SECTION EM
ENGINE MECHANICAL

CONTENTS

PRECAUTION

PRECAUTIONS

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

INFOID:0000000009465990

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 SR 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 SR 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 for Drain Coolant

INFOID:0000000009465991

- Drain coolant when engine is cooled.

Precaution for Disconnecting Fuel Piping

INFOID:0000000009465992

- 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:0000000009465993

- 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:0000000009465994

- 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:0000000009465995

- 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.

Parts Requiring Angular Tightening

INFOID:0000000009465996

- Use an angle wrench for the final tightening of the following engine parts:
- Cylinder head bolts
- 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)
- 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.

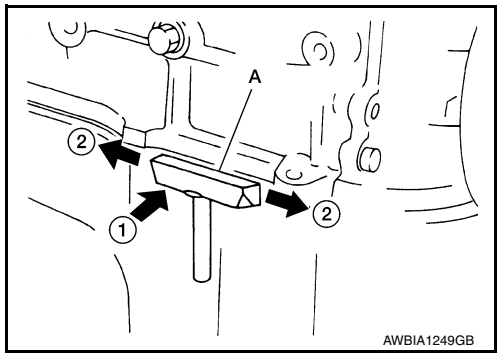
Precaution for Liquid Gasket

INFOID:0000000009465997

REMOVAL OF LIQUID GASKET

- After removing the bolts and nuts, separate the mating surface and remove the liquid gasket using Tool (A).

Tool Number: KV10111100 (J-37228)



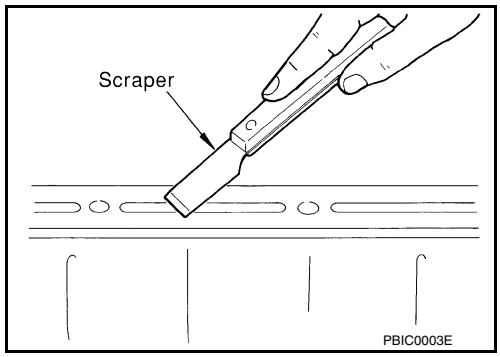
CAUTION:
Be careful not to damage the mating surfaces.

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

CAUTION:
Do not damage the mating surfaces.

LIQUID GASKET APPLICATION PROCEDURE

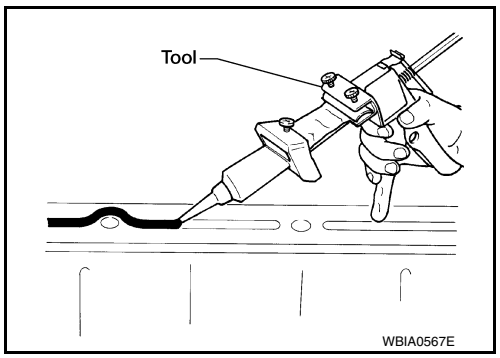
1. Remove the old liquid gasket adhering to the gasket application surface and the mating surface using suitable tool.
   - Remove the liquid gasket completely from the groove of the liquid gasket application surface, bolts, and bolt holes.
2. Thoroughly clean the mating surfaces and remove adhering moisture, grease and foreign material.



3. Attach the liquid gasket tube to the Tool.

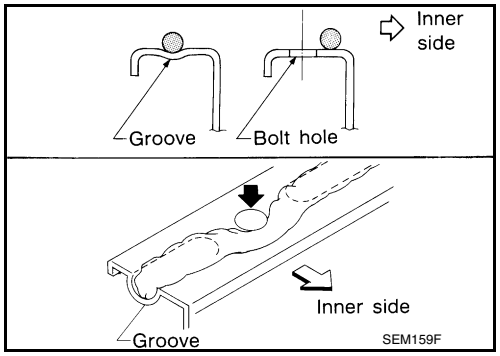
Tool number : WS39930000 (—)

Use Genuine RTV Silicone Sealant or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".



4. Apply the liquid gasket without breaks to the specified location with the specified dimensions.

- If there is a groove for the liquid gasket application, apply the liquid gasket to the groove.
- Normally apply the liquid gasket on the inside edge of the bolt holes. Also apply to the outside edge of the bolt holes when specified in the procedure.
- Within five minutes of liquid gasket application, install the mating component.
- If the liquid gasket protrudes, wipe it off immediately.
- Do not retighten after the installation.
- Wait 30 minutes or more after installation before refilling the engine with oil or coolant.



CAUTION:

If there are more specific instructions in the procedures contained in this manual concerning liquid gasket application, observe them.

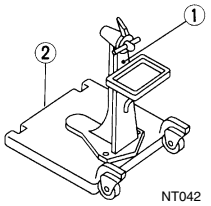
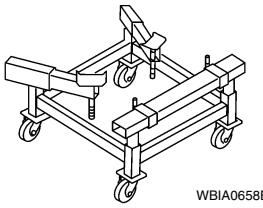
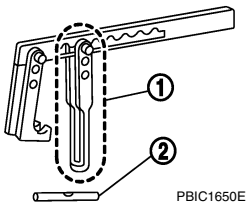
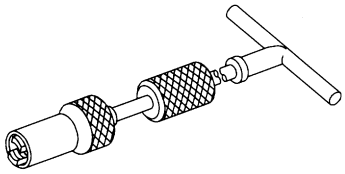
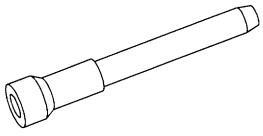
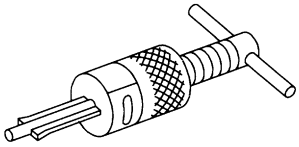
PREPARATION

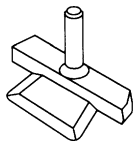
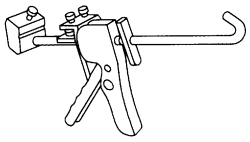
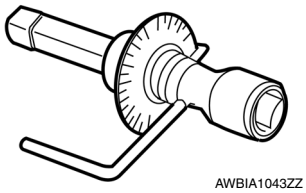
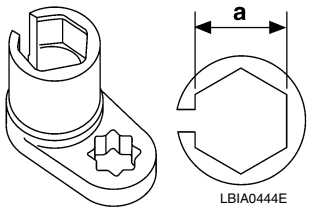
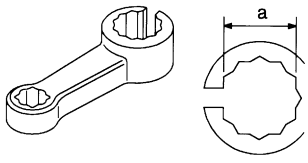
PREPARATION

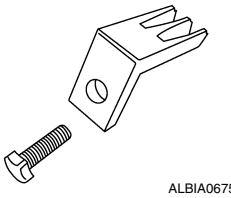
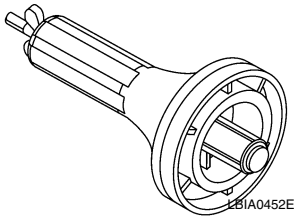
Special Service Tool

INFOID:0000000009465998

The actual shapes of the tools may differ from those illustrated here.

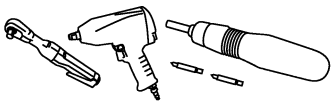
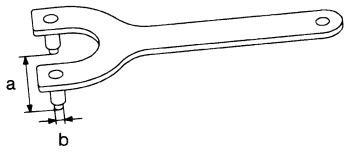
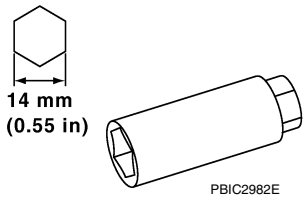
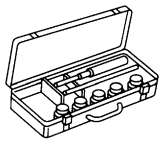
Tool number (TechMate No.) Tool name	Description
ST0501S000 (—) Engine stand assembly 1 ST05011000 (—) Engine stand 2 ST05012000 (—) Base  NT042	Disassembling and assembling
KV101J0010 (J-47242) Engine support table  WBIA0658E	Removal engine and transmission assembly
KV10116200 (J-26336-A) Valve spring compressor 1. KV10115900 (J-26336-20) Attachment 2. KV10109220 (—) Adapter  PBIC1650E	Disassembling valve mechanism Part (1) is a component of KV10116200 (J-26336-A), but part (2) is not.
KV10107902 (J-38959) Valve oil seal puller  S-NT011	Removing valve oil seal
— (J-39386) Valve oil seal drift  NT024	Installing valve oil seal
ST16610001 (J-23907) Pilot bushing puller  NT045	Removing crankshaft pilot bushing

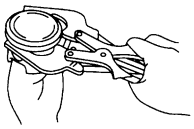
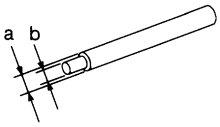
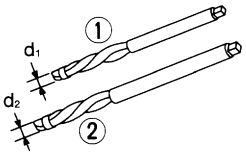
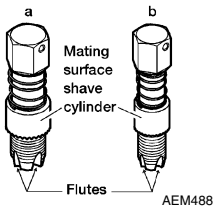
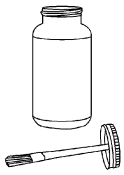
Tool number (TechMate No.) Tool name	Description
KV10111100 (J-37228) Seal cutter  NT046	Removing steel oil pan and rear timing chain case
WS39930000 (—) Tube presser  NT052	Pressing the tube of liquid gasket
16441 6N210 (J-45488) Quick connector release  PBIC0198E	Removing fuel tube quick connectors in engine room (Available in SEC. 164 of PARTS CATALOG: Part No. 16441 6N210)
KV10112100 (BT-8653-A) Angle wrench  AWBIA1043ZZ	Tightening bolts for cylinder head, main bearing cap and connecting rod cap
KV991J0050 (J-44626) Air fuel sensor Socket  LBIA0444E	Loosening or tightening air fuel ratio A/F sensor **a: 22 mm (0.87 in)**
KV10114400 (J-38365) Heated oxygen sensor wrench  NT636	Loosening or tightening rear heated oxygen sensor **a: 22 mm (0.87 in)**

Tool number (TechMate No.) Tool name	Description
— (J-50288) Ring gear stopper  ALBIA0675ZZ	Removing and installing crankshaft pulley
— (J-47128) Seal installer  LBIA0452E	Installing rear main seal

Commercial Service Tool

INFOID:0000000009465999

(TechMate No.) Tool name	Description
Power tool  PIIB1407E	Loosening nuts, screws and bolts
Pulley holder  NT628	Removing and installing crankshaft pulley (Holding crankshaft pulley) a: 68 mm (2.68 in) dia. b: 8 mm (0.31 in) dia.
Spark plug wrench  PBIC2982E	Removing and installing spark plug
Valve seat cutter set  NT048	Finishing valve seat dimensions

