

E4T15B ENGINE MECHANICAL

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دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



GENERAL INFORMATION

Description

1.5 L SQRE4G15B engine has following features:

- Water cooled vertical
- In-line DOHC with 4 cylinders
- Four valves per cylinder
- Dual Variable Valve Timing (DVVT)
- Variable Intake System (VIS)
- Aluminum cylinder head
- Cast iron cylinder block
- Aluminum crankshaft frame

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- Aluminum cylinder head
- Cast iron cylinder block
- Aluminum crankshaft frame
- Turbocharged water-cooled

07

Operation

1.5 L SQRE4G15B engine has DOHC and 4 valves per cylinder. 1.5 L SQRE4G15B engine uses group coil ignition system and a cast iron cylinder block. Bearing caps are integrated with crankshaft frame assembly. Aluminum oil pan is fixed to the bottom of crankshaft frame with bolts. Camshafts are installed in cylinder head and interact with hydraulic lifters to open and close valves. Camshafts are driven by a timing chain, which is driven by sprockets on crankshaft. Piston assembly is an aluminum piston with cast iron connecting rod.

Aluminum cylinder head has DOHC with 4 valves per cylinder. Valves are 2 banks in-line. Cylinder head includes valve guides and valve seats. Cylinder head is held on cylinder block with multilayer steel cylinder head gasket and fixing bolts.

SQRE4T15BB engine adopts design of vertical, in-line 4-cylinder, water-cooled, 4-stroke, 4 valves per cylinder, DOHC, turbocharged water-cooled, VVT and electronic controlled sequential multiport fuel injection. Engine adopts individual ignition.

SQRE4T15BB engine adopts a cast iron cylinder block. Aluminum oil pan is fixed to aluminum frame with bolts. And aluminum cylinder head is fixed to the cylinder block with bolts. Camshaft is installed in cylinder head. Camshaft is driven by timing chain, so the power output from crankshaft passes through crankshaft sprocket, thus the camshaft works together with valve lifter to open and close valve. Piston assembly is an aluminum piston with cast iron connecting rod. This engine has characteristics of reliable construction and excellent performance.

Specifications

SQRE4G15B Engine Specifications

Item	Specifications	
Type	Vertical, in-line 4-cylinder, 16 valves, water-cooled, 4-stroke, DOHC, electronic controlled sequential multiport fuel injection, Variable Valve Timing (VVT), Variable Intake System (VIS)	
Model	SQRE4G15B	
Valve Number Per Cylinder	4	
Cylinder Diameter (mm)	77	
Piston Stroke (mm)	80.5	
Displacement (L)	1.499	
Compression Ratio	11:1	
Combustion Chamber Type	Hemispheric shape	
Fuel Supply Type	Electronic controlled sequential multiport fuel injection	
Ignition Type	Ignite	
Ignition Sequence	1-3-4-2	
Rated Power (kW)	85	
Rated Power Speed (r/min)	6150	
Max. Torque (N·m)	141	
Max. Torque Speed (r/min)	3800	
Min. Fuel Consumption Rate (g/kW·h)	250	
Fuel Octane Number (Not Less Than)	Unleaded gasoline, octane number 93	
Oil Octane Number	In summer	SAE 10W-40 (SM grade or higher)
	In winter	SAE 5W-40 (SM grade or higher)
Oil Capacity (L)	4 ± 0.5	
Crankshaft Rotation Direction	Counterclockwise (viewed from end surface of engine flywheel)	
Starting Type	Electrical starting	
Cooling Type	Forced circulation type antifreeze cooling	
Lubrication Type	Compound type (pressure, splash lubrication)	
Fuel Pressure (bar)	4	
Cylinder Compression Pressure (bar) (180 - 250) r/min	7 - 10	
Oil Pressure (kpa)	Low idling speed (700 ± 50 r/min)	Not less than 70
	Speed (2000 r/min when oil temperature is 90°)	Not less than 250
Thermostat Operation Temperature (°C)	Open Temperature	82
	Full Open Temperature	97

Item	Specifications
Starting Performance	With coolant temperature at -30°C, engine can start smoothly within 8 seconds without taking special measures. Starting test can be performed 3 times consecutively. If it fails to start once, perform starting again after 3 minutes.

SQRE4G15BB Engine Specifications

Item	Specifications	
Type	Vertical, in-line 4-cylinder, 16 valves, water-cooled, 4-stroke, DOHC, electronic controlled sequential multiport fuel injection, Variable Valve Timing (VVT), turbocharged water-cooled	
Model	SQRE4T15BB	
Valve Number Per Cylinder	4	
Cylinder Diameter (mm)	77	
Piston Stroke (mm)	80.5	
Displacement (L)	1.498	
Compression Ratio	9.5:1	
Fuel Supply Type	Electronic controlled sequential multiport fuel injection	
Ignition Type	Ignite	
Ignition Sequence	1-3-4-2	
Rated Power (kW)	108	
Rated Power Speed (r/min)	5500	
Max. Torque (N·m)	210	
Max. Torque Speed (r/min)	1750 - 4000	
Min. Fuel Consumption Rate (g/kW·h)	275	
Fuel Octane Number (Not Less Than)	Unleaded gasoline, octane number 92	
Oil Octane Number	In summer	SAE 10W-40 (SM grade or higher)
	In winter	SAE 5W-40 (SM grade or higher)
Oil Capacity (L)	4.7 ± 0.2	
Crankshaft Rotation Direction	Counterclockwise (viewed from end surface of engine flywheel)	
Starting Type	Electrical starting	
Cooling Type	Forced circulation type antifreeze cooling	
Lubrication Type	Compound type (pressure, splash lubrication)	
Fuel Pressure (bar)	4	
Cylinder Compression Pressure (bar) (180 - 250) r/min	7 - 10	

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Item	Specifications	
Oil Pressure (kpa)	Low idling speed (700 ± 50 r/min)	Not less than 70
	Speed (2000 r/min when oil temperature is 90°)	Not less than 250

SQRE4G15 Engine Mechanical Specifications

Item			Specifications
Camshaft	Cam height (mm)	Intake cam	37.18
		Exhaust cam	37.05
	Camshaft diameter (mm)	Intake cam	$\phi 24_{-0.053}^{-0.040}$
		Exhaust cam	$\phi 24_{-0.053}^{-0.040}$
	Camshaft axial clearance (mm)	Intake cam	0.15 - 0.20
		Exhaust cam	0.15 - 0.20
Cylinder Head	Lower surface flatness (mm)		0.04
	Overall height (mm)		139.4 ± 0.41
	Surface grinding limit (mm)		0.15
	Total grinding amount of cylinder block and cylinder head (mm)		0.20
Valve	Valve head margin thickness (mm)	Intake valve	0.3 ± 0.15
		Exhaust valve	0.3 ± 0.15
	Valve stem diameter (mm)	Intake valve	$\phi 5.98 \pm 0.008$
		Exhaust valve	$\phi 5.96 \pm 0.008$
	Valve face width (mm)	Intake valve	1.158
		Exhaust valve	1.306
	Clearance between valve stem and guide (mm)	Intake valve	0.02
		Exhaust valve	0.04
	Inclination angle (°)	Intake valve	65
		Exhaust valve	68
	Height (mm)	Intake valve	107.998
		Exhaust valve	106.318
Valve Spring	Free height (mm)		47.7
	Operating preload/operating height (mm)		585 ± 25 N/32
Valve Guide	Valve guide length (mm)		38 ± 0.25
	Inner diameter (mm)		$\phi 6.0 \pm 0.015$
	Outer diameter (mm)		$\phi 11_{+0.040}^{+0.051}$
	Depression depth (mm)		16 ± 0.3
	Valve stem protrusion amount (mm)		47.5
Piston	Piston skirt diameter (mm)		$\phi 76.950 \pm 0.009$

Item			Specifications
Piston Ring	Side clearance (mm)	First ring	0.035 - 0.080
		Second ring	0.030 - 0.075
	End gap (mm)	First ring	0.2 - 0.4
		Second ring	0.4 - 0.6
	Height (mm)	First ring	$1_{-0.03}^{+0.01}$
		Second ring	$1.2_{-0.050}^{+0.006}$
		Oil ring	$1.5_{-0.13}^{+0.02}$
Piston Ring Groove	Height (mm)	First ring	$1.2_{+0.05}^{+0.06}$
		Second ring	$1.5_{+0.02}^{+0.04}$
		Oil ring	$1.5_{+0.01}^{+0.03}$
Piston Pin	Diameter (mm)		$\phi 18_{-0.005}^0$
	Length (mm)		$45_{-0.3}^0$
	Piston pin hole diameter (mm)		$\phi 18_{+0.004}^{+0.010}$
Crankshaft	Axial clearance (mm)		0.070 - 0.265
	Radial clearance (mm)		0.021 - 0.060
	Crankshaft main journal	Diameter (mm)	$\phi 54_{-0.016}^0$
		Coaxially (mm)	0.04
		Cylindricity (mm)	0.007
		Roundness (mm)	0.004
	Connecting rod journal	Diameter (mm)	$\phi 46_{-0.016}^0$
		Parallelism to main journal (mm)	0.008
Cylinder Block	Overall height (mm)		$274_{+0.1}^0$
	Bore roundness (mm)		0.008
	Cylindricity (mm)		0.01
	Upper surface flatness (mm)		0.04
	Surface grinding limit (mm)		0.15
	Total grinding amount of cylinder block and cylinder head (mm)		0.20
Connecting Rod	Connecting rod big end hole radial clearance (mm)		0.016 - 0.061
	Big end axial clearance (mm)		0.15 - 0.40

SQRE4T15B Engine Mechanical Specifications

Item			Specifications
Camshaft	Cam height (mm)	Intake cam	37.07 - 37.31
		Exhaust cam	36.94 - 37.18
	Camshaft diameter (it is the same for intake and exhaust camshafts) (mm)	1st journal	33.934 - 33.95
		2nd ~ 5th journal	23.947 - 23.96
	Camshaft axial clearance (mm)	Intake cam	0.15 - 0.20
		Exhaust cam	0.15 - 0.20
Cylinder Head	Lower surface flatness (mm)		0.04
	Overall height (mm)		141.05
	Surface grinding limit (mm)		Never grind
Valve	Valve head margin thickness (mm)	Intake valve	0.68 - 1.1
		Exhaust valve	0.48 - 0.9
	Valve stem diameter (mm)	Intake valve	5.98 ± 0.008
		Exhaust valve	5.96 ± 0.008
	Valve face width (mm)	Intake valve	1.154
		Exhaust valve	1.307
	Clearance between valve stem and guide (mm)	Intake valve	0.012 - 0.043
		Exhaust valve	0.032 - 0.063
	Angle between conical surfaces of valve face	Intake valve	90°
		Exhaust valve	90°
Valve Spring	Height (mm)	Intake valve	107.75 - 108.25
		Exhaust valve	106.07 - 106.57
	Free height (mm)		47.8
	Operating preload/operating height (mm)		229 - 251 N/41
	Inner diameter (mm)		6 - 6.015
Piston	Depression depth (mm)		16 ± 0.3
	Piston skirt diameter (mm)		76.947 - 76.907
Piston Ring	Side clearance (mm)	First ring	0.02 - 0.065
		Second ring	0.02 - 0.06
	End gap (mm)	First ring	0.2 - 0.3
		Second ring	0.3 - 0.5
Piston Pin	Diameter (mm)		17.995 ~ 18
	Length (mm)		$45_{-0.3}^0$
	Piston pin hole diameter (mm)		18.010 - 18.025

Item		Specifications
Crankshaft	Axial clearance (mm)	0.070 - 0.265
	Radial clearance (mm)	0.021 - 0.060
	Crankshaft main journal	Diameter (mm)
		Standard value: 50 Limit value: 49.979
		Coaxially (mm)
		0.05
	Connecting rod journal	Cylindricity (mm)
		0.007
		Roundness (mm)
		0.004
Cylinder Block	Overall height (mm)	274.9
	Bore roundness (mm)	0.008
	Cylindricity (mm)	0.01
	Upper surface flatness (mm)	0.04
	Surface grinding limit (mm)	Never grind
Connecting Rod	Connecting rod big end hole radial clearance (mm)	0.015 - 0.040
	Big end axial clearance (mm)	0.026 - 0.075

Engine Torque Specifications

Description	Torque (N·m)
Ignition Coil Fixing Bolt	8 ± 2
Accessory Drive Belt Tensioner Fixing Bolt	40 ± 5
Idler Pulley Assembly Fixing Bolt	40 ± 5
Cylinder Head Cover Fixing Bolt	1st step: 3 - 5; 2nd step: 8 - 10
Crankshaft Pulley Fixing Bolt	1st step: 90 - 110; 2nd step: $120^\circ \pm 10^\circ$
Clutch Pressure Plate Fixing Bolt	25 ± 2
Flywheel Fixing Bolt	1st step: 25 ± 5 ; 2nd step: $30^\circ \pm 5^\circ$
Water Pump Pulley Fixing Bolt	20 ± 5
Crankshaft Timing Tool Installation Hole Bolt	40 ± 5
Tensioner Assembly Fixing Bolt	9 - 12
Engine Timing Chain Fixing Guide Rail Fixing Bolt	9 - 12
Engine Timing Chain Movable Guide Rail Fixing Bolt	9 - 12
Timing Chain Upper Guide Rail Fixing Bolt	9 - 12
Exhaust Camshaft Phaser Fixing Bolt	105 ± 5
Intake Camshaft Phaser Fixing Bolt	105 ± 5

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Description	Torque (N·m)
Engine Timing Chain Cover Fixing Bolt	Inner hexagon bolt: 20 - 25; Hexagon flange bolt: 40 - 45
Coupling Bolt Between Engine Timing Chain Cover and Oil Pan	20 ± 5
Camshaft Bearing Cap Fixing Bolt	9 ± 1.5
Engine Wire Harness Ground Wire Fixing Bolt	7 ± 1
Intake Camshaft Variable Timing Control Valve Fixing Bolt	8 ± 2
Exhaust Camshaft Variable Timing Control Valve Fixing Bolt	8 ± 2
Intake Camshaft Position Sensor	8 ± 1
Exhaust Camshaft Position Sensor	8 ± 1
Cylinder Head Fixing Bolt	1st step: 40 ± 5; 2nd step: 90° ± 5°; 3rd step: 90° ± 5°
Locking Nut Between Rear Mounting Upper Body Assembly and Rear Mounting Lower Body Assembly	80 ± 5
Rear Mounting Upper Body Assembly Fixing Bolt (for MT Model)	45 ± 5
Rear Mounting Upper Body Assembly Fixing Bolt (for CVT Model)	45 ± 5
Coupling Bolt Between Rear Mounting Lower Body Assembly and Front Sub Frame Welding Assembly	105 ± 5
Coupling Nut Between Left Mounting Cushion Assembly and Left Mounting Bracket	60 ± 5
Coupling Bolt Between Left Mounting Cushion Assembly and Body	60 ± 5
Coupling Nut Between Left Mounting Bracket and Transmission Case (for MT Model)	80 ± 5
Coupling Nut Between Left Mounting Arm and Transmission Case (for CVT Model)	80 ± 5
Coupling Bolt Between Left Mounting Cushion Assembly and Body (for CVT Model)	60 ± 5
Expansion Tank Fixing Bolt	7 ± 1
Coupling Bolt Between Line Bracket and Engine Right Mounting	7 ± 1
Coupling Nut Between Engine Right Mounting Assembly and Engine Timing Chain Cover	70 ± 5
Coupling Bolt Between Engine Right Mounting Assembly and Body	60 ± 5
Coupling Nut Between Shift Cable and Shift Arm (for CVT Model)	18 ± 2

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Description	Torque (N·m)
High Pressure Fluid Pipe Hollow Bolt (Equipped with Hydraulic Power Assist)	45 ± 5
Transmission Ground Wire Fixing Bolt	15 ± 2
Coupling Nut Between Battery Wire Harness and Engine Compartment Fuse and Relay Box	7 ± 1
Engine Wire Harness Ground Wire Fixing Nut	15 ± 2
A/C High/Low Pressure Line Fixing Bolt	25 ± 4
Engine Trim Cover Bracket	8 ± 1
Intake Manifold Fixing Nut	20 ± 5
Oil Dipstick Tube Fixing Bolt	7 ± 1
Knock Sensor Fixing Bolt	20 ± 5
Engine Discharge Pipe Fixing Bolt	7 ± 1
Coolant Pipe Assembly I Fixing Bolt	20 ± 5
Oil Filter Module Fixing Bolt	40 ± 5
Oil Pump Chain Movable Guide Rail Fixing Bolt	9 - 12
Oil Deflector Assembly	8 ± 3
Crankshaft Main Bearing Cap Fixing Bolt	1st step: 45 ± 5; 2nd step: 180° ± 10°
Crankshaft Frame Fixing Bolt	20 ± 3
Connecting Rod Bearing Cap Fixing Bolt	1st step: 15 ± 3; 2nd step: 60° ± 5°

Lubrication Areas during Engine Assembly

Lubrication Area	Note
Piston Pin	SM10W-40
Piston Ring	SM10W-40
Piston	SM10W-40
Cylinder Bore	SM10W-40
Main Bearing Shell and Crankshaft Main Journal	SM10W-40
Crankshaft Thrust Washer (Oil Groove Side)	SM10W-40
Connecting Rod Bearing Cap Bolt Head and Thread	SM10W-40
Connecting Rod Bearing Shell and Crankshaft Connecting Rod Journal	SM10W-40
Main Bearing Cap Bolt Head	SM10W-40
Crankshaft Front Oil Seal Lip and Crankshaft Oil Seal Journal	SM10W-40
Crankshaft Rear Oil Seal Lip and Crankshaft Oil Seal Journal	SM10W-40
Valve Guide Hole	SM10W-40

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Lubrication Area	Note
Valve Stem	SM10W-40
Valve Oil Seal	SM10W-40
Valve Spring	SM10W-40
Camshaft Cam and Journal	SM10W-40
Hydraulic Lifter	SM10W-40
Hydraulic Lifter Hole and Valve Rocker Arm Head	SM10W-40
Valve Seat Hole (Cylinder Head Assembly)	SM10W-40
Valve Guide or Guide Bottom Hole (Cylinder Head)	SM10W-40
Oil Filter Module Gasket Surface	SM10W-40

API SM grade or higher SAE 5W-30 (all year)/10W-40 (for summer), 5W-40 (for winter).

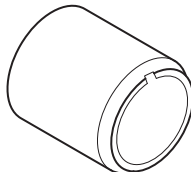
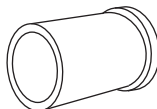
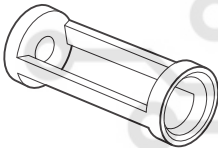
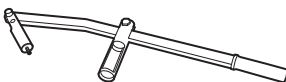
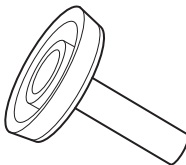
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Areas with Seal Gum Applied during Engine Assembly

Area with Seal Gum Applied	Seal Gum Type
Cylinder Block Bowl Plug	Loctite 747
Cylinder Block Main Oil Passage Plug	Loctite 5910
Contact Surface Between Crankshaft Frame and Cylinder Block	Loctite 518
Crankshaft Frame and Oil Pan	Loctite 5910
Cylinder Head Bowl Plug	Loctite 11747
Cylinder Head Oil Passage Plug	Loctite 577
Coolant Temperature Sensor	Loctite 243
Oil Pressure Sensor	Loctite 577
Oil Deflector Bolt	Loctite 243
Engine Timing Chain Cover	Loctite 5910

Tools

Special Tools

Crankshaft Front Oil Seal Guide Tool	 RCH0000049
Crankshaft Front Oil Seal Installer	 RCH0000067
Valve Spring Compression Adapter	 RCH0000050
Valve Spring Compressor	 RCH0000028
Crankshaft Rear Oil Seal Guide Tool	 RCH0000031

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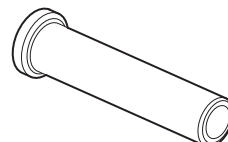
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Crankshaft Rear Oil Seal Installer



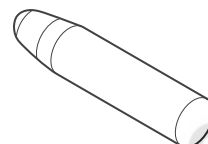
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Valve Oil Seal Installer



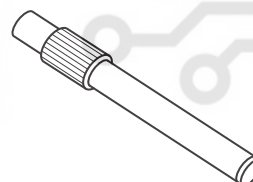
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Valve Oil Seal Guide Sleeve



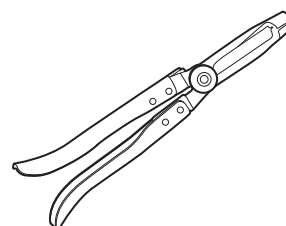
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Clutch Pressure Plate Installer



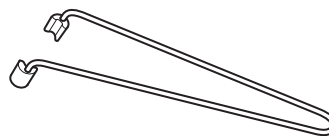
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Valve Oil Seal Remover



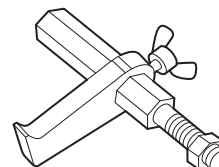
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Valve Cotter Installer



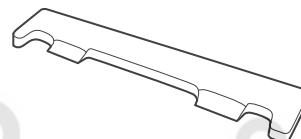
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Flywheel Holding Tool



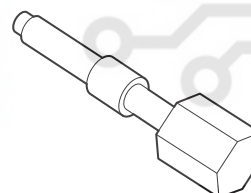
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Camshaft Timing Tool



RCH0000033

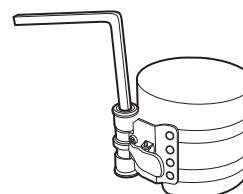
Crankshaft Timing Tool



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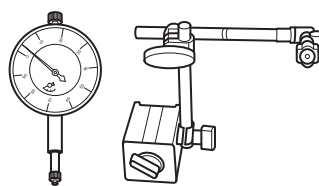
General Tools

Piston Installer



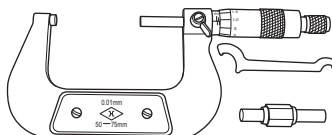
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Dial Indicator and Magnetic Holder



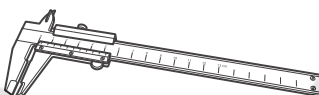
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Outer Diameter Micrometer



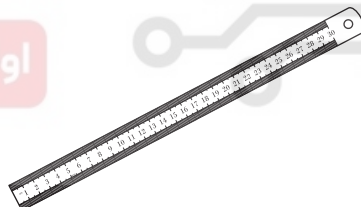
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Vernier Caliper



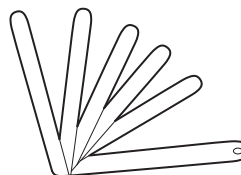
RCH0000019

Precision Straightedge



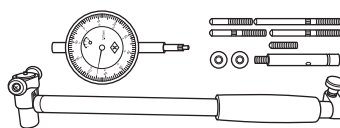
RCH0000063

Feeler Gauge



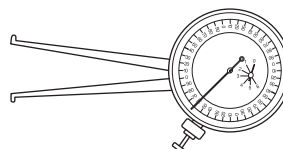
RCH0000060

Cylinder Gauge



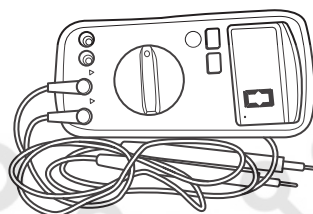
RCH0000065

Caliper Gauge



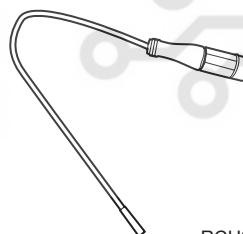
RCH0000069

Digital Multimeter



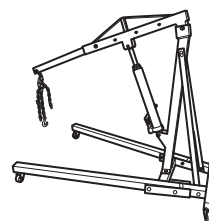
RCH0000002

Flexional Magnetic Rod



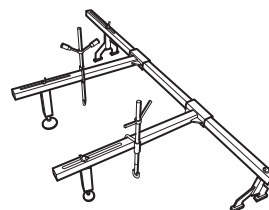
RCH0000042

Engine Hoist



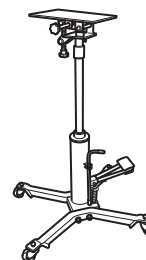
RCH0000043

Engine Equalizer



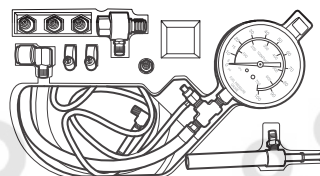
RCH0000026

Transmission Carrier



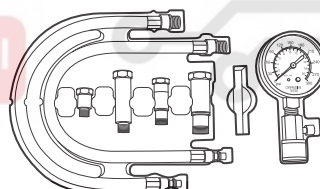
RCH0000005

Fuel System Pressure Tester



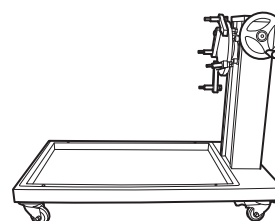
RCH0000048

Cylinder Pressure Gauge



RCH0000044

Engine Service Platform



RCH0000057

DIAGNOSIS & INSPECTION

Engine Performance Diagnosis

Symptom	Suspected Area	See page
Valve mechanism noise	Engine oil (oil level high or low, oil lean or rich)	13-12
	Rocker arm (abnormal worn)	-
	Hydraulic lifter assembly (failure, worn)	-
	Camshaft (bent and deformed, abnormal worn, axial/radial clearance increases)	07-53
	Valve spring seat (excessive runout)	07-58
	Valve (excessive clearance between valve and guide)	07-58
Connecting rod noise	Engine oil (insufficient oil, oil lean and low pressure)	13-12
	Connecting rod bearing cap (loose fixing nut)	07-58
	Connecting rod (misaligned)	07-97
	Connecting rod (bent and deformed)	-
	Connecting rod bearing shell (excessive radial clearance)	07-79
	Connecting rod journal (out-of roundness)	07-79
Main bearing noise	Engine oil (insufficient oil, oil lean and low pressure)	13-12
	Main bearing shell (excessive clearance)	07-79
	Crankshaft axial clearance (excessive)	07-79
	Crankshaft journal (out-of roundness or worn)	07-79
	Flywheel or clutch (loose)	07-41
Oil loss or abnormal carbon deposits in spark plug	Piston ring (worn, scratched or damaged)	07-79
	Piston ring groove (carbon deposited)	07-79
	Valve oil seal (worn or damaged)	07-58
	Valve (excessive clearance between valve and guide)	07-58

Inspection

1. Check the coolant (See page 12-13).
2. Check the engine oil (See page 13-9).
3. Check the battery (See page 16-7).
4. Check the air filter.
 - a. Remove the air filter element.
 - b. Visually check that there is no dirt, blockage or damage in the air filter element.

HINT:

- If there is any dirt or blockage in air filter element, clean it with compressed air.
 - If any dirt or blockage remains, even after cleaning air filter element with compressed air, replace it.
5. Check the spark plugs (See page 14-11).
 6. Test the cylinder compression pressure.
 - Cylinder pressure is the main index to judge engine operation and also can be used to definitely judge whether some system of engine operates well or not. Therefore, it is necessary to perform cylinder pressure measurement when servicing engine.
 - Ensure battery is fully charged and engine starter is in good operating condition. Otherwise, indicated compression pressure used for diagnosis may be invalid.

CAUTION

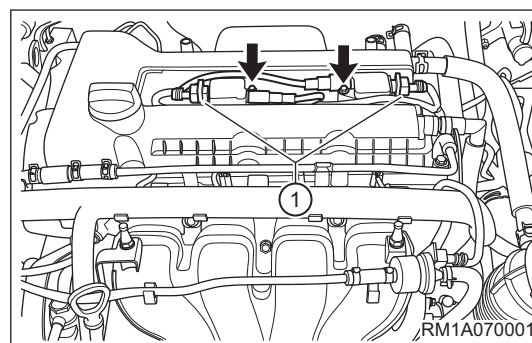
- Recommended compression pressure is only used as a guide for diagnosing engine malfunction.
- Never determine cause of low pressure by disassembling engine unless there are some malfunctions.

Measurement Procedures

CAUTION

- After running engine to normal temperature, use a cylinder pressure gauge with accurate reading and reset it to zero. Otherwise, it will affect accuracy of reading.

- a. Turn off all electrical equipment and the ignition switch.
- b. Remove the engine trim cover.
- c. Remove the ignition coil with high-voltage cable assembly (E4G15).
 - Disconnect ignition coil connectors (1), and move away wire harness from ignition coil.
 - Loosen and remove 2 fixing bolts (arrow) from ignition coil.
(Tightening torque: $8 \pm 2 \text{ N}\cdot\text{m}$)

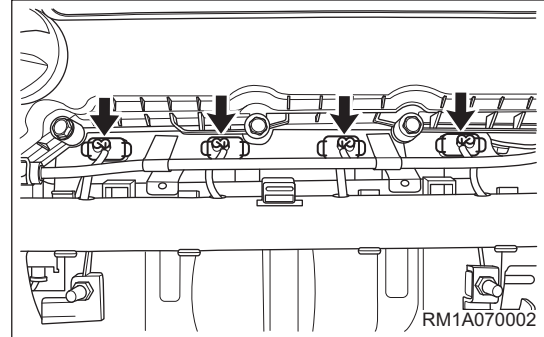


- Remove the ignition coil with high-voltage cable assembly.

CAUTION

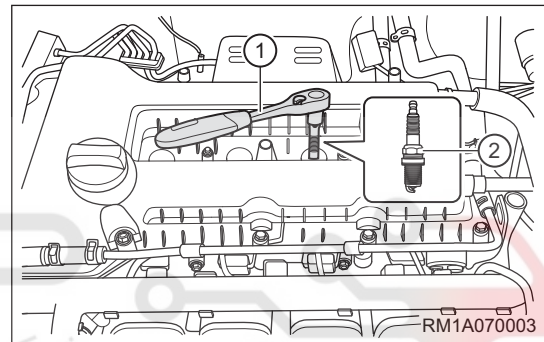
- Be careful not to damage the high-voltage cables when pulling them upward.

d. Disconnect 4 injector connectors (arrow).

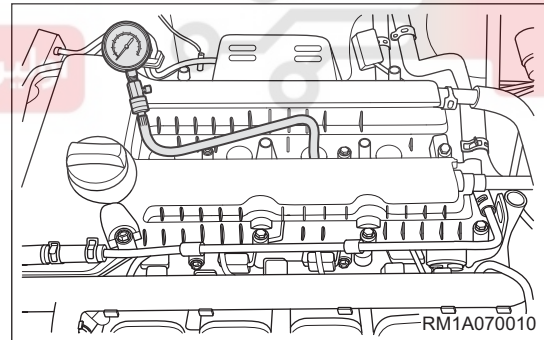


e. Remove the spark plug.

- Using a special spark plug socket wrench (1), loosen spark plug.
- Remove the spark plug (2).

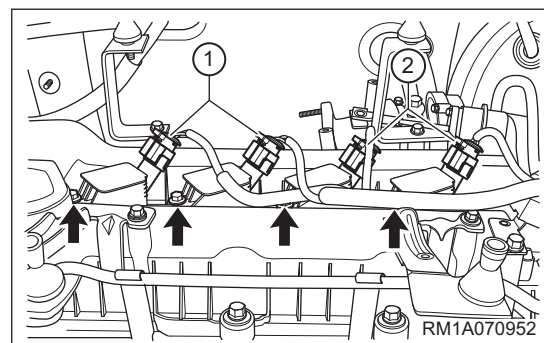


f. Slowly screw the cylinder pressure gauge connector vertically into spark plug hole. Do not tighten it excessively to prevent difficult removal.



g. Remove the ignition coil (for E3T15).

