

EM-2

Engine Mechanical System

General Information

Specifications

| Description | | Specifications | Limit |
|---|---------|--|---------------------------------------|
| General | | | |
| Type | | In-line, DOHC | |
| Number of cylinders | | 4 | |
| Bore [2.0L/2.4L] | | 86mm (3.385in.) / 88mm (3.464in.) | |
| Stroke [2.0L/2.4L] | | 86mm (3.385in.) / 97mm (3.819in.) | |
| Total displacement [2.0L/2.4L] | | 1998cc (121.92cu.in) / 2359cc (143.90cu.in) | |
| Compression ratio | | 10.5 ± 0.3 : 1 | |
| Firing order | | 1-3-4-2 | |
| Valve timing | | | |
| Intake valve | Opens | ATDC 7° ~ BTDC 38° | |
| | Closes | ABDC 67° ~ 22° | |
| Exhaust valve | Opens | BBDC 44° ~ 4° | |
| | Closes | ATDC 0° ~ 40° | |
| Valve clearance [Engine coolant temperature : 20°C (68°F)] | | | |
| Intake valve | | 0.17 ~ 0.23mm (0.0067 ~ 0.0090in.) | 0.10 ~ 0.30mm (0.0039 ~ 0.0118in.) |
| Exhaust valve | | 0.27 ~ 0.33mm (0.0106 ~ 0.0129in.) | 0.20 ~ 0.40mm (0.0079 ~ 0.0157in.) |
| Camshaft | | | |
| Cam height | Intake | 44.2mm (1.7401in.) | |
| | Exhaust | 45.0mm (1.7716in.) | |
| Journal outer diameter | Intake | No.1 : φ 30mm (1.1811in.) No.2,3,4,5 : φ 24mm (0.9449in.) | |
| | Exhaust | No.1 : φ 36mm (1.4173in.) No.2,3,4,5 : φ 24mm (0.9449in.) | |
| Bearing oil clearance | Intake | No.1 : 0.022 ~ 0.057mm (0.00087 ~ 0.00224in.) No.2,3,4,5 : 0.045 ~ 0.082mm (0.00177 ~ 0.00323in.) | No.1 : 0.090mm (0.00354in.) |
| | Exhaust | No.1 : 0 ~ 0.032mm (0 ~ 0.00126in.) No.2,3,4,5 : 0.045 ~ 0.082mm (0.00177 ~ 0.00323in.) | No.2,3,4,5 : 0.120mm (0.00472in.) |
| End play | | 0.04 ~ 0.16mm (0.0016 ~ 0.0063in.) | 0.20mm (0.0078in.) |
| Valve | | | |
| Valve length | Intake | 113.18mm (4.4559in.) | 112.93mm (4.4461in.) |
| | Exhaust | 105.84mm (4.1669in.) | 105.59mm (4.1571in.) |

General Information

EM-3

| Description | | Specifications | Limit |
|---------------------------------------|---------|--|----------------------|
| Stem outer diameter | Intake | 5.465 ~ 5.480mm (0.21516 ~ 0.21575in.) | |
| | Exhaust | 5.458 ~ 5.470mm (0.21488 ~ 0.21535in.) | |
| Face angle | | 45.25° ~ 45.75° | |
| Thickness of valve head (margin) | Intake | 1.02mm (0.0401in.) | |
| | Exhaust | 1.09mm (0.0429in.) | |
| Valve stem to valve guide clearance | Intake | 0.020 ~ 0.047mm (0.00078 ~ 0.00185in.) | 0.070mm (0.00275in.) |
| | Exhaust | 0.030 ~ 0.054mm (0.00118 ~ 0.00212in.) | 0.090mm (0.00354in.) |
| MLA outer diameter | | 31.964 ~ 31.980mm (1.2584 ~ 1.2590in.) | |
| Tappet bore inner diameter | | 32.000 ~ 32.025mm (1.2598 ~ 1.2608in.) | |
| MLA to tappet bore clearance | | 0.020 ~ 0.061mm (0.00078 ~ 0.00240in.) | 0.070mm (0.00275in.) |
| Valve guide | | | |
| Length | Intake | 43.8 ~ 44.2mm (1.7244 ~ 1.7401in.) | |
| | Exhaust | 43.8 ~ 44.2mm (1.7244 ~ 1.7401in.) | |
| Inner diameter | Intake | 5.500 ~ 5.512mm (0.21654 ~ 0.21701in.) | |
| | Exhaust | 5.500 ~ 5.512mm (0.21654 ~ 0.21701in.) | |
| Valve seat | | | |
| Width of seat contact | Intake | 1.16 ~ 1.46mm (0.0457 ~ 0.0575in.) | |
| | Exhaust | 1.35 ~ 1.65mm (0.0531 ~ 0.0649in.) | |
| Seat angle | Intake | 44.75° ~ 45.10° | |
| | Exhaust | 44.75° ~ 45.10° | |
| Valve spring | | | |
| Free length | | 47.44mm (1.8677in.) | |
| Load | | 19.0 ± 0.6kg/35.0mm (41.88 ± 1.32lb/1.3779in) 39.8 ± 1.2kg/26.0mm (87.74 ± 2.64lb/1.0236in.) | |
| Out of squareness | | Less than 1.5° | |
| Cylinder head | | | |
| Flatness of gasket surface | | Less than 0.05mm (0.0019in.) for total area Less than 0.02mm (0.0007in.) for a section of 100mm (3.9370in.)×100mm (3.9370in.) | |
| Flatness of manifold mounting surface | Intake | Less than 0.10mm (0.0039in.) | |
| | Exhaust | Less than 0.10mm (0.0039in.) | |
| Piston | | | |
| Piston outer diameter [2.0L/2.4L] | | 85.975 ~ 86.005mm (3.38484 ~ 3.38602in.) / 87.975 ~ 88.005mm (3.46358 ~ 3.46476in.) | |
| Piston to cylinder clearance | | 0.015 ~ 0.035mm (0.00059 ~ 0.00138in.) | |

EM-4

Engine Mechanical System

| Description | | Specifications | Limit |
|--|------------|---|----------------------|
| Ring groove width | No. 1 ring | 1.235 ~ 1.250mm (0.04862 ~ 0.04921in.) | 1.260mm (0.04961in.) |
| | No. 2 ring | 1.230 ~ 1.250mm (0.04843 ~ 0.04921in.) | 1.260mm (0.04961in.) |
| | Oil ring | 2.010 ~ 2.025mm (0.07913 ~ 0.07972in.) | 2.050mm (0.08071in.) |
| Piston ring | | | |
| Side clearance | No. 1 ring | 0.050 ~ 0.080mm (0.00197 ~ 0.00315in.) | 0.100mm (0.00394in.) |
| | No. 2 ring | 0.040 ~ 0.080mm (0.00157 ~ 0.00315in.) | 0.100mm (0.00394in.) |
| | Oil ring | 0.060 ~ 0.125mm (0.00236 ~ 0.00492in.) | 0.200mm (0.00787in.) |
| End gap | No. 1 ring | 0.15 ~ 0.30mm (0.0059 ~ 0.0118in.) | 0.60mm (0.0236in.) |
| | No. 2 ring | 0.37 ~ 0.52mm (0.0145 ~ 0.0204in.) | 0.70mm (0.0275in.) |
| | Oil ring | 0.20 ~ 0.70mm (0.0079 ~ 0.0275in.) | 0.80mm (0.0315in.) |
| Piston pin | | | |
| Piston pin outer diameter | | 21.001 ~ 21.006mm (0.82681 ~ 0.82701in.) | |
| Piston pin hole inner diameter | | 21.019 ~ 21.024mm (0.82752 ~ 0.82771in.) | |
| Piston pin hole clearance | | 0.013 ~ 0.023mm (0.00051 ~ 0.00091in.) | |
| Connecting rod small end hole inner diameter | | 20.974 ~ 20.985mm (0.82575 ~ 0.82618in.) | |
| Piston pin-to-connecting rod interference | | 0.016 ~ 0.032mm (0.00063 ~ 0.00126in.) | |
| Connecting rod | | | |
| Connecting rod big end inner diameter | | 51.000 ~ 51.018mm (2.00787 ~ 2.00858in.) | |
| Connecting rod bearing oil clearance | | 0.031 ~ 0.045mm (0.00122 ~ 0.00177in.) | 0.050mm (0.00197in.) |
| Side clearance | | 0.10 ~ 0.25mm (0.0039 ~ 0.0098in.) | 0.35mm (0.0138in.) |
| Crankshaft | | | |
| Main journal outer diameter | | 51.942 ~ 51.960mm (2.04496 ~ 2.04567in.) | |
| Pin journal outer diameter | | 47.954 ~ 47.972mm (1.88795 ~ 1.88866in.) | |
| Main bearing oil clearance | | 0.020 ~ 0.038mm (0.00079 ~ 0.00150in.) | 0.100mm (0.00394in.) |
| End play | | 0.07 ~ 0.25mm (0.0028 ~ 0.0098in.) | 0.30mm (0.0118in.) |
| Cylinder block | | | |
| Cylinder bore [2.0L/2.4L] | | 86.00 ~ 86.03mm (3.3858 ~ 3.3870in.) / 88.00 ~ 88.03mm (3.4645 ~ 3.4657in.) | |
| Flatness of gasket surface | | Less than 0.05mm (0.0019in.) for total area Less than 0.02mm (0.0007in.) for a section of 100mm (3.9370in.) × 100mm (3.9370in.) | |
| Engine oil | | | |

General Information

EM-5

| Description | | Specifications | Limit |
|--|-------------------------------------|--|--|
| Oil quantity | Total [2.0L/2.4L] | 4.7L (1.24U.S.gal., 4.97U.S.qt., 4.13Imp.qt.) / 5.5L (1.45U.S.gal., 5.81U.S.qt., 4.84Imp.qt.) | When replacing a short engine or block assembly |
| | Oil pan [2.0L/2.4L] | 3.8L (1.00U.S.gal., 4.01U.S.qt., 3.34Imp.qt.) / 4.2L (1.11U.S.gal., 4.44U.S.qt., 3.70Imp.qt.) | |
| | Drain and refill [2.0L/2.4L] | 4.1L (1.08U.S.gal., 4.33U.S.qt., 3.61Imp.qt.) / 4.6L (1.21U.S.gal., 4.86U.S.qt., 4.05Imp.qt.) | Including oil filter |
| Oil grade | Recommendation (except Middle East) | 5W-20/GF4&SM | If not available, refer to the recommended API or ILSAC classification and SAE viscosity number. |
| | Classification | API SL, SM or above ILSAC GF3, GF4 or above | Satisfy the requirement of the API or ILSAC classification. |
| | SAE viscosity grade | Recommended SAE viscosity number | Refer to the "Lubrication System". |
| Oil pressure (at 1,000rpm) [2.0L/2.4L] | | 108kPa (1.1kgf/cm ² , 15.6psi) or above / 147kPa (1.5kgf/cm ² , 21.3psi) or above | Oil temperature (oil pan): 110±2°C (230±35.6°F) |
| Cooling system @ECU118 | | | |
| Cooling method | | Water-cooled, pressurized. Forced circulation with water pump | |
| Coolant quantity | MT | 6.6L (1.74 U.S.gal., 6.97 U.S.qt., 5.80 Imp.qt.) | |
| | AT | 6.5L (1.72 U.S.gal., 6.87 U.S.qt., 5.72 Imp.qt.) | |
| Thermostat | Type | Wax pellet type | |
| | Opening temperature | 82±1.5°C (179.6±34.7°F) | |
| | Full opening valve lift/temperature | More than 8mm (0.3in.) / 95°C (203°F) | |
| Radiator cap | Main valve opening pressure | 93.16 ~ 122.58kPa (0.95 ~ 1.25kgf/cm ² , 13.51 ~ 17.78psi) | |
| | Vacuum valve opening pressure | 0 ~ 6.86 kPa (0 ~ 0.07kgf/cm ² , 0 ~ 0.99psi) | |

EM-6

Engine Mechanical System

Tightening Torques

| Item | Quantity | N.m | kgf.m | lb-ft |
|--|----------|---------------|-------------|---------------|
| Engine mounting | | | | |
| Engine mounting bracket to body fixing bolt | 4 | 58.8 ~ 73.5 | 6.0 ~ 7.5 | 43.4 ~ 54.2 |
| Engine mounting insulator to engine mounting support bracket fixing nut | 1 | 68.6 ~ 83.4 | 7.0 ~ 8.5 | 50.6 ~ 61.5 |
| Engine mounting support bracket to engine support bracket fixing bolt | 1 | 68.6 ~ 83.4 | 7.0 ~ 8.5 | 50.6 ~ 61.5 |
| Engine mounting support bracket to engine support bracket fixing nut | 2 | 68.6 ~ 83.4 | 7.0 ~ 8.5 | 50.6 ~ 61.5 |
| Transaxle mounting bracket to body fixing bolt | 3 | 49.0 ~ 63.7 | 5.0 ~ 6.5 | 36.2 ~ 47.0 |
| Transaxle mounting bracket to body fixing nut | 1 | 49.0 ~ 63.7 | 5.0 ~ 6.5 | 36.2 ~ 47.0 |
| Transaxle mounting support bracket fixing bolt | 2 | 58.8 ~ 78.5 | 6.0 ~ 8.0 | 43.4 ~ 57.9 |
| Transaxle mounting support bracket fixing nut | 2 | 78.5 ~ 98.0 | 8.0 ~ 10.0 | 57.9 ~ 72.3 |
| Transaxle mounting bracket to transaxle mounting support bracket fixing bolt | 2 | 88.3 ~ 107.9 | 9.0 ~ 11.0 | 65.1 ~ 79.6 |
| Roll rod bracket to sub frame fixing bolt | 2 | 49.0 ~ 63.7 | 5.0 ~ 6.5 | 36.2 ~ 47.0 |
| Roll rod bracket to transaxle fixing bolt & nut | 1 | 88.3 ~ 107.9 | 9.0 ~ 11.0 | 65.1 ~ 79.6 |
| Timing system | | | | |
| Idler bolt | 2 | 53.9 ~ 63.7 | 5.5 ~ 6.5 | 39.7 ~ 47.0 |
| Drive belt tensioner pulley bolt | 1 | 53.9 ~ 63.7 | 5.5 ~ 6.5 | 39.7 ~ 47.0 |
| Drive belt tensioner bolt | 1 | 53.9 ~ 63.7 | 5.5 ~ 6.5 | 39.7 ~ 47.0 |
| Crankshaft pulley bolt | 1 | 166.6 ~ 176.4 | 17.0 ~ 18.0 | 122.9 ~ 130.1 |
| Timing chain cover service hole bolt | 1 | 11.8 ~ 14.7 | 1.2 ~ 1.5 | 8.7 ~ 10.8 |
| Timing chain cover bolt (M6×25) | 7 | 7.8 ~ 9.8 | 0.8 ~ 1.0 | 5.8 ~ 7.2 |
| Timing chain cover bolt (M8×28) | 7 | 18.6 ~ 22.5 | 1.9 ~ 2.3 | 13.7 ~ 16.6 |
| Timing chain cover bolt (M8×30) | 1 | 19.6 ~ 24.5 | 2.0 ~ 2.5 | 14.5 ~ 18.1 |
| Timing chain cover bolt (M10×40) | 1 | 39.2 ~ 44.1 | 4.0 ~ 4.5 | 28.9 ~ 32.5 |
| Timing chain cover bolt (M10×45) | 2 | 39.2 ~ 44.1 | 4.0 ~ 4.5 | 28.9 ~ 32.5 |
| Timing chain tensioner bolt | 2 | 9.8 ~ 11.8 | 1.0 ~ 1.2 | 7.2 ~ 8.7 |
| Timing chain tensioner arm bolt | 1 | 9.8 ~ 11.8 | 1.0 ~ 1.2 | 7.2 ~ 8.7 |
| Timing chain guide bolt | 3 | 9.8 ~ 11.8 | 1.0 ~ 1.2 | 7.2 ~ 8.7 |
| Timing chain oil jet bolt | 1 | 7.8 ~ 9.8 | 0.8 ~ 1.0 | 5.8 ~ 7.2 |

General Information

EM-7

| Item | Quantity | N.m | kgf.m | lb-ft |
|---|---------------------|---------------------------------------|-----------------------------------|---------------------------------------|
| Cylinder head | | | | |
| Ignition coil bolt | 4 | 3.9 ~ 5.9 | 0.4 ~ 0.6 | 2.9 ~ 4.3 |
| Cylinder head cover bolt | 18 | [3.9~5.9] + [7.8~9.8] | [0.4~0.6] + [0.8~1.0] | [2.9~4.3] + [5.8~7.2] |
| CVVT bolt (LH/RH) | 2 | 53.9 ~ 63.7 | 5.5 ~ 6.5 | 39.7 ~ 47.0 |
| Camshaft bearing cap bolt (M6) (LH/RH) | 16 | [5.9] + [10.8~12.7] | [0.6] + [1.1~1.3] | [4.3] + [8.0~9.4] |
| Camshaft bearing cap bolt (M8) | 4 | [14.7] + [27.5 ~ 31.4] | [1.5] + [2.8~3.2] | [10.8] + [20.3~23.1] |
| Cylinder head bolt | 10 | [32.4~36.3] + [90~95°] + [90~95°] | [3.3~3.7] + [90~95°] + [90~95°] | [23.9~26.8] + [90~95°] + [90~95°] |
| Engine hanger bolt (Front/Rear) | 2 | 27.5 ~ 31.4 | 2.8 ~ 3.2 | 20.3 ~ 23.1 |
| Camshaft position sensor (CMPS) (LH/RH) | 2 | 9.8 ~ 11.8 | 1.0 ~ 1.2 | 7.2 ~ 8.7 |
| Oil control valve (OCV) bolt (LH/RH) | 2 | 9.8 ~ 11.8 | 1.0 ~ 1.2 | 7.2 ~ 8.7 |
| Cylinder block | | | | |
| Tensioner assembly intergrated bracket bolt | MDPS : 5 HPS : 6 | 39.2 ~ 44.1 | 4.0 ~ 4.5 | 28.9 ~ 32.5 |
| Flywheel bolt | 7 | 117.7 ~ 127.5 | 12.0 ~ 13.0 | 86.8 ~ 93.9 |
| Drive plate bolt | 7 | 117.7 ~ 127.5 | 12.0 ~ 13.0 | 86.8 ~ 93.9 |
| Oil filter bracket bolt | 4 | 21.6 ~ 26.5 | 2.2 ~ 2.7 | 15.9 ~ 19.5 |
| Ladder frame bolt | 10 | [8.8~9.8] + [17.7~20.6] + [27.5~31.4] | [0.9~0.1] + [1.8~2.1] + [2.8~3.2] | [6.5~7.2] + [13.0~15.2] + [20.3~23.1] |
| Connecting rod bearing cap bolt | 8 | [17.7~21.6] + [88~92°] | [1.8~2.2] + [88~92°] | [13.0~15.9] + [88~92°] |
| Main bearing cap bolt | 10 | [14.7] + [27.5~31.4] + [120~125°] | [1.5] + [2.8~3.2] + [120~125°] | [10.8] + [20.3~23.1] + [120~125°] |
| Crankshaft position sensor (CKPS) bolt | 1 | 9.8 ~ 11.8 | 1.0 ~ 1.2 | 7.2 ~ 8.7 |
| CKPS cover bolt (M6) | 1 | 9.8 ~ 11.8 | 1.0 ~ 1.2 | 7.2 ~ 8.7 |
| CKPS cover bolt (M8) | 1 | 18.6 ~ 23.5 | 1.9 ~ 2.4 | 13.7 ~ 17.4 |
| Knock sensor bolt | 1 | 18.6 ~ 23.5 | 1.9 ~ 2.4 | 13.7 ~ 17.4 |
| Lubrication system | | | | |
| Oil drain plug | 1 | 34.3 ~ 44.1 | 3.5 ~ 4.5 | 25.3 ~ 32.5 |
| Oil filter | 1 | 11.8 ~ 15.7 | 1.2 ~ 1.6 | 8.7 ~ 11.6 |
| Oil level gauge assembly bolt | 1 | 7.8 ~ 11.8 | 0.8 ~ 1.2 | 5.8 ~ 8.7 |
| A/C compressor bracket bolt | 4 | 19.6 ~ 23.5 | 2.0 ~ 2.4 | 14.5 ~ 17.4 |
| Oil pan bolt (M6) | 16 | 9.8 ~ 11.8 | 1.0 ~ 1.2 | 7.2 ~ 8.7 |
| Oil pan bolt (M9) | 2 | 30.4 ~ 34.3 | 3.1 ~ 3.5 | 22.4 ~ 25.3 |

EM-8

Engine Mechanical System

| Item | Quantity | N.m | kgf.m | lb-ft |
|---|----------|--|-----------------------------------|---------------------------------------|
| Oil pump chain tensioner bolt [2.0L] | 1 | 9.8 ~ 11.8 | 1.0 ~ 1.2 | 7.2 ~ 8.7 |
| Oil pump chain guide bolt [2.0L] | 2 | 9.8 ~ 11.8 | 1.0 ~ 1.2 | 7.2 ~ 8.7 |
| Oil pump bolt [2.0L] | 3 | [7.8~11.8] + [17.7~21.6] + [27.5~31.4] | [0.8~1.2] + [1.8~2.2] + [2.8~3.2] | [5.8~8.7] + [13.0~15.9] + [20.3~23.1] |
| BSM chain tensioner arm bolt [2.4L] | 1 | 9.8 ~ 11.8 | 1.0 ~ 1.2 | 7.2 ~ 8.7 |
| BSM chain guide bolt [2.4L] | 2 | 9.8 ~ 11.8 | 1.0 ~ 1.2 | 7.2 ~ 8.7 |
| BSM chain tensioner bolt [2.4L] | 2 | 9.8 ~ 11.8 | 1.0 ~ 1.2 | 7.2 ~ 8.7 |
| Balance shaft module (BSM) bolt (M9 × 181.5) - 4 bolt type [2.4L] | 4 | [22.6~26.5] + [103~107°] | [2.3~2.7] + [103~107°] | [16.6~19.5] + [103~107°] |
| Balance shaft module (BSM) bolt (M9 × 181.5) - 6 bolt type [2.4L] | 4 | [22.6~26.5] + [88~92°] | [2.3~2.7] + [88~92°] | [16.6~19.5] + [88~92°] |
| Balance shaft module (BSM) bolt (M9 × 95) - 6 bolt type [2.4L] | 2 | [22.6~26.5] + [43~47°] | [2.3~2.7] + [43~47°] | [16.6~19.5] + [43~47°] |
| Oil pressure switch | 1 | 7.8 ~ 11.8 | 0.8 ~ 1.2 | 5.8 ~ 8.7 |
| Cooling system | | | | |
| Water pump pulley bolt | 3 | 7.8 ~ 9.8 | 0.8 ~ 1.0 | 5.8 ~ 7.2 |
| Water pump sub assembly bolt | 5 | 9.8 ~ 11.8 | 1.0 ~ 1.2 | 7.2 ~ 8.7 |
| Water pump cover bolt | 5 | 18.6 ~ 23.5 | 1.9 ~ 2.4 | 13.7 ~ 17.4 |
| Water inlet fitting bolt | 3 | 7.8 ~ 11.8 | 0.8 ~ 1.2 | 5.8 ~ 8.7 |
| Water temperature control assembly nut | 1 | 18.6 ~ 23.5 | 1.9 ~ 2.4 | 13.7 ~ 17.4 |
| Water temperature control assembly bolt | 2 | 14.7 ~ 19.6 | 1.5 ~ 2.0 | 10.8 ~ 14.5 |
| Water inlet pipe bolt | 1 | 9.8 ~ 11.8 | 1.0 ~ 1.2 | 7.2 ~ 8.7 |
| Intake and exhaust system | | | | |
| Air intake hose clamp bolt | 2 | 2.9 ~ 4.9 | 0.3 ~ 0.5 | 2.2 ~ 3.6 |
| Air cleaner assembly bolt | 2 | 7.8 ~ 9.8 | 0.8 ~ 1.0 | 5.8 ~ 7.2 |
| Electronic throttle control (ETC) module bolt | 4 | 9.8 ~ 11.8 | 1.0 ~ 1.2 | 7.2 ~ 8.7 |
| Intake manifold stay bolt | 4 | 18.6 ~ 23.5 | 1.9 ~ 2.4 | 13.7 ~ 17.4 |
| Intake manifold bolt | 3 | 18.6 ~ 23.5 | 1.9 ~ 2.4 | 13.7 ~ 17.4 |
| Intake manifold nut | 2 | 18.6 ~ 23.5 | 1.9 ~ 2.4 | 13.7 ~ 17.4 |
| Oxygen sensor (Front/Rear) | 2 | 44.1 ~ 49.0 | 4.5 ~ 5.0 | 32.5 ~ 36.2 |
| Exhaust manifold heat protector bolt | 3 | 7.8 ~ 11.8 | 0.8 ~ 1.2 | 5.8 ~ 8.7 |
| Exhaust manifold stay bolt (M8) | 2 | 18.6 ~ 27.5 | 1.9 ~ 2.8 | 13.7 ~ 20.3 |
| Exhaust manifold stay bolt (M10) | 2 | 51.9 ~ 57.8 | 5.3 ~ 5.9 | 38.3 ~ 42.6 |
| Exhaust manifold nut | 8 | 49.0 ~ 53.9 | 5.0 ~ 5.5 | 36.2 ~ 39.7 |

General Information

EM-9

| Item | Quantity | N.m | kgf.m | lb-ft |
|-----------------------------------|----------|-------------|-----------|-------------|
| Catalytic converter / muffler nut | 6 | 39.2 ~ 58.8 | 4.0 ~ 6.0 | 28.9 ~ 43.4 |

@ECU118

EM-10

Engine Mechanical System

Compression Pressure Inspection

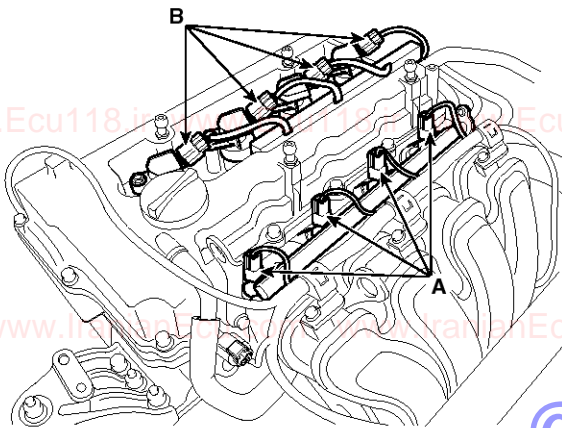
NOTICE

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

1. Warm up and stop engine.

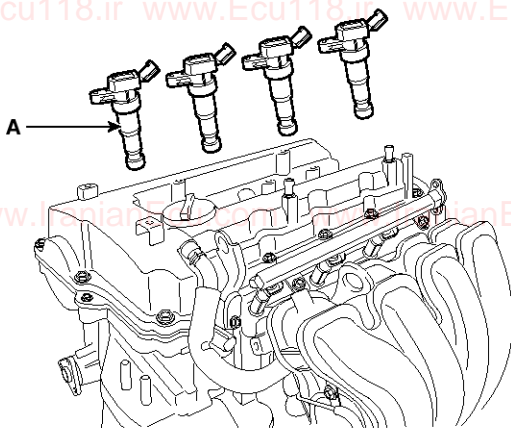
Allow the engine to warm up to normal operating temperature.

2. Remove the engine cover.
3. Disconnect the injector connectors (A) and ignition coil connectors (B).



STFEM1026D

4. Remove ignition coils (A).



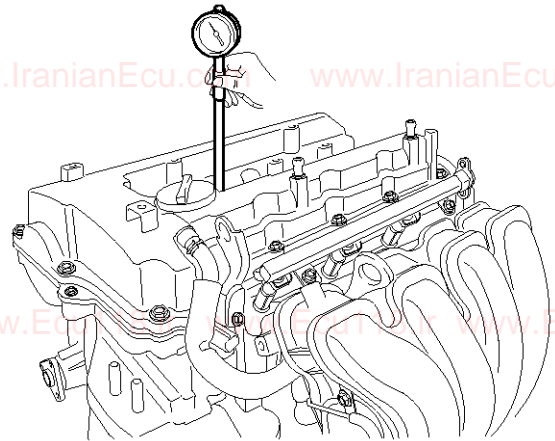
SSLM10002D

5. Remove spark plugs.

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

6. Check cylinder compression pressure.

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



SSLM10120D

- 2) Fully open the throttle.

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

NOTICE

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

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

NOTICE

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

Compression pressure :

1,283kPa (13.0kgf/cm², 185psi) / 200 ~ 250rpm

Minimum pressure :

1,135kPa (11.5kgf/cm², 164psi)

Difference between each cylinder :

100kPa (1.0kgf/cm², 15psi) or less

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

- If adding oil helps the compression, it is likely that the piston rings and/or cylinder bore are worn or damaged.
- If pressure stays low, a valve may be sticking or seating is improper, or there may be leakage past the gasket.

General Information

EM-11

7. Reinstall spark plugs.
8. Install ignition coils.

Tightening torque:

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

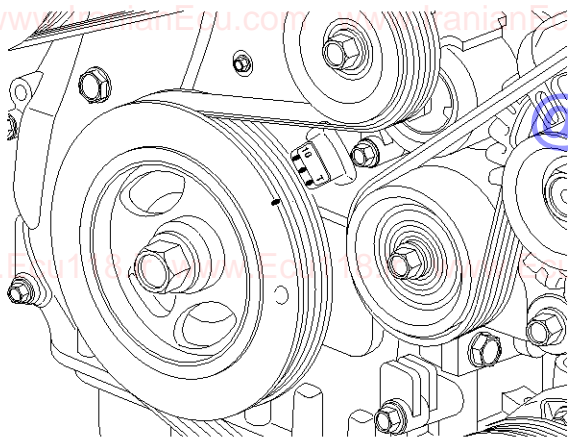
9. Connect the injector connectors and ignition coil connectors.
10. Some DTC's may exist after the inspection test and may need to be manually cleared with GDS.

Valve Clearance Inspection And Adjustment

NOTICE

Inspect and adjust the valve clearance when the engine is cold (Engine coolant temperature : 20°C (68°F)) and cylinder head is installed on the cylinder block.

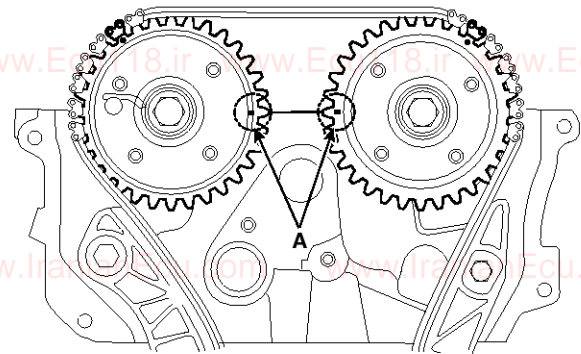
1. Remove the cylinder head cover. (Refer to Timing system in this group)
2. Set No.1 cylinder to TDC/compression.
 - 1) Turn the crankshaft pulley and align its groove with the timing mark "T" of the lower timing chain cover.



SSLM10003D

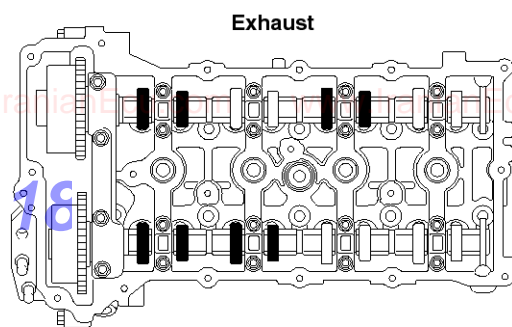
- 2) Check that the TDC marks (A) of the CVVT sprockets are in straight line on the cylinder head surface as shown in the illustration.

If not, turn the crankshaft one revolution (360°)



SVGEM0154D

3. Inspect the valve clearance.
 - 1) Check only the valve indicated as shown. Measure the valve clearance.



[No.1 cylinder : TDC/Compression]

SVGGM1101L

- Using a thickness gauge, measure the clearance between the tappet and the base circle of camshaft.
- Record the out-of-specification valve clearance measurements. They will be used later to determine the required replacement adjusting tappet.

Valve clearance

Specification

Engine coolant temperature : 20°C [68°F]

Limit

Intake : 0.10 ~ 0.30mm (0.0039 ~ 0.0118in.)

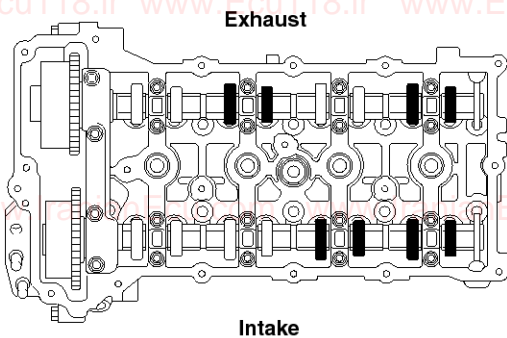
Exhaust : 0.20 ~ 0.40mm (0.0079 ~ 0.0157in.)

- 2) Turn the crankshaft pulley one revolution (360°) and align the groove with timing mark "T" of the timing chain cover.

EM-12

Engine Mechanical System

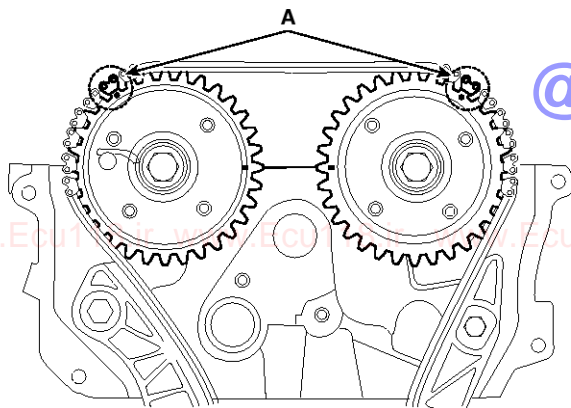
- 3) Check only valves indicated as shown. Measure the valve clearance.



[No.4 cylinder : TDC/Compression]

SVG M11102L

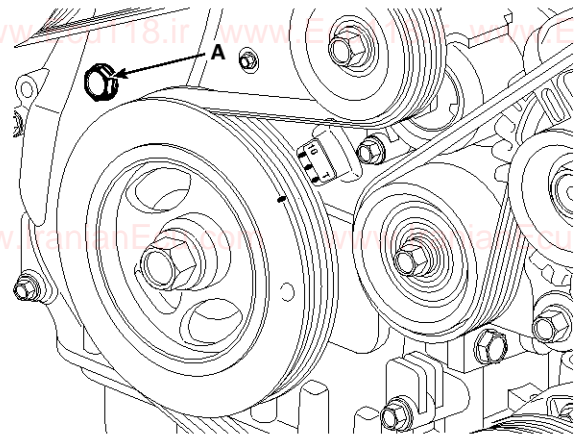
4. Adjust the intake and exhaust valve clearance.
- 1) Set the No.1 cylinder to the TDC/compression.
 - 2) Mark the timing chains (A) on the timing marks of the CVVT sprockets.



SVGEM0160D

- 3) Turn the crankshaft pulley 15° clockwise.

- 4) Remove the service hole bolt(A) of the timing chain cover.

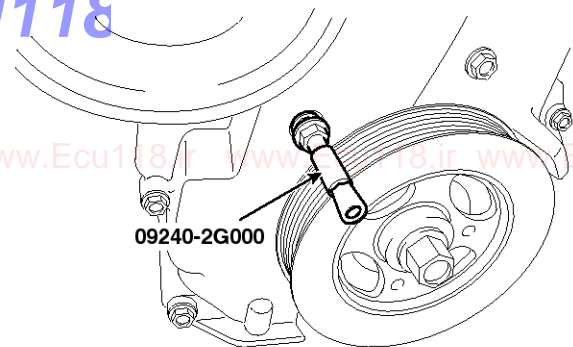


SSL M10121D

⚠ CAUTION

The bolt must not be reused once it has been assembled.

- 5) Insert the SST (09240-2G000) in the service hole of the timing chain cover and release the ratchet.



SVG M11103L

- 6) Remove the front camshaft bearing cap.
- 7) Remove the exhaust camshaft bearing cap and exhaust camshaft.
- 8) Remove the intake camshaft bearing cap and intake camshaft.

⚠ CAUTION

When disconnecting the timing chain from the CVVT sprocket, tie or hold the timing chain so it does not fall into the timing cover.

General Information

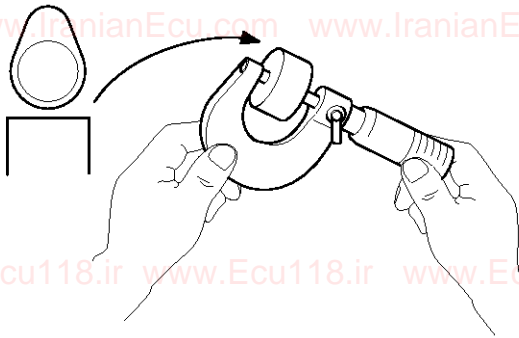
EM-13

- 9) Tie down timing chain so that it doesn't move.

⚠ CAUTION

Be careful not to drop anything inside timing chain cover.

- 10) Measure the thickness of the removed tappet using a micrometer.



EDKE889D

- 11) Calculate the thickness of a new tappet so that the valve clearance comes within the specified value.

Valve clearance [Engine coolant temperature : 20°C(68°F)]

T : Thickness of removed tappet

A : Measured valve clearance

N : Thickness of new tappet

Intake : $N = T + [A - 0.20\text{mm} (0.0079\text{in.})]$

Exhaust : $N = T + [A - 0.30\text{mm} (0.0118\text{in.})]$

- 12) Select a new tappet with a thickness as close as possible to the calculated value.

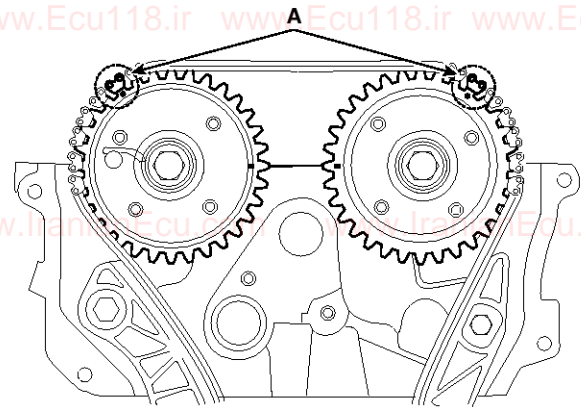
NOTICE

Shims are available in 47 size increments of 0.015mm (0.0006in.) from 3.00mm (0.118in.) to 3.690mm (0.1452in.)

- 13) Place a new tappet on the cylinder head.

- 14) Hold the timing chain, and install the intake camshaft and CVVT assembly.

- 15) Align the timing marks (A) on the timing chains and CVVT sprockets.



SVGEM0160D

- 16) Install the exhaust camshaft and CVVT assembly.

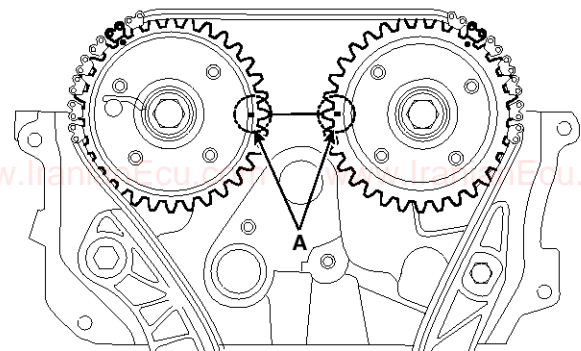
- 17) Install the front bearing cap.

- 18) Install the service hole bolt after removing the SST from the service hole.

Tightening torque :

11.8 ~ 14.7N.m (1.2 ~ 1.5kgf.m, 8.7 ~ 10.8lb-ft)

- 19) Turn the crankshaft two turns in the operating direction (clockwise), and then check that the TDC marks (A) of the CVVT sprockets are in straight line on the cylinder head surface.



SVGEM0154D

- 20) Recheck the valve clearance.

Valve clearance [Engine coolant temperature : 20°C(68°F)]

[Specification]

Intake : 0.17 ~ 0.23mm (0.0067 ~ 0.0090in.)

Exhaust : 0.27 ~ 0.33mm (0.0106 ~ 0.0129in.)

EM-14

Engine Mechanical System

Troubleshooting

| Symptom | Suspect area | Remedy |
|---|---|--|
| Engine misfire with abnormal internal lower engine noises. | Worn crankshaft bearings Loose or out of specification engine flywheel | Replace the crankshaft and bearings as required. Repair or replace the flywheel as required. |
| | Worn piston rings (Oil consumption may or may not cause the engine to misfire.) | Inspect the cylinder for a loss of compression. Repair or replace as required. |
| | Worn crankshaft thrust bearings | Replace the crankshaft and bearings as required |
| Engine misfire with abnormal valve train noise. | Stuck valves. (Carbon buildup on the valve stem) | Repair or replace as required |
| | Excessive worn or mis-aligned timing chain Out of specification valve clearances | Replace the timing chain and sprocket as required. |
| | Worn camshaft lobes. | Replace the camshaft and valve lifters. |
| Engine misfire with coolant consumption | <ul style="list-style-type: none"> 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. | <ul style="list-style-type: none"> Inspect the cylinder head and engine block for damage to the coolant passages and/or a faulty head gasket. Repair or replace as required. |
| Engine misfire with excessive oil consumption | Worn valves, guides and/or valve stem oil seals. | Repair or replace as required. |
| | Worn piston rings. (Oil consumption may or may not cause the engine to misfire) | <ul style="list-style-type: none"> Inspect the cylinder for a loss of compression. Repair or replace as required. |
| 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 | <ul style="list-style-type: none"> Drain the oil. Install the correct viscosity oil. |
| | Worn crankshaft thrust bearing. | <ul style="list-style-type: none"> Inspect the thrust bearing and crankshaft. Repair or replace as required. |

General Information

EM-15

| Symptom | Suspect area | Remedy |
|---|---|--|
| Upper engine noise, regardless of engine speed. | Low oil pressure | Repair or replace as required. |
| | Broken valve spring. | Replace the valve spring. |
| | Worn or dirty valve lifters. | Replace the valve lifters. |
| | Stretched or broken timing chain and/or damaged sprocket teeth. | Replace the timing chain and sprockets. |
| | Worn timing chain tensioner, if applicable. | Replace the timing chain tensioner as required. |
| | Worn camshaft lobes. | <ul style="list-style-type: none"> Inspect the camshaft lobes. Replace the timing camshaft and valve lifters as required. |
| | Out of specification valve clearances 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 replace as required |
| | Loose or damaged flywheel. | Repair or replace the flywheel. |
| | Damaged oil pan, contacting the oil pump screen. | <ul style="list-style-type: none"> Inspect the oil pan. Inspect the oil pump screen. Repair or replace as required. |
| | Oil pump screen loose, damaged or restricted. | <ul style="list-style-type: none"> Inspect the oil pump screen. Repair or replace as required. |
| | Excessive piston-to-cylinder bore clearance. | <ul style="list-style-type: none"> Inspect the piston, piston pin and cylinder bore. Repair or replace as required. |
| | Excessive piston pin-to-piston clearance | <ul style="list-style-type: none"> Inspect the piston, piston pin and the connecting rod. Repair or replace as required. |
| | Excessive connecting rod bearing clearance | Inspect the following components and repair or replace as required. <ul style="list-style-type: none"> 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. <ul style="list-style-type: none"> The crankshaft bearings. The crankshaft main journals. The cylinder block |
| | Incorrect piston, piston pin and connecting rod installation | <ul style="list-style-type: none"> Verify the piston pins and connecting rods are installed correctly. Repair as required. |

EM-16

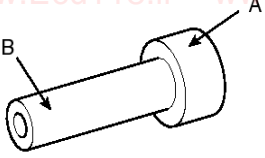
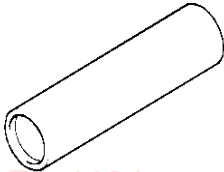
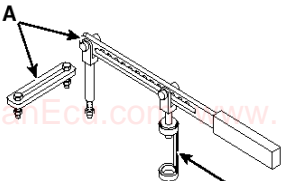
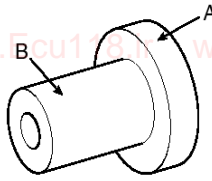
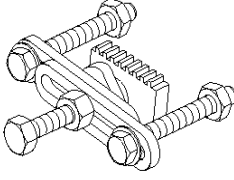
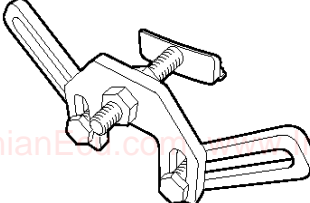
Engine Mechanical System

| Symptom | Suspect area | Remedy |
|--|---|---|
| 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 : <ul style="list-style-type: none"> • The connecting rod bearings. • The connecting rods. • The crankshaft |
| | Excessive crankshaft bearing clearance | Inspect the following components, and repair or replace as required. <ul style="list-style-type: none"> • The crankshaft bearings. • The crankshaft main journals. • The cylinder block. |
| Engine will not crank-crankshaft will not rotate | Hydraulically locked cylinder <ul style="list-style-type: none"> • Coolant/antifreeze in cylinder. • Oil in cylinder. • Fuel in cylinder | <ol style="list-style-type: none"> 1. Remove spark plugs and check for fluid. 2. Inspect for broken head gasket. 3. Inspect for cracked engine block or cylinder head. 4. Inspect for a sticking fuel injector and/or leaking fuel regulator. |
| | Broken timing chain and/or timing chain and/or timing chain gears. | <ol style="list-style-type: none"> 1. Inspect timing chain and gears. 2. Repair as required. |
| | Material in cylinder <ul style="list-style-type: none"> • Broken valve • Piston material • Foreign material | <ol style="list-style-type: none"> 1. Inspect cylinder for damaged components and/or foreign materials. 2. Repair or replace as required. |
| | Seized crankshaft or connecting rod bearings. | <ol style="list-style-type: none"> 1. Inspect crankshaft and connecting rod bearings. 2. Repair as required. |
| | Bent or broken connecting rod. | <ol style="list-style-type: none"> 1. Inspect connecting rods. 2. Repair as required. |
| | Broken crankshaft | <ol style="list-style-type: none"> 1. Inspect crankshaft. 2. Repair as required. |

General Information


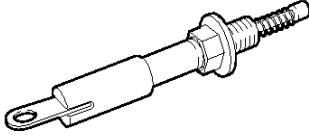
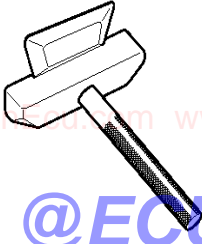
EM-17

Special Service Tools

| Tool (Number and name) | Illustration | Use |
|---|---|---|
| Crankshaft front oil seal installer (09214-3K000) (09231-H1100) |  ACRF002A | Installation of the front oil seal A : 09214-3K000 (installer) B : 09231-H1100 (handle) |
| Valve stem seal installer (09222-4A000) |  LCAC030D | Installation of the valve stem seal |
| Valve spring compressor (09222-3K000) (09222-3K100) |  @ECU118 SYFEM0182N | Removal and installation of the intake or exhaust valve A : 09222-3K000 (compressor) B : 09222-3K100 (holder) |
| Crankshaft rear oil seal installer (09214-3K100) (09231-H1100) |  ACRF003A | Installation of the crankshaft rear oil seal A : 09214-3K100 (installer) B : 09231-H1100 (handle) |
| Ring gear stopper (09231-2B100) |  SHDEM6201D | Removal and installation of crankshaft pulley bolt. |
| Ring gear stopper (09231-3D100) |  SVGEM1001D | Removal and installation of crankshaft pulley bolt. |

EM-18

Engine Mechanical System

| Tool (Number and name) | Illustration | Use |
|--|--|---|
| Torque angle adapter (09221-4A000) |  <p style="text-align: center;">LCAC030A</p> | Installation of bolts & nuts needing an angular method of adjustment. |
| Timing chain tensioner ratchet holder (09240-2G000) |  <p style="text-align: center;">SMGEM8007D</p> | Timing chain tension release in vehicle inspection and adjustment of valve clearance. |
| Oil pan remover (09215-3C000) |  <p style="text-align: center;">@ECU118 ACJF125A</p> | Removal of oil pan |

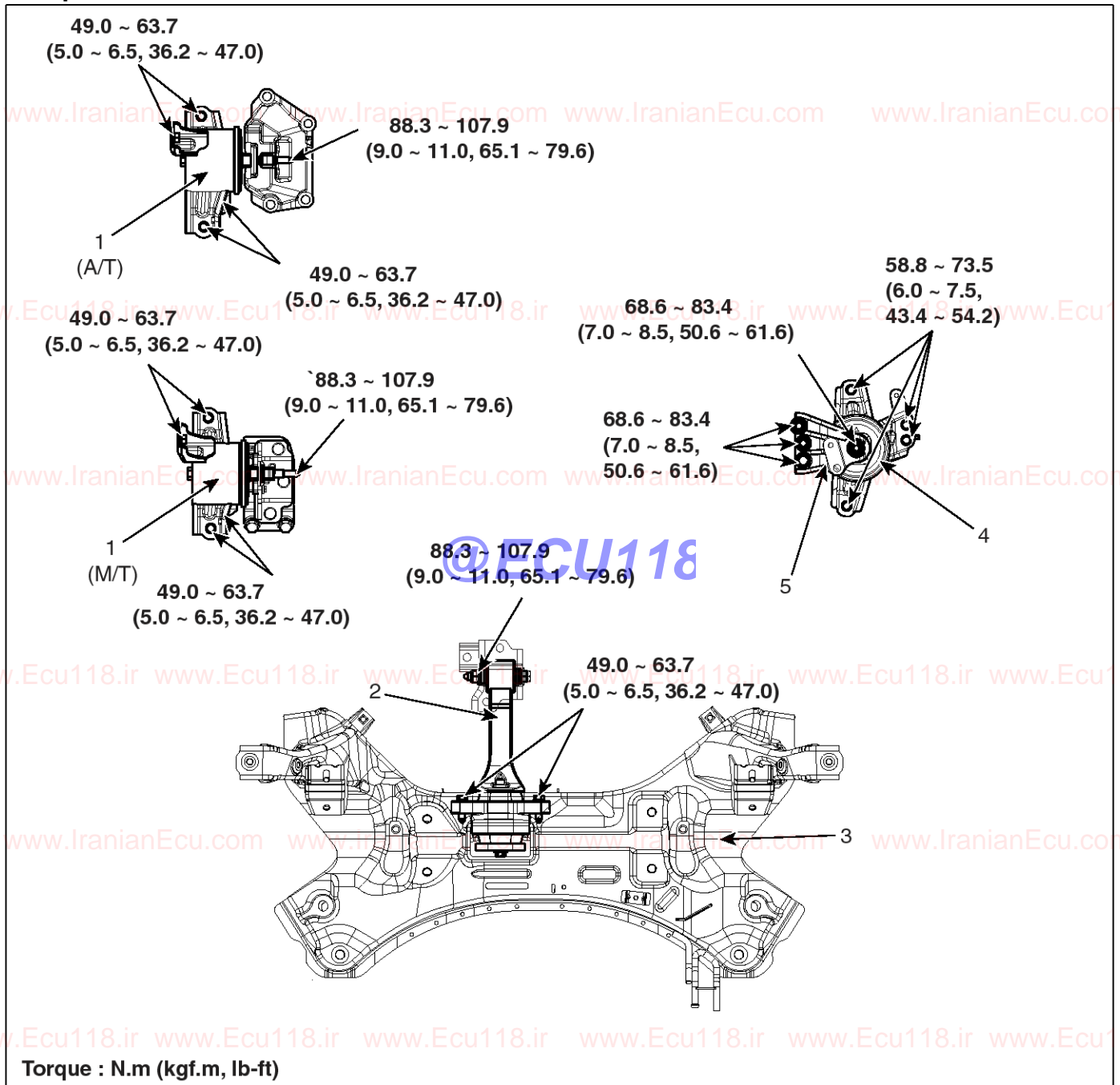
Engine And Transaxle Assembly

EM-19

Engine And Transaxle Assembly

Engine Mounting

Components



STFM1003N

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

EM-20

Engine Mechanical System

Engine And Transaxle Assembly

Removal

⚠ CAUTION

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

📌 NOTICE

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

1. Remove the engine cover.
2. Disconnect the battery terminals (A). Disconnect the negative terminal first.

Tightening torque :

(+) terminal :

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

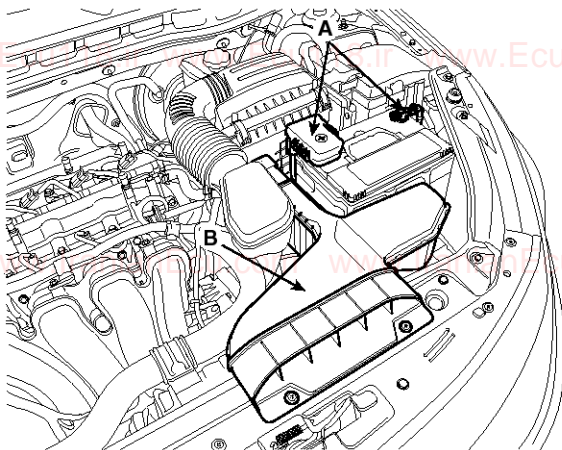
(-) terminal (without battery sensor):

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

(-) terminal (with battery sensor):

4.0 ~ 6.0N.m (0.4 ~ 0.6kgf.m, 3.0 ~ 4.4lb-ft)

3. Remove the air duct (B).

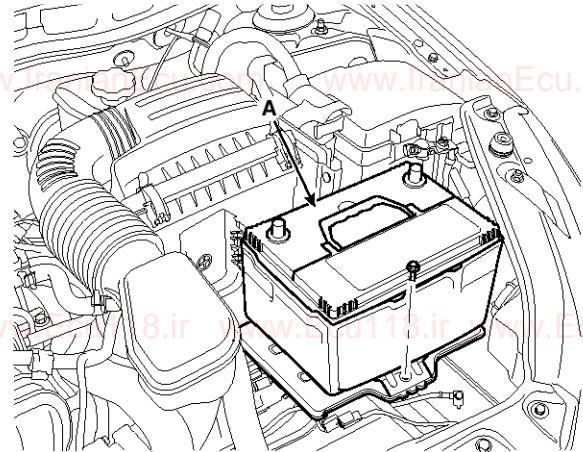


STFEM1001D

4. Remove the battery (A) after removing the mounting bracket.

Tightening torque:

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



STFEM1002D

5. Remove the air cleaner assembly.

- 1) Disconnect the breather hose (A), the brake booster vacuum hose (B) and the brake booster intensifier hose (C) (AT only).
- 2) Disconnect the air intake hose (D) and then remove the air cleaner assembly (E).

