2.6 Engine Mechanical System JL4G18-D

2.6.1 Specifications

2.6.1.1 Fastener Tightening Specifications

Applications	Model	Specifications	
		Metric (Nm)	US English (lb-ft)
Spark Plug Bolt	M14 × 1.25	20-30	14.8-22.2
Cylinder Head Cover (Short Bolt)	M6	7-11	5.2-8.2
Cylinder Head Cover (Long Bolts, Nuts, Special Bolts)	M6	9-13	6.7-9.6
Knock Sensor Bolt	M8 × 30	14.4-21.6	10.7-16
Cylinder Head Bolts	M10 × 1.25	First Pass 46-52	First Pass 34-38.5
		Second Pass 76-84	Second Pass 56-62.2
VVT Actuator Mounting Bolt	M12 × 1.25	59-81	43.7-60
Intake Manifold Mounting Bolt	M8	24-36	17.8-26.7
Crankcase Mounting Bolt	M8	14.4-21.6	10.7-16
Exhaust Pipe Mounting Bolt	M8	20-30	14.8-22.2
Main Bearing Cap Installation Bolt	M10 × 1.25	First Pass 42-46	First Pass 31-34
		Second Pass 54-66	Second Pass 40-48.9
Flywheel Mounting Bolt	M10 × 1.25	83-93	61.4-68.8
Engine Water Pump Short Mounting Bolt	M6 × 25	8-10	6-7.4
Engine Water Pump Long Mounting Bolt	M6 × 35	9-13	6.7-9.6
Fuel Rail Bolt	M6 × 20	7.2-10.8	5.3-8
Connecting Rod Cap Bolt	M8 × 1	First Pass 19-21	First Pass 14-15.5
		Second Pass 50-52	Second Pass 37-38.5
Camshaft Bearing Cap Bolt	M8 M6	21.6-24.5 12.2-13.8	16-18.2 9-10.2
Oil Pan Bolt	M6	7.2-10.8	5.3-8
Oil Filter Mounting Bolt	M6	7.2-10.8	5.3-8
Engine Oil Pressure Alarm Bolt	R1 / 8	10.5-19.5	7.8-14.4
Oil Filter Pipe Joint Bolt	M28 × 1.5	16-24	11.8-17.8
Oil Filter - Pipe Fittings Bolt	UNF3 / 4 "-16	33-37	24.4-27.4
Crankshaft Pulley Mounting Bolt	M12 × 1.25	129.7-146.3	96-108.3

Applications	Model	Specifications	
		Metric (Nm)	US English (lb-ft)
Generator Screw	M10 × 1.25 × 72	43.2-64.8	32-48
Generator Bolt	M8 × 30	20-30	14.8-22.2
Clutch Assembly Mounting Bolt	M8	21.6-32.4	16-24
Coolant Valve Bolt	M10	25 and Above	18.5 and Above
Oil Pump Mounting Bolt	M6	7.2-10.8	5.3-8
Timing Chain Cover Bolt	M8	14.4-21.6	10.7-16
Timing Chain Cover Bolt	M6	8.8-13.2	6.5-9.8
Right Engine Mounting Bracket Bolt	M10 × 55	37.6-56.4	27.8-41.7
Drive Belt Tensioner Bolt	M12	55.2-82.8	40.8-61.3
Drive Belt Tensioner Nut	M8	23.2-34.8	17.2-25.8
Exhaust Camshaft Timing Sprocket Mounting Bolt	M10	43.2-64.8	32-48
Oil Pan Oil Discharge Bolt	M12	25-35	18.5-25.9

2.6.1.2 Mechanical System Specification

Items	Specifications
Bore (mm/in)	79/3.11
Stroke (mm/in)	91.5/3.6
Displacement (L)	1.792
Compression Ratio	10:1
Power (km/rpm)	102/6,000-6,200
Torque (Nm/rpm)	172/4,100-4,300
Idle Speed (rpm)	800 ± 50 (Air Conditioning A/CON 1,000 ± 50)
ASM Emissions (g/km)	CO is less than 2.3; CH is less than 0.2; $NO_X$is less than 0.15
Ignition Sequence	1-3-4-2 (cylinder No.1,4 and cylinder No.2,3 group ignition)
Constant Driving Speed Fuel Consumption (90 km/h) (L/100 km)	Less than 6.5
Fuel	RON93 Unleaded Gasoline or Above
Engine Coolant Capacity (L/pt)	6.5/11.44
Engine Oil Capacity (L/pt)	4.0/7.04
Engine Coolant Specifications / Grades	Line SH0521 (Freezing Point ≤-40°C (-40 °F)

Items	Specifications
Lubricant Specification / Grades	Meet GB11121 standard, API quality grade SJ-class, SL-class exports to the EU statement, viscosity: SAE5W-30, 10W-30, 10W-40, 15W-40
Spark Plug Type	K6RTC
Spark Plug Gap (mm/in)	1.0-1.1/0.03-0.04
Dry Mass (kg/lb)	Without starter, with the engine oil, coolant, with wiring harness, with the clutch 117 ± 2/257.94 ± 4.41
Overall Dimension (LxWxH) mm/in	631 × 610 × 620/24.84 × 24.02 × 24.41
Cam	
Journal Diameter (mm/in)	23/0.91
Camshaft Axial Clearance (mm/in)	0.05-0.12/0.0020-(-0.0047)
Intake Valve Clearance (mm/in)	0.23 ± 0.03/0.0091 ± 0.0011
Exhaust Valve Clearance (mm/in)	0.32 ± 0.03/0.0126 ± 0.0011
Intake VVT Adjustment Range	± 25 °
Valve Timing	
Intake Valve Open	19 ° Before TDC
Intake Valve Close	73 ° After BDC
Exhaust Valve Open	53 ° Before BDC
Exhaust Valve Close	16.5 ° After TDC
Crank Pin	
Connecting Rod Bearing Clearance (mm/in)	0.020-0.044/0.0007-0.0017
Connecting Rod Bearing Axial Clearance (mm/in)	0.16-0.342/0.006-0.0135
Crankshaft	
Axial Clearance (mm/in)	0.04-0.24/0.0015-0.0094
Main Bearing Clearance - All (mm/in)	0.015-0.033/0.0006-0.0013
Spindle Collar Diameter - All (mm/in)	47.982-48/1.8891-1.8898
Body Top Surface Flatness (mm/in)	0.05/0.0019
Crankshaft Main Journal Roundness (mm/in)	0.003/0.0001
Crankshaft Main Journal Round Beating Degree (mm/in)	0.02/0.0008
Cylinder Head	
Minimal Height After Machining (mm/in)	115-0.05/4.53-0.0019
Overall Height (mm/in)	115 +0.05 / 4.53 +0.0019
Valve Guide Hight (mm/in)	34.5/1.36

Items	Specifications
Pistons	
Gap With The Cylinder (mm/in)	0.060-0.083/0.0023-0.0033
Diameter (mm/in)	78.9/3.11
Piston Pin	
Gap With The Piston (mm/in)	0.005-(-0.001) / 0.0002-(-0.00003)
Gap With The Rod (mm/in)	0.005-0.011/0.0002-0.0004
Diameter (mm/in)	20/0.787
Length (mm/in)	50/1.969
Piston Pin Offset - Thrust (mm/in)	0.6/0.0236
Oil Pump	
Safety Valve Opening Pressure (kPa/psi)	500/72.52
Piston Ring	
Oil Ring End Gap (mm/in)	0.20-0.70/0.0079-0.0276
Second Compression Ring End Gap (mm/in)	0.40-0.55/0.0157-0.0217
First Compression Ring End Gap (mm/in)	0.25-0.35/0.0098-0.0138
Sealants and Adhesives	
Cylinder Head Covers Mat Sealant	Kesaisi New 1596 Flat Silicone Rubber Sealants
Engine Oily Road Cones	Kesaisi New 1243 Anaerobic Thread Locking Sealant
Oil Pan and Crank Box Joints	Kesaisi New 1596 Flat Silicone Rubber Sealants
Crankcase With The Cylinder Block Joints	Kesaisi New 1596 Flat Silicone Rubber Sealants
Flywheel Bolt	Letai 204 Anaerobic Sealant
Valve System	
Intake Valve Diameter (mm/in)	31/1.2
Exhaust Valve Diameter (mm/in)	26 / 1
Valve Tube Diameter (mm/in)	5.5/0.22
Valve Stem Diameter - Intake Valve (mm/in)	5.5/0.22
Valve Stem Diameter - Exhaust Valve (mm/in)	5.5/0.22

2.6.1.3 Intake and Exhaust Valves Lifter Specifications Table

Packet No.	Thickness (mm/in)	Packet No.	Thickness (mm/in)
06	5.06 (0.1992)	42	5.42 (0.2134)
08	5.08 (0.2000)	44	5.44 (0.2142)

Packet No.	Thickness (mm/in)	Packet No.	Thickness (mm/in)
10	5.10 (0.2008)	46	5.46 (0.2150)
12	5.12 (0.2016)	48	5.48 (0.2157)
14	5.14 (0.2024)	50	5.50 (0.2165)
16	5.16 (0.2031)	52	5.52 (0.2173)
18	5.18 (0.2039)	54	5.54 (0.2181)
20	5.20 (0.2047)	56	5.56 (0.2189)
22	5.22 (0.2055)	58	5.58 (0.2197)
24	5.24 (0.2063)	60	5.60 (0.2205)
26	5.26 (0.2071)	62	5.62 (0.2213)
28	5.28 (0.2079)	64	5.64 (0.2220)
30	5.30(0.2087)	66	5.66(0.2236)
32	5.32(0.2094)	68	5.68(0.2236)
34	5.34(0.2102)	70	5.70(0.2252)
36	5.36(0.2110)	72	5.72(0.2260)
38	5.38(0.2118)	74	5.74(0.2260)
40	5.40(0.2126)		

2.6.1.4 Intake and Exhaust Valves Lifter Selection Table

Intake Valve Selection Table

5.74(0.2260)	5.72(0.2260)	5.70(0.2252)	5.68(0.2236)	5.66(0.2236)	5.64(0.2220)	5.62(0.2213)	5.60(0.2205)	5.58(0.2197)	5.56(0.2189)	5.54(0.2181)	5.52(0.2173)	5.50(0.2165)	5.48(0.2157)	5.46(0.2150)	5.44(0.2142)	5.42(0.2134)	5.40(0.2126)	5.38(0.2118)	5.36(0.2110)	5.34(0.2102)	5.32(0.2094)	5.30(0.2087)	5.28(0.2079)	5.26(0.2071)	5.24(0.2063)	5.22(0.2055)	5.20(0.2047)	5.18(0.2039)	5.16(0.2031)	5.14(0.2024)	5.12(0.2016)	5.10(0.2008)	5.08(0.2000)	5.06(0.1992)	Lifter No. and Thickness (mm/in) / Gap (mm/in)
54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06											0.000-0.030(0.0000-0.0012)
56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06										0.031-0.050(0.0012-0.0020)
58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06									0.051-0.070(0.0020-0.0028)
60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06								0.071-0.090(0.0028-0.0035)
62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06							0.091-0.110(0.0036-0.0043)
64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06						0.111-0.130(0.0044-0.0051)
66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06					0.131-0.150(0.0052-0.0059)
68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06				0.151-0.170(0.0059-0.0067)
70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06			0.171-0.190(0.0067-0.0075)
70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	08	06		0.191-0.199(0.0075-0.0078)
	74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10		0.261-0.280(0.0103-0.0110)
		74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12		0.281-0.300(0.0111-0.0118)
			74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14		0.301-0.320(0.0119-0.0125)
				74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16		0.321-0.340(0.0126-0.0134)
					74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18		0.341-0.360(0.0134-0.0142)
						74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20		0.361-0.380(0.0142-0.0150)
							74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22		0.381-0.400(0.0150-0.0157)
								74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24		0.401-0.420(0.0158-0.0165)
									74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26		0.421-0.440(0.0166-0.0173)
										74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28		0.441-0.460(0.0174-0.0181)
											74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30		0.461-0.480(0.0181-0.0189)
												74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32		0.481-0.500(0.0189-0.0197)
													74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34		0.501-0.520(0.0197-0.0205)
														74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36		0.521-0.540(0.0205-0.0213)
															74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38		0.541-0.560(0.0213-0.0220)
																74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40		0.561-0.580(0.0221-0.0228)
																	74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42		0.581-0.600(0.0229-0.0236)
																		74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44		0.601-0.620(0.0237-0.0244)
																			74	72	70	68	66	64	62	60	58	56	54	52	50	48	46		0.621-0.640(0.0244-0.0252)
																				74	72	70	68	66	64	62	60	58	56	54	52	50	48		0.641-0.660(0.0252-0.0260)
																					74	72	70	68	66	64	62	60	58	56	54	52	50		0.661-0.680(0.0260-0.0268)
																						74	72	70	68	66	64	62	60	58	56	54	52		0.681-0.700(0.0268-0.0276)
																							74	72	70	68	66	64	62	60	58	56	54		0.701-0.720(0.0276-0.0283)
																								74	72	70	68	66	64	62	60	58	56		0.721-0.740(0.0284-0.0291)
																									74	72	70	68	66	64	62	60	58		0.741-0.760(0.0292-0.0299)
																										74	72	70	68	66	64	62	60		0.761-0.780(0.0300-0.0307)
																											74	72	70	68	66	64	62		0.781-0.800(0.0307-0.0315)
																												74	72	70	68	66	64		0.801-0.820(0.0315-0.0323)
																													74	72	70	68	66		0.821-0.840(0.0323-0.0331)
																														74	72	70	68		0.841-0.860(0.0331-0.0339)
																															74	72	70		0.861-0.880(0.0339-0.0346)
																																74	72		0.881-0.900(0.0347-0.0354)
																																	74		0.901-0.920(0.0355-0.0362)

Exhaust Valve Selection Table

5.74(0.2260)	5.72(0.2260)	5.70(0.2252)	5.68(0.2236)	5.66(0.2236)	5.64(0.2220)	5.62(0.2213)	5.60(0.2205)	5.58(0.2197)	5.56(0.2189)	5.54(0.2181)	5.52(0.2173)	5.50(0.2165)	5.48(0.2157)	5.46(0.2150)	5.44(0.2142)	5.42(0.2134)	5.40(0.2126)	5.38(0.2118)	5.36(0.2110)	5.34(0.2102)	5.32(0.2094)	5.30(0.2087)	5.28(0.2079)	5.26(0.2071)	5.24(0.2063)	5.22(0.2055)	5.20(0.2047)	5.18(0.2039)	5.16(0.2031)	5.14(0.2024)	5.12(0.2016)	5.10(0.2008)	5.08(0.2000)	5.06(0.1992)	Lifter No. and Thickness (mm/in) / Gap (mm/in)
44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06																	0.000-0.030(0.0000-0.0012)
46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06																0.031-0.050(0.0012-0.0020)
48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06															0.051-0.070(0.0020-0.0028)
50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06														0.071-0.090(0.0028-0.0035)
52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06													0.091-0.110(0.0036-0.0043)
54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06												0.111-0.130(0.0044-0.0051)
56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06											0.131-0.150(0.0052-0.0059)
58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06										0.151-0.170(0.0059-0.0067)
60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06									0.171-0.190(0.0067-0.0075)
62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06								0.191-0.210(0.0075-0.0083)
64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06							0.211-0.230(0.0083-0.0091)
66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06						0.231-0.250(0.0091-0.0098)
68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06					0.251-0.270(0.0099-0.0106)
70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	10	08	06				0.271-0.289(0.0107-0.0114)
		74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	/	36	34	32	30	28	26	24	22	20	18	16	14	12	10	0.351-0.370(0.0138-0.0146)
			74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	12	0.371-0.390(0.0146-0.0154)
				74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	14	0.391-0.410(0.0154-0.0161)
					74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	16	0.411-0.430(0.0162-0.0169)
						74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	20	18	0.431-0.450(0.0170-0.0177)
							74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	/	26	24	22	20	0.451-0.470(0.0178-0.0185)
								74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	22	0.471-0.490(0.0185-0.0193)
									74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	24	0.491-0.510(0.0193-0.0201)
										74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	26	0.511-0.530(0.0201-0.0209)
											74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	28	0.531-0.550(0.0209-0.0217)
												74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30	0.551-0.570(0.0217-0.0224)
													74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	0.571-0.590(0.0225-0.0232)
														74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34	0.591-0.610(0.0233-0.0240)
															74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	36	0.611-0.630(0.0241-0.0248)
																74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	38	0.631-0.650(0.0248-0.0256)
																	74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	40	0.651-0.670(0.0256-0/0264)
																		74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	42	0.671-0.690(0.0264-0.0272)
																			74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	44	0.691-0.710(0.0272-0.0280)
																				74	72	70	68	66	64	62	60	58	56	54	52	50	48	46	0.711-0.730(0.0280-0.0287)
																					74	72	70	68	66	64	62	60	58	56	54	52	50	48	0.731-0.750(0.0288-0,0295)
																						74	72	70	68	66	64	62	60	58	56	54	52	50	0.751-0.770(0.0296-0.0303)
																							74	72	70	68	66	64	62	60	58	56	54	52	0.771-0.790(0.0304-0.0311)
																								74	72	70	68	66	64	62	60	58	56	54	0.791-0.810(0.0311-0.0319)
																									74	72	70	68	66	64	62	60	58	56	0.811-0.830(0.0319-0.0327)
																										74	72	70	68	66	64	62	60	58	0.831-0.850(0.0327-0.0335)
																											74	72	70	68	66	64	62	60	0.851-0.870(0.0335-0.0343)
																												74	72	70	68	66	64	62	0.871-0.890(0.0343-0.0350)
																													74	72	70	68	66	64	0.891-0.910(0.0351-0.0358)
																														74	72	70	68	66	0.911-0.930(0.0359-0.0366)
																															74	72	70	68	0.931-0.950(0.0367-0.0374)
																																74	72	70	0.951-0.970(0.0374-0.0382)
																																	74	72	0.971-0.990(0.0382-0.0390)
																																		74	0.991-1.010(0.0390-0.0398)

2.6.2 Description and Operation

2.6.2.1 Description and Operation

1. Cylinder Head

Cylinder head is made from aluminum alloy casting process. cylinder valve stem is a mechanical system. valve clearance can not be automatically adjust, which is very important. The cylinder valve is an integrated part. OEMs can offer 38 different sizes to choose from. During the repair, required quite tube thickness can be calculated according to the formula. For specific information. Refer to 2.6.8.20 Valve Clearance Adjustments. With Double overhead camshaft layout, in the drive sprocket on the intake camshaft there is also a VVT actuator for adjusting the intake valve timing. For the detailed working principle. Refer to 2.6.3.1 System Working Principle.

2. Timing Chain

Dual overhead camshafts are driven by a timing chain. Timing chain must be replaced every 120,000 kilometers. Timing chain system consists of timing chain, timing chain guide rails, timing chain tensioner rail and the timing chain tensioner. Timing chain tensioner tensioning is provide by the pressure from the oil pump to ensure the timing chain tensioner maintain a constant intensity. Timing chain lubrication is provided by the oil pump nozzles. Refer to 2.6.8.11 Timing Chain Inspectionfor specific information.

3. Intake Manifold

Intake manifold has four independent long ports, using inertia to improve the engine torque at low speed.

4. Camshaft

Dual overhead camshaft (DOHC) has two camshafts. A camshaft controls the intake valves, the other camshaft controls the exhaust valves. The camshaft is located in the journal in the cylinder head on the top of the engine and fixed with camshaft cover. The cylinder head camshaft journal drilling is used for engine oil channel. Engine oil flows to the camshaft under pressure, lubrication each camshaft journal. Engine oil flows through the cylinder lid to return to oil sump. Cam convex corner is formed by machining, at the right time, according to the appropriate amount, accurately open and close intake and exhaust valves. Cam convex is lubricated by high-pressure oil escaped from the engine camshaft.

2.6.3 System Working Principle

2.6.3.1 System Working Principle

1. Reciprocating Piston Engine Working Principle:

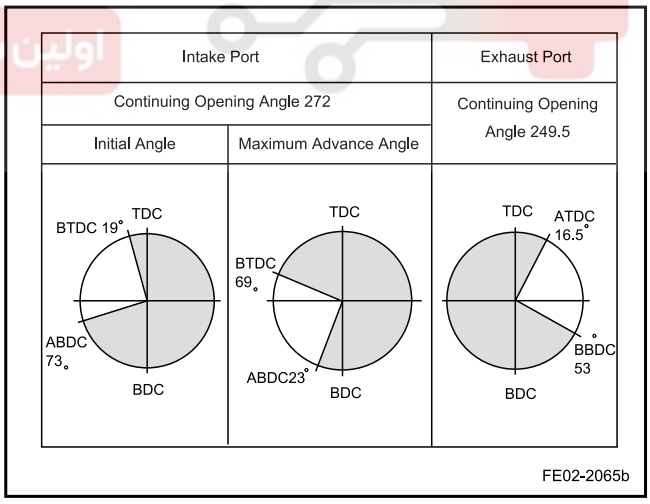
- Intake Stroke:the crankshaft driven piston moves from TDC to BDC. At this point exhaust valve closes, intake valve opens. In the piston moving process, the cylinder volume gradually increased and the vacuum is formed within the cylinder. ECM controlled fuel injectors spray fuel into the intake pipe. At this time the intake valves open, air and fuel mixture sucked through the intake valve into cylinder and forms a combustible mixture.
- Compression Stroke:At the end of the intake stroke, crankshaft continues to drive the piston from the BDC to the TDC. intake and exhaust valves are closed. With the piston moving up, the cylinder volume became smaller and smaller. Because gas is compressed, the temperature of the compressed gas rose rapidly.
- Power Stroke:At the end of compression stroke, ECM controlled ignition coil primary coil circuit is disconnected and the secondary sensor produces a high voltage, which passes rapid through the cylinder head to the top of the spark plug, and finally the high-voltage breaks through the spark plug gap to generate electric spark, igniting the combustible mixture within the cylinder. Fire spreads rapidly inside the combustion chamber, while releasing a large number of heat. Combustion gases rapid expands, the pressure and temperature is also increased, swelling force acting on the piston top, prompting the piston from the TDC moving to the BDC, and through the connecting rod to change piston reciprocating motion into rotary movement. At this point, intake and exhaust valves are still closed.
- Exhaust Stroke:At the beginning of the exhaust stroke, exhaust valve opens, intake valve is still closed. the crankshaft connecting rod drives the piston from the BDC to the TDC. After burning the expanded gas residue will be discharged through the exhaust valve to outside the cylinder by its own pressure and the piston movement. When the piston reaches the TDC, the exhaust stroke ends and exhaust valve closes.

But in the actual process, the intake valve opens before the TDC and closes after BDC. This design is intended to draw more air into cylinder and reduce the power consumed in the intake process. In the exhaust process, the exhaust valve opens before BDC and closes after TDC. The aim is to reduce the mixture within the cylinder and reduce the power consumed in the intake process. Because intake and exhaust valves have a certain overlap angles, namely, at a certain crank angle intake and exhaust valves open at the same time. At this time the gas discharged through the exhaust valve forms a certain amount of inertia and draws the mixture into the cylinder. This will draw more air into the cylinder. But the valve overlap angle is not the bigger the better. In different operating conditions, the valve overlap angle requirements vary, therefore, in this engine there is intake valve variable valve timing, which aims to meet the engine intake valve opening angle requirements at different operating conditions. this function is achieved through the VVT system.

2. VVT System Working Principle

VVT stands for Variable Valve Timing, referring to the variable valve timing system. Where there is mass, there is inertia. The air drawn into the engine cylinders also has inertia, after the intake process the air tends to heep entering into the cylinder. At this time if the valve closing time is delayed, more air will be drawn into the cylinder, so that volumetric efficiency will be improved. As a result, the longer the delay in valve closing time, the better the High-Speed performance; On the contrary the more advanced valve closing, the better performance and the more torque at the Low-Speed.

(1). With A Body-Valve VVT Valve Timing Diagram



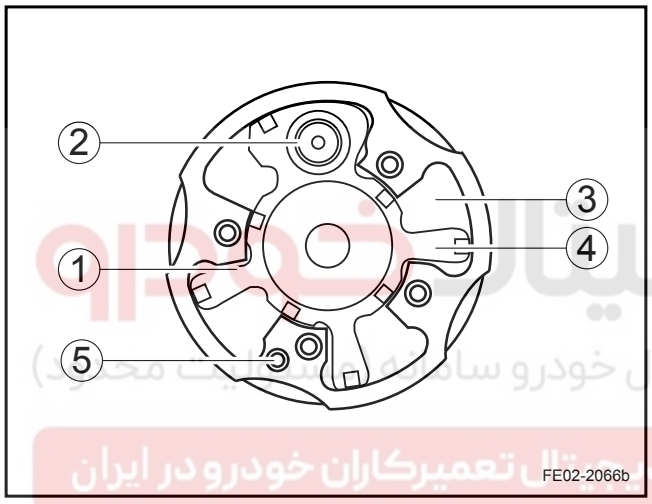
Legend

1. TDC: Top Dead Center
2. BDC: Bottom Dead Center
3. ATDC: After TDC
4. BTDC: Before TDC
5. ABDC: After BDC
6. BBDC: Before BDC

(2). VVT Control Strategy

Driving Conditions	Intake Valve Timing	Cause
Low-Load	Lag	Steady Combustion
High Load, High Speed	Lag	Increased Output Characteristics
High Load, Low Speed	Advance	Increased Torque
Medium-Speed Condition	Advance	Improved Fuel Consumption

(3). Advance Process



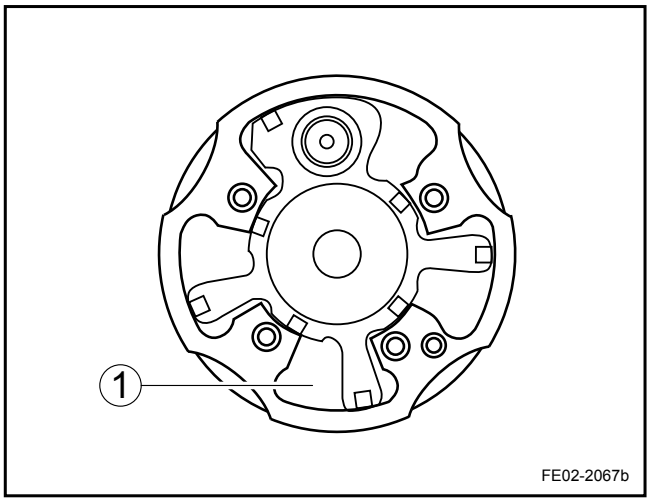
Legend

1. Lag Chamber
2. Locking Pin
3. Advance Chamber
4. Rotor Blade
5. Bracket

In normal operation condition, the oil pump generated engine oil pressure applies on the VVT solenoid valves. ECM controls the VVT solenoid valve by pulse-width modulation. When ECM needs VVT to adjust the intake valve to the maximum advance position, ECM controlled the VVT solenoid valve opening is 100%. At this point the engine oil pressure applies to the advance chamber, VVT rotor blades move in the opposite direction relative to the crank angle and eventually stay at the maximum position.

idling without load VVT actuator position will generally remain at the 8 ° or so, due to intake valve mechanical opening angle is 5 °, so the intake valve opens at idle with actual angle of 13 °.

(4). Lag Process



Legend

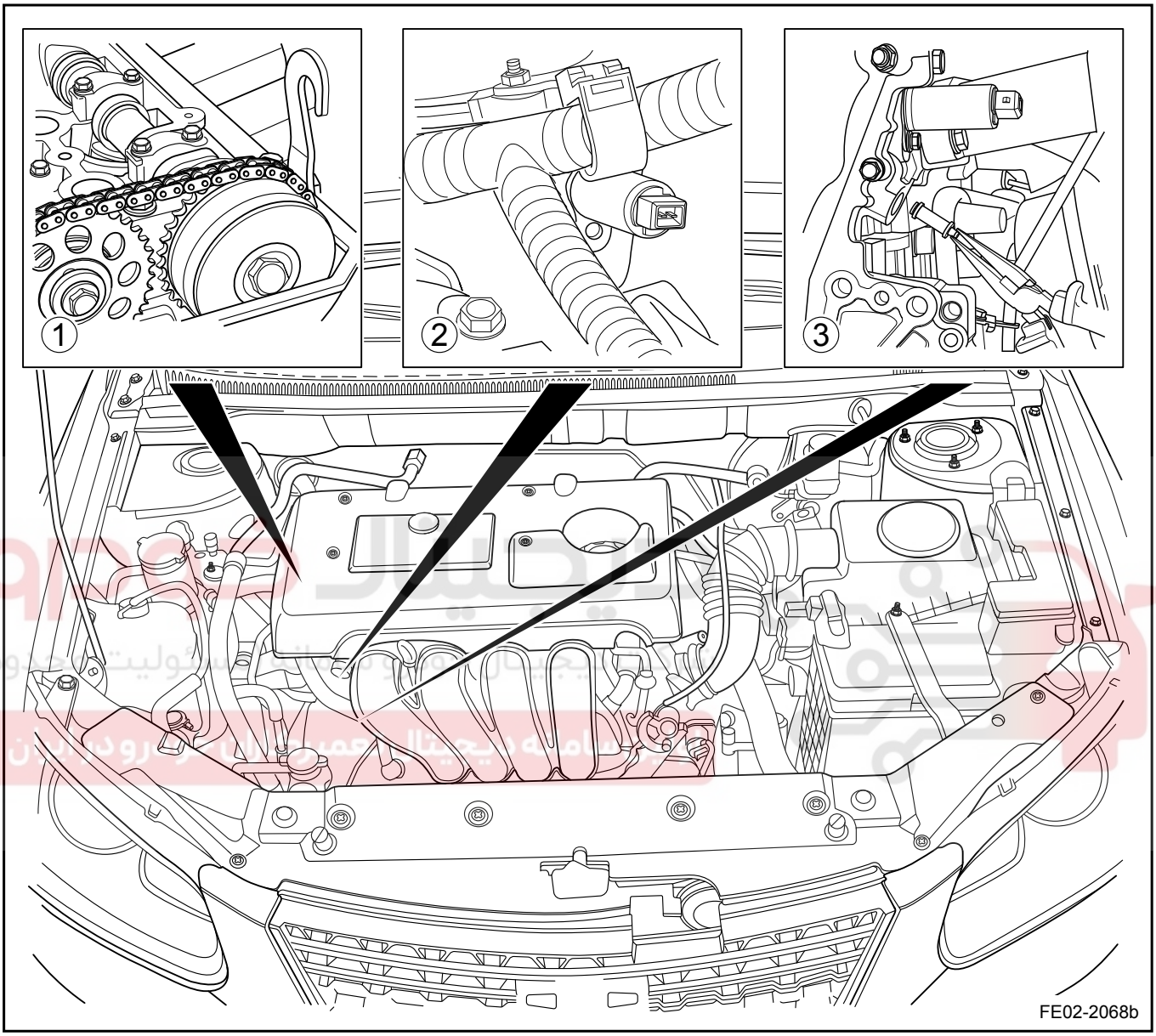
1. Lag Chamber

In normal operation condition, the oil pump generated engine oil pressure applies on the VVT solenoid valves. ECM controls the VVT solenoid valve by pulse-width modulation. When ECM needs VVT to adjust the intake valve to the maximum lag position, ECM controlled the VVT solenoid valve opening is 0%. At this point the engine oil pressure applies to the lag chamber, VVT rotor blades move in the same direction relative to the crank angle and eventually stay at the maximum position.

2.6.4 Component Locator

2.6.4.1 Component Locator

VVT System Component Locator

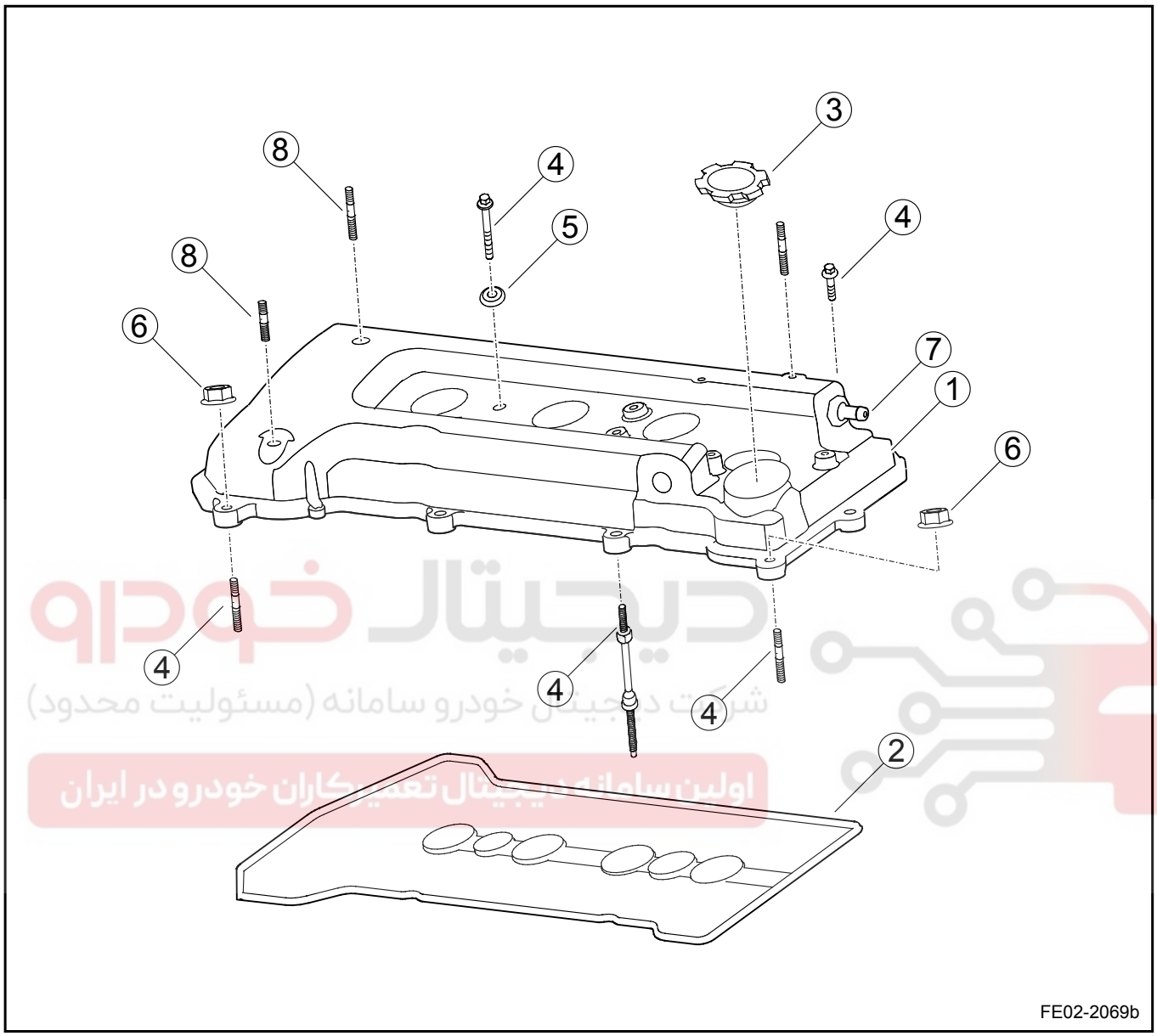


Legend

1. VVT Actuator
2. VVT Solenoid Valve
3. VVT Solenoid Valve Filter

2.6.5 Disassemble View

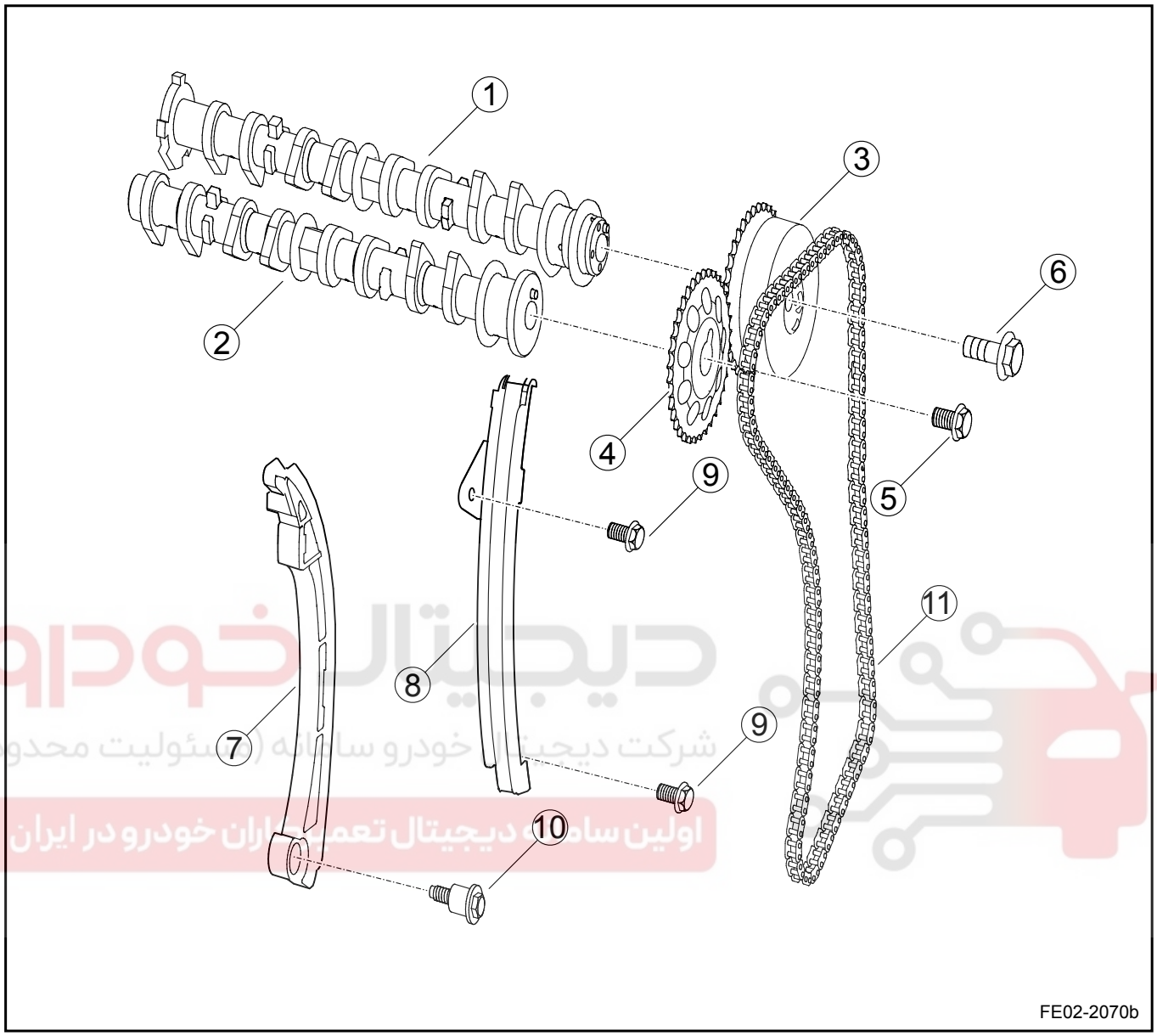
2.6.5.1 Cylinder Head Covers



Legend

1. Cylinder Head Covers
2. Cylinder Head Cover Gasket
3. Engine Oil Cap
4. Cylinder Head Cover Bolts
5. Cylinder Head Cover Bolts Washer
6. Cylinder Head Covers Retaining Nut
7. Purged Crankcase Ventilation Valve
8. Hood Retaining Bolts

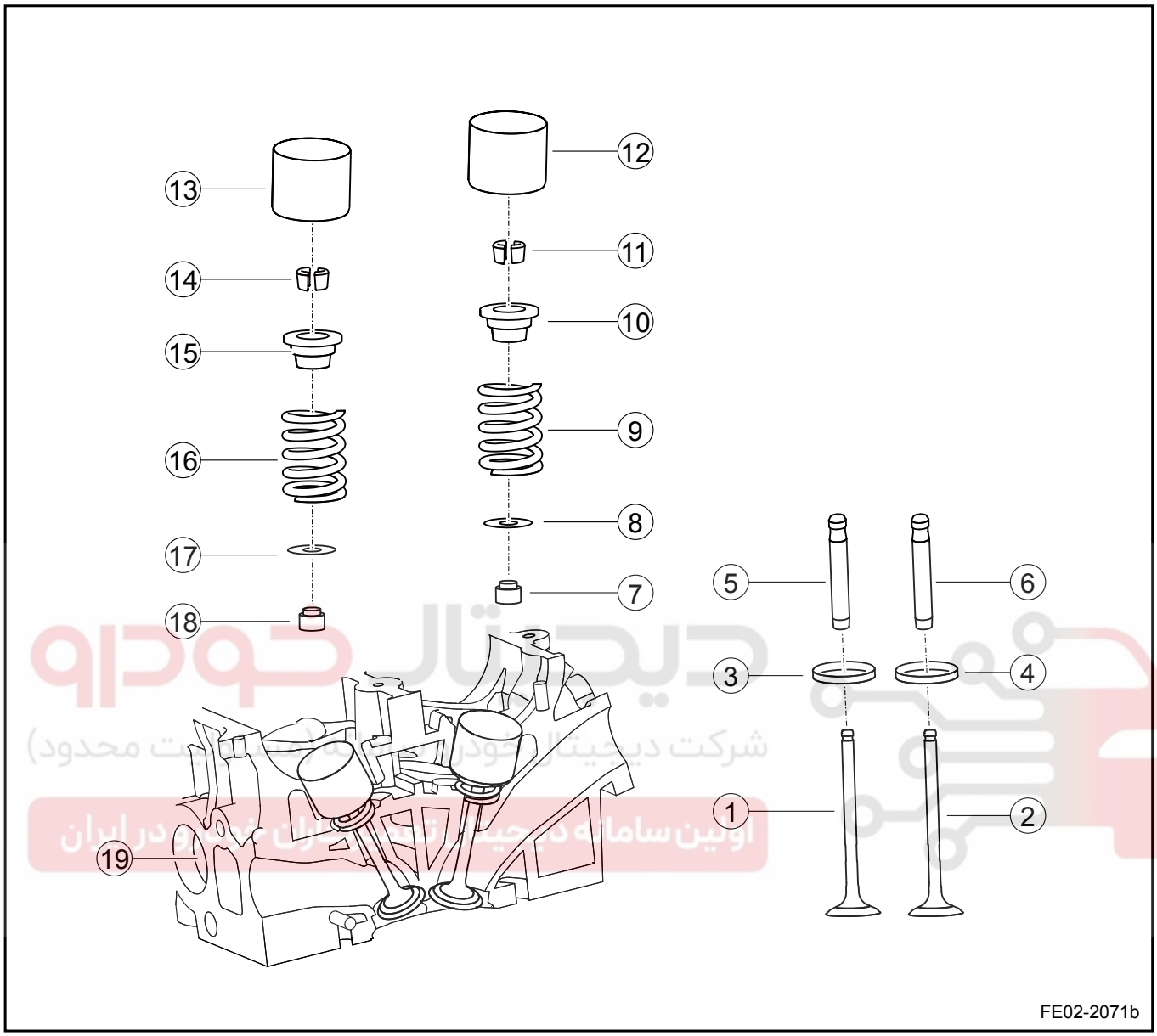
2.6.5.2 Camshaft and Accessories



Legend

1. Intake Camshaft
2. Exhaust Camshaft
3. VVT Actuator
4. Exhaust Camshaft Drive Sprocket
5. Exhaust Camshaft Drive Chain Sprocket Tightening Bolt
6. VVT Actuator Tightening Bolt
7. Timing Chain Tensioner Guide
8. Timing Chain Guide Rail
9. Timing Chain Guide Rail Retaining Bolts
10. Timing Chain Tensioner Rail Bolt
11. Timing Chain

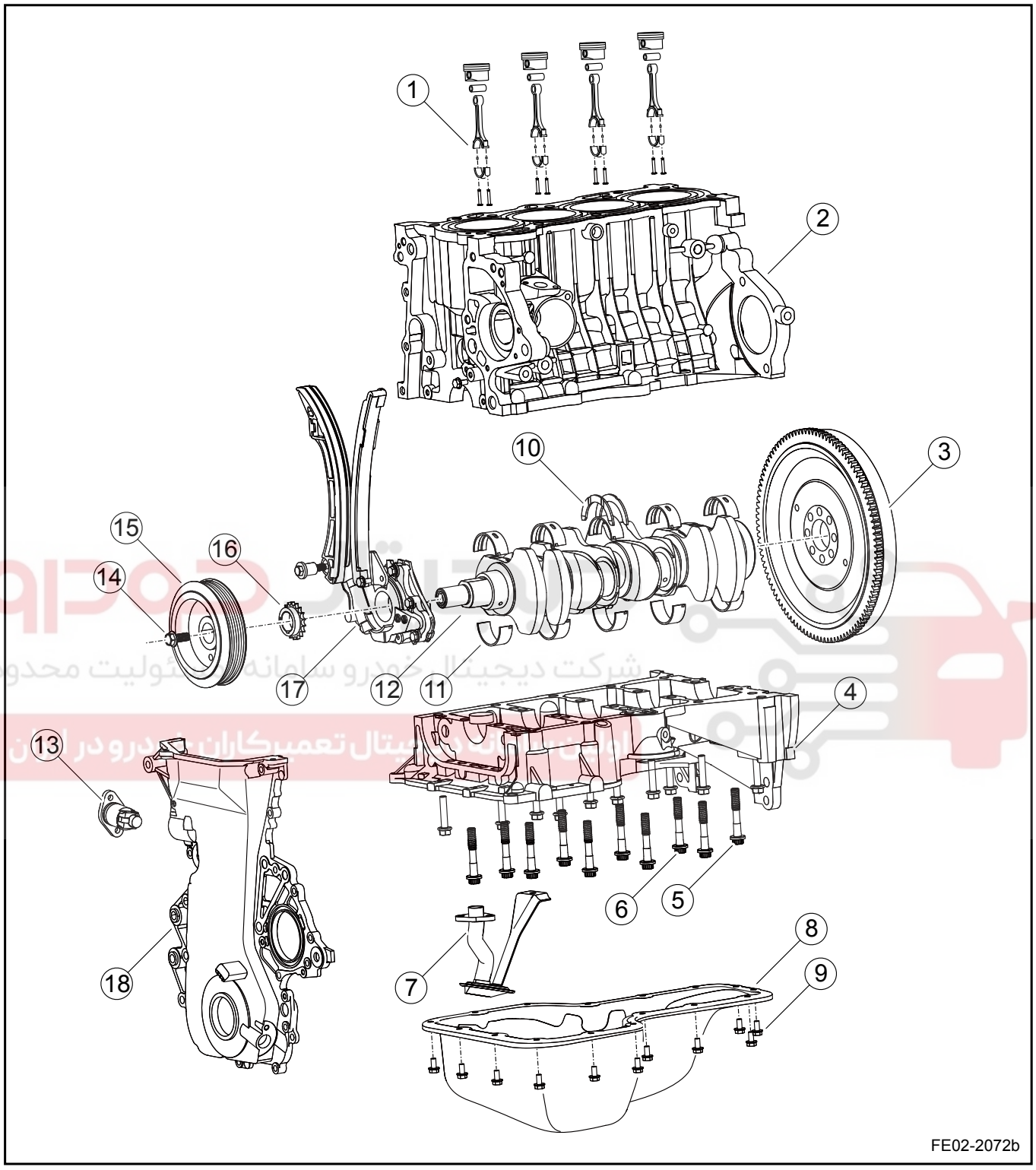
2.6.5.3 Cylinder Head



Legend

1. Exhaust Valve
2. Intake Valve
3. Exhaust Valve Seating Ring
4. Intake Valve Seating Ring
5. Exhaust Valve Tube
6. Intake Valve Tube
7. Intake Valve Seals
8. Intake Valve Spring Washer
9. Intake Valve Spring
10. Intake Valve Spring Seat
11. Intake Locking Piece
12. Intake Valve Lifter
13. Exhaust Valve Lifter
14. Exhaust Locking Piece
15. Exhaust Valve Spring Seat
16. Exhaust Valve Spring
17. Exhaust Valve Spring Washer
18. Exhaust Valve Seals
19. Cylinder Head

2.6.5.4 Cylinder Block



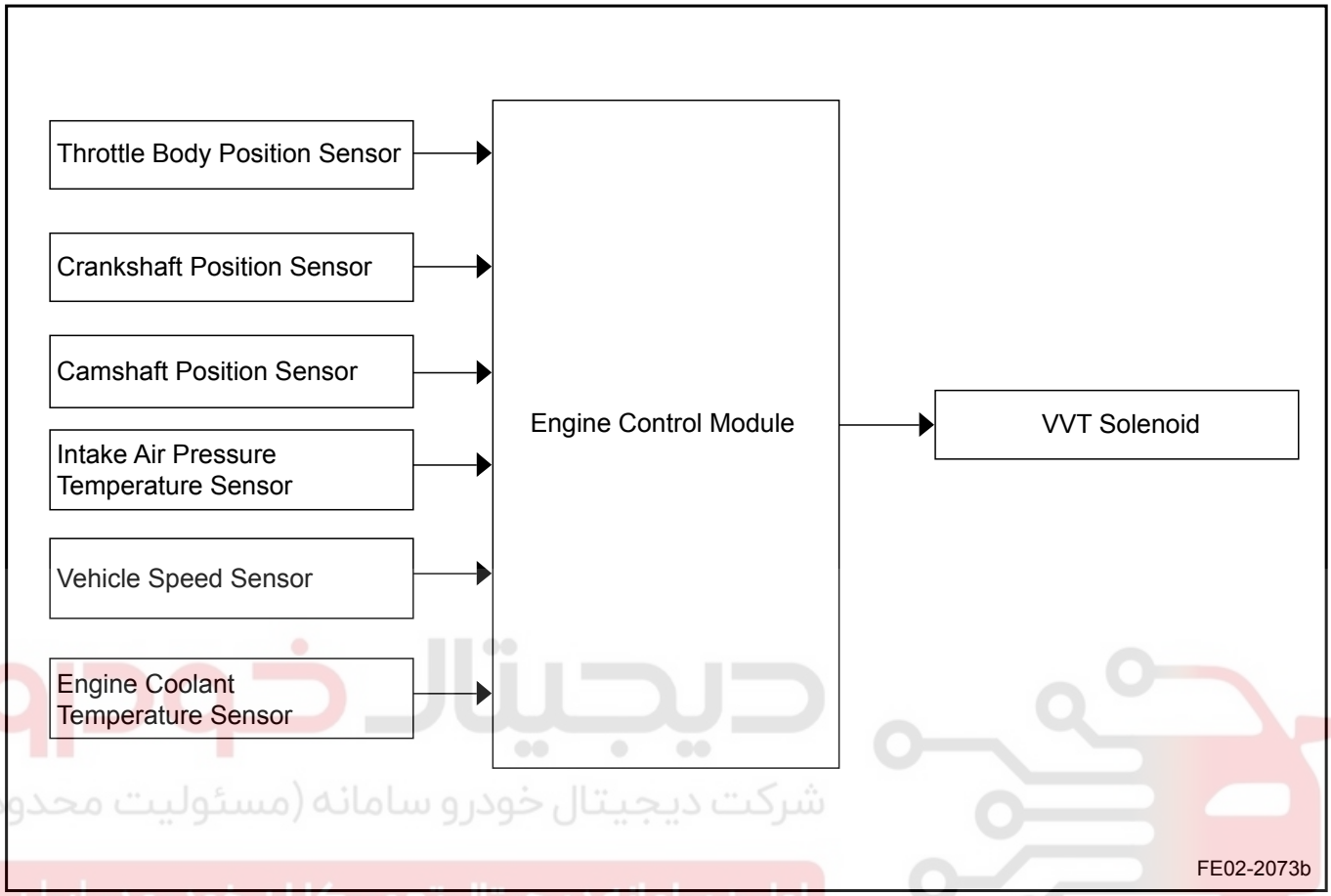
Legend

1. Piston Rod Component
2. Cylinder Block
3. Flywheel
4. Crankcase
5. Crankcase Bolt
6. Crankshaft Bearing Tightening Bolt
7. Filters
8. Oil Sump

9. Oil Pan Bolts
10. Crankshaft Thrust
11. Crankshaft Bearings
12. Crankshaft
13. Timing Chain Tensioner
14. Crankshaft Belt Tightening Bolt
15. Crankshaft Belt Drive
16. Crankshaft Timing Sprocket
17. Engine Oil Pump
18. Timing Chain Cover

2.6.6 Schematic

2.6.6.1 Schematic



2.6.7 Diagnostic Information and Procedures

2.6.7.1 Diagnosis Description

Refer to 2.6.3.1 System Working Principle Get familiar with the system functions and operations before start system diagnostics, so that it will facilitate the correct diagnostic steps, more importantly, it will also help to determine whether the customer described the situation is normal.