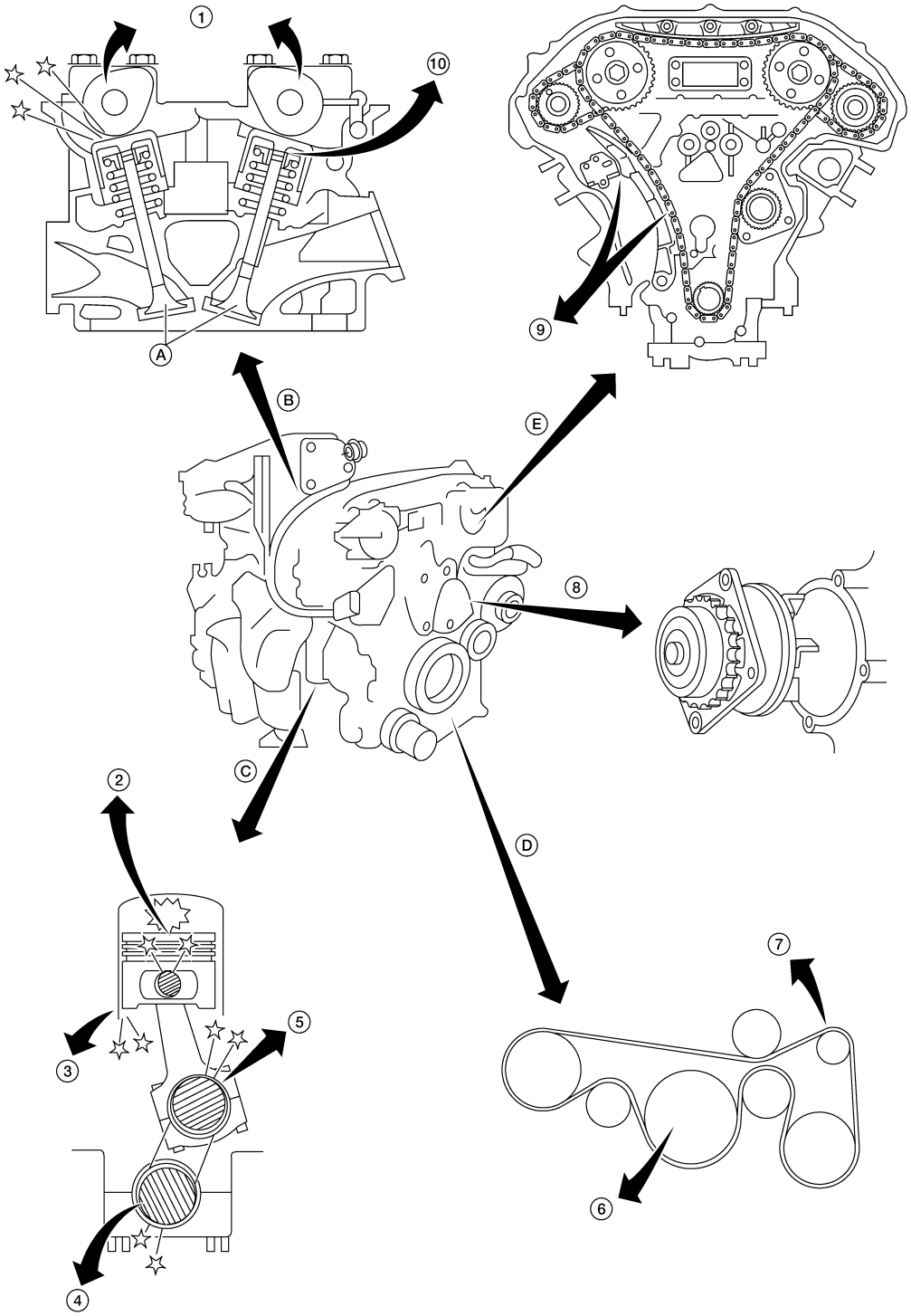
(TechMate No.) Tool name	Description
Piston ring expander  NT030	Removing and installing piston ring
Valve guide drift  NT015	Removing and installing valve guide **Intake & Exhaust:** **a: 9.5 mm (0.374 in) dia.** **b: 5.5 mm (0.217 in) dia.**
Valve guide reamer  NT016	Reaming valve guide 1 or hole for oversize valve guide 2 **Intake & Exhaust:** **d_1: 6.0 mm (0.236 in) dia.** **d_2: 10.2 mm (0.402 in) dia.**
(J-43897-18) (J-43897-12) Oxygen sensor thread cleaner  AEM488	Reconditioning the exhaust system threads before installing a new oxygen sensor (Use with anti-seize lubricant shown below.) **a: J-43897-18 (18 mm dia.) for zirconia oxygen sensor** **b: J-43897-12 (12 mm dia.) for titania oxygen sensor**
Anti-seize lubricant (Permatex 133AR or equivalent meeting MIL specification MIL-A-907)  AEM489	Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads

SYSTEM DESCRIPTION

NOISE, VIBRATION, AND HARSHNESS (NVH) TROUBLESHOOTING

NVH Troubleshooting - Engine Noise

INFOID:0000000009466000



AWBIA0022ZZ

1. Camshaft bearing noise
2. Piston pin noise
3. Piston slap noise
4. Main bearing noise
5. Connecting rod bearing noise
6. Drive belt noise (Sticking/Slipping)
7. Drive belt noise (Slipping)
8. Water pump noise
9. Timing chain and chain tensioner noise

10. Tappet noise
A. Valve
B. Valve mechanism
C. Rotation mechanism
D. Drive belt
E. Timing chain

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

INFOID:0000000009466001

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. Repair or replace the identified part as necessary.

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-18
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal clearance Camshaft runout	EM-76
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston and piston pin clearance Connecting rod bushing clearance	EM-22
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston-to-bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	EM-107
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing clearance (Small end) Connecting rod bearing clearance (Big end)	EM-107
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-107
Front of engine Timing chain 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-64
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	EM-14
	Creaking	A	B	A	B	A	B	Drive belts (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	CO-17

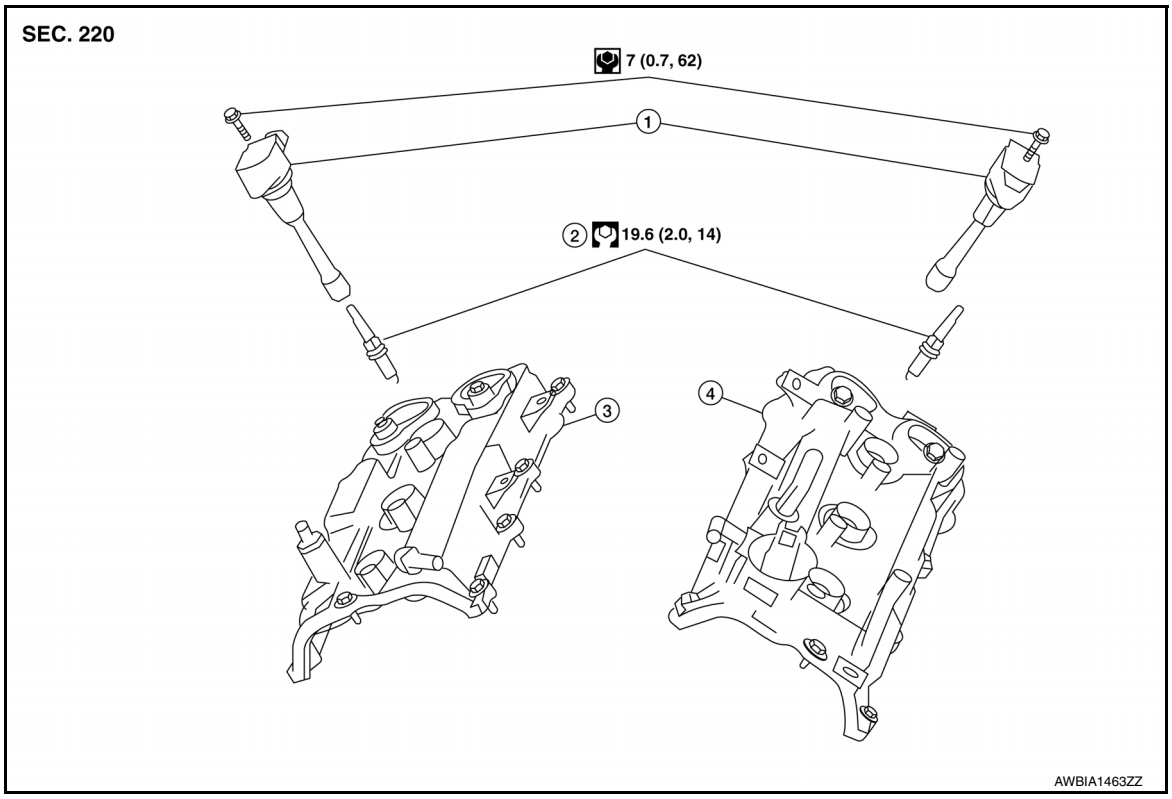
A: Closely related B: Related C: Sometimes related —: Not related

PERIODIC MAINTENANCE

SPARK PLUG

Exploded View

INFOID:0000000009466002



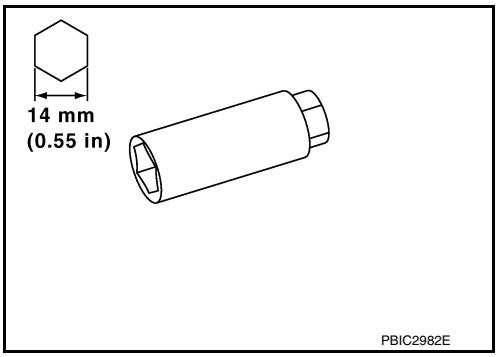
1. Ignition coil
2. Spark plug
3. Rocker cover (RH)
4. Rocker cover (LH)

Removal and Installation

INFOID:0000000009466003

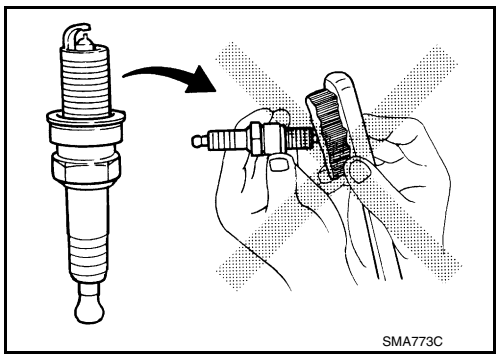
REMOVAL

1. Remove the ignition coil. Refer to EM-42, "Removal and Installation (LH)" and EM-42, "Removal and Installation (RH)".
2. Remove the spark plug with a suitable spark plug wrench.



INSPECTION AFTER REMOVAL

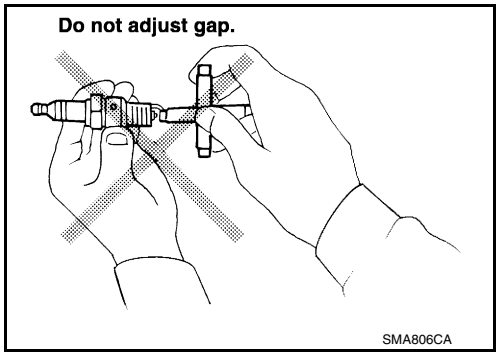
- Do not use a wire brush for cleaning the spark plugs.



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

Cleaner air pressure : less than 588 kPa (6 kg/cm^2, 85 psi)
Cleaning time : less than 20 seconds

- Checking and adjusting spark plug gap is not required between change intervals. Do not adjust the gap; replace the spark plug as necessary if out of specification.



INSTALLATION

Installation is in the reverse order of removal.