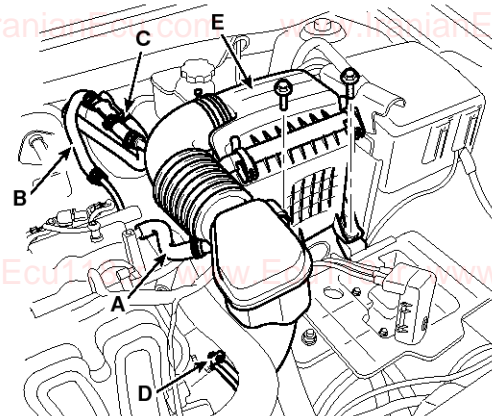
Tightening torque

Hose clamp bolt:

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

Air cleaner assembly bolts:

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



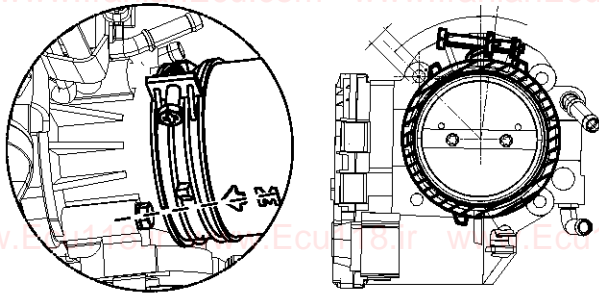
STFM11008D

Engine And Transaxle Assembly

EM-21

NOTICE

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

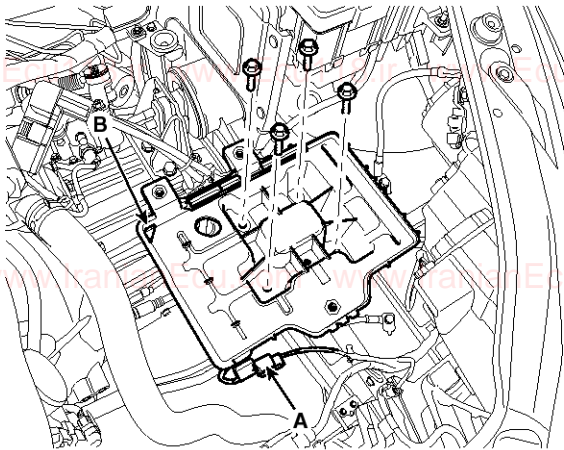


STFEM1039D

6. Disconnect the front connector (A) and then remove the battery tray (B).

Tightening torque:

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

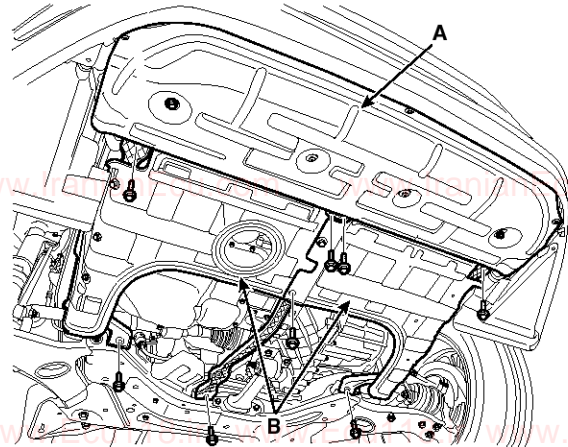


STFEM1003D

7. Remove the under covers (A,B).

Tightening torque:

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

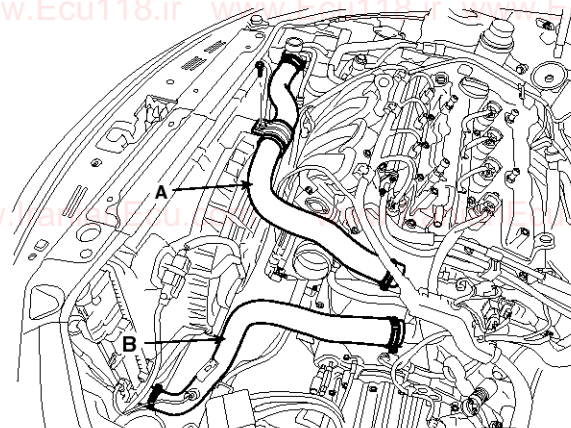


STFEM1004D

NOTICE

When removing the under cover (B), unfasten the mounting bracket bolts and then remove the under cover and mounting bracket assembly.

8. Loosen the drain plug, and drain the engine coolant. Remove the radiator cap to help drain the coolant faster. (Refer to Cooling system in this group)
9. Disconnect the radiator upper hose (A) and lower hose (B).



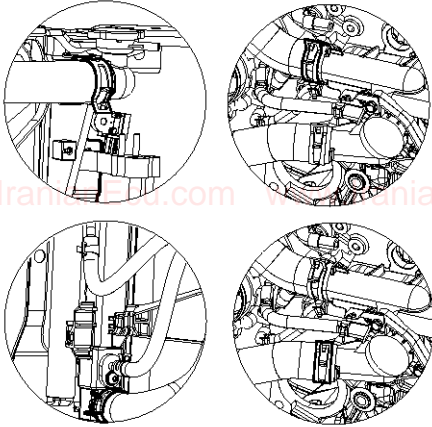
STFEM1005D

EM-22

Engine Mechanical System

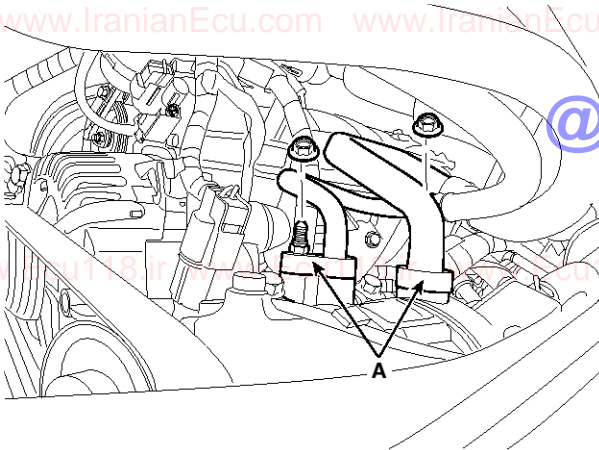
NOTICE

When installing radiator hoses, install as shown in illustrations.



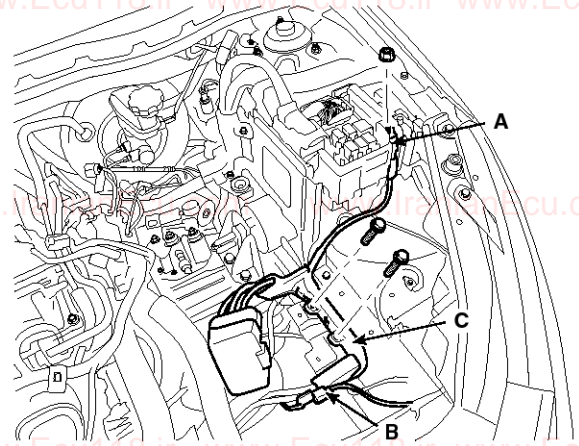
SVGEM0104D

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



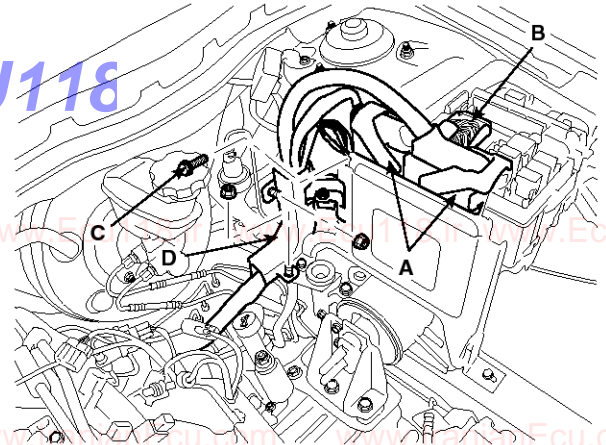
SYFEM0032N

11. Disconnect the (+) cable (A) from the fuse/relay box and the front connector (B). Then remove the wiring protector (C).



STFEM1006D

12. Disconnect the ECM connectors (A) from the ECM, the fuse box connector (B) from the fuse/relay box and the engine ground line (C). Then remove the wiring protector (D).

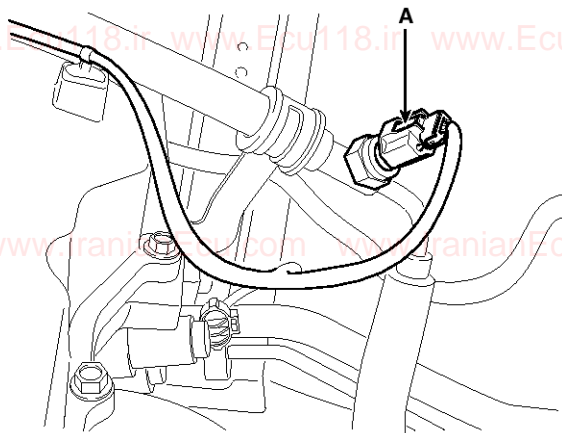


STFEM1007D

Engine And Transaxle Assembly

EM-23

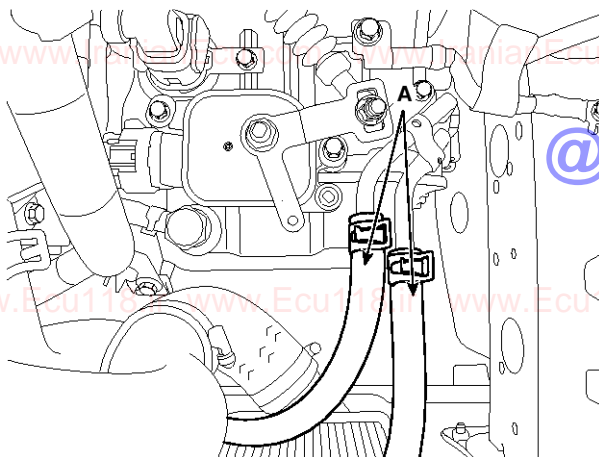
13. Disconnect the power steering oil pressure switch connector (A) (HPS only)



STFEM1100L

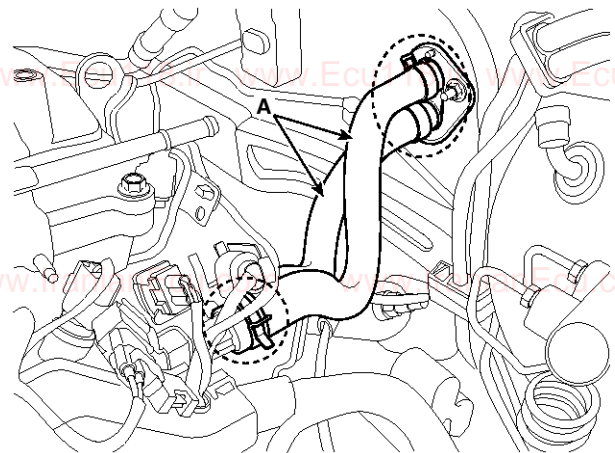
14. Remove the transaxle wire harness connectors and control cable from the transaxle. (Refer to AT or MT group).

15. Disconnect the ATF cooler hoses (A).



STFEM1061D

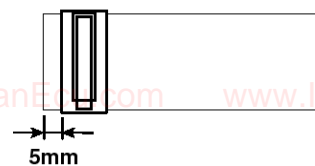
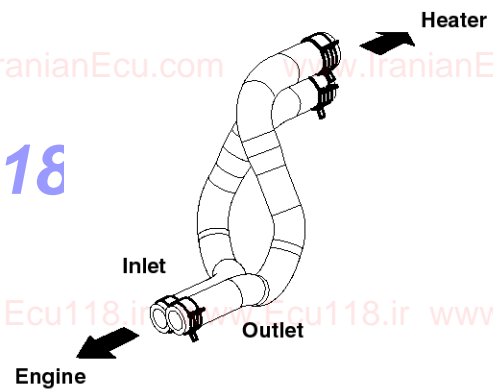
16. Disconnect the heater hoses (A).



SYFEM0022D

NOTICE

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

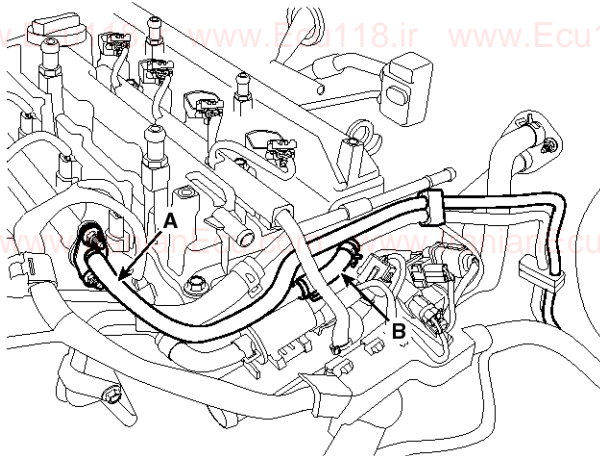


SVGEM0105D

EM-24

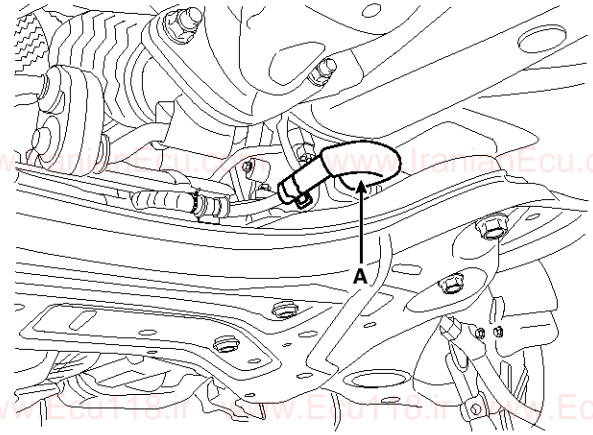
Engine Mechanical System

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

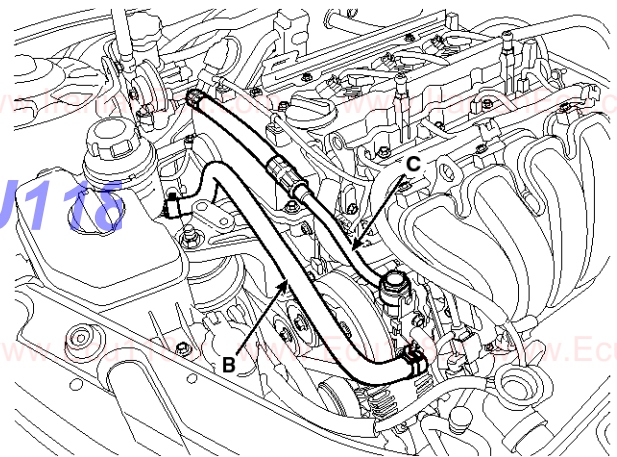


STFEM1059D

18. Disconnect the power steering oil return hose (A) for drain the oil, and then disconnect the suction hose (B), pressure hose (C). (Refer to ST group, HPS type only)



STFEM1080L



STFEM1008D

@ECU118

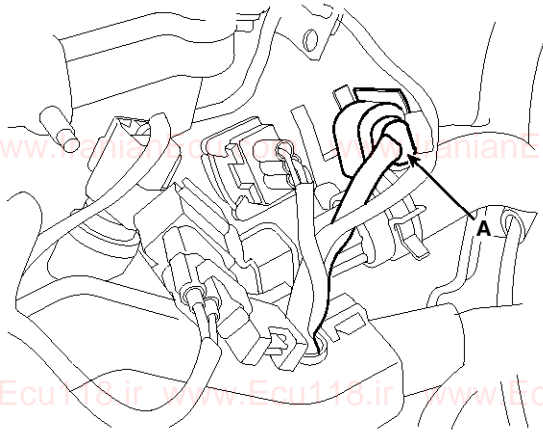
Engine And Transaxle Assembly

EM-25

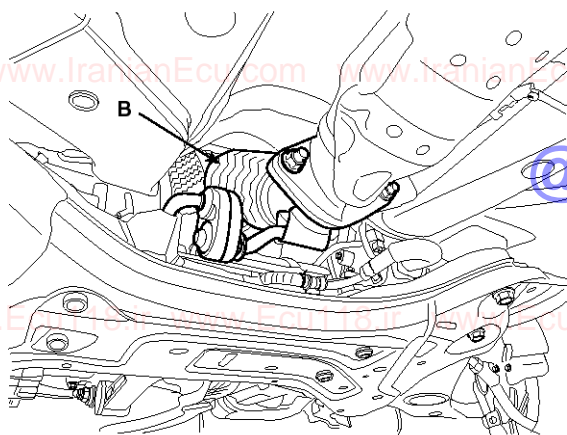
19. Remove the front muffler (B) after removing the front oxygen sensor connector (A) from the bracket.

Tightening torque:

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

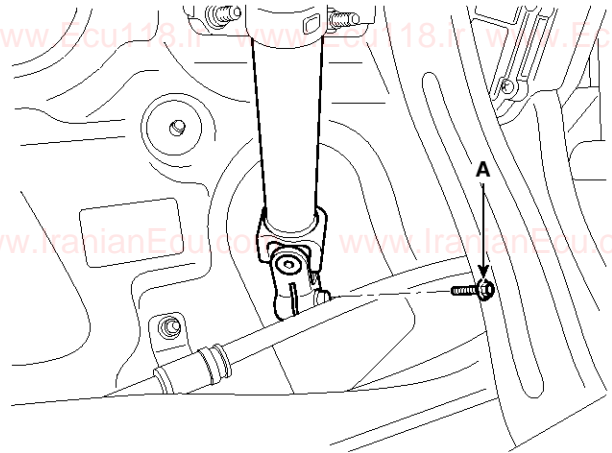


SYFEM0142N



STFEM1009D

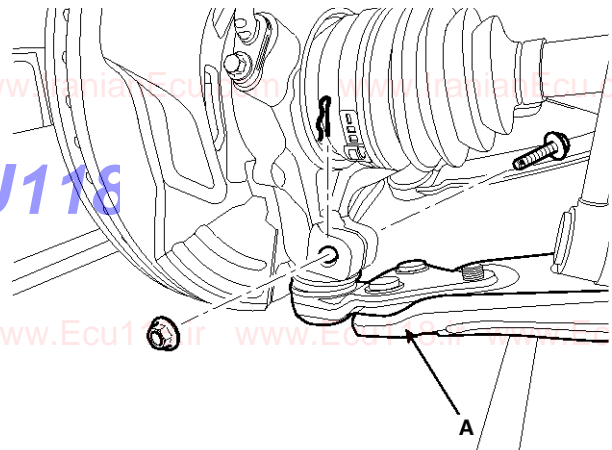
20. Remove the steering u-joint mounting bolt (A). (Refer to ST group)



STFEM1101D

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

22. Remove the lower arms (A). (Refer to SS group)

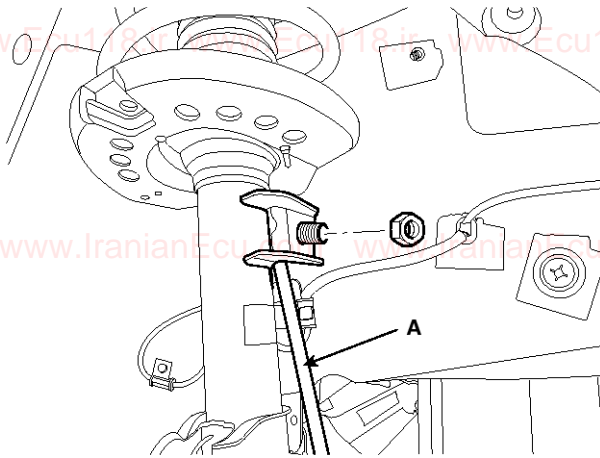


STFEM1049D

EM-26

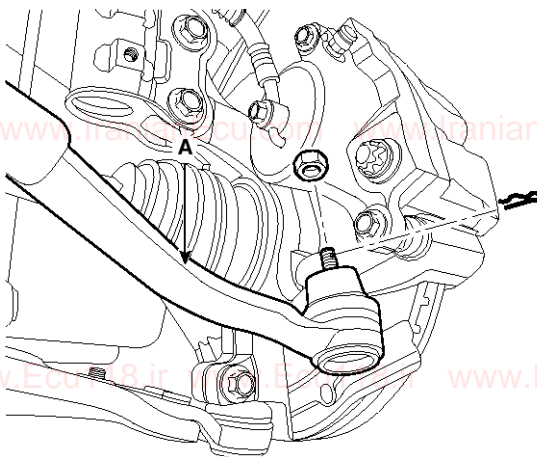
Engine Mechanical System

23. Remove the stabilizer bar links (A). (Refer to SS group)



STFEM1050D

24. Remove the tie rod ends (A). (Refer to ST group)



STFEM1051D

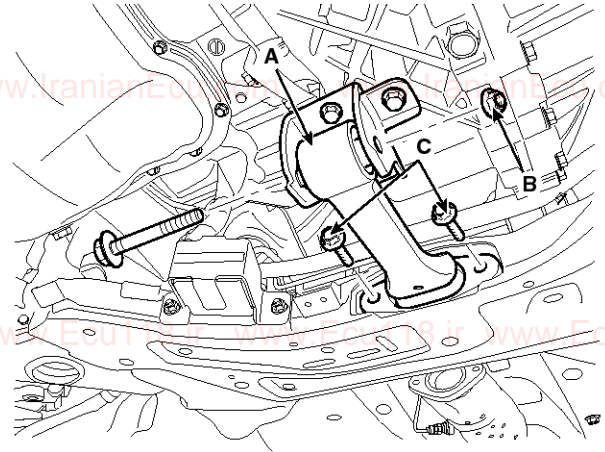
25. Disconnect the drive shafts from the axle hubs. (Refer to DS group)

26. Remove the roll rod 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 (C) : 49.0 ~ 63.7 N.m (5.0 ~ 6.5 kgf.m, 36.2 ~ 47.0 lb-ft)

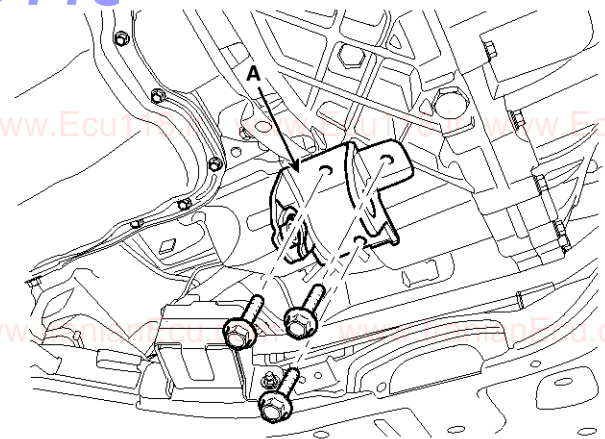


STFEM1015D

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

Tightening torque:

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



STFEM1016D

Engine And Transaxle Assembly

EM-27

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

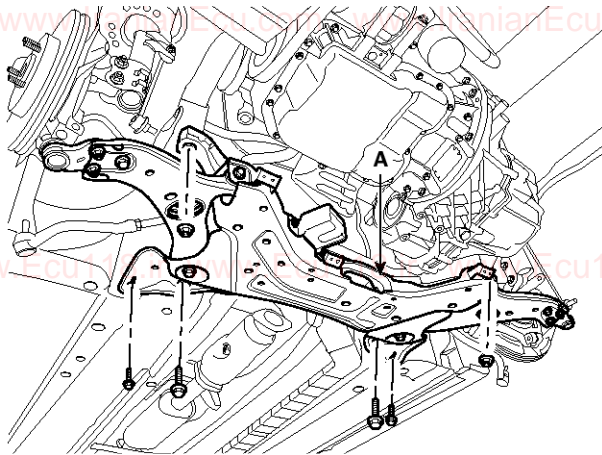
Tightening torque:

Sub frame mounting bolts & nuts :

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

Stay mounting bolts :

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



STFEM1019D

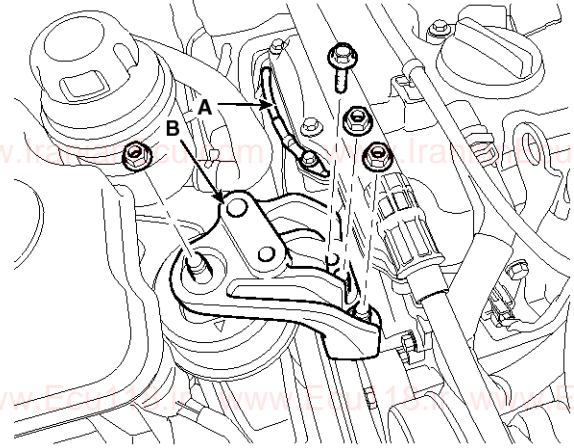
NOTICE

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

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

Tightening torque:

68.6 ~ 83.4 N.m (7.0 ~ 8.5 kgf.m, 50.6 ~ 61.5 lb-ft)

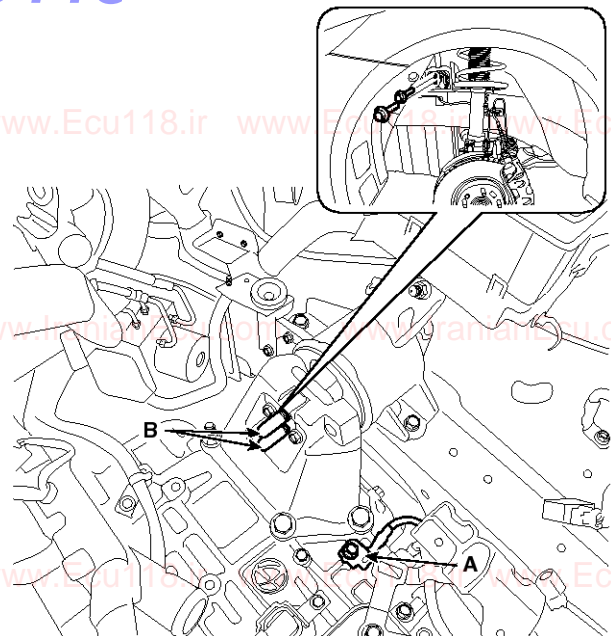


STFEM1014D

30. Disconnect the ground line (A), and then slowly loosen bolts to engine mounting bracket (B), and lower engine and transaxle assembly onto floor jack.

Tightening torque:

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

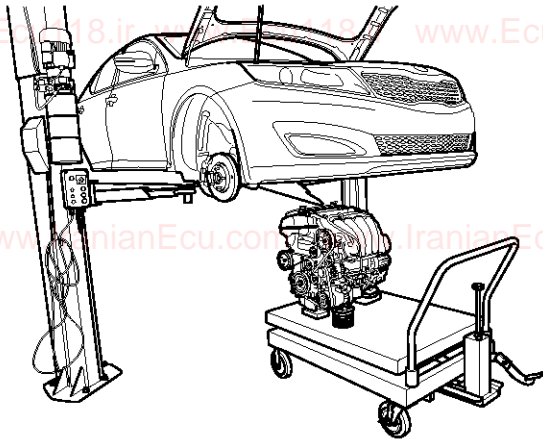


STFM11003D

EM-28

Engine Mechanical System

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



STFEM1010D

⚠ CAUTION

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

Installation

Installation is in the reverse order of removal.

Perform the following :

- Adjust a shift cable.
- Refill engine with engine oil.
- Refill a transaxle with fluid.
- Refill power steering fluid.
- Refill a radiator and a reservoir tank with engine coolant.
- Clean battery posts and cable terminals and assemble.
- 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.
- Bleed air from the cooling system.
 - Start engine and let it run until it warms up. (until the radiator fan operates 3 or 4 times.)
 - Turn Off the engine. Check the level in the radiator, add coolant if needed. This will allow trapped air to be removed from the cooling system.
 - Put radiator cap on tightly, then run the engine again and check for leaks.

@ECU118

Timing System

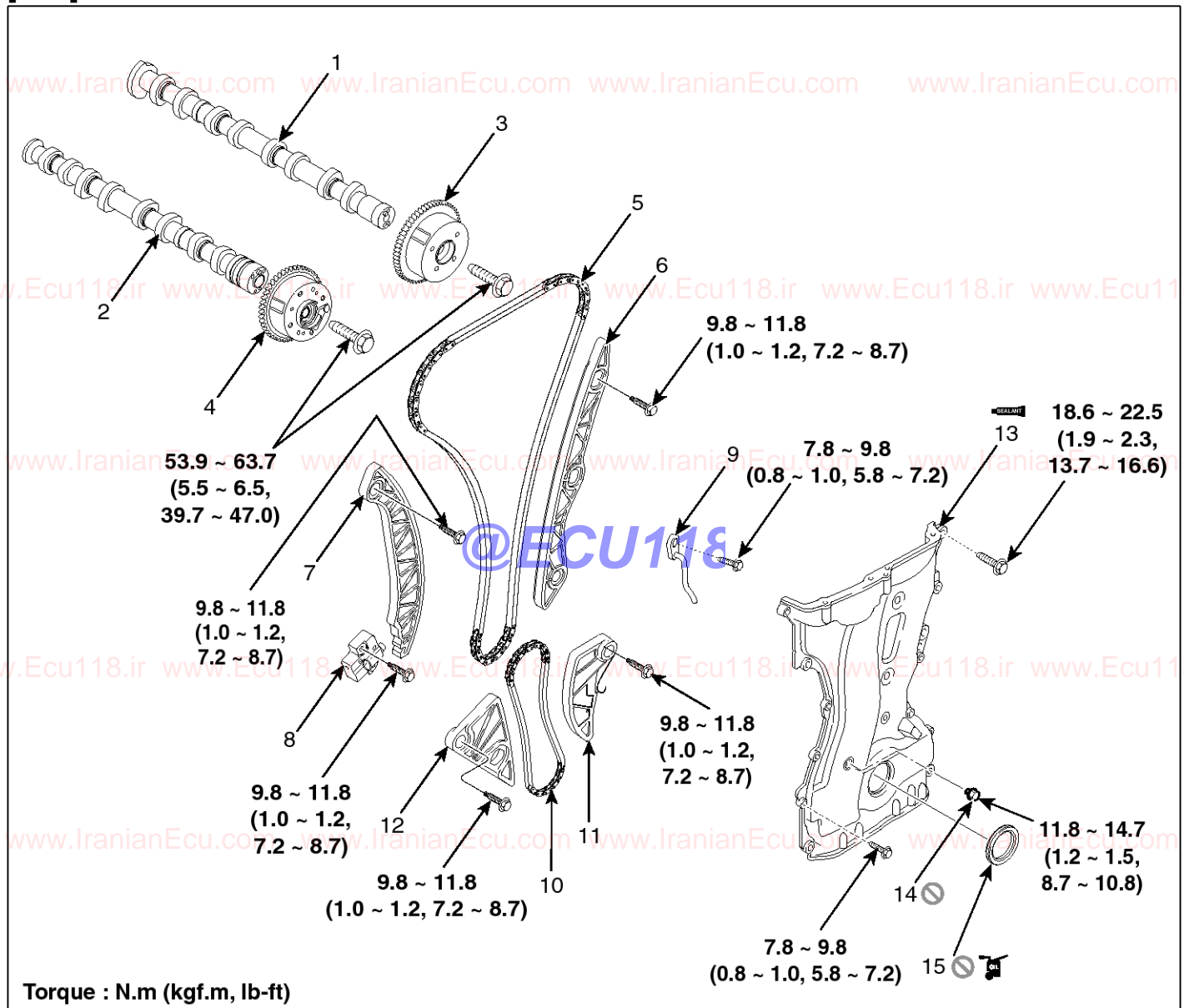
EM-29

Timing System

Timing Chain

Components

[2.0L]



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

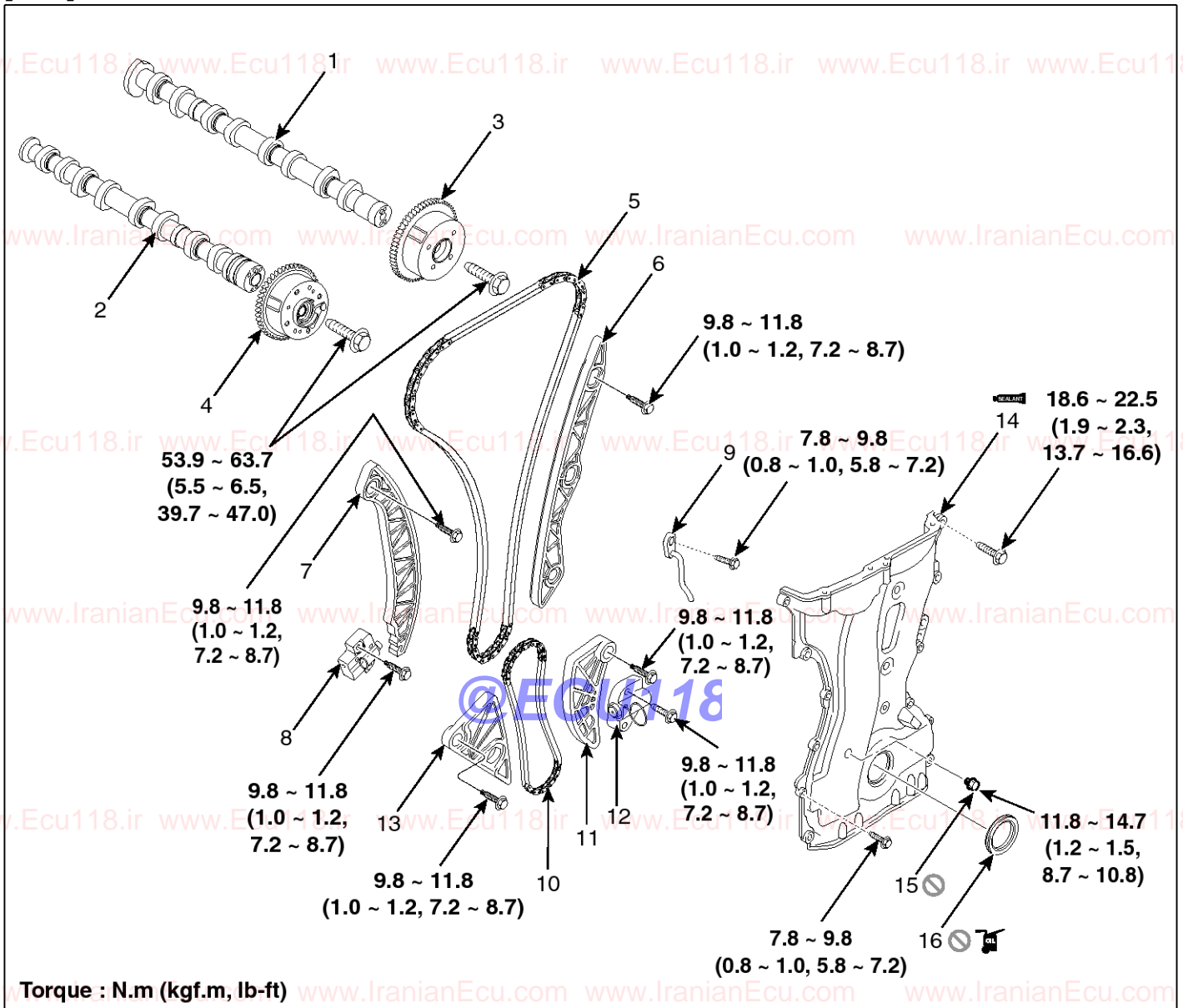
STFEM1081L

- | | | |
|--------------------------|-------------------------------|---|
| 1. Intake camshaft | 6. Timing chain guide | 11. Oil pump chain mechanical tensioner arm |
| 2. Exhaust camshaft | 7. Timing chain tensioner arm | 12. Oil pump chain guide |
| 3. Intake CVVT assembly | 8. Timing chain tensioner | 13. Timing chain cover |
| 4. Exhaust CVVT assembly | 9. Timing chain oil jet | 14. Service hole bolt |
| 5. Timing chain | 10. Oil pump chain | 15. Crankshaft front oil seal |

EM-30

Engine Mechanical System

[2.4L]



STFEM1082L

- | | | |
|--------------------------|-------------------------------|---------------------------------------|
| 1. Intake camshaft | 6. Timing chain guide | 11. Balance shaft chain tensioner arm |
| 2. Exhaust camshaft | 7. Timing chain tensioner arm | 12. Balance shaft chain tensioner |
| 3. Intake CVVT assembly | 8. Timing chain tensioner | 13. Balance shaft chain guide |
| 4. Exhaust CVVT assembly | 9. Timing chain oil jet | 14. Timing chain cover |
| 5. Timing chain | 10. Balance shaft chain | 15. Service hole bolt |
| | | 16. Crankshaft front oil seal |

Timing System

EM-31

Removal

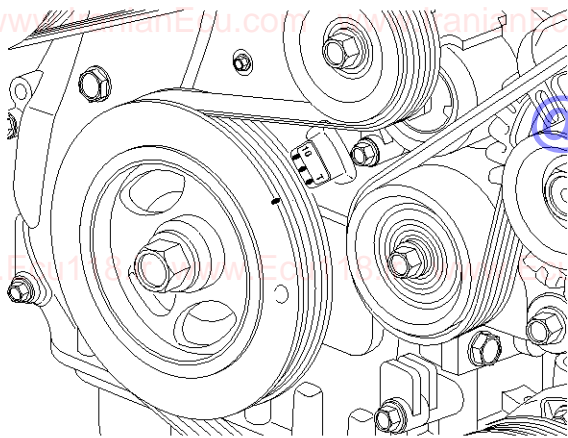
⚠ CAUTION

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

📌 NOTICE

Mark all wiring and hoses to avoid misconnection.

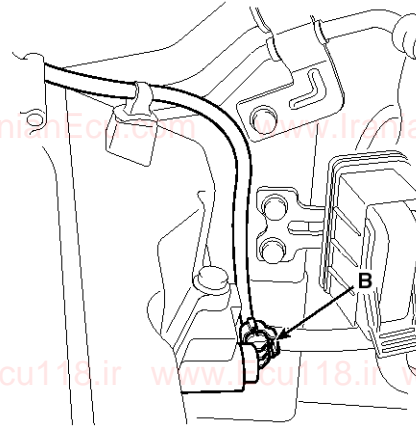
1. Remove the engine cover.
2. Disconnect the battery negative terminal.
3. Remove the air cleaner assembly. (Refer to Engine and transaxle assembly in this group)
4. Remove the RH front wheel. (Refer to SS group)
5. Remove the under cover. (Refer to Engine and transaxle assembly in this group)
6. Turn the crankshaft pulley and align its groove with the timing mark of the timing chain cover to set the piston of No.1 cylinder to the top dead center on compression stroke.



SSLM10003D

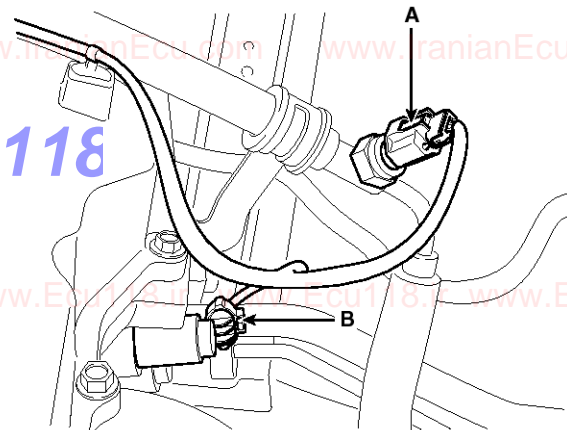
7. Disconnect the power steering oil pressure switch connector (A) (HPS only) and the exhaust OCV (Oil control valve) connector (B) and then remove the wiring from the cylinder head cover.

[MDPS]



SSLM10014L

[HPS]

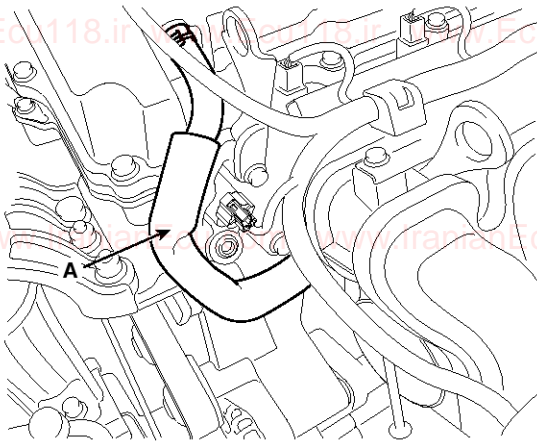


SVGEM0008D

EM-32

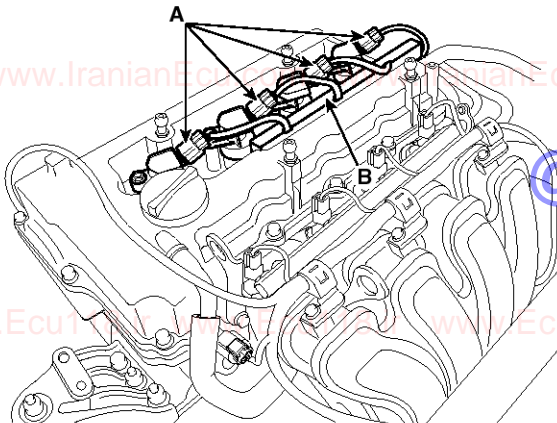
Engine Mechanical System

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



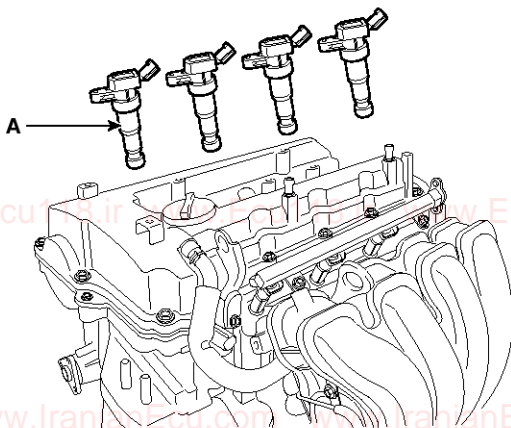
STFEM1028D

9. Disconnect the ignition coil connectors (A) and then remove the wiring protector (B).



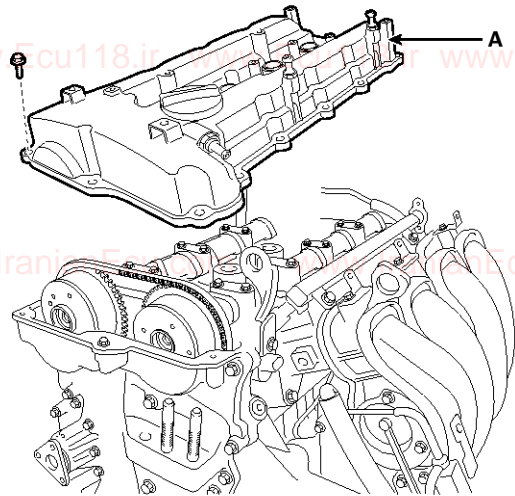
STFEM1029D

10. Remove the ignition coils (A).



SSLM10002D

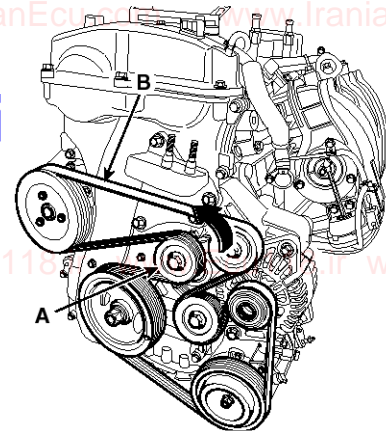
11. Remove the cylinder head cover (A).



SSLM10024D

12. Remove the drive belt (B) after turning the drive belt tensioner (A) counterclockwise.

[MDPS]

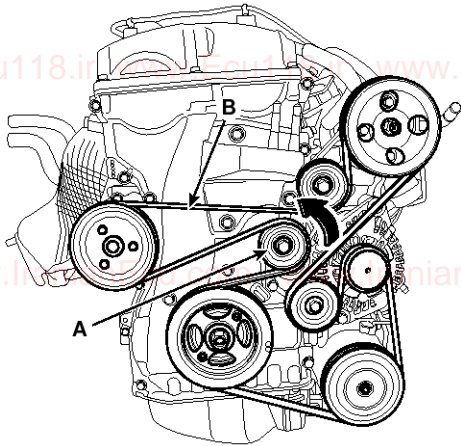


STFEM1054D

Timing System

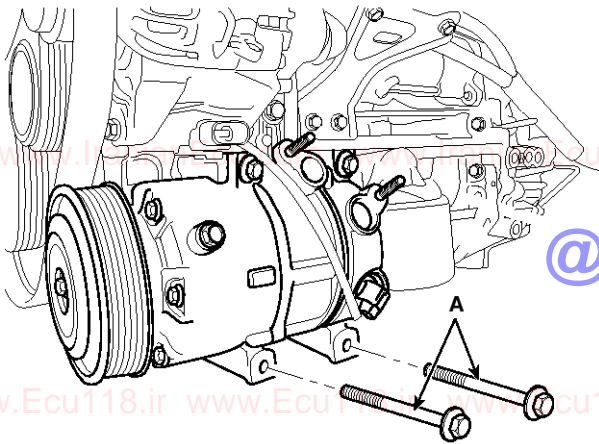
EM-33

[HPS]



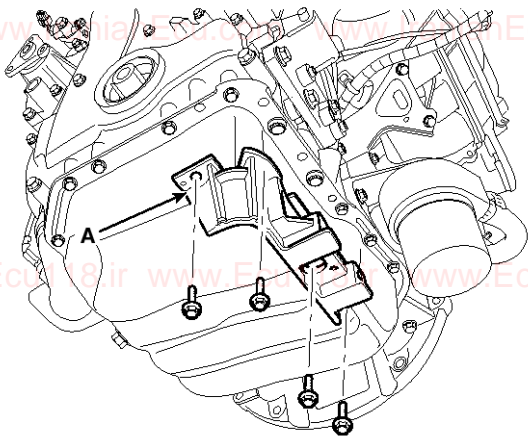
STFEM1011D

13. Remove the A/C compressor lower bolts (A).



STFEM1052D

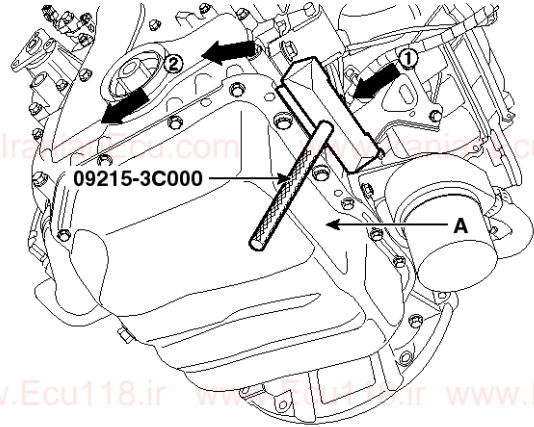
14. Remove the A/C compressor bracket (A).



SYFEM0039N

15. Drain the engine oil.

16. Remove the oil pan (A). Insert the blade of SST (09215-3C000) between the ladder frame and oil pan. Cut off applied sealer and remove the lower oil pan.



SVG11110L

NOTICE

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

NOTICE

- 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.
- Be careful not to damage the contact surfaces of ladder frame and lower oil pan.

EM-34

Engine Mechanical System

17. Set the jack to the edge of ladder frame.

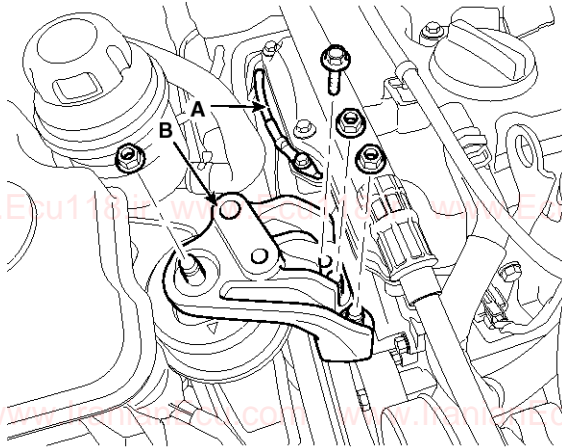
NOTICE

Put the wooden block between ladder frame and jack.

CAUTION

Be careful not to damage the balance shaft & oil pump module.

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

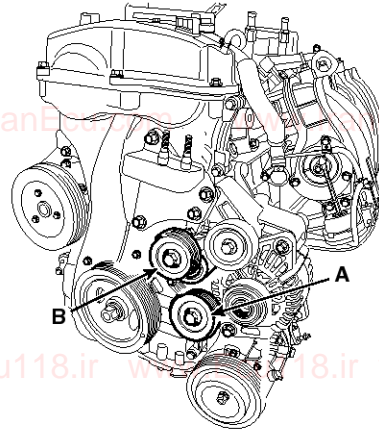


STFEM1014D

19. Separate the power steering oil pump (A) from the bracket. (Refer to ST group)

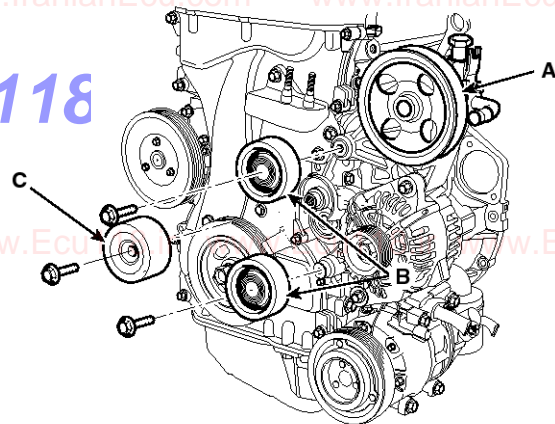
20. Remove the idler (B) and the drive belt tensioner pulley (C).

