
ENGINE

4.1	ENGINE MECHANICAL	357
1	Warning and Precaution	357
1.1	Warning.....	357
2	System Overview	357
2.1	Description.....	357
2.2	System Principle	357
2.3	System Components Description.....	357
3	Special Tool and Equipment.....	360
3.1	General Tools	360
3.2	Special Tools.....	364
4	Parameters.....	366
4.1	Engine Specifications	366
4.2	Tolerance Matching Between Engine Main Components.....	367
4.3	Valve Timing.....	367
4.4	Lubrication Area	368
4.5	Area with Seal Gum Applied.....	369
4.6	Non-reusable Part	369
5	ON-VEHICLE SERVICE	370
5.1	Accessory Pulley	370
5.2	Idler Pulley Assembly.....	371
5.3	Tensioner Assembly.....	372
5.4	Cylinder Head Cover	373
5.5	Crankshaft Front Oil Seal	377
5.6	Crankshaft Rear Oil Seal	378
5.7	Flywheel Assembly	379
5.8	Engine Timing Chain	380
5.9	Camshaft & Rocker Arm.....	387
5.10	Cylinder Head.....	391
5.11	Cylinder Block.....	400
5.12	Engine Mounting Assembly	417
5.13	Engine Assembly	422

4.1 ENGINE MECHANICAL

1 Warning and Precaution

1.1 Warning

Be sure to observe the following instructions before repairing, to prevent property damage, personal injury or even death:

- (1) Temperature in engine compartment is very high when engine is running. Before removal, you must make sure that engine has shut off, and engine compartment has cooled down sufficiently, otherwise, there is a risk of scald injury.

2 System Overview

2.1 Description

SQRF4J16 engine has the following features

- (1) DVVT
- (2) In-line DOHC with 4 cylinders
- (3) Four valves per cylinder
- (4) Aluminum cylinder head
- (5) Aluminum cylinder block
- (6) Supercharged intercooler

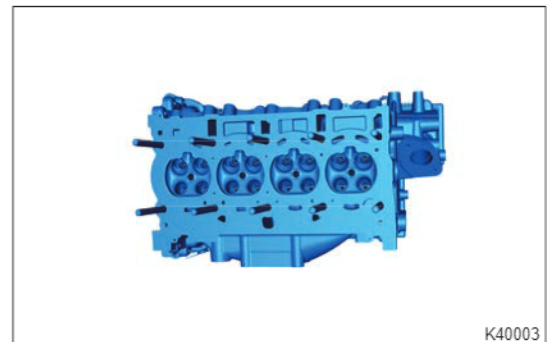
2.2 System Principle

- (1) SQRF4J16 engine adapts a design of transverse, direct injection, in-line 4-cylinder, 4-stroke, four valves per cylinder, DOHC, supercharged intercooler, VVT, electronic controlled multi-port fuel injection, the engine adapts independent ignition.
- (2) SQRF4J16 engine adapts aluminum cylinder block. Aluminum oil pan is fixed to aluminum frame with bolts. The aluminum cylinder head is secured to the block with bolts. The camshaft is installed on cylinder head. Power output from crankshaft drives camshaft by crankshaft sprocket through timing belt to rotate, thus making camshaft interact with rocker arm lifter to open and close valve. Piston assembly is an aluminum piston with cast iron connecting rod. This engine has features of reliable structure and excellent performance.

2.3 System Components Description

■ Cylinder Head

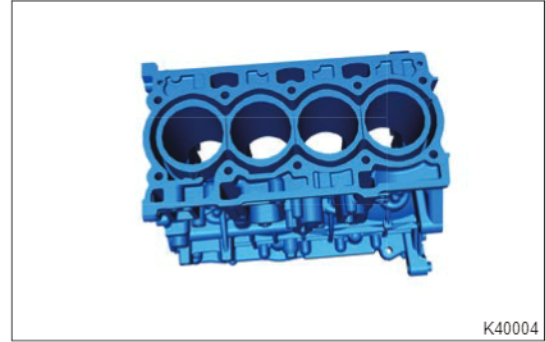
The upper part of the cylinder is closed to form a combustion chamber, and as the support of the camshaft, rocker arm, intake pipe and exhaust pipe. It mainly sucks air into the cylinder, the spark plug ignites the combustible gas mixture to drive the piston, and the exhaust gas is discharged from the exhaust pipe.



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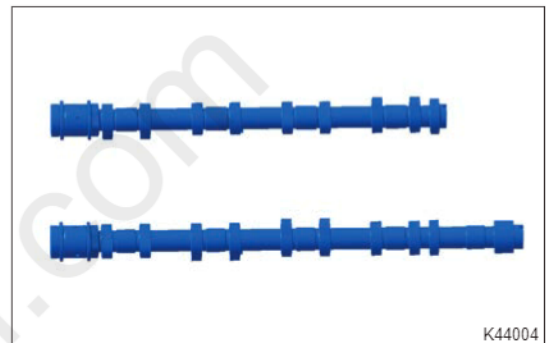
■ Cylinder Block

The main body of the engine, which connects each cylinder and crankcase into a whole, is the support frame for installing piston, crankshaft, other parts and accessories.



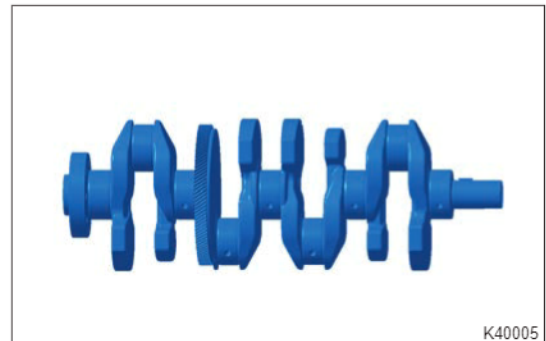
■ Camshaft

Camshaft is a component located inside engine, which is used to control valve opening and closing operations.



■ Crankshaft

Crankshaft is an important component in engine, which bears force from connecting rod and transfers it into rotation torque and outputs it through crankshaft to drives other accessories of engine.



■ Valve

Valve is used to allow air to flow in engine and bleed exhausted air after combustion; Intake valve is used to absorb air in engine and mix it with fuel for combustion; Exhaust valve is used to bleed exhausted air after combustion for radiation.



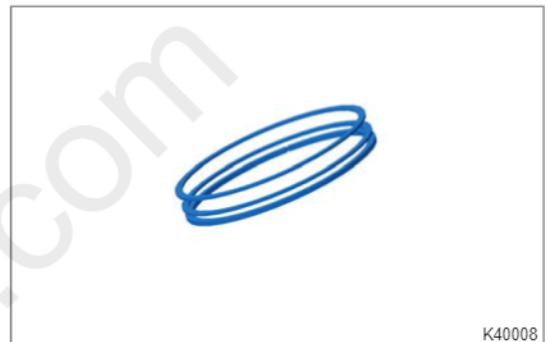
■ Piston

Piston is used to bear combustion compression from cylinder and transfer it to the crankshaft through piston pin and connecting rod.



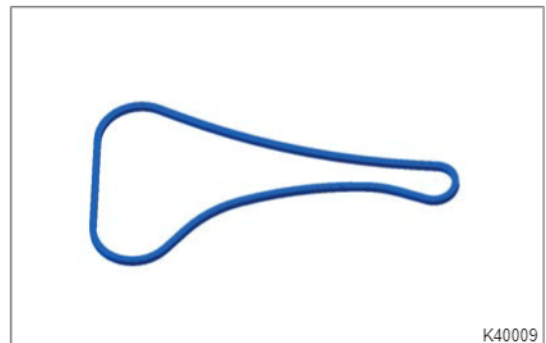
■ Piston Ring

Piston ring has two types of air ring and oil ring. Air ring is used to keep air tightness between cylinder and piston to avoid air leakage. Also it transmits most heat to cylinder wall which is carried away by coolant; Oil ring is used to apply and scrape the oil. Excessive oil can be scraped when oil ring moves downward and a layer of even oil can be applied to cylinder wall when oil ring moves upward. It not only can prevent oil entering the cylinder for combustion and also can reduce friction resistance between piston and cylinder. Furthermore, oil ring helps in air tightness.



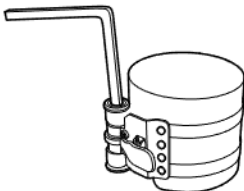
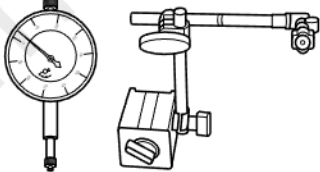
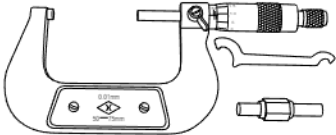
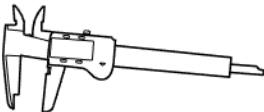
■ Engine Timing Chain

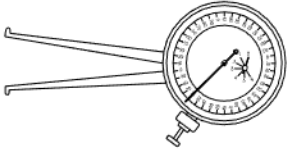
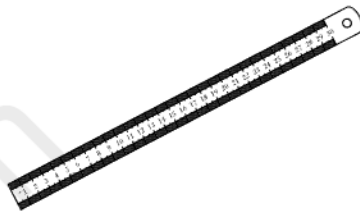
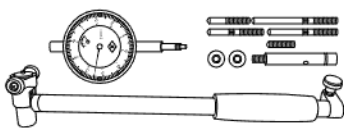
Engine timing chain is mainly used to drive valve mechanism, which allows intake valve and exhaust valve to open and close in proper time so that engine cylinder can absorb and exhaust air normally.

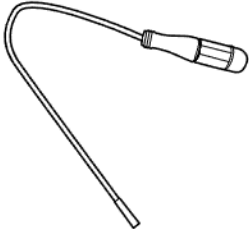
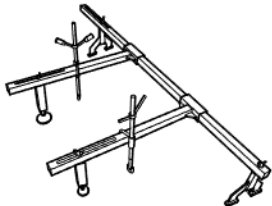
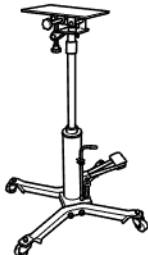
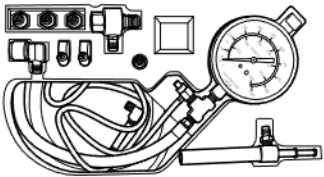


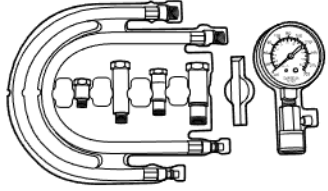
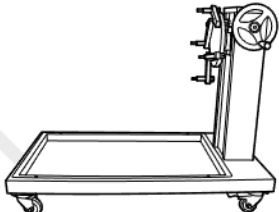
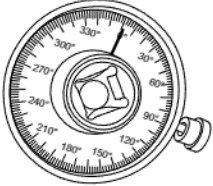
3 Special Tool and Equipment

3.1 General Tools

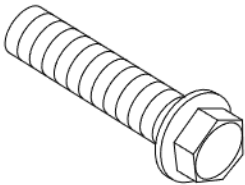
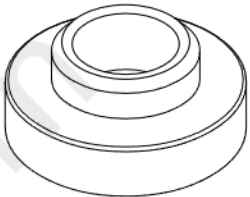
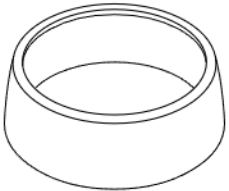
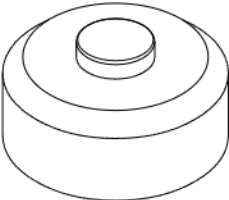
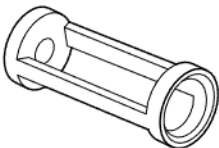
Tool Name	Tool Drawing
Piston Installer	 S00030
Dial Indicator and Magnetic Holder	 S00018
Outer Diameter Micrometer	 S00045
Vernier Caliper	 S00051

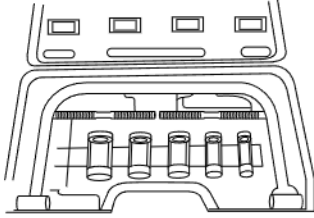
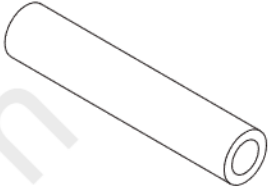
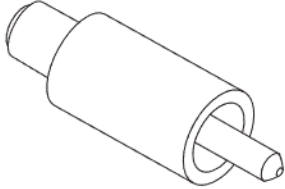
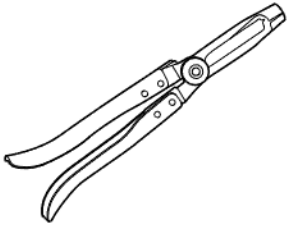
Tool Name	Tool Drawing
Inner Diameter Micrometer	 S00049
Precision Straightedge	 S00044
Feeler Gauge	 S00041
Piston Ring Remover	 S00047
Cylinder Gauge	 S00046

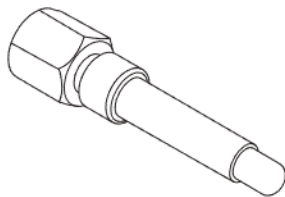
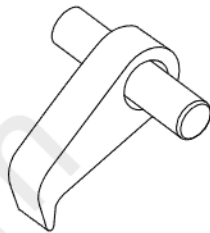
Tool Name	Tool Drawing
Flexional Magnetic Rod	 S00031
Engine Hoist	 S00032
Engine Equalizer	 S00021
Transmission Carrier	 S00004
Fuel System Pressure Tester	 S00035

Tool Name	Tool Drawing
Cylinder Pressure Gauge	 S00033
Engine Service Platform	 S00039
Angle Gauge	 S00065
Valve Cotter Installer	 S00024

3.2 Special Tools

Tool Name	Part No.	Tool Drawing
Crankshaft Front Oil Seal Guide Tool	EPT-0004	 S00088
Crankshaft Front Oil Seal Installer	EPT-0005	 S00089
Crankshaft Rear Oil Seal Guide Tool	EPT-0007	 S00091
Crankshaft Rear Oil Seal Installer	EPT-0006	 S00090
Valve Spring Compression Adapter	EPT-0001	 S00037

Tool Name	Part No.	Tool Drawing
Valve Spring Compressor	EPT-0002	 S00087
Valve Oil Seal Installer	EPT-0010	 S00093
Valve Oil Seal Guide Sleeve	EPT-0009	 S00092
Valve Oil Seal Remover	EPT-0003	 S00029
Camshaft Timing Tool	EPT-0011	 S00094

Tool Name	Part No.	Tool Drawing
Crankshaft Timing Tool	EPT-0012	 S00095
Flywheel Holding Tool	EPT-0008	 S00099

4 Parameters

4.1 Engine Specifications

Items	Specifications
Engine Type	Vertical, direct injection, in-line 4-cylinder, water-cooled, 4-stroke, DOHC
Engine Model	SQRF4J16
Valve Number Per Cylinder	4
Cylinder Diameter (mm)	77
Piston Stroke (mm)	85.8
Displacement (ml)	1598
Compression Ratio	9.9:1
Ignition Type	Independent
Rated Power (kw)	145
Max. Torque (N·m)	290
Fuel Octane Number	Unleaded gasoline, octane number 92 or above
Oil Grade	SM SAE-5W-30
Starting Type	Electric starting
Cooling Type	Forced circulation type antifreeze cooling
Lubrication Type	Compound type (pressure, splash lubrication)
Cylinder Compression Pressure (bar) (180 - 250) r/min	7 -10

4.2 Tolerance Matching Between Engine Main Components

Series Number	Part Name	Size and Tolerance	Matching Clearance
1	Intake Side 1st Bearing Hole	$\Phi 30 (0, +0.025)$	0.050-0.091
	Intake Camshaft Assembly 1st	$\Phi 30 (-0.066, -0.050)$	
	Intake Side 2-6 Bearing Hole	$\Phi 24 (0, +0.021)$	0.040-0.074
	Intake Camshaft Assembly 2nd-6th Journals	$\Phi 24 (-0.053, -0.040)$	
2	Exhaust Side 1st Bearing Hole	$\Phi 30 (0, +0.025)$	0.050-0.091
	Exhaust Camshaft Assembly 1st Journal	$\Phi 30 (-0.066, -0.050)$	
	Exhaust Side 2-5 Bearing Hole	$\Phi 24 (0, +0.021)$	0.040-0.074
	Exhaust Camshaft Assembly 2nd-5th Journals	$\Phi 24 (-0.053, -0.040)$	
3	Cylinder Head Intake Side Camshaft Thrust Gear Width	27.8 (-0.1, 0)	0.15-0.275
	Intake Camshaft Assembly Thrust Gear Width	27.95 (0, +0.025)	
4	Cylinder Head Exhaust Side Camshaft Thrust Gear Width	27.8 (-0.1, 0)	0.15-0.275
	Exhaust Camshaft Assembly Thrust Gear Width	27.95 (0, +0.025)	
5	Hydraulic Lifter Assembly Outer Diameter	$\Phi 11.994 \pm 0.006$	0.006-0.036
	Cylinder Head Hydraulic Lifter Hole Diameter	$\Phi 12 (+0.006, +0.024)$	
6	Valve Guide Hole Diameter	$\Phi 6 (0, +0.015)$	0.013-0.042
	Intake Valve Stem Diameter	$\Phi 5.98 \pm 0.007$	
7	Valve Guide Hole Diameter	$\Phi 6 (0, +0.015)$	0.032 - 0.063
	Exhaust Valve Stem Diameter	$\Phi 5.96 \pm 0.007$	

4.3 Valve Timing

■ Intake (200° Wrapped Angle)

	Angle (°)	Valve Lift (mm)
Valve Opening 0 mm	350	0
Valve Opening 0.5mm	378	0.51
Valve Opening 1mm	385	0.98
Maximum Valve Lift	485	9.49
Valve Closed 1 mm	585	1.01
Valve Closed 0.5mm	593	0.50
Valve Closed 0mm	629	0

■ Exhaust (180.5° Wrapped Angle)

	Angle (°)	Valve Lift (mm)
Valve Opening 0 mm	124	0
Valve Opening 0.5mm	153	0.49
Valve Opening 1mm	160.5	0.99
Maximum Valve Lift	250	8.5
Valve Closed 1 mm	341	0.99
Valve Closed 0.5mm	349	0.50
Valve Closed 0mm	385.5	0

4.4 Lubrication Area

Lubrication Area	Model
Valve Guide Bottom Hole	Use same type of lubricant as engine
Intake Valve Retainer Bottom Hole	Use same type of lubricant as engine
Exhaust Valve Retainer Bottom Hole	Use same type of lubricant as engine
Valve Stem and Valve Guide Hole	Use same type of lubricant as engine
Valve Oil Seal Lip	Use same type of lubricant as engine
Hydraulic Lifter Assembly External Circular Surface and Hydraulic Lifter Hole	Use same type of lubricant as engine
Camshaft Assembly Journal and Bearing Seat Hole	Use same type of lubricant as engine
Roller Rocker Arm Assembly Bearing	Use same type of lubricant as engine
Phaser Solenoid Valve Seal Ring (O-ring)	Use same type of lubricant as engine
Upper and Lower Connecting Rod Bearing Shell and Connecting Rod Journal	Use same type of lubricant as engine
Upper and Lower Main Bearing Shell and Main Journal	Use same type of lubricant as engine
Thrust Washer (Oil Rail Side) and Crankshaft Thrust Surface	Use same type of lubricant as engine
Front and Rear Oil Seal Inner Lip and Crankshaft Oil Seal Journal	Use same type of lubricant as engine
Piston Pin Hole	Use same type of lubricant as engine
Piston Ring Groove	Use same type of lubricant as engine
Cylinder Bore Inner Wall	Use same type of lubricant as engine
Crankshaft Front and Rear Oil Seal External Circular Surface	Use same type of lubricant as engine
Timing System	Use same type of lubricant as engine

4.5 Area with Seal Gum Applied

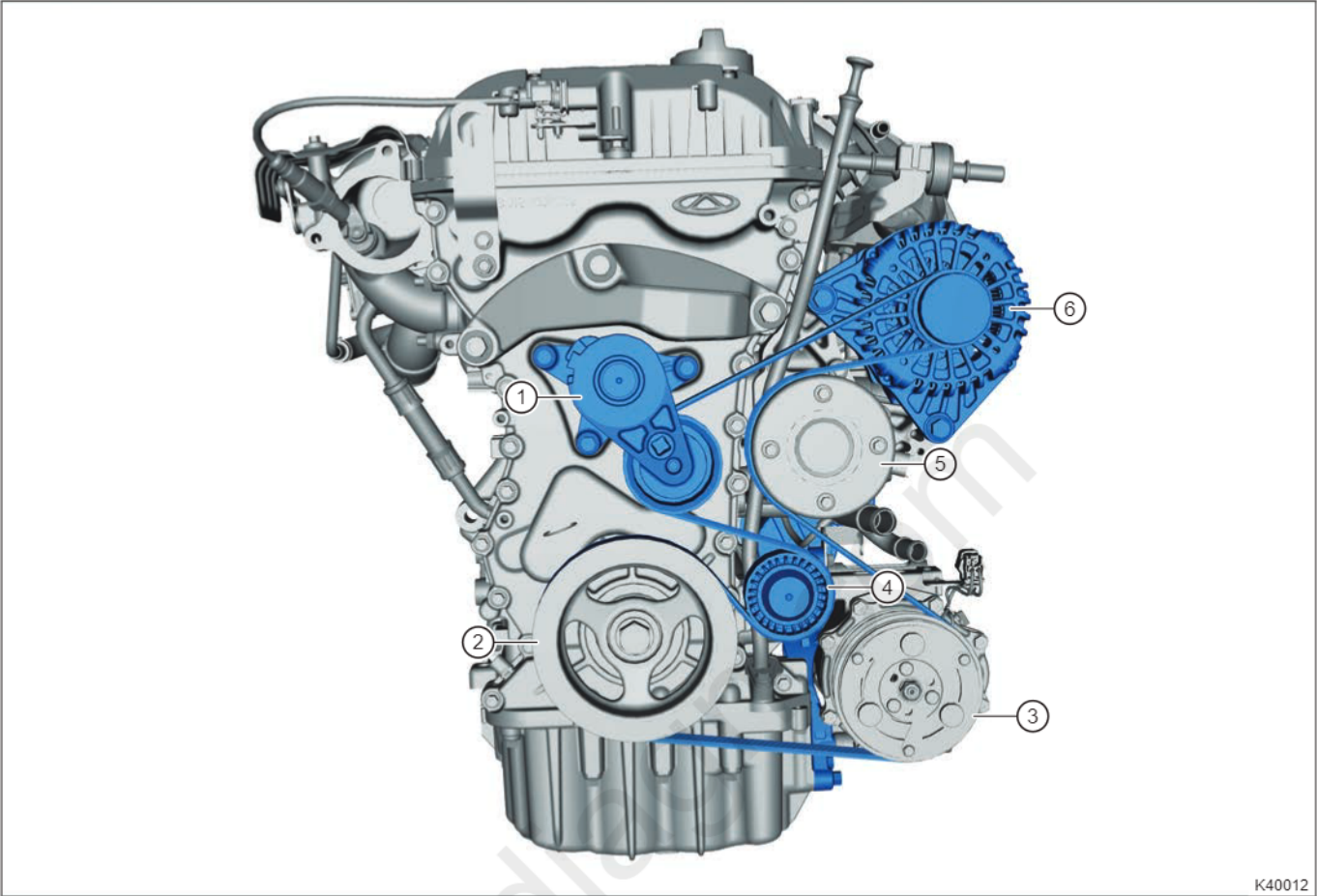
Area with Seal Gum Applied	Seal Gum Type
Bowl Plug - Front and Rear End	Loctite 11747
Bowl Plug - Exhaust Side	Loctite 121078
Top and Bottom Sides of Cylinder Head Front End (T-shaped Area)	Loctite 5900H
"T" Shaped Area Between Timing Chain Cover and Cylinder Head	Loctite 5900H
Timing Chain Cover Frame Bottom Arc Part	Loctite 5900H
Sprocket Head Cover Seal Surface	Loctite 5900H/Loctite 5900HA
Upper Guide Rail Assembly Bolt	Loctite 243

4.6 Non-reusable Part

Non-reusable Part	
Cylinder Head Fixing Bolt	Replace it
Valve Oil Seal	Replace it
Crankshaft Front Oil Seal	Replace it
Crankshaft Rear Oil Seal	Replace it
Cylinder Head Gasket	Replace it
Connecting Rod Bearing Cap Fixing Bolt	Replace it
Flywheel Fixing Bolt	Replace it
Main Bearing Cap Fixing Bolt	Replace it

5 ON-VEHICLE SERVICE

5.1 Accessory Pulley



K40012

1	Tensioner Assembly	4	Idler Pulley Assembly
2	Torsion Shock Absorber Assembly	5	Water Pump Pulley
3	Compressor Pulley	6	Alternator Assembly

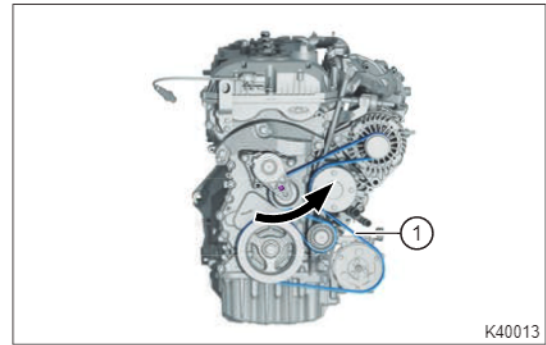
■ Removal

 Warning

- Be sure to wear necessary safety equipment to prevent accidents, when removing accessory drive belt.
- Appropriate force should be applied when removing accessory drive belt. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the engine trim cover assembly.

