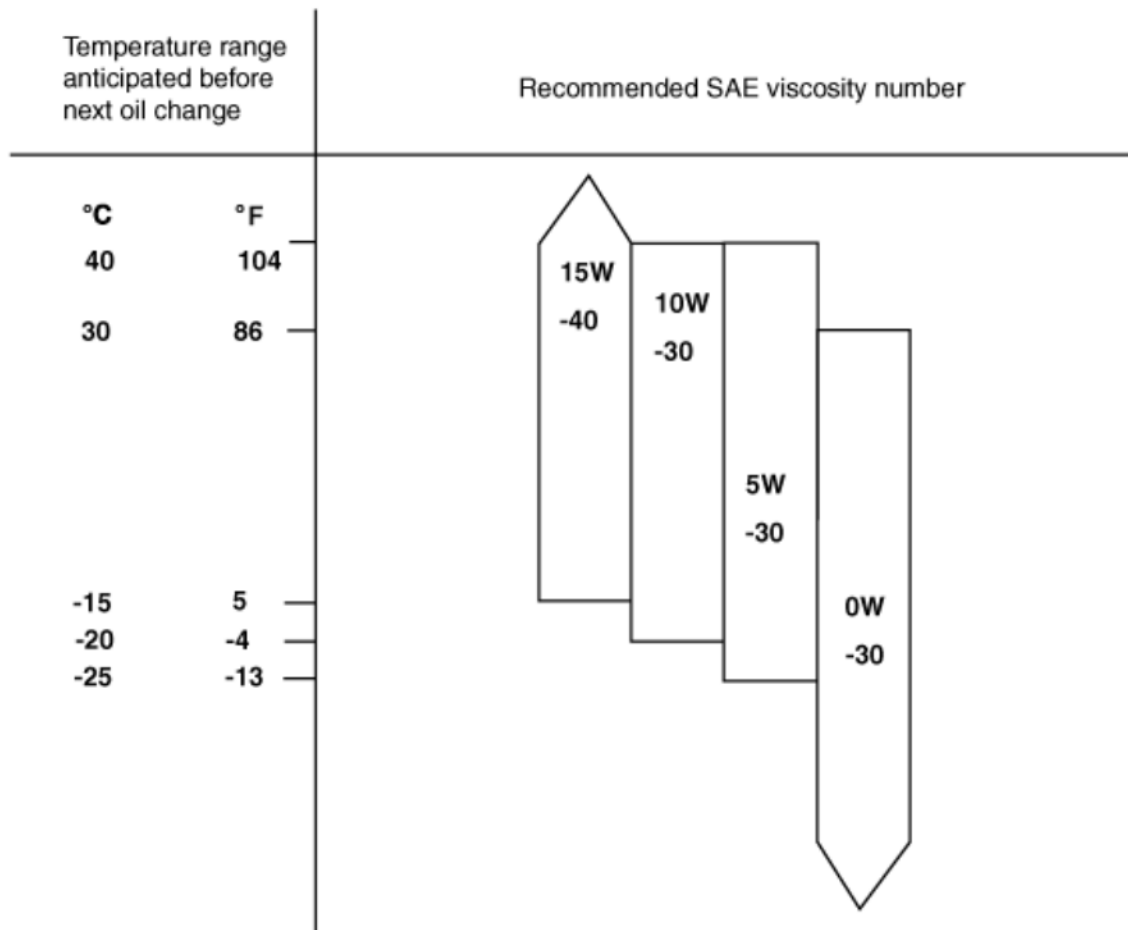
3. Insert a thin rod in the oil hole of the switch and push it in lightly. The switch is normal if no continuity is detected (infinite resistance on the tester). If there is continuity, replace the switch.



SELECTION OF ENGINE OIL

ACEA classification : C3 (with CPF), B4 (without CPF)

SAE viscosity grades : Refer to the recommended SAE viscosity number



NOTICE

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

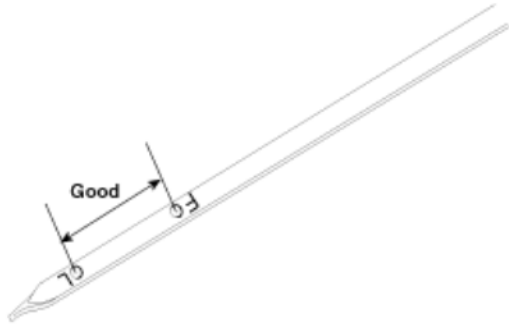
1. Satisfy the requirement of the ACEA classification.
2. Have proper SAE grade number for expected ambient temperature range.
 - Lubricants that do not have both an SAE grade number and ACEA service classification on the container should not be used.
 - The ACEA certified engine oil is required as a service engine oil. Only in case that ACEA certified engine oil is not available, the API certified engine oil (API CH-4 or above) is allowed restrictively.
 - For the vehicle equipped with CPF, the service engine oil quality should meet the ACEA C3 grade. However, oil refill with small amount of ACEA B4 grade between oil change intervals is possible.

ENGINE OIL

1. Park the vehicle on the flat ground.
2. Turn the engine off.
3. The oil level should be between the 'L' and 'F' marks on the dipstick, then.
If low, check for leakage and add oil up to the "F" mark.

NOTICE

When refill the engine oil, use the same type engine oil with current engine oil.



4. Check the oil for deterioration, entry of coolant or fuel, and engine oil viscosity.

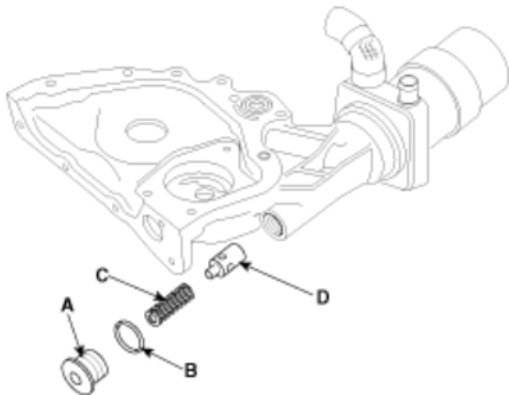
REASSEMBLY

OIL PUMP

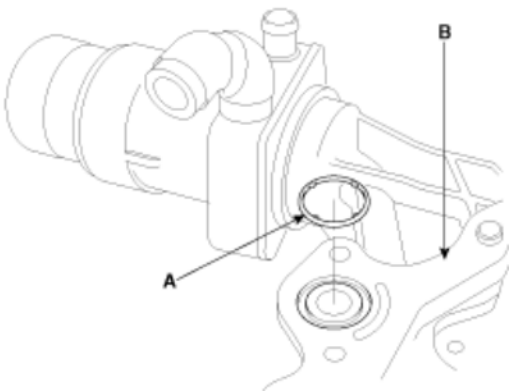
1. Insert the relief plunger(D), the relief spring(C) and the relief cap washer(B). Then torque the relief cap(A).

Tightening torque

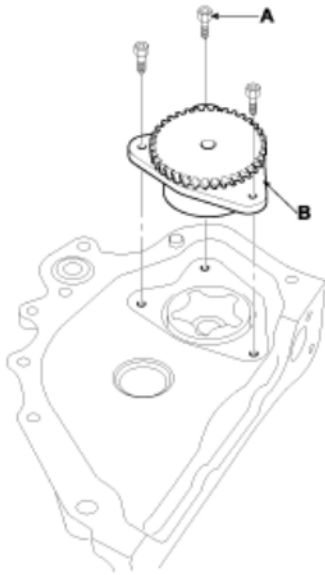
41.2 ~ 51.0N.m (4.2 ~ 5.2kgf.m, 30.4 ~ 37.6lb-ft)



2. Install the new O ring(A) to the oil pump housing(B) after applying engine oil.



3. Assemble the inner/outer rotors with engine oil the drive gear and the oil pump cover.
4. Install the oil pump cover(B)assembly to the oil pump housing with the three hexagon socket head bolts(A).



5. The oil seal which was disassembled in 'Disassembly' step is recommended to be installed after the installation of the crankshaft.

INSTALLATION

1. Install the oil pump assembly and the oil pan on the cylinder block.

Tightening torque

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

NOTICE

Standard liquid gasket : LOCTITE 5900 or TB1217H

2. Install the oil screen.

3. Install the oil pan.

Tightening torque

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

NOTICE

Standard liquid gasket : LOCTITE 5900 or TB1217H

Assemble the oil pan in 5 minutes after applying the liquid gasket.