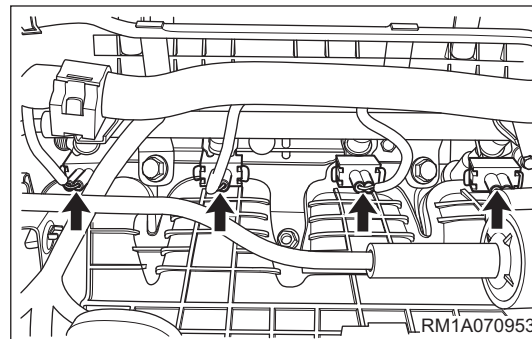
- Disconnect the ignition coil connectors (1) and (2).
- Remove 4 fixing bolts (arrow) from ignition coil. And remove 4 ignition coils. (Tightening torque: $8 \pm 1 \text{ N}\cdot\text{m}$)



CAUTION

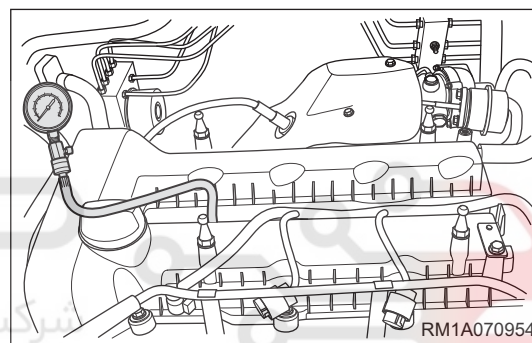
- Be careful not to damage the high-voltage cables when pulling them upward.

h. Disconnect 4 injector connectors (arrow).



07

- Remove the spark plugs (See page 14-11).
- Slowly screw the cylinder pressure gauge connector vertically into spark plug hole. Do not tighten it excessively to prevent difficult removal.

**CAUTION**

- DO NOT screw the cylinder pressure gauge excessively to prevent difficult removal.

- With transmission in neutral position, depress accelerator pedal fully, then start engine and keep it racing for 3 to 5 seconds to measure and record pressure value.
- Press the bleeder button of cylinder pressure gauge to reset it to zero. Repeat this test for three times and then calculate average test value.

Standard value for cylinder pressure: 7 - 10 bar (180 - 250 r/min)

CAUTION

- During measurement, do not turn ignition switch to "START" for more than 10 seconds. Otherwise, engine may be damaged.
- Ensure battery is fully charged when cranking engine. Correct cylinder pressure can be measured only when engine is running at 180 - 250 r/min.
- Use same method to measure pressure of other cylinders.

Cylinder Pressure Value Judgment

- Correct cylinder pressure
 - Standard cylinder pressure value is between 7 and 10 bar and will drop slightly with usage of engine. But lowest value cannot be below 9 bar and pressure difference between each cylinder should not be above 3 bar.
- If cylinder pressure of engine is lower than standard value, it indicates that cylinder pressure is insufficient. Add a small amount of engine oil to cylinder through spark plug hole and perform measurement again.
 - If pressure increases after adding oil, piston ring or cylinder bore may be worn or damaged.
 - If pressure remains low, a valve may be stuck or not properly installed or there is air leakage from cylinder head gasket.

m. Install the spark plug.

CAUTION

- Pay attention to check new spark plug gap first before installing spark plug. Apply an appropriate amount of lubricant to spark plug thread before installing spark plug. Secure spark plug onto socket, and then install spark plug to original place when installing spark plug. DO NOT put spark plug directly from mounting hole, height drop may cause side electrode deformation, thus making gap smaller, spark jump advanced which affects engine harshness. Installation torque: 20 N·m.

07

n. Connect all injector connectors.

o. Install the ignition coil with high-voltage cable assembly.

7. Test the cylinder head gasket.

Cylinder head gasket leakage may be present between adjacent cylinders, between cylinder and adjacent water jacket or from an oil passage to the external of engine.

- Possible indications of cylinder head gasket leakage between adjacent cylinders are as follows:

- Engine power loss
- Engine stall
- Low fuel economy

- Possible indications of cylinder head gasket leakage between cylinder and adjacent water jacket are as follows:

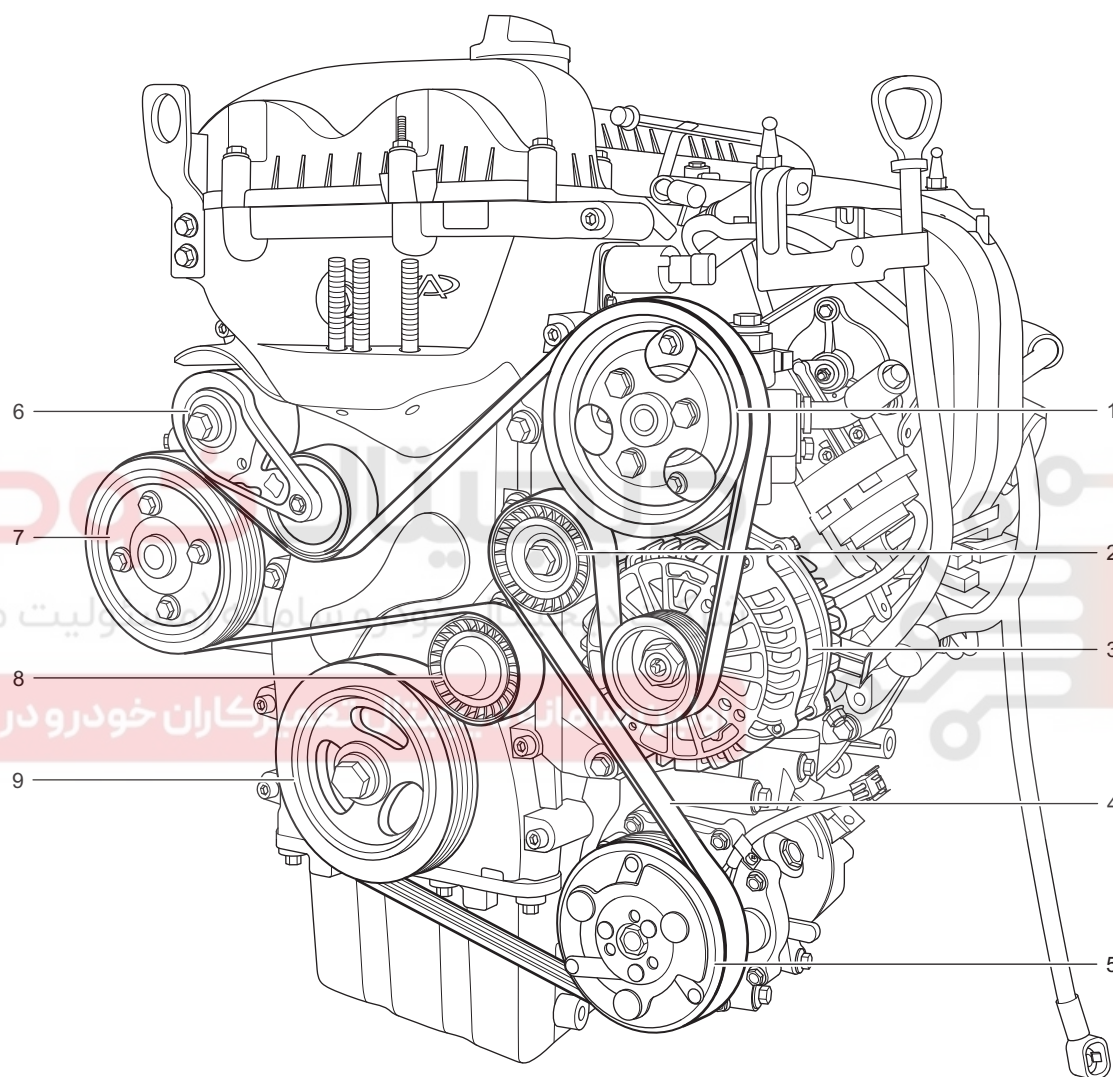
- Engine overheating
- Coolant loss
- Excessive steam (white smoke) emitted from exhaust system
- Coolant foaming

ON-VEHICLE SERVICE

Accessory Drive Belt (E4G15)

Description

07



RM1A070030

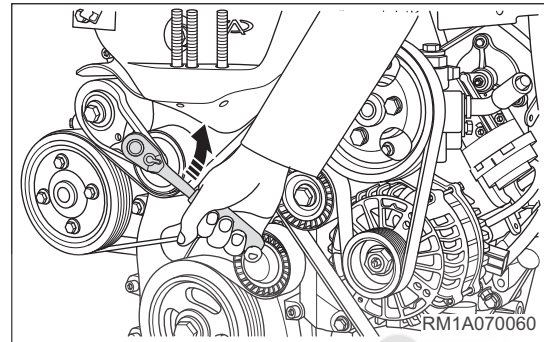
1 - Power Steering Pump Pulley	2 - Upper Idler Pulley
3 - Alternator	4 - Accessory Drive Belt
5 - A/C Compressor Pulley	6 - Belt Tensioner Assembly
7 - Water Pump Pulley	8 - Lower Idler Pulley
9 - Crankshaft Pulley	

Removal

CAUTION

- Be sure to wear necessary safety equipment to prevent accidents when repairing.
- Try to prevent body paint surface from being scratched during removal and installation.

1. Turn off all electrical equipment and the ignition switch.
2. Disconnect the negative battery cable.
3. Remove the engine trim cover.
4. Remove the accessory drive belt.
 - a. Insert head of ratchet wrench into tensioner pin hole, and push in direction of arrow as shown in illustration, so that the tensioner moves upward.



07

WARNING

- Prevent hand from contacting belt tensioner when moving it upward.

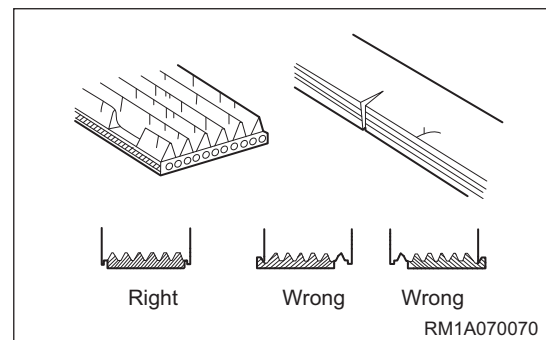
- b. Take out accessory drive belt from idler pulley and loosen ratchet wrench to remove accessory drive belt.

Inspection

1. Check belt surface for pilling, oiliness and deterioration, etc. If any of these defects is found, replace accessory drive belt immediately.
2. Check internal face and edge of belt for damage, wear, foreign matter and cracks, etc. If any of these defects is found, replace accessory drive belt.

HINT:

- Cracks on rib side of accessory drive belt are considered acceptable. If accessory drive belt has chunks missing from ribs, it should be replaced.
- After installing accessory drive belt, check that it fits properly in the ribbed grooves. Check that belt has not slipped out of grooves on bottom of crankshaft pulley by hand.



Installation

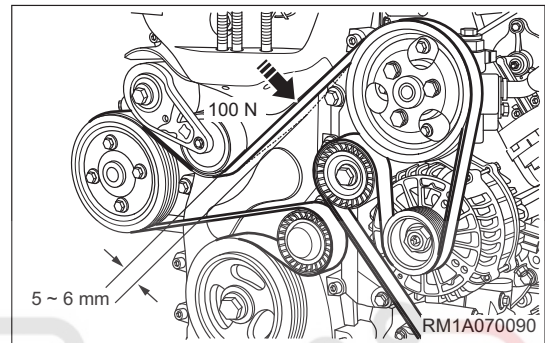
Installation is in the reverse order of removal.

CAUTION

- Before installation, remove oil and foreign matter from accessory drive belt.
- Rotate crankshaft for 2 turns after installation of accessory drive belt, making sure accessory drive belt is installed in place and does not contact with other objects.

Adjustment

1. Check tension of accessory drive belt.
 - a. Rotate crankshaft pulley for 2 turns, making sure belt tension between each pulley is even.
 - b. Apply a force of 100 N to center part of belt between power steering pump pulley and tensioner pulley with your thumb. Check that displacement of belt is within 5 - 6 mm. If displacement is too large or too small, adjust, check or repair.



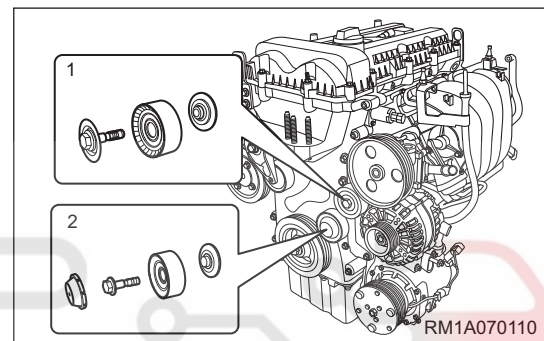
Idler Pulley Assembly (E4G15)

Removal

CAUTION

- Be sure to wear necessary safety equipment to prevent accidents when repairing.
- Try to prevent body paint surface from being scratched during removal and installation.

1. Turn off all electrical equipment and the ignition switch.
2. Disconnect the negative battery cable.
3. Remove the engine trim cover.
4. Remove the engine lower protector (See page 49-20).
5. Move away the accessory drive belt (See page 07-24).
6. Remove the idler pulley assembly.
 - a. Remove fixing bolt from upper idler pulley assembly (1), and remove upper idler pulley and washer. (Tightening torque: 40 ± 5 N·m)
 - b. Remove protector from lower idler pulley assembly (2).
 - c. Remove fixing bolt from lower idler pulley assembly, and remove lower idler pulley and washer.



07

Inspection

1. Rotate idler pulley by hands and check if rotation is smooth and if abnormal noise occurs.
2. Wiggle idler pulley in axial and radial directions to check bearing for looseness.
3. Check if there is damage on idler pulley assembly operating surface.

Installation

Installation is in the reverse order of removal.

CAUTION

- After installation, turn crankshaft with a wrench to run accessory drive belt several circles, and check if crankshaft turns smoothly and belt runs well. If it does not turn smoothly, reinstall accessory drive belt.
- Make sure to correctly install accessory drive belt, and it does not interfere with other components.

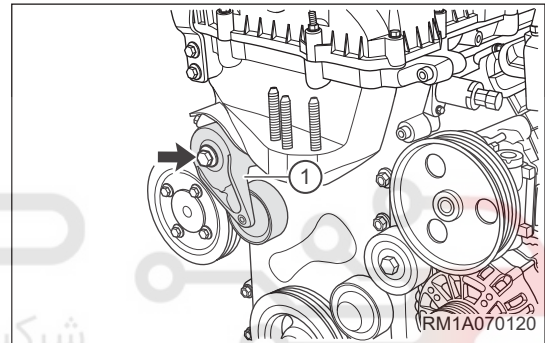
Belt Tensioner Assembly

Removal

CAUTION

- Be sure to wear necessary safety equipment to prevent accidents when repairing.
- Try to prevent body paint surface from being scratched during removal and installation.

1. Turn off all electrical equipment and the ignition switch.
2. Disconnect the negative battery cable.
3. Remove the engine trim cover.
4. Remove the engine lower protector (See page 49-20).
5. Move away the accessory drive belt (See page 07-24).
6. Remove the belt tensioner assembly.
 - a. Remove fixing bolt (arrow) from belt tensioner assembly, and remove belt tensioner assembly (1).
(Tightening torque: 40 ± 5 N·m)



Inspection

1. Rotate belt tensioner assembly by hands and check if rotation is smooth and if abnormal noise occurs.
2. Wiggle belt tensioner assembly in axial and radial directions to check bearing for looseness.
3. Check if there is damage on belt tensioner assembly operating surface.

Installation

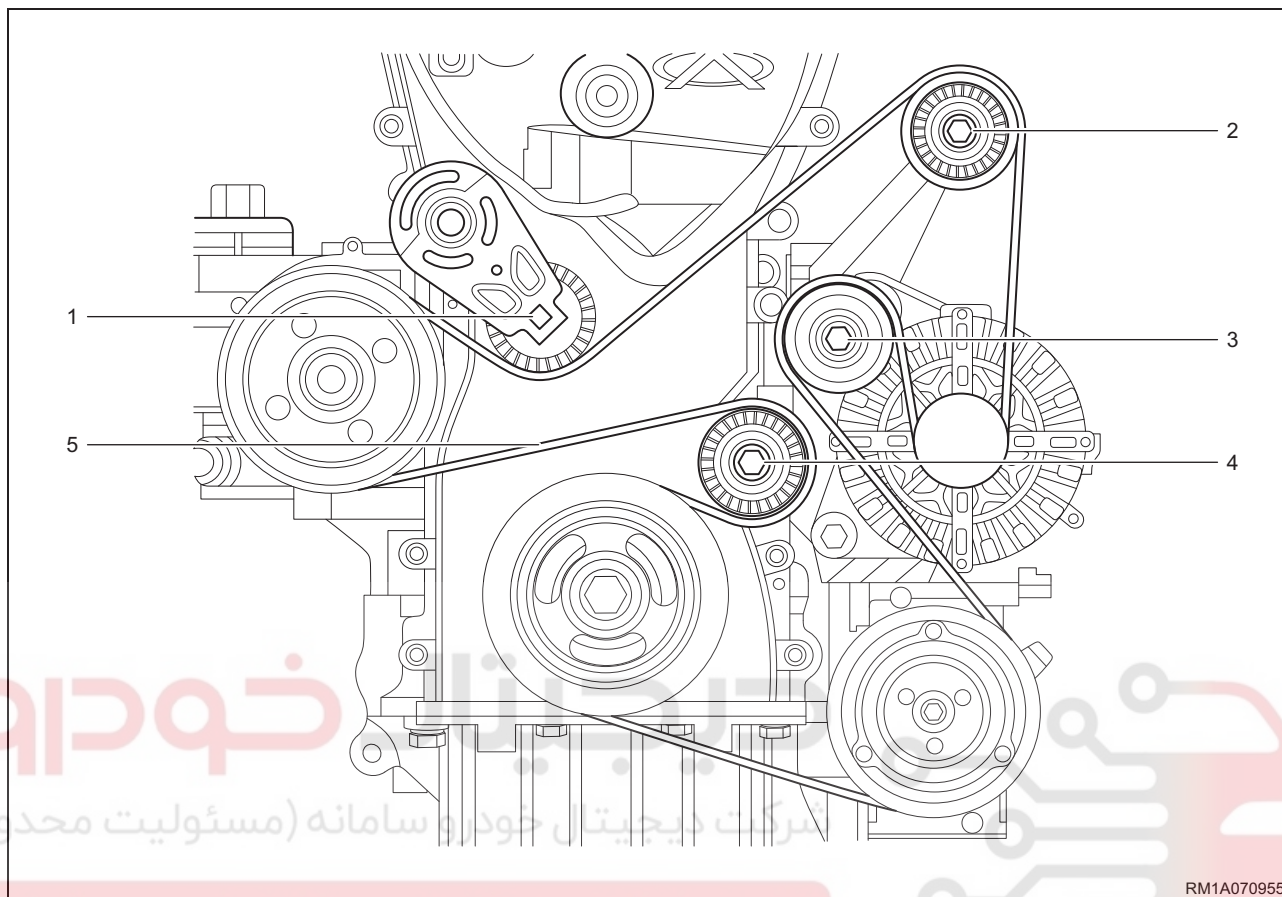
Installation is in the reverse order of removal.

CAUTION

- After installation, turn crankshaft with a wrench to run accessory drive belt several circles, and check if crankshaft turns smoothly and belt runs well. If it does not turn smoothly, reinstall accessory drive belt.
- Make sure to correctly install accessory drive belt, and it does not interfere with other components.

Accessory Drive Belt (E4T15B)

Description



07

RM1A070955

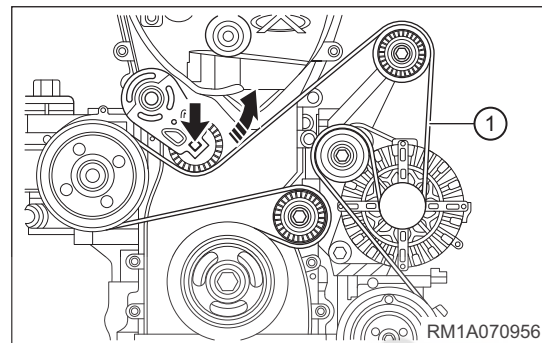
1 - Tensioner Assembly	2 - Idler Pulley Assembly
3 - Idler Pulley Assembly	4 - Idler Pulley Assembly
5 - Accessory Drive Belt	

Removal

CAUTION

- Be sure to wear necessary safety equipment to prevent accidents when repairing.
- Try to prevent body paint surface from being scratched during removal and installation.

1. Turn off all electrical equipment and the ignition switch.
2. Disconnect the negative battery cable.
3. Remove the engine trim cover.
4. Remove the accessory drive belt.
 - a. Insert head of ratchet wrench into tensioner pin hole, and push in direction of arrow as shown in illustration, so that the tensioner moves upward.



WARNING

- Prevent hand from contacting belt tensioner when moving it upward.

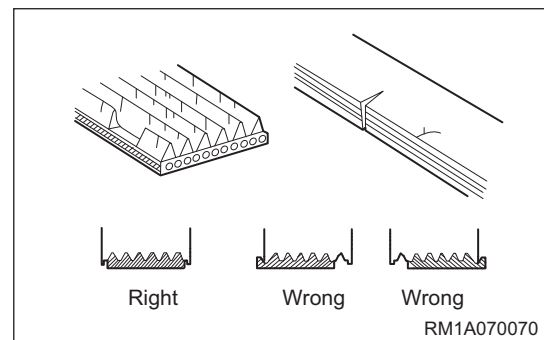
- b. Take out accessory drive belt (1) from idler pulley and loosen ratchet wrench to remove accessory drive belt.

Inspection

1. Check belt surface for pilling, oiliness and deterioration, etc. If any of these defects is found, replace accessory drive belt immediately.
2. Check internal face and edge of belt for damage, wear, foreign matter and cracks, etc. If any of these defects is found, replace accessory drive belt.

HINT:

- Cracks on rib side of accessory drive belt are considered acceptable. If accessory drive belt has chunks missing from ribs, it should be replaced.
- After installing accessory drive belt, check that it fits properly in the ribbed grooves. Check that belt has not slipped out of grooves on bottom of crankshaft pulley by hand.



Installation

Installation is in the reverse order of removal.

CAUTION

- Before installation, remove oil and foreign matter from accessory drive belt.
- Rotate crankshaft for 2 turns after installation of accessory drive belt, making sure accessory drive belt is installed in place and does not contact with other objects.

دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



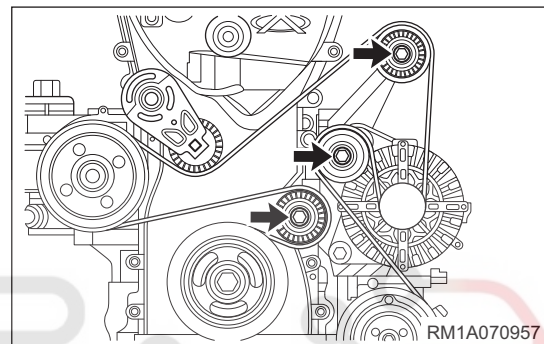
Idler Pulley Assembly (E4T15B)

Removal

CAUTION

- Be sure to wear necessary safety equipment to prevent accidents when repairing.
- Try to prevent body paint surface from being scratched during removal and installation.

1. Turn off all electrical equipment and the ignition switch.
2. Disconnect the negative battery cable.
3. Remove the engine trim cover.
4. Move away the accessory drive belt (See page 07-24).
5. Remove the idler pulley assembly.
 - a. Remove 3 fixing bolts (arrow) from idler pulley assembly.
(Tightening torque: 50 + 5 N·m)
 - b. Remove the idler pulley assembly.



Inspection

1. Rotate idler pulley by hands and check if rotation is smooth and if abnormal noise occurs.
2. Wiggle idler pulley in axial and radial directions to check bearing for looseness.
3. Check if there is damage on idler pulley assembly operating surface.

Installation

Installation is in the reverse order of removal.

CAUTION

- After installation, turn crankshaft with a wrench to run accessory drive belt several circles, and check if crankshaft turns smoothly and belt runs well. If it does not turn smoothly, reinstall accessory drive belt.
- Make sure to correctly install accessory drive belt, and it does not interfere with other components.

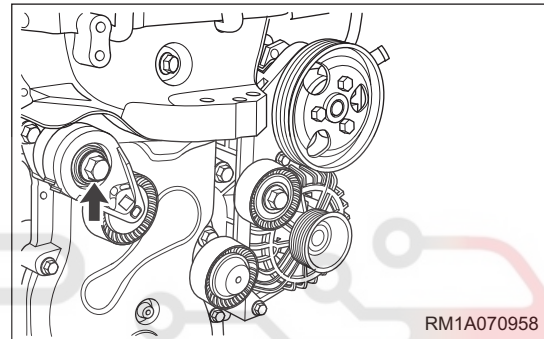
Belt Tensioner Assembly

Removal

CAUTION

- Be sure to wear necessary safety equipment to prevent accidents when repairing.
- Try to prevent body paint surface from being scratched during removal and installation.

1. Turn off all electrical equipment and the ignition switch.
2. Disconnect the negative battery cable.
3. Remove the engine trim cover.
4. Move away the accessory drive belt (See page 07-24).
5. Remove the belt tensioner assembly.
 - a. Remove the tensioner assembly fixing bolt (arrow).
(Tightening torque: 50 + 5 N·m)
 - b. Remove the tensioner assembly.



07

Inspection

1. Rotate belt tensioner pulley assembly by hands and check if rotation is smooth and if abnormal noise occurs.
2. Wiggle belt tensioner pulley assembly in axial and radial directions to check for looseness.
3. Check if there is damage on belt tensioner pulley assembly operating surface.

Installation

Installation is in the reverse order of removal.

CAUTION

- After installation, turn crankshaft with a wrench to run accessory drive belt several circles, and check if crankshaft turns smoothly and belt runs well. If it does not turn smoothly, reinstall accessory drive belt.
- Make sure to correctly install accessory drive belt, and it does not interfere with other components.

Cylinder Head Cover (E4G15)

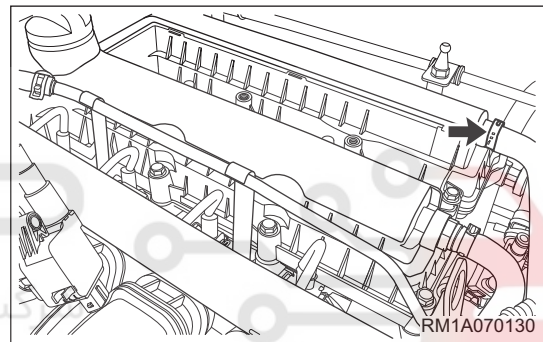
Removal

CAUTION

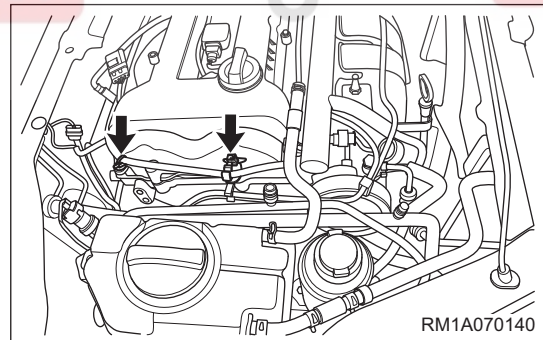
- Blow dirt and debris away from upper surface of cylinder head cover with compressed air before removing cylinder head cover.
- Be sure to wear necessary safety equipment to prevent accidents when repairing.
- Try to prevent body paint surface from being scratched during removal and installation.

07

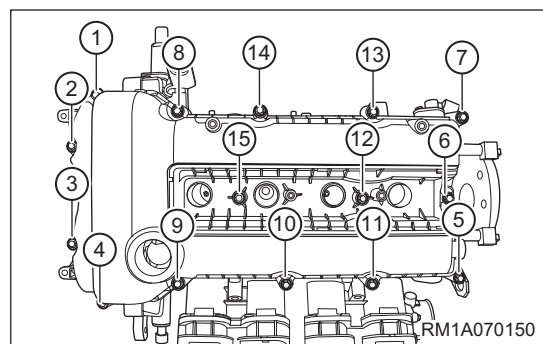
1. Turn off all electrical equipment and the ignition switch.
2. Disconnect the negative battery cable.
3. Remove the engine trim cover.
4. Remove the ignition coils and high-voltage cables (See page 14-8).
5. Remove the cylinder head cover.
 - a. Loosen clamp (arrow) and disconnect connection between crankcase ventilation hose and cylinder head cover.



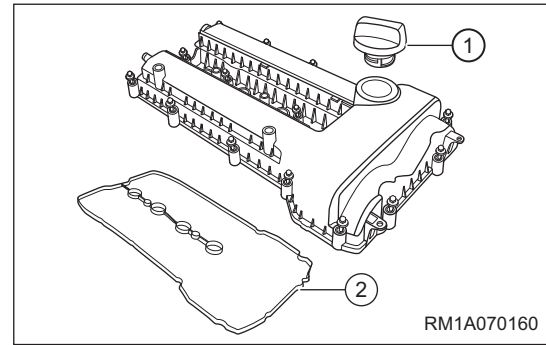
- b. Remove the PCV valve hose (See page 09-11).
- c. Remove the engine wire harness fixing clips (arrow).



- d. Remove 15 fixing bolts from cylinder head cover in order shown in illustration.

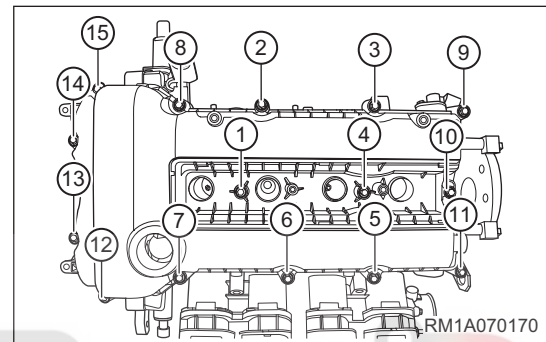


- e. Remove cylinder head cover from cylinder head.
6. Remove oil filler cap (1) and cylinder head cover gasket (2) from cylinder head cover.



Installation

1. Tighten 15 fixing bolts of cylinder head cover in order shown in illustration.
(Tightening torque: 1st step: tighten to 3 - 5 N·m; 2nd step: retighten to 8 - 10 N·m)



07

2. Other installation procedures are in the reverse order of removal.

شرکت دیجیتال خودرو (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران

Cylinder Head Cover (E4T15B)

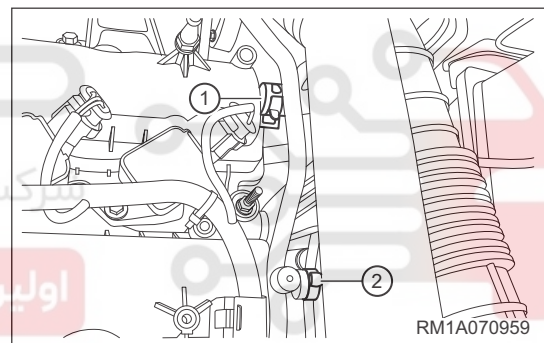
Removal

CAUTION

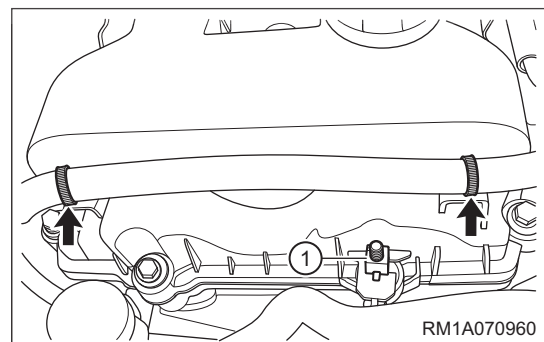
- Blow dirt and debris away from upper surface of cylinder head cover with compressed air before removing cylinder head cover.
- Be sure to wear necessary safety equipment to prevent accidents when repairing.
- Try to prevent body paint surface from being scratched during removal and installation.