- (4) Insert tool into tensioner and pull it upward in direction of arrow as shown in illustration, then remove accessory drive belt assembly (1).



Warning

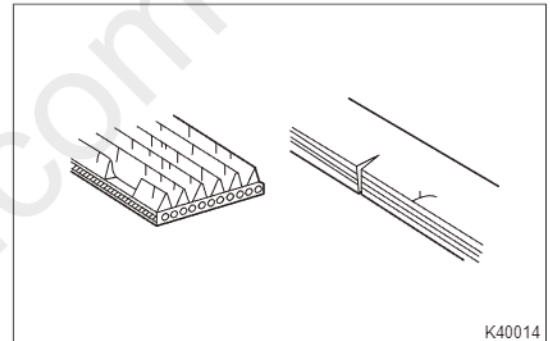
Prevent hand from contacting belt tensioner when raising it upward, so as to avoid damage.

■ Inspection

- (1) Visually check accessory drive belt for excessive wear and cords for wear, etc. If any of these defects is found, replace accessory drive belt.

Hint:

- 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 the crankshaft pulley by hand.



■ Installation

Caution

- Before installation, remove the dirt from accessory drive belt.
- After installation, check if scale on tensioner arm is almost corresponding to the middle scale of tensioner base.
- Check that belt fits well to grooves on bottom of pulley properly. Avoid improper installation and misalignment.

- (1) Install the accessory drive belt properly according to its moving direction.
 (2) Install drive belt on each pulley to operate tensioner freely.

■ Adjustment

- (1) Rotate crankshaft pulley 2 turns, so that belt tension between each pulley is even.
 (2) Apply 100 N of force to center part of the belt between alternator 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.

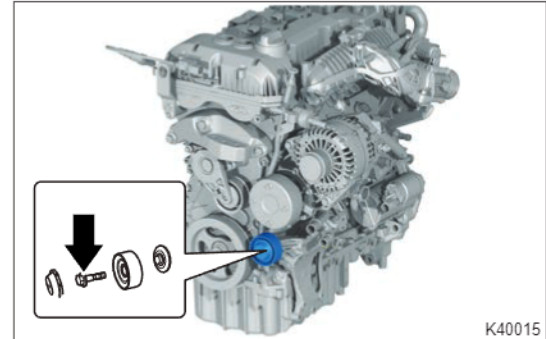
5.2 Idler Pulley Assembly

■ Removal

Warning

- Be sure to wear safety equipment to prevent accidents, when removing idler pulley assembly.
- Appropriate force should be applied, when removing idler pulley assembly. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the engine trim cover assembly.
- (4) Remove the accessory drive belt.
- (5) Remove the idler pulley assembly dust boot.
- (6) Remove fixing bolt and 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

⚠ Caution

- **Pretighten it by 2 to 3 threads first.**
- **After installation, turn crankshaft to run accessory drive belt by several turns, and check if crankshaft turns smoothly and belt runs well. If it cannot turn smoothly, reinstall accessory drive belt.**
- **Make sure to correctly install accessory drive belt, and it does not interfere with other components.**

- (1) Install the idler pulley assembly fixing bolt.

Torque: 47 + 5 N·m

- (2) Install the idler pulley assembly dust boot.
- (3) Install the accessory drive belt.
- (4) Install the engine trim cover.
- (5) Install the engine compartment trim cover.

5.3 Tensioner Assembly

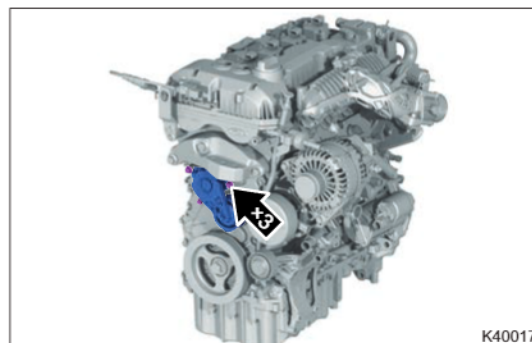
■ Removal

⚠ Warning

- **Be sure to wear safety equipment to prevent accidents, when removing tensioner assembly.**
- **Appropriate force should be applied, when removing the tensioner assembly. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the engine trim cover assembly.
- (4) Remove the accessory drive belt.

- (5) Remove 3 fixing bolts from tensioner assembly.



- (6) Remove the tensioner assembly.

■ Inspection

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

■ Installation

- (1) Install 3 tensioner assembly fixing bolts.
Torque: 20 + 5 N·m
- (2) Install the accessory drive belt.
- (3) Install the engine trim cover.
- (4) Install the engine compartment trim cover.

5.4 Cylinder Head Cover

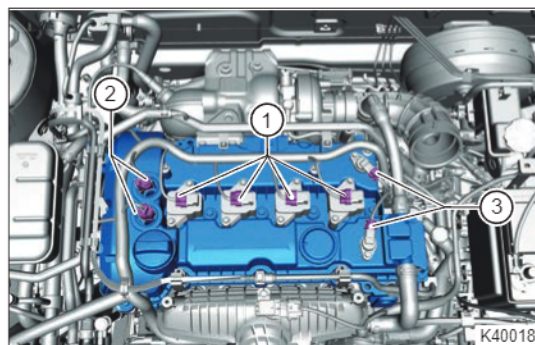
■ Removal

⚠ Warning

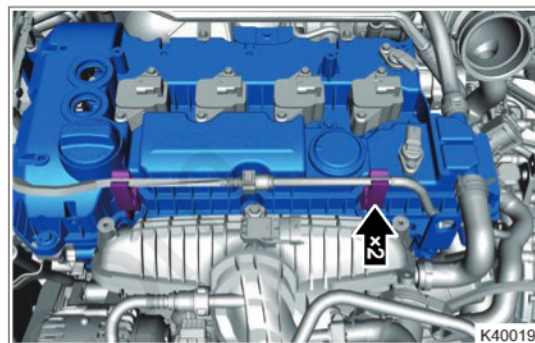
- Blow dirt and debris away from surface of cylinder head cover with compressed air.
- Be sure to wear safety equipment to prevent accidents, when removing cylinder head cover.
- Appropriate force should be applied when removing cylinder head cover. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Remove the engine trim cover assembly.
- (5) Remove the turbocharger heat insulator bracket.
- (6) Remove the intake hose II.

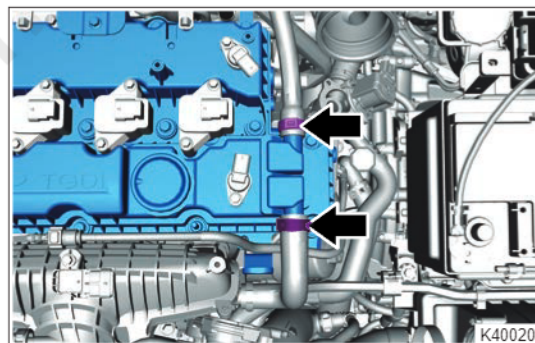
- (7) Disconnect ignition coil connector (1), VVT control valve connector (2), and camshaft position sensor connector (3).



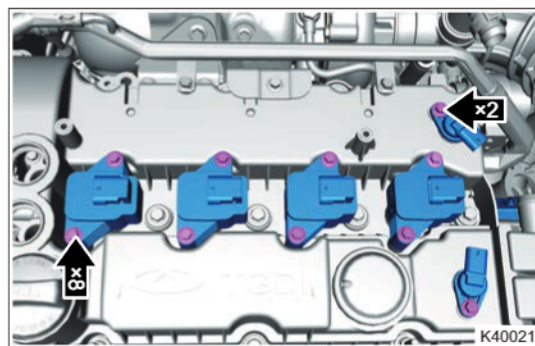
- (8) Remove 2 inlet pipe single tube clamps from cylinder head cover.



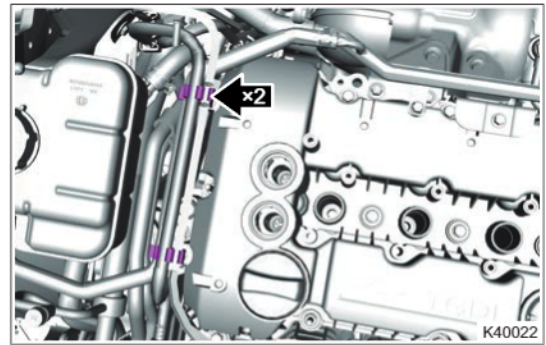
- (9) Loosen elastic clamp and disconnect connection between crankcase ventilation hose and cylinder head cover.



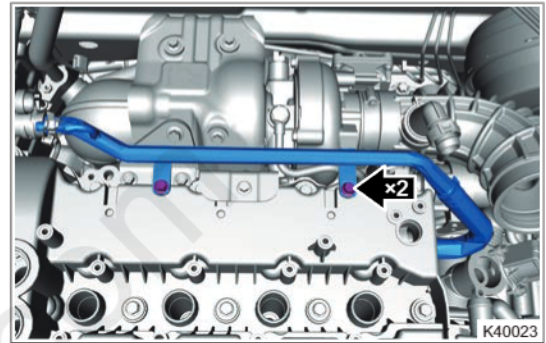
- (10) Remove 8 fixing bolts and ignition coil.
- (11) Remove 2 fixing bolts and camshaft position sensor.



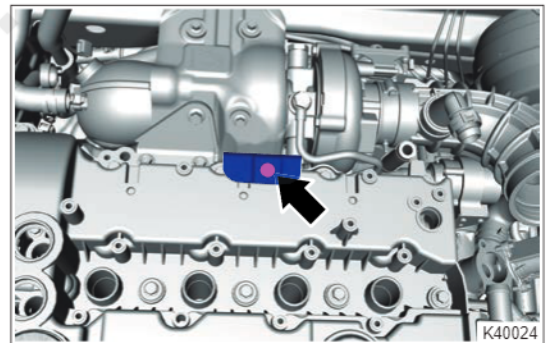
(12) Remove 2 three-tube clamp from cylinder head cover.



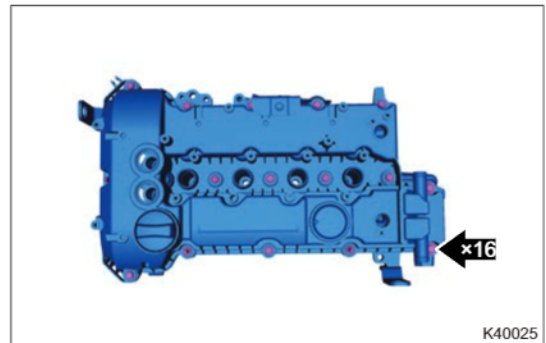
(13) Remove 2 fixing bolts from cooling pipe assembly.



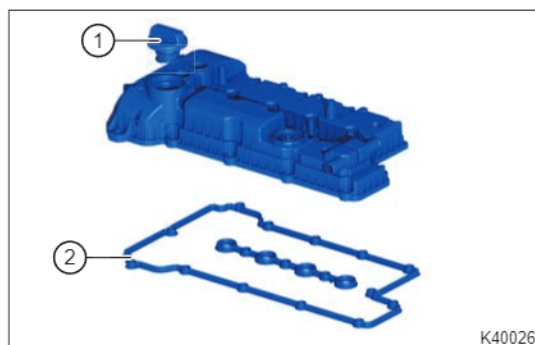
(14) Remove 1 fixing bolt from heat insulator.



(15) Remove 16 fixing bolts cylinder and cylinder head cover.



- (16) Remove fuel filler cap (1) and gasket (2) from cylinder head cover assembly.



■ Inspection

- (1) Check the appearance of the cylinder head cover for cracks, and replace the assembly if necessary.

■ Installation

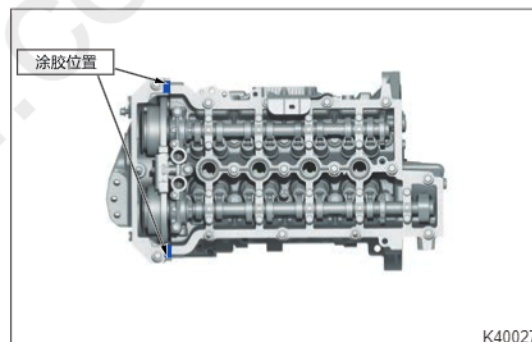
⚠ Caution

- Remove oil dirt and sealant on cylinder head cover and cylinder head before installation.
- Check if gasket is damaged or loses elasticity. If so, replace gasket.

- (1) As shown in illustration, apply seal gum (Loctite 5900H) to "T" position of junction area between timing chain cover and cylinder head.

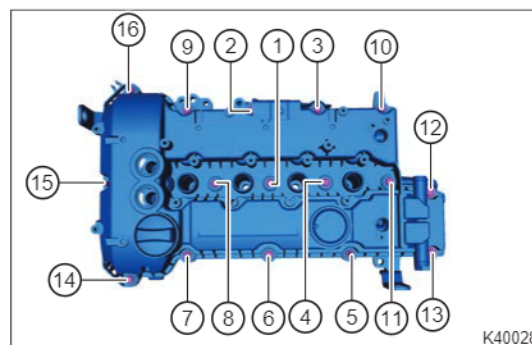
Hint:

- Note that the sealant should not be too thick, to prevent excess sealant into the engine when the valve chamber cover is pressed.
- Install the cylinder head cover assembly and wait for 15 minutes to apply seal gum.



- (2) Install cylinder head cover and first manually install fixing bolts by 1 to 2 threads.
- (3) Tighten 16 cylinder head cover fixing bolts in order shown in illustration.

Torque: Pretighten shock absorber unit by 1 to 2 threads manually then tighten it with torque of 8 + 3 N·m.



- (4) Install fuel filler door.
- (5) Install the cooling pipe assembly.
- (6) Install the camshaft position sensor.
- (7) Install the ignition coil.
- (8) Install hose - intake hose.
- (9) Connect the wire harness connector.
- (10) Install the inlet pipe tube clamp.
- (11) Install the turbocharger heat Insulator bracket.
- (12) Install the engine trim cover.
- (13) Install the engine compartment trim cover assembly.

5.5 Crankshaft Front Oil Seal

■ Removal

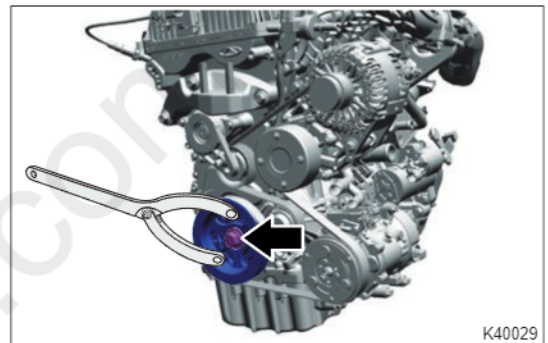
⚠ Warning

- **Be sure to wear safety equipment to prevent accidents, when removing crankshaft front oil seal.**
- **Appropriate force should be applied when removing crankshaft front oil seal. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover.
- (3) Disconnect the negative battery cable.
- (4) Remove the engine trim cover.
- (5) Remove the accessory drive belt.
- (6) Remove fixing bolt from torsion absorber assembly.

Hint:

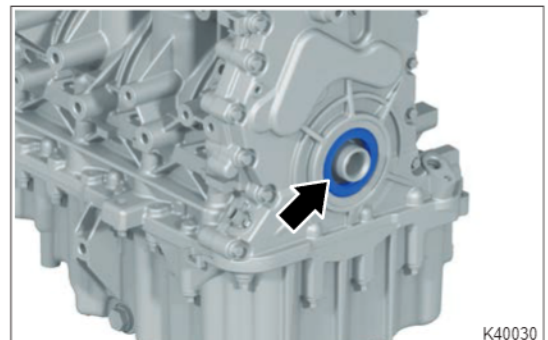
Use tool to lock torsion absorber assembly and fixing bolt.



- (7) Remove the torsion shock absorber assembly.
- (8) Carefully remove the crankshaft front oil seal with proper tool.

Hint:

Be careful not to scratch junction surface, when removing crankshaft front oil seal.



■ Installation

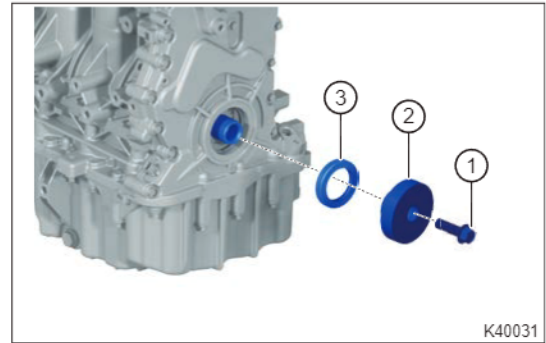
⚠ Caution

- **Apply a small amount 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 small amount of engine oil to oil seal external circular surface and oil seal guide tool (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 it immediately.**

- (1) Install crankshaft front oil seal (3) to crankshaft front oil seal installer (2), then install crankshaft front oil seal in place with crankshaft front oil seal guide tool (1).

Hint:

- Make sure oil seal surface is 0 to 0.5mm lower than end surface of timing chain cover oil seal hole.
- Never allow tilting it by more than 5°, oil seal external rubber breakage or flanges during oil seal press fitting.



- (2) Install fixing bolt of torsion shock absorber assembly.

Torque: 1st step: 180 ± 10 N·m, 2nd step: $150^\circ \pm 5^\circ$

- (3) Install the accessory drive belt.
- (4) Install the engine trim cover.
- (5) Install the engine compartment trim cover assembly.

5.6 Crankshaft Rear Oil Seal

■ Removal

⚠ Warning

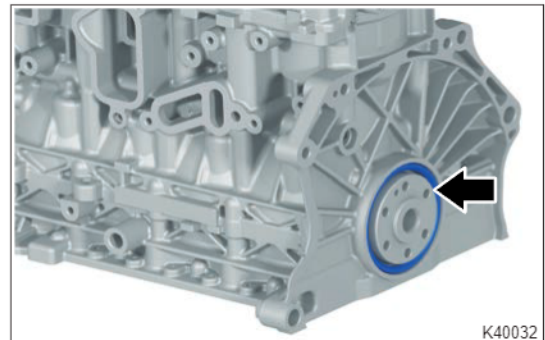
- **Be sure to wear safety equipment to prevent accidents, when removing crankshaft rear oil seal.**
- **Appropriate force should be applied when removing crankshaft rear oil seal. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover.
- (3) Disconnect the negative battery cable.
- (4) Remove the engine trim cover.
- (5) Remove the transmission assembly.
- (6) Remove the flywheel assembly.

- (7) Remove the crankshaft rear oil seal with proper tool carefully.

Hint:

Be careful not to scratch cylinder block, when removing oil seal.



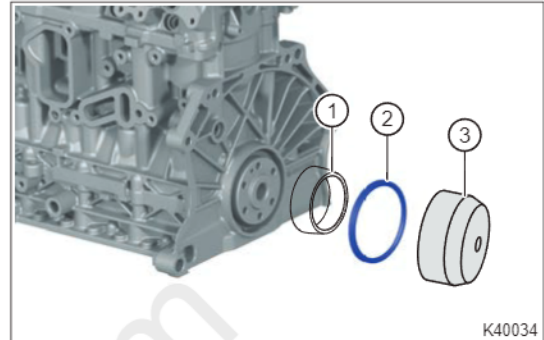
- (8) Remove the crankshaft rear oil seal.

■ Installation

⚠ Caution

- Be sure to clean dirt around oil seal retainer and on inside 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.

- (1) Install guide tool (1) to crankshaft.
- (2) Install new oil seal (2) to crankshaft rear oil seal guide tool, then install new oil seal evenly and fully into oil seal retainer with a crankshaft rear oil seal installer (3).



⚠ Caution

- Make sure oil seal surface is 0.5 to 1 mm lower than end surface of timing chain cover oil seal hole.
- Ensure that oil seal lip has no damage during assembly.
- Never allow tilting it by more than 5°, oil seal external rubber breakage or flanges during oil seal press fitting.

- (3) Install the flywheel assembly.
- (4) Install the transmission assembly.

5.7 Flywheel Assembly

■ Removal

⚠ Warning

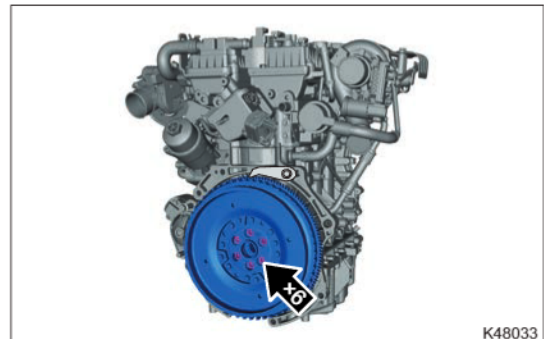
- Be sure to wear safety equipment to prevent accidents, when installing flywheel assembly.
- Appropriate force should be applied, when removing flywheel assembly. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Disconnect the negative battery cable.
- (3) Remove the transmission assembly.
- (4) Install flywheel holding tool to lock flywheel assembly.

- (5) Remove 6 fixing bolts and flywheel assembly.

Hint:

Flywheel assembly 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.

