Component Procedures: Engine

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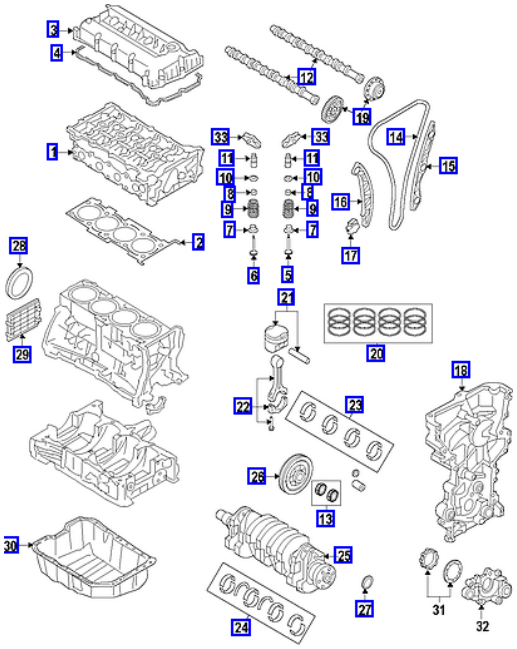
Component Procedures: Engine

Engine (Article 80003)



Parts and Labor (itype_189)

Parts

Qualifier	Part #	Name	Price	Note
Engine	209102EU13	Overhaul Gasket Set	248.32	
Engine	209202EU13	Valve Grind Gasket Kit	302.40	
Engine > Cylinder Block	51ZN32EX00	Korea Built	1361.74	
Engine > Cylinder Block > Us?	51ZN32EX00	Auto Trans	1361.74	
Engine > Cylinder Block > Us?	211032EK00	Manual Trans	2047.27	
Engine > Engine > Korea Built	1D6912EU00	Auto Trans	4838.71	
Engine > Engine > Korea Built	1D6812EU00	Manual Trans	4838.71	
Engine > Engine > Us Built	211012EK07	Auto Trans	4838.71	
Engine > Engine > Us Built	15ZN12EX00	Manual Trans	4838.71	
Engine > Short Block	2D3922EU00A	Korea Built	2074.66	
Engine > Short Block	211022EK04	Us Built	2173.61	

Labor

Operation	Qualifier Path	Skill	Std Hrs	Wty Hrs
Remove & Install	Engine > Engine, R&I	B	9.1	0.0
Remove & Replace	Engine > Engine, R&R	B	11.6	0.0
Remove & Replace	Engine > Long Block, R&R	B	14.6	0.0
Remove & Replace	Engine > Lower Crankcase Seal, R&R	A	12.6	0.0
Remove & Replace	Engine > Short Block, R&R	B	16.6	0.0
Diagnosis	Engine > Oil Leak, Diagnosis	B	1.0	0.0
Overhaul	Engine > Engine, Overhaul	A	24.1	0.0

Specifications Quick Reference (itype_439)

Quick Specifications

- item

Engine and Transaxle Assembly - Repair Procedures (Article 45320)

- Removal

Use fender covers to avoid damaging painted surfaces. To avoid damage, unplug the wiring connectors carefully

while holding the connector portion.

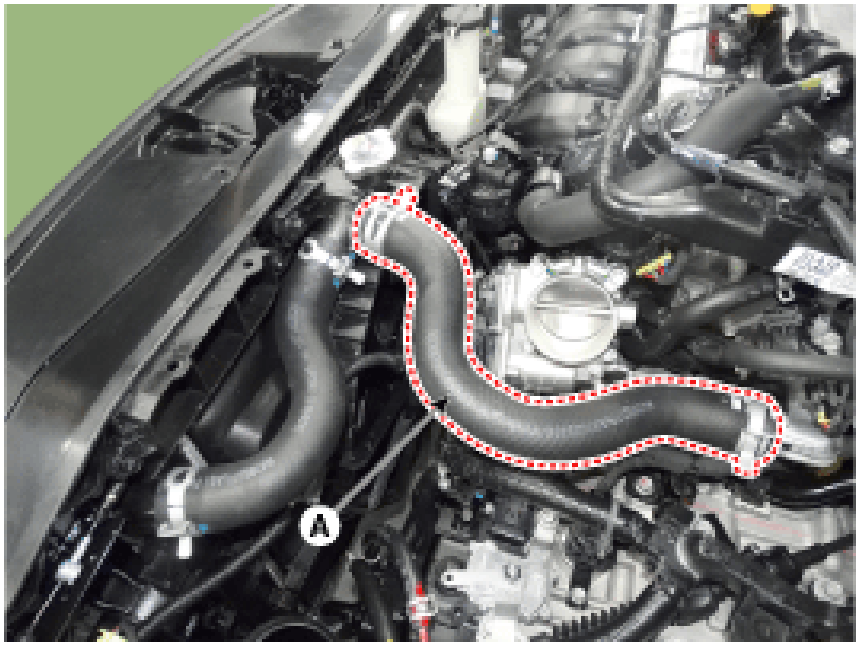
NOTICE

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

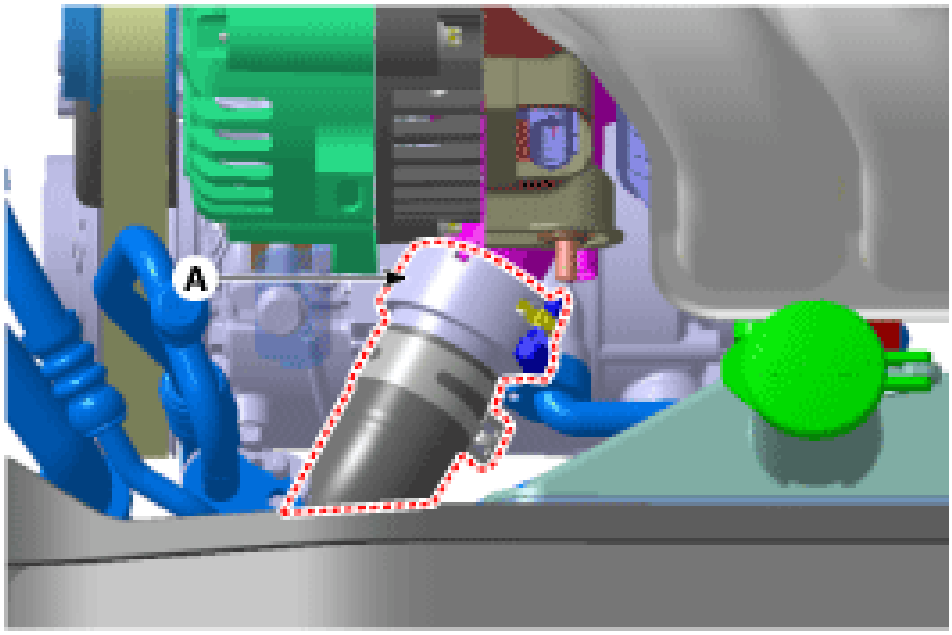
Mark all wiring and hoses to avoid misconnection. For release the fuel system pressure before remove the engine assembly, start the engine without fuel pump relay. and then turn off the ignition switch after engine stops.

Information

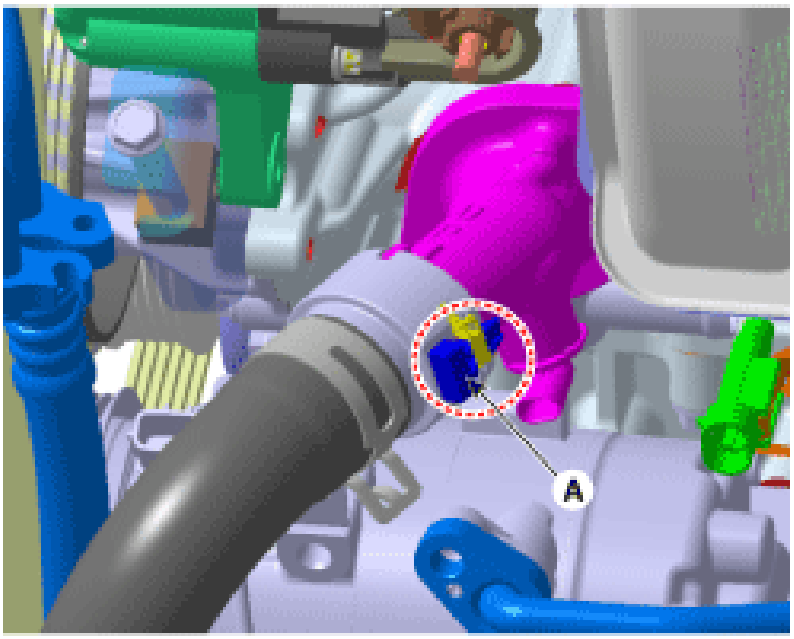
- Mark all wiring and hoses to avoid misconnection.
- For release the fuel system pressure before remove the engine assembly, start the engine without fuel pump relay. and then turn off the ignition switch after engine stops.
- Remove the engine cover . (Refer to Engine and Transaxle Assembly - "Engine Cover")
- Remove the air duct and air cleaner assembly . (Refer to Intake and Exhasut System - "Air Cleaner")
- Remove the battery. (Refer to Engine Electrical System - "Battery")
- Remove the ECM (Engine Control Module). (Refer to Engine Control / Fuel System - "Engine Control Module (ECM)")
- Remove the battery tray. (Refer to Engine Electrical System - "Battery")
- Remove the engine room under cover . (Refer to Engine and Transaxle Assembly - "Engine Room Under Cover")
- Drain the engine coolant. (Refer to Cooling System - "Coolant")
- Disconnect the radiator upper hose (A).



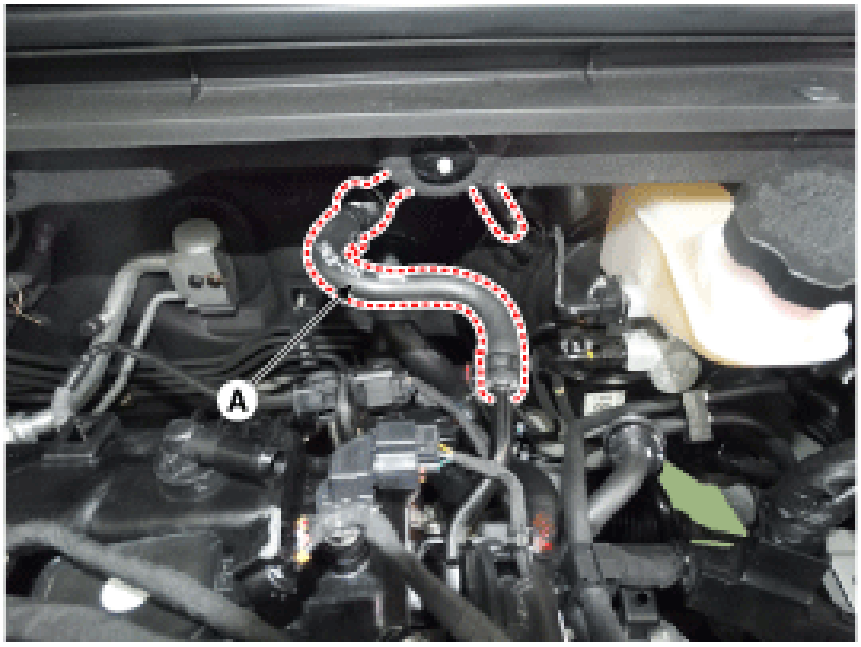
- Disconnect the Radiator lower hose quick connector (A). When the hose detached, remove the holder clip (A) and then disconnect the quick connector.