2.6.7.2 Visual Inspection

- Check installed aftermarket equipment that may affect the mechanical systems performance.
- Check easy to access system components to identify whether there is a significant damage that may lead to the fault.
- Confirm whether the engine oil level is normal and whether the engine oil viscosity is normal.
- Record engine speed, ambient temperature and other specific factors.
- Compare with a known good engine to check whether the current engine status is normal.

2.6.7.3 Comprehensive Engine Inspections

1. Check engine coolant.

Refer to 2.8.8.1 Engine Coolant Discharge and Filling.

2. Check engine oil.

Refer to 2.9.7.4 Engine Oil Pressure Diagnostic and Test.

3. Check the battery.

Refer to 2.11.2.3 Charging System Description and Operation.

4. Check the spark plug.

Refer to 2.10.7.6 Spark Plug Diagnostic.

5. Check the air filter.

Refer to 2.11.2.3 Charging System Description and Operation.

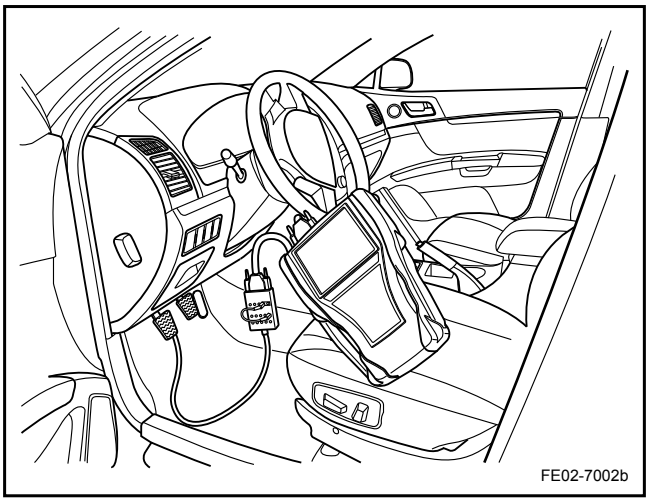
6. Check the ignition timing.

Check the ignition timing. The following conditions must be met:

- Engine reaches normal working temperature.

(1). Use scan tool to test methods:

Step 1	Connect scan tool.



(a) Turn the ignition switch to "OFF" position.
(b) Connect scan tool to the datalink connector.
(c) Start and run the engine to normal working temperature.
(d) Turn off A/C switch.
(e) Select in sequence: Engine / Data List / Cylinder No.1 ignition advance angle.

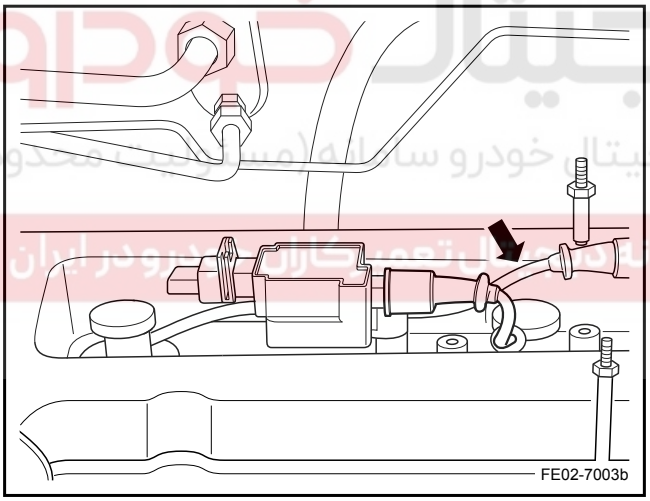
Standard Timing: Standard idling 8 ° -14 ° before TDC.

(2). Use the timing light to test:

Step 1	Remove the engine hood cover.

Next

Step 2	Pull out cylinder No.1 high-pressure resistor wire.



As shown, the lights are connected to cylinder No.1 high-pressure resistor wire.

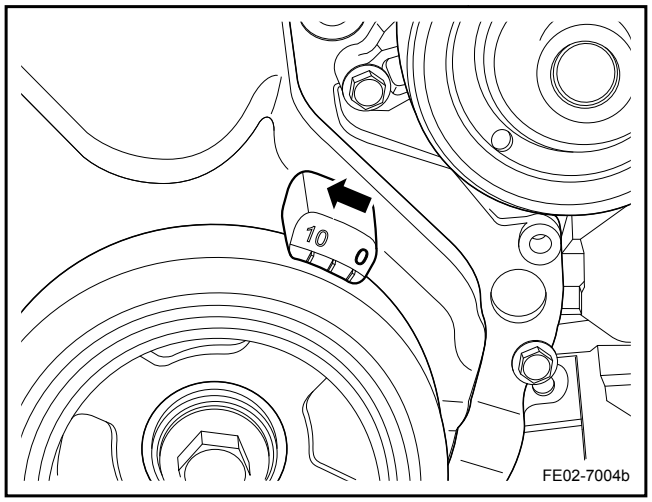
Next

Step 3	Check the ignition timing when idling.

Standard Timing: Standard idling 8 ° -14 ° before TDC.

Next

Step 4	Check the ignition timing during acceleration.



Accelerate the engine, observe the engine ignition timing, which should be moving ahead as shown.

Next

Step 5	Remove the timing light to restore high-voltage resistor wire.

Next

Step 6	End of the test.

7. Cylinder Compression Test

Note

Remove EF12 fuses. Fuel and ignition systems can not work. After the test clear the DTC code with a scan tool.

Before the compression test is done, the following conditions must be met:

- Engine reaches normal working temperature.
- Full throttle
- Remove all four cylinder spark plugs.
- Battery fully charged.

Note

During the start up test, the ignition switch can not remain at the "ST" position for more than 15 s, otherwise it will damage the starter.

Step 1	Test pressure of each cylinder, pressure drop may be due to valve closure or piston ring wear.

Next

Step 2	Spray proper amount of engine oil into each cylinder

Next

Step 3	Install the cylinder pressure test gage to the apark plug installation port.

Next

Step 4	Turn the ignition switch to the "ST" position, so that each cylinder runs 4 to 5 compression strokes.

Next

Step 5	Individual cylinder pressure readings should not be less than 75% of the maximum and any cylinder pressure gage reading should not be less than 750 kPa.

Next

Step 6	Check the pressure gage readings for each cylinder, after the completion of four compression stroke. Readings is explained as follows:

(a) Normal Conditions: The cylinder pressure rapidly increases and reaches the required uniform pressure value.

(b) Piston Ring Fault: The first stroke pressure is low, increasing in the following strokes, but the pressure has not reached normal levels. Add engine oil in the cylinder, the pressure increased significantly.

(c) Valve Fault: The first stroke pressure is low, and can not be increased in the following strokes. Add engine oil in the cylinder, the pressure is not increased.

Next

Step 7	End of the test.

2.6.7.4 Engine Noise Diagnosis

Engine vibration is actually referring to the engine resonance noise. When the engine's vibration frequency is the same as the vibration frequency of a fault, the noise will be perceived. Severe vibrating usually generates big noise, and it is generated by internal parts fracture or serious engine wear and tear. A slight vibration can be heard, but the sound is not big. Slight vibration is due to the engine internal parts wear, loose or engine external components broken and it can lead to serious or slight vibration. In the engine noise diagnostic, the resonance noise cause must be found in order to eliminate the fault.

2.6.7.5 Noisy when there is engine load

Step 1	Check whether drive belt tensioner is too tight or wear?

Yes → Replace/ adjust the drive belt tensioner to the specified value. Confirm whether the fault is fixed.

No

Step 2	Check the exhaust system. Whether the system is interfered with the other body components or scraping to ground?

Yes → Relocate and install the exhaust system to confirm whether the fault is fixed.

No

Step 3	Check the existence of the flywheel cracking, deformation and other components intervention. Is the flywheel normal?

Yes → Replace the flywheel assembly. Confirm whether the fault is fixed.

No

Step 4	Check whether the main bearing clearance is too large. Does it exceed the specified value?

Standard Value: 0.006-0.022 mm (0.0002-0.0008 in)

Yes → Replace the main bearings. Confirm whether the fault is fixed.

No

Step 5	Check connecting rod bearing clearance. Does it exceed the specified value?

Standard Value: 0.020-0.044 mm (0.0007-0.0017 in)

Yes → Replace the connecting rod bearings. Confirm whether the fault is fixed.

No

Step 6	Confirm diagnostic completed.

2.6.7.6 Slight vibration when engine is warming up.

Step 1	Use scan tool to read the "Knock" related data. Is the engine knocking?

Yes → Check the engine timing systems and fuel quality. Repair the faulty part.

No

Step 2	Check whether there is exhaust manifold leakage?

Yes → Replace the exhaust pipe pad and tighten the exhaust pipe.

No

Step 3	Check connecting rod bearing clearance, Does it exceed the specified value?

Standard Value: 0.020-0.044 mm (0.0007-0.0017 in)

Yes → Replace the connecting rod bearings. Confirm whether the fault is fixed.

No

Step 4	Confirm diagnostic completed.

2.6.7.7 Vibration at idle and when engine is warming up

Step 1	Check drive belt tension. Is it too loose or worn. Any fault?

Yes → If necessary, replace the drive belt. Confirm whether the fault is fixed.

No

Step 2	check whether engine oil and oil viscosity is normal?

Yes → Refill engine oil suitable for the current season temperature. Confirm whether the fault is fixed.

No

Step 3	check whether the generator and air-conditioning compressor is working properly. Any abnormal sound?

Yes → Replace failed parts. Confirm whether the fault is fixed.

No

Step 4	Check the valve, valve spring and other valve components. Any fault?

Yes → Replace failed parts. Confirm whether the fault is fixed.

No

Step 5	Check the piston pin gap. Does it exceed the specified value?

Standard Value: 0.005-0.011 mm (0.0002-0.0004 in)

Yes → Replace failed parts. Confirm whether the fault is fixed.

No

Step 6	Check whether the connecting rod is bent?

Yes → Replace failed parts. Confirm whether the fault is fixed.

No

Step 7	Check piston to cylinder gap value. Does it exceed the specified value?

Standard Value: 0.060-0.083 mm (0.0023-0.0033 in)

Yes → Replace failed parts. Confirm whether the fault is fixed.

No

Step 8	Check the piston pin offset. Does it exceed the specified value?

Standard Value: 0.6 mm (0.0236 in)

Yes → Replace failed parts. Confirm whether the fault is fixed.

No

Step 9	Confirm diagnostic completed.

2.6.7.8 Misfire Accompanied By Abnormal Engine Noise

Step 1	Use scan tool to check the engine control system DTC code.

Yes → According to the DTC code, repair the faulty part. Refer to the2.2.7.11 DTC Code Index

No

Step 2	Use scan tool to check the engine "Knock" data, compared with the normal vehicle data. Is it normal?

Yes → Check whether the fuel is normal. Check whether the timing system is normal. Repair the faulty part. Confirm whether the fault is fixed.

No

Step 3	Check valve spring whether it is too soft and broken?

Yes → Repair the faulty part. Refer to 2.6.8.15 Cylinder Head Assembly Removal and Installation

No

Step 4	Check valve whether there is catching and bending?

Yes → Repair faulty parts. Refer to 2.6.8.15 Cylinder Head Assembly Removal and Installation

No

Step 5	Check valve whether it is stretched, stagnant or worn.

Yes → Repair the faulty part. Refer to 2.6.8.15 Cylinder Head Assembly Removal and Installation

No

Step 6	Check whether there are excessive cam wear or obvious fults?

Yes → Repair the faulty part. Refer to 2.6.8.12 Camshaft Replacement

No

Step 7	Check valve for the existence of cracks, excessive wear and tear and other faults?

Yes → Repair the faulty part. Refer to 2.6.8.15 Cylinder Head Assembly Removal and Installation

No

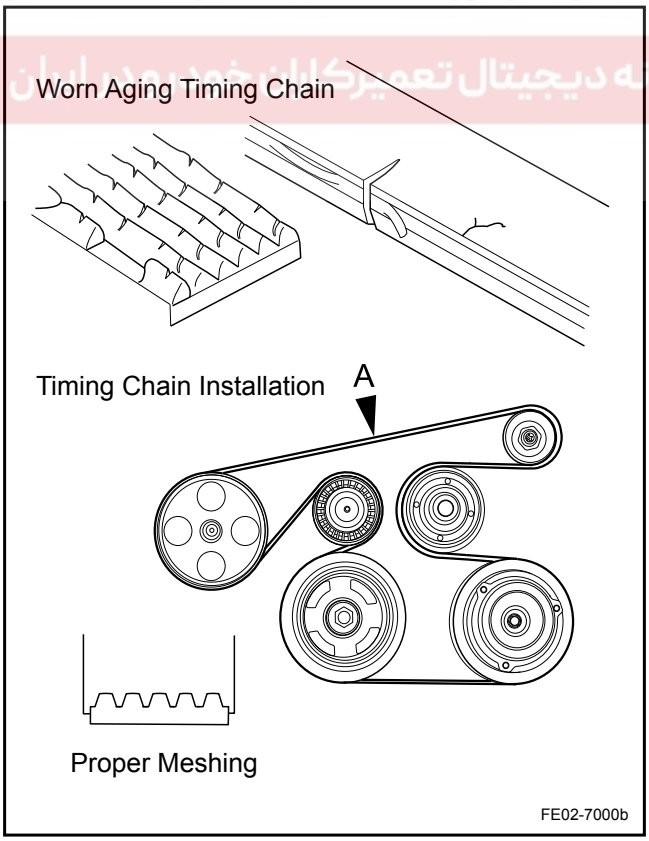
Step 8	Check valve spring seating and the valve spring washer. Is the installation incorrect?

Yes → Repair the faulty part. Refer to 2.6.8.15 Cylinder Head Assembly Removal and Installation

No

Step 9	Confirm whether the fault is fixed.

2.6.7.9 Drive Belt Inspection



1. Inspect when the engine is cool or has been turned off for 30 min.
2. Visual Inspect whether there is V-drive belt excessive wear or cord wear. If faults are found, replace the V-drive belt.
3. Visual Inspect whether there is drive belt inner or outer damage, wear and cracks. If faults are found, replace the drive belt.
4. If no faults are found in steps 2 and 3, measure the drive belt tension: rotate crankshaft pulley two laps clockwise and measure whether the tension is even along the drive belt tensioner pulley.
5. Use sound pressure meter (General Maintenance Tools) to measure drive belt tension and frequency at the marked point A.

	New Drive Belt	Old Drive Belt
Drive Belt Tension (N / lb)	400-500/89.9-112.4	300-400/67.4-89.9

a. Replace with new drive belt. Rotate the crankshaft two laps clockwise, so that the drive belt completely runs through the drive pulley. Measure the tension at marked position A. Refer to the table and replace the drive belt if the measurement is beyond the scope of the table.

b. If the used drive belt tension is beyond the scope of the table, replace it with a new drive belt.

c. During the drive belt installation, please make sure the correct installation to the drive pulley groove.

d. Do not drop engine oil or engine coolant onto the drive belt.

e. Do not over-wind or bend the drive belt.

2.6.7.10 Drive Belt Chirp Sound Diagnostic

Diagnostic Tips:

The symptom may be due to wet drive belt or pulley and may be an intermittent fault. Drive belt may need to spray a small amount of water to reproduce customer reported fault. If the symptom reoccurs after spraying water, then clean the pulley. Body parts, suspension parts or other vehicle parts loose or unreasonable installation can also cause the chirp sound.

Fault Definition: The following conditions are the drive belt chirp sound symptoms

- A chirp jack noise can be heard once rotate the drive belt a lap.
- Noise often happens on a rainy day or in a cold morning.

Step 1	Verify the fault. Does the engine have chirp sound?

No → To diagnose Tips

Yes

Step 2	Remove the drive belt. Confirm whether the sound disappears?

(a) Remove the drive belt. Refer to 2.6.8.3 Drive Belt Replacement.
(b) Run the engine, but no more than 30 s.
Does chirp sound disappear?

No → Refer to 2.6.7.4 Engine Noise Diagnosis

Yes

Step 3	Check whether the drive belt surface is normal? (Balls and cracks, etc?)

Refer to 2.6.7.9 Drive Belt Inspection

No → Replace the drive belt. Refer to 2.6.8.3 Drive Belt Replacement

Yes

Step 4	Check whether the drive pulley is installed correctly? (Misaligned, etc?)

No → Reinstall the drive pulley, if necessary, replace the drive belt.

Yes

Step 5	Check whether the drive pulley is normal?

Check whether the pulley is bent, twisted and so on.

No → Replace the failed pulley.

Yes

Step 6	Check whether all fasteners associated with the drive belt are normal?

No → Tighten loosen fasteners.

Yes

Step 7	Replace the drive belt. Confirm the fault is fixed.

2.6.7.11 Drive Belt Scream Diagnostic

Diagnostic Tips:

Body, suspension and other components loose or unreasonable installation may cause screams. If there is intermittent noise, check the attached parts by changing the engine load. Check whether the air-conditioning system is over filled, power steering hose is clamped, the power steering fluid is correct or whether the generator is faulty.

Fault Definition: The following conditions are the drive belt screams symptoms

- Drive belt screams due to slippage.
- Noise appears when a big load added to the drive belt, such as air-conditioning system compressor starting, the running engine with the throttle quickly opening or drive belt skidding in a drive component.

Step 1	Verify the fault. Does the engine scream?

No → To diagnose Tips

Yes

Step 2	Remove the drive belt. Confirm that the scream disappears?

(a) Remove the drive belt. Refer to 2.6.8.3 Drive Belt Replacement.

(b) Run the engine, but no more than 30 s.

Does the scream disappear?

No → Refer to 2.6.7.4 Engine Noise Diagnosis

Yes

Step 3	Check whether all attached drive pulley bearings are normal?

Pulley bearings do not appear stuck, loose and so on.

No → Replace the damaged pulley or bearing.

Yes

Step 4	Check whether drive belt tensioner device is working properly?

Tensioner pulley bearing device does not appear stuck, loose.
Tensioner device does not appear loose and other damages.

No → Replace the drive belt tensioner assembly. Refer to the 2.6.8.4 Drive Belt Tensioner Replacement

Yes

Step 5	Check whether the correct drive belt is used?

Check whether the drive belt is stretched. Refer to 2.6.7.9 Drive Belt Inspection.

No → Replace the drive belt. Refer to 2.6.8.3 Drive Belt Replacement

Yes

Step 6	Check all fasteners associated with the drive belt are normal?

No → Tighten loose fasteners.

Yes

Step 7	Check whether drive pulley is normal?

Check whether the pulley is bent, twisted and so on.

No → Replace the failed pulley.

Yes

Step 8	To diagnostic tips.

2.6.7.12 Drive Belt Hum Sound Diagnostic

Diagnostic Tips:

Drive belt should not produce hum sound. If there is an intermittent noise, check the attached parts by changing the load. Make sure that components run until the maximum load. These conditions may be due to (but are not limited to) over filling the air-conditioning system, power steering system blocked or steering fluid incorrect, as well as the generator failure.

Fault Definition: Sustained High-Frequency Noise

Step 1	Verify the fault. Does the engine hum appear?

No → To diagnose Tips

Yes

Step 2	Remove the drive belt. Confirm whether the hum sound disappears?

(a) Remove the drive belt. Refer to 2.6.8.3 Drive Belt Replacement.
(b) Run the engine, but no more than 30 s.
Does the hum sound disappear?

No → Refer to 2.6.7.4 Engine Noise Diagnosis

Yes

Step 3	Check whether all attached drive pulley bearings are normal?

Pulley bearings should not appear stuck, loose and so on.

No → Replace the damaged pulley or bearing.

Yes

Step 4	To diagnostic tips.

2.6.7.13 Drive Belt Off Diagnostics

Diagnostic Tips:

If the drive belt falls off from the pulley repeatedly, the reason may be the pulley misalignment. If the attachment drive belt driving components cause the load fluctuates, it may cause drive belt fall off from the pulley. Test whether accessories driving parts are working correctly. If the drive belt's length is not proper, drive belt tensioner will not be able to maintain a suitable drive belt tension.

Fault Definition: Drive belt falls off from the pulley, or incorrectly installed on the pulley.

Step 1	Check the drive belt for damage. If necessary, replace the drive belt.

Next

Step 2	Check whether the pulley is misaligned. Repair the faulty part.

Next

Step 3	Check whether the pulley is bent or depressed. Repair the faulty part.

Next

Step 4	Check whether the drive belt tensioner device bracket is bent or cracked. Repair the faulty part.

Next

Step 5	Check whether the drive belt tensioner device is working properly. Repair the faulty part.

Next

Step 6	Check whether the attached fasteners loose. Repair the faulty part.

Next

Step 7	Confirm that fault has been fixed.

2.6.7.14 Drive Belt Excessive Wear

Diagnostic Tips:

Drive belt excessive wear and tear is usually due to unreasonable installation or the use of the wrong drive belt. Drive pulley slight misalignment will not cause excessive wear and tear, but it could lead to drive belt noise or loss. Drive pulley misalignment can cause excessive wear and can also lead to drive belt fall off.

Fault Definition: The drive belt is not properly installed which led to the drive belt outer edges worn.

Step 1	Check whether there are frictions between drive belt and brackets, wiring harness, hoses and other components?

Yes → Repair the faulty part.

No

Step 2	Check all attachments drive pulley whether there are abnormal scratches on the surface, edges and corners and other abnormal conditions?

Yes → Repair the faulty part. If necessary, replace the drive pulley

No

Step 3	Check whether the installed drive belt model is correct?

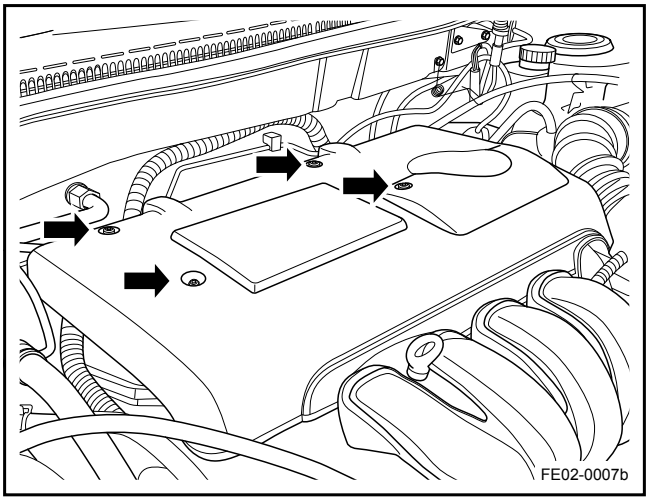
Yes → Replace the drive belt with a correct type.

No

Step 4	To diagnostic tips.

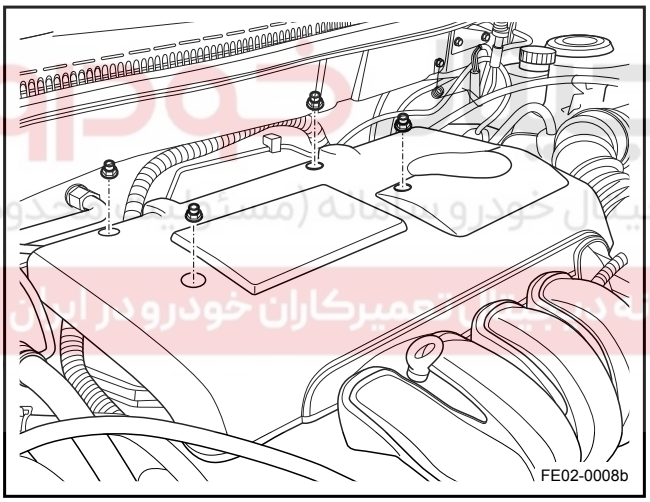
2.6.8 Removal and Installation

2.6.8.1 Plastic Engine Shield Replacement



Removal Procedure:

1. Remove the engine plastic shield retaining nuts.
2. Remove the plastic engine shield.



Installation Procedure:

1. Install the engine plastic shield retaining nuts onto the engine plastic shield.
2. Tighten the engine plastic shield retaining nuts.

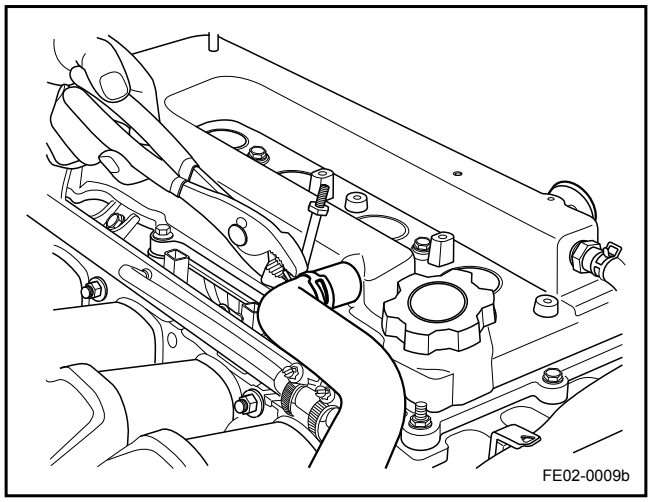
   Torque: 7 Nm (Metric) 5.2 lb-ft (US English)

2.6.8.2 Cylinder Head Cover Replacement

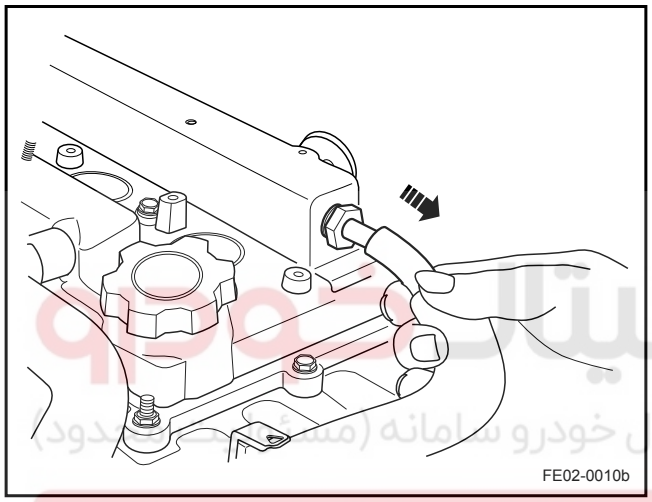
Removal Procedure:

Warning!

Refer to "Battery Disconnection Warning" in "Warnings and Notices".


FE02-0009b

1. Disconnect the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.
2. Remove the engine plastic shield. Refer to 2.6.8.1 Plastic Engine Shield Replacement.
3. Remove the ignition coil and ignition wire. Refer to 2.10.8.3 Ignition Coil Replacement.
4. Remove the crankcase ventilation tube.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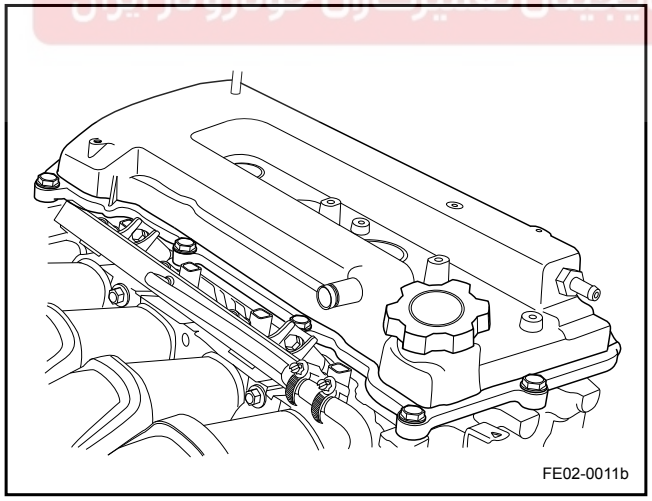
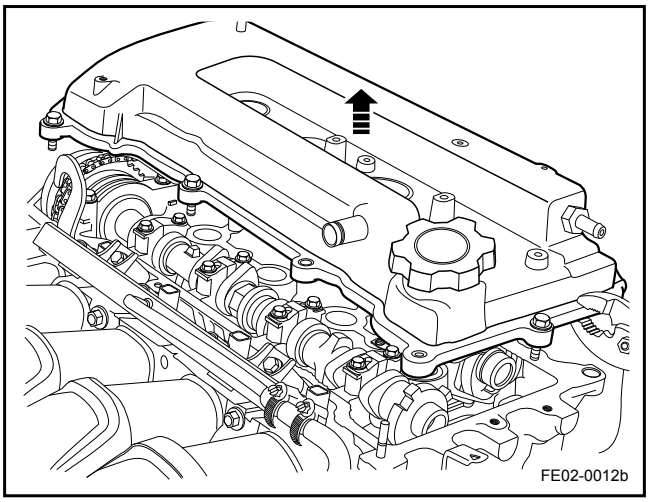
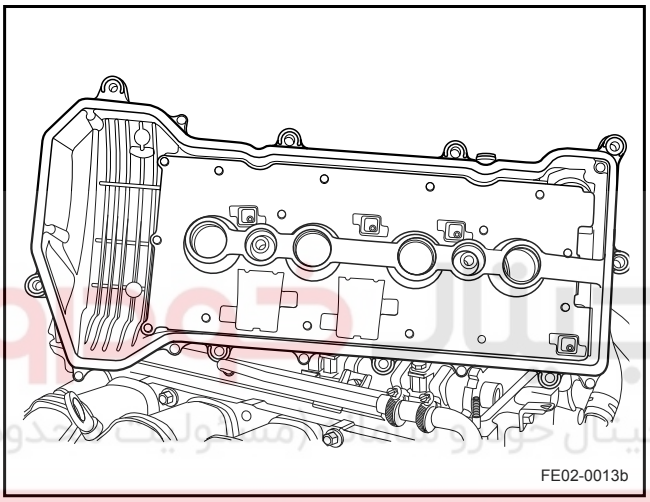
5. Remove the crankcase ventilation vacuum tube.


FE02-0011b

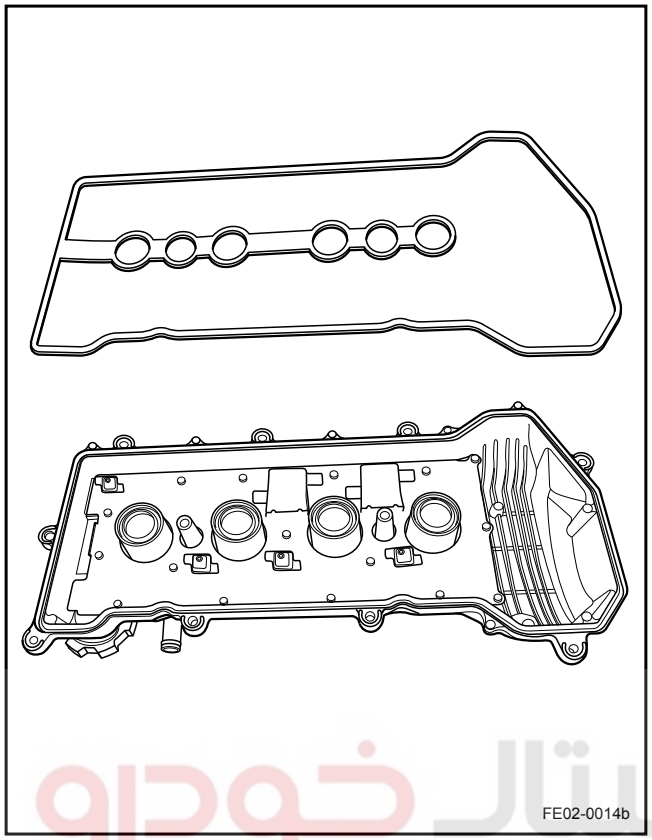
6. Remove cylinder head cover bolts and nuts.



7. Remove the cylinder head cover.

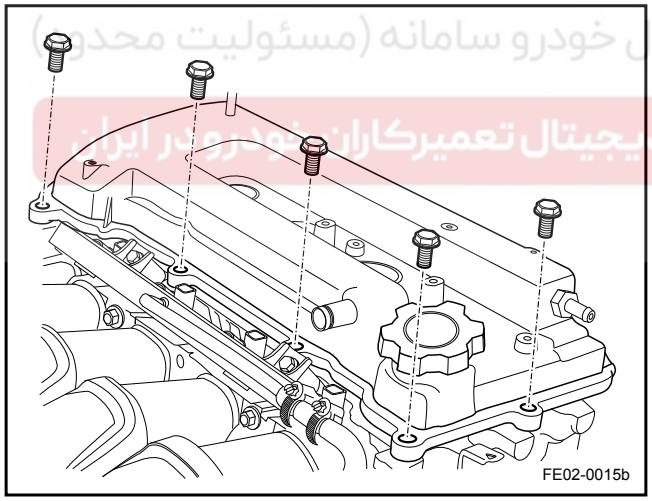


8. Remove the cylinder head gasket from the cylinder head cover.

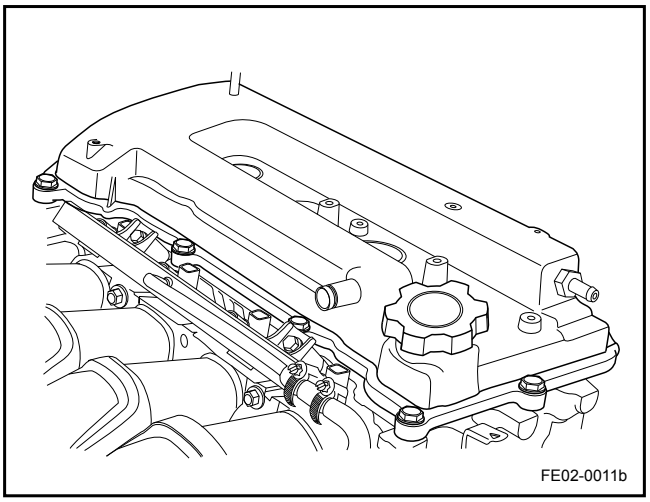


Installation Procedure:

1. Install the cylinder head cover gasket.



2. Apply sealant evenly in the cylinder head gasket.
3. Install the cylinder head cover.

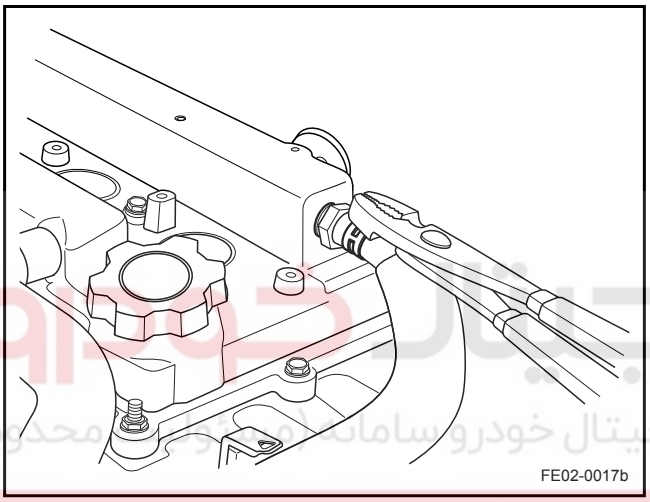

FE02-0011b

4. Tighten the cylinder head cover bolts.

   Note

   When tightening, tighten a single bolt several times, in accordance with the specified torque.
   Short Bolts:
   Torque: 9 Nm (Metric) 6.7 lb-ft (US English)

   Long Bolts, Nuts, Special Bolts:
   Torque: 11 Nm (Metric) 8.2 lb-ft (US English)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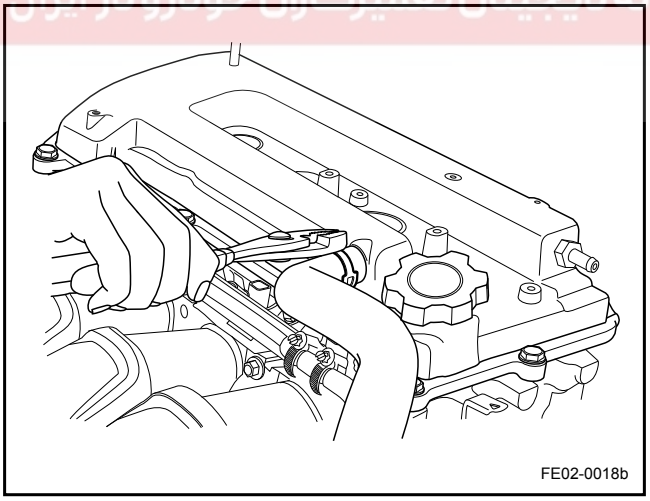
5. Install the crankcase ventilation vacuum tube.


FE02-0018b

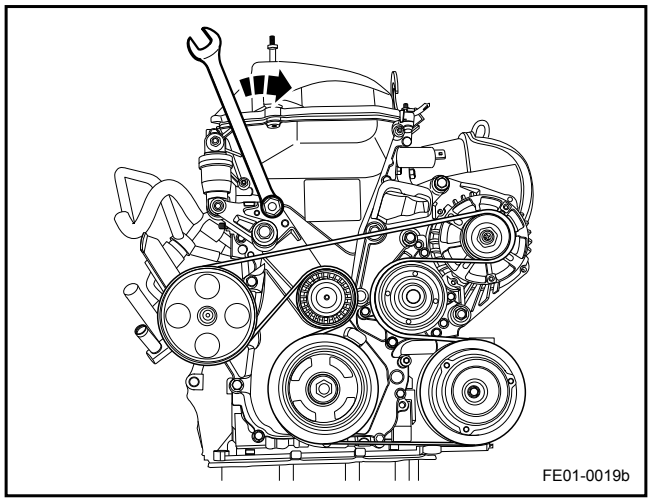
6. Install the crankcase ventilation tube.
7. Install ignition coil and ignition wire.
8. Install the engine plastic shield.
9. Connect the battery negative cable.

2.6.8.3 Drive Belt Replacement

Removal Procedure:

Warning!

Refer to "Battery Disconnection Warning" in "Warnings and Notices".

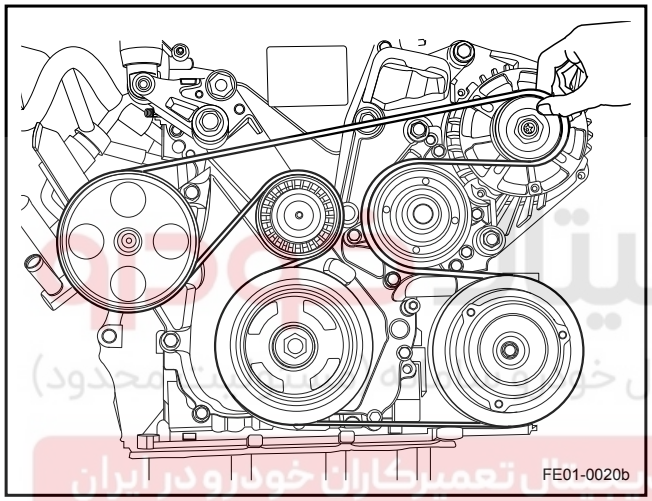


1. Disconnect the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.
2. Rotate the drive belt tensioner anti-clockwise with a wrench to remove the drive belt.

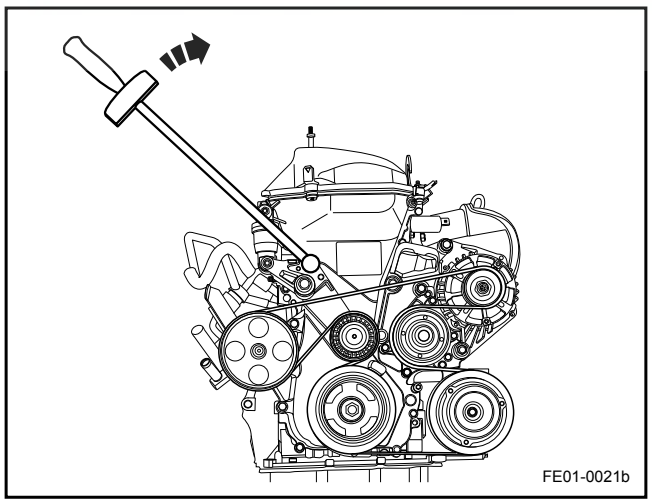
   Note

   In the removal process, prevent the wrench slipping causing injury to the operator.

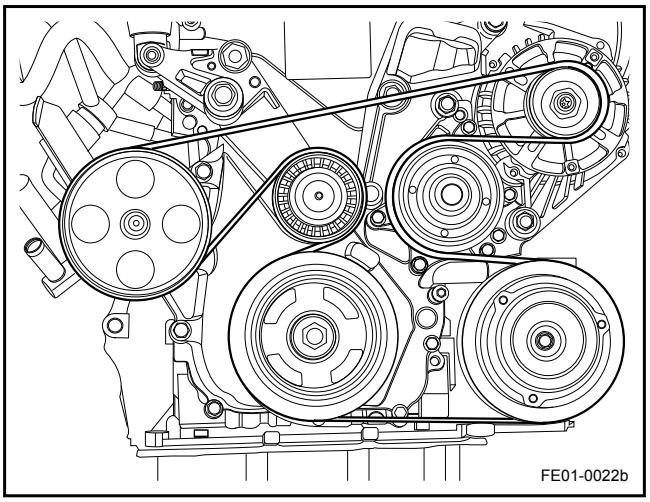
Installation Procedure:



1. Wrap the drive belt as shown.



2. Rotate the drive belt tensioner clockwise with a wrench to install the drive belt.



3. Release the Drive Belt Tensioner device to the normal position.

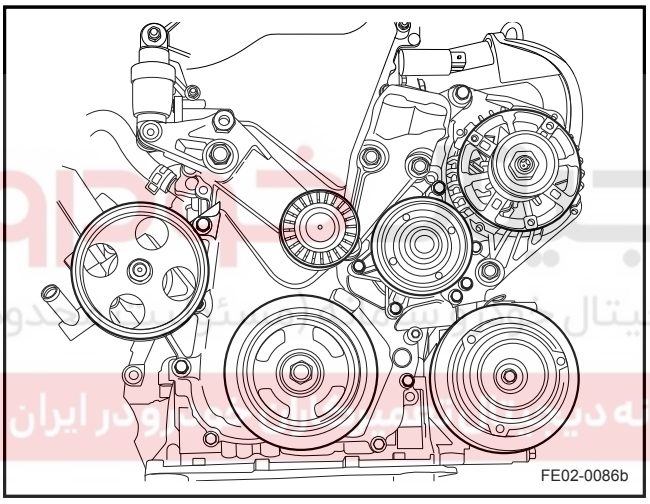
   Note

   Before releasing the tensioner device, confirm the drive belt aligned drive pulley groove, otherwise the drive belt may be damaged.

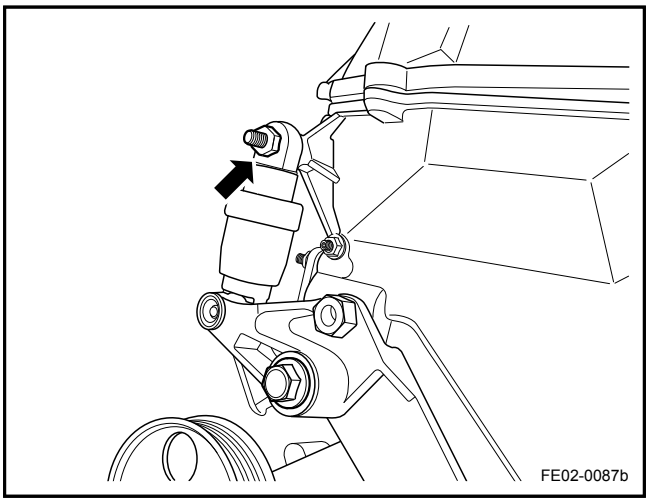
4. Connect the battery negative cable.

2.6.8.4 Drive Belt Tensioner Replacement

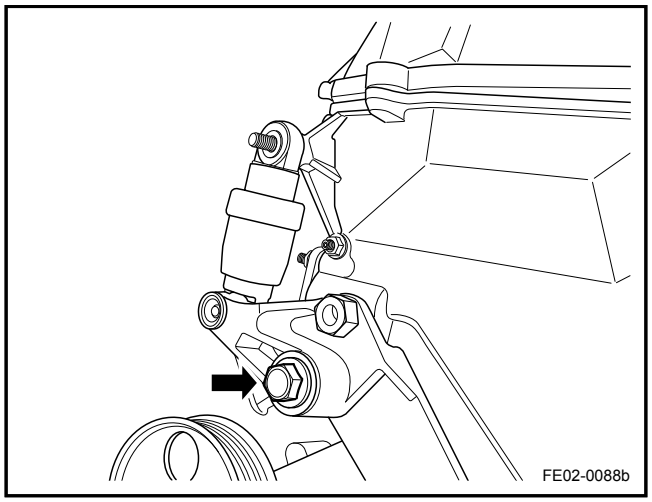
Removal Procedure:



1. Disconnect the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.
2. Remove the hood. Refer to 2.6.8.1 Plastic Engine Shield Replacement.
3. Remove the drive belt. Refer to 2.6.8.3 Drive Belt Replacement.

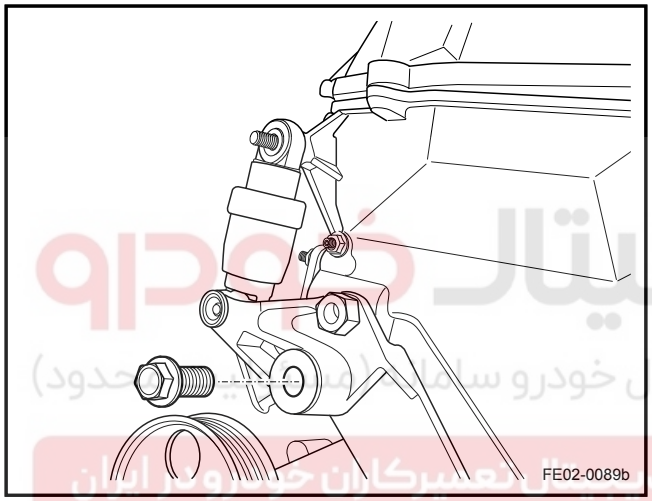


4. Remove the drive belt tensioner retaining nut.



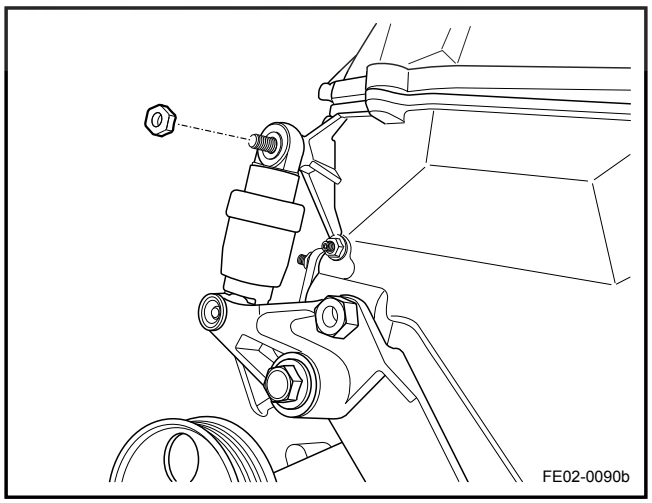
5. Remove the drive belt tensioner pulley bracket bolt.

Installation Procedure:



1. Install drive belt tensioner bracket bolts.

   Torque: 69 Nm (Metric) 51.1 lb-ft (US English)



2. Install drive belt tensioner bracket retaining nut.

   Torque: 29 Nm (Metric) 21.5 lb-ft (US English)

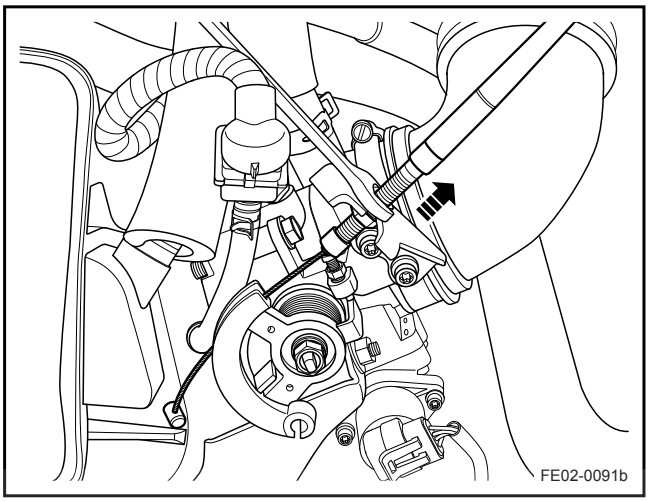
3. Install the drive belt.
4. Install the engine hood.
5. Connect the battery negative cable.

2.6.8.5 Throttle Body Assembly Replacement

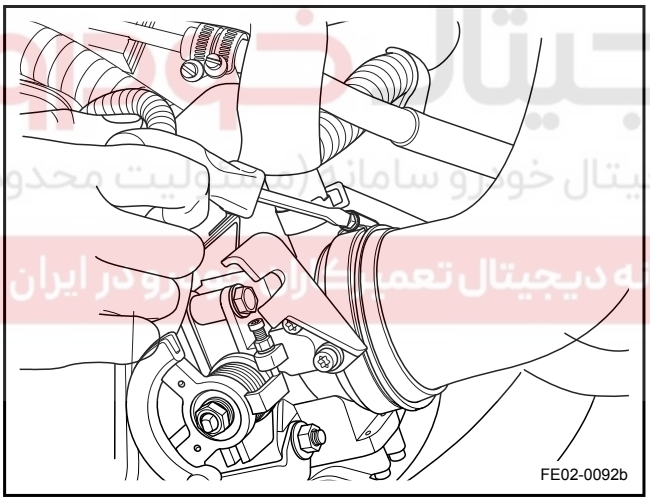
Removal Procedure:

Warning!

