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SECTION **EM**

ENGINE MECHANICAL

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PRECAUTION

PRECAUTIONS

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

INFOID:000000005398023

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. This system includes seat belt switch inputs and dual stage front air bag modules. The SRS system uses the seat belt switches to determine the front air bag deployment, and may only deploy one front air bag, depending on the severity of a collision and whether the front occupants are belted or unbelted. Information necessary to service the system safely is included in the SRS and SB section 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 the SRS section.
- 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.

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

WARNING:

- When working near the Airbag Diagnosis Sensor Unit or other Airbag 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.

Precaution Necessary for Steering Wheel Rotation After Battery Disconnect

INFOID:000000005398024

NOTE:

- This Procedure is applied only to models with Intelligent Key system and NATS (NISSAN ANTI-THEFT SYSTEM).
- Remove and install all control units after disconnecting both battery cables with the ignition knob in the "LOCK" position.
- Always use CONSULT-III to perform self-diagnosis as a part of each function inspection after finishing work. If DTC is detected, perform trouble diagnosis according to self-diagnostic results.

For models equipped with the Intelligent Key system and NATS, an electrically controlled steering lock mechanism is adopted on the key cylinder.

For this reason, if the battery is disconnected or if the battery is discharged, the steering wheel will lock and steering wheel rotation will become impossible.

If steering wheel rotation is required when battery power is interrupted, follow the 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. Use the Intelligent Key or mechanical key to turn the ignition switch to the "ACC" position. At this time, the steering lock will be released.
3. Disconnect both battery cables. The steering lock will remain released and the steering wheel can be rotated.
4. Perform the necessary repair operation.

PRECAUTIONS

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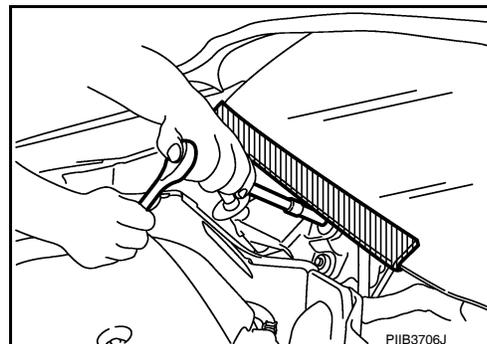
< PRECAUTION >

5. When the repair work is completed, return the ignition switch to the "LOCK" position before connecting the battery cables. (At this time, the steering lock mechanism will engage.)
6. Perform a self-diagnosis check of all control units using CONSULT-III.

Precaution for Procedure without Cowl Top Cover

INFOID:000000005398025

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



Precaution for Drain Coolant

INFOID:000000005398026

- Drain coolant when engine is cooled.

Precaution for Disconnecting Fuel Piping

INFOID:000000005398027

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

Precaution for Removal and Disassembly

INFOID:000000005398028

- When instructed to use special service tools, use the specified tools. Always be careful to work safely, avoid forceful or uninstructed operations.
- Exercise maximum care to avoid damage to mating or sliding surfaces.
- Cover openings of engine system with tape or the equivalent, if necessary, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and assembly.
- 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 where noted in the step.

Precaution for Inspection, Repair and Replacement

INFOID:000000005398029

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

Precaution for Assembly and Installation

INFOID:000000005398030

- 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 oil or 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 after draining coolant.
- Before starting engine, apply fuel pressure to fuel lines with turning ignition switch ON (with engine stopped). Then make sure that there are no leaks at fuel line connections.
- After repairing, start engine and increase engine speed to check coolant, fuel, oil, and exhaust systems for leakage.

PRECAUTIONS

[HR16DE]

< PRECAUTION >

Parts Requiring Angular Tightening

INFOID:000000005398031

- Use an angle wrench for the final tightening of the following engine parts:
 - Cylinder head bolts
 - Camshaft sprocket (INT)
 - Main bearing cap bolts
 - Connecting rod cap nuts
 - Crankshaft pulley bolt (No angle wrench is required as the bolt flange is provided with notches for angular tightening)

Tool number : KV10112100 (BT-8653-A)

- 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.

Precaution for Liquid Gasket

INFOID:000000005398032

REMOVAL OF LIQUID GASKET SEALING

- After removing the bolts and nuts, separate the mating surface and remove the sealant using Tool.

Tool number : KV10111100 (J-37228)

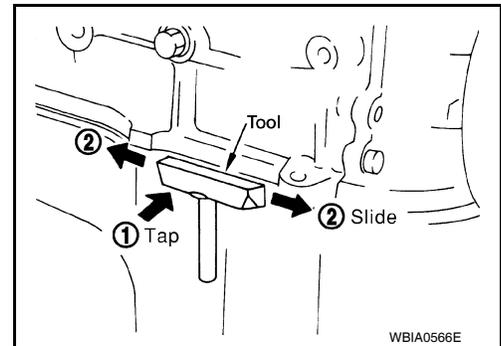
CAUTION:

Be careful not to damage the mating surfaces.

- In areas where the cutter is difficult to use, use a plastic hammer to lightly tap (1) the cutter where the RTV Silicone Sealant is applied. Use a plastic hammer to slide the cutter (2) by tapping on the side.

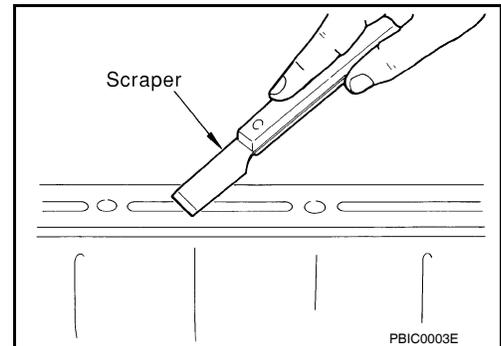
CAUTION:

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



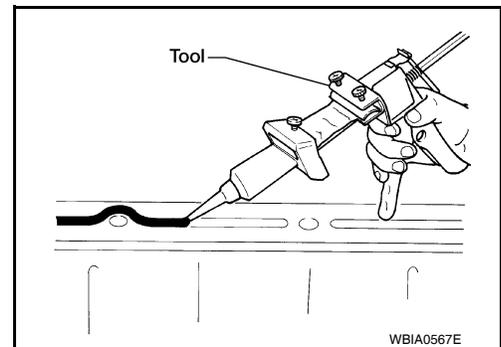
LIQUID GASKET APPLICATION PROCEDURE

1. Using a scraper, remove the old Silicone RTV Sealant adhering to the gasket application surface and the mating surface.
 - Remove the sealant completely from the groove of the gasket application surface, bolts, and bolt holes.
2. Thoroughly clean the gasket application surface and the mating surface and remove adhering moisture, grease and foreign materials.
3. Attach the sealant tube to the tube presser.
Use Genuine Silicone RTV Sealant or equivalent. Refer to [GI-42, "Recommended Chemical Product and Sealant"](#).
4. Apply the sealant without breaks to the specified location using Tool.



Tool number WS39930000 (-)

- If there is a groove for the sealant application, apply the sealant to the groove.
- As for the bolt holes, normally apply the sealant inside the holes. If specified, it should be applied outside the holes. Make sure to read the text of this manual.
- Within five minutes of the sealant application, install the mating component.
- If the sealant protrudes, wipe it off immediately.
- Do not retighten after the installation.

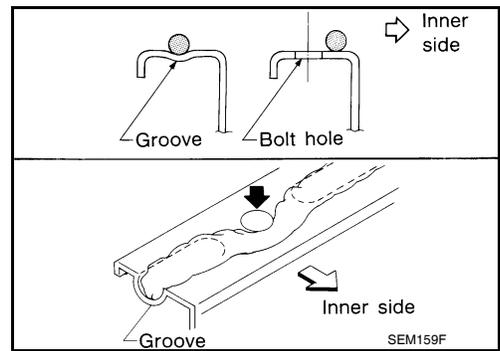


PRECAUTIONS

[HR16DE]

< PRECAUTION >

- After 30 minutes or more have passed from the installation, fill the engine with the specified oil and coolant. Refer to [MA-14, "Fluids and Lubricants"](#).



CAUTION:
Follow all specific instructions in this manual.

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PREPARATION

< PREPARATION >

[HR16DE]

PREPARATION

PREPARATION

Special Service Tools

INFOID:000000005398033

Tool number (Kent-Moore No.) Tool name	Description
KV10111100 (J-37228) Seal cutter	Removing oil pan (lower and upper) etc.
KV10116200 (J-26336-B) Valve spring compressor 1. KV10115900 (J-26336-20) Attachment 2. KV10109220 (—) Adapter	Disassembling and assembling valve mechanism Part (1) is a component of KV10116200, but Part (2) is not so.
KV10112100 (BT-8653-A) Angle wrench	Tightening bolts for bearing cap, cylinder head, etc. in angle
KV10117100 (—) Heated oxygen sensor wrench	Loosening or tightening heated oxygen sensor 1 For 22 mm (0.87 in) width hexagon nut
KV10107902 (J-38959) Valve oil seal puller 1. KV10116100 (—) Valve oil seal puller adapter	Removing valve oil seal
KV10115600 (J-38958) Valve oil seal drift	Installing valve oil seal Use side A. a: 20 mm (0.79 in) dia. d: 8 mm (0.31 in) dia. b: 13 mm (0.51 in) dia. e: 10.7 mm (0.421 in) c: 10.3 mm (0.406 in) dia. f: 5 mm (0.20 in) Unit: mm (in)

PREPARATION

< PREPARATION >

[HR16DE]

Tool number (Kent-Moore No.) Tool name	Description	
EM03470000 (J-8037) Piston ring compressor	Installing piston assembly into cylinder bore	A EM C
KV11103000 (—) Pulley puller	Removing crankshaft pulley	D E F
Quick connector release	Removing fuel tube quick connectors in engine room (Available in SEC. 164 of PARTS CATALOG: Part No. 16441 6N210)	G H
1. Press stand: ST13030020 (—) 2. Center shaft: KV10114120 (—) 3. Drift: KV10109730 (—) 4. Spring: ST13030030 (—) 5. Center cap: KV10110310 (—)	Installing and removing piston pin	I J K
KV11105210 (J-44716) Stopper plate	Fixing drive plate and flywheel	L M
WS39930000 (—) Tube presser	Pressing the tube of liquid gasket	N O P

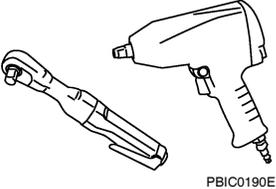
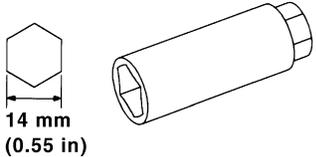
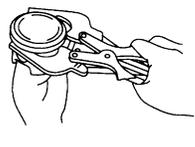
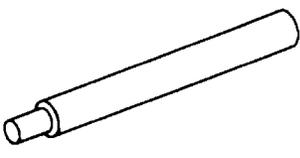
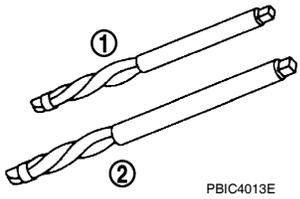
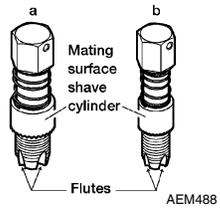
Commercial Service Tools

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PREPARATION

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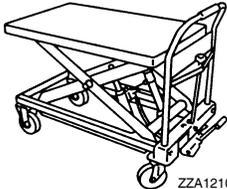
< PREPARATION >

Tool name	Description
<p>Power tool</p>  <p>PBIC0190E</p>	<p>Loosening bolts and nuts</p>
<p>Spark plug wrench</p>  <p>14 mm (0.55 in)</p> <p>PBIC3874E</p>	<p>Removing and installing spark plug</p>
<p>Valve seat cutter set</p>  <p>S-NT048</p>	<p>Finishing valve seat dimensions</p>
<p>Piston ring expander</p>  <p>S-NT030</p>	<p>Removing and installing piston ring</p>
<p>Valve guide drift</p>  <p>PBIC4012E</p>	<p>Removing and installing valve guide</p>
<p>Valve guide reamer</p>  <p>PBIC4013E</p>	<p>(1): Reaming valve guide inner hole (2): Reaming hole for oversize valve guide</p>
<p>(J-43897-18) (J-43897-12) Oxygen sensor thread cleaner</p>  <p>AEM488</p>	<p>Reconditioning the exhaust system threads before installing a new heated oxygen 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</p>

PREPARATION

< PREPARATION >

[HR16DE]

Tool name	Description
<p>Acoustic tension gauge</p> <div style="text-align: center;">  <p>PBIC3881E</p> </div>	<p>Checking drive belt tension</p>
<p>Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)</p> <div style="text-align: center;">  <p>EM489</p> </div>	<p>Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads</p>
<p>Manual lift table caddy</p> <div style="text-align: center;">  <p>ZZA1210D</p> </div>	<p>Removing and installing engine</p>

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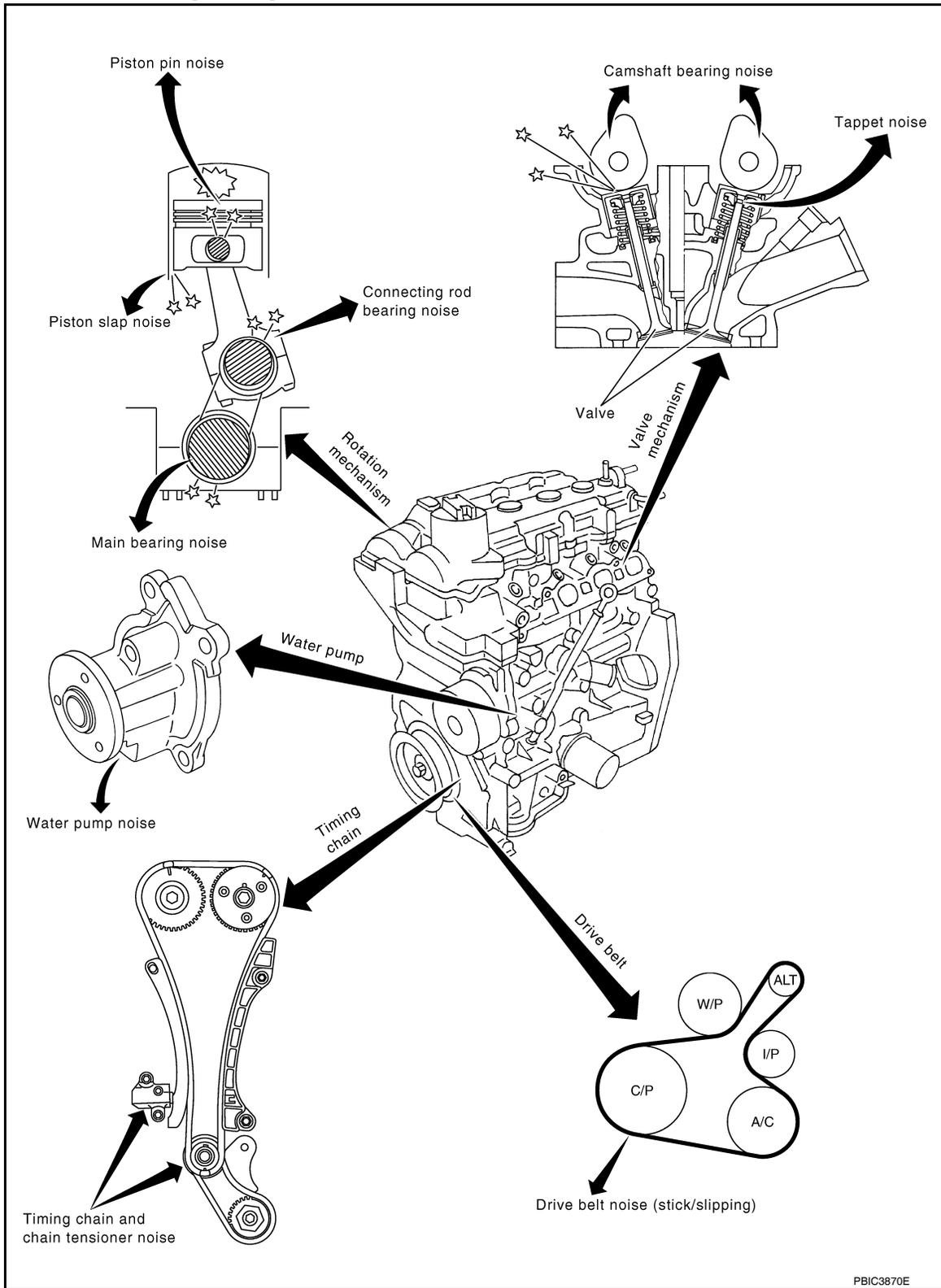
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SYMPTOM DIAGNOSIS

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

NVH Troubleshooting - Engine Noise

INFOID:000000005398035



NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

< SYMPTOM DIAGNOSIS >

[HR16DE]

Use the Chart Below to Help You Find the Cause of the Symptom

INFOID:000000005398036

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-20
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance Camshaft runout	EM-112 EM-112
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 small end clearance	EM-116 EM-119
	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-116 EM-116 EM-116 EM-119
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod small end clearance Connecting rod bearing oil clearance	EM-116 EM-119
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-120 EM-116
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-57
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belt (Sticking or slipping)	Drive belt deflection	EM-111
	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-22

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

ON-VEHICLE MAINTENANCE

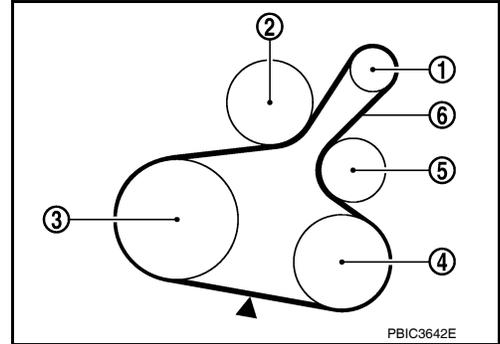
DRIVE BELTS

Checking

INFOID:000000005398037

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

- 1 : Generator
- 2 : Water pump
- 3 : Crankshaft pulley
- 4 : A/C compressor (with A/C models)
- 5 : 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 make sure 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 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, re-adjust to the specified value to avoid variation in deflection between pulleys.

Belt Deflection / Belt Tension and Frequency : Refer to [EM-111, "Drive Belts"](#).

Tension Adjustment

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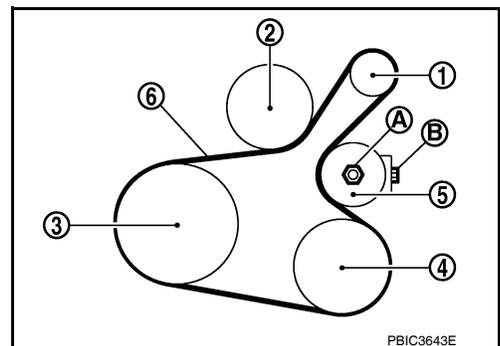
Location	Location of adjuster and tightening method
Drive belt	Adjusting bolt on idler pulley

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, make sure 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. Loosen the idler pulley lock nut (A) from the tightening position with the specified torque by 45 degrees.

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



CAUTION:

DRIVE BELTS

< ON-VEHICLE MAINTENANCE >

[HR16DE]

- When the lock nut is loosened excessively, the idler pulley tilts and the correct tension adjustment cannot be performed. Never loosen it excessively (more than 45 degrees).
 - Put a matching mark on the lock nut, and check turning angle with a protractor. Never visually check the tightening angle.
2. Adjust the belt tension by turning the adjusting bolt.
CAUTION:
 - When checking immediately after installation, first adjust it to the specified value. Then, after turning crankshaft two turns or more, re-adjust 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 standard, the idler pulley tilts and the correct tension adjustment cannot be performed.
 3. Tighten the idler pulley lock nut.

Idler pulley lock nut : 34.8 N·m (3.5 kg-m, 26 ft-lb)

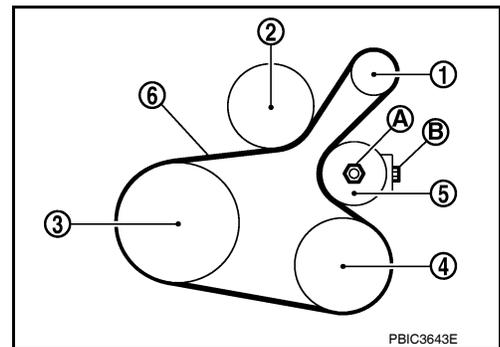
Removal and Installation

INFOID:000000005398039

REMOVAL

1. Loosen the idler pulley lock nut (A), and then adjust the belt tension by turning the adjusting bolt (B).

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

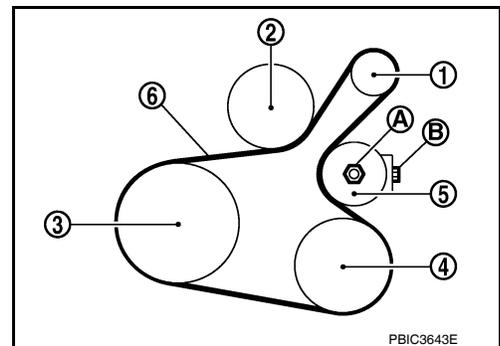


2. Remove drive belt.

INSTALLATION

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

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



Idler pulley lock nut : 4.4 N·m (0.45 kg-m, 39 in-lb)
(temporary tightening)

NOTE:

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

2. Install the drive belt to each pulley.

CAUTION:

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

3. Adjust drive belt tension by turning the adjusting bolt. Refer to [EM-14, "Tension Adjustment"](#).

CAUTION:

DRIVE BELTS

< ON-VEHICLE MAINTENANCE >

[HR16DE]

-
- 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, re-adjust to the specified value to avoid variation in deflection between pulleys.
4. Tighten the idler pulley lock nut.

Idler pulley lock nut : 34.8 N·m (3.5 kg-m, 26 ft-lb)

5. Make sure that belt tension of each belt is within the standard.

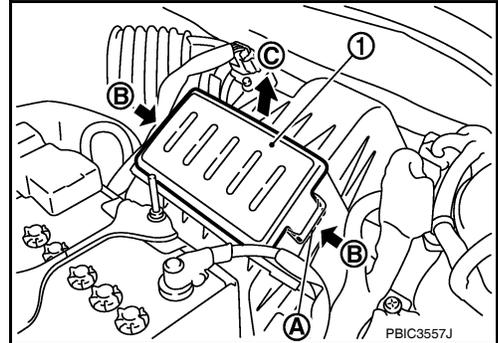
AIR CLEANER FILTER

Removal and Installation

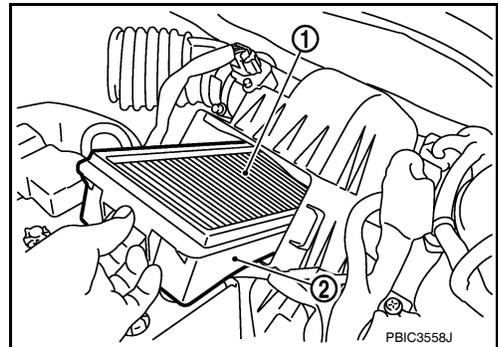
INFOID:000000005398040

REMOVAL

1. Push the tabs (A) of both ends of the air cleaner cover (1) into the inside (B).
2. Pull up the air cleaner cover (1) and remove it (C).



3. Remove air cleaner filter (1) and holder (2) assembly from the air cleaner case.
4. Remove the air cleaner filter (1) from the holder (2).



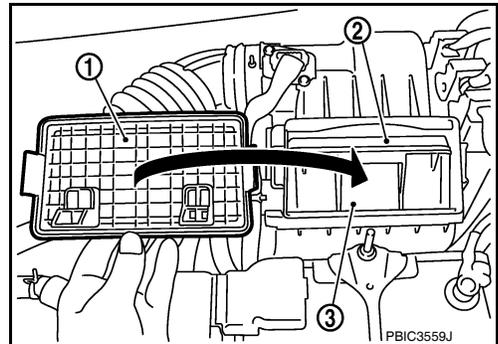
INSPECTION AFTER REMOVAL

It is necessary to replace the air cleaner filter at the recommended intervals, more often under dusty driving conditions. Refer to [MA-9, "Introduction of Periodic Maintenance"](#).

INSTALLATION

Installation is in the reverse order of removal.

- Install the air cleaner cover (1) in the direction shown.
- Air cleaner filter (2)
- Holder (3)



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SPARK PLUG

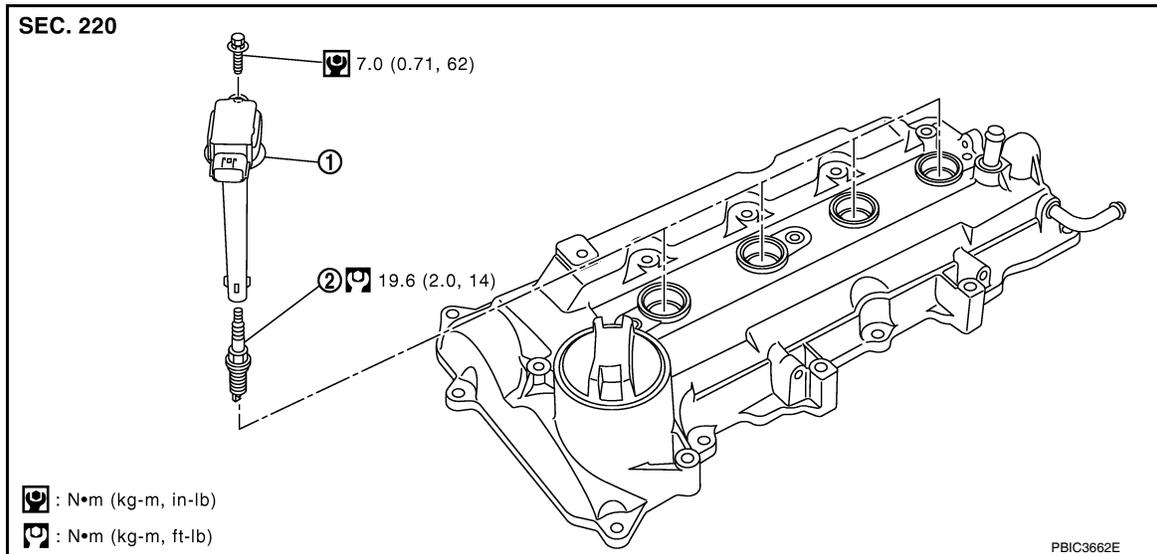
< ON-VEHICLE MAINTENANCE >

[HR16DE]

SPARK PLUG

Exploded View

INFOID:000000005398041



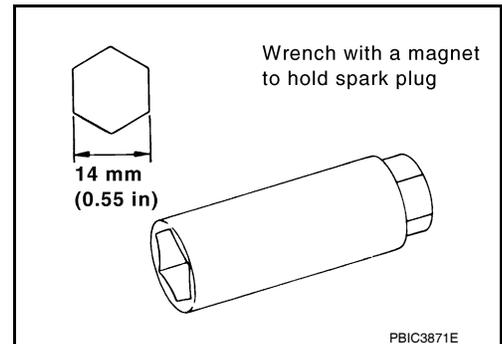
1. Ignition coil
2. Spark plug

Removal and Installation

INFOID:000000005398042

REMOVAL

1. Remove intake manifold. Refer to [EM-28. "Removal and Installation"](#).
2. Remove ignition coil. Refer to [EM-46. "Removal and Installation"](#).
3. Remove spark plug with a suitable tool.

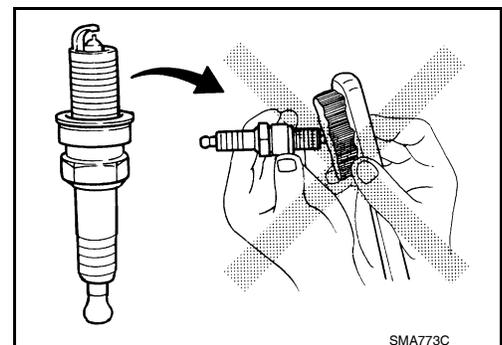


INSPECTION AFTER REMOVAL

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

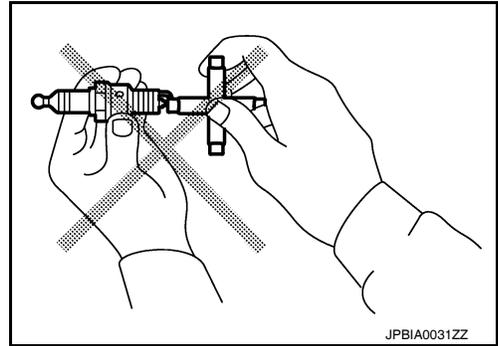


SPARK PLUG

< ON-VEHICLE MAINTENANCE >

[HR16DE]

- Checking and adjusting plug gap is not required between change intervals.



INSTALLATION

Installation is in the reverse order of removal.

Make : Denso
Part number : FXE20HE-11
Gap (nominal) : 1.1 mm (0.043 in)

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CAMSHAFT VALVE CLEARANCE

< ON-VEHICLE MAINTENANCE >

[HR16DE]

CAMSHAFT VALVE CLEARANCE

Inspection and Adjustment

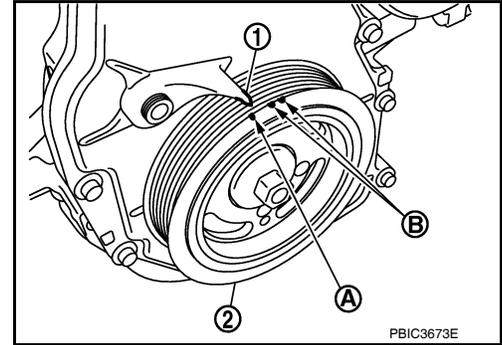
INFOID:000000005398043

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-46. "Exploded View"](#).
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 (without paint mark) (A) to timing indicator (1) on front cover.

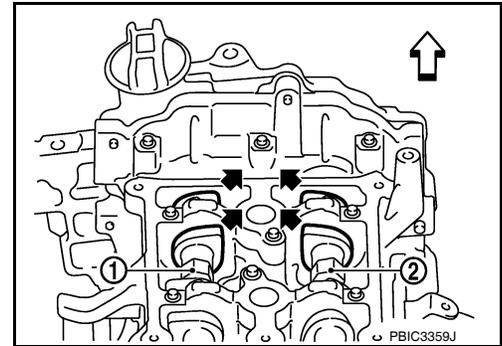
B : White paint mark (Not use for service)



- At the same time, make sure that both intake and exhaust cam noses of No. 1 cylinder face inside as shown.

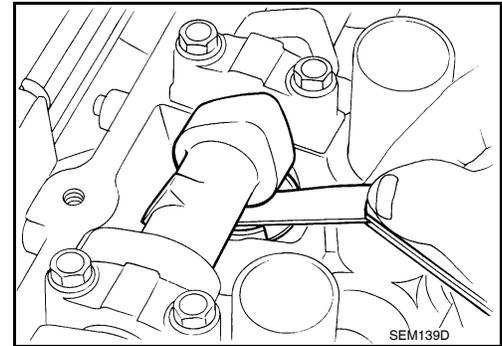
- 1 : Camshaft (INT)
- 2 : Camshaft (EXH)
- ↔ : Engine front

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



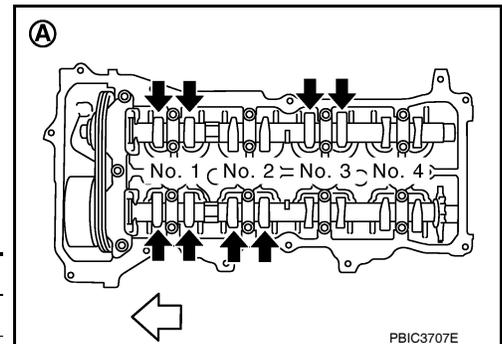
- b. Use a feeler gauge, measure the clearance between valve lifter and camshaft.

Valve Clearance: Refer to [EM-112. "Camshaft"](#).



- Measure the valve clearances at locations marked "x" as shown in the table below [locations indicated with black arrow (↔) as shown] with a feeler gauge.

- A : No. 1 cylinder compression TDC
- ↔ : Engine front



Measuring position		No. 1 CYL.	No. 2 CYL.	No. 3 CYL.	No. 4 CYL.
Measurement position	EXH	x		x	
	INT	x	x		

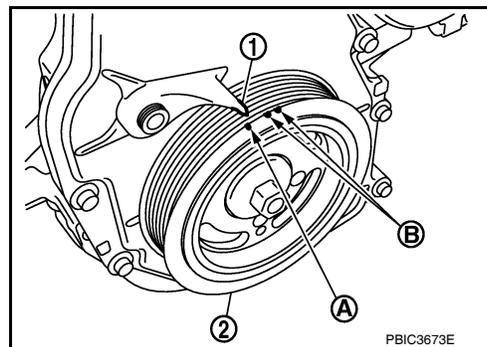
CAMSHAFT VALVE CLEARANCE

[HR16DE]

< ON-VEHICLE MAINTENANCE >

- c. Rotate crankshaft pulley (2) one revolution (360 degrees) and align TDC mark (without paint mark) (A) to timing indicator (1) on front cover.

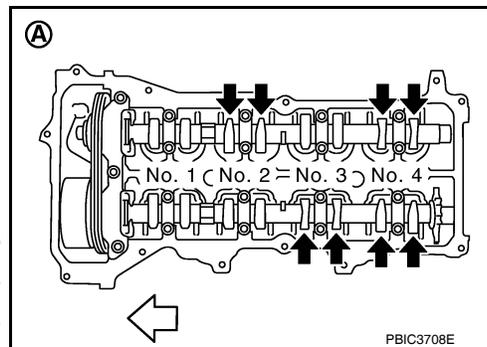
B : White paint mark (Not use for service)



- Measure the valve clearance at locations marked "x" as shown in the table below [locations indicated with black arrow (➡) as shown] with a feeler gauge.

A : No. 4 cylinder compression TDC

↶ : Engine front



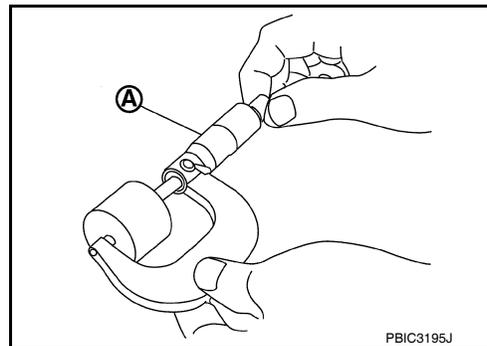
Measuring position		No. 1 CYL.	No. 2 CYL.	No. 3 CYL.	No. 4 CYL.
Measurement point	EXH		x		x
	INT			x	x

3. If out of standard, perform adjustment procedure.

ADJUSTMENT

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

1. Remove camshaft. Refer to [EM-59. "Exploded View"](#).
2. Remove valve lifters at the locations that are out of the standard.
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)

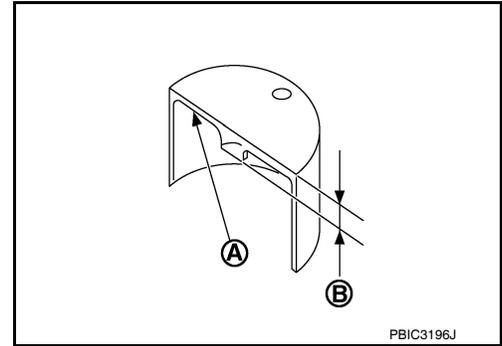
Exhaust : 0.33 mm (0.013 in)

CAMSHAFT VALVE CLEARANCE

[HR16DE]

< ON-VEHICLE MAINTENANCE >

- Thickness of new valve lifter (B) can be identified by stamp mark (A) on the reverse side (inside the cylinder).
- Stamp mark "300" indicates 3.00 mm (0.118 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-112, "Camshaft"](#).

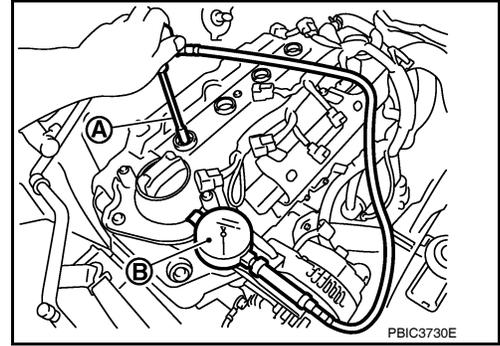
5. Install the selected valve lifter.
6. Install camshaft. Refer to [EM-59, "Exploded View"](#).
7. Manually rotate crankshaft pulley a few rotations.
8. Make sure that valve clearances for cold engine are within specifications by referring to the specified values.
9. Install all removed parts in the reverse order of removal.
10. Warm up the engine, and check for unusual noise and vibration.

COMPRESSION PRESSURE

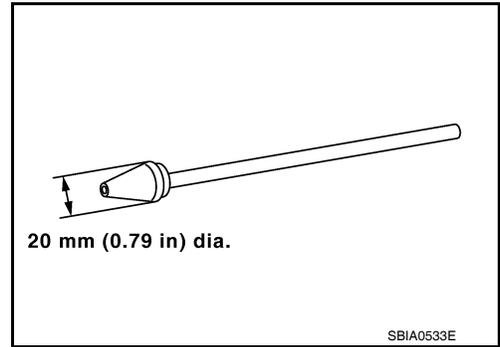
Inspection

INFOID:000000005398044

1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to [EC-496, "Inspection"](#).
3. Remove ignition coil and spark plug from each cylinder. Refer to [EM-46, "Exploded View"](#).
4. Connect an engine tachometer (not required in use of CONSULT-III).
5. Install a compression tester (B) with an adapter (commercial service tool) (A) 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.



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-111, "General Specification"](#).

CAUTION:

Always use fully a 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 engine speed again with normal battery gravity.
 - 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, cylinder head gasket). After the checking, measure the 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 re-check 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 gasket is leaking. In such a case, replace cylinder head gasket.
7. After inspection is completed, install removed parts.
 8. Start the engine, and confirm that the engine runs smoothly.
 9. Perform trouble diagnosis. If DTC appears, erase it. Refer to [EC-106, "Description"](#).

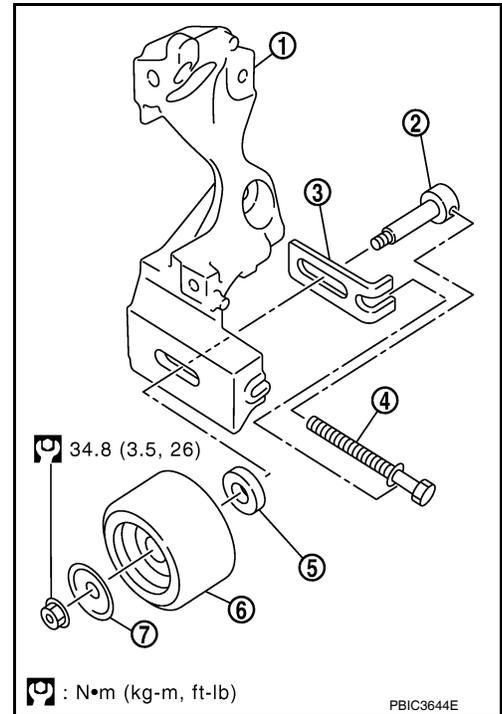
ON-VEHICLE REPAIR

DRIVE BELT IDLER PULLEY

Exploded View

INFOID:000000005398045

- 1 : Generator bracket
- 2 : Center shaft
- 3 : Spacer
- 4 : Adjusting bolt
- 5 : Washer
- 6 : Idler pulley
- 7 : Plate



Removal and Installation

INFOID:000000005398046

REMOVAL

1. Remove drive belt. Refer to [EM-15, "Removal and Installation"](#).
2. Remove the lock nut, and then remove the plate, idler pulley, and washer.
3. Remove the center shaft together with the spacer with inserting the adjusting bolt.

INSTALLATION

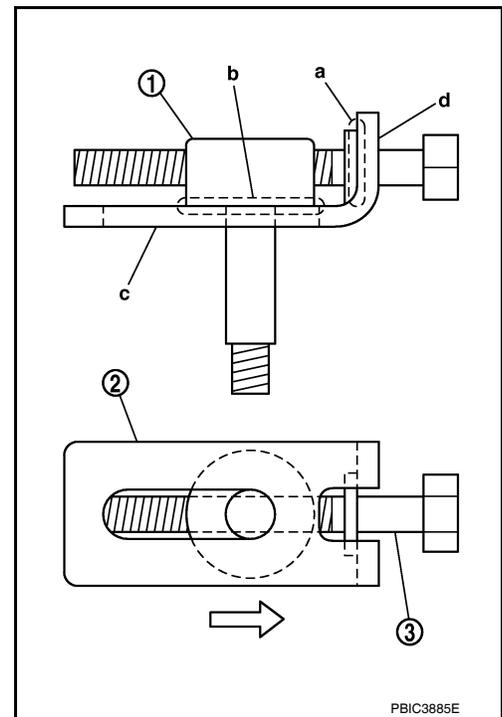
DRIVE BELT IDLER PULLEY

[HR16DE]

< ON-VEHICLE REPAIR >

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, d) of the spacer on the generator 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. Installation is in the reverse order of removal.

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AIR CLEANER AND AIR DUCT

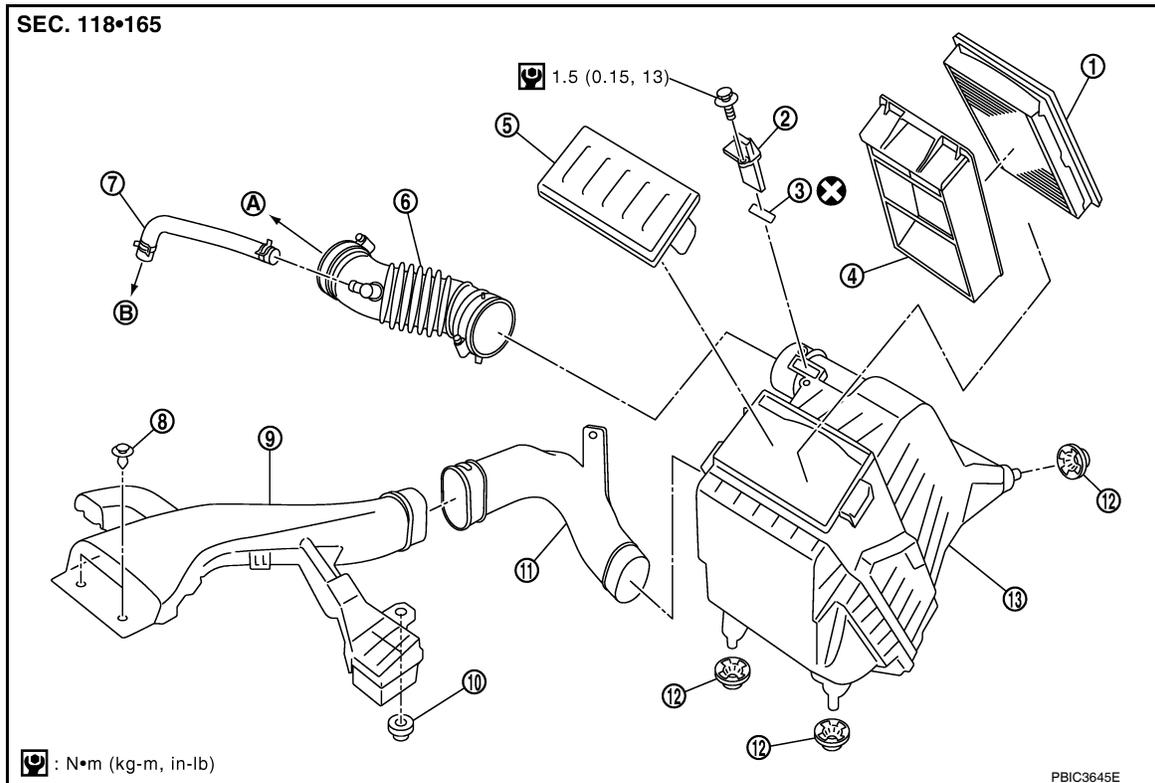
< ON-VEHICLE REPAIR >

[HR16DE]

AIR CLEANER AND AIR DUCT

Exploded View

INFOID:000000005398047



- | | | |
|--|-------------------------|---------------------|
| 1. Air cleaner filter | 2. Mass air flow sensor | 3. O-ring |
| 4. Holder | 5. Air cleaner cover | 6. Air duct |
| 7. PCV hose | 8. Clip | 9. Air duct (Inlet) |
| 10. Grommet | 11. Air duct | 12. Grommet |
| 13. Air cleaner case | | |
| A. To electric throttle control actuator | B. To rocker cover | |

Removal and Installation

INFOID:000000005398048

REMOVAL

1. Remove the battery. Refer to [SC-7. "Removal and Installation"](#).
2. Remove the air duct (inlet).
3. Remove the air cleaner filter from the air cleaner case. Refer to [EM-17. "Removal and Installation"](#).
4. Remove the air duct [between air duct (inlet) and air cleaner case] from the air cleaner case.
5. Remove the PCV hose.
6. Remove the air duct (between air cleaner case and electric throttle control actuator).
 - Add marks as necessary for easier installation.
7. Disconnect harness connector from mass air flow sensor.
8. Remove air cleaner case.
9. Remove the mass air flow sensor from the air cleaner case, if necessary.

CAUTION:

- Handle mass air flow sensor carefully and avoid impacts.
- Never touch sensor part.

INSTALLATION

Installation is in the reverse order of removal.

AIR CLEANER AND AIR DUCT

< ON-VEHICLE REPAIR >

[HR16DE]

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

Inspection

INFOID:000000005398049

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INSPECTION AFTER REMOVAL

Inspect air ducts and air cleaner assembly for crack or tear.

- If anything found, replace air ducts and air cleaner assembly as necessary.

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INTAKE MANIFOLD

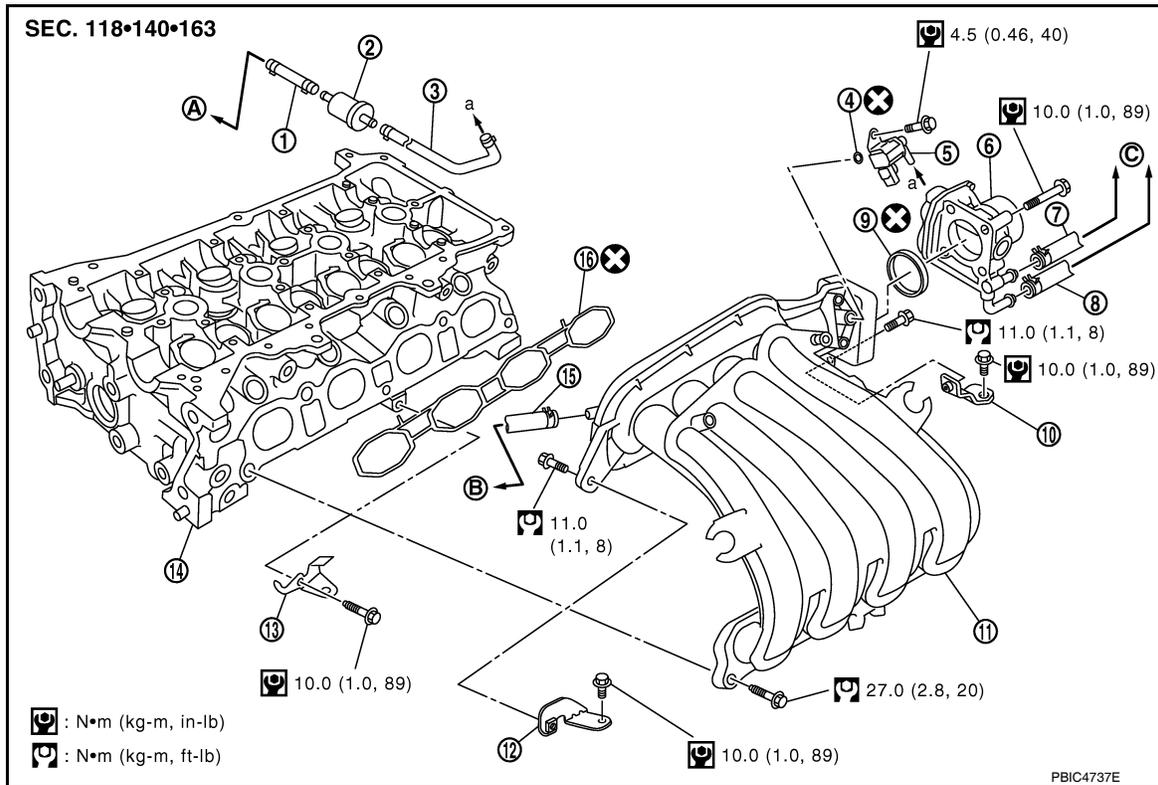
< ON-VEHICLE REPAIR >

[HR16DE]

INTAKE MANIFOLD

Exploded View

INFOID:000000005398050



- | | | |
|--------------------------------------|--|---------------------------------------|
| 1. EVAP hose | 2. Vacuum tank | 3. EVAP hose |
| 4. O-ring | 5. EVAP canister purge volume control solenoid valve | 6. Electric throttle control actuator |
| 7. Water hose | 8. Water hose | 9. Gasket |
| 10. Intake manifold support (rear) | 11. Intake manifold | 12. Intake manifold support (front) |
| 13. Intake manifold support (center) | 14. Cylinder head | 15. Vacuum hose |
| 16. Gasket | | |
| A. To centralized under-floor piping | B. To brake booster | C. To water outlet |

Removal and Installation

INFOID:000000005398051

REMOVAL

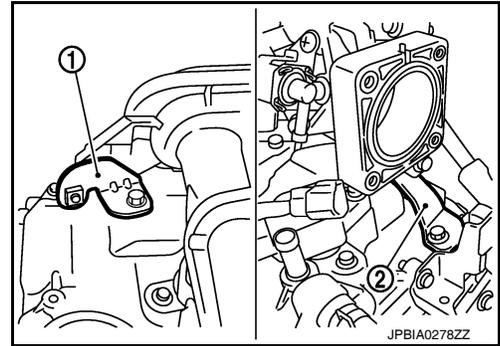
- Remove the air duct (inlet) and air duct (between air cleaner case and electric throttle control actuator). Refer to [EM-26, "Exploded View"](#).
- Remove the reservoir tank. Refer to [CO-17, "Component"](#).
- Remove the oil level gauge.
CAUTION:
Cover the oil level gauge guide openings to avoid entry of foreign materials.
- Remove electric throttle control actuator and position aside.
CAUTION:
 - Handle electric throttle control actuator carefully and avoid impacts.
 - Never disassemble or adjust electric throttle control actuator.
- Disconnect the harness connector and EVAP hose from the EVAP canister purge volume control solenoid valve.
- Disconnect vacuum hose for brake booster from intake manifold.

INTAKE MANIFOLD

< ON-VEHICLE REPAIR >

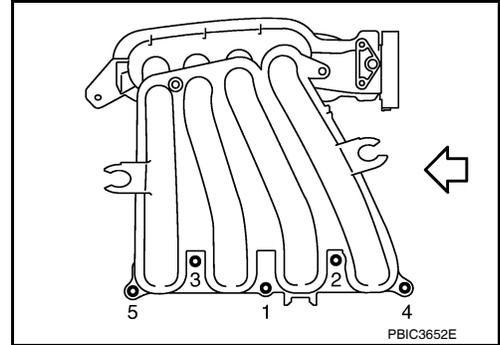
[HR16DE]

- Remove intake manifold support front (1) and bolt from rear (2).
 - Bracket (2) is not removed. Remove bolt from intake manifold.



- Remove intake manifold.
 - Loosen bolts in the reverse of the order shown.

← : Engine front



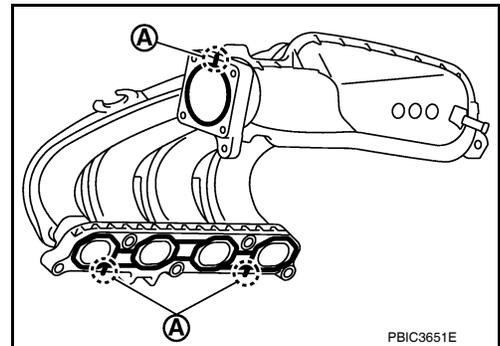
- Remove EVAP canister purge volume control solenoid valve from intake manifold, if necessary.
CAUTION:
Handle EVAP canister purge volume control solenoid valve carefully and avoid impacts.
- Remove intake manifold support (center) from cylinder head, if necessary.
NOTE:
The intake manifold support (center) functions as the guide when the intake manifold is installed.

INSTALLATION

Installation is in the reverse order of removal.

Intake Manifold

- Install the gasket to the intake manifold.
 - Align the protrusion (A) of gasket to the groove of intake manifold.



- Place the intake manifold into the installation position.
CAUTION:
Make sure that the oil level gauge guide is not disconnected from the fixing clip of water inlet due to interference with intake manifold.

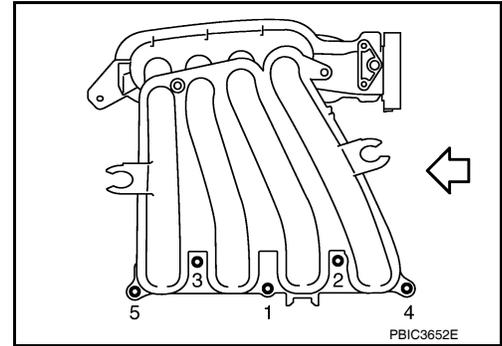
INTAKE MANIFOLD

[HR16DE]

< ON-VEHICLE REPAIR >

3. Tighten bolts in the numerical order shown.

⇐ : Engine front



4. Install intake manifold support (front and rear).

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-25, "THROTTLE VALVE CLOSED POSITION LEARNING : Special Repair Requirement"](#).
- Perform "Throttle Valve Closed Position Learning" and "Idle Air Volume Learning" after repair when replacing electric throttle control actuator. Refer to [EC-25, "THROTTLE VALVE CLOSED POSITION LEARNING : Special Repair Requirement"](#) and [EC-26, "IDLE AIR VOLUME LEARNING : Special Repair Requirement"](#).

EXHAUST MANIFOLD

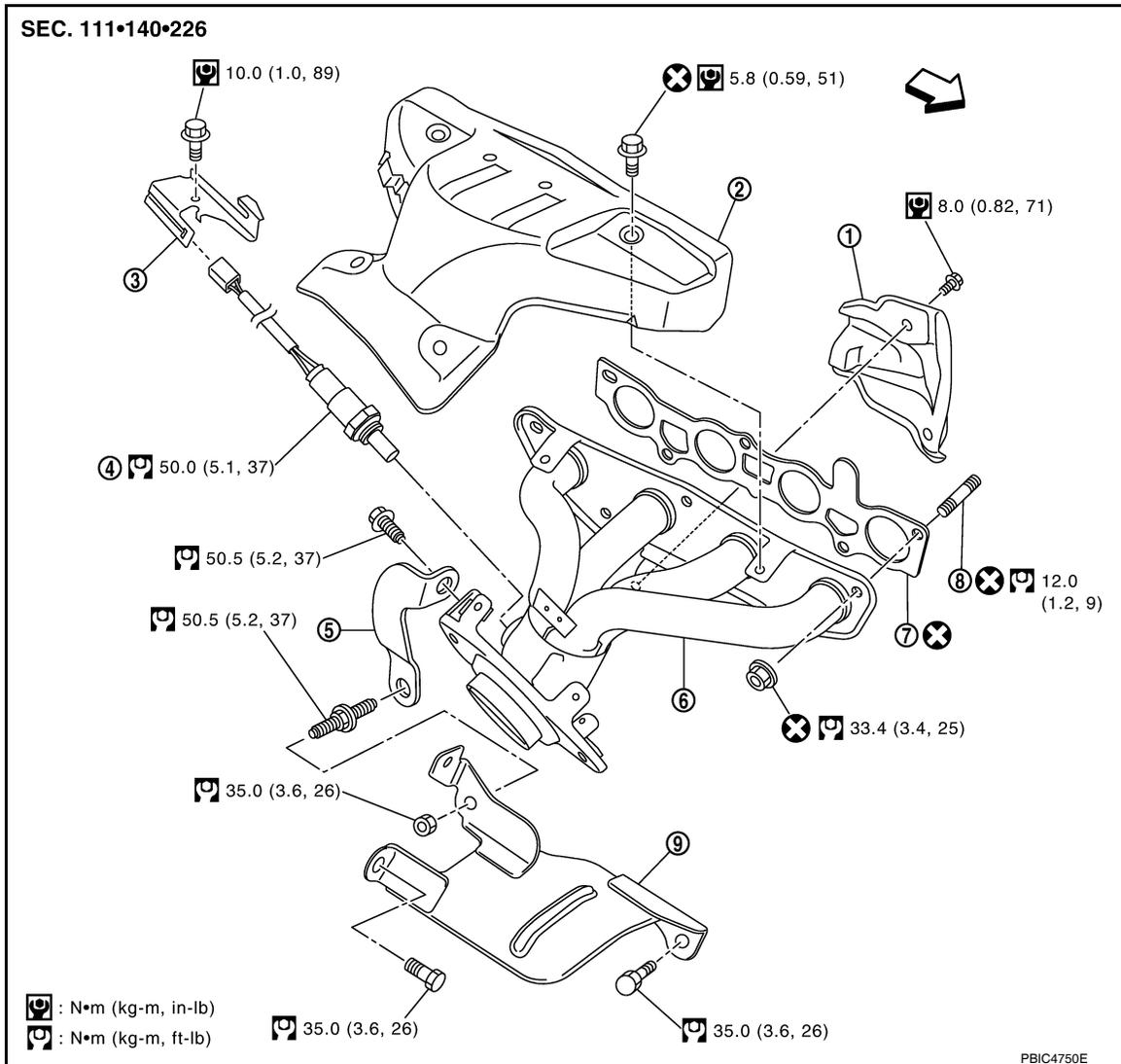
< ON-VEHICLE REPAIR >

[HR16DE]

EXHAUST MANIFOLD

Exploded View

INFOID:000000005398052



- | | | |
|----------------------------|---------------------------|---------------------|
| 1. Exhaust manifold cover | 2. Exhaust manifold cover | 3. Harness bracket |
| 4. Air fuel ratio sensor 1 | 5. Exhaust manifold stay | 6. Exhaust manifold |
| 7. Gasket | 8. Stud bolt | 9. Heat insulator |

← : Engine front

Removal and Installation

INFOID:000000005398053

REMOVAL

1. Remove the cowl. Refer to [EI-22. "Removal and Installation"](#).
2. Remove heat insulator.
3. Remove exhaust front tube. Refer to [EX-6. "Component"](#).
4. Remove the harness bracket of air fuel ratio sensor 1 from the cylinder head.
5. Remove exhaust manifold covers.
6. Remove the air fuel ratio sensor 1.

EXHAUST MANIFOLD

[HR16DE]

< ON-VEHICLE REPAIR >

- Use Tool (A) to remove air fuel ratio sensor 1.

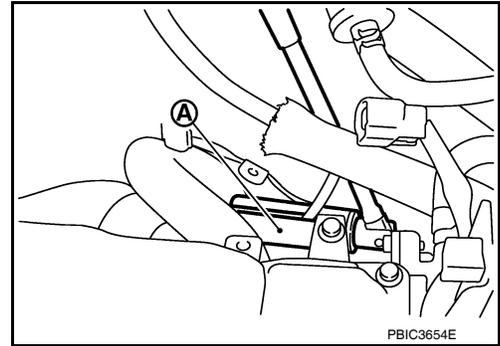
CAUTION:

Handle air fuel ratio sensor 1 carefully and avoid impacts.

NOTE:

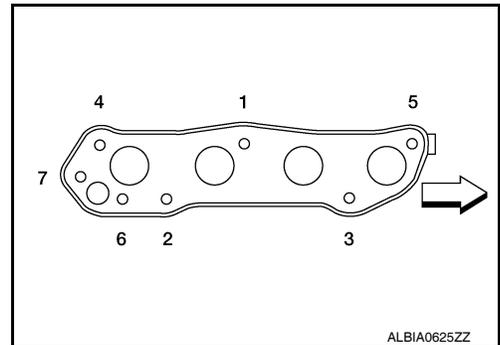
The exhaust manifold can be removed and installed without removing the air fuel ratio sensor 1 (Disassembly of harness connector is necessary).

Tool number : KV10117100 (—)



7. Remove exhaust manifold side bolt of exhaust manifold stay.
8. Remove exhaust manifold.
 - Loosen nuts in the reverse of the order shown.

↶ : Engine front



9. Remove gasket.

CAUTION:

Cover engine openings to avoid entry of foreign materials.

10. Remove exhaust manifold cover from back of exhaust manifold.

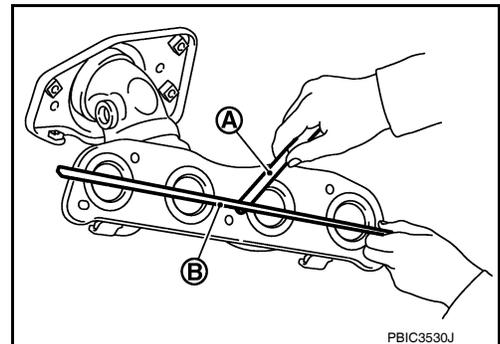
INSPECTION AFTER REMOVAL

Mounting Surface Distortion

- Use suitable tools (A) and (B) to check distortion of exhaust manifold mounting surface as shown.

Limit : 0.3 mm (0.012 in)

- Replace exhaust manifold if outside the limit.



INSTALLATION

Installation is in the reverse order of removal.

Exhaust Manifold

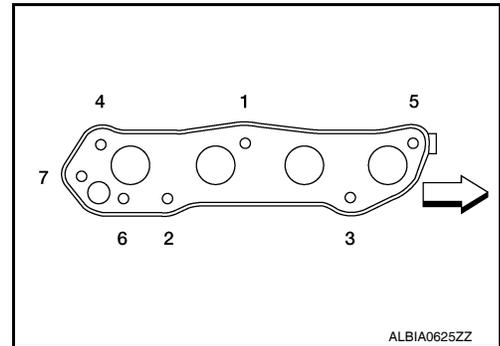
EXHAUST MANIFOLD

[HR16DE]

< ON-VEHICLE REPAIR >

1. Tighten exhaust manifold nuts to specification in two stages in the numerical order shown.

↶ : Engine front

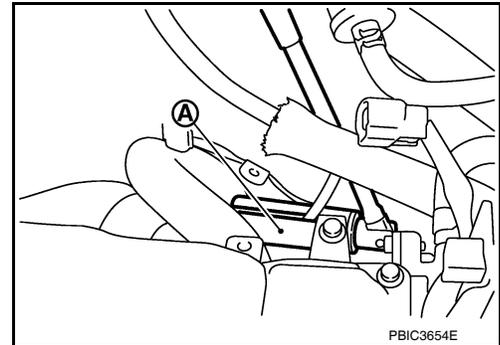


2. Use Tool (A) to install the air fuel ratio sensor 1.

Tool number : KV10117100 (—)

CAUTION:

- Handle it carefully and avoid impacts.
- Before installing a new air fuel ratio sensor 1, clean the exhaust tube threads using suitable tool and approved anti-seize lubricant.
- Do not over-tighten the air fuel ratio sensor 1. Doing so may damage the air fuel ratio sensor 1, resulting in the MIL coming on.



Tool number : — (J-43897-12)

Tool number : — (J-43897-18)

A
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FUEL INJECTOR AND FUEL TUBE

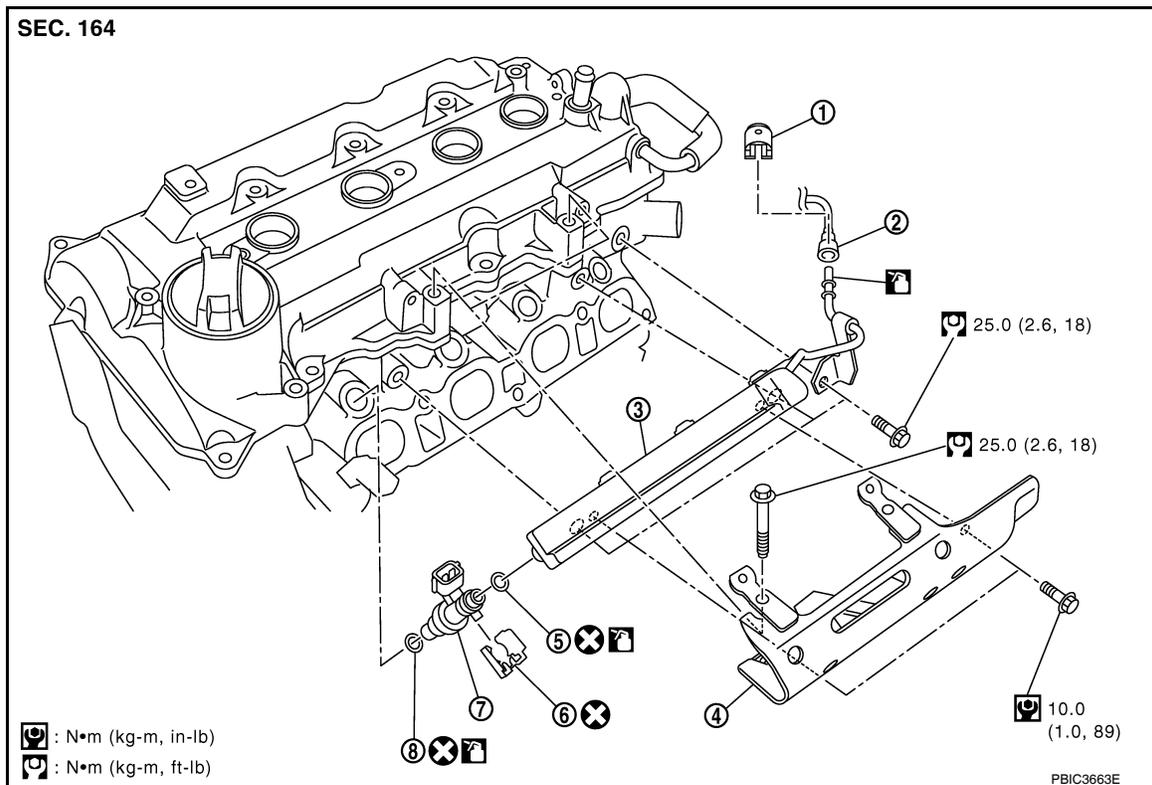
< ON-VEHICLE REPAIR >

[HR16DE]

FUEL INJECTOR AND FUEL TUBE

Exploded View

INFOID:000000005398054



- | | | |
|------------------------|-------------------|--------------|
| 1. Quick connector cap | 2. Fuel feed hose | 3. Fuel tube |
| 4. Fuel tube protector | 5. O-ring (black) | 6. Clip |
| 7. Fuel injector | 8. O-ring (green) | |

CAUTION:

Never remove or disassemble parts unless instructed as shown.

Removal and Installation

INFOID:000000005398055

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.
- Do not smoke while servicing fuel system. Keep open flames and sparks away from the work area.

REMOVAL

1. Release the fuel pressure. Refer to [EC-496, "Inspection"](#).
2. Disconnect battery negative terminal. Refer to [SC-7, "Removal and Installation"](#).
3. Remove intake manifold. Refer to [EM-28, "Exploded View"](#).

FUEL INJECTOR AND FUEL TUBE

< ON-VEHICLE REPAIR >

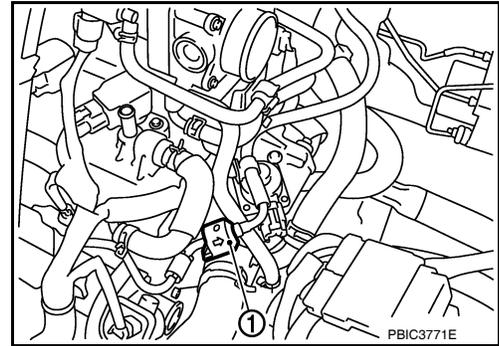
[HR16DE]

4. Disconnect quick connector with the following procedure. Disconnect fuel feed hose from fuel tube.

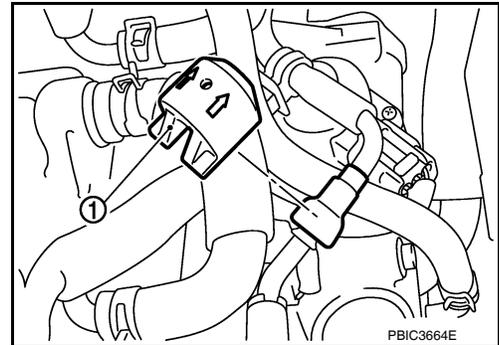
1 : Quick connector cap

NOTE:

There is no fuel return path.



- a. Remove quick connector cap (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 onto fuel tube.
d. Insert quick connector release into quick connector until sleeve contacts and goes no further. Hold quick connector release on that position.

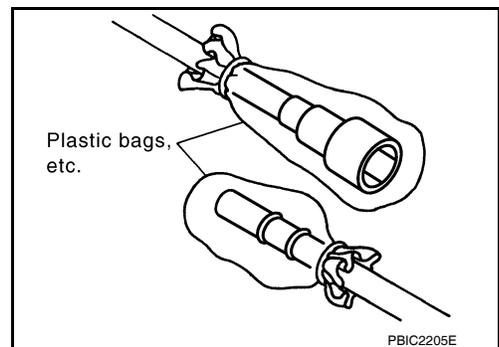
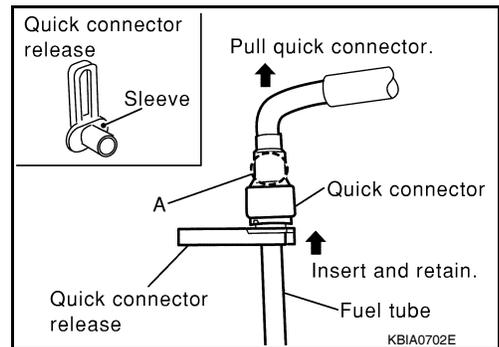
CAUTION:

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.

CAUTION:

- Pull quick connector holding "A" position.
- Do not pull with lateral force applied. O-ring inside quick connector may be damaged.
- Prepare container and cloth beforehand as fuel will leak out.
- Avoid fire and sparks.
- Keep parts away from heat source. Especially, be careful when welding is performed around them.
- Do not expose parts to battery electrolyte or other acids.
- Do not bend or twist connection between quick connector and fuel feed hose during installation/removal.
- To keep clean the connecting portion and to avoid damage and foreign materials, cover them completely with plastic bags or something similar.



5. Disconnect harness connector from fuel injector.

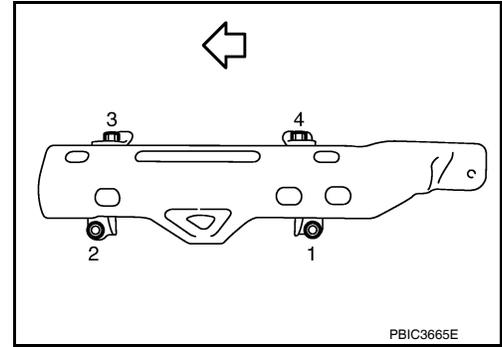
FUEL INJECTOR AND FUEL TUBE

[HR16DE]

< ON-VEHICLE REPAIR >

6. Remove fuel tube protector.
 - Loosen bolts in the reverse of the order shown.

⇐ : Engine front

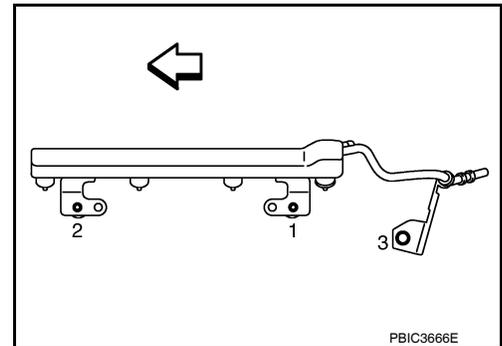


7. Remove the fuel injector and fuel tube assembly.
 - Loosen bolts in the reverse of the order shown.

⇐ : Engine front

CAUTION:

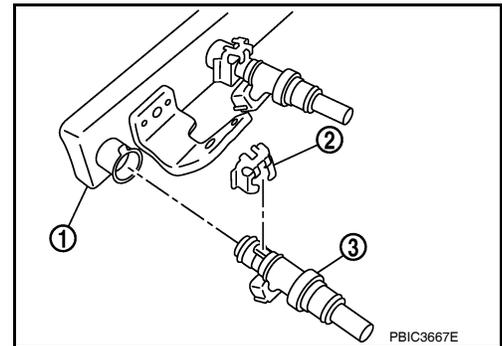
- When removing, be careful to avoid any interference with fuel injector.
- Use a shop cloth to absorb any fuel leaks from fuel tube.



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

CAUTION:

- Be careful about spilling fuel remaining in fuel tube.
- Be careful not to damage the fuel injector nozzle during removal.
- Never bump or drop fuel injector.
- Never disassemble fuel injector.



INSTALLATION

1. Install new O-rings to the fuel injector.

CAUTION:

- The 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.
- Make sure that the O-ring and its mating part are free of foreign material.
- Be careful not to scratch O-ring with tool or fingernails when installing.
- Do not twist or stretch O-ring. If O-ring is stretched while installing, never insert it into fuel tube immediately.
- Insert O-ring straight into fuel tube. Never angle or twist it.

FUEL INJECTOR AND FUEL TUBE

[HR16DE]

< ON-VEHICLE REPAIR >

2. Install the fuel injector (4) onto the fuel tube (1) with the following procedure:

- 3 : O-ring (Black)
- 5 : O-ring (Green)

- a. Insert the clips (2) into the clip mounting grooves on the fuel injector.

- Insert clip cut-out (D) into fuel injector protrusion (F).

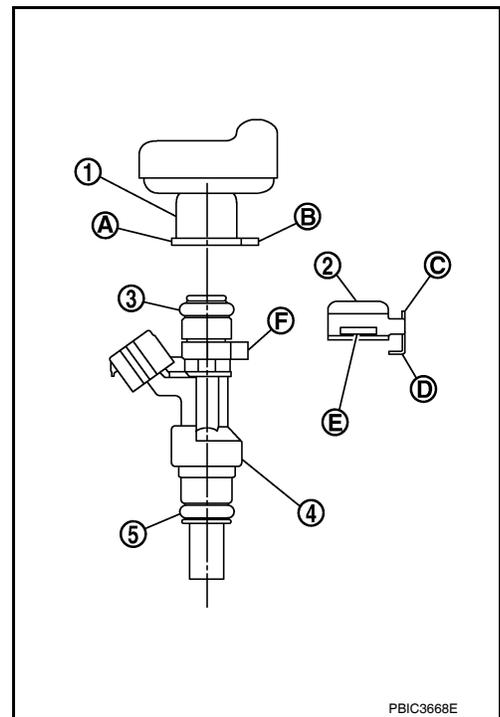
CAUTION:

- Always replace clip with new one.
- Make sure that the clip does not interfere with the O-ring. If interference occurs, replace the O-ring.

- b. Insert the fuel injector into the fuel tube with clip attached.

- Make sure that the axis is lined up when inserting.
- Insert clip cut-out (C) into fuel tube protrusion (B).
- Make sure that the flange (A) on the fuel tube fits securely in the clip flange fixing groove (E).

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



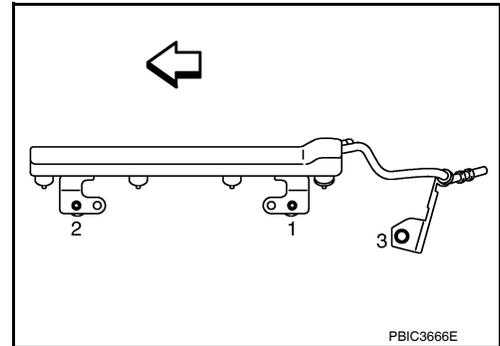
3. Install fuel tube and injector assembly onto cylinder head.

- Tighten bolts in the numerical order shown.

← : Engine front

CAUTION:

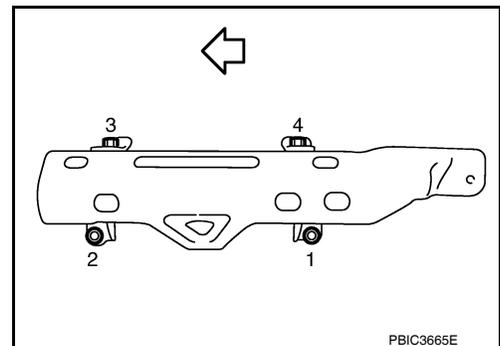
Be careful not to let tip of injector nozzle interfere with other parts.



4. Install fuel tube protector.

- Tighten bolts in the numerical order shown.

← : Engine front



5. Connect harness connector to fuel injector.

6. Connect fuel feed hose with the following procedure.

- a. Check for damage or foreign material on the fuel tube and quick connector.
b. Apply new engine oil lightly to area around the top of fuel tube.

FUEL INJECTOR AND FUEL TUBE

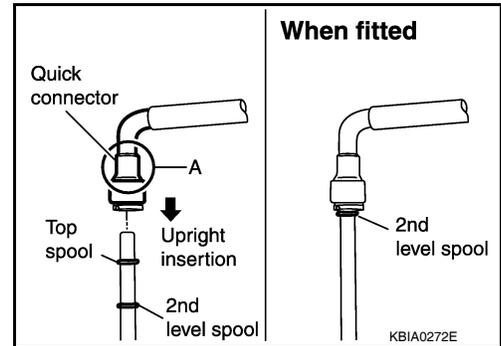
< ON-VEHICLE REPAIR >

[HR16DE]

- c. Align center to insert quick connector straightly into fuel tube.
- Insert quick connector to fuel tube until the top spool on fuel tube is inserted completely and the 2nd level spool is positioned slightly below quick connector bottom end.