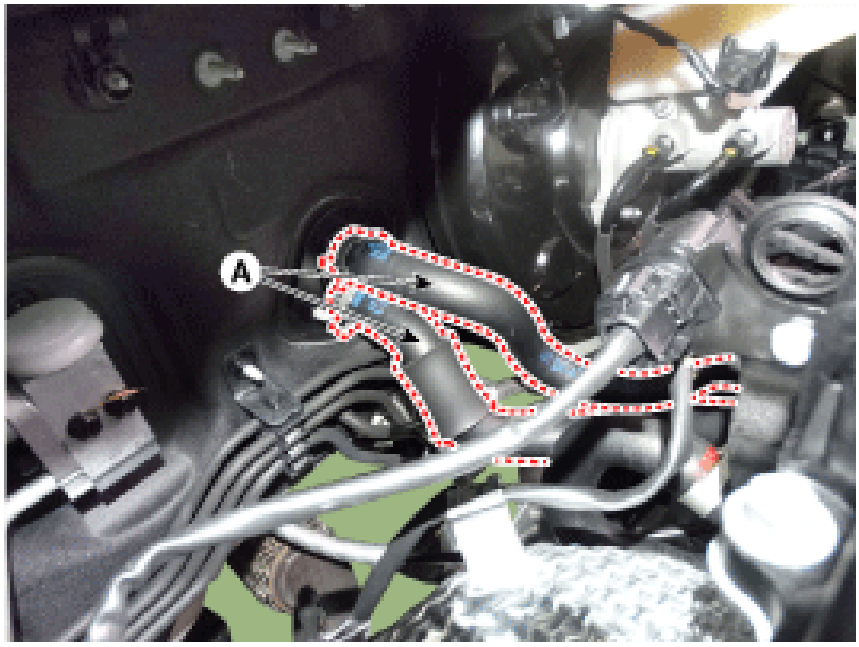
When the hose detached, remove the holder clip (A) and then disconnect the quick connector.
- When the hose detached, remove the holder clip (A) and then disconnect the quick connector.



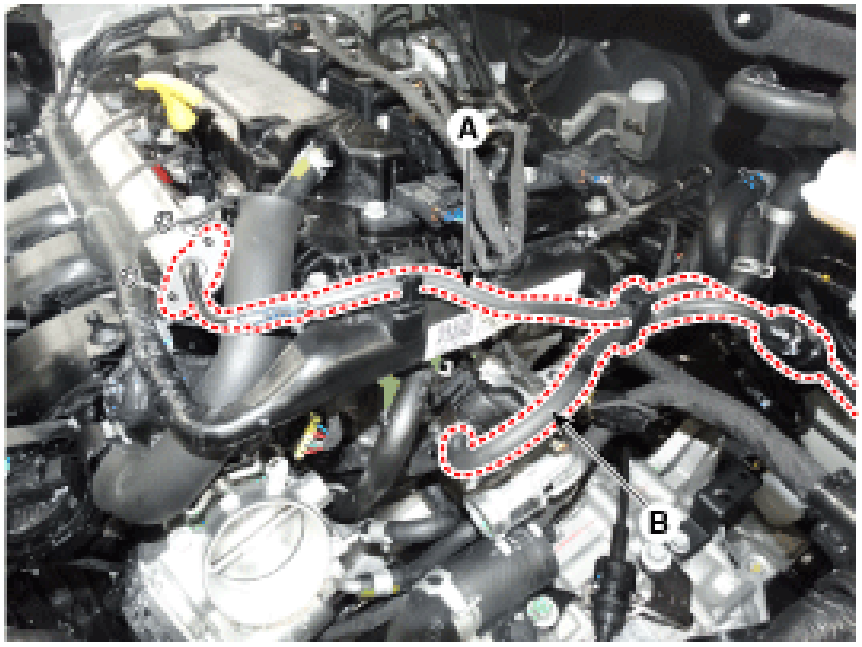
- Recover the refrigerant and then remove the high pressure pipe and low pressure pipe. (Refer to Heating, Ventilation Air conditioning - "Compressor")
- Remove the transaxle wire harness connectors and control cable from the transaxle. (Refer to Automatic Transaxle System - "Automatic Transaxle")
- Disconnect the brake booster vacuum hose (A).



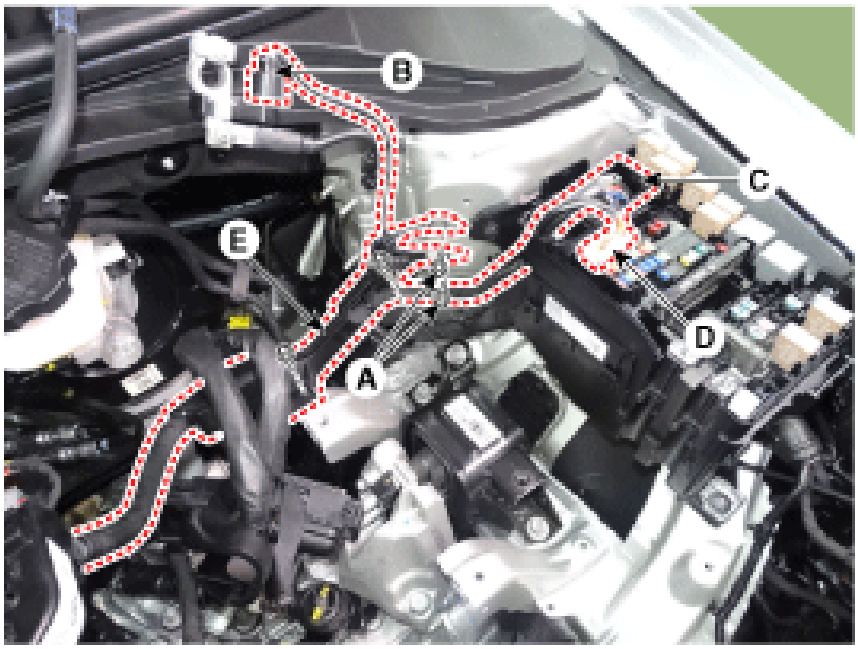
- Disconnect the heater hose s (A).



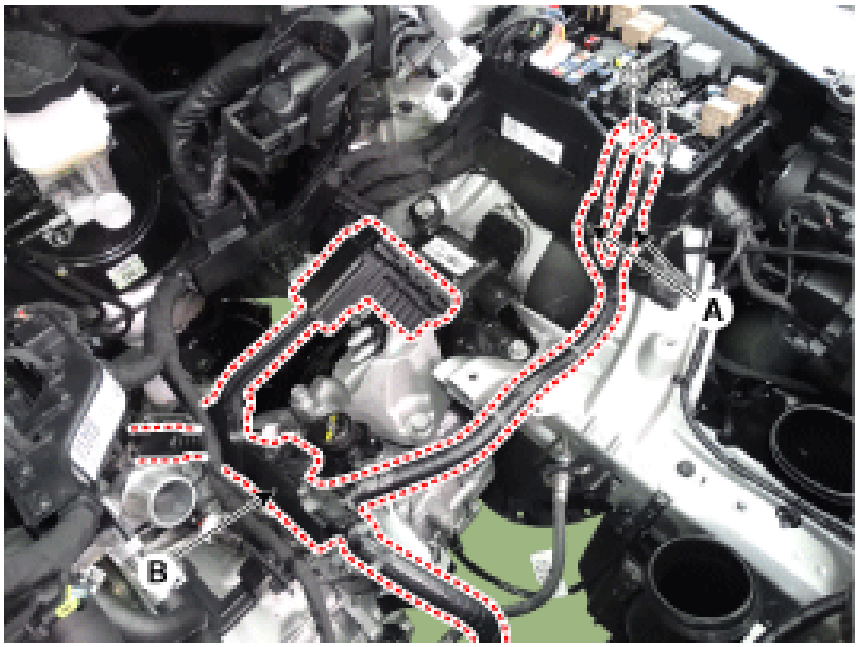
- Disconnect the fuel hose (A) and the purge control solenoid valve (PCSV) hose (B).



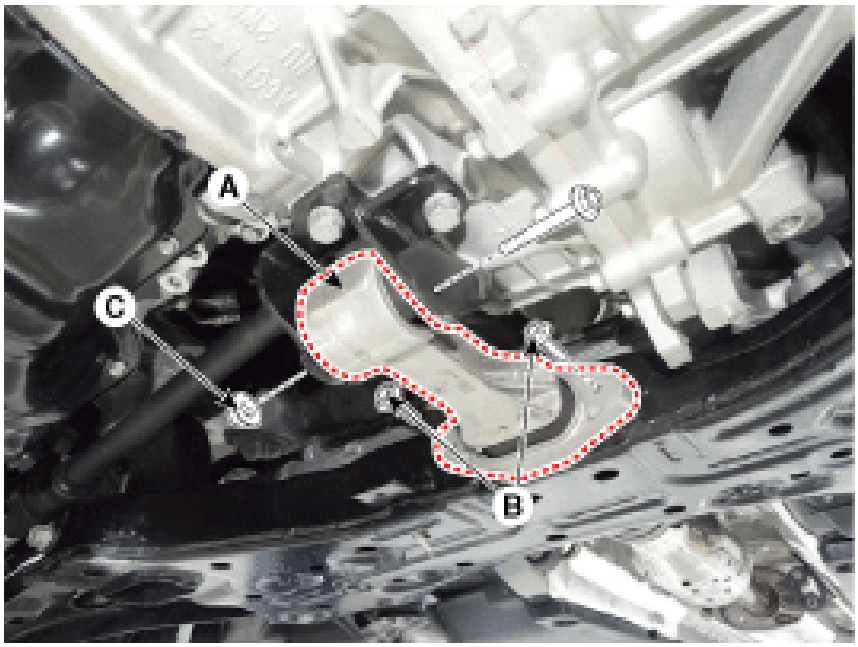
- Disconnect the wiring harness from the engine room. Remove the ground bolt (A). Disconnect the battery negative terminal connector (B). Disconnect the front harness connector (C). Disconnect the PCB block (D). Disconnect the wiring protector (E). Disconnect the battery positive wirings (A). Disconnect the wiring protector (B).
- Remove the ground bolt (A).
- Disconnect the battery negative terminal connector (B).
- Disconnect the front harness connector (C).
- Disconnect the PCB block (D).
- Disconnect the wiring protector (E).