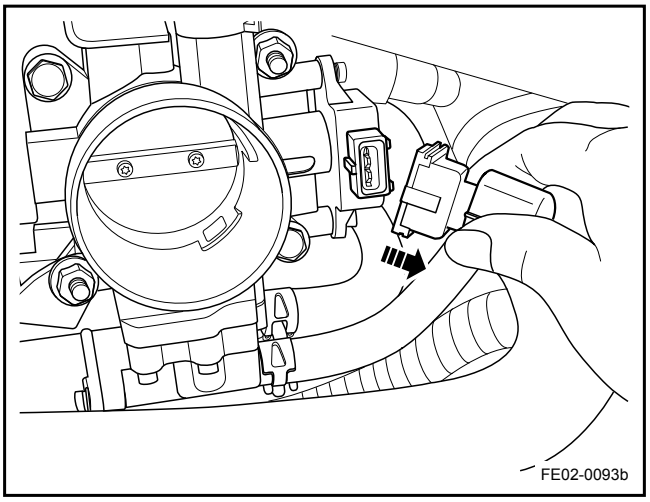
Refer to "Battery Disconnection Warning" in "Warnings and Notices".



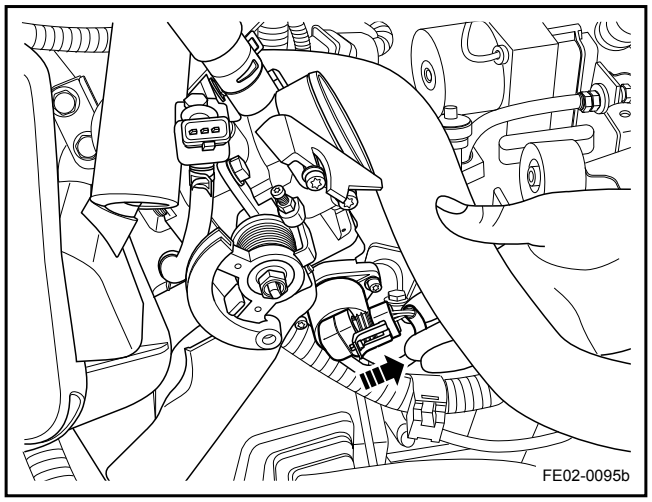
1. Disconnect the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.
2. Remove the throttle pull cable.



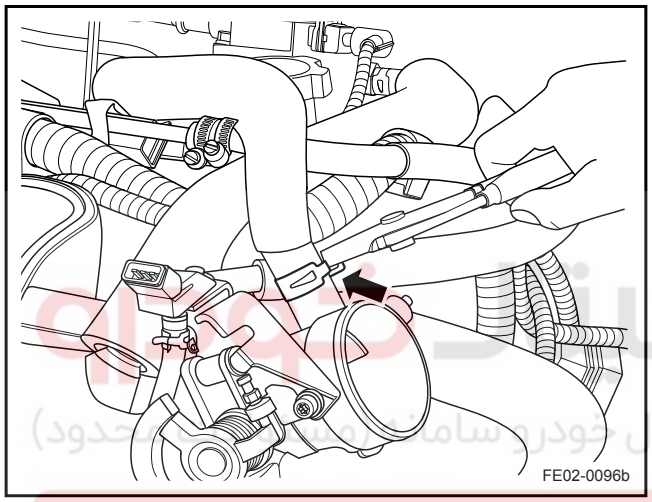
3. Remove the throttle body from the intake manifold.



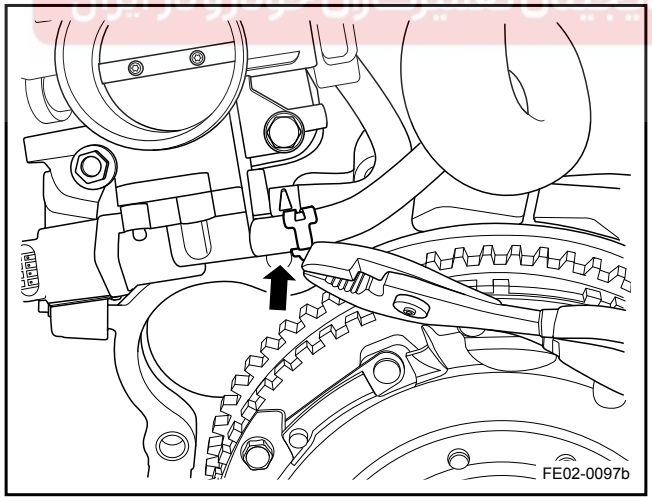
4. Disconnect throttle position sensor wiring harness connector.



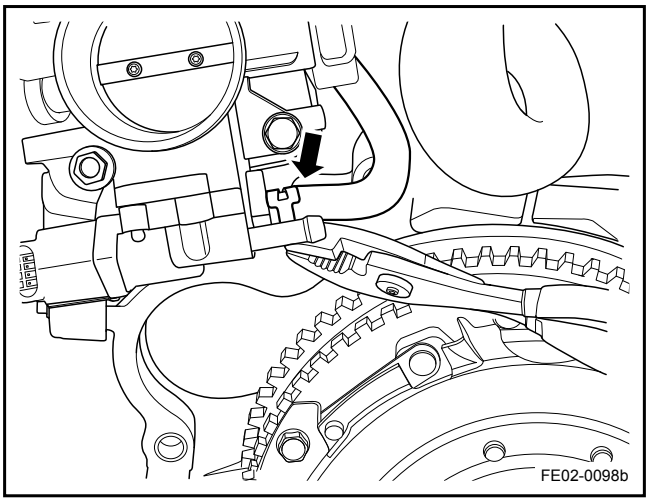
5. Disconnect idle speed control valve wiring harness connector.



6. Remove the crankcase ventilation hose.



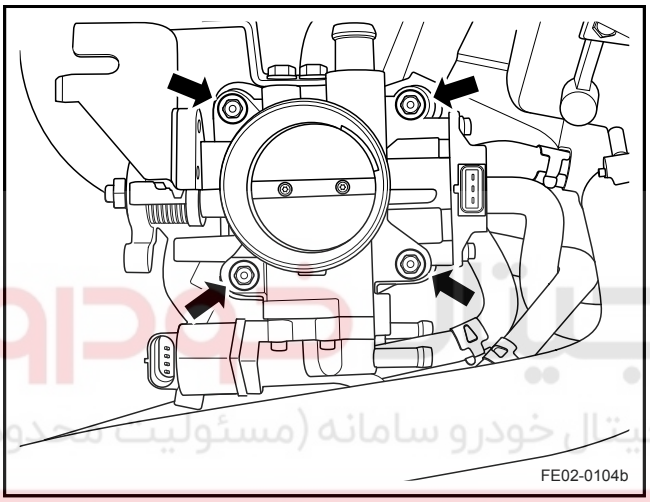
7. Remove throttle body preheated water inlet pipe.



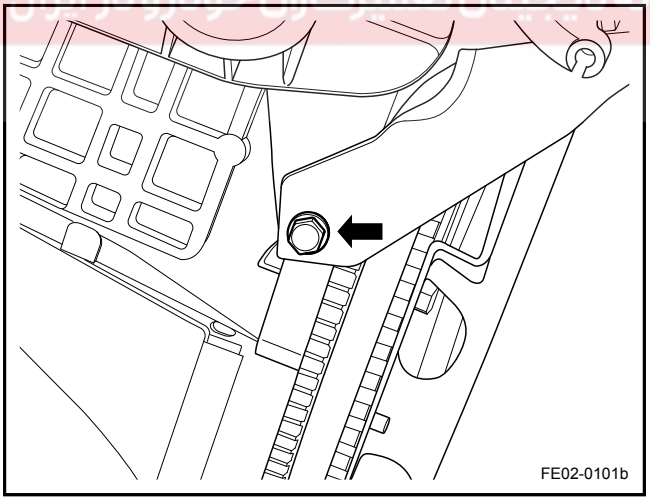
8. Remove throttle body preheated water outlet pipe.

   Warning!

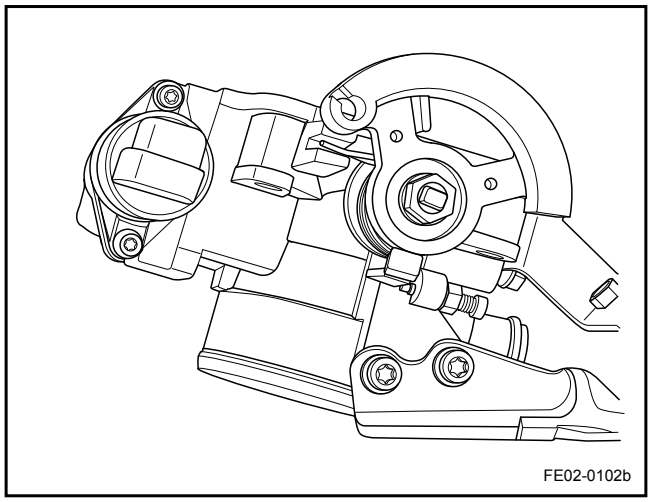
   When the engine temperature is high, prevent the engine coolant spray, causing burns in the removal procedure.



9. Remove throttle body retaining nut from the intake manifold.

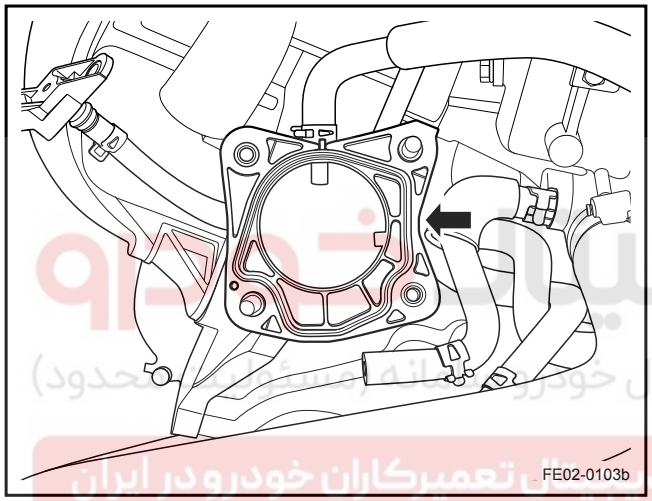


10. Remove throttle body bracket bolts.


FE02-0102b

11. Remove the throttle body assembly from the intake manifold and complete the removal procedure.

Installation Procedure: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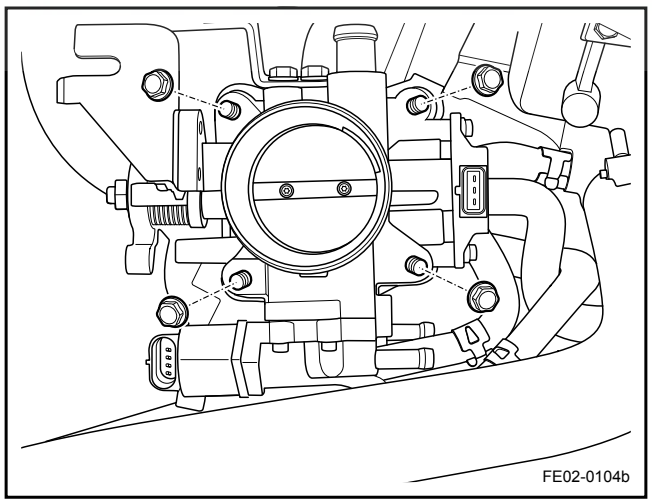
1. Clean the engine throttle body and the engine intake manifold mating surface and replace the seals.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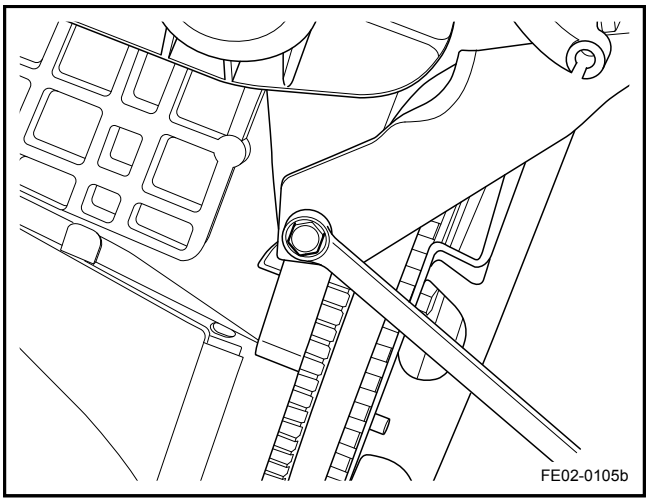
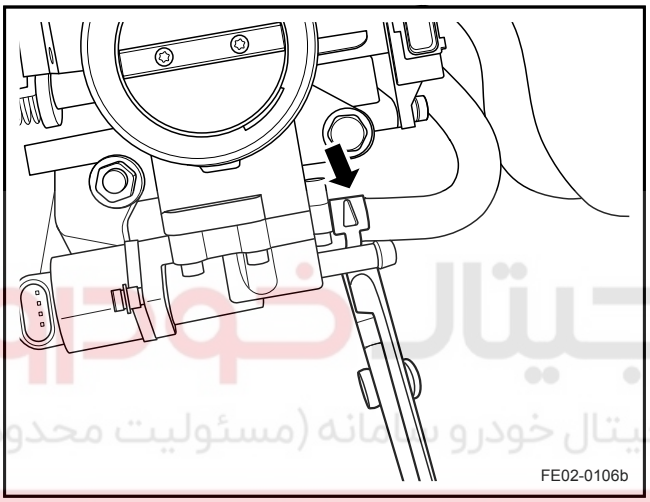
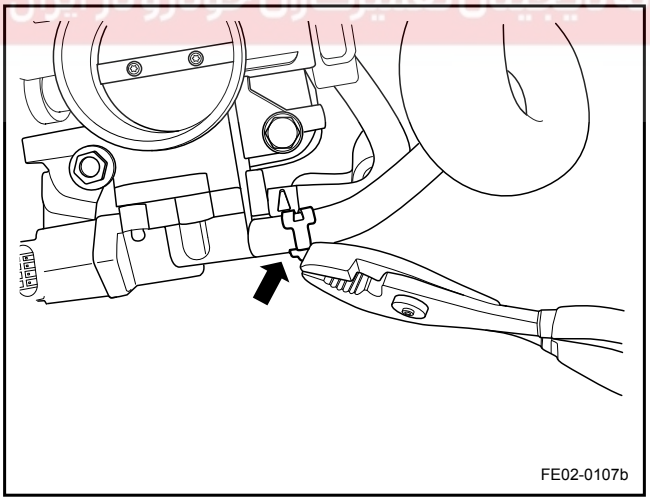
2. Install the throttle body to the intake manifold and tighten the retaining nut.



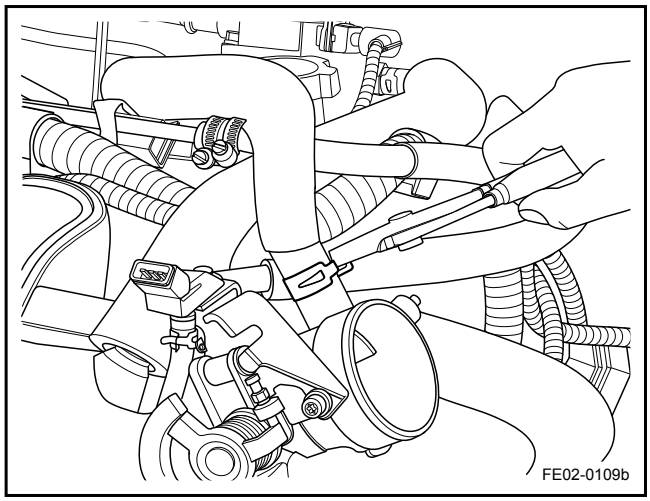
3. Install throttle body bracket and tighten the bolts.



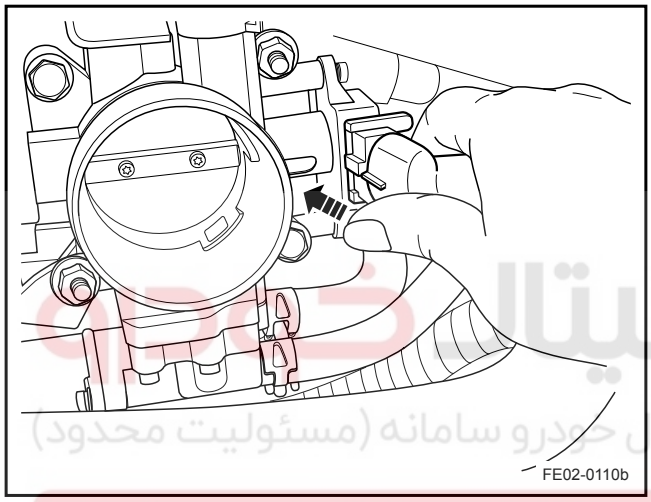
4. Install the throttle preheated water inlet pipe.



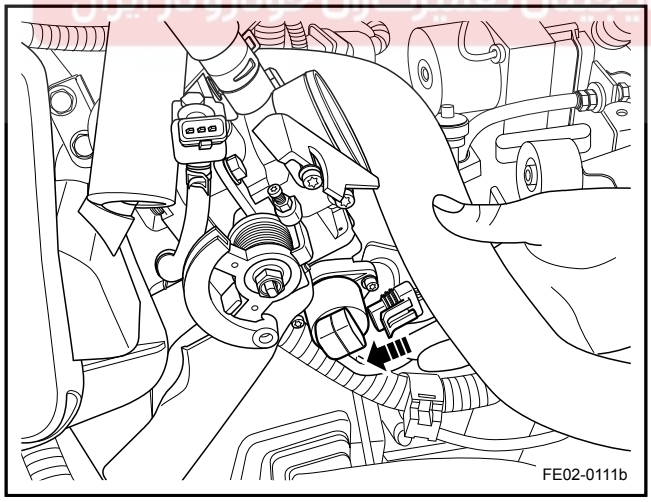
5. Install the throttle preheated water outlet pipe.



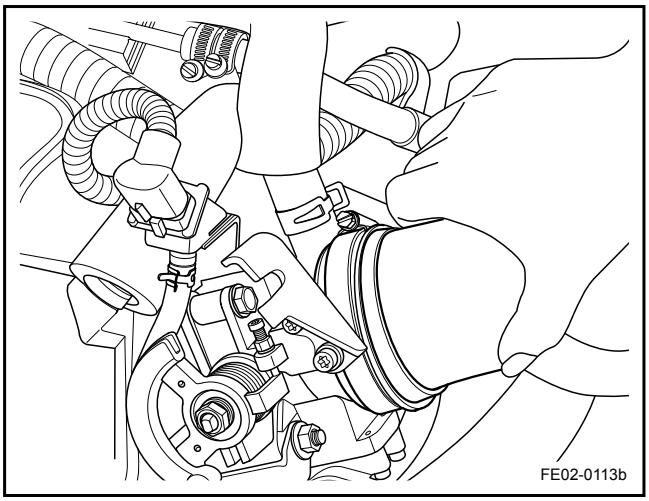
6. Install the crankcase ventilation hose.



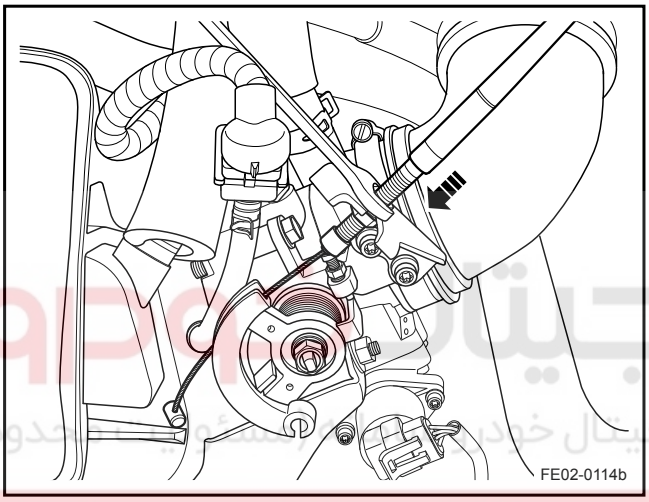
7. Connect the throttle position sensor wiring harness connector.



8. Connect the idle speed control valve wiring harness connector.



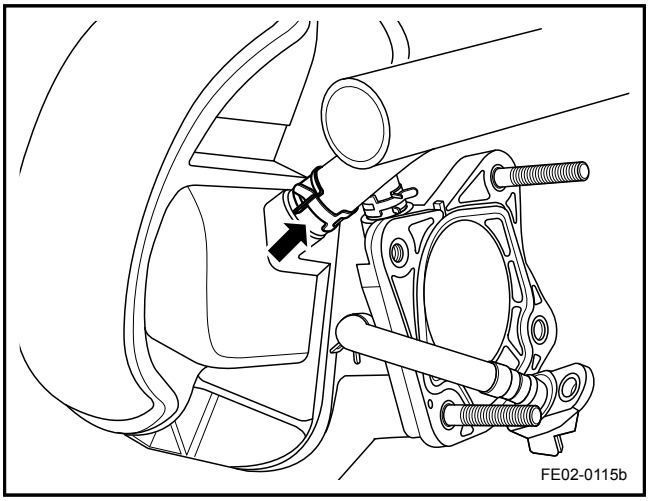
9. Install and tighten the intake manifold clamp.



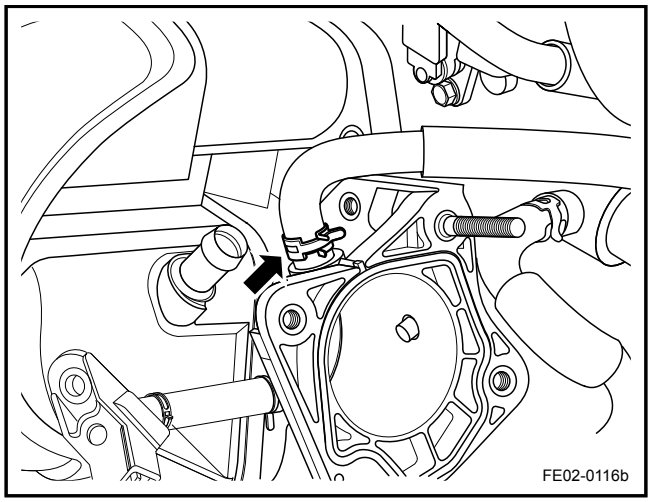
10. Install the throttle pull cable.
11. Connect the battery negative cable.

2.6.8.6 Intake Manifold Assembly Replacement

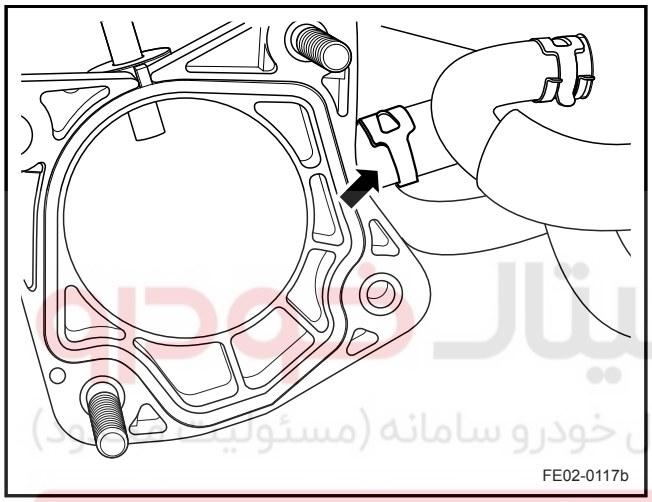
Removal Procedure:



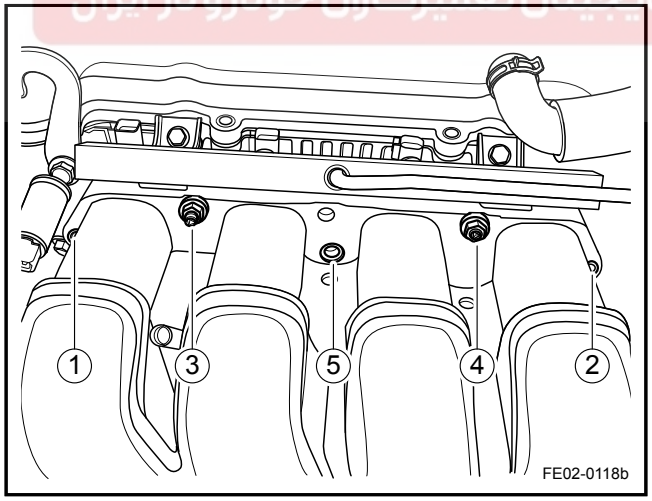
1. Disconnect the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.
2. Remove the hood. Refer to 2.6.8.1 Plastic Engine Shield Replacement.
3. Remove throttle body. Refer to 2.6.8.5 Throttle Body Assembly Replacement.
4. Remove the crankcase ventilation vacuum tube.



5. Remove the canister solenoid valve vacuum tube.

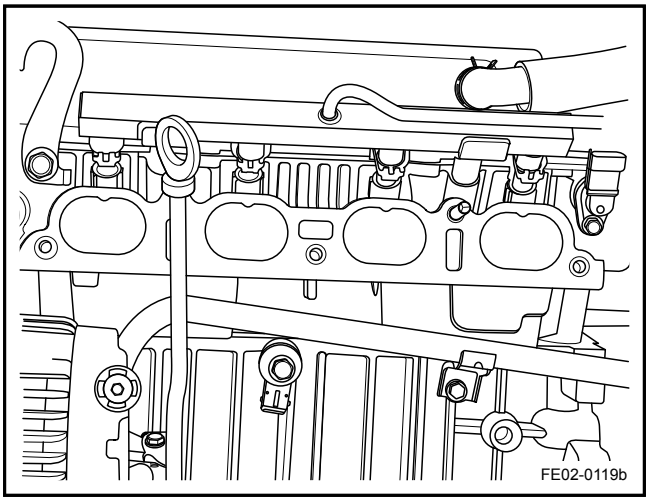


6. Remove the vacuum booster vacuum tubes.

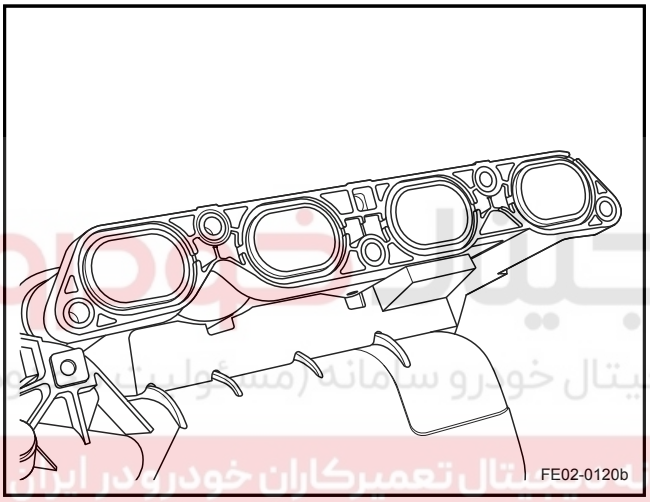


7. Remove the intake manifold retaining bolts and nuts in the sequence shown in the graphic.

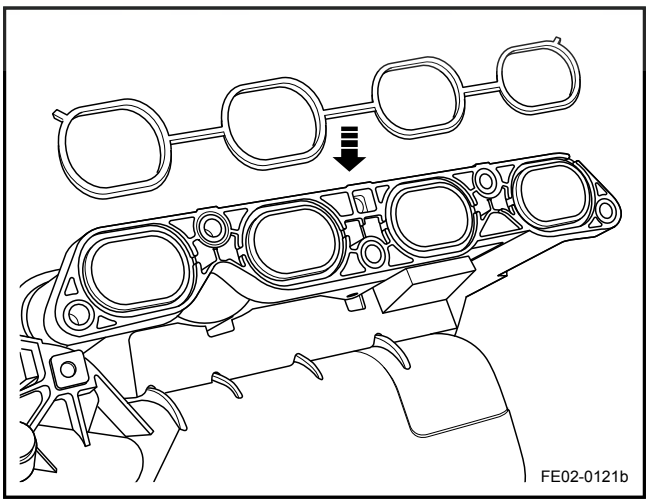
Installation Procedure:



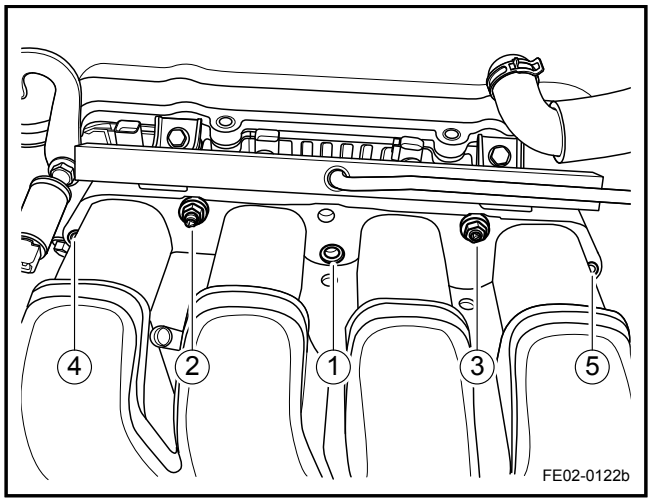
1. Clean the cylinder head intake manifold installation surface.



2. Clean the intake manifold installation surface.



3. Install the intake manifold seals.

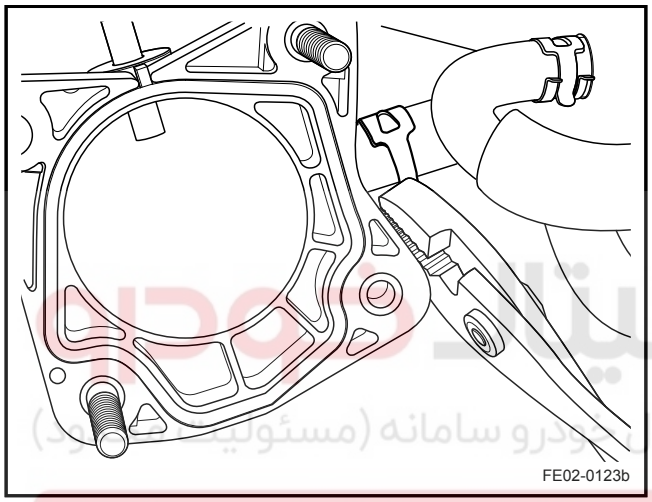


4. Tighten the intake manifold retaining bolts and nuts in the sequence shown in the graphic.

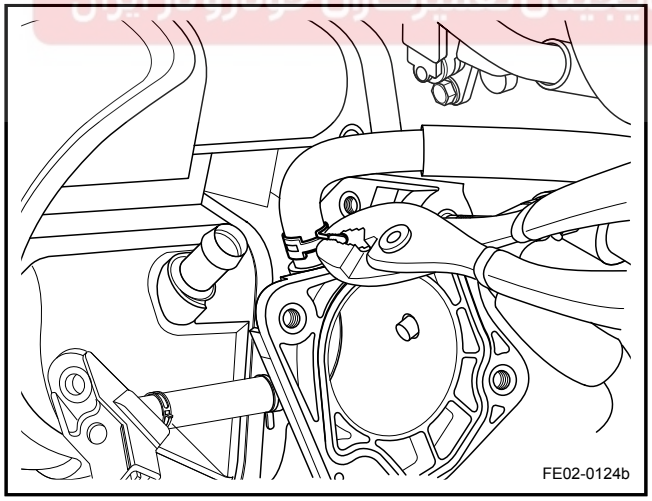
   Note

   The bolts and nuts can not tighten to the specified torque at once, otherwise it will result in the intake manifold leakage. They should be tightened at several stages to the specified torques.

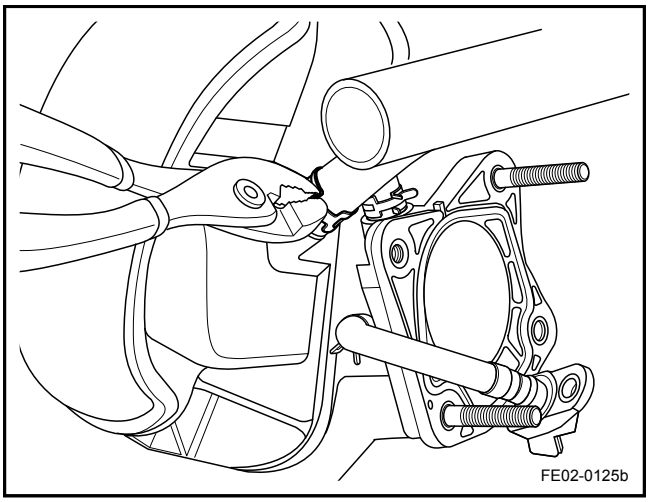
   Torque: 30 Nm (Metric) 22.3 lb-ft (US English)



5. Install the vacuum booster vacuum tube.



6. Install the canister solenoid valve vacuum tube.


FE02-0125b

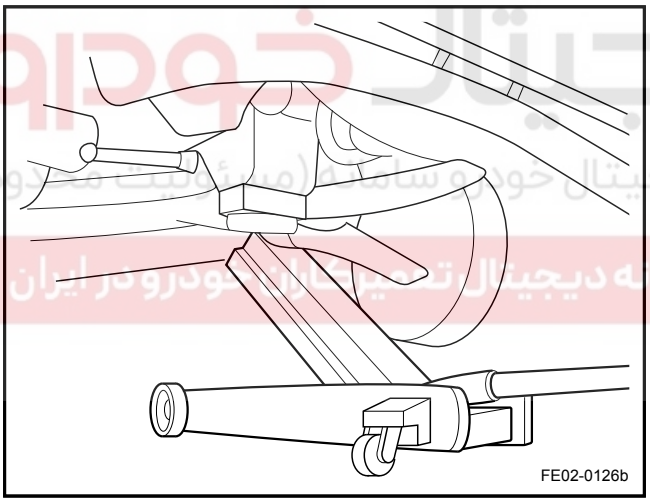
7. Install the crankcase ventilation tube.
8. Install the throttle body.
9. Install the engine hood.
10. Install the battery negative cable.

2.6.8.7 Engine Mount Replacement

Removal Procedure:

Warning!

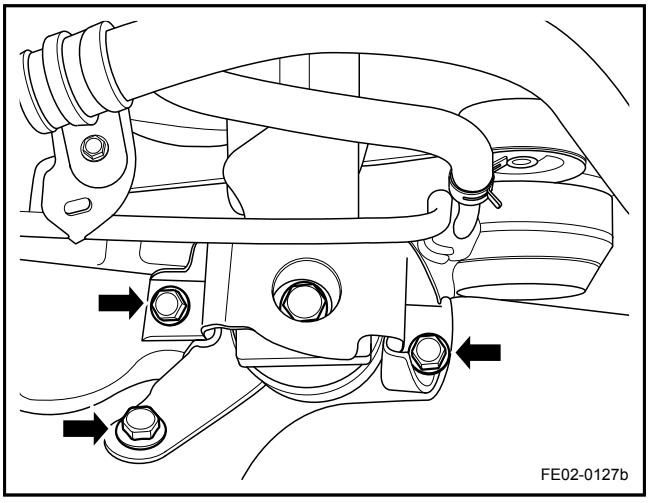
Refer to "Battery Disconnection Warning" in "Warnings and Notices".


FE02-0126b

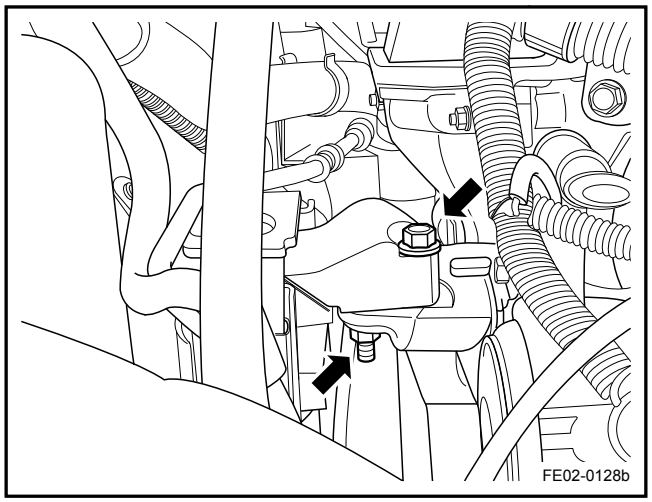
1. Disconnect the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.
2. Remove the engine hood. Refer to 2.6.8.1 Plastic Engine Shield Replacement.
3. Support the engine assembly with a jack.

Note

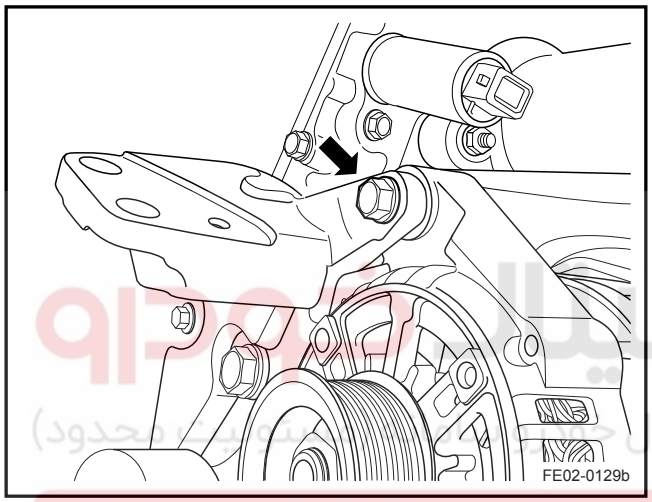
Before jacking the engine, place a piece of wood between the jack and the engine oil pan, otherwise it will damage the engine oil pan.


FE02-0127b

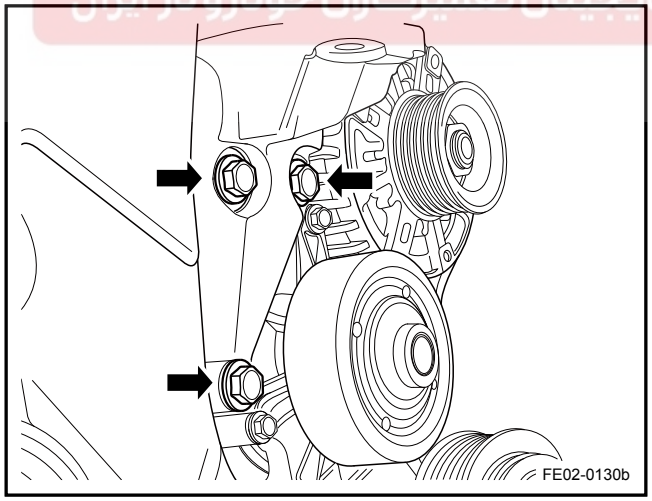
4. Remove the engine to body right mount bolts.



5. Remove the engine mount to engine right retaining bolts and nuts.

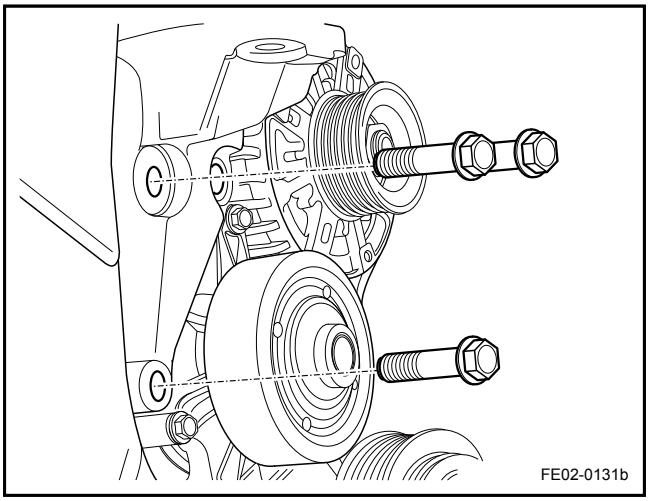


6. Remove the drive belt. Refer to 2.6.8.3 Drive Belt Replacement.
7. Remove the drive belt tensioner. Refer to 2.6.8.4 Drive Belt Tensioner Replacement.
8. Remove the generator bracket bolts.



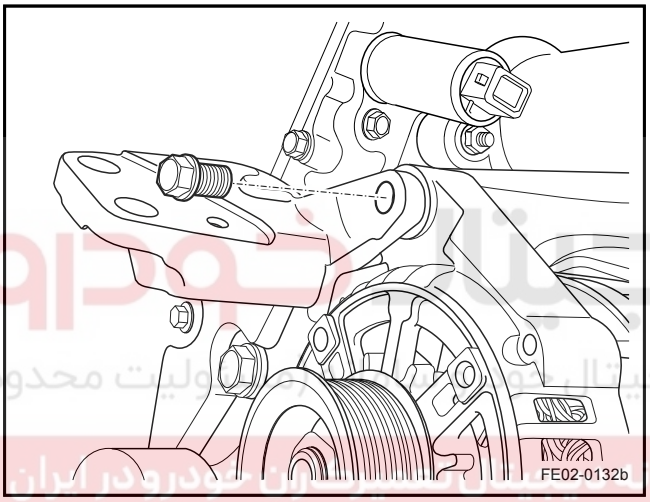
9. Remove the engine mount retaining bolts and remove the engine mount.

Installation Procedure:



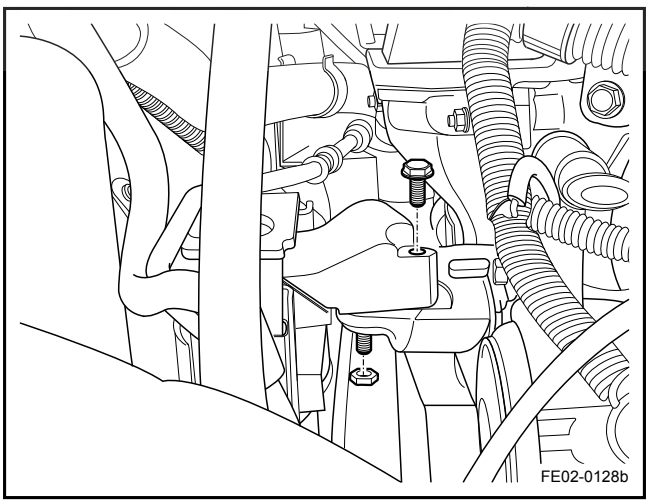
1. Install and tighten the engine mount retaining bolts to the specified torque.

   Torque: 47 Nm (Metric) 34.8 lb-ft (US English)



2. Install the generator bracket bolts.

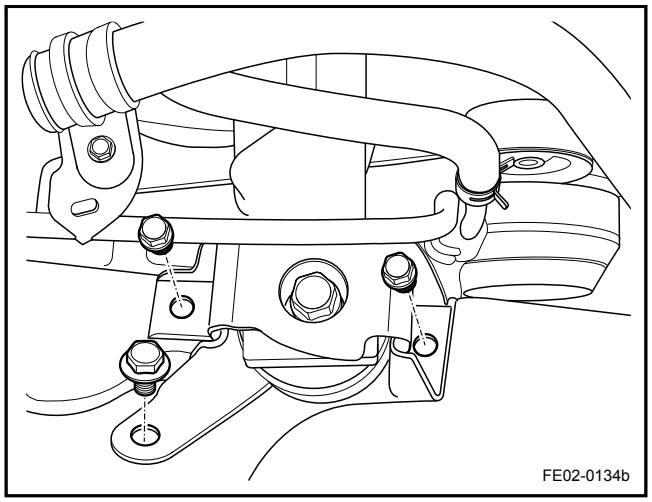
   Torque: 47 Nm (Metric) 34.8 lb-ft (US English)



3. Install the drive belt tensioner.
4. Install the drive belt.
5. Install and tighten the right engine mount to the engine retaining bolts and nuts.

   Bolts
   Torque: 52 Nm (Metric) 38.5 lb-ft (US English)

   Nuts
   Torque: 52 Nm (Metric) 38.5 lb-ft (US English)



6. Install and tighten the right engine mount to the body bolts.

   Torque: 52 Nm (Metric) 38.5 lb-ft (US English)

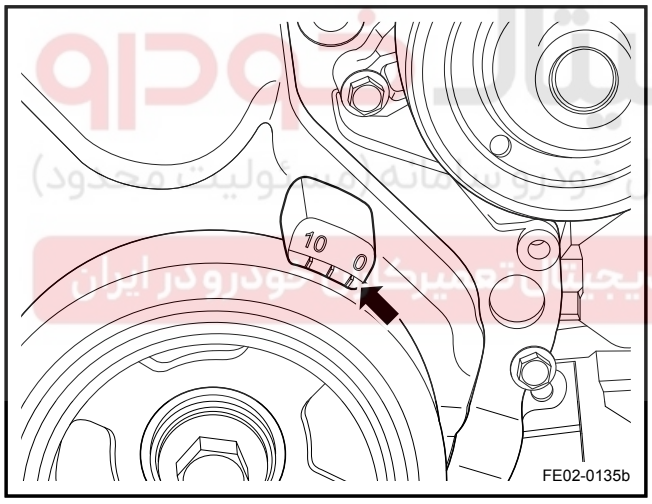
7. Remove the supporting jack.
8. Install the engine hood.
9. Install the battery negative cable.

2.6.8.8 Timing Chain Tensioner Replacement

Removal Procedure:

Warning!

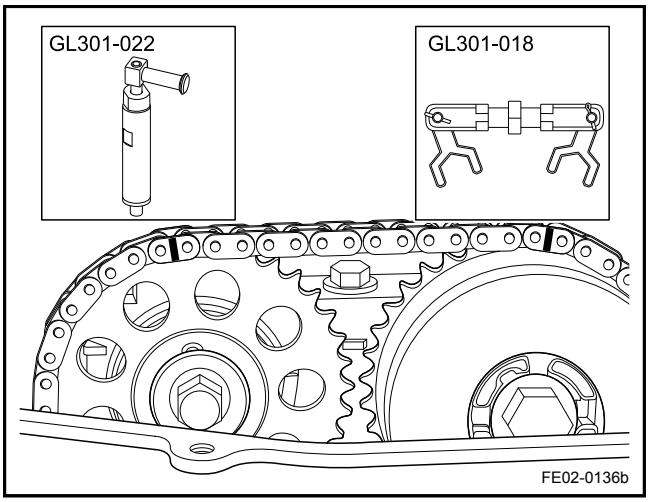
Refer to "Battery Disconnection Warning" in "Warnings and Notices".



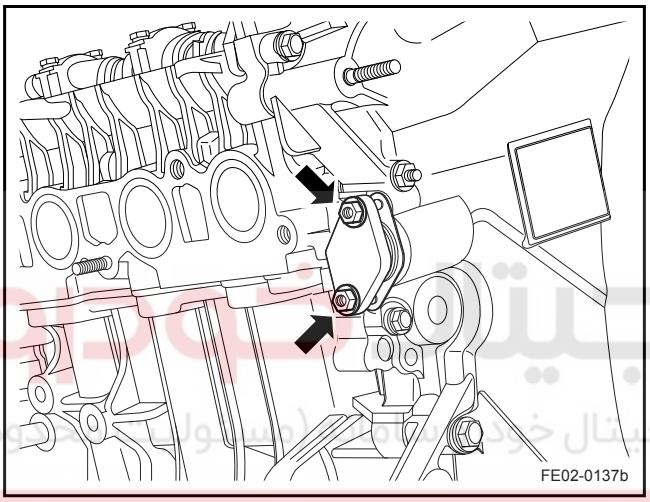
1. Disconnect the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.
2. Remove the engine hood. Refer to 2.6.8.1 Plastic Engine Shield Replacement.
3. Remove the ignition coil. Refer to 2.10.8.3 Ignition Coil Replacement.
4. Remove the cylinder head cover. Refer to 2.6.8.2 Cylinder Head Cover Replacement.
5. Rotate the crankshaft and make sure the cylinder No.1 is at TDC position.

   Note

   Crankshaft timing mark is aligned with the timing chain cast scale line "0".



6. As shown in the graphic, mark on the intake and exhaust sprocket timing with a marker and use a special tool GL301-022 to fix the timing chain and special tool GL301-018 to fix the camshaft.

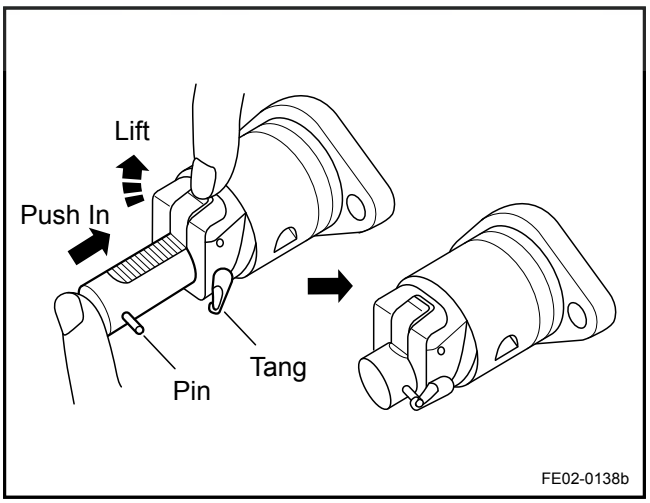


7. Remove Timing Chain Tensioner Assembly.

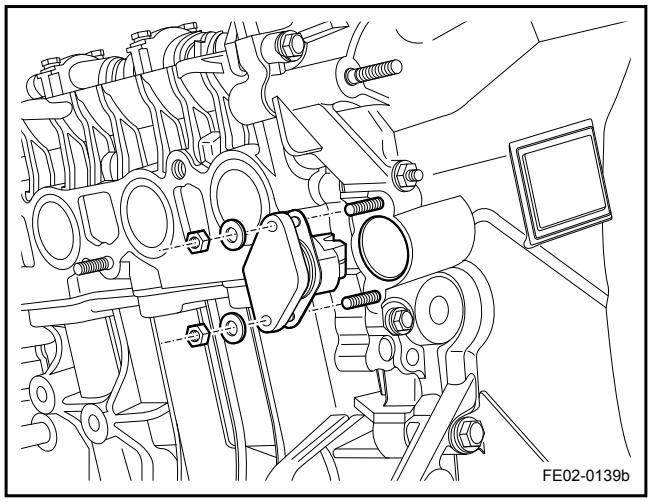
Note

At this time do not rotate the crankshaft in order to prevent the timing chain teeth rolling.

