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SECTION **EM**

ENGINE MECHANICAL

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HOW TO USE THIS MANUAL

APPLICATION NOTICE

How to Check Vehicle Type

INFOID:000000006095081

Check the vehicle type to confirm the service information in EM section.

Vehicle type			Service information
Engine control	Destination	Transmission	
L-jetronic	General areas (Except for India)	M/T	HR12DE (TYPE 1)
	For Europe		
	General areas (For Thailand)	CVT	
	For Europe		
D-jetronic	For India	M/T	HR12DE (TYPE 2)
	Except for Europe		
	General area (Except for Thailand)	A/T	
	Except for Europe		

NOTE:

- L-jetronic is a fuel injection control method that the mass air flow sensor mounted on the air cleaner case directly measures air volume taken into the engine (cylinder) and determines the fundamental fuel injection amount.
- D-jetronic is a fuel injection control method to calculate air volume taken into the engine (cylinder) and determine the fundamental fuel injection amount, based on a throttle angle and an intake air pressure calculated by the manifold absolute pressure sensor mounted on the intake manifold.

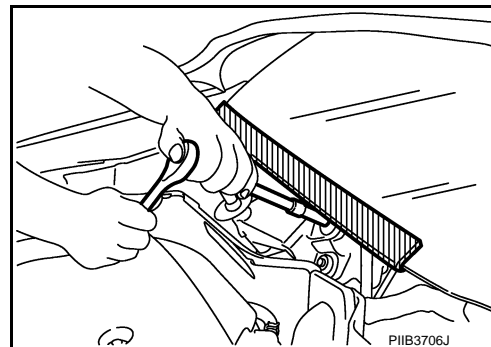
PRECAUTION

PRECAUTIONS
FOR EUROPE

FOR EUROPE : Precaution for Procedure without Cowl Top Cover

INFOID:000000005988153

When performing the procedure after removing cowl top cover, cover the lower end of windshield with urethane, etc.



FOR EUROPE : Precaution Necessary for Steering Wheel Rotation after Battery Disconnect

INFOID:000000006882235

NOTE:

- Before removing and installing any control units, first turn the ignition switch to the LOCK position, then disconnect both battery cables.
- After finishing work, confirm that all control unit connectors are connected properly, then re-connect both battery cables.
- Always use CONSULT to perform self-diagnosis as a part of each function inspection after finishing work. If a DTC is detected, perform trouble diagnosis according to self-diagnosis results.

For vehicle with steering lock unit, if the battery is disconnected or discharged, the steering wheel will lock and cannot be turned.

If turning the steering wheel is required with the battery disconnected or discharged, follow the operation procedure below before starting the repair operation.

OPERATION PROCEDURE

1. Connect both battery cables.
 - NOTE:**
Supply power using jumper cables if battery is discharged.
2. Turn the ignition switch to ACC position.
(At this time, the steering lock will be released.)
3. Disconnect both battery cables. The steering lock will remain released with both battery cables disconnected and the steering wheel can be turned.
4. Perform the necessary repair operation.
5. When the repair work is completed, re-connect both battery cables. With the brake pedal released, turn the ignition switch from ACC position to ON position, then to LOCK position. (The steering wheel will lock when the ignition switch is turned to LOCK position.)
6. Perform self-diagnosis check of all control units using CONSULT.

FOR EUROPE : Precaution for Supplemental Restraint System (SRS) "AIR BAG" and "SEAT BELT PRE-TENSIONER"

INFOID:000000006845187

The Supplemental Restraint System such as "AIR BAG" and "SEAT BELT PRE-TENSIONER", used along with a front seat belt, helps to reduce the risk or severity of injury to the driver and front passenger for certain types of collision. Information necessary to service the system safely is included in the "SRS AIR BAG" and "SEAT BELT" of this Service Manual.

The vehicle may be equipped with a passenger air bag deactivation switch. Because no rear seat exists where a rear-facing child restraint can be placed, the switch is designed to turn off the passenger air bag so that a rear-facing child restraint can be used in the front passenger seat. The switch is located in the center of the

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instrument panel, near the ashtray. When the switch is turned to the ON position, the passenger air bag is enabled and could inflate for certain types of collision. When the switch is turned to the OFF position, the passenger air bag is disabled and will not inflate. A passenger air bag OFF indicator on the instrument panel lights up when the passenger air bag is switched OFF. The driver air bag always remains enabled and is not affected by the passenger air bag deactivation switch.

WARNING:

- To avoid rendering the SRS inoperative, which could increase the risk of personal injury or death in the event of a collision that would result in air bag inflation, all maintenance must be performed by an authorized NISSAN/INFINITI dealer.
- Improper maintenance, including incorrect removal and installation of the SRS, can lead to personal injury caused by unintentional activation of the system. For removal of Spiral Cable and Air Bag Module, see the "SRS AIR BAG".
- Do not use electrical test equipment on any circuit related to the SRS unless instructed to in this Service Manual. SRS wiring harnesses can be identified by yellow and/or orange harnesses or harness connectors.
- The vehicle may be equipped with a passenger air bag deactivation switch which can be operated by the customer. When the passenger air bag is switched OFF, the passenger air bag is disabled and will not inflate. When the passenger air bag is switched ON, the passenger air bag is enabled and could inflate for certain types of collision. After SRS maintenance or repair, make sure the passenger air bag deactivation switch is in the same position (ON or OFF) as when the vehicle arrived for service.

PRECAUTIONS WHEN USING POWER TOOLS (AIR OR ELECTRIC) AND HAMMERS

WARNING:

- When working near the Air Bag Diagnosis Sensor Unit or other Air Bag System sensors with the ignition ON or engine running, DO NOT use air or electric power tools or strike near the sensor(s) with a hammer. Heavy vibration could activate the sensor(s) and deploy the air bag(s), possibly causing serious injury.
- When using air or electric power tools or hammers, always switch the ignition OFF, disconnect the battery, and wait at least 3 minutes before performing any service.

FOR EUROPE : Draining Engine Coolant

INFOID:000000005988156

Drain engine coolant and engine oil when the engine is cooled.

FOR EUROPE : Disconnecting Fuel Piping

INFOID:000000005988157

- Before starting work, check no fire or spark producing items are in the work area.
- Release fuel pressure before disconnecting and disassembly.
- After disconnecting pipes, plug openings to stop fuel leakage.

FOR EUROPE : Removal and Disassembly

INFOID:000000005988158

- When instructed to use SST, use specified tools. Always be careful to work safely, avoid forceful or uninstructed operations.
- Exercise maximum care to avoid damage to mating or sliding surfaces.
- Dowel pins are used for several parts alignment. When replacing and reassembling parts with dowel pins, check that dowel pins are installed in the original position.
- Cover openings of engine system with a tape or equivalent, if necessary, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and reassembly.
- When loosening nuts and bolts, as a basic rule, start with the one furthest outside, then the one diagonally opposite, and so on. If the order of loosening is specified, do exactly as specified. Power tools may be used in the step.

FOR EUROPE : Inspection, Repair and Replacement

INFOID:000000005988159

Before repairing or replacing, thoroughly inspect parts. Inspect new replacement parts in the same way, and replace if necessary.

FOR EUROPE : Assembly and Installation

INFOID:000000005988160

- Use torque wrench to tighten bolts or nuts to specification.

PRECAUTIONS

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< PRECAUTION >

- When tightening nuts and bolts, as a basic rule, equally tighten in several different steps starting with the ones in center, then ones on inside and outside diagonally in this order. If the order of tightening is specified, do exactly as specified.
- Replace with new gasket, packing, oil seal or O-ring.
- Thoroughly wash, clean, and air-blow each part. Carefully check engine oil or engine coolant passages for any restriction and blockage.
- Avoid damaging sliding or mating surfaces. Completely remove foreign materials such as cloth lint or dust. Before assembly, oil sliding surfaces well.
- Release air within route when refilling after draining engine coolant.
- After repairing, start the engine and increase engine speed to check engine coolant, fuel, engine oil, and exhaust gases for leakage.

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FOR EUROPE : Parts Requiring Angle Tightening

INFOID:000000005988161

- Use the angle wrench [SST: KV10112100] for the final tightening of the following engine parts:
 - Camshaft sprocket (INT) bolt
 - Cylinder head bolts
 - Main bearing cap bolts
 - Connecting rod cap bolts
 - Crankshaft pulley bolt (No the angle wrench is required as bolt flange is provided with notches for angle tightening)
- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.

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FOR EUROPE : Liquid Gasket

INFOID:000000005988162

REMOVAL OF LIQUID GASKET SEALING

- After removing mounting nuts and bolts, separate the mating surface using the seal cutter [SST: KV10111100] (A) and remove old liquid gasket sealing.

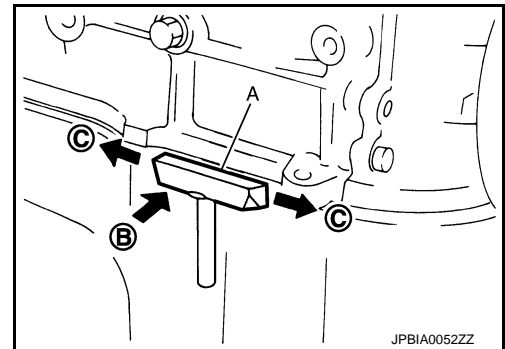
CAUTION:

Be careful not to damage the mating surfaces.

- Tap the seal cutter [SST: KV10111100] to insert it (B), and then slide it (C) by tapping on the side as shown in the figure.
- In areas where the seal cutter [SST: KV10111100] is difficult to use, lightly tap the parts using a plastic hammer to remove it.

CAUTION:

If for some unavoidable reason tool such as a screwdriver is used, be careful not to damage the mating surfaces.



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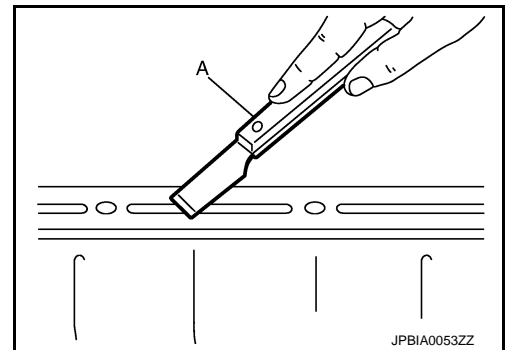
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LIQUID GASKET APPLICATION PROCEDURE

1. Using a scraper (A), remove old liquid gasket adhering to the liquid gasket application surface and the mating surface.
 - Remove liquid gasket completely from the groove of the liquid gasket application surface, mounting bolts, and bolt holes.
2. Wipe the liquid gasket application surface and the mating surface with white gasoline (lighting and heating use) to remove adhering moisture, grease and foreign materials.



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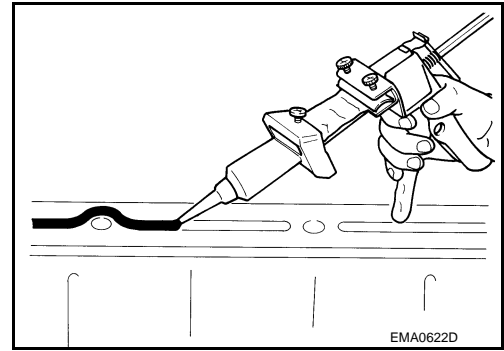
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PRECAUTIONS

[HR12DE]

< PRECAUTION >

3. Attach liquid gasket tube to the tube presser (commercial service tool).
Use Genuine Liquid Gasket or equivalent.
4. Apply liquid gasket without gaps to the specified location according to the specified dimensions.
 - If there is a groove for liquid gasket application, apply liquid gasket to the groove.

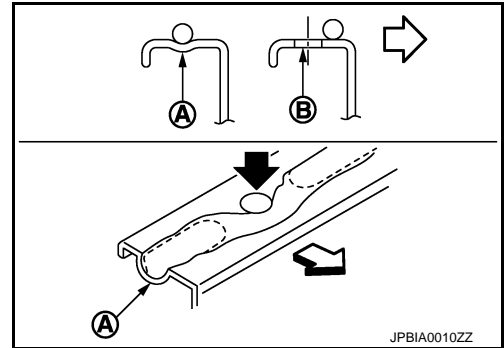


- As for bolt holes (B), normally apply liquid gasket inside the holes. Occasionally, it should be applied outside the holes. Check to read the text of this manual.

A : Groove

⇐ : Inside

- Within five minutes of liquid gasket application, install the mating component.
- If liquid gasket protrudes, wipe it off immediately.
- Do not retighten mounting bolts or nuts after the installation.
- After 30 minutes or more have passed from the installation, fill engine oil and engine coolant.



CAUTION:

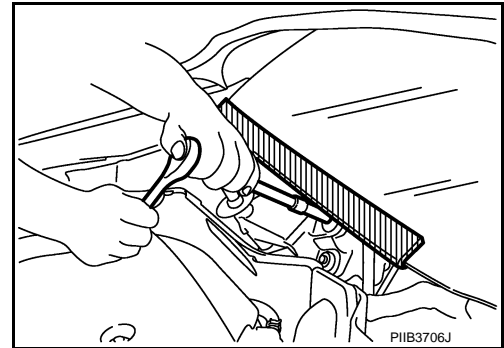
If there are specific instructions in this manual, observe them.

EXCEPT FOR EUROPE

EXCEPT FOR EUROPE : Precaution for Procedure without Cowl Top Cover

INFOID:000000006845176

When performing the procedure after removing cowl top cover, cover the lower end of windshield with urethane, etc.



EXCEPT FOR EUROPE : Precaution Necessary for Steering Wheel Rotation after Battery Disconnect

INFOID:000000006882236

NOTE:

- Before removing and installing any control units, first turn the ignition switch to the LOCK position, then disconnect both battery cables.
- After finishing work, confirm that all control unit connectors are connected properly, then re-connect both battery cables.
- Always use CONSULT to perform self-diagnosis as a part of each function inspection after finishing work. If a DTC is detected, perform trouble diagnosis according to self-diagnosis results.

For vehicle with steering lock unit, if the battery is disconnected or discharged, the steering wheel will lock and cannot be turned.

If turning the steering wheel is required with the battery disconnected or discharged, follow the operation procedure below before starting the repair operation.

OPERATION PROCEDURE

PRECAUTIONS

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< PRECAUTION >

1. Connect both battery cables.
NOTE:
Supply power using jumper cables if battery is discharged.
2. Turn the ignition switch to ACC position.
(At this time, the steering lock will be released.)
3. Disconnect both battery cables. The steering lock will remain released with both battery cables disconnected and the steering wheel can be turned.
4. Perform the necessary repair operation.
5. When the repair work is completed, re-connect both battery cables. With the brake pedal released, turn the ignition switch from ACC position to ON position, then to LOCK position. (The steering wheel will lock when the ignition switch is turned to LOCK position.)
6. Perform self-diagnosis check of all control units using CONSULT.

EXCEPT FOR EUROPE : Precaution for Supplemental Restraint System (SRS) "AIR BAG" and "SEAT BELT PRE-TENSIONER"

INFOID:000000006845188

The Supplemental Restraint System such as "AIR BAG" and "SEAT BELT PRE-TENSIONER", used along with a front seat belt, helps to reduce the risk or severity of injury to the driver and front passenger for certain types of collision. Information necessary to service the system safely is included in the "SRS AIR BAG" and "SEAT BELT" of this Service Manual.

WARNING:

- To avoid rendering the SRS inoperative, which could increase the risk of personal injury or death in the event of a collision which would result in air bag inflation, all maintenance must be performed by an authorized NISSAN/INFINITI dealer.
- Improper maintenance, including incorrect removal and installation of the SRS, can lead to personal injury caused by unintentional activation of the system. For removal of Spiral Cable and Air Bag Module, see "SRS AIR BAG".
- Never use electrical test equipment on any circuit related to the SRS unless instructed to in this Service Manual. SRS wiring harnesses can be identified by yellow and/or orange harnesses or harness connectors.

PRECAUTIONS WHEN USING POWER TOOLS (AIR OR ELECTRIC) AND HAMMERS

WARNING:

- When working near the Air Bag Diagnosis Sensor Unit or other Air Bag System sensors with the ignition ON or engine running, never use air or electric power tools or strike near the sensor(s) with a hammer. Heavy vibration could activate the sensor(s) and deploy the air bag(s), possibly causing serious injury.
- When using air or electric power tools or hammers, always switch the ignition OFF, disconnect the battery, and wait at least 3 minutes before performing any service.

EXCEPT FOR EUROPE : Draining Engine Coolant

INFOID:000000006845179

Drain engine coolant and engine oil when the engine is cooled.

EXCEPT FOR EUROPE : Disconnecting Fuel Piping

INFOID:000000006845180

- Before starting work, check no fire or spark producing items are in the work area.
- Release fuel pressure before disconnecting and disassembly.
- After disconnecting pipes, plug openings to stop fuel leakage.

EXCEPT FOR EUROPE : Removal and Disassembly

INFOID:000000006845181

- When instructed to use SST, use specified tools. Always be careful to work safely, avoid forceful or uninstructed operations.
- Exercise maximum care to avoid damage to mating or sliding surfaces.
- Dowel pins are used for several parts alignment. When replacing and reassembling parts with dowel pins, check that dowel pins are installed in the original position.
- Cover openings of engine system with a tape or equivalent, if necessary, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and reassembly.

PRECAUTIONS

[HR12DE]

< PRECAUTION >

- When loosening nuts and bolts, as a basic rule, start with the one furthest outside, then the one diagonally opposite, and so on. If the order of loosening is specified, do exactly as specified. Power tools may be used in the step.

EXCEPT FOR EUROPE : Inspection, Repair and Replacement

INFOID:000000006845182

Before repairing or replacing, thoroughly inspect parts. Inspect new replacement parts in the same way, and replace if necessary.

EXCEPT FOR EUROPE : Assembly and Installation

INFOID:000000006845183

- Use torque wrench to tighten bolts or nuts to specification.
- When tightening nuts and bolts, as a basic rule, equally tighten in several different steps starting with the ones in center, then ones on inside and outside diagonally in this order. If the order of tightening is specified, do exactly as specified.
- Replace with new gasket, packing, oil seal or O-ring.
- Thoroughly wash, clean, and air-blow each part. Carefully check engine oil or engine coolant passages for any restriction and blockage.
- Avoid damaging sliding or mating surfaces. Completely remove foreign materials such as cloth lint or dust. Before assembly, oil sliding surfaces well.
- Release air within route when refilling after draining engine coolant.
- After repairing, start the engine and increase engine speed to check engine coolant, fuel, engine oil, and exhaust gases for leakage.

EXCEPT FOR EUROPE : Parts Requiring Angle Tightening

INFOID:000000006845184

- Use the angle wrench [SST: KV10112100] for the final tightening of the following engine parts:
 - Camshaft sprocket (INT) bolt
 - Cylinder head bolts
 - Main bearing cap bolts
 - Connecting rod cap bolts
 - Crankshaft pulley bolt (No the angle wrench is required as bolt flange is provided with notches for angle tightening)
- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.

EXCEPT FOR EUROPE : Liquid Gasket

INFOID:000000006845185

REMOVAL OF LIQUID GASKET SEALING

- After removing mounting nuts and bolts, separate the mating surface using the seal cutter [SST: KV10111100] (A) and remove old liquid gasket sealing.

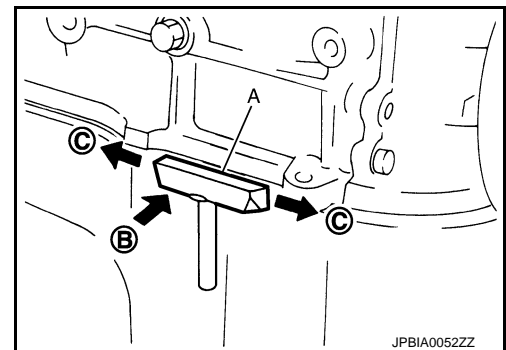
CAUTION:

Be careful not to damage the mating surfaces.

- Tap the seal cutter [SST: KV10111100] to insert it (B), and then slide it (C) by tapping on the side as shown in the figure.
- In areas where the seal cutter [SST: KV10111100] is difficult to use, lightly tap the parts using a plastic hammer to remove it.

CAUTION:

If for some unavoidable reason tool such as a screwdriver is used, be careful not to damage the mating surfaces.



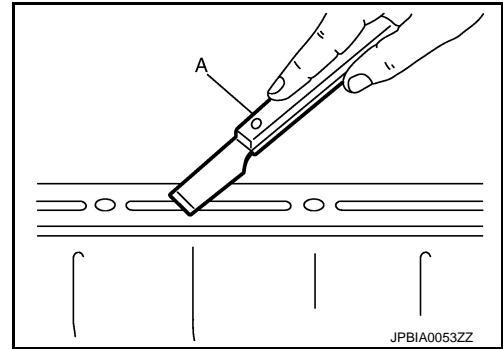
LIQUID GASKET APPLICATION PROCEDURE

PRECAUTIONS

[HR12DE]

< PRECAUTION >

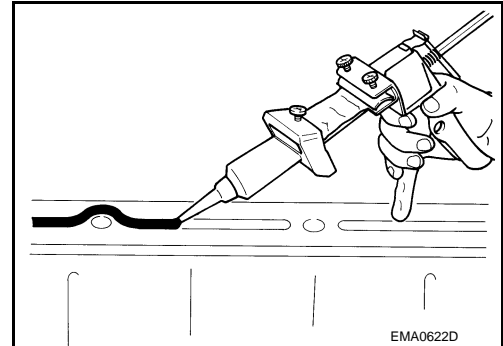
1. Using a scraper (A), remove old liquid gasket adhering to the liquid gasket application surface and the mating surface.
 - Remove liquid gasket completely from the groove of the liquid gasket application surface, mounting bolts, and bolt holes.
2. Wipe the liquid gasket application surface and the mating surface with white gasoline (lighting and heating use) to remove adhering moisture, grease and foreign materials.



3. Attach liquid gasket tube to the tube presser (commercial service tool).

Use Genuine Liquid Gasket or equivalent.

4. Apply liquid gasket without gaps to the specified location according to the specified dimensions.
 - If there is a groove for liquid gasket application, apply liquid gasket to the groove.



- As for bolt holes (B), normally apply liquid gasket inside the holes. Occasionally, it should be applied outside the holes. Check to read the text of this manual.

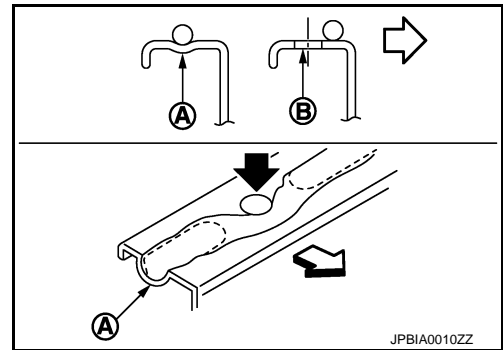
A : Groove

⇐ : Inside

- Within five minutes of liquid gasket application, install the mating component.
- If liquid gasket protrudes, wipe it off immediately.
- Do not retighten mounting bolts or nuts after the installation.
- After 30 minutes or more have passed from the installation, fill engine oil and engine coolant.

CAUTION:

If there are specific instructions in this manual, observe them.



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PREPARATION

< PREPARATION >

[HR12DE]

PREPARATION

PREPARATION

Special Service Tools

INFOID:000000005988163

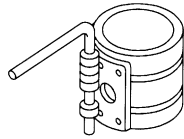
Tool number Tool name	Description
KV10111100 Seal cutter	Removing oil pan (upper and lower) etc.
KV10116200 Valve spring compressor 1. KV10115900 Attachment 2. KV10109220 Adapter	Disassembling and assembling valve mechanism Part (1) is a component of KV10116200, but Part (2) is not so.
KV10112100 Angle wrench	Tightening bolts for main bearing cap, cylinder head, etc.
KV10117100 Heated oxygen sensor wrench	Loosening or tightening air fuel ratio sensor 1 For 22 mm (0.87 in) width hexagon nut
KV10107902 Valve oil seal puller	Removing valve oil seal
KV10115600 Valve oil seal drift	Installing valve oil seal Use side A (G). a: 20 (0.79) dia. d: 8 (0.31) dia. b: 13 (0.51) dia. e: 10.7 (0.421) c: 10.3 (0.406) dia. f: 5 (0.20) H: Side B Unit: mm (in)

PREPARATION

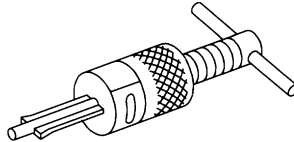
< PREPARATION >

[HR12DE]

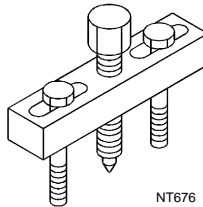
Tool number Tool name	Description
EM03470000 Piston ring compressor	Installing piston assembly into cylinder bore
ST16610001 Pilot bushing puller	Removing pilot converter
KV11103000 Pulley puller	Removing crankshaft pulley



S-NT044



S-NT045

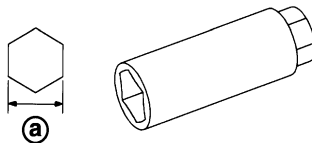


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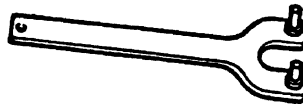
Commercial Service Tools

INFOID:0000000005988164

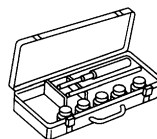
Tool name	Description
Spark plug wrench	Removing and installing spark plug a: 14 mm (0.55 in)
Pulley holder	Crankshaft pulley removing and installing
Valve seat cutter set	Finishing valve seat dimensions



JPBIA0399ZZ



ZZA1010D

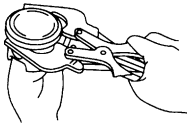
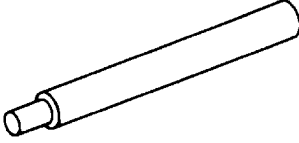
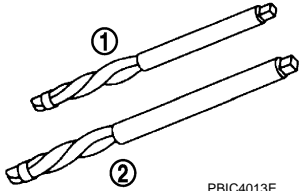
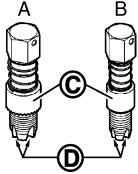
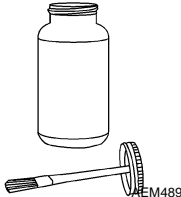
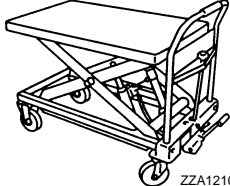
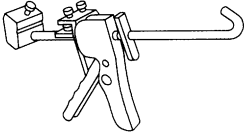


S-NT048

PREPARATION

< PREPARATION >

[HR12DE]

Tool name	Description
Piston ring expander  S-NT030	Removing and installing piston ring
Valve guide drift  PBIC4012E	Removing and installing valve guide
Valve guide reamer  PBIC4013E	1: Reaming valve guide inner hole 2: Reaming hole for oversize valve guide
Oxygen sensor thread cleaner  JPBIA0238ZZ	Reconditioning the exhaust system threads before installing a new air fuel ratio sensor (Use with anti-seize lubricant shown below.) A: For zirconia heated oxygen sensor [18 mm (0.71 in) dia.] B: For titania heated oxygen sensor [12mm (0.47 in) dia.] C: Mating surface shave cylinder D: Flutes
Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)  EM489	Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads
Manual lift table caddy  ZZA1210D	Removing and installing engine
Tube presser  S-NT052	Pressing the tube of liquid gasket

BASIC INSPECTION

CAMSHAFT VALVE CLEARANCE

Inspection and Adjustment

INFOID:000000005988165

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EM

INSPECTION

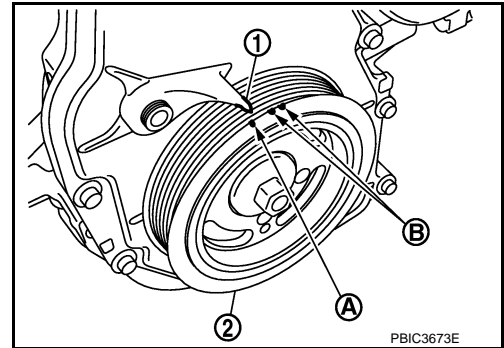
Perform inspection as follows after removal, installation or replacement of camshaft or valve-related parts, or if there is unusual engine conditions regarding valve clearance.

1. Remove rocker cover. Refer to [EM-58, "Removal and Installation"](#).
2. Measure the valve clearance with the following procedure:
 - a. Set No. 1 cylinder at TDC of its compression stroke.
 - Rotate crankshaft pulley (2) clockwise and align TDC mark (no paint) (A) to timing indicator (1) on front cover.

B : White paint mark (Not use for service)

CAUTION:

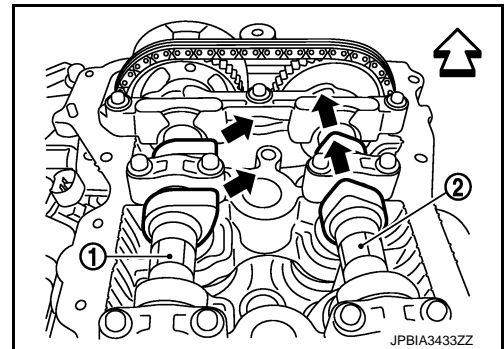
Do not rotate crankshaft pulley counterclockwise.



- At the same time, check that both intake and exhaust cam noses of No. 1 cylinder face inside (←) as shown in the figure.

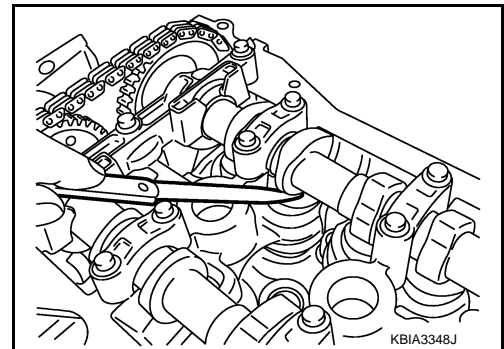
- 1 : Camshaft (INT)
- 2 : Camshaft (EXH)
- ↔ : Engine front

- If they do not face inside, rotate crankshaft pulley once more (360 degrees) and align as shown in the figure.



- b. Use a feeler gauge, measure the clearance between valve lifter and camshaft.

Valve clearance : Refer to [EM-150, "Camshaft"](#).



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CAMSHAFT VALVE CLEARANCE

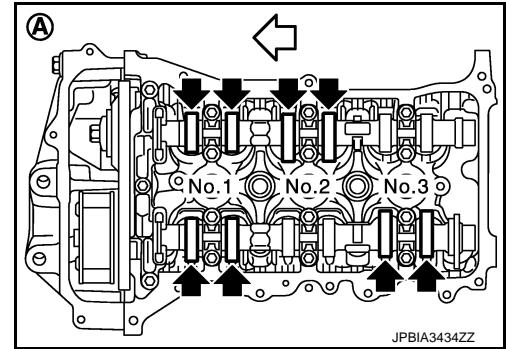
[HR12DE]

< BASIC INSPECTION >

- By referring to the figure, measure the valve clearances at locations marked "x" as shown in the table below [locations indicated with black arrow (➡) in the figure] with a feeler gauge.

A : No. 1 cylinder at compression TDC

↔ : Engine front



Measuring position		No. 1 CYL.	No. 2 CYL.	No. 3 CYL.
No. 1 cylinder at compression TDC	EXH	x	x	
	INT	x		x

- c. Set No. 3 cylinder at TDC of its compression stroke.

- Rotate crankshaft pulley (2) (480 degrees).

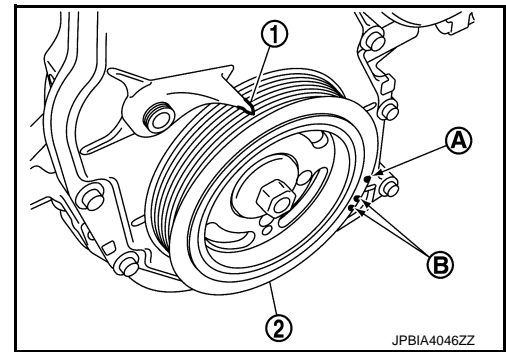
1 : Timing indicator

A : TDC mark (no paint)

B : White paint mark (Not use for service)

CAUTION:

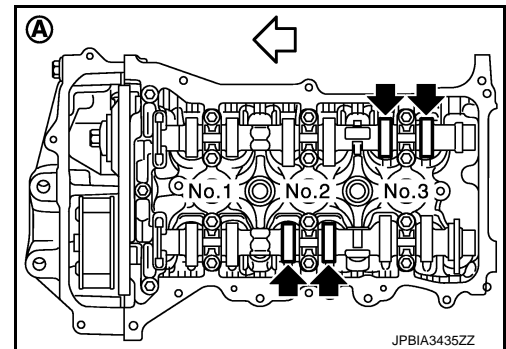
Do not rotate crankshaft pulley counterclockwise. In case of excess rotate, set the No.1 cylinder at TDC of its compression stroke, and turn it 480 degrees clockwise.



- By referring to the figure, measure the valve clearance at locations marked "x" as shown in the table below [locations indicated with black arrow (➡) in the figure] with a feeler gauge.

A : No. 3 cylinder at compression TDC

↔ : Engine front



Measuring position		No. 1 CYL.	No. 2 CYL.	No. 3 CYL.
No. 3 cylinder at compression TDC	EXH			x
	INT		x	

3. If out of standard, perform adjustment. Refer to "ADJUSTMENT".

ADJUSTMENT

- Perform adjustment depending on selected head thickness of valve lifter.

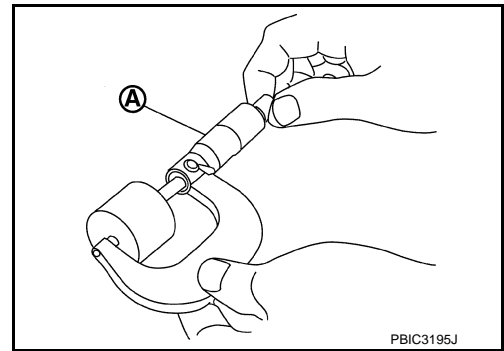
- Remove camshaft. Refer to [EM-73. "TYPE 1 : Exploded View"](#) (Type 1) or [EM-89. "TYPE 2 : Exploded View"](#) (Type 2).
- Remove valve lifters at the locations that are out of the standard.

CAMSHAFT VALVE CLEARANCE

[HR12DE]

< BASIC INSPECTION >

3. Measure the center thickness of the removed valve lifters with a micrometer (A).



4. Use the equation below to calculate valve lifter thickness for replacement.

Valve lifter thickness calculation: $t = t_1 + (C_1 - C_2)$

t = Valve lifter thickness to be replaced

t₁ = Removed valve lifter thickness

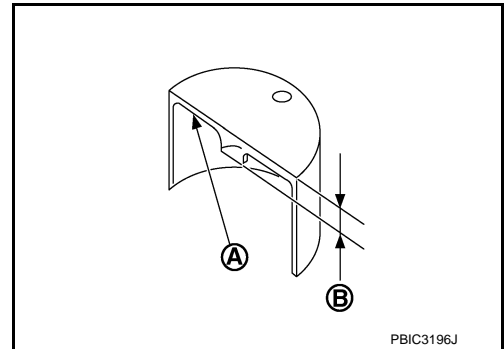
C₁ = Measured valve clearance

C₂ = Standard valve clearance:

Intake : 0.30 mm (0.012 in)

Exhaust : 0.33 mm (0.013 in)

- Thickness of new valve lifter (B) can be identified by stamp mark (A) on the reverse side (inside the cylinder).
- Stamp mark "302" indicates 3.02 mm (0.1189 in) in thickness.



NOTE:

Available thickness of valve lifter: 26 sizes range 3.00 to 3.50 mm (0.1181 to 0.1378 in) in steps of 0.02 mm (0.0008 in) (when manufactured at factory). Refer to [EM-150, "Camshaft"](#).

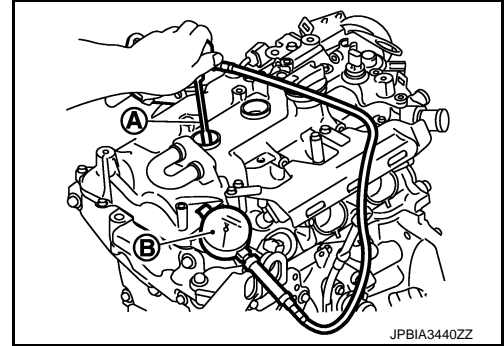
5. Install the selected valve lifter.
6. Install camshaft. Refer to [EM-73, "TYPE 1 : Exploded View"](#) (Type 1) or [EM-89, "TYPE 2 : Exploded View"](#) (type 2).
7. Install timing chain and related parts. Refer to [EM-61, "Exploded View"](#).
8. Manually rotate crankshaft pulley a few rotations.
9. Check that the valve clearances is within the standard. Refer to "INSPECTION".
10. Install remaining parts in the reverse order of removal.
11. Warm up the engine, and check for unusual noise and vibration.

COMPRESSION PRESSURE

Inspection

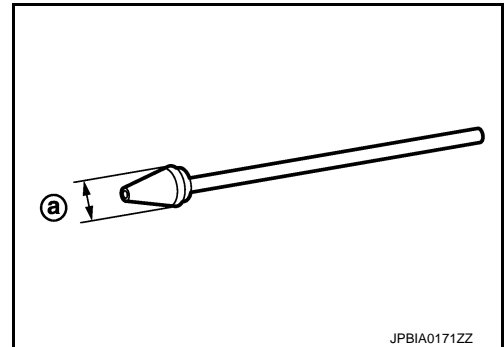
INFOID:000000005988166

1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to following.
 - HR12DE (TYPE 1): [EC-179, "Work Procedure"](#)
 - HR12DE (TYPE 2): [EC-579, "Work Procedure"](#)
3. Disconnect fuel pump fuse (No.50, located in IPDM E/R) to avoid fuel injection during measurement.
4. Remove ignition coil and spark plug from each cylinder. Refer to [EM-58, "Removal and Installation"](#).
5. Connect engine tachometer (not required in use of CONSULT-III).
6. Install compression gauge (B) with an adapter (A) (commercial service tool) onto spark plug hole.



- Use the adapter whose picking up end inserted to spark plug hole is smaller than 20 mm (0.79 in) in diameter. Otherwise, it may be caught by cylinder head during removal.

a : 20 mm (0.79 in)



7. With accelerator pedal fully depressed, turn ignition switch to "START" for cranking. When the gauge pointer stabilizes, read the compression pressure and the engine rpm. Perform these steps to check each cylinder.

Compression pressure : Refer to [EM-148, "General Specification"](#).

CAUTION:

Always use a fully charged battery to obtain the specified engine speed.

- If the engine speed is out of the specified range, check battery liquid for proper gravity. Check the engine speed again with normal battery gravity. Refer to [PG-265, "FOR MAINTENANCE REQUIRED BATTERY MODELS : How to Handle Battery"](#).
 - If compression pressure is below minimum value, check valve clearances, and parts associated with combustion chamber (valve, valve seat, piston, piston ring, cylinder bore, cylinder head, and cylinder head gasket). After the checking, measure compression pressure again.
 - If some cylinder has low compression pressure, pour small amount of engine oil into the spark plug hole of the cylinder to recheck it for compression.
 - If the added engine oil improves the compression, piston rings may be worn out or damaged. Check piston rings and replace if necessary.
 - If the compression pressure remains at low level despite the addition of engine oil, valves may be malfunctioning. Check valves for damage. Replace valve or valve seat accordingly.
 - If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, cylinder head gaskets are leaking. In such a case, replace cylinder head gaskets.
8. After inspection is completed, install removed parts.

COMPRESSION PRESSURE

[HR12DE]

< BASIC INSPECTION >

9. Start the engine, and check that the engine runs smoothly.
10. Perform trouble diagnosis. If DTC appears, erase it. Refer to following.
 - HR12DE (TYPE 1): [EC-76. "Diagnosis Description"](#)
 - HR12DE (TYPE 2): [EC-501. "Diagnosis Description"](#)

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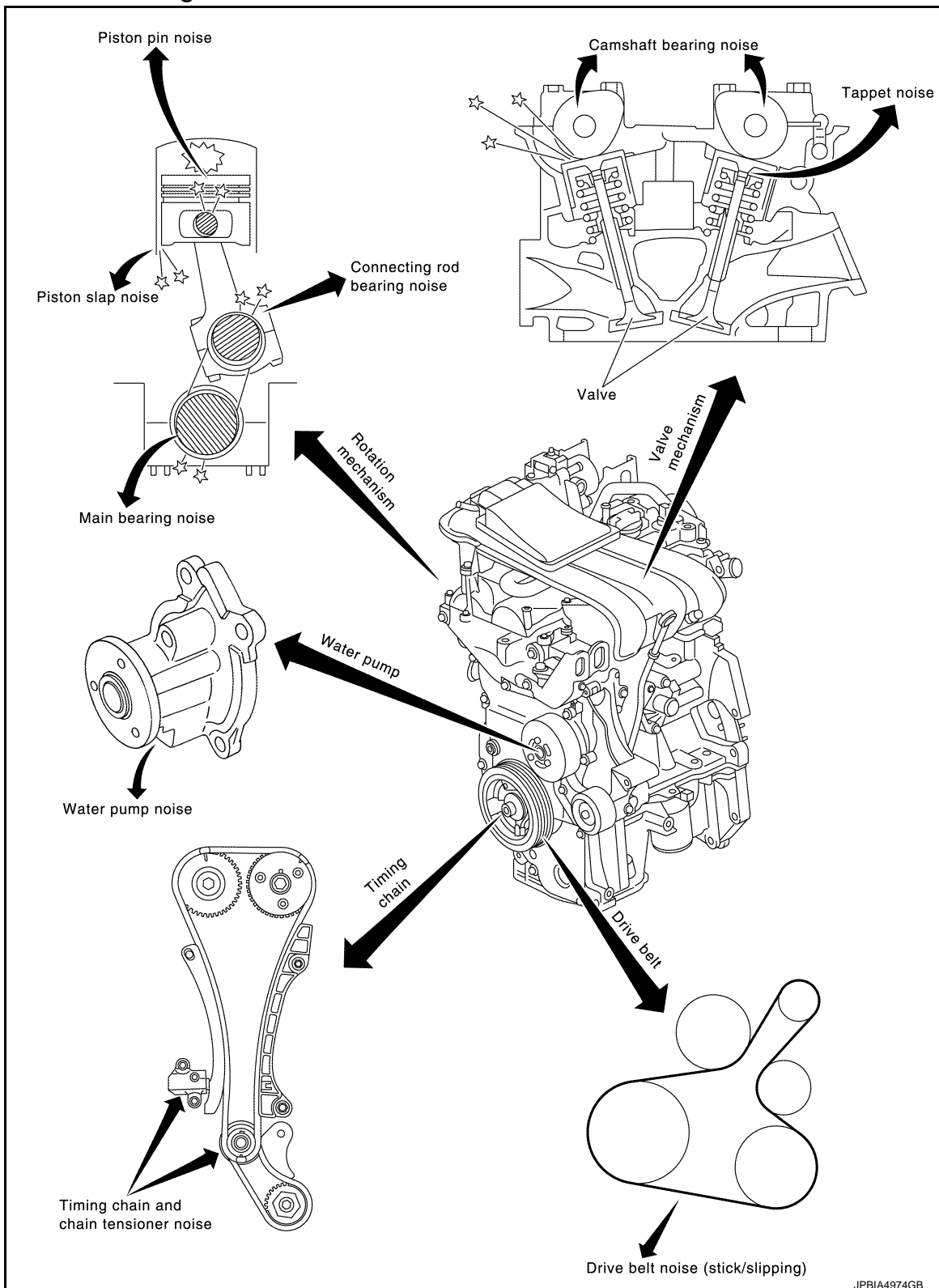
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SYMPTOM DIAGNOSIS

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

NVH troubleshooting Chart

INFOID:000000005988167



JPBIA4974GB

1. Locate the area where noise occurs.
2. Confirm the type of noise.
3. Specify the operating condition of engine.

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

< SYMPTOM DIAGNOSIS >

[HR12DE]

4. Check specified noise source.

If necessary, repair or replace these parts.

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Valve clearance	EM-17
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance Camshaft runout	EM-150
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston to piston pin oil clearance Connecting rod bushing oil clearance	EM-154
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston to cylinder bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	EM-154
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance	EM-154 EM-157
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-156 EM-154
Front of engine Front cover	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	EM-71 EM-61
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belt (Sticking or slipping)	Drive belt deflection	EM-149
	Creaking	A	B	A	B	A	B	Drive belt (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	CO-24

A: Closely related B: Related C: Sometimes related —: Not related

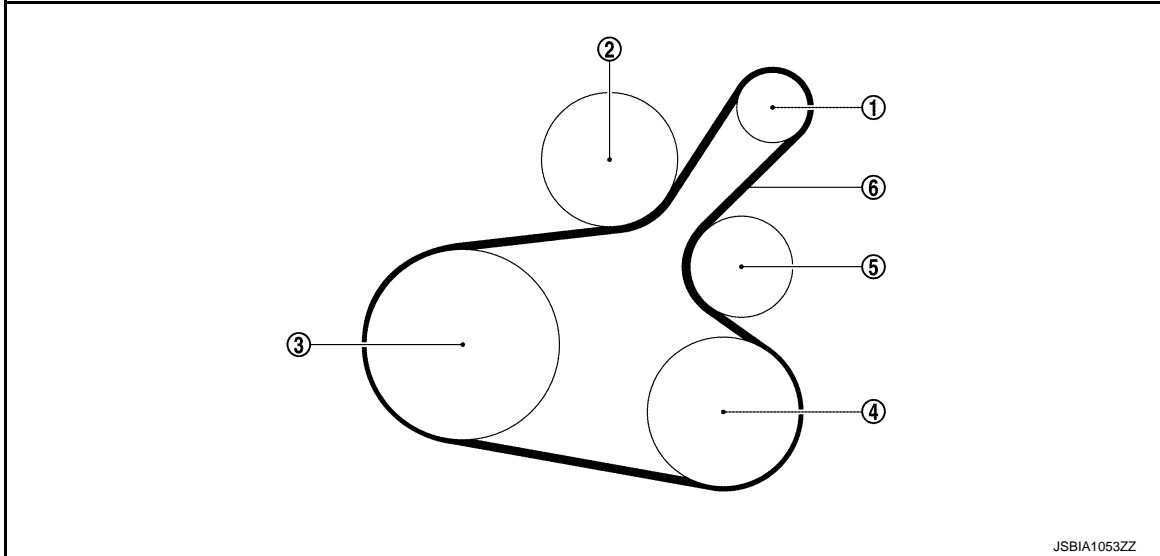
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PERIODIC MAINTENANCE

DRIVE BELT

Exploded View

INFOID:000000006882457



- | | | |
|--|-----------------|----------------------|
| 1. Alternator | 2. Water pump | 3. Crankshaft pulley |
| 4. A/C compressor (with A/C models)
Idler pulley (without A/C models) | 5. Idler pulley | 6. Drive belt |

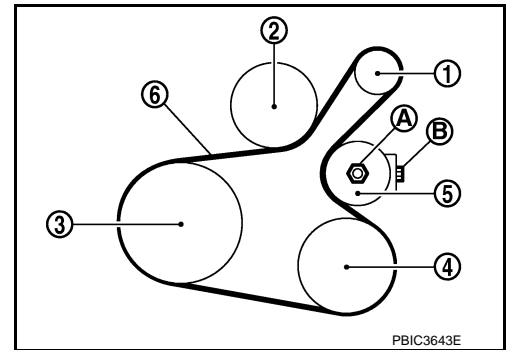
Removal and Installation

INFOID:000000006882458

REMOVAL

1. Remove the fender protector (RH) front side clip. And keep a service area. Refer to [EXT-20, "FENDER PROTECTOR : Exploded View"](#).
2. Loosen the lock nut (A), and then adjust the belt tension by turning the adjusting bolt (B).

- | | |
|---|---|
| 1 | : Alternator |
| 2 | : Water pump |
| 3 | : Crankshaft pulley |
| 4 | : A/C compressor (with A/C models)
Idler pulley (without A/C models) |
| 5 | : Idler pulley |
| 6 | : Drive belt |



3. Remove drive belt.

INSTALLATION

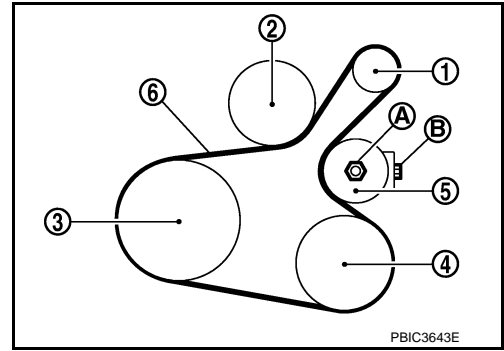
DRIVE BELT

< PERIODIC MAINTENANCE >

[HR12DE]

1. Pull the idler pulley in the loosening direction, and then temporarily tighten the lock nut (A) to the following torque.

- 1 : Alternator
- 2 : Water pump
- 3 : Crankshaft pulley
- 4 : A/C compressor (with A/C models)
: Idler pulley (without A/C models)
- 5 : Idler pulley
- 6 : Drive belt
- B : Adjusting bolt



 : 4.4 N·m (0.45 kg·m, 39 in·lb)

NOTE:

Do not move the lock nut from the tightened position. Go to step "2".

2. Install the drive belt to each pulley.

CAUTION:

- Check that there is no oil, grease, or coolant, etc. in pulley grooves.
- Check that the belt is securely inside the groove on each pulley.

3. Adjust drive belt tension by turning the adjusting bolt (B). Refer to [EM-26. "Adjustment"](#).

CAUTION:

- Perform the belt tension adjustment with the lock nut temporarily tightened at the step "1" so as not to tilt the idler pulley.
- When checking immediately after installation, first adjust it to the specified value. Then, after turning crankshaft two turns or more, readjust to the specified value to avoid variation in deflection between pulleys.

4. Tighten the lock nut.

 : 34.8 N·m (3.5 kg·m, 26 ft·lb)

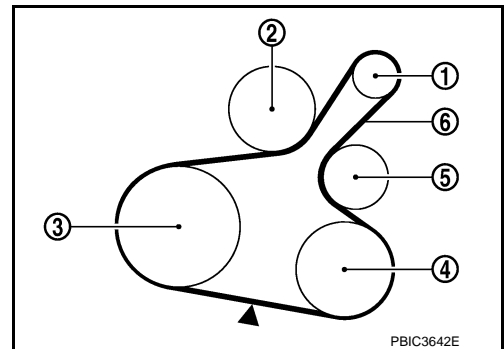
5. Check that belt tension of each belt within the standard.

Inspection

INFOID:000000006882459

- Inspection should be done only when engine is cold or over 30 minutes after the engine is stopped.

- 1 : Alternator
- 2 : Water pump
- 3 : Crankshaft pulley
- 4 : A/C compressor (with A/C models)
: Idler pulley (without A/C models)
- 5 : Idler pulley
- 6 : Drive belt



- Visually check belts for wear, damage, and cracks on inside and edges.
- Turn crankshaft pulley two times clockwise, and check tension on all pulleys is equal before doing the test.
- When measuring deflection, apply 98 N (10 kg, 22 lb) at the (▼) marked point.
- Measure the belt tension and frequency with acoustic tension gauge (commercial service tool) at the (▼) marked point.

CAUTION:

- When the tension and frequency are measured, the acoustic tension gauge should be used.
- When checking immediately after installation, first adjust it to the specified value. Then, after turning crankshaft two turns or more, readjust to the specified value to avoid variation in deflection between pulleys.

DRIVE BELT

< PERIODIC MAINTENANCE >

[HR12DE]

Belt Deflection/Belt Tension and Frequency: Refer to [EM-272, "Drive Belt"](#).

Adjustment

INFOID:000000006882460

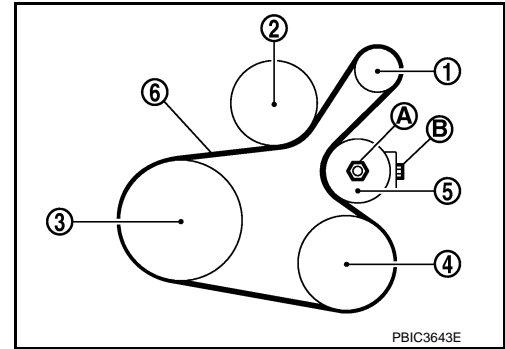
Location	Location of adjuster and tightening method
Drive belt	Adjusting bolt on idler pulley

CAUTION:

- When belt is replaced with new one, adjust belt tension to the value for “New belt”, because new belt will not fully seat in the pulley groove.
- When tension of the belt being used exceeds “Limit”, adjust it to the value for “After adjusted”.
- When installing a belt, check it is correctly engaged with the pulley groove.
- Never allow oil or engine coolant to get on the belt.
- Never twist or bend the belt strongly.

1. Remove the fender protector (RH) front side clip. And keep a service area. Refer to [EXT-20, "FENDER PROTECTOR : Exploded View"](#).
2. Loosen the idler pulley lock nut (A) from the tightening position.

- 1 : Alternator
- 2 : Water pump
- 3 : Crankshaft pulley
- 4 : A/C compressor (with A/C models)
: Idler pulley (without A/C models)
- 5 : Idler pulley
- 6 : Drive belt
- B : Adjusting blot



3. Lock nut (A) is temporarily tightened by the following torque.

Tightening torque : 4.4N·m(0.45kg·m, 39in·lb)

4. Adjust the belt tension by turning the adjusting bolt (B). Refer to [EM-26, "Adjustment"](#).

CAUTION:

- When checking immediately after installation, first adjust it to the specified value. Then, after turning crankshaft two turns or more, readjust to the specified value to avoid variation in deflection between pulleys.
 - When the tension adjustment is performed, the lock nut should be in the condition at step“ 2”. If the tension adjustment is performed when the lock nut is loosened more than the temporary tightening, the idler pulley tilts and the correct tension adjustment cannot be performed.
5. Tighten the lock nut.

 : **34.8 N·m (3.5 kg·m, 26 ft·lb)**

AIR CLEANER FILTER

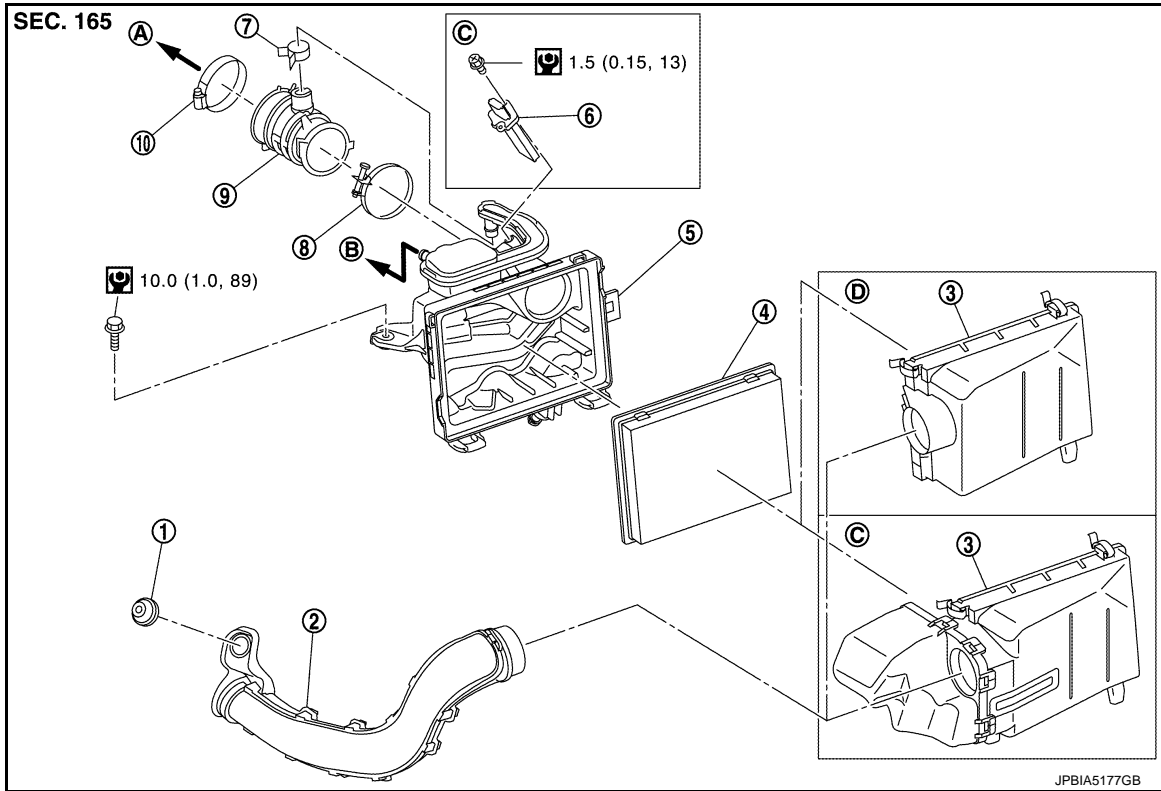
< PERIODIC MAINTENANCE >

[HR12DE]

AIR CLEANER FILTER

Exploded View

INFOID:000000005988171



- | | | |
|--|-------------------------------|------------------------------|
| 1. Mounting rubber | 2. Air duct (inlet) | 3. Air cleaner body assembly |
| 4. Air cleaner filter | 5. Air cleaner cover assembly | 6. Mass air flow sensor |
| 7. Clamp | 8. Clamp | 9. Air duct |
| 10. Clamp | | |
| A. To electric throttle control actuator | B. To PCV hose | C. For type 1 models |
| | | D. For type 2 models |

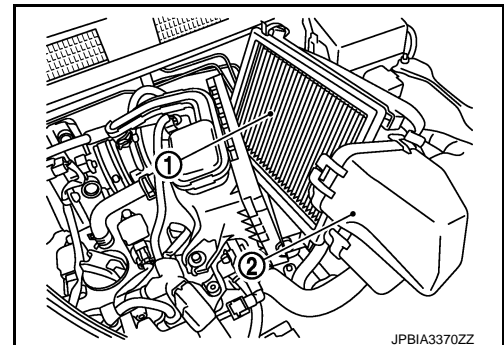
: N·m (kg-m, in-lb)

Removal and Installation

INFOID:000000005988172

REMOVAL

1. Remove air duct (inlet).
2. Remove air cleaner body assembly (2) with air cleaner filter (1).



3. Remove air cleaner filter from the air cleaner body assembly.

AIR CLEANER FILTER

[HR12DE]

< PERIODIC MAINTENANCE >

INSTALLATION

Install in the reverse order of removal.

Inspection

INFOID:000000006825252

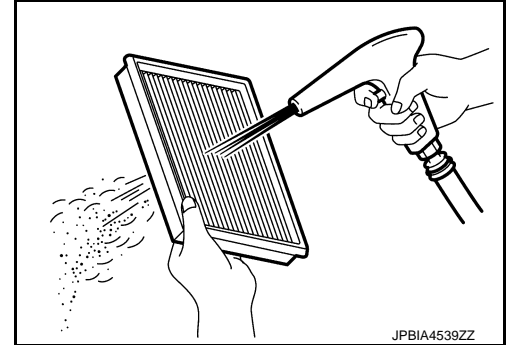
INSPECTION AFTER REMOVAL

Dry paper type

It is necessary to clean the element or replace it at the recommended intervals, more often under dusty driving conditions.

NOTE:

The viscous paper type air cleaner filter does not require any cleaning operation between renewal.



SPARK PLUG

< PERIODIC MAINTENANCE >

[HR12DE]

SPARK PLUG

Removal and Installation

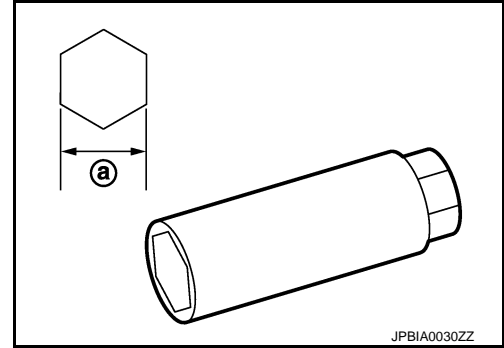
INFOID:000000005988173

REMOVAL

1. Remove ignition coil. Refer to [EM-58, "Exploded View"](#).
2. Remove spark plug with a spark plug wrench (commercial service tool).

a : 14 mm (0.55 in)

CAUTION:
Never drop or shock spark plug.



INSTALLATION

Install in the reverse order of removal.

Inspection

INFOID:000000005988174

INSPECTION AFTER REMOVAL

Use the standard type spark plug for normal condition.

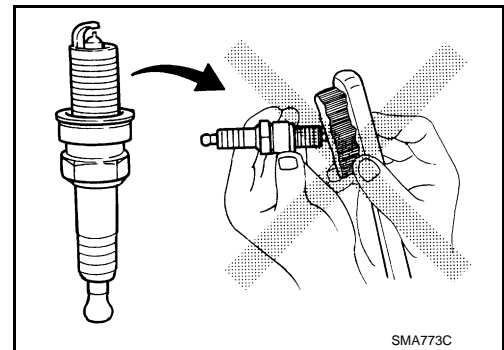
Spark plug (Standard type) : Refer to [EM-149, "Spark Plug"](#).

CAUTION:

- Never drop or shock spark plug.
- Never use a wire brush for cleaning.
- If plug tip is covered with carbon, spark plug cleaner may be used.

Cleaner air pressure : Less than 588 kPa (6 kg/cm², 85 psi)

Cleaning time : Less than 20 seconds



REMOVAL AND INSTALLATION

DRIVE BELT IDLER PULLEY

Removal and Installation

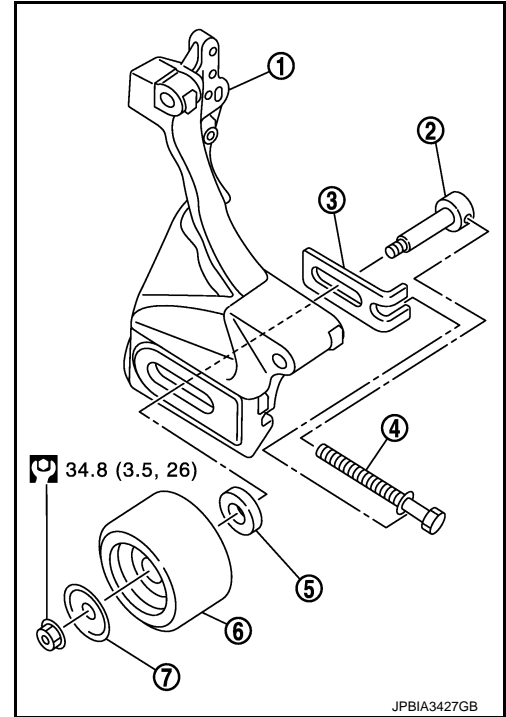
INFOID:000000005988175

REMOVAL

1. Remove drive belt. Refer to [EM-24. "Removal and Installation"](#).
2. Remove the lock nut, and then remove the plate (7), idler pulley (6), and washer (5).

1 : Alternator bracket

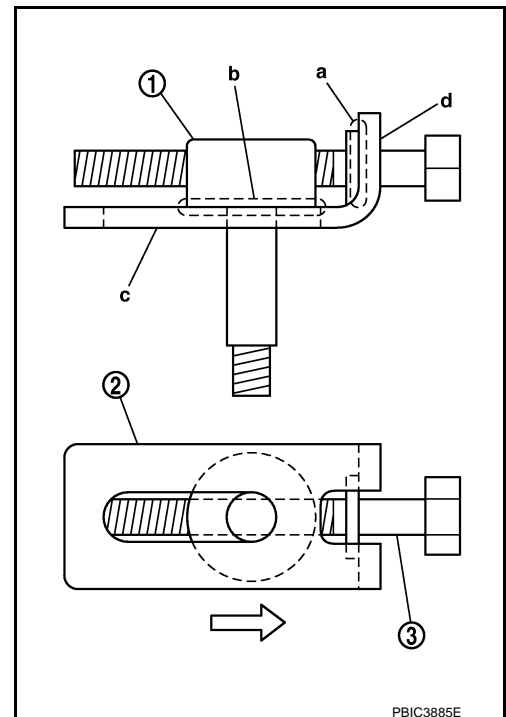
3. Remove the center shaft (2) together with the spacer (3) with inserting the adjusting bolt (4).



INSTALLATION

1. Insert the center shaft (1) into the slide groove of the spacer (2). Fully screw in the adjusting bolt (3) in the belt loosening direction (↔).
 - At that time, place the flange (a) of the adjusting bolt and the seat (b) of the center shaft on the spacer.
2. Place each surface (c and d) of the spacer on the alternator bracket. Install the washer, idler pulley, and plate, and then temporarily tighten the lock nut.

: 4.4 N·m (0.45 kg·m, 39 in·lb)



3. Install removed parts in the reverse order of removal.

AIR CLEANER AND AIR DUCT

< REMOVAL AND INSTALLATION >

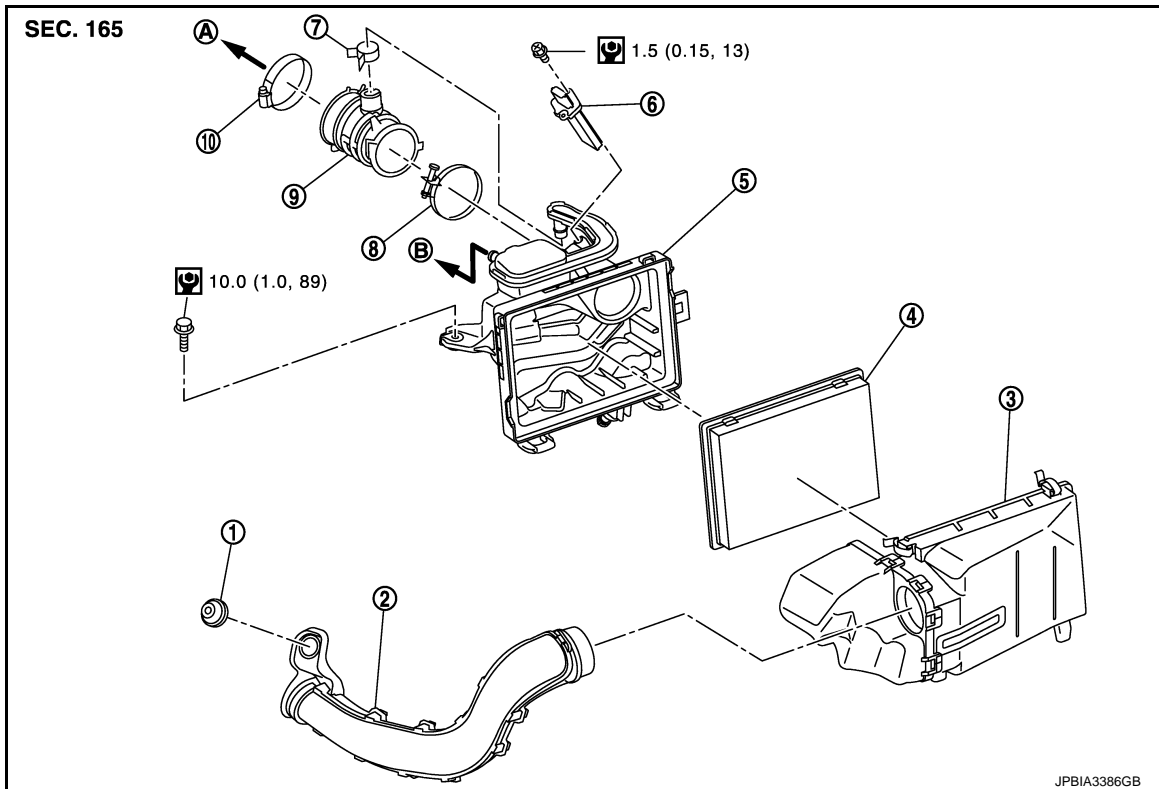
[HR12DE]

AIR CLEANER AND AIR DUCT TYPE 1


TYPE 1 : Exploded View

INFOID:000000005988176

A
EM



- | | | |
|--|-------------------------------|------------------------------|
| 1. Mounting rubber | 2. Air duct (inlet) | 3. Air cleaner body assembly |
| 4. Air cleaner filter | 5. Air cleaner cover assembly | 6. Mas air flow sensor |
| 7. Clamp | 8. Clamp | 9. Air duct |
| 10. Clamp | | |
| A. To electric throttle control actuator | B. To PCV hose | |

 : N·m (kg·m, in·lb)

TYPE 1 : Removal and Installation

INFOID:000000005988177

REMOVAL

NOTE:

Mass air flow sensor is removable under the car-mounted condition.

1. Remove air duct (inlet).
2. Remove the air cleaner body assembly with air cleaner filter.
3. Disconnect PCV hose. Refer to [EM-58, "Exploded View"](#).
4. Disconnect mass air flow sensor harness connector.
5. Remove air cleaner cover assembly with air duct (between air cleaner cover assembly and electric throttle control actuator).
 - Add matching marks if necessary for easier installation.
6. Separate air duct and air cleaner cover assembly.
7. Remove mass air flow sensor from air cleaner case, if necessary.

CAUTION:

Handle the mass air flow sensor with following cares.

- Never shock the mass air flow sensor.

AIR CLEANER AND AIR DUCT

[HR12DE]

< REMOVAL AND INSTALLATION >

- Never disassemble the mass air flow sensor.
- Never touch the sensor of the mass air flow sensor.

INSTALLATION

Note the following, and install in the reverse order of removal.

- Align marks. Attach each joint. Screw clamps firmly.

Clamp tightening torque : 4.5 N·m (0.46 kg-m, 40 ft-lb)

TYPE 1 : Inspection

INFOID:000000005988178

INSPECTION AFTER REMOVAL

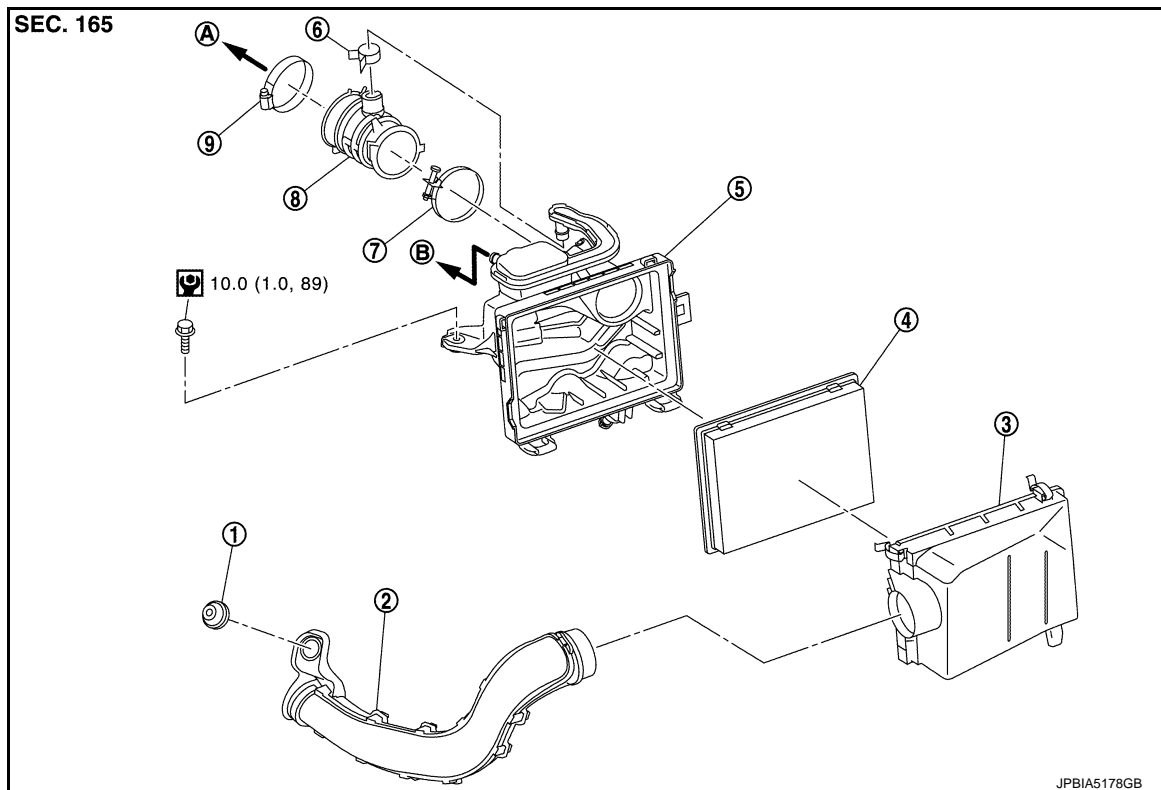
Inspect air duct and resonator assembly for crack or tear.

- If anything found, replace air duct and resonator assembly.


TYPE 2

TYPE 2 : Exploded View

INFOID:000000006095087



- | | | |
|--|-------------------------------|------------------------------|
| 1. Mounting rubber | 2. Air duct (inlet) | 3. Air cleaner body assembly |
| 4. Air cleaner filter | 5. Air cleaner cover assembly | 6. Clamp |
| 7. Clamp | 8. Air duct | 9. Clamp |
| A. To electric throttle control actuator | B. To PCV hose | |

 : N·m (kg-m, in-lb)

TYPE 2 : Removal and Installation

INFOID:000000006095088

REMOVAL

NOTE:

Mass air flow sensor is removable under the car-mounted condition.

1. Remove air duct (inlet).
2. Remove the air cleaner body assembly with air cleaner filter.

AIR CLEANER AND AIR DUCT

[HR12DE]

< REMOVAL AND INSTALLATION >

3. Disconnect PCV hose. Refer to [EM-58. "Exploded View"](#).
4. Remove air cleaner cover assembly with air duct (between air cleaner cover assembly and electric throttle control actuator).
 - Add matching marks if necessary for easier installation.
5. Separate air duct and air cleaner cover assembly.

A

EM

INSTALLATION

Note the following, and install in the reverse order of removal.

- Align marks. Attach each joint. Screw clamps firmly.

C

Clamp tightening torque : **4.5 N·m (0.46 kg-m, 40 ft-lb)**

D

TYPE 2 : Inspection

INFOID:000000006095089

INSPECTION AFTER REMOVAL

Inspect air duct and resonator assembly for crack or tear.

- If anything found, replace air duct and resonator assembly.

E

F

G

H

I

J

K

L

M

N

O

P

EGR SYSTEM

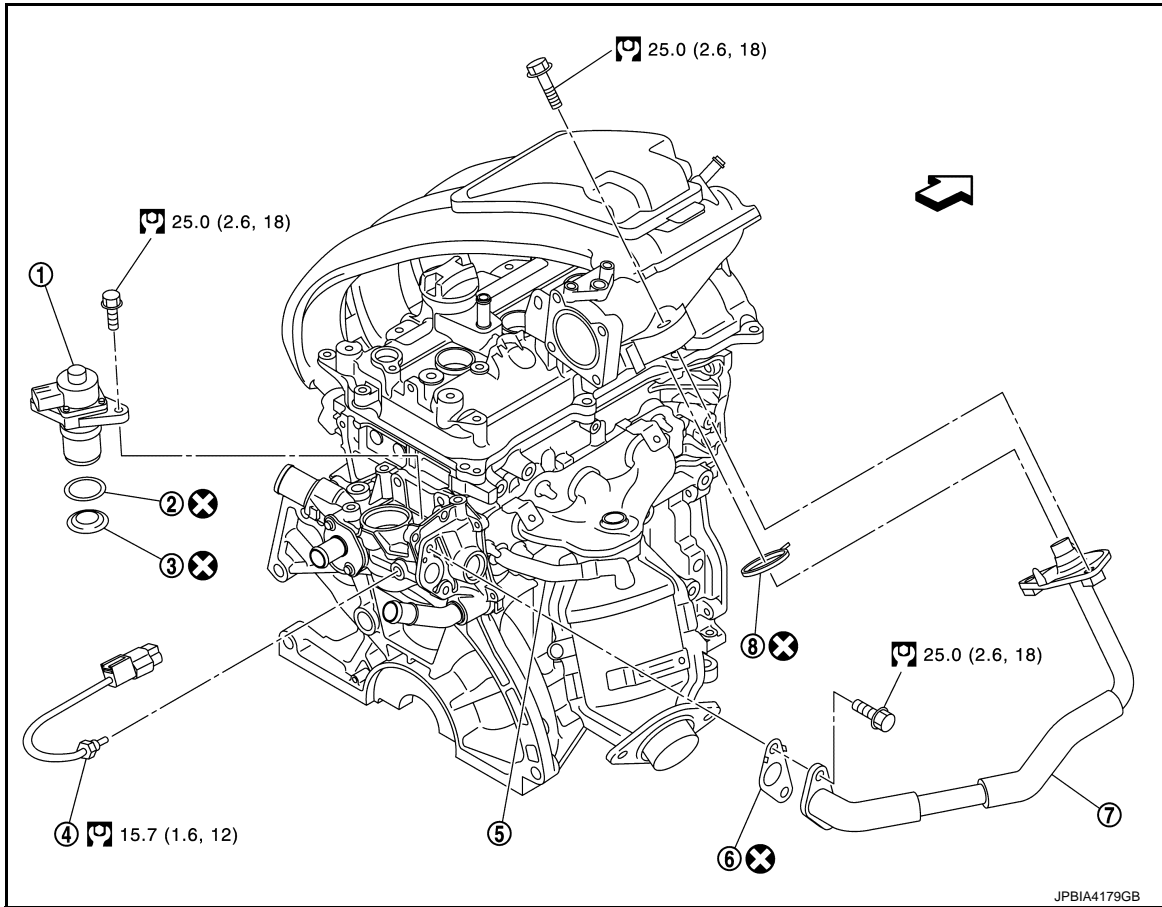
< REMOVAL AND INSTALLATION >

[HR12DE]

EGR SYSTEM

Exploded View

INFOID:000000006038725



- | | | |
|-----------------------------|-------------|-----------|
| 1. EGR volume control valve | 2. O-ring | 3. Holder |
| 4. EGR temperature sensor | 5. EGR tube | 6. Gasket |
| 7. EGR guide tube | 8. Gasket | |

: N·m (kg-m, ft-lb)

: Always replace after every disassembly.

Engine front

Removal and Installation

INFOID:000000006038726

REMOVAL

1. Remove air duct (inlet) and air cleaner cover and body assembly. Refer to [EM-31, "TYPE 1 : Removal and Installation"](#).
2. Remove EGR guide tube.
3. Remove gasket to intake manifold.
4. Remove EGR volume control valve.

EGR SYSTEM

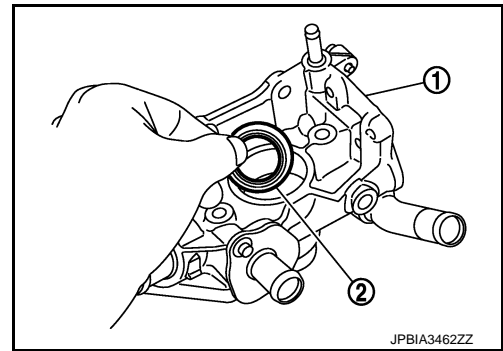
< REMOVAL AND INSTALLATION >

[HR12DE]

- Remove holder (2) from water outlet (1) if removed from EGR volume control valve.

CAUTION:

- **Never damage or impact EGR volume control valve.**
- **Never disassemble or adjust EGR volume control valve.**

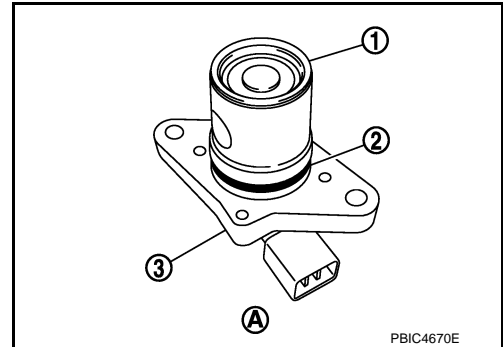


Installation

1. Install O-ring (2) to the mounting groove of EGR volume control valve (3).

A : Upside down

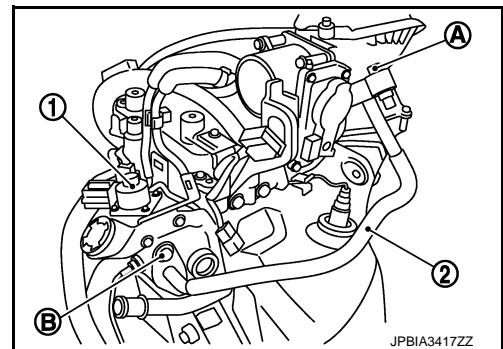
2. Install holder (1) to EGR volume control valve in the direction as shown in the figure.



3. Install EGR volume control valve to water outlet.
4. Install gasket to intake manifold.
5. Install EGR guide tube (2) and tighten bolts (A) temporarily (approximately two or three turns) with the EGR guide tube aligned with the installation position of intake manifold.

1 : Water outlet

6. Tighten bolts (B) temporarily.
7. Tighten bolts (B) to the specified torque.
8. Tighten bolts (A) to the specified torque.



9. Install in the reverse order of removal.

A
EM
C
D
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INTAKE MANIFOLD

< REMOVAL AND INSTALLATION >

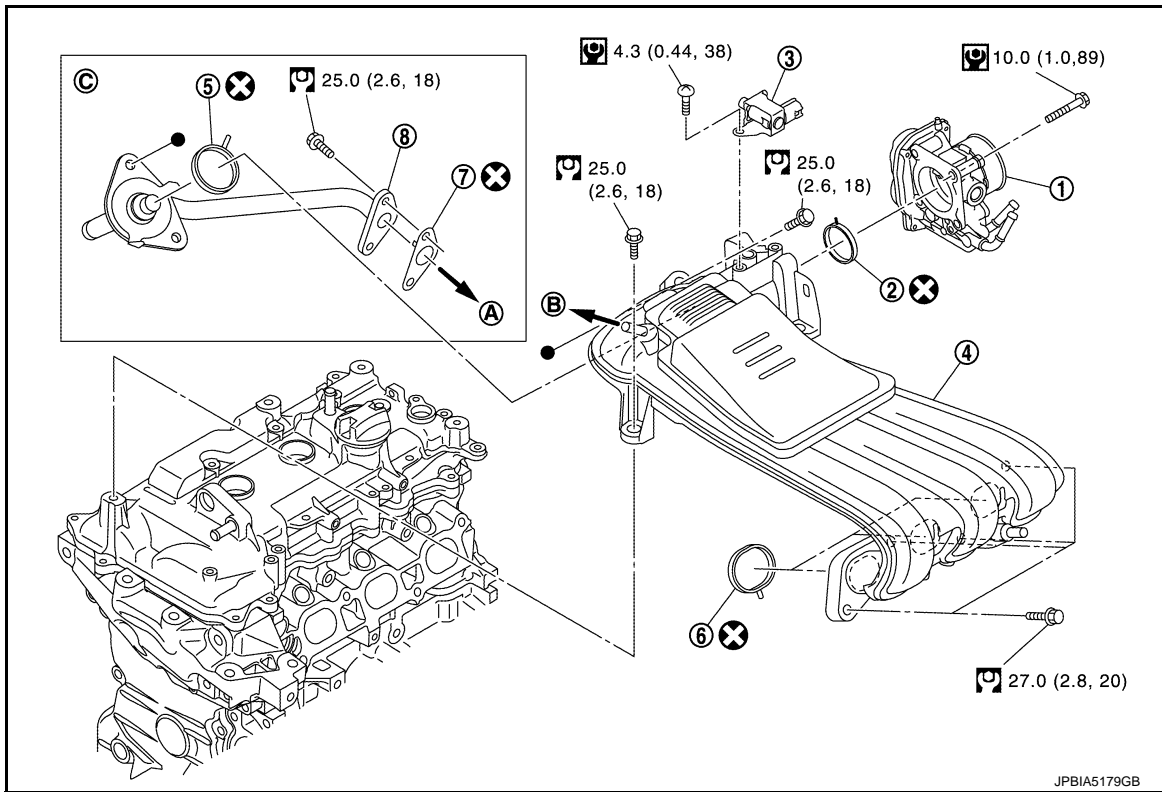
[HR12DE]

INTAKE MANIFOLD

TYPE 1

TYPE 1 : Exploded View

INFOID:000000005988179



- | | | |
|---------------------------------------|--------------------------|--|
| 1. Electric throttle control actuator | 2. Gasket | 3. EVAP canister purge volume control solenoid valve |
| 4. Intake manifold | 5. Gasket | 6. Gasket |
| 7. Gasket | 8. EGR guide tube | |
| A. To water outlet | B. To break booster hose | C. Except for Europe |

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

TYPE 1 : Removal and Installation

INFOID:000000005988180

REMOVAL

- Remove air duct (inlet) and air cleaner cover and body assembly. Refer to [EM-31, "TYPE 1 : Exploded View"](#).
- Drain engine coolant. Refer to [CO-13, "Draining"](#).
CAUTION:
 - Perform this step when the engine is cold.
 - Never spill engine coolant on drive belt.**NOTE:**
This step is not required when removing only intake manifold.
- Pull out oil level gauge.
CAUTION:
Cover the oil level gauge guide openings to avoid entry of foreign materials.
- Disconnect water hoses from electric throttle control actuator as follows:

INTAKE MANIFOLD

[HR12DE]

< REMOVAL AND INSTALLATION >

- Attach plug to prevent engine coolant leakage when engine coolant is not drained. Refer to [CO-13. "Draining"](#).

CAUTION:

Perform this step when the engine is cold.

NOTE:

This step is not required when removing only intake manifold.

5. Remove electric throttle control actuator.

CAUTION:

- **Handle carefully to avoid any shock to electric throttle control actuator.**
- **Never disassemble electric throttle control actuator.**

NOTE:

When removing only intake manifold, move the electric throttle control actuator without disconnecting the water hose.

6. Disconnect the harness connector and EVAP hose from the EVAP canister purge volume control solenoid valve.

CAUTION:

Handle it carefully and avoid impacts.

7. Disconnect vacuum hose for brake booster from intake manifold.

8. Remove EGR guide tube (Except for Europe). Refer to [EM-34. "Removal and Installation"](#).

9. Remove intake manifold mounting bolts.

- Loosen mounting bolts in reverse order as shown in the figure.

← : Engine front

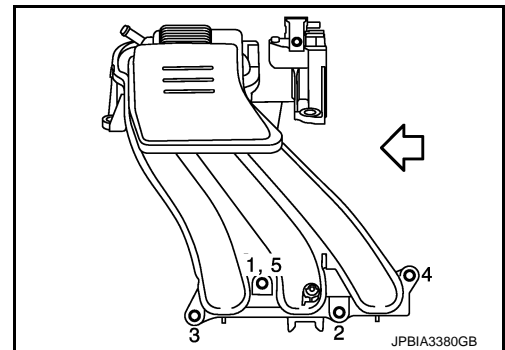
NOTE:

Disregard the numerical order No.5 in removal.

CAUTION:

Cover engine openings to avoid entry of foreign materials.

10. Remove intake manifold.



INSTALLATION

Note the following, and install in the reverse order of removal.

Intake Manifold

1. Install the gasket to the intake manifold.

NOTE:

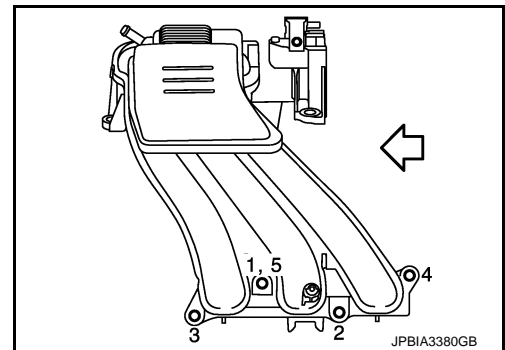
Be sure the intake manifold gasket is seated correctly in groove of intake manifold.

2. Place the intake manifold into the installation position.
3. Tighten bolts in the numerical order as shown in the figure.

← : Engine front

NOTE:

Tighten bolt the No.1 in two steps. The numerical order No.5 shows the second step.



4. Tighten intake manifold mounting bolts of rocker cover side.

Electric Throttle Control Actuator

- Tighten bolts of electric throttle control actuator equally and diagonally in several steps.
- Perform "Throttle Valve Closed Position Learning" after repair when removing harness connector of the electric throttle control actuator. Refer to following;
 - HR12DE (TYPE 1): [EC-165. "Work Procedure"](#)

INTAKE MANIFOLD

[HR12DE]

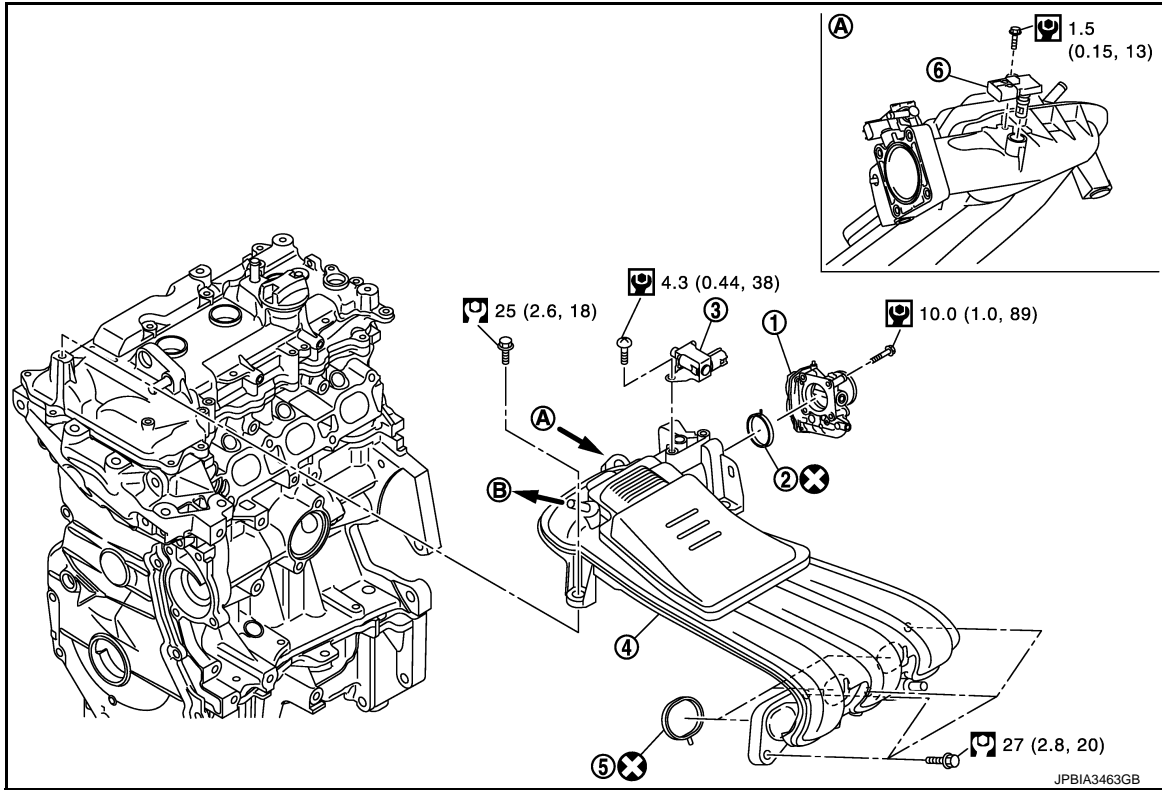
< REMOVAL AND INSTALLATION >

- HR12DE (TYPE 2): [EC-571, "Work Procedure"](#)
- Perform "Throttle Valve Closed Position Learning" and "Idle Air Volume Learning" after repair when replacing electric throttle control actuator. Refer to following;
- HR12DE (TYPE 1): [EC-165, "Work Procedure"](#) and [EC-166, "Work Procedure"](#)
- HR12DE (TYPE 2): [EC-571, "Work Procedure"](#) and [EC-572, "Work Procedure"](#)

TYPE 2

TYPE 2 : Exploded View

INFOID:000000006038272



- | | | |
|---------------------------------------|--------------------------|--|
| 1. Electric throttle control actuator | 2. Gasket | 3. EVAP canister purge volume control solenoid valve |
| 4. Intake manifold | 5. Gasket | 6. Manifold absolute pressure sensor |
| A. View A | B. To break booster hose | |

: N·m (kg·m, ft·lb)

: N·m (kg·m, in·lb)

: Always replace after every disassembly.

TYPE 2 : Removal and Installation

INFOID:000000006038273

REMOVAL

1. Remove air duct (inlet) and air cleaner cover and body assembly. Refer to [EM-32, "TYPE 2 : Removal and Installation"](#).
2. Pull out oil level gauge.
CAUTION:
Cover the oil level gauge guide openings to avoid entry of foreign materials.
3. Remove electric throttle control actuator.
CAUTION:
 - Handle carefully to avoid any shock to electric throttle control actuator.
 - Never disassemble electric throttle control actuator.

INTAKE MANIFOLD

[HR12DE]

< REMOVAL AND INSTALLATION >

4. Disconnect the harness connector and EVAP hose from the EVAP canister purge volume control solenoid valve.
CAUTION:
Handle it carefully and avoid impacts.
5. Disconnect vacuum hose for brake booster from intake manifold.
6. Remove intake manifold mounting bolts.
 - Loosen mounting bolts in reverse order as shown in the figure.

⇐ : Engine front

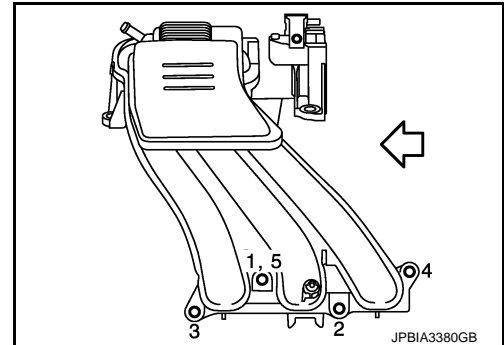
NOTE:

Disregard the numerical order No.5 in removal.

CAUTION:

Cover engine openings to avoid entry of foreign materials.

7. Remove intake manifold.



INSTALLATION

Note the following, and install in the reverse order of removal.

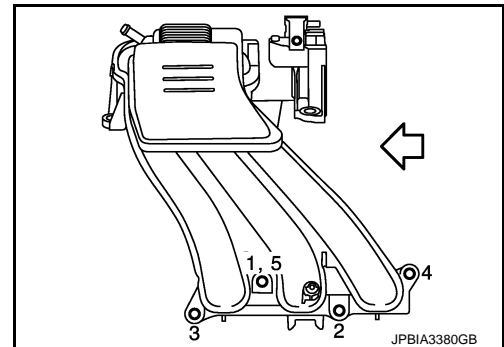
Intake Manifold

1. Install the gasket to the intake manifold.
NOTE:
Be sure the intake manifold gasket is seated correctly in groove of intake manifold.
2. Place the intake manifold into the installation position.
3. Tighten bolts in the numerical order as shown in the figure.

⇐ : Engine front

NOTE:

Tighten bolt the No.1 in two steps. The numerical order No.5 shows the second step.



4. Tighten intake manifold mounting bolts of rocker cover side.

Electric Throttle Control Actuator

- Tighten bolts of electric throttle control actuator equally and diagonally in several steps.
- Perform "Throttle Valve Closed Position Learning" after repair when removing harness connector of the electric throttle control actuator. Refer to following.
 - HR12DE (TYPE 1): [EC-165. "Work Procedure"](#)
 - HR12DE (TYPE 2): [EC-571. "Work Procedure"](#)
- Perform "Throttle Valve Closed Position Learning" and "Idle Air Volume Learning" after repair when replacing electric throttle control actuator. Refer to following.
 - HR12DE (TYPE 1): [EC-165. "Work Procedure"](#) and [EC-166. "Work Procedure"](#)
 - HR12DE (TYPE 2): [EC-571. "Work Procedure"](#) and [EC-572. "Work Procedure"](#)

EXHAUST MANIFOLD

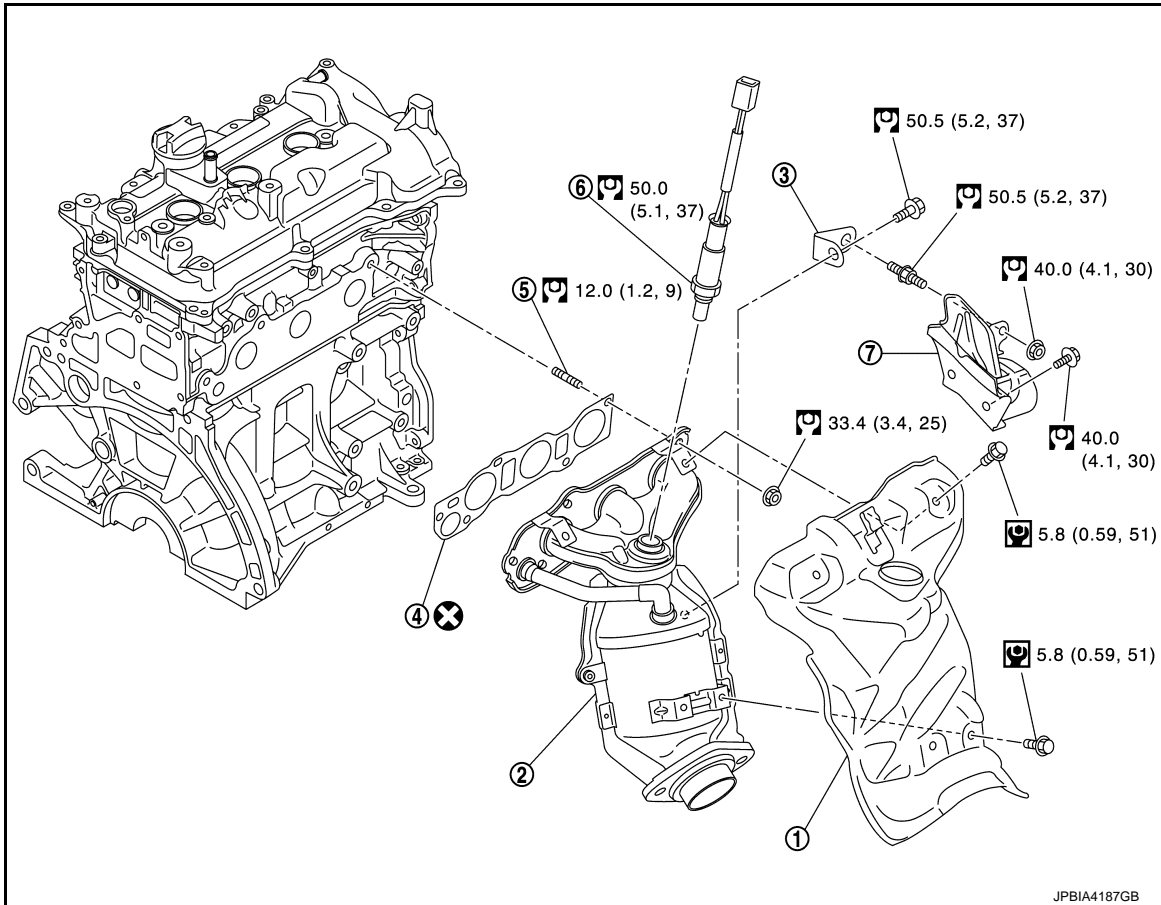
< REMOVAL AND INSTALLATION >

[HR12DE]

EXHAUST MANIFOLD

Exploded View

INFOID:000000005988181



- | | | |
|---------------------------|---------------------|---|
| 1. Exhaust manifold cover | 2. Exhaust manifold | 3. Exhaust manifold stay |
| 4. Gasket | 5. Stud bolt | 6. Air fuel ratio sensor 1 (For type 1 models)
O2 sensor (For type 2 models) |

7. Heat insulator

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

Removal and Installation

INFOID:000000005988182

REMOVAL

1. Remove exhaust front tube. Refer to [EX-6, "Removal and Installation"](#).
2. Remove air duct (inlet) and air cleaner cover and body assembly. Refer to [EM-31, "TYPE 1 : Exploded View"](#) (type 1) or [EM-32, "TYPE 2 : Exploded View"](#) (type 2).
3. Remove electric throttle control actuator. [EM-36, "TYPE 1 : Exploded View"](#) (type 1) or [EM-38, "TYPE 2 : Exploded View"](#) (Type 2).
4. Disconnect air fuel ratio sensor 1 harness connector.
5. Remove air fuel ratio sensor 1.
 - Using heated oxygen sensor wrench [SST: KV10117100], remove air fuel ratio sensor 1.

CAUTION:

- Discard any sensor which has been dropped from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; use a new one.

EXHAUST MANIFOLD

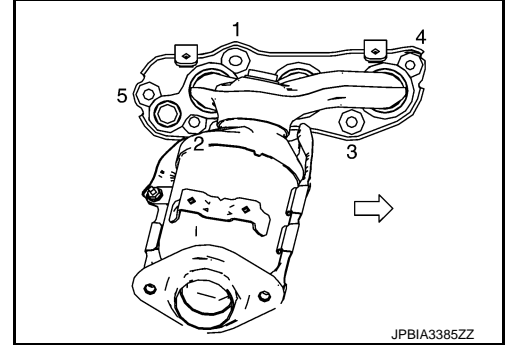
[HR12DE]

< REMOVAL AND INSTALLATION >

- Before installing new heated oxygen sensor, clean exhaust system threads using Heated Oxygen Sensor Thread Cleaner (commercial service tool) and approved Anti-seize lubricant (commercial service tool).

6. Remove exhaust manifold cover.
7. Remove exhaust manifold stay.
8. Remove exhaust manifold.
 - Loosen nuts in reverse order as shown in the figure.

⇐ : Engine front



9. Remove gasket.
CAUTION:
Cover engine openings to avoid entry of foreign materials.

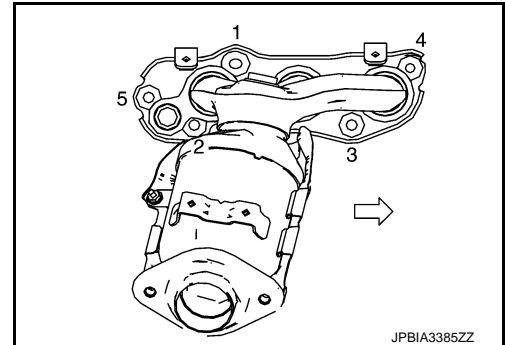
INSTALLATION

Note the following, and install in the reverse order of removal.

Exhaust manifold

1. Tighten nuts in numerical order as shown in the figure.

⇐ : Engine front



2. Tighten to the specified torque again.

Inspection

INFOID:000000005988183

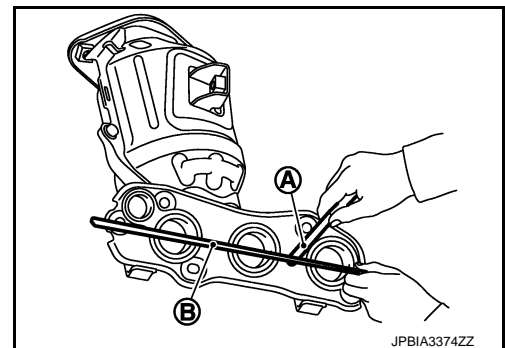
INSPECTION AFTER REMOVAL

Surface Distortion

- Using feeler gauge (A) and straightedge (B), check the surface distortion of exhaust manifold mating surface in each exhaust port and entire part.

Limit : Refer to [EM-150, "Exhaust Manifold"](#).

- If it exceeds the limit, replace exhaust manifold.



OIL PAN (LOWER)

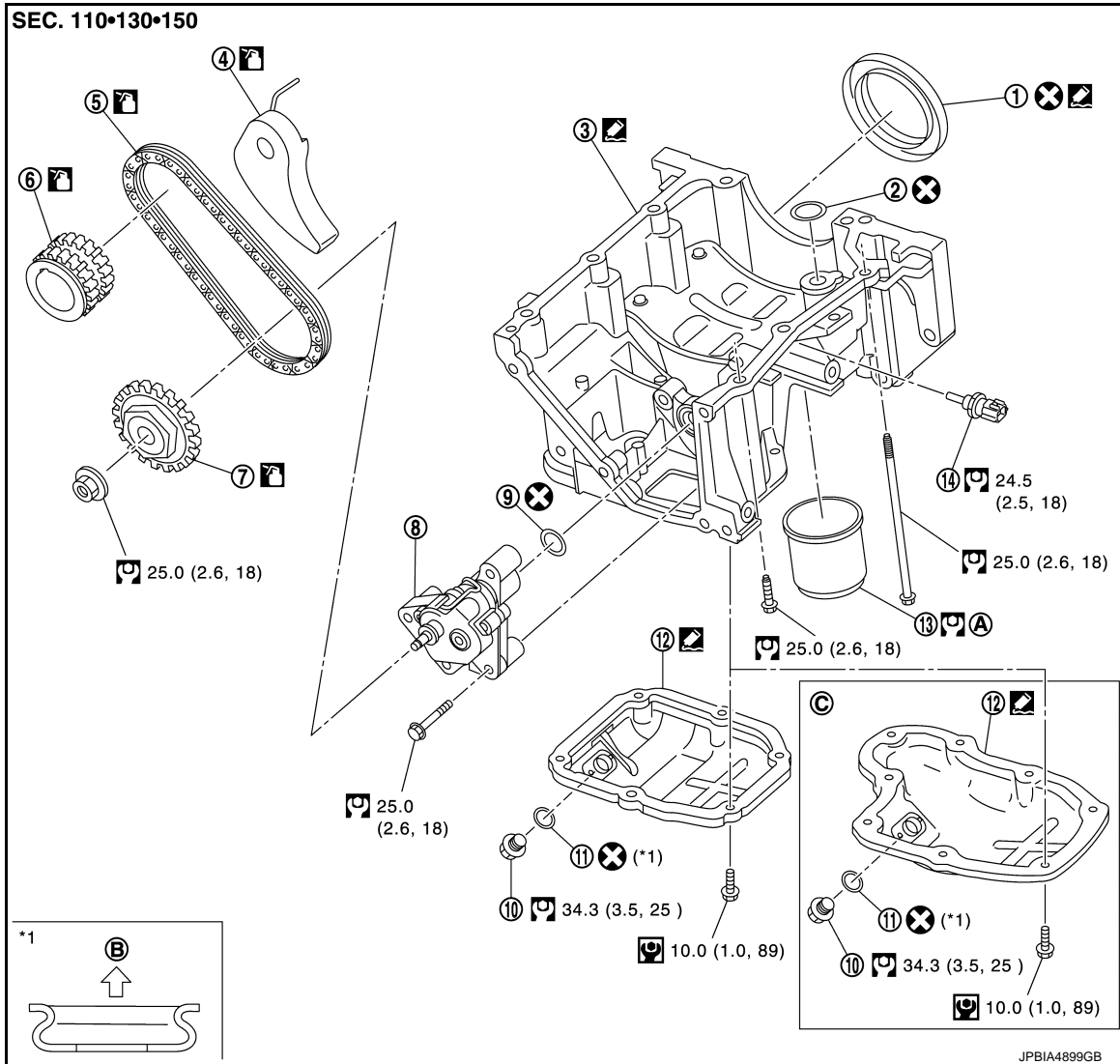
< REMOVAL AND INSTALLATION >

[HR12DE]

OIL PAN (LOWER)

Exploded View

INFOID:000000005988184



- | | | |
|--|--|------------------------|
| 1. Rear oil seal | 2. O-ring | 3. Oil pan (upper) |
| 4. Chain tensioner
(for oil pump drive chain) | 5. Oil pump drive chain | 6. Crankshaft sprocket |
| 7. Oil pump sprocket | 8. Oil pump | 9. O-ring |
| 10. Drain plug | 11. Drain plug washer | 12. Oil pan (lower) |
| 13. Oil filter | 14. Oil temperature sensor
(Except for India) | |
| A. Refer to LU-9, "Removal and Installation" | B. Oil pan (lower) side | C. For Europe |

: N·m (kg·m, ft·lb)

: N·m (kg·m, in·lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

: Sealing point

JPBIA4899GB

OIL PAN (LOWER)

< REMOVAL AND INSTALLATION >

[HR12DE]

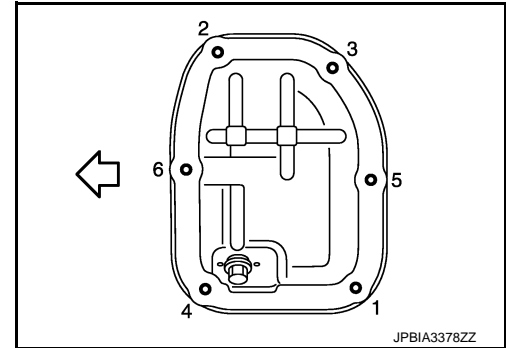
INFOID:000000005988185

Removal and Installation

REMOVAL

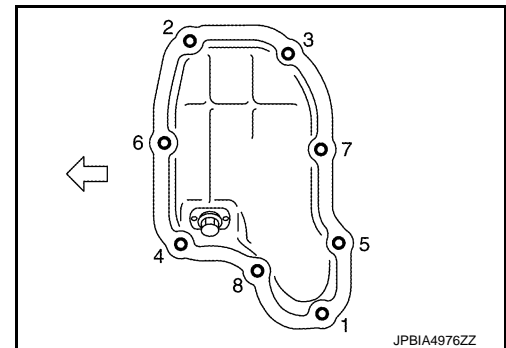
1. Drain engine oil. Refer to [LU-7. "Draining"](#).
2. Remove oil pan (lower) with the following procedure:
 - a. Loosen mounting bolts in reverse order as shown in the figure.
 - Except for Europe

← : Engine front



- For Europe

← : Engine front



- b. Insert seal cutter [SST: KV10111100] between oil pan (upper) and oil pan (lower).

CAUTION:

 - Be careful not to damage the mating surface.
 - Never insert a screwdriver. This damages the mating surfaces.
- c. Slide the seal cutter [SST: KV10111100] by tapping on the side of tool with a hammer.
- d. Remove oil pan (lower).

INSTALLATION

1. Install oil pan (lower) as follows:
 - a. Use a scraper to remove old liquid gasket from mating surfaces.
 - Also remove old liquid gasket from mating surface of oil pan (upper).
 - Remove old liquid gasket from the bolt holes and threads.

CAUTION:

Never scratch or damage the mating surface when cleaning off old liquid gasket.
- b. Apply a continuous bead of liquid gasket with a tube presser (commercial service tool) as shown in the figure.

OIL PAN (LOWER)

< REMOVAL AND INSTALLATION >

[HR12DE]

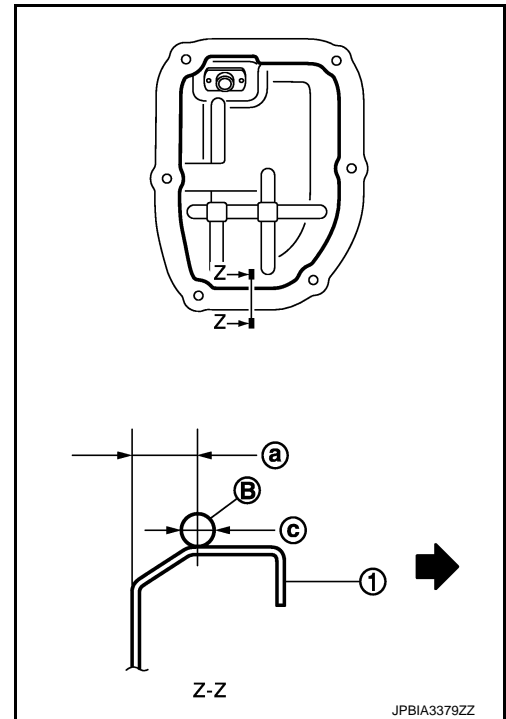
- Except for Europe

- 1 : Oil pan (lower)
- B : Liquid gasket
- a : 7.5 - 9.5 mm (0.295 - 0.374 in)
- c : $\phi 4.0 - 5.0$ mm (0.157 - 0.197 in)
- ← : Engine outside

Use Genuine Liquid Gasket or equivalent.

CAUTION:

Attaching should be done within 5 minutes after liquid gasket application.



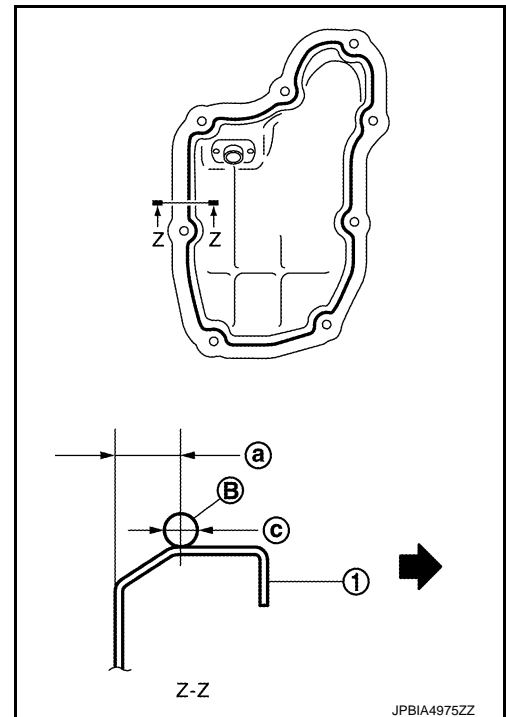
- For Europe

- 1 : Oil pan (lower)
- B : Liquid gasket
- a : 7.5 - 9.5 mm (0.295 - 0.374 in)
- c : $\phi 4.0 - 5.0$ mm (0.157 - 0.197 in)
- ← : Engine outside

Use Genuine Liquid Gasket or equivalent.

CAUTION:

Attaching should be done within 5 minutes after liquid gasket application.



- c. Tighten bolts in numerical order as shown in the figure.

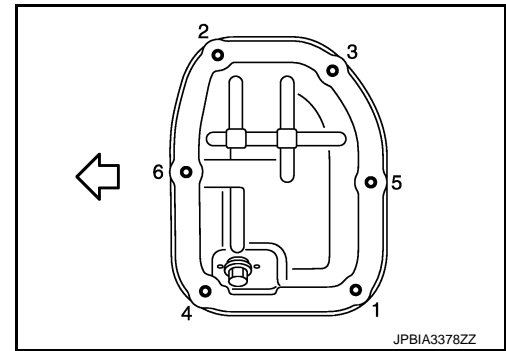
OIL PAN (LOWER)

< REMOVAL AND INSTALLATION >

[HR12DE]

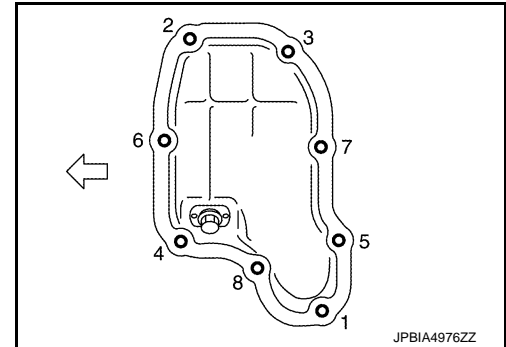
- Except for Europe

← : Engine front



- For Europe

← : Engine front



2. Install oil pan drain plug.
 - Refer to the figure of components of former page for installation direction of drain plug washer. Refer to [EM-42. "Exploded View"](#).

3. Install in the reverse order of removal after this step.

NOTE:

Wait at least 30 minutes after oil pan (lower) is installed before pouring engine oil.

Inspection

INFOID:000000005988186

INSPECTION AFTER REMOVAL

Clean oil strainer if any object attached.

INSPECTION AFTER INSTALLATION

1. Check the engine oil level and adjust engine oil. Refer to [LU-6. "Inspection"](#).
2. Start engine, and check there is no leakage of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check the engine oil level again. Refer to [LU-6. "Inspection"](#).

FUEL INJECTOR AND FUEL TUBE

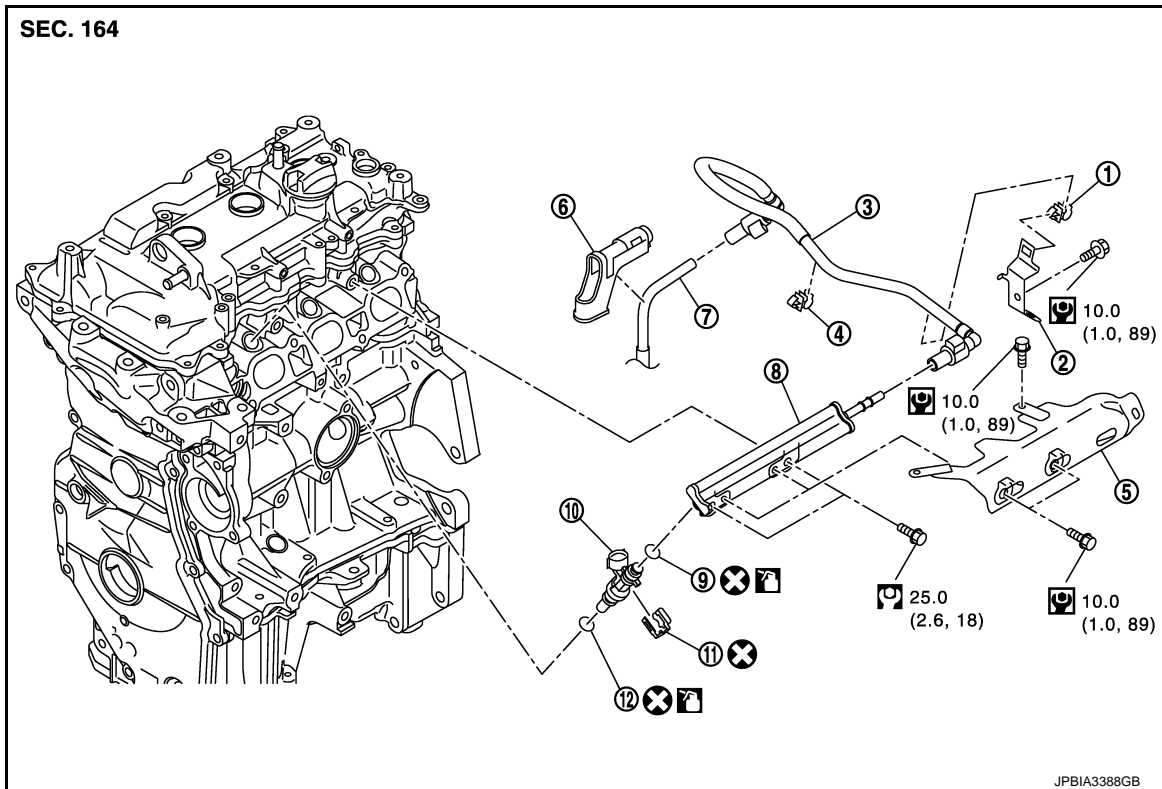
< REMOVAL AND INSTALLATION >

[HR12DE]

FUEL INJECTOR AND FUEL TUBE FOR THAILAND PRODUCTION MODELS

FOR THAILAND PRODUCTION MODELS : Exploded View

INFOID:000000005988187



- | | | |
|-----------------------------------|------------------------|------------------------|
| 1. Clamp | 2. Bracket | 3. Fuel feed hose |
| 4. Clamp | 5. Fuel tube protector | 6. Quick connector cap |
| 7. Centralized under floor piping | 8. Fuel tube | 9. O-ring (black) |
| 10. Fuel injector | 11. Clip | 12. O-ring (green) |

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

CAUTION:

Never remove or disassemble parts unless instructed as shown in the figure.

FOR THAILAND PRODUCTION MODELS : Removal and Installation

INFOID:000000006418474

WARNING:

- Put a “CAUTION: FLAMMABLE” sign in the workshop.
- Be sure to work in a well ventilated area and furnish workshop with a CO₂ fire extinguisher.
- Never smoke while servicing fuel system. Keep open flames and sparks away from the work area.

REMOVAL

1. Release the fuel pressure. Refer to following;
 - HR12DE (TYPE 1): [EC-179, "Work Procedure"](#)
 - HR12DE (TYPE 2): [EC-579, "Work Procedure"](#)
2. Disconnect battery cable from negative terminal.

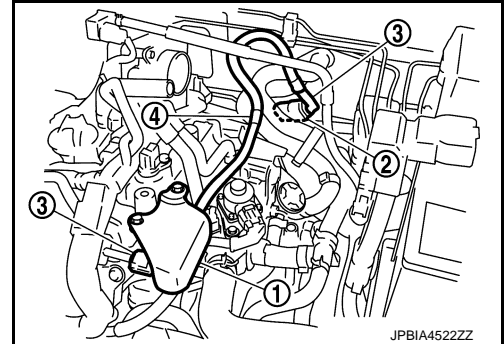
FUEL INJECTOR AND FUEL TUBE

[HR12DE]

< REMOVAL AND INSTALLATION >

3. Remove air duct (inlet) and air cleaner cover and body assembly. Refer to [EM-31. "TYPE 1 : Removal and Installation"](#) (Type 1) or [EM-32. "TYPE 2 : Removal and Installation"](#) (Type 2).
4. Remove intake manifold. Refer to [EM-36. "TYPE 1 : Removal and Installation"](#) (Type 1) or [EM-38. "TYPE 2 : Removal and Installation"](#) (Type 2).
5. Disconnect quick connector with the following procedure (engine side or centralized under-floor piping side).
 - a. Remove fuel connector protector (1).
 - b. Remove quick connector cap (2).
 - c. Disconnect fuel feed hose (4) from clamp (3).

3 : Quick connector



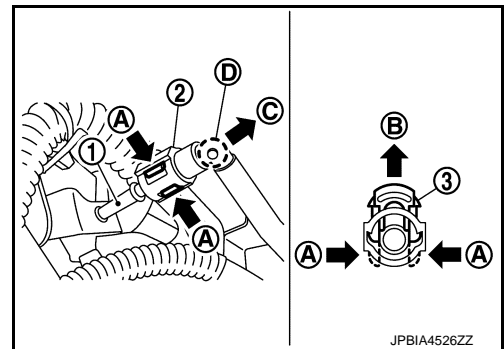
- d. Disengage two pawls (A) of the quick connector (2) retainer (3) and push (B) the quick connector upward to remove (C) it from the fuel tube (1), holding (D).

NOTE:

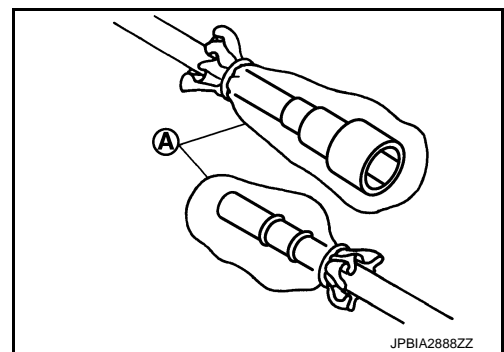
- If the quick connector cannot be detached from the fuel feed tube, push and pull the connector several times for the smooth removal.

CAUTION:

- **Never pull with lateral force applied. O-ring inside quick connector may be damaged.**
- **Prepare container and cloth beforehand as fuel will leakage out.**
- **Avoid fire and sparks.**
- **Keep parts away from heat source. Especially, be careful when welding is performed around them.**
- **Never expose parts to battery electrolyte or other acids.**
- **Never bend or twist connection between quick connector and fuel feed tube during installation/removal.**
- **To keep clean the connecting portion and to avoid damage and foreign materials, cover them completely with plastic bags, etc. (A) or something similar.**
- **Never remove retainer.**
- **Never separate the quick connector from the hose.**



Retainer color : Green (engine side)
 : Blue (Vehicle side)



6. Disconnect harness connector from fuel injector.
7. Remove fuel tube protector.

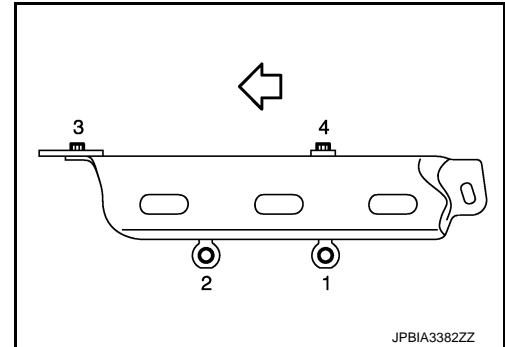
FUEL INJECTOR AND FUEL TUBE

< REMOVAL AND INSTALLATION >

[HR12DE]

- Loosen mounting bolts in reverse order as shown in the figure.

⇐ : Engine front



- Remove fuel tube and fuel injector assembly.

CAUTION:

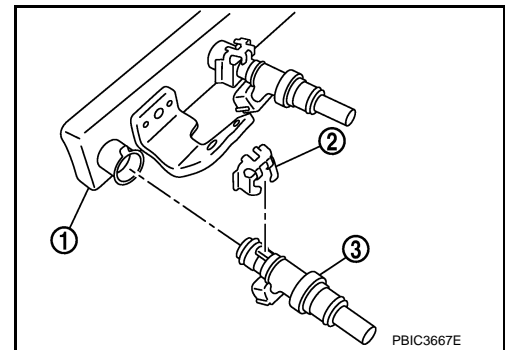
- When removing, be careful to avoid any interference with fuel injector.
- Use a shop cloth to absorb any fuel leakage from fuel tube.

- Remove fuel injector from fuel tube with the following procedure:

- Open and remove clip (2).
- Remove fuel injector (3) from fuel tube (1) by pulling straight.

CAUTION:

- Be careful with remaining fuel that may go out from fuel tube.
- Be careful not to damage fuel injector nozzle during removal.
- Never bump or drop fuel injector.
- Never disassemble fuel injector.



INSTALLATION

- Note the following, and install O-rings to fuel injector.

CAUTION:

- Upper and lower O-rings are different. Be careful not to confuse them.

Fuel tube side : Black

Nozzle side : Green

- Handle O-ring with bare hands. Never wear gloves.
 - Lubricate O-ring with new engine oil.
 - Never clean O-ring with solvent.
 - Check that O-ring and its mating part are free of foreign material.
 - When installing O-ring, be careful not to scratch it with tool or fingernails. Also be careful not to twist or stretch O-ring. If O-ring is stretched while installing, never insert it quickly into fuel tube.
 - Insert O-ring straight into fuel tube. Never decenter or twist it.
- Install fuel injector to fuel tube with the following procedure:

FUEL INJECTOR AND FUEL TUBE

[HR12DE]

< REMOVAL AND INSTALLATION >

a. Insert clip (2) into clip mounting groove (G) on fuel injector (4).

3 : O-ring (black)

5 : O-ring (green)

- Insert clip so that protrusion (F) of fuel injector matches cut-out (D) of clip.

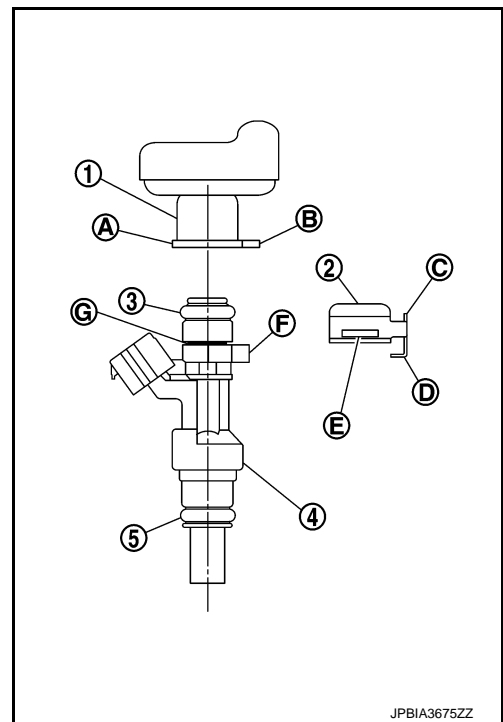
CAUTION:

- **Never reuse clip. Replace it with a new one.**
- **Be careful to keep clip from interfering with O-ring. If interference occurs, replace O-ring.**

b. Insert fuel injector into fuel tube (1) with clip attached.

- Insert it while matching it to the axial center.
- Insert fuel injector so that protrusion (B) of fuel tube matches cut-out (C) of clip.
- Check that fuel tube flange (A) is securely fixed in flange fixing groove (E) on clip.

c. Check that installation is complete by checking that fuel injector does not rotate or come off.



3. Set fuel tube and fuel injector assembly at its position for installation on cylinder head.

CAUTION:

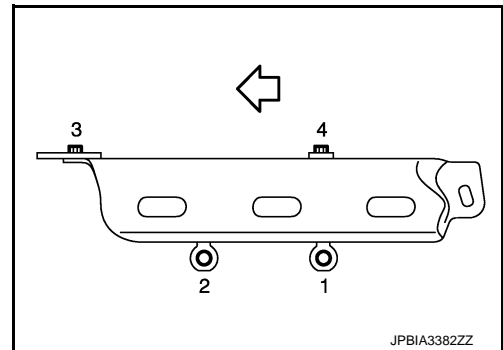
For installation, be careful not to interfere with fuel injector nozzle.

4. Install fuel tube and injector assembly onto cylinder.

5. Install fuel tube protector.

- After temporary tightening of bolts (3), (4), tighten mounting bolts in numerical order as shown in the figure.

⇐ : Engine front



6. Connect harness connector to fuel injector.

7. Connect fuel feed tube with the following procedure (engine side or centralized under-floor piping side).

FUEL INJECTOR AND FUEL TUBE

[HR12DE]

< REMOVAL AND INSTALLATION >

- Align the center of quick connector with the counterpart pipe and insert (A) the connector slowly and direct all the way to the counterpart pipe.
- Push retainer (1) until it clicks (B) and check that retainer is in place.

D : Unlock

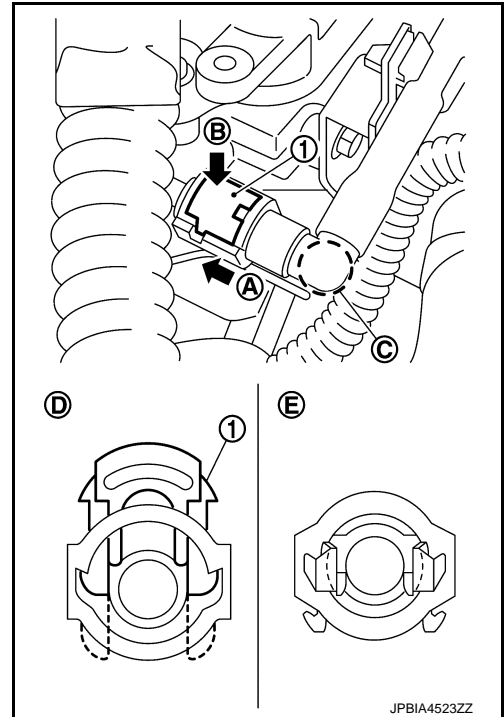
E : Lock

NOTE:

After installing retainer, pull the connector to check that it is locked.

CAUTION:

- Carefully align center to avoid inclined insertion to prevent damage to O-ring inside quick connector.
- Insert fuel hose by holding (C) as instructed in the figure.
- If fuel hose cannot be connected smoothly, recheck the connection because the quick connector may not be properly connected.



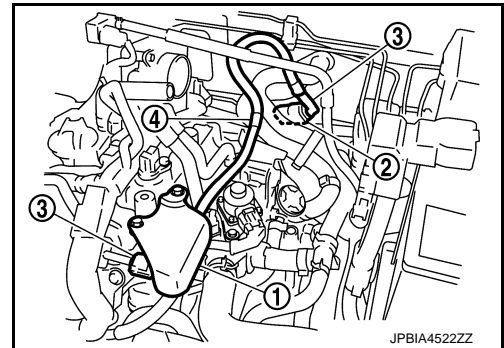
- With the fuel feed hose not fixed to the clamp, pull quick connector hard by hand to check that the quick connector is not disconnected from the fuel tube and that the quick connector is securely fixed.
- After connecting quick connector, turn the connector to fix it securely to hose clamp.
- Install fuel connector protector (1).
 - Install them and tighten to the torque specified below.

2 : Quick connector cap

3 : Quick connector

4 : Fuel feed hose

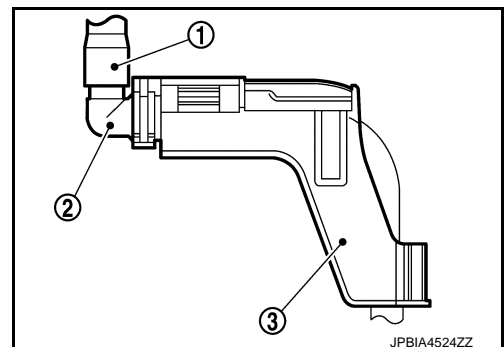
Tightening torque **10 N·m (1.0 kg-m, 89 in-lb)**



- Install quick connector cap (3) to the quick connector connection (vehicle side)

1 : Fuel feed hose

2 : Quick connector



- Install remaining parts in the reverse order of removal.

FOR THAILAND PRODUCTION MODELS : Inspection

INFOID:000000006418475

INSPECTION AFTER INSTALLATION

Check on Fuel Leakage

- Turn ignition switch "ON" (with the engine stopped). With fuel pressure applied to fuel piping, check there are no fuel leakage at connection points.

FUEL INJECTOR AND FUEL TUBE

[HR12DE]

< REMOVAL AND INSTALLATION >

NOTE:

Use mirrors for checking at points out of clear sight.

- Start the engine. With engine speed increased, check again that there are no fuel leakage at connection points.

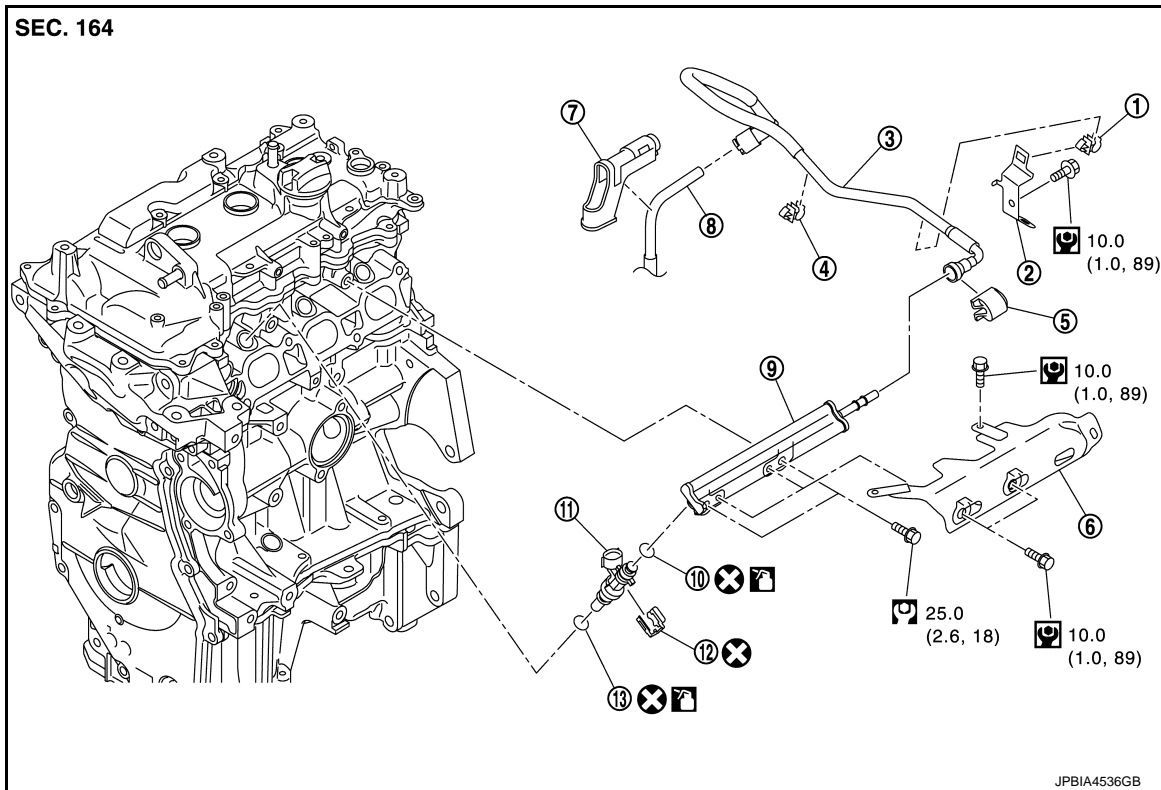
CAUTION:

Never touch the engine immediately after stopped, as the engine becomes extremely hot.

FOR INDIA PRODUCTION MODELS

FOR INDIA PRODUCTION MODELS : Exploded View

INFOID:000000006418473



- | | | |
|------------------------|-----------------------------------|------------------------|
| 1. Clamp | 2. Bracket | 3. Fuel feed hose |
| 4. Clamp | 5. Quick connector cap | 6. Fuel tube protector |
| 7. Quick connector cap | 8. Centralized under floor piping | 9. Fuel tube |
| 10. O-ring (black) | 11. Fuel injector | 12. Clip |
| 13. O-ring (green) | | |

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

CAUTION:

Never remove or disassemble parts unless instructed as shown in the figure.

FOR INDIA PRODUCTION MODELS : Removal and Installation

INFOID:000000005988188

WARNING:

- Put a “CAUTION: FLAMMABLE” sign in the workshop.
- Be sure to work in a well ventilated area and furnish workshop with a CO2 fire extinguisher.
- Never smoke while servicing fuel system. Keep open flames and sparks away from the work area.

FUEL INJECTOR AND FUEL TUBE

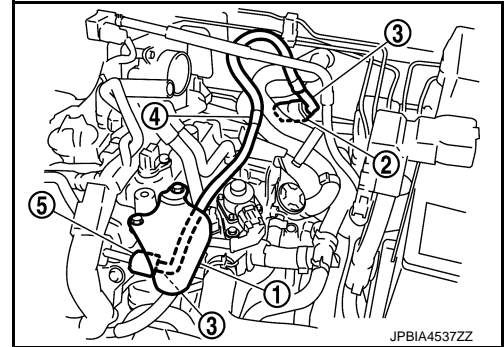
[HR12DE]

< REMOVAL AND INSTALLATION >

REMOVAL

1. Release the fuel pressure. Refer to following;
 - HR12DE (TYPE 1): [EC-179, "Work Procedure"](#)
 - HR12DE (TYPE 2): [EC-579, "Work Procedure"](#)
2. Disconnect battery cable from negative terminal.
3. Remove air duct (inlet) and air cleaner cover and body assembly. Refer to [EM-31, "TYPE 1 : Removal and Installation"](#) (Type 1) or [EM-32, "TYPE 2 : Removal and Installation"](#) (Type 2).
4. Remove intake manifold. Refer to [EM-36, "TYPE 1 : Removal and Installation"](#) (Type 1) or [EM-38, "TYPE 2 : Removal and Installation"](#) (Type 2).
5. Disconnect quick connector with the following procedure.
 - a. Vehicle side
 - i. Remove quick connector cap (vehicle side) (2) from quick connector connection.

- 1 : Fuel connector protector
- 3 : Quick connector
- 4 : Fuel feed hose
- 5 : Quick connector cap

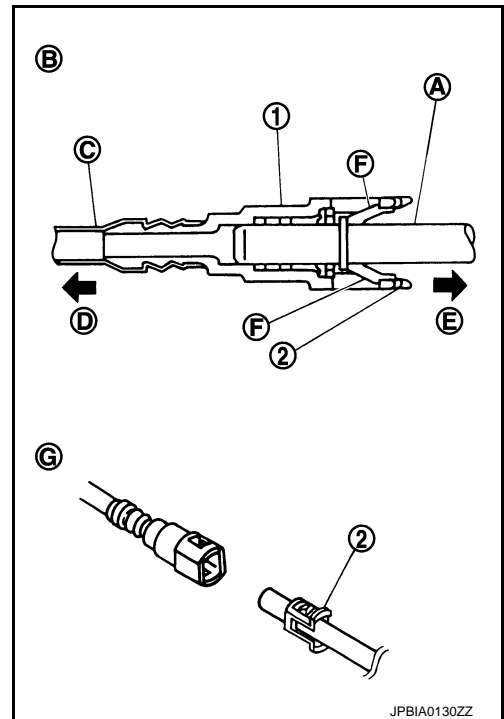


- ii. Disconnect quick connector (vehicle side) (1) from centralized under-floor piping (A).

NOTE:

If the fuel tube connector is stuck, hold the fuel pipe by hand and disconnect it by pushing and pulling.