CAUTION:

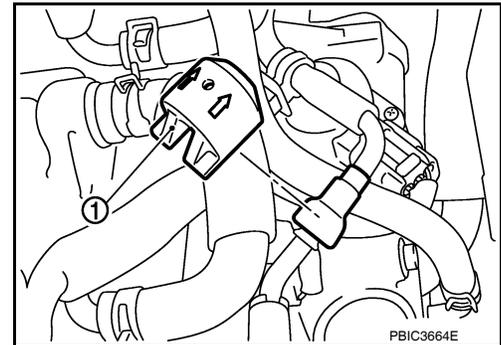
- Hold “A” position shown when inserting fuel tube into quick connector.
- Carefully align center to avoid inclined insertion to prevent damage to O-ring inside quick connector.
- Insert until you hear a “click” sound and actually feel the engagement.
- To avoid misidentification of engagement with a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



- d. Before clamping fuel feed hose with hose clamp, pull quick connector hard by hand holding “A” position. Make sure it is completely engaged (connected) so that it does not come out from fuel tube.
- e. Install quick connector cap (1) to quick connector connection.
- Install quick connector cap with the side arrow facing quick connector side (fuel feed hose side).

CAUTION:

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



- f. Install fuel feed hose to hose clamp.
7. Installation of the remaining components is in the reverse order of removal.

Inspection

INFOID:000000005398056

INSPECTION AFTER INSTALLATION

Check on Fuel Leakage

1. Turn ignition switch “ON” (with the engine stopped). With fuel pressure applied to fuel piping, make sure there are no fuel leaks at connection points.

NOTE:

Use mirrors for checking at points out of clear sight.

2. Start the engine. With engine speed increased, make sure again that there are no fuel leaks at connection points.

CAUTION:

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

OIL PAN (LOWER)

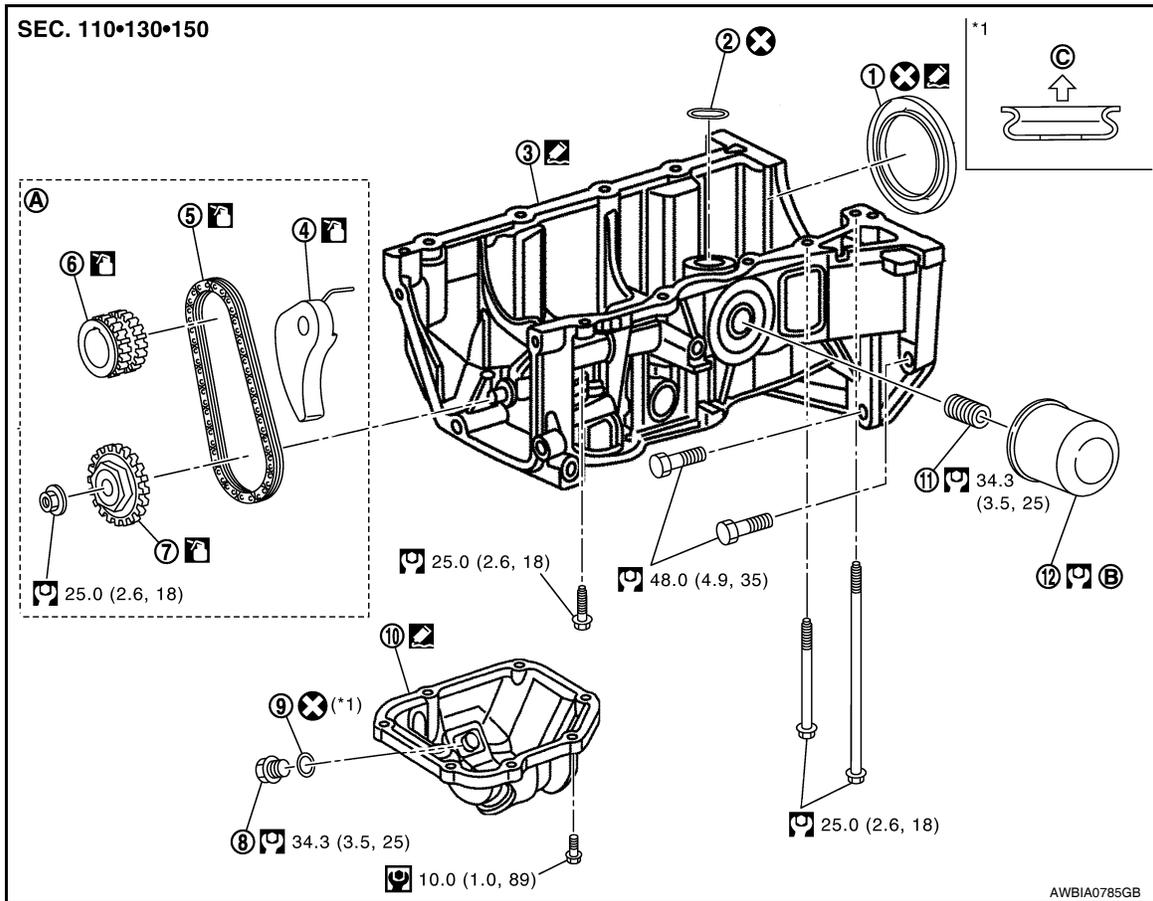
< ON-VEHICLE REPAIR >

[HR16DE]

OIL PAN (LOWER)

Exploded View

INFOID:000000005398057



- | | | |
|-----------------------------------|----------------------------------|------------------------|
| 1. Rear oil seal | 2. O-ring | 3. Oil pan (upper) |
| 4. Chain tensioner | 5. Oil pump drive chain | 6. Crankshaft sprocket |
| 7. Oil pump sprocket | 8. Oil pan drain plug | 9. Washer |
| 10. Oil pan (lower) | 11. Oil filter stud bolt | 12. Oil filter |
| A. Refer to EM-49 | B. Refer to LU-9 | C. Oil pan side |

Removal and Installation

INFOID:000000005398058

REMOVAL

WARNING:

- Be careful not to burn yourself, as the engine oil is hot.
- Prolonged and repeated contact with used engine oil may cause skin cancer; try to avoid direct skin contact with used oil. If skin contact is made, wash thoroughly with soap or hand cleaner as soon as possible.

1. Drain engine oil. Refer to [LU-8. "Draining"](#).
2. Remove the oil pan (lower) with the following procedure.

OIL PAN (LOWER)

[HR16DE]

< ON-VEHICLE REPAIR >

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

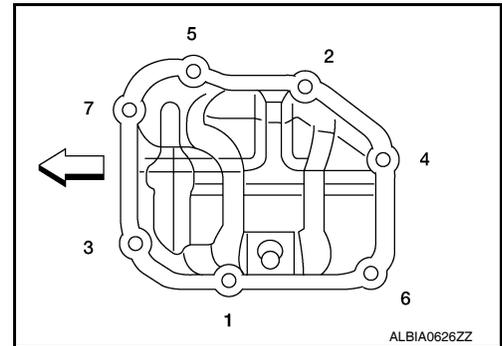
⇐ : Engine front

- b. Insert the Tool between oil pan (upper) and oil pan (lower).

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 flat-bladed screwdriver, etc.

Tool number : KV10111100 (J-37228)



INSTALLATION

1. Install oil pan (lower) with the following procedure.

- a. Use scraper to remove old liquid gasket from mating surfaces.
- Also remove the 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 surfaces when cleaning off old liquid gasket.

- b. Apply a continuous bead of liquid gasket (B) with Tool to areas shown.

⇐ : Engine front

← : Engine outside

(A) : 7.5 - 9.5 mm (0.295 - 0.374 in)

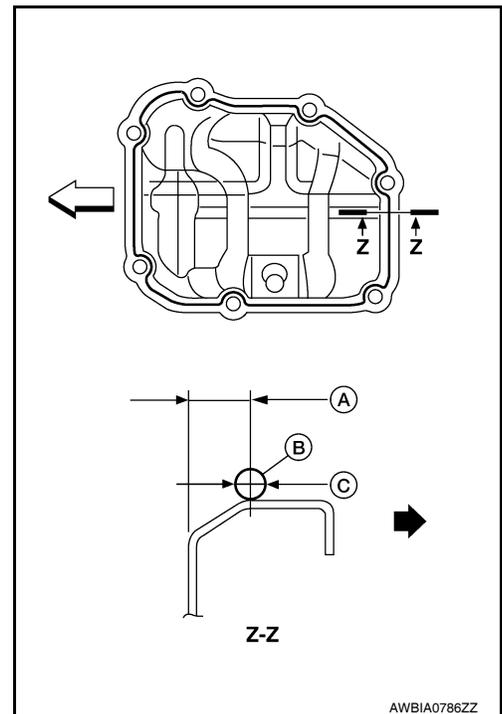
(C) : 4.0 - 5.0 mm (0.157 - 0.196 in)

Use Genuine Silicone RTV Sealant or equivalent. Refer to [GI-42, "Recommended Chemical Product and Sealant"](#).

CAUTION:

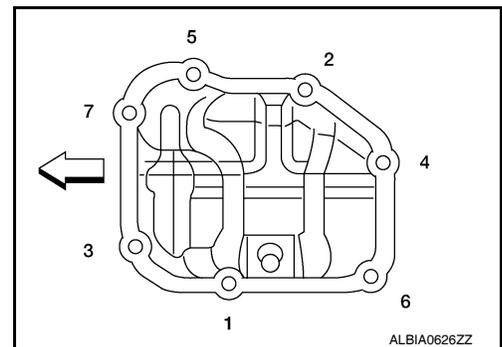
Attaching should be done within 5 minutes after coating.

Tool number : WS39930000 (—)



- c. Tighten bolts in the numerical order shown.

⇐ : Engine front



2. Installation of the remaining components is in the reverse order of removal.

CAUTION:

Do not pour engine oil until at least 30 minutes after oil pan (lower) is installed.

OIL PAN (LOWER)

< ON-VEHICLE REPAIR >

[HR16DE]

Inspection

INFOID:000000005398059

A

INSPECTION AFTER INSTALLATION

1. Check the engine oil level and adjust as necessary. Refer to [LU-7. "Inspection"](#).
2. Start engine, and check there are no leaks of engine oil.
3. Stop engine and wait for 10 minutes.
4. Check the engine oil level again. Refer to [LU-7. "Inspection"](#).

EM

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P

OIL PAN (UPPER) AND OIL STRAINER

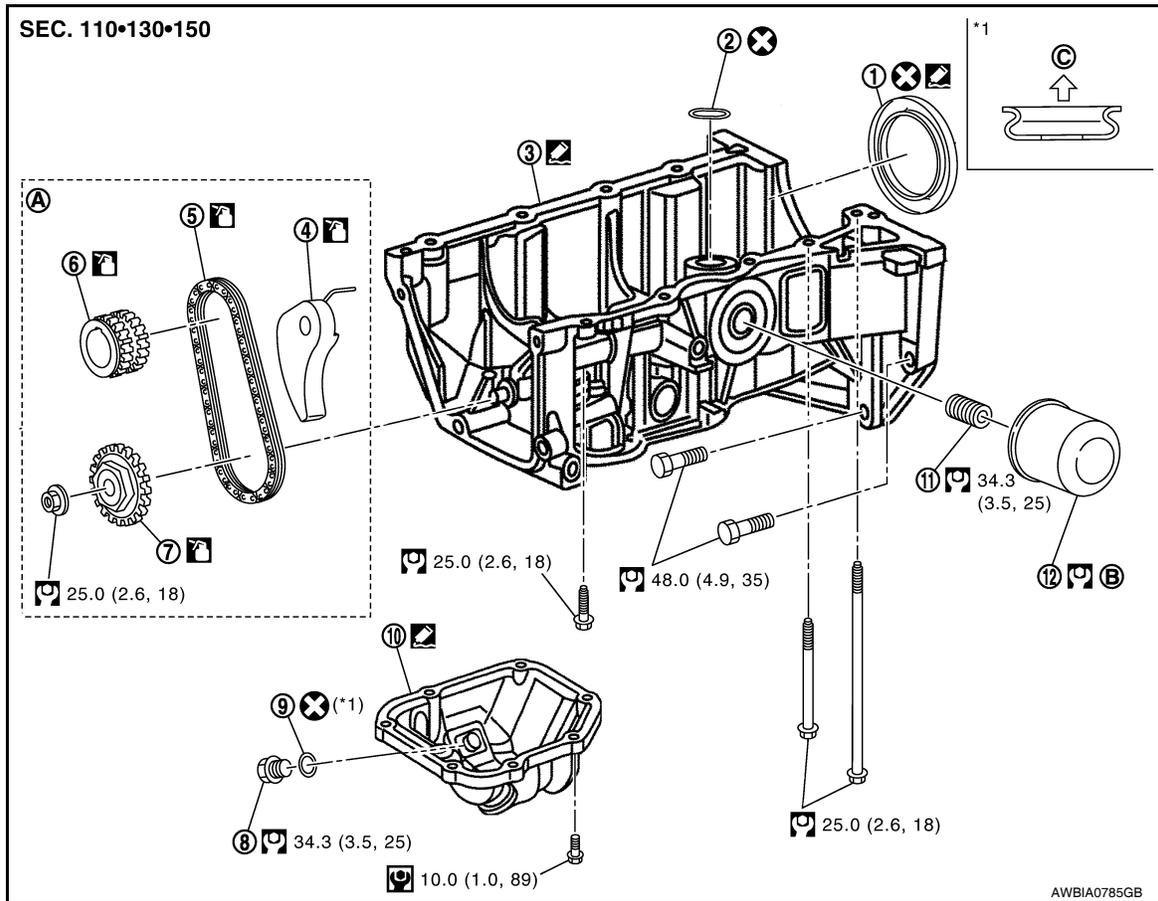
< ON-VEHICLE REPAIR >

[HR16DE]

OIL PAN (UPPER) AND OIL STRAINER

Component

INFOID:000000005398060



- | | | |
|-----------------------------------|----------------------------------|------------------------|
| 1. Rear oil seal | 2. O-ring | 3. Oil pan (upper) |
| 4. Chain tensioner | 5. Oil pump drive chain | 6. Crankshaft sprocket |
| 7. Oil pump sprocket | 8. Oil pan drain plug | 9. Washer |
| 10. Oil pan (lower) | 11. Oil filter stud bolt | 12. Oil filter |
| A. Refer to EM-49 | B. Refer to LU-9 | C. Oil pan side |

Removal and Installation

INFOID:000000005398061

NOTE:

The oil strainer and oil pump are included in the oil pan (upper). Individual disassembly is prohibited.

REMOVAL

1. Remove engine and transaxle assembly from the vehicle, and then separate engine and transaxle. Refer to [EM-82, "Removal and Installation"](#).
2. Install engine assembly to widely use engine stand. Refer to [EM-87, "Setting"](#).
3. Drain engine oil. Refer to [LU-8, "Draining"](#).
4. Remove the oil pan (lower). Refer to [EM-39, "Removal and Installation"](#).
5. Remove oil level gauge.
6. Remove front cover and timing chain. Refer to [EM-49, "Removal and Installation"](#).
7. Remove oil pump sprocket and crankshaft sprocket together with oil pump drive chain. Refer to [EM-49, "Exploded View"](#).
8. Remove oil pan (upper) using the following procedure.

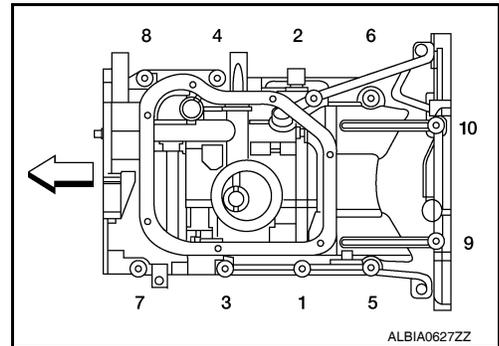
OIL PAN (UPPER) AND OIL STRAINER

< ON-VEHICLE REPAIR >

[HR16DE]

- a. Loosen oil pan (upper) bolts in the reverse of the order shown.

↩ : Engine front



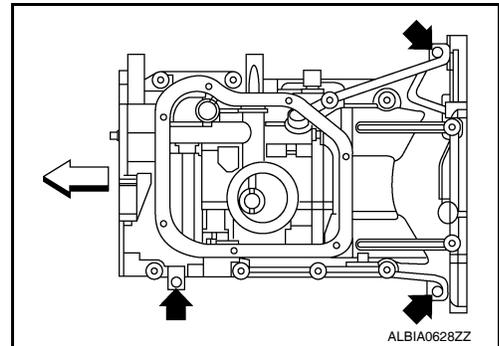
- b. Insert a flat-bladed offset screwdriver into the arrow (↔) shown and open up a crack between the oil pan (upper) cylinder block.

↔ : Engine front

- c. Insert the Tool 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.
- Do not remove oil pump and oil strainer from oil pan (upper).



Tool number : KV10111100 (J-37228)

9. 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:

Do not scratch or damage the mating surfaces when cleaning off old liquid gasket.

- b. Install O-ring to the cylinder block.

OIL PAN (UPPER) AND OIL STRAINER

[HR16DE]

< ON-VEHICLE REPAIR >

- c. Apply a continuous bead of liquid gasket (D) with Tool to areas shown.

Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-42, "Recommended Chemical Product and Sealant".

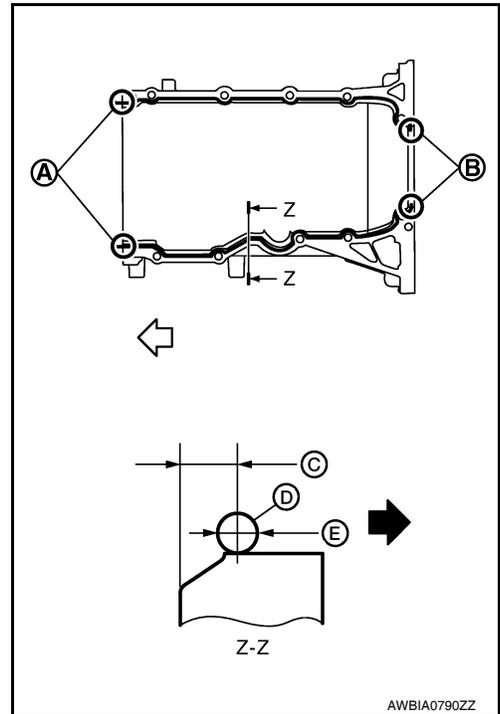
- A : 2 mm (0.07 in) protruded to outside
- B : 2 mm (0.07 in) protruded to rear oil seal mounting side
- C : 5.5 - 7.5 mm (0.216 - 0.295 in)
- E : 4.0 - 5.0 mm (0.157 - 0.196 in) dia.

⇐ : Engine front

← : Engine out side

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

Tool number : WS39930000 (—)



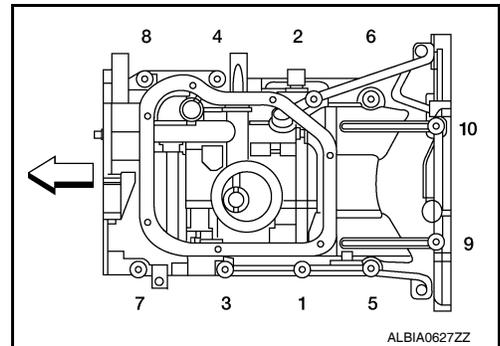
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- d. Tighten bolts in the numerical order shown.

⇐ : Engine front

CAUTION:
Avoid misalignment of both oil pan gasket and O-ring.
• The bolts are different according to the installation position.
Follow the numbers shown.

- M8 × 179 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

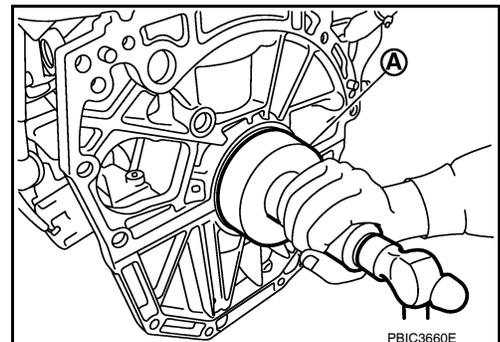


ALBIA0627ZZ

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).
• Do not 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 Silicone RTV Sealant or equivalent. Refer to GI-42, "Recommended Chemical Product and Sealant".
- 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) (A).



PBIC3660E

OIL PAN (UPPER) AND OIL STRAINER

[HR16DE]

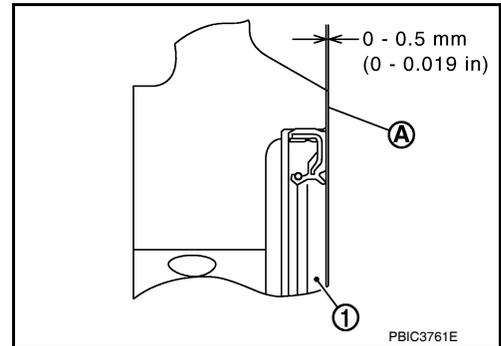
< ON-VEHICLE REPAIR >

- Press-fit to the dimensions specified.

1. Rear oil seal
- A. Rear end surface of cylinder block

CAUTION:

- Do not 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.
- Install straight to make sure 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 crankshaft sprocket, oil pump sprocket, oil pump drive chain, and chain tensioner. Refer to [EM-49. "Exploded View"](#).
4. Install timing chain and related parts. Refer to [EM-49. "Removal and Installation"](#).
5. Install front cover and related parts. Refer to [EM-49. "Removal and Installation"](#).
6. Install oil pan (lower). Refer to [EM-39. "Removal and Installation"](#).
7. Install oil pan drain plug.
 - For installation direction of washer. Refer to [EM-42. "Component"](#).
8. Installation of the remaining components is in the reverse order of removal.

CAUTION:

Do not fill engine with engine oil until at least 30 minutes after oil pan is installed.

INSPECTION AFTER INSTALLATION

1. Check engine oil level and adjust engine oil. Refer to [LU-7. "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-7. "Inspection"](#).

IGNITION COIL, SPARK PLUG AND ROCKER COVER

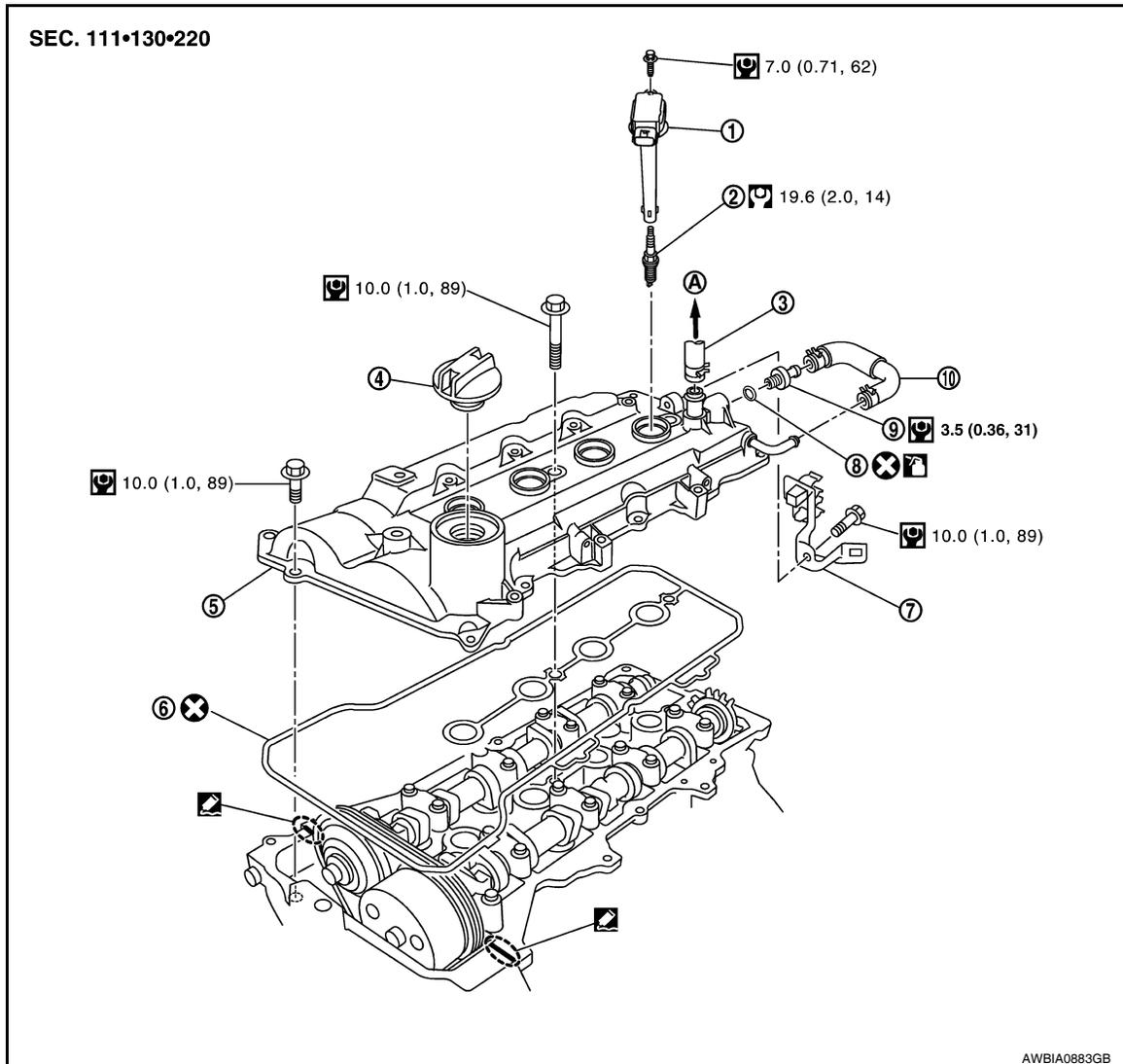
< ON-VEHICLE REPAIR >

[HR16DE]

IGNITION COIL, SPARK PLUG AND ROCKER COVER

Exploded View

INFOID:000000005398062



- | | | |
|-------------------|-----------------|--------------|
| 1. Ignition coil | 2. Spark plug | 3. PCV hose |
| 4. Oil filler cap | 5. Rocker cover | 6. Gasket |
| 7. Bracket | 8. O-ring | 9. PCV valve |
| 10. PCV hose | A: To air duct | |

Removal and Installation

INFOID:000000005398063

REMOVAL

1. Remove intake manifold. Refer to [EM-28. "Exploded View"](#).
2. Remove ignition coil.

CAUTION:

- Handle ignition coil carefully and avoid impacts.
- Never disassemble.

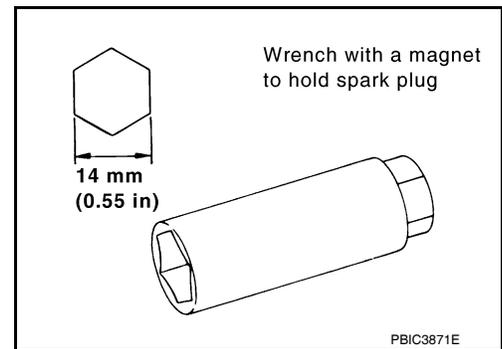
IGNITION COIL, SPARK PLUG AND ROCKER COVER

< ON-VEHICLE REPAIR >

[HR16DE]

- Remove spark plug using suitable tool.

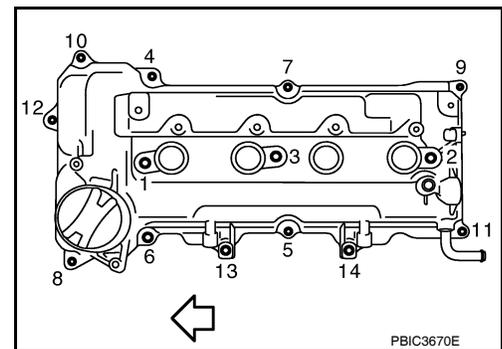
CAUTION:
Never drop or shock it.



- Remove ground cable (RH).
- Support the bottom surface of engine using a transmission jack, and then remove the engine mounting bracket and insulator (RH). Refer to [EM-82. "Exploded View"](#).
- Remove fuel tube protector.
- Disconnect PCV valve hose from PCV valve.
- Remove oil filler cap.
- Remove rocker cover.
 - Loosen bolts in reverse order shown.

← : Engine front

NOTE:
13 and 14 shown are used to tighten the fuel tube protector.

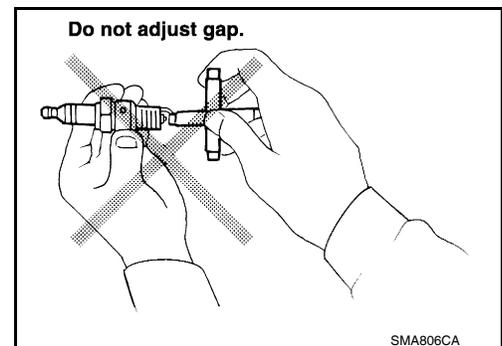


- Remove rocker cover gasket from rocker cover.
- Use scraper to remove all traces of liquid gasket from cylinder head and front cover.

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

INSPECTION AFTER REMOVAL

- CAUTION:**
- Never drop or shock spark plug.
 - Checking and adjusting spark plug gap is not required between change intervals.



- If spark plug tip is covered with carbon, a spark plug cleaner may be used.

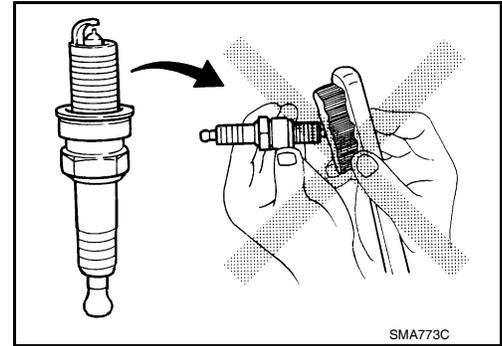
Cleaner air pressure : Less than 588 kPa (5.88 bar, 6 kg/cm², 85 psi)
Cleaning time : Less than 20 seconds

IGNITION COIL, SPARK PLUG AND ROCKER COVER

< ON-VEHICLE REPAIR >

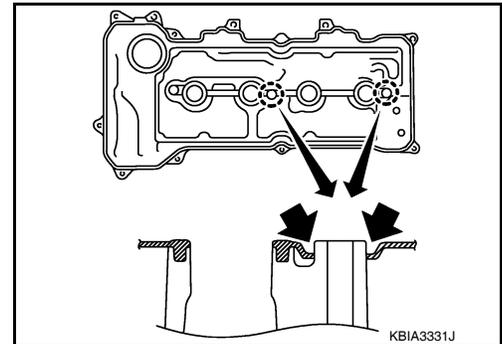
[HR16DE]

- Never use wire brush for cleaning spark plug.



INSTALLATION

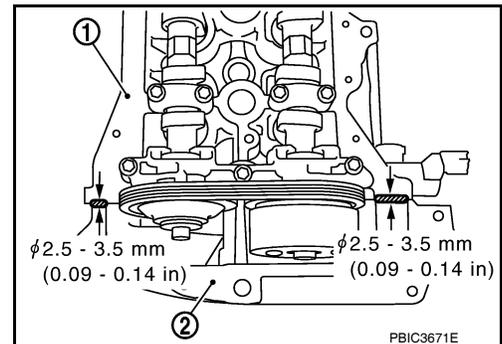
1. Install the rocker cover with the following procedure.
 - a. Install the rocker cover gasket to the rocker cover.
 - Check for damage or foreign material.
 - Make sure that it is securely inserted in the mounting groove of rocker cover.
 - For the two bolt holes shown, push the gasket into the boss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



- b. Apply liquid gasket to the position shown.

- 1 : Cylinder head
- 2 : Front cover

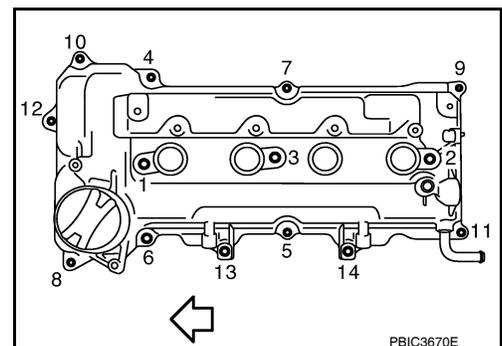
Use Genuine Silicone RTV Sealant or equivalent. Refer to [GI-42. "Recommended Chemical Product and Sealant"](#)



2. Install rocker cover to the cylinder head.

CAUTION:
Make sure the gasket is not dropped.
3. Install rocker cover.
 - Tighten bolts in two steps separately in numerical order as shown.

← : Engine front



4. Installation of the remaining components is in the reverse order of removal.

TIMING CHAIN

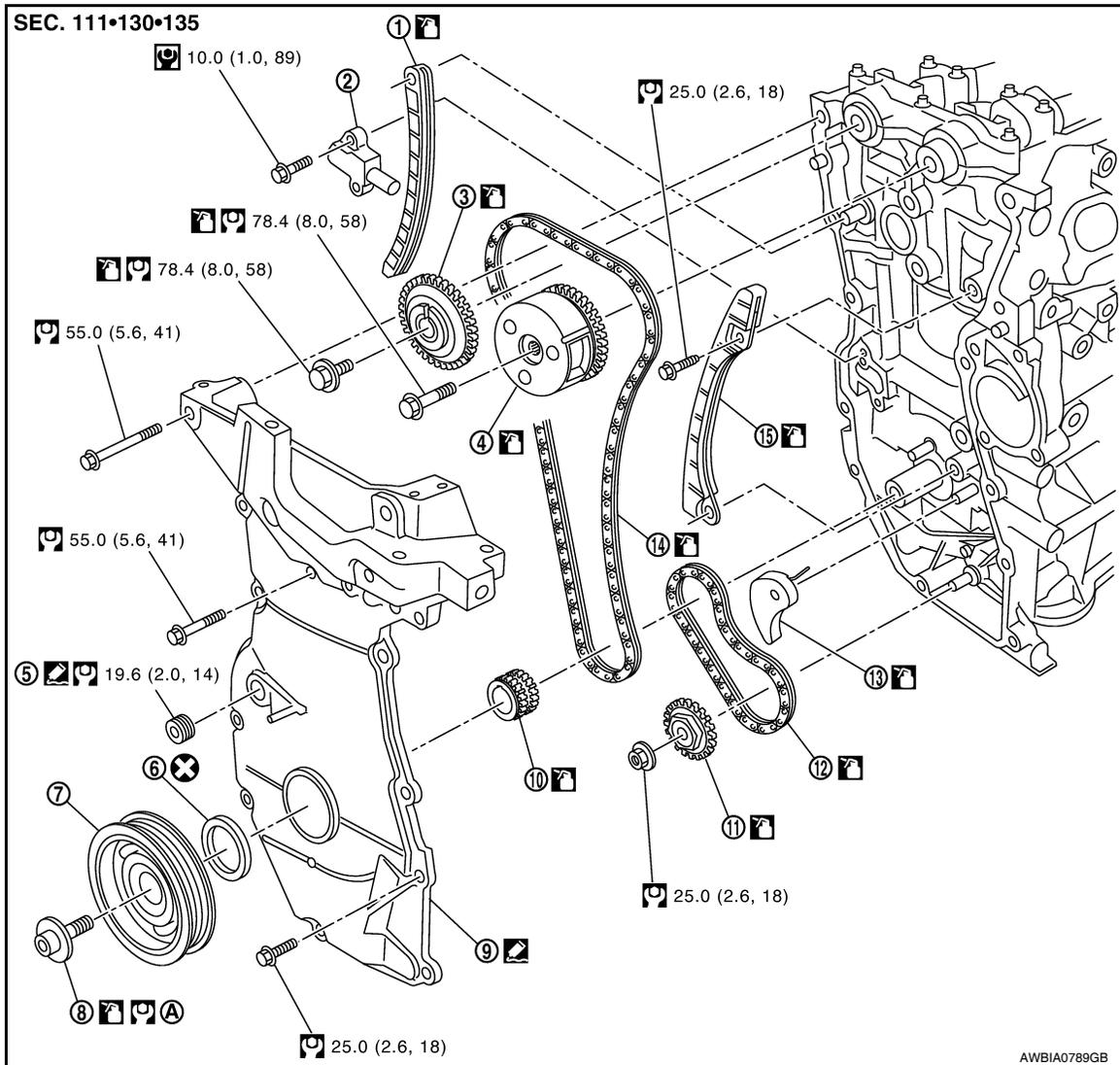
< ON-VEHICLE REPAIR >

[HR16DE]

TIMING CHAIN

Exploded View

INFOID:000000005398064



- | | | |
|--|---------------------------------------|--------------------------------|
| 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. Refer to Installation procedure

Removal and Installation

INFOID:000000005398065

CAUTION:

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

REMOVAL

1. Remove front wheel (RH). Refer to [WT-7, "Adjustment"](#).
2. Remove front fender protector (RH). Refer to [EI-24, "Removal and Installation"](#).
3. Drain engine oil. Refer to [LU-8, "Draining"](#).

CAUTION:

Perform this step when engine is cold.

TIMING CHAIN

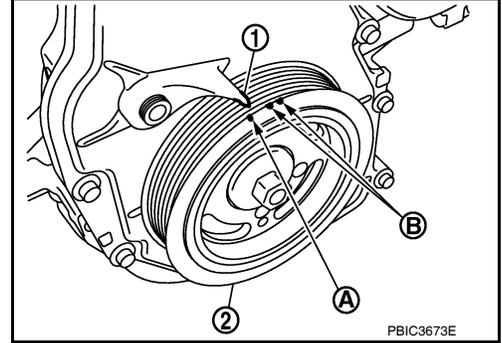
[HR16DE]

< ON-VEHICLE REPAIR >

4. Remove the following parts.
 - Intake manifold: Refer to [EM-28, "Exploded View"](#).
 - Drive belt: Refer to [EM-15, "Removal and Installation"](#).
 - Water pump pulley: Refer to [CO-21, "Exploded View"](#).
 - Ground cable (RH)
5. Support the bottom surface of engine using a transmission jack, and then remove the engine mounting bracket and insulator (RH). Refer to [EM-82, "Exploded View"](#).
6. Remove rocker cover. Refer to [EM-46, "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.

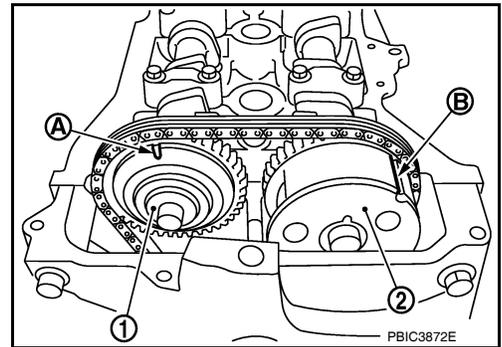
B : White paint mark (Not use for service)



- b. Make sure the matching marks on each camshaft sprocket are positioned as shown.

- 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.

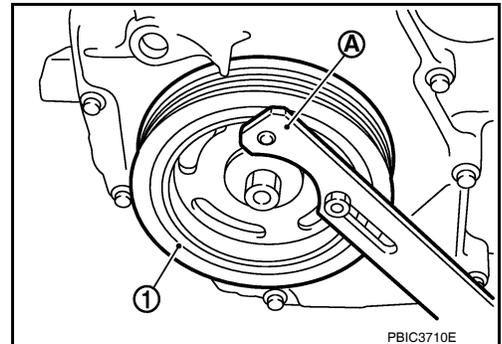


8. Remove crankshaft pulley with the following procedure:

- a. Secure crankshaft pulley (1) using a suitable tool (A).
- b. Loosen and pull out crankshaft pulley bolts.

CAUTION:

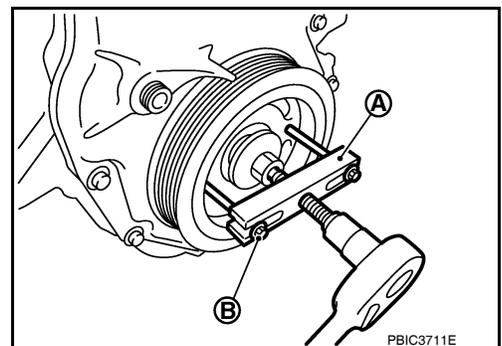
Never remove the bolts as they are used as a supporting point for the pulley puller.



- c. Attach Tool (A) in the M 6 thread hole on crankshaft pulley, and remove crankshaft pulley.

B : M6 bolt

Tool number : KV11103000 (—)

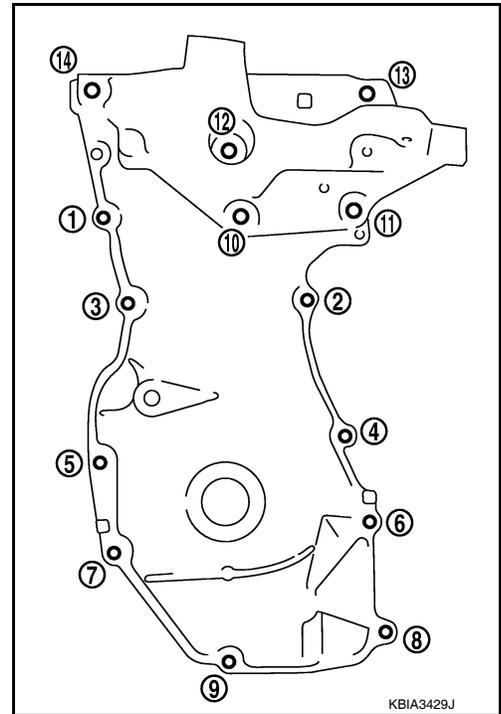


TIMING CHAIN

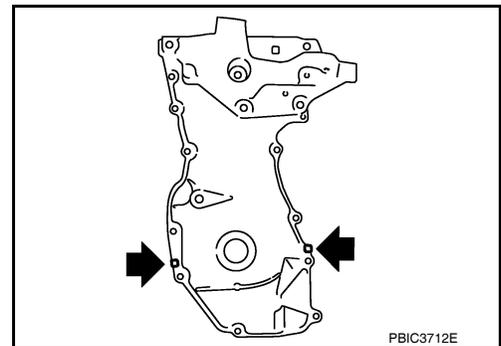
[HR16DE]

< ON-VEHICLE REPAIR >

9. Remove front cover with the following procedure:
 - a. Loosen bolts in the reverse of the order shown.



- b. Cut liquid gasket by prying the position (←) shown, and then remove the front cover.



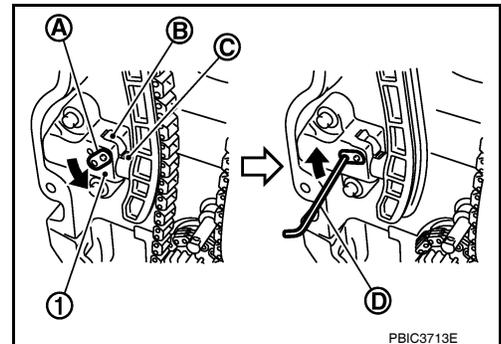
10. Remove front oil seal from front cover.
 - Remove by lifting it up using a suitable tool.

CAUTION:

Be careful not to damage the front cover.

11. Remove chain tensioner (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.
 - The example that a hexagonal wrench for 2.5 mm (0.098 in) is used as shown.
 - d. Remove chain tensioner.

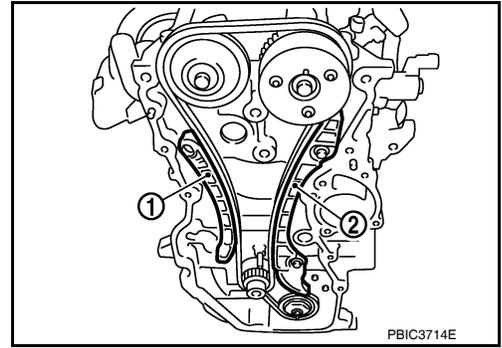


TIMING CHAIN

[HR16DE]

< ON-VEHICLE REPAIR >

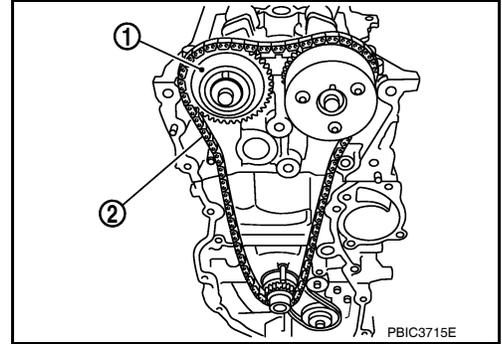
12. Remove the timing chain tension guide (2) and the timing chain slack guide (1).



13. Remove the timing chain (2).
- Pull the looseness of timing chain toward the camshaft sprocket (EXH) (1), and then remove the timing chain (2) and start the removal from camshaft sprocket (EXH) (1) side.

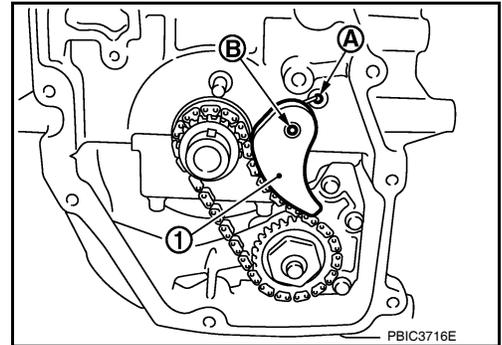
CAUTION:

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

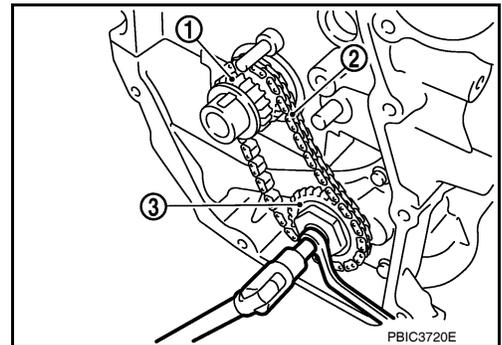


14. Remove the crankshaft sprocket and the oil pump drive related parts with the following procedure.

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



- b. Hold the top of the oil pump shaft using the TORX socket (size: E8), and then loosen the oil pump sprocket nut and remove it.
- c. Remove the crankshaft sprocket (1), the oil pump drive chain (2), and the oil pump sprocket (3) at the same time.



INSTALLATION

NOTE:

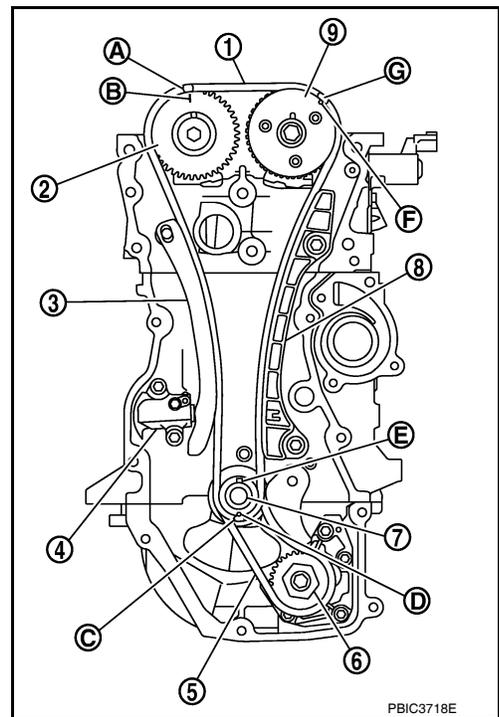
TIMING CHAIN

[HR16DE]

< ON-VEHICLE REPAIR >

The illustration 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 : Dark 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 : Dark blue link



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

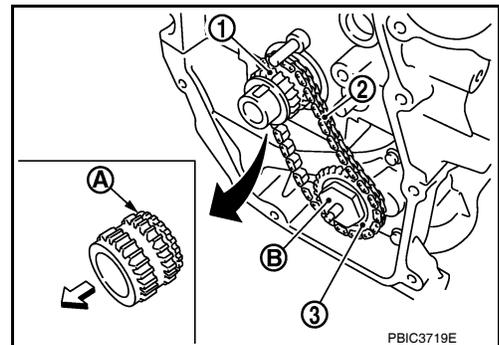
- a. Install the crankshaft sprocket (1), the oil pump drive chain (2), and the oil pump sprocket (3) at the same time.

⇐ : Engine front

- Install the crankshaft sprocket (1) so that its invalid gear area (A) is towards the back of the engine.
- Install the oil pump sprocket (3) so that its hexagonal surface faces (B) the front of engine.

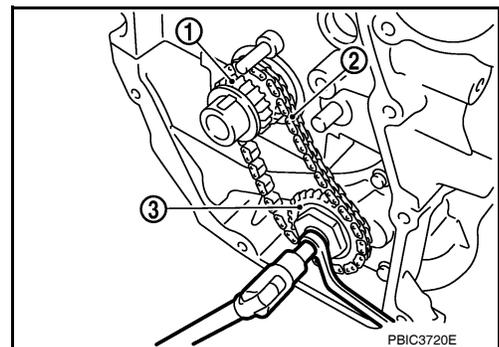
NOTE:

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



- 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

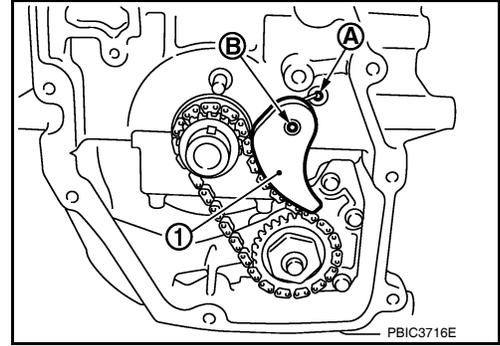


TIMING CHAIN

[HR16DE]

< ON-VEHICLE REPAIR >

- 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.
 - Make sure that the tension is applied to the oil pump drive chain after installing.



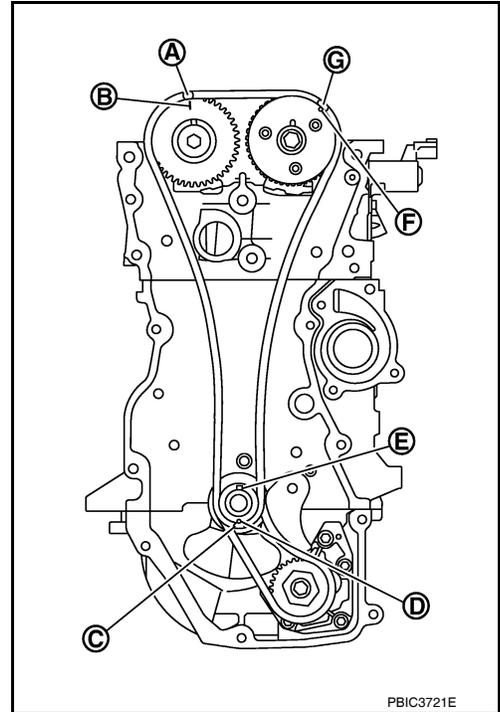
2. Install timing chain with the following procedure.

- A : Dark 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 : Dark blue link

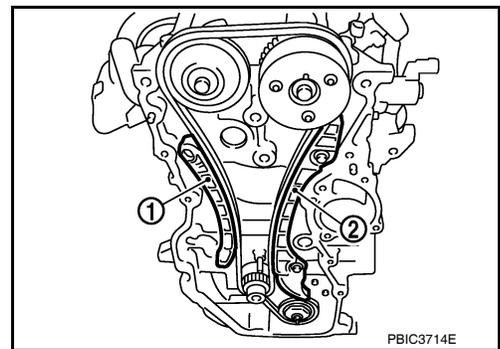
- Install by aligning matching marks on each sprocket and timing chain.
- If these matching marks are not aligned, rotate the camshaft slightly to correct the position.

CAUTION:

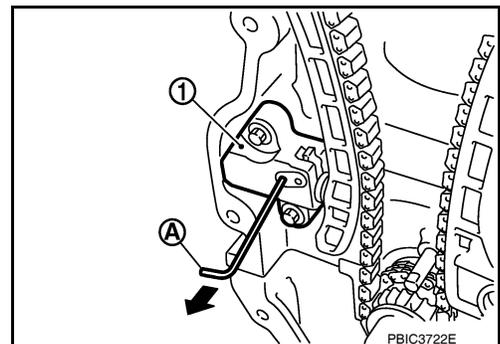
- Check matching mark position of each sprocket and timing chain again after installing the timing chain, keep matching marks aligned by holding them with a hand.
- To avoid skipped teeth, never rotate crankshaft and camshaft until front cover is installed.



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



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



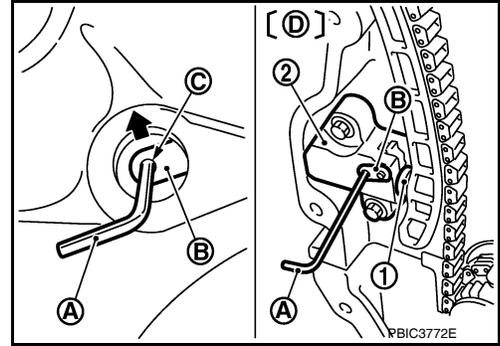
TIMING CHAIN

[HR16DE]

< ON-VEHICLE REPAIR >

5. Check matching mark position of timing chain and each sprocket again.
6. Pull out the stopper pin (A), and then apply the tension to the timing chain by rotating the crankshaft pulley clockwise slightly.

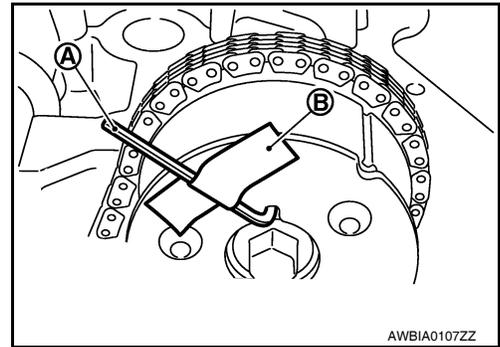
- 1 : Plunger
- 2 : Chain tensioner
- B : Lever
- C : Lever hole
- D : Front cover has been omitted



7. 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

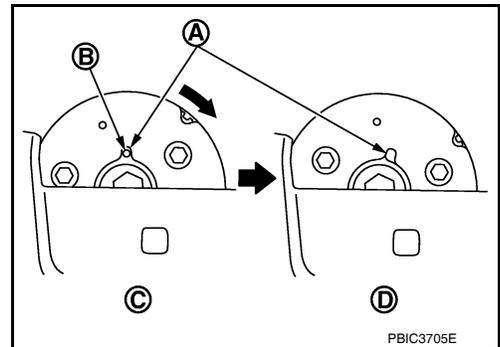


- b. Turn the crankshaft slowly clockwise and return the camshaft sprocket (INT) to the most retarded angle position.

- 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 : Most retarded angle (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 make sure the lock pin has joined by seeing if the vane (camshaft) and the sprocket move together.



8. Install the front oil seal to the front cover. Refer to [EM-71. "FRONT OIL SEAL : Removal and Installation"](#)
9. Install front cover with the following procedure:

TIMING CHAIN

[HR16DE]

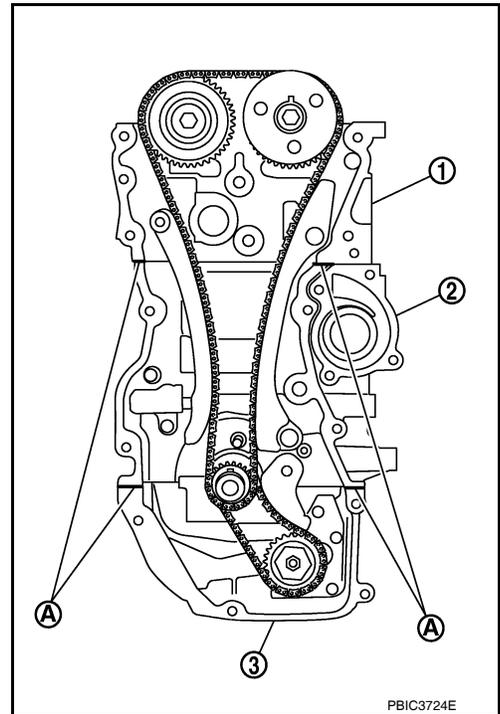
< ON-VEHICLE REPAIR >

- a. Apply a continuous bead of liquid gasket with Tool to front of engine as shown.

Use Genuine Silicone RTV Sealant or equivalent. Refer to [GI-42. "Recommended Chemical Product and Sealant"](#).

- 1 : Cylinder head
- 2 : Cylinder block
- 3 : Oil pan (upper)
- A : Liquid gasket application ϕ 3.0 - 4.0 mm (0.12 - 0.16 in) dia.

Tool number : WS39930000 (—)

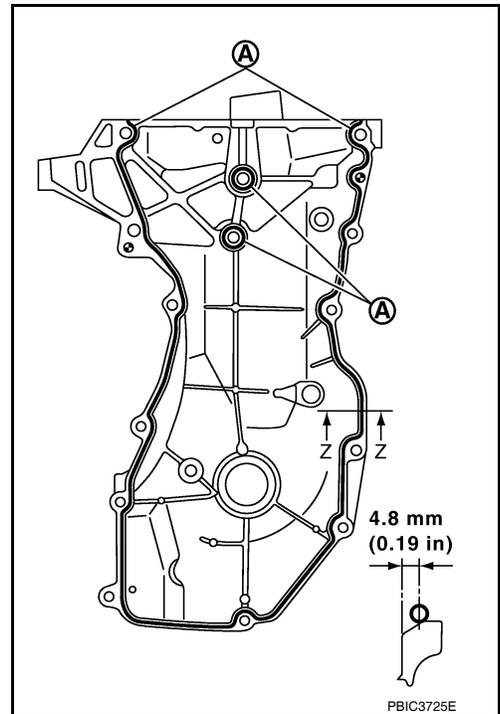


- b. Apply a continuous bead of liquid gasket with Tool to front cover as shown.

Use Genuine Silicone RTV Sealant or equivalent. Refer to [GI-42. "Recommended Chemical Product and Sealant"](#).

- A : Liquid gasket application ϕ 3.0 - 4.0 mm (0.12 - 0.16 in) dia.

Tool number : WS39930000 (—)



TIMING CHAIN

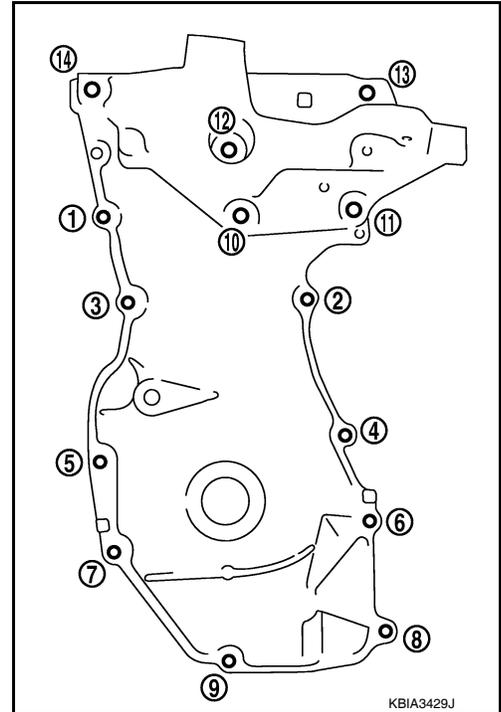
[HR16DE]

< ON-VEHICLE REPAIR >

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

CAUTION:

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



10. Insert crankshaft pulley by aligning with crankshaft key.
 - When inserting crankshaft pulley with a plastic hammer, tap on its center portion (not circumference).

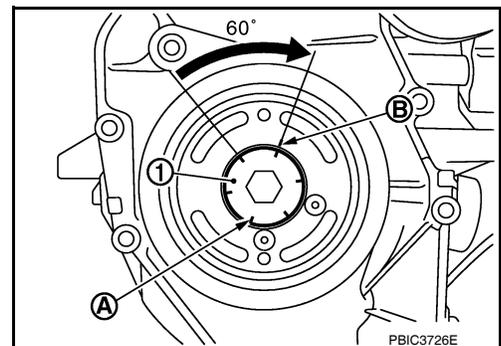
CAUTION:

Never damage front oil seal lip section.

11. Tighten crankshaft pulley bolt with the following procedure:
 - Secure crankshaft pulley with a suitable 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.

Crankshaft pulley bolt : 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.



12. Make sure that crankshaft turns smoothly by rotating by hand clockwise.
13. Installation of the remaining components is in the reverse order of removal.

Inspection

INFOID:000000005398066

INSPECTION AFTER REMOVAL

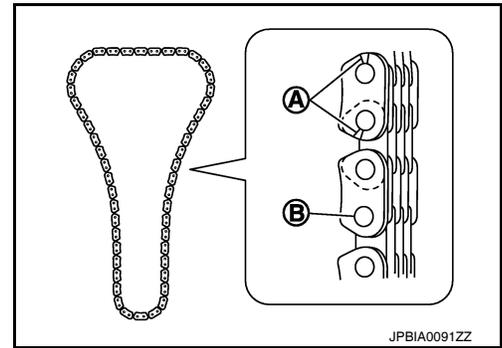
Timing Chain

TIMING CHAIN

[HR16DE]

< ON-VEHICLE REPAIR >

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



INSPECTION AFTER INSTALLATION

Inspection for Leaks

- 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-14, "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 make sure 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
Fuel	Leakage	Leakage	Leakage

* Transaxle fluid, power steering fluid, brake fluid, etc.

CAMSHAFT

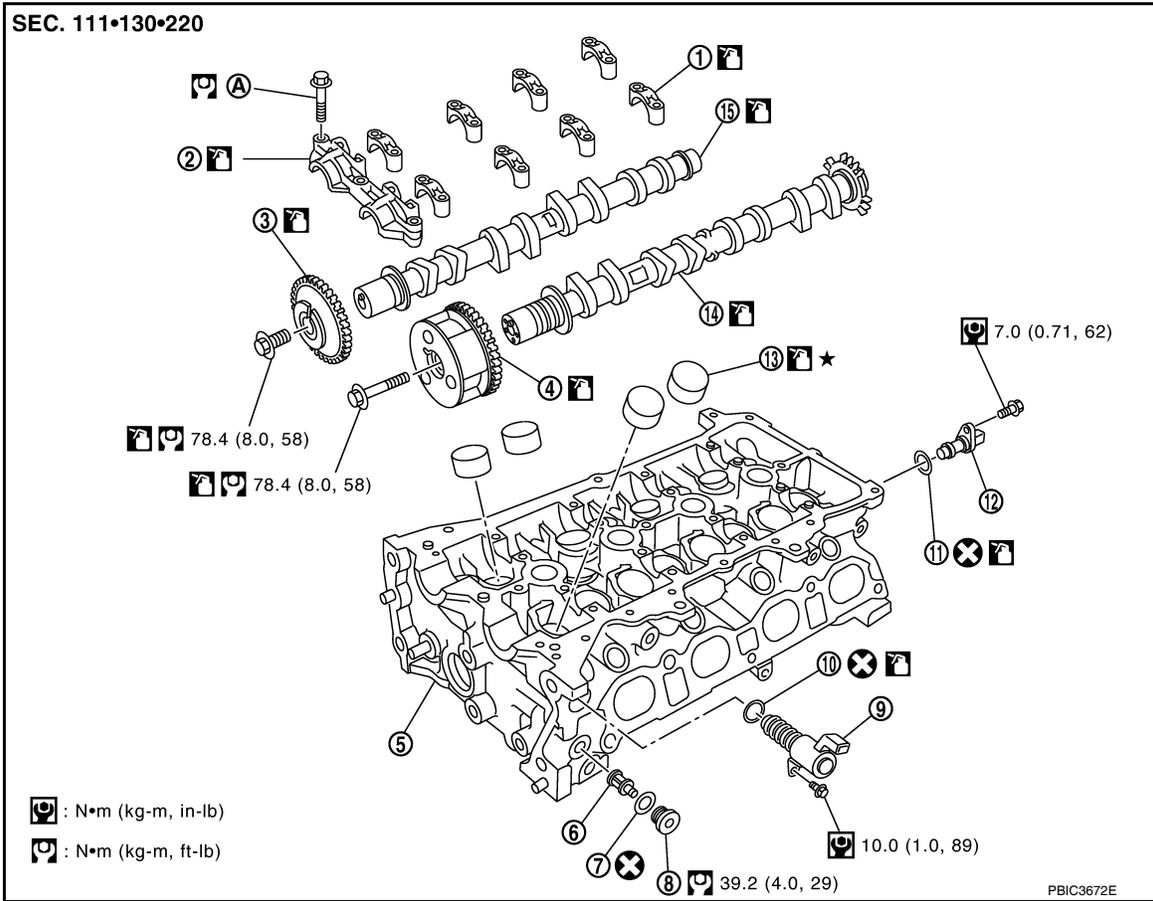
< ON-VEHICLE REPAIR >

[HR16DE]

CAMSHAFT

Exploded View

INFOID:000000005398067



- | | | |
|----------------------------------|----------------------------|---|
| 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) |
| 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) |
- A. Refer to Installation procedure

Removal and Installation

INFOID:000000005398068

CAUTION:

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

REMOVAL

1. Remove timing chain. Refer to [EM-49, "Removal and Installation"](#).
2. Remove camshaft position sensor (PHASE) from rear end of cylinder head.

CAUTION:

Handle it carefully and avoid impacts.

CAMSHAFT

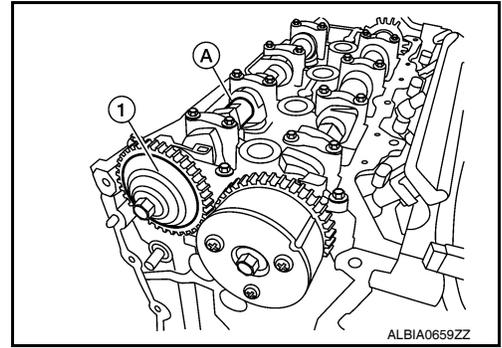
[HR16DE]

< ON-VEHICLE REPAIR >

3. Remove camshaft sprocket (EXH) bolt and 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.

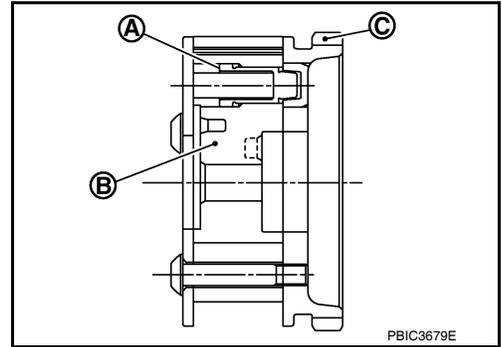


4. Turn the camshaft sprocket (INT) to the most advanced position.

CAUTION:

Installation and removal of the camshaft sprocket (INT) must be done in the most advanced position for the following reasons.

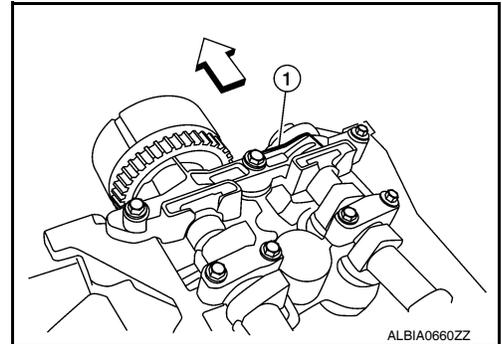
- The sprocket (C) and vane (camshaft coupling) (B) are designed to spin and move within the range of a certain angle.
- With the engine stopped and the vane in the most retarded angle, it will not spin because it is locked to the sprocket side by the internal lock pin (A).
- If the camshaft sprocket 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.



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

⇐ : Engine front

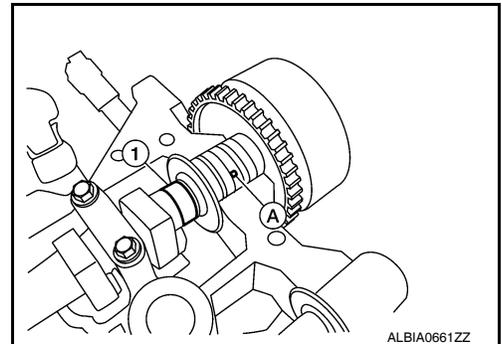
- Loosen the bolts in several steps, and then remove them.



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

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

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



CAMSHAFT

< ON-VEHICLE REPAIR >

[HR16DE]

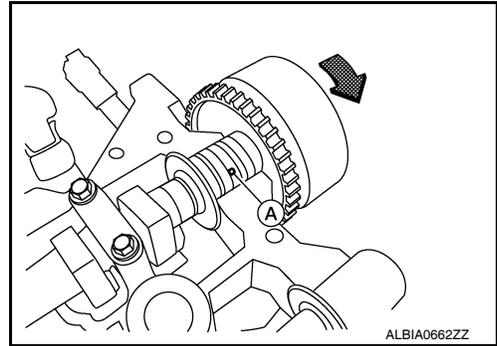
- Attach the rubber nozzle narrowed to the top of the air gun to prevent air leakage from the oil hole. Securely apply the air pressure to the oil hole (A).

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.

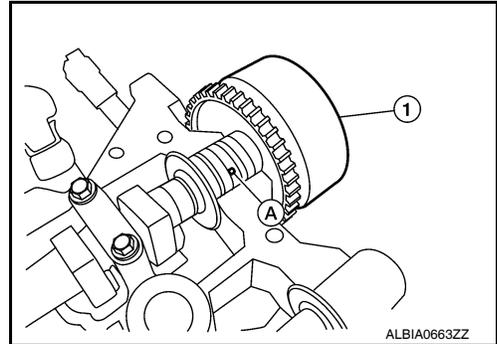
NOTE:

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) (1) lightly with a plastic hammer.
- If the camshaft sprocket (INT) (1) is not rotated counterclockwise even if the above procedures are performed, check the air pressure and the oil hole position.

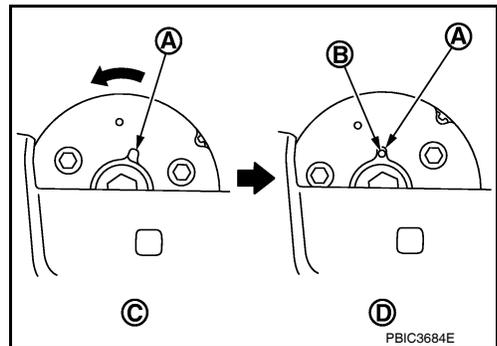


- d. While doing the above, once you hear a click (the sound of the internal lock pin disengaging) from inside the camshaft sprocket (INT), start turning the camshaft sprocket (INT) in the counterclockwise direction in the most advanced angle position.

C : Most retarded angle (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.
- Make sure 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.



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

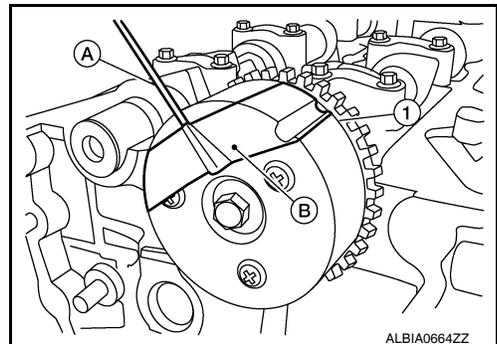
- f. Insert the stopper pin (A) into the stopper pin holes in the camshaft sprocket (INT) (1) and lock in the most advanced angle position.

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



A
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CAMSHAFT

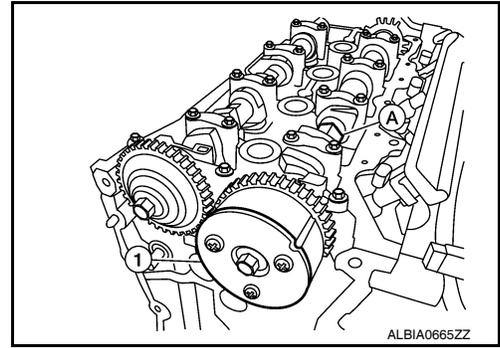
[HR16DE]

< ON-VEHICLE REPAIR >

- Remove camshaft sprocket (INT) bolt and camshaft sprocket (INT) (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.

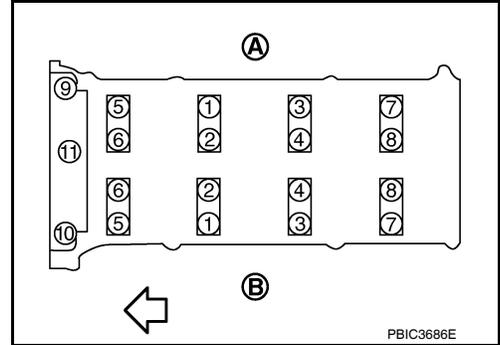


- Remove camshaft brackets (No. 2 to 5).
 - Loosen bolts in several steps in the reverse of the order shown.

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

NOTE:

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

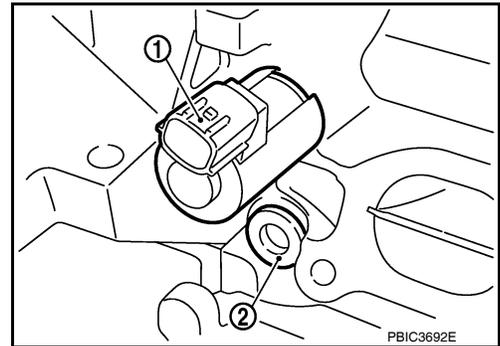


- Remove camshaft (EXH).
 - Remove camshaft (INT).
- CAUTION:**
Never damage the signal plate of rear end.
- Remove valve lifter.
 - Identify installation positions, and store them without mixing them up.
 - Remove intake valve timing control solenoid valve (1).

- Remove the generator and bracket, if necessary, then remove the plug (2), washer and oil filter. Refer to [SC-25, "Removal and Installation"](#).

CAUTION:

Discard the washer, do not reuse.

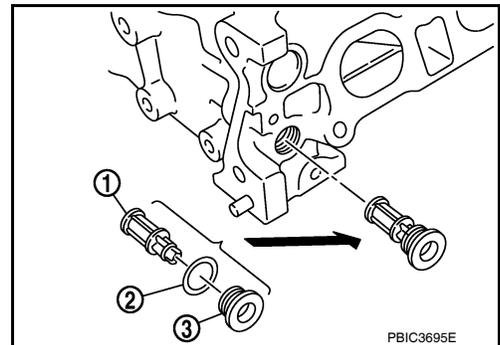


INSTALLATION

- Install the oil filter (1) and new washer (2).
 - The oil filter is assembled to the plug (3), and then install it to the cylinder head.

CAUTION:

Do not reuse the washer, install a new washer.



- Install intake valve timing control solenoid valve.
 - Insert it straightly into the cylinder head.
 - Tighten bolts after placing it completely.

CAMSHAFT

< ON-VEHICLE REPAIR >

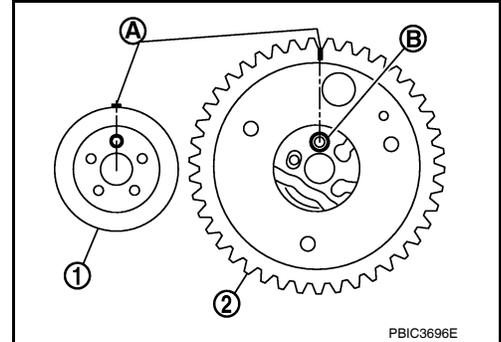
[HR16DE]

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).

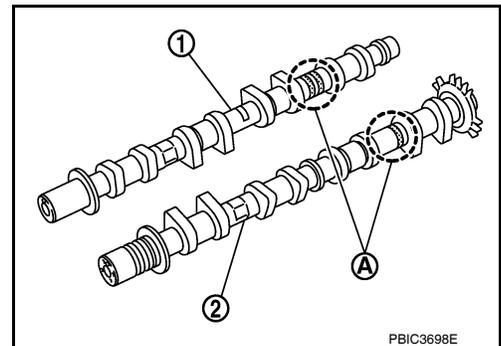
- a. Put the matching marks (A) on a line extending from the knock pin position of camshaft (INT) (1) front surface.
 - Put the marks on the visible position with the camshaft sprocket installed. (Example shown)
- b. Put the matching marks on a line extending from the knock pin hole (B) position of camshaft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



5. Install camshafts.

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

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

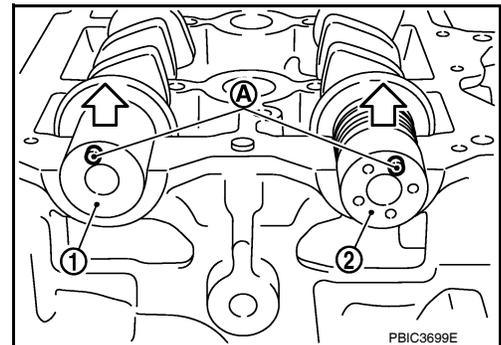


- Install camshafts to the cylinder head so that knock pins (A) on front end are positioned as shown.

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

NOTE:

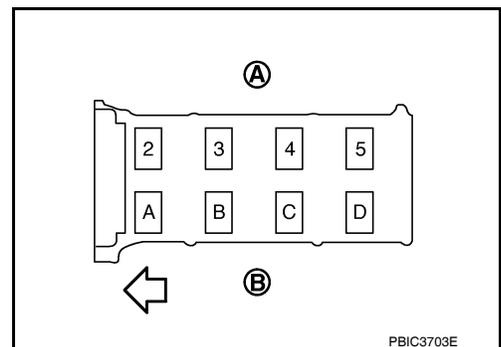
Though camshaft does not stop at the portion as shown, for the placement of cam nose, it is generally accepted camshaft is placed for the same direction.



6. Install camshaft brackets (No. 2 to 5) aligning the identification marks on upper surface as shown.

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

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



CAMSHAFT

[HR16DE]

< ON-VEHICLE REPAIR >

7. Tighten bolts of camshaft brackets in the following steps, in numerical order as shown.

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

- a. Tighten No. 9 to 11 in numerical order.