Installation Procedure:

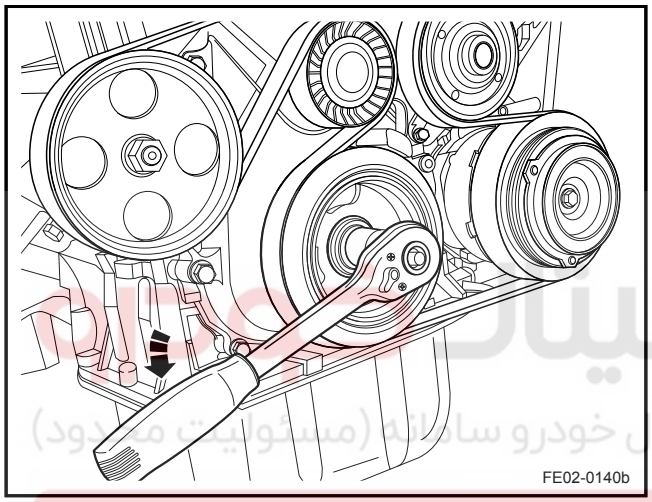


1. Press the timing chain tensioner device as shown to enter the self-locking state.



2. Install the timing chain tensioner and tighten the nuts.

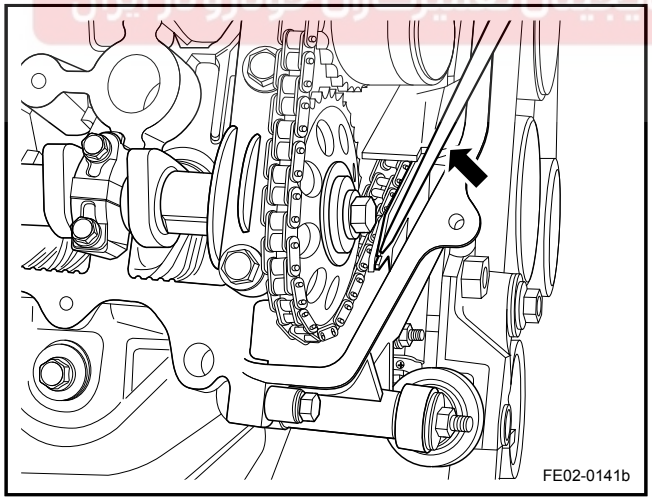
   Torque: 29 Nm (Metric) 21.5 lb-ft (US English)



3. Rotate the crankshaft pulley counter clockwise to unlock the self-locking device and pop up the handle.

   Note

   Rotating process should be even, otherwise it may cause the timing chain teeth skidding.



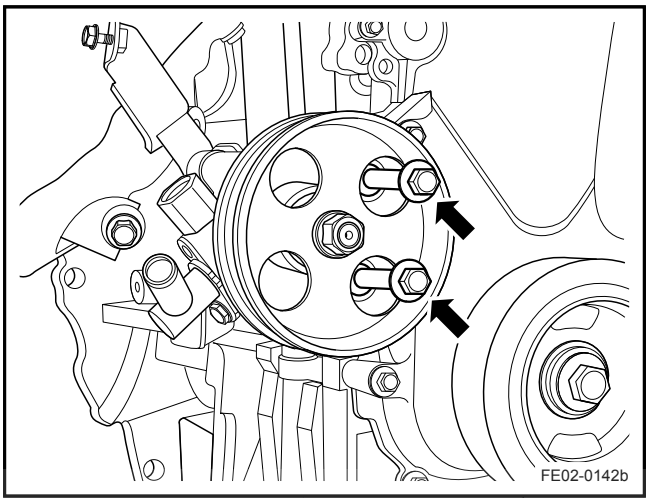
4. Confirm the tensioner unlocked and the tensioner guide is firmly pressed by the handle.

   Note

   If not properly unlocked, use a screwdriver to push tensioner in the opposite direction to unlock the guide.

5. Install the valve chamber cover.
6. Install the ignition coil.
7. Install the engine hood.
8. Connect the battery negative cable.

2.6.8.9 Timing Chain Cover Replacement



Removal Procedure:

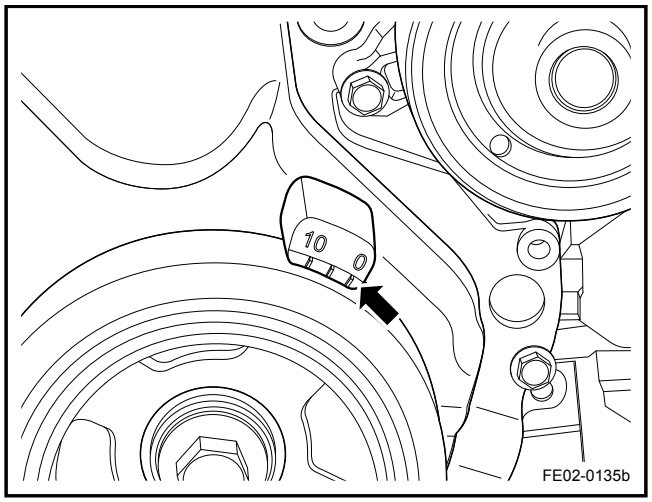
Warning!

Refer to "Battery Disconnection Warning" and "Cooling System Service Warning" in "Warnings and Notices".

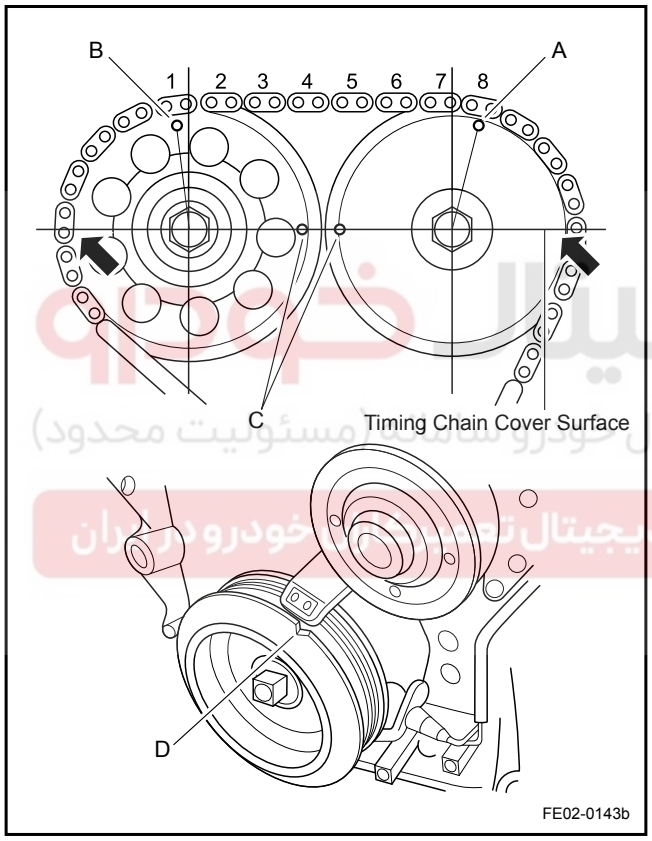
1. Disconnect the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.
2. Discharge the engine coolant. Refer to 2.8.8.1 Engine Coolant Discharge and Filling.
3. Remove the engine plastic shield. Refer to 2.6.8.1 Plastic Engine Shield Replacement.
4. Remove the ignition coil. Refer to 2.10.8.3 Ignition Coil Replacement.
5. Remove the cylinder head cover. Refer to 2.6.8.2 Cylinder Head Cover Replacement.
6. Remove the drive belt. Refer to 2.6.8.3 Drive Belt Replacement.
7. Remove the drive belt tensioner. Refer to 2.6.8.4 Drive Belt Tensioner Replacement.
8. Remove the generator. Refer to 2.11.8.3 Generator Replacement.
9. Remove the water pump. Refer to 2.8.8.6 Water Pump Replacement.
10. Remove the engine mounting. Refer to 2.6.8.7 Engine Mount Replacement.
11. Remove power steering pump bolts.

    Note

    In the confined operating space, lower the jack to facilitate the operation.



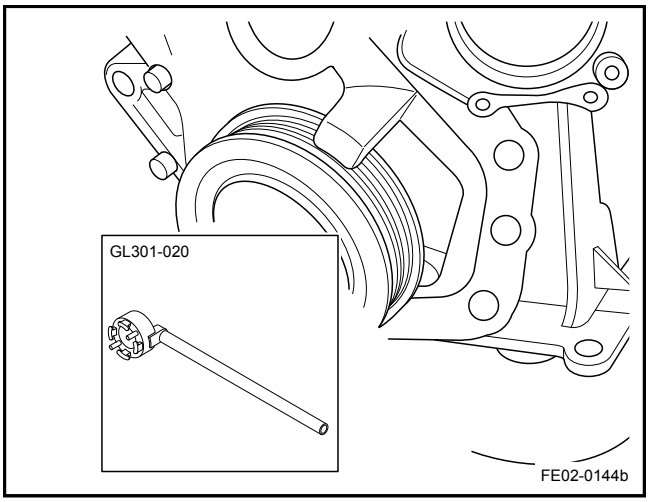
12. Rotate the crankshaft, so that the crankshaft pulley timing mark is aligned with calibration line No.0, as shown.



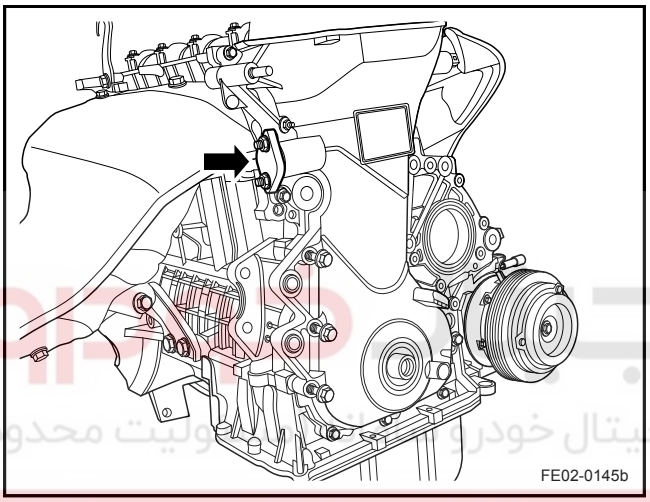
13. Make sure intake and exhaust VVT sprocket sprocket timing mark location is as shown in order to ensure that the cylinder No.1 is at TDC position. If the location is not correct, repeat steps 12 until the intake and exhaust sprocket timing mark is at the correct position and mark on the sprocket with a marker.

Note

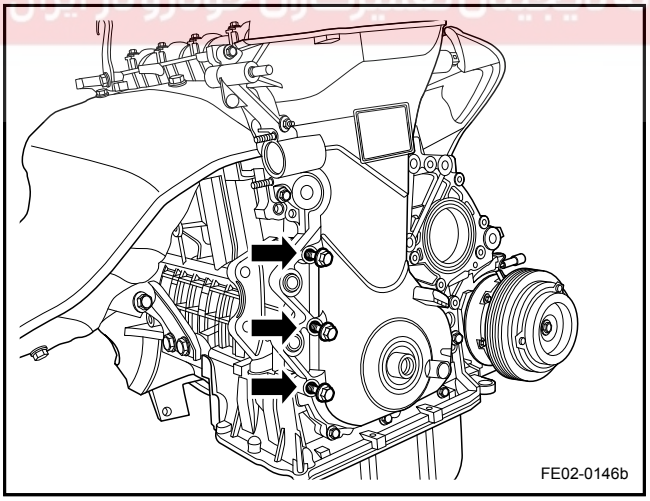
Exhaust sprocket has three marked positions, with two-point upward. VVT sprocket has three marked positions. Grooves on the aluminum alloy body are upward, in the alignment process, the yellow section of the chain may not be aligned with the mark-point. During the removal procedure, make sure two sprocket timing marks at the top location, single-point mark on the sprocket at the level of linear position.



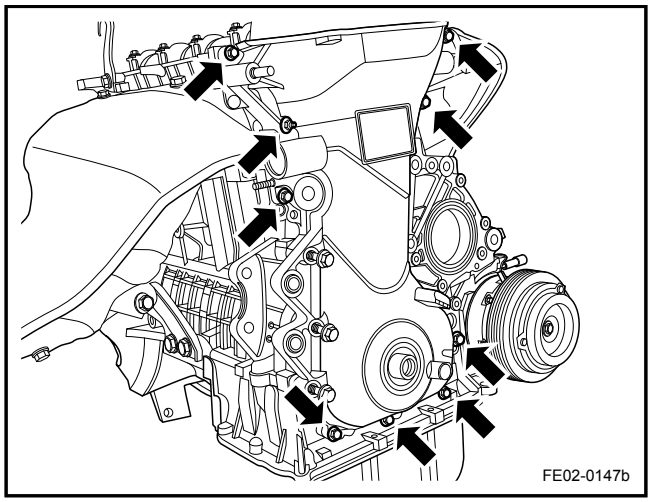
14. Use special tool GL301-020 to remove the crankshaft pulley.



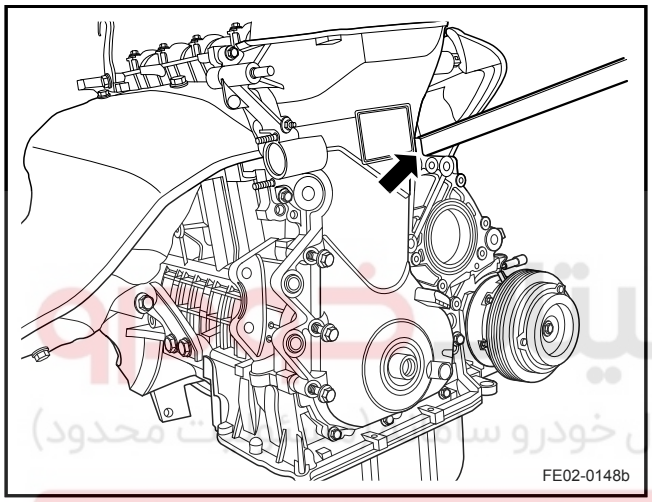
15. Remove the timing chain tensioner.



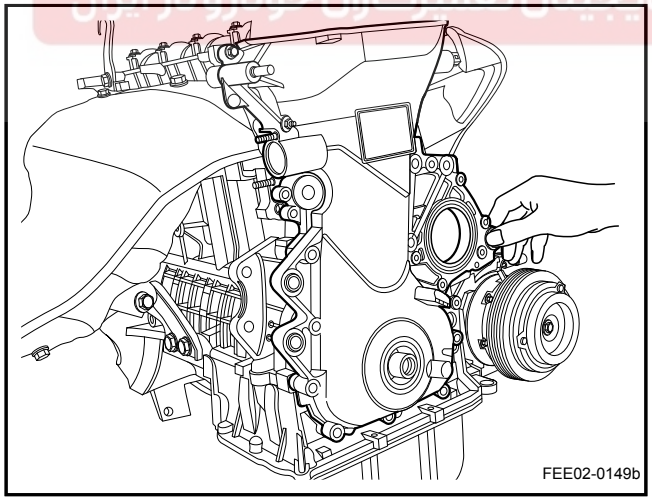
16. Remove the timing chain cover M8 tightening bolts.



17. Remove the timing chain cover M6 tightening bolts and nuts.

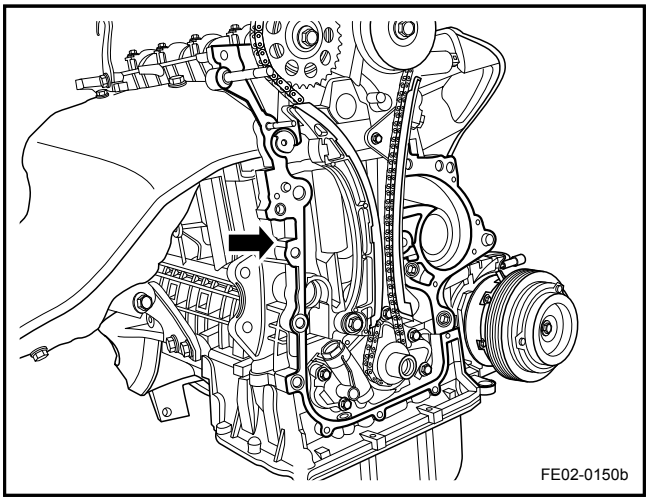


18. Pry groove position with a bar to loosen the timing chain cover.

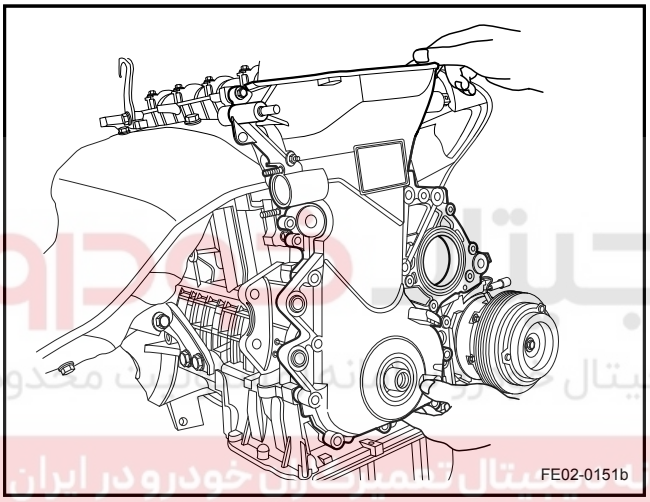


19. Remove the timing chain cover.

Installation Procedure:



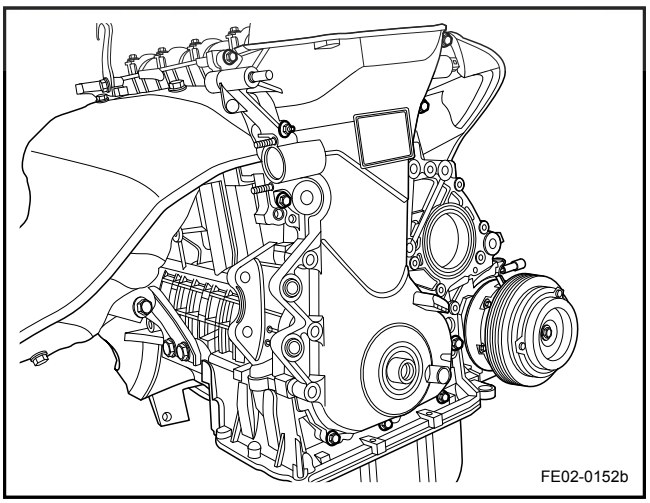
1. Clean the residual sealant on the timing chain cover and cylinder.



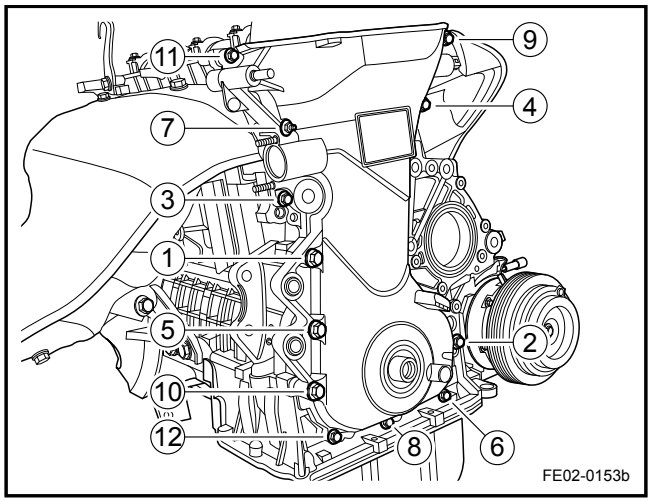
2. Apply special sealant on the timing chain cover and cylinder block mounting surface evenly and install the timing chain cover.

   Note

   Before installing the timing chain cover, pay attention to check the timing chain marks made above are consistent. If there is bias, please re-install the timing chain. Refer to 2.6.8.10 Timing Chain Replacement.

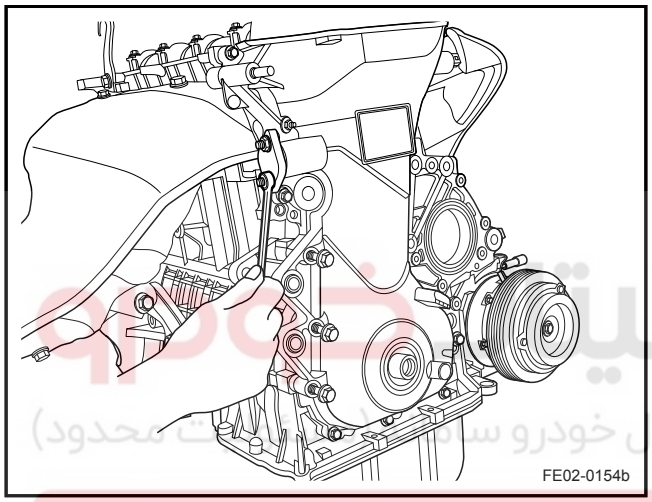


3. Install M6 timing chain cover tightening bolts and nuts, but do not tighten at this stage.

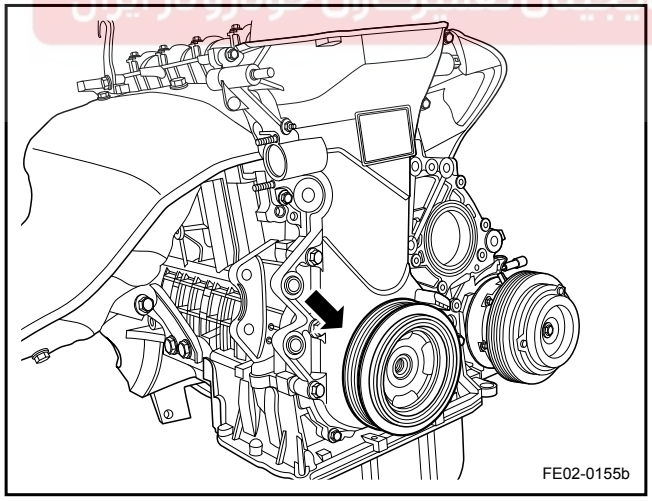


4. Install M8 timing chain cover tightening bolts and tighten timing chain cover tightening bolts and nuts, total of 12, according to the sequence shown in the graphic.

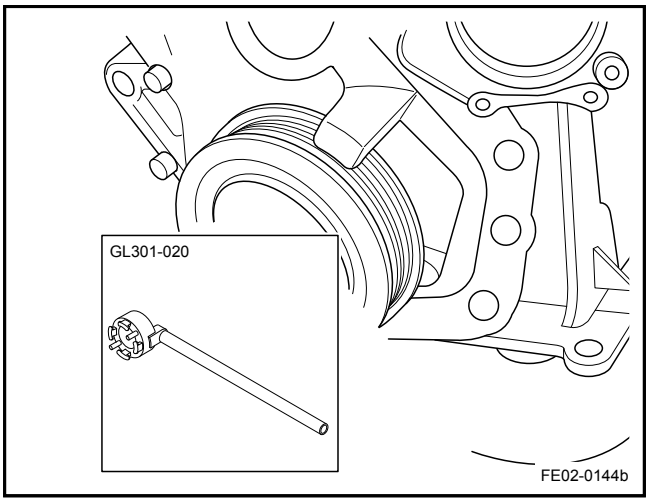
   M6 Bolts and Nuts:
   Torque: 12 Nm (Metric) 8.2 lb-ft (US English)
   M8 Bolt:
   Torque: 18 Nm (Metric) 13.4 lb-ft (US English)



5. Install the timing chain tensioner. Refer to 2.6.8.8 Timing Chain Tensioner Replacement.

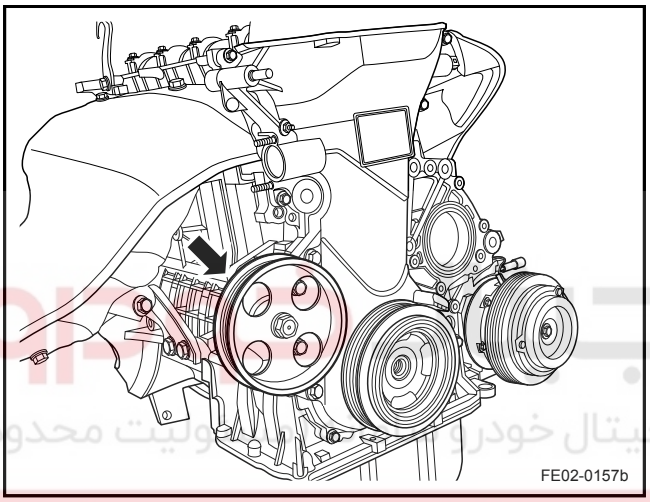


6. Install the crankshaft belt sprocket.



7. Use a special tool GL301-020 to install the crankshaft bolt.

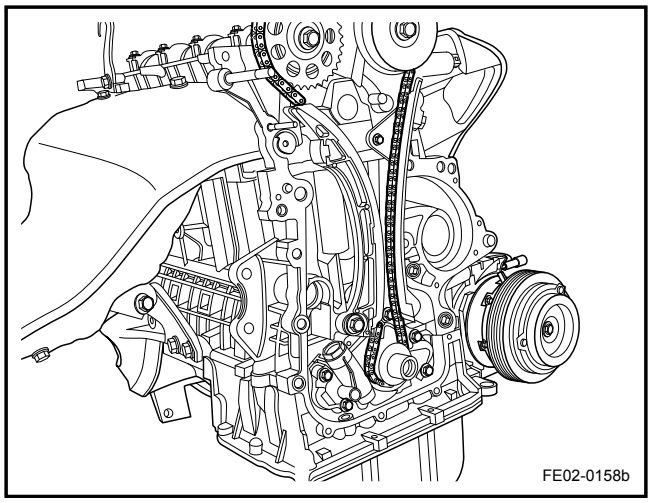
   Torque: 138 Nm (Metric) 102.2 lb-ft (US English)



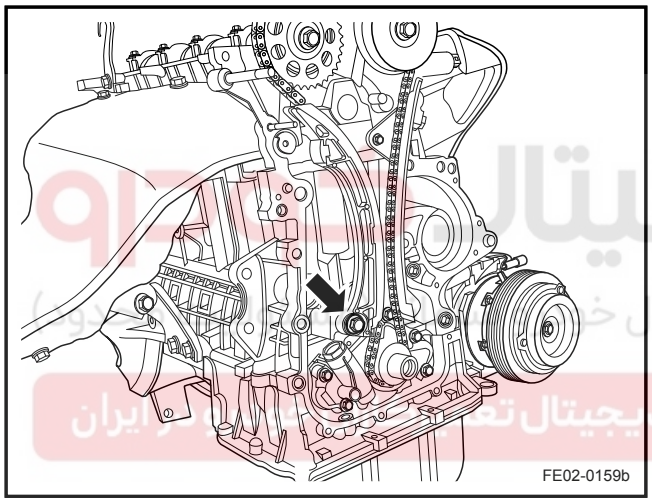
8. Install power steering pump.
9. Install the engine mounting.
10. Install the water pump.
11. Install the generator.
12. Install the drive belt tensioner.
13. Install the drive belt.
14. Install the cylinder head cover.
15. Install the ignition coil.
16. Install the engine plastic shield.
17. Fill the engine coolant.
18. Connect the battery negative cable.

2.6.8.10 Timing Chain Replacement

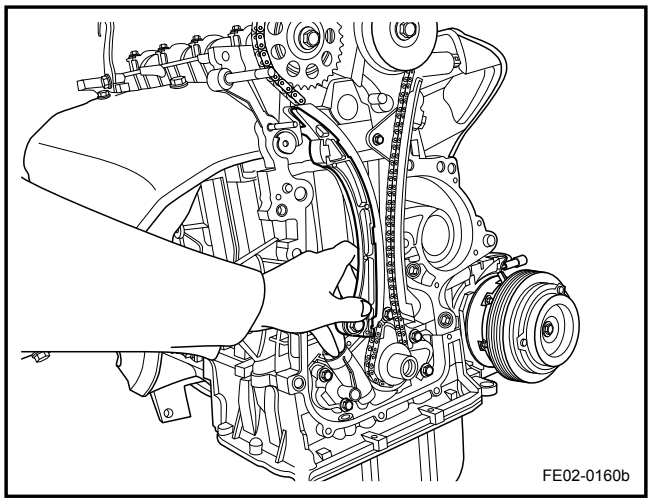
Removal Procedure:



1. Rotate the crankshaft so that the cylinder No.1 is at TDC position. Remove the timing chain cover. Refer to the2.6.8.9 Timing Chain Cover Replacement.



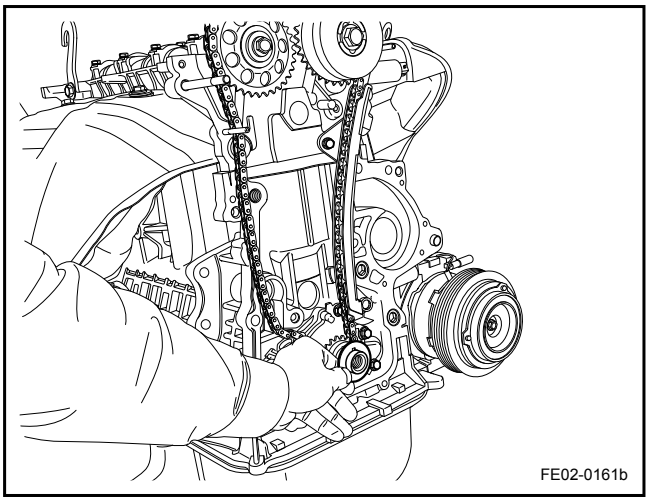
2. Remove the timing chain tensioner rail components retaining bolts.



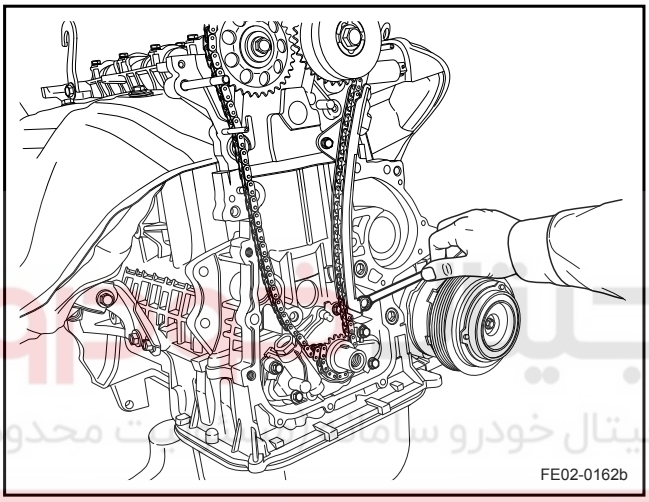
3. Remove the timing chain tensioner rail component.

   Note

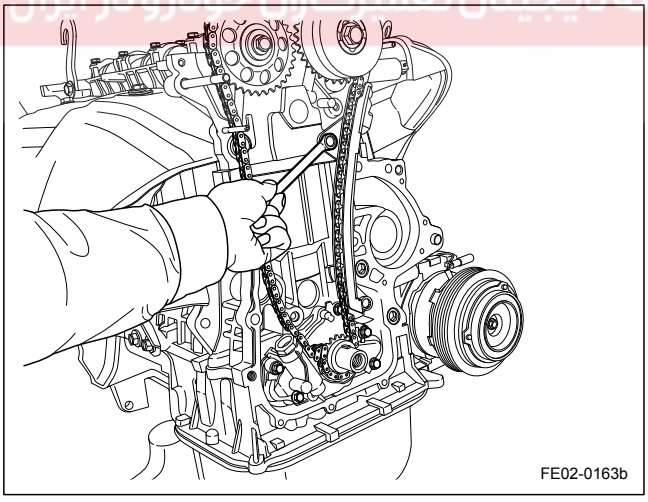
   Do not drop the tensioner device shoe during removal, otherwise it is likely to cause damage to the tensioner hoof block.



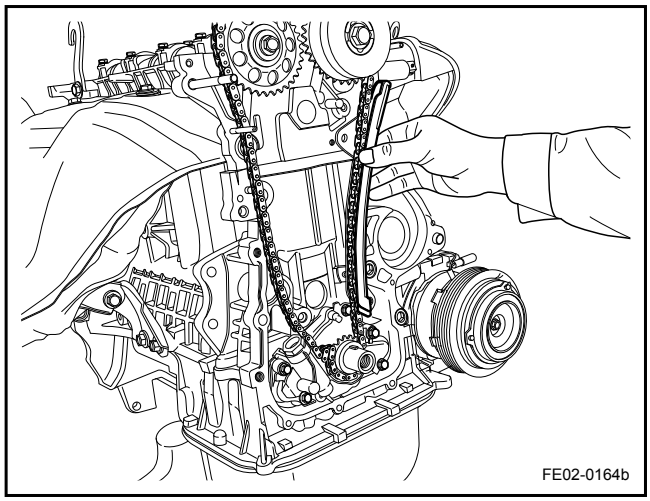
4. Remove the crankshaft sprocket Collar.



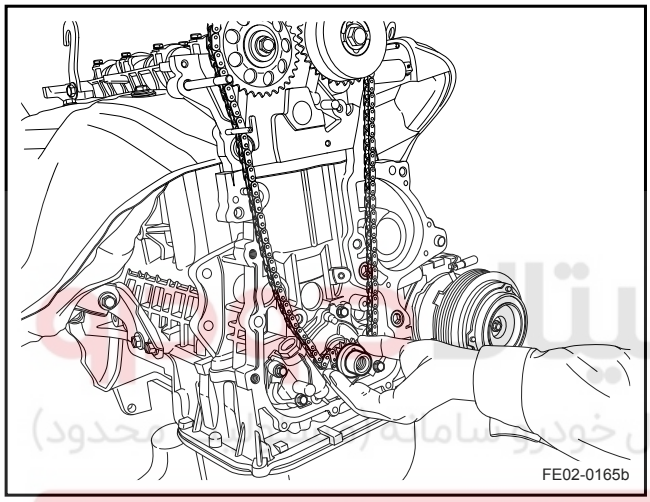
5. Remove the timing chain guide rail lower retaining bolts.



6. Remove the timing chain guide rail upper retaining bolt.

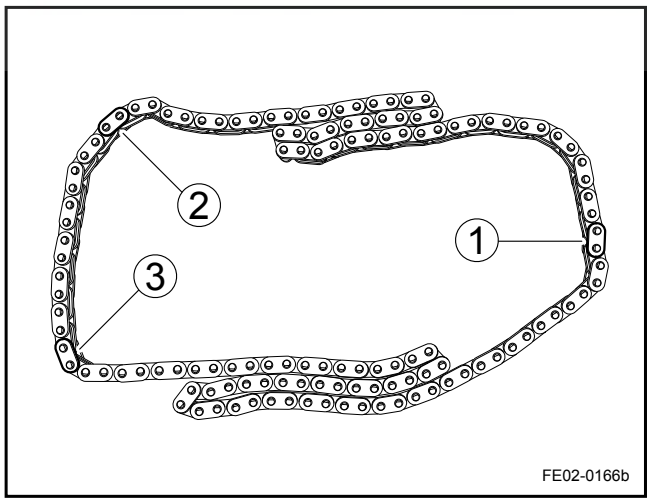


7. Remove the timing chain guide rail.

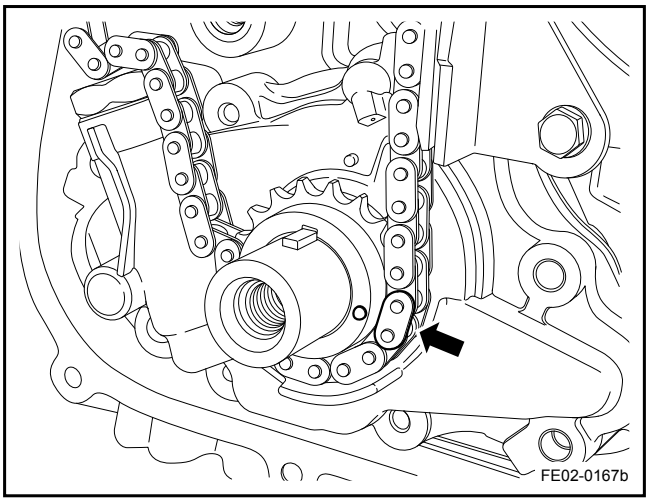


8. Remove the timing chain and crankshaft sprocket.

Installation Procedure:



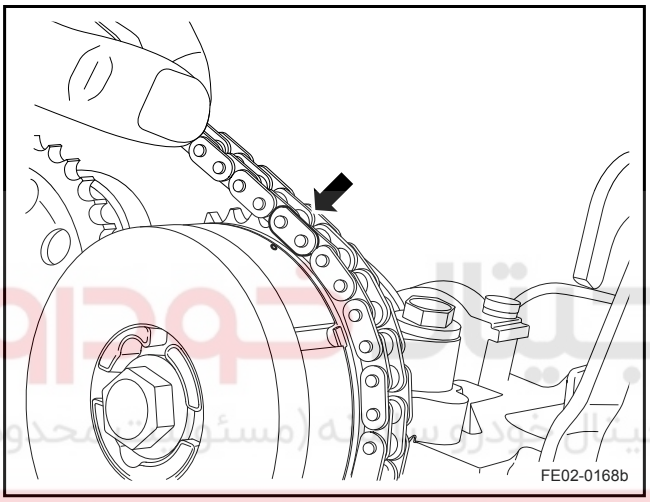
1. Confirm the timing chain three yellow sections.



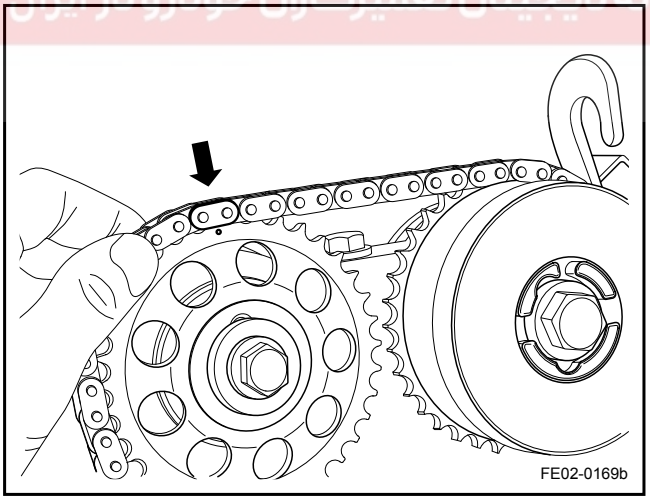
2. Install timing chain and crankshaft sprocket and align the first yellow chain section with the crankshaft sprocket timing mark.

Note

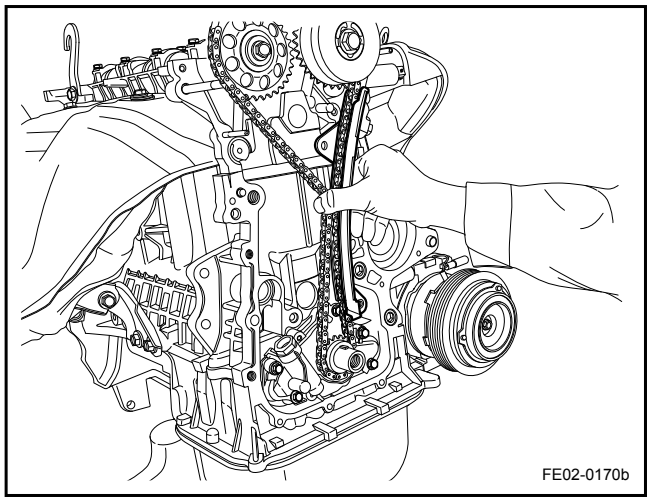
There are total three yellow sections on the timing chain, including two yellow chain section (a difference of 6 links between the sections) and aligned with the intake and exhaust camshaft sprocket timing marks.



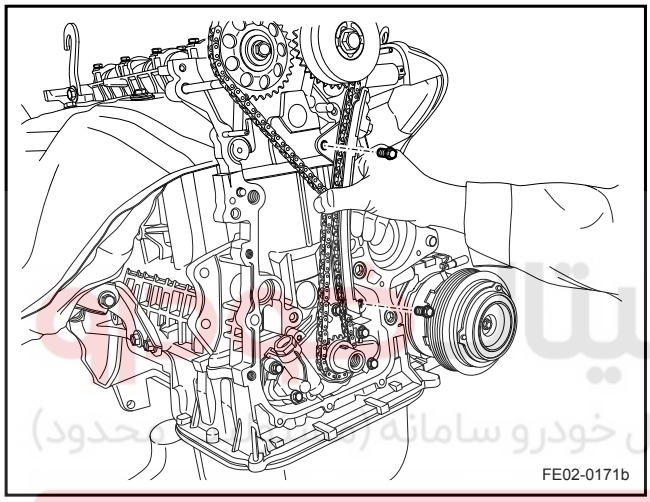
3. Align the second yellow chain section with the intake cam VVT actuator sprocket timing mark.



4. Align the third yellow chain section with the exhaust sprocket timing mark.

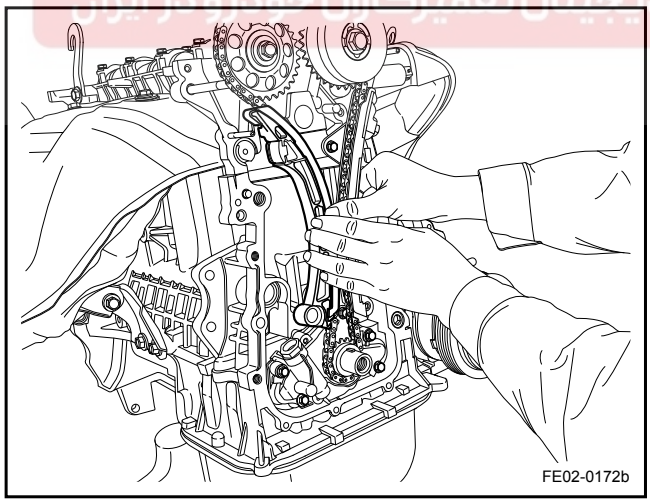


5. Install the timing chain guide rail components.

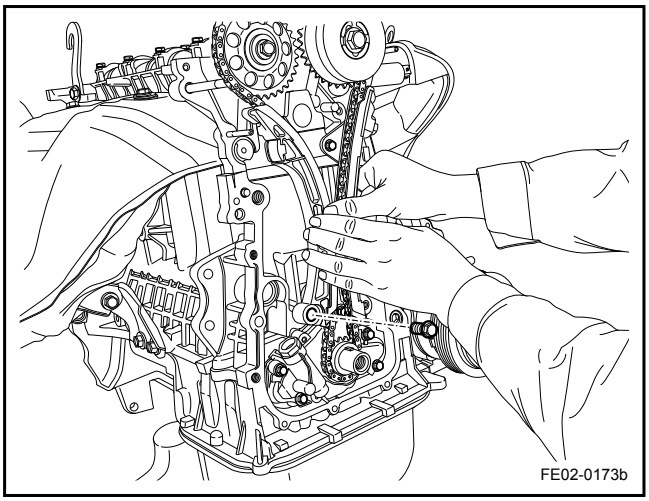


6. Install the timing chain guide rail components retaining bolts.

   Torque: 10 Nm (Metric) 7.4 lb-ft (US English)

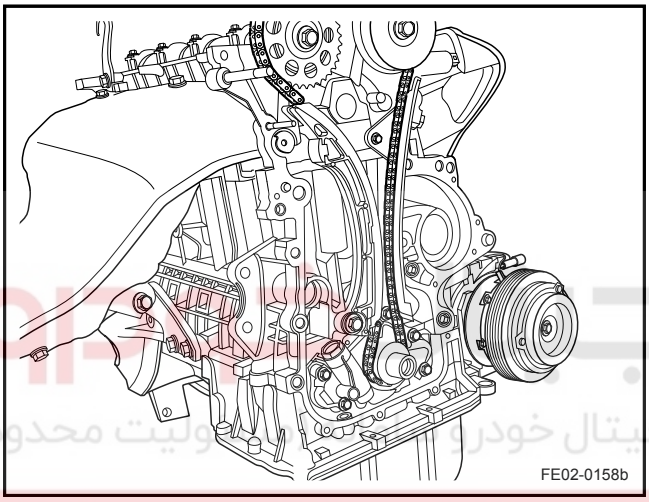


7. Install the tensioner rail components.



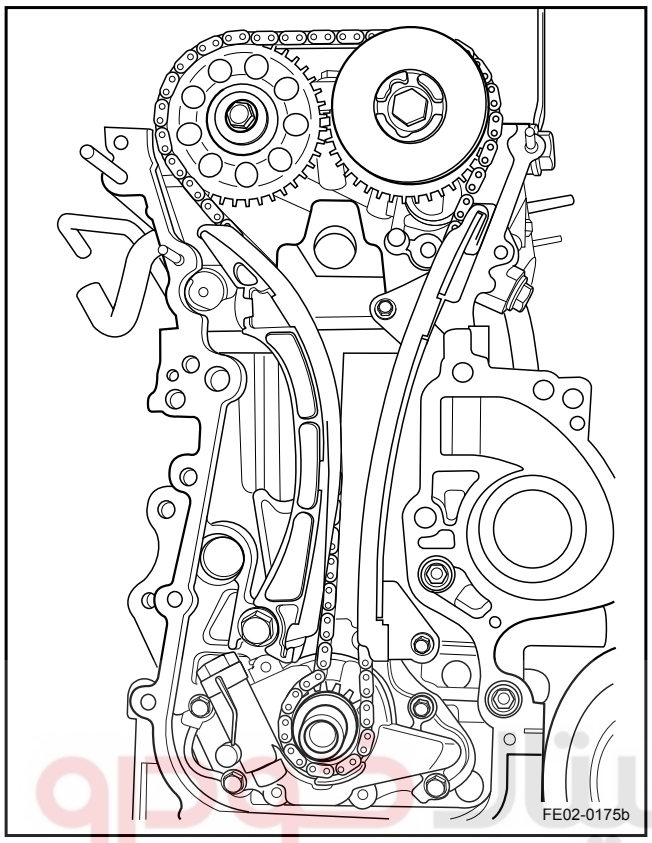
8. Install the tensioner rail components retaining bolts.

   Torque: 19 Nm (Metric) 14 lb-ft (US English)



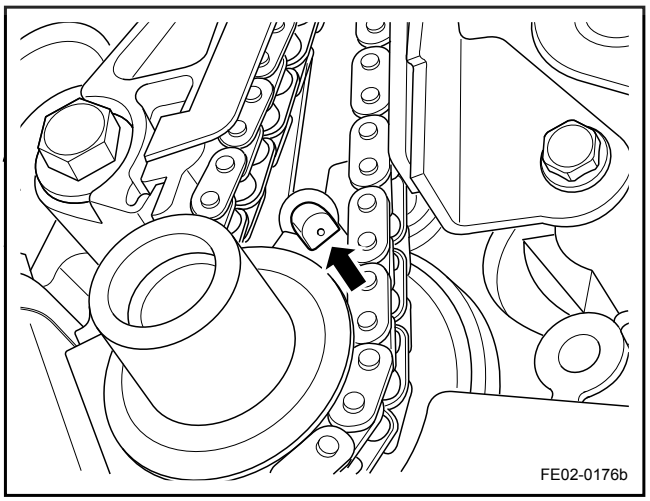
9. Install the crankshaft sprocket.

10. Install the timing chain cover and accessories.



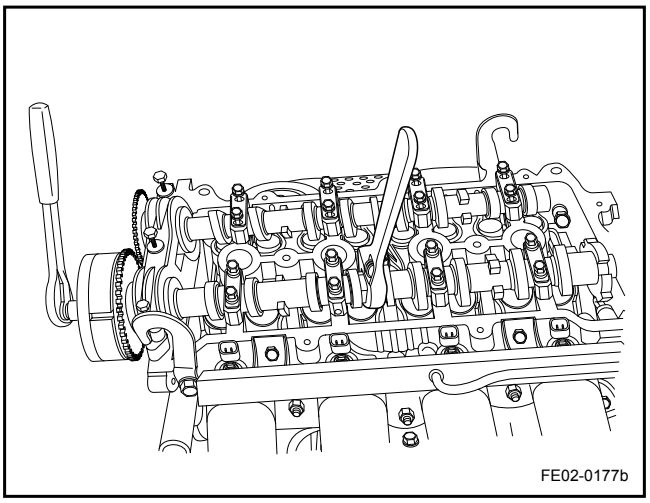
2.6.8.11 Timing Chain Inspection

1. Remove the timing chain cover. Refer to 2.6.8.9 Timing Chain Cover Replacement.
2. Remove the timing chain. Refer to 2.6.8.10 Timing Chain Replacement.
3. Inspect timing chain guide rail component for cracking, wear and tear.
4. If the timing chain guide rail components surface wear is deeper than 1 mm (0.04 in) then replace the timing chain guide rail components.
5. Inspect timing chain tensioner rail component for wear and tear.
6. If the timing chain guide rail components surface wear is deeper than 1 mm (0.04 in) then replace the timing chain guide rail components.
7. Inspect timing chain and sprocket for VVT actuator wear.
8. Inspect the exhaust camshaft sprocket teeth and the VVT actuator sprocket teeth and chain for excessive wear, damage or stuck.
9. Inspect the crankshaft timing sprocket teeth and chain for excessive wear, damage, or stuck.
10. Inspect timing chain tensioner for damaged and gasket intact. If damaged, replace the timing chain tensioner and the gasket.



11. Inspect timing chain lubrication nozzles. If necessary, remove the oil pump assembly. Check the oil channel. Refer to 2.9.8.1 Oil Pump Replacement.

2.6.8.12 Camshaft Replacement

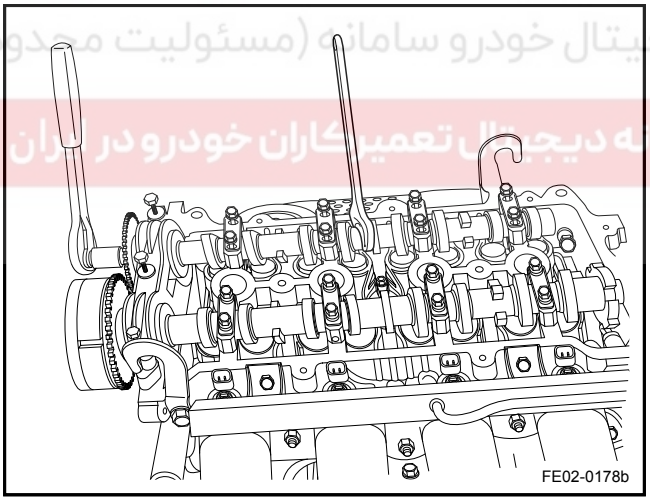

FE02-0177b

Removal Procedure:

1. Disconnect the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.
2. Remove the engine plastic shield. Refer to 2.6.8.1 Plastic Engine Shield Replacement.
3. Remove the cylinder head cover. Refer to 2.6.8.2 Cylinder Head Cover Replacement.
4. Remove the drive belt. Refer to 2.6.8.3 Drive Belt Replacement.
5. Remove the timing chain cover. Refer to 2.6.8.9 Timing Chain Cover Replacement.
6. Remove the timing chain. Refer to 2.6.8.10 Timing Chain Replacement.
7. Remove the intake camshaft VVT actuator.