■ Installation

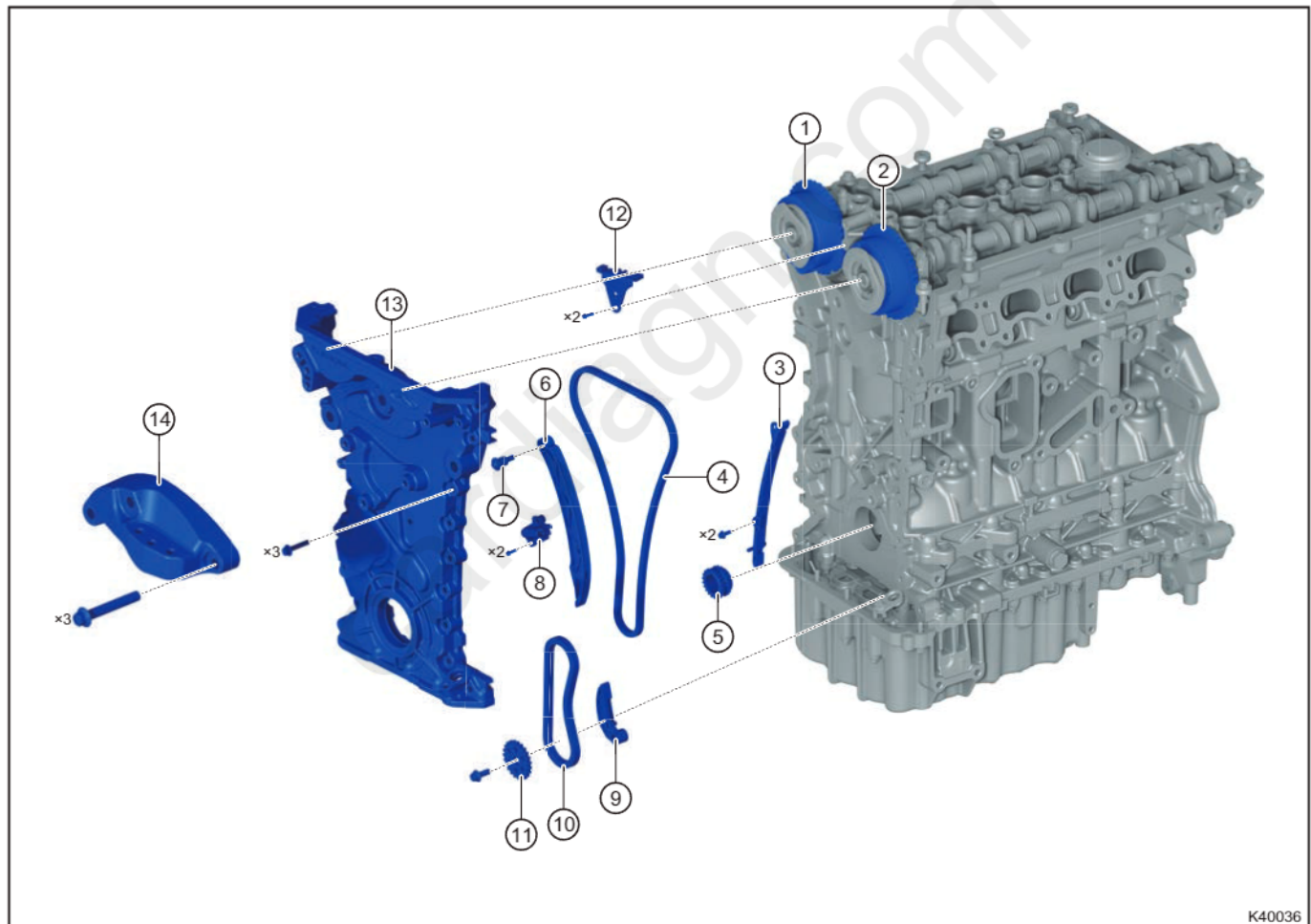
⚠ Caution

- Lightly push flywheel after alignment during assembly. Do not tap flywheel with a hammer.
- Replace flywheel fixing bolts with new ones.

- (1) Install 6 fixing bolts to flywheel assembly, and pretighten the bolts.
- (2) Installing flywheel holding tool, then tighten each flywheel bolt diagonally in order.

Torque: 1st step: $35 \pm 5 \text{ N}\cdot\text{m}$, 2nd step: $30^\circ \pm 5^\circ$

5.8 Engine Timing Chain



K40036

1	Exhaust Phaser Assembly	8	Hydraulic Tensioner Assembly
2	Intake Phaser Assembly	9	Oil Pump Movable Rail
3	Fixing Guide Rail Assembly	10	Oil Pump Chain Assembly
4	Timing Chain	11	Oil Pump Sprocket
5	Crankshaft Timing Sprocket	12	Upper Chain Guide Rail Assembly

6	Movable Guide Rail Assembly	13	Sprocket Head Cover
7	Movable Guide Rail Assembly Fixing Bolt	14	Engine Front End Bracket

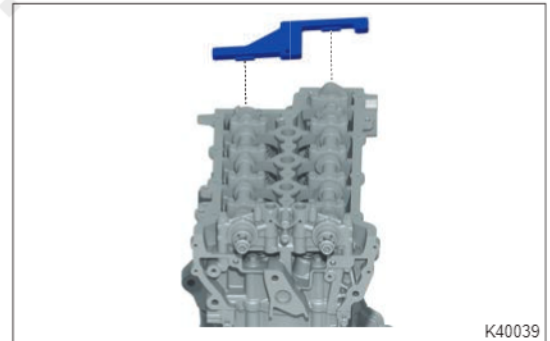
■ Removal

⚠ Warning

- **Be sure to wear necessary safety equipment to prevent accidents, when removing engine timing chain.**
- **Appropriate force should be applied when removing engine timing chain. Be careful not to operate roughly.**

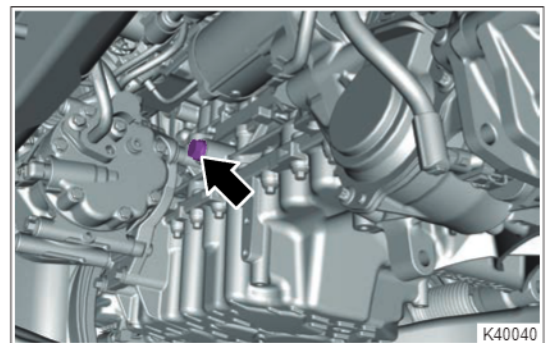
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the engine trim cover assembly.
- (4) Remove the cylinder head cover.
- (5) Remove the engine lower protector assembly.
- (6) Remove the accessory drive belt.
- (7) Remove the accessory drive belt tensioner assembly.
- (8) Remove the idler pulley assembly.
- (9) Remove the torsion shock absorber assembly.
- (10) Use an engine equalizer to hang engine assembly.
- (11) Remove the engine right mounting cushion assembly.

- (12) Place camshaft timing positioning special tool on the back of cylinder head upper plane, rotate intake and exhaust camshafts separately in order to clamp the special tool into slots on rear end of both camshafts.



K40039

- (13) Remove crankshaft balancer locating hole fixing bolt from engine block.

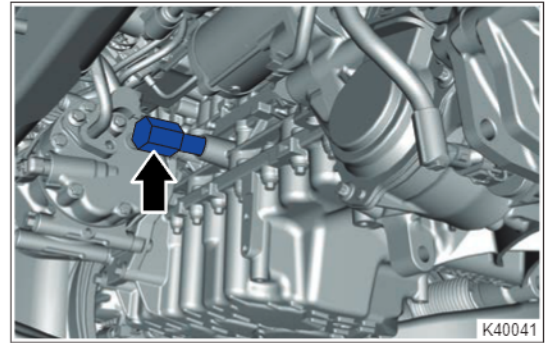


K40040

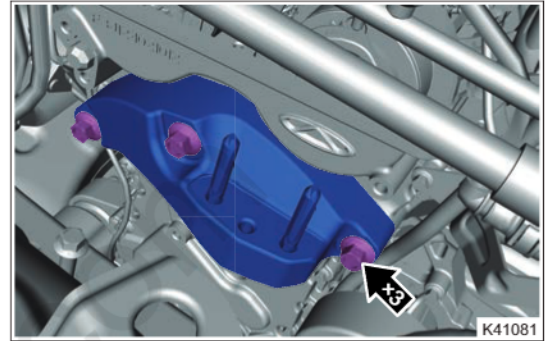
- (14) Install crankshaft timing positioning pin to cylinder block through thread hole on intake side of cylinder block, and insert front end of positioning pin into positioning hole of crankshaft balancer (each cylinder piston should be in the same plane).

Hint:

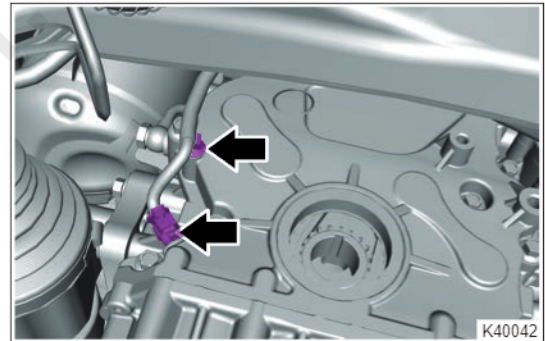
It takes patience to perform this operation and pay more attention to avoid damage to crankshaft.



- (15) Remove 3 fixing bolts between engine front end bracket and sprocket head cover.



- (16) Disconnect oil pump assembly connector and detach wire harness fixing clip.



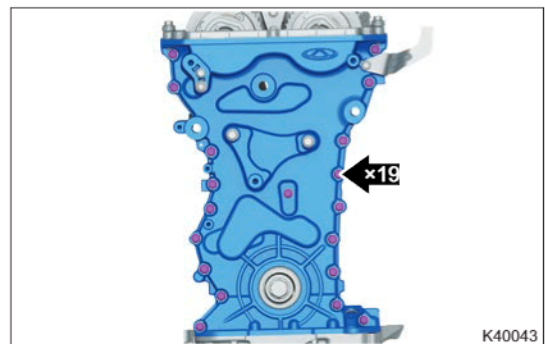
- (17) Remove the oil pan assembly.

- (18) Remove the oil dipstick and guide.

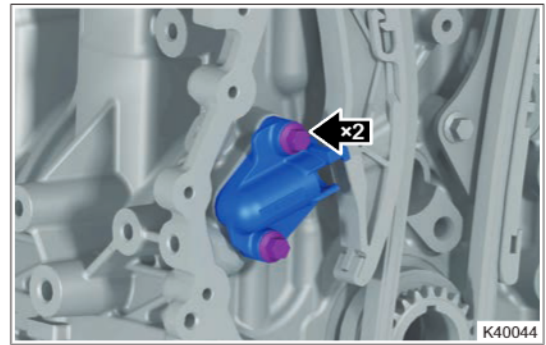
- (19) Remove 19 fixing bolts and cylinder head cover.

Hint:

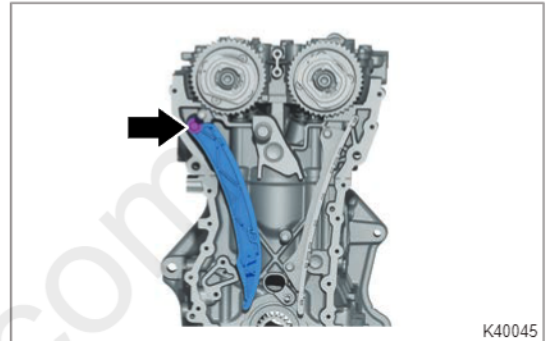
Carefully observe sprocket head cover for cracks or oil leakage; If exists, replace sprocket head cover assembly.



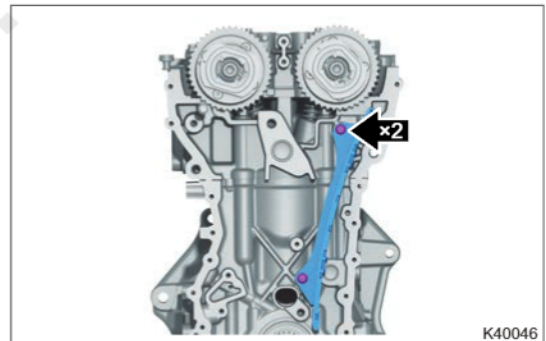
- (20) Remove 2 fixing bolts and hydraulic tensioner assembly.



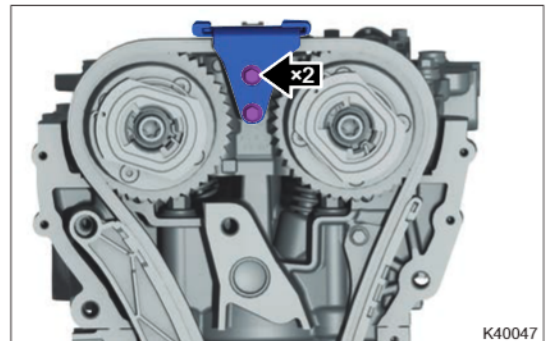
- (21) Remove 1 fixing bolt and movable guide rail assembly.



- (22) Remove 2 fixing bolts and fixing guide rail assembly.

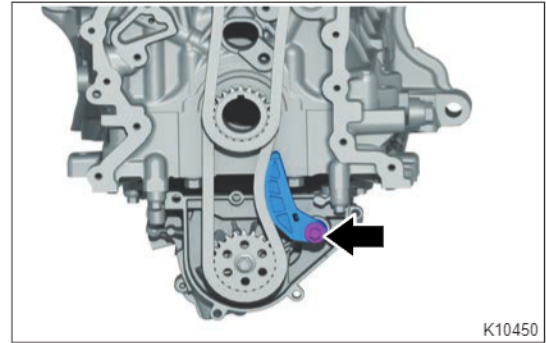


- (23) Remove 2 fixing bolts and upper chain guide rail assembly.



- (24) Remove the engine timing chain.

- (25) Remove 1 fixing bolt from oil pump chain movable guide rail and remove oil pump chain.

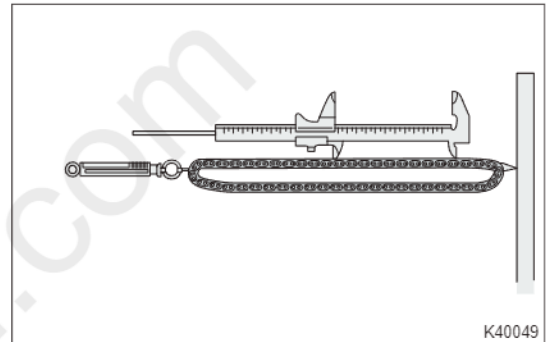


■ Inspection

- (1) Carefully check if timing chain is seriously worn or cracked. If exists, replace timing chain assembly.
- (2) Use a force of 147 N to pull the chain. Take 15 links from chain and perform measurement with a vernier caliper. Max. elongation: 120.6 mm.

Hint:

Take 3 positions for measurement. If the average value is larger than max. elongation ratio, replace timing chain assembly. If it is not as specified, replace timing chain cover assembly.



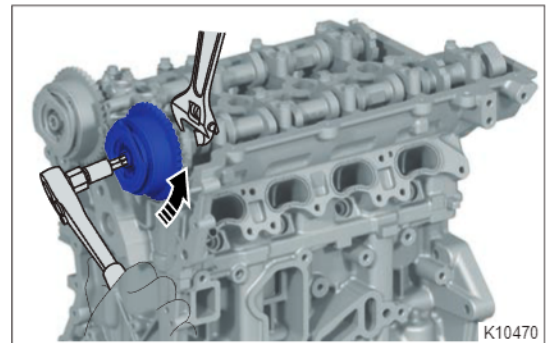
- (3) Measure depth of movable guide rail with a vernier caliper.

Hint:

If wear limit is beyond 2 mm, replace movable guide rail assembly.

■ Installation

- (1) Use a proper wrench to hold intake camshaft and loosen fixing bolt from intake phaser assembly.

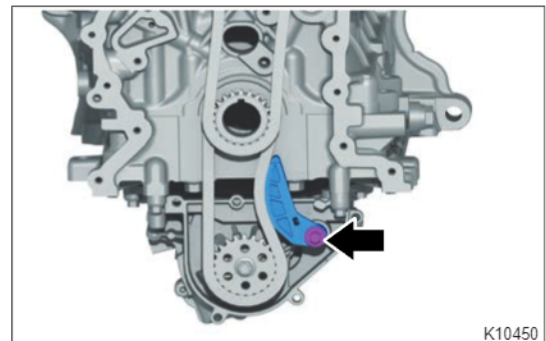


- (2) Install oil pump chain and 1 movable guide rail fixing bolt.

Torque: 12 ± 2 N·m

Hint:

The movable guide rail should rotate smoothly around the bolt after assembling and either end of spring should hook the oil pump housing.



- (3) Install 2 fixing bolts to upper chain guide rail assembly.

Torque: 8 + 3 N·m

- (4) Install 2 fixing bolts from fixing guide rail assembly.

Torque: 8 + 3 N·m

- (5) Install 1 fixing bolt to movable guide rail assembly.

Torque: 20 + 5 N·m

Hint:

The movable guide rail should rotate smoothly around the bolt after installation.

- (6) Install the timing chain.

Hint:

Ensure timing chain is set to intake and exhaust phasers and crankshaft sprocket. Make sure that timing chain and upper guide rail are in level.

- (7) Install hydraulic tensioner assembly, and tighten 2 fixing bolts.

Torque: 8 + 3 N·m

Hint:

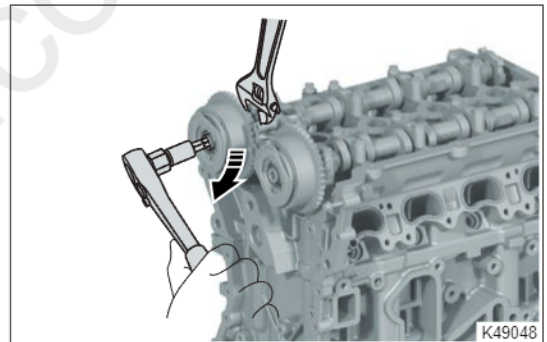
Pull up hydraulic tensioner upper steel ring pin after installation and tightening.

- (8) Use a proper wrench to hold intake camshaft and tighten fixing bolt of intake and exhaust phaser valve body.

Torque: 1st step: 60 + 3 N·m 2nd step: clockwise rotation angle $95^\circ \pm 5^\circ$

Hint:

- Tighten exhaust phase valve body bolt first, and then tighten intake phaser valve body bolt. Failure to tighten in order may cause "tooth missing" phenomenon in timing chain.



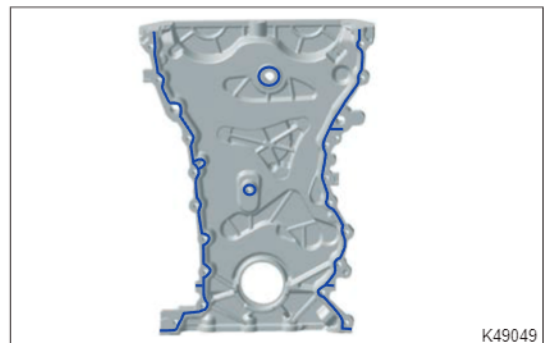
- (9) Remove crankshaft timing tool and camshaft timing tool, then rotate crankshaft clockwise 2 turns at least to check if timing system can operate normally.

⚠ Caution

- **Never rotate crankshaft counterclockwise.**

- (10) Apply seal gum to inside of timing chain cover mounting bolt hole.

Seal gum: Loctite 5900H



- (11) Install and tighten 19 cylinder head cover fixing bolts in order shown in illustration.

Torque: $8 + 3 \text{ N}\cdot\text{m}$

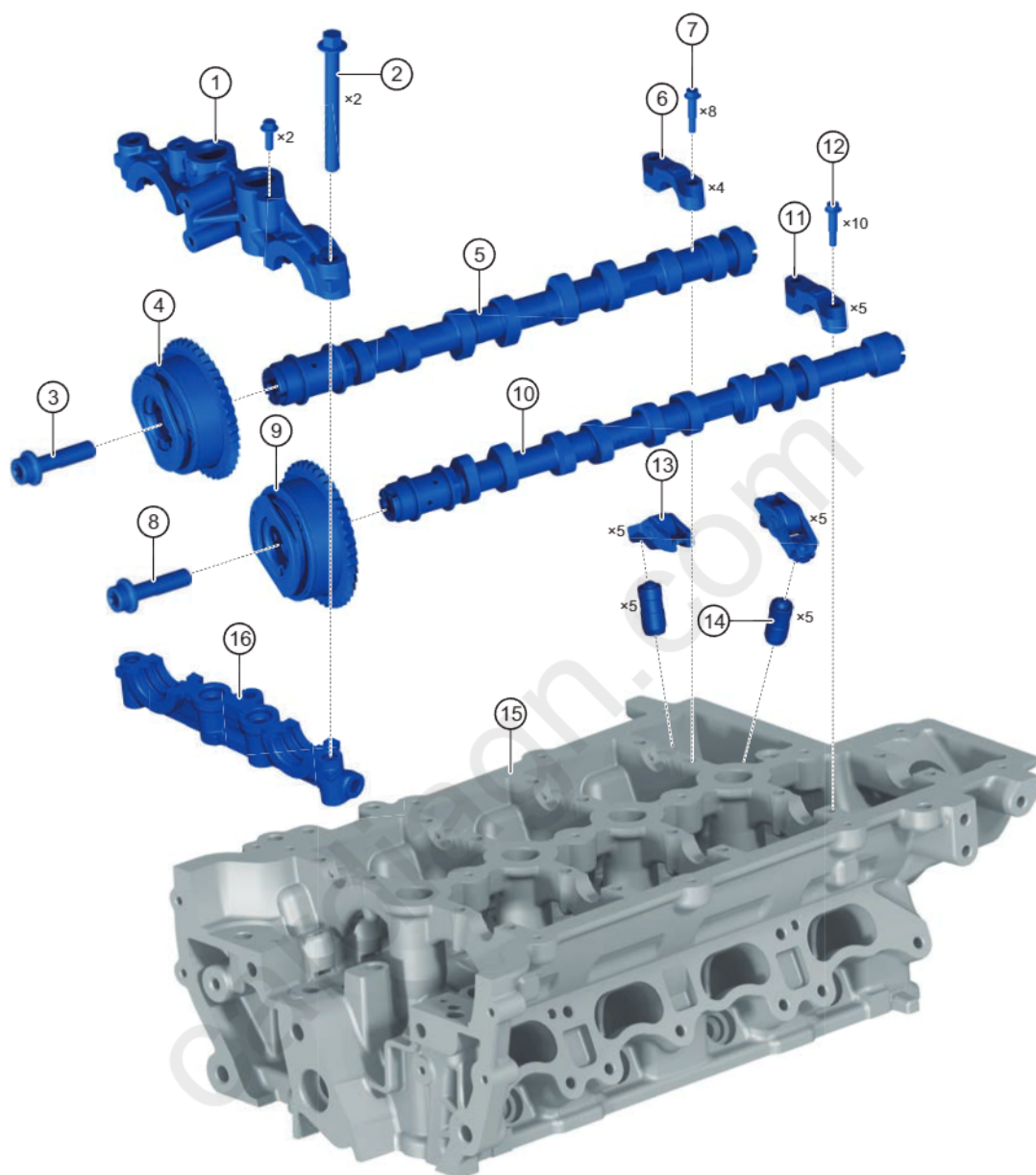


- (12) Install 3 fixing bolts to engine front end bracket.

Torque: $80 + 5 \text{ N}\cdot\text{m}$

- (13) Install the oil dipstick guide.
(14) Connect variable oil pump connector and secure wire harness clip.
(15) Install the crankshaft balancer positioning hole fixing bolt.
(16) Install the torsion shock absorber.
(17) Install the idler pulley assembly.
(18) Install the tensioner assembly.
(19) Install the accessory drive belt.
(20) Install the cylinder head cover.
(21) Install the front compartment lower protector assembly.
(22) Install the engine trim cover assembly.
(23) Install the engine compartment trim cover assembly.

5.9 Camshaft & Rocker Arm



K40050

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

7	Exhaust Camshaft Bearing Cap Fixing Bolt	15	Cylinder Head
8	Intake Phaser Fixing Bolt	16	1st Bearing Lower Cap

■ Removal

⚠ Warning

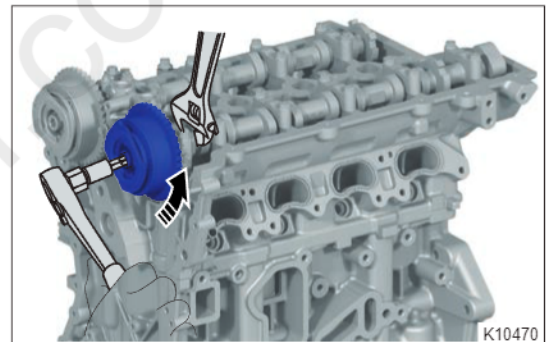
- **Blow dirt and debris away from surface of cylinder head cover with compressed air.**
- **Be sure to wear necessary safety equipment to prevent accidents, when removing camshaft and rocker arm.**
- **Appropriate force should be applied when removing camshaft and rocker arm. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the engine trim cover assembly.
- (4) Remove the cylinder head cover.
- (5) Remove the accessory drive belt.
- (6) Remove the engine timing chain.