- 2 : Retainer
- B : Connection (cross-section)
- C : Fuel feed hose
- D : To engine
- E : To fuel tank
- G : Disconnection



CAUTION:

- Quick connector can be disconnected when the tabs (F) are depressed completely. Never twist it more than necessary.
- Avoid fire and sparks.
- Never expose parts to battery electrolyte or other acids.
- Never bend or twist connection between quick connector and fuel feed tube during installation/removal.
- Never remove the remaining retainer on hard tube (or the equivalent except when resin tube or retainer is replaced).
- When resin tube or hard tube (or the equivalent) is replaced, also replace retainer with new one.

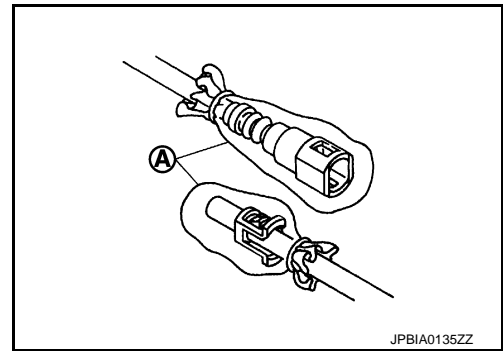
Retainer color : Green

FUEL INJECTOR AND FUEL TUBE

< REMOVAL AND INSTALLATION >

[HR12DE]

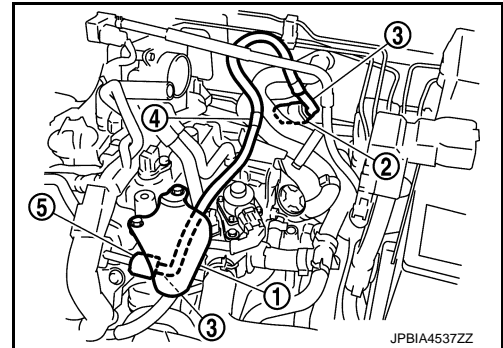
- To keep clean the connecting portion and to avoid damage and foreign materials, cover them completely with plastic bags, etc. (A) or something similar.



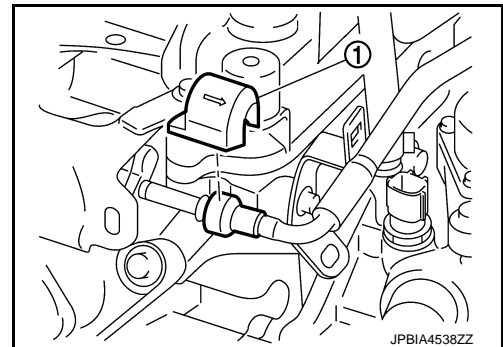
b. Engine side

i. Remove fuel connector protector (1).

- 2 : Quick connector cap (vehicle side)
- 3 : Quick connector
- 4 : Fuel feed hose
- 5 : Quick connector cap (engine side)



ii. Remove quick connector cap (engine side) (1) from quick connector connection.



iii. Disconnect fuel feed hose from clamp.

iv. With the sleeve side of quick connector release facing quick connector, install quick connector release (commercial service tool) onto fuel tube.

v. Insert quick connector release (A) into quick connector (2) until sleeve (B) contacts and goes no further. Hold quick connector release on that position.

- D : Insert and retain

CAUTION:

Inserting quick connector release hard will not disconnect quick connector. Hold quick connector release where it contacts and goes no further.

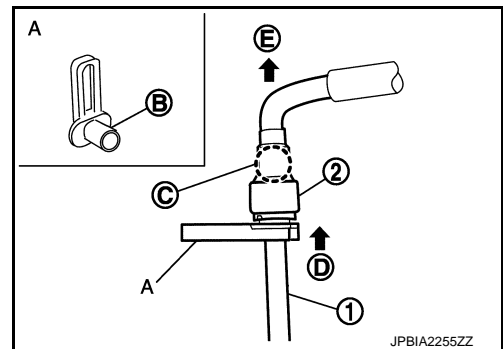
vi. Draw and pull out quick connector straight from fuel tube (1).

NOTE:

If the quick connector is stuck, hold the fuel pipe by hand and disconnect it by pushing and pulling.

CAUTION:

- Pull quick connector (E) holding position (C) in the figure.
- Prepare container and cloth beforehand as fuel will leakage out.
- Never pull with lateral force applied. O-ring inside quick connector may be damaged.
- Avoid fire and sparks.

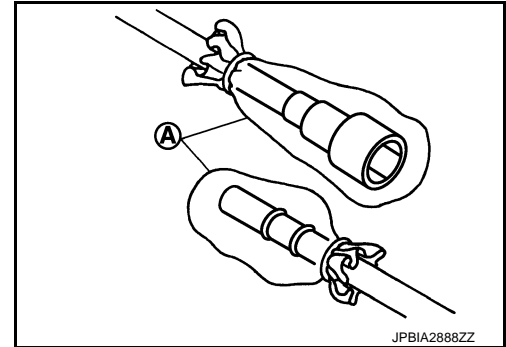


FUEL INJECTOR AND FUEL TUBE

[HR12DE]

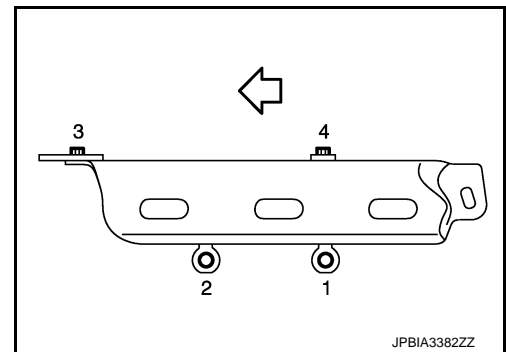
< REMOVAL AND INSTALLATION >

- Keep parts away from heat source. Especially, be careful when welding is performed around them.
- Never expose parts to battery electrolyte or other acids.
- Never bend or twist connection between quick connector and fuel feed tube during installation/removal.
- To keep clean the connecting portion and to avoid damage and foreign materials, cover them completely with plastic bags, etc. (A) or something similar.



6. Disconnect harness connector from fuel injector.
7. Remove fuel tube protector.
 - Loosen mounting bolts in reverse order as shown in the figure.

⇐ : Engine front



8. Remove fuel tube and fuel injector assembly.

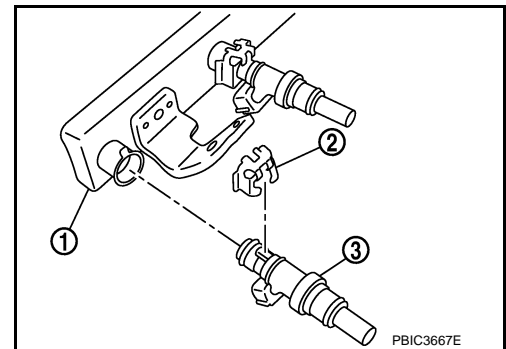
CAUTION:

- When removing, be careful to avoid any interference with fuel injector.
- Use a shop cloth to absorb any fuel leakage from fuel tube.

9. Remove fuel injector from fuel tube with the following procedure:
 - a. Open and remove clip (2).
 - b. Remove fuel injector (3) from fuel tube (1) by pulling straight.

CAUTION:

- Be careful with remaining fuel that may go out from fuel tube.
- Be careful not to damage fuel injector nozzle during removal.
- Never bump or drop fuel injector.
- Never disassemble fuel injector.



INSTALLATION

1. Note the following, and install O-rings to fuel injector.

CAUTION:

- Upper and lower O-rings are different. Be careful not to confuse them.

Fuel tube side : Black

Nozzle side : Green

- Handle O-ring with bare hands. Never wear gloves.

FUEL INJECTOR AND FUEL TUBE

[HR12DE]

< REMOVAL AND INSTALLATION >

- Lubricate O-ring with new engine oil.
- Never clean O-ring with solvent.
- Check that O-ring and its mating part are free of foreign material.
- When installing O-ring, be careful not to scratch it with tool or fingernails. Also be careful not to twist or stretch O-ring. If O-ring is stretched while installing, never insert it quickly into fuel tube.
- Insert O-ring straight into fuel tube. Never decenter or twist it.

2. Install fuel injector to fuel tube with the following procedure:
 - a. Insert clip (2) into clip mounting groove (G) on fuel injector (4).

3 : O-ring (black)

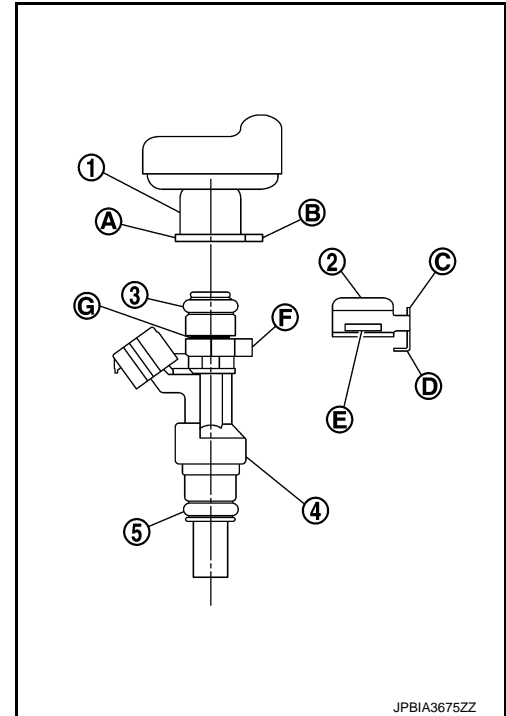
5 : O-ring (green)

- Insert clip so that protrusion (F) of fuel injector matches cut-out (D) of clip.

CAUTION:

- Never reuse clip. Replace it with a new one.
- Be careful to keep clip from interfering with O-ring. If interference occurs, replace O-ring.

- b. Insert fuel injector into fuel tube (1) with clip attached.
 - Insert it while matching it to the axial center.
 - Insert fuel injector so that protrusion (B) of fuel tube matches cut-out (C) of clip.
 - Check that fuel tube flange (A) is securely fixed in flange fixing groove (E) on clip.
- c. Check that installation is complete by checking that fuel injector does not rotate or come off.



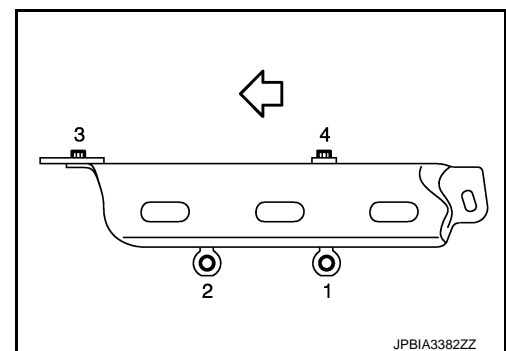
3. Set fuel tube and fuel injector assembly at its position for installation on cylinder head.

CAUTION:

For installation, be careful not to interfere with fuel injector nozzle.

4. Install fuel tube and injector assembly onto cylinder head.
5. Install fuel tube protector.
 - After temporary tightening of bolts (3), (4), tighten mounting bolts in numerical order as shown in the figure.

← : Engine front



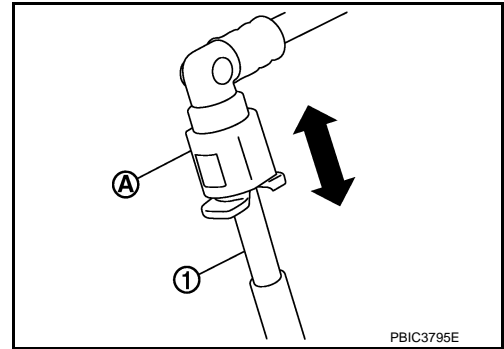
6. Connect harness connector to fuel injector.
7. Connect fuel feed hose with the following procedure, and then install the fuel feed hose.
 - a. Vehicle side
 - i. Check the connection for damage or any foreign materials.
 - ii. Align the quick connector with the tube, then insert the connector straight into the centralized under floor piping until a click sound is heard.

FUEL INJECTOR AND FUEL TUBE

[HR12DE]

< REMOVAL AND INSTALLATION >

- iii. After connecting, check that the connection is secure by following method.
- Visually confirm that the two retainer tabs are connected to the connector.
 - With the fuel feed hose not fixed to the clamp, pull quick connector hard by hand to check that the quick connector is not disconnected from the centralized under floor piping and that the quick connector is securely.



- iv. Install quick connector cap to quick connector connection.

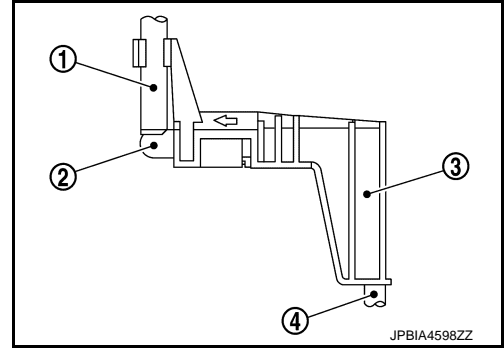
- 1 : Fuel feed hose
- 2 : Quick connector
- 3 : Quick connector cap
- 4 : Centralized under-floor piping

NOTE:

To install quick connector cap, face the marking (arrow) provided on the side toward the quick connector (fuel feed hose side).

CAUTION:

If fuel hose cannot be connected smoothly, recheck the connection because the quick connector may not be properly connected.

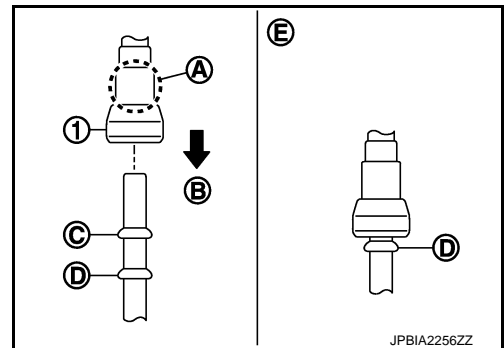


- b. Engine side
- i. Check for damage or foreign material on the fuel tube and quick connector.
- ii. Apply new engine oil lightly to area around the top of fuel tube.
- iii. Align center to insert quick connector straightly into fuel tube.
- Insert quick connector (1) to fuel tube until the top spool (C) on fuel tube is inserted completely and the 2nd level spool (D) is positioned slightly below quick connector bottom end.

- B : Upright insertion
- E : Fitted condition

CAUTION:

- Hold (A) position in the figure when inserting fuel tube into quick connector.
- Carefully align center to avoid inclined insertion to prevent damage to O-ring inside quick connector.
- Insert until you hear a “click” sound and actually feel the engagement.
- To avoid misidentification of engagement with a similar sound, be sure to perform the next step.



- iv. Pull quick connector hard by hand holding position. Check it is completely engaged (connected) so that it does not come out from fuel tube.

FUEL INJECTOR AND FUEL TUBE

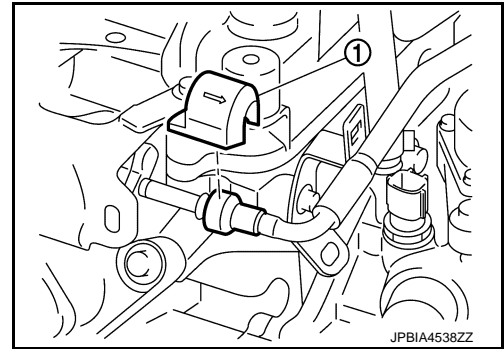
[HR12DE]

< REMOVAL AND INSTALLATION >

- v. Install quick connector cap (engine side) (1) to quick connector connection.
- Install quick connector cap (engine side) with the side arrow facing quick connector side (fuel feed hose side).

CAUTION:

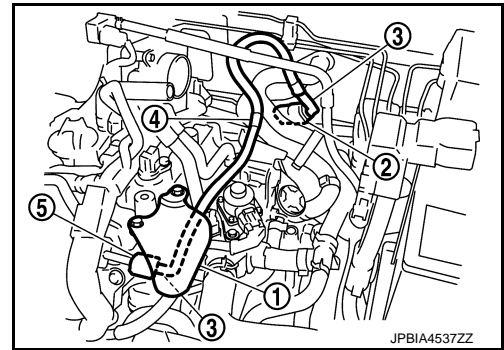
- **Check that the quick connector and fuel tube are securely engaged with the quick connector cap (engine side) mounting groove.**
- **Quick connector may not be connected correctly if quick connector cap (engine side) cannot be installed easily. Remove the quick connector cap (engine side), and then check the connection of quick connector again.**



- vi. Install fuel feed hose to hose clamp.
vii. Install fuel connector protector (1).
• Install them and tighten to the torque specified below.

- 2 : Quick connector cap (vehicle side)
- 3 : Quick connector
- 4 : Fuel feed hose
- 5 : Quick connector cap (engine side)

Tightening torque **10 N·m (1.0 kg·m, 89 in·lb)**



8. Install remaining parts in the reverse order of removal.

FOR INDIA PRODUCTION MODELS : Inspection

INFOID:000000005988189

INSPECTION AFTER INSTALLATION

Check on Fuel Leakage

1. Turn ignition switch "ON" (with the engine stopped). With fuel pressure applied to fuel piping, check there are no fuel leakage at connection points.

NOTE:

Use mirrors for checking at points out of clear sight.

2. Start the engine. With engine speed increased, check again that there are no fuel leakage at connection points.

CAUTION:

Never touch the engine immediately after stopped, as the engine becomes extremely hot.

IGNITION COIL, SPARK PLUG AND ROCKER COVER

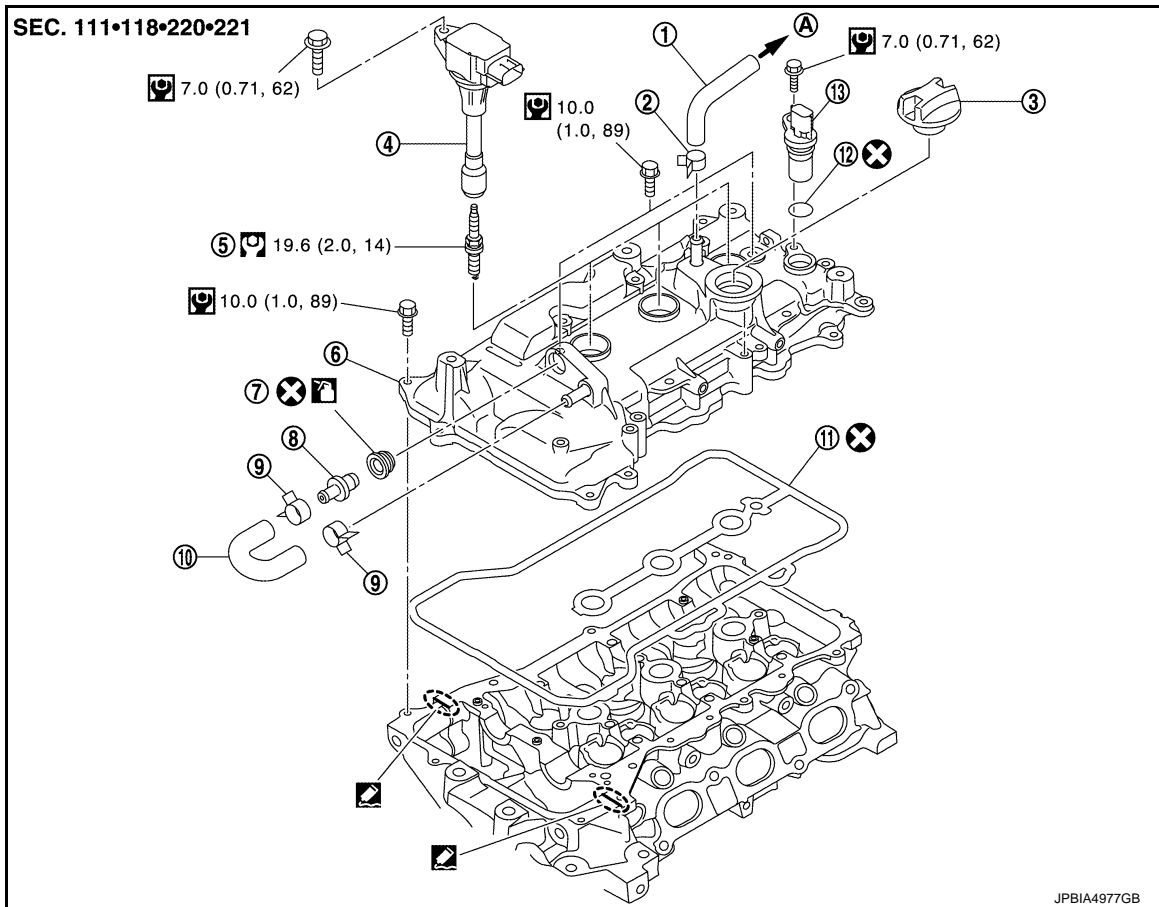
< REMOVAL AND INSTALLATION >

[HR12DE]

IGNITION COIL, SPARK PLUG AND ROCKER COVER

Exploded View

INFOID:000000005988190



JPBIA4977GB

- | | | |
|--------------------------------------|---------------|-------------------|
| 1. PCV hose | 2. Clamp | 3. Oil filler cap |
| 4. Ignition coil | 5. Spark plug | 6. Rocker cover |
| 7. Grommet | 8. PCV valve | 9. Clamp |
| 10. PCV hose | 11. Gasket | 12. O-ring |
| 13. Camshaft position sensor (PHASE) | | |
| A. To air cleaner cover assembly | | |

: N·m (kg·m, ft·lb)

: N·m (kg·m, in·lb)

: Always replace after every disassembly.

: Sealing point

: Should be lubricated with oil.

Removal and Installation

INFOID:000000005988191

REMOVAL

1. Remove air duct (inlet) and air cleaner cover and body assembly. Refer to [EM-31. "TYPE 1 : Removal and Installation"](#) (Type 1) [EM-32. "TYPE 2 : Removal and Installation"](#) (Type 2).
2. Remove intake manifold. Refer to [EM-36. "TYPE 1 : Removal and Installation"](#) (Type 1) or [EM-38. "TYPE 2 : Removal and Installation"](#) (Type 2).
3. Remove camshaft position sensor (PHASE).

IGNITION COIL, SPARK PLUG AND ROCKER COVER

< REMOVAL AND INSTALLATION >

[HR12DE]

CAUTION:

Handle it carefully and avoid impacts.

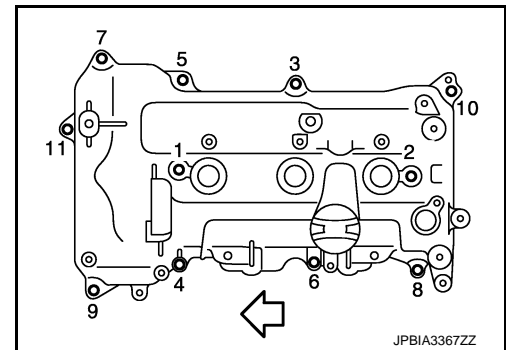
4. Remove ignition coil.

CAUTION:

- Never drop or shock ignition coil.
- Never disassemble ignition coil.

5. Remove spark plug using suitable tool. Refer to [EM-29, "Removal and Installation"](#).
6. Remove fuel tube protector. Refer to [EM-46, "FOR THAILAND PRODUCTION MODELS : Removal and Installation"](#) or [EM-51, "FOR INDIA PRODUCTION MODELS : Removal and Installation"](#).
7. Remove fuel injector harness clamp, and move injector harness.
8. Remove engine mounting stay. Refer to [EM-113, "Removal and Installation"](#).
9. Remove PCV valve and PCV hose, if necessary.
10. Remove rocker cover.
 - Loosen bolts in reverse order as shown in the figure.

⇐ : Engine front



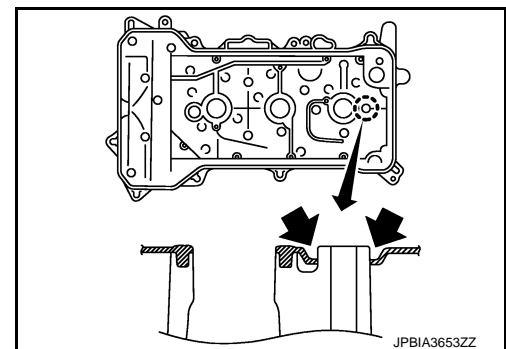
11. Remove rocker cover gasket from rocker cover.
12. Use scraper to remove all traces of liquid gasket from cylinder head and front cover.

CAUTION:

Never scratch or damage the mating surface when cleaning off old liquid gasket.

INSTALLATION

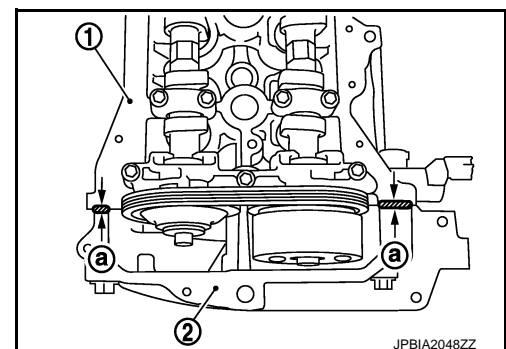
1. Rocker cover with the following procedure:
 - a. Install the rocker cover gasket to rocker cover.
 - Check for damage or foreign material.
 - Make sure that it is securely inserted in the mounting groove of rocker cover.
 - For the 1 bolt hole shown in the figure, push the gasket into the boss for the rocker cover bolt hole to prevent it from falling.



- b. Apply liquid gasket to the position as shown in the figure.

- 1 : Cylinder head
- 2 : Front cover
- a : $\phi 2.5 - 3.5$ mm

Use Genuine Liquid Gasket or equivalent.



IGNITION COIL, SPARK PLUG AND ROCKER COVER

< REMOVAL AND INSTALLATION >

[HR12DE]

- c. Install rocker cover to cylinder head.

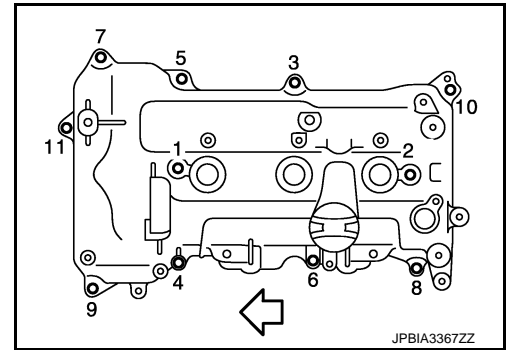
CAUTION:

Check the gasket is not dropped.

- Tighten bolts in two steps separately in numerical order as shown in the figure.

⇐ : Engine front

2. Install PCV control valve.
 - Insert until the flange is flush with the grommet.
3. Install the camshaft position sensor (PHASE).
 - Tighten bolt with it seated completely.
4. Install in the reverse order of removal, for the rest of parts.



TIMING CHAIN

< REMOVAL AND INSTALLATION >

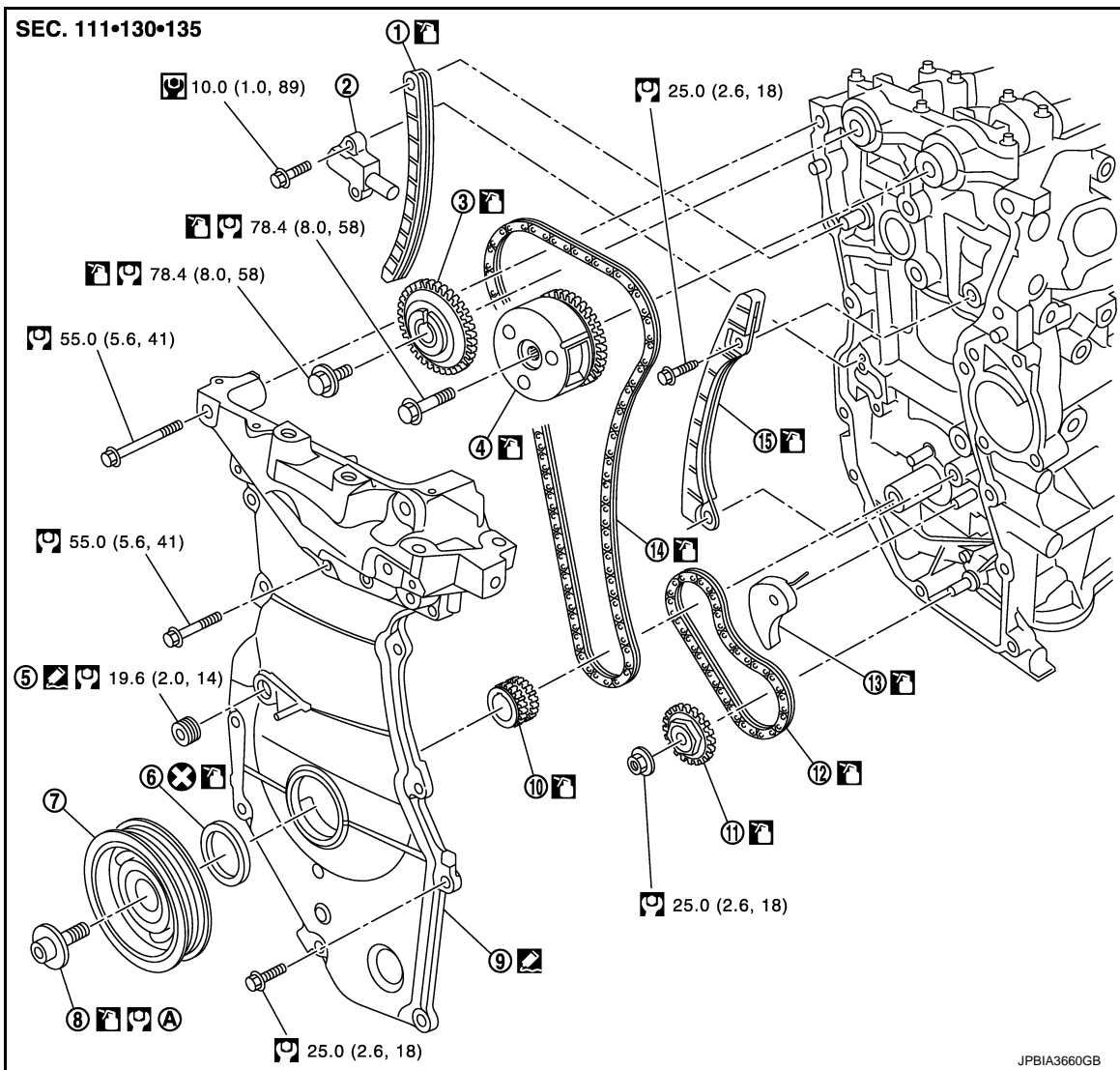
[HR12DE]

TIMING CHAIN

Exploded View

INFOID:000000005988192

TYPE 1



- | | | |
|--|---------------------------------------|--------------------------------|
| 1. Timing chain slack guide | 2. Chain tensioner (for timing chain) | 3. Camshaft sprocket (EXH) |
| 4. Camshaft sprocket (INT) | 5. Plug | 6. Front oil seal |
| 7. Crankshaft pulley | 8. Crankshaft pulley bolt | 9. Front cover |
| 10. Crankshaft sprocket | 11. Oil pump sprocket | 12. Oil pump drive chain |
| 13. Chain tensioner (for oil pump drive chain) | 14. Timing chain | 15. Timing chain tension guide |

A. Comply with the assembly procedure when tightening. Refer to [EM-62](#).

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

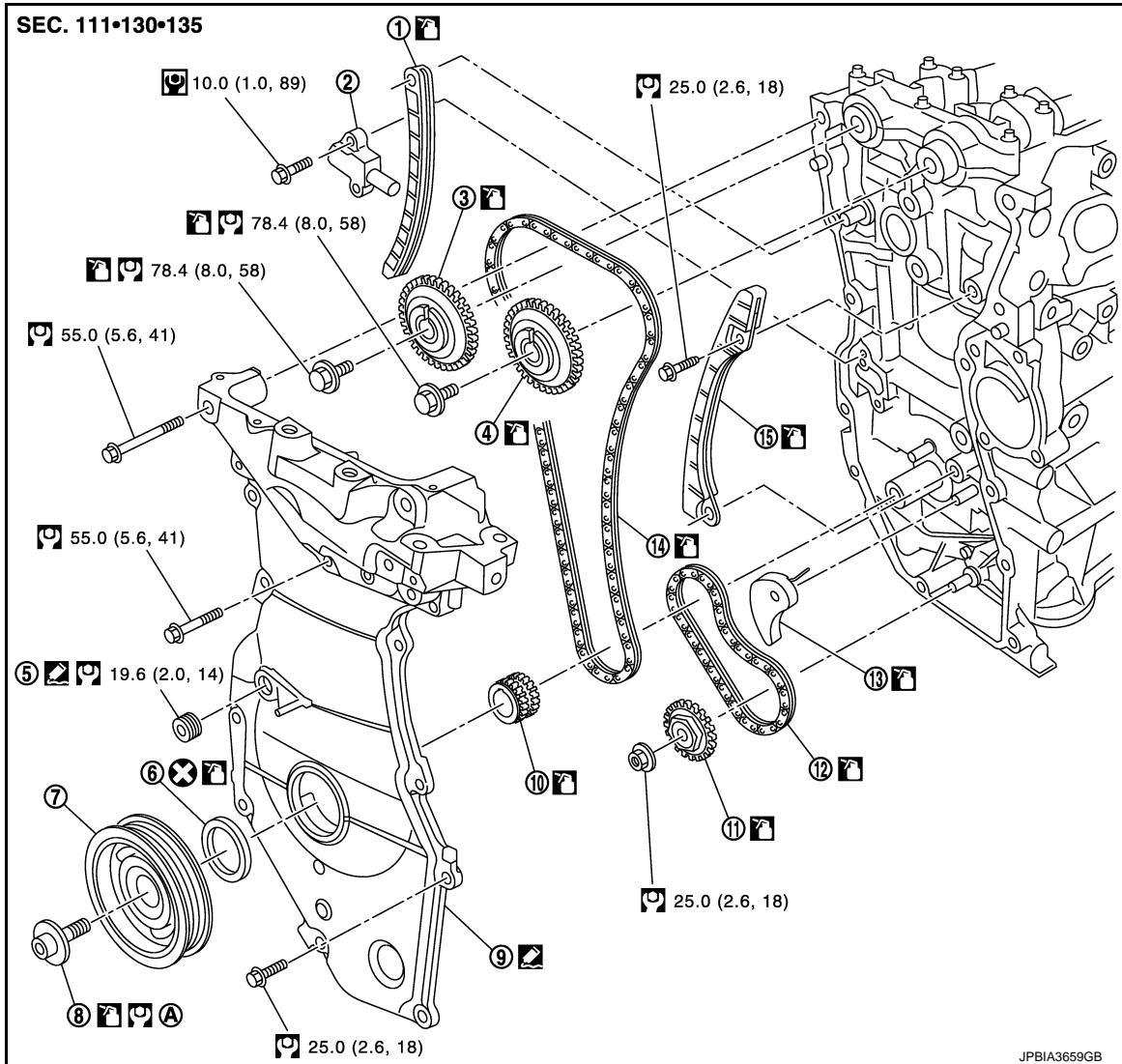
: Sealing point

TIMING CHAIN

< REMOVAL AND INSTALLATION >

[HR12DE]

TYPE 2



- | | | |
|--|---------------------------------------|--------------------------------|
| 1. Timing chain slack guide | 2. Chain tensioner (for timing chain) | 3. Camshaft sprocket (EXH) |
| 4. Camshaft sprocket (INT) | 5. Plug | 6. Front oil seal |
| 7. Crankshaft pulley | 8. Crankshaft pulley bolt | 9. Front cover |
| 10. Crankshaft sprocket | 11. Oil pump sprocket | 12. Oil pump drive chain |
| 13. Chain tensioner (for oil pump drive chain) | 14. Timing chain | 15. Timing chain tension guide |

A. Comply with the assembly procedure when tightening. Refer to [EM-62](#).

: N·m (kg·m, ft·lb)

: N·m (kg·m, in·lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

: Sealing point

Removal and Installation

INFOID:000000005988193

CAUTION:

The rotation direction indicated in the text indicates all directions seen from the engine front direction.

REMOVAL

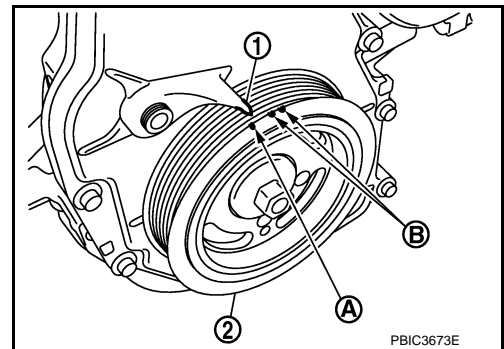
TIMING CHAIN

[HR12DE]

< REMOVAL AND INSTALLATION >

1. Remove front road wheel (RH).
2. Remove front fender protector (RH). Refer to [EXT-20, "FENDER PROTECTOR : Removal and Installation"](#).
3. Drain engine oil. Refer to [LU-7, "Draining"](#).
NOTE:
Perform this step when engine is cold.
4. Remove the following parts.
 - Rocker cover: Refer to [EM-58, "Exploded View"](#).
 - Drive belt: Refer to [EM-24, "Removal and Installation"](#).
 - Water pump pulley: Refer to [CO-24, "Removal and Installation"](#).
 - Ground cable (between front cover and radiator core support)
5. Remove low pressure flexible hose. Refer to [HA-35, "Exploded View"](#).
6. Support the bottom surface of engine using a transmission jack, and then remove the engine mounting bracket and insulator (RH). Refer to [EM-113, "Exploded View"](#).
7. Set No. 1 cylinder at TDC of its compression stroke with the following procedure:
 - a. Rotate crankshaft pulley (2) clockwise and align TDC mark (without paint mark) (A) to timing indicator (1) on front cover.

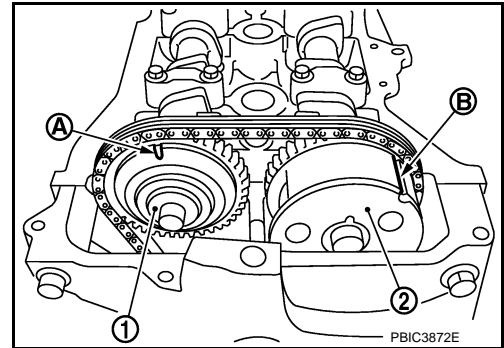
B : White paint mark (Not use for service)



- b. Check the matching marks on each camshaft sprocket are positioned as shown in the figure.

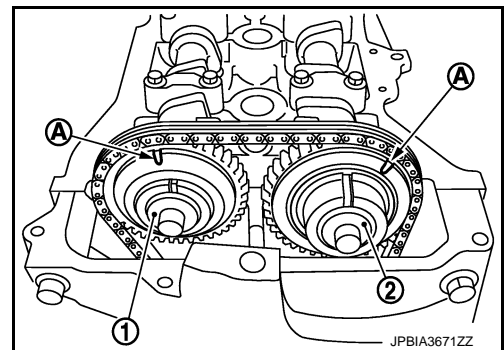
- Type 1

- 1 : Camshaft sprocket (EXH)
- 2 : Camshaft sprocket (INT)
- A : Matching mark (stamp)
- B : Matching mark (peripheral stamp line)



- Type 2

- 1 : Camshaft sprocket (EXH)
- 2 : Camshaft sprocket (INT)
- A : Matching mark (stamp)



- If not, rotate crankshaft pulley one more turn to align matching marks to the positions in the figure.

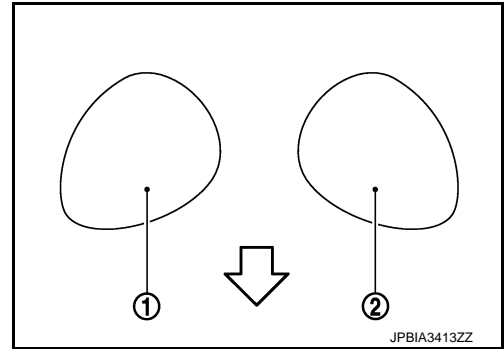
TIMING CHAIN

[HR12DE]

< REMOVAL AND INSTALLATION >

- c. Check that the cam nose of cylinder 1 is positioned as shown in the figure.

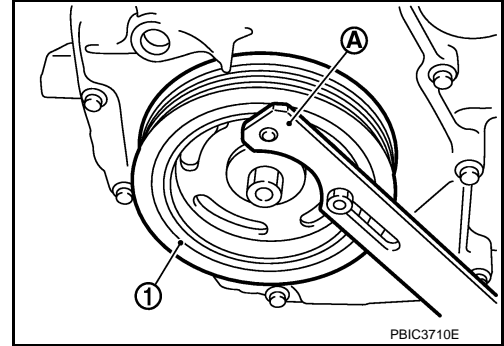
- 1 : Camshaft (EXH)
- 2 : Camshaft (INT)
- ⇐ : Cylinder head side



8. Remove crankshaft pulley with the following procedure:
- a. Secure crankshaft pulley (1) using a pulley holder (commercial service tool) (A).
 - b. Loosen and pull out crankshaft pulley bolts.

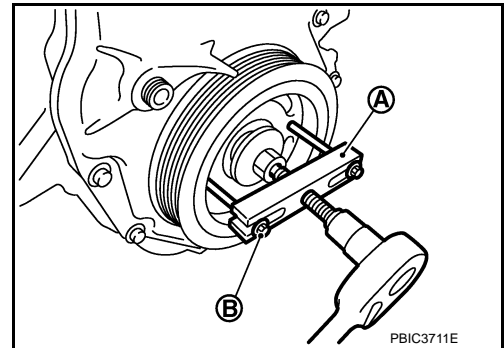
CAUTION:

Never remove the mounting bolts as they will be used as a supporting point for the pulley puller [SST: KV11103000].



- c. Attach a pulley puller [SST: KV11103000] (A) in the M 6 thread hole on crankshaft pulley, and remove crankshaft pulley.

- B : M6 bolt



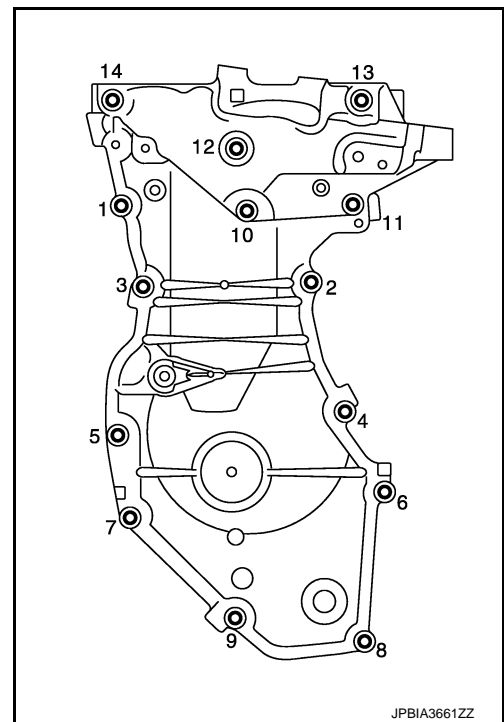
9. Remove front cover with the following procedure:

TIMING CHAIN

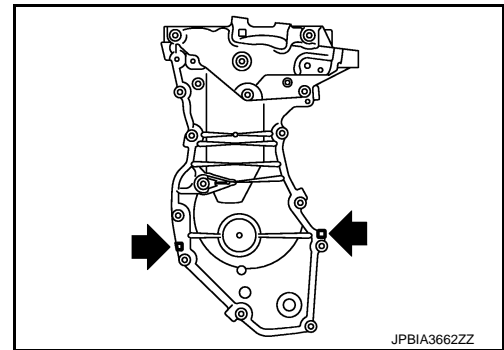
[HR12DE]

< REMOVAL AND INSTALLATION >

- a. Loosen bolts in the reverse of the order as shown in the figure.



- b. Cut liquid gasket by prying the position (↔) as shown in the figure, and then remove the front cover.



10. Remove front oil seal from front cover.
• Remove by lifting it up using a suitable tool.

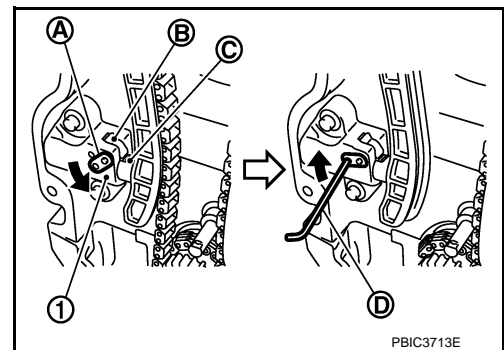
CAUTION:

Be careful not to damage the front cover.

11. Remove chain tensioner (for timing chain) (1) with the following procedure.

- a. Fully push down the chain tensioner lever (A), and then push the plunger (C) into the inside of chain tensioner (for timing chain).
• The tab (B) is released by fully pushing the lever down. As a result, the plunger can be moved.

- b. Pull up the lever to align its hole position with the body hole position.
• When the lever hole is aligned with the body hole position, the plunger is fixed.
• When the protrusion parts of the plunger ratchet and the tab face each other, both hole positions are not aligned. At that time, correctly engage them and align these hole positions by slightly moving the plunger.



- c. Insert the stopper pin (D) into the body hole through the lever hole, and then fix the lever at the upper position.
• Figure shows the example that a hexagonal wrench for 2.5 mm (0.098 in) is used.
- d. Remove chain tensioner (for timing chain).

A
EM
C
D
E
F
G
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K
L
M
N
O
P

TIMING CHAIN

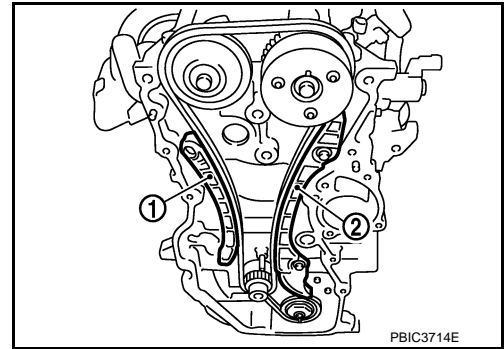
[HR12DE]

< REMOVAL AND INSTALLATION >

12. Remove the timing chain tension guide (2) and the timing chain slack guide (1).

NOTE:

The above exploded view type 1 as an example.



13. Remove the timing chain (2).

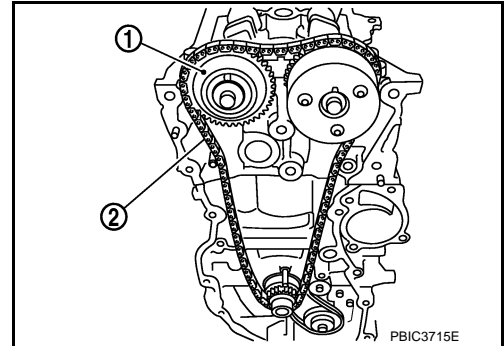
- Pull the looseness of timing chain toward the camshaft sprocket (EXH) (1), and then remove the timing chain and start the removal from camshaft sprocket (EXH) side.

CAUTION:

Never rotate crankshaft or camshaft while timing chain is removed. It causes interference between valve and piston.

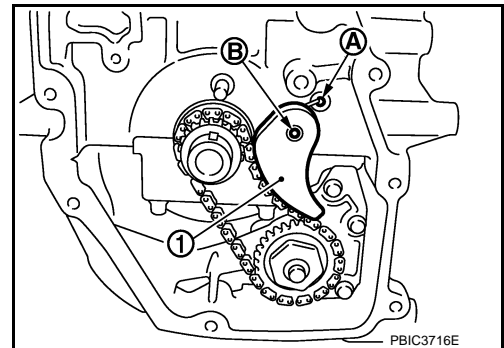
NOTE:

The above exploded view type 1 as an example.



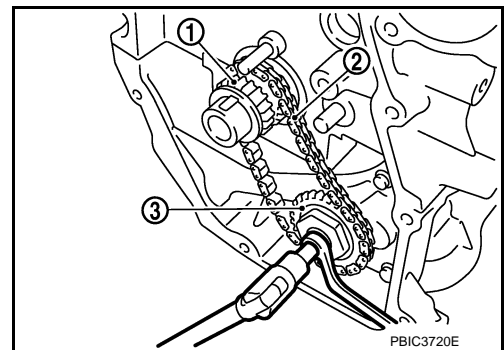
14. Remove the crankshaft sprocket and the oil pump drive related parts with the following procedure.

- a. Remove chain tensioner (for oil pump drive chain) (1).
- Pull out from the shaft (B) and spring fixing holes (A).



- b. Hold the top of the oil pump shaft using the TORX socket (size: E8), and then loosen the oil pump sprocket nuts and remove them.

- c. Remove the crankshaft sprocket (1), the oil pump drive chain (2), and the oil pump sprocket (3) at the same time.



INSTALLATION

NOTE:

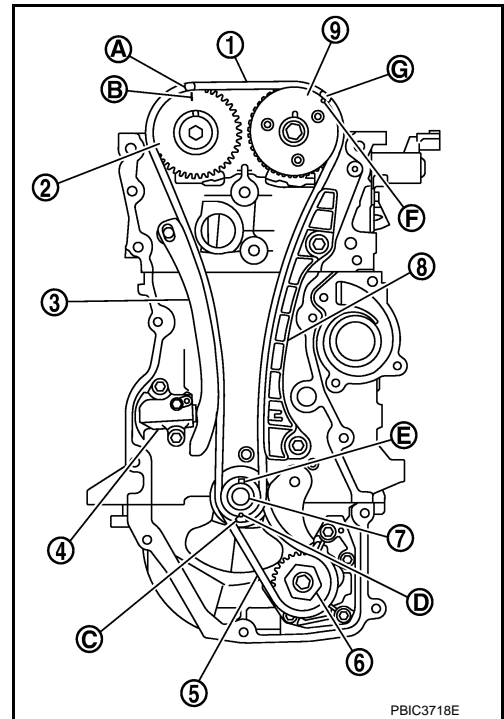
TIMING CHAIN

[HR12DE]

< REMOVAL AND INSTALLATION >

- The figure shows the relationship between the matching mark on each timing chain and that on the corresponding sprocket, with the components installed.

- 1 : Timing chain
- 2 : Camshaft sprocket (EXH)
- 3 : Timing chain slack guide
- 4 : Chain tensioner (for timing chain)
- 5 : Oil pump drive chain
- 6 : Oil pump sprocket
- 7 : Crankshaft sprocket
- 8 : Timing chain tension guide
- 9 : Camshaft sprocket (INT)
- A : Yellow link (type 1)
- B : Blue link (type 2)
- C : Orange link
- D : Matching mark (stamp)
- E : Crankshaft key (point straight up)
- F : Matching mark [(peripheral stamp line) (type 1)]
- G : Matching mark [(stamp) (type 2)]
- H : Yellow link (type 1)
- I : Blue link (type 2)



- The above exploded view type 1 as an example.

- Install the crankshaft sprocket and the oil pump drive related parts with the following procedure:

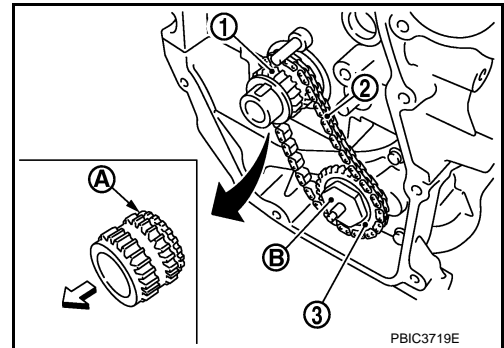
- Install the crankshaft sprocket (1), the oil pump drive chain (2), and the oil pump sprocket (3) at the same time.

⇐ : Engine front

- Install the crankshaft sprocket so that its invalid gear area (A) is towards the back of the engine.
- Install the oil pump sprocket so that its hexagonal surface faces (B) the front of engine.

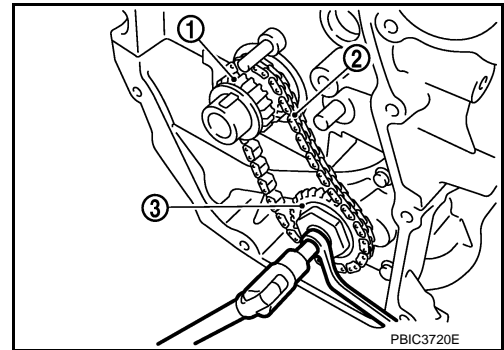
NOTE:

There is no matching mark in the oil pump drive related parts.



- Hold the top of the oil pump shaft using the TORX socket (size: E8), and then tighten the oil pump sprocket nuts.

- 1 : Crankshaft sprocket
- 2 : Oil pump drive chain
- 3 : Oil pump sprocket

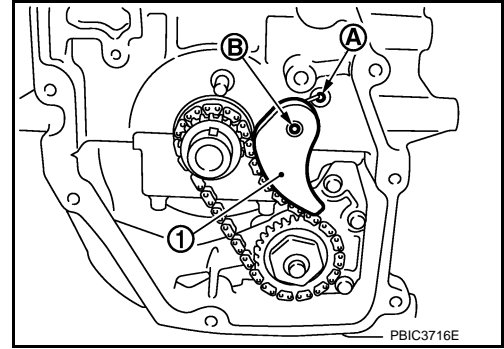


TIMING CHAIN

[HR12DE]

< REMOVAL AND INSTALLATION >

- c. Install chain tensioner (for oil pump drive chain) (1).
- Insert the body into the shaft (B) while inserting the spring into the fixing hole (A) of cylinder block front surface.
 - Check that the tension is applied to the oil pump drive chain after installing.



2. Install timing chain with the following procedure.

- A : Yellow link (type 1)
- : Blue link (type 2)
- B : Matching mark (stamp)
- C : Orange link
- D : Matching mark (stamp)
- E : Crankshaft key (point straight up)
- : Matching mark [(peripheral stamp line) (type 1)]
- F : Matching mark [(stamp) (type 2)]
- : Yellow link (type 1)
- G : Blue link (type 2)

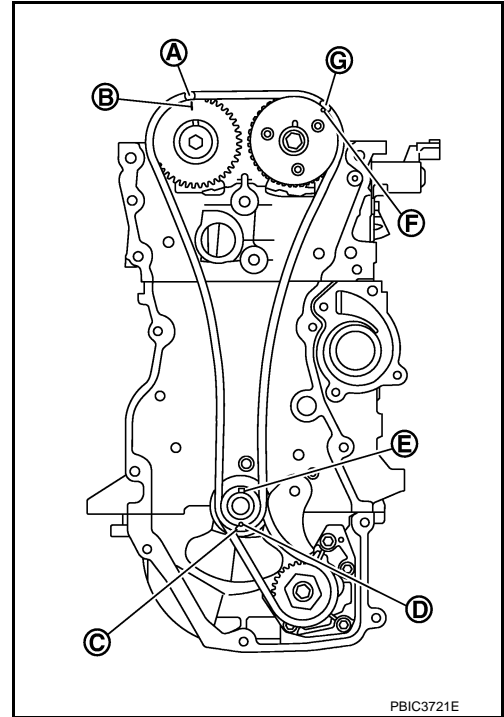
NOTE:

The above exploded view type 1 as an example.

- Install by aligning matching marks on each sprocket and timing chain.
- If these matching marks are not aligned, rotate the camshaft slightly to correct the position.

CAUTION:

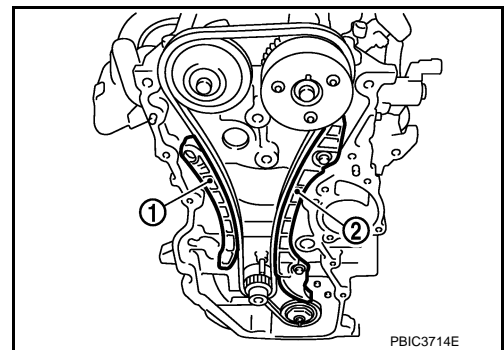
- For the following note, after the matching marks are aligned, keep them aligned by holding them with a hand.
- To avoid skipped teeth, never rotate crankshaft and camshaft until front cover is installed.



3. Install timing chain tension guide (2) and timing chain slack guide (1).

NOTE:

The above exploded view type 1 as an example.

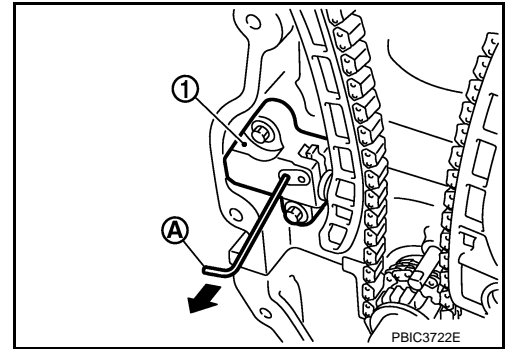


TIMING CHAIN

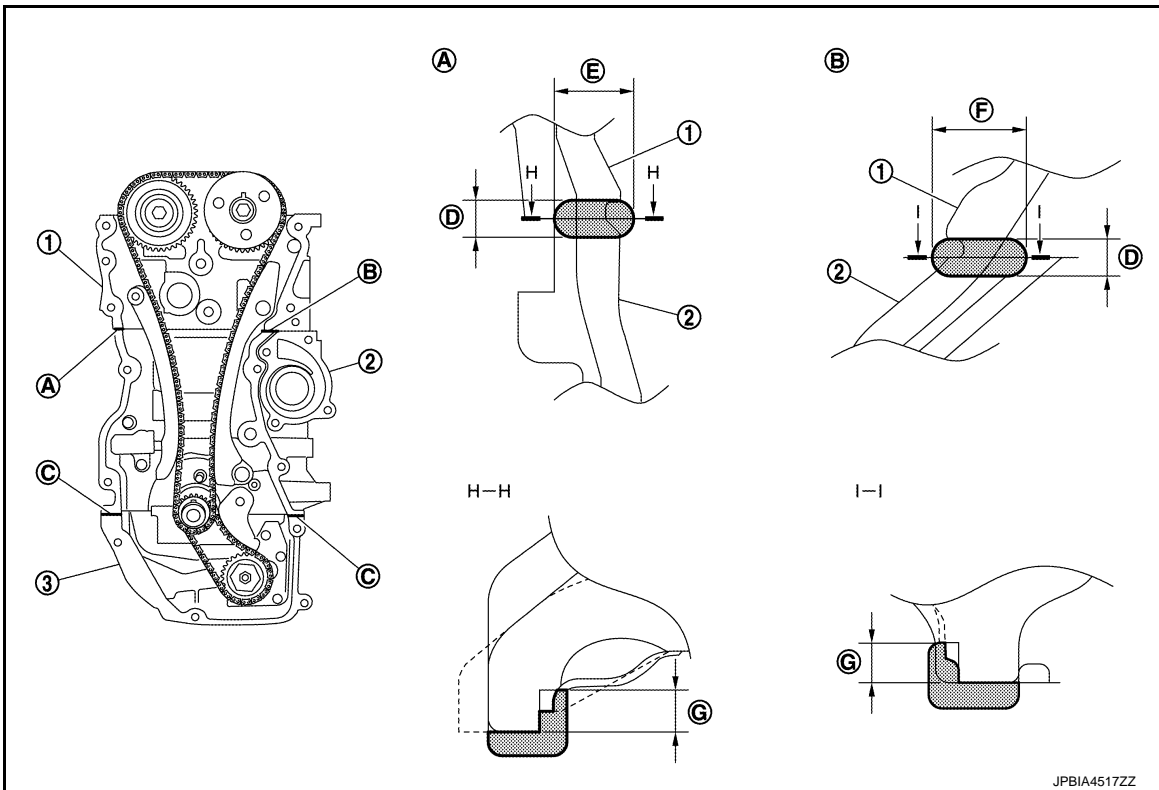
[HR12DE]

< REMOVAL AND INSTALLATION >

4. Install chain tensioner (for timing chain) (1).
 - Fix the plunger at the most compressed position using a stopper pin (A), and then install it.
 - Securely pull out the stopper pin after installing the chain tensioner.



5. Check matching mark position of timing chain and each sprocket again.
6. Install the front oil seal to the front cover. Refer to [EM-101, "FRONT OIL SEAL : Removal and Installation"](#)
7. Install front cover with the following procedure:
 - a. Apply a continuous bead of liquid gasket with tube presser (commercial service tool) to cylinder block as shown in the figure.
Use Genuine Liquid Gasket or equivalent.



- | | | |
|-----------------------------------|-----------------------------------|-----------------------------------|
| 1. Cylinder head | 2. Cylinder block | 3. Oil pan (upper) |
| A. Liquid gasket application area | B. Liquid gasket application area | C. Liquid gasket application area |
| D. ϕ 5 mm (0.2 in) | E. 11 mm (0.4 in) | F. 13 mm (0.5 in) |
| G. 6 mm (0.23 in) | | |

NOTE:

The above exploded view type 1 as an example.

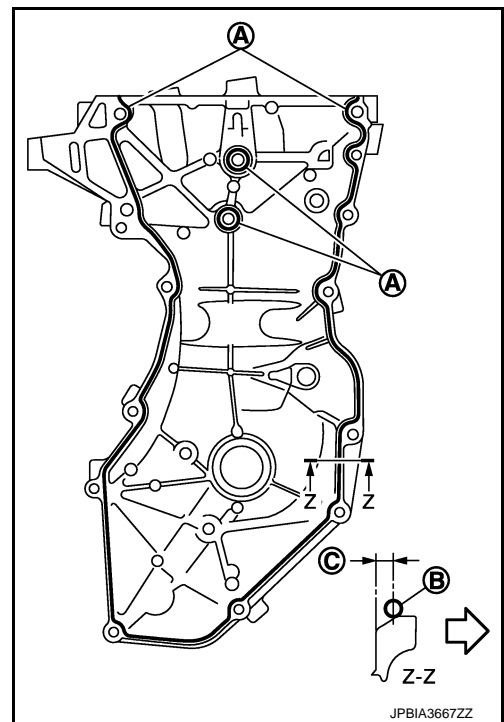
TIMING CHAIN

[HR12DE]

< REMOVAL AND INSTALLATION >

- b. Apply a continuous bead of liquid gasket with tube presser (commercial service tool) to front cover as shown in the figure. **Use Genuine Liquid Gasket or equivalent.**

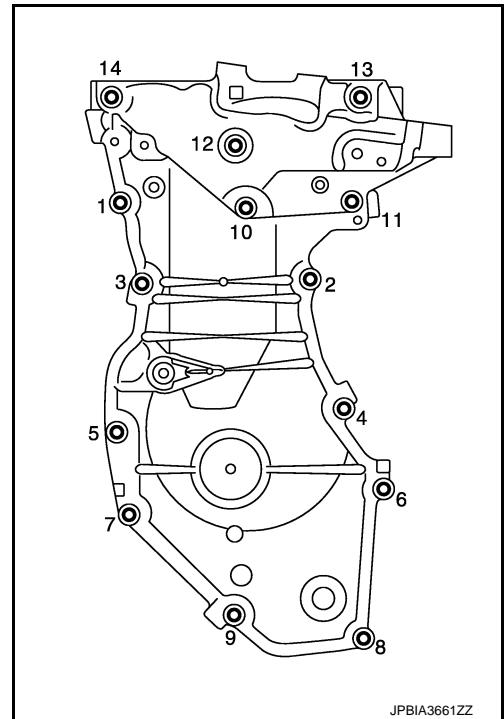
- A : Liquid gasket application area
B : Liquid gasket
C : $\phi 3.0 - 4.0$ mm (0.12 - 0.16 in)
⇐ : Engine outside



- c. Tighten bolts in the numerical order as shown in the figure.
d. After all bolts are tightened, retighten them to specified torque in numerical order as shown in the figure.

CAUTION:

Be sure to wipe off any excessive liquid gasket leaking to surface.



8. Insert crankshaft pulley by aligning with crankshaft key.
- When inserting crankshaft pulley with a plastic hammer, tap on its center portion (not circumference).
- CAUTION:**
Install protecting front oil seal lip section from any damage.
9. Tighten crankshaft pulley bolt with the following procedure:
- Secure crankshaft pulley with a pulley holder (commercial service tool), and tighten crankshaft pulley bolt.
- a. Apply new engine oil to thread and seat surfaces of crankshaft pulley bolt.
b. Tighten crankshaft pulley bolt.

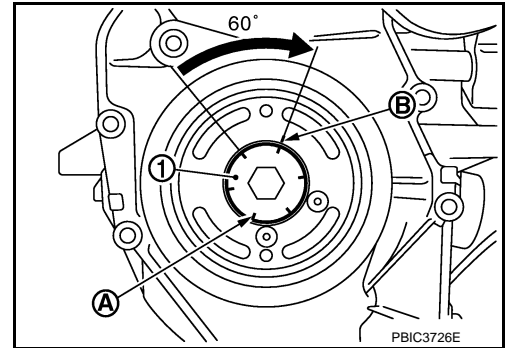
TIMING CHAIN

< REMOVAL AND INSTALLATION >

[HR12DE]

 : 35.0 N-m (3.6 kg-m, 26 ft-lb)

- c. Put a paint mark (B) on crankshaft pulley, mating with any one of six easy to recognize angle marks (A) on crankshaft bolt flange (1).
- d. Turn another 60 degrees clockwise (angle tightening).
 - Check the tightening angle with movement of one angle mark.



10. Check that crankshaft turns smoothly by rotating by hand clockwise.
11. Install in the reverse order of removal.

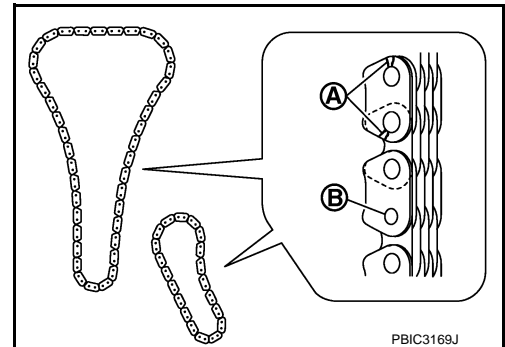
Inspection

INFOID:000000005988194

INSPECTION AFTER REMOVAL

Timing Chain

Check for cracks (A) and any excessive wear (B) at link plates and roller links of timing chain. Replace timing chain if necessary.



INSPECTION AFTER INSTALLATION

Inspection for Leakage

The following are procedures for checking fluids leakage, lubricates leakage, and exhaust gases leakage.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-19. "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
 - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

NOTE:

If hydraulic pressure inside chain tensioner drops after removal/installation, slack in guide may generate a pounding noise during and just after the engine start. However, this does not indicate an unusualness. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to check there is no leakage of fuel, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

Items	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level

TIMING CHAIN

< REMOVAL AND INSTALLATION >

[HR12DE]

Transmission / transaxle fluid	AT & CVT Models	Leakage	Level / Leakage	Leakage
	MT Models	Level / Leakage	Leakage	Level / Leakage
Other oils and fluids*		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gases		—	Leakage	—

*: Power steering fluid, brake fluid, etc.

CAMSHAFT

< REMOVAL AND INSTALLATION >

[HR12DE]

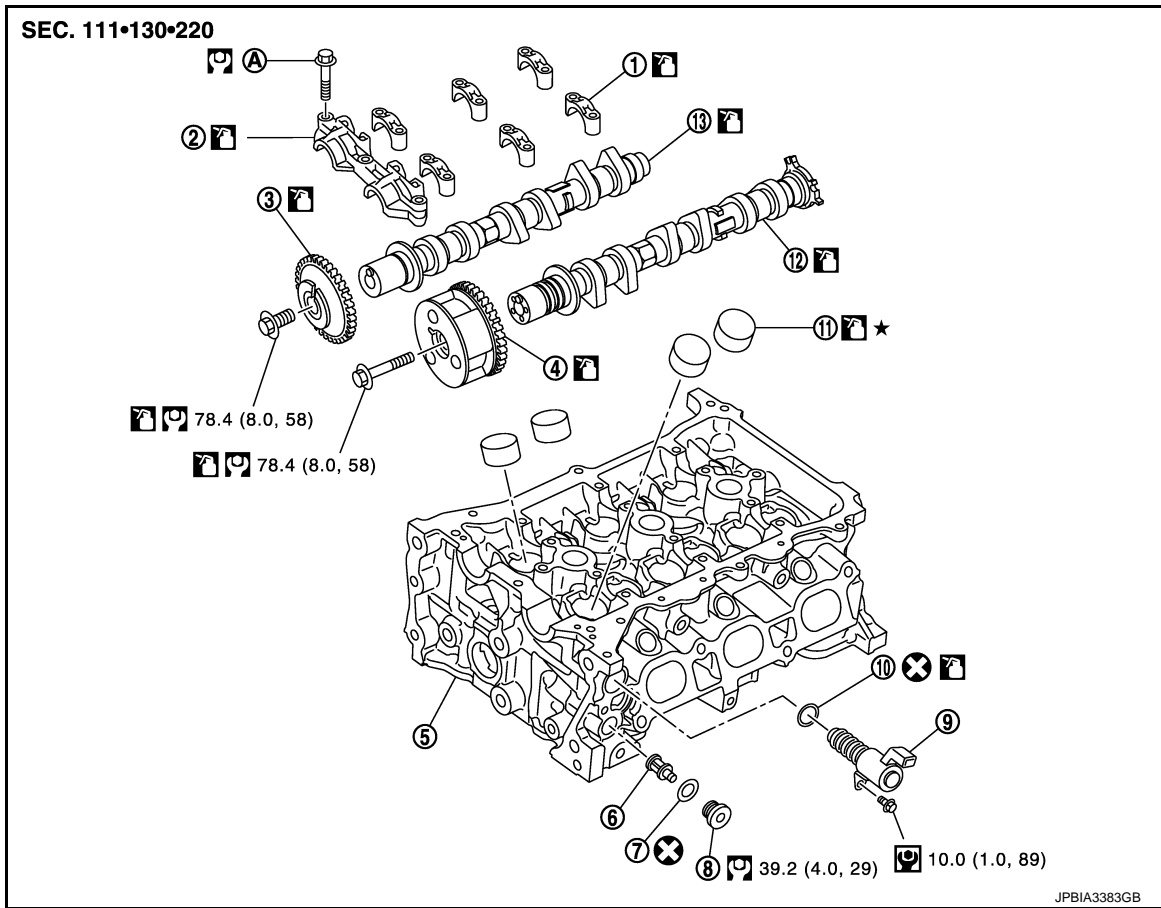
CAMSHAFT

TYPE 1

TYPE 1 : Exploded View

INFOID:000000005988195

A
EM



- | | | |
|----------------------------------|-----------------------------|--|
| 1. Camshaft bracket (No. 2 to 4) | 2. Camshaft bracket (No. 1) | 3. Camshaft sprocket (EXH) |
| 4. Camshaft sprocket (INT) | 5. Cylinder head | 6. Oil filter (for intake valve timing control solenoid valve) |
| 7. Washer | 8. Plug | 9. Intake valve timing control solenoid valve |
| 10. O-ring | 11. Valve lifter | 12. Camshaft (INT) |
| 13. Camshaft (EXH) | | |

Comply with the assembly procedure when tightening. Refe to [EM-73](#).

: N·m (kg-m, ft-lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

★ : Select with proper thickness.

TYPE 1 : Removal and Installation

INFOID:000000005988196

CAUTION:

The rotation direction indicated in the text indicates all directions seen from the engine front direction.

REMOVAL

NOTE:

CAMSHAFT

[HR12DE]

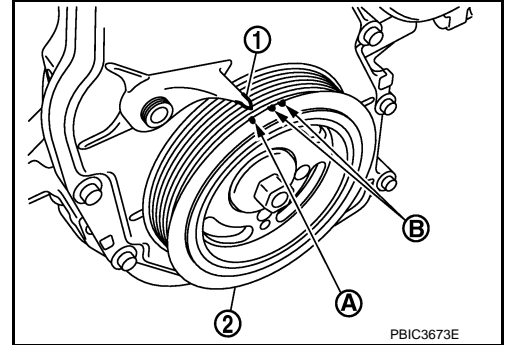
< REMOVAL AND INSTALLATION >

This section describes the procedure for removal and installation of camshaft with front cover. If the front cover is removed first, change the following procedure.

- Step 7 : After camshaft sprocket is removed, remove the camshaft brackets (No. 2 to 4).
- Step 8 : The camshaft (EXH) can be removed simultaneously with the camshaft (INT).
- Step 9 : When the camshaft sprocket (INT) mounting bolt is removed, the lifting up of camshaft is not necessary.

1. Support the bottom surface of engine using a transmission jack, and then remove the engine mounting insulator (RH). Refer to [EM-113, "Exploded View"](#).
2. Remove rocker cover. Refer to [EM-58, "Exploded View"](#).
3. Place cylinder No. 1 at TDC with the following procedure.
 - a. Rotate crankshaft pulley (2) clockwise and align TDC mark (without paint mark) (A) to timing indicator (1) on front cover.

B : White paint mark (Not use for service)



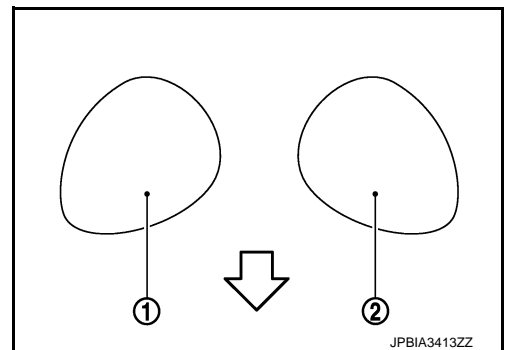
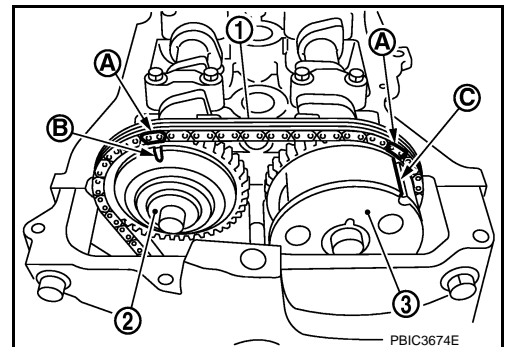
- b. Check that the matching marks on each camshaft sprocket are in the position as shown in the figure.

1. : Timing chain
2. : Camshaft sprocket (EXH)
3. : Camshaft sprocket (INT)
- A : Matching mark (Paint)
- B : Matching mark (Stamp)
- C : Matching mark (Peripheral stamp line)

- If the matching marks are not in place, rotate crankshaft pull one more turn to satisfy the position shown in figure.

- c. Check that the cam nose of No.1 cylinder is positioned as shown in the figure.

1. : Camshaft (EXH)
2. : Camshaft (INT)
- ⇐ : Cylinder head side



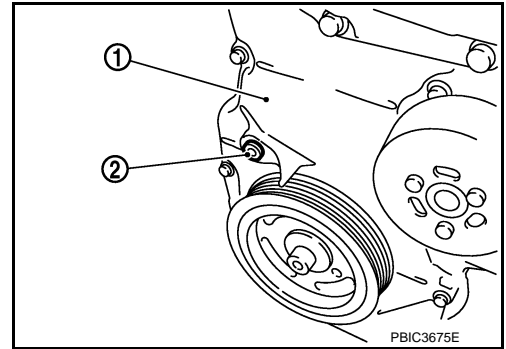
- d. Paint matching marks on the timing chain links
 4. Secure the plunger of chain tensioner (for timing chain) in the fully compressed position with the following procedure. And then, loosen the timing chain tension.

CAMSHAFT

< REMOVAL AND INSTALLATION >

[HR12DE]

- a. Remove the plug (2) from the front cover (1).



- b. Fully push down the lever (B) of chain tensioner (for timing chain) (2) from the plug hole, and then insert the stopper pin (A) into the body side hole and secure the lever at the lowest position.

C : Front cover has been omitted

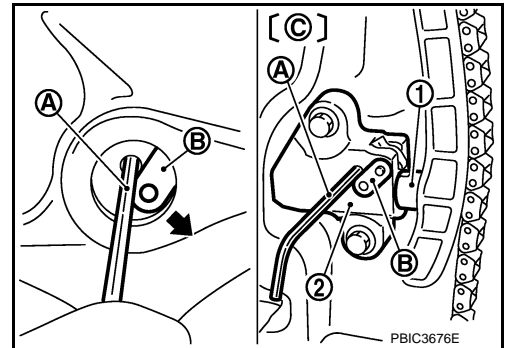
- The tab is released by fully pushing the lever down. As a result, the plunger (1) can be moved.

NOTE:

Hexagonal wrench [2.5 mm (0.098 in)] is used for a stopper pin as an example.

CAUTION:

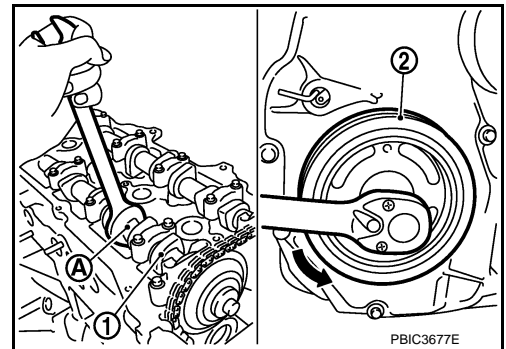
The stopper pin must use a shape that cannot fall in the front cover when dropping out.



- c. Turn the crankshaft pulley (2) counterclockwise with the camshaft (EXH) (1) fixing. Apply the tension to the timing chain, and then push the plunger of into the inside of chain tensioner (for timing chain).

CAUTION:

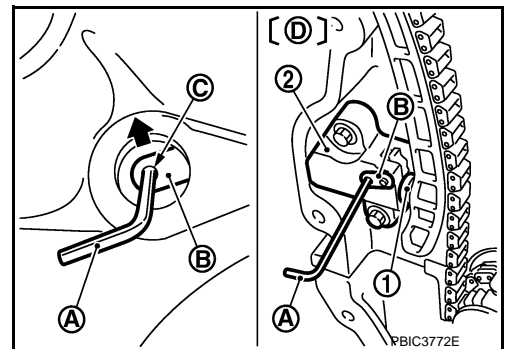
Hold the camshaft hexagonal part (A), and then secure the camshaft.



- d. Pull out the stopper pin (A) of chain tensioner (for timing chain) (2) side from plug hole. Lift the lever (B) up to align its hole position with the hole of the body.

D : Front cover has been omitted

- When the lever hole (C) is aligned with the body hole position, the plunger (1) is fixed.
- When the protrusion parts of the plunger ratchet and the tab face each other, both hole positions are not aligned. At that time, correctly engage them and align these hole positions by slightly moving the plunger.



- e. Insert the stopper pin into the body hole through the lever hole, and then fix the lever at the upper position.

CAMSHAFT

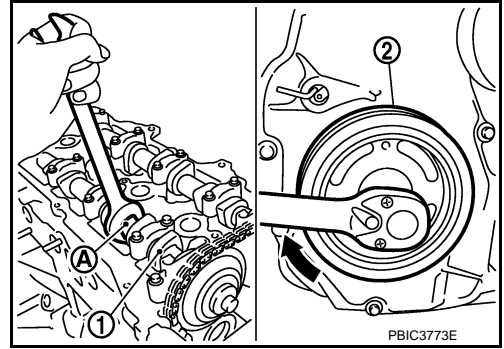
[HR12DE]

< REMOVAL AND INSTALLATION >

- f. Slightly rotate the crankshaft pulley (2) clockwise to loosen the timing chain on camshaft sprocket (EXH) (1) side.

CAUTION:

Hold the camshaft hexagonal part (A), and then secure the camshaft.



5. Remove camshaft sprocket (EXH) (1).

CAUTION:

- Hold the camshaft hexagonal part (A), and then secure the camshaft.
- Never rotate crankshaft and camshaft separately, so as not to contact valve with piston in the following steps.

NOTE:

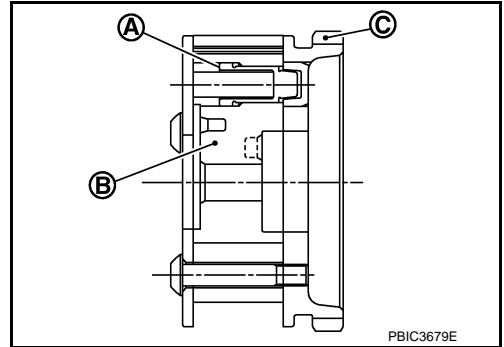
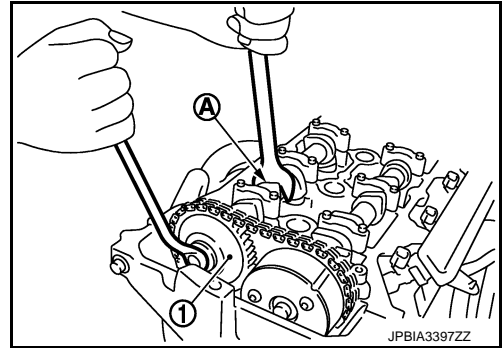
The timing chain with the front cover installed is not disengaged from the crankshaft sprocket and it is not dropped into the front cover. Therefore, the timing chain tension holding device is not necessary.

6. Turn the camshaft sprocket (INT) to the most advanced position.

CAUTION:

Installation and removal of the camshaft sprocket (INT) must be done in the most advanced position for the following reasons, so check that you follow the procedure exactly.

- The sprocket (C) and vane (camshaft coupling) (B) are designed to spin and move within the range of a certain angle.
- With the engine stopped and the vane in the most retarded angle, it will not spin because it is locked to the sprocket side by the internal lock pin (A).
- If the camshaft sprocket mounting bolts are turned in the situation described above, the lock pin will become damaged and cause malfunctions because of the increased horizontal load (cutting force) on the lock pin.

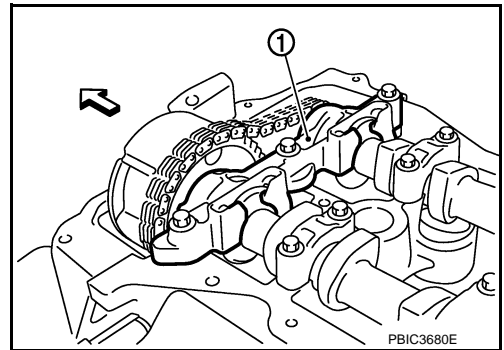


- Put the camshaft sprocket (INT) in the most advance position with the following procedure.

- a. Remove camshaft bracket (No. 1) (1).

↶ : Engine front

- Loosen the bolts in several steps, and then remove them.



CAMSHAFT

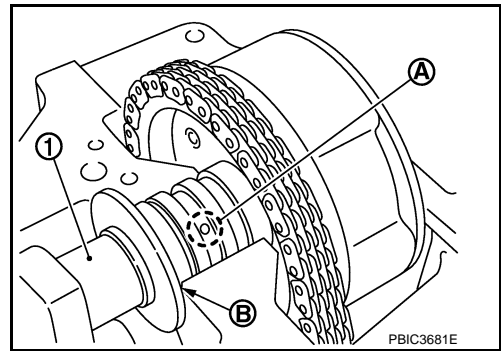
< REMOVAL AND INSTALLATION >

[HR12DE]

- b. Apply the following air pressure to the No. 1 journal oil hole (A) of camshaft (INT) (1) shown in the figure using an air gun.

Pressure : 300 kPa (3.0 bar, 3.1 kg/cm², 44psi) or more

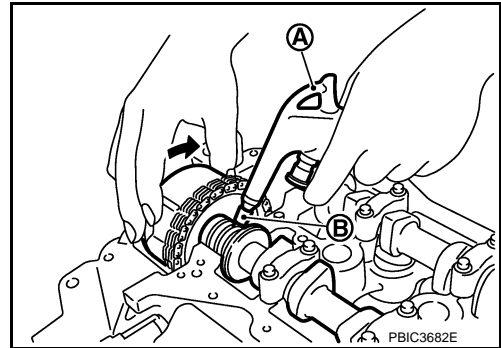
- Apply the air pressure into the oil hole on the second groove from the front of camshaft thrust (B).
- Proceed all the way through step “e” with the air pressure on.



- Attach the rubber nozzle (B) narrowed to the top of the air gun (A) to prevent air leakage from the oil hole. Securely apply the air pressure to the oil hole.

CAUTION:

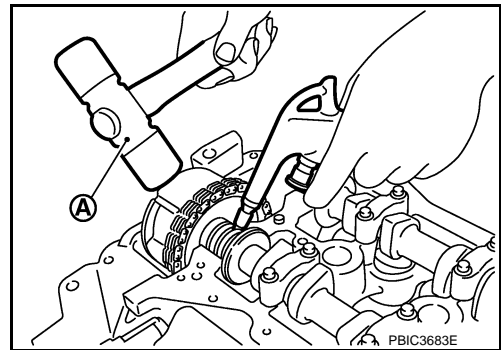
- There are other oil holes in the side grooves. Never use the incorrect oil holes.
- Be sure not to damage the oil path with the tip of the air gun.
- Wipe all the oil off the air gun to prevent oil from being blown all over along with the air, and the area around the air gun should be wiped with a rag when applying air pressure. Eye protection should be worn as needed.



NOTE:

The air pressure is used to move the lock pin into the disengage position.

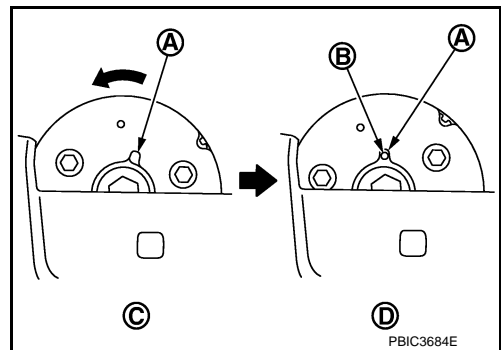
- c. Hold the camshaft sprocket (INT) with hands, and then apply the power counterclockwise/clockwise alternatively.
- Finally rotate the sprocket of the camshaft sprocket (INT) counterclockwise [the direction shown by the arrow (←)].
 - Perform the work while applying the air pressure to the oil hole.
 - If the lock pin is not released by hands, tap the camshaft sprocket (INT) lightly with a plastic hammer (A).
 - If the camshaft sprocket (INT) is not rotated counterclockwise even if the above procedures are performed, check the air pressure and the oil hole position.



- d. While doing the above, once you hear a click (the sound of the internal lock pin disengaging) from inside the camshaft sprocket (INT), start turning the camshaft sprocket (INT) in the counterclockwise direction in the most advanced angle position.

C : Lock pin engaged
D : Most advanced angle

- Keep the air pressure on.
- If there is no click, as soon as the vane-side (camshaft side) starts moving independently of the sprocket, the lock pin has become disengaged.
- Check that it is in the most advanced angle position by seeing if the stopper pin groove (A) and the stopper pin hole (B) are matched up as shown in the figure.



- e. Complete the applying procedure of air pressure and the holding procedure of camshaft (INT).

CAMSHAFT

[HR12DE]

< REMOVAL AND INSTALLATION >

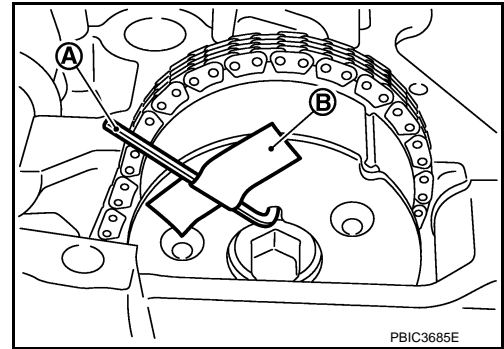
- f. Insert the stopper pin (A) into the stopper pin holes in the camshaft sprocket (INT) and lock in the most advanced angle position.

CAUTION:

No load is exerted on the stopper pin (spring reaction, etc.). Since it comes out easily, secure it with tape (B) to prevent it from coming out.

NOTE:

The stopper pin in the figure shows one example of a hexagonal wrench for 2.5 mm (0.098 in) [length of inserted section: approximately 15 mm (0.59 in)].

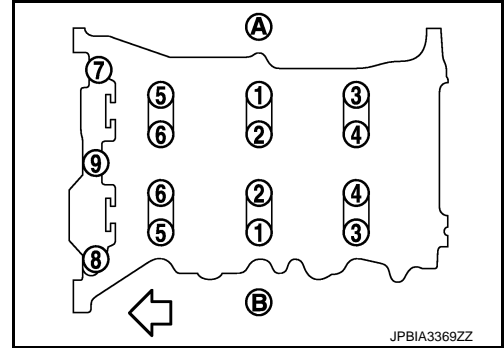


7. Remove camshaft brackets (No. 2 to 4).
 • Loosen bolts in several steps in the reverse of the order as shown in the figure.

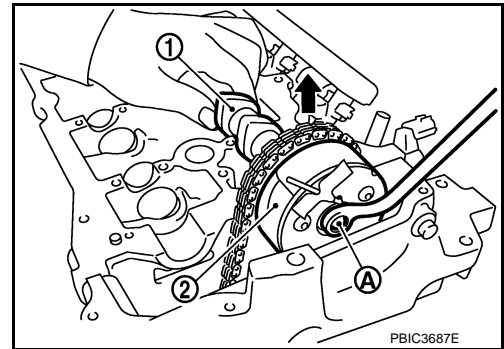
- A : EXH side
 B : INT side
 ⇐ : Engine front

NOTE:

The camshaft bracket (No. 1) has been already removed.

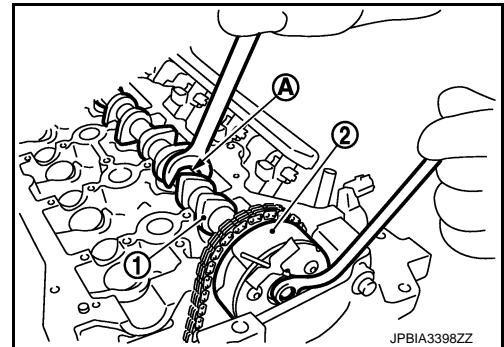


8. Remove camshaft (EXH).
 9. Remove the camshaft (INT) (1) and the camshaft sprocket (INT) (2) with the following procedure.
 a. Lift up the camshaft sprocket (INT), and then set the thin tools (a box wrench, etc.) to the mounting bolt (A).
 b. Return the camshaft (INT) to the cylinder head journal quietly.



- c. Keeping the camshaft hexagonal part (A) still with the wrench, loosen mounting the bolts for the camshaft sprocket (INT) (2).

1. Camshaft (INT)

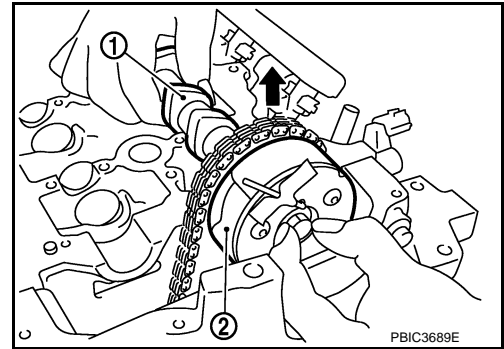


CAMSHAFT

[HR12DE]

< REMOVAL AND INSTALLATION >

- d. Lift up the camshaft (INT) (1), and then disassemble the camshaft from the camshaft sprocket (INT) (2).



- e. Remove camshaft (INT) rearward.

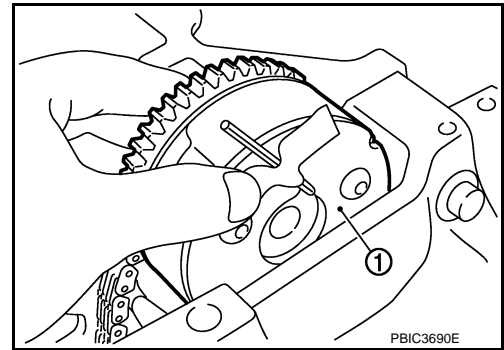
CAUTION:

Never damage the signal plate of rear end.

- f. Remove camshaft sprocket (INT) (1).

CAUTION:

Never drop stopper pin.

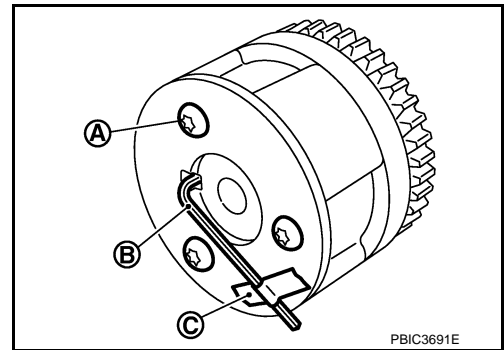


CAUTION:

- Tape (C) the stopper pin (B) so it does not come out.
- Never subject it to impact by dropping.
- Never disassemble. [Never loosen the three mounting bolts (A)].

NOTE:

While removing the camshaft sprocket (INT), if you have taken out the stopper pin and the lock pin has been rejoined in the most retarded angle, do the following to restore it.



- i. Install the camshaft (INT) and tighten the mounting bolts enough to prevent air from leaking out.

CAUTION:

The internal lock pin will get damaged, so keep the torque on the mounting bolts to the minimum required to prevent air from escaping.

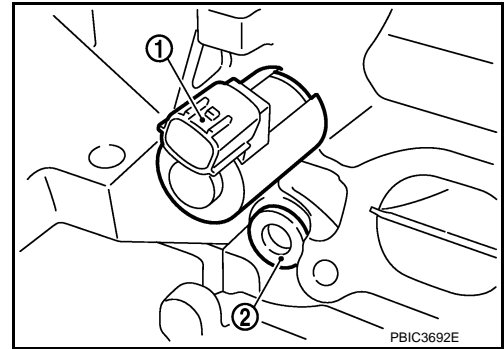
- Apply the air pressure, disengage the lock pin, and turn the vane to the most advanced angle position.
 - Insert the stopper pin.
 - Remove camshaft sprocket (INT) from the camshaft.
10. Remove valve lifter.
- Identify installation positions, and store them without mixing them up.

CAMSHAFT

< REMOVAL AND INSTALLATION >

[HR12DE]

11. Remove intake valve timing control solenoid valve (1).
12. Remove the alternator and bracket, remove the plug (2), and then remove the oil filter (for intake valve timing control solenoid valve). Refer to [CHG-36. "HR12DE : Removal and Installation"](#).

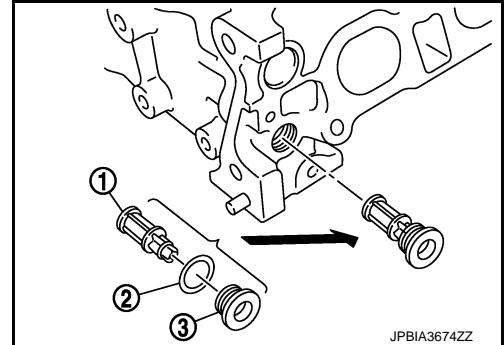


INSTALLATION

1. Install the oil filter (for intake valve timing control solenoid valve) (1).

2 : Washer

- The oil filter is assembled to the plug (3), and then install it to the cylinder head.

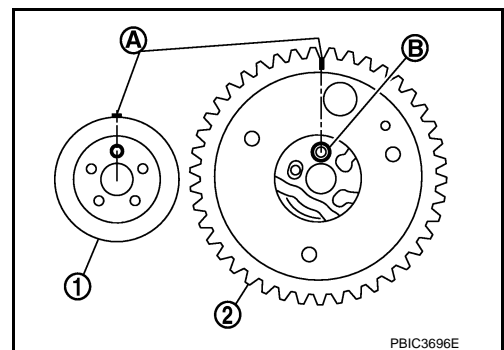


2. Install intake valve timing control solenoid valve.
 - Insert it straightly into the cylinder head.
 - Tighten bolts after placing it completely.
3. Install valve lifter.
 - If it is reused, install in its original positions.
4. Put a matching mark for positioning the camshaft (INT) and the camshaft sprocket (INT) with the following procedure.

NOTE:

It prevents the knock pin from engaging with the incorrect pin hole after installing the camshaft (INT) and the camshaft sprocket (INT).

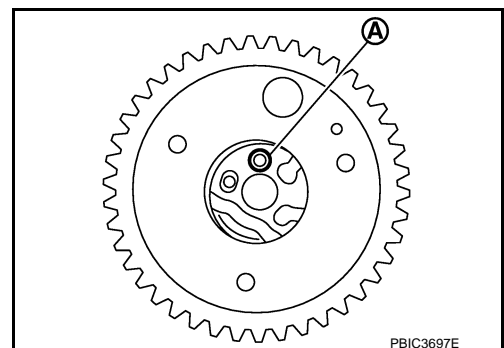
- a. Put the matching marks (A) on a line extending from the knock pin position of camshaft (INT) (1) front surface.
 - Put the marks on the visible position with the camshaft sprocket installed. (The figure shows an example.)
- b. Put the matching marks on a line extending from the knock pin hole (B) position of camshaft sprocket (INT) (2). (The figure shows an example.)
 - Put the marks on the visible position with it installed to the camshaft.



5. Set the camshaft sprocket (INT) to between cylinder head and front cover.
 - Set it with the knock pin hole (A) facing up.

CAUTION:

Check the stopper pin is inserted at the most advanced position beforehand.



CAMSHAFT

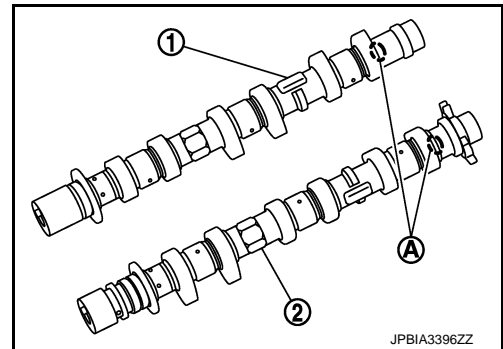
< REMOVAL AND INSTALLATION >

[HR12DE]

6. Install camshaft.

- 1 : Camshaft (EXH)
- 2 : Camshaft (INT)
- A : Identification mark

- Distinction between camshaft (INT and EXH) is performed with the different shapes of rear end.

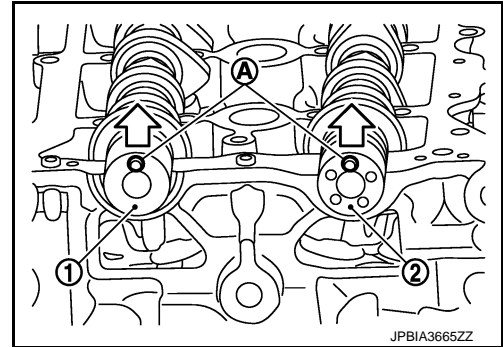


- Install camshafts to the cylinder head so that knock pins (A) on front end are positioned as shown in the figure.

- 1 : Camshaft (EXH)
- 2 : Camshaft (INT)
- ⇐ : Upper side

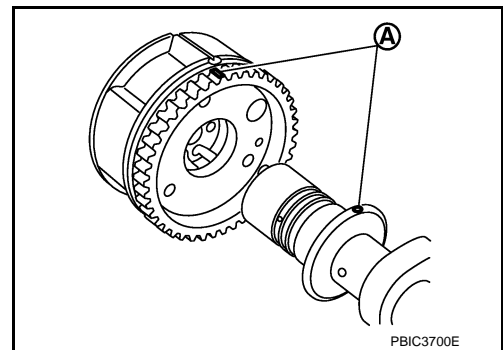
NOTE:

Though camshaft does not stop at the portion as shown in the figure, for the placement of cam nose, it is generally accepted camshaft is placed for the same direction of the figure.



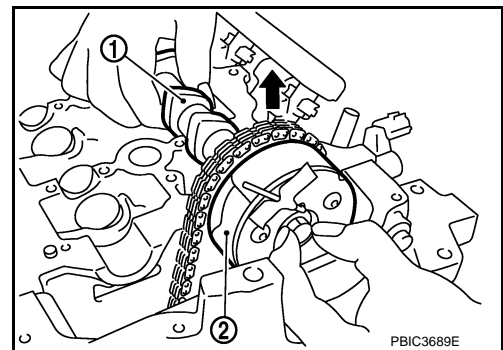
7. Install the camshaft sprocket (INT) to the camshaft (INT) with the following procedure.

- a. Refer to the matching mark (A) put according to step "4". Securely align the knock pin and the pin hole, and then install them.



- b. Lift up the front side of camshaft (INT) (1), and then temporarily tighten the bolt.

- 2 : Camshaft sprocket (INT)



CAMSHAFT

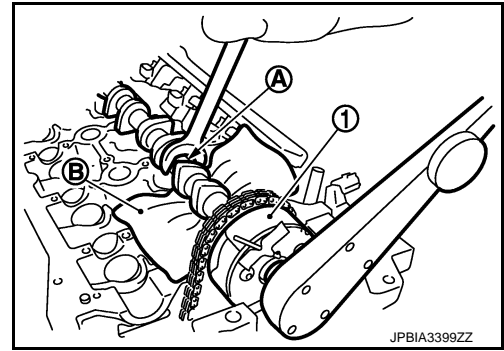
[HR12DE]

< REMOVAL AND INSTALLATION >

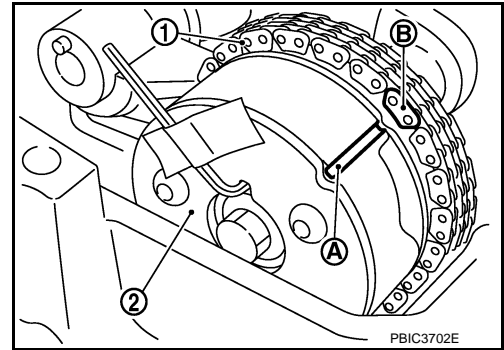
8. Put a thick shop cloth (B) to the lower surface, and then set the tools to the bolt while lifting up the front side of camshaft (INT) (1).
9. Tighten the mounting bolt.

CAUTION:

Hold the camshaft hexagonal part (A), and then secure the camshaft.



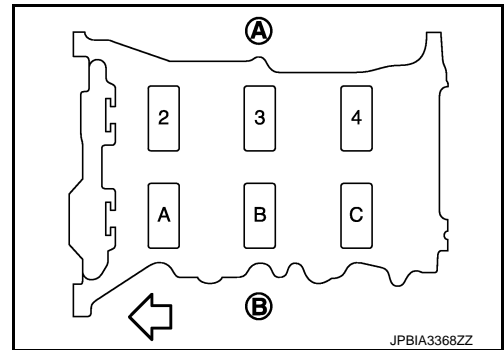
10. Return the camshaft (INT) to the cylinder head quietly.
11. Install timing chain (1) by aligning its matching mark (marked when timing chain is removed) (B) with matching mark (peripheral stamp line) (A) on camshaft sprocket (INT) (2).



12. Install camshaft brackets (No. 2 to 4) aligning the identification marks on upper surface as shown in the figure.

- A : EXH side
- B : INT side
- ⇐ : Engine front

- Install so that identification mark can be correctly read when viewed from the INT side.



13. Tighten mounting bolts of camshaft brackets in the following steps, in numerical order as shown in the figure.

- A : EXH side
- B : INT side
- ⇐ : Engine front

- a. Tighten No. 7 to 9 in numerical order.

: 2.0 N·m (0.2 kg·m, 1 ft·lb)

- b. Tighten No. 1 to 6 in numerical order.

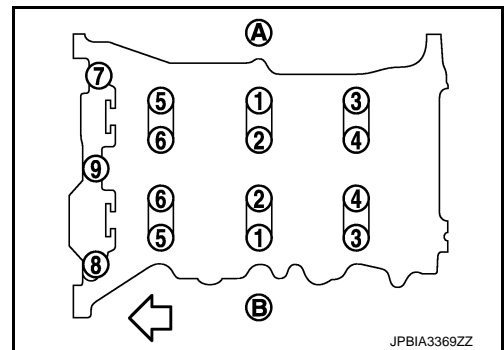
: 2.0 N·m (0.2 kg·m, 1 ft·lb)

- c. Tighten all bolts in numerical order.

: 5.9 N·m (0.6 kg·m, 4 ft·lb)

- d. Tighten all bolts in numerical order.

: 10.4 N·m (1.1 kg·m, 8 ft·lb)



CAMSHAFT

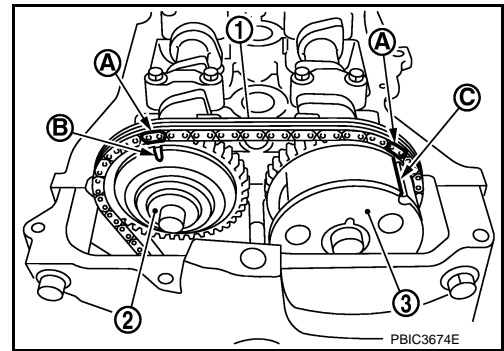
[HR12DE]

< REMOVAL AND INSTALLATION >

14. Install the camshaft (EXH) to the camshaft sprocket (EXH) (2) while aligning the matching mark (marked when timing chain is removed) (A) and the matching mark (stamp) (B) of camshaft sprocket (EXH).

- 1 : Timing chain
- 3 : Camshaft sprocket (INT)
- C : Matching mark (peripheral stamp line)

- If the positions of knock pin and pin groove are not aligned, move the camshaft (EXH) slightly to correct these positions.

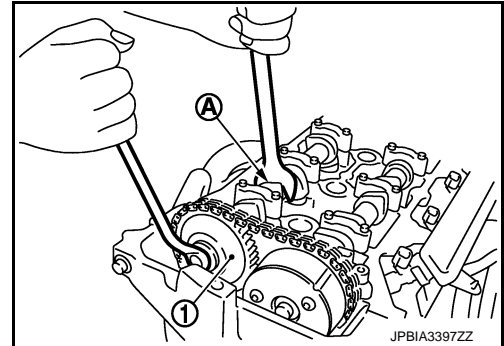


15. Tighten the mounting bolt.

- 1 : Camshaft sprocket (EXH)

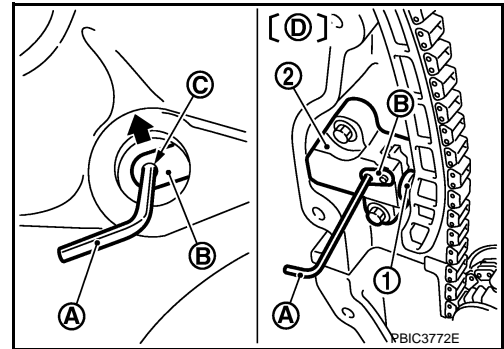
CAUTION:

- Hold the camshaft hexagonal part (A), and then secure the camshaft.
- Check that the matching mark (marked when timing chain is removed) and each camshaft sprocket matching mark are in the correct location.

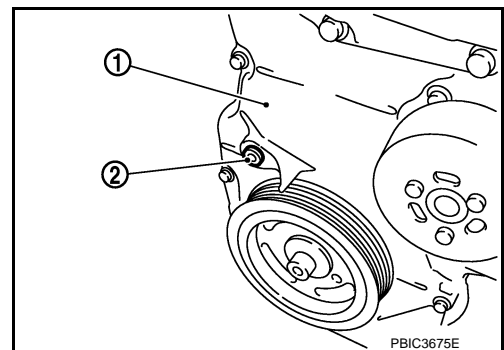


16. Pull out the stopper pin (A), and then apply the tension to the timing chain by rotating the crankshaft pulley clockwise slightly.

- 1 : Plunger
- 2 : Chain tensioner (for timing chain)
- B : Lever
- C : Lever hole
- D : Front cover has been omitted



17. Install the plug (2) to the front cover (1).
- Apply liquid gasket to the threads, and tighten them.
- Use Genuine Liquid Gasket or equivalent.**



18. Return the camshaft sprocket (INT) in the most retarded position with the following procedure.

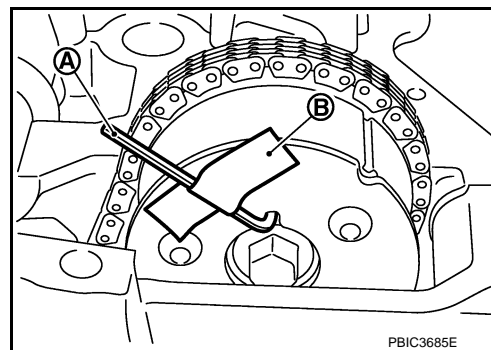
CAMSHAFT

[HR12DE]

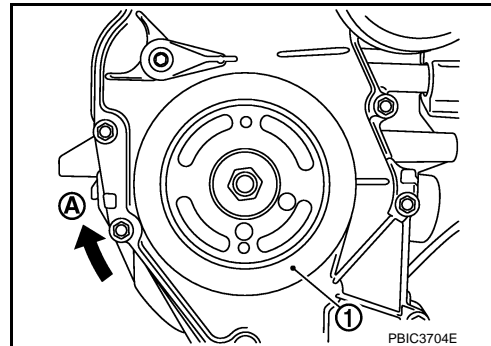
< REMOVAL AND INSTALLATION >

- a. Remove the stopper pin (A) from the camshaft sprocket (INT).

B : Tape



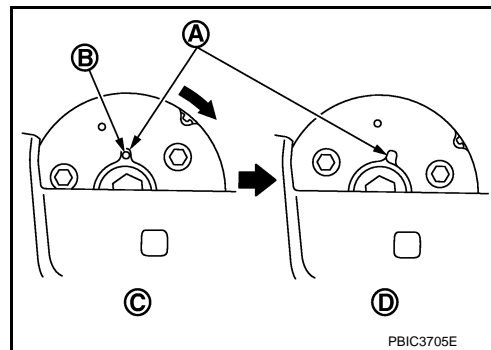
- b. Turn the crankshaft pulley (1) slowly clockwise (A) and return the camshaft sprocket (INT) to the most retarded angle position.



- When first turning the crankshaft the camshaft sprocket (INT) will turn. Once it is turned more, and the vane (camshaft) also turns, then it has reached the most retarded angle position.

B : Stopper pin hole
C : Most advanced angle
D : Lock pin engaged

- The most retarded angle position can be checked by seeing if the stopper pin groove (A) is shifted clockwise.
- After spinning the crankshaft slightly in the counterclockwise direction, you can check the lock pin has joined by seeing if the vane (camshaft) and the sprocket move together.



19. Check and adjust valve clearance. Refer to [EM-17. "Inspection and Adjustment"](#).

20. Install in the reverse order of removal.

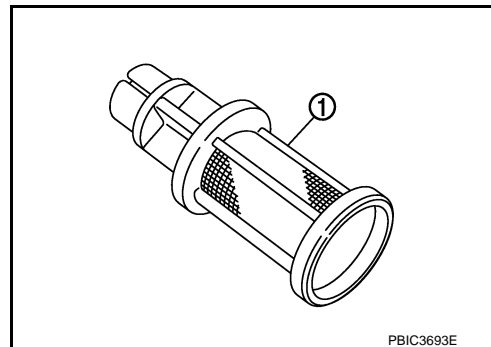
TYPE 1 : Inspection

INFOID:000000005988197

INSPECTION AFTER REMOVAL

Oil Filter

- Check that there is no foreign material on the oil filter (1) and check it for clogging.
- Check the oil (for intake valve timing control solenoid valve) filter for damage.
- If there is some damage, replace the oil filter (for intake valve timing control solenoid valve), the plug, and the washer as a set.



Camshaft Runout

CAMSHAFT

[HR12DE]

< REMOVAL AND INSTALLATION >

1. Put V-block on a precise flat table, and support No. 2 and 4 journals of camshaft.

CAUTION:

Never support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other three locations.

2. Set a dial indicator vertically to No. 3 journal.
3. Turn camshaft to one direction with hands, and measure the camshaft runout on the dial indicator. (Total indicator reading)

Standard and Limit

: Refer to [EM-150, "Camshaft"](#).

4. If it exceeds the limit, replace camshaft.

Camshaft Cam Height

1. Measure the camshaft cam height with a micrometer (A).

Standard and Limit

Intake

Exhaust

: Refer to [EM-150, "Camshaft"](#).

2. If wear exceeds the limit, replace camshaft.

Camshaft Journal Oil Clearance

CAMSHAFT JOURNAL DIAMETER

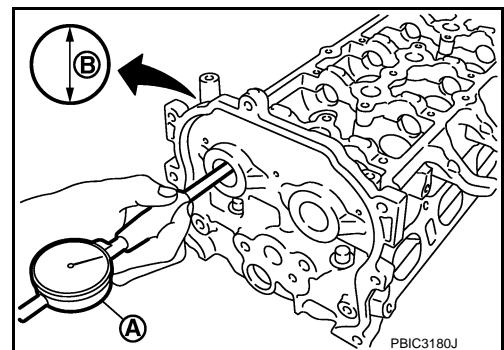
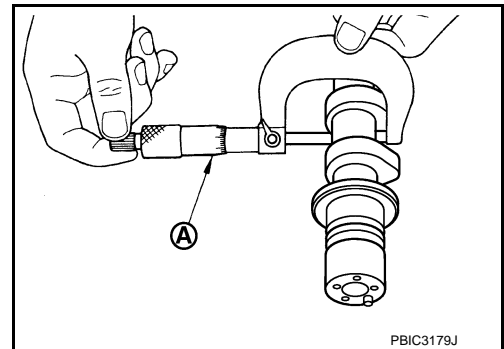
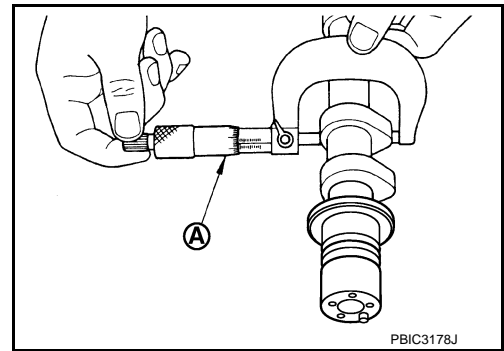
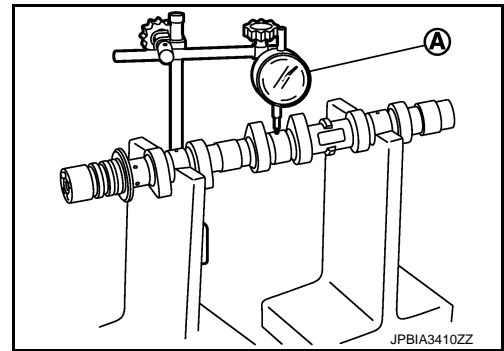
Measure the outer diameter of camshaft journal with a micrometer (A).

Standard: : Refer to [EM-150, "Camshaft"](#).

CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolts with the specified torque. Refer to "INSTALLATION" for the tightening procedure.
- Measure inner diameter (B) of camshaft bracket with a bore gauge (A).

Standard : Refer to [EM-150, "Camshaft"](#).



CAMSHAFT JOURNAL OIL CLEARANCE

CAMSHAFT

[HR12DE]

< REMOVAL AND INSTALLATION >

- (Oil clearance) = (Camshaft bracket inner diameter) – (Camshaft journal diameter)

Standard and Limit : Refer to [EM-150, "Camshaft"](#).

- If it exceeds the limit, replace either or both camshaft and cylinder head.

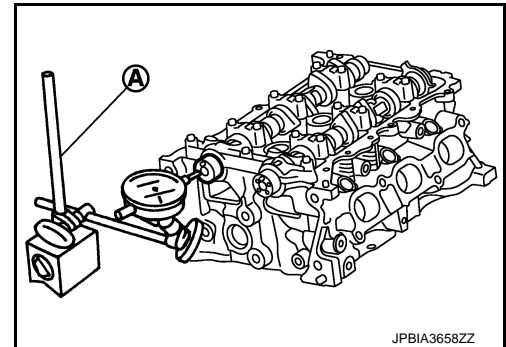
NOTE:

Camshaft brackets cannot be replaced as single parts, because they are machined together with cylinder head. Replace whole cylinder head assembly.

Camshaft End Play

1. Install camshaft in cylinder head. Refer to [EM-73, "TYPE 1 : Removal and Installation"](#) for tightening procedure.
2. Install a dial indicator (A) in thrust direction on front end of camshaft. Measure the camshaft end play on the dial indicator when camshaft is moved forward/backward (in direction to axis).

Standard and Limit : Refer to [EM-150, "Camshaft"](#).



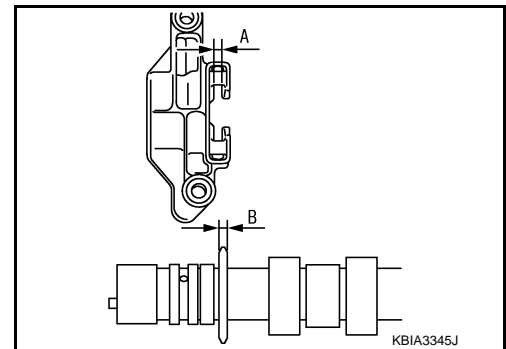
- Measure the following parts if out of the standard.
 - Dimension "A" for cylinder head No. 1 journal bearing

Standard : 4.000 - 4.030 mm (0.1574 - 0.1586 in)

- Dimension "B" for camshaft thrust

Standard : 3.877 - 3.925 mm (0.1526 - 0.1545 in)

- Refer to the standards above, and then replace camshaft and/or cylinder head.



Camshaft Sprocket Runout

1. Put V-block on precise flat table, and support No. 2 and 5 journals of camshaft.

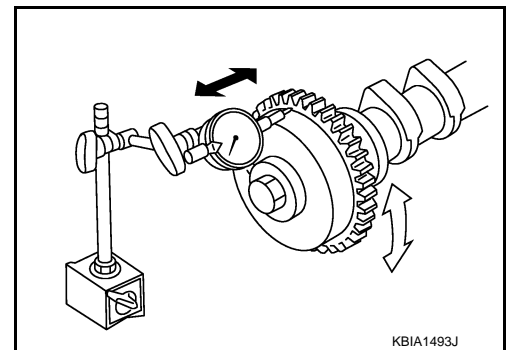
CAUTION:

Never support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other four locations.

2. Measure the camshaft sprocket runout with a dial indicator. (Total indicator reading)

Limit : 0.15 mm (0.0059 in)

- If it exceeds the limit, replace camshaft sprocket.



Valve Lifter

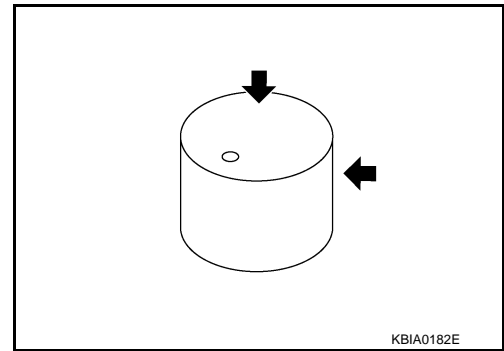
CAMSHAFT

[HR12DE]

< REMOVAL AND INSTALLATION >

Check if surface of valve lifter has any wear or cracks.

- If anything above is found, replace valve lifter. Refer to [EM-150, "Camshaft"](#).

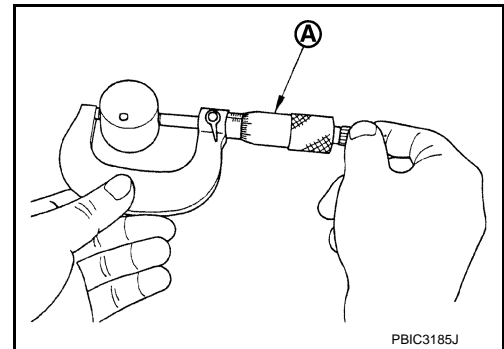


Valve Lifter Clearance

VALVE LIFTER OUTER DIAMETER

- Measure the outer diameter of valve lifter with a micrometer (A).

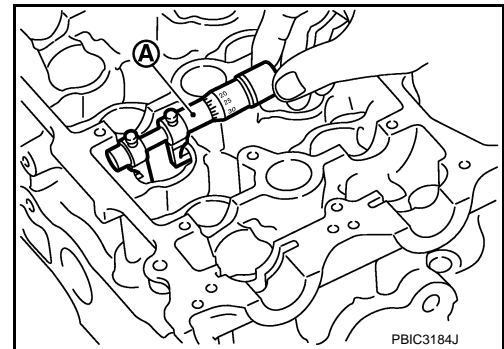
Standard : Refer to [EM-150, "Camshaft"](#).



VALVE LIFTER HOLE DIAMETER

Measure the diameter of valve lifter hole of cylinder head with an inside micrometer (A).

Standard : Refer to [EM-150, "Camshaft"](#).



VALVE LIFTER CLEARANCE

- (Valve lifter clearance) = (Valve lifter hole diameter) – (Valve lifter outer diameter)

Standard : Refer to [EM-150, "Camshaft"](#).

- If out of the standard, referring to the each standard of valve lifter outer diameter and valve lifter hole diameter, replace either or both valve lifter and cylinder head.

INSPECTION AFTER INSTALLATION

Valve clearance

Check and adjust valve clearance. Refer to [EM-17, "Inspection and Adjustment"](#).

Inspection for Leaks

The following are procedures for checking fluids leak, lubricates leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-19, "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
 - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

CAMSHAFT

< REMOVAL AND INSTALLATION >

[HR12DE]

NOTE:

If hydraulic pressure inside timing chain tensioner drops after removal/installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to check there is no leakage of fuel, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

Items		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leakage	Level
Engine oil		Level	Leakage	Level
Transmission / transaxle fluid	AT & CVT Models	Leakage	Level / Leakage	Leakage
	MT Models	Level / Leakage	Leakage	Level / Leakage
Other oils and fluids*		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gases		—	Leakage	—

*: Power steering fluid, brake fluid, etc.

Inspection of Camshaft Sprocket (INT) Oil Groove

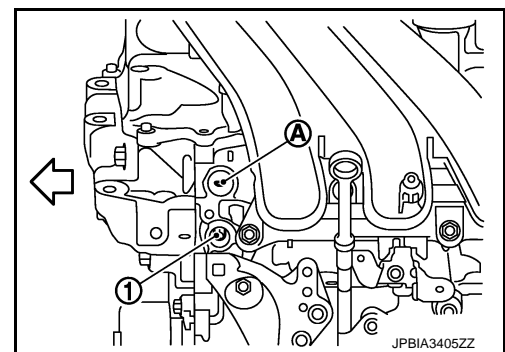
CAUTION:

- Perform this inspection only when DTC P0011 is detected in self-diagnostic results of CONSULT-III and it is directed according to inspection procedure of EC section. Refer to [EC-217, "DTC Logic"](#).
- Check when engine is cold so as to prevent burns from the splashing engine oil.

1. Check engine oil level. Refer to [LU-6, "Inspection"](#).
2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.
 - a. Release the fuel pressure. Refer to following;
 - HR12DE (TYPE 1): [EC-179, "Work Procedure"](#)
 - b. Remove intake manifold. Refer to [EM-36, "TYPE 1 : Exploded View"](#).
 - c. Disconnect ignition coil and injector harness connectors. Refer to [EM-58, "Exploded View"](#).
3. Remove intake valve timing control solenoid valve. Refer to [EM-73, "TYPE 1 : Exploded View"](#).
4. Crank engine, and then check that engine oil comes out from intake valve timing control solenoid valve hole (A). End crank after checking.

1 : Plug

← : Engine front



WARNING:

Be careful not to touch rotating parts (drive belts, idler pulley, and crankshaft pulley, etc.).

CAUTION:

- Prevent splashing by using a shop cloth so as to prevent the worker from injury from engine oil and so as to prevent engine oil contamination.
 - Prevent splashing by using a shop cloth so as to prevent engine oil from being splashed to engine and vehicle. Especially, be careful not to apply engine oil to rubber parts of drive belts, engine mounting insulator, etc. Wipe engine oil off immediately if it is splashed.
5. Perform the following inspection if engine oil does not come out from intake valve timing control solenoid valve oil hole of the cylinder head.
 - Remove oil filter, and then clean it. Refer to [LU-9, "Removal and Installation"](#).
 - Clean oil groove between oil strainer and intake valve timing control solenoid valve. Refer to [LU-5, "Engine Lubrication System"](#).
 6. Remove components between intake valve timing control solenoid valve and camshaft sprocket (INT), and then check each oil groove for clogging.

CAMSHAFT

< REMOVAL AND INSTALLATION >

[HR12DE]

- Clean oil groove if necessary. Refer to [LU-5. "Engine Lubrication System"](#).

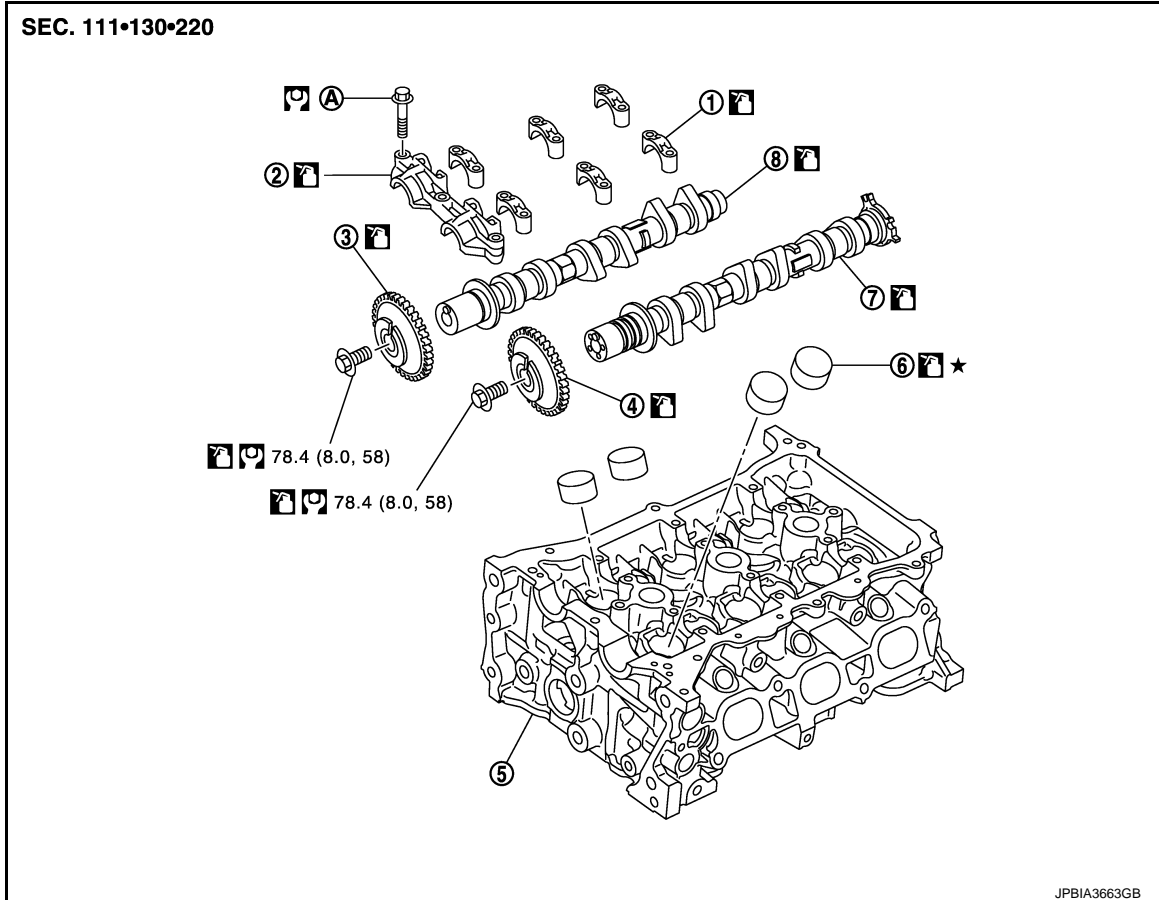
7. After inspection, install removed parts in the reverse order.

TYPE 2

TYPE 2 : Exploded View

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EM



- | | | |
|----------------------------------|-----------------------------|----------------------------|
| 1. Camshaft bracket (No. 2 to 4) | 2. Camshaft bracket (No. 1) | 3. Camshaft sprocket (EXH) |
| 4. Camshaft sprocket (INT) | 5. Cylinder head | 6. Valve lifter |
| 7. Camshaft (INT) | 8. Camshaft (EXH) | |

Comply with the assembly procedure when tightening. Refer to [EM-89](#).

: N-m (kg-m, ft-lb)

: Should be lubricated with oil.

★ : Select with proper thickness.

TYPE 2 : Removal and Installation

INFOID:000000006095138

CAUTION:

The rotation direction indicated in the text indicates all directions seen from the engine front direction.

REMOVAL

NOTE:

This section describes the procedure for removal and installation of camshaft with front cover. If the front cover is removed first, change the following procedure.

CAMSHAFT

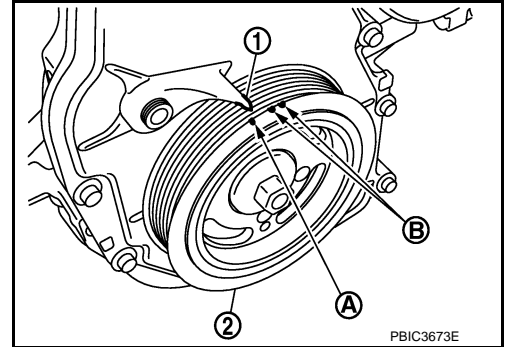
< REMOVAL AND INSTALLATION >

[HR12DE]

- Step 6 : After camshaft sprocket is removed, remove the camshaft brackets (No. 2 to 4).
- Step 7 : The camshaft (EXH) can be removed simultaneously with the camshaft (INT).
- Step 8 : When the camshaft sprocket (INT) mounting bolt is removed, the lifting up of camshaft is not necessary.

1. Support the bottom surface of engine using a transmission jack, and then remove the engine mounting insulator (RH). Refer to [EM-113, "Exploded View"](#).
2. Remove rocker cover. Refer to [EM-58, "Exploded View"](#).
3. Place cylinder No. 1 at TDC with the following procedure.
 - a. Rotate crankshaft pulley (2) clockwise and align TDC mark (without paint mark) (A) to timing indicator (1) on front cover.

B : White paint mark (Not use for service)



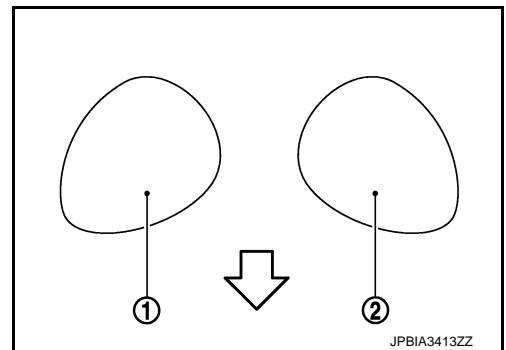
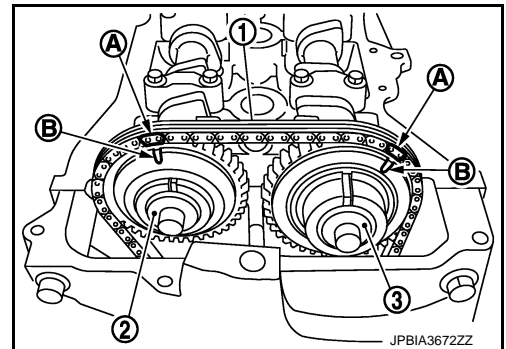
- b. Check that the matching marks on each camshaft sprocket are in the position as shown in the figure.

- 1. : Timing chain
- 2. : Camshaft sprocket (EXH)
- 3. : Camshaft sprocket (INT)
- A : Matching mark (Paint)
- B : Matching mark (Stamp)

- If the matching marks are not in place, rotate crankshaft pull one more turn to satisfy the position shown in figure.

- c. Check that the cam nose of No.1 cylinder is positioned as shown in the figure.

- 1. : Camshaft (EXH)
- 2. : Camshaft (INT)
- ⇐ : Cylinder head side



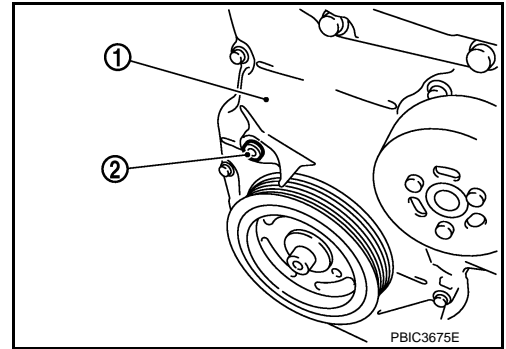
- d. Paint matching marks on the timing chain links
 4. Secure the plunger of chain tensioner (for timing chain) in the fully compressed position with the following procedure. And then, loosen the timing chain tension.

CAMSHAFT

< REMOVAL AND INSTALLATION >

[HR12DE]

- a. Remove the plug (2) from the front cover (1).



- b. Fully push down the lever (B) of chain tensioner (for timing chain) (2) from the plug hole, and then insert the stopper pin (A) into the body side hole and secure the lever at the lowest position.

C : Front cover has been omitted

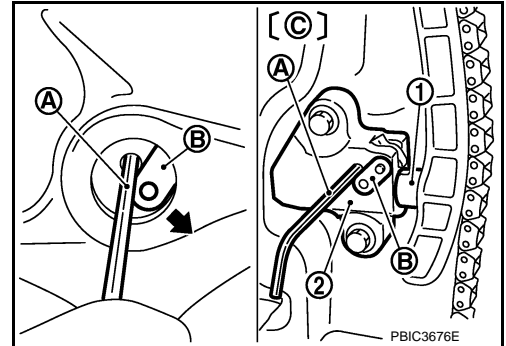
- The tab is released by fully pushing the lever down. As a result, the plunger (1) can be moved.

NOTE:

Hexagonal wrench [2.5 mm (0.098 in)] is used for a stopper pin as an example.

CAUTION:

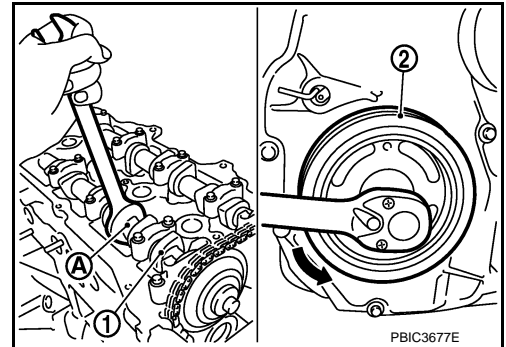
The stopper pin must use a shape that cannot fall in the front cover when dropping out.



- c. Turn the crankshaft pulley (2) counterclockwise with the camshaft (EXH) (1) fixing. Apply the tension to the timing chain, and then push the plunger of into the inside of chain tensioner (for timing chain).

CAUTION:

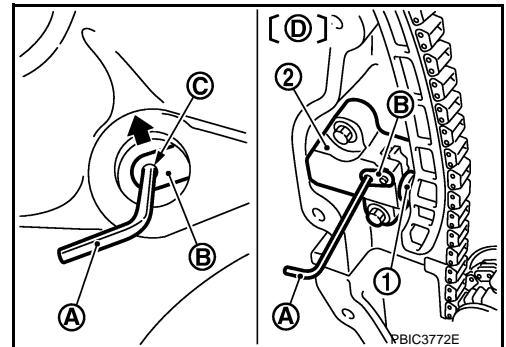
Hold the camshaft hexagonal part (A), and then secure the camshaft.



- d. Pull out the stopper pin (A) of chain tensioner (for timing chain) (2) side from plug hole. Lift the lever (B) up to align its hole position with the hole of the body.

D : Front cover has been omitted

- When the lever hole (C) is aligned with the body hole position, the plunger (1) is fixed.
- When the protrusion parts of the plunger ratchet and the tab face each other, both hole positions are not aligned. At that time, correctly engage them and align these hole positions by slightly moving the plunger.



- e. Insert the stopper pin into the body hole through the lever hole, and then fix the lever at the upper position.

CAMSHAFT

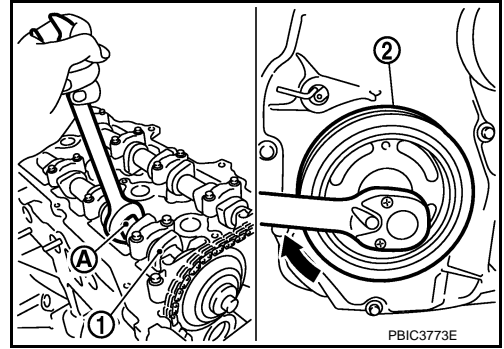
[HR12DE]

< REMOVAL AND INSTALLATION >

- f. Slightly rotate the crankshaft pulley (2) clockwise to loosen the timing chain on camshaft sprocket (EXH) (1) side.

CAUTION:

Hold the camshaft hexagonal part (A), and then secure the camshaft.



5. Remove camshaft sprocket (EXH) (1).

CAUTION:

- Hold the camshaft hexagonal part (A), and then secure the camshaft.
- Never rotate crankshaft and camshaft separately, so as not to contact valve with piston in the following steps.

NOTE:

The timing chain with the front cover installed is not disengaged from the crankshaft sprocket and it is not dropped into the front cover. Therefore, the timing chain tension holding device is not necessary.

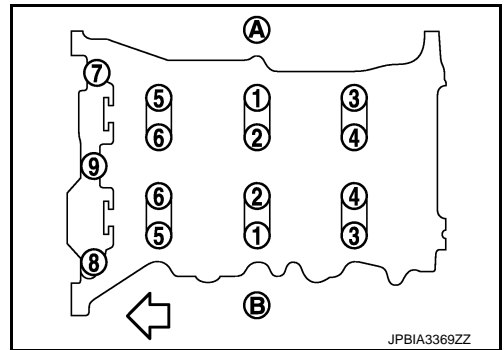
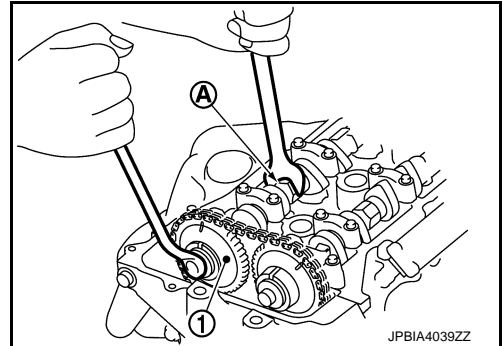
6. Remove camshaft brackets (No. 2 to 4).

- Loosen bolts in several steps in the reverse of the order as shown in the figure.

A : EXH side

B : INT side

← : Engine front



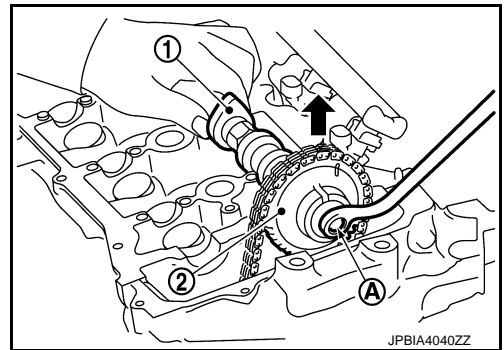
NOTE:

The camshaft bracket (No. 1) has been already removed.

7. Remove camshaft (EXH).

8. Remove the camshaft (INT) (1) and the camshaft sprocket (INT) (2) with the following procedure.

- Lift up the camshaft sprocket (INT), and then set the thin tools (a box wrench, etc.) to the mounting bolt (A).
- Return the camshaft (INT) to the cylinder head journal quietly.



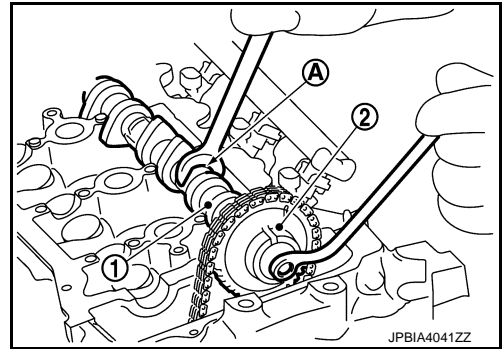
CAMSHAFT

< REMOVAL AND INSTALLATION >

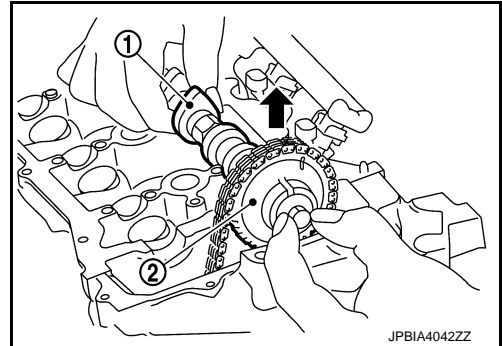
[HR12DE]

- c. Keeping the camshaft hexagonal part (A) still with the wrench, loosen mounting the bolts for the camshaft sprocket (INT) (2).