Apply liquid gasket in a 3mm wide bead without stopping.

The clearance between the liquid gasket end and the flange inner end at T-joint should be 2 ~ 3mm.(2places)

4. Fill the engine oil in the room below the oil cooler (50cc).

5. Tightening the oil filter fitting, install the oil cooler and hose assembly.

NOTICE

Before assembling the oil cooler apply engine oil on the O-ring.

Tightening torque

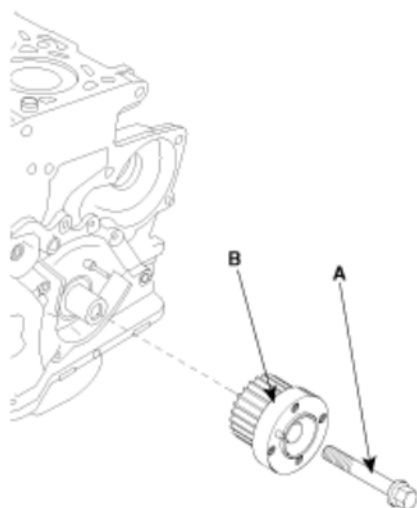
47.1 ~ 51.0N.m (4.8 ~ 5.2kgf.m, 34.7 ~ 37.6lb-ft)

6. Install the oil filter after applying engine oil on the O-ring.

7. Install the crankshaft sprocket(B) with bolt(A).

Tightening torque

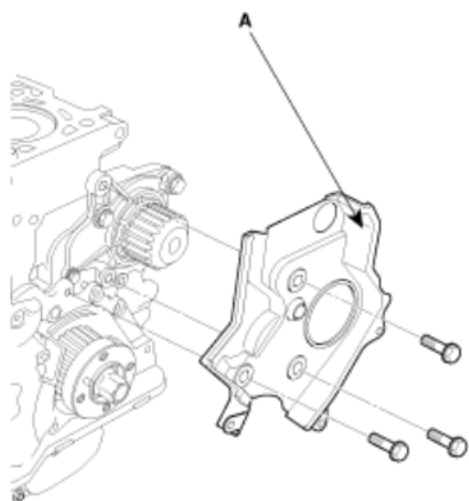
196.1 ~ 205.9N.m (20.0 ~ 21.0kgf.m, 144.7 ~ 151.9lb-ft)



8. Install the timing belt rear cover(A).

Tightening torque

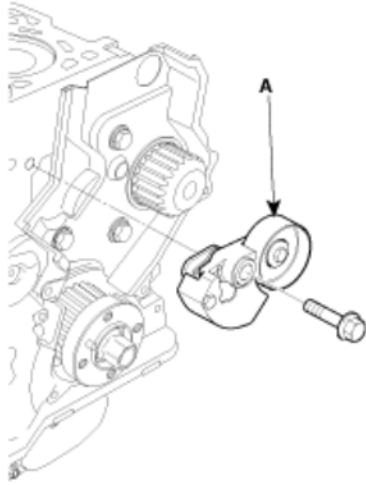
7.8 ~ 11.8N.m (0.8 ~ 1.2kgf.m, 5.8 ~ 8.7lb-ft)



9. Install the auto tensioner(A).

Tightening torque

49.0 ~ 53.9N.m (5.0 ~ 5.5kgf.m, 36.2 ~ 39.8lb-ft)

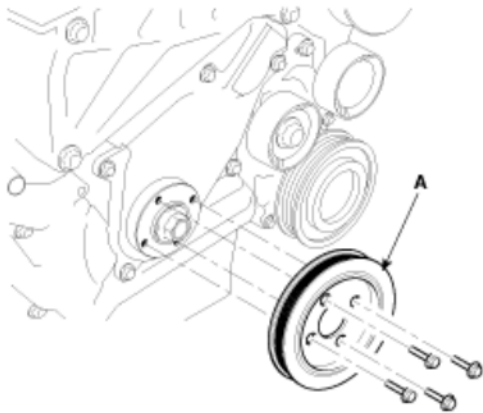


10. Install timing belt.

11. Install the crankshaft pulley(A).

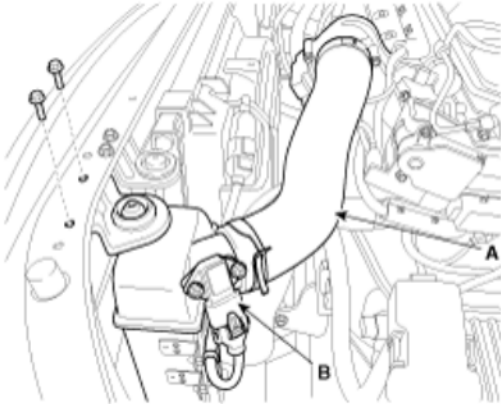
Tightening torque

29.4 ~ 33.3N.m (3.0 ~ 3.4kgf.m, 21.7 ~ 24.6lb-ft)



REPLACEMENT

1. Remove the intercooler hose(A).
2. Disconnect the booster pressure sensor(B).
3. Remove intercooler lower hose and intercooler mounting bracket(C).

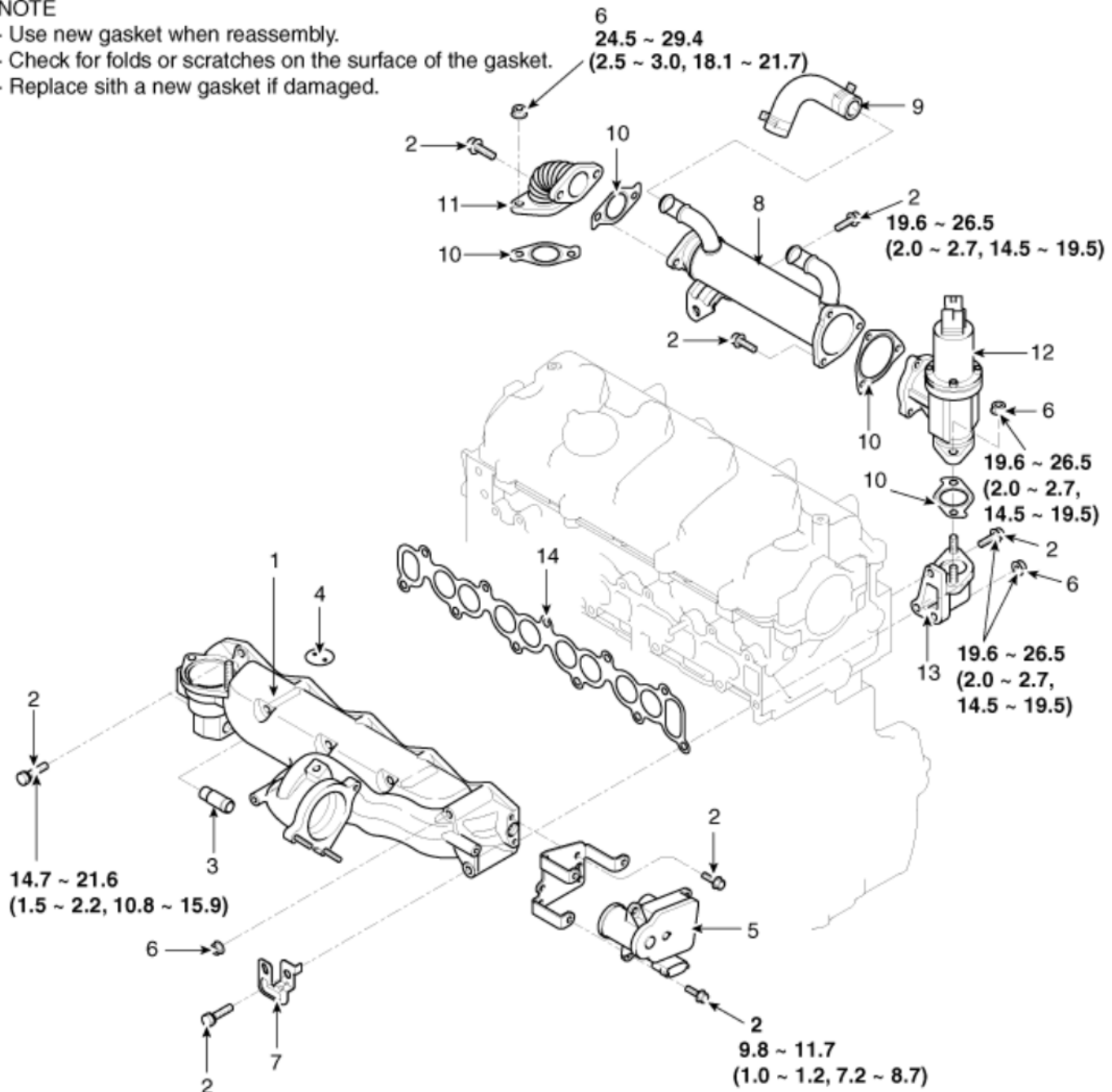


4. Installation is in the reverse order of removal.

COMPONENTS

NOTE

- Use new gasket when reassembly.
- Check for folds or scratches on the surface of the gasket.
- Replace with a new gasket if damaged.