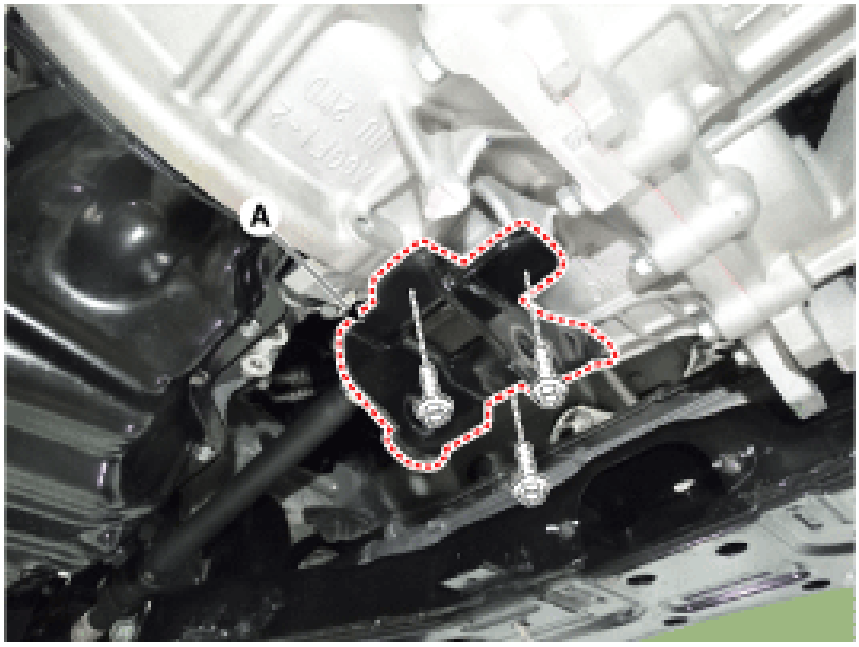
- Disconnect the battery positive wirings (A).
- Disconnect the wiring protector (B).



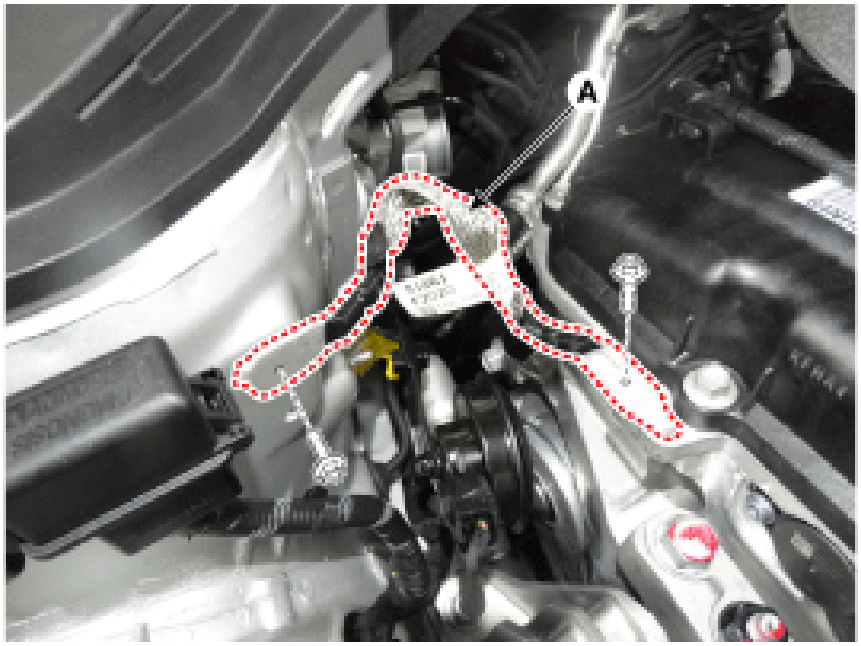
- Remove the front muffler . (Refer to Intake and Exhaust System - "Muffler")
- Remove the steering U-joint mounting bolts. (Refer to Steering System - "Steering Column and Shaft")
- Remove the roll rod bracket (A). Tightening torque Bolts (B) : 49.0 - 63.7 N.m (5.0 - 6.5 kgf.m, 36.2 - 47.0 lb-ft) Nut (C) : 107.9 - 127.5 N.m (11.0 - 13.0 kgf.m, 79.6 - 94.0 lb-ft)



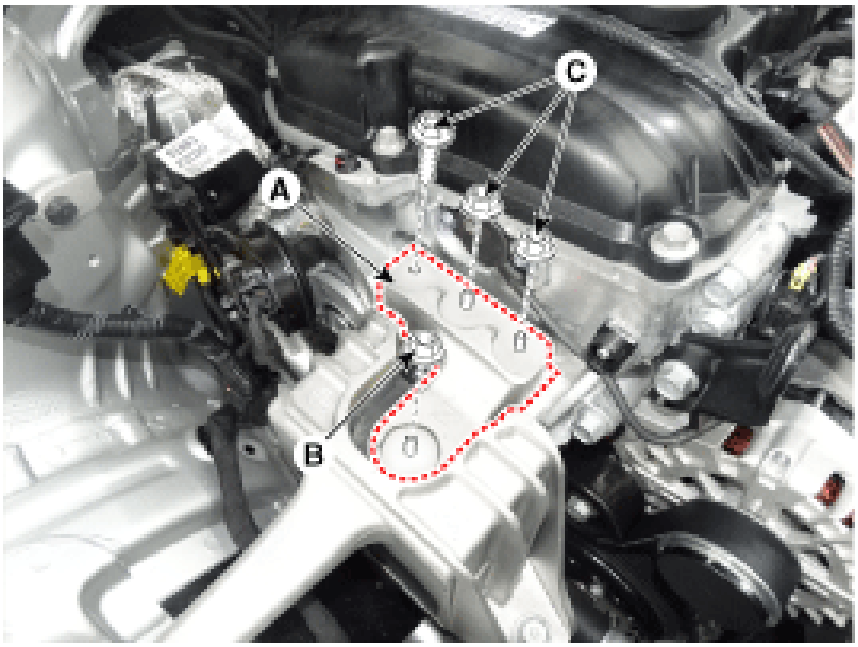
- Remove the roll rod mounting support bracket (A). Tightening torque : 49.0 - 68.6 N.m (5.0 - 7.0 kgf.m, 36.2 - 50.6 lb-ft)



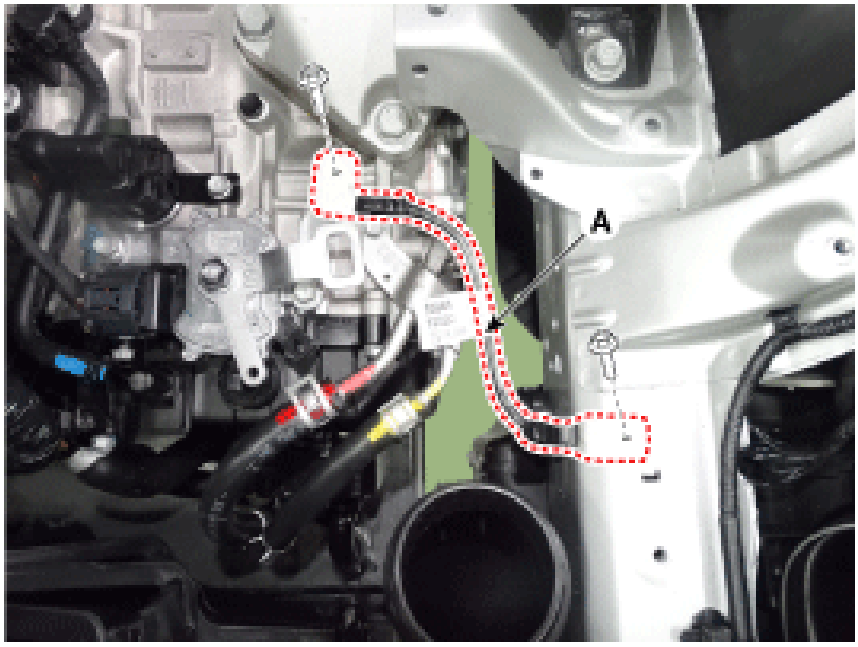
- Remove the sub frame. (Refer to Suspension System - "Sub Frame")
- Support the engine and transaxle assembly with a floor jack.
- Disconnect the ground cable (A). Tightening torque : 10.8 - 13.7 N.m (1.1 - 1.4 kgf.m. 8.0 - 10.1 lb-ft)



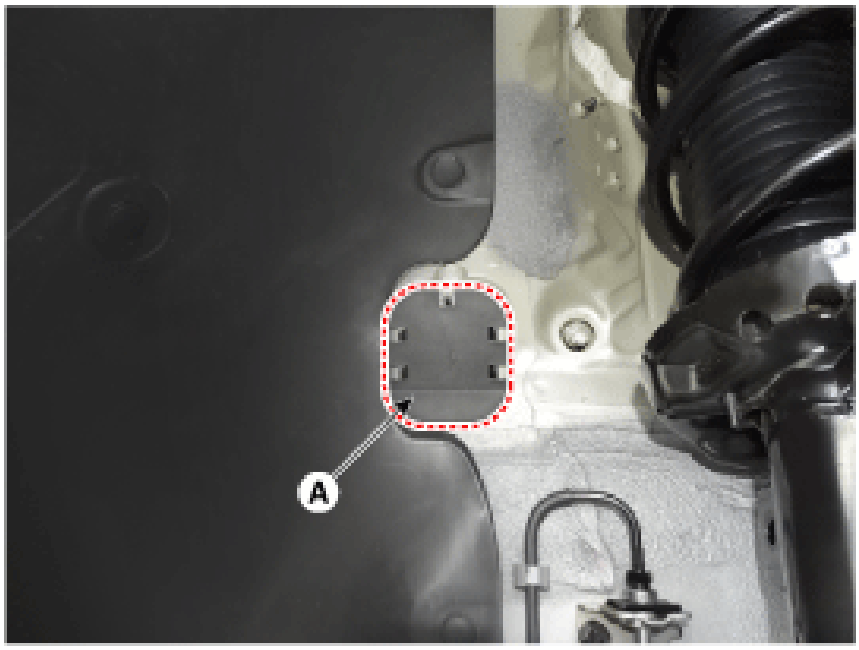
- Remove the engine mounting support bracket (A). Tightening torque Nut (B) : 88.3 - 107.9 N.m (9.0 - 11.0 kgf.m, 65.1 - 79.6 lb-ft) Bolt, Nuts (C) : 58.8 - 73.5 N.m (6.0 - 7.5 kgf.m, 43.4 - 54.2 lb-ft)