1. Camshaft (INT)



- d. Lift up the camshaft (INT) (1), and then disassemble the camshaft from the camshaft sprocket (INT) (2).



- e. Remove camshaft (INT) rearward.

CAUTION:
Never damage the signal plate of rear end.

- f. Remove camshaft sprocket (INT).

9. Remove valve lifter.

- Identify installation positions, and store them without mixing them up.

INSTALLATION

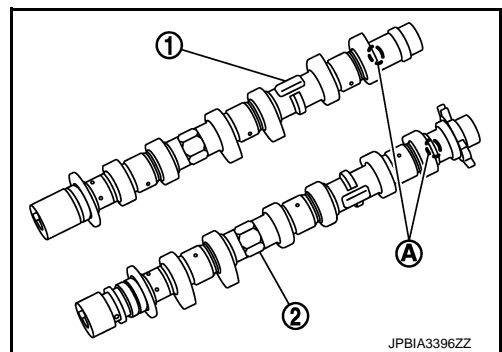
1. Install valve lifter.

- If it is reused, install in its original positions.

2. Install camshaft.

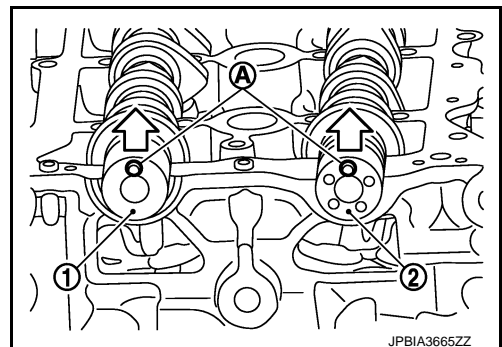
- 1 : Camshaft (EXH)
2 : Camshaft (INT)
A : Identification mark

- Distinction between camshaft (INT and EXH) is performed with the different shapes of rear end.



- Install camshafts to the cylinder head so that knock pins (A) on front end are positioned as shown in the figure.

- 1 : Camshaft (EXH)
2 : Camshaft (INT)
⇐ : Upper side



NOTE:

Though camshaft does not stop at the portion as shown in the figure, for the placement of cam nose, it is generally accepted camshaft is placed for the same direction of the figure.

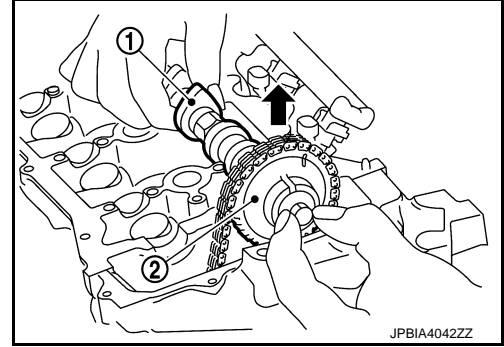
CAMSHAFT

[HR12DE]

< REMOVAL AND INSTALLATION >

3. Install the camshaft sprocket (INT) to the camshaft (INT) with the following procedure.
 - a. Lift up the front side of camshaft (INT) (1), and then temporarily tighten the bolt.

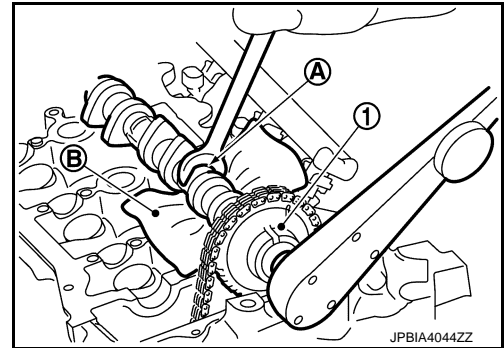
2 : Camshaft sprocket (INT)



4. Put a thick shop cloth (B) to the lower surface, and then set the tools to the bolt while lifting up the front side of camshaft (INT) (1).
5. Tighten the mounting bolt.

CAUTION:

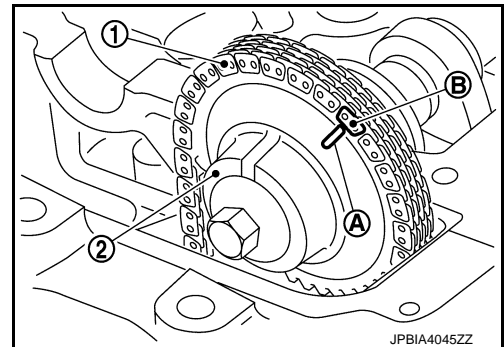
Hold the camshaft hexagonal part (A), and then secure the camshaft.



6. Return the camshaft (INT) to the cylinder head quietly.
7. Install timing chain (1) by aligning its matching mark (marked when timing chain is removed) (B) with matching mark (stamp line) (A) on camshaft sprocket (INT) (2).

NOTE:

The above exploded view shows type 1 as an example.



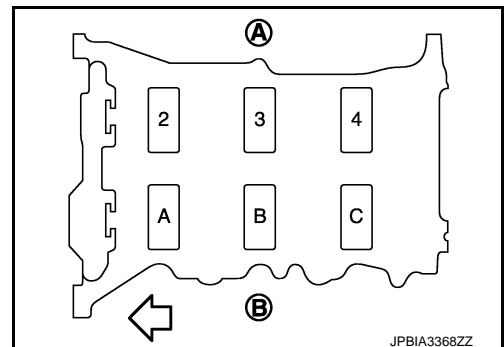
8. Install camshaft brackets (No. 2 to 4) aligning the identification marks on upper surface as shown in the figure.

A : EXH side

B : INT side

← : Engine front

- Install so that identification mark can be correctly read when viewed from the INT side.




CAMSHAFT

[HR12DE]

< REMOVAL AND INSTALLATION >

9. Tighten mounting bolts of camshaft brackets in the following steps, in numerical order as shown in the figure.

A : EXH side
 B : INT side
 : Engine front

- a. Tighten No. 7 to 9 in numerical order.

: **2.0 N·m (0.2 kg·m, 1 ft·lb)**


- b. Tighten No. 1 to 6 in numerical order.

: **2.0 N·m (0.2 kg·m, 1 ft·lb)**

- c. Tighten all bolts in numerical order.

: **5.9 N·m (0.6 kg·m, 4 ft·lb)**

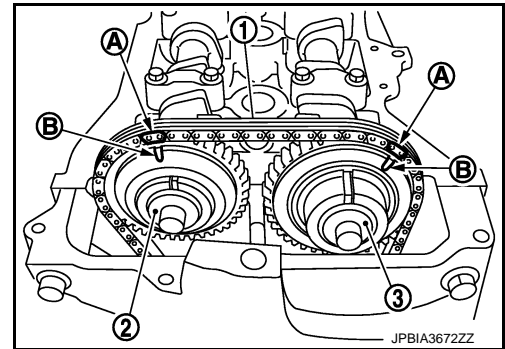
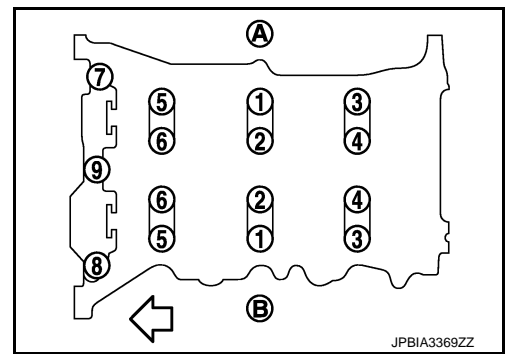
- d. Tighten all bolts in numerical order.

: **10.4 N·m (1.1 kg·m, 8 ft·lb)**

10. Install the camshaft (EXH) to the camshaft sprocket (EXH) (2) while aligning the matching mark (marked when timing chain is removed) (A) and the matching mark (stamp) (B) of camshaft sprocket (EXH).

1 : Timing chain
 3 : Camshaft sprocket (INT)

- If the positions of knock pin and pin groove are not aligned, move the camshaft (EXH) slightly to correct these positions.

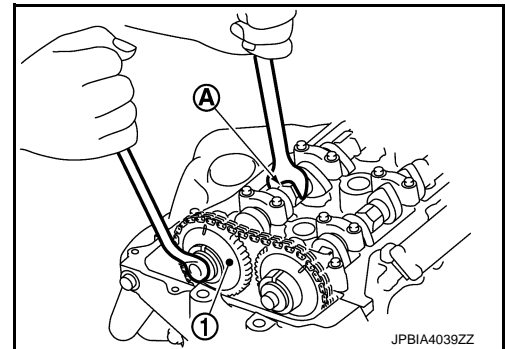


11. Tighten the mounting bolt.

1 : Camshaft sprocket (EXH)

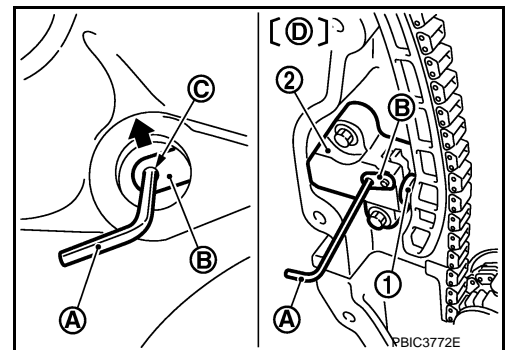
CAUTION:

- Hold the camshaft hexagonal part (A), and then secure the camshaft.
- Check that the matching mark (marked when timing chain is removed) and each camshaft sprocket matching mark are in the correct location.



12. Pull out the stopper pin (A), and then apply the tension to the timing chain by rotating the crankshaft pulley clockwise slightly.

1 : Plunger
 2 : Chain tensioner
 B : Lever
 C : Lever hole
 D : Front cover has been omitted



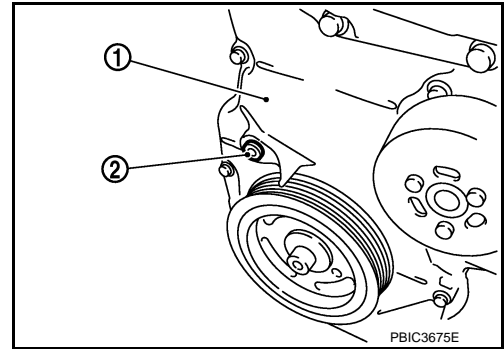
A
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 N
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 P

CAMSHAFT

[HR12DE]

< REMOVAL AND INSTALLATION >

13. Install the plug (2) to the front cover (1).
 - Apply liquid gasket to the threads, and tighten them.**Use Genuine Liquid Gasket or equivalent.**



14. Install the camshaft position sensor (PHASE) to the rear end of cylinder head.
 - Tighten bolts with it seated completely.
15. Check and adjust valve clearance. Refer to [EM-17. "Inspection and Adjustment"](#).
16. Install in the reverse order of removal.

TYPE 2 : Inspection

INFOID:000000006095139

INSPECTION AFTER REMOVAL

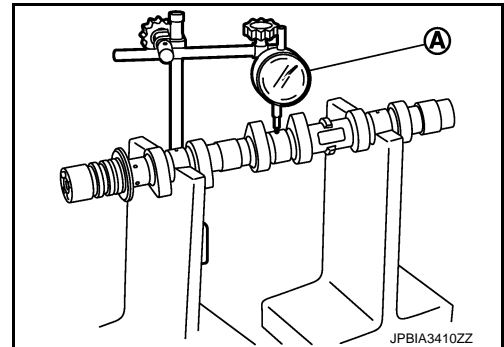
Camshaft Runout

1. Put V-block on a precise flat table, and support No. 2 and 4 journals of camshaft.

CAUTION:

Never support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other three locations.

2. Set a dial indicator vertically to No. 3 journal.
3. Turn camshaft to one direction with hands, and measure the camshaft runout on the dial indicator. (Total indicator reading)



Standard and Limit

: Refer to [EM-150. "Camshaft"](#).

4. If it exceeds the limit, replace camshaft.

Camshaft Cam Height

1. Measure the camshaft cam height with a micrometer (A).

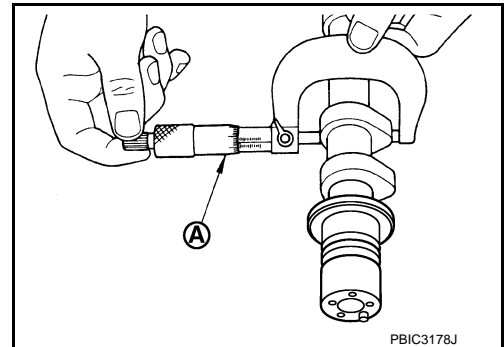
Standard and Limit

Intake

Exhaust

: Refer to [EM-150. "Camshaft"](#).

2. If wear exceeds the limit, replace camshaft.



Camshaft Journal Oil Clearance

CAMSHAFT JOURNAL DIAMETER

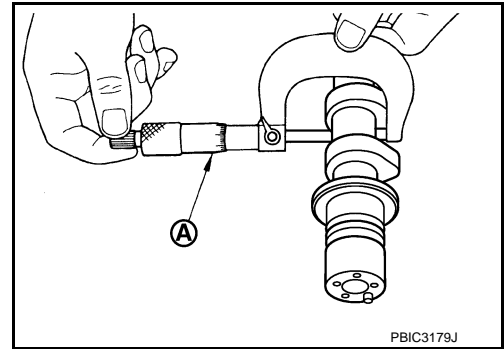
CAMSHAFT

[HR12DE]

< REMOVAL AND INSTALLATION >

Measure the outer diameter of camshaft journal with a micrometer (A).

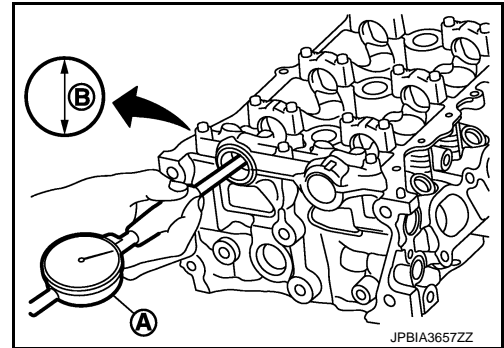
Standard: : Refer to [EM-150, "Camshaft"](#).



CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolts with the specified torque. Refer to "INSTALLATION" for the tightening procedure.
- Measure inner diameter (B) of camshaft bracket with a bore gauge (A).

Standard : Refer to [EM-150, "Camshaft"](#).



CAMSHAFT JOURNAL OIL CLEARANCE

- (Oil clearance) = (Camshaft bracket inner diameter) – (Camshaft journal diameter)

Standard and Limit : Refer to [EM-150, "Camshaft"](#).

- If it exceeds the limit, replace either or both camshaft and cylinder head.

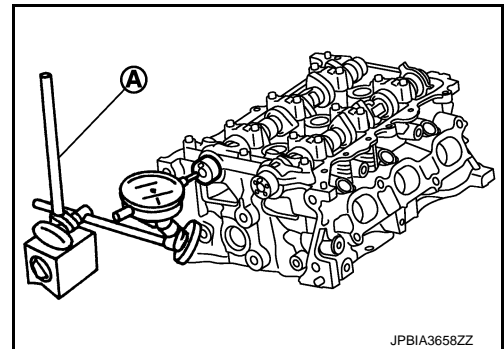
NOTE:

Camshaft brackets cannot be replaced as single parts, because they are machined together with cylinder head. Replace whole cylinder head assembly.

Camshaft End Play

1. Install camshaft in cylinder head. Refer to [EM-89, "TYPE 2 : Removal and Installation"](#) for tightening procedure.
2. Install a dial indicator (A) in thrust direction on front end of camshaft. Measure the camshaft end play on the dial indicator when camshaft is moved forward/backward (in direction to axis).

Standard and Limit : Refer to [EM-150, "Camshaft"](#).



CAMSHAFT

[HR12DE]

< REMOVAL AND INSTALLATION >

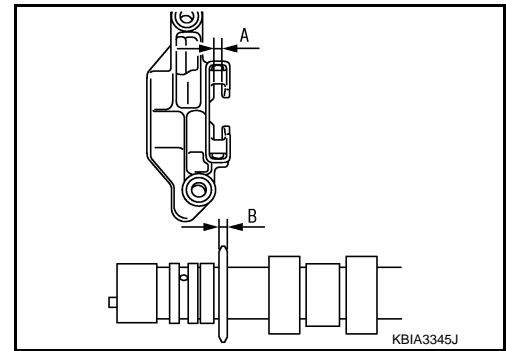
- Measure the following parts if out of the standard.
 - Dimension "A" for cylinder head No. 1 journal bearing

Standard : 4.000 - 4.030 mm (0.1574 - 0.1586 in)

- Dimension "B" for camshaft thrust

Standard : 3.877 - 3.925 mm (0.1526 - 0.1545 in)

- Refer to the standards above, and then replace camshaft and/or cylinder head.



Camshaft Sprocket Runout

1. Put V-block on precise flat table, and support No. 2 and 5 journals of camshaft.

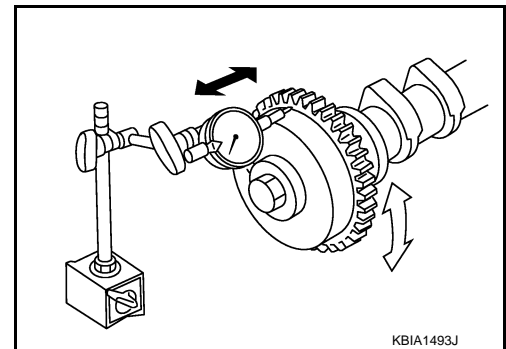
CAUTION:

Never support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other four locations.

2. Measure the camshaft sprocket runout with a dial indicator. (Total indicator reading)

Limit : 0.15 mm (0.0059 in)

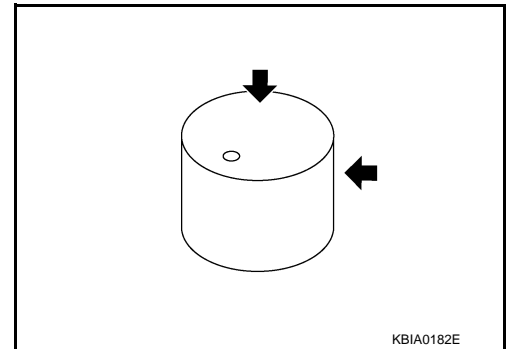
- If it exceeds the limit, replace camshaft sprocket.



Valve Lifter

Check if surface of valve lifter has any wear or cracks.

- If anything above is found, replace valve lifter. Refer to [EM-150, "Camshaft"](#).

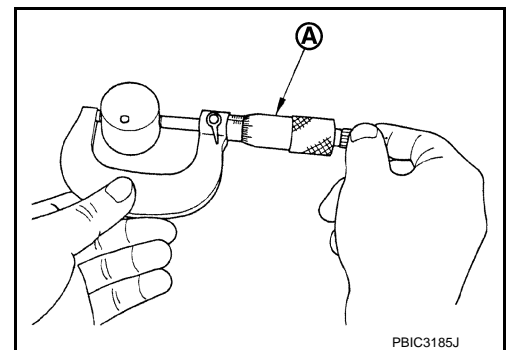


Valve Lifter Clearance

VALVE LIFTER OUTER DIAMETER

- Measure the outer diameter of valve lifter with a micrometer (A).

Standard : Refer to [EM-150, "Camshaft"](#).



VALVE LIFTER HOLE DIAMETER

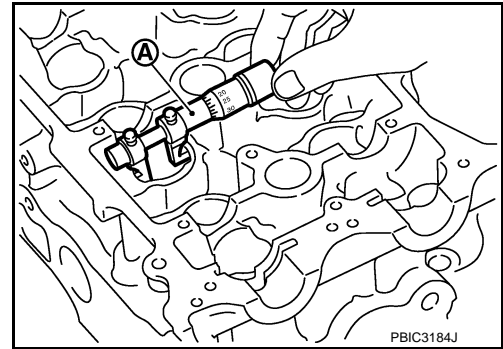
CAMSHAFT

< REMOVAL AND INSTALLATION >

[HR12DE]

Measure the diameter of valve lifter hole of cylinder head with an inside micrometer (A).

Standard : Refer to [EM-150, "Camshaft"](#).



VALVE LIFTER CLEARANCE

- (Valve lifter clearance) = (Valve lifter hole diameter) – (Valve lifter outer diameter)

Standard : Refer to [EM-150, "Camshaft"](#).

- If out of the standard, referring to the each standard of valve lifter outer diameter and valve lifter hole diameter, replace either or both valve lifter and cylinder head.

INSPECTION AFTER INSTALLATION

Valve clearance

Check and adjust valve clearance. Refer to [EM-17, "Inspection and Adjustment"](#).

Inspection for Leaks

The following are procedures for checking fluids leak, lubricates leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-19, "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
 - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

NOTE:

If hydraulic pressure inside timing chain tensioner drops after removal/installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to check there is no leakage of fuel, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

Items		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leakage	Level
Engine oil		Level	Leakage	Level
Transmission / transaxle fluid	AT & CVT Models	Leakage	Level / Leakage	Leakage
	MT Models	Level / Leakage	Leakage	Level / Leakage
Other oils and fluids*		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gases		—	Leakage	—

*: Power steering fluid, brake fluid, etc.

OIL SEAL VALVE OIL SEAL

VALVE OIL SEAL : Removal and Installation

INFOID:000000005988198

REMOVAL

1. Remove camshafts. Refer to [EM-73, "TYPE 1 : Exploded View"](#) (TYPE 1) or [EM-89, "TYPE 2 : Exploded View"](#) (TYPE 2).
2. Remove valve lifters. Refer to [EM-73, "TYPE 1 : Exploded View"](#) (TYPE 1) or [EM-89, "TYPE 2 : Exploded View"](#) (TYPE 2).
3. Rotate crankshaft, and set piston whose valve oil seal is to be removed to TDC. This will prevent valve from dropping into cylinder.

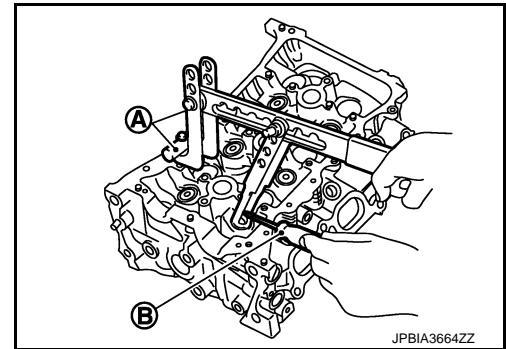
CAUTION:

When rotating crankshaft, be careful to avoid scarring front cover with timing chain.

4. Remove valve collet.
 - Compress valve spring with the valve spring compressor [SST: KV10116200] and the adapter [SST: KV10109220] (A). Remove valve collet with magnet hand (B).

CAUTION:

Be careful not to damage valve lifter holes.

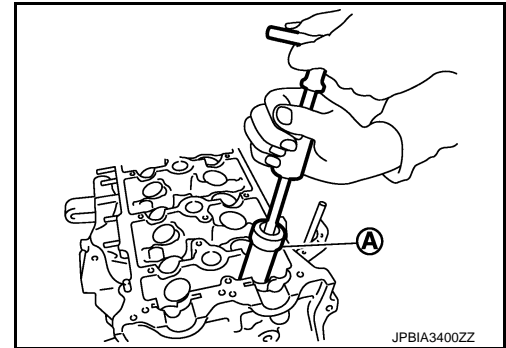


5. Remove valve spring retainer and valve spring (with valve spring seat).

CAUTION:

Never remove valve spring seat from valve spring.

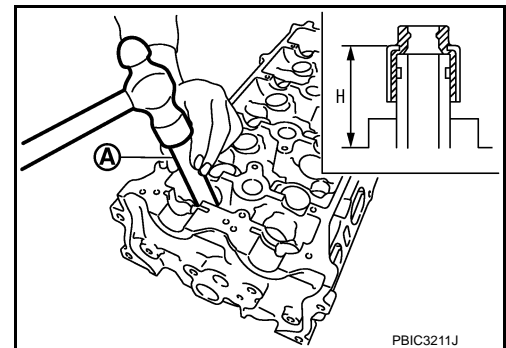
6. Remove valve oil seal with the valve oil seal puller [SST: KV10107902] (A).



INSTALLATION

1. Apply new engine oil to valve oil seal joint surface and seal lip.
2. Press in valve oil seal to the height (H) shown in the figure with the valve oil seal drift [SST: KV10115600] (A).

Height (H) : 13.2 - 13.8 mm (0.519 - 0.543 in)



3. Install in the reverse order of removal, for the rest of parts.

FRONT OIL SEAL

FRONT OIL SEAL : Removal and Installation

INFOID:000000005988199

REMOVAL

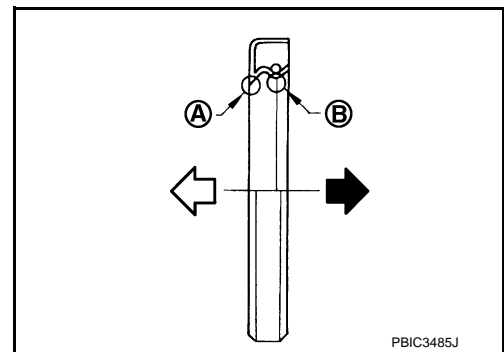
- Remove the following parts.
 - Front fender protector (RH): Refer to [EXT-20, "FENDER PROTECTOR : Exploded View"](#).
 - Drive belt: Refer to [EM-24, "Removal and Installation"](#).
 - Crankshaft pulley: Refer to [EM-61, "Exploded View"](#).
- Remove front oil seal with a suitable tool.

CAUTION:**Be careful not to damage front cover and crankshaft.**

INSTALLATION

- Apply new engine oil to new front oil seal joint surface and seal lip.
- Install front oil seal so that each seal lip is oriented as shown in the figure.

- A : Dust seal lip
 B : Oil seal lip
 ⇐ : Engine outside
 ⇨ : Engine inside



- Press-fit front oil seal using a suitable drift with outer diameter 50 mm (1.97 in) and inner diameter 44 mm (1.73 in).

CAUTION:

- Be careful not to damage front cover and crankshaft.**
- Press-fit oil seal straight to avoid causing burrs or tilting.**

- Install in the reverse order of removal, for the rest of parts.

REAR OIL SEAL

REAR OIL SEAL : Removal and Installation

INFOID:000000005988200

REMOVAL

- Remove transaxle assembly. Refer to [TM-35, "HR12DE : Removal and Installation"](#) (M/T models) or [TM-305, "Exploded View"](#). (A/T models) or [TM-551, "Exploded View"](#) (CVT models).
- Remove clutch cover and clutch disk (M/T models). Refer to [CL-25, "HR12DE : Removal and Installation"](#).
- Remove flywheel (M/T models) or drive plate (A/T models, CVT models). Refer to [EM-126, "Exploded View"](#).
- Remove rear oil seal with a suitable tool.

CAUTION:**Be careful not to damage crankshaft and cylinder block.**

INSTALLATION

- Apply the liquid gasket lightly to entire outside area of new rear oil seal.
Use Genuine Liquid Gasket or equivalent.

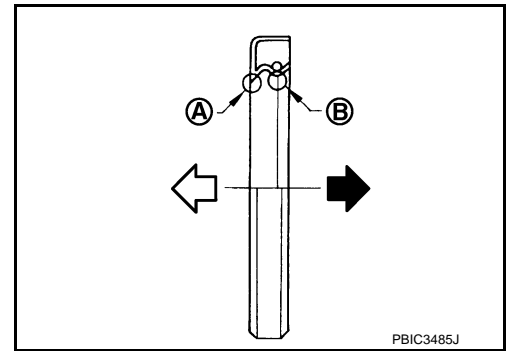
OIL SEAL

[HR12DE]

< REMOVAL AND INSTALLATION >

2. Install rear oil seal so that each seal lip is oriented as shown in the figure.

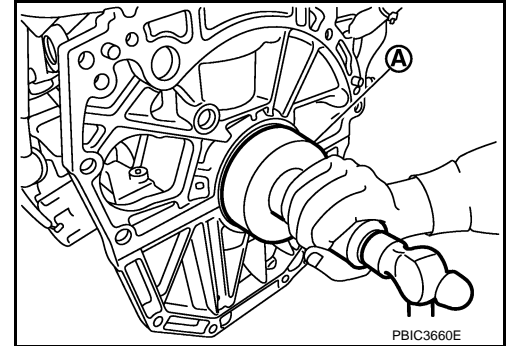
- A : Dust seal lip
- B : Oil seal lip
- ⇐ : Engine outside
- ➡ : Engine inside



- Press-fit rear oil seal with a suitable drift (A) outer diameter 113 mm (4.45 in) and inner diameter 90 mm (3.54 in).

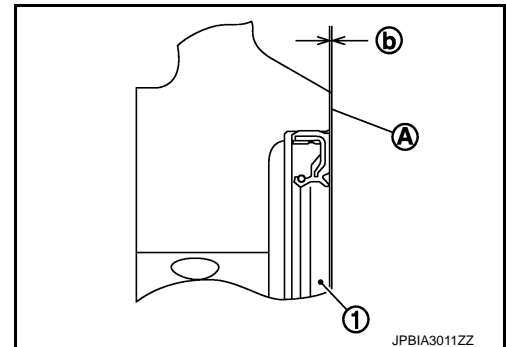
CAUTION:

- Be careful not to damage crankshaft and cylinder block.
- Press-fit oil seal straight to avoid causing burrs or tilting.
- Never touch grease applied onto oil seal lip.



- Press in rear oil seal (1) to the position as shown in the figure.

- A : Rear end surface of cylinder block
- b : 0 - 0.5 mm (0 - 0.020 in)



3. Install in the reverse order of removal, for the rest of parts.

CYLINDER HEAD

< REMOVAL AND INSTALLATION >

[HR12DE]

CYLINDER HEAD

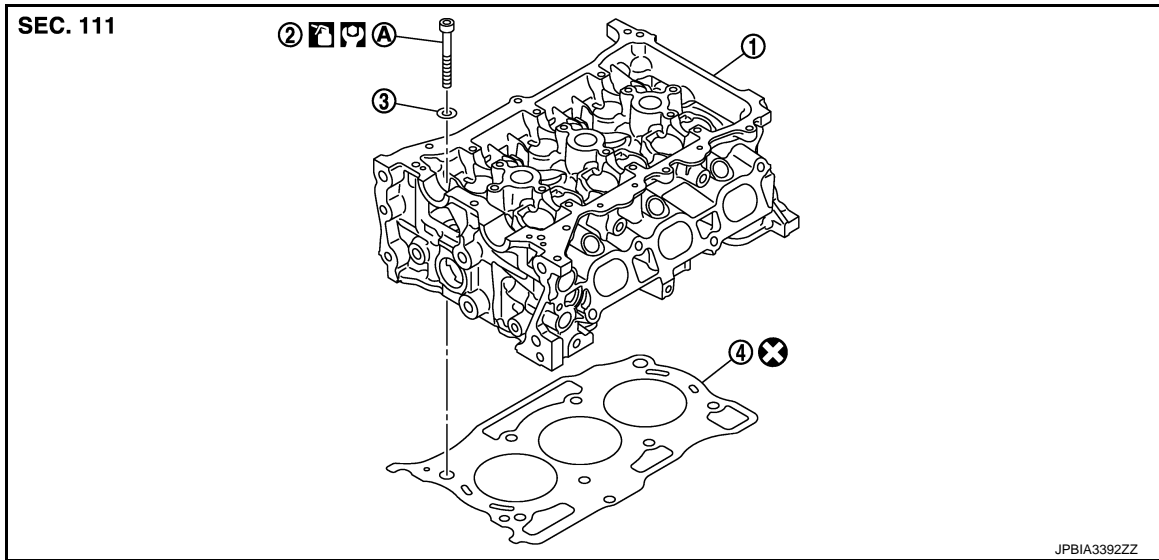
Exploded View

INFOID:000000005988201

REMOVAL

A

EM



1. Cylinder head assembly
 2. Cylinder head bolt
 3. Washer
 4. Cylinder head gasket
- A. Comply with the assembly procedure when tightening. Refer to [EM-104](#).

: N·m (kg-m, ft-lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

DISASSEMBLY

C

D

E

F

G

H

I

J

K

L

M

N

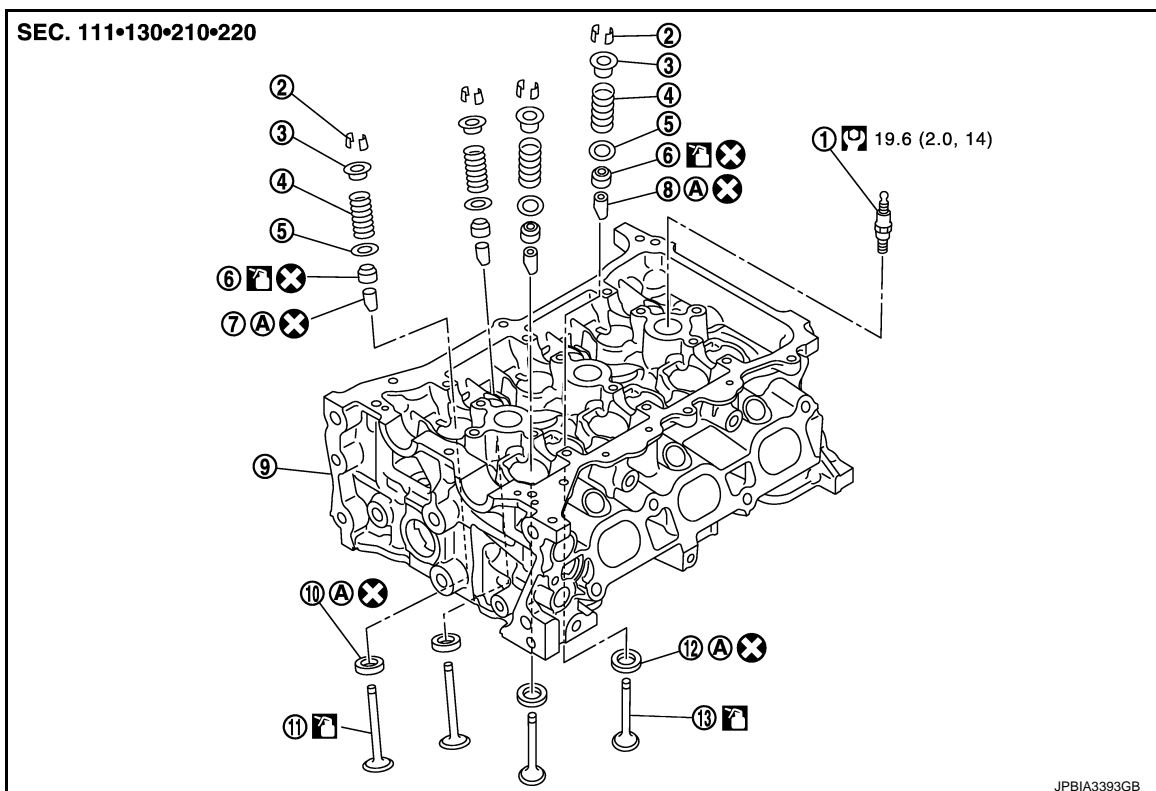
O

P

CYLINDER HEAD

< REMOVAL AND INSTALLATION >

[HR12DE]



- | | | |
|----------------------|----------------------|--------------------------|
| 1. Spark plug | 2. Valve collet | 3. Valve spring retainer |
| 4. Valve spring | 5. Valve spring seat | 6. Valve oil seal |
| 7. Valve guide (EXH) | 8. Valve guide (INT) | 9. Cylinder head |
| 10. Valve seat (EXH) | 11. Valve (EXH) | 12. Valve seat (INT) |
| 13. Valve (INT) | | |

Replacement must be following the

- A. disassembly and assembly procedure. Refer to [EM-106](#)

: N·m (kg·m, ft·lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

Removal and Installation

INFOID:000000005988202

REMOVAL

- Release fuel pressure. Refer to following;
 - HR12DE (TYPE 1): [EC-179, "Work Procedure"](#)
 - HR12DE (TYPE 2): [EC-579, "Work Procedure"](#)
- Drain engine coolant and engine oil. Refer to [CO-13, "Draining"](#) and [LU-7, "Draining"](#).
CAUTION:
Perform this step when the engine is cold.
- Remove the following components and related parts.
 - Front road wheel and tire (RH): Refer to [WT-6, "Removal and Installation"](#).
 - Front fender protector (RH): Refer to [EXT-20, "FENDER PROTECTOR : Exploded View"](#).
 - Drive belt: Refer to [EM-24, "Removal and Installation"](#).
 - Air duct: Refer to [EM-31, "TYPE 1 : Exploded View"](#) (Type 1) or [EM-32, "TYPE 2 : Exploded View"](#) (Type 2).
 - Intake manifold: Refer to [EM-36, "TYPE 1 : Exploded View"](#) (Type 1) or [EM-38, "TYPE 2 : Exploded View"](#) (Type 2).

CYLINDER HEAD

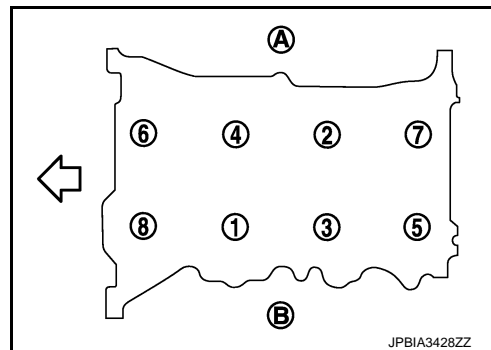
[HR12DE]

< REMOVAL AND INSTALLATION >

- Fuel tube and fuel injector: Refer to [EM-46, "FOR THAILAND PRODUCTION MODELS : Exploded View"](#) or [EM-51, "FOR INDIA PRODUCTION MODELS : Exploded View"](#).
- Water outlet: Refer to [CO-28, "Exploded View"](#).
- Exhaust manifold: Refer to [EX-5, "Exploded View"](#).
- Rocker cover, ignition coil and spark plug: Refer to [EM-58, "Exploded View"](#).
- Front cover and timing chain: Refer to [EM-61, "Exploded View"](#).
- Camshaft: Refer to [EM-73, "TYPE 1 : Exploded View"](#) (Type 1) or [EM-89, "TYPE 2 : Exploded View"](#) (Type 2).

4. Remove cylinder head loosening bolts in reverse order as shown in the figure with cylinder head wrench (commercial service tool).

- A : EXH side
- B : INT side
- ⇐ : Engine front



5. Remove cylinder head gasket.

INSTALLATION

1. Install new cylinder head gasket.
2. Tighten cylinder head bolts in numerical order as shown in the figure with the following procedure to install cylinder head.

- A : EXH side
- B : INT side
- ⇐ : Engine front

CAUTION:

If cylinder head bolts are reused, check their outer diameters before installation. Refer to "Cylinder Head Bolts Outer Diameter".

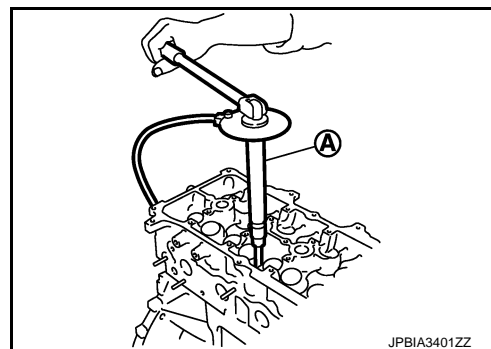
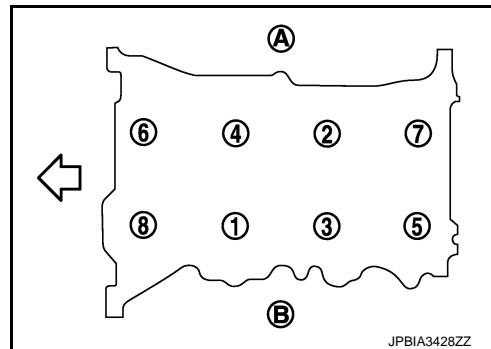
- a. Apply new engine oil to threads and seating surfaces of mounting bolts.
- b. Tighten all bolts.

: 40.0 N·m (4.1 kg-m, 30 ft-lb)

- c. Turn all bolts 60 degrees clockwise (angle tightening).

CAUTION:

Check and confirm the tightening angle by using the angle wrench [SST: KV10112100] (A) or protractor. Avoid judgment by visual inspection without the tool.



- d. Completely loosen.

: 0 N·m (0 kg-m, 0 ft-lb)

CYLINDER HEAD

< REMOVAL AND INSTALLATION >

[HR12DE]

CAUTION:

In this step, loosen bolts in reverse order of that indicated in the figure.

e. Tighten all bolts.

: 40.0 N·m (4.1 kg-m, 30 ft-lb)

- f. Turn all bolts 75 degrees clockwise (angle tightening).
- g. Turn all bolts 75 degrees clockwise again (angle tightening).
3. Install in the reverse order of removal after this step.

Disassembly and Assembly

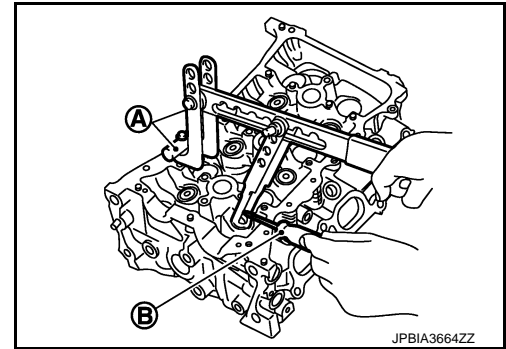
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DISASSEMBLY

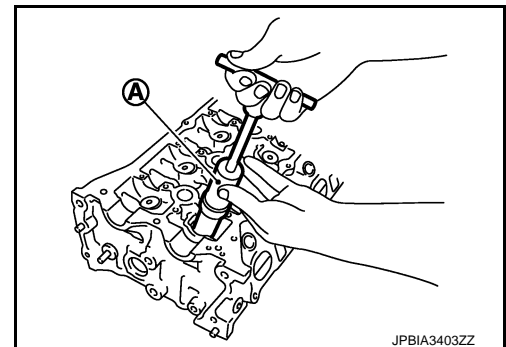
1. Remove spark plug with a spark plug wrench (commercial service tool).
2. Remove valve lifter.
 - Identify installation positions, and store them without mixing them up.
3. Remove valve collet.
 - Compress valve spring with the valve spring compressor, the attachment and the adapter [SST: KV10116200] (A). Remove valve collet with a magnet hand (B).

CAUTION:

When working, be careful not to damage valve lifter holes.



4. Remove valve spring retainer and valve spring.
5. Push valve stem to combustion chamber side, and remove valve.
 - Identify installation positions, and store them without mixing them up.
6. Remove valve oil seal with the valve oil seal puller [SST: KV10107902] (A).



7. Remove valve spring seat.
8. When valve seat must be replaced, refer to [EM-107, "Inspection"](#) to removal.
9. When valve guide must be replaced, refer to [EM-107, "Inspection"](#) to removal.

ASSEMBLY

1. Install valve guide if removed. Refer to [EM-107, "Inspection"](#).
2. Install valve seat if removed. Refer to [EM-107, "Inspection"](#).
3. Install valve oil seal.

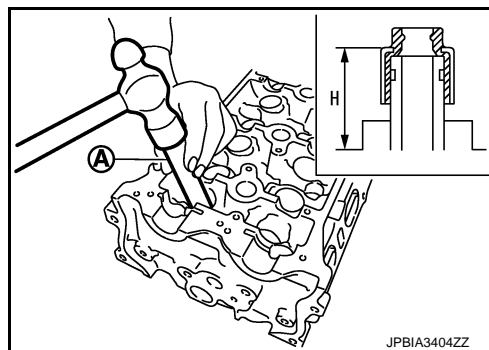
CYLINDER HEAD

< REMOVAL AND INSTALLATION >

[HR12DE]

- Install with the valve oil seal drift [SST: KV10115600] (A) to match dimension in the figure.

Height "H" : 13.2 - 13.8 mm (0.519 - 0.543 in)



4. Install valve spring seat.
5. Install valve.
 - Install larger diameter to intake side.
6. Install valve spring.

CAUTION:

The installation direction depends on engine specifications.

- Type 1 models
 - To install valve spring face the directions paint (yellow) upward.
- Type 2 models
 - It can be installed in either direction.

7. Install valve spring retainer.

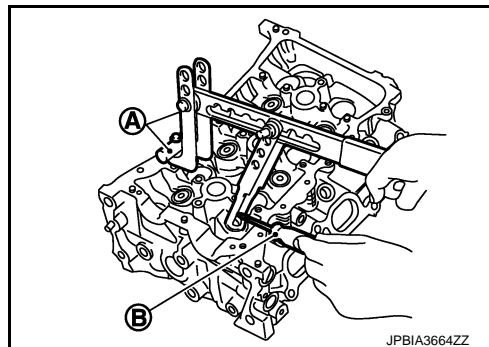
8. Install valve collet.

- Compress valve spring with the valve spring compressor, the attachment and the adapter [SST: KV10116200] (A). Install valve collet with a magnet hand (B).

CAUTION:

When working, be careful not to damage valve lifter holes.

- Tap valve stem edge lightly with a plastic hammer after installation to check its installed condition.



9. Install valve lifter.

10. Install spark plug with a spark plug wrench (commercial service tool).

Inspection

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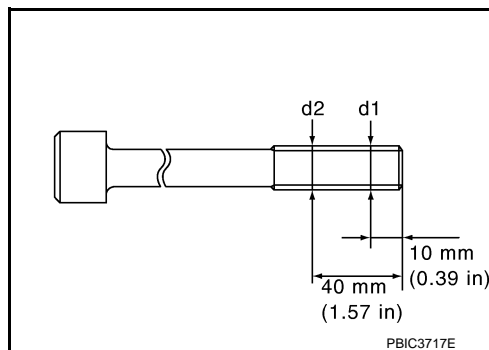
INSPECTION AFTER REMOVAL

Cylinder Head Bolts Outer Diameter

- Cylinder head bolts are tightened by plastic zone tightening method. Whenever the size difference between "d1" and "d2" exceeds the limit, replace them with a new one.

Limit ("d1"-"d2"): 0.15 mm (0.0059 in)

- If reduction of outer diameter appears in a position other than "d2", use it as "d2" point.



Cylinder Head Distortion

NOTE:

When performing this inspection, cylinder block distortion should be also checking.

CYLINDER HEAD

[HR12DE]

< REMOVAL AND INSTALLATION >

1. Wipe off engine oil and remove water scale (like deposit), gasket, sealant, carbon, etc. with a scraper.

CAUTION:

Use utmost care not to allow gasket debris to enter passages for engine oil or engine coolant.

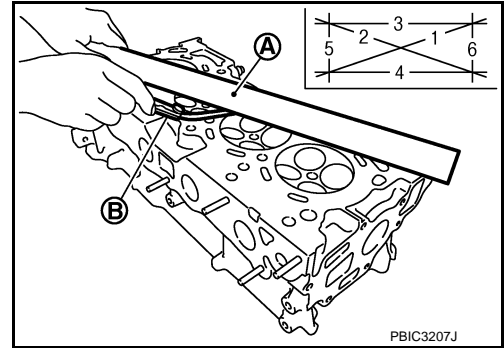
2. At each of several locations on bottom surface of cylinder head, measure the distortion in six directions.

A : Straightedge

B : Feeler gauge

Limit : Refer to [EM-151, "Cylinder head"](#).

- If it exceeds the limit, replace cylinder head.



INSPECTION AFTER DISASSEMBLY

VALVE DIMENSIONS

- Check the dimensions of each valve. For the dimensions, refer to [EM-151, "Cylinder head"](#).
- If dimensions are out of the standard, replace valve and check valve seat contact. Refer to "VALVE SEAT CONTACT".

VALVE GUIDE CLEARANCE

Valve Stem Diameter

- Measure the diameter of valve stem with micrometer (A).

Standard : Refer to [EM-151, "Cylinder head"](#).

Valve Guide Inner Diameter

- Measure the inner diameter of valve guide with bore gauge.

Standard : Refer to [EM-151, "Cylinder head"](#).

Valve Guide Clearance

- (Valve guide clearance) = (Valve guide inner diameter) – (Valve stem diameter)

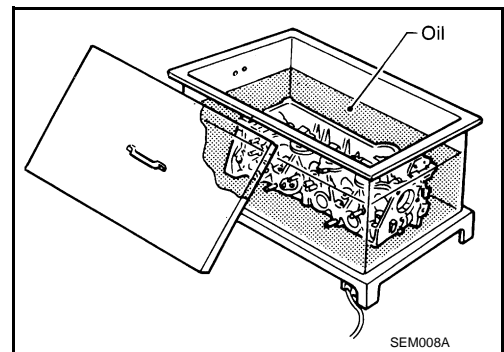
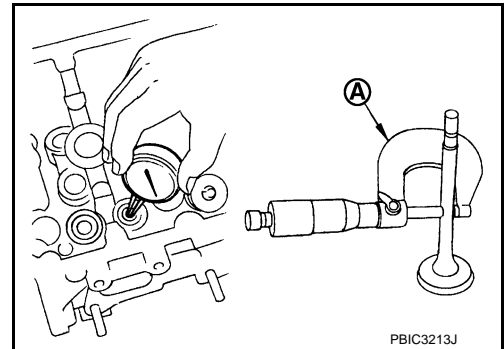
Standard and Limit : Refer to [EM-151, "Cylinder head"](#).

- If the calculated value exceeds the limit, replace valve and/or valve guide. When valve guide must be replaced. Refer to [EM-106, "Disassembly and Assembly"](#).

VALVE GUIDE REPLACEMENT

When valve guide is removed, replace with over sized [0.2mm (0.008in)] valve guide.

1. To remove valve guide, heat cylinder head to 110 to 130°C(230 to 266°F) by soaking in heated oil.



CYLINDER HEAD

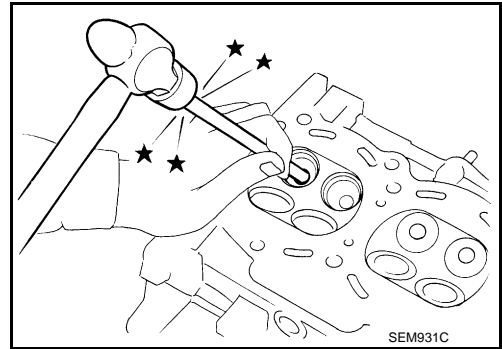
< REMOVAL AND INSTALLATION >

[HR12DE]

2. Drive out valve guide with a press [under a 20 kN (2 ton, 2.2US ton, 2.0 Imp ton) force] or hammer and valve guide drift (commercial service tool).

CAUTION:

Cylinder head contains heat, when working, wear protective equipment to avoid getting burned.

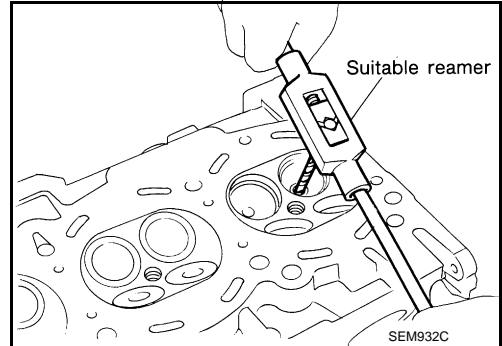


3. Ream cylinder head valve guide hole with a valve guide reamer (commercial service tool).

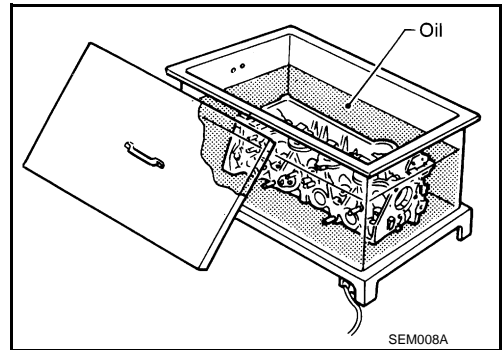
Valve guide hole diameter (for service parts):

Intake and exhaust

: 9.175 - 9.196 mm (0.3612 - 0.3620 in)



4. Heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.

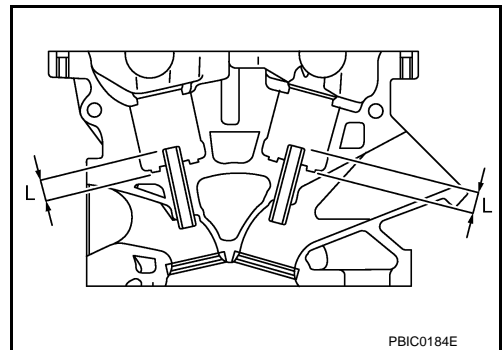


5. Using a valve guide drift (commercial service tool), press valve guide from camshaft side to dimensions as shown in the figure.

Projection "L": : 11.4 - 11.8 mm (0.448 - 0.464 in)

CAUTION:

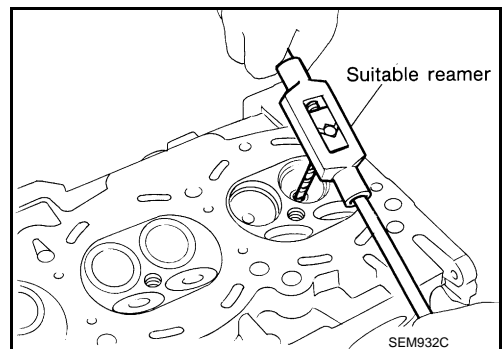
Cylinder head contains heat, when working, wear protective equipment to avoid getting burned.



6. Apply reamer finish to valve guide with a valve guide reamer (commercial service tool).

Standard

5.000 - 5.018 mm (0.1968 - 0.1975 in)



A
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CYLINDER HEAD

[HR12DE]

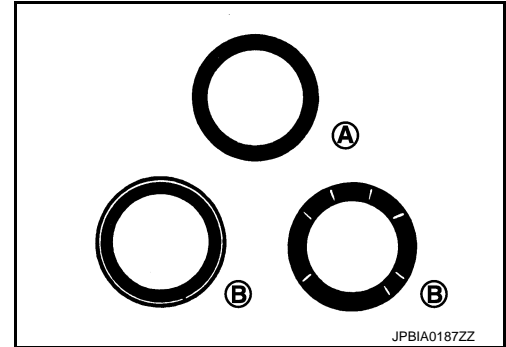
< REMOVAL AND INSTALLATION >

VALVE SEAT CONTACT

- After confirming that the dimensions of valve guides and valves are within the specifications, perform this procedure.
- Apply prussian blue (or white lead) onto contacting surface of valve seat to check the condition of the valve contact on the surface.
- Check if the contact area band is continuous all around the circumference.

A : OK

- If not, grind to adjust valve fitting and check again. If the contacting surface still has "NG" conditions (B) even after the recheck, replace valve seat. Refer to [EM-106. "Disassembly and Assembly"](#).



VALVE SEAT REPLACEMENT

When valve seat is removed, replace with oversized [0.5 mm (0.020 in)] valve seat.

1. Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this.

CAUTION:

Prevent to scratch cylinder head by excessive boring.

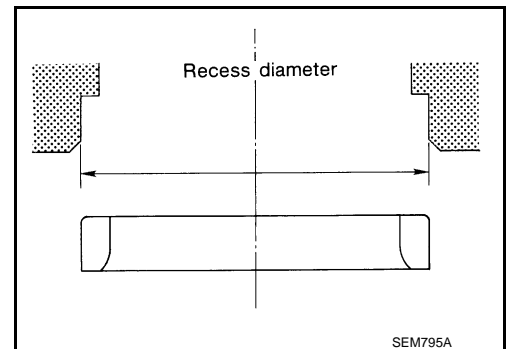
2. Ream cylinder head recess diameter for service valve seat.

Oversize [0.5 mm (0.020 in)]

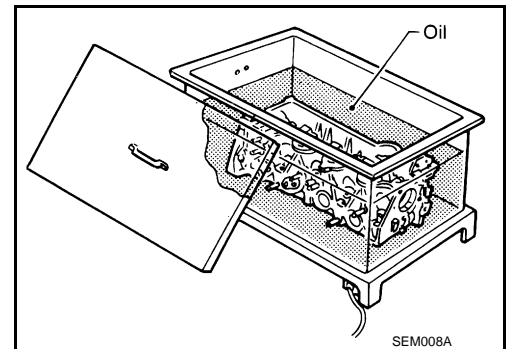
Intake : 31.900 - 31.916 mm (1.2559 - 1.2565 in)

Exhaust : 26.400 - 26.416 mm (1.0393 - 1.0399 in)

- Be sure to ream in circles concentric to the valve guide center. This will enable valve seat to fit correctly.



3. Heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.



4. Provide valve seats cooled well with a dry ice. Press-fit valve seats into cylinder head.

CAUTION:

- **Avoid directly to touching cold valve seats.**
- **Cylinder head contains heat, when working, wear protective equipment to avoid getting burned.**

CYLINDER HEAD

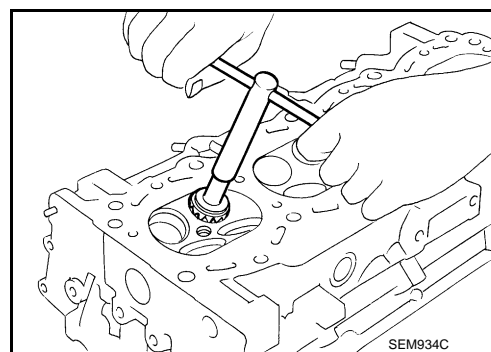
< REMOVAL AND INSTALLATION >

[HR12DE]

- Using a valve seat cutter set (commercial service tool) or a valve seat grinder, finish valve seat to the specified dimensions. For dimensions, refer to [EM-151, "Cylinder head"](#).

CAUTION:

When using a valve seat cutter, firmly grip the cutter handle with both hands. Then, press on the contacting surface all around the circumference to cut in a single drive. Improper pressure on with the cutter or cutting many different times may result in stage valve seat.



- Using compound, grind to adjust valve fitting.
- Check again for normal contact. Refer to "VALVE SEAT CONTACT".

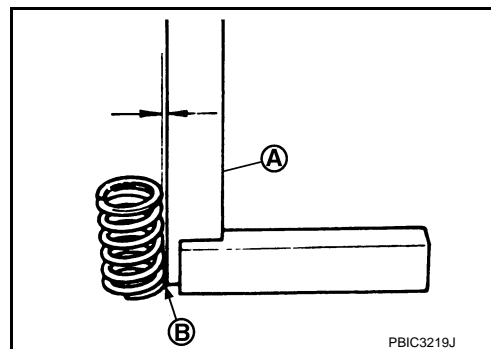
VALVE SPRING SQUARENESS

- Set a try square (A) along the side of valve spring and rotate spring. Measure the maximum clearance between the top of spring and try square.

B : Contact

Limit : Refer to [EM-151, "Cylinder head"](#).

- If it exceeds the limit, replace valve spring.



VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

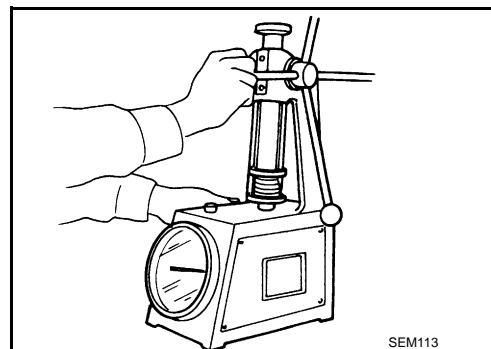
- Check valve spring pressure with valve spring seat installed at the specified spring height.

CAUTION:

Never remove valve spring seat from valve spring.

Standard : Refer to [EM-151, "Cylinder head"](#).

- If the installation load or load with valve open is out of the standard, replace valve spring (with valve spring seat).



INSPECTION AFTER INSTALLATION

Inspection for Leaks

The following are procedures for checking fluids leak, lubricates leak and exhaust gases leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-19, "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
 - Turn ignition switch ON (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

NOTE:

If hydraulic pressure inside timing chain tensioner drops after removal/installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to check there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

CYLINDER HEAD

< REMOVAL AND INSTALLATION >

[HR12DE]

Summary of the inspection items:

Items		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leakage	Level
Engine oil		Level	Leakage	Level
Transmission / transaxle fluid	AT & CVT Models	Leakage	Level / Leakage	Leakage
	MT Models	Level / Leakage	Leakage	Level / Leakage
Other oils and fluids*		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gases		—	Leakage	—

*: Power steering fluid, brake fluid, etc.

UNIT REMOVAL AND INSTALLATION

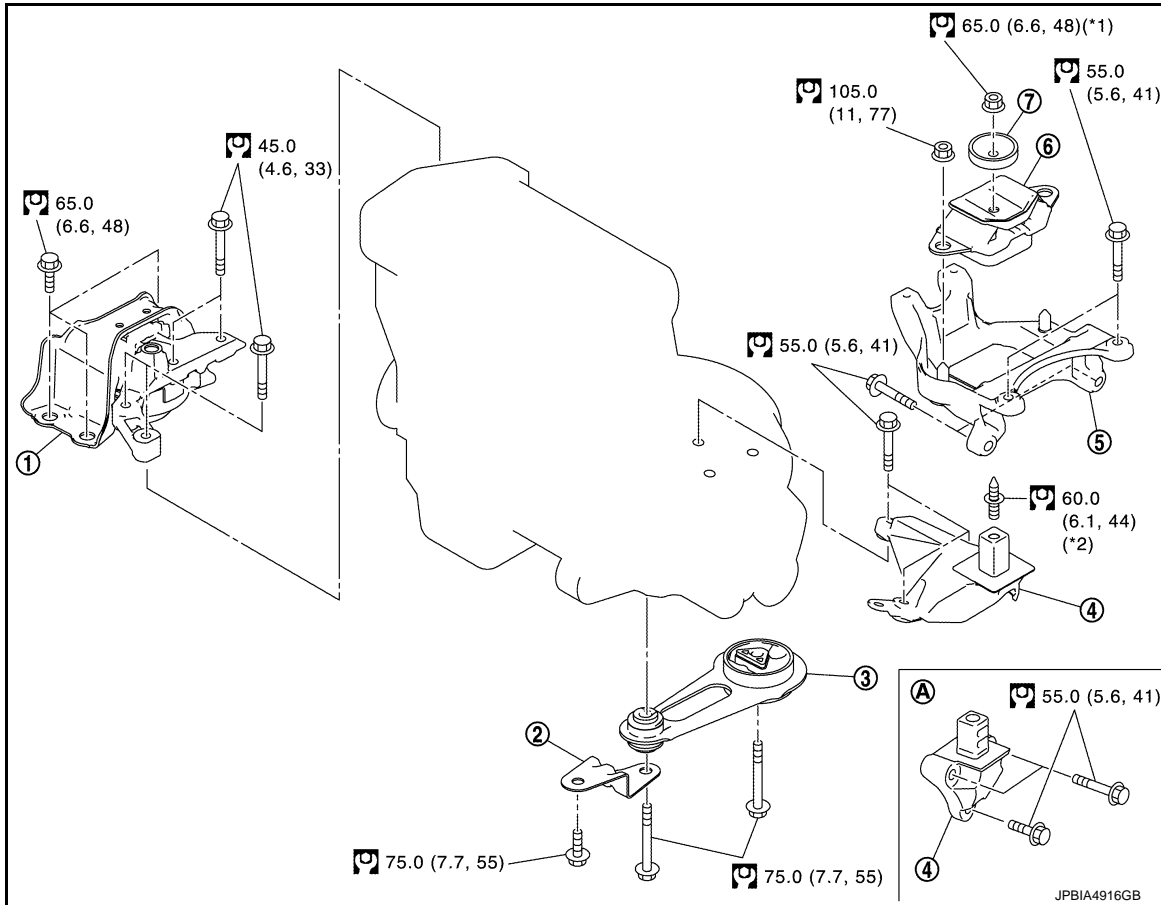
ENGINE ASSEMBLY

Exploded View

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A

EM



- | | | |
|-----------------------------------|---------------------------------------|-----------------------------------|
| 1. Engine mounting insulator (RH) | 2. Rear engine mounting bracket | 3. Rear torque rod |
| 4. Engine mounting bracket (LH) | 5. Engine mounting frame support (LH) | 6. Engine mounting insulator (LH) |
| 7. Mass damper (M/T models) | | |
| A. CVT models | | |

: N·m (kg-m, ft-lb)

CAUTION:

Check that the stud bolt (*2) is tight at the specified torque before tightening the mounting nut (*1) shown in the figure. [Stud bolt (*2) may be loosened after loosening the mounting nut (*1)]

Removal and Installation

INFOID:000000005988206

WARNING:

- Situate the vehicle on a flat and solid surface.
- Place chocks at front and back of rear wheels.
- Attach proper slingers and bolts described in PARTS CATALOG if engine slingers are not equipped.

CAUTION:

- Always be careful to work safely, avoid forceful or uninstructed operations.
- Never start working until exhaust system and coolant are cool enough.
- If items or work required are not covered by the engine section, refer to the applicable sections.
- Always use the support point specified for lifting.

ENGINE ASSEMBLY

< UNIT REMOVAL AND INSTALLATION >

[HR12DE]

- Use either 2-pole lift type or separate type lift as best you can. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with a transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.
- For supporting points for lifting and jacking point at rear axle, refer to [GI-41, "Garage Jack and Safety Stand and 2-Pole Lift"](#).

REMOVAL

Outline

Remove the engine and the transaxle assembly from the vehicle downward. Separate the engine and the transaxle.

Preparation

1. Release fuel pressure. Refer to following;
HR12DE (TYPE 1): [EC-179, "Work Procedure"](#)
HR12DE (TYPE 2): [EC-579, "Work Procedure"](#)
2. Drain engine coolant from radiator. Refer to [CO-13, "Draining"](#).
CAUTION:
 - Perform this step when the engine is cold.
 - Never spill engine coolant on drive belts.
3. Remove the following parts.
 - Front road wheels and tires (RH and LH)
 - Front fender protector (RH and LH): Refer to [EXT-20, "FENDER PROTECTOR : Exploded View"](#).
 - Drive belt: Refer to [EM-24, "Removal and Installation"](#).
 - Battery and battery tray: Refer to [PG-284, "FOR MAINTENANCE REQUIRED BATTERY MODELS : Removal and Installation"](#).
 - Air duct (inlet), air duct, and air cleaner cover and body assembly: Refer to [EM-31, "TYPE 1 : Removal and Installation"](#) (Type 1) or [EM-32, "TYPE 2 : Removal and Installation"](#) (Type 2).
 - Radiator hose (upper and lower): Refer to [CO-18, "Exploded View"](#).
 - Radiator fan shroud assembly. Refer to [CO-22, "Removal and Installation"](#).
 - Exhaust front tube: Refer to [EX-5, "Exploded View"](#).

Engine Room LH

1. Disconnect all connections of engine harness around the battery, and then temporarily secure the engine harness into the engine side.
CAUTION:
Protect connectors using a resin bag against foreign materials during the operation.
2. Disconnect heater hoses. Refer to [CO-28, "Exploded View"](#).
3. Disconnect fuel feed tube at engine side. Refer to [EM-46, "FOR THAILAND PRODUCTION MODELS : Exploded View"](#) or [EM-51, "FOR INDIA PRODUCTION MODELS : Exploded View"](#).
4. Disconnect control linkage from transaxle. Refer to [TM-29, "Removal and Installation"](#) (M/T models).
5. Disconnect clutch tube on transaxle side from clutch damper (M/T models). Refer to [CL-22, "Removal and Installation"](#).

Engine Room RH

1. Remove ground cable at engine side.
2. Remove alternator. Refer to [CHG-33, "HR12DE : Exploded View"](#).
3. Disconnect vacuum hose from intake manifold. Refer to [EM-36, "TYPE 1 : Exploded View"](#) (Type 1) or [EM-38, "TYPE 2 : Exploded View"](#) (Type 2).
4. Remove EVAP hoses. Refer to [EM-36, "TYPE 1 : Exploded View"](#) (Type 1) or [EM-38, "TYPE 2 : Exploded View"](#) (Type 2).
5. Remove A/C compressor. Refer to [HA-32, "COMPRESSOR : Removal and Installation"](#).

Vehicle Underbody

1. Remove ground cable at transaxle side.
2. Remove drive shafts (RH and LH). Refer to [FAX-23, "Exploded View"](#).

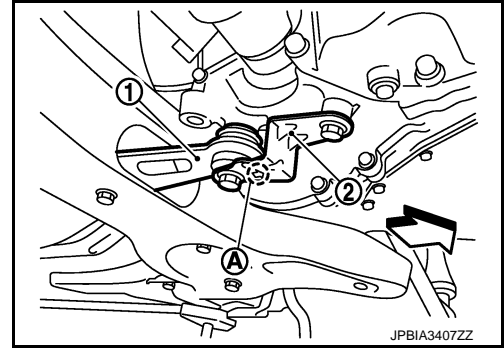
ENGINE ASSEMBLY

< UNIT REMOVAL AND INSTALLATION >

[HR12DE]

3. Remove rear torque rod (1).

- 2 : Rear engine mounting bracket
- A : Front mark
- ↔ : Vehicle front



4. Preparation for the separation work of transaxle is as follows:

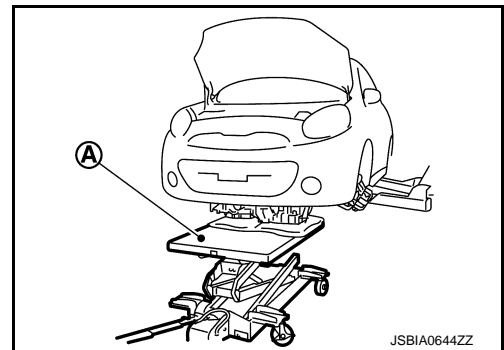
- Remove transaxle joint bolts which pierce at oil pan (upper) lower rear side. Refer to [EM-42, "Exploded View"](#).

Removal

1. Use a manual lift table caddy (commercial service tool) (A) or equivalently rigid tool such as a transmission jack. Securely support bottom of the engine and the transaxle assembly.

CAUTION:

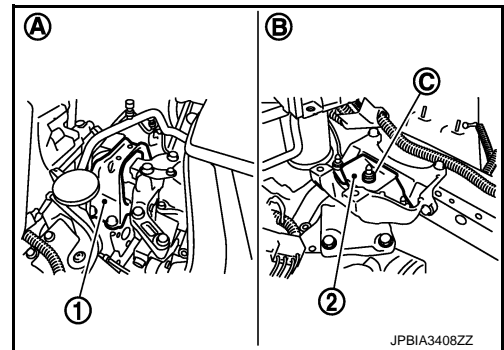
Put a piece of wood or an equivalent as the supporting surface, secure a completely stable condition.



2. Remove engine mounting insulator (RH) (1).

- 2 : Engine mounting insulator (LH)
- A : Engine front side
- B : Transaxle side

3. Remove engine mounting through bolt-securing nut (C).



4. Carefully lower jack, or raise lift to remove the engine and the transaxle assembly. When performing work, observe the following caution.

CAUTION:

- **Check that no part interferes with the vehicle side.**
- **Before and during this lifting, always check if any harnesses are left connected.**
- **During the removal, always be careful to prevent the vehicle from falling off the lift due to changes in the center of gravity.**
- **If necessary, support the vehicle by setting jack or suitable tool at the rear.**

Separation

ENGINE ASSEMBLY

< UNIT REMOVAL AND INSTALLATION >

[HR12DE]

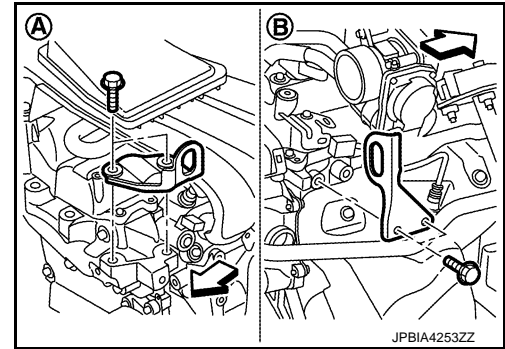
1. When engine can be hoisted, install engine slinger to cylinder head front left side (A) and rear right side (B) and support the engine position with a hoist.

⇐ : Engine front

NOTE:

Remove harness bracket when installing the engine slinger to the rear of the right lateral.

- Install a spacer (use nut or washer) of 6 mm in thickness between the slinger and the cylinder head to prevent interference.



Slinger bolts : 25.0 N·m (2.6 kg·m, 18 ft·lb)

CAUTION:

- Use a specified front/rear engine slingers and mounting bolts.
 - To install rear engine slinger, the flange must be faced to the engine.
 - Two spacers used for the rear engine slinger must be the same in thickness.
2. Remove starter motor. Refer to [STR-43, "HR12DE : Exploded View"](#).
 3. Lift with a hoist and separate the engine from the transaxle assembly. Refer to [TM-35, "HR12DE : Exploded View"](#) (M/T models).

INSTALLATION

Note the following, and install in the reverse order of removal.

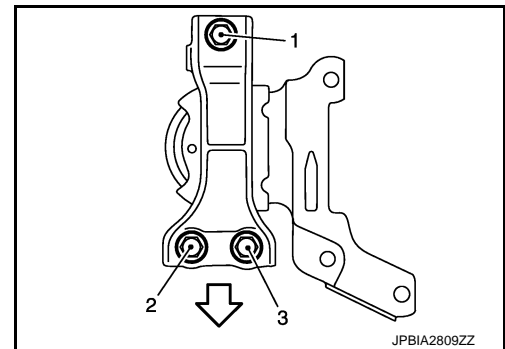
CAUTION:

- Never allow engine oil to get on engine mounting insulator. Be careful not to damage engine mounting insulator.
- Check that each mounting insulator is seated properly, and tighten mounting nuts and bolts.
- When installation directions are specified, install parts according to the direction marks on them referring to the figure of components. Refer to [EM-113, "Exploded View"](#).

Engine Mounting Bracket (RH)

- Tighten mounting bolts in the numerical order as shown in the figure.

⇐ : Vehicle front



Inspection

INFOID:000000005988207

INSPECTION AFTER INSTALLATION

Inspection for Leakage

The following are procedures for checking fluids leakage, lubricates leakage, and exhaust gases leakage.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-19, "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
 - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to check there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.

ENGINE ASSEMBLY

< UNIT REMOVAL AND INSTALLATION >

[HR12DE]

- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

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Summary of the inspection items:

Items		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leakage	Level
Engine oil		Level	Leakage	Level
Transmission / transaxle fluid	AT & CVT Models	Leakage	Level / Leakage	Leakage
	MT Models	Level / Leakage	Leakage	Level / Leakage
Other oils and fluids*		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gases		—	Leakage	—

*: Power steering fluid, brake fluid, etc.

UNIT DISASSEMBLY AND ASSEMBLY

ENGINE STAND SETTING

Setting

INFOID:000000006218116

NOTE:

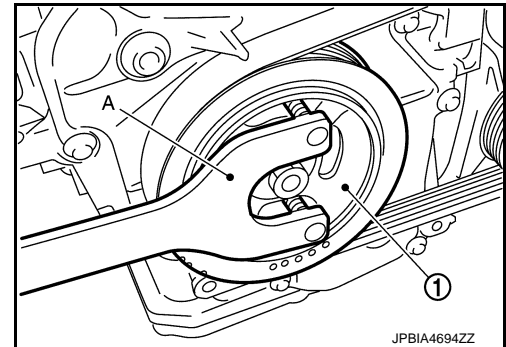
Explained here is how to disassemble with engine stand supporting transaxle surface. When using different type of engine stand, note with difference in steps and etc.

1. Remove the engine and the transaxle assembly from the vehicle, and separate the transaxle from the engine. Refer to [EM-113. "Exploded View"](#).
2. Remove clutch cover and clutch disc (M/T models).
3. Install engine to engine stand with the following procedure:
 - a. Remove flywheel (M/T models) or drive plate (A/T models, CVT models).

- Secure crankshaft pulley (1) with a pulley holder [commercial service tool] (A), and remove flywheel or drive plate mounting bolts.

CAUTION:

- Never disassemble them.
- Never place them with signal plate facing down.
- When handling signal plate, take care not to damage or scratch them.
- Handle signal plate in a manner that prevents them from becoming magnetized.
- Take care not to damage the periphery of the sensing area.
- Any dropped flywheel shall not be used. (The flywheel to which the sensing area shall not be placed on the floor.)
- Any dropped drive plate shall not be used. (The drive plate to which the signal plate shall not be placed on the floor.)
- Never touch flywheel or drive plate with bare hands. Always use urethane coating gloves or skin gloves when removing these parts.
- Never use torn glove.



- b. Lift the engine with a hoist to install it onto widely use engine stand.

CAUTION:

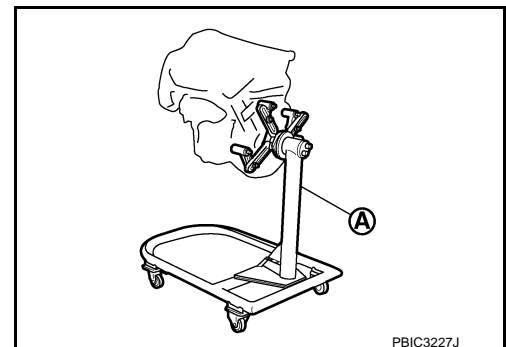
- Use the engine stand that has a load capacity [approximately 150 kg (331 lb) or more] large enough for supporting the engine weight.
- If the load capacity of stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning stand.
 - Intake manifold: Refer to [EM-36. "TYPE 1 : Exploded View"](#) (Type 1) or [EM-38. "TYPE 2 : Exploded View"](#) (Type 2).
 - Exhaust manifold: Refer to [EM-40. "Exploded View"](#).
 - Rocker cover: Refer to [EM-58. "Exploded View"](#).

NOTE:

The figure shows an example of widely used engine stand (A) that can support mating surface of transaxle with flywheel removed.

CAUTION:

Before removing the hanging chains, check the engine stand is stable and there is no risk of overturning.



4. Drain engine oil. Refer to [LU-7. "Draining"](#).

CAUTION:

Be sure to clean drain plug and install with new drain plug washer.

ENGINE STAND SETTING

< UNIT DISASSEMBLY AND ASSEMBLY >

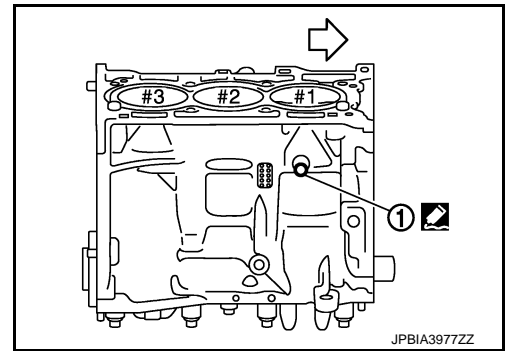
[HR12DE]

5. Drain engine coolant by removing water drain plug (1) from inside of the engine.

← : Engine front

Tightening torque : Refer to [EM-126. "Exploded View"](#).

Use Genuine Liquid Gasket or equivalent.



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ENGINE UNIT

Disassembly

INFOID:000000006218117

1. Remove intake manifold. Refer to [EM-36, "TYPE 1 : Exploded View"](#) (Type1) or [EM-38, "TYPE 2 : Exploded View"](#) (Type 2).
2. Remove exhaust manifold. Refer to [EM-40, "Exploded View"](#).
3. Remove oil pan (lower). Refer to [EM-42, "Exploded View"](#).
4. Remove ignition coil, spark plug, and rocker cover. Refer to [EM-58, "Exploded View"](#).
5. Remove fuel injector and fuel tube. Refer to [EM-46, "FOR THAILAND PRODUCTION MODELS : Exploded View"](#) or [EM-51, "FOR INDIA PRODUCTION MODELS : Exploded View"](#).
6. Remove front cover and timing chain. Refer to [EM-61, "Exploded View"](#).
7. Remove camshaft. Refer to [EM-73, "TYPE 1 : Exploded View"](#) (Type 1) or [EM-89, "TYPE 2 : Exploded View"](#) (Type 2).
8. Remove cylinder head. Refer to [EM-103, "Exploded View"](#).

Assembly

INFOID:000000006218118

Assemble in the reverse order of disassembly.

OIL PAN (UPPER)

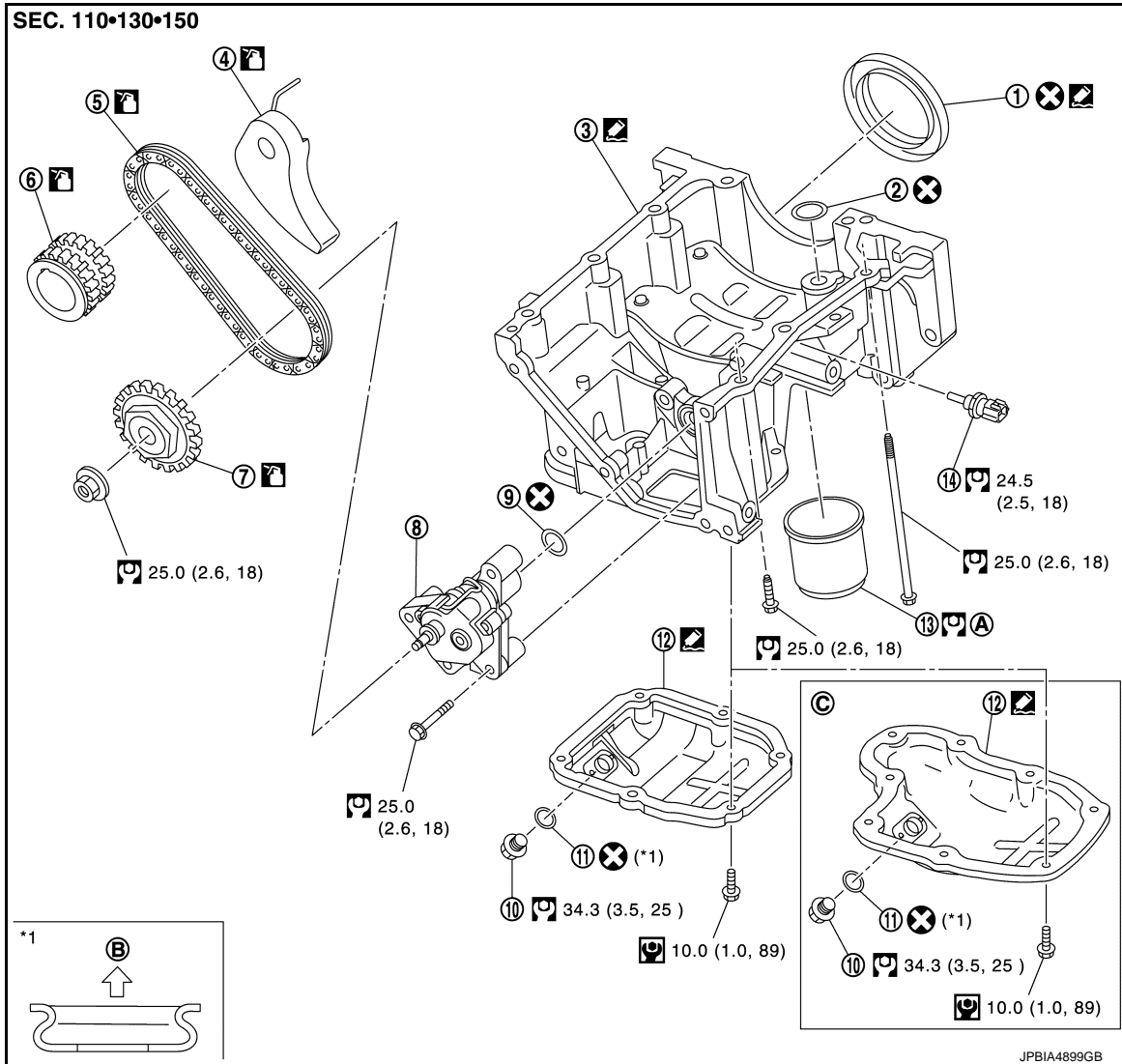
< UNIT DISASSEMBLY AND ASSEMBLY >

[HR12DE]

OIL PAN (UPPER)

Exploded View

INFOID:000000005988211



- | | | |
|--|---|------------------------|
| 1. Rear oil seal | 2. O-ring | 3. Oil pan (upper) |
| 4. Chain tensioner (for oil pump drive chain) | 5. Oil pump drive chain | 6. Crankshaft sprocket |
| 7. Oil pump sprocket | 8. Oil pump | 9. O-ring |
| 10. Drain plug | 11. Drain plug washer | 12. Oil pan (lower) |
| 13. Oil filter | 14. Oil temperature sensor (Except for India) | |
| A. Refer to LU-9. "Removal and Installation" | B. Oil pan (lower) side | C. For Europe |

: N-m (kg-m, ft-lb)

: N-m (kg-m, in-lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

: Sealing point

OIL PAN (UPPER)

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR12DE]

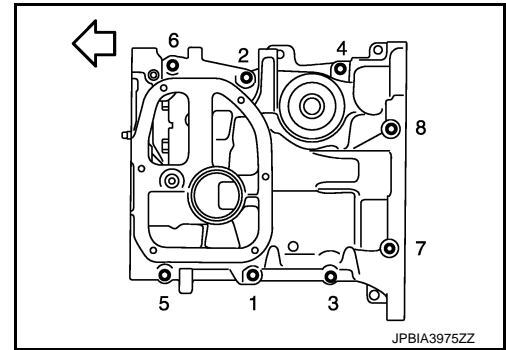
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Removal and Installation

REMOVAL

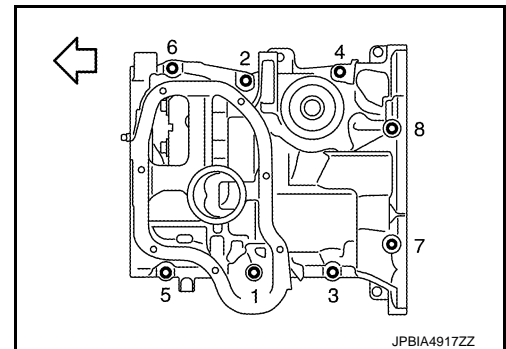
1. Remove the oil pan (lower). Refer to [EM-42. "Exploded View"](#).
2. Remove oil pump sprocket and crankshaft sprocket together with oil pump drive chain. Refer to [EM-61. "Exploded View"](#).
3. Remove oil pump assembly.
4. Remove oil pan (upper) with the following procedure.
 - a. Loosen oil pan (upper) mounting bolts in the reverse of the order as shown in the figure.
 - Except for Europe

⇐ : Engine front



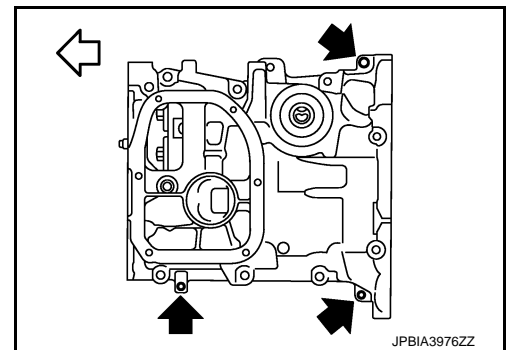
- For Europe

⇐ : Engine front



- b. Insert a flat-bladed offset screwdriver into the arrow (⇐) in the figure and open up a crack between the oil pan (upper) cylinder block.

⇐ : Engine front



- c. Insert the seal cutter [SST: KV10111100] between the oil pan (upper) and cylinder block. Slide seal cutter by tapping on the side of tool with a hammer.

CAUTION:

- Be careful not to damage the mating surface.
- A more adhesive liquid gasket is applied compared to previous types when shipped, so it should not be forced off using a screwdriver, etc. outside the indicated location.

5. Remove rear oil seal from crankshaft.

INSTALLATION

1. Install the oil pan (upper) in the following procedure:
 - a. Use scraper to remove old liquid gasket from mating surfaces.
 - Also remove the old liquid gasket from mating surface of cylinder block.
 - Remove old liquid gasket from the bolt holes and threads.
 - b. Install O-ring to the cylinder block.

CAUTION:

Never scratch or damage the mating surfaces when cleaning off old liquid gasket.

OIL PAN (UPPER)

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR12DE]

c. Apply gasket according to the following instructions.

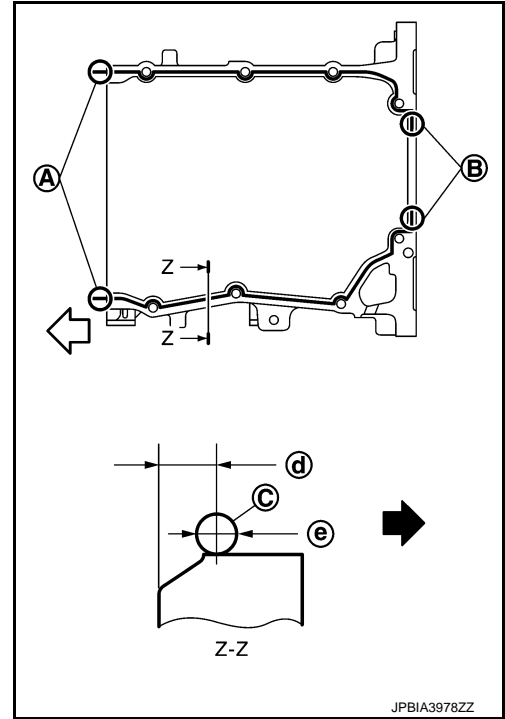
i. Except for Europe

Apply a continuous bead of liquid gasket (C) with the tube presser (commercial service tool) to areas as shown in the figure.

Use Genuine Liquid Gasket or equivalent.

- A : 2 mm (0.07 in) protruded to outside
- B : 2 mm (0.07 in) protruded to rear oil seal mounting side
- d : 5.5 - 7.5 mm (0.217 - 0.295 in)
- e : ϕ 4.0 - 5.0 mm (0.157 - 0.197 in)
- ↶ : Engine front side
- ➡ : Engine out side

CAUTION:
Attaching should be done within 5 minutes after coating.



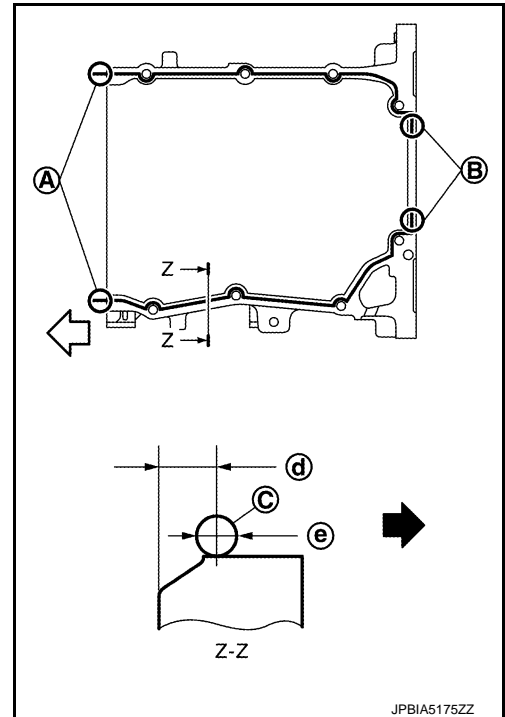
ii. For Europe

Apply a continuous bead of liquid gasket (C) with the tube presser (commercial service tool) to areas as shown in the figure.

Use Genuine Liquid Gasket or equivalent.

- A : 2 mm (0.07 in) protruded to outside
- B : 2 mm (0.07 in) protruded to rear oil seal mounting side
- d : 5.5 - 7.5 mm (0.217 - 0.295 in)
- e : ϕ 4.0 - 5.0 mm (0.157 - 0.197 in)
- ↶ : Engine front side
- ➡ : Engine out side

CAUTION:
Attaching should be done within 5 minutes after coating.



d. Tighten bolts in the numerical order as shown in the figure.

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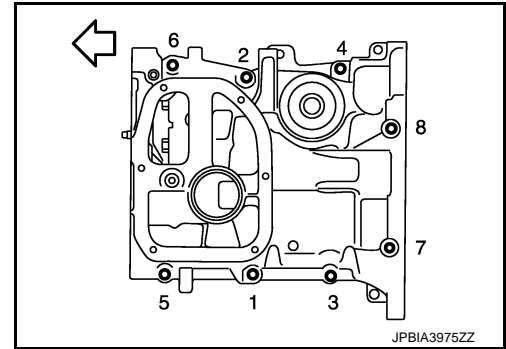
OIL PAN (UPPER)

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR12DE]

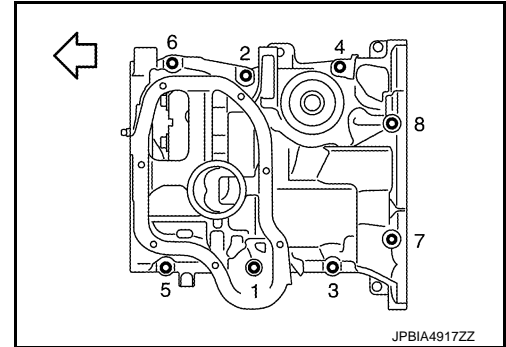
- Except for Europe

⇐ : Engine front



- For Europe

⇐ : Engine front



CAUTION:

Install avoiding misalignment of both oil pan gasket and O-ring.

- The bolts are different according to the installation position. Refer to the numbers as shown in the figure.

Except for Europe

M8×180 mm (7.09 in) : No. 7, 8

M8×25 mm (0.98 in) : No.1, 2, 3, 4, 5, 6

For Europe

M8×180 mm (7.09 in) : No. 7, 8

M8×90 mm (3.54 in) : No. 1

M8×25 mm (0.98 in) : No. 2, 3, 4, 5, 6

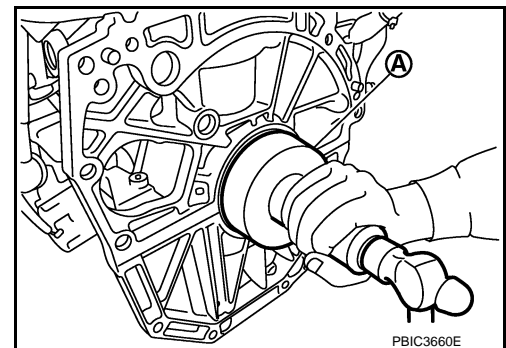
2. Install rear oil seal with the following procedure:

CAUTION:

- The installation of rear oil seal should be completed within 5 minutes after installing oil pan (upper).

- Never touch oil seal lip.

- a. Wipe off any liquid gasket protruding to the rear oil seal mounting part of oil pan (upper) and cylinder block using a spatula.
- b. Apply the liquid gasket lightly to entire outside area of new rear oil seal.
Use Genuine Liquid Gasket or equivalent.
- c. Press-fit the rear oil seal using a drift with outer diameter 113 mm (4.45 in) and inner diameter 90 mm (3.54 in) (commercial service tool) (A).



OIL PAN (UPPER)

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR12DE]

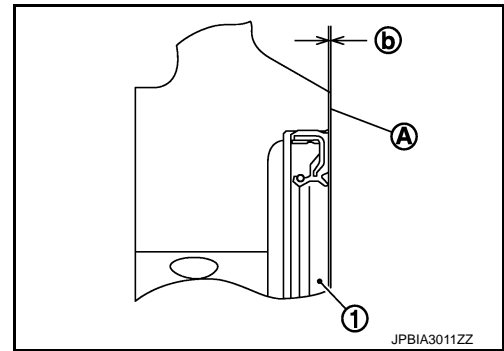
- Press-fit to the dimensions specified as shown in the figure.

- 1 : Rear oil seal
- A : Rear end surface of cylinder block
- b : 0 - 0.5 mm (0 - 0.020 in)

CAUTION:

- Never touch the grease applied to the oil seal lip.
- Be careful not to damage the rear oil seal mounting part of oil pan (upper) and cylinder block or the crankshaft.
- Press-fit straight check that oil seal does not curl or tilt.

- d. After press-fitting the rear oil seal, completely wipe off any liquid gasket protruding to rear end surface side.
3. Install in the reverse order of removal, for the rest of parts.



Inspection

INFOID:000000006218120

INSPECTION AFTER INSTALLATION

1. Check engine oil level and adjust engine oil. Refer to [LU-6. "Inspection"](#).
2. Check for leakage of engine oil when engine is warmed.
3. Stop engine and wait for 10 minutes.
4. Check engine oil level again. Refer to [LU-6. "Inspection"](#).

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CYLINDER BLOCK

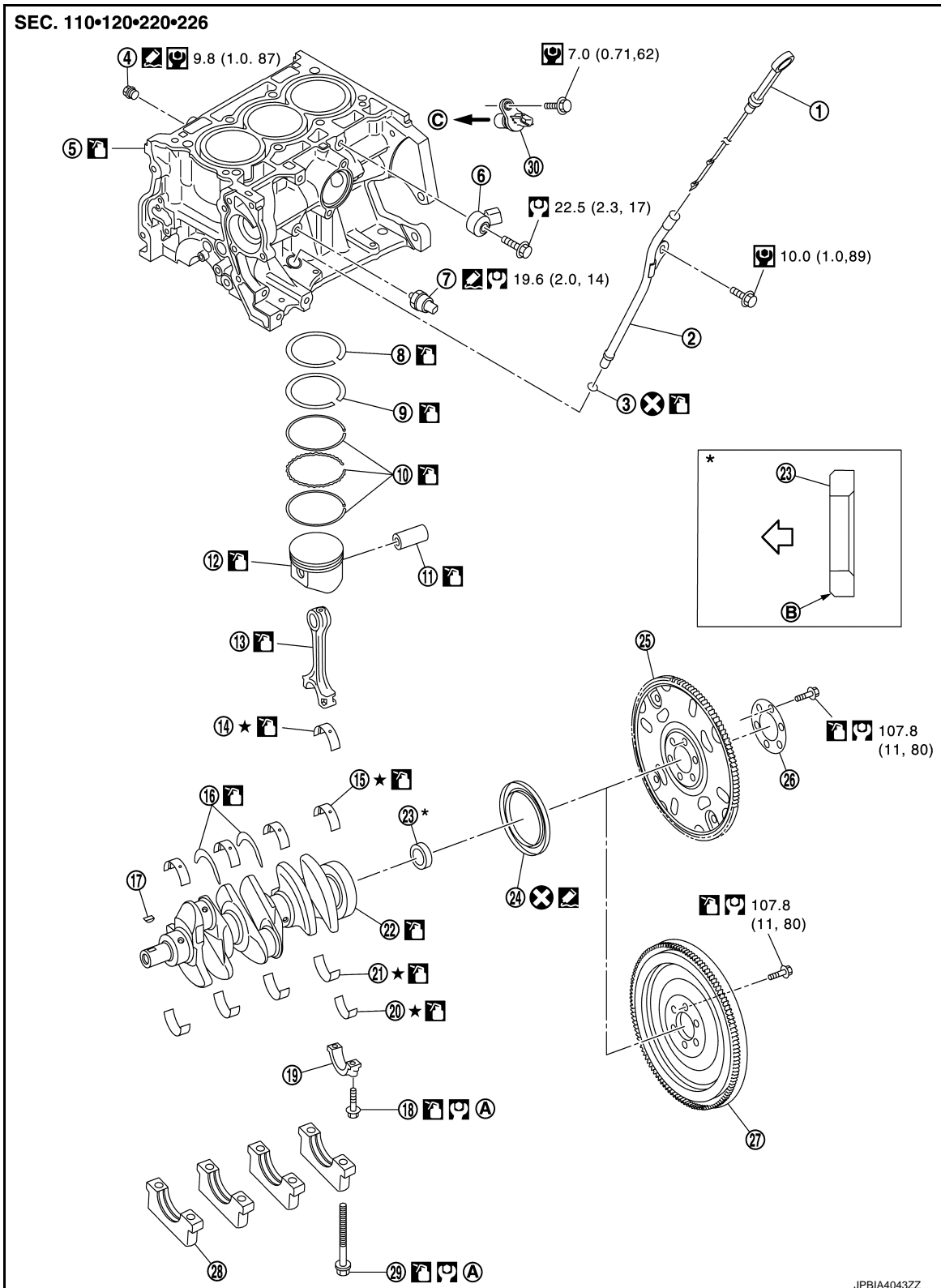
< UNIT DISASSEMBLY AND ASSEMBLY >

[HR12DE]

CYLINDER BLOCK

Exploded View

INFOID:000000005988214



JPBIA4043ZZ

- | | | |
|------------------------|--------------------------|-----------------|
| 1. Oil level gauge | 2. Oil level gauge guide | 3. O-ring |
| 4. Drain plug | 5. Cylinder block | 6. Knock sensor |
| 7. Oil pressure switch | 8. Top ring | 9. Second ring |


CYLINDER BLOCK


< UNIT DISASSEMBLY AND ASSEMBLY >


[HR12DE]


- | | | |
|--|---|--------------------------------|
| 10. Oil ring | 11. Piston pin | 12. Piston |
| 13. Connecting rod | 14. Connecting rod bearing (upper) | 15. Main bearing (upper) |
| 16. Thrust bearing | 17. Crankshaft key | 18. Connecting rod bolt |
| 19. Connecting rod cap | 20. Connecting rod bearing (lower) | 21. Main bearing (lower) |
| 22. Crankshaft | 23. Pilot converter
(A/T models, CVT models) | 24. Rear oil seal |
| 25. Drive plate
(A/T models, CVT models) | 26. Reinforcement plate
(A/T models, CVT models) | 27. Flywheel
(M/T models) |
| 28. Main bearing cap | 29. Main bearing cap bolt | 30. Crankshaft position sensor |
| A. Comply with the assembly procedure when tightening. Refer to EM-127 . | B. Chamfered | C. To T/M housing |


↶ : Crankshaft side

 : N·m (kg·m, ft·lb)

 : N·m (kg·m, in·lb)

 : Always replace after every disassembly.

 : Should be lubricated with oil.

 : Sealing point

★ : Select with proper thickness.

Disassembly and Assembly

INFOID:000000006218121

DISASSEMBLY

NOTE:

Explained here is how to disassemble with an engine stand supporting mating surface of transaxle. When using different type of engine stand, note with difference in steps and etc.

1. Remove cylinder head. Refer to [EM-103, "Exploded View"](#).
2. Remove oil pan (upper and lower). Refer to [EM-121, "Exploded View"](#).
3. Remove knock sensor.

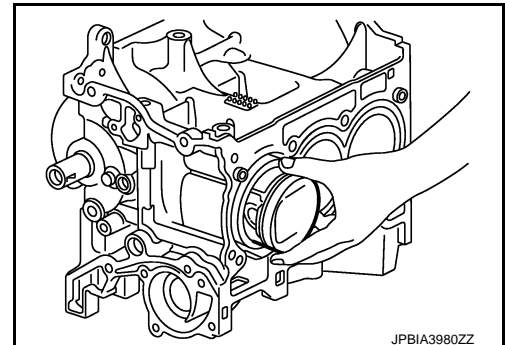
CAUTION:

Carefully handle knock sensor avoiding shocks.

4. Remove piston and connecting rod assembly with the following procedure:
 - Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to [EM-134, "Inspection"](#).
- a. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.
- b. Remove connecting rod cap.
- c. Using a hammer handle or similar tool, push piston and connecting rod assembly out to the cylinder head side.

CAUTION:

- Be careful not to damage matching surface with connecting rod cap.
- Be careful not to damage the cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.



5. Remove connecting rod bearings.

CAUTION:

Identify installation positions, and store them without mixing them up.

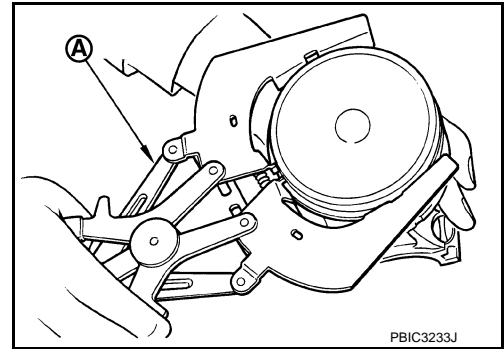
6. Remove piston rings from piston.
 - Before removing piston rings, check the piston ring side clearance. Refer to [EM-134, "Inspection"](#).

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR12DE]

- Use a piston ring expander (commercial service tool) (A).
- CAUTION:**
- When removing piston rings, be careful not to damage the piston.
 - Be careful not to damage piston rings by expanding them excessively.



7. Remove piston from connecting rod.
- Use a piston pin press stand (SST) and a press to remove the piston pin.
 - For the details of SST, refer to the following.

A : Drift [KV10109730]

B : Center cap [KV10110310]

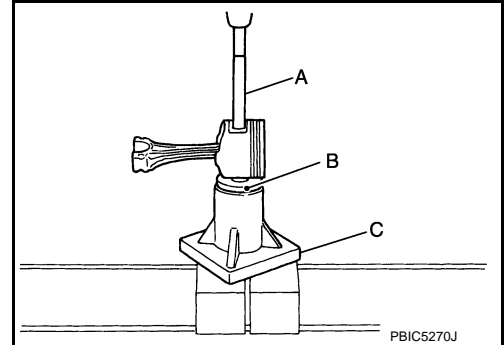
C : Press stand [ST13030020]

CAUTION:

Be careful not to damage the piston and connecting rod.

NOTE:

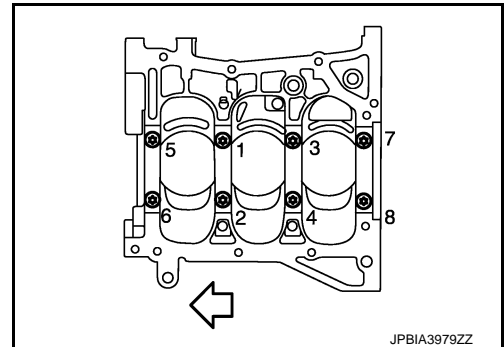
The joint between the connecting rod and the piston pin is a press fit.



8. Remove the main bearing cap in the following procedure.
- Measure crankshaft end play before loosening main bearing cap bolts. Refer to [EM-134, "Inspection"](#).
- a. Loosen and remove bolts in several steps in reverse of the numerical order as shown in the figure.

⇐ : Engine front

- TORX socket (size: E14) can be used.



- b. Remove the main bearing cap from the cylinder block while tapping lightly with a plastic hammer.
9. Remove crankshaft.
10. Pull rear oil seal out from rear end of crankshaft.
11. Remove main bearing (upper and lower) and thrust bearings from cylinder block and main bearing cap.

CAUTION:

Identify installation positions, and store them without mixing them up.

ASSEMBLY

1. Fully air-blow engine coolant and engine oil passages in cylinder block, cylinder bore and crankcase to remove any foreign material.

CAUTION:

Use a goggles to protect your eye.

2. Install main bearings and thrust bearings with the following procedure:
- a. Remove dust, dirt, and engine oil on the bearing mating surfaces of cylinder block.

CYLINDER BLOCK

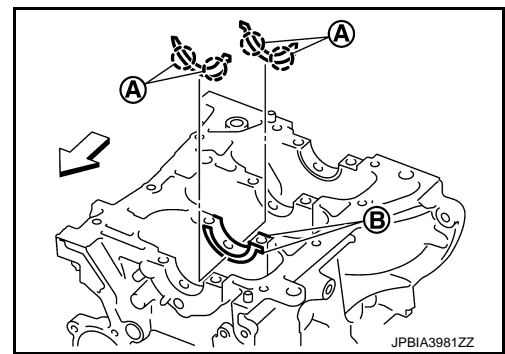
< UNIT DISASSEMBLY AND ASSEMBLY >

[HR12DE]

- b. Install thrust bearings to the both sides of the No. 2 journal housing (B) on cylinder block.

⇐ : Engine front

- Install thrust bearings with the oil groove (A) facing crankshaft arm (outside).

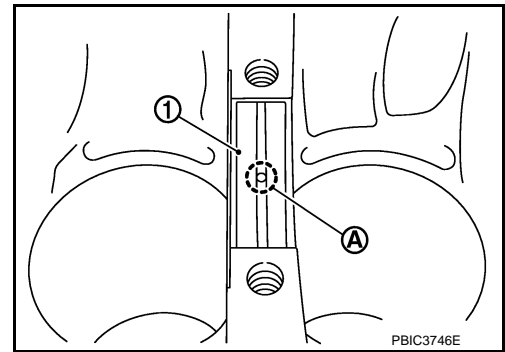


- c. Install the main bearings paying attention to the direction.
- Before installing main bearings, apply new engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
 - When installing, align main bearing to the center position of cylinder block and main bearing cap.
 - Ensure the oil holes on cylinder block and oil holes (A) on the main bearings (1) are aligned.

NOTE:

For service work, the center position can be visually identified.

- To install the main bearing, obtain a proper fit. Do not allow the main bearing to lie off the cylinder block chamfer.
- To install the main bearing, obtain a proper fit. Do not allow the main bearing to lie off bearing cap chamfer.



3. Install crankshaft to cylinder block.

- While turning crankshaft by hand, check that it turns smoothly.

CAUTION:

- **Never install rear oil seal yet.**
- **Before bearing cap is assembled to cylinder block, rotate crankshaft and No.2 journal oil hole must be located on 80°-100° from the mating face of cylinder block with bearing cap. (To use of No.1 journal oil hole or No.3 journal oil hole is permissible instead of No.2 journal oil hole.)**

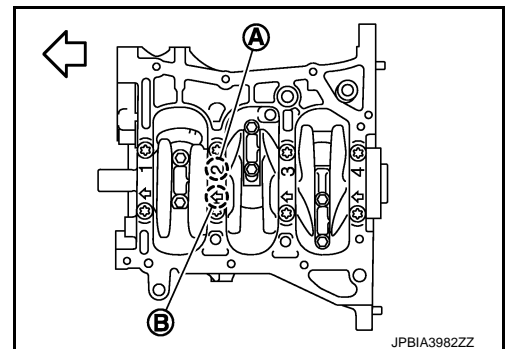
4. Install main bearing caps.

- Install the main bearing cap while referring to the front mark (B) and the journal number stamp (A).

⇐ : Engine front

NOTE:

Main bearing cap cannot be replaced as a single parts, because it is machined together with cylinder block.



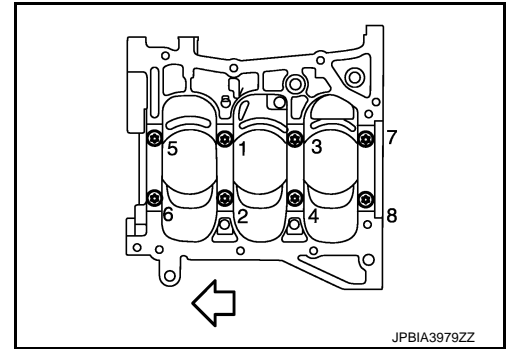
CYLINDER BLOCK

[HR12DE]

< UNIT DISASSEMBLY AND ASSEMBLY >

5. Tighten main bearing cap bolts in numerical order as shown in the figure with the following steps.

↶ : Engine front



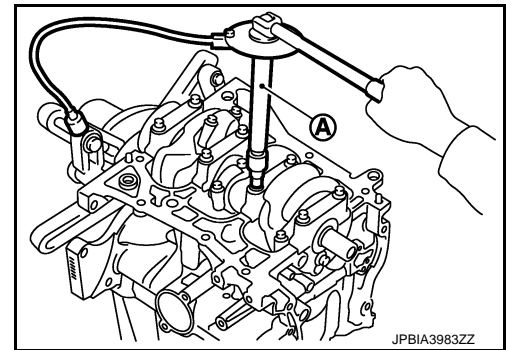
- a. Apply new engine oil to threads and seat surfaces of the mounting bolts.
- b. Tighten main bearing cap bolts.

: 32.4 N·m (3.3 kg-m, 24 ft-lb)

- c. Turn main bearing cap bolts 60 degrees clockwise (angle tightening) in numerical order as shown in the figure.

CAUTION:

Check and confirm the tightening angle by using the angle wrench [SST: KV10112100] (A) or protractor. Avoid judgment by visual inspection without the tool.



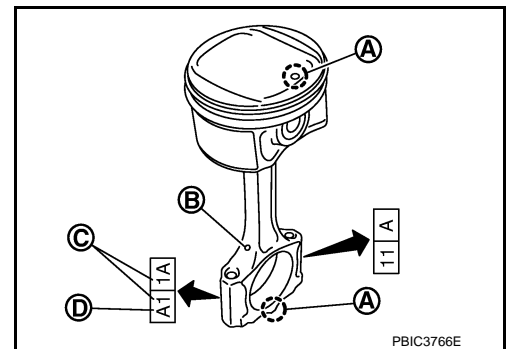
- After installing the mounting bolts, check that crankshaft can be rotated smoothly by hand.
- Check crankshaft end play. Refer to [EM-134, "Inspection"](#).

6. Install piston to connecting rod with the following procedure:
 - a. Set so that the front mark (A) on the piston head and the cylinder number (C) are in the position as shown in the figure.

B : Oil hole
D : Connecting rod big end grade

NOTE:

The symbols without notes are for management



CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR12DE]

- b. Press-fit the piston pin using the piston pin press stand (SST).
- For the details of SST, refer to the following.

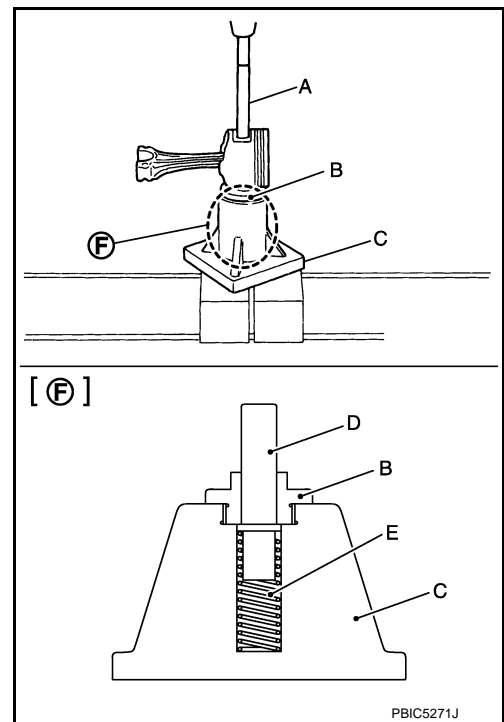
- A : Drift [KV10109730]
- B : Center cap [KV10110310]
- C : Press stand [ST13030020]
- D : Center shaft KV10114120]
- E : Spring [ST13030030]
- F : Detail

CAUTION:

Press-fit the piston so as not to damage it.

NOTE:

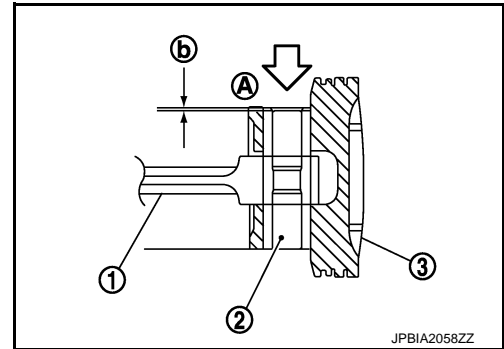
The joint between the connecting rod and the piston pin is a press fit.



- Press-fit the piston pin (2) from piston surface (A) to the depth of 2.35 mm (0.092 in) (b).

- 1 : Connecting rod
- ⇐ : Press-fit direction

- After finishing work, check that the piston (3) moves freely.



7. Using a piston ring expander (commercial service tool), install piston rings.

CAUTION:

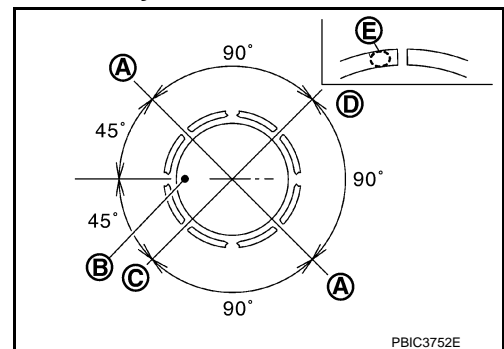
- Be careful not to damage piston.
- Be careful not to damage piston rings by expanding them excessively.
- Position each ring with the gap as shown in the figure referring to the piston front mark (B).

- A : Oil ring upper or lower rail gap (either of them)
- C : Second ring and oil ring spacer gap
- D : Top ring gap

- Install second ring with the stamped mark (E) facing upward.

Stamped mark:

Second ring : R



8. Install connecting rod bearings to connecting rod and connecting rod cap.

- When installing connecting rod bearings, apply new engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
- Install the bearing in the center position.

NOTE:

There is no stopper tab.

- Check that the oil holes on connecting rod and connecting rod bearing are aligned.

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

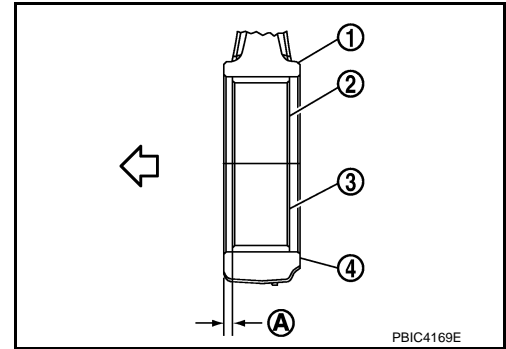
[HR12DE]

- Install the connecting rod in the dimension as shown in the figure.

- 1 : Connecting rod
- 2 : Connecting rod bearing (upper)
- 3 : Connecting rod bearing (lower)
- 4 : Connecting rod cap
- A : 1.7 - 2.1 mm (0.067 - 0.083 in)
- ↔ : Engine front

NOTE:

Install the connecting rod bearing in the center position with the dimension as shown in the figure. For service operation, the center position can be checked visually.

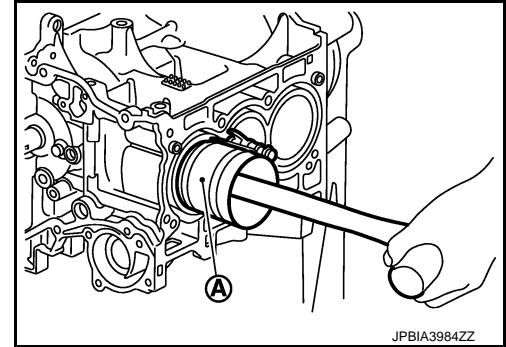


9. Install piston and connecting rod assembly to crankshaft.

- Position crankshaft pin corresponding to connecting rod to be installed onto the bottom dead center.
- Apply new engine oil sufficiently to the cylinder bore, piston and crankshaft pin.
- Match the cylinder position with the cylinder number on connecting rod to install.
- Using the piston ring compressor [SST: EM03470000] (A) or suitable tool, install piston with the front mark on the piston head facing the front of the engine.

CAUTION:

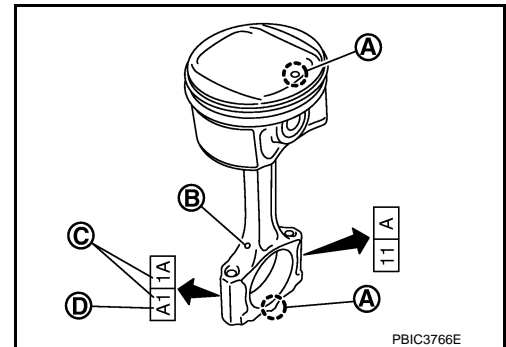
- Be careful not to damage matching surface with connecting rod cap.
- Be careful not to damage the cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.



10. Install connecting rod cap.

- Match the stamped cylinder number marks (C) on connecting rod with those on connecting rod cap to install.

- A : Front mark
- B : Oil hole
- D : Connecting rod big end grade



11. Inspect outer diameter of connecting rod bolts. Refer to [EM-134. "Inspection"](#).

12. Tighten connecting rod bolt with the following procedure:

- a. Apply new engine oil to the threads and seats of connecting rod bolts.
- b. Tighten bolts in several steps.

: 27.4 N·m (2.8 kg-m, 20 ft-lb)

- c. Completely loosen bolts.

: 0 N·m (0 kg-m, 0 ft-lb)

- d. Tighten bolts in several steps.

: 19.6 N·m (2.0 kg-m, 14 ft-lb)

- e. Then turn all bolts 60 degrees clockwise (angle tightening).

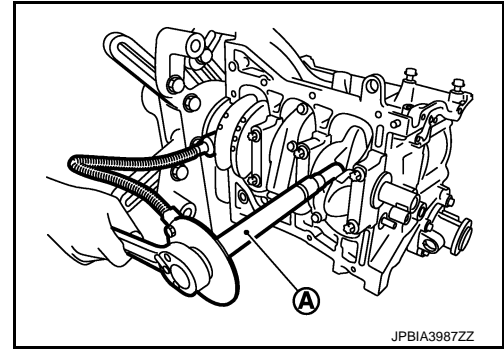
CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR12DE]

CAUTION:

Check and confirm the tightening angle by using the angle wrench [SST: KV10112100] (A) or protractor. Avoid judgement by visual inspection without the tool.



- After tightening connecting rod bolt, check that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to [EM-134, "Inspection"](#).

13. Install oil pan (upper). Refer to [EM-121, "Exploded View"](#).

NOTE:

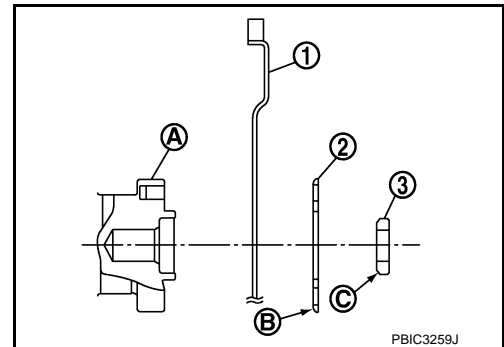
Install the rear oil seal after installing the oil pan (upper).

14. Install rear oil seal. Refer to [EM-101, "REAR OIL SEAL : Removal and Installation"](#).

15. Install flywheel (M/T models) (1) or drive plate (A/T models, CVT models).

- When installing flywheel (M/T models) or drive plate (A/T models, CVT models) to crankshaft, make sure that align crankshaft side dowel pin with flywheel/drive plate side dowel pin hole correctly.
- Install drive plate (1), reinforcement plate (2) and pilot converter (3) as shown in the figure (A/T models, CVT models)

- A : Crankshaft rear end
- B : Rounded
- D : Chamfered



CAUTION:

Be careful about the installing direction (front/back).

- Using a drift of 33 mm (1.30 in) in diameter, press-fit pilot converter into the end of crankshaft until it stops (A/T models, CVT models).
- Before tightening bolts, anti-corrosive fluid shall be applied to the bolt threads and bolt flange.
- No impact shall be applied the flywheel (M/T models) or drive plate (A/T models, CVT models).
- Pilot converter driving method (A/T models, CVT models).
- Reinforcing plate shall be attached so that the radius faces the drive plate side as shown in the above figure (A/T models, CVT models).
- When assembling drive plate, take care not to damage one-piece signal plate.
- Any dropped drive plate shall not be used. Take care not to apply a bending force to the signal plate. (The drive plate to which the signal plate shall not be placed on the floor.) (A/T models, CVT models)
- Any dropped flywheel shall not be used (The flywheel to which the sensing area shall not be placed on the floor.) (M/T models).
- Not bringing the part which had magnetism close to the flywheel or drive plate.
- If you can not avoid directly touch, please use skin gloves or urethane coating gloves.
- When the gloves have a tear or, a pip, a break. The glove should be changed.

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR12DE]

16. Install knock sensor (1).

- a : 24°
- b : 16°
- C : Rib
- ⇐ : Engine front

- Install connectors so that they are positioned towards the rear of the engine.

CAUTION:

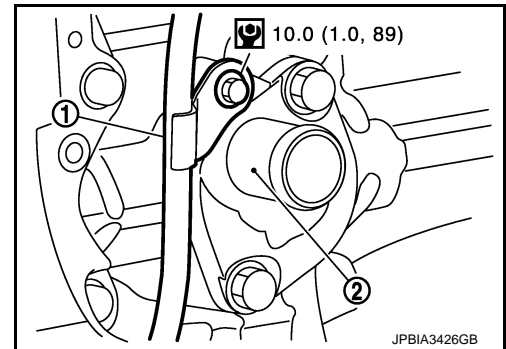
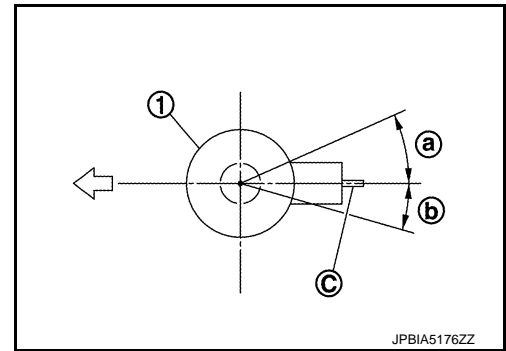
- **Never tighten mounting bolt while holding the connector.**
- **If any impact by dropping is applied to knock sensor, replace it with a new one.**
- **Always use genuine mounting bolts.**

NOTE:

- Check that there is no foreign material on the cylinder block mating surface and the back surface of knock sensor.
- Check that knock sensor does not interfere with other parts.

17. Install oil level gauge guide (1) after inserting to the cylinder block side.

- 2 : Water inlet



18. Assemble in the reverse order of disassembly after this step.

Inspection

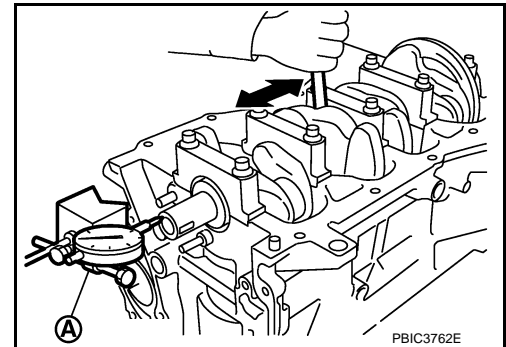
INFOID:000000006218122

CRANKSHAFT END PLAY

- Measure the clearance between thrust bearings and crankshaft arm when crankshaft is moved fully forward or backward with a dial indicator (A).

Standard and Limit : Refer to [EM-154, "Cylinder Block"](#).

- If the measured value exceeds the limit, replace thrust bearings, and measure again. If it still exceeds the limit, replace crankshaft also.

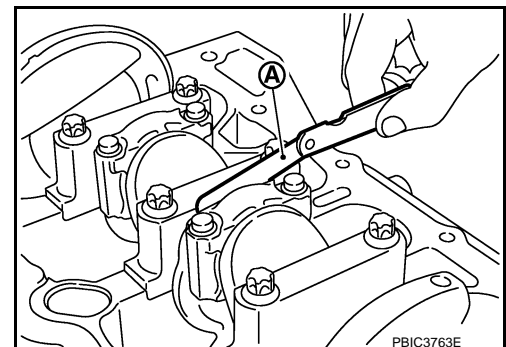


CONNECTING ROD SIDE CLEARANCE

- Measure the side clearance between connecting rod and crankshaft arm with a feeler gauge (A).

Standard and Limit : Refer to [EM-154, "Cylinder Block"](#).

- If the measured value exceeds the limit, replace connecting rod, and measure again. If it still exceeds the limit, replace crankshaft also.



CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

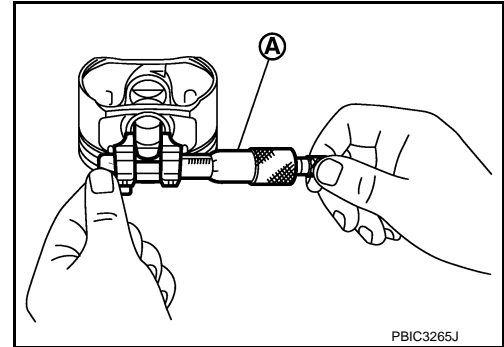
[HR12DE]

PISTON TO PISTON PIN OIL CLEARANCE

Piston Pin Hole Diameter

Measure the inner diameter of piston pin hole with an inside micrometer (A).

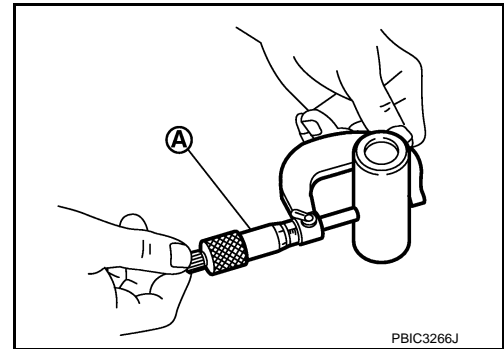
Standard : Refer to [EM-154, "Cylinder Block"](#).



Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer (A).

Standard : Refer to [EM-154, "Cylinder Block"](#).



Piston to Piston Pin Oil Clearance

(Piston to piston pin oil clearance) = (Piston pin hole diameter) – (Piston pin outer diameter)

Standard : Refer to [EM-154, "Cylinder Block"](#).

- If oil clearance is out of the standard, replace piston and piston pin assembly.
- When replacing piston and piston pin assembly. Refer to "".

NOTE:

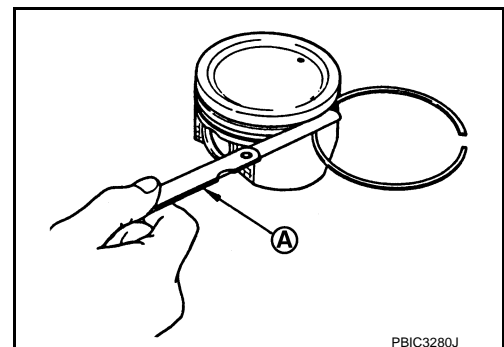
- Piston is available together with piston pin as assembly.
- Piston pin (piston pin hole) grade is provided only for the parts installed at the plant. For service parts, no grades can be selected. (Only grade "0" is available.)

PISTON RING SIDE CLEARANCE

- Measure the side clearance of piston ring and piston ring groove with a feeler gauge (A).

Standard and Limit : Refer to [EM-154, "Cylinder Block"](#).

- If the measured value exceeds the limit, replace piston ring, and measure again. If it still exceeds the limit, replace piston also.



PISTON RING END GAP

- Check that cylinder bore inner diameter is within specification. Refer to "PISTON TO CYLINDER BORE CLEARANCE".

CYLINDER BLOCK

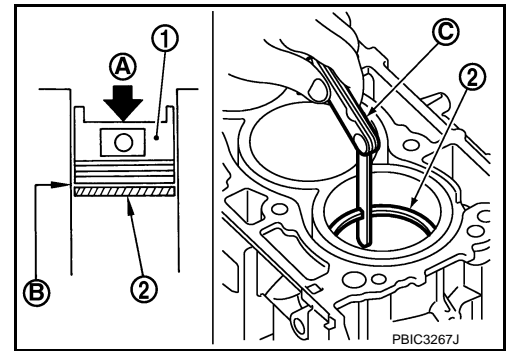
< UNIT DISASSEMBLY AND ASSEMBLY >

[HR12DE]

- Lubricate with new engine oil to piston (1) and piston ring (2), and then insert (A) piston ring until middle of cylinder (B) with piston, and measure piston ring end gap with a feeler gauge (C).

Standard and Limit : Refer to [EM-154, "Cylinder Block"](#).

- If the measured value exceeds the limit, replace piston ring, and measure again. If it still exceeds the limit, replace cylinder block.



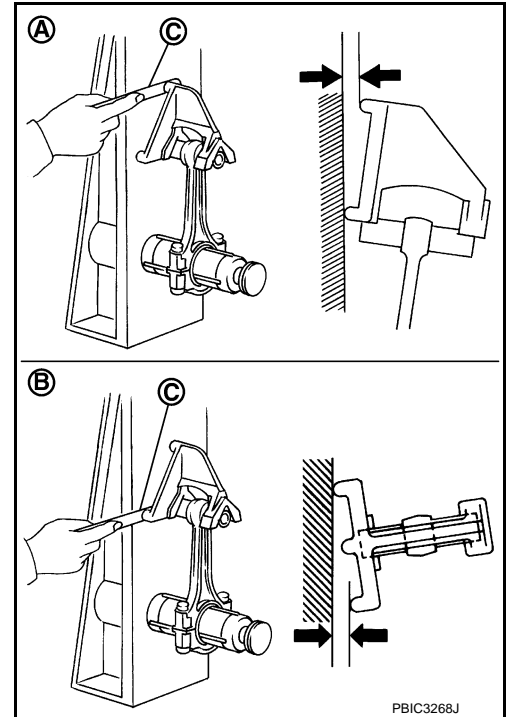
CONNECTING ROD BEND AND TORSION

- Check with a connecting rod aligner.

A : Bend
B : Torsion
C : Feeler gauge

Limit : Refer to [EM-154, "Cylinder Block"](#).

- If it exceeds the limit, replace connecting rod assembly.



CONNECTING ROD BIG END DIAMETER

- Install connecting rod cap (1) without connecting rod bearing installed, and tightening connecting rod cap bolts to the specified torque. Refer to [EM-126, "Exploded View"](#).

2 : Connecting rod
A : Example
B : Measuring direction of inner diameter

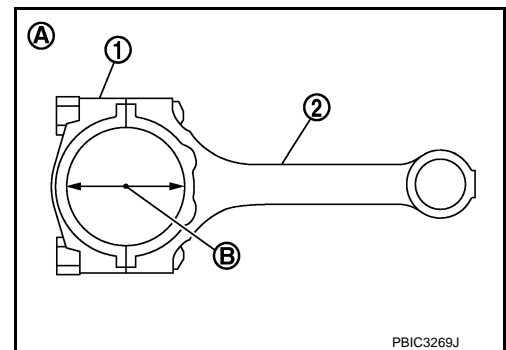
- Measure the inner diameter of connecting rod big end with an inside micrometer.

Standard : Refer to [EM-154, "Cylinder Block"](#).

- If out of the standard, replace connecting rod assembly.

CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter



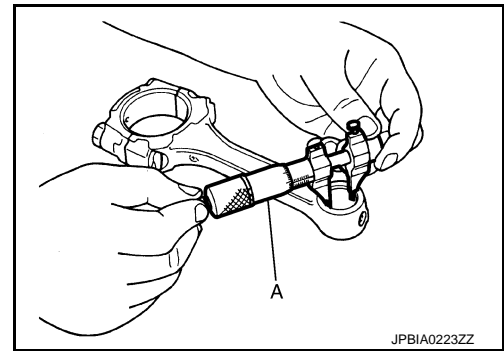
CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR12DE]

Measure the inner diameter of connecting rod bushing with an inside micrometer (A).

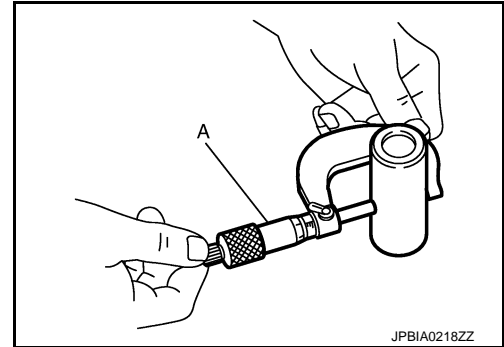
Standard : Refer to [EM-154, "Cylinder Block"](#).



Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer (A).

Standard : Refer to [EM-154, "Cylinder Block"](#).



Connecting Rod Bushing Oil Clearance

(Connecting rod bushing oil clearance) = (Connecting rod bushing inner diameter) – (Piston pin outer diameter)

Standard and Limit : Refer to [EM-154, "Cylinder Block"](#).

- If the measured value is out of the standard, replace connecting rod assembly and/or piston and piston pin assembly.
- If replacing piston and piston pin assembly. Refer to [EM-154, "Cylinder Block"](#).
- If replacing connecting rod assembly. Refer to [EM-157, "Connecting Rod Bearing"](#).

CYLINDER BLOCK TOP SURFACE DISTORTION

- Using a scraper, remove gasket on the cylinder block surface, and also remove engine oil, scale, carbon, or other contamination.

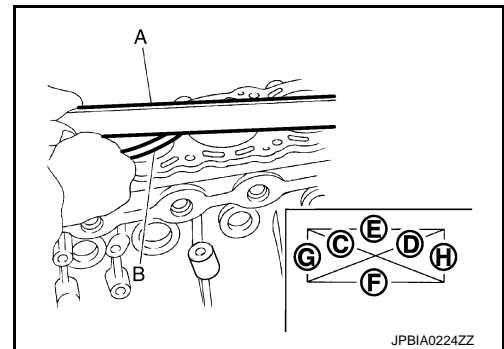
CAUTION:

Be careful not to allow gasket flakes to enter engine oil or engine coolant passages.

- Measure the distortion on the cylinder block upper face at some different points in six directions with a straight edge (A) and feeler gauge (B).

Limit : Refer to [EM-154, "Cylinder Block"](#).

- If it exceeds the limit, replace cylinder block.



MAIN BEARING HOUSING INNER DIAMETER

- Install main bearing cap without main bearings installed, and tighten main bearing cap mounting bolts to the specified torque. Refer to [EM-127, "Disassembly and Assembly"](#).
- Measure the inner diameter of main bearing housing with a bore gauge.

CYLINDER BLOCK

[HR12DE]

< UNIT DISASSEMBLY AND ASSEMBLY >

- Measure the position shown in the figure [5 mm (0.20 in)] backward from main bearing housing front side in the 2 directions as shown in the figure. The smaller one is the measured value.

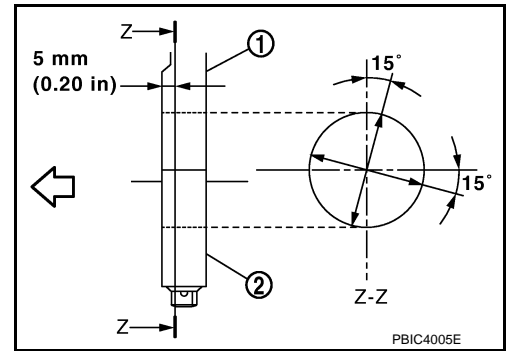
- 1 : Cylinder block
- 2 : Main bearing cap
- ⇐ : Engine front

Standard : Refer to [EM-154, "Cylinder Block"](#).

- If out of the standard, replace cylinder block and main bearing caps assembly.

NOTE:

Main bearing caps cannot be replaced as a single, because it is machined together with cylinder block.



PISTON TO CYLINDER BORE CLEARANCE

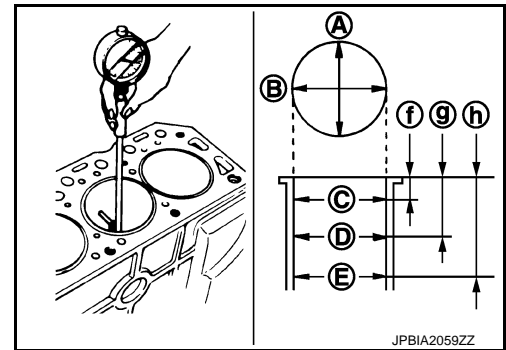
Cylinder Bore Inner Diameter

- Using a bore gauge, measure the cylinder bore for wear, out-of-round and taper at six different points on each cylinder. [(A) and (B) directions at (C), (D), and (E)] [(A) is in longitudinal direction of engine]

- f : 10 mm (0.39 in)
- g : 60 mm (2.36 in)
- h : 124 mm (4.88 in)

NOTE:

When determining cylinder bore grade, measure the cylinder bore (B) direction at (D) position.



Standard:

Cylinder bore inner diameter

: Refer to [EM-154, "Cylinder Block"](#).

Limit:

Out-of-round [Difference between (A) and (B)]

Taper [Difference between (C) and (D)]

: Refer to [EM-154, "Cylinder Block"](#).

- If the measured value exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, replace cylinder block.

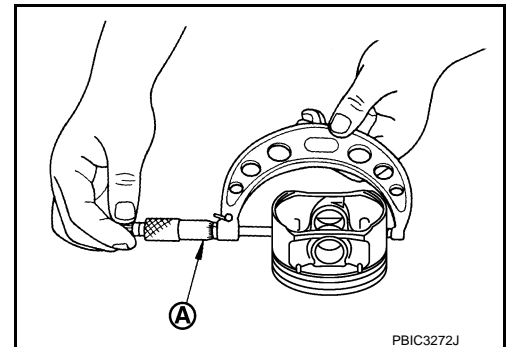
NOTE:

Oversize piston is not provided.

Piston Skirt Diameter

Measure the outer diameter of piston skirt with a micrometer (A).

Standard : Refer to [EM-154, "Cylinder Block"](#).