   Note

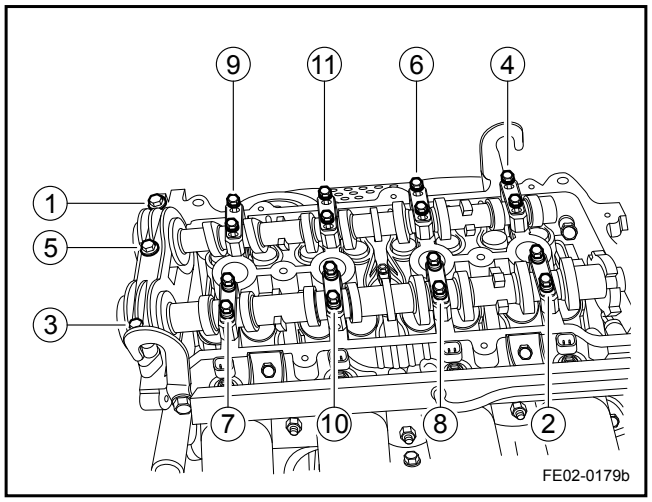
   Remove the camshaft VVT actuator tightening bolt with a wrench holding the camshaft.


FE02-0178b

8. Remove the exhaust camshaft sprocket.

   Note

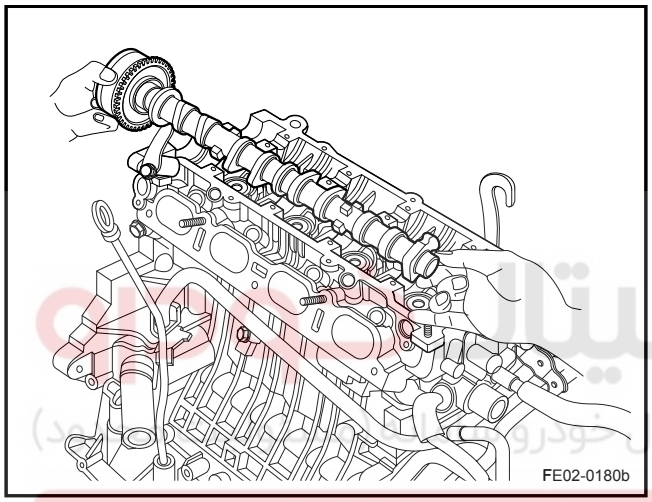
   Remove the camshaft sprocket tightening bolts with a wrench holding the camshaft.



9. As shown in the graphic, gradually release the camshaft bearing cap bolts, rotate half a circle to a whole circle each time.

Note

Be careful when remove the camshaft. Avoid abrasions, scratches or damage to the camshaft surface or bearing surface.



10. Remove the camshaft.

Note

Camshaft must be withdraw from the bearing in order to avoid abrasions, scratches or damage to the camshaft surface or bearing surface.

11. Inspect for the camshaft and bearing wear. If necessary, replace.

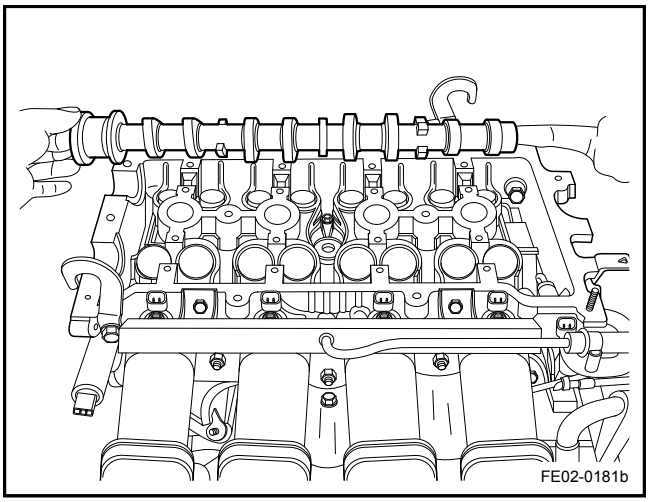
Installation Procedure:

Note

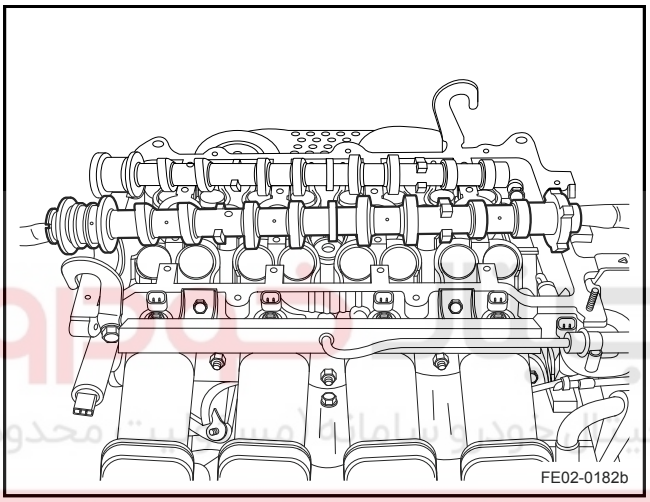
Be careful when install the camshaft. Avoid abrasions, scratches or damage to the camshaft surface or bearing surface.

Note

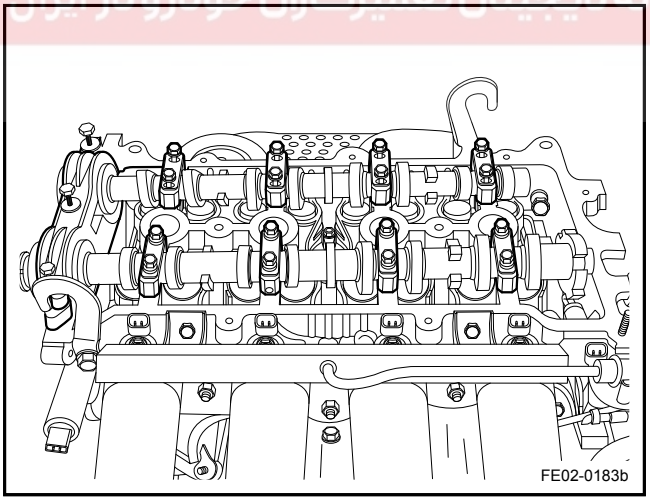
Before installation apply engine oil to the camshaft and the seal contacting surface.



1. Apply a small amount of engine oil to lubricate the journal and camshaft cap.
2. Install the exhaust camshaft.



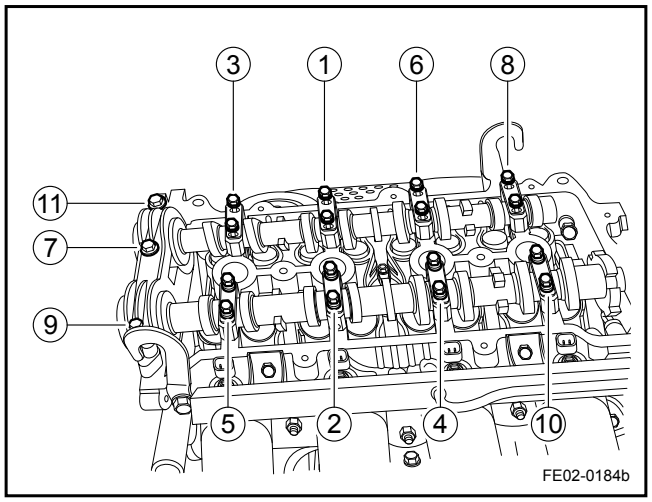
3. Install the intake camshaft.



4. Install the intake and exhaust camshaft cover.

Note

There are letters on the camshaft cover. Avoid installation errors. For example, "I ↑ 2" indicates that the camshaft cover is the No.2 intake camshaft cover. The arrow is toward the direction of timing chain. "E ↑ 2 indicates the No.2 exhaust camshaft cover. The arrow is toward the direction of timing chain.

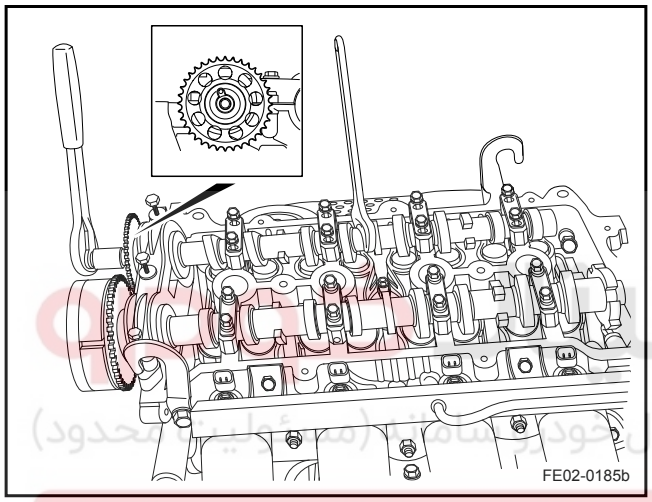


5. Gradually tighten the camshaft cover bolts according to the sequence as shown in the graphic.

Note

Tighten the bolts during several stages. Do not tighten at once which may damage the camshaft and the camshaft cover.

Torque:
M6 Bolts 13 Nm (Metric) 10 lb-ft (US English)
M8 Bolts 23 Nm (Metric) 17 lb-ft (US English)

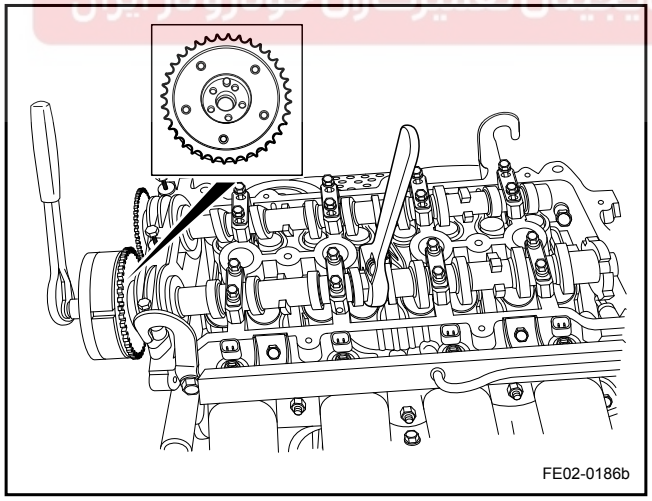


6. Install the exhaust camshaft sprocket.

Note

Check for the sprocket pin wear. IF there is wear, replace the sprocket pin. Hold the camshaft with a wrench and then tighten the VVT actuator bolts.

Torque: 55 Nm (Metric) 41 lb-ft (US English)



7. Install the intake camshaft VVT actuator.

Note

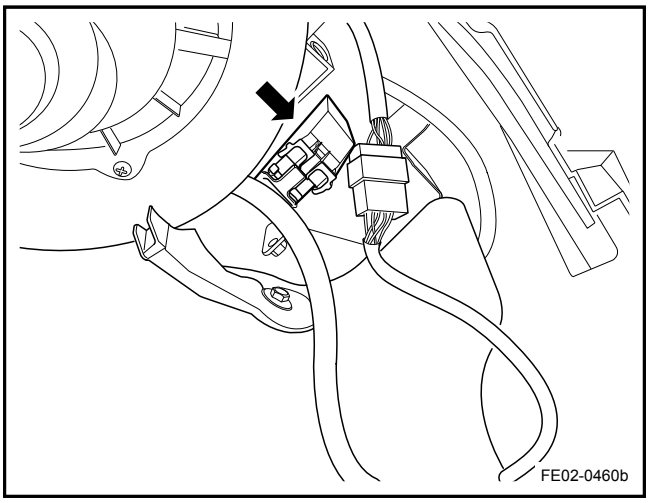
Check for the sprocket pin wear. Hold the camshaft with a wrench and then tighten the sprocket bolts.

Torque: 70 Nm (Metric) 52 lb-ft (US English)

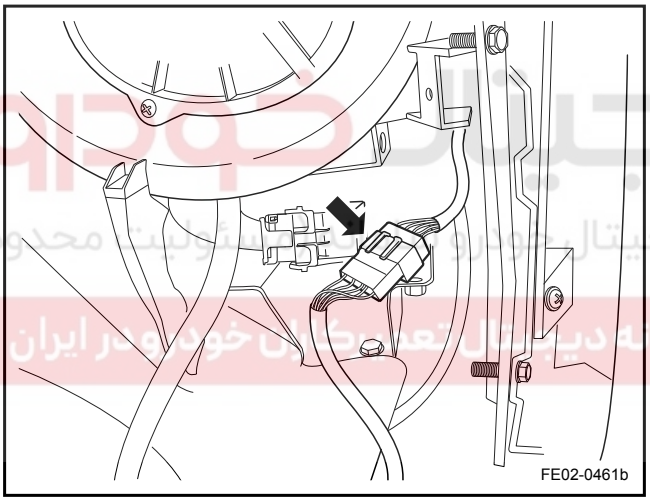
8. Install the timing chain.
9. Install the timing chain cover.
10. Install the drive belt
11. Install the cylinder head cover.
12. Install the engine plastic shield.
13. Connect the battery negative cable.

2.6.8.13 Engine Replacement

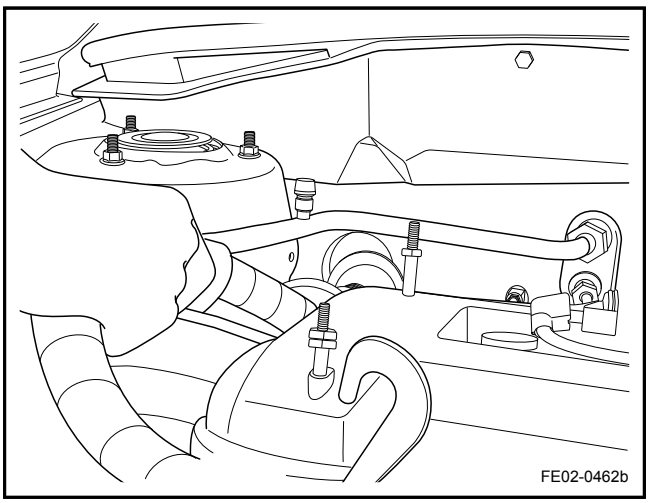
Removal Procedure:



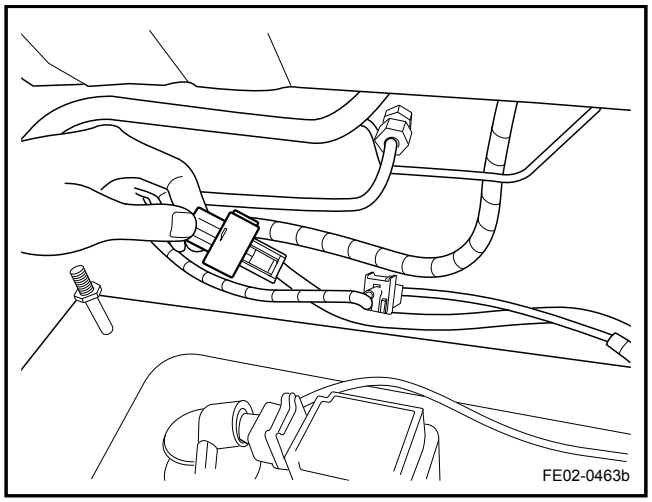
1. Remove the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.
2. Release the fuel pressure. Refer to 2.3.8.1 Fuel Pressure Release Procedure.
3. Discharge the engine coolant. Refer to 2.8.8.1 Engine Coolant Discharge and Filling.
4. Recover the air-conditioning refrigerant. Refer to 8.2.7.10 Air-conditioning Refrigerant Recovery and Filling.
5. Remove the battery bracket. Refer to 2.11.8.2 Battery Replacement.
6. Disconnect ECM harness connector.



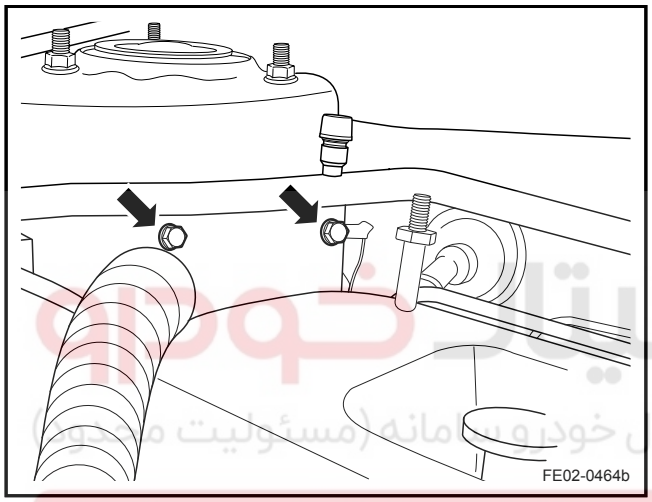
7. Disconnect the engine wiring harness connector and the floor harness connector.



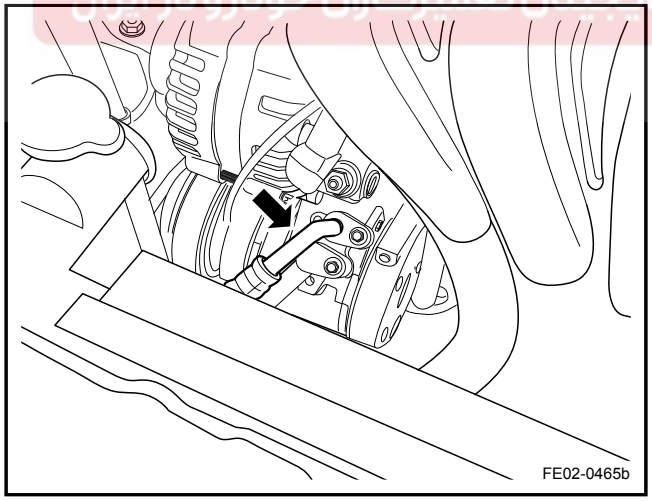
8. Pull the engine wiring harness out of the firewall.



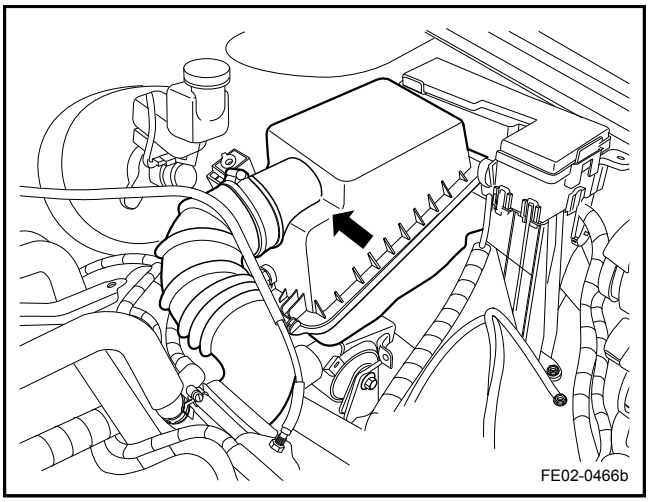
9. Disconnect pre-catalytic and post-catalytic oxygen sensor wiring harness connectors.



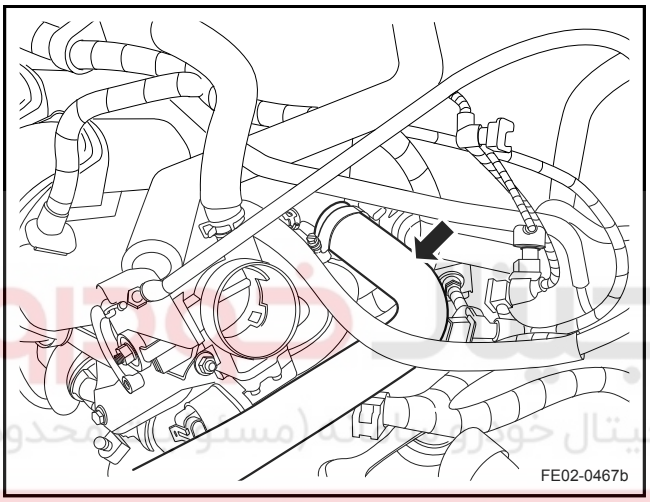
10. Remove the engine wiring harness ground cable bolts.



11. Remove the air-conditioning compressor high and low pressure connecting tubes.



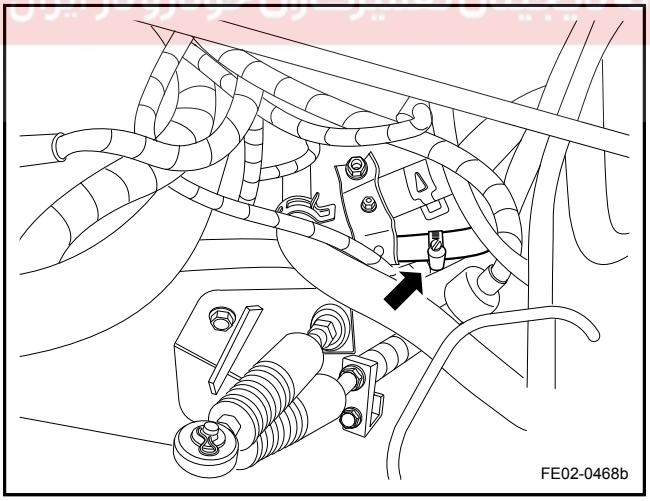
12. Remove the intake manifold assembly.



13. Removing the radiator inlet and outlet pipes.

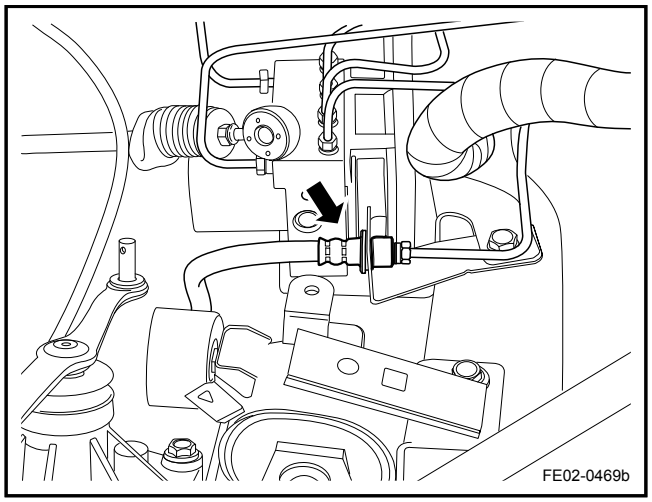
    Warning!

    Refer to "Cooling System Service Warning" in "Warnings and Notices".

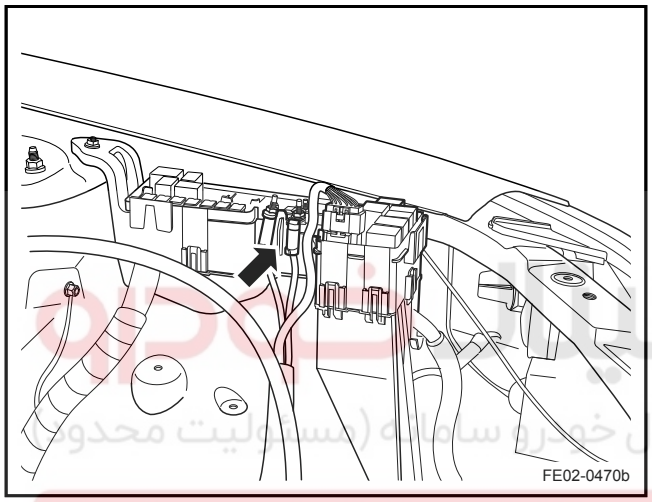


14. Remove the air filter support.

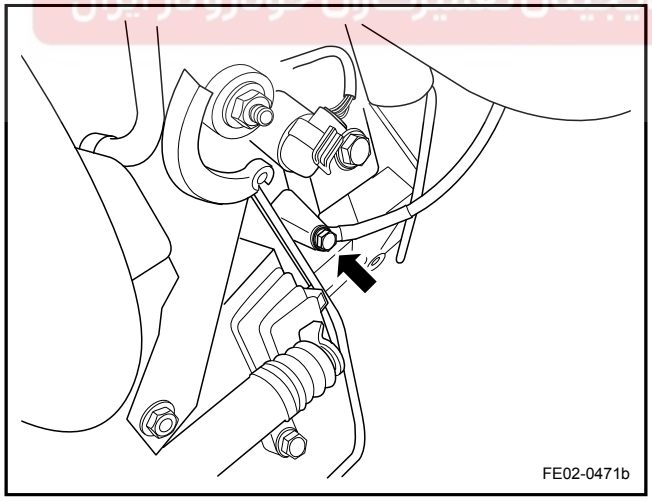
15. Remove the vacuum booster vacuum tubes.



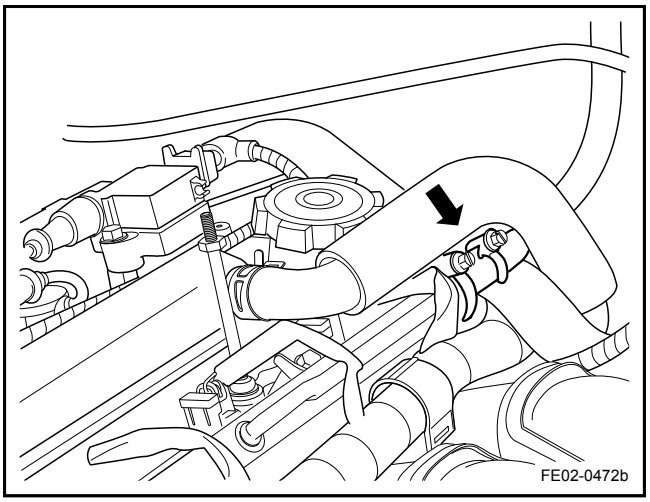
16. Remove the clutch tube.



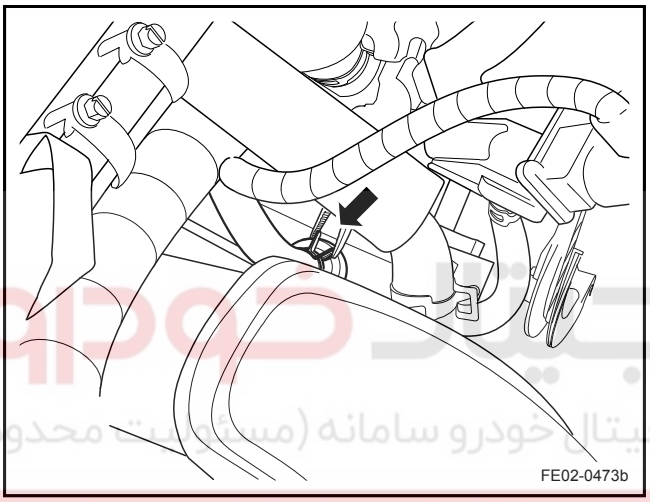
17. Disconnect the engine wiring harness to the underhood fuse and relay box cables and connectors.



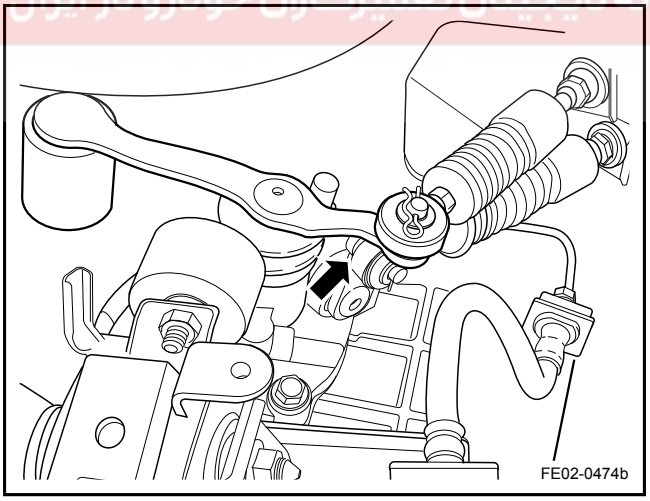
18. Remove battery negative cable gearbox shell ground cable.



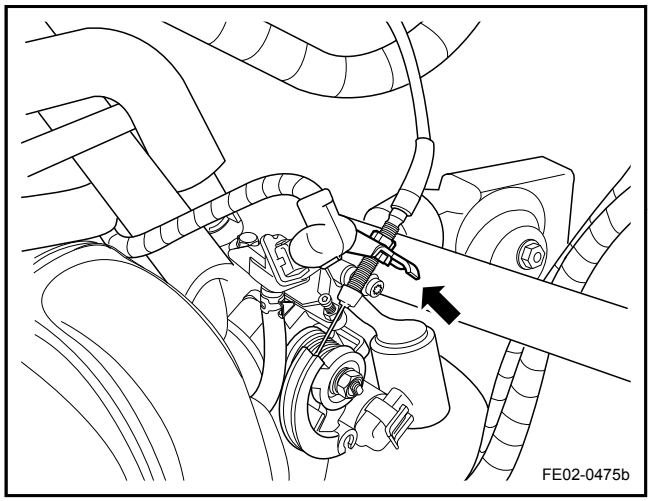
19. Remove the fuel pipe.



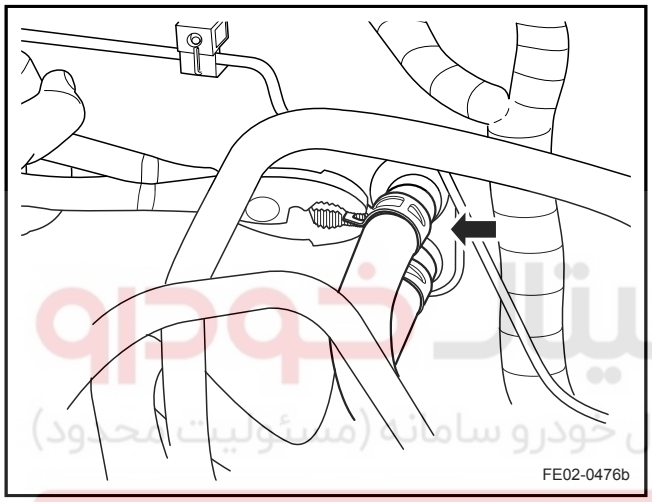
20. Remove the canister vacuum tubes.



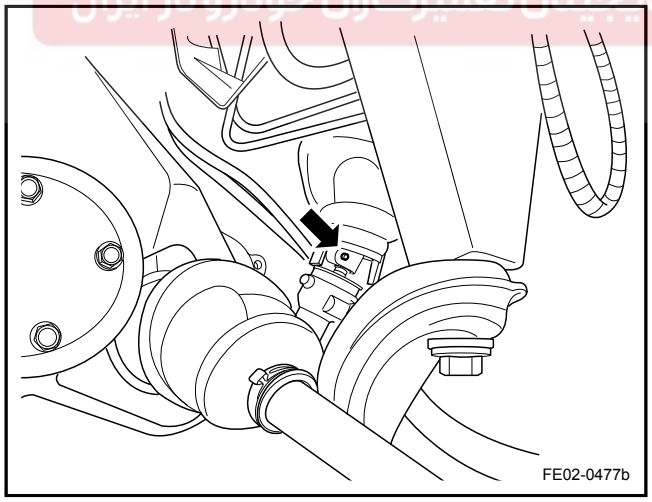
21. Remove shift lever pull cable.



22. Remove the throttle cable.



23. Remove the heater intake and outlet pipes.



24. Remove the front wheels.

25. Lift the vehicle.

Warning!

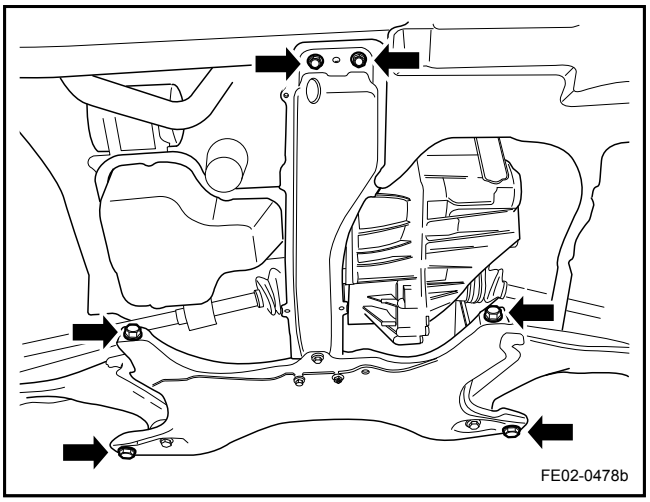
Refer to "Vehicle Lifting Warning" in "Warnings and Notices".

26. Remove the gearbox oil discharge bolt until all the gearbox oil is discharged and reinstall. Refer to 3.3.8.1 Transmission Fluid Level Inspection.

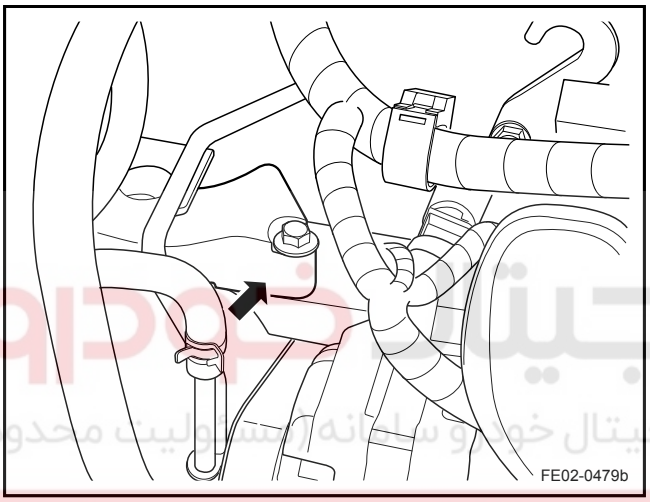
27. Remove the steering cross pin bolts.

Warning!

Before remove the steering cross pin bolt, remove the key from the ignition switch first and turn the steering wheel to lock position. Otherwise it will damage the airbag clock spring.



28. Remove the front subframe and related components. Refer to 12.6.4.2 Subframe Replacement.



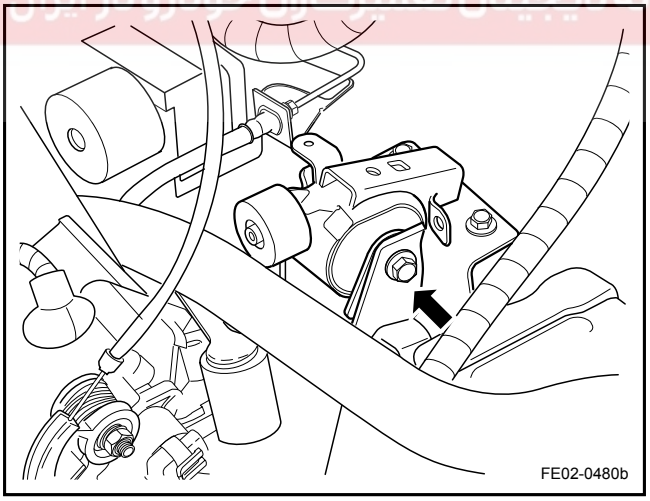
29. Remove the left and right side drive shafts. Refer to 5.3.4.1 Drive Shaft Replacement".

30. Place a mobile working table under the engine assembly to lower and support the powertrain assembly.

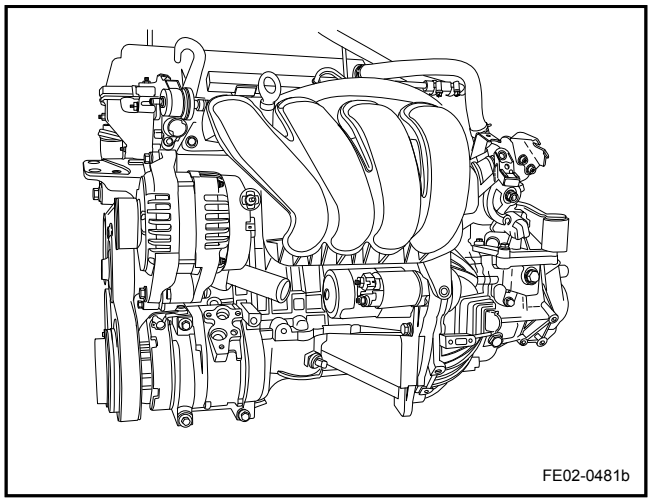
Note

Make sure solid contact between the working table and the powertrain assembly, otherwise it will result in bodily injury.

31. Remove the right engine mount assembly.



32. Remove the left gearbox mount assembly.

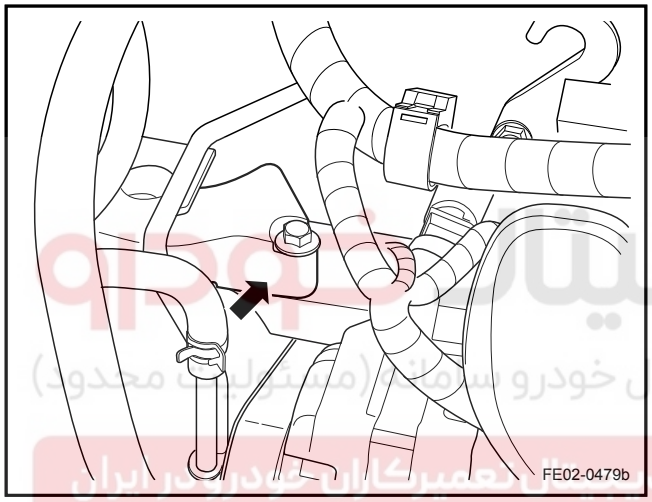

FE02-0481b

33. Slowly lift the vehicle to separate the powertrain from the vehicle body.

    Note

    In the lifting process, avoid the powertrain assembly tilt on the working table. Pay attention to the powertrain and vehicle body interference.

34. Use an engine lifting device to support the engine and then separate the engine and the gearbox. Refer to 3.3.8.3 Transmission Assembly Replacement.


FE02-0479b

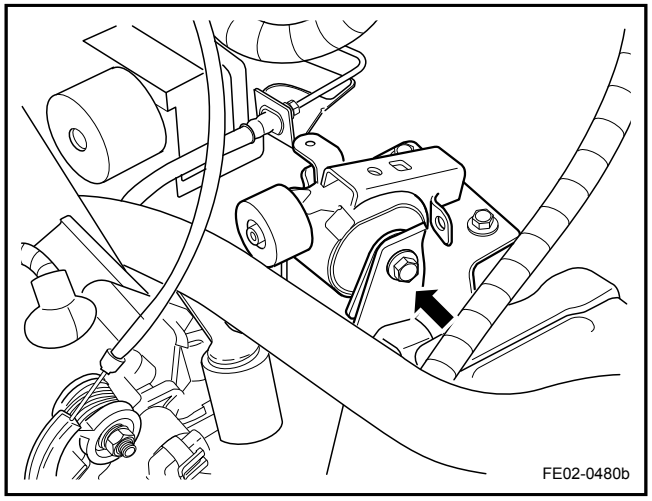
Installation Procedure:

1. Use the engine lifting device to support the engine and then assemble the engine and the gearbox assembly.
2. Place the powertrain assembly on the mobile working table, lift the vehicle and move the working table so the powertrain assembly moves back into the vehicle body frame.
3. Slowly lower the vehicle. Pay attention in the lowering process, do not interfere with the vehicle body frame.

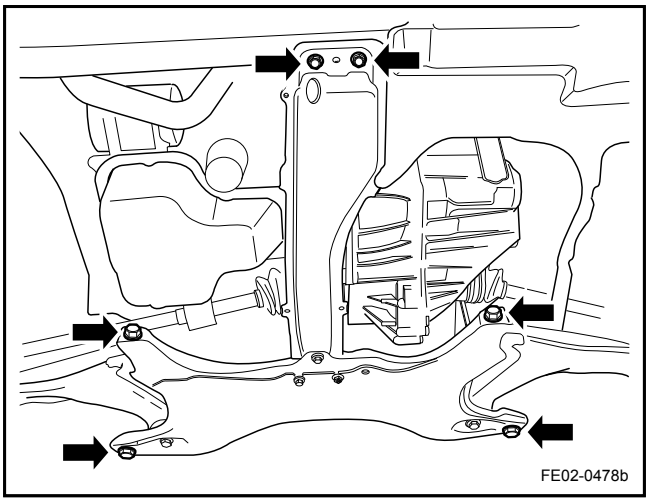
    Note

    Make sure solid contact between the working table and the powertrain, otherwise it will result in bodily injury.

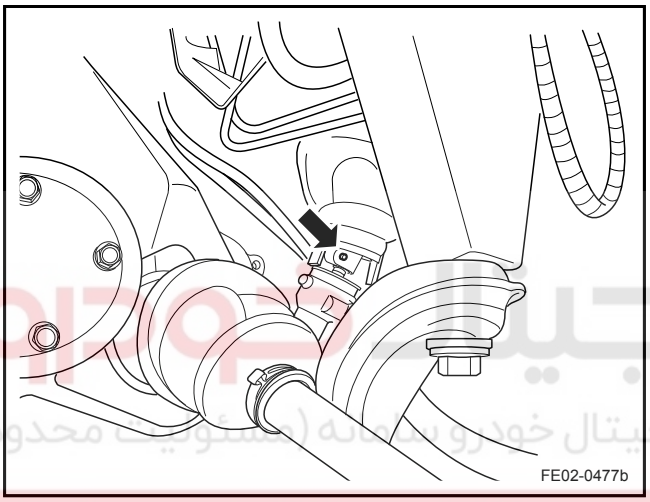
4. Install the right engine mount assembly.


FE02-0480b

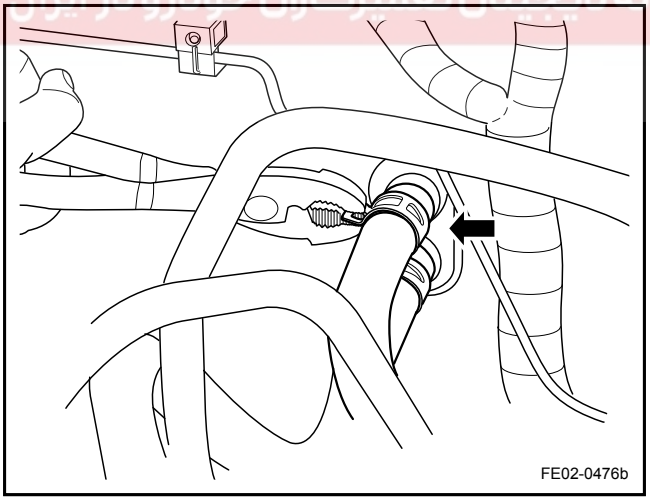
5. Install the left gearbox mount assembly.



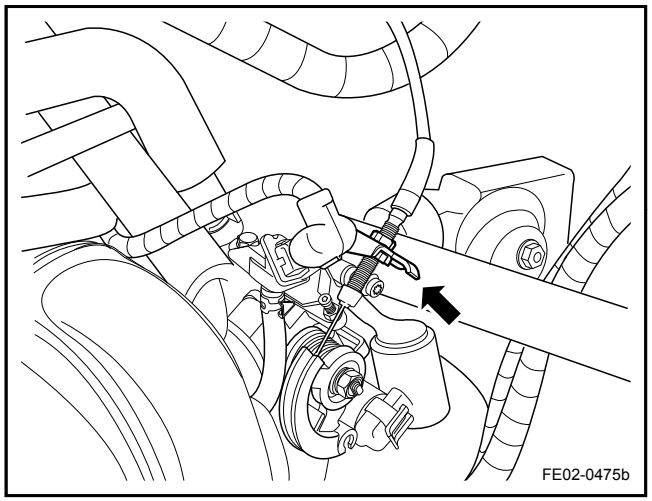
6. Lift the vehicle.
7. Install the left and right drive shafts.
8. Install the front subframes.



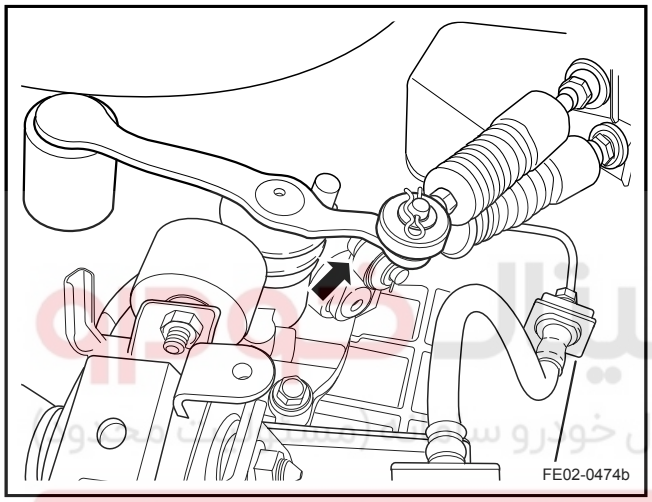
9. Install the steering cross pin bolts.



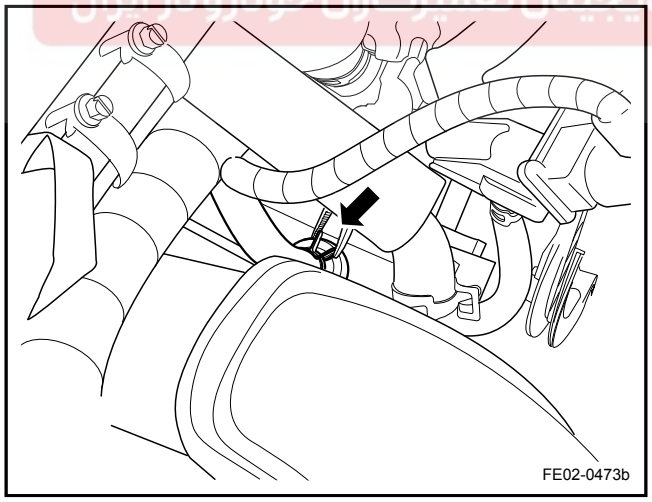
10. Tighten the gearbox oil discharge bolt and fill gearbox oil. Refer to 3.3.8.1 Transmission Fluid Level Inspection.
11. Lower the vehicle.
12. Install the front wheels.
13. Install the heater intake and outlet pipes.



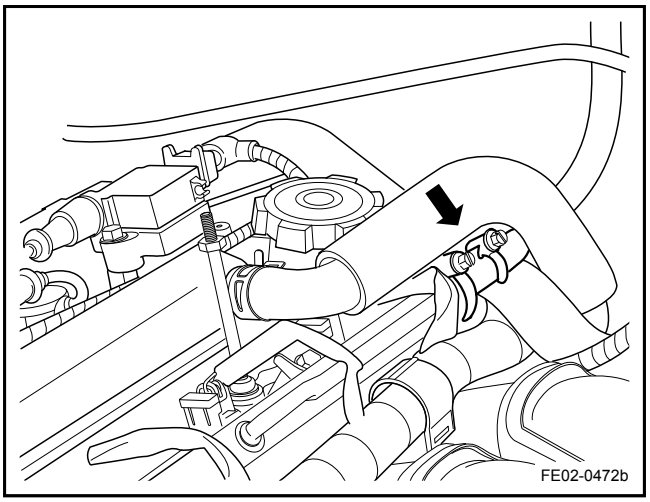
14. Install the throttle pull cable.



15. Install the gear lever pull cable.



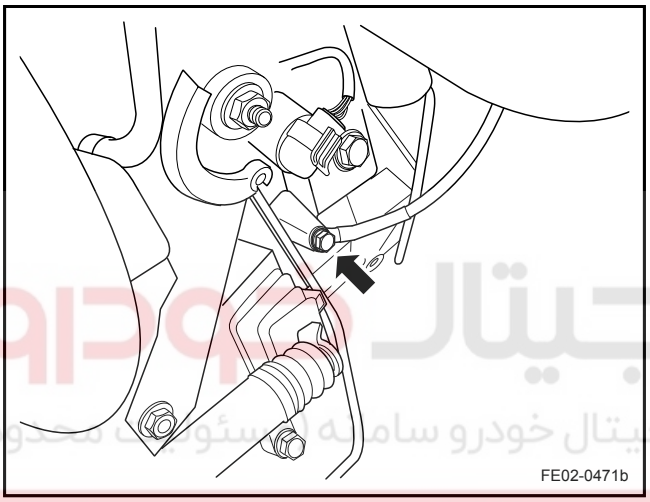
16. Install canister vacuum tubes.



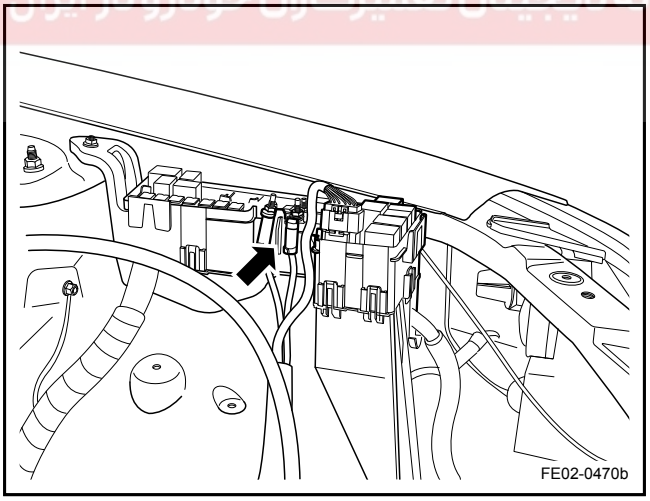
17. Install the fuel pipe.

    Note

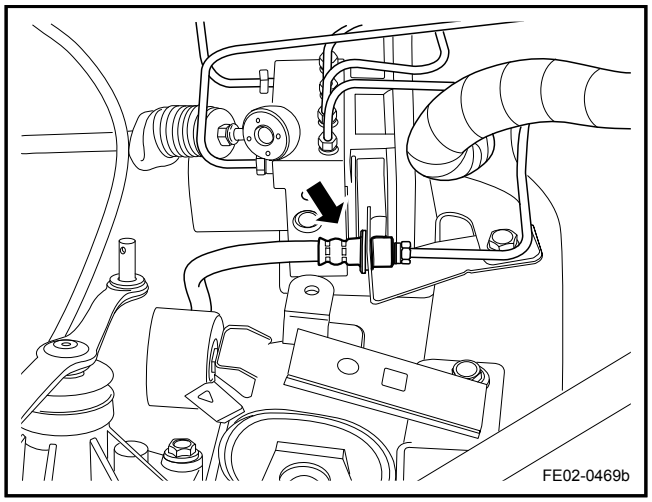
    The fuel pipe must be inserted into the fuel distribution tube and then fastened after the second boss.