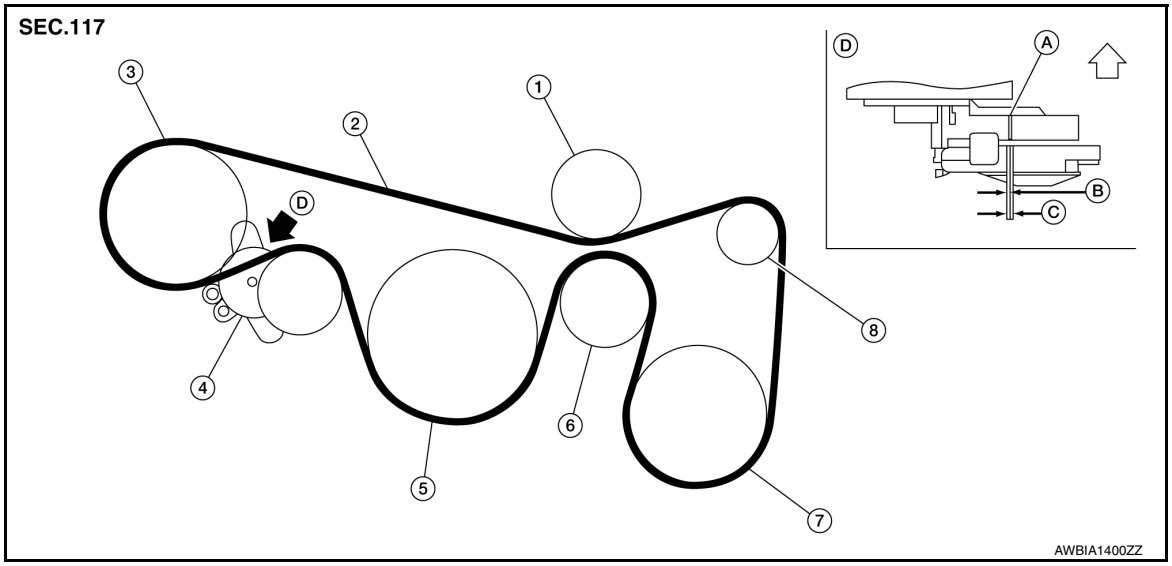
Make	DENSO
Standard type*	FXE22HR11
Gap (nominal)	1.1 mm (0.043 in)

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

DRIVE BELTS

Checking Drive Belts

INFOID:0000000009466004



1.	Idler pulley	2.	Drive belt	3.	Power steering oil pump
4.	Drive belt auto-tensioner	5.	Crankshaft pulley	6.	Idler pulley
7.	A/C compressor	8.	Generator	A.	Indicator
B.	New drive belt range	C.	Possible use range	D.	View D
⇦	Engine front				

WARNING:

Inspect and check the drive belt with the engine off.

- Check that the indicator 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 should be within the new drive belt range.
- Visually check entire drive belt for wear, damage or cracks.
- If the indicator is out of the possible use range or the drive belt is damaged, replace the drive belt.

Tension Adjustment

INFOID:0000000009466005

- Drive belt tension is not manually adjustable, it is automatically adjusted by the drive belt auto-tensioner.

Removal and Installation

INFOID:0000000009466006

REMOVAL

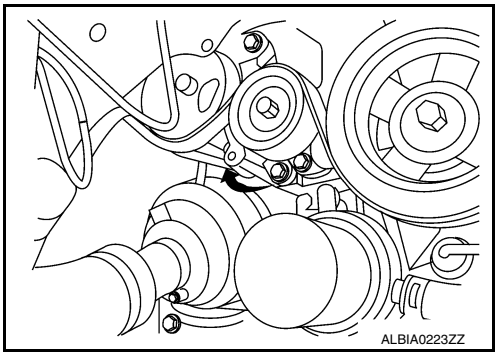
1. Remove the front RH wheel and tire using power tool. Refer to WT-60, "Adjustment".
2. Remove the fender protector side cover (RH). Refer to EXT-24, "Removal and Installation".
3. While securely holding the hexagonal part in pulley center of drive belt auto-tensioner, move in the direction of arrow (loosening direction of drive belt auto-tensioner) using suitable tool.

   WARNING:

   - **Avoid placing hand in a location where pinching may occur if the holding tool accidentally comes off.**

   CAUTION:

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



4. Insert a rod approximately 6 mm (0.24 in) in diameter through the rear of drive belt auto-tensioner into retaining boss to lock drive belt auto-tensioner pulley.
   • Leave drive belt auto-tensioner pulley arm locked until drive belt is installed again.
5. Remove drive belt from crankshaft pulley and then remove it from the other pulleys.

INSTALLATION

1. Install the drive belt onto all of the pulleys.

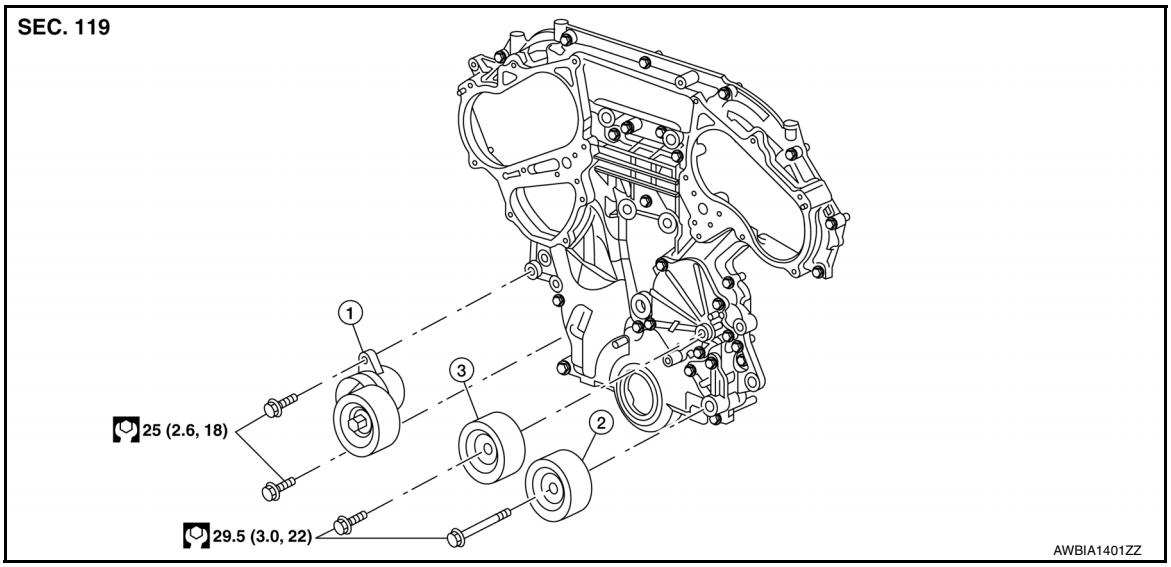
CAUTION:
Confirm drive belt is completely set on the pulleys.

2. Release drive belt auto-tensioner, and apply tension to drive belt.

   WARNING:
   • **Avoid placing hand in a location where pinching may occur if the holding tool accidentally comes off.**
   CAUTION:
   • **Do not loosen the drive belt auto-tensioner pulley bolt. (Don't turn it counterclockwise. If turned counterclockwise, the complete drive belt auto-tensioner must be replaced as a unit, including pulley.)**
3. Turn crankshaft pulley clockwise several times to equalize tension between each pulley.
4. Confirm indicator is within the possible use range. Refer to EM-14, "Checking Drive Belts".

Removal and Installation of Drive Belt Auto-tensioner

INFOID:0000000009466007



1. Drive belt auto-tensioner
2. Idler pulley
3. A/C idler pulley

REMOVAL

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

1. Remove the drive belt. Refer to EM-14, "Removal and Installation".
   NOTE:
   Insert a rod approximately 6 mm (0.24 in) in diameter through the rear of drive belt auto-tensioner into the retaining boss to lock drive belt auto-tensioner pulley.
2. Remove the drive belt auto-tensioner using a power tool.

CAUTION:
Do not loosen the drive belt auto-tensioner pulley bolt. Don't turn it counterclockwise. If turned counterclockwise, the complete auto-tensioner including the pulley must be replaced as a unit.

INSTALLATION

Installation is in the reverse order of removal.

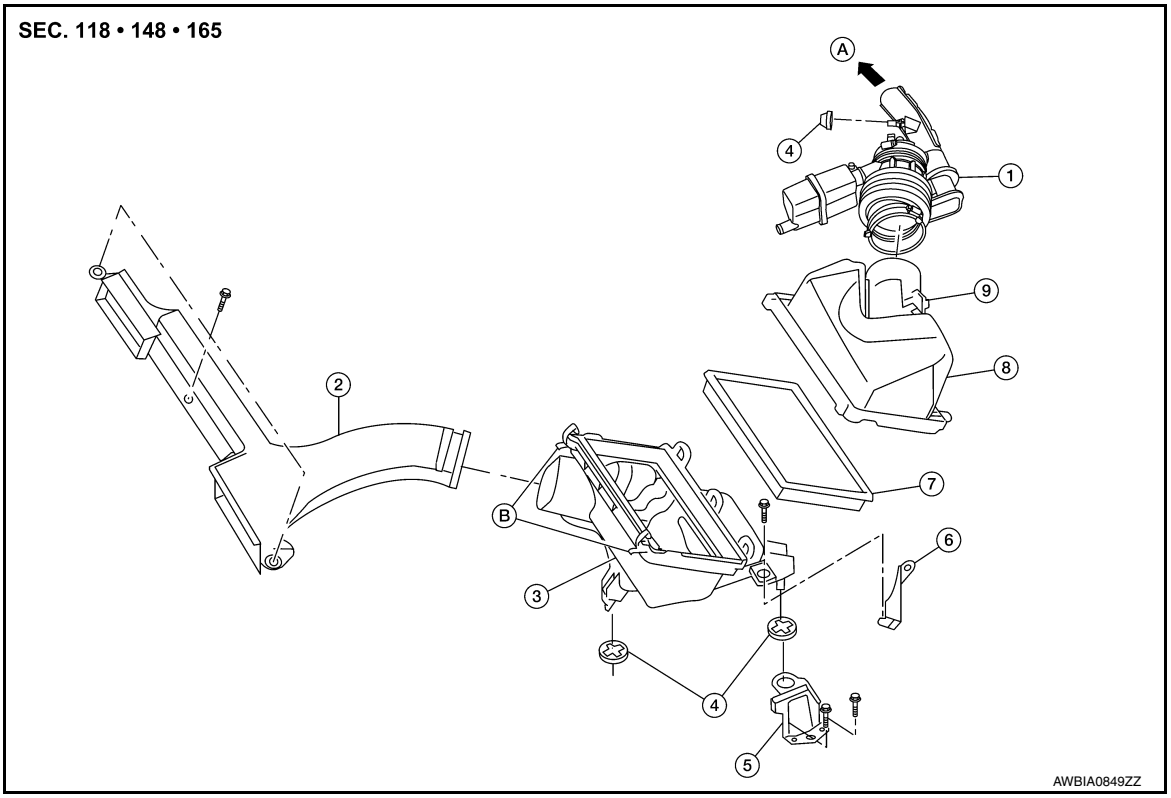
CAUTION:
• **If there is damage greater than peeled paint, replace drive belt auto-tensioner unit.**

- **Do not swap the pulley between the new and old drive belt auto-tensioner units.**

AIR CLEANER FILTER

Removal and Installation

INFOID:0000000009466008



1. Air duct hose and resonator assembly
2. Front air duct
3. Air cleaner case (lower)
4. Grommets
5. Air cleaner case mounting bracket
6. Bracket
7. Air cleaner filter
8. Air cleaner case (upper)
9. Mass air flow sensor

A. To electric throttle control actuator
B. Air cleaner case side clips

CHANGING THE AIR CLEANER FILTER

NOTE:
It is not necessary to remove the front air duct to replace the air cleaner filter.