07

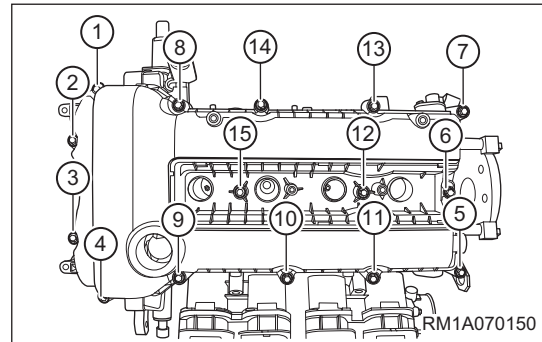
1. Turn off all electrical equipment and the ignition switch.
2. Disconnect the negative battery cable.
3. Remove the engine trim cover.
4. Remove the ignition coil (See page 14-8).
5. Drain the coolant (See page 12-13).
6. Remove the turbocharger water outlet pipe set (See page 11-20).
7. Remove the discharge pipe (See page 12-28).
8. Remove the cylinder head cover.
 - a. Loosen clamping ring (2) and elastic clamp (1), disconnect connection between crankcase ventilation hose and cylinder head cover.



- b. Remove the oil pipe fixing clamp (1).
- c. Remove engine wire harness fixing clips (arrow) from cylinder head cover.

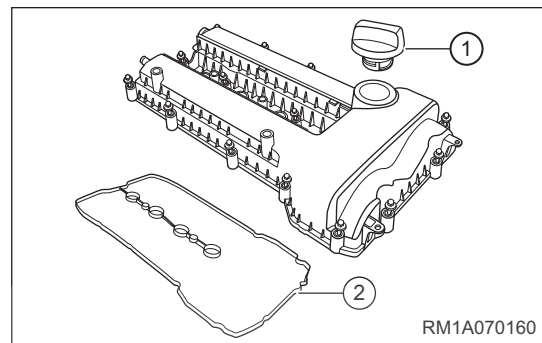


- d. Remove 15 fixing bolts from cylinder head cover in order shown in illustration.



- e. Remove cylinder head cover from cylinder head.

9. Remove oil filler cap (1) and cylinder head cover gasket (2) from cylinder head cover.



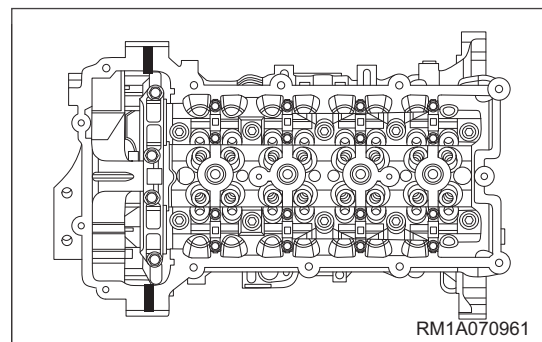
07

Installation

CAUTION

- Remove oil and seal gum on cylinder head cover and cylinder head before installation.
- Check if gasket is damaged or loses elasticity, if so, replace it.

1. Install the cylinder head cover assembly.
- a. As shown in illustration, apply seal gum to timing chain cover and T type part of cylinder head.



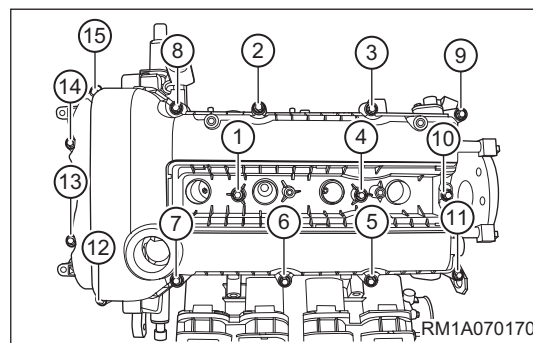
CAUTION

- Pay attention that seal gum should not be applied too thick, to prevent excessive seal gum entering into inside of engine when press fitting the cylinder head cover.
- Install cylinder head cover assembly 15 minutes elapse after applying seal gum.

- b. Install cylinder head cover and manually install bolts to 1 to 2 threads.

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- c. Tighten 15 fixing bolts on cylinder head cover in order shown in illustration.
(Tightening torque: 1st step: tighten to 3 - 5 N·m; 2nd step: retighten to 8 - 11 N·m)



2. Other installation procedures are in the reverse order of removal.

دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

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Crankshaft Front Oil Seal

Removal

CAUTION

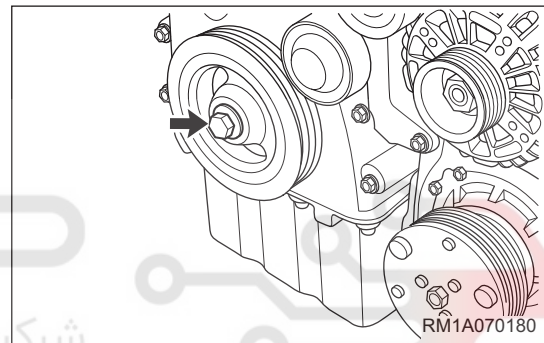
- Be sure to wear necessary safety equipment to prevent accidents when repairing.
- Try to prevent body paint surface from being scratched during removal and installation.

1. Turn off all electrical equipment and the ignition switch.
2. Disconnect the negative battery cable.
3. Remove the engine trim cover.
4. Remove the engine lower protector assembly (See page 49-20).
5. Remove the accessory drive belt (See page 07-24).
6. Remove the crankshaft front oil seal.

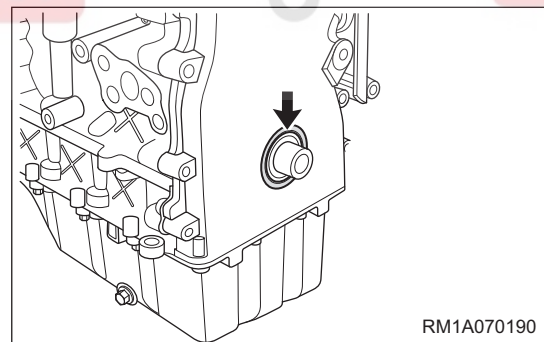
- a. Remove the crankshaft pulley fixing bolt (arrow).
(Tightening torque: 1st step: tighten to 100 ± 10 N·m;
2nd step: retighten by $120^\circ \pm 10^\circ$)

HINT:

Shift transmission into 5th gear (for MT model) or D (for CVT model) when loosening crankshaft timing gear fixing bolt to engage crankshaft and propeller shaft. Another technician depresses brake pedal, which can lock the crankshaft by mechanical gear train.



- b. Remove the crankshaft pulley.
- c. Using a flat tip screwdriver with tip wrapped with tape, carefully pry out crankshaft front oil seal (arrow).



CAUTION

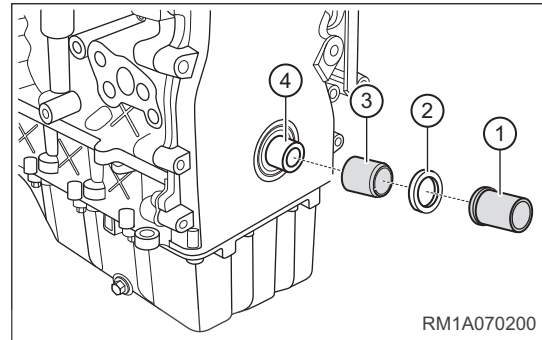
- Be careful not to damage oil seal retainer and surface of crankshaft, when removing crankshaft front oil seal.

Installation

CAUTION

- Apply a coat of engine oil to the crankshaft front oil seal guide tool before installing a new oil seal.
- Remove dirt on junction surface and apply a coat of engine oil to junction surface and oil seal lip (except the oil seal with surface applied wax) before assembly. Be sure to prevent the lip of crankshaft front oil seal from being scratched during installation. If it is damaged, replace immediately.

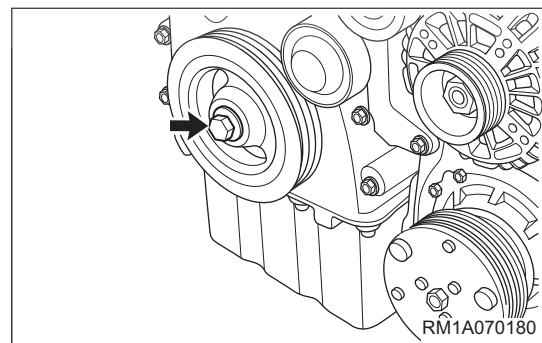
1. Remove the dirt around crankshaft front oil seal retainer and on its inner wall.
2. Install crankshaft front oil seal guide tool (3) to crankshaft (4).
3. Install new oil seal (2) to crankshaft front oil seal guide tool, then install new oil seal fully into oil seal retainer with a crankshaft front oil seal installer (1).



CAUTION

- Press oil seal in place by pressing installer around oil seal, making sure oil seal surface is 0 to 1.0 mm lower than front cover.
- Make sure that the oil seal lip is not damaged during assembly.
- Tilting for 5° or more or squeezing and trimming of oil seal outer retainer rubber are not allowed during assembly of oil seal.

4. Tighten the crankshaft pulley fixing bolt (arrow).
(Tightening torque: 1st step: tighten to 100 ± 10 N·m; 2nd step: retighten by $120^\circ \pm 10^\circ$)



5. Other installation procedures are in the reverse order of removal.

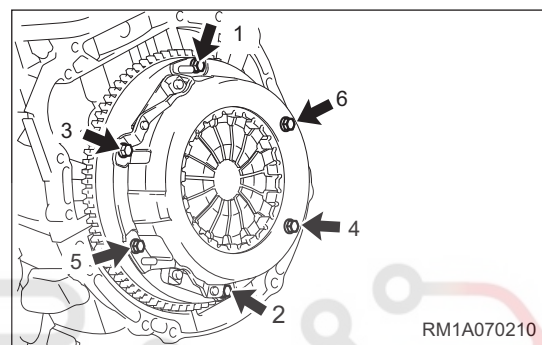
Flywheel

Removal

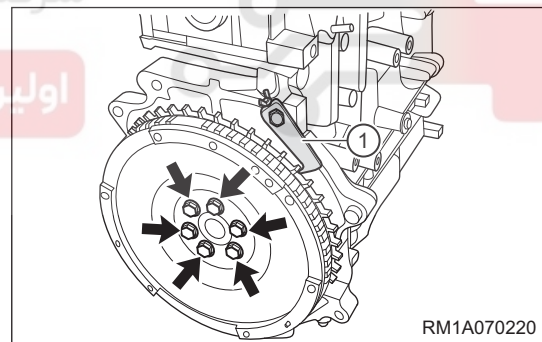
CAUTION

- Be sure to wear necessary safety equipment to prevent accidents when repairing.
- Try to prevent body paint surface from being scratched during removal and installation.

1. Turn off all electrical equipment and the ignition switch.
2. Disconnect the negative battery cable.
3. Remove the transmission assembly (See page 17-19 for MT model, See page 18-124 for CVT model).
4. Remove the clutch assembly.
 - a. Remove 6 fixing bolts from clutch pressure plate in order shown in illustration, and remove the clutch pressure plate.
(Tightening torque: 25 ± 2 N·m)



5. Remove the flywheel.
 - a. As shown in illustration, install flywheel holding tool (1) to hold the flywheel securely.
 - b. Remove 6 fixing bolts (arrow) from flywheel and remove flywheel.
(Tightening torque: 1st step: tighten to 25 ± 5 N·m; 2nd step: retighten by $30^\circ \pm 5^\circ$)



WARNING

- Pay special attention to safety during operation, do not remove all flywheel fixing bolts without any auxiliary measures. If necessary, other operators will be required to assist.

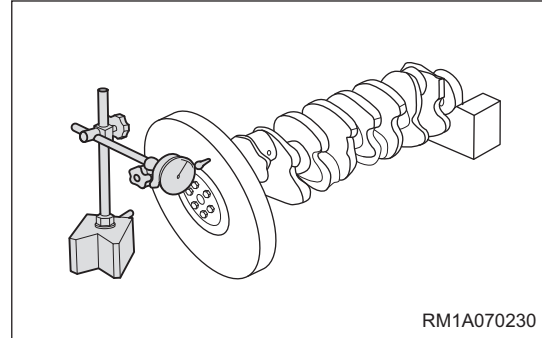
CAUTION

- Flywheel fixing bolts must be disposed after removal. Never reuse them.

Inspection

1. Check if crankshaft position signal gear is distorted or deformed. If damaged, replace flywheel. Clean signal gear before installation.
2. Check if starter drive gear ring is worn. If excessively worn, replace flywheel.
3. Check contact surface of clutch lining. If contact surface is damaged or excessively worn, replace flywheel with a new one.
4. Measure flywheel end surface runout with a dial indicator. If measured value exceeds the limit, replace flywheel with a new one.

Limit for end surface runout: 0.2 mm



RM1A070230

07

Installation

⚠ WARNING

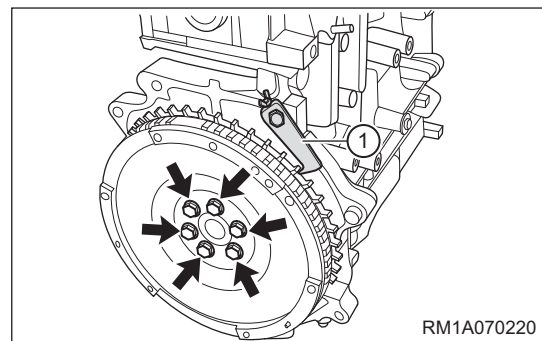
- Never reuse flywheel fixing bolts after removal.
- Make sure to apply seal gum to new flywheel fixing bolts before installation.

👁 CAUTION

- Six bolt holes on the flywheel have asymmetrical positions. There are matchmark holes on flywheel. Mark hole is located right above when 1st cylinder of engine is at top dead center and flywheel fixing bolts are aligned with bolt holes on crankshaft.

Installation procedures are in the reverse order of removal, and pay attention to the following:

1. Align flywheel installation hole with crankshaft positioning journal and then lightly push flywheel onto journal. DO NOT tap flywheel with a hammer.
2. Replace flywheel fixing bolts with new ones and apply seal gum to bolt threads.
3. Install flywheel fixing bolts (arrow), and then hold flywheel securely with flywheel holding tool (1). Tighten the flywheel fixing bolts.
(Tightening torque: 1st step: tighten to $25 \pm 5 \text{ N}\cdot\text{m}$; 2nd step: retighten by $30^\circ \pm 5^\circ$)



RM1A070220

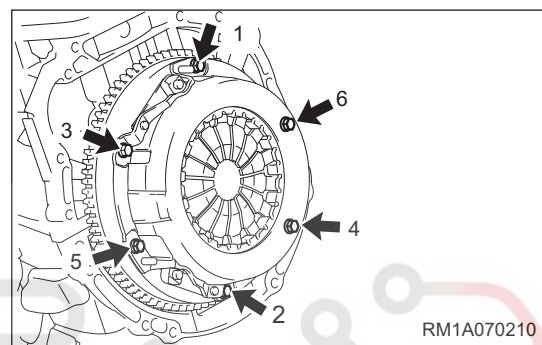
Crankshaft Rear Oil Seal

Removal

CAUTION

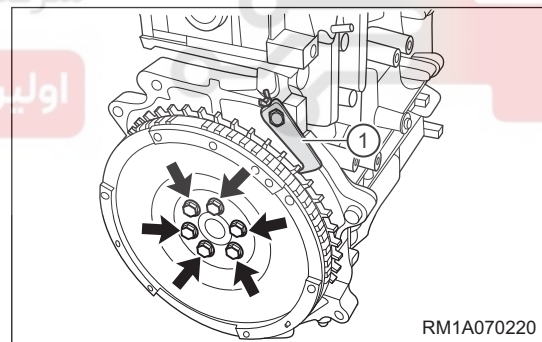
- Be sure to wear necessary safety equipment to prevent accidents when repairing.
- Try to prevent body paint surface from being scratched during removal and installation.

1. Turn off all electrical equipment and the ignition switch.
2. Disconnect the negative battery cable.
3. Remove the transmission assembly (See page 17-19 for MT model, See page 18-124 for CVT model).
4. Remove the clutch assembly.
 - a. Remove 6 fixing bolts from clutch pressure plate in order shown in illustration, and remove the clutch pressure plate.
(Tightening torque: 25 ± 2 N·m)

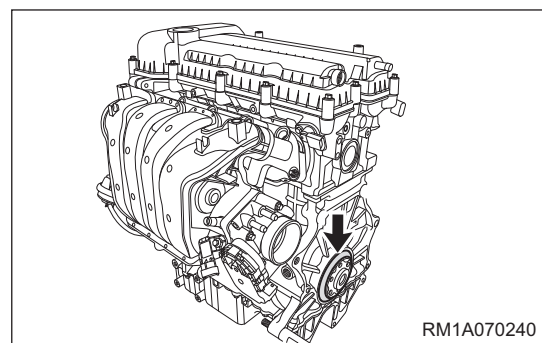


07

5. Remove the flywheel.
 - a. As shown in illustration, install flywheel holding tool (1) to hold the flywheel securely.
 - b. Remove 6 fixing bolts (arrow) from flywheel and remove flywheel.
(Tightening torque: 1st step: tighten to 25 ± 5 N·m; 2nd step: retighten by $30^\circ \pm 5^\circ$)



6. Remove the crankshaft rear oil seal.
 - a. Using a screwdriver with tip wrapped with tape, remove crankshaft rear oil seal (arrow).



CAUTION

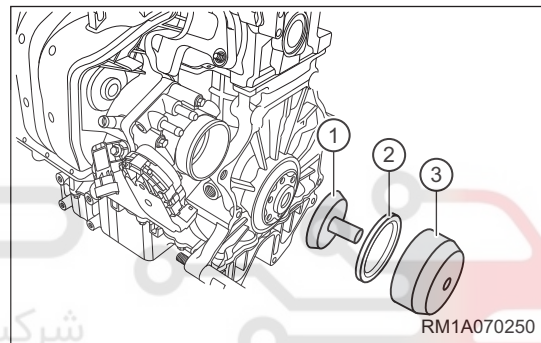
- Be careful not to damage surrounding parts and oil seal retainer, when removing oil seal.

Installation**CAUTION**

- Be sure to clean dirt around oil seal retainer and on inner wall before installation.
- Check oil seal for damage before installation. If there is any damage, replace it.
- Be sure to prevent the lip of crankshaft rear oil seal from being scratched during installation.
- Be careful not to damage oil seal retainer during installation.

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1. Apply a coat of engine oil to crankshaft oil seal retainer and crankshaft rear oil seal lip.
2. Install crankshaft rear oil seal guide tool (1) to crankshaft.
3. Install new crankshaft rear oil seal (2) to crankshaft rear oil seal guide tool, then install new oil seal fully into oil seal retainer with a crankshaft rear oil seal installer (3).

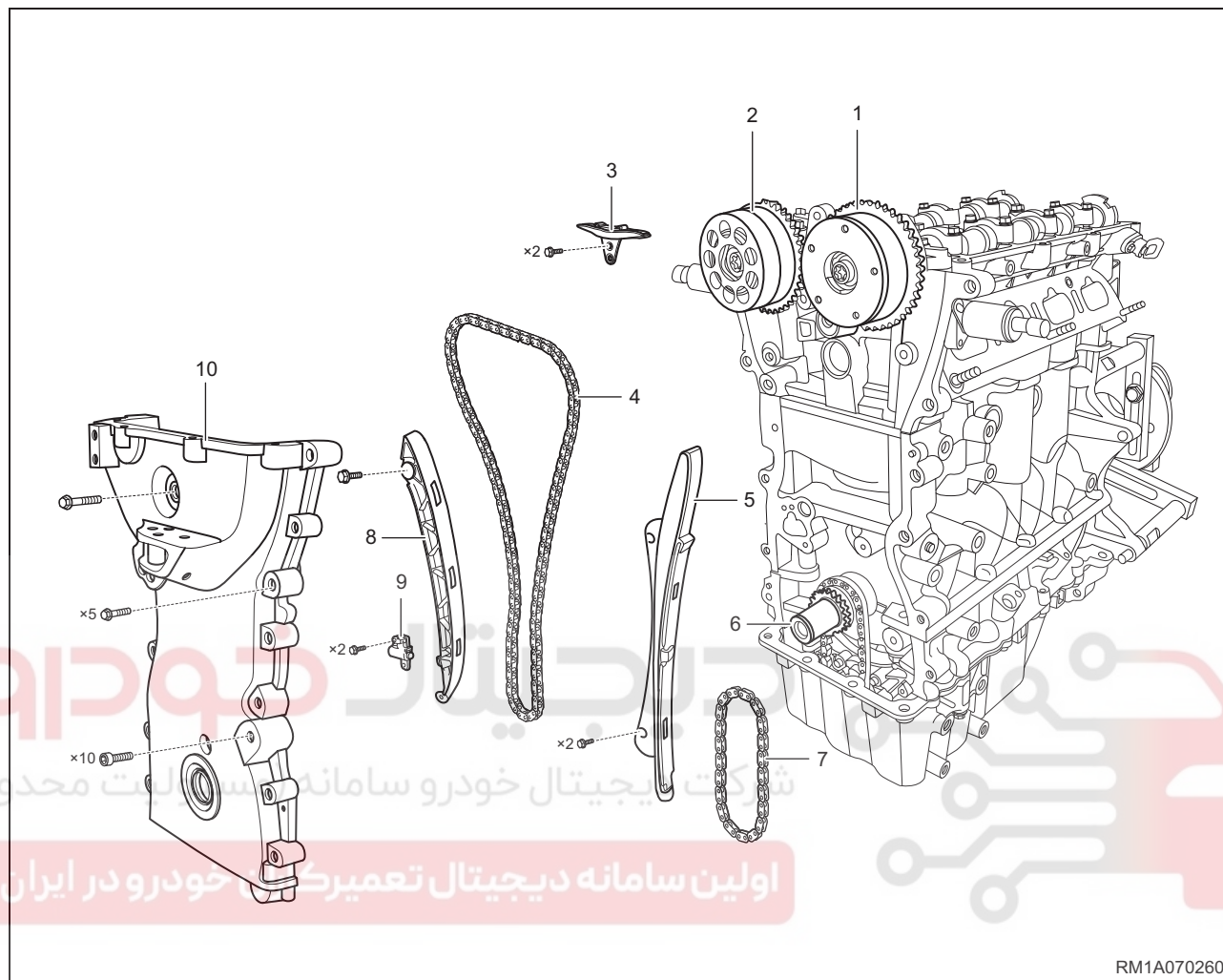
**CAUTION**

- Makes sure to install crankshaft rear oil seal in place. Otherwise it will lead to engine oil leakage.

4. Other installation procedures are in the reverse order of removal.

Engine Timing Chain

Description



RM1A070260

1 - Intake Camshaft Phaser Assembly	2 - Exhaust Camshaft Phaser Assembly
3 - Upper Guide Rail Assembly	4 - Engine Timing Chain
5 - Fixing Guide Rail Assembly	6 - Crankshaft Assembly
7 - Oil Pump Chain	8 - Movable Guide Rail Assembly
9 - Tensioner Assembly	10 - Timing Chain Cover

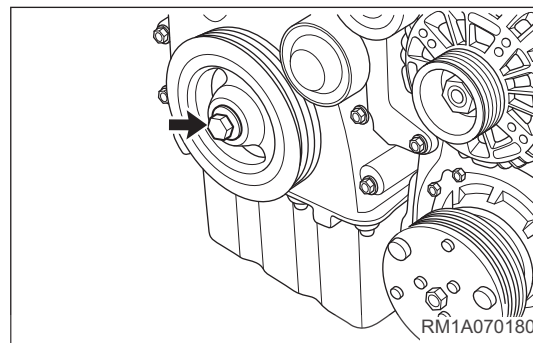
Removal

CAUTION

- Be sure to wear necessary safety equipment to prevent accidents when repairing.
- Try to prevent body paint surface from being scratched during removal and installation.
- Blow dirt and debris away from upper surface of cylinder head cover with compressed air before removing cylinder head cover.

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1. Turn off all electrical equipment and the ignition switch.
2. Disconnect the negative battery cable.
3. Remove the engine trim cover.
4. Remove the ignition coils and high-voltage cables (See page 14-8).
5. Remove the cylinder head cover (See page 07-34).
6. Remove the engine lower protector assembly (See page 49-20).
7. Remove the accessory drive belt (See page 07-24).
8. Remove the accessory drive belt tensioner assembly (See page 07-28).
9. Remove the idler pulley assembly (See page 07-27).
10. Remove the crankshaft pulley.
 - a. Loosen the crankshaft pulley fixing bolt (arrow).
(Tightening torque: 1st step: tighten to 100 ± 10 N·m;
2nd step: retighten by $120^\circ \pm 10^\circ$)



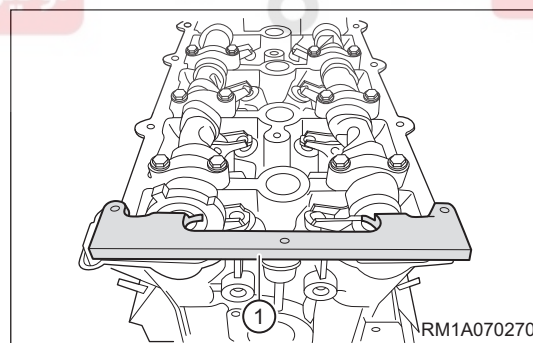
07

11. Remove 4 fixing bolts (arrow) from water pump pulley, and remove water pump pulley.
12. Use an engine equalizer to hang engine right lifting eye.

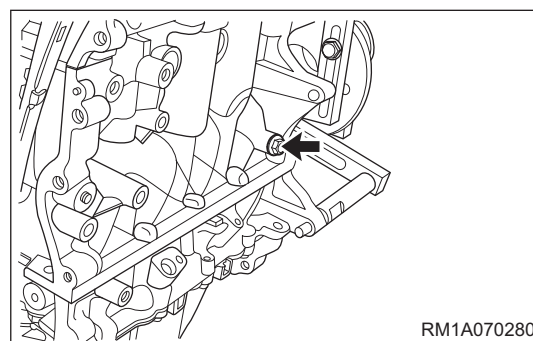
HINT:

Use an engine equalizer to hang engine right lifting eye while supporting engine oil pan with a jack. Avoid engine from leaning to right side, so as to remove engine right mounting assembly.

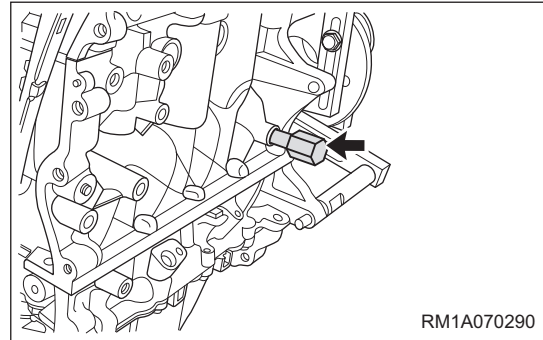
13. Remove the engine right mounting assembly (See page 07-72).
14. Install the timing tool.
 - a. Turn camshaft, install camshaft timing tool (1), tighten fixing bolts and lock exhaust camshaft and intake camshaft.



- b. Remove the starter (See page 15-9).
- c. Remove the plug (arrow) for installing crankshaft timing tool from bottom of engine block.
(Tightening torque: 40 ± 5 N·m)



- d. Carefully screw in crankshaft timing tool (arrow) until crankshaft is stuck completely.



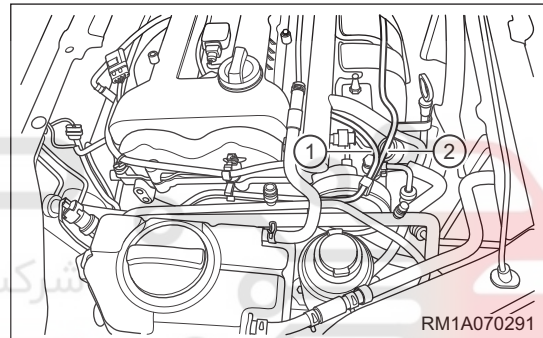
CAUTION

- This operation needs patience, and perform with extreme care not to damage the crankshaft.
- When crankshaft is stuck completely, pistons in 4 cylinders of engine are at the same level.

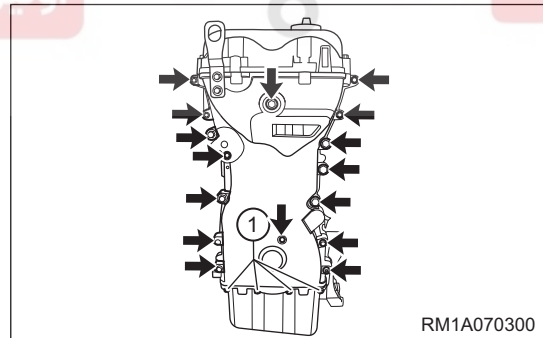
07

15. Remove the engine timing chain cover.

- a. Move away inlet pipe (1) and fuel vapor pipe (2) from line bracket.



- b. Remove 4 coupling bolts (1) between engine timing chain cover and oil pan.
- c. Remove fixing bolts (arrow) from engine timing chain cover.

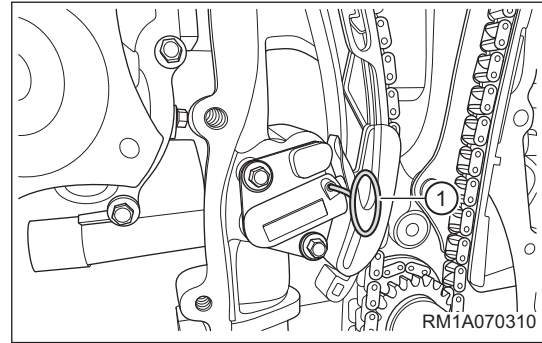


- d. Remove the engine timing chain cover.

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16. Remove the engine timing chain.

- a. Compress movable guide rail, push tensioner plunger to maximum compression position, and hold tensioner plunger with a snap pin (1).

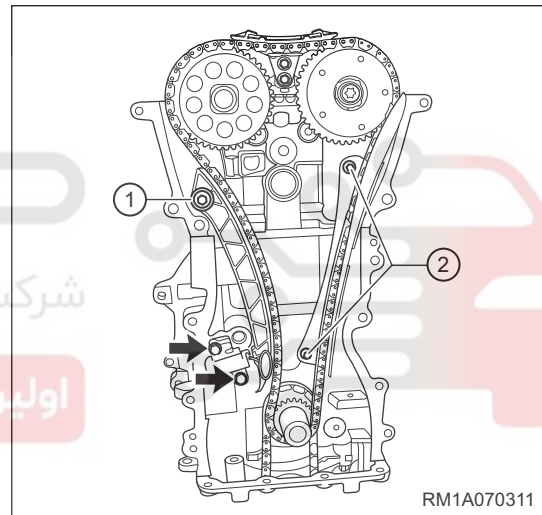


CAUTION

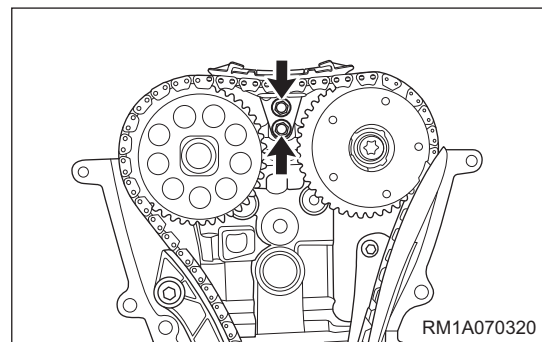
- There is a spring with large tensile force in tensioner assembly. Never remove tensioner assembly mounting bolts directly to prevent plunger from popping out suddenly.