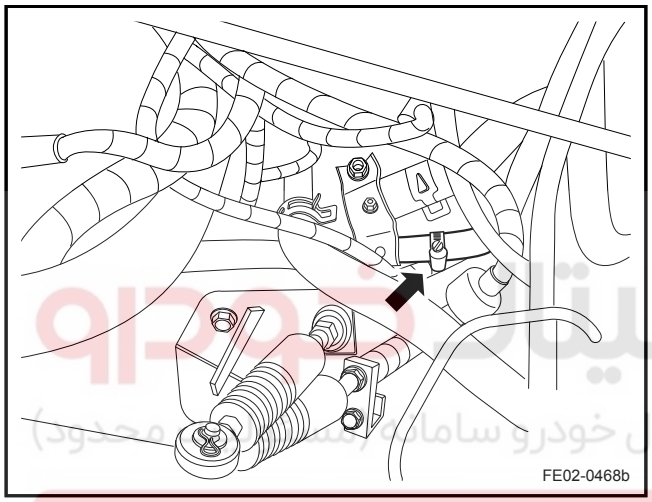
18. Connect the battery negative cable gearbox shell ground point.



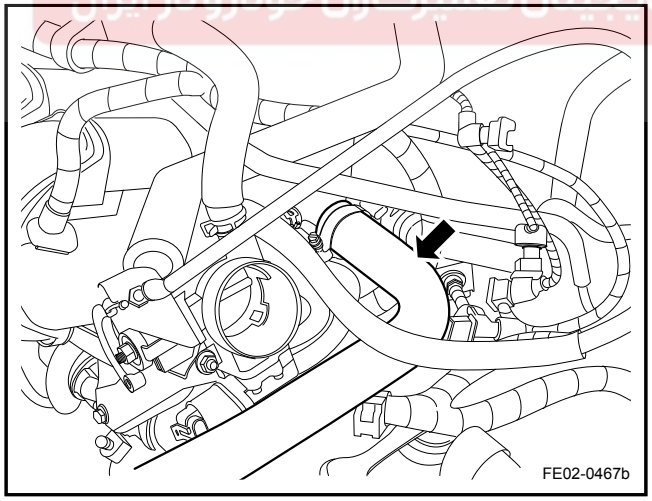
19. Connect the engine wiring harness to the underhood fuse and relay box cables and connectors.



20. Install the clutch pipe and discharge the air. Refer to 3.2.6.3 Hydraulic Clutch Bleeding.

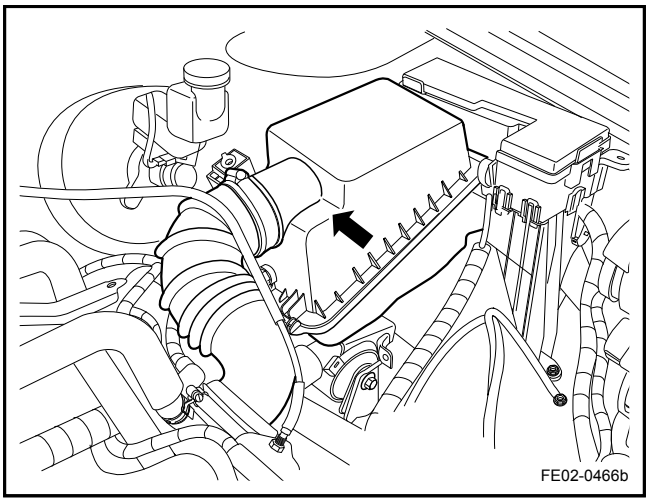


21. Install the vacuum booster vacuum tubes.

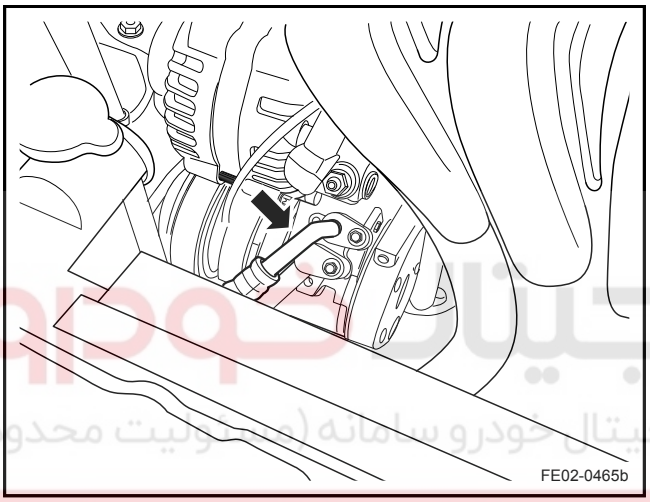


22. Install the air filter support.

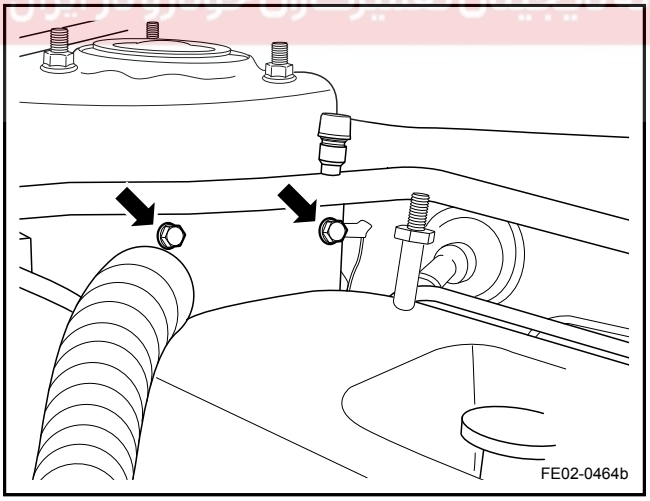
23. Install the radiator inlet and outlet pipes.



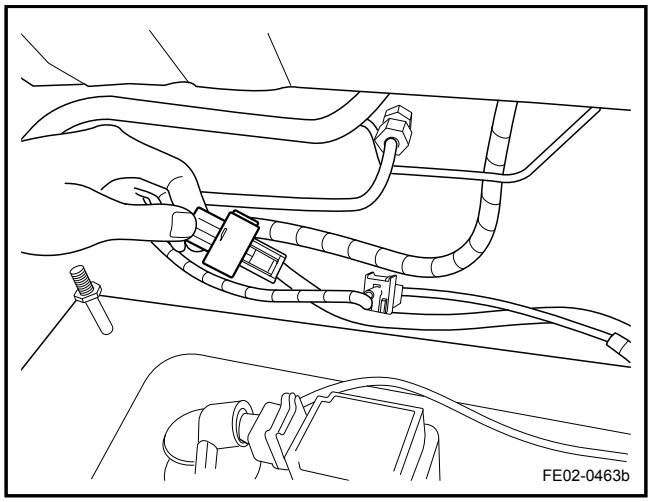
24. Install the intake manifold assembly.



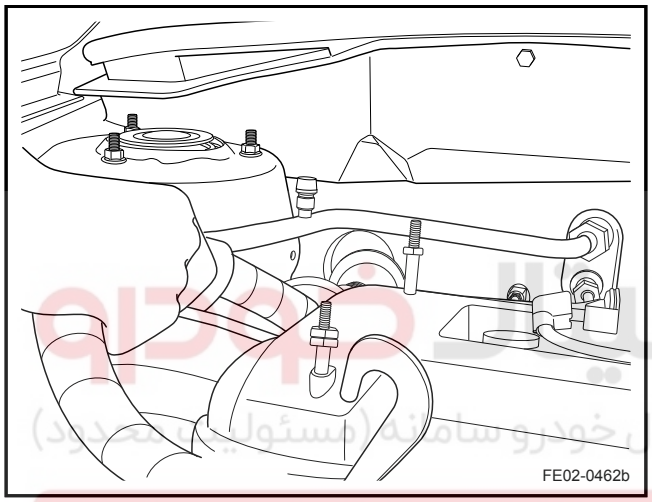
25. Install the air-conditioning compressor high and low pressure connecting pipes.



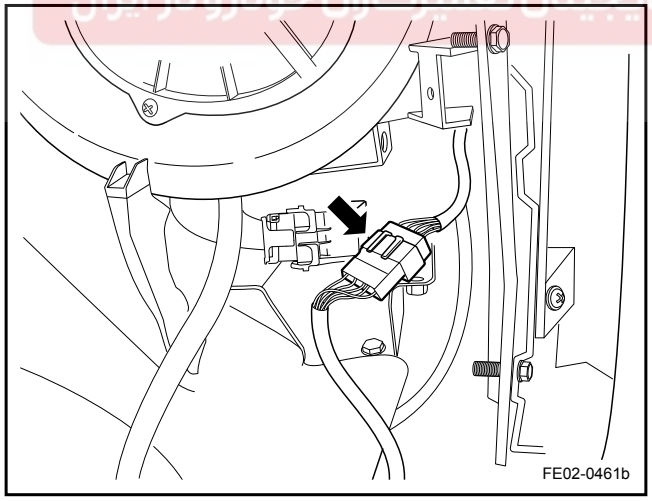
26. Install the engine wiring harness engine compartment ground cable and tightening bolt.



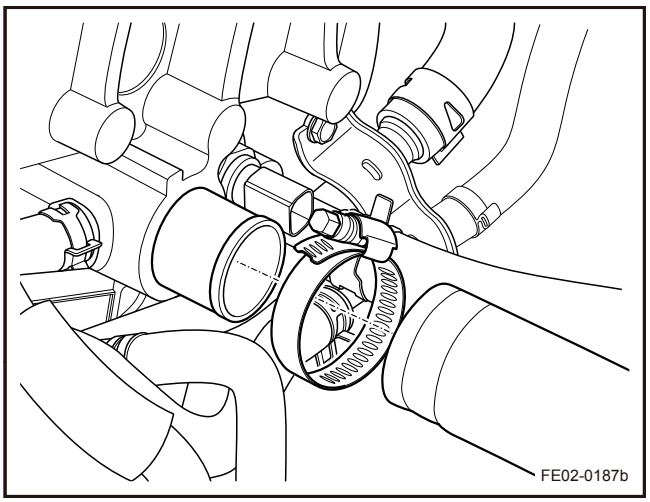
27. Connect the pre-catalytic and post-catalytic oxygen sensor wiring harness connectors.



28. Connect ECM harness connector.



29. Connect the engine wiring harness and floor harness connectors.
30. Install the battery bracket.
31. Fill the engine coolant.
32. Fill the air-conditioning refrigerant.
33. Connect the battery negative cable.

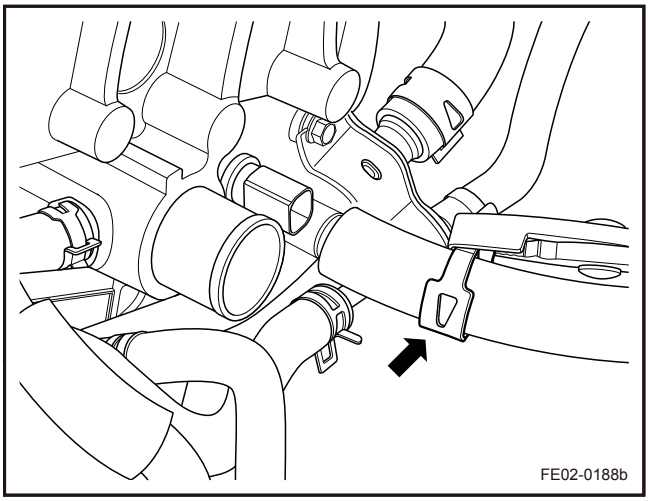


2.6.8.14 Cylinder Head Assembly Replacement

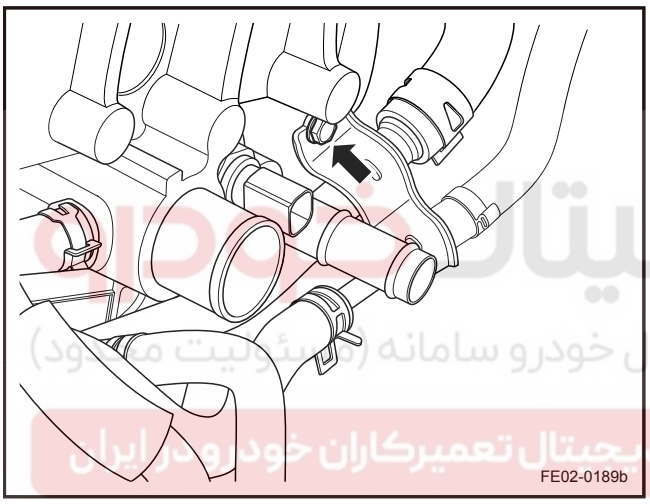
Removal Procedure:

1. Disconnect the battery negative cable. Refer to 2.11.8.1 Battery Disconnection.
2. Remove the engine plastic shield. Refer to 2.6.8.1 Plastic Engine Shield Replacement.
3. Discharge the engine coolant. Refer to 2.8.8.1 Engine Coolant Discharge and Filling.
4. Remove the throttle body. Refer to 2.6.8.5 Throttle Body Assembly Replacement.
5. Remove the intake manifold assembly. Refer to 2.6.8.6 Intake Manifold Assembly Replacement.
6. Remove the exhaust manifold. Refer to 2.7.6.1 Exhaust Manifold Replacement.
7. Remove the ignition coil and ignition wire. Refer to 2.10.8.3 Ignition Coil Replacement.
8. Remove the cylinder head cover. Refer to 2.6.8.2 Cylinder Head Cover Replacement.
9. Remove the drive belt. Refer to 2.6.8.3 Drive Belt Replacement.
10. Remove the engine mounting. Refer to 2.6.8.7 Engine Mount Replacement.
11. Remove the timing chain cover. Refer to 2.6.8.9 Timing Chain Cover Replacement.
12. Remove the timing chain. Refer to 2.6.8.10 Timing Chain Replacement.
13. Remove the fuel rail. Refer to 2.2.8.2 Fuel Injector Replacement.
14. Disconnect the coolant temperature sensor wiring harness connector. Refer to 2.2.8.6 Engine Coolant Temperature Sensor Replacement.
15. Remove the camshaft position sensor. Refer to 2.10.8.1 Camshaft Position Sensor Replacement.
16. Remove the VVT solenoid valve. Refer to 2.2.8.4 VVT Solenoid Valve Replacement and Filter Cleaning.
17. Remove the camshaft. Refer to 2.6.8.12 Camshaft Replacement.

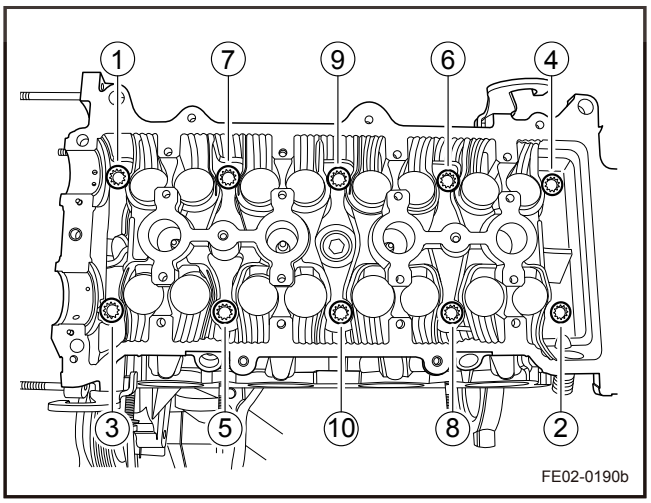
18. Remove the radiator inlet and outlet pipes.



19. Remove the heater inlet and outlet pipes.



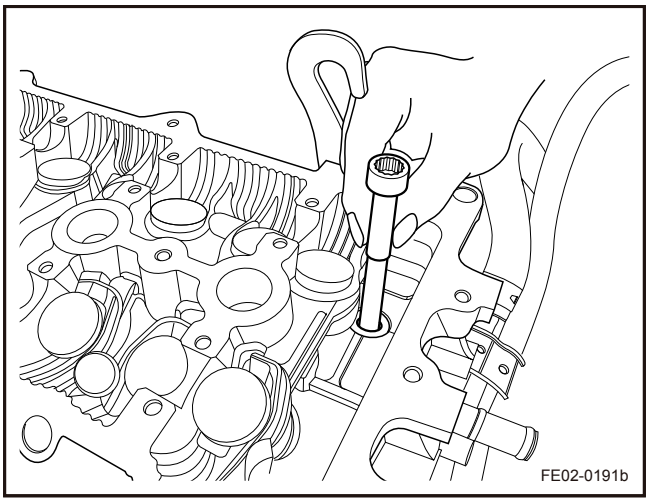
20. Remove the small cycle pipes cylinder head retaining bolts.



21. Remove the cylinder head bolts according to the sequence in the graphic.

Note

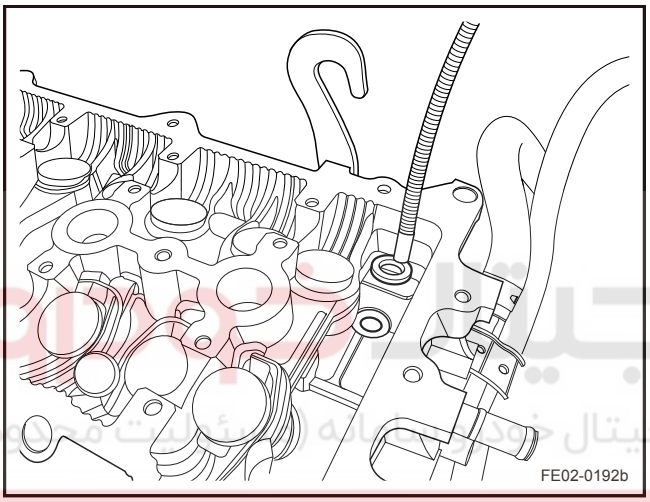
When the engine is hot, it is prohibited to remove the cylinder head, as this will cause the cylinder head distortion.



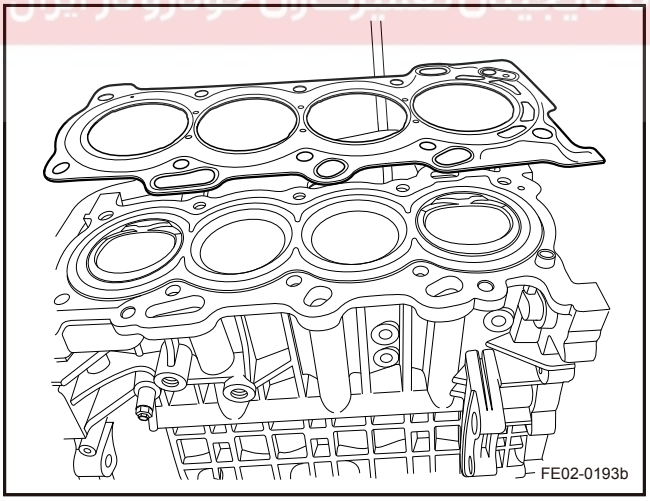
22. Remove the cylinder head bolts.

    Note

    Due to confined space, cylinder head bolts and gasket bolts can not be removed together.

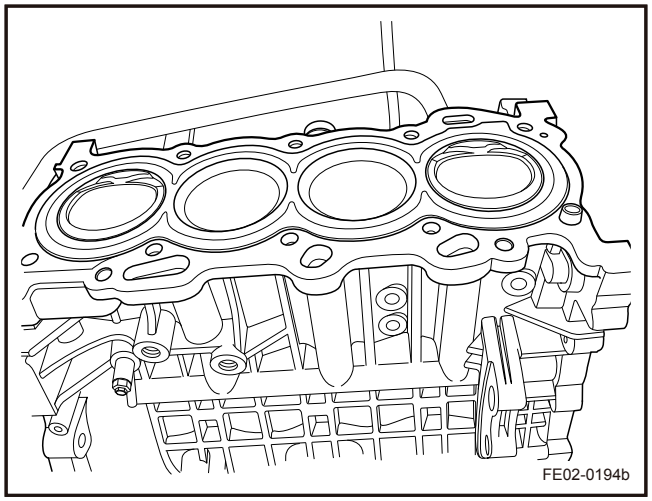


23. Remove the cylinder head bolt gasket with a magnetic stick.

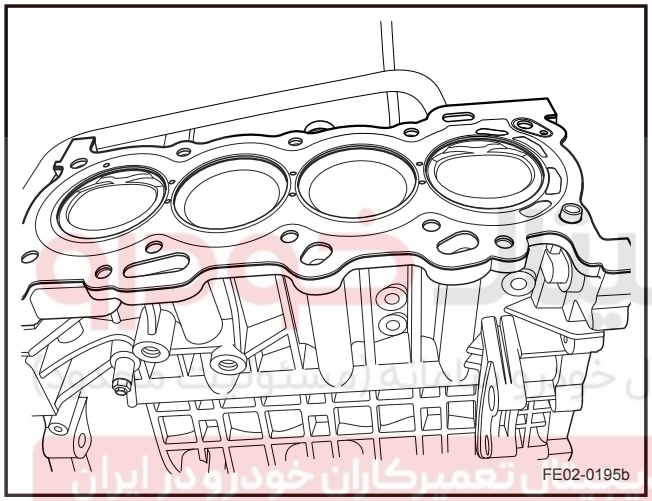


24. Remove the cylinder head gasket.

Installation Procedure:



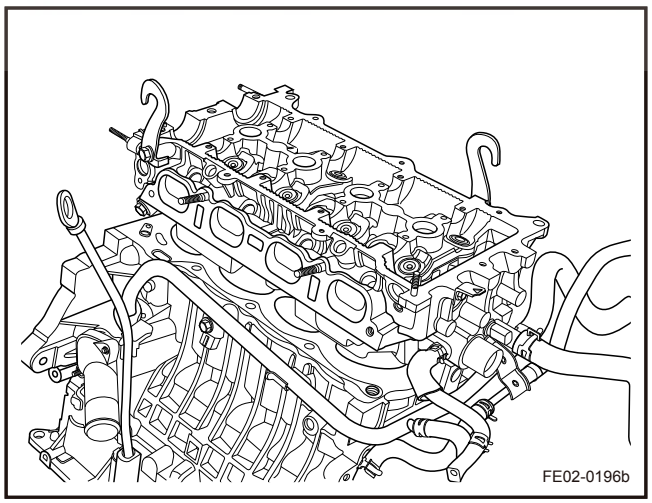
1. Clean the surface of the cylinder head and cylinder head.



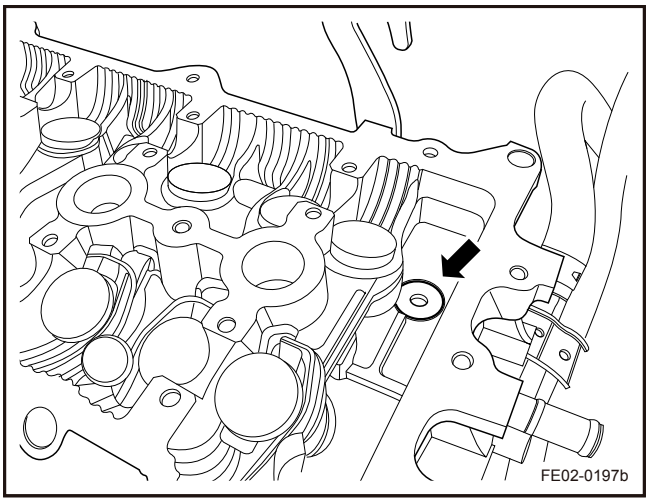
2. Install the cylinder head gasket.

   Note

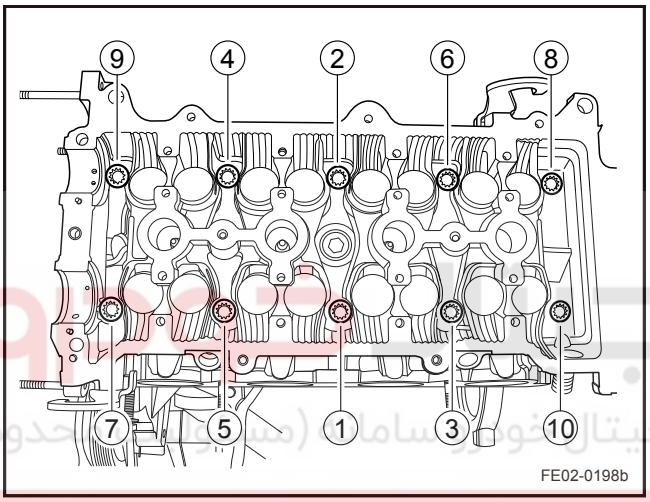
   Cylinder head gasket is a single used item and must be replaced with a new part.



3. Install the cylinder head assembly.

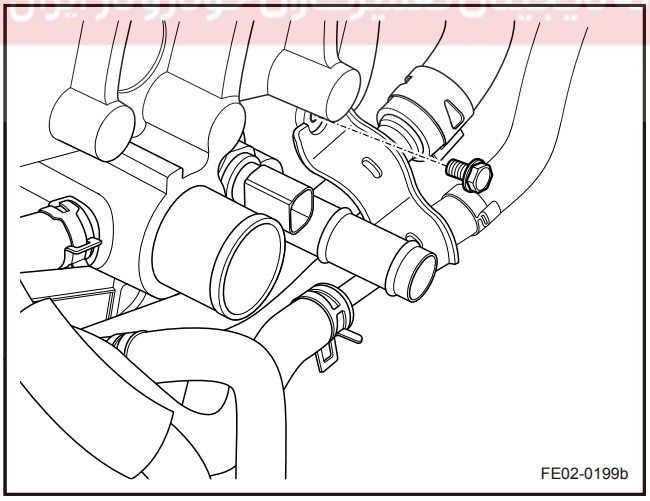


4. Install the cylinder head gasket bolt washers.

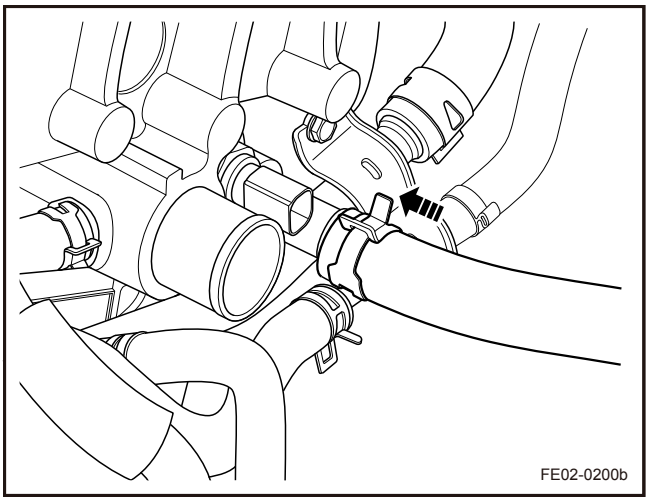


5. Install and tighten the cylinder head bolts, according to the sequence in the graphic.

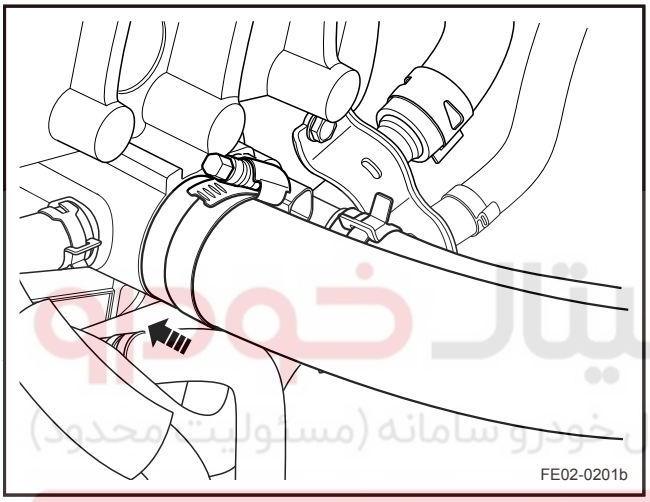
   Torque:
   First Pass: 49 Nm (Metric) 36.3 lb-ft (US English)
   Second Pass: 80 Nm (Metric) 59.1 lb-ft (US English)



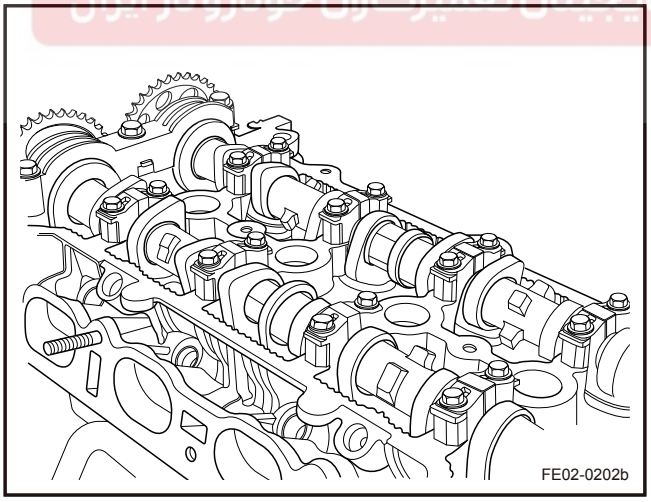
6. Install the small cycle pipes to cylinder head retaining bolts.



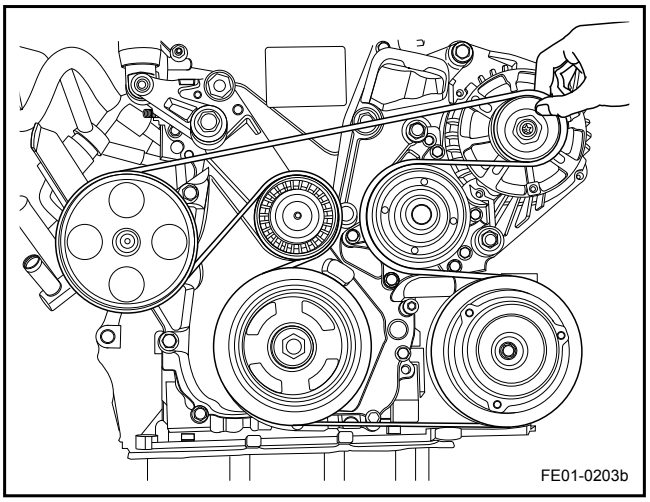
7. Install the heater inlet and outlet pipes.



8. Install the radiator inlet and outlet pipes.



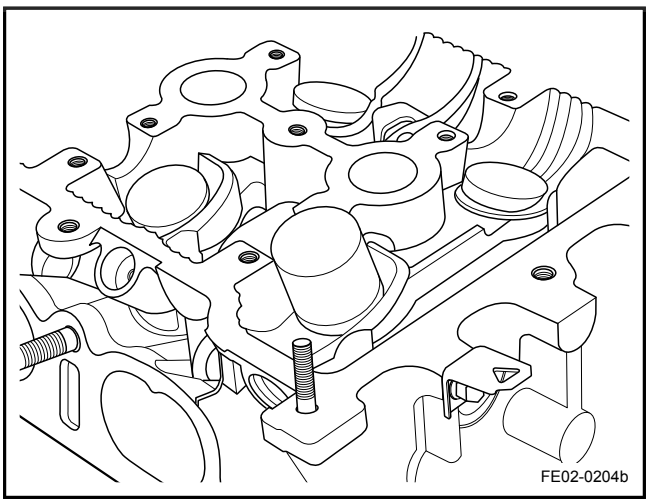
9. Install the camshaft.


FE01-0203b

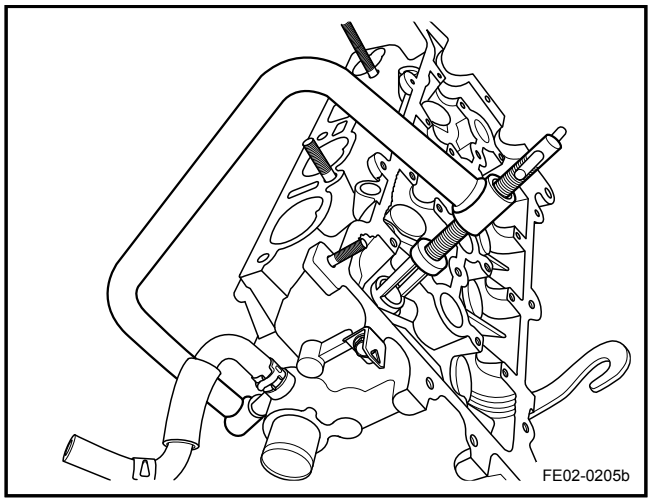
10. Install the VVT solenoid valve.
11. Install the camshaft position sensor.
12. Install the coolant temperature sensor wiring harness connector.
13. Install the fuel rail assembly.
14. Install the timing chain.
15. Install the timing chain cover.
16. Install the engine mounting.
17. Install the drive belt.
18. Install the cylinder head cover.
19. Install the ignition coil and ignition wire.
20. Install the exhaust manifold.
21. Install the intake manifold assembly.
22. Install the throttle body.
23. Fill the engine coolant.
24. Install the engine plastic shield.
25. Connect the battery negative cable.

2.6.8.15 Cylinder Head Assembly Removal and Installation

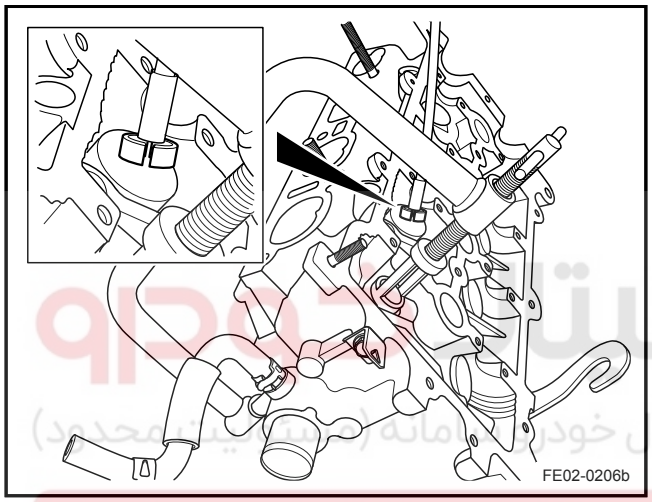
Removal Procedure:


FE02-0204b

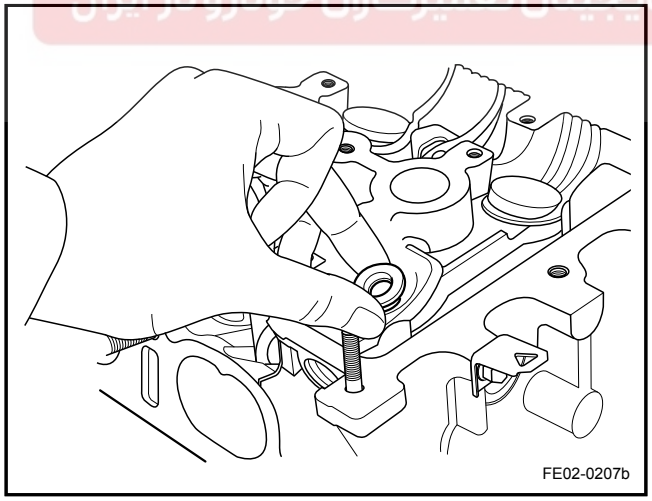
1. Remove the cylinder head assembly. Refer to 2.6.8.14 Cylinder Head Assembly Replacement.
2. Remove the valve Lifter.



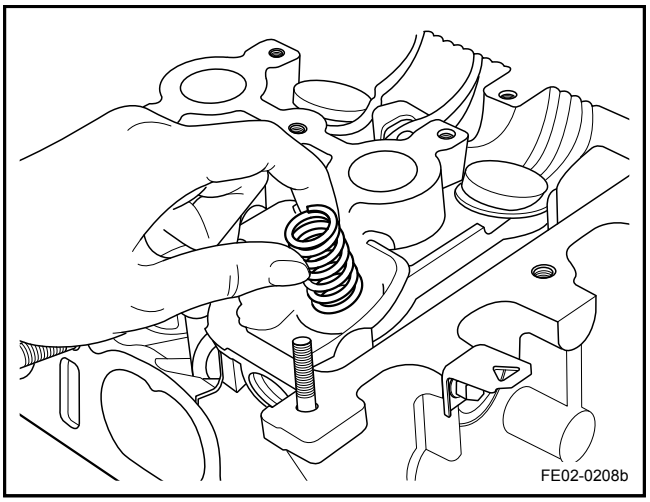
3. Use a universal tool to compress the valve springs.



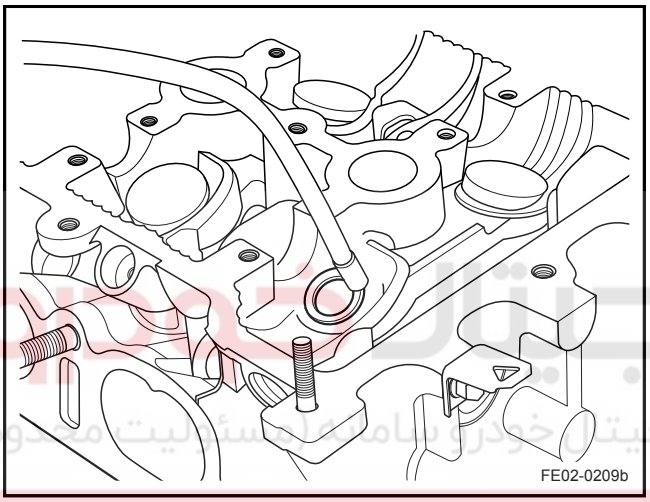
4. Remove the valve locking piece with a magnetic stick.



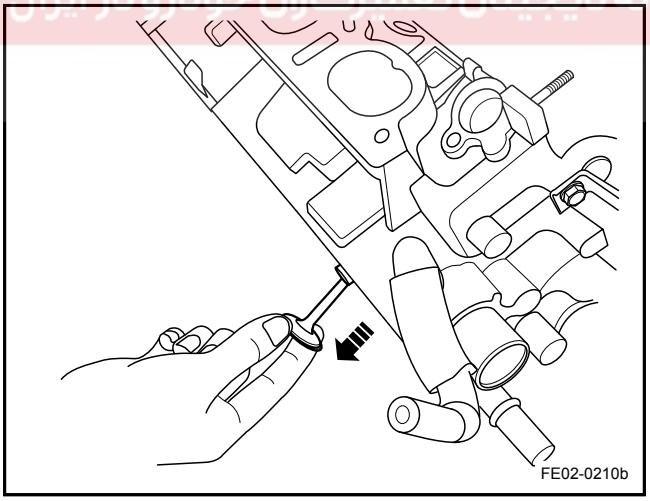
5. Remove the special tools and remove the valve spring seat.



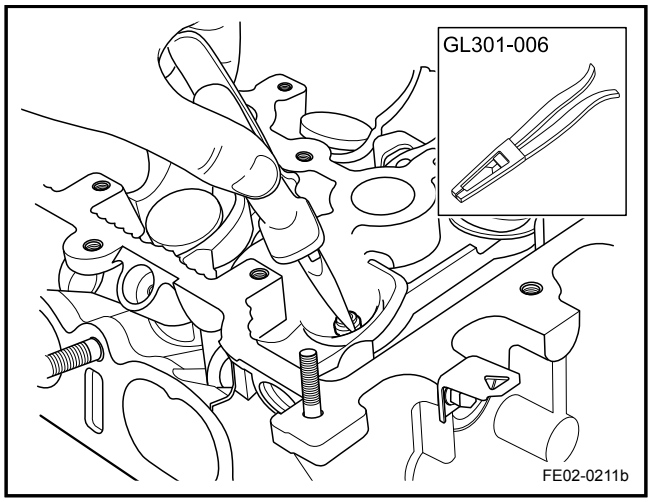
6. Remove the valve spring.



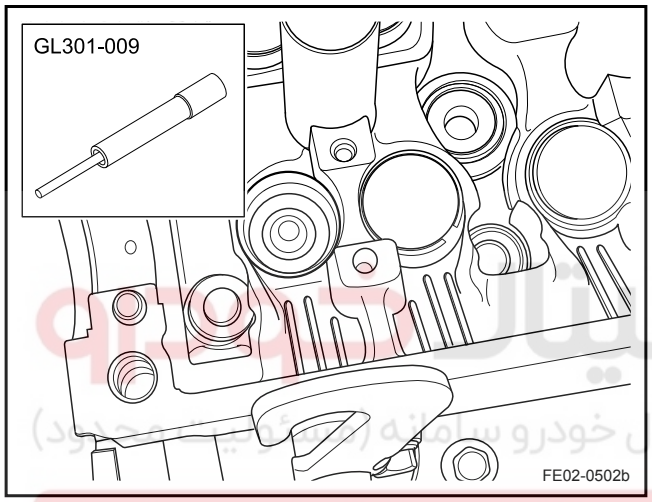
7. Remove the valve spring pads with a magnetic stick.



8. Remove the valve, mark the original position of the valve in order to re-install.

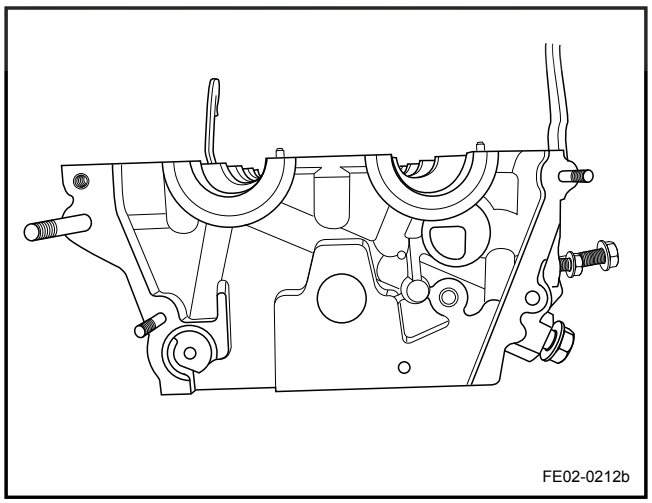


9. Remove the valve seals with the special tool GL301-006.



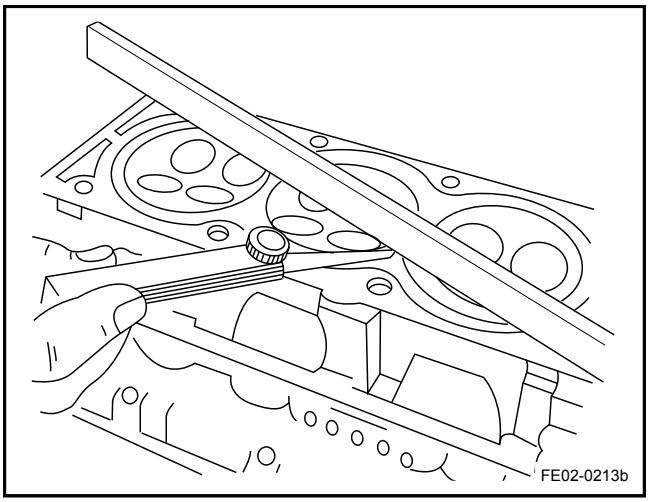
10. Remove the valve guide rod with the special tool GL301-009.

Cleaning:



1. Clean cylinder head and cylinder head gasket contacting surface.
2. Clean cylinder head and cylinder head cover contacting surface.
3. Inspect and confirm that the cylinder head and cylinder head gasket contacting surface has no scratches.
4. Inspect and confirm that the cylinder head gasket joints has no leakage or channeling gas.
5. Check whether there are cracks on the cylinder head.
6. Confirm that the height of the cylinder head tolerance is within the acceptable range. Refer to 2.6.1.2 Mechanical System Specification, if the height is lower than the standard value, replace the cylinder cover.

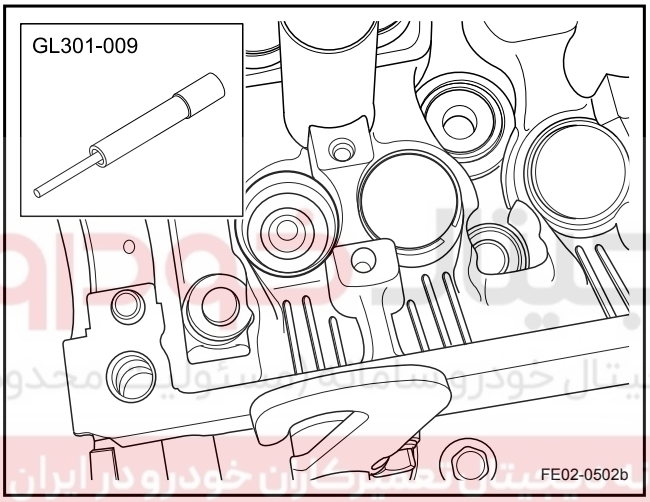
   Standard Value: 114.95 mm (Metric) 4.526 in (US English)



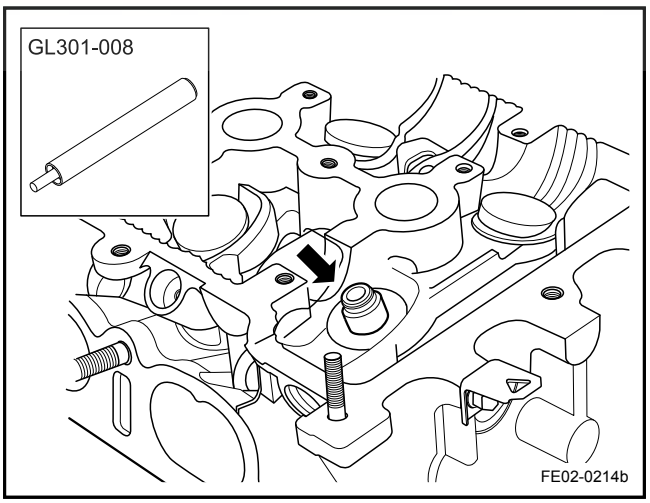
7. Inspect and confirm that the sealing surface has no distortion and warping and the cylinder head sealing surface flatness must be 0.05 mm (0.002 in).

8. Inspect and confirm that valve seat ring has no excessive wear and burnt places.

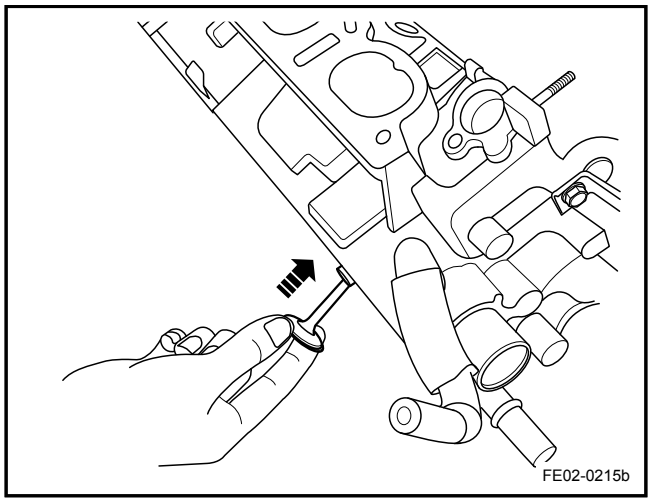
Installation Procedure:



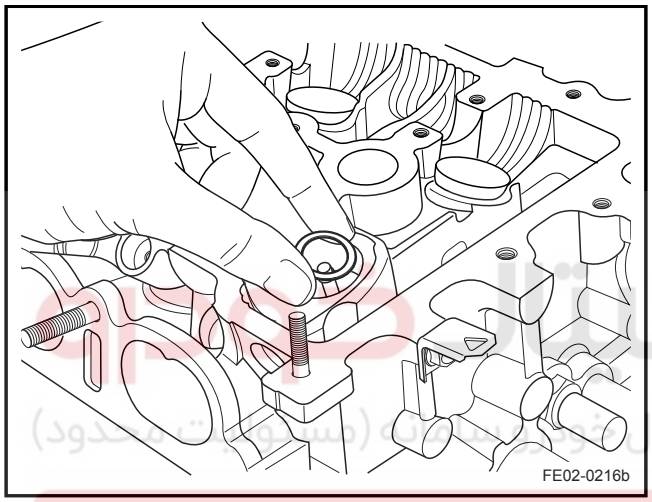
1. Use a special tool GL301-009 to install the valve guide rod.



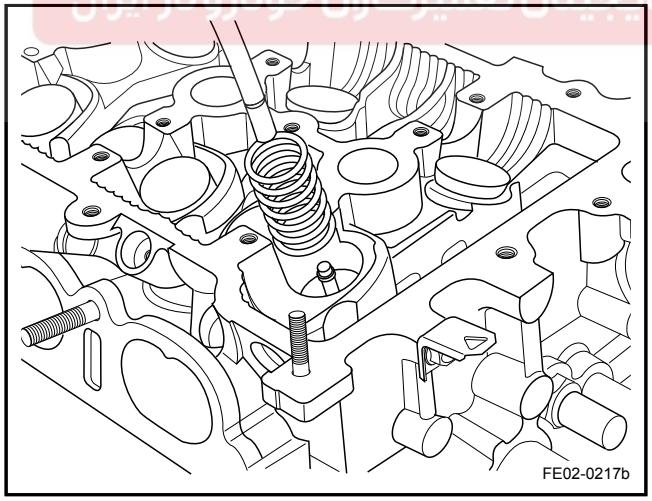
2. Use a special tool GL301-008 to install the special valve seals.



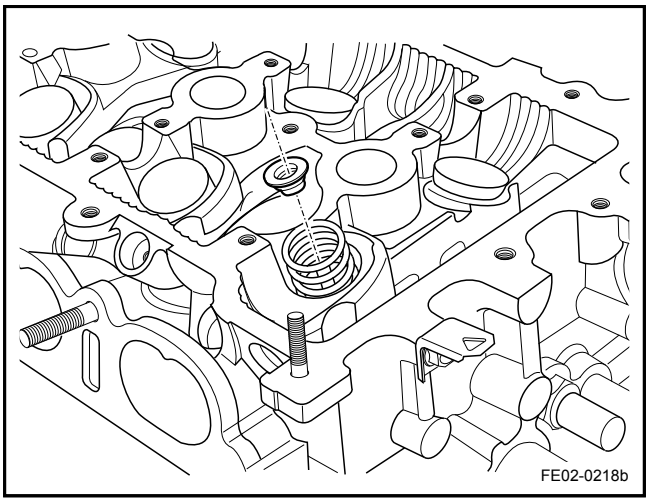
3. Install the valves.



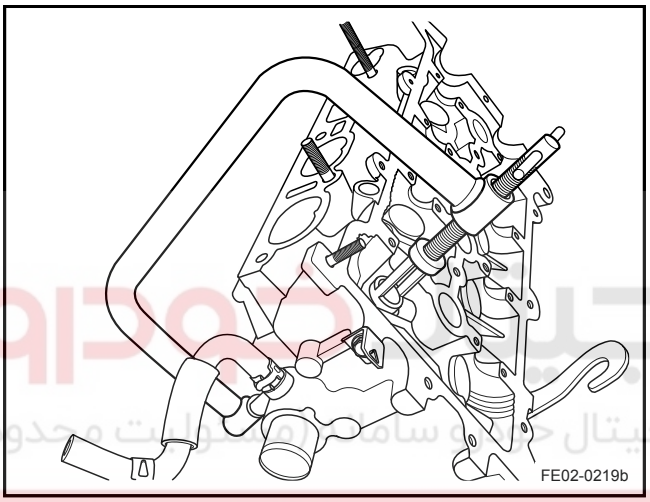
4. Install the valve spring pads.