1. Unhook the air cleaner case side clips.
2. Remove the air cleaner filter.
3. Install a new air cleaner filter.
4. Lock the air cleaner case side clips.

CAMSHAFT VALVE CLEARANCE

Valve Clearance

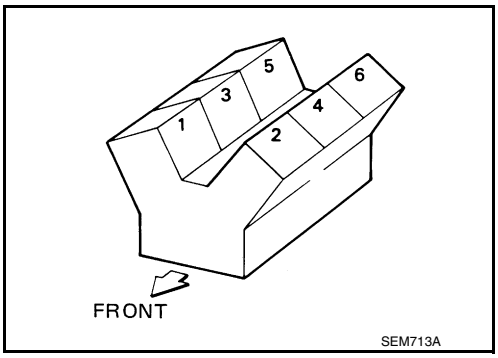
INFOID:0000000009466009

CHECKING

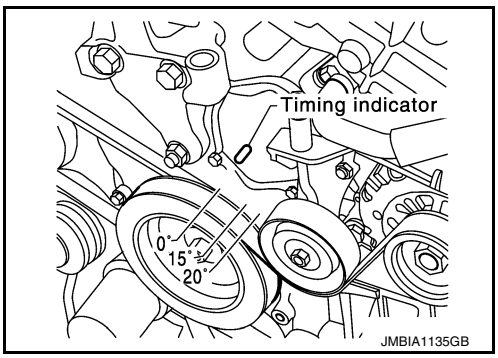
NOTE:

- Perform inspection as follows after removal, installation or replacement of camshaft or valve related parts, or if there are unusual engine conditions regarding valve clearance.
- Check valve clearance while engine is cold and not running.

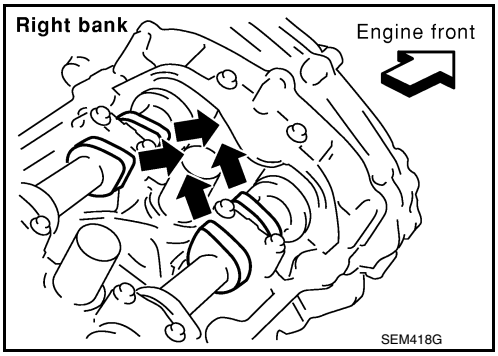
1. Remove the front air duct with air cleaner case, collectors, hoses, wires, harnesses, and connectors. Refer to EM-24, "Removal and Installation".
2. Remove the intake manifold collectors. Refer to EM-25, "Removal and Installation".
3. Remove the ignition coils and spark plugs. Refer to EM-42, "Exploded View".
4. Remove the rocker covers. Refer to EM-48, "Exploded View".



5. Set No.1 cylinder at TDC on its compression stroke.
   - Align timing indicator with TDC mark (0°) on crankshaft pulley.

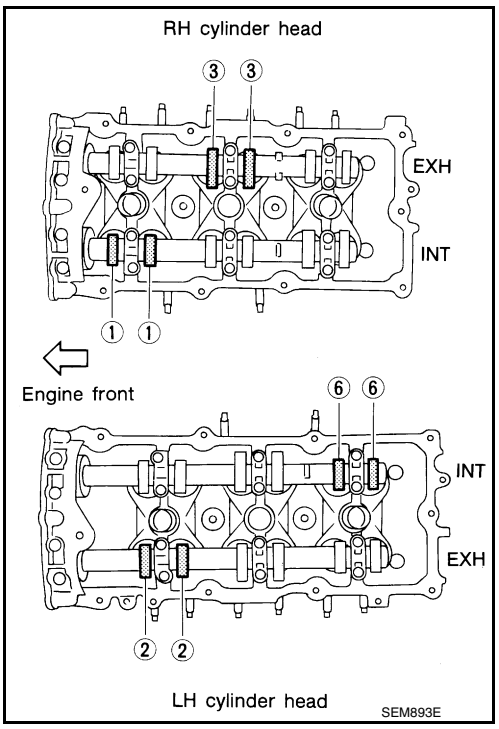


   - Check that the valve lifters on No.1 cylinder are loose and valve lifters on No.4 are tight. If not, turn the crankshaft one full revolution (360°) and align as shown.



6. Check only the valve lifters as shown.

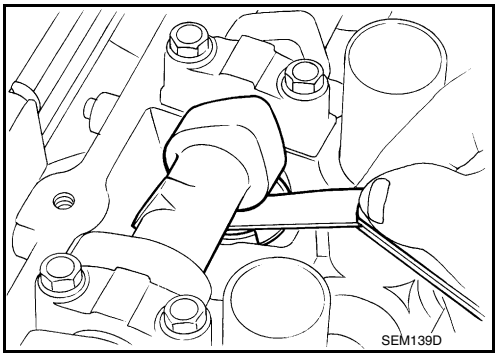
Crank Position	Valve No. 1	Valve No. 2	Valve No. 3	Valve No. 6
No. 1 TDC	Intake	Exhaust	Exhaust	Intake

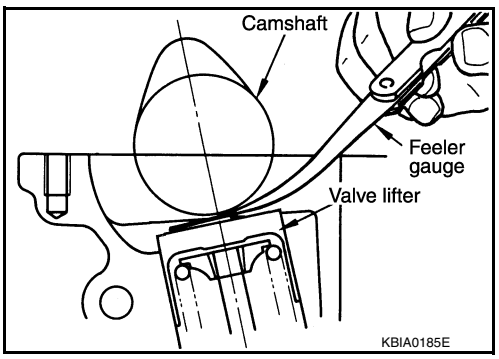


- Using a suitable tool, measure the clearance between the valve lifter and camshaft.
- Record any valve lifter clearance measurements which are out of specification. They will be used later to determine the required replacement valve lifter size.

Valve Clearance for Checking (cold)

Intake : 0.26 - 0.34 mm (0.010 - 0.013 in)
Exhaust : 0.29 - 0.37 mm (0.011 - 0.015 in)

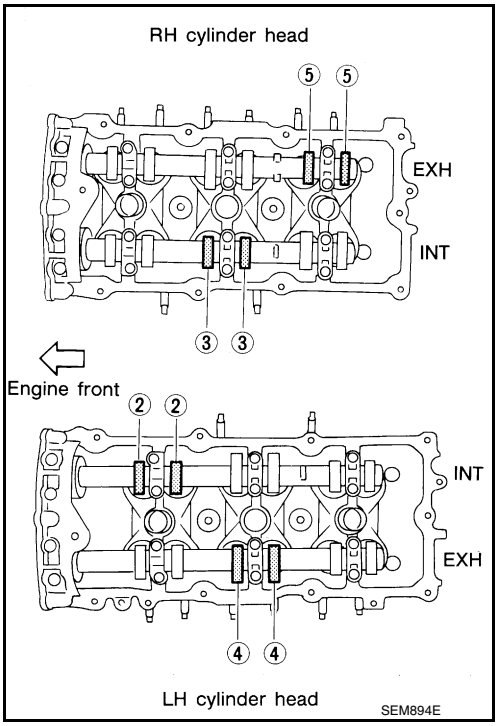




7. Turn crankshaft 240°.
8. Set No.3 cylinder at TDC on its compression stroke.

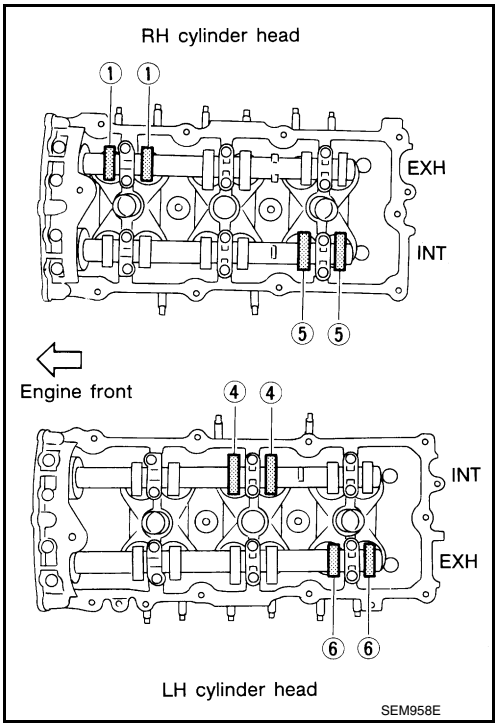
9. Check only those valve lifters as shown.

Crank Position	Valve No. 2	Valve No. 3	Valve No. 4	Valve No. 5
No. 3 TDC	Intake	Intake	Exhaust	Exhaust



10. Turn the crankshaft 240°.
11. Set No.5 cylinder at TDC on its compression stroke.
12. Check only those valve lifters as shown.

Crank Position	Valve No. 1	Valve No. 4	Valve No. 5	Valve No. 6
No. 5 TDC	Exhaust	Intake	Intake	Exhaust

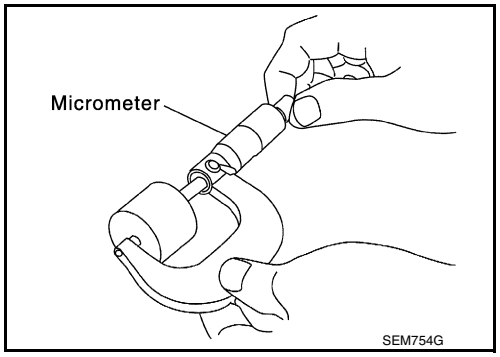


13. If all valve lifter clearances are within specification, install the following components. If the valve lifter clearances are out of specification, adjust the valve lifter clearances.
    - Intake manifold collectors
    - Rocker covers
    - All spark plugs
    - All ignition coils

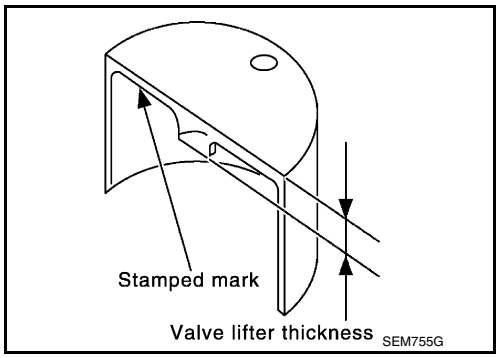
VALVE LIFTER ADJUSTING

CAUTION:
Adjust valve lifter clearance while engine is cold.
NOTE:
- Perform adjustment by selecting the correct head thickness of the valve lifter (adjusting shims are not used).
- The specified valve lifter thickness is the dimension at normal temperatures. Ignore dimensional differences caused by temperature. Use specifications for hot engine condition to confirm valve lifter clearances.

1. Remove the camshaft. Refer to EM-76, "Removal and Installation".
2. Remove the valve lifter that was measured as being outside the standard specifications.
3. Measure the center thickness of the removed valve lifter using suitable tool as shown.



4. Use the equation below to calculate the replacement valve lifter thickness.
   Valve lifter thickness calculation equation: t = t1 + (C1 - C2)
   t = thickness of the replacement valve lifter
   t1 = thickness of the removed valve lifter
   C1 = measured valve lifter clearance
   C2 = standard valve lifter clearance
   - The thickness of the new valve lifter can be identified by the stamp mark on the reverse side (inside the valve lifter).
   - Available thickness of the valve lifter (factory setting): 7.88 - 8.40 mm (0.3102 - 0.3307 in), in 0.02 mm (0.0008 in) increments, in 27 sizes (intake/exhaust). Refer to EM-130, "Camshaft".