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- b. Remove 2 fixing bolts (arrow) and tensioner assembly. (Tightening torque: 9 - 12 N·m)
- c. Remove fixing bolt (1) from movable guide rail, and remove movable guide rail.
- d. Remove 2 fixing bolts (2) from fixing guide rail, and remove fixing guide rail.



- e. Remove 2 fixing bolts (arrow) from engine timing chain upper guide rail, and remove engine timing chain upper guide rail.



CAUTION

- Two sides of silent chain are worn differently due to direction of chain movement. It is necessary to remove and install the chain in same direction.

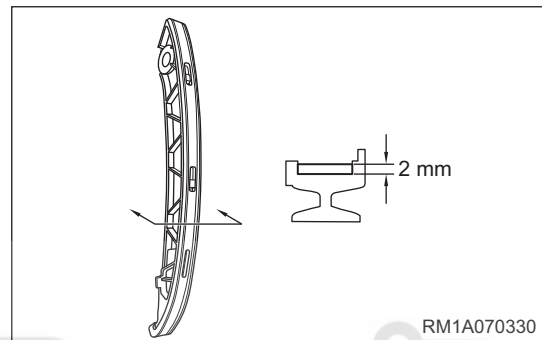
- f. Remove the engine timing chain.

CAUTION

- After removal, always mark front and back sides of chain with marking pen to keep it installed in same direction during assembly.

Inspection

- Check the engine timing chain.
 - Carefully inspect timing chain. Timing chain has same service life with engine. It can be reused if there is no serious wear or cracks on tooth face.
 - If timing chain is to be replaced, sprocket, chain and guide rail should be replaced as a set.
- Check the engine timing chain movable guide rail.
Measure depth of engine timing chain movable guide rail with a vernier caliper.
Grinding limit is 1 mm.



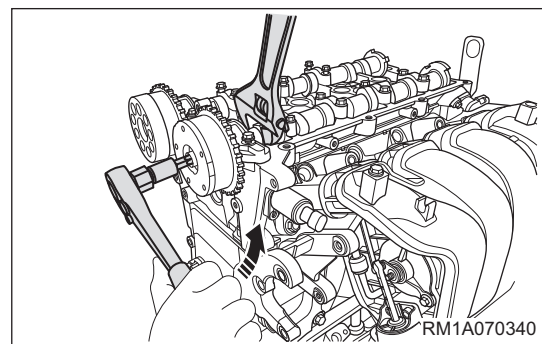
07

Installation

CAUTION

- Perform engine timing adjustment before assembly.
- Apply seal gum along inside edge of engine timing chain cover. Pay attention to apply seal gum to inside of timing chain cover mounting bolt holes.

- While holding hexagon surface on intake camshaft with an appropriate wrench, loosen fixing bolt of intake camshaft phaser in direction of arrow as shown in illustration.

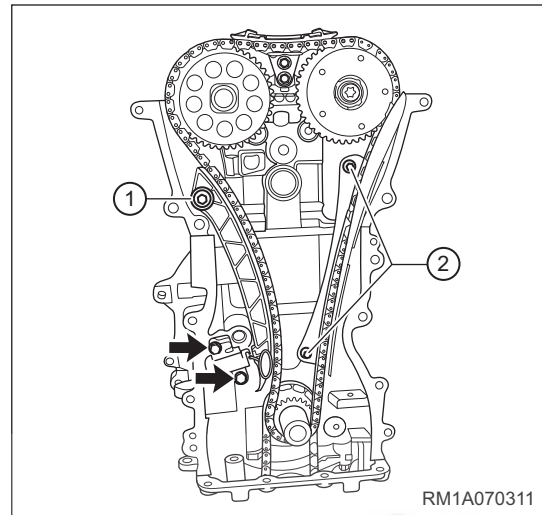


- Loosen exhaust camshaft phaser fixing bolt in the same way as intake camshaft phaser fixing bolt.
- Install the engine timing chain upper guide rail.
- Install the engine timing chain.

CAUTION

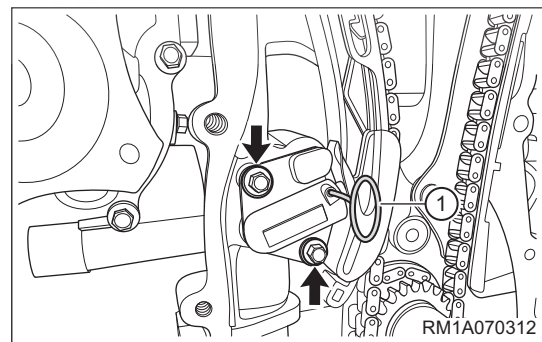
- Install engine timing chain according to marks on it, making sure it is installed correctly.
- Hang engine timing chain on intake phaser, exhaust phaser and crankshaft sprocket. Make sure chain is fixed to lower surface of upper guide rail and upper guide rail surface is level.

5. Install engine timing chain fixing guide rail and tighten 2 fixing bolts (2).
(Tightening torque: 9 - 12 N·m)
6. Install engine timing chain movable guide rail and tighten fixing bolt (1).
(Tightening torque: 9 - 12 N·m)

**CAUTION**

- After tightening, movable guide rail should rotate around the bolt flexibly. Otherwise remove and check bolt and movable guide rail assembly.

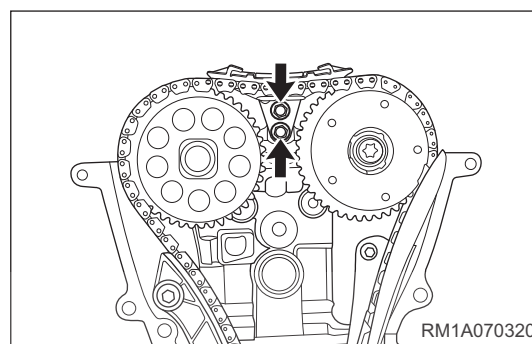
7. Install the tensioner assembly.
 - a. Install tensioner assembly, and tighten 2 tensioner assembly fixing bolts (arrow).
(Tightening torque: 9 - 12 N·m)
 - b. Pull movable guide rail, press tensioner plunger firmly and pull out tensioner assembly snap pin (1) to tense chain.



CAUTION

- During installation, make sure orifice of tensioner assembly is clean. Otherwise poor lubrication will result in abnormal noises of engine and damage of timing chain and guide rail.
- After chain is tensed, rotate intake and exhaust camshaft phasers successively, ensuring that timing chain is tensed on fixing guide rail side. Check that chain is pressed in fixing guide rail and movable guide rail, and engages normally with crankshaft sprocket, intake and exhaust camshaft phasers.
- Always make sure that engagement points from intake camshaft phaser to crankshaft sprocket and chain between intake and exhaust camshaft phasers (chain that contacts with upper guide rail) are not loose and keep upper guide rail level.

8. Tighten 2 timing chain upper guide rail fixing bolts (arrow).
(Tightening torque: 9 - 12 N·m)



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9. Tighten the exhaust camshaft phaser fixing bolt.
(Tightening torque: 105 ± 5 N·m)

10. Tighten the intake camshaft phaser fixing bolt.
(Tightening torque: 105 ± 5 N·m)

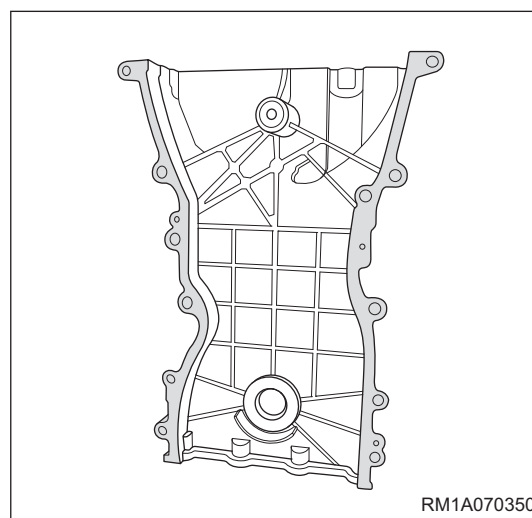
11. Remove crankshaft timing tool and camshaft timing special tool, and rotate crankshaft 2 turns clockwise to check if timing system operates normally.

CAUTION

- It is prohibited to rotate crankshaft counterclockwise.

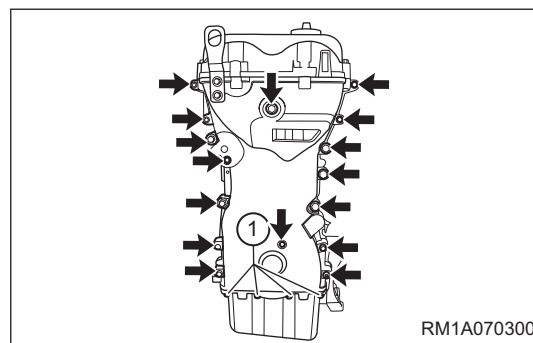
12. Install the engine timing chain cover.

- a. Apply seal gum along inside edge of engine timing chain cover. Pay attention to apply seal gum to inside of timing chain cover mounting bolt holes.



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- b. Install and tighten the engine timing chain cover fixing bolts (arrow).
(Tightening torque for inner hexagon bolts: 20 - 25 N·m; Tightening torque for hexagon flange bolt: 40 - 45 N·m)
- c. Install and tighten 4 coupling bolts (1) between engine timing chain cover and oil pan.
(Tightening torque: 20 ± 5 N·m)



13. Other installation procedures are in the reverse order of removal.

دیجیتال خودرو

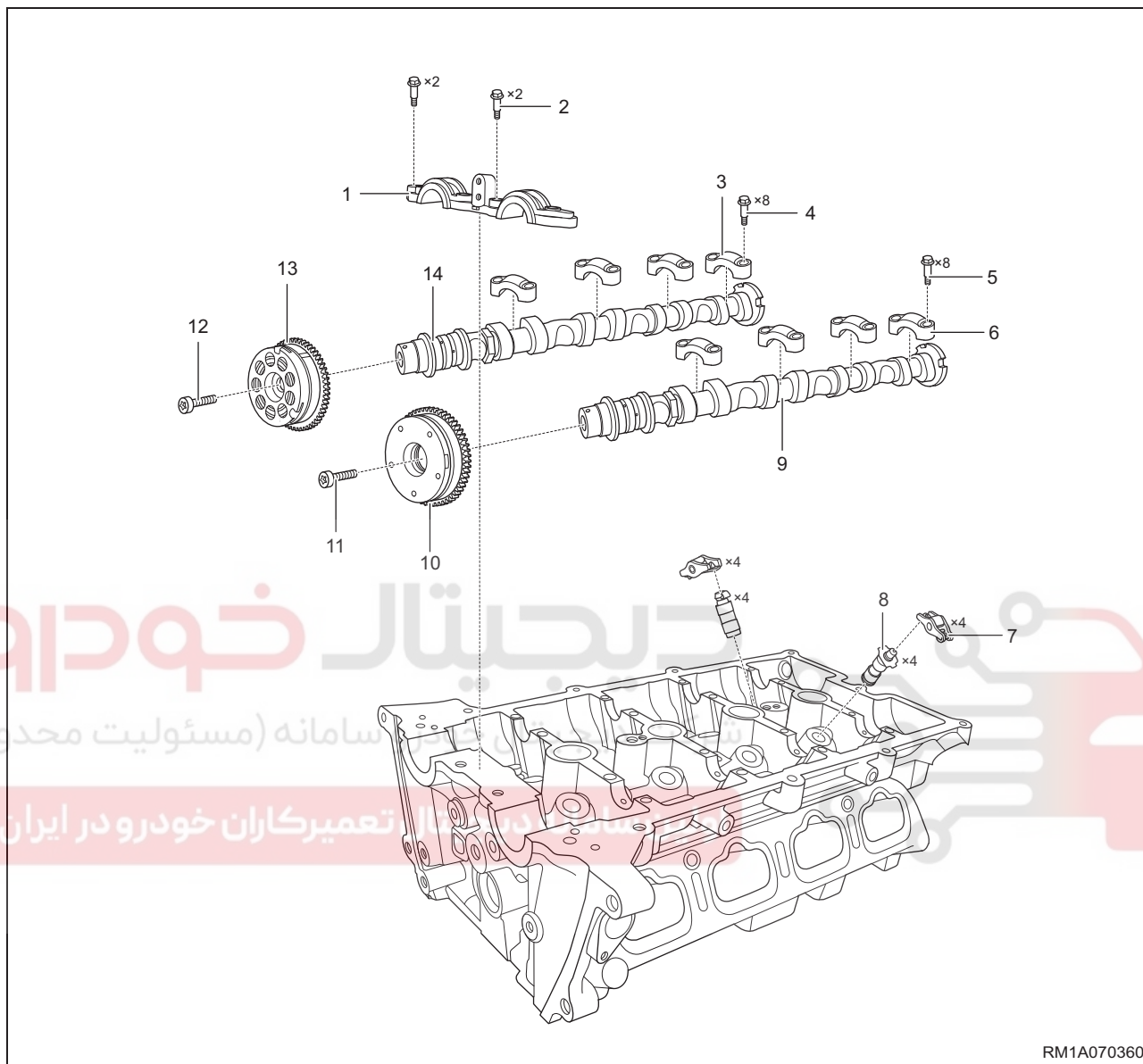
شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



Camshaft & Rocker Arm

Description



RM1A070360

1 - Camshaft 1st Bearing Cap	2 - Camshaft 1st Bearing Cap Fixing Bolt
3 - Exhaust Camshaft Bearing Cap	4 - Exhaust Camshaft Bearing Cap Fixing Bolt
5 - Intake Camshaft Bearing Cap Fixing Bolt	6 - Intake Camshaft Bearing Cap
7 - Rocker Arm	8 - Hydraulic Lifter
9 - Intake Camshaft	10 - Intake Camshaft Phaser Assembly
11 - Intake Camshaft Phaser Assembly Fixing Bolt	12 - Exhaust Camshaft Phaser Assembly Fixing Bolt
13 - Exhaust Camshaft Phaser Assembly	14 - Exhaust Camshaft

Removal

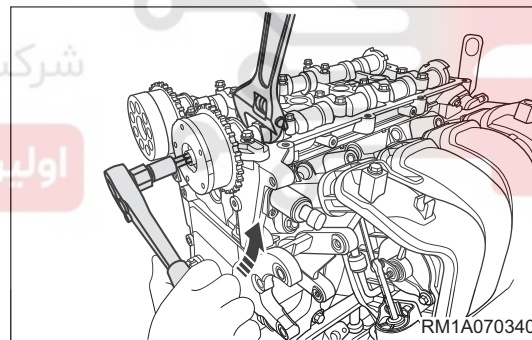
CAUTION

- Be sure to wear necessary safety equipment to prevent accidents when repairing.
- Try to prevent body paint surface from being scratched during removal and installation.
- Blow dirt and debris away from upper surface of cylinder head cover with compressed air before removing cylinder head cover.

07

1. Turn off all electrical equipment and the ignition switch.
2. Disconnect the negative battery cable.
3. Remove the engine trim cover.
4. Remove the ignition coils and high-voltage cables (See page 14-8).
5. Remove the cylinder head cover (See page 07-34).
6. Remove the engine lower protector assembly (See page 49-20).
7. Remove the accessory drive belt (See page 07-24).
8. Remove the accessory drive belt tensioner assembly (See page 07-28).
9. Remove the idler pulley assembly (See page 07-27).
10. Remove the water pump pulley assembly (See page 12-34).
11. Remove the timing chain cover (See page 07-45).
12. Remove the engine timing chain (See page 07-45).
13. Remove the exhaust camshaft phaser assembly.

- a. While holding hexagon surface on intake camshaft with an appropriate wrench, loosen fixing bolt of intake camshaft phaser in direction of arrow as shown in illustration, and remove intake camshaft phaser.
(Tightening torque: $105 \pm 5 \text{ N}\cdot\text{m}$)



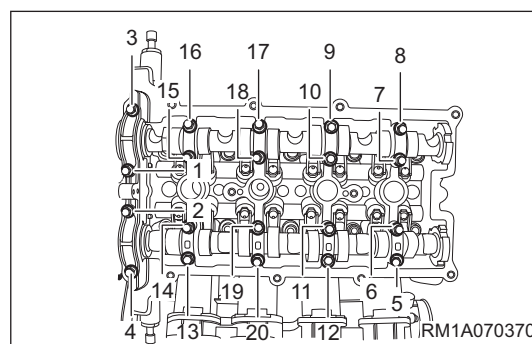
- b. Remove exhaust camshaft phaser in the same way as intake camshaft phaser.
(Tightening torque: $105 \pm 5 \text{ N}\cdot\text{m}$)

14. Remove the camshaft.

- a. Remove intake/exhaust camshaft bearing cap fixing bolts in order shown in illustration.

HINT:

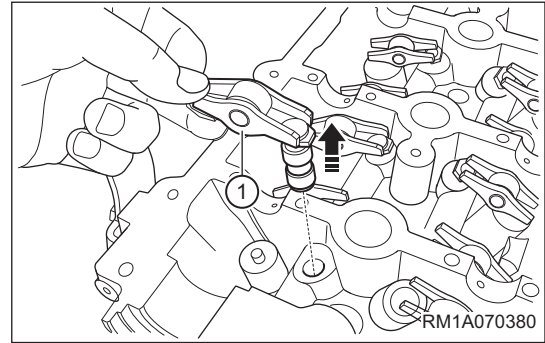
During removal, loosen fixing bolts in steps in order shown in illustration.



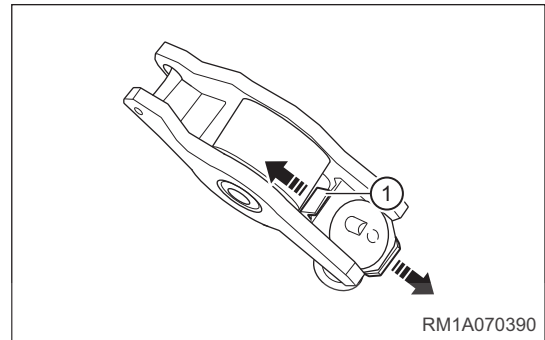
- b. Place removed camshaft bearing caps in order.
- c. Remove intake camshaft and exhaust camshaft.

15. Remove rocker arm and hydraulic lifter.

- a. Carefully remove rocker arm with hydraulic lifter assembly (1) in direction of arrow as shown in illustration.



- b. Remove snap spring (1) in direction of arrow as shown in illustration, and separate rocker arm and hydraulic lifter.



07

Inspection

1. Check the camshaft.

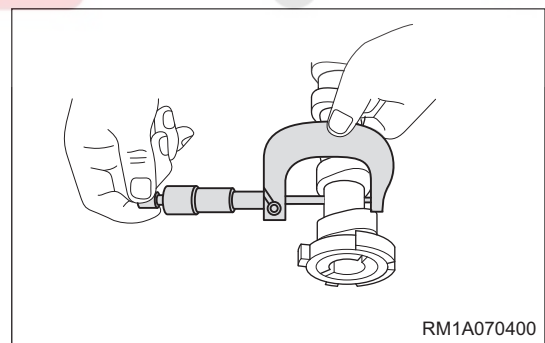
- a. Check the appearance.

- Check if there are scratches on camshaft bearings and cam surfaces. If there are scratches, repair or replace camshaft.
- Check if there are leaking holes and cracks on camshaft bearing caps. If there are leaking holes or cracks, replace camshaft.

- b. Check the camshaft journal diameter.

Measure camshaft journal diameter with an outer diameter micrometer.

Measurement Item	Specification (mm)
Intake Camshaft Journal (E4G15)	$\phi 24 \begin{smallmatrix} -0.040 \\ -0.053 \end{smallmatrix}$
Exhaust Camshaft Journal (E4G15)	$\phi 24e6 \begin{smallmatrix} -0.040 \\ -0.053 \end{smallmatrix}$
1st Journal Diameter (same for intake and exhaust) (E4T15B)	33.934 - 33.95
2nd - 5th Journal Diameter (same for intake and exhaust) (E4T15B)	23.947 - 23.96



If camshaft journal diameter is not within specified range, replace camshaft.

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c. Check the cam height.

Measure cam height with an outer diameter micrometer as shown in illustration.

Measurement Item	Specification (mm)
Intake Cam Hight (E4G15)	37.18
Exhaust Cam Height (E4G15)	37.05
Intake Cam Height (E4T15B)	37.07 - 37.31
Exhaust Cam Height (E4T15B)	36.94 - 37.18

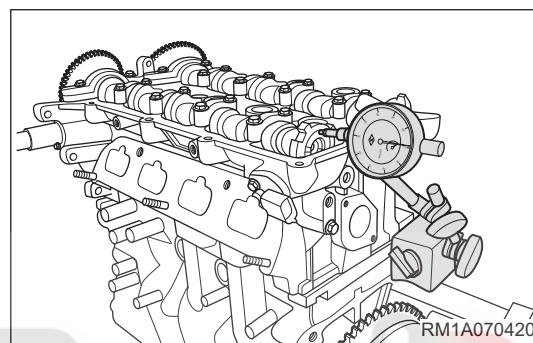
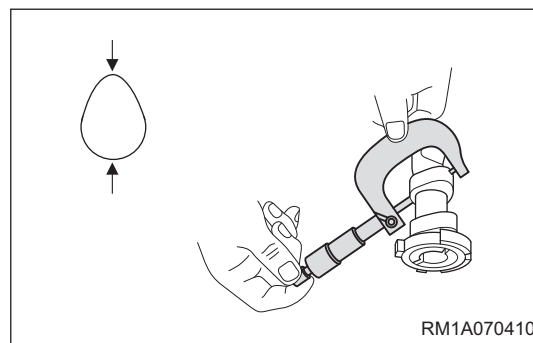
If cam height is not within specified range, replace camshaft.

d. Check the camshaft axial clearance.

- Reinstall the camshaft.
- Keep plunger of dial indicator in contact with front end of camshaft. Turn dial of dial indicator to reset it to zero.
- Push camshaft forward and backward gently (do not rotate camshaft) and read value from dial indicator.

Measurement Item	Specification (mm)
Intake Camshaft Axial Clearance (E4G15)	0.15 - 0.20
Exhaust Camshaft Axial Clearance (E4G15)	0.15 - 0.20
Intake Camshaft Axial Clearance (E4T15B)	0.15 - 0.20
Exhaust Camshaft Axial Clearance (E4T15B)	0.15 - 0.20

If camshaft axial clearance is not within specified range, replace camshaft.



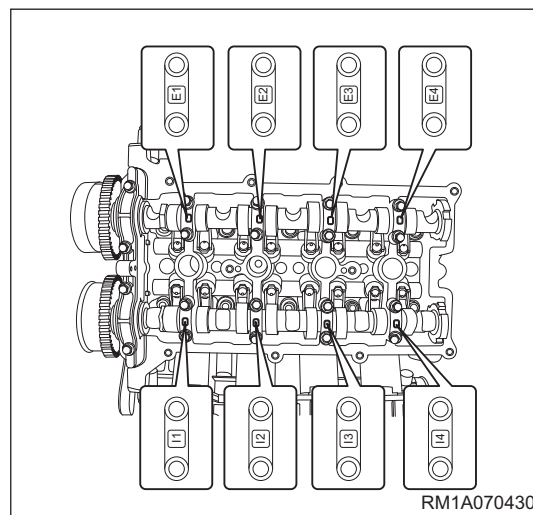
Installation

CAUTION

- Adjust 4 pistons to same level and adjust timing before installing camshaft.
- Install exhaust camshaft phaser to exhaust camshaft, screw in bolts by hand (no tighten), and check if exhaust camshaft phaser can rotate smoothly around the bolt. Otherwise, remove and check exhaust camshaft phaser and bolt. Install intake camshaft phaser in the same way. Tighten bolts on exhaust side, then tighten bolts on intake side.

1. Clean intake, exhaust camshafts and camshaft bearing caps.
2. Apply engine oil to outer surface of camshaft cam and journal. Also add engine oil into cylinder head camshaft bearing holes.

3. Install intake camshaft, exhaust camshaft, and intake and exhaust camshaft bearing caps.

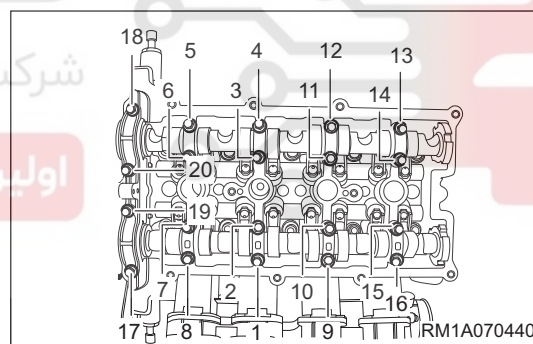


CAUTION

- Install camshaft bearing caps according to marks on them.
- I: Intake Camshaft Bearing Cap
- E: Exhaust Camshaft Bearing Cap

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4. First screw camshaft bearing cap fixing bolts without tighten.
5. Tighten camshaft bearing cap fixing bolts in order shown in illustration.
(Tightening torque: $9 \pm 1.5 \text{ N}\cdot\text{m}$)

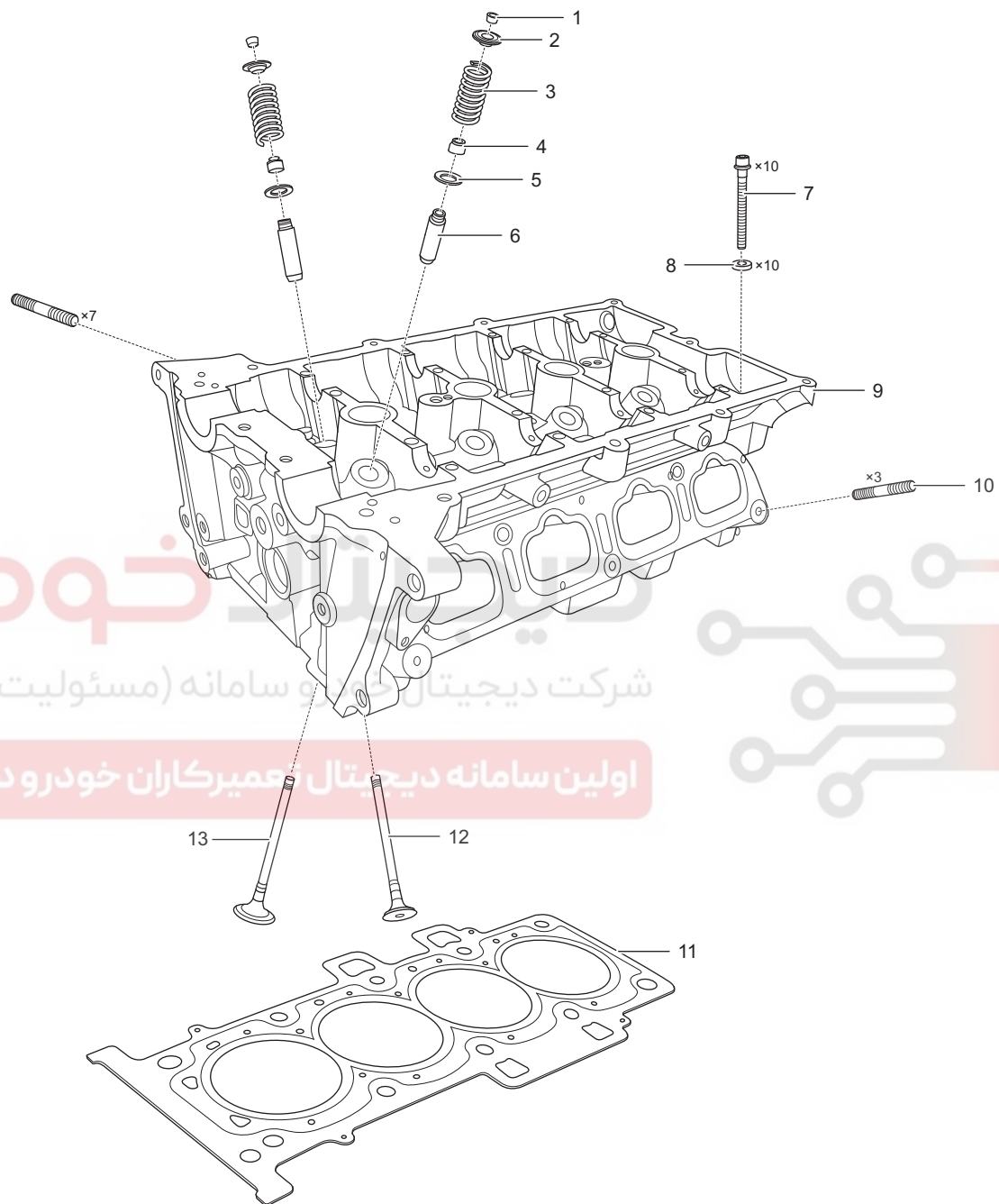


6. Other installation procedures are in the reverse order of removal.

Cylinder Head

Description

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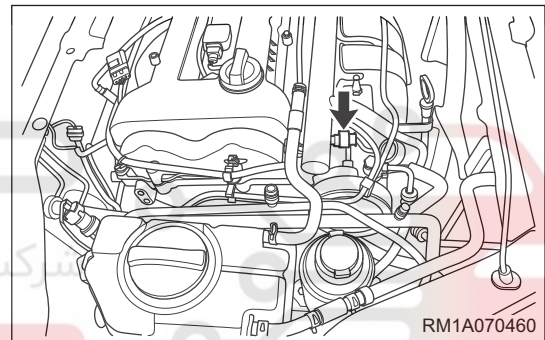


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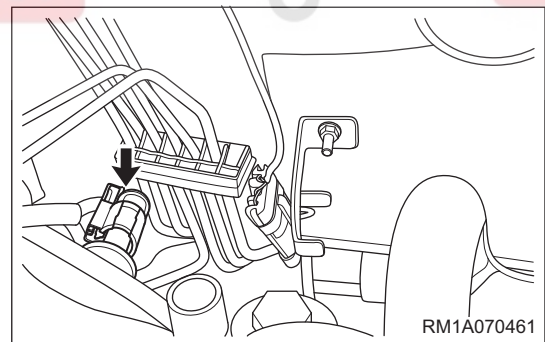
1 - Valve Cotter	2 - Valve Spring Upper Seat
3 - Valve Spring	4 - Valve Oil Seal
5 - Valve Spring Lower Seat	6 - Valve Guide
7 - Cylinder Head Fixing Bolt	8 - Cylinder Head Fixing Bolt Washer
9 - Cylinder Head	10 - Stud
11 - Cylinder Head Gasket	12 - Exhaust Valve
13 - Intake Valve	

Removal

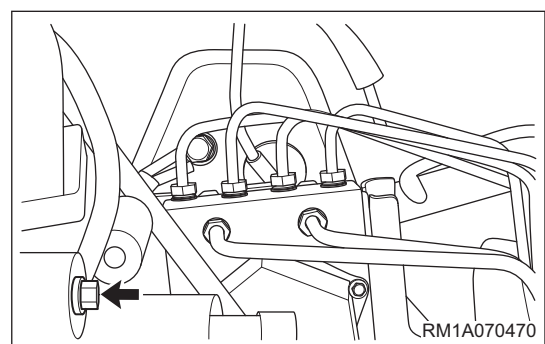
1. Release the fuel system pressure (See page 08-10).
2. Turn off all electrical equipment and the ignition switch.
3. Disconnect the negative battery cable.
4. Drain the engine oil (See page 13-12).
5. Drain the coolant (See page 12-13).
6. Disconnect the wire harness connector.
 - a. Disconnect the intake camshaft variable timing control valve connector (arrow).