Piston to Cylinder Bore Clearance

CYLINDER BLOCK

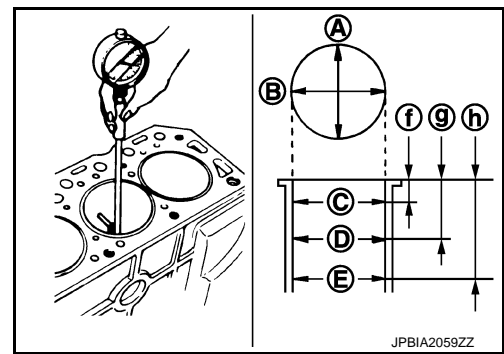
< UNIT DISASSEMBLY AND ASSEMBLY >

[HR12DE]

Calculate by piston skirt diameter and cylinder bore inner diameter [direction (B), position (D)].

- A : Direction A
- C : Position C
- E : Position E
- f : 10 mm (0.39 in)
- g : 60 mm (2.36 in)
- h : 124 mm (4.88 in)

(Clearance) = (Cylinder bore inner diameter) – (Piston skirt diameter)



Standard and Limit : Refer to [EM-154, "Cylinder Block"](#).

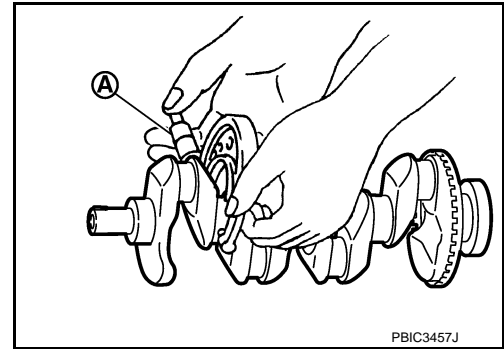
- If it exceeds the limit, replace piston and piston pin assembly and/or cylinder block. Refer to [EM-154, "Cylinder Block"](#).

CRANKSHAFT MAIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft main journals with a micrometer (A).

Standard : Refer to [EM-154, "Cylinder Block"](#).

- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing. Refer to [EM-156, "Main Bearing"](#).



CRANKSHAFT PIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft pin journal with a micrometer.

Standard : Refer to [EM-154, "Cylinder Block"](#).

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing. Refer to [EM-157, "Connecting Rod Bearing"](#).

OUT-OF-ROUND AND TAPER OF CRANKSHAFT

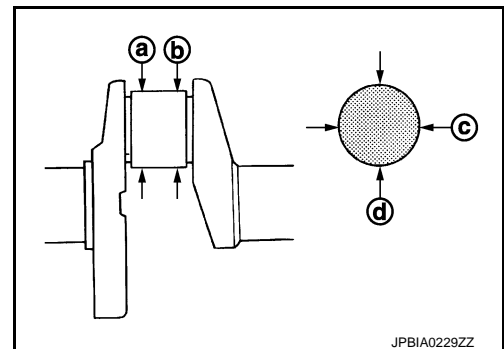
- Measure the dimensions at four different points as shown in the figure on each main journal and pin journal with a micrometer.
- Out-of-round is indicated by the difference in dimensions between (a) and (b) at (c) and (d).
- Taper is indicated by the difference in dimension between (c) and (d) at (a) and (b).

Limit:

Out-of-round [Difference between (a) and (b)]

Taper [Difference between (c) and (d)]

: Refer to [EM-154, "Cylinder Block"](#).



- If the measured value exceeds the limit, correct or replace crankshaft.
- If corrected, measure the bearing oil clearance of the corrected main journal and/or pin journal. Then select main bearing and/or connecting rod bearing. Refer to [EM-157, "Connecting Rod Bearing"](#) and/or [EM-156, "Main Bearing"](#).

CRANKSHAFT RUNOUT

- Place a V-block on a precise flat table to support the journals on the both end of the crankshaft.

CYLINDER BLOCK

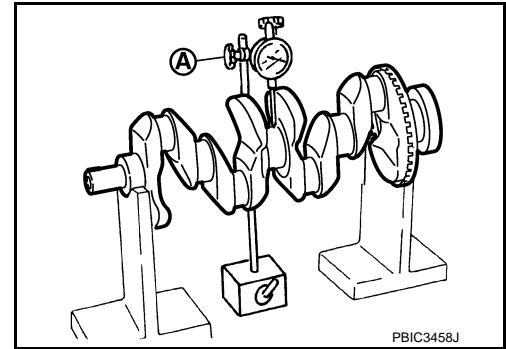
[HR12DE]

< UNIT DISASSEMBLY AND ASSEMBLY >

- Place a dial indicator (A) straight up on the No. 3 journal.
- While rotating crankshaft, read the movement of the pointer on the dial indicator. (Total indicator reading)

Standard and Limit : Refer to [EM-154, "Cylinder Block"](#).

- If it exceeds the limit, replace crankshaft.



CONNECTING ROD BEARING OIL CLEARANCE

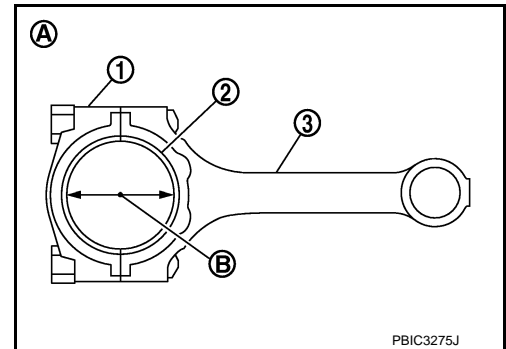
Method by Calculation

- Install connecting rod bearings (2) to connecting rod (3) and connecting rod cap (1), and tighten connecting rod cap bolts to the specified torque. Refer to [EM-127, "Disassembly and Assembly"](#).

A : Example

B : Inner diameter measuring direction

- Measure the inner diameter of connecting rod bearing with an inside micrometer.
(Bearing oil clearance) = (Connecting rod bearing inner diameter) – (Crankshaft pin journal diameter)



Standard and Limit : Refer to [EM-157, "Connecting Rod Bearing"](#).

- If clearance exceeds the limit, select proper connecting rod bearing according to connecting rod big end diameter and crankshaft pin journal diameter to obtain specified bearing oil clearance. Refer to [EM-157, "Connecting Rod Bearing"](#).

Method of Using Plastigage

- Remove engine oil and dust on crankshaft pin and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod cap bolts to the specified torque. Refer to [EM-127, "Disassembly and Assembly"](#).

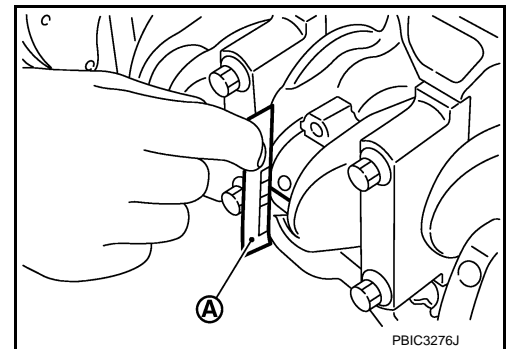
CAUTION:

Never rotate crankshaft.

- Remove connecting rod cap and bearing, and using the scale (A) on the plastigage bag, measure the plastigage width.

NOTE:

The procedure when the measured value exceeds the limit is same as that described in the "Method by Calculation".



MAIN BEARING OIL CLEARANCE

Method by Calculation

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR12DE]

- Install main bearings (3) to cylinder block (1) and main bearing cap (2), and tighten main bearing cap mounting bolts to the specified torque. Refer to [EM-127, "Disassembly and Assembly"](#).

A : Example
B : Inner diameter measuring direction

- Measure the inner diameter of main bearing with a bore gauge. (Bearing oil clearance) = (Main bearing inner diameter) – (Crankshaft main journal diameter)

Standard and Limit : Refer to [EM-156, "Main Bearing"](#).

- If clearance exceeds the limit, select proper main bearing according to main bearing inner diameter and crankshaft main journal diameter to obtain specified bearing oil clearance. Refer to [EM-156, "Main Bearing"](#).

Method of Using Plastigage

- Remove engine oil and dust on crankshaft main journal and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install main bearings to cylinder block and main bearing cap, and tighten main bearing cap mounting bolts to the specified torque. Refer to [EM-127, "Disassembly and Assembly"](#).

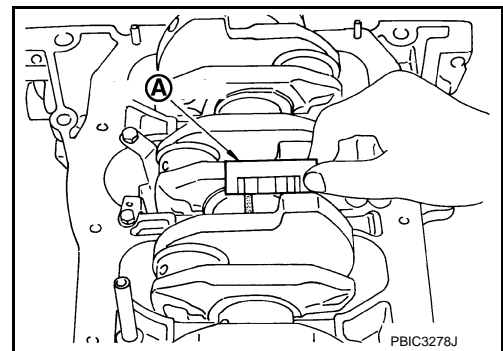
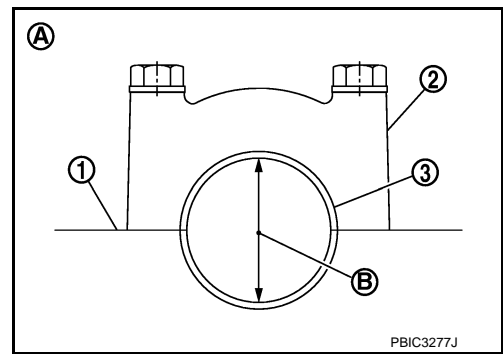
CAUTION:

Never rotate crankshaft.

- Remove main bearing cap and bearings, and using the scale (A) on the plastigage bag, measure the plastigage width.

NOTE:

The procedure when the measured value exceeds the limit is same as that described in the "Method by Calculation".



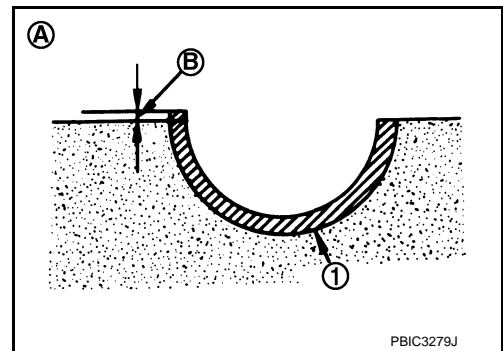
MAIN BEARING CRUSH HEIGHT

- When main bearing cap is removed after being tightened to the specified torque with main bearings (1) installed, the tip end of bearing must protrude (B). Refer to [EM-127, "Disassembly and Assembly"](#).

A : Example

Standard : There must be crush height.

- If the standard is not met, replace main bearings.



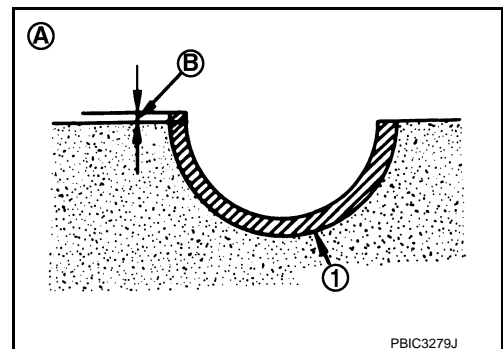
CONNECTING ROD BEARING CRUSH HEIGHT

- When connecting rod cap is removed after being tightened to the specified torque with connecting rod bearings (1) installed, the tip end of bearing must protrude (B). Refer to [EM-127, "Disassembly and Assembly"](#).

A : Example

Standard : There must be crush height.

- If the standard is not met, replace connecting rod bearings.



CYLINDER BLOCK

[HR12DE]

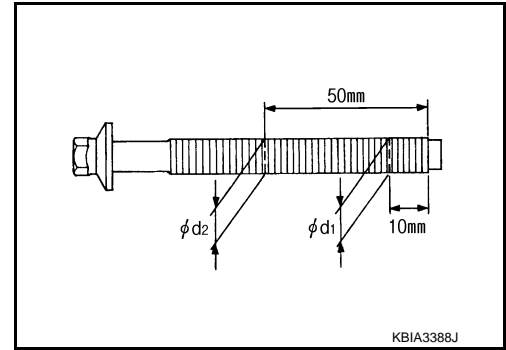
< UNIT DISASSEMBLY AND ASSEMBLY >

MAIN BEARING CAP BOLT OUTER DIAMETER

- Measure the outer diameters (d_1) and (d_2) at two positions as shown in the figure.
- If reduction appears in places other than range, regard it as (d_2).

Limit [(d_1) – (d_2): 0.2 mm (0.0079 in)]

- If it exceeds the limit (a large difference in dimensions), replace main bearing cap mounting bolt with a new one.

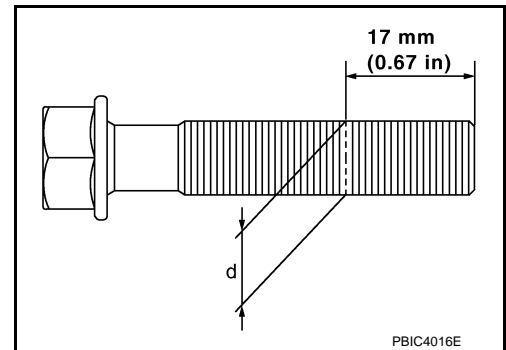


CONNECTING ROD CAP BOLT OUTER DIAMETER

- Measure the outer diameter (d) at position as shown in the figure.
- If reduction appears in a position other than (d), regard it as (d).

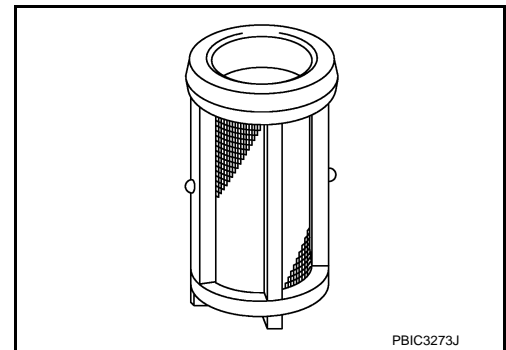
Limit: 7.75 mm (0.3051 in)

- When (d) exceeds the limit (when it becomes thinner), replace connecting rod cap bolt with a new one.



CLOGGED OR DAMAGED OIL FILTER (FOR INTAKE VALVE TIMING CONTROL)

- Check that there is no foreign material on the oil filter and check it for clogging.
 - Clean it if necessary.
- Check the oil filter for damage.
 - Replace it if necessary.



FLYWHEEL DEFLECTION

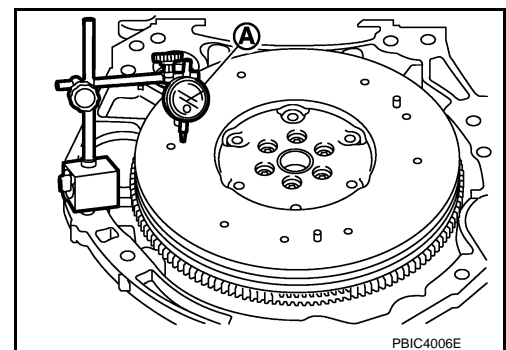
- Measure the deflection of flywheel contact surface to torque with a dial indicator (A).
- Measure the deflection at 210 mm (8.27 in) diameter.

Limit : 0.45 mm (0.0177 in) or less.

- If measured value is out of the standard, replace flywheel.
- If a trace of burn or discoloration is found on the surface, repair it with sandpaper.

CAUTION:

When measuring, keep magnetic fields (such as dial indicator stand) away from signal plate of the rear end of crankshaft.



HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR12DE]

HOW TO SELECT PISTON AND BEARING

Description

INFOID:000000005988217

Selection points	Selection parts	Selection items	Selection methods
Between cylinder block and crankshaft	Main bearing	Main bearing grade (bearing thickness)	Determined by match of cylinder block bearing housing grade (inner diameter of housing) and crankshaft journal grade (outer diameter of journal)
Between crankshaft and connecting rod	Connecting rod bearing	Connecting rod bearing grade (bearing thickness)	Combining service grades for connecting rod big end diameter and crankshaft pin outer diameter determine connecting rod bearing selection.

- The identification grade stamped on each part is the grade for the dimension measured in new condition. This grade cannot apply to reused parts.
- For reused or repaired parts, measure the dimension accurately. Determine the grade by comparing the measurement with the values of each selection table.
- For details of the measurement method of each part, the reuse standards and the selection method of the selective fitting parts, refer to the text.

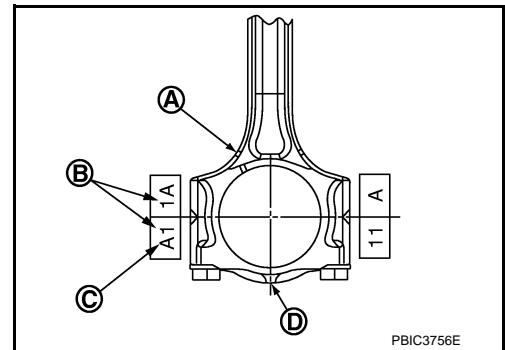
Connecting Rod Bearing

INFOID:000000005988218

WHEN NEW CONNECTING ROD AND CRANKSHAFT ARE USED

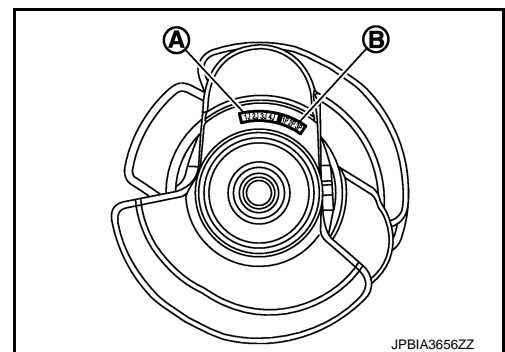
1. Apply connecting rod big end diameter grade stamped (C) on connecting rod side face to the row in the "Connecting Rod Bearing Selection Table".

- A : Oil hole
- B : Cylinder number
- D : Front mark



2. Apply crankshaft pin journal diameter grade stamped (B) on crankshaft front side to the column in the "Connecting Rod Bearing Selection Table".

- A : Main journal diameter grade (No. 1 to 4 from left)
- B : Crankshaft pin journal diameter grade (No. 1 to 3 from left)



3. Read the symbol at the cross point of selected row and column in the "Connecting Rod Bearing Selection Table".
4. Apply the symbol obtained to the "Connecting Rod Bearing Grade Table" to select connecting rod bearing.

WHEN CONNECTING ROD AND CRANKSHAFT ARE REUSED

1. Measure the dimensions of the connecting rod big end diameter and crankshaft pin journal diameter individually. Refer to EM.

HOW TO SELECT PISTON AND BEARING

[HR12DE]

< UNIT DISASSEMBLY AND ASSEMBLY >

2. Apply the measured dimension to the "Connecting Rod Bearing Selection Table".
3. Read the symbol at the cross point of selected row and column in the "Connecting Rod Bearing Selection Table".
4. Apply the symbol obtained to the "Connecting Rod Bearing Grade Table" to select connecting rod bearing.

Connecting Rod Bearing Selection Table

Connecting rod big end diameter		I.D. mark	Hole diameter Unit: mm (in)													
			A	B	C	D	E	F	G	H	J	K	L	M	N	
I.D. mark	Axle diameter Unit mm (in)	Crankshaft pin journal diameter														
		43.000 - 43.001 (1.6929 - 1.6929)	43.001 - 43.002 (1.6929 - 1.6930)	43.002 - 43.003 (1.6930 - 1.6930)	43.003 - 43.004 (1.6930 - 1.6931)	43.004 - 43.005 (1.6931 - 1.6931)	43.005 - 43.006 (1.6931 - 1.6931)	43.006 - 43.007 (1.6931 - 1.6932)	43.007 - 43.008 (1.6932 - 1.6932)	43.008 - 43.009 (1.6932 - 1.6933)	43.009 - 43.010 (1.6933 - 1.6933)	43.010 - 43.011 (1.6933 - 1.6933)	43.011 - 43.012 (1.6933 - 1.6934)	43.012 - 43.013 (1.6934 - 1.6934)	43.013 - 43.014 (1.6934 - 1.6934)	
A	39.971 - 39.970 (1.5737 - 1.5736)	12	12	12	12	12	2	2	2	2	23	23	23	3	3	
B	39.970 - 39.969 (1.5736 - 1.5736)	12	12	12	12	2	2	2	23	23	23	3	3	3	3	
C	39.969 - 39.968 (1.5736 - 1.5735)	12	12	12	2	2	2	23	23	23	3	3	3	3	34	
D	39.968 - 39.967 (1.5735 - 1.5735)	12	12	2	2	2	23	23	23	3	3	3	34	34	34	
E	39.967 - 39.966 (1.5735 - 1.5735)	12	2	2	2	23	23	23	3	3	3	34	34	34	34	
F	39.966 - 39.965 (1.5735 - 1.5734)	2	2	2	23	23	23	3	3	3	34	34	34	34	4	
G	39.965 - 39.964 (1.5734 - 1.5734)	2	2	23	23	23	3	3	3	34	34	34	4	4	4	
H	39.964 - 39.963 (1.5734 - 1.5733)	2	23	23	23	3	3	3	34	34	34	4	4	4	4	
J	39.963 - 39.962 (1.5733 - 1.5733)	23	23	23	3	3	3	34	34	34	4	4	4	4	45	
K	39.962 - 39.961 (1.5733 - 1.5733)	23	23	3	3	3	34	34	34	4	4	4	45	45	45	
L	39.961 - 39.960 (1.5733 - 1.5732)	23	3	3	3	34	34	34	4	4	4	4	45	45	45	
M	39.960 - 39.959 (1.5732 - 1.5732)	3	3	3	34	34	34	4	4	4	45	45	45	45	5	
N	39.959 - 39.958 (1.5732 - 1.5731)	3	3	34	34	34	4	4	4	4	45	45	45	45	5	
P	39.958 - 39.957 (1.5731 - 1.5731)	3	34	34	34	4	4	4	4	45	45	45	45	45	5	
R	39.957 - 39.956 (1.5731 - 1.5731)	34	34	34	4	4	4	4	45	45	45	45	45	45	56	
S	39.956 - 39.955 (1.5731 - 1.5730)	34	34	4	4	4	4	4	45	45	45	45	45	45	56	
T	39.955 - 39.954 (1.5730 - 1.5730)	34	4	4	4	4	4	4	45	45	45	45	45	45	56	
U	39.954 - 39.953 (1.5730 - 1.5729)	4	4	4	4	4	4	4	45	45	45	45	45	45	56	

JPBIA3673GB

Connecting Rod Bearing Grade Table

Connecting Rod Bearing Grade Table : Refer to [EM-157, "Connecting Rod Bearing"](#).

Undersize Bearings Usage Guide

- When the specified connecting rod bearing oil clearance is not obtained with standard size connecting rod bearings, use undersize (US) bearings.
- When using undersize (US) bearing, measure the connecting rod bearing inner diameter with bearing installed, and grind the crankshaft pin so that the connecting rod bearing oil clearance satisfies the standard.

CAUTION:

HOW TO SELECT PISTON AND BEARING

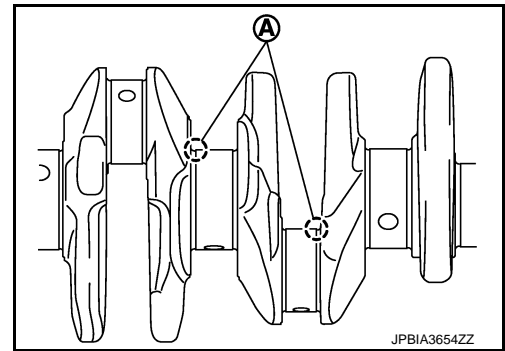
< UNIT DISASSEMBLY AND ASSEMBLY >

[HR12DE]

In grinding crankshaft pin to use undersize bearings, keep the fillet R (A) [0.8 - 1.2 mm (0.031 - 0.047 in)].

Bearing undersize table:

Refer to [EM-157, "Connecting Rod Bearing"](#).



INFOID:000000005988219

Main Bearing

HOW TO SELECT MAIN BEARING

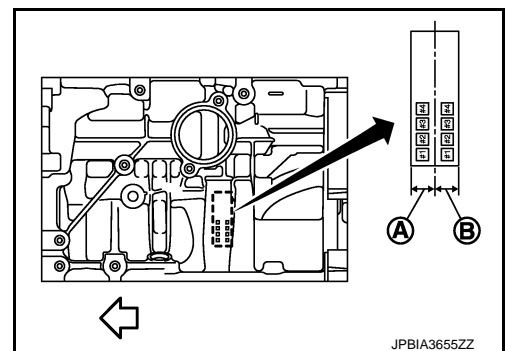
When New Cylinder Block and Crankshaft Are Used

1. "Main Bearing Selection Table" rows correspond to main bearing housing grade on left side of cylinder block.

A : Basic stamp mark

← : Engine front

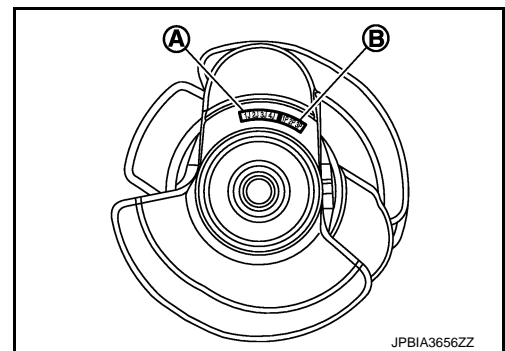
- If there is a corrected stamp mark (B) on cylinder block, use it as a correct reference.



2. Apply main journal diameter grade stamped on crankshaft front side to column in the "Main Bearing Selection Table".

A : Main journal diameter grade (No. 1 to 4 from left)

B : Crankshaft pin journal diameter grade (No. 1 to 3 from left)



3. Read the symbol at the cross point of selected row and column in the "Main Bearing Selection Table".
4. Apply the symbol obtained to the "Main Bearing Grade Table" to select main bearing.

NOTE:

Service part is available as a set of both upper and lower.

When Cylinder Block and Crankshaft Are Reused

1. Measure the dimensions of the cylinder block main bearing housing inner diameter and crankshaft main journal diameter individually. Refer to EM.
2. Apply the measured dimension to the "Main Bearing Selection Table".
3. Read the symbol at the cross point of selected row and column in the "Main Bearing Selection Table".
4. Apply the symbol obtained to the "Main Bearing Grade Table" to select main bearing.

HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR12DE]

Main Bearing Selection Table

I.D. mark	Axle diameter Unit mm (in)	Cylinder block main bearing housing inner diameter	Crankshaft main journal diameter	I.D. mark		Hole diameter Unit: mm (in)																									
				A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W								
A	47.979 - 47.978 (1.8889 - 1.8889)			51.997 - 51.998 (2.0471 - 2.0472)	0	0	0	0	0	0	0	0	0	01	01	01	01	1	1	1	12	12	12	12	2	2	2	2	23	23	
B	47.978 - 47.977 (1.8889 - 1.8889)			51.998 - 51.999 (2.0472 - 2.0472)	0	0	0	0	0	0	0	01	01	01	01	1	1	1	1	12	12	12	12	2	2	2	2	23	23		
C	47.977 - 47.976 (1.8889 - 1.8888)			51.999 - 52.000 (2.0472 - 2.0472)	0	0	0	0	0	01	01	01	01	1	1	1	1	1	1	12	12	12	12	2	2	2	2	23	23	23	
D	47.976 - 47.975 (1.8888 - 1.8888)			52.000 - 52.001 (2.0472 - 2.0472)	0	0	0	0	01	01	01	01	1	1	1	1	1	1	1	12	12	12	12	2	2	2	2	23	23	3	
E	47.975 - 47.974 (1.8888 - 1.8887)			52.001 - 52.002 (2.0473 - 2.0473)	0	0	0	01	01	01	1	1	1	1	1	1	1	1	1	12	12	12	12	2	2	2	2	23	23	3	
F	47.974 - 47.973 (1.8887 - 1.8887)			52.002 - 52.003 (2.0473 - 2.0473)	0	0	01	01	01	1	1	1	1	1	1	1	1	1	1	12	12	12	12	2	2	2	2	23	23	3	
G	47.973 - 47.972 (1.8887 - 1.8887)			52.003 - 52.004 (2.0474 - 2.0474)	0	01	01	01	1	1	1	1	1	1	1	1	1	1	1	12	12	12	12	2	2	2	23	23	3	34	
H	47.972 - 47.971 (1.8886 - 1.8886)			52.004 - 52.005 (2.0474 - 2.0474)	01	01	01	1	1	1	1	1	1	1	1	1	1	1	1	12	12	12	12	2	2	2	23	23	3	34	
J	47.971 - 47.970 (1.8886 - 1.8886)			52.005 - 52.006 (2.0474 - 2.0474)	01	01	1	1	1	1	1	1	1	1	1	1	1	1	1	12	12	12	12	2	2	2	23	23	3	34	
K	47.970 - 47.969 (1.8886 - 1.8885)			52.006 - 52.007 (2.0475 - 2.0475)	01	1	1	1	1	1	1	1	1	1	1	1	1	1	1	12	12	12	12	2	2	2	23	23	3	34	
L	47.969 - 47.968 (1.8885 - 1.8885)			52.007 - 52.008 (2.0475 - 2.0475)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	12	12	12	12	2	2	2	23	23	3	34	
M	47.968 - 47.967 (1.8885 - 1.8885)			52.008 - 52.009 (2.0476 - 2.0476)	1	1	12	12	12	2	2	2	2	2	2	2	2	2	2	2	12	12	12	12	2	2	2	23	23	3	34
N	47.967 - 47.966 (1.8885 - 1.8884)			52.009 - 52.010 (2.0476 - 2.0476)	1	12	12	12	2	2	2	2	2	2	2	2	2	2	2	2	12	12	12	12	2	2	2	23	23	3	34
P	47.966 - 47.965 (1.8884 - 1.8884)			52.010 - 52.011 (2.0477 - 2.0477)	12	12	12	2	2	2	2	2	2	2	2	2	2	2	2	2	12	12	12	12	2	2	2	23	23	3	34
R	47.965 - 47.964 (1.8884 - 1.8883)			52.011 - 52.012 (2.0477 - 2.0477)	12	12	2	2	2	2	2	2	2	2	2	2	2	2	2	2	12	12	12	12	2	2	2	23	23	3	34
S	47.964 - 47.963 (1.8883 - 1.8883)			52.012 - 52.013 (2.0477 - 2.0477)	12	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	12	12	12	12	2	2	2	23	23	3	34
T	47.963 - 47.962 (1.8883 - 1.8883)			52.013 - 52.014 (2.0478 - 2.0478)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	12	12	12	12	2	2	2	23	23	3	34
U	47.962 - 47.961 (1.8883 - 1.8882)			52.014 - 52.015 (2.0478 - 2.0478)	2	2	23	23	23	3	3	3	3	3	3	3	3	3	3	3	12	12	12	12	2	2	2	23	23	3	34
V	47.961 - 47.960 (1.8882 - 1.8882)			52.015 - 52.016 (2.0478 - 2.0478)	2	23	23	23	3	3	3	3	3	3	3	3	3	3	3	3	12	12	12	12	2	2	2	23	23	3	34
W	47.960 - 47.959 (1.8882 - 1.8881)			52.016 - 52.017 (2.0479 - 2.0479)	23	23	23	3	3	3	3	3	3	3	3	3	3	3	3	3	12	12	12	12	2	2	2	23	23	3	34

PBIC3759E

Main Bearing Grade Table

Main Bearing Grade Table : Refer to [EM-156, "Main Bearing"](#).

Use Undersize Bearing Usage Guide

- When the specified main bearing oil clearance is not obtained with standard size main bearings, use undersize (US) bearing.
- When using undersize (US) bearing, measure the main bearing inner diameter with bearing installed, and grind main journal so that the main bearing oil clearance satisfies the standard.

CAUTION:

HOW TO SELECT PISTON AND BEARING

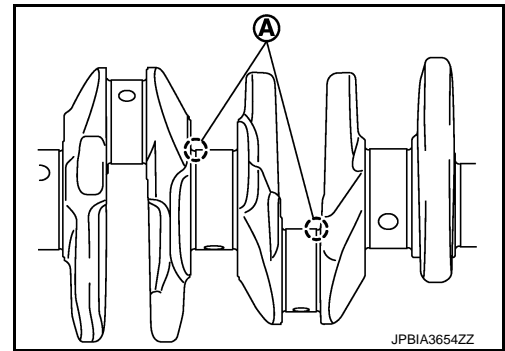
< UNIT DISASSEMBLY AND ASSEMBLY >

[HR12DE]

In grinding crankshaft main journal to use undersize bearings, keep fillet R (A) [0.8 - 1.2 mm (0.031 - 0.047 in)].

Bearing undersize table:

Refer to [EM-156, "Main Bearing"](#).



A

EM

C

D

E

F

G

H

I

J

K

L

M

N

O

P

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR12DE]

SERVICE DATA AND SPECIFICATIONS (SDS)

SERVICE DATA AND SPECIFICATIONS (SDS)

General Specification

INFOID:000000005988220

GENERAL SPECIFICATIONS

Engine type		HR12DE	
Cylinder arrangement		In-line 3	
Displacement	cm ³ (cu in)	1,198 (73.1)	
Bore and stroke	mm (in)	78.0×83.6 (3.070×3.291)	
Valve arrangement		DOHC	
Firing order		1-2-3	
Number of piston rings	Compression	2	
	Oil	1	
Compression ratio	With EGR control valve	10.2	
	Without EGR control valve (For Europe)	10.7	
	Without EGR control valve (Except for Europe)	9.8	
Compression pressure kPa (bar, kg/cm ² , psi) / 200 rpm	With EGR control valve	Standard	1,450 (14.5, 14.79., 210)
		Minimum	1,350 (13.5, 13.77, 196)
	Without EGR control valve (For Europe)	Standard	1,540 (15.4, 15.70, 223)
		Minimum	1,440 (14.4, 14.69, 209)
	Without EGR control valve (Except for Europe)	Standard	1,380 (13.8, 14.07, 200)
		Minimum	1,280 (12.8, 13.05, 186)
Differential limit between cylinders		100 (1.0, 1.0, 14.5)	

Valve Timing

Unit: degree

Valve timing ⇐: Intake valve ⇐: Exhaust valve	<p style="text-align: right; font-size: small;">JPBIA0552ZZ</p>					
		a	b	c	d	e
With valve timing control solenoid valve	208	228	19 (-16) ATDC	67 (32) ABDC	6	22
Without valve timing control solenoid valve	208	216	6 ATDC	42 ABDC	6	22

(): Valve timing control "ON"

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR12DE]

Drive Belt

INFOID:000000005988221

DRIVE BELT

Belt Deflection

Location		Deflection adjustment *			Unit: mm (in)
		Used belt		New belt	
		Limit	After adjusted		
Drive belt	With A/C	10.9 (0.43)	5.1 - 5.6 (0.20 - 0.22)	4.3 - 4.7 (0.17 - 0.19)	
	Without A/C	9.8 (0.39)	4.6 - 5.0 (0.18 - 0.20)	3.9 - 4.2 (0.15 - 0.17)	
Applied pushing force		98 N (10 kg)			

*: When engine is cold.

Belt Tension and Frequency

Location	Tension adjustment *		Unit: N (kg)	Frequency adjustment *		Unit: Hz
	Used belt			New belt	Used belt	
	Limit	After adjusted	Limit		After adjusted	New belt
Drive belt	330 (33.7)	876 - 964 (89.4 - 98.3)	1064 - 1152 (108.5 - 117.5)	133	217 - 227	239 - 248

*: When engine is cold.

Necessary command for belt tension calculation.

Belt span : 0.207m

Belt unit mass : 0.109 kg/m

Spark Plug

INFOID:000000005988222

SPARK PLUG (PLATINUM-TIPPED TYPE)

- With EGR control valve

For Hong Kong

Unit: mm (in)

Make	NGK	
Standard type	DILKAR6A11	
Spark plug gap	Standard	1.1 (0.043)

Except for Hong Kong

Unit: mm (in)

Make	DENSO	
Standard type	FXE20HR11	
Spark plug gap	Standard	1.1 (0.043)

- Without EGR control valve

For Europe

Unit: mm (in)

Make	FEDEMO	
Standard type	REA12WMB4	
Spark plug gap	Standard	1.1 (0.043)

Except for Europe

Unit: mm (in)

Make	FEDEMO	
Standard type	REA12MC4	
Spark plug gap	Standard	1.1 (0.043)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR12DE]

Exhaust Manifold

INFOID:000000005988223

EXHAUST MANIFOLD

Unit: mm (in)

Items	Limit
Surface distortion	0.3 (0.012)

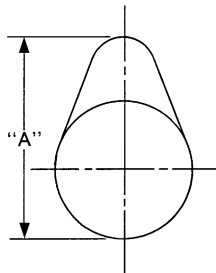
Camshaft

INFOID:000000005988224

CAMSHAFT

Unit: mm (in)

Items	Standard	Limit
Camshaft runout [TIR*]	0.02 (0.0008)	0.1 (0.0039)



SEM671

Camshaft cam height "A"	With valve timing control solenoid valve	Intake	41.705 - 41.895 (1.6419 - 1.6494)	41.505 (1.6341)
		Exhaust	40.175 - 40.365 (1.5816 - 1.5891)	39.975 (1.5738)
	Without valve timing control solenoid valve	Intake	40.915 - 41.105 (1.6108 - 1.6183)	40.715 (1.5738)
		Exhaust	40.175 - 40.365 (1.5816 - 1.5891)	39.975 (1.5738)
Camshaft journal outer diameter	No. 1	27.935 - 27.955 (1.0998 - 1.1006)		—
	No. 2, 3, 4	24.950 - 24.970 (0.9822 - 0.9830)		—
Camshaft bracket inner diameter	No. 1	28.000 - 28.021 (1.1024 - 1.1032)		—
	No. 2, 3, 4	25.000 - 25.021 (0.9842 - 0.9850)		—
Camshaft journal oil clearance	No. 1	0.045 - 0.086 (0.0018 - 0.0034)		—
	No. 2, 3, 4	0.030 - 0.071 (0.0011 - 0.0027)		—
Camshaft end play	0.075 - 0.153 (0.0029 - 0.0060)		0.2 (0.0078)	
Camshaft sprocket runout [TIR*]	—		0.15 (0.0059)	

*: Total indicator reading

Valve Lifter

Unit: mm (in)

Items	Standard
Valve lifter outer diameter	29.977 - 29.987 (1.1801 - 1.1805)
Valve lifter hole diameter	30.000 - 30.021 (1.1811 - 1.1819)
Valve lifter clearance	0.013 - 0.044 (0.0005 - 0.0017)

Valve Clearance

Unit: mm (in)

	Cold	Hot * (reference data)
Intake	0.26 - 0.34 (0.010 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.29 - 0.37 (0.011 - 0.014)	0.308 - 0.432 (0.012 - 0.017)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

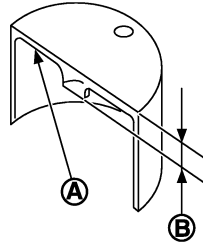
[HR12DE]

*:Approximately 80°C (176°F)

Available Valve Lifter

Unit: mm (in)

Identification mark (A)	Thickness (B)
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JPBIA0170ZZ

300	3.00 (0.1181)
302	3.02 (0.1188)
304	3.04 (0.1196)
306	3.06 (0.1204)
308	3.08 (0.1212)
310	3.10 (0.1220)
312	3.12 (0.1228)
314	3.14 (0.1236)
316	3.16 (0.1244)
318	3.18 (0.1251)
320	3.20 (0.1259)
322	3.22 (0.1267)
324	3.24 (0.1275)
326	3.26 (0.1283)
328	3.28 (0.1291)
330	3.30 (0.1299)
332	3.32 (0.1307)
334	3.34 (0.1314)
336	3.36 (0.1322)
338	3.38 (0.1330)
340	3.40 (0.1338)
342	3.42 (0.1346)
344	3.44 (0.1354)
346	3.46 (0.1362)
348	3.48 (0.1370)
350	3.50 (0.1377)

Cylinder head

INFOID:000000005988225

CYLINDER HEAD

Unit: mm (in)

Items	Limit
Head surface distortion	0.1 (0.004)

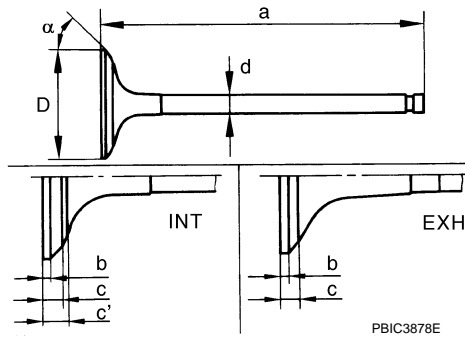
SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR12DE]

Valve Dimensions

Unit: mm (in)

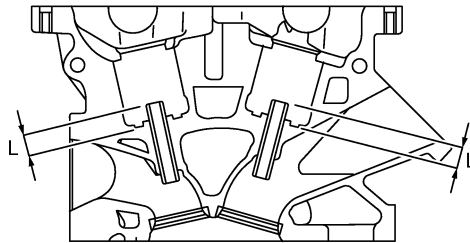


PBIC3878E

Valve head diameter "D"	Intake	31.0 - 31.3 (1.220 - 1.232)
	Exhaust	25.3 - 25.6 (0.996 - 1.007)
Valve length "a"	Intake	101.73 (4.01)
	Exhaust	102.49 (4.04)
"b"	Intake	1.0 (0.0393)
	Exhaust	1.0 (0.0393)
"c"	Intake	2.1 - 2.8 (0.0826 - 0.1102)
	Exhaust	2.3 - 3.0 (0.0905 - 0.1181)
"c'"	Intake	3.0 (0.1181)
	Exhaust	-
"d "	Intake	4.965 - 4.980 (0.1954 - 0.1960)
	Exhaust	4.955 - 4.970 (0.1950 - 0.1956)
Valve seat angle "α"	Intake	45°15' - 45°45'
	Exhaust	

Valve Guide

Unit: mm (in)



PBIC0184E

Items		Standard part	Service part
Valve guide	Outer diameter	9.023 - 9.034 (0.3552 - 0.3556)	9.223 - 9.234 (0.3631 - 0.3635)
	Inner diameter (Finished size)	5.000 - 5.018 (0.1968 - 0.1975)	
Cylinder head valve guide hole diameter		8.975 - 8.996 (0.3533 - 0.3541)	9.175 - 9.196 (0.3612 - 0.3620)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
Items		Standard	Limit
Valve guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.1 (0.004)
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)	0.1 (0.004)
Projection length "L"		11.4 - 11.8 (0.448 - 0.464)	

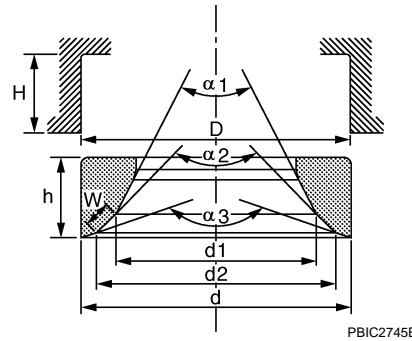
SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR12DE]

Valve Seat

Unit: mm (in)



Items		Standard	Oversize [0.5 (0.02)] (Service)
Cylinder head seat recess diameter "D"	Intake	31.400 - 31.416 (1.2362 - 1.2368)	31.900 - 31.916 (1.2559 - 1.2565)
	Exhaust	25.900 - 25.916 (1.0196 - 1.0203)	26.400 - 26.416 (1.0393 - 1.0399)
Valve seat outer diameter "d"	Intake	31.497 - 31.513 (1.2400 - 1.2406)	31.997 - 32.013 (1.2597 - 1.2603)
	Exhaust	25.991 - 26.007 (1.0233 - 1.0239)	26.491 - 26.507 (1.0430 - 1.0436)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.075 - 0.107 (0.0030 - 0.0042)	
Diameter "d1"*1	Intake	29.0 (1.141)	
	Exhaust	23.0 (0.905)	
Diameter "d2"*2	Intake	30.6 - 30.8 (1.204 - 1.212)	
	Exhaust	24.9 - 25.1 (0.980 - 0.988)	
Angle "α1"	Intake	80°	
	Exhaust	45°	
Angle "α2"	Intake	89°45' - 90°15'	
	Exhaust	89°45' - 90°15'	
Angle "α3"	Intake	140°	
	Exhaust	120°	
Contacting width "W"*3	Intake	1.05 - 1.35 (0.0413 - 0.0531)	
	Exhaust	1.25 - 1.55 (0.0492 - 0.0610)	
Height "h"	Intake	4.7 (0.185)	4.15 (0.163)
	Exhaust	6.0 (0.236)	5.43 (0.213)
Depth "H"	Intake	4.7 (0.185)	
	Exhaust	6.0 (0.236)	

*1: Diameter made by intersection point of conic angles α1 and α2

*2: Diameter made by intersection point of conic angles α2 and α3

*3: Machining data

Valve Spring

Items	Standard	
	Without valve timing control valve	With valve timing control valve
Free height	42.26 mm (1.6637 in)	46.73 mm (1.8398 in)
Installation height	32.40 mm (1.2755 in)	←
Installation load	136 - 154 N (13.9 - 15.7 kg, 31 - 35 lb)	←

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR12DE]

Height during valve open	23.96 mm (0.9433 in)	←
Load with valve open	262 - 296 N (26.7 - 30.2 kg, 59 - 67 lb)	242 - 272 N (24.7 - 27.7 kg, 54 - 66 lb)

Unit: mm (in)

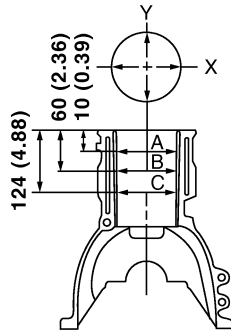
Items	Limit	
	Without valve timing control valve	With valve timing control valve
Valve spring squareness	1.8 (0.071)	2.0 (0.079)

Cylinder Block

INFOID:000000005988226

CYLINDER BLOCK

Unit: mm (in)



PBIC3924E

Surface distortion	Limit	0.1 (0.004)
Cylinder bore	Inner diameter	Standard 78.000 - 78.015 (3.0708 - 3.0714)
		Wear limit —
Out-of-round (Difference between "X" and "Y")	Limit	0.015 (0.0006)
Taper (Difference between "A" and "C")		0.010 (0.0004)
Cylinder block main bearing housing inner diameter grade	Grade No. A	51.997 - 51.998 (2.0471 - 2.0472)
	Grade No. B	51.998 - 51.999 (2.0472 - 2.0472)
	Grade No. C	51.999 - 52.000 (2.0472 - 2.0472)
	Grade No. D	52.000 - 52.001 (2.0472 - 2.0472)
	Grade No. E	52.001 - 52.002 (2.0473 - 2.0473)
	Grade No. F	52.002 - 52.003 (2.0473 - 2.0473)
	Grade No. G	52.003 - 52.004 (2.0474 - 2.0474)
	Grade No. H	52.004 - 52.005 (2.0474 - 2.0474)
	Grade No. J	52.005 - 52.006 (2.0474 - 2.0474)
	Grade No. K	52.006 - 52.007 (2.0475 - 2.0475)
	Grade No. L	52.007 - 52.008 (2.0475 - 2.0475)
	Grade No. M	52.008 - 52.009 (2.0476 - 2.0476)
	Grade No. N	52.009 - 52.010 (2.0476 - 2.0476)
	Grade No. P	52.010 - 52.011 (2.0476 - 2.0476)
Grade No. R	52.011 - 52.012 (2.0477 - 2.0477)	
Grade No. S	52.012 - 52.013 (2.0477 - 2.0477)	
Grade No. T	52.013 - 52.014 (2.0478 - 2.0478)	
Grade No. U	52.014 - 52.015 (2.0478 - 2.0478)	
Grade No. V	52.015 - 52.016 (2.0478 - 2.0478)	
Grade No. W	52.016 - 52.017 (2.0479 - 2.0479)	
Difference in inner diameter between cylinders	Standard	Less than 0.03 (0.0012)

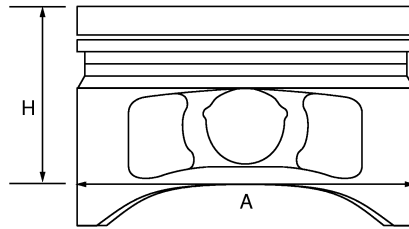
Available Piston

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR12DE]

Unit: mm (in)



PBIC0188E

Piston skirt diameter "A"	For Europe	77.965 - 77.980 (3.0690 - 3.0700)
	Except for Europe	77.966 - 77.980 (3.0695 - 3.0700)
Piston height "H" dimension	For Europe	37.1 (1.4610)
	Except for Europe	35.0 (1.3780)
Piston pin hole diameter	For Europe	19.006 - 19.012 (0.7483 - 0.7485)
	Except for Europe	19.008 - 19.012 (0.7483 - 0.7485)
Piston to cylinder bore clearance		0.020 - 0.050 (0.0007 - 0.0019)

Piston Ring

Unit: mm (in)

Items		Standard	Limit
Side clearance	Top	0.040 - 0.080 (0.0015 - 0.0031)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.10 (0.0039)
	Oil (rail ring)	0.045 - 0.125 (0.0017 - 0.0049)	—
End gap	Top	0.20 - 0.30 (0.0078 - 0.0118)	0.50 (0.0196)
	2nd	0.35 - 0.50 (0.0137 - 0.0196)	0.66 (0.0259)
	Oil (rail ring)	0.20 - 0.60 (0.0079 - 0.0236)	0.92 (0.0362)

Piston Pin

Unit: mm (in)

Piston pin outer diameter		18.996 - 19.000 (0.7478 - 0.7480)	
Piston to piston pin oil clearance	Standard	For Europe	0.008 - 0.012 (0.0003 - 0.0005)
		Except for Europe	0.010 - 0.014 (0.0004 - 0.0005)

Connecting Rod

Unit: mm (in)

Center distance		129.84 - 129.94 (5.1118 - 5.1157)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)
Connecting rod bushing inner diameter*		18.958 - 18.978 (0.7463 - 0.7471)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR12DE]

Side clearance	Standard	0.200 - 0.352 (0.0079 - 0.0138)
Connecting rod big end diameter	Grade No. A	43.000 - 43.001 (1.6929 - 1.6929)
	Grade No. B	43.001 - 43.002 (1.6929 - 1.6930)
	Grade No. C	43.002 - 43.003 (1.6930 - 1.6930)
	Grade No. D	43.003 - 43.004 (1.6930 - 1.6931)
	Grade No. E	43.004 - 43.005 (1.6931 - 1.6931)
	Grade No. F	43.005 - 43.006 (1.6931 - 1.6931)
	Grade No. G	43.006 - 43.007 (1.6931 - 1.6932)
	Grade No. H	43.007 - 43.008 (1.6932 - 1.6932)
	Grade No. J	43.008 - 43.009 (1.6932 - 1.6933)
	Grade No. K	43.009 - 43.010 (1.6933 - 1.6933)
	Grade No. L	43.010 - 43.011 (1.6933 - 1.6933)
	Grade No. M	43.011 - 43.012 (1.6933 - 1.6934)
	Grade No. N	43.012 - 43.013 (1.6934 - 1.6934)

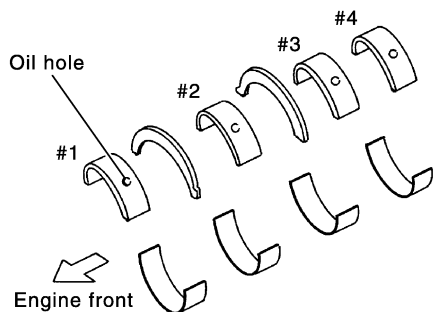
*: After installing in connecting rod

Main Bearing

INFOID:000000005988227

MAIN BEARING

Unit: mm (in)



JPBIA3528GB

Grade number	Thickness	Identification color	Remarks
0	1.996 - 1.999 (0.0785 - 0.0787)	Black	Grade and color are the same for upper and lower bearings.
1	1.999 - 2.002 (0.0787 - 0.0788)	Brown	
2	2.002 - 2.005 (0.0788 - 0.0789)	Green	
3	2.005 - 2.008 (0.0789 - 0.0790)	Yellow	
4	2.008 - 2.011 (0.0790 - 0.0791)	Blue	
5	2.011 - 2.014 (0.0791 - 0.0792)	Pink	
01	UPR	1.996 - 1.999 (0.0785 - 0.0787)	Grade and color are different for upper and lower bearings.
	LWR	1.999 - 2.002 (0.0787 - 0.0788)	
12	UPR	1.999 - 2.002 (0.0787 - 0.0788)	
	LWR	2.002 - 2.005 (0.0788 - 0.0789)	
23	UPR	2.002 - 2.005 (0.0788 - 0.0789)	
	LWR	2.005 - 2.008 (0.0789 - 0.0790)	
34	UPR	2.005 - 2.008 (0.0789 - 0.0790)	
	LWR	2.008 - 2.011 (0.0790 - 0.0791)	
45	UPR	2.008 - 2.011 (0.0790 - 0.0791)	
	LWR	2.011 - 2.014 (0.0791 - 0.0792)	

Undersize

Unit: mm (in)

Items	Thickness	Main journal diameter
US 0.25 (0.0098)	2.126 - 2.134 (0.0837 - 0.0840)	Grind so that bearing clearance is the specified value.

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR12DE]

Bearing Oil Clearance

Unit: mm (in)

Main bearing oil clearance	Standard	0.024 - 0.034 (0.0009 - 0.0013)
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Connecting Rod Bearing

INFOID:000000005988228

CONNECTING ROD BEARING

Unit: mm (in)

Grade number	Thickness	Identification color	Remarks
2	1.504 - 1.507 (0.0592 - 0.0593)	Green	Grade and color are the same for upper and lower bearings.
3	1.507 - 1.510 (0.0593 - 0.0594)	Yellow	
4	1.510 - 1.513 (0.0594 - 0.0596)	Blue	
5	1.513 - 1.516 (0.0596 - 0.0597)	Pink	
12	UPR 1.501 - 1.504 (0.0591 - 0.0592) LWR 1.504 - 1.507 (0.0592 - 0.0593)	Brown Green	
23	UPR 1.504 - 1.507 (0.0592 - 0.0593) LWR 1.507 - 1.510 (0.0593 - 0.0594)	Green Yellow	Grade and color are different between upper and lower bearings.
34	UPR 1.507 - 1.510 (0.0593 - 0.0594) LWR 1.510 - 1.513 (0.0594 - 0.0596)	Yellow Blue	
45	UPR 1.510 - 1.513 (0.0594 - 0.0596) LWR 1.513 - 1.516 (0.0596 - 0.0597)	Blue Pink	
56	UPR 1.513 - 1.516 (0.0596 - 0.0597) LWR 1.516 - 1.519 (0.0597 - 0.0598)	Pink Purple	

Undersize

Unit: mm (in)

Items	Thickness	Crankshaft pin journal diameter
US 0.25 (0.0098)	1.627 - 1.635 (0.0640 - 0.0644)	Grind so that bearing clearance is the specified value.

Bearing Oil Clearance

Unit: mm (in)

Connecting rod bearing oil clearance	Standard	0.020 - 0.030 (0.0008 - 0.0012)
	Limit	0.10 (0.0039)

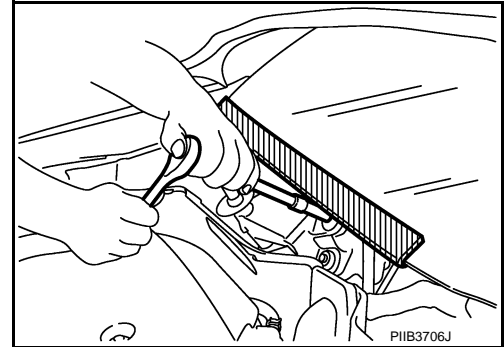
PRECAUTION

PRECAUTIONS

Precaution for Procedure without Cowl Top Cover

INFOID:000000006282241

When performing the procedure after removing cowl top cover, cover the lower end of windshield with urethane, etc.



Precaution Necessary for Steering Wheel Rotation after Battery Disconnect

INFOID:000000006881166

NOTE:

- Before removing and installing any control units, first turn the ignition switch to the LOCK position, then disconnect both battery cables.
- After finishing work, confirm that all control unit connectors are connected properly, then re-connect both battery cables.
- Always use CONSULT to perform self-diagnosis as a part of each function inspection after finishing work. If a DTC is detected, perform trouble diagnosis according to self-diagnosis results.

For vehicle with steering lock unit, if the battery is disconnected or discharged, the steering wheel will lock and cannot be turned.

If turning the steering wheel is required with the battery disconnected or discharged, follow the operation procedure below before starting the repair operation.

OPERATION PROCEDURE

1. Connect both battery cables.
 - NOTE:**
Supply power using jumper cables if battery is discharged.
2. Turn the ignition switch to ACC position.
(At this time, the steering lock will be released.)
3. Disconnect both battery cables. The steering lock will remain released with both battery cables disconnected and the steering wheel can be turned.
4. Perform the necessary repair operation.
5. When the repair work is completed, re-connect both battery cables. With the brake pedal released, turn the ignition switch from ACC position to ON position, then to LOCK position. (The steering wheel will lock when the ignition switch is turned to LOCK position.)
6. Perform self-diagnosis check of all control units using CONSULT.

Precaution for Supplemental Restraint System (SRS) "AIR BAG" and "SEAT BELT PRE-TENSIONER"

INFOID:00000000625126

The Supplemental Restraint System such as "AIR BAG" and "SEAT BELT PRE-TENSIONER", used along with a front seat belt, helps to reduce the risk or severity of injury to the driver and front passenger for certain types of collision. Information necessary to service the system safely is included in the "SRS AIR BAG" and "SEAT BELT" of this Service Manual.

WARNING:

- To avoid rendering the SRS inoperative, which could increase the risk of personal injury or death in the event of a collision which would result in air bag inflation, all maintenance must be performed by an authorized NISSAN/INFINITI dealer.

PRECAUTIONS

[HR15DE]

< PRECAUTION >

- **Improper maintenance, including incorrect removal and installation of the SRS, can lead to personal injury caused by unintentional activation of the system. For removal of Spiral Cable and Air Bag Module, see “SRS AIR BAG”.**
- **Never use electrical test equipment on any circuit related to the SRS unless instructed to in this Service Manual. SRS wiring harnesses can be identified by yellow and/or orange harnesses or harness connectors.**

A

EM

PRECAUTIONS WHEN USING POWER TOOLS (AIR OR ELECTRIC) AND HAMMERS

WARNING:

- **When working near the Air Bag Diagnosis Sensor Unit or other Air Bag System sensors with the ignition ON or engine running, never use air or electric power tools or strike near the sensor(s) with a hammer. Heavy vibration could activate the sensor(s) and deploy the air bag(s), possibly causing serious injury.**
- **When using air or electric power tools or hammers, always switch the ignition OFF, disconnect the battery, and wait at least 3 minutes before performing any service.**

C

D

E

Draining Engine Coolant

INFOID:000000006282244

Drain engine coolant and engine oil when the engine is cooled.

F

Disconnecting Fuel Piping

INFOID:000000006282245

- Before starting work, check no fire or spark producing items are in the work area.
- Release fuel pressure before disconnecting and disassembly.
- After disconnecting pipes, plug openings to stop fuel leakage.

G

Removal and Disassembly

INFOID:000000006282246

- When instructed to use SST, use specified tools. Always be careful to work safely, avoid forceful or uninstructed operations.
- Exercise maximum care to avoid damage to mating or sliding surfaces.
- Dowel pins are used for several parts alignment. When replacing and reassembling parts with dowel pins, check that dowel pins are installed in the original position.
- Cover openings of engine system with a tape or equivalent, if necessary, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and reassembly.
- When loosening nuts and bolts, as a basic rule, start with the one furthest outside, then the one diagonally opposite, and so on. If the order of loosening is specified, do exactly as specified. Power tools may be used in the step.

H

I

J

K

Inspection, Repair and Replacement

INFOID:000000006282247

Before repairing or replacing, thoroughly inspect parts. Inspect new replacement parts in the same way, and replace if necessary.

L

Assembly and Installation

INFOID:000000006282248

- Use torque wrench to tighten bolts or nuts to specification.
- When tightening nuts and bolts, as a basic rule, equally tighten in several different steps starting with the ones in center, then ones on inside and outside diagonally in this order. If the order of tightening is specified, do exactly as specified.
- Replace with new gasket, packing, oil seal or O-ring.
- Thoroughly wash, clean, and air-blow each part. Carefully check engine oil or engine coolant passages for any restriction and blockage.
- Avoid damaging sliding or mating surfaces. Completely remove foreign materials such as cloth lint or dust. Before assembly, oil sliding surfaces well.
- Release air within route when refilling after draining engine coolant.
- After repairing, start the engine and increase engine speed to check engine coolant, fuel, engine oil, and exhaust gases for leakage.

M

N

O

P

Parts Requiring Angle Tightening

INFOID:000000006282249

- Use the angle wrench [SST: KV10112100] for the final tightening of the following engine parts:
 - Camshaft sprocket (INT) bolt

PRECAUTIONS

[HR15DE]

< PRECAUTION >

- Cylinder head bolts
- Main bearing cap bolts
- Connecting rod cap bolts
- Crankshaft pulley bolt (No the angle wrench is required as bolt flange is provided with notches for angle tightening)
- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.

Liquid Gasket

INFOID:000000006282250

REMOVAL OF LIQUID GASKET SEALING

- After removing mounting nuts and bolts, separate the mating surface using the seal cutter [SST: KV10111100] (A) and remove old liquid gasket sealing.

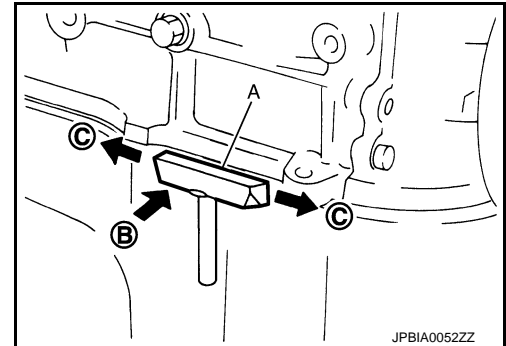
CAUTION:

Be careful not to damage the mating surfaces.

- Tap the seal cutter [SST: KV10111100] to insert it (B), and then slide it (C) by tapping on the side as shown in the figure.
- In areas where the seal cutter [SST: KV10111100] is difficult to use, lightly tap the parts using a plastic hammer to remove it.

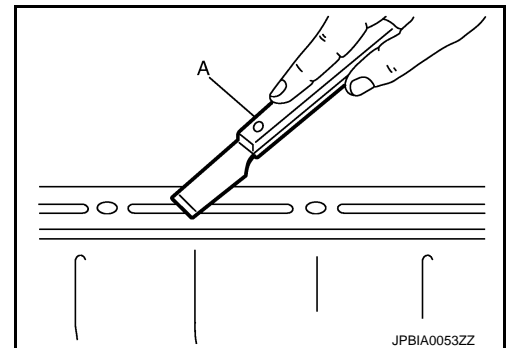
CAUTION:

If for some unavoidable reason tool such as a screwdriver is used, be careful not to damage the mating surfaces.

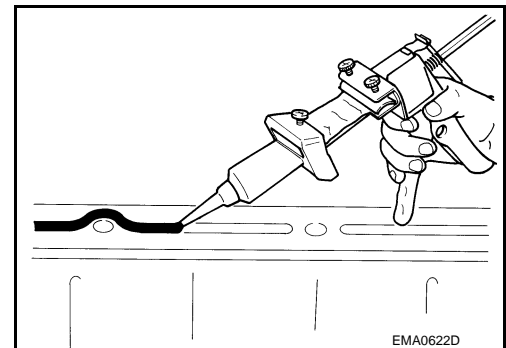


LIQUID GASKET APPLICATION PROCEDURE

1. Using a scraper (A), remove old liquid gasket adhering to the liquid gasket application surface and the mating surface.
 - Remove liquid gasket completely from the groove of the liquid gasket application surface, mounting bolts, and bolt holes.
2. Wipe the liquid gasket application surface and the mating surface with white gasoline (lighting and heating use) to remove adhering moisture, grease and foreign materials.



3. Attach liquid gasket tube to the tube presser (commercial service tool).
Use Genuine Liquid Gasket or equivalent.
4. Apply liquid gasket without gaps to the specified location according to the specified dimensions.
 - If there is a groove for liquid gasket application, apply liquid gasket to the groove.



PRECAUTIONS

[HR15DE]

< PRECAUTION >

- As for bolt holes (B), normally apply liquid gasket inside the holes. Occasionally, it should be applied outside the holes. Check to read the text of this manual.

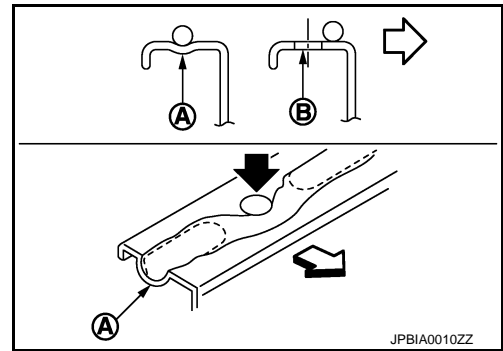
A : Groove

⇐ : Inside

- Within five minutes of liquid gasket application, install the mating component.
- If liquid gasket protrudes, wipe it off immediately.
- Do not retighten mounting bolts or nuts after the installation.
- After 30 minutes or more have passed from the installation, fill engine oil and engine coolant.

CAUTION:

If there are specific instructions in this manual, observe them.



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PREPARATION

< PREPARATION >

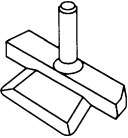
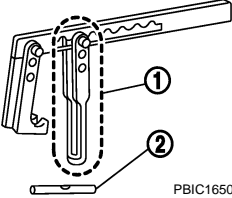
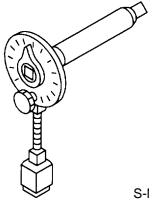
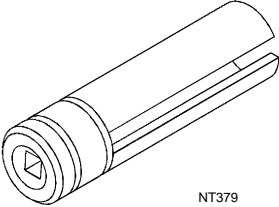
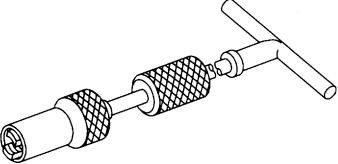
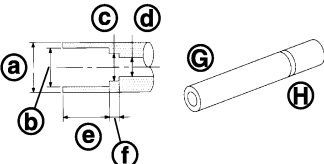
[HR15DE]

PREPARATION

PREPARATION

Special Service Tools

INFOID:000000006282251

Tool number Tool name	Description
KV10111100 Seal cutter	Removing oil pan (upper and lower) etc. <div style="text-align: center; margin-top: 20px;">  <p>S-NT046</p> </div>
KV10116200 Valve spring compressor 1. KV10115900 Attachment 2. KV10109220 Adapter	Disassembling and assembling valve mechanism Part (1) is a component of KV10116200, but Part (2) is not so. <div style="text-align: center; margin-top: 20px;">  <p>PBIC1650E</p> </div>
KV10112100 Angle wrench	Tightening bolts for main bearing cap, cylinder head, etc. <div style="text-align: center; margin-top: 20px;">  <p>S-NT014</p> </div>
KV10117100 Heated oxygen sensor wrench	Loosening or tightening air fuel ratio sensor 1 For 22 mm (0.87 in) width hexagon nut <div style="text-align: center; margin-top: 20px;">  <p>NT379</p> </div>
KV10107902 Valve oil seal puller	Removing valve oil seal <div style="text-align: center; margin-top: 20px;">  <p>NT011</p> </div>
KV10115600 Valve oil seal drift	Installing valve oil seal Use side A (G). a: 20 (0.79) dia. d: 8 (0.31) dia. b: 13 (0.51) dia. e: 10.7 (0.421) c: 10.3 (0.406) dia. f: 5 (0.20) H: Side B <div style="text-align: center; margin-top: 20px;">  <p>JPBIA0396ZZ</p> </div> <p style="text-align: right;">Unit: mm (in)</p>

PREPARATION

< PREPARATION >

[HR15DE]

Tool number Tool name	Description
EM03470000 Piston ring compressor	Installing piston assembly into cylinder bore
ST16610001 Pilot bushing puller	Removing pilot converter
KV11103000 Pulley puller	Removing crankshaft pulley
KV11105210 Stopper plate	Fixing drive plate

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Commercial Service Tools

INFOID:000000006282252

K

Tool name	Description
Quick connector release	Removing fuel tube quick connectors in engine room
Spark plug wrench	Removing and installing spark plug a: 14 mm (0.55 in)

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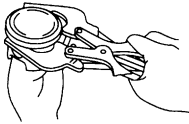
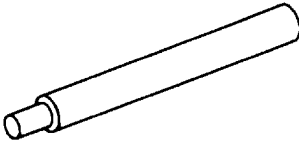
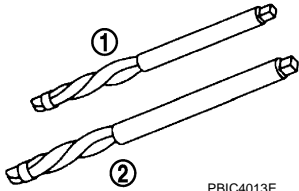
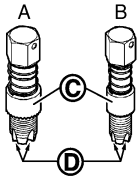

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PREPARATION

< PREPARATION >

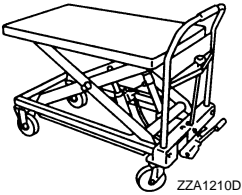
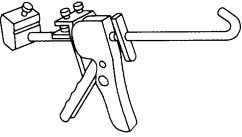
[HR15DE]

Tool name	Description
Pulley holder  <p style="text-align: center; font-size: small;">ZZA1010D</p>	Crankshaft pulley removing and installing
Valve seat cutter set  <p style="text-align: center; font-size: small;">S-NT048</p>	Finishing valve seat dimensions
Piston ring expander  <p style="text-align: center; font-size: small;">S-NT030</p>	Removing and installing piston ring
Valve guide drift  <p style="text-align: center; font-size: small;">PBIC4012E</p>	Removing and installing valve guide
Valve guide reamer  <p style="text-align: center; font-size: small;">PBIC4013E</p>	1: Reaming valve guide inner hole 2: Reaming hole for oversize valve guide
Oxygen sensor thread cleaner  <p style="text-align: center; font-size: small;">JPBIA0238ZZ</p>	Reconditioning the exhaust system threads before installing a new air fuel ratio sensor (Use with anti-seize lubricant shown below.) A: [18 mm (0.71 in) dia.] for zirconia heated oxygen sensor B: [12 mm (0.47 in) dia.] for titania heated oxygen sensor C: Mating surface shave cylinder D: Flutes
Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)  <p style="text-align: center; font-size: small;">EM489</p>	Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads

PREPARATION

< PREPARATION >

[HR15DE]

Tool name	Description
<p>Manual lift table caddy</p> <div style="text-align: center;">  <p>ZZA1210D</p> </div>	<p>Removing and installing engine</p>
<p>Tube presser</p> <div style="text-align: center;">  <p>S-NT052</p> </div>	<p>Pressing the tube of liquid gasket</p>

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BASIC INSPECTION

CAMSHAFT VALVE CLEARANCE

Inspection and Adjustment

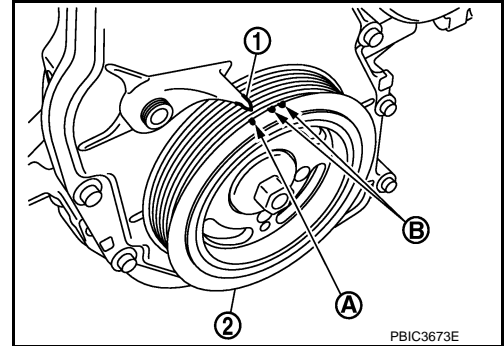
INFOID:000000006282253

INSPECTION

Perform inspection as follows after removal, installation or replacement of camshaft or valve-related parts, or if there is unusual engine conditions regarding valve clearance.

1. Remove rocker cover. Refer to [EM-198, "Removal and Installation"](#).
2. Measure the valve clearance with the following procedure:
 - a. Set No. 1 cylinder at TDC of its compression stroke.
 - Rotate crankshaft pulley (2) clockwise and align TDC mark (no paint) (A) to timing indicator (1) on front cover.

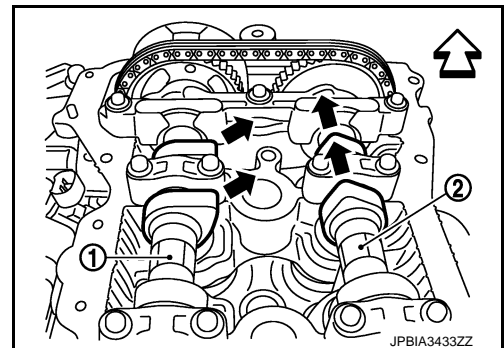
B : White paint mark (Not use for service)



- At the same time, check that both intake and exhaust cam noses of No. 1 cylinder face inside (←) as shown in the figure.

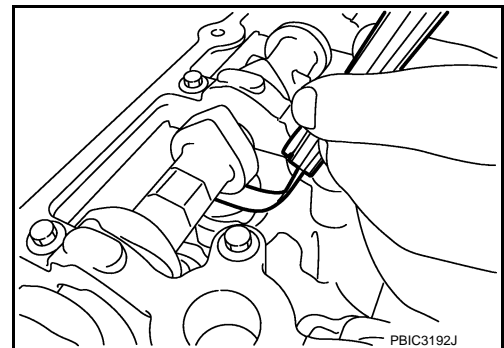
- 1 : Camshaft (INT)
- 2 : Camshaft (EXH)
- ← : Engine front

- If they do not face inside, rotate crankshaft pulley once more (360 degrees) and align as shown in the figure.



- b. Use a feeler gauge, measure the clearance between valve lifter and camshaft.

Valve clearance : Refer to [EM-273, "Camshaft"](#).



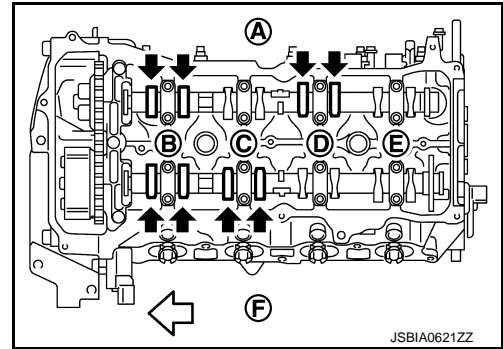
CAMSHAFT VALVE CLEARANCE

[HR15DE]

< BASIC INSPECTION >

- By referring to the figure, measure the valve clearances at locations marked "x" as shown in the table below [locations indicated with black arrow (↖)] with a feeler gauge.
- No. 1 cylinder compression TDC

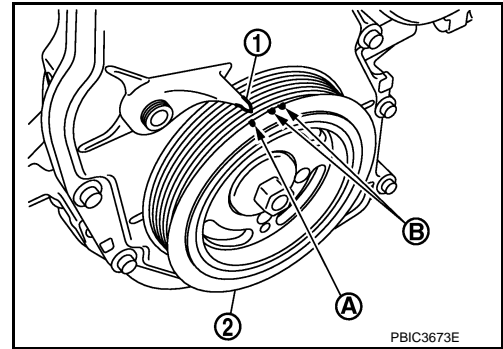
- A : Exhaust side
- B : No.1 cylinder
- C : No.2 cylinder
- D : No.3 cylinder
- E : No.4 cylinder
- F : Intake side
- ↖ : Engine front



Measuring position		No. 1 CYL.	No. 2 CYL.	No. 3 CYL.	No. 4 CYL.
No. 1 cylinder at compression TDC	EXH	x		x	
	INT	x	x		

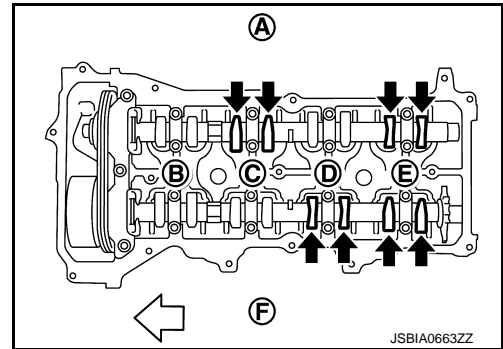
- c. Set No. 4 cylinder at TDC of its compression stroke.
- Rotate crankshaft pulley (2) one revolution (360 degrees) and align TDC mark (no paint) (A) to timing indicator (1) on front cover.

- B : White paint mark (Not use for service)



- By referring to the figure, measure the valve clearance at locations marked "x" as shown in the table below [locations indicated with black arrow (↖)] with a feeler gauge.
- No. 4 cylinder compression TDC

- A : Exhaust side
- B : No.1 cylinder
- C : No.2 cylinder
- D : No.3 cylinder
- E : No.4 cylinder
- F : Intake side
- ↖ : Engine front



Measuring position		No. 1 CYL.	No. 2 CYL.	No. 3 CYL.	No. 4 CYL.
No. 4 cylinder at compression TDC	EXH		x		x
	INT			x	x

3. If out of standard, perform adjustment. Refer to "ADJUSTMENT".

ADJUSTMENT

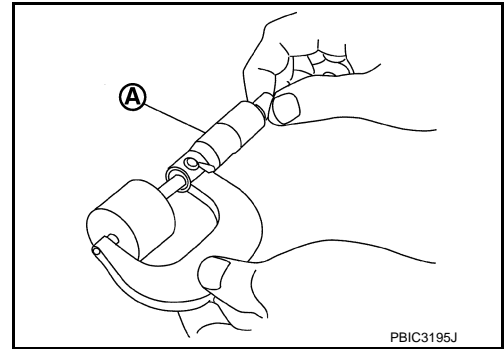
- Perform adjustment depending on selected head thickness of valve lifter.
1. Remove camshaft. Refer to [EM-210, "Exploded View"](#).
 2. Remove valve lifters at the locations that are out of the standard.

CAMSHAFT VALVE CLEARANCE

[HR15DE]

< BASIC INSPECTION >

3. Measure the center thickness of the removed valve lifters with a micrometer (A).



4. Use the equation below to calculate valve lifter thickness for replacement.

Valve lifter thickness calculation: $t = t_1 + (C_1 - C_2)$

t = Valve lifter thickness to be replaced

t₁ = Removed valve lifter thickness

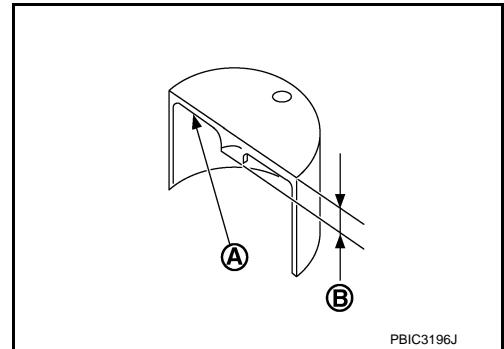
C₁ = Measured valve clearance

C₂ = Standard valve clearance:

Intake : 0.30 mm (0.012 in)

Exhaust : 0.33 mm (0.013 in)

- Thickness of new valve lifter (B) can be identified by stamp mark (A) on the reverse side (inside the cylinder).
- Stamp mark "302" indicates 3.02 mm (0.1189 in) in thickness.



NOTE:

Available thickness of valve lifter: 26 sizes range 3.00 to 3.50 mm (0.1181 to 0.1378 in) in steps of 0.02 mm (0.0008 in) (when manufactured at factory). Refer to [EM-273, "Camshaft"](#).

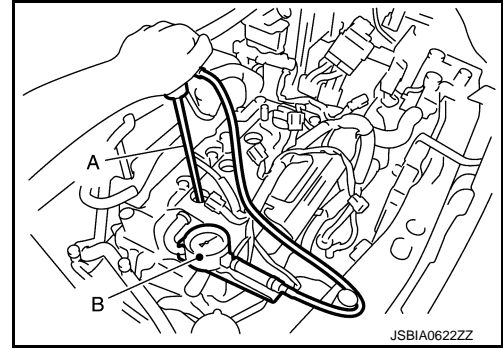
5. Install the selected valve lifter.
6. Install camshaft. Refer to [EM-210, "Exploded View"](#).
7. Install timing chain and related parts. Refer to [EM-200, "Exploded View"](#).
8. Manually rotate crankshaft pulley a few rotations.
9. Check that the valve clearances is within the standard. Refer to "INSPECTION".
10. Install remaining parts in the reverse order of removal.
11. Warm up the engine, and check for unusual noise and vibration.

COMPRESSION PRESSURE

Inspection

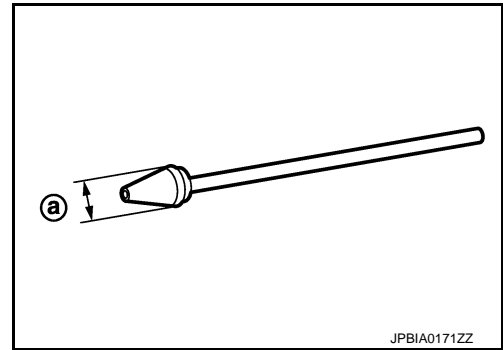
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1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to [EC-887, "Work Procedure"](#).
3. Remove ignition coil and spark plug from each cylinder. Refer to [EM-198, "Exploded View"](#).
4. Connect engine tachometer (not required in use of CONSULT-III).
5. Install compression gauge (B) with an adapter (A) (commercial service tool) onto spark plug hole.



- Use the adapter whose picking up end inserted to spark plug hole is smaller than 20 mm (0.79 in) in diameter. Otherwise, it may be caught by cylinder head during removal.

a : 20 mm (0.79 in)



6. With accelerator pedal fully depressed, turn ignition switch to "START" for cranking. When the gauge pointer stabilizes, read the compression pressure and the engine rpm. Perform these steps to check each cylinder.

Compression pressure : Refer to [EM-272, "General Specification"](#).

CAUTION:

Always use a fully charged battery to obtain the specified engine speed.

- If the engine speed is out of the specified range, check battery liquid for proper gravity. Check the engine speed again with normal battery gravity. Refer to following.
 - For maintenance required battery models: [PG-265, "FOR MAINTENANCE REQUIRED BATTERY MODELS : How to Handle Battery"](#).
 - For maintenance free battery models: [PG-273, "FOR MAINTENANCE FREE BATTERY MODELS : How to Handle Battery"](#).
 - If compression pressure is below minimum value, check valve clearances, and parts associated with combustion chamber (valve, valve seat, piston, piston ring, cylinder bore, cylinder head, and cylinder head gasket). After the checking, measure compression pressure again.
 - If some cylinder has low compression pressure, pour small amount of engine oil into the spark plug hole of the cylinder to recheck it for compression.
 - If the added engine oil improves the compression, piston rings may be worn out or damaged. Check piston rings and replace if necessary.
 - If the compression pressure remains at low level despite the addition of engine oil, valves may be malfunctioning. Check valves for damage. Replace valve or valve seat accordingly.
 - If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, cylinder head gaskets are leaking. In such a case, replace cylinder head gaskets.
7. After inspection is completed, install removed parts.

COMPRESSION PRESSURE

< BASIC INSPECTION >

[HR15DE]

8. Start the engine, and check that the engine runs smoothly.
9. Perform trouble diagnosis. If DTC appears, erase it. Refer to [EC-895, "Diagnosis Procedure"](#).

SYMPTOM DIAGNOSIS

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

NVH troubleshooting Chart

INFOID:000000006282255

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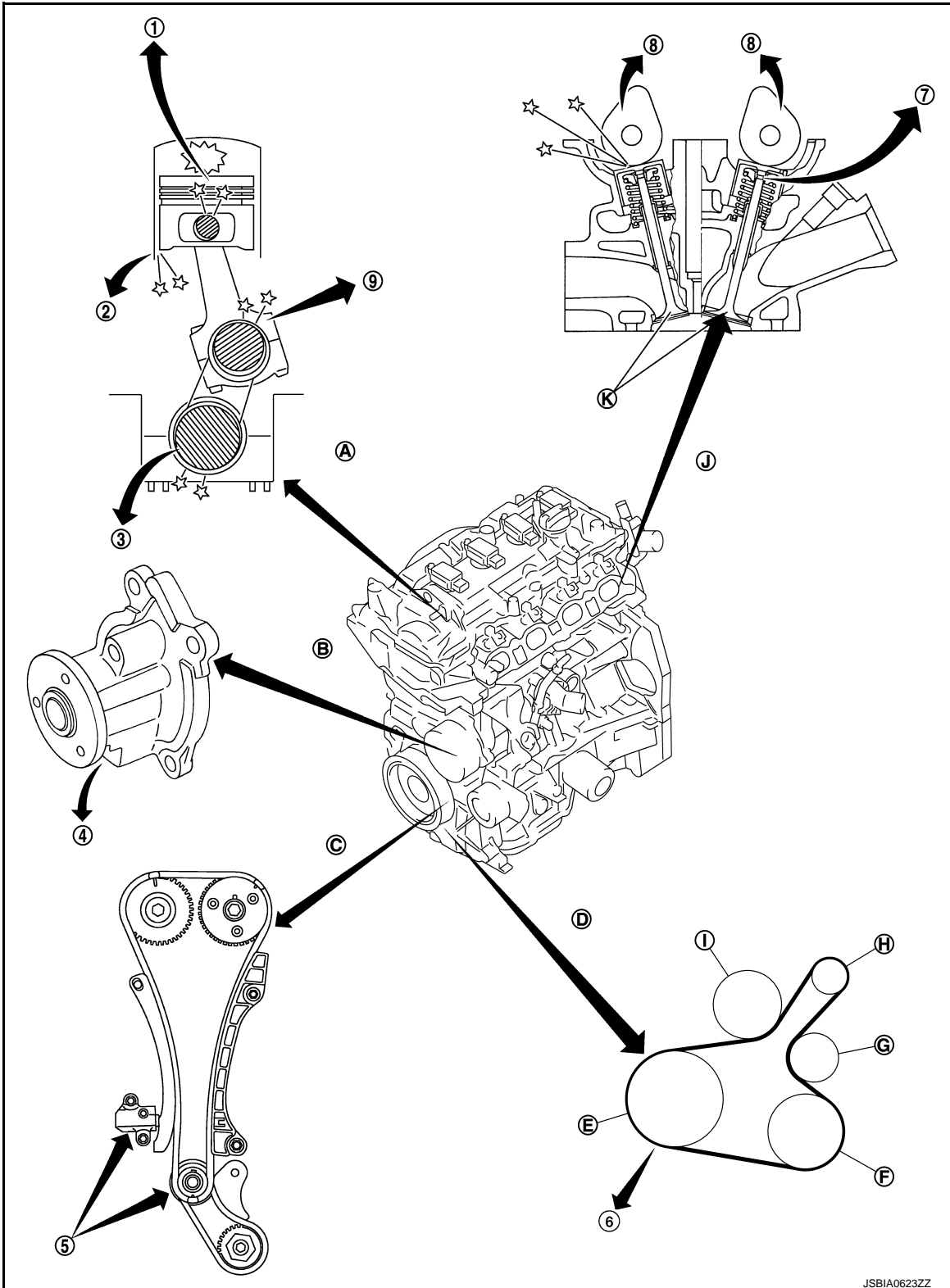
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JSBIA0623ZZ

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

< SYMPTOM DIAGNOSIS >

[HR15DE]

- | | | |
|-------------------------|-------------------------------------|--------------------------------------|
| 1. Piston pin noise | 2. Piston slap noise | 3. Main bearing noise |
| 4. Water pump noise | 5. Timing chain and tensioner noise | 6. Drive belt noise (stick/slipping) |
| 7. Tappet noise | 8. Camshaft bearing noise | 9. Connecting rod noise |
| A. Rotational mechanism | B. Water pump | C. Timing chain |
| D. Drive belt | E. Crankshaft pulley | F. A/C compressor |
| G. Tension pulley | H. Alternator | I. Water pump |
| J. Valve mechanism | K. Valves | |

Use the Chart Below to Help You Find the Cause of the Symptom

INFOID:000000006307776

1. Locate the area where noise occurs.
 2. Confirm the type of noise.
 3. Specify the operating condition of engine.
 4. Check specified noise source.
- If necessary, repair or replace these parts.

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Valve clearance	EM-166
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance Camshaft runout	EM-273
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston to piston pin oil clearance Connecting rod bushing oil clearance	EM-277
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston to cylinder bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	EM-277
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance	EM-277 EM-280
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-279 EM-277
Front of engine Front cover	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	EM-208 EM-200
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belt (Sticking or slipping)	Drive belt deflection	EM-272
	Creaking	A	B	A	B	A	B	Drive belt (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	CO-48

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

< SYMPTOM DIAGNOSIS >

[HR15DE]

A: Closely related B: Related C: Sometimes related —: Not related

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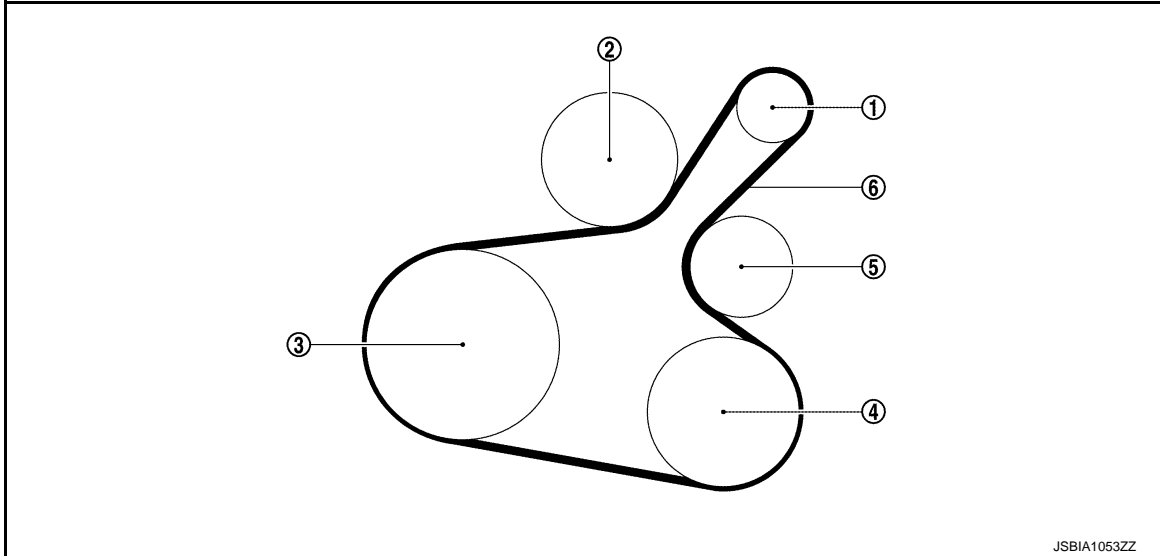
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PERIODIC MAINTENANCE

DRIVE BELT

Exploded View

INFOID:000000006839888



- | | | |
|--|-----------------|----------------------|
| 1. Alternator | 2. Water pump | 3. Crankshaft pulley |
| 4. A/C compressor (with A/C models)
Idler pulley (without A/C models) | 5. Idler pulley | 6. Drive belt |

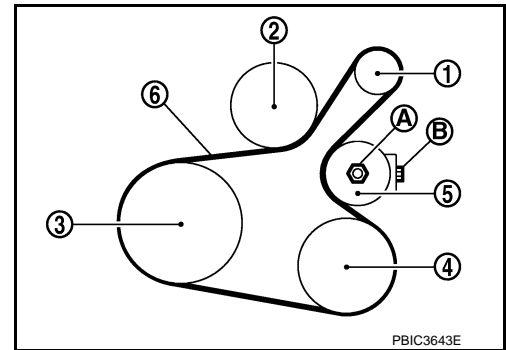
Removal and Installation

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REMOVAL

1. Remove the fender protector (RH) front side clip. And keep a service area. Refer to [EXT-20, "FENDER PROTECTOR : Exploded View"](#).
2. Loosen the lock nut (A), and then adjust the belt tension by turning the adjusting bolt (B).

- | | |
|---|---|
| 1 | : Alternator |
| 2 | : Water pump |
| 3 | : Crankshaft pulley |
| 4 | : A/C compressor (with A/C models)
: Idler pulley (without A/C models) |
| 5 | : Idler pulley |
| 6 | : Drive belt |



3. Remove drive belt.

INSTALLATION

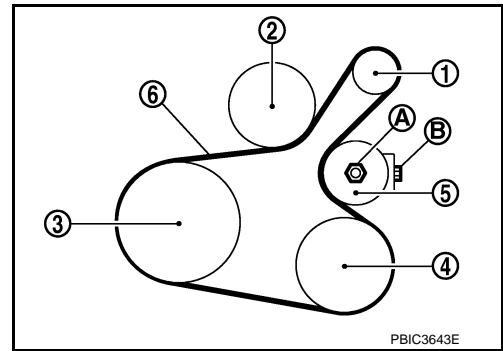
DRIVE BELT

< PERIODIC MAINTENANCE >

[HR15DE]

1. Pull the idler pulley in the loosening direction, and then temporarily tighten the lock nut (A) to the following torque.

- 1 : Alternator
- 2 : Water pump
- 3 : Crankshaft pulley
- 4 : A/C compressor (with A/C models)
: Idler pulley (without A/C models)
- 5 : Idler pulley
- 6 : Drive belt
- B : Adjusting bolt



 : 4.4 N·m (0.45 kg·m, 39 in·lb)

NOTE:

Do not move the lock nut from the tightened position. Go to step "2".

2. Install the drive belt to each pulley.

CAUTION:


- Check that there is no oil, grease, or coolant, etc. in pulley grooves.
- Check that the belt is securely inside the groove on each pulley.

3. Adjust drive belt tension by turning the adjusting bolt (B). Refer to [EM-176. "Adjustment"](#).

CAUTION:

- Perform the belt tension adjustment with the lock nut temporarily tightened at the step "1" so as not to tilt the idler pulley.
- When checking immediately after installation, first adjust it to the specified value. Then, after turning crankshaft two turns or more, readjust to the specified value to avoid variation in deflection between pulleys.

4. Tighten the lock nut.

 : 34.8 N·m (3.5 kg·m, 26 ft·lb)

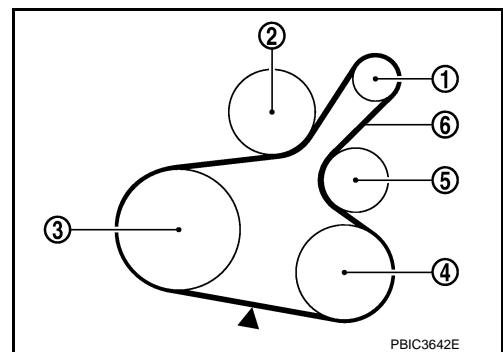
5. Check that belt tension of each belt within the standard.

Inspection

INFOID:000000006839889

- Inspection should be done only when engine is cold or over 30 minutes after the engine is stopped.

- 1 : Alternator
- 2 : Water pump
- 3 : Crankshaft pulley
- 4 : A/C compressor (with A/C models)
: Idler pulley (without A/C models)
- 5 : Idler pulley
- 6 : Drive belt



- Visually check belts for wear, damage, and cracks on inside and edges.
- Turn crankshaft pulley two times clockwise, and check tension on all pulleys is equal before doing the test.
- When measuring deflection, apply 98 N (10 kg, 22 lb) at the (▼) marked point.
- Measure the belt tension and frequency with acoustic tension gauge (commercial service tool) at the (▼) marked point.

CAUTION:

- When the tension and frequency are measured, the acoustic tension gauge should be used.
- When checking immediately after installation, first adjust it to the specified value. Then, after turning crankshaft two turns or more, readjust to the specified value to avoid variation in deflection between pulleys.

DRIVE BELT

< PERIODIC MAINTENANCE >

[HR15DE]

Belt Deflection/Belt Tension and Frequency: Refer to [EM-272, "Drive Belt"](#).

Adjustment

INFOID:000000006839890

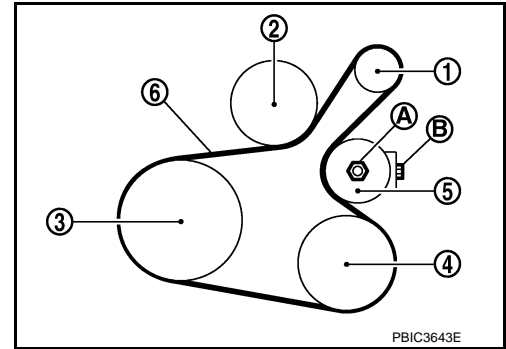
Location	Location of adjuster and tightening method
Drive belt	Adjusting bolt on idler pulley

CAUTION:

- When belt is replaced with new one, adjust belt tension to the value for “New belt”, because new belt will not fully seat in the pulley groove.
- When tension of the belt being used exceeds “Limit”, adjust it to the value for “After adjusted”.
- When installing a belt, check it is correctly engaged with the pulley groove.
- Never allow oil or engine coolant to get on the belt.
- Never twist or bend the belt strongly.

1. Remove the fender protector (RH) front side clip. And keep a service area. Refer to [EXT-20, "FENDER PROTECTOR : Exploded View"](#).
2. Loosen the idler pulley lock nut (A) from the tightening position.

- 1 : Alternator
- 2 : Water pump
- 3 : Crankshaft pulley
- 4 : A/C compressor (with A/C models)
: Idler pulley (without A/C models)
- 5 : Idler pulley
- 6 : Drive belt
- B : Adjusting blot



3. Lock nut (A) is temporarily tightened by the following torque.

Tightening torque : 4.4N·m(0.45kg·m, 39in·lb)

4. Adjust the belt tension by turning the adjusting bolt (B). Refer to [EM-176, "Adjustment"](#).

CAUTION:

- When checking immediately after installation, first adjust it to the specified value. Then, after turning crankshaft two turns or more, readjust to the specified value to avoid variation in deflection between pulleys.
 - When the tension adjustment is performed, the lock nut should be in the condition at step“ 2”. If the tension adjustment is performed when the lock nut is loosened more than the temporary tightening, the idler pulley tilts and the correct tension adjustment cannot be performed.
5. Tighten the lock nut.

 : **34.8 N·m (3.5 kg·m, 26 ft·lb)**

AIR CLEANER FILTER

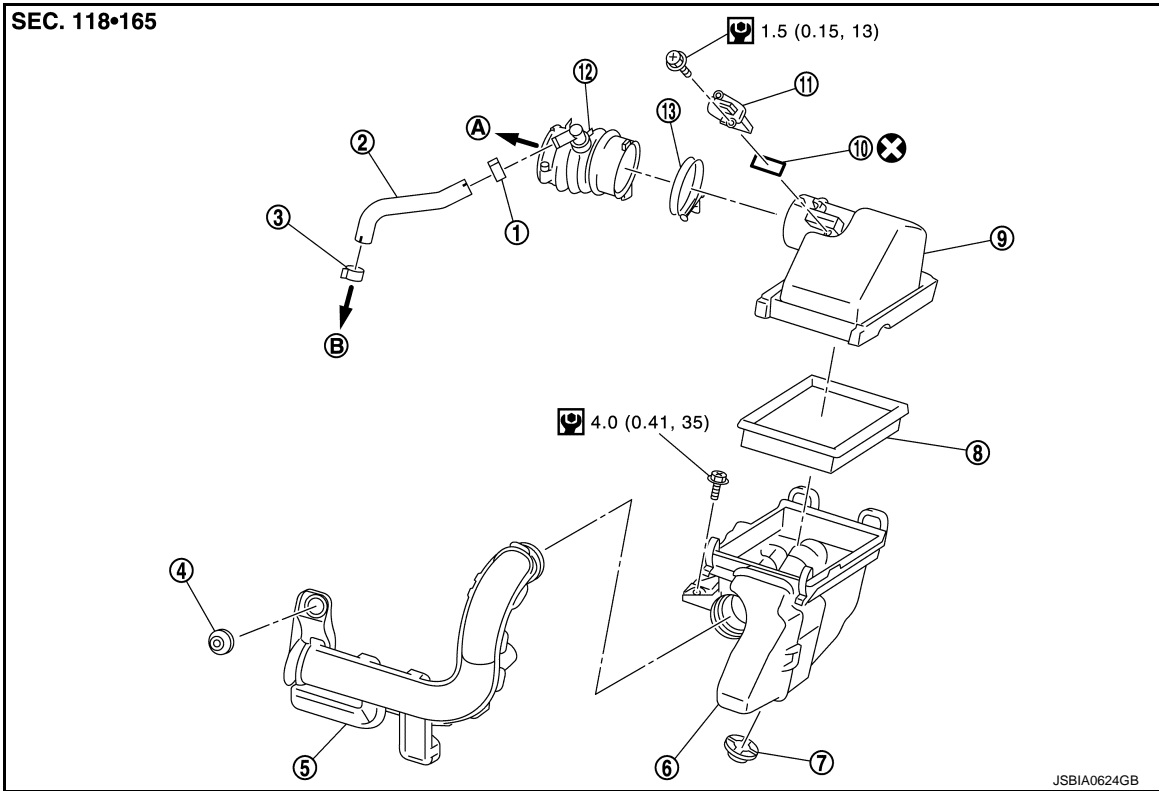
[HR15DE]

< PERIODIC MAINTENANCE >

AIR CLEANER FILTER

Exploded View

INFOID:000000006282259



- | | | |
|-----------------|--------------------------|----------------------|
| 1. Clamp | 2. PCV hose | 3. Clamp |
| 4. Mount rubber | 5. Air duct (inlet) | 6. Air cleaner body |
| 7. Grommet | 8. Air cleaner filter | 9. Air cleaner cover |
| 10. O-ring | 11. Mass air flow sensor | 12. Air duct |
| 13. Clamp | | |

A. To electric throttle control actuator B. To rocker cover

⊗ : Always replace after every disassembly.

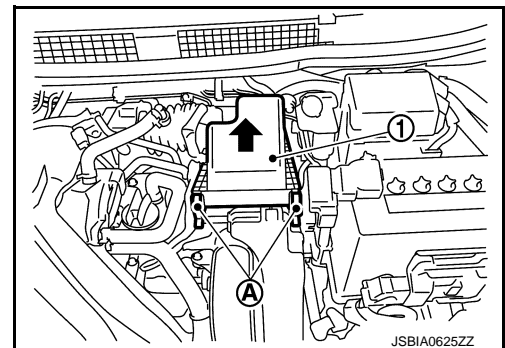
☐ : N·m (kg·m, in·lb)

Removal and Installation

INFOID:000000006282260

REMOVAL

1. Unhook clips (A) and pull up the air cleaner cover upward (1).



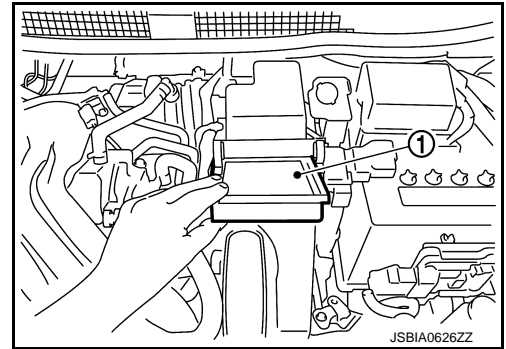
JSBIA0625ZZ

AIR CLEANER FILTER

< PERIODIC MAINTENANCE >

[HR15DE]

2. Remove the air cleaner filter (1) from the air cleaner body.



INSTALLATION

Note the following, and install in the reverse order of removal.

- Check that the air cleaner filter is securely placed in the air cleaner body.

SPARK PLUG

< PERIODIC MAINTENANCE >

[HR15DE]

SPARK PLUG

Removal and Installation

INFOID:000000006282261

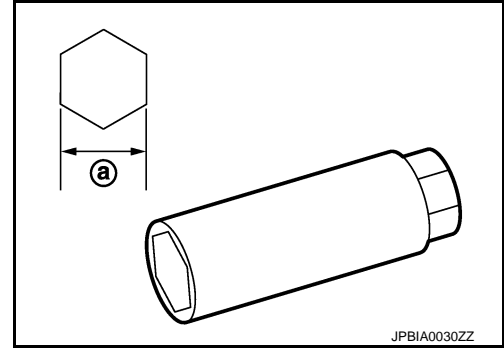
REMOVAL

1. Remove ignition coil. Refer to [EM-198, "Exploded View"](#).
2. Remove spark plug with a spark plug wrench (commercial service tool).

a : 14 mm (0.55 in)

CAUTION:

Never drop or shock spark plug.



INSTALLATION

Install in the reverse order of removal.

Inspection

INFOID:000000006282262

INSPECTION AFTER REMOVAL

Use the standard type spark plug for normal condition.

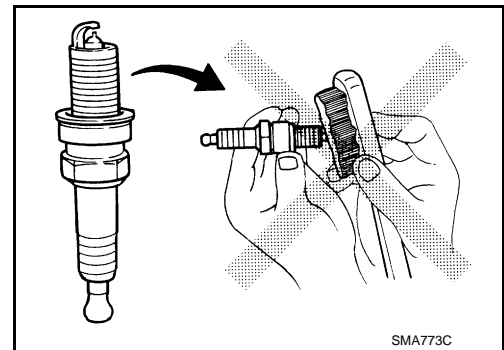
Spark plug (Standard type) : Refer to [EM-273, "Spark Plug"](#).

CAUTION:

- Never drop or shock spark plug.
- Never use a wire brush for cleaning.
- If plug tip is covered with carbon, spark plug cleaner may be used.

Cleaner air pressure : Less than 588 kPa (6 kg/cm², 85 psi)

Cleaning time : Less than 20 seconds



REMOVAL AND INSTALLATION

DRIVE BELT IDLER PULLEY

Removal and Installation

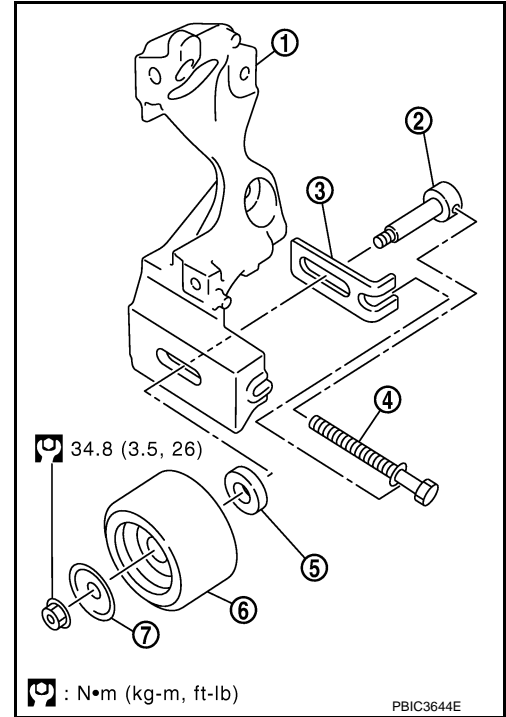
INFOID:000000006282263

REMOVAL

1. Remove drive belt. Refer to [EM-174. "Removal and Installation"](#).
2. Remove the lock nut, and then remove the plate (7), idler pulley (6), and washer (5).

1 : Alternator bracket

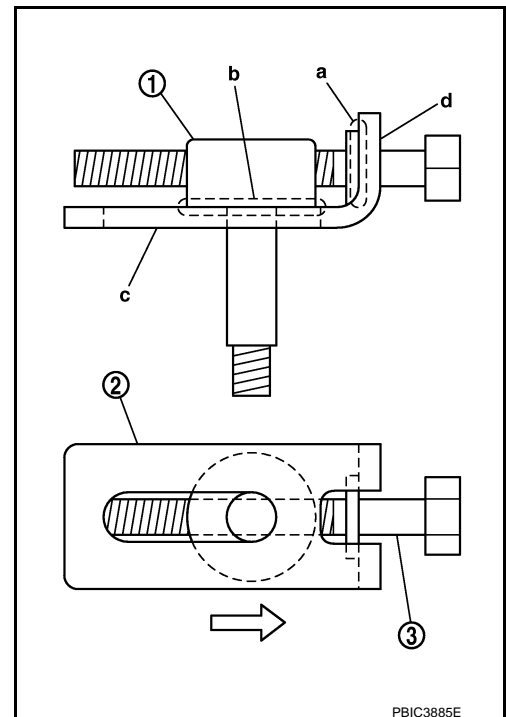
3. Remove the center shaft (2) together with the spacer (3) with inserting the adjusting bolt (4).



INSTALLATION

1. Insert the center shaft (1) into the slide groove of the spacer (2). Fully screw in the adjusting bolt (3) in the belt loosening direction (↔).
 - At that time, place the flange (a) of the adjusting bolt and the seat (b) of the center shaft on the spacer.
2. Place each surface (c and d) of the spacer on the alternator bracket. Install the washer, idler pulley, and plate, and then temporarily tighten the lock nut.

: 4.4 N·m (0.45 kg-m, 39 in-lb)



3. Install removed parts in the reverse order of removal.

AIR CLEANER AND AIR DUCT

< REMOVAL AND INSTALLATION >

[HR15DE]

- **Never shock the mass air flow sensor.**
- **Never disassemble the mass air flow sensor.**
- **Never touch the sensor of the mass air flow sensor.**

INSTALLATION

Note the following, and install in the reverse order of removal.

- Align marks. Attach each joint. Screw clamps firmly.

Inspection

INFOID:000000006282266

INSPECTION AFTER REMOVAL

Inspect air duct and resonator assembly for crack or tear.

- If anything found, replace air duct and resonator assembly.

INTAKE MANIFOLD

< REMOVAL AND INSTALLATION >

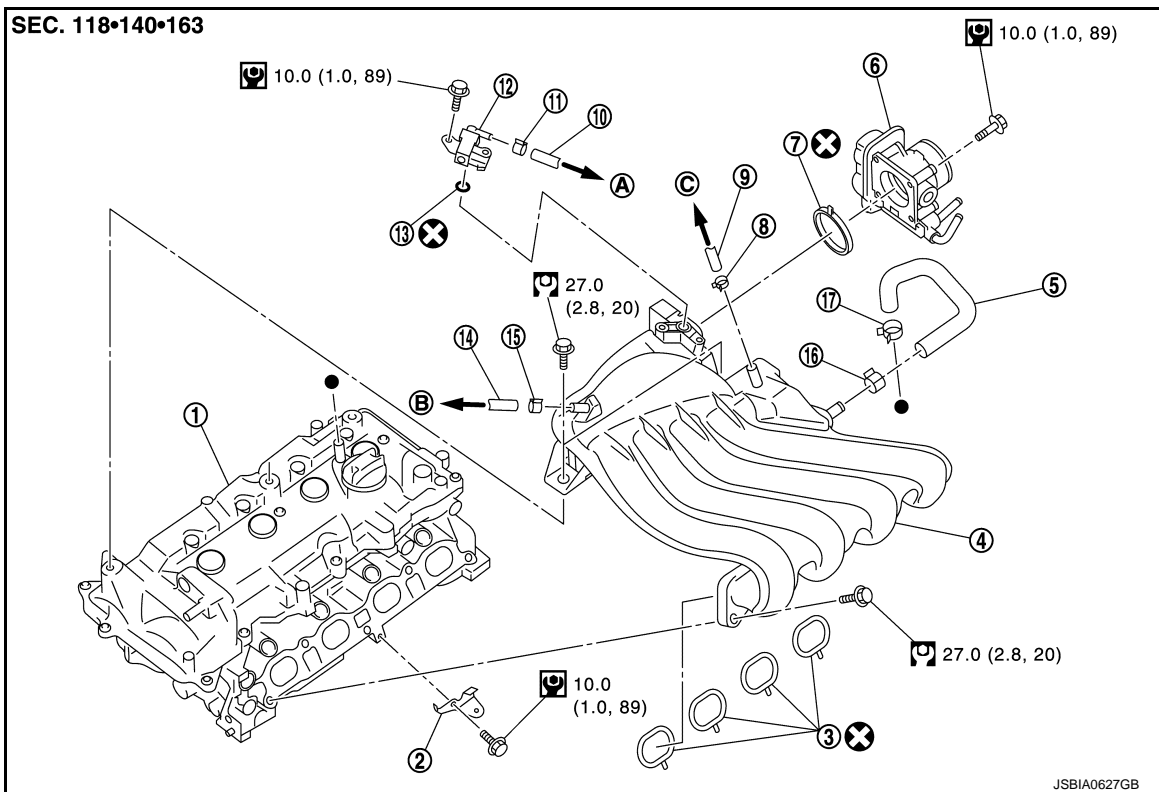
[HR15DE]

INTAKE MANIFOLD

Exploded View

INFOID:000000006282267

For China



- | | | |
|--------------------------------------|----------------------------|---|
| 1. Cylinder head | 2. Intake manifold support | 3. Gasket |
| 4. Intake manifold | 5. PCV hose | 6. Electric throttle control actuator |
| 7. Gasket | 8. Clamp | 9. PCV hose |
| 10. Vacuum hose | 11. Clamp | 12. EVAP canister purge volume control solenoid valve |
| 13. O-ring | 14. Vacuum hose | 15. Clamp |
| 16. Clamp | 17. Clamp | |
| A. To centralized under-floor piping | B. To brake booster | C. To air duct |

⊗ : Always replace after every disassembly.

🔧 : N·m (kg-m, in-lb)

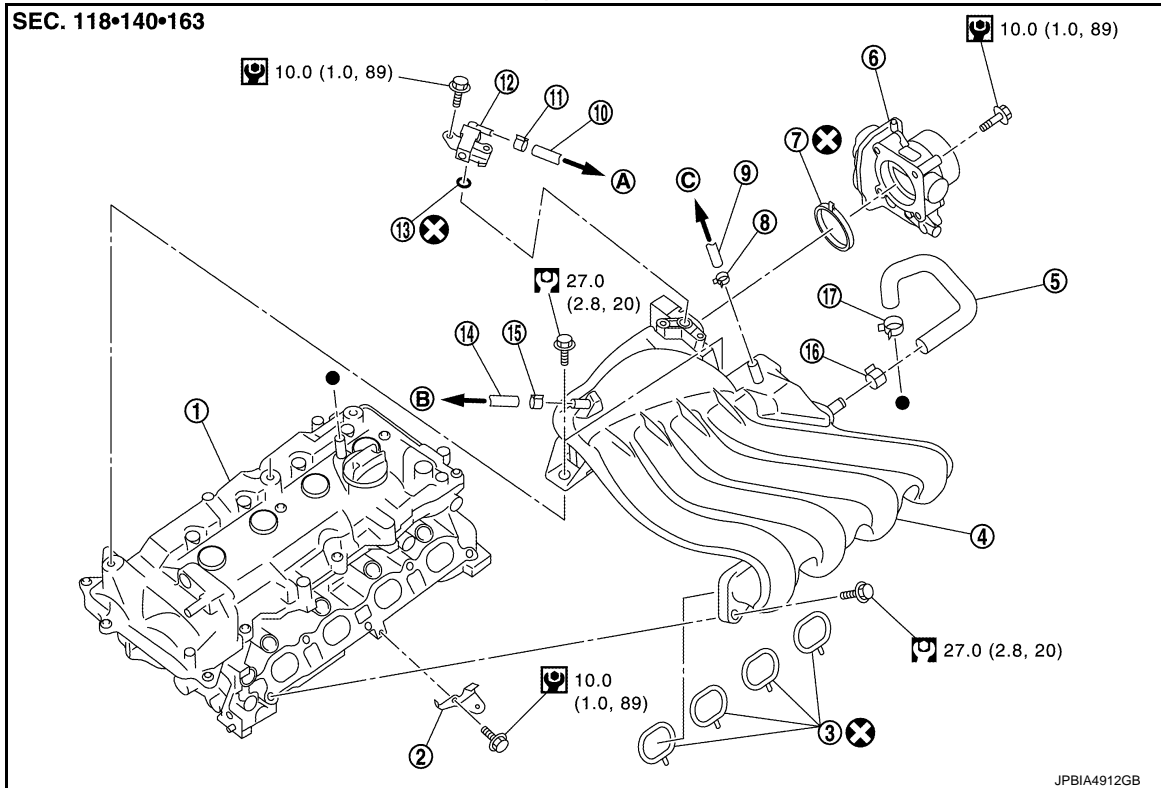
🔧 : N·m (kg-m, ft-lb)

INTAKE MANIFOLD

< REMOVAL AND INSTALLATION >

[HR15DE]

Except for China



- | | | |
|--------------------------------------|----------------------------|---|
| 1. Cylinder head | 2. Intake manifold support | 3. Gasket |
| 4. Intake manifold | 5. PCV hose | 6. Electric throttle control actuator |
| 7. Gasket | 8. Clamp | 9. PCV hose |
| 10. Vacuum hose | 11. Clamp | 12. EVAP canister purge volume control solenoid valve |
| 13. O-ring | 14. Vacuum hose | 15. Clamp |
| 16. Clamp | 17. Clamp | |
| A. To centralized under-floor piping | B. To brake booster | C. To air duct |

⊗ : Always replace after every disassembly.

🔧 : N·m (kg·m, in·lb)

🔧 : N·m (kg·m, ft·lb)

Removal and Installation

INFOID:000000006282268

REMOVAL

- Remove air duct (inlet) and air duct assembly. Refer to [EM-181, "Exploded View"](#).
- Drain engine coolant. Refer to [CO-38, "Draining"](#) (For china).
CAUTION:
• Perform this step when the engine is cold.
• Never spill engine coolant on drive belt.
- Pull out oil level gauge.
CAUTION:
Cover the oil level gauge guide openings to avoid entry of foreign materials.
- Disconnect water hoses from electric throttle control actuator (For china) as follows:
• Drain engine coolant from radiator or attach plug to prevent engine coolant leakage when engine coolant is not drained. Refer to [CO-38, "Draining"](#).
CAUTION:
Perform this step when the engine is cold.
- Remove electric throttle control actuator.

INTAKE MANIFOLD

< REMOVAL AND INSTALLATION >

[HR15DE]

CAUTION:

- Handle carefully to avoid any shock to electric throttle control actuator.
- Never disassemble electric throttle control actuator.

6. Disconnect the harness connector and EVAP hose from the EVAP canister purge volume control solenoid valve.

CAUTION:

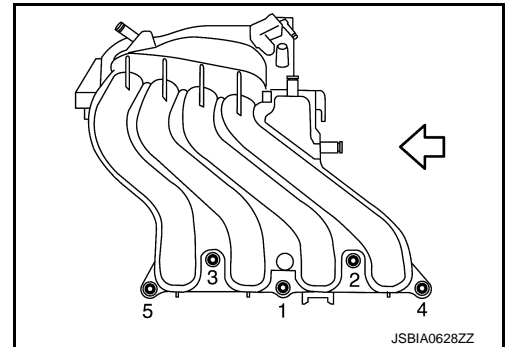
Handle it carefully and avoid impacts.

7. Disconnect vacuum hose for brake booster from intake manifold.
8. Remove intake manifold with the following procedure:
- a. Loosen mounting bolts between intake manifold and rocker cover.
 - b. Loosen mounting bolts in reverse order as shown in the figure.

← : Engine front

CAUTION:

Cover engine openings to avoid entry of foreign materials.

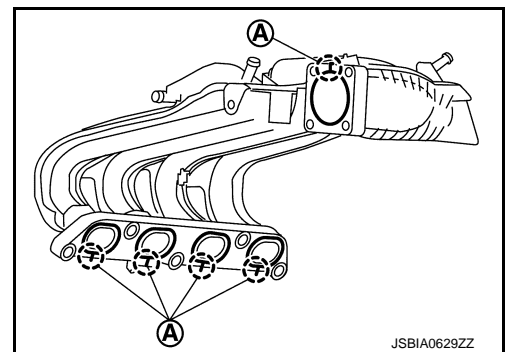


INSTALLATION

Note the following, and install in the reverse order of removal.

Intake Manifold

1. Install the gasket to the intake manifold.
- Align the protrusion (A) of gasket to the groove of intake manifold.



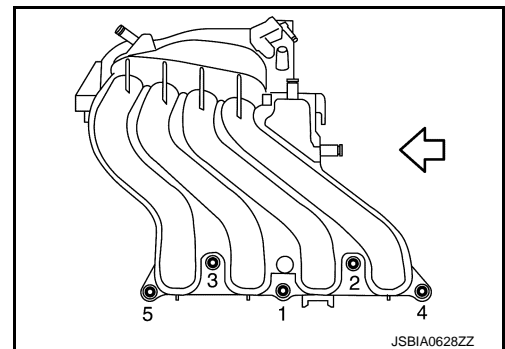
2. Place the intake manifold into the installation position.

CAUTION:

Check that the oil level gauge guide is not disconnected from the fixing clip of water inlet due to interference with intake manifold.

3. Tighten bolts in the numerical order as shown in the figure.

← : Engine front



Electric Throttle Control Actuator

- Tighten bolts of electric throttle control actuator equally and diagonally in several steps.
- Perform "Throttle Valve Closed Position Learning" after repair when removing harness connector of the electric throttle control actuator. Refer to [EC-879, "Work Procedure"](#).

INTAKE MANIFOLD

< REMOVAL AND INSTALLATION >

[HR15DE]

- Perform “Throttle Valve Closed Position Learning” and “Idle Air Volume Learning” after repair when replacing electric throttle control actuator. Refer to [EC-880, "Work Procedure"](#)

EXHAUST MANIFOLD

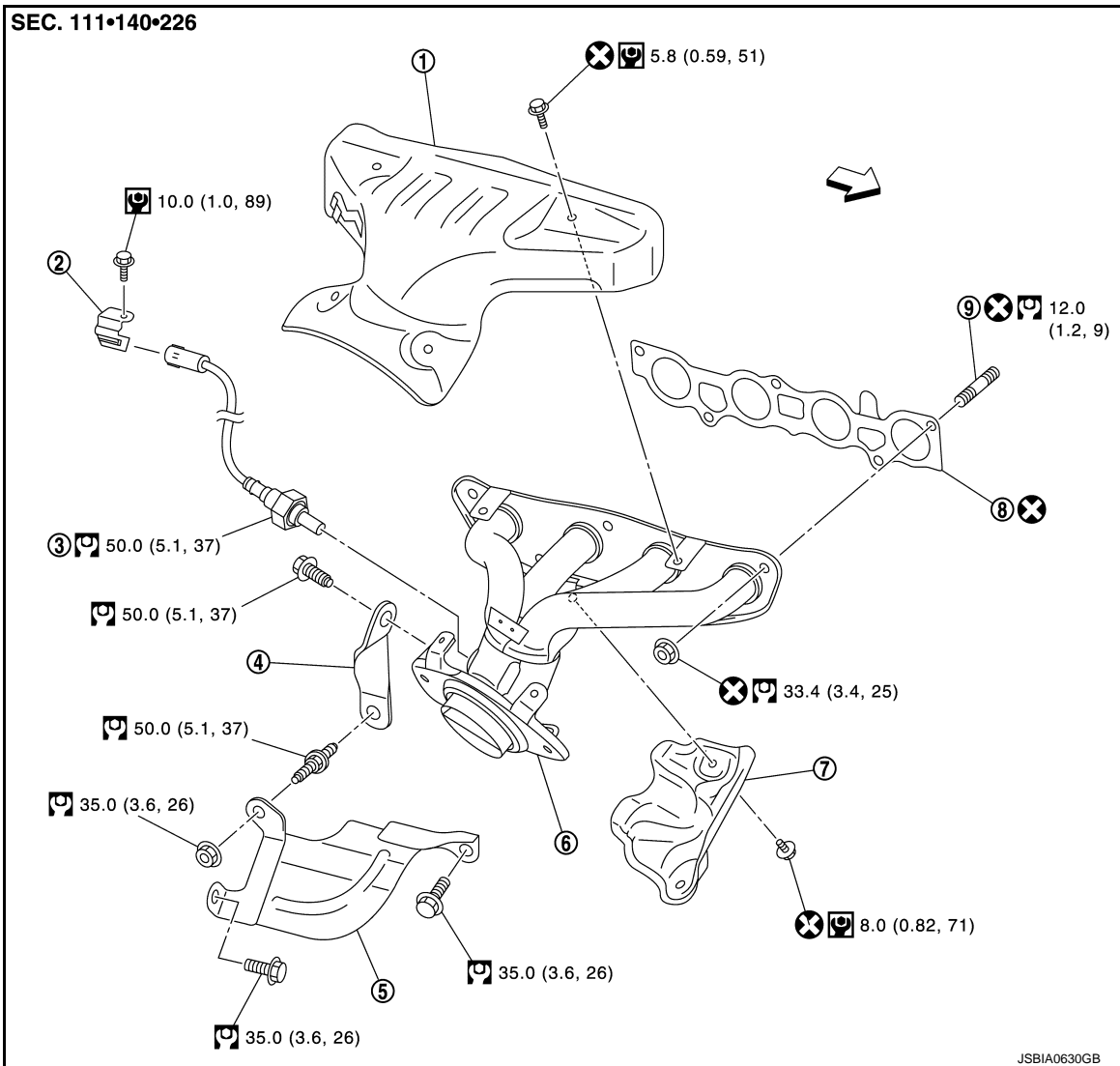
< REMOVAL AND INSTALLATION >

[HR15DE]

EXHAUST MANIFOLD

Exploded View

INFOID:000000006282269



- | | | |
|---------------------------|--------------------|----------------------------|
| 1. Exhaust manifold cover | 2. Harness bracket | 3. Air fuel ratio sensor 1 |
| 4. Exhaust manifold stay | 5. Heat insulator | 6. Exhaust manifold |
| 7. Exhaust manifold cover | 8. Gasket | 9. Stud bolt |

⇐ : Engine front

⊗ : Always replace after every disassembly.

⊗ : N·m (kg-m, in-lb)

⊗ : N·m (kg-m, ft-lb)

Removal and Installation

INFOID:000000006282270

REMOVAL

1. Remove exhaust front tube. Refer to [EX-5. "Exploded View"](#).
2. Remove air cleaner assy and the air duct (between air cleaner case and electric throttle control actuator). Refer to [EM-181. "Exploded View"](#).
3. Disconnect throttle control actuator harness connector.

EXHAUST MANIFOLD

[HR15DE]

< REMOVAL AND INSTALLATION >

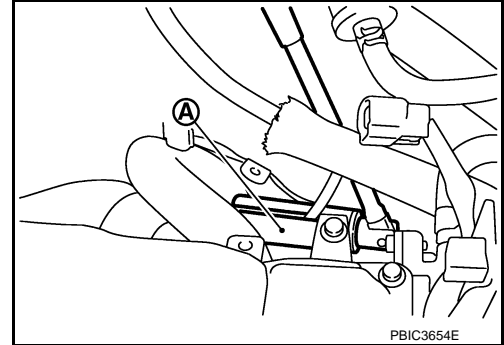
4. Remove electric throttle control actuator assy.
5. Disconnect air fuel ratio sensor 1 harness connector.
6. Remove exhaust manifold cover.
7. Remove exhaust manifold side mounting bolt of exhaust manifold stay.
8. Remove the air fuel ratio sensor 1.
 - Using heated oxygen sensor wrench [SST: KV10117100], remove air fuel ratio sensor 1.

CAUTION:

Handle air fuel ratio sensor 1 carefully and avoid impacts.

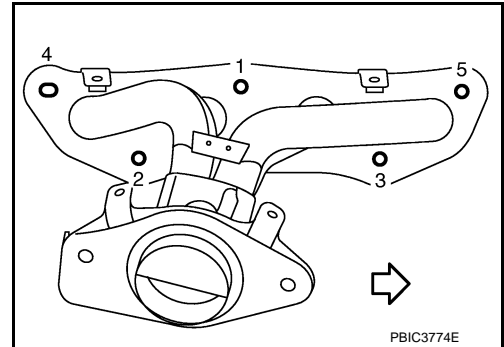
NOTE:

The exhaust manifold can be removed and installed without removing the air fuel ratio sensor 1 (Disassembly of harness connector is necessary).



9. Remove exhaust manifold.
 - Loosen nuts in reverse order as shown in the figure.

⇐ : Engine front



10. Remove stud bolt from cylinder head.
 - Using TORX socket.
11. Remove exhaust manifold cover from exhaust manifold back side.

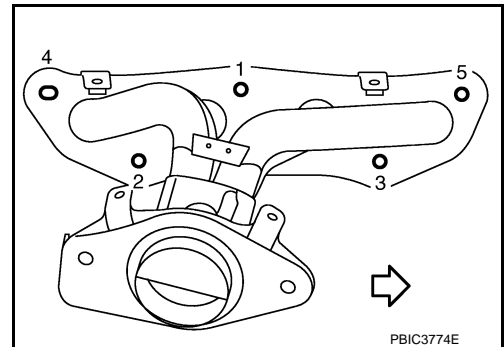
INSTALLATION

NOTE the following, and install in the reverse order of removal.

Exhaust manifold

1. Tighten nuts in numerical order as shown in the figure.

⇐ : Engine front



2. Tighten to the specified torque again.

Inspection

INFOID:000000006282271

INSPECTION AFTER REMOVAL

Surface Distortion

EXHAUST MANIFOLD

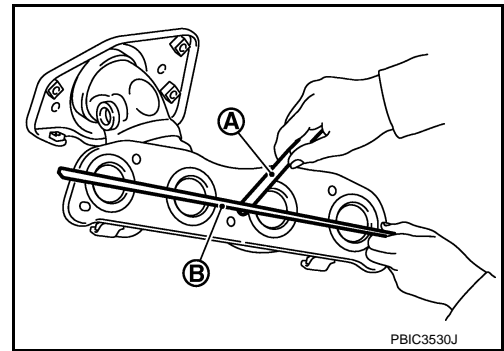
[HR15DE]

< REMOVAL AND INSTALLATION >

- Using feeler gauge (A) and straightedge (B), check the surface distortion of exhaust manifold mating surface in each exhaust port and entire part.

Limit : Refer to [EM-273, "Exhaust Manifold"](#).

- If it exceeds the limit, replace exhaust manifold.



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D

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OIL PAN (LOWER)

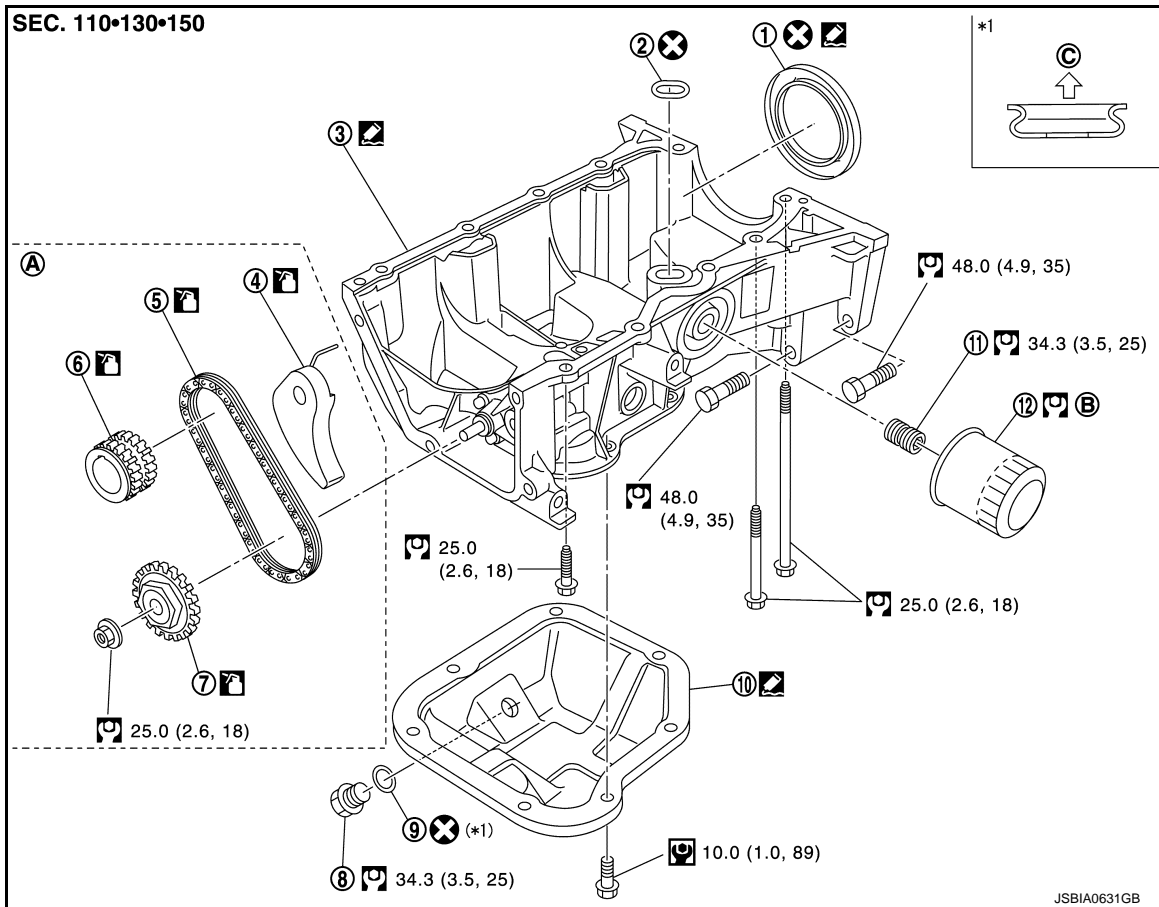
< REMOVAL AND INSTALLATION >

[HR15DE]

OIL PAN (LOWER)

Exploded View

INFOID:000000006282272



- | | | |
|--|--|-------------------------|
| 1. Rear oil seal | 2. O-ring | 3. Oil pan (upper) |
| 4. Oil pump chain tensioner (for oil pump drive chain) | 5. Oil pump drive chain | 6. Crankshaft sprocket |
| 7. Oil pump sprocket | 8. Oil pan drain plug | 9. Drain plug washer |
| 10. Oil pan (lower) | 11. Oil filter stud bolt | 12. Oil filter |
| A. Comply with the assembly procedure when tightening. Refer to EM-200 , "Exploded View" | B. Comply with the assembly procedure when tightening. Refer to LU-19 , "Removal and Installation" | C. Oil pan (lower) side |

⊗ : Always replace after every disassembly.

🔧 : N·m (kg·m, in·lb)

🔧 : N·m (kg·m, ft·lb)

🛢 : Should be lubricated with oil.

🔧 : Sealing point

Removal and Installation

INFOID:000000006282273

REMOVAL

1. Drain engine oil. Refer to [CO-38](#), "Draining".
2. Remove oil pan (lower) with the following procedure:

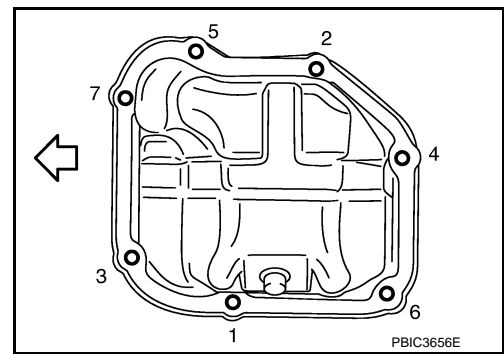
OIL PAN (LOWER)

[HR15DE]

< REMOVAL AND INSTALLATION >

- a. Loosen mounting bolts in reverse order as shown in the figure.

← : Engine front

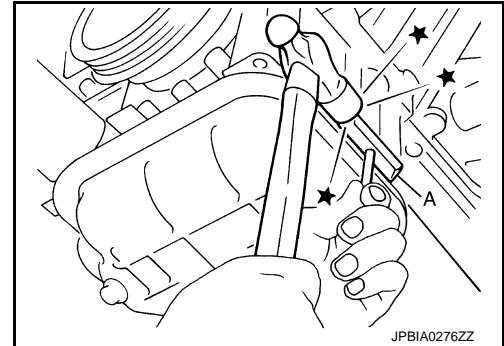


- b. Insert seal cutter [SST: KV10111100] (A) between oil pan (upper) and oil pan (lower).

CAUTION:

- Be careful not to damage the mating surface.
- Never insert a screwdriver. This damages the mating surfaces.

- c. Slide the seal cutter [SST: KV10111100] by tapping on the side of tool with a hammer.
- d. Remove oil pan (lower).



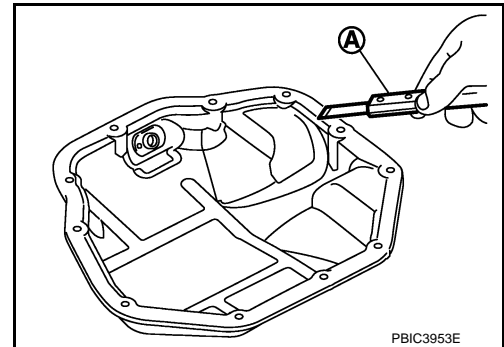
INSTALLATION

1. Install oil pan (lower) as follows:

- a. Use a scraper (A) to remove old liquid gasket from mating surfaces.
- Also remove old liquid gasket from mating surface of oil pan (upper).
 - Remove old liquid gasket from the bolt holes and threads.

CAUTION:

Never scratch or damage the mating surface when cleaning off old liquid gasket.



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OIL PAN (LOWER)

[HR15DE]

< REMOVAL AND INSTALLATION >

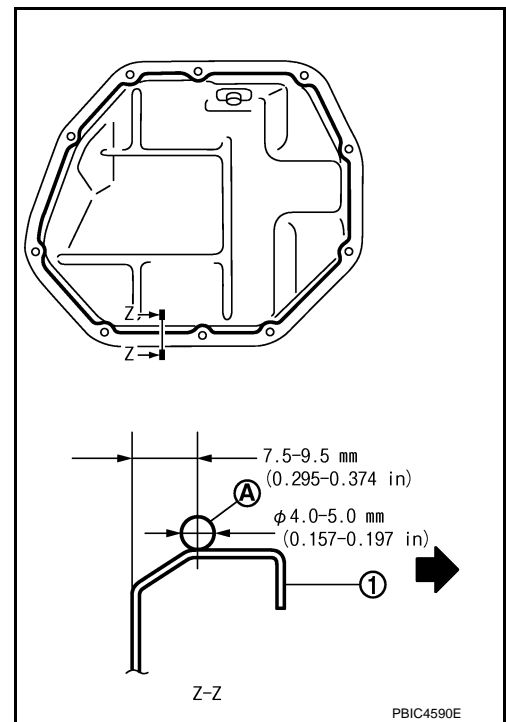
- b. Apply a continuous bead of liquid gasket (B) with a tube presser (commercial service tool) as shown in the figure.

- a : 7.5 - 9.5 mm (0.295 - 0.374 in)
- c : ϕ 4.0 - 5.0 mm (0.157 - 0.197 in)
- 1 : Oil pan (lower)
- ← : Engine outside

Use Genuine Liquid Gasket or equivalent.

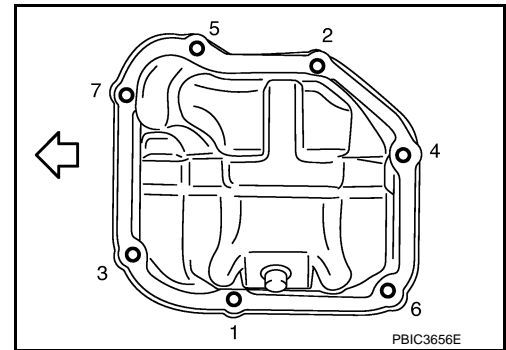
CAUTION:

Attaching should be done within 5 minutes after liquid gasket application.



- c. Tighten bolts in numerical order as shown in the figure.

- ⇐ : Engine front



2. Install oil pan drain plug.
 - Refer to the figure of components of former page for installation direction of drain plug washer. Refer to [EM-190, "Exploded View"](#).
3. Install in the reverse order of removal after this step.

NOTE:
Wait at least 30 minutes after oil pan (lower) is installed before pouring engine oil.

Inspection

INFOID:000000006282274

INSPECTION AFTER REMOVAL

Clean oil strainer if any object attached.

INSPECTION AFTER INSTALLATION

1. Check the engine oil level and adjust engine oil. Refer to [LU-16, "Inspection"](#).
2. Start engine, and check there is no leakage of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check the engine oil level again. Refer to [LU-16, "Inspection"](#).