5. Install the selected replacement valve lifter.
6. Install the camshaft. Refer to EM-76, "Removal and Installation".
7. Rotate the crankshaft a few turns by hand.
8. Confirm that the valve lifter clearances are within specification.
9. After the engine has been run to full operating temperature, confirm that the valve lifter clearances are within specification.

Standard Valve Clearance	Cold	Hot* (reference data)
Intake	0.26 - 0.34 mm (0.010 - 0.013 in)	0.304 - 0.416 mm (0.012 - 0.016 in)
Exhaust	0.29 - 0.37 mm (0.011 - 0.015 in)	0.308 - 0.432 mm (0.012 - 0.017 in)

* Approximately 80°C (176°F)

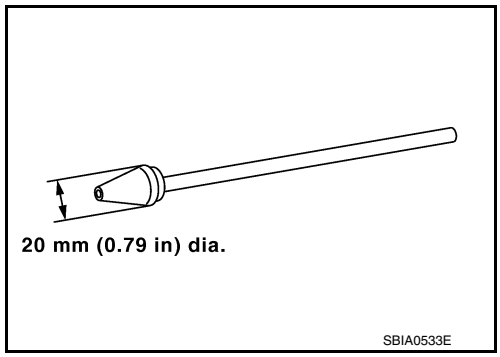
COMPRESSION PRESSURE

On-Vehicle Service

INFOID:0000000009466010

CHECKING COMPRESSION PRESSURE

1. Run the engine until it reaches normal operating temperature.
2. Turn the ignition switch to OFF.
3. Release fuel pressure. Refer to EC-592, "Inspection".
4. Remove all six spark plugs.
   Refer to EM-12, "Removal and Installation".
5. Attach a compression tester to No. 1 cylinder.



6. Depress accelerator pedal fully to keep the electric throttle control actuator butterfly-valve wide open to maximize air intake flow.
7. Crank the engine and record the highest gauge indication.
8. Repeat the measurement on each cylinder (steps 5 - 7).

Unit: kPa (kg/cm^2, psi)/rpm

Standard	Minimum	Difference limit between cylinders
1,275 (13.0, 185)/300	981 (10.0, 142)/300	98 (1.0, 14)/300

- **Always use a fully-charged battery to obtain specified engine speed.**
- If the engine speed is out of the specified range check the battery and recharge as necessary. Check the engine speed again with the battery properly charged.
- If some cylinders have low compression pressure, pour a 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 the piston rings and replace if necessary
  - If the compression pressure remains at low level despite the addition of engine oil, the valves may be malfunctioning. Check the valves for damage. Replace the valve or valve seat accordingly.
- If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, cylinder head gaskets may be leaking, or a valve in adjacent cylinders may be damaged. Inspect and repair as required.
- If the compression pressure is below the minimum value, check the valve clearances and parts associated with the combustion chamber (valve, valve seat, piston, piston ring, cylinder bore, cylinder head, cylinder head gasket). After the checking, measure the compression pressure again.

REMOVAL AND INSTALLATION

ENGINE ROOM COVER

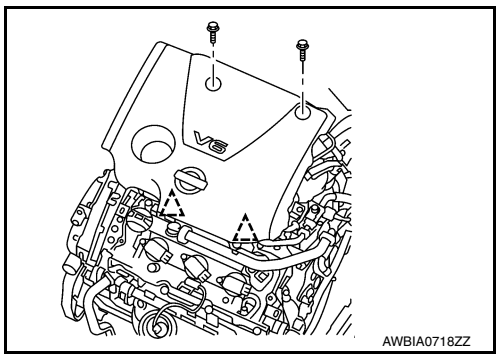
Removal and Installation

INFOID:0000000009466011

CAUTION:
Do not damage or scratch engine room cover when installing or removing.

REMOVAL

- Remove the engine room cover bolts and engine room cover.



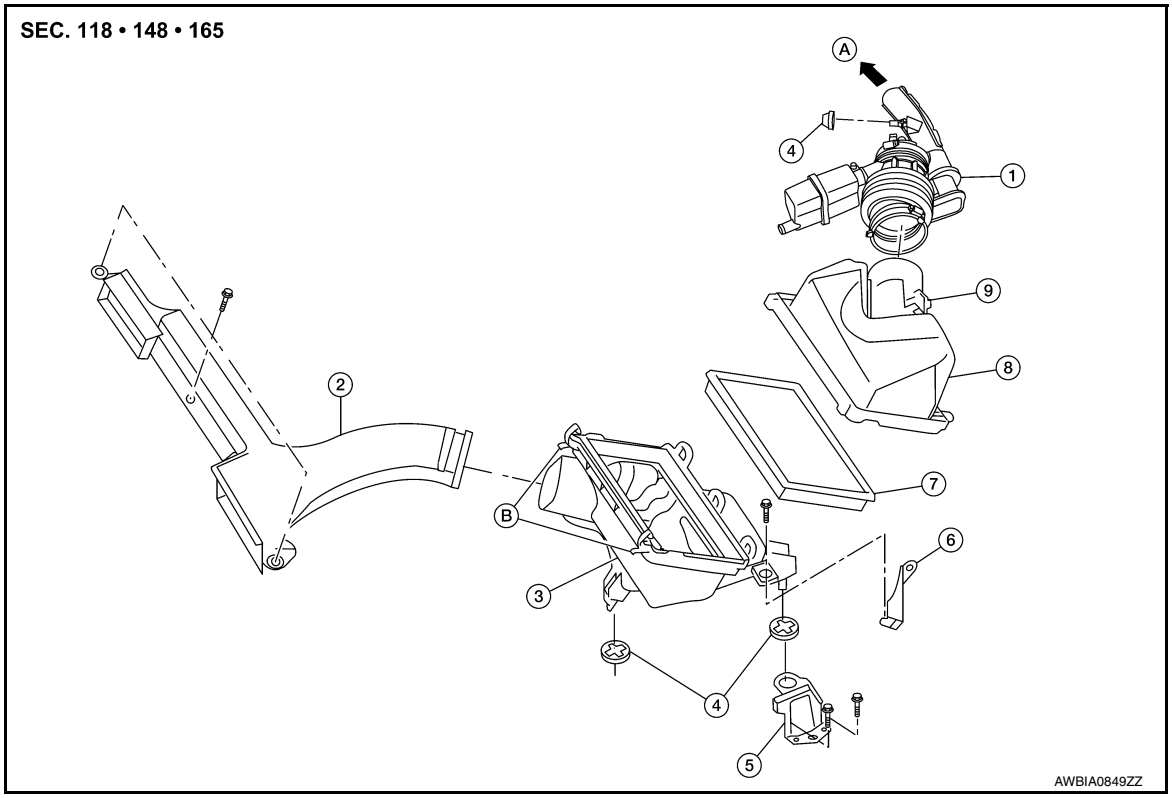
INSTALLATION

Installation is in the reverse order of removal.

AIR CLEANER AND AIR DUCT

Removal and Installation

INFOID:0000000009466012



1. Air duct hose and resonator assembly	2. Front air duct	3. Air cleaner case (lower)
4. Grommets	5. Air cleaner case mounting bracket	6. Bracket
7. Air cleaner filter	8. Air cleaner case (upper)	9. Mass air flow sensor
A. To electric throttle control actuator	B. Air cleaner case side clips	

REMOVAL

1. Remove engine room cover. Refer to EM-23, "Removal and Installation".
2. Remove front air duct.
3. Disconnect the tube clamp at the electric throttle control actuator and at the air duct hose and resonator assembly.
4. Disconnect the blow-by hose.
5. Remove air duct hose and resonator assembly.
6. Disconnect mass air flow sensor.
7. Remove mass air flow sensor from air cleaner case (upper), as necessary.
   CAUTION:
   Handle mass air flow sensor with care.
   - **Do not shock it.**
   - **Do not disassemble it.**
   - **Do not touch its sensor.**
8. Disconnect transaxle breather.
9. Remove air cleaner case assembly.

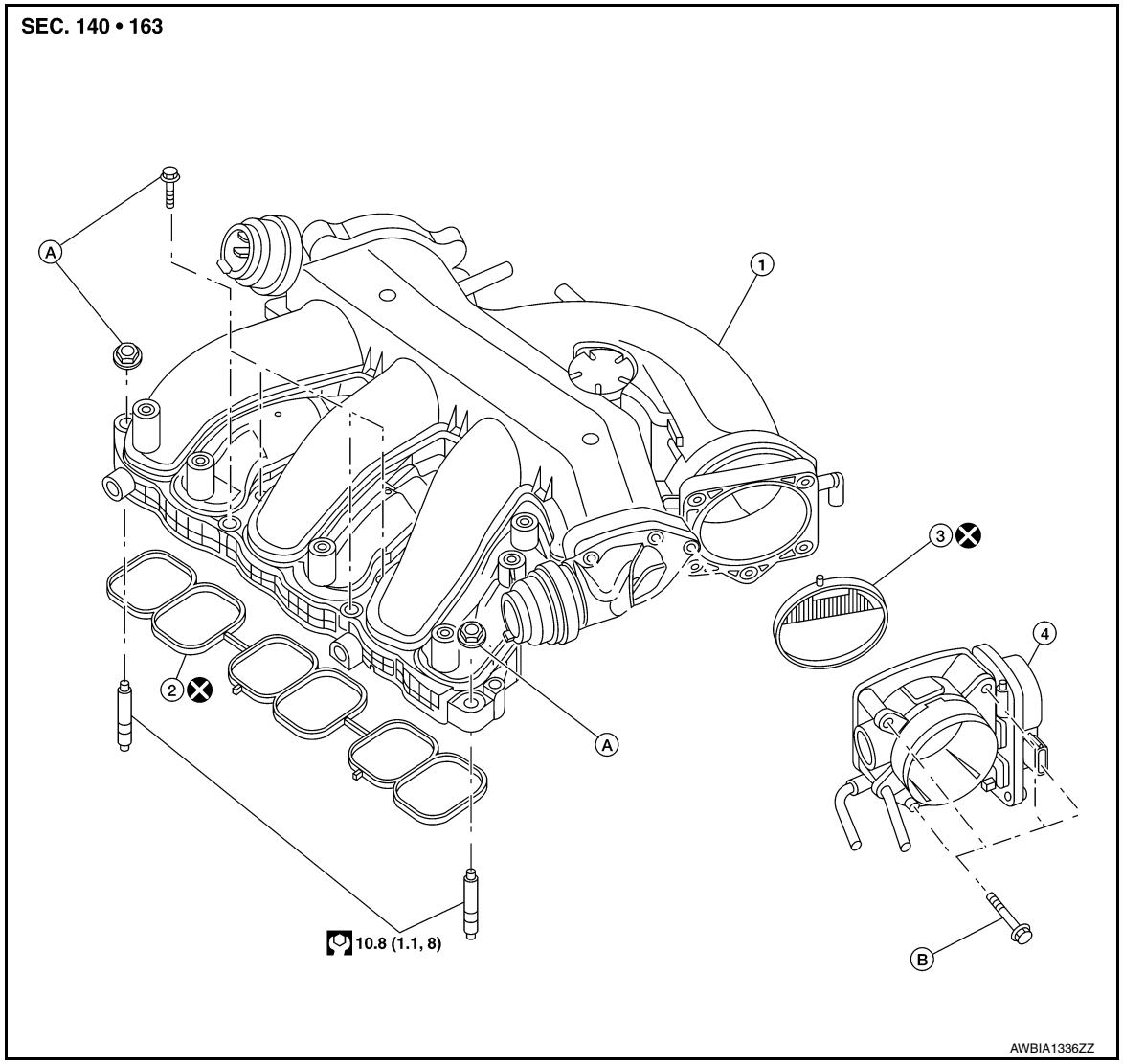
INSTALLATION

Installation is in the reverse order of removal.