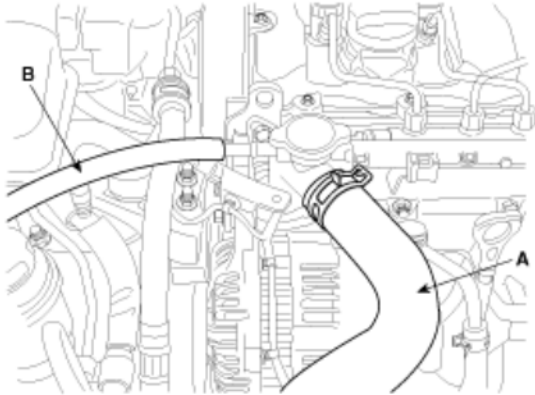


TORQUE : N.m (kgf-m, lb-ft)

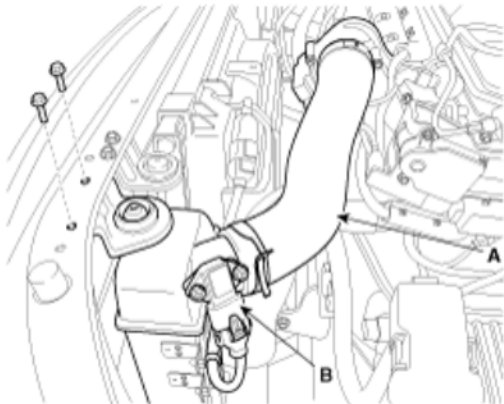
- | | | |
|-----------------------------|----------------------------|------------------------|
| 1. Intake manifold assembly | 6. Nuts | 11. EGR pipe assembly |
| 2. Bolts | 7. Wiring mounting bracket | 12. EGR valve assembly |
| 3. Water bypass connector | 8. EGR cooler | 13. EGR elbow |
| 4. Swirl control valve | 9. EGR cooler hose | |
| 5. Swirl control actuator | 10. Gasket | |

REMOVAL

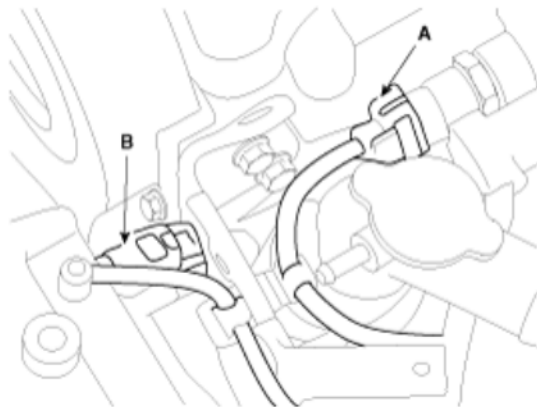
1. Remove the radiator upper hose(A) and the coolant bleed hose(B).



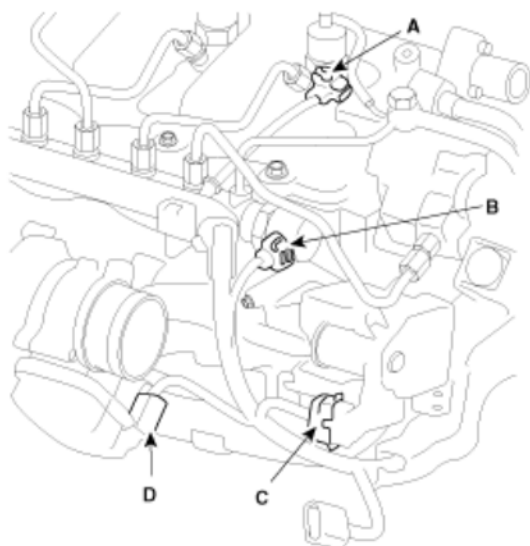
2. Remove the alternator. (Refer to Alternator in EEC Group).
3. Remove the intercooler hose(A) and the disconnect booster pressure sensor(BPS) connector(B).



4. Disconnect the engine wire harness connectors from intake manifold side.
 - a. Disconnect the rail pressure sensor connector(A) and the water temperature sensor connector(B).



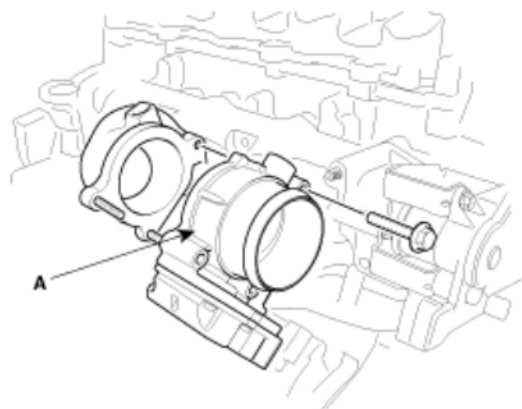
5. Disconnect the camshaft position sensor(A), pressure control valve(B), valve control actuator (c) and throttle body actuator(D) connector.



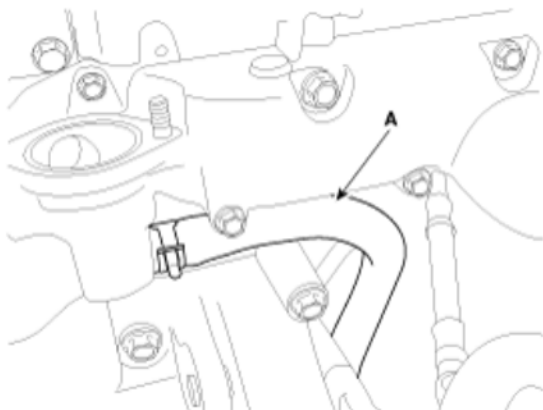
6. Remove oil level gauge.
7. Remove the thermostat housing(A).
Tightening torque :
20 ~ 25N.m (2.0 ~ 2.5kgf.m, 15 ~ 18lb-ft)



8. Remove the EGR throttle body(A).
Tightening torque :
10 ~ 12N.m (1.0 ~ 1.2kgf.m, 7 ~ 9lb-ft)



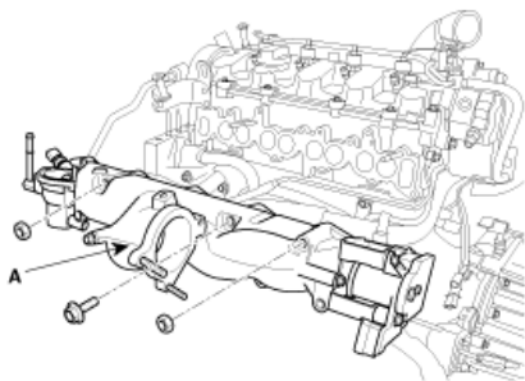
9. Remove the thermostat hose(A).