[MDPS]



STFEM1055D

[HPS]



SYFEM0053D

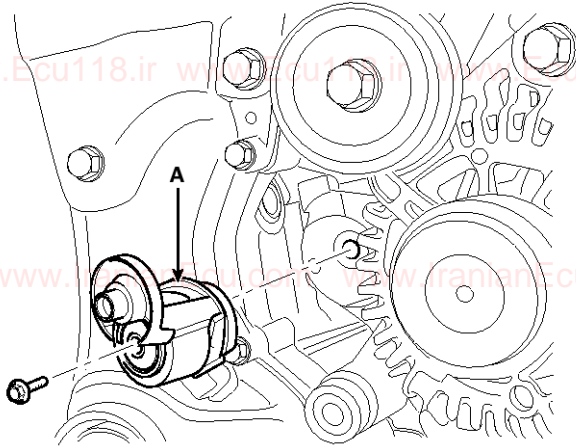
CAUTION

Tensioner pulley bolt is left-handed screw.

Timing System

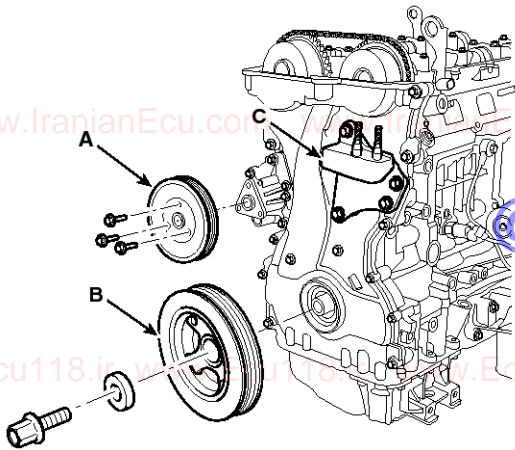
EM-35

21. Remove the drive belt tensioner (A).



SYFEM0038N

22. Remove the water pump pulley (A) and the crankshaft pulley (B) engine support bracket (C).

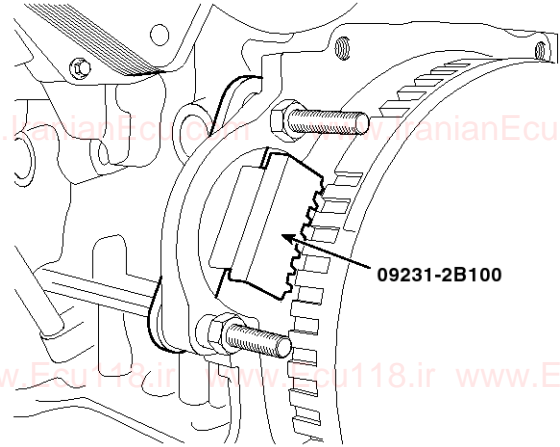


STFEM1056D

NOTICE

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

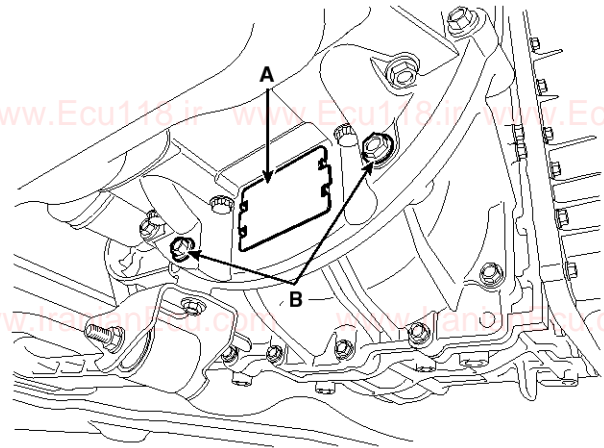
- Install the SST (09231-2B100) to hold the ring gear after removing the starter.



SVGEM20026D

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

1. Remove the dust cover (A) on the bottom of the ladder frame and unfasten the two transaxle mounting bolts (B).

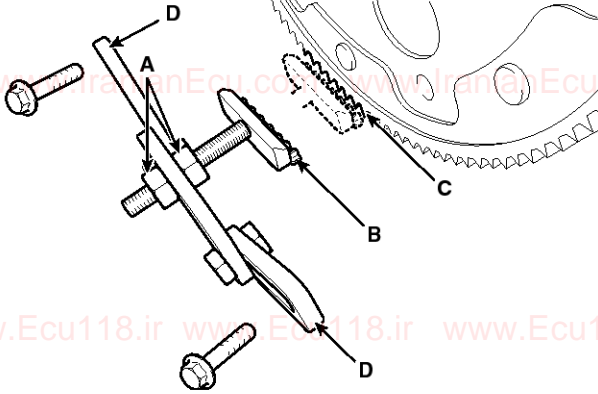


SVGEM1003D

EM-36

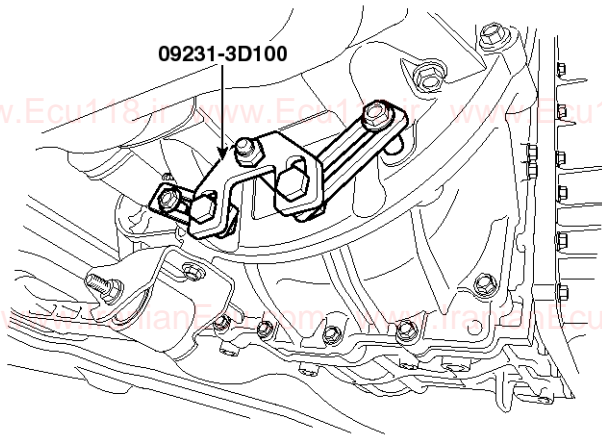
Engine Mechanical System

2. Adjust the length of the holder nuts (A) so that the front plate of the holder (B) puts in the ring gear (C) teeth.
3. Adjust the angle of the links (D) so that the two transaxle mounting bolts can be fastened to the original mounted holes.



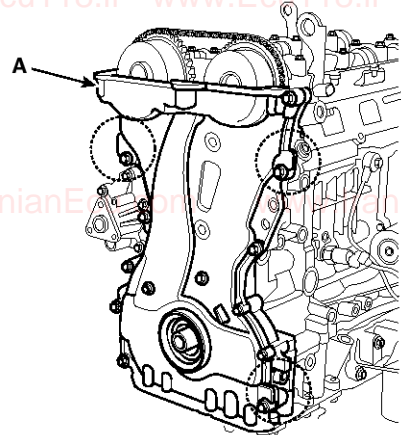
SVGEM1002D

4. Install the SST (09231-3D100) using the two transaxle mounting bolts and spacers. Tighten the bolts and nuts of the holder and links securely.



SVGEM1004D

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



STFEM1057D

⚠ CAUTION

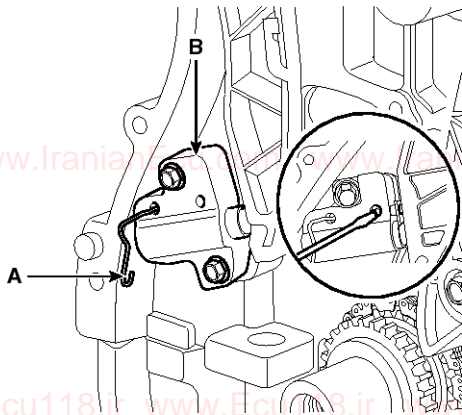
Be careful not to damage the contact surfaces of cylinder block, cylinder head and timing chain cover.

24. Make sure that the key of crankshaft is aligned with the mating surface of main bearing cap. As a result of this, the piston of No.1 cylinder is placed at the top dead center on compression stroke.

Timing System

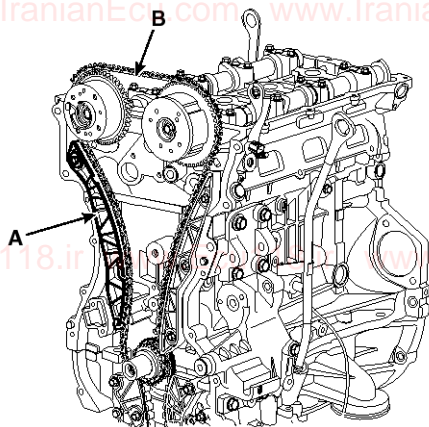
EM-37

25. Release the ratchet using a thin rod. Compress the piston and then insert a stopper pin (A) into the hole on the ratchet to hold the compressed piston. Remove the timing chain tensioner (B).



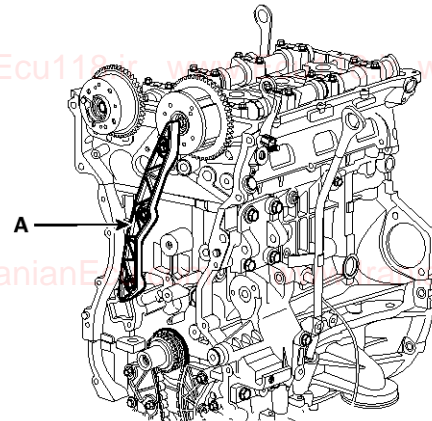
SVGEM0163D

26. Remove the timing chain tensioner arm (A).
27. Remove the timing chain (B).



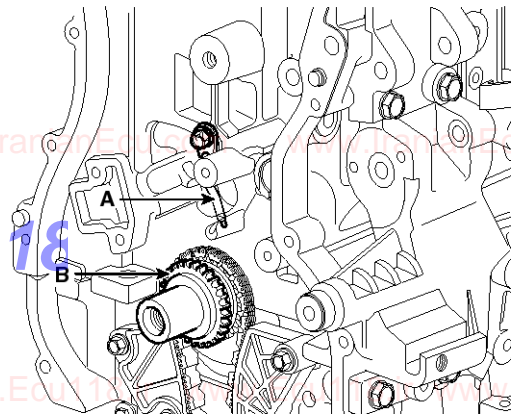
SVGEM0164D

28. Remove the timing chain guide (A).



SLMM10049D

29. Remove the timing chain oil jet (A) and the crankshaft chain sprocket (B).



SUNM19116N

30. Remove the balance shaft chain (oil pump chain).
(Refer to Lubrication system in this group)

EM-38

Engine Mechanical System

Inspection

Sprockets, Chain Tensioner, Chain Guide, Chain Tensioner Arm

1. Check the CVVT sprocket and crankshaft sprocket for abnormal wear, cracks, or damage. Replace as necessary.
2. Inspect the tensioner arm and chain guide for abnormal wear, cracks, or damage. Replace as necessary.
3. Check that the tensioner piston moves smoothly when the ratchet pawl is released with thin rod.

Drive belt, Idler, Pulley

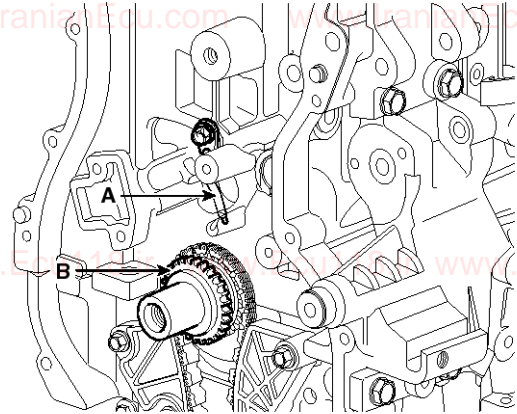
1. Check the idler for excessive oil leakage, abnormal rotation or vibration. Replace if necessary.
2. Check belt for maintenance and abnormal wear of V-ribbed part. Replace if necessary.
3. Check the pulleys for vibration in rotation, oil or dust deposit of V-ribbed part. Replace if necessary.

Installation

1. Install the balance shaft chain. (Refer to Lubrication system in this group)
2. Install the crankshaft chain sprocket (B) and the timing chain oil jet (A).

Tightening torque:

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



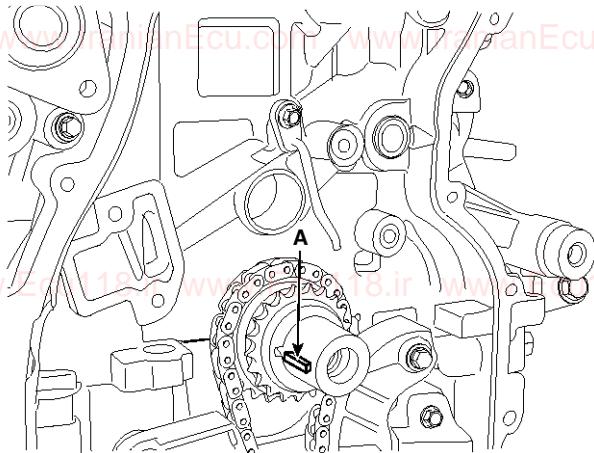
SUNM19116N

@ECU118

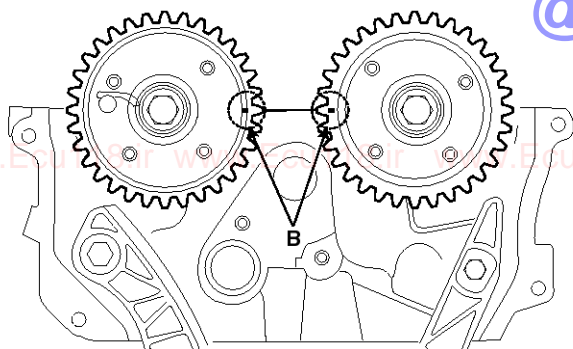
Timing System

EM-39

3. Set the crankshaft so that the key (A) of crankshaft will be aligned with the mating surface of main bearing cap. Put the intake and exhaust camshaft assembly so that the TDC marks (B) of the intake and exhaust CVVT sprockets will be aligned with the top surface of cylinder head. As a result of this, the piston of No.1 cylinder is placed at the top dead center on compression stroke.



SYFEM0146N

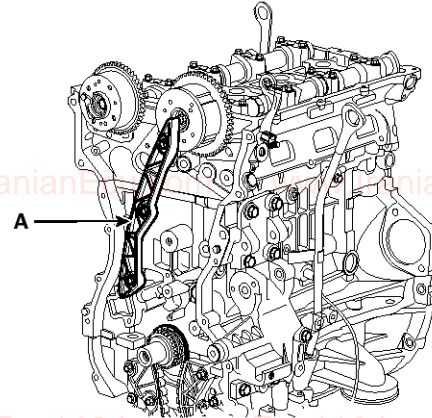


SYFEM0109N

4. Install the timing chain guide (A).

Tightening torque:

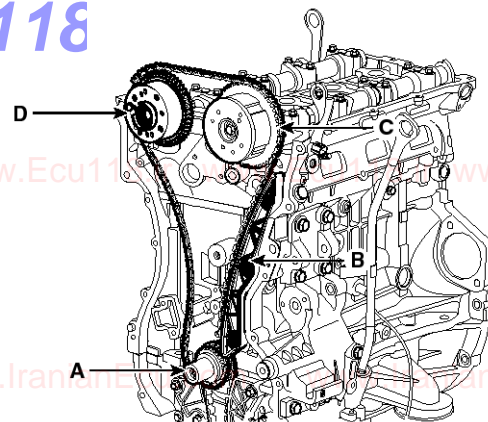
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



SLMM10049D

5. Install the timing chain. To install the timing chain with no slack between each shaft (cam, crank), follow the below procedure.

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



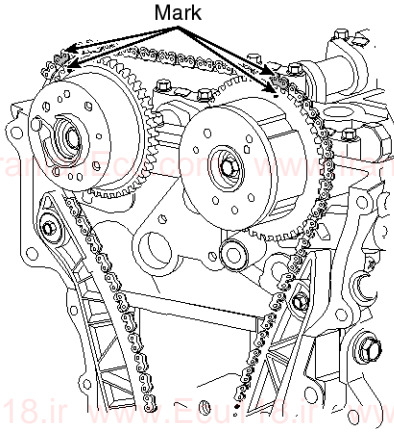
SVGEM0183D

EM-40

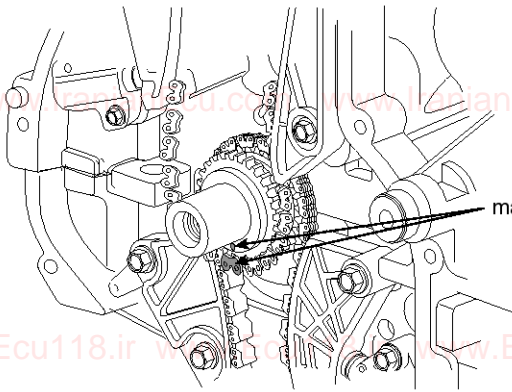
Engine Mechanical System

NOTICE

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



SLMM10046N

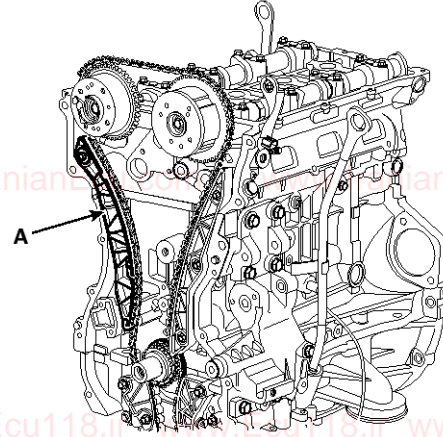


SLMM10047N

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

Tightening torque:

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

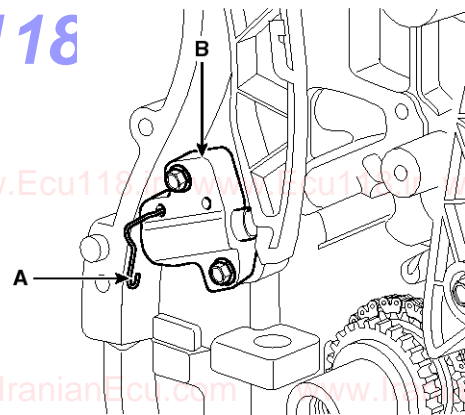


SVGEM0165D

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

Tightening torque:

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

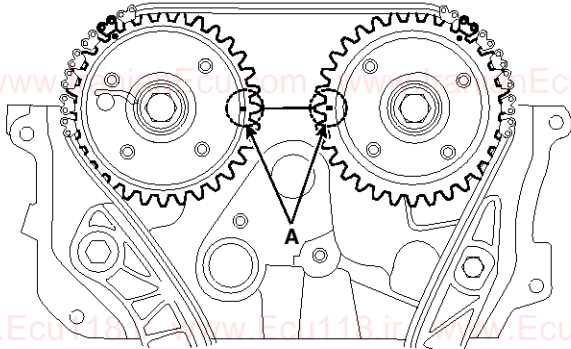


SSLM10113D

Timing System

EM-41

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



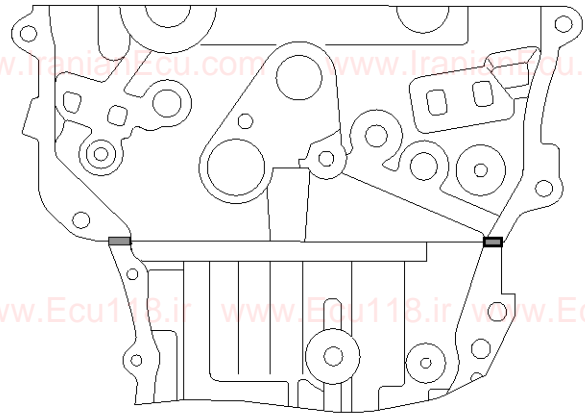
SVGEM0154D

9. Install the timing chain cover.

- 1) Using a gasket scraper, remove all the old packing material from the gasket surfaces.
- 2) The sealant locations on chain cover and on counter parts (cylinder head, cylinder block, and ladder frame) must be free of engine oil and etc.

- 3) Before assembling the timing chain cover, liquid sealant Loctite 5900H or equivalent should be applied on the gap between cylinder head and cylinder block. The part must be assembled within 5 minutes after sealant was applied.

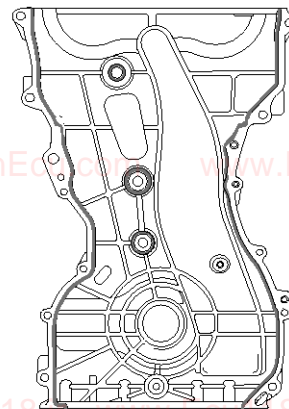
Bead width: 2.5mm (0.10in.)



SVGEM0141D

- 4) After applying liquid sealant Loctite 5900H or equivalent on the timing chain cover. The part must be assembled within 5 minutes after sealant was applied. Continuous bead of sealant should be applied to prevent any path of oil leakage.

Bead width: 3.0mm (0.12in.)



STFEM1058D

EM-42

Engine Mechanical System

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

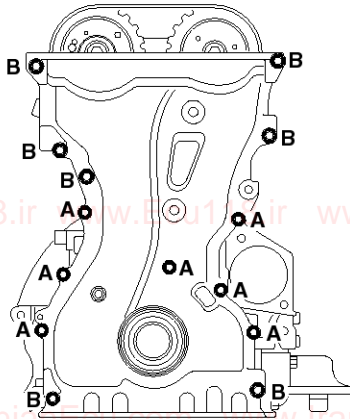
Tightening torque:

Bolts A (M6×25) :

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

Bolts B (M8×28) :

18.6 ~ 22.5N.m (1.9 ~ 2.3kgf.m, 13.7 ~ 16.6lb-ft)

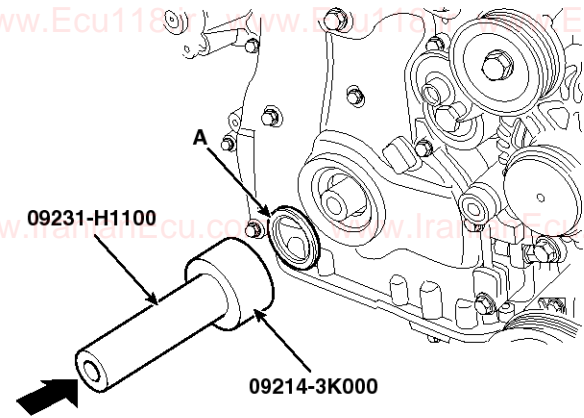


SYFM10151D

⚠ CAUTION

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

10. Install the crankshaft front oil seal (A) using SST (09214-3K000, 09231-H1100).



SSLM10114D

11. Install the water pump pulley (A), crankshaft pulley (B), engine support bracket (C).

Tightening torque :

Water pump pulley (A) :

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

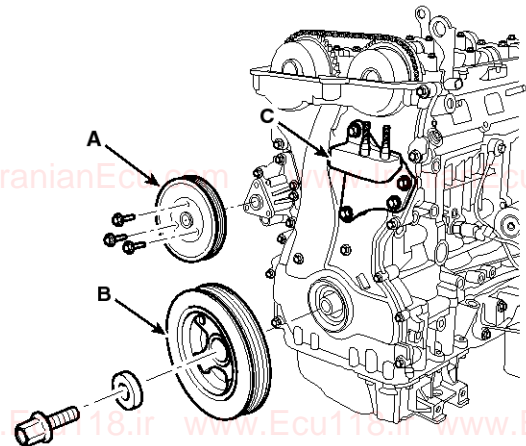
Crankshaft pulley (B) :

166.6 ~ 176.4N.m (17.0 ~ 18.0kgf.m, 122.9 ~ 130.1lb-ft)

Engine support bracket (C) :

M10 bolts : 39.2 ~ 44.1N.m (4.0 ~ 4.5kgf.m, 28.9 ~ 32.5lb-ft)

M8 bolts : 19.6 ~ 24.5N.m (2.0 ~ 2.5kgf.m, 14.5 ~ 18.1lb-ft)



STFEM1056D

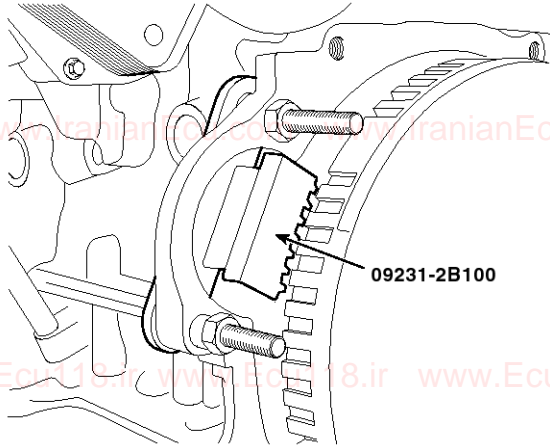
Timing System

EM-43

NOTICE

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

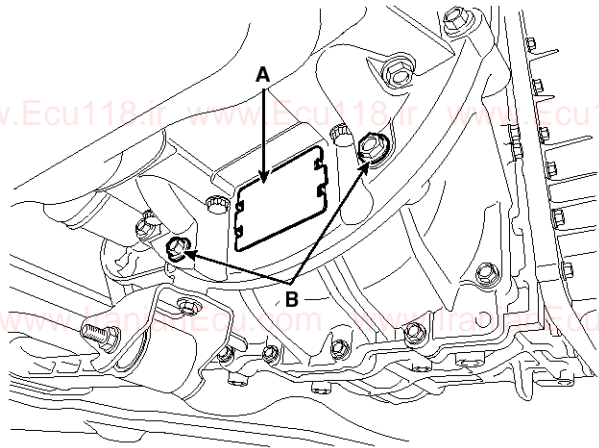
- Install the SST (09231-2B100) to hold the ring gear after removing the starter.



SVG M20026D

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

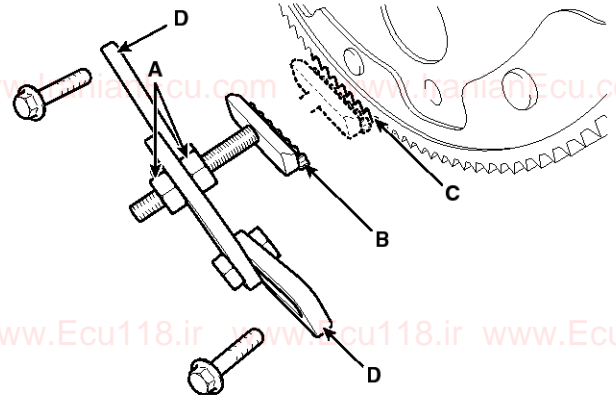
1. Remove the dust cover (A) on the bottom of the ladder frame and unfasten the two transaxle mounting bolts (B).



SVGEM1003D

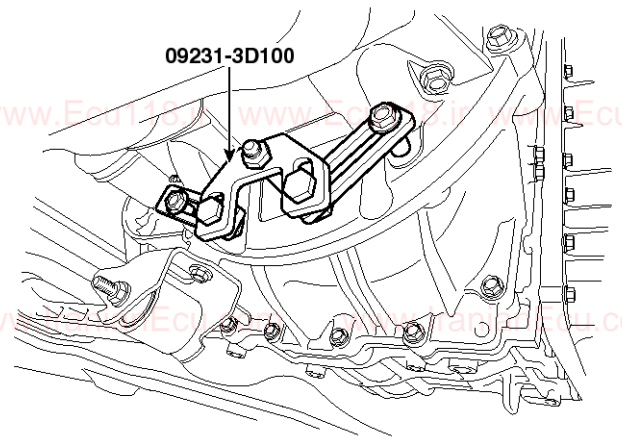
2. Adjust the length of the holder nuts (A) so that the front plate of the holder (B) puts in the ring gear (C) teeth.

3. Adjust the angle of the links (D) so that the two transaxle mounting bolts can be fastened to the original mounted holes.



SVGEM1002D

4. Install the SST (09231-3D100) using the two transaxle mounting bolts and spacers. Tighten the bolts and nuts of the holder and links securely.



SVGEM1004D

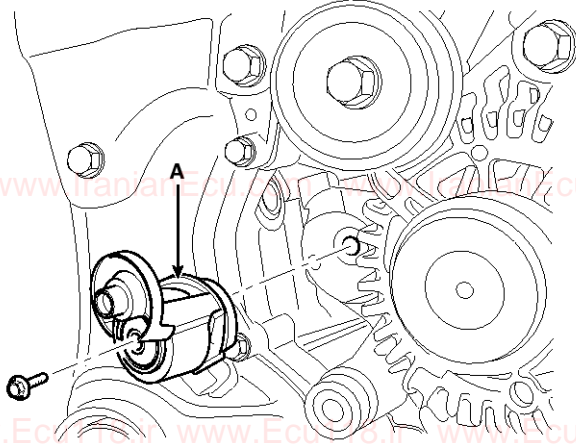
EM-44

Engine Mechanical System

12. Install the drive belt tensioner (A).

Tightening torque :

53.9 ~ 63.7N.m (5.5 ~ 6.5kgf.m, 39.7 ~ 47.0lb-ft)



SYFEM0038N

13. Install the idler (B) and the drive belt tensioner pulley (C).

Tightening torque :

Idler (B) :

53.9 ~ 63.7N.m (5.5 ~ 6.5kgf.m, 39.7 ~ 47.0lb-ft)

Drive belt tensioner pulley (C) :

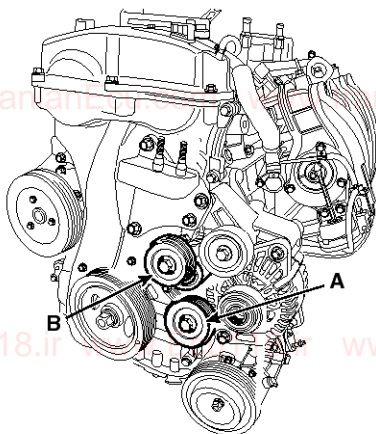
53.9 ~ 63.7N.m (5.5 ~ 6.5kgf.m, 39.7 ~ 47.0lb-ft)

⚠ CAUTION

Tensioner pulley bolt is left-handed screw.

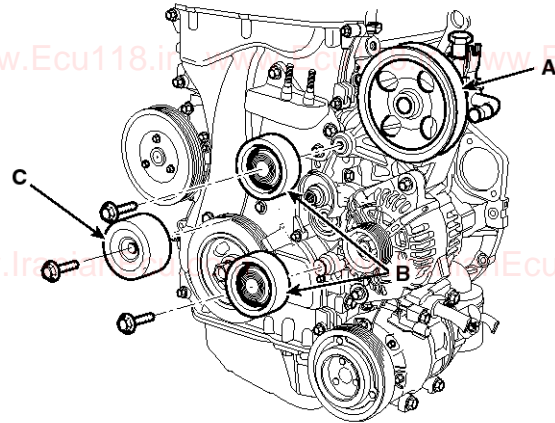
14. Install the power steering oil pump (A). (Refer to ST group)

[MDPS]



STFEM1055D

[HPS]

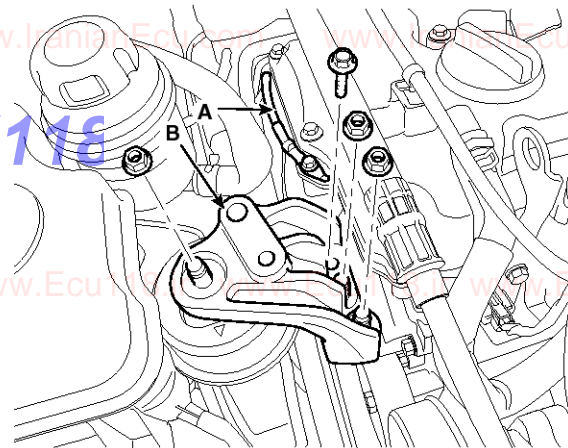


SYFEM0053D

15. Install the engine mounting support bracket (B) and connect the ground line (A).

Tightening torque :

63.8 ~ 83.4 N.m (6.5 ~ 8.5 kgf.m, 47.0 ~ 61.5 lb-ft)



STFEM1014D

Timing System

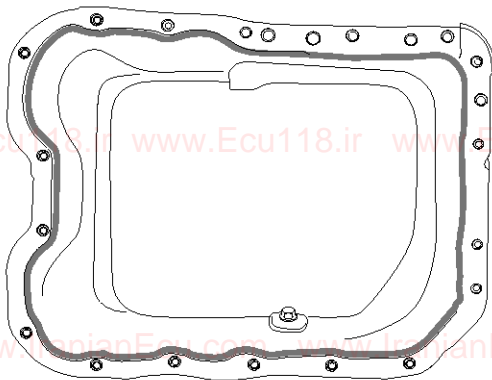
EM-45

16. Remove the jack from the ladder frame.

17. Install the oil pan.

- 1) Using a gasket scraper, remove all the old sealant material from the gasket surfaces.
- 2) Before assembling the oil pan, liquid sealant Loctite 5900H, Threebond 1217H or equivalent should be applied on oil pan. The part must be assembled within 5 minutes after sealant was applied.

Bead width : 2.5mm (0.10in.)



SYFEM0012N

⚠ CAUTION

- When applying sealant gasket, sealant must not be protruded into the inside of oil pan.
- To prevent leakage of oil, apply sealant gasket on the inner threads of the bolt holes.

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

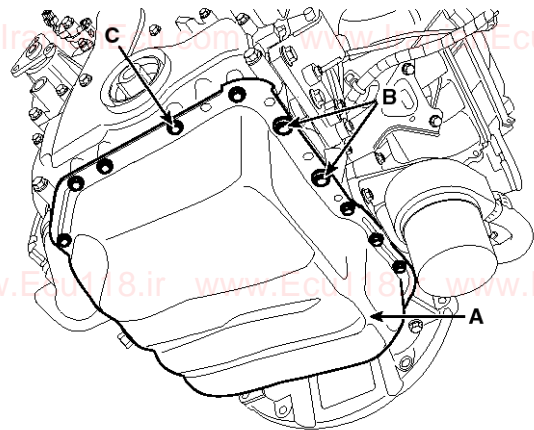
Tightening torque

Bolts B (M9) :

30.4 ~ 34.3N.m (3.1 ~ 3.5kgf.m, 22.4 ~ 25.3lb-ft)

Bolts C (M6) :

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



SVGEM0149D

⚠ CAUTION

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

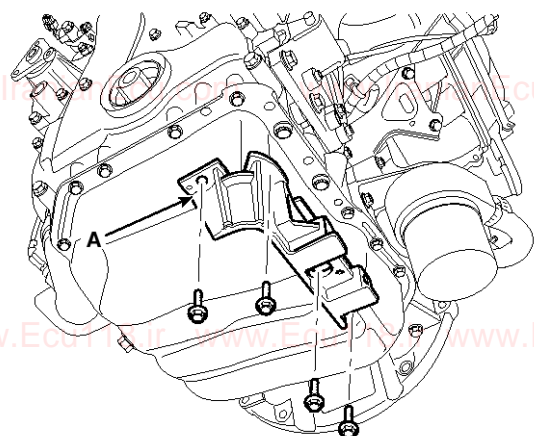
📖 NOTICE

Always use a new drain plug gasket.

18. Install the A/C compressor bracket (A).

Tightening torque :

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



SYFEM0039N

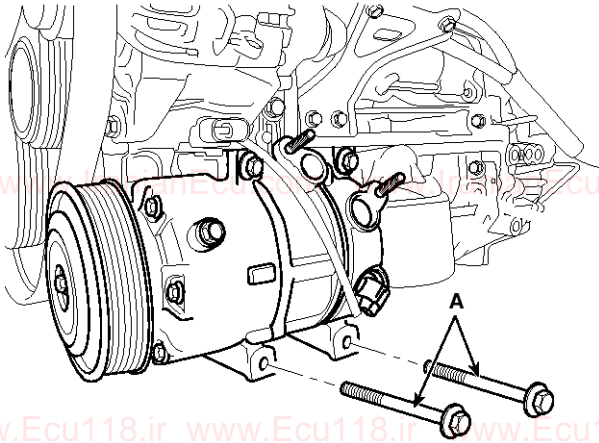
EM-46

Engine Mechanical System

19. Install the A/C compressor lower bolts (A).

Tightening torque :

20.0 ~ 33.0N.m (2.04 ~ 3.36kgf.m, 14.8 ~ 24.3lb-ft)



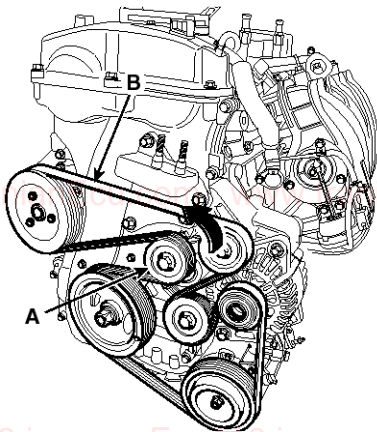
STFEM1052D

20. Install the drive belt (B).

Crankshaft pulley → A/C pulley → Alternator pulley
→ Idler #1 pulley → Power steering oil pump pulley
(HPS only) → Idler #2 pulley → Water pump pulley →
Tensioner pulley.

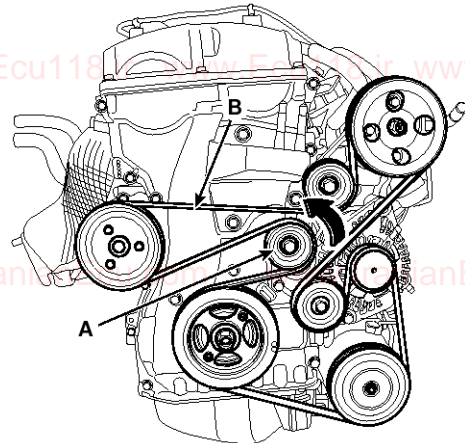
Rotate the drive belt tensioner arm (A) counterclockwise moving the tensioner pulley bolt with wrench. After putting the belt on the tensioner pulley, release the tensioner pulley slowly.

[MDPS]



STFEM1054D

[HPS]

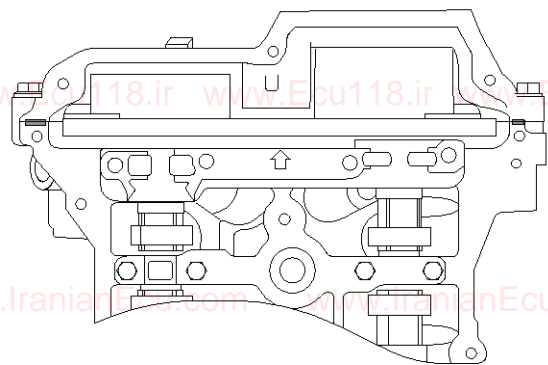


STFEM1011D

21. Install cylinder head cover.

- 1) The hardening sealant located on the upper area between timing chain cover and cylinder head should be removed before assembling cylinder head cover.
- 2) After applying sealant, it should be assembled within 5 minutes.

Bead width : 2.5mm (0.10in.)



SNFEM8045D

Timing System

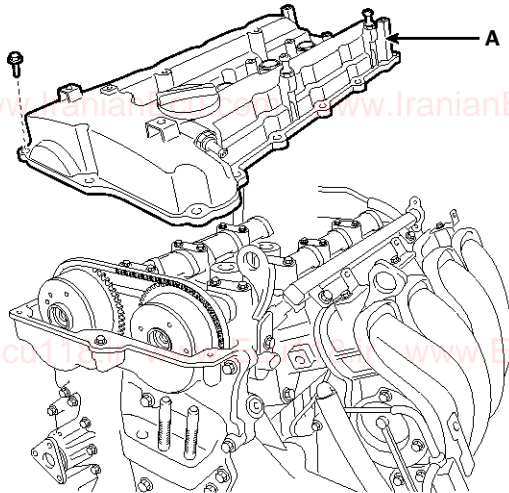
EM-47

- 3) Install the cylinder head cover (A) by tightening the bolts as following method.

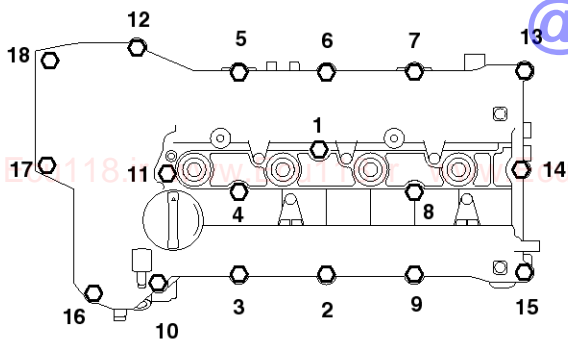
Tightening torque

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

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



SSLM10024D



SNFEM8046D

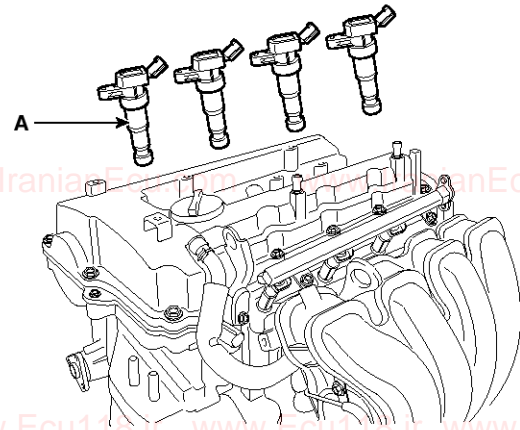
⚠ CAUTION

- Do not reuse cylinder head cover gasket.
- The firing and/or blow out test should not be performed within 30 minutes after the cylinder head cover was assembled.

22. Install the ignition coils (A).

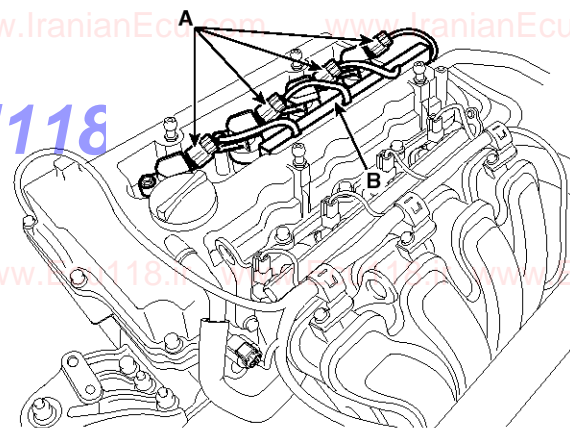
Tightening torque :

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



SSLM10002D

23. Install the wiring protector (B), and then connect the ignition coil connectors (A).

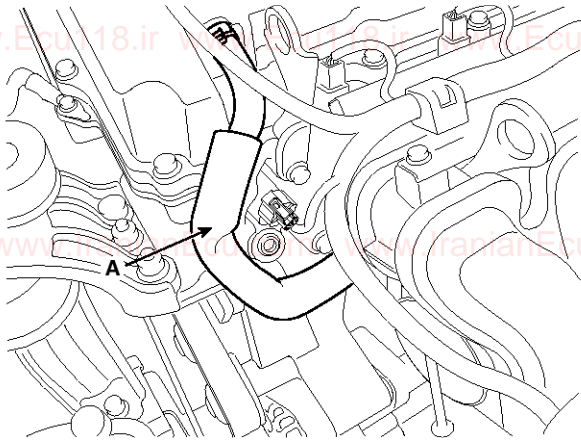


STFEM1029D

EM-48

Engine Mechanical System

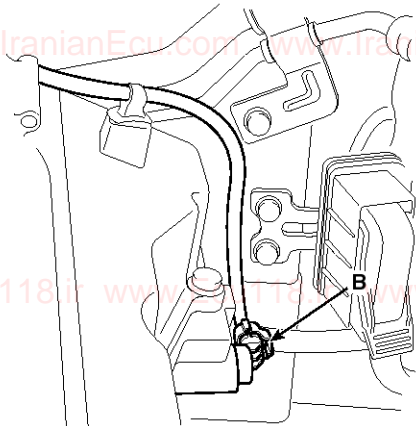
24. Connect the PCV (Positive crankcase ventilation) hose (A).



SSLM10109D

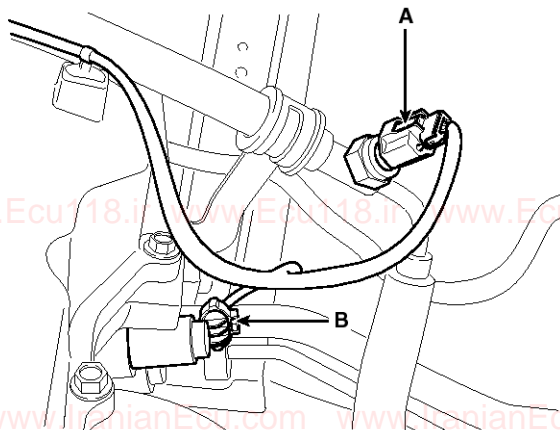
25. Connect the power steering oil pressure switch connector (A) (HPS only) and the exhaust OCV (Oil control valve) connector (B).

[MDPS]



SSLM10014L

[HPS]



SVGEM0008D

26. Install the under cover. (Refer to Engine and transaxle assembly in this group)

27. Install the RH front wheel. (Refer to SS group)

28. Install the air cleaner assembly. (Refer to Engine and transaxle assembly in this group)

29. Connect the battery negative terminal.

Tightening torque:

Without battery sensor :

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

With battery sensor :

4.0 ~ 6.0N.m (0.4 ~ 0.6kgf.m, 3.0 ~ 4.4lb-ft)

30. Install the engine cover.

31. Add all the necessary fluids and check for leaks. Connect GDS. Check for codes, note, and clear. Recheck.

NOTICE

- Refill engine with engine oil.
- Refill a transaxle with fluid.
- Refill a radiator and a reservoir tank with engine coolant.
- Clean battery posts and cable terminals and assemble.
- Inspect for fuel leakage.
 - After 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 fuelline pressurizes.
 - Repeat this operation two or three times, then check for fuel leakage at any point in the fuel line.
- Refill radiator and reservoir tank with engine coolant.
- Bleed air from the cooling system.
 - Start engine and let it run until it warms up. (until the radiator fan operates 3 or 4 times.)
 - Turn Off the engine. Check the level in the radiator, add coolant if needed. This will allow trapped air to be removed from the cooling system.
 - Put radiator cap on tightly, then run the engine again and check for leaks

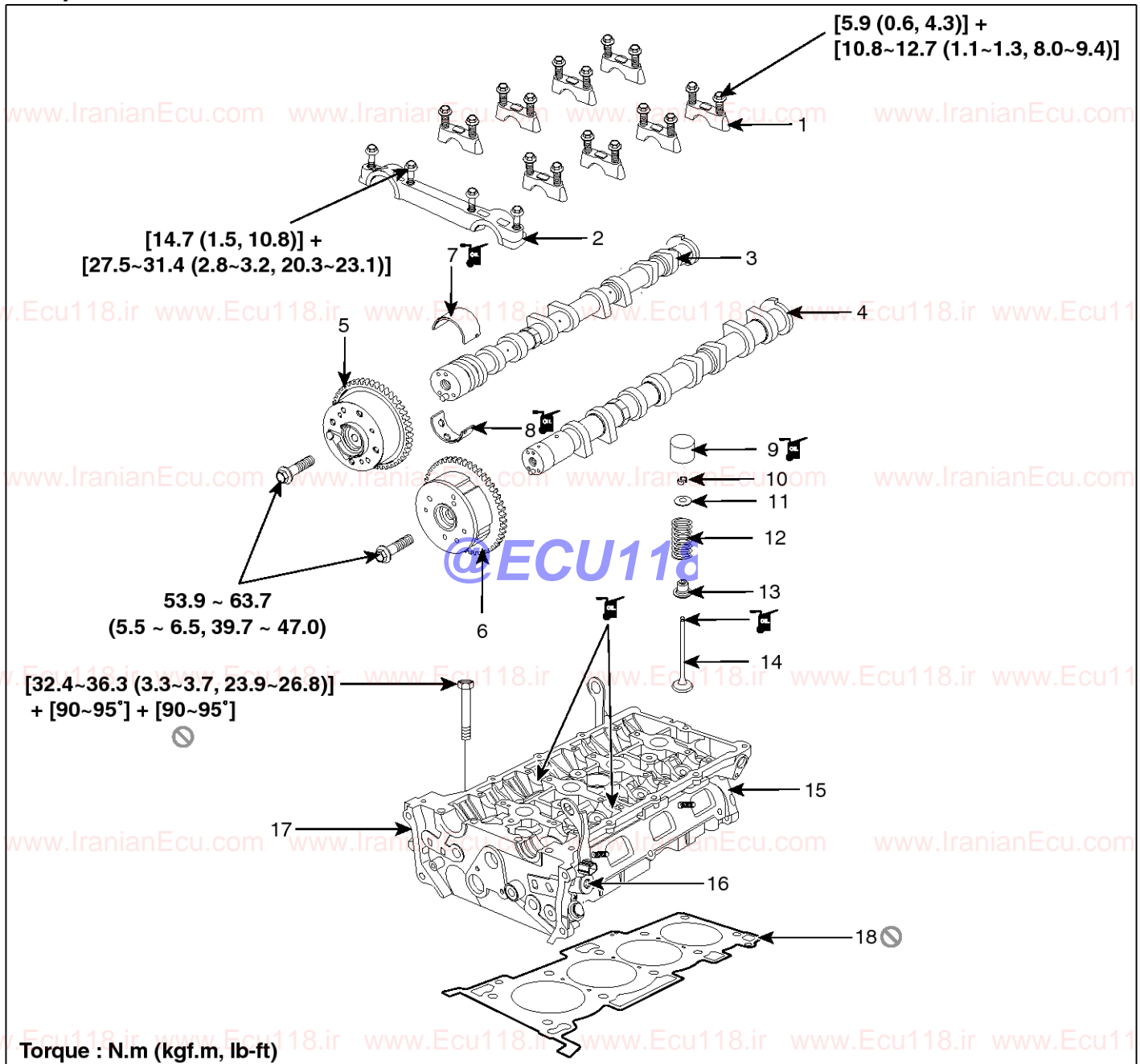
Cylinder Head Assembly

EM-49

Cylinder Head Assembly

Cylinder Head

Components



SSLM10142N

- | | | |
|-------------------------------|-----------------------------------|-------------------------------------|
| 1. Camshaft bearing cap | 7. Exhaust camshaft upper bearing | 13. Valve stem seal |
| 2. Camshaft front bearing cap | 8. Exhaust camshaft lower bearing | 14. Valve |
| 3. Exhaust camshaft | 9. MLA (Mechanical lash adjuster) | 15. Cylinder head |
| 4. Intake camshaft | 10. Retainer lock | 16. Intake OCV (Oil control valve) |
| 5. Exhaust CVVT assembly | 11. Retainer | 17. Exhaust OCV (Oil control valve) |
| 6. Intake CVVT assembly | 12. Valve spring | 18. Cylinder head gasket |

EM-50

Engine Mechanical System

Removal

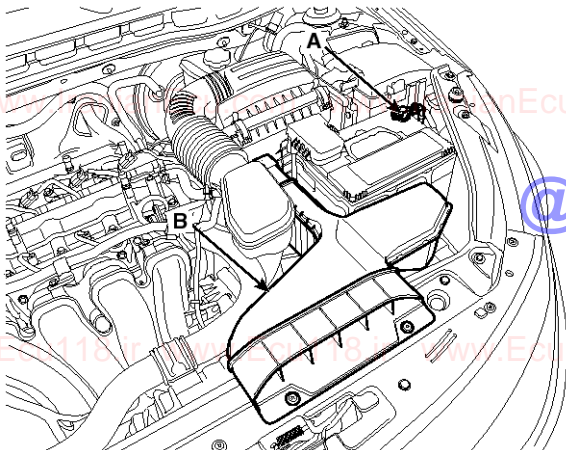
⚠ CAUTION

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

📌 NOTICE

Mark all wiring and hoses to avoid misconnection.

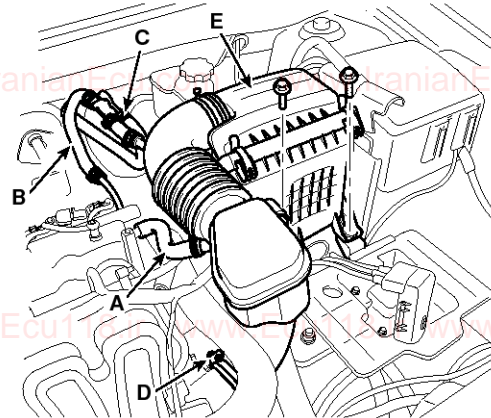
1. Remove the engine cover.
2. Disconnect the battery negative terminal (A).
3. Remove the air duct (B).