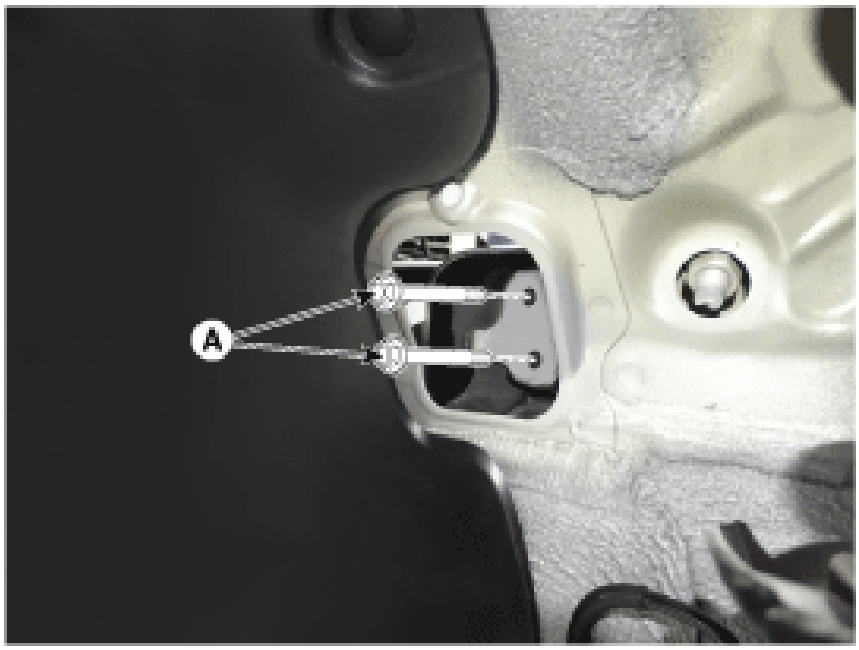
- Disconnect the ground line (A). Tightening torque : 10.8 - 13.7 N.m (1.1 - 1.4 kgf.m, 8.0 - 10.1 lb-ft)



- Remove the service cover (A).



- Remove the transaxle support bracket mounting bolts (A). Tightening torque : 88.3 - 107.9 N.m (9.0 - 11.0 kgf.m, 65.1 - 79.6 lb-ft)



- Remove the engine and transaxle assembly by lifting vehicle. Before removing the engine and transaxle assembly, make sure hoses and wire connectors are disconnected. When removing the engine and transaxle assembly, be careful not to damage any surrounding parts or body components.

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- Before removing the engine and transaxle assembly, make sure hoses and wire connectors are disconnected.
- When removing the engine and transaxle assembly, be careful not to damage any surrounding parts or body components.
- Installation
- Adjust shift cable.
- Adjust throttle cable.
- Refill engine with engine oil.
- Refill transaxle with fluid.
- Refill radiator and reservoir tank with engine coolant.
- Place heater control knob on "HOT" position.
- Bleed air from the cooling system .
- (Refer to Cooling System - "Coolant")
- Clean battery posts and cable terminals with sandpaper assemble them, then apply grease to prevent corrosion.
- Inspect for fuel leakage.
- After assemble the fuel line, turn on the ignition switch (do not operate the starter) so that the fuel pump runs for approximately two seconds and fuel line pressurizes.
- Repeat this operation two or three times, then check for fuel leakage at any point in the fuel line.

Engine Mechanical System - Specifications (Article 45307)

- Specifications

Description Specifications Limit
General
Type In-line, DOHC
Number of cylinders 4
Bore 81.0 mm (3.1890 in.)
Stroke 97.0 mm (3.8189 in.)
Total displacement 1999 cc (121.99 cu.in.)
Compression ratio 12.5 ± 0.2 : 1
Firing order 1-3-4-2
Valve timing
Intake valve Open [BTDC 38° - ATDC 2°(initial position)] - [ATDC 42°]
Close [ABDC 43° - ABDC 83°(initial position)] - [ABDC 123°]
Exhaust valve Open BBDC 54° - ABDC 6°
Close ATDC 1° - ATDC 61°
Camshaft
Cam height Intake 39.0 mm (1.5354 in.)

Exhaust 38.66 mm (1.5220 in.)
Journal outer diameter Intake No.1 : 35.959 - 35.975 mm (1.41571 - 1.41634 in.)
No.2,3,4,5 : 22.959 - 22.975 mm (0.90390 - 0.90453 in.)
Exhaust No.1 : 35.959 - 35.975 mm (1.41571 - 1.41634 in.)
Bearing oil clearance Intake No.1 : 0.032 - 0.062 mm (0.00126 - 0.00244 in.)
No.2,3,4,5 : 0.032 - 0.062 mm (0.00126 - 0.00244 in.)
Exhaust No.1 : 0.032 - 0.062 mm (0.00126 - 0.00244 in.)
End play 0.10 - 0.19 mm (0.0039 - 0.0075 in.)
Valve
Valve length Intake 102.22 mm (4.0244 in.) 101.97 mm (4.0146 in.)
Exhaust 104.04 mm (4.0961 in.) 103.79 mm (4.0862 in.)
Stem outer diameter Intake 5.465 - 5.480 mm (0.21516 - 0.21575 in.)
Exhaust 5.458 - 5.470 mm (0.21488 - 0.21535 in.)
Face angle 45.25° - 45.75°
Thickness of valve head (margin) Intake 1.41 - 1.71 mm (0.0555 - 0.0673 in.)
Exhaust 1.55 - 1.85 mm (0.0610 - 0.0728 in.)
Valve stem to valve guide clearance Intake 0.020 - 0.047 mm (0.00079 - 0.00185 in.)
Exhaust 0.030 - 0.054 mm (0.00118 - 0.00213 in.)
Valve guide
Length Intake 43.8 - 44.2 mm (1.7244 - 1.7402 in.)
Exhaust 43.8 - 44.2 mm (1.7244 - 1.7402 in.)
Inner diameter Intake 5.500 - 5.512 mm (0.21654 - 0.21701 in.)
Exhaust 5.500 - 5.512 mm (0.21654 - 0.21701 in.)
Valve seat
Width of seat contact Intake 1.05 - 1.35 mm (0.0413 - 0.0532 in.)
Exhaust 1.35 - 1.65 mm (0.0532 - 0.0650 in.)
Seat angle Intake 44° 45' - 45° 6'
Exhaust 44° 45' - 45° 6'
Valve spring
Free length 45.93 mm (1.8083 in.)
Load 19.6 ± 1.0 kg / 37.0 mm (43.21 ± 2.20 lb / 1.4567 in.)
45.7 ± 1.8 kg / 27.0 mm (100.75 ± 3.97 lb / 1.0630 in.)
Out of squareness Less than 1.5°
Cylinder head
Flatness of gasket surface Less than 0.05 mm (0.0020 in.) for total area
Less than 0.02 mm (0.0008 in.) for a section of 100 mm (3.9370 in.) x 100 mm (3.9370 in.)
Flatness of manifold mounting surface Intake Less than 0.10 mm (0.0039 in.)
Exhaust Less than 0.10 mm (0.0039 in.)
Piston
Piston outer diameter 80.97 - 81.00 mm (3.1878 - 3.1890 in.)
Piston to cylinder clearance 0.02 - 0.04 mm (0.0008 - 0.0016 in.)
Ring groove width No. 1 ring 1.030 - 1.050 mm (0.04055 - 0.04134 in.)
No. 2 ring 1.230 - 1.250 mm (0.04843 - 0.04921 in.)
Oil ring 2.010 - 2.025 mm (0.07913 - 0.07972 in.)
Piston ring
Side clearance No. 1 ring 0.040 - 0.080 mm (0.00157 - 0.00315 in.)
No. 2 ring 0.040 - 0.080 mm (0.00157 - 0.00315 in.)
Oil ring 0.020 - 0.055 mm (0.00079 - 0.00216 in.)
End gap No. 1 ring 0.15 - 0.30 mm (0.0059 - 0.0118 in.)
No. 2 ring 0.30 - 0.45 mm (0.0118 - 0.0177 in.)
Oil ring 0.20 - 0.40 mm (0.0079 - 0.0157 in.)
Piston pin
Piston pin outer diameter 19.997 - 20.000 mm (0.78728 - 0.78740 in.)
Piston pin hole inner diameter 20.004 - 20.009 mm (0.78756 - 0.78775 in.)
Piston pin hole clearance 0.004 - 0.012 mm (0.00016 - 0.00047 in.)
Connecting rod small end hole inner diameter 20.007 - 20.015 mm (0.78768 - 0.78799 in.)
Piston pin-to-connecting rod bushing oil clearance 0.007 - 0.018 mm (0.00028 - 0.00071 in.)
Connecting rod
Connecting rod big end inner diameter 48.000 - 48.018 mm (1.88976 - 1.89047 in.)
Connecting rod bearing oil clearance 0.024 - 0.042 mm (0.00094 - 0.00165 in.)

Side clearance 0.10 - 0.25 mm (0.0039 - 0.0098 in.)
Crankshaft
Main journal outer diameter 54.942 - 54.960 mm (2.16307 - 2.16378 in.)
Pin journal outer diameter 44.954 - 44.972 mm (1.76984 - 1.77055 in.)
Main bearing oil clearance 0.016 - 0.034 mm (0.00063 - 0.00134 in.)
End play 0.07 - 0.25 mm (0.0028 - 0.0098 in.)
Cylinder block
Cylinder bore 81.00 - 81.03 mm (3.1890 - 3.1902 in.)
Engine oil
Oil quantity Total 4.5 L (1.19 U.S.gal., 4.76 U.S.qt., 3.96 lmp.qt.) When replacing a short engine or block assembly
Oil pan 3.7 L (0.98 U.S.gal., 3.91 U.S.qt., 3.26 lmp.qt.)
Drain and refill 4.0 L (1.06 U.S.gal., 4.23 U.S.qt., 3.52 lmp.qt.) Including oil filter
Oil grade Specifications 5W-20 / API SM& ILSAC GF-4 (or above) / ACEA A5 (or above) API SL, ILSAC GF-3, ACEA A3 Class engine oil can be used if the recommended engine oil is not available. Refer to the "Lubrication System" for recommended SAE viscosity number.
API SL, ILSAC GF-3, ACEA A3 Class engine oil can be used if the recommended engine oil is not available. Refer to the "Lubrication System" for recommended SAE viscosity number.