10. Remove the intake manifold(A).

Tightening torque :

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

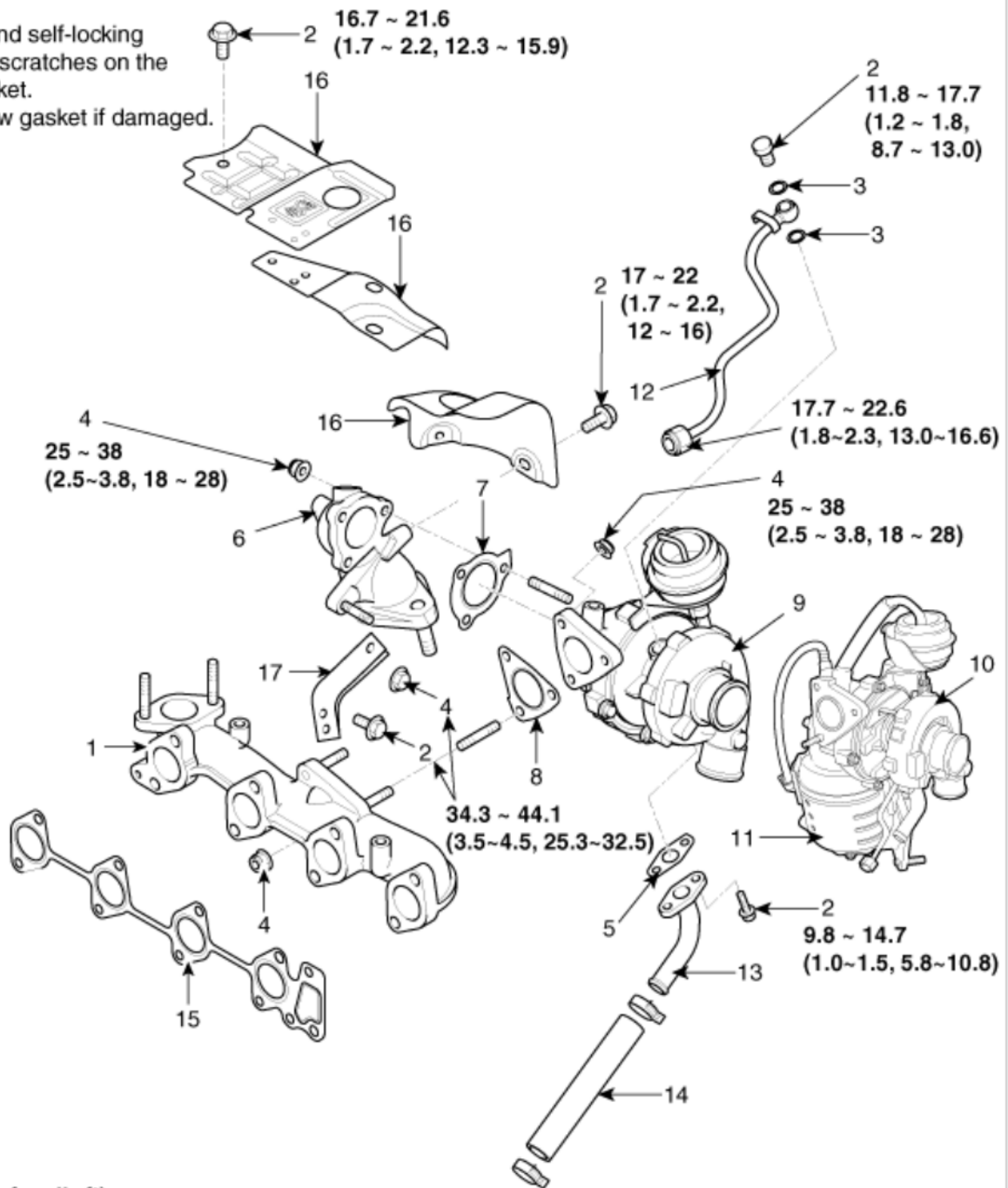


11. Installation is in the reverse order of removal.

COMPONENTS

NOTE

- Use new gasket and self-locking
- Check for folds or scratches on the surface of the gasket.
- Replace with a new gasket if damaged.

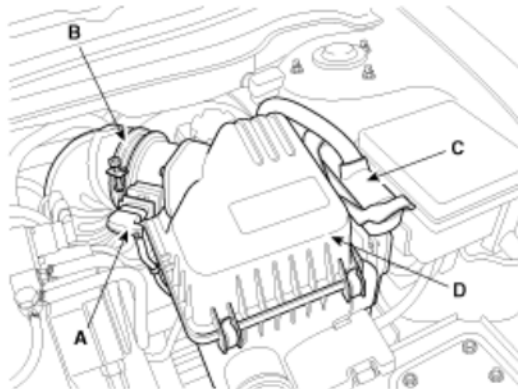


TORQUE : N.m (kgf-m, lb-ft)

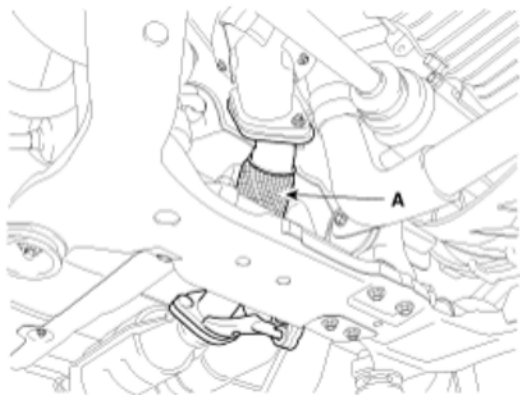
- | | | |
|-----------------------------------|--|-----------------------------------|
| 1. Exhaust manifold | 7. Turbo charger exhaust gasket | 13. Oil drain pipe |
| 2. Bolts | 8. Turbo charger intake gasket | 14. Oil drain hose |
| 3. Gasket | 9. Turbo charger[C.P.F vehicle] | 15. Exhaust manifold gasket |
| 4. Nuts | 10. Turbo charger[Non C.P.F vehicle] | 16. Oil hose |
| 5. Turbo charger oil drain gasket | 11. Warm up catalytic converter[W.C.C] | 17. Turbo charger support bracket |
| 6. Turbo charger discharger pipe | 12. Oil feed pipe | |

REMOVAL

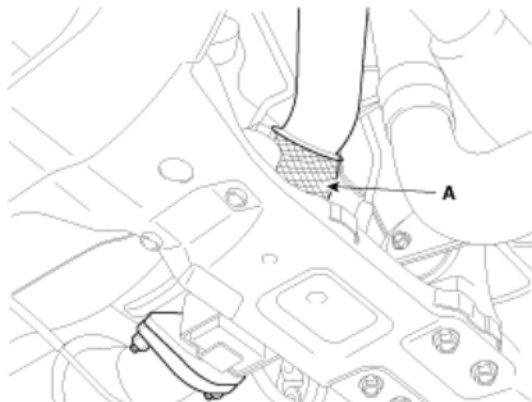
1. Remove the air cleaner.
 - (1) Disconnect the Air Flow Sensor (AFS) connect(A).
 - (2) Remove the air intake hose clamp first, then remove the air cleaner assembly(B).
 - (3) Disconnect the electric control unit(E,C,U) connector(C).
 - (4) Remove the air cleaner assembly(D).



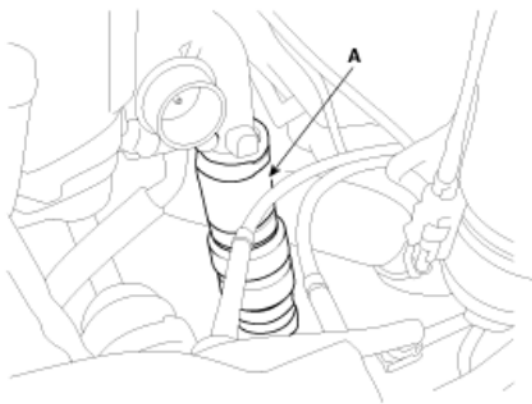
2. Remove the front muffler(A).



[C.P.F]



3. Remove the intercooler hose(A).



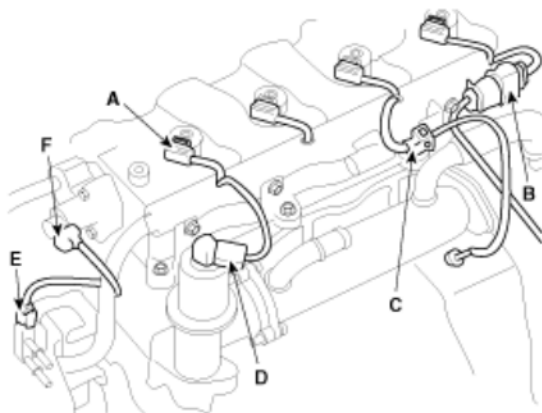
4. Disconnect the engine wire harness connectors from exhaust manifold.

(1) Disconnect the injector connector(A).