FUEL INJECTOR AND FUEL TUBE

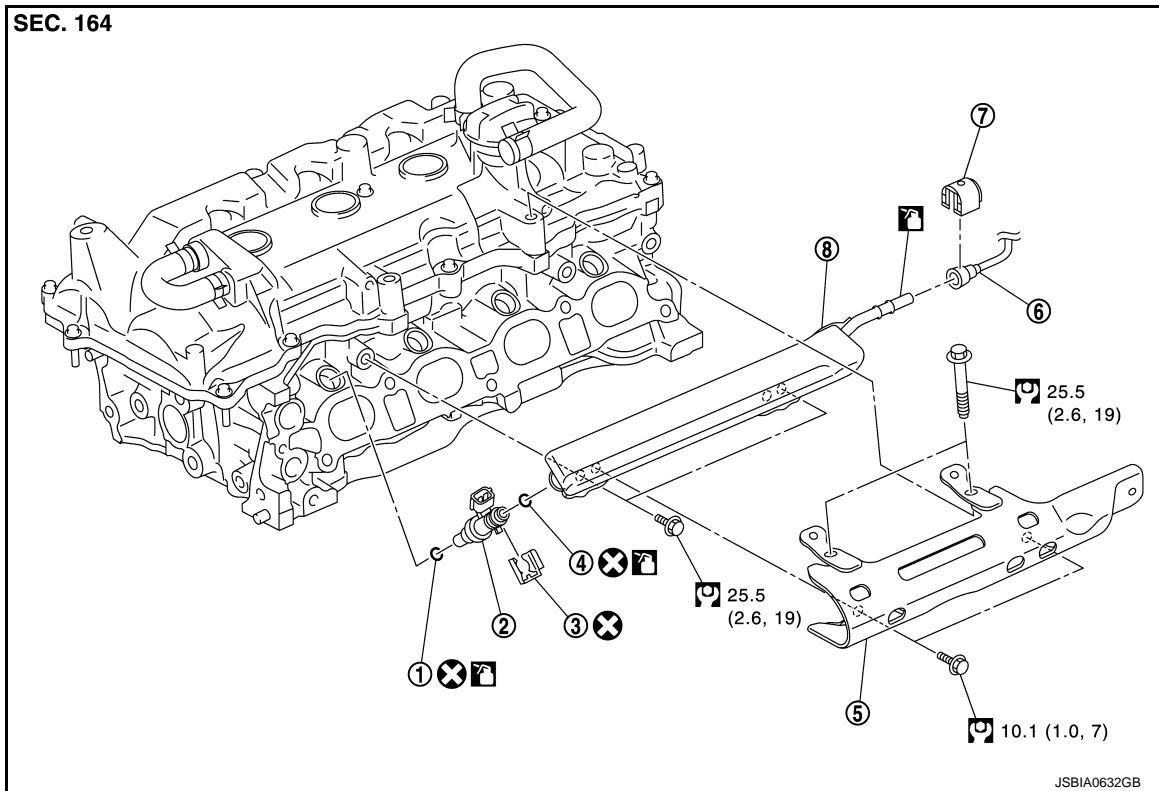
< REMOVAL AND INSTALLATION >

[HR15DE]

FUEL INJECTOR AND FUEL TUBE

Exploded View

INFOID:000000006282275



- | | | |
|------------------------|------------------------|-------------------|
| 1. O-ring (green) | 2. Fuel injector | 3. Clip |
| 4. O-ring (black) | 5. Fuel tube protector | 6. Fuel feed tube |
| 7. Quick connector cap | 8. Fuel tube | |

⊗: Always replace after every disassembly.

⊞: N·m (kg·m, ft·lb)

⌚: Should be lubricated with oil.

CAUTION:

Never remove or disassemble parts unless instructed as shown in the figure.

Removal and Installation

INFOID:000000006282276

WARNING:

- Put a "CAUTION: FLAMMABLE" sign in the workshop.
- Be sure to work in a well ventilated area and furnish workshop with a CO2 fire extinguisher.
- Never smoke while servicing fuel system. Keep open flames and sparks away from the work area.

REMOVAL

1. Release the fuel pressure. Refer to [EC-887, "Work Procedure"](#).
2. Remove intake manifold. Refer to [EM-183, "Exploded View"](#).

FUEL INJECTOR AND FUEL TUBE

[HR15DE]

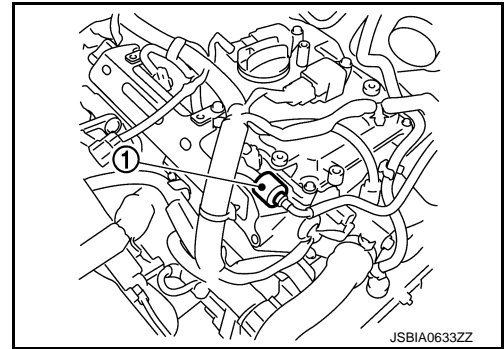
< REMOVAL AND INSTALLATION >

3. Disconnect quick connector with the following procedure. Disconnect fuel feed tube from fuel tube.

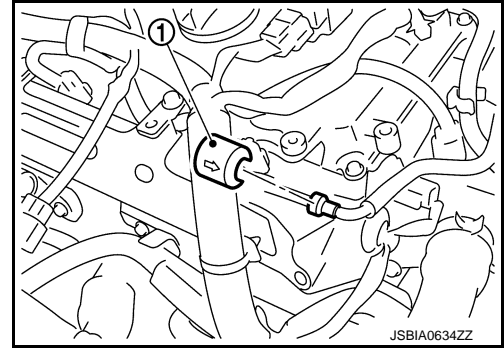
1 : Quick connector cap

NOTE:

There is no fuel return path.



- a. Remove quick connector cap (engine side) (1) from quick connector connection.
b. Disconnect fuel feed hose from hose clamp.



- c. With the sleeve side of quick connector release facing quick connector, install quick connector release (commercial service tool) onto fuel tube.
d. Insert quick connector release (A) into quick connector (2) until sleeve (B) contacts and goes no further. Hold quick connector release on that position.

D : Insert and retain

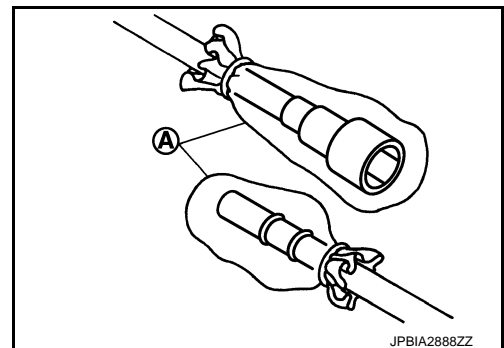
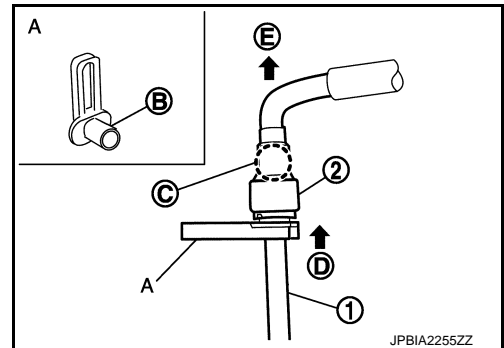
CAUTION:

Inserting quick connector release hard will not disconnect quick connector. Hold quick connector release where it contacts and goes no further.

- e. Draw and pull out quick connector straight from fuel tube (1).

CAUTION:

- Pull quick connector (E) holding position (C) in the figure.
- Never pull with lateral force applied. O-ring inside quick connector may be damaged.
- Prepare container and cloth beforehand as fuel will leakage out.
- Avoid fire and sparks.
- Keep parts away from heat source. Especially, be careful when welding is performed around them.
- Never expose parts to battery electrolyte or other acids.
- Never bend or twist connection between quick connector and fuel feed tube during installation/removal.
- To keep clean the connecting portion and to avoid damage and foreign materials, cover them completely with plastic bags, etc. (A) or something similar.



4. Disconnect harness connector from fuel injector.

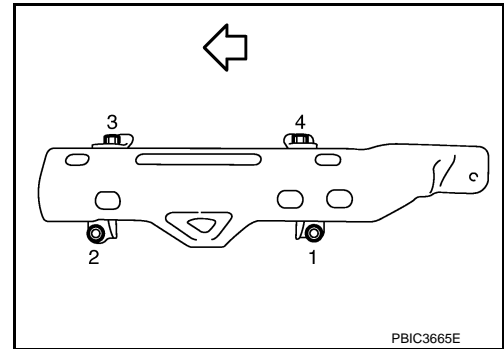
FUEL INJECTOR AND FUEL TUBE

[HR15DE]

< REMOVAL AND INSTALLATION >

- Remove fuel tube protector.
 - Loosen mounting bolts in reverse order as shown in the figure.

⇐ : Engine front

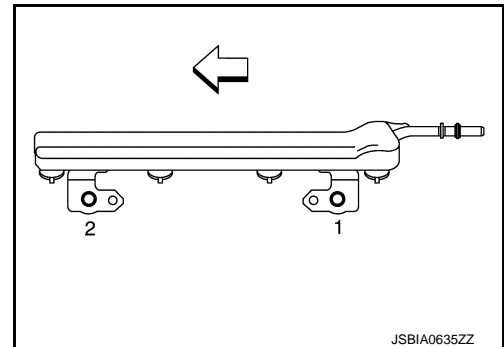


- Remove fuel tube and fuel injector assembly.
 - Loosen mounting bolts in reverse order as shown in the figure.

⇐ : Engine front

CAUTION:

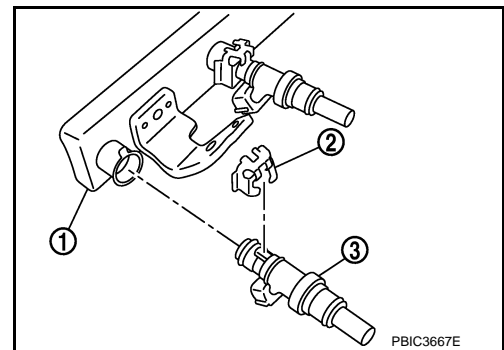
- When removing, be careful to avoid any interference with fuel injector.
- Use a shop cloth to absorb any fuel leakage from fuel tube.



- Remove fuel injector from fuel tube with the following procedure:
 - Open and remove clip (2).
 - Remove fuel injector (3) from fuel tube (1) by pulling straight.

CAUTION:

- Be careful with remaining fuel that may go out from fuel tube.
- Be careful not to damage fuel injector nozzle during removal.
- Never bump or drop fuel injector.
- Never disassemble fuel injector.



INSTALLATION

- Note the following, and install O-rings to fuel injector.

CAUTION:

- Upper and lower O-rings are different. Be careful not to confuse them.

Fuel tube side : Black

Nozzle side : Green

- Handle O-ring with bare hands. Never wear gloves.
 - Lubricate O-ring with new engine oil.
 - Never clean O-ring with solvent.
 - Check that O-ring and its mating part are free of foreign material.
 - When installing O-ring, be careful not to scratch it with tool or fingernails. Also be careful not to twist or stretch O-ring. If O-ring is stretched while installing, never insert it quickly into fuel tube.
 - Insert O-ring straight into fuel tube. Never decenter or twist it.
- Install fuel injector to fuel tube with the following procedure:

FUEL INJECTOR AND FUEL TUBE

[HR15DE]

< REMOVAL AND INSTALLATION >

- a. Insert clip (2) into clip mounting groove on fuel injector (4).

3 : O-ring (black)

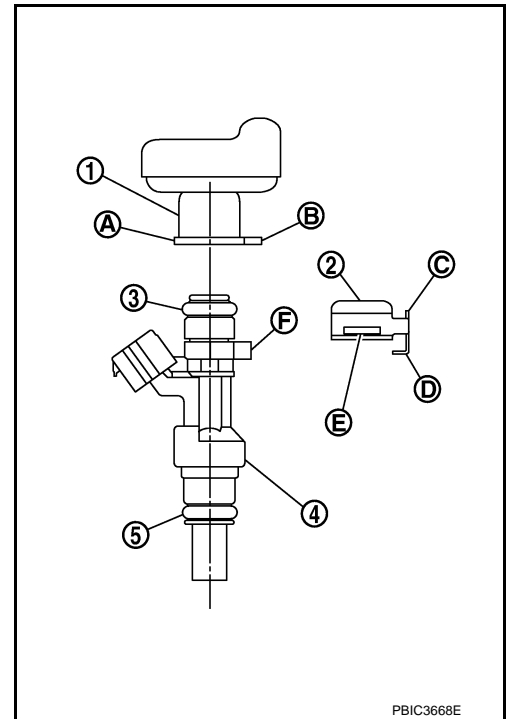
5 : O-ring (green)

- Insert clip so that protrusion (F) of fuel injector matches cut-out (D) of clip.

CAUTION:

- **Never reuse clip. Replace it with a new one.**
- **Be careful to keep clip from interfering with O-ring. If interference occurs, replace O-ring.**

- b. Insert fuel injector into fuel tube (1) with clip attached.
- Insert it while matching it to the axial center.
 - Insert fuel injector so that protrusion (B) of fuel tube matches cut-out (C) of clip.
 - Check that fuel tube flange (A) is securely fixed in flange fixing groove (E) on clip.
- c. Check that installation is complete by checking that fuel injector does not rotate or come off.



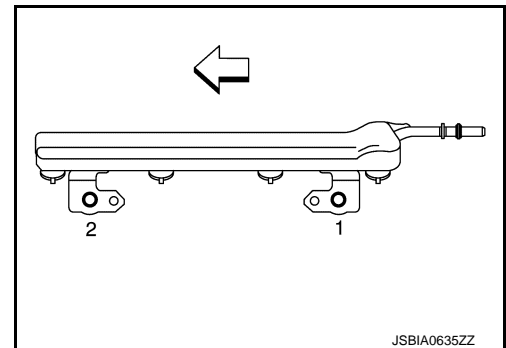
3. Set fuel tube and fuel injector assembly at its position for installation on cylinder head.

CAUTION:

For installation, be careful not to interfere with fuel injector nozzle.

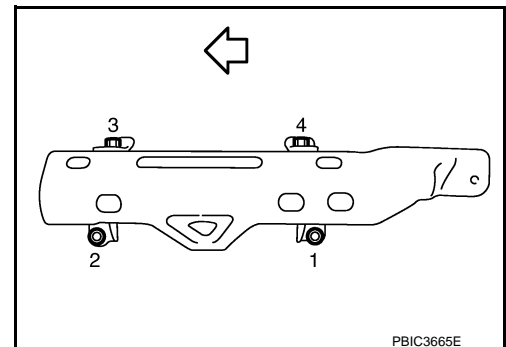
4. Install fuel tube and injector assembly onto cylinder.
- Tighten mounting bolts in numerical order as shown in the figure.

⇐ : Engine front



5. Install fuel tube protector.
- Tighten mounting bolts in numerical order as shown in the figure.

⇐ : Engine front



6. Connect harness connector to fuel injector.
7. Connect fuel feed tube with the following procedure.
- Check for damage or foreign material on the fuel tube and quick connector.
 - Apply new engine oil lightly to area around the top of fuel tube.
 - Align center to insert quick connector straightly into fuel tube.

FUEL INJECTOR AND FUEL TUBE

[HR15DE]

< REMOVAL AND INSTALLATION >

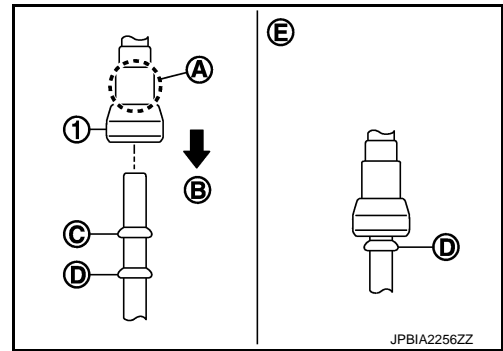
- Insert quick connector (1) to fuel tube until the top spool (C) on fuel tube is inserted completely and the 2nd level spool (D) is positioned slightly below quick connector bottom end.

B : Upright insertion

E : Fitted condition

CAUTION:

- Hold (A) position in the figure when inserting fuel tube into quick connector.
- Carefully align center to avoid inclined insertion to prevent damage to O-ring inside quick connector.
- Insert until you hear a “click” sound and actually feel the engagement.
- To avoid misidentification of engagement with a similar sound, be sure to perform the next step.



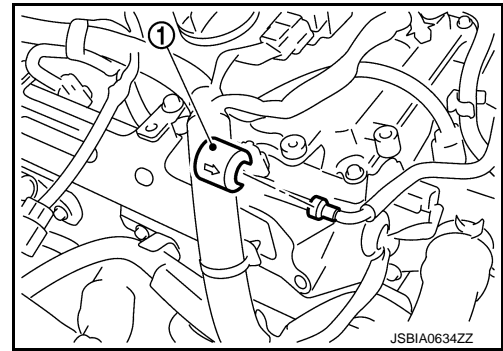
- d. Pull quick connector hard by hand holding position. Check it is completely engaged (connected) so that it does not come out from fuel tube.

- e. Install quick connector cap (engine side) (1) to quick connector connection.

- Install quick connector cap (engine side) with the side arrow facing quick connector side (fuel feed tube side).

CAUTION:

- Check that the quick connector and fuel tube are securely engaged with the quick connector cap (engine side) mounting groove.
- Quick connector may not be connected correctly if quick connector cap (engine side) cannot be installed easily. Remove the quick connector cap (engine side), and then check the connection of quick connector again.



- f. Install fuel feed hose to hose clamp.

8. Install remaining parts in the reverse order of removal.

Inspection

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INSPECTION AFTER INSTALLATION

Check on Fuel Leakage

1. Turn ignition switch “ON” (with the engine stopped). With fuel pressure applied to fuel piping, check there are no fuel leakage at connection points.

NOTE:

Use mirrors for checking at points out of clear sight.

2. Start the engine. With engine speed increased, check again that there are no fuel leakage at connection points.

CAUTION:

Never touch the engine immediately after stopped, as the engine becomes extremely hot.

IGNITION COIL, SPARK PLUG AND ROCKER COVER

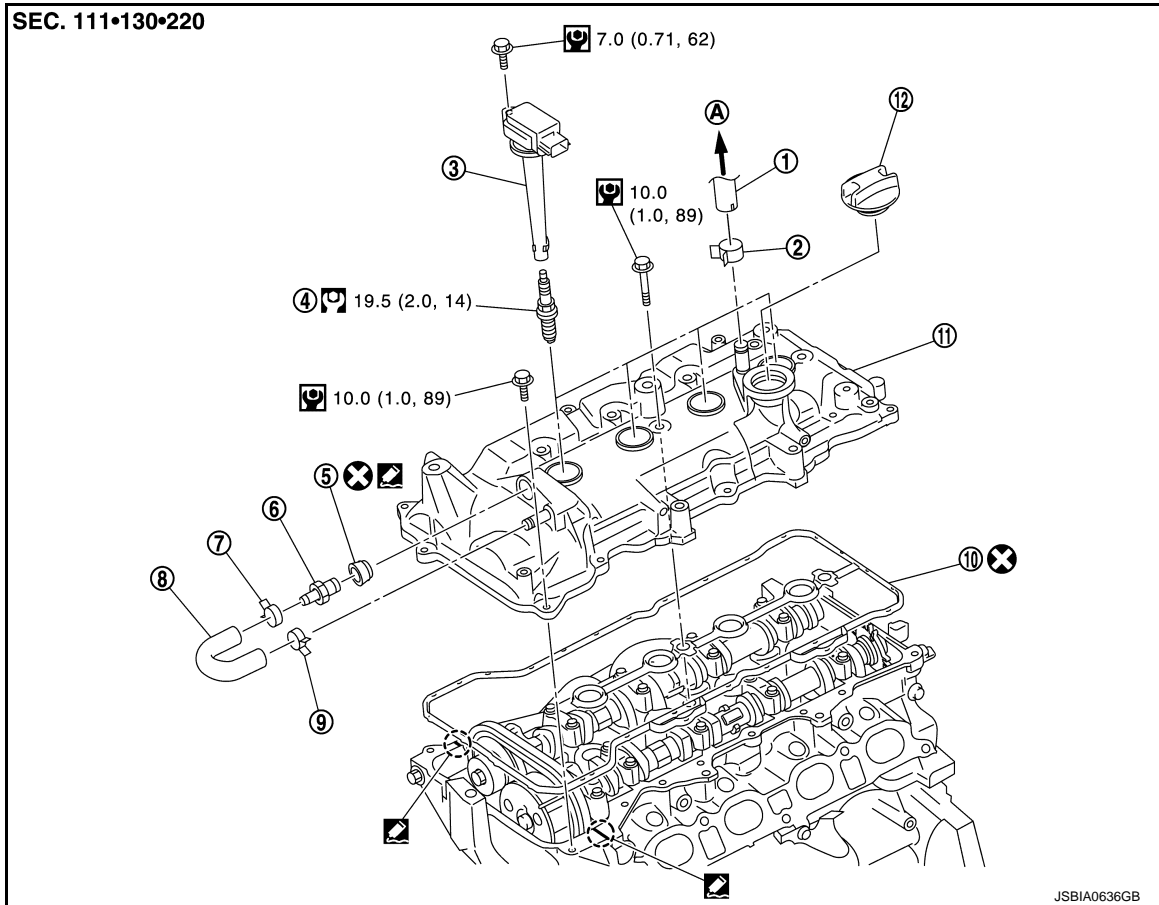
< REMOVAL AND INSTALLATION >

[HR15DE]

IGNITION COIL, SPARK PLUG AND ROCKER COVER

Exploded View

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- | | | |
|---------------|------------------|--------------------|
| 1. PCV hose | 2. Clamp | 3. Ignition coil |
| 4. Spark plug | 5. Grommet | 6. PCV valve |
| 7. Clamp | 8. PCV hose | 9. Clamp |
| 10. Gasket | 11. Rocker cover | 12. Oil filler cap |

A. To air duct assembly

⊗: Always replace after every disassembly.

🔧: N-m (kg-m, in-lb)

🔧: N-m (kg-m, ft-lb)

🔧: Sealing point

Removal and Installation

INFOID:000000006282279

REMOVAL

1. Remove intake manifold. Refer to [EM-183, "Exploded View"](#).
2. Remove ignition coil.
CAUTION:
 - Never drop or shock ignition coil.
 - Never disassemble ignition coil.
3. Remove fuel tube protector. Refer to [EM-193, "Exploded View"](#).
4. Remove PCV valve and PCV hose, if necessary.
5. Remove engine mount bracket link. Refer to [EM-236, "Exploded View"](#).

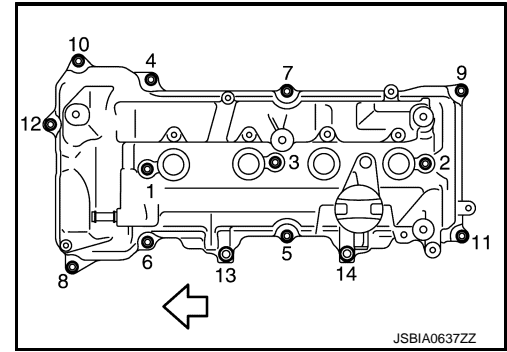
IGNITION COIL, SPARK PLUG AND ROCKER COVER

< REMOVAL AND INSTALLATION >

[HR15DE]

6. Remove rocker cover.
 - Loosen bolts in reverse order as shown in the figure.

⇐ : Engine front



7. Remove rocker cover gasket from rocker cover.
8. Use scraper to remove all traces of liquid gasket from cylinder head and front cover.

CAUTION:

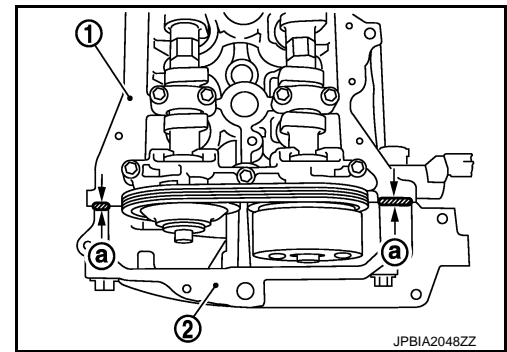
Never scratch or damage the mating surface when cleaning off old liquid gasket.

INSTALLATION

1. Rocker cover with the following procedure:
 - a. Install the rocker cover gasket to rocker cover.
 - b. Apply liquid gasket to the position as shown in the figure.

- 1 : Cylinder head
- 2 : Front cover
- a : $\phi 2.5 - 3.5$ mm

Use Genuine Liquid Gasket or equivalent.



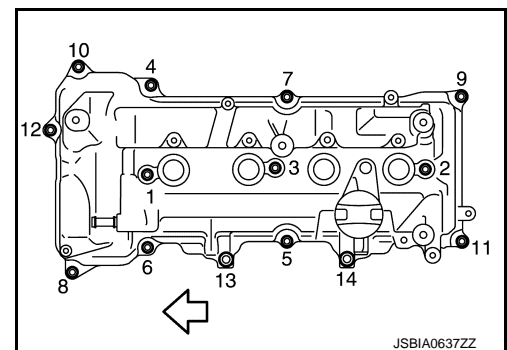
- c. Install rocker cover to cylinder head.

CAUTION:
Check the gasket is not dropped.

 - Tighten bolts in two steps separately in numerical order as shown in the figure.

⇐ : Engine front

2. Install in the reverse order of removal, for the rest of parts.



TIMING CHAIN

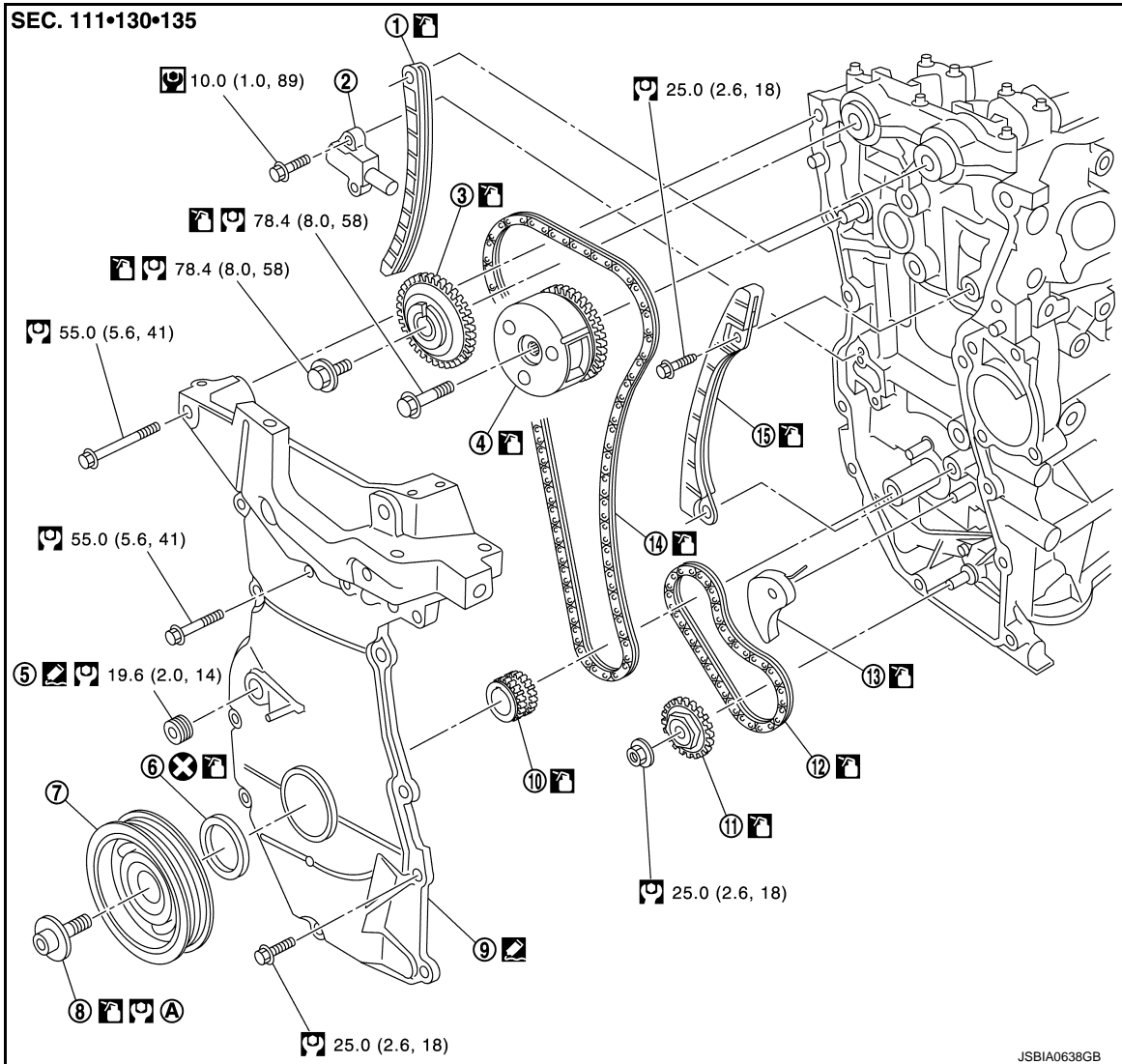
< REMOVAL AND INSTALLATION >

[HR15DE]

TIMING CHAIN

Exploded View

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- | | | |
|--|---------------------------|--------------------------------|
| 1. Timing chain slack guide | 2. Timing chain tensioner | 3. Camshaft sprocket (EXH) |
| 4. Camshaft sprocket (INT) | 5. Plug | 6. Front oil seal |
| 7. Crankshaft pulley | 8. Crankshaft pulley bolt | 9. Front cover |
| 10. Crankshaft sprocket | 11. Oil pump sprocket | 12. Oil pump drive chain |
| 13. Chain tensioner (for oil pump drive chain) | 14. Timing chain | 15. Timing chain tension guide |

Comply with the assembly procedure

A. when tightening.

Refer to [EM-201](#)

⊗: Always replace after every disassembly.

⊙: N-m (kg-m, in-lb)

⊕: N-m (kg-m, ft-lb)

🛢: Should be lubricated with oil.

🔧: Sealing point

Removal and Installation

CAUTION:

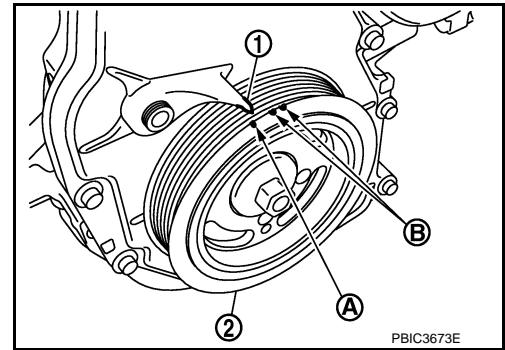
The rotation direction indicated in the text indicates all directions seen from the engine front direction.

REMOVAL

1. Remove front road wheel (RH).
2. Remove front fender protector (RH). Refer to [EXT-20, "FENDER PROTECTOR : Exploded View"](#).
3. Drain engine oil. Refer to [LU-17, "Draining"](#).
NOTE:
Perform this step when engine is cold.
4. Remove the following parts.
 - Rocker cover: Refer to [EM-198, "Exploded View"](#).
 - Drive belt: Refer to [EM-174, "Removal and Installation"](#).
 - Water pump pulley: Refer to [CO-48, "Exploded View"](#).
 - Ground cable (between engine mounting bracket (RH))
 - Low pressure flexible hose: Refer to [HA-35, "Exploded View"](#).
5. Support the bottom surface of engine using a transmission jack, and then remove the engine mounting bracket and insulator (RH). Refer to [EM-236, "Exploded View"](#).
6. Set No. 1 cylinder at TDC of its compression stroke with the following procedure:

- a. Rotate crankshaft pulley (2) clockwise and align TDC mark (without paint mark) (A) to timing indicator (1) on front cover.

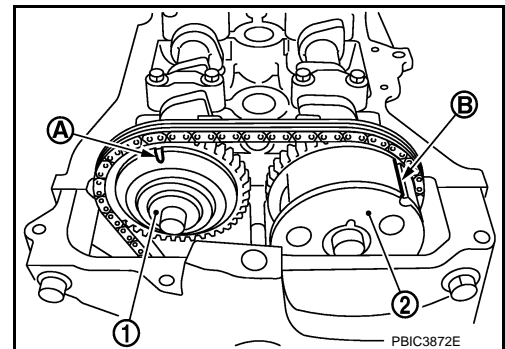
B : White paint mark (Not use for service)



- b. Check the matching marks on each camshaft sprocket are positioned as shown in the figure.

- 1 : Camshaft sprocket (EXH)
- 2 : Camshaft sprocket (INT)
- A : Matching mark (stamp)
- B : Matching mark (peripheral stamp line)

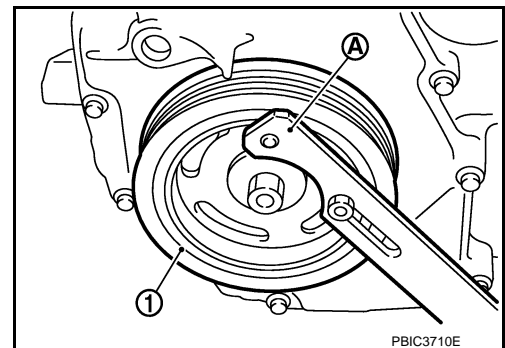
- If not, rotate crankshaft pulley one more turn to align matching marks to the positions in the figure.



7. Remove crankshaft pulley with the following procedure:
 - a. Secure crankshaft pulley (1) using a pulley holder (commercial service tool) (A).
 - b. Loosen and pull out crankshaft pulley bolts.

CAUTION:

Never remove the mounting bolts as they will be used as a supporting point for the pulley puller [SST: KV11103000].



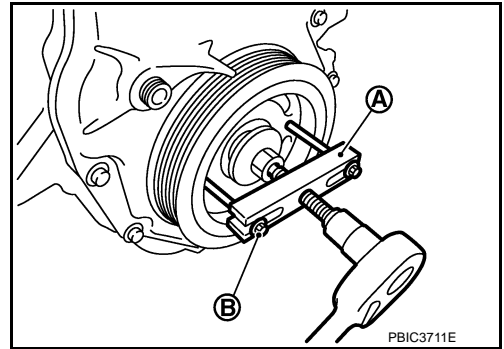
TIMING CHAIN

[HR15DE]

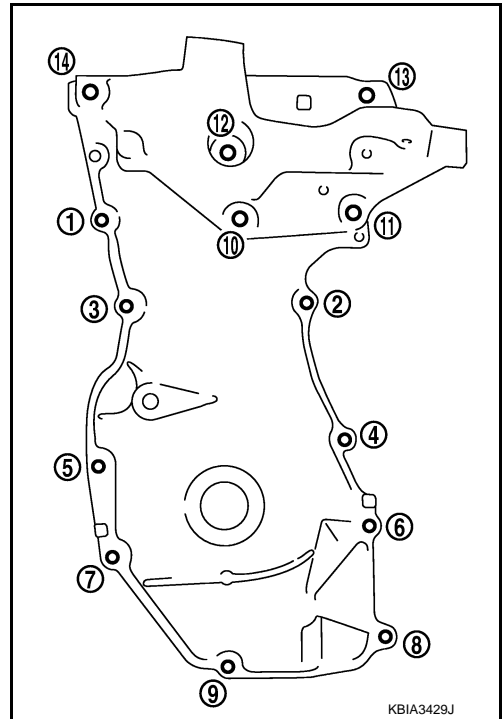
< REMOVAL AND INSTALLATION >

- c. Attach a pulley puller [SST: KV11103000] (A) in the M 6 thread hole on crankshaft pulley, and remove crankshaft pulley.

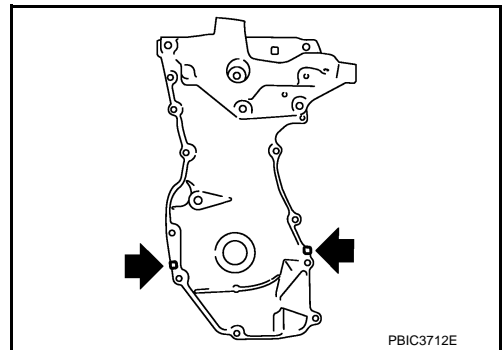
B : M6 bolt



8. Remove front cover with the following procedure:
a. Loosen bolts in the reverse of the order as shown in the figure.



- b. Cut liquid gasket by prying the position (←) as shown in the figure, and then remove the front cover.



9. Remove front oil seal from front cover.
• Remove by lifting it up using a suitable tool.
CAUTION:
Be careful not to damage the front cover.

TIMING CHAIN

[HR15DE]

< REMOVAL AND INSTALLATION >

10. Remove chain tensioner (1) with the following procedure.

a. Fully push down the chain tensioner lever (A), and then push the plunger (C) into the inside of tensioner.
• The tab (B) is released by fully pushing the lever down. As a result, the plunger can be moved.

b. Pull up the lever to align its hole position with the body hole position.

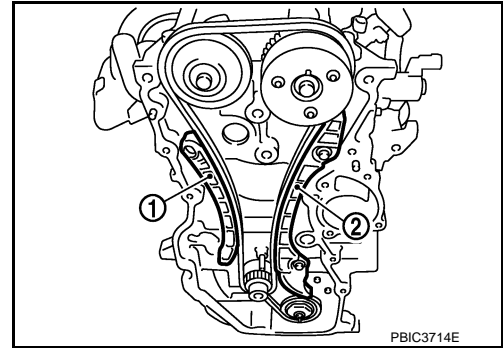
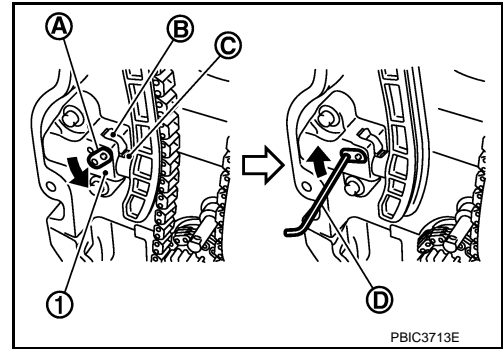
- When the lever hole is aligned with the body hole position, the plunger is fixed.
- When the protrusion parts of the plunger ratchet and the tab face each other, both hole positions are not aligned. At that time, correctly engage them and align these hole positions by slightly moving the plunger.

c. Insert the stopper pin (D) into the body hole through the lever hole, and then fix the lever at the upper position.

- Figure shows the example that a hexagonal wrench for 2.5 mm (0.098 in) is used.

d. Remove chain tensioner.

11. Remove the timing chain tension guide (2) and the timing chain slack guide (1).

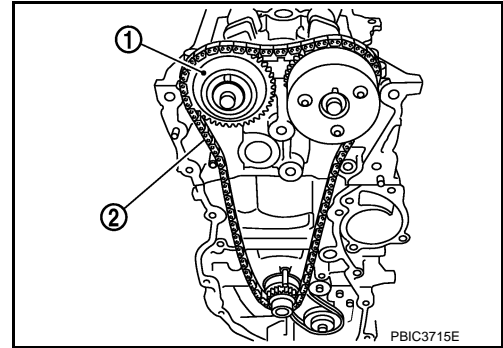


12. Remove the timing chain (2).

- Pull the looseness of timing chain toward the camshaft sprocket (EXH) (1), and then remove the timing chain and start the removal from camshaft sprocket (EXH) side.

CAUTION:

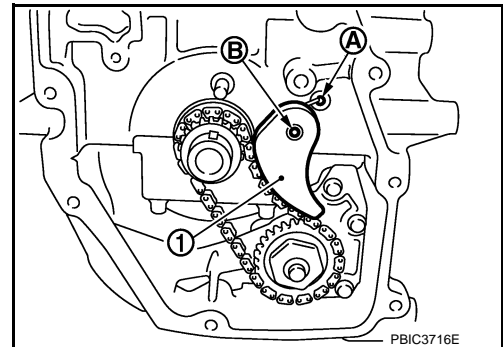
Never rotate crankshaft or camshaft while timing chain is removed. It causes interference between valve and piston.



13. Remove the crankshaft sprocket and the oil pump drive related parts with the following procedure.

a. Remove chain tensioner (1).

- Pull out from the shaft (B) and spring fixing holes (A).



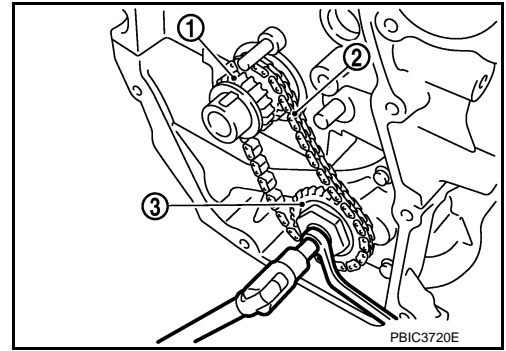
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TIMING CHAIN

[HR15DE]

< REMOVAL AND INSTALLATION >

- b. Hold the top of the oil pump shaft using the TORX socket (size: E8), and then loosen the oil pump sprocket nuts and remove them.
- c. Remove the crankshaft sprocket (1), the oil pump drive chain (2), and the oil pump sprocket (3) at the same time.

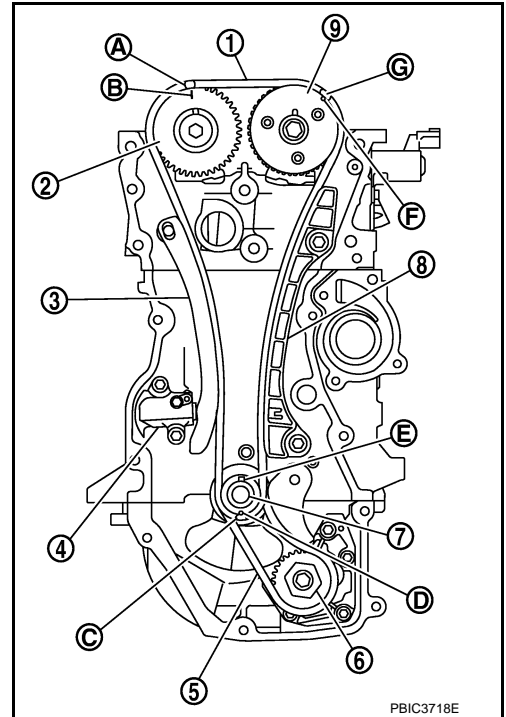


INSTALLATION

NOTE:

The figure shows the relationship between the matching mark on each timing chain and that on the corresponding sprocket, with the components installed.

- 1 : Timing chain
- 2 : Camshaft sprocket (EXH)
- 3 : Timing chain slack guide
- 4 : Chain tensioner
- 5 : Oil pump drive chain
- 6 : Oil pump sprocket
- 7 : Crankshaft sprocket
- 8 : Timing chain tension guide
- 9 : Camshaft sprocket (INT)
- A : Blue link
- B : Matching mark (stamp)
- C : Orange link
- D : Matching mark (stamp)
- E : Crankshaft key (point straight up)
- F : Matching mark (peripheral stamp line)
- G : Blue link



1. Install the crankshaft sprocket and the oil pump drive related parts with the following procedure:

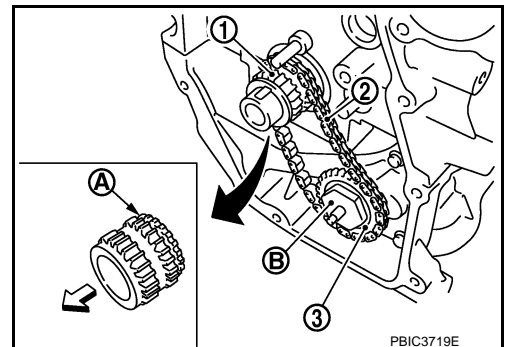
- a. Install the crankshaft sprocket (1), the oil pump drive chain (2), and the oil pump sprocket (3) at the same time.

⇐ : Engine front

- Install the crankshaft sprocket so that its invalid gear area (A) is towards the back of the engine.
- Install the oil pump sprocket so that its hexagonal surface faces (B) the front of engine.

NOTE:

There is no matching mark in the oil pump drive related parts.



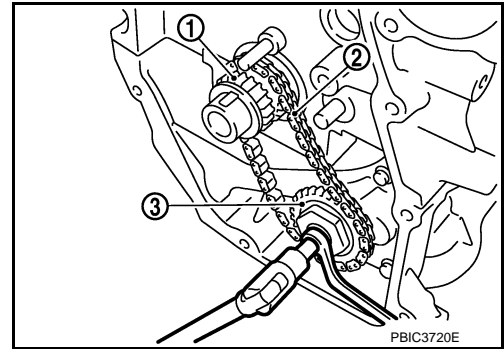
TIMING CHAIN

[HR15DE]

< REMOVAL AND INSTALLATION >

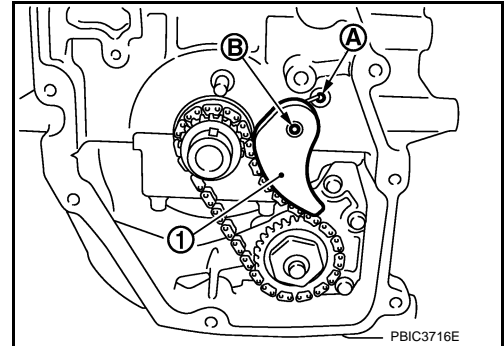
- b. Hold the top of the oil pump shaft using the TORX socket (size: E8), and then tighten the oil pump sprocket nuts.

- 1 : Crankshaft sprocket
- 2 : Oil pump drive chain
- 3 : Oil pump sprocket



- c. Install chain tensioner (1).

- Insert the body into the shaft (B) while inserting the spring into the fixing hole (A) of cylinder block front surface.
- Check that the tension is applied to the oil pump drive chain after installing.



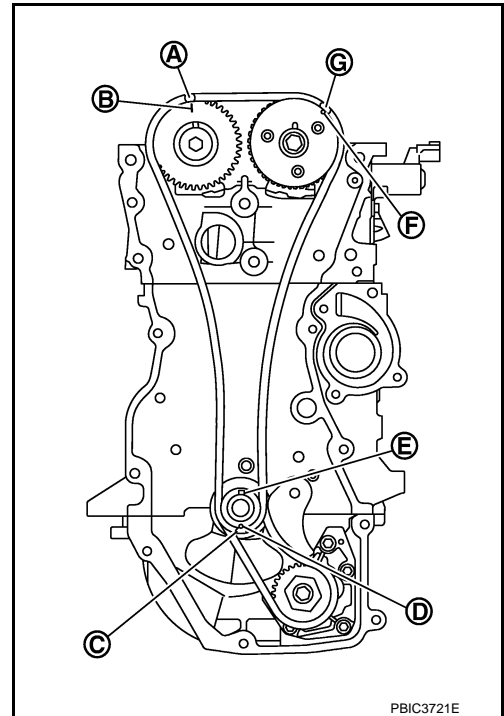
2. Install timing chain with the following procedure.

- A : Blue link
- B : Matching mark (stamp)
- C : Orange link
- D : Matching mark (stamp)
- E : Crankshaft key (point straight up)
- F : Matching mark (peripheral stamp line)
- G : Blue link

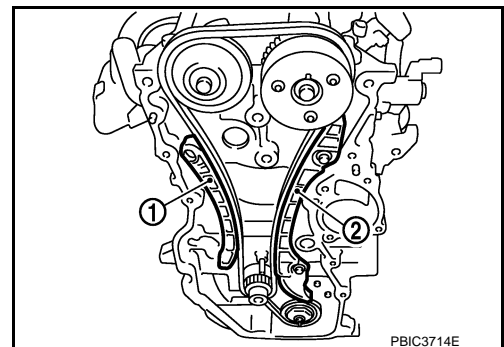
- Install by aligning matching marks on each sprocket and timing chain.
- If these matching marks are not aligned, rotate the camshaft slightly to correct the position.

CAUTION:

- For the following note, after the matching marks are aligned, keep them aligned by holding them with a hand.
- To avoid skipped teeth, never rotate crankshaft and camshaft until front cover is installed.



3. Install timing chain tension guide (2) and timing chain slack guide (1).



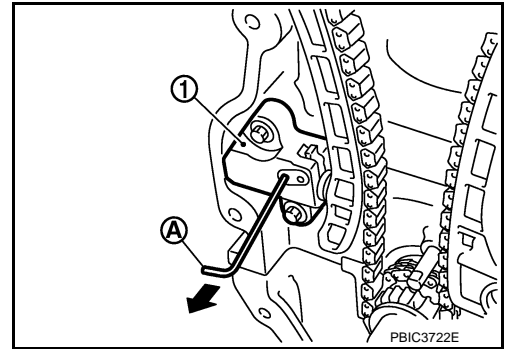
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TIMING CHAIN

[HR15DE]

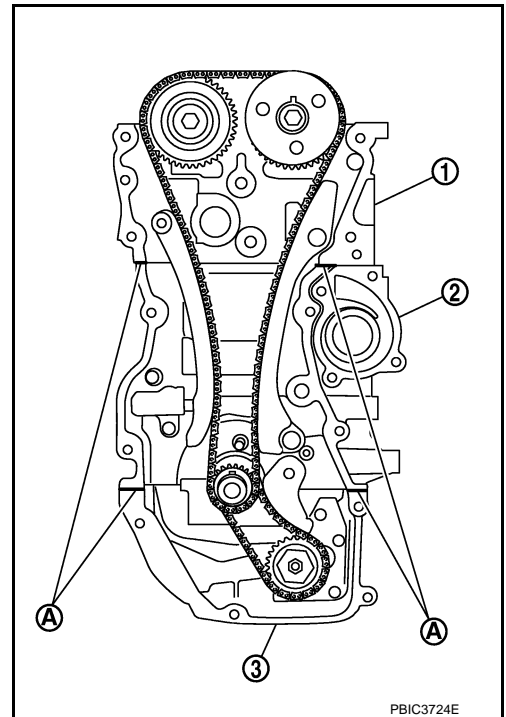
< REMOVAL AND INSTALLATION >

4. Install chain tensioner (1).
 - Fix the plunger at the most compressed position using a stopper pin (A), and then install it.
 - Securely pull out the stopper pin after installing the chain tensioner.



5. Check matching mark position of timing chain and each sprocket again.
6. Install the front oil seal to the front cover. Refer to [EM-227, "FRONT OIL SEAL : Removal and Installation"](#)
7. Install front cover with the following procedure:
 - a. Apply a continuous bead of liquid gasket with tube presser (commercial service tool) to front cover as shown in the figure. **Use Genuine Liquid Gasket or equivalent.**

- 1 : Cylinder head
- 2 : Cylinder block
- 3 : Oil pan (upper)
- A : Liquid gasket application area [ϕ 3.0 - 4.0 mm (0.12 - 0.16 in)]



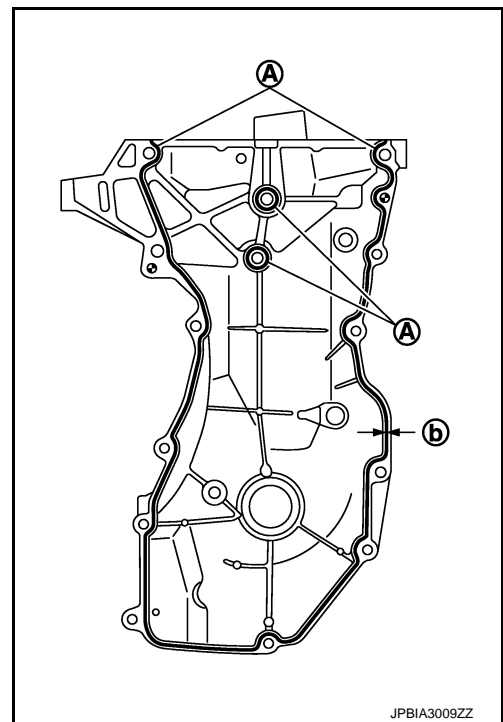
TIMING CHAIN

[HR15DE]

< REMOVAL AND INSTALLATION >

- b. Apply a continuous bead of liquid gasket with tube presser (commercial service tool) to front cover as shown in the figure. **Use Genuine Liquid Gasket or equivalent.**

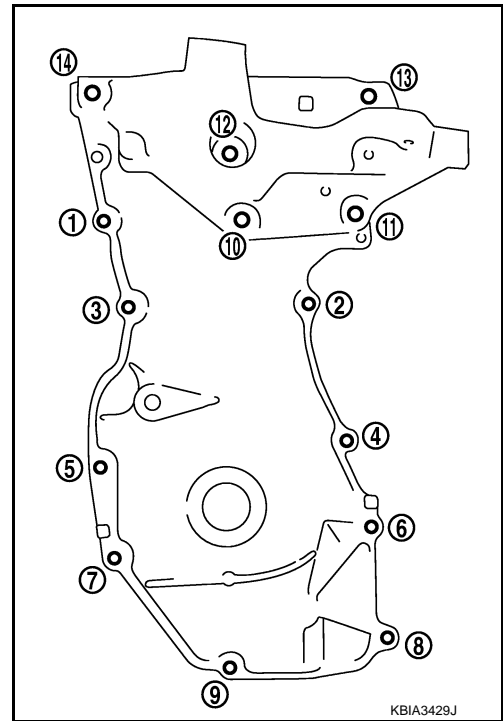
A : Liquid gasket application area [ϕ 3.0 - 4.0 mm (0.12 - 0.16 in)]



- c. Tighten bolts in the numerical order as shown in the figure.
d. After all bolts are tightened, retighten them to specified torque in numerical order as shown in the figure.

CAUTION:

Be sure to wipe off any excessive liquid gasket leaking to surface.



8. Insert crankshaft pulley by aligning with crankshaft key.
• When inserting crankshaft pulley with a plastic hammer, tap on its center portion (not circumference).
CAUTION:
Install protecting front oil seal lip section from any damage.
9. Tighten crankshaft pulley bolt with the following procedure:
• Secure crankshaft pulley with a pulley holder (commercial service tool), and tighten crankshaft pulley bolt.
- a. Apply new engine oil to thread and seat surfaces of crankshaft pulley bolt.
b. Tighten crankshaft pulley bolt.

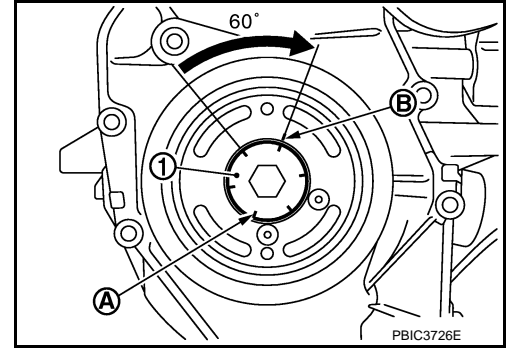
TIMING CHAIN

< REMOVAL AND INSTALLATION >

[HR15DE]

 : 35.0 N·m (3.6 kg·m, 26 ft·lb)

- c. Put a paint mark (B) on crankshaft pulley, mating with any one of six easy to recognize angle marks (A) on crankshaft bolt flange (1).
- d. Turn another 60 degrees clockwise (angle tightening).
 - Check the tightening angle with movement of one angle mark.



10. Check that crankshaft turns smoothly by rotating by hand clockwise.
11. Install in the reverse order of removal.

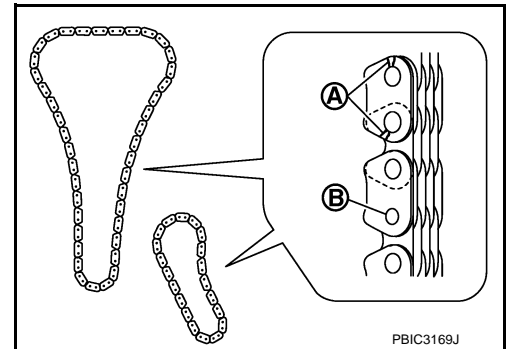
Inspection

INFOID:000000006282282

INSPECTION AFTER REMOVAL

Timing Chain

Check for cracks (A) and any excessive wear (B) at link plates and roller links of timing chain. Replace timing chain if necessary.



INSPECTION AFTER INSTALLATION

Inspection for Leakage

The following are procedures for checking fluids leakage, lubricates leakage, and exhaust gases leakage.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-19, "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
 - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

NOTE:

If hydraulic pressure inside chain tensioner drops after removal/installation, slack in guide may generate a pounding noise during and just after the engine start. However, this does not indicate an unusualness. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to check there is no leakage of fuel, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

Items	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level

TIMING CHAIN

< REMOVAL AND INSTALLATION >

[HR15DE]

Other oils and fluid*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage

A

EM

C

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*: Transmission/transaxle/A/T fluid, power steering fluid, brake fluid, etc.

CAMSHAFT

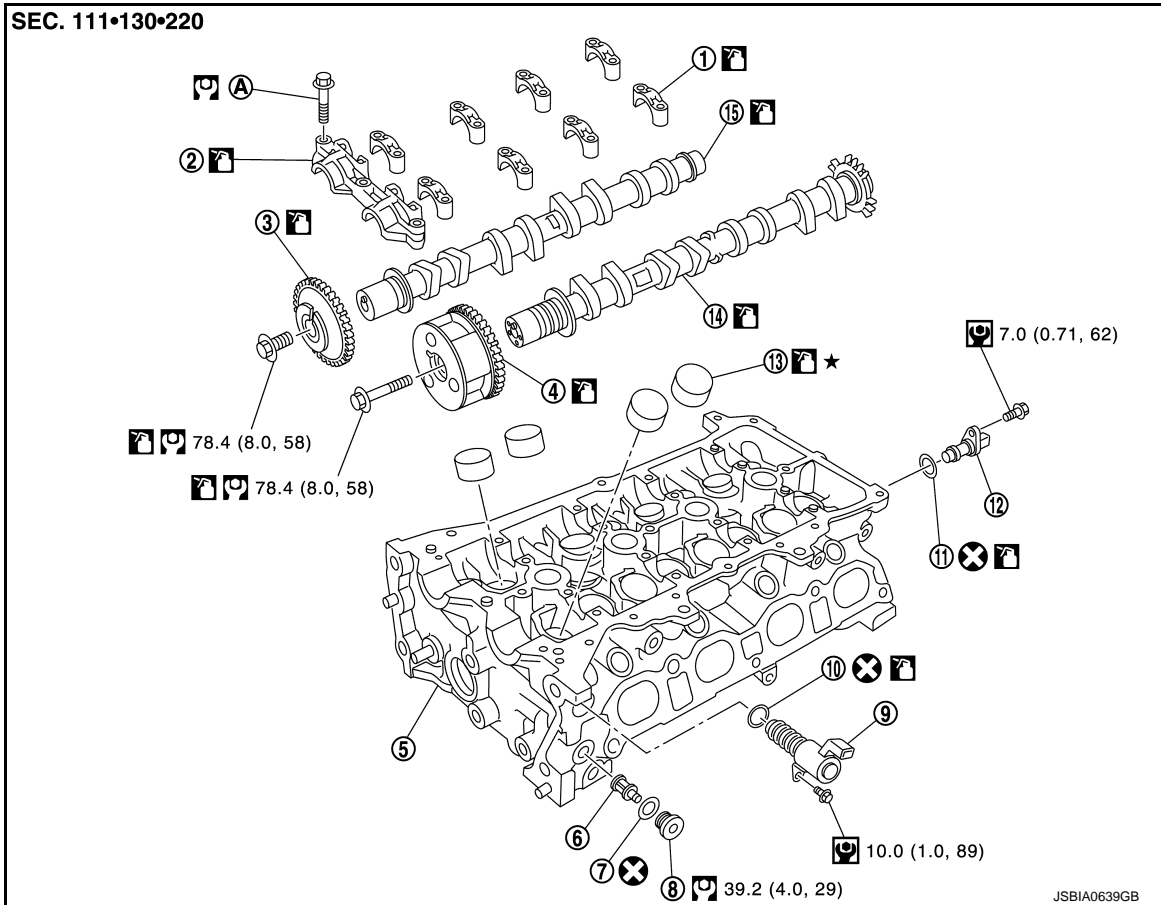
< REMOVAL AND INSTALLATION >

[HR15DE]

CAMSHAFT

Exploded View

INFOID:000000006282283



- | | | |
|----------------------------------|-----------------------------|--|
| 1. Camshaft bracket (No. 2 to 5) | 2. Camshaft bracket (No. 1) | 3. Camshaft sprocket (EXH) |
| 4. Camshaft sprocket (INT) | 5. Cylinder head | 6. Oil filter (for intake valve timing control solenoid valve) |
| 7. Washer | 8. Plug | 9. Intake valve timing control solenoid valve |
| 10. O-ring | 11. O-ring | 12. Camshaft position sensor (PHASE) |
| 13. Valve lifter | 14. Camshaft (INT) | 15. Camshaft (EXH) |

Comply with the assembly procedure when tightening.
Refer to [EM-210](#)

⊗ : Always replace after every disassembly.

🔧 : N·m (kg-m, in-lb)

🔧 : N·m (kg-m, ft-lb)

🛢️ : Should be lubricated with oil.

★ : Select with proper thickness.

Removal and Installation

INFOID:000000006282284

CAUTION:

The rotation direction indicated in the text indicates all directions seen from the engine front direction.

REMOVAL

CAMSHAFT

< REMOVAL AND INSTALLATION >

[HR15DE]

NOTE:

This section describes the procedure for removal and installation of camshaft without front cover. If the front cover is removed first, change the following procedure.

- Step 8 : After camshaft sprocket is removed, remove the camshaft brackets (No. 2 to 5).
- Step 9 : The camshaft (EXH) can be removed simultaneously with the camshaft (INT).
- Step 10 : When the camshaft sprocket (INT) mounting bolt is removed, the lifting up of camshaft is not necessary.

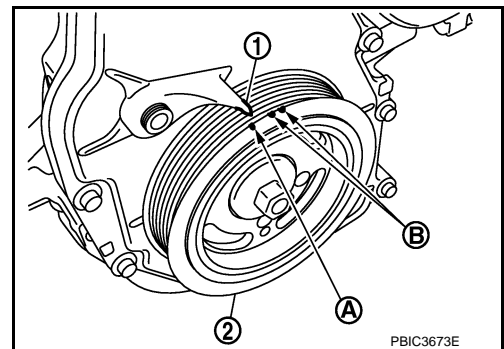
1. Support the bottom surface of engine using a transmission jack, and then remove the engine mounting bracket and insulator (RH). Refer to [EM-236, "Exploded View"](#).
2. Remove rocker cover. Refer to [EM-198, "Exploded View"](#).
3. Remove camshaft position sensor (PHASE) from rear end of cylinder head.

CAUTION:

Handle it carefully and avoid impacts.

4. Place cylinder No. 1 at TDC of its compression stroke with the following procedure.
 - a. Rotate crankshaft pulley (2) clockwise and align TDC mark (without paint mark) (A) to timing indicator (1) on front cover.

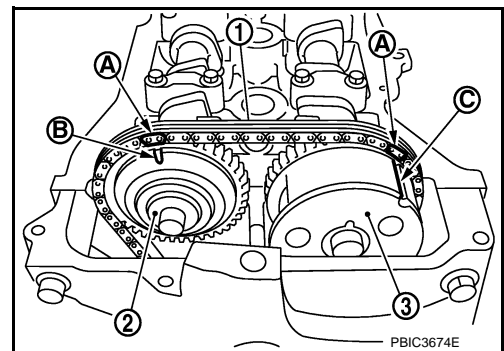
B : White paint mark (Not use for service)



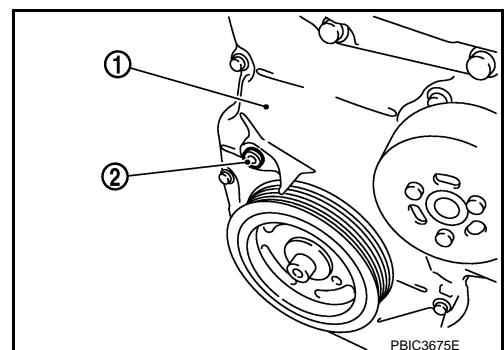
- b. Check that the matching marks on each the camshaft sprockets are in the position as shown in the figure.

1. : Timing chain
2. : Camshaft sprocket (EXH)
3. : Camshaft sprocket (INT)
- A : Matching mark (Paint)
- B : Matching mark (Stamp)
- C : Matching mark (Peripheral stamp line)

- If not, rotate crankshaft pulley one more turn to align matching marks to the positions in the figure.



- c. Paint matching marks (A) on the timing chain links
5. Secure the plunger of chain tensioner in the fully compressed position with the following procedure. And then, loosen the timing chain tension.
 - a. Remove the plug (2) from the front cover (1).



CAMSHAFT

[HR15DE]

< REMOVAL AND INSTALLATION >

- b. Fully push down the lever (B) of chain tensioner (2) from the plug hole, and then insert the stopper pin (A) into the body side hole and secure the lever at the lowest position.

C : Front cover has been omitted

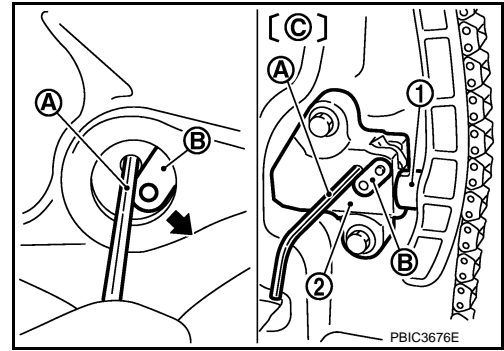
- The tab is released by fully pushing the lever down. As a result, the plunger (1) can be moved.

NOTE:

Hexagonal wrench [2.5 mm (0.098 in)] is used for a stopper pin as an example.

CAUTION:

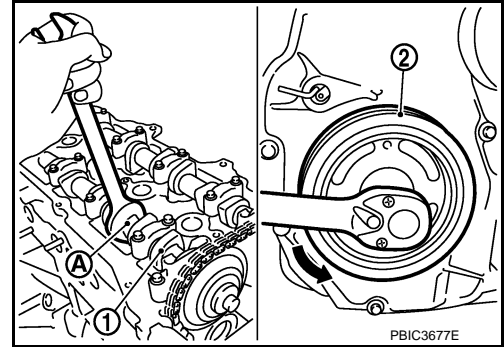
The stopper pin must use a shape that cannot fall in the front cover when dropping out.



- c. Turn the crankshaft pulley (2) counterclockwise with the camshaft (EXH) (1) fixing. Apply the tension to the timing chain, and then push the plunger of into the inside of chain tensioner.

CAUTION:

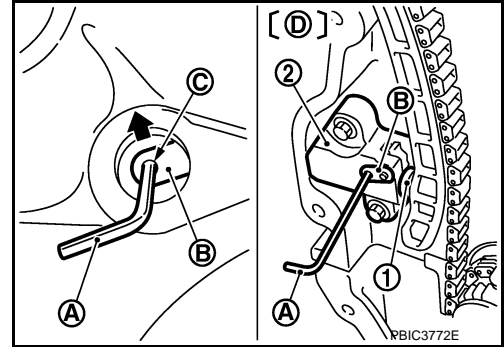
Hold the camshaft hexagonal part (A), and then secure the camshaft.



- d. Pull out the stopper pin (A) of chain tensioner (2) side from plug hole. Lift the lever (B) up to align its hole position with the hole of the body.

D : Front cover has been omitted

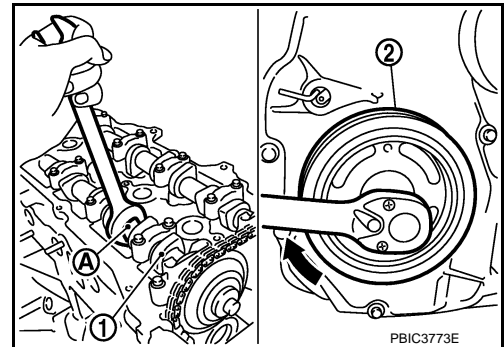
- When the lever hole (C) is aligned with the body hole position, the plunger (1) is fixed.
- When the protrusion parts of the plunger ratchet and the tab face each other, both hole positions are not aligned. At that time, correctly engage them and align these hole positions by slightly moving the plunger.



- e. Insert the stopper pin into the body hole through the lever hole, and then fix the lever at the upper position.
- f. Slightly rotate the crankshaft pulley (2) clockwise to loosen the timing chain on camshaft sprocket (EXH) (1) side.

CAUTION:

Hold the camshaft hexagonal part (A), and then secure the camshaft.



CAMSHAFT

< REMOVAL AND INSTALLATION >

[HR15DE]

6. Remove camshaft sprocket (EXH) (1).

CAUTION:

- Hold the camshaft hexagonal part (A), and then secure the camshaft.
- Never rotate crankshaft and camshaft separately, so as not to contact valve with piston in the following steps.

NOTE:

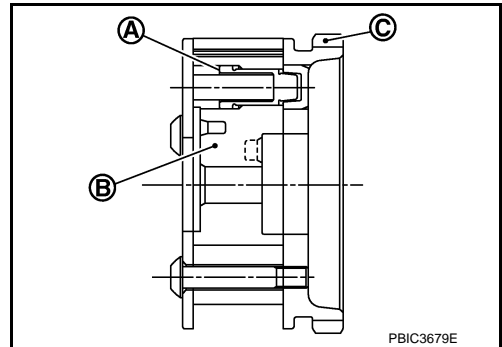
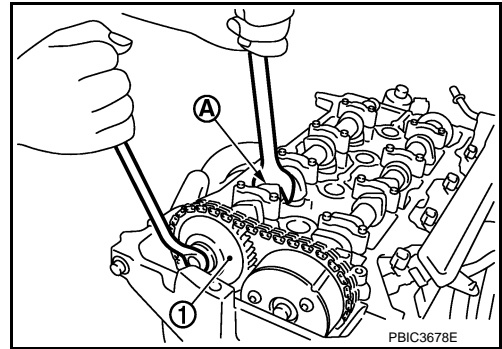
The timing chain with the front cover installed is not disengaged from the crankshaft sprocket and it is not dropped into the front cover. Therefore, the timing chain tension holding device is not necessary.

7. Turn the camshaft sprocket (INT) to the most advanced position.

CAUTION:

Installation and removal of the camshaft sprocket (INT) must be done in the most advanced position for the following reasons, so check that you follow the procedure exactly.

- The sprocket (C) and vane (camshaft coupling) (B) are designed to spin and move within the range of a certain angle.
- With the engine stopped and the vane in the most retarded angle, it will not spin because it is locked to the sprocket side by the internal lock pin (A).
- If the camshaft sprocket mounting bolts are turned in the situation described above, the lock pin will become damaged and cause malfunctions because of the increased horizontal load (cutting force) on the lock pin.

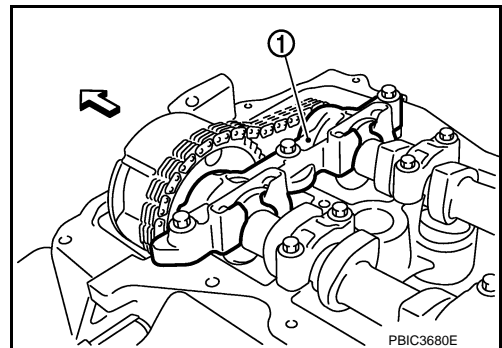


- Put the camshaft sprocket (INT) in the most advance position with the following procedure.

- a. Remove camshaft bracket (No. 1) (1).

↶ : Engine front

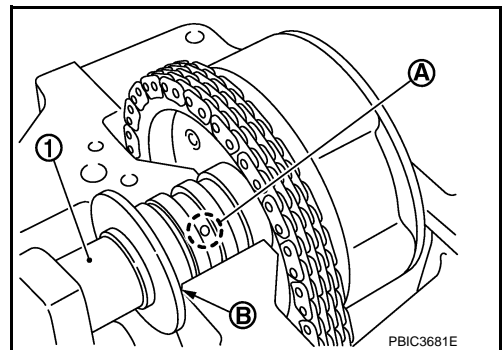
- Loosen the bolts in several steps, and then remove them.



- b. Apply the following air pressure to the No. 1 journal oil hole (A) of camshaft (INT) (1) shown in the figure using an air gun.

Pressure : 300 kPa (3.0 bar, 3.1 kg/cm², 44psi) or more

- Apply the air pressure into the oil hole on the second groove from the front of camshaft thrust (B).
- Proceed all the way through step "e" with the air pressure on.



CAMSHAFT

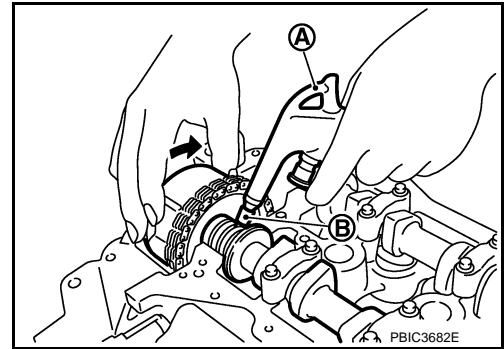
< REMOVAL AND INSTALLATION >

[HR15DE]

- Attach the rubber nozzle (B) narrowed to the top of the air gun (A) to prevent air leakage from the oil hole. Securely apply the air pressure to the oil hole.

CAUTION:

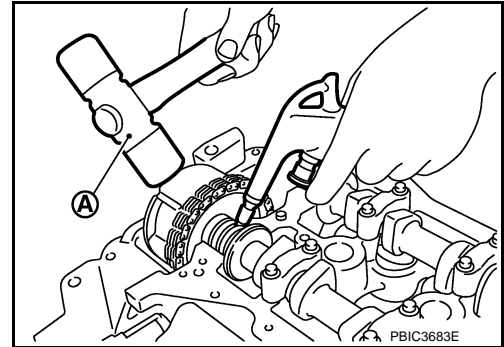
- There are other oil holes in the side grooves. Never use the incorrect oil holes.
- Be sure not to damage the oil path with the tip of the air gun.
- Wipe all the oil off the air gun to prevent oil from being blown all over along with the air, and the area around the air gun should be wiped with a rag when applying air pressure. Eye protection should be worn as needed.



NOTE:

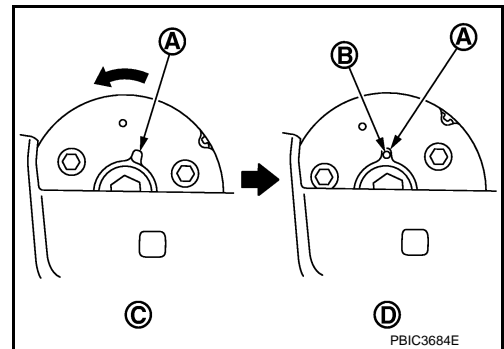
The air pressure is used to move the lock pin into the disengage position.

- Hold the camshaft sprocket (INT) with hands, and then apply the power counterclockwise/clockwise alternatively.
 - Finally rotate the sprocket of the camshaft sprocket (INT) counterclockwise [the direction shown by the arrow (←)].
 - Perform the work while applying the air pressure to the oil hole.
 - If the lock pin is not released by hands, tap the camshaft sprocket (INT) lightly with a plastic hammer (A).
 - If the camshaft sprocket (INT) is not rotated counterclockwise even if the above procedures are performed, check the air pressure and the oil hole position.



- While doing the above, once you hear a click (the sound of the internal lock pin disengaging) from inside the camshaft sprocket (INT), start turning the camshaft sprocket (INT) in the counterclockwise direction in the most advanced angle position.

- C : Lock pin engaged
- D : Most advanced angle



- Keep the air pressure on.
- If there is no click, as soon as the vane-side (camshaft side) starts moving independently of the sprocket, the lock pin has become disengaged.
- Check that it is in the most advanced angle position by seeing if the stopper pin groove (A) and the stopper pin hole (B) are matched up as shown in the figure.

- Complete the applying procedure of air pressure and the holding procedure of camshaft (INT).

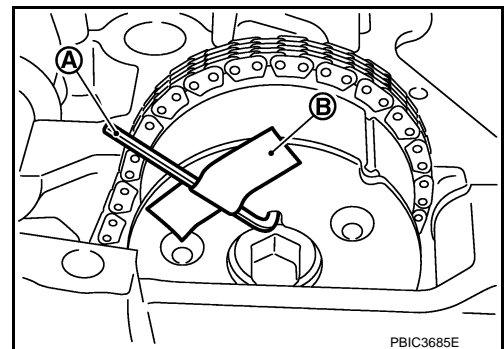
- Insert the stopper pin (A) into the stopper pin holes in the camshaft sprocket (INT) and lock in the most advanced angle position.

CAUTION:

No load is exerted on the stopper pin (spring reaction, etc.). Since it comes out easily, secure it with tape (B) to prevent it from coming out.

NOTE:

The stopper pin in the figure shows one example of a hexagonal wrench for 2.5 mm (0.098 in) [length of inserted section: approximately 15 mm (0.59 in)].



- Remove camshaft brackets (No. 2 to 5).

CAMSHAFT

< REMOVAL AND INSTALLATION >

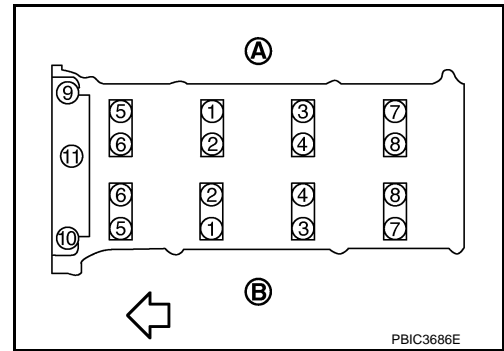
[HR15DE]

- Loosen bolts in several steps in the reverse of the order as shown in the figure.

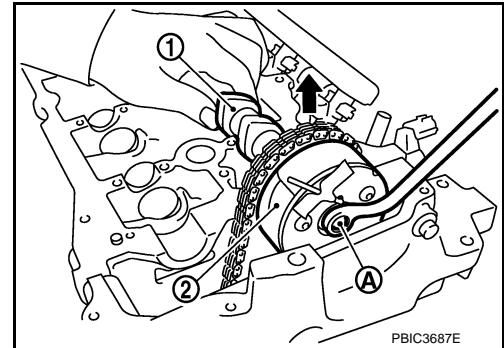
- A : EXH side
 B : INT side
 ← : Engine front

NOTE:

The camshaft bracket (No. 1) has been already removed.

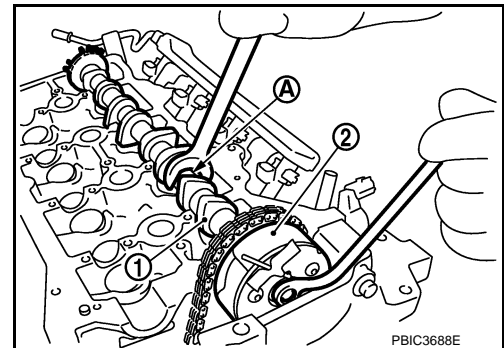


9. Remove camshaft (EXH).
10. Remove the camshaft (INT) (1) and the camshaft sprocket (INT) (2) with the following procedure.
 - a. Lift up the camshaft sprocket (INT), and then set the thin tools (a box wrench, etc.) to the mounting bolt (A).
 - b. Return the camshaft (INT) to the cylinder head journal quietly.

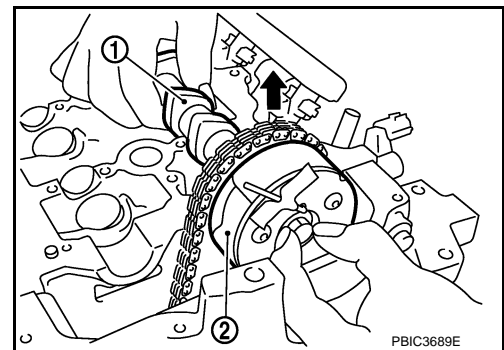


- c. Keeping the camshaft hexagonal part (A) still with the wrench, loosen mounting the bolts for the camshaft sprocket (INT) (2).

1. Camshaft (INT)



- d. Lift up the camshaft (INT) (1), and then disassemble the camshaft from the camshaft sprocket (INT) (2).



- e. Remove camshaft (INT) rearward.

CAUTION:
 Never damage the signal plate of rear end.

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CAMSHAFT

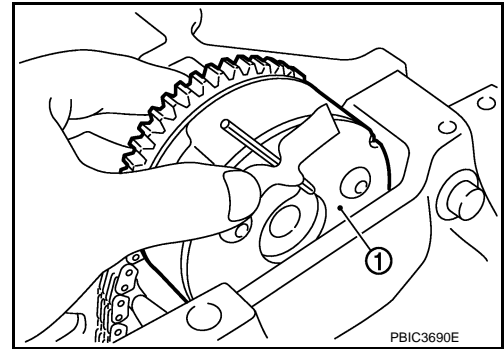
[HR15DE]

< REMOVAL AND INSTALLATION >

- f. Remove camshaft sprocket (INT) (1).

CAUTION:

Never drop stopper pin.

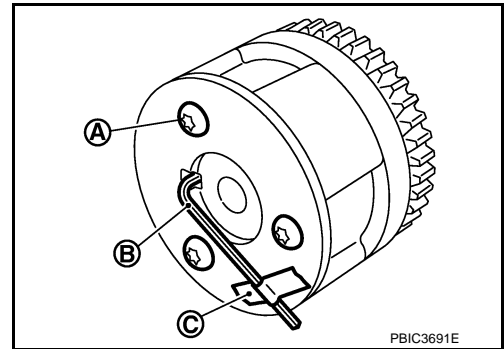


CAUTION:

- Tape (C) the stopper pin (B) so it does not come out.
- Never subject it to impact by dropping.
- Never disassemble. [Never loosen the three mounting bolts (A)].

NOTE:

While removing the camshaft sprocket (INT), if you have taken out the stopper pin and the lock pin has been rejoined in the most retarded angle, do the following to restore it.



- i. Install the camshaft (INT) and tighten the mounting bolts enough to prevent air from leaking out.

CAUTION:

The internal lock pin will get damaged, so keep the torque on the mounting bolts to the minimum required to prevent air from escaping.

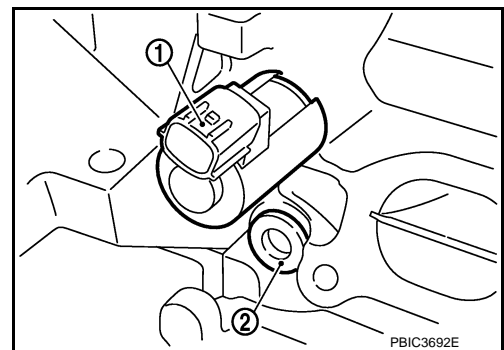
- ii. Apply the air pressure, disengage the lock pin, and turn the vane to the most advanced angle position.
iii. Insert the stopper pin.
iv. Remove camshaft sprocket (INT) from the camshaft.

11. Remove valve lifter.

- Identify installation positions, and store them without mixing them up.

12. Remove intake valve timing control solenoid valve (1).

13. Remove the alternator and bracket, remove the plug (2), and then remove the oil filter. Refer to [CHG-33. "HR12DE : Exploded View"](#).



INSTALLATION

CAMSHAFT

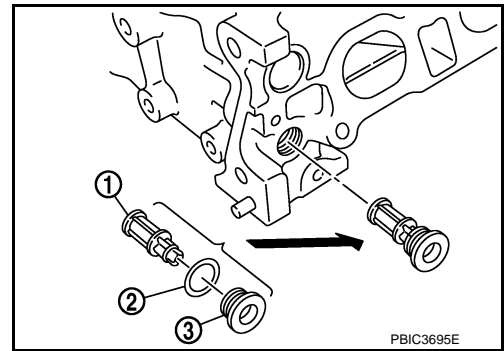
< REMOVAL AND INSTALLATION >

[HR15DE]

1. Install the oil filter (1).

2 : Washer

- The oil filter is assembled to the plug (3), and then install it to the cylinder head.



2. Install intake valve timing control solenoid valve.

- Insert it straightly into the cylinder head.
- Tighten bolts after placing it completely.

3. Install valve lifter.

- If it is reused, install in its original positions.

4. Put a matching mark for positioning the camshaft (INT) and the camshaft sprocket (INT) with the following procedure.

NOTE:

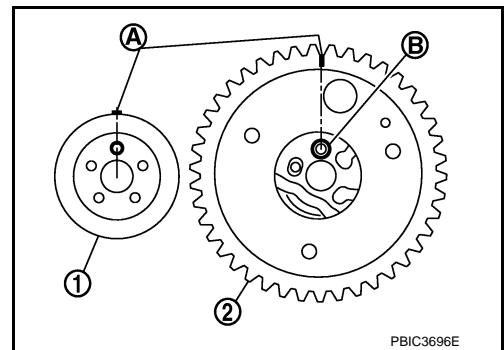
It prevents the knock pin from engaging with the incorrect pin hole after installing the camshaft (INT) and the camshaft sprocket (INT).

a. Put the matching marks (A) on a line extending from the knock pin position of camshaft (INT) (1) front surface.

- Put the marks on the visible position with the camshaft sprocket installed. (The figure shows an example.)

b. Put the matching marks on a line extending from the knock pin hole (B) position of camshaft sprocket (INT) (2). (The figure shows an example.)

- Put the marks on the visible position with it installed to the camshaft.

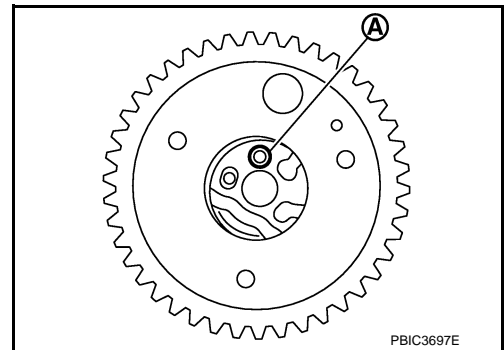


5. Set the camshaft sprocket (INT) to between cylinder head and front cover.

- Set it with the knock pin hole (A) facing up.

CAUTION:

Check the stopper pin is inserted at the most advanced position beforehand.



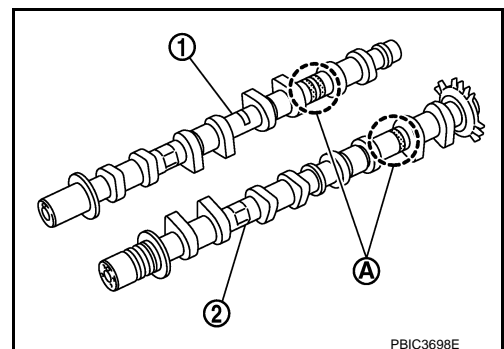
6. Install camshaft.

1 : Camshaft (EXH)

2 : Camshaft (INT)

A : Identification mark

- Distinction between camshaft (INT and EXH) is performed with the different shapes of rear end.



CAMSHAFT

[HR15DE]

< REMOVAL AND INSTALLATION >

- Install camshafts to the cylinder head so that knock pins (A) on front end are positioned as shown in the figure.

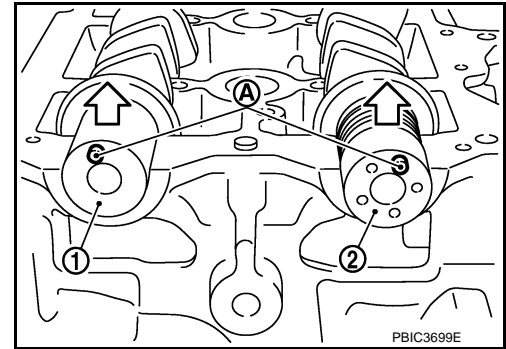
1 : Camshaft (EXH)

2 : Camshaft (INT)

⇐ : Upper side

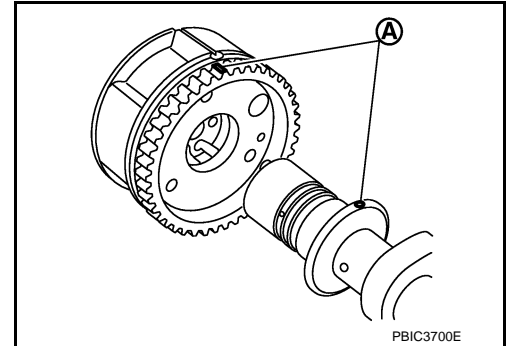
NOTE:

Though camshaft does not stop at the portion as shown in the figure, for the placement of cam nose, it is generally accepted camshaft is placed for the same direction of the figure.



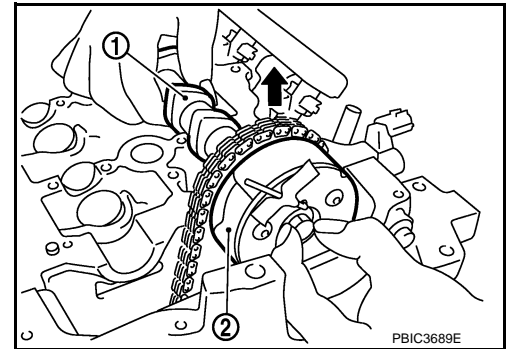
7. Install the camshaft sprocket (INT) to the camshaft (INT) with the following procedure.

- a. Refer to the matching mark (A) put according to step "4". Securely align the knock pin and the pin hole, and then install them.



- b. Lift up the front side of camshaft (INT) (1), and then temporarily tighten the bolt.

2 : Camshaft sprocket (INT)

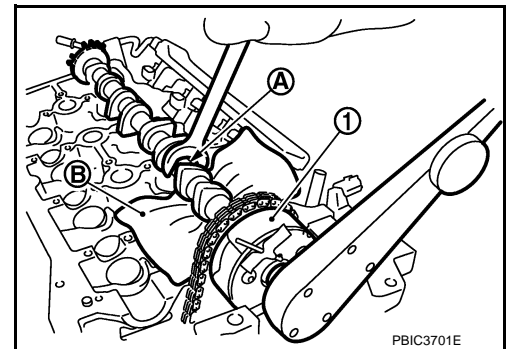


8. Put a thick shop cloth (B) to the lower surface, and then set the tools to the bolt while lifting up the front side of camshaft (INT) (1).

9. Tighten the mounting bolt.

CAUTION:

Hold the camshaft hexagonal part (A), and then secure the camshaft.



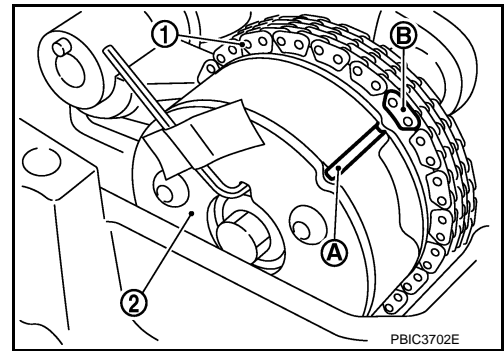
10. Return the camshaft (INT) to the cylinder head quietly.

CAMSHAFT

[HR15DE]

< REMOVAL AND INSTALLATION >

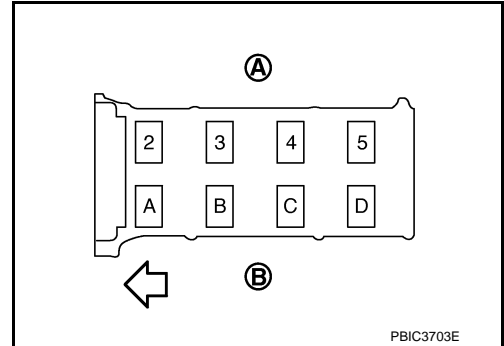
11. Install timing chain (1) by aligning its matching mark (marked when timing chain is removed) (B) with matching mark (peripheral stamp line) (A) on camshaft sprocket (INT) (2).



12. Install camshaft brackets (No. 2 to 5) aligning the identification marks on upper surface as shown in the figure.

A : EXH side
 B : INT side
 ← : Engine front

- Install so that identification mark can be correctly read when viewed from the INT side.



13. Tighten mounting bolts of camshaft brackets in the following steps, in numerical order as shown in the figure.

A : EXH side
 B : INT side
 ← : Engine front

- a. Tighten No. 9 to 11 in numerical order.

: **2.0 N-m (0.2 kg-m, 1 ft-lb)**

- b. Tighten No. 1 to 8 in numerical order.

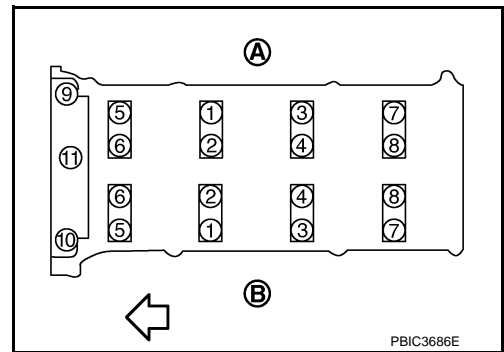
: **2.0 N-m (0.2 kg-m, 1 ft-lb)**

- c. Tighten all bolts in numerical order.

: **5.9 N-m (0.6 kg-m, 4 ft-lb)**

- d. Tighten all bolts in numerical order.

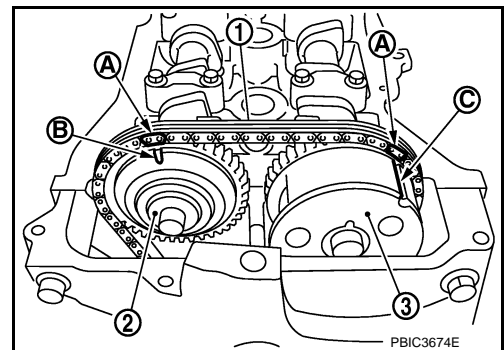
: **10.4 N-m (1.1 kg-m, 8 ft-lb)**



14. Install the camshaft (EXH) (2) to the camshaft sprocket (EXH) (3) while aligning the matching mark (marked when timing chain is removed) (A) and the matching mark (stamp) (B) of camshaft sprocket (EXH).

1 : Timing chain
 3 : Camshaft sprocket (INT)
 C : Matching mark (peripheral stamp line)

- If the positions of knock pin and pin groove are not aligned, move the camshaft (EXH) slightly to correct these positions.



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CAMSHAFT

< REMOVAL AND INSTALLATION >

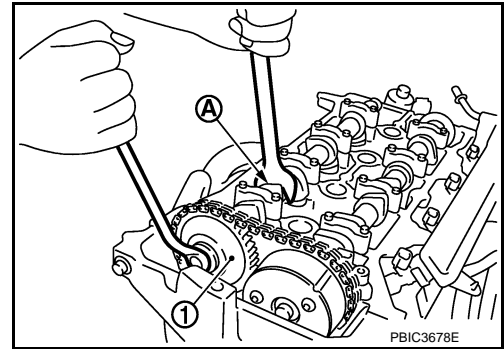
[HR15DE]

15. Tighten the mounting bolt.

1 : Camshaft sprocket (EXH)

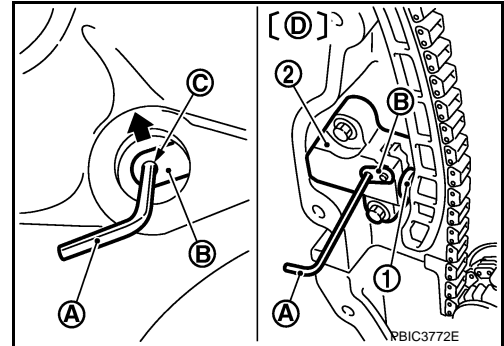
CAUTION:

- Hold the camshaft hexagonal part (A), and then secure the camshaft.
- Check that the matching mark (marked when timing chain is removed) and each camshaft sprocket matching mark are in the correct location.



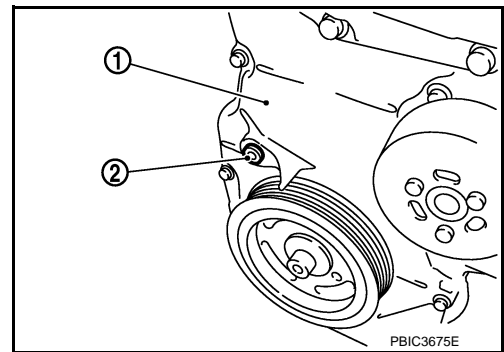
16. Pull out the stopper pin (A), and then apply the tension to the timing chain by rotating the crankshaft pulley clockwise slightly.

1 : Plunger
2 : Chain tensioner
B : Lever
C : Lever hole
D : Front cover has been omitted



17. Install the plug (2) to the front cover (1).

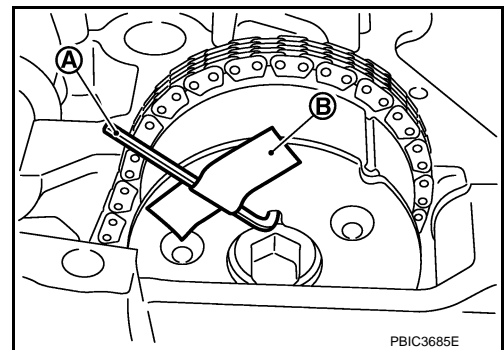
- Apply liquid gasket to the threads, and tighten them.
Use Genuine Liquid Gasket or equivalent.



18. Return the camshaft sprocket (INT) in the most retarded position with the following procedure.

a. Remove the stopper pin (A) from the camshaft sprocket (INT).

B : Tape

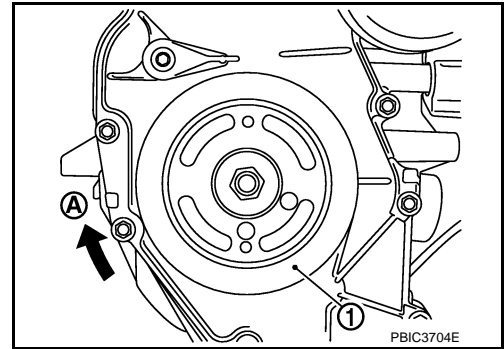


CAMSHAFT

[HR15DE]

< REMOVAL AND INSTALLATION >

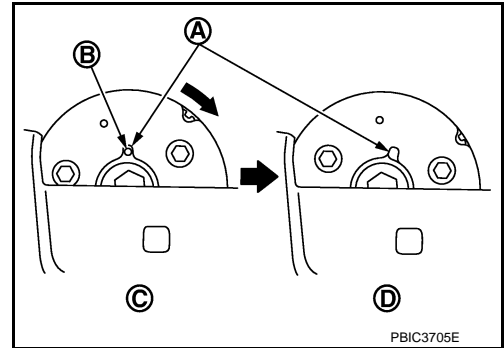
- b. Turn the crankshaft pulley (1) slowly clockwise (A) and return the camshaft sprocket (INT) to the most retarded angle position.



- When first turning the crankshaft the camshaft sprocket (INT) will turn. Once it is turned more, and the vane (camshaft) also turns, then it has reached the most retarded angle position.

- B : Stopper pin hole
C : Most advanced angle
D : Lock pin engaged

- The most retarded angle position can be checked by seeing if the stopper pin groove (A) is shifted clockwise.
- After spinning the crankshaft slightly in the counterclockwise direction, you can check the lock pin has joined by seeing if the vane (camshaft) and the sprocket move together.



19. Install the camshaft position sensor (PHASE) to the rear end of cylinder head.
- Tighten bolts with it seated completely.

20. Check and adjust valve clearance. Refer to [EM-166, "Inspection and Adjustment"](#).

21. Install in the reverse order of removal.

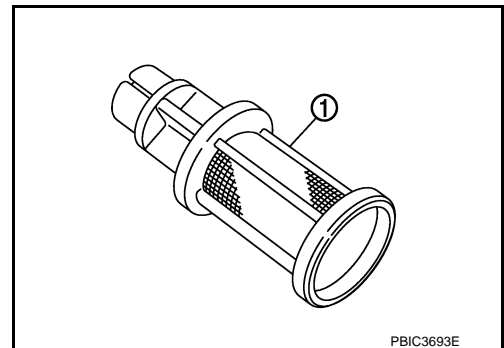
Inspection

INFOID:000000006282285

INSPECTION AFTER REMOVAL

Oil Filter

- Check that there is no foreign material on the oil filter (1) and check it for clogging.
- Check the oil filter for damage.
- If there is some damage, replace the oil filter, the plug, and the washer as a set.



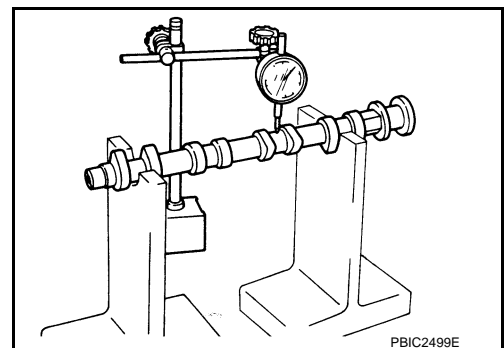
Camshaft Runout

1. Put V-block on a precise flat table, and support No. 2 and 5 journals of camshaft.

CAUTION:

Never support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other four locations.

2. Set a dial indicator vertically to No. 3 journal.
3. Turn camshaft to one direction with hands, and measure the camshaft runout on the dial indicator. (Total indicator reading)



CAMSHAFT

< REMOVAL AND INSTALLATION >

[HR15DE]

Standard and Limit

: Refer to [EM-273, "Camshaft"](#).

4. If it exceeds the limit, replace camshaft.

Camshaft Cam Height

1. Measure the camshaft cam height with a micrometer (A).

Standard and Limit

Intake

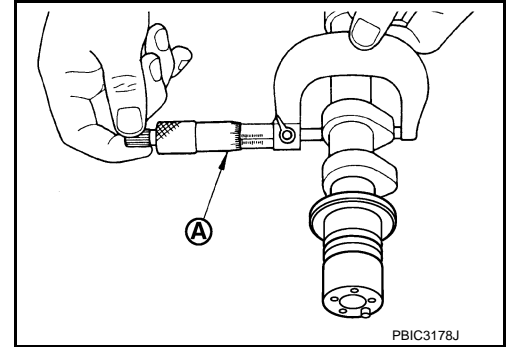
Exhaust

: Refer to [EM-273, "Camshaft"](#).

Cam wear limit:

: Refer to [EM-273, "Camshaft"](#).

2. If wear exceeds the limit, replace camshaft.

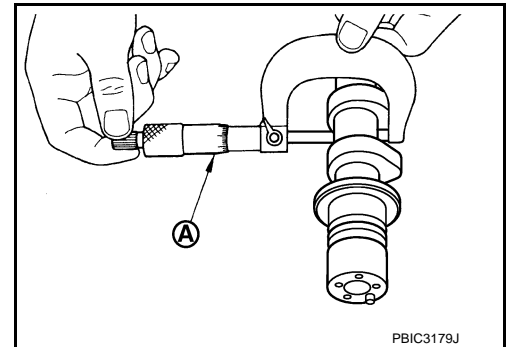


Camshaft Journal Oil Clearance

CAMSHAFT JOURNAL DIAMETER

Measure the outer diameter of camshaft journal with a micrometer (A).

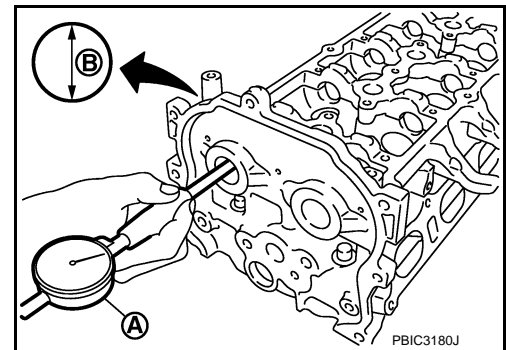
Standard: : Refer to [EM-273, "Camshaft"](#).



CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolts with the specified torque. Refer to "INSTALLATION" for the tightening procedure.
- Measure inner diameter (B) of camshaft bracket with a bore gauge (A).

Standard : Refer to [EM-273, "Camshaft"](#).



CAMSHAFT JOURNAL OIL CLEARANCE

- (Oil clearance) = (Camshaft bracket inner diameter) – (Camshaft journal diameter)

Standard and Limit : Refer to [EM-273, "Camshaft"](#).

- If it exceeds the limit, replace either or both camshaft and cylinder head.

NOTE:

Camshaft brackets cannot be replaced as single parts, because they are machined together with cylinder head. Replace whole cylinder head assembly.

Camshaft End Play

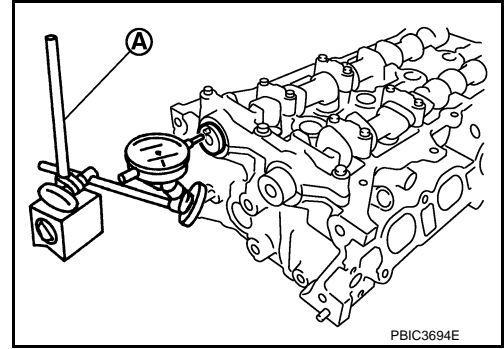
CAMSHAFT

[HR15DE]

< REMOVAL AND INSTALLATION >

1. Install camshaft in cylinder head. Refer to [EM-210, "Removal and Installation"](#) for tightening procedure.
2. Install a dial indicator (A) in thrust direction on front end of camshaft. Measure the camshaft end play on the dial indicator when camshaft is moved forward/backward (in direction to axis).

Standard and Limit : Refer to [EM-273, "Camshaft"](#).



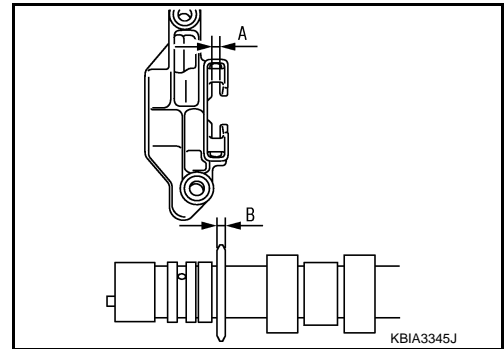
- Measure the following parts if out of the standard.
- Dimension "A" for cylinder head No. 1 journal bearing

Standard : 4.000 - 4.030 mm (0.1574 - 0.1586 in)

- Dimension "B" for camshaft thrust

Standard : 3.877 - 3.925 mm (0.1526 - 0.1545 in)

- Refer to the standards above, and then replace camshaft and/or cylinder head.



Camshaft Sprocket Runout

1. Put V-block on precise flat table, and support No. 2 and 5 journals of camshaft.

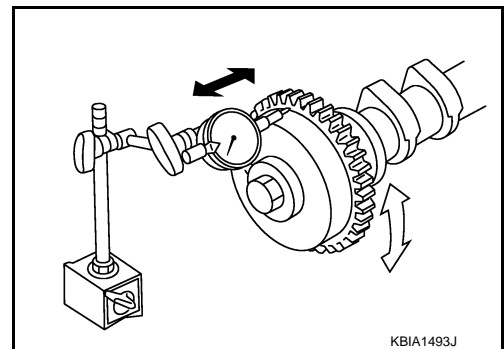
CAUTION:

Never support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other four locations.

2. Measure the camshaft sprocket runout with a dial indicator. (Total indicator reading)

Limit : 0.15 mm (0.0059 in)

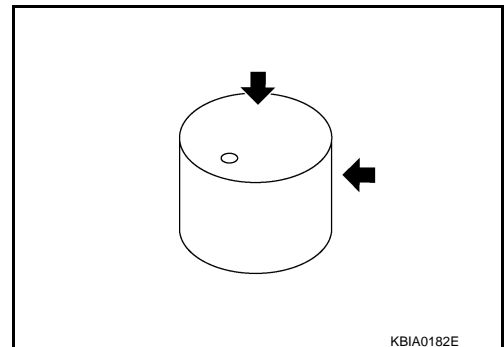
- If it exceeds the limit, replace camshaft sprocket.



Valve Lifter

Check if surface of valve lifter has any wear or cracks.

- If anything above is found, replace valve lifter. Refer to [EM-273, "Camshaft"](#).



Valve Lifter Clearance

VALVE LIFTER OUTER DIAMETER

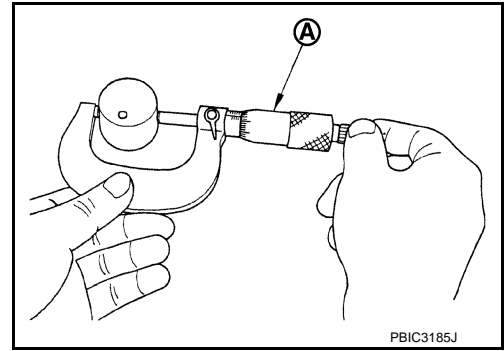
CAMSHAFT

< REMOVAL AND INSTALLATION >

[HR15DE]

- Measure the outer diameter of valve lifter with a micrometer (A).

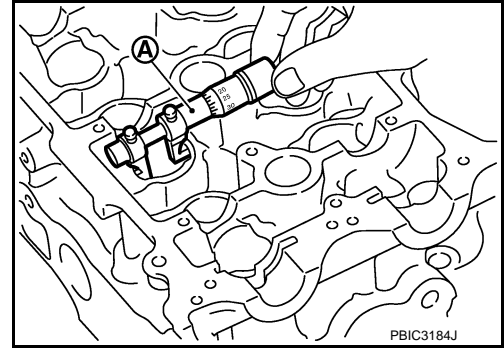
Standard : Refer to [EM-273, "Camshaft"](#).



VALVE LIFTER HOLE DIAMETER

Measure the diameter of valve lifter hole of cylinder head with an inside micrometer (A).

Standard : Refer to [EM-273, "Camshaft"](#).



VALVE LIFTER CLEARANCE

- (Valve lifter clearance) = (Valve lifter hole diameter) – (Valve lifter outer diameter)

Standard : Refer to [EM-273, "Camshaft"](#).

- If out of the standard, referring to the each standard of valve lifter outer diameter and valve lifter hole diameter, replace either or both valve lifter and cylinder head.

INSPECTION AFTER INSTALLATION

Inspection for Leaks

The following are procedures for checking fluids leak, lubricates leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-19, "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
 - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

NOTE:

If hydraulic pressure inside timing chain tensioner drops after removal/installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to check there is no leakage of fuel, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

Items	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Other oils and fluid*	Level	Leakage	Level

CAMSHAFT

< REMOVAL AND INSTALLATION >

[HR15DE]

Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

*: Transmission/transaxle fluid, power steering fluid, brake fluid, etc.

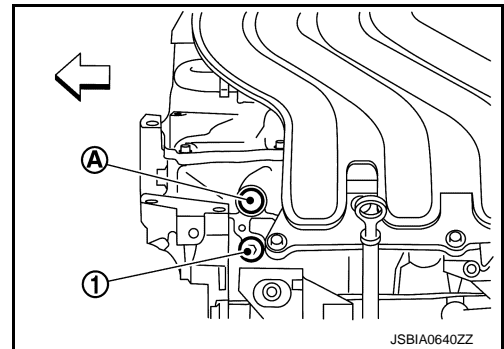
Inspection of Camshaft Sprocket (INT) Oil Groove

CAUTION:

- Perform this inspection only when DTC P0011 is detected in self-diagnostic results of CONSULT-III and it is directed according to inspection procedure of EC section. Refer to [EC-908, "Diagnosis Procedure"](#).
- Check when engine is cold so as to prevent burns from the splashing engine oil.

1. Check engine oil level. Refer to [LU-16, "Inspection"](#).
2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.
 - a. Release the fuel pressure. Refer to [LU-16, "Inspection"](#).
 - b. Remove intake manifold. Refer to [EM-183, "Exploded View"](#).
 - c. Disconnect ignition coil and injector harness connectors. Refer to [EM-198, "Exploded View"](#).
 3. Remove intake valve timing control solenoid valve. Refer to [EM-210, "Exploded View"](#).
 4. Crank engine, and then check that engine oil comes out from intake valve timing control solenoid valve hole (A). End crank after checking.

- 1 : Plug
- ⇐ :Engine front



WARNING:

Be careful not to touch rotating parts (drive belts, idler pulley, and crankshaft pulley, etc.).

CAUTION:

- Prevent splashing by using a shop cloth so as to prevent the worker from injury from engine oil and so as to prevent engine oil contamination.
 - Prevent splashing by using a shop cloth so as to prevent engine oil from being splashed to engine and vehicle. Especially, be careful not to apply engine oil to rubber parts of drive belts, engine mounting insulator, etc. Wipe engine oil off immediately if it is splashed.
5. Perform the following inspection if engine oil does not come out from intake valve timing control solenoid valve oil hole of the cylinder head.
 - Remove oil filter, and then clean it. Refer to [EM-257, "Inspection"](#).
 - Clean oil groove between oil strainer and intake valve timing control solenoid valve. Refer to [LU-15, "Engine Lubrication System"](#).
 6. Remove components between intake valve timing control solenoid valve and camshaft sprocket (INT), and then check each oil groove for clogging.
 - Clean oil groove if necessary. Refer to [LU-15, "Engine Lubrication System"](#).
 7. After inspection, install removed parts in the reverse order.

OIL SEAL VALVE OIL SEAL

VALVE OIL SEAL : Removal and Installation

INFOID:000000006282286

REMOVAL

1. Remove camshafts. Refer to [EM-210. "Exploded View"](#).
2. Remove valve lifters. Refer to [EM-210. "Exploded View"](#).
3. Rotate crankshaft, and set piston whose valve oil seal is to be removed to TDC. This will prevent valve from dropping into cylinder.

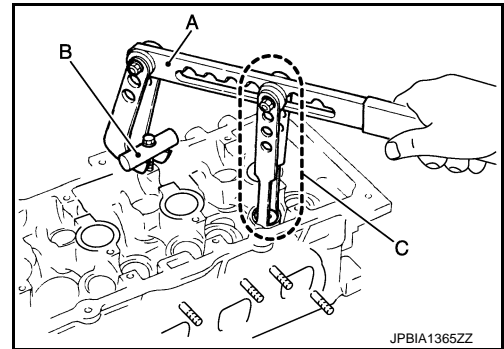
CAUTION:

When rotating crankshaft, be careful to avoid scarring front cover with timing chain.

4. Remove valve collet.
 - Compress valve spring with the valve spring compressor [SST: KV10116200] (A), the attachment [SST: KV10115900] (C), and the adapter [SST: KV10109220] (B). Remove valve collet with magnet hand.

CAUTION:

Be careful not to damage valve lifter holes.

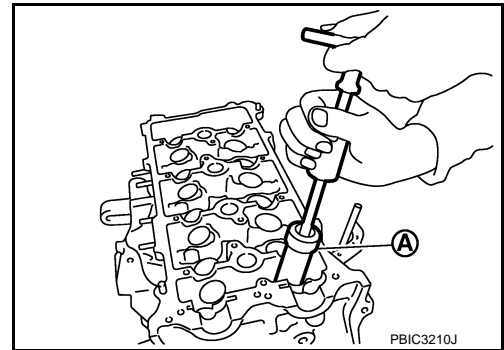


5. Remove valve spring retainer and valve spring (with valve spring seat).

CAUTION:

Never remove valve spring seat from valve spring.

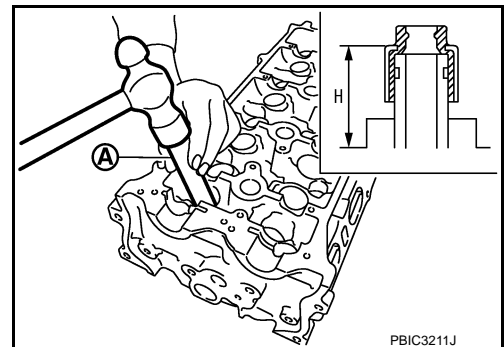
6. Remove valve oil seal with the valve oil seal puller [SST: KV10107902] (A).



INSTALLATION

1. Apply new engine oil to valve oil seal joint surface and seal lip.
2. Press in valve oil seal to the height (H) shown in the figure with the valve oil seal drift [SST: KV10115600] (A).

Height (H) : 13.2 - 13.8 mm (0.520 - 0.543 in)



3. Install in the reverse order of removal, for the rest of parts.

FRONT OIL SEAL

OIL SEAL

< REMOVAL AND INSTALLATION >

[HR15DE]

INFOID:000000006282287

FRONT OIL SEAL : Removal and Installation

REMOVAL

1. Remove the following parts.
 - Front fender protector (RH): Refer to [EXT-20, "FENDER PROTECTOR : Exploded View"](#).
 - Drive belt: Refer to [EM-174, "Removal and Installation"](#).
 - Crankshaft pulley: Refer to [EM-200, "Exploded View"](#).
2. Remove front oil seal with a suitable tool.

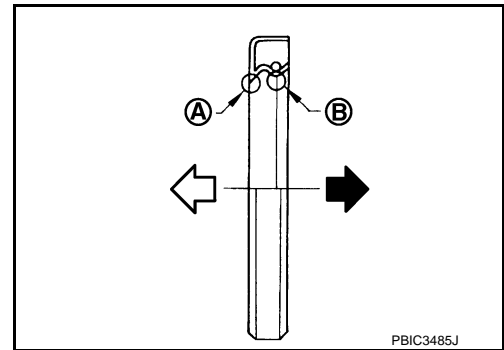
CAUTION:

Be careful not to damage front cover and crankshaft.

INSTALLATION

1. Apply new engine oil to new front oil seal joint surface and seal lip.
2. Install front oil seal so that each seal lip is oriented as shown in the figure.

- A : Dust seal lip
- B : Oil seal lip
- ⇐ : Engine outside
- ⇨ : Engine inside



- Press-fit front oil seal using a suitable drift with outer diameter 50 mm (1.97 in) and inner diameter 44 mm (1.73 in).

CAUTION:

- **Be careful not to damage front cover and crankshaft.**
- **Press-fit oil seal straight to avoid causing burrs or tilting.**

3. Install in the reverse order of removal, for the rest of parts.

REAR OIL SEAL

REAR OIL SEAL : Removal and Installation

INFOID:000000006282288

REMOVAL

1. Remove transaxle assembly. Refer to [TM-37, "HR15DE : Exploded View"](#) (M/T models), [TM-305, "Exploded View"](#) (A/T models).
2. Remove clutch cover and clutch disk (M/T models). Refer to [CL-25, "HR12DE : Exploded View"](#).
3. Remove flywheel (M/T models) or drive plate (A/T models). Refer to [EM-248, "Exploded View"](#).
4. Remove rear oil seal with a suitable tool.

CAUTION:

Be careful not to damage crankshaft and cylinder block.

INSTALLATION

1. Apply the liquid gasket lightly to entire outside area of new rear oil seal.
Use Genuine Liquid Gasket or equivalent.

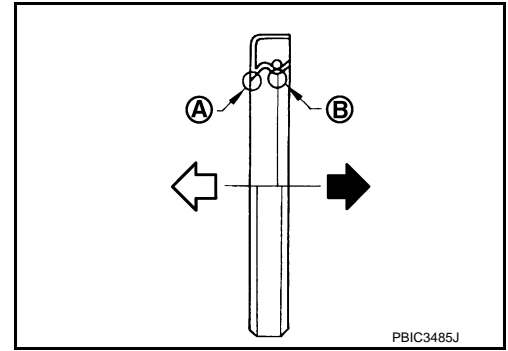
OIL SEAL

[HR15DE]

< REMOVAL AND INSTALLATION >

2. Install rear oil seal so that each seal lip is oriented as shown in the figure.

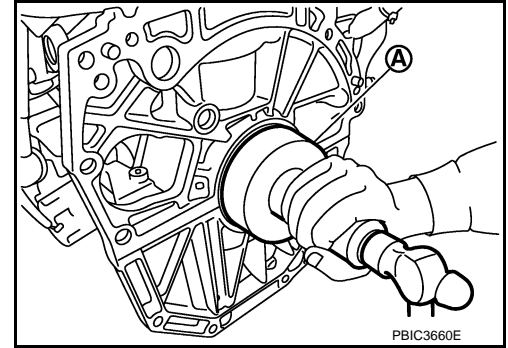
- A : Dust seal lip
- B : Oil seal lip
- ⇐ : Engine outside
- ➡ : Engine inside



- Press-fit rear oil seal with a suitable drift (A) outer diameter 113 mm (4.45 in) and inner diameter 90 mm (3.54 in).

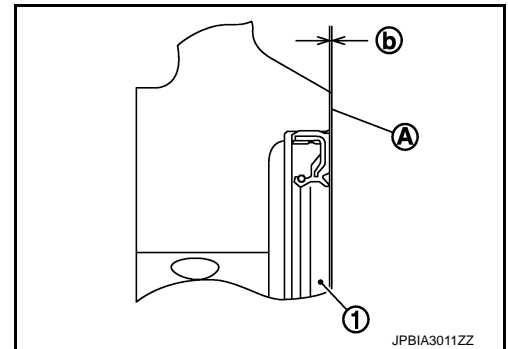
CAUTION:

- Be careful not to damage crankshaft and cylinder block.
- Press-fit oil seal straight to avoid causing burrs or tilting.
- Never touch grease applied onto oil seal lip.



- Press in rear oil seal (1) to the position as shown in the figure.

- A : Rear end surface of cylinder block
- b : 0 - 0.5 mm (0 - 0.020 in)



3. Install in the reverse order of removal, for the rest of parts.

CYLINDER HEAD

< REMOVAL AND INSTALLATION >

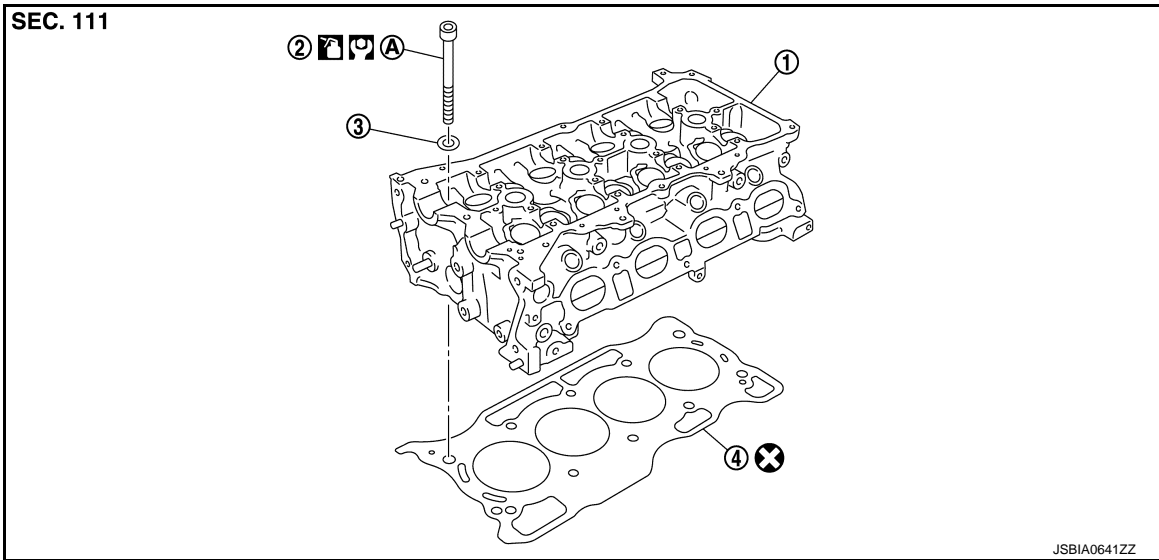
[HR15DE]

CYLINDER HEAD

Exploded View

INFOID:000000006282289

REMOVAL



1. Cylinder head assembly
2. Cylinder head bolt
3. Washer
4. Cylinder head gasket

Comply with the assembly procedure

A. when tightening.

Refer to [EM-230](#)

⊗ : Always replace after every disassembly.

Ⓜ : N-m (kg-m, ft-lb)

👉 : Should be lubricated with oil.

DISASSEMBLY

A

EM

C

D

E

F

G

H

I

J

K

L

M

N

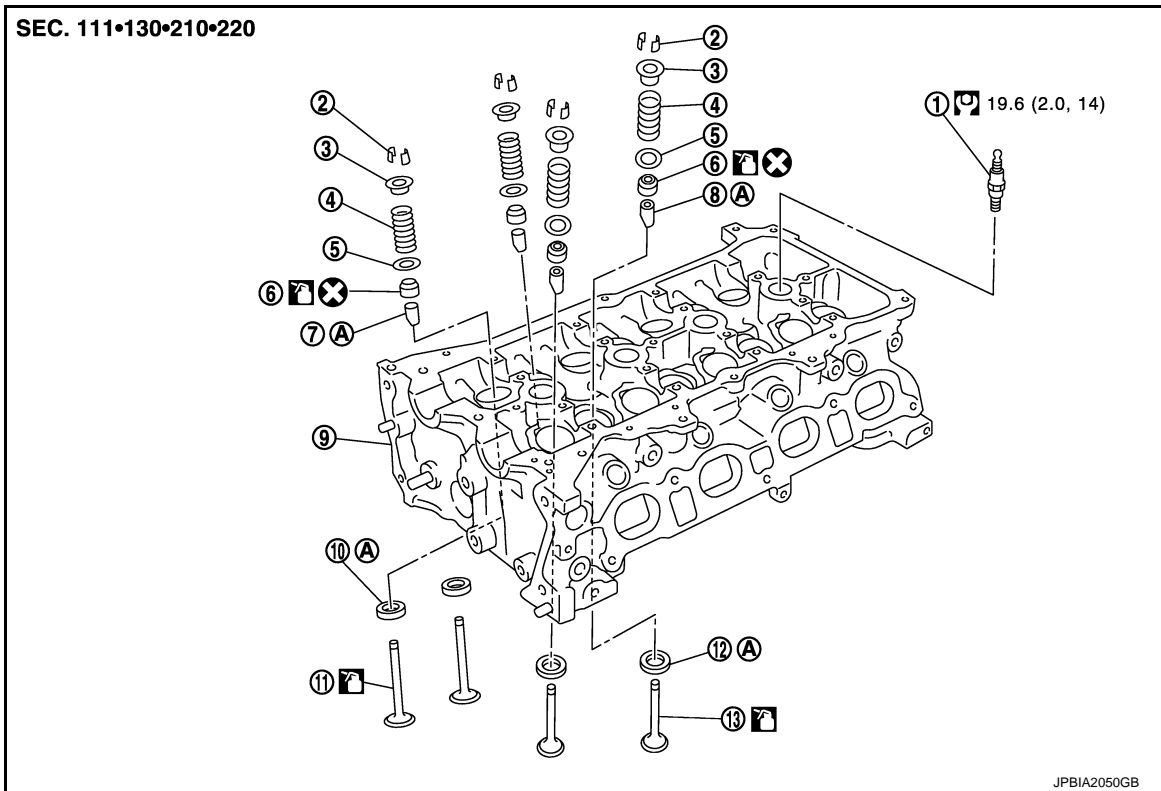
O

P

CYLINDER HEAD

< REMOVAL AND INSTALLATION >

[HR15DE]



- | | | |
|----------------------|----------------------|--------------------------|
| 1. Spark plug | 2. Valve collet | 3. Valve spring retainer |
| 4. Valve spring | 5. Valve spring seat | 6. Valve oil seal |
| 7. Valve guide (EXH) | 8. Valve guide (INT) | 9. Cylinder head |
| 10. Valve seat (EXH) | 11. Valve (EXH) | 12. Valve seat (INT) |
| 13. Valve (INT) | | |

Replacement must be following the

- A. disassembly and assembly procedure. Refer to [EM-232](#)

⊗: Always replace after every disassembly.

Ⓜ: N·m (kg·m, ft·lb)

🛢: Should be lubricated with oil.

Removal and Installation

INFOID:000000006282290

REMOVAL

1. Release fuel pressure. Refer to [EC-887, "Work Procedure"](#).
2. Drain engine coolant and engine oil. Refer to [CO-38, "Draining"](#) and [LU-17, "Draining"](#).
CAUTION:
Perform this step when the engine is cold.
3. Remove the following components and related parts.
 - Front road wheel and tire (RH): Refer to [WT-6, "Exploded View"](#).
 - Front fender protector (RH): Refer to [EXT-20, "FENDER PROTECTOR : Exploded View"](#).
 - Drive belt: Refer to [EM-174, "Removal and Installation"](#).
 - Air duct: Refer to [EM-181, "Exploded View"](#).
 - Intake manifold: Refer to [EM-183, "Exploded View"](#).
 - Fuel tube and fuel injector: Refer to [EM-193, "Exploded View"](#).
 - Water outlet: Refer to [CO-52, "Exploded View"](#).
 - Exhaust manifold: Refer to [EM-187, "Exploded View"](#).
 - Rocker cover: Refer to [EM-198, "Exploded View"](#).
 - Front cover and timing chain: Refer to [EM-200, "Exploded View"](#).

CYLINDER HEAD

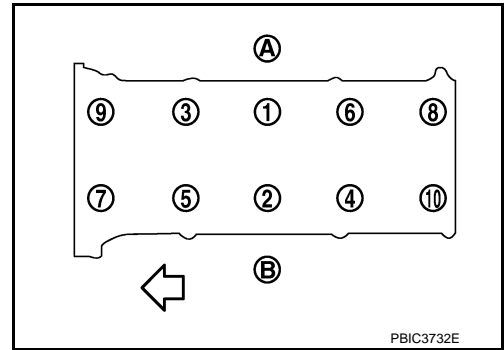
< REMOVAL AND INSTALLATION >

[HR15DE]

- Camshaft: Refer to [EM-210. "Exploded View"](#).

- Remove cylinder head loosening bolts in reverse order as shown in the figure with cylinder head wrench (commercial service tool).

- A : EXH side
- B : INT side
- ⇐ : Engine front



- Remove cylinder head gasket.

INSTALLATION

- Install new cylinder head gasket.
- Tighten cylinder head bolts in numerical order as shown in the figure with the following procedure to install cylinder head.

- A : EXH side
- B : INT side
- ⇐ : Engine front

CAUTION:

If cylinder head bolts are reused, check their outer diameters before installation. Refer to "Cylinder Head Bolts Outer Diameter".

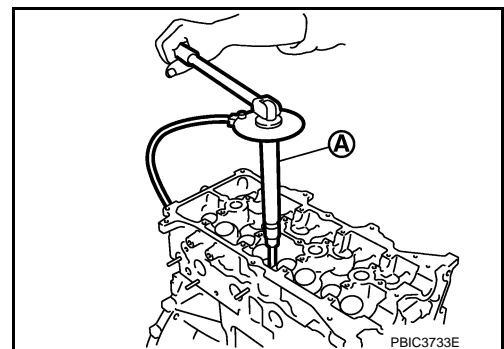
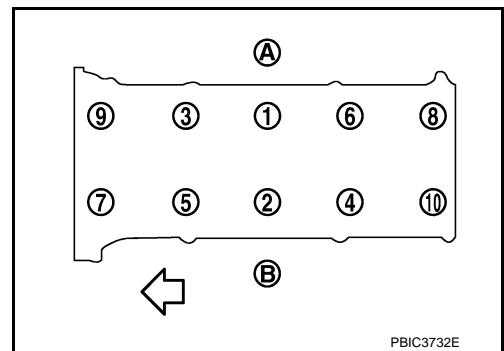
- Apply new engine oil to threads and seating surfaces of mounting bolts.
- Tighten all bolts.

: 40.0 N·m (4.1 kg-m, 30 ft-lb)

- Turn all bolts 60 degrees clockwise (angle tightening).

CAUTION:

Check and confirm the tightening angle by using the angle wrench [SST: KV10112100] (A) or protractor. Avoid judgment by visual inspection without the tool.



- Completely loosen.

: 0 N·m (0 kg-m, 0 ft-lb)

CAUTION:

In this step, loosen bolts in reverse order of that indicated in the figure.

- Tighten all bolts.

: 40.0 N·m (4.1 kg-m, 30 ft-lb)

- Turn all bolts 75 degrees clockwise (angle tightening).

CYLINDER HEAD

< REMOVAL AND INSTALLATION >

[HR15DE]

- g. Turn all bolts 75 degrees clockwise again (angle tightening).
3. Install in the reverse order of removal after this step.

Disassembly and Assembly

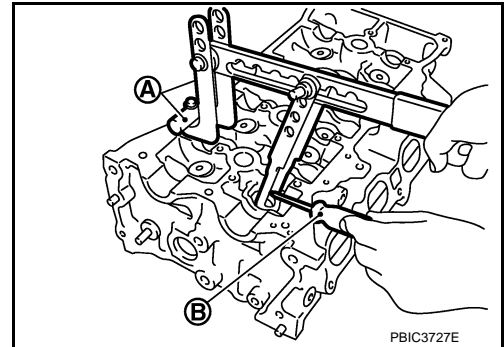
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DISASSEMBLY

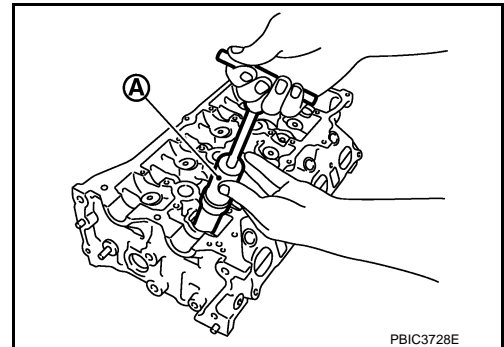
1. Remove spark plug with a spark plug wrench (commercial service tool).
2. Remove valve lifter.
 - Identify installation positions, and store them without mixing them up.
3. Remove valve collet.
 - Compress valve spring with the valve spring compressor, the attachment and the adapter [SST: KV10116200] (A). Remove valve collet with a magnet hand (B).

CAUTION:

When working, be careful not to damage valve lifter holes.



4. Remove valve spring retainer and valve spring.
5. Push valve stem to combustion chamber side, and remove valve.
 - Identify installation positions, and store them without mixing them up.
6. Remove valve oil seal with the valve oil seal puller [SST: KV10107902] (A).

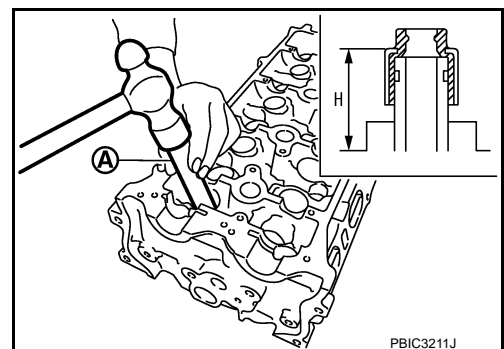


7. Remove valve spring seat.
8. When valve seat must be replaced, refer to [EM-233, "Inspection"](#) to removal.
9. When valve guide must be replaced, refer to [EM-233, "Inspection"](#) to removal.

ASSEMBLY

1. Install valve guide if removed. Refer to [EM-233, "Inspection"](#).
2. Install valve seat if removed. Refer to [EM-233, "Inspection"](#).
3. Install valve oil seal.
 - Install with the valve oil seal drift [SST: KV10115600] (A) to match dimension in the figure.

Height "H" : 13.2 - 13.8 mm (0.519 - 0.543 in)



4. Install valve spring seat.

CYLINDER HEAD

[HR15DE]

< REMOVAL AND INSTALLATION >

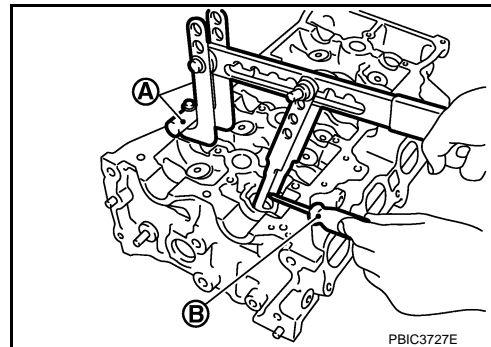
5. Install valve.
 - Install larger diameter to intake side.
6. Install valve spring.

NOTE:
It can be installed in either direction.
7. Install valve spring retainer.
8. Install valve collet.
 - Compress valve spring with the valve spring compressor, the attachment and the adapter [SST: KV10116200] (A). Install valve collet with a magnet hand (B).

CAUTION:

When working, be careful not to damage valve lifter holes.

- Tap valve stem edge lightly with a plastic hammer after installation to check its installed condition.



9. Install valve lifter.
10. Install spark plug with a spark plug wrench (commercial service tool).

Inspection

INFOID:000000006282292

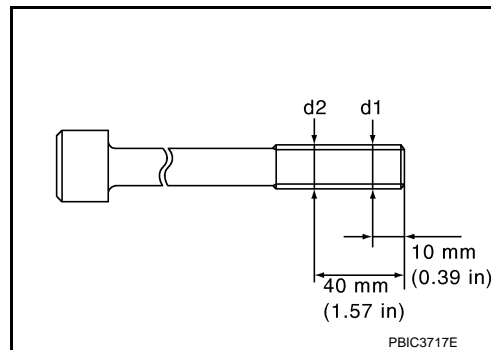
INSPECTION AFTER REMOVAL

Cylinder Head Bolts Outer Diameter

- Cylinder head bolts are tightened by plastic zone tightening method. Whenever the size difference between “d1” and “d2” exceeds the limit, replace them with a new one.

Limit (“d1”–“d2”): 0.15 mm (0.0059 in)

- If reduction of outer diameter appears in a position other than “d2”, use it as “d2” point.



Cylinder Head Distortion

NOTE:

When performing this inspection, cylinder block distortion should be also checking. Refer to [EM-257, "Inspection"](#).

1. Wipe off engine oil and remove water scale (like deposit), gasket, sealant, carbon, etc. with a scraper.

CAUTION:

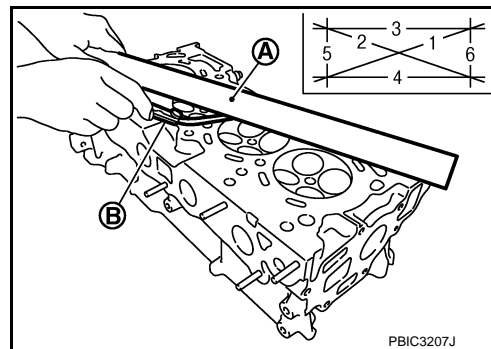
Use utmost care not to allow gasket debris to enter passages for engine oil or engine coolant.

2. At each of several locations on bottom surface of cylinder head, measure the distortion in six directions.

- A : Straightedge
- B : Feeler gauge

Limit : Refer to [EM-275, "Cylinder head"](#).

- If it exceeds the limit, replace cylinder head.



INSPECTION AFTER DISASSEMBLY

CYLINDER HEAD

[HR15DE]

< REMOVAL AND INSTALLATION >

VALVE DIMENSIONS

- Check the dimensions of each valve. For the dimensions, refer to [EM-275, "Cylinder head"](#).
- If dimensions are out of the standard, replace valve and check valve seat contact. Refer to "VALVE SEAT CONTACT".

VALVE GUIDE CLEARANCE

Valve Stem Diameter

- Measure the diameter of valve stem with micrometer (A).

Standard : Refer to [EM-275, "Cylinder head"](#).

Valve Guide Inner Diameter

- Measure the inner diameter of valve guide with bore gauge.

Standard : Refer to [EM-275, "Cylinder head"](#).

Valve Guide Clearance

- (Valve guide clearance) = (Valve guide inner diameter) – (Valve stem diameter)

Standard and Limit : Refer to [EM-275, "Cylinder head"](#).

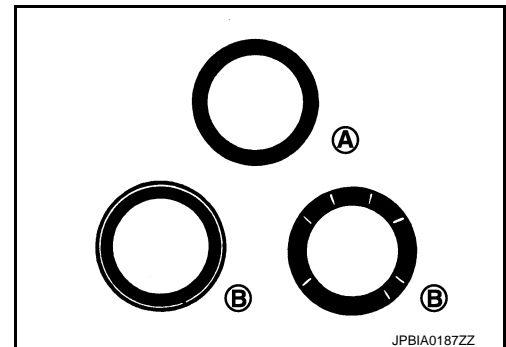
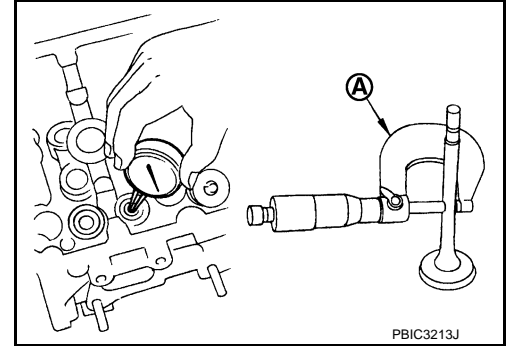
- If the calculated value exceeds the limit, replace valve and/or valve guide. When valve guide must be replaced. Refer to [EM-232, "Disassembly and Assembly"](#).

VALVE SEAT CONTACT

- After confirming that the dimensions of valve guides and valves are within the specifications, perform this procedure.
- Apply prussian blue (or white lead) onto contacting surface of valve seat to check the condition of the valve contact on the surface.
- Check if the contact area band is continuous all around the circumference.

A : OK

- If not, grind to adjust valve fitting and check again. If the contacting surface still has "NG" conditions (B) even after the recheck, replace valve seat. Refer to [EM-232, "Disassembly and Assembly"](#).



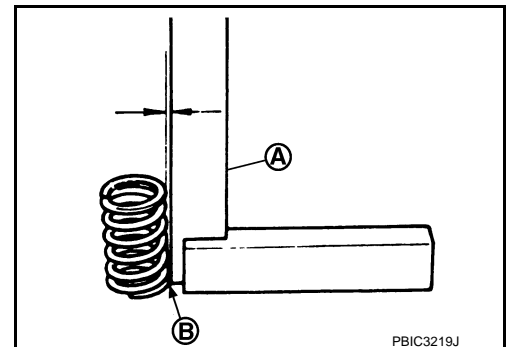
VALVE SPRING SQUARENESS

- Set a try square (A) along the side of valve spring and rotate spring. Measure the maximum clearance between the top of spring and try square.