- b. Disconnect the exhaust camshaft variable timing control valve connector (arrow).

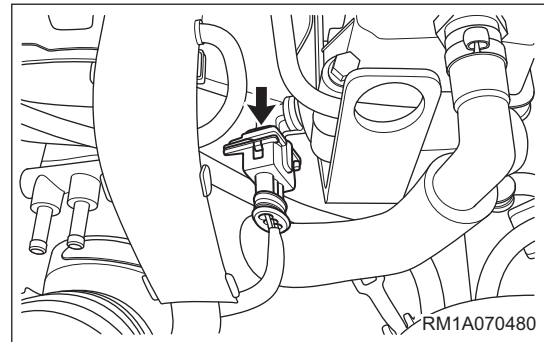


- c. Remove engine wire harness ground wire fixing bolt (1), and move away engine wire harness ground wire. (Tightening torque: 7 ± 1 N·m)

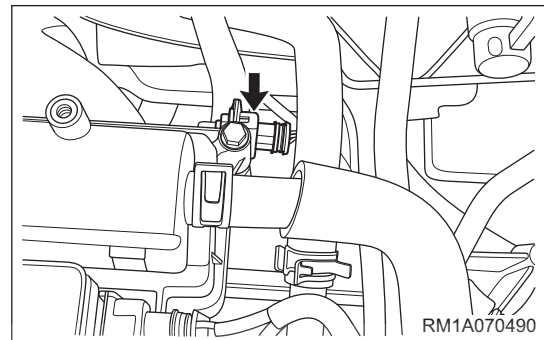


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- d. Disconnect the intake camshaft position sensor connector (arrow).



- e. Disconnect the exhaust camshaft position sensor connector (arrow).



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7. Remove the air filter assembly (See page 10-12).
8. Remove the battery (See page 16-7).
9. Remove the battery tray (See page 16-9).
10. Remove the ignition coils and high-voltage cables (See page 14-8).
11. Remove the spark plug (See page 14-11).
12. Remove the fuel rail injector assembly (See page 08-26).
13. Remove the electronic throttle assembly (See page 10-17).
14. Remove the intake manifold assembly (See page 10-22).
15. Remove the thermostat assembly (See page 12-20).
16. Remove the thermostat seat assembly (See page 12-24).
17. Remove the exhaust manifold assembly (See page 11-6).
18. Remove the accessory drive belt (See page 07-24).
19. Remove the idler pulley assembly (See page 07-32).
20. Remove the water pump pulley assembly (See page 12-34).
21. Remove the cylinder head cover (See page 07-34).
22. Use an engine equalizer to hang the engine.

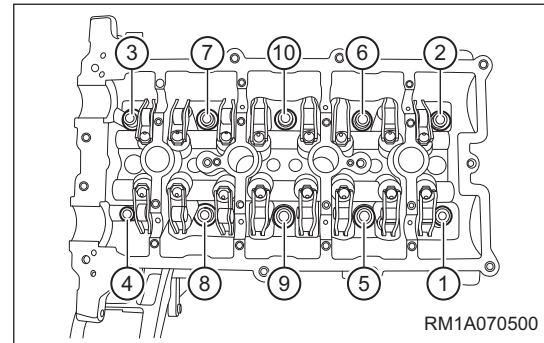
HINT:

Use an engine equalizer to hang the engine while supporting engine oil pan with a jack. Avoid engine from leaning to right side.

23. Remove the engine timing chain (See page 07-45).
24. Remove camshaft and rocker arm (See page 07-53).
25. Remove the engine equalizer.

26. Remove the cylinder head.

- a. Remove 10 fixing bolts from cylinder head in order shown in illustration.

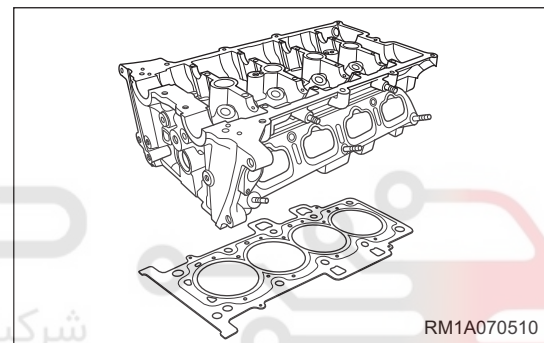


CAUTION

- Failure to follow the sequence to remove cylinder head bolts will cause cylinder head deformation.

07

- b. Remove cylinder head and cylinder head gasket.

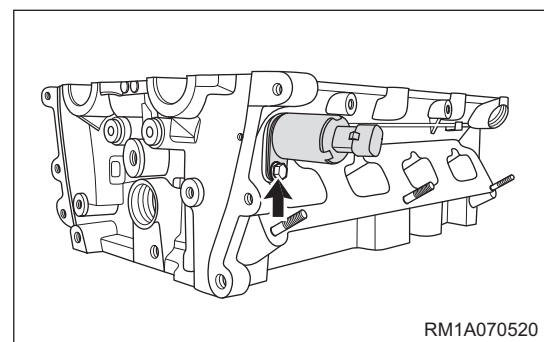


CAUTION

- Removed cylinder head gasket cannot be reused. Replace it with a new one. Be careful not lost cylinder head dowel pin during removal.

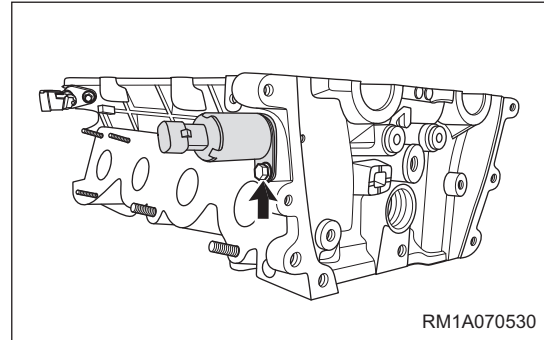
Disassembly

- Remove fixing bolt (arrow) from intake camshaft variable timing control valve, and remove intake camshaft variable timing control valve.
(Tightening torque: 8 + 2 N·m)

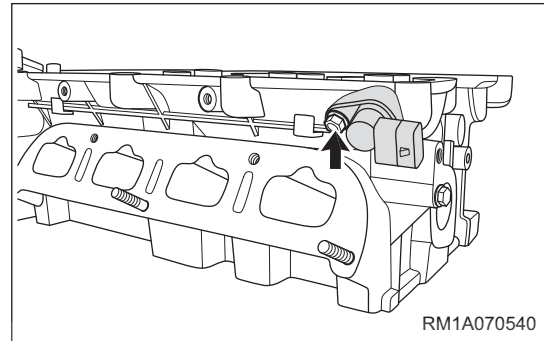


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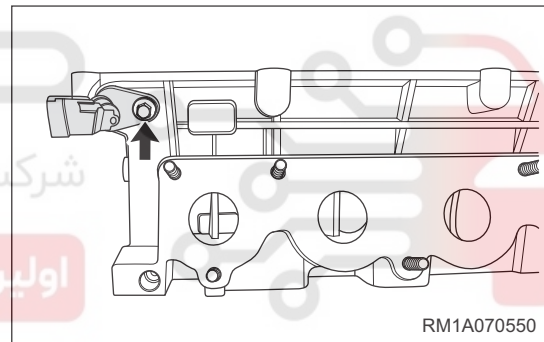
2. Remove fixing bolt (arrow) from exhaust camshaft variable timing control valve, and remove exhaust camshaft variable timing control valve.
(Tightening torque: $8 + 2 \text{ N}\cdot\text{m}$)



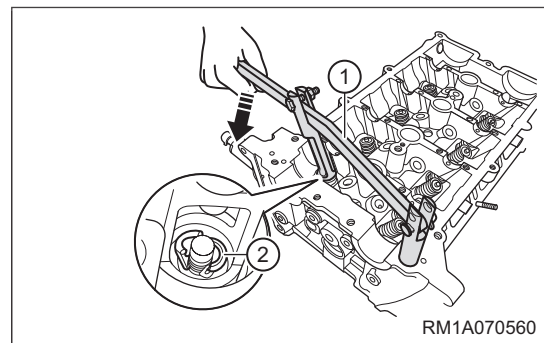
3. Remove fixing bolt (arrow) from intake camshaft position sensor, and remove intake camshaft position sensor.
(Tightening torque: $8 + 1 \text{ N}\cdot\text{m}$)



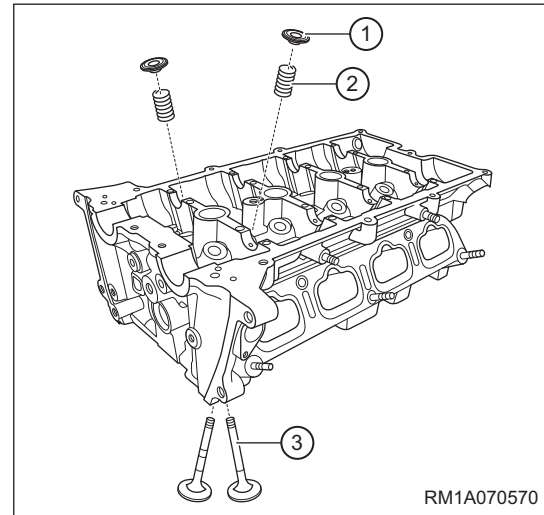
4. Remove fixing bolt (arrow) from exhaust camshaft position sensor, and remove exhaust camshaft position sensor.
(Tightening torque: $8 + 1 \text{ N}\cdot\text{m}$)



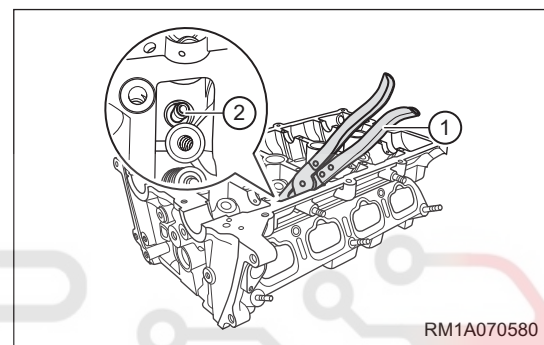
5. Use a special tool (valve spring compressor) (1) to compress valve spring, and remove valve cotter (2) with a flexional magnetic rod.



6. Remove valve spring upper seat (1), valve spring (2) and valve (3) from cylinder head.

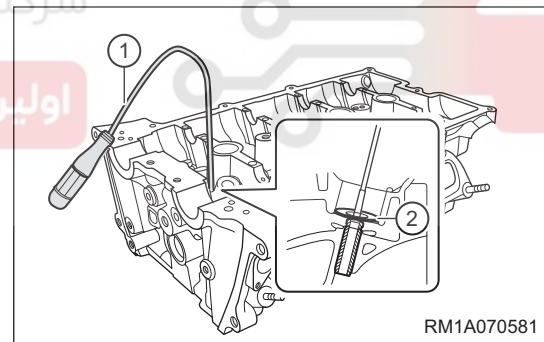


7. Using a valve oil seal remover (1), remove valve oil seal (2).



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8. Using a flexional magnetic rod (1), remove valve spring lower seat (2).



Inspection

1. Check the cylinder head.
 - a. Check the appearance.

Check if there are scratches on camshaft bearing journals operating surface.

Remove carbon deposits inside valve guides with valve guide cleaner.

Make sure valve stem can move and rotate freely in its mounting hole.

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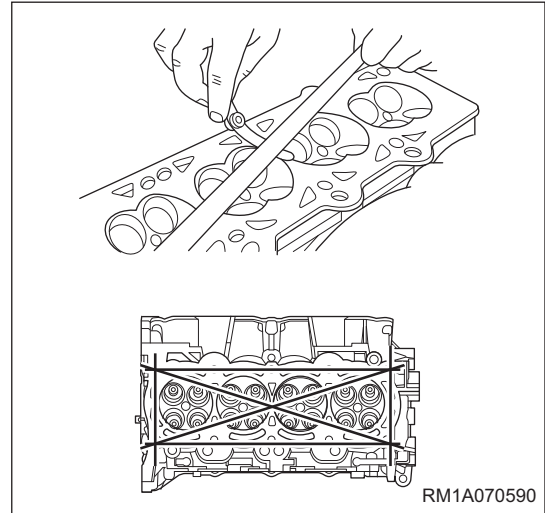
b. Check the cylinder head flatness.

Using a precision straightedge and feeler gauge, check cylinder head flatness. Cylinder head flatness must be within 0.04 mm.

Measurement Item	Specification (mm)
Cylinder Head Flatness (E4G15)	0.04
Cylinder Head Flatness (E4T15B)	0.04

If cylinder head flatness exceeds specified value, adjust it. If cylinder head flatness exceeds the limit value, replace cylinder head.

- Maximum allowable wear thickness of cylinder head is 0.15 mm.
- Maximum total allowable wear thickness of cylinder block and cylinder head is 0.20 mm. (E4T15) It is not allowed to grind cylinder head, if it exceeds specified value, replace cylinder head assembly.



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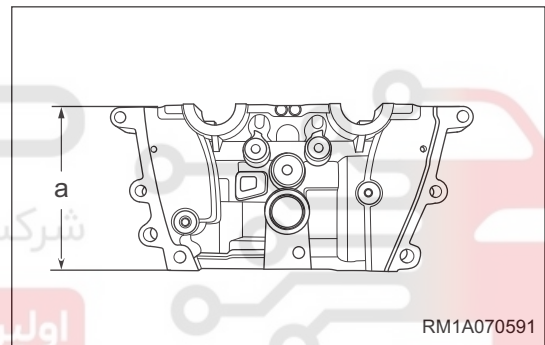
07

c. Check the cylinder head height.

Using a precision straightedge, measure cylinder head height.

Measurement Item	Specification (mm)
Cylinder Head Height (E4G15)	139.40 ± 0.41
Cylinder Head Height (E4T15B)	141.05

If cylinder head height is not within specified range, replace cylinder head.



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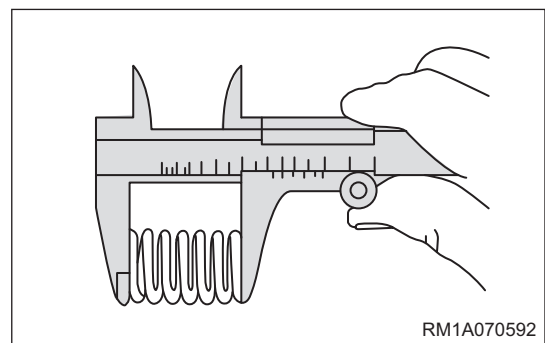
CAUTION

- During replacement, cylinder head should be fully equipped with valves, valve oil seals, springs, seats, cotters, hydraulic lifters and crankshaft.

2. Check the valve spring.

Using a vernier caliper, measure free length of valve spring and length of valve spring under the operation pre-pressure of 585 ± 25 N (E4G15)/229 - 251 N (E4T15B).

Measurement Item	Specification (mm)
Valve Spring Free Length (E4G15)	47.70
Valve Spring Length Under Operation Pre-pressure (E4G15)	32
Valve Spring Free Length (E4T15B)	47.80



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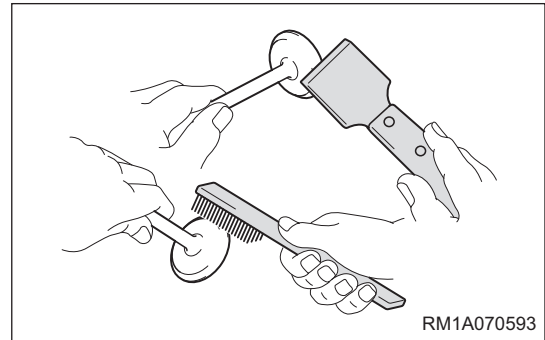
Measurement Item	Specification (mm)
Valve Spring Length Under Operation Pre-pressure (E4T15B)	41

If valve spring length is not within specified range, replace valve spring.

3. Check the valve.

a. Clean the valve.

- Using a scraper, remove carbon deposited on valve head.
- Using a wire brush, clean valve thoroughly.

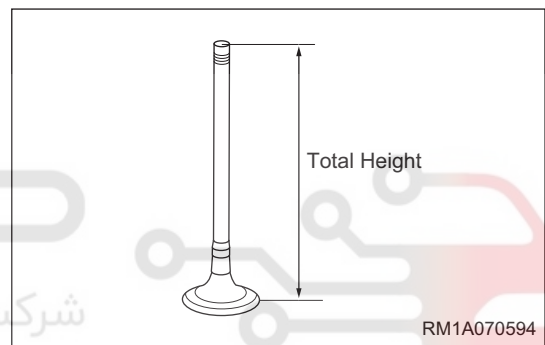


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b. Check the valve height.

Using a vernier caliper, measure the valve height.

Measurement Item	Specification (mm)
Intake Valve Height (E4G15)	107.998
Exhaust Valve Height (E4G15)	106.318
Intake Valve Height (E4T15B)	107.75 - 108.25
Exhaust Valve Height (E4T15B)	106.07 - 106.57

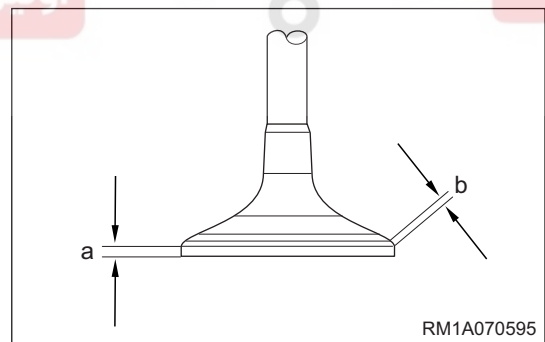


If height is less than specified value, replace valve.

c. Check the valve head.

- Measure valve head thickness a and record.
- Check if contacting area of valve face is even and if valve face is located at the center of valve inclined plane, and measure valve face width b.

Measurement Item	Specification (mm)
Intake Valve Head Thickness (E4G15)	0.3 ± 0.15
Exhaust Valve Head Thickness (E4G15)	0.3 ± 0.15
Intake Valve Face Width (E4G15)	1.158
Exhaust Valve Face Width (E4G15)	1.306
Intake Valve Head Thickness (E4T15B)	0.68 - 1.1
Exhaust Valve Head Thickness (E4T15B)	0.48 - 0.9
Intake Valve Face Width (E4T15B)	1.154
Exhaust Valve Face Width (E4T15B)	1.307



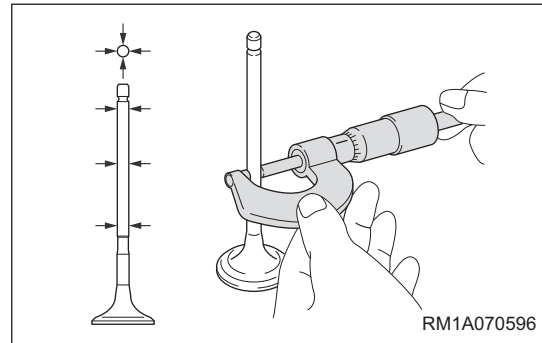
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If result is not within specified range, replace valve.

d. Check the valve stem diameter.

Using a vernier caliper, measure valve stem diameter.

Measurement Item	Specification (mm)
Intake Valve Stem Diameter (E4G15)	$\phi 5.98 \pm 0.008$
Exhaust Valve Stem Diameter (E4G15)	$\phi 5.96 \pm 0.008$
Intake Valve Stem Diameter (E4T15B)	$\phi 5.98 \pm 0.008$
Exhaust Valve Stem Diameter (E4T15B)	$\phi 5.96 \pm 0.008$



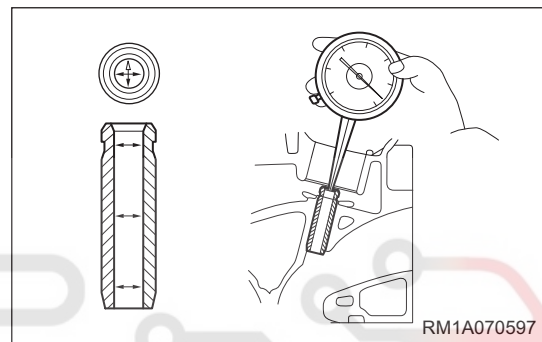
If valve stem diameter is not within specified range, check clearance between valve stem and valve guide.

e. Check clearance between valve and guide.

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

Measurement Item	Specification (mm)
Valve Guide Inner Diameter (E4G15)	$\phi 6.0 \pm 0.015$
Valve Guide Inner Diameter (E4T15B)	$\phi 6.0 \pm 0.015$

- Clearance between valve and guide = Valve guide inner diameter - Valve stem diameter



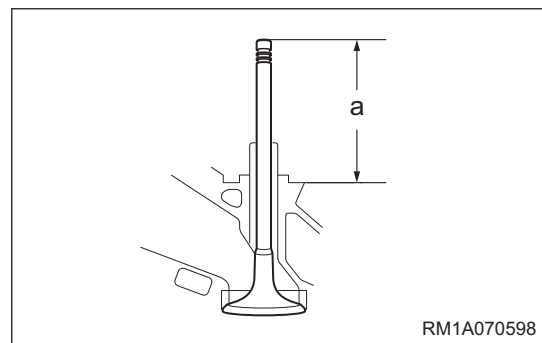
Measurement Item	Specification (mm)
Clearance Between Intake Valve and Guide (E4G15)	0.02
Clearance Between Exhaust Valve and Guide (E4G15)	0.04
Clearance Between Intake Valve and Guide (E4T15B)	0.012 - 0.043
Clearance Between Exhaust Valve and Guide (E4T15B)	0.032 - 0.063

If clearance between valve and guide is not within specified range, replace valve or valve guide.

4. Check the valve stem protrusion amount.

- Using a vernier caliper, measure distance a (valve stem protrusion amount) between valve stem end surface and valve spring seat end surface.

Measurement Item	Specification (mm)
Intake Valve Stem Protrusion Amount	47.5
Exhaust Valve Stem Protrusion Amount	47.5



If valve stem protrusion amount is not within specified range, replace valve.

Assembly

CAUTION

- Soak new valve oil seal in oil for several minutes before installation.
- Check if valve spring lower seat is installed properly before installing valve spring.
- Variable pitch valve spring is used, which must be installed with the painted side facing the valve spring lower seat.

HINT:

Clean all components to be assembled thoroughly before assembly.

1. Install valve (1) into cylinder head.

HINT:

- Distinguish intake valves and exhaust valves during installation.
- Apply a light coat of engine oil to valve stem end, when assembling valve.

2. Install new valve spring lower seat (2) if necessary.

HINT:

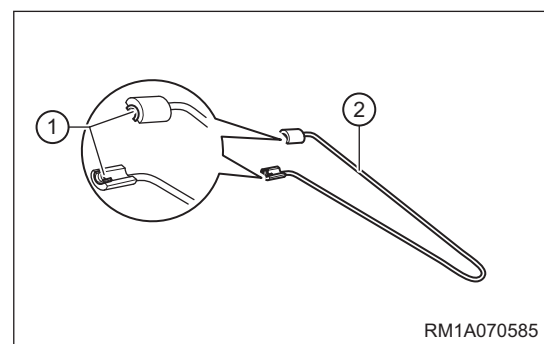
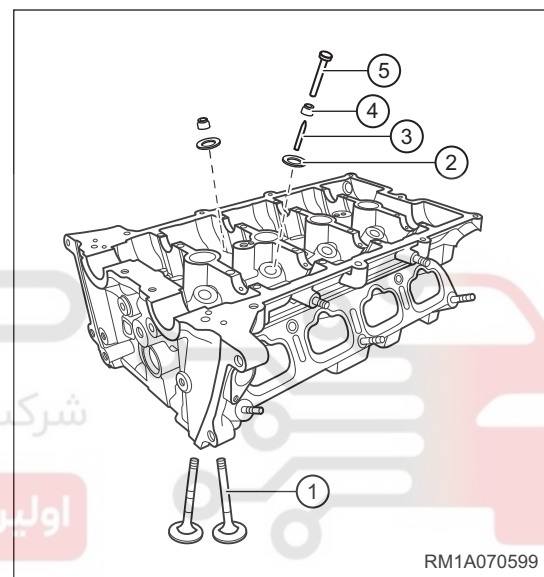
Bottom of valve spring lower seat should face cylinder head.

3. Install the valve oil seal.

HINT:

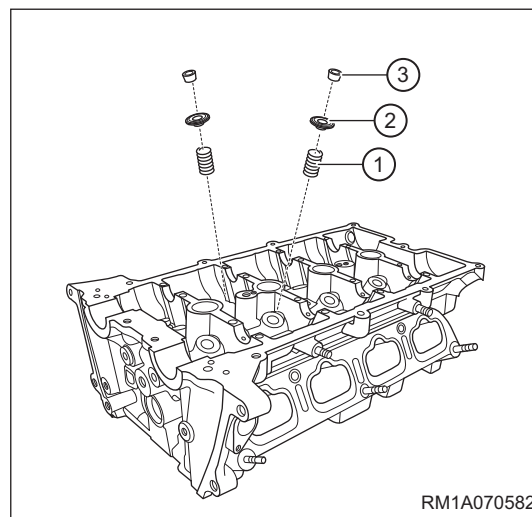
Apply a light coat of engine oil to installation surface of valve oil seal, when assembling valve oil seal.

- a. Install valve oil seal guide sleeve (3) to valve stem.
 - b. Install valve oil seal (4) to valve oil seal guide sleeve.
 - c. Tap valve oil seal installer (5) lightly with a rubber hammer to install valve oil seal in place.
4. Install valve cotter (1) to valve cotter installer (2).



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5. Install valve spring (1) and valve spring upper seat (2).
6. Using a valve spring compressor, compress valve spring and install valve cotter (3) in place.



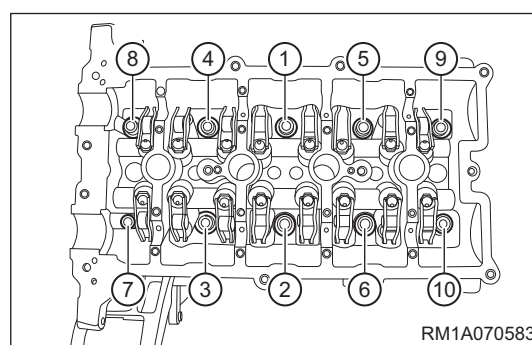
- 07 7. Tap valve cotter lightly with a rubber hammer to make sure cotter is installed in place after assembly.

Installation

CAUTION

- Remove residual seal gum and oil on cylinder head and cylinder block.
- Replace the cylinder head gasket.
- Check that cylinder head gasket is neat and clean without any chips and scratches. The side stamped with part number of cylinder head gasket should face upward.
- Install cylinder head gasket to flat surface of cylinder block with a dowel pin.
- Clean joint surfaces between cylinder head and combustion chamber, together with flat surface of cylinder block and thread hole. There should be no accumulated oil at bottom of cylinder block thread hole.
- During installation, piston should not be located at the top dead center, in order to prevent it from being impacted by opening valve, when installing the rocker arm.
- Install the cylinder head bolt washer with chamfering surface facing upward and flat side facing cylinder head.

1. Make sure to tighten cylinder head fixing bolts in sequence from (1) to (10) shown in illustration:
 - a. Apply a small amount of oil to bolt head and root.
 - b. Install bolts and tighten them in place by hands.
 - c. Tighten cylinder head fixing bolts in following procedures:
 - 1st step: Tighten bolts to 40 ± 5 N·m in sequence from (1) to (10) shown in illustration.
 - 2nd step: Rotate bolts clockwise by $90^\circ \pm 5^\circ$ in tightening sequence.
 - 3rd step: Rotate bolts clockwise by $90^\circ \pm 5^\circ$ in tightening sequence.



CAUTION

- Check cylinder head fixing bolts before installation. If they are damaged, replace immediately.
- Be sure to tighten cylinder head bolts strictly according to operating procedures above, to achieve the technology standard for vehicle usage.

2. Other installation procedures are in the reverse order of removal.

دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



Engine Mounting Assembly

Removal & Installation - Rear Mounting Assembly

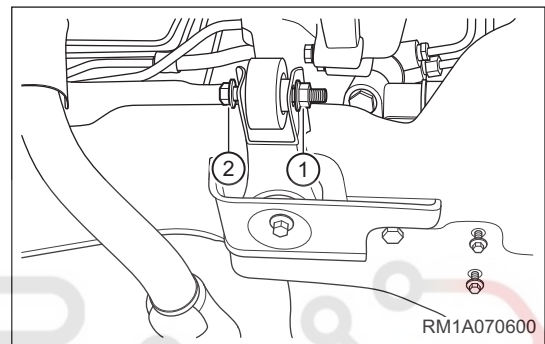
CAUTION

- Be sure to wear necessary safety equipment to prevent accidents when repairing.
- Try to prevent body paint surface from being scratched during removal and installation.

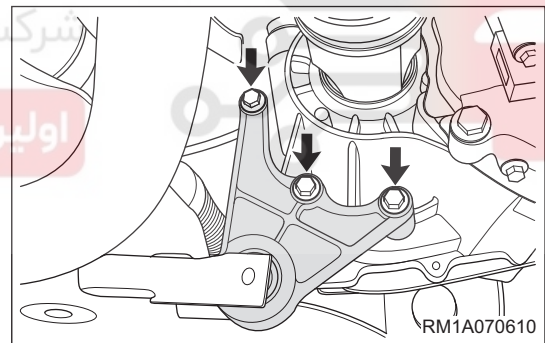
1. Turn off all electrical equipment and the ignition switch.
2. Disconnect the negative battery cable.
3. Support transmission with a transmission carrier.
4. Remove the engine rear mounting assembly.

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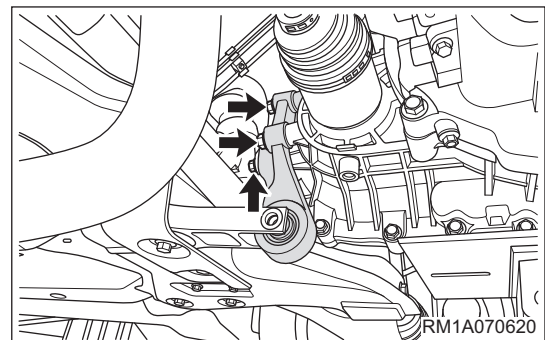
- a. Remove locking nut (1) between rear mounting upper body assembly and rear mounting lower body assembly, and then remove through bolt (2).
(Tightening torque: 80 ± 5 N·m)



- b. Remove 3 rear mounting upper body assembly fixing bolts (arrow) from transmission case (for MT model).
(Tightening torque: 45 ± 5 N·m)



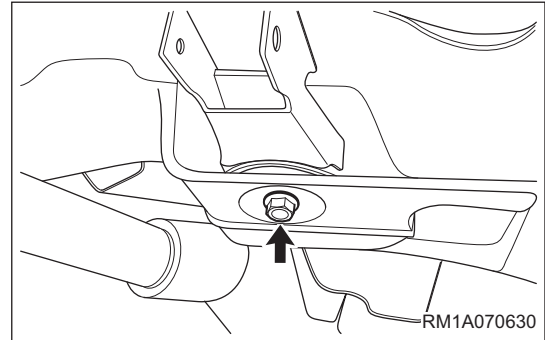
- c. Remove 3 rear mounting upper body assembly fixing bolts (arrow) from transmission case (for CVT model).
(Tightening torque: 45 ± 5 N·m)



- d. Remove the engine rear mounting upper body assembly.