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Oil pressure (at 1,000rpm) 90.22 kPa (0.92 kgf/cm², 13.09 psi) or above Oil temperature (oil pan): 110 ± 2°C (230 ± 35.6°F)
Oil Pump
Relief valve opening pressure 500.14 - 600.16 kPa (5.10 - 6.12 kgf/cm², 72.54 - 87.05 psi) (5-6bar)
Side clearance 0.040 - 0.090 mm (0.00157 - 0.00354 in.)
Body clearance 0.200 - 0.292 mm (0.00787 - 0.01149 in.)
Guide clearance 0.030 - 0.075 mm (0.00118 - 0.00295 in.)
Cooling system
Cooling method Forced circulation with cooling fan
Coolant quantity Approx. 6.6 L (1.66 U.S.gal., 6.97 U.S.qt., 5.81 lmp.qt.)
Electric thermostat (ECT) Type Wax pellet type
Opening temperature 100 ± 2°C (212 ± 3.6°F)
Full opening valve lift / temperature More than 8 mm (0.3 in.) / 115°C (239°F)
Radiator cap Main valve opening pressure 93.16 - 122.58 kPa (0.95 - 1.25 kgf/cm², 13.51 - 17.78 psi)
Vacuum valve opening pressure 0 - 6.86 kPa (0 - 0.07 kgf/cm², 0 - 1.00 psi)
- Liquid Gasket

Location Product
Mating surface of timing chain cover Threebond 1217H or equivalent
Front area of mating surface between cam carrier and cylinder head
Front area of mating surface between cylinder block and head
Upper area of mating surface between timing chain cover and cam carrier
Front upper area of cylinder block
Front upper area of cylinder head gasket
Lower area of cam carrier
Lower area of cylinder block
Mating surface of oil pan
Mating surface of oil pressure switch THREEBOND 2403

- Tightening Torques

Item N.m kgf.m lb-ft

Engine mounting
Engine mount ing bracket to body fixing bolt 49.0 - 63.7 5.0 - 6.5 36.2 - 47.0
Engine mounting support bracket to engine mounting insulator fixing nut 88.3 - 107.9 9.0 - 11.0 65.1 - 79.6
Engine mounting support bracket to engine support bracket fixing bolt 58.8 - 73.5 6.0 - 7.5 43.4 - 54.2
Engine mounting support bracket to engine support bracket fixing nut 58.8 - 73.5 6.0 - 7.5 43.4 - 54.2
Transaxle mounting bracket to body fixing bolt 49.0 - 63.7 5.0 - 6.5 36.2 - 47.0
Transaxle mounting bracket to transaxle mounting support bracket fixing bolt 88.3 - 107.9 9.0 - 11.0 65.1 - 79.6
Roll rod bracket to sub frame fixing bolt 49.0 - 63.7 5.0 - 6.5 36.2 - 47.0
Roll rod bracket to roll rod support bracket fixing bolt & nut 107.9 - 127.5 11.0 - 13.0 79.6 - 94.0
Timing system
Crankshaft pulley bolt 196.1 - 205.9 20.0 - 21.0 144.7 - 151.9
Timing chain cover service plug bolt 29.4 - 39.2 3.0 - 4.0 21.7 - 28.9
Timing chain cover bolt (M10×55) 39.2 - 49.0 4.0 - 5.0 28.9 - 36.2
Timing chain cover bolt (M10×85) 39.2 - 49.0 4.0 - 5.0 28.9 - 36.2
Timing chain cover bolt - Seal bolt (M6×38) 9.8 - 11.8 1.0 - 1.2 7.2 - 8.7
Timing chain cover bolt - Seal bolt (M8×50) 19.6 - 23.5 2.0 - 2.4 14.5 - 17.4
Timing chain cover bolt (M8×50) 18.6 - 23.5 1.9 - 2.4 13.7 - 17.4
Timing chain cover bolt (M8×28) 18.6 - 23.5 1.9 - 2.4 13.7 - 17.4
Timing chain tensioner bolt 9.8 - 11.8 1.0 - 1.2 7.2 - 8.7
Timing chain tensioner arm bolt 18.6 - 22.6 1.9 - 2.3 13.7 - 16.6
Timing chain guide bolt 18.6 - 22.6 1.9 - 2.3 13.7 - 16.6
Engine cover mounting bolt 7.8 - 9.8 0.8 - 1.0 5.8 - 7.2
Ignition coil bolt 9.8 - 11.8 1.0 - 1.2 7.2 - 8.7
Cylinder head cover bolt [3.9 - 5.9] + [7.8 - 9.8] [0.4 - 0.6] + [0.8 - 1.0] [2.9 - 4.3] + [5.8 - 7.2]
Injector & rail assembly bolt 18.6 - 23.5 1.9 - 2.4 13.7 - 17.4
CVVT bolt (LH/RH) 64.7 - 76.5 6.6 - 7.8 47.7 - 56.4
Camshaft bearing cap bolt (M6) 11.8 - 13.7 1.2 - 1.4 8.7 - 10.1
Camshaft bearing cap bolt (M8) 18.6 - 22.6 1.9 - 2.3 13.7 - 16.6
Cam carrier bolt 18.6 - 22.6 1.9 - 2.3 13.7 - 16.6
Cylinder head bolt [32.4 - 36.3] + [90 - 95°] + [90 - 95°] [3.3 - 3.7] + [90 - 95°] + [90 - 95°] [23.9 - 26.8] + [90 - 95°] + [90 - 95°]
Engine hanger bolt (Front/Rear) 34.3 - 39.2 3.5 - 4.0 25.3 - 28.9
Camshaft position sensor (LH/RH) 9.8 - 11.8 1.0 - 1.2 7.2 - 8.7
Oil control valve (OCV) bolt (LH/RH) 9.8 - 11.8 1.0 - 1.2 7.2 - 8.7
Drive plate bolt 117.7 - 127.5 12.0 - 13.0 86.8 - 93.9
Connecting rod bearing cap bolt [17.7 - 21.6] + [103 - 107°] [1.8 - 2.2] + [103 - 107°] [13.0 - 15.9] + [103 - 107°]
Lower crankcase bolt 18.6 - 23.5 1.9 - 2.4 13.7 - 17.4
Main bearing cap bolt [27.5 - 31.4] + [120 - 125°] [2.8 - 3.2] + [120 - 125°] [20.3 - 23.1] + [120 - 125°]
Crankshaft position sensor bolt 10.8 - 11.8 1.1 - 1.2 8.0 - 8.7
Knock sensor 18.6 - 23.5 1.9 - 2.4 13.7 - 17.4
Lubrication system
Oil drain plug 34.3 - 44.1 3.5 - 4.5 25.3 - 32.5
Oil filter 11.8 - 15.7 1.2 - 1.6 8.7 - 11.6
Oil pan bolt 11.8 - 13.7 1.2 - 1.4 8.7 - 10.1
Oil screen bolt 19.6 - 26.5 2.0 - 2.7 14.5 - 19.5
Oil screen nut 11.8 - 13.7 1.2 - 1.4 8.7 - 10.1
Oil pressure sw itch 9.8 - 11.8 1.0 - 1.2 7.2 - 8.7
Water pump pulley bolt 9.8 - 11.8 1.0 - 1.2 7.2 - 8.7
Water pump bolt 9.8 - 11.8 1.0 - 1.2 7.2 - 8.7
Water inlet fitting nut 18.6 - 23.5 1.9 - 2.4 13.7 - 17.4
Water temperature control assembly bolt 9.8 - 11.8 1.0 - 1.2 7.2 - 8.7
Heater pipe bolt 19.6 - 23.5 2.0 - 2.4 14.5 - 17.4
Intake and exhaust system
Air intake hose clamp bolt 2.9 - 4.9 0.3 - 0.5 2.2 - 3.6
Air cleaner assembly bolt 7.8 - 9.8 0.8 - 1.0 5.8 - 7.2
Electronic throttle control (ETC) module bolt 9.8 - 11.8 1.0 - 1.2 7.2 - 8.7
Intake manifold stay bolt 18.6 - 23.5 1.9 - 2.4 13.7 - 17.4
Intake manifold bolt 18.6 - 23.5 1.9 - 2.4 13.7 - 17.4

Intake manifold nut 18.6 - 23.5 1.9 - 2.4 13.7 - 17.4
Exhaust manifold heat protector bolt 9.8 - 11.8 1.0 - 1.2 7.2 - 8.7
Exhaust manifold stay bolt 39.2 -49.0 4.0 - 5.0 28.9 - 36.2
Exhaust manifold nut 34.3 - 39.2 3.5 - 4.0 25.3 - 28.9
Muffler nut 39.2 - 58.8 4.0 - 6.0 28.9 - 43.4

Engine Mechanical System - Specifications (Article 45308)

- Specifications
Description Specifications Limit
General
Type In-line, DOHC
Number of cylinders 4
Bore 81.0 mm (3.1890 in.)
Stroke 97.0 mm (3.8189 in.)
Total displacement 1999 cc (121.99 cu.in.)
Compression ratio 12.5 ± 0.2 : 1
Firing order 1-3-4-2
Valve timing
Intake valve Open [BTDC 38° - ATDC 2°(initial position)] - [ATDC 42°]
Close [ABDC 43° - ABDC 83°(initial position)] - [ABDC 123°]
Exhaust valve Open BBDC 54° - ABDC 6°
Close ATDC 1° - ATDC 61°
Camshaft
Cam height Intake 39.0 mm (1.5354 in.)
Exhaust 38.66 mm (1.5220 in.)
Journal outer diameter Intake No.1 : 35.959 - 35.975 mm (1.41571 - 1.41634 in.)
No.2,3,4,5 : 22.959 - 22.975 mm (0.90390 - 0.90453 in.)
Exhaust No.1 : 35.959 - 35.975 mm (1.41571 - 1.41634 in.)
Bearing oil clearance Intake No.1 : 0.032 - 0.062 mm (0.00126 - 0.00244 in.)
No.2,3,4,5 : 0.032 - 0.062 mm (0.00126 - 0.00244 in.)
Exhaust No.1 : 0.032 - 0.062 mm (0.00126 - 0.00244 in.)
End play 0.10 - 0.19 mm (0.0039 - 0.0075 in.)
Valve
Valve length Intake 102.22 mm (4.0244 in.) 101.97 mm (4.0146 in.)
Exhaust 104.04 mm (4.0961 in.) 103.79 mm (4.0862 in.)
Stem outer diameter Intake 5.465 - 5.480 mm (0.21516 - 0.21575 in.)
Exhaust 5.458 - 5.470 mm (0.21488 - 0.21535 in.)
Face angle 45.25° - 45.75°
Thickness of valve head (margin) Intake 1.41 - 1.71 mm (0.0555 - 0.0673 in.)
Exhaust 1.55 - 1.85 mm (0.0610 - 0.0728 in.)
Valve stem to valve guide clearance Intake 0.020 - 0.047 mm (0.00079 - 0.00185 in.)
Exhaust 0.030 - 0.054 mm (0.00118 - 0.00213 in.)
Valve guide
Length Intake 43.8 - 44.2 mm (1.7244 - 1.7402 in.)
Exhaust 43.8 - 44.2 mm (1.7244 - 1.7402 in.)
Inner diameter Intake 5.500 - 5.512 mm (0.21654 - 0.21701 in.)
Exhaust 5.500 - 5.512 mm (0.21654 - 0.21701 in.)
Valve seat
Width of seat contact Intake 1.05 - 1.35 mm (0.0413 - 0.0532 in.)
Exhaust 1.35 - 1.65 mm (0.0532 - 0.0650 in.)
Seat angle Intake 44° 45' - 45° 6'
Exhaust 44° 45' - 45° 6'
Valve spring
Free length 45.93 mm (1.8083 in.)
Load 19.6 ± 1.0 kg / 37.0 mm (43.21 ± 2.20 lb / 1.4567 in.)
45.7 ± 1.8 kg / 27.0 mm (100.75 ± 3.97 lb / 1.0630 in.)
Out of squareness Less than 1.5°
Cylinder head
Flatness of gasket surface Less than 0.05 mm (0.0020 in.) for total area
Less than 0.02 mm (0.0008 in.) for a section of 100 mm (3.9370 in.) x 100 mm (3.9370 in.)