STFEM1045D

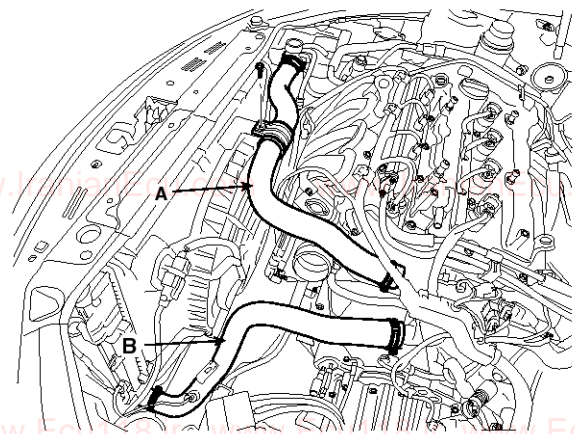
4. Remove the air cleaner assembly.

- 1) Disconnect the breather hose (A), the brake booster vacuum hose (B) and the brake booster intensifier hose (C) (AT only).
- 2) Disconnect the air intake hose (D) and then remove the air cleaner assembly (E).



STFM11008D

5. Remove the RH front wheel. (Refer to SS group)
6. Remove the under cover. (Refer to Engine and transaxle assembly in this group)
7. Loosen the drain plug, and drain the engine coolant. Remove the radiator cap to help drain the coolant faster. (Refer to Cooling system in this group)
8. Disconnect the radiator upper hose (A) and lower hose (B).



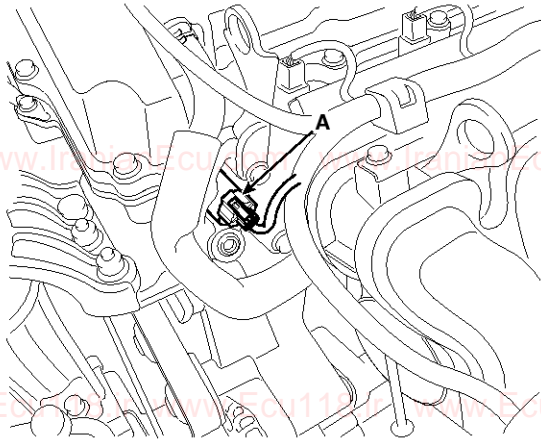
STFEM1005D

Cylinder Head Assembly

EM-51

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

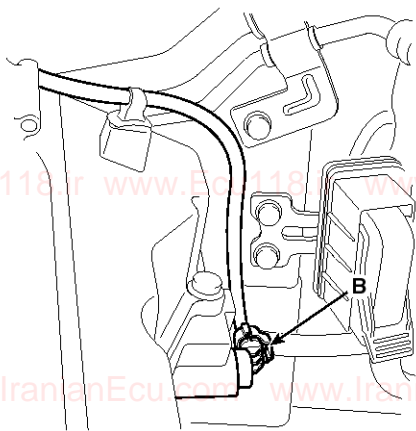
- 1) The intake OCV (Oil control valve) connector (A)



STFEM1030D

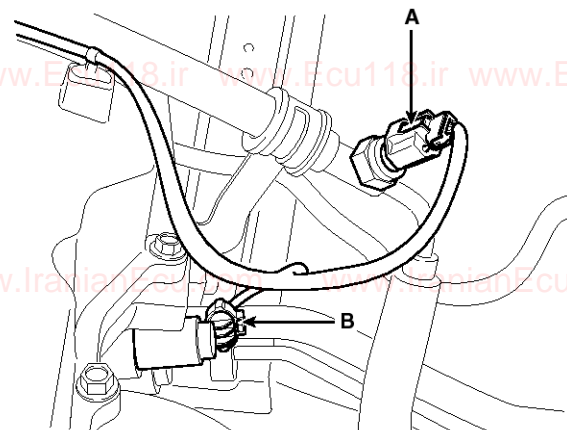
- 2) The power steering oil pressure switch connector (A) (HPS only) and the exhaust OCV (Oil control valve) connector (B)

[MDPS]



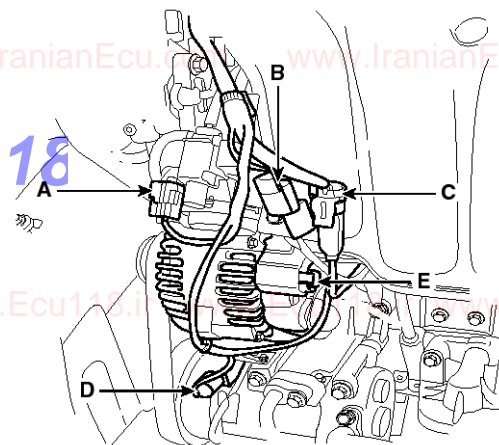
SSLM10014L

[HPS]



SVGEM0008D

- 3) The VIS (Variable intake system) connector (A), the OPS (Oil pressure switch) connector (B), the knock sensor connector (C), the A/C compressor switch connector (D) and the alternator connector (E)

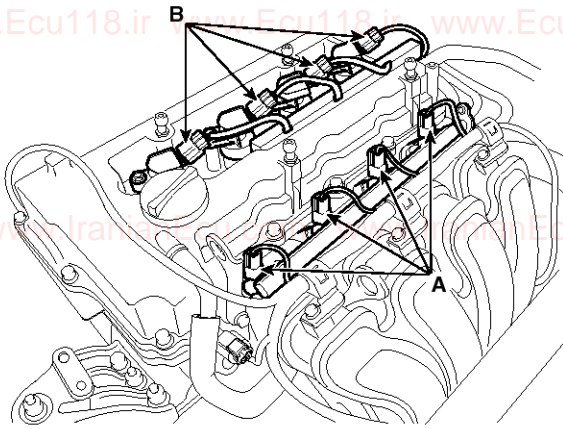


SSLM10123D

EM-52

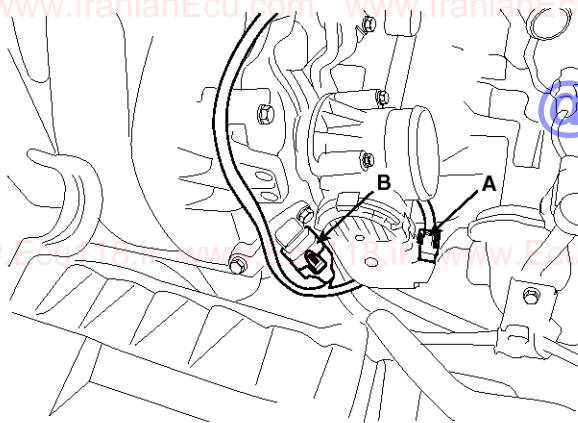
Engine Mechanical System

- 4) The injector connectors (A) and the ignition coil connectors (B).



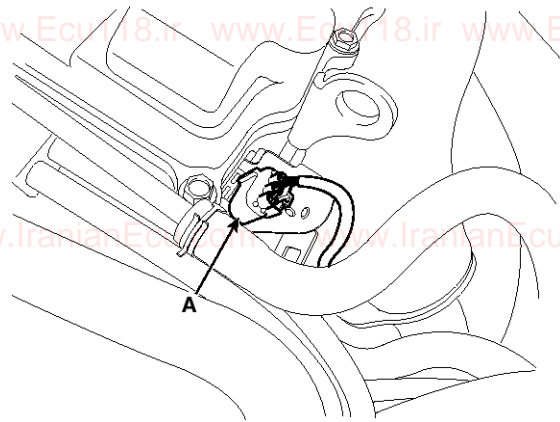
STFEM1026D

- 5) The ETC (Electronic throttle control) connector (A) and the MAPS (Manifold absolute pressure sensor) & IATS (Intake air temperature sensor) connector (B)



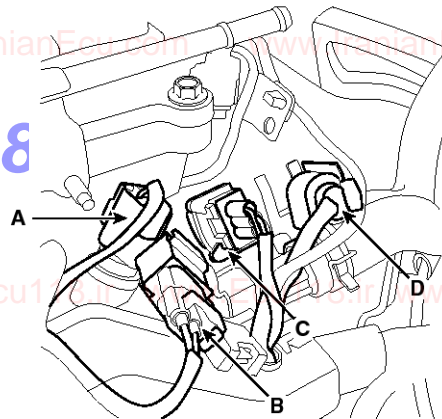
STFEM1031D

- 6) The exhaust CMPS (Camshaft position sensor) connector (A)



SSLM10151N

- 7) The ECTS (Engine coolant temperature sensor) connector (A), the condenser connector (B), the CKPS (Crankshaft position sensor) connector (C), the front oxygen sensor connector (D)

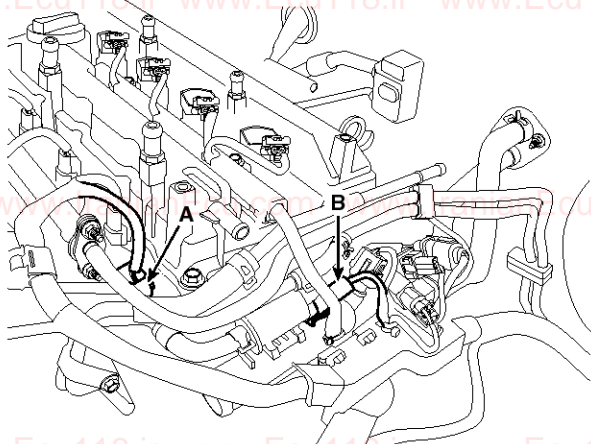


SSLM10158L

Cylinder Head Assembly

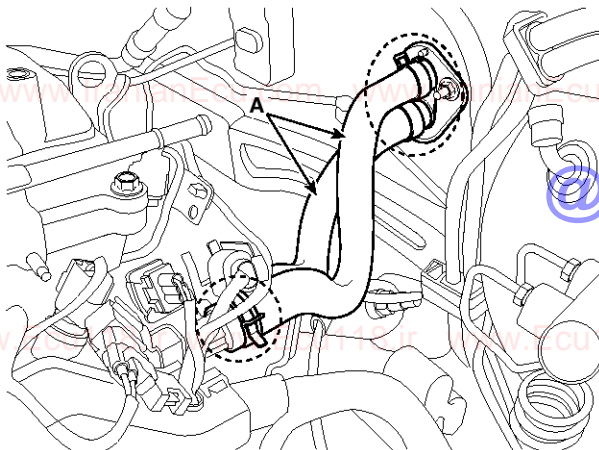
EM-53

- 8) The intake CMPS (Camshaft position sensor) connector (A) and the PCSV (Purge control solenoid valve) connector (B)



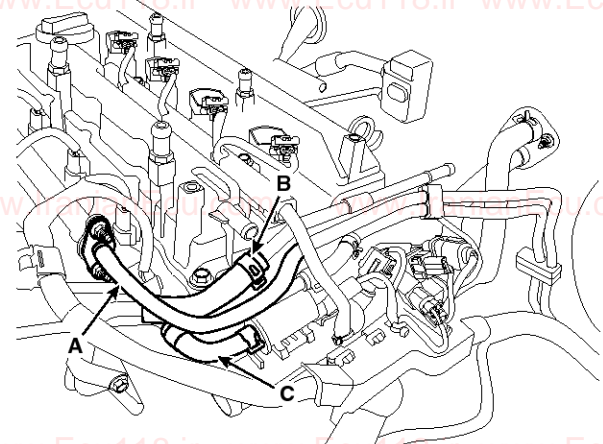
STFEM1032D

10. Disconnect the heater hose (A).



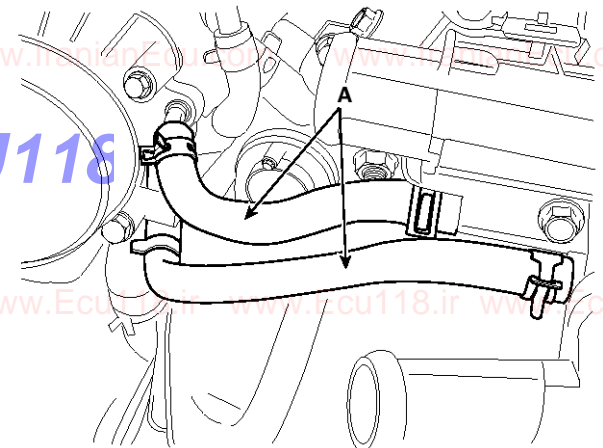
SYFEM0022D

11. Disconnect the fuel hose (A), the brake booster vacuum hose (B), the PCSV (Purge control solenoid valve) hose (C).



STFEM1033D

12. Disconnect the throttle body coolant hoses (A). (if equipped)

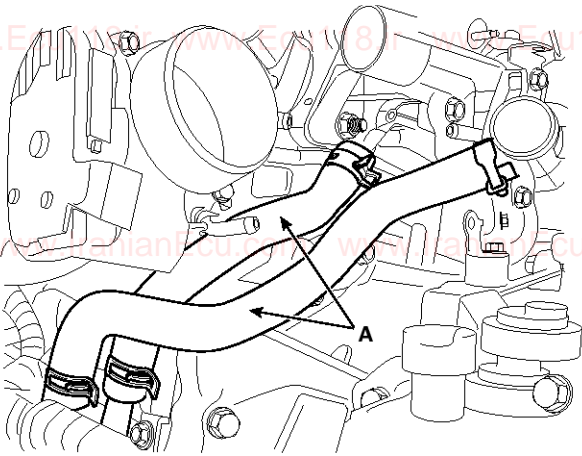


SVG11117L

EM-54

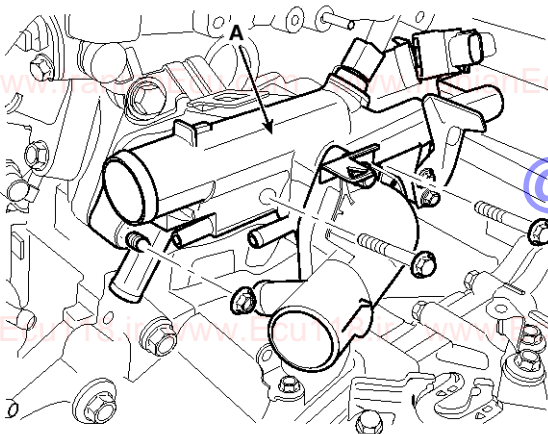
Engine Mechanical System

13. Disconnect the oil cooler coolant hoses (A). (2.4L only)

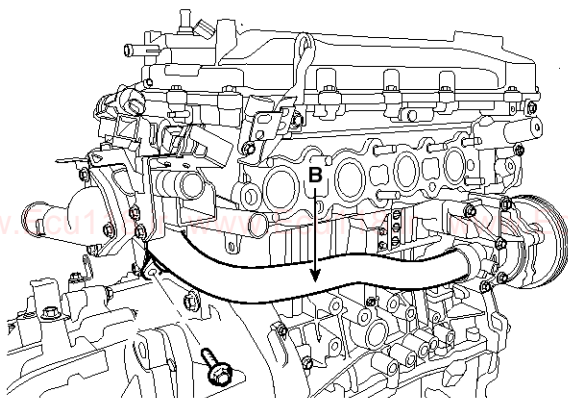


SYFEM0048N

14. Remove the water temperature control assembly (A) with the water inlet pipe (B).



SYFEM0049N

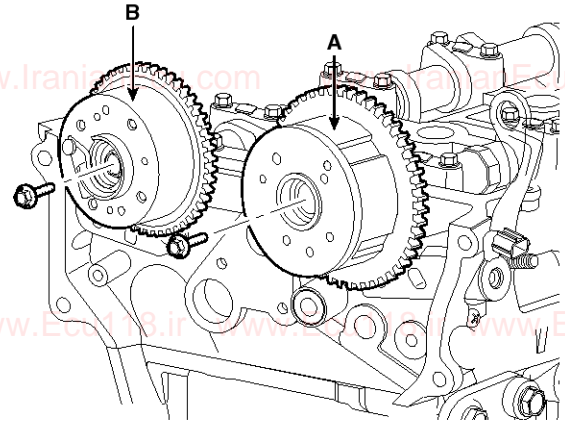


STFEM1060D

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

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

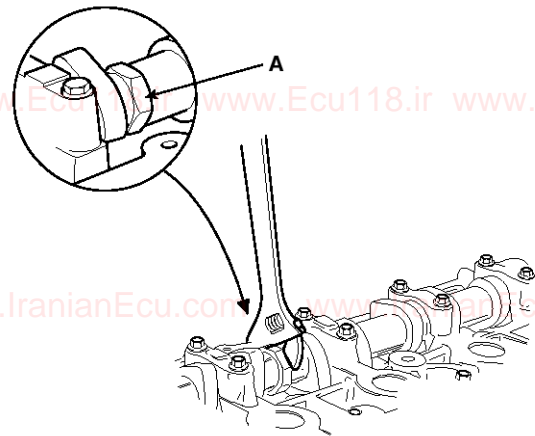
17. Remove the intake CVVT assembly (A) and exhaust CVVT assembly (B).



SVGEM0167D

NOTICE

When removing the CVVT assembly bolt, prevent the camshaft from rotating by using a wrench at position A.



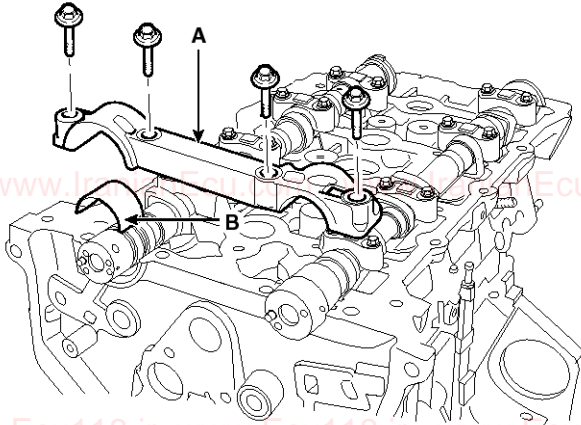
STDM19324L

Cylinder Head Assembly

EM-55

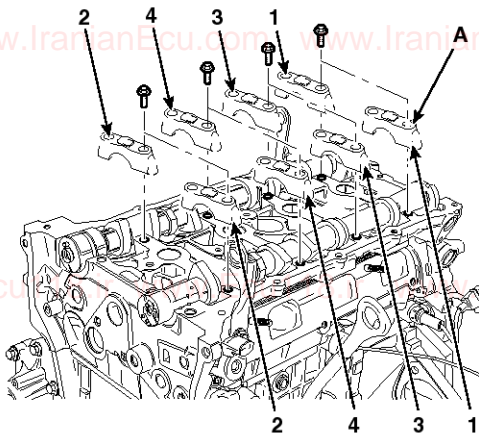
18. Remove the camshaft.

- 1) Remove the front camshaft bearing cap (A) with the upper bearing (B).



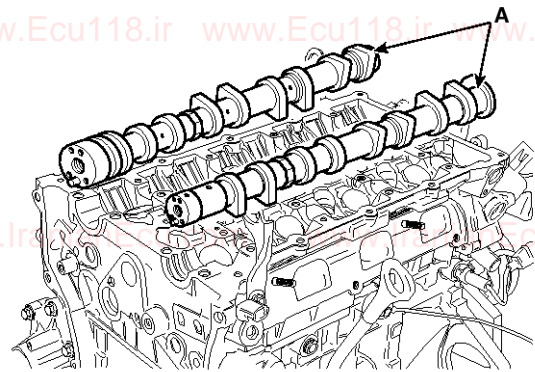
SYFEM0015N

- 2) Remove the camshaft bearing cap (A) in the sequence shown.



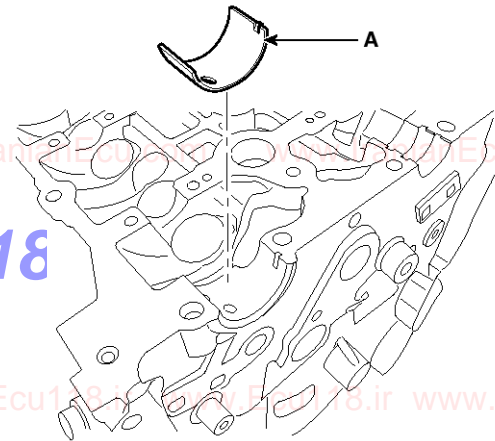
SUNM19125N

- 3) Remove the camshafts (A).



STGEM9111D

- 4) Remove the exhaust camshaft lower bearing (A).

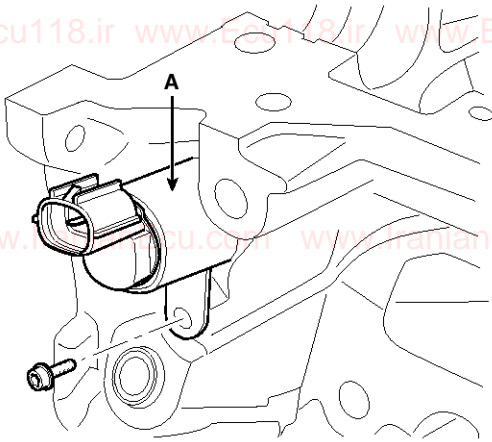


SYFEM0018N

EM-56

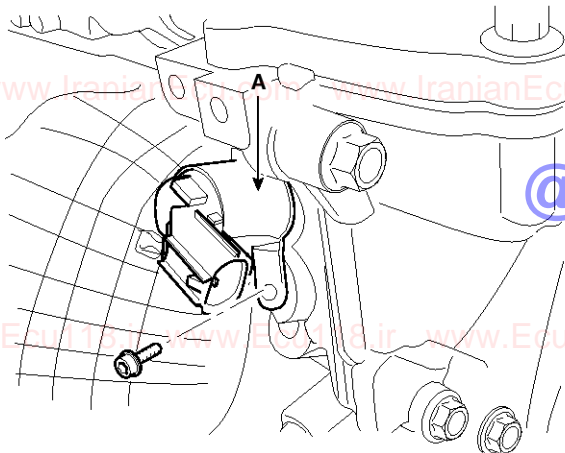
Engine Mechanical System

19. Remove the intake OCV (Oil control valve) (A) using a torx wrench.



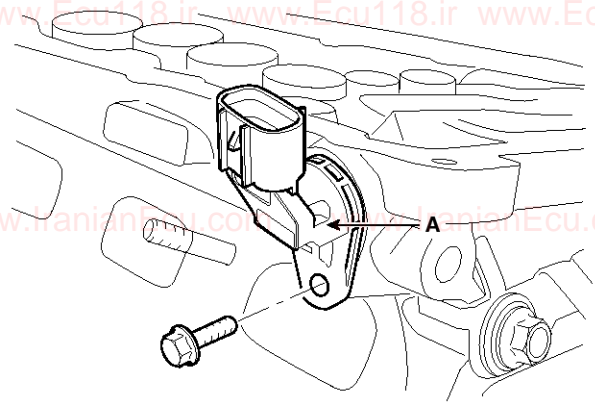
SYFEM0019N

20. Remove the exhaust OCV (Oil control valve) (A) using a torx wrench.



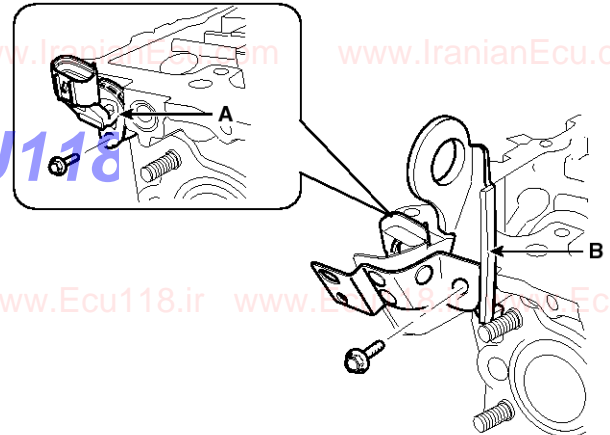
SYFEM0050N

21. Remove the intake CMPS (Camshaft position sensor) (A).



SSLM10116D

22. Remove the exhaust CMPS (Camshaft position sensor) (A) after removing the engine hanger and cam position sensor cover (B).



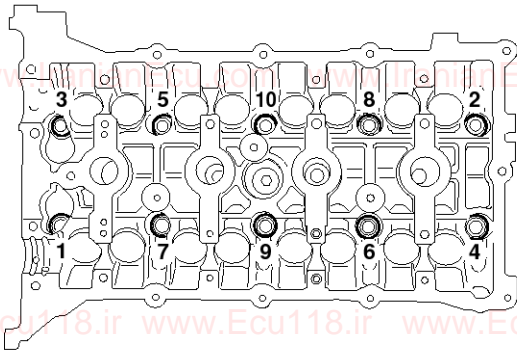
SYFEM0024N

Cylinder Head Assembly

EM-57

23. Remove the cylinder head.

- 1) Using triple square wrench, uniformly loosen and remove the 10 cylinder head bolts, in several passes, in the sequence shown. Remove the 10 cylinder head bolts and plate washers.



SNFEM8086L

⚠ CAUTION

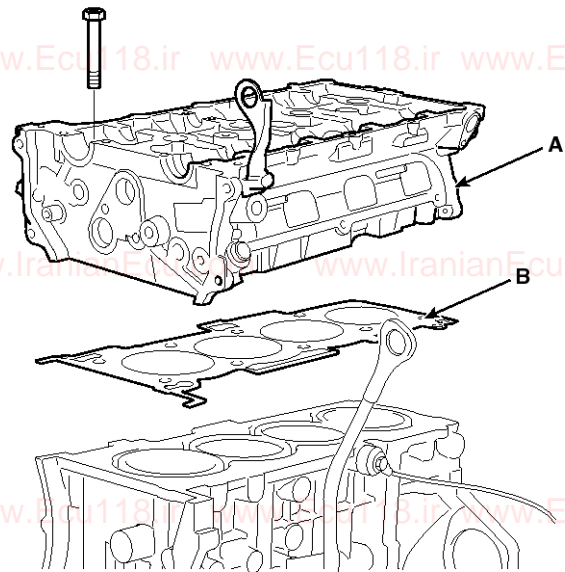
Head warpage or cracking could result from removing bolts in an incorrect order.

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

⚠ CAUTION

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

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



SVGEM0168D

EM-58

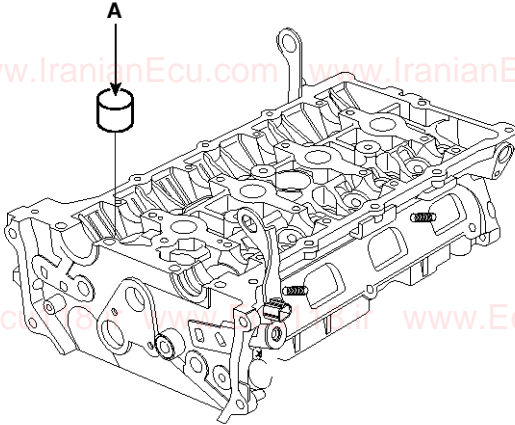
Engine Mechanical System

Disassembly

NOTICE

Identify MLA (Mechanical Lash Adjuster), valves, valve springs as they are removed so that each item can be reinstalled in its original position.

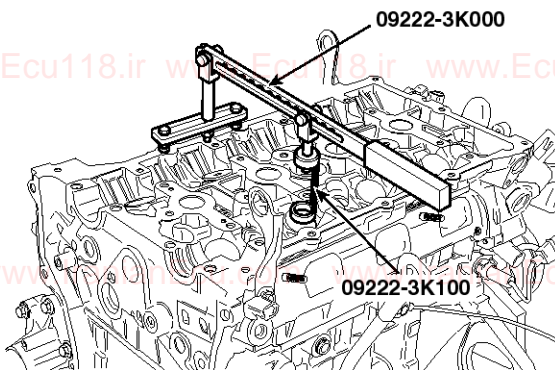
1. Remove the MLAs (A).



SNFEM8081D

2. Remove the valves.

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



SVGEM0169D

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

NOTICE

Do not reuse old valve stem seals.

Inspection

Cylinder Head

1. Inspect for flatness.

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

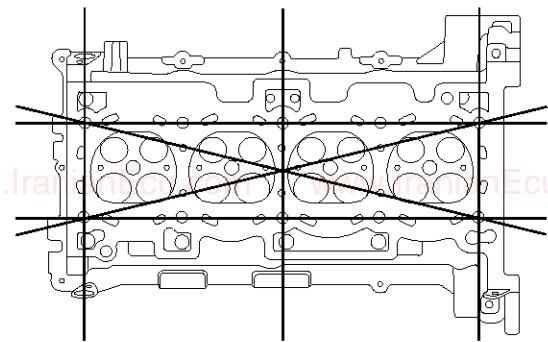
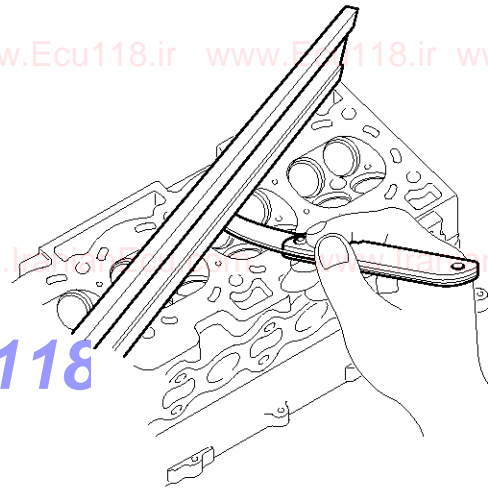
Flatness of cylinder head gasket surface

Standard : Less than 0.05mm (0.0019in.) for total area

Less than 0.02mm (0.0007in.) for a section of 100mm (3.9370in.) X 100mm (3.9370in.)

Flatness of manifold mounting surface (Intake/Exhaust)

Standard : Less than 0.10mm (0.0039in.)



STQM39031D

2. Inspect for cracks.

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

Cylinder Head Assembly

EM-59

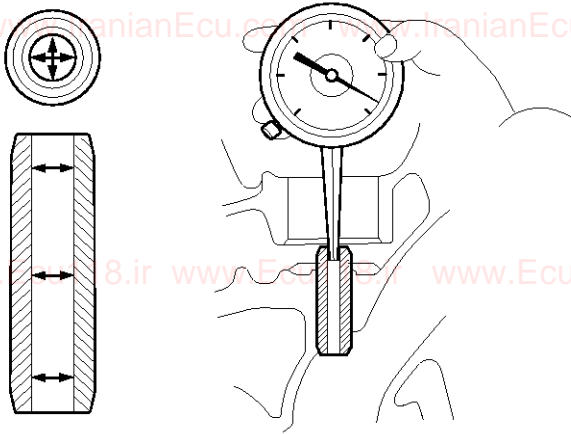
Valve And Valve Spring

1. Inspect valve stems and valve guides.

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

Valve guide inner diameter

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

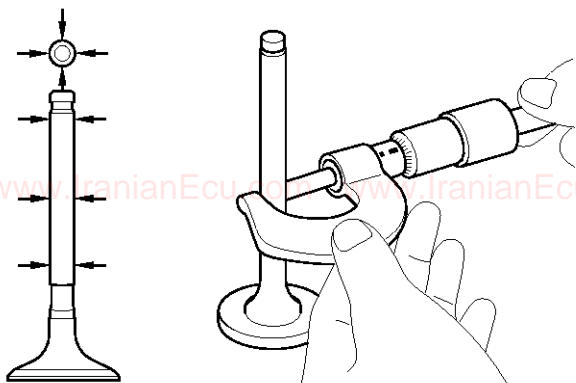


STQM39122D

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

Valve stem outer diameter

Intake : 5.465 ~ 5.480mm (0.21516 ~ 0.21575in.)
Exhaust : 5.458 ~ 5.470mm (0.214988 ~ 0.21535in.)



KCRF227A

- Subtract the valve stem diameter measurement from the valve guide inside diameter measurement.

Valve stem-to-guide clearance

[Standard]

Intake : 0.020 ~ 0.047mm (0.00078 ~ 0.00185in.)

Exhaust : 0.030 ~ 0.054mm (0.00118 ~ 0.00212in.)

[Limit]

Intake : 0.070mm (0.00275in.)

Exhaust : 0.090mm (0.00354in.)

If the clearance is greater than maximum, replace the valve or cylinder head.

2. Inspect the valves.

- Check the valve is ground to the correct valve face angle.
- Check that the surface of the valve for wear.

If the valve face is worn, replace the valve.

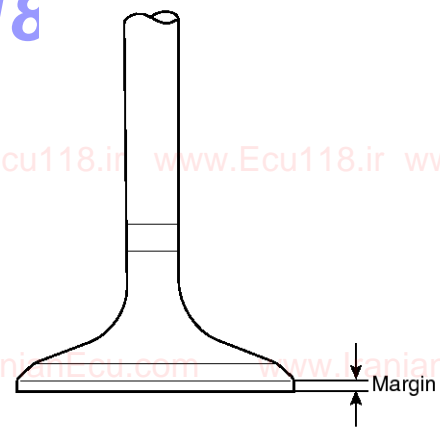
- Check the valve head margin thickness.

Valve head thickness (Margin)

[Standard]

Intake : 1.02mm(0.0401in.)

Exhaust : 1.09mm(0.0429in.)



ECKD221A

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

- Check the valve length.

Valve length

[Standard]

Intake : 113.18mm(4.4559in.)

Exhaust : 105.84mm(4.1669in.)

[Limit]

Intake : 112.93mm(4.4461in.)

Exhaust : 105.59m(4.1571in.)

EM-60

Engine Mechanical System

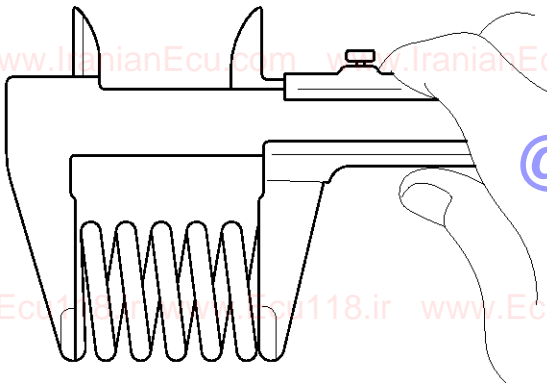
- 5) Check the surface of the valve stem tip for wear.
If the valve stem tip is worn, replace the valve.
3. Inspect the valve seats
 - 1) Check the valve seat for evidence of overheating and improper contact with the valve face.
Replace the cylinder head if necessary.
 - 2) Check the valve guide for wear. If the valve guide is worn, replace the cylinder head.
4. Inspect the valve springs.
 - 1) Using a steel square, measure the out-of-square of the valve spring.
 - 2) Using a vernier calipers, measure the free length of the valve spring.

Valve spring

[Standard]

Free height : 47.44mm (1.8677in.)

Out-of-square : Less than 1.5°



KCRF205A

If the free length is not as specified, replace the valve spring.

MLA (Mechanical Lash Adjuster)

1. Inspect the MLA.

Using a micrometer, measure the MLA outside diameter.

MLA outer diameter :

31.964 ~ 31.980mm (1.2584 ~ 1.2590in.)

2. Using a caliper gauge, measure MLA tappet bore inner diameter of cylinder head.

Tappet bore inner diameter :

32.000 ~ 32.025mm (1.2598 ~ 1.2608in.)

3. Subtract MLA outside diameter measurement from tappet bore inside diameter measurement.

MLA to tappet bore clearance

[Standard] : 0.020 ~ 0.061mm (0.00078 ~ 0.00240in.)

[Limit] : 0.070mm (0.00275in.)

Camshaft

1. Inspect the cam lobes.

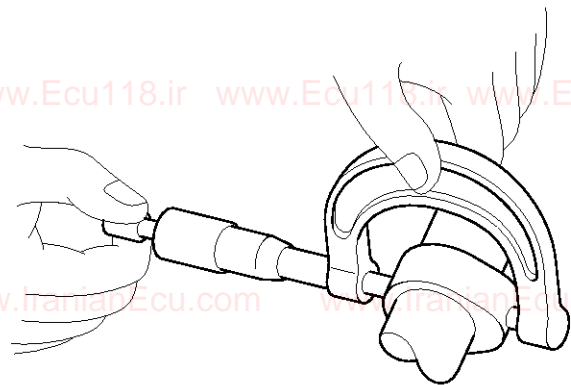
Using a micrometer, measure the cam lobe height.

Cam height

[Standard value]

Intake : 44.10 ~ 44.30mm (1.7362 ~ 1.7440in.)

Exhaust : 44.90 ~ 45.10mm (1.7677 ~ 1.7756in.)



KCRF206A

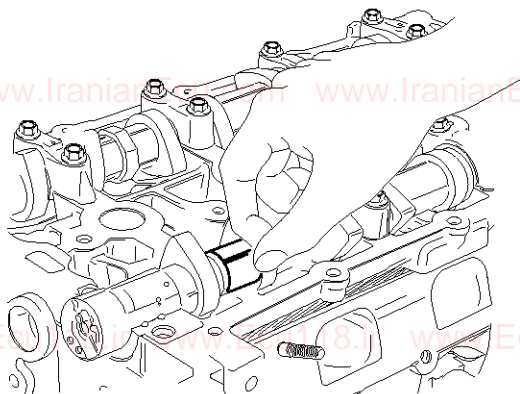
If the cam lobe height is less than standard, replace the camshaft.

2. Check the surface of the camshaft journal for wear. If the journal is worn excessively, replace the camshaft.

Cylinder Head Assembly

EM-61

3. Inspect the camshaft journal clearance.
 - 1) Clean the bearing caps and camshaft journals.
 - 2) Place the camshafts on the cylinder head.
 - 3) Lay a strip of plastigage across each of the camshaft journal.



SVGEM0111D

- 4) Install the bearing caps.
 - ⚠ CAUTION**
Do not turn the camshaft.
- 5) Remove the bearing caps.
- 6) Measure the plastigage at its widest point.

Bearing oil clearance

[Standard value]

Intake :

No.1 : 0.022 ~ 0.057mm (0.00087 ~ 0.00224in.)

No.2, 3, 4, 5 : 0.045 ~ 0.082mm (0.00177 ~ 0.00323in.)

Exhaust:

No.1 : 0 ~ 0.032mm (0 ~ 0.00126in.)

No.2, 3, 4, 5 : 0.045 ~ 0.082mm (0.00177 ~ 0.00323in.)

[Limit]

Intake:

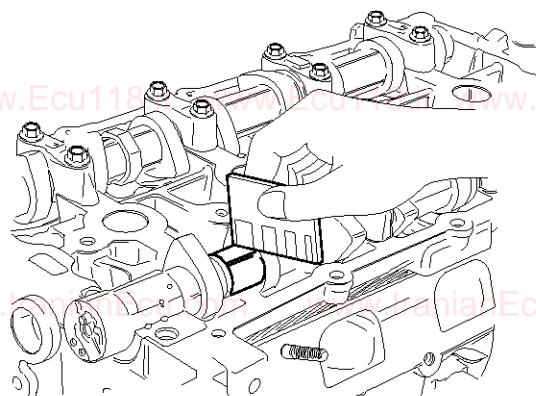
No.1 : 0.090mm (0.00354in.)

No.2, 3, 4, 5 : 0.120mm (0.00472in.)

Exhaust :

No.1 : 0.090mm (0.00354in.)

No.2, 3, 4, 5 : 0.120mm (0.00472in.)



SVGEM0112D

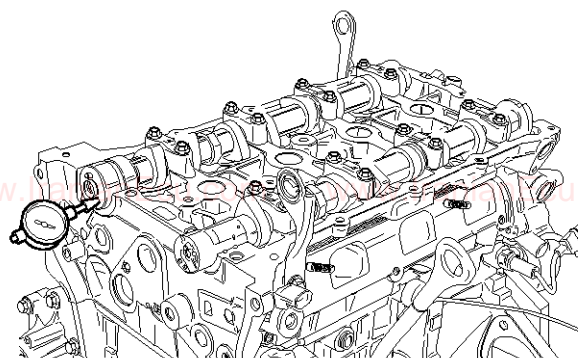
If the oil clearance is greater than maximum, replace the camshaft. If necessary, replace cylinder head.

- 7) Completely remove the plastigage.
 - 8) Remove the camshafts.
4. Inspect the camshaft end play.
 - 1) Install the camshafts.
 - 2) Using a dial indicator, measure the end play while moving the camshaft back and forth.

Camshaft end play

[Standard value] : 0.04 ~ 0.16mm (0.0016 ~ 0.0063in.)

[Limit] : 0.20mm (0.0078in.)



SUNM19128N

If the end play is greater than maximum, replace the camshaft. If necessary, replace cylinder head.

- 3) Remove the camshafts.

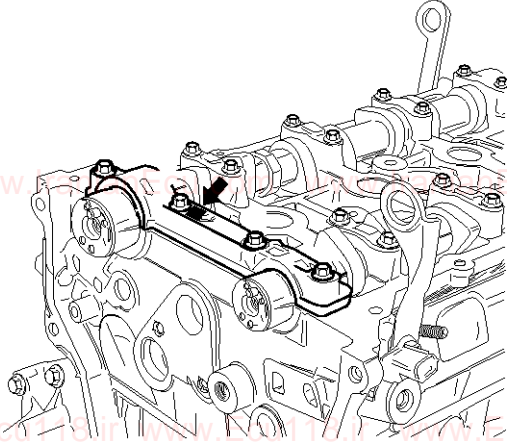
EM-62

Engine Mechanical System

Exhaust Camshaft Bearing

1. Check the cylinder head bore mark.

Cylinder Head Bore Identification Mark



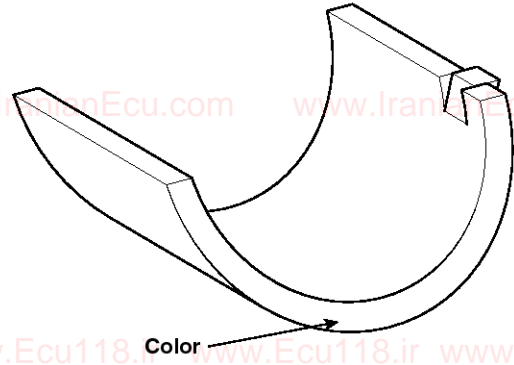
SUNM19129N

Cylinder Head Specifications

| Class | Mark | Exhaust No.1 Inside Diameter Of Cylinder Head Bore |
|-------|------|--|
| a | A | 40.000 ~ 40.008mm (1.57480 ~ 1.5751in.) |
| b | B | 40.008 ~ 40.016mm (1.57511 ~ 1.57543in.) |
| c | C | 40.016 ~ 40.021mm (1.57543 ~ 1.57563in.) |

2. Select class of camshaft bearing same as class of cylinder head as shown on the table below.

Exhaust Camshaft Bearing Identification Mark



ECRF021A

Exhaust Camshaft Bearing Specifications

| Cylinder Head Bore Class | Bearing Class For Installing (Color) | Thickness Of Bearing |
|--------------------------|--------------------------------------|---------------------------------------|
| a (A) | C (Green) | 1.996~2.000mm (0.07858~0.07874in.) |
| b (B) | B (None) | 2.000~2.004mm (0.07874~0.07890in.) |
| c (C) | A (Black) | 2.004~2.008mm (0.07890~0.07905in.) |

Oil clearance : 0 ~ 0.032mm (0 ~ 0.00126in.)

Cylinder Head Assembly

EM-63

CVVT Assembly

1. Inspect CVVT assembly.

1) Fix the camshaft using a vise.

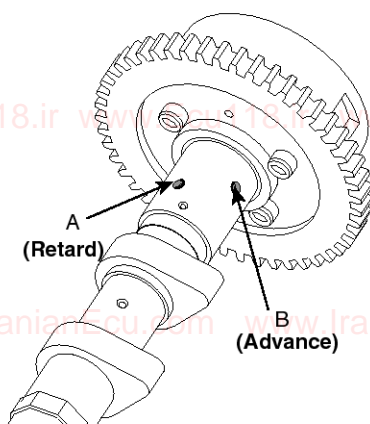
Be careful not to damage the cam lobe and journal.

2) Check that the CVVT assembly will not turn.

3) Apply vinyl tape to the retard hole like the one indicated by the arrow in the illustration.

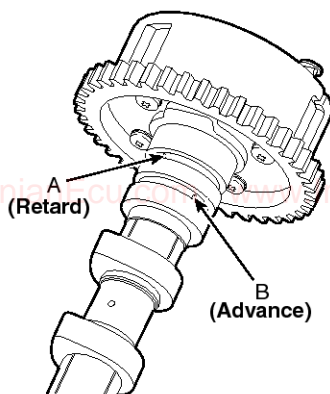
Verify that the tape holds and put air through the port of the camshaft.

[Intake]



SXMM19073L

[Exhaust]



SXMM19074L

4) Wind tape around the tip of the air gun and apply air of approx. 150kPa(1.5kgf/cm², 21psi) to the port of the camshaft.

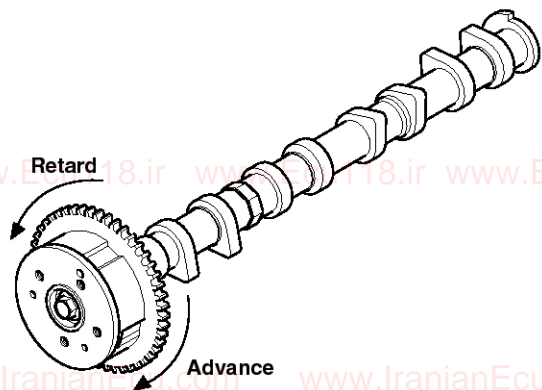
(Perform this in order to release the lock pin.)

NOTICE

When the oil splashes, wipe it off with a shop rag and the likes.

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

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



ECRF016A

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

Standard:

Should move smoothly in a range from about 22.5° (Intake) / 20.0° (Exhaust)

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

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

EM-64

Engine Mechanical System

Reassembly

NOTICE

Thoroughly clean all parts to be assembled.
Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.

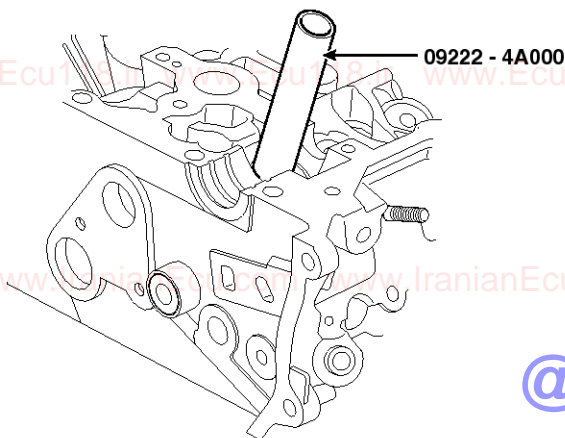
Replace oil seals with new ones.

1. Install valves.

- 1) Using SST(09222-4A000), push in a new oil seal.

NOTICE

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



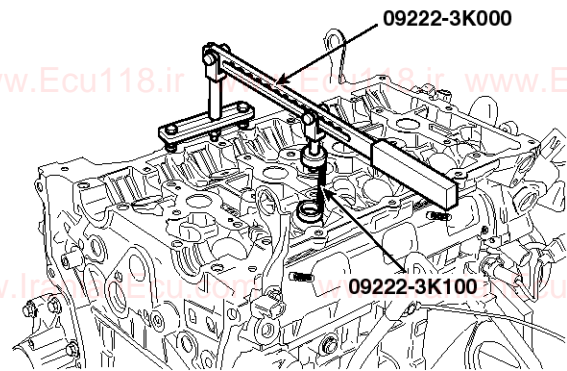
SYFEM0116N

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

NOTICE

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

- 3) Using the SST(09222-3K000, 09222-3K100), compress the spring and install the retainer locks. After installing the valves, ensure that the retainer locks are correctly in place before releasing the valve spring compressor.



SVGEM0169D

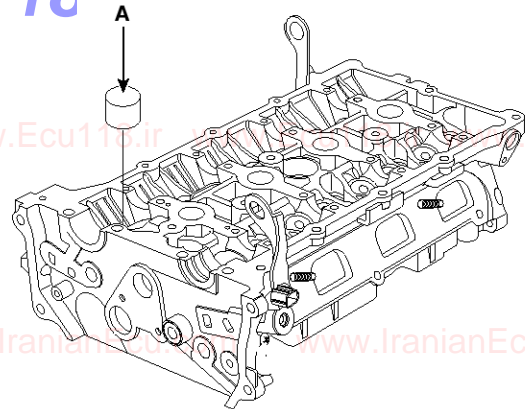
NOTICE

Do not press down the valve spring retainer more than 10mm (0.4in.).

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

2. Install the MLAs after applying engine oil.

Check that the MLA rotates smoothly by hand.



SNFEM8062D

NOTICE

MLA can be reinstalled in its original position.

However, the valve lash clearances must be rechecked and adjusted accordingly before the cylinder head is installed onto the cylinder block.

Refer to General information in EM section for Valve Clearance checking and adjustment procedure.

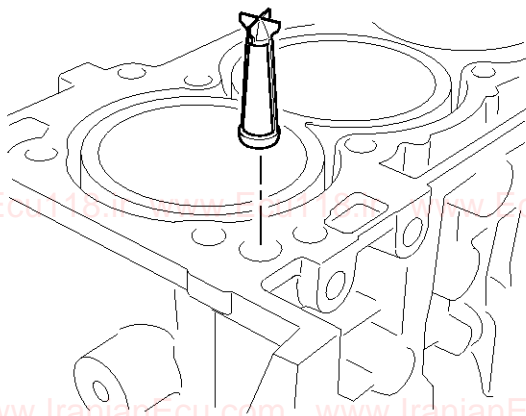
Cylinder Head Assembly

EM-65

Installation

NOTICE

- Thoroughly clean all parts to be assembled.
 - Always use a new head and manifold gasket.
 - The cylinder head gasket is a metal gasket. Take care not to bend it.
 - Rotate the crankshaft, set the No.1 piston at TDC.
1. Install the OCV (Oil control valve) filter.



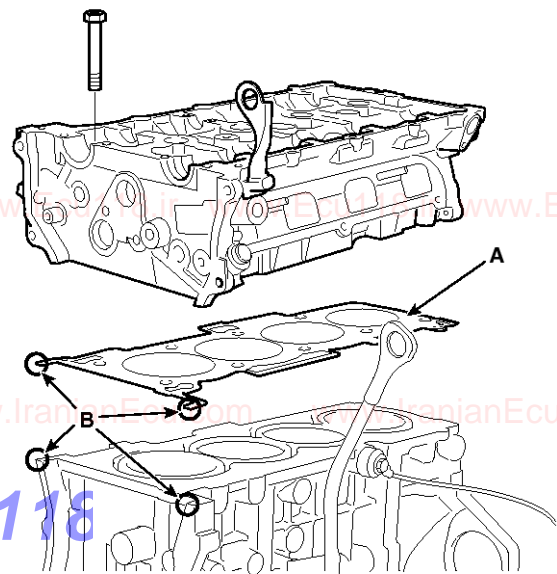
KCRF176A

CAUTION
Keep the OCV filter clean.

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

NOTICE

- Be careful of the installation direction.
- Apply liquid gasket (Loctite 5900H or equivalent) on the edge of cylinder head gasket upside and downside. (At the position 'B')
- After applying sealant, assemble the cylinder head in five minutes.



SUNM19112N

3. Place the cylinder head carefully in order not to damage the gasket with the bottom part of the end.

EM-66

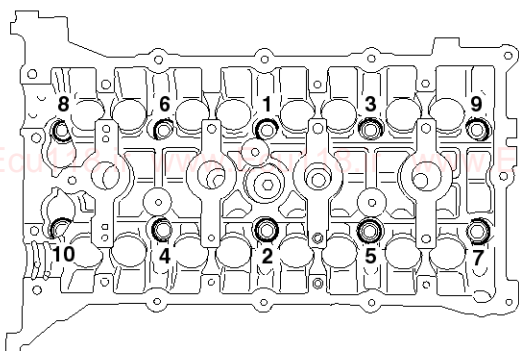
Engine Mechanical System

4. Install cylinder head bolts.

- 1) Do not apply engine oil on the the cylinder head bolts.
- 2) Using the SST(09221-4A000), tighten the cylinder head bolts and plate washers, in several passes, in the sequence shown.