- e. Remove coupling bolt (arrow) between rear mounting lower body assembly and front sub frame welding assembly, and remove engine rear mounting lower body assembly.

(Tightening torque: 105 ± 5 N·m)



- f. Remove engine rear mounting lower body assembly from front sub frame welding assembly.

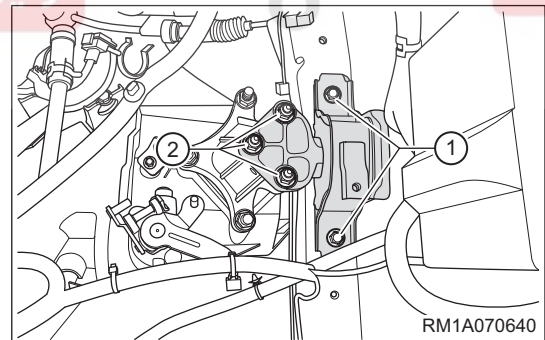
5. Installation is in the reverse order of removal.

Removal & Installation - Left Mounting Assembly

CAUTION

- Be sure to wear necessary safety equipment to prevent accidents when repairing.
- Try to prevent body paint surface from being scratched during removal and installation.

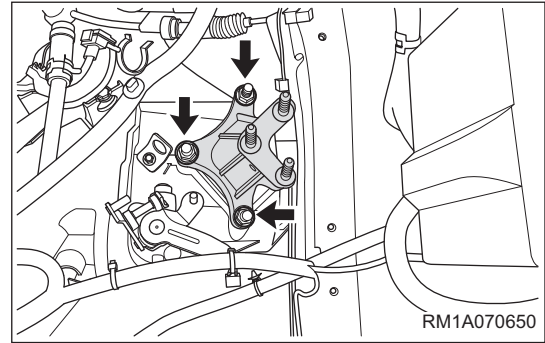
1. Turn off all electrical equipment and the ignition switch.
2. Disconnect the negative battery cable.
3. Use an engine equalizer to hang the engine.
4. Remove the air filter assembly (See page 10-12).
5. Remove the battery (See page 16-7).
6. Remove the battery tray (See page 16-9).
7. Remove the engine left mounting cushion assembly (for MT model).
 - a. Remove 3 coupling nuts (1) between left mounting cushion assembly and left mounting bracket. (Tightening torque: 60 ± 5 N·m)
 - b. Remove 2 coupling bolts (2) between left mounting cushion assembly and body. (Tightening torque: 60 ± 5 N·m)



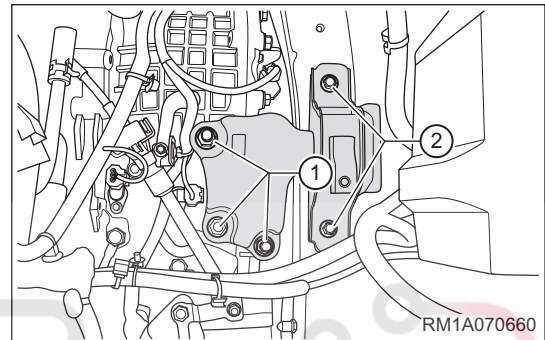
- c. Remove the left mounting cushion assembly.

07 - E4T15B ENGINE MECHANICAL

8. Remove the engine left mounting bracket (for MT model).
- Remove 3 coupling nuts (arrow) between left mounting bracket and transmission case.
(Tightening torque: 80 ± 5 N·m)



- Remove the left mounting bracket.
9. Remove the engine left mounting assembly (for CVT model).
- Remove 3 coupling nuts (1) between left mounting arm and transmission case.
(Tightening torque: 80 ± 5 N·m)
 - Remove 2 fixing bolts (2) between left mounting cushion assembly and body.
(Tightening torque: 60 ± 5 N·m)



- Remove the engine left mounting assembly.

10. Installation is in the reverse order of removal.

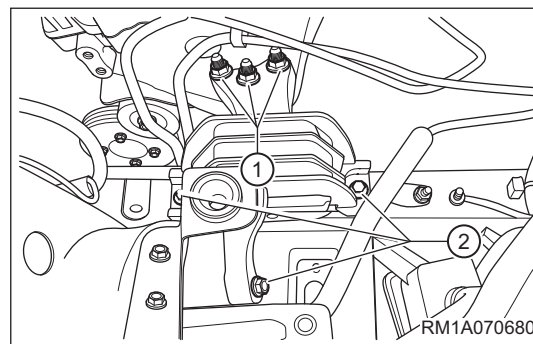
Removal & Installation - Right Mounting Assembly

CAUTION

- Be sure to wear necessary safety equipment to prevent accidents when repairing.
- Try to prevent body paint surface from being scratched during removal and installation.

- Turn off all electrical equipment and the ignition switch.
- Disconnect the negative battery cable.
- Remove the engine trim cover.
- Use an engine equalizer to hang the engine.
- Remove the expansion tank assembly (See page 12-18).

6. Remove the engine right mounting assembly.
 - a. Remove 3 coupling nuts (1) between engine right mounting assembly and engine timing chain cover.
(Tightening torque: 70 ± 5 N·m)
 - b. Remove 3 coupling bolts (2) between engine right mounting assembly and body.
(Tightening torque: 60 ± 5 N·m)



- c. Remove the engine right mounting assembly.

7. Installation is in the reverse order of removal.

دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



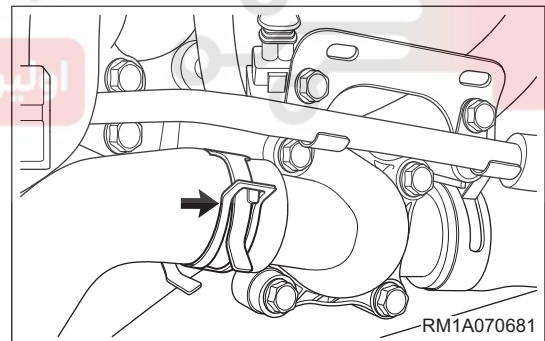
Engine Assembly

Removal

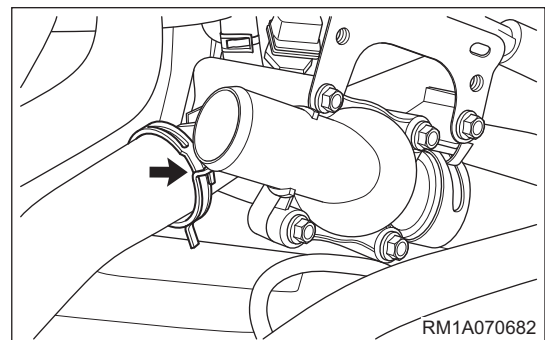
CAUTION

- Remove engine and transmission as an assembly.
- Install protector to prevent body from being scratched.

- 07
1. Remove the engine trim cover.
 2. Remove the trim cover rear left bracket.
 3. Release the fuel system pressure (See page 08-10).
 4. Turn off all electrical equipment and the ignition switch.
 5. Disconnect the negative battery cable.
 6. Drain the engine oil (See page 13-12).
 7. Drain the transmission oil (See page 17-12 for MT model, See page 18-104 for CVT model).
 8. Drain the coolant (See page 12-13).
 9. Drain the steering fluid (See page 29-8).
 10. Recover the refrigerant (See page 30-24).
 11. Remove the engine lower protector assembly (See page 49-20).
 12. Remove the air filter assembly (See page 10-12).
 13. Remove the battery (See page 16-7).
 14. Remove the battery tray (See page 16-9).
 15. Move away engine inlet hose and outlet hose.
 - a. Loosen elastic clamp (arrow) and disconnect connection between engine inlet hose and thermostat cover.

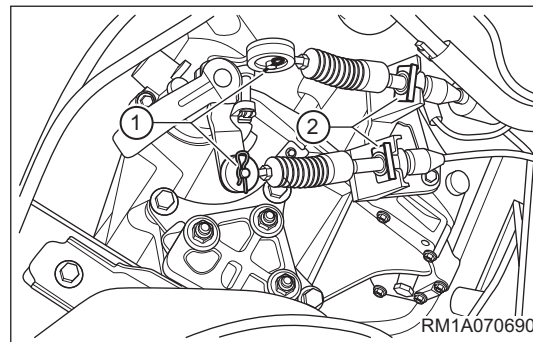


- b. Loosen elastic clamp (arrow) and disconnect connection between engine outlet hose and thermostat seat.



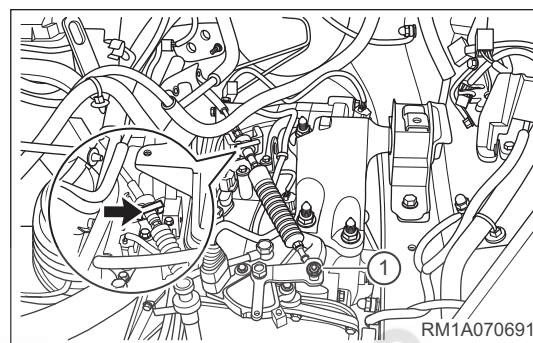
16. Move away the gear select and shift cable (for MT model).

- a. Remove cotter pins (1) connecting the gear select and shift cable and the transmission gear shift mechanism.
- b. Remove flexible shaft clamps (2) from gear select and shift cable, and move away gear select and shift cable from flexible shaft bracket.



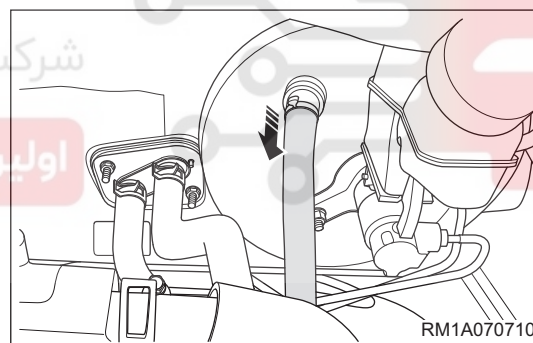
17. Move away the gear shift cable (for CVT model).

- a. Remove coupling nut (1) between gear shift cable and gear shift arm, and disconnect gear shift cable from gear shift arm.
(Tightening torque: 18 ± 2 N·m)
- b. Remove flexible shaft clamp (arrow) from gear select and shift cable, and move away gear select and shift cable from flexible shaft bracket.



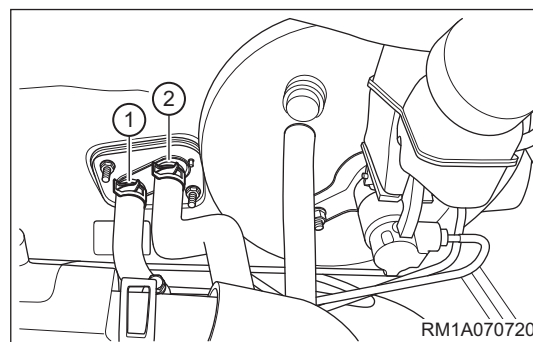
18. Disconnect connection between vacuum pipe and vacuum booster.

- a. Move vacuum pipe away from vacuum booster in direction of arrow as shown in illustration.



19. Disconnect connection between hose and heater core.

- a. Loosen elastic clamp (1) and disconnect connection between heater inlet pipe and heater core.
- b. Loosen elastic clamp (2) and disconnect connection between heater outlet pipe and heater core.



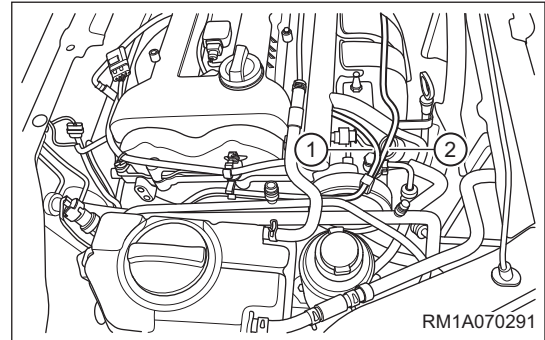
20. Remove the front exhaust pipe assembly (See page 11-10).

21. Move away the canister solenoid valve inlet pipe.

22. Disconnect coupling joint between inlet pipe III and fuel rail injector assembly.

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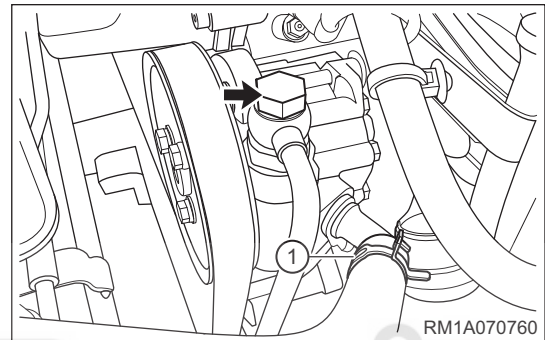
23. Move away inlet pipe III (1) and canister solenoid valve inlet pipe (2) from line bracket.



24. Remove the expansion tank (See page 12-18).

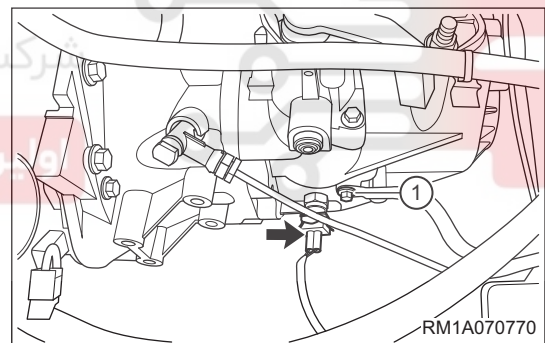
25. Disconnect the steering pump line.

- a. Remove high pressure fluid pipe hollow bolt (arrow), and move away steering pump line from steering pump.
(Tightening torque: 45 ± 5 N·m)
- b. Loosen clamp (1) and disconnect connection between fluid suction pipe and power steering pump assembly.



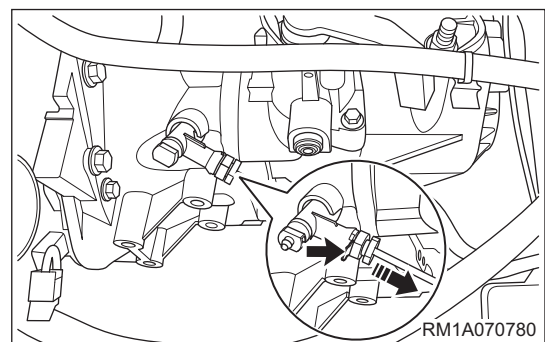
26. Disconnect back-up light connector, and move away ground wire (for MT model).

- a. Disconnect the back-up light switch connector (arrow).
- b. Remove transmission ground wire fixing bolt (1), and move away transmission ground wire.
(Tightening torque: 15 ± 2 N·m)



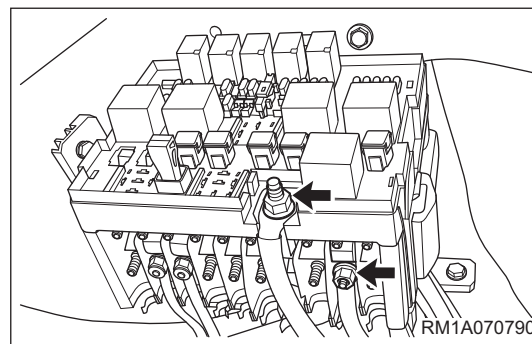
27. Disconnect the clutch pipe (for MT model).

- a. Separate clutch pipe clip (arrow), and move away clutch pipe in direction of arrow as shown in illustration.

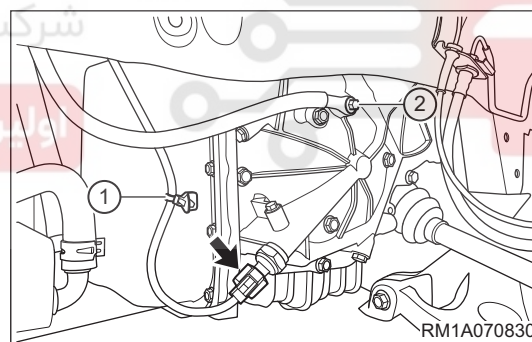
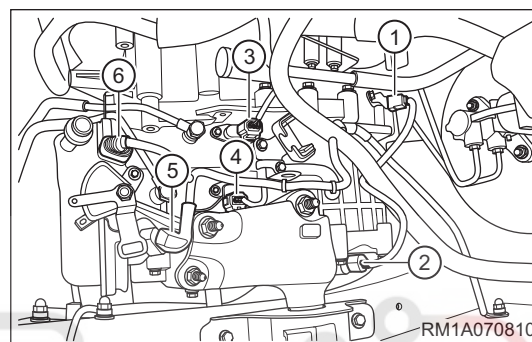


28. Disconnect the following wire harness connectors.

- a. Open fuse and relay box cover and remove battery wire harness fixing nuts (arrow), then disconnect connection between battery wire harness and engine compartment fuse and relay box.
(Tightening torque: 7 ± 1 N·m)



- b. Remove engine compartment fuse and relay box, and disconnect engine wire harness connector from engine compartment fuse and relay box.
- c. Disconnect the second shaft speed sensor connector (1) (for CVT model).
- d. Disconnect the second shaft pressure sensor connector (2) (for CVT model).
- e. Disconnect the turbo speed sensor connector (3) (for CVT model).
- f. Disconnect the primary shaft speed sensor connector (4) (for CVT model).
- g. Disconnect the transmission connector (5) (for CVT model).
- h. Disconnect the gear switch connector (6) (for CVT model).
- i. Disconnect primary shaft pressure sensor connector (arrow) and loosen clip (1) (for CVT model).
- j. Remove transmission ground wire fixing bolt (2) and move away transmission ground wire (for CVT model).
(Tightening torque: 15 ± 2 N·m)

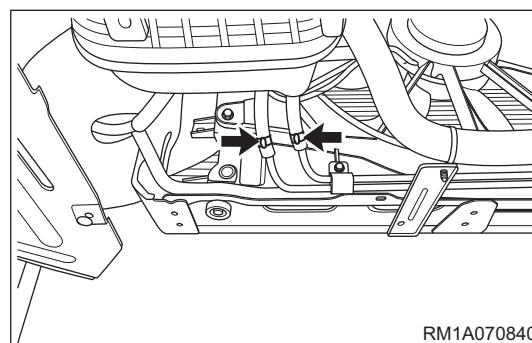


29. Remove the front wheel (See page 24-9).

30. Remove the drive shaft (See page 20-5).

31. Disconnect the transmission oil cooling pipe (for CVT model).

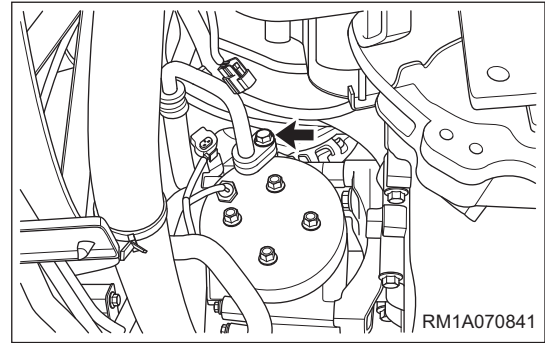
- a. Remove tightening clamps (arrow) and disconnect transmission oil cooling pipe.



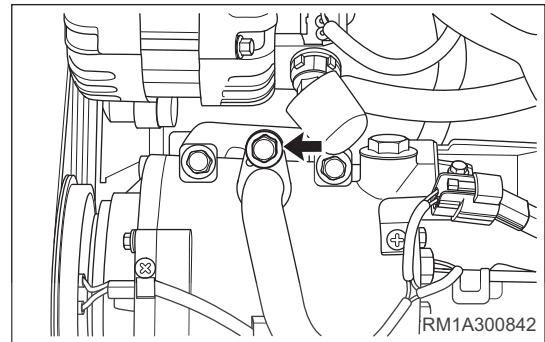
07 - E4T15B ENGINE MECHANICAL

32. Disconnect the A/C line.

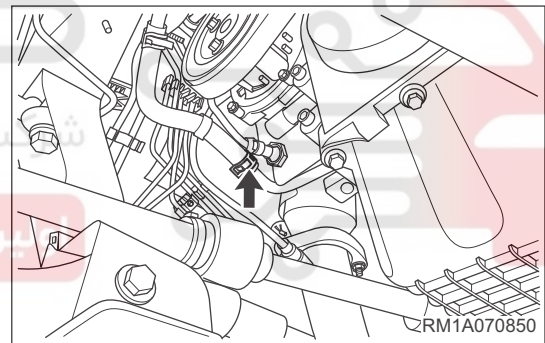
- a. Remove bolt (arrow) and disengage A/C high pressure line from compressor assembly.
(Tightening torque: 25 ± 4 N·m)



- b. Remove bolt (arrow) and disengage A/C low pressure line from compressor assembly.
(Tightening torque: 25 ± 4 N·m)



33. Loosen elastic clamp (arrow) and disconnect connection between expansion tank outlet hose and coolant pipe assembly I.



34. Use an engine equalizer to hang lifting eyes on both sides of engine.

35. Remove the engine rear mounting assembly (See page 07-70).

36. Remove the engine left mounting assembly (See page 07-70).

37. Remove the engine right mounting assembly (See page 07-70).

38. Confirm that all components are disconnected from engine and engine compartment.

39. Hang out power assembly from engine compartment.

40. Remove engine wire harness and battery wire harness from engine.

41. Separate engine and transmission.

42. Remove clutch from engine assembly.

43. Install engine on engine service platform.

Installation

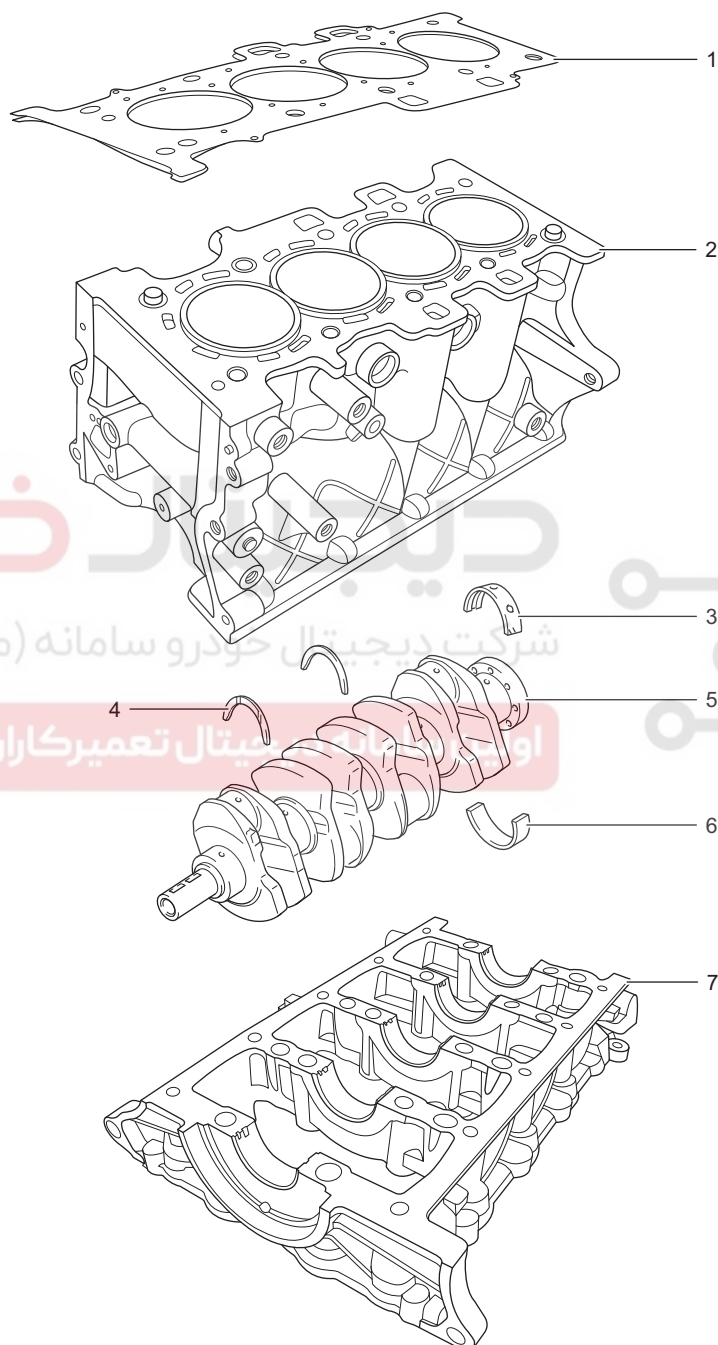
Installation is in the reverse order of removal.

CYLINDER BLOCK UNIT REPAIR

Cylinder Block

Description

07



RM1A070860

07 - E4T15B ENGINE MECHANICAL

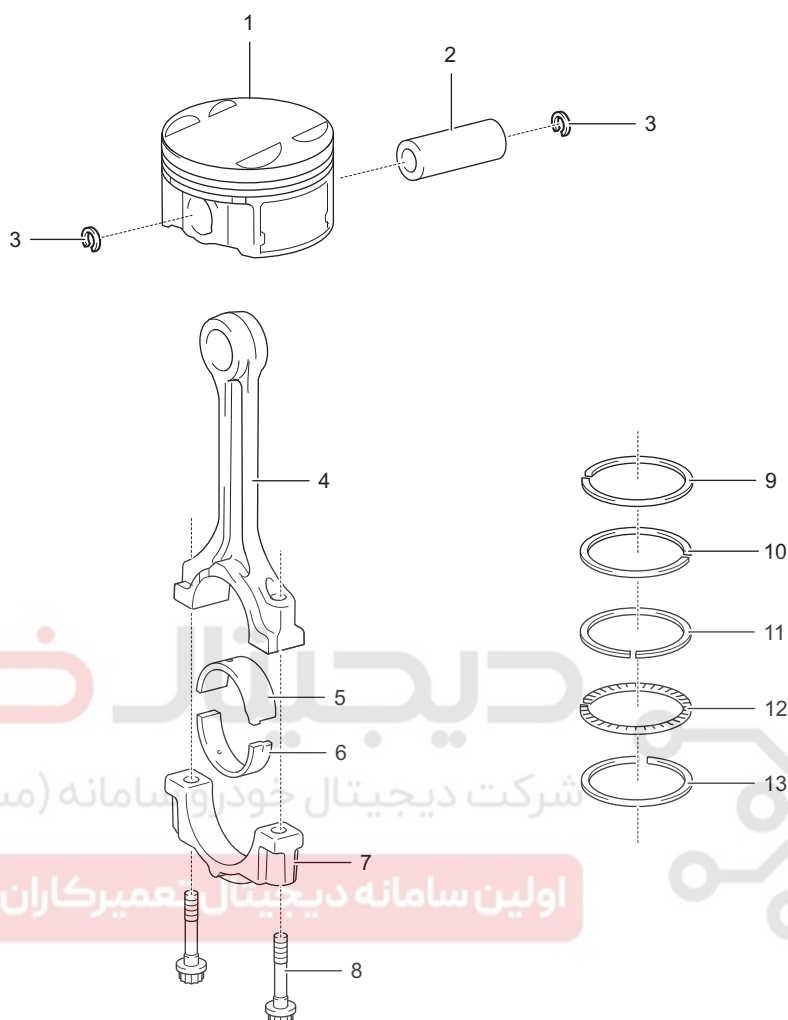
1 - Cylinder Head Gasket	2 - Cylinder Block
3 - Crankshaft Main Bearing Upper Shell	4 - Thrust Washer
5 - Crankshaft	6 - Crankshaft Main Bearing Lower Shell
7 - Crankshaft Frame	

دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران



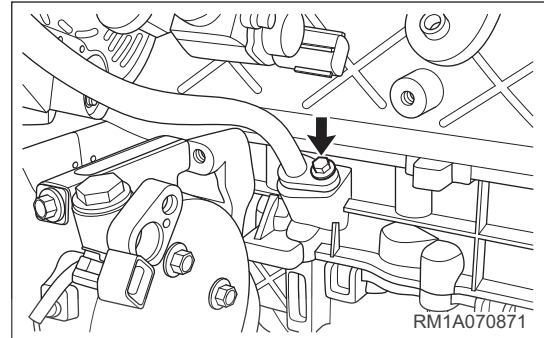


RM1A070870

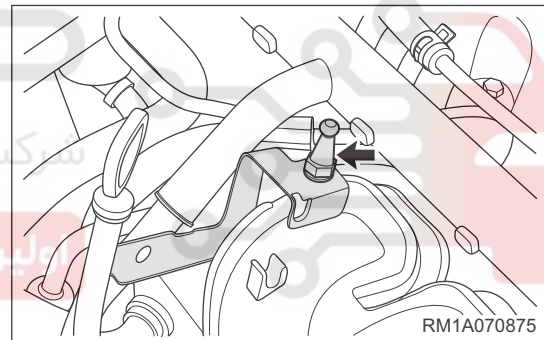
1 - Piston	2 - Piston Pin (Semi-floating)
3 - Piston Pin Snap Ring	4 - Connecting Rod
5 - Connecting Rod Bearing Upper Shell	6 - Connecting Rod Bearing Lower Shell
7 - Connecting Rod Bearing Cap	8 - Connecting Rod Bearing Cap Fixing Bolt
9 - First Compression Ring	10 - Second Compression Ring
11 - Upper Rail	12 - Expander
13 - Lower Rail	

Disassembly

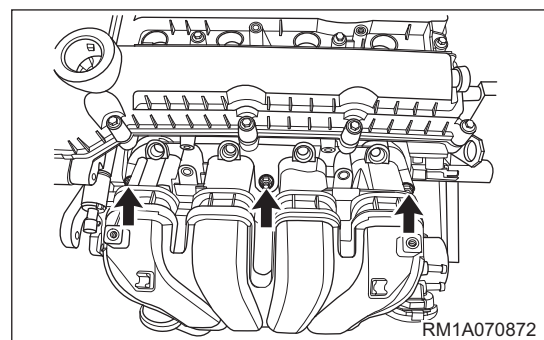
1. Remove engine assembly and install engine on engine service platform.
2. Remove the accessory drive belt (See page 07-24).
3. Remove the idler pulley assembly (See page 07-32).
4. Remove the belt tensioner assembly (See page 07-33).
5. Remove the fuel rail injector assembly (See page 08-26).
6. Remove the thermostat assembly (See page 12-20).
7. Remove the thermostat seat assembly (See page 12-22).
8. Remove the exhaust manifold assembly (See page 11-6).
9. Remove the oil dipstick tube with oil dipstick assembly.
 - a. Remove the oil dipstick tube fixing bolt (arrow).
(Tightening torque: 7 ± 1 N·m)



- b. Remove the engine trim cover bracket (arrow).
(Tightening torque: 7 ± 1 N·m)



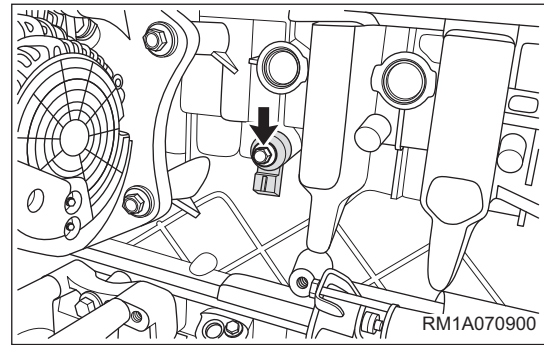
- c. Remove the oil dipstick tube with oil dipstick assembly.
10. Remove the intake manifold assembly (w/electronic throttle assembly).
 - a. Disconnect connection between positive crankcase vent hose and intake manifold.
 - b. Remove 3 fixing nuts (arrow) from intake manifold assembly.
(Tightening torque: 20 ± 5 N·m)



- c. Remove the intake manifold assembly (w/electronic throttle assembly and canister solenoid valve).