- (7) Use a proper wrench to hold intake camshaft, and remove fixing bolt from intake phaser in direction of arrow, remove intake phaser.

Hint:

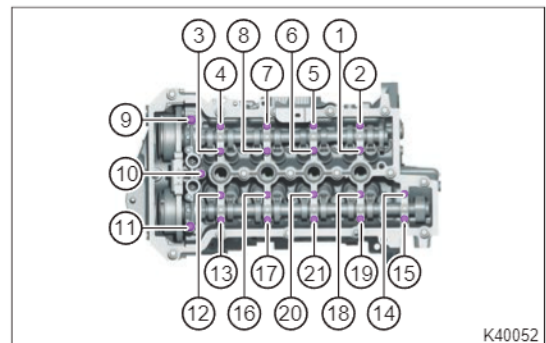
Removal method for exhaust phaser is the same as that of intake phaser.



- (8) Remove intake and exhaust camshaft bearing cap fixing bolts.

Hint:

During removal, loosen fixing bolts in order shown in illustration first, and then remove bolts thoroughly in order.



- (9) Remove the camshaft bearing caps.
- (10) Remove intake and exhaust camshaft.
- (11) Remove rocker arm and hydraulic lifter component.

■ Camshaft Appearance inspection

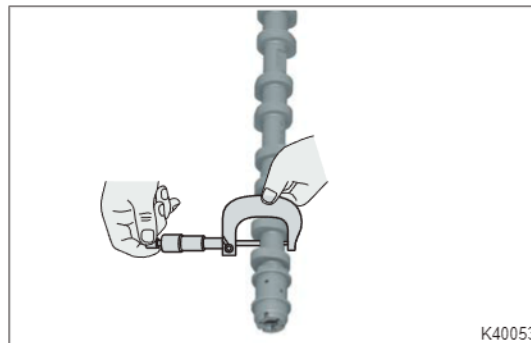
- (1) Check if there are scratches on camshaft surface. If there are scratches, replace camshaft.
- (2) Check if there are leaking holes and cracks on camshaft bearing caps. If so, replace camshaft.

■ Measure camshaft journal diameter with a micrometer

Measurement Item	Specification (mm)
1st journal diameter (same for intake and exhaust sides) (mm)	$\Phi 30$ (-0.066 - 0.050)
2nd - 5th journals (same for intake and exhaust sides)	$\Phi 24$ (-0.053 - 0.040)

Hint:

If camshaft journal diameter is not within specified range, replace intake/exhaust camshaft assembly.



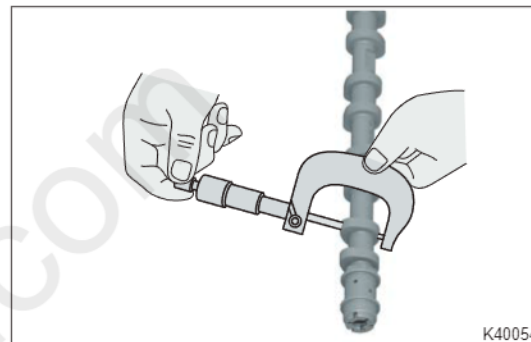
K40053

■ Measure highest point of cam with a micrometer.

Measurement Item	Specification (mm)
Cam Height (Highest Point)	Intake: 37.07 - 37.31
	Exhaust: 36.94 - 37.18

Hint:

If cam height is not within specified range, replace intake/exhaust camshaft assembly.



K40054

■ Check the camshaft axial clearance.

- (1) Perform measurement with roller rocker arm and intake and exhaust phasers not installed.
- (2) Place dial indicator on cylinder head body. Press indicator tip on front end of camshaft, and push camshaft forward and backward. The difference between the two limit reading equals to camshaft axial clearance. It is normal if the difference is between 0.15 and 0.275mm.

■ Check the hydraulic lifter.

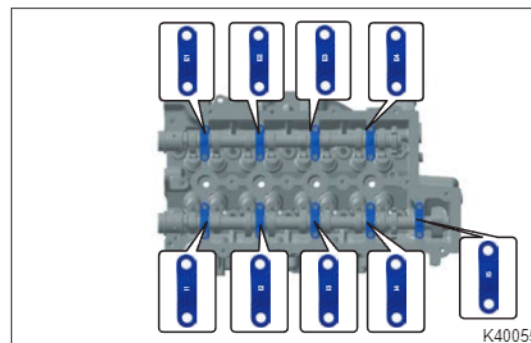
- (1) Check if end surface and cylindrical operating surface of hydraulic lifter are normal.
- (2) Check if hydraulic lifter slides smoothly in cylinder head guide hole.
- (3) Check each hydraulic lifter for weakness. If exists, remove and soak it for 24 hours, then press the hydraulic lifter plunger. If the engine block upper surface flatness is above the limit, replace the engine block.

■ Installation

- (1) Clean intake and exhaust camshafts and camshaft bearing caps.
- (2) Apply engine oil to camshaft cam surface and add a proper amount of engine oil to camshaft bearing hole.
- (3) Install intake, exhaust camshaft assemblies and intake and exhaust camshaft bearing caps.

Hint:

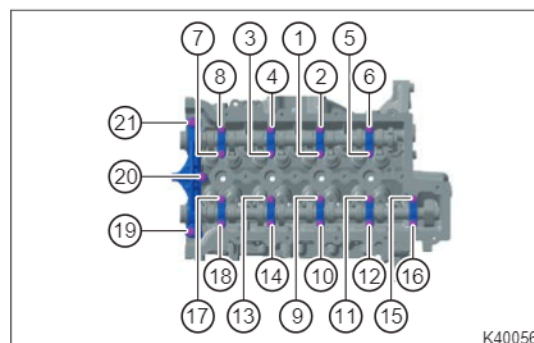
- Install according to marks on bearing cap: "I" indicates intake camshaft bearing cap and "E" indicates exhaust camshaft bearing cap.



K40055

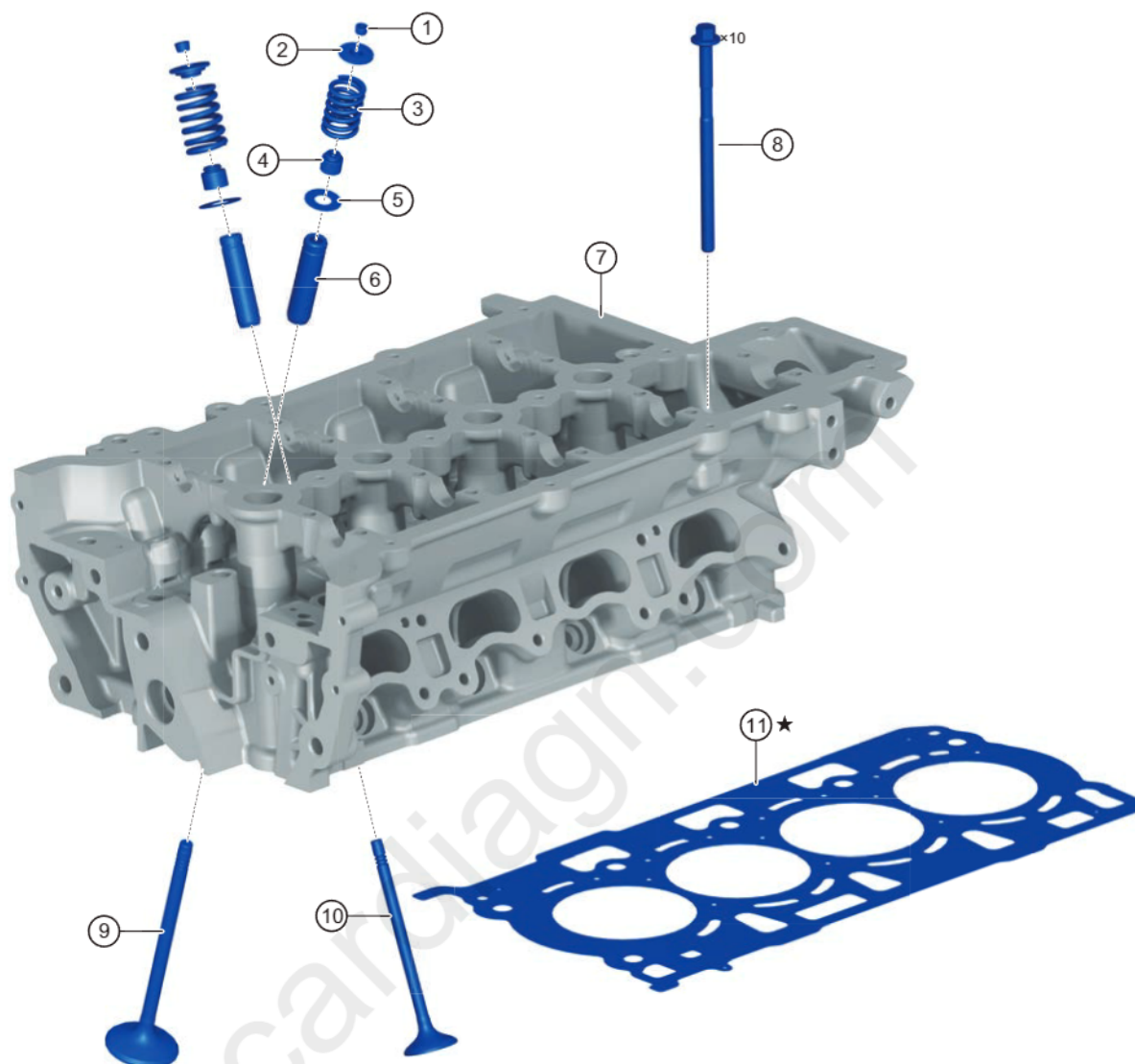
- (4) Tighten the camshaft bearing cap fixing bolt manually then tighten camshaft bearing cap fixing bolt.

Torque: For the 1st bearing cap fixing bolt 20 + 3 N·m, for bearing cap bolt 8 + 3 N·m



- (5) Install the engine timing chain.
(6) Install the accessory drive belt.
(7) Install the cylinder head cover.
(8) Install the engine trim cover assembly.
(9) Install the engine compartment trim cover assembly.

5.10 Cylinder Head



★ : Indicates that it is a non-reusable part

K40057

1	Valve Cotter	7	Cylinder Head
2	Valve Spring Upper Seat	8	Cylinder Head Bolt
3	Valve Spring	9	Exhaust Valve
4	Valve Oil Seal	10	Intake Valve
5	Valve Spring Lower Seat	11	Cylinder Head Gasket
6	Valve Guide	★	Non-reusable Part

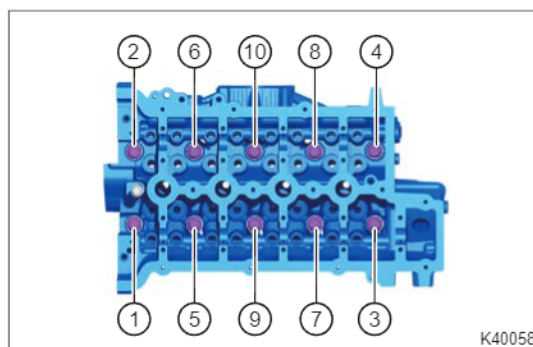
■ Removal

⚠ Warning

- **Be sure to wear necessary safety equipment to prevent accidents, when removing cylinder cover.**
- **Appropriate force should be applied when removing cylinder cover. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the engine trim cover assembly.
- (4) Drain the engine oil
- (5) Drain the coolant.
- (6) Remove the battery assembly.
- (7) Remove the battery tray assembly.
- (8) Remove the intake hose assembly.
- (9) Remove the air filter assembly.
- (10) Remove the coolant pipe assembly.
- (11) Remove expansion tank inlet pipe assembly.
- (12) Remove the intake manifold assembly.
- (13) Remove the fuel rail injector assembly.
- (14) Remove the precataltic converter assembly.
- (15) Remove the turbocharger assembly.
- (16) Remove the accessory drive belt.
- (17) Remove the tensioner assembly.
- (18) Remove the idler pulley assembly.
- (19) Remove the cylinder head cover.
- (20) Remove the timing chain cover.
- (21) Remove the engine timing chain.
- (22) Remove camshaft and rocker arm.

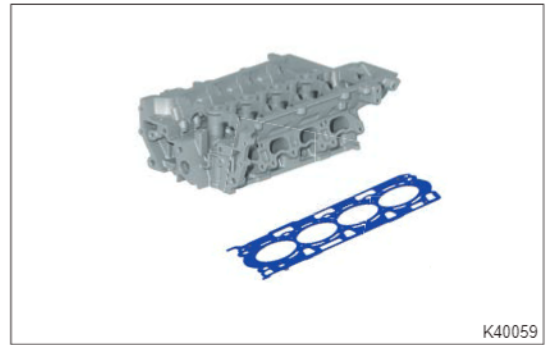
- (23) Remove 10 fixing bolts from cylinder cover in order shown in illustration.



⚠ Caution

- **When engine is in high temperature, removal and installation may cause deformation to cylinder head, so perform removal and installation at normal temperature.**
- **Failure to remove cylinder head bolts in order may cause cylinder head deformation.**
- **Make scraping marks on removed cylinder head bolt, and they cannot be reused.**

- (24) Remove cylinder head assembly and cylinder head gasket.



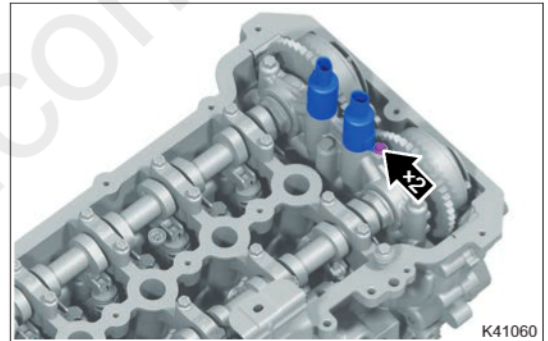
K40059

⚠ Caution

- **DO NOT** reuse the removed cylinder head gasket, and it is necessary to replace with a new one.
- **Be careful not to lose cylinder head mounting dowel pin during removal.**

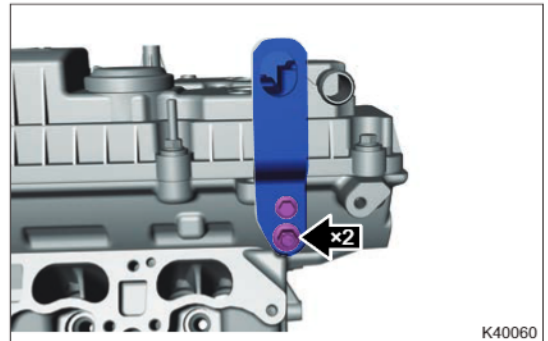
■ Disassembly

- (1) Remove 2 fixing bolts and intake and exhaust phaser oil control valve.



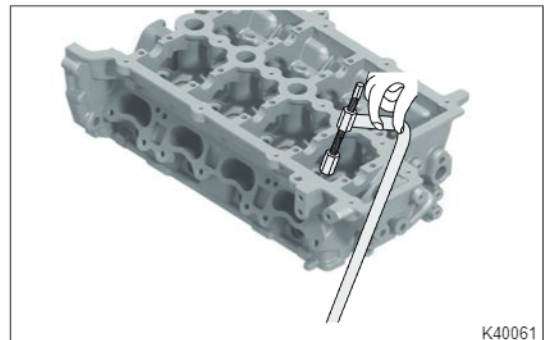
K41060

- (2) Remove 2 fixing bolts and bracket.



K40060

- (3) Using a valve spring compressor, compress valve spring to a position so that valve cotter can be removed.



K40061

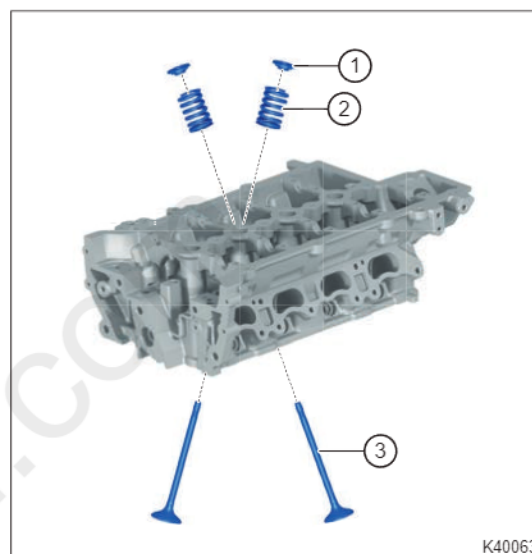
- (4) Using a magnetic rod, remove valve cotter.

Hint:

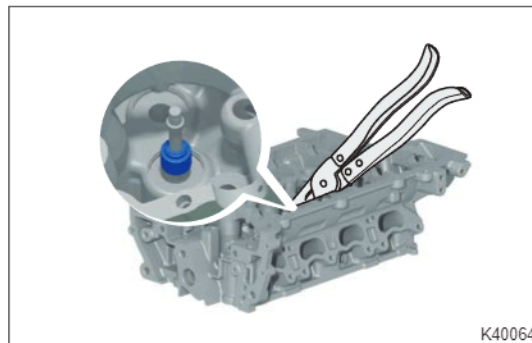
Due to the valve cotter is small, please operate carefully when operating it, so as to avoid loss.



- (5) Remove valve spring upper seat (1), valve spring (2) and intake and exhaust valve (3) from cylinder head.



- (6) Using a valve oil seal remover, remove the valve oil seal.



- (7) Using a magnetic rod, remove valve spring lower seat.

■ **Check the cylinder head**

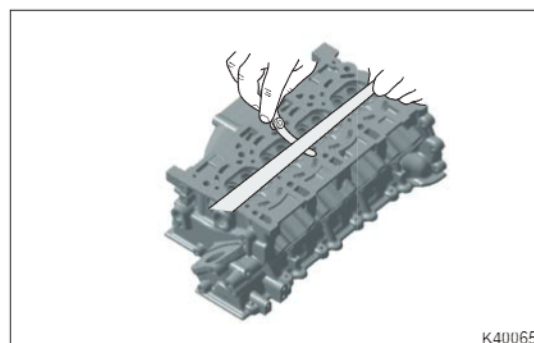
- (1) Check the appearance.
- 1) Remove carbon deposits inside valve guides with cleaner.
 - 2) Make sure valve stem can move and rotate freely in its mounting hole.

- (2) Using a precision straightedge and feeler gauge, check cylinder head flatness.

Measurement Item	Specification (mm)
Cylinder Head Flatness	0.04

Hint:

If cylinder head flatness is not within specified range, replace cylinder head assembly.



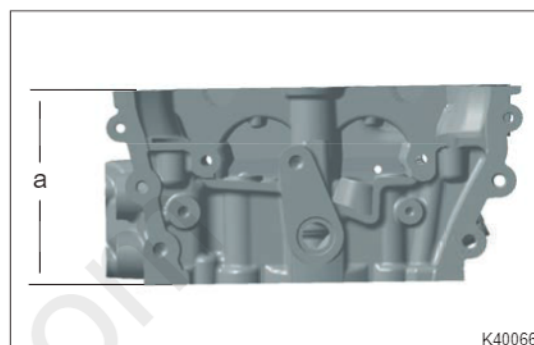
K40065

- (3) Using a precision straightedge, measure cylinder head height a.

Measurement Item	Specification (mm)
Cylinder Head Height	136.9

Hint:

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



K40066

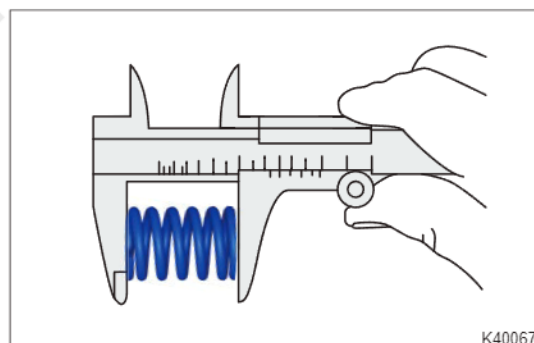
■ Check the valve spring

- (1) Using a vernier caliper, measure free length of valve spring and length of valve spring under the pre-pressure of $(230 \pm 11 \text{ N})$.

Measurement Item	Specification (mm)
Valve Spring Free Length	47.8 ± 2
Valve Spring Length Under Pre-pressure	36.5

Hint:

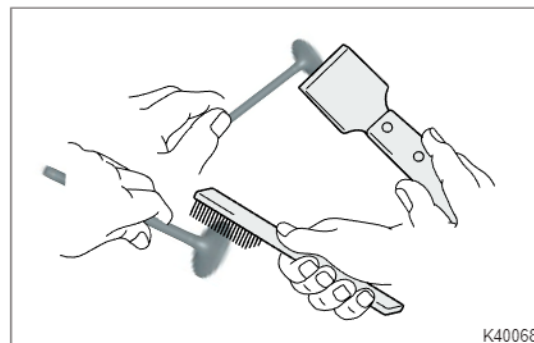
If valve spring length is not within specified range, replace valve spring.



K40067

■ Check the valve

- (1) Clean the valve.
- 1) Using a scraper, remove carbon deposited on valve head.
 - 2) Using a thin and soft wire brush, clean the valve thoroughly.



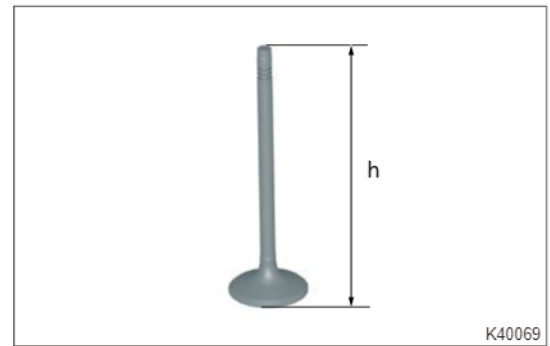
K40068

- (2) Using a micrometer, measure the valve height h.

Measurement Item	Specification (mm)
Intake Valve	106.66 ± 0.25
Exhaust Valve	107.26 ± 0.25

Hint:

If valve height is less than specified value, replace valve.



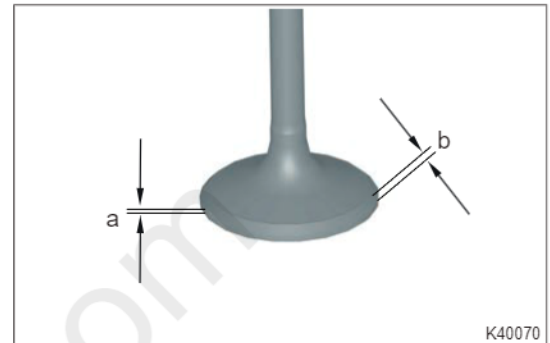
- (3) Check the valve head.

- 1) Measure margin thickness (a) of valve head.
- 2) Measure width (b) of valve face.

Measurement Item	Specification (mm)
Valve Head Margin Thickness (Intake)	1.3 ± 0.15
Valve Head Margin Thickness (Exhaust)	1.4 ± 0.15
Valve Face Width (Intake)	2.12
Valve Face Width (Exhaust)	3.12

Hint:

If valve head margin thickness and face width are not within specified range, replace valve.

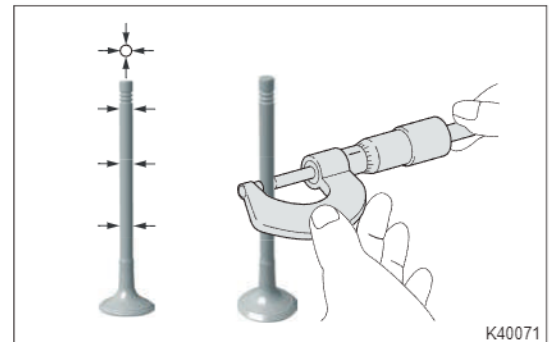


- (4) Using a micrometer, measure the valve stem diameter.

Measurement Item	Specification (mm)
Valve Stem Diameter (Intake)	5.98 ± 0.007
Exhaust Valve Stem Diameter (Exhaust)	5.96 ± 0.007

Hint:

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



(5) Check clearance between valve stem and valve guide.