Tightening torque :

32.4~36.3Nm (3.3~3.7kgf.m, 23.9~26.8lb-ft) + 90~95°
+ 90~95°



SNFEM8088L

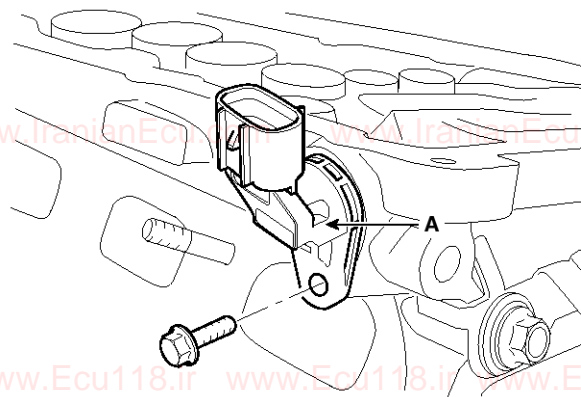
⚠ CAUTION

Always use new cylinder head bolt.

5. Install the intake CMPS (Camshaft position sensor) (A).

Tightening torque :

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

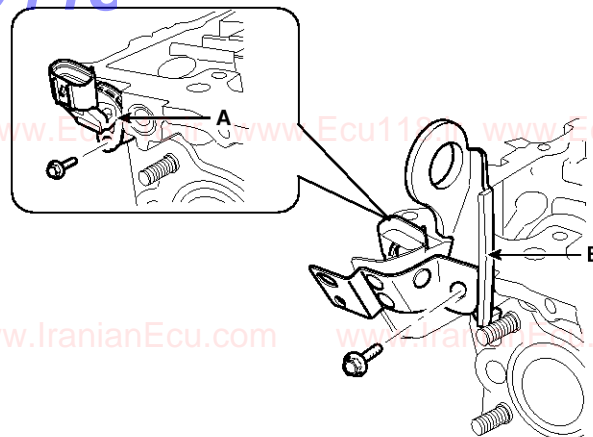


SSLM10116D

6. Install the exhaust CMPS (Camshaft position sensor) (A) and the engine hanger and cam position sensor cover (B).

Tightening torque :

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



SYFEM0024N

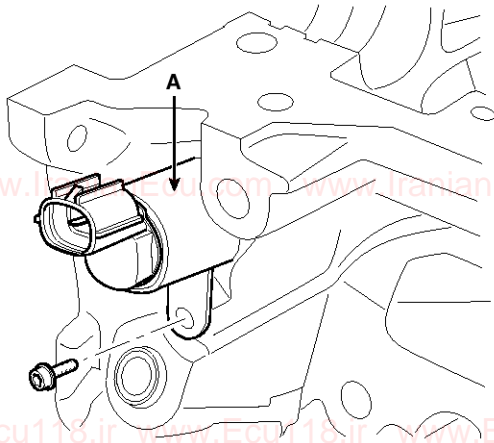
Cylinder Head Assembly

EM-67

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

Tightening torque :

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

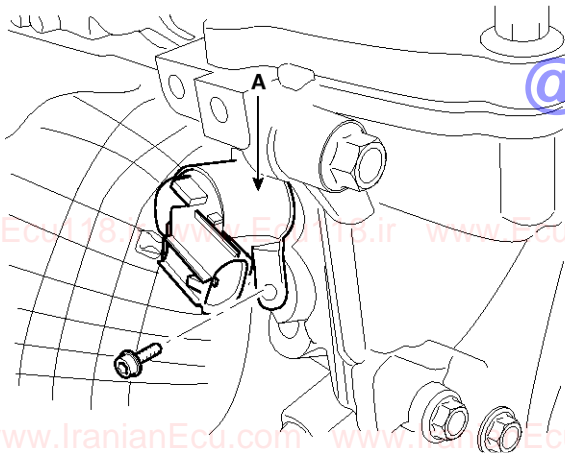


SYFEM0019N

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

Tightening torque :

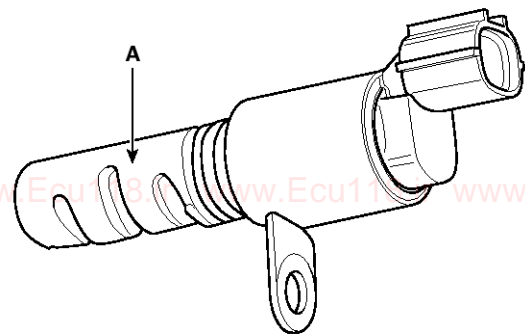
9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)



SYFEM0050N

⚠ CAUTION

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



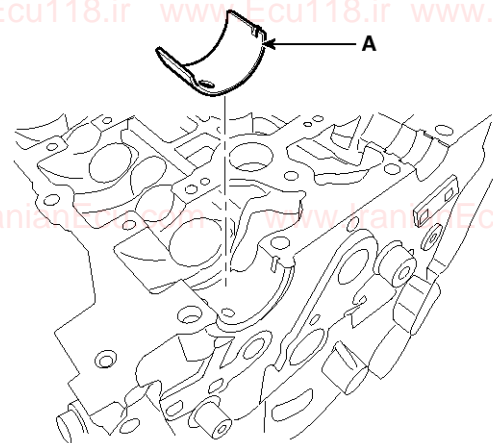
SYFEM0021N

9. Install the camshafts.

⚠ NOTICE

Apply a light coat of engine oil on camshaft journals.

- 1) Install the exhaust camshaft lower bearing (A).

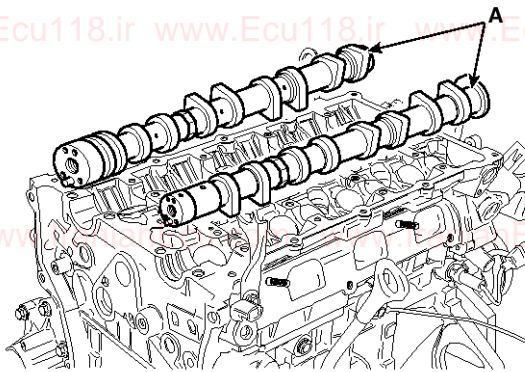


SYFEM0018N

EM-68

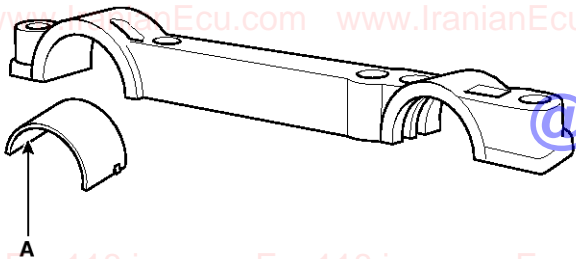
Engine Mechanical System

2) Install the camshafts (A).



STGEM9111D

3) Install the exhaust camshaft upper bearing (A) to the front bearing cap.



SNFEM8016D

4) Install camshaft bearing caps (A) in their proper locations.

Tightening order

Group A → Group B → Group C.

Tightening torque :

Step 1

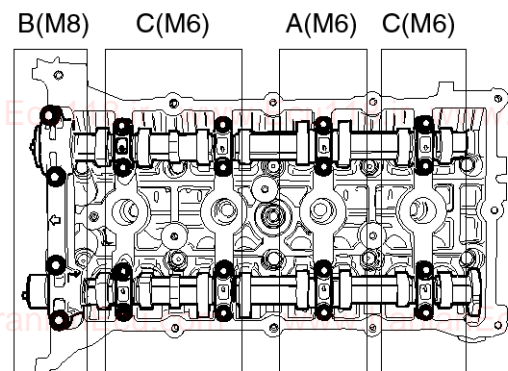
M6 : 5.9N.m (0.6kgf.m, 4.3lb-ft)

M8 : 14.7N.m (1.5kgf.m, 10.8lb-ft)

Step 2

M6 : 10.8 ~ 12.7N.m (1.1 ~ 1.3kgf.m, 8.0 ~ 9.4lb-ft)

M8 : 27.5 ~ 31.4N.m (2.8 ~ 3.2kgf.m, 20.3 ~ 23.1lb-ft)



SUNM16115D

⚠ CAUTION

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

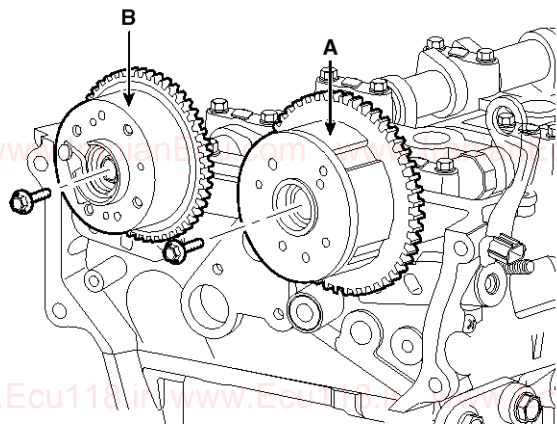
Cylinder Head Assembly

EM-69

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

Tightening torque :

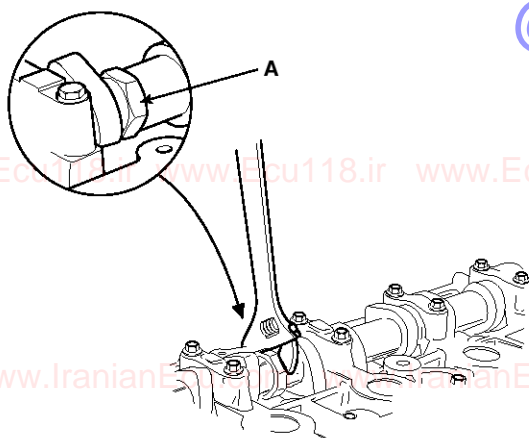
53.9 ~ 63.7N.m (5.5 ~ 6.5kgf.m, 39.7 ~ 47.0lb-ft)



SVGEM0167D

NOTICE

When installing the CVVT assembly bolt, prevent the camshaft from rotating by using a wrench at position A.



STDM19324L

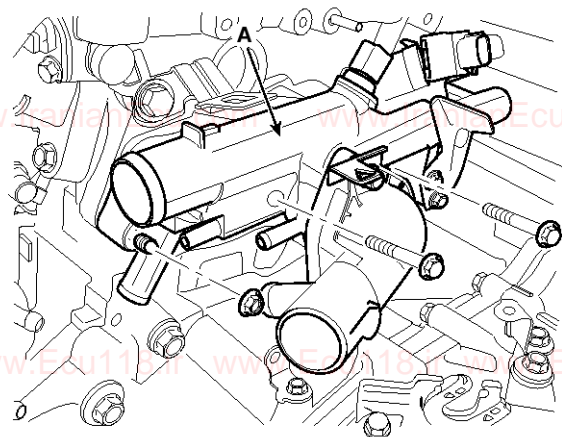
11. Install the intake and exhaust manifold. (Refer to Intake and exhaust system in this group)
12. Install the timing chain. (Refer to Timing system in this group)
13. Check and adjust the valve clearance. (Refer to General information in this group)

14. Install the water temperature control assembly (A) with the water inlet pipe (B).

Tightening torque :

Bolts : 14.7 ~ 19.6N.m (1.5 ~ 2.0kgf.m, 10.8 ~ 14.5lb-ft)

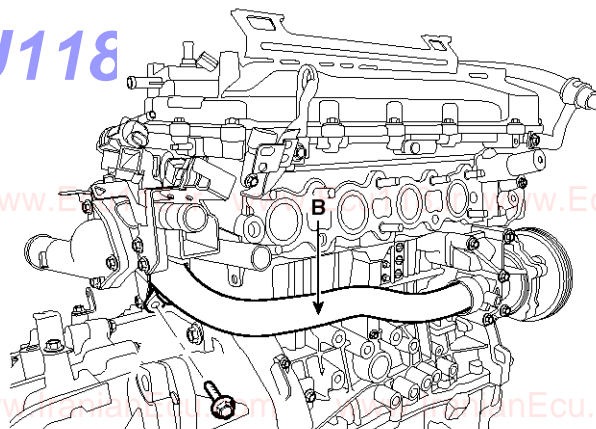
Nut : 18.6 ~ 23.5N.m (1.9 ~ 2.4kgf.m, 13.7 ~ 17.4lb-ft)



SYFEM0049N

Tightening torque :

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



SSLM10144D

NOTICE

- Assemble water temp control assembly and water inlet pipe to water pump assembly before nuts for assembling of water inlet pipe to be tightened.
- Insert after wetting O-ring or inner surface of thermostat housing.
- Always use a new O-ring.

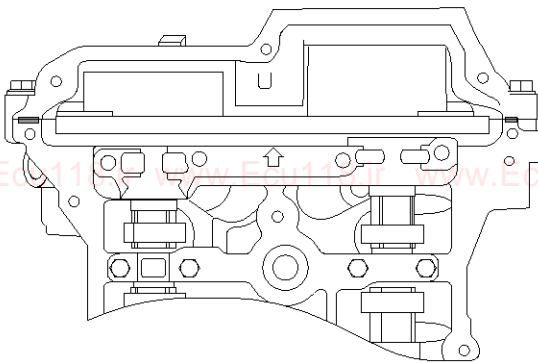
EM-70

Engine Mechanical System

15. Install cylinder head cover.

- 1) The hardening sealant located on the upper area between timing chain cover and cylinder head should be removed before assembling cylinder head cover.
- 2) After applying sealant (Loctite 5900H or equivalent), it should be assembled within 5 minutes.

Bead width : 2.5mm (0.10in.)

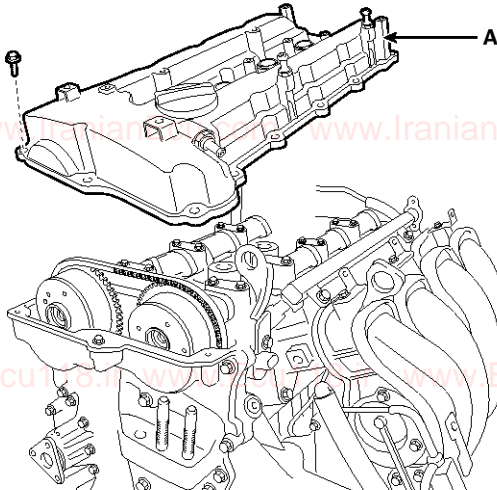


SNFEM8045D

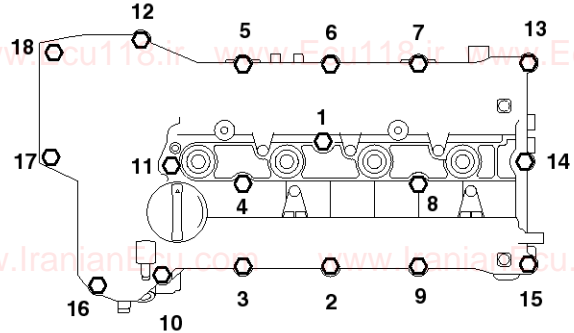
- 3) Install the cylinder head cover (A) by tightening the bolts as following method.

Tightening torque :

1st step : 3.9 ~ 5.9N.m(0.4 ~ 0.6kgf.m, 2.9 ~ 4.3lb-ft)
2nd step : 7.8 ~ 9.8N.m(0.8 ~ 1.0kgf.m, 5.8 ~ 7.2lb-ft)



SSLM10024D

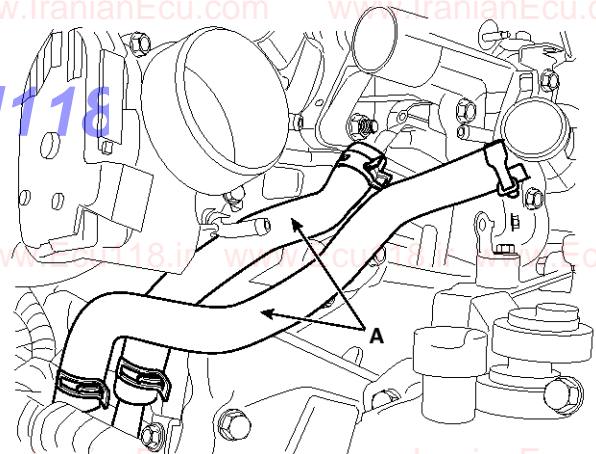


SNFEM8046D

⚠ CAUTION

- Do not reuse cylinder head cover gasket.
- The firing and/or blow out test should not be performed within 30 minutes after the cylinder head cover was assembled.

16. Connect the oil cooler coolant hoses (A). (2.4L only)

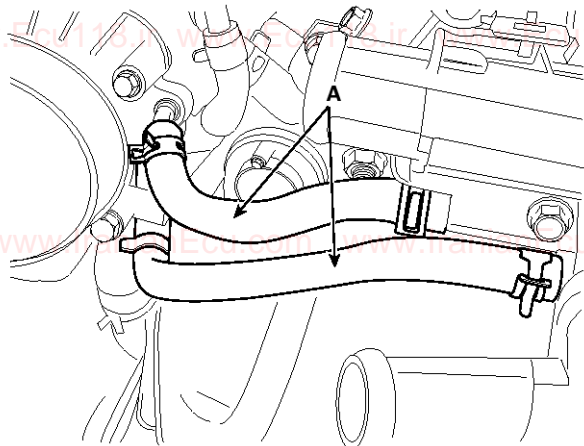


SYFEM0048N

Cylinder Head Assembly

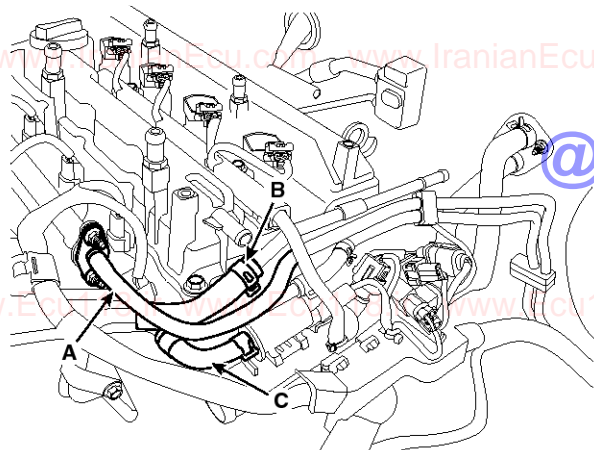
EM-71

17. Connect the throttle body coolant hoses (A). (if equipped)



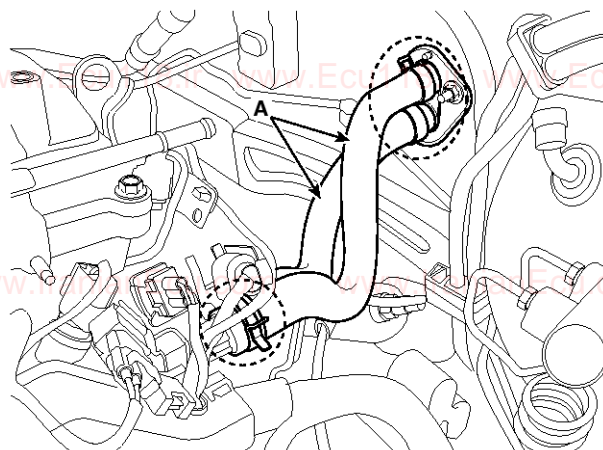
SVG11117L

18. Connect the fuel hose (A), the brake booster vacuum hose (B), the PCSV (Purge control solenoid valve) hose (C).



STFEM1033D

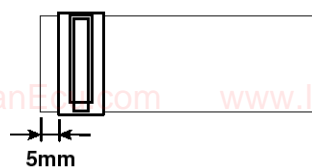
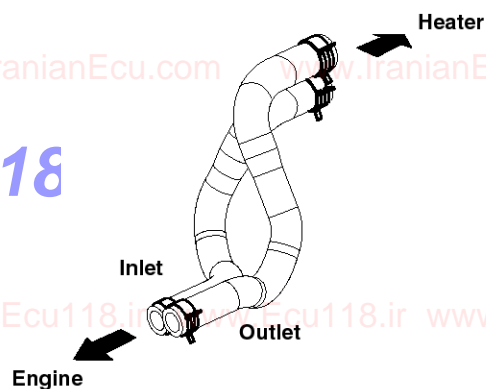
19. Connect the heater hose (A).



SYFEM0022D

NOTICE

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



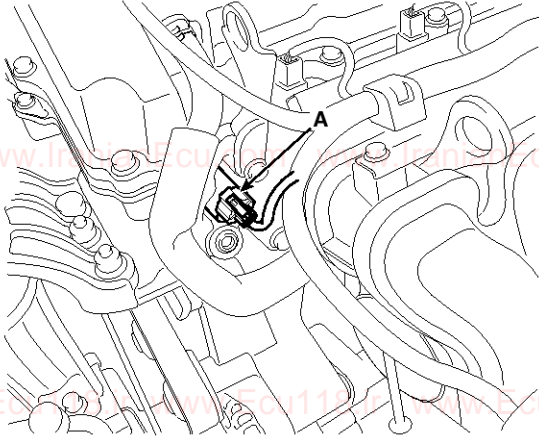
SVGEM0105D

EM-72

Engine Mechanical System

20. Connect the wiring connectors and harness clamps, and install the wiring and protectors to the cylinder head and intake manifold.

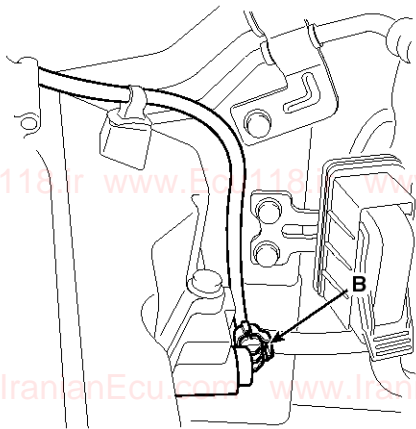
- 1) The intake OCV (Oil control valve) connector (A)



STFEM1030D

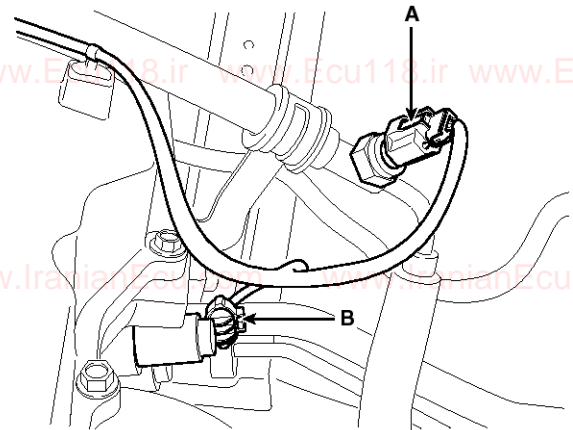
- 2) The power steering oil pressure switch connector (A) (HPS only) and the exhaust OCV (Oil control valve) connector (B)

[MDPS]



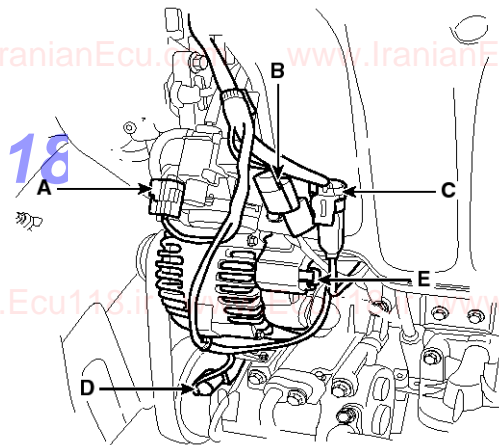
SSLM10014L

[HPS]



SVGEM0008D

- 3) The VIS (Variable intake system) connector (A), the OPS (Oil pressure switch) connector (B), the knock sensor connector (C), the A/C compressor switch connector (D) and the alternator connector (E)

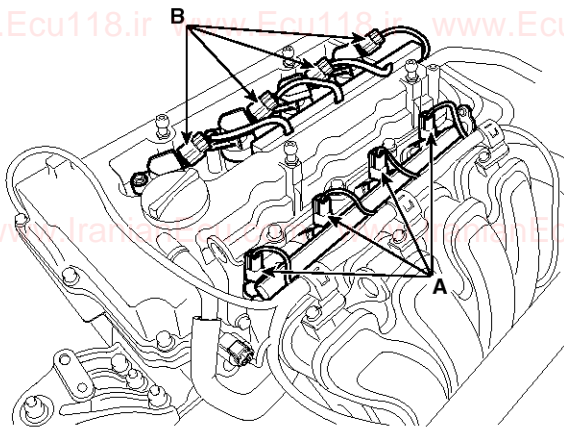


SSLM10123D

Cylinder Head Assembly

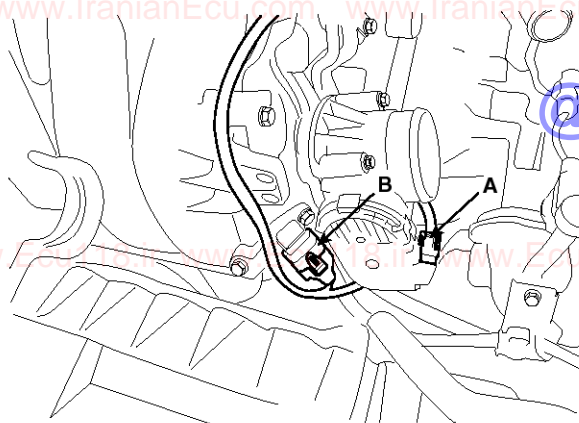
EM-73

- 4) The injector connectors (A) and the ignition coil connectors (B).



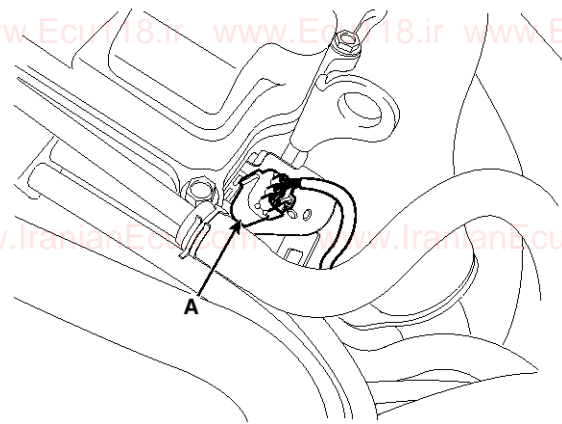
STFEM1026D

- 5) The ETC (Electronic throttle control) connector (A) and the MAPS (Manifold absolute pressure sensor) & IATS (Intake air temperature sensor) connector (B)



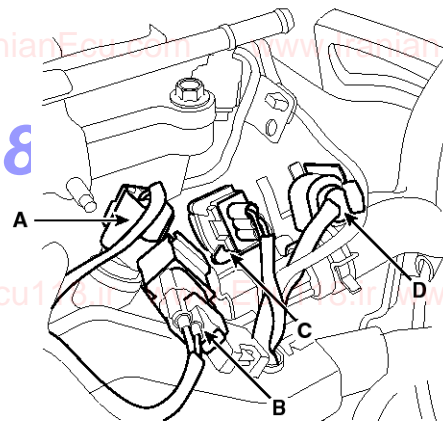
STFEM1031D

- 6) The exhaust CMPS (Camshaft position sensor) connector (A)



SSLM10151N

- 7) The ECTS (Engine coolant temperature sensor) connector (A), the condenser connector (B), the CKPS (Crankshaft position sensor) connector (C), the front oxygen sensor connector (D)

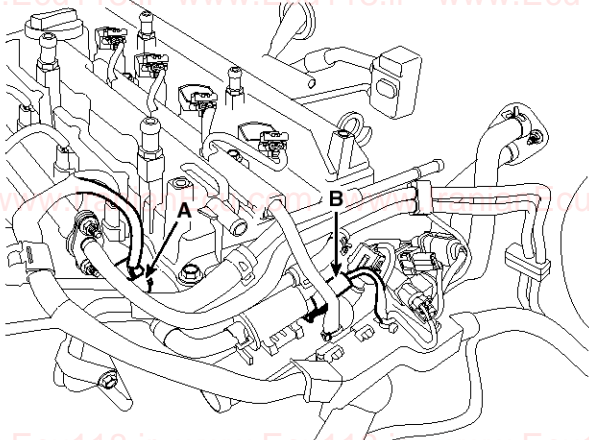


SSLM10158L

EM-74

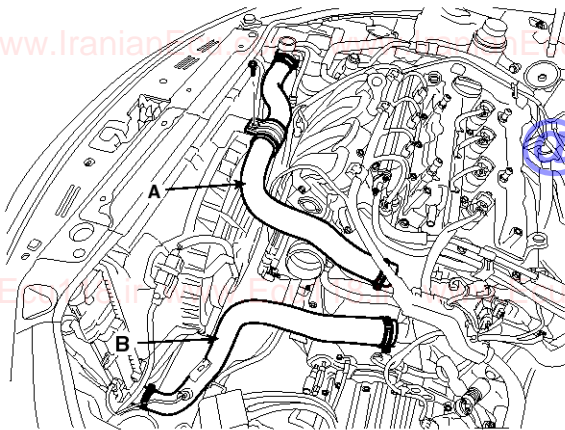
Engine Mechanical System

- 8) The intake CMPS (Camshaft position sensor) connector (A) and the PCSV (Purge control solenoid valve) connector (B)



STFEM1032D

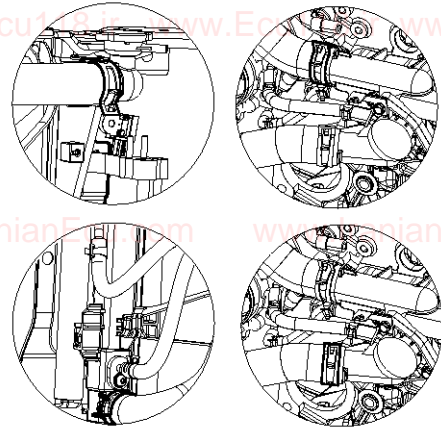
21. Connect the radiator upper hose (A) and lower hose (B).



STFEM1005D

NOTICE

Install the radiator hoses as shown illustrations.



SVGEM0104D

22. Install the under cover. (Refer to Timing system in this group)
23. Remove the RH front wheel. (Refer to SS group)
24. Install the air cleaner assembly.
- 1) Install the air cleaner assembly (E) and then connect the air intake hose (D).

Tightening torque

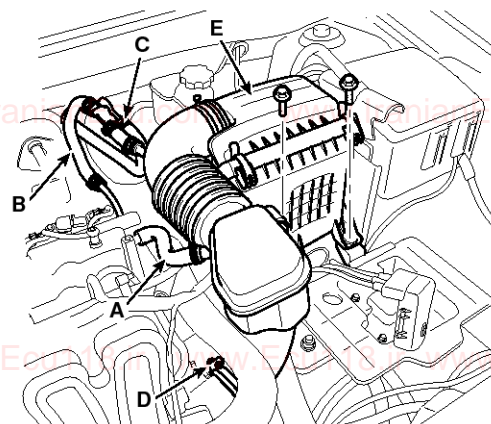
Hose clamp bolt :

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

Air cleaner assembly bolts :

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

- 2) Connect the breather hose (A), the brake booster vacuum hose (B) and the intensifier hose (C).



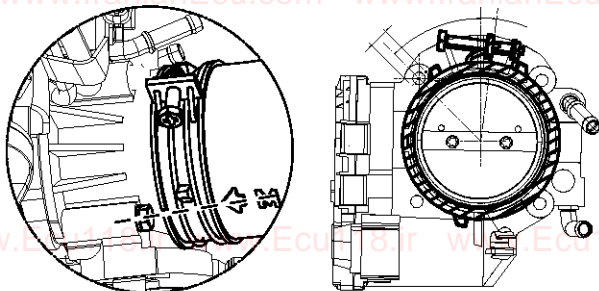
STFM11008D

Cylinder Head Assembly

EM-75

NOTICE

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



STFEM1039D

25. Install the air duct (B).

26. Connect the battery negative terminal (A).

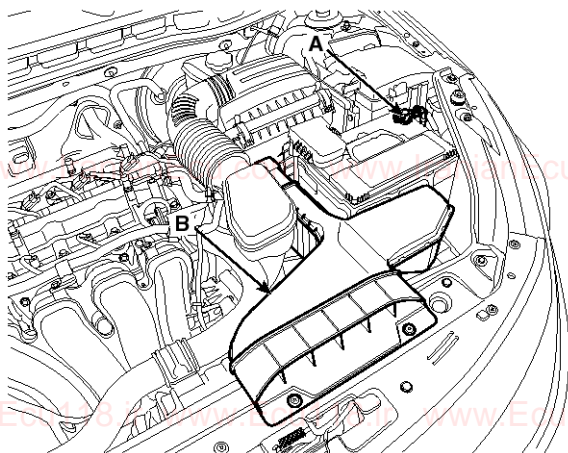
Tightening torque:

Without battery sensor :

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

With battery sensor :

4.0 ~ 6.0N.m (0.4 ~ 0.6kgf.m, 3.0 ~ 4.4lb-ft)



STFEM1045D

27. Install the engine cover.

Perform the following :

- Adjust a shift cable.
- Refill engine with engine oil.
- Refill a transaxle with fluid.
- Refill a radiator and a reservoir tank with engine coolant.
- Clean battery posts and cable terminals and assemble.
- Inspect for fuel leakage.
 - After 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.
- Bleed air from the cooling system.
 - Start engine and let it run until it warms up. (until the radiator fan operates 3 or 4 times.)
 - Turn Off the engine. Check the level in the radiator, add coolant if needed. This will allow trapped air to be removed from the cooling system.
 - Put radiator cap on tightly, then run the engine again and check for leaks.

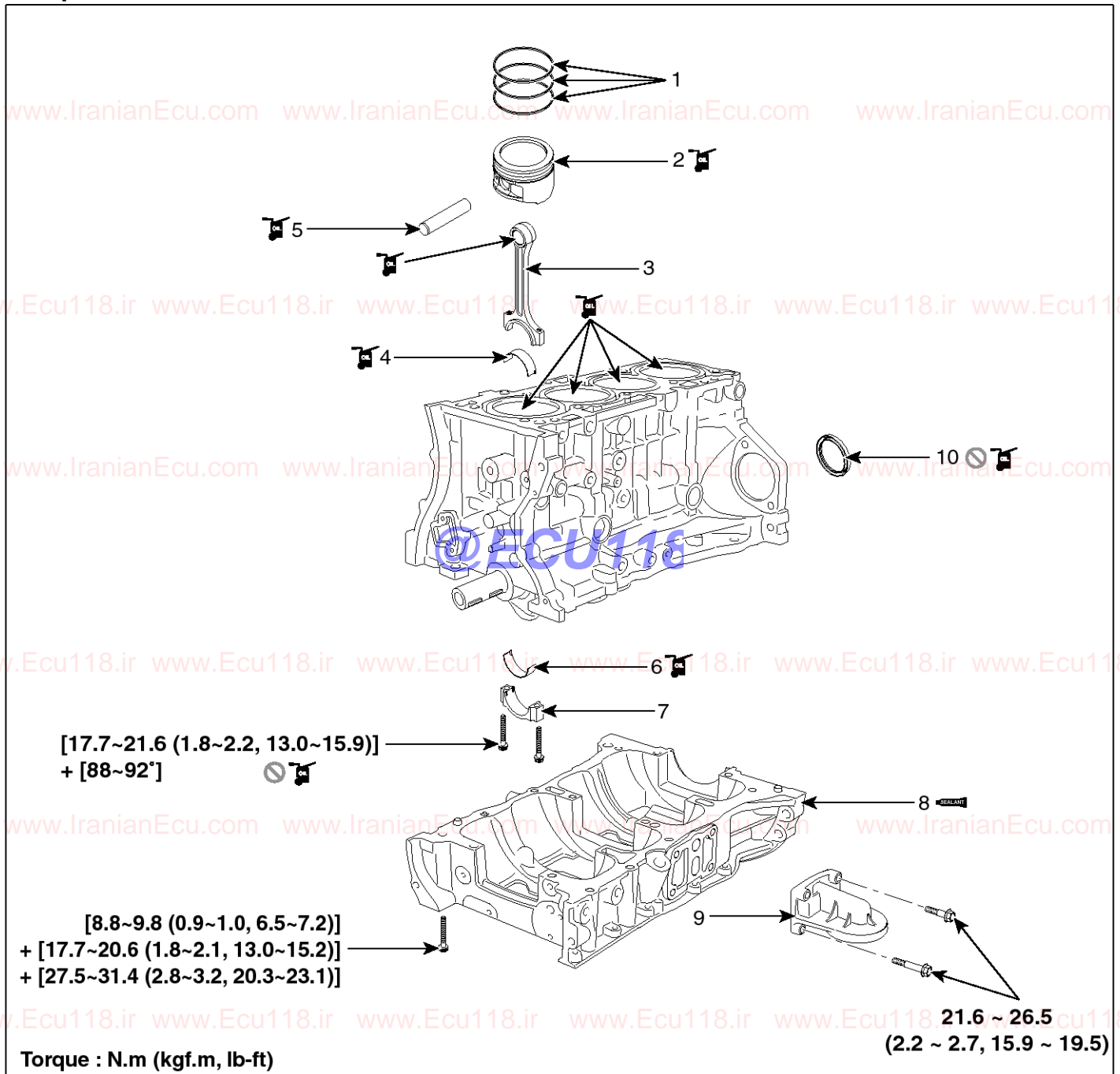
EM-76

Engine Mechanical System

Cylinder Block

Cylinder Block

Components



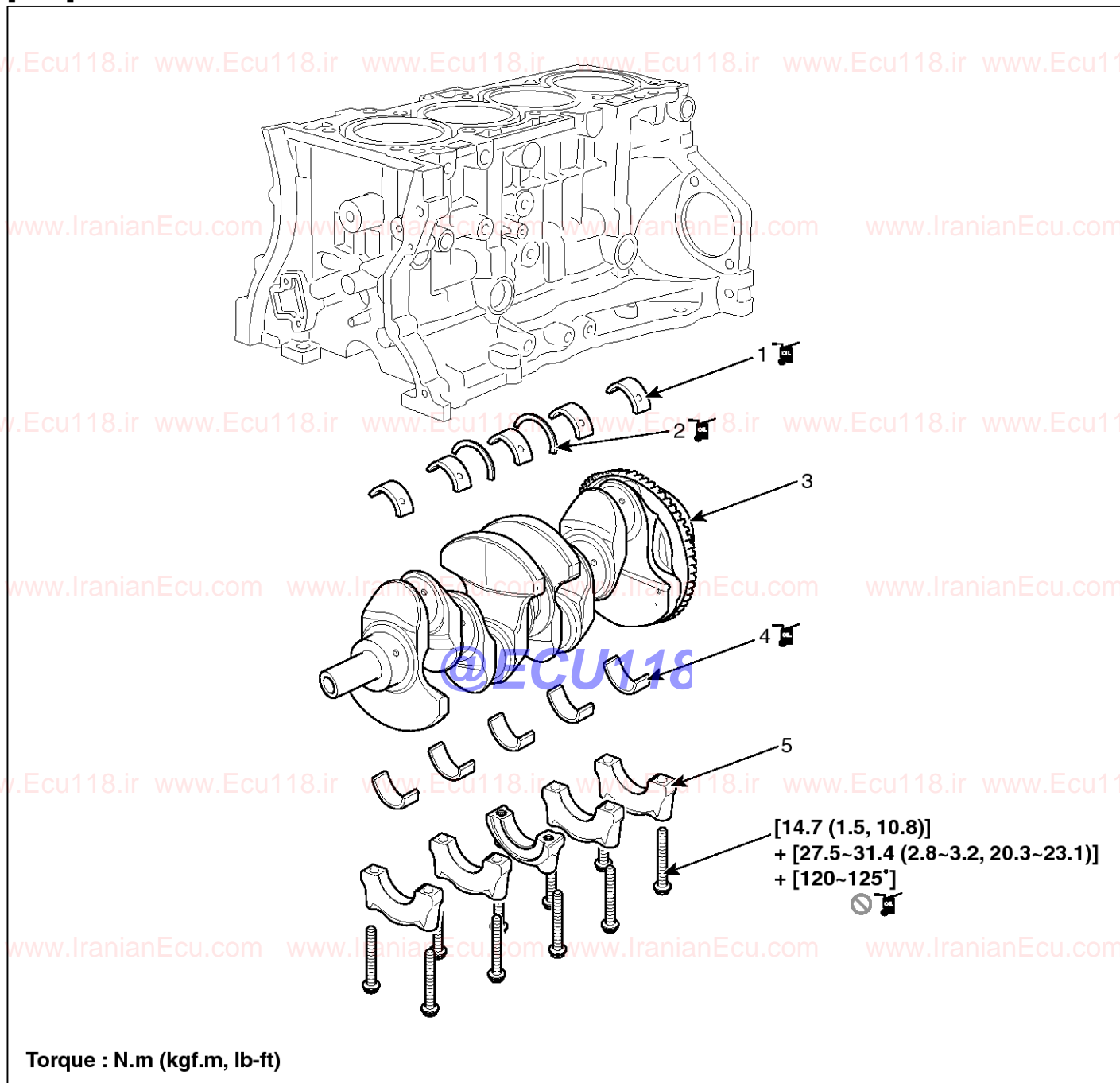
SVG11118L

- | | |
|---------------------------------|---------------------------------|
| 1. Piston ring | 6. Connecting rod lower bearing |
| 2. Piston | 7. Connecting rod bearing cap |
| 3. Connecting rod | 8. Ladder frame |
| 4. Connecting rod upper bearing | 9. Oil filter bracket |
| 5. Piston pin | 10. Crankshaft rear oil seal |

Cylinder Block

EM-77

[2.0L]



STFEM1101L

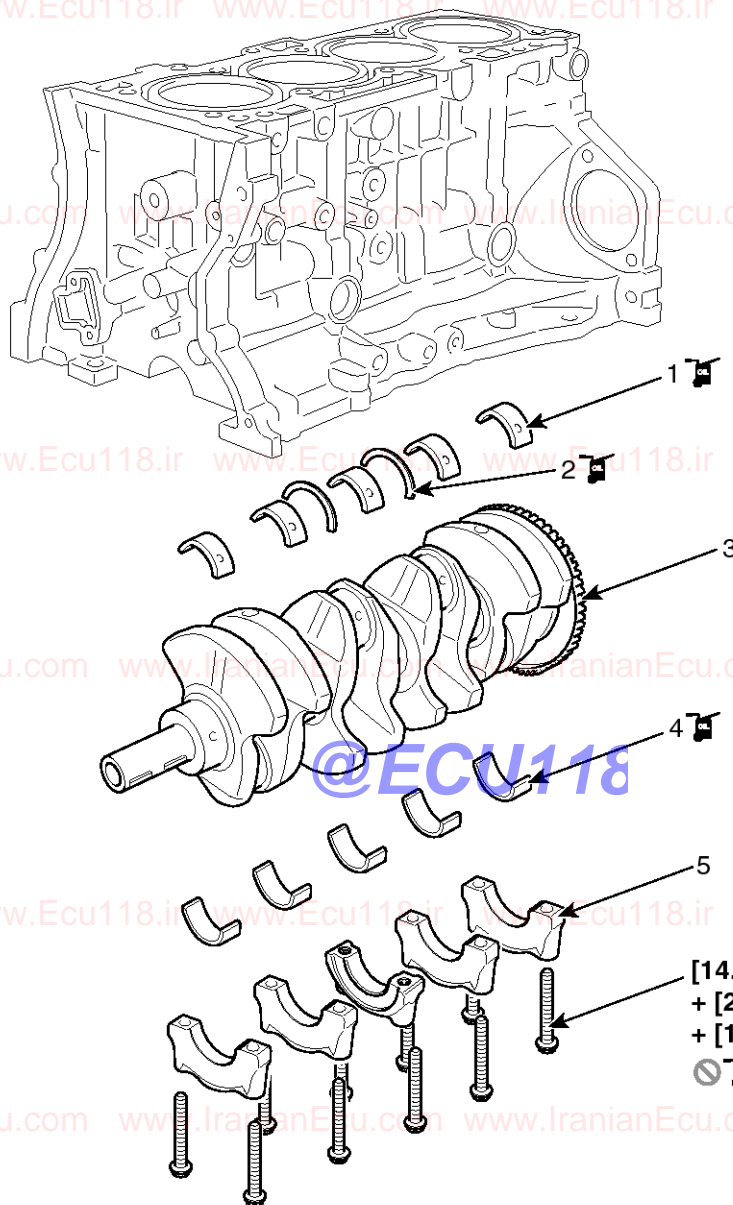
- 1. Crankshaft upper bearing
- 2. Thrust bearing
- 3. Crankshaft

- 4. Crankshaft lower bearing
- 5. Main bearing cap

EM-78

Engine Mechanical System

[2.4L]



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

SVG11119L

1. Crankshaft upper bearing
2. Thrust bearing
3. Crankshaft

4. Crankshaft lower bearing
5. Main bearing cap

Cylinder Block

EM-79

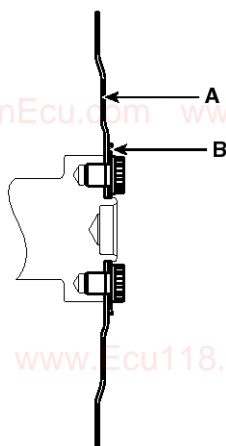
Disassembly

⚠ CAUTION

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

📌 NOTICE

- Mark all wiring and hoses to avoid misconnection.
 - Turn the crankshaft pulley so that the No.1 piston is at top dead center.
1. Remove the engine assembly from the vehicle. (Refer to Engine and transaxle assembly in this group)
 2. Install the engine to an engine stand for disassembly.
 3. Remove the intake manifold and exhaust manifold. (Refer to Intake and exhaust system in this group)
 4. Remove the timing chain. (Refer to Timing system in this group)
 5. Remove the cylinder head assembly. (Refer to Cylinder head in this group)
 6. AT : Remove the drive plate (A) and the adapter plate (B).

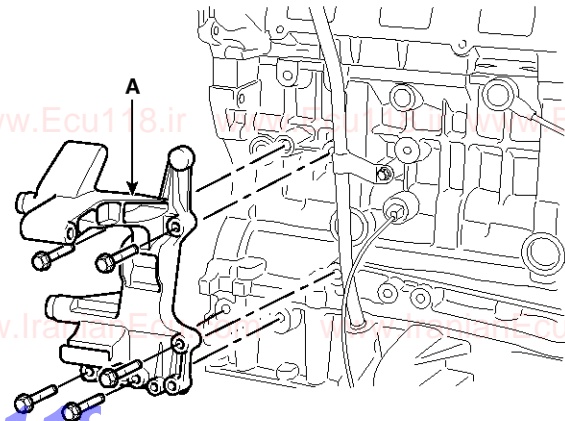


KCRF224A

MT : Remove the flywheel.

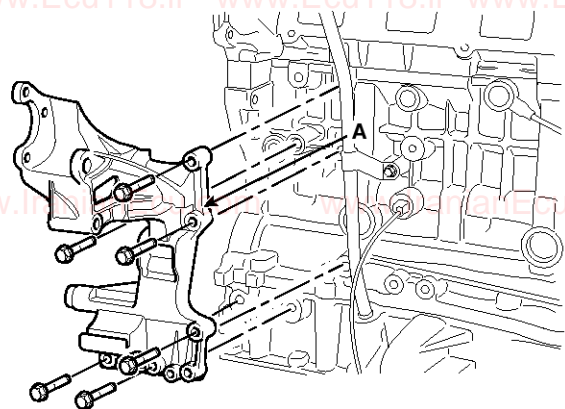
7. Remove the balance shaft & oil pump assembly. (Refer to Lubrication system in this group)
8. Remove the A/C compressor. (Refer to HA group)
9. Remove the alternator. (Refer to EE group)
10. Remove the water pump assembly. (Refer to Cooling system in this group)
11. Remove the power steering oil pump. (Refer to ST group)
12. Remove the tensioner assembly integrated bracket (A).

[MDPS]



SYFEM0083N

[HPS]

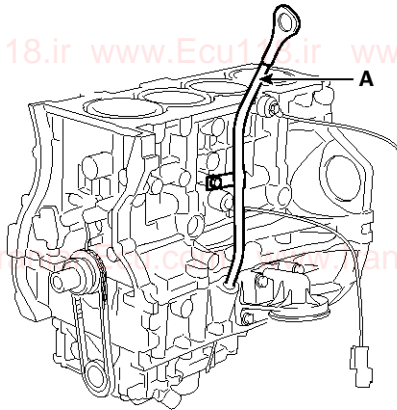


SVGEM0021D

EM-80

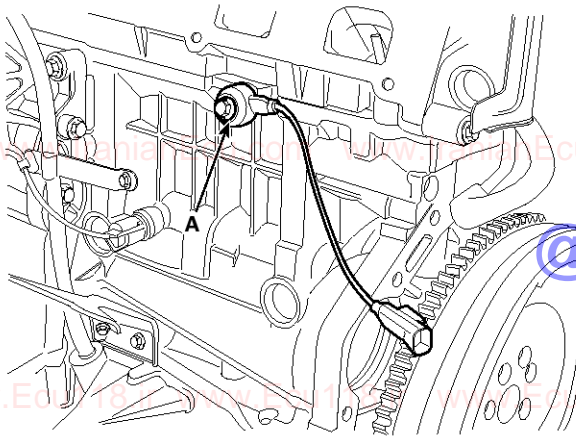
Engine Mechanical System

13. Remove the oil level gauge tube (A).



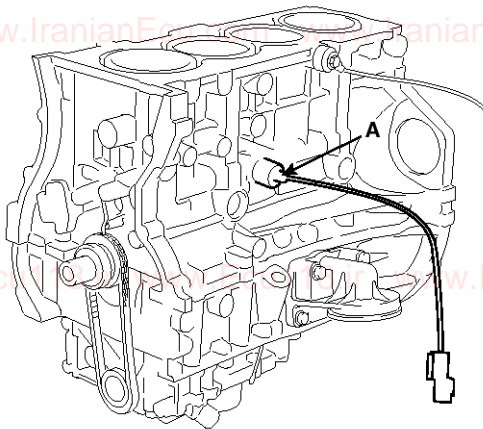
SXMM19108D

14. Remove the knock sensor (A).



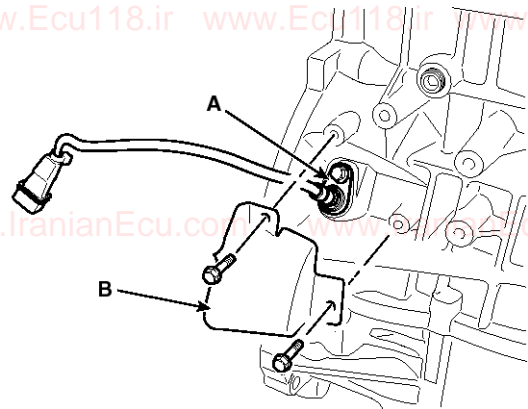
SSLM10145D

15. Remove the OPS (Oil pressure switch) (A).



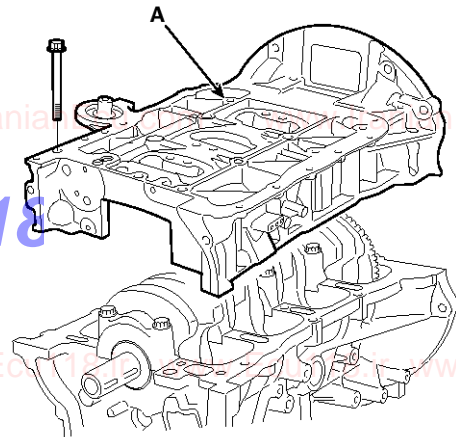
SXMM19109D

16. Remove the CKPS (Crankshaft position sensor) (A) after removing the cover (B).



SSLM10124D

17. Remove the ladder frame (A).



STGEM9037D

18. Check the connecting rod end play.

19. Remove the connecting rod caps and check oil clearance.

Cylinder Block

EM-81

20. Remove piston and connecting rod assemblies.

- 1) Using a ridge reamer, remove all the carbon from the top of the cylinder.
- 2) Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

NOTICE

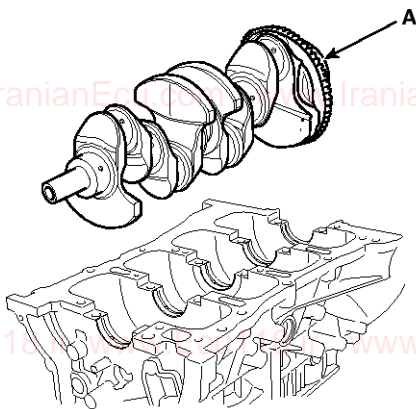
- Keep the bearings, connecting rod and cap together.
- Arrange the piston and connecting rod assemblies in the correct order.