B : Contact

Limit : Refer to [EM-275, "Cylinder head"](#).

- If it exceeds the limit, replace valve spring.



VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

CYLINDER HEAD

< REMOVAL AND INSTALLATION >

[HR15DE]

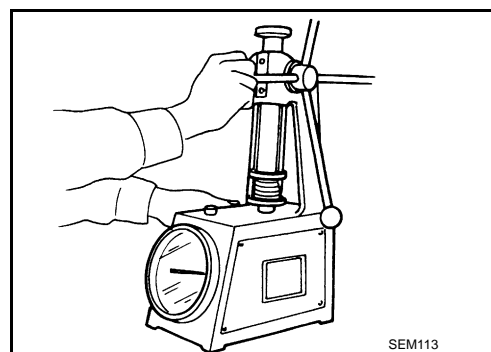
- Check valve spring pressure with valve spring seat installed at the specified spring height.

CAUTION:

Never remove valve spring seat from valve spring.

Standard : Refer to [EM-275, "Cylinder head"](#).

- If the installation load or load with valve open is out of the standard, replace valve spring (with valve spring seat).



INSPECTION AFTER INSTALLATION

Inspection for Leaks

The following are procedures for checking fluids leak, lubricates leak and exhaust gases leak.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-19, "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
 - Turn ignition switch ON (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

NOTE:

If hydraulic pressure inside timing chain tensioner drops after removal/installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to check there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

Items	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Other oils and fluid*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

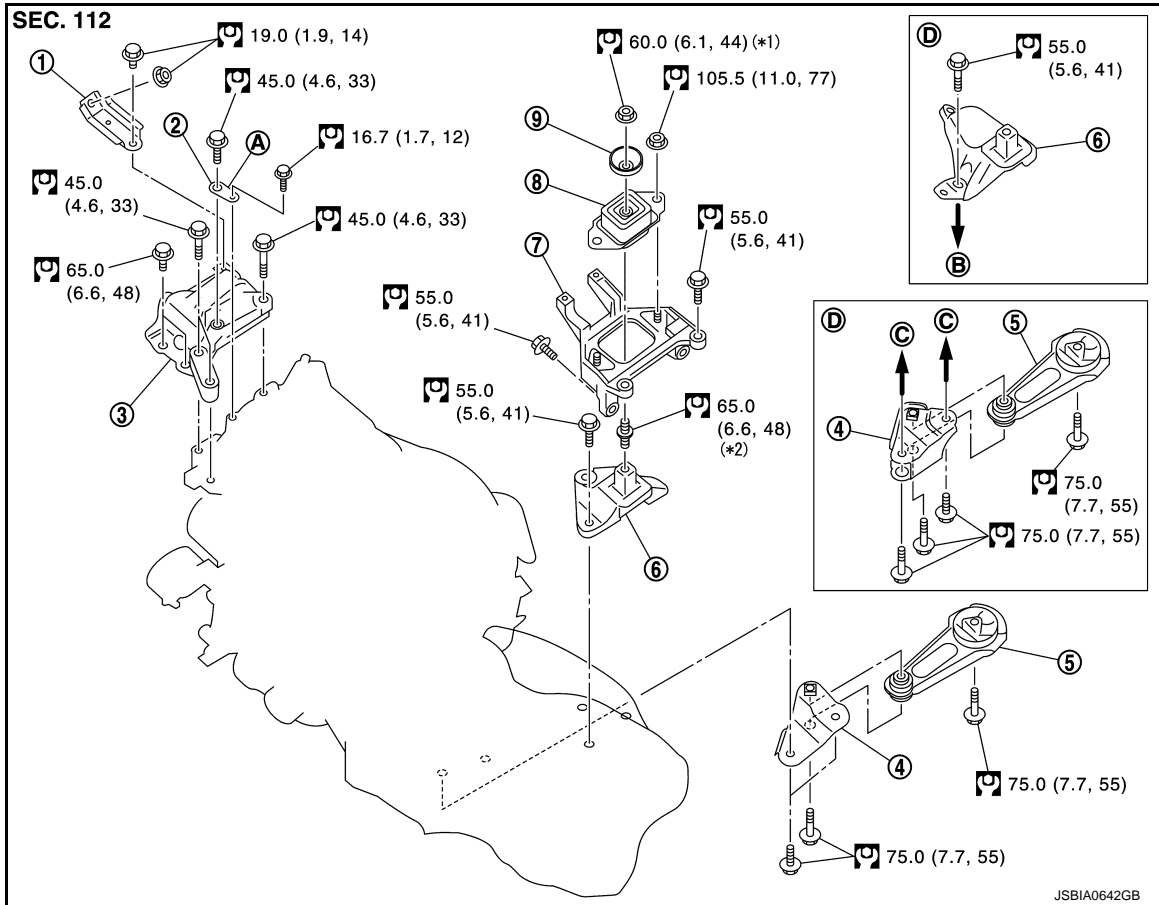
*: Transmission/transaxle fluid, power steering fluid, brake fluid, etc.

UNIT REMOVAL AND INSTALLATION

ENGINE ASSEMBLY

Exploded View

INFOID:000000006282293



- | | | |
|--|-----------------------------------|-----------------------------------|
| 1. Engine mounting insulator (RH) stay | 2. Engine mount bracket link | 3. Engine mounting insulator (RH) |
| 4. Rear engine mounting bracket | 5. Rear torque rod | 6. Engine mounting bracket (LH) |
| 7. Engine mounting bracket (LH) | 8. Engine mounting insulator (LH) | 9. Mass damper (M/T models) |
| A. Front mark | B. Transaxle (upper) | C. Transaxle (lower) |

: N·m (kg-m, ft-lb)

CAUTION:

Check that the stud bolt (*2) is tight at the specified torque before tightening the mounting nut (*1) shown in the figure. [Stud bolt (*2) may be loosened after loosening the mounting nut (*1)]

Removal and Installation

INFOID:000000006282294

WARNING:

- Situate the vehicle on a flat and solid surface.
- Place chocks at front and back of rear wheels.
- Attach proper slingers and bolts described in PARTS CATALOG if engine slingers are not equipped.

CAUTION:

- Always be careful to work safely, avoid forceful or uninstructed operations.
- Never start working until exhaust system and coolant are cool enough.
- If items or work required are not covered by the engine section, refer to the applicable sections.
- Always use the support point specified for lifting.

ENGINE ASSEMBLY

< UNIT REMOVAL AND INSTALLATION >

[HR15DE]

- Use either 2-pole lift type or separate type lift as best you can. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with a transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.
- For supporting points for lifting and jacking point at rear axle, refer to [GI-41, "Garage Jack and Safety Stand and 2-Pole Lift"](#).

REMOVAL

Outline

Remove the engine and the transaxle assembly from the vehicle downward. Separate the engine and the transaxle.

Preparation

1. Release fuel pressure. Refer to [EC-179, "Work Procedure"](#).
2. Drain engine coolant from radiator. Refer to [CO-13, "Draining"](#).
CAUTION:
 - Perform this step when the engine is cold.
 - Never spill engine coolant on drive belts.
3. Remove the following parts.
 - Front road wheels and tires (RH and LH)
 - Front fender protector (RH and LH): Refer to [EXT-20, "FENDER PROTECTOR : Exploded View"](#).
 - Drive belt: Refer to [EM-174, "Removal and Installation"](#).
 - Battery and battery tray: Refer to [PG-284, "FOR MAINTENANCE REQUIRED BATTERY MODELS : Removal and Installation"](#).
 - Air duct (inlet), air duct, and air cleaner cover and body assembly: Refer to [EM-181, "Removal and Installation"](#).
 - Radiator hose (upper and lower): Refer to [CO-43, "Exploded View"](#).
 - Exhaust front tube: Refer to [EX-5, "Exploded View"](#).

Engine Room LH

1. Disconnect all connections of engine harness around the battery, and then temporarily secure the engine harness into the engine side.
CAUTION:
Protect connectors using a resin bag against foreign materials during the operation.
2. Disconnect heater hoses. Refer to [CO-52, "Exploded View"](#).
3. Disconnect fuel feed tube at engine side. Refer to [EM-193, "Exploded View"](#).
4. Disconnect control linkage from transaxle. Refer to [TM-29, "Removal and Installation"](#) (M/T models).
5. Disconnect clutch tube on transaxle side from clutch damper (M/T models). Refer to [CL-22, "Removal and Installation"](#).

Engine Room RH

1. Remove ground cable at engine side.
2. Remove alternator. Refer to [CHG-39, "HR15DE : Exploded View"](#).
3. Disconnect vacuum hose from intake manifold. Refer to [EM-183, "Exploded View"](#).
4. Remove EVAP hoses. Refer to [EM-183, "Exploded View"](#).
5. Remove A/C compressor. Refer to [HA-32, "COMPRESSOR : Removal and Installation"](#).

Vehicle Underbody

1. Remove ground cable at transaxle side.
2. Remove drive shafts (RH and LH). Refer to [FAX-23, "Exploded View"](#).
3. Disconnect A/T fluid hose from radiator (A/T models).
 - Install blind plug to avoid leakage of A/T fluid.

ENGINE ASSEMBLY

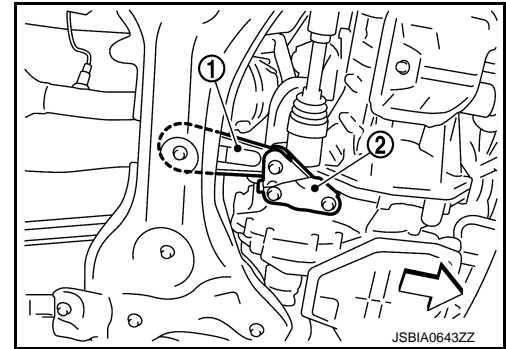
< UNIT REMOVAL AND INSTALLATION >

[HR15DE]

4. Remove rear torque rod (1).

2 : Rear engine mounting bracket

↔ : Vehicle front



5. Preparation for the separation work of transaxle is as follows:

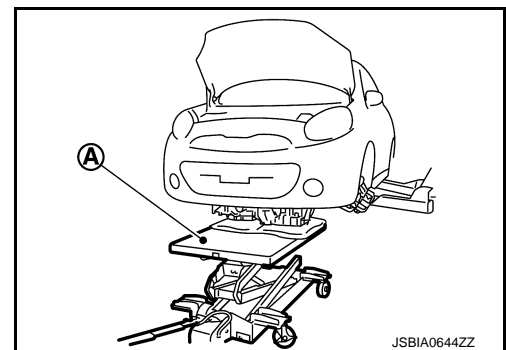
- Remove transaxle joint bolts which pierce at oil pan (upper) lower rear side. Refer to [EM-190, "Exploded View"](#).

Removal

1. Use a manual lift table caddy (commercial service tool) (A) or equivalently rigid tool such as a transmission jack. Securely support bottom of the engine and the transaxle assembly.

CAUTION:

Put a piece of wood or an equivalent as the supporting surface, secure a completely stable condition.



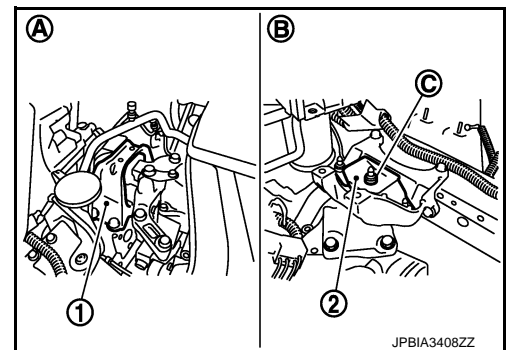
2. Remove engine mounting insulator (RH) (1).

2 : Engine mounting insulator (LH)

A : Engine front side

B : Transaxle side

3. Remove engine mounting through bolt-securing nut (C).



4. Carefully lower jack, or raise lift to remove the engine and the transaxle assembly. When performing work, observe the following caution.

CAUTION:

- Check that no part interferes with the vehicle side.
- Before and during this lifting, always check if any harnesses are left connected.
- During the removal, always be careful to prevent the vehicle from falling off the lift due to changes in the center of gravity.
- If necessary, support the vehicle by setting jack or suitable tool at the rear.

Separation

ENGINE ASSEMBLY

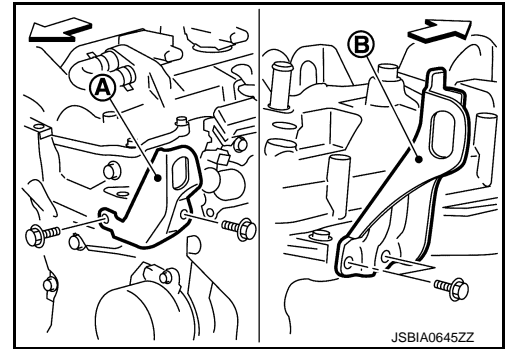
< UNIT REMOVAL AND INSTALLATION >

[HR15DE]

- When engine can be hoisted, install engine slinger to cylinder head front left side (A) and rear right side (B) and support the engine position with a hoist.

← : Engine front

Slinger bolts : 25.0 N-m (2.6 kg-m, 18 ft-lb)



- Remove starter motor. Refer to [STR-49, "HR15DE : Exploded View"](#).
- Lift with a hoist and separate the engine from the transaxle assembly. Refer to [TM-37, "HR15DE : Exploded View"](#) (M/T models), [TM-305, "Exploded View"](#) (A/T models).

INSTALLATION

Note the following, and install in the reverse order of removal.

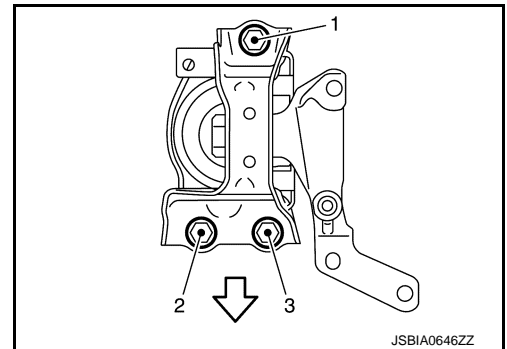
CAUTION:

- Never allow engine oil to get on engine mounting insulator. Be careful not to damage engine mounting insulator.
- Check that each mounting insulator is seated properly, and tighten mounting nuts and bolts.
- When installation directions are specified, install parts according to the direction marks on them referring to the figure of components. Refer to [EM-236, "Exploded View"](#).

Engine Mounting Bracket (RH)

- Tighten mounting bolts in the numerical order as shown in the figure.

← : Vehicle front



Inspection

INFOID:000000006282295

INSPECTION AFTER INSTALLATION

Inspection for Leakage

The following are procedures for checking fluids leakage, lubricates leakage, and exhaust gases leakage.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-19, "Fluids and Lubricants"](#).
- Use procedure below to check for fuel leakage.
 - Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
 - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to check there is no leakage of fuel, exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

Items	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level

ENGINE ASSEMBLY

< UNIT REMOVAL AND INSTALLATION >

[HR15DE]

Other oils and fluid*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gases	—	Leakage	—

*: Transmission/transaxle/A/T fluid, power steering fluid, brake fluid, etc.

UNIT DISASSEMBLY AND ASSEMBLY

ENGINE STAND SETTING

Setting

INFOID:000000006282296

EM

NOTE:

Explained here is how to disassemble with engine stand supporting transaxle surface. When using different type of engine stand, note with difference in steps and etc.

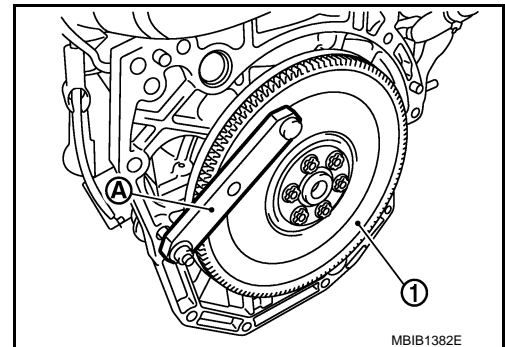
1. Remove the engine and the transaxle assembly from the vehicle, and separate the transaxle from the engine. Refer to [EM-236, "Exploded View"](#).
2. Install engine to engine stand with the following procedure:

a. Remove flywheel.

- Secure flywheel (1) with a stopper plate [SST: KV11105210] (A), and remove mounting bolts.

CAUTION:

- **Never disassemble them.**
- **Never place them with signal plate facing down.**
- **When handling signal plate, take care not to damage or scratch them.**
- **Handle signal plate in a manner that prevents them from becoming magnetized.**



- b. Lift the engine with a hoist to install it onto widely use engine stand.

CAUTION:

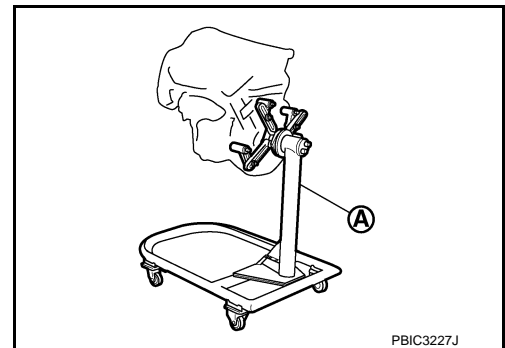
- **Use the engine stand that has a load capacity [approximately 150 kg (331 lb) or more] large enough for supporting the engine weight.**
- If the load capacity of stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning stand.
 - Intake manifold: Refer to [EM-183, "Exploded View"](#).
 - Exhaust manifold: Refer to [EX-5, "Exploded View"](#).
 - Rocker cover: Refer to [EM-198, "Exploded View"](#).

NOTE:

The figure shows an example of widely used engine stand (A) that can support mating surface of transaxle with flywheel removed.

CAUTION:

Before removing the hanging chains, check the engine stand is stable and there is no risk of overturning.



3. Drain engine oil. Refer to [LU-17, "Draining"](#).

CAUTION:

Be sure to clean drain plug and install with new drain plug washer.

ENGINE STAND SETTING

< UNIT DISASSEMBLY AND ASSEMBLY >

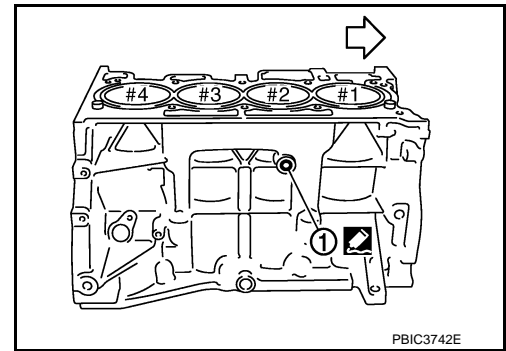
[HR15DE]

4. Drain engine coolant by removing water drain plug (1) from inside of the engine.

← : Engine front

Tightening torque : Refer to [EM-248. "Exploded View"](#).

Use Genuine Liquid Gasket or equivalent.



ENGINE UNIT

Disassembly

INFOID:000000006282297

1. Remove intake manifold. Refer to [EM-183. "Exploded View"](#).
2. Remove exhaust manifold. Refer to [EX-5. "Exploded View"](#).
3. Remove oil pan (lower). Refer to [EM-190. "Exploded View"](#).
4. Remove ignition coil, spark plug, and rocker cover. Refer to [EM-198. "Exploded View"](#).
5. Remove fuel injector and fuel tube. Refer to [EM-193. "Exploded View"](#).
6. Remove front cover and timing chain. Refer to [EM-200. "Exploded View"](#).
7. Remove camshaft. Refer to [EM-210. "Exploded View"](#).
8. Remove cylinder head. Refer to [EM-229. "Exploded View"](#).

Assembly

INFOID:000000006282298

Assemble in the reverse order of disassembly.

A

EM

C

D

E

F

G

H

I

J

K

L

M

N

O

P

OIL PAN (UPPER)

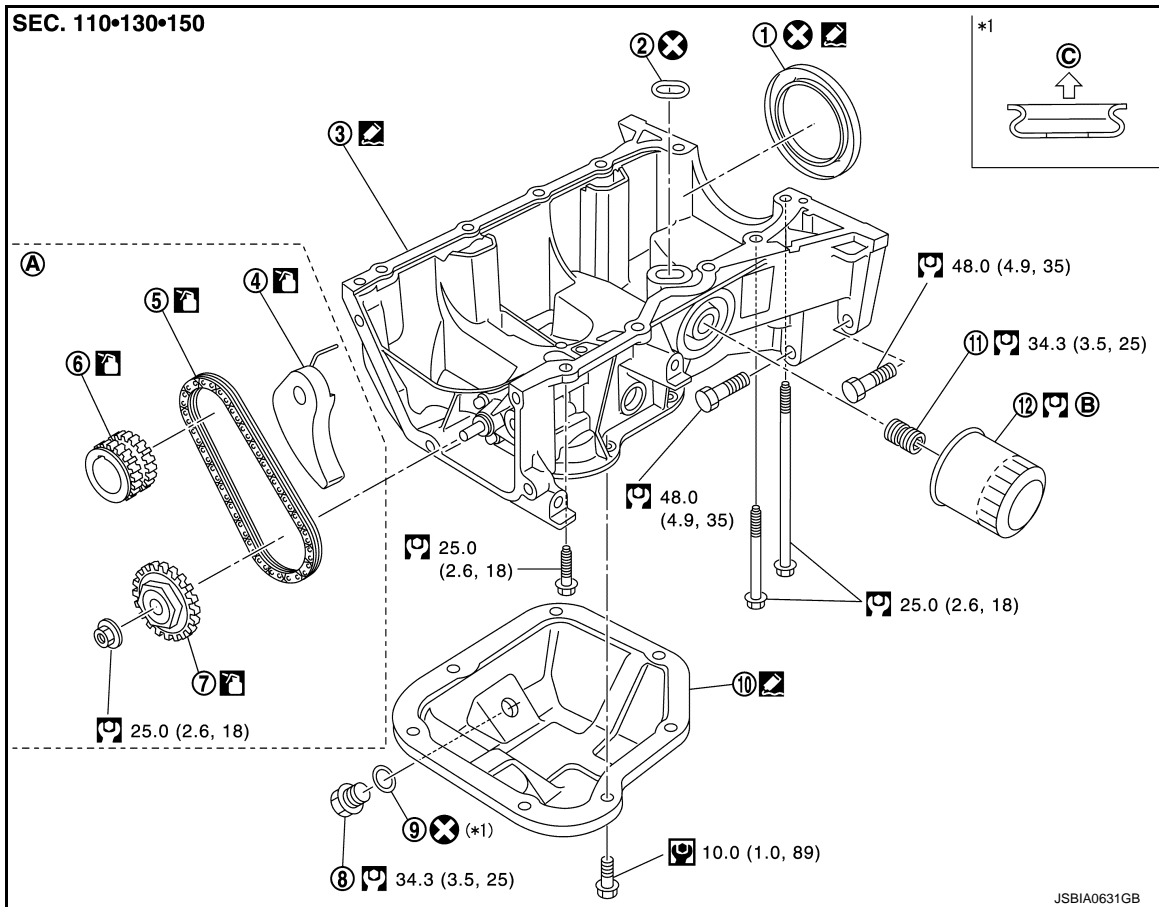
< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

OIL PAN (UPPER)

Exploded View

INFOID:000000006282299



- | | | |
|--|---|-------------------------|
| 1. Rear oil seal | 2. O-ring | 3. Oil pan (upper) |
| 4. Oil pump chain tensioner (for oil pump drive chain) | 5. Oil pump drive chain | 6. Crankshaft sprocket |
| 7. Oil pump sprocket | 8. Drain plug | 9. Drain plug washer |
| 10. Oil pan (lower) | 11. Oil filter stud | 12. Oil filter |
| A. Comply with the assembly procedure when tightening. Refer to EM-200 | B. Comply with the assembly procedure when tightening. Refer to LU-19 | C. Oil pan (lower) side |

⊗ : Always replace after every disassembly.

🔧 : N·m (kg-m, in-lb)

🔧 : N·m (kg-m, ft-lb)

🔧 : Sealing point

🔧 : Should be lubricated with oil.

Removal and Installation

INFOID:000000006282300

NOTE:

The oil strainer and oil pump are included in the oil pan (upper). Individual disassembly is prohibited.

REMOVAL

1. Remove the oil pan (lower). Refer to [EM-190, "Exploded View"](#).

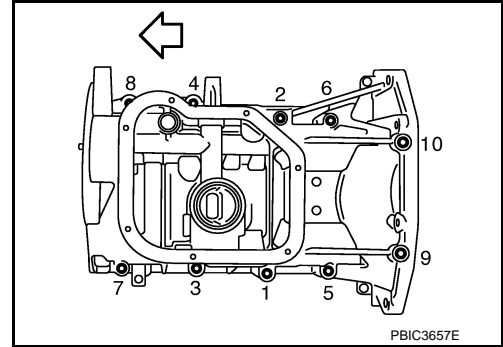
OIL PAN (UPPER)

[HR15DE]

< UNIT DISASSEMBLY AND ASSEMBLY >

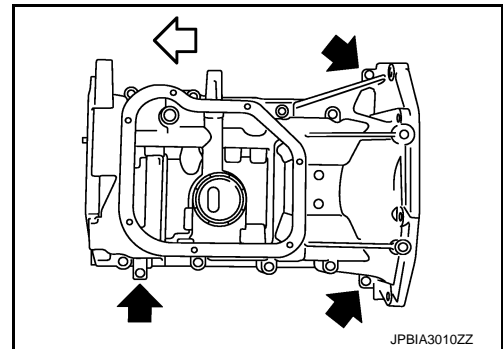
2. Remove oil pump sprocket and crankshaft sprocket together with oil pump drive chain. Refer to [EM-200](#), "[Exploded View](#)".
3. Remove oil pan (upper) with the following procedure.
 - a. Loosen oil pan (upper) mounting bolts in the reverse of the order as shown in the figure.

↩ : Engine front



- b. Insert a flat-bladed offset screwdriver into the arrow (↩) in the figure and open up a crack between the oil pan (upper) cylinder block.

↩ : Engine front



- c. Insert the seal cutter [SST: KV10111100] between the oil pan (upper) and cylinder block. Slide seal cutter by tapping on the side of tool with a hammer.

CAUTION:

- Be careful not to damage the mating surface.
- A more adhesive liquid gasket is applied compared to previous types when shipped, so it should not be forced off using a screwdriver, etc. outside the indicated location.
- Never remove oil pump and oil strainer from oil pan (upper).

4. Remove rear oil seal from crankshaft.

INSTALLATION

1. Install the oil pan (upper) in the following procedure:
 - a. Use scraper to remove old liquid gasket from mating surfaces.
 - Also remove the old liquid gasket from mating surface of cylinder block.
 - Remove old liquid gasket from the bolt holes and threads.
 - CAUTION:
Never scratch or damage the mating surfaces when cleaning off old liquid gasket.
 - b. Install O-ring to the cylinder block.



OIL PAN (UPPER)

[HR15DE]

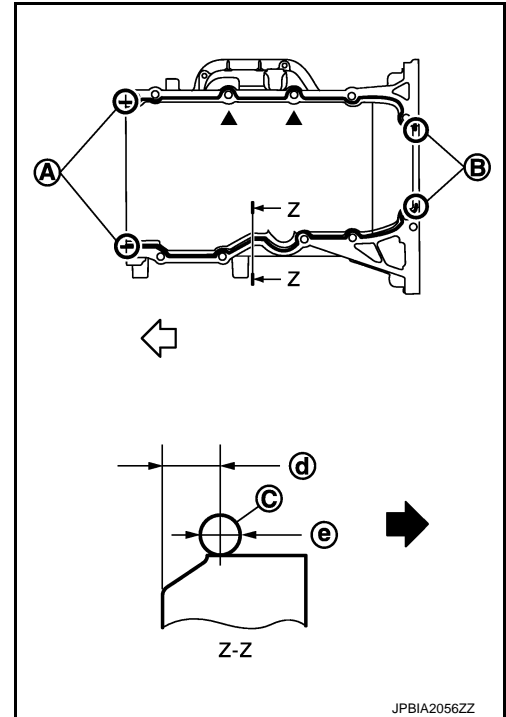
< UNIT DISASSEMBLY AND ASSEMBLY >

- c. Apply a continuous bead of liquid gasket (C) with the tube presser (commercial service tool) to areas as shown in the figure.


Use Genuine Liquid Gasket or equivalent.

- A : 2 mm (0.07 in) protruded to outside
- B : 2 mm (0.07 in) protruded to rear oil seal mounting side
- d : 5.5 - 7.5 mm (0.217 - 0.295 in)
- e : $\phi 4.0 - 5.0$ mm (0.157 - 0.197 in)
-  : Engine front side
-  : Engine out side

CAUTION:
Attaching should be done within 5 minutes after coating.



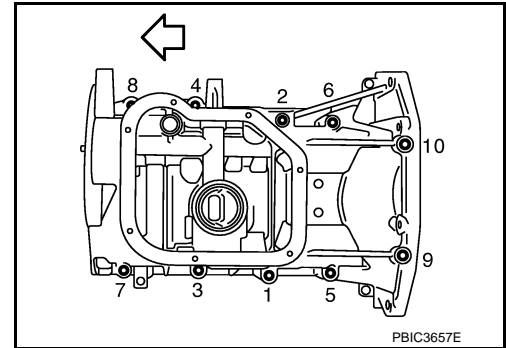
- d. Tighten bolts in the numerical order as shown in the figure.

 : Engine front

CAUTION:
Install avoiding misalignment of both oil pan gasket and O-ring.

- The bolts are different according to the installation position. Refer to the numbers as shown in the figure.

- M8×180 mm (7.09 in) : No. 9, 10**
- M8×25 mm (0.98 in) : No. 3, 4, 7, 8**
- M8×90 mm (3.54 in) : No. 1, 2, 5, 6**

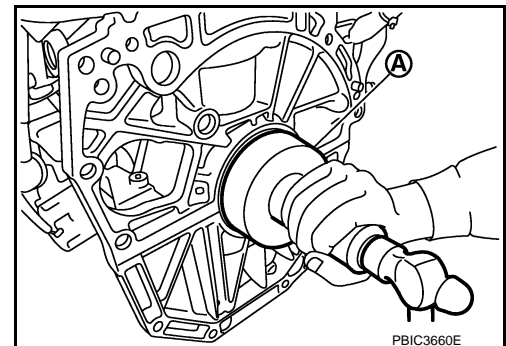


2. Install rear oil seal with the following procedure:

CAUTION:

- The installation of rear oil seal should be completed within 5 minutes after installing oil pan (upper).
- Never touch oil seal lip.

- a. Wipe off any liquid gasket protruding to the rear oil seal mounting part of oil pan (upper) and cylinder block using a spatula.
- b. Apply the liquid gasket lightly to entire outside area of new rear oil seal.
Use Genuine Liquid Gasket or equivalent.
- c. Press-fit the rear oil seal using a drift with outer diameter 113 mm (4.45 in) and inner diameter 90 mm (3.54 in) (commercial service tool) (A).



OIL PAN (UPPER)

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

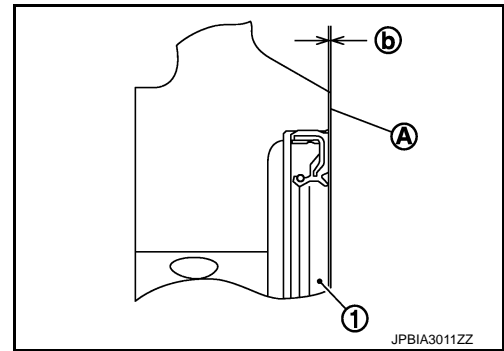
- Press-fit to the dimensions specified as shown in the figure.

- 1 : Rear oil seal
- A : Rear end surface of cylinder block
- b : 0 - 0.5 mm (0 - 0.020 in)

CAUTION:

- Never touch the grease applied to the oil seal lip.
- Be careful not to damage the rear oil seal mounting part of oil pan (upper) and cylinder block or the crankshaft.
- Press-fit straight check that oil seal does not curl or tilt.

- d. After press-fitting the rear oil seal, completely wipe off any liquid gasket protruding to rear end surface side.
3. Install in the reverse order of removal, for the rest of parts.



Inspection

INFOID:000000006282301

INSPECTION AFTER INSTALLATION

1. Check engine oil level and adjust engine oil. Refer to [LU-16. "Inspection"](#).
2. Check for leakage of engine oil when engine is warmed.
3. Stop engine and wait for 10 minutes.
4. Check engine oil level again. Refer to [LU-16. "Inspection"](#).

A
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CYLINDER BLOCK

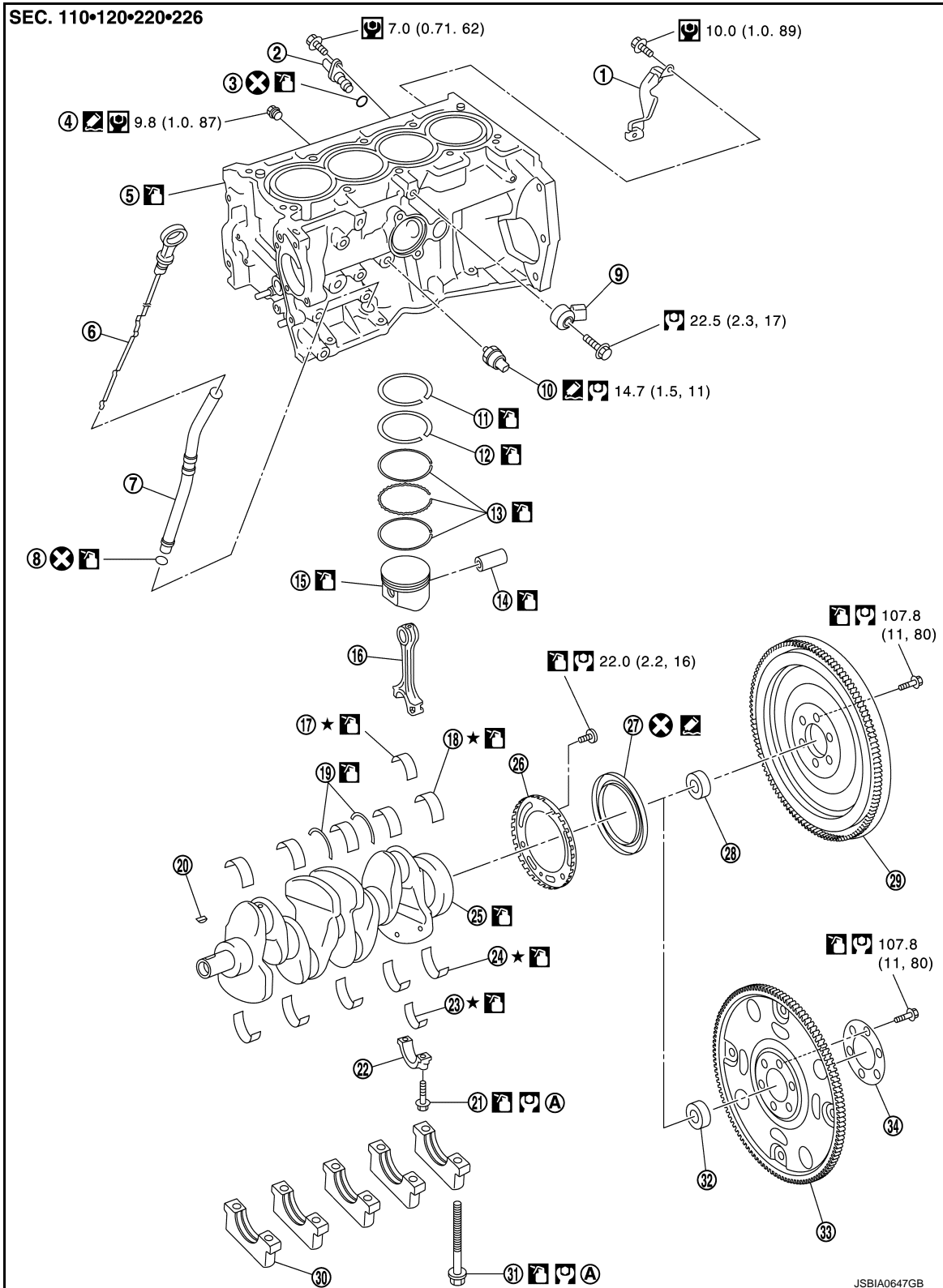
< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

CYLINDER BLOCK

Exploded View

INFOID:00000006282302



- | | | |
|---|-------------------------------------|--------------------|
| 1. Crankshaft position sensor (POS) cover | 2. Crankshaft position sensor (POS) | 3. O-ring |
| 4. Drain plug | 5. Cylinder block | 6. Oil level gauge |
| 7. Oil level gauge guide | 8. O-ring | 9. Knock sensor |

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

- | | | |
|--------------------------------------|------------------------------------|------------------------------|
| 10. Oil pressure switch | 11. Top ring | 12. Second ring |
| 13. Oil ring | 14. Piston pin | 15. Piston |
| 16. Connecting rod | 17. Connecting rod bearing (upper) | 18. Main bearing (upper) |
| 19. Thrust bearing | 20. Crankshaft key | 21. Connecting rod bolt |
| 22. Connecting rod cap | 23. Connecting rod bearing (lower) | 24. Main bearing (lower) |
| 25. Crankshaft | 26. Signal plate | 27. Rear oil seal |
| 28. Pilot bushing (M/T models) | 29. Flywheel (M/T models) | 30. Main bearing cap |
| 31. Main bearing cap bolt | 32. Pilot converter (A/T models) | 33. Drive plate (A/T models) |
| 34. Reinforcement plate (A/T models) | | |
- A. Comply with the assembly procedure when tightening. Refer to [EM-249](#)
 B. Chamfered

⊗ : Always replace after every disassembly.

🔧 : N·m (kg·m, in·lb)

🔧 : N·m (kg·m, ft·lb)

🛢️ : Should be lubricated with oil.

🔍 : Sealing point

★ : Select with proper thickness.

Disassembly and Assembly

INFOID:000000006282303

DISASSEMBLY

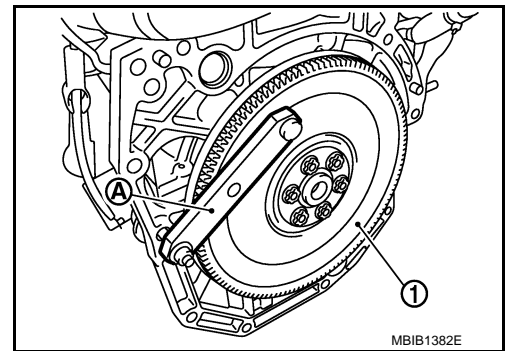
NOTE:

Explained here is how to disassemble with an engine stand supporting mating surface of transaxle. When using different type of engine stand, note with difference in steps and etc.

1. Remove clutch cover and clutch disc. Refer to [CL-27, "HR15DE : Exploded View"](#).
2. Remove flywheel (1).
 - Secure flywheel with a stopper plate [SST: KV11105210] (A), and remove mounting bolts.
 - Using TORX socket (size E20), loosen mounting bolts.

CAUTION:

Be careful not to damage or scratch and contact surface for clutch disc of flywheel.

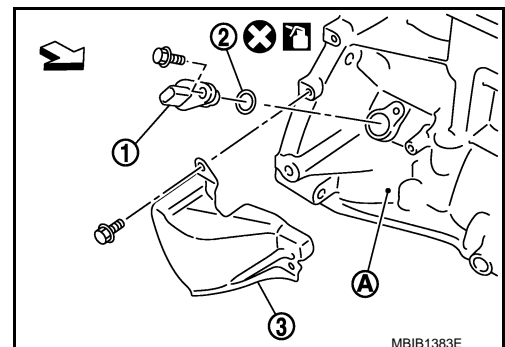


3. Remove cylinder head. Refer to [EM-229, "Exploded View"](#).
4. Remove oil pan (upper and lower). Refer to [EM-244, "Exploded View"](#).
5. Remove knock sensor.
 - CAUTION:**
Carefully handle knock sensor avoiding shocks.
6. Remove cover, and then crankshaft position sensor (POS).

1. Crank shaft position sensor (POS)
 2. O-ring
 3. Cover
- A. Cylinder block LHD side
 ⇐ : Engine front

CAUTION:

- Avoid impacts such as a dropping.
- Never disassemble.



CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

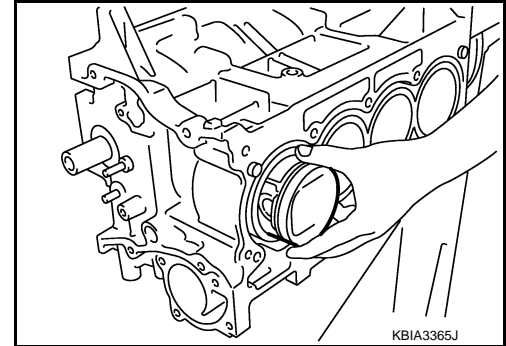
[HR15DE]

- Keep it away from metal particles.
- Never place the sensor in a location where it is exposed to magnetism.

7. Remove piston and connecting rod assembly with the following procedure:
- Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to [EM-257, "Inspection"](#).
- a. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.
- b. Remove connecting rod cap.
- c. Using a hammer handle or similar tool, push piston and connecting rod assembly out to the cylinder head side.

CAUTION:

- Be careful not to damage matching surface with connecting rod cap.
- Be careful not to damage the cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.



8. Remove connecting rod bearings.

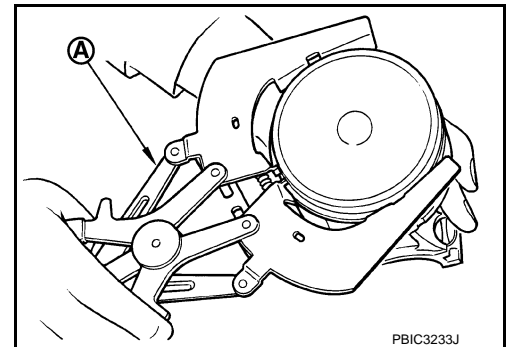
CAUTION:

Identify installation positions, and store them without mixing them up.

9. Remove piston rings from piston.
- Before removing piston rings, check the piston ring side clearance. Refer to [EM-257, "Inspection"](#).
 - Use a piston ring expander (commercial service tool) (A).

CAUTION:

- When removing piston rings, be careful not to damage the piston.
- Be careful not to damage piston rings by expanding them excessively.



10. Remove piston from connecting rod.
- Use a piston pin press stand (SST) and a press to remove the piston pin.
 - For the details of SST, refer to the following.

A : Drift [KV10109730]

B : Center cap [KV10110310]

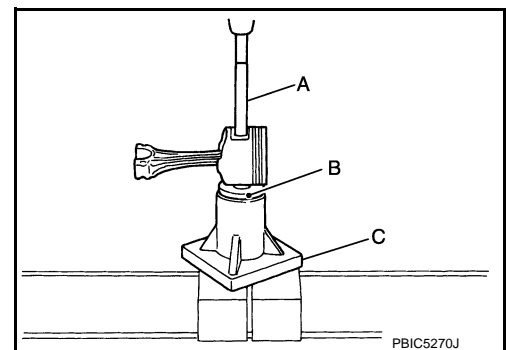
C : Press stand [ST13030020]

CAUTION:

Be careful not to damage the piston and connecting rod.

NOTE:

The joint between the connecting rod and the piston pin is a press fit.



11. Remove the main bearing cap in the following procedure.
- Measure crankshaft end play before loosening main bearing cap bolts. Refer to [EM-257, "Inspection"](#).

CYLINDER BLOCK

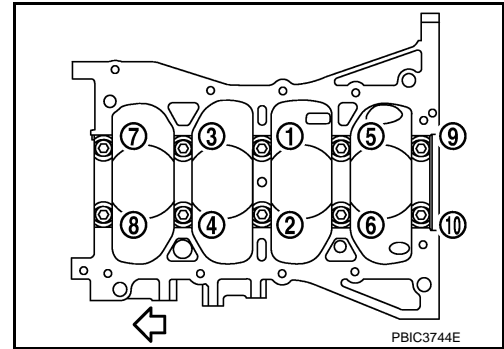
[HR15DE]

< UNIT DISASSEMBLY AND ASSEMBLY >

- a. Loosen and remove bolts in several steps in reverse of the numerical order as shown in the figure.

⇐ : Engine front

- TORX socket (size: E14) can be used.



- b. Remove the main bearing cap from the cylinder block while tapping lightly with a plastic hammer.

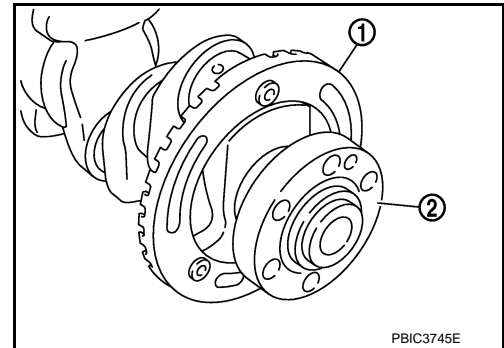
12. Remove crankshaft (2).

CAUTION:

- Be careful not damage or deform signal plate (1) mounted on crankshaft.
- When setting crankshaft on a flat floor surface, use a block of wood to avoid interference between signal plate and the floor surface.
- Never remove signal plate unless it is necessary to do so.

NOTE:

When removing or installing signal plate, use TORX socket (size T40).



13. Pull rear oil seal out from rear end of crankshaft.

14. Remove main bearing (upper and lower) and thrust bearings from cylinder block and main bearing cap.

CAUTION:

Identify installation positions, and store them without mixing them up.

ASSEMBLY

1. Fully air-blow engine coolant and engine oil passages in cylinder block, cylinder bore and crankcase to remove any foreign material.

CAUTION:

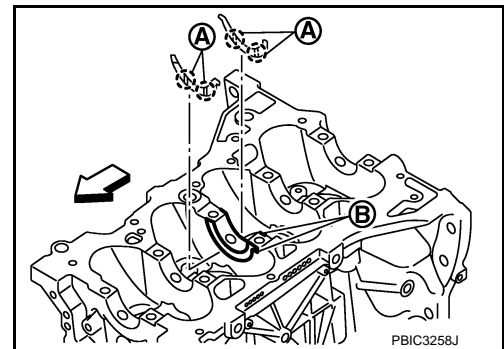
Use a goggles to protect your eye.

2. Install main bearings and thrust bearings with the following procedure:

- Remove dust, dirt, and engine oil on the bearing mating surfaces of cylinder block.
- Install thrust bearings to the both sides of the No. 3 journal housing (B) on cylinder block.

⇐ : Engine front

- Install thrust bearings with the oil groove (A) facing crankshaft arm (outside).

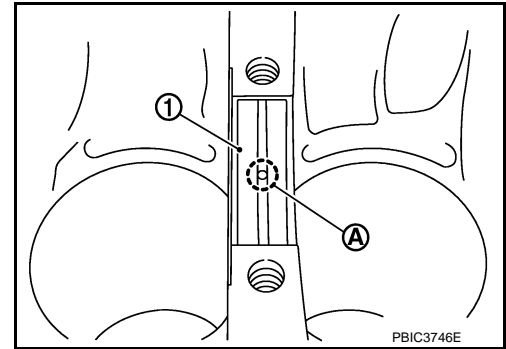


CYLINDER BLOCK

[HR15DE]

< UNIT DISASSEMBLY AND ASSEMBLY >

- c. Install the main bearings (1) paying attention to the direction.
- Install the one with oil holes (A) onto cylinder block and the one without oil holes onto main bearing cap.
 - Before installing main bearings, apply new engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
 - Ensure the oil holes on cylinder block and those on the corresponding bearing are aligned.

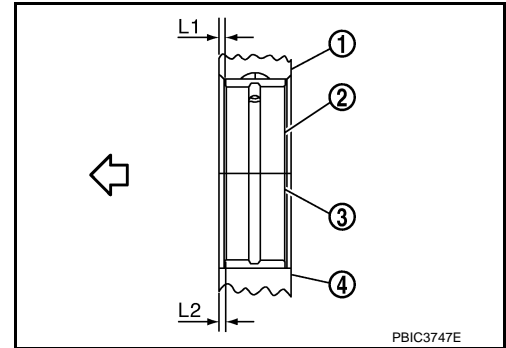


- Install the main bearing in the position as shown in the figure.

- 1 : Cylinder block
- 2 : Main bearing (upper)
- 3 : Main bearing (lower)
- 4 : Main bearing cap
- ⇐ : Engine front

NOTE:

Install the main bearing in the center position with the following dimension. For service operation, the center position can be checked visually.



Journal position	No. 1	No. 2	No. 3	No. 4	No. 5
L1 [Unit: mm (in)]	1.65 - 2.05 (0.064 - 0.080)	1.25 - 1.65 (0.049 - 0.064)	2.30 - 2.70 (0.090 - 0.106)	1.25 - 1.65 (0.049 - 0.064)	1.60 - 2.00 (0.062 - 0.078)
L2 [Unit: mm (in)]	1.30 - 1.70 (0.051 - 0.066)	1.30 - 1.70 (0.051 - 0.066)	2.30 - 2.70 (0.090 - 0.106)	1.30 - 1.70 (0.051 - 0.066)	1.30 - 1.70 (0.051 - 0.066)

CAUTION:

Dimension L1 of journal No. 3 is the distance from the housing base end surface (bulk) (it is not the distance from the thrust bearing mounting end surface).

3. Install signal plate to crankshaft if removed.
- a. Set the signal plate (1) with the flange facing toward the counterweight side (engine front side) to the crankshaft rear surface.

A : Dowel pin hole

- b. After positioning crankshaft and signal plate with positioning dowel pin, tighten bolt.

NOTE:

Dowel pin of crankshaft and signal plate is provided as a set for each.

- c. Remove dowel pin.

CAUTION:

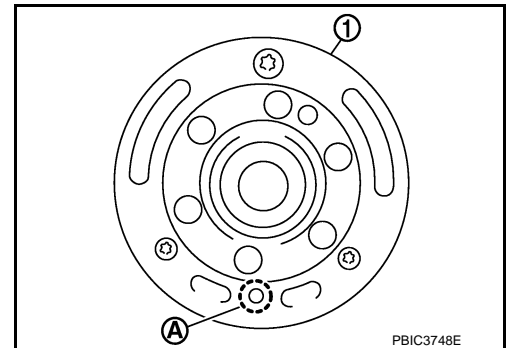
Be sure to remove dowel pin.

4. Install crankshaft to cylinder block.
- While turning crankshaft by hand, check that it turns smoothly.

CAUTION:

Never install rear oil seal yet.

5. Install main bearing caps.



CYLINDER BLOCK

[HR15DE]

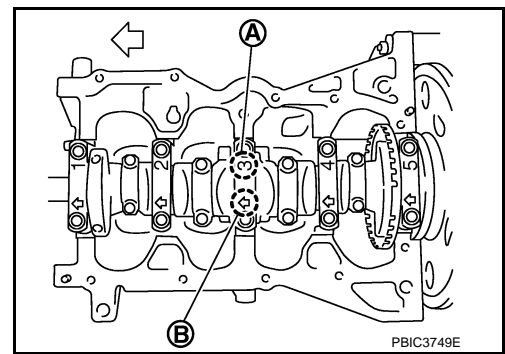
< UNIT DISASSEMBLY AND ASSEMBLY >

- Install the main bearing cap while referring to the front mark (B) and the journal number stamp (A).

⇐ : Engine front

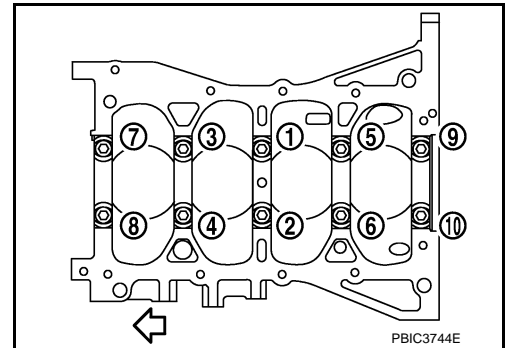
NOTE:

Main bearing cap cannot be replaced as a single parts, because it is machined together with cylinder block.



6. Tighten main bearing cap bolts in numerical order as shown in the figure with the following steps.

⇐ : Engine front



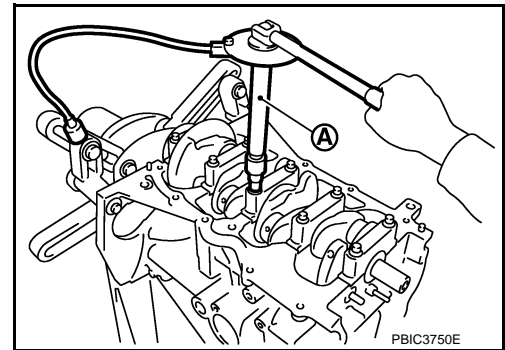
- a. Apply new engine oil to threads and seat surfaces of the mounting bolts.
- b. Tighten main bearing cap bolts.

: 32.4 N·m (3.3 kg·m, 24 ft·lb)

- c. Turn main bearing cap bolts 60 degrees clockwise (angle tightening) in numerical order as shown in the figure.

CAUTION:

Check and confirm the tightening angle by using the angle wrench [SST: KV10112100] (A) or protractor. Avoid judgment by visual inspection without the tool.



- After installing the mounting bolts, check that crankshaft can be rotated smoothly by hand.
- Check crankshaft end play. Refer to [EM-257, "Inspection"](#).

7. Install piston to connecting rod with the following procedure:

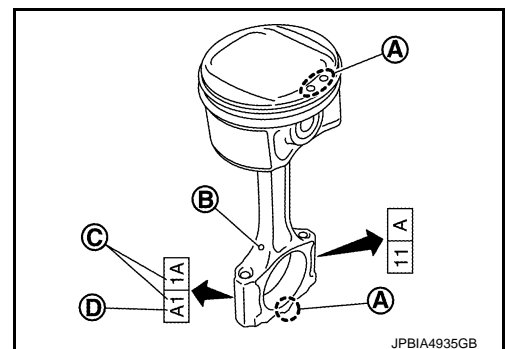
- a. Set so that the front mark (A) on the piston head and the cylinder number (C) are in the position as shown in the figure.

B : Oil hole

D : Connecting rod big end grade

NOTE:

The symbols without notes are for management



CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

- b. Press-fit the piston pin using the piston pin press stand (SST).
- For the details of SST, refer to the following.

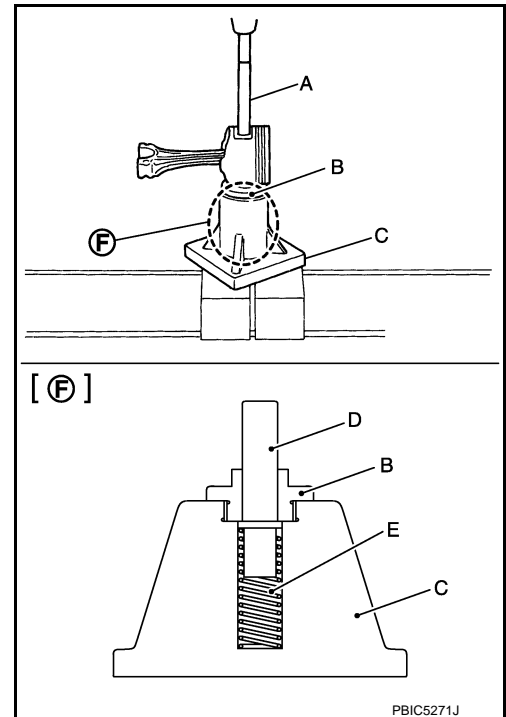
- A : Drift [KV10109730]
- B : Center cap [KV10110310]
- C : Press stand [ST13030020]
- D : Center shaft KV10114120]
- E : Spring [ST13030030]
- F : Detail

CAUTION:

Press-fit the piston so as not to damage it.

NOTE:

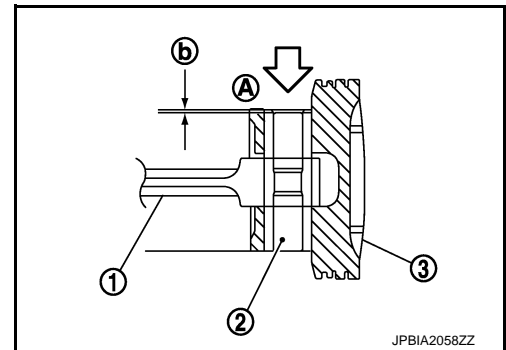
The joint between the connecting rod and the piston pin is a press fit.



- Press-fit the piston pin (2) from piston surface (A) to the depth of 2.35 mm (0.092 in) (b).

- 1 : Connecting rod
- ⇐ : Press-fit direction

- After finishing work, check that the piston (3) moves freely.



8. Using a piston ring expander (commercial service tool), install piston rings.

CAUTION:

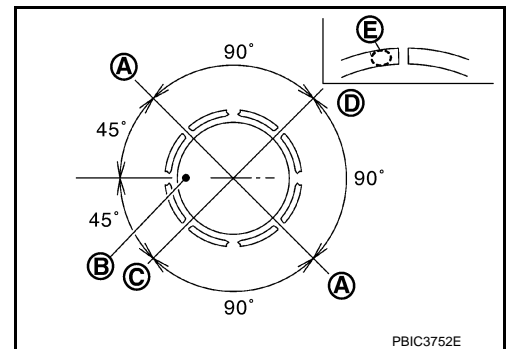
- Be careful not to damage piston.
- Be careful not to damage piston rings by expanding them excessively.
- Position each ring with the gap as shown in the figure referring to the piston front mark (B).

- A : Oil ring upper or lower rail gap (either of them)
- C : Second ring and oil ring spacer gap
- D : Top ring gap

- Install second ring with the stamped mark (E) facing upward.

Stamped mark:

Second ring : R



9. Install connecting rod bearings to connecting rod and connecting rod cap.

- When installing connecting rod bearings, apply new engine oil to the bearing surface (inside). Do not apply engine oil to the back surface, but thoroughly clean it.
- Install the bearing in the center position.

NOTE:

- There is no stopper tab.
- Check that the oil holes on connecting rod and connecting rod bearing are aligned.

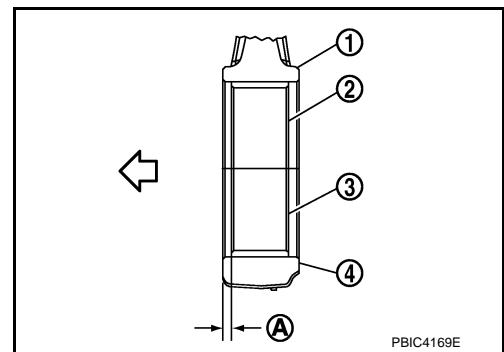
CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

- Install the connecting rod in the dimension as shown in the figure.

- 1 : Connecting rod
- 2 : Connecting rod bearing (upper)
- 3 : Connecting rod bearing (lower)
- 4 : Connecting rod cap
- A : 1.7 - 2.1 mm (0.067 - 0.083 in)
- ↔ : Engine front



NOTE:

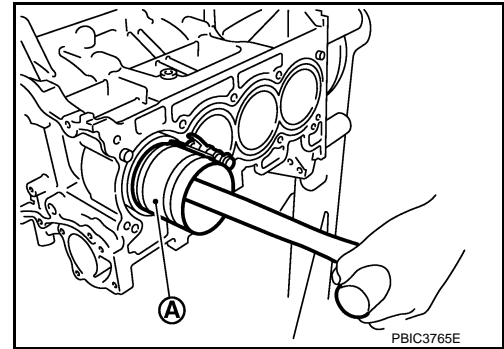
Install the connecting rod bearing in the center position with the dimension as shown in the figure. For service operation, the center position can be checked visually.

10. Install piston and connecting rod assembly to crankshaft.

- Position crankshaft pin corresponding to connecting rod to be installed onto the bottom dead center.
- Apply new engine oil sufficiently to the cylinder bore, piston and crankshaft pin.
- Match the cylinder position with the cylinder number on connecting rod to install.
- Using the piston ring compressor [SST: EM03470000] (A) or suitable tool, install piston with the front mark on the piston head facing the front of the engine.

CAUTION:

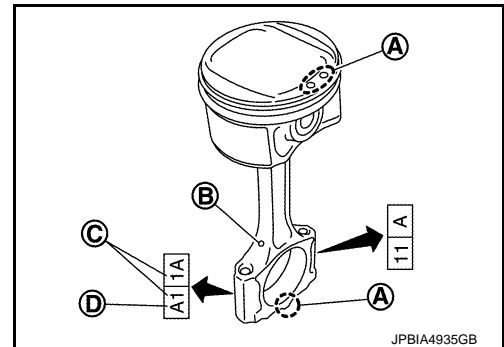
- Be careful not to damage matching surface with connecting rod cap.
- Be careful not to damage the cylinder wall and crankshaft pin, resulting from an interference of the connecting rod big end.



11. Install connecting rod cap.

- Match the stamped cylinder number marks (C) on connecting rod with those on connecting rod cap to install.

- A : Front mark
- B : Oil hole
- D : Connecting rod big end grade



12. Inspect outer diameter of connecting rod bolts. Refer to [EM-257. "Inspection"](#).

13. Tighten connecting rod bolt with the following procedure:

- a. Apply new engine oil to the threads and seats of connecting rod bolts.
- b. Tighten bolts in several steps.

: 27.4 N·m (2.8 kg-m, 20 ft-lb)

- c. Completely loosen bolts.

: 0 N·m (0 kg-m, 0 ft-lb)

- d. Tighten bolts in several steps.

: 19.6 N·m (2.0 kg-m, 14 ft-lb)

- e. Then turn all bolts 60 degrees clockwise (angle tightening).

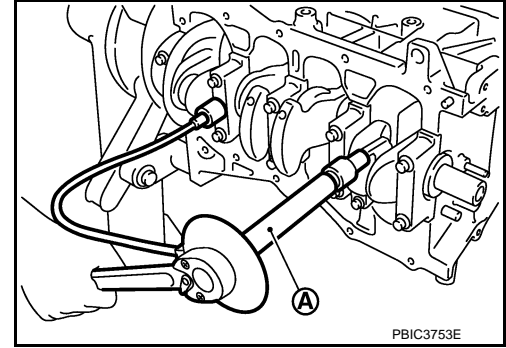
CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

CAUTION:

Check and confirm the tightening angle by using the angle wrench [SST: KV10112100] (A) or protractor. Avoid judgment by visual inspection without the tool.



- After tightening connecting rod bolt, check that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to [EM-257, "Inspection"](#).

14. Install oil pan (upper). Refer to [EM-244, "Exploded View"](#).

NOTE:

Install the rear oil seal after installing the oil pan (upper).

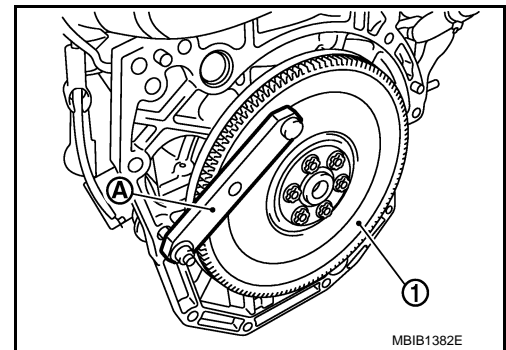
15. Install rear oil seal. Refer to [EM-227, "REAR OIL SEAL : Removal and Installation"](#).

16. Install flywheel (1).

- Secure flywheel with a stopper plate [SST: KV11105210] (A), and remove mounting bolts.
- Using TORX socket (size E20), loosen mounting bolts.

CAUTION:

Be careful not to damage or scratch and contact surface for clutch disc of flywheel.



17. Install knock sensor (1).

⇐ : Engine front

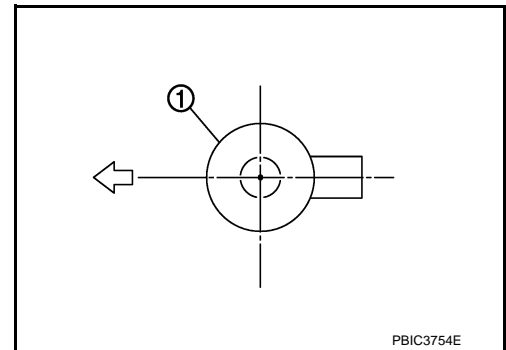
- Install connectors so that they are positioned towards the rear of the engine.

CAUTION:

- **Never tighten mounting bolt while holding the connector.**
- **If any impact by dropping is applied to knock sensor, replace it with a new one.**

NOTE:

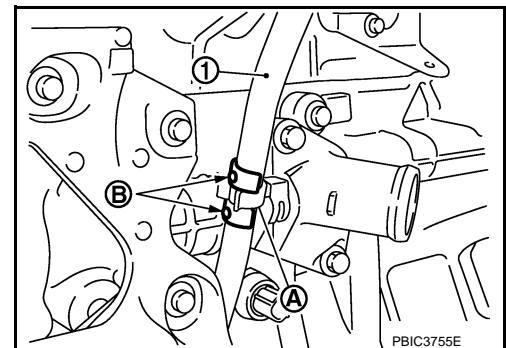
- Check that there is no foreign material on the cylinder block mating surface and the back surface of knock sensor.
- Check that knock sensor does not interfere with other parts.



18. Install crankshaft position sensor (POS).

- Tighten bolts with it seated completely.

19. For the oil level gauge guide (1), fix the position (B) shown in the figure to the water inlet clip (A) after inserting to the cylinder block side.



CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

20. Assemble in the reverse order of disassembly after this step.

Inspection

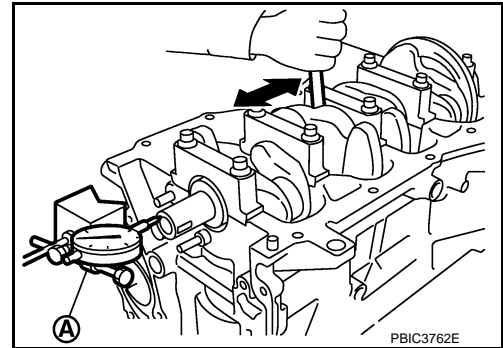
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CRANKSHAFT END PLAY

- Measure the clearance between thrust bearings and crankshaft arm when crankshaft is moved fully forward or backward with a dial indicator (A).

Standard and Limit : Refer to [EM-277, "Cylinder Block"](#).

- If the measured value exceeds the limit, replace thrust bearings, and measure again. If it still exceeds the limit, replace crankshaft also.

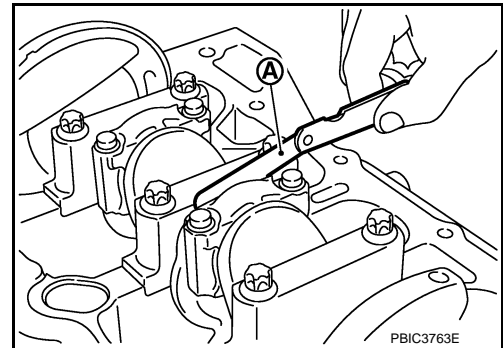


CONNECTING ROD SIDE CLEARANCE

- Measure the side clearance between connecting rod and crankshaft arm with a feeler gauge (A).

Standard and Limit : Refer to [EM-277, "Cylinder Block"](#).

- If the measured value exceeds the limit, replace connecting rod, and measure again. If it still exceeds the limit, replace crankshaft also.

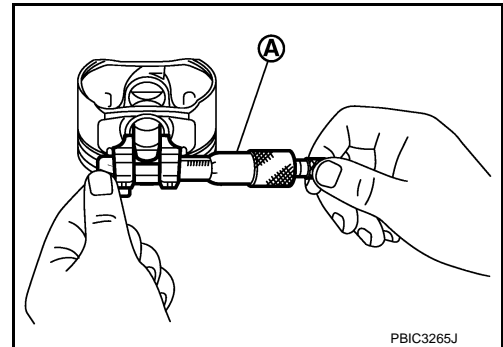


PISTON TO PISTON PIN OIL CLEARANCE

Piston Pin Hole Diameter

Measure the inner diameter of piston pin hole with an inside micrometer (A).

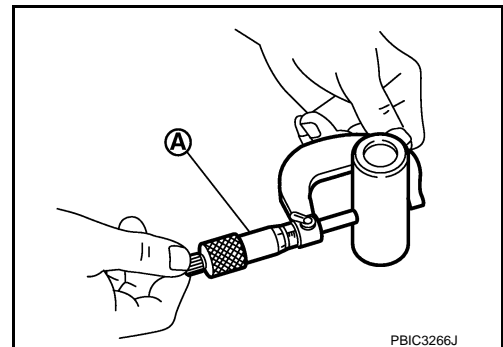
Standard : Refer to [EM-277, "Cylinder Block"](#).



Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer (A).

Standard : Refer to [EM-277, "Cylinder Block"](#).



Piston to Piston Pin Oil Clearance

(Piston to piston pin oil clearance) = (Piston pin hole diameter) – (Piston pin outer diameter)

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

Standard : Refer to [EM-277, "Cylinder Block"](#).

- If oil clearance is out of the standard, replace piston and piston pin assembly.
- When replacing piston and piston pin assembly. Refer to "".

NOTE:

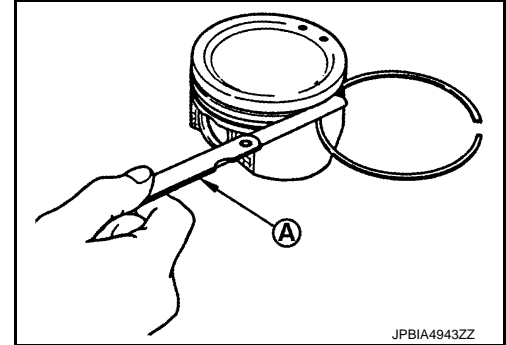
- Piston is available together with piston pin as assembly.
- Piston pin (piston pin hole) grade is provided only for the parts installed at the plant. For service parts, no grades can be selected. (Only grade "0" is available.)

PISTON RING SIDE CLEARANCE

- Measure the side clearance of piston ring and piston ring groove with a feeler gauge (A).

Standard and Limit : Refer to [EM-277, "Cylinder Block"](#).

- If the measured value exceeds the limit, replace piston ring, and measure again. If it still exceeds the limit, replace piston also.

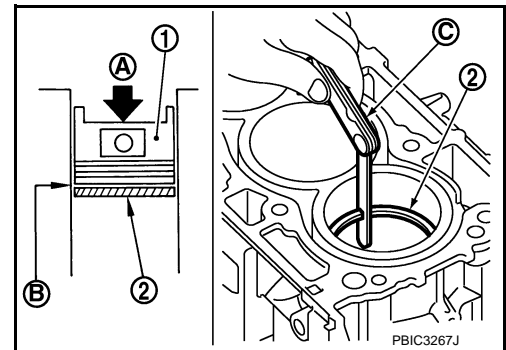


PISTON RING END GAP

- Check that cylinder bore inner diameter is within specification. Refer to "PISTON TO CYLINDER BORE CLEARANCE".
- Lubricate with new engine oil to piston (1) and piston ring (2), and then insert (A) piston ring until middle of cylinder (B) with piston, and measure piston ring end gap with a feeler gauge (C).

Standard and Limit : Refer to [EM-277, "Cylinder Block"](#).

- If the measured value exceeds the limit, replace piston ring, and measure again. If it still exceeds the limit, replace cylinder block.



CONNECTING ROD BEND AND TORSION

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

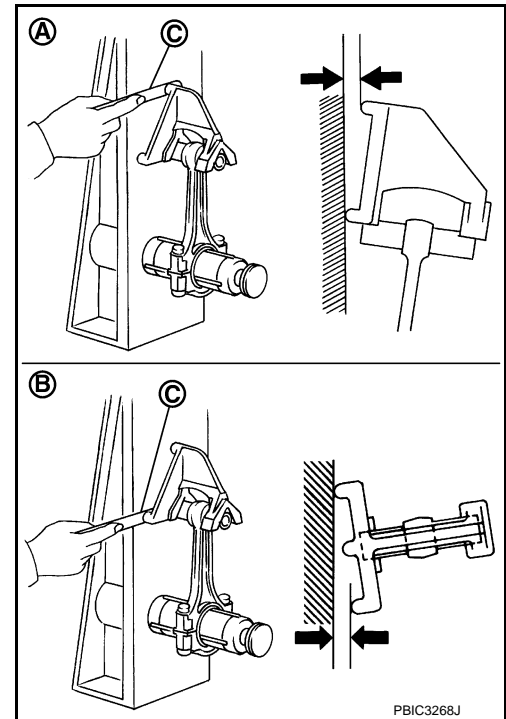
[HR15DE]

- Check with a connecting rod aligner.

A : Bend
B : Torsion
C : Feeler gauge

Limit : Refer to [EM-277, "Cylinder Block"](#).

- If it exceeds the limit, replace connecting rod assembly.



CONNECTING ROD BIG END DIAMETER

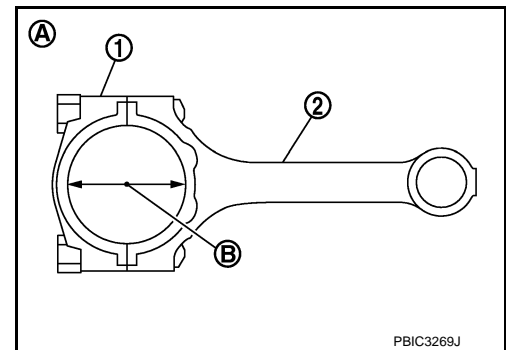
- Install connecting rod cap (1) without connecting rod bearing installed, and tightening connecting rod cap bolts to the specified torque. Refer to [EM-248, "Exploded View"](#).

2 : Connecting rod
A : Example
B : Measuring direction of inner diameter

- Measure the inner diameter of connecting rod big end with an inside micrometer.

Standard : Refer to [EM-277, "Cylinder Block"](#).

- If out of the standard, replace connecting rod assembly.

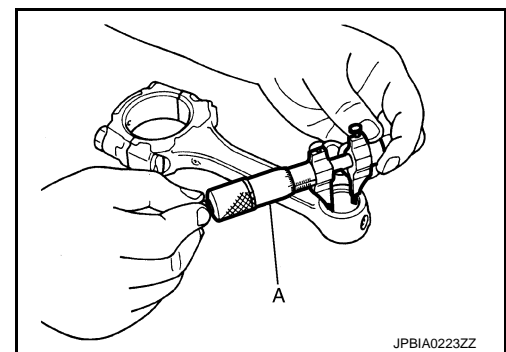


CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter

Measure the inner diameter of connecting rod bushing with an inside micrometer (A).

Standard : Refer to [EM-277, "Cylinder Block"](#).



Piston Pin Outer Diameter

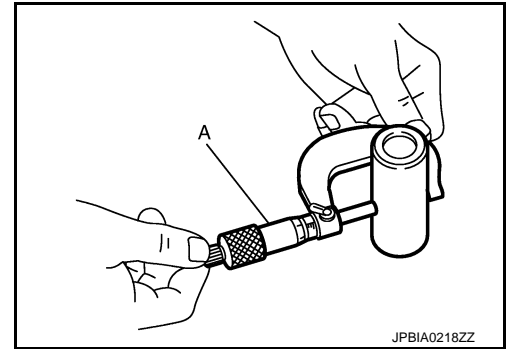
CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

Measure the outer diameter of piston pin with a micrometer (A).

Standard : Refer to [EM-277, "Cylinder Block"](#).



Connecting Rod Bushing Oil Clearance

(Connecting rod bushing oil clearance) = (Connecting rod bushing inner diameter) – (Piston pin outer diameter)

Standard and Limit : Refer to [EM-277, "Cylinder Block"](#).

- If the measured value is out of the standard, replace connecting rod assembly and/or piston and piston pin assembly.
- If replacing piston and piston pin assembly. Refer to [EM-277, "Cylinder Block"](#).
- If replacing connecting rod assembly. Refer to [EM-280, "Connecting Rod Bearing"](#).

CYLINDER BLOCK TOP SURFACE DISTORTION

- Using a scraper, remove gasket on the cylinder block surface, and also remove engine oil, scale, carbon, or other contamination.

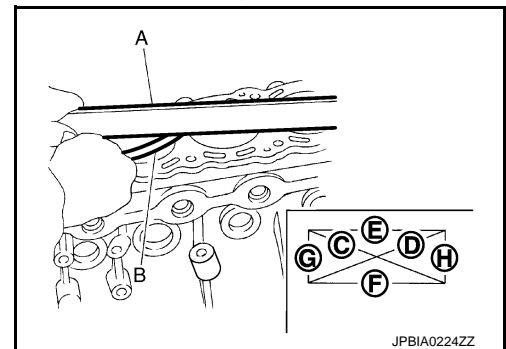
CAUTION:

Be careful not to allow gasket flakes to enter engine oil or engine coolant passages.

- Measure the distortion on the cylinder block upper face at some different points in six directions with a straight edge (A) and feeler gauge (B).

Limit : Refer to [EM-277, "Cylinder Block"](#).

- If it exceeds the limit, replace cylinder block.



MAIN BEARING HOUSING INNER DIAMETER

- Install main bearing cap without main bearings installed, and tighten main bearing cap mounting bolts to the specified torque. Refer to [EM-249, "Disassembly and Assembly"](#).
- Measure the inner diameter of main bearing housing with a bore gauge.
- Measure the position shown in the figure [5 mm (0.20 in)] backward from main bearing housing front side in the 2 directions as shown in the figure. The smaller one is the measured value.

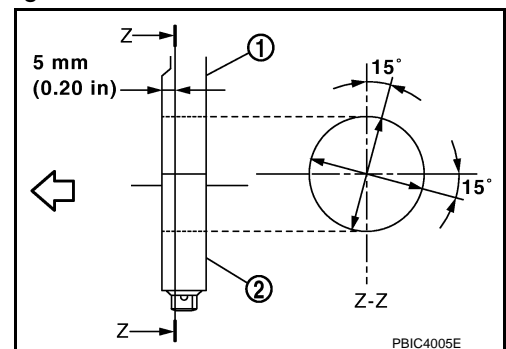
- 1 : Cylinder block
- 2 : Main bearing cap
- ⇐ : Engine front

Standard : Refer to [EM-277, "Cylinder Block"](#).

- If out of the standard, replace cylinder block and main bearing caps assembly.

NOTE:

Main bearing caps cannot be replaced as a single, because it is machined together with cylinder block.



PISTON TO CYLINDER BORE CLEARANCE

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

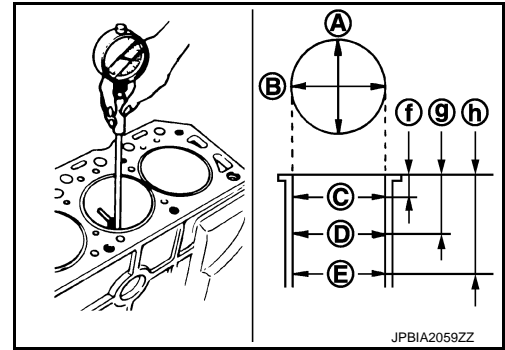
Cylinder Bore Inner Diameter

- Using a bore gauge, measure the cylinder bore for wear, out-of-round and taper at six different points on each cylinder. [(A) and (B) directions at (C), (D), and (E)] [(A) is in longitudinal direction of engine]

- f : 10 mm (0.39 in)
- g : 60 mm (2.36 in)
- h : 124 mm (4.88 in)

NOTE:

When determining cylinder bore grade, measure the cylinder bore (B) direction at (D) position.



Standard:

Cylinder bore inner diameter

: Refer to [EM-277, "Cylinder Block"](#).

Limit:

Out-of-round [Difference between (A) and (B)]

Taper [Difference between (C) and (D)]

: Refer to [EM-277, "Cylinder Block"](#).

- If the measured value exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, replace cylinder block.

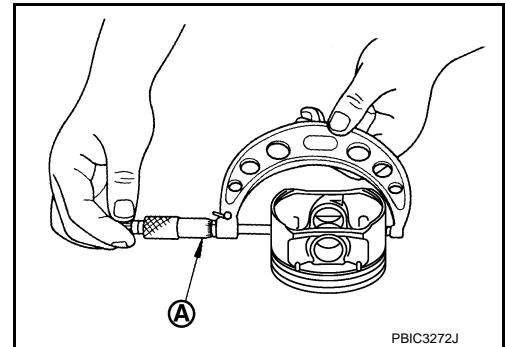
NOTE:

Oversize piston is not provided.

Piston Skirt Diameter

Measure the outer diameter of piston skirt with a micrometer (A).

Standard : Refer to [EM-277, "Cylinder Block"](#).

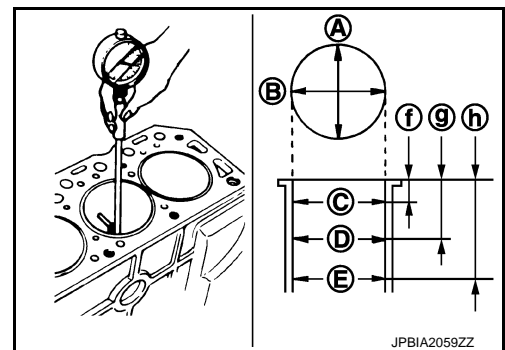


Piston to Cylinder Bore Clearance

Calculate by piston skirt diameter and cylinder bore inner diameter [direction (B), position (D)].

- A : Direction A
- C : Position C
- E : Position E
- f : 10 mm (0.39 in)
- g : 60 mm (2.36 in)
- h : 124 mm (4.88 in)

(Clearance) = (Cylinder bore inner diameter) – (Piston skirt diameter)



Standard and Limit : Refer to [EM-277, "Cylinder Block"](#).

- If it exceeds the limit, replace piston and piston pin assembly and/or cylinder block. Refer to [EM-277, "Cylinder Block"](#).

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

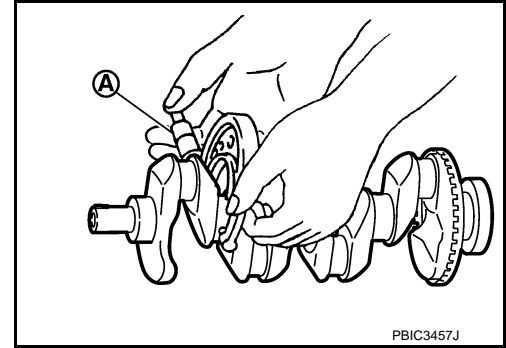
[HR15DE]

CRANKSHAFT MAIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft main journals with a micrometer (A).

Standard : Refer to [EM-277, "Cylinder Block"](#).

- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing. Refer to [EM-279, "Main Bearing"](#).



CRANKSHAFT PIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft pin journal with a micrometer.

Standard : Refer to [EM-277, "Cylinder Block"](#).

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing. Refer to [EM-280, "Connecting Rod Bearing"](#).

OUT-OF-ROUND AND TAPER OF CRANKSHAFT

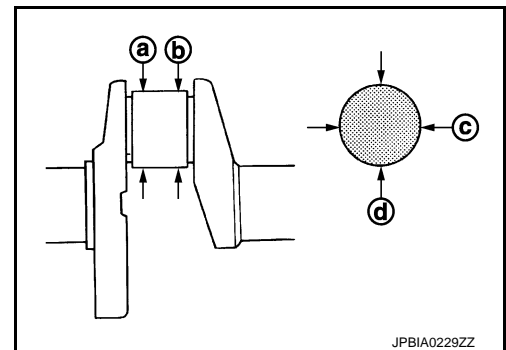
- Measure the dimensions at four different points as shown in the figure on each main journal and pin journal with a micrometer.
- Out-of-round is indicated by the difference in dimensions between (a) and (b) at (c) and (d).
- Taper is indicated by the difference in dimension between (c) and (d) at (a) and (b).

Limit:

Out-of-round [Difference between (a) and (b)]

Taper [Difference between (c) and (d)]

: Refer to [EM-277, "Cylinder Block"](#).



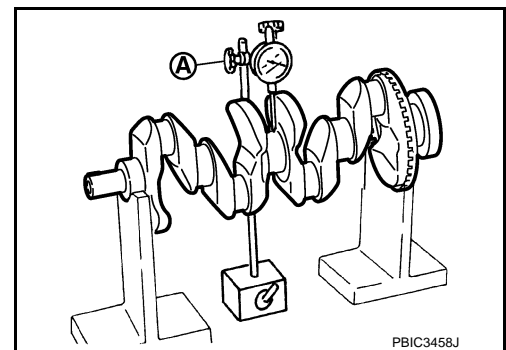
- If the measured value exceeds the limit, correct or replace crankshaft.
- If corrected, measure the bearing oil clearance of the corrected main journal and/or pin journal. Then select main bearing and/or connecting rod bearing. Refer to [EM-280, "Connecting Rod Bearing"](#) and/or [EM-279, "Main Bearing"](#).

CRANKSHAFT RUNOUT

- Place a V-block on a precise flat table to support the journals on the both end of the crankshaft.
- Place a dial indicator (A) straight up on the No. 3 journal.
- While rotating crankshaft, read the movement of the pointer on the dial indicator. (Total indicator reading)

Standard and Limit : Refer to [EM-277, "Cylinder Block"](#).

- If it exceeds the limit, replace crankshaft.



CONNECTING ROD BEARING OIL CLEARANCE

Method by Calculation

CYLINDER BLOCK

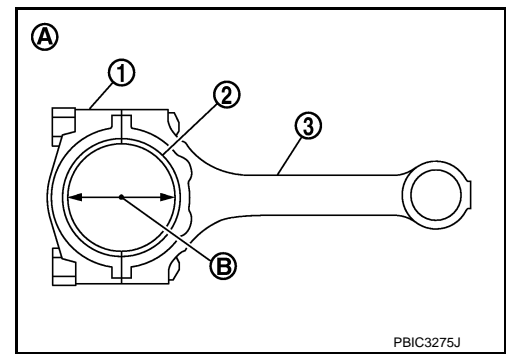
< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

- Install connecting rod bearings (2) to connecting rod (3) and connecting rod bearing cap (1), and tighten connecting rod cap bolts to the specified torque. Refer to [EM-249, "Disassembly and Assembly"](#).

A : Example
B : Inner diameter measuring direction

- Measure the inner diameter of connecting rod bearing with an inside micrometer.
(Bearing oil clearance) = (Connecting rod bearing inner diameter) – (Crankshaft pin journal diameter)



Standard and Limit : Refer to [EM-280, "Connecting Rod Bearing"](#).

- If clearance exceeds the limit, select proper connecting rod bearing according to connecting rod big end diameter and crankshaft pin journal diameter to obtain specified bearing oil clearance. Refer to [EM-280, "Connecting Rod Bearing"](#).

Method of Using Plastigage

- Remove engine oil and dust on crankshaft pin and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod cap bolts to the specified torque. Refer to [EM-249, "Disassembly and Assembly"](#).

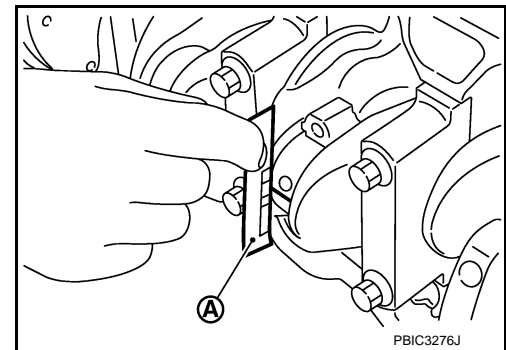
CAUTION:

Never rotate crankshaft.

- Remove connecting rod cap and bearing, and using the scale (A) on the plastigage bag, measure the plastigage width.

NOTE:

The procedure when the measured value exceeds the limit is same as that described in the "Method by Calculation".



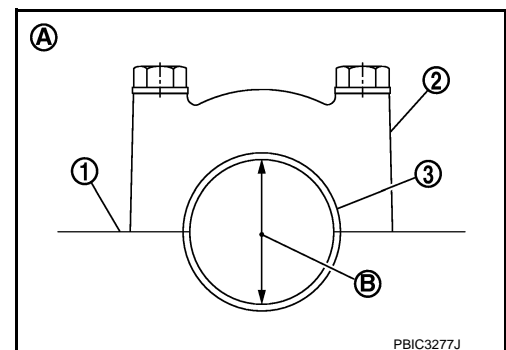
MAIN BEARING OIL CLEARANCE

Method by Calculation

- Install main bearings (3) to cylinder block (1) and main bearing cap (2), and tighten main bearing cap mounting bolts to the specified torque. Refer to [EM-249, "Disassembly and Assembly"](#).

A : Example
B : Inner diameter measuring direction

- Measure the inner diameter of main bearing with a bore gauge.
(Bearing oil clearance) = (Main bearing inner diameter) – (Crankshaft main journal diameter)



Standard and Limit : Refer to [EM-279, "Main Bearing"](#).

- If clearance exceeds the limit, select proper main bearing according to main bearing inner diameter and crankshaft main journal diameter to obtain specified bearing oil clearance. Refer to [EM-279, "Main Bearing"](#).

Method of Using Plastigage

- Remove engine oil and dust on crankshaft main journal and the surfaces of each bearing completely.
- Cut a plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install main bearings to cylinder block and main bearing cap, and tighten main bearing cap mounting bolts to the specified torque. Refer to [EM-249, "Disassembly and Assembly"](#).

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

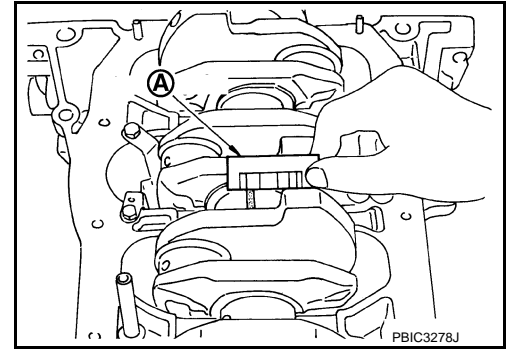
CAUTION:

Never rotate crankshaft.

- Remove main bearing cap and bearings, and using the scale (A) on the plastigage bag, measure the plastigage width.

NOTE:

The procedure when the measured value exceeds the limit is same as that described in the "Method by Calculation".



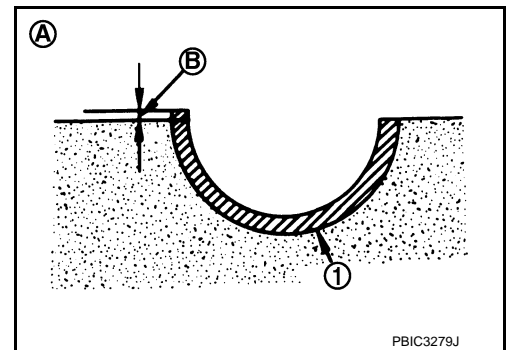
MAIN BEARING CRUSH HEIGHT

- When main bearing cap is removed after being tightened to the specified torque with main bearings (1) installed, the tip end of bearing must protrude (B). Refer to [EM-249, "Disassembly and Assembly"](#).

A : Example

Standard : There must be crush height.

- If the standard is not met, replace main bearings.



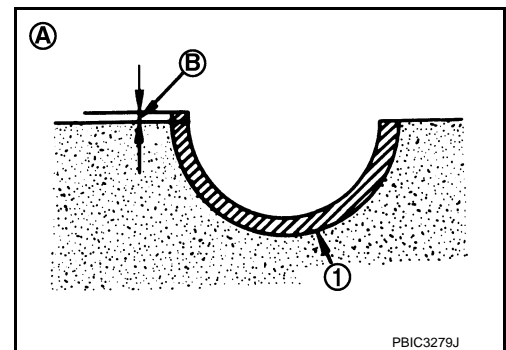
CONNECTING ROD BEARING CRUSH HEIGHT

- When connecting rod cap is removed after being tightened to the specified torque with connecting rod bearings (1) installed, the tip end of bearing must protrude (B). Refer to [EM-249, "Disassembly and Assembly"](#).

A : Example

Standard : There must be crush height.

- If the standard is not met, replace connecting rod bearings.



MAIN BEARING CAP BOLT OUTER DIAMETER

- Measure the outer diameters (d1) and (d2) at two positions as shown in the figure.

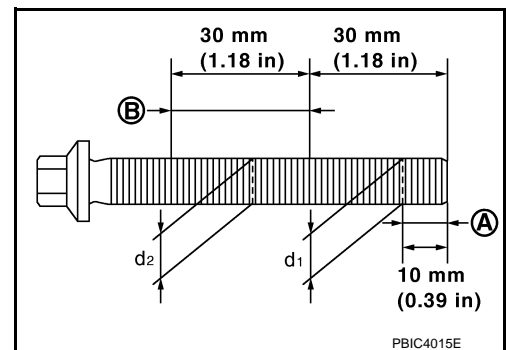
A : (d1) measuring position

B : (d2) measuring position

- If reduction appears in places other than (B) range, regard it as (d2).

Limit [(d1) - (d2)]: 0.15 mm (0.0059 in)

- If it exceeds the limit (a large difference in dimensions), replace main bearing cap mounting bolt with a new one.



CONNECTING ROD CAP BOLT OUTER DIAMETER

CYLINDER BLOCK

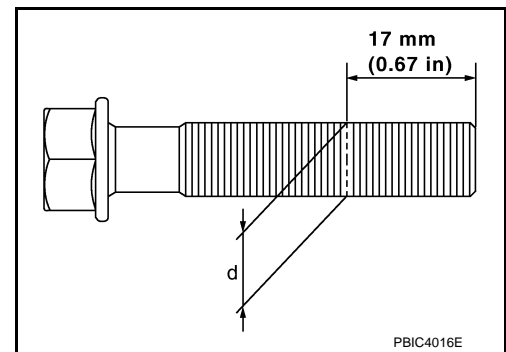
< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

- Measure the outer diameter (d) at position as shown in the figure.
- If reduction appears in a position other than (d), regard it as (d).

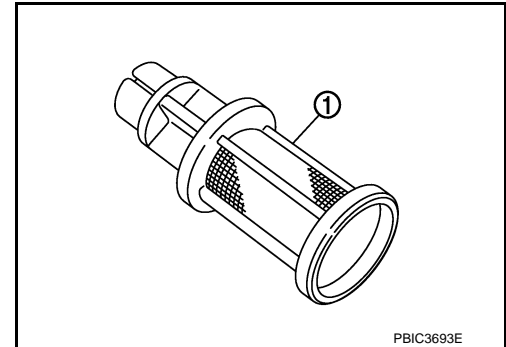
Limit: 7.75 mm (0.3051 in)

- When (d) exceeds the limit (when it becomes thinner), replace connecting rod cap bolt with a new one.



CLOGGED OR DAMAGED OIL FILTER (FOR INTAKE VALVE TIMING CONTROL)

- Check that there is no foreign material on the oil filter (1) and check it for clogging.
 - Clean it if necessary.
- Check the oil filter for damage.
 - Replace it if necessary.



FLYWHEEL DEFLECTION

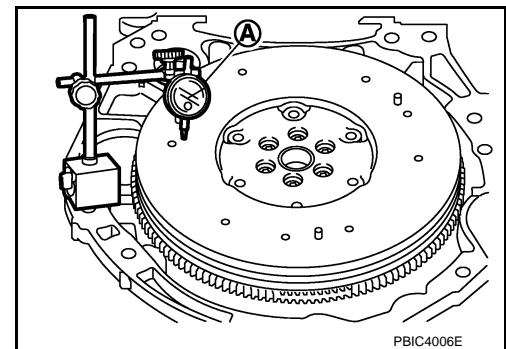
- Measure the deflection of flywheel contact surface to torque with a dial indicator (A).
- Measure the deflection at 210 mm (8.27 in) diameter.

Limit : 0.45 mm (0.0177 in) or less.

- If measured value is out of the standard, replace flywheel.
- If a trace of burn or discoloration is found on the surface, repair it with sandpaper.

CAUTION:

When measuring, keep magnetic fields (such as dial indicator stand) away from signal plate of the rear end of crankshaft.



MOVEMENT AMOUNT OF FLYWHEEL

CAUTION:

Never disassemble double mass flywheel.

Movement Amount of Thrust (Fore-and-Aft) Direction

- Measure the movement amount of thrust (fore-and-aft) direction when 100 N (10.2 kg, 22 lb) force is added at the portion of 125 mm (4.92 in) radius from the center of flywheel.

Standard : 1.8 mm (0.071 in) or less

- If measured value is out of the standard, replace flywheel.

Movement Amount in Radial (Rotation) Direction

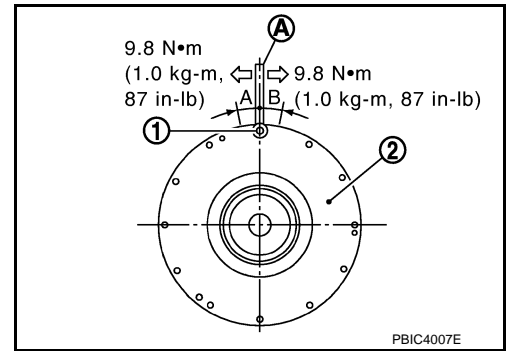
Check the movement amount of radial (rotation) direction with the following procedure:

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

1. Install clutch cover mounting bolt (1) to clutch cover mounting hole, and place a torque wrench (A) on the extended line of the flywheel (2) center line.
 - Tighten bolt at a force of 9.8 N·m (1.0 kg·m, 87 in-lb) to keep it from loosening.
2. Put a matching mark on circumferences of the two flywheel masses without applying any load (Measurement standard points).
3. Apply a force of 9.8 N·m (1.0 kg·m, 87 in-lb) in each direction, and mark the movement amount on the mass on the transaxle side.
4. Measure the dimensions of movement amounts "A" and "B" on circumference of the flywheel on the transaxle side.



Limit : 33.2 mm (1.307 in) or less.

- If measured value is out of the standard, replace flywheel.

HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

HOW TO SELECT PISTON AND BEARING

Description

INFOID:000000006282305

Selection points	Selection parts	Selection items	Selection methods
Between cylinder block and crankshaft	Main bearing	Main bearing grade (bearing thickness)	Determined by match of cylinder block bearing housing grade (inner diameter of housing) and crankshaft journal grade (outer diameter of journal)
Between crankshaft and connecting rod	Connecting rod bearing	Connecting rod bearing grade (bearing thickness)	Combining service grades for connecting rod big end diameter and crankshaft pin outer diameter determine connecting rod bearing selection.

- The identification grade stamped on each part is the grade for the dimension measured in new condition. This grade cannot apply to reused parts.
- For reused or repaired parts, measure the dimension accurately. Determine the grade by comparing the measurement with the values of each selection table.
- For details of the measurement method of each part, the reuse standards and the selection method of the selective fitting parts, refer to the text.

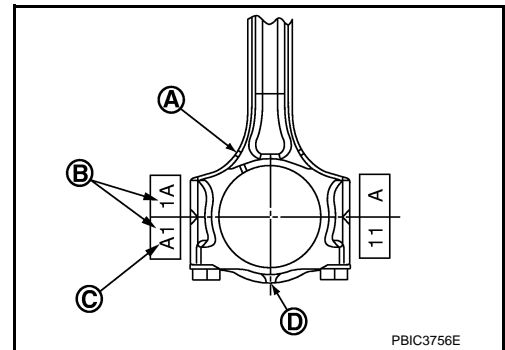
Connecting Rod Bearing

INFOID:000000006282306

WHEN NEW CONNECTING ROD AND CRANKSHAFT ARE USED

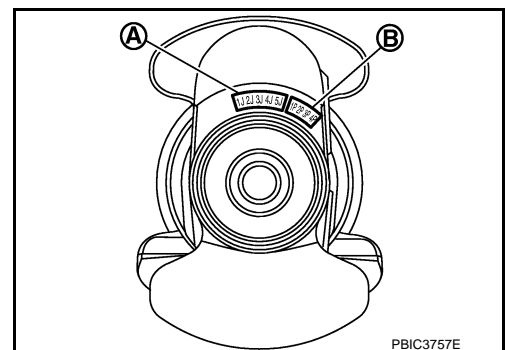
1. Apply connecting rod big end diameter grade stamped (C) on connecting rod side face to the row in the "Connecting Rod Bearing Selection Table".

- A : Oil hole
- B : Cylinder number
- D : Front mark



2. Apply crankshaft pin journal diameter grade stamped (B) on crankshaft front side to the column in the "Connecting Rod Bearing Selection Table".

- A : Main journal diameter grade (No. 1 to 5 from left)
- B : Crankshaft pin journal diameter grade (No. 1 to 4 from left)



3. Read the symbol at the cross point of selected row and column in the "Connecting Rod Bearing Selection Table".
4. Apply the symbol obtained to the "Connecting Rod Bearing Grade Table" to select connecting rod bearing.

WHEN CONNECTING ROD AND CRANKSHAFT ARE REUSED

1. Measure the dimensions of the connecting rod big end diameter and crankshaft pin journal diameter individually. Refer to [EM-257, "Inspection"](#).

HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

2. Apply the measured dimension to the "Connecting Rod Bearing Selection Table".
3. Read the symbol at the cross point of selected row and column in the "Connecting Rod Bearing Selection Table".
4. Apply the symbol obtained to the "Connecting Rod Bearing Grade Table" to select connecting rod bearing.

Connecting Rod Bearing Selection Table

Connecting rod big end diameter		I.D. mark	Hole diameter Unit: mm (in)													
			A	B	C	D	E	F	G	H	J	K	L	M	N	
I.D. mark	Axle diameter Unit mm (in)	Hole diameter Unit: mm (in)														
		43.000 - 43.001 (1.6929 - 1.6929)	43.001 - 43.002 (1.6929 - 1.6930)	43.002 - 43.003 (1.6930 - 1.6930)	43.003 - 43.004 (1.6930 - 1.6931)	43.004 - 43.005 (1.6931 - 1.6931)	43.005 - 43.006 (1.6931 - 1.6931)	43.006 - 43.007 (1.6931 - 1.6932)	43.007 - 43.008 (1.6932 - 1.6932)	43.008 - 43.009 (1.6932 - 1.6933)	43.009 - 43.010 (1.6933 - 1.6933)	43.010 - 43.011 (1.6933 - 1.6933)	43.011 - 43.012 (1.6933 - 1.6934)	43.012 - 43.013 (1.6934 - 1.6934)	43.013 - 43.014 (1.6934 - 1.6934)	
A	39.971 - 39.970 (1.5737 - 1.5736)	0	0	0	0	0	01	01	01	1	1	1	12	12		
B	39.970 - 39.969 (1.5736 - 1.5736)	0	0	0	0	01	01	01	1	1	1	12	12	12		
C	39.969 - 39.968 (1.5736 - 1.5735)	0	0	0	01	01	01	1	1	1	12	12	12	2		
D	39.968 - 39.967 (1.5735 - 1.5735)	0	0	01	01	01	1	1	1	12	12	12	2	2		
E	39.967 - 39.966 (1.5735 - 1.5735)	0	01	01	01	1	1	1	12	12	12	2	2	2		
F	39.966 - 39.965 (1.5735 - 1.5734)	01	01	01	1	1	1	12	12	12	2	2	2	23		
G	39.965 - 39.964 (1.5734 - 1.5734)	01	01	1	1	1	12	12	12	2	2	2	23	23		
H	39.964 - 39.963 (1.5734 - 1.5733)	01	1	1	1	12	12	12	2	2	2	23	23	23		
J	39.963 - 39.962 (1.5733 - 1.5733)	1	1	1	12	12	12	2	2	2	23	23	23	3		
K	39.962 - 39.961 (1.5733 - 1.5733)	1	1	12	12	12	2	2	2	23	23	23	3	3		
L	39.961 - 39.960 (1.5733 - 1.5732)	1	12	12	12	2	2	2	23	23	23	3	3	3		
M	39.960 - 39.959 (1.5732 - 1.5732)	12	12	12	2	2	2	23	23	23	3	3	3	34		
N	39.959 - 39.958 (1.5732 - 1.5731)	12	12	2	2	2	23	23	23	3	3	3	34	34		
P	39.958 - 39.957 (1.5731 - 1.5731)	12	2	2	2	23	23	23	3	3	3	34	34	34		
R	39.957 - 39.956 (1.5731 - 1.5731)	2	2	2	23	23	23	3	3	3	34	34	34	4		
S	39.956 - 39.955 (1.5731 - 1.5730)	2	2	23	23	23	3	3	3	34	34	34	4	4		
T	39.955 - 39.954 (1.5730 - 1.5730)	2	23	23	23	3	3	3	34	34	34	4	4	4		
U	39.954 - 39.953 (1.5730 - 1.5729)	23	23	23	3	3	3	34	34	34	4	4	4	4		

PBIC3758E

Connecting Rod Bearing Grade Table

Connecting Rod Bearing Grade Table : Refer to [EM-280, "Connecting Rod Bearing"](#).

Undersize Bearings Usage Guide

- When the specified connecting rod bearing oil clearance is not obtained with standard size connecting rod bearings, use undersize (US) bearings.
- When using undersize (US) bearing, measure the connecting rod bearing inner diameter with bearing installed, and grind the crankshaft pin so that the connecting rod bearing oil clearance satisfies the standard.

CAUTION:

HOW TO SELECT PISTON AND BEARING

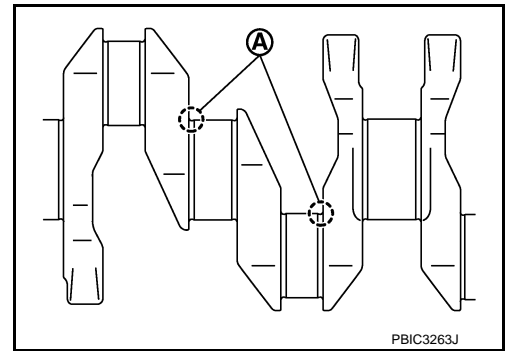
< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

In grinding crankshaft pin to use undersize bearings, keep the fillet R (A) [0.8 - 1.2 mm (0.031 - 0.047 in)].

Bearing undersize table:

Refer to [EM-280, "Connecting Rod Bearing"](#).



INFOID:000000006282307

Main Bearing

HOW TO SELECT MAIN BEARING

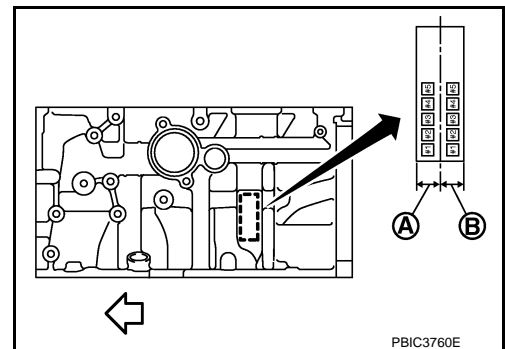
When New Cylinder Block and Crankshaft Are Used

1. "Main Bearing Selection Table" rows correspond to main bearing housing grade on left side of cylinder block.

A : Basic stamp mark

← : Engine front

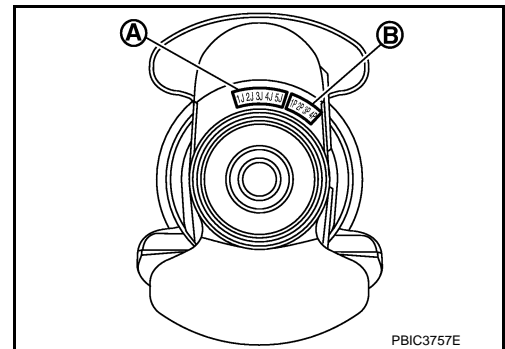
- If there is a corrected stamp mark (B) on cylinder block, use it as a correct reference.



2. Apply main journal diameter grade stamped on crankshaft front side to column in the "Main Bearing Selection Table".

A : Main journal diameter grade (No. 1 to 5 from left)

B : Crankshaft pin journal diameter grade (No. 1 to 4 from left)



3. Read the symbol at the cross point of selected row and column in the "Main Bearing Selection Table".
4. Apply the symbol obtained to the "Main Bearing Grade Table" to select main bearing.

NOTE:

Service part is available as a set of both upper and lower.

When Cylinder Block and Crankshaft Are Reused

1. Measure the dimensions of the cylinder block main bearing housing inner diameter and crankshaft main journal diameter individually. Refer to [EM-257, "Inspection"](#).
2. Apply the measured dimension to the "Main Bearing Selection Table".
3. Read the symbol at the cross point of selected row and column in the "Main Bearing Selection Table".
4. Apply the symbol obtained to the "Main Bearing Grade Table" to select main bearing.

HOW TO SELECT PISTON AND BEARING

< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

Main Bearing Selection Table

I.D. mark	Axle diameter Unit mm (in)	Cylinder block main bearing housing inner diameter	Crankshaft main journal diameter	I.D. mark		Hole diameter Unit: mm (in)																								
				A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W							
A	47.979 - 47.978 (1.8889 - 1.8889)			51.997 - 51.998 (2.0471 - 2.0472)	0	0	0	0	0	0	0	0	0	01	01	01	01	1	1	1	12	12	12	12	2	2	2	2	23	23
B	47.978 - 47.977 (1.8889 - 1.8889)			51.998 - 51.999 (2.0472 - 2.0472)	0	0	0	0	0	0	0	01	01	01	01	1	1	1	1	1	12	12	12	12	2	2	2	2	23	23
C	47.977 - 47.976 (1.8889 - 1.8888)			51.999 - 52.000 (2.0472 - 2.0472)	0	0	0	0	0	0	01	01	01	01	1	1	1	1	1	1	12	12	12	12	2	2	2	2	23	23
D	47.976 - 47.975 (1.8888 - 1.8888)			52.000 - 52.001 (2.0472 - 2.0472)	0	0	0	0	01	01	01	01	1	1	1	1	1	1	1	1	12	12	12	12	2	2	2	2	23	23
E	47.975 - 47.974 (1.8888 - 1.8887)			52.001 - 52.002 (2.0473 - 2.0473)	0	0	0	01	01	01	01	1	1	1	1	1	1	1	1	1	12	12	12	12	2	2	2	2	23	23
F	47.974 - 47.973 (1.8887 - 1.8887)			52.002 - 52.003 (2.0473 - 2.0473)	0	0	01	01	01	01	1	1	1	1	1	1	1	1	1	1	12	12	12	12	2	2	2	2	23	23
G	47.973 - 47.972 (1.8887 - 1.8887)			52.003 - 52.004 (2.0474 - 2.0474)	0	01	01	01	01	1	1	1	1	1	1	1	1	1	1	1	12	12	12	12	2	2	2	2	23	23
H	47.972 - 47.971 (1.8886 - 1.8886)			52.004 - 52.005 (2.0474 - 2.0474)	01	01	01	01	1	1	1	1	1	1	1	1	1	1	1	1	12	12	12	12	2	2	2	2	23	23
J	47.971 - 47.970 (1.8886 - 1.8886)			52.005 - 52.006 (2.0474 - 2.0474)	01	01	1	1	1	1	1	1	1	1	1	1	1	1	1	1	12	12	12	12	2	2	2	2	23	23
K	47.970 - 47.969 (1.8886 - 1.8885)			52.006 - 52.007 (2.0475 - 2.0475)	01	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	12	12	12	12	2	2	2	2	23	23
L	47.969 - 47.968 (1.8885 - 1.8885)			52.007 - 52.008 (2.0475 - 2.0475)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	12	12	12	12	2	2	2	2	23	23
M	47.968 - 47.967 (1.8885 - 1.8885)			52.008 - 52.009 (2.0476 - 2.0476)	1	1	12	12	12	2	2	2	2	2	2	2	2	2	2	2	2	23	23	23	3	3	3	3	34	34
N	47.967 - 47.966 (1.8885 - 1.8884)			52.009 - 52.010 (2.0476 - 2.0476)	1	12	12	12	2	2	2	2	2	2	2	2	2	2	2	2	2	23	23	23	3	3	3	3	34	34
P	47.966 - 47.965 (1.8884 - 1.8884)			52.010 - 52.011 (2.0477 - 2.0477)	12	12	12	2	2	2	2	2	2	2	2	2	2	2	2	2	2	23	23	23	3	3	3	3	34	34
R	47.965 - 47.964 (1.8884 - 1.8883)			52.011 - 52.012 (2.0477 - 2.0477)	12	12	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	23	23	23	3	3	3	3	34	34
S	47.964 - 47.963 (1.8883 - 1.8883)			52.012 - 52.013 (2.0477 - 2.0477)	12	12	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	23	23	23	3	3	3	3	34	34
T	47.963 - 47.962 (1.8883 - 1.8883)			52.013 - 52.014 (2.0478 - 2.0478)	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	23	23	23	3	3	3	3	34	34
U	47.962 - 47.961 (1.8883 - 1.8882)			52.014 - 52.015 (2.0478 - 2.0478)	2	2	23	23	23	3	3	3	3	3	3	3	3	3	3	3	3	34	34	34	4	4	4	4	45	45
V	47.961 - 47.960 (1.8882 - 1.8882)			52.015 - 52.016 (2.0478 - 2.0478)	2	23	23	23	3	3	3	3	3	3	3	3	3	3	3	3	3	34	34	34	4	4	4	4	45	45
W	47.960 - 47.959 (1.8882 - 1.8881)			52.016 - 52.017 (2.0479 - 2.0479)	23	23	23	3	3	3	3	3	3	3	3	3	3	3	3	3	3	34	34	34	4	4	4	4	45	45

PBIC3759E

Main Bearing Grade Table

Main Bearing Grade Table : Refer to [EM-279, "Main Bearing"](#).

Use Undersize Bearing Usage Guide

- When the specified main bearing oil clearance is not obtained with standard size main bearings, use undersize (US) bearing.
- When using undersize (US) bearing, measure the main bearing inner diameter with bearing installed, and grind main journal so that the main bearing oil clearance satisfies the standard.

CAUTION:

HOW TO SELECT PISTON AND BEARING

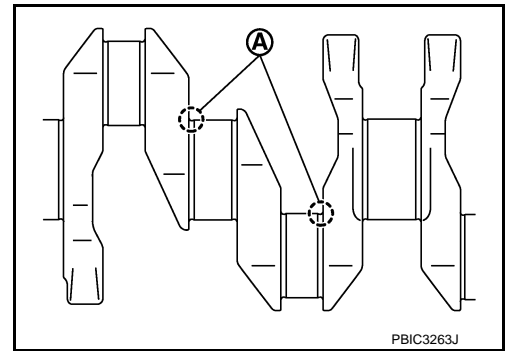
< UNIT DISASSEMBLY AND ASSEMBLY >

[HR15DE]

In grinding crankshaft main journal to use undersize bearings, keep fillet R (A) [0.8 - 1.2 mm (0.031 - 0.047 in)].

Bearing undersize table:

Refer to [EM-279, "Main Bearing"](#).



A

EM

C

D

E

F

G

H

I

J

K

L

M

N

O

P

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR15DE]

SERVICE DATA AND SPECIFICATIONS (SDS)

SERVICE DATA AND SPECIFICATIONS (SDS)

General Specification

INFOID:000000006282308

GENERAL SPECIFICATIONS

Engine type		HR15DE
Cylinder arrangement		In-line 4
Displacement	cm ³ (cu in)	1,498 (91.41)
Bore and stroke	mm (in)	78.0×78.4 (3.070×3.087)
Valve arrangement		DOHC
Firing order		1-3-4-2
Number of piston rings	Compression	2
	Oil	1
Compression ratio		10.1
Compression pressure kPa (bar, kg/cm ² , psi) / 200 rpm	Standard	1,510 (15.1, 15.4, 219)
	Minimum	1,170 (11.7, 12.0, 170)
	Differential limit between cylinders	100 (1.0, 1.0, 14.5)

Valve Timing

Unit: degree

Valve timing ⇐: Intake valve ⇐: Exhaust valve	<p style="text-align: right; font-size: small;">JPBIA0552ZZ</p>					
	a	b	c	d	e	f
	208	222	-14 (19) ATDC	56 (23) ABDC	7	21

(): Valve timing control "ON"

Drive Belt

INFOID:000000006282309

DRIVE BELT

Belt Deflection

Location	Deflection adjustment *		Unit: mm (in)
	Used belt		New belt
	Limit	After adjusted	
Drive belt	10.1 (0.398)	4.8 - 5.3 (0.19 - 0.21)	4.1 - 4.4 (0.16 - 0.17)
Applied pushing force	98 N (10 kg, 22 lb)		

*: When engine is cold.

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR15DE]

Belt Tension and Frequency

Location	Tension adjustment *		Unit: N (kg, lb)	Frequency adjustment *		Unit: Hz
	Used belt		New belt	Used belt		New belt
	Limit	After adjusted		Limit	After adjusted	
Drive belt	350 (35.7, 79)	876 - 964 (89.4 - 98.3, 197 - 217)	1064 - 1152 (108.5 - 117.5, 239 - 259)	145	229 - 239	253.5 - 261.5

*: When engine is cold.

Necessary command for belt tension calculation.

Belt span : 0.196m
Belt unit mass : 0.109 kg/m
Width of belt : 3.56 mm/rib × 7 rib

Spark Plug

INFOID:0000000006282310

SPARK PLUG (PLATINUM-TIPPED TYPE)

Unit: mm (in)

Make	FEDERAL MOFUL	
Standard type	REA12WMB4	
Spark plug gap	Standard	1.1 (0.043)

Exhaust Manifold

INFOID:0000000006282311

EXHAUST MANIFOLD

Unit: mm (in)

Items	Limit
Surface distortion	0.3 (0.012)

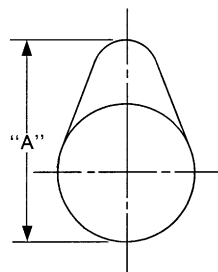
Camshaft

INFOID:0000000006282312

CAMSHAFT

Unit: mm (in)

Items	Standard	Limit
Camshaft runout [TIR*]	0.02 (0.0008)	0.1 (0.0039)



SEM671

Camshaft cam height "A"	Intake	41.205 - 41.395 (1.6222 - 1.6297)	41.005 (1.6144)
	Exhaust	40.175 - 40.365 (1.5816 - 1.5891)	39.975 (1.5738)
Camshaft journal outer diameter	No. 1	27.935 - 27.955 (1.0998 - 1.1006)	—
	No. 2, 3, 4, 5	24.950 - 24.970 (0.9822 - 0.9830)	—

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR15DE]

Items	Standard	Limit
Camshaft bracket inner diameter	No. 1	28.000 - 28.021 (1.1024 - 1.1032)
	No. 2, 3, 4, 5	25.000 - 25.021 (0.9842 - 0.9850)
Camshaft journal oil clearance	No. 1	0.045 - 0.086 (0.0018 - 0.0034)
	No. 2, 3, 4, 5	0.030 - 0.071 (0.0011 - 0.0027)
Camshaft end play	0.075 - 0.153 (0.0029 - 0.0060)	0.2 (0.0078)
Camshaft sprocket runout [TIR*]	—	0.15 (0.0059)

*: Total indicator reading

Valve Lifter

Unit: mm (in)

Items	Standard
Valve lifter outer diameter	29.977 - 29.987 (1.1801 - 1.1805)
Valve lifter hole diameter	30.000 - 30.021 (1.1811 - 1.1819)
Valve lifter clearance	0.013 - 0.044 (0.0005 - 0.0017)

Valve Clearance

Unit: mm (in)

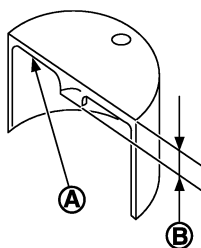
	Cold	Hot * (reference data)
Intake	0.26 - 0.34 (0.010 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.29 - 0.37 (0.011 - 0.014)	0.308 - 0.432 (0.012 - 0.017)

*: Approximately 80°C (176°F)

Available Valve Lifter

Unit: mm (in)

Identification mark (A)	Thickness (B)
-------------------------	---------------



JPBIA0170ZZ

300	3.00 (0.1181)
302	3.02 (0.1188)
304	3.04 (0.1196)
306	3.06 (0.1204)
308	3.08 (0.1212)
310	3.10 (0.1220)
312	3.12 (0.1228)
314	3.14 (0.1236)
316	3.16 (0.1244)
318	3.18 (0.1251)
320	3.20 (0.1259)
322	3.22 (0.1267)
324	3.24 (0.1275)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR15DE]

Identification mark (A)	Thickness (B)
326	3.26 (0.1283)
328	3.28 (0.1291)
330	3.30 (0.1299)
332	3.32 (0.1307)
334	3.34 (0.1314)
336	3.36 (0.1322)
338	3.38 (0.1330)
340	3.40 (0.1338)
342	3.42 (0.1346)
344	3.44 (0.1354)
346	3.46 (0.1362)
348	3.48 (0.1370)
350	3.50 (0.1377)

Cylinder head

INFOID:000000006282313

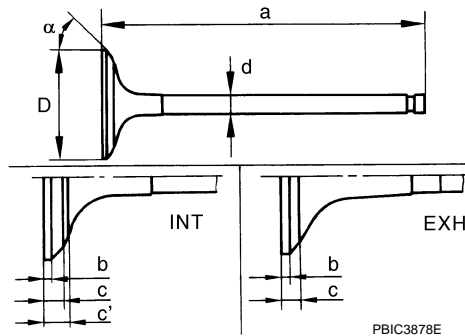
CYLINDER HEAD

Unit: mm (in)

Items	Limit
Head surface distortion	0.1 (0.004)

Valve Dimensions

Unit: mm (in)



Valve head diameter "D"	Intake	31.0 - 31.3 (1.220 - 1.232)
	Exhaust	25.3 - 25.6 (0.996 - 1.007)
Valve length "a"	Intake	101.73 (4.01)
	Exhaust	102.49 (4.04)
"b"	Intake	1.0 (0.0393)
	Exhaust	1.0 (0.0393)
"c"	Intake	2.1 - 2.8 (0.0826 - 0.1102)
	Exhaust	2.3 - 3.0 (0.0905 - 0.1181)
"c"	Intake	3.0 (0.1181)
	Exhaust	-
"d"	Intake	4.965 - 4.980 (0.1954 - 0.1960)
	Exhaust	4.955 - 4.970 (0.1950 - 0.1956)
Valve seat angle "α"	Intake	45°15' - 45°45'
	Exhaust	

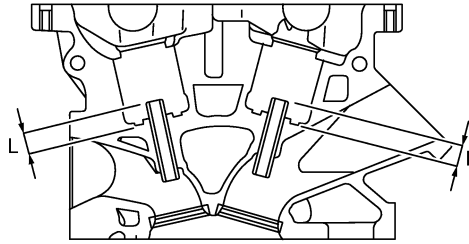
SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR15DE]

Valve Guide

Unit: mm (in)

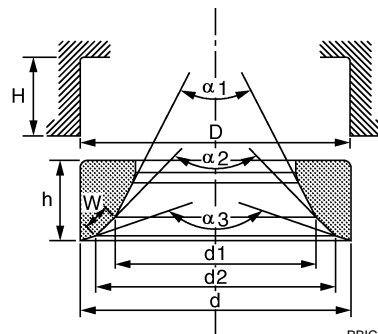


PBIC0184E

Items		Standard part	Service part
Valve guide	Outer diameter	9.023 - 9.034 (0.3552 - 0.3556)	9.223 - 9.234 (0.3631 - 0.3635)
	Inner diameter (Finished size)	5.000 - 5.018 (0.1968 - 0.1975)	
Cylinder head valve guide hole diameter		8.975 - 8.996 (0.3533 - 0.3541)	9.175 - 9.196 (0.3612 - 0.3620)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
Items		Standard	Limit
Valve guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.1 (0.004)
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)	0.1 (0.004)
Projection length "H"		11.4 - 11.8 (0.448 - 0.464)	

Valve Seat

Unit: mm (in)



PBIC2745E

Items		Standard	Oversize [0.5 (0.02)] (Service)
Cylinder head seat recess diameter "D"	Intake	31.400 - 31.416 (1.2362 - 1.2368)	31.900 - 31.916 (1.2559 - 1.2565)
	Exhaust	25.900 - 25.916 (1.0196 - 1.0203)	26.400 - 26.416 (1.0393 - 1.0399)
Valve seat outer diameter "d"	Intake	31.497 - 31.513 (1.2400 - 1.2406)	31.997 - 32.013 (1.2597 - 1.2603)
	Exhaust	25.997 - 26.013 (1.0235 - 1.0241)	26.497 - 26.513 (1.0431 - 1.0438)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.081 - 0.113 (0.0032 - 0.0044)	
Diameter "d1"*1	Intake	29.0 (1.141)	
	Exhaust	23.0 (0.905)	
Diameter "d2"*2	Intake	30.6 - 30.8 (1.204 - 1.212)	
	Exhaust	24.9 - 25.1 (0.980 - 0.988)	
Angle "alpha 1"	Intake	60°	
	Exhaust	45°	

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR15DE]

Angle "α2"	Intake	89°45' - 90°15'	
	Exhaust	89°45' - 90°15'	
Angle "α3"	Intake	120°	
	Exhaust	120°	
Contacting width "W"*3	Intake	1.05 - 1.35 (0.0413 - 0.0531)	
	Exhaust	1.25 - 1.55 (0.0492 - 0.0610)	
Height "h"	Intake	6.0 (0.236)	5.45 (0.214)
	Exhaust	6.0 (0.236)	5.43 (0.213)
Depth "H"	6.0 (0.236)		

*1: Diameter made by intersection point of conic angles α1 and α2

*2: Diameter made by intersection point of conic angles α2 and α3

*3: Machining data

Valve Spring

Standard:

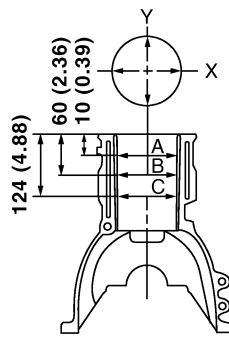
Free height	42.26 mm (1.6637 in)
Installation height	32.40 mm (1.2755 in)
Installation load	136 - 154 N (13.9 - 15.7 kg, 31 - 35 lb)
Height during valve open	23.96 mm (0.9433 in)
Load with valve open	262 - 296 N (26.7 - 30.2 kg, 59 - 67 lb)

Cylinder Block

INFOID:000000006282314

CYLINDER BLOCK

Unit: mm (in)



PBIC3924E

Surface distortion	Limit	0.1 (0.004)	
Cylinder bore	Inner diameter	Standard	78.000 - 78.015 (3.0708 - 3.0714)
		Wear limit	0.2 (0.008)
Out-of-round (Difference between "a" and "b")	Limit	0.015 (0.0006)	
Taper (Difference between "c" and "d")		0.010 (0.0004)	

SERVICE DATA AND SPECIFICATIONS (SDS)

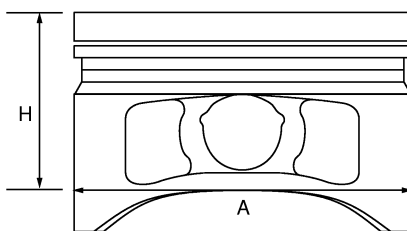
< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR15DE]

Cylinder block main bearing housing inner diameter grade	Grade No. A	51.997 - 51.998 (2.0471 - 2.0472)
	Grade No. B	51.998 - 51.999 (2.0472 - 2.0472)
	Grade No. C	51.999 - 52.000 (2.0472 - 2.0472)
	Grade No. D	52.000 - 52.001 (2.0472 - 2.0472)
	Grade No. E	52.001 - 52.002 (2.0473 - 2.0473)
	Grade No. F	52.002 - 52.003 (2.0473 - 2.0473)
	Grade No. G	52.003 - 52.004 (2.0474 - 2.0474)
	Grade No. H	52.004 - 52.005 (2.0474 - 2.0474)
	Grade No. J	52.005 - 52.006 (2.0474 - 2.0474)
	Grade No. K	52.006 - 52.007 (2.0475 - 2.0475)
	Grade No. L	52.007 - 52.008 (2.0475 - 2.0475)
	Grade No. M	52.008 - 52.009 (2.0476 - 2.0476)
	Grade No. N	52.009 - 52.010 (2.0476 - 2.0476)
	Grade No. P	52.010 - 52.011 (2.0476 - 2.0476)
	Grade No. R	52.011 - 52.012 (2.0477 - 2.0477)
	Grade No. S	52.012 - 52.013 (2.0477 - 2.0477)
	Grade No. T	52.013 - 52.014 (2.0478 - 2.0478)
Grade No. U	52.014 - 52.015 (2.0478 - 2.0478)	
Grade No. V	52.015 - 52.016 (2.0478 - 2.0478)	
Grade No. W	52.016 - 52.017 (2.0479 - 2.0479)	
Difference in inner diameter between cylinders	Standard	Less than 0.03 (0.0012)

Available Piston

Unit: mm (in)



PBIC0188E

Items	Standard	Limit
Piston skirt diameter "A"	77.965 - 77.980 (3.0694 - 3.0700)	—
Piston height "H" dimension	37.1 (1.460)	—
Piston pin hole diameter	19.010 - 19.016 (0.7484 - 0.7487)	—
Piston to cylinder bore clearance	0.020 - 0.050 (0.0007 - 0.0019)	0.09 (0.0035)

Piston Ring

Unit: mm (in)

Items	Standard	Limit
Side clearance	Top	0.040 - 0.080 (0.0015 - 0.0031)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)
	Oil (rail ring)	0.045 - 0.125 (0.0017 - 0.0049)
End gap	Top	0.20 - 0.30 (0.0078 - 0.0118)
	2nd	0.35 - 0.50 (0.0137 - 0.0196)
	Oil (rail ring)	0.20 - 0.60 (0.0079 - 0.0236)

Piston Pin

Unit: mm (in)

Piston pin outer diameter		18.996 - 19.002 (0.7478 - 0.7481)
Piston to piston pin oil clearance	Standard	0.012 - 0.016 (0.0004 - 0.0006)
Connecting rod bushing oil clearance	Standard	-0.018 to -0.044 (-0.0007 to -0.0017)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR15DE]

Connecting Rod

Unit: mm (in)

Center distance		132.43 - 132.53 (5.2138 - 5.2177)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)
Connecting rod bushing inner diameter*		18.958 - 18.978 (0.7463 - 0.7471)
Side clearance	Standard	0.200 - 0.352 (0.0079 - 0.0138)
Connecting rod big end diameter	Grade No. A	43.000 - 43.001 (1.6929 - 1.6929)
	Grade No. B	43.001 - 43.002 (1.6929 - 1.6930)
	Grade No. C	43.002 - 43.003 (1.6930 - 1.6930)
	Grade No. D	43.003 - 43.004 (1.6930 - 1.6931)
	Grade No. E	43.004 - 43.005 (1.6931 - 1.6931)
	Grade No. F	43.005 - 43.006 (1.6931 - 1.6931)
	Grade No. G	43.006 - 43.007 (1.6931 - 1.6932)
	Grade No. H	43.007 - 43.008 (1.6932 - 1.6932)
	Grade No. J	43.008 - 43.009 (1.6932 - 1.6933)
	Grade No. K	43.009 - 43.010 (1.6933 - 1.6933)
Grade No. L	43.010 - 43.011 (1.6933 - 1.6933)	
Grade No. M	43.011 - 43.012 (1.6933 - 1.6934)	
Grade No. N	43.012 - 43.013 (1.6934 - 1.6934)	

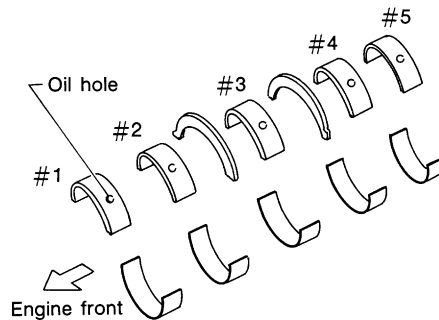
*: After installing in connecting rod

Main Bearing

INFOID:000000006282315

MAIN BEARING

Unit: mm (in)



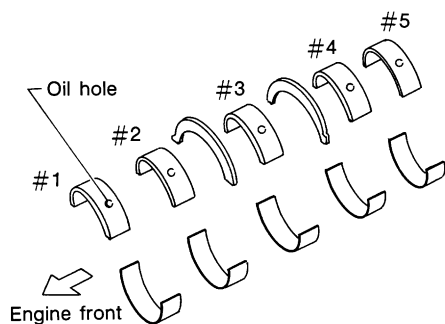
SEM685D

Grade number	Thickness	Identification color	Remarks
0	1.996 - 1.999 (0.0785 - 0.0787)	Black	Grade and color are the same for upper and lower bearings.
1	1.999 - 2.002 (0.0787 - 0.0788)	Brown	
2	2.002 - 2.005 (0.0788 - 0.0789)	Green	
3	2.005 - 2.008 (0.0789 - 0.0790)	Yellow	
4	2.008 - 2.011 (0.0790 - 0.0791)	Blue	
5	2.011 - 2.014 (0.0791 - 0.0792)	Pink	

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR15DE]



SEM685D

Grade number		Thickness	Identification color	Remarks
01	UPR	1.996 - 1.999 (0.0785 - 0.0787)	Black	Grade and color are different for upper and lower bearings.
	LWR	1.999 - 2.002 (0.0787 - 0.0788)	Brown	
12	UPR	1.999 - 2.002 (0.0787 - 0.0788)	Brown	
	LWR	2.002 - 2.005 (0.0788 - 0.0789)	Green	
23	UPR	2.002 - 2.005 (0.0788 - 0.0789)	Green	
	LWR	2.005 - 2.008 (0.0789 - 0.0790)	Yellow	
34	UPR	2.005 - 2.008 (0.0789 - 0.0790)	Yellow	
	LWR	2.008 - 2.011 (0.0790 - 0.0791)	Blue	
45	UPR	2.008 - 2.011 (0.0790 - 0.0791)	Blue	
	LWR	2.011 - 2.014 (0.0791 - 0.0792)	Pink	

Undersize

Unit: mm (in)

Items	Thickness	Main journal diameter
US 0.25 (0.0098)	2.126 - 2.134 (0.0837 - 0.0840)	Grind so that bearing clearance is the specified value.

Bearing Oil Clearance

Unit: mm (in)

Main bearing oil clearance	Standard	0.024 - 0.034 (0.0009 - 0.0013)
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Connecting Rod Bearing

INFOID:000000006282316

CONNECTING ROD BEARING

Unit: mm (in)

Grade number		Thickness	Identification color	Remarks
0		1.498 - 1.501 (0.0590 - 0.0591)	Black	Grade and color are the same for upper and lower bearings.
1		1.501 - 1.504 (0.0591 - 0.0592)	Brown	
2		1.504 - 1.507 (0.0592 - 0.0593)	Green	
3		1.507 - 1.510 (0.0593 - 0.0594)	Yellow	
4		1.510 - 1.513 (0.0594 - 0.0596)	Blue	
01	UPR	1.498 - 1.501 (0.0590 - 0.0591)	Black	Grade and color are different between upper and lower bearings.
	LWR	1.501 - 1.504 (0.0591 - 0.0592)	Brown	
12	UPR	1.501 - 1.504 (0.0591 - 0.0592)	Brown	
	LWR	1.504 - 1.507 (0.0592 - 0.0593)	Green	
23	UPR	1.504 - 1.507 (0.0592 - 0.0593)	Green	
	LWR	1.507 - 1.510 (0.0593 - 0.0594)	Yellow	
34	UPR	1.507 - 1.510 (0.0593 - 0.0594)	Yellow	
	LWR	1.510 - 1.513 (0.0594 - 0.0596)	Blue	

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR15DE]

Undersize

Unit: mm (in)

Items	Thickness	Crankshaft pin journal diameter
US 0.25 (0.0098)	1.627 - 1.635 (0.0640 - 0.0644)	Grind so that bearing clearance is the specified value.

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Bearing Oil Clearance

Unit: mm (in)

Connecting rod bearing oil clearance	Standard	0.029 - 0.039 (0.0011 - 0.0015)
	Limit	0.10 (0.0039)

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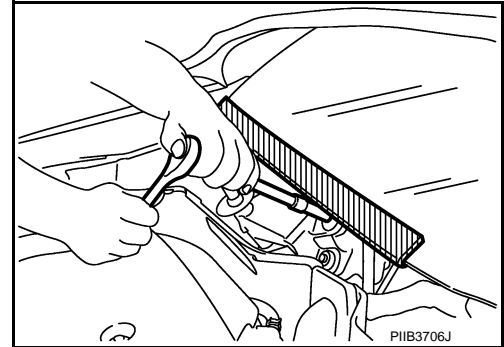
PRECAUTION

PRECAUTIONS

Precaution for Procedure without Cowl Top Cover

INFOID:000000006659386

When performing the procedure after removing cowl top cover, cover the lower end of windshield with urethane, etc.



Precaution Necessary for Steering Wheel Rotation after Battery Disconnect

INFOID:000000006659387

NOTE:

- Before removing and installing any control units, first turn the ignition switch to the LOCK position, then disconnect both battery cables.
- After finishing work, confirm that all control unit connectors are connected properly, then re-connect both battery cables.
- Always use CONSULT-III to perform self-diagnosis as a part of each function inspection after finishing work. If a DTC is detected, perform trouble diagnosis according to self-diagnosis results.

For vehicle with steering lock unit, if the battery is disconnected or discharged, the steering wheel will lock and cannot be turned.

If turning the steering wheel is required with the battery disconnected or discharged, follow the operation procedure below before starting the repair operation.

OPERATION PROCEDURE

1. Connect both battery cables.
 - NOTE:**
Supply power using jumper cables if battery is discharged.
2. Turn the ignition switch to ACC position.
(At this time, the steering lock will be released.)
3. Disconnect both battery cables. The steering lock will remain released with both battery cables disconnected and the steering wheel can be turned.
4. Perform the necessary repair operation.
5. When the repair work is completed, re-connect both battery cables. With the brake pedal released, turn the ignition switch from ACC position to ON position, then to LOCK position. (The steering wheel will lock when the ignition switch is turned to LOCK position.)
6. Perform self-diagnosis check of all control units using CONSULT-III.

Precaution for Supplemental Restraint System (SRS) "AIR BAG" and "SEAT BELT PRE-TENSIONER"

INFOID:0000000066881065

The Supplemental Restraint System such as "AIR BAG" and "SEAT BELT PRE-TENSIONER", used along with a front seat belt, helps to reduce the risk or severity of injury to the driver and front passenger for certain types of collision. Information necessary to service the system safely is included in the "SRS AIR BAG" and "SEAT BELT" of this Service Manual.

WARNING:

- **To avoid rendering the SRS inoperative, which could increase the risk of personal injury or death in the event of a collision which would result in air bag inflation, all maintenance must be performed by an authorized NISSAN/INFINITI dealer.**

PRECAUTIONS

[K9K]

< PRECAUTION >

- **Improper maintenance, including incorrect removal and installation of the SRS, can lead to personal injury caused by unintentional activation of the system. For removal of Spiral Cable and Air Bag Module, see “SRS AIR BAG”.**
- **Never use electrical test equipment on any circuit related to the SRS unless instructed to in this Service Manual. SRS wiring harnesses can be identified by yellow and/or orange harnesses or harness connectors.**

A

EM

PRECAUTIONS WHEN USING POWER TOOLS (AIR OR ELECTRIC) AND HAMMERS

WARNING:

- **When working near the Air Bag Diagnosis Sensor Unit or other Air Bag System sensors with the ignition ON or engine running, never use air or electric power tools or strike near the sensor(s) with a hammer. Heavy vibration could activate the sensor(s) and deploy the air bag(s), possibly causing serious injury.**
- **When using air or electric power tools or hammers, always switch the ignition OFF, disconnect the battery, and wait at least 3 minutes before performing any service.**

C

D

E

Draining Engine Coolant

INFOID:0000000006659389

Drain engine coolant and engine oil when the engine is cooled.

F

Disconnecting Fuel Piping

INFOID:0000000006659390

- Before starting work, check no fire or spark producing items are in the work area.
- Release fuel pressure before disconnecting and disassembly.
- After disconnecting pipes, plug openings to stop fuel leakage.

G

Removal and Disassembly

INFOID:0000000006659391

- When instructed to use SST, use specified tools. Always be careful to work safely, avoid forceful or uninstructed operations.
- Exercise maximum care to avoid damage to mating or sliding surfaces.
- Dowel pins are used for several parts alignment. When replacing and reassembling parts with dowel pins, check that dowel pins are installed in the original position.
- Cover openings of engine system with a tape or equivalent, if necessary, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and reassembly.
- When loosening nuts and bolts, as a basic rule, start with the one furthest outside, then the one diagonally opposite, and so on. If the order of loosening is specified, do exactly as specified. Power tools may be used in the step.

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Inspection, Repair and Replacement

INFOID:0000000006659392

Before repairing or replacing, thoroughly inspect parts. Inspect new replacement parts in the same way, and replace if necessary.