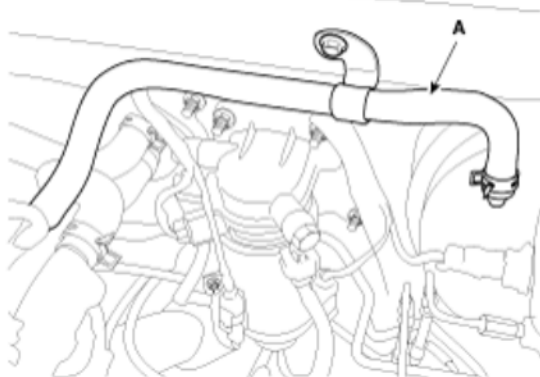
(2) Lambda sensor connector(B).

(3) VGT exhaust gas temperature sensor connector(C).[Only C.P.F]

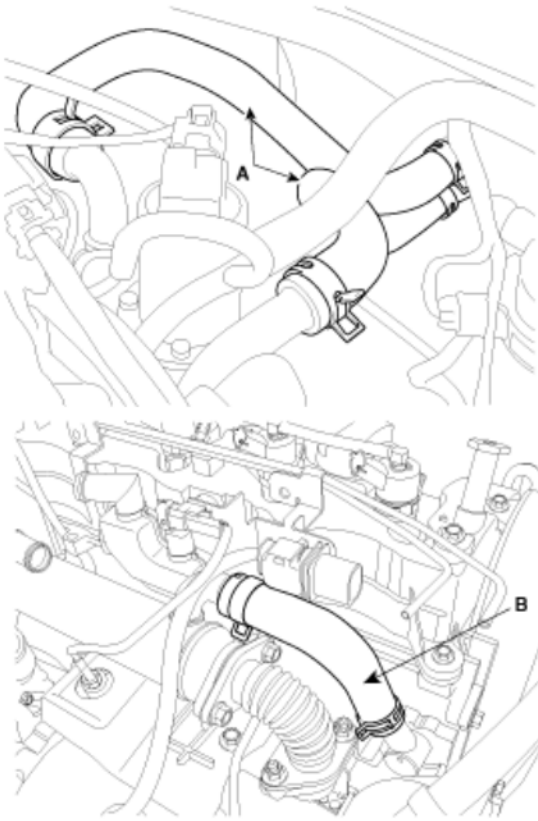
(4) Disconnect the EGR actuator(D),fuel temperature sensor(E) and the fuel pressure regulator connector(E).



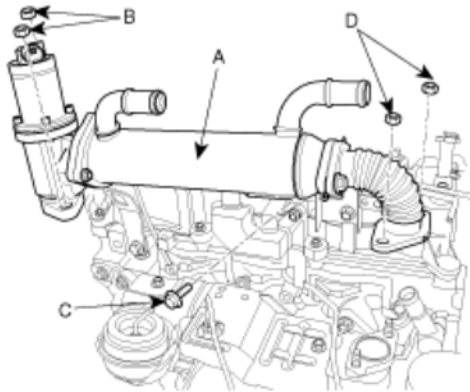
5. Remove the brake booster vacuum hose(A).



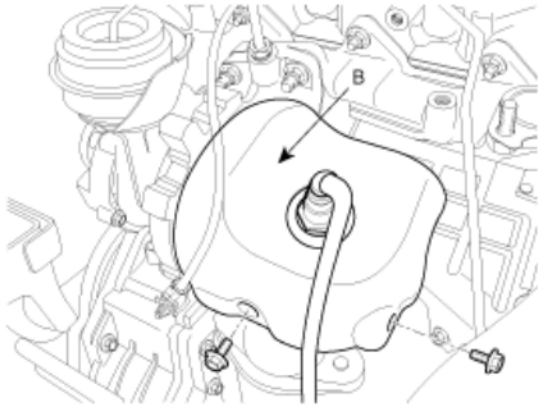
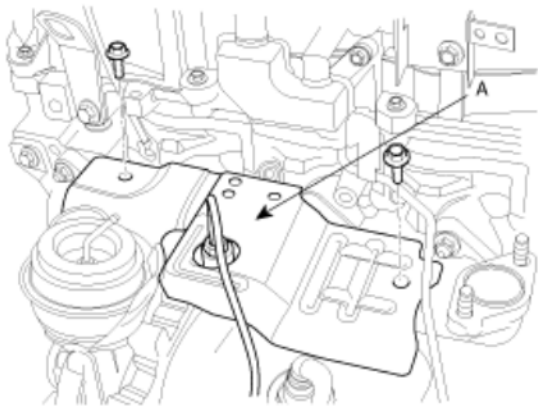
6. Remove the heater hose(A) and EGR cooler hose(B).



7. Remove VGT actuator vacuum hose.
8. Remove the EGR valve and cooler assembly(A).
 Tightening torque :
 Nuts(B), Bolt(C)
 19.6 ~ 26.5N.m (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft)
 Nuts(D) : 24.5 ~ 29.4N.m (2.5 ~ 3.0kgf.m, 18.1 ~ 21.7lb-ft)



9. Remove the turbo charger heat protector(A, B).
 Tightening torque :
 16.7 ~ 21.6N.m (1.7 ~ 2.2kgf.m, 12.3 ~ 15.9lb-ft)



10. Remove the heater pipe heat protector(A).

Tightening torque :

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

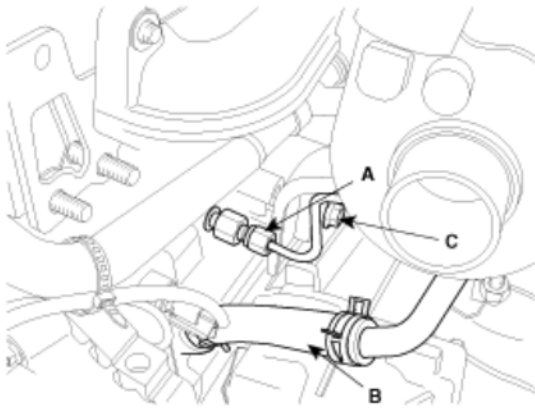


11. Disconnect the turbo charger oil feed pipe(A) and oil return hose(B).

12. Remove turbocharger support bracket mounting bolts(C).

Tightening torque :

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



13. Remove the EGR elbow(A) and turbocharger & exhaust manifold assembly(B).

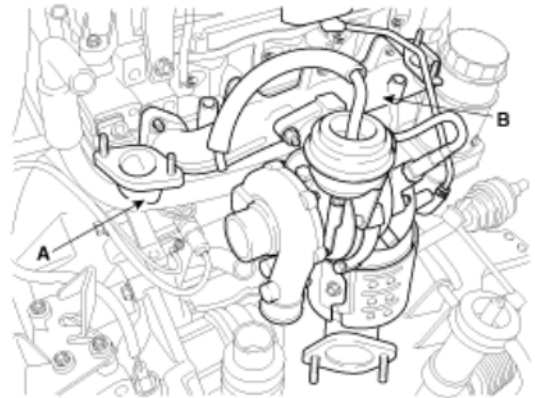
Tightening torque :

EGR elbow bolt and nuts

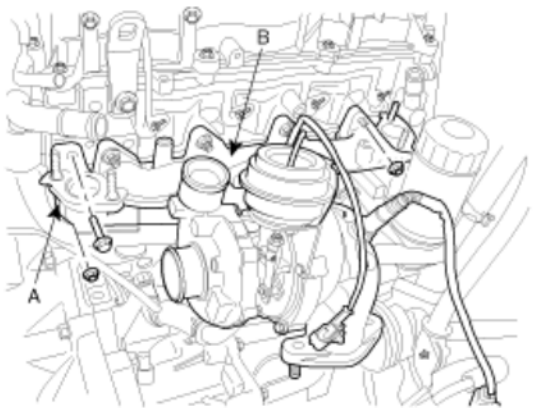
19.6 ~ 26.5N.m (2.0 ~ 2.7kgf.m, 14.5 ~ 19.5lb-ft)

Exhaust manifold nuts

29.4 ~ 37.3N.m (3.0 ~ 3.8kgf.m, 21.7 ~ 27.5lb-ft)