INTAKE MANIFOLD COLLECTOR

Removal and Installation

INFOID:0000000009466013



1. Intake manifold collector
2. Intake manifold collector gasket
3. Electric throttle control actuator gasket
4. Electric throttle control actuator
A. Refer to INSTALLATION
B. Refer to INSTALLATION

WARNING:
To avoid the danger of being scalded, do not drain the coolant when the engine is hot.
CAUTION:
Do not remove power valves.
NOTE:
When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.

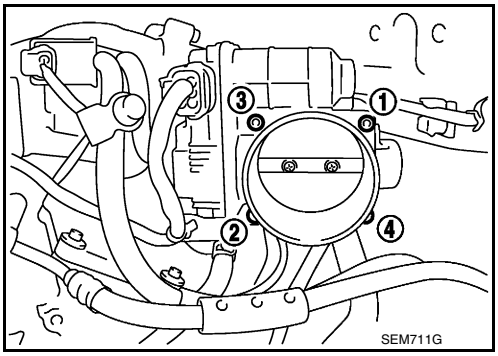
REMOVAL

1. Remove the cowl top, lower cowl top extension and lower cowl top extension brace. Refer to EXT-21, "Removal and Installation".
2. Remove the engine room cover. Refer to EM-23, "Removal and Installation".
3. Remove front air duct and air duct hose and resonator assembly. Refer to EM-24, "Removal and Installation".

4. Remove the electric throttle control actuator bolts in the reverse order as shown and remove the electric throttle control actuator and position aside.

CAUTION:

- **Handle carefully to avoid any shock to the electric throttle control actuator.**
- **Do not disassemble.**

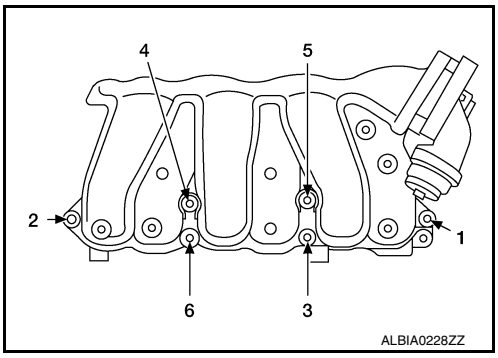


5. Disconnect the following:
   - Power brake booster vacuum hose
   - PCV hose
   - Electric throttle control actuator electrical connector
   - EVAP canister purge hose

CAUTION:

Cover any engine openings to avoid the entry of any foreign material.

6. Remove the EVAP canister purge volume solenoid valve bracket bolt. Position the valve aside.
7. Loosen the intake manifold collector bolts in the order as shown using power tool, and remove the intake manifold collector and gasket.



8. If necessary remove the following components:
   - VIAS control solenoid valve
   - EVAP canister purge volume control solenoid valve

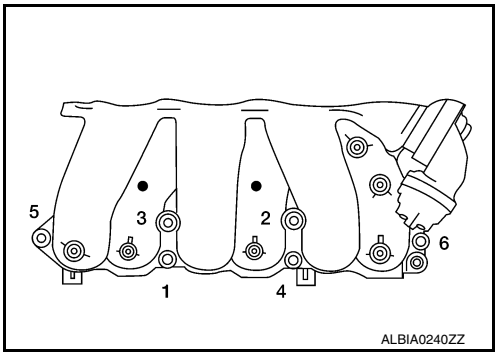
INSTALLATION

Installation is in the reverse order of removal.

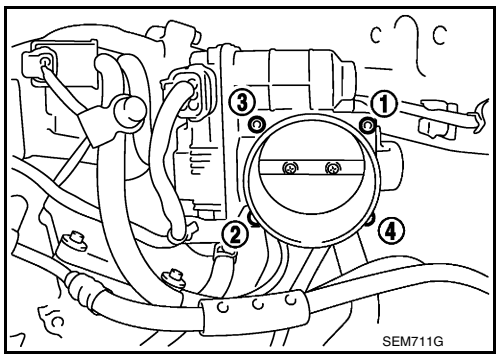
CAUTION:

Do not reuse intake manifold collector gasket or electric throttle control actuator gasket.

- Tighten intake manifold collector bolts in the order as shown.



- Tighten electric throttle control actuator bolts in the order shown.



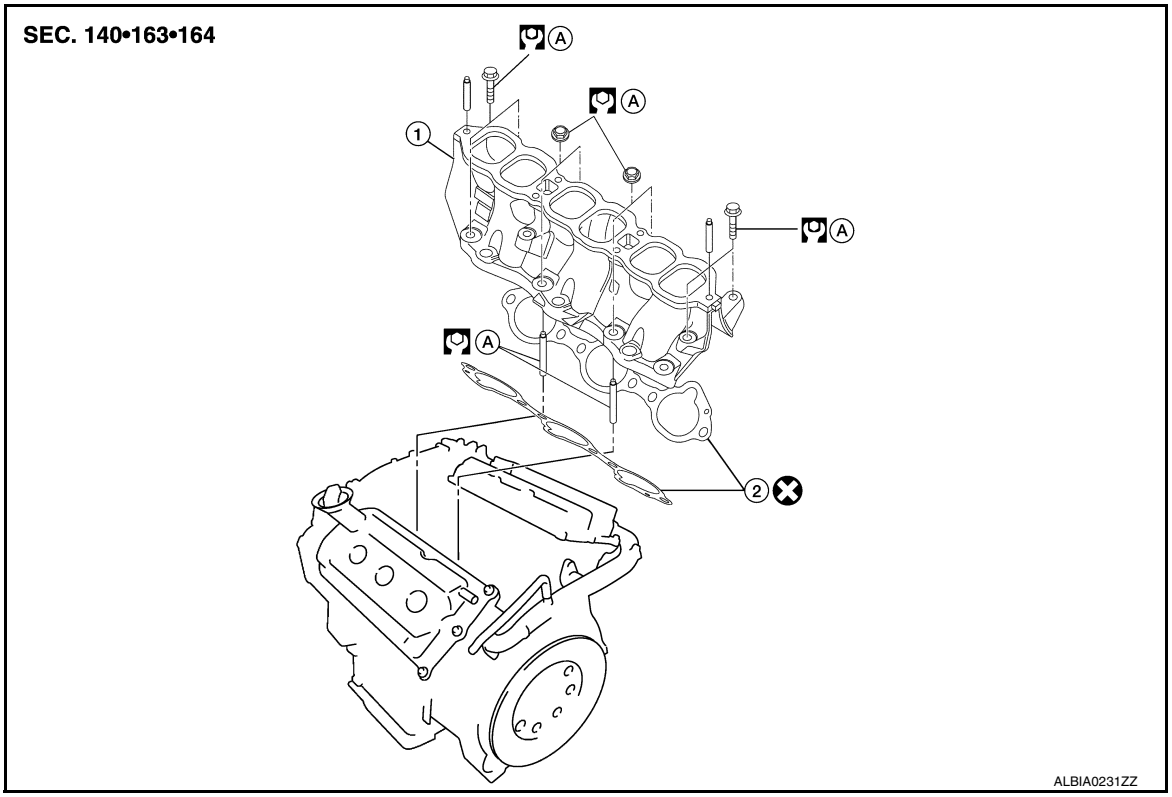
NOTE:
After installation, it is necessary to re-calibrate the electric throttle control actuator as follows:

1. Perform the "Throttle Valve Closed Position Learning" when harness connector of the electric throttle control actuator is disconnected. Refer to EC-21, "THROTTLE VALVE CLOSED POSITION LEARNING : Special Repair Requirement".
2. Perform the "Idle Air Volume Learning" when the electric throttle control actuator is replaced. Refer to EC-21, "IDLE AIR VOLUME LEARNING : Special Repair Requirement".

INTAKE MANIFOLD

Removal and Installation

INFOID:0000000009466014



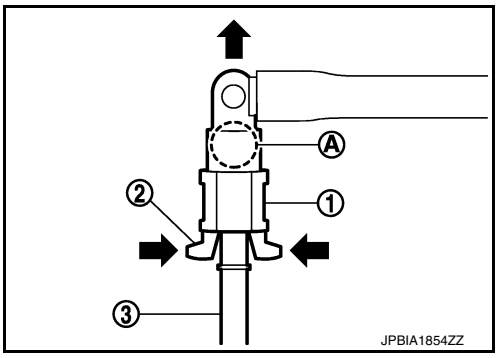
1. Intake manifold
2. Intake manifold gaskets
A. Refer to INSTALLATION

REMOVAL

WARNING:

To avoid the danger of being scalded, do not drain the coolant when the engine is hot.

1. Release the fuel pressure. Refer to EC-592, "Inspection".
2. Disconnect the battery negative terminal. Refer to PG-67, "Removal and Installation (Battery)".
3. Remove intake manifold collector. Refer to EM-25, "Removal and Installation".
4. Disconnect fuel tube quick connector at vehicle piping side.
5. To remove the quick connector cap (1), hold the sides of the connector (A), push in the tabs (2) and pull out the fuel tube (3).

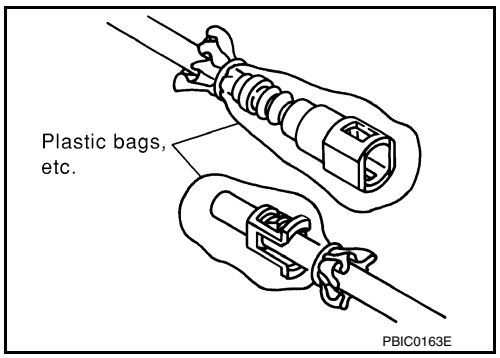


CAUTION:

- **The tube can be removed when the tabs are completely depressed. Do not twist fuel tube.**
- **Do not use any tools to remove the quick connector.**
- **Keep the resin tube away from heat. Be especially careful when welding near the tube.**
- **Prevent acid liquids such as battery electrolyte, etc. from getting on the resin tube.**
- **Do not bend or twist the tube during removal or installation.**
- **Do not remove the remaining retainer on the tube.**
- **When the tube is replaced, also replace the retainer with a new one.**

- **To keep the connecting portion clean and to avoid damage and foreign materials entering, cover the ends of the fuel tubes with plastic bags or something similar.**

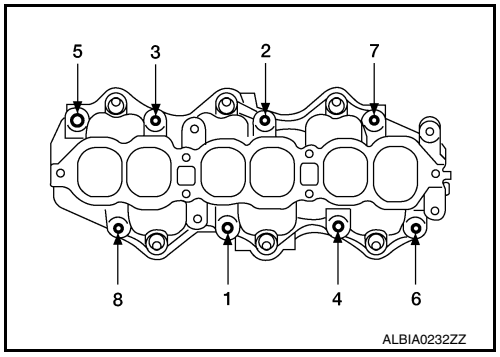
NOTE:
If the connector and the tube are stuck together, push and pull several times until they start to move. Then disconnect them by pulling.