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

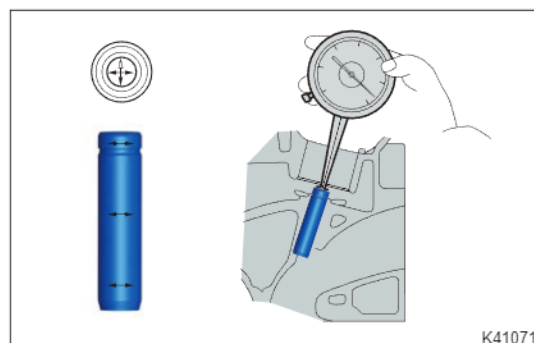
Measurement Item	Size and Tolerance (mm)
Valve Guide Inner Diameter	6.0 - 6.015

- 2) Clearance between valve stem and valve guide =
Valve guide inner diameter - Valve stem diameter.

Measurement Item	Specification (mm)
Clearance Between Intake Valve and Valve Guide	0.023 -0.042
Clearance Between Exhaust Valve and Valve Guide	0.033 -0.062

Hint:

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

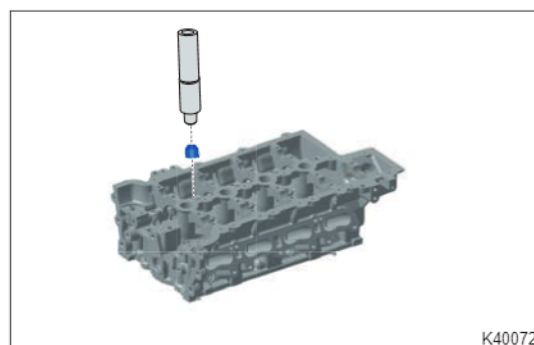


■ Assembly

⚠ Caution

- Apply lubricant to valve oil seal lip before installing valve oil seal.
- Before installing valve spring, check valve spring lower seat for proper installation.
- Clean all components to be assembled thoroughly before assembly.

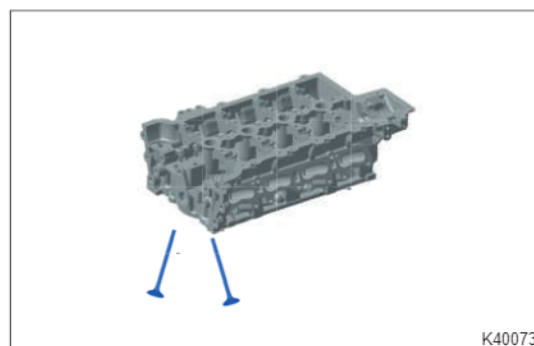
- (1) Install valve spring lower seat to valve guide end to fit it with cylinder head.
- (2) Install valve oil seal to valve oil seal special tool and press it on valve guide. Tap the tool end with a hammer to press in oil seal.



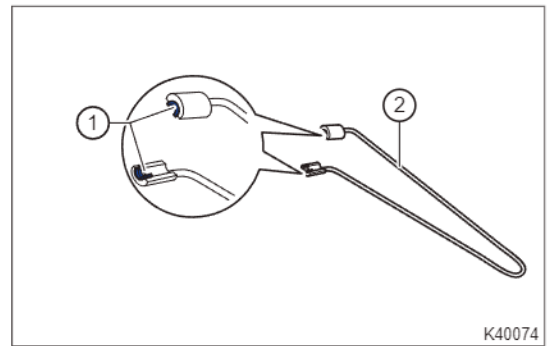
- (3) Clean valve surface, install exhaust valve into cylinder head guide hole.

Hint:

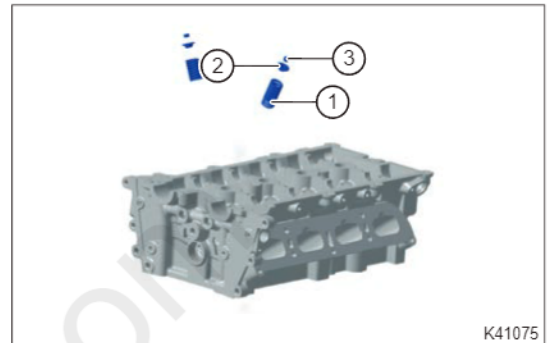
Slightly rotate valve collar until valve conical face fully contacts retainer conical face.



- (4) Install valve cotter (1) to valve cotter installer (2).



- (5) Install valve spring (1) and valve spring upper seat (2). Using a valve spring compressor, compress valve spring to a position so that valve cotter can be installed; Using a valve cotter installer, install valve cotter (3) in place.



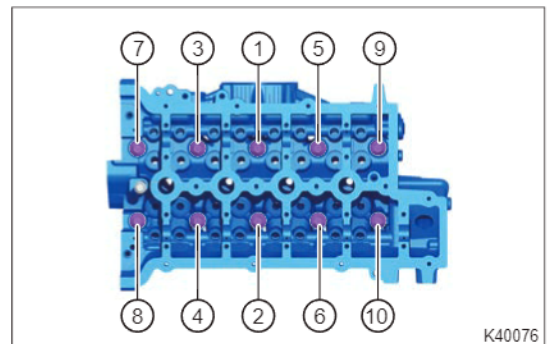
- (6) Tap tip of valve stem lightly with a rubber hammer to make sure valve cotter is installed in place after assembly.

■ Installation

⚠ Caution

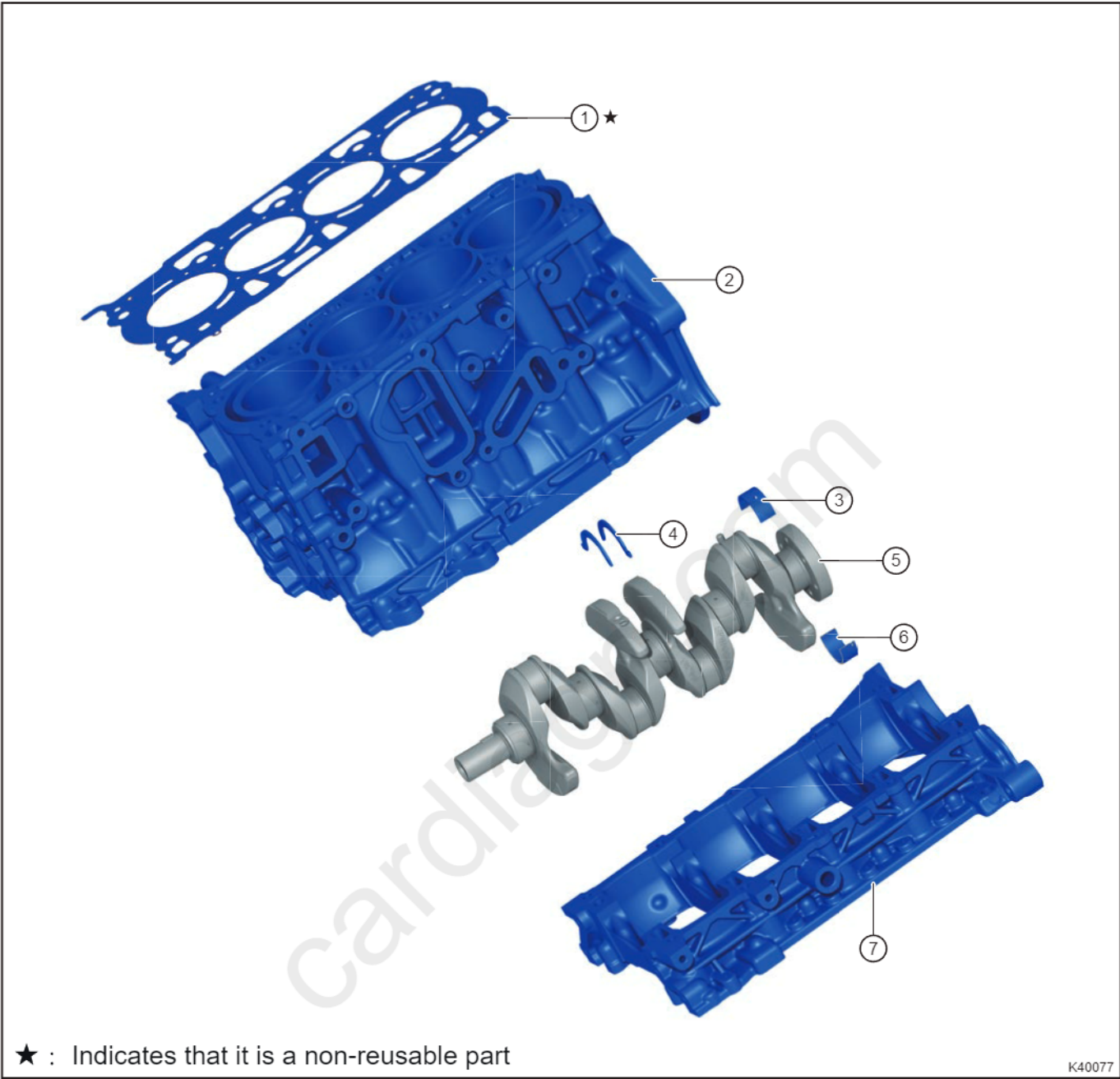
- **DO NOT** damage or lose dowel pin on cylinder block.
- **Remove** residual oil on cylinder head and cylinder block.
- **Replace** cylinder head gasket with a new one.
- **Check** that cylinder head gasket is neat and clean without any chips and scratches.
- **Clean** junction surface between cylinder head and combustion chamber, and remove any accumulated oil at bottom of cylinder block thread.
- **Replace** cylinder head fixing bolt, and make scraping marks on removed cylinder head bolt.

- (1) Tighten bolts in place by hands.
- (2) 1st step: Tighten bolts to $35 \pm 5 \text{ N}\cdot\text{m}$ in order from (1) to (10) shown in illustration.
- (3) 2nd step: Rotate bolts clockwise by $90^\circ \pm 5^\circ$ in tightening order.
- (4) 3rd step: Rotate bolts clockwise by $90^\circ \pm 5^\circ$ in tightening order again.

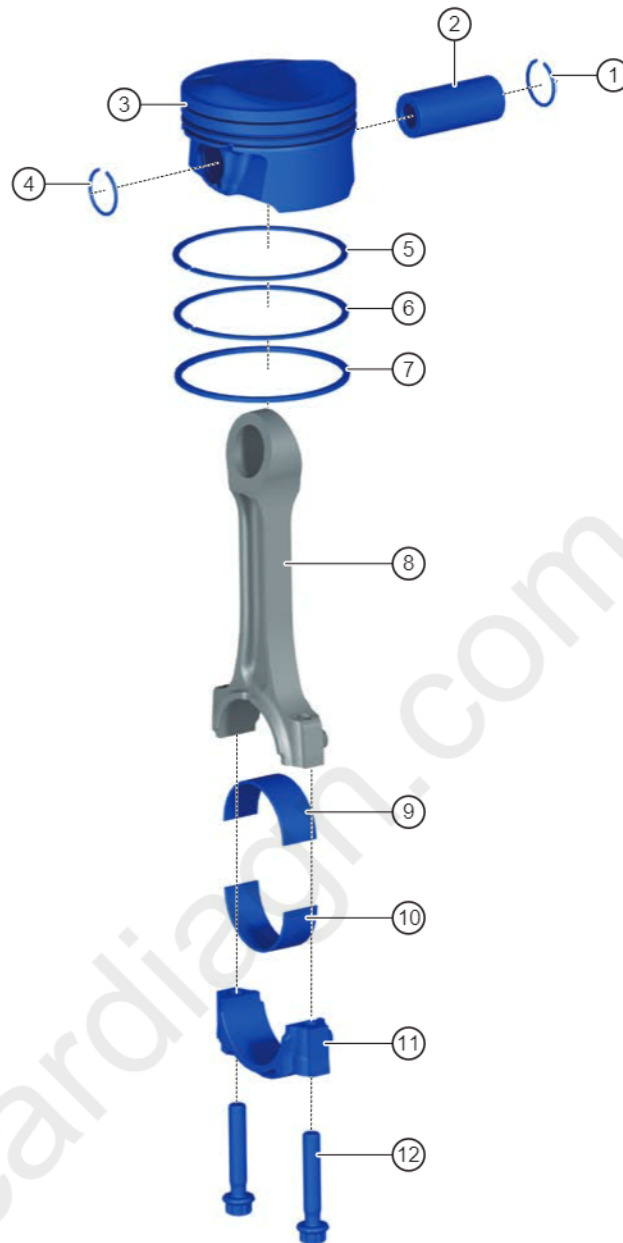


- (5) Install the camshaft and rocker arm.
- (6) Install the engine timing chain.
- (7) Install the cylinder head cover.
- (8) Install the idler pulley assembly.
- (9) Install the tensioner assembly.
- (10) Install the accessory drive belt.
- (11) Install the turbocharger assembly.
- (12) Install the precataltic converter assembly.
- (13) Install the fuel rail injector assembly.
- (14) Install the intake manifold assembly.
- (15) Install the cooling pipe assembly.
- (16) Install the intake hose assembly.
- (17) Install the battery tray.
- (18) Install the battery assembly.
- (19) Install the air filter assembly.
- (20) Add the coolant as specified.
- (21) Add the engine oil as specified.
- (22) Install the engine trim cover assembly.
- (23) Install the engine compartment trim cover assembly.

5.11 Cylinder Block



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



K40078

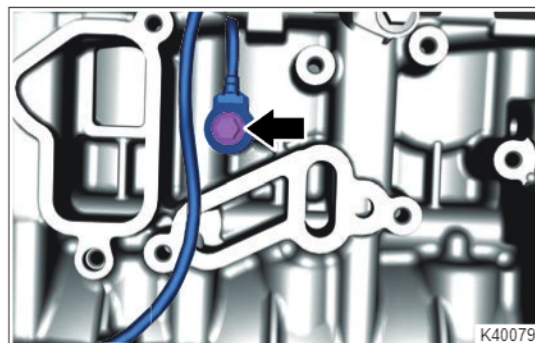
1	Elastic Circlip	7	Oil Ring Assembly
2	Piston pin	8	Connecting Rod Body
3	Piston	9	Connecting Rod Bearing Upper Shell
4	Elastic Circlip	10	Connecting Rod Bearing Lower Shell
5	First Compression Ring	11	Connecting Rod Bearing Cap
6	Second Compression Ring	12	Connecting Rod Bearing Cap Fixing Bolt

■ Removal

⚠ Warning

- **Be sure to wear necessary safety equipment to prevent accidents, when removing cylinder block.**
- **Appropriate force should be applied when removing cylinder block. Be careful not to operate roughly.**

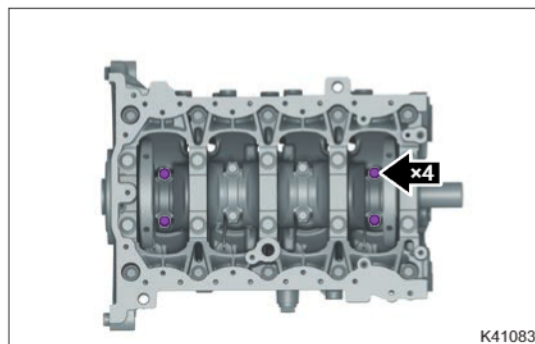
- (1) Remove engine assembly from vehicle.
- (2) Separate transmission from engine.
- (3) Remove the flywheel assembly.
- (4) Remove the turbocharger assembly.
- (5) Remove the turbocharger inlet pipe.
- (6) Remove the turbocharger oil return pipe.
- (7) Remove the electric water pump.
- (8) Remove the intake manifold assembly.
- (9) Remove the accessory drive belt.
- (10) Remove the idler pulley assembly.
- (11) Remove the tensioner assembly.
- (12) Remove the torsion shock absorber.
- (13) Remove the alternator assembly.
- (14) Remove the water pump module assembly.
- (15) Remove the oil filter module assembly.
- (16) Remove the A/C compressor bracket.
- (17) Remove the engine timing chain.
- (18) Remove the cylinder head assembly.
- (19) Remove the oil pan assembly.
- (20) Remove the oil deflector.
- (21) Remove the oil pump chain.
- (22) Remove the variable oil pump.
- (23) Remove the knock sensor fixing bolt and remove the knock sensor.



- (24) Turn crankshaft, so that of cylinders 1 and 4 are at bottom dead center, remove fixing bolts from connecting rod bearing caps of cylinders 1 and 4, and remove connecting rod bearing caps of cylinders 1 and 4.

Hint:

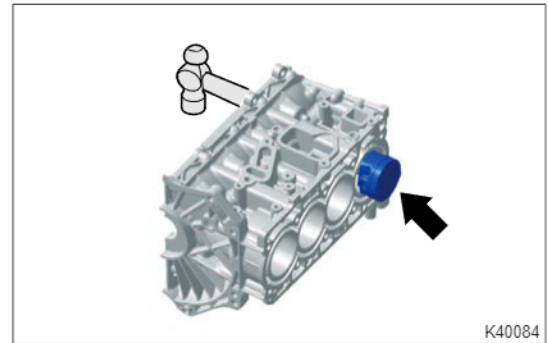
Removal procedures of cylinders 2 and 3 are the same as cylinders 1 and 4.



- (25) Using a hammer handle, push out piston connecting rod assembly from cylinder block.

Hint:

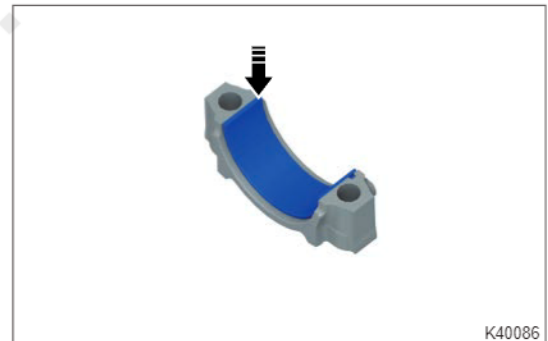
- Please operate carefully when pushing out piston, to avoid cylinder liner damage.
- Mark the removed piston connecting rod assemblies, so as to distinguish them.
- Replace with new connecting rod bearing cap bolts during assembly.



- (26) Push out upper shell from connecting rod body slightly in direction of arrow to remove it.



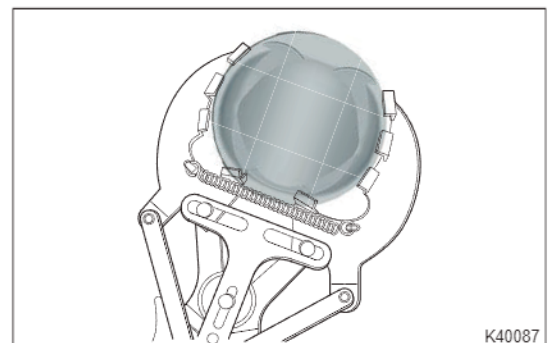
- (27) Push out bearing lower shell slightly from connecting rod bearing cap in direction of arrow to remove it.



- (28) Using a piston ring remover, remove first compression ring and second compression ring.

Hint:

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

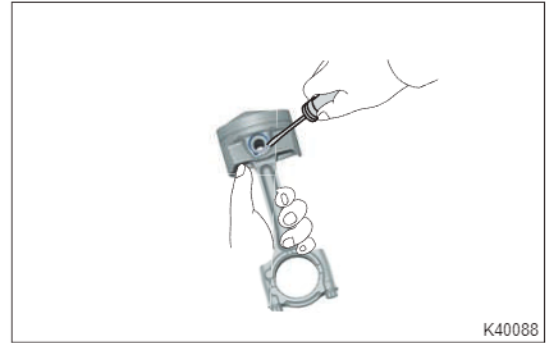


- (29) Remove oil ring rail and expander.

- (30) Using a flat tip screwdriver, pry out elastic circlips at both sides of piston pin carefully from notch.

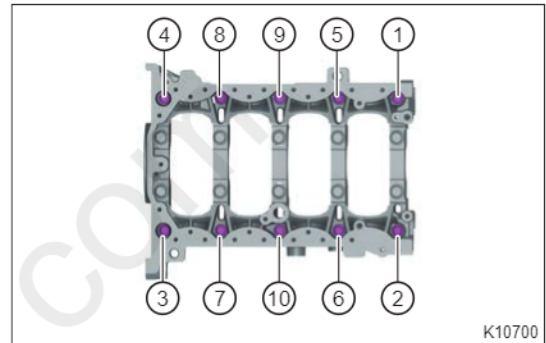
Caution

- **Elastic circlip has a large tensile force. Be careful during removal to prevent personal injury.**



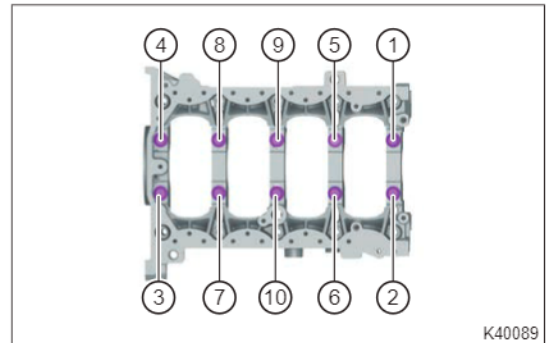
K40088

- (31) Remove the piston pin assembly.
- (32) Remove 10 fixing bolts from crankshaft frame in order shown in illustration.



K10700

- (33) Remove 10 fixing bolts from crankshaft main bearing cap in order as shown in illustration.



K40089

- (34) Remove the crankshaft frame.

Hint:

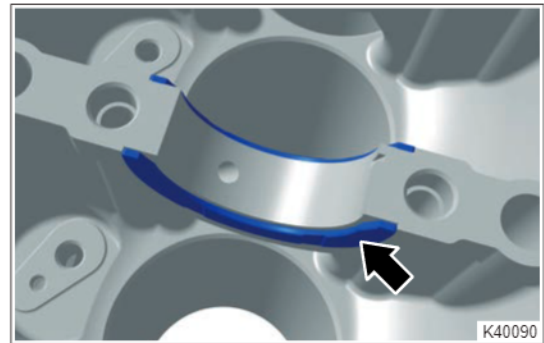
Take care when removing the crankshaft frame, be sure not to damage surrounding components.

- (35) Remove the crankshaft assembly.

Hint:

Take care when removing crankshaft, ask other operators to assist when necessary. Avoid scratching contact surfaces between crankshaft and bearing shell.

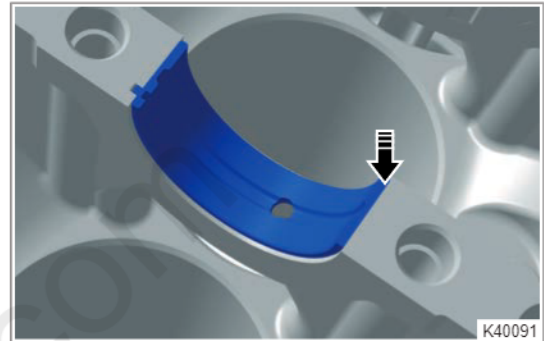
(36) Remove crankshaft thrust washers from cylinder block.



(37) Push out main bearing upper shell slightly from cylinder block in direction of arrow to remove it.

⚠ Caution

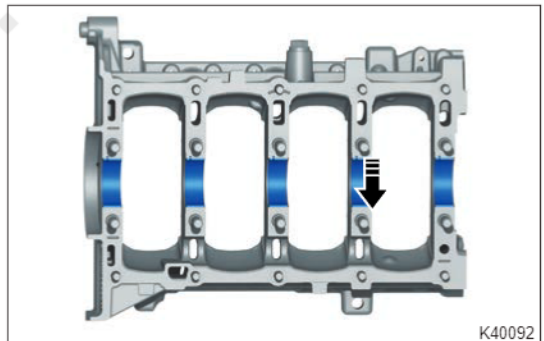
- Pay attention to the notch position. Push out bearing shell carefully. It is difficult to push out bearing shell and parts may be damaged if pushing in opposite direction.