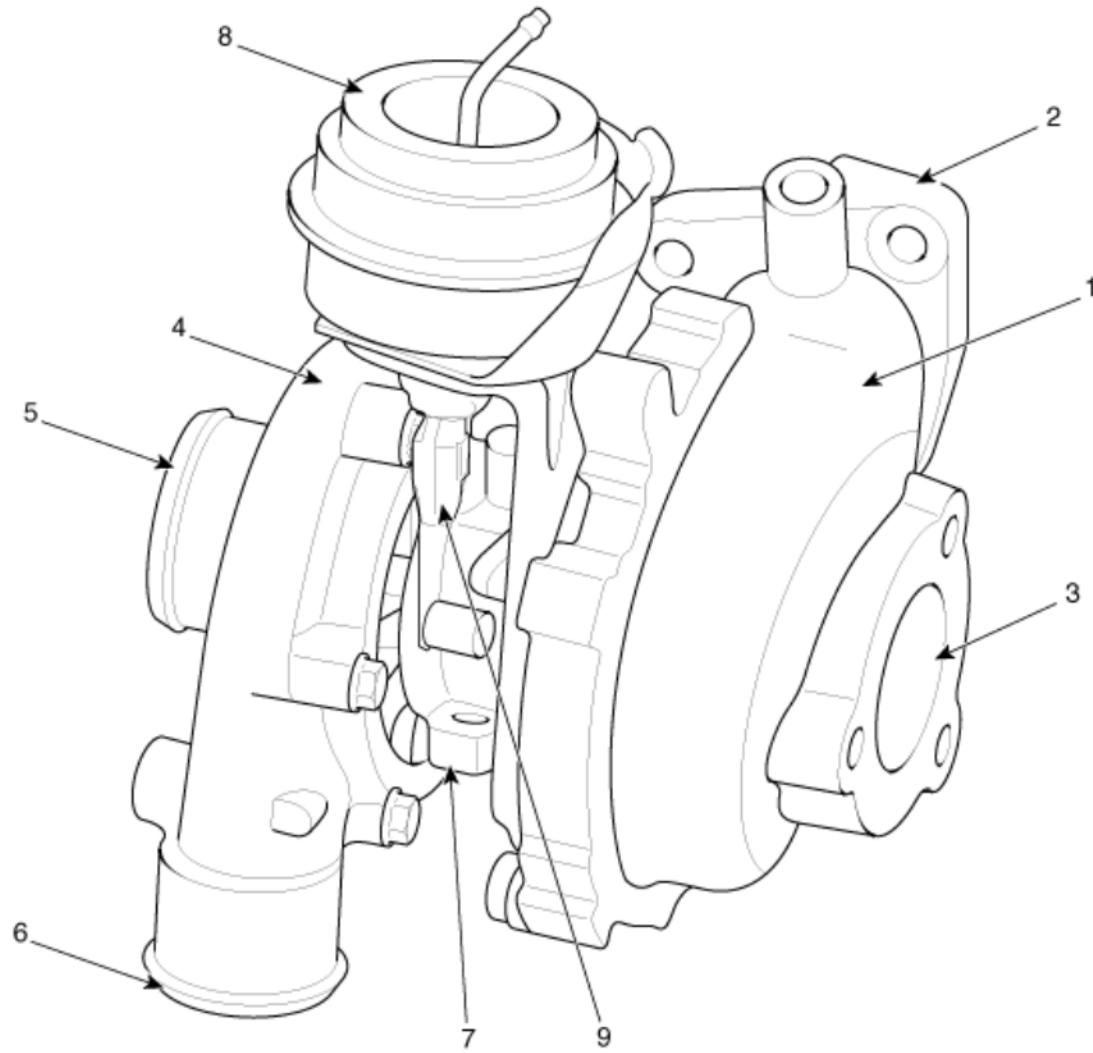


[C.P.F]



14. Installation is in the reverse order of removal.

COMPONENTS



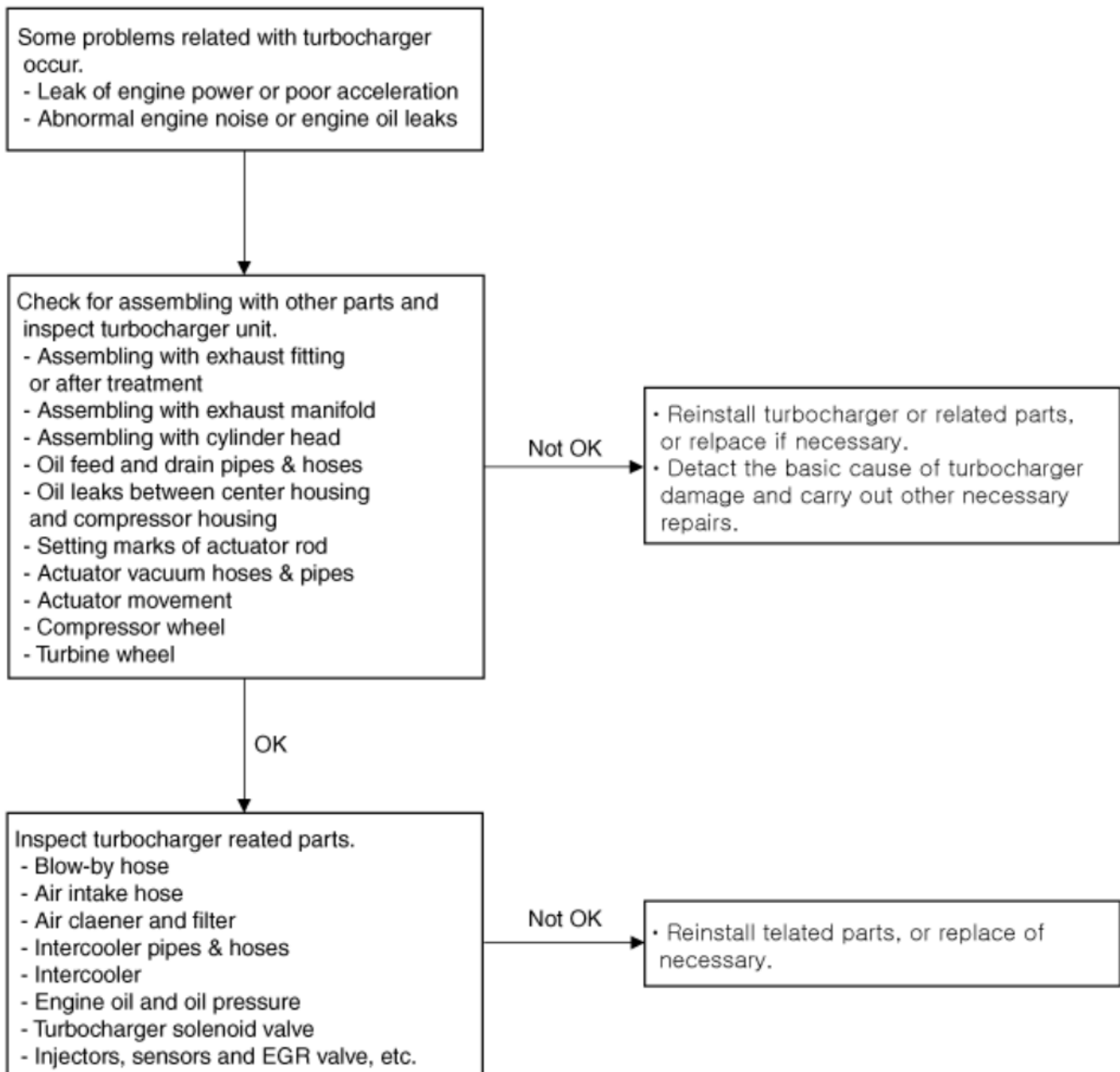
- | | |
|---|---|
| 1. Turbine housing
2. Turbine inlet
3. Turbine outlet
4. Compressor housing
5. Compressor inlet | 6. Compressor outlet
7. Center housing
8. Actuator
9. Actuator rod |
|---|---|

REMOVAL AND INSTALLATION

1. Remove the turbocharger.
(Refer to Intake And Exhaust System - "Exhaust Manifold")

ON-VEHICLE INSPECTION

Turbocharger Diagnostic Flow



If any problem related with turbocharger, such as lack of engine power, poor acceleration, abnormal engine noise or oil leaks, may

occur, check the turbocharger according to the procedure as follows.

English ▼

1. Check for assembling of the turbocharger and the exhaust fitting (or the after treatment).

- Check if a gasket is installed.
- Check if mounting bolts (or nuts) are tightened properly.
- Check if there is a gas leak.
- Check if there is any damage, such as crack, on the parts.

If a gas leak occur as a gasket was not installed or mounting bolts (or nuts) were tightened inadequately, it may cause abnormal engine noise.