21. Remove crankshaft bearing cap and check oil clearance.

22. Check the crankshaft end play.

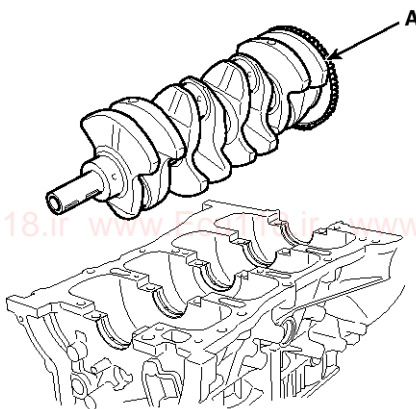
23. Lift the crankshaft (A) out of the engine, being careful not to damage journals.

[2.0L]



STFEM1069D

[2.4L]



KCRF172A

NOTICE

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

24. Check fit between piston and piston pin.

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

25. Remove piston rings.

- 1) Using a piston ring expander, remove the 2 compression rings.
- 2) Remove 2 side rails and the spacer by hand.

NOTICE

Arrange the piston rings in the correct order only.

26. Disconnect connecting rod from piston.

Remove the piston pin from the piston using a hydraulic press.

@ECU118

EM-82

Engine Mechanical System

Inspection

Connecting Rod

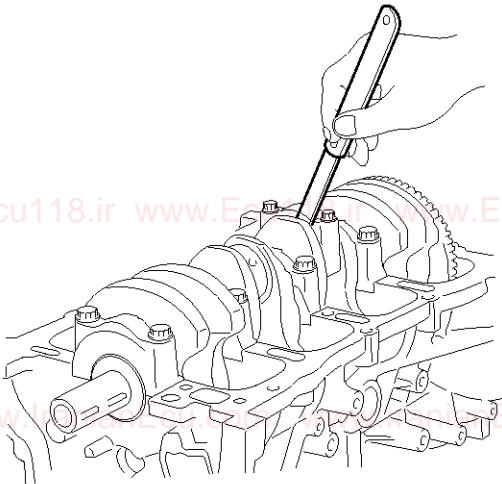
1. Check the connecting rod end play.

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

End play :

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

Limit : 0.35mm (0.0138in.)



KCRF169B

- If out-of-tolerance, install a new connecting rod.
 - If still out-of-tolerance, replace the crankshaft.
2. Check the connecting rod bearing oil clearance.
 - 1) Check the matchmarks on the connecting rod and cap are aligned to ensure correct reassembly.
 - 2) Remove 2 connecting rod cap bolts.
 - 3) Remove the connecting rod cap and bearing half.
 - 4) Clean the crank pin and bearing.
 - 5) Place plastigage across the crank pin.
 - 6) Reinstall the bearing half and cap, and torque the bolts.

Tightening torque

17.7~21.6Nm (1.8~2.2kgf.m, 13.0~15.9lb-ft) + 88~92°

NOTICE

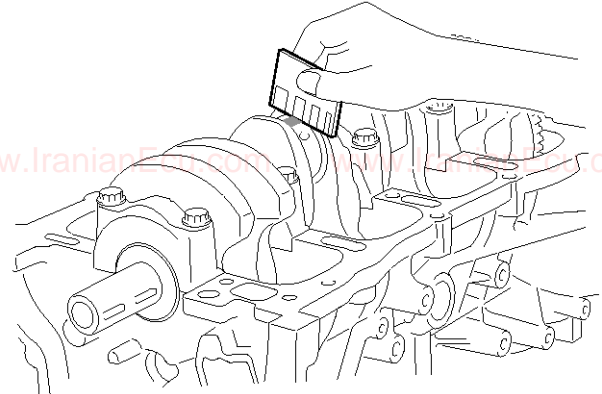
Do not turn the crankshaft.

- 7) Remove 2 bolts, connecting rod cap and bearing half.

- 8) Measure the plastigage at its widest point.

Standard oil clearance

0.031 ~ 0.045mm (0.00122 ~ 0.00177in.)



KCRF169A

- 9) If the plastigage measures too wide or too narrow, remove the upper half of the bearing, install a new, complete bearing with the same color mark (select the color as shown in the next column), and recheck the clearance.

CAUTION

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

- 10) If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing (the color listed above or below that one), and check clearance again.

NOTICE

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

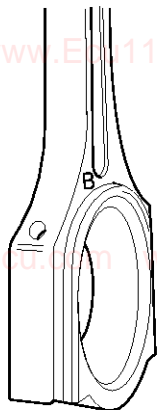
CAUTION

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

Cylinder Block

EM-83

Connecting Rod Identification Mark

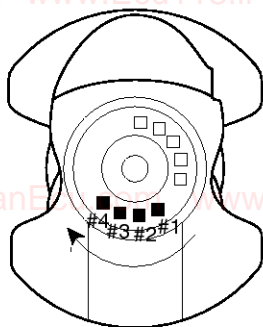


SNFEM8089L

Connecting Rod Specifications

| Class | Mark | Inside Diameter |
|-------|------|---|
| a | A | 51.000 ~ 51.006mm (2.00787 ~ 2.00811in.) |
| b | B | 51.006 ~ 51.012mm (2.00811 ~ 2.00834in.) |
| c | C | 51.012 ~ 51.018mm (2.00834 ~ 2.00858in.) |

Crankshaft Pin Identification Mark



SNFEM8090L

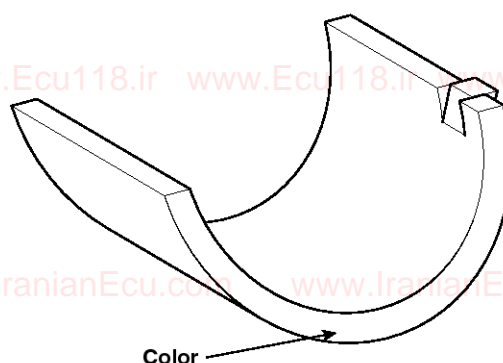
NOTICE

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

Crankshaft Specifications

| Class | Mark | Outside Diameter Of Pin |
|-------|------|---|
| I | 1 | 47.966 ~ 47.972mm (1.88842 ~ 1.88866in.) |
| II | 2 | 47.960 ~ 47.966mm (1.88819 ~ 1.88842in.) |
| III | 3 | 47.954 ~ 47.960mm (1.88795 ~ 1.88819in.) |

Connecting Rod Bearing Identification Mark



ECRF021A

Connecting Rod Bearing Specifications

| Class | Mark | Thickness Of Bearing |
|-------|--------|---|
| AA | Blue | 1.515 ~ 1.518mm (0.05965 ~ 0.05976in.) |
| A | Black | 1.512 ~ 1.515mm (0.05953 ~ 0.05965in.) |
| B | None | 1.509 ~ 1.512mm (0.05941 ~ 0.05953in.) |
| C | Green | 1.506 ~ 1.509mm (0.05929 ~ 0.05941in.) |
| D | Yellow | 1.503 ~ 1.506mm (0.05917 ~ 0.05929in.) |

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

EM-84

Engine Mechanical System

Selection Chart For Connecting Rod Bearings

| Crankshaft Identification Mark | Connecting Rod Identification Mark | Assembling Classification Of Bearing |
|--------------------------------|------------------------------------|--------------------------------------|
| I (1) | a (A) | D (Yellow) |
| | b (B) | C (Green) |
| | c (C) | B (None) |
| II (2) | a (A) | C (Green) |
| | b (B) | B (None) |
| | c (C) | A (Black) |
| III (3) | a (A) | B (None) |
| | b (B) | A (Black) |
| | c (C) | AA (Blue) |

3. Inspect the connecting rods.

- When reinstalling, make sure that cylinder numbers put on the connecting rod and cap at disassembly match. When a new connecting rod is installed, make sure that the notches for holding the bearing in place are on the same side.
- Replace the connecting rod if it is damaged on the thrust faces at either end. Also if step wear or a severely rough surface of the inside diameter of the small end is apparent, the rod must be replaced as well.
- Using a connecting rod aligning tool, check the rod for bend and twist. If the measured value is close to the repair limit, correct the rod by a press. Any connecting rod that has been severely bent or distorted should be replaced.

Allowable bend of connecting rod :

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

Allowable twist of connecting rod :

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

Crankshaft

1. Check the crankshaft bearing oil clearance.

- To check main bearing-to-journal oil clearance, remove the main caps and bearing halves.
- Clean each main journal and bearing half with a clean shop towel.
- Place one strip of plastigage across each main journal.
- Reinstall the bearings and caps, then torque the bolts.

Tightening torque

14.7N.m (1.5kgf.m, 10.8lb-ft) + 27.5~31.4Nm (2.8~3.2kgf.m, 20.3~23.1lb-ft) + 120~125°

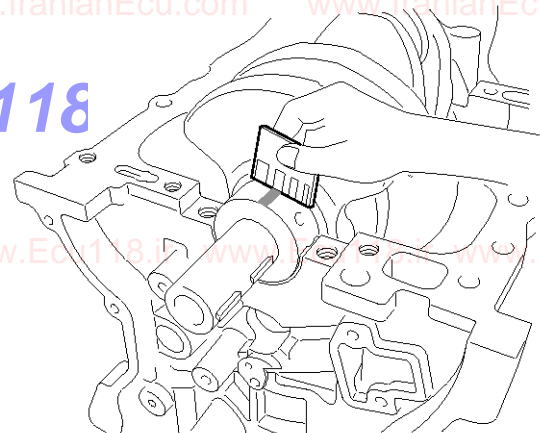
NOTICE

Do not turn the crankshaft.

- Remove the cap and bearing again, and measure the widest part of the plastigage.

Standard oil clearance

0.020 ~ 0.038mm (0.00079 ~ 0.00150in.)



KCRF170A

- If the plastigage measures too wide or too narrow, remove the upper half of the bearing, install a new, complete bearing with the same color mark (select the color as shown in the next column), and recheck the clearance.

CAUTION

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

Cylinder Block

EM-85

7) If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing (the color listed above or below that one), and check clearance again.

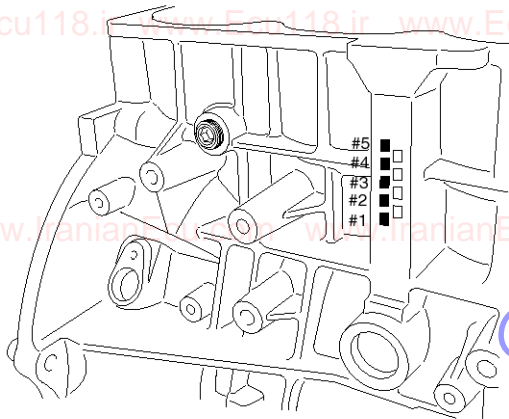
NOTICE

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

CAUTION

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

Crankshaft Bore Identification Mark



SNFEM8091L

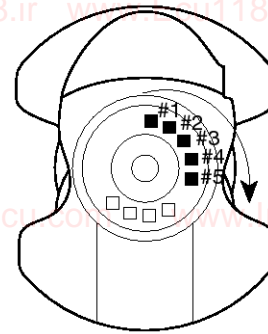
Letters have been stamped on the block as a mark for the size of each of the 5 main journal bores.

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

Cylinder Block Specifications

| Class | Mark | Inside Diameter |
|-------|------|---|
| a | A | 56.000 ~ 56.006mm (2.20472 ~ 2.20496in.) |
| b | B | 56.006 ~ 56.012mm (2.20496 ~ 2.20519in.) |
| c | C | 56.012 ~ 56.018mm (2.20519 ~ 2.20543in.) |

Crankshaft Journal Identification Mark



SNFEM8092L

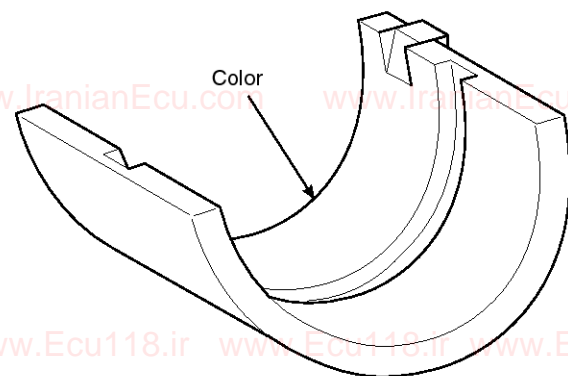
NOTICE

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

Crankshaft Specifications

| Class | Mark | Outside Diameter Of Journal |
|-------|------|---|
| I | 1 | 51.954 ~ 51.960mm (2.04543 ~ 2.04567in.) |
| II | 2 | 51.948 ~ 51.954mm (2.04519 ~ 2.04543in.) |
| III | 3 | 51.942 ~ 51.948mm (2.04496 ~ 2.04519in.) |

Crankshaft Bearing Identification Mark



ECRF022A

EM-86

Engine Mechanical System

Crankshaft Bearing Specifications

| Class | Mark | Thickness Of Bearing |
|-------|--------|---|
| AA | Blue | 2.026 ~ 2.029mm (0.07976 ~ 0.07988in.) |
| A | Black | 2.023 ~ 2.026mm (0.07965 ~ 0.07976in.) |
| B | None | 2.020 ~ 2.023mm (0.07953 ~ 0.07965in.) |
| C | Green | 2.017 ~ 2.020mm (0.07941 ~ 0.7953in.) |
| D | Yellow | 2.014 ~ 2.017mm (0.07929 ~ 0.07941in.) |

8) Select a crankshaft bearing using the selection chart.

Selection Chart For Crankshaft Bearings

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

2. Check crankshaft end play.

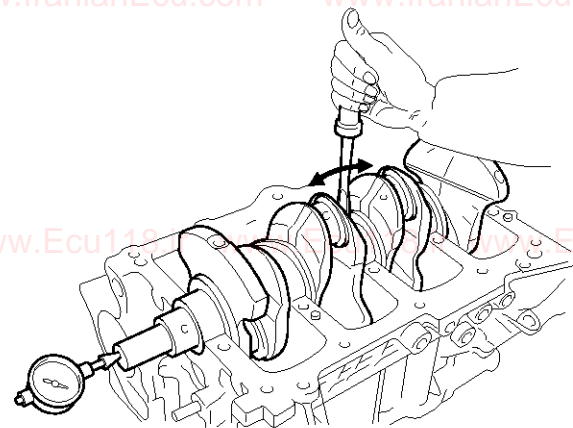
Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

End play

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

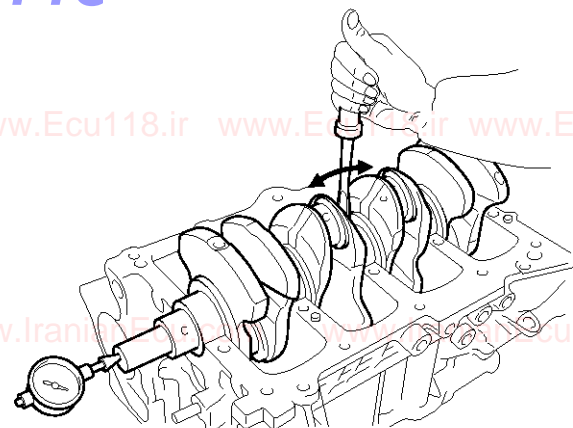
Limit : 0.30mm (0.0118in.)

[2.0L]



STFEM1066D

[2.4L]



KCRF211A

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

Thrust bearing thickness

1.925 ~ 1.965mm (0.07579 ~ 0.07736in.)

Cylinder Block

EM-87

3. Inspect main journals and crank pins.

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

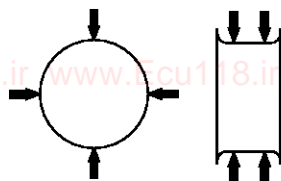
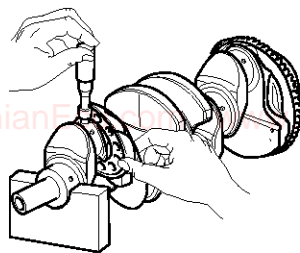
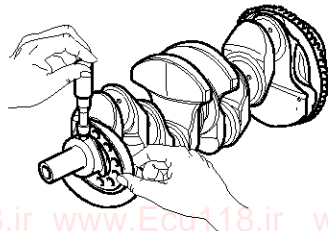
Main journal diameter :

51.942 ~ 51.960mm (2.04496 ~ 2.04567in.)

Crank pin diameter :

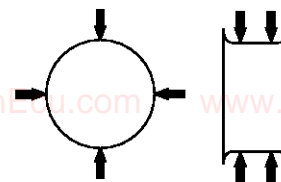
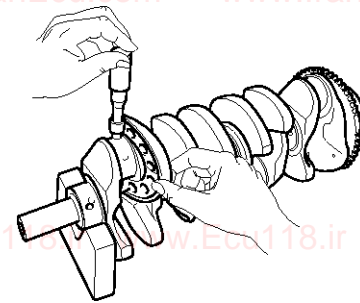
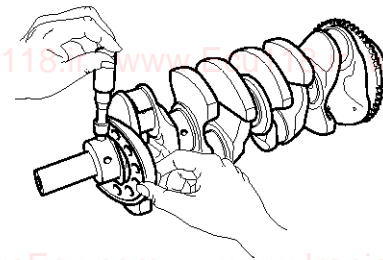
47.954 ~ 47.972mm (1.88795 ~ 1.88866in.)

[2.0L]



STFEM1070D

[2.4L]



SYFEM0124N

@ECU118

EM-88

Engine Mechanical System

Cylinder Block

1. Remove gasket material.

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

2. Clean cylinder block

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

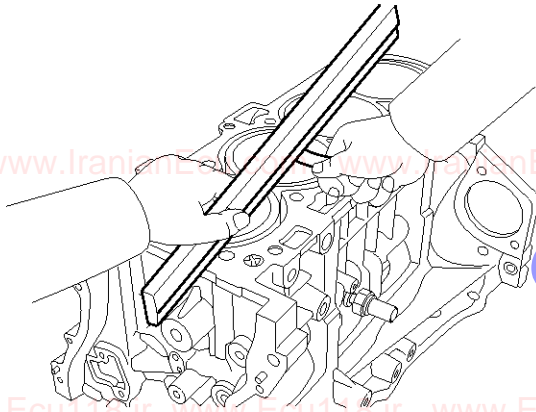
3. Inspect top surface of cylinder block for flatness.

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

Flatness of cylinder block gasket surface

Standard : Less than 0.05mm (0.0019in.) for all

Less than 0.02 (0.0007in.) for 100mm (3.9370in.) x 100mm (3.9370in.)



SYFEM0125N

4. Inspect cylinder bore diameter.

Visually check the cylinder for vertical scratches.

If deep scratches are present, replace the cylinder block.

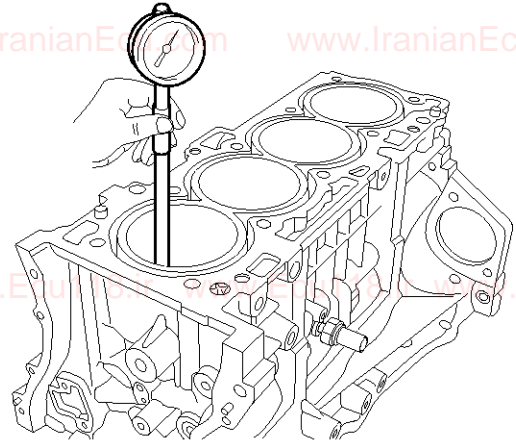
5. Inspect cylinder bore diameter.

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

Standard diameter

[2.0L] : 86.00 ~ 86.03mm (3.3858 ~ 3.3870in.)

[2.4L] : 88.00 ~ 88.03mm (3.4645 ~ 3.4657in.)



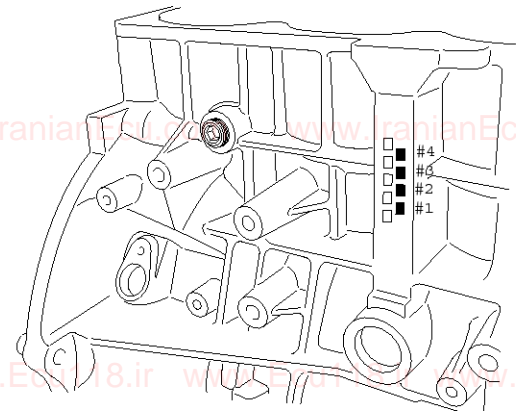
SYFEM0126N

NOTICE

Measure position points (from the bottom of the cylinder block)

: 110.7mm(4.3582in.)/160mm(6.2992in.)/210mm(8.2677in.)

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



SNFEM8093L

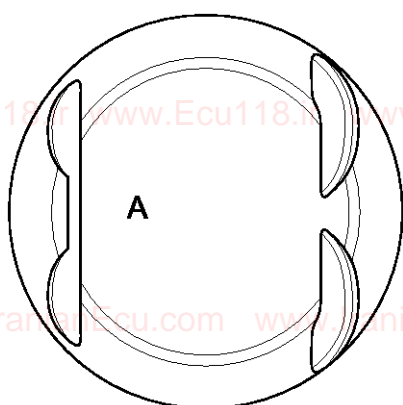
Cylinder Block

EM-89

Cylinder Bore Inner Diameter

| Size Code | 2.0L | 2.4L |
|-----------|---|---|
| A | 86.00 ~ 86.01mm (3.3858 ~ 3.3862in.) | 88.00 ~ 88.01mm (3.4645 ~ 3.4649in.) |
| B | 86.01 ~ 86.02mm (3.3862 ~ 3.3866in.) | 88.01 ~ 88.02mm (3.4649 ~ 3.4653in.) |
| C | 86.02 ~ 86.03mm (3.3866 ~ 3.3870in.) | 88.02 ~ 88.03mm (3.4653 ~ 3.4657in.) |

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



ECKE320B

NOTICE

Stamp the grade mark of basic diameter with rubber stamp.

Piston Outer Diameter

| Size Code | 2.0L | 2.4L |
|-----------|---|---|
| A | 85.975 ~ 85.985mm (3.3848 ~ 3.3852in.) | 87.975 ~ 87.985mm (3.46358 ~ 3.46397in.) |
| B | 85.985 ~ 85.995mm (3.3852 ~ 3.3856in.) | 87.985 ~ 87.995mm (3.46397 ~ 3.46436in.) |
| C | 85.995 ~ 86.005mm (3.3856 ~ 3.3860in.) | 87.995 ~ 88.005mm (3.46436 ~ 3.46476in.) |

8. Select the piston related to cylinder bore class.

Clearance : 0.015 ~ 0.035mm (0.00059 ~ 0.00138in.)

Piston And Rings

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

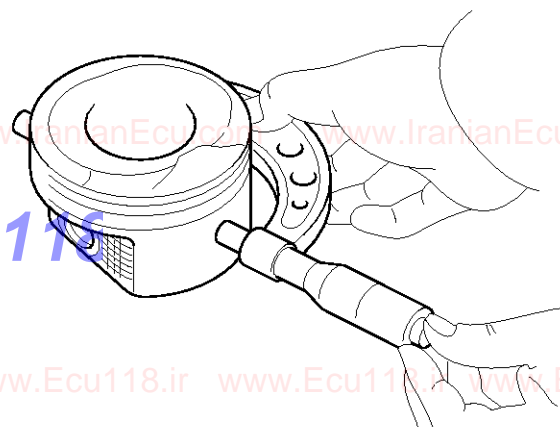
NOTICE

Do not use a wire brush.

- The standard measurement of the piston outside diameter is taken 17mm (0.67in.) from the top land of the piston.

Standard diameter

[2.0] : 85.975 ~ 86.005mm (3.38484 ~ 3.38602in.)
 [2.4] : 87.975 ~ 88.005mm (3.46358 ~ 3.46476in.)



KCRF215A

- Calculate the difference between the cylinder bore diameter and the piston diameter.

Piston-to-cylinder clearance

0.015 ~ 0.035mm (0.00059 ~ 0.00138in.)

EM-90

Engine Mechanical System

4. Inspect the piston ring side clearance.

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

Piston ring side clearance

Standard

No.1 : 0.050 ~ 0.080mm (0.00197 ~ 0.00315in.)

No.2 : 0.040 ~ 0.080mm (0.00157 ~ 0.00315in.)

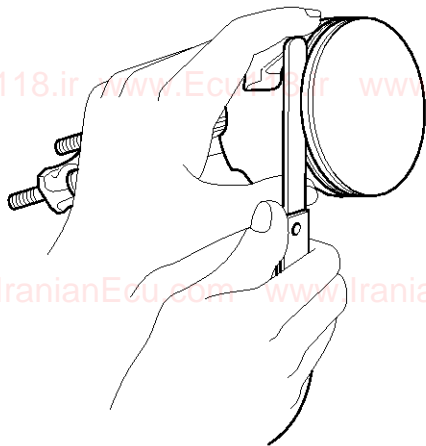
Oil ring : 0.060 ~ 0.125mm (0.00236 ~ 0.00492in.)

Limit

No.1 : 0.100mm (0.00394in.)

No.2 : 0.100mm (0.00394in.)

Oil ring : 0.200mm (0.00787in.)



KCRF216A

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

5. Inspect piston ring end gap.

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

Piston ring end gap

Standard

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

No.2 : 0.37 ~ 0.52mm (0.0145 ~ 0.0204in.)

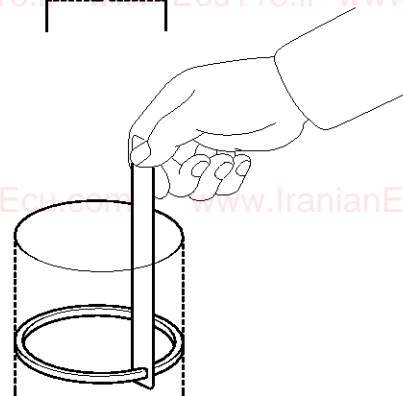
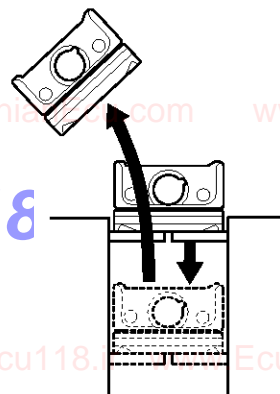
Oil ring : 0.20 ~ 0.70mm (0.0079 ~ 0.0275in.)

Limit

No.1 : 0.60mm (0.0236in.)

No.2 : 0.70mm (0.0275in.)

Oil ring : 0.80mm (0.0315in.)



KCRF217A

Cylinder Block

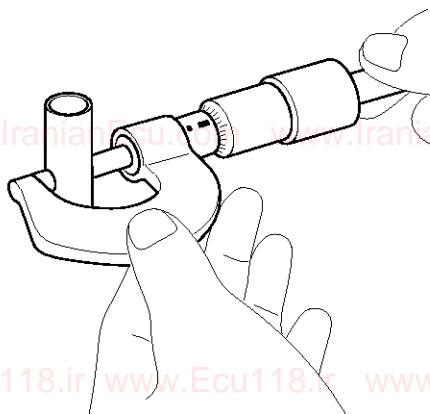
EM-91

Piston Pins

1. Measure the diameter of the piston pin.

Piston pin diameter

21.001 ~ 21.006mm (0.82681 ~ 0.82701in.)



KCRF218A

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

Piston pin-to-piston clearance

0.013 ~ 0.023m (0.00051 ~ 0.00091in.)

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

Piston pin-to-connecting rod interference

0.016 ~ 0.032mm (0.00063 ~ 0.00126in.)

Reassembly

NOTICE

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

1. Assemble the piston and connecting rod.

- 1) Before pressing the piston pin, apply a coat of lubricant oil to the piston pin outer and connecting rod.

CAUTION

- Take care that piston pin is not damaged during pressing process.
- When replace the piston pin, check the piston pin outer diameter and connecting rod small end inner diameter as below.

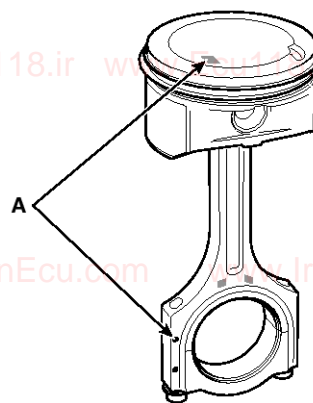
Piston pin outer diameter :

21.001 ~ 21.006mm (0.82681 ~ 0.82701in)

Connecting rod small end inner diameter :

20.974 ~ 20.985mm (0.82575 ~ 0.82618in)

- 2) The piston front mark and the connecting rod front mark (A) must face the timing chain side of the engine.



KCRF168A

- 3) Use a hydraulic press for installation.

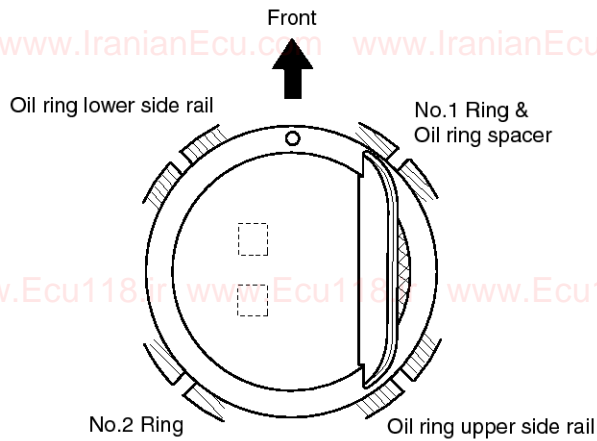
Pressing load : 250 ~ 1250kg (551.2 ~ 2755.7lb)

EM-92

Engine Mechanical System

2. Install the piston rings.

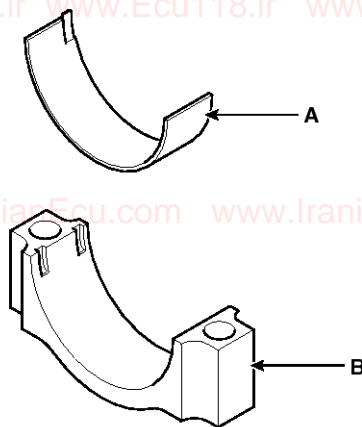
- 1) Install the oil ring spacer and 2 side rails by hand.
- 2) Using a piston ring expander, install the 2 compression rings with the code mark facing upward.
- 3) Position the piston rings so that the ring ends are as shown.



SVG11120L

3. Install the connecting rod bearings.

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



KCRF118B

CAUTION

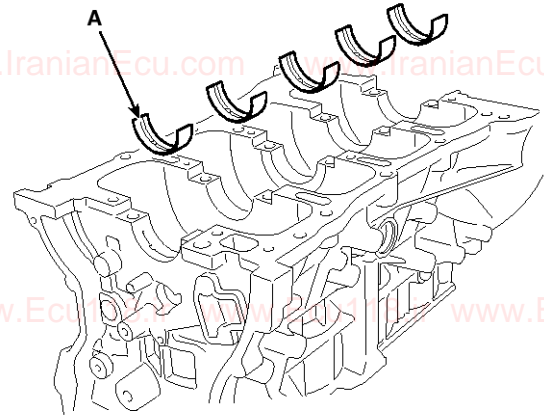
Be careful not to change the position of bearing caps.

4. Install the main bearings.

NOTICE

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

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

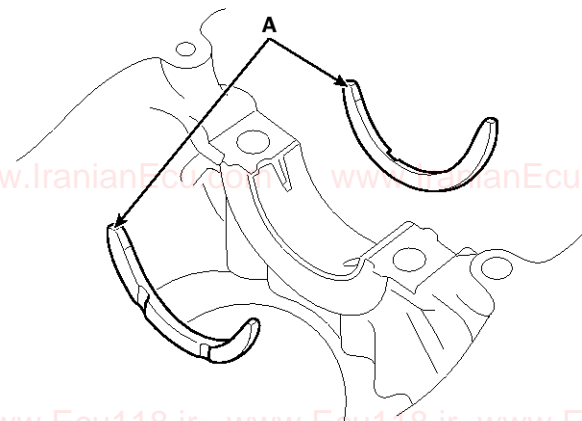


KCRF173A

- 2) Align the bearing claw with the claw groove of the main bearing cap, and push in the 5 lower bearings.

5. Install the thrust bearings.

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



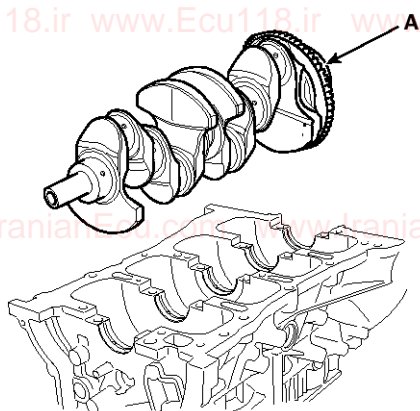
KCRF222A

Cylinder Block

EM-93

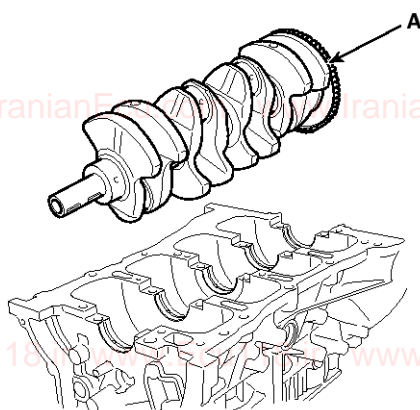
6. Place the crankshaft(A) on the cylinder block.

[2.0L]



STFEM1069D

[2.4L]



KCRF172A

7. Place the main bearing caps on cylinder block.

8. Install the main bearing cap bolts.

⚠ CAUTION

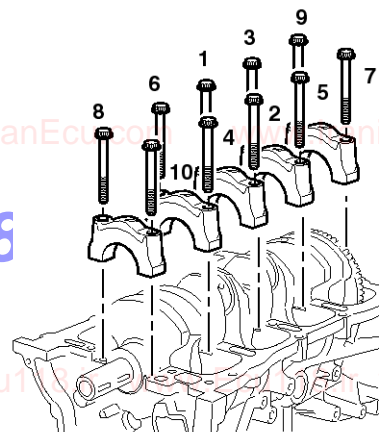
Always use new main bearing cap bolts.

📌 NOTICE

- The main bearing cap bolts are tightened in 3 progressive steps.
 - If any of the bearing cap bolts is broken or deformed, replace it.
- 1) Apply a light coat of engine oil on the threads and under the bearing cap bolts.
 - 2) Using the SST (09221-4A000), install and uniformly tighten the 10 bearing cap bolts, in several passes, in the sequence shown.

Tightening torque

14.7N.m (1.5kgf.m, 10.8lb-ft) + 27.5~31.4Nm (2.8~3.2kgf.m, 20.3~23.1lb-ft) + 120~125°



KCRF171A

3) Check that the crankshaft turns smoothly.

9. Check crankshaft end play.

10. Install piston and connecting rod assemblies.

📌 NOTICE

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

- 1) Remove the connecting rod caps, and slip short sections of rubber hose over the threaded ends of the connecting rod bolts.
- 2) Install the ring compressor, check that the bearing is securely in place, then position the piston in the cylinder, and tap it in using the wooden handle of a hammer.
- 3) Stop after the ring compressor pops free, and check the connecting rod-to-check journal alignment before pushing the piston into place.

EM-94

Engine Mechanical System

- 4) Apply engine oil to the bolt threads. Using the SST (09221-4A000), install the rod caps with bearings, and torque the bolts.

Tightening torque

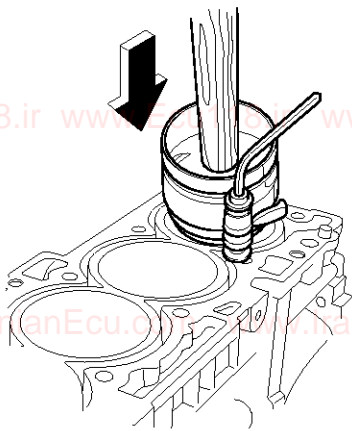
17.7~21.6Nm (1.8~2.2kgf.m, 13.0~15.9lb-ft) + 88~92°

⚠ CAUTION

Always use new connecting rod cap bolts.

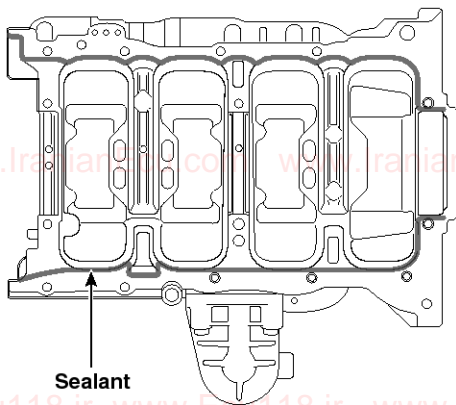
📌 NOTICE

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



SYFEM0131N

11. Apply liquid gasket to the mating surface of cylinder block and ladder frame.



SYFEM0132N

📌 NOTICE

- When assembling ladder frame, the liquid sealant Loctite 5900H, Threebond 1217H or equivalent should be applied ladder frame.
- The part must be assembled within 5 minutes after sealant was applied.
- Apply sealant to the inner threads of the bolt holes.

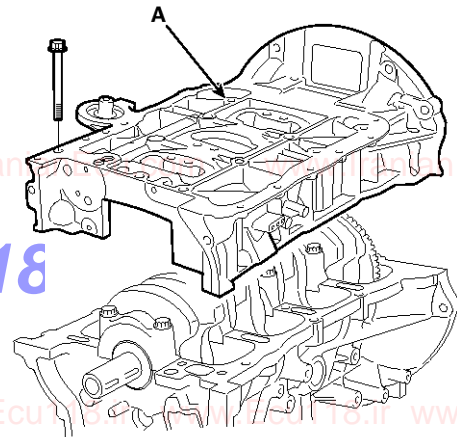
12. Install ladder frame (A) with 10 bolts, in several passes, in sequence shown.

Tightening torque

Step 1 : 8.8 ~ 9.8N.m (0.9 ~ 1.0kgf.m, 6.5 ~ 7.2lb-ft)

Step 2 : 17.7 ~ 20.6N.m (1.8 ~ 2.1kgf.m, 13.0 ~ 15.2lb-ft)

Step 3 : 27.5 ~ 31.4N.m (2.8 ~ 3.2kgf.m, 20.3 ~ 23.1lb-ft)



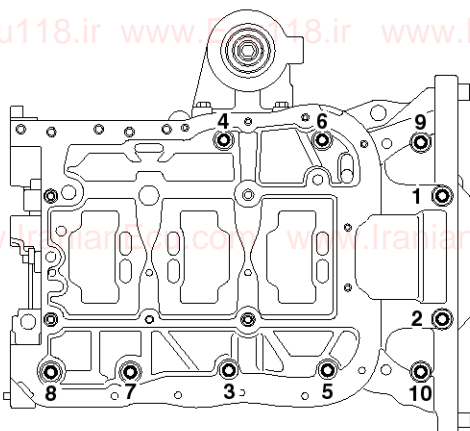
STGEM9037D

- 1) Tighten the bolts in order number as shown with the 3 steps.
- 2) Loosen the bolts as reverse tightening order.

Cylinder Block

EM-95

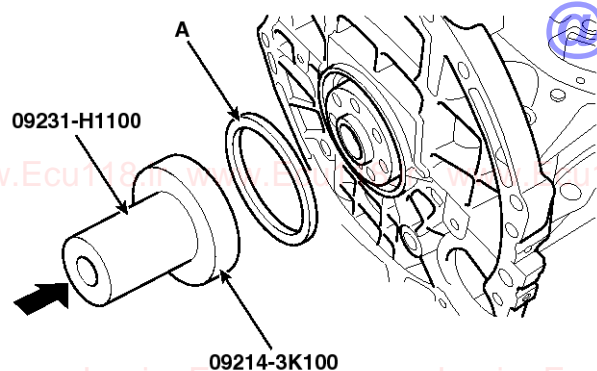
- 3) Tighten the bolts in order number as shown with the 3 steps.



SVGEM0018D

13. Install rear oil seal.

- 1) Apply engine oil to a new oil seal lip.
- 2) Using SST(09231-H1100, 09214-3K100) and a hammer, tap in the oil seal (A) until its surface is flush with the rear oil seal retainer edge.



SSLM10118D

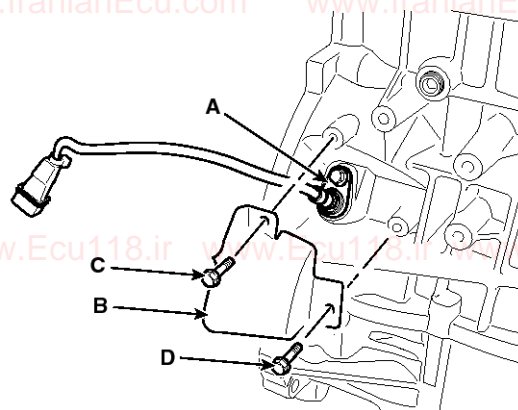
14. Install CKPS (Crankshaft position sensor) (A) and sensor cover (B).

Tightening torque

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

M6 Bolt (C): 9.8 ~ 11.8N.m (1.0 ~ 1.2kgf.m, 7.2 ~ 8.7lb-ft)

M8 Bolt (D): 18.6 ~ 23.5N.m (1.9 ~ 2.4kgf.m, 13.7 ~ 17.4lb-ft)



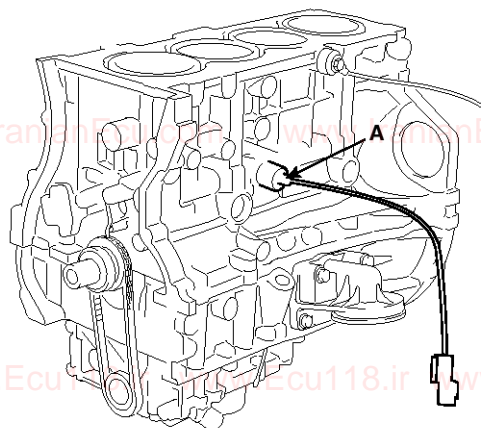
SSLM10125D

15. Install OPS (Oil pressure switch).

- 1) Apply adhesive to 2 or 3 threads.
Adhesive : MS 721-39(B) or equivalent.
- 2) Install the oil pressure switch (A).

Tightening torque

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



SXMM19109D

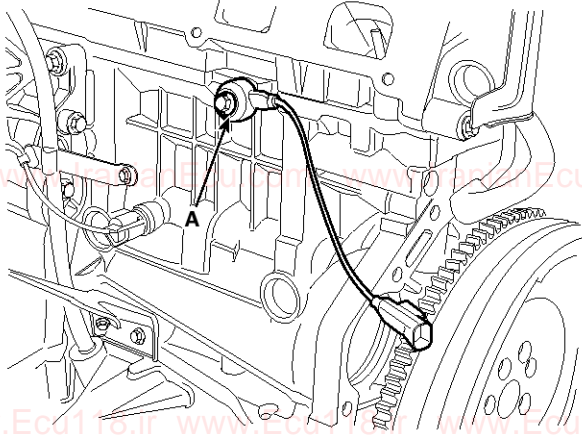
EM-96

Engine Mechanical System

16. Install knock sensor (A).

Tightening torque

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



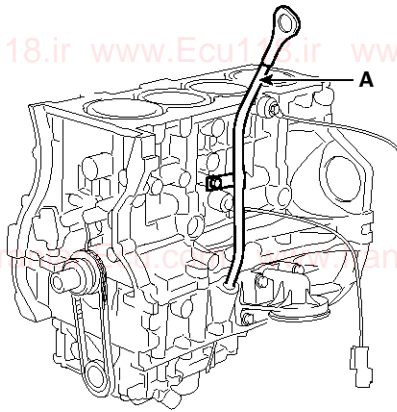
SSLM10145D

17. Install oil level gauge assembly.

- 1) Install a new O-ring on the oil level gauge.
- 2) Apply engine oil on the O-ring.
- 3) Install the oil level gauge assembly (A) with the bolt.

Tightening torque

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



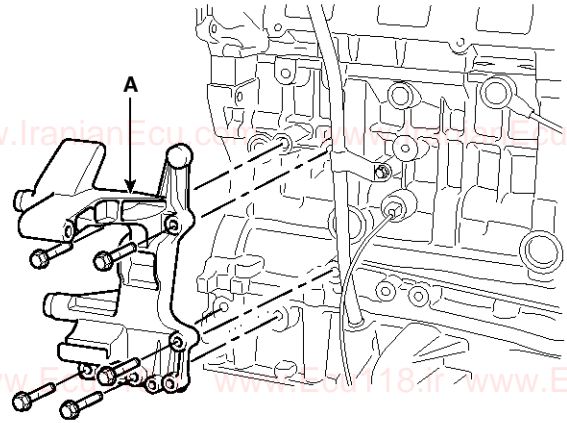
SXMM19108D

18. Install tensioner assembly integrated bracket (A).

Tightening torque

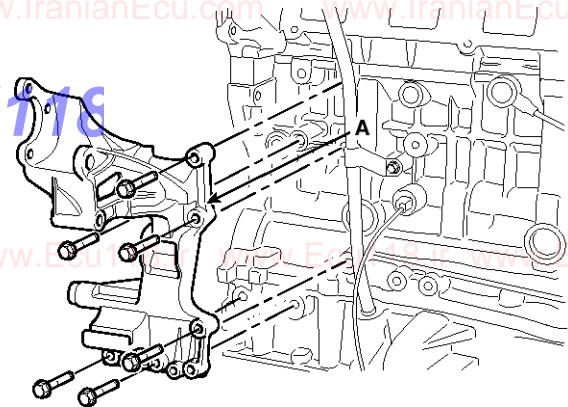
39.2 ~ 44.1N.m (4.0 ~ 4.5kgf.m, 28.9 ~ 32.5lb-ft)

[MDPS]



SYFEM0083N

[HPS]



SVGEM0021D

19. Install the power steering oil pump. (Refer to ST group)

20. Install the water pump. (Refer to Cooling system in this group)

21. Install the alternator. (Refer to EE group)

22. Install the balance shaft & oil pump assembly. (Refer to Lubrication system in this group)

23. Install the cylinder head assembly. (Refer to Cylinder head in this group)

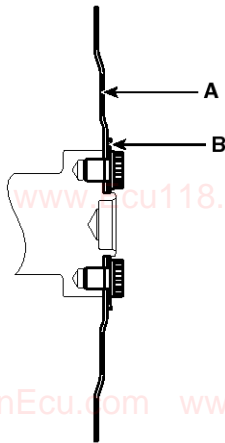
Cylinder Block

EM-97

24. Install the timing chain. (Refer to Timing system in this group)
25. Install the intake manifold and exhaust manifold. (Refer to Intake and exhaust system in this group)
26. Remove the engine from the engine stand.
27. AT : Install the drive plate (A) and the adapter plate (B).

Tightening torque :

117.7 ~ 127.5N.m (12.0 ~ 13.0kgf.m, 86.8 ~ 93.9lb-ft)



KCRF224A 

MT : Install the flywheel.

NOTICE

- Always use new drive plate (or flywheel) bolts.
- Apply sealant to the screw part (10mm (0.39in) from the end of the bolt) when reusing the drive plate (or flywheel) bolts.

Sealant: Three bond 2403, Loctite 200 or 204

- Install and uniformly tighten the 7 bolts, in several passes.

28. Install the engine assembly on the vehicle. (Refer to Engine and transaxle assembly in this group)
Add all fluids to their normal operating levels.

EM-98

Engine Mechanical System

Cooling System

Coolant

Refilling And Bleeding

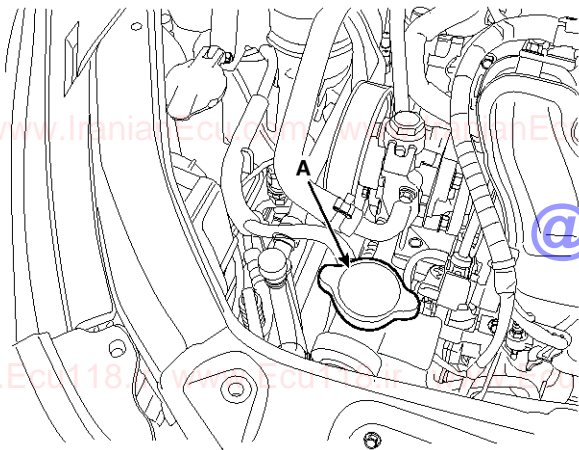
⚠WARNING

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

⚠CAUTION

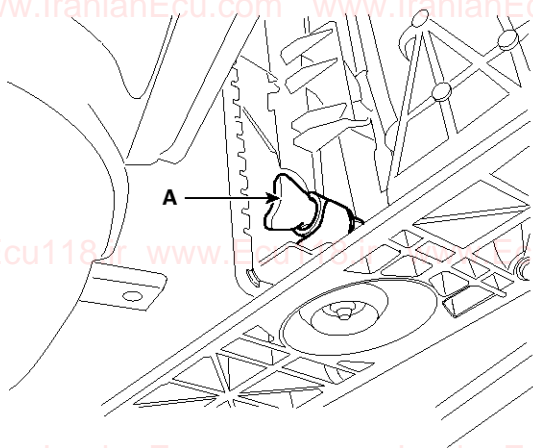
When pouring engine coolant, be sure to shut the relay box lid and not to let coolant spill on the electrical parts or the paint. If any coolant spills, rinse it off immediately.

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



STFEM1012D

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



SYFEM0030N

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

⚠NOTICE

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

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

⚠NOTICE

- Use only genuine antifreeze/coolant.
- For best corrosion protection, the coolant concentration must be maintained year-round at 55% (except for North America, Europe and China : 45%) minimum.
Coolant concentrations less than 55% (except for North America, Europe and China : 45%) may not provide sufficient protection against corrosion or freezing.
- Coolant concentrations greater than 60% will impair cooling efficiency and are not recommended.

⚠CAUTION

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

Cooling System

EM-99

11. Start the engine and run until coolant circulates.

When the cooling fan operates and coolant circulates, refill coolant through the radiator cap.

12. Repeat 11 until the cooling fan 3 ~ 5 times and bleed air sufficiently out of the cooling system.

13. Install the radiator cap and fill the reservoir tank to the "MAX" (or "F") line with coolant.

14. Run the vehicle under idle until the cooling fan operates 2 ~ 3 times.

15. Stop the engine and wait coolant gets cool.

16. Repeat 10 to 15 until the coolant level doesn't fall any more, bleed air out of the cooling system.

NOTICE

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

Coolant capacity :

MT : 6.6L (1.74 U.S.gal., 6.97 U.S.qt., 5.80 Imp.qt.)

AT : 6.5L (1.72 U.S.gal., 6.87 U.S.qt., 5.72 Imp.qt.)