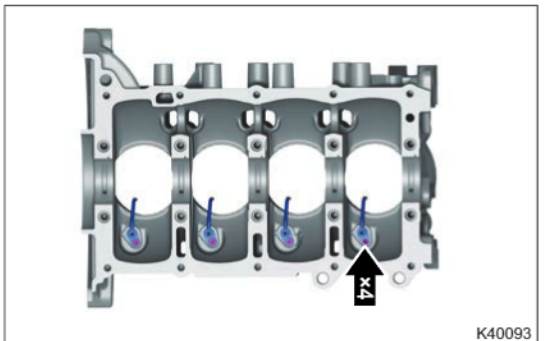
(38) Remove crankshaft main bearing lower shell from frame slightly in the direction of arrow.

⚠ Caution

- Pay attention to the notch position. Push out bearing shell carefully. It is difficult to push out bearing shell and parts may be damaged if pushing in opposite direction.



(39) Remove 4 fixing bolts and piston cooling nozzles.



■ Inspection

(1) Check the cylinder block appearance.

- 1) Clean engine block thoroughly and check all hole passages for leakage.
- 2) Check cylinder liner for cracks.
- 3) Check cylinder block for cracks.

Hint:

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

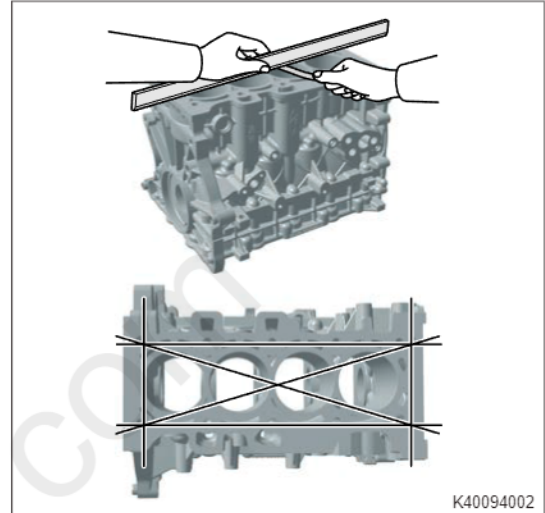
(2) Check the cylinder block upper surface flatness.

- 1) Clean the cylinder block upper surface, using precision straightedge and feeler gauge, measure cylinder block upper surface flatness.

Measurement Item	Specification (mm)	Limit Value (mm)
Cylinder Block Upper Surface Flatness	0.04	0.1

Hint:

Never grind the cylinder block upper surface. If the engine block upper surface flatness is above the limit, replace the engine block.



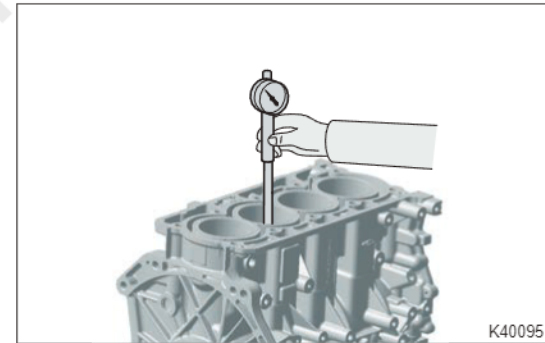
(3) Check cylinder diameter and piston clearance.

- 1) Using a cylinder gauge, measure cylinder diameter and calculate the gap between cylinder and piston.

Measurement Item	Specification (mm)	Limit Value (mm)
Cylinder Diameter	77	77.105
Clearance Between Piston and Cylinder	0.045	0.063

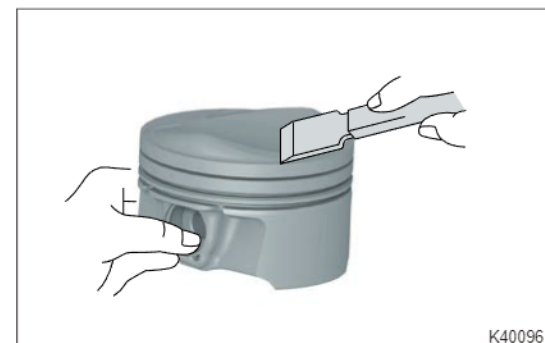
Hint:

If the cylinder diameter is beyond the limit, replace the cylinder block. If the clearance between piston and cylinder is beyond the specified value, check cylinder diameter and piston diameter. Replace as necessary.

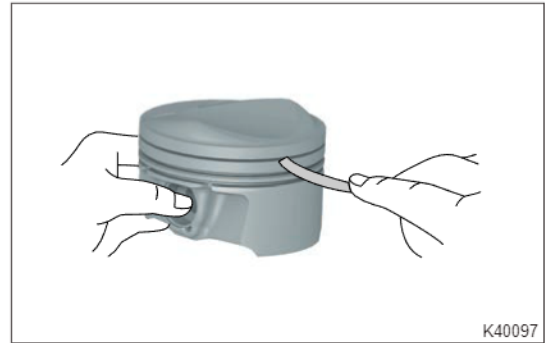


(4) Check the piston.

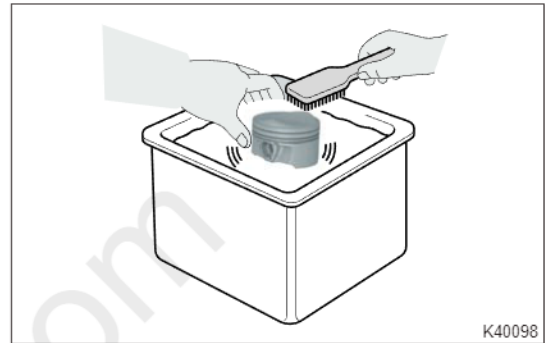
- 1) Using a scraper, remove carbon deposits on piston top.



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



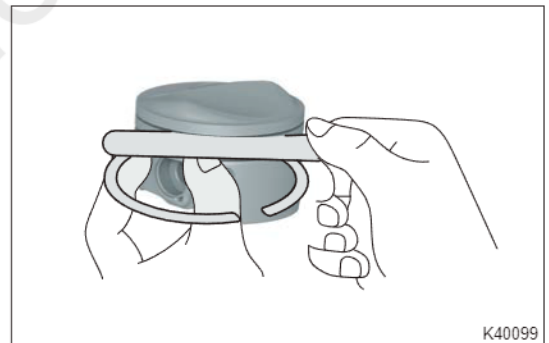
- 3) Using a brush and solvent, thoroughly clean piston.



- (5) Check the piston ring.

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

Measurement Item	Specification (mm)	Limit Value (mm)
First Compression Ring Groove Side Clearance	0.035 - 0.075	0.075
Second Compression Ring Groove Side Clearance	0.03 - 0.07	0.07



Hint:

If piston ring side clearance exceeds specified range, replace piston ring and piston assembly.

- 2) Using a piston, push piston ring from top of cylinder to bottom of cylinder bore, that is 45mm from bottom of cylinder bore. Keep the piston ring level.
- 3) Measure at the specified position, which has the minimum piston ring wear with a feeler gauge.

Measurement Item		Limit Value (mm)
Piston Ring End Gap	First Ring	0.2 - 0.3
	Second Ring	0.4 - 0.6

Hint:

- If piston ring end gap is not within specified range, replace piston ring with a new set.
- If end gap is still not within specified range after replacement, replace cylinder block assembly.

- (6) Check the piston pin.

- 1) Using a feeler gauge, measure diameter of piston pin hole.

Measurement Item	Specification (mm)
Piston Pin Hole Diameter	20.004 - 20.009

Hint:

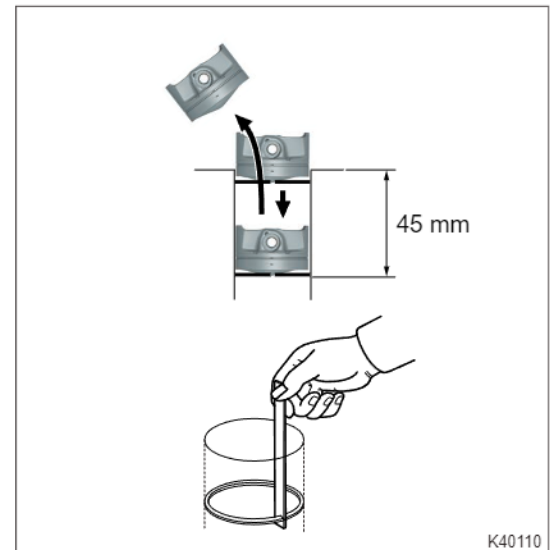
If piston pin hole diameter is not within specified range, replace piston.

- 2) Using an external micrometer, measure diameter of piston pin.

Measurement Item	Specification (mm)
Piston Pin Diameter	19.995 - 20

Hint:

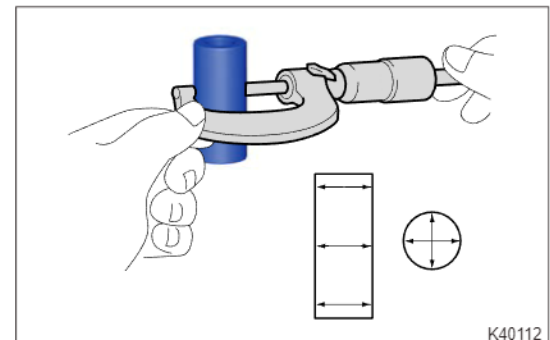
If piston pin diameter is not within specified range, replace piston.



K40110



K40111



K40112

- (7) Check the crankshaft main journal diameter.

- 1) Measure crankshaft main bearing diameter with an external micrometer, and measure again after rotating the crankshaft 90°.

Measurement Item	Specification (mm)	Limit Value (mm)
Crankshaft Main Journal Diameter	46	45.984
Taper and Out-of roundness	0	0.008

Hint:

- If crankshaft main journal diameter is not within specified range, replace main bearing shells with new ones and check matching clearance of crankshaft main bearing.
- If matching clearance of main bearing is still not within specified range after replacing with new main bearing shells, replace crankshaft.

- (8) Check matching clearance of crankshaft main bearing.

- 1) Clean crankshaft main journals and main bearing shells.
- 2) Install the crankshaft. Place feeler (1) on crankshaft main journal, parallel to crankshaft center axis and as wide as distance covered.
- 3) Install crankshaft frame and tighten main bearing cap fixing bolts to specified torque.

Torque: 1st step: $45 \pm 5 \text{ N}\cdot\text{m}$, 2nd step: $180^\circ \pm 10^\circ$

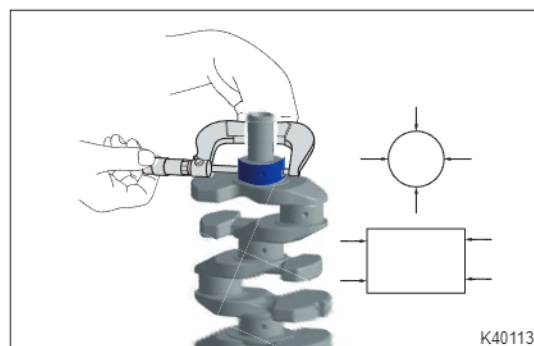
- 4) Remove the crankshaft frame; Using a feeler gauge, measure widest part of compressed feeler gauge. Measured value is matching clearance of crankshaft main bearing.

Measurement Item	Specification (mm)
Matching Clearance of Crankshaft Main Bearing	0.013 - 0.043

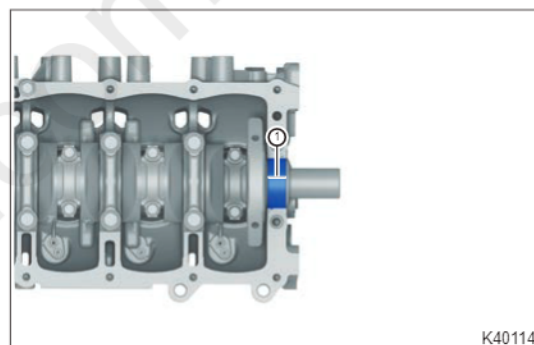
Hint:

- If matching clearance of crankshaft main bearing is not within specified range, install new main bearing shells; Replace crankshaft assembly if necessary.
- Replace bearing shells in pairs.

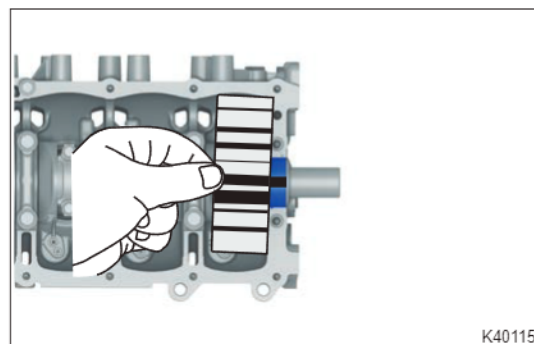
- (9) Check the crankshaft axial clearance.



K40113



K40114



K40115

- 1) Clean crankshaft main journals and main bearing shells.
- 2) Install crankshaft frame and tighten main bearing cap fixing bolts to specified torque.

Torque: 1st step: $45 \pm 5 \text{ N}\cdot\text{m}$, 2nd step: $180^\circ \pm 10^\circ$

- 3) Using a flat tip screwdriver, pry crank position left and right, and read value on dial indicator.

Measurement Item	Specification (mm)	Limit Value (mm)
Crankshaft Axial Clearance	0.120 - 0.315	0.315

(10) Check the crankshaft main journal coaxiality.

- 1) Install crankshaft onto tester and keep it level.
- 2) Rotate crankshaft slowly and read maximum change value from dial indicator. (Readings on dial indicator)/ 2 is the coaxiality of crankshaft main journal.

Measurement Item	Specification (mm)	Limit Value (mm)
Crankshaft Main Journal Coaxiality	0	0.05

Hint:

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

(11) Detect diameter of crankshaft connecting rod journal.

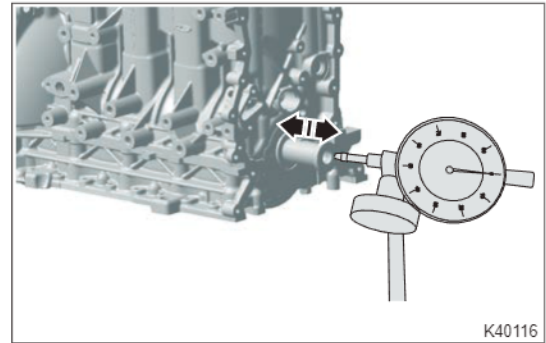
- 1) Using an external micrometer, measure diameter of crankshaft connecting rod journal.

Measurement Item	Specification (mm)	Limit Value (mm)
Crankshaft Connecting Rod Journal Diameter	44	43.984

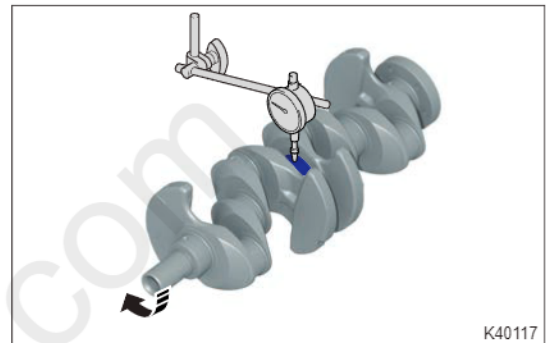
Hint:

- 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.

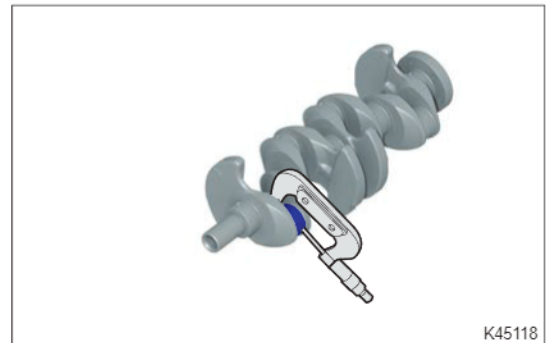
(12) Check radial clearance of crankshaft connecting rod bearing shell.



K40116



K40117



K45118

- 1) Clean connecting rod journals and connecting rod bearing shells.
- 2) Place a feeler (1) on connecting rod journal.
- 3) Install connecting rod bearing caps, and tighten connecting rod bearing cap fixing bolts to specified torque.

Torque: 1st step: 20 - 25 N·m, 2nd step: $85^\circ \pm 5^\circ$

Hint:

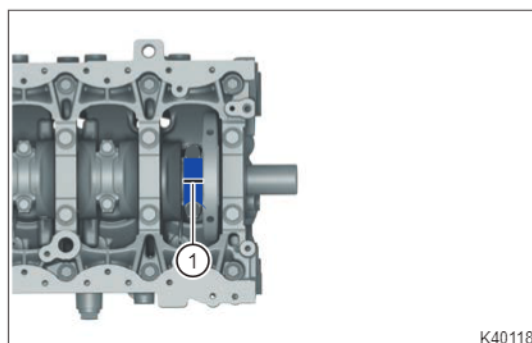
DO NOT turn crankshaft during installation.

- 4) Remove the connecting rod bearing cap.
- 5) Using gauge scale of feeler gauge, measure the widest part of compressed feeler gauge to obtain radial clearance of connecting rod bearing shell.

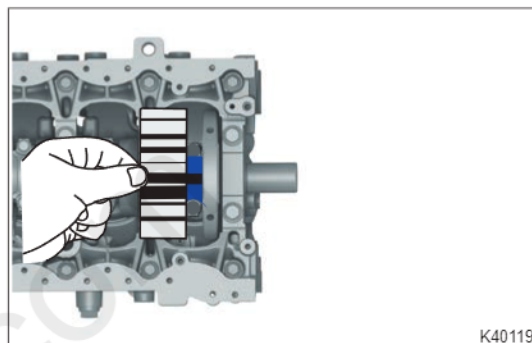
Measurement Item	Specification (mm)
Connecting Rod Bearing Shell Radial Clearance	0.035 - 0.067

Hint:

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



K40118



K40119

(13) Check axial clearance of connecting rod.

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

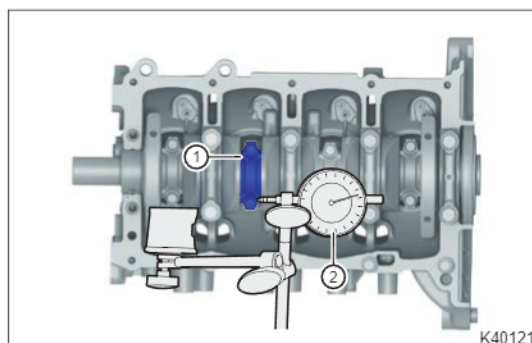
Torque: 1st step: 20 - 25 N·m, 2nd step: $85^\circ \pm 5^\circ$

- 2) Install a dial indicator (2) with its plunger contacting the side of connecting rod cap (1) Reset dial of dial indicator to zero.
- 3) Push connecting rod bearing cap forward and backward (do not move crankshaft forward and backward) and read value on dial indicator.

Measurement Item	Specifications
Connecting Rod Axial Clearance	0.15 - 0.40

Hint:

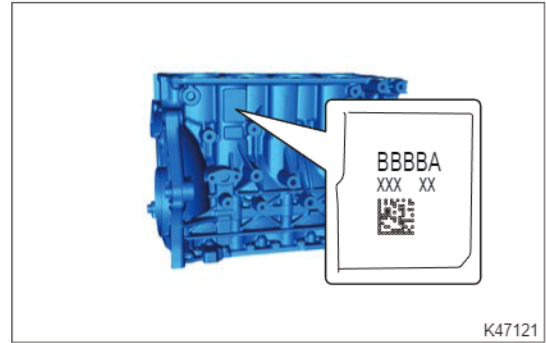
If axial clearance of connecting rod is not within specified range, replace piston connecting rod assembly. Replace crankshaft assembly if necessary.



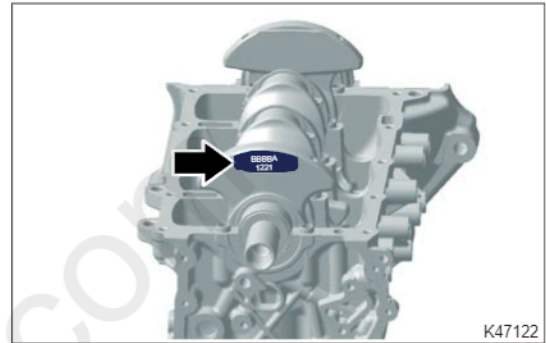
K40121

■ Selection of Main Bearing Shell

- (1) Related letter marks are available on cylinder block (- consisting of A, B, C). Such as “BBBBA” in illustration, each letter from left to right is corresponding to the size of each cylinder block main bearing hole. First letter “B” indicates the first main bearing hole and the fifth letter “A” indicates the fifth main bearing hole.



- (2) Related letter marks are available on first balancer at front end of crankshaft (consisting of A, B, C). Such as “BBBBA” in illustration, each letter from left to right is corresponding to the size of each crankshaft main journal. First letter “B” indicates the first main journal and the fifth letter “A” indicates the fifth main journal.



- (3) Crankshaft Main Bearing Shell Selection Information Table

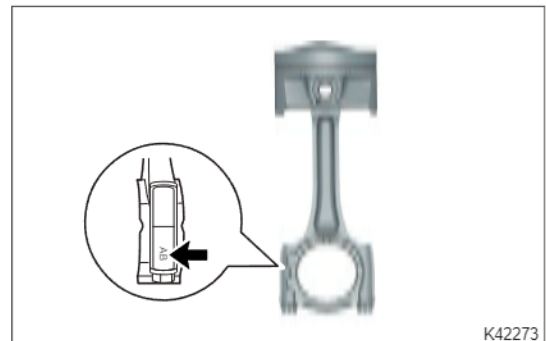
Main Journal Main Shaft Hole	C Yellow 45.984~45.989	B Red 45.989~45.995	A Blue 45.995~46.000
	Bearing Shell	Bearing Shell	Bearing Shell
A Blue (50.000~50.005)	Red	Red	Blue
B Red (50.005~50.011)	Yellow	Red	Blue
C Yellow (50.011~50.016)	Yellow	Yellow	Red

K41091

■ Selection of connecting rod bearing upper shell

- (1) Connecting rod bearing upper shells are divided into red shell and blue shell. Related letter marks are available on connecting rod bearing shell cap (consisting of A and B).
- (2) As shown in illustration, mark “A” on connecting rod indicates red shell, “B” indicates blue shell.

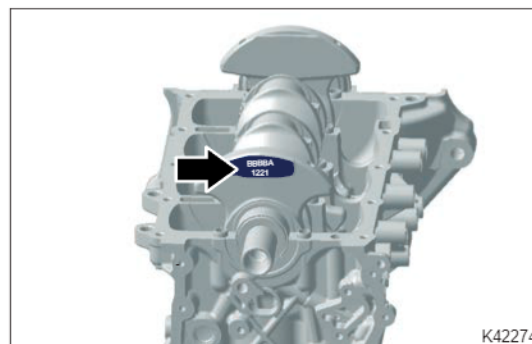
Name	Type	Letter Mark
Connecting Rod Upper Shell	Red shell	A
	Blue shell	B



■ Selection of connecting rod lower shell

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

Name	Type	Letter Mark
Rod Bearing Lower Shell	Red shell	1
	Blue shell	2



K42274

Hint:

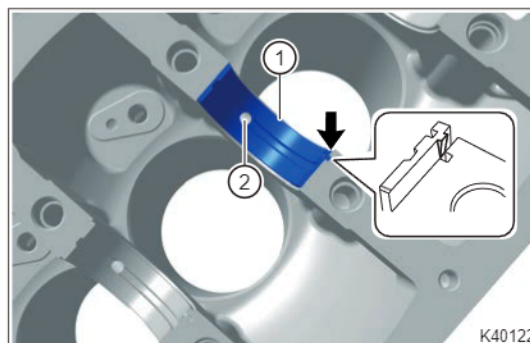
- Connecting rod upper and lower bearing shells cannot be interchanged.
- It is necessary to use a set of connecting rod bearing shells that are provided by the same manufacturer on the same engine.
- Apply a coat of engine oil to inner surface of connecting rod bearing shell before installation. Back side of bearing shell should be clean without any oil or foreign matter during assembly, and make sure that back side and inner surface are clean.

■ Installation

- (1) Install 4 fixing bolts to piston cooling nozzles.