If the cause of the problem is detected, retighten the mounting bolts (or nuts) as the specified torque or replace the gasket or damaged parts with new ones if necessary.

2. Check for assembling of the turbocharger and the exhaust manifold.

- Check if a gasket is installed.
- Check if the mounting bolts (or nuts) are tightened properly.
- Check if there is a gas leak.
- Check if there is any damage, such as crack, on the parts.

If a gas leak occur as a gasket was not installed or mounting bolts (or nuts) were tightened inadequately, it may cause abnormal engine noise.

If the cause of the problem is detected, retighten the mounting bolts (or nuts) as the specified torque or replace the gasket or damaged parts with new ones if necessary.

3. Check for assembling of the exhaust manifold and the cylinder head.

- Check if a gasket is installed.
- Check if the mounting bolts (or nuts) are tightened properly.
- Check if there is a gas leak.

If a gas leak occur as a gasket was not installed or mounting bolts (or nuts) were tightened inadequately, it may cause abnormal engine noise.

If the cause of the problem is detected, retighten the mounting bolts (or nuts) as the specified torque or install a new gasket if necessary.

4. Check the turbocharger oil feed pipe & hose and oil drain pipe & hose.

- Check if a gasket is installed.
- Check if the mounting bolts are tightened properly.
- Check if the clamps are positioned in place.
- Check if the oil pipes & hoses are damaged (bent, crushed, torn or cracked).

If a gas leak occur as a gasket was not installed or mounting bolts were tightened inadequately, it may cause oil leaks.

If the oil feed pipe & hose is damaged, engine oil is not supplied sufficiently to the turbocharger then it may damage the turbocharger. If the oil drain pipe & hose is damaged and clogged, engine oil is not drained smoothly then it may cause oil leaks from the turbocharger.

If the cause of the problem is detected, retighten the mounting bolts (or nuts) as the specified torque or replace the gasket or damaged parts with new ones if necessary.

5. Check for oil leaks between center housing and compressor housing.

- Check if the mounting bolts are tightened properly.
- Check if there is an oil leak.

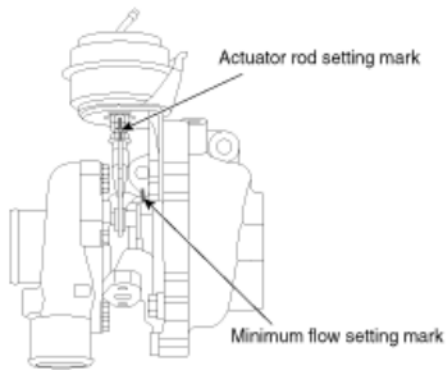
If the O-ring (gasket) between the center housing and the compressor housing is damaged, it may cause oil leaks.

If an oil leak is detected, replace the turbocharger with a new one.

6. Check the setting marks of the turbocharger actuator rod.

- Check if the actuator rod setting mark is aligned in line.

- Check if the minimum flow setting mark is aligned in line.



If the setting marks are not aligned in line, the engine performance is changed by an arbitrary tune-up of the turbocharger after delivery.

If the setting marks are not aligned in line, replace the turbocharger with a new one.

7. Check the turbocharger actuator vacuum hoses & pipes.

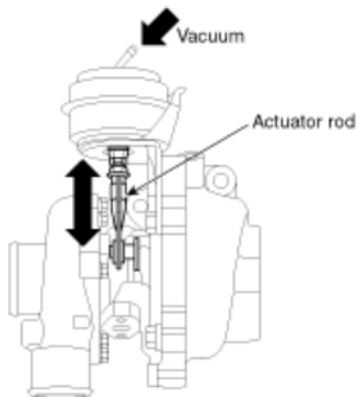
- Check if the vacuum hose is connected to the actuator properly.
- Check if the vacuum hoses & pipes are damaged (bent, detached or torn).
- Check if there is any damage, such as crack, on the vacuum pipes.
- Check if the vacuum hoses are connected to inlet or outlet of the solenoid valve correctly.

If the vacuum pipes & hoses are damaged or disconnected, the actuator does not work properly then it may cause lack of engine power and poor acceleration.

If the vacuum hoses & pipes are damaged, replace them with new ones.

8. Check the turbocharger actuator.

- Vacuum type actuator: Check for movement of the actuator rod when a vacuum of 60kPa (450mmHg, 8.7psi) is applied to the actuator or a forced actuator operating mode is performed by GDS. (Refer to DTC guide)

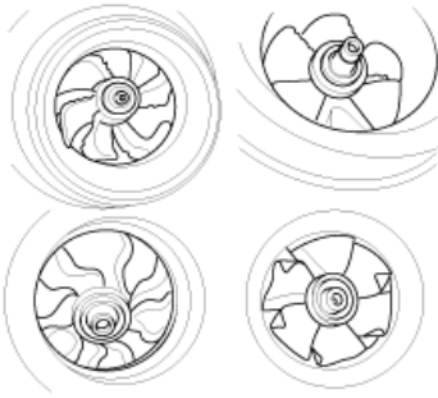


If the turbocharger actuator is damaged, it may cause lack of engine power and poor acceleration.

If the actuator rod does not move, replace the turbocharger with a new one.

9. Check the turbocharger compressor wheel.

- Check if the compressor wheel is damaged (bent or deformed).
- Check if the compressor wheel rotates smoothly.
EX)

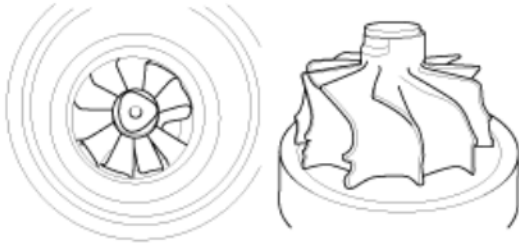


If the compressor wheel are damaged, it may cause abnormal noise from the turbocharger and poor acceleration.
If the compressor wheel are damaged or deformed, replace the turbocharger with new ones.

10. Check the turbocharger turbine wheel.

- Check if the turbine wheel is damaged.
- Check if the turbine wheel rotates smoothly.

EX)



If the turbine wheel are damaged, it may cause abnormal noise from the turbocharger and poor acceleration.
If the turbine wheel are damaged or deformed, replace the turbocharger with new ones.

If any problem is not detected in the turbocharger, check the turbocharger-related parts according to the procedure as follows .

1. Check the blow-by hose. (Refer to FL group)

- Check if the breather hose is damaged (bent, clogged).
- Check if the positive crankcase ventilation (PCV) valve is clogged.

If the breather hose is bent or clogged, the internal pressure in the engine increases then engine oil is not supplied smoothly to the turbocharger. So it may cause damage of the turbocharger and oil leaks.

If the cause of the problem is detected, replace the breather hose or the related parts with new ones.

2. Check the air intake hose connected to the turbocharger.

- Check if the air intake hose is damaged (bent, crushed, detached or torn).

If a cross-section of the hose diminishes as the air intake hose is bent or crushed, intake air to the turbocharger reduces and the pressure in front of turbocharger drops. So it may cause damage of the turbocharger and oil leaks. If the air intake hose is detached or torn, a foreign substance goes into the turbocharger and causes damage of it.

If the air intake hose is damaged, replace it with a new one.

3. Check the air cleaner.

- Check the air cleaner filter for pollution state.
- Check the air cleaner filter for water influx.
- Check the air cleaner cover for dirtiness.
- Check if the air cleaner filter is a genuine part..

If the air cleaner filter is moistened or polluted excessively or a non-genuine part is used, intake air to the turbocharger reduces and the pressure in front of turbocharger drops. So it may cause damage of the turbocharger and oil leaks. .
If the air cleaner filter is moistened or polluted excessively, replace it with a new one.

NOTICE

Replace the air cleaner filter according to the maintenance schedule.

4. Check the intercooler hoses & pipes.

- Check if the intercooler hoses & pipes are connected properly.
- Check if the intercooler hoses & pipes are damaged (bent, detached or torn).
- Check if there is any damage, such as crack, on the intercooler pipes.
- Check if the clamps are positioned in place.

If the intercooler hoses & pipes are damaged or disconnected, oil leaks may occur from the hoses & pipes and the turbocharger may exceed the permissible speed then it may cause damage of the turbocharger.

If the intercooler hoses & pipes are damaged, replace them with new ones.