Camshaft bracket bolts (9 - 11) : 1.96 N·m (0.20 kg-m, 17 in-lb)

- b. Tighten No. 1 to 8 in numerical order.

Camshaft bracket bolts (1 - 8) : 1.96 N·m (0.20 kg-m, 17 in-lb)

- c. Tighten all bolts in numerical order.

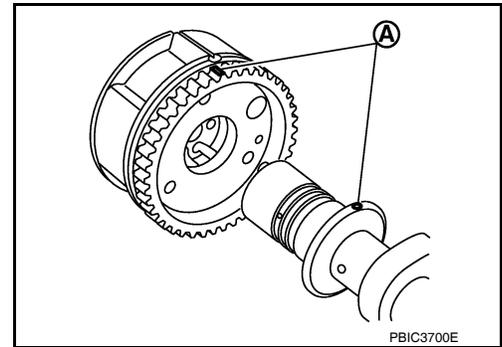
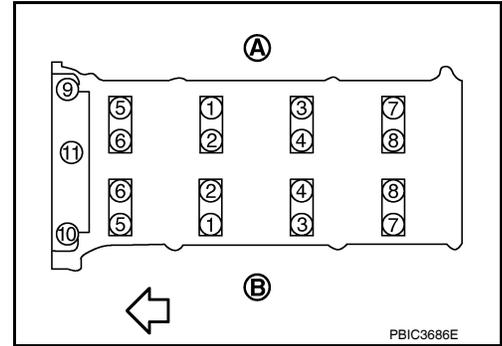
Camshaft bracket bolts (all) : 5.88 N·m (0.60 kg-m, 52 in-lb)

- d. Tighten all bolts in numerical order.

Camshaft bracket bolts (all) : 10.4 N·m (1.1 kg-m, 8 ft-lb)

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

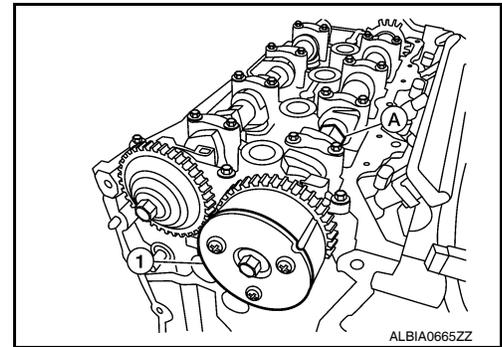
- a. Align the matching mark (A) put according to step "4". Securely align the knock pin and the pin hole, and then install them.



- b. Temporarily tighten the camshaft sprocket (INT) bolt on the front side of camshaft sprocket (INT) (1).

- 2 : Camshaft sprocket (INT)

- c. Hold the camshaft hexagonal part (A), to secure the camshaft and tighten the bolt.

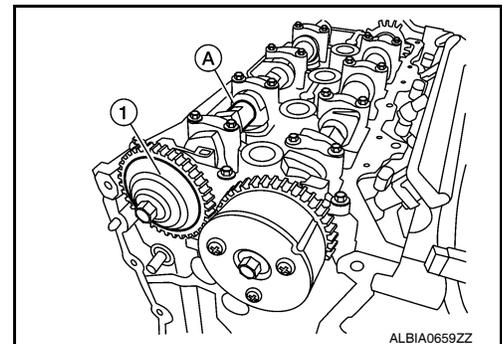


9. Install the camshaft sprocket (EXH) (1) to the camshaft (EXH) while aligning the matching mark (marked when timing chain is removed) and the matching mark (stamp) of camshaft sprocket (EXH).

- If the positions of knock pin and pin groove are not aligned, move the camshaft (EXH) slightly to correct these positions.
- Hold the camshaft hexagonal part (A), to secure the camshaft and tighten the bolt.

CAUTION:

Make sure that the matching mark (marked when timing chain is removed) and each camshaft sprocket matching mark are in the correct location.



CAMSHAFT

[HR16DE]

< ON-VEHICLE REPAIR >

10. Install timing chain. Refer to [EM-49. "Removal and Installation"](#).
11. Install the camshaft position sensor (PHASE) to the rear end of cylinder head.
 - Tighten bolts with it seated completely.
12. Check and adjust valve clearance. Refer to [EM-20. "Inspection and Adjustment"](#).
13. Installation of the remaining components is in the reverse order of removal.

Inspection

INFOID:000000005398069

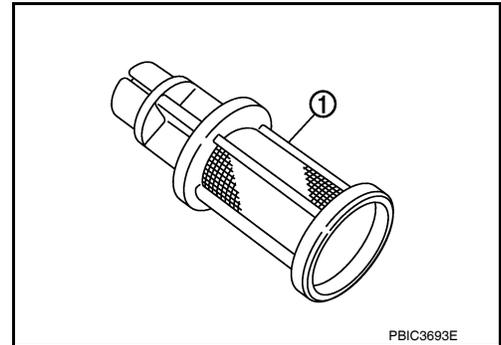
INSPECTION AFTER REMOVAL

Oil Filter

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

CAUTION:

Do not reuse the washer.



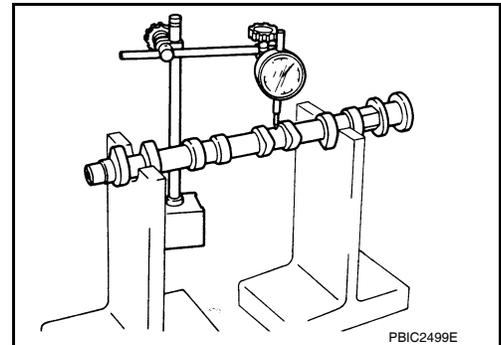
Camshaft Runout

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)



Standard and Limit:

Refer to [EM-112. "Camshaft"](#).

4. If it exceeds the limit, replace camshaft.

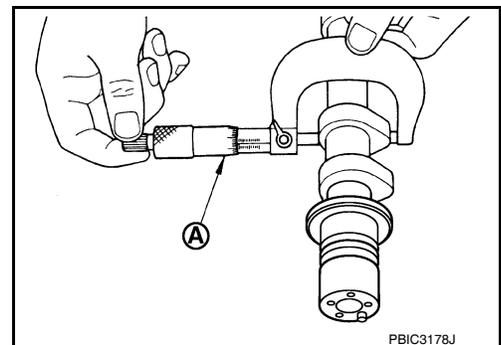
Camshaft Cam Height

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

Standard and Cam wear Limit:

Refer to [EM-112. "Camshaft"](#).

2. If wear exceeds the limit, replace camshaft.



Camshaft Journal Oil Clearance

CAMSHAFT JOURNAL DIAMETER

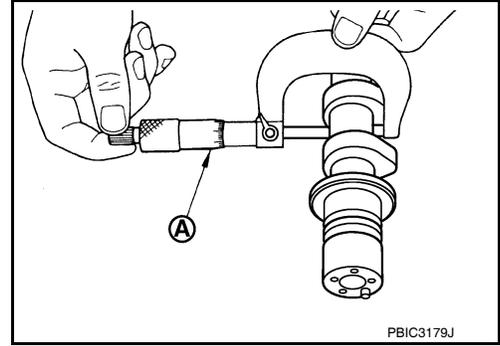
CAMSHAFT

[HR16DE]

< ON-VEHICLE REPAIR >

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

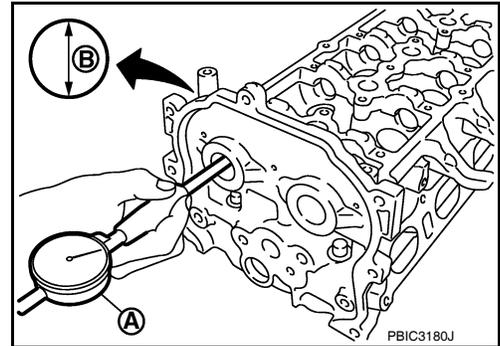
Standard: Refer to [EM-112, "Camshaft"](#).



CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolts with the specified torque. Refer to [EM-59, "Removal and Installation"](#).
- Measure inner diameter (B) of camshaft bracket with a bore gauge (A).

Standard: Refer to [EM-112, "Camshaft"](#).



CAMSHAFT JOURNAL OIL CLEARANCE

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

Standard and Limit: Refer to [EM-112, "Camshaft"](#).

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

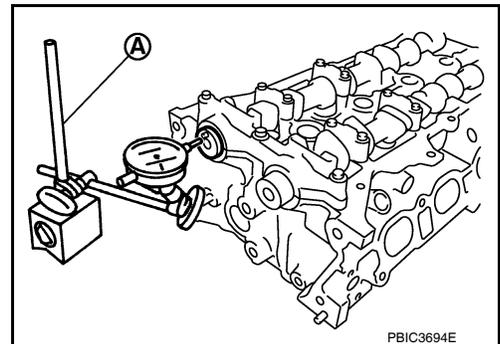
NOTE:

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-59, "Removal and Installation"](#).
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-112, "Camshaft"](#).



CAMSHAFT

[HR16DE]

< ON-VEHICLE REPAIR >

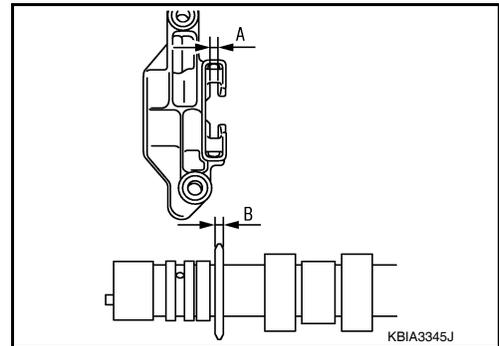
- Measure the following parts if out of the standard.
- Dimension "A" for cylinder head No. 1 journal bearing

Standard : 4.000 - 4.030 mm (0.1575 - 0.1587 in)

- Dimension "B" for camshaft thrust

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

- Follow 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.

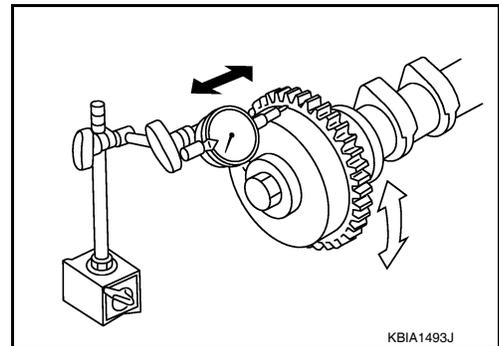
CAUTION:

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: Refer to [EM-112, "Camshaft"](#).

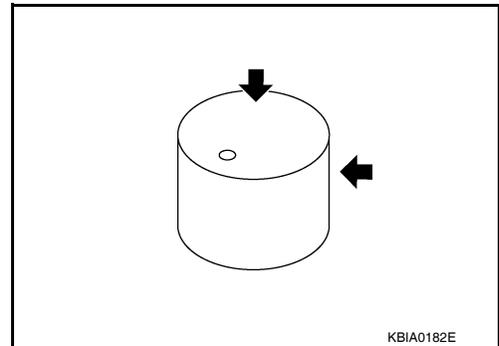
- If it exceeds the limit, replace camshaft sprocket.



Valve Lifter

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

- If anything above is found, replace valve lifter. Refer to [EM-112, "Camshaft"](#).

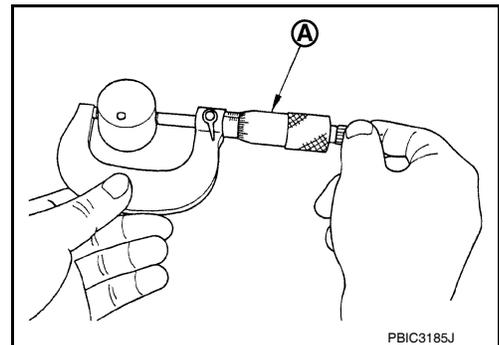


Valve Lifter Clearance

VALVE LIFTER OUTER DIAMETER

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

Standard: Refer to [EM-112, "Camshaft"](#).



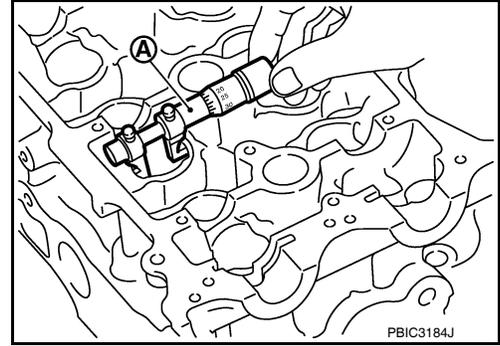
VALVE LIFTER HOLE DIAMETER

CAMSHAFT

[HR16DE]

< ON-VEHICLE REPAIR >

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



Standard: Refer to [EM-112, "Camshaft"](#).

VALVE LIFTER CLEARANCE

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

Standard: Refer to [EM-112, "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-14, "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 make sure 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
Fuel	Leakage	Leakage	Leakage

*: Transmission/transaxle/CVT 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-127, "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-7, "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 [EC-496, "Inspection"](#).

CAMSHAFT

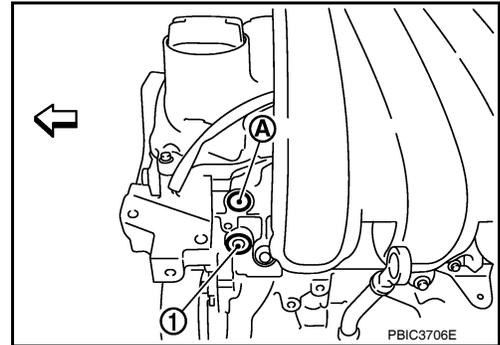
[HR16DE]

< ON-VEHICLE REPAIR >

- b. Remove intake manifold. Refer to [EM-28, "Exploded View"](#).
- c. Disconnect ignition coil and injector harness connectors. Refer to [EM-46, "Exploded View"](#).
3. Remove intake valve timing control solenoid valve. Refer to [EM-49, "Exploded View"](#).
4. Crank engine, and then make sure 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-65, "Inspection"](#).
 - Clean oil groove between oil strainer and intake valve timing control solenoid valve. Refer to [LU-6, "Engine Lubrication System"](#) and [LU-6, "Engine Lubrication System Schematic"](#).
 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-6, "Engine Lubrication System"](#) and [LU-6, "Engine Lubrication System Schematic"](#).
 7. After inspection, installation is in the reverse order of removal.

OIL SEAL VALVE OIL SEAL

VALVE OIL SEAL : Removal and Installation

INFOID:000000005398070

REMOVAL

1. Remove camshafts. Refer to [EM-59. "Exploded View"](#).
2. Remove valve lifters. Refer to [EM-59. "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:

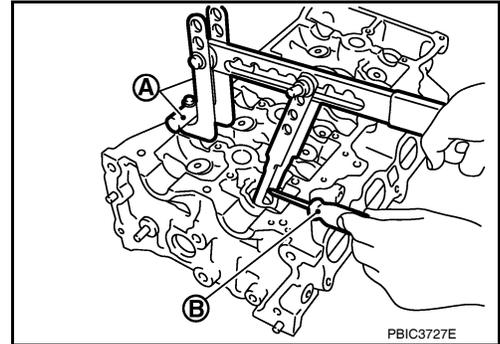
When rotating crankshaft, be careful to avoid scarring front cover with timing chain.

4. Remove valve collet.
 - Compress valve spring with Tool (A). Remove valve collet with a magnet hand (B).

CAUTION:

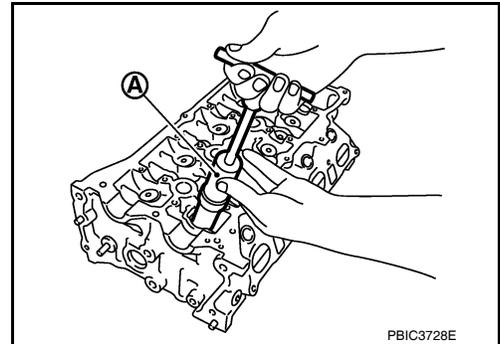
Be careful not to damage valve lifter holes.

Tool number : KV10116200 (J-26336-B)
 : KV10115900 (J-26336-20)
 : KV10109220 (—)



5. Remove valve spring retainer, valve spring and valve spring seat. Refer to [EM-76. "Disassembly and Assembly"](#).
6. Remove valve oil seal with Tool (A).

Tool number : KV10107902 (J-38959)
 : KV10116100 (—)

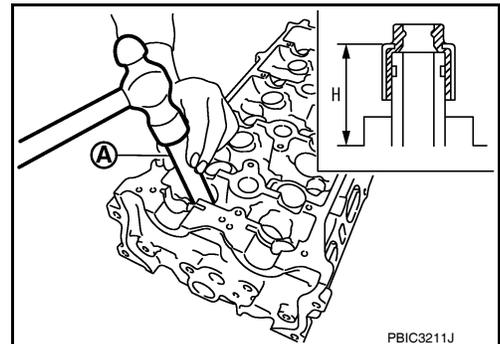


INSTALLATION

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 with Tool (A).

Height "H" : 13.2 - 13.8 mm (0.520 - 0.543 in)

Tool number : KV10115600 (J-38958)



3. Installation of the remaining components is in the reverse order of removal.

FRONT OIL SEAL

OIL SEAL

< ON-VEHICLE REPAIR >

[HR16DE]

INFOID:000000005398071

FRONT OIL SEAL : Removal and Installation

REMOVAL

1. Remove the following parts:
 - Front wheel and tire (RH). Refer to [WT-7, "Adjustment"](#).
 - Front fender protector (RH): Refer to [EI-24, "Removal and Installation"](#).
 - Drive belt: Refer to [EM-15, "Removal and Installation"](#).
 - Crankshaft pulley: Refer to [EM-49, "Exploded View"](#).
2. Remove front oil seal using a suitable tool.

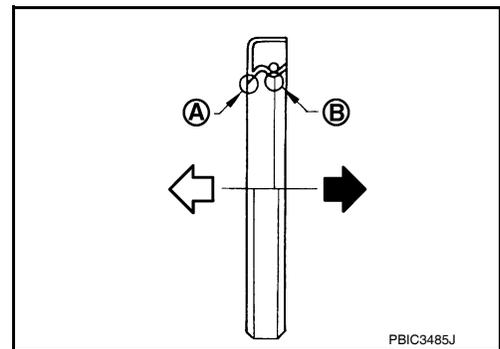
CAUTION:

Be careful not to damage front timing chain case and crankshaft.

INSTALLATION

1. Apply new engine oil to both oil seal lip and dust seal lip of new front oil seal.
2. Install front oil seal.
 - Install front oil seal so that each seal lip is oriented as shown.

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



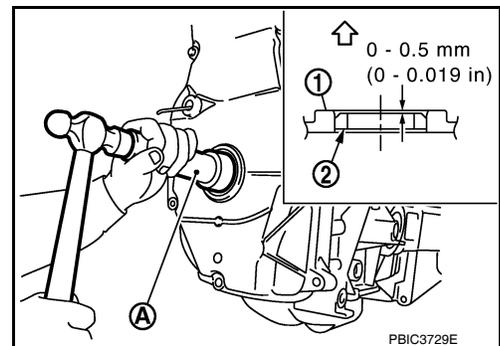
- Using a suitable drift, press-fit until the height of front oil seal (2) is level with the mounting surface.

- 1 : Front cover
- ⇐ : Engine outside

- Suitable drift (A): outer diameter 50 mm (1.97 in), inner diameter 44 mm (1.73 in).
- Make sure the garter spring is in position and seal lips not inverted

CAUTION:

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



3. Installation of the remaining components is in the reverse order of removal.

REAR OIL SEAL

REAR OIL SEAL : Removal and Installation

INFOID:000000005398072

REMOVAL

1. Remove transaxle assembly. Refer to [AT-233, "Removal and Installation"](#) (A/T), [MT-17, "Removal and Installation"](#) (M/T).
2. Remove clutch cover and clutch disc (M/T). Refer to [CL-16, "Removal and Installation"](#).
3. Remove flywheel (M/T) or drive plate (A/T). Refer to [EM-89, "Exploded View"](#).
4. Remove rear oil seal with a suitable tool.

CAUTION:

Be careful not to damage crankshaft and cylinder block.

INSTALLATION

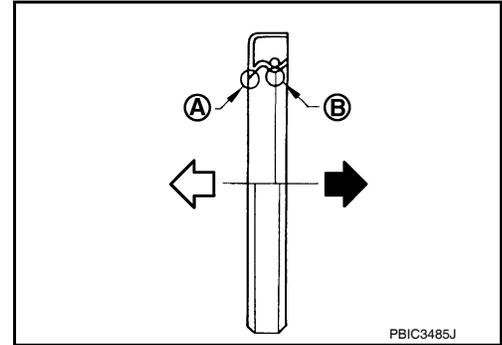
OIL SEAL

< ON-VEHICLE REPAIR >

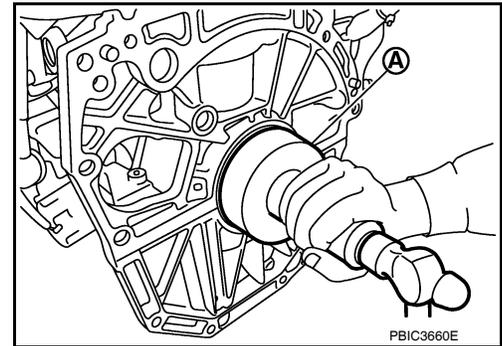
[HR16DE]

1. Apply the liquid gasket lightly to entire outside area of new rear oil seal.
Use Genuine Silicone RTV Sealant or equivalent. Refer to [GI-42, "Recommended Chemical Product and Sealant"](#).
2. Install rear oil seal so that each seal lip is oriented as shown.

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

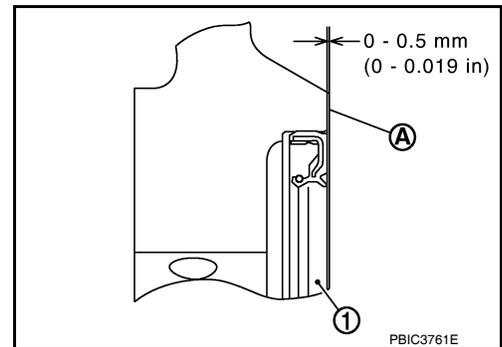


- Press-fit rear oil seal with a drift (a) outer diameter 113 mm (4.45 in) and inner diameter 90 mm (3.54 in).
- CAUTION:**
- **Be careful not to damage crankshaft and cylinder block.**
 - **Press-fit oil seal straight to avoid causing burrs or tilting.**
 - **Never touch grease applied onto oil seal lip.**



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

- A : Rear end surface of cylinder block



3. After press-fitting rear oil seal, completely wipe off any liquid gasket protruding to rear end surface side.
4. Installation of the remaining components is in the reverse order of removal.

CYLINDER HEAD

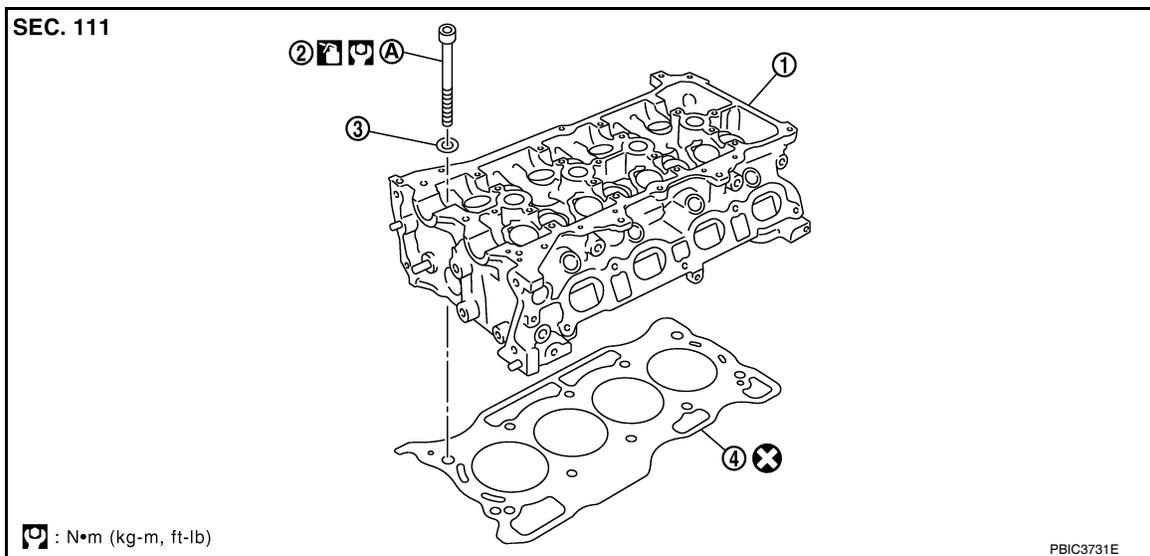
< ON-VEHICLE REPAIR >

[HR16DE]

CYLINDER HEAD

Removal and Installation

INFOID:000000005398073



1. Cylinder head assembly
 2. Cylinder head bolt
 3. Washer
 4. Cylinder head gasket
- A. Refer to [EM-73](#)

REMOVAL

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.
- Do not smoke while servicing fuel system. Keep open flames and sparks away from the work area.

1. Release fuel pressure. Refer to [EC-496, "Inspection"](#).
2. Drain engine coolant and engine oil. Refer to [CO-12, "Changing Engine Coolant"](#) and [LU-8, "Draining"](#).

CAUTION:

- Perform this step when the engine is cold.
 - Never spill engine coolant and engine oil on drive belt.
3. Remove the following components and related parts.
 - Front fender protector (RH). Refer to [EI-24, "Removal and Installation"](#).
 - Generator. Refer to [SC-25, "Removal and Installation"](#).
 - Exhaust front tube. Refer to [EX-6, "Component"](#).
 - Exhaust manifold. Refer to [EM-31, "Exploded View"](#).
 - Intake manifold. Refer to [EM-28, "Exploded View"](#).
 - Fuel tube and fuel injector. Refer to [EM-34, "Exploded View"](#).
 - Water outlet. Refer to [CO-25, "Removal and Installation"](#).
 - Drive belt. Refer to [EM-15, "Removal and Installation"](#).
 - Front cover. Refer to [EM-49, "Exploded View"](#).
 - Camshaft. Refer to [EM-59, "Exploded View"](#).
 - Air cleaner assembly. Refer to [EM-26, "Removal and Installation"](#).

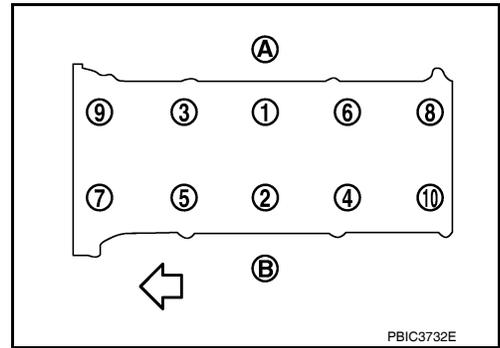
CYLINDER HEAD

[HR16DE]

< ON-VEHICLE REPAIR >

4. Remove cylinder head loosening bolts in reverse order as shown.

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



5. Remove cylinder head gasket.

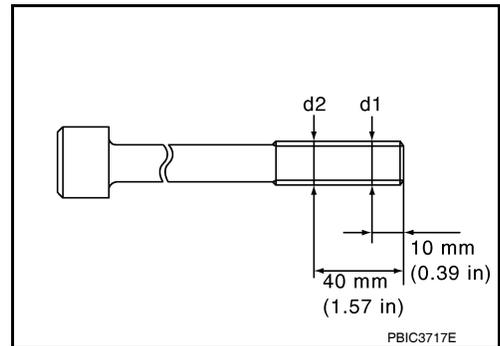
INSPECTION AFTER REMOVAL

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-116, "Cylinder Block"](#).

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

CAUTION:

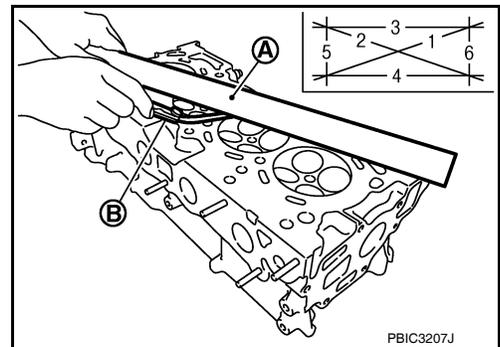
Never allow gasket debris to enter passages for engine oil or engine coolant.

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

- A : Straight edge
- B : Feeler gauge

Limit : Refer to [EM-114, "Cylinder Head"](#).

- If it exceeds the limit, replace cylinder head.



INSTALLATION

1. Install new cylinder head gasket.

CYLINDER HEAD

[HR16DE]

< ON-VEHICLE REPAIR >

2. Tighten cylinder head bolts in numerical order as shown with the following procedure to install cylinder head.

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

CAUTION:

If cylinder head bolts are re-used, check their outer diameters before installation. Follow the "Cylinder Head Bolts Outer Diameter" measurement procedure.

- a. Apply new engine oil to threads and seating surfaces of bolts.
b. Tighten all bolts in the specified order.

: 40.0 N·m (4.1 kg-m, 30 ft-lb)

- c. Turn all bolts 60 degrees clockwise (angle tightening) using Tool (A) in the specified order.

CAUTION:

Check and confirm the tightening angle by using Tool (A) or protractor. Avoid judgment by visual inspection without the tool.

Tool number : KV10112100 (BT-8653-A)

- d. Completely loosen all bolts in reverse order.

: 0 N·m (0 kg-m, 0 ft-lb)

CAUTION:

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

- e. Tighten all bolts in the specified order.

: 40.0 N·m (4.1 kg-m, 30 ft-lb)

- f. Turn all bolts 75 degrees clockwise (angle tightening) using Tool (A) in the specified order.

CAUTION:

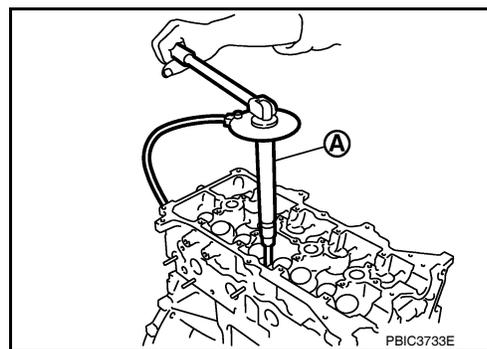
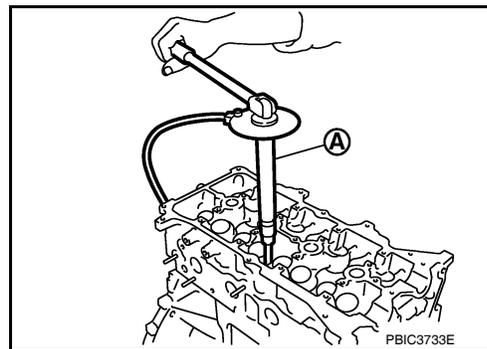
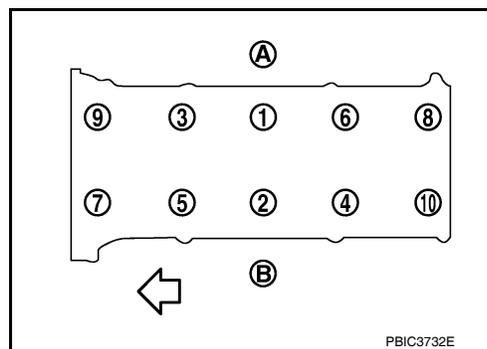
Check and confirm the tightening angle by using Tool (A) or protractor. Avoid judgment by visual inspection without the tool.

Tool number : KV10112100 (BT-8653-A)

- g. Turn all bolts 75 degrees clockwise again (angle tightening) using Tool (A) in the specified order.

CAUTION:

Check and confirm the tightening angle by using Tool (A) or protractor. Avoid judgment by visual inspection without the tool.



3. Installation of the remaining components is in the reverse order of removal.

INSPECTION AFTER INSTALLATION

Inspection for Leaks

- 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-14. "Fluids and Lubricants"](#).

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

CYLINDER HEAD

[HR16DE]

< ON-VEHICLE REPAIR >

- 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 make sure 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.

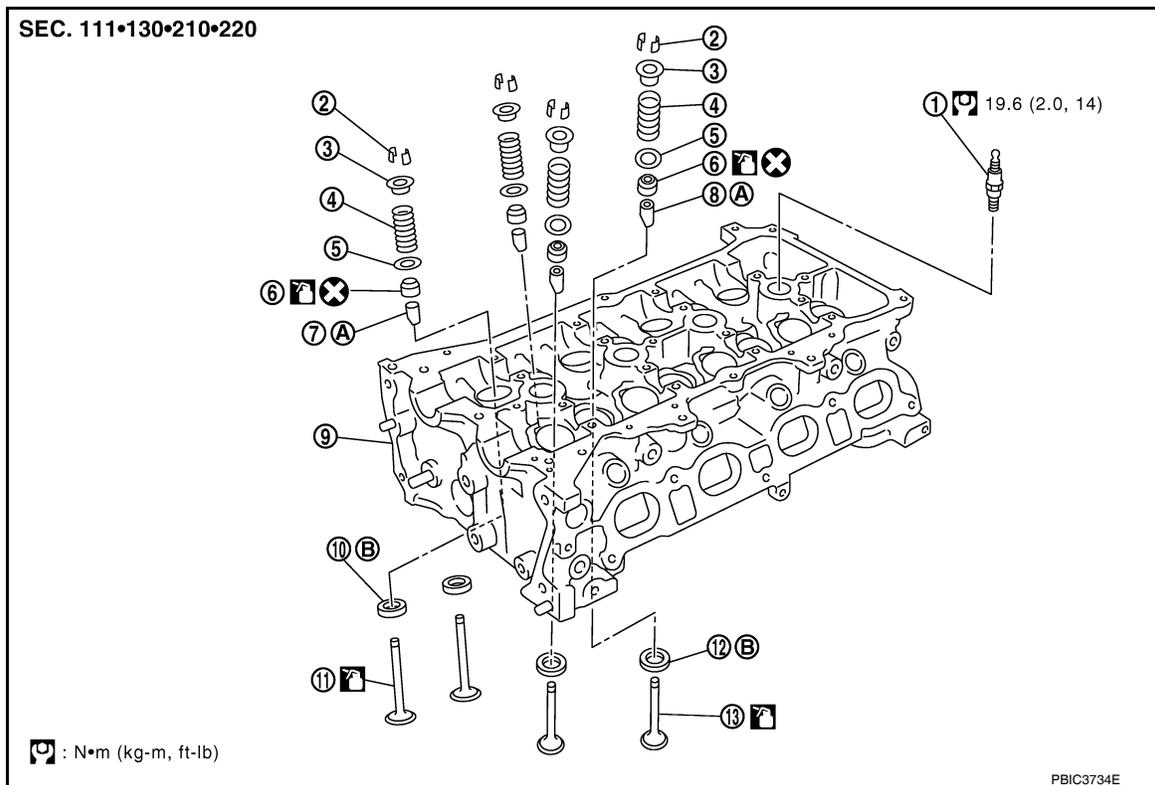
Summary of the inspection items:

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	—

*: Transaxle fluid, power steering fluid, brake fluid, etc.

Disassembly and Assembly

INFOID:000000005398074



- | | | |
|------------------------------------|------------------------------------|--------------------------|
| 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) | | |
| A. Refer to Installation procedure | B. Refer to Installation procedure | |

DISASSEMBLY

CYLINDER HEAD

[HR16DE]

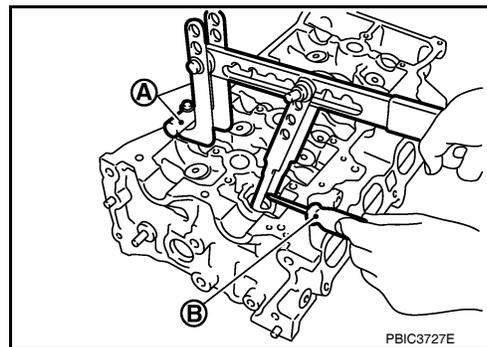
< ON-VEHICLE REPAIR >

1. Remove spark plug using suitable tool.
2. Remove valve lifter.
 - Identify installation positions, and store them without mixing them up.
3. Remove valve collet.
 - Compress valve spring with Tool (A). Remove valve collet with a magnet tool (B).

CAUTION:

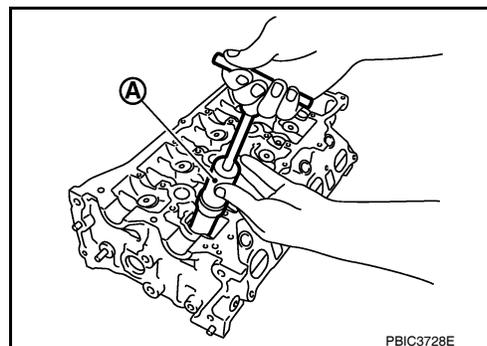
Be careful not to damage valve lifter holes.

Tool number : KV10116200 (J-26336-B)
: KV10115900 (J-26336-20)
: KV10109220 (—)



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 using Tool (A).

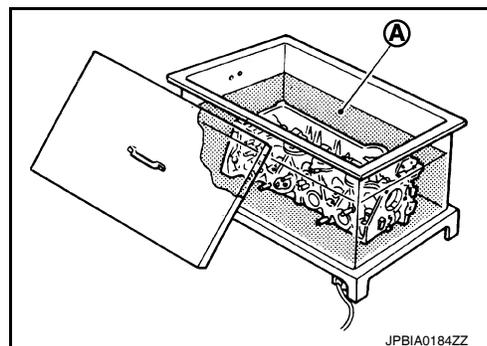
Tool number : KV10107902 (J-38959)
: KV10116100 (—)



7. Remove valve spring seat.
8. Remove valve seat, if necessary.
 - 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.
9. Remove valve guide, if necessary.
 - a. To remove valve guide, heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil (A).

CAUTION:

Never bore excessively to prevent cylinder head from scratching.



CYLINDER HEAD

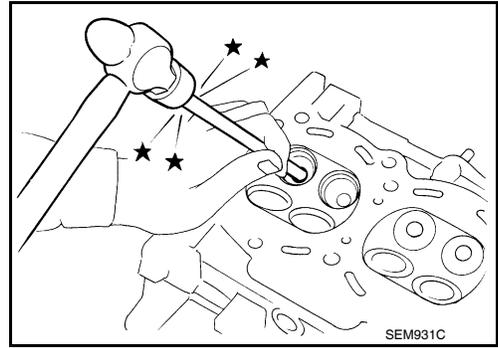
[HR16DE]

< ON-VEHICLE REPAIR >

- b. Drive out valve guide with a press [under a 20 kN (2 ton, 2.2 US ton, 2.0 Imp ton) pressure] or a hammer and the valve guide drift.

WARNING:

Cylinder head contains heat. Wear protective equipment to avoid getting burned.



INSPECTION AFTER DISASSEMBLY

Valve Dimensions

- Check the dimensions of each valve. For the dimensions, refer to [EM-114, "Cylinder Head"](#).
- If dimensions are out of the standard, replace valve and check valve seat contact.

Valve Guide Clearance

Valve Stem Diameter

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

Standard : Refer to [EM-114, "Cylinder Head"](#).

Valve Guide Inner Diameter

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

Standard : Refer to [EM-114, "Cylinder Head"](#).

Valve Guide Clearance

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

Standard and Limit : Refer to [EM-114, "Cylinder Head"](#).

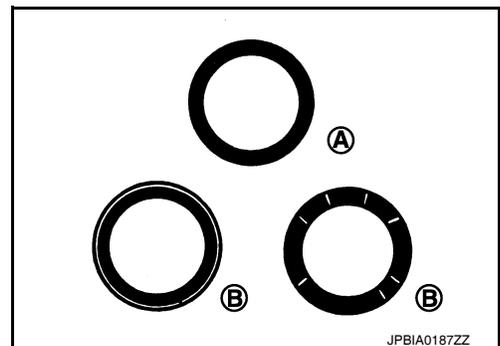
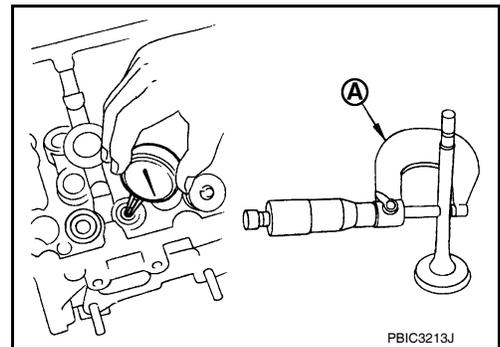
- If the calculated value exceeds the limit, replace valve and/or valve guide.

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.
- If not, grind to adjust valve fitting and check again. If the contacting surface still has "NG" conditions even after the re-check, replace valve seat. Refer to [EM-76, "Disassembly and Assembly"](#).

A : OK

B : NG



Valve Spring Squareness

CYLINDER HEAD

[HR16DE]

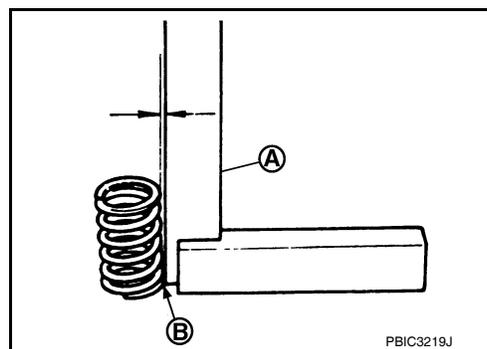
< ON-VEHICLE REPAIR >

- 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-114, "Cylinder Head"](#).

- If it exceeds the limit, replace valve spring.



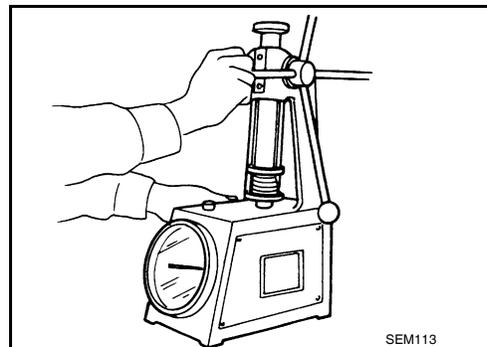
Valve Spring Dimensions and Valve Spring Pressure Load

- Check the valve spring pressure at specified spring height.

Standard : Refer to [EM-114, "Cylinder Head"](#).

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

Standard : Refer to [EM-114, "Cylinder Head"](#).



ASSEMBLY

1. Install the valve guide, if necessary.

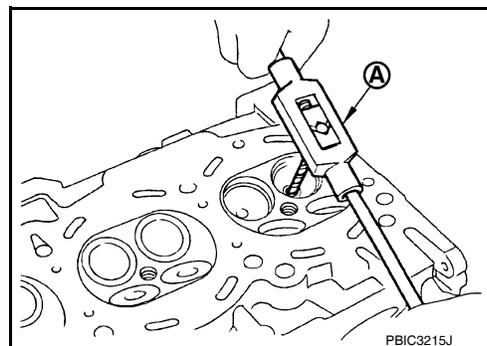
CAUTION:

Replace with oversize [0.2 mm (0.008 in)] valve guide.

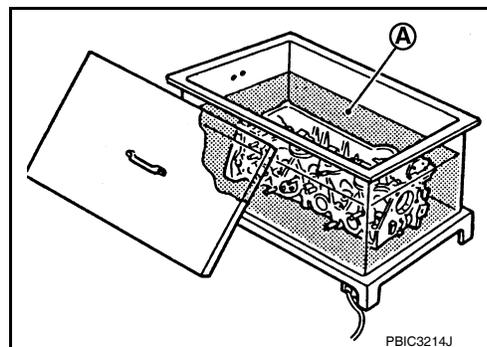
- a. Using suitable tool (A), ream cylinder head valve guide hole.

For service parts: Oversized [0.2 mm (0.008 in)]

Refer to [EM-114, "Cylinder Head"](#).



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



CYLINDER HEAD

[HR16DE]

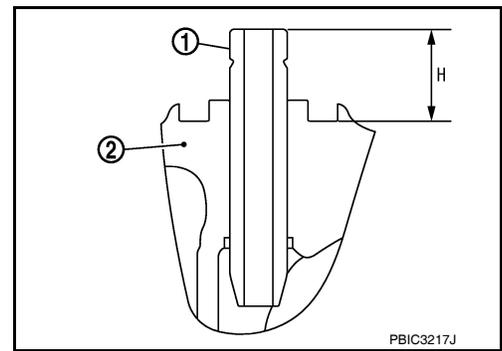
< ON-VEHICLE REPAIR >

- c. Using suitable tool, press valve guide (1) from camshaft side to the dimensions as shown.

Projection "H": Refer to [EM-114, "Cylinder Head"](#).

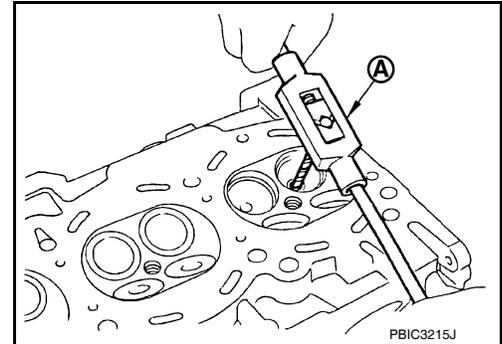
WARNING:

Cylinder head (2) contains heat. Wear protective equipment to avoid getting burned.



- d. Using suitable tool (A), apply reamer finish to valve guide.

Standard: Refer to [EM-114, "Cylinder Head"](#).



2. Install the valve seat, if necessary.

CAUTION:

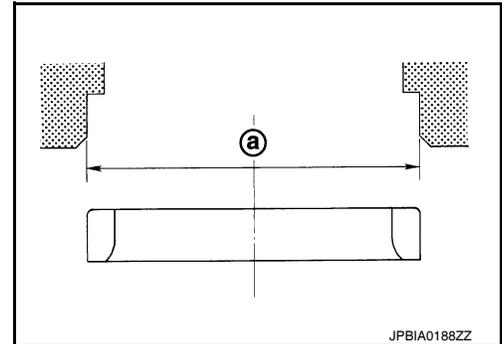
Replace with oversize [0.5 mm (0.020 in)] valve seat.

- a. Ream cylinder head recess diameter (a) for service valve seat.

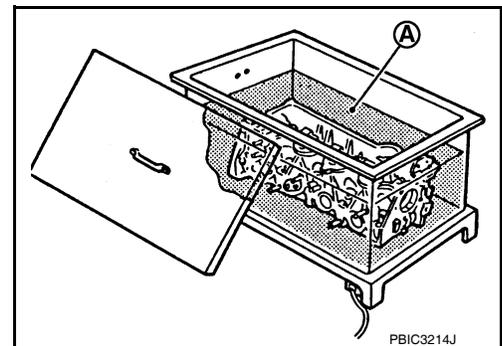
For service parts: Oversize [0.5 mm (0.020 in)]

Refer to [EM-114, "Cylinder Head"](#).

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



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



- c. Use dry ice to thoroughly cool valve seats. Force fit valve seat into cylinder head.

WARNING:

- Cylinder head contains heat. Wear protective equipment to avoid getting burned.
- Avoid directly touching cold valve seats.

CYLINDER HEAD

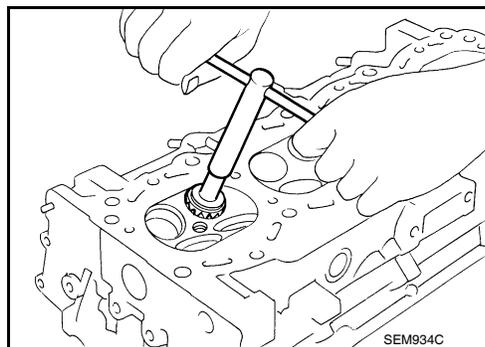
< ON-VEHICLE REPAIR >

[HR16DE]

- d. Using suitable tool or valve seat grinder, finish seat to the specified dimensions. Refer to [EM-114, "Cylinder Head"](#).

CAUTION:

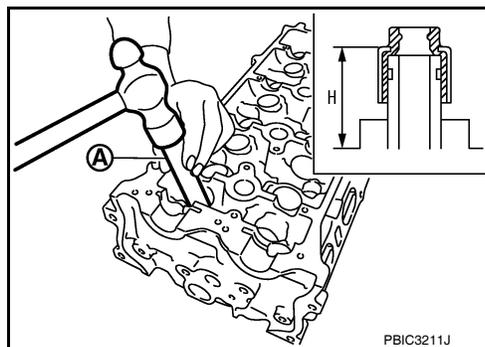
When using the valve seat cutter, firmly grip cutter handle with both hands. Then, press on the contacting surface all around the circumference to cut in a single drive. Improper pressure on with cutter or cutting many different times may result in stage valve seat.



- e. Using compound, grind to adjust valve fitting.
f. Check again for normal contact. Refer to [EM-76, "Disassembly and Assembly"](#).
3. Install valve oil seal.
• Install with Tool (A) to match dimension as shown.

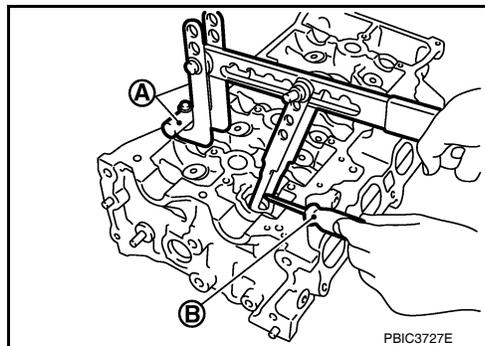
Height "H" : 13.2 - 13.8 mm (0.520 - 0.543 in)

Tool number : KV10115600 (J-38958)



4. Install valve spring seat.
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 Tool (A). Install valve collet with a magnet hand (B).
CAUTION:
Be careful not to damage valve lifter holes.
• Tap valve stem edge lightly with a plastic hammer after installation to check its installed condition.

Tool number : KV10116200 (J-26336-B)
: KV10115900 (J-26336-20)
: KV10109220 (—)



9. Install valve lifter.
10. Install spark plug with a suitable tool.

ENGINE ASSEMBLY

< REMOVAL AND INSTALLATION >

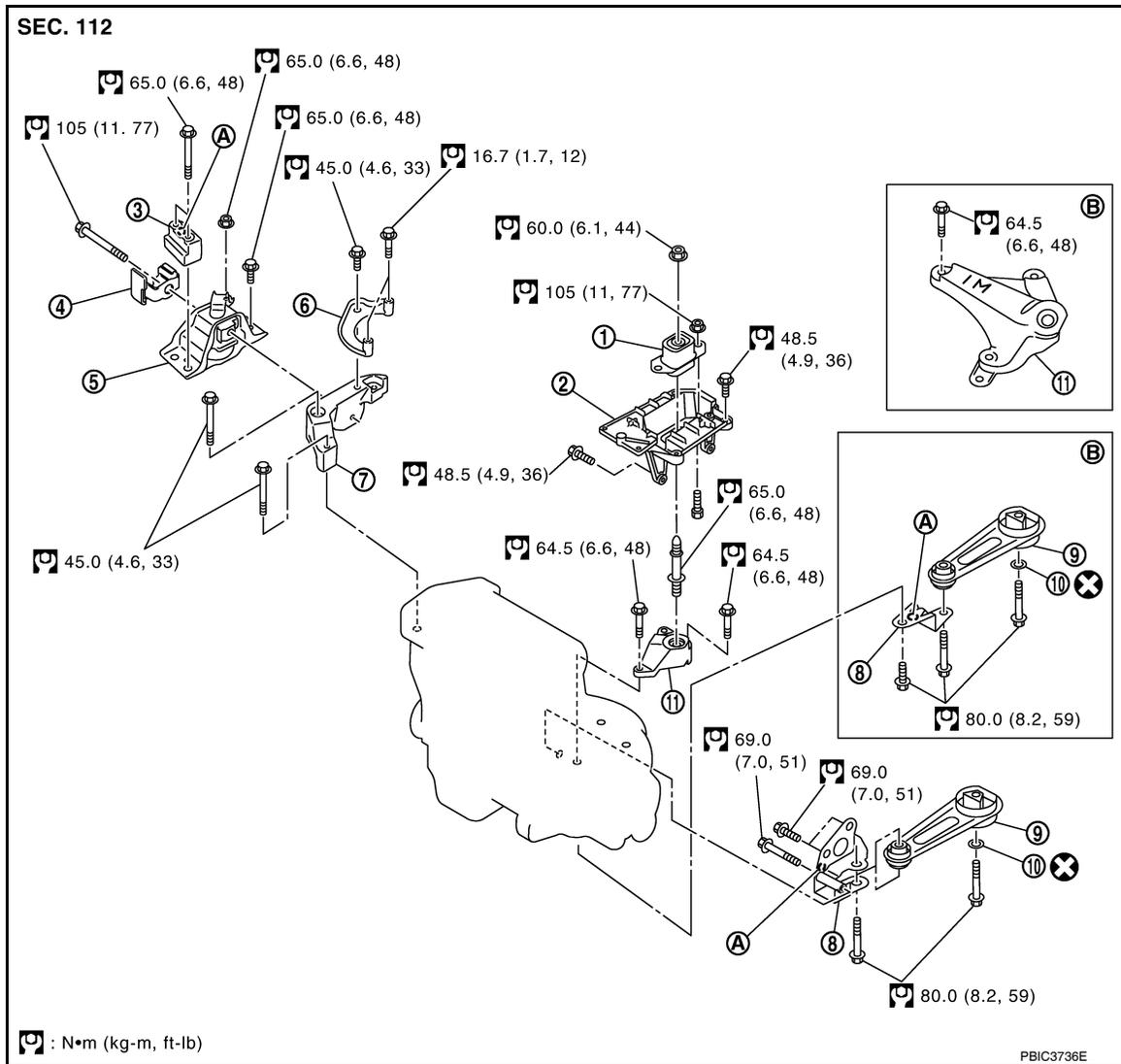
[HR16DE]

REMOVAL AND INSTALLATION

ENGINE ASSEMBLY

Exploded View

INFOID:000000005398075



- | | | |
|-----------------------------------|-----------------------------------|-------------------------|
| 1. Engine mounting insulator (LH) | 2. Engine mounting bracket (LH) | 3. Mass damper |
| 4. Dynamic damper | 5. Engine mounting insulator (RH) | 6. Engine mounting stay |
| 7. Engine mounting bracket (RH) | 8. Rear engine mounting bracket | 9. Rear torque rod |
| 10. Washer | 11. Engine mounting bracket (LH) | |
| A. Front mark | B. M/T models | |

Removal and Installation

INFOID:000000005398076

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.
- Always be careful to work safely, avoid forceful or uninstructed operations.
- Never start working until exhaust system and coolant are cool enough.

CAUTION:

ENGINE ASSEMBLY

[HR16DE]

< REMOVAL AND INSTALLATION >

- If items or work required are not covered by the engine section, follow the procedures in 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 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-38. "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. Remove the hood assembly. Refer to [BL-14. "Removal and Installation"](#).
2. Remove the cowl top cover and cowl top extension assembly. Refer to [EI-22. "Removal and Installation"](#).
3. Release fuel pressure. Refer to [EC-496. "Inspection"](#).
4. Drain engine coolant from radiator. Refer to [CO-12. "Changing Engine Coolant"](#).
CAUTION:
 - Perform this step when the engine is cold.
 - Never spill engine coolant on drive belt.
5. Drain the transmission fluid. Refer to [MT-11. "Draining"](#) (M/T).
6. Remove the following parts.
 - Engine under cover. Refer to [EI-15. "Removal and Installation"](#).
 - Front road wheels and tires. Refer to [WT-7. "Adjustment"](#).
 - Front fender protector (RH and LH). Refer to [EI-24. "Removal and Installation"](#).
 - Battery and battery tray. Refer to [SC-7. "Removal and Installation"](#).
 - Drive belt. Refer to [EM-15. "Removal and Installation"](#).
 - Air duct and air cleaner case assembly. Refer to [EM-26. "Exploded View"](#).
 - Radiator hose (upper and lower). Refer to [CO-17. "Component"](#).
 - Disconnect cooling fan controller wiring harness.
 - Remove coolant reservoir tank.
 - Remove fan shroud and cooling fan assembly. Refer to [CO-19. "Component \(Models with A/C\)"](#) or [CO-19. "Component \(Models without A/C\)"](#).

Engine Room LH

1. Disconnect all connections of engine harness around the engine mounting insulator (LH), and then temporarily secure the engine harness into the engine side.
CAUTION:
Protect connectors using a resin bag against foreign materials.
2. Remove ground cable at transaxle side.
3. Disconnect fuel feed hose at engine side. Refer to [EM-34. "Exploded View"](#).
4. Disconnect EVAP purge hose and brake booster vacuum hose.
5. Disconnect heater hoses, and install plugs them to prevent engine coolant from draining. Refer to [CO-17. "Component"](#).
6. Disconnect control linkage from transaxle. Refer to [AT-213. "A/T Shift Selector Removal and Installation"](#) (A/T), [MT-14. "Exploded View"](#) (M/T).
7. Disconnect the clutch tube at transmission side (if equipped). Refer to [CL-15. "Removal and Installation"](#).

Engine Room RH

1. Remove ground cable between front cover and vehicle.
2. Remove generator and generator bracket (A/C models). Refer to [SC-25. "Removal and Installation"](#).
3. Remove A/C compressor with piping connected from the engine. Temporarily secure it on the vehicle side with a rope to avoid putting load on it (if equipped). Refer to [MTC-79. "Removal and Installation of Compressor - HR16DE"](#).

Vehicle Underbody

ENGINE ASSEMBLY

[HR16DE]

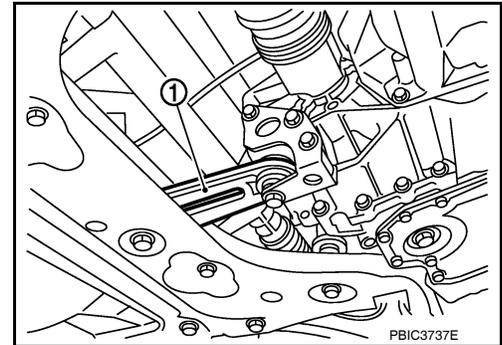
< REMOVAL AND INSTALLATION >

1. Remove front wheel sensor (LH and RH) for ABS from steering knuckle (if equipped). Refer to [BRC-34. "Removal and Installation"](#) (ABS).
2. Remove brake caliper assembly with piping connected from steering knuckle. Temporarily secure it on the vehicle side with a rope to avoid load on it. Refer to [BR-25. "Component"](#).
3. Remove drive shafts (LH and RH) from steering knuckle. Refer to [FAX-9. "Removal and Installation \(Left Side\)"](#) and [FAX-10. "Removal and Installation \(Right Side\)"](#).
4. Remove exhaust front tube. Refer to [EX-6. "Component"](#).

5. Remove rear torque rod.

NOTE:

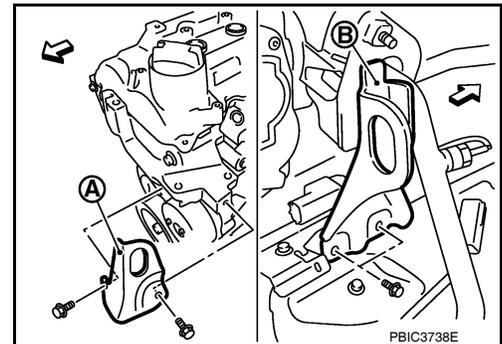
A/T models shown.



6. Remove A/T cooler hoses from transmission (if equipped).
7. 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. "Component"](#).

Removal

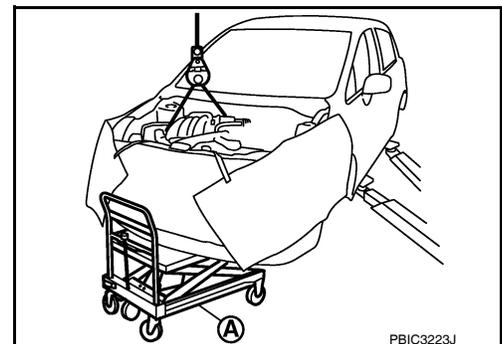
1. Install engine slinger to cylinder head front left side (A) and rear right side (B) and support the engine with a hoist.



2. Lift with a hoist and secure the engine in appropriate position.
3. Use a suitable tool (A) to securely support bottom of the engine and the transaxle assembly and simultaneously adjust hoist tension.

CAUTION:

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

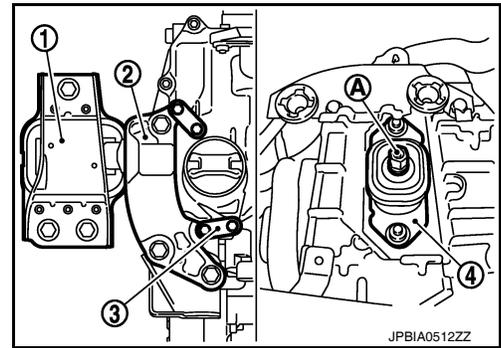


ENGINE ASSEMBLY

[HR16DE]

< REMOVAL AND INSTALLATION >

4. Remove engine mounting insulator (RH) (1), engine mounting bracket (RH) (2) and engine mounting stay (3).
5. Remove engine mounting insulator (LH) (4) through bolt securing nut (A).



6. Carefully lower jack, or raise lift to remove the engine and the transaxle assembly.

CAUTION:

- Make sure 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

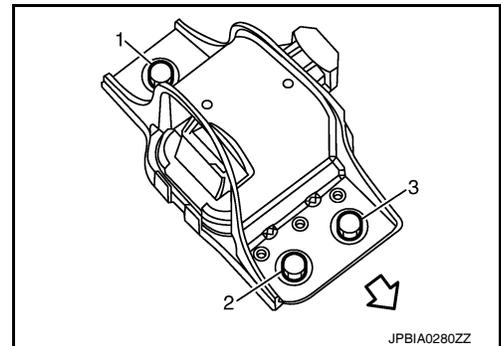
1. Remove starter motor. Refer to [SC-19, "Removal and Installation HR16DE"](#).
2. Lift with a hoist and separate the engine from the transaxle assembly. Refer to [EM-82, "Exploded View"](#).

INSTALLATION

Installation is in the reverse order of removal.

- Do not allow engine oil to get on engine mounting insulator. Be careful not to damage engine mounting insulator.
- Make sure that each mounting insulator is seated properly, and tighten nuts and bolts.
- Tighten engine mounting insulator (RH) bolts in the numerical order shown.

← : Vehicle front



Inspection

INFOID:000000005398077

INSPECTION AFTER INSTALLATION

Inspection for Leaks

- 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-14, "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 make sure 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.

ENGINE ASSEMBLY

< REMOVAL AND INSTALLATION >

[HR16DE]

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	—

*: Transaxle fluid, power steering fluid, brake fluid, etc.

DISASSEMBLY AND ASSEMBLY

ENGINE STAND SETTING

Setting

INFOID:000000005398078

A

EM

NOTE:

Explained here is how to disassemble with engine stand supporting transmission 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-82. "Exploded View"](#).
2. Remove clutch cover and clutch disc (if equipped). Refer to [CL-16. "Removal and Installation"](#).
3. Remove flywheel or driveplate.
 - Secure flywheel or driveplate with Tool, and remove bolts.

CAUTION:

- **Never disassemble flywheel.**
- **Never place flywheel or driveplate with signal plate facing down.**
- **When handling signal plate, take care not to damage or scratch it.**
- **Handle signal plate in a manner that prevents it from becoming magnetized.**

Tool number : KV11105210 (J-44716)

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

CAUTION:

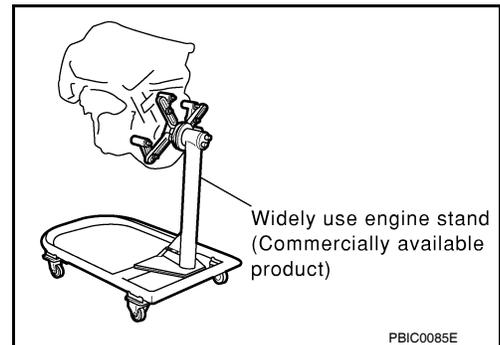
- **Use the engine stand that has a load capacity [approximately 135 kg (298 lb) or more] large enough for supporting the engine weight.**
- If the load capacity of stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning stand.
 - Intake manifold: Refer to [EM-28. "Exploded View"](#).
 - Exhaust manifold: Refer to [EM-31. "Exploded View"](#).
 - Rocker cover: Refer to [EM-46. "Exploded View"](#).

NOTE:

The figure shows an example of widely use engine stand that can support mating surface of transaxle with flywheel or driveplate removed.

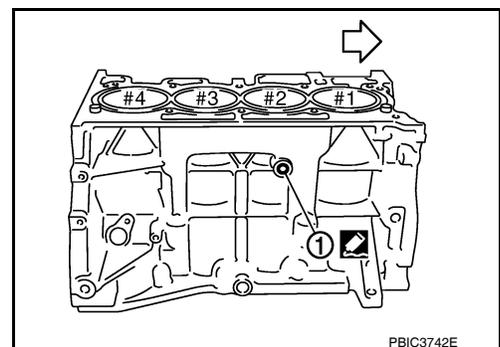
CAUTION:

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



5. Drain engine oil. Refer to [LU-8. "Draining"](#).
6. Drain engine coolant by removing water drain plug (1) from RH side of the engine.

← : Engine front



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ENGINE UNIT

Disassembly

INFOID:000000005398079

1. Remove intake manifold. Refer to [EM-28. "Exploded View"](#).
2. Remove exhaust manifold. Refer to [EM-31. "Exploded View"](#).
3. Remove oil pan (upper). Refer to [EM-42. "Component"](#).
4. Remove ignition coil, spark plug and rocker cover. Refer to [EM-46. "Exploded View"](#).
5. Remove fuel injector and fuel tube. Refer to [EM-34. "Exploded View"](#).
6. Remove timing chain. Refer to [EM-49. "Exploded View"](#).
7. Remove camshaft. Refer to [EM-59. "Exploded View"](#).
8. Remove cylinder head. Refer to [EM-73. "Removal and Installation"](#).

Assembly

INFOID:000000005398080

Assembly is in the reverse order of disassembly.

CYLINDER BLOCK

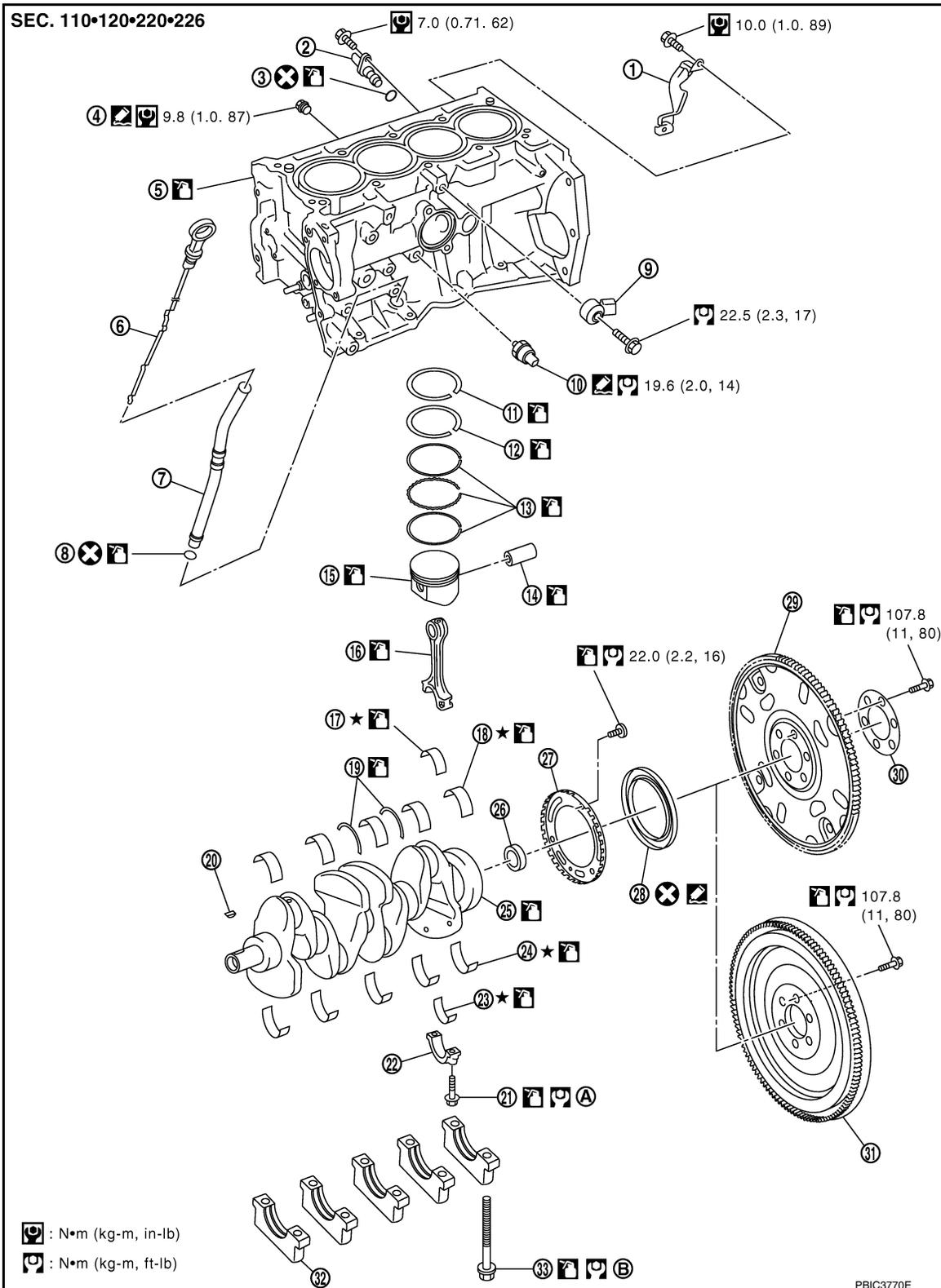
< DISASSEMBLY AND ASSEMBLY >

[HR16DE]

CYLINDER BLOCK

Exploded View

INFOID:000000005398081



A
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EM

- | | | |
|---|-------------------------------------|--------------------|
| 1. Crankshaft position sensor (POS) cover | 2. Crankshaft position sensor (POS) | 3. O-ring |
| 4. Water drain plug | 5. Cylinder block | 6. Oil level gauge |
| 7. Oil level gauge guide | 8. O-ring | 9. Knock sensor |

CYLINDER BLOCK

[HR16DE]

< DISASSEMBLY AND ASSEMBLY >

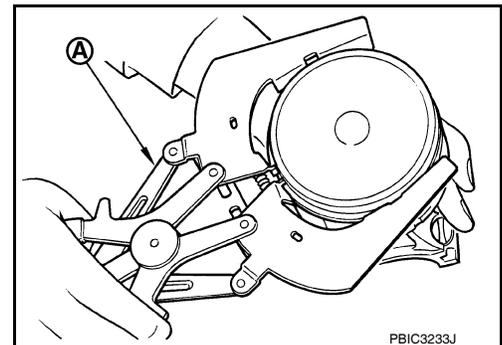
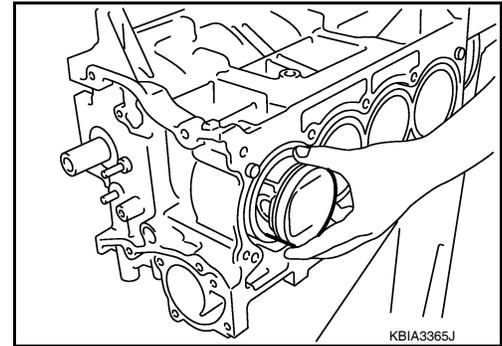
- | | | |
|--------------------------------|------------------------------------|--------------------------------------|
| 10. Oil pressure switch | 11. Top ring | 12. Second ring |
| 13. Oil ring | 14. Piston pin | 15. Piston |
| 16. Connecting rod | 17. Connecting rod bearing (upper) | 18. Main bearing (upper) |
| 19. Thrust bearing | 20. Crankshaft key | 21. Connecting rod cap bolt |
| 22. Connecting rod cap | 23. Connecting rod bearing (lower) | 24. Main bearing (lower) |
| 25. Crankshaft | 26. Pilot converter (A/T models) | 27. Signal plate |
| 28. Rear oil seal | 29. Drive plate (A/T models) | 30. Reinforcement plate (A/T models) |
| 31. Flywheel (M/T models) | 32. Main bearing cap | 33. Main bearing cap bolt |
| A. Refer to Assembly procedure | B. Refer to Assembly procedure | |

Disassembly and Assembly

INFOID:000000005398082

DISASSEMBLY

1. Remove cylinder head. Refer to [EM-73. "Removal and Installation"](#).
2. Remove knock sensor.
CAUTION:
Carefully handle knock sensor avoiding shocks.
3. Remove crankshaft position sensor (POS) and cover.
CAUTION:
 - Avoid impacts such as a dropping.
 - Never disassemble.
 - Keep it away from metal particles.
 - Never place the sensor where it is exposed to magnetism.
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-97. "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 up.
6. Remove piston rings from piston.
 - Before removing piston rings, check the piston ring side clearance. Refer to [EM-97. "Inspection"](#).
 - Use suitable 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.



CYLINDER BLOCK

< DISASSEMBLY AND ASSEMBLY >

[HR16DE]

7. Remove piston from connecting rod.
 - Use Tool and a press to remove the piston pin.

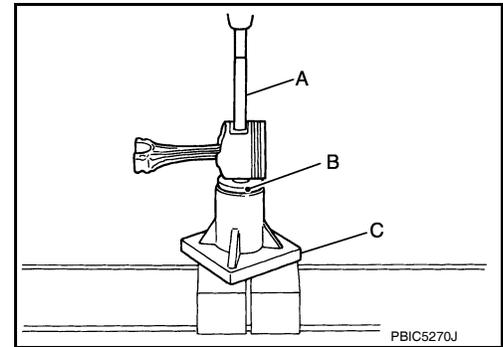
Tool number (A) : KV10109730 (—)
Tool number (B) : KV10110310 (—)
Tool number (C) : ST13030020 (—)

CAUTION:

Be careful not to damage the piston and connecting rod.

NOTE:

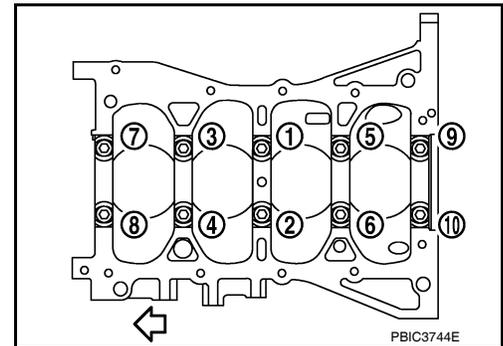
The joint between the connecting rod and the piston pin is a press fit.



8. Remove the main bearing cap in the following procedure.
 - Measure crankshaft end play before loosening main bearing cap bolts. Refer to [EM-97. "Inspection"](#)
- a. Loosen and remove bolts in several steps in reverse of the numerical order shown.

⇐ : Engine front

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



- b. Label parts for assembly and remove the main bearing cap from the cylinder block while tapping lightly with a plastic hammer.

CAUTION:

Identify installation positions, and store them without mixing up.

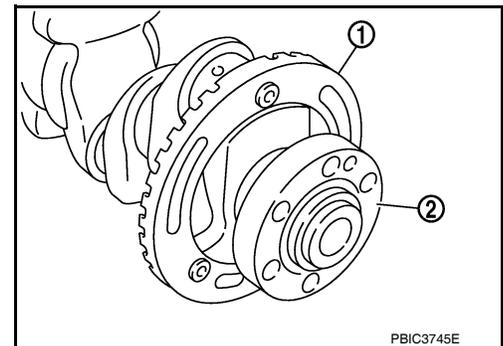
9. Remove crankshaft (2).

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).



10. Pull rear oil seal out from rear end of crankshaft.
11. Label parts for assembly and 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 up.

ASSEMBLY

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

WARNING:

Use goggles to protect your eyes.

CYLINDER BLOCK

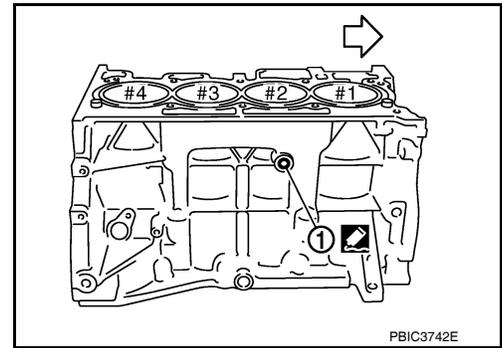
[HR16DE]

< DISASSEMBLY AND ASSEMBLY >

2. Install water drain plug (1) to cylinder block as shown.

↔ : Engine front

Use Genuine Silicone RTV Sealant or equivalent. Refer to [GI-42, "Recommended Chemical Product and Sealant"](#).

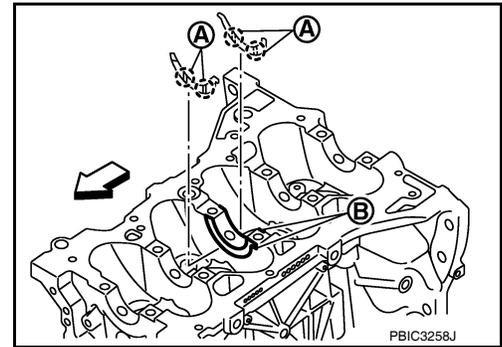


3. Install main bearings and thrust bearings in their original positions with the following procedure:

- a. Remove dust, dirt, and engine oil on the bearing mating surfaces of cylinder block.
- b. Install thrust bearings to the both sides of the No. 3 journal housing (B) on cylinder block.