Flatness of manifold mounting surface Intake Less than 0.10 mm (0.0039 in.)
Exhaust Less than 0.10 mm (0.0039 in.)
Piston
Piston outer diameter 80.97 - 81.00 mm (3.1878 - 3.1890 in.)
Piston to cylinder clearance 0.02 - 0.04 mm (0.0008 - 0.0016 in.)
Ring groove width No. 1 ring 1.030 - 1.050 mm (0.04055 - 0.04134 in.)
No. 2 ring 1.230 - 1.250 mm (0.04843 - 0.04921 in.)
Oil ring 2.010 - 2.025 mm (0.07913 - 0.07972 in.)
Piston ring
Side clearance No. 1 ring 0.040 - 0.080 mm (0.00157 - 0.00315 in.)
No. 2 ring 0.040 - 0.080 mm (0.00157 - 0.00315 in.)
Oil ring 0.020 - 0.055 mm (0.00079 - 0.00216 in.)
End gap No. 1 ring 0.15 - 0.30 mm (0.0059 - 0.0118 in.)
No. 2 ring 0.30 - 0.45 mm (0.0118 - 0.0177 in.)
Oil ring 0.20 - 0.40 mm (0.0079 - 0.0157 in.)
Piston pin
Piston pin outer diameter 19.997 - 20.000 mm (0.78728 - 0.78740 in.)
Piston pin hole inner diameter 20.004 - 20.009 mm (0.78756 - 0.78775 in.)
Piston pin hole clearance 0.004 - 0.012 mm (0.00016 - 0.00047 in.)
Connecting rod small end hole inner diameter 20.007 - 20.015 mm (0.78768 - 0.78799 in.)
Piston pin-to-connecting rod bushing oil clearance 0.007 - 0.018 mm (0.00028 - 0.00071 in.)
Connecting rod
Connecting rod big end inner diameter 48.000 - 48.018 mm (1.88976 - 1.89047 in.)
Connecting rod bearing oil clearance 0.024 - 0.042 mm (0.00094 - 0.00165 in.)
Side clearance 0.10 - 0.25 mm (0.0039 - 0.0098 in.)
Crankshaft
Main journal outer diameter 54.942 - 54.960 mm (2.16307 - 2.16378 in.)
Pin journal outer diameter 44.954 - 44.972 mm (1.76984 - 1.77055 in.)
Main bearing oil clearance 0.016 - 0.034 mm (0.00063 - 0.00134 in.)
End play 0.07 - 0.25 mm (0.0028 - 0.0098 in.)
Cylinder block
Cylinder bore 81.00 - 81.03 mm (3.1890 - 3.1902 in.)
Engine oil
Oil quantity Total 4.5 L (1.19 U.S.gal., 4.76 U.S.qt., 3.96 lmp.qt.) When replacing a short engine or block assembly
Oil pan 3.7 L (0.98 U.S.gal., 3.91 U.S.qt., 3.26 lmp.qt.)
Drain and refill 4.0 L (1.06 U.S.gal., 4.23 U.S.qt., 3.52 lmp.qt.) Including oil filter
Oil grade Specifications 5W-20 / API SM& ILSAC GF-4 (or above) / ACEA A5 (or above) API SL, ILSAC GF-3, ACEA A3 Class engine oil can be used if the recommended engine oil is not available. Refer to the "Lubrication System" for recommended SAE viscosity number.
API SL, ILSAC GF-3, ACEA A3 Class engine oil can be used if the recommended engine oil is not available. Refer to the "Lubrication System" for recommended SAE viscosity number.

- API SL, ILSAC GF-3, ACEA A3 Class engine oil can be used if the recommended engine oil is not available.
- Refer to the "Lubrication System" for recommended SAE viscosity number.

Oil pressure (at 1,000rpm) 90.22 kPa (0.92 kgf/cm², 13.09 psi) or above Oil temperature (oil pan): 110 ± 2°C (230 ± 35.6°F)
Oil Pump
Relief valve opening pressure 500.14 - 600.16 kPa (5.10 - 6.12 kgf/cm², 72.54 - 87.05 psi) (5-6bar)
Side clearance 0.040 - 0.090 mm (0.00157 - 0.00354 in.)

Body clearance 0.200 - 0.292 mm (0.00787 - 0.01149 in.)
Guide clearance 0.030 - 0.075 mm (0.00118 - 0.00295 in.)
Cooling system
Cooling method Forced circulation with cooling fan
Coolant quantity Approx. 6.6 L (1.66 U.S.gal., 6.97 U.S.qt., 5.81 lmp.qt.)
Electric thermostat (ECT) Type Wax pellet type
Opening temperature 100 ± 2°C (212 ± 3.6°F)
Full opening valve lift / temperature More than 8 mm (0.3 in.) / 115°C (239°F)
Radiator cap Main valve opening pressure 93.16 - 122.58 kPa (0.95 - 1.25 kgf/cm², 13.51 - 17.78 psi)
Vacuum valve opening pressure 0 - 6.86 kPa (0 - 0.07 kgf/cm², 0 - 1.00 psi)
- Liquid Gasket
Location Product
Mating surface of timing chain cover Threebond 1217H or equivalent
Front area of mating surface between cam carrier and cylinder head
Front area of mating surface between cylinder block and head
Upper area of mating surface between timing chain cover and cam carrier
Front upper area of cylinder block
Front upper area of cylinder head gasket
Lower area of cam carrier
Lower area of cylinder block
Mating surface of oil pan
Mating surface of oil pressure switch THREEBOND 2403
- Tightening Torques
Item N.m kgf.m lb-ft
Engine mounting
Engine mount ing bracket to body fixing bolt 49.0 - 63.7 5.0 - 6.5 36.2 - 47.0
Engine mounting support bracket to engine mounting insulator fixing nut 88.3 - 107.9 9.0 - 11.0 65.1 - 79.6
Engine mounting support bracket to engine support bracket fixing bolt 58.8 - 73.5 6.0 - 7.5 43.4 - 54.2
Engine mounting support bracket to engine support bracket fixing nut 58.8 - 73.5 6.0 - 7.5 43.4 - 54.2
Transaxle mounting bracket to body fixing bolt 49.0 - 63.7 5.0 - 6.5 36.2 - 47.0
Transaxle mounting bracket to transaxle mounting support bracket fixing bolt 88.3 - 107.9 9.0 - 11.0 65.1 - 79.6
Roll rod bracket to sub frame fixing bolt 49.0 - 63.7 5.0 - 6.5 36.2 - 47.0
Roll rod bracket to roll rod support bracket fixing bolt & nut 107.9 - 127.5 11.0 - 13.0 79.6 - 94.0
Timing system
Crankshaft pulley bolt 196.1 - 205.9 20.0 - 21.0 144.7 - 151.9
Timing chain cover service plug bolt 29.4 - 39.2 3.0 - 4.0 21.7 - 28.9
Timing chain cover bolt (M10×55) 39.2 - 49.0 4.0 - 5.0 28.9 - 36.2
Timing chain cover bolt (M10×85) 39.2 - 49.0 4.0 - 5.0 28.9 - 36.2
Timing chain cover bolt - Seal bolt (M6×38) 9.8 - 11.8 1.0 - 1.2 7.2 - 8.7
Timing chain cover bolt - Seal bolt (M8×50) 19.6 - 23.5 2.0 - 2.4 14.5 - 17.4
Timing chain cover bolt (M8×50) 18.6 - 23.5 1.9 - 2.4 13.7 - 17.4
Timing chain cover bolt (M8×28) 18.6 - 23.5 1.9 - 2.4 13.7 - 17.4
Timing chain tensioner bolt 9.8 - 11.8 1.0 - 1.2 7.2 - 8.7
Timing chain tensioner arm bolt 18.6 - 22.6 1.9 - 2.3 13.7 - 16.6
Timing chain guide bolt 18.6 - 22.6 1.9 - 2.3 13.7 - 16.6
Engine cover mounting bolt 7.8 - 9.8 0.8 - 1.0 5.8 - 7.2
Ignition coil bolt 9.8 - 11.8 1.0 - 1.2 7.2 - 8.7
Cylinder head cover bolt [3.9 - 5.9] + [7.8 - 9.8] [0.4 - 0.6] + [0.8 - 1.0] [2.9 - 4.3] + [5.8 - 7.2]
Injector & rail assembly bolt 18.6 - 23.5 1.9 - 2.4 13.7 - 17.4
CVVT bolt (LH/RH) 64.7 - 76.5 6.6 - 7.8 47.7 - 56.4
Camshaft bearing cap bolt (M6) 11.8 - 13.7 1.2 - 1.4 8.7 - 10.1
Camshaft bearing cap bolt (M8) 18.6 - 22.6 1.9 - 2.3 13.7 - 16.6
Cam carrier bolt 18.6 - 22.6 1.9 - 2.3 13.7 - 16.6
Cylinder head bolt [32.4 - 36.3] + [90 - 95°] + [90 - 95°] [3.3 - 3.7] + [90 - 95°] + [90 - 95°] [23.9 - 26.8] + [90 - 95°] + [90 - 95°]
Engine hanger bolt (Front/Rear) 34.3 - 39.2 3.5 - 4.0 25.3 - 28.9
Camshaft position sensor (LH/RH) 9.8 - 11.8 1.0 - 1.2 7.2 - 8.7
Oil control valve (OCV) bolt (LH/RH) 9.8 - 11.8 1.0 - 1.2 7.2 - 8.7
Drive plate bolt 117.7 - 127.5 12.0 - 13.0 86.8 - 93.9