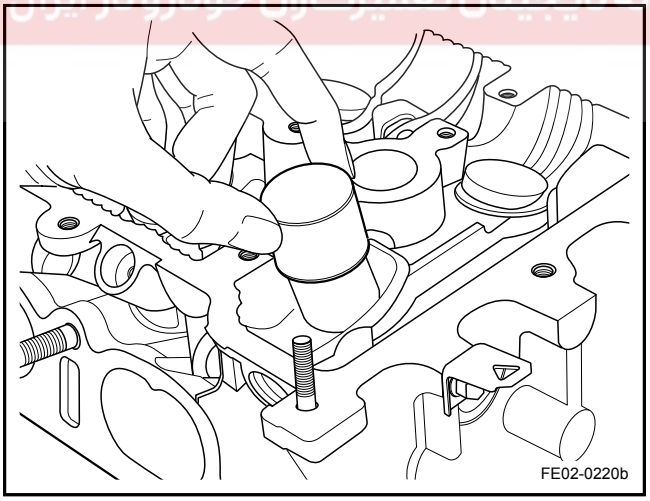
5. Install the valve springs.



6. Install the valve spring seat.



7. Use a universal tool to compress the valve springs and install the valve spring locking pieces.



8. Confirm locking pieces is in place. slowly remove the special tool with a wood hammer gently knock the valve, so that the valve is in place.

   Warning!

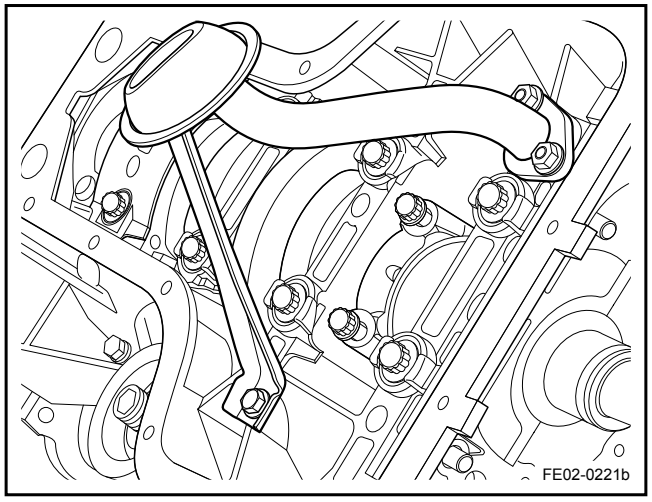
   Do not apply excessive force, otherwise the valve spring might pop up and cause personal injury.

9. Install the valve lifter.

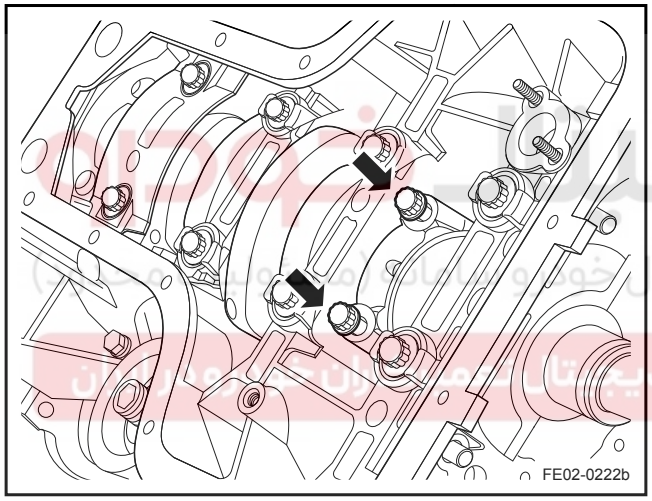
10. Install the cylinder head assembly.

2.6.8.16 Piston Connecting Rod and Bearing Replacement

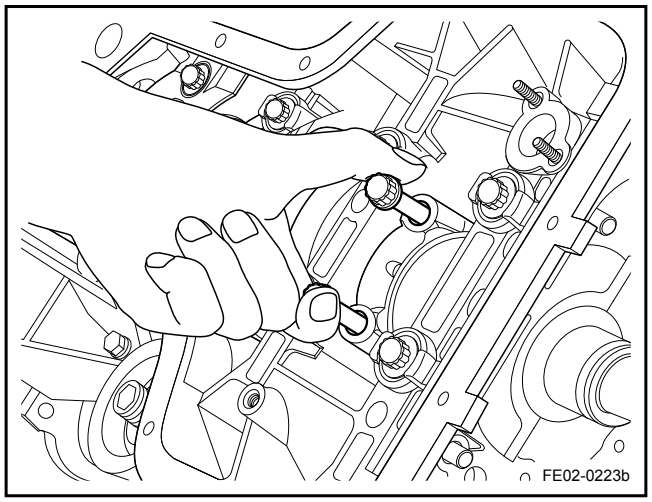
Removal Procedure:



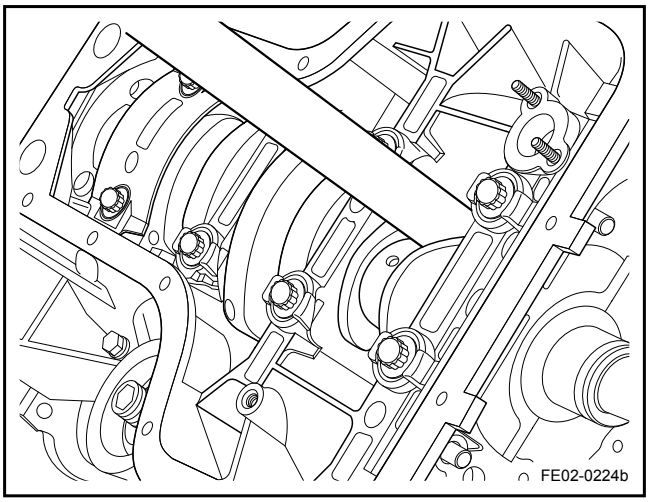
1. Remove the engine assembly. Refer to 2.6.8.13 Engine Replacement.
2. Remove the cylinder head cover. Refer to 2.6.8.14 Cylinder Head Assembly Replacement.
3. Remove the oil pan. Refer to 2.9.8.3 Oil Pan Replacement.
4. Remove the filters.



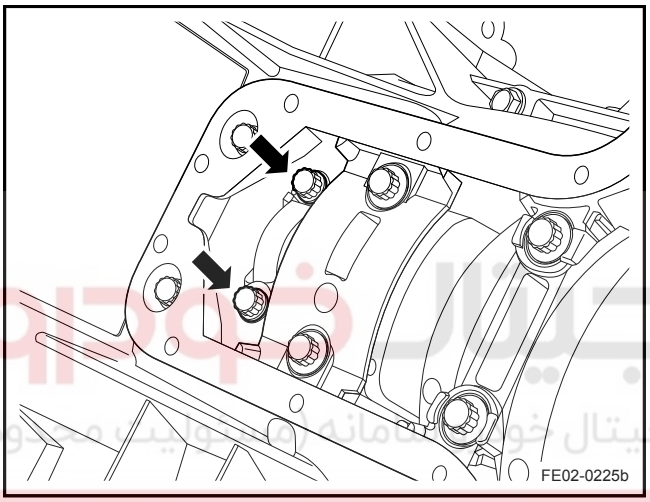
5. Rotate the crankshaft, so that the cylinder NO.1 and 4 are at BDC positions. Remove the cylinder NO.1 rod bearing cap bolts.



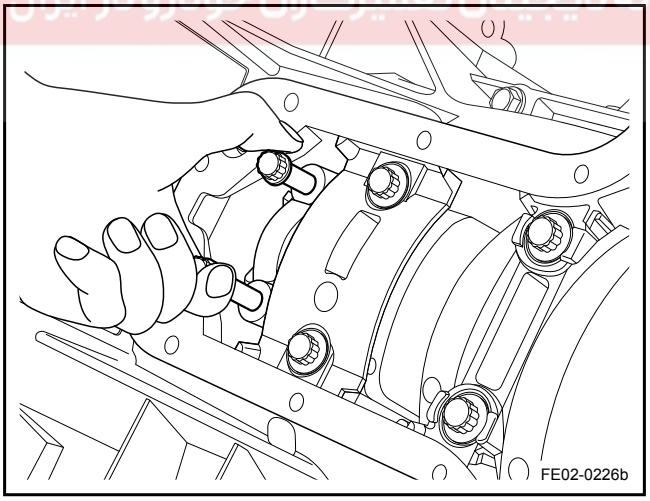
6. hold the rod bolts. Remove the cylinder NO.1 connecting rod bearing caps and mark the location of the cylinder NO. 1 on the bearing cover.



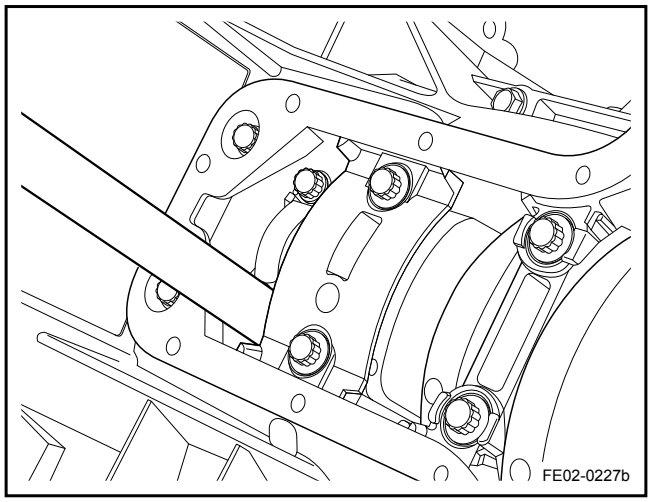
7. With a wood handle, remove cylinder No.1 piston rod and mark the location of cylinder No.1.



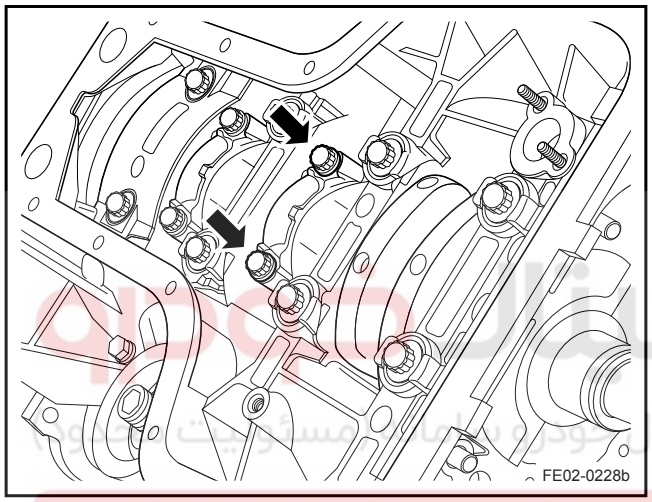
8. Remove the cylinder No.4 connecting rod bearing cap bolts.



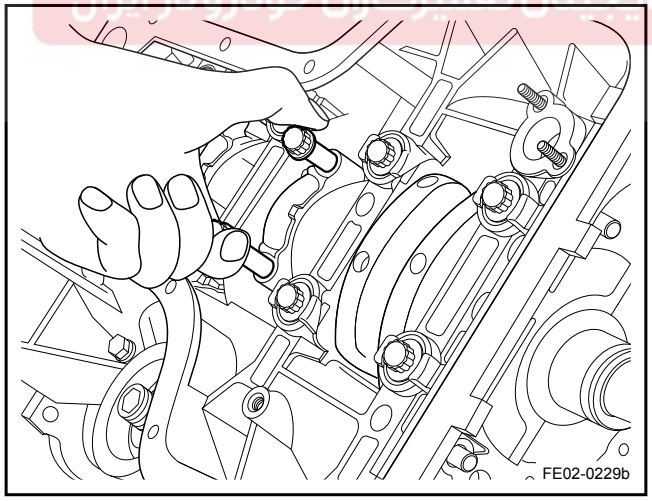
9. Hold the rod bolt, remove the cylinder No.4 connecting rod bearing caps and mark the location cylinder No.4.



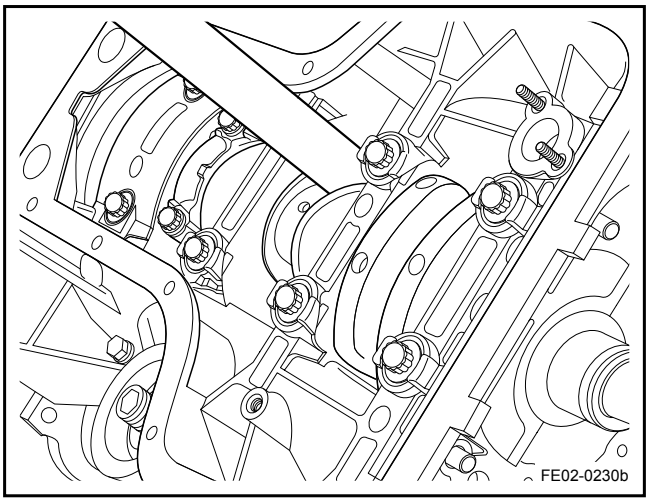
10. With a wood handle, remove cylinder No.1 piston rod and mark the location of cylinder No.4.



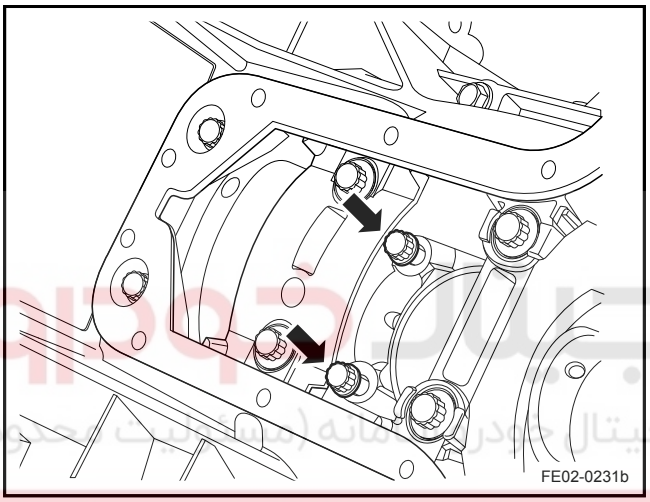
11. Rotate the crankshaft 180 °, so that the cylinder NO.2 and 3 are at BDC positions. Remove the cylinder NO.2 rod bearing cap bolts.



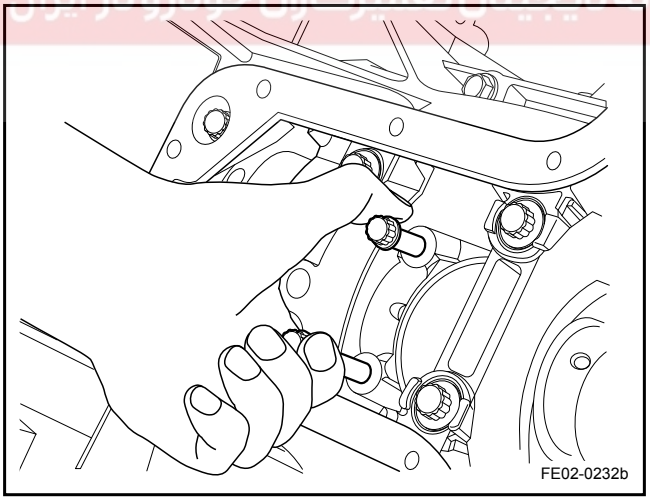
12. Hold the rod bolt, remove the cylinder No.2 connecting rod bearing caps and mark the location cylinder No.2.



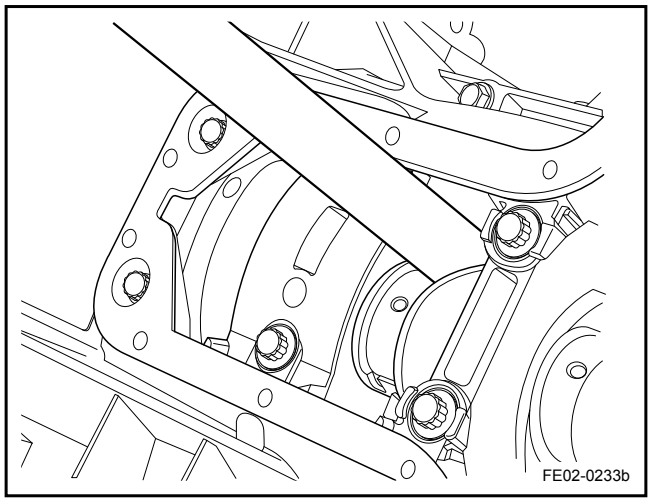
13. With a wood handle, remove cylinder No.2 piston rod and mark the location of cylinder No.2.



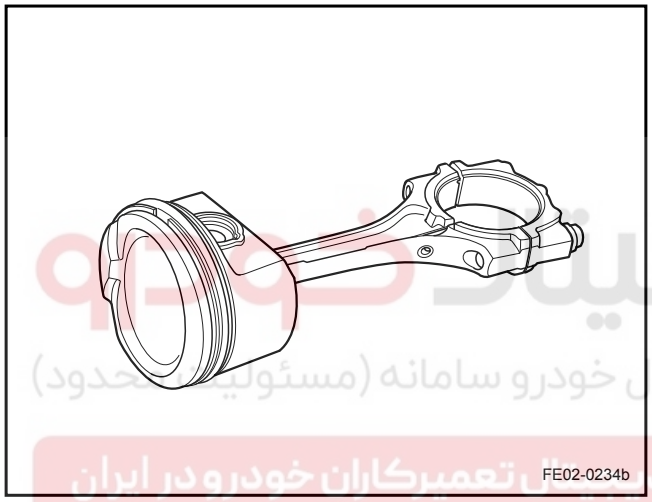
14. Remove the cylinder No.3 connecting rod bearing cap bolts.



15. Hold the rod bolt, remove the cylinder No.3 connecting rod bearing caps and mark the location of cylinder No.3.



16. With a wood handle, remove cylinder No.3 piston rod and mark the location of cylinder No.3.



Inspection Procedures Before Installing The Piston:

1. Check whether the rod is bent or distorted. If the rod is bent or distorted, replace the connecting rod.

   Cross Degree: 0.03/100 (Metric) 0.001/3.9 (US English)
   Twisted Degree: 0.05/100 (Metric) 0.002/3.9 (US English)

2. Check the connecting rod bearings.
3. Check whether the bottom rod is worn.
4. Check whether the connecting rod upper end is scratched.
5. Check whether there is the crankshaft connecting rod bearing journal wear and tear.
6. Check whether the piston is scratched, cracked and worn.
7. Check the piston and piston pin mating.

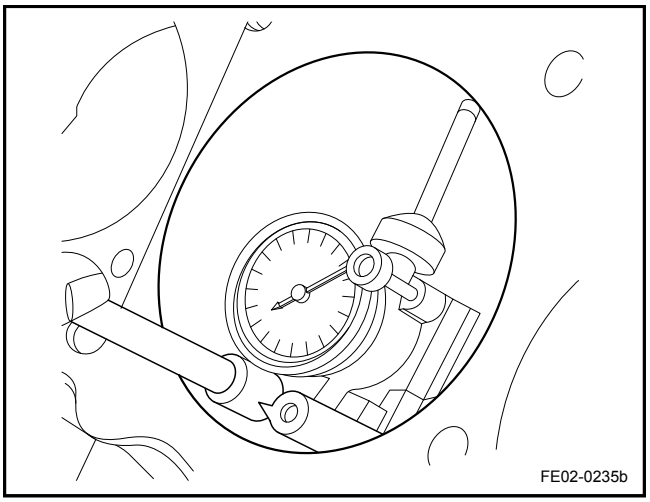
   Standard Value:
   0.005-(-0.001) mm (Metric) 0.0002-(-0.00004) in (US English)

8. Check piston pin and connecting rod small head hole clearance.

   Standard Value:
   0.005-0.011 mm (Metric) 0.0002-0.0004 in (US English)

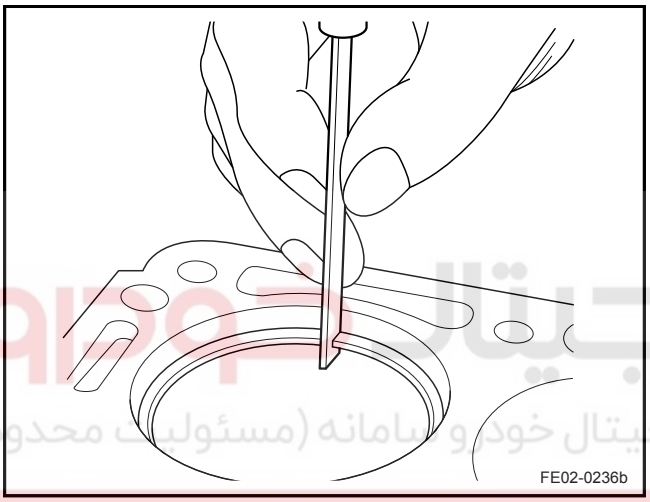
9. Check piston pin and piston pin hole clearance

   Standard Value:
   (-0.001)-0.005 mm (Metric) (-0.00003)-0.0002 in (US English)


FE02-0235b

10. Check whether the engine block cylinder bore is worn, runout and taper.
11. Check whether the engine block cylinder bore is polished, if necessary, slightly polish the cylinder bore.
12. With a ruler and gap regulator, check the engine block top surface flatness.

    Standard Value: 0.05 mm (Metric) 0.002 in (US English)


FE02-0236b

13. Select a new set of piston rings, use a gap regulator to measure piston ring end gap.

    Oil Ring End Gap:
    0.20-0.70 mm (Metric) 0.0079-0.0276 in (US English)

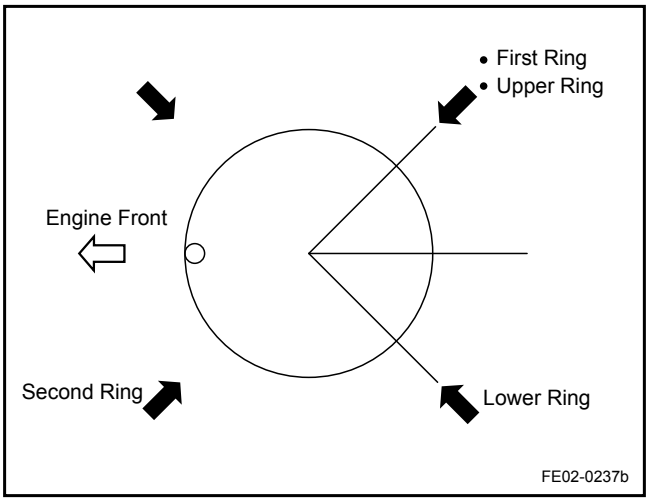
    Second Compression Ring End Gap:
    0.40-0.55 mm (Metric) 0.0157-0.0217 in (US English)

    First Compression Ring End Gap:
    0.25-0.35 mm (Metric) 0.0098-0.0138 in (US English)
14. Check the connecting rod bearings gap.

    Standard Value:
    0.020-0.044 mm (Metric) 0.0007-0.0017 in (US English)
15. check the connecting rod bearing clearance.

    Standard Value:
    0.16-0.342 mm (Metric) 0.006-0.0135 in (US English)

Installation Procedure:



FE02-0237b

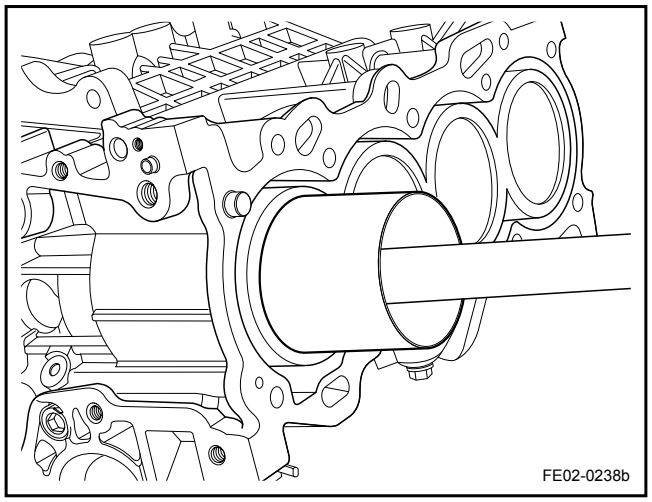
1. install piston rings.

   Note

   Note when installing the piston rings do not expand too much, otherwise it will break piston rings.
2. Install the piston rings to the location as shown in the graphic.

   Note

   Oil ring opening can not be parallel to the piston pin axis.

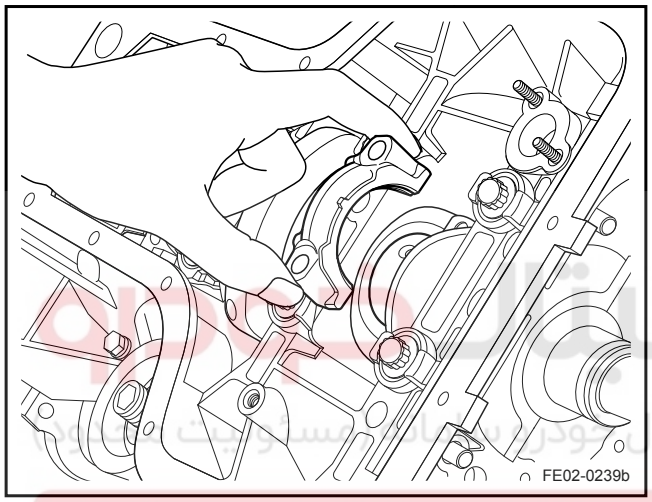


3. With the new engine oil lubricate the cylinder wall.

4. With the new engine oil lubricate the piston, use universal tools and wood handle to install cylinder No.1 piston rod components marked with cylinder No.1 location.

   Note

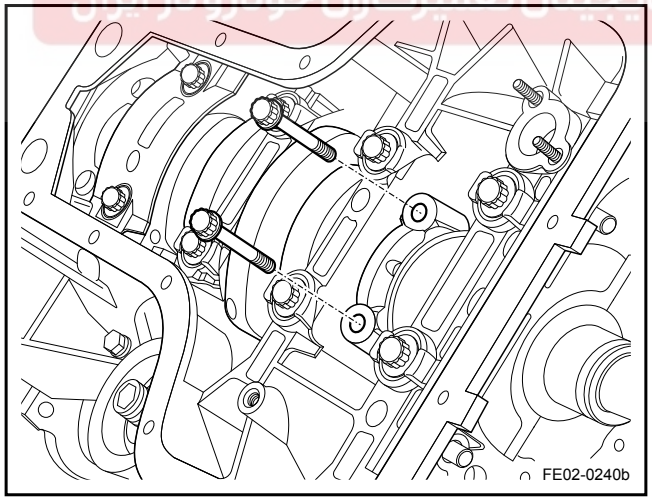
   The dot mark on the piston top surface should face the engine front end. Note that during the installation process prevent the lower connecting rod hitting the crankshaft journal, causing damage.



5. Install the cylinder No.1 connecting rod bearing cap marked with cylinder No.1 location.

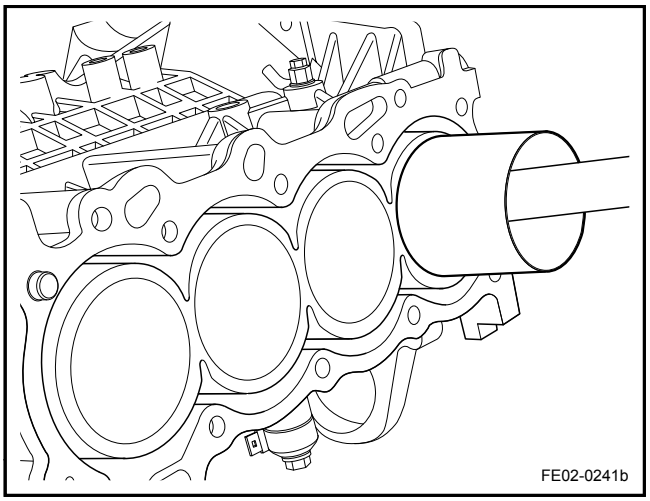
   Note

   The dot mark on the bearing cap should face the engine front end.



6. Install and tighten cylinder No.1 connecting rod bearing cap bolts.

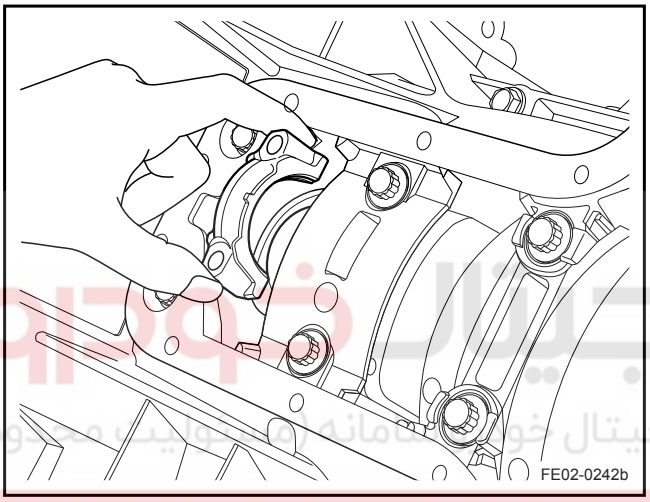
   Torque
   First Pass: 20 Nm (Metric) 14.8 lb-ft (US English)
   Second Pass: 51 Nm (Metric) 37.8 lb-ft (US English)



7. With a small amount of new engine oil lubricate the piston, use universal tools and a wood handle to install cylinder No.4 piston rod components marked with cylinder No.4 location.

Note

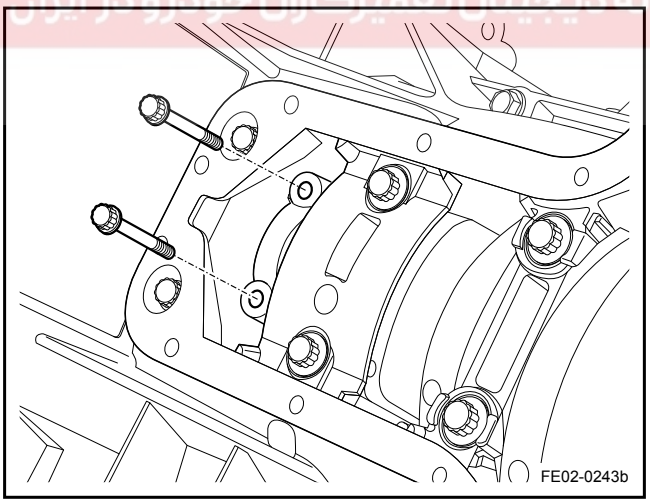
The dot mark on the piston top surface should face the engine front end. Note that during the installation process prevent the lower connecting rod hitting the crankshaft journal, causing damage.



8. Install the cylinder No.4 connecting rod bearing cap marked with cylinder No.4 location.

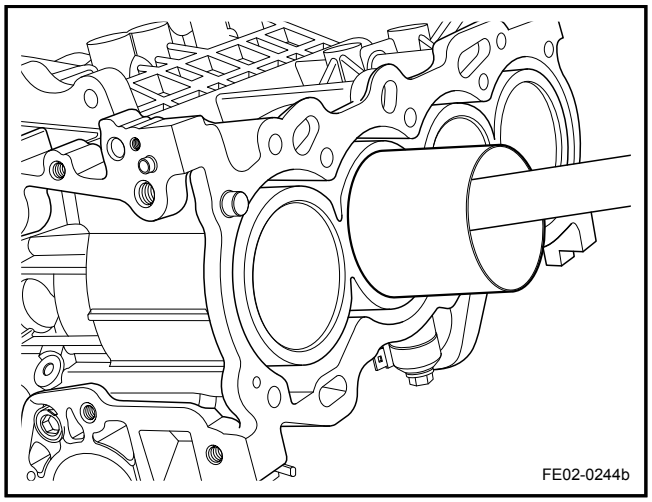
Note

The dot mark on the bearing cap should face the engine front end.



9. Install and tighten cylinder No.1 connecting rod bearing cap bolts.

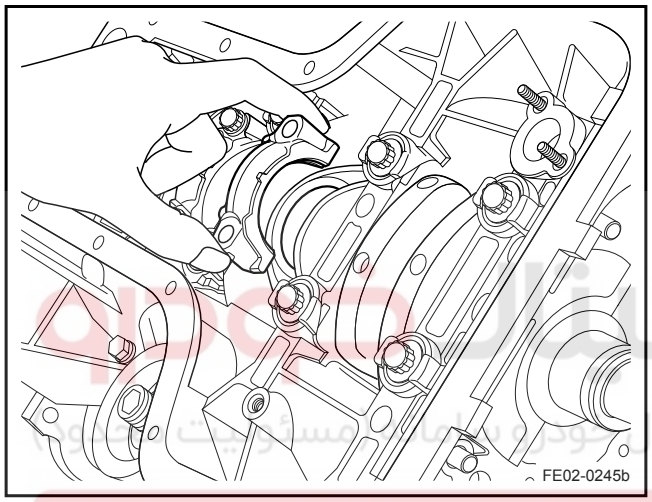
Torque
First Pass: 20 Nm (Metric) 14.8 lb-ft (US English)
Second Pass: 51 Nm (Metric) 37.8 lb-ft (US English)



10. Rotate the crankshaft 180 °, so that cylinder No.2 and 3 are at BDC positions. With the new engine oil lubricate the piston, use universal tools and a wood handle to install cylinder No.2 piston connecting rod component marked with cylinder No.2 location.

    Note

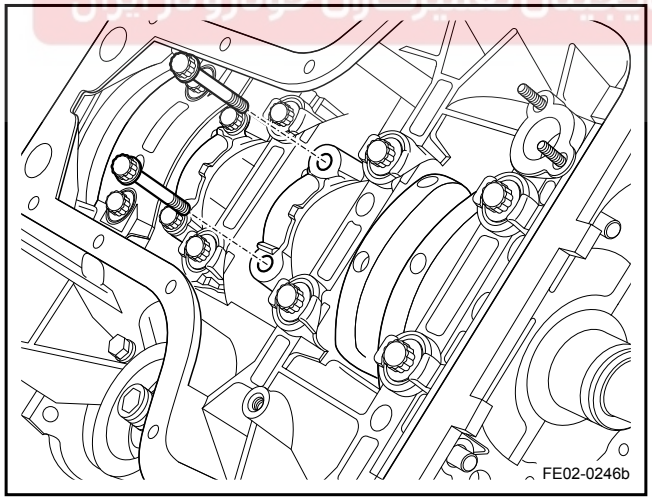
    The dot mark on the piston top surface should face the engine front end. Note that during the installation process prevent the lower connecting rod hitting the crankshaft journal, causing damage.



11. Install the cylinder No.2 connecting rod bearing cap marked with cylinder No.2 location.

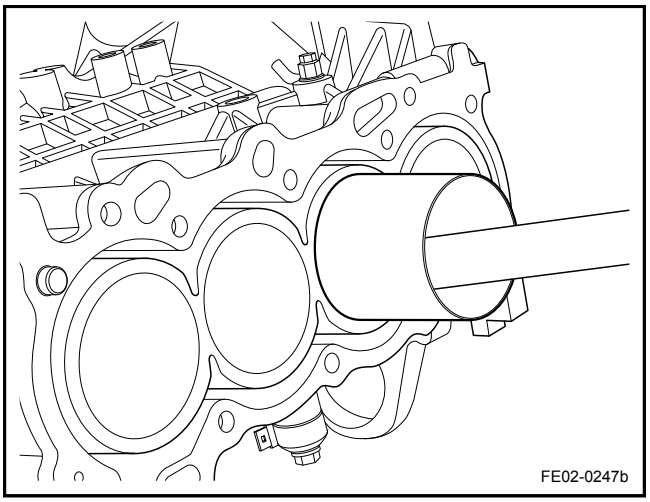
    Note

    The dot mark on the bearing cap should face the engine front end.



12. Install and tighten cylinder No.2 connecting rod bearing cap bolts.

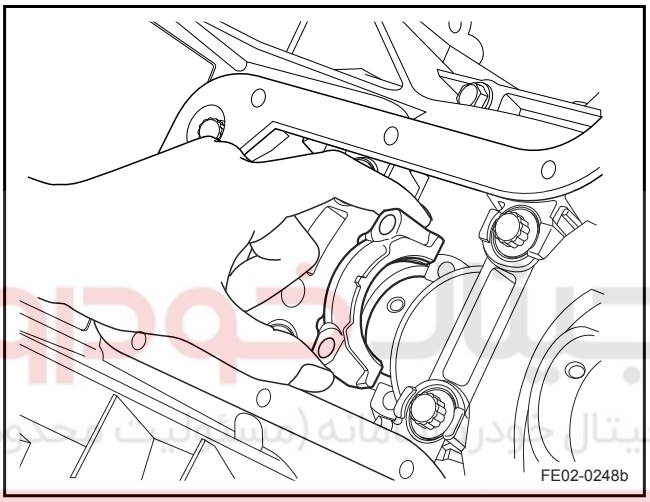
    Torque
    First Pass: 20 Nm (Metric) 14.8 lb-ft (US English)
    Second Pass: 51 Nm (Metric) 37.8 lb-ft (US English)



13. With the new engine oil lubricate the piston, use universal tools and a wood handle to install cylinder No.3 piston connecting rod component marked with cylinder No.3 location.

Note

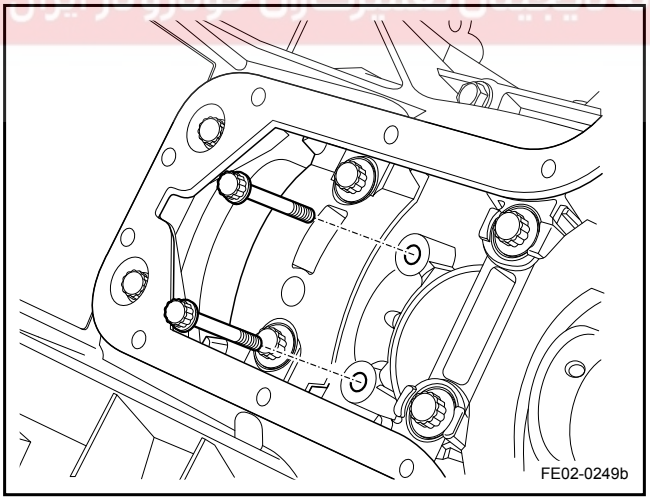
The dot mark on the piston top surface should face the engine front end. Note that during the installation process prevent the lower connecting rod hitting the crankshaft journal, causing damage.



14. Install
Install the cylinder No.3 connecting rod bearing cap marked with cylinder No.3 location.

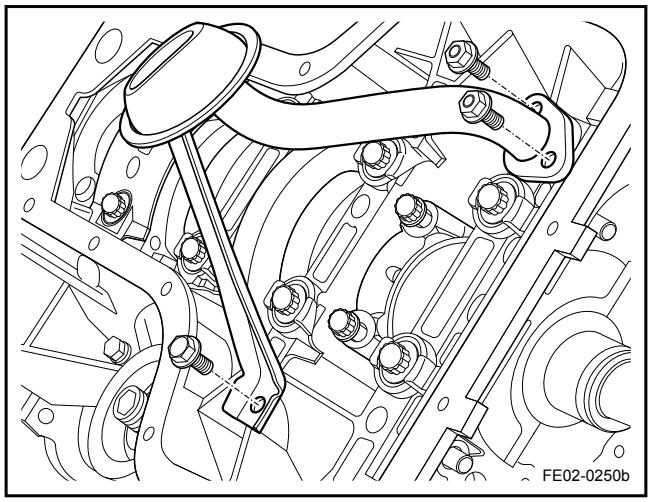
Note

The dot mark on the bearing cap should face the engine front end.



15. Install and tighten cylinder No.3 connecting rod bearing cap bolts.

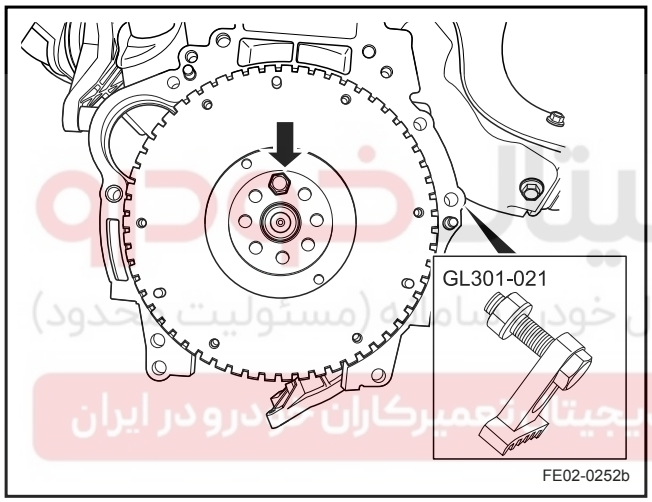
Torque
First Pass: 20 Nm (Metric) 14.8 lb-ft (US English)
Second Pass: 51 Nm (Metric) 37.8 lb-ft (US English)



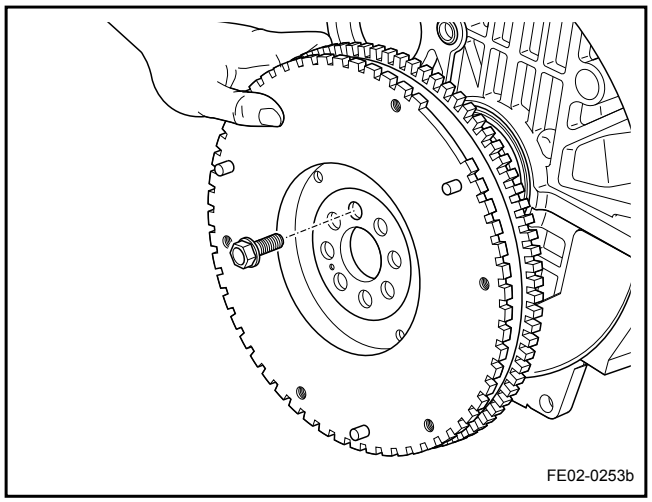
16. Install the filters.
17. Install the oil pan.
18. Install the cylinder head.
19. Install the engine assembly.

2.6.8.17 Flywheel Replacement

Removal Procedure:



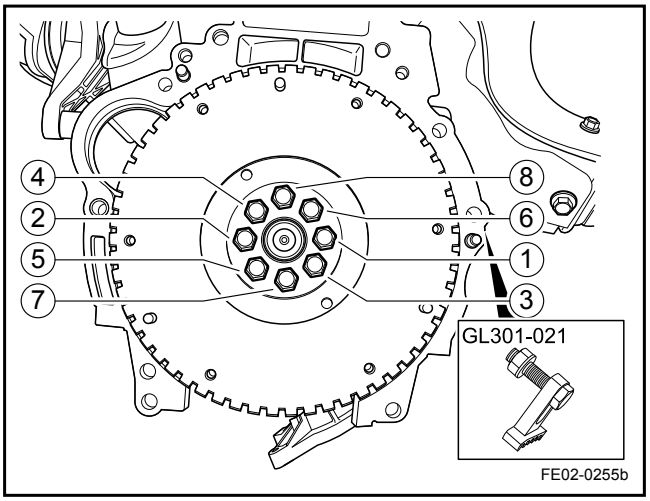
1. Remove the gearbox assembly. Refer to 3.3.8.3 Transmission Assembly Replacement.
2. Remove the clutch assembly. Refer to 3.2.6.5 Clutch Assembly Replacement.
3. Use a special tool GL301-021 to prevent the crankshaft rotation.
4. Remove the flywheel retaining bolts, leaving the last bolt at the top of the crankshaft in order to stabilize the flywheel.



5. Hold the engine flywheel and remove the last bolt.

   Note

   Be careful when remove the last bolt avoid the flywheel drop.



Installation Procedure:

1. Install new bolts to the engine flywheel, but do not tighten at this stage.

   Note

   Apply adhesive on the bolts.
   Adhesive: Thread Locking Sealant.

2. Install a special tool GL301-021 to prevent the crankshaft rotating.

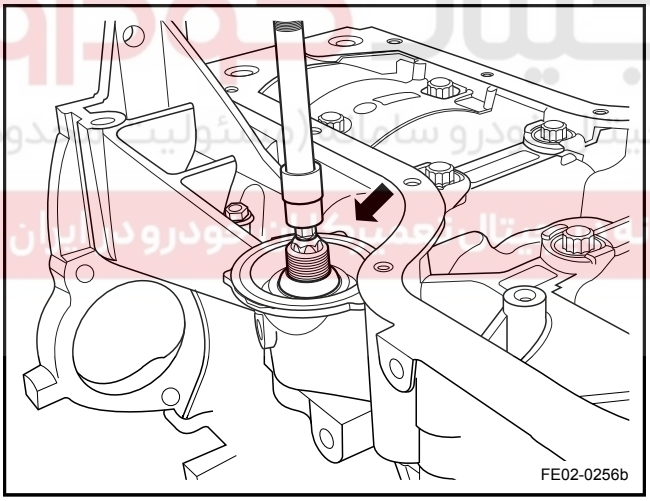
3. Install and tighten the engine flywheel bolts to the specified torque, according to the sequence in the graphic.

   Torque: 88 Nm (Metric) 65.1 lb-ft (US English)

4. Install the clutch assembly.

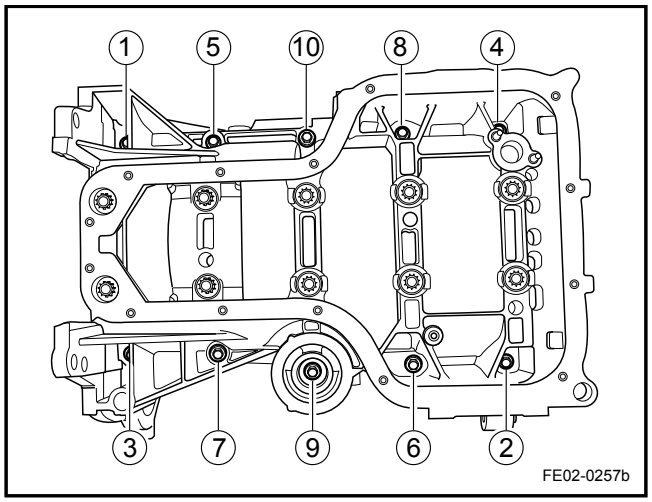
5. Install the gearbox assembly.

2.6.8.18 Crankshaft Replacement

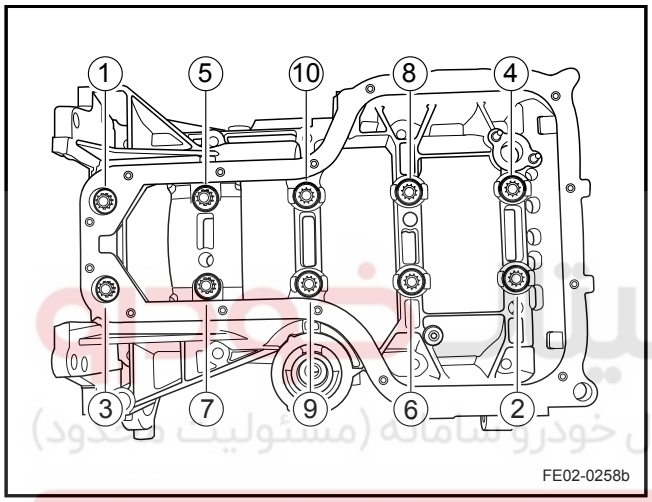


Removal Procedure:

1. Remove the engine. Refer to 2.6.8.13 Engine Replacement.
2. Remove the gearbox. Refer to 3.3.8.3 Transmission Assembly Replacement.
3. Remove the flywheel. Refer to 2.6.8.17 Flywheel Replacement.
4. Remove the crankshaft oil seals.
5. Remove the cylinder head cover. Refer to 2.6.8.14 Cylinder Head Assembly Replacement.
6. Remove the oil pump. Refer to 2.9.8.1 Oil Pump Replacement.
7. Remove the oil pan. Refer to 2.9.8.3 Oil Pan Replacement.
8. Remove the piston connecting rod and bearing. Refer to 2.6.8.16 Piston Connecting Rod and Bearing Replacement.
9. Remove the oil filter bolts.



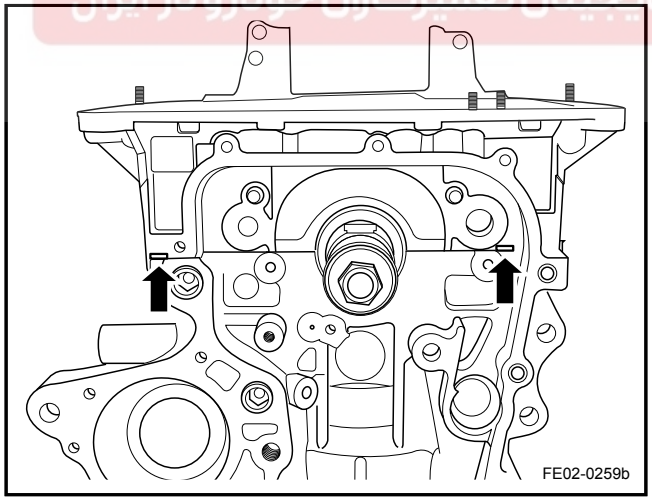
10. Remove the crankcase retaining bolts according to the sequence in the graphic.



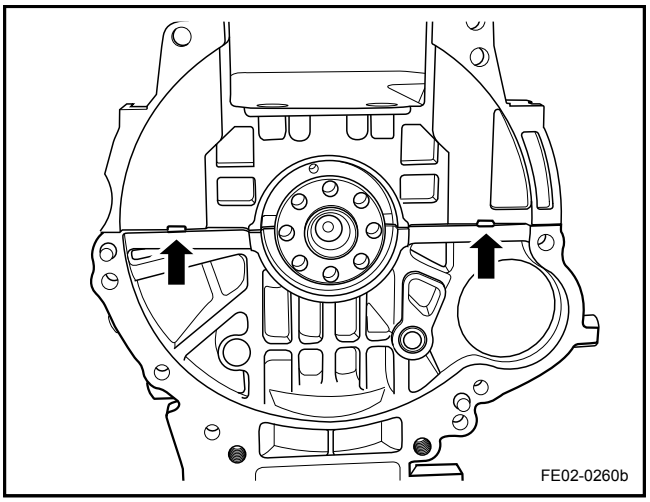
11. Remove the crankshaft bearing cap bolts according to the sequence in the graphic.

Note

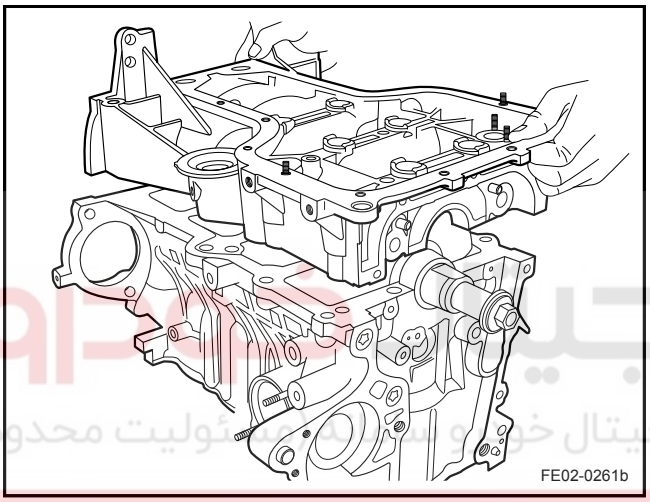
Do not loose a single bolt completely. Remove the bolt in multiple operations, otherwise it may cause damage to the crankshaft.