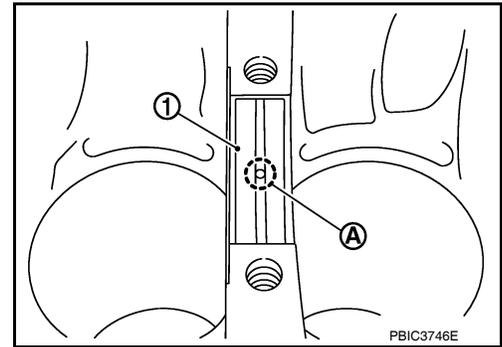
↔ : Engine front

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



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.



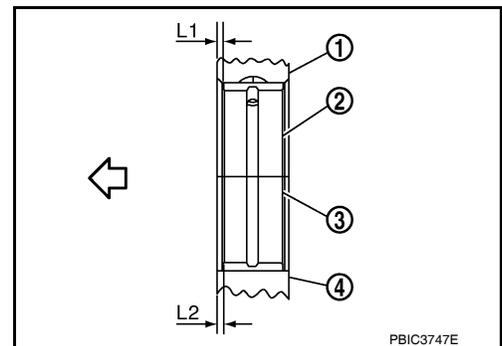
- Install the main bearing in the position shown.

- 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 (0.065-0.081)	1.25–1.65 (0.049-0.065)	2.30–2.70 (0.091-0.106)	1.25–1.65 (0.049-0.065)	1.60–2.00 (0.063-0.079)
L2 [Unit: mm (in)]	1.30–1.70 (0.051-0.067)	1.30–1.70 (0.051-0.067)	2.30–2.70 (0.091-0.106)	1.30–1.70 (0.051-0.067)	1.30–1.70 (0.051-0.067)

CYLINDER BLOCK

< DISASSEMBLY AND ASSEMBLY >

[HR16DE]

CAUTION:

Dimension L1 of journal No. 3 is the distance from the housing base end surface (bulk) (not the distance from the thrust bearing mounting end surface).

4. Install signal plate to crankshaft if removed.
- a. Set the signal plate (1) with the flange facing toward the counter-weight 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.

5. Install crankshaft to cylinder block.
 - Make sure that crankshaft turns smoothly by hand.

CAUTION:

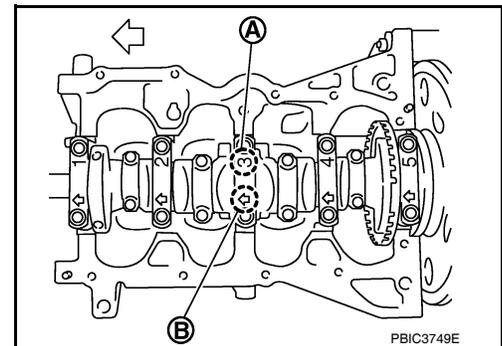
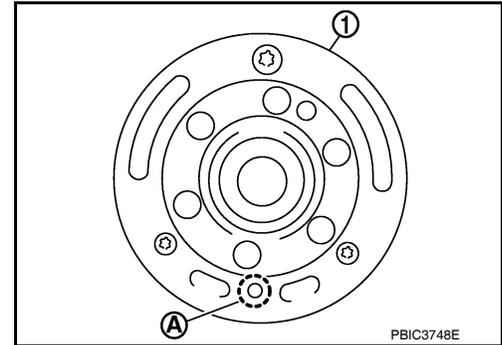
Never install rear oil seal yet.

6. Install main bearing caps in their original positions.
 - Install the main bearing cap while referring to the front mark (B) and the journal number stamp (A).

⇐ : Engine front

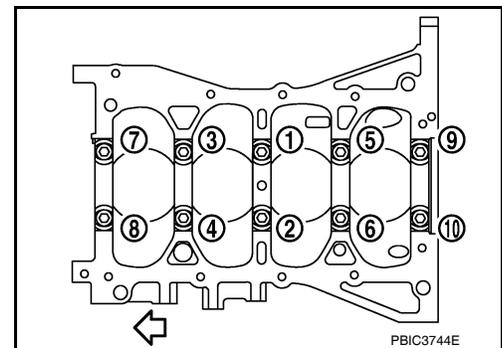
NOTE:

Main bearing cap cannot be replaced as a single part, because it is machined together with cylinder block.



7. Tighten main bearing cap bolts in numerical order shown with the following steps.

⇐ : Engine front



- a. Apply new engine oil to threads and seat surfaces of the bolts.
- b. Tighten main bearing cap bolts in the numerical order shown.

: 32.4 N·m (3.3 kg-m, 24 ft-lb)

CYLINDER BLOCK

[HR16DE]

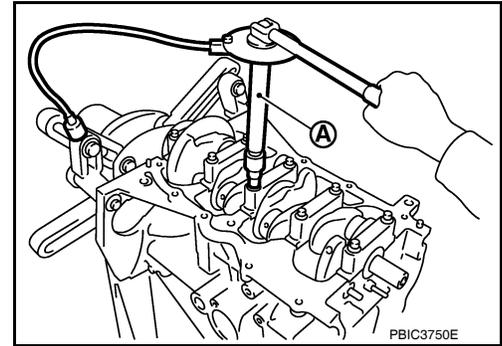
< DISASSEMBLY AND ASSEMBLY >

- c. Turn main bearing cap bolts 60 degrees clockwise (angle tightening) in numerical order shown.

CAUTION:

Check and confirm the tightening angle by using Tool (A) or protractor. Avoid judgment by visual inspection without the tool.

Tool number : KV10112100 (BT-8653-A)



- After installing the bolts, make sure that crankshaft can be rotated smoothly by hand.
- Check crankshaft end play. Refer to [EM-97, "Inspection"](#).

8. Install piston to connecting rod with the following procedure:

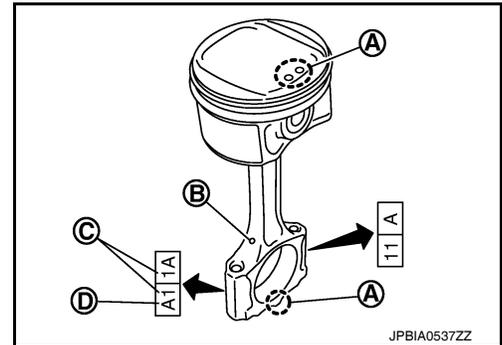
- a. Set so that the front mark (A) on the piston head and the cylinder number (C) are in the position shown.

B : Oil hole

D : Connecting rod big end grade

NOTE:

The symbols without notes are for management.



- b. Press-fit the piston pin using Tool.

Tool number (A) : KV10109730 (—)

Tool number (B) : KV10110310 (—)

Tool number (C) : ST13030020 (—)

Tool number (D) : KV10114120 (—)

Tool number (E) : ST13030030 (—)

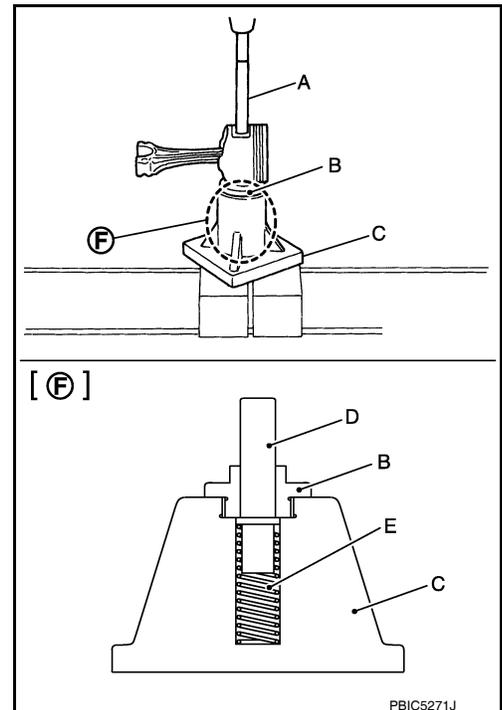
F : For detail

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.



CYLINDER BLOCK

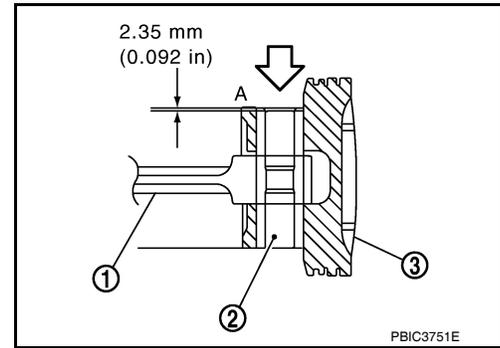
[HR16DE]

< DISASSEMBLY AND ASSEMBLY >

- Press-fit the piston pin (2) from piston surface "A" to the depth of 2.35 mm (0.092 in).

1 : Connecting rod
 ⇐ : Press-fit direction

- After finishing work, make sure that the piston (3) moves freely.



9. Using a suitable tool, install piston rings.

CAUTION:

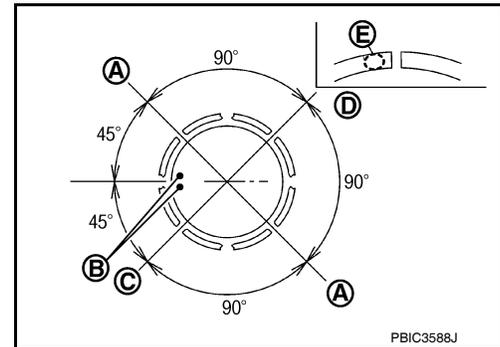
- Be careful not to damage piston.
- Be careful not to damage piston rings by expanding them excessively.
- Position each ring with the gap as shown referring to the piston front mark (B).

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



10. 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.

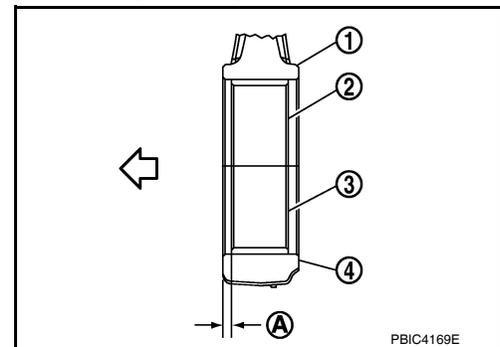
- Make sure that the oil holes on connecting rod and connecting rod bearing are aligned.
- Install the connecting rod in the dimension shown.

1 : Connecting rod
 2 : Connecting rod bearing (upper)
 3 : Connecting rod bearing (lower)
 4 : Connecting rod cap
 ⇐ : Engine front

Dimension "A" : 1.7 - 2.1 mm (0.067 - 0.083 in)

NOTE:

Install the connecting rod bearing in the center position with the dimension shown. For service operation, the center position can be checked visually.



11. 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.

CYLINDER BLOCK

[HR16DE]

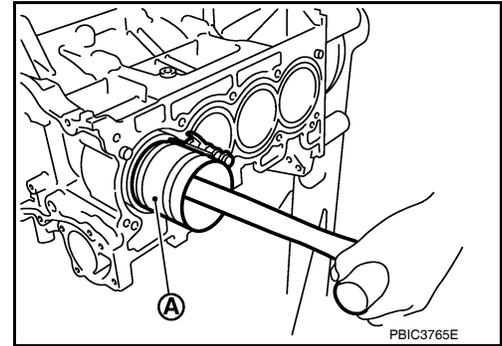
< DISASSEMBLY AND ASSEMBLY >

- Using Tool (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.

Tool number : EM03470000 (J-8037)



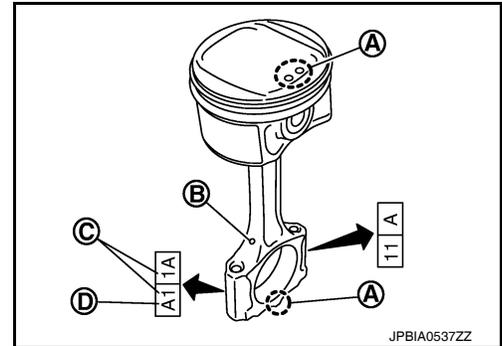
12. Install connecting rod cap.

- 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



13. Inspect outer diameter of connecting rod cap bolts. Refer to [EM-97, "Inspection"](#).

14. Tighten connecting rod bolt with the following procedure:

- Apply new engine oil to the threads and seats of connecting rod bolts.
- Tighten connecting rod bolts in several steps.

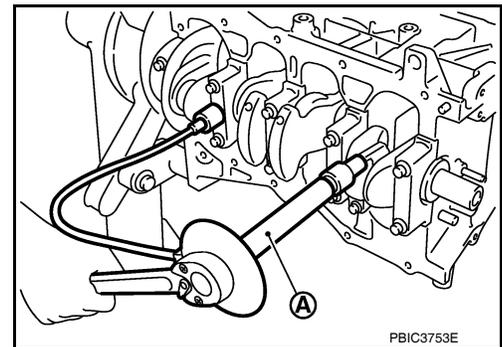
: 19.6 N·m (2.0 kg-m, 14 ft-lb)

c. Then turn all bolts 60 degrees clockwise (angle tightening).

CAUTION:

Confirm the tightening angle by using Tool (A) or protractor. Avoid judgment by visual inspection without the tool.

Tool number : KV10112100 (BT-8653-A)



- After tightening connecting rod bolts, make sure that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to [EM-97, "Inspection"](#).

15. Install oil pan (upper). Refer to [EM-42, "Removal and Installation"](#).

NOTE:

Install the rear oil seal after installing the oil pan (upper).

16. Install rear oil seal. Refer to [EM-71, "REAR OIL SEAL : Removal and Installation"](#).

17. Install flywheel.

- Secure crankshaft with Tool, and tighten bolts crosswise over several times.

Tool number : KV11105210 (J-44716)

CYLINDER BLOCK

< DISASSEMBLY AND ASSEMBLY >

[HR16DE]

18. Install knock sensor (1).

↔ : Engine front

- Install connectors so that they are positioned towards the rear of the engine.

CAUTION:

- **Never tighten bolt while holding the connector.**
- **If any impact by dropping is applied to knock sensor, replace it with a new one.**

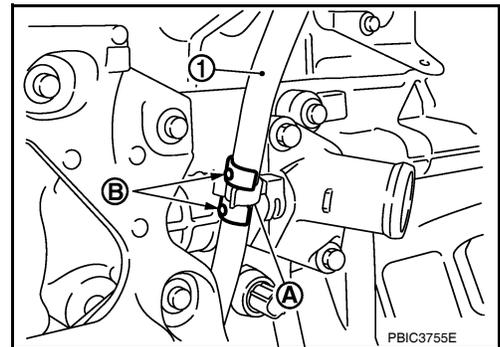
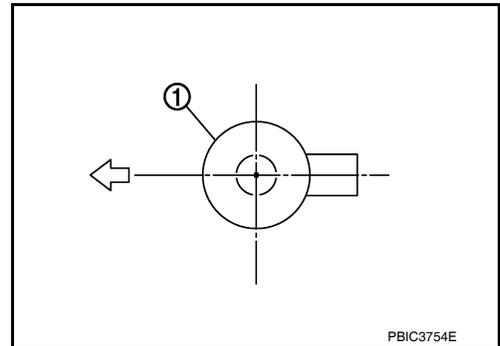
NOTE:

- Make sure that there is no foreign material on the cylinder block mating surface and the back surface of knock sensor.
- Make sure that knock sensor does not interfere with other parts.

19. Install crankshaft position sensor (POS) and cover.

- Tighten bolts with it seated completely.

20. For the oil level gauge guide (1), fix the position (B) shown to the water inlet clip (A) after inserting to the cylinder block side.



21. Assembly is in the reverse order of disassembly after this step.

Inspection

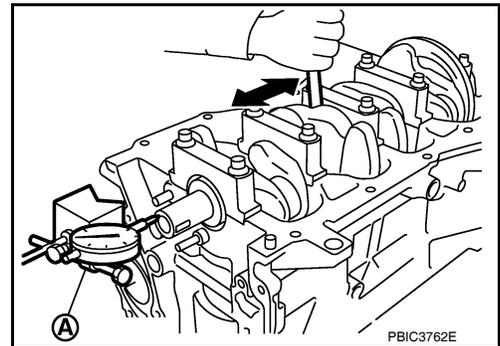
INFOID:000000005398083

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-116, "Cylinder Block"](#).

- If the measured value exceeds the limit, replace thrust bearings, and measure again. If it still exceeds the limit, replace crankshaft also.

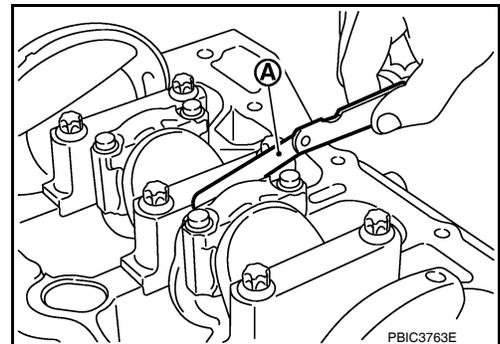


CONNECTING ROD SIDE CLEARANCE

- Measure the side clearance between connecting rod and crankshaft arm with a feeler gauge (A).

Standard : Refer to [EM-116, "Cylinder Block"](#).

- If the measured value exceeds the limit, replace connecting rod, and measure again. If it still exceeds the standard, replace crankshaft also.



PISTON TO PISTON PIN OIL CLEARANCE

Piston Pin Hole Diameter

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

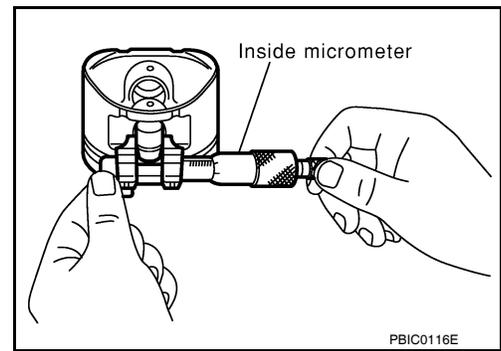
CYLINDER BLOCK

[HR16DE]

< DISASSEMBLY AND ASSEMBLY >

Measure the inner diameter of piston pin hole with an inside micrometer.

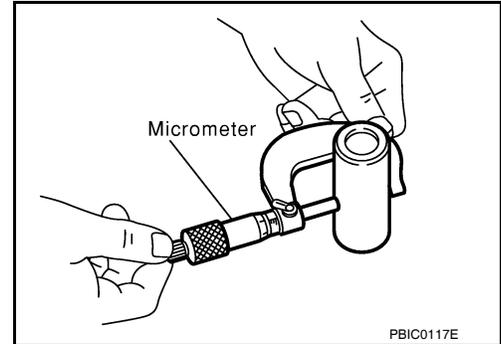
Standard : Refer to [EM-116, "Cylinder Block"](#).



Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer.

Standard : Refer to [EM-116, "Cylinder Block"](#).



Piston to Piston Pin Oil Clearance

$(\text{Piston to piston pin oil clearance}) = (\text{Piston pin hole diameter}) - (\text{Piston pin outer diameter})$

Standard : Refer to [EM-116, "Cylinder Block"](#).

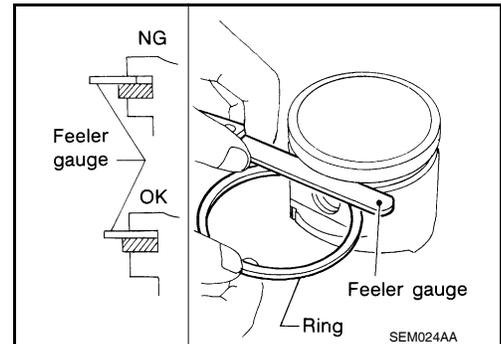
- If oil clearance is out of the standard, replace piston and piston pin assembly.

PISTON RING SIDE CLEARANCE

- Measure the side clearance of piston ring and piston ring groove with a feeler gauge.

Standard and Limit : Refer to [EM-116, "Cylinder Block"](#).

- If the measured value exceeds the limit, replace piston ring, and measure again. If it still exceeds the limit, replace piston also.

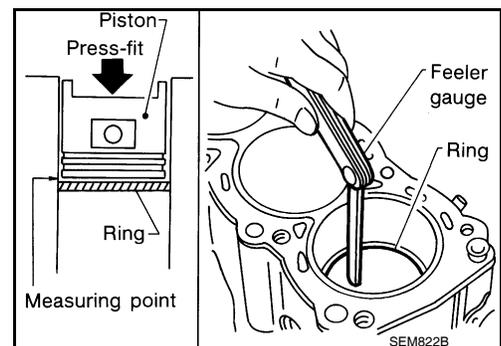


PISTON RING END GAP

- Make sure that cylinder bore inner diameter is within the specification. Check "Cylinder Bore Inner Diameter".
- Lubricate with new engine oil to piston and piston ring, and then insert piston ring until middle of cylinder with piston, and measure piston ring end gap with a feeler gauge.

Standard and Limit : Refer to [EM-116, "Cylinder Block"](#).

- If the measured value exceeds the limit, replace piston ring.



CONNECTING ROD BEND AND TORSION

CYLINDER BLOCK

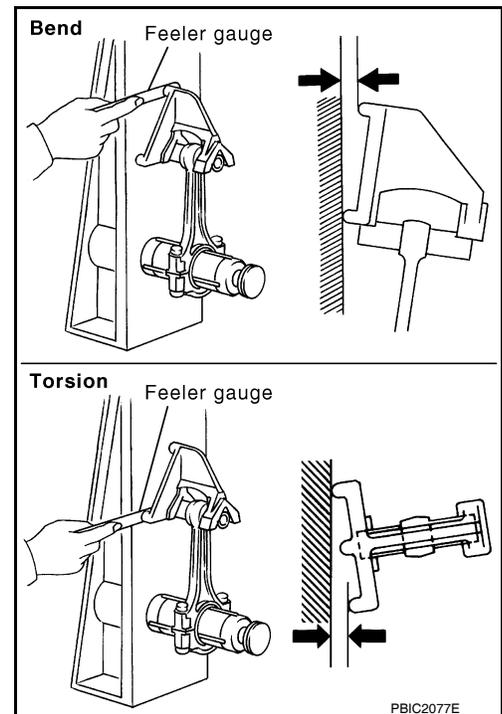
[HR16DE]

< DISASSEMBLY AND ASSEMBLY >

- Check with a connecting rod aligner.

Limit : Refer to [EM-116, "Cylinder Block"](#).

- If it exceeds the limit, replace connecting rod assembly.

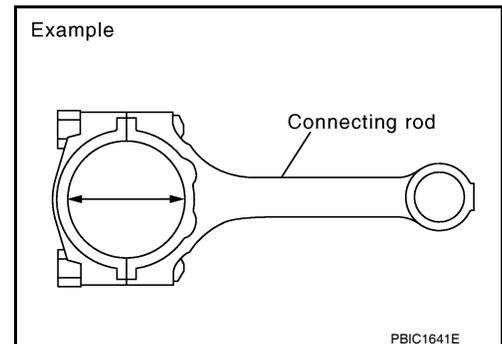


CONNECTING ROD BIG END DIAMETER

- Install connecting rod cap without connecting rod bearing installed, and tightening connecting rod bolts to the specified torque. Refer to [EM-90, "Disassembly and Assembly"](#).
- Measure the inner diameter of connecting rod big end with an inside micrometer.

Standard : Refer to [EM-116, "Cylinder Block"](#).

- If out of the standard, replace connecting rod assembly.

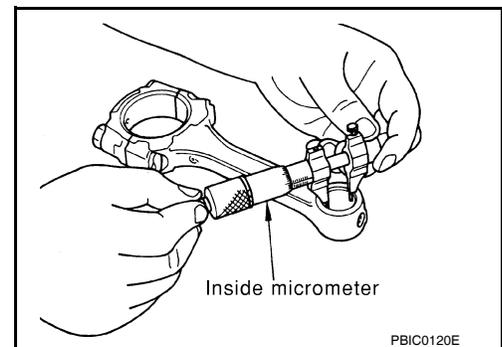


CONNECTING ROD SMALL END CLEARANCE

Connecting Rod Small End Inner Diameter

Measure the inner diameter of connecting rod small end with an inside micrometer.

Standard : Refer to [EM-116, "Cylinder Block"](#).



Piston Pin Outer Diameter

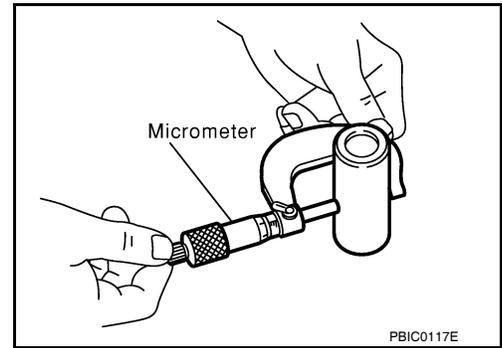
CYLINDER BLOCK

< DISASSEMBLY AND ASSEMBLY >

[HR16DE]

Measure the outer diameter of piston pin with a micrometer.

Standard : Refer to [EM-116, "Cylinder Block"](#).



Connecting Rod Small End Clearance

(Connecting rod small end clearance) = (Connecting rod small end inner diameter) – (Piston pin outer diameter)

Standard : Refer to [EM-116, "Cylinder Block"](#).

- If the measured value is out of the standard, replace connecting rod assembly and/or piston and piston pin assembly.
- If replacing connecting rod assembly, use "CONNECTING ROD BEARING OIL CLEARANCE" to select 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.

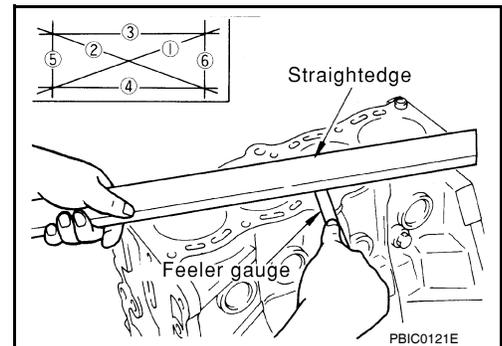
CAUTION:

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 and a feeler gauge.

Limit : Refer to [EM-116, "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 bolts to the specified torque. Refer to [EM-90, "Disassembly and Assembly"](#).
- Measure the position shown [5 mm (0.196 in) rearward from main bearing housing front side end surface) in the 2 directions as shown. The smaller one is the measured value.

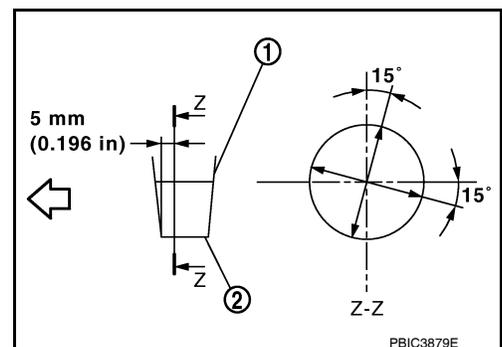
- 1 : Cylinder block
- 2 : Main bearing cap
- ⇐ : Engine front

Standard : Refer to [EM-116, "Cylinder Block"](#).

- If out of the standard, replace cylinder block and main bearing caps as an assembly.

NOTE:

These components cannot be replaced as a single unit, because they were processed together.



PISTON TO CYLINDER BORE CLEARANCE

Cylinder Bore Inner Diameter

CYLINDER BLOCK

[HR16DE]

< DISASSEMBLY AND ASSEMBLY >

- Using a bore gauge, measure the cylinder bore for wear, out-of-round and taper at six different points on each cylinder. ("X" and "Y" directions at "A", "B" and "C") ("Y" is in longitudinal direction of the engine)

A : Unit: mm (in)

NOTE:

When determining cylinder bore grade, measure cylinder bore at "B" position.

Standard:

Cylinder bore inner diameter

: Refer to [EM-116, "Cylinder Block"](#).

Limit:

Out-of-round (Difference between "X" and "Y")

Taper (Difference between "A" and "B")

: Refer to [EM-116, "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.

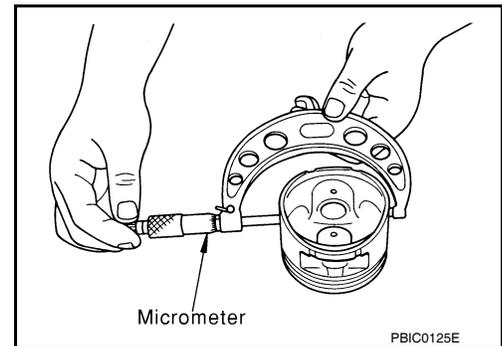
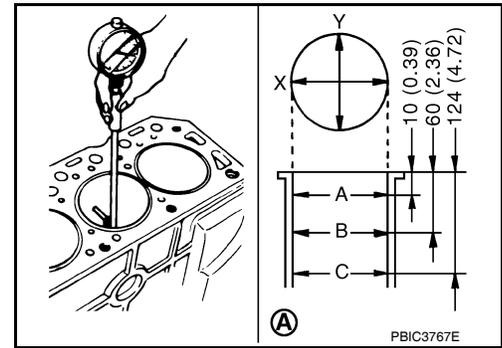
NOTE:

There is no service setting for oversized piston.

Piston Skirt Diameter

Measure the outer diameter of piston skirt with a micrometer.

Standard : Refer to [EM-116, "Cylinder Block"](#).



Piston to Cylinder Bore Clearance

Calculate by piston skirt diameter and cylinder bore inner diameter (direction "X", position "B").

(Clearance) = (Cylinder bore inner diameter) – (Piston skirt diameter)

Standard and Limit : Refer to [EM-116, "Cylinder Block"](#).

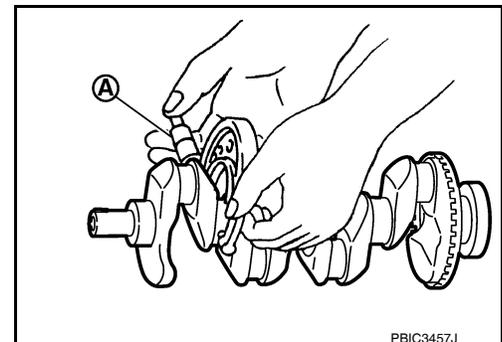
- If it exceeds the limit, replace piston and piston pin assembly and/or cylinder block.

CRANKSHAFT MAIN JOURNAL DIAMETER

- Measure the outer diameter of crankshaft main journals with a micrometer (A).

Standard : Refer to [EM-116, "Cylinder Block"](#).

- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing.



CRANKSHAFT PIN JOURNAL DIAMETER

CYLINDER BLOCK

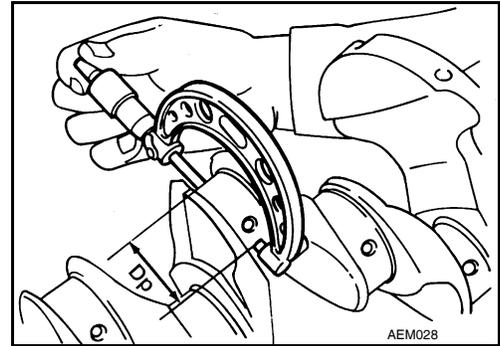
[HR16DE]

< DISASSEMBLY AND ASSEMBLY >

- Measure the outer diameter (Dp) of crankshaft pin journal with a micrometer.

Standard : Refer to [EM-116, "Cylinder Block"](#).

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing.



OUT-OF-ROUND AND TAPER OF CRANKSHAFT

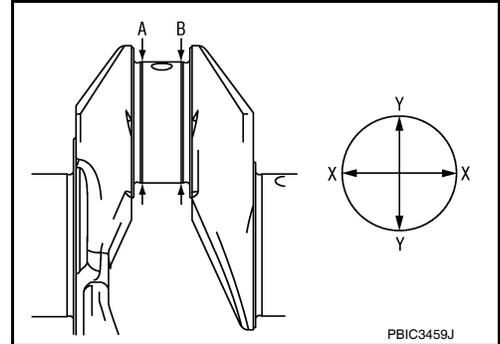
- Measure the dimensions at four different points as shown on each main journal and pin journal with a micrometer.
- Out-of-round is indicated by the difference in dimensions between "X" and "Y" at "A" and "B".
- Taper is indicated by the difference in dimension between "A" and "B" at "X" and "Y".

Limit:

Out-of-round (Difference between "X" and "Y")

Taper (Difference between "A" and "B")

: Refer to [EM-116, "Cylinder Block"](#).



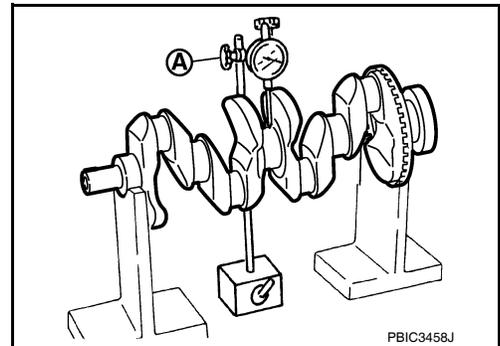
- If the measured value exceeds the limit, correct or replace crankshaft.
- If corrected, measure the bearing oil clearance of the corrected main journal and/or pin journal. Then select main bearing and/or connecting rod bearing.

CRANKSHAFT RUNOUT

- Place a V-block on a precise flat table to support the journals on the both end of 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)

Limit : Refer to [EM-116, "Cylinder Block"](#).

- If it exceeds the limit, replace crankshaft.



CONNECTING ROD BEARING OIL CLEARANCE

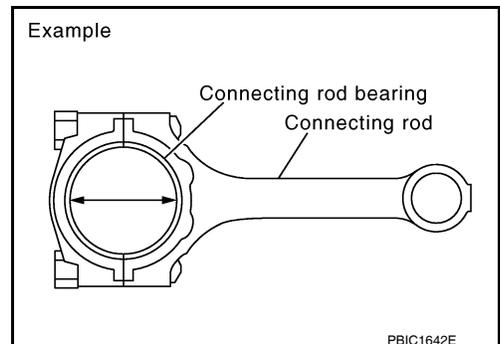
Method by Calculation

- Install connecting rod bearings to connecting rod and cap, and tighten connecting rod bolts to the specified torque. Refer to [EM-90, "Disassembly and Assembly"](#).
- 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-119, "Connecting Rod Bearing"](#).

- If the clearance exceeds the limit, select proper connecting rod bearing according to connecting rod big end diameter and crankshaft pin journal diameter to obtain the specified bearing oil clearance. Refer to [EM-106, "Connecting Rod Bearing"](#).



Method of Using Plastigage

CYLINDER BLOCK

[HR16DE]

< DISASSEMBLY AND ASSEMBLY >

- 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 bolts to the specified torque. Refer to [EM-90, "Disassembly and Assembly"](#).

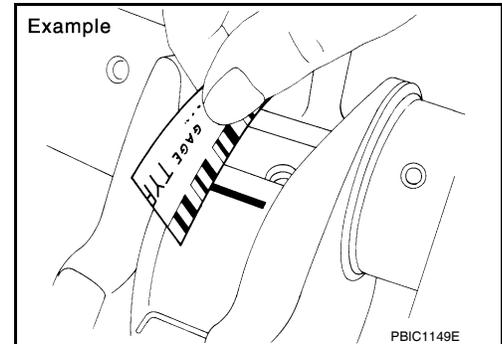
CAUTION:

Never rotate crankshaft.

- Remove connecting rod cap and bearing, and using the scale 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".



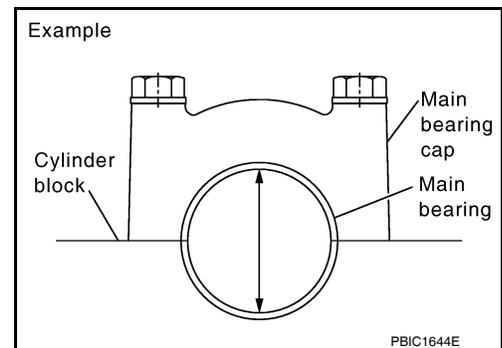
MAIN BEARING OIL CLEARANCE

Method by Calculation

- Install main bearings to cylinder block and main bearing cap, and tighten main bearing cap bolts to the specified torque. Refer to [EM-90, "Disassembly and Assembly"](#).
- Measure the inner diameter of main bearing with a bore gauge.
(Bearing oil clearance) = (Main bearing inner diameter) – (Crankshaft main journal diameter)

Standard : Refer to [EM-120, "Main Bearing"](#).

- If the clearance exceeds the limit, select proper main bearing according to main bearing inner diameter and crankshaft main journal diameter to obtain the specified bearing oil clearance. Refer to [EM-108, "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 bolts to the specified torque. Refer to [EM-90, "Disassembly and Assembly"](#).

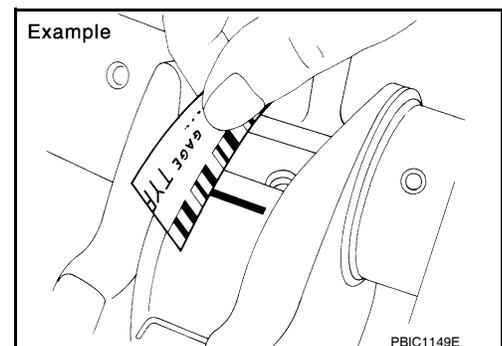
CAUTION:

Never rotate crankshaft.

- Remove main bearing cap and bearings, and using the scale 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

CYLINDER BLOCK

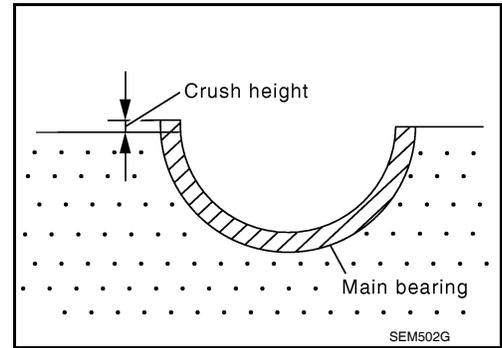
[HR16DE]

< DISASSEMBLY AND ASSEMBLY >

- When main bearing cap is removed after being tightened to the specified torque with main bearings installed, the tip end of bearing must protrude. Refer to [EM-90, "Disassembly and Assembly"](#).

Standard: There must be crush height.

- If the standard is not met, replace main bearings.

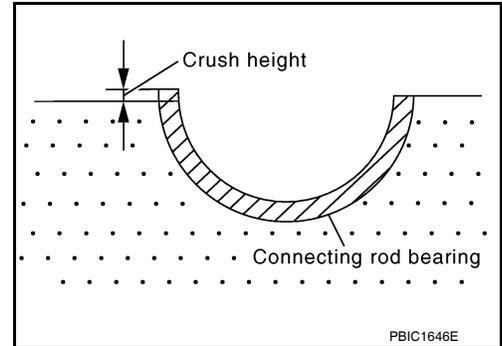


CONNECTING ROD BEARING CRUSH HEIGHT

- When connecting rod bearing cap is removed after being tightened to the specified torque with connecting rod bearings installed, the tip end of bearing must protrude. Refer to [EM-90, "Disassembly and Assembly"](#).

Standard: There must be crush height.

- If the standard is not met, replace connecting rod bearings.

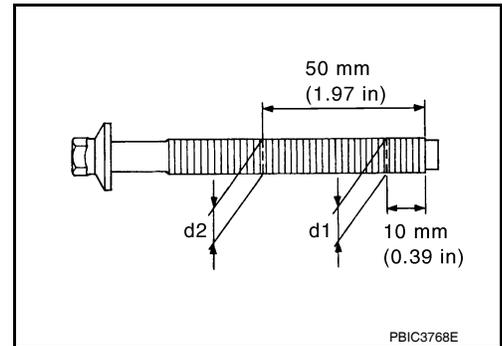


MAIN BEARING CAP BOLT OUTER DIAMETER

- Measure the outer diameters ("d1", "d2") at two positions as shown.
- If reduction appears in a position other than "d2", regard it as "d2".

Limit ("d1"–"d2"): 0.2 mm (0.008 in)

- If it exceeds the limit (a large difference in dimensions), replace main bearing cap bolt with a new one.

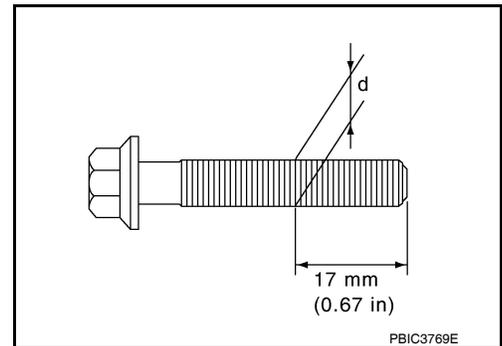


CONNECTING ROD CAP BOLT OUTER DIAMETER

- Measure the outer diameter "d" at position as shown.
- If reduction appears in a position other than "d", regard it as "d".

Limit: 7.75 mm (0.3051 in)

- When "d" falls below the limit (when it becomes thinner), replace connecting rod cap bolt with a new one.



FLYWHEEL DEFLECTION

CYLINDER BLOCK

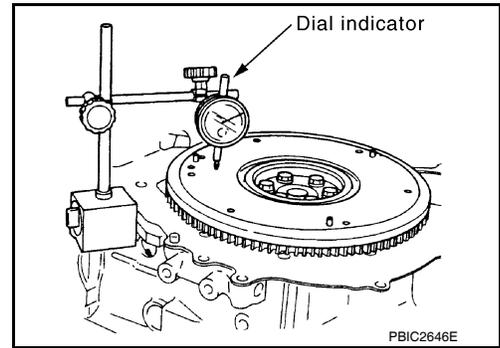
< DISASSEMBLY AND ASSEMBLY >

[HR16DE]

- Measure the deflection of flywheel contact surface to clutch with a dial indicator.

Standard : 0.25 mm (0.0098 in) or less.

- If measured value is out of the standard, replace flywheel.



A

EM

C

D

E

F

G

H

I

J

K

L

M

N

O

P

HOW TO SELECT PISTON AND BEARING

< DISASSEMBLY AND ASSEMBLY >

[HR16DE]

HOW TO SELECT PISTON AND BEARING

Description

INFOID:000000005398084

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, follow the procedures.

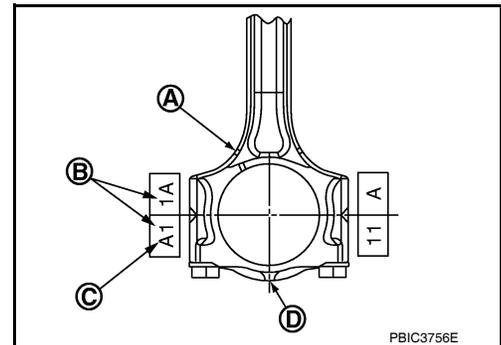
Connecting Rod Bearing

INFOID:000000005398085

WHEN NEW CONNECTING ROD AND CRANKSHAFT ARE USED

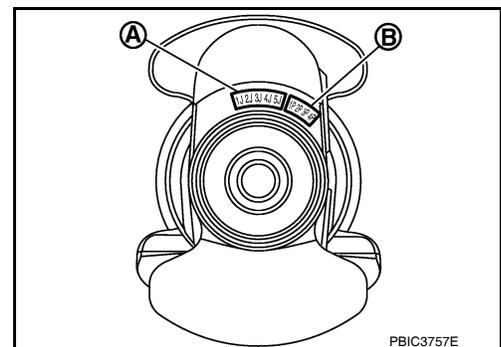
1. Apply connecting rod big end diameter grade stamped (C) on connecting rod side face to the row in the "Connecting Rod Bearing Selection Table".

- 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-97, "Inspection"](#).

HOW TO SELECT PISTON AND BEARING

[HR16DE]

< 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 Crankshaft pin journal diameter		I.D. mark	A	B	C	D	E	F	G	H	J	K	L	M	N
			Hole diameter Unit: mm (in)												
I.D. mark	Axle 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)
A	39.971 - 39.970 (1.5737 - 1.5736)	0	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	0	01	01	01	1	1	1	12	12	12
C	39.969 - 39.968 (1.5736 - 1.5735)	0	0	0	0	01	01	01	1	1	1	12	12	12	2
D	39.968 - 39.967 (1.5735 - 1.5735)	0	0	0	01	01	01	1	1	1	12	12	12	2	2
E	39.967 - 39.966 (1.5735 - 1.5735)	0	0	01	01	01	1	1	1	12	12	12	2	2	2
F	39.966 - 39.965 (1.5735 - 1.5734)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	39.965 - 39.964 (1.5734 - 1.5734)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H	39.964 - 39.963 (1.5734 - 1.5733)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
J	39.963 - 39.962 (1.5733 - 1.5733)	1	1	1	1	12	12	12	2	2	2	23	23	23	3
K	39.962 - 39.961 (1.5733 - 1.5733)	1	1	1	1	12	12	12	2	2	2	23	23	23	3
L	39.961 - 39.960 (1.5733 - 1.5732)	1	1	1	1	12	12	12	2	2	2	23	23	23	3
M	39.960 - 39.959 (1.5732 - 1.5732)	1	1	1	1	12	12	12	2	2	2	23	23	23	3
N	39.959 - 39.958 (1.5732 - 1.5731)	1	1	1	1	12	12	12	2	2	2	23	23	23	3
P	39.958 - 39.957 (1.5731 - 1.5731)	1	1	1	1	12	12	12	2	2	2	23	23	23	3
R	39.957 - 39.956 (1.5731 - 1.5731)	2	2	2	2	23	23	23	3	3	3	34	34	34	4
S	39.956 - 39.955 (1.5731 - 1.5730)	2	2	2	2	23	23	23	3	3	3	34	34	34	4
T	39.955 - 39.954 (1.5730 - 1.5730)	2	2	2	2	23	23	23	3	3	3	34	34	34	4
U	39.954 - 39.953 (1.5730 - 1.5729)	2	2	2	2	23	23	23	3	3	3	34	34	34	4

PBIC3758E

Connecting Rod Bearing Grade Table

Connecting Rod Bearing Grade Table : Refer to [EM-119, "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

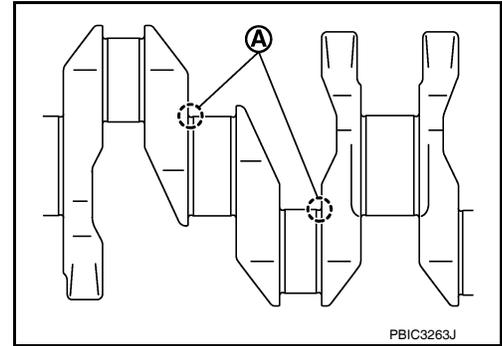
< DISASSEMBLY AND ASSEMBLY >

[HR16DE]

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-119, "Connecting Rod Bearing"](#).



INFOID:000000005398086

Main Bearing

HOW TO SELECT MAIN BEARING

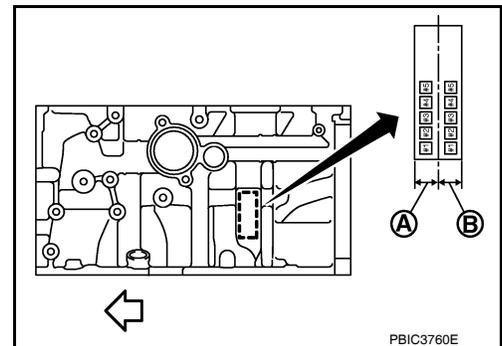
When New Cylinder Block and Crankshaft Are Used

1. "Main Bearing Selection Table" rows correspond to main bearing housing grade on left side of cylinder block.

A : Basic stamp mark

⇐ : Engine front

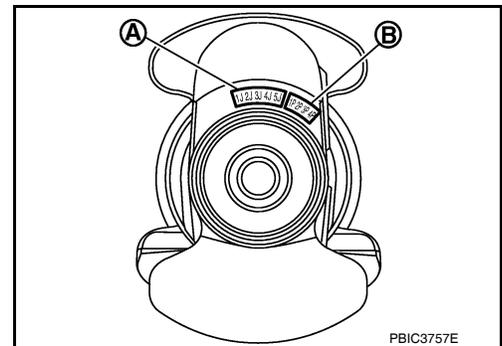
- If there is a corrected stamp mark (B) on cylinder block, use it as a correct reference.



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-97, "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

< DISASSEMBLY AND ASSEMBLY >

[HR16DE]

Main Bearing Selection Table

I.D. mark	Axle diameter Unit mm (in)	Cylinder block main bearing housing inner 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)			0	0	0	0	0	0	0	0	0	01	01	01	1	1	1	1	12	12	12	2	2	2	23	23	
B	47.978 - 47.977 (1.8889 - 1.8889)			0	0	0	0	0	0	0	0	01	01	01	1	1	1	1	12	12	12	2	2	2	2	23	23	
C	47.977 - 47.976 (1.8889 - 1.8888)			0	0	0	0	0	0	0	01	01	01	1	1	1	1	12	12	12	2	2	2	2	23	23	23	
D	47.976 - 47.975 (1.8888 - 1.8888)			0	0	0	0	0	0	01	01	01	1	1	1	1	1	12	12	12	2	2	2	2	23	23	23	3
E	47.975 - 47.974 (1.8888 - 1.8887)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F	47.974 - 47.973 (1.8887 - 1.8887)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	47.973 - 47.972 (1.8887 - 1.8887)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H	47.972 - 47.971 (1.8886 - 1.8886)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
J	47.971 - 47.970 (1.8886 - 1.8886)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K	47.970 - 47.969 (1.8886 - 1.8885)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L	47.969 - 47.968 (1.8885 - 1.8885)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M	47.968 - 47.967 (1.8885 - 1.8885)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N	47.967 - 47.966 (1.8885 - 1.8884)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P	47.966 - 47.965 (1.8884 - 1.8884)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R	47.965 - 47.964 (1.8884 - 1.8883)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S	47.964 - 47.963 (1.8883 - 1.8883)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T	47.963 - 47.962 (1.8883 - 1.8883)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U	47.962 - 47.961 (1.8883 - 1.8882)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V	47.961 - 47.960 (1.8882 - 1.8882)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	47.960 - 47.959 (1.8882 - 1.8881)			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

PBIC3759E

Main Bearing Grade Table

Main Bearing Grade Table : Refer to [EM-120, "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

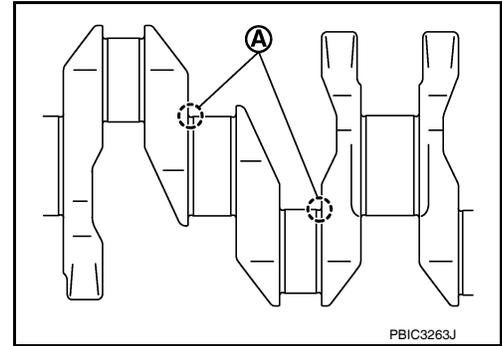
< DISASSEMBLY AND ASSEMBLY >

[HR16DE]

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-120, "Main Bearing"](#).



SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR16DE]

SERVICE DATA AND SPECIFICATIONS (SDS)

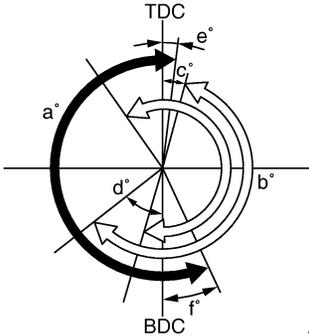
SERVICE DATA AND SPECIFICATIONS (SDS)

General Specification

INFOID:000000005398087

A
EM

GENERAL SPECIFICATIONS

Engine type		HR16DE
Cylinder arrangement		In-line 4
Displacement cm ³ (cu in)		1,598 (97.51)
Bore and stroke mm (in)		78.0 x 83.6 (3.071 x 3.291)
Valve arrangement		DOHC
Firing order		1-3-4-2
Number of piston rings	Compression	2
	Oil	1
Number of main bearings		5
Compression ratio		10.7
Compression pressure kPa (bar, kg/cm ² , psi)/200 rpm	Standard	1,510 (15.1, 15.4, 219)
	Minimum	1,265 (12.65, 12.9, 183)
	Differential limit between cylinders	6.2 (0.06, 0.06, 0.9)
Valve timing (Intake valve timing control - "ON")		 <p style="text-align: right;">JPBIA0552ZZ</p>

Unit: degree

a	b	c	d	e	f
208	228	-11 (24)	59 (24)	4	24

Drive Belts

INFOID:000000005398088

BELT DEFLECTION:

Location		Deflection adjustment *		
		Used belt		New belt
		Limit	After adjusted	
Drive belt	With A/C models	8.2 (0.323)	4.8 - 5.3 (0.19 - 0.21)	4.1 - 4.4 (0.161 - 0.173)
	Without A/C models	7.4 (0.291)	4.3 - 4.7 (0.17 - 0.19)	3.7 - 3.9 (0.146 - 0.154)
Applied pushing force		98 N (10 kg, 22 lb)		

*: When engine is cold.

BELT TENSION AND FREQUENCY:

C
D
E
F
G
H
I
J
K
L
M
N
O
P

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR16DE]

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	With A/C models	500 (51.0, 112)	876 - 964 (89.4 - 98.3, 197 - 217)	1064 - 1152 (108.5 - 117.5, 239 - 259)	173	229 - 239	253.5 - 261.5
	Without A/C models	500 (51.0, 112)	876 - 964 (89.4 - 98.3, 197 - 217)	1064 - 1152 (108.5 - 117.5, 239 - 259)	194	257.5 - 267.5	283 - 293

*: When engine is cold.

Spark Plug

INFOID:000000005398089

SPARK PLUG

Unit: mm (in)

Make	Denso
Standard type*	FXE20HE-11
Gap (Nominal)	1.1 (0.043)

*: Always check with the Parts Department for the latest parts information

Exhaust Manifold

INFOID:000000005398090

EXHAUST MANIFOLD

Unit: mm (in)

Items	Limit
Surface distortion Exhaust manifold	0.3 (0.012)

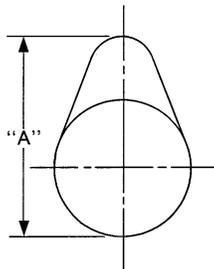
Camshaft

INFOID:000000005398091

CAMSHAFT

Unit: mm (in)

Items	Standard	Limit
Camshaft runout [TIR*]	0.02 (0.0008)	0.1 (0.004)



SEM671

Camshaft cam height "A"	Intake	41.705 - 41.895 (1.6419 - 1.6494)	—
	Exhaust	40.175 - 40.365 (1.5817 - 1.5892)	—
Camshaft journal diameter	No. 1	27.935 - 27.955 (1.0998 - 1.1006)	—
	No. 2, 3, 4, 5	24.950 - 24.970 (0.9823 - 0.9831)	—
Camshaft bracket inner diameter	No. 1	28.000 - 28.021 (1.1024 - 1.1032)	—
	No. 2, 3, 4, 5	25.000 - 25.021 (0.9843 - 0.9851)	—

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR16DE]

Items		Standard	Limit
Camshaft journal oil clearance	No. 1	0.045 - 0.086 (0.0018 - 0.0034)	0.15 (0.0059)
	No. 2, 3, 4, 5	0.030 - 0.071 (0.0012 - 0.0028)	
Camshaft end play		0.075 - 0.153 (0.0030 - 0.0060)	0.2 (0.008)
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 (1.1802 - 1.1806)
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

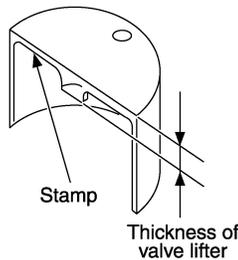
Unit: mm (in)

Items	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 - 0.015)	0.308 - 0.432 (0.012 - 0.017)

*: Approximately 80°C (176°F)

AVAILABLE VALVE LIFTER

Thickness mm (in)	Identification mark*
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KBIA0119E

3.00 (0.1181)	300
3.02 (0.1189)	302
3.04 (0.1197)	304
3.06 (0.1205)	306
3.08 (0.1213)	308
3.10 (0.1220)	310
3.12 (0.1228)	312
3.14 (0.1236)	314
3.16 (0.1244)	316
3.18 (0.1252)	318
3.20 (0.1260)	320
3.22 (0.1268)	322
3.24 (0.1276)	324
3.26 (0.1283)	326
3.28 (0.1291)	328

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR16DE]

Thickness mm (in)	Identification mark*
3.30 (0.1299)	330
3.32 (0.1307)	332
3.34 (0.1315)	334
3.36 (0.1323)	336
3.38 (0.1331)	338
3.40 (0.1339)	340
3.42 (0.1346)	342
3.44 (0.1354)	344
3.46 (0.1362)	346
3.48 (0.1370)	348
3.50 (0.1378)	350

*: Always check with the Parts Department for the latest parts information

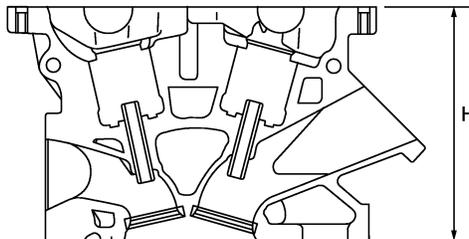
Cylinder Head

INFOID:000000005398092

CYLINDER HEAD

Unit: mm (in)

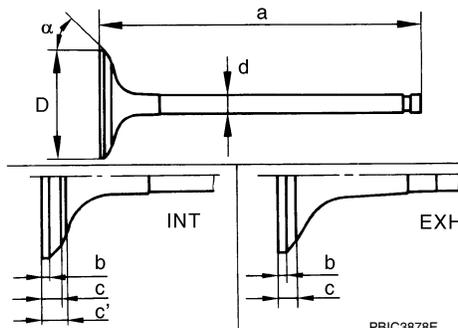
Items	Standard	Limit
Head surface distortion	—	0.1 (0.004)
Normal cylinder head height "H"	125.0 (4.92)	—



PBIC0924E

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 - 1.008)
Valve length "a"	Intake	101.65 (4.002)
	Exhaust	102.46 (4.034)

SERVICE DATA AND SPECIFICATIONS (SDS)

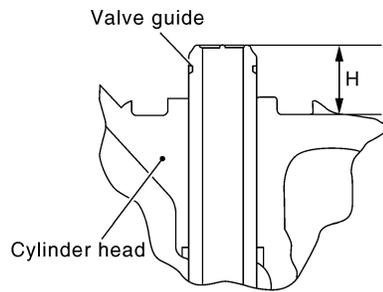
< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR16DE]

"b"	Intake	1.0 (0.039)	A
	Exhaust		
"c"	Intake	2.1 - 2.8 (0.083 - 0.110)	EM
	Exhaust	2.3 - 3.0 (0.091 - 0.118)	
"c"	Intake	3.0 (0.118)	C
	Exhaust	-	
Valve stem diameter "d "	Intake	4.965 - 4.980 (0.1955 - 0.1961)	D
	Exhaust	4.955 - 4.970 (0.1951 - 0.1957)	
Valve seat angle "α"	Intake	45°15' - 45°45'	E
	Exhaust		

VALVE GUIDE

Unit: mm (in)

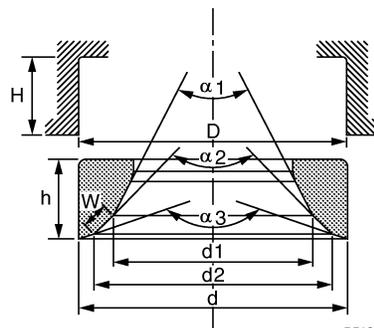


PBIC2187E

Items		Standard	Oversize (service) [0.2 (0.008)]
Valve guide	Outer diameter	9.023 - 9.034 (0.3552 - 0.3557)	9.223 - 9.234 (0.3631 - 0.3635)
	Inner diameter (Finished size)	5.000 - 5.018 (0.1969 - 0.1976)	
Cylinder head valve guide hole diameter		8.975 - 8.996 (0.3533 - 0.3542)	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)	
Projection length "H"		11.4 - 11.8 (0.449 - 0.465)	

VALVE SEAT

Unit: mm (in)



PBIC2745E

Items		Standard	Oversize (service) [0.5 (0.02)]
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 (1.0197 - 1.0203)	26.400 - 26.416 (1.0394 - 1.0400)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR16DE]

Valve seat outer diameter "d"	Intake	31.497 - 31.513 (1.2400 - 1.2407)	31.997 - 32.013 (1.2597 - 1.2604)
	Exhaust	25.997 - 26.013 (1.0235 - 1.0241)	26.497 - 26.513 (1.0432 - 1.0438)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust		
Diameter "d1"*1	Intake	29.0 (1.142)	
	Exhaust	23.0 (0.906)	
Diameter "d2"*2	Intake	30.6 - 30.8 (1.205 - 1.213)	
	Exhaust	24.9 - 25.1 (0.980 - 0.988)	
Angle "α1"	Intake	60°	
	Exhaust	45°	
Angle "α2"	Intake	89°45' - 90°15'	
	Exhaust		
Angle "α3"	Intake	120°	
	Exhaust		
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 (0.215)
	Exhaust		5.43 (0.214)
Depth "H"		6.0 (0.236)	

*1 : Diameter made by intersection point of conic angles α_1 and α_2

*2 : Diameter made by intersection point of conic angles α_2 and α_3

*3 : Machining data

VALVE SPRING

Items	Standard
Free height	42.26 mm (1.6638 in)
Installation height	32.40 mm (1.2756 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)

Items	Limit
Valve spring squareness	1.8 mm (0.071 in)

Cylinder Block

INFOID:000000005398093

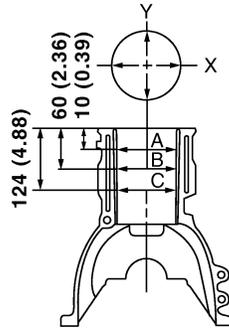
CYLINDER BLOCK

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR16DE]

Unit: mm (in)

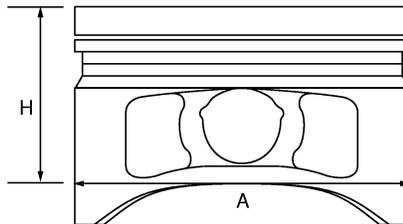


PBIC3924E

Cylinder block top surface distortion	Limit	0.1 (0.004)
Cylinder bore inner diameter	Standard	78.000 - 78.015 (3.0709 - 3.0715)
Out-of-round	Limit	0.015 (0.0006)
Taper		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 - 2.0473)
	Grade No. E	52.001 - 52.002 (2.0473 - 2.0473)
	Grade No. F	52.002 - 52.003 (2.0473 - 2.0474)
	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 - 2.0475)
	Grade No. K	52.006 - 52.007 (2.0475 - 2.0475)
	Grade No. L	52.007 - 52.008 (2.0475 - 2.0476)
	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 - 2.0477)
	Grade No. R	52.011 - 52.012 (2.0477 - 2.0477)
	Grade No. S	52.012 - 52.013 (2.0477 - 2.0478)
	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 - 2.0479)	
Grade No. W	52.016 - 52.017 (2.0479 - 2.0479)	
Difference in inner diameter between cylinders	Standard	Less than 0.015 (0.0006)

AVAILABLE PISTON

Unit: mm (in)



PBIC0188E

Item	Standard	Limit
Piston skirt diameter "A"*	77.965 - 77.980 (3.0695 - 3.0701)	—
Measure point "H"	37.1 (1.461)	—
Piston pin hole diameter*	19.006 - 19.012 (0.7483 - 0.7485)	—
Piston to cylinder bore clearance	0.020 - 0.050 (0.0008 - 0.0020)	0.09 (0.0035)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR16DE]

*: Always check with the Parts Department for the latest parts information

PISTON RING

Unit: mm (in)

Items		Standard	Limit
Piston ring side clearance	Top	0.040 - 0.080 (0.0016 - 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 (0.0018 - 0.0049)	—
Piston ring end gap	Top	0.20 - 0.30 (0.0079 - 0.0118)	0.50 (0.0197)
	2nd	0.35 - 0.50 (0.0138 - 0.0197)	0.66 (0.0260)
	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 - 19.002 (0.7479 - 0.7481)
Piston to piston pin oil clearance	Standard	0.008 - 0.012 (0.0003 - 0.0005)

CONNECTING ROD

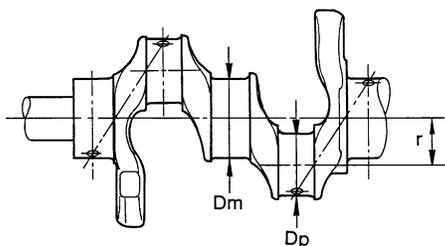
Unit: mm (in)

Center distance		129.84 - 129.94 (5.11 - 5.12)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)
Connecting rod small end clearance	Standard	-0.018 - -0.044 (-0.0007 - -0.0017)
Connecting rod small end inner diameter	Standard	18.958 - 18.978 (0.7464 - 0.7472)
Connecting rod side clearance	Standard	0.200 - 0.352 (0.0079 - 0.0139)
Connecting rod big end diameter	Grade*	Dimension
	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)	

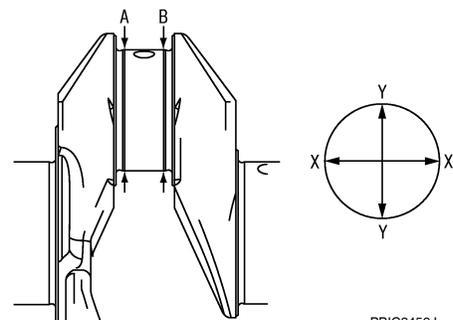
*: Always check with the Parts Department for the latest parts information

CRANKSHAFT

Unit: mm (in)



SEM645



PBIC3459J

Center distance "r"	41.68 - 41.76 (1.6409 - 1.6441)
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SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR16DE]

Out-of-round	Limit	0.003 (0.0001)	
Taper	Limit	0.004 (0.0002)	A
Runout [TIR ¹]	Limit	0.10 (0.0039)	
Crankshaft end play	Standard	0.098 - 0.260 (0.0039 - 0.0102)	EM
	Limit	0.35 (0.0138)	
Crankshaft pin journal diameter grade. "Dp"	Grade ²	Dimension	
	Grade No. A	39.971 - 39.970 (1.5737 - 1.5736)	C
	Grade No. B	39.970 - 39.969 (1.5736 - 1.5736)	
	Grade No. C	39.969 - 39.968 (1.5736 - 1.5735)	
	Grade No. D	39.968 - 39.967 (1.5735 - 1.5735)	D
	Grade No. E	39.967 - 39.966 (1.5735 - 1.5735)	
	Grade No. F	39.966 - 39.965 (1.5735 - 1.5734)	
	Grade No. G	39.965 - 39.964 (1.5734 - 1.5734)	
	Grade No. H	39.964 - 39.963 (1.5734 - 1.5733)	E
	Grade No. J	39.963 - 39.962 (1.5733 - 1.5733)	
	Grade No. K	39.962 - 39.961 (1.5733 - 1.5733)	
	Grade No. L	39.961 - 39.960 (1.5733 - 1.5732)	
	Grade No. M	39.960 - 39.959 (1.5732 - 1.5732)	F
	Grade No. N	39.959 - 39.958 (1.5732 - 1.5731)	
	Grade No. P	39.958 - 39.957 (1.5731 - 1.5731)	
	Grade No. R	39.957 - 39.956 (1.5731 - 1.5731)	G
	Grade No. S	39.956 - 39.955 (1.5731 - 1.5730)	
Grade No. T	39.955 - 39.954 (1.5730 - 1.5730)		
Grade No. U	39.954 - 39.953 (1.5730 - 1.5729)		
Crankshaft main journal diameter grade. "Dm"	Grade No. A	47.979 - 47.978 (1.8889 - 1.8889)	H
	Grade No. B	47.978 - 47.977 (1.8889 - 1.8889)	
	Grade No. C	47.977 - 47.976 (1.8889 - 1.8888)	
	Grade No. D	47.976 - 47.975 (1.8888 - 1.8888)	
	Grade No. E	47.975 - 47.974 (1.8888 - 1.8887)	I
	Grade No. F	47.974 - 47.973 (1.8887 - 1.8887)	
	Grade No. G	47.973 - 47.972 (1.8887 - 1.8887)	
	Grade No. H	47.972 - 47.971 (1.8887 - 1.8886)	J
	Grade No. J	47.971 - 47.970 (1.8886 - 1.8886)	
	Grade No. K	47.970 - 47.969 (1.8886 - 1.8885)	
	Grade No. L	47.969 - 47.968 (1.8885 - 1.8885)	
	Grade No. M	47.968 - 47.967 (1.8885 - 1.8885)	K
	Grade No. N	47.967 - 47.966 (1.8885 - 1.8884)	
	Grade No. P	47.966 - 47.965 (1.8884 - 1.8884)	
	Grade No. R	47.965 - 47.964 (1.8884 - 1.8883)	
	Grade No. S	47.964 - 47.963 (1.8883 - 1.8883)	L
	Grade No. T	47.963 - 47.962 (1.8883 - 1.8883)	
Grade No. U	47.962 - 47.961 (1.8883 - 1.8882)		
Grade No. V	47.961 - 47.960 (1.8882 - 1.8882)	M	
Grade No. W	47.960 - 47.959 (1.8882 - 1.8881)		

¹: Total indicator reading

²: Always check with the Parts Department for the latest parts information

Connecting Rod Bearing

INFOID:000000005398094

CONNECTING ROD BEARING GRADE TABLE

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	

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR16DE]

Grade number*		Thickness	Identification color	Remarks
01	UPR	1.498 - 1.501 (0.0590 - 0.0591)	Black	Grade and color are different for 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	

*: Always check with the Parts Department for the latest parts information

UNDERSIZE TABLE

Unit: mm (in)

Item	Thickness	Crankshaft pin journal diameter
US 0.25 (0.0098)	1.627 - 1.635 (0.0641 - 0.0644)	Grind so that bearing clearance is the specified value.

CONNECTING ROD BEARING OIL CLEARANCE

Unit: mm (in)

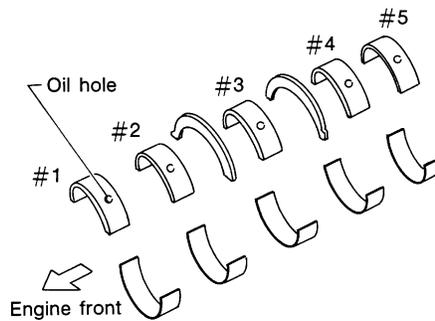
Connecting rod bearing oil clearance	Standard	0.029 - 0.039 (0.0011 - 0.0015)
	Limit	0.10 (0.0039)

Main Bearing

INFOID:000000005398095

MAIN BEARING GRADE TABLE

Unit: mm (in)



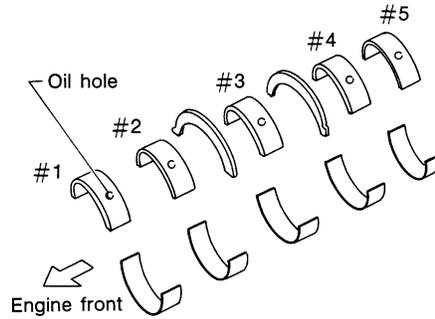
SEM685D

Grade number*	Thickness	Identification color	Remarks
0	1.996 - 1.999 (0.0786 - 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 - 0.0791)	Yellow	
4	2.008 - 2.011 (0.0791 - 0.0792)	Blue	
5	2.011 - 2.014 (0.0792 - 0.0793)	Pink	

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE DATA AND SPECIFICATIONS (SDS)

[HR16DE]



SEM685D

Grade number*		Thickness	Identification color	Remarks
01	UPR	1.996 - 1.999 (0.0786 - 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 - 0.0791)	Yellow	
34	UPR	2.005 - 2.008 (0.0789 - 0.0791)	Yellow	
	LWR	2.008 - 2.011 (0.0791 - 0.0792)	Blue	
45	UPR	2.008 - 2.011 (0.0791 - 0.0792)	Blue	
	LWR	2.011 - 2.014 (0.0792 - 0.0793)	Pink	

*: Always check with the Parts Department for the latest parts information

UNDERSIZE TABLE

Unit: mm (in)

Items	Thickness	Main journal diameter
0.25 (0.0098)	2.126 - 2.134 (0.0837 - 0.0840)	Grind so that bearing clearance is the specified value.

MAIN BEARING OIL CLEARANCE

Unit: mm (in)

Main bearing oil clearance	Standard	0.024 - 0.034 (0.0009 - 0.0013)

SERVICE INFORMATION

PRECAUTIONS

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

INFOID:000000005398096

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. This system includes seat belt switch inputs and dual stage front air bag modules. The SRS system uses the seat belt switches to determine the front air bag deployment, and may only deploy one front air bag, depending on the severity of a collision and whether the front occupants are belted or unbelted. Information necessary to service the system safely is included in the SRS and SB section 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 the SRS section.
- 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.

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

WARNING:

- When working near the Airbag Diagnosis Sensor Unit or other Airbag 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.

Precaution Necessary for Steering Wheel Rotation After Battery Disconnect

INFOID:000000005398097

NOTE:

- This Procedure is applied only to models with Intelligent Key system and NATS (NISSAN ANTI-THEFT SYSTEM).
- Remove and install all control units after disconnecting both battery cables with the ignition knob in the "LOCK" position.
- Always use CONSULT-III to perform self-diagnosis as a part of each function inspection after finishing work. If DTC is detected, perform trouble diagnosis according to self-diagnostic results.

For models equipped with the Intelligent Key system and NATS, an electrically controlled steering lock mechanism is adopted on the key cylinder.

For this reason, if the battery is disconnected or if the battery is discharged, the steering wheel will lock and steering wheel rotation will become impossible.

If steering wheel rotation is required when battery power is interrupted, follow the 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. Use the Intelligent Key or mechanical key to turn the ignition switch to the "ACC" position. At this time, the steering lock will be released.
3. Disconnect both battery cables. The steering lock will remain released and the steering wheel can be rotated.
4. Perform the necessary repair operation.

PRECAUTIONS

[MR18DE]

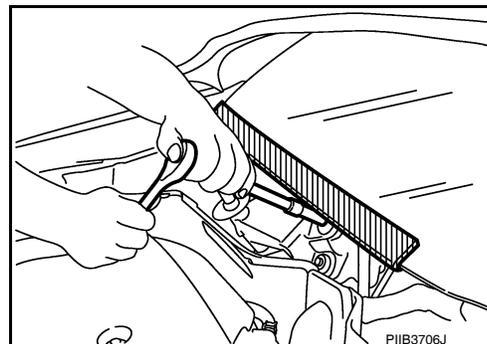
< SERVICE INFORMATION >

- When the repair work is completed, return the ignition switch to the "LOCK" position before connecting the battery cables. (At this time, the steering lock mechanism will engage.)
- Perform a self-diagnosis check of all control units using CONSULT-III.

Precaution for Procedure without Cowl Top Cover

INFOID:000000005398098

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



Precaution for Drain Coolant

INFOID:000000005398099

- Drain coolant when engine is cooled.

Precaution for Disconnecting Fuel Piping

INFOID:000000005398100

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

Precaution for Removal and Disassembly

INFOID:000000005398101

- When instructed to use special service tools, use the specified tools. Always be careful to work safely, avoid forceful or uninstructed operations.
- Exercise maximum care to avoid damage to mating or sliding surfaces.
- Cover openings of engine system with tape or the equivalent, if necessary, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and assembly.
- 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 where noted in the step.

Precaution for Inspection, Repair and Replacement

INFOID:000000005398102

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

Precaution for Assembly and Installation

INFOID:000000005398103

- 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 oil or 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 after draining coolant.
- Before starting engine, apply fuel pressure to fuel lines with turning ignition switch ON (with engine stopped). Then make sure that there are no leaks at fuel line connections.
- After repairing, start engine and increase engine speed to check coolant, fuel, oil, and exhaust systems for leakage.

PRECAUTIONS

< SERVICE INFORMATION >

[MR18DE]

INFOID:000000005398104

Parts Requiring Angular Tightening

- Use an angle wrench for the final tightening of the following engine parts:
 - Cylinder head bolts
 - Camshaft sprocket (INT)
 - Main bearing cap bolts
 - Connecting rod cap nuts
 - Crankshaft pulley bolt (No angle wrench is required as the bolt flange is provided with notches for angular tightening)

Tool number : KV10112100 (BT-8653-A)

- 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.

Precaution for Liquid Gasket

INFOID:000000005398105

REMOVAL OF LIQUID GASKET SEALING

- After removing the bolts and nuts, separate the mating surface and remove the sealant using Tool.

Tool number : KV10111100 (J-37228)

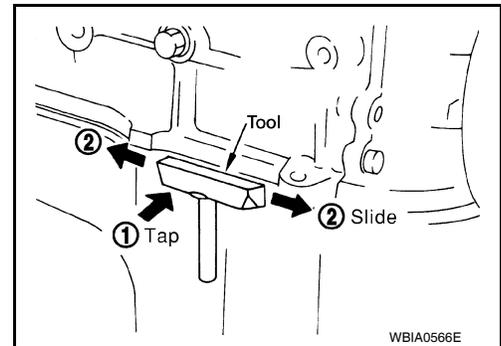
CAUTION:

Be careful not to damage the mating surfaces.

- In areas where the cutter is difficult to use, use a plastic hammer to lightly tap (1) the cutter where the RTV Silicone Sealant is applied. Use a plastic hammer to slide the cutter (2) by tapping on the side.