Connecting rod bearing cap bolt [17.7 - 21.6] + [103 - 107°] [1.8 - 2.2] + [103 - 107°] [13.0 - 15.9] + [103 - 107°]
Lower crankcase bolt 18.6 - 23.5 1.9 - 2.4 13.7 - 17.4
Main bearing cap bolt [27.5 - 31.4] + [120 - 125°] [2.8 - 3.2] + [120 - 125°] [20.3 - 23.1] + [120 - 125°]
Crankshaft position sensor bolt 10.8 - 11.8 1.1 - 1.2 8.0 - 8.7
Knock sensor 18.6 - 23.5 1.9 - 2.4 13.7 - 17.4
Lubrication system
Oil drain plug 34.3 - 44.1 3.5 - 4.5 25.3 - 32.5
Oil filter 11.8 - 15.7 1.2 - 1.6 8.7 - 11.6
Oil pan bolt 11.8 - 13.7 1.2 - 1.4 8.7 - 10.1
Oil screen bolt 19.6 - 26.5 2.0 - 2.7 14.5 - 19.5
Oil screen nut 11.8 - 13.7 1.2 - 1.4 8.7 - 10.1
Oil pressure sw itch 9.8 - 11.8 1.0 - 1.2 7.2 - 8.7
Water pump pulley bolt 9.8 - 11.8 1.0 - 1.2 7.2 - 8.7
Water pump bolt 9.8 - 11.8 1.0 - 1.2 7.2 - 8.7
Water inlet fitting nut 18.6 - 23.5 1.9 - 2.4 13.7 - 17.4
Water temperature control assembly bolt 9.8 - 11.8 1.0 - 1.2 7.2 - 8.7
Heater pipe bolt 19.6 - 23.5 2.0 - 2.4 14.5 - 17.4
Intake and exhaust system
Air intake hose clamp bolt 2.9 - 4.9 0.3 - 0.5 2.2 - 3.6
Air cleaner assembly bolt 7.8 - 9.8 0.8 - 1.0 5.8 - 7.2
Electronic throttle control (ETC) module bolt 9.8 - 11.8 1.0 - 1.2 7.2 - 8.7
Intake manifold stay bolt 18.6 - 23.5 1.9 - 2.4 13.7 - 17.4
Intake manifold bolt 18.6 - 23.5 1.9 - 2.4 13.7 - 17.4
Intake manifold nut 18.6 - 23.5 1.9 - 2.4 13.7 - 17.4
Exhaust manifold heat protector bolt 9.8 - 11.8 1.0 - 1.2 7.2 - 8.7
Exhaust manifold stay bolt 39.2 -49.0 4.0 - 5.0 28.9 - 36.2
Exhaust manifold nut 34.3 - 39.2 3.5 - 4.0 25.3 - 28.9
Muffler nut 39.2 - 58.8 4.0 - 6.0 28.9 - 43.4

All New Technical Service Bulletins (itype_432)

Tsbs
- ENGINE BEARING CLEARANCE TESTER (BCT) TECHNICAL REFERENCE GUIDE (24-GI-008H, 2024/05/21)
- INTAKE & EXHAUST SYSTEM INSPECTION & REPLACEMENT GUIDELINES DURING ENGINE REPLACEMENT (26-EM-001H, 2026/02/11)
- BEARING CLEARANCE TEST SERVICE PROCEDURE (25-EM-006H, 2025/07/29)

All Technical Service Bulletins (itype_100)

Tsbs
- ENGINE BEARING CLEARANCE TESTER (BCT) TECHNICAL REFERENCE GUIDE (24-GI-008H, 2024/05/21)
- PRIOR APPROVAL ENGINE WARRANTY HANDLING PROCESS GUIDELINES (19-EM-003H, 2019/08/23)
- INTAKE & EXHAUST SYSTEM INSPECTION & REPLACEMENT GUIDELINES DURING ENGINE REPLACEMENT (26-EM-001H, 2026/02/11)
- DTC P1327 ENGINE REPLACEMENT (22-EM-008H, 2022/05/06)
- BEARING CLEARANCE TEST SERVICE PROCEDURE (25-EM-006H, 2025/07/29)
- COMBUSTION CHAMBER CLEANING PROCEDURE (23-EM-007H, 2023/12/08)
- NU 2.0L ATKINSON ENGINE INSPECTION AND REPLACEMENT (RECALL 203) (22-01-042H, 2022/05/06)
- ENGINE OIL AND FILTER CHANGE SERVICE GUIDELINES (23-EM-005H, 2023/10/12)

Engine Mechanical System - Troubleshooting (Article 45314)

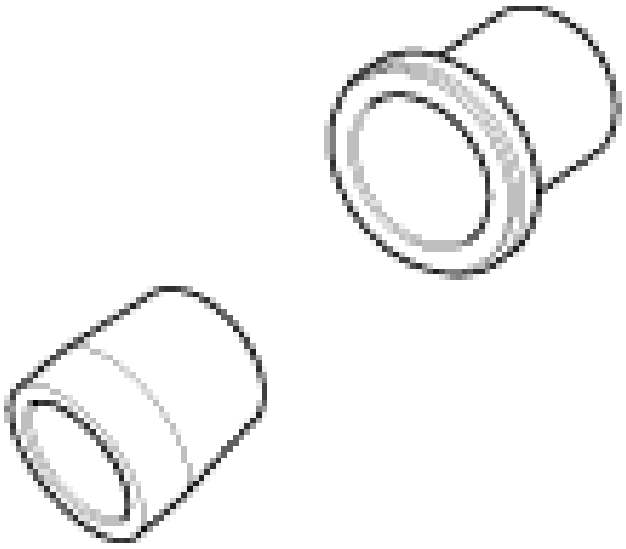
- Troubleshooting
Symption Suspect area Remedy
Engine misfire with abnormal internal lower engine noises Worn crankshaft bearing s Loose or out of specification engine flywheel Replace the crankshaft and bearings as required. Repair or replace the flywheel as required.
- Worn crankshaft bearing s
- Loose or out of specification engine flywheel
- Replace the crankshaft and bearings as required.
- Repair or replace the flywheel as required.

Worn piston ring s (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 buidup on the valve stem) Repair or replace as required.
Excessive worn or mis-aligned timing chain Replace the timing chain and sprocket as required.
Worn camshaft lobes Replace the camshaft.
Engine misfire with coolant consumption Faulty cylinder head gasket or other damage to the cylinder head and engine block cooling system Coolant consumption may or may not cause the engine to overheat Inspect the cylinder head and engine block for damage to the coolant passages and/or a faulty head gasket. Repair or replace as required.
- Faulty cylinder head gasket or other damage to the cylinder head and engine block cooling system
- Coolant consumption may or may not cause the engine to overheat
- Inspect the cylinder head and engine block for damage to the coolant passages and/or a faulty head gasket.
- Repair or replace as required.
Engine misfire with excessive oil consumption Worn valves, guides and/or valve stem oil seal s 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.
- Inspect the cylinder for a loss of compression.
Engine noise on start-up, but only lasting a few seconds (Check and compare with known good vehicle to determine normal condition.) Incorrect oil viscosity Drain the oil. Install the correct viscosity oil.
- Drain the oil.
- Install the correct viscosity oil.
Worn crankshaft thrust bearing Inspect the thrust bearing and crankshaft. Repair or replace as required.
- Inspect the thrust bearing and crankshaft.
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 lifter s Replace the valve lifters.
Stetched or broken timing chain and/or damaged sprocket teeth Replace the timing chain and sprockets.
Worn timing chain tensioner , if applicable Replace the timing chain tensioner as required.
Worn camshaft lobes Inspect the camshaft lobes. Replace the camshaft as required.
- Inspect the camshaft lobes.
- Replace the camshaft as required.
Worn valve guides or valve stems Inspect the valves and valve guides, then repair or replace as required.
Stuck valves (Carbon on the valve stem or valve seat may cause the valve to stay open.) Inspect the valves and valve guides, then repair or replace as required.
Worn drive belt , idler, tensioner and bearing Replace as required.
Lower engine noise, regardless of engine speed Low oil pressure Repair or required.
Loose or damaged flywheel Repair or replace the flywheel.
Damaged oil pan , contacting the oil pump screen Inspect the oil pan. Inspect the oil pump screen. Repair or replace as required.
- Inspect the oil pan.
- Inspect the oil pump screen.
Oil pump screen loose, damaged or restricted Inspect the oil pump screen. Repair or replace as required.
Excessive piston-to- cylinder bore clearance Inspect the piston, piston pin and cylinder bore. Repair or replace as required.
- Inspect the piston, piston pin and cylinder bore.
Excessive piston pin-to-piston clearance Inspect the piston, piston pin and the connecting rod . Repair or replace as required.
- Inspect the piston, piston pin and the connecting rod .
Excessive connecting rod bearing clearance Inspect the following components and repair or replace as required.
The connecting rod bearings. The connecting rods. The crankshaft pin journals.
- The connecting rod bearings.
- The connecting rods.
- The crankshaft pin journals.
Excessive crankshaft bearing clearance Inspect the following components, and repair or replace as required.
The crankshaft bearings. The crankshaft main journals. The cylinder block
- The crankshaft bearings.
- The crankshaft main journals.