11. Remove the knock sensor.

- a. Remove knock sensor fixing bolt (arrow) and remove knock sensor.
(Tightening torque: 20 ± 5 N·m)



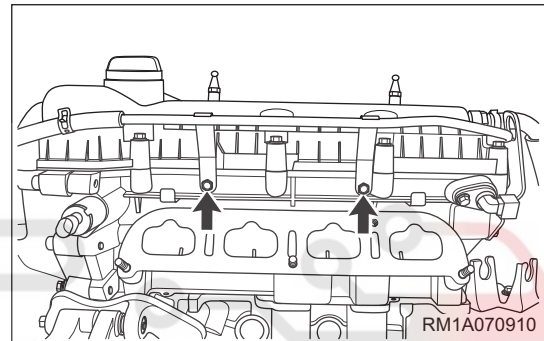
12. Remove the power steering pump (See page 29-15).

13. Remove the alternator and alternator bracket (See page 16-11).

14. Remove A/C compressor assembly and bracket (See page 30-61).

15. Remove the engine discharge pipe.

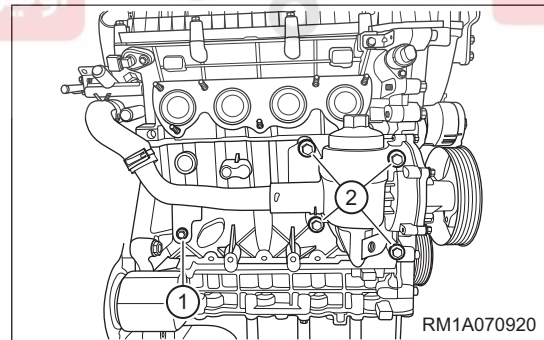
- a. Remove 2 fixing bolts (arrow) from engine discharge pipe.
(Tightening torque: 7 ± 1 N·m)



16. Remove the ignition coils and high-voltage cables (See page 14-8).

17. Remove the oil filter module with water pump assembly.

- a. Remove the coolant pipe assembly I fixing bolt (1).
(Tightening torque: 20 ± 5 N·m)
- b. Remove 4 fixing bolts (2) from oil filter module.
(Tightening torque: 40 ± 5 N·m)



CAUTION

- There will be coolant residue in engine. If coolant gets on your skin, wash off with water immediately.
- There will be oil residue in engine. Prolonged and repeated contact with engine oil will be harmful to your skin. If engine oil spills on your skin, wash it off immediately with water. In addition, used engine oil contains potentially harmful contaminants, which may cause skin cancer. Therefore, always take proper skin protection measures when performing vehicle service.

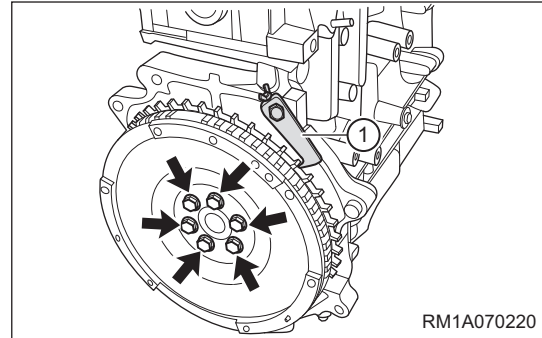


ENVIRONMENTAL PROTECTION

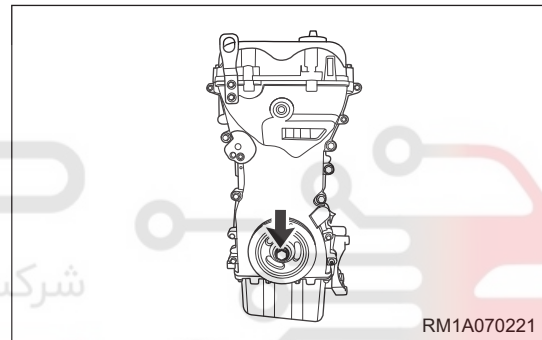
- There will be coolant and oil residue in engine. Wasted coolant should be handled according to local environmental regulations.

18. Remove the crankshaft pulley.

- a. As shown in illustration, install flywheel holding tool (1) to hold flywheel securely.



- b. Loosen the crankshaft pulley fixing bolt (arrow).
(Tightening torque: 1st step: tighten to 100 ± 10 N·m;
2nd step: retighten by $120^\circ \pm 10^\circ$)

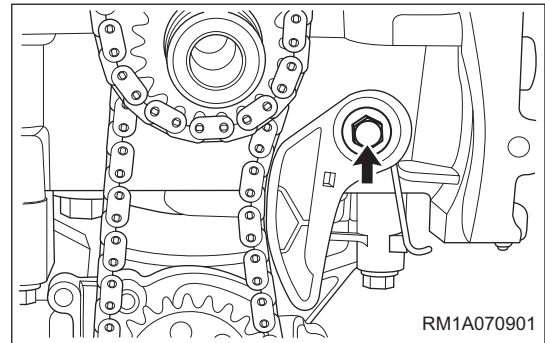


- c. Remove the crankshaft pulley.

19. Remove the crankshaft front oil seal (See page 07-39).
20. Remove the flywheel assembly (See page 07-41).
21. Remove the crankshaft rear oil seal (See page 07-43).
22. Remove the cylinder head cover (See page 07-34).
23. Remove the oil pan (See page 13-20).
24. Remove the engine timing chain (See page 07-45).
25. Remove camshaft (See page 07-53).
26. Remove the cylinder head (See page 07-58).
27. Remove the oil strainer (See page 13-23).
28. Remove the oil pump assembly (See page 13-24).

29. Remove the oil pump chain.

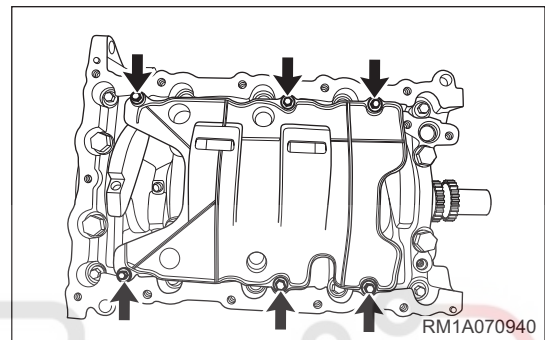
- a. Remove oil pump chain movable guide rail fixing bolt (arrow), and remove oil pump chain movable guide rail.
(Tightening torque: $20 \pm 5 \text{ N}\cdot\text{m}$)



- b. Remove the oil pump chain.

30. Remove the oil deflector assembly.

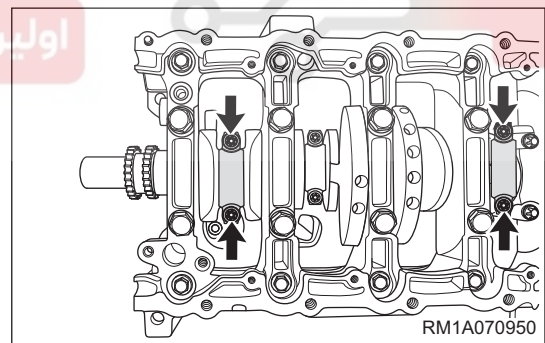
- a. Remove 6 fixing bolts (arrow) from oil deflector assembly.
(Tightening torque: $8 + 3 \text{ N}\cdot\text{m}$)



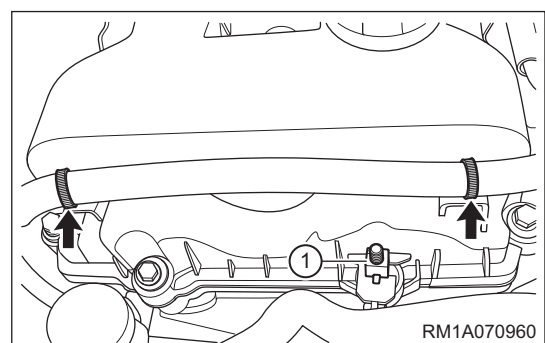
- b. Remove the oil deflector assembly.

31. Remove the piston connecting rod assembly.

- a. Using a ridge reamer or equivalent, remove all carbon deposit from top of cylinder.
- b. Turn crankshaft counterclockwise at flywheel side, so that cylinder 1 and 4 are at bottom dead center, remove fixing bolts (arrow) from cylinder 1 and 4 connecting rod bearing caps, and remove cylinder 1 and cylinder 4 connecting rod bearing caps.



- c. Using a hammer handle (1), push cylinder 1 and cylinder 4 piston connecting rod assembly (2) out of cylinder block.



- d. Removal procedures for cylinder 2 and cylinder 3 piston connecting rod assembly are the same as above.

CAUTION

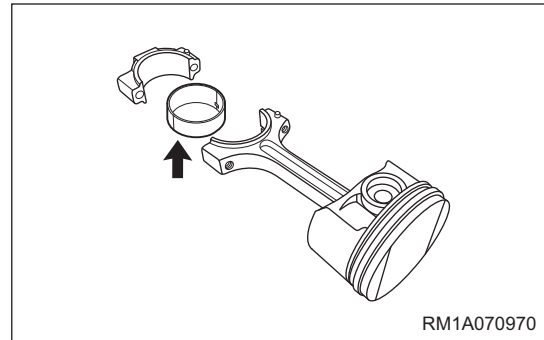
- Operate careful during removal, avoid damaging cylinder liner.

32.Remove the connecting rod bearing.

- a. Remove the connecting rod bearing (arrow).

HINT:

Arrange removed parts in correct order.



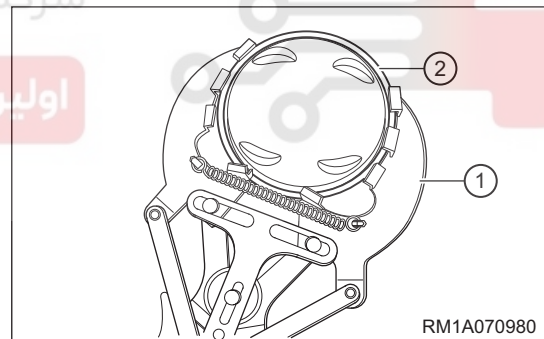
07

CAUTION

- Be careful not to scratch cylinder wall during operation.
- Attach a label with corresponding number to each piston connecting rod assembly to prevent incorrect installation.

33.Remove the piston rings.

- a. Using a piston ring remover (1), remove 2 compression rings (2).

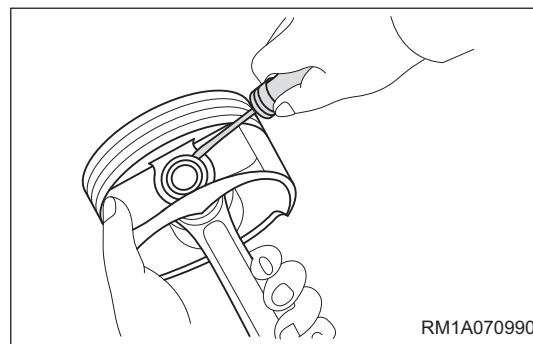
**CAUTION**

- Before removing piston ring, check piston ring side clearance. If it is necessary to be reused, be sure to mark piston ring position.

- b. Remove oil ring rail and expander by hands.

34. Separate piston and piston connecting rod.

- a. Using a flat tip screwdriver, pull out piston pin snap rings from two ends of piston pin.

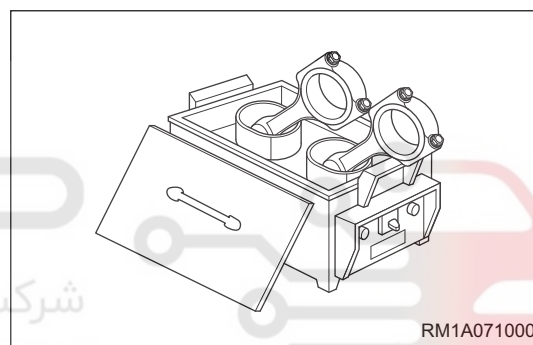


CAUTION

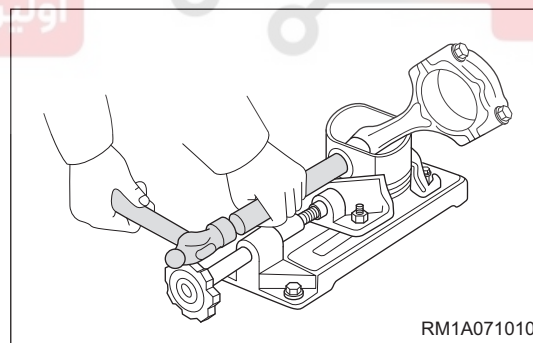
- Piston pin snap ring has a large tensile force. Make sure to take it out carefully during removal to prevent personal injury.

07

- b. Gradually heat pistons to 80°C - 90°C.

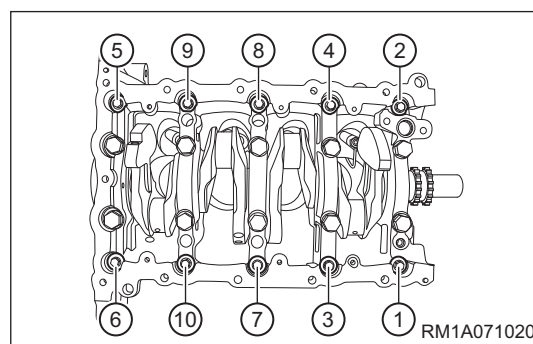


- c. Gently tap out piston pin and remove connecting rod with a rubber hammer and a brass bar.



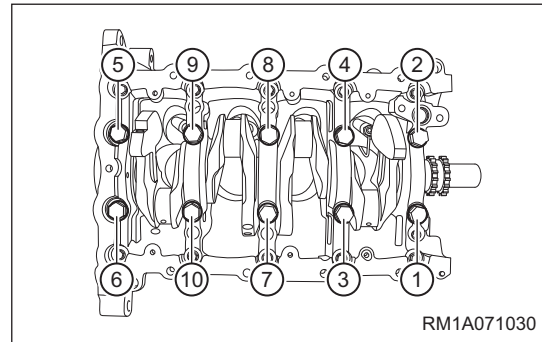
35. Remove the crankshaft.

- a. Evenly loosen and remove 10 crankshaft frame fixing bolts in order shown in illustration.



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- b. Evenly loosen and remove 10 main bearing cap fixing bolts in order shown in illustration.



- c. Remove the crankshaft frame.

HINT:

If it is difficult to remove crankshaft frame due to seal gum, tap it gently with a rubber hammer to make it loose. Be sure not to damage surrounding components.

- d. Take out the crankshaft.

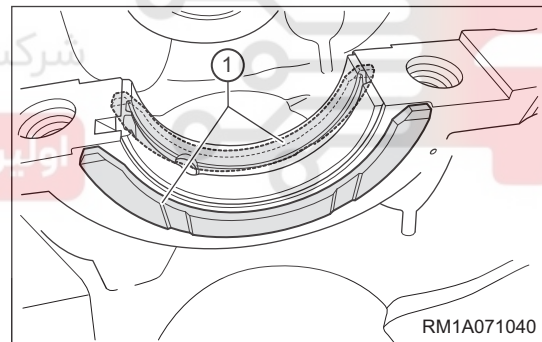
07

CAUTION

- Take care when removing crankshaft, as it is heavy. If necessary, ask other operators to assist.
- Take particular care when removing crankshaft. Avoid scratching contact surfaces of crankshaft and bearing shell.

36. Remove the crankshaft thrust washers.

- a. Remove crankshaft thrust washers (1) from cylinder block.

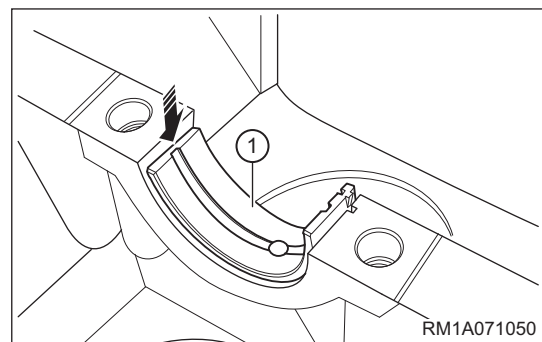


37. Remove the crankshaft main bearing shell.

- a. Slightly push crankshaft main bearing upper shell (1) in direction of arrow and remove it carefully.

HINT:

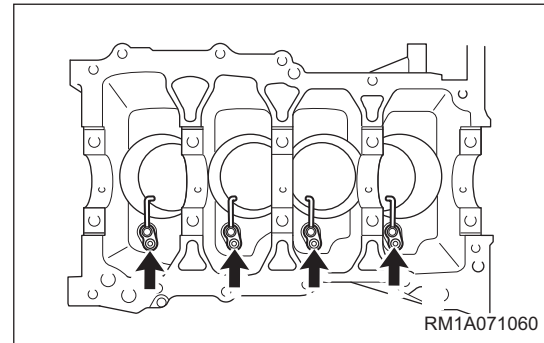
- Remove other crankshaft main bearing upper shells from cylinder block in the same way.
- Pay attention to the notch position. Push out bearing shell carefully as shown in illustration. It is difficult to push out bearing shell and parts may be damaged if pushing in opposite direction.



- b. Remove crankshaft main bearing lower shell from crankshaft frame in the same way.

38. Remove the piston cooling nozzles.

- a. Remove piston cooling nozzle fixing bolts (arrow), and remove piston cooling nozzles.



Inspection

1. Check the cylinder block.

- Clean cylinder block thoroughly and check all hole passages for leakage.
- Check cylinder block and cylinder bore for cracks.
- Check bottom surface of cylinder block for cracks.

07

CAUTION

- DO NOT wash cylinder at high temperature; otherwise, cylinder liner will stick out beyond cylinder block.

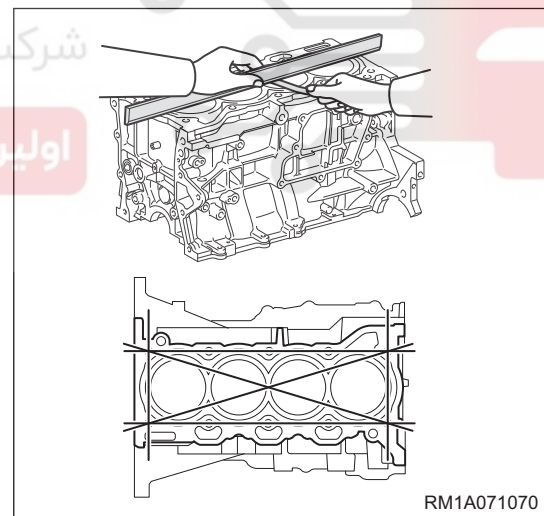
2. Check flatness of cylinder block upper surface.

- a. Clean the cylinder block upper surface.
- b. Using a precision straightedge and feeler gauge, measure flatness of cylinder block upper surface.

Measurement Item	Specification (mm)
Cylinder Block Upper Surface Flatness (E4G15)	0.04
Cylinder Block Upper Surface Flatness (E4T15B)	0.04

If upper surface flatness exceeds specified value, adjust it. If upper surface flatness exceeds limit value, replace cylinder block assembly.

- Maximum allowable wear thickness of cylinder block is 0.15 mm.
- Maximum total allowable wear thickness of cylinder block and cylinder head is 0.20 mm.



3. Check the cylinder.

- a. Roundness and cylindricity calculation method for cylinder (for general measurement):

Thrust direction - perpendicular to axis of crankshaft; Axial direction: parallel with axis of crankshaft

- Cylindricity calculation method

Cylindricity is half of diameter difference measured in the same direction.

Cylindricity in thrust direction = (maximum bore diameter measured at A, B and C in thrust direction - minimum bore diameter measured at A, B and C in thrust direction)/2

Cylindricity in axial direction = (maximum bore diameter measured at A, B and C in axial direction - minimum bore diameter measured at A, B and C in axial direction)/2

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Compare maximum value measured at 2 directions with standard cylinder cylindricity.

- Roundness calculation method

Roundness error is half of diameter difference measured at the same section.

Roundness of section A = (maximum bore diameter measured in thrust direction and axial direction at point A - minimum bore diameter measured in thrust direction and axial direction at point A)/2

Roundness of section B = (maximum bore diameter measured in thrust direction and axial direction at point B - minimum bore diameter measured in thrust direction and axial direction at point B)/2

Roundness of section C = (maximum bore diameter measured in thrust direction and axial direction at point C - minimum bore diameter measured in thrust direction and axial direction at point C)/2

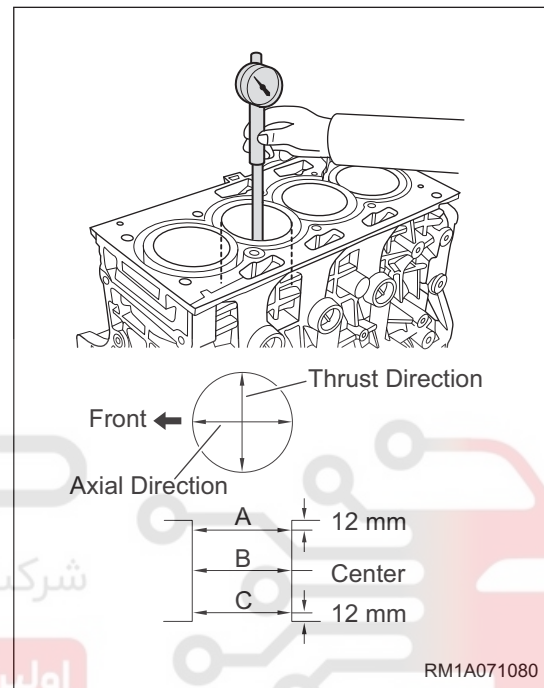
Compare maximum value measured at A, B and C with standard cylinder roundness.

- Check cylindricity of cylinder.

Using a cylinder gauge, measure cylinder bore at positions A, B and C in thrust and axial directions.

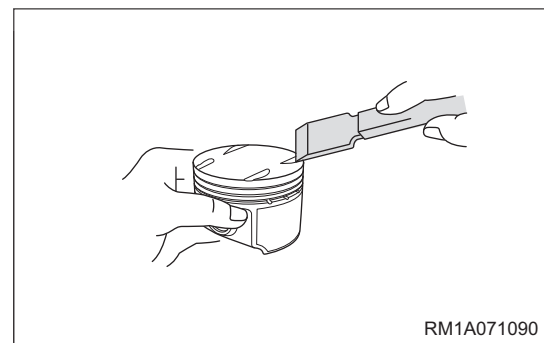
Measurement Item	Specification (mm)
Cylinder Cylindricity (E4G15)	0.01
Cylinder Roundness (E4G15)	0.008
Cylinder Cylindricity (E4T15B)	0.01
Cylinder Roundness (E4T15B)	0.008

If cylindricity or roundness value measured at positions A, B and C exceeds specified value, replace cylinder block.

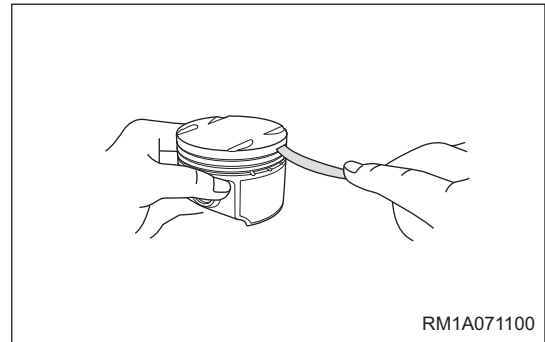


- Check the piston.

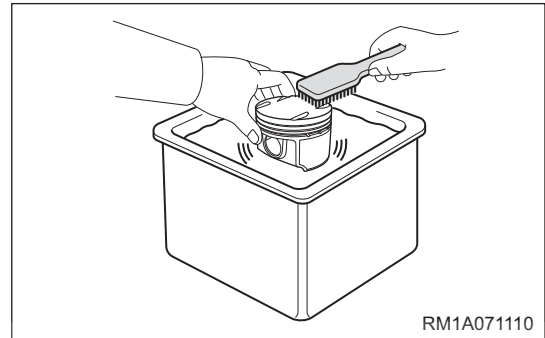
- Using a scraper, remove carbon deposits on piston top.



- b. Using a piston ring, remove carbon deposits from piston ring grooves.



- c. Using a brush and solvent, thoroughly clean piston.



07

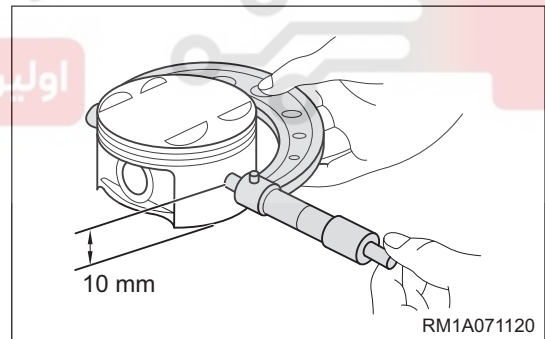
CAUTION

- DO NOT use a wire brush to clean.

- d. Measure piston diameter with a micrometer at position, that is approximately 10 mm below piston skirt in vertical direction of piston pin.

Measurement Item	Specification (mm)
Piston Diameter (E4G15)	$\phi 76.950 \pm 0.009$
Piston Diameter (E4T15B)	76.955 - 76.965

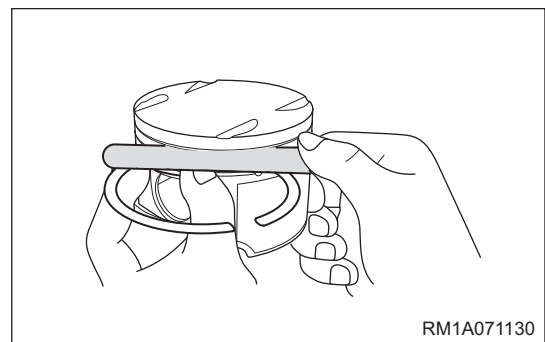
If piston diameter is not within specified range, replace piston connecting rod assembly.



5. Check clearance between piston ring and ring groove side.

Using a feeler gauge, measure clearance between new piston ring and ring groove side.

Measurement Item		Specification (mm)
Piston Ring Side Clearance (E4G15)	First ring	0.035 - 0.080
	Second ring	0.030 - 0.075
Piston Ring Side Clearance (E4T15B)	First ring	0.020 - 0.065
	Second ring	0.020 - 0.060



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If piston ring side clearance is not within specified range, replace piston connecting rod assembly.

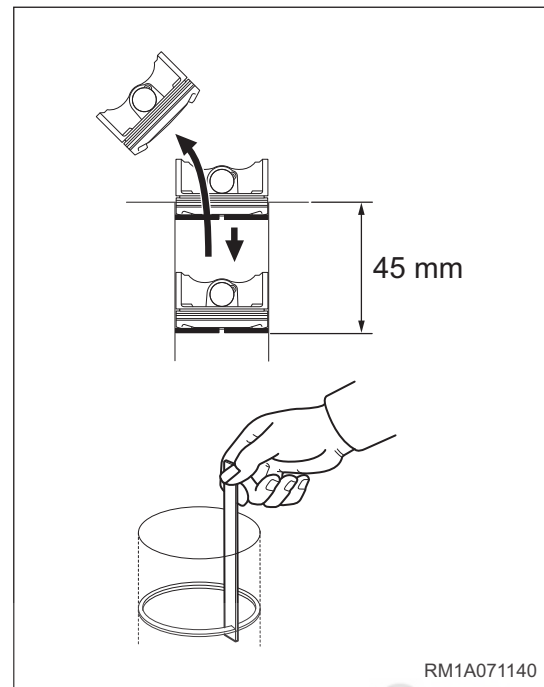
6. Check the piston ring end gap.
 - a. Using a piston, push piston ring from top of cylinder block to a place, that is about 45 mm from top of cylinder bore.
 - b. Using a feeler gauge, measure end gap.

Measurement Item		Specification (mm)
Piston Ring End Gap (E4G15)	First ring	0.2 - 0.4
	Second ring	0.4 - 0.6
Piston Ring End Gap (E4T15B)	First ring	0.2 - 0.3
	Second ring	0.3 - 0.5

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If piston ring end gap is not within specified range, replace piston rings with a new set.

If end gap is still not within specified range after replacement, replace cylinder block.

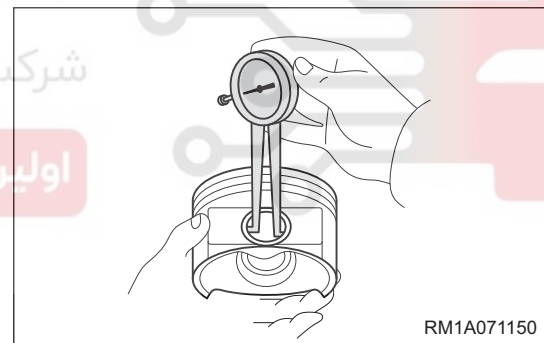


RM1A071140

7. Check the piston pin.
 - a. Using a feeler gauge, measure diameter of piston pin hole.

Measurement Item	Specification (mm)
Piston Pin Hole Diameter (E4G15)	$\phi 18^{+0.010}_{+0.004}$
Piston Pin Hole Diameter (E4T15B)	18.004 - 18.009

If piston pin hole diameter is not within specified range, replace piston with a new one.

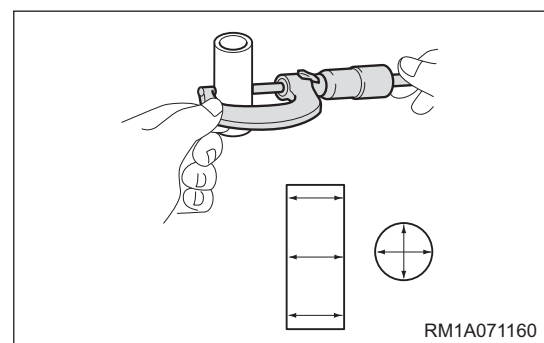


RM1A071150

- b. Using an outer diameter micrometer, measure diameter of piston pin.

Measurement Item	Specification (mm)
Piston Pin Diameter (E4G15)	$\phi 18^0_{-0.005}$
Piston Pin Diameter (E4T15B)	17.995 - 18

If piston pin diameter is not within specified range, replace piston pin with a new one.

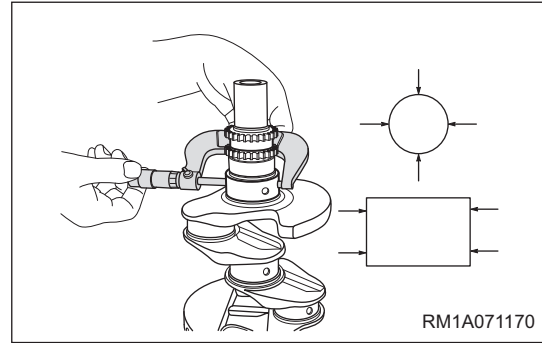


RM1A071160

8. Check diameter of crankshaft main journal.

- a. Measure main journal diameter with an outer diameter micrometer, and measure again after rotating crankshaft 90°.