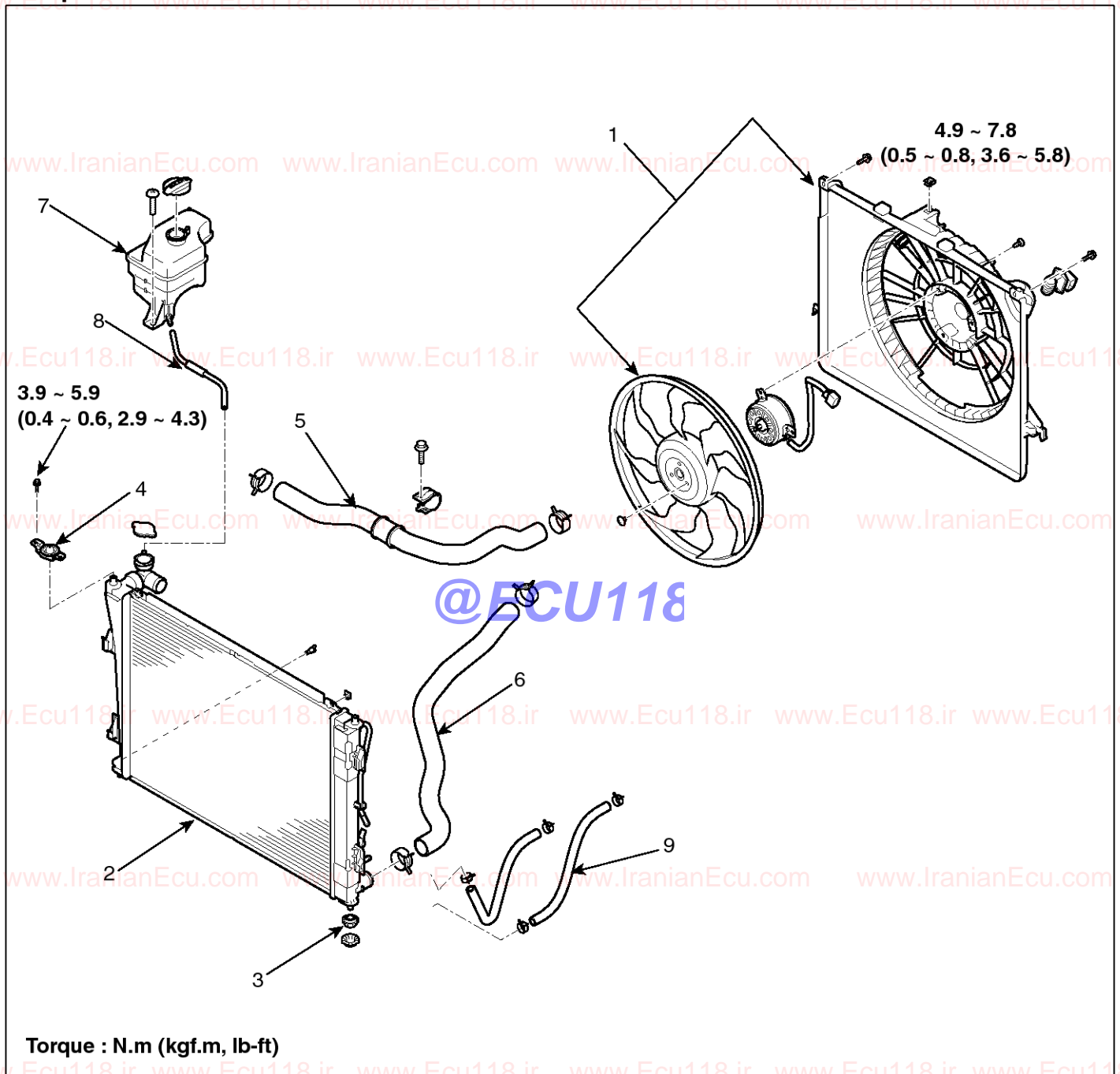
@ECU118

EM-100

Engine Mechanical System

Radiator

Components



STFEM1102L

- | | |
|------------------------------|------------------------|
| 1. Cooling fan assembly | 6. Radiator lower hose |
| 2. Radiator assembly | 7. Reservoir tank |
| 3. Mounting insulator | 8. Over flow hose |
| 4. Radiator mounting bracket | 9. ATF cooler hose |
| 5. Radiator upper hose | |

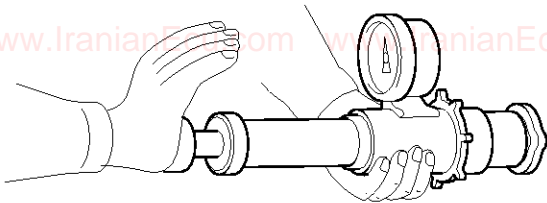
Cooling System

EM-101

Inspection

Radiator Cap Testing

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

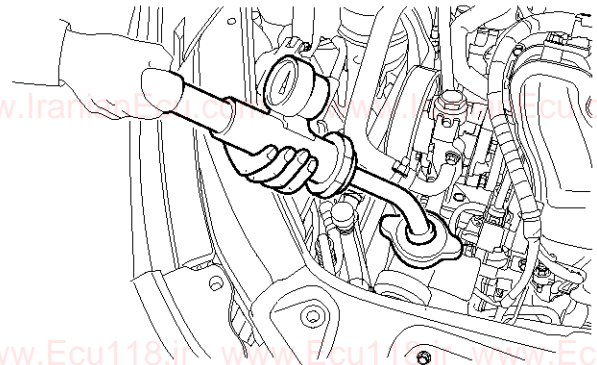


ECKD501X

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

Radiator Leakage Test

1. Wait until engine is cool, then carefully remove the radiator cap and fill the radiator with engine coolant, then install it on the pressure tester (A).



STFEM1035D

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

NOTICE

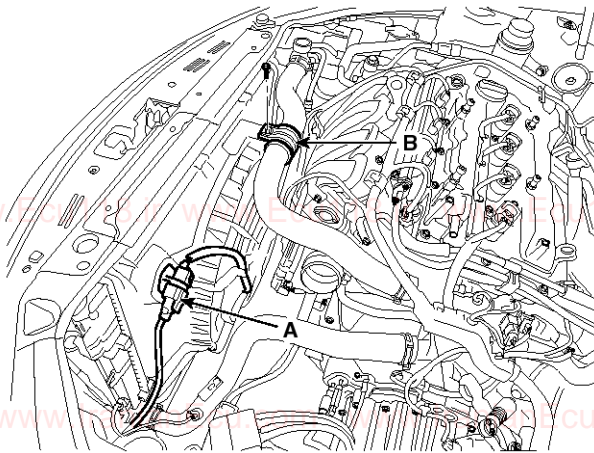
Check for engine oil in the coolant and/or coolant in the engine oil.

EM-102

Engine Mechanical System

Removal and Installation

1. Disconnect the battery terminals. (Refer to Engine and transaxle assembly in this group)
2. Remove the air cleaner assembly. (Refer to Engine and transaxle assembly in this group)
3. Remove the battery and battery tray. (Refer to Engine and transaxle assembly in this group)
4. Disconnect the fan motor connector (A)
5. Remove the radiator upper hose clip bolt (B).

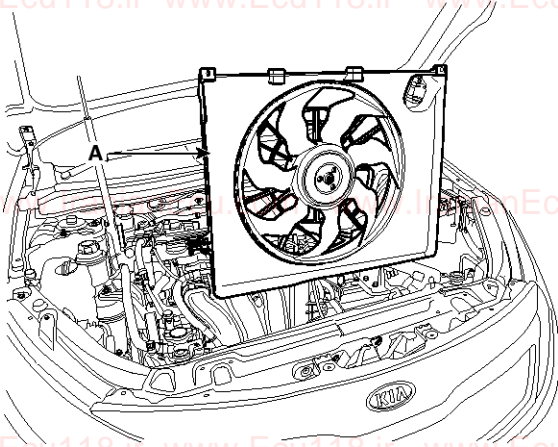


STFEM1047D

6. Remove the cooling fan assembly (A).

Tightening torque :

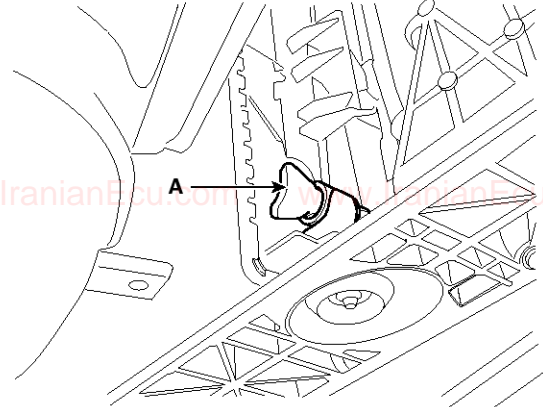
4.9 ~ 7.8 N.m (0.5 ~ 0.8 kgf.m, 3.6 ~ 5.8 lb-ft)



STFEM1020D

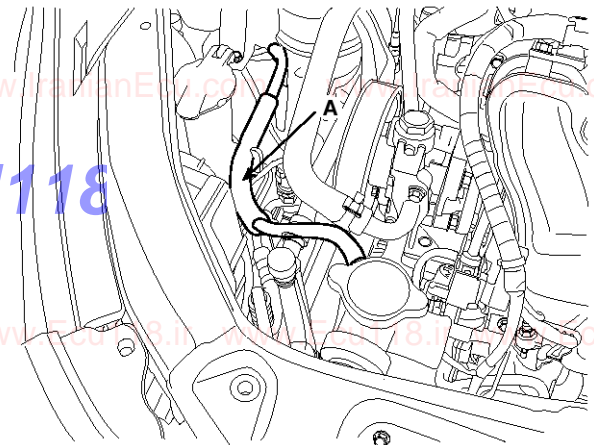
7. Remove the under cover. (Refer to Engine and transaxle assembly in this group)

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



SYFEM0030N

9. Disconnect the over flow hose (A) from the radiator.

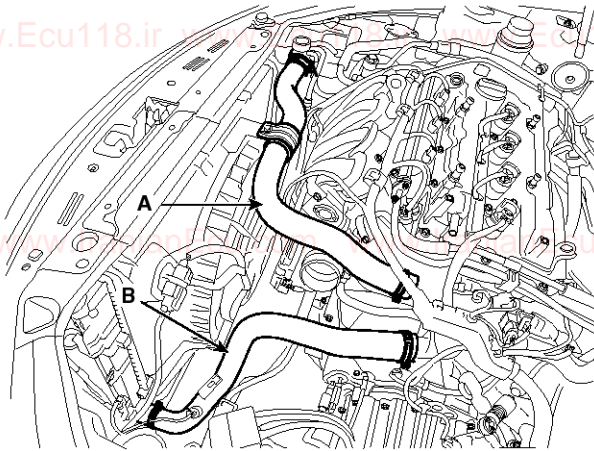


STFEM1046D

Cooling System

EM-103

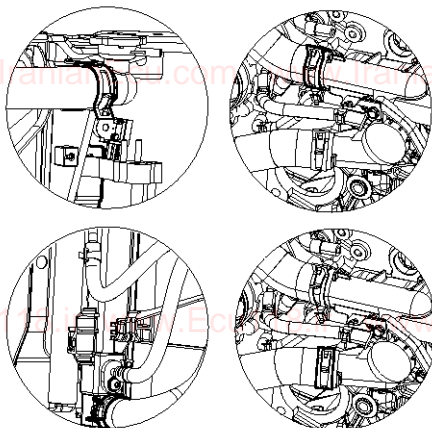
10. Disconnect the radiator upper hose (A) and lower hose (B).



STFEM1048D

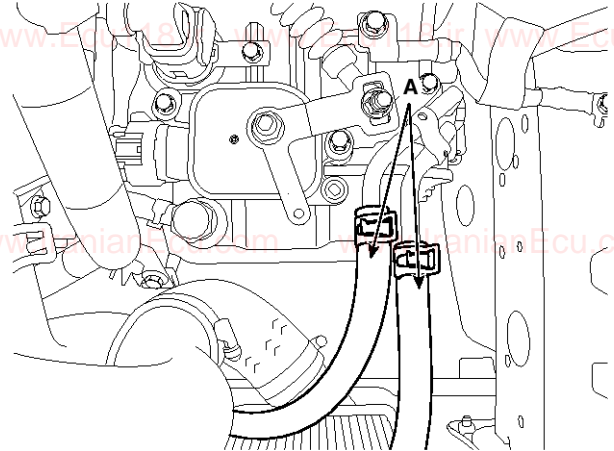
NOTICE

Install the radiator hoses as shown illustrations.



SVGEM0104D

11. Disconnect the ATF cooler hoses (A/T only). (Refer to AT group)

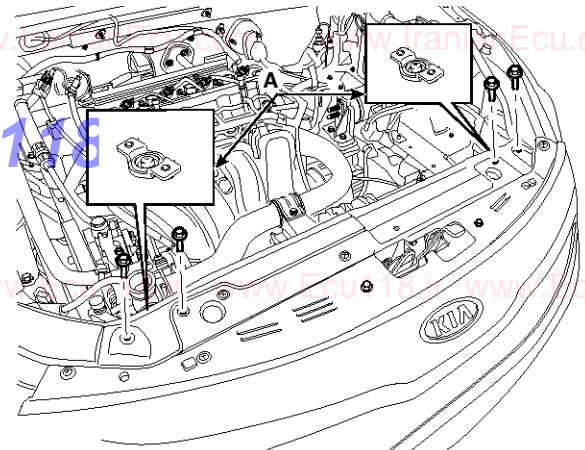


STFEM1061D

12. Remove the radiator mounting brackets (A).

Tightening torque:

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

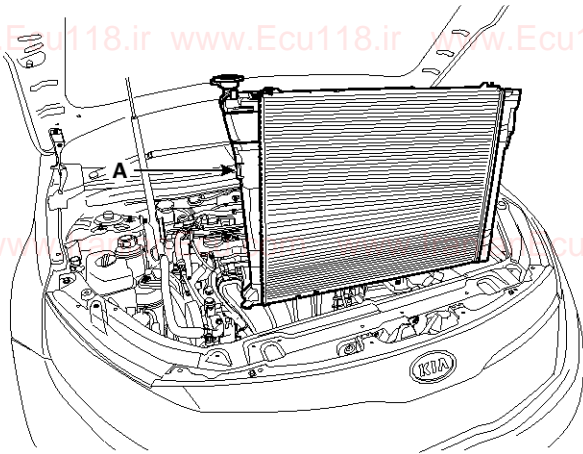


STFEM1017D

EM-104

Engine Mechanical System

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



STFEM1021D

14. Installation is the reverse order of removal.
15. Fill the radiator with coolant and check for leaks.

NOTICE

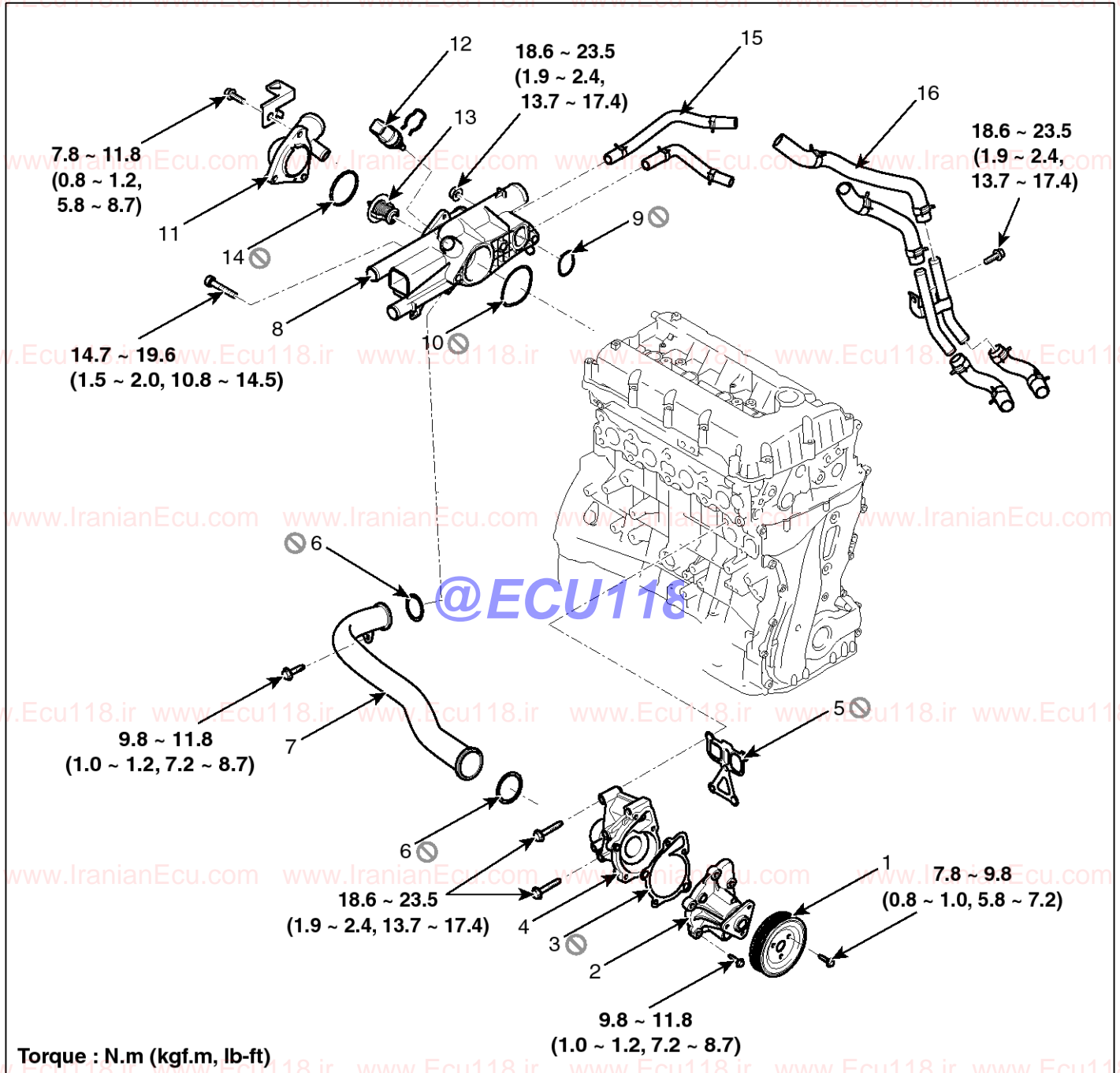
- *Bleed air from the cooling system.*
 - *Start engine and let it run until it warms up. (Until the radiator fan operates 3 or 4 times.)*
 - *Turn off engine. Check the coolant level and add coolant if needed. This will allow trapped air to be removed from the cooling system.*
 - *Put the radiator cap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

Cooling System

EM-105

Water pump

Components



SSLM10146N

- | | | |
|---|---|--|
| 1. Water pump pulley | 7. Water inlet pipe | 12. Engine coolant temperature sensor |
| 2. Water pump sub assembly (Water pump housing) | 8. Water temperature control assembly | 13. Thermostat |
| 3. Water pump housing gasket | 9. Water temperature control assembly gasket A | 14. Thermostat gasket |
| 4. Water pump cover | 10. Water temperature control assembly gasket B | 15. Throttle body coolant hose (if equipped) |
| 5. Water pump gasket | 11. Water inlet fitting | 16. Oil cooler coolant hose (2.4L only) |

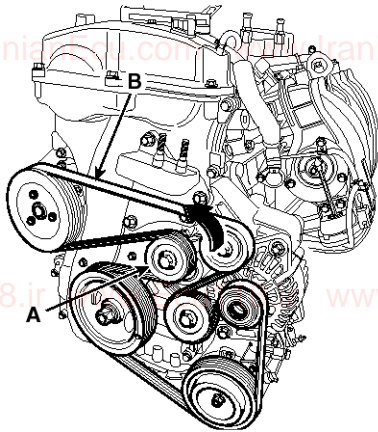
EM-106

Engine Mechanical System

Removal and Installation

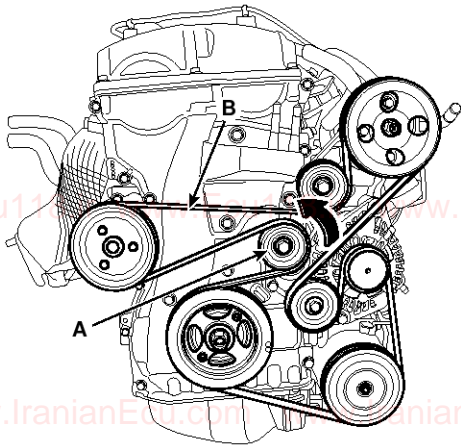
1. Loosen the drain plug, and then drain the engine coolant. Remove the radiator cap to help drain the coolant faster.
2. Remove the drive belt (B) after turning the drive belt tensioner (A) counterclockwise.

[MDPS]



STFEM1054D

[HPS]

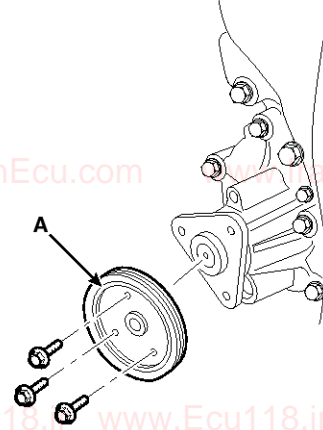


STFEM1011D

3. Remove the water pump pulley (A).

Tightening torque :

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

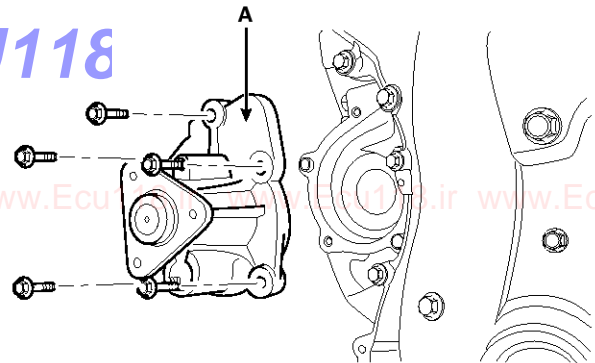


SYFEM0164N

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

Tightening torque :

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



SYFEM0064N

@ECU118

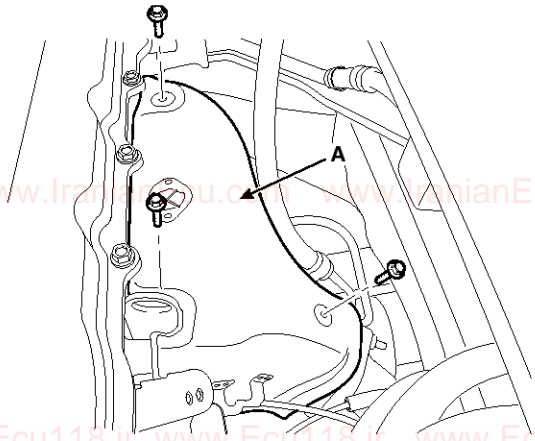
Cooling System

EM-107

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

Tightening torque :

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



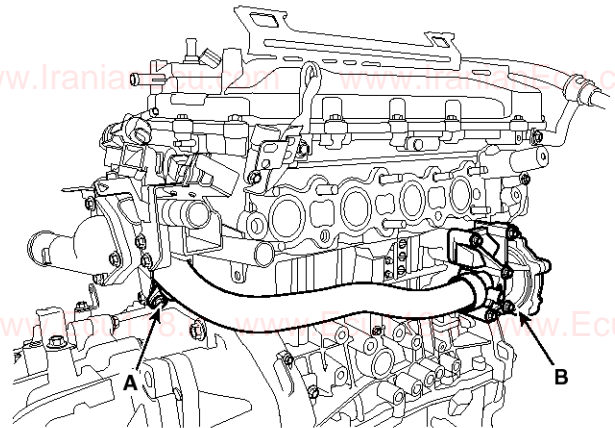
SVGEM0010D

6. Remove the water pump cover (B) with the gasket and the water inlet pipe (A).

Tightening torque :

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

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



SVGEM0174D

7. Installation is reverse order of removal with a new water pump gasket.

8. Fill the engine coolant.

9. Start the engine and check for leaks.

10. Recheck the coolant level.

Inspection

1. Check each part for cracks, damage or wear, and replace the coolant pump assembly if necessary.

2. Check the bearing for damage, abnormal noise and sluggish rotation, and replace the coolant pump assembly if necessary.

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

NOTICE

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

@ECU118

EM-108

Engine Mechanical System

Troubleshooting

Water Pump

| Symptoms | Possible Causes | Remedy | |
|-----------------|---|--|---|
| Coolant leakage | • From the bleed hole of the water pump | Visually check | <ul style="list-style-type: none"> • Check leaks after about ten-minute warming up. • If coolant still leaks, replace a water pump. • If leakage stops, reuse the water pump (Do not replace the pump with a new one). |
| | • From gaskets or bolts | | <ul style="list-style-type: none"> • Check the tightening of the water pump mounting bolts. • Retighten the mounting bolts. |
| | • From outer surface of water pump | | <ul style="list-style-type: none"> • Check damage of gaskets or inflow of dust. • Replace the gasket and clean dust off. • Check the material or any cracks of the water pump. • Poor material. If any crack found, replace the water pump. |
| Noise | <ul style="list-style-type: none"> • From bearings • From mechanical seals • Impeller interference | Inspection with a stethoscope | <ul style="list-style-type: none"> • After starting the engine, check noise with a stethoscope. • If there is no noise, reuse the water pump (do not replace it). • If there is any noise from the water pump, remove the drive belt and recheck. |
| | | Inspection after removing a drive belt | <ul style="list-style-type: none"> • After removing a water pump and a drive belt, check noise again. • If there is noise, reuse the water pump. Check other drive line parts. • If there is no noise, replace the water pump with a new one. |
| | | Inspection after removing a water pump | <ul style="list-style-type: none"> • After removing a water pump and a drive belt, check noise again. • If there is any interference between them, replace the water pump with a new one. |
| Overheating | <ul style="list-style-type: none"> • Damaged impeller • Loosened impeller | Loosened impeller | <ul style="list-style-type: none"> • Corrosion of the impeller wing • Check engine coolant. • Poor coolant quality / Maintenance check |
| | | | <ul style="list-style-type: none"> • Impeller separation from the shaft • Replace the water pump. |

Cooling System

EM-109

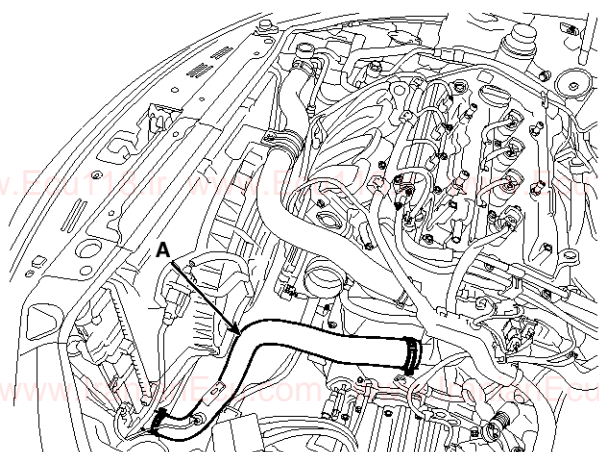
Thermostat

Removal and Installation

NOTICE

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

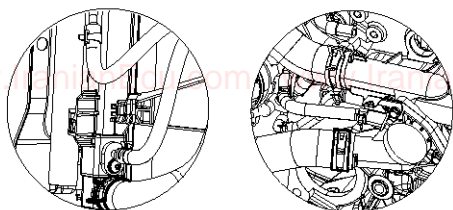
1. Drain engine coolant so its level is below thermostat.
2. Disconnect the radiator lower hose (A).



STFEM1036D

NOTICE

When installing radiator hoses, install as shown in illustrations.

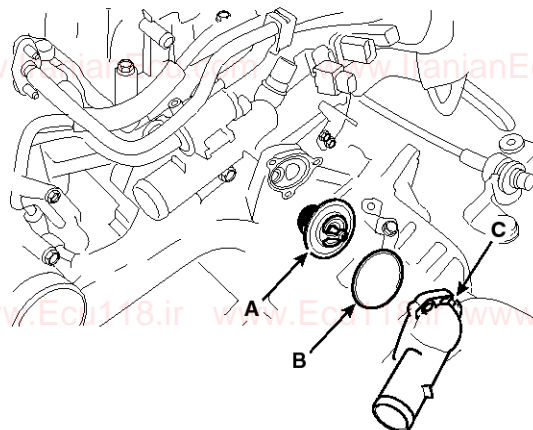


SVGEM0158D

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

Tightening torque :

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



SXMM19026D

4. Installation is reverse order of removal.

CAUTION

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

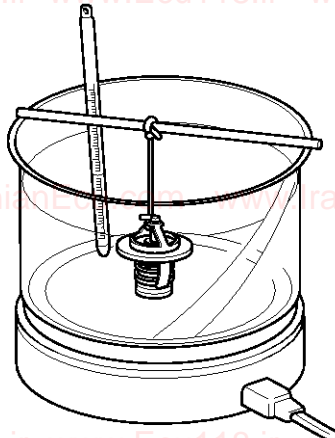
5. Fill the engine coolant.
6. Start the engine and check for leaks.
7. Recheck the coolant level.

EM-110

Engine Mechanical System

Inspection

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



KCRF226A

2. Check the valve opening temperature.

Valve opening temperature: $82 \pm 1.5^{\circ}\text{C}$ ($179.6 \pm 34.7^{\circ}\text{F}$)

Full opening temperature: 95°C (203°F)

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

3. Check the valve lift.

Valve lift : 8mm (0.3in.) or more at 95°C (203°F)

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

@ECU118

Cooling System

EM-111

Troubleshooting

| Symptoms | | Possible Causes | | Remedy |
|--------------------|--|---|---|--|
| Coolant leakage | <ul style="list-style-type: none"> From the thermostat gasket | Check the mounting bolts | <ul style="list-style-type: none"> Check the torque of the mounting bolts | <ul style="list-style-type: none"> Retighten the bolts and check leakage again. |
| | | Check the gasket for damage | <ul style="list-style-type: none"> Check gasket or seal for damage | <ul style="list-style-type: none"> Replace gaskets and reuse the thermostat. |
| Cooled excessively | <ul style="list-style-type: none"> Low heater performance (cool air blows-out) Thermogauge indicates 'LOW' | Visually check after removing the radiator cap. | <ul style="list-style-type: none"> Insufficient coolant or leakage. | <ul style="list-style-type: none"> After refilling coolant, recheck. |
| | | GDS check & Starting engine | <ul style="list-style-type: none"> Check DTCs Check the fan motor performance as temperature varies. Check connection of the fan clutch or the fan motor. ※ If the fan clutch is always connected, there will be a noise at idle. | <ul style="list-style-type: none"> Check the engine coolant sensor, wiring and connectors. Check the fan motor, the relay and the connector. Replace the components |
| | | Remove the thermostat and inspect | <ul style="list-style-type: none"> Check if there are dusts or chips in the thermostat valve. Check adherence of the thermostat. | <ul style="list-style-type: none"> Clean the thermostat valve and reuse the thermostat. Replace the thermostat, if it doesn't work properly |

EM-112

Engine Mechanical System

| Symptoms | | Possible Causes | | Remedy |
|--------------------|---|---|--|--|
| Heated excessively | <ul style="list-style-type: none"> • Engine overheated • Thermogauge indicates 'HI' | Visually check after removing the radiator cap. | <ul style="list-style-type: none"> • Insufficient coolant or leakage. <ul style="list-style-type: none"> ※ Be careful when removing a radiator cap of the overheated vehicle. • Check air in cooling system. | <ul style="list-style-type: none"> • After refilling coolant, re-check. • Check the cylinder head gaskets for damage and the tightening torque of the mounting bolts. |
| | | GDS check & Starting engine | <ul style="list-style-type: none"> • Check DTCs • Check the fan motor performance as temperature varies. • Check if the fan clutch slips. • Check the water pump adherence or impeller damaged. | <ul style="list-style-type: none"> • Check the engine coolant sensor, wiring and connectors. • Check the fan motor, the relay and the connector. • Replace the fan clutch, if it doesn't work properly. • Replace the water pump, if it doesn't work properly. |
| | | Immerse the thermostat in boiling water and inspection. | <ul style="list-style-type: none"> • After removing the thermostat, check it works properly. <ul style="list-style-type: none"> ※ Check the thermostat opens at the valve opening temperature. | <ul style="list-style-type: none"> • Replace the thermostat, if it doesn't work properly. |

Lubrication System

EM-113

Lubrication System

Engine Oil

Oil And Filter Replacement

⚠ CAUTION

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

1. Park the car on level ground.

Start the engine and let it warm up.

2. Drain engine oil.

1) Remove the oil filler cap.

2) After lifting the car, remove the oil drain plug (A) and drain oil into a container.

3. Replace the oil filter (B).

1) Remove the oil filter.

2) Check and clean the oil filter installation surface.

3) Check the part number of the new oil filter is as same as old one.

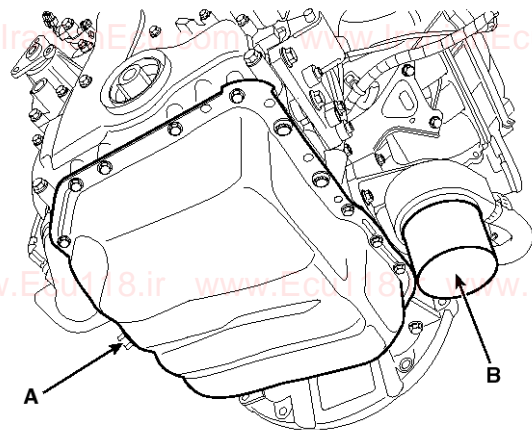
4) Apply clean engine oil to the gasket of a new oil filter.

5) Lightly screw the oil filter into place, and tighten it until the gasket contacts the seat.

6) Tighten it with the torque below.

Tightening torque :

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



SVGEM0178D

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

Tightening torque :

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

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

Capacity :

2.0L

Total : 4.7 L (1.24 U.S.gal., 4.97 U.S.qt., 4.13 Imp.qt.)

Oil pan : 3.8 L (1.00 U.S.gal., 4.01 U.S.qt., 3.34 Imp.qt.)

Drain and refill including oil filter :

4.1 L (1.08 U.S.gal., 4.33 U.S.qt., 3.61 Imp.qt.)

2.4L

Total : 5.5 L (1.43 U.S.gal., 5.71 U.S.qt., 4.75 Imp.qt.)

Oil pan : 4.2 L (1.11 U.S.gal., 4.44 U.S.qt., 3.70 Imp.qt.)

Drain and refill including oil filter :

4.6 L (1.21 U.S.gal., 4.86 U.S.qt., 4.05 Imp.qt.)

6. Install the oil filler cap.

7. Start engine and check for oil leaks and check the oil gauge or light for an indication of oil pressure.

8. Recheck the engine oil level.

EM-114

Engine Mechanical System

Inspection

1. Check the engine oil quality.

Check the oil deterioration, entry of water, discoloring of thinning. If the quality is visibly poor, replace the oil.

2. Check the engine oil level.

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

NOTICE

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

@ECU118

Lubrication System

EM-115

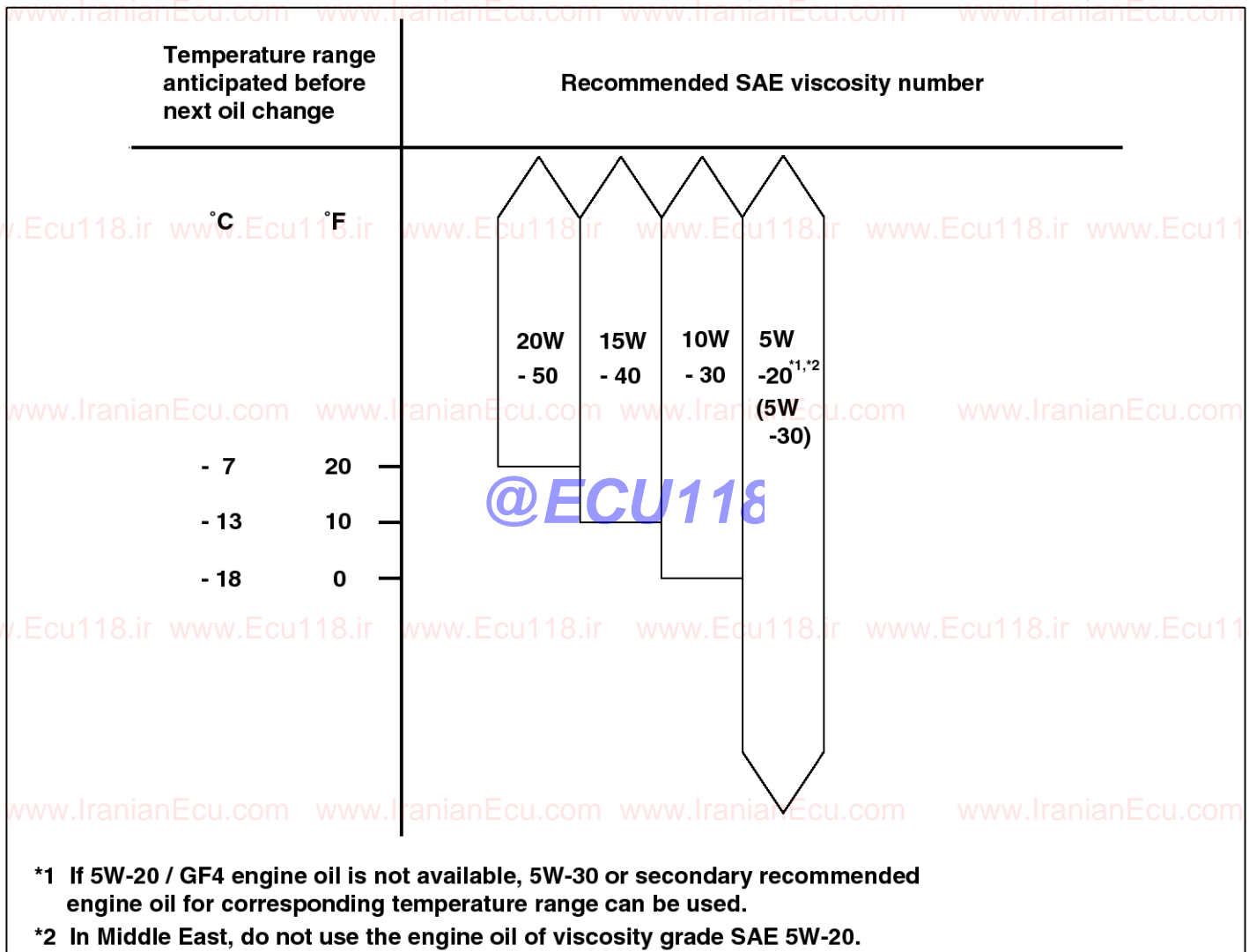
Selection Of Engine Oil

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

API classification: SL, SM or above

ILSAC classification : GF3, GF4 or above

SAE viscosity grade : Refer to the recommended SAE viscosity number



SAMM29103L

NOTICE

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

1. Satisfy the requirement of the API or ILSAC classification.
2. Have proper SAE grade number for expected ambient temperature range.

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

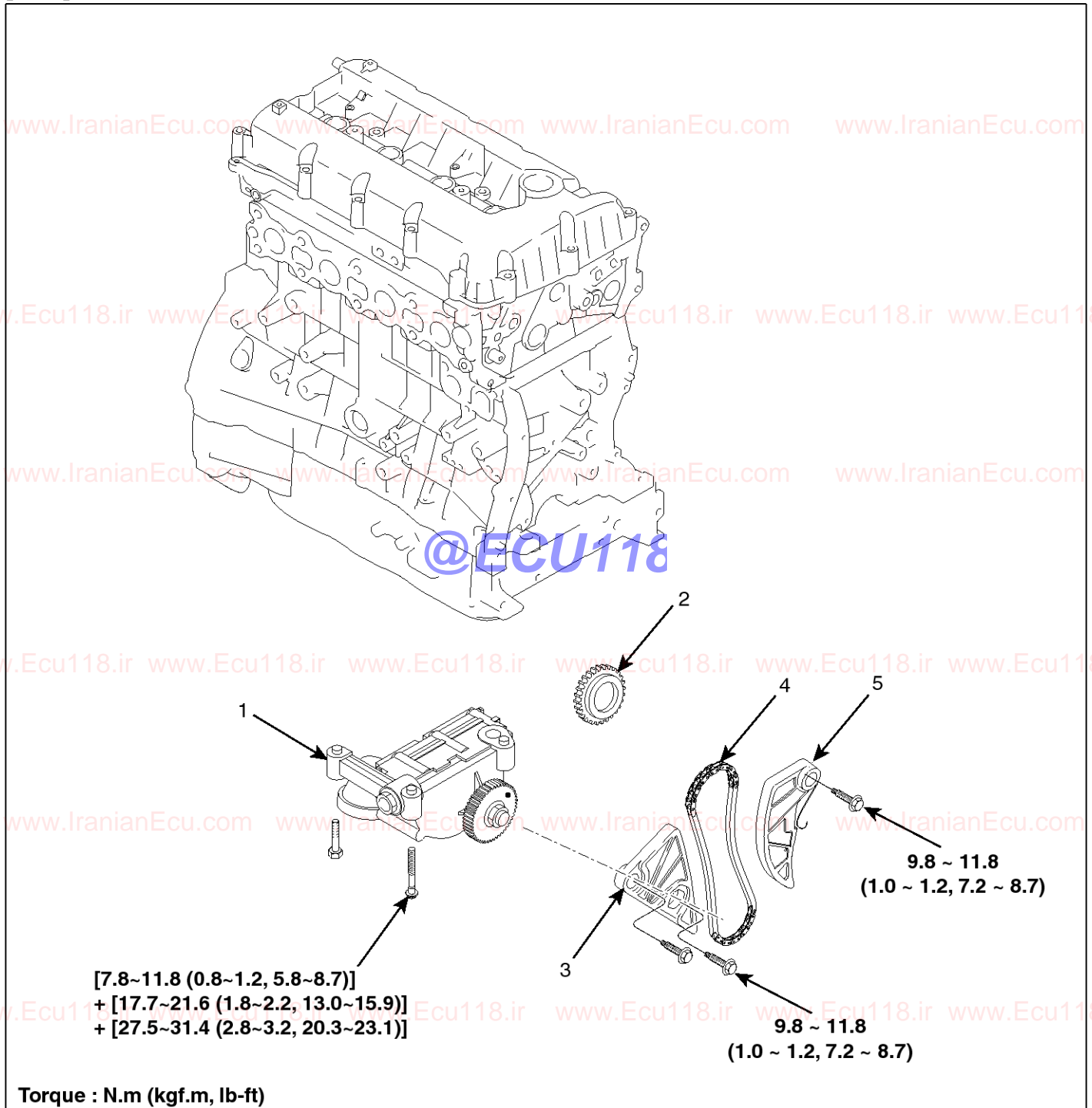
EM-116

Engine Mechanical System

Balance Shaft & Oil Pump

Components

[2.0L]



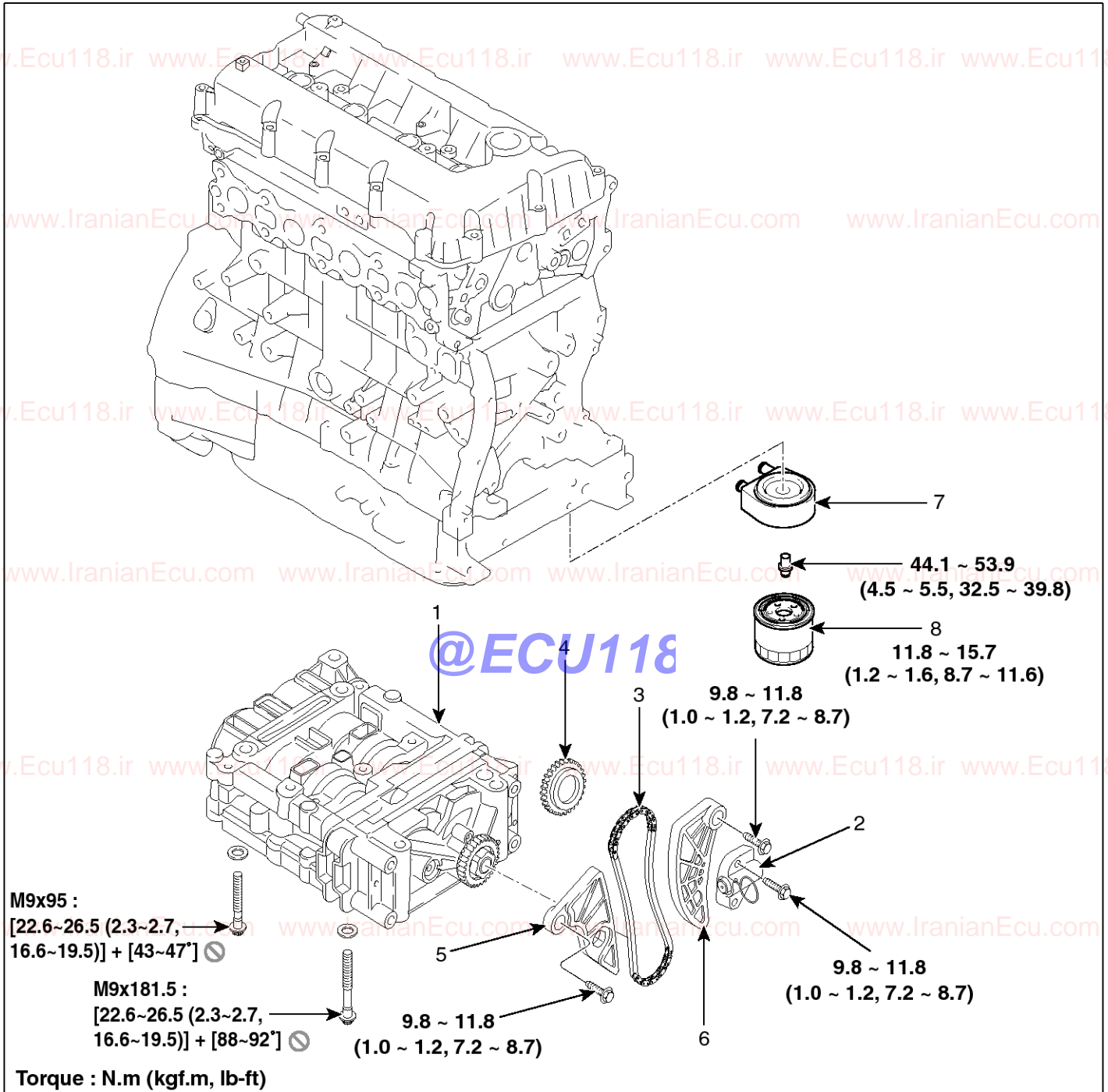
SLMM10009N

- 1. Oil pump
- 2. Oil pump chain sprocket
- 3. Oil pump chain guide
- 4. Oil pump chain
- 5. Oil pump chain mechanical tensioner

Lubrication System

EM-117

[2.4L]



STFEM1103L

- | | |
|--------------------------------------|--------------------------------------|
| 1. Balance shaft & oil pump assembly | 5. Balance shaft chain guide |
| 2. Balance shaft chain tensioner | 6. Balance shaft chain tensioner arm |
| 3. Balance shaft chain | 7. Oil cooler |
| 4. Balance shaft chain sprocket | 8. Oil filter |

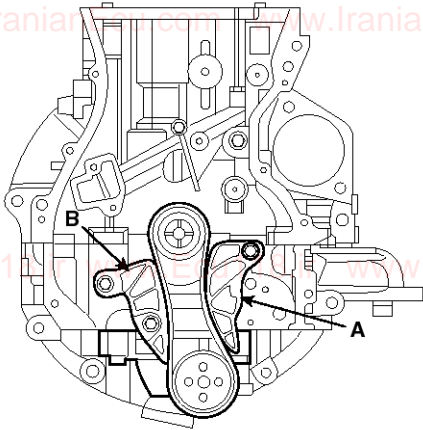
EM-118

Engine Mechanical System

Removal

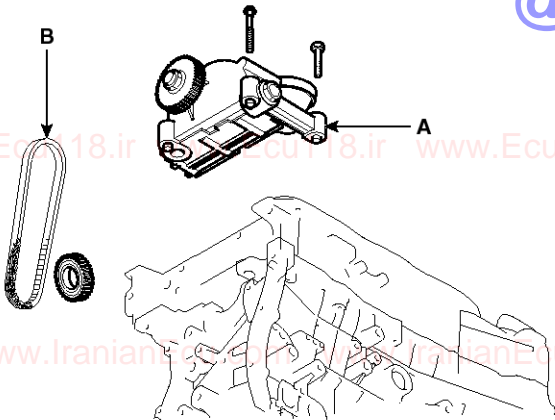
[2.0L]

1. Remove the timing chain.
(Refer to timing system in this group)
2. Remove the oil pump chain mechanical tensioner (A).
3. Remove the oil pump chain guide (B).



SYFM10116D

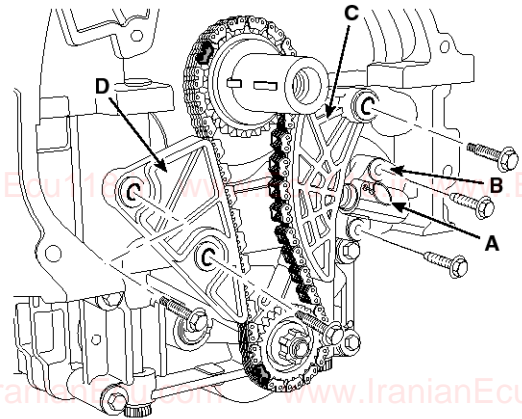
4. Remove the oil pump (A) with the oil pump chain (B).



SYFM10115D

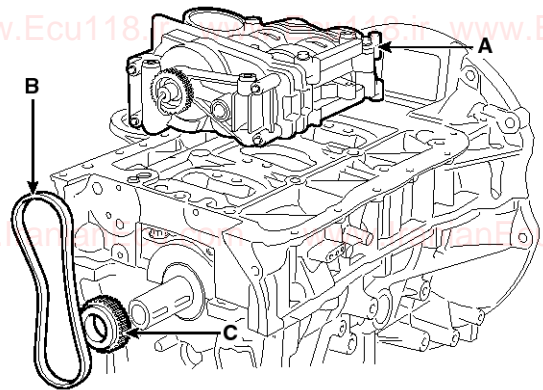
[2.4L]

1. Remove the timing chain. (Refer to Timing system in this group)
2. Install a stopper pin (A) after compressing the balance shaft chain tensioner.
3. Remove the balance shaft chain hydraulic tensioner (B).
4. Remove the balance shaft chain tensioner arm (C).
5. Remove the balance shaft chain guide (D).



SVGEM0176D

6. Remove the balance shaft & oil pump module (A) with the chain (B) and sprocket (C).



SSLM10156N

⚠ CAUTION

Do not disassemble the balance shaft & oil pump module.

Lubrication System

EM-119

Installation

[2.0L]

1. The key of crankshaft should be aligned with the mating face of main bearing cap. As a result of this, the piston of No.1 cylinder is placed at the top dead center on compression stroke.
2. Assemble the crankshaft sprocket on the crankshaft as the front mark on the crankshaft sprocket to be outward.
3. Tighten the oil pump tensioner (A) bolt after placing the tensioner spring on the dowel pin located in ladder frame, and then insert stopper pin (B) to fix the tensioner.

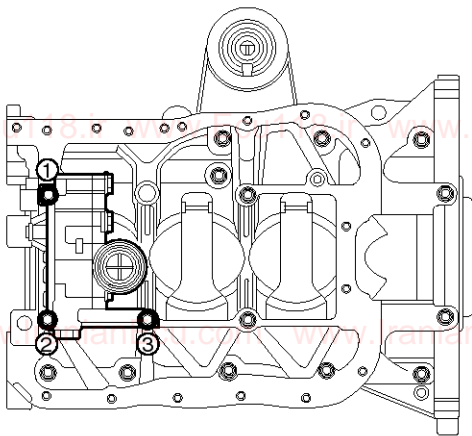
Tightening torque :

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

4. Assemble the oil pump chain on the crankshaft sprocket.
5. Assemble the oil pump assembly (C) on the ladder frame as placing oil pump sprocket in to oil pump.

Tightening torque :

7.8~11.8N.m (0.8~1.2kgf.m, 5.8~8.7lb.ft) +
 17.7~21.6N.m (1.8~2.2kgf.m, 13.0~15.9lb.ft) +
 27.5~31.4N.m (2.8~3.2kgf.m, 20.3~23.1lb.ft)



SMGEM8011D

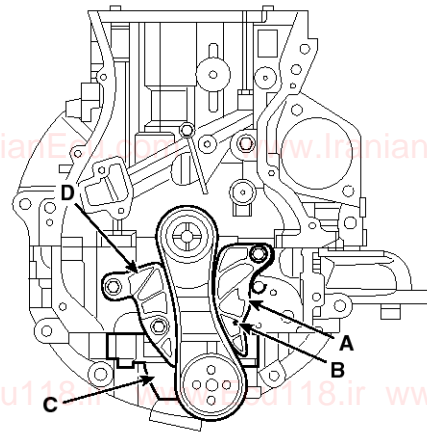
Bolting order

- a. Assemble the bolts in order number as shown with seating torque 26.5 N.m (2.7kgf.m, 19.5 lb-ft)
- b. Unfasten the bolts as reverse bolting order. (3-2-1)
- c. Assemble the bolts as specified bolting order in same increments as follows.