NOTICE

Use new clamps when replacing the hoses & pipes.

5. Check the intercooler.

- Check if the intercooler tubes and tanks are damaged (oil leak or crack).

If the intercooler is damaged, the turbocharger may exceed the permissible speed then it may cause damage of the turbocharger.

If the intercooler is damaged, replace them with a new one.

NOTICE

Use new clamps when replacing the intercooler.

6. Check the engine oil.

- Check the engine oil level.
- Check the engine oil for discoloration, water influx and viscosity degradation.
- Check the engine oil grade.

If the engine oil level is low, amount of engine oil fed to turbocharger reduces then the bearings in the turbocharger may adhere due to insufficient lubrication and cooling.

If the cause of the problem is detected, add or change engine oil.

NOTICE

Change the engine oil according to the maintenance schedule.

7. Check the engine oil pressure.

- Engine oil pressure: Check the oil pressure using an oil pressure gauge after removing the oil pressure switch on the cylinder block.
- Check the engine oil screen in the oil pan if the engine oil level is low. Then check the injectors for gas leaks if foreign substances are accumulated on the oil screen.

If the engine oil level is low, amount of engine oil fed to turbocharger reduces then the bearings in the turbocharger may adhere due to insufficient lubrication and cooling.

If the cause of the problem is detected, add or change engine oil. If foreign substances are accumulated on the oil screen,

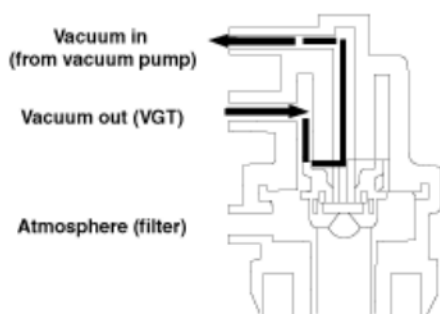
wash the oil screen and replace the injector's washer with a new one after checking the injectors for gas leaks. Check the engine oil-related parts, such as oil pump, if necessary.

NOTICE

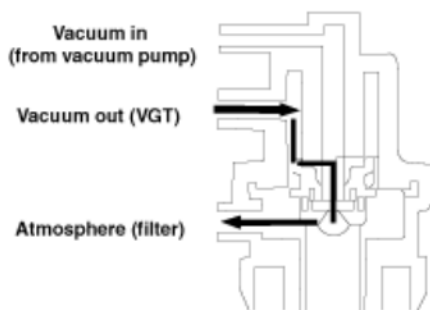
As the turbocharger rotates at high speed of 100,000 rpm or above, deterioration of engine oil can cause damage of the turbocharger bearings. Check engine oil for discoloration, water influx, viscosity degradation and oil pressure lowering.

8. Check the solenoid valve of turbocharger. (Refer to DTC guide)

- Damage of the solenoid valve: Check if vacuum is generated at the disconnected vacuum hose from the actuator when a forced actuator operating mode is performed by GDS..
- Clog of the solenoid valve filter: Check if vacuum is released when a forced actuator operating mode is performed from max. duty (95%) to min. duty (5%) by GDS. (If the solenoid valve filter is clogged, the vacuum won't be released or it will take a long time to be released.)



<Valve On>



<Valve Off>

If the solenoid valve is damaged, the actuator does not work properly then it may cause lack of engine power and poor acceleration. If the solenoid valve filter is clogged, vacuum is not released then it may cause damage of the turbocharger by overrunning.

If the solenoid valve is damaged, replace it with a new one.

9. Check the injectors, sensors, EGR valve, etc. (Refer to FL group)

- Check if the injectors operate properly.
- Check if the sensors, such as the mass air flow sensor (MAFS), intake air temperature sensor (IATS), boost pressure sensor (BPS), operate properly.
- Check if the exhaust gas recirculation (EGR) valve operates properly.

If the injectors, sensors, EGR valve and etc. don't work properly, it may cause lack of engine power.

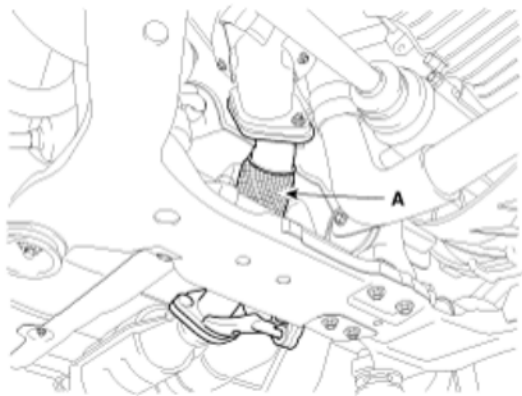
If the cause of the problem is detected, replace the related parts with new ones.

REMOVAL

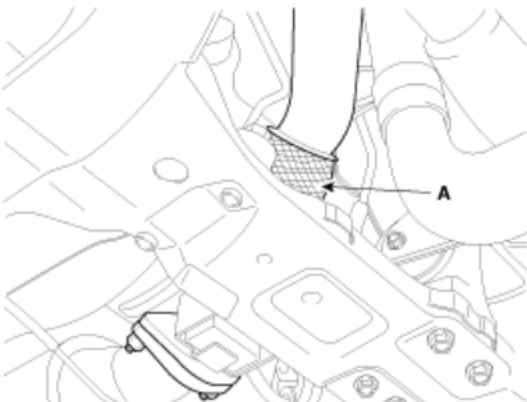
1. Remove the front muffler(A).

Tightening torque :

40 ~ 60N.m (4.0 ~ 6.0kgf.m, 30 ~ 43lb-ft)



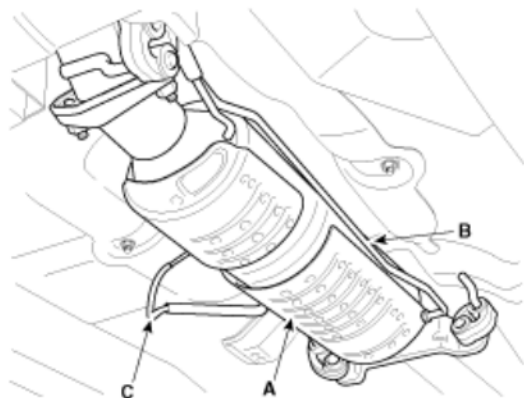
[C.P.F]



- (1) Remove the Catalyzed Particulate Filter(CPF)(A) after disconnecting the differential pressure hoses(B) and exhaust gas temperature sensor(C).(Only C.P.F)

Tightening torque :

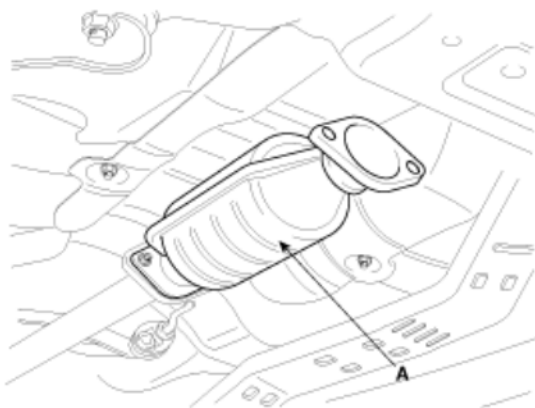
40 ~ 60N.m (4.0 ~ 6.0kgf.m, 30 ~ 43lb-ft)



2. Remove the catalytic converter(A).

Tightening torque :

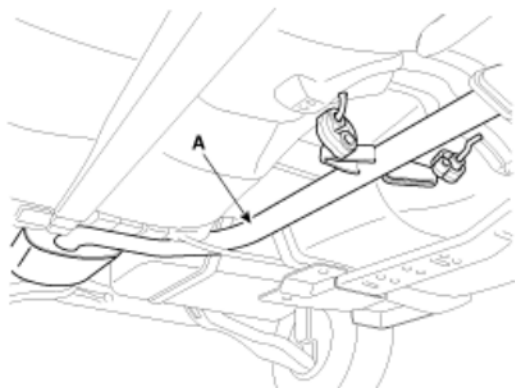
40 ~ 60N.m (4.0 ~ 6.0kgf.m, 30 ~ 43lb-ft)



3. Remove the main muffler(A).

Tightening torque :

40 ~ 60N.m (4.0 ~ 6.0kgf.m, 30 ~ 43lb-ft)



4. Installation is in the reverse order of removal.