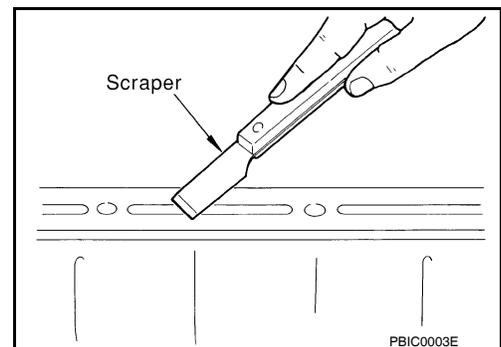
CAUTION:

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



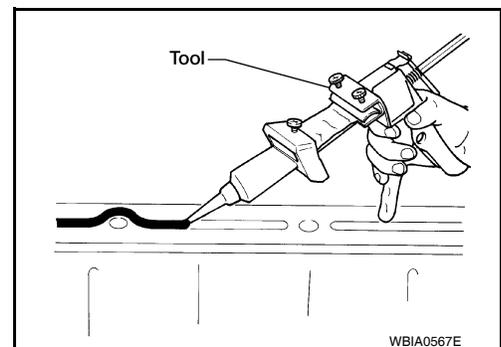
LIQUID GASKET APPLICATION PROCEDURE

1. Using a scraper, remove the old Silicone RTV Sealant adhering to the gasket application surface and the mating surface.
 - Remove the sealant completely from the groove of the gasket application surface, bolts, and bolt holes.
2. Thoroughly clean the gasket application surface and the mating surface and remove adhering moisture, grease and foreign materials.
3. Attach the sealant tube to the tube presser.
Use Genuine Silicone RTV Sealant or equivalent. Refer to [GI-42, "Recommended Chemical Product and Sealant"](#).
4. Apply the sealant without breaks to the specified location using Tool.



Tool number WS39930000 (-)

- If there is a groove for the sealant application, apply the sealant to the groove.
- As for the bolt holes, normally apply the sealant inside the holes. If specified, it should be applied outside the holes. Make sure to read the text of this manual.
- Within five minutes of the sealant application, install the mating component.
- If the sealant protrudes, wipe it off immediately.
- Do not retighten after the installation.

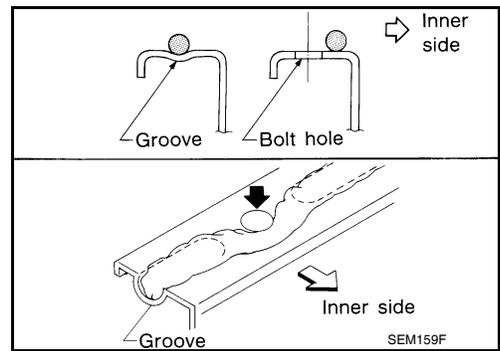


PRECAUTIONS

< SERVICE INFORMATION >

[MR18DE]

- After 30 minutes or more have passed from the installation, fill the engine with the specified oil and coolant. Refer to [MA-14, "Fluids and Lubricants"](#).



CAUTION:
Follow all specific instructions in this manual.

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PREPARATION

< SERVICE INFORMATION >

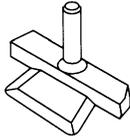
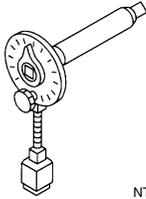
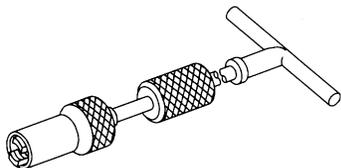
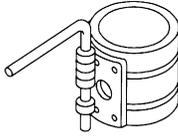
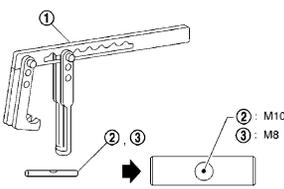
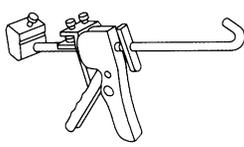
[MR18DE]

PREPARATION

Special Service Tool

INFOID:000000005398106

The actual shapes of Kent-Moore tools may differ from those of special service tools illustrated here.

Tool number (Kent-Moore No.) Tool name	Description
KV10111100 (J-37228) Seal cutter	Removing steel oil pan and rear timing chain case  <p style="text-align: center;">NT046</p>
KV10112100 (BT-8653-A) Angle wrench	Tightening bolts for bearing cap, cylinder head, etc.  <p style="text-align: center;">NT014</p>
KV10107902 (J-38959) Valve oil seal puller	Removing valve oil seal  <p style="text-align: center;">S-NT011</p>
EM03470000 (J-8037) Piston ring compressor	Installing piston assembly into cylinder bore  <p style="text-align: center;">NT044</p>
KV101092S0 (J-26336-B) Valve spring compressor 1. KV10109210 (J-26336-B and J-26336-20) Compressor 2. KV10109220 (—) Adapter (M10) 3. KV10109230 (—) Adapter (M8)	Disassembling and assembling valve mechanism  <p style="text-align: center;">NT718</p>
WS39930000 (—) Tube presser	Pressing the tube of liquid gasket  <p style="text-align: center;">NT052</p>

PREPARATION

< SERVICE INFORMATION >

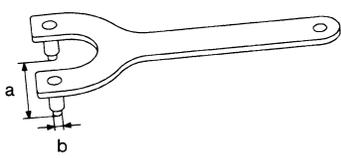
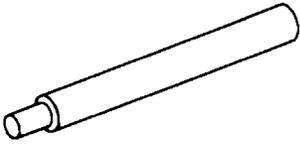
[MR18DE]

Tool number (Kent-Moore No.) Tool name	Description	
ST16610001 (J-23907) Pilot bushing puller	Removing crankshaft pilot bushing	A EM C
KV11103000 (—) Pulley puller	Removing crankshaft pulley	D E F
KV991J0050 (J-44626) Air fuel sensor Socket	Loosening or tightening air fuel ratio sensor a: 22 mm (0.87 in)	G H
KV10114400 (J-38365) Heated oxygen sensor wrench	Loosening or tightening rear heated oxygen sensor a: 22 mm (0.87 in)	I J K
KV11105210 (J-44716) Stopper plate	Securing drive plate and flywheel	L M
KV10115600 (J-38958) Valve oil seal drift	Installing valve oil seal Use side A. a: 20 (0.79) dia. b: 13 (0.51) dia. c: 10.3 (0.406) dia. d: 8 (0.31) dia. e: 10.7 (0.421) f: 5 (0.20)	N O
KV10115801 (—) Oil filter wrench	Removing and installing oil filter a: 64.3 mm (2.531 in)	P

PREPARATION

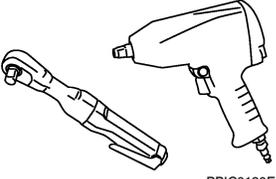
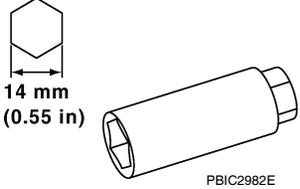
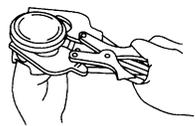
< SERVICE INFORMATION >

[MR18DE]

Tool number (Kent-Moore No.) Tool name	Description
KV10109300 (—) Pulley holder	Removing and installing crankshaft pulley
 <p style="text-align: center;">NT628</p>	
KV10111800 (—) Valve guide drift	Removing and installing valve guide
 <p style="text-align: center;">PBIC4012E</p>	

Commercial Service Tool

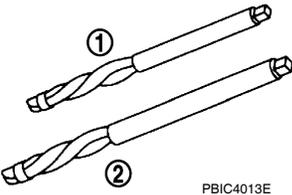
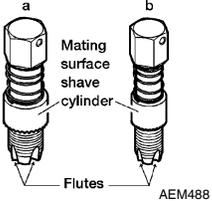
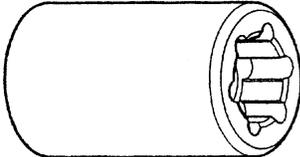
INFOID:000000005398107

(Kent-Moore No.) Tool name	Description
Power tool	Loosening bolts and nuts
 <p style="text-align: center;">PBIC0190E</p>	
Spark plug wrench	Removing and installing spark plug
 <p style="text-align: center;">PBIC2982E</p>	
Valve seat cutter set	Finishing valve seat dimensions
 <p style="text-align: center;">NT048</p>	
Piston ring expander	Removing and installing piston ring
 <p style="text-align: center;">NT030</p>	

PREPARATION

< SERVICE INFORMATION >

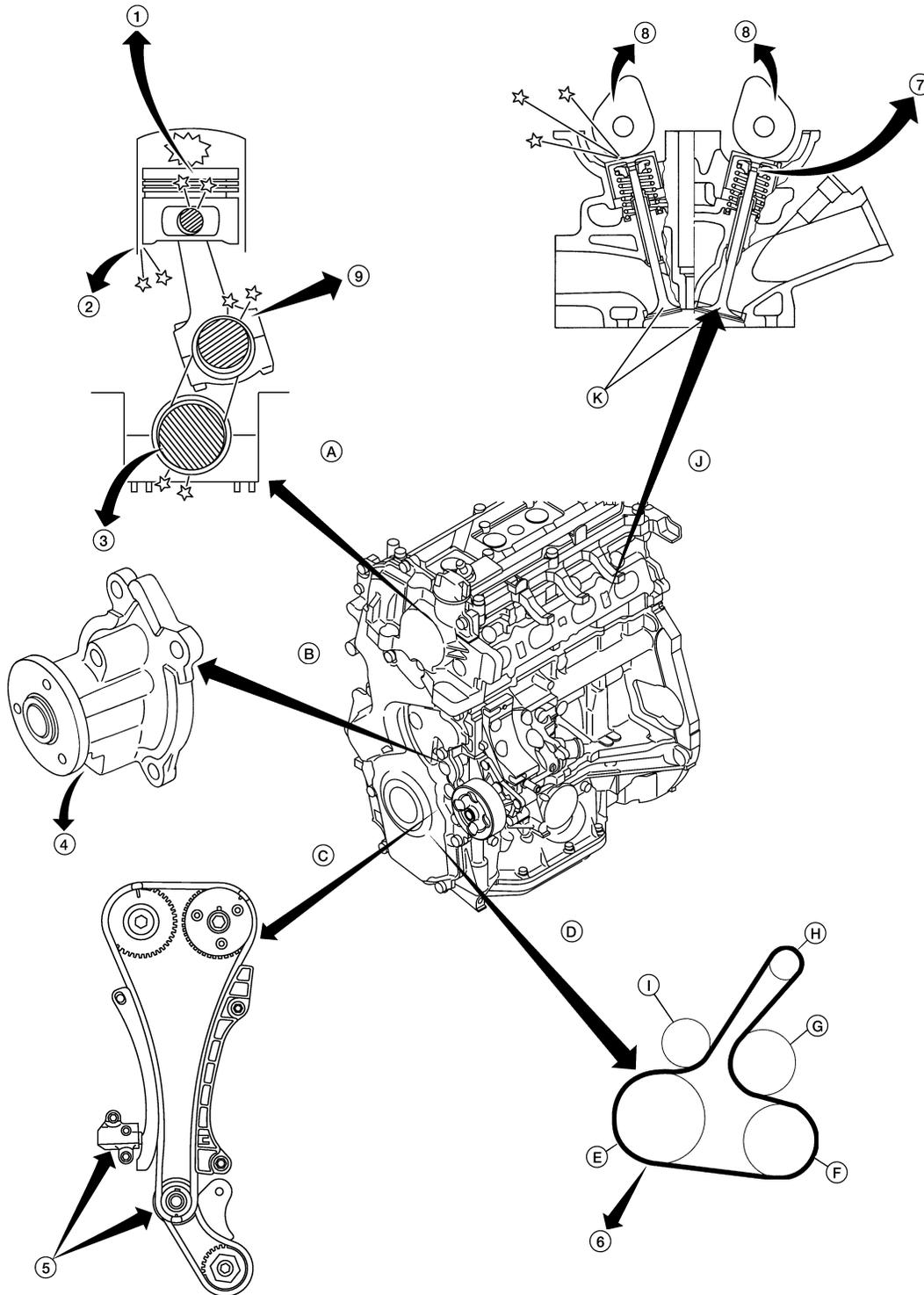
[MR18DE]

(Kent-Moore No.) Tool name	Description	
Valve guide reamer 	(1): Reaming valve guide inner hole (2): Reaming hole for oversize valve guide	A EM C
(J-43897-18) (J-43897-12) Oxygen sensor thread cleaner		D E F
Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specifica- tion MIL-A-907)		G H
E20 Torx® Socket (J-45816)		I J K L M N O P

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

NVH Troubleshooting - Engine Noise

INFOID:000000005398108



WBIA0769E

- | | | |
|-------------------------|-------------------------------------|--------------------------------------|
| 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 |

NOISE, VIBRATION AND HARSHNESS (NVH) TROUBLESHOOTING

< SERVICE INFORMATION >

[MR18DE]

- | | | |
|--------------------|----------------------|-------------------|
| D. Drive belt | E. Crankshaft pulley | F. A/C compressor |
| G. Water pump | H. Generator | I. Tension pulley |
| J. Valve mechanism | K. Valves | |

Use the Chart Below to Help You Find the Cause of the Symptom

INFOID:000000005398109

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.

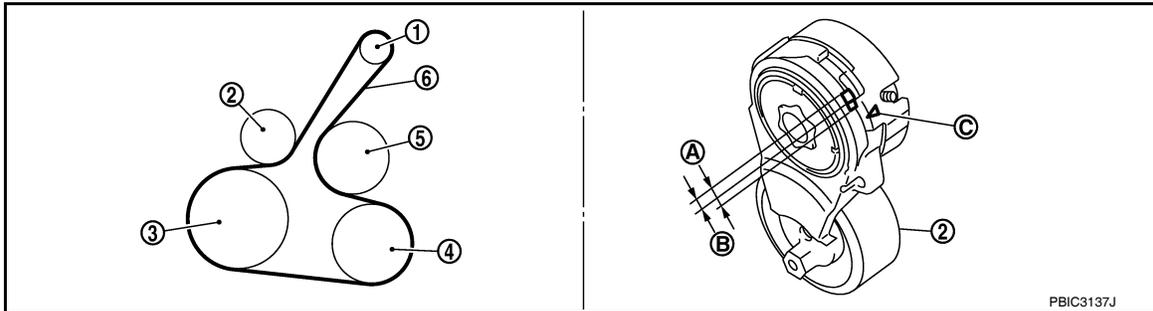
Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Valve clearance	EM-223
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal oil clearance Camshaft runout	EM-166 EM-166
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-212 EM-212
	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-212 EM-212 EM-212 EM-212
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing oil clearance Connecting rod bearing oil clearance	EM-212 EM-212
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-212 EM-212
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-157
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belt (Sticking or slipping)	Drive belt deflection	EM-132
	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-44

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

DRIVE BELTS

Component

INFOID:000000005398110



- | | | |
|--|---|----------------------|
| 1. Generator | 2. Drive belt auto-tensioner | 3. Crankshaft pulley |
| 4. A/C compressor (models with A/C)
Idler pulley (models without A/C) | 5. Water pump | 6. Drive belt |
| A. Possible use range | B. Range when new drive belt is installed | C. Indicator |

Checking Drive Belts

INFOID:000000005398111

WARNING:

Be sure to perform this step when the engine is stopped.

NOTE:

On vehicles not equipped with A/C, there is an idler pulley in the position for the drive belt routing.

- Make sure that the indicator (notch on fixed side) of drive belt auto-tensioner is within the possible use range.

NOTE:

- Check the drive belt auto-tensioner indication when the engine is cold.
- When new drive belt is installed, the indicator (notch on fixed side) should be within the range.
- Visually check entire drive belt for wear, damage or cracks.
- If the indicator (notch on fixed side) is out of the possible use range or belt is damaged, replace drive belt.

Tension Adjustment

INFOID:000000005398112

Belt tension is not necessary, as it is automatically adjusted by drive belt auto-tensioner.

Removal and Installation

INFOID:000000005398113

REMOVAL

1. Remove fender protector (RH). Refer to [EI-24, "Removal and Installation"](#).
2. Hold the hexagonal part (A) of drive belt auto-tensioner (1) with a wrench securely. Then move the wrench handle in the direction of arrow (loosening direction of tensioner).

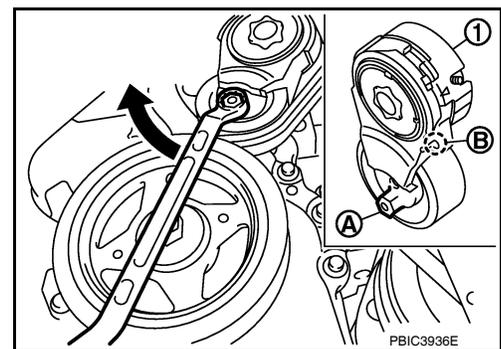
WARNING:

Never place hand in a location where pinching may occur if the holding tool accidentally comes off.

CAUTION:

Do not loosen the auto-tensioner pulley bolt. (Do not turn it counterclockwise.) If turned counterclockwise, the complete auto-tensioner must be replaced as a unit, including pulley.

3. Insert a rod such as short-length screwdriver approximately 6 mm (0.24 in) in diameter into the hole (B) of the retaining boss to fix drive belt auto-tensioner.
 - Leave tensioner pulley arm locked until belt is installed again.
4. Remove drive belt.



INSTALLATION

DRIVE BELTS

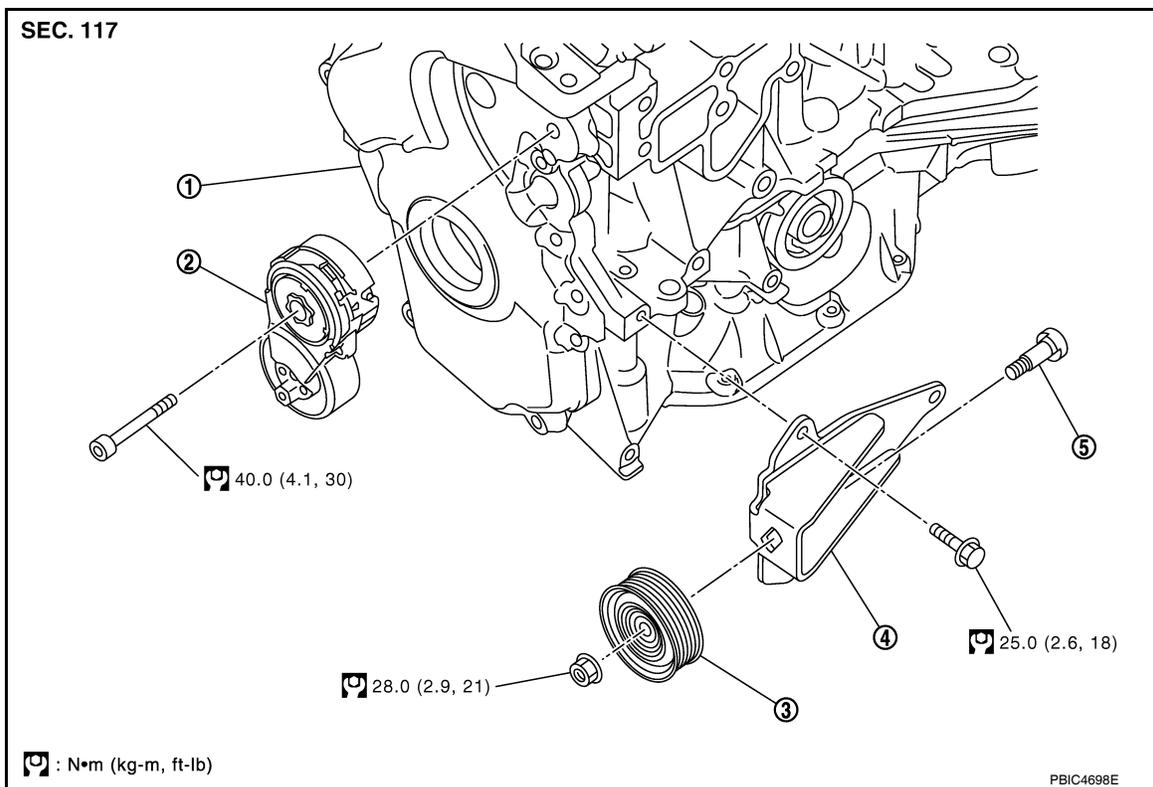
< SERVICE INFORMATION >

[MR18DE]

1. Install drive belt.
CAUTION:
Confirm drive belt is completely set to pulleys.
2. Release drive belt auto-tensioner, and apply tension to drive belt.
WARNING:
Never place hand in a location where pinching may occur if the holding tool accidentally comes off.
CAUTION:
Make sure no engine oil, working fluid and engine coolant are adhered to drive belt and each pulley groove.
3. Turn crankshaft pulley clockwise several times to equalize tension between each pulley.
4. Confirm tension of drive belt at indicator (notch on fixed side) is within the possible use range. Refer to [EM-132, "Checking Drive Belts"](#).
5. Install fender protector (RH). Refer to [EI-24, "Removal and Installation"](#).

Component

INFOID:000000005398114



- | | | |
|---------------------------------|-------------------------------|--------------------------------------|
| 1. Front cover | 2. Drive belt auto-tensioner | 3. Idler pulley (models without A/C) |
| 4. Bracket (models without A/C) | 5. Shaft (models without A/C) | |

Removal and Installation of Drive Belt Auto Tensioner

INFOID:000000005398115

REMOVAL

CAUTION:
The complete auto-tensioner must be replaced as a unit, including the pulley.

1. Remove drive belt. Refer to [EM-132, "Removal and Installation"](#).
2. Support the engine and remove the torque rod (RH), engine mounting insulator (RH) and engine mounting bracket (RH). Refer to [EM-191, "Component"](#).
3. Release the fixed drive belt auto-tensioner pulley.
4. Loosen bolt and remove drive belt auto-tensioner.

NOTE:

DRIVE BELTS

< SERVICE INFORMATION >

[MR18DE]

Use TORX socket (size T50).

5. Remove idler pulley and bracket (models without A/C).

CAUTION:

Do not loosen the auto-tensioner pulley bolt. (Do not turn it counterclockwise). If turned counterclockwise, the complete auto-tensioner must be replaced as a unit, including pulley.

INSTALLATION

Installation is in the reverse order of removal.

CAUTION:

- When installing drive belt auto-tensioner, be careful not to interfere with water pump pulley.
- If there is damage greater than peeled paint, replace drive belt auto-tensioner and/or idler pulley, if equipped.
- Install the drive belt auto-tensioner carefully so not to damage the water pump pulley.
- Do not swap the pulley between the new and old auto-tensioner units

AIR CLEANER AND AIR DUCT

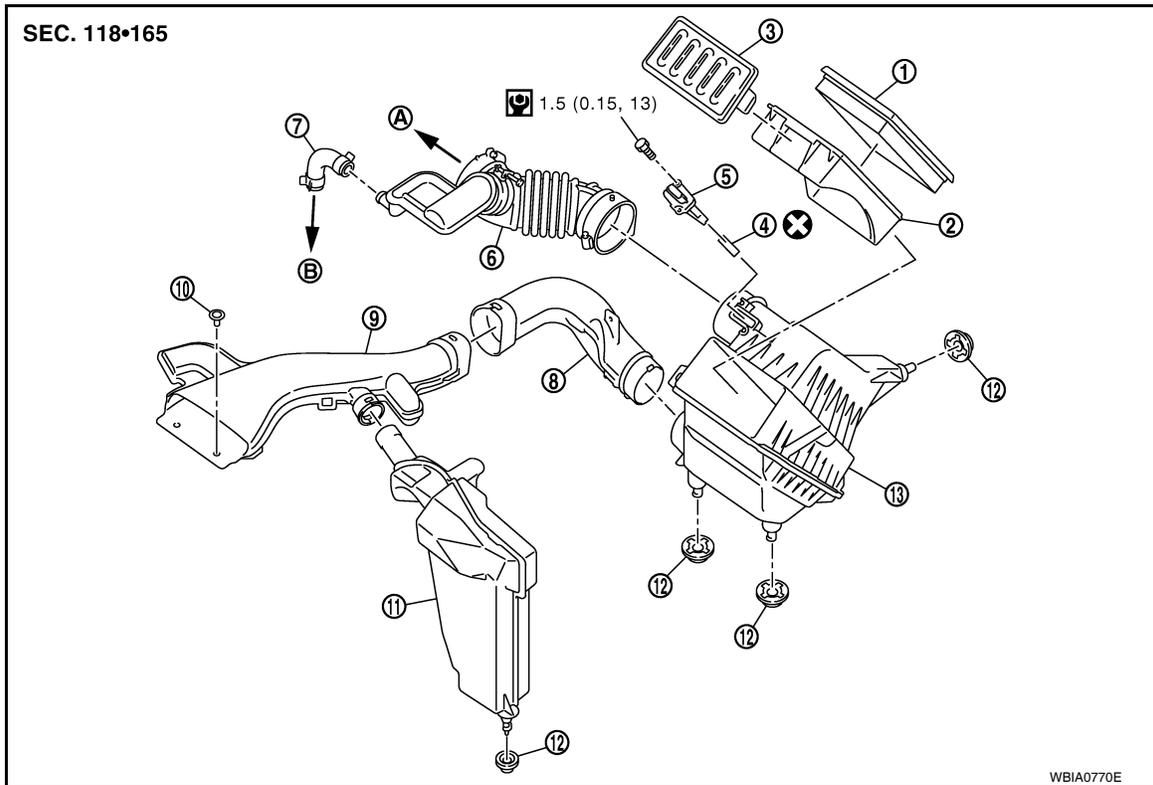
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[MR18DE]

AIR CLEANER AND AIR DUCT

Component

INFOID:000000005398116



- | | | |
|-----------------------|--|----------------------|
| 1. Air cleaner filter | 2. Holder | 3. Air cleaner cover |
| 4. Seal | 5. Mass air flow sensor | 6. Air duct |
| 7. PCV hose | 8. Air duct (Inlet) | 9. Air duct (Front) |
| 10. Clip | 11. Resonator | 12. Grommet |
| 13. Air cleaner case | A. To electric throttle control actuator | B. To rocker cover |

Removal and Installation

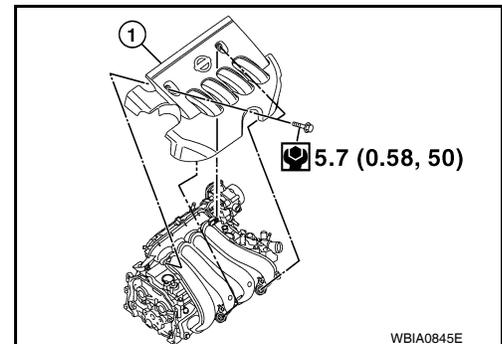
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REMOVAL

- Remove the engine room cover (1).
- Remove the air duct (front).
- Remove the air cleaner filter from the air cleaner case. Refer to [EM-136. "Changing Air Cleaner Filter"](#).
- Remove the air duct (inlet) from the air cleaner case.
- Remove the PCV hose.
- Remove the air duct.
 - Add marks as necessary for easier installation.
- Remove air cleaner case with the following procedure.
 - Remove battery. Refer to [SC-5](#).
 - Disconnect harness connector from mass air flow sensor.
 - Remove the air cleaner case.
- Remove the mass air flow sensor from the air cleaner case, if necessary.

CAUTION:

- Handle it carefully and avoid impacts.
- Do not touch sensor part.



AIR CLEANER AND AIR DUCT

[MR18DE]

< SERVICE INFORMATION >

INSTALLATION

Installation is in the reverse order of removal.

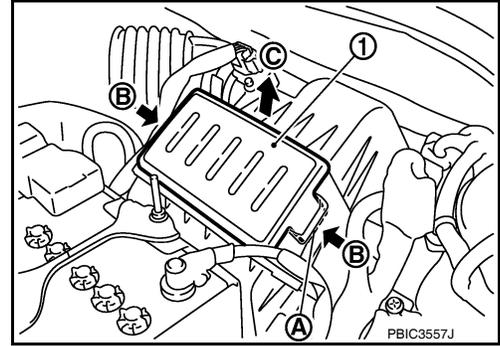
- Align marks.
- Attach each joint securely.
- Screw clamps firmly.

Changing Air Cleaner Filter

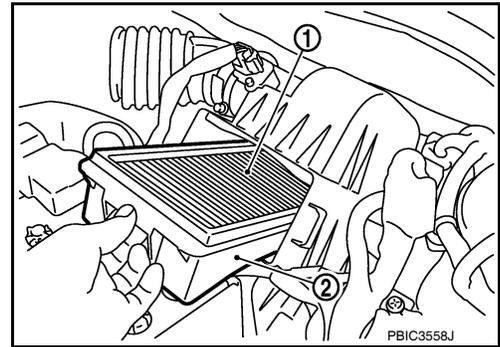
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REMOVAL

1. Push the tabs (A) of both ends of the air cleaner cover (1) into the inside (B).
2. Pull up the air cleaner cover (1) and remove it (C).



3. Remove the air cleaner filter (1) and holder (2) assembly from the air cleaner case.
4. Remove the air cleaner filter (1) from the holder (2).



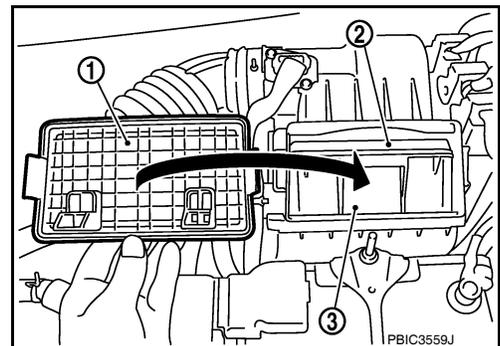
INSPECTION AFTER REMOVAL

It is necessary to replace the air cleaner filter at the recommended intervals, more often under dusty driving conditions. Refer to [MA-9, "Introduction of Periodic Maintenance"](#).

INSTALLATION

Installation is in the reverse order of removal.

- Install the air cleaner cover (1) in the direction shown.
- Air cleaner filter (2)
- Holder (3)



INTAKE MANIFOLD

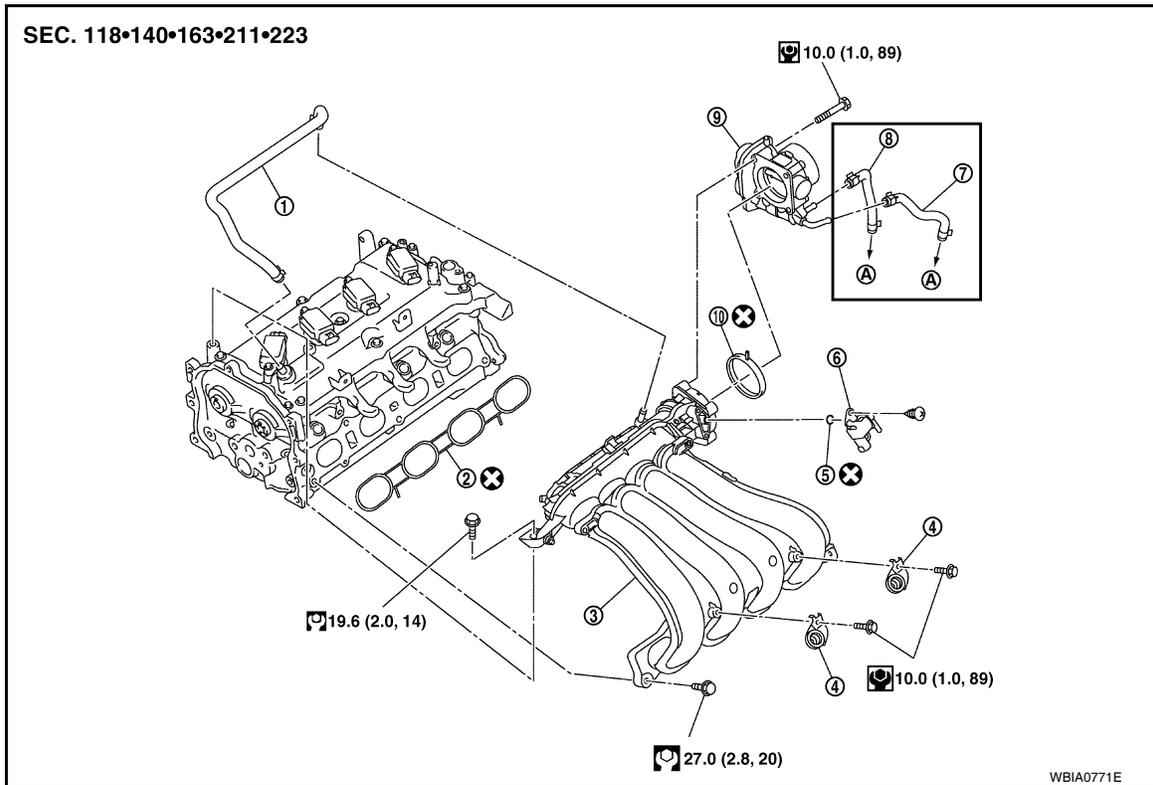
[MR18DE]

< SERVICE INFORMATION >

INTAKE MANIFOLD

Component

INFOID:000000005398119



- | | | |
|---------------|--------------------|--|
| 1. PCV hose | 2. Gasket | 3. Intake manifold |
| 4. Bracket | 5. O-ring | 6. EVAP canister purge volume control solenoid valve |
| 7. Water hose | 8. Water hose | 9. Electric throttle control actuator |
| 10. Gasket | A. To water outlet | |

Removal and Installation

INFOID:000000005398120

REMOVAL

WARNING:

To avoid the danger of being scalded, never drain the coolant when the engine is hot.

1. Remove engine room cover (1).
2. Remove air duct, air duct (inlet) and air duct (front). Refer to [EM-135, "Component"](#).
3. Disconnect the EVAP canister purge volume control solenoid valve.
4. Partially drain engine coolant. Refer to [CO-36, "Changing Engine Coolant"](#).

CAUTION:

Perform this step when engine is cold.

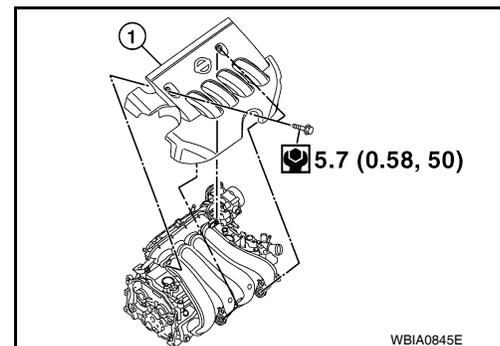
NOTE:

This step is unnecessary when putting plugs to water hoses (to electric throttle control actuator).

- a. Disconnect water hoses from electric throttle control actuator.
- b. Remove electric throttle control actuator.

CAUTION:

- Handle electric throttle control actuator carefully and avoid impacts.



INTAKE MANIFOLD

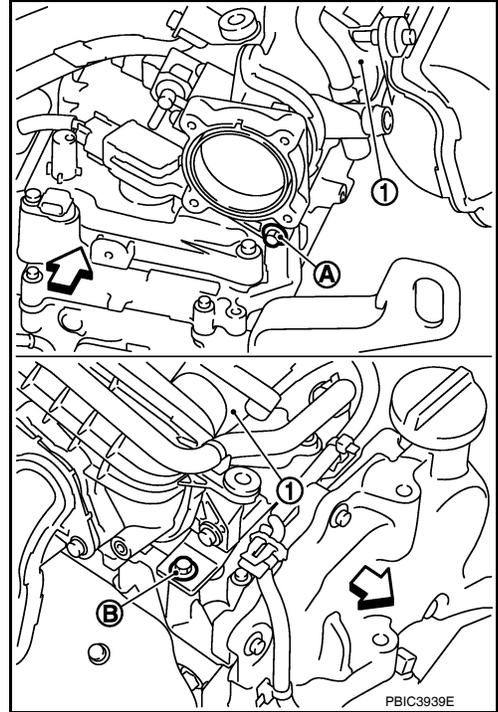
[MR18DE]

< SERVICE INFORMATION >

- **Never disassemble or adjust electric throttle control actuator.**

5. Remove the PCV hose and the vacuum hose.
6. Remove oil level gauge.
CAUTION:
Cover the oil level gauge guide openings to avoid entry of foreign materials.
7. Loosen and remove intake manifold (1) bolts (A) (B).

⇐ : Engine front



8. Loosen remaining intake manifold bolts in the reverse order as shown.

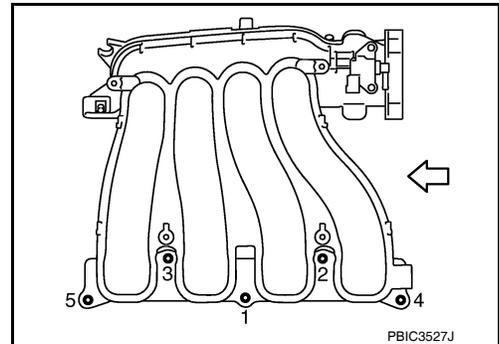
⇐ : Engine front

- CAUTION:**
Cover engine openings to avoid entry of foreign materials.

9. Remove EVAP canister purge volume control solenoid valve from intake manifold, if necessary.

- CAUTION:**
Handle EVAP canister purge volume control solenoid valve carefully and avoid impacts.

10. Remove intake manifold.



INSTALLATION

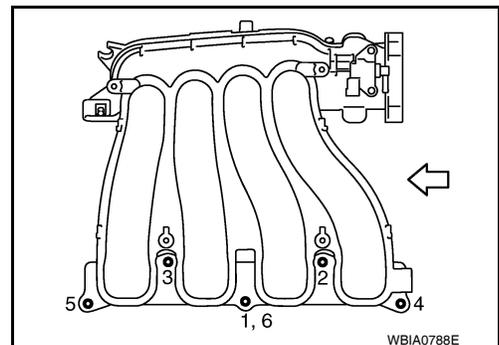
1. Install intake manifold.

NOTE:

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

2. Tighten bolts in numerical order as shown.

⇐ : Engine front



INTAKE MANIFOLD

[MR18DE]

< SERVICE INFORMATION >

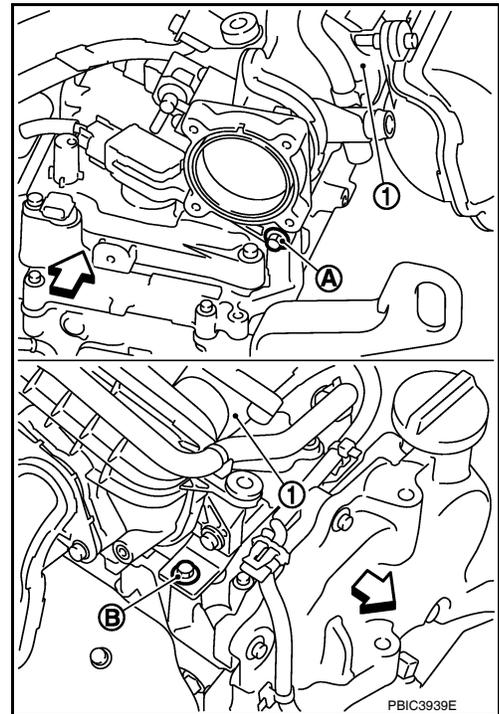
3. Tighten intake manifold bolt (A). Then tighten intake manifold bolt (B).

1 : Intake manifold

↔ : Engine front

Intake manifold bolt (A) : 19.6 N·m (2.0 kg-m, 14 ft-lb)

Intake manifold bolt (B) : 19.6 N·m (2.0 kg-m, 14 ft-lb)



4. Install electric throttle control actuator.
5. Install water hoses (3), (5) to electric throttle control actuator as shown.

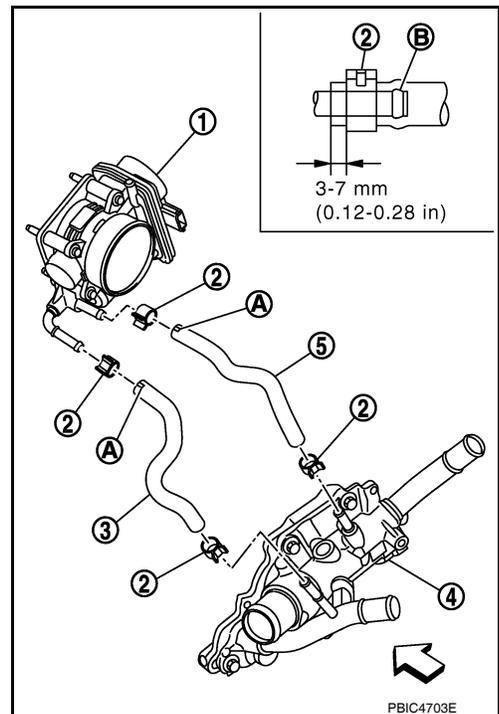
1 : Electric throttle control actuator

2 : Clamp

4 : Water outlet

A : Paint Mark

B : The clamp shall not interfere with the bulged section.



6. Installation of the remaining components is in the reverse order of removal.

INSPECTION AFTER INSTALLATION

- Check for leaks of engine coolant. Refer to [CO-36, "Inspection"](#).
- Start and warm up the engine. Visually check for engine coolant leaks.

EXHAUST MANIFOLD

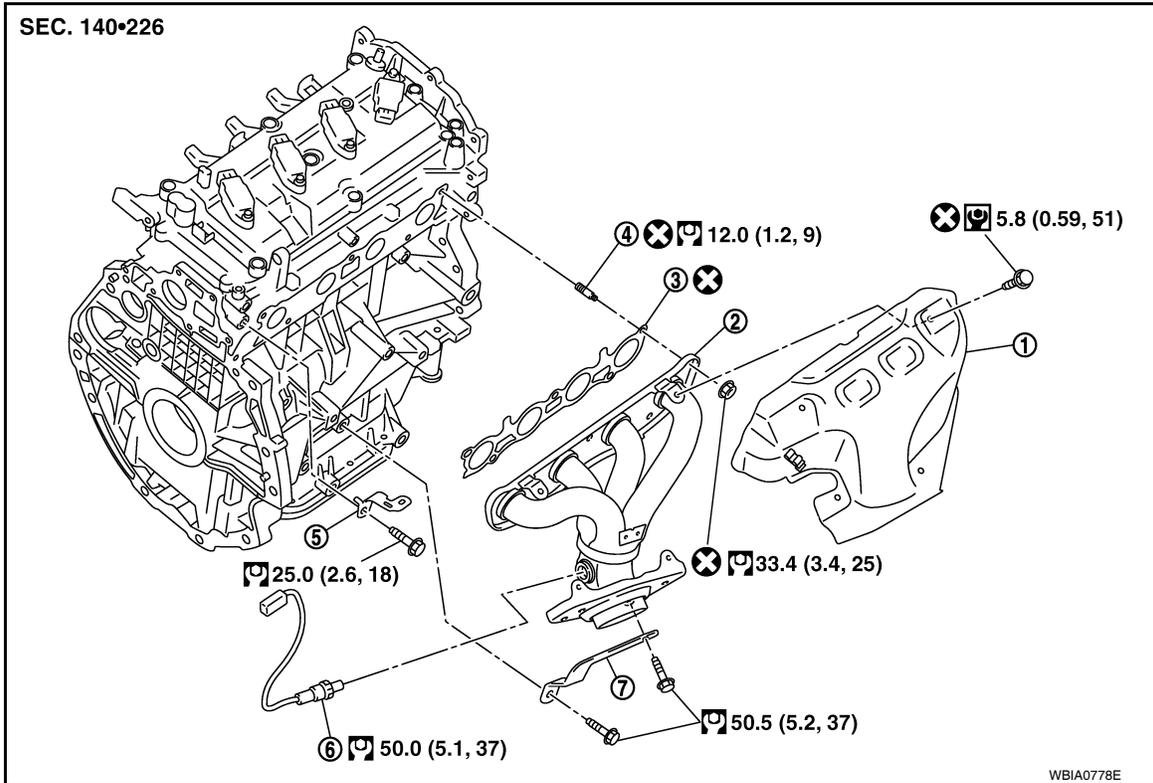
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[MR18DE]

EXHAUST MANIFOLD

Component

INFOID:000000005398121



- | | | |
|---------------------------|---------------------|----------------------------|
| 1. Exhaust manifold cover | 2. Exhaust manifold | 3. Gasket |
| 4. Stud bolt | 5. Bracket | 6. Air fuel ratio sensor 1 |
| 7. Exhaust manifold stay | ↔ Engine front | |

Removal and Installation

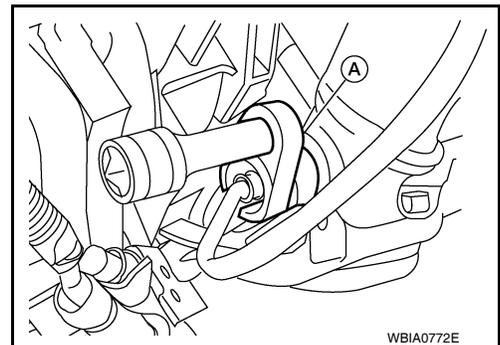
INFOID:000000005398122

REMOVAL

1. Remove cowl top. Refer to [EI-22, "Removal and Installation"](#).
2. Remove exhaust front tube. Refer to [EX-11, "Component"](#).
3. Remove exhaust manifold cover.
4. Remove the air fuel ratio sensor 1, using Tool (A).

Tool number :KV991J0050 (J-44626)

CAUTION:
Handle it carefully and avoid impacts.



5. Remove exhaust manifold side bolt of exhaust manifold stay.

EXHAUST MANIFOLD

[MR18DE]

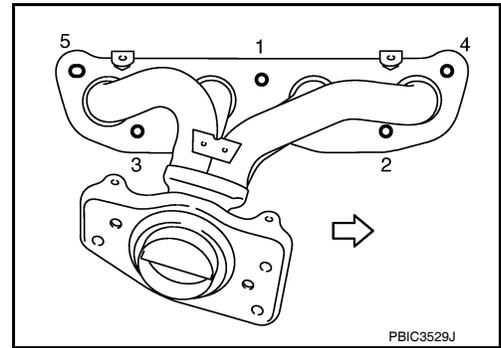
< SERVICE INFORMATION >

- Loosen nuts in reverse order as shown and remove exhaust manifold.

← : Engine front

CAUTION:

Cover engine openings to avoid entry of foreign materials.



INSPECTION AFTER REMOVAL

Surface Distortion

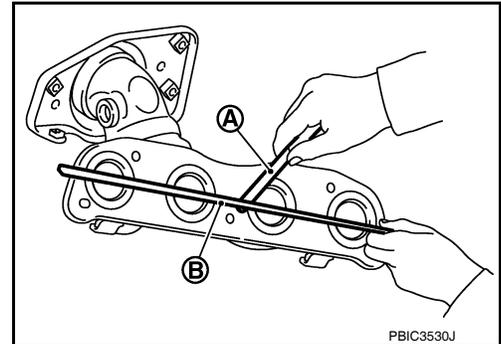
- Using straightedge (B) and feeler gauge (A), check the surface distortion of exhaust manifold mating surface in each exhaust port and entire part.

Limit:

Each exhaust port : 0.3 mm (0.012 in)

Entire part : 0.7 mm (0.028 in)

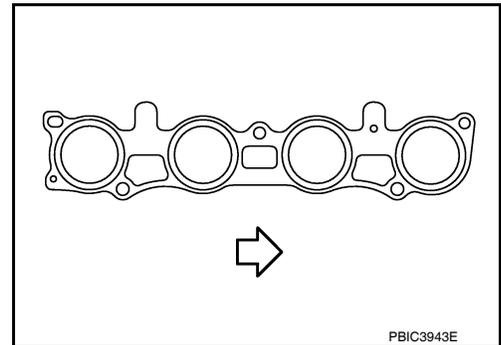
- If it exceeds the limit, replace exhaust manifold.



INSTALLATION

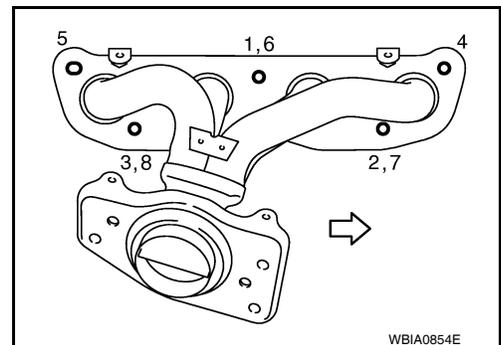
- Install exhaust manifold gasket to cylinder head as shown.

← : Engine front



- Tighten exhaust manifold nuts to specification in two stages in the numerical order shown.

← : Engine front



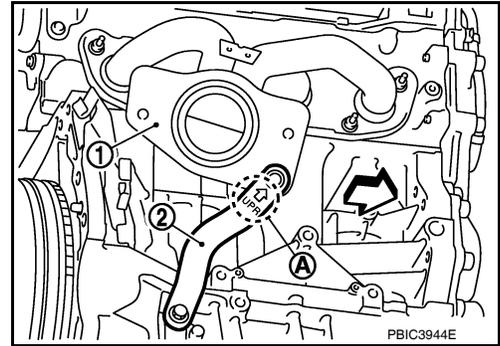
EXHAUST MANIFOLD

[MR18DE]

< SERVICE INFORMATION >

3. Install exhaust manifold stay (2) in the direction as shown.

- 1 : Exhaust manifold
- A : Upper mark
- ⇐ : Engine front

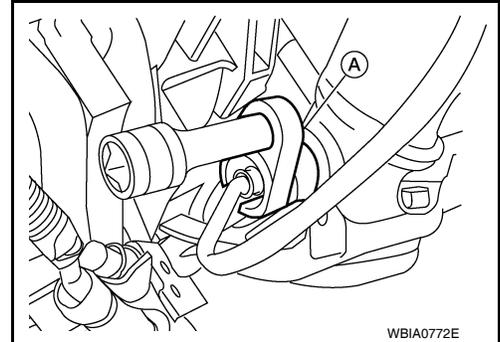


4. Install the air fuel ratio sensor 1, using Tool (A).

Tool number : KV991J0050 (J-44626)

CAUTION:

- Handle it carefully and avoid impacts.
- Before installing a new air fuel ratio sensor, clean the exhaust tube threads using suitable tool and approved anti-seize lubricant.
- Do not over-tighten the air fuel ratio sensor. Doing so may damage the air fuel ratio sensor, resulting in the MIL coming on.



Oxygen sensor thread cleaner : (J-43897-12)

Oxygen sensor thread cleaner : (J-43897-18)

5. Installation of the remaining parts is in the reverse order of removal.

OIL PAN

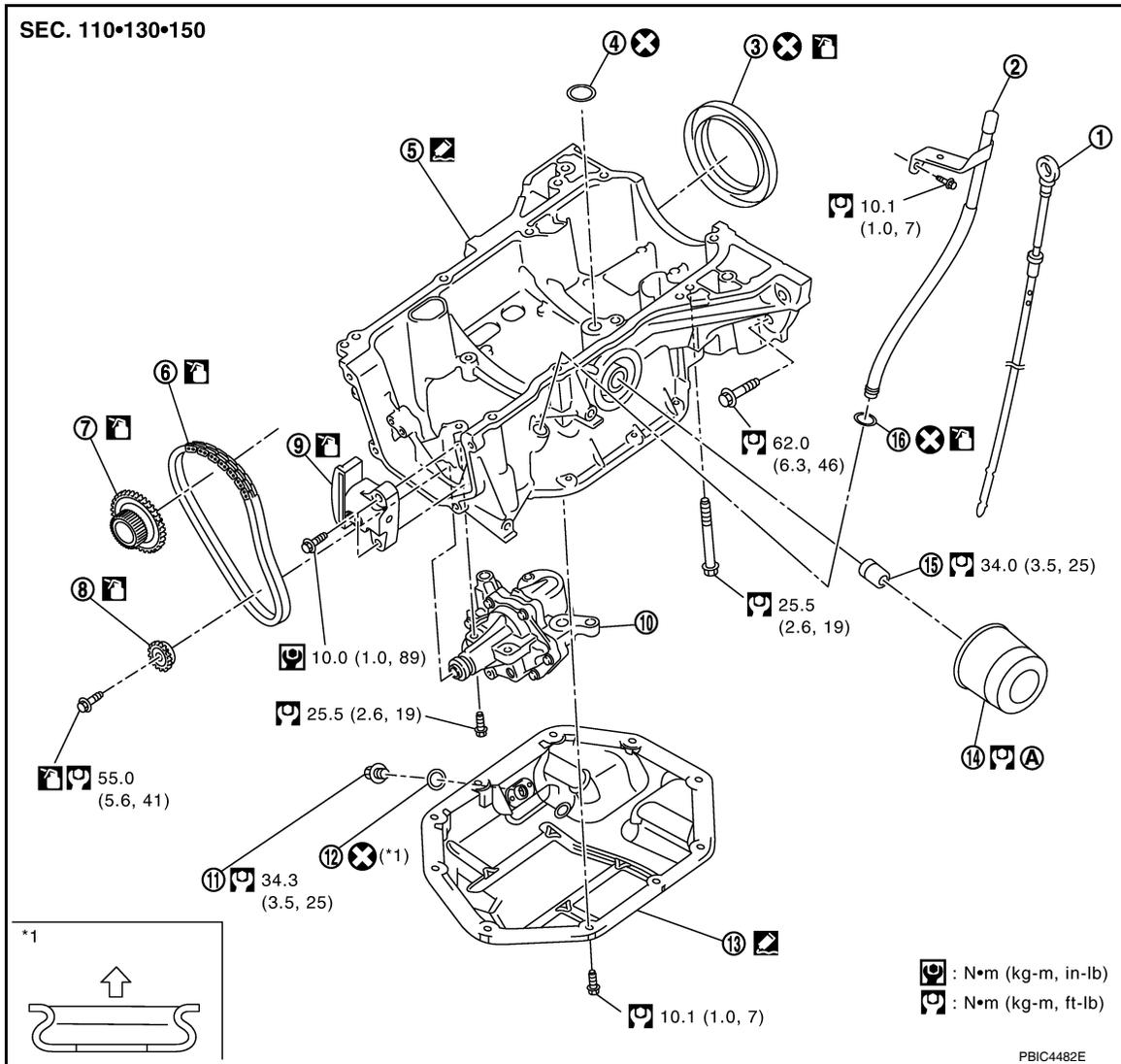
< SERVICE INFORMATION >

[MR18DE]

OIL PAN

Component

INFOID:000000005398123



- | | | |
|------------------------|------------------------------------|--|
| 1. Oil level gauge | 2. Oil level gauge guide | 3. Rear oil seal |
| 4. O-ring | 5. Oil pan (upper) | 6. Oil pump drive chain |
| 7. Crankshaft sprocket | 8. Oil pump sprocket | 9. Timing chain tensioner (for oil pump) |
| 10. Oil pump | 11. Drain plug | 12. Drain plug washer |
| 13. Oil pan (lower) | 14. Oil filter | 15. Connector bolt |
| 16. O-ring | A. Refer to EM-143 | ↔ Oil pan side |

Removal and Installation

INFOID:000000005398124

REMOVAL

WARNING:

- Be careful not to burn yourself, as the engine oil is hot.
- Prolonged and repeated contact with used engine oil may cause skin cancer; try to avoid direct skin contact with used oil. If skin contact is made, wash thoroughly with soap or hand cleaner as soon as possible.

1. Drain engine oil. Refer to [LU-17](#).
2. Remove engine and transaxle assembly. Refer to [EM-191](#).

OIL PAN

[MR18DE]

< SERVICE INFORMATION >

3. Remove flywheel (M/T models) or drive plate (CVT or A/T models). Refer to [EM-195. "Component"](#).
4. Remove oil filter using Tool.

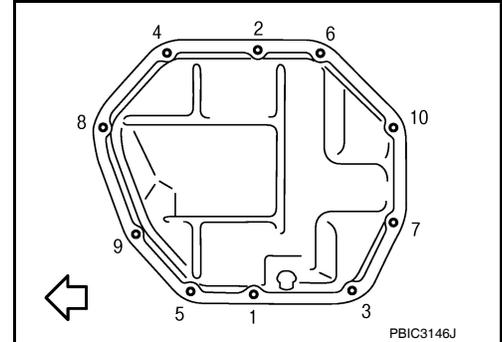
Tool number : KV10115801 (—)

CAUTION:

When removing, prepare a shop cloth to absorb any engine oil leakage or spillage.

5. Remove oil pan (lower) bolts in reverse order as shown.

⇐ : Engine front



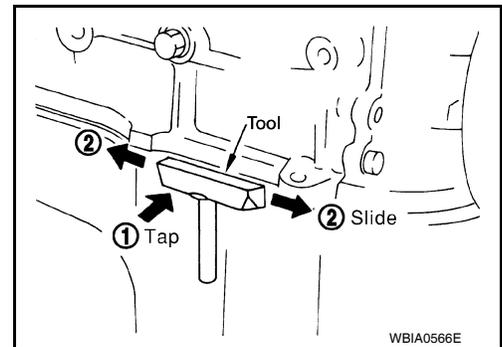
6. After removing the bolts and nuts, separate the mating surface and remove the sealant using Tool.

Tool number : KV10111100 (J-37228)

- Slide (2) the Tool by tapping (1) its side with a hammer to remove the oil pan (lower) from the oil pan (upper).

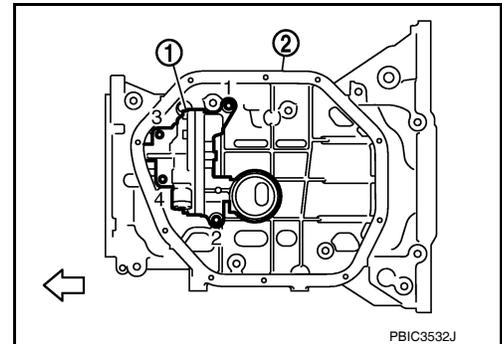
CAUTION:

Be careful not to damage the mating surfaces.



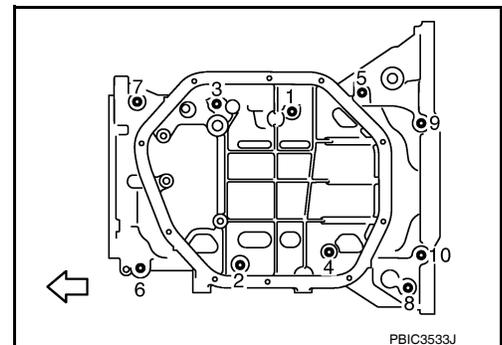
7. Remove the following parts:
 - Front cover, timing chain, oil pump drive chain. Refer to [EM-156](#).
8. Remove oil pump.
 - Loosen bolts in reverse order as shown.

1 : Oil pump
2 : Oil pan (upper)
⇐ : Engine front



9. Remove oil pan (upper) bolts in reverse order as shown.

⇐ : Engine front



OIL PAN

[MR18DE]

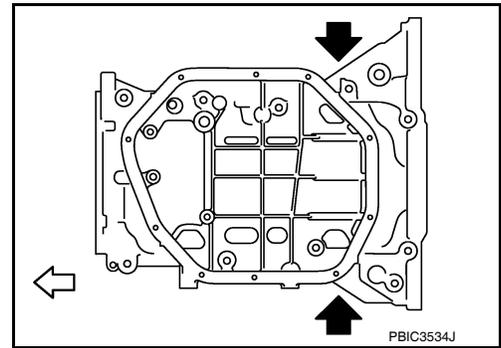
< SERVICE INFORMATION >

10. Insert a screwdriver shown by the arrow (←) and open up a crack between oil pan (upper) and cylinder block.

← : Engine front

CAUTION:

A more adhesive liquid gasket is applied compared to previous types when shipped, so it should not be forced off the position not specified.



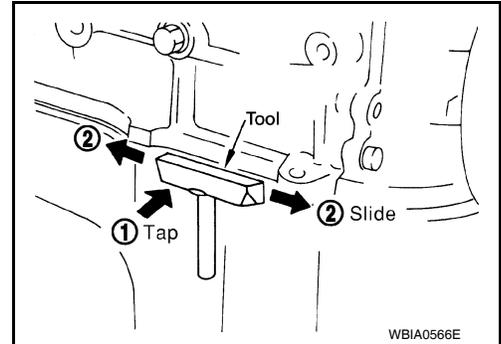
11. After removing the bolts, separate the mating surface and remove the sealant using Tool.

Tool number : KV10111100 (J-37228)

- Slide (1) the Tool by tapping (2) its side with a hammer to remove the oil pan (upper) from the cylinder block.

CAUTION:

Be careful not to damage the mating surfaces.



12. Remove O-ring between cylinder block and oil pan (upper).

INSPECTION AFTER REMOVAL

Oil Filter

Clean oil strainer portion (part of the oil pump) if any object attached.

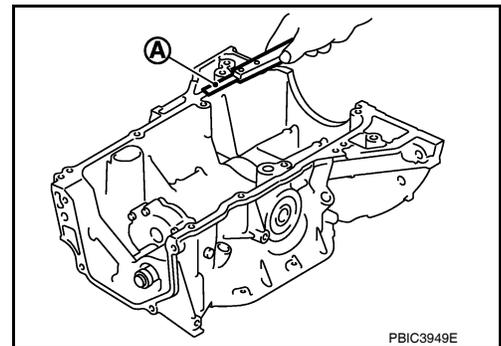
INSTALLATION

1. Use a scraper (A) to remove old liquid gasket from mating surfaces of oil pan (upper).

- 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.



OIL PAN

[MR18DE]

< SERVICE INFORMATION >

2. Apply the sealant without breaks to the specified location using Tool.

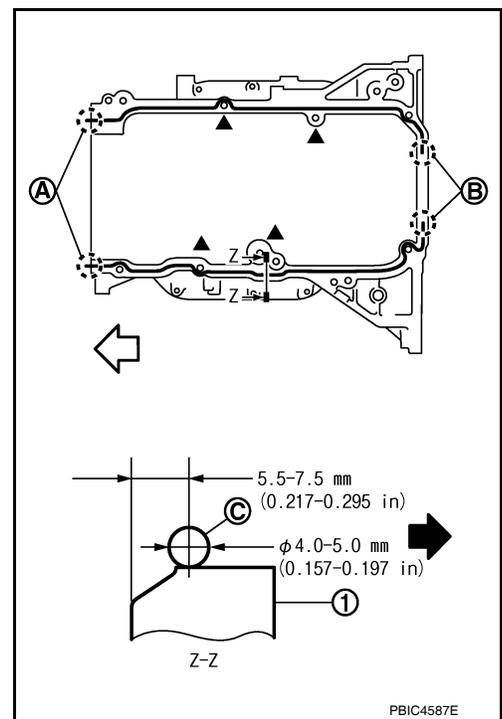
Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-42. "Recommended Chemical Product and Sealant".

Tool number WS39930000 (-)

- 1 : Oil pan (upper)
- A : 2 mm protruded to outside
- B : 2 mm protruded to rear oil seal mounting side
- C : Liquid gasket
- ⇐ : Engine front
- ← : Engine outside

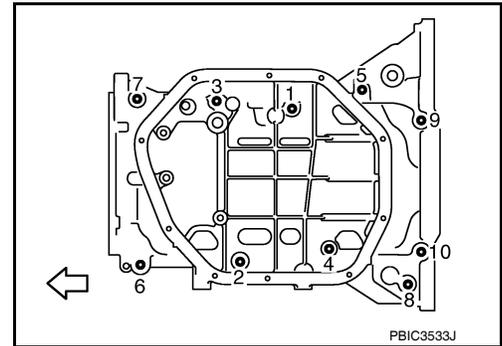
CAUTION:

Apply liquid gasket to outside of bolt hole for the positions shown by ▲ marks.



3. Install new O-ring at cylinder block side.
- CAUTION:**
Install avoiding misalignment of O-ring.
4. Tighten bolts in numerical order as shown.

⇐ : Engine front



5. 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).
- Always replace rear oil seal with new one.
- Never touch oil seal lip.

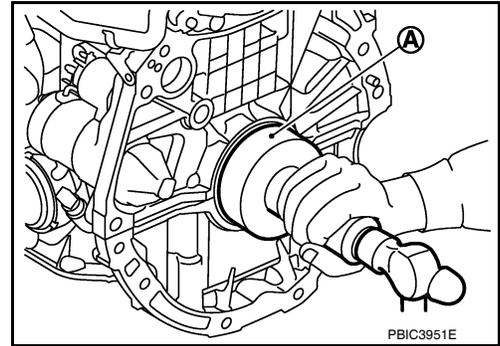
- a. Wipe off liquid gasket protruding to the rear oil seal mating part of oil pan (upper) and cylinder block using a scraper.
- b. Apply engine oil to entire outside area of rear oil seal.

OIL PAN

[MR18DE]

< SERVICE INFORMATION >

- c. Press-fit the rear oil seal using a drift with outer diameter 115 mm (4.53 in) and inner diameter 90 mm (3.54 in) (A).



- Press-fit to the specified dimensions as shown.

1 : Rear oil seal

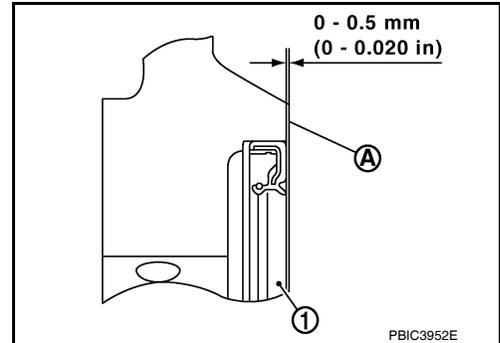
A : Cylinder block rear end surface

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, making sure that rear oil seal does not curl or tilt.

NOTE:

The standard surface of the dimension is the rear end surface of cylinder block.



6. Install oil pump.

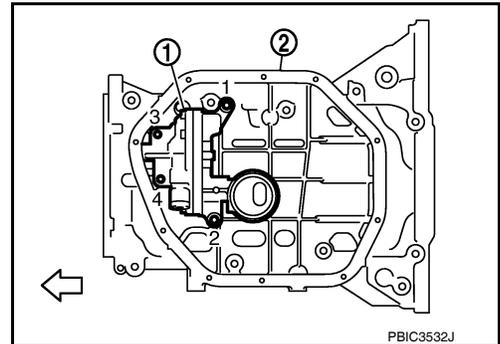
- Tighten bolts in numerical order as shown.

1 : Oil pump

2 : Oil pan (upper)

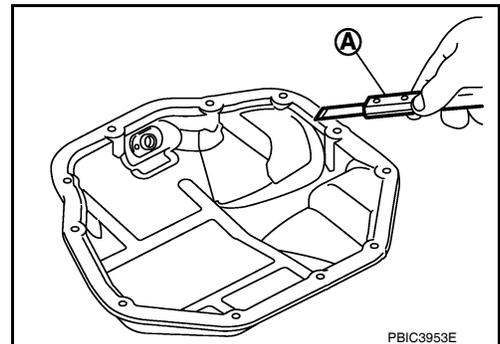
← : Engine front

7. Install oil pump sprocket, oil pump drive chain and other related parts if removed.



8. Use a scraper (A) to remove old liquid gasket from mating surfaces of oil pan (lower).

- Also remove old liquid gasket from mating surface of oil pan (upper).
- Remove old liquid gasket from the bolt holes and threads.



OIL PAN

[MR18DE]

< SERVICE INFORMATION >

9. Apply the sealant without breaks to the specified location using Tool.

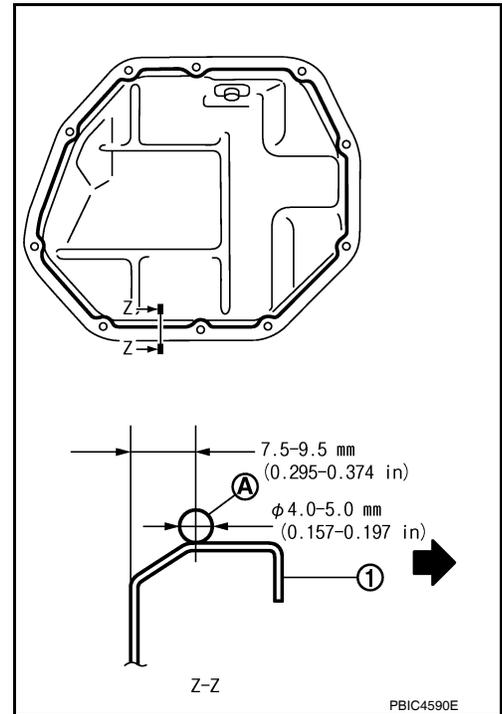
Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-42, "Recommended Chemical Product and Sealant".

Tool number WS39930000 (-)

1 : Oil pan (lower)

A : Liquid gasket

← : Engine outside

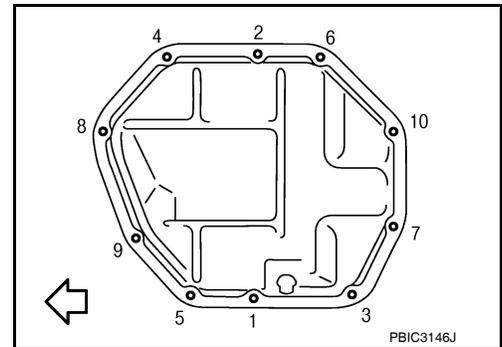


10. Tighten bolts in numerical order as shown.

↔ : Engine front

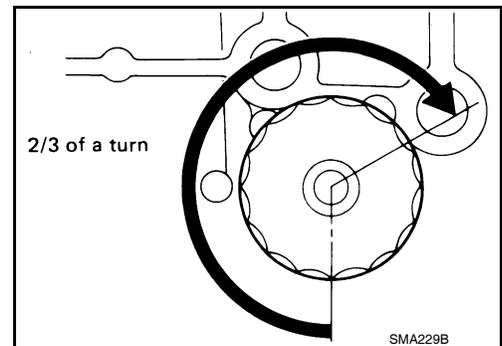
11. Install oil filter with the following procedure:

- Remove foreign materials adhering to the oil filter installation surface.
- Apply new engine oil to the oil seal contact surface of new oil filter.



- Screw oil filter manually until it touches the installation surface, then tighten it by 2/3 turn. Or tighten to specification.

Oil filter: : 17.7 N·m (1.8 kg-m, 13 ft-lb)



12. Installation of the remaining components is in the reverse order of removal.

IGNITION COIL, SPARK PLUG AND ROCKER COVER

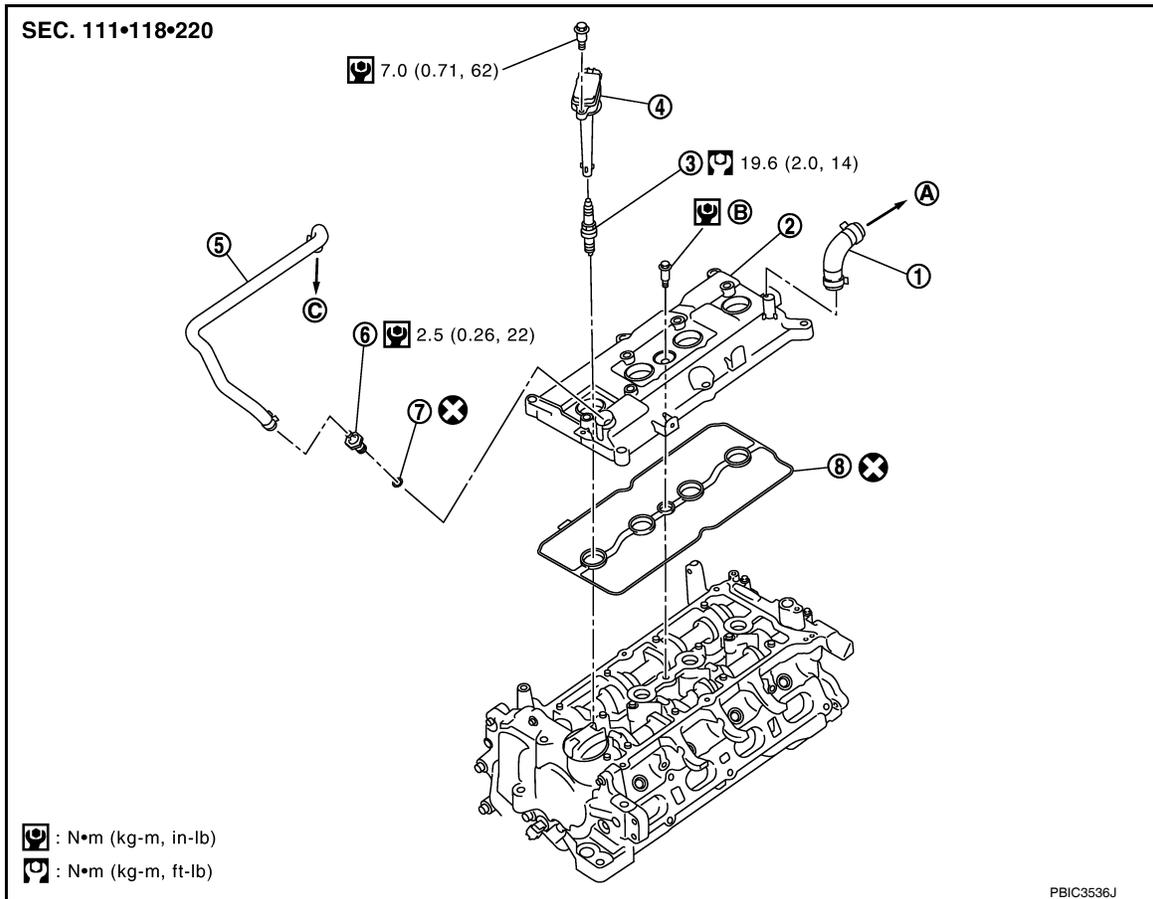
< SERVICE INFORMATION >

[MR18DE]

IGNITION COIL, SPARK PLUG AND ROCKER COVER

Component

INFOID:000000005398125



- | | | |
|------------------|--------------------------------------|-----------------------|
| 1. PCV hose | 2. Rocker cover | 3. Spark plug |
| 4. Ignition coil | 5. PCV hose | 6. PCV valve |
| 7. O-ring | 8. Gasket | |
| A. To air duct | B. Refer to EM-149 . | C. To intake manifold |

Removal and Installation

INFOID:000000005398126

REMOVAL

1. Remove intake manifold. Refer to [EM-137](#).
2. Remove ignition coil.
CAUTION:
 - Handle ignition coil carefully and avoid impacts.
 - Never disassemble.

IGNITION COIL, SPARK PLUG AND ROCKER COVER

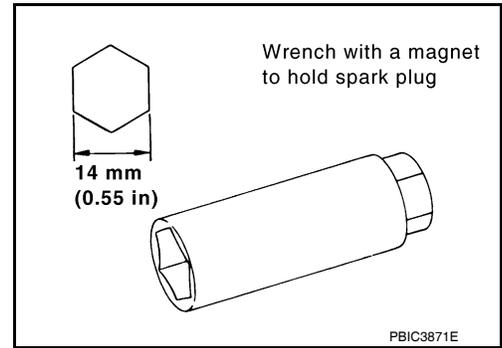
[MR18DE]

< SERVICE INFORMATION >

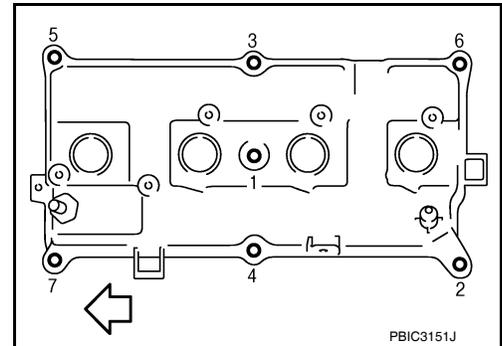
3. Remove spark plug using suitable tool.

CAUTION:

Never drop or shock it.



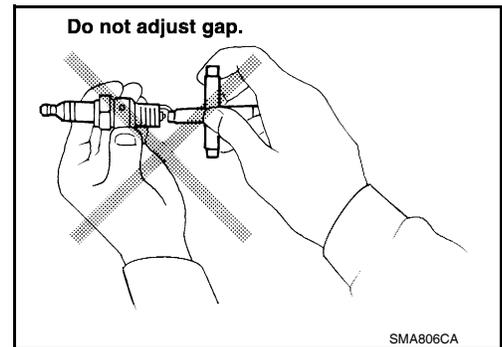
4. Remove rocker cover.
 - Loosen bolts in reverse order as shown.
 - ← Engine front



INSPECTION AFTER REMOVAL

CAUTION:

- Never drop or shock spark plug.
- Checking and adjusting spark plug gap is not required between change intervals.

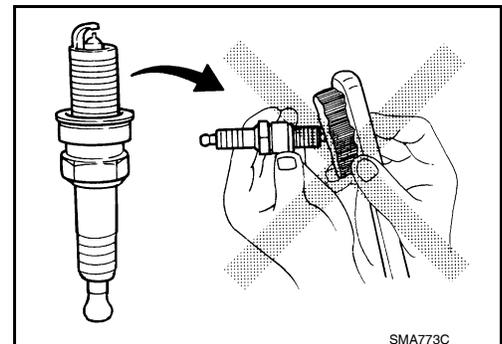


- If spark plug tip is covered with carbon, a spark plug cleaner may be used.

Cleaner air pressure : Less than 588 kPa (5.88 bar, 6 kg/cm², 85 psi)

Cleaning time : Less than 20 seconds

- Never use wire brush for cleaning spark plug.



INSTALLATION

1. Install the rocker cover gasket to the rocker cover.

IGNITION COIL, SPARK PLUG AND ROCKER COVER

[MR18DE]

< SERVICE INFORMATION >

2. Install rocker cover.
 - Tighten bolts in two steps separately in numerical order as shown.

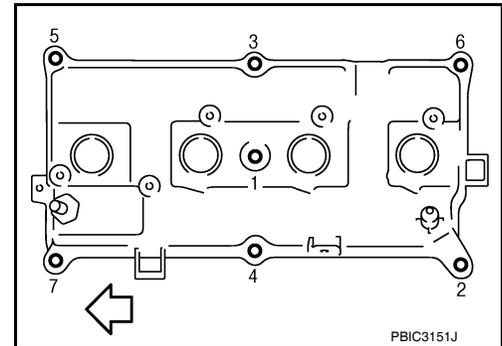
1st step : 1.96 N·m (0.20 kg-m, 17 in-lb)

2nd step : 8.33 N·m (0.85 kg-m, 73 in-lb)

- ⇐ Engine front

CAUTION:

Check if rocker cover gasket is not dropped from the installation groove of rocker cover.