Torque: 6 - 8 N·m

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



K40122

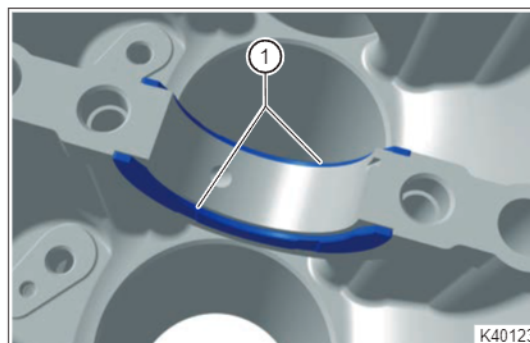
⚠ Caution

- Apply a proper amount of engine oil to inner surface of main bearing shell before installation.
- Install main bearing lower shell in the same way of crankshaft main bearing upper shell.

- (3) Install crankshaft thrust washer to front and rear thrust surfaces of 3rd main bearing seat respectively.

Hint:

The side of crankshaft thrust washers (1) without groove should face cylinder block side while the other side with groove should face crankshaft side.



K40123

- (4) Apply seal gum to installation surface of crankshaft frame.

Seal gum: Loctite 5900H

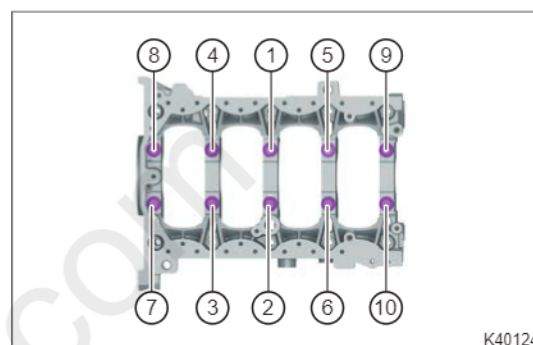
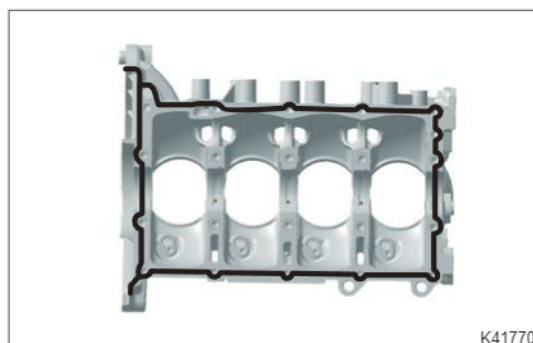
Diameter of seal gum line: 2.5 - 3.5 mm

Hint:

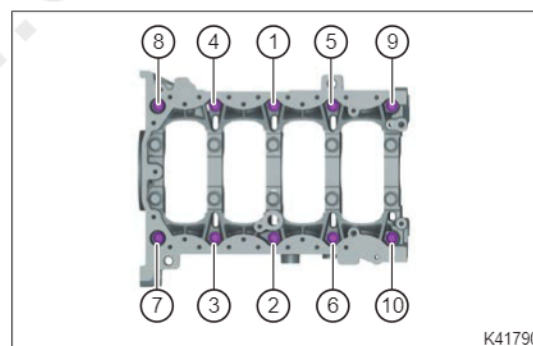
- DO NOT apply seal gum to bearing shell when applying seal gum.
- Seal gum should not be applied too thick. Avoid seal gum entering bearing shell installation area due to compression.

- (5) Place crankshaft on cylinder block carefully.
- (6) 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.

Torque: 1st step: $45 \pm 5 \text{ N}\cdot\text{m}$, 2nd step: $180^\circ \pm 10^\circ$



- (7) Evenly tighten 10 crankshaft frame fixing bolts in order shown in illustration.

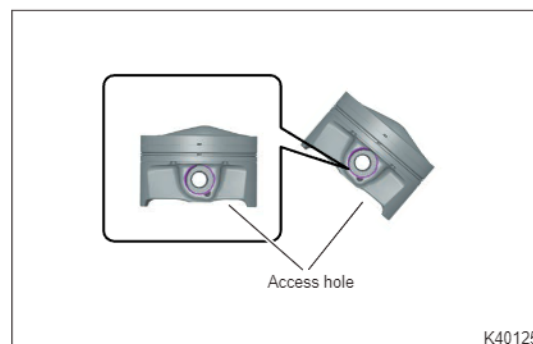


- (8) Using a small screwdriver, install new elastic circlip to one end of piston pin hole.

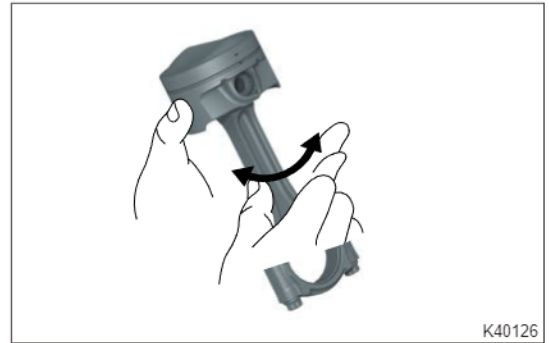
Hint:

Relative angle between elastic circlip opening and removed notch is $180^\circ \pm 40^\circ$

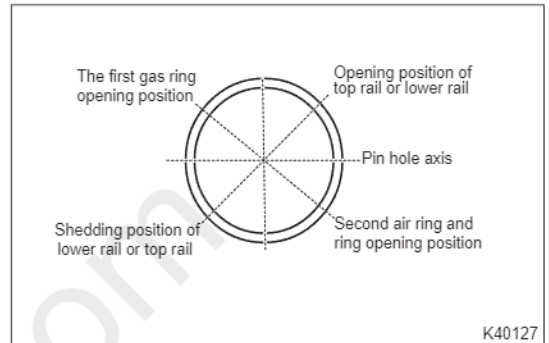
- (9) Align front marks on piston and connecting rod, push piston pin with thumb until it contacts with elastic circlip.



- (10) Install elastic circlip to the other end of piston pin hole, and check for free rotation between piston and connecting rod assembly.

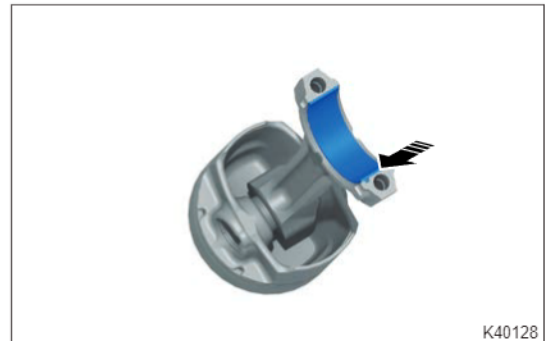


- (11) Apply a small amount of engine oil to piston ring groove and piston. Pay attention that the sides with words of first compression ring (1) and second compression ring (2) should face upward.
- (12) When installing the oil ring, first install the expander into oil groove, then install upper and lower rails with opening staggered by 90° from the expander, and the upper and lower rails at 180° . Then install the second compression ring, and install the first compression ring finally with two compression rings staggered by 90° from upper rail opening; The piston ring should rotate in the ring groove freely without any stuck condition.
- (13) Rotate piston ring several turns after adding engine oil to piston ring groove, and note that the position of ring notch should be the same with that described above; clean crankshaft connecting rod journal and cylinder with a non-woven fabric cloth.
- (14) Carefully install the connecting rod bearing upper shell in direction of arrow, and keep notch of each connecting rod bearing upper shell face the cutout of connecting rod bearing cap.



Hint:

Apply a proper amount of engine oil to connecting rod bearing shell inner surface before installation.



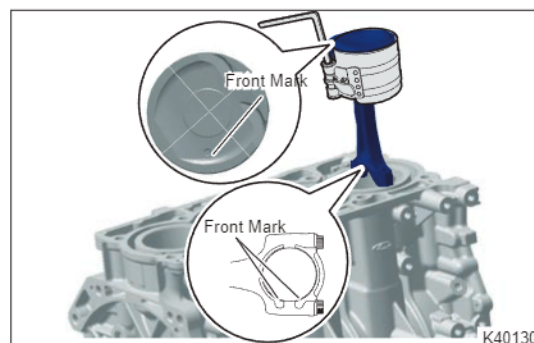
- (15) Carefully install connecting rod bearing lower shell in direction of arrow, and keep notch of each connecting rod bearing lower shell face the cutout of connecting rod bearing cap.

Hint:

Back side of connecting rod bearing shell should be clean without any foreign matter during assembly.



- (16) Rotate crankshaft to top dead center of cylinder 1 and cylinder 4.
- (17) Apply a coat of engine oil to piston surface and cylinder inner wall.
- (18) As shown in illustration, install piston connecting rod assembly to cylinder with piston installer; Pay attention to front marks on piston and connecting rod during assembly, without being reversed.

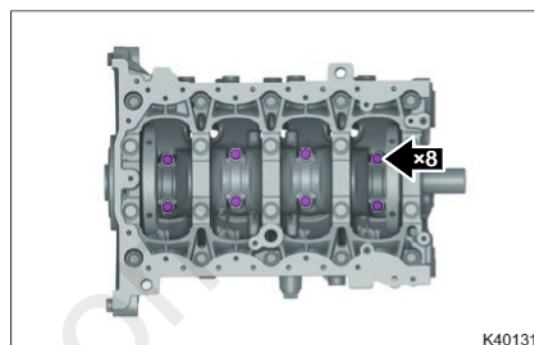


- (19) Install connecting rod bearing caps in place, install connecting rod bearing cap fixing bolts and tighten connecting rod bearing cap fixing bolts to specified torque.

Torque: 1st step: 20 - 25 N·m, 2nd step: 85° ± 5°

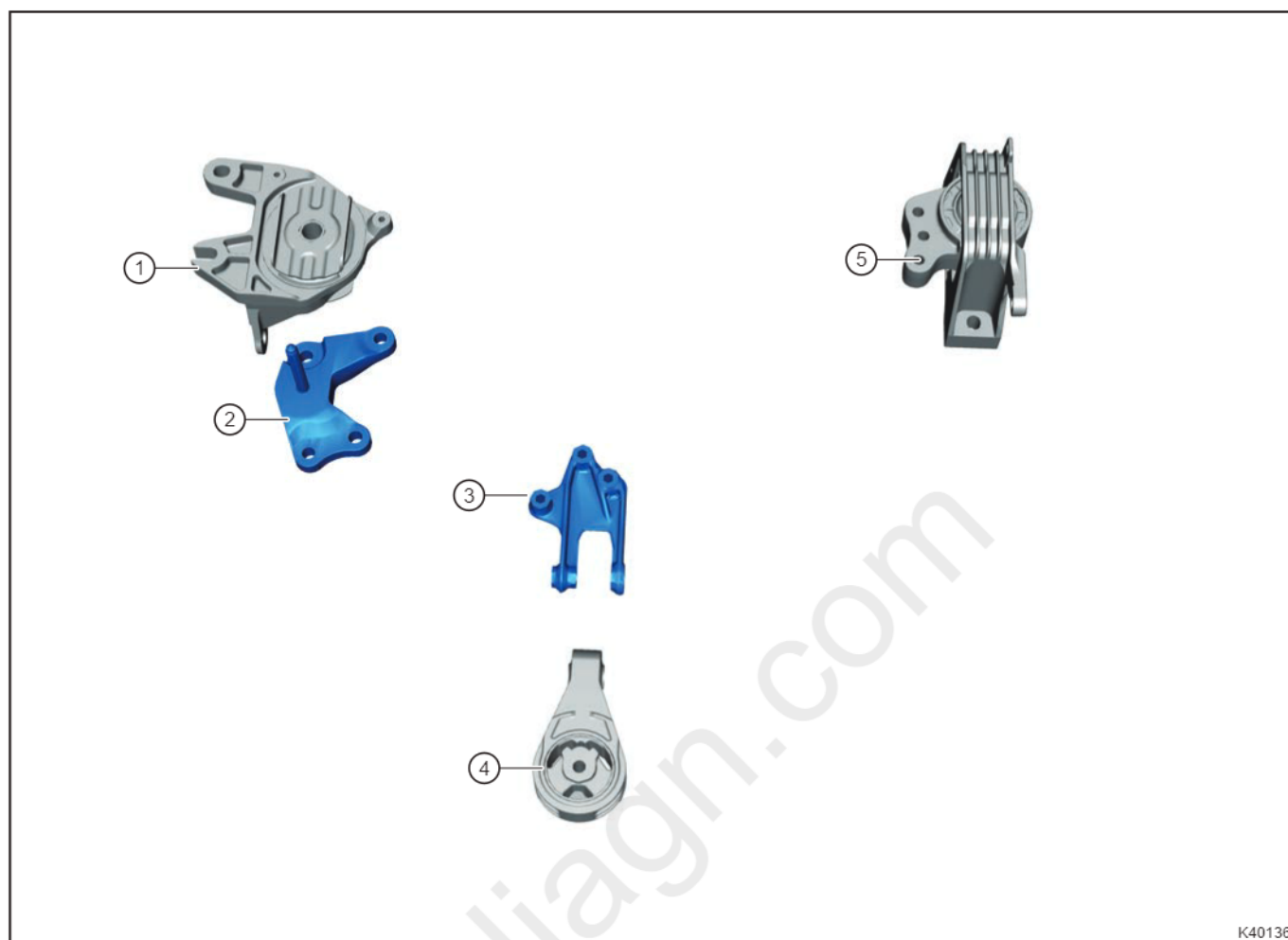
Hint:

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



- (20) Install the knock sensor.
- (21) Install the oil pump assembly.
- (22) Install the oil pump chain.
- (23) Install the oil deflector.
- (24) Install the oil pan assembly.
- (25) Install the cylinder cover assembly.
- (26) Install the engine timing chain.
- (27) Install the A/C compressor bracket and A/C compressor.
- (28) Install the oil filter module assembly.
- (29) Install the water pump module.
- (30) Install the alternator assembly.
- (31) Install the timing chain cover .
- (32) Install the torsion shock absorber.
- (33) Install the tensioner assembly.
- (34) Install the idler pulley assembly.
- (35) Install the engine accessory drive belt.
- (36) Install the intake manifold assembly.
- (37) Install the turbocharger assembly.
- (38) Install the flywheel assembly.
- (39) Install the transmission assembly.
- (40) Install the engine assembly to vehicle body.

5.12 Engine Mounting Assembly



K40136

1	Left Mounting Cushion Assembly	4	Rear Mounting Cushion Assembly
2	Left Mounting Bracket	5	Right Mounting Cushion Assembly
3	Rear Mounting Bracket		

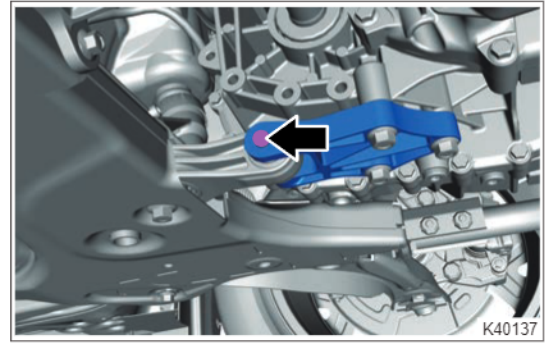
■ Remove the rear mounting assembly

⚠ Warning

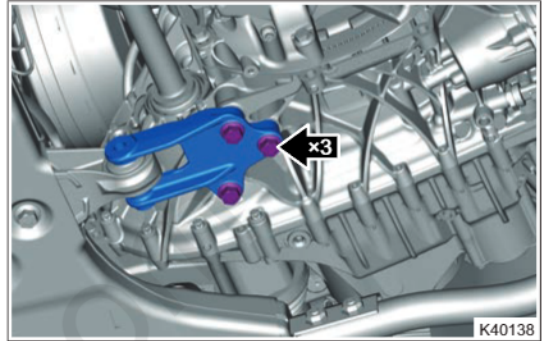
- Be sure to wear safety equipment to prevent accidents, when removing rear mounting assembly.
- Appropriate force should be applied when removing rear mounting assembly. Be careful not to operate roughly.

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Raise the vehicle to a proper position.

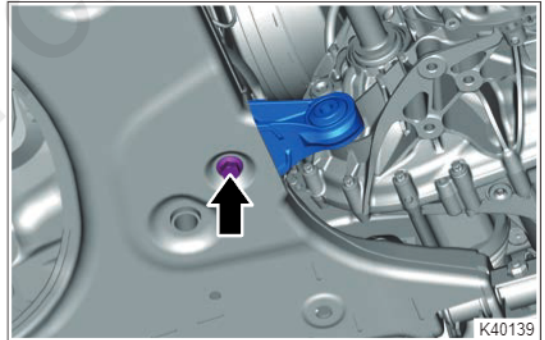
- (3) Remove 1 through bolt between rear mounting bracket and rear mounting cushion.



- (4) Remove 3 fixing bolts between rear mounting bracket and transmission assembly and remove rear mounting bracket.



- (5) Remove 1 fixing bolt between rear mounting cushion and front sub frame and remove rear mounting cushion.



■ Inspection

- (1) Check rubber part on rear mounting cushion for damage or deformation. Replace rear mounting cushion as necessary.
- (2) Check rear mounting bracket for deformation or cracks. Replace rear mounting bracket as necessary.

■ Installation

⚠ Caution

- **Pre-tighten 2 to 3 threads manually first during assembly of bolts, then pre-tighten and tighten it to specified torque with a tool.**

- (1) Install 1 fixing bolt between rear mounting cushion and front sub frame.

Torque: 200 ± 15 N·m

- (2) Install 3 fixing bolts between rear mounting bracket and transmission assembly.

Torque: 110 ± 15 N·m

- (3) Install 1 fixing bolt to rear mounting pull rod and rear mounting bracket.

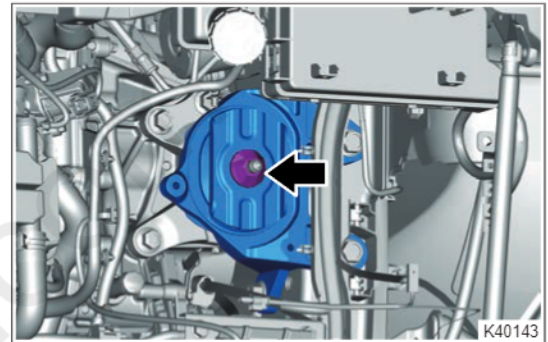
Torque: 200 ± 15 N·m

■ Remove the left mounting assembly

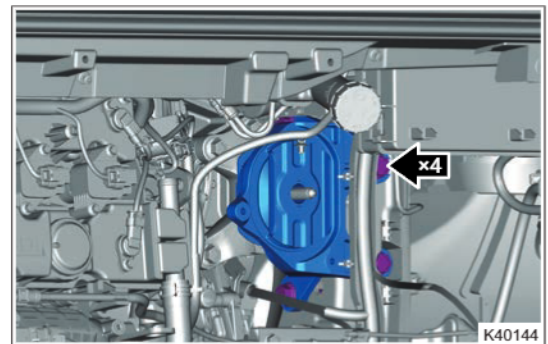
⚠ Warning

- **Be sure to wear safety equipment to prevent accidents, when removing left mounting assembly.**
- **Appropriate force should be applied when removing left mounting assembly. Be careful not to operate roughly.**

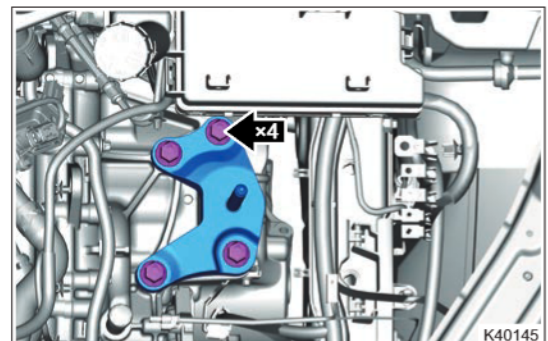
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Disconnect the negative battery cable.
- (4) Remove the air filter assembly.
- (5) Remove the battery assembly.
- (6) Remove the battery tray.
- (7) Remove 1 fixing nut between left mounting cushion assembly and left mounting bracket.



- (8) Remove 4 fixing bolts between left mounting cushion assembly and body and remove left mounting cushion assembly.



- (9) Remove 4 fixing bolts between left mounting bracket and transmission assembly and remove left mounting bracket.



■ Inspection

- (1) Check rubber part on left mounting cushion assembly for damage or deformation. Replace left mounting cushion as necessary.
- (2) Check left mounting bracket for deformation or cracks. Replace left mounting bracket as necessary.

■ Installation

⚠ Caution

- **Pre-tighten 2 to 3 threads manually first during assembly of bolts, then pre-tighten and tighten it to specified torque with a tool.**

(1) Install 4 fixing bolts between left mounting bracket and transmission assembly.

Torque: $110 \pm 15 \text{ N}\cdot\text{m}$

(2) Install 4 fixing bolts between left mounting cushion assembly and body.

Torque: $110 \pm 15 \text{ N}\cdot\text{m}$

(3) Install 1 fixing nut between left mounting cushion assembly and left mounting bracket.

Torque: $110 \pm 15 \text{ N}\cdot\text{m}$

(4) Install the battery tray.

(5) Install the battery assembly.

(6) Install the air filter assembly.

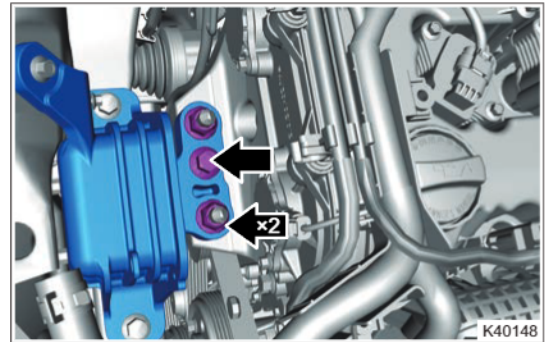
(7) Install the engine compartment trim cover.

■ Removal of Right Mounting Cushion Assembly

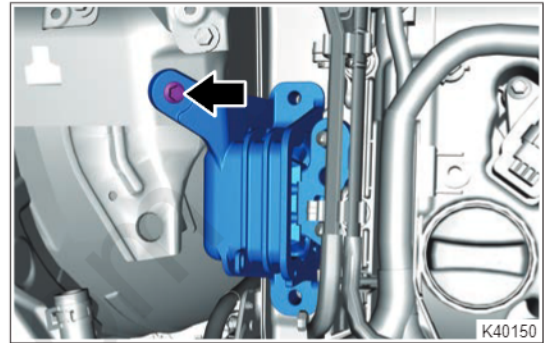
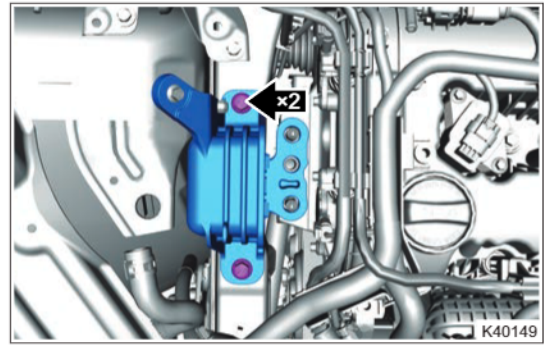
⚠ Warning

- **Be sure to wear safety equipment to prevent accidents, when removing right mounting cushion assembly.**
- **Appropriate force should be applied when removing right mounting cushion assembly. Be careful not to operate roughly.**

- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Move the expansion tank to proper position.
- (4) Remove 2 fixing nuts and 1 fixing bolt between right mounting cushion assembly and engine.



- (5) Remove 3 fixing bolts between right mounting cushion assembly and right side rail.



- (6) Remove the right mounting cushion assembly.

■ Inspection

- (1) Check rubber part on right mounting cushion assembly for damage or deformation. Replace right mounting cushion as necessary.

■ Installation

⚠ Caution

- Pre-tighten 2 to 3 threads manually first during assembly of bolts, then pre-tighten and tighten it to specified torque with a tool.

- (1) Install 3 fixing bolts between right mounting cushion assembly and right side rail.