6. Remove the fuel rail with the fuel injectors attached, from the intake manifold. Remove the fuel injector O-rings and use new O-rings for installation.

CAUTION:
Do not reuse O-rings.

7. Loosen the bolts in the order as shown, and remove the intake manifold with power tool.

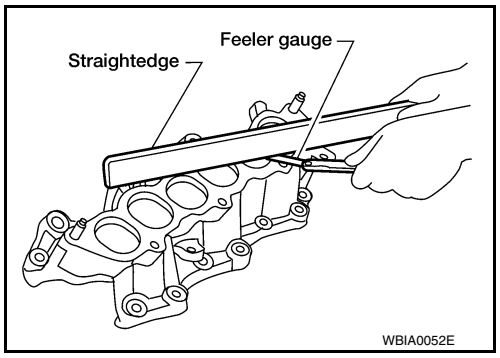


INSPECTION AFTER REMOVAL

Surface Distortion

- Using straightedge and feeler gauge, inspect the surface distortion of the intake manifold.

Standard : 0.1 mm (0.004 in)



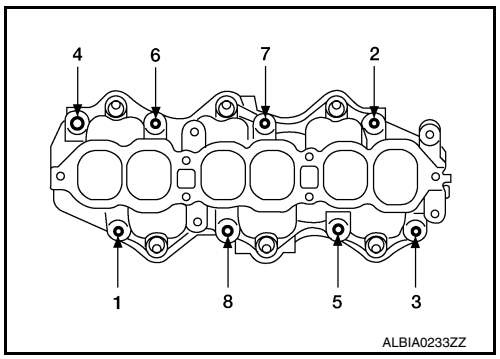
INSTALLATION

CAUTION:
Do not reuse intake manifold gaskets.

Installation is in the reverse order of removal. Follow the procedure below for specific tightening sequences and procedures.

- Install intake manifold bolts in two steps in the numerical order as shown.

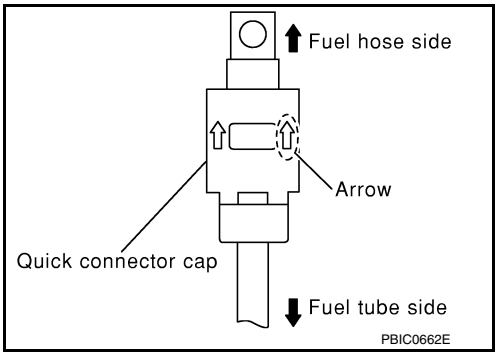
Step 1 : 7.4 N·m (0.75 kg-m, 65 in-lb)
Step 2 : 25.5 N·m (2.6 kg-m, 19 ft-lb)



NOTE:
After installation, it is necessary to re-calibrate the electric throttle control actuator as follows:

1. Perform the "Throttle Valve Closed Position Learning" when harness connector of the electric throttle control actuator is disconnected. Refer to EC-21, "THROTTLE VALVE CLOSED POSITION LEARNING : Special Repair Requirement".
2. Perform the "Idle Air Volume Learning" when the electric throttle control actuator is replaced. Refer to EC-21, "IDLE AIR VOLUME LEARNING : Special Repair Requirement".

• Install the quick connector as follows:
- Make sure no foreign substances are deposited in and around the fuel tube and quick connector and that there is no damage.
- Align the center to insert the quick connector straight onto the fuel tube.
- Insert the fuel tube until a click is heard.
- Install the quick connector cap on the quick connector joint. Align the arrow mark on the quick connector cap to the upper side.
- Install the fuel hose into the hose clamp.



INSPECTION AFTER INSTALLATION

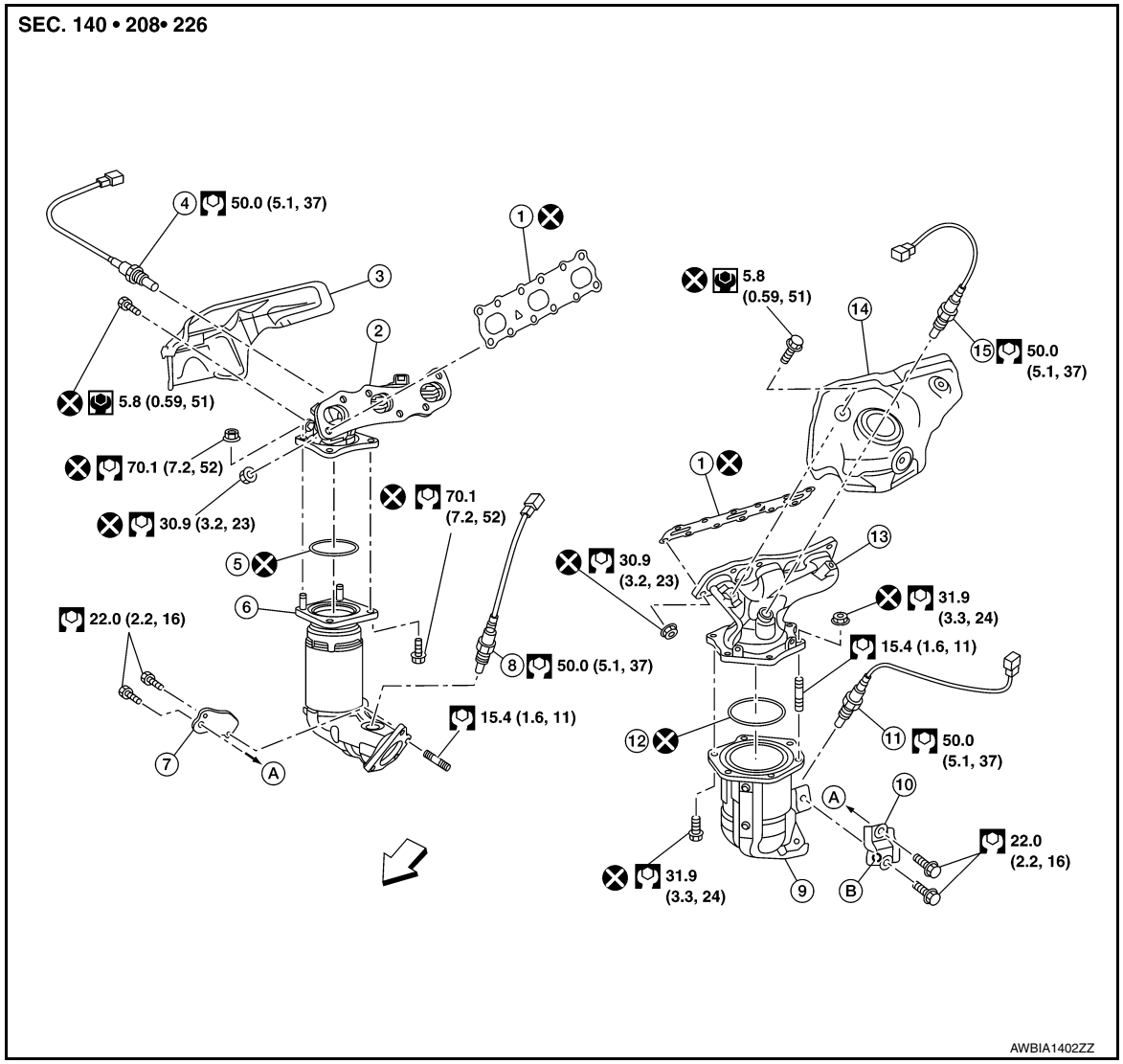
Make sure there are no fuel leaks at connections as follows:

1. Apply fuel pressure to fuel lines by turning ignition switch ON with engine stopped. Then check for fuel leaks at connections.
2. Start the engine and rev it up and check for fuel leaks at connections.
   CAUTION:
   Do not touch engine immediately after stopping as engine is extremely hot.
   NOTE:
   Use mirrors for checking on connections out of the direct line of sight.

EXHAUST MANIFOLD AND THREE WAY CATALYST

Exploded View

INFOID:0000000009466015



1.	Gasket	2.	Exhaust manifold (RH)	3.	Exhaust manifold heat shield (RH)
4.	Air fuel ratio sensor 1 (bank 1)	5.	Ring gasket	6.	Three way catalyst (bank 1)
7.	Three way catalyst support (bank 1)	8.	Heated oxygen sensor 2 (bank 1)	9.	Three way catalyst (bank 2)
10.	Three way catalyst support (bank 2)	11.	Heated oxygen sensor 2 (bank 2)	12.	Ring gasket
13.	Exhaust manifold (LH)	14.	Exhaust manifold heat shield (LH)	15.	Air fuel ratio sensor 1 (bank 2)
A.	To oil pan (upper)	B.	Upper mark	⇦	Engine front

Removal and Installation (LH)

INFOID:0000000009466016

REMOVAL

WARNING:

- **Perform the work when the exhaust system has completely cooled down.**
- **When removing the front and rear engine mounting through bolts and nuts, lift the engine up slightly for safety.**

NOTE:

When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.

1. Remove the air cleaner case assembly, and air duct hose and resonator assembly. Refer to EM-24, "Removal and Installation".
2. Remove the battery and battery tray assembly. Refer to PG-68, "Removal and Installation (Battery Tray)".
3. Remove the radiator. Refer to CO-14, "Removal and Installation".
4. Remove the fan shroud and fan motor. Refer to CO-16, "Removal and Installation".
5. Remove the front exhaust tube. Refer to EX-5, "Exploded View".
6. Remove the three way catalyst support brackets (LH).
7. Remove heated oxygen sensor 2 (bank 2), air fuel ratio (A/F) sensor 1 (bank 2).

a. Remove harness connector of each sensor, and disconnect the harness from the bracket and middle clamp.

b. Remove both heated oxygen sensor 2 and air fuel ratio (A/F) sensor 1 using Tool.

Tool numbers : KV10114400 (J-38365)
: KV991J0050 (J-44626)

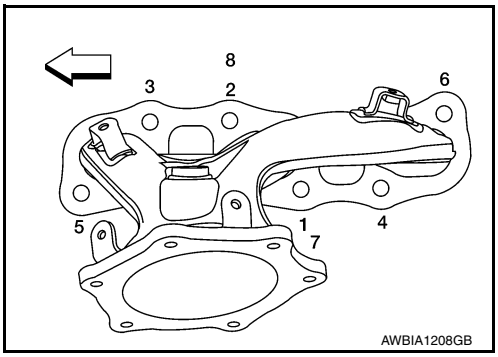
CAUTION:
- **Be careful not to damage heated oxygen sensors 2 or air fuel ratio (A/F) sensors 1.**
- **Discard any heated oxygen sensor 2 which has been dropped from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; replace with a new sensor.**

8. Remove exhaust manifold heat shield (LH) and three way catalyst heat shields (LH) using power tool.
9. Remove the three way catalyst (bank 2) by loosening the bolts first and then removing the nuts and through bolts.
10. Loosen and remove the exhaust manifold nuts in the reverse order as shown.

⇦ **: Engine front**

NOTE:
Number 7 and 8 are not applicable to removal.

11. Remove the exhaust manifold (LH) and gasket.



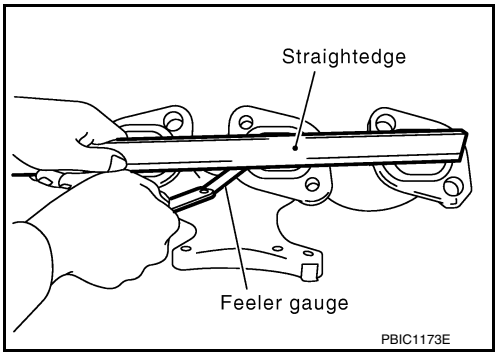
INSPECTION AFTER REMOVAL

Surface Distortion

- Use a suitable tool to check the flatness of the exhaust manifold mating surfaces as shown.