3. Install spark plug using suitable tool.

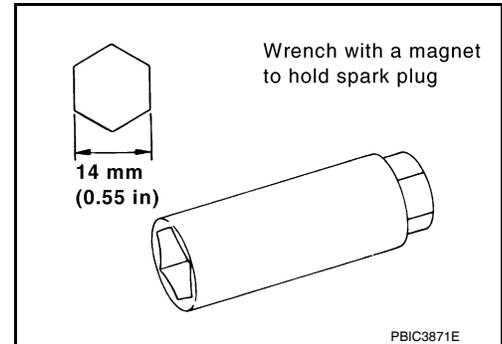
Make : DENSO

Part number : FXE20HR11

Gap (nominal) : 1.1 mm (0.043 in)

CAUTION:

Never drop or shock it.



4. Install ignition coil.

CAUTION:

 - Handle it carefully and avoid impacts.
 - Never disassemble.
5. Install intake manifold. Refer to [EM-137](#).

FUEL INJECTOR AND FUEL TUBE

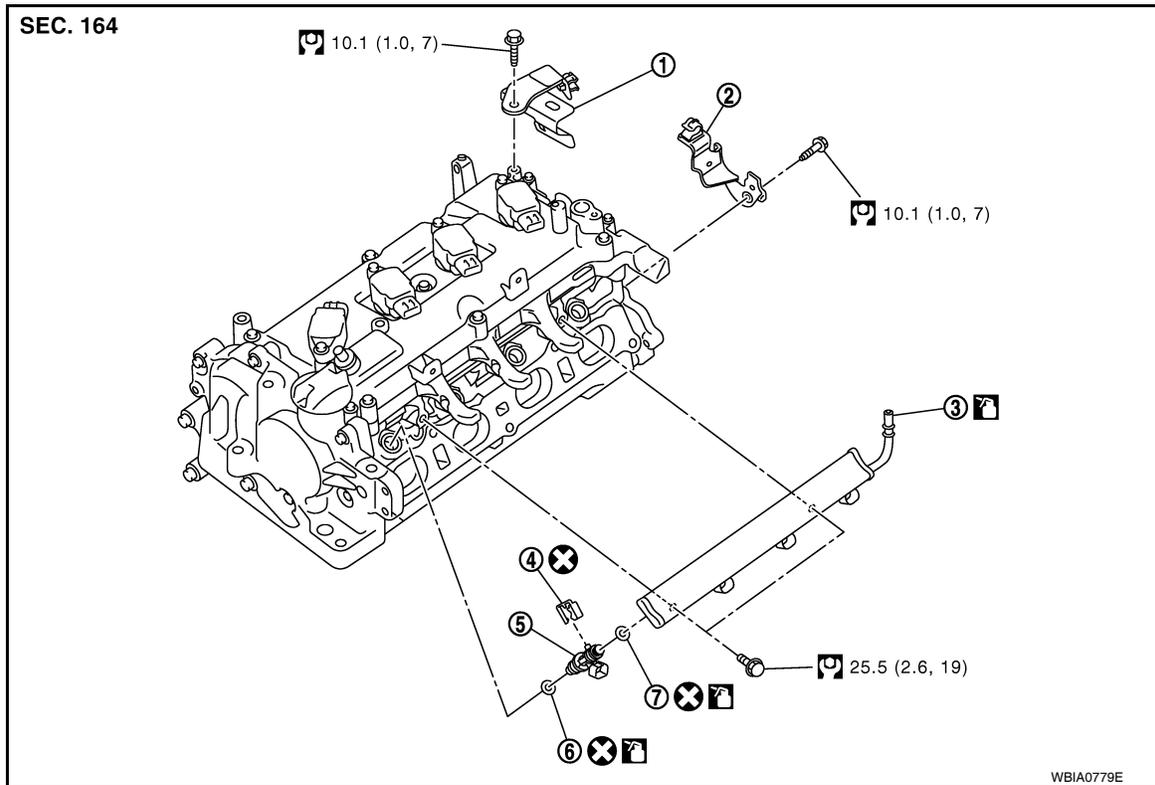
< SERVICE INFORMATION >

[MR18DE]

FUEL INJECTOR AND FUEL TUBE

Component

INFOID:000000005398127



- | | | |
|-------------------|------------------|-------------------|
| 1. Bracket | 2. Bracket | 3. Fuel tube |
| 4. Clip | 5. Fuel injector | 6. O-ring (green) |
| 7. O-ring (black) | | |

Removal and Installation

INFOID:000000005398128

WARNING:

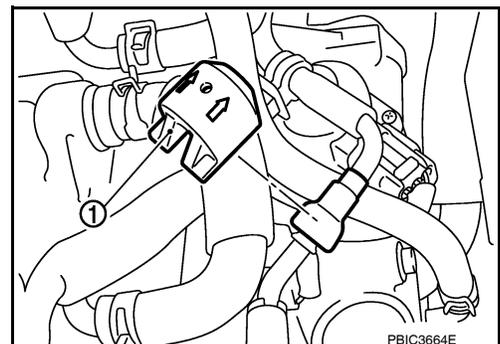
- Put a "CAUTION: FLAMMABLE" sign in the workshop.
- Be sure to work in a well ventilated area and furnish workshop with a CO2 fire extinguisher.
- Do not smoke while servicing fuel system. Keep open flames and sparks away from the work area.

CAUTION:

- Apply new engine oil to parts before installing the parts, as shown above.
- Do not remove or disassemble parts unless instructed as shown.

REMOVAL

1. Release the fuel pressure. Refer to [EC-582. "Fuel Pressure Check"](#).
2. Disconnect the battery negative terminal. Refer to [SC-7. "Removal and Installation"](#).
3. Remove quick connector cap (1) from quick connector connection.



FUEL INJECTOR AND FUEL TUBE

[MR18DE]

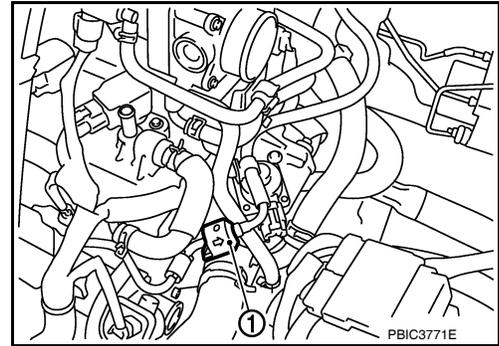
< SERVICE INFORMATION >

4. Disconnect fuel feed hose from hose clamp.

1 : Quick connector cap

NOTE:

There is no fuel return path.

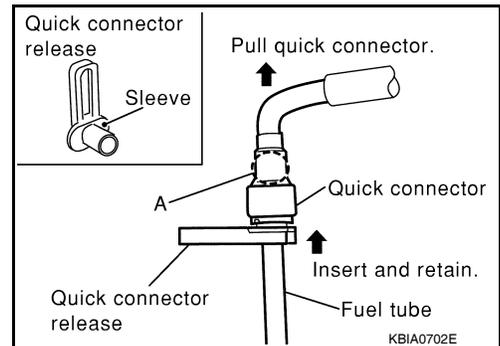


5. With the sleeve side of quick connector release facing quick connector, install quick connector release onto fuel tube.

6. Insert quick connector release into quick connector until sleeve contacts and goes no further. Hold quick connector release on that position.

CAUTION:

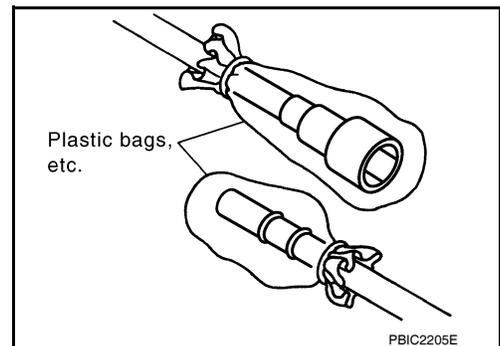
Inserting quick connector release hard will not disconnect quick connector. Hold quick connector release where it contacts and goes no further.



7. Draw and pull out quick connector straight from fuel tube.

CAUTION:

- Pull quick connector holding (A) position.
- Do not pull with lateral force applied. O-ring inside quick connector may be damaged.
- Prepare container and cloth beforehand as fuel will leak out.
- Avoid fire and sparks.
- Keep parts away from heat source. Especially, be careful when welding is performed around them.
- Do not expose parts to battery electrolyte or other acids.
- Do not bend or twist connection between quick connector and fuel feed hose during installation/removal.
- To keep clean the connecting portion and to avoid damage and foreign materials, cover them completely with plastic bags or something similar.



8. Remove intake manifold. Refer to [EM-137](#).

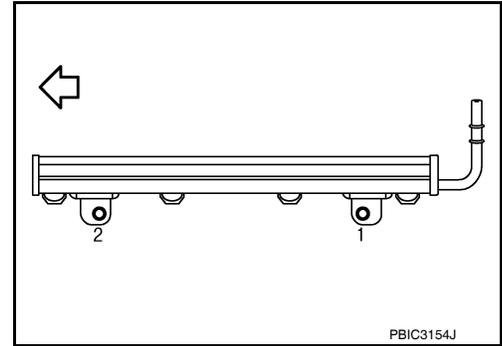
FUEL INJECTOR AND FUEL TUBE

[MR18DE]

< SERVICE INFORMATION >

9. Remove fuel tube bolts.
 - Loosen bolts in reverse order as shown.

⇐ : Engine front



10. Remove the 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 leaks from fuel tube.
11. Remove fuel injector from the fuel tube with the following procedure:
 - a. Open and remove the clip.
 - b. Remove fuel injector from the fuel tube by pulling straight.

CAUTION:

 - Be careful about spilling fuel remaining in fuel tube.
 - Be careful not to damage the fuel injector nozzle during removal.
 - Never bump or drop fuel injector.
 - Never disassemble fuel injector.

INSTALLATION

1. Install new O-rings to the fuel injector.

CAUTION:

 - The 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.
- Make sure that the O-ring and its mating part are free of foreign material.
- Be careful not to scratch O-ring with tool or fingernails when installing.
- Do not twist or stretch O-ring. If O-ring was stretched while installing, never insert it into fuel tube immediately.
- Insert O-ring straight into fuel tube. Never angle or twist it.

TIMING CHAIN

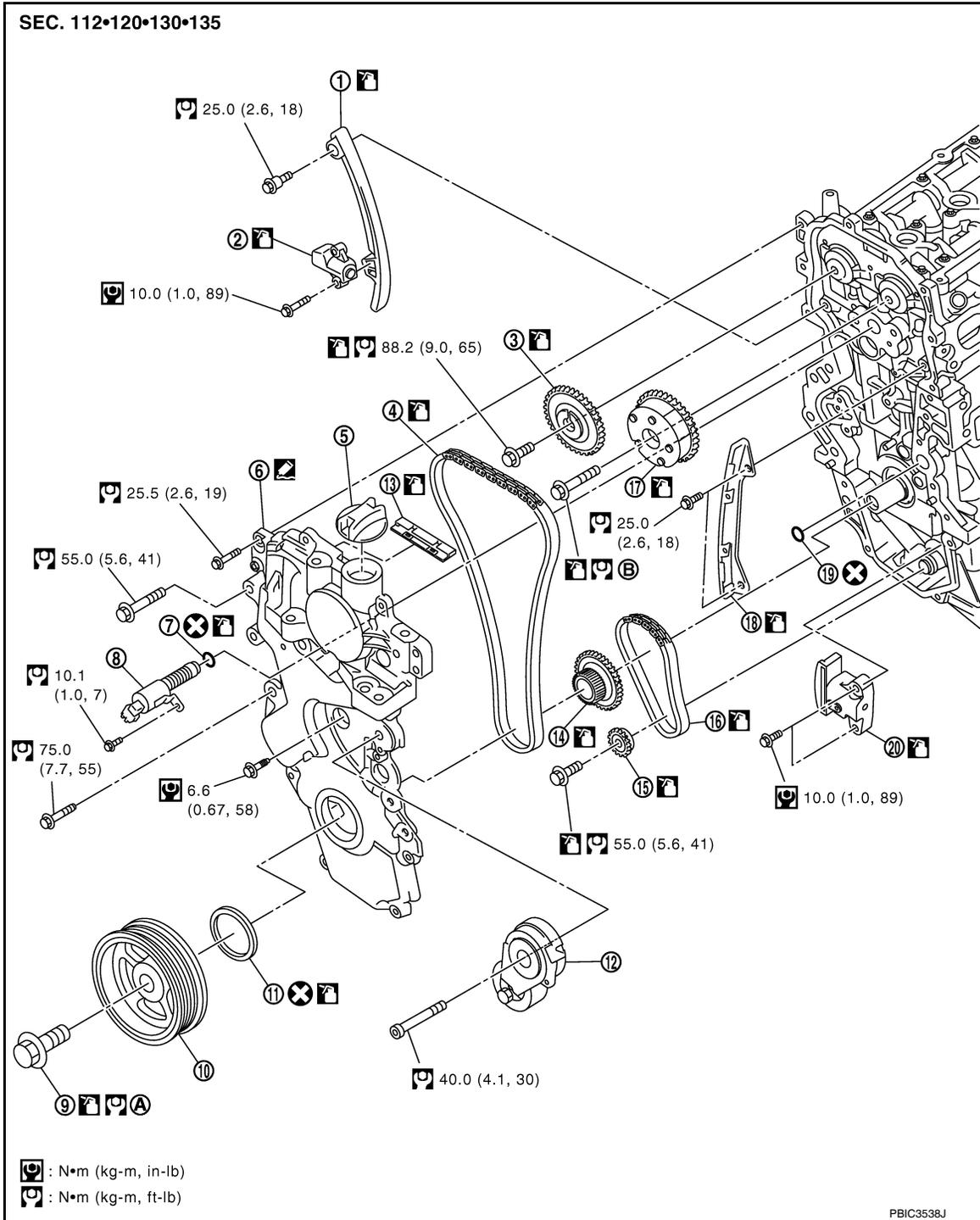
< SERVICE INFORMATION >

[MR18DE]

TIMING CHAIN

Component

INFOID:000000005398129



- | | | |
|---|---|-------------------------------|
| 1. Timing chain slack guide | 2. Timing chain tensioner | 3. Camshaft sprocket (EXH) |
| 4. Timing chain | 5. Oil filler cap | 6. Front cover |
| 7. O-ring | 8. Intake valve timing control solenoid valve | 9. Crankshaft pulley bolt |
| 10. Crankshaft pulley | 11. Front oil seal | 12. Drive belt auto-tensioner |
| 13. Timing chain tension guide (front cover side) | 14. Crankshaft sprocket | 15. Oil pump sprocket |

TIMING CHAIN

[MR18DE]

< SERVICE INFORMATION >

- | | | |
|------------------------------------|------------------------------------|--------------------------------|
| 16. Oil pump drive chain | 17. Camshaft sprocket (INT) | 18. Timing chain tension guide |
| 19. O-ring | 20. Chain tensioner (for oil pump) | |
| A. Refer to EM-157 | B. Refer to EM-166 | |

Removal and Installation

INFOID:000000005398130

EM

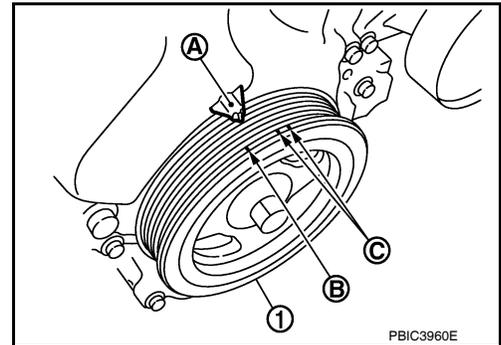
CAUTION:

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

REMOVAL

1. Disconnect the battery negative terminal. Refer to [SC-7, "Removal and Installation"](#).
 2. Drain engine oil. Refer to [LU-18, "Changing Engine Oil"](#).
- CAUTION:**
Perform this step when engine is cold.
3. Partially drain engine coolant from the radiator. Refer to [CO-36, "Changing Engine Coolant"](#).
 4. Remove front RH wheel. Refer to [WT-7, "Adjustment"](#).
 5. Remove front fender protector (RH). Refer to [EI-24, "Removal and Installation"](#).
 6. Remove the following parts.
 - Rocker cover: Refer to [EM-149, "Component"](#).
 - Drive belt: Refer to [EM-132, "Removal and Installation"](#).
 - Water pump pulley: Refer to [CO-44, "Component"](#).
 - Ground cable (between engine bracket (RH) and radiator core support)
 7. Support the bottom surface of engine using a transmission jack, and then remove the engine bracket and insulator (RH). Refer to [EM-191, "Component"](#).
 8. Set No. 1 cylinder at TDC on its compression stroke with the following procedure:
 - a. Rotate crankshaft pulley (1) clockwise and align TDC mark (no paint) (B) to timing indicator (A) on front cover.

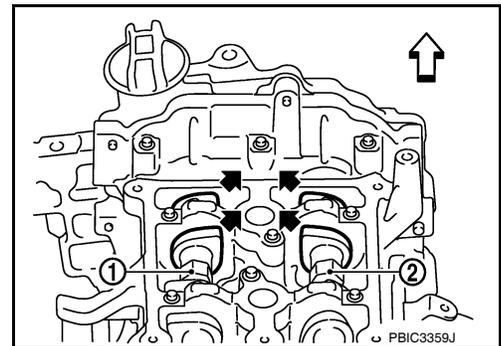
C : White paint mark (Not use for service)



- b. At the same time, make sure that the cam noses of the No.1 cylinder are located (←) as shown.

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

- If not, rotate crankshaft pulley one revolution (360 degrees) and align as shown.



TIMING CHAIN

[MR18DE]

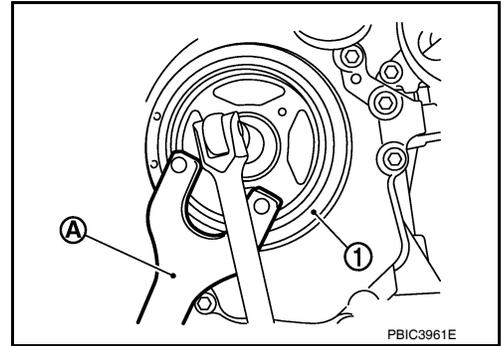
< SERVICE INFORMATION >

9. Hold crankshaft pulley (1) using suitable tool (A) loosen crankshaft pulley bolt, and locate bolt seating surface at 10 mm (0.39 in) from its original position.

CAUTION:

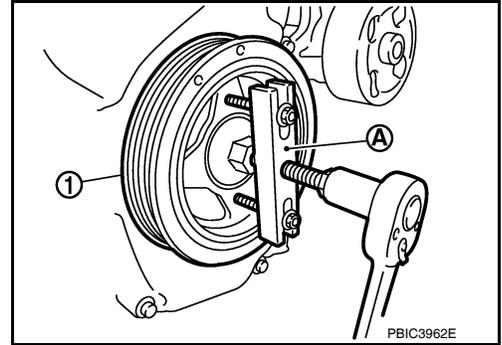
Never remove the crankshaft pulley bolt as it will be used as a supporting point for the pulley puller.

Tool number : KV10109300 (—)



10. Attach Tool (A) in the M6 thread hole on crankshaft pulley (1), and remove crankshaft pulley.

Tool number : KV11103000 (—)

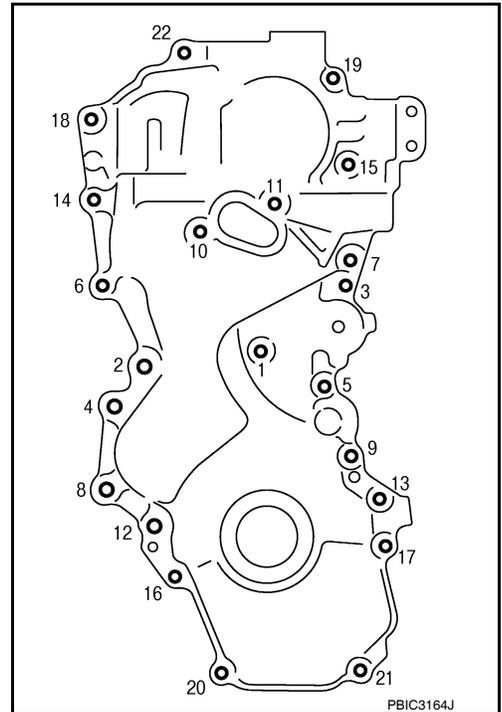


11. Remove oil pan (lower). Refer to [EM-143. "Component"](#).

NOTE:

When crankshaft sprocket, oil pump sprocket and other related parts are not removed, this step is unnecessary.

12. Remove intake valve timing control solenoid valve.
13. Remove drive belt auto-tensioner.
14. Loosen bolts in reverse order as shown.



TIMING CHAIN

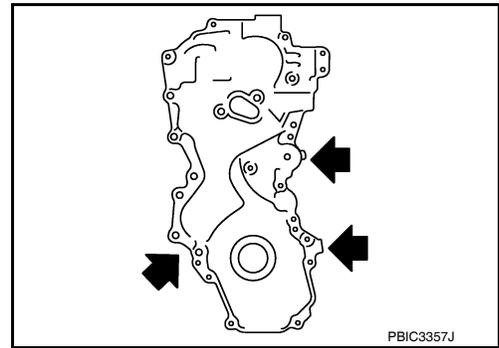
[MR18DE]

< SERVICE INFORMATION >

15. Cut liquid gasket by prying the position (←) shown, and then remove the front cover.

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 the position not specified.



16. Remove front oil seal from front cover.
• Lift up front oil seal using a suitable tool.

CAUTION:

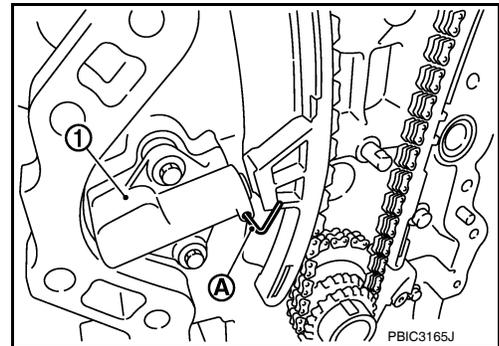
Be careful not to damage front cover.

17. Push in timing chain tensioner plunger.
18. Insert a stopper pin (A) into the body hole to retain the plunger in collapsed position.

NOTE:

Use approximately 1.5 mm (0.059 in) diameter hard metal pin as a stopper pin.

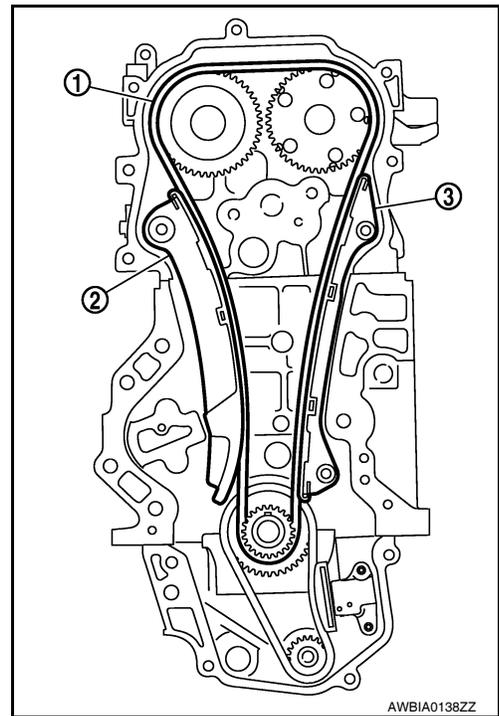
19. Remove timing chain tensioner (1).



20. Remove timing chain slack guide (2), timing chain tension guide (3) and timing chain (1).

CAUTION:

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



A
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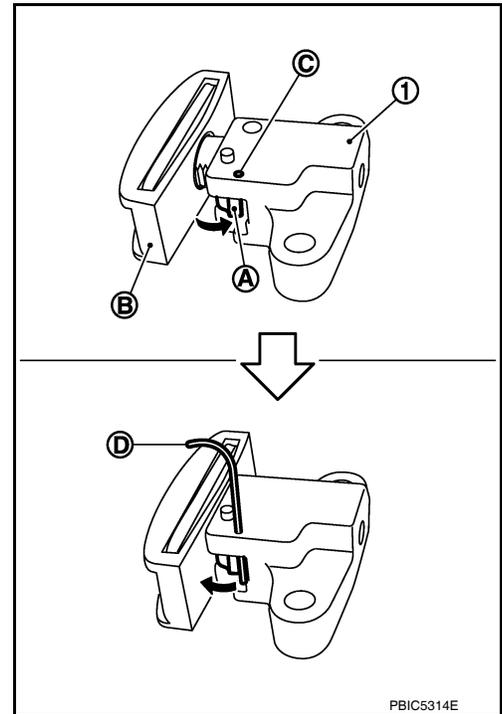
TIMING CHAIN

[MR18DE]

< SERVICE INFORMATION >

21. Press stopper tab (A) in the direction shown to push the timing chain slack guide (B) toward timing chain tensioner (for oil pump) (1).
 - The slack guide (B) is released by pressing the stopper tab (A). As a result, the slack guide (B) can be moved.
22. Insert stopper pin (D) into tensioner body hole (C) to secure timing chain slack guide (B).

NOTE:
Use a hard metal pin with a diameter of approximately 1.2 mm (0.047 in) as a stopper pin.
23. Remove timing chain tensioner (for oil pump), if necessary.

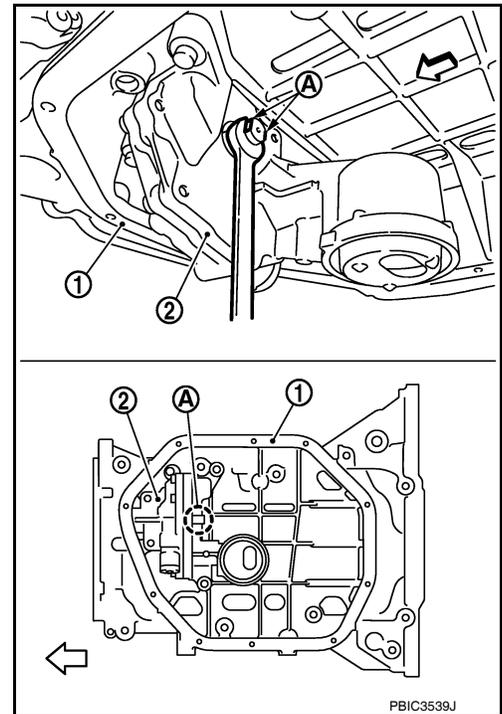


24. Hold the WAF part of oil pump shaft (A), and then loosen the oil pump sprocket bolt and remove them.

- 1 : Oil pan (upper)
- 2 : Oil pump
- ⇐ : Engine front

CAUTION:

- Secure the oil pump shaft with the WAF part (A).
- Never loosen the oil pump sprocket bolt by tightening the oil pump drive chain.



25. Remove crankshaft sprocket, oil pump sprocket and oil pump drive chain as a set, if necessary.
26. Remove timing chain tension guide (front cover side) from front cover, if necessary.

INSPECTION AFTER REMOVAL

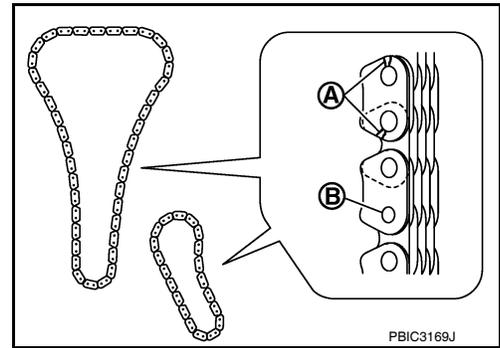
Timing Chain

TIMING CHAIN

[MR18DE]

< SERVICE INFORMATION >

- Check timing chain and oil pump drive chain for cracks (A) and any excessive wear (B) at the roller links of timing chain.
- Replace timing chain and/or oil pump drive chain, if necessary.



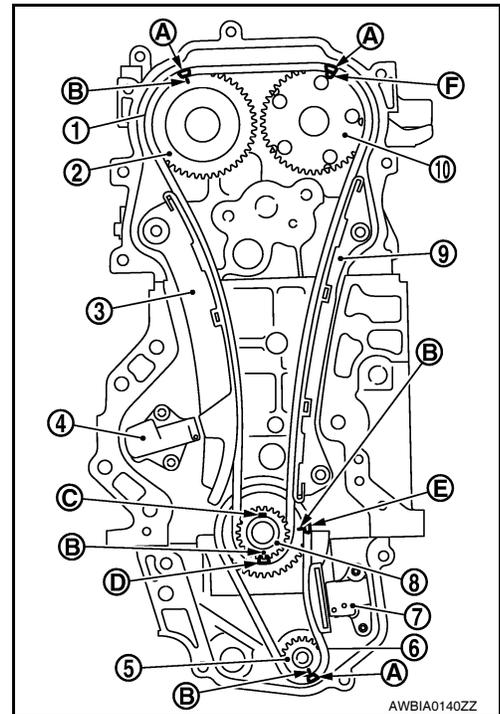
INSTALLATION

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. Make sure that crankshaft key points are aligned.

- 1 : Timing chain
- 2 : Camshaft sprocket (EXH)
- 3 : Timing chain slack guide
- 4 : Timing chain tensioner
- 5 : Oil pump sprocket
- 6 : Oil pump drive chain
- 7 : Chain tensioner (for oil pump)
- 8 : Crankshaft sprocket
- 9 : Timing chain tension guide
- 10 : Camshaft sprocket (INT)
- A : Matching mark (dark blue link)
- B : Matching mark (stamping)
- C : Crankshaft key position (straight up)
- D : Matching mark (orange link)
- E : Matching mark (orange link)
- F : Matching mark (outer groove*)



NOTE:

*: There are two outer grooves in camshaft sprocket (INT). The wider one is a matching mark.

2. If the timing chain tension guide (front cover side) is removed, install it to the front cover.

CAUTION:

Check the joint condition by sound or feeling.

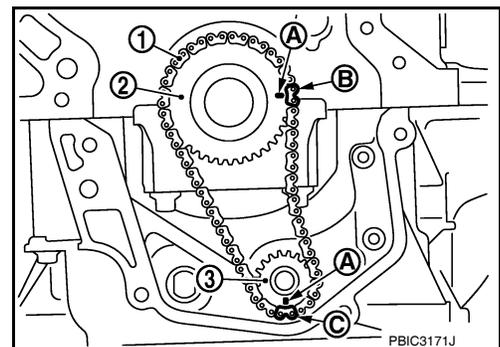
3. Install crankshaft sprocket (2), oil pump sprocket (3) and oil pump drive chain (1).

- A : Matching mark (stamping)
- B : Matching mark (orange link)
- C : Matching mark (dark blue link)

- Install it by aligning matching marks on each sprocket and oil pump drive chain.
- If these matching marks are not aligned, rotate the oil pump shaft slightly to correct the position.

CAUTION:

Check matching mark position of each sprocket after installing the oil pump drive chain.



TIMING CHAIN

[MR18DE]

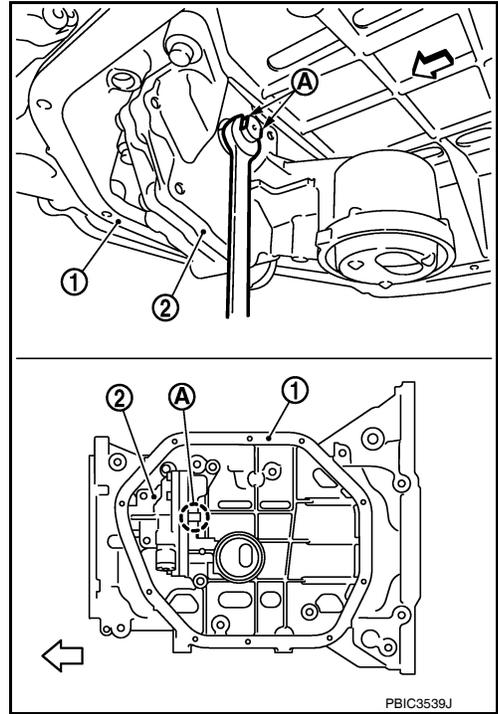
< SERVICE INFORMATION >

4. Hold the WAF part of oil pump shaft (A), and then tighten the oil pump sprocket bolt.

- 1 : Oil pan (upper)
- 2 : Oil pump
- ⇐ : Engine front

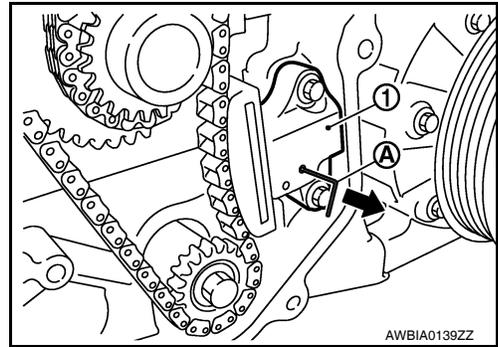
CAUTION:

- Secure the oil pump shaft with the WAF part (A).
- Never loosen the oil pump sprocket bolt by tightening the oil pump drive chain.



5. Install chain tensioner (for oil pump) (1).

1. Fix the plunger at the most compressed position using a stopper pin (A), and then install it.
2. Securely pull out (⇐) the stopper pin after installing the chain tensioner (for oil pump).
3. Check matching mark position of oil pump drive chain and each sprocket again.



6. Align the matching marks of each sprocket with the matching marks of timing chain.

- 1 : Camshaft sprocket (EXH)
- 2 : Camshaft sprocket (INT)
- 3 : Timing chain
- A : Matching mark (dark blue link)
- B : Matching mark (stamping)
- C : Matching mark (outer groove*)
- D : Matching mark (orange link)
- E : Matching mark (stamping)

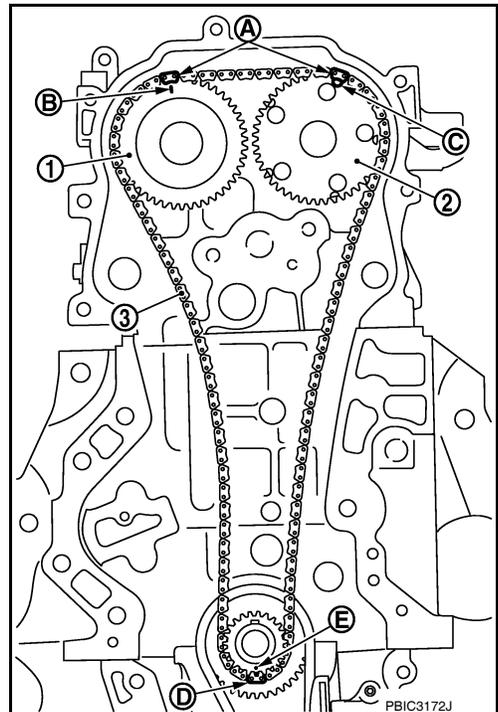
NOTE:

*: There are 2 outer grooves in camshaft sprocket (INT). The wider one is a matching mark.

- If these matching marks are not aligned, rotate the camshaft slightly by holding the hexagonal portion to correct the position.

CAUTION:

Check matching mark position of each sprocket and timing chain again after installing the timing chain.



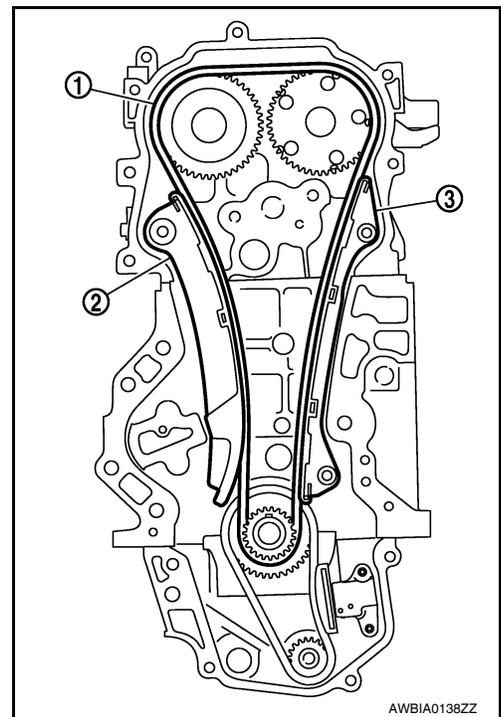
TIMING CHAIN

[MR18DE]

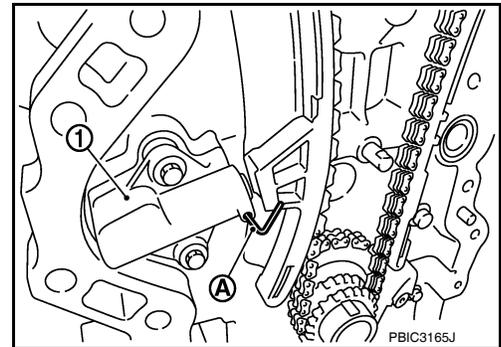
< SERVICE INFORMATION >

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

1 : Timing chain

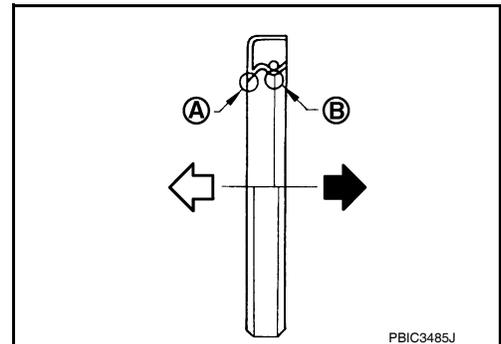


8. Install timing chain tensioner (1).
 1. Fix the plunger at the most compressed position using a stopper pin (A), and then install it.
 2. Securely pull out the stopper pin after installing the timing chain tensioner.



9. Check matching mark position of timing chain and each sprocket again.
10. Apply new engine oil to new front oil seal joint surface.
11. Install front oil seal so that each seal lip is oriented as shown.

- A : Dust seal lip
- B : Oil seal lip
- ◁ : Engine front
- ◀ : Engine rear



A
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TIMING CHAIN

[MR18DE]

< SERVICE INFORMATION >

- Install front oil seal (2) using a suitable tool with outer diameter 57 mm (2.24 in) and inner diameter 45 mm (1.77 in) (A) to the dimension shown.

1 : Front cover

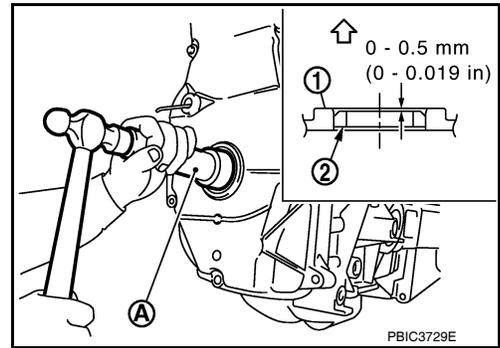
⇐ : Engine front

Within 0.3 mm (0.012 in) toward engine front

Within 0.5 mm (0.020 in) toward engine rear

CAUTION:

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



12. Install new O-ring to cylinder block.

CAUTION:

Be sure O-rings are aligned properly.

13. Apply the sealant without breaks to the specified location using Tool.

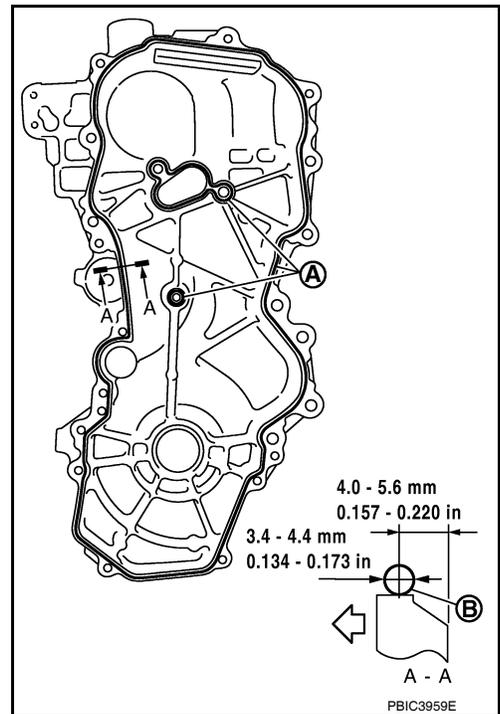
Use Genuine Silicone RTV Sealant or equivalent. Refer to [GI-42, "Recommended Chemical Product and Sealant"](#).

Tool number WS39930000 (-)

A : Liquid gasket application area

B : Liquid gasket

⇐ : Engine outside



14. Make sure that matching marks of timing chain and each sprocket are still aligned.

CAUTION:

- Make sure O-ring on cylinder block is correctly installed.
- Be careful not to damage front oil seal by interference with front end of crankshaft.

TIMING CHAIN

[MR18DE]

< SERVICE INFORMATION >

15. Install front cover, and tighten bolts in two stages to specified torque in numerical order as shown.

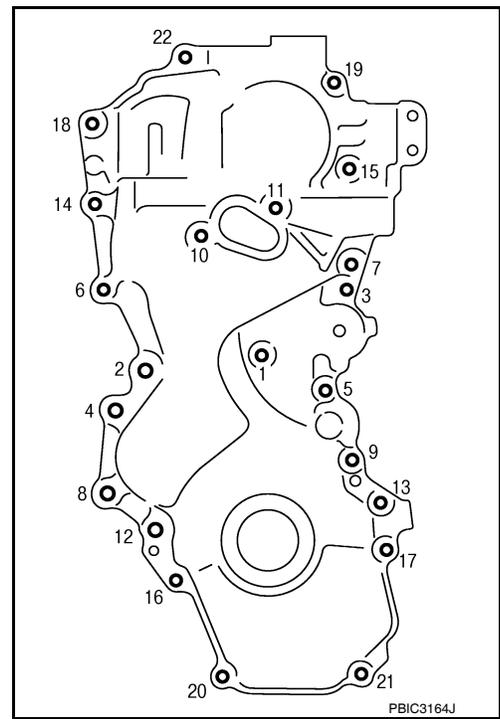
CAUTION:

- **Attaching should be done within 5 minutes after liquid gasket application.**
- **Be sure to wipe off any excessive liquid gasket leaking.**

NOTE:

Installation position of bolts is as shown.

M6 bolts	:	No. 1
M10 bolts	:	No. 6, 7, 10, 11, 14
M12 bolts	:	No. 2, 4, 8, 12
M8 bolts	:	Except the above



16. Install crankshaft pulley using the following procedure.

- a. Install crankshaft pulley.

CAUTION:

- **Never damage front oil seal lip section.**
- **If needed use a plastic hammer, tap on its center portion (not circumference) to seat crankshaft pulley.**

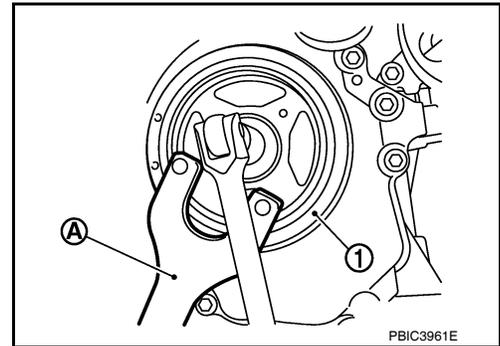
- b. Apply new engine oil to thread and seat surfaces of crankshaft pulley bolt.
 c. Secure crankshaft pulley (1) using Tool (A).

Tool Number : KV10109300 (—)

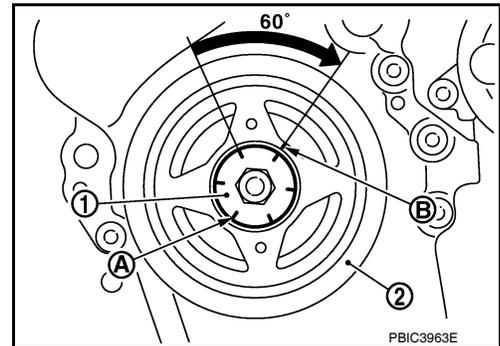
- d. Tighten crankshaft pulley bolt in two steps.

Step 1 : 29.4 N·m (3.0 kg·m, 22 ft·lb)

Step 2 : 60° clockwise



- For angle tightening, put a paint mark (B) on crankshaft pulley (2), matching with any one of six easy to recognize angle marks (A) on crankshaft pulley bolt flange (1).
 - Turn 60 degrees clockwise (angle tightening).
 - Check the tightening angle with movement of one angle mark.
- e. Make sure that crankshaft rotates clockwise smoothly.



17. Installation of the remaining components is in the reverse order of removal.

CAMSHAFT

[MR18DE]

< SERVICE INFORMATION >

- Fuel tube and fuel injector assembly. Refer to [EM-152](#).
- Front cover, timing chain and related parts. Refer to [EM-156](#).
- Generator. Refer to [SC-25. "Removal and Installation"](#).

7. Remove camshaft position sensor (PHASE) from camshaft bracket.

CAUTION:

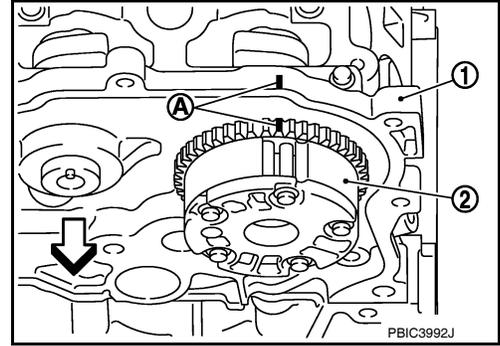
- **Handle carefully to avoid dropping and shocks.**
- **Never disassemble.**
- **Never allow metal powder to adhere to magnetic part at sensor tip.**
- **Never place sensor in a location where it is exposed to magnetism.**

8. Put matching marks (A) on the camshaft sprocket (INT) (2) and the camshaft bracket (1) as shown.

⇐ : Engine front

NOTE:

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

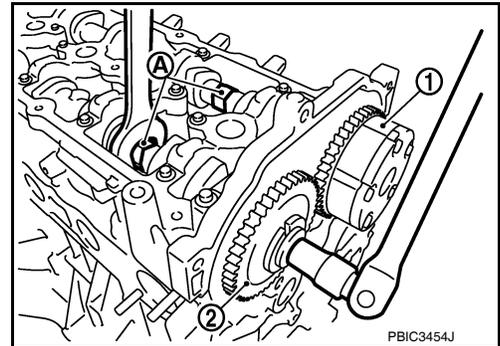


9. Remove camshaft sprockets (INT) (1) and (EXH) (2).

- Secure hexagonal part (A) of camshaft with a wrench. Loosen camshaft sprocket bolts and remove camshaft sprocket.

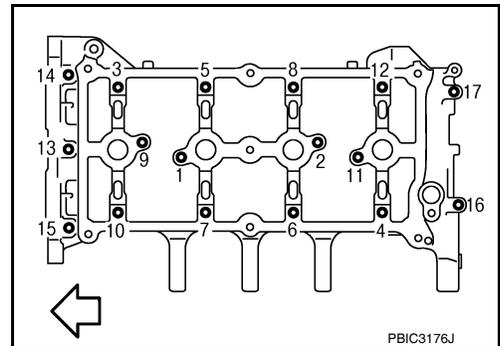
CAUTION:

- **Never rotate crankshaft or camshaft while timing chain is removed. It causes interference between valve and piston.**
- **Never loosen the bolts with securing anything other than the camshaft hexagonal part or with tensioning the timing chain.**



10. Loosen bolts in reverse order as shown.

⇐ : Engine front

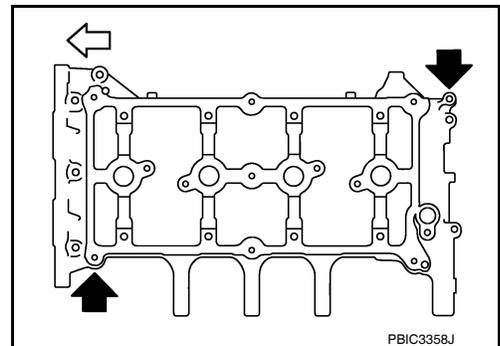


11. Cut liquid gasket by prying the position (⇐) shown, and then remove the camshaft bracket.

⇐ : Engine front

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 the position not specified.**



12. Remove camshafts.

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P

CAMSHAFT

[MR18DE]

< SERVICE INFORMATION >

13. Remove valve lifters, if necessary.

NOTE:

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

INSPECTION AFTER REMOVAL

Camshaft Runout

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

CAUTION:

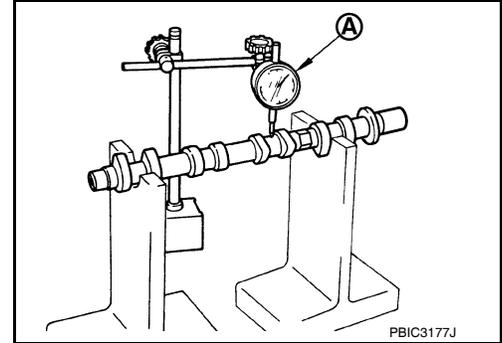
Never support No. 1 journal (on the side of camshaft sprocket) because it has a different diameter from the other four locations.

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

Standard : Less than 0.02 mm (0.0008 in).

Limit : 0.05 mm (0.0020 in)

4. If it exceeds the limit, replace camshaft.



Camshaft Cam Height

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

Standard:

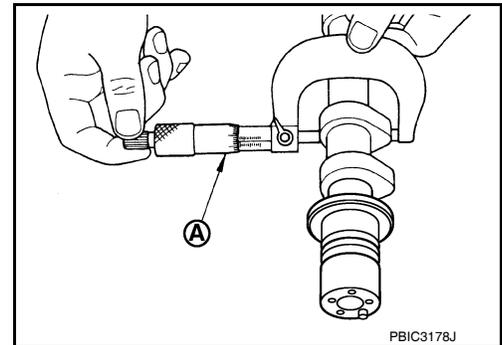
Intake : 44.605 - 44.795 mm (1.7560 - 1.7635 in)

Exhaust : 43.175 - 43.365 mm (1.6997 - 1.7072 in)

Limit:

Intake : 44.405 mm (1.7482 in)

Exhaust : 42.975 mm (1.6919 in)



2. If it exceeds the limit, replace camshaft.

Camshaft Journal Oil Clearance

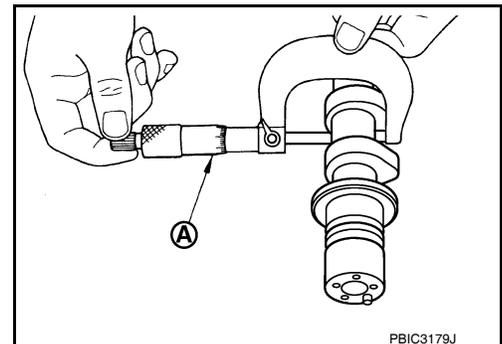
CAMSHAFT JOURNAL OUTER DIAMETER

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

Standard:

No. 1 : 27.935 - 27.955 mm (1.0998 - 1.1006 in)

No. 2, 3, 4, 5 : 24.950 - 24.970 mm (0.9823 - 0.9831 in)



CAMSHAFT BRACKET INNER DIAMETER

- Tighten camshaft bracket bolts with specified torque.

CAMSHAFT

[MR18DE]

< SERVICE INFORMATION >

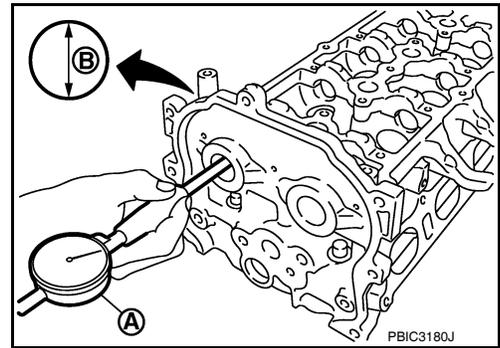
- Measure the inner diameter of camshaft bracket with a bore gauge (A).

B : Measuring direction of inner diameter

Standard:

No. 1 : 28.000 - 28.021 mm (1.1024 - 1.1032 in)

No. 2, 3, 4, 5 : 25.000 - 25.021 mm (0.9843 - 0.9851 in)



CAMSHAFT JOURNAL OIL CLEARANCE

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

Standard:

No. 1 : 0.045 - 0.086 mm (0.0018 - 0.0034 in)

No. 2, 3, 4, 5 : 0.030 - 0.071 mm (0.0012 - 0.0028 in)

Limit:

: 0.15 mm (0.0059 in)

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

NOTE:

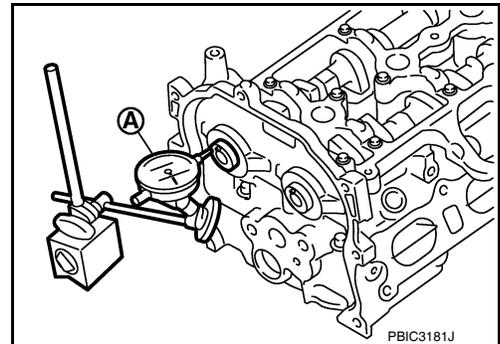
Camshaft bracket cannot be replaced as a single part, because it is machined together with cylinder head. Replace whole cylinder head assembly.

Camshaft End Play

1. Install camshaft in cylinder head.
2. Install dial indicator in thrust direction on front end of camshaft. Read the end play of dial indicator (A) when camshaft is moved forward/backward (in direction to axis).

Standard : 0.075 - 0.153 mm (0.0030 - 0.0060 in)

Limit : 0.24 mm (0.0094 in)



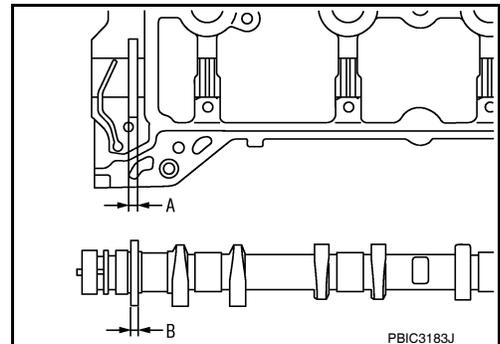
- Measure the following parts if out of the standard.
 - Dimension (A) for groove of cylinder head No. 1 journal

Standard : 4.000 - 4.030 mm (0.1575 - 0.1587 in)

- Dimension (B) for camshaft flange

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

- Apply the standards above, and then replace camshaft and/or cylinder head, if necessary.



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.

CAMSHAFT

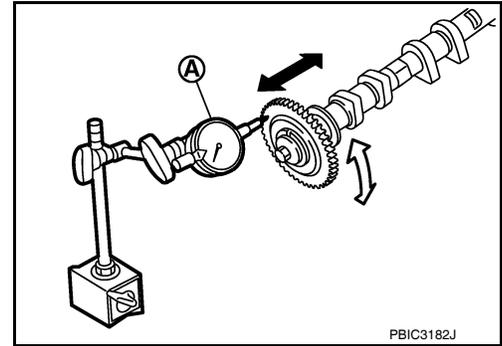
[MR18DE]

< SERVICE INFORMATION >

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

Limit : 0.15 mm (0.0059 in)

- If it exceeds the limit, replace camshaft sprocket.

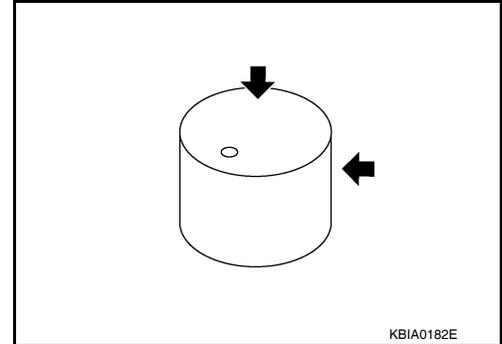


PBIC3182J

Valve Lifter

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

- If anything above is found, replace valve lifter. Refer to [EM-174](#), "[Valve Clearance](#)".



KBIA0182E

Valve Lifter Clearance

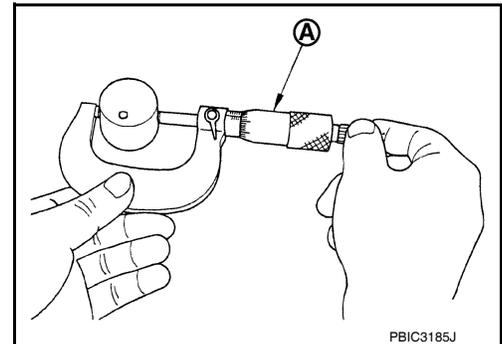
VALVE LIFTER OUTER DIAMETER

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

Standard:

Intake : 33.977 - 33.987 mm (1.3377 - 1.3381 in)

Exhaust : 29.977 - 29.987 mm (1.1802 - 1.1806 in)



PBIC3185J

VALVE LIFTER HOLE DIAMETER

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

Standard:

Intake : 34.000 - 34.021 mm (1.3386 - 1.3394 in)

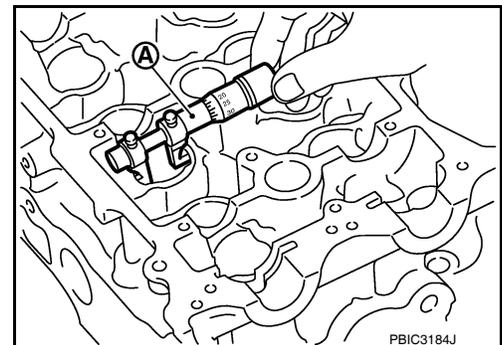
Exhaust : 30.000 - 30.021 mm (1.1811 - 1.1819 in)

VALVE LIFTER CLEARANCE

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

Standard: 0.013 - 0.044 mm (0.0005 - 0.0017 in)

- 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.



PBIC3184J

INSTALLATION

1. Install valve lifters.
 - Install them in the original positions.
2. Install camshafts.

CAMSHAFT

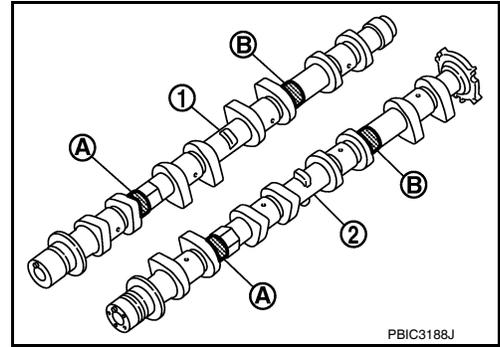
[MR18DE]

< SERVICE INFORMATION >

- Clean camshaft journal to remove any foreign material.
- Distinguish between the intake and the exhaust by looking at the different shapes of the front and rear ends of the camshaft or using the identification colors (A) and (B).

- 1 : Camshaft (EXH)
2 : Camshaft (INT)

Identification color	A	B
Camshaft (EXH)	—	Yellow
Camshaft (INT)	Yellow	—

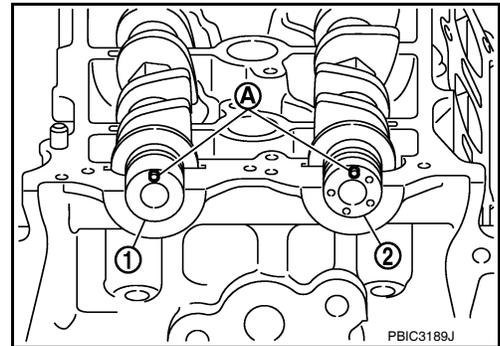


- Install camshafts so that camshaft dowel pins (A) on the front side are positioned as shown.

- 1 : Camshaft (EXH)
2 : Camshaft (INT)

NOTE:

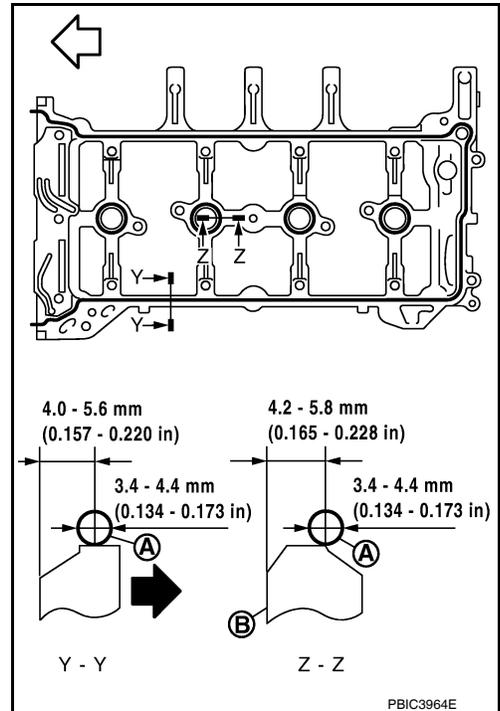
Though camshaft does not stop at the positions as shown, for the placement of cam nose, it is generally accepted camshaft is placed for the same direction as shown.



- Remove foreign material completely from camshaft bracket backside and from cylinder head installation face.
- Apply liquid gasket (A) to camshaft bracket as shown. **Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-42. "Recommended Chemical Product and Sealant".**

Tool number WS39930000 (-)

- B : Plug hole inner wall
 ← : Engine front
 → : Engine outside



CAMSHAFT

[MR18DE]

< SERVICE INFORMATION >

5. Install camshaft bracket bolts in three stage in numerical order as shown.

⇐ : Engine front

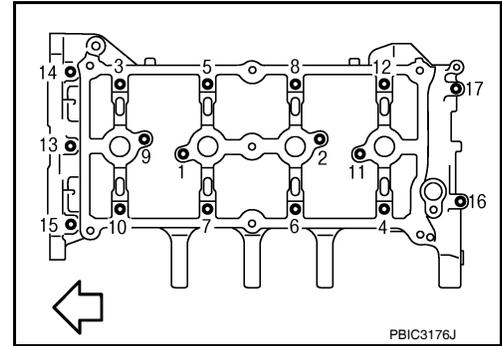
- There are two types of bolts. Locate the bolts as shown.

M6 bolts [thread length: 57.5 mm (2.264 in)]

: 13, 14 and 15

M6 bolts [thread length: 35.00 mm (1.378 in)]

: Except the above



6. Tighten all bolts in numerical order in three steps.

Step 1 : 1.96 N·m (0.20 kg-m, 17 in-lb)

Step 2 : 5.88 N·m (0.60 kg-m, 52 in-lb)

Step 3 : 9.5 N·m (0.97 kg-m, 84 in-lb)

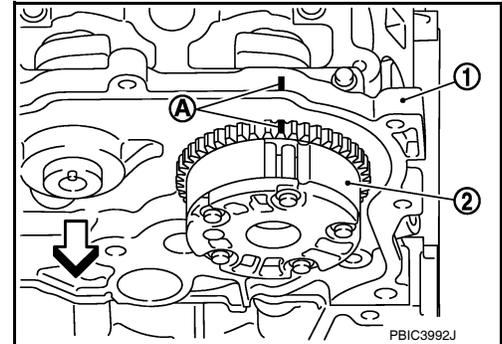
7. Install the camshaft sprocket (INT) (2) to the camshaft (INT).

NOTE:

Align the matching mark (A) applied during removal. Securely align the knock pin and the pin hole, and then install them.

1 : Camshaft bracket

⇐ : Engine front



8. Tighten camshaft (INT) sprocket bolt.

Camshaft sprocket bolt (INT) : 35.0 N·m (3.6 kg-m, 26 ft-lb)

NOTE:

Secure the hexagonal part of camshaft (INT) using wrench to tighten bolt.

9. Turn 67 degrees clockwise (angle tightening) using Tool (B).

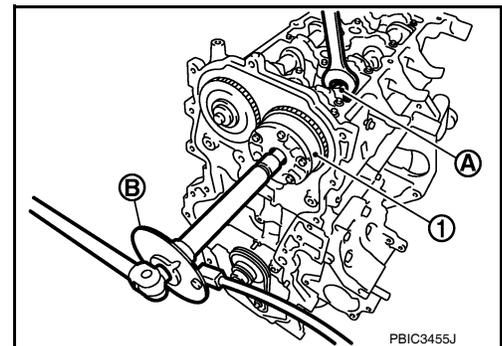
1 : Camshaft sprocket (INT)

A : Camshaft (INT) hexagonal part

CAUTION:

Never judge by visual inspection without an angle wrench.

Tool number : KV10112100 (BT-8653-A)



CAMSHAFT

[MR18DE]

< SERVICE INFORMATION >

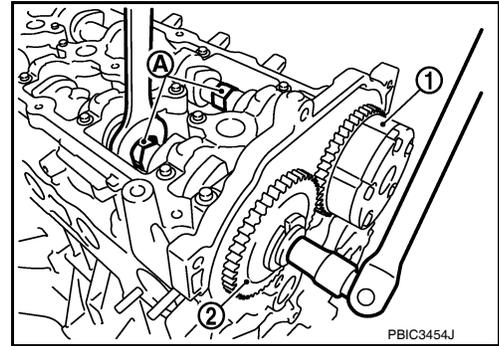
10. Install camshaft sprocket (EXH) (2).

1 : Camshaft sprocket (INT)

Camshaft sprocket bolt (EXH) : 88.2 N·m (9.0 kg-m, 65 ft-lb)

NOTE:

Secure the hexagonal part (A) of camshaft (EXH) using wrench to tighten bolt.



- 11. Install timing chain and related parts. Refer to [EM-156](#).
- 12. Inspect and adjust valve clearance. Refer to [EM-174, "Valve Clearance"](#).
- 13. Installation of the remaining components is in the reverse order of removal.

INSPECTION AFTER INSTALLATION

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 [GI-42, "Recommended Chemical Product and Sealant"](#).
- 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 make sure 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:

Item	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/CVT 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-647, "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-17, "Inspection"](#).
 2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.
 - a. Remove intake manifold. Refer to [EM-137, "Component"](#).
 - b. Disconnect ignition coil and injector harness connectors.
 3. Remove intake valve timing control solenoid valve. Refer to [EM-156, "Component"](#).

CAMSHAFT

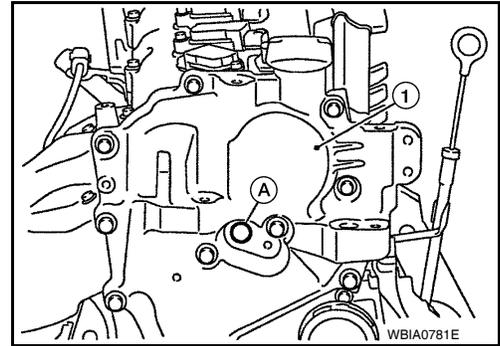
[MR18DE]

< SERVICE INFORMATION >

4. Clean the mating area of intake valve timing control solenoid valve. Insert a clean shop cloth (with no oil adhesion) into the oil hole (A) of the cylinder head.

1 : Front cover

↶ : Vehicle front



5. Install engine mounting bracket (RH), engine mounting insulator, and torque rod (RH) under the Step 4 condition. (With intake valve timing control solenoid valve removed, and a shop cloth inserted into the oil hole.) Refer to [EM-191. "Component"](#).
6. Crank engine, and then make sure that engine oil comes out from intake valve timing control solenoid valve hole (A). End cranking after checking.
 - Check engine oil leakage by oil amount adhered to the shop cloth inserted into the oil hole.

WARNING:

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

CAUTION:

- Do not perform cranking without installing right engine mount bracket, right engine mount insulator, and right torque rod.
 - 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.
7. 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 (for intake valve timing control), and then clean it. Refer to [EM-195. "Component"](#).
 - Clean oil groove between oil strainer and intake valve timing control solenoid valve. Refer to [LU-16](#).
 8. 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-16](#).
 9. Installation of the remaining components is in the reverse order of removal

Valve Clearance

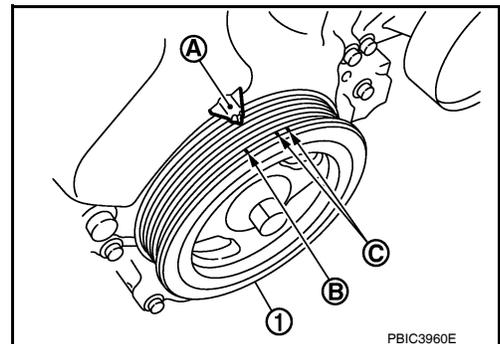
INFOID:000000005398133

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-149](#).
2. Measure the valve clearance with the following procedure:
 - a. Set No. 1 cylinder at TDC of its compression stroke.
 - Rotate crankshaft pulley (1) clockwise and align TDC mark (no paint) (B) to timing indicator (A) on front cover.

C : White paint mark (Not use for service)



CAMSHAFT

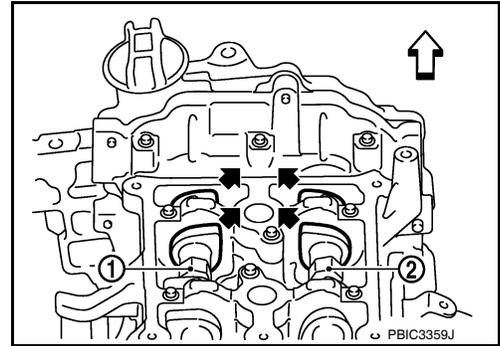
[MR18DE]

< SERVICE INFORMATION >

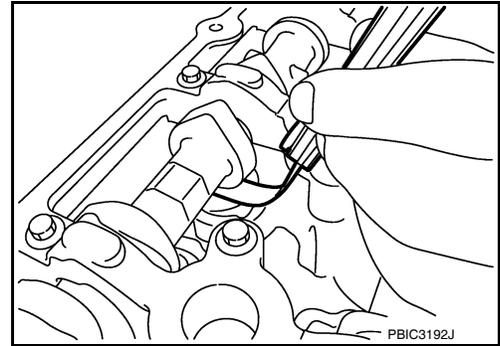
- At the same time, make sure that both intake and exhaust cam noses of No. 1 cylinder face inside (←) as shown.

- 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.



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



Valve clearance:

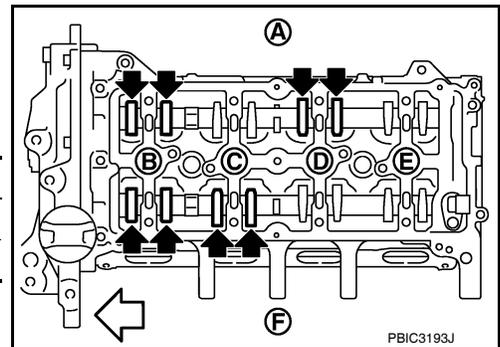
Unit: mm (in)

	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 - 0.015)	0.308 - 0.432 (0.012 - 0.017)

*: Approximately 80°C (176°F)

- By referring to the figure, measure the valve clearances at locations marked × as shown in the table below [locations indicated with black arrow (←)] with a feeler gauge.
- No. 1 cylinder compression TDC

Measuring position		No. 1 CYL.	No. 2 CYL.	No. 3 CYL.	No. 4 CYL.
No. 1 cylinder at compression TDC	EXH	×		×	
	INT	×	×		



- A : Exhaust side
- B : No.1 cylinder
- C : No.2 cylinder
- D : No.3 cylinder
- E : No.4 cylinder
- F : Intake side
- ← : Engine front

- c. Set No.4 cylinder at TDC of its compression stroke.

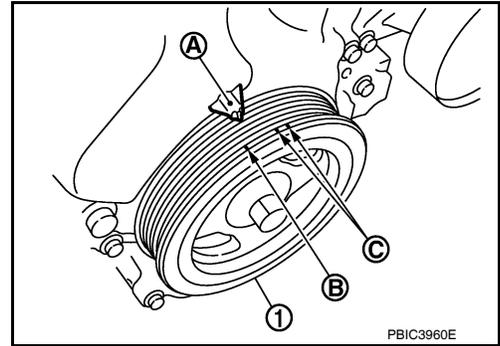
CAMSHAFT

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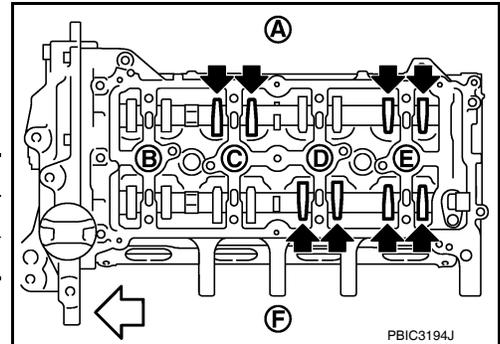
- Rotate crankshaft pulley (1) one revolution (360 degrees) and align TDC mark (no paint) (B) to timing indicator (A) on front cover.

C : White paint mark (Not use for service)



- By referring to the figure, measure the valve clearance at locations marked × as shown in the table below [locations indicated with black arrow (←)] with a feeler gauge.
- No. 4 cylinder compression TDC

Measuring position		No. 1 CYL.	No. 2 CYL.	No. 3 CYL.	No. 4 CYL.
No. 4 cylinder at compression TDC	EXH		×		×
	INT			×	×

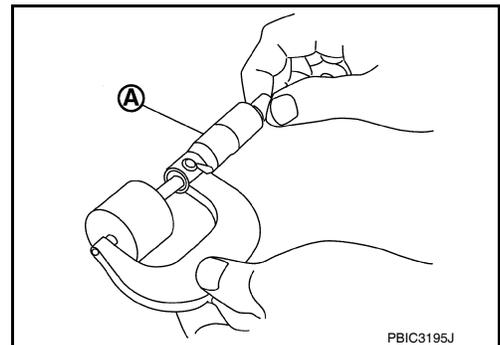


- A : Exhaust side
- B : No.1 cylinder
- C : No.2 cylinder
- D : No.3 cylinder
- E : No.4 cylinder
- F : Intake side
- ← : Engine front

3. If out of standard, perform adjustment.

ADJUSTMENT

- Perform adjustment depending on selected head thickness of valve lifter.
1. Remove camshaft. Refer to [EM-166, "Removal and Installation"](#).
 2. Remove valve lifters at the locations that are out of the standard.
 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:

CAMSHAFT

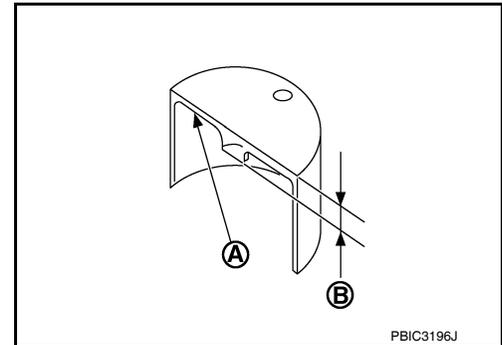
< SERVICE INFORMATION >

[MR18DE]

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-223, "Standard and Limit"](#).

5. Install the selected valve lifter.
6. Install camshaft. Refer to [EM-166, "Removal and Installation"](#).
7. Install timing chain and related parts. Refer to [EM-156](#).
8. Manually rotate crankshaft pulley a few rotations.
9. Make sure that the valve clearances is within the standard.
10. Installation of the remaining components is in the reverse order of removal.

OIL SEAL

Removal and Installation of Valve Oil Seal

INFOID:000000005398134

REMOVAL

1. Remove camshafts. Refer to [EM-166, "Component"](#).
2. Remove valve lifters. Refer to [EM-166](#).
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:

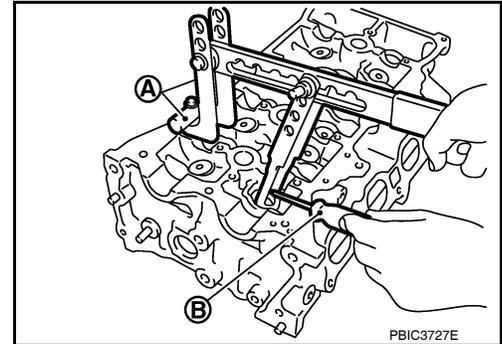
When rotating crankshaft, be careful to avoid scarring front cover with timing chain.

4. Remove valve collet.
 - Compress valve spring using Tool, the attachment and the adapter (A). Remove valve collet with a suitable magnet hand (B).

CAUTION:

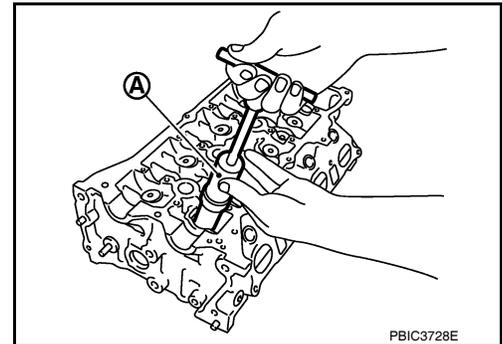
When working, be careful not to damage valve lifter holes.

Tool number : KV101092S0 (J-26336-B)



5. Remove valve spring retainer, valve spring and valve spring seat.
6. Remove valve oil seal using Tool (A).

Tool number : KV10107902 (J-38959)

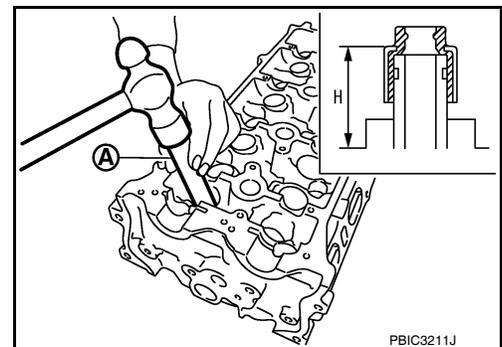


INSTALLATION

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 using Tool (A).

Height (H) : 15.1 - 15.7 mm (0.594 - 0.618 in)

Tool number : KV10115600 (J-38958)



3. Installation of the remaining components is in the reverse order of removal.

Removal and Installation of Front Oil Seal

INFOID:000000005398135

REMOVAL

1. Remove the following parts.
 - RH front wheel and tire. Refer to [WT-7, "Adjustment"](#).

< SERVICE INFORMATION >

- Front fender protector (RH). Refer to [EI-24](#).
- Drive belt. Refer to [EM-132](#), "Component".
- Crankshaft pulley. Refer to [EM-156](#), "Component".