Torque: $110 \pm 15 \text{ N}\cdot\text{m}$

Torque: $25 \pm 3 \text{ N}\cdot\text{m}$

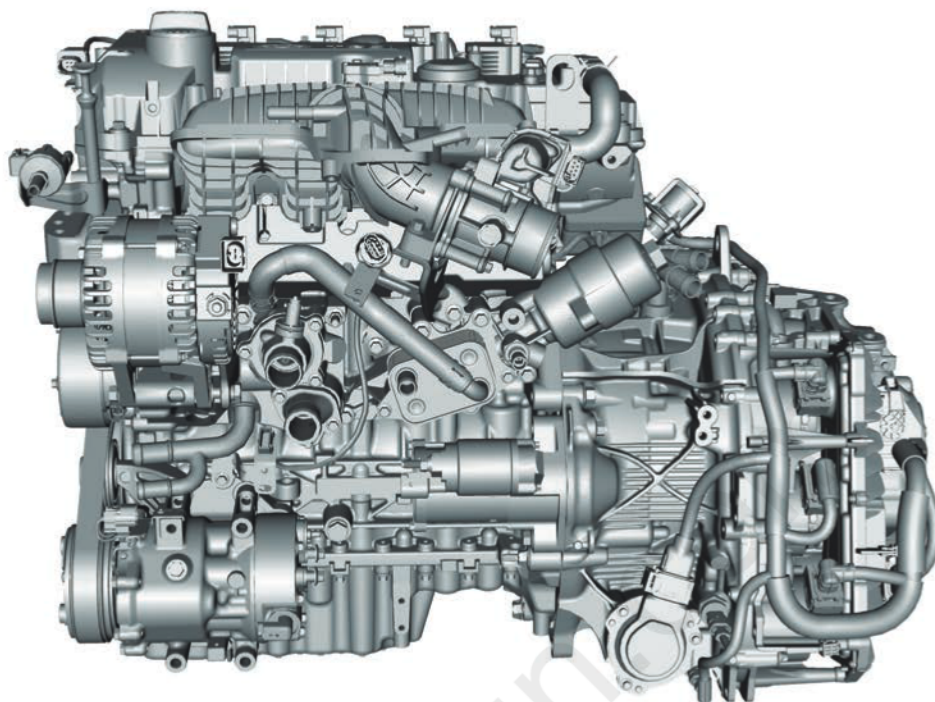
- (2) Install 2 fixing nuts and 1 fixing bolt on right mounting cushion assembly and sprocket head cover assembly.

Torque: $110 \pm 15 \text{ N}\cdot\text{m}$

- (3) Install expansion tank.

- (4) Install the engine compartment trim cover.

5.13 Engine Assembly



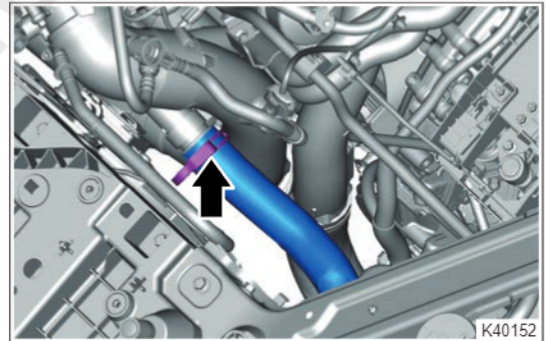
K40151

■ Removal

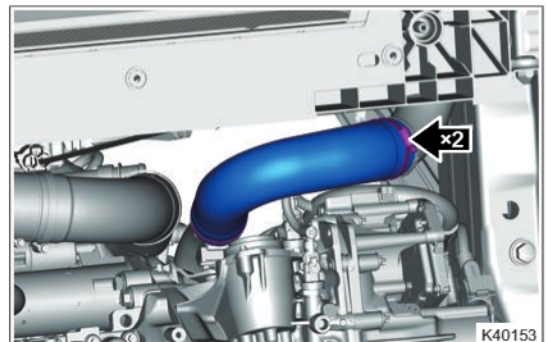
⚠ Caution

- Remove engine and transmission as an assembly.
- Install protector to prevent body from being scratched.
- Plug inlet port of intake pipe to prevent foreign matter from entering after removing intake system components. Or the foreign matter will block cylinder intake passage when starting to seriously damage the engine.

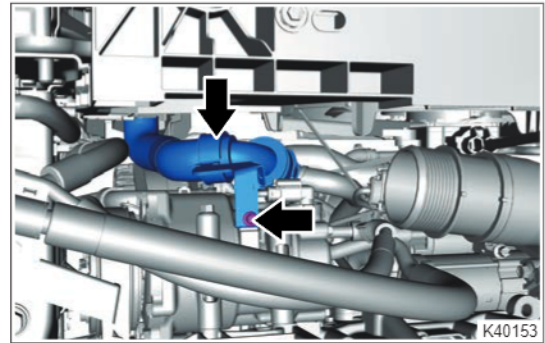
- (1) Turn off all electrical equipment and ENGINE START STOP switch.
- (2) Remove the engine compartment trim cover assembly.
- (3) Remove the engine trim cover assembly.
- (4) Disconnect the negative battery cable.
- (5) Drain the coolant.
- (6) Recover/Drain the refrigerant.
- (7) Drain the transmission oil.
- (8) Remove the air filter assembly.
- (9) Remove the intake hose assembly.
- (10) Remove the battery assembly.
- (11) Remove the battery tray.
- (12) Remove the engine compartment lower protector assembly.
- (13) Remove the intercooler outlet pipe assembly II .
- (14) Remove the intercooler intake pipe assembly III .
- (15) Remove the front wheel tire.
- (16) Remove the left/right side rail assembly.
- (17) Remove the front left drive shaft assembly.
- (18) Remove the front right drive shaft assembly.
- (19) Remove the transfer case assembly.
- (20) Remove the precatlytic converter assembly.
- (21) Remove the front sub frame assembly.
- (22) Loosen elastic clamps and disconnect engine inlet pipe connection.



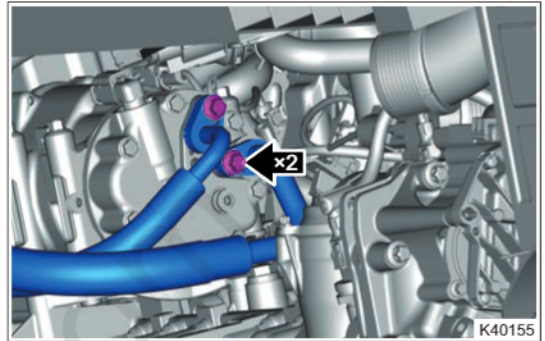
- (23) Loosen 2 elastic clamps and remove the intercooler intake pipe assembly III .



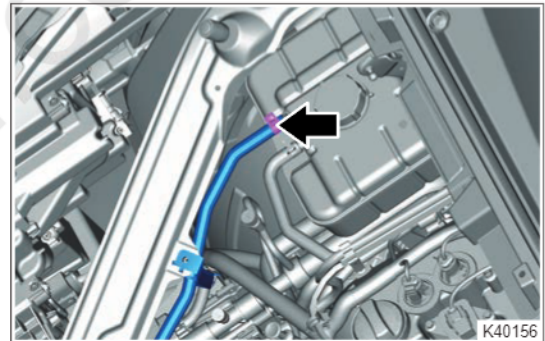
- (24) Loosen elastic clamps, remove 1 bolt from fixing bracket and disconnect engine outlet pipe connection.



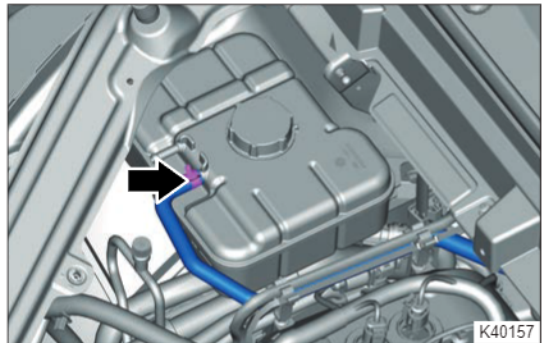
- (25) Remove 2 fixing bolts from A/C pipes, disconnect the compressor.



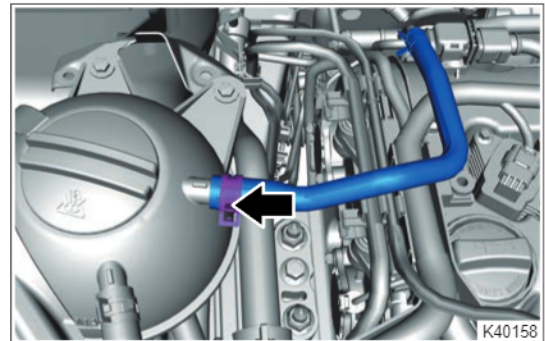
- (26) Loosen elastic clamp and disconnect radiator discharge pipe assembly.



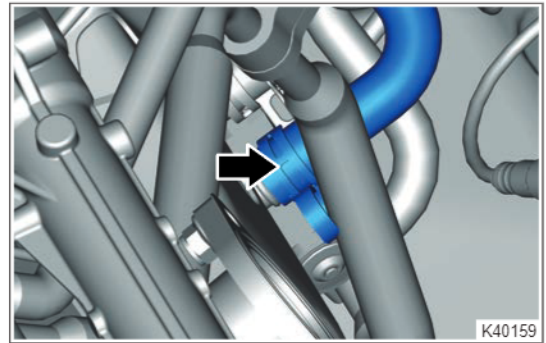
- (27) Loosen elastic clamps and disconnect engine discharge pipe.



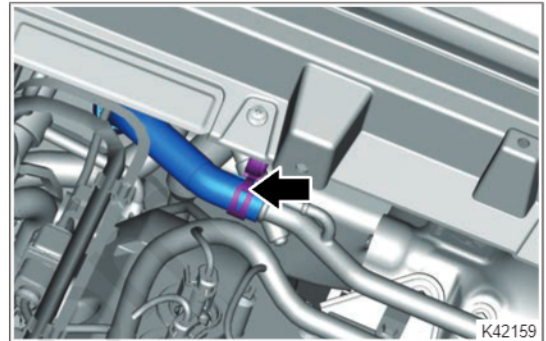
- (28) Loosen elastic clamps and disconnect engine discharge pipe.



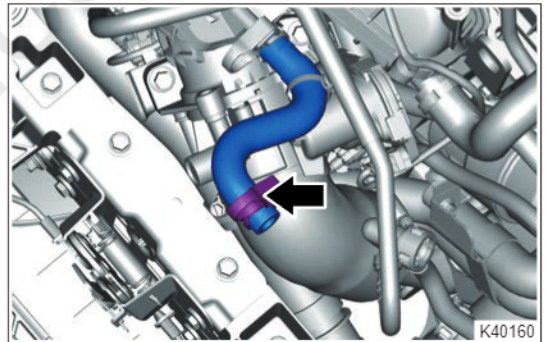
(29) Loosen elastic clamps and disconnect outlet pipe.



(30) Loosen elastic clamps and disconnect heater inlet pipe.

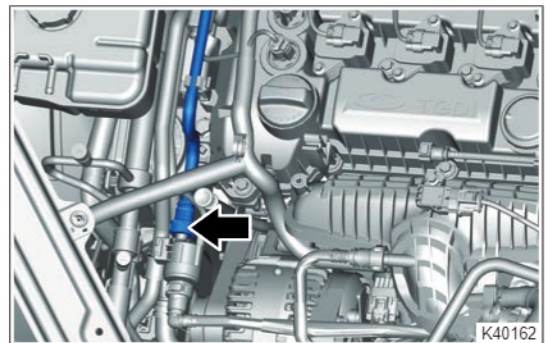


(31) Loosen elastic clamps and disconnect vacuum pipe connection.

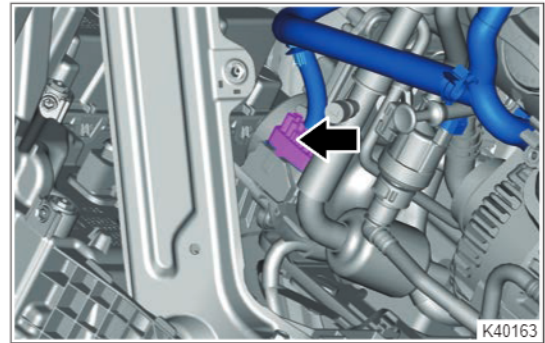


(32) Disconnect connection between engine compartment oil supply pipe and floor oil supply pipe.

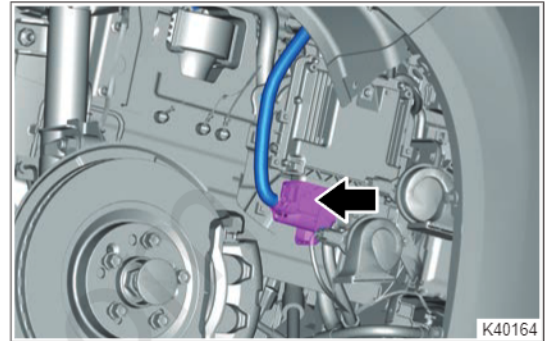
(33) Disconnect the fuel vapor pipe III connection.



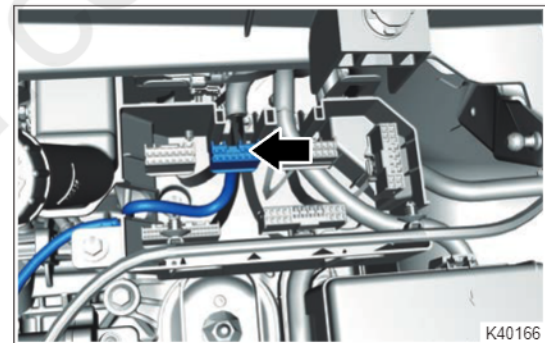
- (34) Disconnect the connector between engine electronic injection wire harness and interior floor wire harness.



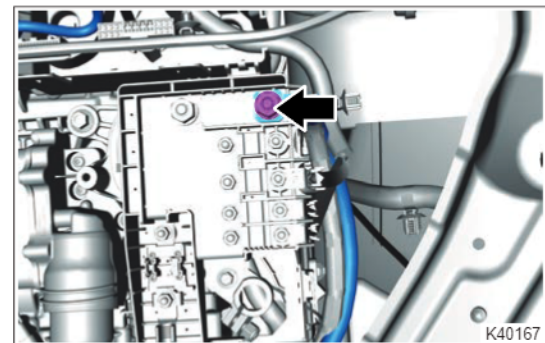
- (35) Remove the front right wheel house protector body, disconnect ECU connector.



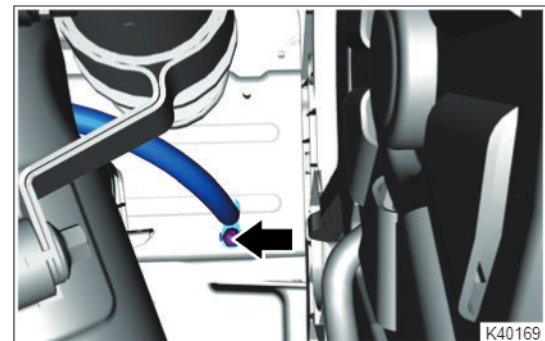
- (36) Disconnect connector between engine electronic injection wire harness and engine compartment fuse and relay box.



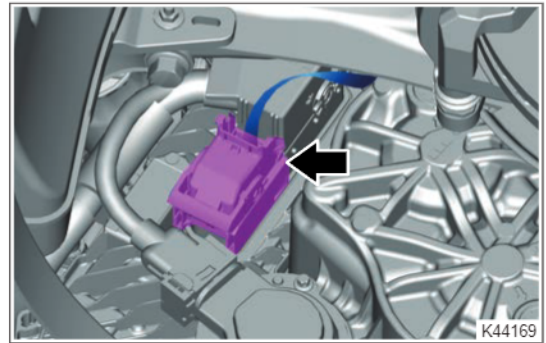
- (37) Remove fixing nuts from positive battery wire harness and positive battery wire harness.



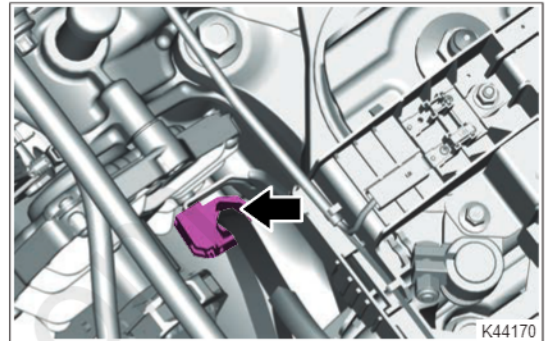
- (38) Remove fixing nuts from ground wire harness and move away the ground wire.



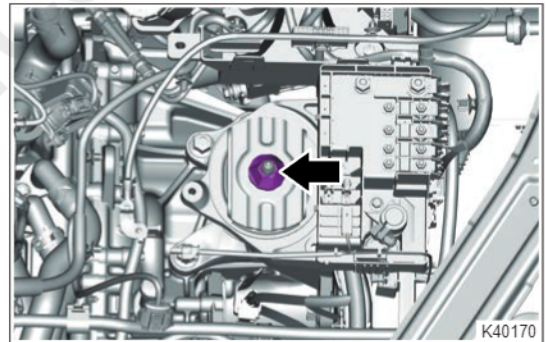
(39) Disconnect the TCU connector.



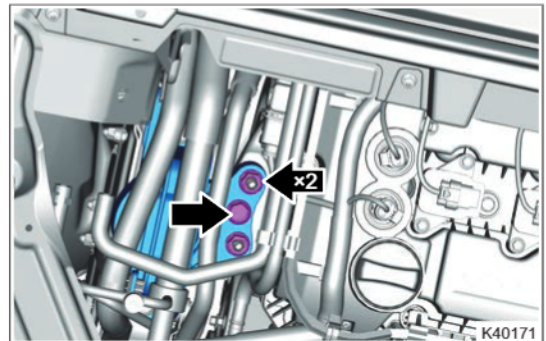
(40) Remove fixing clips from interior floor wire harness.



(41) Remove 1 fixing nut between left mounting cushion assembly.



(42) Remove 2 fixing nuts and 1 fixing bolt from right mounting cushion assembly.

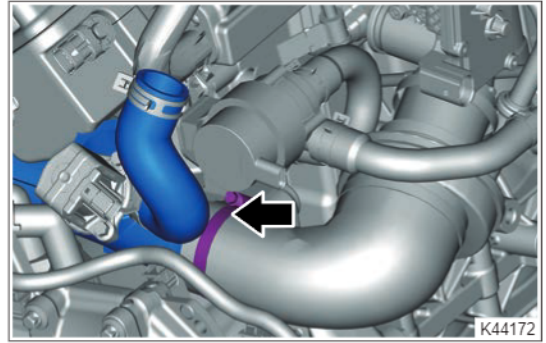


(43) Check that engine assembly is separated with external components.

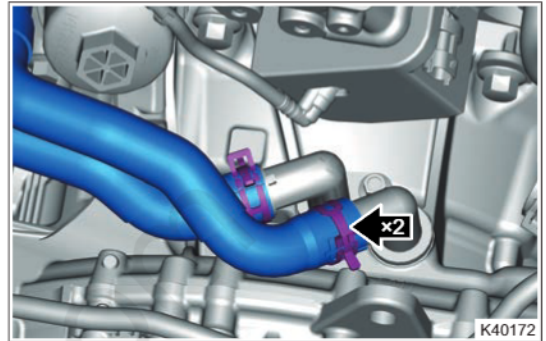
(44) Remove engine and transmission assembly.

(45) Remove engine electronic injection wire harness from engine assembly.

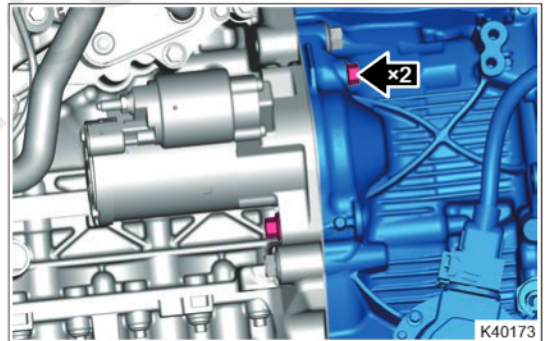
- (46) Loosen worm clamp and remove the intercooler intake pipe assembly II.



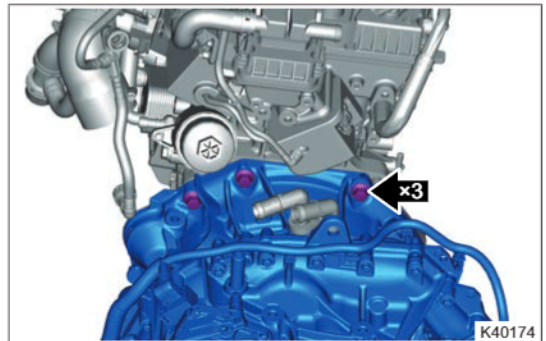
- (47) Loosen 2 elastic clamps and disconnect engine inlet pipe assembly - rear connections.



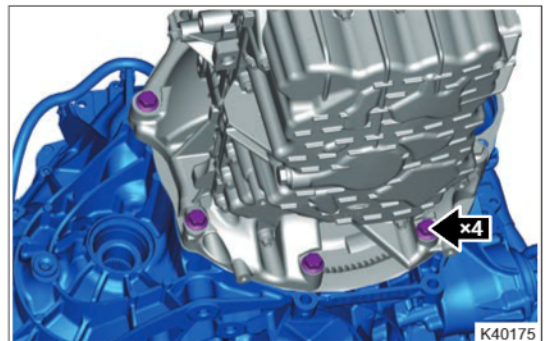
- (48) Remove 2 fixing bolts and starter assembly.



- (49) Remove 3 fixing bolts from upper part of transmission assembly.



- (50) Remove 4 fixing bolts from lower part of transmission assembly.



- (51) Separate transmission assembly from engine assembly.
- (52) Install engine assembly to engine service platform.

■ Installation

- (1) Install the transmission assembly.
- (2) Install engine electronic injection wire harness and positive battery wire harness on the engine.
- (3) Install 2 fixing nuts and 1 fixing bolt to right mounting cushion assembly.
- (4) Install 1 fixing nut on left mounting cushion assembly.
- (5) Install fixing clips to interior floor wire harness.
- (6) Connect transmission assembly connectors.
- (7) Connect the engine ground wire harness and tighten fixing nut.
- (8) Connect the positive battery wire harness and tighten fixing nut.
- (9) Connect connector between engine electronic injection wire harness and engine compartment fuse and relay box.
- (10) Connect the ECU connector.
- (11) Connect connectors between interior floor wire harness and engine electronic injection wire harness.
- (12) Connect fuel vapor pipe III.
- (13) Connect floor oil supply pipe and engine compartment oil supply pipe.
- (14) Connect vacuum tube and install elastic clamps.
- (15) Connect heater outlet and inlet pipe and install elastic clamps.
- (16) Connect engine discharge pipe and install elastic clamps.
- (17) Connect radiator discharge pipe assembly and install elastic clamps.
- (18) Connect compressor A/C line and tighten fixing bolts.
- (19) Connect engine outlet pipe and tighten fixing bolts of bracket.
- (20) Install intercooler intake pipe assembly III
- (21) Connect engine inlet pipe and install elastic clamp.
- (22) Install front sub frame assembly.
- (23) Install the precatalytic converter assembly.
- (24) Install the transfer case assembly.
- (25) Install front left drive shaft assembly.
- (26) Install the front right drive shaft assembly.
- (27) Install the left/right side rail assembly.
- (28) Install the battery tray and battery assembly.
- (29) Install the intake hose assembly.
- (30) Install the air filter assembly.
- (31) Add transmission oil to specified position.
- (32) Add coolant to specified value.
- (33) Connect the negative battery cable.
- (34) Add refrigerant to specified value.
- (35) Install the engine trim cover assembly.
- (36) Install the engine compartment trim cover assembly.
- (37) Install the front compartment lower protector assembly.