L

Assembly and Installation

INFOID:0000000006659393

- Use torque wrench to tighten bolts or nuts to specification.
- When tightening nuts and bolts, as a basic rule, equally tighten in several different steps starting with the ones in center, then ones on inside and outside diagonally in this order. If the order of tightening is specified, do exactly as specified.
- Replace with new gasket, packing, oil seal or O-ring.
- Thoroughly wash, clean, and air-blow each part. Carefully check engine oil or engine coolant passages for any restriction and blockage.
- Avoid damaging sliding or mating surfaces. Completely remove foreign materials such as cloth lint or dust. Before assembly, oil sliding surfaces well.
- Release air within route when refilling after draining engine coolant.
- After repairing, start the engine and increase engine speed to check engine coolant, fuel, engine oil, and exhaust gases for leakage.

M

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Parts Requiring Angle Tightening

INFOID:0000000006659394

- Use the angle wrench [SST: KV10112100] for the final tightening of the following engine parts:
 - Cylinder head bolts

PRECAUTIONS

[K9K]

< PRECAUTION >

- Lower cylinder block bolts
- Connecting rod cap bolts
- Crankshaft pulley bolt (No the angle wrench is required as bolt flange is provided with notches for angle tightening)
- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.

Liquid Gasket

INFOID:000000006659395

REMOVAL OF LIQUID GASKET SEALING

- After removing mounting nuts and bolts, separate the mating surface using the seal cutter [SST: KV10111100] (A) and remove old liquid gasket sealing.

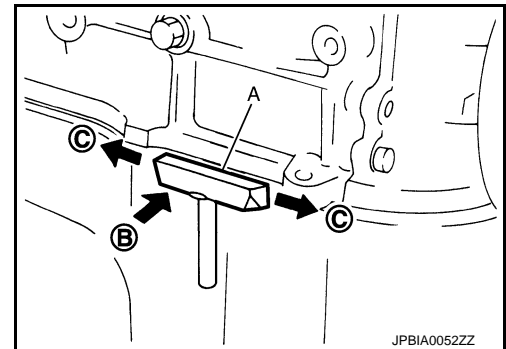
CAUTION:

Be careful not to damage the mating surfaces.

- Tap the seal cutter [SST: KV10111100] to insert it (B), and then slide it (C) by tapping on the side as shown in the figure.
- In areas where the seal cutter [SST: KV10111100] is difficult to use, lightly tap the parts using a plastic hammer to remove it.

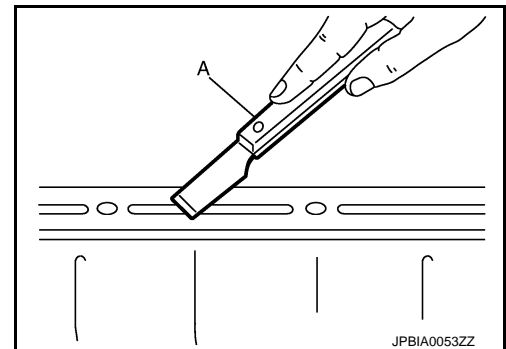
CAUTION:

If for some unavoidable reason tool such as a screwdriver is used, be careful not to damage the mating surfaces.

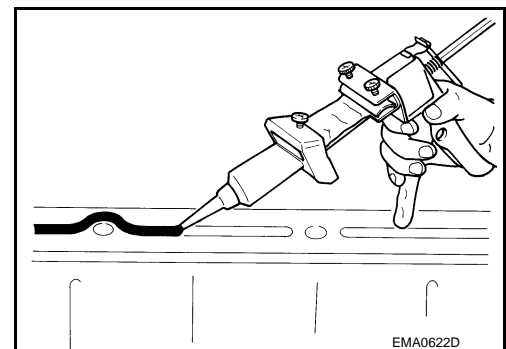


LIQUID GASKET APPLICATION PROCEDURE

1. Using a scraper (A), remove old liquid gasket adhering to the liquid gasket application surface and the mating surface.
 - Remove liquid gasket completely from the groove of the liquid gasket application surface, mounting bolts, and bolt holes.
2. Wipe the liquid gasket application surface and the mating surface with white gasoline (lighting and heating use) to remove adhering moisture, grease and foreign materials.



3. Attach liquid gasket tube to the tube presser (commercial service tool).
Use Genuine Liquid Gasket or equivalent.
4. Apply liquid gasket without gaps to the specified location according to the specified dimensions.
 - If there is a groove for liquid gasket application, apply liquid gasket to the groove.

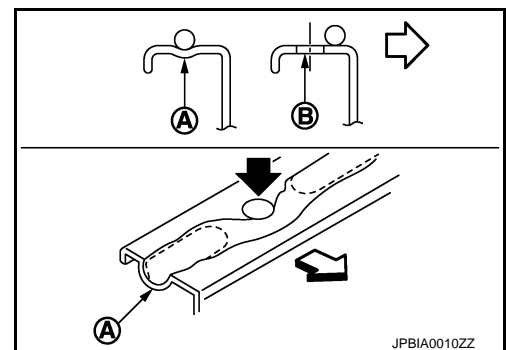


- As for bolt holes (B), normally apply liquid gasket inside the holes. Occasionally, it should be applied outside the holes. Check to read the text of this manual.

A : Groove

⇐ : Inside

- Within five minutes of liquid gasket application, install the mating component.
- If liquid gasket protrudes, wipe it off immediately.
- Do not retighten mounting bolts or nuts after the installation.



PRECAUTIONS

[K9K]

< PRECAUTION >

- After 30 minutes or more have passed from the installation, fill engine oil and engine coolant.

CAUTION:

If there are specific instructions in this manual, observe them.

Precaution for Diesel Equipment

INFOID:000000006659396

EM

CLEANLINESS

CLEANLINESS INSTRUCTIONS WHICH MUST BE FOLLOWED WHEN WORKING ON THE HIGH PRESSURE DIRECT INJECTION SYSTEM

Risks relating to contamination

The system is very sensitive to contamination. The risks caused by the introduction of contamination are:

- Damage or destruction of the high pressure injection system and the engine,
- Seizing or leaking of a component.

All After-Sales operations must be performed under very clean conditions. This means that no impurities (particles a few microns in size) get into the system during dismantling or into the circuits via the fuel unions.

The cleanliness principle must be applied from the filter to the injectors.

WHAT ARE THE SOURCES OF CONTAMINATION?

Contamination is caused by:

- Metal or plastic chips,
- Paint,
- Fibres:
 - Boxes,
 - Brushes,
 - Paper,
 - Clothing,
 - Cloths,
- Foreign bodies such as hair,
- Ambient air,
- Etc.

IMPORTANT: It is not possible to clean the engine using a high pressure washer because of the risk of damaging connections. In addition, moisture may collect in the connectors and create electrical connection malfunctions.

INSTRUCTIONS TO BE FOLLOWED BEFORE ANY WORK IS CARRIED OUT ON THE INJECTION SYSTEM

- Ensure that you have the plugs for the unions to be opened (bag of plugs sold at the Parts Stores - Nissan part No.: 16830 BN700, Renault part No.: 77 01 206 804). Plugs are to be used once only. After use, they must be thrown away (once used they are soiled and cleaning is not sufficient to make them reusable). Unused plugs must be thrown away.
- Ensure that you have hermetically resealable plastic bags for storing removed parts. Stored parts will therefore be less subject to the risk of impurities. The bags must be used only once, and after use they must be thrown away.
- Lint-free towelettes to be used for injection pump related service purpose. The use of a normal cloth or paper for cleaning purposes is forbidden. These are not lint-free and may contaminate the fuel circuit of the system. Each lint-free cloth should only be used once.

INSTRUCTIONS TO BE FOLLOWED BEFORE OPENING THE FUEL CIRCUIT

- For each operation, use new thinner (used thinner contains impurities). Pour it into a clean receptacle.
- For each operation, use a clean brush which is in good condition (the brush must not shed its bristles).
- Use a brush and thinners to clean the connections to be opened.
- Blow compressed air over the cleaned parts (tools, cleaned the same way as the parts, connections and injection system zone). Check that no bristles remain adhered.
- Wash your hands before and during the operation if necessary.
- When wearing leather protective gloves, cover these with latex gloves.

INSTRUCTIONS TO BE FOLLOWED DURING THE OPERATION

- As soon as the circuit is open, all openings must be plugged to prevent impurities from entering the system. The plugs to be used are available from the Parts Stores - Nissan part No.: 16830 BN700, Renault part No.: 77 01 206 804. They must not, under any circumstances, be reused.
- Close the hermetically sealed bag, even if it has to be reopened shortly afterwards. Ambient air carries contamination.
- All components of the injection system that are removed must be stored in a hermetically sealed plastic bag once the plugs have been inserted.

PRECAUTIONS

[K9K]

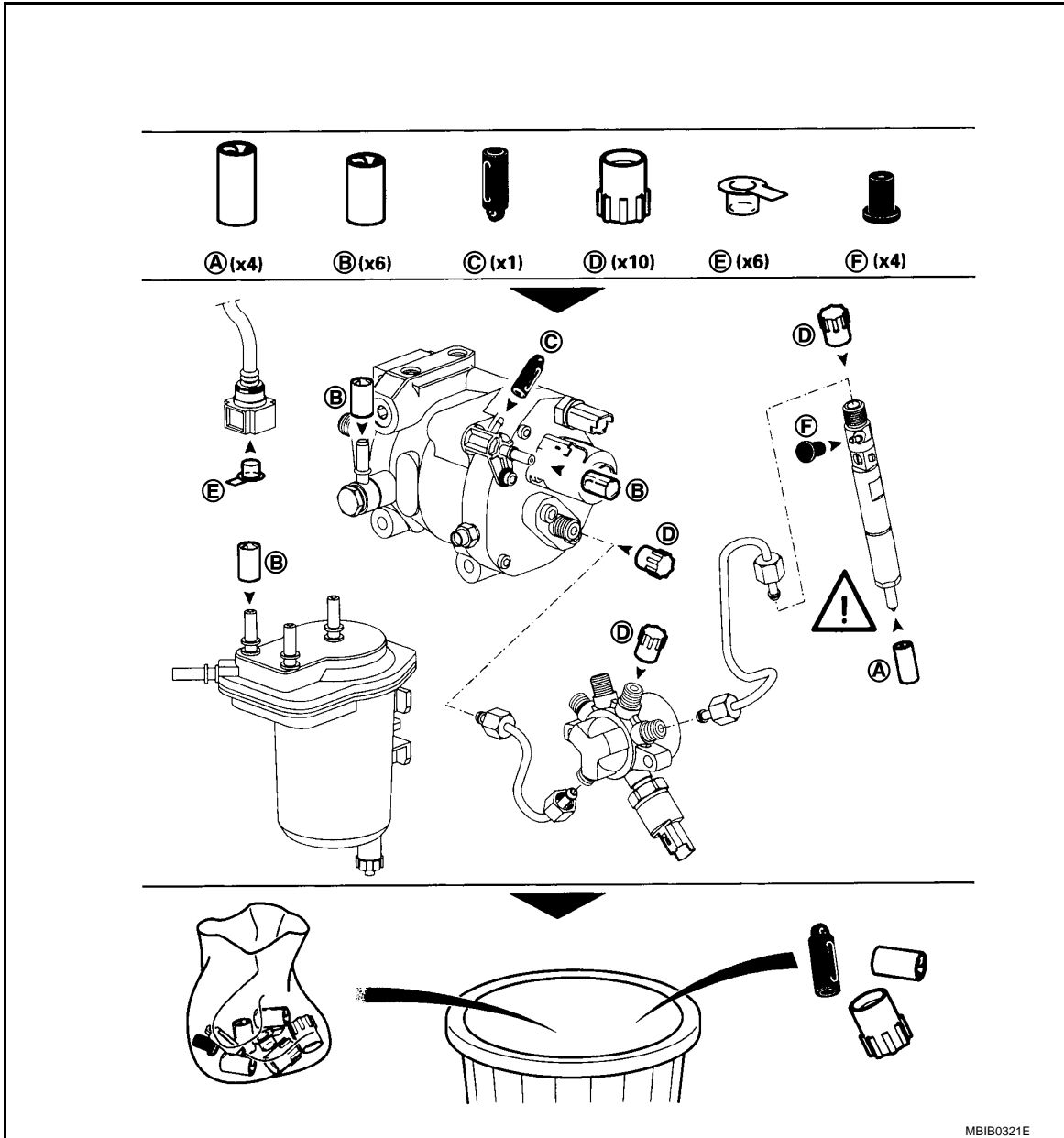
< PRECAUTION >

- The use of a brush, thinner, bellows, sponge or normal cloth is strictly forbidden once the circuit has been opened. These items are likely to allow impurities to enter the system.
- A new component replacing an old one must not be removed from its packaging until it is to be fitted to the vehicle.

Instructions for Fitting the Plugs

Nissan part number: 16830 BN700

(Renault part number: 77 01 206 804)



CAUTION:

- The engine must not run with:
 - Diesel containing more than 10% diester
 - Petrol, even in very small amounts.
- The system can inject the diesel into the engine at a pressure of up to 140,000 kPa (1,400 bar, 1,428 kg/cm², 20,300 psi). Before carrying out any work, check that the injector rail is no longer pressurized and that the fuel temperature is not too high.
- You must respect the cleaning and safety advice specified in this document for any work on the high pressure injection system.

SPECIAL FEATURES

CAUTION:

- The engine must not operate with:
 - Diesel engine fuel containing more than 10% diester,

PRECAUTIONS

[K9K]

< PRECAUTION >

- Petrol, even in tiny quantities.
- The system can inject the diesel into the engine at a pressure up to 1400 bars. Before carrying out any work, check that the injector rail is not under pressure and that the fuel temperature is not too high.
- You must respect the cleaning and safety advice specified in this document for any work on the high pressure injection system.
- Removal of the interior of the pump and injectors is prohibited. Only the flow actuator, the fuel temperature sensor and the venturi can be replaced.
- For safety reasons, it is strictly forbidden to slacken a high pressure pipe union when the engine is running.
- It is not possible to remove the pressure sensor from the fuel rail because this may cause circuit contamination malfunctions. If the pressure sensor fails, the pressure sensor, the rail and the five high pressure pipes must be replaced.
- It is strictly forbidden to remove any injection pump pulley marked number 070 575. If the pump is being replaced, the pulley must be replaced.
- It is forbidden to repair the wiring connecting the knock sensor (accelerometer) and the CKP sensor (engine speed sensor). If the wiring should fail, it has to be replaced with new wiring.
- Applying 12 volts directly to any component in the system is prohibited.
- Ultrasonic carbon removal and cleaning are prohibited.
- Never start the engine without the battery being connected correctly.
- It is essential to replace all the disconnected air inlet plastic pipes.

There is a 16 digit code on the injectors called individual injector correction. This code is specific to each injector, and takes into account differences in manufacture and specifies the flow injected by each of them.

When an injector is replaced, it is necessary to program the code of the new injector into the ECM. Refer to [EC-1185, "Diagnosis Procedure"](#).

INSTRUCTIONS FOR HIGH PRESSURE PIPES

CAUTION:

All the high pressure pipe removed must be systematically replaced along with the clips.

TIGHTENING THE HIGH PRESSURE PIPES

NOTE:

fit the pump/rail pipe before the rail/injector pipes.

Rail-pump pipe

- Undo the rail,
- Grease the threads of the high pressure pipe nuts,
- Insert the high pressure pipe olive into the taper of the high pressure pump outlet,
- Insert the high pressure pipe olive into the taper of the high pressure rail inlet.
- Move the nut into position by hand, on the rail side then the pump side,
- Tighten the rail,
- Tighten the high pressure pipe nuts on the rail side then on the pump side.

Rail/injector pipes

- Undo the rail,
- Grease the threads of the high pressure pipe nuts,
- Insert the high pressure pipe olive into the taper of the high pressure injector inlet,
- Insert the high pressure pipe olive into the taper of the high pressure rail outlet,
- Move the nuts into position by hand, on the injector side then the rail side,
- Tighten the rail,
- Ensure that the new clip, supplied with the new high pressure pipe, is fitted,
- Tighten the nuts of the high pressure pipes on the injector side first and then on the fuel rail side.

NOTE:

Before fitting a new high pressure pipe, move back the nuts on the pipe then lightly lubricate the nut threads with the oil from the sachet provided in the parts kit.

CHECKING SEALING AFTER REPAIR

CAUTION:

After any operation, check that there are no diesel leaks.

- Reprime the circuit using the priming pump.
- Start the engine and allow to warm up at idle speed, visually inspecting for any fuel leaks.
- Apply tracing fluid around the high pressure connections of the pipe that has been replaced.
- Once the engine coolant temperature is above 50°C and provided there are no malfunctions present, carry out a road test, taking the engine speed up to 4000 rpm at least once to check that there are no leaks.
- Perform a visual inspection after the road test to make sure that there are no high pressure leaks.

PRECAUTIONS

[K9K]

< PRECAUTION >

- Clean off the tracing fluid.

REPLACING THE INJECTORS

NOTE:

Individual injector correction is a factory calibration carried out on each injector to adjust the flow of each one precisely, taking into account differences in manufacture.

The correction values are written on a label affixed to each injector then entered in the ECM which can then control each injector by taking account of their differences in manufacture.

The system can be programmed "WORK SUPPORT" mode with CONSULT-III.

The correction values (16 digit code) must be replaced after replacing an injector. Refer to [EC-1185, "Diagnosis Procedure"](#).

- **Entering each injector's individual correction value, when replacing the ECM. Refer to [EC-1158, "Description"](#).**

Parts To Be Replaced After Removal

INFOID:000000006659397

- All gaskets
- Flywheel bolts
- Crankshaft bearing bolts
- Camshaft pulley bolt
- Crankshaft pulley bolts
- Big end cap bolts
- Injector holder copper washers
- Fuel injection tubes
- Pipe plugs
- Belts
- Timing belt tension wheel
- Oil jets
- Turbocharger plastic pipes

Installation of Thread Inserts

INFOID:000000006659398

Threaded holes on all engine component parts can be repaired by using thread inserts.

PREPARATION

< PREPARATION >

[K9K]

PREPARATION

PREPARATION

Special Service Tool

INFOID:000000006659399

A

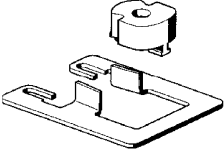
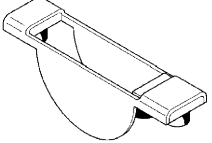
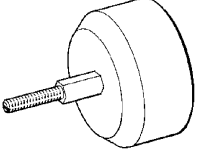
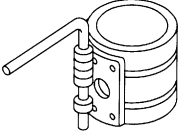
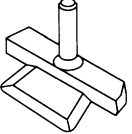
EM

NISSAN tool number (RENAULT tool No.) Tool name	Description	C
KV113B0020 (Emb. 880) Sliding hammer	Inertia extractor	D E
KV113B0060 (Mot. 582-01) Ring gear stopper	Flywheel immobilizing tool.	F G H
KV113B0110 (Mot. 1430) TDC set pin	Set of TDC pins	I
KV113B0120 (Mot. 1485-01) Oil jet remover	Tool for removing the piston bottom oil jets	J K
KV113B0130 (Mot. 1489) TDC set pin	TDC setting pin	L M
KV113B0140 (Mot. 1492) Bearing assembling set	Tool for installing connecting rod bearing	N O P

PREPARATION

< PREPARATION >

[K9K]

NISSAN tool number (RENAULT tool No.) Tool name	Description
<p> KV113B0150 (Mot. 1492-03) Bearing assembling adapter </p>  <p style="text-align: right; font-size: small;">MBIB0375E</p>	Adaptation kit for installing the detachable cap connecting rod bearing
<p> KV113B0160 (Mot. 1493-01) Bearing insert </p>  <p style="text-align: right; font-size: small;">MBIB0376E</p>	Tool for installing main bearing
<p> KV113B0170 (Mot. 1494) Oil jet remover plate </p>	Tool for removing oil jets
<p> KV113B0190 (Mot. 1567) Clip pliers </p>	Pliers for exhaust gas recycling pipe clips
<p> KV113B0210 (Mot. 1585) Front oil seal drift </p>  <p style="text-align: right; font-size: small;">MBIB0381E</p>	Tool for installing crankshaft seals, flywheel end
<p> KV113B0220 (Mot. 1586) Front oil seal drift set </p>	Tool for installing crankshaft seals, timing end
<p> KV113B0230 (Mot. 1632) Camshaft seal insert </p>	Tool for installing inlet camshaft seals
<p> KV113B0240 (Rou. 15-01) Shaft protector </p>	Internal shaft protector 16 mm (0.63 in) dia.
<p> EM03470000 (—) Piston ring compressor </p>  <p style="text-align: right; font-size: small;">NT044</p>	Installing piston assembly into cylinder bore
<p> KV10111100 (—) Seal cutter </p>  <p style="text-align: right; font-size: small;">NT046</p>	Removing oil pan

PREPARATION

< PREPARATION >

[K9K]

NISSAN tool number (RENAULT tool No.) Tool name	Description
KV10112100 (—) Angle wrench	Tightening bolts for bearing cap, cylinder head, etc. in angle
— (Mot. 1638) Belt tension gauge	Setting drive belt tension
— (Mot. 1606-A) Camshaft pulley holder	Tool for locking sprockets for toothed timing belt

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Commercial Service Tool

INFOID:000000006659400

NISSAN tool number (RENAULT tool No.) Tool name	Description
KV113B0030 (Mot. 11) Crankshaft bearing remover	Crankshaft bearing extractor
KV113B0040 (Mot. 251-01) Dial gauge stand set	Gauge stand used with KV113B0050 (Mot. 252-01)
KV113B0050 (Mot. 252-01) Dial gauge stand set	Thrust plate for measuring the protrusion of cylinder liners used with KV113B0040 (Mot. 251-01).

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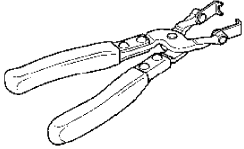
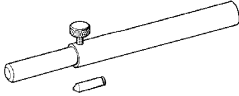
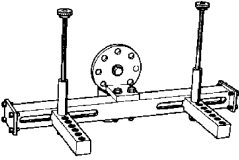
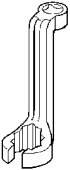
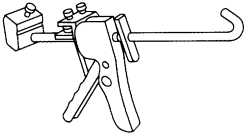
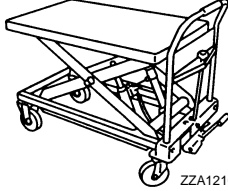
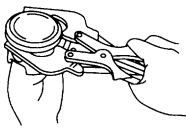
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PREPARATION

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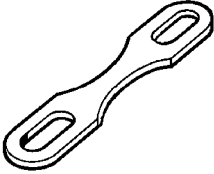
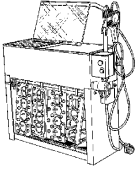

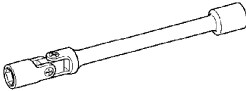
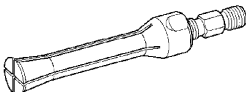
[K9K]

NISSAN tool number (RENAULT tool No.) Tool name		Description
KV113B0090 (Mot. 1335) Valve seal remover	 <small>MBIB0370E</small>	Tool for removing valve stem seals
KV113B0180 (Mot. 1511-01) Valve seal drift	 <small>MBIB0378E</small>	Tool for installing valve stem seals
KV113B0200 (Mot. 1573) Cylinder head stand	 <small>MBIB0380E</small>	Cylinder head support
KV113E0010 (Mot. 1566) Fuel spill tube spanner	 <small>MBIB0379E</small>	Spanner for installing and removing high pressure pipes
WS39930000 (—) Tube presser	 <small>NT052</small>	Pressing the tube of liquid gasket
Manual lift table caddy	 <small>ZZA1210D</small>	Removing and installing engine
Piston ring expander	 <small>NT030</small>	Removing and installing piston ring

PREPARATION

< PREPARATION >

[K9K]

NISSAN tool number (RENAULT tool No.) Tool name	Description
(Mot. 588)  MBIB0364E	Liner retaining strap
(664000) Cylinder head test container  MBIB0383E	Tool for testing the cylinder head, including: a tray and the various kits suited for each model of cylinder head (plug, sealing plate, blanking plate).
Torx socket	Standard 1/2" (12.7 mm) square drive 8/12/14 female torx socket.
(Mot. 1505) (Mot. 1715) Frequency meter  MBIB1423E	Tool for belt tension checking with frequency
Glow plug wrench  MBIB0387E	Articulated wrench for removing and installing the glow plugs
Main bearing wrench  MBIB0388E	Wrench for removing main bearings

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BASIC INSPECTION

CAMSHAFT VALVE CLEARANCE

Valve Clearance

INFOID:000000006659401

CHECKING AND ADJUSTING THE VALVE CLEARANCE

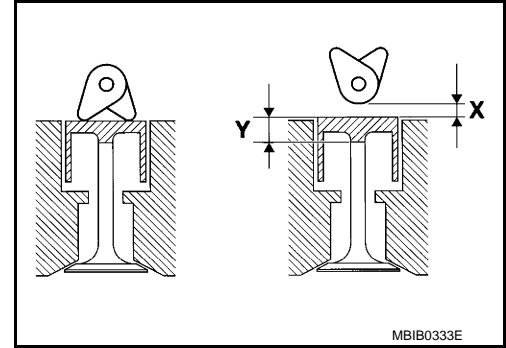
1. Install the tappet.
2. Install the camshaft.
3. Install the camshaft brackets.

: 11 N·m (1.1 kg·m, 8 ft·lb)

4. Place the valves of the cylinder concerned at the “end of exhaust - beginning of inlet” position and check the clearance (X).

NOTE:

Dimension (Y) corresponds to the tappet thickness sizes (there are 25 sizes at the service parts).



MBIB0333E

1	4
3	2
4	1
2	3

5. Compare the values recorded with the values specified, then replace the tappets which are not within tolerance.

Clearance, when the engine cold:

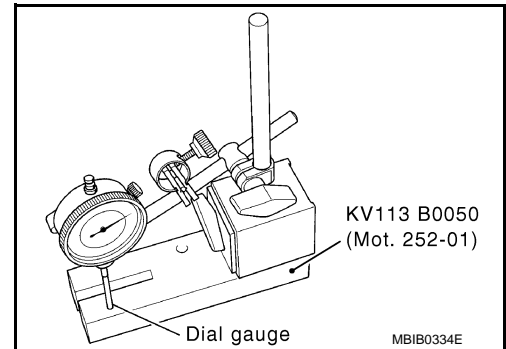
Intake : 0.125 - 0.25 mm (0.0049 - 0.0098 in)

Exhaust : 0.325 - 0.45 mm (0.0128 - 0.0177 in)

6. Remove the camshaft brackets.
7. Remove the camshaft.
8. Remove the tappet not within tolerance.

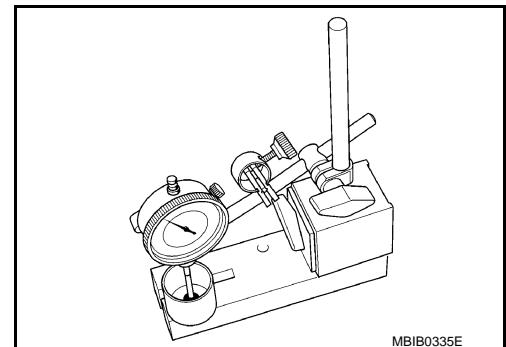
Determining dimension Y.

Set up the following assembly using KV113B0050 (Mot. 252-01) (Commercial service tool) or equivalent tool and dial gauge, then calibrate the gauge.



MBIB0334E

9. Raise the gauge extension (without modifying the position of the magnetic support/gauge assembly), then slide in the tappet to be measured.
 - Note dimension (Y) and repeat the operation for the tappets where the valve clearance is not within tolerance.
 - Refer to the Replacement Parts Catalogue for the vehicle concerned to select the various thicknesses of the tappet(s).
10. Check the valve clearance again.
11. Remove the camshaft brackets.
12. Remove the camshaft.
13. Remove the tappet(s) not within tolerance.




MBIB0335E

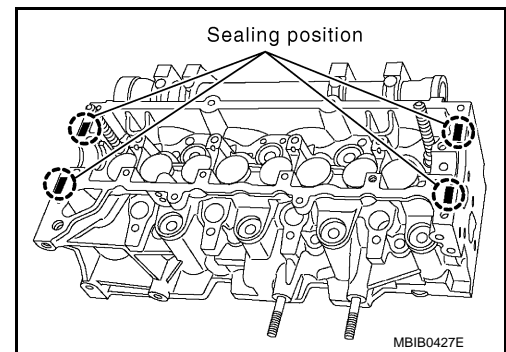
CAMSHAFT VALVE CLEARANCE

[K9K]

< BASIC INSPECTION >

14. Grease the underside of the tappets and the camshaft brackets.
15. Degrease the gasket faces (of the cylinder head and brackets 1 and 6). They should be clean, dry and free from grease (in particular, remove finger marks).
16. Lay four beads of Loctite with a width of 1 mm (0.04 in) on brackets 1 and 6 of the cylinder head.
17. Install the camshaft.
18. Install the camshaft brackets (these are numbered from 1 to 6 and bearing (1) should be positioned on the flywheel end).

 : 11 N·m (1.1 kg-m, 8 ft-lb)



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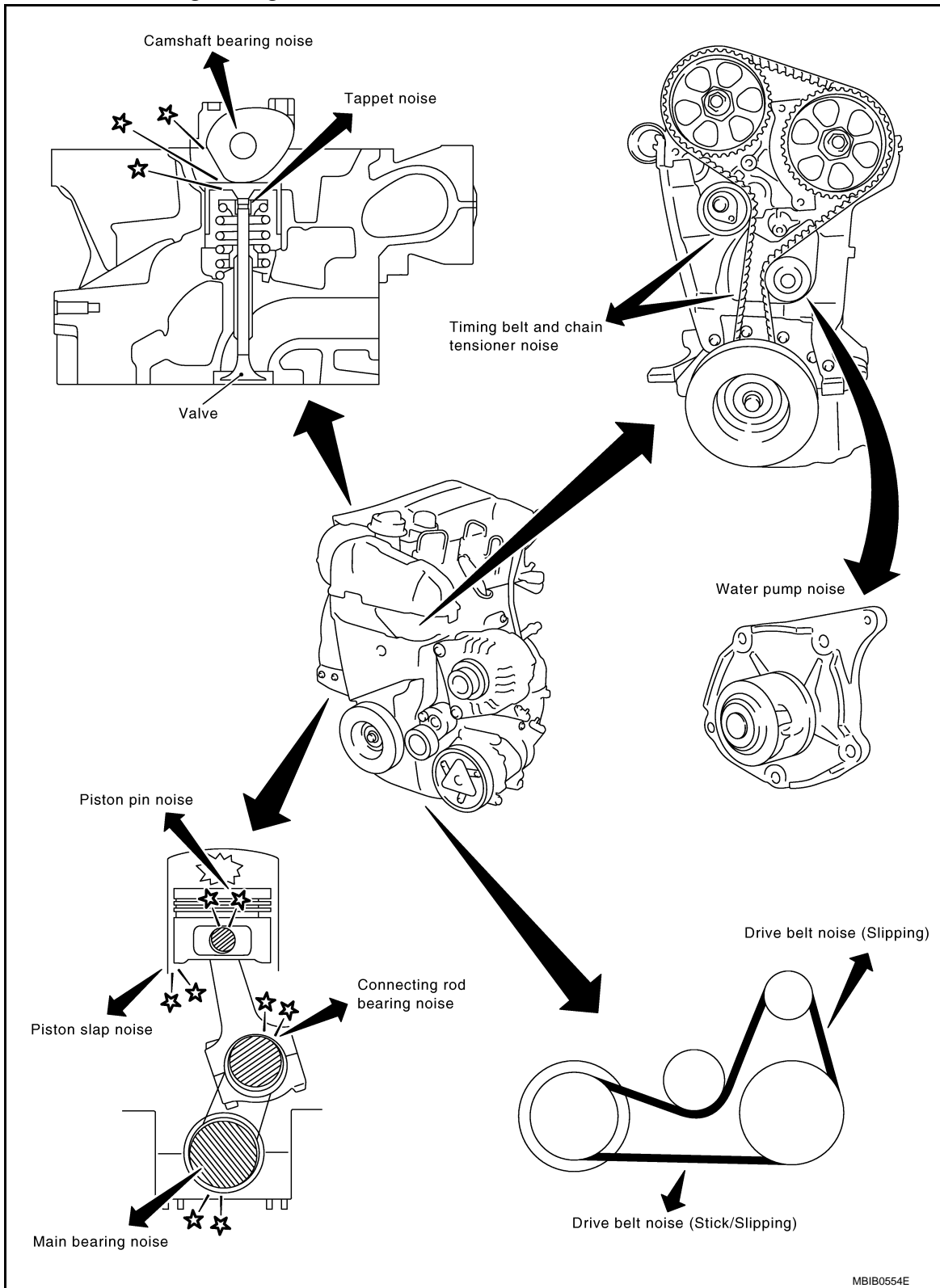
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SYMPTOM DIAGNOSIS

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

NVH Troubleshooting - Engine Noise

INFOID:000000006659402



NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

< SYMPTOM DIAGNOSIS >

[K9K]

Use the Chart Below to Help You Find the Cause of the Symptom

INFOID:000000006659403

1. Locate the area where noise occurs.
2. Confirm the type of noise.
3. Specify the operating condition of engine.
4. Check specified noise source.

If necessary, repair or replace these parts.

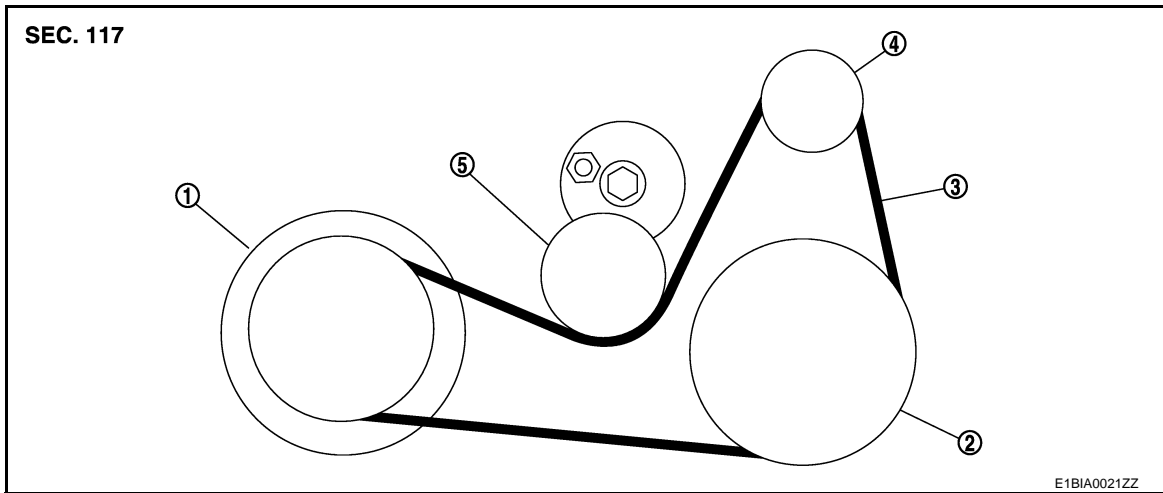
Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Valve clearance	EM-294
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston ring end gap	EM-375
Front of engine Timing belt cover	Tapping or ticking	A	A	—	B	B	B	Timing belt tensioner noise	Timing belt tensioner operation	EM-324
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	EM-299
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	CO-72

A: Closely related B: Related C: Sometimes related —: Not related

PERIODIC MAINTENANCE

DRIVE BELT

Exploded View



- | | | |
|----------------------|------------------------------|---------------|
| 1. Crankshaft pulley | 2. A/C compressor | 3. Drive belt |
| 4. Generator | 5. Drive belt auto-tensioner | |

Removal and Installation

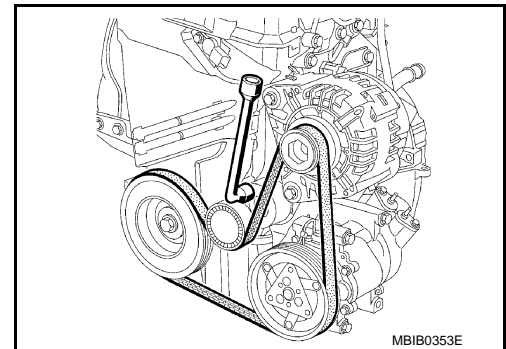
INFOID:000000006659406

CAUTION:

- Replace any belt that has been removed with a new one.
- Auto-tensioner must be replaced with new ones when the belt is replaced.
- Never run the engine without the drive belts to avoid damaging the crankshaft pulley.

REMOVAL

1. Remove RH front wheel.
2. Remove front fender protector (RH) front side bolts and clips. And keep a service area. Refer to [EXT-20. "FENDER PROTECTOR : Exploded View"](#).
3. Remove drive belt.
 - Turn clockwise adjusting bolt.



4. If necessary, remove auto-tensioner.

INSTALLATION

1. Install auto-tensioner mounting bolt.

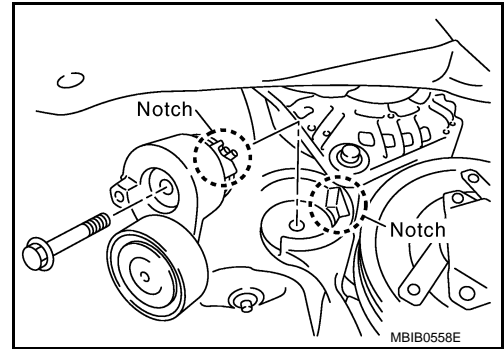
Auto-tensioner mounting bolt : 40 N-m (4.1 kg-m, 30 ft-lb)

DRIVE BELT

[K9K]

< PERIODIC MAINTENANCE >

- Align the notch and tighten mounting bolt.



2. Install the drive belt.

CAUTION:

- Make sure belt is correctly engaged with the pulley groove.
- Check for oil and coolant on belt and each pulley groove.

3. Make sure that tension of each belt is within the standard.

Inspection

INFOID:000000006707063

INSPECTION

WARNING:

Be sure to perform when the engine is stopped.

1. Inspect drive belt for cracks, fraying, wear and oil. Replace drive belt if necessary.
2. Manually evaluate the drive belt tension (tension cannot be measured using frequency meter).
3. Replace drive belt when tension is beyond normal operating limit.

CAUTION:

Auto-tensioner must be replaced with a new one when the belt is replaced.

Adjustment

INFOID:000000006659405

Belt tensioning is not necessary, as it is automatically adjusted by auto-tensioner.

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AIR CLEANER FILTER

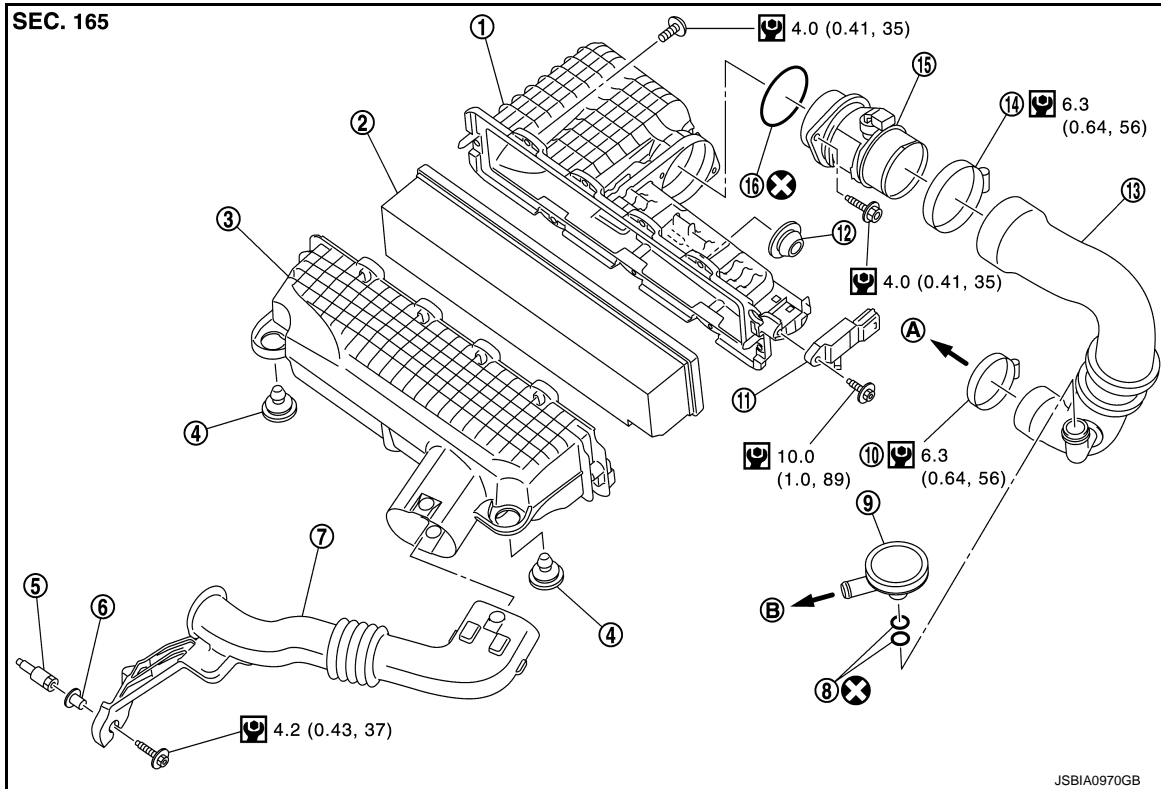
< PERIODIC MAINTENANCE >

[K9K]

AIR CLEANER FILTER

Exploded View

INFOID:000000006659407



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| 1. Air cleaner case | 2. Air cleaner filter | 3. Air cleaner case |
| 4. Grommet | 5. Air duct mount spacer | 6. Retainer |
| 7. Air duct (inlet) | 8. O-ring | 9. Resonator |
| 10. Clamp | 11. Turbocharger boost sensor | 12. Grommet |
| 13. Air inlet pipe | 14. Clamp | 15. Mass air flow sensor 1 (Intake air temperature sensor) |
- A. : To turbocharger
B. To blow-by hose

: N·m (kg·m, in·lb)

: Always replace after every disassembly.

Removal and Installation

INFOID:000000006659408

REMOVAL

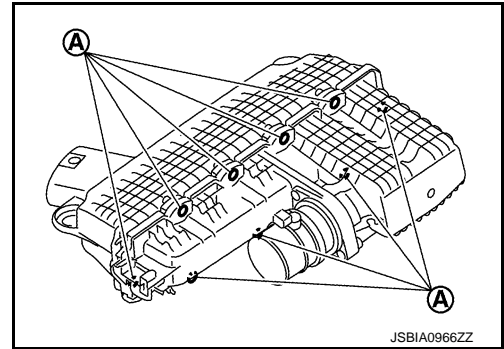
1. Remove engine cover. Refer to [EM-302, "Exploded View"](#).
2. Remove air duct (inlet).
3. Disconnect EVAP canister purge volume control solenoid valve harness connector and mass air flow sensor 1 harness connector.
4. Remove air inlet pipe from air cleaner case.
5. Remove air cleaner case assembly.

AIR CLEANER FILTER

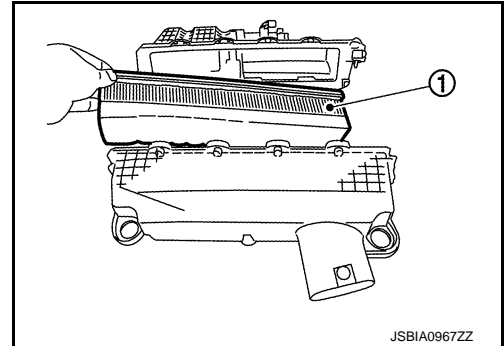
[K9K]

< PERIODIC MAINTENANCE >

6. Remove air cleaner case bolts (A).



7. Remove air cleaner filter (1) from air cleaner case.



INSTALLATION

Install in the reverse order of removal.

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ENGINE COVER

< REMOVAL AND INSTALLATION >

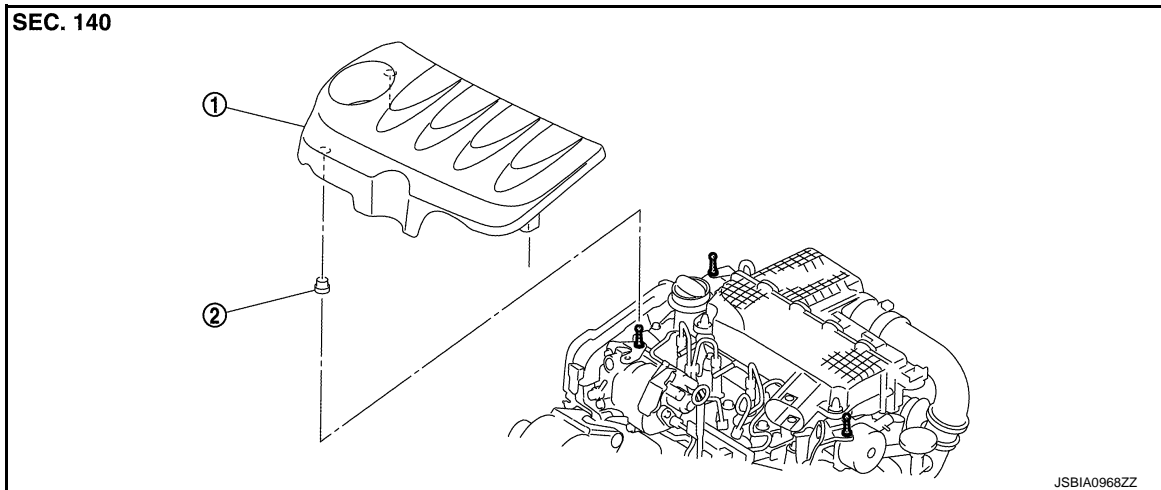
[K9K]

REMOVAL AND INSTALLATION

ENGINE COVER

Exploded View

INFOID:000000006703141



1. Engine cover

2. Mounting rubber

Removal and Installation

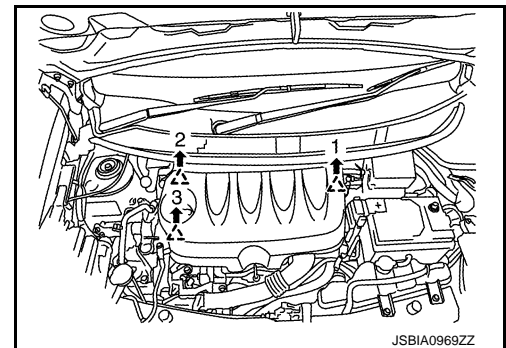
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REMOVAL

1. Remove fixed pins of the engine cover in numerical sequence as shown in the figure to remove the engine cover.

CAUTION:

- When detaching, hold the engine cover nearby the fixing point, and remove the pins one by one.
- Never damage or scratch cover when installing or removing.



INSTALLATION

Note the following, and install in the reverse order of removal.

CAUTION:

When installing, push the engine cover at the position on the pins.

AIR CLEANER AND AIR DUCT

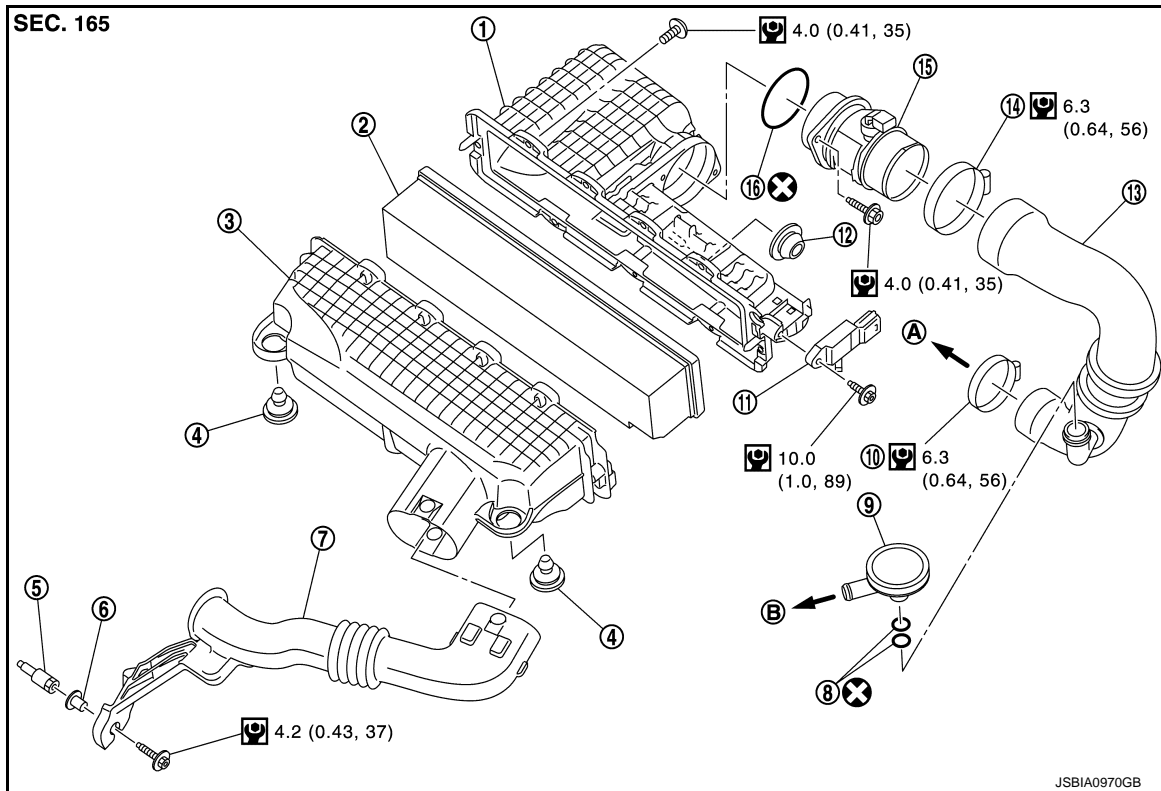
< REMOVAL AND INSTALLATION >

[K9K]

AIR CLEANER AND AIR DUCT

Exploded View

INFOID:000000006659409



- | | | |
|---------------------|-------------------------------|--|
| 1. Air cleaner case | 2. Air cleaner filter | 3. Air cleaner case |
| 4. Grommet | 5. Air duct mount spacer | 6. Retainer |
| 7. Air duct (inlet) | 8. O-ring | 9. Resonator |
| 10. Clamp | 11. Turbocharger boost sensor | 12. Grommet |
| 13. Air inlet pipe | 14. Clamp | 15. Mass air flow sensor 1 (Intake air temperature sensor) |
- A. : To turbocharger
B. To blow-by hose

: N·m (kg·m, in·lb)

: Always replace after every disassembly.

Removal and Installation

INFOID:000000006659410

REMOVAL

1. Remove engine cover. Refer to [EM-302, "Exploded View"](#).
2. Remove air duct (inlet).
3. Disconnect EVAP canister purge volume control solenoid valve harness connector and mass air flow sensor 1 harness connector.
4. Remove air inlet pipe from air cleaner case.
5. Remove air cleaner case assembly.

INSTALLATION

- Install in the reverse order of removal.

CHARGE AIR COOLER

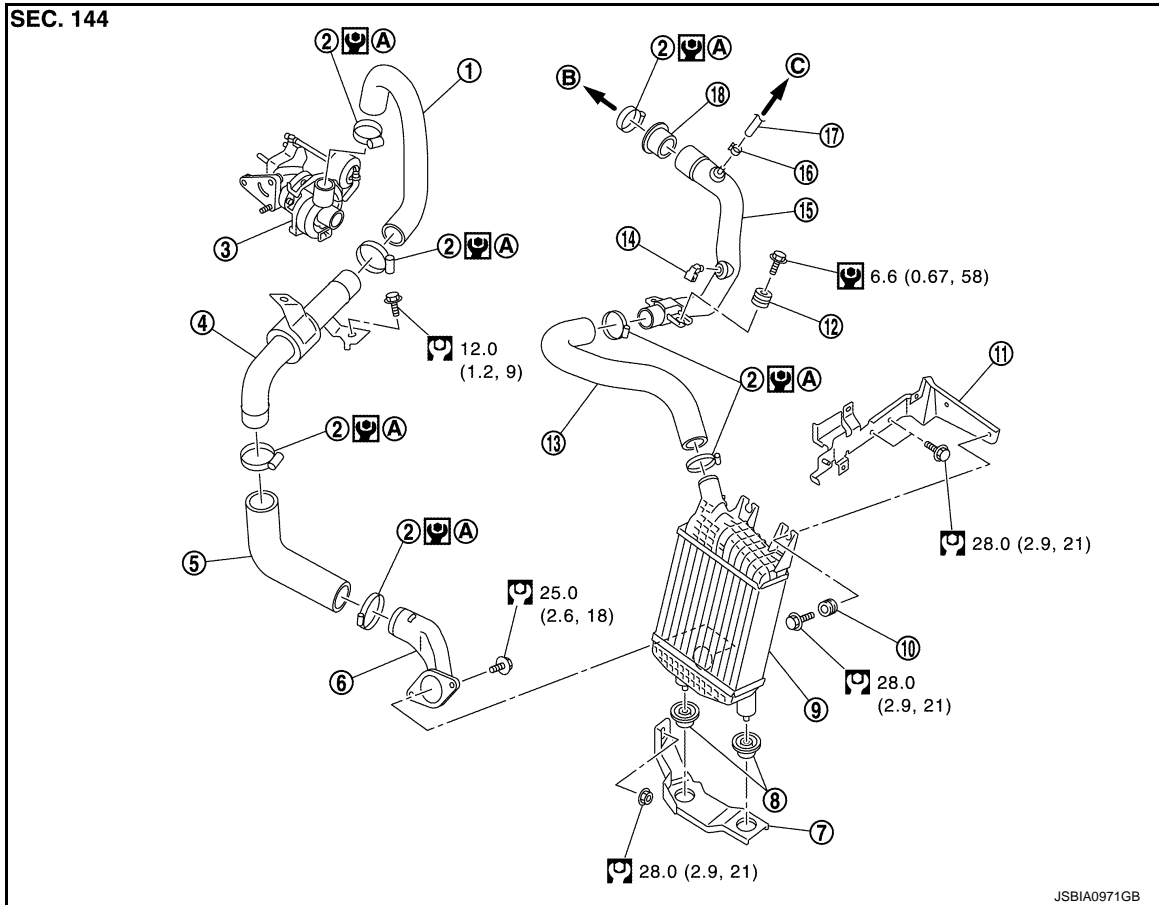
< REMOVAL AND INSTALLATION >

[K9K]

CHARGE AIR COOLER

Exploded View

INFOID:000000006659411



- | | | |
|--------------------------------------|--|----------------------|
| 1. Air inlet hose | 2. Clamp | 3. Turbocharger |
| 4. Air inlet tube | 5. Air inlet hose | 6. Air inlet tube |
| 7. Charge air cooler bracket (lower) | 8. Mounting rubber | 9. Charge air cooler |
| 10. Retainer | 11. Charge air cooler bracket (upper) | 12. Retainer |
| 13. Air inlet hose | 14. Mass air flow sensor 2 (Turbocharger air temperature sensor) | 15. Air inlet tube |
| 16. Clamp | 17. Electric throttle control actuator hose | 18. Insulator rubber |
- A. 1st step: 5.0 N·m (0.51 kg·m, 44 ft·lb)
2nd step: 7.0 N·m (0.71 kg·m, 62 ft·lb)
- B. To EGR valve
- C. To turbocharger boost sensor

: N·m (kg·m, ft·lb)

: N·m (kg·m, in·lb)

Removal and Installation

INFOID:000000006659412

REMOVAL

1. Remove front bumper. Refer to [EXT-12, "Exploded View"](#).
2. Remove air inlet hose between air inlet tube and charge air cooler.
3. Remove air inlet tube between air inlet hose and charge air cooler.

CHARGE AIR COOLER

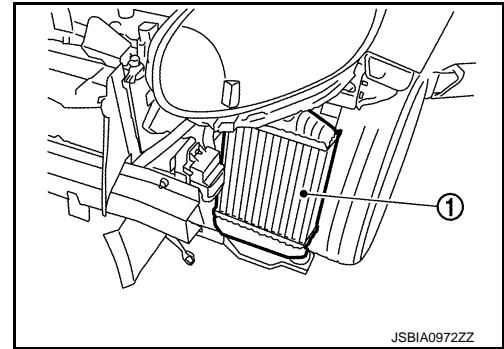
[K9K]

< REMOVAL AND INSTALLATION >

4. Remove charge air cooler (1).

CAUTION:

- Avoid interference between the charge air cooler and radiator.
- When removing charge air cooler, close opening on turbo charger and intake manifold with shop cloth or other suitable material.



INSTALLATION

Install in the reverse order of removal paying attention to the following points:

- Apply a neutral detergent (fluid) to the joint between hoses and pipes (oil is not permissible).
- Pay attention to identification mark and direction.
- When installing air inlet hoses and tubes. Refer to [EM-304, "Removal and Installation"](#).

Inspection

INFOID:000000006659413

INSPECTION AFTER REMOVAL

1. Check that the charge air cooler is not full of oil. In that case, clean it with cleaning agent and then let it dry.
2. Check air passages of charge air cooler core and fins for clogging, leaks or deformation. Clean or replace charge air cooler in necessary.
 - Be careful not to deform core fins.
 - For cleaning procedure of charge air cooler core, refer to [CO-60, "Inspection"](#).

EGR VALVE

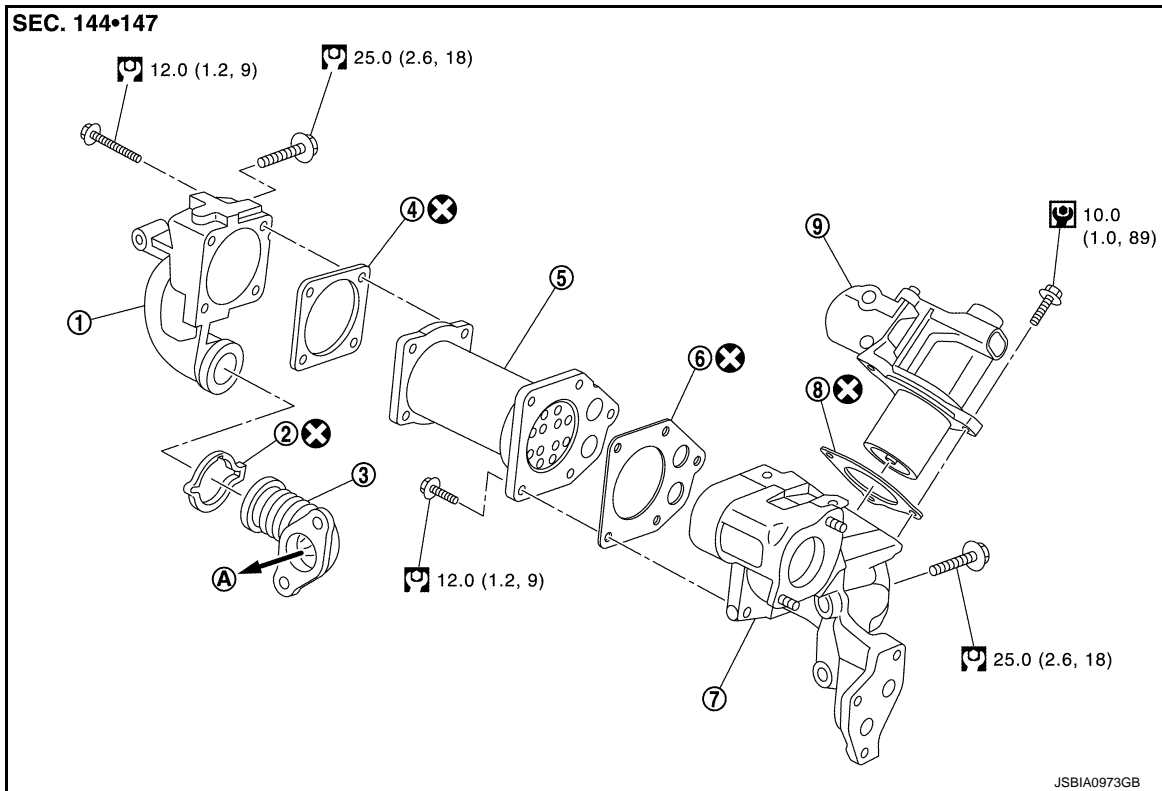
< REMOVAL AND INSTALLATION >

[K9K]

EGR VALVE

Exploded View

INFOID:000000006659414



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|-------------------------------------|---------------|-----------------------------|
| 1. EGR tube | 2. Clamp | 3. EGR tube |
| 4. Gasket | 5. EGR cooler | 6. Gasket |
| 7. EGR volume control valve housing | 8. Gasket | 9. EGR volume control valve |
- A. To exhaust manifold

: N·m (kg-m, ft-lb)

: N·m (kg-m, in-lb)

: Always replace after every disassembly.

Removal and Installation

INFOID:000000006659415

REMOVAL

1. Drain engine coolant. Refer to [CO-63, "Draining"](#).
2. Remove engine cover. Refer to [EM-302, "Exploded View"](#).
3. Remove air duct (inlet). Refer to [EM-303, "Exploded View"](#).
4. Remove air cleaner case. Refer to [EM-303, "Exploded View"](#).
5. Remove air cleaner mount bracket. Refer to [EM-303, "Exploded View"](#).
6. Remove fender protector RH. Refer to [EXT-20, "FENDER PROTECTOR : Exploded View"](#).
7. Remove battery and battery tray. Refer to [PG-284, "FOR MAINTENANCE REQUIRED BATTERY MODELS : Exploded View"](#).
8. Disconnect intake air temperature sensor connector.
9. Remove reservoir tank. Refer to [CO-67, "Exploded View"](#).
10. Remove air inlet hose. Refer to [EM-304, "Exploded View"](#).
11. Remove air inlet tube. Refer to [EM-304, "Exploded View"](#).

EGR VALVE

[K9K]

< REMOVAL AND INSTALLATION >

12. Remove EGR volume control valve.
13. Remove EGR inlet tube.
14. Remove EGR volume control valve housing.
15. Remove EGR cooler.

INSTALLATION

- Install in the reverse order of removal.

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TURBOCHARGER

[K9K]

< REMOVAL AND INSTALLATION >

8. Remove EGR cooler. Refer to [EM-306. "Exploded View"](#).
9. Remove oil return pipe.
10. Remove turbocharger assembly.

NOTE:

After applying penetrative lubricant to the mounting nuts, check for the penetration of the lubricant, and then loosen the nuts to remove.

CAUTION:

Be careful not to deform each turbocharger piping when pulling out the assembly.

INSTALLATION

Install in the reverse order of removal.

NOTE:

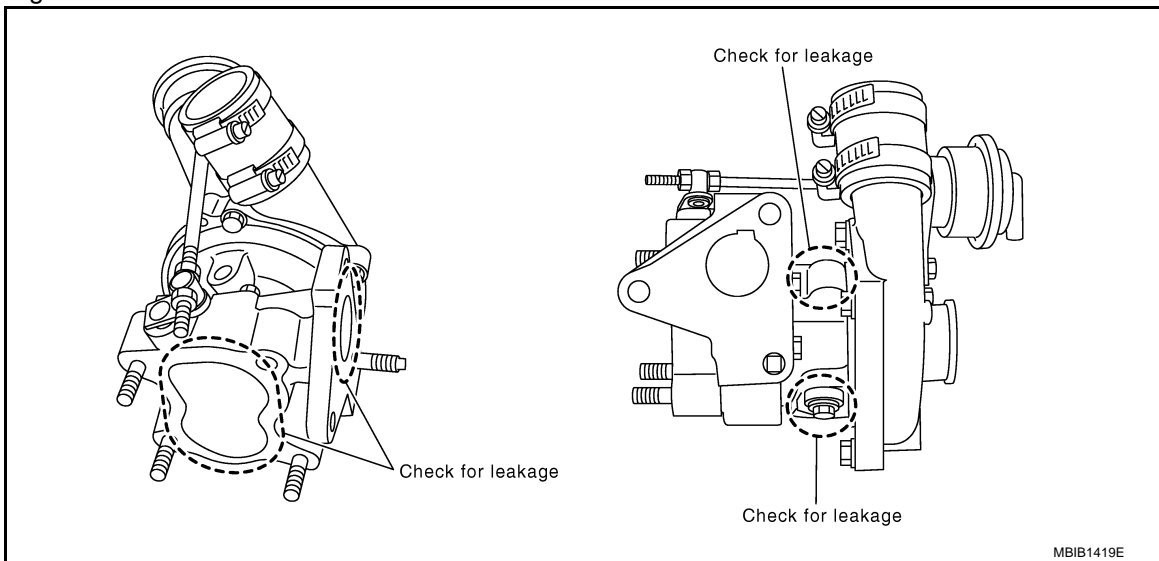
Apply LOCTITE FRENETANCH or equivalent to the threads of the turbocharger oil inlet pipe union to the cylinder head.

Inspection

INFOID:000000006659418

INSPECTION AFTER REMOVAL

Turbocharger



CAUTION:

When the compressor wheel, turbine wheel or rotor shaft is damaged, remove all the fragments and foreign matter left in the following passages in order to prevent a secondary failure:

Suction side : Between turbocharger and air cleaner

Exhaust side : Between turbocharger and outlet duct

INSPECTION AFTER INSTALLATION

Start engine and raise engine speed to check no exhaust emission leaks.

EXHAUST MANIFOLD

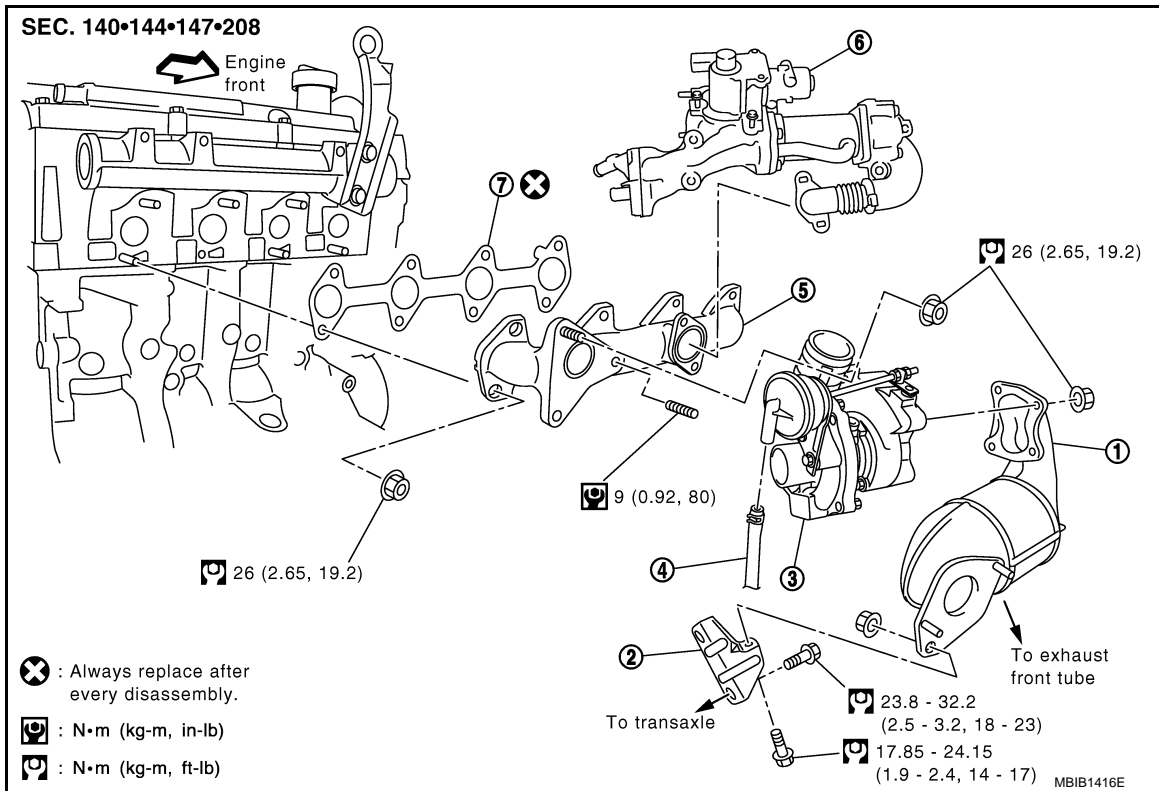
< REMOVAL AND INSTALLATION >

[K9K]

EXHAUST MANIFOLD

Exploded View

INFOID:000000006659419



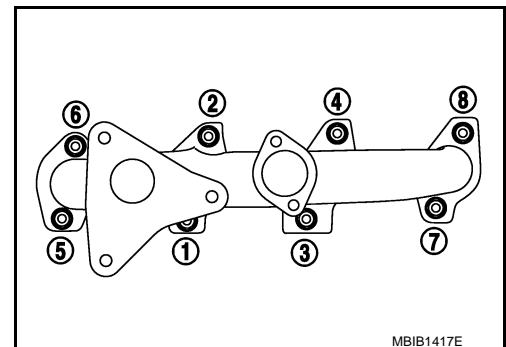
1. Catalyst
2. Bracket
3. Turbocharger assembly
4. Hose
5. Exhaust manifold
6. EGR unit
7. Gasket

Removal and Installation

INFOID:000000006659420

REMOVAL

1. Remove turbocharger assembly. Refer to [EM-308. "Exploded View"](#).
2. Loosen exhaust manifold mounting nuts in the reverse order as shown.



3. Remove exhaust manifold.

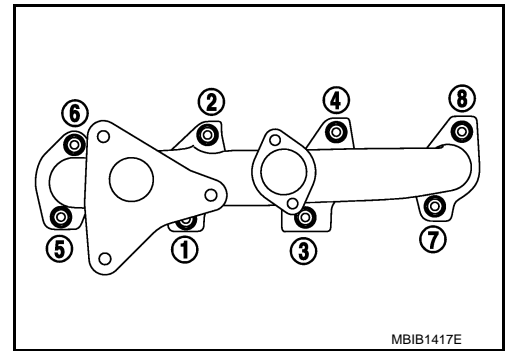
INSTALLATION

EXHAUST MANIFOLD

< REMOVAL AND INSTALLATION >

[K9K]

1. Tighten the mounting nuts in numerical order as shown.



2. Install in reverse order of removal after this step.

Inspection

INFOID:000000006659421

INSPECTION AFTER INSTALLATION

Start engine and raise engine speed to check no exhaust emission leaks.

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OIL PAN

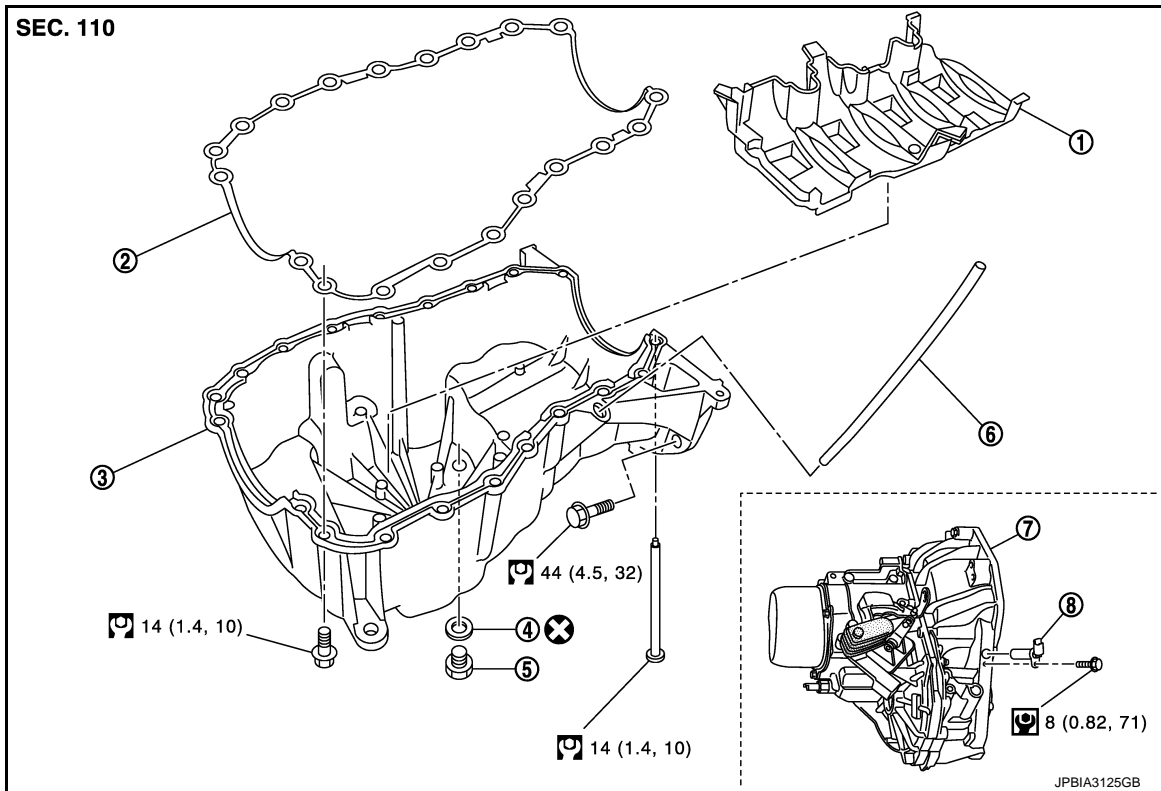
< REMOVAL AND INSTALLATION >

[K9K]

OIL PAN

Exploded View

INFOID:000000006659422



- | | | |
|-----------------|-------------------------------------|--------------------------|
| 1. Baffle plate | 2. Gasket | 3. Oil pan |
| 4. O-ring | 5. Drain plug | 6. Oil level gauge guide |
| 7. Transaxle | 8. Crankshaft position sensor (POS) | |

: N·m (kg·m, ft·lb)

: N·m (kg·m, in·lb)

: Always replace after every disassembly.

Removal and Installation

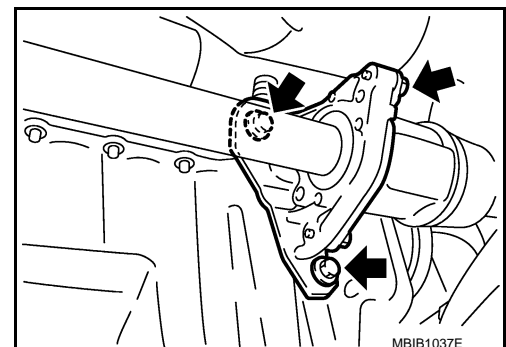
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REMOVAL

CAUTION:

Never drain engine oil when the engine is hot to avoid the danger of being scalded.

1. Remove RH front wheel. Refer to [WT-6, "Exploded View"](#).
2. Remove fender protector RH. Refer to [EXT-20, "FENDER PROTECTOR : Exploded View"](#).
3. Remove engine mounting bracket. Refer to [EM-348, "Exploded View"](#).
4. Remove center bearing bracket as shown. Refer to [FAX-53, "Exploded View"](#).

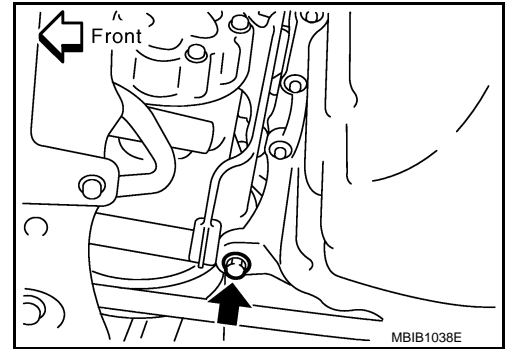


OIL PAN

[K9K]

< REMOVAL AND INSTALLATION >

5. Remove A/C compressor bracket mounting bolt as shown. Refer to [CHG-44, "K9K : Exploded View"](#).

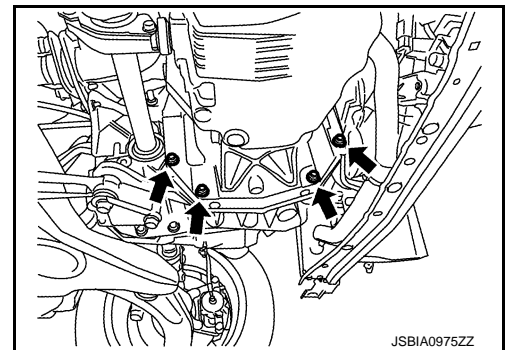


6. Remove oil level gauge guide. Refer to [EM-318, "Exploded View"](#).
7. Drain engine oil. Refer to [LU-24, "Draining"](#).

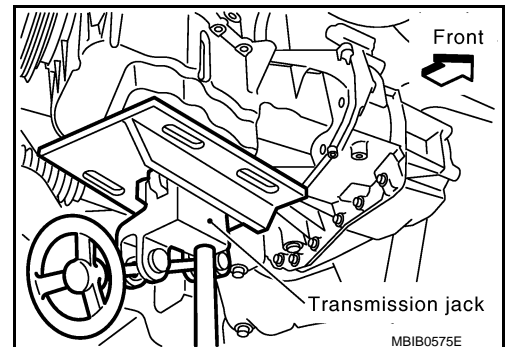
CAUTION:

Perform when engine is cold.

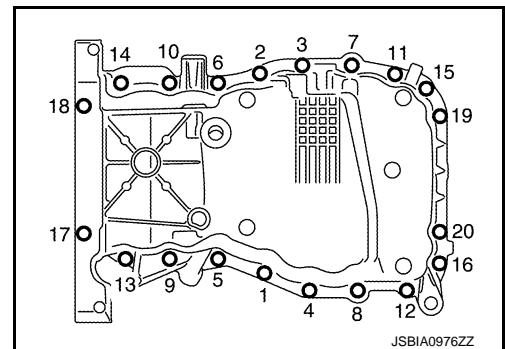
8. Remove oil pan and transaxle joint bolts.



9. Support the engine bottom of the oil pan with a transmission jack etc.



10. Remove oil pan bolt reverse order as shown.



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OIL PAN

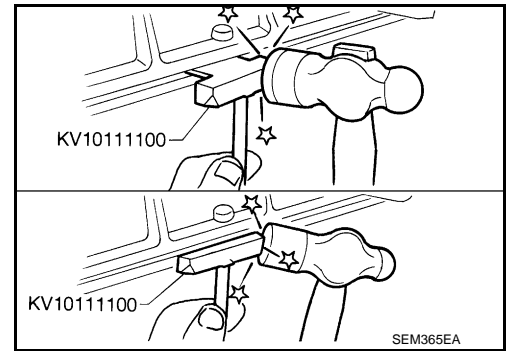
[K9K]

< REMOVAL AND INSTALLATION >

- Insert seal cutter (special service tool) between upper oil pan and cylinder block. Slide tool by tapping on the side of the tool with a hammer.

CAUTION:

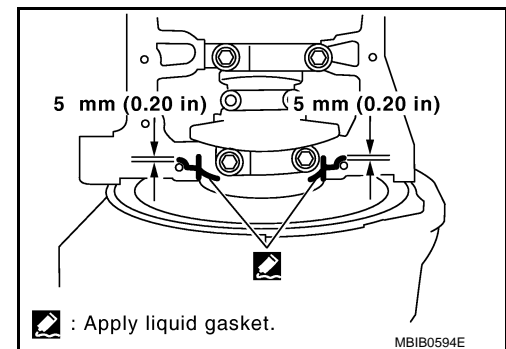
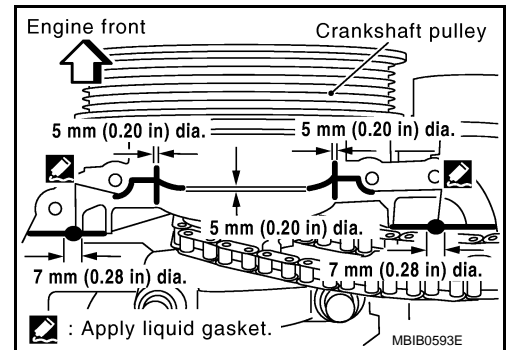
Exercise care not to damage mating surface.



11. Remove oil pan and baffle plate.

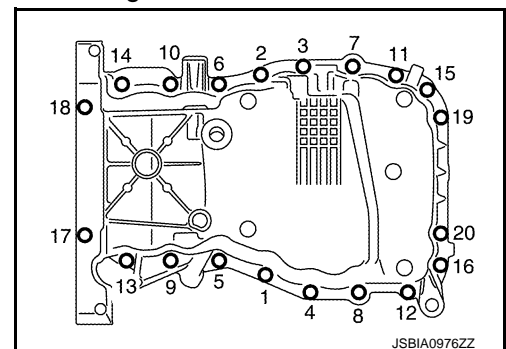
INSTALLATION

- Install in the reverse order of removal paying attention to the following.
1. Apply liquid gasket as shown.
 - Use Genuine Liquid Gasket or equivalent.



2. Install baffle plate.
3. Install oil pan.
 - Tighten the mounting bolts of oil pan on the clutch housing without locking.
 - Tighten the bolts in the numerical order shown in the figure.

 : 14 N·m (1.4 kg-m, 10 ft-lb)



- Tighten the mounting bolts of oil pan on the clutch housing.

 : 44 N·m (4.5 kg-m, 10 ft-lb)

4. At least 30 minutes after oil pan is installed, pour engine oil.

OIL PAN

< REMOVAL AND INSTALLATION >

[K9K]

Inspection

INFOID:000000006659424

A

INSPECTION AFTER REMOVAL

Clean oil pump assembly if any object attached.

INSPECTION AFTER INSTALLATION

- Inspection the engine oil level. Refer to [LU-23, "Inspection"](#).
- Start the engine, and make sure there is no leak of engine oil. Refer to [LU-23, "Inspection"](#).

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GLOW PLUG

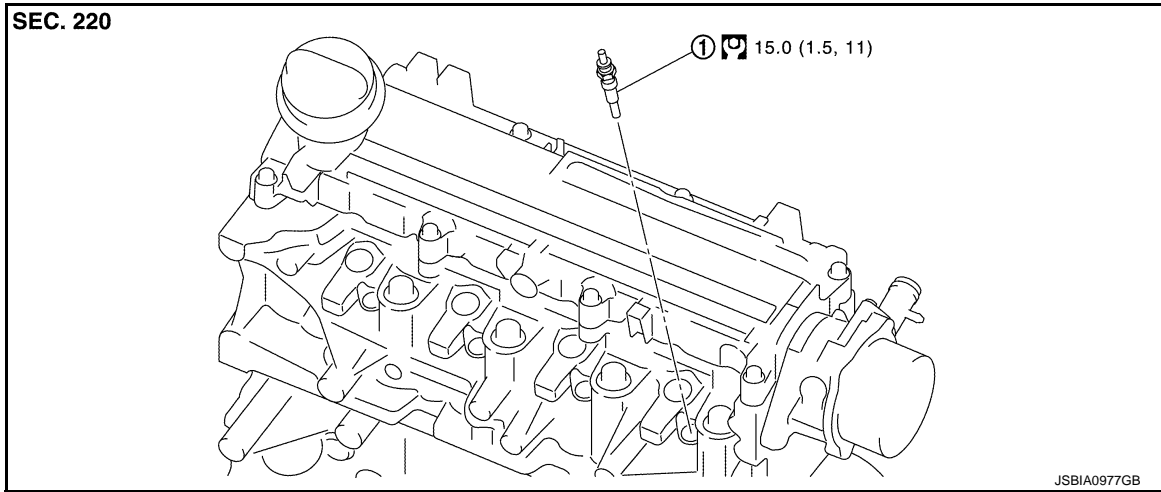
< REMOVAL AND INSTALLATION >

[K9K]


GLOW PLUG

Exploded View

INFOID:000000006659425



1. Glow plug

 : N·m (kg-m, ft-lb)

Removal and Installation

INFOID:000000006659426

REMOVAL

CAUTION:

Remove glow plug only if necessary. If carbon adheres, it may be stuck and broken.

1. Remove engine cover. Refer to [EM-302, "Exploded View"](#).
2. Remove air duct (inlet). Refer to [EM-303, "Exploded View"](#).
3. Remove air cleaner case. Refer to [EM-303, "Exploded View"](#).
4. Disconnect the battery cable from the negative terminal.
5. Disconnect harness connector from glow plug.
6. Remove glow plug.

CAUTION:

- **When removing or installing, never use such tools as an air impact wrench.**
- **Handle it carefully without giving any impact, even after removal. [As a guide, if it drops from height of 10 cm (3.94 in) or higher, always replace it.]**

INSTALLATION

1. Remove adhered carbon from glow plug installation hole with a reamer.
2. Install glow plug.
3. Install remaining parts in reverse order of removal.

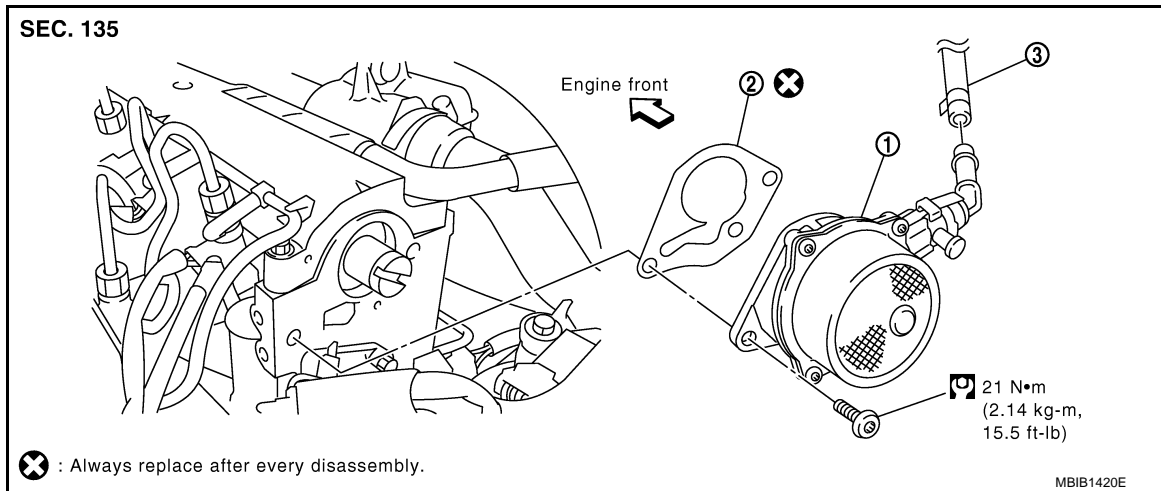
VACUUM PUMP

< REMOVAL AND INSTALLATION >

[K9K]

VACUUM PUMP

Exploded View



1. Vacuum pump
2. Gasket
3. Vacuum hose

Removal and Installation

INFOID:000000006659428

REMOVAL

1. Remove engine cover. Refer to [EM-302, "Exploded View"](#).
2. Remove air duct (inlet). Refer to [EM-303, "Exploded View"](#).
3. Remove air cleaner case. Refer to [EM-303, "Exploded View"](#).
4. Disconnect vacuum hose from vacuum pump side.
5. Remove air cleaner case bracket. Refer to [EM-303, "Exploded View"](#).
6. Remove battery and battery tray. Refer to [PG-284, "FOR MAINTENANCE REQUIRED BATTERY MOD-ELS : Exploded View"](#).
7. Remove vacuum pump.

INSTALLATION

Install in the reverse order of removal.

Inspection

INFOID:000000006659429

INSPECTION BEFORE REMOVAL

1. Disconnect vacuum hose, and connect a vacuum gauge via 3-way connector.
 - Disconnect point where vacuum from vacuum pump can be measured directly and install 3-way connector.
2. Start engine and measure generated vacuum at idle speed.

Standard : -86.6 to -101.3 kPa (-866 to -1,013 mbar, -650 to -760 mmHg, -25.59 to -29.92 inHg)

INJECTION TUBE AND FUEL INJECTOR

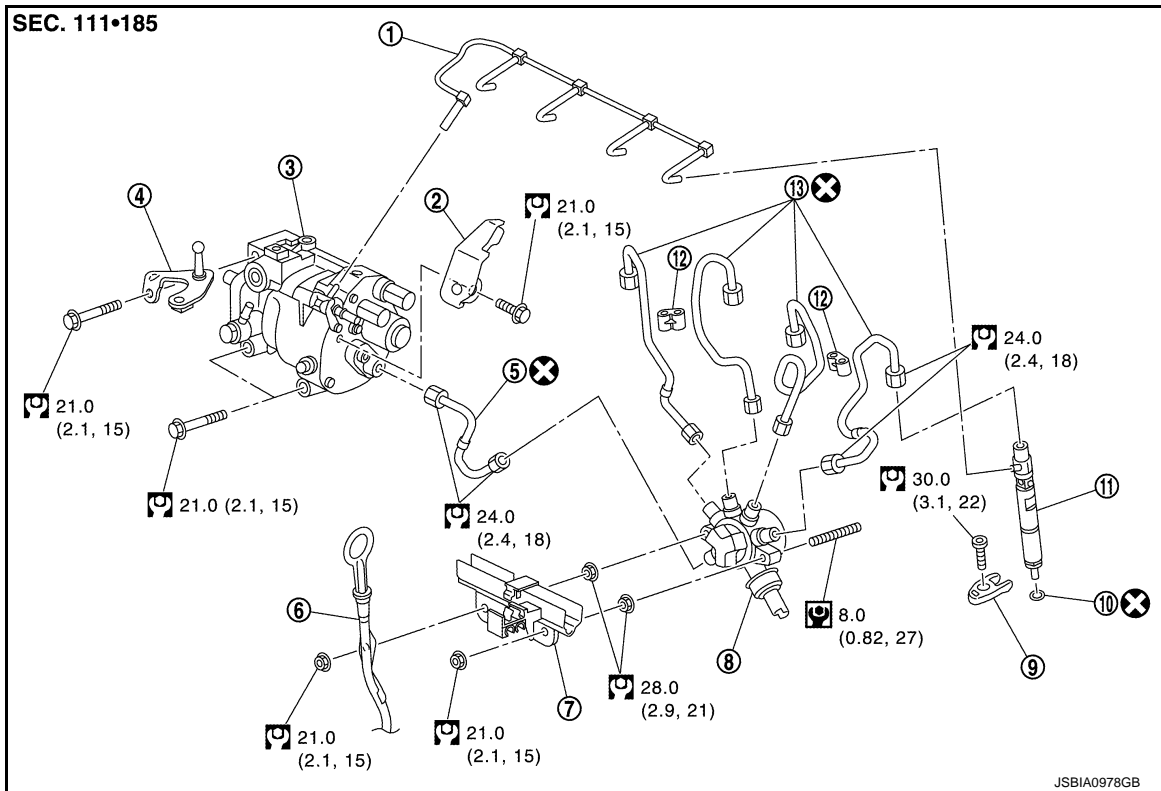
< REMOVAL AND INSTALLATION >

[K9K]

INJECTION TUBE AND FUEL INJECTOR

Exploded View

INFOID:000000006659430



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|---------------------------------------|-----------------------------------|------------------------------|
| 1. Spill hose | 2. High pressure protection cover | 3. High pressure supply pump |
| 4. Air cleaner case bracket | 5. Injector tube | 6. Oil level gauge guide |
| 7. Glow plug harness protection cover | 8. Fuel rail | 9. Fuel injector bracket |
| 10. Heat protection washer | 11. Fuel injector | 12. Injector tube bracket |
| 13. Injection tube | | |

: N-m (kg-m, ft-lb)

: N-m (kg-m, in-lb)

: Always replace after every disassembly.

Removal and Installation

INFOID:000000006659431

REMOVAL

CAUTION:

- Be sure to read "Precautions for Diesel Equipment". Refer to [EM-285, "Precaution for Diesel Equipment"](#).
- Wait until the fuel temperature drops before carrying out any work.
- Order the special high pressure injection circuit plug kit.
- It is forbidden to open an injector. If you open an injector by mistake, you will have to change it. This is because of the manufacturing and installation tolerances and because there is a risk of contaminating the inside of the injector.
- The rod filter of the injector must not be removed.

NOTE:

It is possible to replace a single injection tube.

1. Disconnect the battery cable from negative terminal.
2. Remove oil level gauge guide and plug the hole.
3. Remove glow plug harness protection cover.

INJECTION TUBE AND FUEL INJECTOR

[K9K]

< REMOVAL AND INSTALLATION >

4. Remove the neck located on the fuel rail.

NOTE:

Undo the nut on the pump side or the injector side, then the nut located on the rail side. Undo the nuts for each pipe in turn. Move the nut along the pipe keeping the olive in contact with the taper.

5. Remove all the injection tubes.
6. Plug all the holes in the injection circuit.
7. Remove fuel rail.
8. Manually remove the spill hose.

CAUTION:

Do not force on the diesel injector return hose

9. Plug all the holes of the injection circuit.
10. Disconnect the injector harness connector.
11. Unscrew the injector bracket.
12. Remove the injector.
13. Pull off the flame shield washer.

INSTALLATION

CAUTION:

All the injection tubes removed must be systematically replaced.

1. Clean the injector sockets and the injector bodies, as well as their brackets using a lint-free cloth (use the wipes recommended for this purpose, dipped in clean solvent).
2. Dry off using a different new wipe.
3. Replace the flame shield washer with a new one.
4. Position the injector.
5. Tighten its mounting bracket.

 **30.0 N·m (3.1 kg·m, 22 ft·lb)**

6. Install injection tubes with new one.
7. Finger tightens the nuts.
8. Before fitting the new injection tubes, lightly lubricate the nut threads with the oil from the sachet provided in the new parts kit.

NOTE:

Fit the pump/rail pipe before the rail/injector tubes.

9. Fit the pump-rail injection tube as follow:
 - Remove the protective plugs from the high pressure pump outlet, the high pressure rail inlet and the pipe.
 - Insert the injection tube olive into the taper of the high pressure pump outlet,
 - Insert the injection tube olive into the taper of the high pressure rail inlet.
 - Finger tighten the nuts of the injection tube starting with the one located on the rail side.
10. Install the rail-injector injection tube.
11. Tighten the injection tube nut.

 **24.0 N·m (2.4 kg·m, 18 ft·lb)**

12. Connect fuel return pipe.
13. Install in the reverse order to removal for the other refitting operations.

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HIGH PRESSURE SUPPLY PUMP

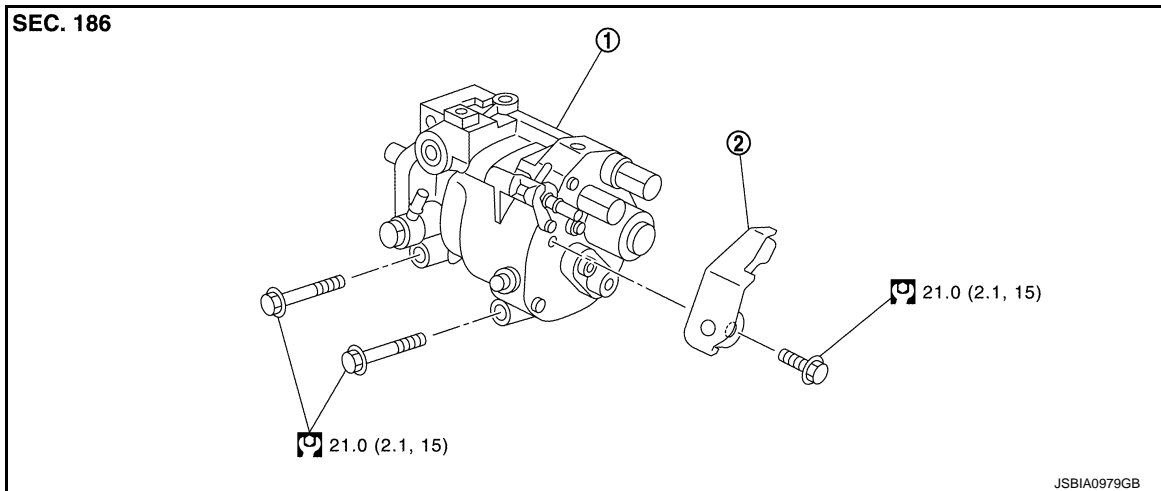
< REMOVAL AND INSTALLATION >

[K9K]

HIGH PRESSURE SUPPLY PUMP

Exploded View

INFOID:000000006659434



1. High pressure supply pump protector
2. High pressure supply pump

: N-m (kg-m, ft-lb)

Removal and Installation

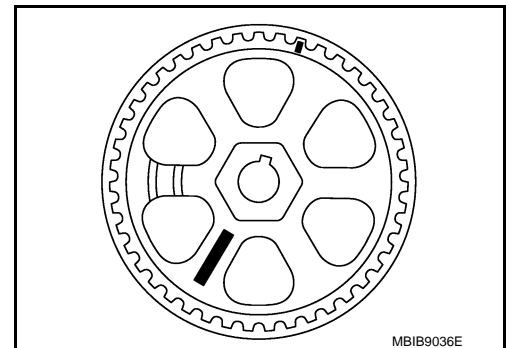
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REMOVAL

CAUTION:

- Be sure to read "Precautions for Diesel Equipment". Refer to [EM-285, "Precaution for Diesel Equipment"](#).
- Wait until the fuel temperature drops before carrying out any work.
- Order the special high pressure injection circuit plug kit.
- In case of the replacement of the high pressure supply pump sprocket, please apply the following tightening torque:

: 70.0 N-m (7.1 kg-m, 52 ft-lb)



1. Remove engine cover. Refer to [EM-302, "Exploded View"](#).
2. Remove air duct (inlet). Refer to [EM-303, "Exploded View"](#).
3. Remove air cleaner case. Refer to [EM-303, "Exploded View"](#).
4. Disconnect the battery cable from the negative terminal.
5. Remove the timing belt. Refer to [EM-324, "Exploded View"](#).
6. Remove the neck located on the fuel rail. Refer to [EM-318, "Exploded View"](#).
7. Remove the oil level gauge guide and plug the hole. Refer to [EM-318, "Exploded View"](#).
8. Remove high pressure protection cover. Refer to [EM-318, "Exploded View"](#).
9. Carefully disconnect:
 - The connectors from the flow actuator,
 - The connectors from the fuel temperature sensor,
 - On the pump, the fuel supply and return pipes.

HIGH PRESSURE SUPPLY PUMP

[K9K]

< REMOVAL AND INSTALLATION >

- The return pipe connecting the injectors with the pump.
10. Remove the injection tube connecting the pump to the rail. Refer to [EM-318, "Exploded View"](#).
 11. Plug all the holes of the injection circuit.
 12. Remove the three mounting bolts from the high pressure supply pump then remove it.

INSTALLATION

1. Install the pump then position the mounting bolts without tightening them.
2. Before fitting the new injection tube, lightly lubricate the nut threads with the oil from the sachet provided in the new parts kit.
3. Refit the injection tube, to do this:
 - remove the protective plugs,
 - insert the injection tube olive into the taper of the high pressure pump outlet,
 - insert the injection tube olive into the taper of the high pressure rail inlet.
4. Finger tighten the nuts of the injection tube starting with the one located on the rail side.
5. Tighten the mounting bolts on the high pressure pump.

 **21.0 N-m (2.1 kg-m, 15 ft-lb)**

6. Tighten the injection tube nut.

 **24.0 N-m (2.4 kg-m, 18 ft-lb)**

7. Refit high pressure supply pump protector.

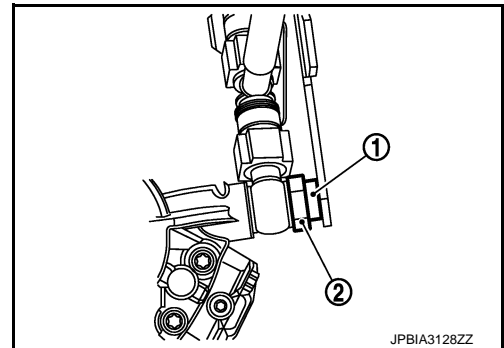
CAUTION:

When refitting high pressure supply pump protector, follow steps below.

- Be sure disk rubber (1) is touching bolt head of high pressure supply pump (2) as shown in the figure.
- Tighten bolt with holding protector towards to high pressure supply pump.

 **21.0 N-m (2.1 kg-m, 15 ft-lb)**

- Make sure disk rubber (1) is touching with bolt head of high pressure supply pump (2).



8. Refit in the reverse order to removal for the other refitting operations.
9. Test the sealing of the high pressure after it has been repaired (refer to "SPECIAL FEATURES" in [EM-285, "Precaution for Diesel Equipment"](#)).

ROCKER COVER

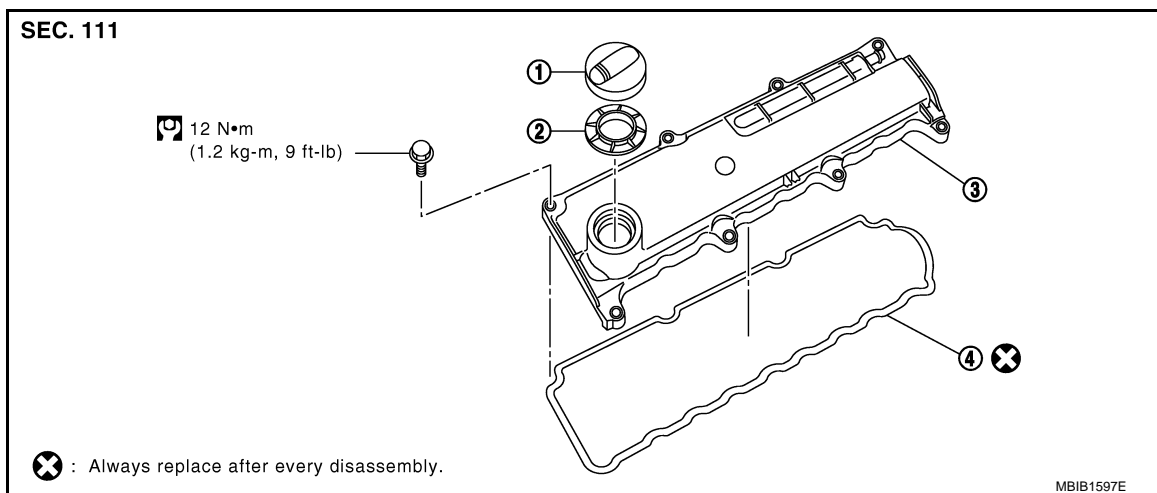
< REMOVAL AND INSTALLATION >

[K9K]

ROCKER COVER

Exploded View

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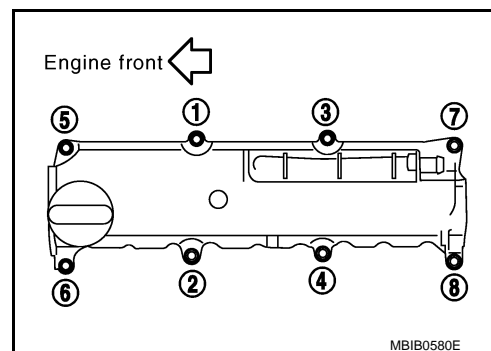
1. Oil filler cap
2. Oil catcher
3. Rocker cover
4. Gasket

Removal and Installation

INFOID:000000006659437

REMOVAL

1. Remove engine cover. Refer to [EM-302, "Exploded View"](#).
2. Remove air duct (inlet). Refer to [EM-303, "Exploded View"](#).
3. Remove air cleaner case. Refer to [EM-303, "Exploded View"](#).
4. Remove fuel return hose.
5. Remove rocker cover.
 - Loosen holding bolts in the reverse order as shown in the figure and remove.



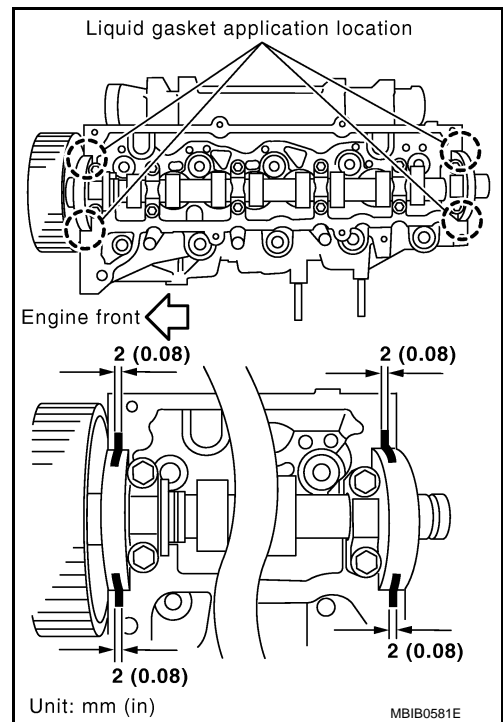
INSTALLATION

ROCKER COVER

[K9K]

< REMOVAL AND INSTALLATION >

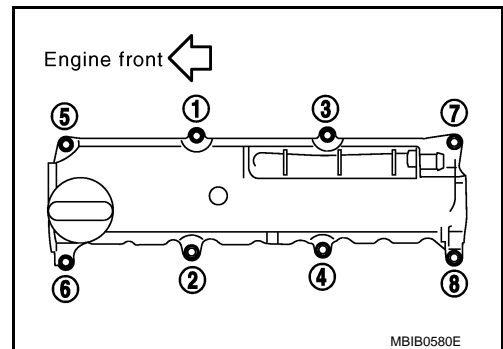
1. Apply liquid gasket on locations shown in the figure.
 - Use Genuine Liquid gasket or equivalent.



2. Tighten holding bolts in the numerical order as shown in the figure.

: 12 N·m (1.2 kg·m, 9 ft·lb)

3. Install in the reverse order of removal after this steps.



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TIMING BELT

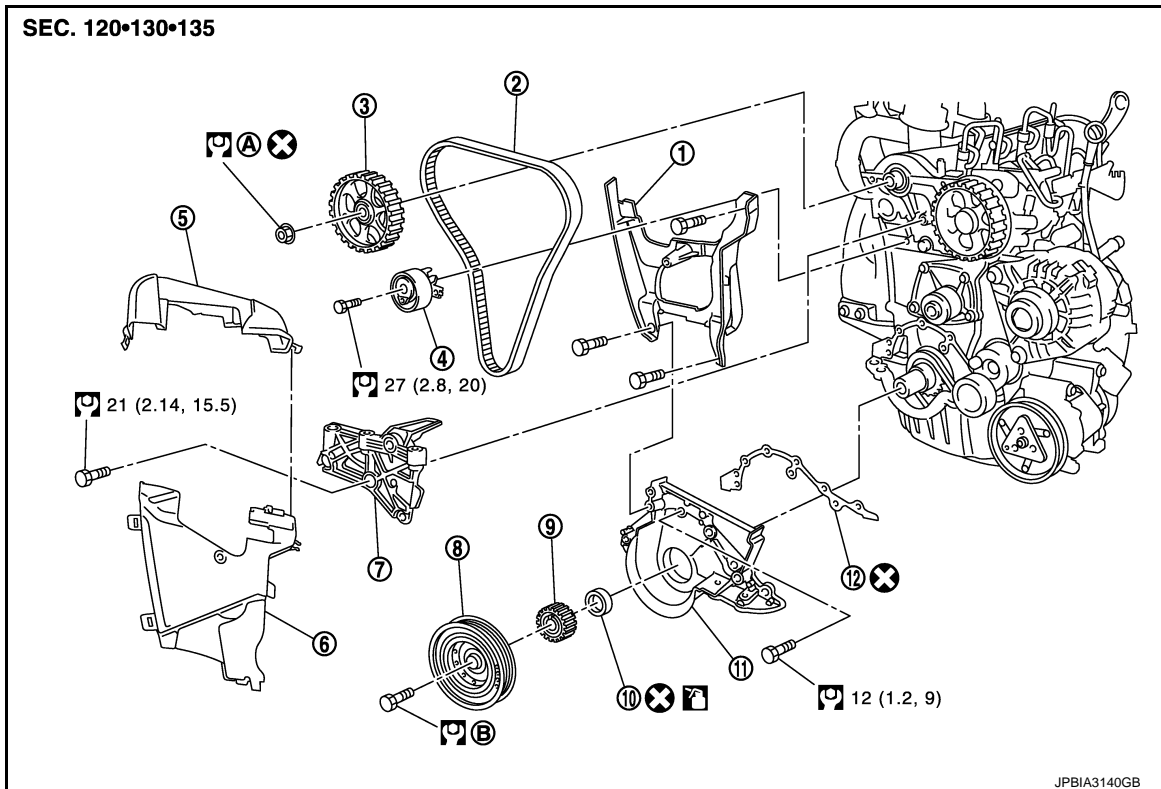
< REMOVAL AND INSTALLATION >

[K9K]

TIMING BELT

Exploded View

INFOID:000000006659438



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| 1. Timing belt inner cover | 2. Timing belt | 3. Camshaft sprocket |
| 4. Timing belt tensioner | 5. Timing belt upper cover | 6. Timing belt lower cover |
| 7. Cylinder head suspended bracket | 8. Crankshaft pulley | 9. Crankshaft sprocket |
| 10. Rear oil seal | 11. Rear oil seal retainer | 12. Gasket |

Comply with the assembly procedure when tightening. Refer to [EM-333](#)

Comply with the assembly procedure when tightening. Refer to [EM-324](#)

: N·m (kg-m, ft-lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

Removal and Installation

INFOID:000000006659439

CAUTION:

- Apply new engine oil to parts marked in illustration before installation.
- Replace any belt that has been removed.
- Never turn the engine in the direction opposite to that of normal operation.
- When replacing the timing belt, be sure to replace the timing belt tensioner.
- Never run the engine without the drive belts to avoid damaging the crankshaft pulley.

REMOVAL

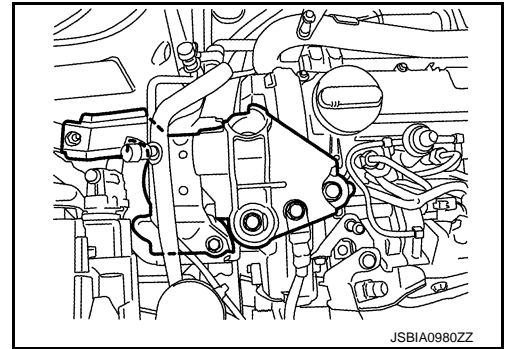
1. Disconnect battery cable from the negative terminal.
2. Remove engine cover. Refer to [EM-302. "Exploded View"](#)
3. Remove front wheel RH.
4. Remove fender protector RH. Refer to [EXT-20. "FENDER PROTECTOR : Exploded View"](#)
5. Remove drive belt, and auto-tensioner. Refer to [EM-298. "Removal and Installation"](#).

TIMING BELT

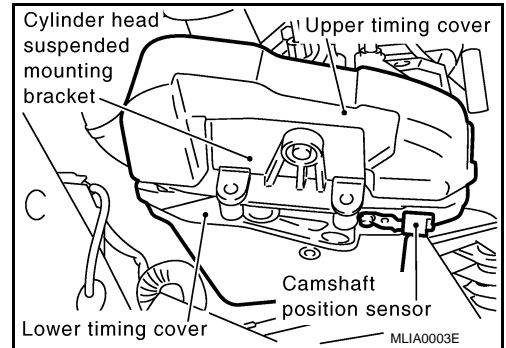
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< REMOVAL AND INSTALLATION >

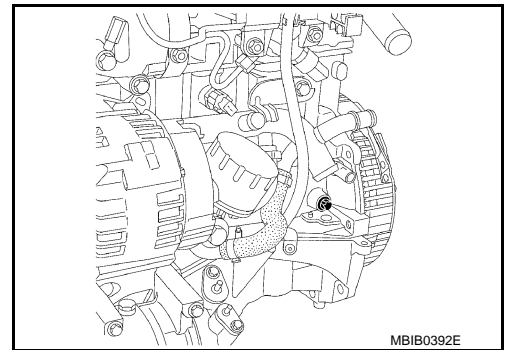
6. Remove engine mounting insulator (RH) .



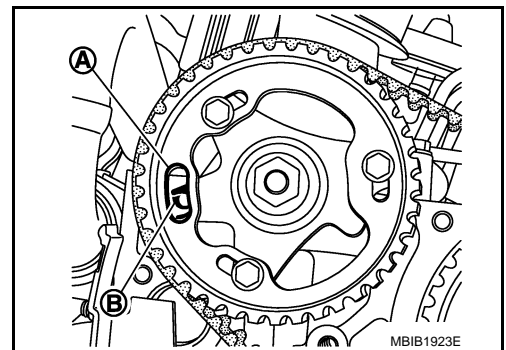
7. Remove upper timing cover, camshaft position sensor and cylinder head suspended mounting bracket.



8. Remove timing belt lower cover.
9. Remove the TDC pin bolt.



10. Rotate the crankshaft clockwise, until the position (A) of the camshaft pulley becomes opposite of the position (B) on the cylinder head.



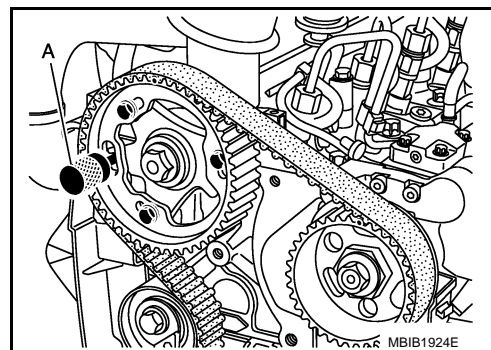
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TIMING BELT

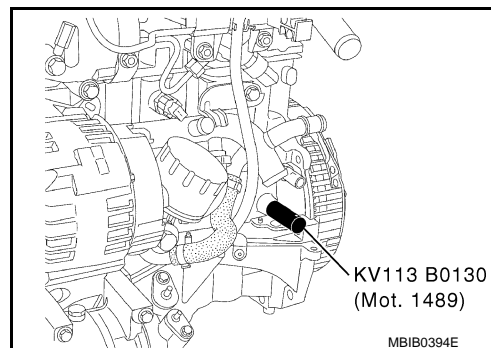
[K9K]

< REMOVAL AND INSTALLATION >

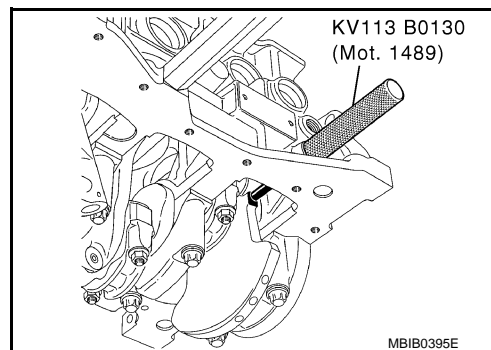
11. Insert TDC set pin [SST: KV113B0110 (Mot. 1430)] (A) into the camshaft pulley and cylinder head hole.



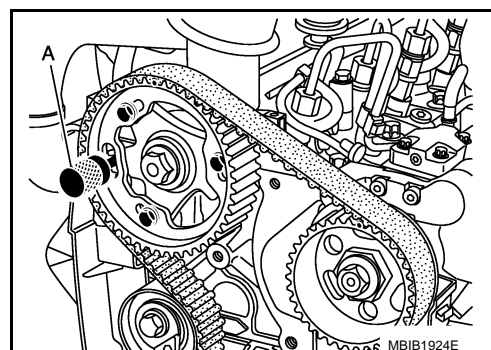
12. Screw in the TDC pin (special service tool).



13. Turn the engine clockwise (timing side) until the crankshaft reaches the TDC pin (special service tool).



14. The pin [SST: KV113B0110 (Mot. 1430)] (A) must engage in the camshaft pulley and cylinder head holes.

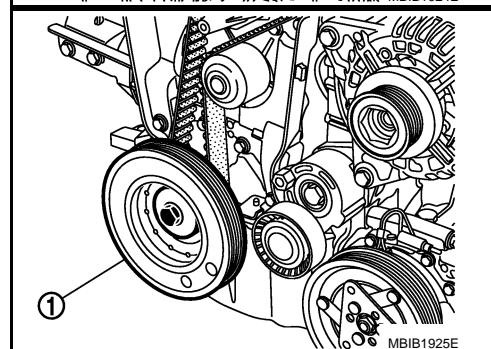


15. Insert flat-bladed screwdriver into the place of crankshaft position sensor to block crankshaft and loosen crankshaft pulley bolt (1).

16. Remove crankshaft pulley.

CAUTION:

Never remove fixing bolts. Keep loosened fixing bolts in place to protect removed crankshaft pulley from dropping.

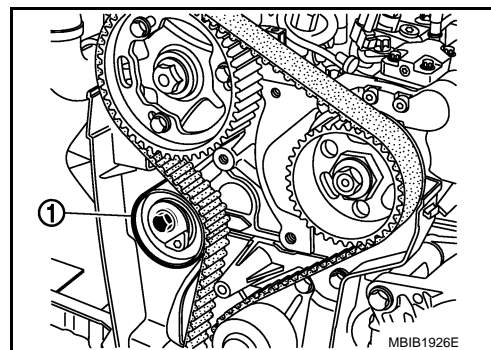


TIMING BELT

[K9K]

< REMOVAL AND INSTALLATION >

17. Slacken the timing belt by loosening the bolt of tensioner (1), then remove timing belt.



INSTALLATION

Install in the reverse order of removal paying attention to the following.

TIMING ADJUSTMENT

CAUTION:

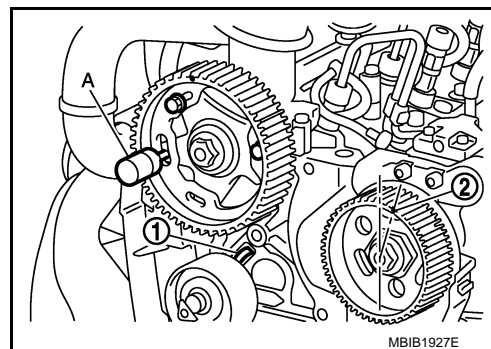
It is essential to degrease the end of the crankshaft, the bore of the crankshaft sprocket and the bearing faces of the drive belt pulley to prevent any slip between the timing and the crankshaft which would risk destroying the engine.

1. Install timing belt tensioner.

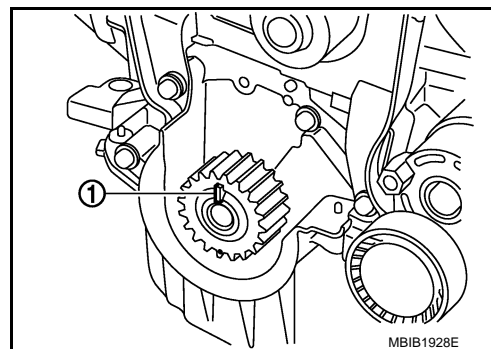
NOTE:

Put the timing belt tensioner spigot (1) in the cylinder head groove.

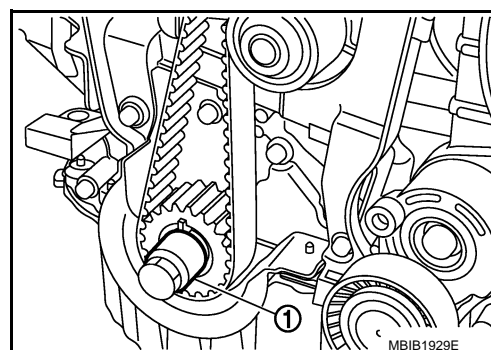
2. Insert Tool KV113B0110 (Mot. 1430) (A) in the camshaft pulley and cylinder head holes.
3. Check that the mark on the high pressure pump pulley (2) has shifted one tooth to the right of vertical axle.



4. Turn crankshaft to set Tool KV113B0130 (Mot. 1489) (the crankshaft groove (1) must be facing upwards).



5. Tighten old crankshaft pulley bolt with a spacer (1) (which does not cover the timing sprocket mark).



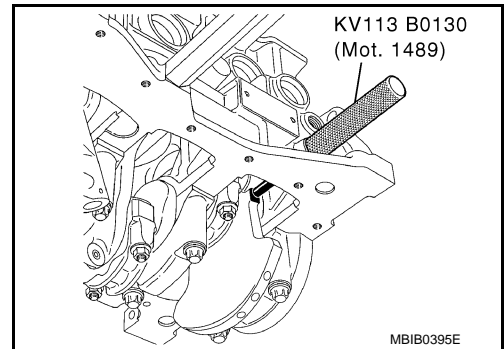
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TIMING BELT

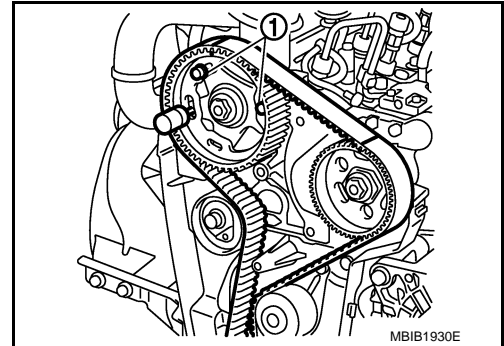
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< REMOVAL AND INSTALLATION >

6. Insert tool KV113B0130 (Mot. 1489) to crankshaft.

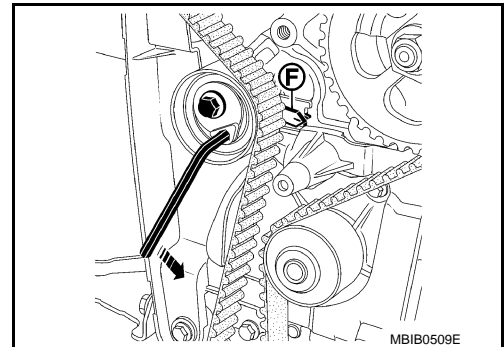


7. Remove one wheel bolt from crankshaft pulley, and then loosen the other two bolts (1).



8. Install the timing belt, aligning the marks on the belt with those on the camshaft and fuel injection pump sprockets (19 teeth spaces on the belt between the marks on the camshaft and pump sprockets).

9. Using a 6 mm (0.24 in) Allen key, move the movable index (F) of the tension wheel into the position shown below, by turning the key counterclockwise.



10. Tighten the tension wheel bolt.

 : 27 N·m (2.8 kg-m, 20 ft-lb)

11. Check that the camshaft pulley wheel bolts are not fully up against the camshaft pulley wheel.
12. Install and tighten camshaft pulley wheel bolt.

 : 14 N·m (1.4 kg-m, 10 ft-lb)

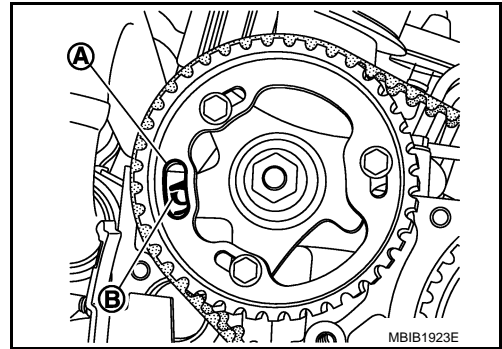
13. Remove Tool KV113B0130 (Mot. 1489) and Tool KV113B0110 (Mot. 1430).

TIMING BELT

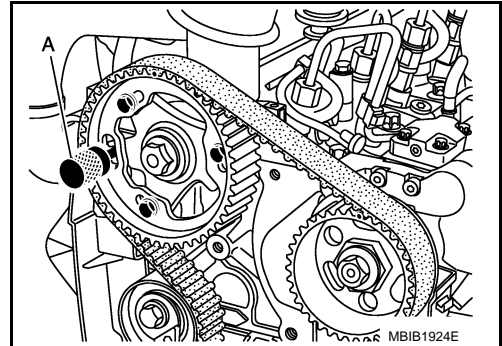
[K9K]

< REMOVAL AND INSTALLATION >

14. Turn the crankshaft two full turns in a clockwise direction (timing side). Just before the hole (A) of the camshaft pulley is opposite the cylinder head hole (B), insert tool KV113B0130 (Mot. 1489) into the cylinder block.
15. Then turn the crankshaft slowly and smoothly against TDC set pin.



16. Insert TDC set pin [SST: KV113B0110 (Mot. 1430)] (A). If the pin cannot be inserted, perform the following.
 - a. Remove TDC set pin [SST: KV113B0130 (Mot. 1489)].
 - b. Loosen camshaft pulley wheel bolts.
 - c. Turn camshaft pulley to adjust.
 - d. Confirm that the crankshaft sprocket groove is facing upward.
 - e. Loosen timing belt tensioner bolt.

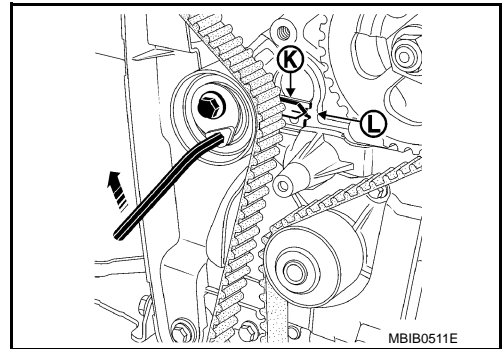


- f. Move the movable index of the drive belt tensioner into the position as shown in the figure, by turning the key clockwise.
- g. Tighten timing belt tensioner bolt.

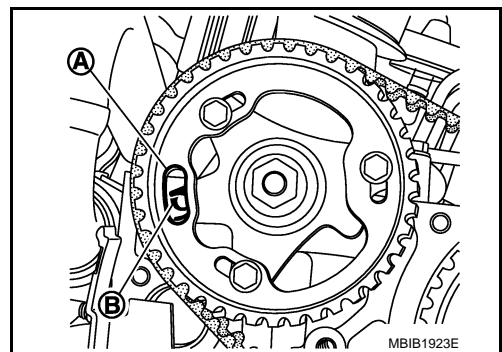
 : 27 N·m (2.8 kg-m, 20 ft-lb)

- h. Install and tighten camshaft sprocket wheel bolts.

 : 14 N·m (1.4 kg-m, 10 ft-lb)



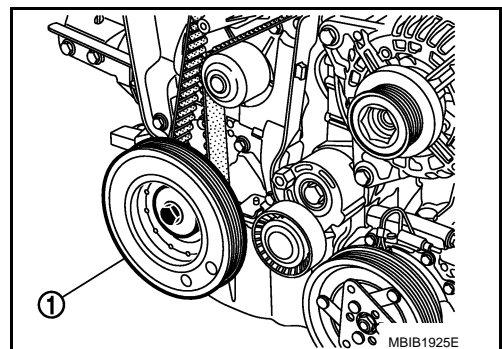
- i. Turn the crankshaft two revolutions in a clockwise direction (timing side). Just before the hole (A) of the camshaft pulley is opposite the cylinder head hole (B), insert TDC set pin [SST: KV113B0130 (Mot. 1489)] into the cylinder block.
- j. Then turn the crankshaft slowly and smoothly against TDC set pin.



17. Install crankshaft pulley (1), and tighten the bolts as follows:
 - a. Tighten the bolt.

 : 120 N·m (12 kg-m, 89 ft-lb)

- b. Turn the bolt 95 degrees ±15 degrees clockwise (angle tightening).



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TIMING BELT

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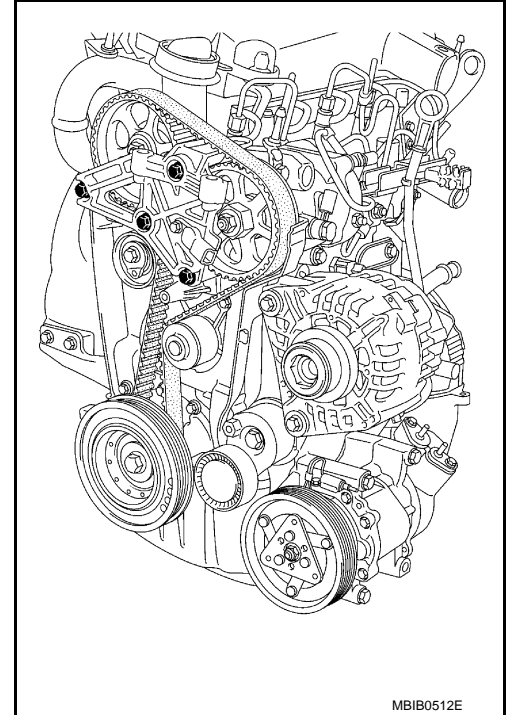
< REMOVAL AND INSTALLATION >

18. Remove TDC set pin [SST: KV113B0130 (Mot. 1489)] and TDC set pin [SST: KV113B0110 (Mot. 1430)].
19. Apply liquid gasket to the thread of TDC pin plug.
20. Install TDC pin plug.

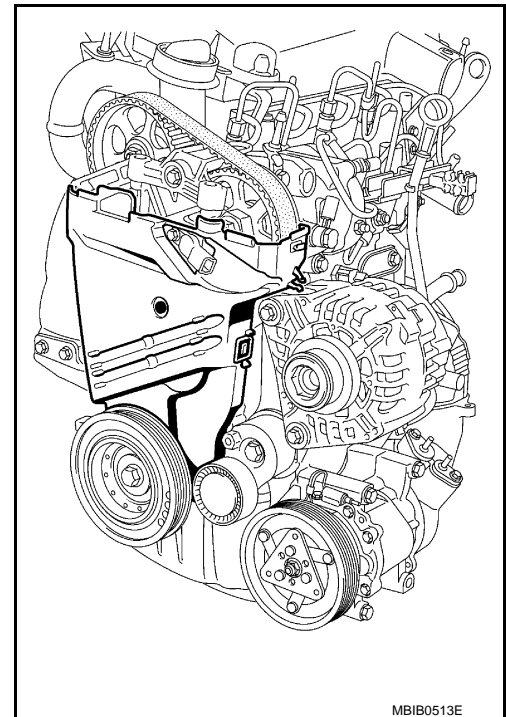
 : 20 N·m (2.0 kg-m, 15 ft-lb)

21. Install the cylinder head suspended bracket.

 : 21 N·m (2.1 kg-m, 15 ft-lb)



22. Install the lower timing cover by positioning the tab (M) into the hole (N) on the inner timing cover.



TIMING BELT

< REMOVAL AND INSTALLATION >

[K9K]

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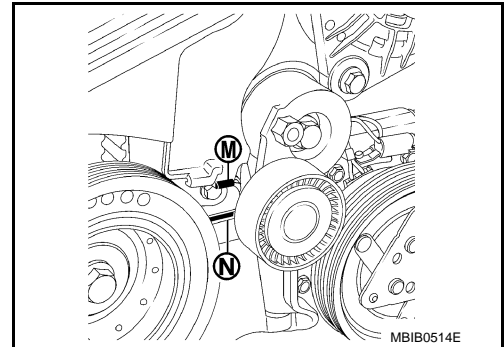
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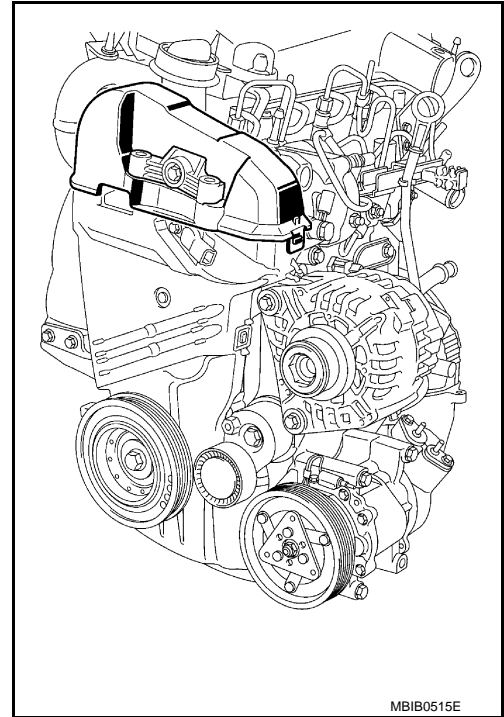
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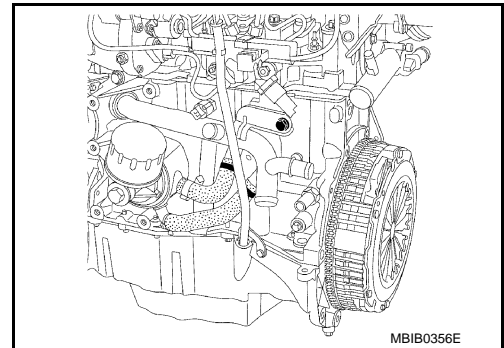
23. Install the upper timing cover.



24. Install the water pipe.

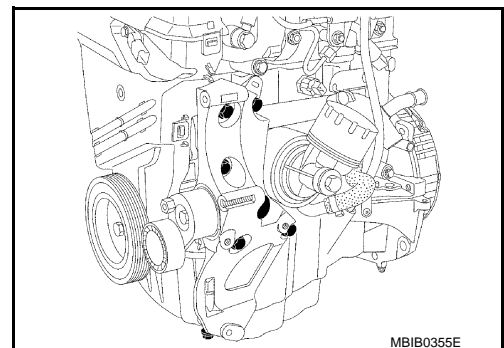
 : 22 N·m (2.2 kg-m, 16 ft-lb)

25. Install the two water hoses.



26. Install the alternator bracket.

 : 44 N·m (4.5 kg-m, 32 ft-lb)



TIMING BELT

< REMOVAL AND INSTALLATION >

[K9K]

27. Install the alternator.

Engine number	Tightening torque
< D051474	: 21 N·m (2.1 kg-m, 15 ft-lb)
>>>	: 25 N·m (2.6 kg-m, 18 ft-lb)

28. Install the A/C compressor.

 : 21 N·m (2.1 kg-m, 15 ft-lb)

29. Install the power steering pump or the washer which replaces the pulley (if the engine has one).

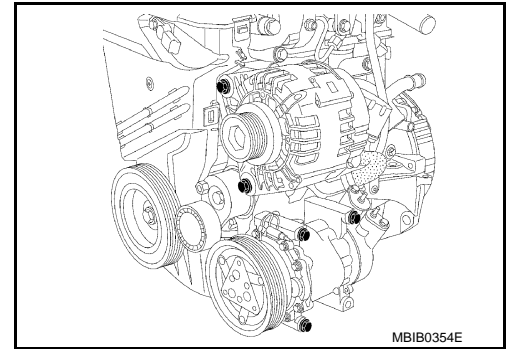
 : 21 N·m (2.1 kg-m, 15 ft-lb)

30. Install the drive belt.

CAUTION:

- Make sure belt is correctly engaged with the pulley groove.
- Check for oil and coolant on belt and each pulley groove.

31. Make sure that tension of each belt is within the standard.



CYLINDER HEAD

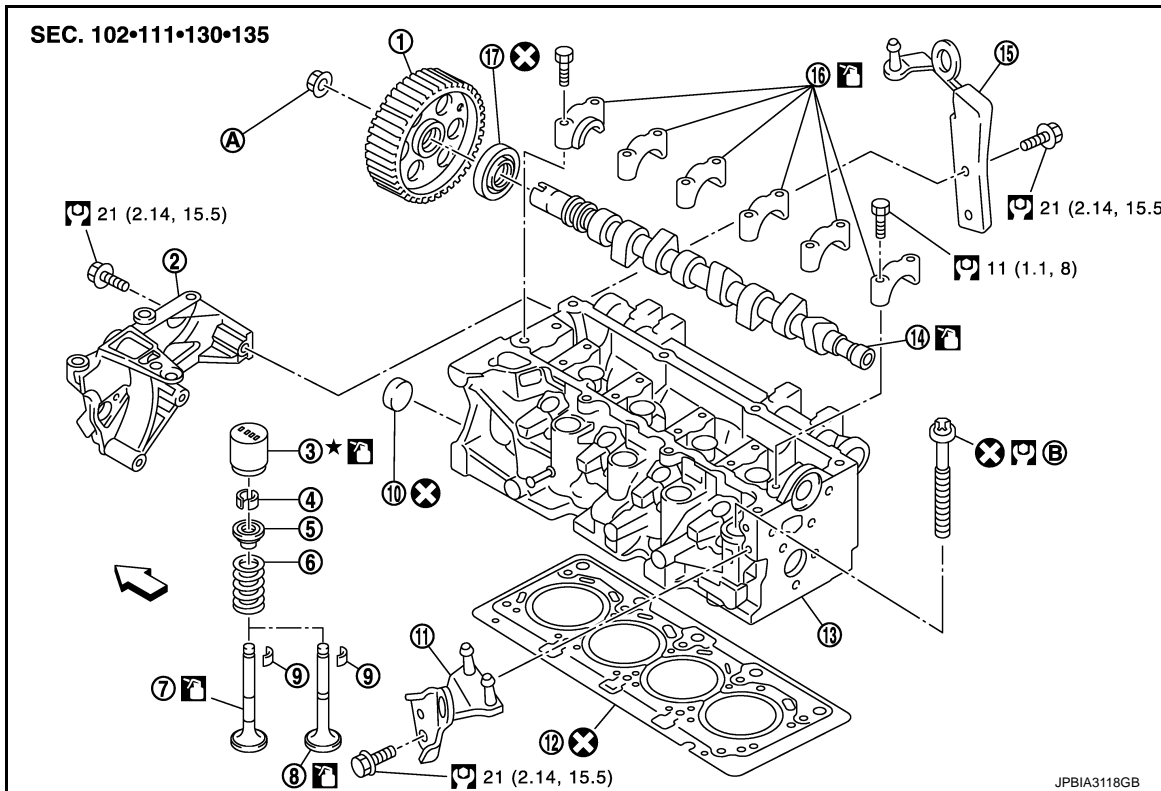
< REMOVAL AND INSTALLATION >

[K9K]

CYLINDER HEAD

Exploded View

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- | | | |
|----------------------|------------------------------------|--------------------------|
| 1. Camshaft sprocket | 2. Cylinder head suspended bracket | 3. Valve lifter |
| 4. Valve rotator | 5. Valve spring retainer | 6. Valve spring |
| 7. Exhaust valve | 8. Intake valve | 9. Valve collet |
| 10. Cap | 11. Rear engine slinger | 12. Cylinder head gasket |
| 13. Cylinder head | 14. Camshaft | 15. Front engine slinger |
| 16. Camshaft bracket | 17. Oil seal | |

A :Comply with the assembly procedure when tightening. Refer to [EM-333](#).

B :Comply with the assembly procedure when tightening. Refer to [EM-333](#).

⇐ : Vehicle front

: N·m (kg-m, ft-lb)

: Always replace after every disassembly.

: Should be lubricated with oil.

★ : Select with proper thickness.

CAUTION:

Apply new engine oil to parts marked in illustration before installation.

Removal and Installation

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REMOVAL

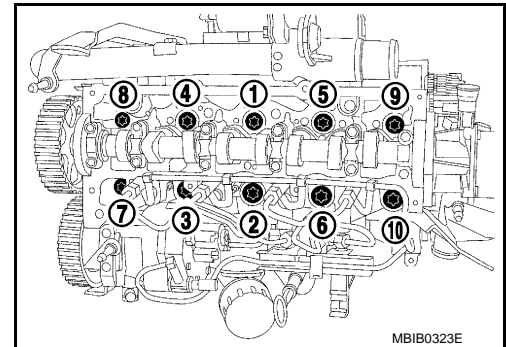
- Remove the following parts.
 - Battery ground cable
 - Engine cover
 - RH front wheel

CYLINDER HEAD

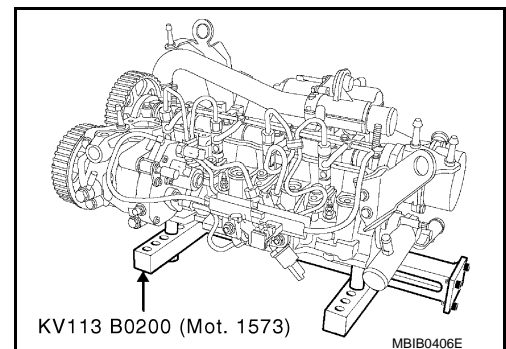
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< REMOVAL AND INSTALLATION >

2. Remove fender protector RH.
3. Drain engine coolant. Refer to [CO-63, "Draining"](#).
CAUTION:
Perform when engine is cold.
4. Remove air cleaner case. Refer to [EM-303, "Exploded View"](#).
5. Remove radiator upper hose. Refer to [CO-67, "Exploded View"](#).
6. Disconnect fuel feed tube and return tube from high pressure supply pump. Refer to [EM-320, "Exploded View"](#).
7. Remove oil level gauge guide.
8. Remove harnesses and connectors.
9. Remove heater hoses.
10. Remove turbocharger assembly. Refer to [EM-308, "Exploded View"](#).
11. Remove drive belt. Refer to [EM-298, "Removal and Installation"](#).
12. Remove rocker cover. Refer to [EM-322, "Exploded View"](#).
13. Support underneath of engine by setting a manual lift table caddy (commercial service tool) or equivalent tool.
CAUTION:
Put a piece of wood or something similar as supporting surface, secure a completely stable condition.
14. Remove timing belt. Refer to [EM-324, "Exploded View"](#).
15. Remove engine support bar.
CAUTION:
During the removal operation, always be careful to prevent engine moves downward from the vehicle.
16. Remove cylinder head bolt in the reverse order as shown.