2. Remove front oil seal using a suitable tool.

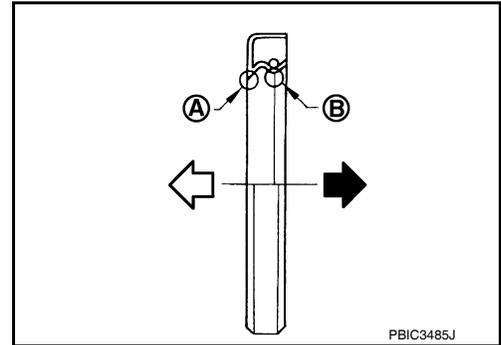
CAUTION:

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.

- A : Dust seal lip
- B : Oil seal lip
- ⇐ : Engine front
- ⇐ : Engine rear

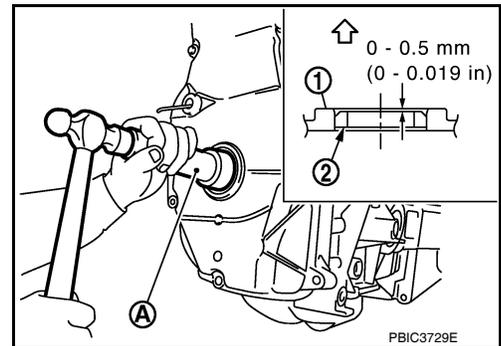


- Install front oil seal (2) using a suitable tool with outer diameter 57 mm (2.24 in) and inner diameter 45 mm (1.77 in) (A) to the dimension as shown.

- 1 : Front cover
- ⇐ : Engine front

Within 0.3 mm (0.012 in) toward engine front

Within 0.5 mm (0.020 in) toward engine rear



CAUTION:

- **Be careful not to damage front cover and crankshaft.**
- **Press-fit oil seal straight to avoid causing burrs or tilting.**
- **Do not touch grease applied on oil seal lip.**

3. Installation of the remaining components is in the reverse order of removal.

Removal and Installation of Rear Oil Seal

INFOID:000000005398136

REMOVAL

1. Remove transaxle assembly. Refer to [MT-61](#), "Removal and Installation" (M/T models), [AT-233](#) (A/T models), [CVT-173](#), "Removal and Installation" (CVT models).
2. Remove clutch cover and clutch disk (M/T models). Refer to [CL-16](#).
3. Remove drive plate (A/T or CVT models) or flywheel (M/T models). Refer to [EM-195](#), "Component".
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 Silicone RTV Sealant or equivalent. Refer to [GI-42](#), "Recommended Chemical Product and Sealant".

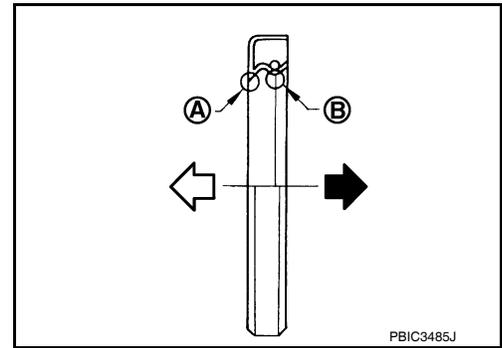
OIL SEAL

< SERVICE INFORMATION >

[MR18DE]

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

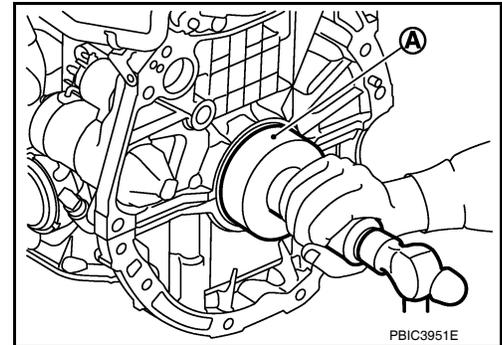
- A : Dust seal lip
- B : Oil seal lip
- ⇐ : Engine outside
- ⇨ : Engine inside



- Install rear oil seal with a suitable tool with an outer diameter 115 mm (4.53 in) and inner diameter 90 mm (3.54 in) (A).

CAUTION:

- Be careful not to damage crankshaft and cylinder block.
- Press-fit oil seal straight to avoid causing burrs or tilting.
- Do not touch grease applied onto oil seal lip.

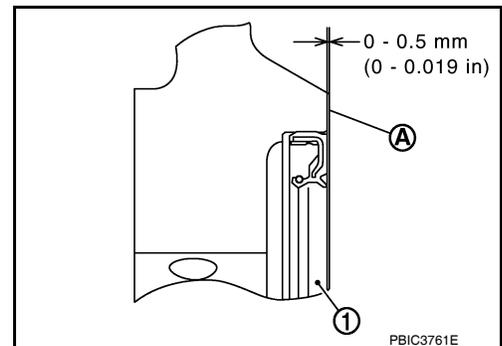


- Install rear oil seal (1) to the position as shown.

- A : Rear end surface of cylinder block

NOTE:

The standard surface of the dimension is the rear end surface of cylinder block.



3. Installation of the remaining components is in the reverse order of removal.

CYLINDER HEAD

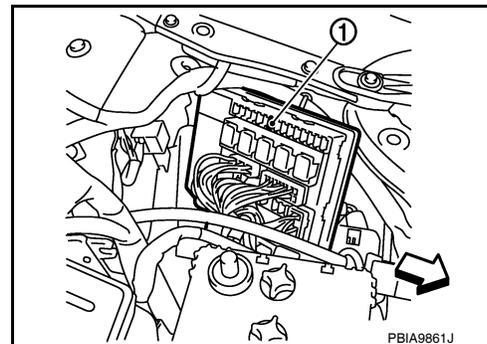
On-Vehicle Service

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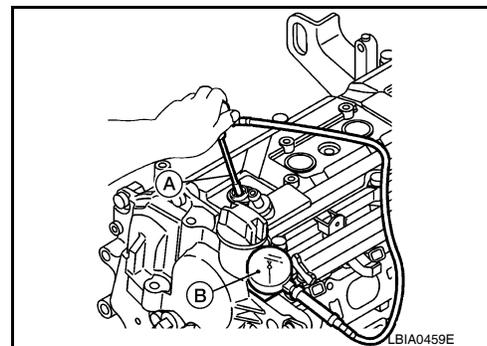
CHECKING COMPRESSION PRESSURE

1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure. Refer to [EC-582, "Fuel Pressure Check"](#).
3. Disconnect fuel pump fuse (1) to avoid fuel injection during measurement.

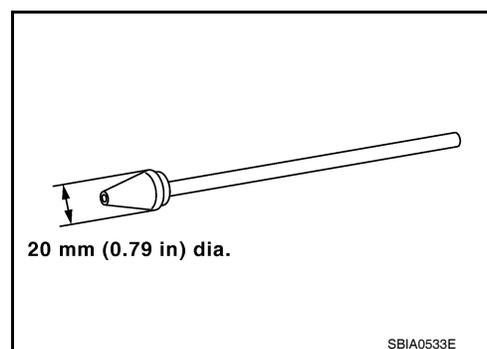
← : Vehicle front



4. Remove engine room cover.
5. Remove ignition coil and spark plug from each cylinder. Refer to [EM-149](#).
6. Connect an engine tachometer (not required in use of CONSULT-III).
7. Install a suitable compression tester (B) with an adapter (A) 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.



8. 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:

Unit: kPa (bar, kg/cm² psi) /rpm

Standard	Minimum	Differential limit between cylinders
1,500 (15.0, 15.3, 217.6) / 250	1,200 (12.0, 12.2, 174) / 250	100 (1.0, 1.0, 15) / 250

CAUTION:

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

CYLINDER HEAD

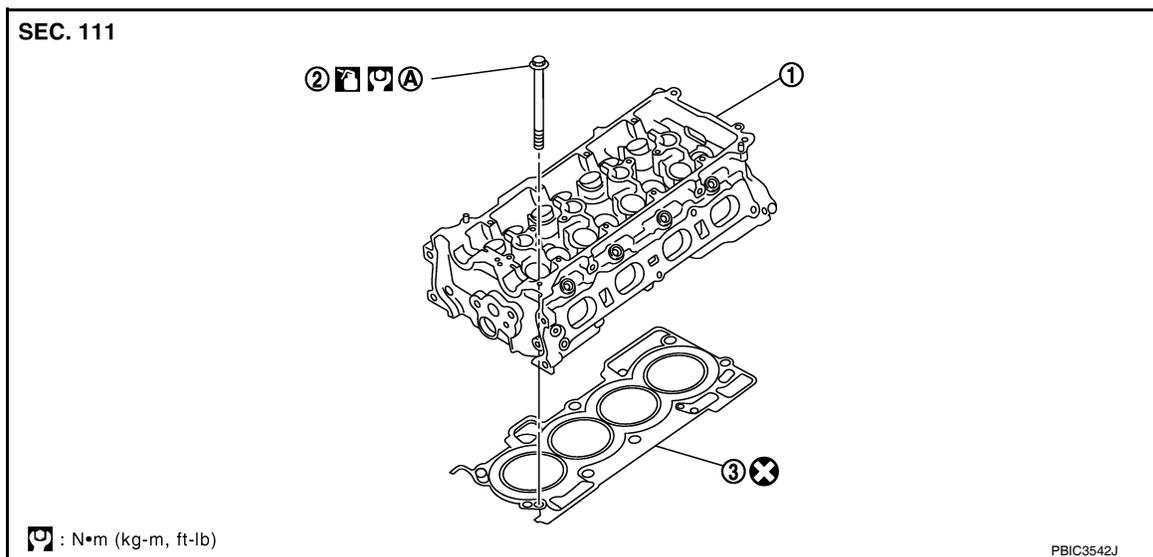
[MR18DE]

< SERVICE INFORMATION >

- If the engine speed is out of the specified range, check battery liquid for proper gravity. Check engine speed again with normal battery gravity.
 - 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, cylinder head gasket). After the checking, measure the compression pressure again.
 - If one cylinder has low compression pressure, pour small amount of engine oil into the spark plug hole of the cylinder to re-check 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 gasket is leaking. In such a case, replace cylinder head gasket.
9. After inspection is completed, install removed parts.
 10. Start the engine, and confirm that the engine runs smoothly.
 11. Perform trouble diagnosis. If DTC appears, erase it. Refer to [EC-585, "Trouble Diagnosis Introduction"](#).

Component

INFOID:000000005398138



1. Cylinder head assembly
 2. Cylinder head bolt
 3. Cylinder head gasket
- A. Refer to [EM-182](#)

Removal and Installation

INFOID:000000005398139

REMOVAL

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.
- Do not smoke while servicing fuel system. Keep open flames and sparks away from the work area.

1. Release the fuel pressure. Refer to [EC-582, "Fuel Pressure Check"](#).
2. Drain engine coolant and engine oil. Refer to [CO-36](#) and [LU-17](#).

CAUTION:

- Perform this step when the engine is cold.
 - Never spill engine coolant and engine oil on drive belt.
3. Remove front fender protector (RH). Refer to [EI-24](#).
 4. Remove drive belt. Refer to [EM-132, "Removal and Installation"](#).
 5. Remove the following components and related parts.

CYLINDER HEAD

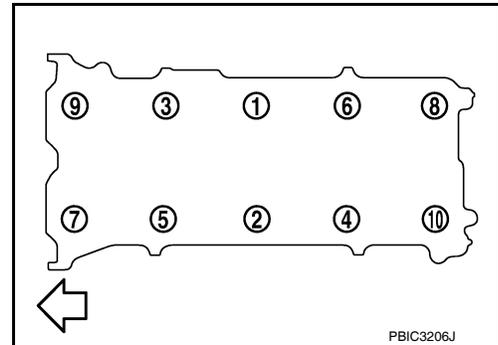
[MR18DE]

< SERVICE INFORMATION >

- Exhaust manifold. Refer to [EM-140](#).
 - Intake manifold. Refer to [EM-137](#).
 - Fuel tube and fuel injector assembly. Refer to [EM-152](#).
 - Water outlet. Refer to [CO-48](#).
 - Rocker cover. Refer to [EM-149](#).
 - Front cover, timing chain. Refer to [EM-156](#).
 - Camshaft. Refer to [EM-166](#).
6. Remove cylinder head.
- Loosen bolts in reverse order as shown.

← : Engine front

- Using TORX socket (size E18), loosen cylinder head bolts.
7. Remove cylinder head gasket.



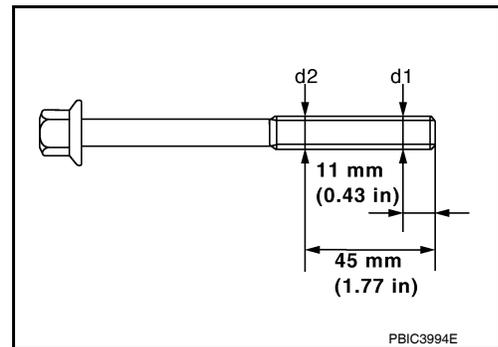
INSPECTION AFTER REMOVAL

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 checked. Refer to [EM-212. "Inspection After Disassembly"](#).

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

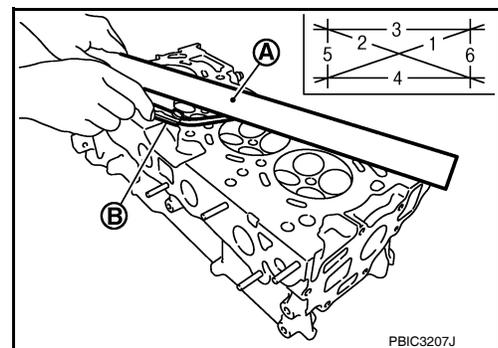
CAUTION:

Never 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 using straightedge (A) and feeler gauge (B).

Limit: 0.1 mm (0.004 in)

- If it exceeds the limit, replace cylinder head.



INSTALLATION

1. Install cylinder head gasket.
2. Apply new engine oil to threads and seating surface of bolts.

CAUTION:

If cylinder head bolts re-used, check their outer diameters before installation. Follow the "Cylinder Head Bolts Outer Diameter" procedure.

CYLINDER HEAD

[MR18DE]

< SERVICE INFORMATION >

3. Install cylinder head, follow the steps below to tighten cylinder head bolts in numerical order as shown.

Step a : 40 N·m (4.1 kg-m, 30 ft-lb)

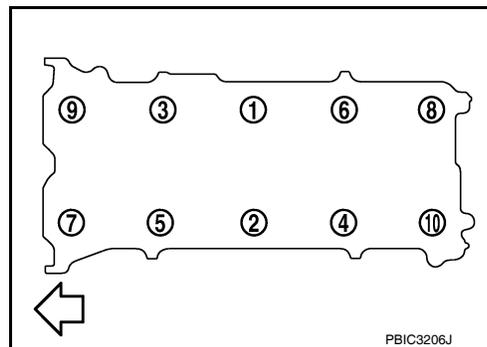
Step b : 100° clockwise

Step c : Loosen to 0 N·m in the reverse order of tightening.

Step d : 40 N·m (4.1 kg-m, 30 ft-lb)

Step e : 100° clockwise

Step f : 100° clockwise

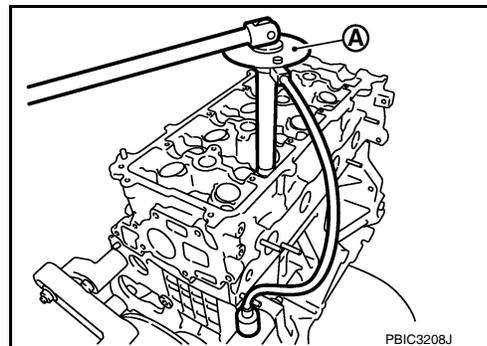


⇐: Engine front

CAUTION:

Check and confirm the tightening angle by using Tool (A) or protractor. Never judge by visual inspection without the tool.

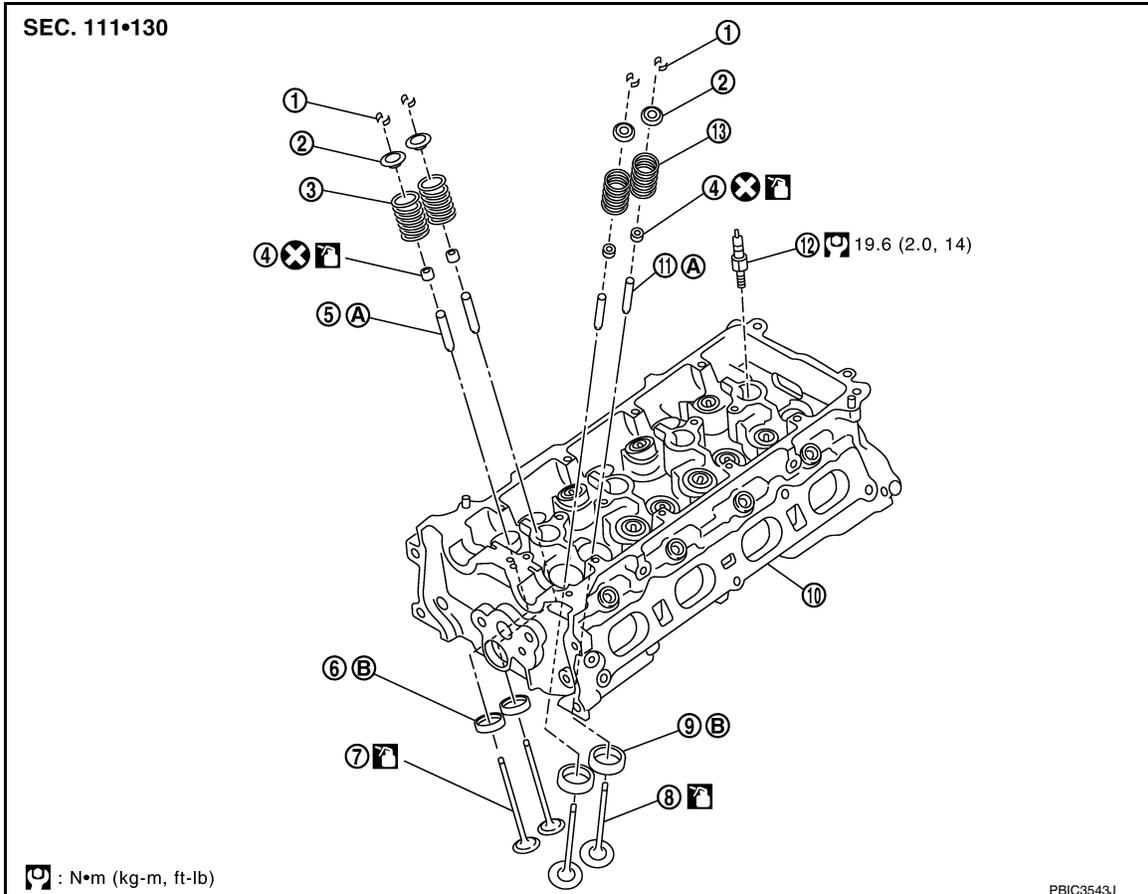
Tool number : KV10112100 (BT-8653-A)



4. Installation of the remaining components is in the reverse order of removal.

Component

INFOID:000000005398140



CYLINDER HEAD

[MR18DE]

< SERVICE INFORMATION >

- | | | |
|---|------------------------------------|--|
| 1. Valve collet | 2. Valve spring retainer | 3. Valve spring (EXH) (with valve spring seat) |
| 4. Valve oil seal | 5. Valve guide (EXH) | 6. Valve seat (EXH) |
| 7. Valve (EXH) | 8. Valve (INT) | 9. Valve seat (INT) |
| 10. Cylinder head | 11. Valve guide (INT) | 12. Spark plug |
| 13. Valve spring (INT) (with valve spring seat) | | |
| A. Refer to EM-186 | B. Refer to EM-186 | |

A

EM

C

Disassembly and Assembly

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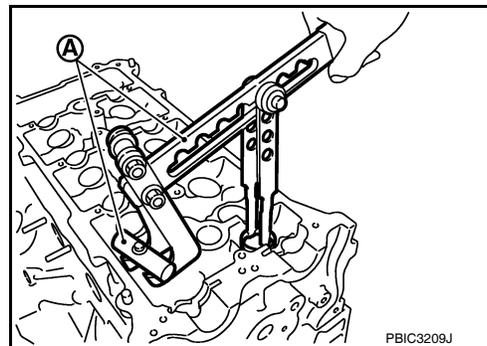
DISASSEMBLY

1. Remove spark plug using suitable tool.
2. Remove valve lifter.
 - Identify installation positions, and store them without mixing them up.
3. Remove valve collet.
 - Compress valve spring using Tool, attachment and adapter (A). Remove valve collet using a suitable magnet hand.

CAUTION:

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

Tool number : KV101092S0 (J-26336-B)



PBIC3209J

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

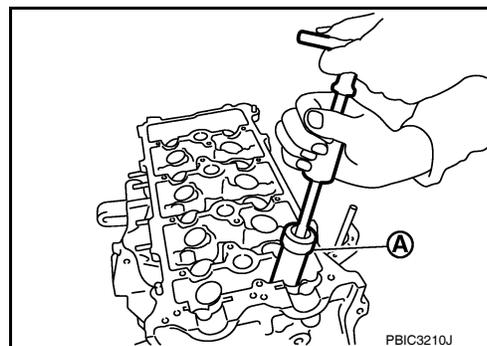
CAUTION:

Never remove valve spring seat from valve spring.

5. Push valve stem to combustion chamber side, and remove valve.

NOTE:
Identify installed positions, and store them without mixing them up.
6. Remove valve oil seal using Tool (A).

Tool number : KV10107902 (J-38959)



PBIC3210J

7. When valve seat must be replaced, refer to [EM-186, "Inspection After Disassembly"](#).
8. When valve guide must be replaced, refer to [EM-186, "Inspection After Disassembly"](#).

ASSEMBLY

1. Install valve guide if removed. Refer to [EM-186, "Inspection After Disassembly"](#).
2. Install valve seat if removed. Refer to [EM-186, "Inspection After Disassembly"](#).

CYLINDER HEAD

[MR18DE]

< SERVICE INFORMATION >

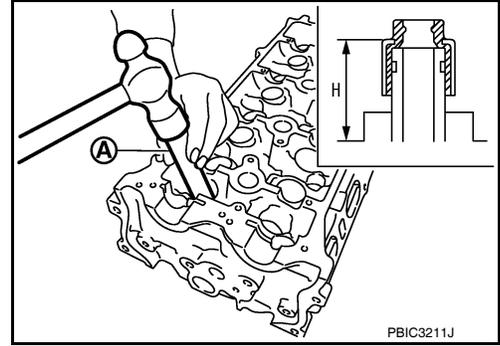
3. Install valve oil seal.
 - Install with a valve oil seal using Tool (A) to match dimension as shown.

Tool number : KV10115600 (J-38958)

NOTE:

Dimension (H) is height that measured before installing valve spring (with valve spring seat).

Height (H) : 15.1 - 15.7 mm (0.594 - 0.618 in)

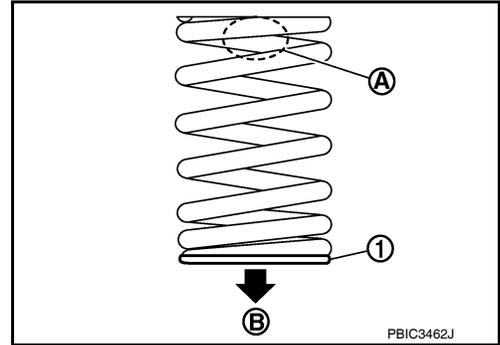


4. Install valve.
 - Install larger diameter to intake side.
5. Install valve spring (with valve spring seat).
 - Install smaller pitch (valve spring seat side) to cylinder head side (B).
 - Confirm identification color (A) of valve spring.

1 : Valve spring seat (Do not remove from valve spring.)

Intake : White

Exhaust : Orange



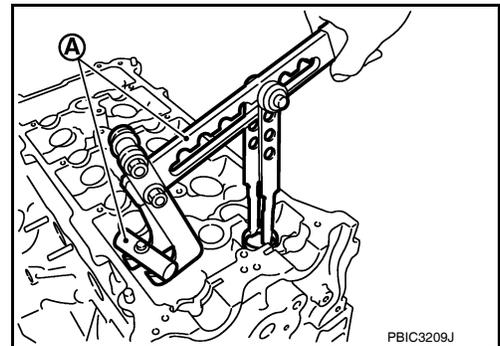
6. Install valve spring retainer.
7. Install valve collet.
 - Compress valve spring using Tool, attachment and adapter (A). Install valve collet with a magnet hand.

Tool number : KV101092S0 (J-26336 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.



8. Install valve lifter.
 - Install it in the original position.
9. Install spark plug using suitable tool.

Inspection After Disassembly

INFOID:000000005398142

VALVE DIMENSIONS

- Check dimensions of each valve. For dimensions, refer to [EM-223. "Standard and Limit"](#).
- If dimensions are out of the standard, replace valve.

VALVE GUIDE CLEARANCE

Valve Stem Diameter

CYLINDER HEAD

< SERVICE INFORMATION >

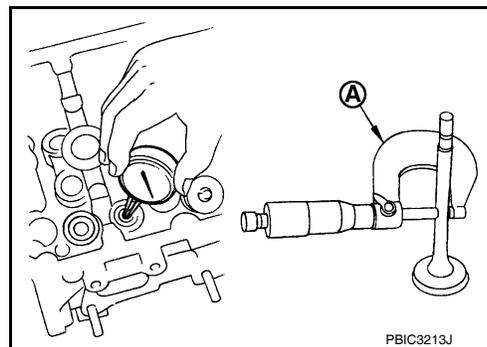
[MR18DE]

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

Standard

Intake : 5.465 - 5.480 mm (0.2152 - 0.2157 in)

Exhaust : 5.455 - 5.470 mm (0.2148 - 0.2154 in)



Valve Guide Inner Diameter

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

Standard

: 5.500 - 5.518 mm (0.2165 - 0.2172 in)

Valve Guide Clearance

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

Valve guide clearance:

Standard

Intake : 0.020 - 0.053 mm (0.0008 - 0.0021 in)

Exhaust : 0.030 - 0.063 mm (0.0012 - 0.0025 in)

Limit

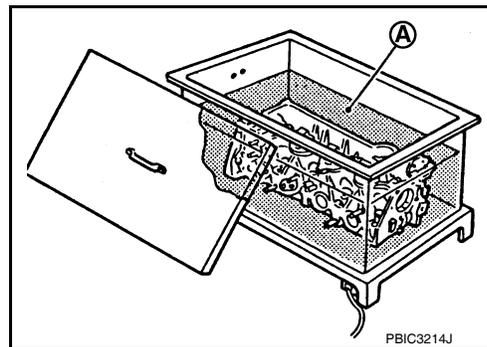
: 0.1 mm (0.004 in)

- If it exceeds the limit, replace valve guide and/or valve.

VALVE GUIDE REPLACEMENT

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

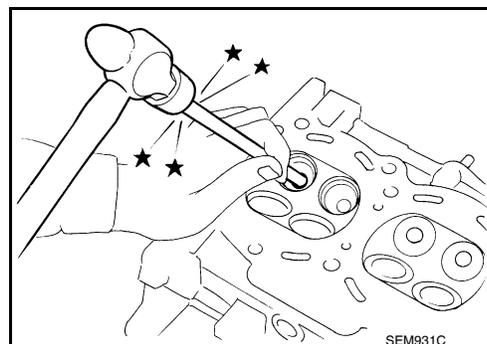
1. To remove valve guide, heat cylinder head to 110° to 130°C (230° to 266°F) by soaking in heated oil (A).



2. Drive out valve guide using suitable tools.

WARNING:

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



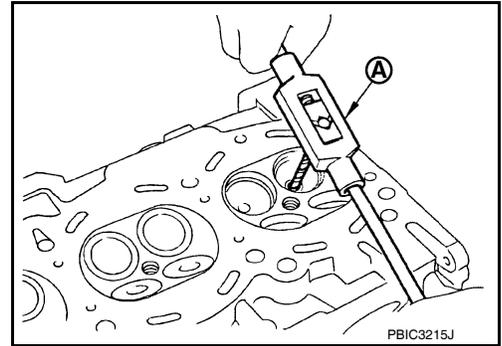
CYLINDER HEAD

[MR18DE]

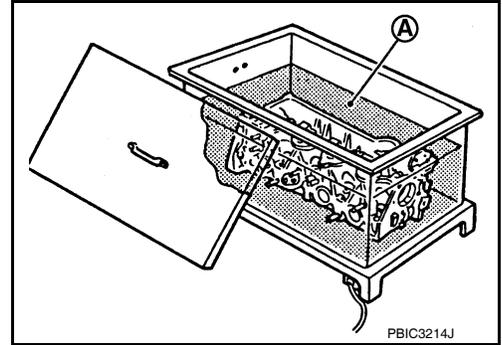
< SERVICE INFORMATION >

3. Ream cylinder head valve guide hole using suitable tool (A).

Valve guide hole diameter (for service parts):
: 9.675 - 9.696 mm (0.3809 - 0.3817 in)



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



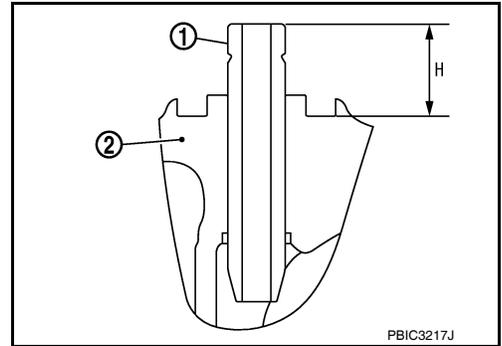
5. Press valve guide (1) from camshaft side to dimensions as shown.

2 : Cylinder head

Projection (H) : 13.35 - 13.65 mm (0.526 - 0.537 in)

WARNING:

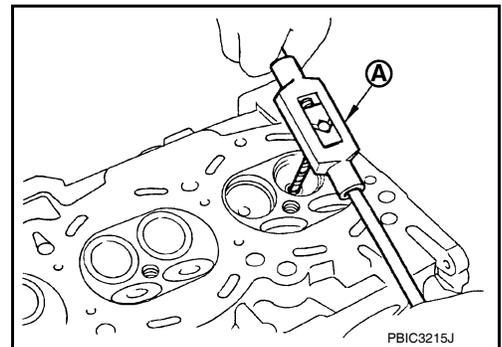
Cylinder head contains heat, when working, wear protective equipment to avoid getting burned.



6. Apply reamer finish to valve guide using suitable tool (A).

Standard

: 5.500 - 5.518 mm (0.2165 - 0.2172 in)



VALVE SEAT CONTACT

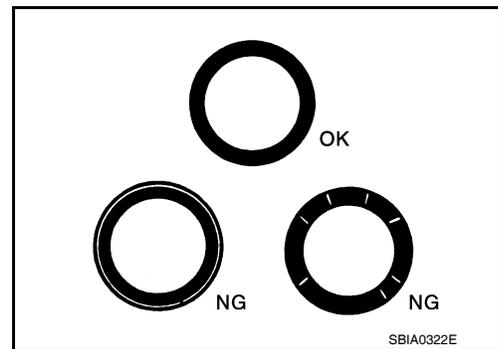
- After confirming that the dimensions of valve guides and valves are within specifications, perform this procedure.
- Apply prussian blue (or white lead) onto contacting surface of valve seat to check the condition of the valve contact on the surface.

CYLINDER HEAD

[MR18DE]

< SERVICE INFORMATION >

- Check if the contact area band is continuous all around the circumference.
- If not, grind to adjust valve fitting and check again. If the contacting surface still has NG conditions even after the re-check, replace valve seat.



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. Refer to [EM-223, "Standard and Limit"](#).
2. Ream cylinder head (1) recess diameter for service valve seat.

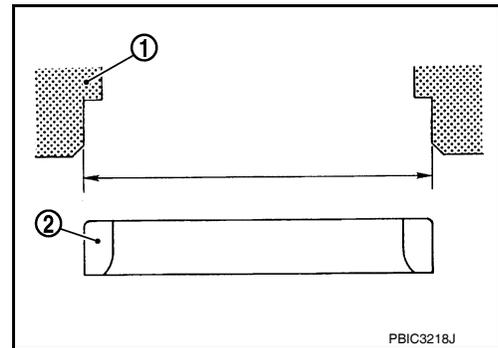
2 : Valve seat

Oversize [0.5 mm (0.020 in)]

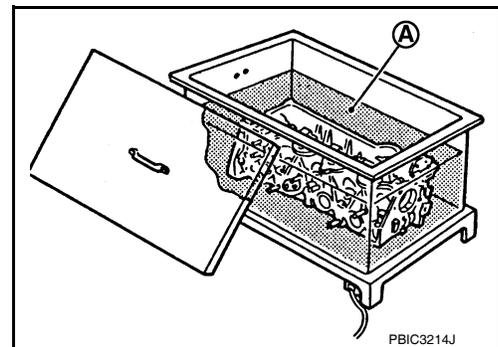
Intake : 35.200 - 35.227 mm (1.3858 - 1.3869 in)

Exhaust : 29.200 - 29.227 mm (1.1496 - 1.1507 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 (A).



4. Use dry ice to thoroughly cool valve seats. Press-fit valve seat into cylinder head.

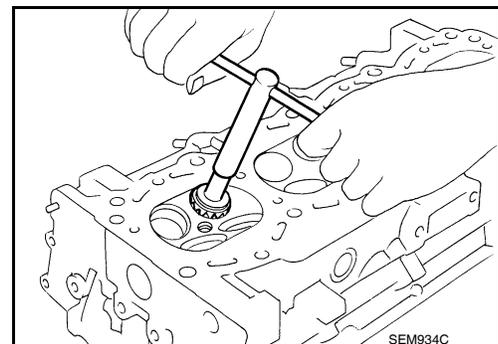
WARNING:

- **Never touch cold valve seats directly.**
- **Cylinder head contains heat, when working, wear protective equipment to avoid getting burned.**

5. Using valve seat cutter set or valve seat grinder, finish valve seat to the specified dimensions. For dimensions, refer to [EM-223, "Standard and Limit"](#).

CAUTION:

When using 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 the cutter or cutting many different times may result in staged valve seat.



6. Using compound, grind to adjust valve fitting.
7. Check again for normal contact.

CYLINDER HEAD

[MR18DE]

< SERVICE INFORMATION >

VALVE SPRING SQUARENESS

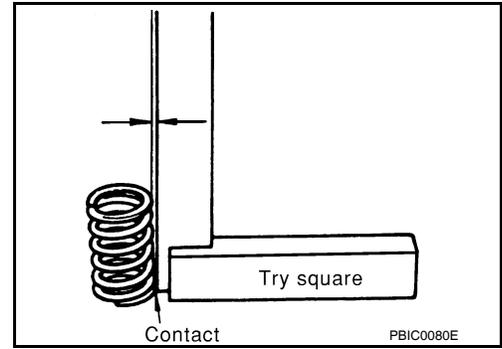
- Set try square along the side of valve spring and rotate the spring. Measure the maximum clearance between the top of valve spring and try square.

CAUTION:

Never remove valve spring seat from valve spring.

Limit: 1.9 mm (0.075 in)

- If it exceeds the limit, replace valve spring (with valve spring seat).

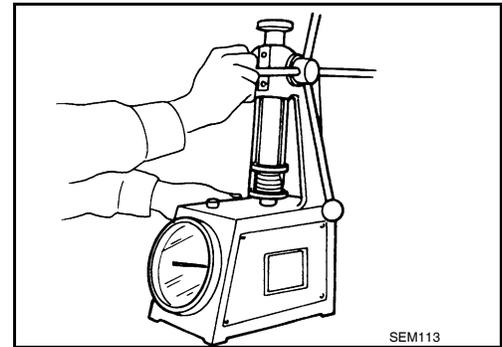


VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

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

CAUTION:

Never remove valve spring seat from valve spring.



Standard:

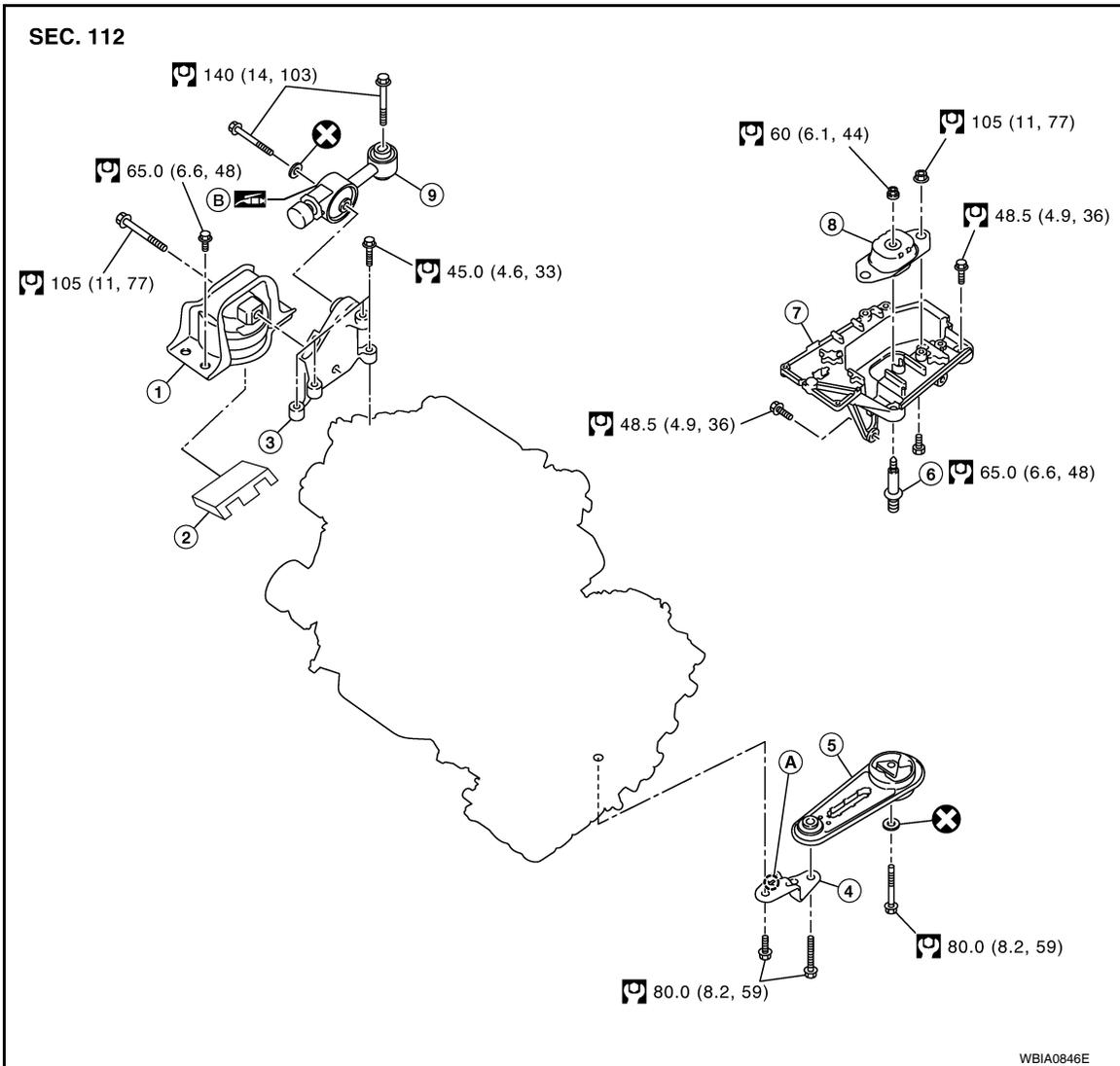
Items	Intake	Exhaust
Free height	44.90 - 45.10 mm (1.7677 - 1.7755 in)	45.74 - 45.94 mm (1.8007 - 1.8086 in)
Installation height	35.30 mm (1.390 in)	35.30 mm (1.390 in)
Installation load	153 - 173 N (15.6 - 17.6 kg, 34 - 39 lb)	139 - 157 N (14.2 - 16 kg, 31 - 35 lb)
Height during valve open	26.36 mm (1.0377 in)	27.80 mm (1.0944 in)
Load with valve open	335 - 377 N (34.2 - 38.5 kg, 75 - 85 lb)	266 - 297 N (27.1 - 30.3 kg, 60 - 67 lb)
Identification color	White	Orange

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

ENGINE ASSEMBLY

Component

INFOID:000000005398143



- | | | |
|-----------------------------------|--|---------------------------------|
| 1. Engine mounting Insulator (RH) | 2. Engine mounting shim (RH) (if equipped) | 3. Engine mounting bracket (RH) |
| 4. Bracket | 5. Rear torque rod | 6. Engine through bolt |
| 7. Engine mounting bracket (LH) | 8. Engine mounting insulator (LH) | 9. Torque rod (RH) |
| A. Front mark | B. Silicone lubricant | |

Removal and Installation

INFOID:000000005398144

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.
- Do not start working until exhaust system and coolant are cool enough.
- If items or work required are not covered by the engine section, follow the applicable procedures.
- Always use the support point specified for lifting.

ENGINE ASSEMBLY

[MR18DE]

< SERVICE INFORMATION >

- 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-38. "Garage Jack and Safety Stand and 2-Pole Lift"](#).

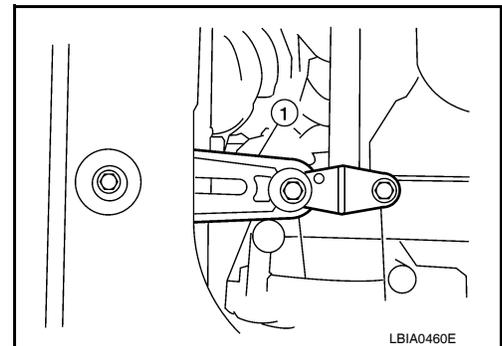
REMOVAL

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

1. Remove engine under cover. Refer to [EI-15. "Removal and Installation"](#).
 2. Drain engine coolant from radiator. Refer to [CO-36. "Changing Engine Coolant"](#).
- CAUTION:**
- Perform this step when the engine is cold.
 - Do not spill engine coolant on drive belt.
3. Drain clutch fluid (M/T models). Refer to [CL-9. "Air Bleeding Procedure"](#).
 4. Drain M/T oil (M/T models). Refer to [MT-54. "Changing M/T Oil"](#).
 5. Remove front fender protector (RH and LH). Refer to [EI-24](#).
 6. Remove exhaust front tube. Refer to [EX-11](#).
 7. Remove drive shafts (LH and RH) from steering knuckle. Refer to [FAX-9](#).
 8. Remove transaxle joint bolts which pierce at oil pan (upper) lower rear side. Refer to [AT-233](#) (A/T models), [CVT-173. "Removal and Installation"](#) (CVT models) or [MT-61. "Removal and Installation"](#) (M/T models).
 9. Remove rear torque rod (1).

NOTE:

A/T model shown CVT and M/T models similar.



10. Remove hood assembly. Refer to [BL-13](#).
 11. Remove cowl top cover and cowl top extension assembly. Refer to [EI-22](#).
 12. Release fuel pressure. Refer to [EC-582. "Fuel Pressure Check"](#).
 13. Remove battery and battery tray. Refer to [SC-5](#).
 14. Remove drive belt; Refer to [EM-132. "Component"](#).
 15. Remove engine room cover.
 16. Remove air duct and air cleaner case assembly. Refer to [EM-135](#).
 17. Remove cooling fan assembly. Refer to [CO-43. "Removal and Installation"](#).
 18. Remove radiator hose (upper and lower). Refer to [CO-40](#).
 19. Disconnect A/T, CVT fluid cooler hoses (A/T or CVT models). Refer to [CO-40](#).
 20. Disconnect all connections of engine harness around the engine mounting insulator (LH), and then temporarily secure the engine harness into the engine side.
- CAUTION:**
- Protect connectors using a resin bag to protect against foreign materials during the operation.**
21. Disconnect fuel feed hose at engine side. Refer to [EM-152. "Component"](#).
 22. Disconnect heater hoses, and install plugs in them to prevent engine coolant from draining. Refer to [CO-48. "Component"](#).
 23. Disconnect control cable from transaxle. Refer to [CVT-173. "Removal and Installation"](#) (CVT models), [AT-213](#) (A/T models) or [MT-61. "Removal and Installation"](#) (M/T models).
 24. Remove ground cable at transaxle side.
 25. Remove ground cable between front cover and vehicle.
 26. Remove generator. Refer to [SC-21](#).

ENGINE ASSEMBLY

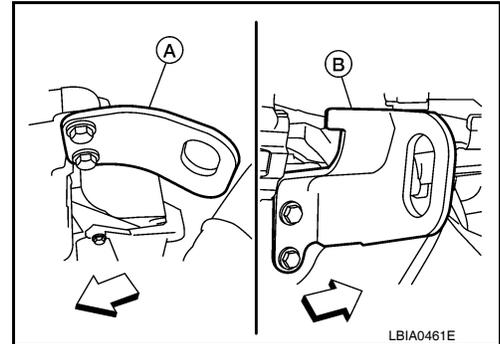
[MR18DE]

< SERVICE INFORMATION >

27. Remove A/C compressor with piping connected from the engine. Temporarily secure it on the vehicle side with a rope to avoid putting load on it. Refer to [MTC-81, "Removal and Installation of Compressor - MR18DE"](#).
28. Remove the intake manifold to prevent the hanging chain from interfering. Refer to [EM-137, "Component"](#).
29. 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 : 25.5 N·m (2.6 kg-m, 19 ft-lb)

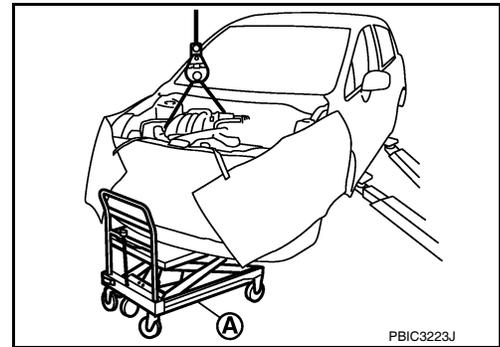


30. Support engine and transaxle assembly with a hoist and secure the engine in appropriate position.

31. Use a manual lift table caddy (A) or equivalently rigid tool such as a transmission jack. Securely support bottom of the engine and the transaxle, and simultaneously adjust hoist tension.

CAUTION:

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

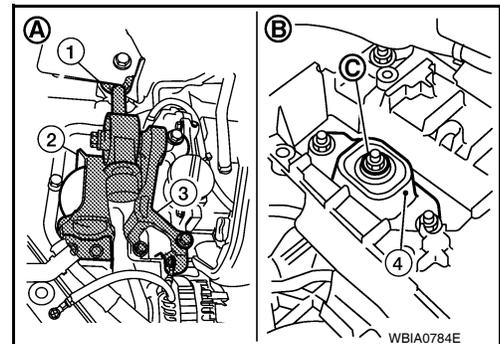


32. Remove torque rod (RH) (1), engine insulator (RH) (2) and engine bracket (RH) (3).

4 : Engine insulator (LH)

A : Engine front side

B : Transaxle side



33. Remove engine through bolt-securing nut (C).

34. Remove the engine and the transaxle assembly from the vehicle downward by carefully operating supporting tools.

CAUTION:

- During the operation, make sure that no part interferes with the vehicle side.
- Before and during this lifting, always check if any harnesses are left connected.
- During the removal operation, 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.
- During operation, securely support the engine by placing a piece of wood under the engine oil pan and transaxle oil pan. Securely support the engine slingers with a hoist.

35. Remove starter motor. Refer to [SC-9](#).

36. Separate the engine and the transaxle and mount the engine on a suitable engine stand. Refer to [AT-233 \(A/T models\)](#), [CVT-173, "Removal and Installation"](#) (CVT models) or [MT-61, "Removal and Installation"](#) (M/T models).

INSTALLATION

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

ENGINE ASSEMBLY

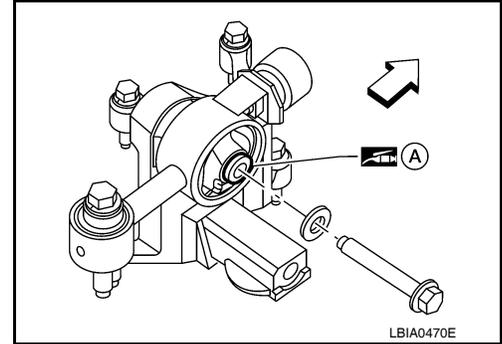
[MR18DE]

< SERVICE INFORMATION >

- Do not allow engine oil to get on engine mounting insulator. Be careful not to damage engine mounting insulator.
- When installation directions are specified, install parts according to the directions. Refer to [EM-191. "Component"](#).
- Prior to installing the upper torque rod, apply a light coat of silicone lubricant (A) to the washer facing side of the bushing inner tube as shown.

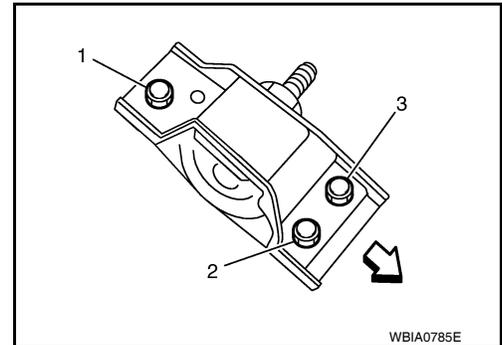
NOTE:

- Apply silicone lubricant (A) by dabbing the outward facing tube surface with a sponge or suitable tool.
- Do not apply excess lubricant.



↔ : Vehicle front

- Make sure that each mounting insulator is seated properly, and tighten nuts and bolts.
- Tighten engine mounting insulator (RH) bolts in the numerical order shown.



↔ : Vehicle front

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-14](#).
- 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 make sure 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:

Item	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/CVT fluid, power steering fluid, brake fluid, etc.

CYLINDER BLOCK

< SERVICE INFORMATION >

[MR18DE]

CYLINDER BLOCK

Component

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A

EM

C

D

E

F

G

H

I

J

K

L

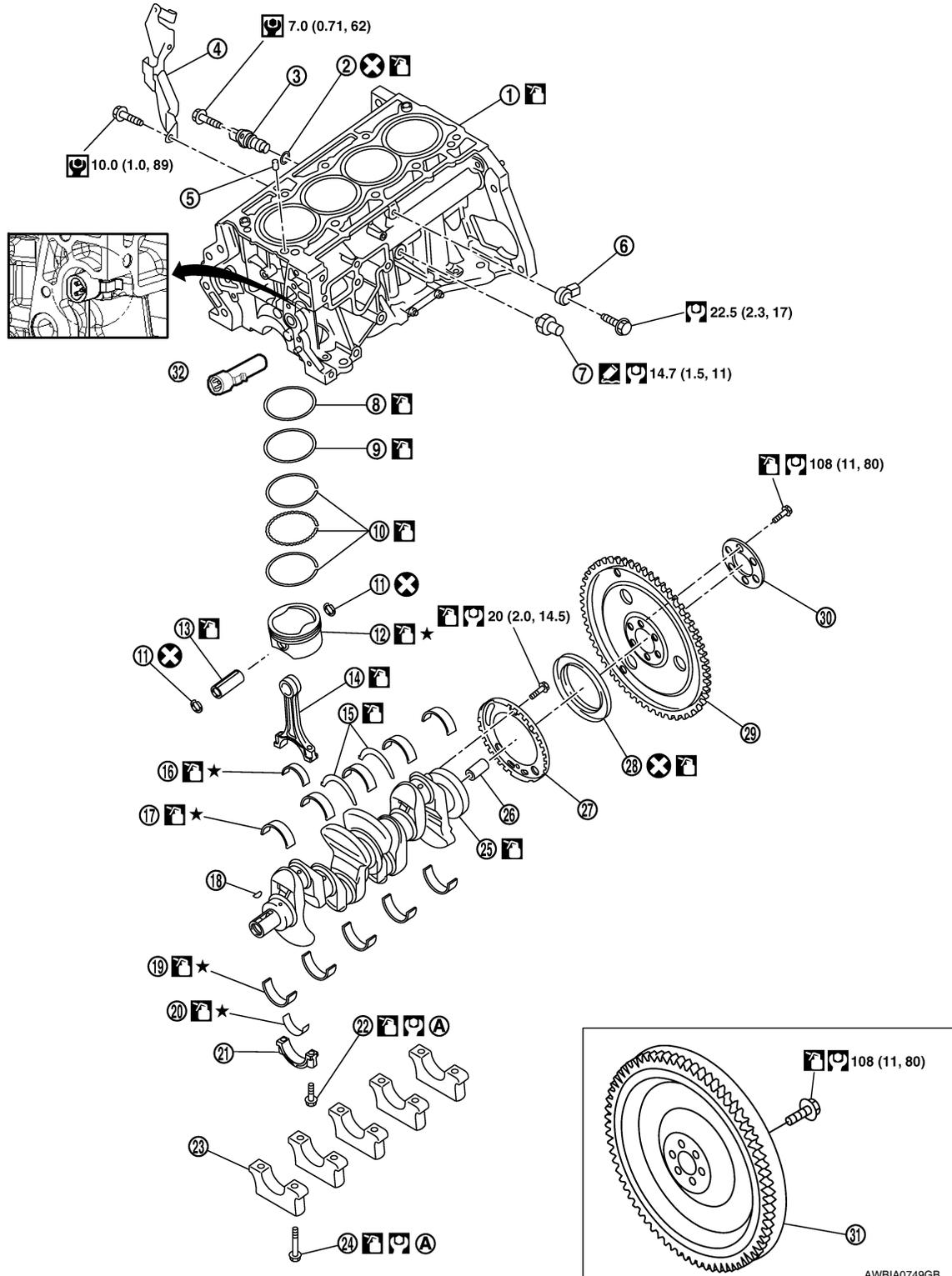
M

N

O

P

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- | | | |
|---|---|-------------------------------------|
| 1. Cylinder block | 2. O-ring | 3. Crankshaft position sensor (POS) |
| 4. Crankshaft position sensor (POS) cover | 5. Oil filter (for intake valve timing control) | 6. Knock sensor |

CYLINDER BLOCK

[MR18DE]

< SERVICE INFORMATION >

- | | | |
|----------------------------------|---|---|
| 7. Oil pressure switch | 8. Top ring | 9. Second ring |
| 10. Oil ring | 11. Snap ring | 12. Piston |
| 13. Piston pin | 14. Connecting rod | 15. Thrust bearing |
| 16. Connecting rod bearing upper | 17. Main bearing upper | 18. Crankshaft key |
| 19. Main bearing lower | 20. Connecting rod bearing lower | 21. Connecting rod bearing cap |
| 22. Connecting rod bolt | 23. Main bearing cap | 24. Main bearing cap bolt |
| 25. Crankshaft | 26. Pilot converter (A/T or CVT models) | 27. Signal plate |
| 28. Rear oil seal | 29. Drive plate (A/T or CVT models) | 30. Reinforcement plate (A/T or CVT models) |
| 31. Flywheel (M/T models) | 32. Block heater (Canada only) | A. Refer to EM-196 |

Disassembly and Assembly

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DISASSEMBLY

1. Remove engine and transaxle assembly from vehicle, separate transaxle from engine. Refer to [EM-191](#).
2. Install engine to engine stand as follows;
 - a. Remove flywheel (M/T models) or drive plate (1) (A/T or CVT models).
 - Secure flywheel (M/T models) or drive plate (A/T or CVT models) using Tool (A), and remove bolts.

Tool number : KV 11105210 (J-44716)

CAUTION:

Be careful not to damage or scratch drive plate (A/T or CVT models) and contact surface for clutch disc of flywheel (M/T models).

NOTE:

Figure shows drive plate (1) (A/T or CVT models)

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

CAUTION:

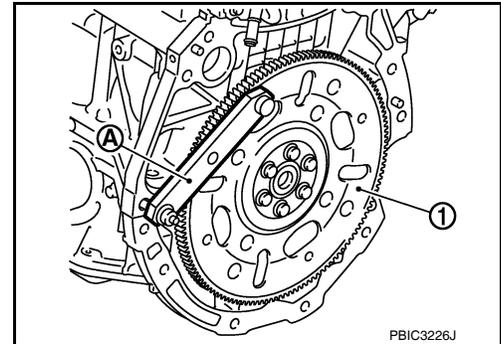
- Use the engine stand that has a load capacity [approximately 135 kg (298 lb) or more] large enough for supporting the engine weight.
- If the load capacity of stand is not adequate, remove the following parts beforehand to reduce the potential risk of overturning stand.
 - Exhaust manifold; Refer to [EM-140](#).
 - Rocker cover; Refer to [EM-149](#).

NOTE:

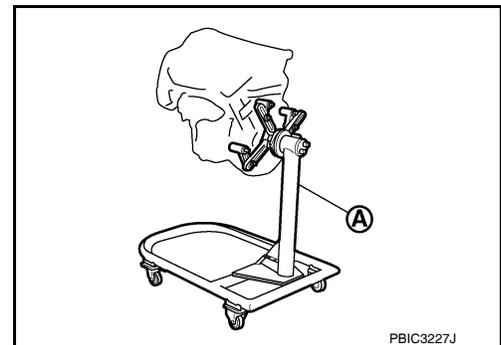
The figure shows an example of widely used engine stand (A) that can support mating surface of transaxle with flywheel (M/T models) or drive plate (A/T or CVT models) removed.

CAUTION:

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



PBIC3226J



PBIC3227J

3. Remove oil pan (upper and lower). Refer to [EM-143](#).
4. Remove cylinder head. Refer to [EM-181](#).
5. Remove thermostat housing. Refer to [CO-46](#).
6. Remove knock sensor.
CAUTION:
Carefully handle knock sensor avoiding shocks.
7. Remove crankshaft position sensor (POS) cover and crankshaft position sensor (POS).

CYLINDER BLOCK

[MR18DE]

< SERVICE INFORMATION >

CAUTION:

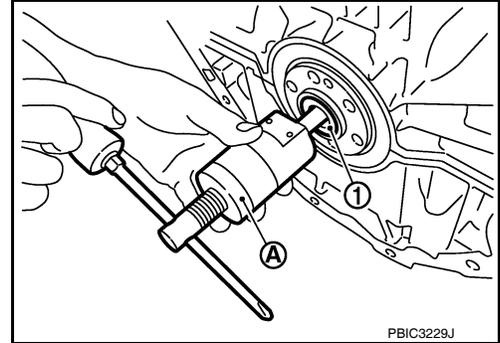
- Avoid impacts such as a dropping.
- Never disassemble.
- Keep it away from metal particles.
- Never place sensor in a location where it is exposed to magnetism.

8. Remove oil filter (for intake valve timing control).
9. Remove pilot converter (1) using Tool (A). (A/T or CVT models)

Tool number :ST16610001 (J-23907)

NOTE:

M/T models have no pilot converter.



10. Position crankshaft pin corresponding to connecting rod to be removed onto the bottom dead center.

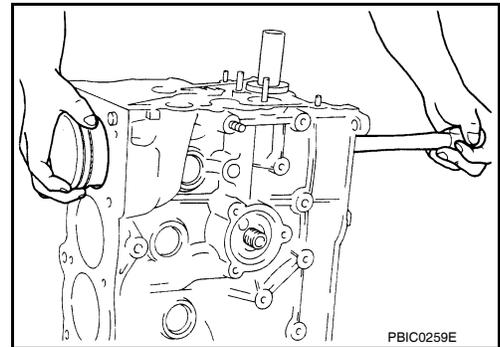
NOTE:

Before removing piston and connecting rod assembly, check the connecting rod side clearance. Refer to [EM-212. "Inspection After Disassembly"](#).

11. Remove connecting rod cap.
12. Using a suitable 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.



13. Remove connecting rod bearings.

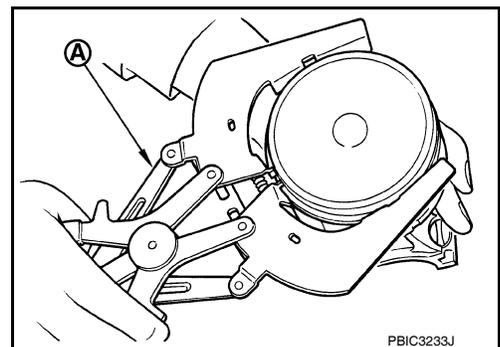
CAUTION:

When removing them, note the installation position. Keep them in the correct order.

14. Remove piston rings from piston.
 - Before removing piston rings, check the piston ring side clearance. Refer to [EM-212. "Inspection After Disassembly"](#).
15. Using a suitable tool (A) remove piston rings.

CAUTION:

- When removing piston rings, be careful not to damage the piston.
- Be careful not to damage piston rings by expanding them excessively.

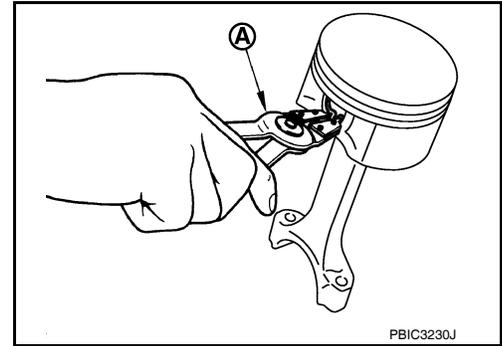


CYLINDER BLOCK

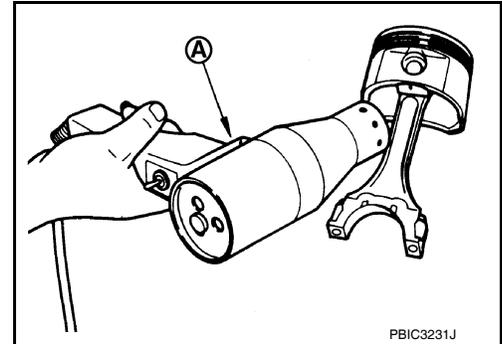
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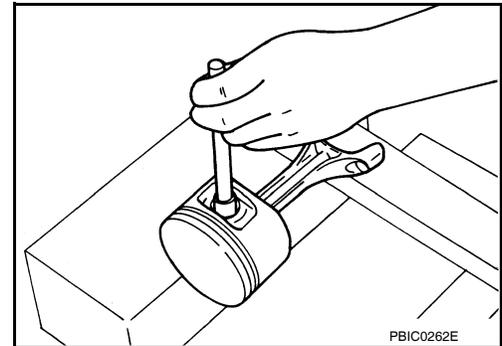
16. Using snap ring pliers (A), remove snap rings.



17. Heat piston to 60° to 70°C (140° to 158°F) using a suitable tool (A).



18. Push out piston pin using a suitable tool of an outer diameter approximately 18 mm (0.71 in).



19. Loosen main bearing cap bolts in reverse order as shown, and remove them.

NOTE:

Before loosening main bearing cap bolts, measure crankshaft end play. Refer to [EM-212, "Inspection After Disassembly"](#).

⇐ : Engine front

20. Remove main bearing caps.

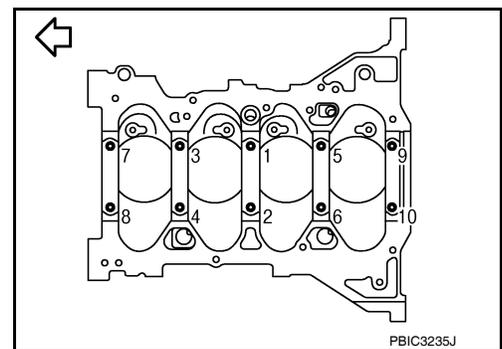
- Tap main bearing caps lightly using a suitable tool for removal.

CAUTION:

Be careful not to damage the mounting surface.

21. Remove crankshaft.

CAUTION:



CYLINDER BLOCK

< SERVICE INFORMATION >

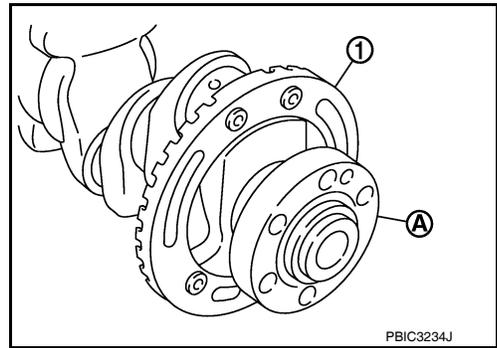
[MR18DE]

- Be careful not to damage or deform signal plate (1) mounted on rear end of crankshaft (A).
- 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.

22. Pull rear oil seal out from rear end of crankshaft.
23. Remove main bearings and thrust bearings from cylinder block and main bearing caps.

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.

WARNING:

Use goggles to protect your eyes.

2. Install water drain plug (1) to cylinder block.

⇐ : Engine front

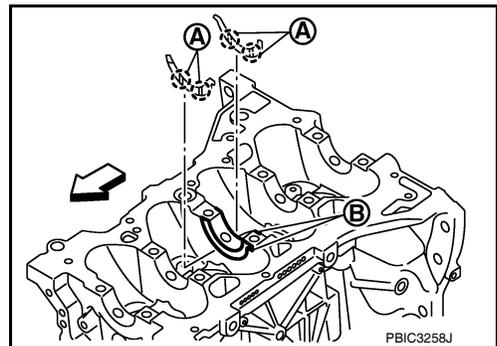
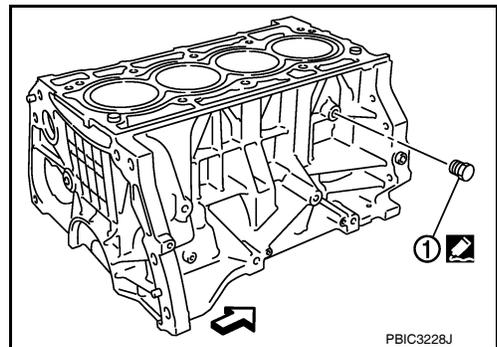
- Apply liquid gasket to the drain plug thread.
Use Genuine Silicone RTV Sealant or equivalent. Refer to [GI-42, "Recommended Chemical Product and Sealant"](#).

9.8 N·m (1.0 kg-m, 87 in-lb)

3. Remove dust, dirt, and engine oil on the bearing mating surfaces of cylinder block and main bearing cap.
4. Install thrust bearings to 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).



5. Install the main bearings paying attention to the direction.

CAUTION:

- Before installing main bearings, apply new engine oil to the bearing surface (inside). Do not apply new 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.

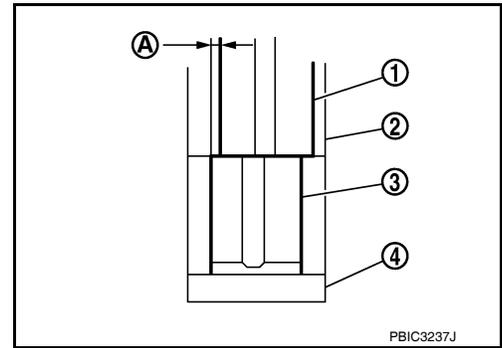
CYLINDER BLOCK

[MR18DE]

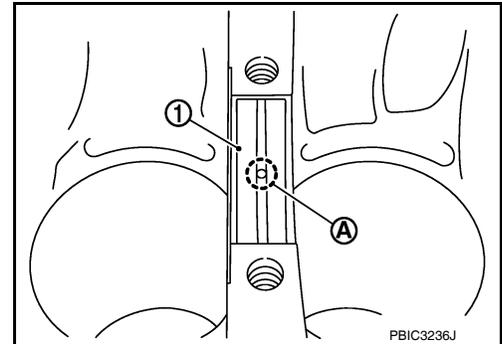
< SERVICE INFORMATION >

- The difference (A) between main bearing upper (1) and main bearing lower (3) should be 0.85 mm (0.033 in) or less when installing.

- 2 : Cylinder block
4 : Main bearing cap



- Ensure the oil holes on cylinder block and oil holes (A) on the main bearings (1) are aligned.



6. Install signal plate to crankshaft if removed.
7. Set the signal plate with the flange facing toward the counter weight side (engine front side) to the crankshaft rear surface.
8. Apply new engine oil to threads and seat surfaces of bolts.
9. Position crankshaft (2) and signal plate (1) using a dowel pin (service part), and tighten bolts in numerical order as shown.

A : Dowel pin hole

NOTE:

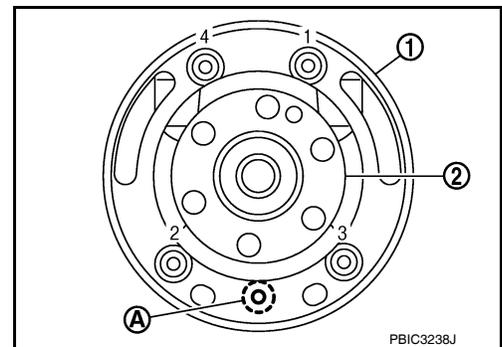
Dowel pin of crankshaft and signal plate is provided as a set for each.

10. Tighten bolts in numerical order as shown.
11. Remove dowel pin. (service parts)

CAUTION:

Be sure to remove dowel pin.

12. Install crankshaft to cylinder block.
 - While turning crankshaft by hand, make sure that it turns smoothly.

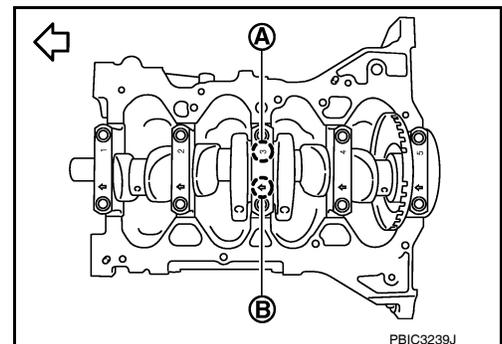


13. Install main bearing caps referring to the journal No. stamp (A) and front mark (B) as shown.

← : Engine front

NOTE:

Main bearing cap cannot be replaced as a single part, because it is machined together with cylinder block.



14. Apply new engine oil to threads and seat surfaces of bolts.

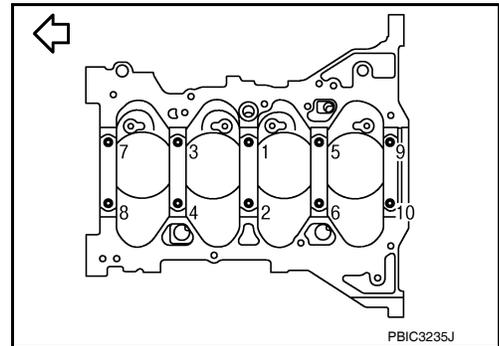
CYLINDER BLOCK

[MR18DE]

< SERVICE INFORMATION >

15. Tighten main bearing cap bolts in two steps in numerical order as shown.

↶ : Engine front



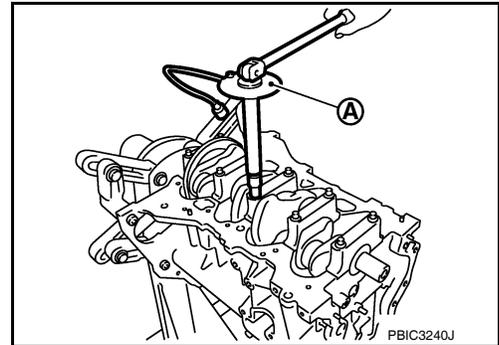
CAUTION:

Measure the angle in step 2 using Tool (A). Do not measure visually.

Step 1 : 34.3 N·m (3.5 kg-m, 25 ft-lb)

Step 2 : 60° clockwise

Tool number : KV10112100 (BT-8653-A)



- After installing bolts, make sure that crankshaft can be rotated smoothly by hand.
- Check crankshaft end play. Refer to [EM-212. "Inspection After Disassembly"](#).

16. Using snap ring pliers, install new snap ring to the groove of the piston rear side.
- Insert it fully into groove to install.

17. Assemble piston to connecting rod.

- Using a suitable tool, heat the piston until the piston pin can be pushed in by hand without excess force [approximately 60° to 70 °C (140° to 158 °F)]. From the front to the rear, insert piston pin into piston and connecting rod.
- Assemble so that the front mark (A) on the piston head and the oil hole (B) and the cylinder number (C) on connecting rod are positioned as shown.

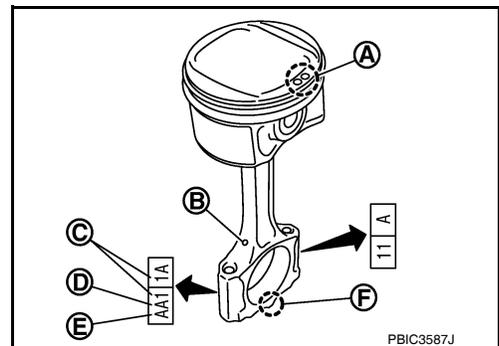
D : Big end diameter grade

E : Small end diameter grade

F : Front mark (connecting rod bearing cap)

18. Install new snap ring to the groove of the piston front side.

- Insert it fully into groove to install.
- After installing, make sure that connecting rod moves smoothly.



19. Using a suitable tool, install piston rings.

CAUTION:

- Be careful not to damage piston.
- Be careful not to damage piston rings by expanding them excessively.

CYLINDER BLOCK

[MR18DE]

< SERVICE INFORMATION >

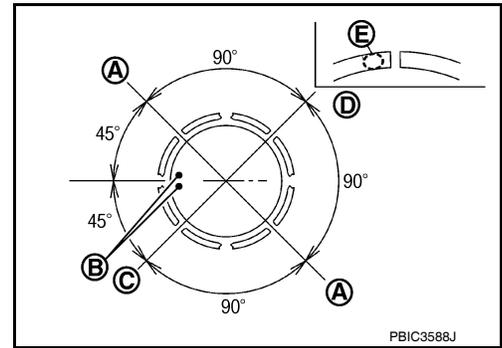
- Position each ring with the gap as shown referring to the piston front mark.

- A : Oil ring upper or lower rail gap
- B : Front mark
- C : Second ring and oil ring spacer gap
- D : Top ring gap
- E : Stamped mark

CAUTION:

Never contact the rail end gap under the oil ring with the oil drain cast groove of piston.

- Install second ring with the stamped surface facing upward.



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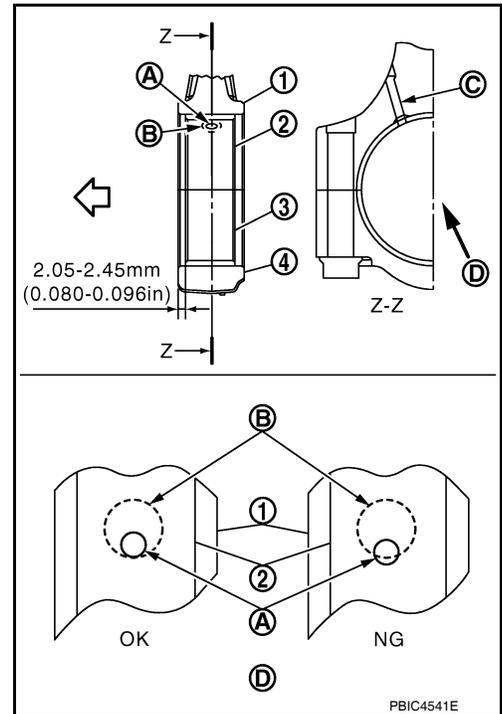
20. Install connecting rod bearing upper (2) and lower (3) to connecting rod (1) and connecting rod cap (4).

- C : Oil hole (connecting rod)
- D : Arrow view
- ↔ : Engine front

- Install the connecting rod in the dimension shown.
- Make sure that connecting rod bearing oil hole (A) is completely in the inside of connecting rod oil hole chamfered area (B).
- When installing connecting rod bearings, apply new engine oil to the bearing surface (inside). Do not apply new engine oil to the back surface, but thoroughly clean it.

NOTE:

- There is no positioning tab.
- Install the connecting rod bearings in the center of connecting rod and connecting rod bearing cap as shown. For service operation, the center position can be checked, visually.



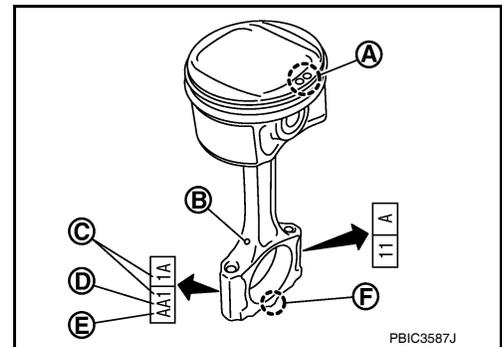
PBIC4541E

21. 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 (C) on connecting rod to install.

- B : Oil hole
- D : Big end diameter grade
- E : Small end diameter grade
- F : Front mark (connecting rod bearing cap)

- Install so that front mark (A) on the piston head faces the front of engine.



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CYLINDER BLOCK

[MR18DE]

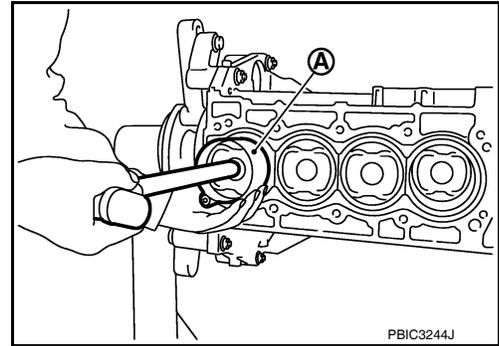
< SERVICE INFORMATION >

- Using Tool (A), install piston with the front mark on the piston head facing the front of the engine.