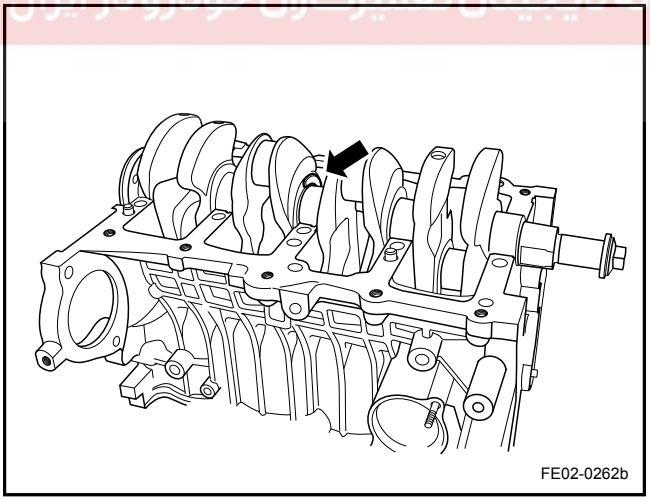
12. Insert a flat screwdriver into the position shown in the graphic and loosen the crankcase front end.



13. Insert a flat screwdriver into the position shown in the graphic and loosen the crankcase rear end.



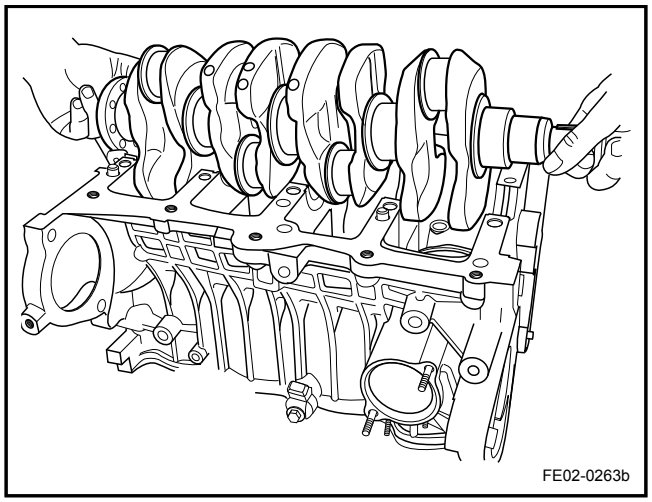
14. Remove the crankcase.



15. Remove the No.3 bearing crankshaft thrust film.

Note

Rotate the crankshaft, so that thrust film turns to facilitate removal.


FE02-0263b

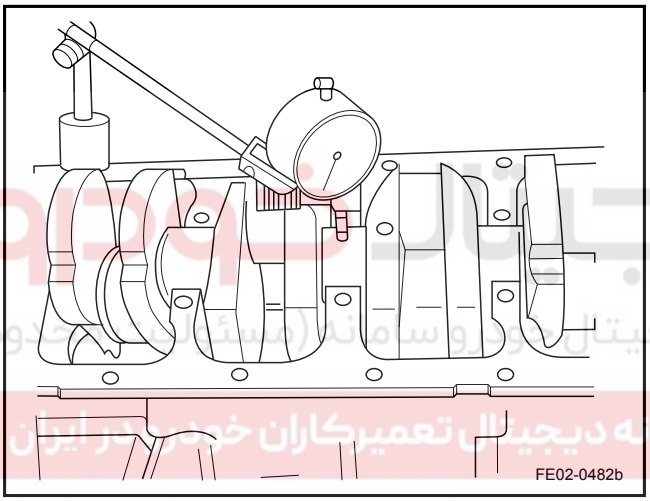
16. Remove the crankshaft.

Crankshaft inspection, the crankshaft bearing clearance matching inspection procedure:

1. Measure the main bearing bore diameter with an inner diameter micrometer and record.
2. Measure the crankshaft axis with an outside diameter micrometer and record.
3. Select the crankshaft main bearing sizes according to the recorded sizes in the following table .

Main Bearing Bore Diameter (mm/in)	Crank Spindle Diameter Diameter (mm/in)	Thickness Of The Main Bearing (mm/in)
52.005-52.011 / 2.0474-2.0477 (No.1)	47.994-48 / 1.8895-1.8898 (No.1)	1.993 ≤ t ≤ 1.996/0.0785 ≤ t ≤ 0.0786 (No.2)
52.011-52.017 / 2.0477-2.0479 (No.2)	47.994-48 / 1.8895-1.8898 (No.1)	1.996 ≤ t ≤ 1.999/0.0786 ≤ t ≤ 0.0787 (No.3)
52.005-52.011 / 2.0474-2.0477 (No.1)	47.988-47.994 / 1.8893-1.8895 (No.2)	
52.017-52.021 / 2.0479-2.0481 (No.3)	47.994-48 / 1.8895-1.8898 (No.1)	1.999 ≤ t ≤ 2.002/0.0787 ≤ t ≤ 0.0788 (No.4)
52.005-52.011 / 2.0474-2.0477 (No.1)	47.982-47.988 / 1.8891-1.8893 (No.3)	

Main Bearing Bore Diameter (mm/in)	Crank Spindle Diameter Diameter (mm/in)	Thickness Of The Main Bearing (mm/in)
52.011-52.017 / 2.0477-2.0479 (No.2)	47.982-47.988 / 1.8891-1.8893 (No.3)	2.002 ≤ t ≤ 2.005/0.0788 ≤ t ≤ 0.0789 (No. 5)
52.017-52.021 / 2.0479-2.0481 (No.3)	47.988-47.994 / 1.8893-1.8895 (No.2)	
52.017-52.021 / 2.0479-2.0481 (No.3)	47.982-47.988 / 1.8891-1.8893 (No.3)	2.005 ≤ t ≤ 2.008/0.0789 ≤ t ≤ 0.0791 (No. 6)

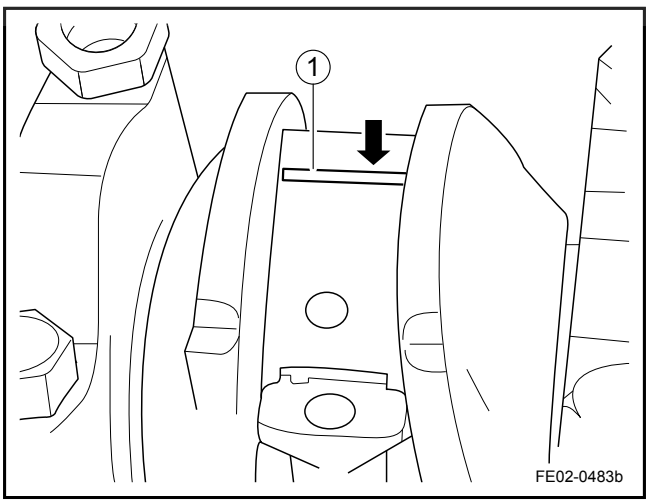

FE02-0482b

4. Install the crankshaft bearing crankshaft and check whether the middle of the crankshaft journal has acceptable loss of roundness and the beating degree.

   Standard Value:
   Roundness 0.003 mm (Metric) 0.0001 in (US English)
   Run Out 0.02 mm (Metric) 0.0008 in (US English)

5. Check the crankshaft axial clearance.

   Standard Value:
   0.04-0.24 mm (Metric) 0.0015-0.0094 in (US English)



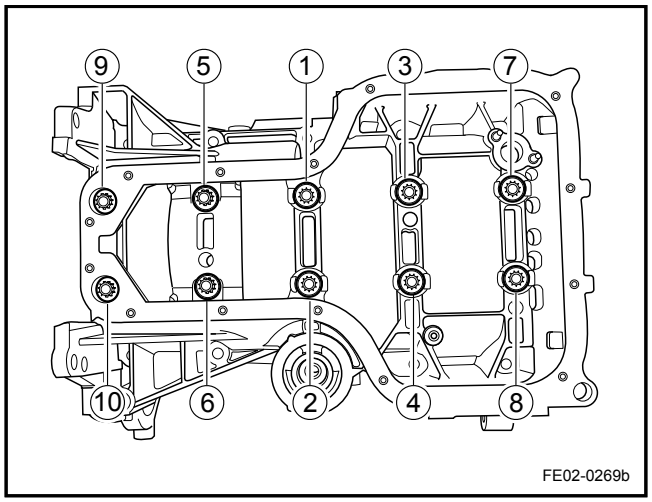
FE02-0483b

6. With a plastic gap measurement regulator, measure all the crankshaft bearings.

   Note

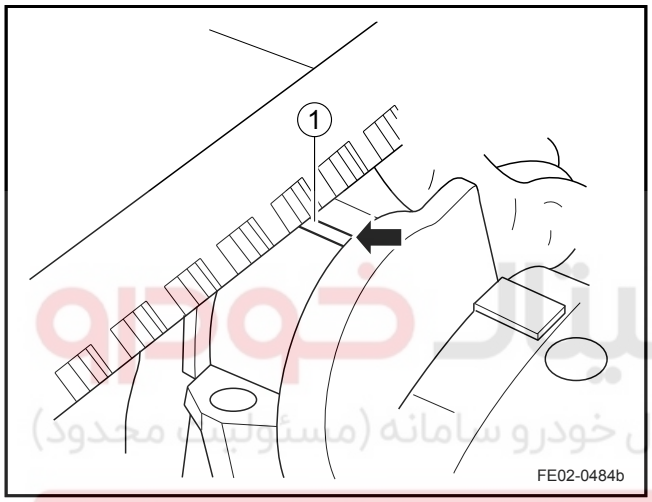
   Apply grease on the crankshaft journal and crankshaft bearings and lubricate slightly so the plastic gap measurement regulator will not be torn when measure the clearance of the crankshaft bearing cap.

7. According to the width of bearing 1, cut the plastic gap measurement regulator, place the plastic along the axis between the journal and the crankshaft bearings.



8. Install the crankcase, install and tighten the crankshaft bearing cap bolts according to the sequence shown in the graphic.

   Torque
   First Pass: 44 Nm (Metric) 32.5 lb-ft (US English)
   Second Pass: 60 Nm (Metric) 44.5 lb-ft (US English)



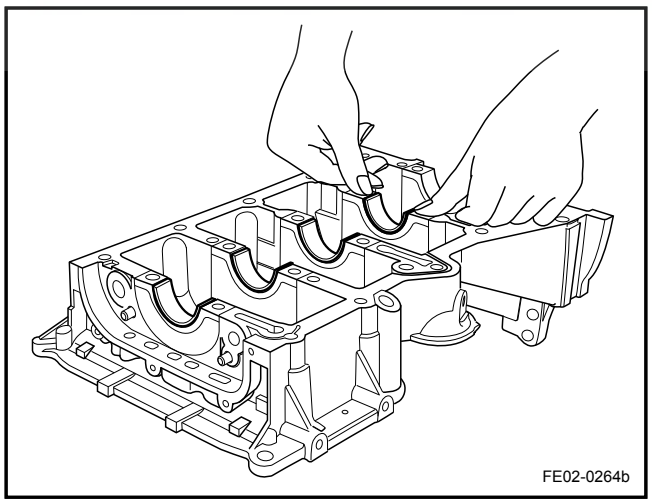
9. Remove the crankcase.

10. Measure the width of the plastic strip, check whether the value of crankshaft bearing clearance is within the following range:

    Standard Value:
    0.015-0.033 mm (Metric) 0.0006-0.0013 in (US English)

11. If the gap value is not within the specified range, re-adjust the crankshaft clearance. If necessary, replace the crankshaft.

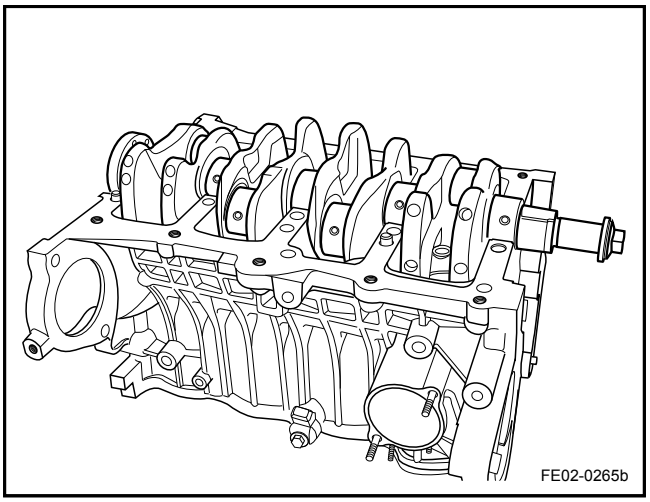
Installation Sequence:



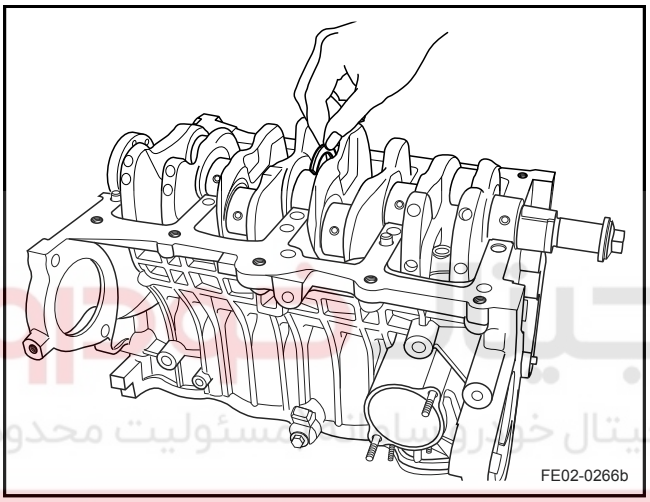
1. Clean all the relevant parts.

2. Apply a small amount of engine oil to the crankshaft bearing.

3. Install the selected crankshaft bearings.



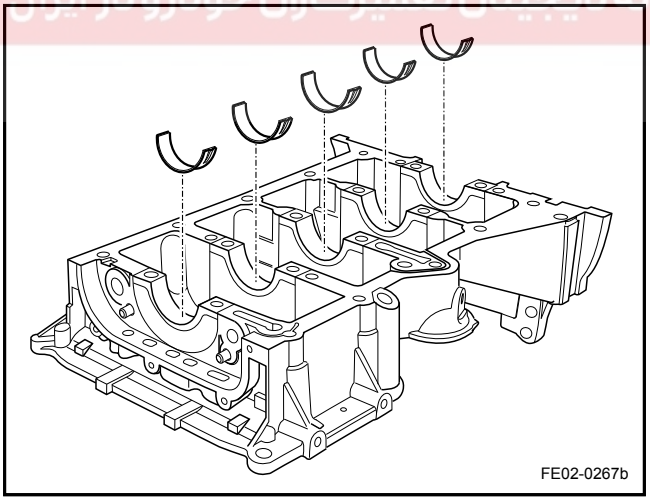
4. Install the crankshaft.



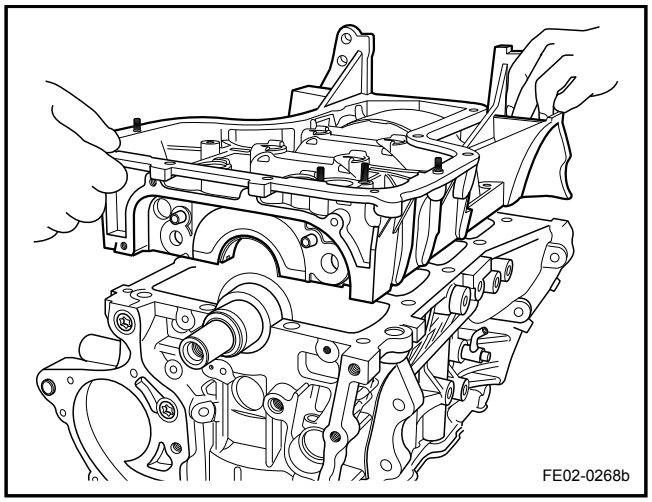
5. Install the crankshaft thrust sheet, with the grooves facing outside.

6. Check the crankshaft axial clearance, to confirm the crankshaft axial clearance is acceptable. Refer to 2.6.1.2 Mechanical System Specification.

   Standard Value:
   0.04-0.24 mm (Metric) 0.0015-0.0094 in (US English)



7. Install the crankcase bearings.



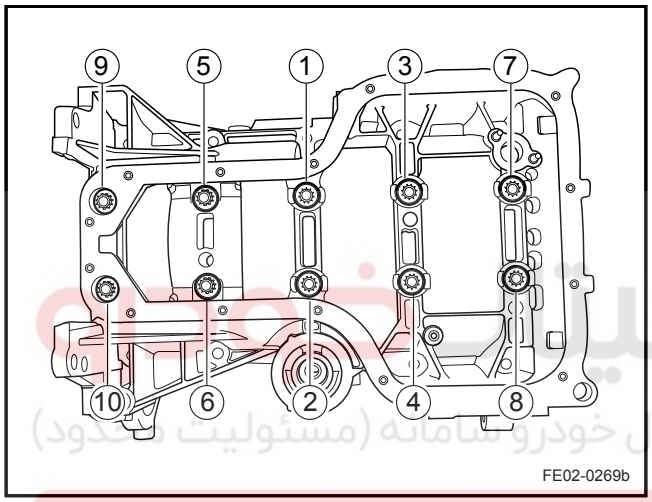
8. After installing the crankshaft in the front and rear crankshaft bearings, check whether the crankshaft journal has acceptable roundness and runout.

   Note

   Apply lubricant to the crankshaft journal and slightly lubricate the crankshaft bearings.

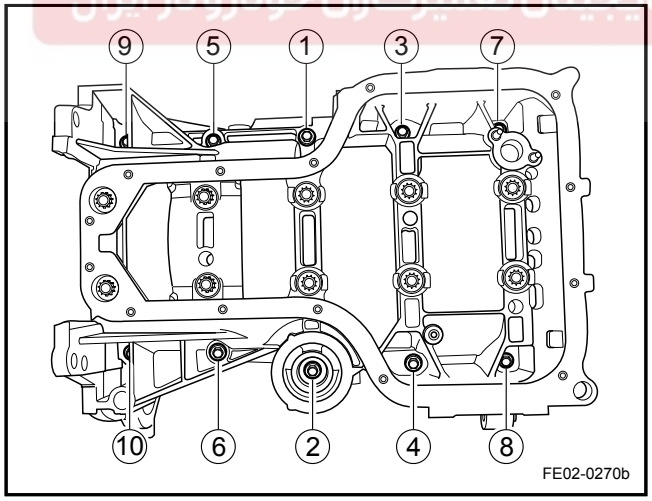
9. Apply sealant evenly on the crankshaft and cylinder block mating surface.

10. Install the crankcase.



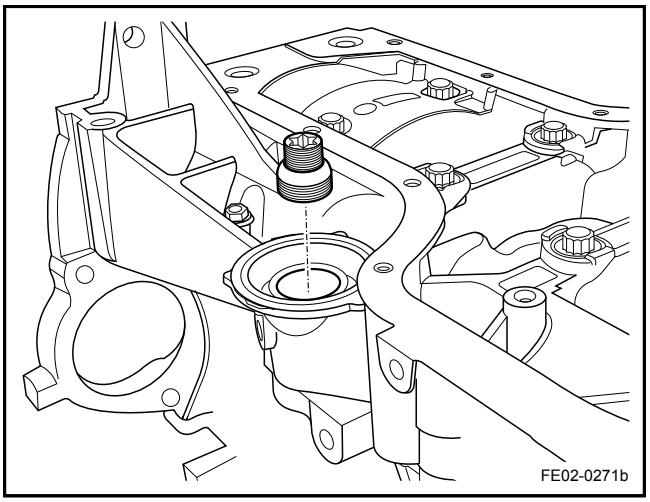
11. Install and tighten the crankshaft bearing cap bolts according to the sequence shown in the graphic.

    Torque
    First Pass: 44 Nm (Metric) 32.5 lb-ft (US English)
    Second Pass: 60 Nm (Metric) 44.5 lb-ft (US English)



12. Install the crankcase retaining bolt.

    Torque
    18 Nm (Metric) 13.4 lb-ft (US English)



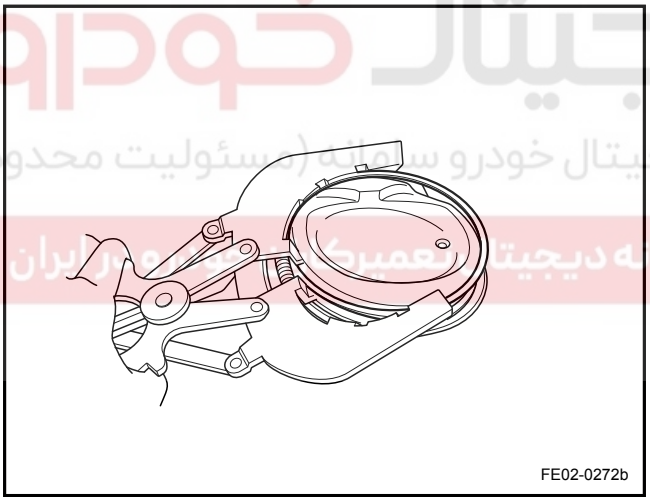
13. Install the oil filter retaining bolts.

    Torque
    20 Nm (Metric) 14.8 lb-ft (US English)

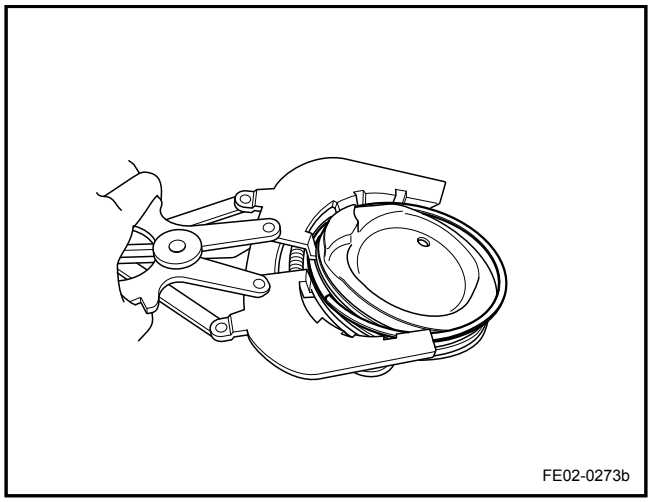
14. Install pistons, connecting rods and bearings.
15. Install sump.
16. Install the oil pan.
17. Install the cylinder head.
18. Install the crankshaft oil seals.
19. Install the flywheel.
20. Install the gearbox.
21. Install the engine.

2.6.8.19 Piston Rod Disassemble, Assemble and Inspection

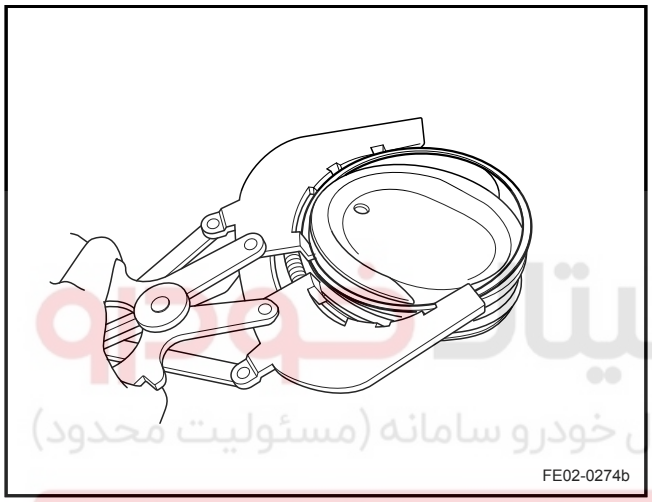
Removal Procedure:



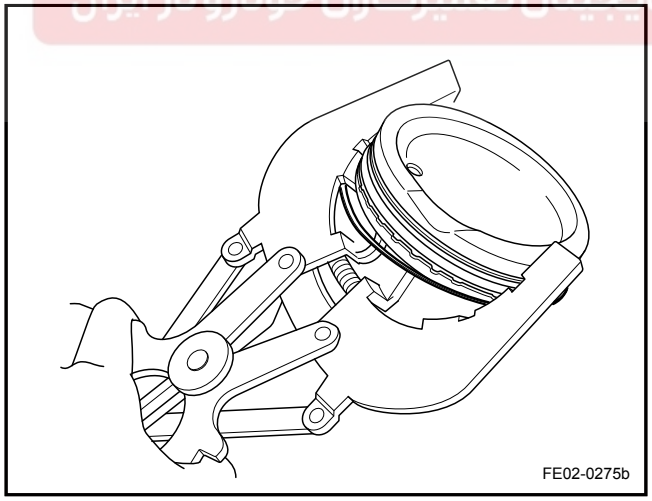
1. Remove the piston rod components. Refer to 2.6.8.16 Piston Connecting Rod and Bearing Replacement.
2. Remove the first gas ring.


FE02-0273b

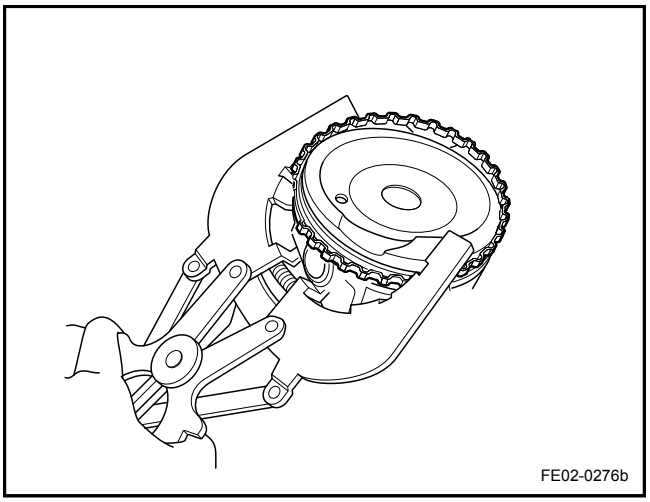
3. Remove the second air ring.


FE02-0274b

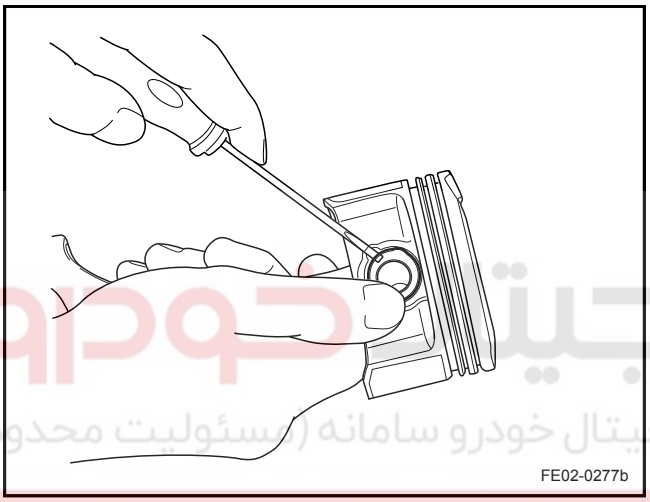
4. Remove the oil ring upper ring combination.


FE02-0275b

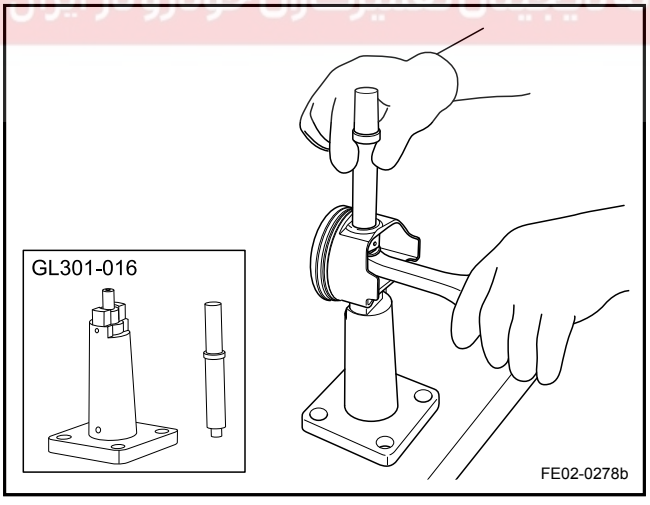
5. Remove the oil ring lower ring combination.



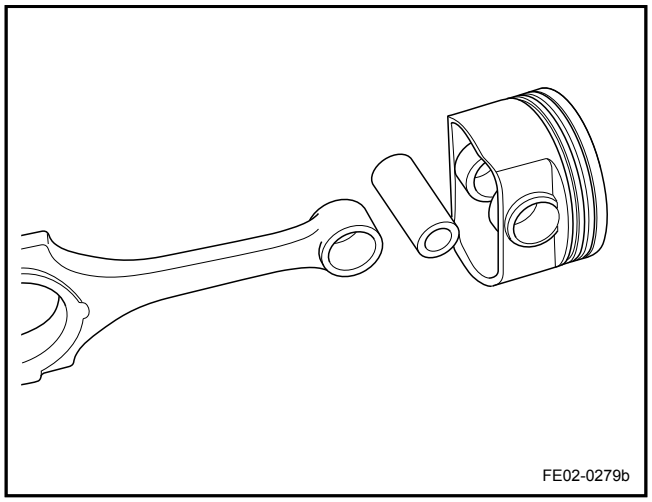
6. Remove the oil ring.



7. Remove the piston pin circlip at both ends.

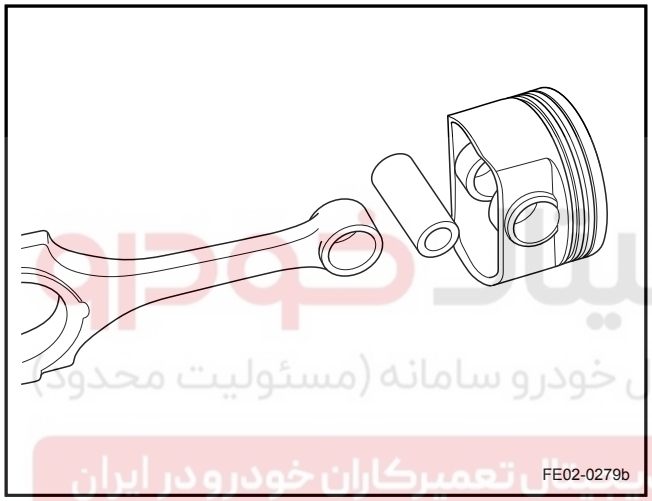


8. With a special tool GL301-016 remove the piston pin.



9. Disassemble connecting rod, piston pin and piston are shown in the graphic.

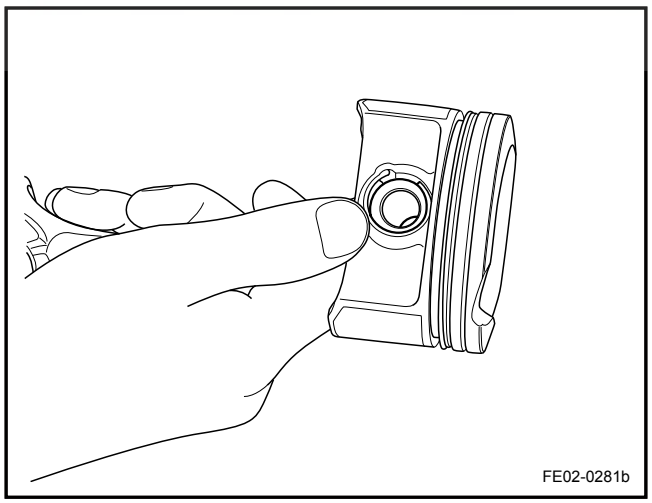
Installation Procedure:



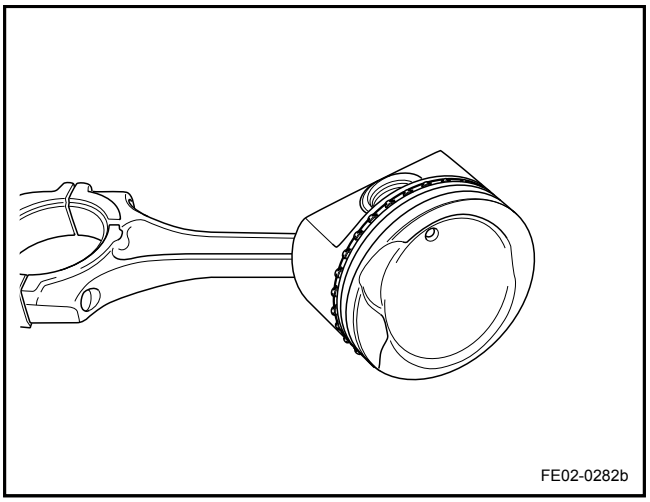
1. Install piston pin, connecting rod and piston.

   Note

   During installation, connecting rod bearings mark and the piston mark should face the same the direction.



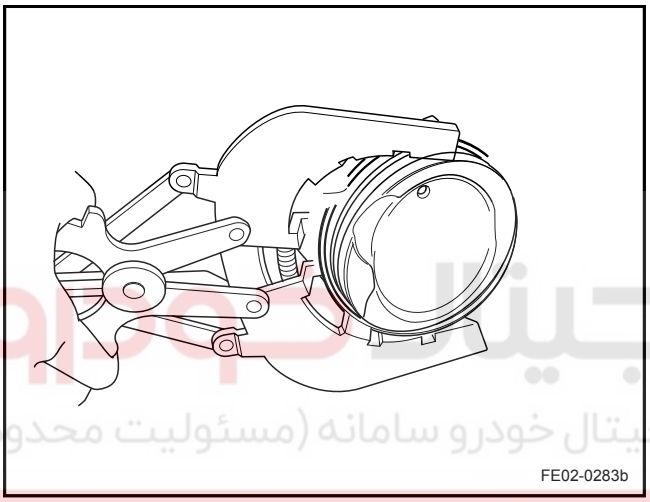
2. Install the piston pin circlip.


FE02-0282b

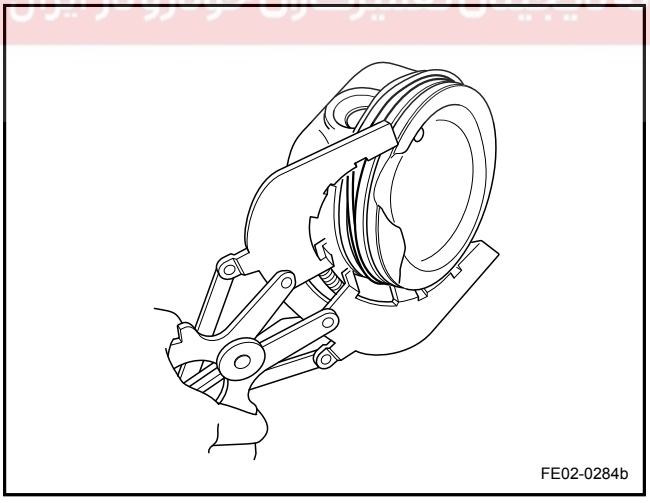
3. Confirm normal movements between the piston and rod without any interference.
4. Check piston pin and connecting rod clearance.

   Standard Value:0.005-0.011 mm (Metric) 0.0002-0.0004 in (US English)
5. Check the piston and piston pin clearance.

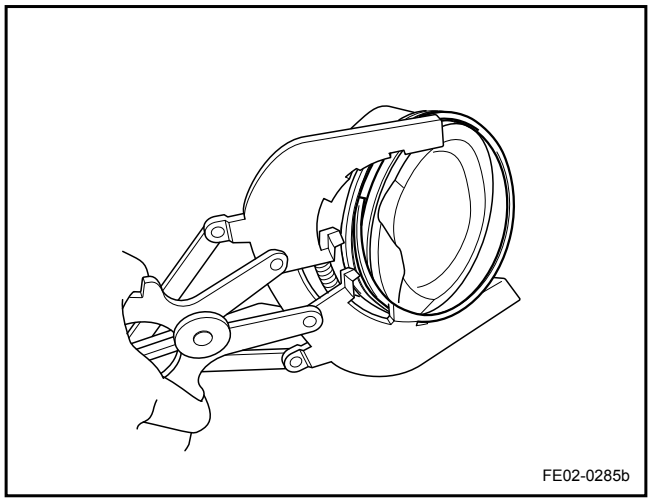
   Standard Value: 0.005-(-0.001) mm (Metric) 0.0002-(-0.00003) in (US English)
6. Install the oil ring.


FE02-0283b

7. Install the oil ring lower ring combination.


FE02-0284b

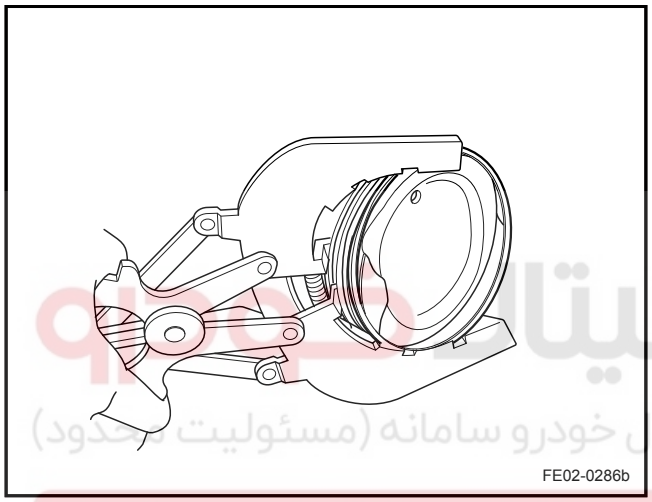
8. Install the oil ring upper ring combination.


FE02-0285b

9. Install the second air ring.

   Note

   The side with letters should face the top.


FE02-0286b

10. Install first gas ring.

    Note

    The chamfered side should face the top.

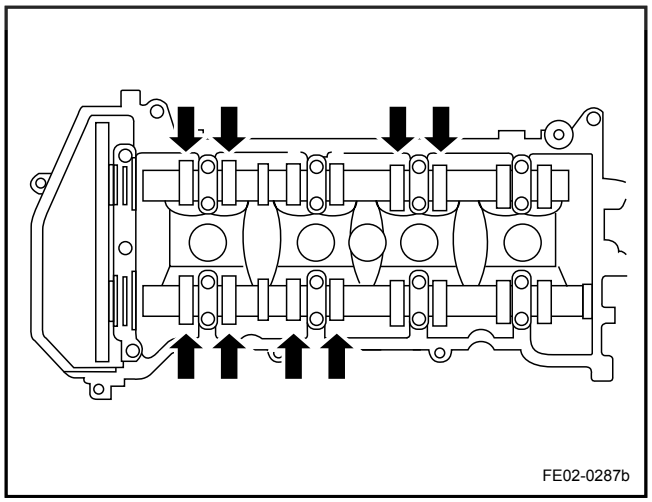
11. Apply the engine oil to the connecting rod bearings and install the connecting rod journal and the bearing cap.

12. Install the connecting rod to the crankshaft. Check whether the bearing clearance is acceptable. Refer to 2.6.1.2 Mechanical System Specification.

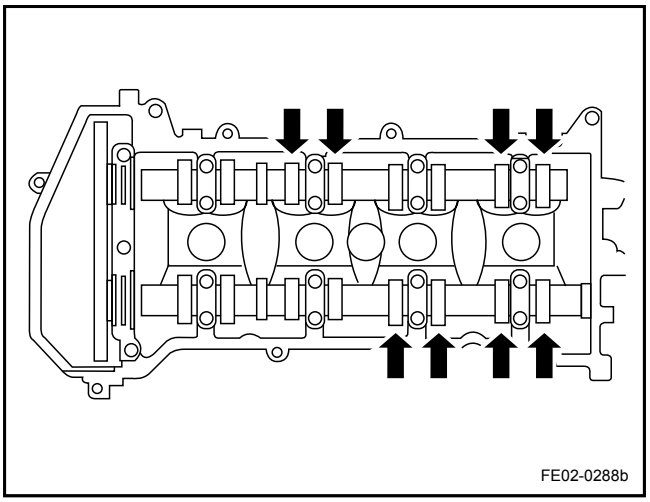
    Standard Value: 0.020-0.044 mm (Metric) 0.0007-0.0017 in (US English)

13. Install the piston rod components.

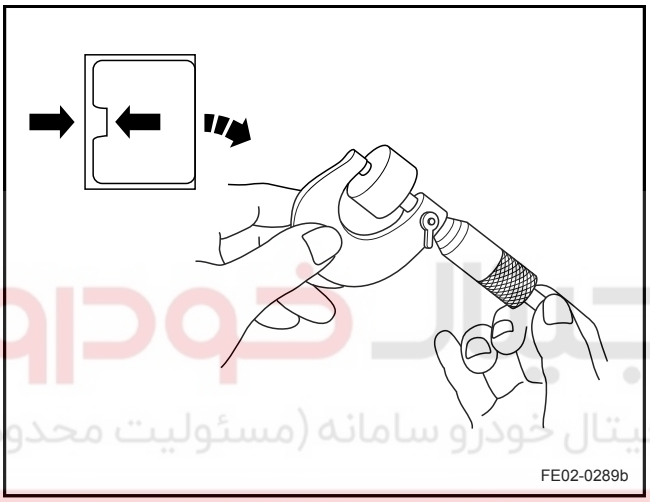
2.6.8.20 Valve Clearance Adjustments


FE02-0287b

1. Remove the engine plastic shield. Refer to 2.6.8.1 Plastic Engine Shield Replacement.
2. Remove the ignition coil. Refer to 2.10.8.3 Ignition Coil Replacement.
3. Remove the cylinder head cover. Refer to 2.6.8.2 Cylinder Head Cover Replacement.
4. Remove the timing chain cover, rotate the crankshaft so that cylinder No.1 is at TDC position. Refer to 2.6.8.9 Timing Chain Cover Replacement.
5. Check valve clearance. Use the plug gage to measure valve clearance value, as arrows shown in the graphic and record the valve location and tolerance that exceeds the tolerance.


FE02-0288b

6. Rotate the crank a circle (360 °), enable the cylinder No. 4 is at TDC position, measure the clearance as arrow pointed in the graphic and record the clearance.


FE02-0289b

7. Use a jack to support the engine. Remove the timing chain. Refer to 2.6.8.10 Timing Chain Replacement.

8. Remove the camshaft. Refer to 2.6.8.12 Camshaft Replacement.

9. Remove the valve lifter that exceeds the tolerances. Use outside diameter micrometer to measure the thickness, according to the following formula calculate the thickness of the new valve lifters.

   Intake: A=B + C - 0.23 mm (0.01 in)
   Exhaust: A=B + C - 0.32 mm (0.13 in)

A	New Valve Lifter Thickness
B	Old Valve Lifter Thickness
C	Measured Valve Clearance

10. Selected new valve lifters must be as close as possible to the calculated values. For specifications. Refer to the thickness of the valve lifter2.6.1.3 Intake and Exhaust Valves Lifter Specifications Table.

11. Based on the measurement, according to2.6.1.4 Intake and Exhaust Valves Lifter Selection Table, choose the valve lifter to meet the specifications .

12. Install intake and exhaust camshafts.

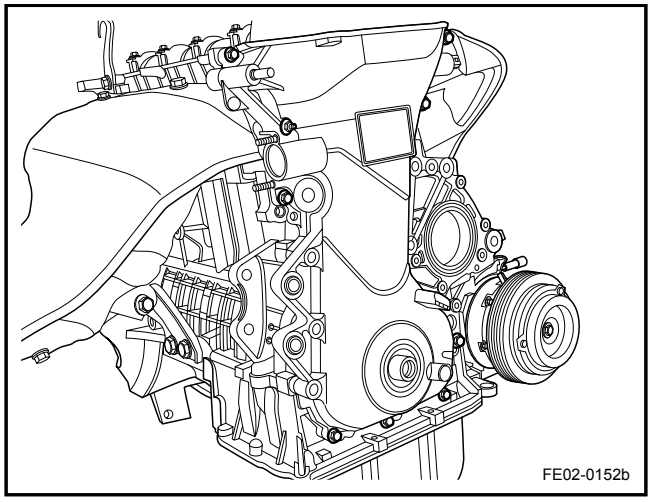
13. Install the timing chain.

14. Install the timing chain cover.

15. Install the ignition coil.

16. Install the engine plastic shield.

2.6.8.21 Crankshaft Front Oil Seal Replacement

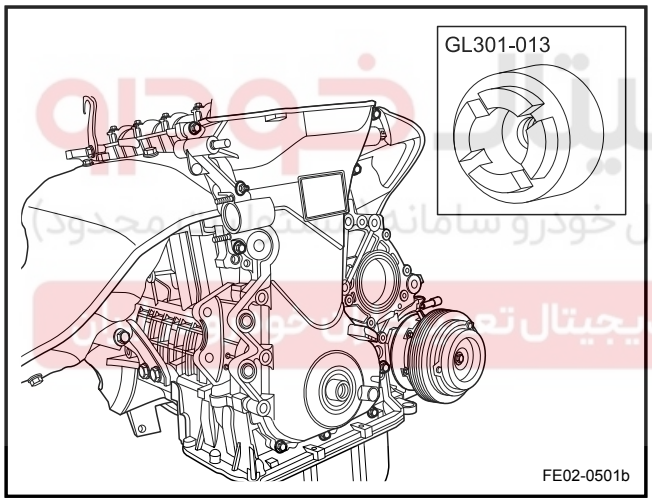


Removal Procedure:

1. Remove the crankshaft belt plate. Refer to 2.6.8.9 Timing Chain Cover Replacement.
2. Remove the crankshaft front oil seals.

   Note

   Be careful not to damage the crankshaft journal.

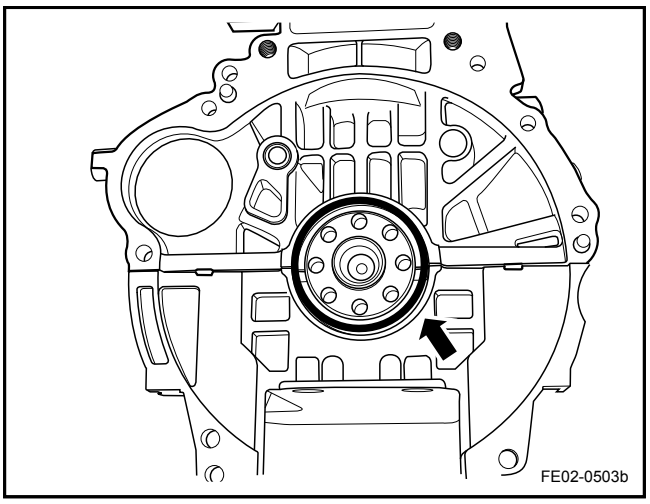


Installation Procedure:

1. Use a special tool GL301-013 to install the crankshaft front oil seals.
2. Install the crankshaft belt plate.

2.6.8.22 Crankshaft Rear Oil Seal Replacement

Removal Procedure:

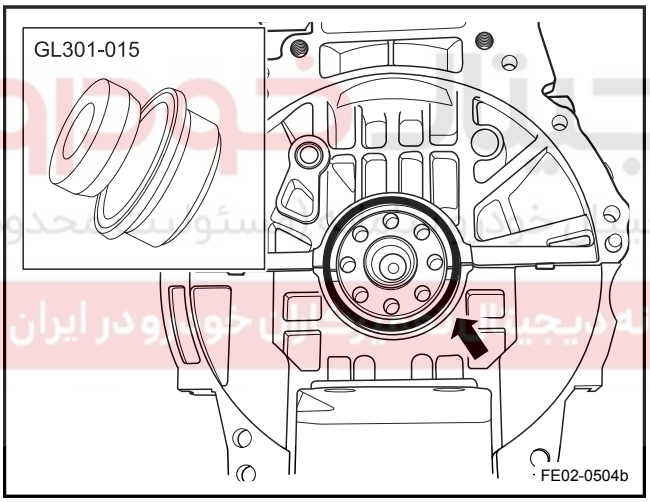


1. Remove the flywheel. Refer to 2.6.8.17 Flywheel Replacement.
2. Remove the crankshaft rear oil seals.

   Note

   Be careful not to damage the crankshaft journal.

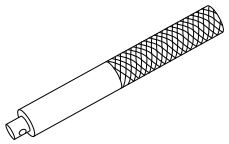
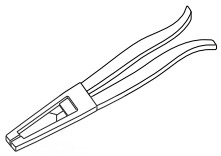
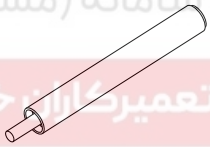
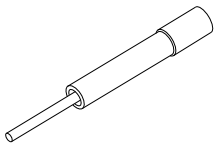
Installation Procedure:

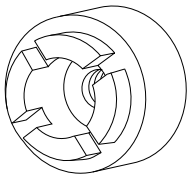
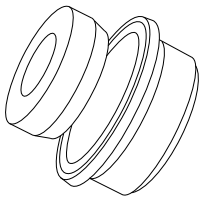
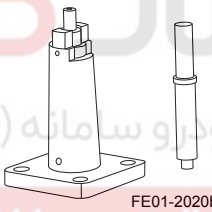
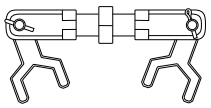
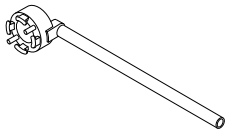


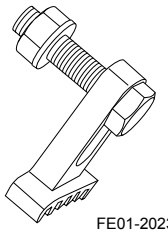
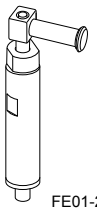
1. Use a special tool GL301-015 to install the crankcase rear oil seals.
2. Install the flywheel.

2.6.9 Special Tools and Equipment

2.6.9.1 Special Tools List

Serial Number	Illustration	Tool Number	Description
1	 FE01-2014b	GT301-002	Seal Handle
2	 FE01-2015b	GT301-006	Valve Oil Seal Removal Tool
3	 FE01-2016b	GT301-008	Valve Seal Installation Tool
4	 FE01-2017b	GT301-009	Valve Guide Removal Tool

Serial Number	Illustration	Tool Number	Description
5	 FE01-2018b	GT301-013	Crankshaft Front Oil Seal Installation Tool
6	 FE01-2019b	GT301-015	Crankshaft Rear Oil Seal Installation Tool
7	 FE01-2020b	GT301-016	Piston Pin Removal Tool
8	 FE01-2022b	GT301-018	Camshaft Locking Tool
9	 FE01-2029b	GT301-020	Crankshaft Drive Belt Locking Tool

Serial Number	Illustration	Tool Number	Description
10	 FE01-2023b	GT301-021	Flywheel Locking Tool
11	 FE01-2024b	GT301-022	Timing Chain Locking Tool