17. Remove cylinder head assembly.
18. Place the cylinder head on Tool KV113B0200 (Mot. 1573) (Commercial service tool) or equivalent tool.
CAUTION:
Pay strict attention to the rules regarding cleanliness. Refer to [EM-285, "Precaution for Diesel Equipment"](#).



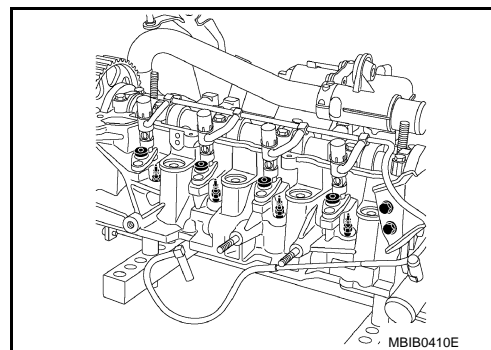
19. Remove high pressure supply pump and related parts. Refer to [EM-318, "Exploded View"](#), [EM-320, "Exploded View"](#).

CYLINDER HEAD

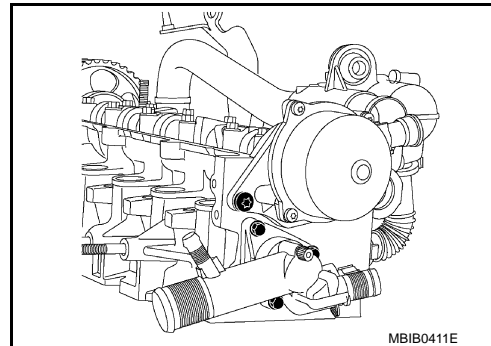
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< REMOVAL AND INSTALLATION >

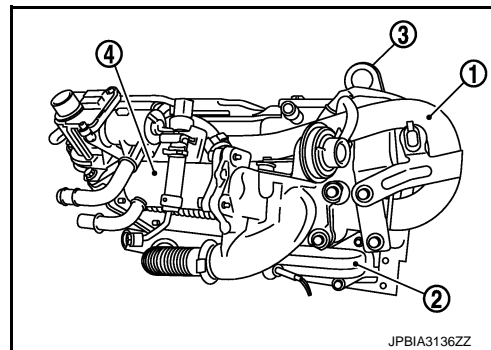
20. Remove the injectors (by marking them in relation to their cylinder), glow plugs using Tool KV113E0010 (Mot. 1566) (Commercial service tool) or equivalent tool, and rear engine slinger.



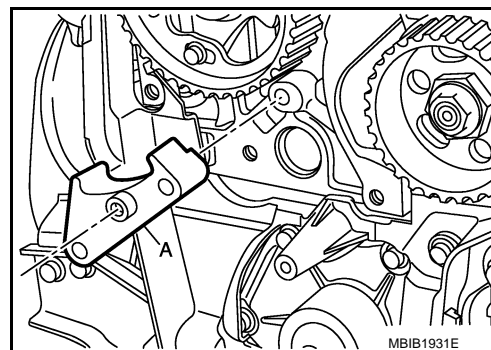
21. Remove the vacuum pump and water outlet.



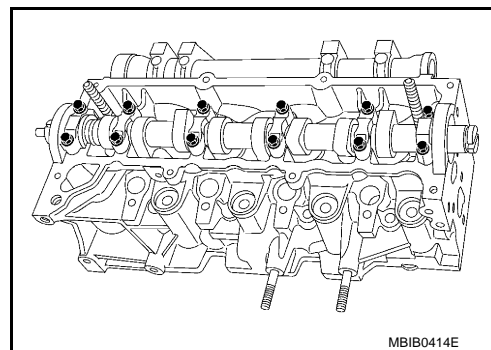
22. Remove the air inlet pipe (1), front engine slinger (2), EGR unit (4), and exhaust manifold (3).



23. Remove the camshaft pulley using sprocket holder [SST: — (Mot. 1606-A)] (A).



24. Remove the camshaft brackets.



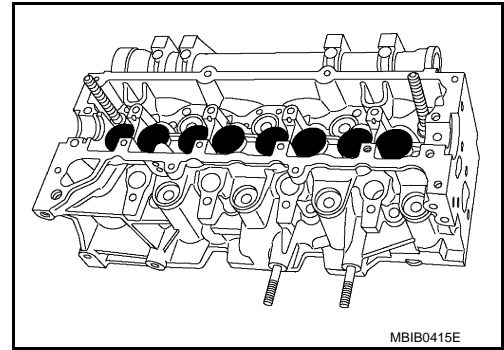
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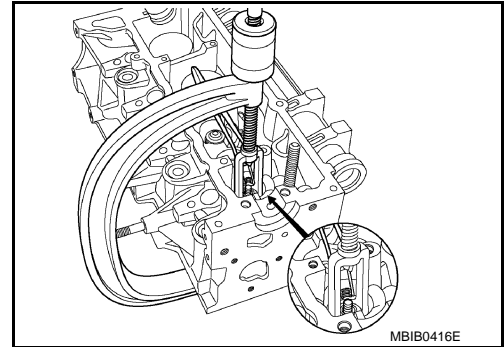
< REMOVAL AND INSTALLATION >

[K9K]

25. Remove the tappets, noting their position.

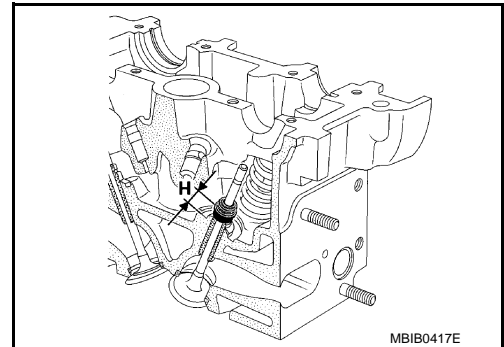


26. Compress the valve springs using the valve lifter. Remove the keys, upper cups and springs.



NOTE:

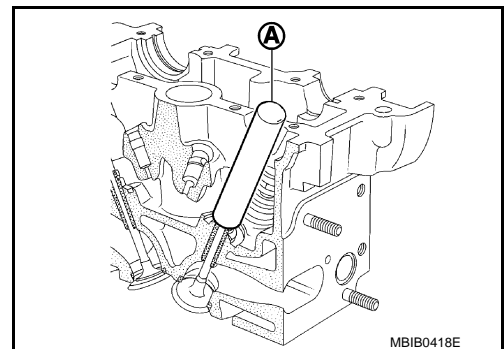
Before removing the valves and the valve stem seals, it is vital to measure position "H" of one of the old seals in relation to the cylinder head using Tool KV113B0180 (Mot. 1511-01) (Commercial service tool) or equivalent tool.



27. Install the push rod (A) of Tool KV113B0180 (Mot. 1511-01) (Commercial service tool) on the valve stem seal.

NOTE:

The inner diameter of the push rod must be identical to that of the valve. In addition, the bottom of the push rod must come into contact with the metal upper section of the valve stem seal.

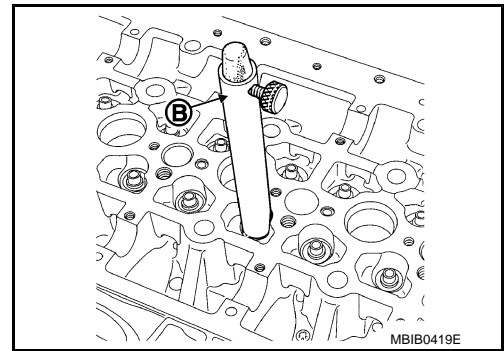


CYLINDER HEAD

[K9K]

< REMOVAL AND INSTALLATION >

28. Install the guide tube (B) over the push rod until the guide tube comes into contact with the cylinder head, locking the push rod with the knurled wheel.
29. Remove the guide tube assembly plus push rod, being careful not to loosen the knurled wheel.
30. Remove the valves and valve guide seals using the Tool KV113B0090 (Mot. 1335) (Commercial service tool) or equivalent tool.

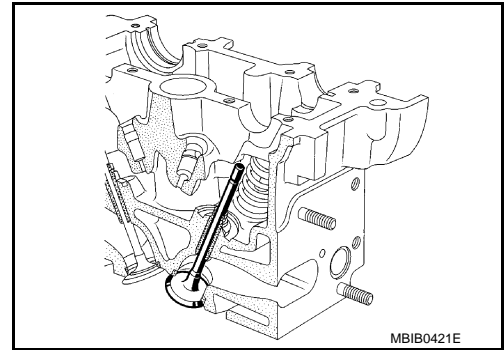


ASSEMBLY OF THE CYLINDER HEAD

1. Install new valves and grind them gently into their respective seats. Clean all the parts thoroughly, mark them for identification purposes, then carry out the refitting operation. Lubricate the inside of the valve guide.
 - It is imperative to fit the valve stem seals using Tool KV113B0180 (Mot. 1511-01) (Commercial service tool) or equivalent tool.

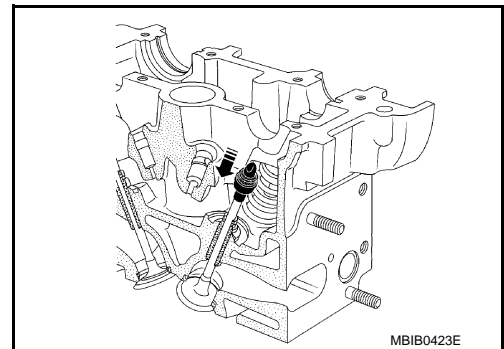
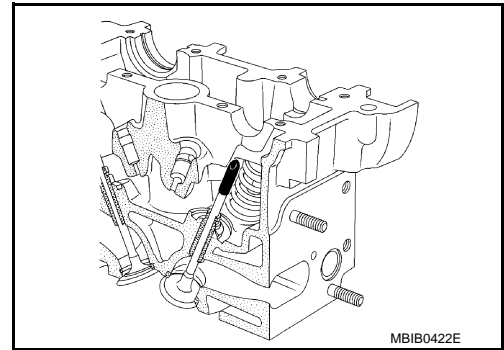
NOTE:

Never lubricate the valve stem seals before fitting them.



New Valve Stem Seals

1. Place the valve in the cylinder head.
2. Place the barrel of Tool KV113B0180 (Mot. 1511-01) (Commercial service tool) or equivalent tool over the valve stem (the inner diameter of the barrel must be identical to the diameter of the valve stem).
3. Keep the valve pressed against its seat.
4. Place the valve stem seal (not lubricated) over the tool barrel.



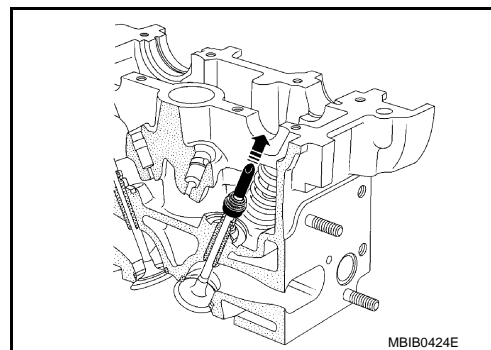
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CYLINDER HEAD

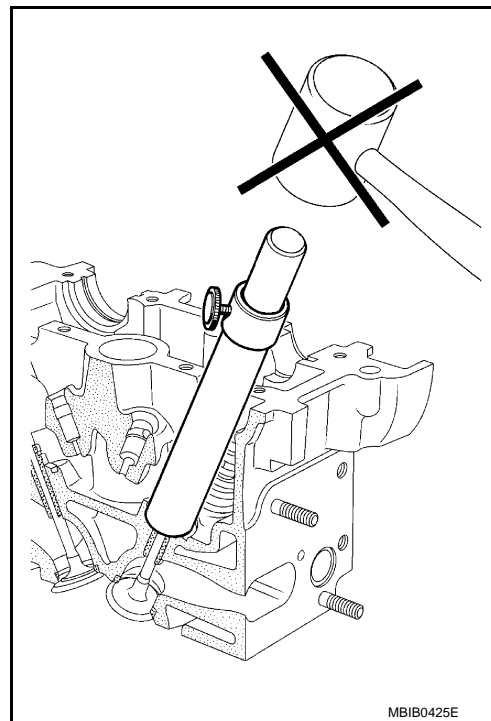
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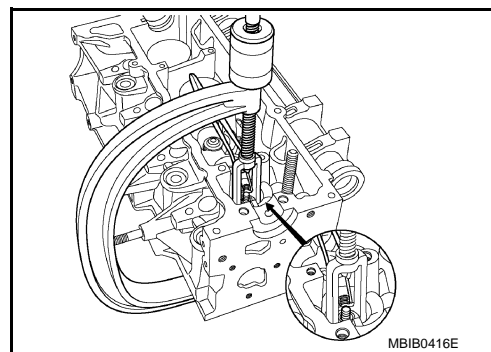
5. Push the valve stem seal past the tool barrel, then withdraw the barrel.



6. Place the guide tube plus push rod assembly on the valve stem seal.
7. Push the valve stem seal down by tapping the top of the sleeve with the palm of your hand until the guide tube reaches the cylinder head.
8. Repeat these operations for all the valves.



9. Install the valve springs and upper cups using valve spring compressor.
10. Install the keys using tweezers.



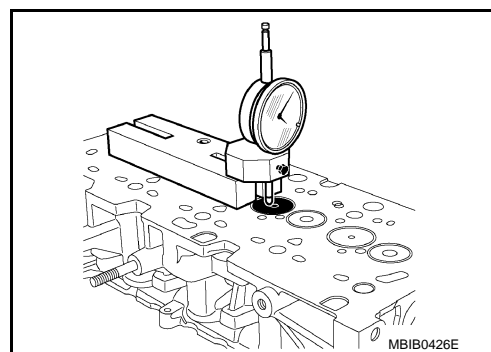
CYLINDER HEAD

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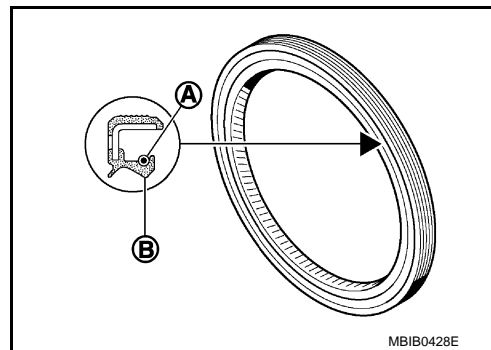
11. Check the valve protrusion using KV113B0040 (Mot. 251-01) (Commercial service tool) or equivalent tool and KV113B0050 (Mot. 252-01) (Commercial service tool) or equivalent tool as shown.

Valve protrusion : **-0.07 to 0.07 mm (-0.0028 to 0.0028 in)**

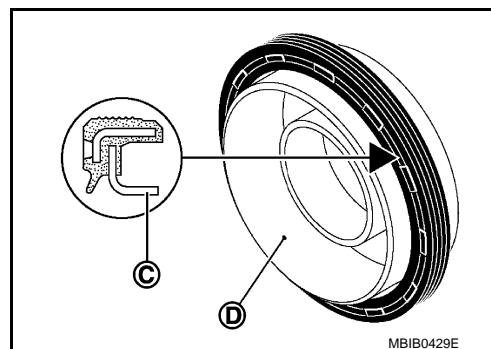


Camshaft Seal

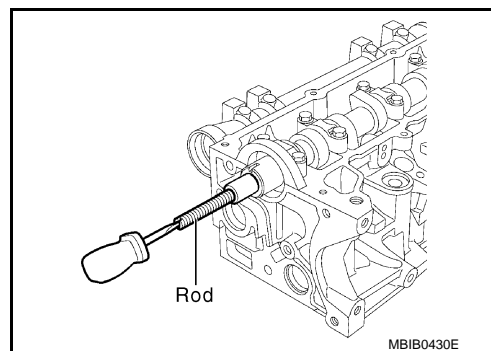
- This engine can be fitted with two different types of seals. Old and new seals are easily recognized.
1. The old rubber seal is installed with a spring (A) and has a “V”-shaped sealing lip (B).



2. The new rubber seal has a flat sealing lip (C) and a protector (D) which also assists in installing the seal to the engine.



3. Screw the shouldered rod of Tool KV113B0230 (Mot. 1632) onto the stud of the camshaft.
4. Install the old seal on the camshaft.



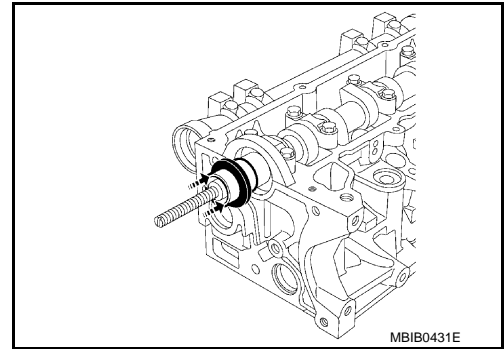
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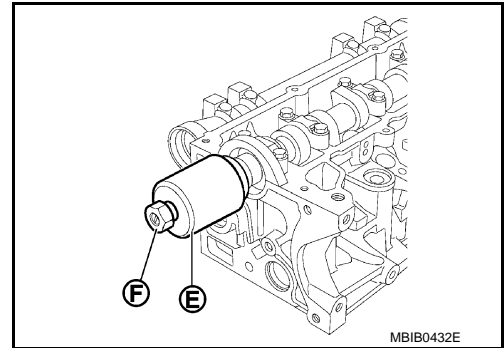
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< REMOVAL AND INSTALLATION >

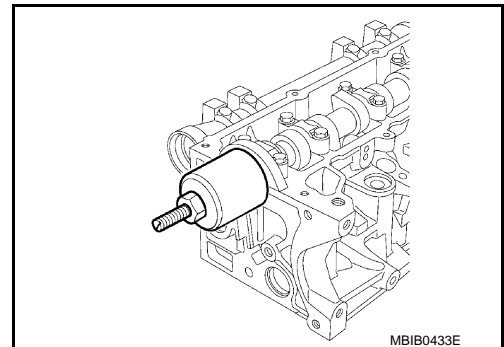
5. For the new seal, put the protector with the seal on the camshaft, taking care not to touch the seal.



6. Install the cover (E) and the collar nut (F) of Tool KV113B0230 (Mot. 1632).



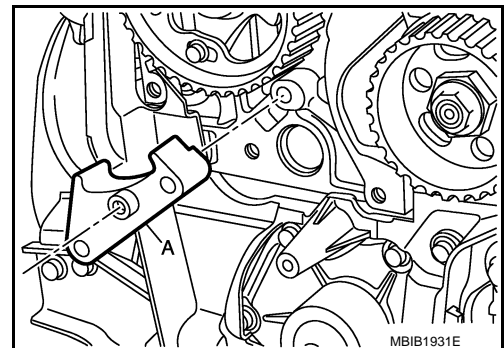
7. Screw the collar nut until the cover reaches the cylinder head.



8. Remove the nut, the cover, the protector and the shouldered rod.
9. Install the camshaft pulley, and tighten the new nut as follows:
 - a. Tighten the new nut.

 : 30 N·m (3.1 kg-m, 22 ft-lb)

- b. Turn the bolt 86 degrees clockwise (angle tightening) using sprocket holder [SST: - (Mot. 1606-A)] (A).



CYLINDER HEAD


[K9K]

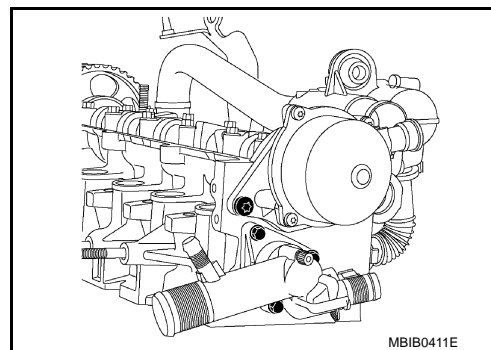
< REMOVAL AND INSTALLATION >

10. Install the vacuum pump with a new gasket

 : 21 N-m (2.1 kg-m, 15 ft-lb)

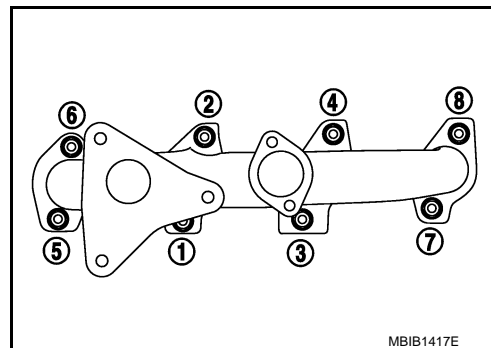
11. Install water outlet unit with a new gasket.

 : 11 N-m (1.1 kg-m, 8 ft-lb)



12. Install the exhaust manifold with new gasket. Tighten the bolts in the numerical order as shown.

 : 26 N-m (2.7 kg-m, 19 ft-lb)



13. Install the EGR unit with new clips. Tighten the mounting bolts of the valve to a torque of 21 N-m (2.1 kg-m, 15 ft-lb), then tighten the clips of the pipe using Tool KV113B0190 (Mot. 1567).

14. Install the air inlet pipe with a new seal.

15. Install the front engine slinger.

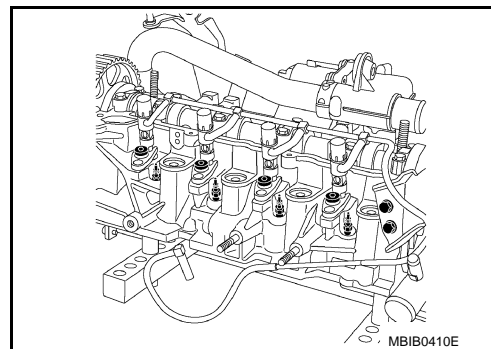
16. Clean the injector sockets and the injector bodies, as well as their brackets using a lint-free cloth (use the wipes recommended for this purpose) dipped in clean solvent. Dry off using a different new wipe. Replace the compression washer with a new washer.

17. Install the injectors (using the marks made during removal).

 : 28 N-m (2.9 kg-m, 21 ft-lb)

18. Install the glow plugs.

 : 15 N-m (1.5 kg-m, 11 ft-lb)



19. Install the rear engine slinger.

20. Install high pressure supply pump and related parts. Refer to [EM-318. "Exploded View"](#), [EM-320. "Exploded View"](#).

INSTALLATION

- Install in the reverse order of removal paying attention to the following.

INSTALLATION OF THE CYLINDER HEAD

1. Position the pistons at mid-stroke.
2. Install the cylinder head gasket using the centering dowels of the cylinder block.
3. Tighten the cylinder head to the following procedure.

CAUTION:

All bolts must always be changed after removal. Never oil the new bolts.

NOTE:

Use a syringe to remove any oil which may have entered the cylinder head mounting bolt holes to achieve correct tightening of the bolts.

CYLINDER HEAD

[K9K]

< REMOVAL AND INSTALLATION >

- a. Tighten all the bolts in the numerical order as shown.

 : 25 N·m (2.6 kg·m, 18 ft·lb)

- b. Check that all the bolts are correctly tightened to 25 N·m (2.6 kg·m, 18 ft·lb), then angle tightening of 245 to 265 degrees.

CAUTION:

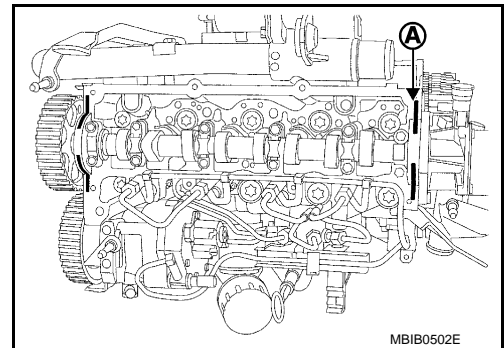
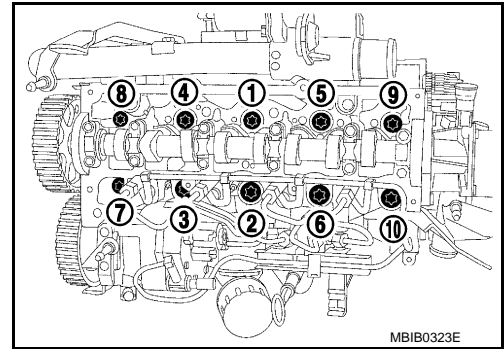
- Use an angle wrench (special service tool) to check tightening angle.
- Never retighten the cylinder head bolts after performing this procedure.

NOTE:


The gasket faces (cylinder head and rocker cover) must be clean, dry and free from grease (in particular, remove finger marks).

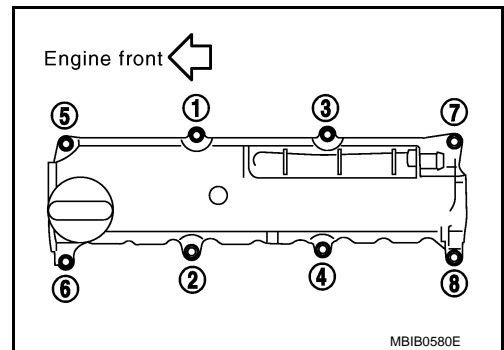
4. Lay four beads (A) of liquid gasket, with a diameter of 2 mm (0.08 in).

- Use Genuine Liquid Gasket or equivalent.



5. Install the rocker cover, tighten the bolts in numerical order as shown.

 : 12 N·m (1.2 kg·m, 9 ft·lb)




6. Put new seals on the pipe ends and install the turbocharger oil return pipe.

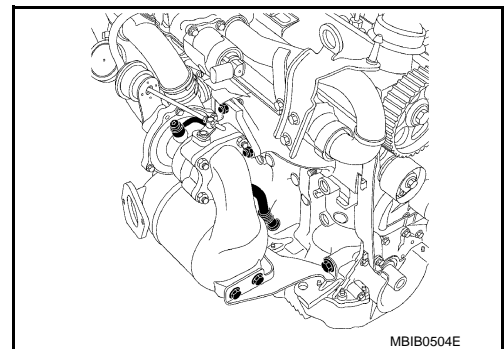
7. Install the turbocharger.

 : 26 N·m (2.7 kg·m, 19 ft·lb)

8. Install the turbocharger oil supply pipe.

9. Tighten the bolts of the turbocharger oil return pipe.

 : 12 N·m (1.2 kg·m, 9 ft·lb)



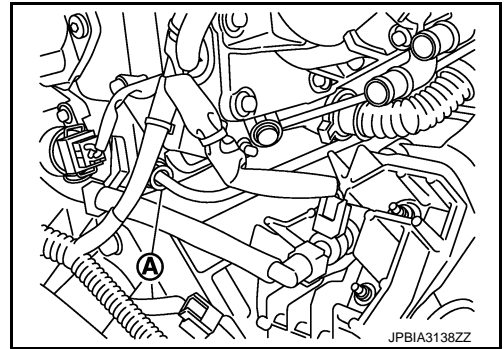
CYLINDER HEAD

< REMOVAL AND INSTALLATION >

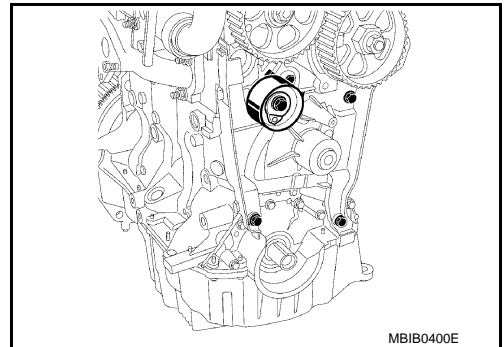
[K9K]

10. Tighten the nut and the bolt of the turbocharger oil supply pipe (A).

 : 23 N·m (2.3 kg·m, 17 ft·lb)



11. Install the oil vapor rebreathing pipe.
12. Install the new turbocharger air ducts.
13. Install the inner timing cover.
14. Install the timing tensioner.



Cleaning

INFOID:000000006659442

- It is very important not to scratch the gasket faces of any aluminium components.
- Use suitable tool to dissolve any part of the seal which remains stuck to the metal surface.
- Apply the dissolving product to the part to be cleaned, wait approximately 10 minutes, then remove it using a wooden spatula.
- Wear gloves while carrying out this operation.
- Do not allow this dissolving product to drip on to the paintwork.
- **Great care should be taken when performing this operation, to prevent foreign objects from entering the pipes taking oil under pressure to the camshafts (pipes in both the cylinder head and its cover) and the oil return pipes.**
- **Failure to follow these instructions could lead to the blocking of the oilways, resulting in rapid and serious damage to the engine.**

Inspection

INFOID:000000006659443

INSPECTION AFTER REMOVAL

GASKET FACE

- Inspect mating surface bow using a ruler and a set of shims.

Maximum bow : 0.05 mm (0.0020 in)

- Test the cylinder head to detect possible cracks using the cylinder head test tools (comprising a tray and a kit suited to the cylinder head, plug, sealing plate and blanking plate). The approval number of the cylinder head test container (commercial service tool) is 664000.

CAMSHAFT END PLAY

NOTE:

Set the dial gauge to the cylinder head and inspect following dimensions:

Outer diameter : 18 mm (0.71 in)

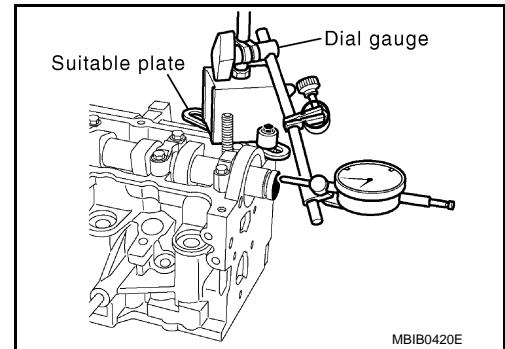
Height : 15 mm (0.59 in)

CYLINDER HEAD

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< REMOVAL AND INSTALLATION >

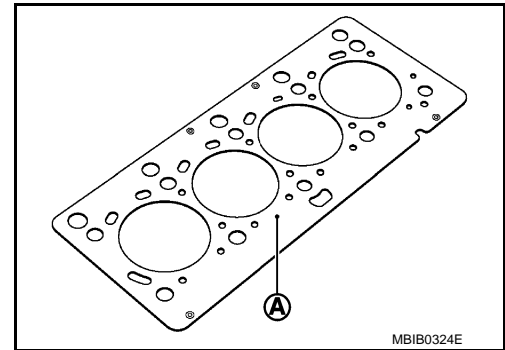
1. Install the camshaft.
2. Install the camshaft brackets (positioning them correctly with bracket 1 on the flywheel end), then tighten the bolts to a torque of 11 N·m (1.1 kg-m, 8 ft-lb).
Check the end play, which must be between 0.08 mm (0.0031 in) and 0.178 mm (0.0070 in).
Remove the camshaft brackets and the camshaft.



THICKNESS OF THE CYLINDER HEAD GASKET

- The thickness of the cylinder head gasket is measured at (A):

Thickness : 0.75 - 0.81 mm (0.0295 - 0.0319 in)



VALVE DIMENSIONS

Stem diameter:

Intake : 5.969 - 5.985 mm (0.2350 - 0.2356 in)
Exhaust : 5.955 - 5.971 mm (0.2344 - 0.2351 in)

Face angle:

**Intake and ex-
haust : 90°**

Head diameter:

Intake : 33.38 - 33.62 mm (1.3142 - 1.3236 in)
Exhaust : 28.88 - 29.12 mm (1.1370 - 1.1465 in)

Valve length:

Intake : 100.73 - 101.17 mm (3.9657 - 3.9831 in)
Exhaust : 100.53 - 100.97 mm (3.9579 - 3.9752 in)

Max. valve lift:

Intake : 8.015 mm (0.3156 in)
Exhaust : 8.595 mm (0.3384 in)

Protrusion of valves in relation to the cylinder head gasket face:

**Intake and ex-
haust : -0.7 to 0.7 mm (-0.028 to 0.028 in)**

VALVE SEAT

CYLINDER HEAD

< REMOVAL AND INSTALLATION >

[K9K]

Seat angle (α):

Intake : 89°30'
and ex-
haust

Contacting width (X):

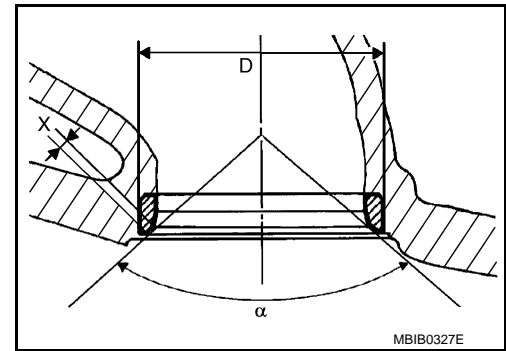
Intake : 1.8 mm (0.071 in)
and ex-
haust

Seat outer diameter (D):

Intake : 34.444 - 34.460 mm (1.3561 - 1.3567 in)
Exhaust : 30.034 - 30.050 mm (1.1824 - 1.1831 in)

Diameter of the housing in the cylinder head:

Intake : 34.444 - 34.474 mm (1.3561 - 1.3572 in)
Exhaust : 29.955 - 29.985 mm (1.1793 - 1.1805 in)



VALVE GUIDE

Length:

Intake and : 40.35 - 40.65 mm (1.5886 - 1.6004 in)
exhaust

Guide outer diameter:

Standard : 11.044 - 11.062 mm (0.4348 - 0.4355 in)

Guide inner diameter:

Intake and exhaust

Not ma- : 5.50 - 5.62 mm (0.2165 - 0.2213 in)
chined

Machined* : 6.000 - 6.018 mm (0.2362 - 0.2369 in)

* This dimension is measured with the guide fitted in the cylinder head.

Diameter of the housing in the cylinder head:

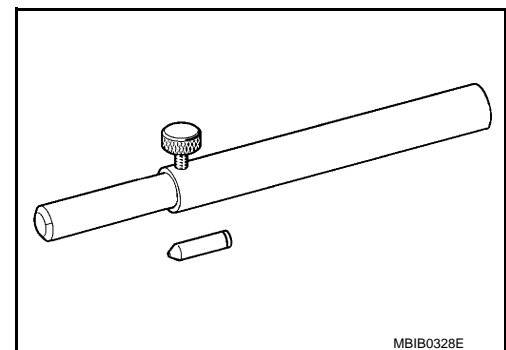
Standard : 10.9925 - 11.0075 mm (0.4328 - 0.4334 in)

The intake and exhaust guides have valve stem seals which must be changed each time the valves are removed.

It is imperative to fit the valve stem seals using Tool KV113B0180 (Mot. 1511-01) (Commercial service tool) or equivalent tool.

NOTE:

Do not lubricate the valve stem seals before fitting them.

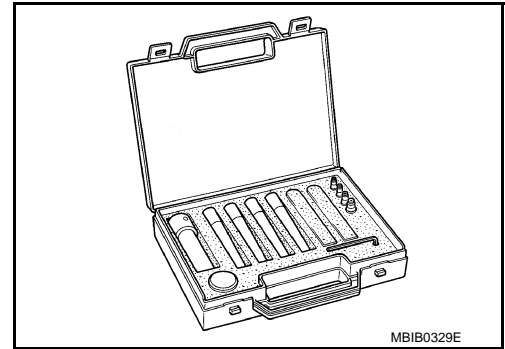


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CYLINDER HEAD

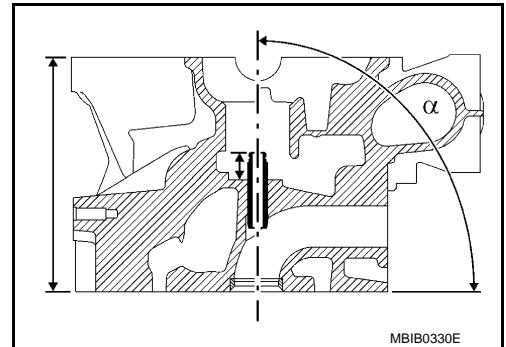
< REMOVAL AND INSTALLATION >

[K9K]



Angle of the intake and exhaust guides (in degrees)

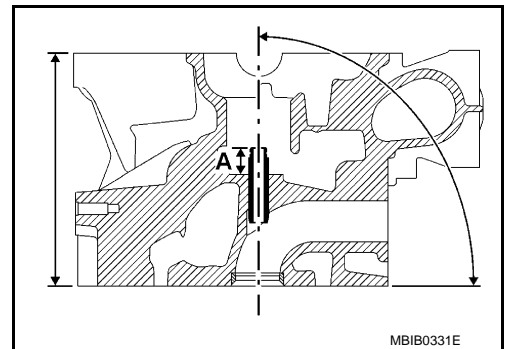
Intake and exhaust : $\alpha = 90$



Position of the intake and exhaust valve guides

Intake : A = 14 mm (0.55 in)

Exhaust : A = 14.2 mm (0.559 in)



VALVE SPRING

The valve springs are tapered (ensure the correct direction of fitting).

Free height: : 43.31 mm (1.7051 in)

Length under a load of

230 N (23.5 kg, 51.7 lb) : 33.80 mm (1.3307 in)

500 N (51.0 kg, 112.4 lb) : 24.80 mm (0.9764 in)

Joined spires: : 23.40 mm (0.9213 in)

Wire diameter: : 3.45 mm (0.1358 in)

Inner diameter:

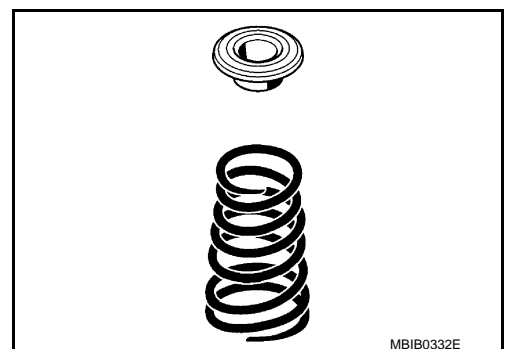
Bottom : 18.78 - 18.82 mm
(0.7394 - 0.7409 in)

Top : 13.90 - 14.30 mm
(0.5472 - 0.5630 in)

Outer diameter:

Bottom : 25.50 - 25.90 mm
(1.0039 - 1.0197 in)

Top : 20.8 - 21.2 mm (0.819
- 0.835 in)



WARNING:

CYLINDER HEAD

< REMOVAL AND INSTALLATION >

[K9K]

This engine does not have any valve spring lower washers.

PISTON

Piston outer diameter : 34.965 - 34.985 mm (1.3766 - 1.3774 in)
Diameter of the housing in the cylinder head : 35.00 - 35.04 mm (1.3780 - 1.3795 in)

CAMSHAFT

End play : 0.08 - 0.178 mm (0.0031 - 0.0070 in)

Number of bearings : 6

Diameter of the camshaft bearings

On the camshaft:

Bearings 1, 2, 3, 4, 5 : 24.979 - 24.999 mm (0.9834 - 0.9842 in)

Bearing 6 : 27.979 - 27.999 mm (1.1015 - 1.1023 in)

On the cylinder head:

Bearings 1, 2, 3, 4, 5 : 25.04 - 25.06 mm (0.9858 - 0.9866 in)

Bearing 6 : 28.04 - 28.06 mm (1.1039 - 1.1047 in)

Timing diagram

Intake opening retard * : -9

Intake closing retard : 20

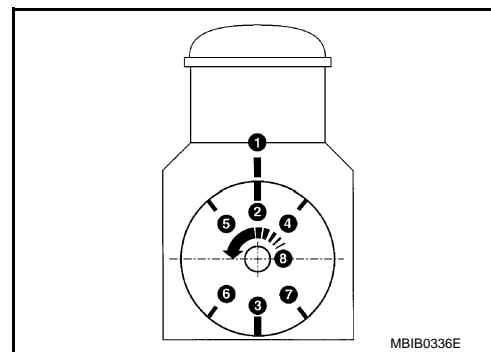
Exhaust opening advance : 27

Exhaust closing advance ** : -7

* As the intake opening retard is negative, the valve is opened after TDC.

** As the exhaust closing advance is negative, the valve is closed before TDC.

1	Cylinder block TDC fixed mark
2	Flywheel TDC moving mark
3	Flywheel BDC moving mark
4	Intake Opening Retard
5	Exhaust Closing Advance
6	Intake Closing Retard
7	Exhaust Opening Advance
8	Direction of engine rotation (flywheel end).

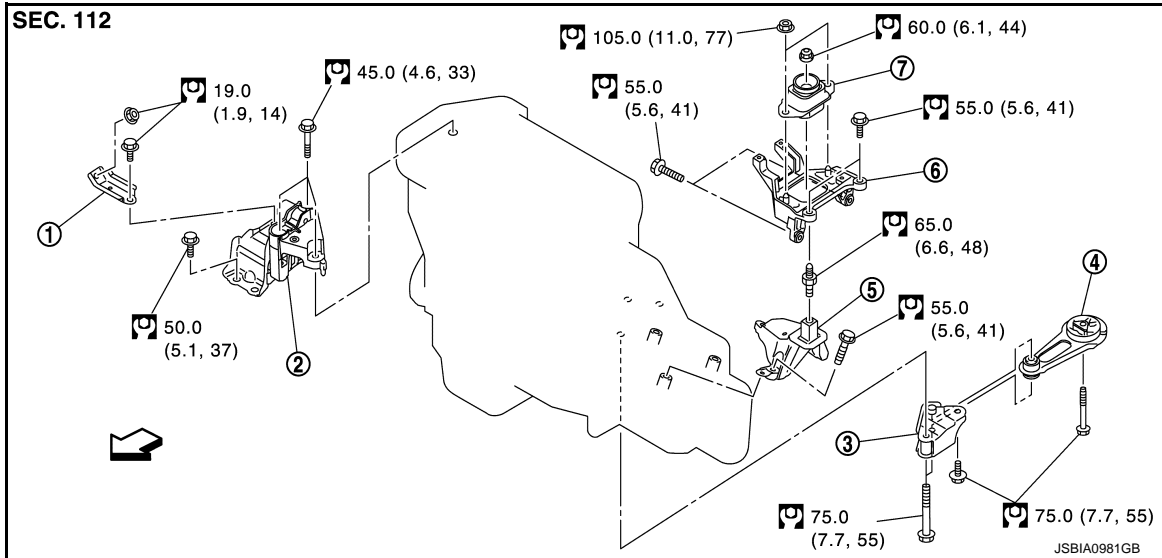


UNIT REMOVAL AND INSTALLATION

ENGINE ASSEMBLY

Exploded View

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- | | | |
|--|-----------------------------------|---------------------------------------|
| 1. Engine mounting insulator (RH) body | 2. Engine mounting insulator (RH) | 3. Rear engine mounting bracket stay |
| 4. Rear torque rod | 5. Engine mounting bracket (LH) | 6. Engine mounting frame support (LH) |
| 7. Engine mounting insulator (LH) | | |

↔ : Vehicle front

⊞ : N·m (kg-m, ft-lb)

Removal and Installation

INFOID:000000006659445

WARNING:

- Situate vehicle on a flat and solid surface.
- Place chocks at front and back of rear wheels.
- For engines not equipped with engine slingers, attach proper slingers and bolts described in PARTS CATALOG.

CAUTION:

- Always be careful to work safely, avoid forceful or uninstructed operations.
- Never start working until exhaust system and coolant are cool enough.
- If items or work required are not covered by the engine main body section, refer to the applicable sections.
- Always use the support point specified for lifting.
- Use either 2-pole lift type or separate type lift as best you can. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.
- For supporting points for lifting and jacking point at rear axle, refer to [GI-42. "Board-On Lift"](#).

REMOVAL

Description of work

Remove engine and transaxle assembly from vehicle down ward. Separate engine and transaxle.

Preparation

1. Remove the following parts.
 - Battery ground cable.
 - Engine cover.
 - LH/RH front wheel. Refer to [WT-6. "Exploded View"](#).

ENGINE ASSEMBLY

< UNIT REMOVAL AND INSTALLATION >

[K9K]

Install in the reverse order of removal.

- Do not allow oil to get on mounting insulator. Be careful not to damage mounting insulator.
- When installation directions are specified, install parts according to the direction marks on them referring to components illustration.
- Make sure that each mounting insulator is seated properly, and tighten mounting bolts and nuts.

Inspection

INFOID:000000006659446

INSPECTION AFTER INSTALLATION

- Before starting engine check the levels of coolant, lubrications and working oils. If less than required quantity, fill to the specified level.
- Before starting engine, bleed air from fuel piping. Refer to [FL-18, "Air Bleeding"](#).
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of coolant, lubricants, working oil, fuel and exhaust gas.
- Bleed air from passages in pipes and tubes of applicable lines.

UNIT DISASSEMBLY AND ASSEMBLY

ENGINE STAND SETTING

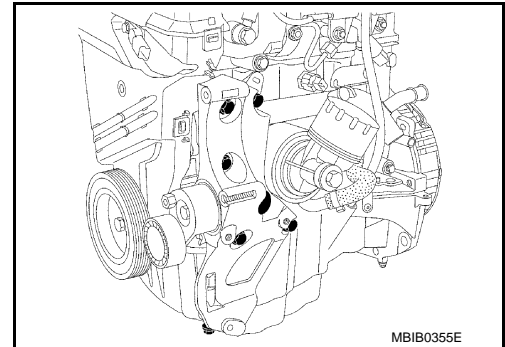
Preparing the engine to be on the stand

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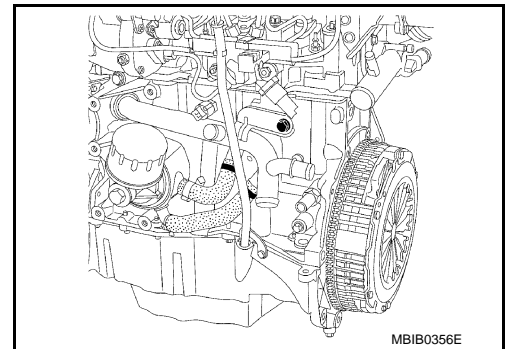
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Before the engine is mounted on the engine sub-attachment, the engine's electrical harness must be removed and the engine oil drained.

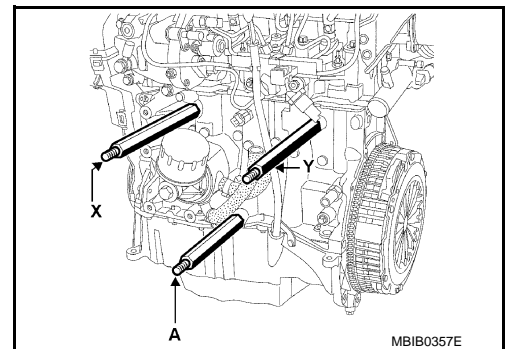
1. Remove the multifunction support.



2. Remove the coolant inlet pipe on the water pump.



3. Place the rods (A), (X), (Y) on the cylinder block.



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CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

CYLINDER BLOCK

Disassembly and Assembly

INFOID:000000006659448

PREPARING USED ENGINE

The engine should be cleaned and drained (oil and water).

Leave on the used engine or include in the return box:

- Oil filter
- Oil pressure switch
- Water pump
- Fuel injection pump
- Rail
- Injectors
- Glow plugs
- Oil level gauge
- Vacuum pump
- Flywheel

Remember to remove:

- All coolant pipes
- Exhaust manifold
- Alternator
- Power steering pump
- A/C compressor
- Alternator bracket
- Oil level sensor
- Cylinder head coolant outlet unit

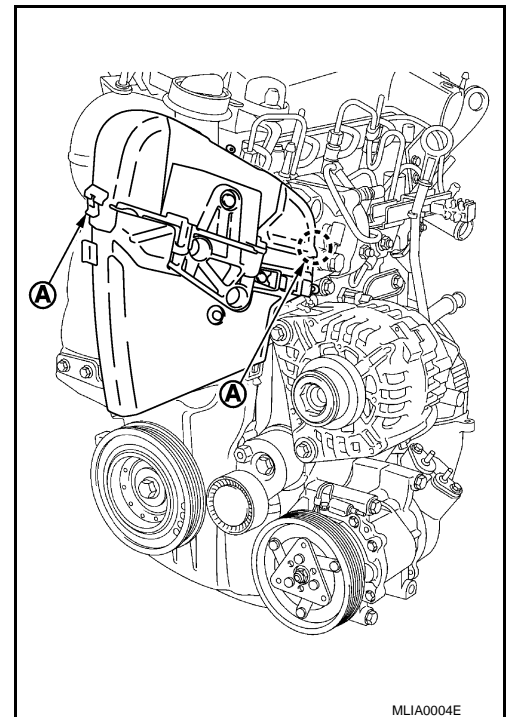
The used engine should be secured to the base under the same conditions as the overhauled engine:

- Plastic plugs and covers fitted
- Cardboard cover over the assembly

DISASSEMBLY

REMOVING THE UPPER ENGINE

1. Remove the upper timing cover by unclipping the two tabs (A).



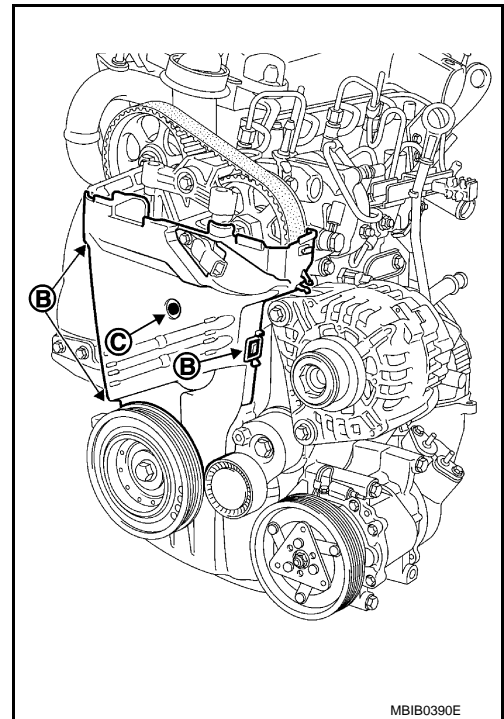
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CYLINDER BLOCK

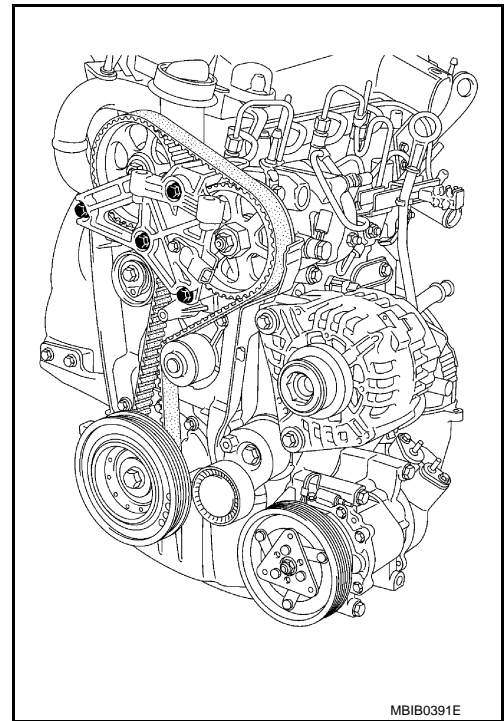
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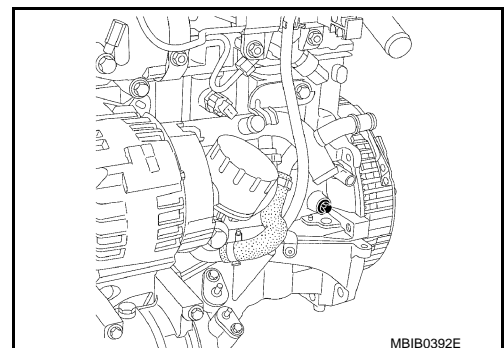
2. Remove the lower timing cover by unclipping the three tabs (B) and pulling out the plastic bolt (C).



3. Remove the cylinder head suspended mounting bracket and high pressure pump position sensor.



4. Remove the TDC pin cap.



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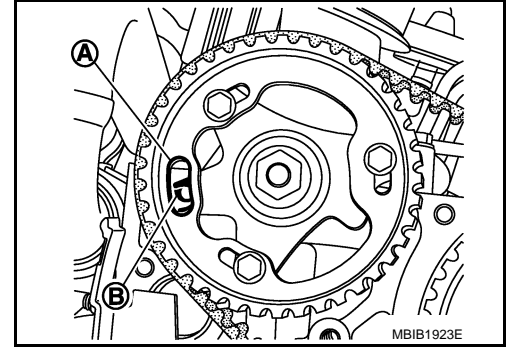
CYLINDER BLOCK

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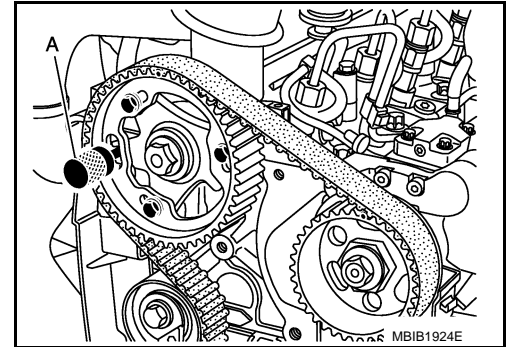
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POSITIONING THE BELT AT THE TIMING POINT

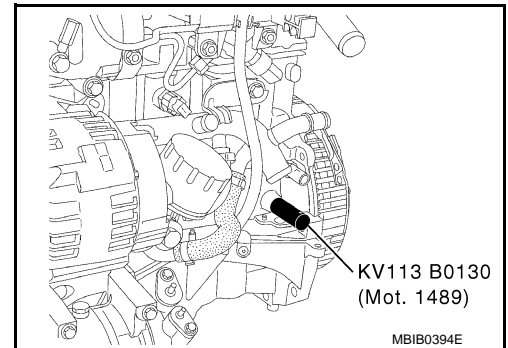
1. Rotate the crankshaft clockwise, until the position (A) of the camshaft pulley becomes opposite of the position (B) on the cylinder head.



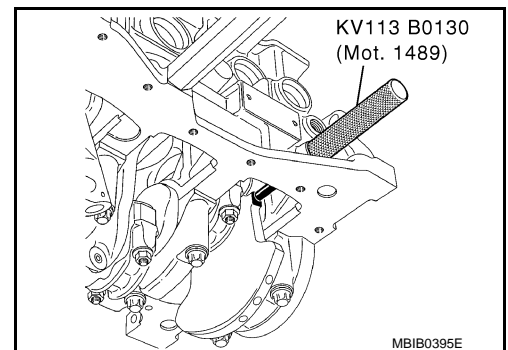
2. Insert TDC set pin [SST: KV 113B0110 (Mot. 1430)] (A) into the camshaft pulley and cylinder head.



3. Screw in the Tool KV113B0130 (Mot. 1489).



4. Turn the engine clockwise (timing side) until the crankshaft reaches the Tool KV113B0130 (Mot. 1489).

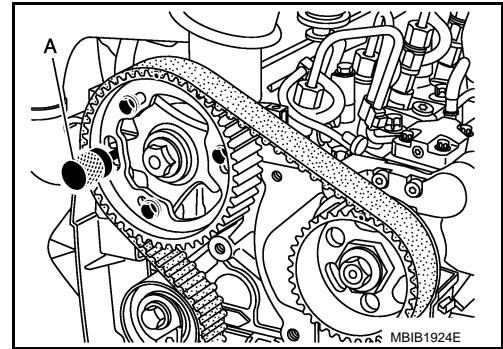


CYLINDER BLOCK

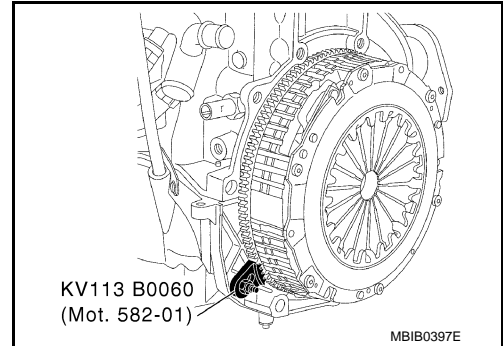
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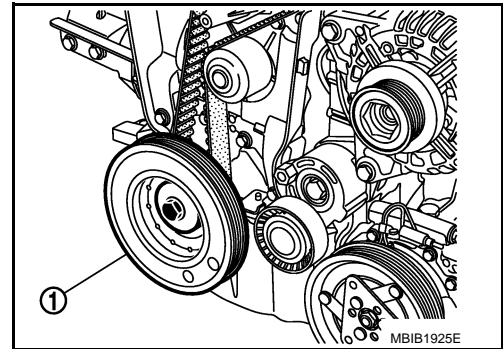
5. The Tool KV113B110 (Mot. 1430) (A) must engage in the camshaft pulley and cylinder head holes.
6. Remove Tool KV113B0130 (Mot. 1489).



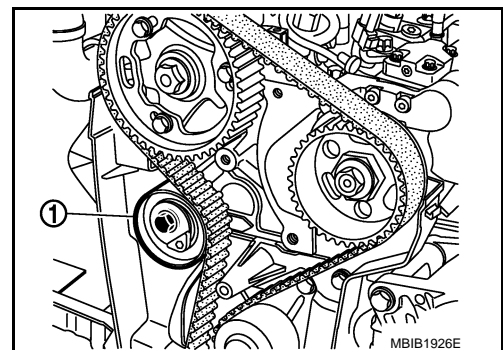
7. Install the Tool KV113B0060 (Mot. 582-01).



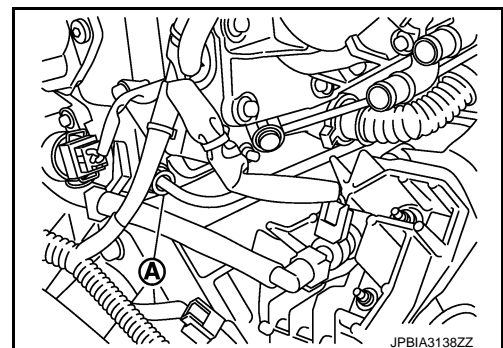
8. Remove the crankshaft pulley (1).



9. Slacken the timing belt by loosening the bolt of the tensioner (1), then remove the timing belt.
10. Remove the timing belt tensioner and inner timing cover.
11. Remove air cleaner case. Refer to [EM-300](#).



12. Remove the turbocharger oil supply pipe (A) on the cylinder head side.



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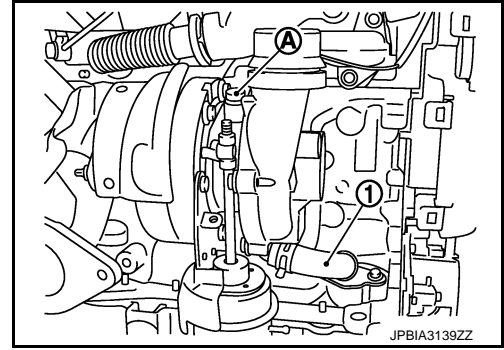
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CYLINDER BLOCK

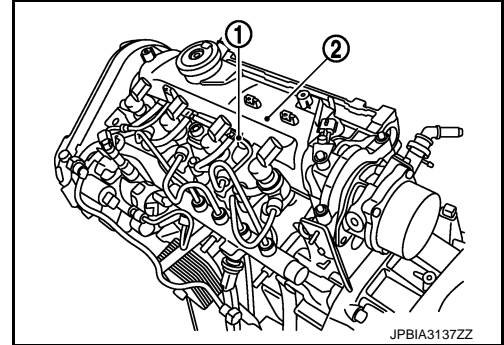
< UNIT DISASSEMBLY AND ASSEMBLY >

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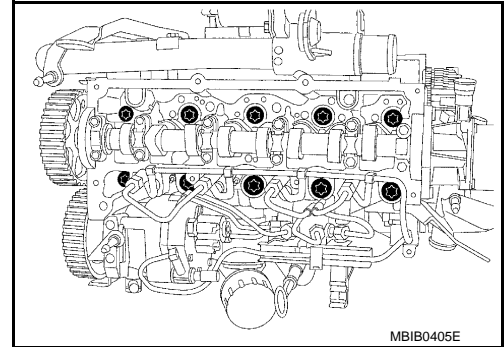
13. Remove the turbocharger oil supply pipe on the turbocharger side, nuts (A) and the torx bolt of the turbocharger flange, and turbocharger oil outlet hose (1).



14. Unclip the fuel return pipe from the cylinder head cover at the fuel spill tube (1), then remove the rocker cover (2).



15. Remove the oil level gauge guide and cylinder head.



CLEANING

- It is very important not to scratch the gasket faces of any aluminium components.
- Use suitable tool to dissolve any part of the seal which remains stuck to the metal surface.
- Apply the dissolving product to the part to be cleaned, wait approximately 10 minutes, then remove it using a wooden spatula.
- Wear gloves while carrying out this operation.
- Do not allow this dissolving product to drip on to the paintwork.
- **Great care should be taken when performing this operation, to prevent foreign objects from entering the pipes taking oil under pressure to the camshafts (pipes in both the cylinder head and its cover) and the oil return pipes.**
- **Failure to follow these instructions could lead to the blocking of the oilways, resulting in rapid and serious damage to the engine.**

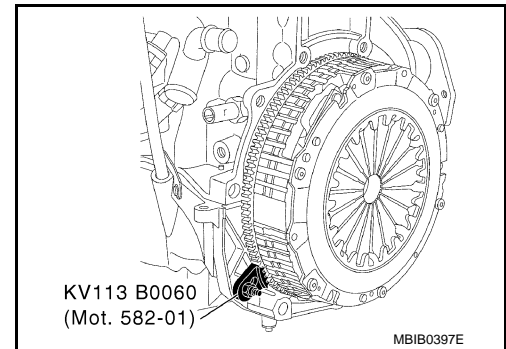
DISASSEMBLY OF THE BOTTOM ENGINE

CYLINDER BLOCK

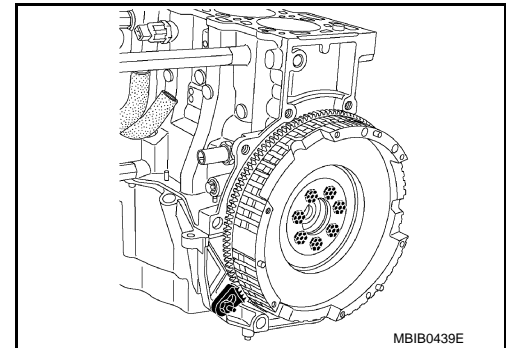
< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

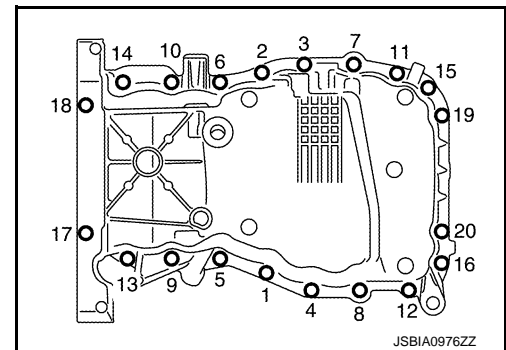
1. Install the Tool KV113B0060 (Mot. 582-01).



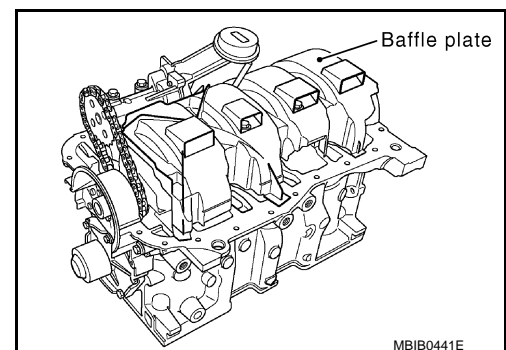
2. Remove the clutch housing.
3. Remove the flywheel.



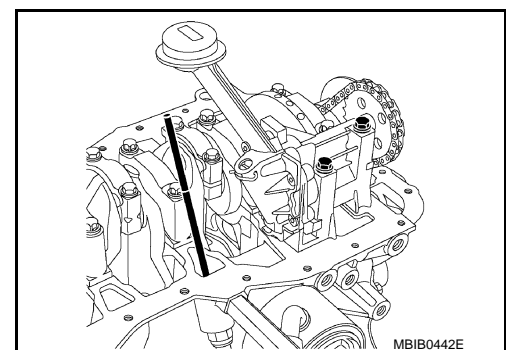
4. Remove the oil pan bolt in reverse order as shown.



5. Remove the baffle plate.



6. Remove the oil level sensor.
7. Remove the oil pump.



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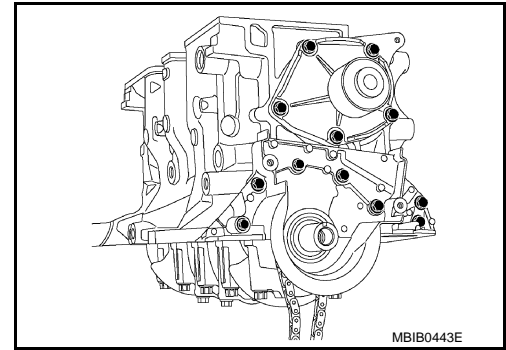
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CYLINDER BLOCK

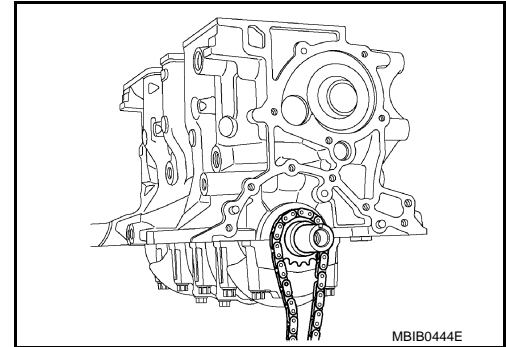
< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

8. Remove the rear oil seal retainer.
9. Remove the water pump.



10. Remove the oil pump chain.
11. Remove the oil pump drive sprocket.



WARNING:

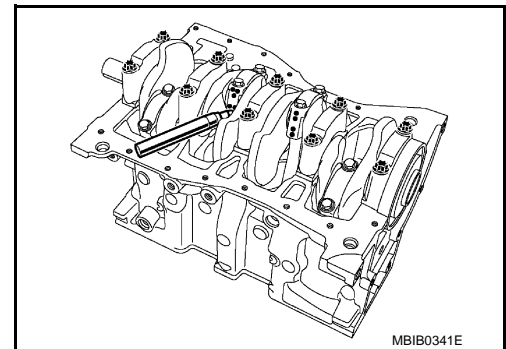
Never use a sharp point to mark the bearing caps in relation to their connecting rods to avoid starting a crack in the rod. Use a permanent marker pen.

12. Remove the big end cap bolts and the connecting rod/piston assemblies.

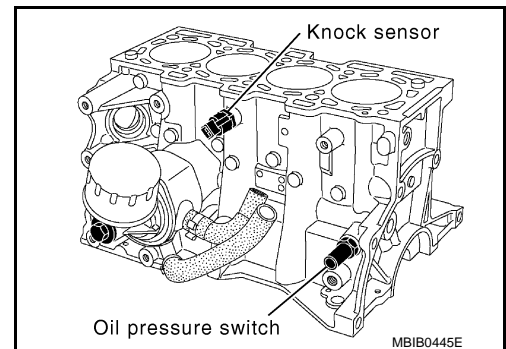
NOTE:

It is essential to mark the position of the main bearing cap, as the category may be different for each bearing.

13. Remove the main bearing caps.
14. Remove the crankshaft.



15. Remove the oil pressure switch, the knock sensor and oil filter bracket connecting bolt.

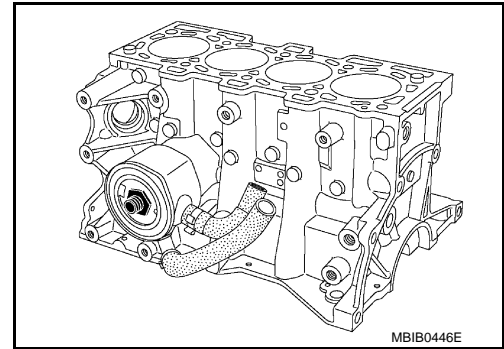


CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

16. Remove the oil cooler connecting bolt.



REMOVING THE PISTON PINS

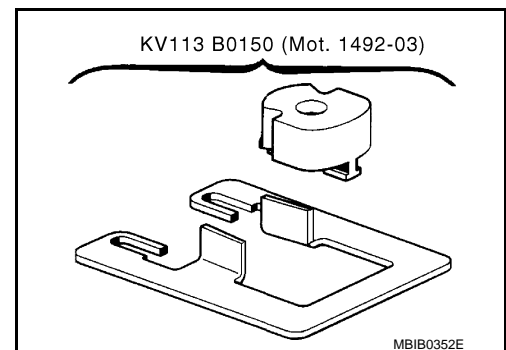
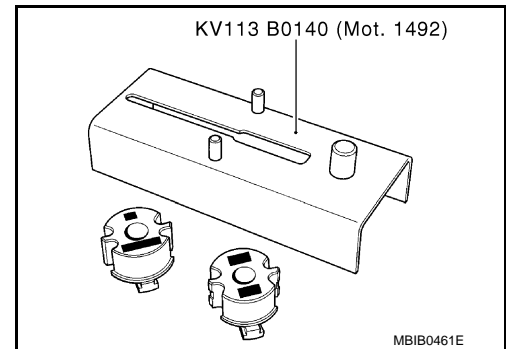
NOTE:

It is imperative to mark the connecting rod to match it to its piston, because the piston height classes in the same engine may be different (see Technical Specifications section).

To remove the piston pin, remove the snap ring using a screwdriver, then release the pin.

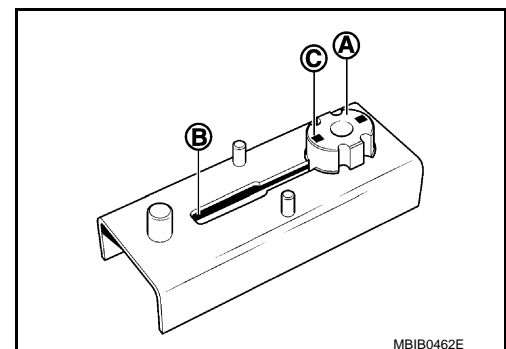
CONNECTING ROD BEARING

- The connecting rod bearing are installed using Tool KV113B0140 (Mot. 1492) and Tool KV113B0150 (Mot. 1492-03).



ON THE CONNECTING ROD BODY

1. Slide the connecting rod bearing support (A) of Tool KV113B0150 [Mot. 1492-03 (positioning the engraved mark (B) as shown in the figure)] into the groove (C) of the base of Tool KV113B0140 (Mot. 1492).



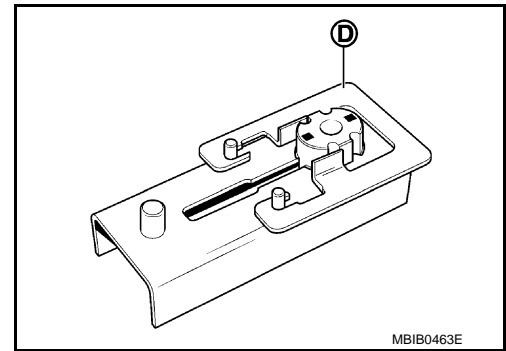
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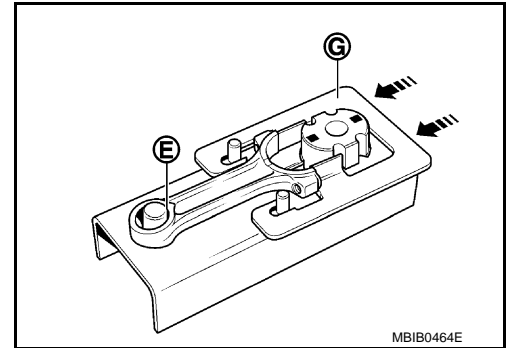
< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

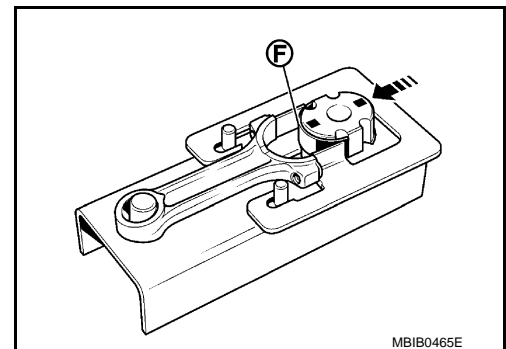
2. Install the guide (D) of Tool KV113B0150 (Mot. 1492-03) onto the base (as shown in the figure).



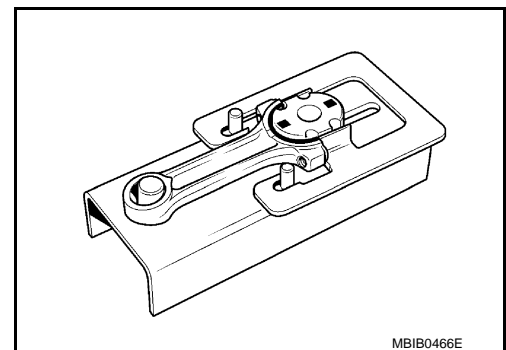
3. Lay the body of the connecting rod on the base of the tool (as shown in the diagram). Check that the lower part (E) of the small end is touching the centering pin and push the guide (G) in the direction of the arrow.



4. Lay the connecting rod bearing [with a width of 20.625 mm (0.8120 in)] (F) on the connecting rod bearing support, then push it in the direction of the arrow (as shown in the figure).



5. Bring the connecting rod support up against the base of the connecting rod body.
6. Remove the connecting rod body support and repeat the operation for the remaining connecting rod bodies.



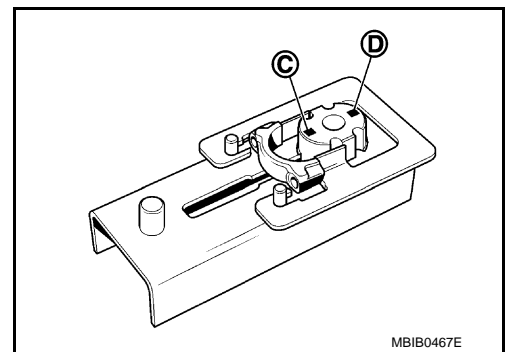
ON THE CONNECTING ROD CAP

CYLINDER BLOCK

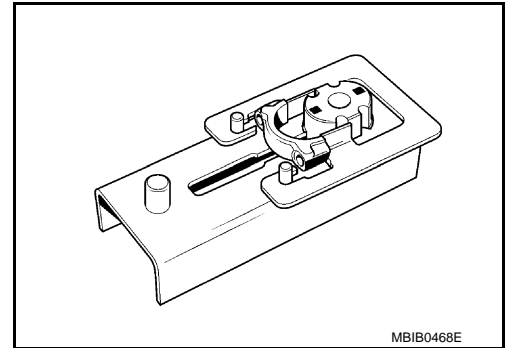
< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

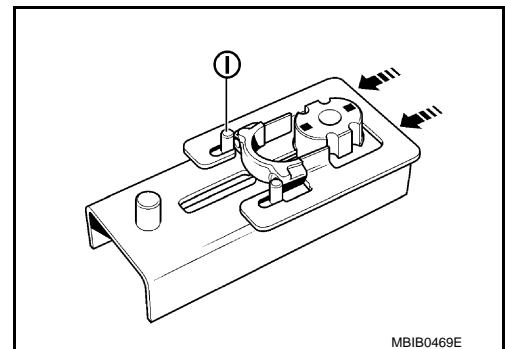
1. Position the connecting rod bearing support either on the engraved mark (C) if the width of the connecting rod bearing is equal to 20.625 mm (0.8120 in).
2. Position the connecting rod bearing support either on the engraved mark (D) if the width of the connecting rod bearing is equal to 17.625 mm (0.6939 in).



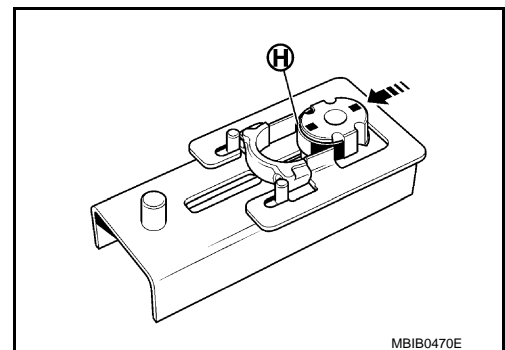
3. Install the connecting rod cap as shown in the figure.



4. Push the guide (in the direction of the arrow) until the connecting rod cap is in contact with the pins (I) on the base of the tool.



5. Install the connecting rod bearing (H) on the bearing support, then push it in the direction of the arrow (as shown in the figure).



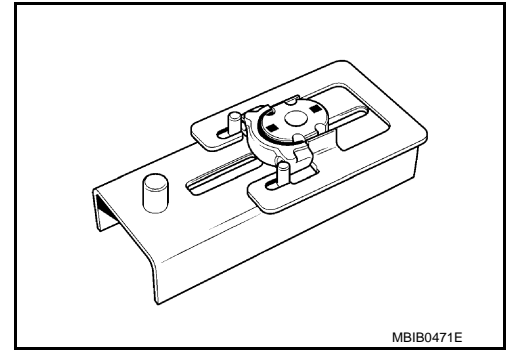
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CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

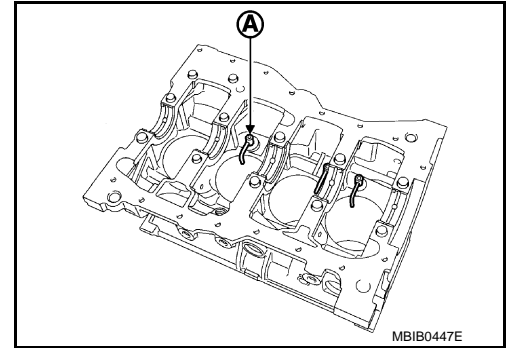
6. Bring the connecting rod bearing support up against the base of the connecting rod cap.
7. Remove the connecting rod bearing support and repeat the operation for the remaining connecting rod caps.



REPLACEMENT OF THE OIL JETS

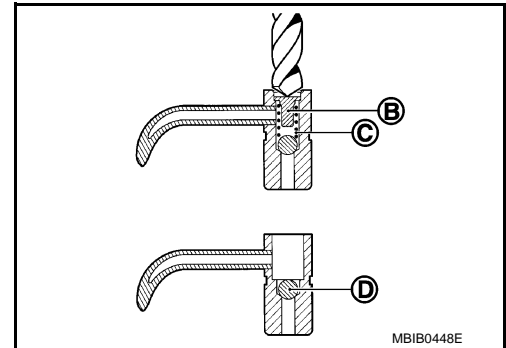
Removal

1. To remove the oil jets (A), they must be drilled with a 7 mm (0.28 in) diameter drill. This is necessary in order to remove the spring stop (B) and the spring (C).

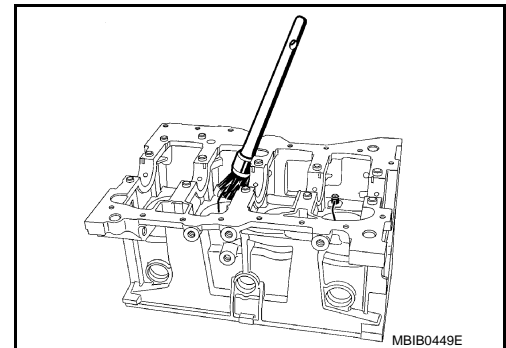


NOTE:

Do not remove the ball (D) to prevent from entering the cooling circuit.



2. Remove the chippings and spring using a suitable brush.

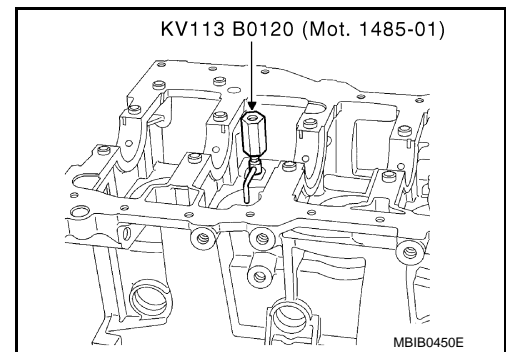


CYLINDER BLOCK

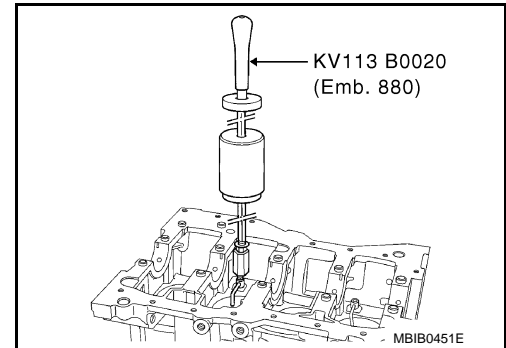
< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

3. Screw Tool KV113B0120 (Mot. 1485-01) in the drilled out jets using a 6 mm (0.24 in) Allen key which must slide into the tool.



4. Screw Tool KV113B0020 (Emb. 880) onto KV113B0120 (Mot. 1485-01) and remove the oil jet.

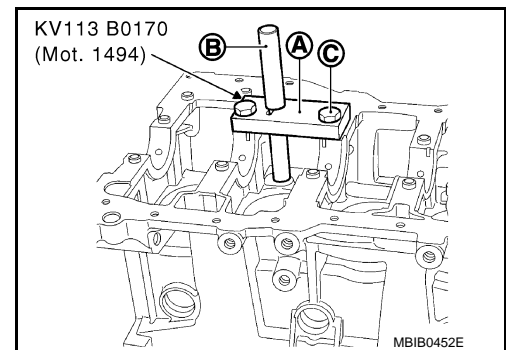


ASSEMBLY

INSTALLATION OF OIL JETS

Installation of The Oil Jets For No.1 and No.3 Cylinders

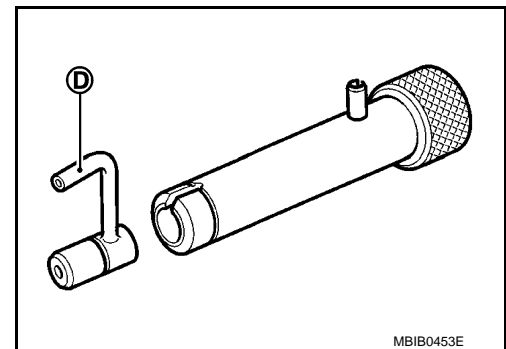
1. Install plate (A) of Tool KV113B0170 (Mot. 1494) onto the cylinder block (as shown in the figure) without tightening the two bolts (C).
2. Position the guide rod (B) in the plate (A) and the end of the guide rod in the hole of the oil jet to center the plate (A).
3. Tighten the two bolts (C).
4. Remove the guide rod.



5. Install the push rod instead of the guide rod, then insert the oil jet into the push rod.

NOTE:

Check that the oil jet is correctly oriented with the end of the jet (D) directed towards the center of the cylinder.



6. The oil jets must be installed using Tool KV113B0170 (Mot. 1494).

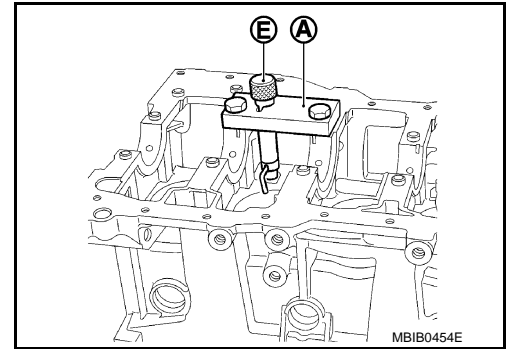
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CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

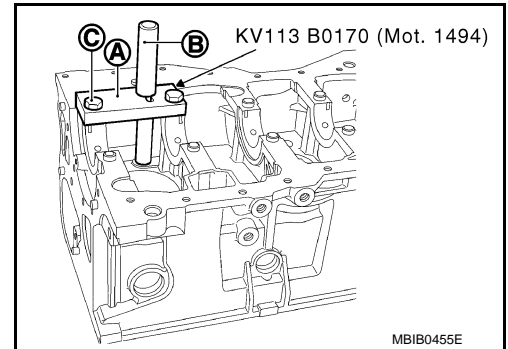
[K9K]

7. With a hammer, tap the push rod until the shoulder (E) of the push rod comes into contact with the plate (A).



Installation of The Oil Jets For No.2 and No.4 Cylinders

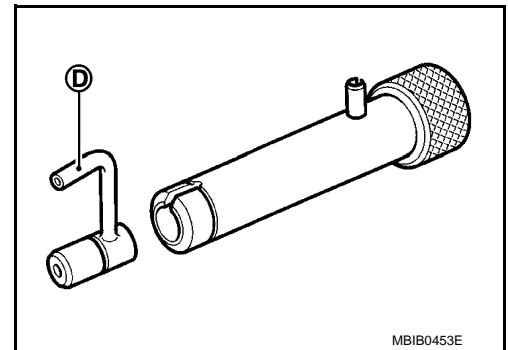
1. Fit plate (A) of Tool KV113B0170 (Mot. 1494) onto the cylinder block (as shown in the figure) without tightening the two bolts (C).
2. Position the guide rod (B) in the plate (A) and the end of the guide rod in the hole of the oil jet to center the plate (A).
3. Tighten the two bolts (C).
4. Remove the guide rod.



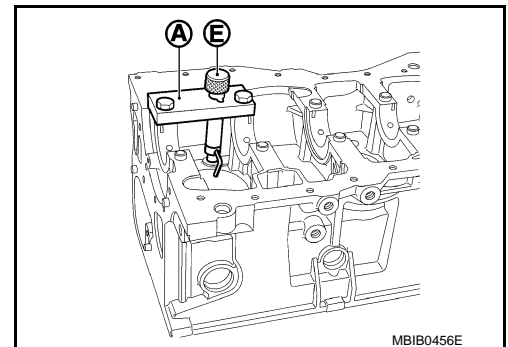
5. Position the push rod instead of the guide rod, then insert the oil jet into the push rod.

NOTE:

Check that the oil jet is correctly oriented with the end of the jet (D) directed towards the center of the cylinder.



6. With a hammer, tap the push rod until the shoulder (E) of the push rod comes into contact with the plate (A).



Orientation Of The Oil Jets (See Diagram Below)

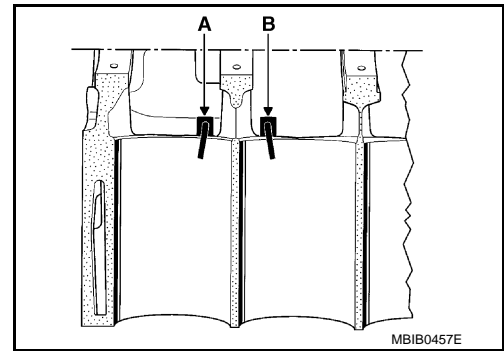
- Clean the cylinder block and crankshaft by passing a wire through the lubrication channels.

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

A	Orientation of the oil jets of No. 2 and No. 4 cylinders
B	Orientation of the oil jets of No. 1 and No. 3 cylinders



A

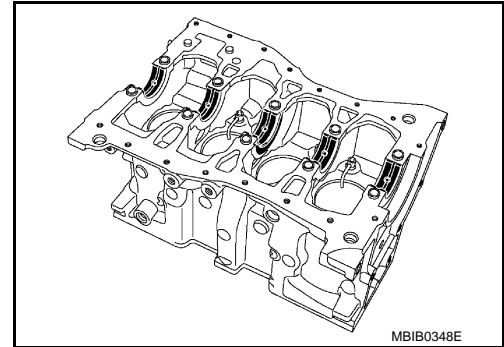
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INSTALLATION OF MAIN BEARING

1. Position the grooved main bearings on the cylinder block.

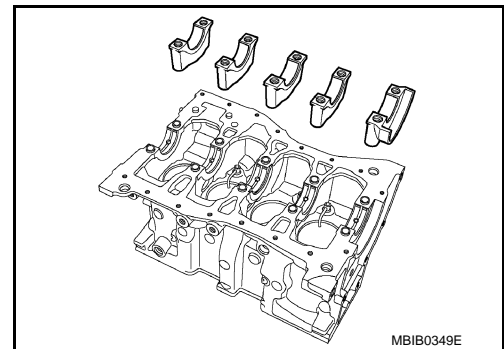


E

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2. Install the smooth bearings on the bearing caps.



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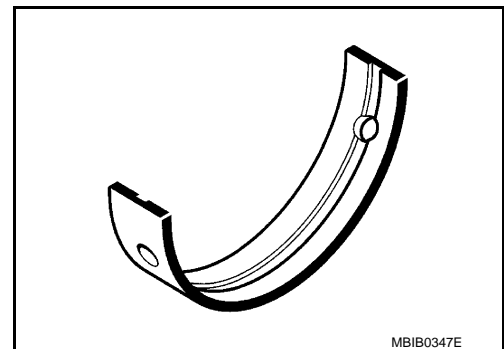
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MAIN BEARING

- The engine is installed with main bearing without a locator notch.

1. The main bearings are installed on the cylinder block and on the bearings using Tool KV113B0160 (Mot. 1493-01).



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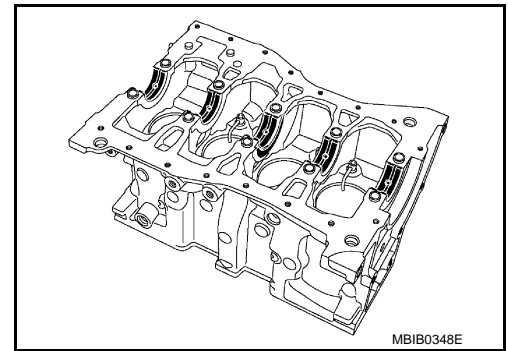
P

CYLINDER BLOCK

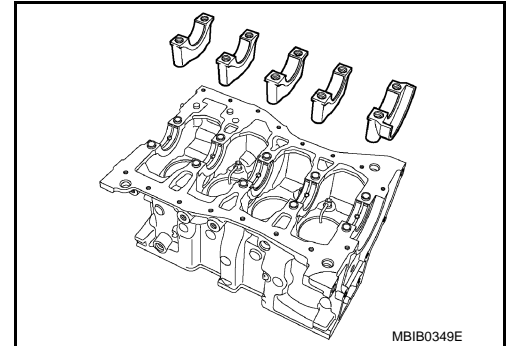
[K9K]

< UNIT DISASSEMBLY AND ASSEMBLY >

2. For direction of installation on the cylinder block, install grooved main bearing on all the bearings.

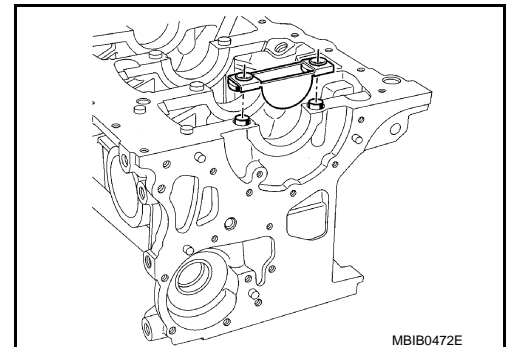


3. For direction of installation on the bearing caps, install non-grooved main bearing.

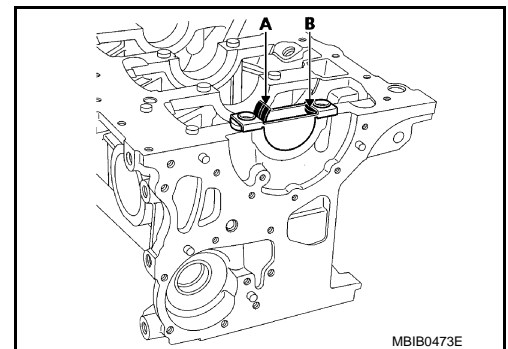


ON THE CYLINDER BLOCK

1. Position tool KV113B0160 (Mot. 1493-01) on the cylinder block.



2. Press at (A) until the bearing cap is touching at (B) with KV113B0160 (Mot. 1493-01).



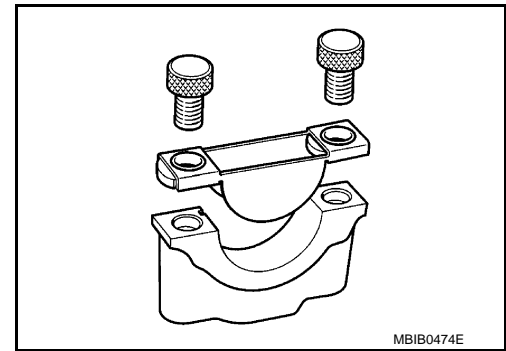
ON THE BEARING CAPS

CYLINDER BLOCK

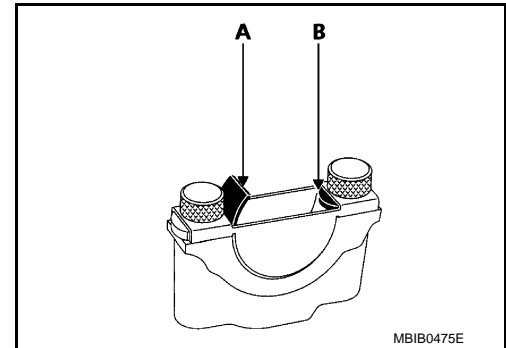
< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

1. Position Tool KV113B0160 (Mot. 1493-01) on the bearing cap.



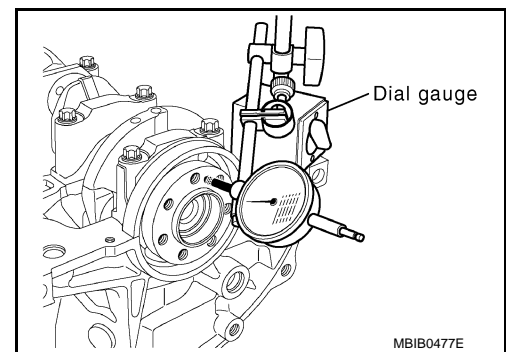
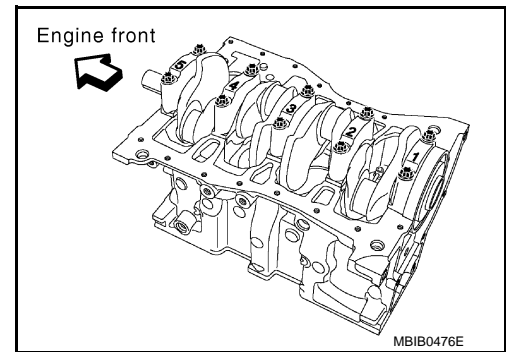
2. Install the main bearing in Tool KV113B0160 (Mot. 1493-01), then press at (A) until the main bearing is touching at (B) with Tool KV113B0160 (Mot. 1493-01).



3. Oil the main bearing.
4. Install the crankshaft.
5. Install the lateral shims on bearing No. 3, putting the grooves on the crankshaft side.
6. Install the main bearing caps on bearing cap No. 1 (these are numbered from 1 - 5 and these numbers should be positioned opposite the water pump), and tighten the bolts as follows:
 - a. Tighten the bolts.

 : 25 N·m (2.6 kg-m, 18 ft-lb)

- b. Turn the bolt 47 degrees \pm 6 degrees clockwise (angle tightening).
7. Check the lateral clearance of the crankshaft which should be without wear on lateral shims: 0.045 - 0.252 mm (0.0018 - 0.0099 in)
 8. Check the lateral clearance of the crankshaft which should be with wear on the lateral shims: 0.045 - 0.852 mm (0.0018 - 0.0335 in)



INSTALLATION OF NO. 1 BEARING

CYLINDER BLOCK

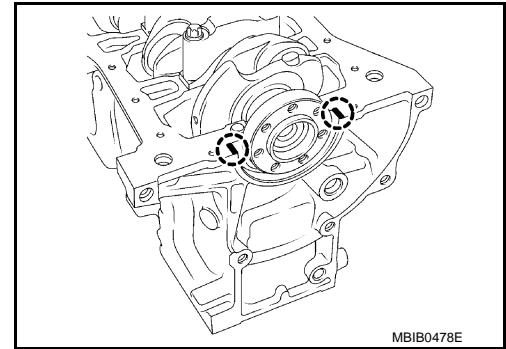
< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

1. **Degrease the gasket faces (of the cylinder block and bearing No. 1). They should be clean, dry and free from grease (in particular, remove finger marks).**
2. Lay two beads of liquid sealant with a width of 1 mm (0.04 in) on bearing No. 1 of the cylinder block.
Tighten the bolts of bearing cap No. 1, and tighten the bolts as follows:
 - a. Tighten the bolts.

 : 25 N·m (2.6 kg-m, 18 ft-lb)

- b. Turn the bolt 47 degrees \pm 6 degrees clockwise (angle tightening).

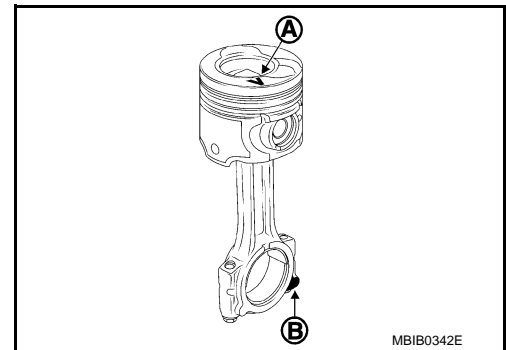


CONNECTING RODS / PISTON ASSEMBLY

- The pistons have a mark engraved on their heads indicating the engine rear side.
1. Oil the piston pin.
 2. Check that the piston pins rotate correctly in the new piston and in the matching connecting rod.

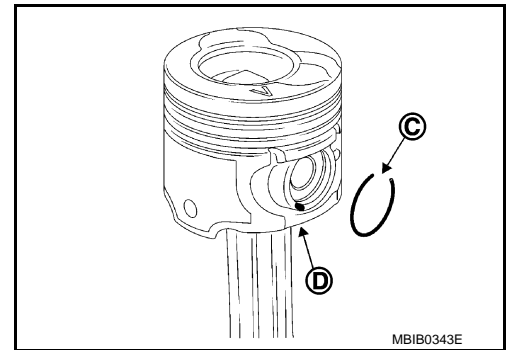
Direction Of Installation Of The Connecting Rod In Relation To The Piston

- Point the mark (A) engraved on the top of the piston upwards and the flat (B) of the big end downwards as shown in the figure.



DIRECTION FOR INSTALLATION THE SNAP RINGS ON THE PISTON

- Position the opening (C) of the snap rings opposite the removal and fitting channel (D).



INSTALLATION OF THE SNAP RINGS

1. Rings set to their original adjustment must be free within their channels.
2. Ensure the snap rings are fitted the correct way, with the word TOP pointing upwards.

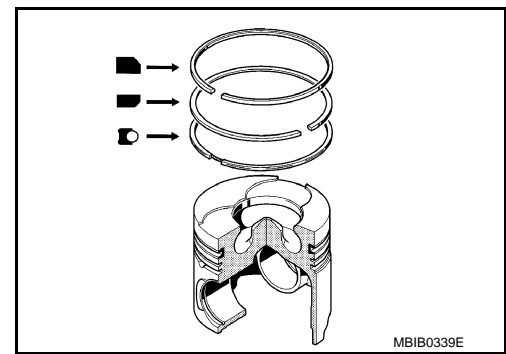
Orientation Of The Piston Rings In The Piston

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

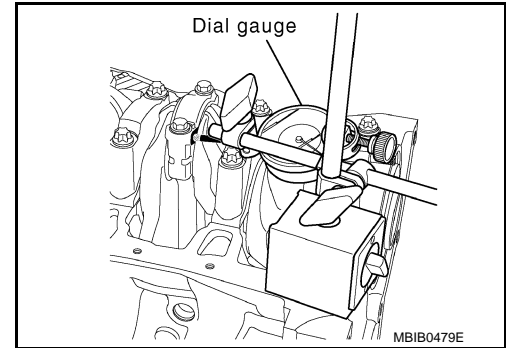
[K9K]

1. Ensure the break in each piston ring is correctly oriented as shown in the figure.



2. Apply new engine oil to the pistons.
3. Install the connecting rod/piston assemblies into the cylinder block using the ring, being careful to fit them the right way round (mark towards the flywheel).
4. Install the connecting rods onto the oiled crankshaft pins of the crankshaft.
5. Install the connecting rod caps, ensuring they are correctly matched.
6. Tighten the big end cap bolts to a torque of 20 N·m (2.0 kg·m, 15 ft·lb), plus an angle tightening of $45^{\circ} \pm 6^{\circ}$.

 : 20 N·m (2.0 kg·m, 15ft·lb)



7. Inspect that the big ends have the correct lateral clearance of 0.205 to 0.467 mm (0.0081 to 0.0184 in).

CONNECTING ROD BEARING

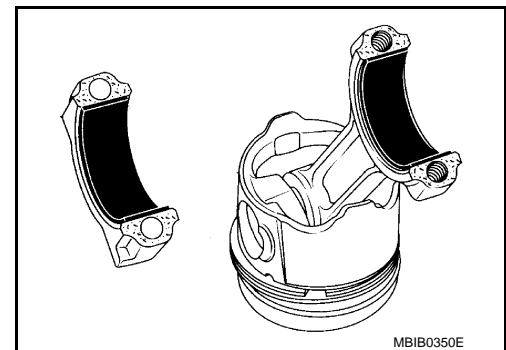
- The engine is installed with connecting rod bearing without a locator notch.

NOTE:

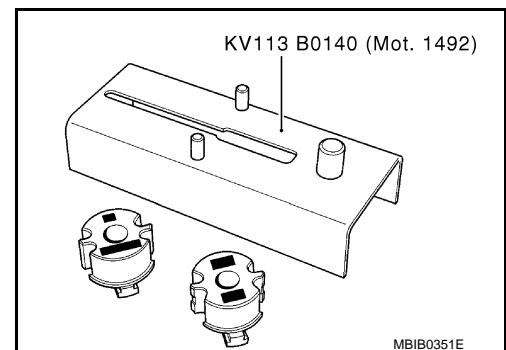
The upper and lower connecting rod bearing are not the same width.

Connecting rod bearing width:

Upper bearing : 20.625 mm (0.8120 in)
 Lower bearing : 17.625 mm (0.6939 in)



- The connecting rod bearing are installed using Tool KV113B0140 (Mot. 1492) and Tool KV113B0150 (Mot. 1492-03).

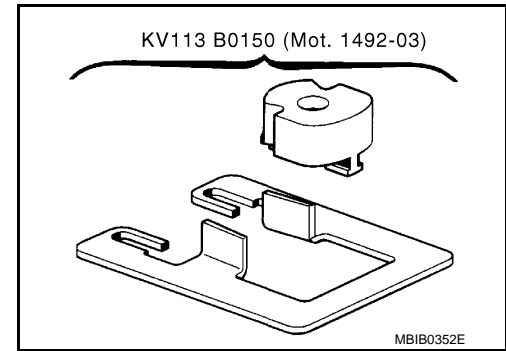


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CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]



CHECKING PISTON PROTRUSION

1. Clean the piston head.
2. Turn the crankshaft one turn in its operating direction to bring piston No. 1 close to TDC.
3. Install Tool KV113B0050 (Mot. 252-01) (Commercial service tool) or equivalent tool on the piston.
4. Install Tool KV113B0040 (Mot. 251-01) (Commercial service tool) or equivalent tool equipped with a gauge on support plate KV113B0050 (Mot. 252-01) (Commercial service tool) or equivalent tool, and find TDC.

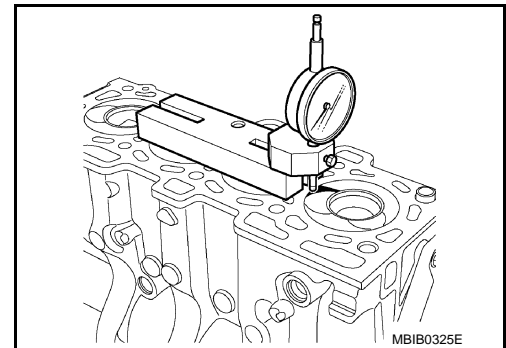
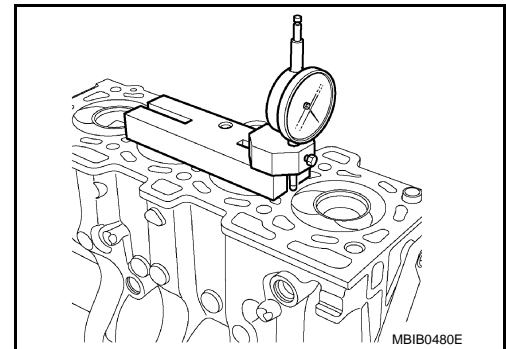
NOTE:

All measurements must be carried out along the longitudinal axis of the engine, in order to eliminate any errors due to tilting of the piston.

WARNING:

The gauge follower must not be in the valve clearance.

5. Inspect the piston protrusion which must be 0.099 to 0.285 mm (0.0039 to 0.0112 in).



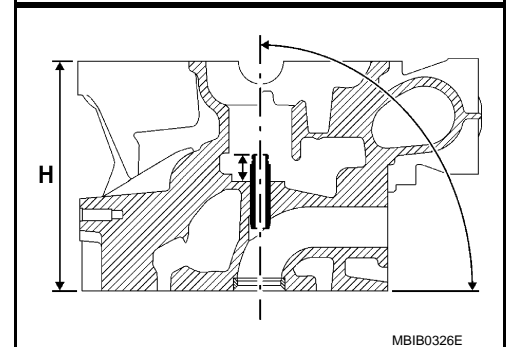
Height of the cylinder head:

$$H = 127 \text{ mm (5.00 in)}$$

Gasket face bow:

Cylinder head : 0.05 mm (0.0020 in)

Cylinder block : 0.03 mm (0.0012 in)



NO REGRINDING IS AUTHORIZED

Test the cylinder head to detect possible cracks using the cylinder head test container (comprising a tray and a kit suited to the cylinder head, plug, sealing plate and blanking plate).

INSTALLATION OF REAR OIL SEAL RETAINER AND OIL PUMP

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

1. Tighten the knock sensor.

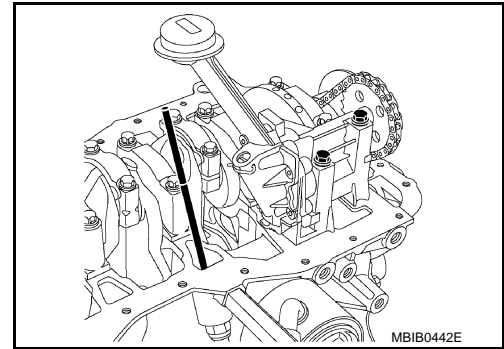
 : 20 N·m (2.0 kg·m, 15ft·lb)

2. Tighten the oil pressure sensor.

 : 25 N·m (2.6 kg·m, 18ft·lb)

3. Install the oil pump sprocket and chain.

 : 25 N·m (2.6 kg·m, 18ft·lb)

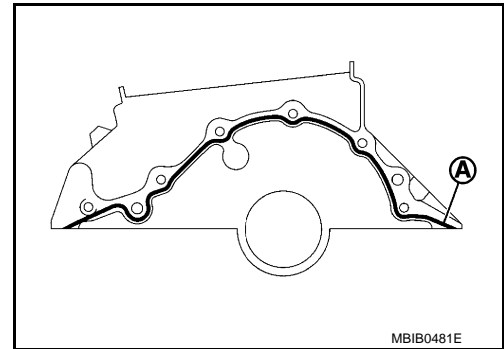


NOTE:


The gasket faces (cylinder block, rear oil seal retainer and water pump) must be clean, dry and free from grease (in particular, remove finger marks).

The rear oil seal retainer should be applied with liquid gasket. The bead (A) must be 1.5 to 2 mm (0.059 to 0.079 in) wide and be applied in accordance with the figure.


- Use Genuine Liquid Gasket or equivalent.



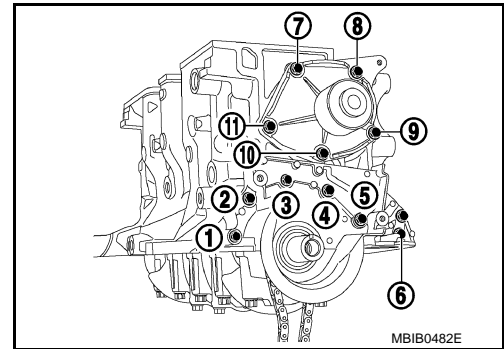
4. Install the rear oil seal retainer. Tighten bolts (No.1 to 6) as shown in the figure.

 : 12 N·m (1.2 kg·m, 9ft·lb)

5. Put a new gasket to water pump face and install the water pump. Put a drop of locking sealant on the bolts (No.7 to 11) in the numerical order as shown in the figure.

 : 11 N·m (1.1 kg·m, 8ft·lb)

- Use Genuine thread locking sealant or equivalent.

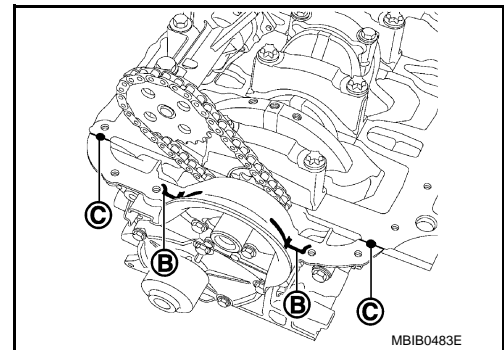


NOTE:

The gasket faces (cylinder block and rear oil seal retainer) must be clean, dry and free from grease (in particular, remove finger marks).

6. Apply four beads (B) of liquid gasket, with a diameter of 5 mm (0.20 in).
7. Apply two drops (C) of liquid gasket, with a diameter of 7 mm (0.28 in) at the intersection of the rear oil seal retainer and the cylinder block.

- Use Genuine Liquid Gasket or equivalent.

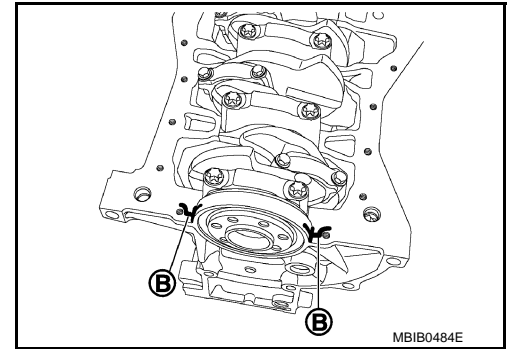


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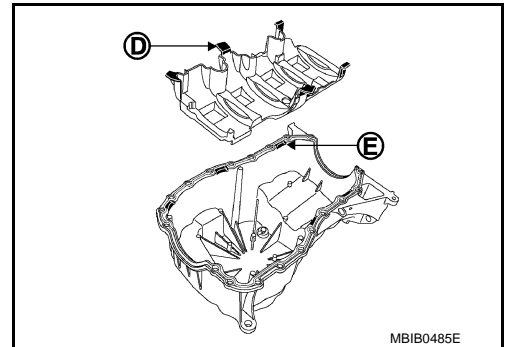
CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

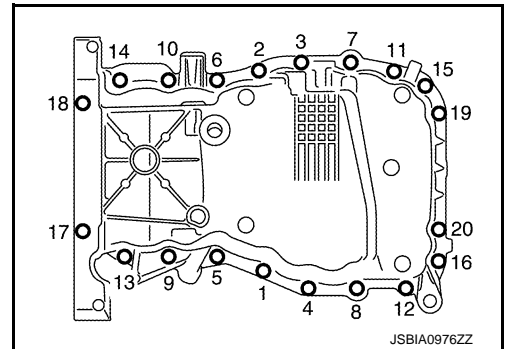


8. When installing the oil pan, ensure that the tabs (D) of the baffle plate are correctly positioned in the slots (E).
9. When installing the oil pan, ensure that the cylinder block and the oil pan are correctly aligned on the flywheel side, to prevent the clutch housing from being damaged when installing the transaxle.
10. Install the baffle plate.



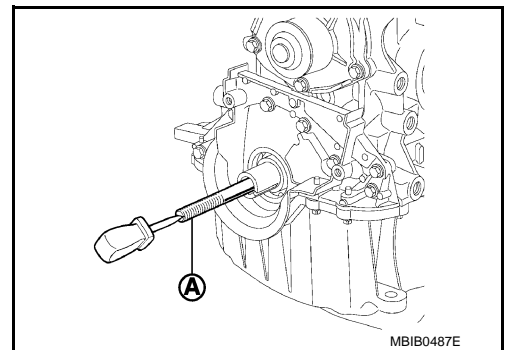
11. Install the oil pan, and tighten the bolts in the numerical order as shown in the figure

 : 14 N·m (1.4 kg·m, 10ft·lb)

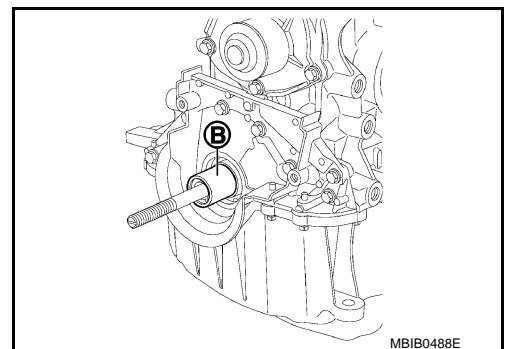


INSTALLATION OF THE CRANKSHAFT SEAL GASKETS

1. Crankshaft elastomer seal, timing side.
2. Screw the threaded rod (A) of Tool KV113B0220 (Mot. 1586) into the crankshaft.



3. Position the spacer (B) of Tool KV113B0220 (Mot. 1586) on the crankshaft.

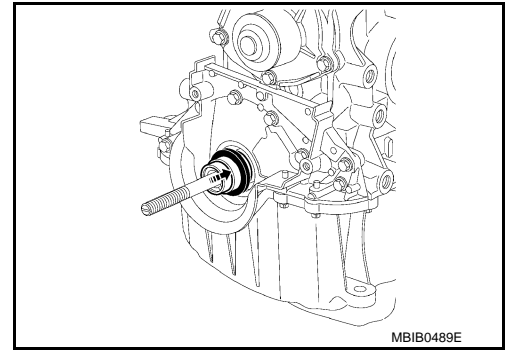


CYLINDER BLOCK

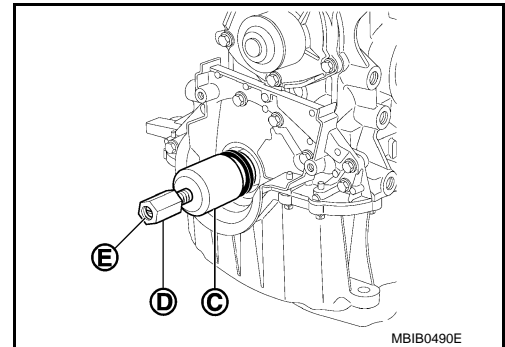
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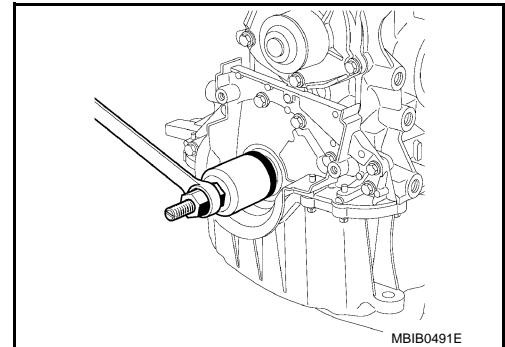
4. Install the protector complete with the seal onto the spacer, taking care not to touch the seal.



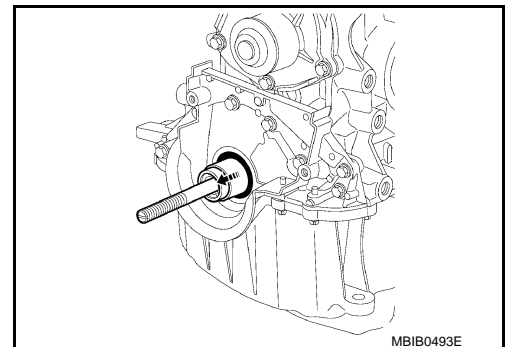
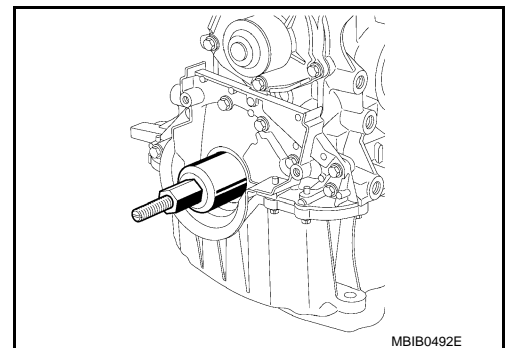
5. Install the cover (A) and the nut (B) (putting the threaded part (C) of the nut on the side away from the engine) of Tool KV113B0220 (Mot. 1586).



6. Tighten the nut until the cover touches the spacer.



7. Remove the nut, the cover, the protector and the threaded rod.



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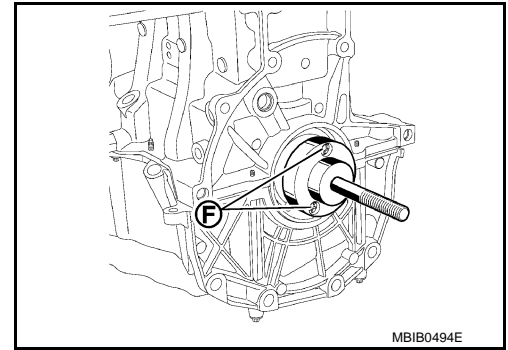
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CYLINDER BLOCK

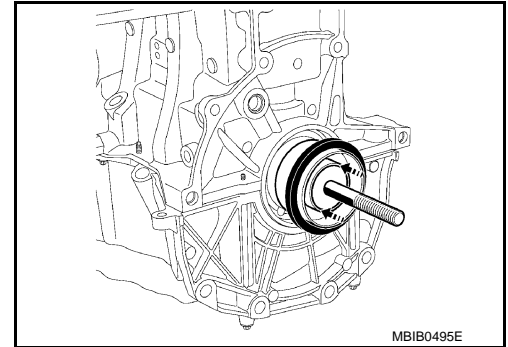
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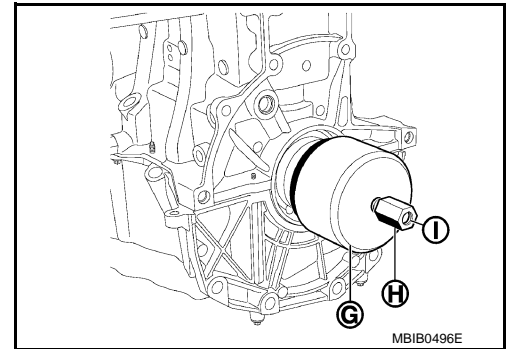
8. Crankshaft elastomer seal, flywheel side.
9. Install Tool KV113B0210 (Mot. 1585) on the crankshaft, securing it with bolts (F).



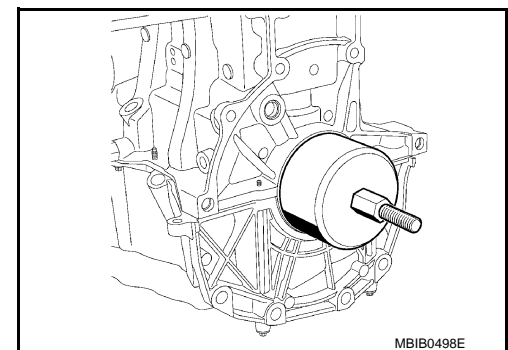
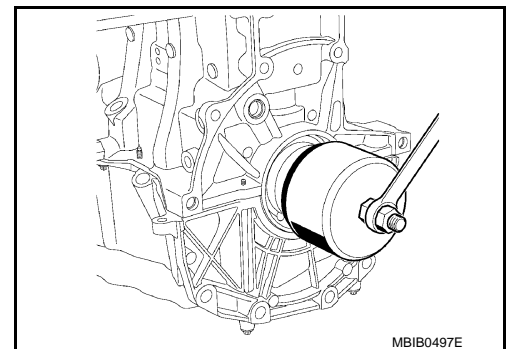
10. Put the protector complete with the seal on Tool KV113B0210 (Mot. 1585), being careful not to touch the seal.



11. Install the cover (G) and nut (H) (putting the threaded part (I) of the nut on the side away from the engine) of Tool KV113B0210 (Mot. 1585).



12. Tighten the nut until the cover touches the cylinder block.

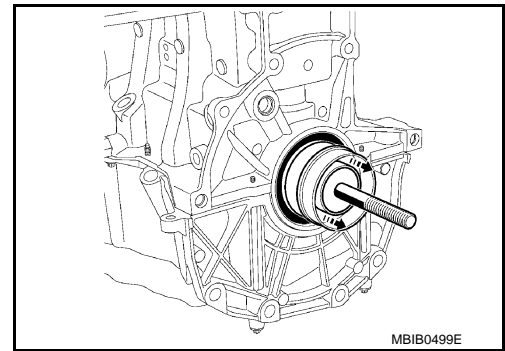


CYLINDER BLOCK


< UNIT DISASSEMBLY AND ASSEMBLY >

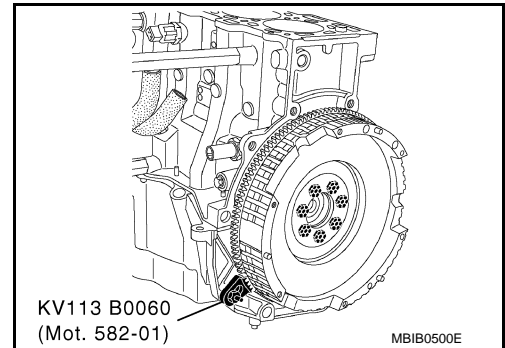
[K9K]

13. Remove the nut, the cover, the protector and the threaded rod.



14. Install Tool KV113B0060 (Mot. 582-01) and tighten the new bolts.

 : 50 - 60 N·m (5.1 - 6.1 kg·m, 37 - 44 ft·lb)

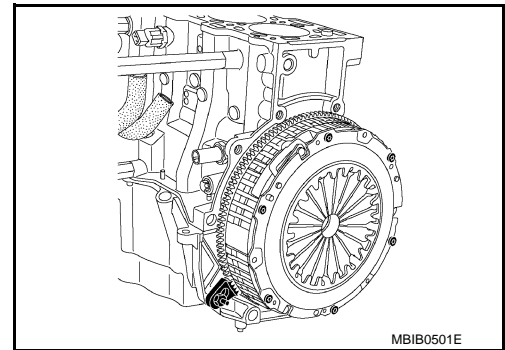


15. Install the clutch housing, tightening the bolts to the torque.

M6 bolt : 13 - 16 N·m
(1.3 - 1.6 kg·m, 10 - 12 ft·lb)

M7 bolt : 18 - 22 N·m
(1.8 - 2.2 kg·m, 13 - 16 ft·lb)

16. Remove Tool KV113B0060 (Mot. 582-01).



METHOD FOR INSTALLING THE OIL COOLER AND OIL FILTER

1. Install oil cooler. Refer to [LU-27, "Exploded View"](#).
2. Install oil filter. Refer to [LU-25, "Exploded View"](#).

Inspection

INFOID:000000006659449

PISTON MARKING

1	Direction of fitting of the piston mark towards the flywheel
2	Height between the piston pin and the top of the piston (see table below).
3	Used by the supplier only
4	Used by the supplier only
5	Used by the supplier only
6	Piston axis of symmetry
7	Piston pin hole axis
8	Offset between the hole axis (7) and the piston's axis of symmetry (6) is 0.3 mm (0.012 in)

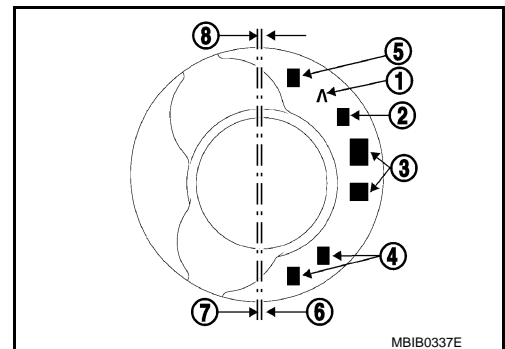


TABLE OF PISTON PIN HEIGHT

CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

Unit: mm (in)

* Mark on piston	Piston pin height
K	41.667 (1.6404)
L	41.709 (1.6421)
M	41.751 (1.6437)
N	41.793 (1.6454)
P	41.835 (1.6470)

The tolerance on the piston pin heights is ± 0.02 mm (± 0.0008).

* The different piston pin heights are exclusively reserved for the engine assembly plant.

The service parts will only supply piston classes (height) L, M, N.

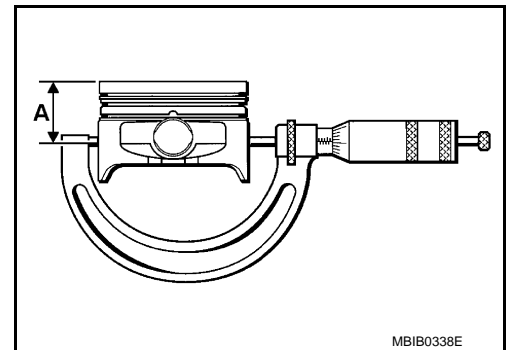
NOTE:

- If the engine is installed with a K class piston, an L class piston must be installed as a replacement.
- If the engine is installed with a P class piston, an N class piston must be installed as a replacement.

MEASURING THE PISTON DIAMETER

The piston diameter must be measured at height A = 56 mm (2.20 in).

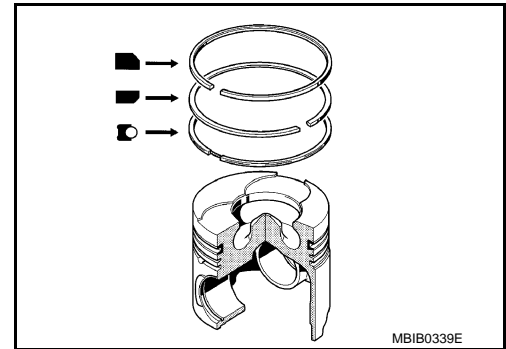
- Piston diameter** : 75.933 - 75.947 mm (2.9895 - 2.9900 in)
- Piston pin:**
 - Length** : 59.7 - 60.3 mm (2.350 - 2.374 in)
 - Outer diameter** : 24.8 - 25.2 mm (0.976 - 0.992 in)
 - Inner diameter** : 13.55 - 13.95 mm (0.5335 - 0.5492 in)



PISTON RING

- Thickness:**
 - Top ring** : 1.97 - 1.99 mm (0.0776 - 0.0783 in)
 - 2nd ring** : 1.97 - 1.99 mm (0.0776 - 0.0783 in)
 - Oil ring** : 2.47 - 2.49 mm (0.0972 - 0.0980 in)

The piston rings are supplied ready adjusted.



PISTON RING END GAP

- Top ring** : 0.20 - 0.35 mm (0.0079 - 0.0138 in)
- 2nd ring** : 0.70 - 0.90 mm (0.0276 - 0.0354 in)
- Oil ring** : 0.25 - 0.50 mm (0.0098 - 0.0197 in)

CONNECTING ROD

CYLINDER BLOCK

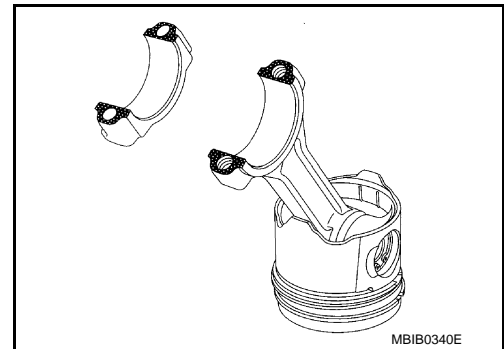
< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

The connecting rod is of the detachable cap type.

WARNING:

- The bolts must be coated with engine oil under the heads and on the threads when the connecting rods are installed in the engine.
- The big end caps are positioned on the connecting rod by irregularities on the parting line.
- The occurrence of impacts or a foreign body between the body - cap mating surfaces will lead to rapid rupture of the connecting rod.



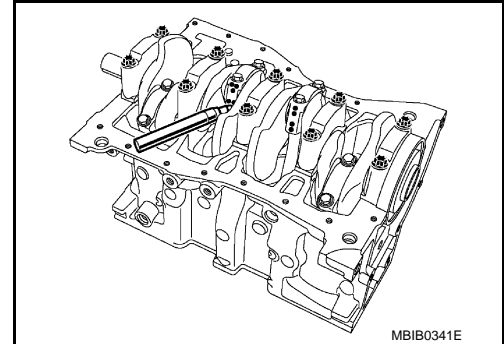
Lateral big end play	: 0.205 - 0.467 mm (0.0081 - 0.0184 in)
Diametrical big end play	: 0.035 - 0.045 mm (0.0014 - 0.0018 in)
Center distance between the big end and small end	: 133.75 mm (5.2657 in)
Diameter of the big end	: 47.610 - 47.628 mm (1.8744 - 1.8751 in)
Diameter of the small end	
(without ring)	: 27.24 - 27.26 mm (1.0724 - 1.0732 in)
(with ring)	: 25.013 - 25.025 mm (0.9848 - 0.9852 in)

NOTE:

The connecting rod small end rings cannot be replaced.
The maximum weight difference for the connecting rod, piston and piston pin assemblies for the same engine must be 0.245 N (25 g, 0.88 oz).

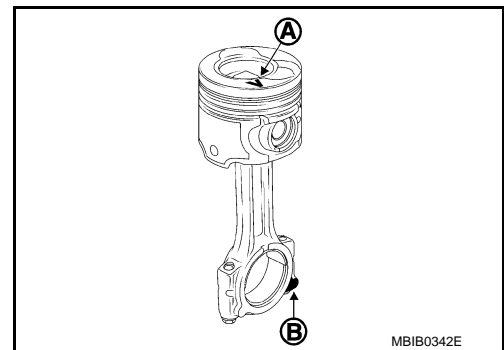
WARNING:

- To avoid initiating a crack in the connecting rod, Never use a sharp point to mark the big end caps in relation to their connecting rod.
- Use a permanent marker pen.



DIRECTION OF INSTALLATION OF THE CONNECTING ROD IN RELATION TO THE PISTON

- Point the mark (A) engraved on the top of the piston upwards and the machined flat (B) of the big end downwards as shown in the figure.



DIRECTION FOR INSTALLATION THE SNAP RINGS ON THE PISTON

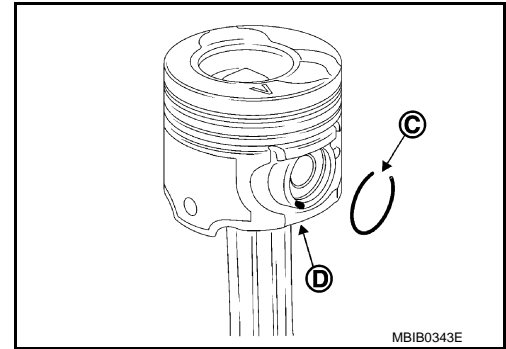
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CYLINDER BLOCK

< UNIT DISASSEMBLY AND ASSEMBLY >

[K9K]

- Position the opening (C) of the snap rings opposite of the removal and installation channel (D).



CRANKSHAFT

Number of main journals	: 5
Crankshaft side clearance:	
Without wear on side shims	: 0.045 - 0.252 mm (0.0018 - 0.0099 in)
With wear on side shims	: 0.045 - 0.852 mm (0.0018 - 0.0335 in)
Crankshaft diametrical clearance:	
Journals	: 0.027 - 0.054 mm (0.0011 - 0.0021 in)
Crankshaft pins	: 0.035 - 0.045 mm (0.0014 - 0.0018 in)
Journal diameter:	: 47.99 - 48.01 mm (1.8894 - 1.8902 in)
Crankshaft pin diameter:	: 43.96 - 43.98 mm (1.7307 - 1.7315 in)

- The lateral shims are located on bearing No. 3.
- No rectifications are allowed.

WORKING OUT THE CLASS OF MAIN BEARING (ORIGINAL FITMENT)

Marking (A) On The Crankshaft

- Detail of the marking (A):

Number of journals

1*	2	3	4	5	Classes of journal diameters A = D1 B = D2 C = D3
B	B	C	C	B	

* Flywheel end.

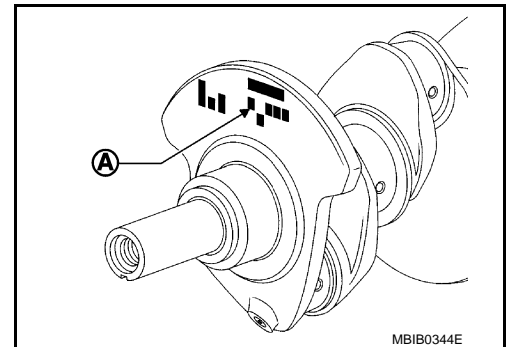


Table Of Journal Diameter Classes

Unit: mm (in)

Journal class mark on the crankshaft	Journal diameter
A = D1	47.990 - 47.996 (1.8894 - 1.8896)
B = D2	47.997 - 48.003 (1.8896 - 1.8899)
C = D3	48.004 - 48.010 (1.8899 - 1.8902)

CYLINDER BLOCK

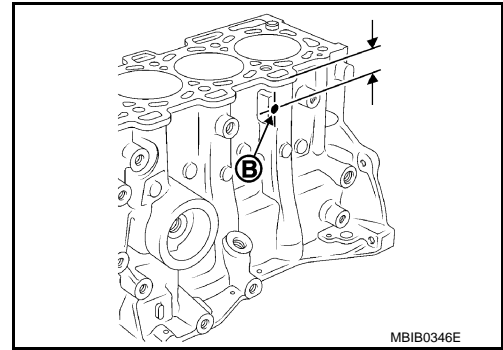
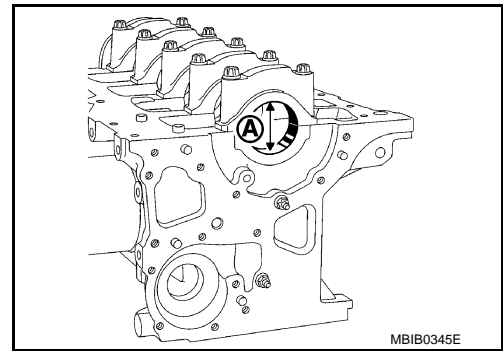
ENGINE IDENTIFICATION

CYLINDER BLOCK

[K9K]

< UNIT DISASSEMBLY AND ASSEMBLY >

The diameters of the bearings (A) of the cylinder block are marked by a hole on the block (B) located above the oil filter.



ENGINE IDENTIFICATION

Identification is by means of an engraved plate on the cylinder block which carries:

- A: engine type
- B: engine type approval letter
- D: code
- E: engine suffix
- F: engine serial number
- G: engine assembly plant

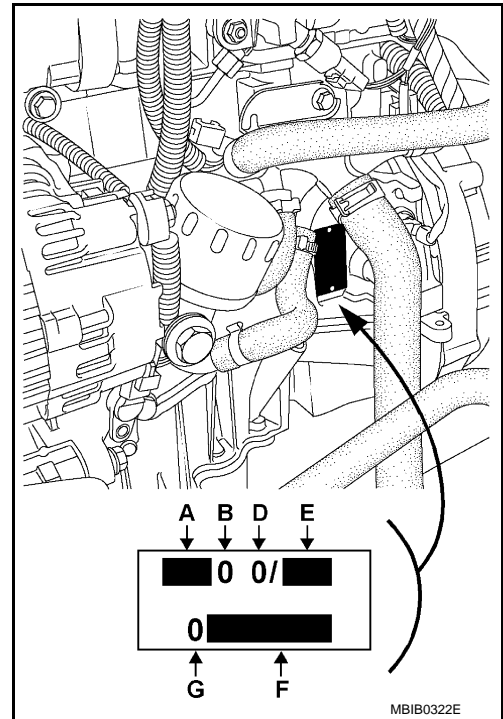


TABLE OF CYLINDER BLOCK MAIN BEARING HOUSING INNER DIAMETERS

Hole position (B)	Class reference	Cylinder block main bearing housing inner diameter
X = 33 mm (1.30 in)	1 or blue	51.936 - 51.942 mm (2.0447 - 2.0450 in)
Y = 43 mm (1.69 in)	2 or red	51.942 - 51.949 mm (2.0450 - 2.0452 in)

NOTE:

The marking zone includes:

CYLINDER BLOCK

[K9K]

< UNIT DISASSEMBLY AND ASSEMBLY >

- X - Y gives the diameter class of bearings A or B.

MATCHING THE MAIN BEARING

	Journal diameter class		
	D1	D2	D3
1*	C1 1.949 - 1.955 mm (0.0767 - 0.0770 in) yellow	C2 1.946 - 1.952 mm (0.0766 - 0.0769 in) blue	C3 1.943 - 1.949 mm (0.0765 - 0.0767 in) black
2*	C4 1.953 - 1.959 mm (0.0769 - 0.0771 in) red	C1 1.949 - 1.955 mm (0.0767 - 0.0770 in) yellow	C2 1.946 - 1.952 mm (0.0766 - 0.0769 in) blue
	Bearing thickness and class		

* Cylinder block main bearing diameter class.

NOTE:

The service parts will only supply class C2 (blue).

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[K9K]

SERVICE DATA AND SPECIFICATIONS (SDS)

SERVICE DATA AND SPECIFICATIONS (SDS)

General Specification

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A

EM

Engine	Compression ratio	Bore and stroke mm (in)	Displacement cm ³ (cu in)	Compression pressure kPa (bar, kg/cm ² , psi)
K9K	18.25/1	76 x 80.5 (2.992 x 3.169)	1,461 (89.15)	Maximum pressure must be least 1,800 (18, 18.36, 261)

C

D

Tightening torque

INFOID:0000000006659451

E

UPPER ENGINE

Unit: N·m (kg-m, ft-lb)

F

Tightening torque		
	Cylinder head	: *1
	Camshaft bracket	: 11 (1.1, 8)
	Vacuum pump	: 21 (2.1, 15)
	Cylinder head coolant outlet unit	: 11 (1.1, 8)
	Exhaust manifold	: 26 (2.7, 19)
	Glow plug	: 15 (1.5, 11)
	Rocker cover	: 12 (1.2, 9)
	Turbocharger-manifold mounting	: 26 (2.7, 19)
	Turbocharger oil return pipe	: 12 (1.2, 9)
	Turbocharger oil supply pipe	: 23 (2.3, 17)
	Timing tensioner	: 27 (2.8, 20)
	TDC cap	: 20 (2.0, 15)
	Cylinder head suspended mounting bracket	: 21 (2.1, 15)

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*1: Refer to tightening procedure in the text.

BOTTOM ENGINE

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SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[K9K]

Unit: N·m (kg·m,ft·lb)

Tightening torque	Oil cooler connector bolt	: 45 (4.6, 33)
	Oil filter bracket	: 45 (4.6, 33)
	Main bearing cap	: 25 (2.6, 18) + 47°±6° (Angle tightening)
	Connecting rod	: 20 (2.0, 15) + 45°±6° (Angle tightening)
	Knock sensor	: 20 (2.0, 15)
	Oil level sensor	: 25 (2.6, 18)
	Oil pump	: 25 (2.6, 18)
	Oil pan	: *1
	Water pump	: 11 (1.1, 8)
	Flywheel	: 50 - 55 (5.1 - 5.6, 37 - 40)
	Crankshaft pulley	: 60 (6.1, 44) + 100°±10° (Angle tightening)/M12 bolt. :120 (12, 89) + 95°±15° (Angle tightening)/M14 bolt.
	Water pump inlet pipe	: 22 (2.2, 16)
	Alternator bracket	: 44 (4.5, 32)
	Alternator	: 21 (2.1,15) for engine number < D051474,
		: 25 (2.6, 18) for engine number ≥ D051474
	A/C compressor	: 21 (2.1, 15)

*1: Refer to tightening procedure in the text.