CAUTION:

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

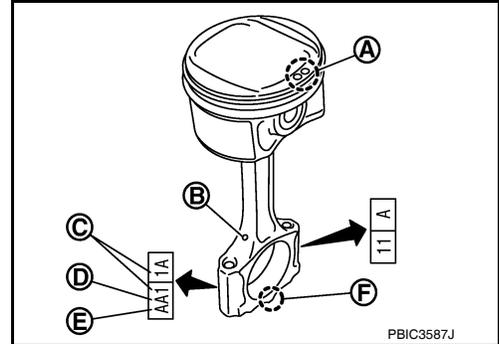
Tool number : EM03470000 (J-8037)



22. 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 (piston)
- B : Oil hole
- D : Big end diameter grade
- E : Small end diameter grade
- F : Front mark (connecting rod bearing cap)



23. Tighten connecting rod bolt with the following procedure:

CAUTION:

- Make sure that there is no gap in the thrust surface (A) of the joint between connecting rod (1) and connecting rod bearing cap (2) and that these parts are in the correct position. And then, tighten the connecting rod bolts.
- If the connecting rod bolts are reused, measure the outer diameter. Refer to [EM-212, "Inspection After Disassembly"](#).

- Apply new engine oil to the threads and seats of connecting rod bolts.
- Tighten connecting rod bolts in two steps using Tool.

Step 1 : 19.6 N·m (2.0 kg-m, 14 ft-lb)

Step 2 : 60° clockwise

Tool number : KV10112100 (BT-8653-A)

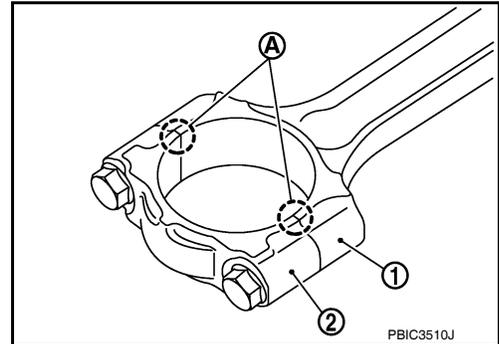
- After tightening connecting rod bolt, make sure that crankshaft rotates smoothly.
- Check the connecting rod side clearance. Refer to [EM-212, "Inspection After Disassembly"](#).

24. Install oil pan (upper). Refer to [EM-143](#).

NOTE:

Install the rear oil seal after installing the oil pan (upper).

25. Install rear oil seal. Refer to [EM-143](#).



CYLINDER BLOCK

[MR18DE]

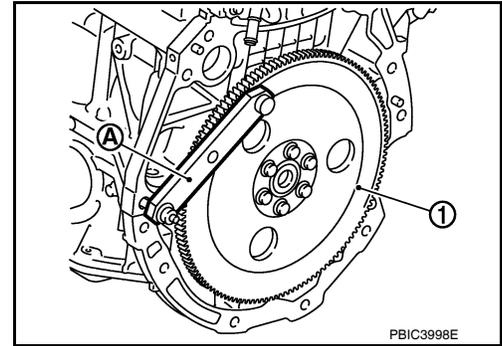
< SERVICE INFORMATION >

26. Install flywheel (M/T models) or drive plate (1) (A/T or CVT models).
- Secure crankshaft using Tool (A), and tighten bolts crosswise over several times.

Tool number : KV11105210 (J-44716)

NOTE:

A/T model shown CVT and M/T similar.



- Install pilot converter (3), drive plate (1) and reinforcement plate (2) as shown (A/T or CVT models).

A : Crankshaft rear end

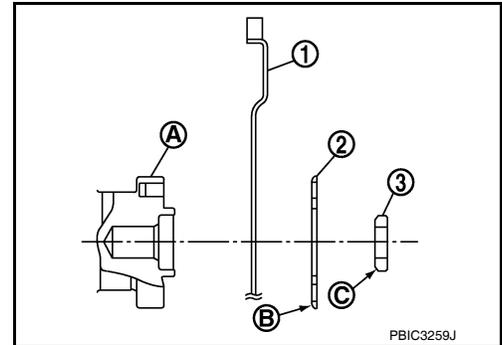
B : Rounded

C : Chamfered

- Using a suitable tool of 33 mm (1.30 in) in diameter, press-fit pilot converter into the end of crankshaft until it stops (A/T or CVT models).

NOTE:

M/T models have no pilot converter and reinforcement plate.



27. Install knock sensor (1) with connector facing toward the rear of engine.

A : Cylinder block left side

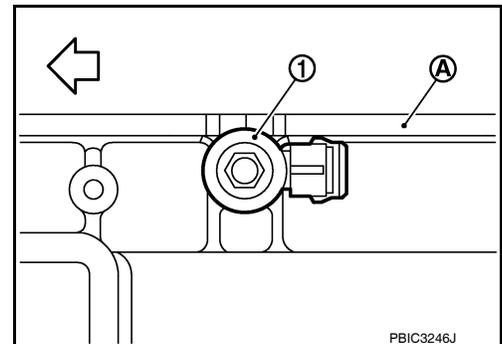
⇐ : Engine front

CAUTION:

- Never tighten bolts while holding the connector.
- If any impact by dropping is applied to knock sensor, replace it with a new one.

NOTE:

- Make sure that there is no foreign material on the cylinder block mating surface and the back surface of knock sensor.
- Make sure that knock sensor does not interfere with other parts.



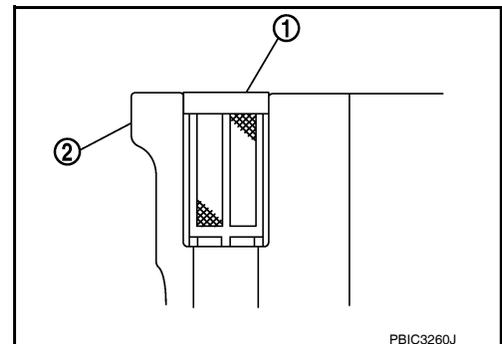
28. Install crankshaft position sensor (POS) and crankshaft position sensor (POS) cover.

CAUTION:

- Avoid impacts such as a dropping.
- Keep it away from metal particles.
- Never place sensor in a location where it is exposed to magnetism.

29. Install oil filter (for intake valve timing control) (1) in the direction shown.

- Make sure that the oil filter does not protrude from the upper surface of cylinder block (2) after installation.



30. Assembly is in the reverse order of disassembly.

CYLINDER BLOCK

< SERVICE INFORMATION >

[MR18DE]

INFOID:000000005398147

How to Select Piston and Bearing

DESCRIPTION

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.
Between cylinder block and piston	Piston and piston pin assembly (piston is available together with piston pin as an assembly.)	Piston grade (piston outer diameter)	Piston grade = cylinder bore grade (inner diameter of bore)

- 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, follow the applicable procedures.

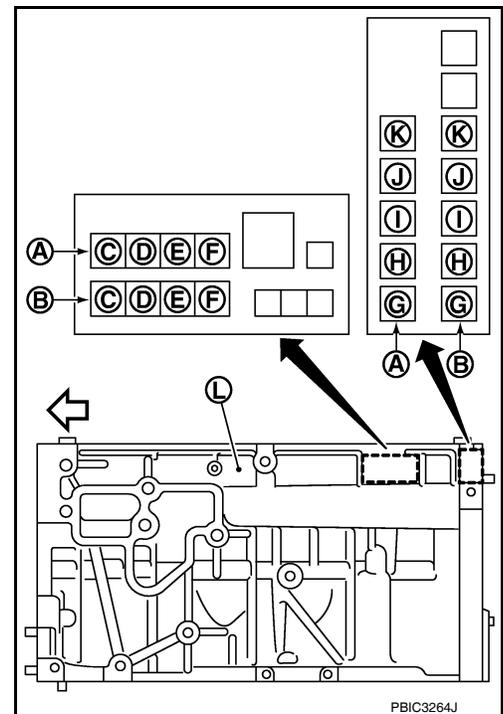
HOW TO SELECT PISTON

When New Cylinder Block is Used

- Check the cylinder bore grade on rear left side of cylinder block (L), and select piston of the same grade.

- A : Correction stamp
- B : Standard stamp
- C : Cylinder No. 1 bore grade
- D : Cylinder No. 2 bore grade
- E : Cylinder No. 3 bore grade
- F : Cylinder No. 4 bore grade
- G : No. 1 main bearing housing grade
- H : No. 2 main bearing housing grade
- I : No. 3 main bearing housing grade
- J : No. 4 main bearing housing grade
- K : No. 5 main bearing housing grade
- ↔ : Engine front

- If there is a correction stamp mark on the cylinder block, use it as a correct reference.



When Cylinder Block is Reused

1. Measure the cylinder bore inner diameter. Refer to [EM-212, "Inspection After Disassembly"](#).
2. Determine the bore grade by comparing the measurement with the values under the cylinder bore inner diameter of the "Piston Selection Table".

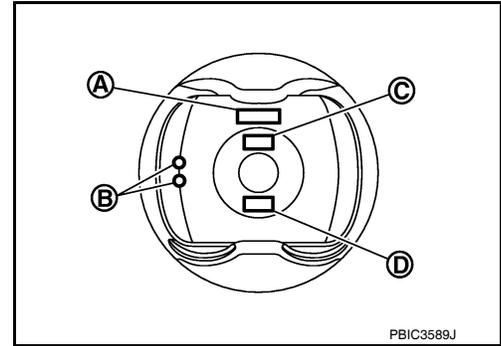
CYLINDER BLOCK

[MR18DE]

< SERVICE INFORMATION >

3. Select piston of the same grade.

- A : Identification code
- B : Front mark
- C : Piston grade number
- D : Sub grade number



Piston Selection Table

Unit: mm (in)

Grade number (Mark)	1	2 [or no mark (piston only)]
Cylinder bore Inner diameter	84.000 - 84.010 (3.3071 - 3.3075)	84.010 - 84.020 (3.3075 - 3.3079)
Piston skirt diameter	83.970 - 83.980 (3.3059 - 3.3063)	83.980 - 83.990 (3.3063 - 3.3067)

NOTE:

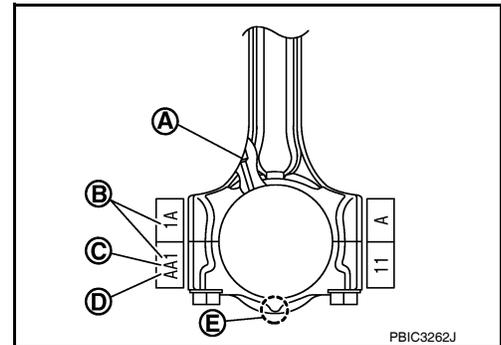
- Piston is available together with piston pin as an assembly.
- There is no piston pin (piston pin hole) grade.

HOW TO SELECT CONNECTING ROD BEARING

When New Connecting Rod and Crankshaft are Used

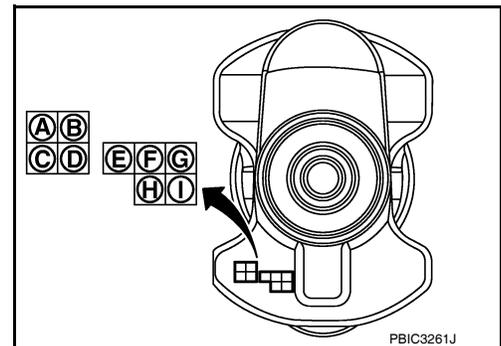
- Apply connecting rod big end diameter grade stamped (C) on connecting rod side face to the row in the "Connecting Rod Bearing Selection Table".

- A : Oil hole
- B : Cylinder number
- D : Small end diameter grade
- E : Front mark



- Apply crankshaft pin journal diameter grade stamped on crankshaft front side to the column in the "Connecting Rod Bearing Selection Table".

- A : No. 1 pin journal diameter grade
- B : No. 2 pin journal diameter grade
- C : No. 3 pin journal diameter grade
- D : No. 4 pin journal diameter grade
- E : No. 1 main journal diameter grade
- F : No. 2 main journal diameter grade
- G : No. 3 main journal diameter grade
- H : No. 4 main journal diameter grade
- I : No. 5 main journal diameter grade



- Read the symbol at the cross point of selected row and column in the "Connecting Rod Bearing Selection Table".
- Apply the symbol obtained to the "Connecting Rod Bearing Grade Table" to select connecting rod bearing.

When Crankshaft and Connecting Rod are Reused

- Measure the dimensions of the connecting rod big end diameter and crankshaft pin journal diameter individually. Refer to [EM-212. "Inspection After Disassembly"](#) and [EM-212. "Inspection After Disassembly"](#).

CYLINDER BLOCK

[MR18DE]

< SERVICE INFORMATION >

- Apply the measured dimension to the "Connecting Rod Bearing Selection Table".
- Read the symbol at the cross point of selected row and column in the "Connecting Rod Bearing Selection Table".
- 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 Unit: mm (in)		Mark													
		Hole diameter													
Crankshaft pin journal diameter Unit: mm (in)		Mark													
		Axle diameter													
		A	B	C	D	E	F	G	H	J	K	L	M	N	
A	43.970 - 43.971 (1.7311 - 1.7311)	0	0	0	0	0	01	01	01	1	1	1	12	12	
B	43.969 - 43.970 (1.7311 - 1.7311)	0	0	0	0	01	01	01	1	1	1	12	12	12	
C	43.968 - 43.969 (1.7310 - 1.7311)	0	0	0	01	01	01	1	1	1	1	12	12	2	
D	43.967 - 43.968 (1.7310 - 1.7310)	0	0	01	01	01	1	1	1	12	12	12	2	2	
E	43.966 - 43.967 (1.7309 - 1.7310)	0	01	01	01	1	1	1	12	12	12	2	2	2	
F	43.965 - 43.966 (1.7309 - 1.7309)	01	01	01	1	1	1	12	12	12	2	2	2	23	
G	43.964 - 43.965 (1.7309 - 1.7309)	01	01	1	1	1	12	12	12	2	2	2	23	23	
H	43.963 - 43.964 (1.7308 - 1.7309)	01	1	1	1	12	12	12	2	2	2	23	23	23	
J	43.962 - 43.963 (1.7308 - 1.7308)	1	1	1	12	12	12	2	2	2	23	23	23	3	
K	43.961 - 43.962 (1.7307 - 1.7308)	1	1	12	12	12	2	2	2	23	23	23	3	3	
L	43.960 - 43.961 (1.7307 - 1.7307)	1	12	12	12	2	2	2	23	23	23	3	3	3	
M	43.959 - 43.960 (1.7307 - 1.7307)	12	12	12	2	2	2	23	23	23	3	3	3	34	
N	43.958 - 43.959 (1.7306 - 1.7307)	12	12	2	2	2	23	23	23	3	3	3	34	34	
P	43.957 - 43.958 (1.7306 - 1.7306)	12	2	2	2	23	23	23	3	3	3	34	34	34	
R	43.956 - 43.957 (1.7305 - 1.7306)	2	2	2	23	23	23	3	3	3	34	34	34	4	
S	43.955 - 43.956 (1.7305 - 1.7305)	2	2	23	23	23	3	3	3	34	34	34	4	4	
T	43.954 - 43.955 (1.7305 - 1.7305)	2	23	23	23	3	3	3	34	34	34	4	4	4	
U	43.953 - 43.954 (1.7304 - 1.7305)	23	23	23	3	3	3	34	34	34	4	4	4	4	

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Connecting Rod Bearing Grade Table

Unit: mm (in)

Grade number	Thickness	Identification color	Remarks
0	1.494 - 1.497 (0.0588 - 0.0589)	Black	Grade and color are the same for upper and lower bearings.
1	1.497 - 1.500 (0.0589 - 0.0591)	Brown	
2	1.500 - 1.503 (0.0591 - 0.0592)	Green	
3	1.503 - 1.506 (0.0592 - 0.0593)	Yellow	
4	1.506 - 1.509 (0.0593 - 0.0594)	Blue	

CYLINDER BLOCK

[MR18DE]

< SERVICE INFORMATION >

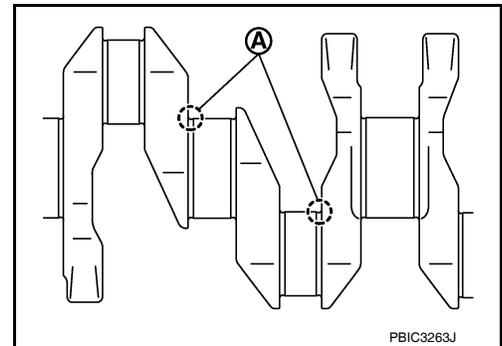
Grade number		Thickness	Identification color	Remarks
01	UPR	1.494 - 1.497 (0.0588 - 0.0589)	Black	Grade and color are different between upper and lower bearings.
	LWR	1.497 - 1.500 (0.0589 - 0.0591)	Brown	
12	UPR	1.497 - 1.500 (0.0589 - 0.0591)	Brown	
	LWR	1.500 - 1.503 (0.0591 - 0.0592)	Green	
23	UPR	1.500 - 1.503 (0.0591 - 0.0592)	Green	
	LWR	1.503 - 1.506 (0.0592 - 0.0593)	Yellow	
34	UPR	1.503 - 1.506 (0.0592 - 0.0593)	Yellow	
	LWR	1.506 - 1.509 (0.0593 - 0.0594)	Blue	

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:

In grinding crankshaft pin to use undersize bearings, keep the fillet R [1.5 - 1.7 mm (0.059 - 0.067 in)] (A).



Bearing undersize table

Unit: mm (in)

Size	Thickness
US 0.25 (0.0098)	1.623 - 1.631 (0.0639 - 0.0642)

HOW TO SELECT MAIN BEARING

When New Cylinder Block and Crankshaft are Used

CYLINDER BLOCK

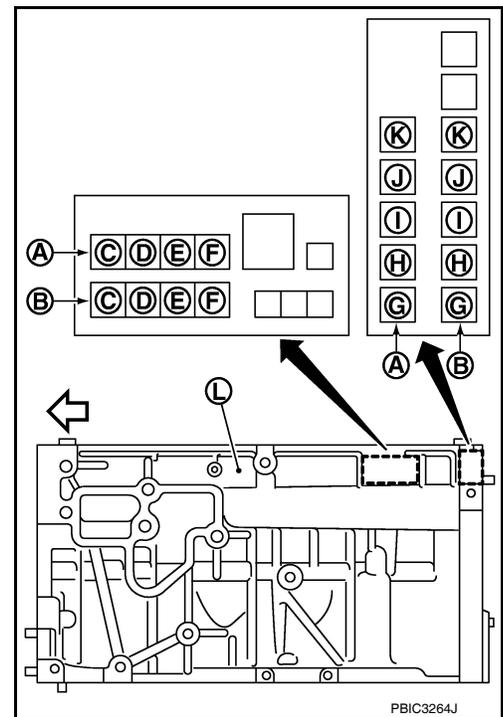
[MR18DE]

< SERVICE INFORMATION >

1. "Main Bearing Selection Table" rows correspond to main bearing housing grade on rear left side of cylinder block (L).

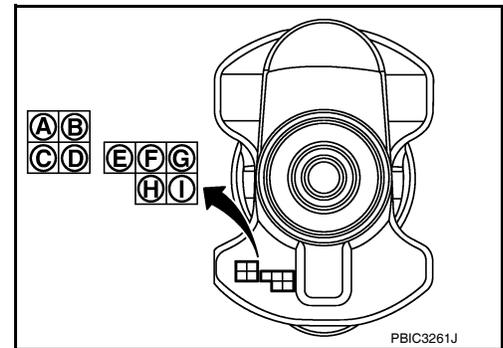
- A : Correction stamp
- B : Standard stamp
- C : Cylinder No. 1 bore grade
- D : Cylinder No. 2 bore grade
- E : Cylinder No. 3 bore grade
- F : Cylinder No. 4 bore grade
- G : No. 1 main bearing housing grade
- H : No. 2 main bearing housing grade
- I : No. 3 main bearing housing grade
- J : No. 4 main bearing housing grade
- K : No. 5 main bearing housing grade
- ↶ : Engine front

- If there is a correction stamp mark 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 : No. 1 pin journal diameter grade
- B : No. 2 pin journal diameter grade
- C : No. 3 pin journal diameter grade
- D : No. 4 pin journal diameter grade
- E : No. 1 main journal diameter grade
- F : No. 2 main journal diameter grade
- G : No. 3 main journal diameter grade
- H : No. 4 main journal diameter grade
- I : No. 5 main journal diameter grade



3. Read the symbol at the cross point of selected row and column in the "Main Bearing Selection Table".

CAUTION:

There are two main bearing selection tables. One is for No. 1, 4 and 5 journals and the other is for No. 2 and 3 journals. Make certain to use the appropriate table. This is due to differences in the specified clearances.

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-212, "Inspection After Disassembly"](#) and [EM-212, "Inspection After Disassembly"](#).
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".

CAUTION:

There are two main bearing selection tables. One is for No. 1, 4 and 5 journals and the other is for No. 2 and 3 journals. Make certain to use the appropriate table. This is due to differences in the specified clearances.

4. Apply the symbol obtained to the "Main Bearing Grade Table" to select main bearing.

NOTE:

CYLINDER BLOCK

[MR18DE]

< SERVICE INFORMATION >

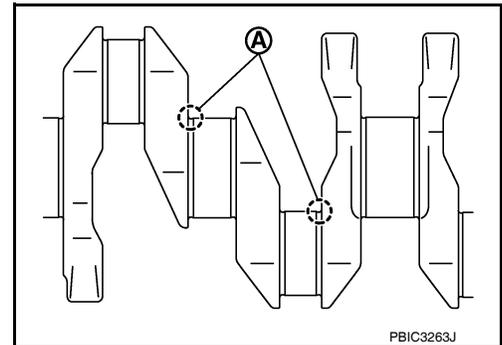
Grade number	Thickness	Identification color	Remarks
01	UPR 1.996 - 1.999 (0.0786 - 0.0787)	Black	Grade and color are different between upper and lower bearings.
	LWR 1.999 - 2.002 (0.0787 - 0.0788)	Brown	
12	UPR 1.999 - 2.002 (0.0787 - 0.0788)	Brown	
	LWR 2.002 - 2.005 (0.0788 - 0.0789)	Green	
23	UPR 2.002 - 2.005 (0.0788 - 0.0789)	Green	
	LWR 2.005 - 2.008 (0.0789 - 0.0791)	Yellow	
34	UPR 2.005 - 2.008 (0.0789 - 0.0791)	Yellow	
	LWR 2.008 - 2.011 (0.0791 - 0.0792)	Blue	
45	UPR 2.008 - 2.011 (0.0791 - 0.0792)	Blue	
	LWR 2.011 - 2.014 (0.0792 - 0.0793)	Pink	
56	UPR 2.011 - 2.014 (0.0792 - 0.0793)	Pink	
	LWR 2.014 - 2.017 (0.0793 - 0.0794)	Purple	
67	UPR 2.014 - 2.017 (0.0793 - 0.0794)	Purple	
	LWR 2.017 - 2.020 (0.0794 - 0.0795)	White	

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:

In grinding crankshaft main journal to use undersize bearings, keep the fillet R [1.5 - 1.7 mm (0.059 - 0.067 in)] (A).



Bearing undersize table

Unit: mm (in)

Size	Thickness
US 0.25 (0.0098)	2.126 - 2.134 (0.0837 - 0.0840)

Inspection After Disassembly

INFOID:000000005398148

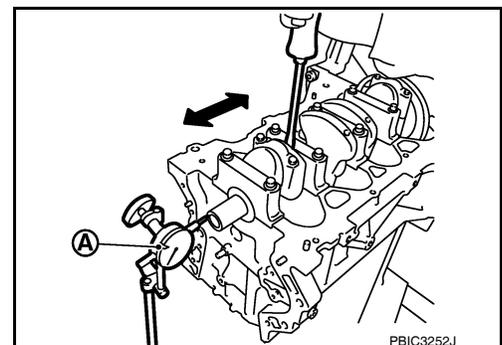
CRANKSHAFT END PLAY

- Measure the clearance between thrust bearings and crankshaft arm when crankshaft is moved fully forward or backward with a dial indicator (A).

Standard : 0.10 - 0.26 mm (0.0039 - 0.0102 in)

Limit : 0.30 mm (0.012 in)

- 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

CYLINDER BLOCK

[MR18DE]

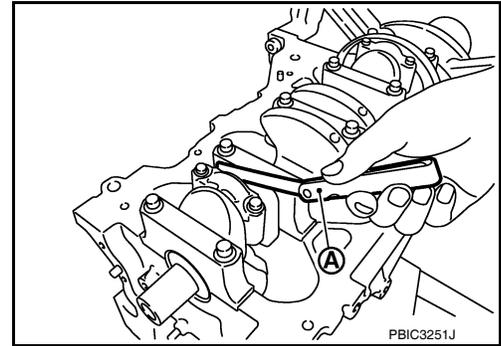
< SERVICE INFORMATION >

- Measure the side clearance between connecting rod and crankshaft arm with a feeler gauge (A).

Standard : 0.20 - 0.35 mm (0.0079 - 0.0138 in)

Limit : 0.40 mm (0.0157 in)

- If the measured value exceeds the limit, replace connecting rod, and measure again. If it still exceeds the limit, replace crankshaft also.

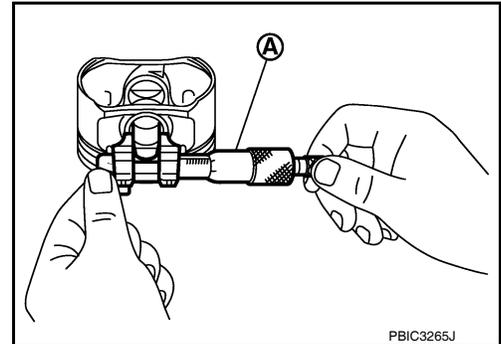


PISTON TO PISTON PIN OIL CLEARANCE

Piston Pin Hole Diameter

Measure the inner diameter of piston pin hole with an inside micrometer (A).

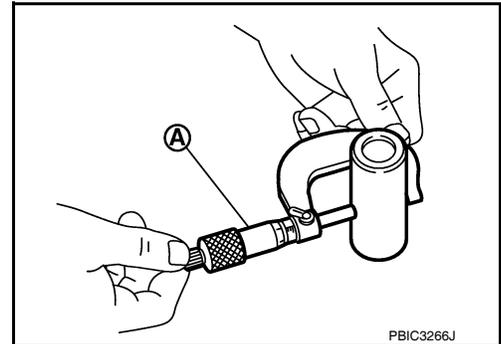
Standard: 19.993 - 19.999 mm (0.7871 - 0.7874 in)



Piston Pin Outer Diameter

Measure the outer diameter of piston pin with a micrometer (A).

Standard: 19.989 - 19.995 mm (0.7870 - 0.7872 in)



Piston to Piston Pin Oil Clearance

(Piston to piston pin oil clearance) = (Piston pin hole diameter) – (Piston pin outer diameter)

Standard: 0.002 - 0.006 mm (0.0001 - 0.0002 in)

- If oil clearance is out of the standard, replace piston and piston pin assembly.
- When replacing piston and piston pin assembly, follow the "Piston to Cylinder Bore Clearance" procedure.

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

CYLINDER BLOCK

[MR18DE]

< SERVICE INFORMATION >

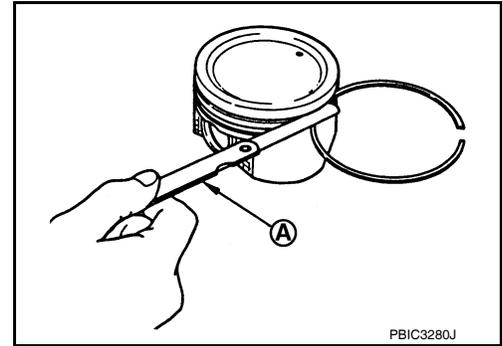
- Measure the side clearance of piston ring and piston ring groove with a feeler gauge (A).

Standard:

Top ring	: 0.04 - 0.08 mm (0.002 - 0.003 in)
2nd ring	: 0.03 - 0.07 mm (0.001 - 0.003 in)
Oil ring	: 0.015 - 0.185 mm (0.001 - 0.007 in)

Limit:

Top ring	: 0.11 mm (0.0043 in)
2nd ring	: 0.10 mm (0.0039 in)



- 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

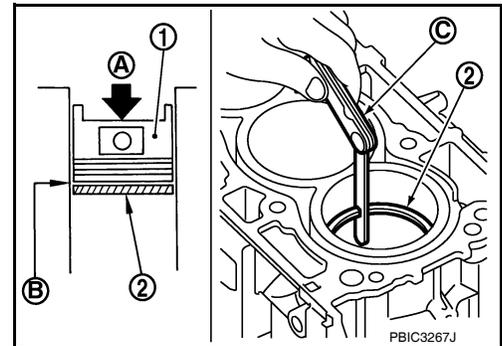
- Make sure that cylinder bore inner diameter is within specification. Follow the "Cylinder Bore Inner Diameter" procedure.
- Lubricate with new engine oil to piston (1) and piston ring (2), and then insert (A) piston ring until middle of cylinder (B) with piston, and measure piston ring end gap with a feeler gauge (C).

Standard:

Top ring	: 0.20 - 0.30 mm (0.008 - 0.012 in)
2nd ring	: 0.50 - 0.65 mm (0.020 - 0.026 in)
Oil ring (rail ring)	: 0.15 - 0.45 mm (0.006 - 0.018 in)

Limit:

Top ring	: 0.51 mm (0.020 in)
2nd ring	: 0.83 mm (0.033 in)
Oil ring (rail ring)	: 0.78 mm (0.031 in)



- If the measured value exceeds the limit, replace piston ring, and measure again. If it still exceeds the limit, replace the cylinder block.

CONNECTING ROD BEND AND TORSION

CYLINDER BLOCK

[MR18DE]

< SERVICE INFORMATION >

- Check with a connecting rod aligner.

C : Feeler gauge

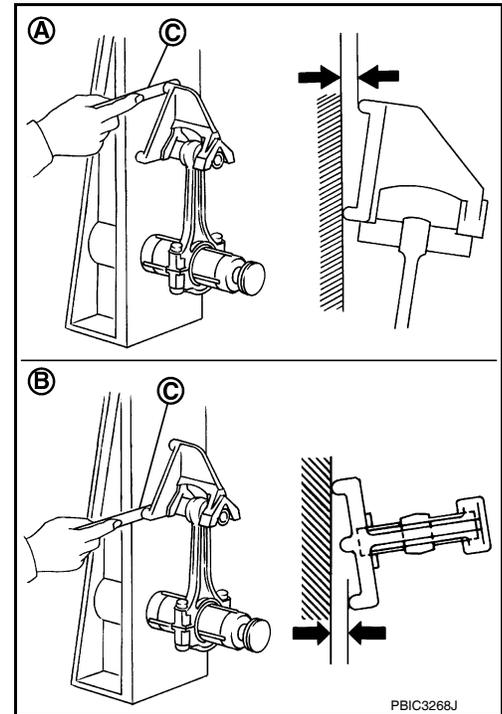
Bend (A):

Limit: 0.15 mm (0.0059 in) per 100 mm (3.94 in) length

Torsion (B):

Limit: 0.30 mm (0.0118 in) per 100 mm (3.94 in) length

- 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 bolts to the specified torque. Refer to [EM-196, "Disassembly and Assembly"](#) for the tightening procedure.

2 : Connecting rod

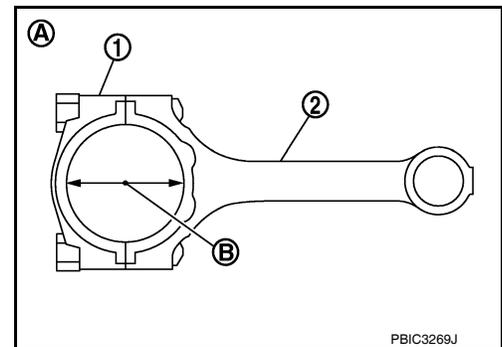
A : Example

B : Measuring direction of inner diameter

- Measure the inner diameter of connecting rod big end with an inside micrometer.

Standard: 47.000 - 47.013 mm (1.8504 - 1.8509 in)

- If out of the standard, replace connecting rod assembly.

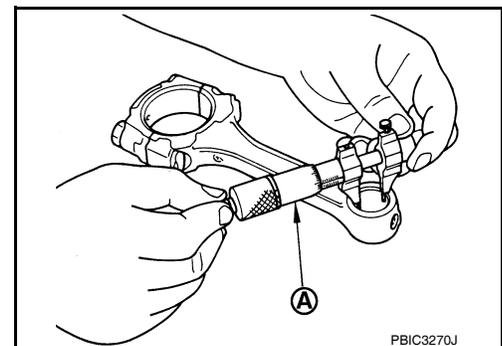


CONNECTING ROD BUSHING OIL CLEARANCE

Connecting Rod Bushing Inner Diameter

Measure the inner diameter of connecting rod bushing with an inside micrometer (A).

Standard: 20.000 - 20.012 mm (0.7874 - 0.7879 in)



Piston Pin Outer Diameter

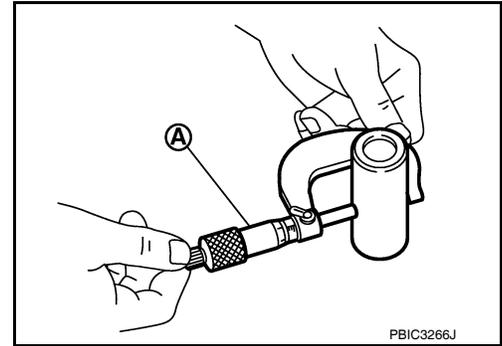
CYLINDER BLOCK

[MR18DE]

< SERVICE INFORMATION >

Measure the outer diameter of piston pin with a micrometer (A).

Standard: 19.989 - 19.995 mm (0.7870 - 0.7872 in)



Connecting Rod Bushing Oil Clearance

(Connecting rod bushing oil clearance) = (Connecting rod bushing inner diameter) – (Piston pin outer diameter)

Standard : 0.005 - 0.023 mm (0.0002 - 0.0009 in)

Limit : 0.03 mm (0.0012 in)

- 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, follow the "PISTON TO PISTON PIN OIL CLEARANCE" procedure.
- If replacing connecting rod assembly, follow the "Connecting Rod Bushing Oil Clearance" procedure to select 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.

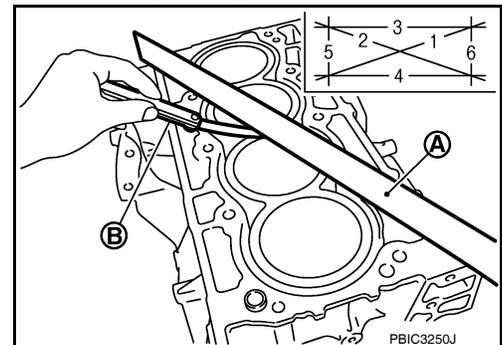
CAUTION:

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: 0.1 mm (0.004 in)

- If it exceeds the limit, replace cylinder block.



MAIN BEARING HOUSING INNER DIAMETER

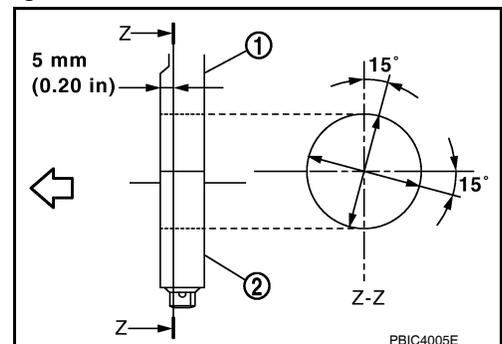
- Install main bearing cap without main bearings installed, and tighten main bearing cap bolts to the specified torque. Refer to [EM-196, "Disassembly and Assembly"](#) for the tightening procedure.
- Measure the inner diameter of main bearing housing with a bore gauge.
- Measure the position shown [5 mm (0.20 in)] backward from main bearing housing front side in the 2 directions as shown. The smaller one is the measured value.

- 1 : Cylinder block
- 2 : Main bearing cap
- ⇐ : Engine front

Standard: 55.997 - 56.017 mm (2.2046 - 2.2054 in)

- If out of the standard, replace cylinder block and main bearing caps assembly.

NOTE:



CYLINDER BLOCK

[MR18DE]

< SERVICE INFORMATION >

Main bearing caps cannot be replaced as a single part, because it is machined together with cylinder block.

PISTON TO CYLINDER BORE CLEARANCE

Cylinder Bore Inner Diameter

- Using a bore gauge (A), measure the cylinder bore for wear, out-of-round and taper at six different points on each cylinder. [(X) and (Y) directions at (A), (B) and (C)] [(Y) is in longitudinal direction of engine].

NOTE:

When determining cylinder bore grade, measure the cylinder bore (X) direction at (B) position.

Standard inner diameter:

84.000 - 84.020 mm (3.3071 - 3.3079 in)

Out-of-round [Difference between (X) and (Y)]:

0.015 mm (0.0006 in)

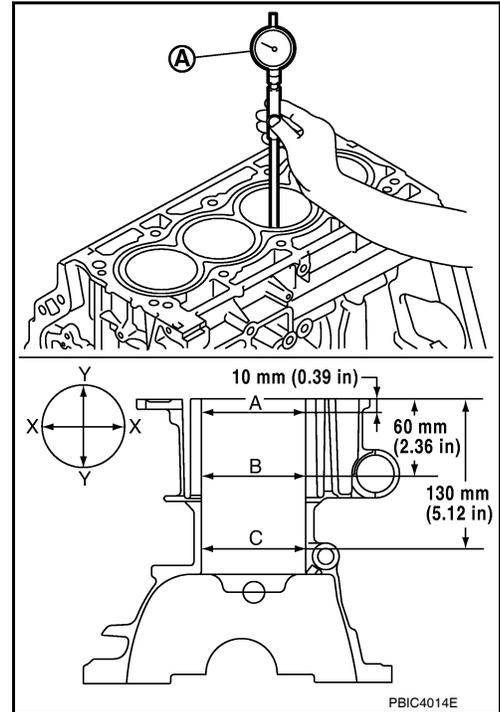
Taper limit [Difference between (A) and (C)]:

0.01 mm (0.0004 in)

- 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

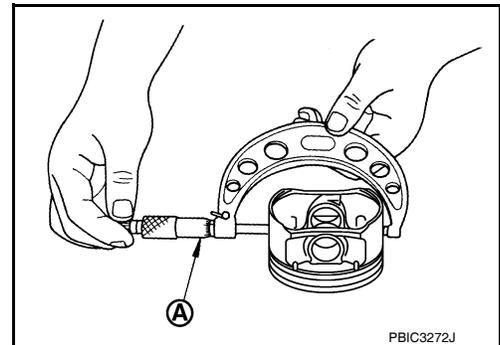
Measure the outer diameter of piston skirt with a micrometer (A).

Measure point

: Distance from the top 39.9 mm (1.571 in)

Standard

: 83.970 - 83.990 mm (3.3059 - 3.3067 in)



Piston to Cylinder Bore Clearance

Calculate by piston skirt diameter and cylinder bore inner diameter [direction (X), position (B)].

(Clearance) = (Cylinder bore inner diameter) – (Piston skirt diameter)

Standard : 0.020 - 0.040 mm (0.0008 - 0.0016 in)

Limit : 0.08 mm (0.0031 in)

- If it exceeds the limit, replace piston and piston pin assembly and/or cylinder block. Refer to [EM-205, "How to Select Piston and Bearing"](#).

CRANKSHAFT MAIN JOURNAL DIAMETER

CYLINDER BLOCK

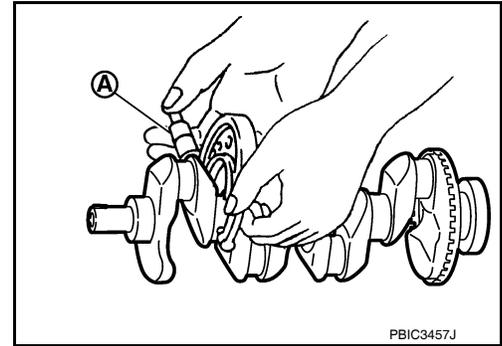
[MR18DE]

< SERVICE INFORMATION >

- Measure the outer diameter of crankshaft main journals with a micrometer (A).

Standard: 51.959 - 51.979 mm (2.0456 - 2.0464 in) dia.

- If out of the standard, measure the main bearing oil clearance. Then use undersize bearing. Follow the "MAIN BEARING OIL CLEARANCE" procedure.

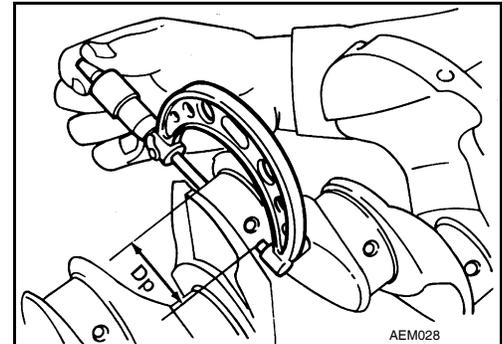


CRANKSHAFT PIN JOURNAL DIAMETER

- Measure the outer diameter (Dp) of crankshaft pin journal with a micrometer.

Standard: 43.953 - 43.971 mm (1.7304-1.7311 in) dia.

- If out of the standard, measure the connecting rod bearing oil clearance. Then use undersize bearing. Follow the "CONNECTING ROD BEARING OIL CLEARANCE" procedure.



OUT-OF-ROUND AND TAPER OF CRANKSHAFT

- Measure the dimensions at four different points as shown on each main journal and pin journal with a micrometer.
- Out-of-round is indicated by the difference in dimensions between (X) and (Y) at (A) and (B).
- Taper is indicated by the difference in dimension between (A) and (B) at (X) and (Y).

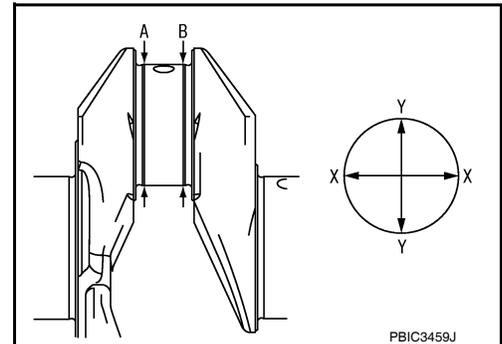
Limit:

Out-of-round [Difference between (X) and (Y)]

: 0.0035 mm (0.0001 in)

Taper [Difference between (A) and (B)]

: 0.0035 mm (0.0001 in)



- 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. Follow the "MAIN BEARING OIL CLEARANCE" and/or "CONNECTING ROD BEARING OIL CLEARANCE" procedures.

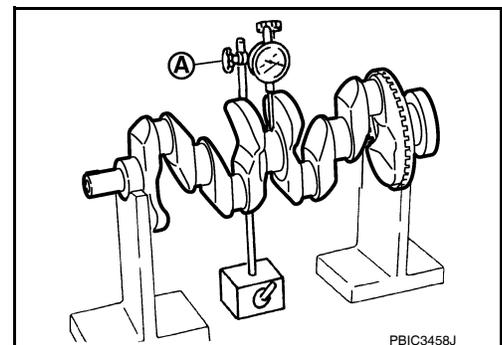
CRANKSHAFT RUNOUT

- 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 : 0.05 mm (0.0020 in)

Limit : 0.10 mm (0.0040 in)

- If it exceeds the limit, replace crankshaft.



CONNECTING ROD BEARING OIL CLEARANCE

Method by Calculation

CYLINDER BLOCK

[MR18DE]

< SERVICE INFORMATION >

- Install connecting rod bearings (2) to connecting rod (3) and connecting rod bearing cap (1), and tighten connecting rod bolts to the specified torque. Refer to [EM-196, "Disassembly and Assembly"](#) for tightening procedure.

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 : 0.037 - 0.047 mm (0.0015 - 0.0019 in)
Limit : 0.07 mm (0.0028 in)

- 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-205, "How to Select Piston and 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 bolts to the specified torque. Refer to [EM-196, "Disassembly and Assembly"](#) for the tightening procedure.

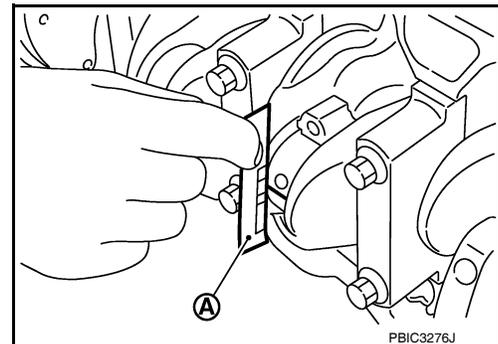
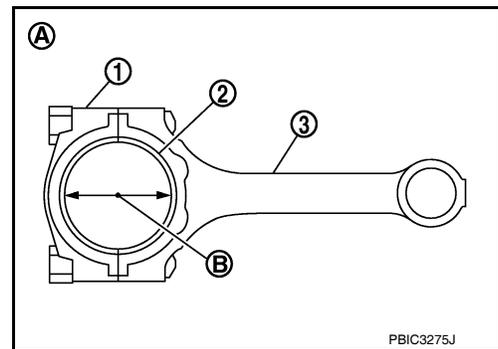
CAUTION:

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 bolts to the specified torque. Refer to [EM-196, "Disassembly and Assembly"](#) for the tightening procedure.

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:

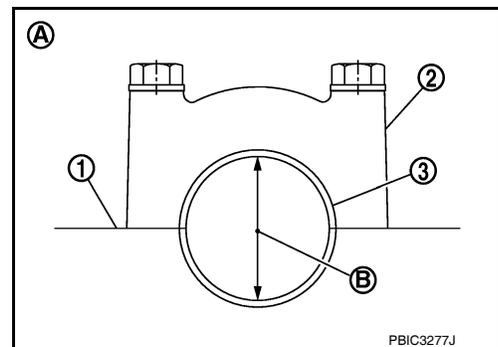
No. 1, 4 and 5 journals

: 0.024 - 0.034 mm (0.0009 - 0.0013 in)

No. 2 and 3 journals

: 0.012 - 0.022 mm (0.0005 - 0.0009 in)

Limit : 0.065 mm (0.0026 in)



CYLINDER BLOCK

[MR18DE]

< SERVICE INFORMATION >

- 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-205, "How to Select Piston and 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 bolts to the specified torque. Refer to [EM-196, "Disassembly and Assembly"](#) for the tightening procedure.

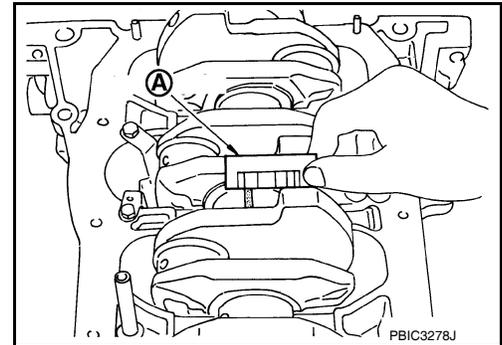
CAUTION:

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".



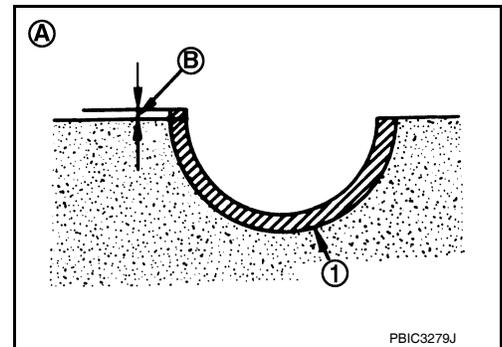
MAIN BEARING CRUSH HEIGHT

- 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-196, "Disassembly and Assembly"](#) for the tightening procedure.

A : Example

Standard : There must be crush height.

- If the standard is not met, replace main bearings.



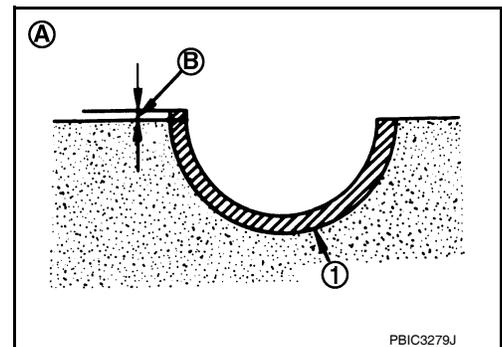
CONNECTING ROD BEARING CRUSH HEIGHT

- When connecting rod bearing cap is removed after being tightened to the specified torque with connecting rod bearings (1) installed, the tip end of bearing must protrude. Refer to [EM-196, "Disassembly and Assembly"](#) for the tightening procedure (B).

A : Example

Standard : There must be crush height.

- If the standard is not met, replace connecting rod bearings.



MAIN BEARING CAP BOLT OUTER DIAMETER

CYLINDER BLOCK

[MR18DE]

< SERVICE INFORMATION >

- Measure the outer diameters [(d1), (d2)] at two positions as shown.

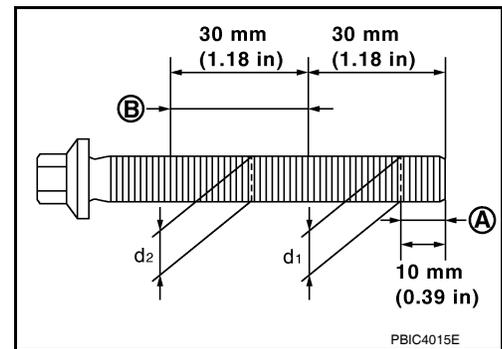
A : (d1) measuring position

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 bolt with a new one.

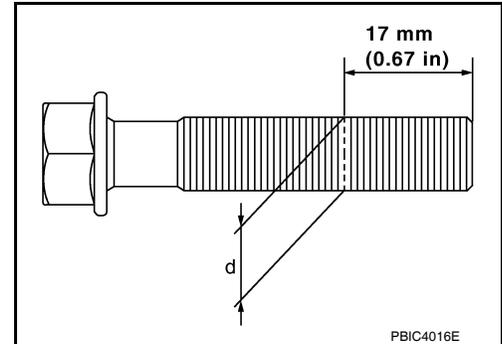


CONNECTING ROD BOLT OUTER DIAMETER

- Measure the outer diameter (d) at position as shown.
- If reduction appears in a position other than (d), regard it as (d).

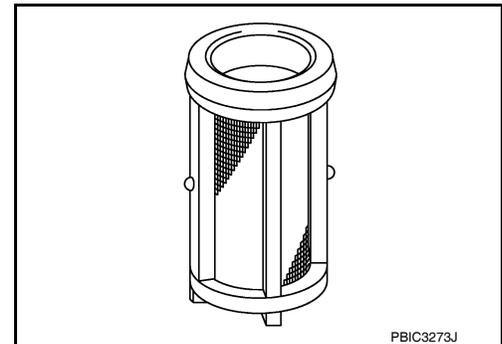
Limit: 7.75 mm (0.3051 in)

- When (d) exceeds the limit (when it becomes thinner), replace connecting rod bolt with a new one.



CLOGGED OR DAMAGED OIL FILTER (FOR INTAKE VALVE TIMING CONTROL)

- Make sure 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 (M/T MODELS)

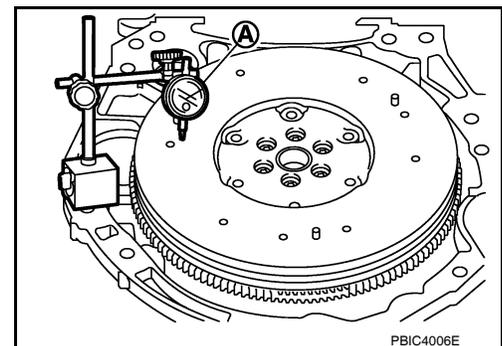
- Measure the deflection of flywheel contact surface to clutch with a dial indicator (A).
- Measure the deflection at 210 mm (8.27 in) diameter.

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 (M/T MODELS)

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

CYLINDER BLOCK

[MR18DE]

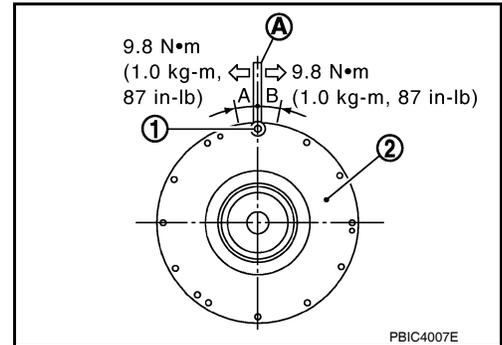
< SERVICE INFORMATION >

- 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:

1. Install clutch cover bolt (1) to clutch cover mating 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 mating 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.

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE INFORMATION >

[MR18DE]

SERVICE DATA AND SPECIFICATIONS (SDS)

Standard and Limit

INFOID:000000005398149

GENERAL SPECIFICATIONS

Engine type	MR18DE	
Cylinder arrangement	In-line 4	
Displacement	cm ³ (cu in)	1,797 (109.65)
Bore and stroke	mm (in)	84.0 x 81.1 (3.307 x 3.192)
Valve arrangement	DOHC	
Firing order	1-3-4-2	
Number of piston rings	Compression	2
	Oil	1
Compression ratio	9.9	
Compression pressure kPa (bar, kg/cm ² , psi) / 250 rpm	Standard	1,500 (15.0, 15.3, 217.6)
	Minimum	1,200 (12.0, 12.2, 174)
	Differential limit between cylinders	100 (1.0, 1.0, 15)

DRIVE BELT

Tension of drive belt	Auto adjustment by auto-tensioner
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WATER CONTROL VALVE

Valve opening temperature	93.5 - 96.5°C (200 - 206°F)
Full-open valve lift amount	8 mm/ 108°C (0.315 in/ 226°F)
Valve closing temperature	More than 90°C (194°F)

EXHAUST MANIFOLD

Unit: mm (in)

Items		Limit
Surface distortion	Each exhaust port	0.3 (0.012)
	Entire part	0.7 (0.028)

THERMOSTAT

Valve opening temperature	80.5 - 83.5°C (177 - 182°F)
Full-open valve lift amount	8 mm/ 95°C (0.315 in/ 203°F)
Valve closing temperature	More than 77°C (171°F)

SPARK PLUG

Unit: mm (in)

Make	DENSO
Standard type*	FXE20HR11
Spark plug gap	Nominal: 1.1 (0.043)

*: Always check with the Parts Department for the latest parts information

CYLINDER HEAD

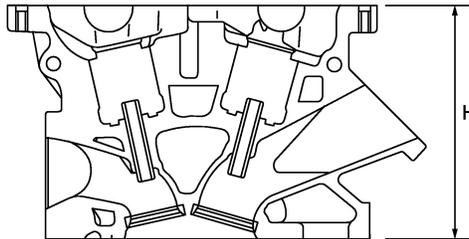
SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE INFORMATION >

[MR18DE]

Unit: mm (in)

Items	Standard	Limit
Head surface distortion	—	0.1 (0.004)
Normal cylinder head height (H)	130.9 (5.15)	—
Groove of No. 1 journal	4.000 - 4.300 (0.1575 - 0.1587)	—



PBIC0924E

VALVE

Valve Timing

Unit: degree

Valve timing						
	a	b	c	d	e	f
	212	224	-8 (32)	52 (12)	7	25

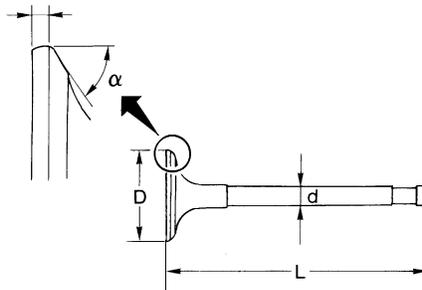
PBIC4542E

(): Valve timing control "ON"

Valve Dimensions

Unit: mm (in)

T (Margin thickness)



SEM188A

Valve head diameter (D)	Intake	33.8 - 34.1 (1.331 - 1.343)
	Exhaust	27.6 - 27.9 (1.087 - 1.098)
Valve length (L)	Intake	106.27 (4.184)
	Exhaust	105.26 (4.144)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE INFORMATION >

[MR18DE]

Valve stem diameter (d)	Intake	5.465 - 5.480 (0.2152 - 0.2157)
	Exhaust	5.455 - 5.470 (0.2148 - 0.2154)
Valve seat angle (α)		45°15' - 45°45'
Valve margin (T)	Intake	1.1 (0.043)
	Exhaust	1.2 (0.047)

Valve Clearance

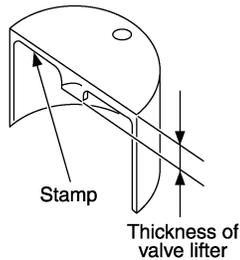
Unit: mm (in)

Items	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 - 0.015)	0.308 - 0.432 (0.012 - 0.017)

*: Approximately 80°C (176°F)

Available Valve Lifter

Thickness mm (in)	Identification mark*
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KBIA0119E

3.00 (0.1181)	300
3.02 (0.1189)	302
3.04 (0.1197)	304
3.06 (0.1205)	306
3.08 (0.1213)	308
3.10 (0.1220)	310
3.12 (0.1228)	312
3.14 (0.1236)	314
3.16 (0.1244)	316
3.18 (0.1252)	318
3.20 (0.1260)	320
3.22 (0.1268)	322
3.24 (0.1276)	324
3.26 (0.1283)	326
3.28 (0.1291)	328
3.30 (0.1299)	330
3.32 (0.1307)	332
3.34 (0.1315)	334
3.36 (0.1323)	336
3.38 (0.1331)	338
3.40 (0.1339)	340
3.42 (0.1346)	342

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE INFORMATION >

[MR18DE]

Thickness mm (in)	Identification mark*
3.44 (0.1354)	344
3.46 (0.1362)	346
3.48 (0.1370)	348
3.50 (0.1378)	350

*: Always check with the Parts Department for the latest parts information

Valve Spring

Items	Intake	Exhaust
Free height	44.90 - 45.10 mm (1.7677 - 1.7755 in)	45.74 - 45.94 mm (1.8007 - 1.8086 in)
Installation height	35.30 mm (1.390 in)	35.30 mm (1.390 in)
Installation load	153 - 173 N (15.6 - 17.6 kg, 34 - 39 lb)	139 - 157 N (14.2 - 16.0 kg, 31 - 35 lb)
Height during valve open	26.36 mm (1.0377 in)	27.80 mm (1.0944 in)
Load with valve open	335 - 377 N (34.2 - 38.5 kg, 75 - 85 lb)	266 - 297 N (27.1 - 30.3 kg, 60 - 67 lb)
Identification color	White	Orange
Squareness [Limit]	1.9 mm (0.075 in)	

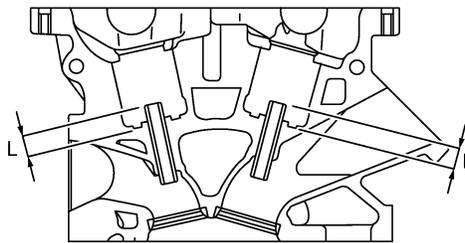
Valve Lifter

Unit: mm (in)

Items	Standard
Valve lifter outer diameter	Intake 33.977 - 33.987 (1.3377 - 1.3381)
	Exhaust 29.977 - 29.987 (1.1802 - 1.1806)
Valve lifter hole diameter	Intake 34.000 - 34.021 (1.3386 - 1.3394)
	Exhaust 30.000 - 30.021 (1.1811 - 1.1819)
Valve lifter clearance	0.013 - 0.044 (0.0005 - 0.0017)

Valve Guide

Unit: mm (in)



PBIC0184E

Items	Standard part	Service part
Valve guide	Outer diameter 9.523 - 9.534 (0.3749 - 0.3754)	9.723 - 9.734 (0.3828 - 0.3832)
	Inner diameter (Finished size) 5.500 - 5.518 (0.2165 - 0.2172)	
Cylinder head valve guide hole diameter	9.475 - 9.496 (0.3730 - 0.3739)	9.675 - 9.696 (0.3809 - 0.3817)
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)	
Projection length (L)	13.35 - 13.65 (0.526 - 0.537)	

Valve Seal

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE INFORMATION >

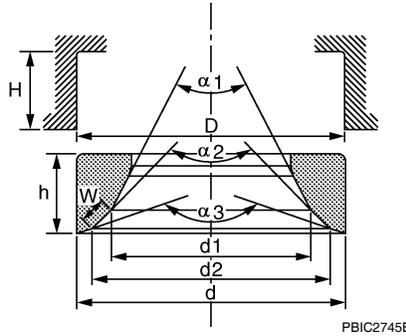
[MR18DE]

Unit: mm (in)

Items	Standard	Limit
Valve seal installed height	15.1 - 15.7 (0.594 - 0.618)	—

Valve Seat

Unit: mm (in)



Items	Standard	Oversize [0.5 (0.02)] (Service)
Cylinder head seat recess diameter (D)	Intake	34.700 - 34.727 (1.3661 - 1.3672)
	Exhaust	28.700 - 28.727 (1.1299 - 1.1310)
Valve seat outer diameter (d)	Intake	34.808 - 34.824 (1.3704 - 1.3710)
	Exhaust	28.808 - 28.824 (1.1342 - 1.1348)
Valve seat interference fit	0.081 - 0.124 (0.0032 - 0.0049)	
Diameter (d1)*1	Intake	31.8 (1.252)
	Exhaust	25.3 (0.996)
Diameter (d2)*2	Intake	33.1 - 33.6 (1.303 - 1.323)
	Exhaust	26.9 - 27.4 (1.059 - 1.079)
Angle (α1)	Intake	60°
	Exhaust	45°
Angle (α2)	88°45' - 90°15'	
Angle (α3)	120°	
Contacting width (W)*3	Intake	1.0 - 1.4 (0.039 - 0.055)
	Exhaust	1.2 - 1.6 (0.047 - 0.063)
Height (h)	Intake	5.9 - 6.0 (0.232 - 0.236) 5.03 - 5.13 (0.1980 - 0.2020)
	Exhaust	5.9 - 6.0 (0.232 - 0.236) 4.95 - 5.05 (0.1949 - 0.1988)
Depth (H)	Intake	6.04 (0.2378)
	Exhaust	6.05 (0.2382)

*: 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

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

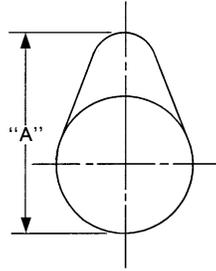
Items	Standard	Limit
Camshaft journal oil clearance	No. 1	0.045 - 0.086 (0.0018 - 0.0034)
	No. 2, 3, 4, 5	0.030 - 0.071 (0.0012 - 0.0028)
Camshaft bracket inner diameter	No. 1	28.000 - 28.021 (1.1024 - 1.1032)
	No. 2, 3, 4, 5	25.000 - 25.021 (0.9843 - 0.9851)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE INFORMATION >

[MR18DE]

Camshaft journal diameter	No. 1	27.935 - 27.955 (1.0998 - 1.1006)	—
	No. 2, 3, 4, 5	24.950 - 24.970 (0.9823 - 0.9381)	—
Camshaft end play		0.075 - 0.153 (0.0030 - 0.0060)	0.24 (0.0094)
Camshaft cam height (A)	Intake	44.605 - 44.795 (1.7560 - 1.7635)	44.405 (1.7482)
	Exhaust	43.175 - 43.365 (1.6997 - 1.7072)	42.975 (1.6919)
Camshaft flange		3.877 - 3.925 (0.1526 - 0.1545)	—
Camshaft runout [TIR*]		Less than 0.02 (0.0008)	0.05 (0.0020)
Camshaft sprocket runout [TIR*]		—	0.15 (0.0059)

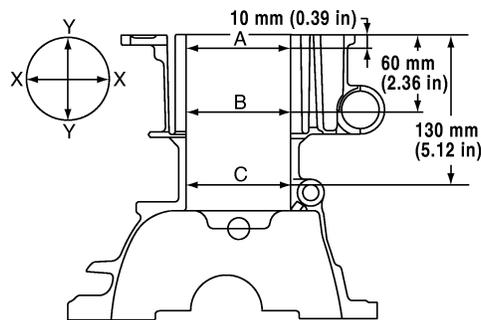


SEM671

*: Total indicator reading

CYLINDER BLOCK

Unit: mm (in)



PBIC4017E

Top surface distortion		Limit	0.1 (0.004)
Cylinder bore	Inner diameter	Standard	Grade No. 1
			Grade No. 2
			84.000 - 84.010 (3.3071 - 3.3075)
			84.010 - 84.020 (3.3075 - 3.3079)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE INFORMATION >

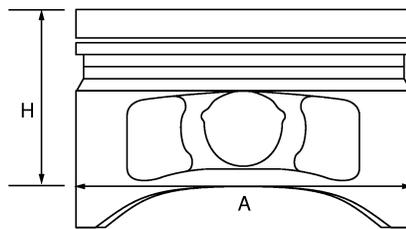
[MR18DE]

Out-of-round [Difference between (X) and (Y)]	Limit	0.015 (0.0006)
Taper [Difference between (A) and (C)]		0.01 (0.0004)
Main bearing housing inner diameter grade	Grade No. A	55.997 - 55.998 (2.2046 - 2.2046)
	Grade No. B	55.998 - 55.999 (2.2046 - 2.2047)
	Grade No. C	55.999 - 56.000 (2.2047 - 2.2047)
	Grade No. D	56.000 - 56.001 (2.2047 - 2.2048)
	Grade No. E	56.001 - 56.002 (2.2048 - 2.2048)
	Grade No. F	56.002 - 56.003 (2.2048 - 2.2048)
	Grade No. G	56.003 - 56.004 (2.2048 - 2.2049)
	Grade No. H	56.004 - 56.005 (2.2049 - 2.2049)
	Grade No. J	56.005 - 56.006 (2.2049 - 2.2050)
	Grade No. K	56.006 - 56.007 (2.2050 - 2.2050)
	Grade No. L	56.007 - 56.008 (2.2050 - 2.2050)
	Grade No. M	56.008 - 56.009 (2.2050 - 2.2051)
	Grade No. N	56.009 - 56.010 (2.2051 - 2.2051)
	Grade No. P	56.010 - 56.011 (2.2051 - 2.2052)
	Grade No. R	56.011 - 56.012 (2.2052 - 2.2052)
	Grade No. S	56.012 - 56.013 (2.2052 - 2.2052)
	Grade No. T	56.013 - 56.014 (2.2052 - 2.2053)
Grade No. U	56.014 - 56.015 (2.2053 - 2.2053)	
Grade No. V	56.015 - 56.016 (2.2053 - 2.2053)	
Grade No. W	56.016 - 56.017 (2.2053 - 2.2054)	

PISTON, PISTON RING AND PISTON PIN

Available Piston

Unit: mm (in)



		Grade*	Dimension
Piston skirt diameter (A)	Standard	Grade No. 1	83.970 - 83.980 (3.3059 - 3.3063)
		Grade No. 2	83.980 - 83.990 (3.3063 - 3.3067)
Piston height (H) dimension			39.9 (1.571)
Piston pin hole diameter			19.993 - 19.999 (0.7871 - 0.7874)
Piston to cylinder bore clearance	Standard		0.020 - 0.040 (0.0008 - 0.0016)
	Limit		0.08 (0.0031)

*: Always check with the Parts Department for the latest parts information

Piston Ring

Unit: mm (in)

Items		Standard	Limit
Side clearance	Top	0.04 - 0.08 (0.002 - 0.003)	0.11 (0.0043)
	2nd	0.03 - 0.07 (0.001 - 0.003)	0.10 (0.0039)
	Oil ring	0.015 - 0.185 (0.001 - 0.007)	—
End gap	Top	0.20 - 0.30 (0.008 - 0.012)	0.51 (0.020)
	2nd	0.50 - 0.65 (0.020 - 0.026)	0.83 (0.033)
	Oil (rail ring)	0.15 - 0.45 (0.006 - 0.018)	0.78 (0.031)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE INFORMATION >

[MR18DE]

Piston Pin

Unit: mm (in)

Items	Standard	Limit
Piston pin outer diameter	19.989 - 19.995 (0.7870 - 0.7872)	—
Piston to piston pin oil clearance	0.002 - 0.006 (0.0001 - 0.0002)	—
Connecting rod bushing oil clearance	0.005 - 0.023 (0.0002 - 0.0009)	0.03 (0.0012)

CONNECTING ROD

Unit: mm (in)

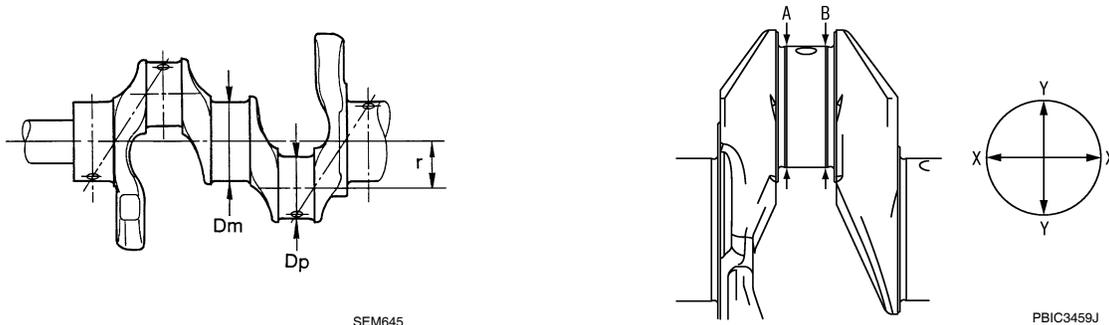
Center distance		143.44 - 143.54 (5.647 - 5.650)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)
Connecting rod bushing inner diameter ¹		20.000 - 20.012 (0.7874 - 0.7879)
Side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)
	Limit	0.40 (0.0157)
Connecting rod big end diameter	Grade ²	Dimension
	Grade No. A	47.000 - 47.001 (1.8504 - 1.8504)
	Grade No. B	47.001 - 47.002 (1.8504 - 1.8505)
	Grade No. C	47.002 - 47.003 (1.8505 - 1.8505)
	Grade No. D	47.003 - 47.004 (1.8505 - 1.8505)
	Grade No. E	47.004 - 47.005 (1.8505 - 1.8506)
	Grade No. F	47.005 - 47.006 (1.8506 - 1.8506)
	Grade No. G	47.006 - 47.007 (1.8506 - 1.8507)
	Grade No. H	47.007 - 47.008 (1.8507 - 1.8507)
	Grade No. J	47.008 - 47.009 (1.8507 - 1.8507)
	Grade No. K	47.009 - 47.010 (1.8507 - 1.8508)
	Grade No. L	47.010 - 47.011 (1.8508 - 1.8508)
	Grade No. M	47.011 - 47.012 (1.8508 - 1.8509)
Grade No. N	47.012 - 47.013 (1.8509 - 1.8509)	

¹: After installing in connecting rod

²: Always check with the Parts Department for the latest parts information

CRANKSHAFT

Unit: mm (in)



Center distance (r)		40.41 - 40.49 (1.5909 - 1.5940)
Out-of-round [Difference between (X) and (Y)]	Limit	0.0035 (0.0001)
Taper [Difference between (A) and (B)]	Limit	0.0035 (0.0001)
Runout [TIR ¹]	Standard	0.05 (0.0020)
	Limit	0.10 (0.0040)
Crankshaft end play	Standard	0.10 - 0.26 (0.0039 - 0.0102)
	Limit	0.30 (0.012)

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE INFORMATION >

[MR18DE]

	Grade ²	Dimension
Pin journal diameter grade. (Dp)	Grade No. A	43.970 - 43.971 (1.7311 - 1.7311)
	Grade No. B	43.969 - 43.970 (1.7311 - 1.7311)
	Grade No. C	43.968 - 43.969 (1.7310 - 1.7311)
	Grade No. D	43.967 - 43.968 (1.7310 - 1.7310)
	Grade No. E	43.966 - 43.967 (1.7309 - 1.7310)
	Grade No. F	43.965 - 43.966 (1.7309 - 1.7309)
	Grade No. G	43.964 - 43.965 (1.7309 - 1.7309)
	Grade No. H	43.963 - 43.964 (1.7308 - 1.7309)
	Grade No. J	43.962 - 43.963 (1.7308 - 1.7308)
	Grade No. K	43.961 - 43.962 (1.7307 - 1.7308)
	Grade No. L	43.960 - 43.961 (1.7307 - 1.7307)
	Grade No. M	43.959 - 43.960 (1.7307 - 1.7307)
	Grade No. N	43.958 - 43.959 (1.7306 - 1.7307)
	Grade No. P	43.957 - 43.958 (1.7306 - 1.7306)
	Grade No. R	43.956 - 43.957 (1.7305 - 1.7306)
	Grade No. S	43.955 - 43.956 (1.7305 - 1.7305)
	Grade No. T	43.954 - 43.955 (1.7305 - 1.7305)
Grade No. U	43.953 - 43.954 (1.7304 - 1.7305)	
Main journal diameter grade. (Dm)	Grade No. A	51.978 - 51.979 (2.0464 - 2.0464)
	Grade No. B	51.977 - 51.978 (2.0463 - 2.0464)
	Grade No. C	51.976 - 51.977 (2.0463 - 2.0463)
	Grade No. D	51.975 - 51.976 (2.0463 - 2.0463)
	Grade No. E	51.974 - 51.975 (2.0462 - 2.0463)
	Grade No. F	51.973 - 51.974 (2.0462 - 2.0462)
	Grade No. G	51.972 - 51.973 (2.0461 - 2.0462)
	Grade No. H	51.971 - 51.972 (2.0461 - 2.0461)
	Grade No. J	51.970 - 51.971 (2.0461 - 2.0461)
	Grade No. K	51.969 - 51.970 (2.0460 - 2.0461)
	Grade No. L	51.968 - 51.969 (2.0460 - 2.0460)
	Grade No. M	51.967 - 51.968 (2.0459 - 2.0460)
	Grade No. N	51.966 - 51.967 (2.0459 - 2.0459)
	Grade No. P	51.965 - 51.966 (2.0459 - 2.0459)
	Grade No. R	51.964 - 51.965 (2.0458 - 2.0459)
	Grade No. S	51.963 - 51.964 (2.0458 - 2.0458)
	Grade No. T	51.962 - 51.963 (2.0457 - 2.0458)
Grade No. U	51.961 - 51.962 (2.0457 - 2.0457)	
Grade No. V	51.960 - 51.961 (2.0457 - 2.0457)	
Grade No. W	51.959 - 51.960 (2.0456 - 2.0457)	

¹: Total indicator reading

²: Always check with the Parts Department for the latest parts information

MAIN BEARING

Unit: mm (in)

Grade number*	Thickness	Identification color	Remarks
0	1.996 - 1.999 (0.0786 - 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 - 0.0791)	Yellow	
4	2.008 - 2.011 (0.0791 - 0.0792)	Blue	
5	2.011 - 2.014 (0.0792 - 0.0793)	Pink	
6	2.014 - 2.017 (0.0793 - 0.0794)	Purple	
7	2.017 - 2.020 (0.0794 - 0.0795)	White	

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE INFORMATION >

[MR18DE]

01	UPR	1.996 - 1.999 (0.0786 - 0.0787)	Black	Grade and color are different between 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 - 0.0791)	Yellow	
34	UPR	2.005 - 2.008 (0.0789 - 0.0791)	Yellow	
	LWR	2.008 - 2.011 (0.0791 - 0.0792)	Blue	
45	UPR	2.008 - 2.011 (0.0791 - 0.0792)	Blue	
	LWR	2.011 - 2.014 (0.0792 - 0.0793)	Pink	
56	UPR	2.011 - 2.014 (0.0792 - 0.0793)	Pink	
	LWR	2.014 - 2.017 (0.0793 - 0.0794)	Purple	
67	UPR	2.014 - 2.017 (0.0793 - 0.0794)	Purple	
	LWR	2.017 - 2.020 (0.0794 - 0.0795)	White	

*: Always check with the Parts Department for the latest parts information

Undersize

Unit: mm (in)

Item	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	No. 1, 4 and 5	0.024 - 0.034 (0.0009 - 0.0013)
		No. 2 and 3	0.012 - 0.022 (0.0005 - 0.0009)
	Limit		0.065 (0.0026)

CONNECTING ROD BEARING

Grade number*	Thickness	mm (in)	Identification color	Remarks
0	1.494 - 1.497	(0.0588 - 0.0589)	Black	Grade and color are the same for upper and lower bearings.
1	1.497 - 1.500	(0.0589 - 0.0591)	Brown	
2	1.500 - 1.503	(0.0591 - 0.0592)	Green	
3	1.503 - 1.506	(0.0592 - 0.0593)	Yellow	
4	1.506 - 1.509	(0.0593 - 0.0594)	Blue	
01	UPR	1.494 - 1.497 (0.0588 - 0.0589)	Black	Grade and color are different between upper and lower bearings.
	LWR	1.497 - 1.500 (0.0589 - 0.0591)	Brown	
12	UPR	1.497 - 1.500 (0.0589 - 0.0591)	Brown	
	LWR	1.500 - 1.503 (0.0591 - 0.0592)	Green	
23	UPR	1.500 - 1.503 (0.0591 - 0.0592)	Green	
	LWR	1.503 - 1.506 (0.0592 - 0.0593)	Yellow	
34	UPR	1.503 - 1.506 (0.0592 - 0.0593)	Yellow	
	LWR	1.506 - 1.509 (0.0593 - 0.0594)	Blue	

*: Always check with the Parts Department for the latest parts information

Undersize

Unit: mm (in)

Item	Thickness	Crank pin journal diameter
US 0.25 (0.0098)	1.623 - 1.631 (0.0639 - 0.0642)	Grind so that bearing clearance is the specified value.

SERVICE DATA AND SPECIFICATIONS (SDS)

< SERVICE INFORMATION >

[MR18DE]

Bearing Oil Clearance

Unit: mm (in)

Connecting rod bearing oil clearance	Standard	0.037 - 0.047 (0.0015 - 0.0019)
	Limit	0.07 (0.0028)

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EM

FLYWHEEL

Unit: mm (in)

Items	Standard	Limit
Flywheel deflection	—	0.45 (0.0177) or less
Movement amount in thrust direction	1.8 (0.071) or less	—
Movement amount in radial direction	—	33.2 (1.307) or less

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