Measurement Item	Specification (mm)
Crankshaft Main Journal Diameter (E4G15)	$\phi 54^{+0}_{-0.016}$
Crankshaft Main Journal Diameter (E4T15B)	50



If crankshaft main journal diameter is not within specified range, replace main bearing shells with new ones and check radial clearance of crankshaft.

If radial clearance of main bearing shell is still not within specified range after replacement, replace crankshaft.

- b. Calculate roundness and cylindricity for crankshaft with measured values (measured area is shown in illustration).

Roundness and cylindricity calculation method (for general measurement):

- Measure diameter twice on the same cross section, and roundness is half of difference between maximum and minimum values.

$$\text{Roundness} = (\text{maximum measurement diameter} - \text{minimum measurement diameter})/2$$

- As shown in illustration, measure diameter twice in different directions on two cross sections separately to obtain four values. Cylindricity is half of difference between maximum and minimum values among four values.

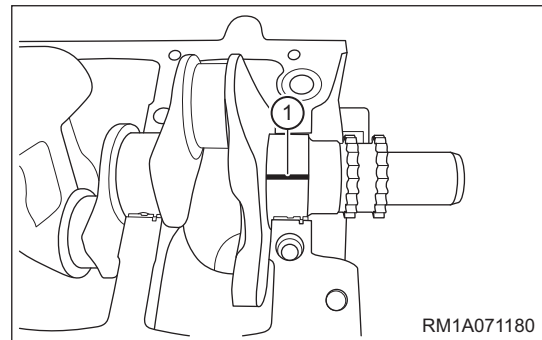
$$\text{Cylindricity} = (\text{maximum measurement diameter} - \text{minimum measurement diameter})/2$$

Measurement Item	Specification (mm)
Crankshaft Main Journal (E4G15)	Cylindricity
	0.007
Crankshaft Main Journal (E4T15B)	Roundness
	0.04
Crankshaft Main Journal (E4T15B)	Cylindricity
	0.007
Crankshaft Main Journal (E4T15B)	Roundness
	0.004

If roundness or cylindricity of crankshaft main journal exceeds specified value, replace crankshaft.

9. Check the crankshaft radial clearance.

- a. Clean crankshaft main journals and main bearing shells.
- b. Install the crankshaft. Place plastic feeler gauge (1) on crankshaft main journal, parallel to crankshaft center axis and as wide as distance covered by main bearing cap.



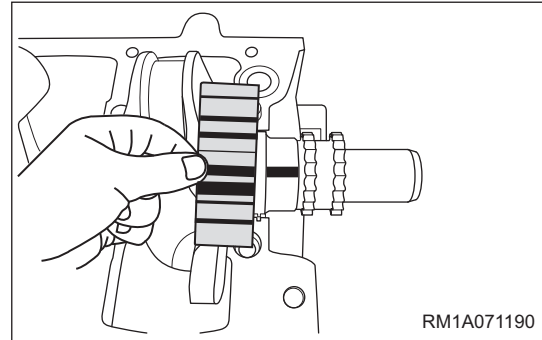
- c. Install crankshaft frame and tighten main bearing cap fixing bolts to specified torque in order.

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- d. Remove the main bearing caps. Using a feeler gauge, measure widest part of compressed feeler gauge. Measured value is crankshaft radial clearance.

Measurement Item	Specification (mm)
Crankshaft Radial Clearance (E4G15)	0.021 - 0.060
Crankshaft Radial Clearance (E4T15B)	0.023 - 0.075

If crankshaft radial clearance is not within specified range, install new main bearing shells. Replace crankshaft if necessary.



 CAUTION

- Replace bearing shells in pairs.

07

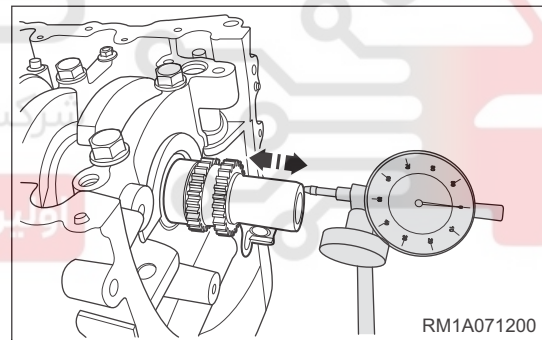
For selection of main bearing shell, refer to 07-97.

10. Check the crankshaft axial clearance.

- Clean crankshaft main journals and main bearing shells.
- Install crankshaft frame and tighten crankshaft frame fixing bolts to specified torque in order.
- Push crankshaft forward and backward and read value from dial indicator.

Measurement Item	Specification (mm)
Crankshaft Axial Clearance (E4G15)	0.070 - 0.265
Crankshaft Axial Clearance (E4T15B)	0.070 - 0.265

If crankshaft axial clearance is not within specified range, replace thrust washers as a set.

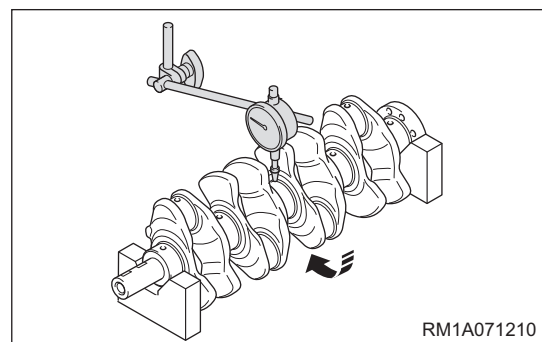


11. Check the crankshaft coaxiality.

- Install crankshaft onto tester and keep it level as shown in illustration.
- Rotate crankshaft slowly and read maximum change value from dial indicator. (Readings from dial indicator)/2 is coaxiality of crankshaft.

Measurement Item	Specification (mm)
Crankshaft Coaxiality (E4G15)	0.04
Crankshaft Coaxiality (E4T15B)	0.05

If crankshaft main journal runout is not within specified range, replace crankshaft.



12. Check diameter of crankshaft connecting rod journal.

- a. Using an outer diameter micrometer, measure diameter of crankshaft connecting rod journal.

Measurement Item	Specification (mm)
Crankshaft Connecting Rod Journal Diameter (E4G15)	$\phi 47.9^{+0}_{-0.016}$
Crankshaft Connecting Rod Journal Diameter (E4T15B)	46

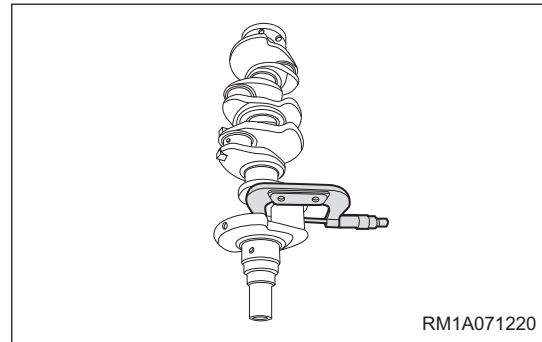
If connecting rod journal diameter is not within specified range, replace connecting rod bearing shells with new ones, and check radial clearance of connecting rod bearing shell.

If radial clearance of connecting rod bearing shell is still not within specified range after replacement, replace crankshaft.

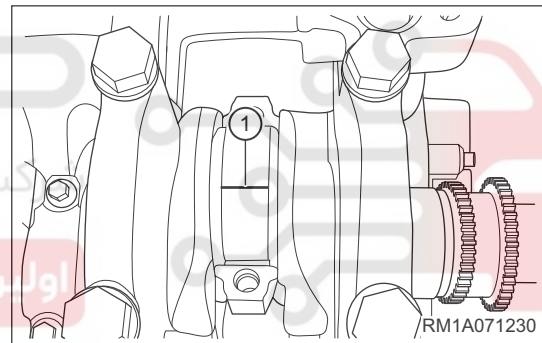
For selection of connecting rod bearing shell, refer to 07-97.

13. Check radial clearance of crankshaft connecting rod bearing shell.

- a. Clean connecting rod journals and connecting rod bearing shells.
b. Place a feeler gauge (1) on connecting rod journal as shown in illustration.



07



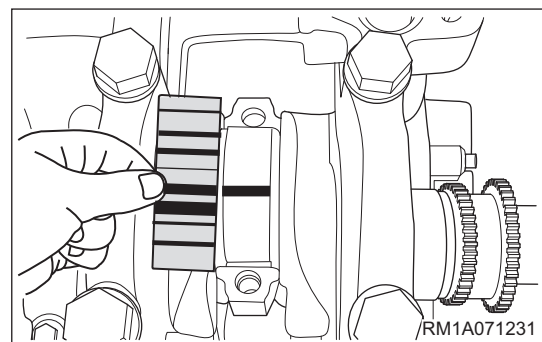
- c. Install connecting rod bearing caps, and tighten connecting rod bearing cap fixing bolts to specified torque.

 CAUTION

- DO NOT turn crankshaft during installation.

- d. Remove the connecting rod bearing caps.
e. Using gauge scale of feeler gauge, measure widest part of compressed feeler gauge to obtain radial clearance of connecting rod bearing shell as shown in illustration.

Measurement Item	Specification (mm)
Connecting Rod Bearing Shell Radial Clearance (E4G15)	0.016 - 0.061
Connecting Rod Bearing Shell Radial Clearance (E4T15B)	0.026 - 0.075

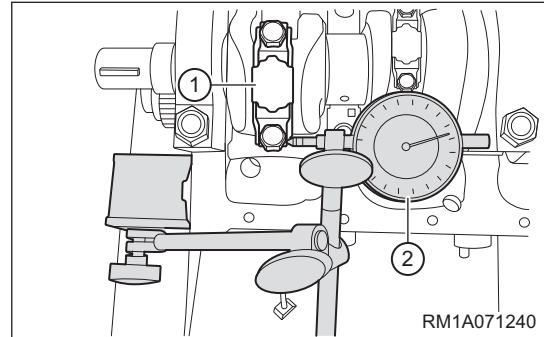


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If radial clearance of connecting rod bearing shell is not within specified range, replace connecting rod bearing shells. Replace crankshaft if necessary.

14. Check the connecting rod big end axial clearance.

- a. Install connecting rod bearing caps, and tighten connecting rod bearing cap fixing bolts to specified torque.
- b. Install a dial indicator (2) with its plunger contacting the side of connecting rod cap (1).
- c. Turn the dial of dial indicator to reset it to zero.
- d. Push connecting rod cap forward and backward (do not move crankshaft forward and backward) and read value on dial indicator.



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Measurement Item	Specification (mm)
Connecting Rod Big End Axial Clearance (E4G15)	0.15 - 0.40
Connecting Rod Big End Axial Clearance (E4T15B)	0.15 - 0.40

If axial clearance of connecting rod big end is not within specified range, replace piston connecting rod assembly.

دیجیتال خودرو

شرکت دیجیتال خودرو سامانه (مسئولیت محدود)

اولین سامانه دیجیتال تعمیرکاران خودرو در ایران

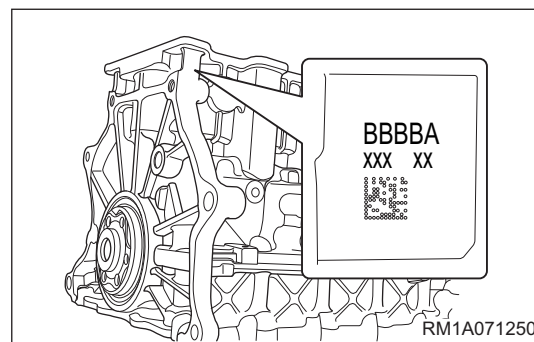


Selection of Bearing Shell

Selection of Main Bearing Shell

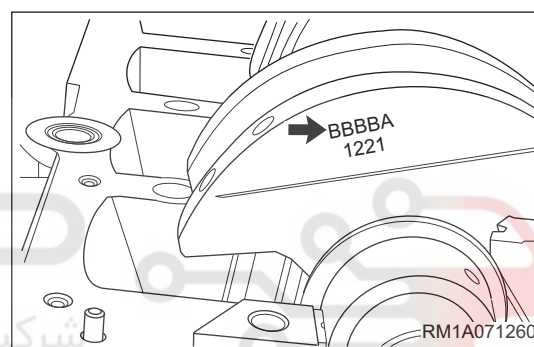
1. Selection of crankshaft main bearing upper shell.
 - a. Related letter marks are available on cylinder block (consisting of A and B). Such as "BBBBA" in the illustration, each letter from left to right is for one type of crankshaft bearing upper shell. First letter "B" is for the upper shell type of crankshaft main bearing first journal, and so on; fifth letter "A" is for the upper shell type of crankshaft main bearing fifth journal.

Name	Color	Cylinder Block Mark
Main Bearing Upper Shell	Red	A
	Blue	B



2. Selection of crankshaft main bearing lower shell.
 - a. Related marks are available on first balancer at front end of crankshaft (consisting of A and B). Such as "BBBBA" on the first crankshaft front end balancer shown in illustration, first letter "B" is for the lower shell type of crankshaft main bearing first journal, and so on; fifth letter "A" is for the lower shell type of crankshaft main bearing fifth journal.

Name	Color	Cylinder Block Mark
Main Bearing Lower Shell	Red	A
	Blue	B



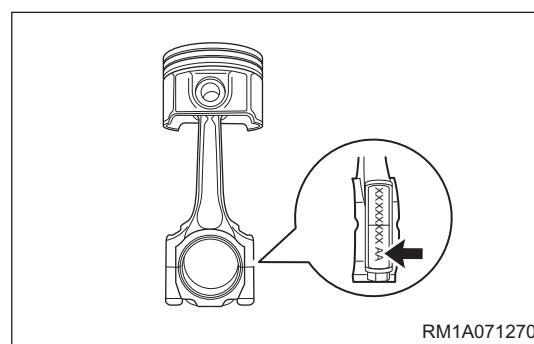
3. Assembly precautions for crankshaft main bearing shell:
 - a. There is a shell groove and oil hole on the main bearing upper shell, and oil hole should be aligned with that on cylinder block, but the main bearing lower shell has no oil hole.
 - b. Apply a coat of engine oil to inner surface of main bearing shell before installation. Back side of bearing shell should be clean without any oil or foreign matter during assembly.

Selection of Connecting Rod Bearing Shell

1. Selection of connecting rod bearing upper shell.
 - a. Connecting rod bearing upper shells are divided into red shells and blue shells. Related marks are available on connecting rod. Select related connecting rod bearing shell according to marks.

As shown in illustration, among mark "130523 A" on connecting rod, "A" indicates "red" shell.

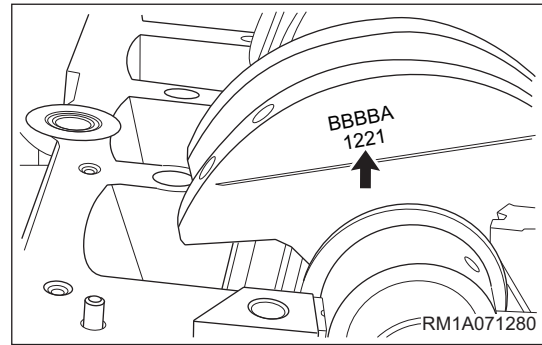
Name	Color	Connecting Rod Mark
Connecting Rod Bearing Upper Shell	Red	A
	Blue	B



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2. Selection of connecting rod bearing lower shell.

- a. Related digital marks are available on first balancer at front end of crankshaft (consisting of 1 and 2). Such as "1221" on the first crankshaft front end balancer shown in illustration, first digit "1" is for the lower shell type of cylinder 1 piston connecting rod, and so on; fourth digit "1" is for the lower shell type of cylinder 4 piston connecting rod.



Name	Color	Connecting Rod Mark
Connecting Rod Bearing Lower Shell	Red	1
	Blue	2

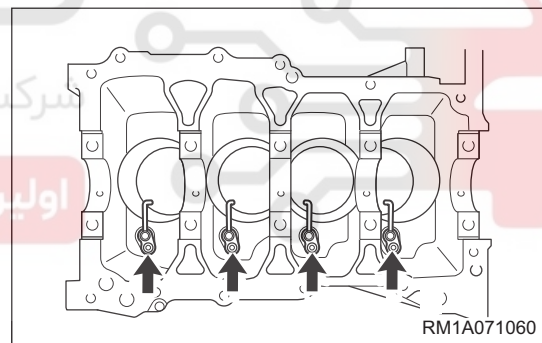
3. Assembly precautions for connecting rod bearing shell:

- a. Connecting rod upper and lower bearing shells without oil grooves are universal, but one of the connecting rod bearing shells has an oil hole.
- b. It is necessary to use a set of connecting rod bearing shells that are provided by the same manufacturer on the same engine.
- c. Apply a coat of engine oil to inner surface of connecting rod bearing shell before installation. Back side of bearing shell should be clean without any oil or foreign matter during assembly.

Assembly

1. Install the piston cooling nozzles.

- a. Install piston cooling nozzles and tighten piston cooling nozzle fixing bolts.

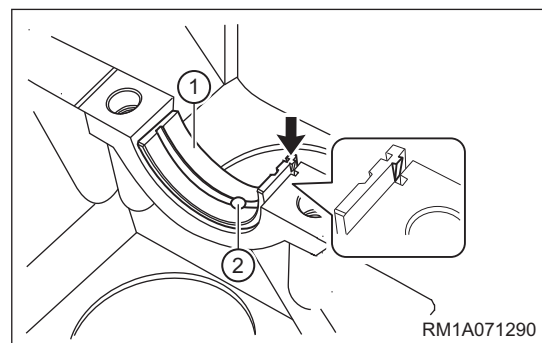


2. Install the crankshaft main bearing shells.

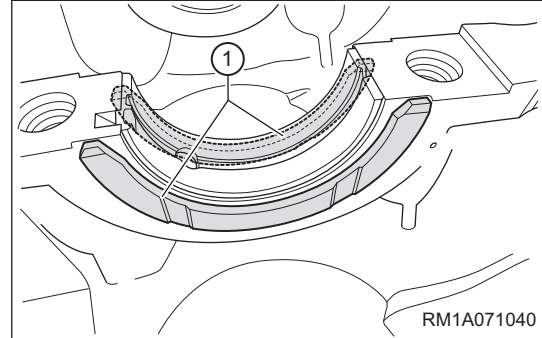
CAUTION

- Apply a coat of engine oil to inner surface of main bearing shell before installation.

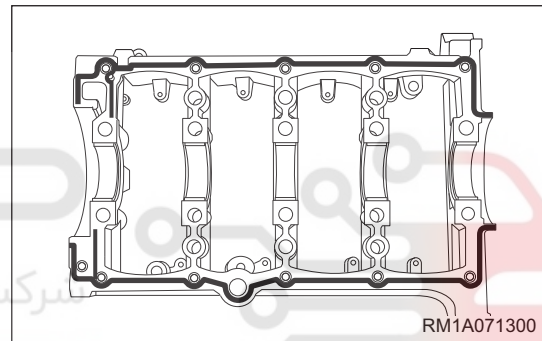
- a. Carefully install crankshaft main bearing upper shell (1) in direction of arrow, and the notch of each main bearing should be aligned with cylinder block. Oil passage hole (2) on crankshaft main bearing upper shell should be aligned with the passage hole on cylinder block after installation.



- b. Install crankshaft main bearing lower shell to crankshaft frame in the same way.
3. Install the crankshaft thrust washers.
- Clean crankshaft thrust washers and cylinder block inner wall before installation.
 - Apply a coat of engine oil to crankshaft thrust washers.
 - There are 2 crankshaft thrust washers on cylinder, which are installed on front and rear sides of thrust surface (both sides of 3rd bearing) respectively.
 - As shown in illustration, the two grooves on one side of crankshaft thrust washers (1) face outward while other side without groove is jointed with cylinder block inner wall.



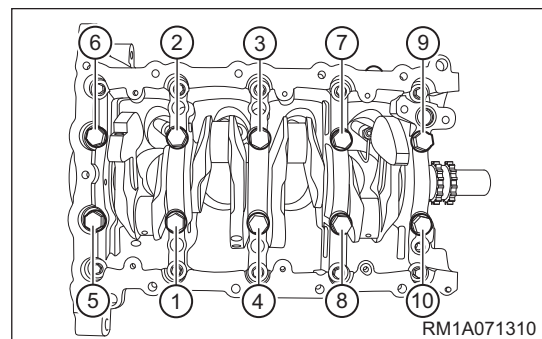
4. Install the crankshaft.
- Apply seal gum to installation surface of crankshaft frame before installation.



CAUTION

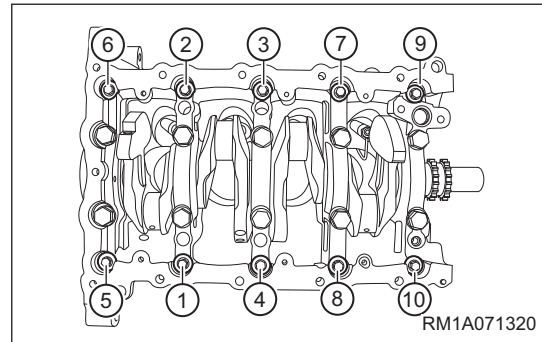
- DO NOT apply seal gum into bearing shell installation area when applying seal gum.
- Seal gum should not be applied too thick. Avoid seal gum entering bearing shell installation area due to compression.

- b. Place crankshaft on cylinder block carefully.
- c. Install crankshaft main bearing cap fixing bolts in place by hands, and then tighten 10 crankshaft main bearing cap fixing bolts in order shown in illustration. (Tightening torque: 1st step: tighten to 45 ± 5 N·m; 2nd step: retighten by $180^\circ \pm 10^\circ$)



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- d. Evenly tighten 10 crankshaft frame fixing bolts in order shown in illustration.
(Tightening torque: 20 ± 3 N·m)



5. Assembly piston and piston connecting rod.

CAUTION

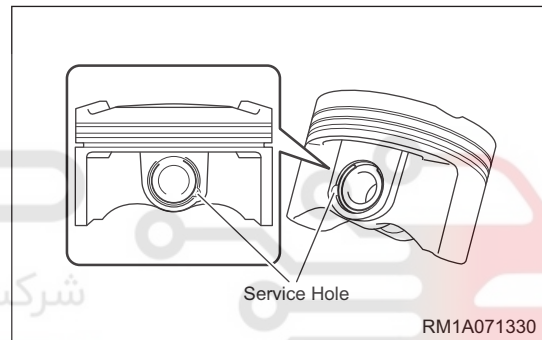
- Apply a coat of clean engine oil to piston pin outer surface and piston hole inner surface before assembly.

07

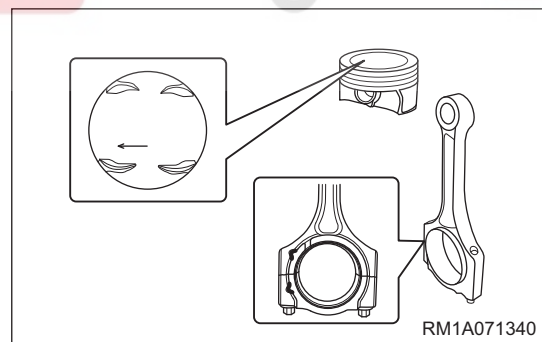
- a. Using a small screwdriver, install new piston pin snap ring to one end of piston pin service hole.

HINT:

Make sure to stagger end gap of piston pin snap ring and cutout of piston pin service hole.



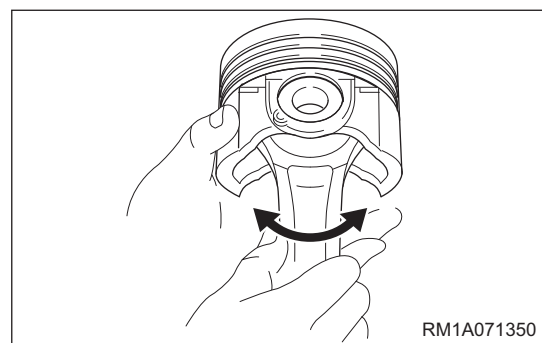
- b. Gradually heat pistons to about 80°C - 90°C.
c. Align front marks on piston and piston connecting rod and push piston pin in with your thumb, until piston pin contacts snap ring pin hole.



- d. Install piston pin snap ring to other end of piston pin service hole, and check if piston pin rotates smoothly after installation.

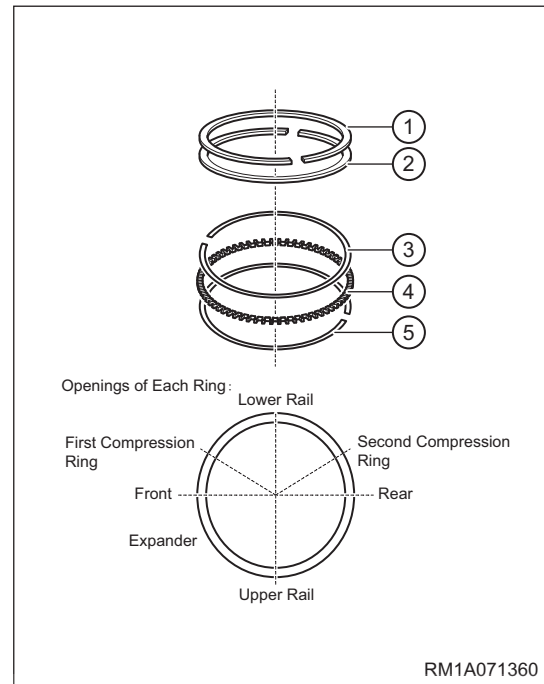
HINT:

Make sure to stagger end gap of piston pin snap ring and cutout of piston pin service hole.



6. Install the piston rings.

- a. Apply a small amount of engine lubricant to piston ring grooves and piston. Note that the side with words for first compression ring (1) and second compression ring (2) should face piston top.
- b. Oil ring is steel band combination oil ring and composed of upper rail (3), lower rail (5) and expander (4). When installing oil ring, first install expander into oil groove, then install two rails with two rails opening of steel band combination oil ring staggered by 90° from expander closed gap, and the upper and lower rails form an angle of 180° . Then install the second compression ring, and install the first compression ring finally with two compression rings staggered by 120° from the upper rail opening. Piston ring should rotate in ring groove freely without any stuck condition.



07

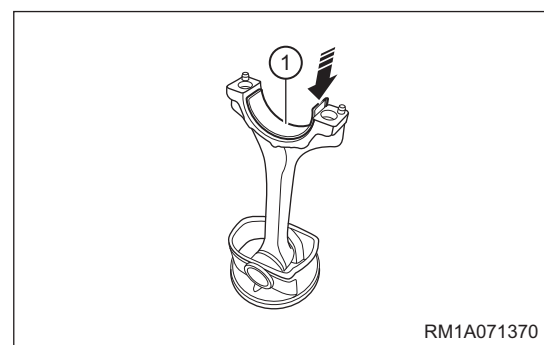
- c. Rotate piston ring several turns after applying engine oil to piston ring groove, and note that position of ring notch should be the same with that described above; clean crankshaft connecting rod journal and cylinder bore with a non-woven fabric cloth.

7. Install the connecting rod bearing shells.

CAUTION

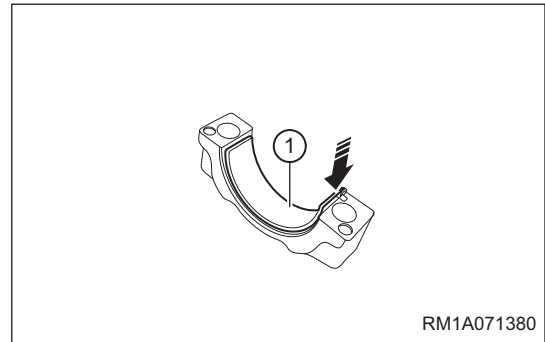
- Apply a coat of engine oil to inner surface of connecting rod bearing shell before installation.
- Back side of connecting rod bearing shell should be clean without any oil or foreign matter during assembly.

- a. Carefully install connecting rod bearing upper shell (1) in direction of arrow, and keep groove opening of each connecting rod bearing upper shell face piston and connecting rod assembly.

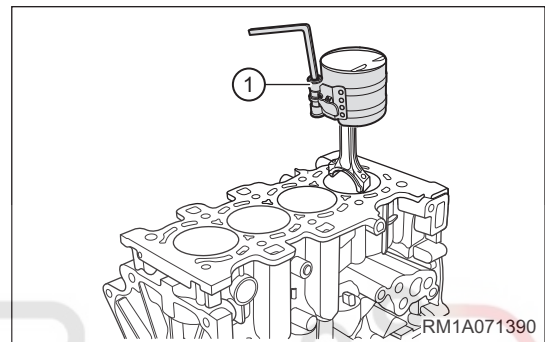


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- b. Carefully install connecting rod bearing lower shell (1) in direction of arrow, and keep groove opening of each connecting rod bearing lower shell face connecting rod bearing cap.

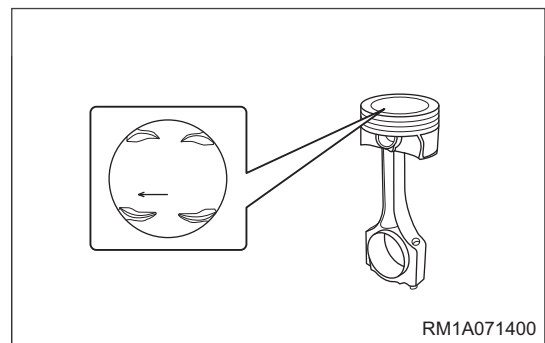


8. Install the piston connecting rod assembly.
- Rotate crankshaft to top dead center of cylinders 1 and 4.
 - Apply a coat of engine oil to piston surface and cylinder inner wall.
 - As shown in illustration, install piston connecting rod assembly to cylinder with a piston installer (1).



CAUTION

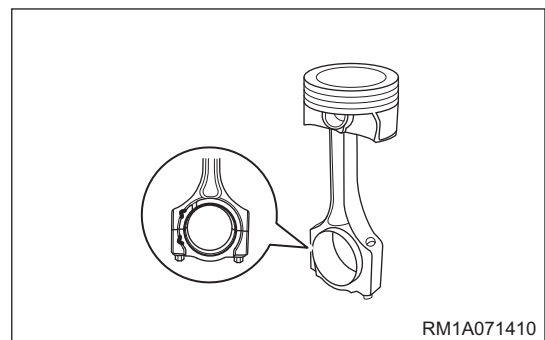
- Pay attention to face front marks on top of piston to timing belt side during assembly, without being reversed.



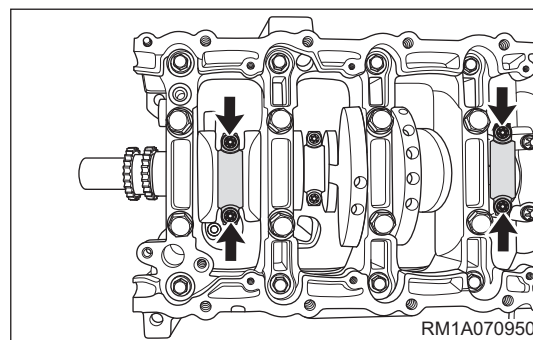
9. Install the connecting rod bearing cap.

HINT:

Salient points on one side of connecting rod and connecting rod bearing cap should be in the same side.



- a. Correctly install connecting rod bearing caps, and screw connecting rod bearing cap fixing bolts (arrow) by hands, then tighten connecting rod bearing cap fixing bolts in 2 steps with a torque wrench.
(Tightening torque: 1st step: tighten to 15 ± 3 N·m; 2nd step: retighten by $60^\circ \pm 5^\circ$)

**CAUTION**

- Apply a small amount of engine lubricant to connecting rod, connecting rod bearing caps and thread joint surfaces.

07

10. Other assembly is in the reverse order of disassembly.

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