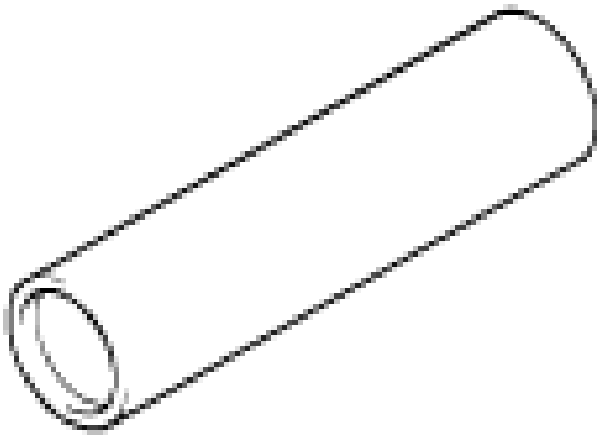
- The cylinder block
Incorrect piston, piston pin and connecting rod installation Verify the piston pins and connecting rods are installed correctly. Repair as required.
- Verify the piston pins and connecting rods are installed correctly.
- Repair as required.
Engine noise under load Low oil pressure Repair or replace as required.
Excessive connecting rod bearing clearance Inspect the following components and repair or replace as required: The connecting rod bearings The connecting rods The crankshaft
- The connecting rod bearings
- The connecting rods
- The crankshaft
Excessive crankshaft bearing clearance Inspect the following components, and repair or replace as required: The crankshaft bearings The crankshaft main journals The cylinder block
- The crankshaft bearings
- The crankshaft main journals
Engine is not cranked. Crankshaft does not rotate. Hydraulically locked cylinder Coolant/antifreeze in cylinder Oil in cylinder Fuel in cylinder Remove spark plugs and check for fluid. Inspect for broken head gasket. Inspect for cracked engine block or cylinder head. Inspect for a sticking fuel injector and/or leaking fuel regulator.
- Coolant/antifreeze in cylinder
- Oil in cylinder
- Fuel in cylinder
- Remove spark plugs and check for fluid.
- Inspect for broken head gasket.
- Inspect for cracked engine block or cylinder head.
- Inspect for a sticking fuel injector and/or leaking fuel regulator.
Broken timing chain and/or timing chain gear s Inspect timing chain and gears . Repair as required.
- Inspect timing chain and gears .
Material in cylinder Broken valve Piston material Foreign material Inspect cylinder for damaged components and/or foreign materials. Repair or replace as required.
- Broken valve
- Piston material
- Foreign material
- Inspect cylinder for damaged components and/or foreign materials.
Seized crankshaft or connecting rod bearings Inspect crankshaft and connecting rod bearing. Repair as required.
- Inspect crankshaft and connecting rod bearing.
Bent or broken connecting rod Inspect connecting rods. Repair as required.
- Inspect connecting rods.
Broken crankshaft Inspect crankshaft. Repair as required.
- Inspect crankshaft.

Engine Mechanical System - Special Service Tools (Article 45315)

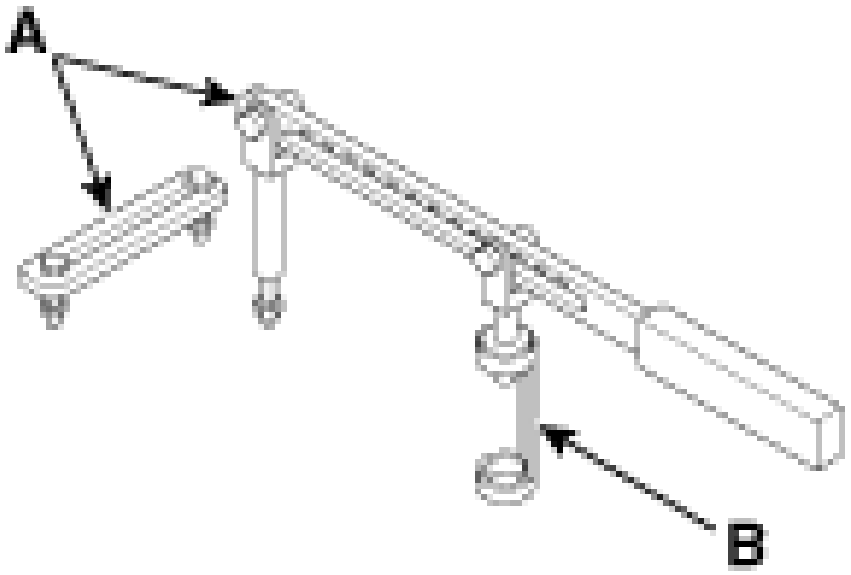
- Special Service Tools
Tool (Number and name) Illustration Use
Crankshaft front oil seal installer 09231-2E000 Installation of the front oil seal



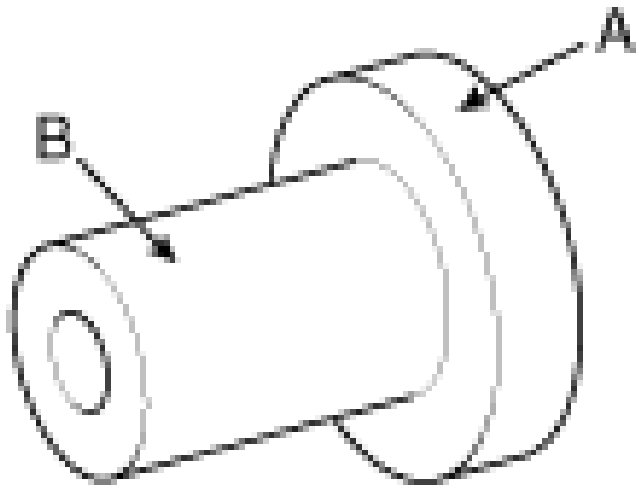
Valve stem seal installer 09222-2E000 Installation of the valve stem oil seal



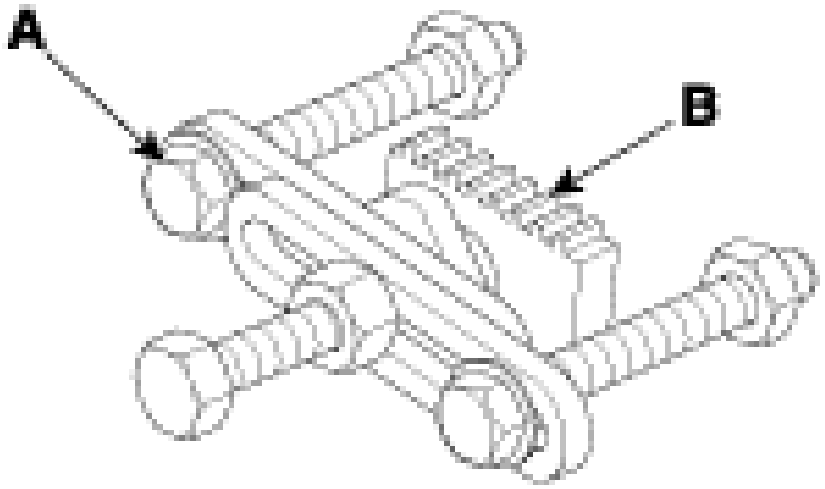
Valve spring compressor A : 09222-3K000 B : 09222-2A100 Removal and installation of the intake or exhaust valve



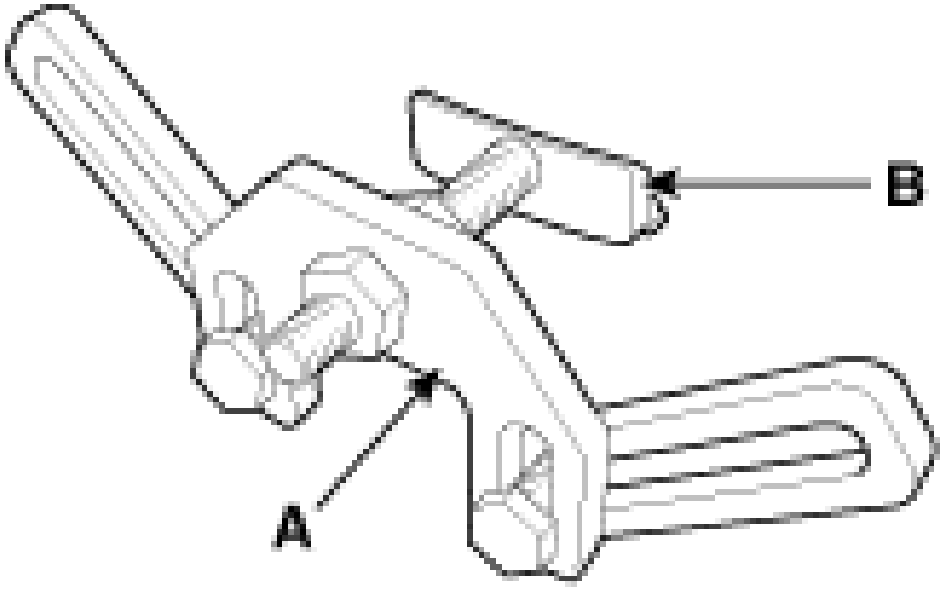
Crankshaft rear oil seal installer A : 09214-2E000 B : 09231-H1100 Installation of the rear oil seal



Ring gear stopper A : 09231-2B100 B : 09231-3N100 Removal and installation of crankshaft pulley bolt.



Ring gear stopper A : 09231-3D100 B : 09231-2W100 Removal and installation of crankshaft pulley bolt.

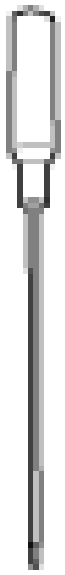


Torque angle adapter 09221-4A000 Installation of bolts & nuts needing an angular method of adjustment

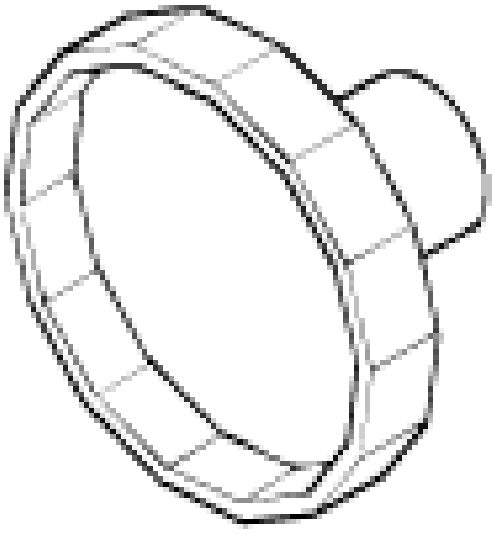
Oil pan remover 09215-3C000 Removal of oil pan Must use this tool to separate the oil pan from the lower crankcase assembly without damage to the sealing surfaces

- Removal of oil pan
- Must use this tool to separate the oil pan from the lower crankcase assembly without damage to the sealing surfaces

Tensioner stopper pin 09240-2E100 Holding compressed piston of tensioner



Oil filter wrench 09263-2E000 Removal and installation of oil filter



OEM Policies and Procedures (itype_120)

Tsbs
- ENGINE BEARING CLEARANCE TESTER (BCT) TECHNICAL REFERENCE GUIDE (24-GI-008H, 2024/05/21)
- DTC P1327 ENGINE REPLACEMENT (22-EM-008H, 2022/05/06)
- COMBUSTION CHAMBER CLEANING PROCEDURE (23-EM-007H, 2023/12/08)
- ENGINE OIL AND FILTER CHANGE SERVICE GUIDELINES (23-EM-005H, 2023/10/12)

Tools and Equipment (itype_113)

Tsbs
- ENGINE BEARING CLEARANCE TESTER (BCT) TECHNICAL REFERENCE GUIDE (24-GI-008H, 2024/05/21)

Warranty Information (itype_119)

Tsbs
- PRIOR APPROVAL ENGINE WARRANTY HANDLING PROCESS GUIDELINES (19-EM-003H, 2019/08/23)

Safety (itype_107)

Tsbs

- NU 2.0L ATKINSON ENGINE INSPECTION AND REPLACEMENT (RECALL 203) (22-01-042H, 2022/05/06)