6. Install the oil pump chain guide (D) then remove the stopper pin.

Tightening torque :

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

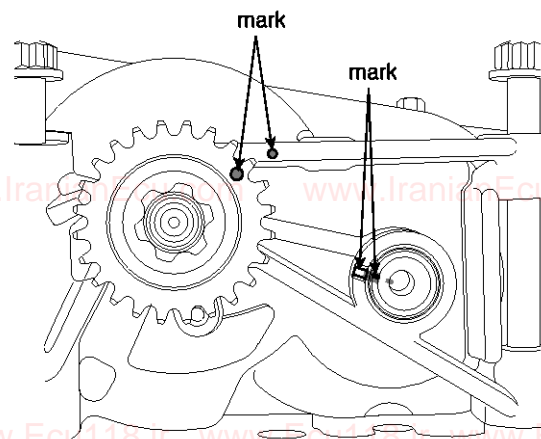


SSLM10119D

[2.4L]

1. The key of crankshaft should be aligned with the mating face of main bearing cap. As a result of this, the piston of No.1 cylinder is placed at the top dead center on compression stroke.
2. Confirm the balance shaft & oil pump module timing mark.

Timing marks to be visually aligned with centers of adjacent cast timing notches.

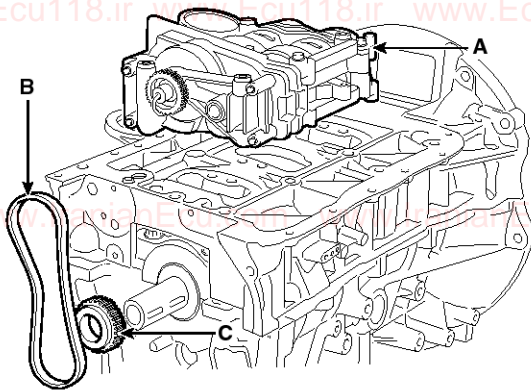


SNFEM8095L

EM-120

Engine Mechanical System

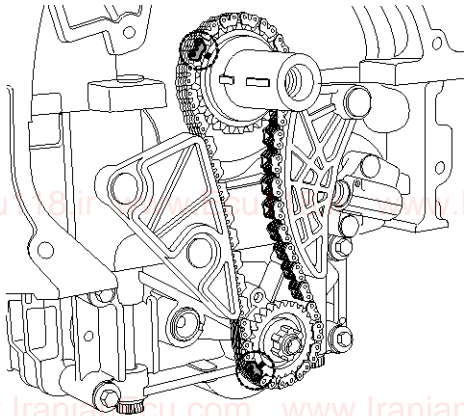
3. Install balance shaft & oil pump module (A) with the chain (B) and sprocket (C).



SSLM10156N

NOTICE

The timing marks of balance shaft & oil pump module sprocket and crankshaft sprocket should be matched with the timing marks (color link) of balance shaft chain.



SVGEM0177D

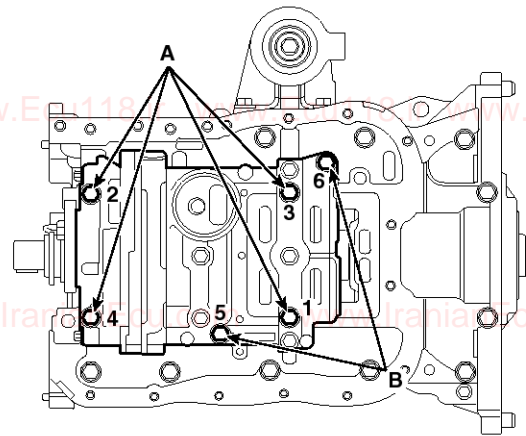
Tightening order

- 1) Tighten the bolts in order number as shown with seating torque 26.5 N.m (2.7kgf.m, 19.5 lb-ft) and then loosen the bolts as reverse tightening order (4-3-2-1).
- 2) Using the SST (09221-4A000), tighten the bolts as specified tightening order in same increments as follows.

Tightening torque :

Bolts (A) (M9x181.5) : 22.6~26.5N.m (2.3~2.7kgf.m, 16.6~19.5lb-ft) + 88~92°

Bolts (B) (M9x95) : 22.6~26.5N.m (2.3~2.7kgf.m, 16.6~19.5lb-ft) + 43~47°



SSLEM0001N

4. Install the balance shaft chain guide (D).

Tightening torque :

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

5. Install the balance shaft chain tensioner arm (C).

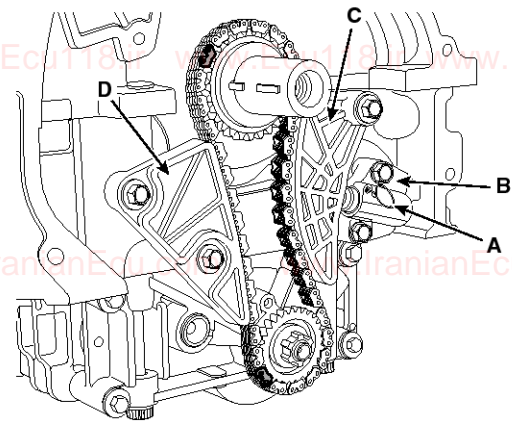
Tightening torque :

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

6. Install the balance shaft chain hydraulic tensioner (B) then remove the stopper pin (A).

Tightening torque :

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



SVGEM0182D

7. Confirm the timing marks.
8. Install the timing chain. (Refer to Timing system in this group)

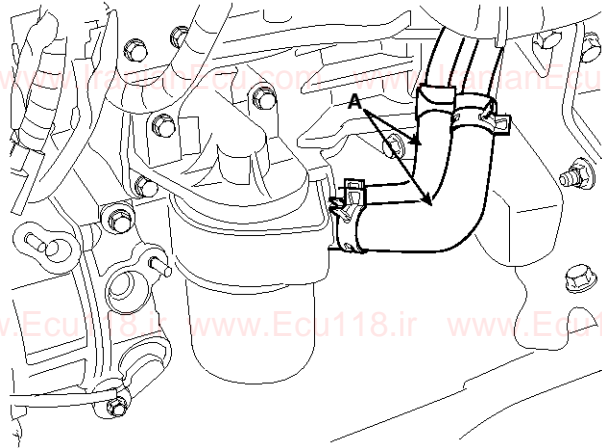
Lubrication System

EM-121

Oil Cooler

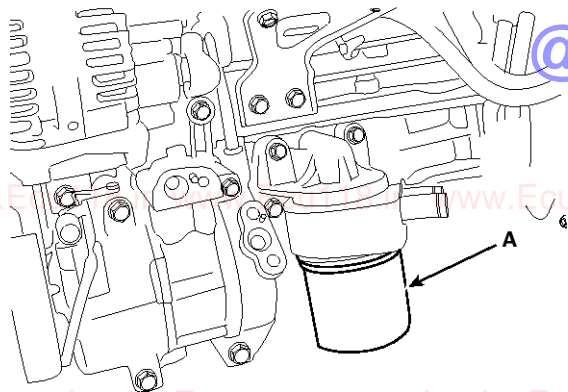
Removal

1. Loosen the drain plug, and drain the coolant.
Remove the radiator cap to speed draining.
2. Disconnect the oil cooler coolant hoses (A).



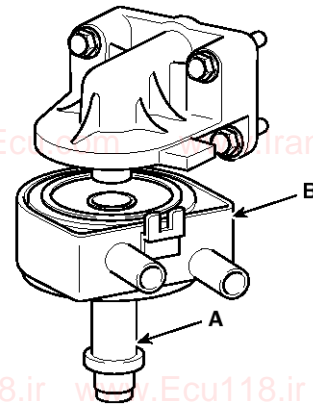
STFEM1083L

3. Remove the oil filter (A).



STFEM1084L

4. Loosen the mounting bolt (A) and remove the oil cooler assembly (B).



SXMM19017D

EM-122

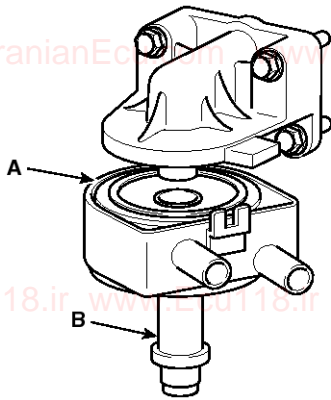
Engine Mechanical System

Installation

1. Apply a light coat of engine oil to the oil cooler packing surface (A), and then install the oil cooler with fix bolt (B).

Tightening torque:

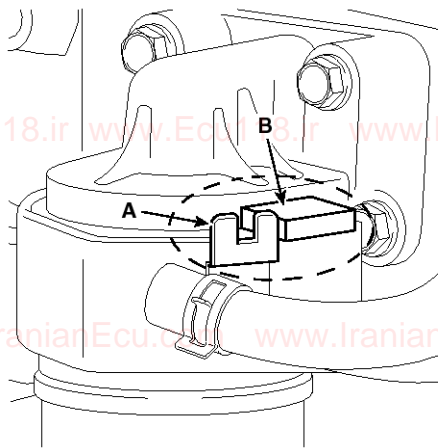
44.1 ~ 53.9 N.m (4.5 ~ 5.5 kgf.m, 32.5 ~ 39.8 lb-ft)



SXMM19032D

⚠ CAUTION

Fix position of oil cooler stopper(A) where oil cooler rests on ladder frame stopper (B).



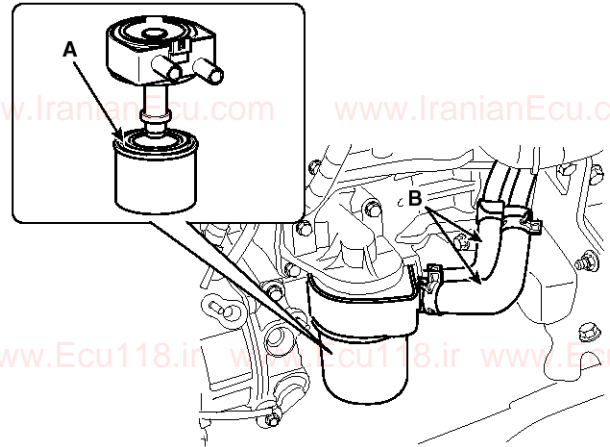
SXMM19033D

2. Apply a light coat of engine oil to the oil filter packing surface (A), and then install the oil filter.

Tightening torque:

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

3. Connect the oil cooler coolant hoses (B).



STFEM1085L

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

Lubrication System

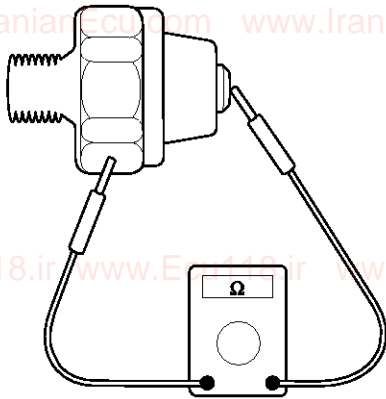
EM-123

Oil Pressure Switch

Inspection

1. Check the continuity between the terminal and the body with an ohmmeter.

If there is no continuity, replace the oil pressure switch.

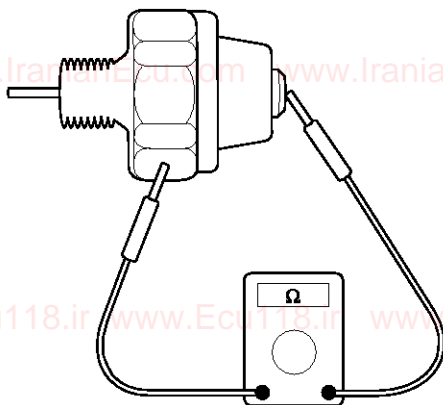


KCRF219A

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

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

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



KCRF220A

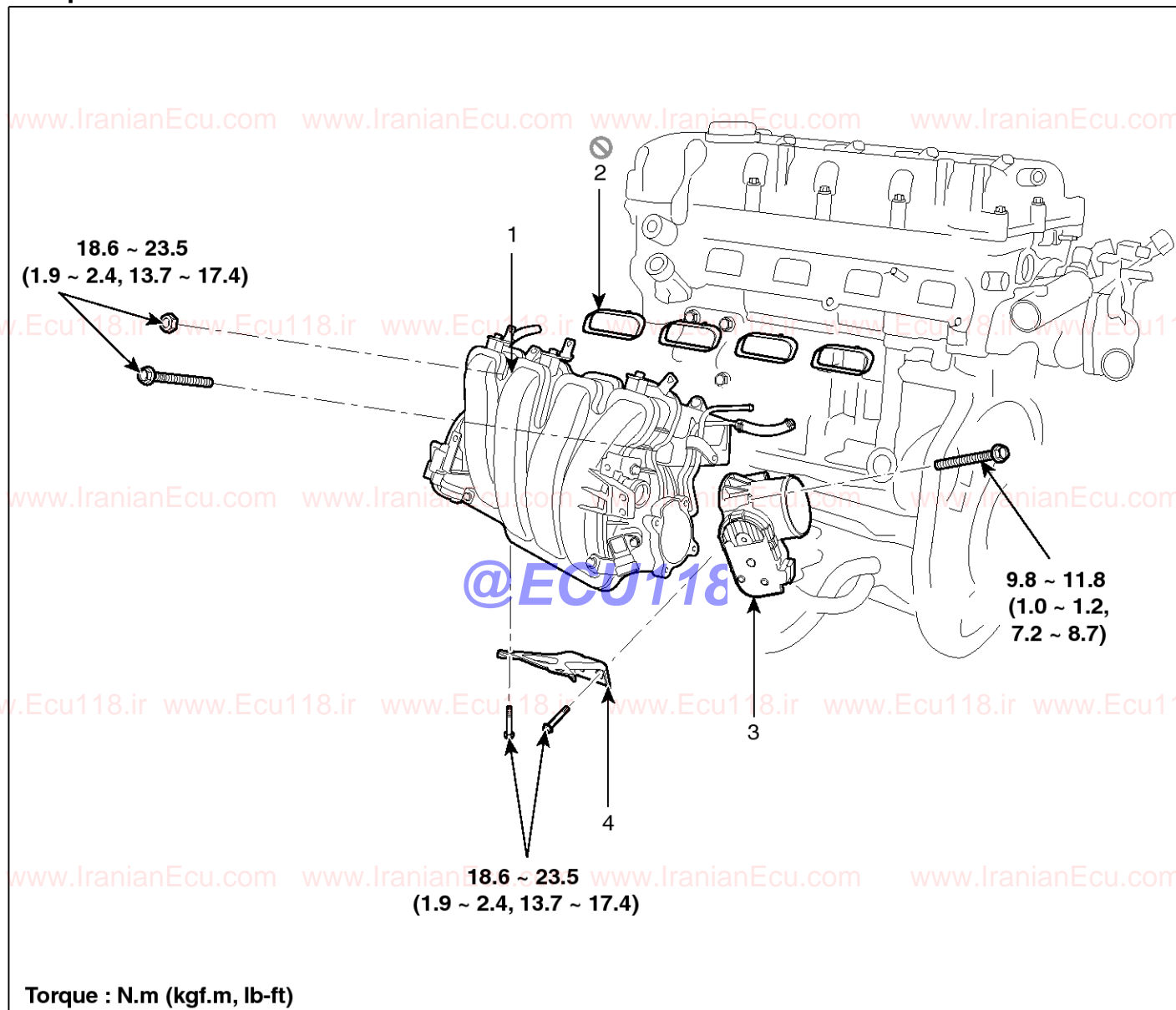
EM-124

Engine Mechanical System

Intake And Exhaust System

Intake Manifold

Components



SVG11127L

- 1. Intake manifold assembly
- 2. Intake manifold gasket

- 3. ETC (Electronic throttle body)
- 4. Intake manifold stay

Intake And Exhaust System

EM-125

Removal and Installation

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

Tightening torque:

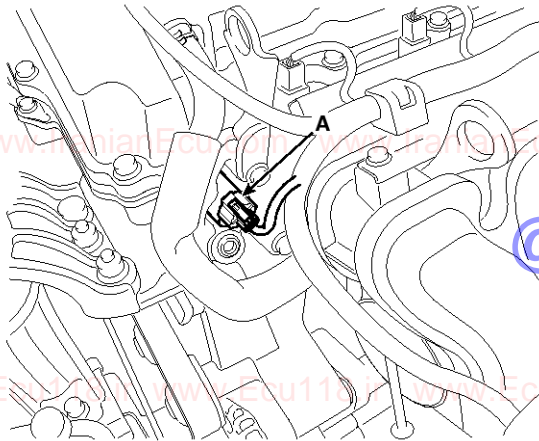
Without battery sensor :

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

With battery sensor :

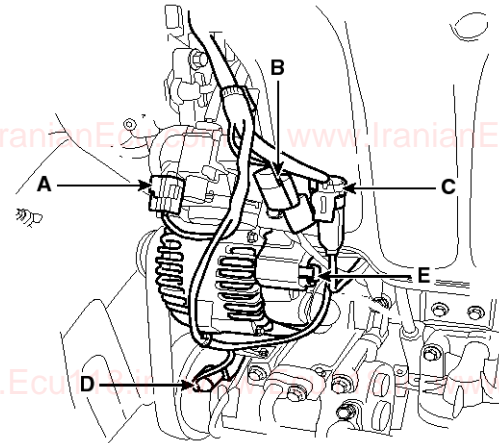
4.0 ~ 6.0N.m (0.4 ~ 0.6kgf.m, 3.0 ~ 4.4lb-ft)

3. Remove the air cleaner assembly. (Refer to Engine and transaxle assembly in this group)
4. Remove the under cover. (Refer to Engine and transaxle assembly in this group)
5. Disconnect the wiring connectors and harness clamps, and remove the wiring and protectors from the cylinder head and intake manifold.
 - 1) The intake OCV (Oil control valve) connector (A)



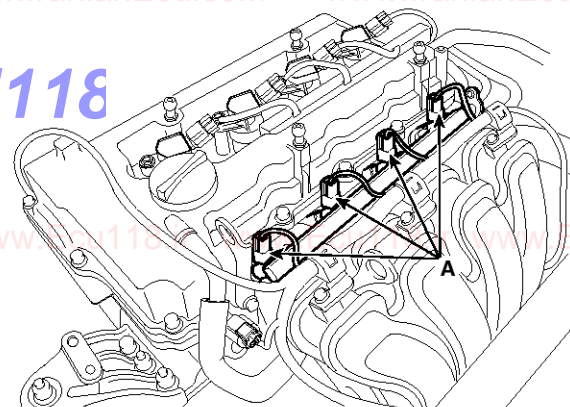
STFEM1030D

- 2) The VIS (Variable intake system) connector (A), the OPS (Oil pressure switch) connector (B), the knock sensor connector (C), the A/C compressor switch connector (D) and the alternator connector (E)



SSLM10123D

- 3) The injector connectors (A)

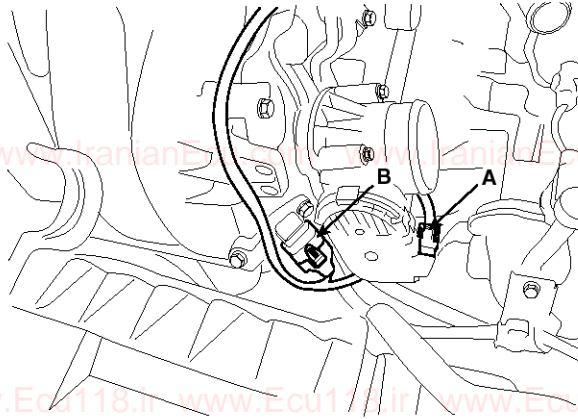


STFEM1037D

EM-126

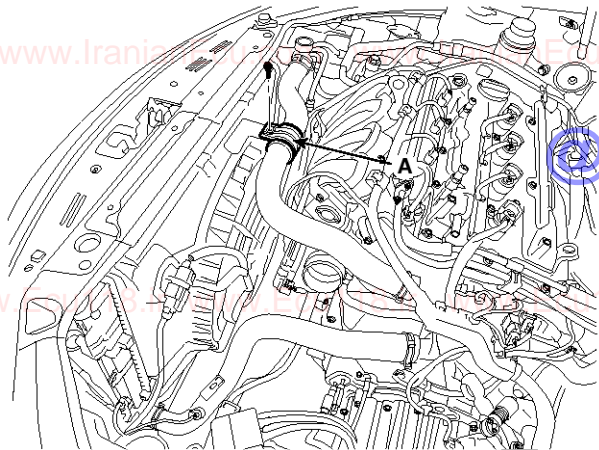
Engine Mechanical System

- 4) The ETC (Electronic throttle control) connector (A) and the MAPS (Manifold absolute pressure sensor) & IATS (Intake air temperature sensor) connector (B)



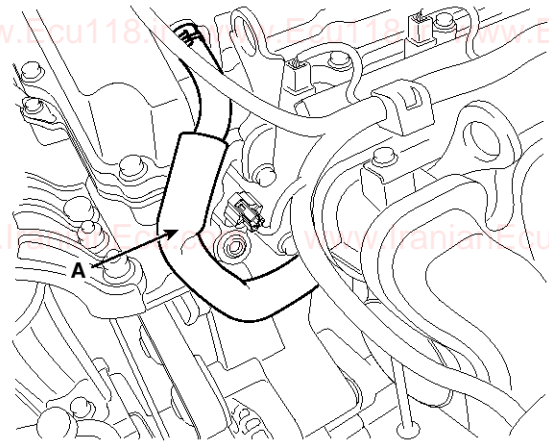
STFEM1031D

6. Remove the radiator upper hose clip (A).



STFEM1038D

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

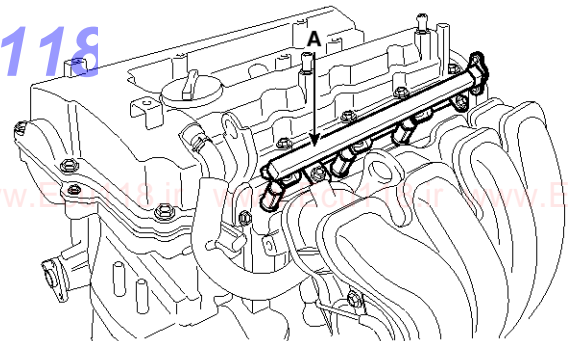


STFEM1028D

8. Remove the delivery pipe & injector assembly (A). (Refer to FL group)

Tightening torque :

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

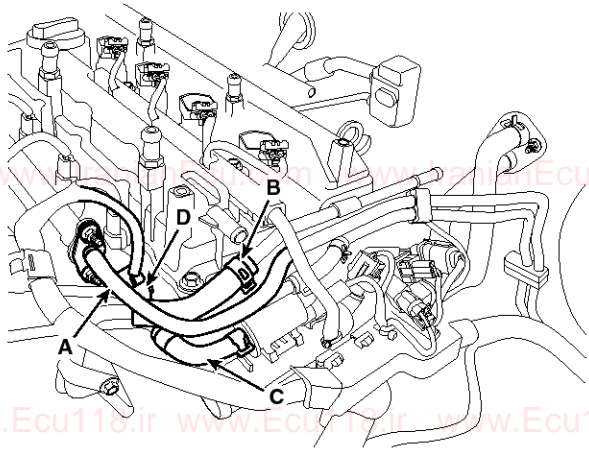


SSLM10147D

Intake And Exhaust System

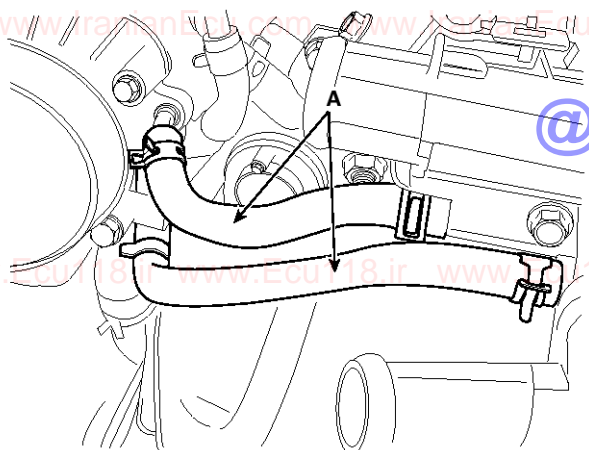
EM-127

9. Disconnect the fuel hose (A), the brake booster vacuum hose (B), the PCSV (Purge control solenoid valve) hose (C), the intake CMPS (Camshaft position sensor) connector (D).



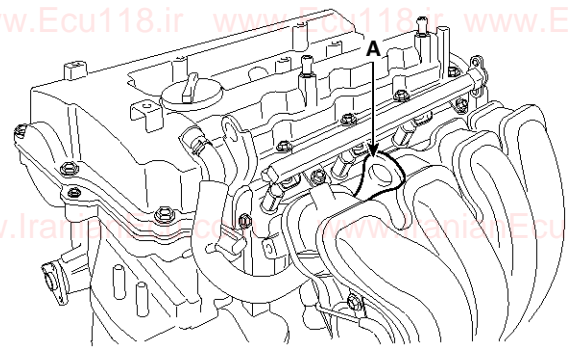
SYFEM0046D

10. Disconnect the throttle body coolant hoses (A). (if equipped)



SVG11117L

11. Remove the oil level gauge (A).

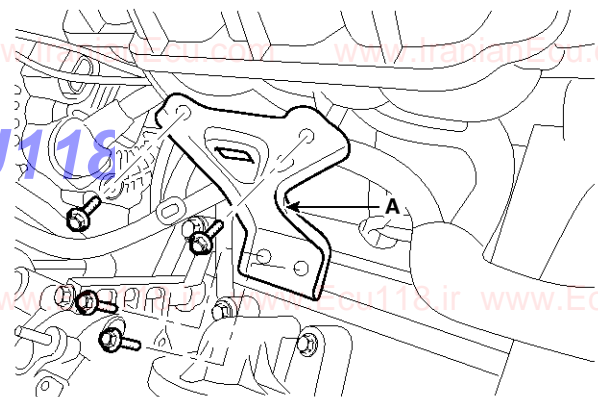


SSLM10133D

12. Remove the intake manifold stay (A).

Tightening torque :

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



SYFEM0068N

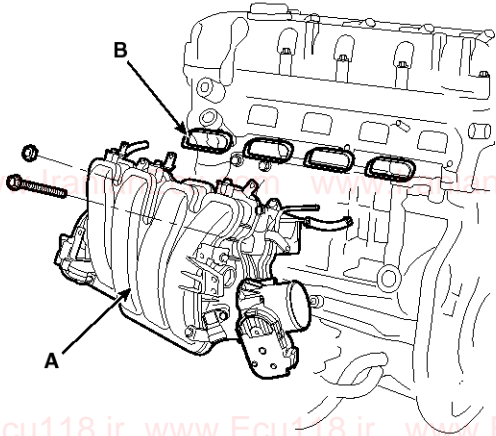
EM-128

Engine Mechanical System

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

Tightening torque :

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

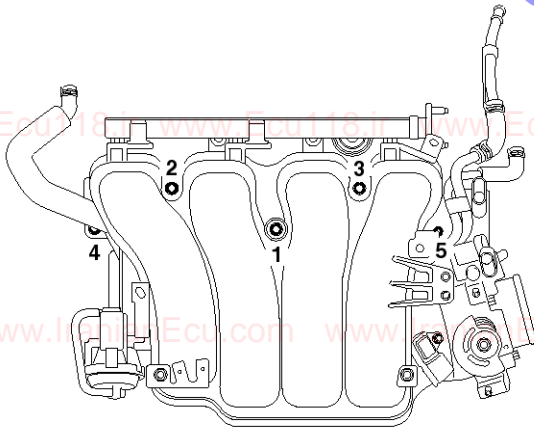


SVGEM0179D

NOTICE

When installing, replace with new gaskets.

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



SVGEM0019D

14. Installation is reverse order of removal.

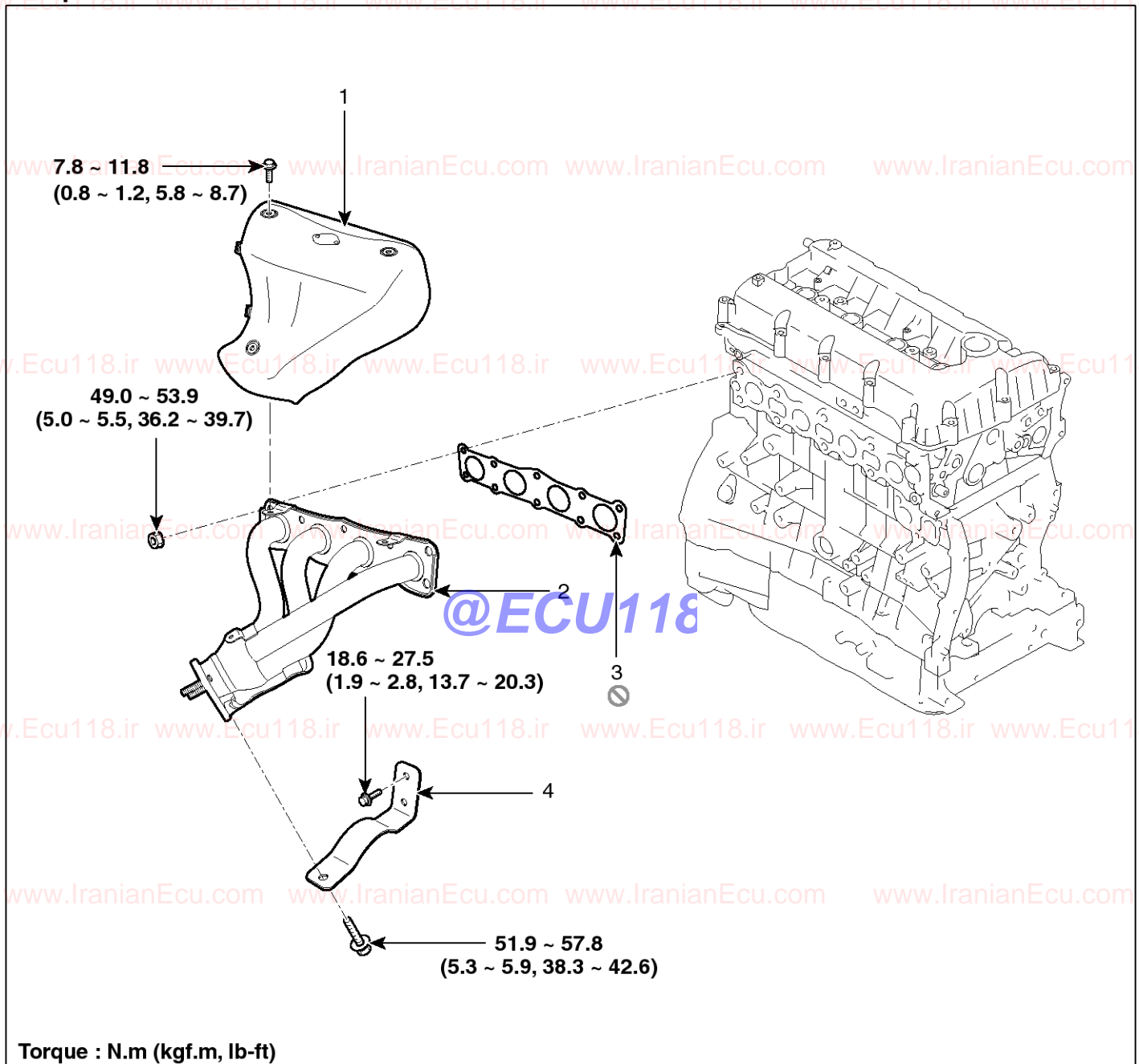
@ECU118

Intake And Exhaust System

EM-129

Exhaust Manifold

Components



- 1. Heat protector
- 2. Exhaust manifold

- 3. Exhaust manifold gasket
- 4. Exhaust manifold stay

SVG11131L

EM-130

Engine Mechanical System

Removal and Installation

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

Tightening torque:

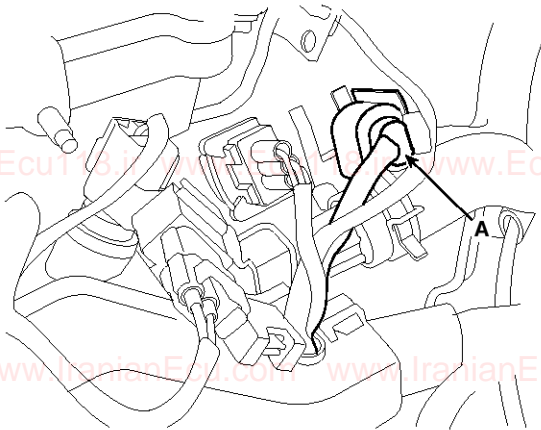
Without battery sensor :

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

With battery sensor :

4.0 ~ 6.0N.m (0.4 ~ 0.6kgf.m, 3.0 ~ 4.4lb-ft)

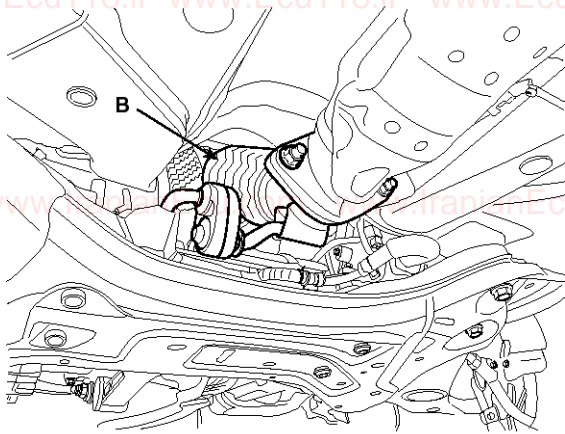
3. Remove the front muffler (B) after disconnect the front oxygen sensor connector (A).



SYFEM0142N

Tightening torque:

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

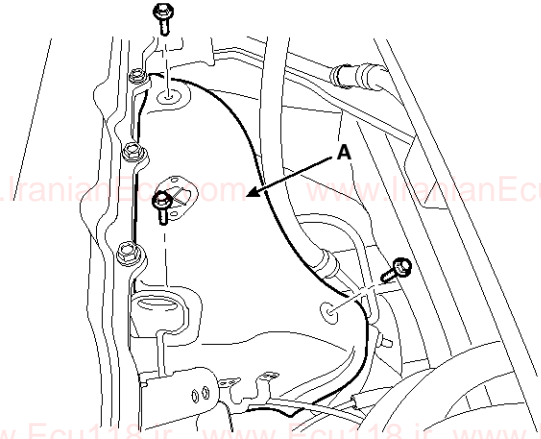


STFEM1009D

4. Remove the exhaust manifold heat protector (A).

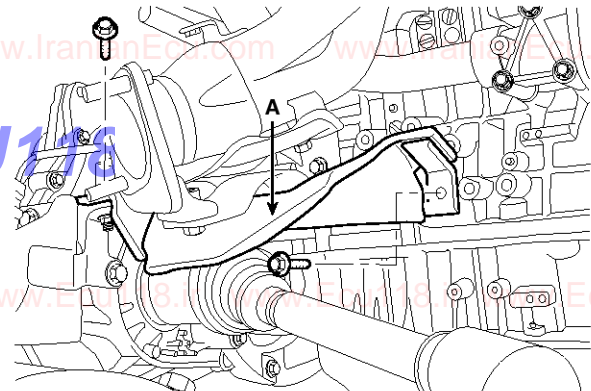
Tightening torque :

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



SVGEM0010D

5. Remove the driveshaft heat protector (A).



SYFEM0071N

Intake And Exhaust System

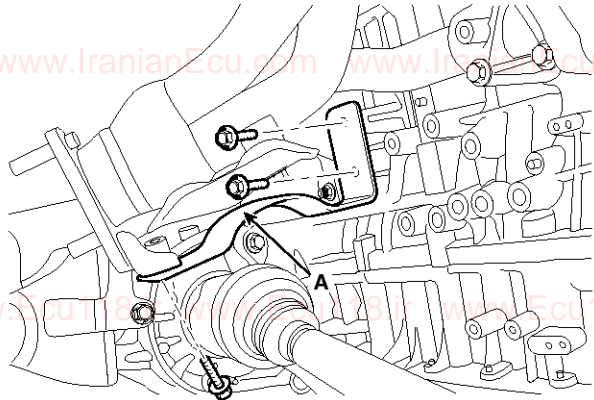
EM-131

6. Remove the exhaust manifold stay (A).

Tightening torque :

M8 bolts(B): 18.6 ~ 27.5N.m (1.9 ~ 2.8kgf.m, 13.7 ~ 20.3lb-ft)

M10 bolts(C): 51.9 ~ 57.8.m (5.3 ~ 5.9kgf.m, 38.3 ~ 42.6lb-ft)

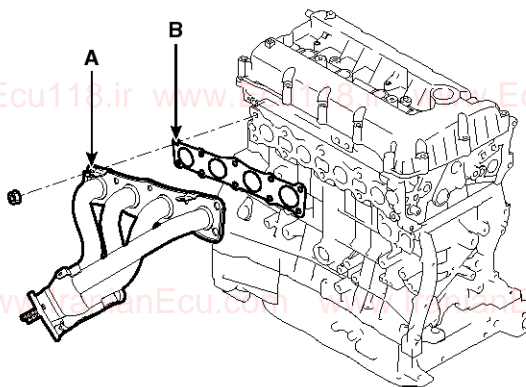


SYFEM0072N

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

Tightening torque

49.0 ~ 53.9N.m (5.0 ~ 5.5kgf.m, 36.2 ~ 39.7lb-ft)

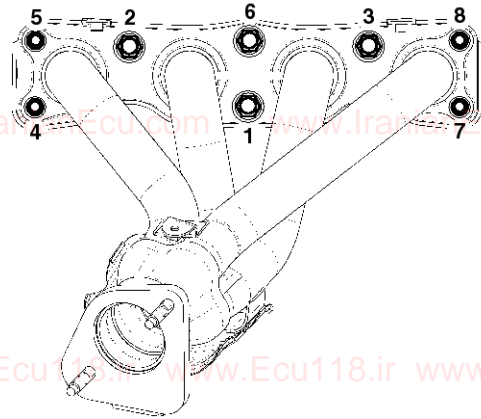


SVGEM0155D

NOTICE

When installing, replace with a new gasket.

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



SVGEM0020D

8. Installation is reverse order of removal.

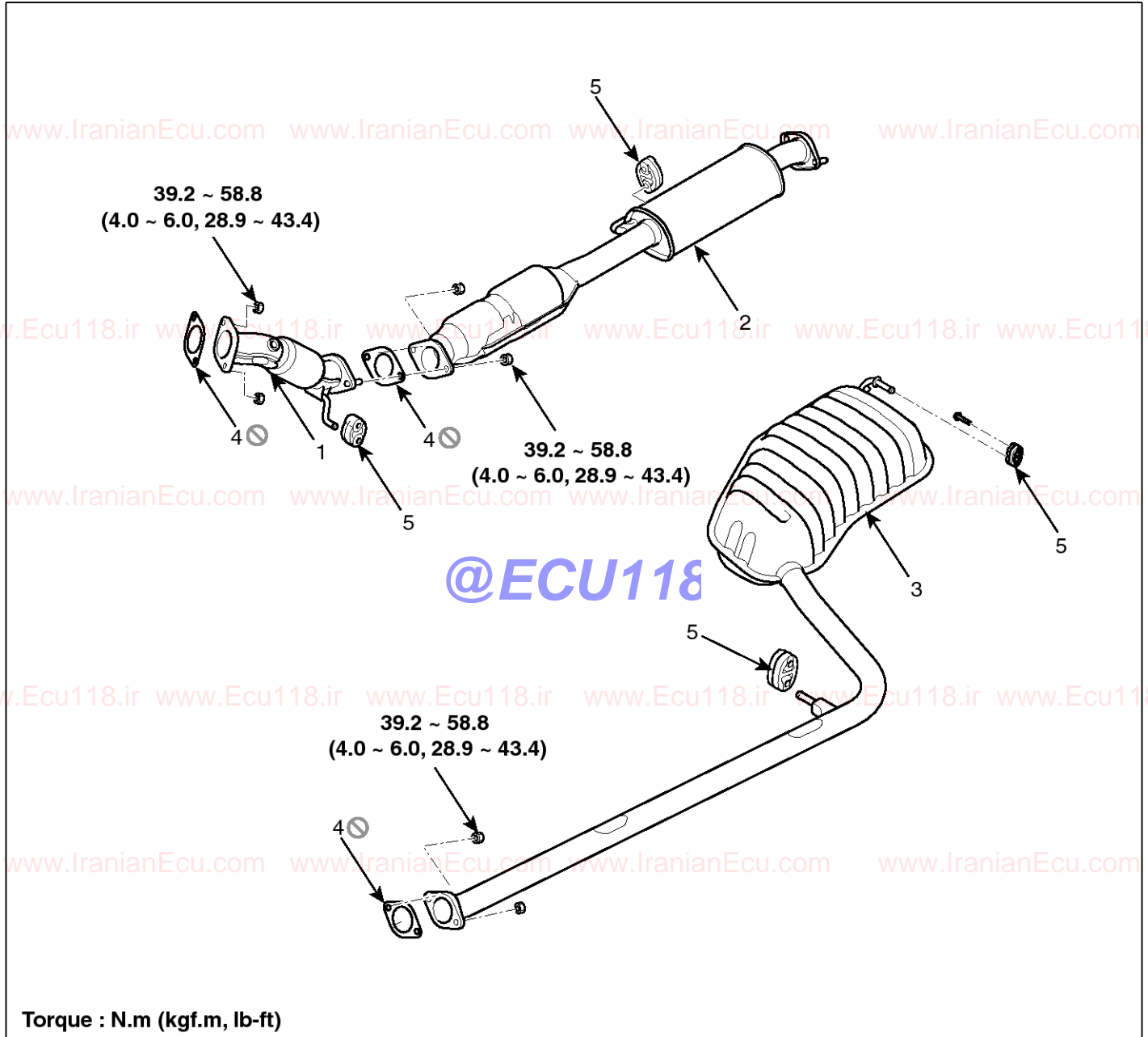


EM-132

Engine Mechanical System

Muffler

Components [2.0L]



STFEM1104L

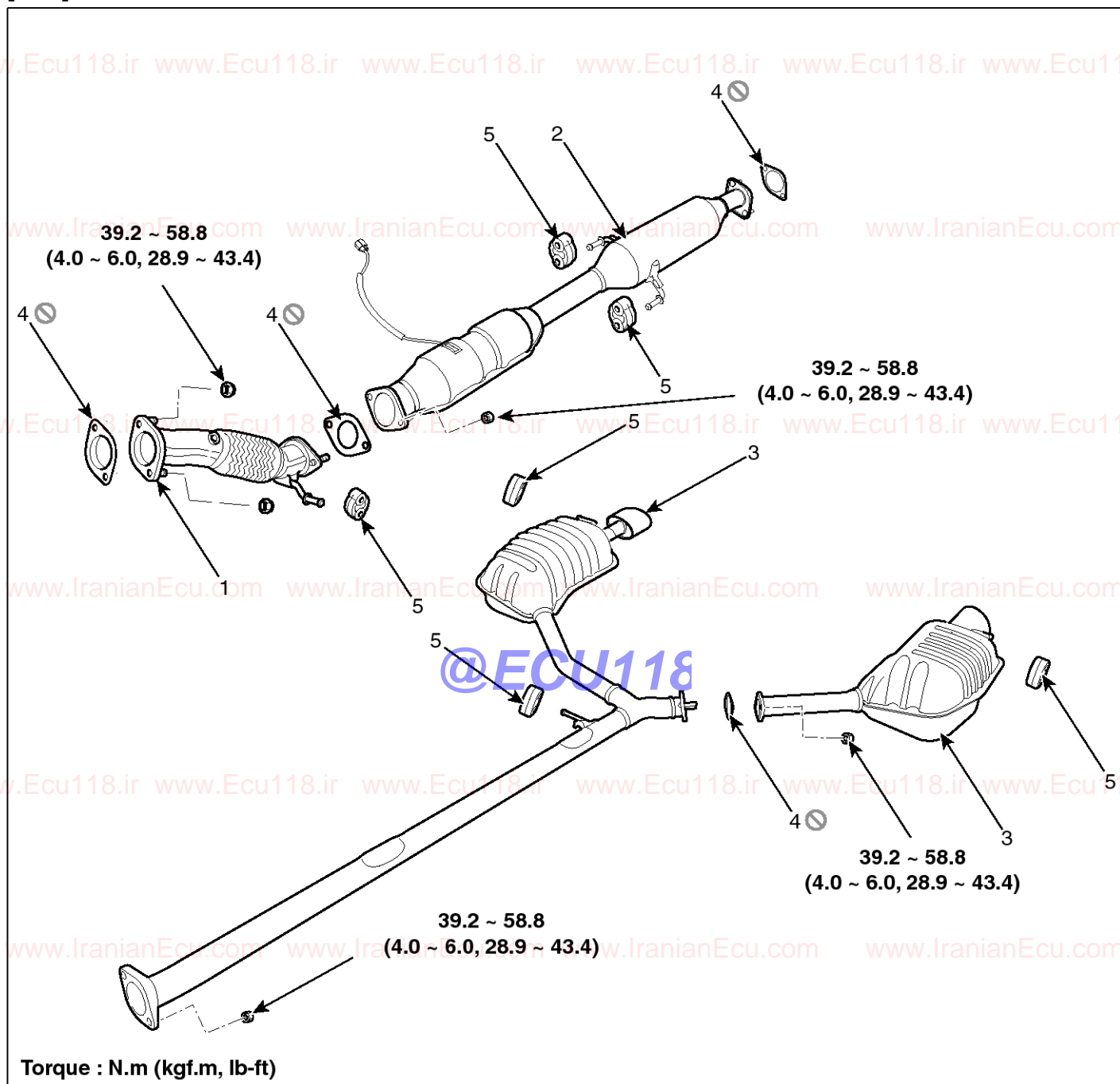
- 1. Front muffler
- 2. Catalytic converter & center muffler
- 3. Main muffler

- 4. Gasket
- 5. Hanger

Intake And Exhaust System

EM-133

[2.4L]



STFM10001N

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

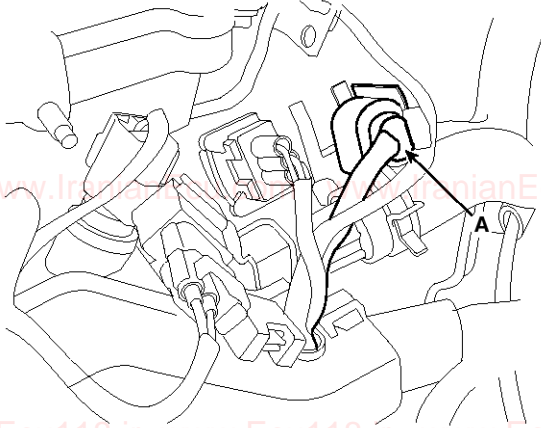
- 4. Gasket
- 5. Hanger

EM-134

Engine Mechanical System

Removal and Installation

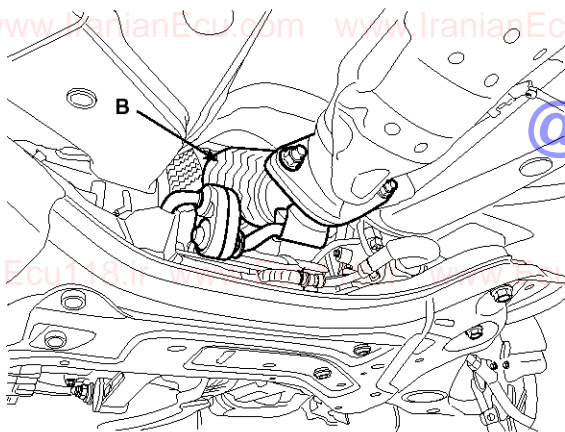
1. Remove the front muffler (B) after disconnecting the front oxygen sensor connector (A).



SYFEM0142N

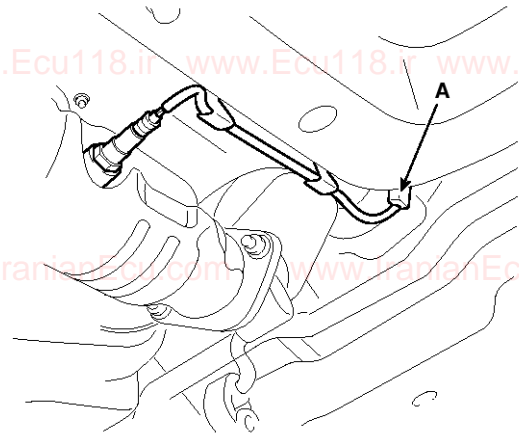
Tightening torque:

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



STFEM1009D

2. Disconnect the oxygen sensor connector (A).



STFEM1106L

@ECU118

Intake And Exhaust System

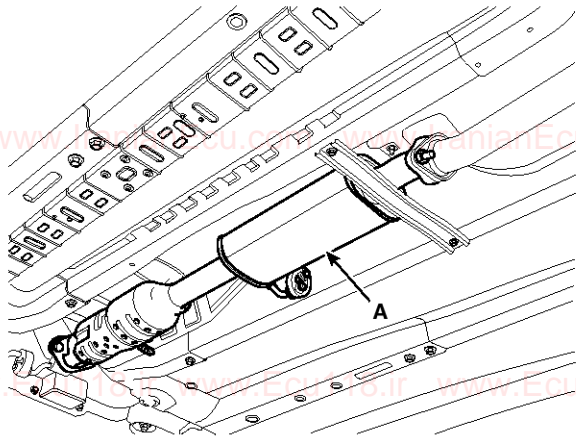
EM-135

3. Remove the catalytic converter & center muffler (A).

Tightening torque:

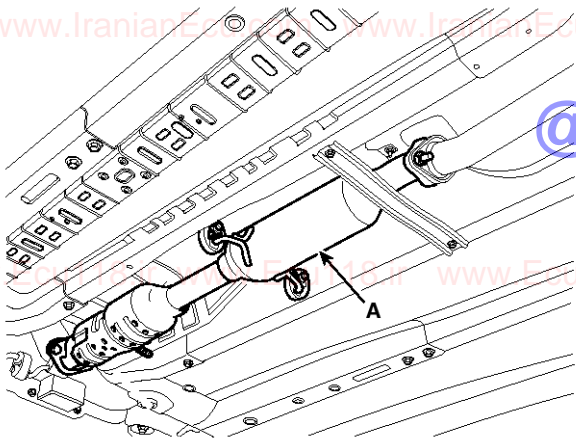
39.2 ~ 58.8 N.m (4.0 ~ 6.0 kgf.m, 28.9 ~ 43.4 lb-ft)

[2.0L]



STFEM1104D

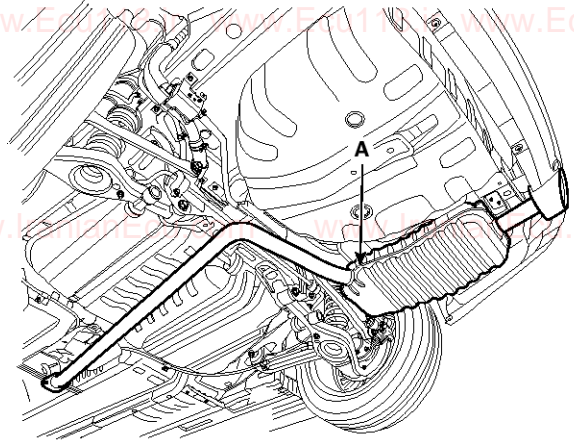
[2.4L]



STFM11035D

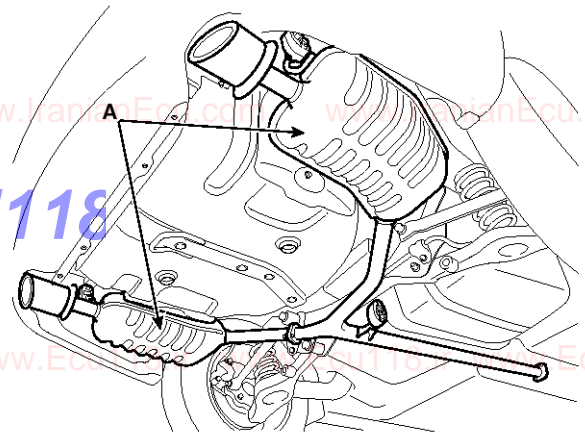
4. Remove the main muffler (A).

[2.0L]



STFEM1024D

[2.4L]



STFM11033D

5. Installation is the reverse order of removal.

NOTICE

When installing, replace with new gaskets.