Limit : 0.3 mm (0.012 in)

- Replace the exhaust manifold if the measurement exceeds specifications.



INSTALLATION

Installation is in the reverse order of removal.

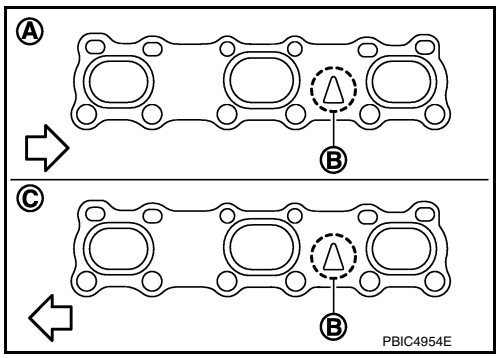
1. Install the studs in the exhaust manifold (if removed), and tighten to specification.

Exhaust manifold studs : 15.4 N·m (1.6 kg-m, 11 ft-lb)

2. Install the exhaust manifold gasket in the direction shown.

CAUTION:
Do not reuse exhaust manifold gaskets.

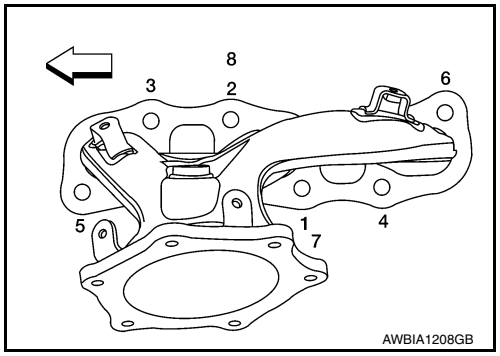
(A) : Bank 1
(B) : Triangle press
(C) : Bank 2
⇦ : Engine front



3. Install the exhaust manifold (LH) nuts and tighten to specification in the order shown.

⇦ **: Engine front**

NOTE:
Number 7 and 8 are tightened a second time.



CAUTION:
- **Before installing a heated oxygen sensor 2 or air fuel ratio (A/F) sensor 1, clean the exhaust manifold threads using the oxygen sensor thread cleaner tool and apply anti-seize lubricant.**

Oxygen sensor thread cleaner : (J-43897-18)
Oxygen sensor thread cleaner : (J-43897-12)

- **Do not over-tighten the air fuel ratio (A/F) sensor 1 or heated oxygen sensors 2. Doing so may cause damage.**

Tool numbers : KV10114400 (J-38365)
: KV991J0050 (J-44626)

Removal and Installation (RH)

INFOID:0000000009466017

REMOVAL

WARNING:
- **Perform the work when the exhaust and cooling system have completely cooled down.**
- **When removing the front and rear engine mounting through bolts and nuts, lift the engine up slightly for safety. For engine slingers, refer to EM-103, "Removal and Installation".**

1. Remove the engine and transaxle assembly. Refer to EM-103, "Removal and Installation".
2. Remove the (RH) three way catalyst supports.
3. Remove rear engine mount bracket. Refer to EM-103, "Removal and Installation".
4. Remove heated oxygen sensor 2 (bank 1), air fuel ratio (A/F) sensor 1 (bank 1).

a. Remove harness connector from heated oxygen sensor 2 (bank 1) and air fuel ratio (A/F) sensor 1, and disconnect the harness from the bracket and middle clamp.
b. Remove both heated oxygen sensors 2 (bank 1) and air fuel ratio (A/F) sensors 1 using Tool.

Tool numbers : KV10114400 (J-38365)
: KV991J0050 (J-44626)

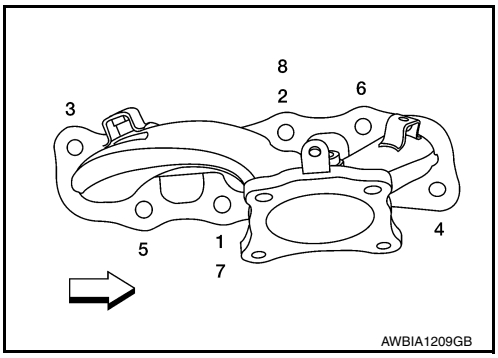
CAUTION:
- **Be careful not to damage heated oxygen sensors 2 or air fuel ratio (A/F) sensors 1.**

- **Discard any heated oxygen sensor 2 which has been dropped from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; replace with a new sensor.**

5. Remove exhaust manifold heat shield (RH) and three way catalyst heat shields (RH) using power tool.
6. Remove the three way catalyst (bank 1) by loosening the bolts first and then removing the nuts and through bolts.
7. Loosen the exhaust manifold nuts in the reverse order as shown and remove the exhaust manifold (RH).

⇦ **: Engine front**

NOTE:
Number 7 and 8 are not applicable to removal.

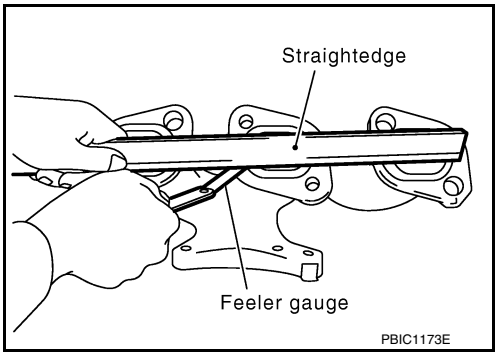


INSPECTION AFTER REMOVAL

Surface Distortion

- Use a suitable tool to check the flatness of the exhaust manifold mating surfaces as shown.

Limit : 0.3mm (0.012 in)



INSTALLATION

Installation is in the reverse order of removal.

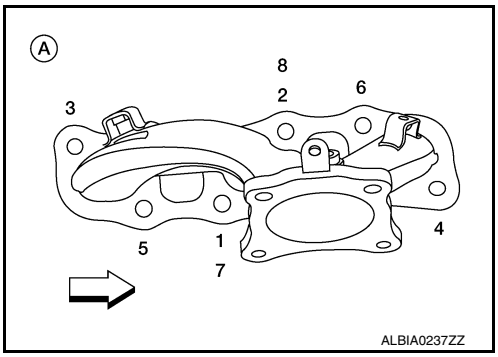
CAUTION:

Do not reuse exhaust manifold gaskets.

- Install the exhaust manifold nuts in the order as shown (A).

⇦ **:Engine front**

NOTE:
Number 7 and 8 are tightened a second time.



CAUTION:

- **Before installing a heated oxygen sensor 2 or air fuel ratio (A/F) sensor 1, clean the exhaust manifold threads using the oxygen sensor thread cleaner tool, and apply anti-seize lubricant.**

Tool numbers : J-43897-18
: J-43897-12

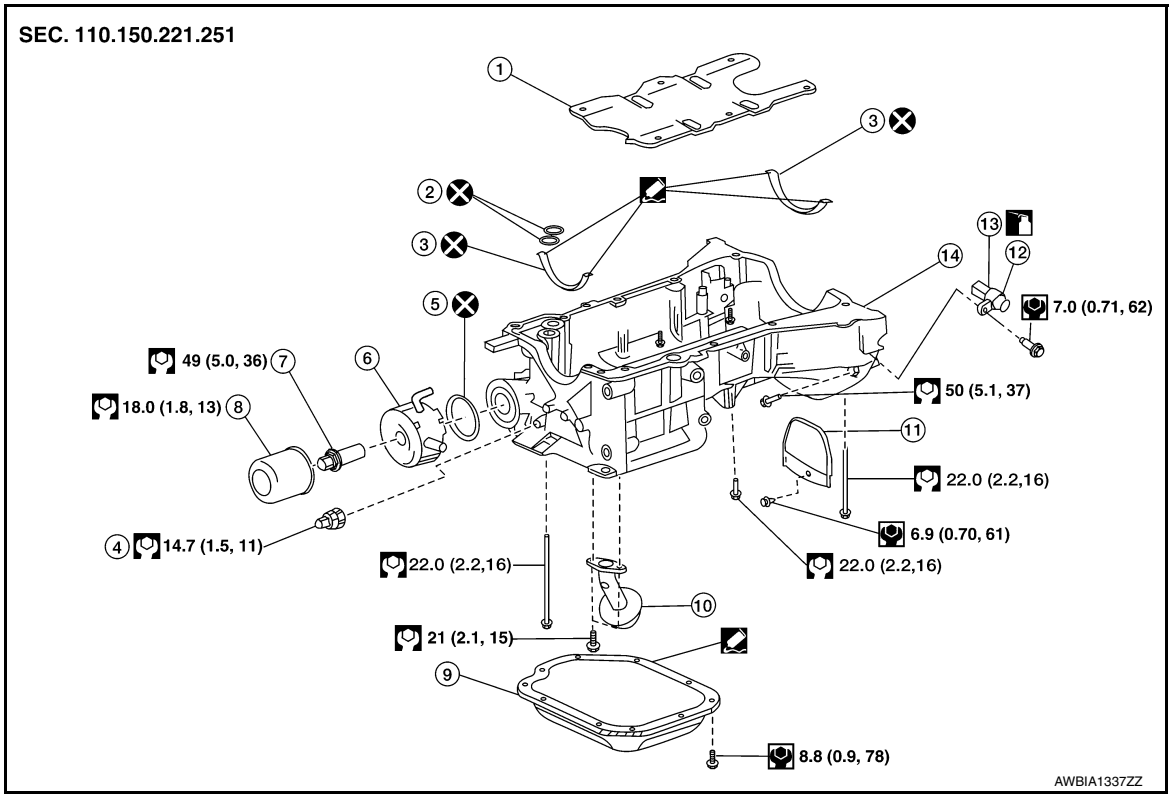
- **Do not over-tighten the air fuel ratio (A/F) sensor 1 or heated oxygen sensors 2. Doing so may cause damage.**

Tool numbers : **KV10114400 (J-38365)**
: **KV991J0050 (J-44626)**

OIL PAN AND OIL STRAINER

Exploded View

INFOID:0000000009466018



1. Oil pan baffle	2. O-ring	3. Gasket
4. Oil pressure switch	5. Oil cooler gasket	6. Oil cooler
7. Oil cooler connection	8. Oil filter	9. Lower oil pan
10. Oil strainer	11. Rear plate cover	12. Crankshaft position sensor (POS)
13. O-ring	14. Upper oil pan	

Removal and Installation (Lower Oil Pan)

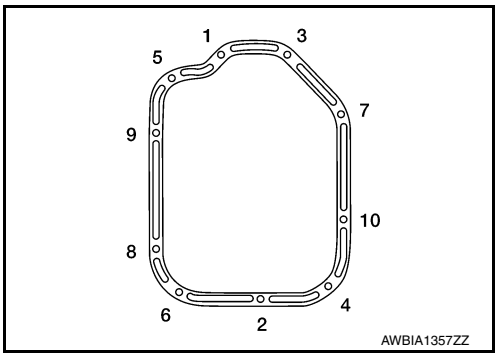
INFOID:0000000009466019

REMOVAL

WARNING:

Do not remove the oil pan until the exhaust system and cooling system are completely cooled.

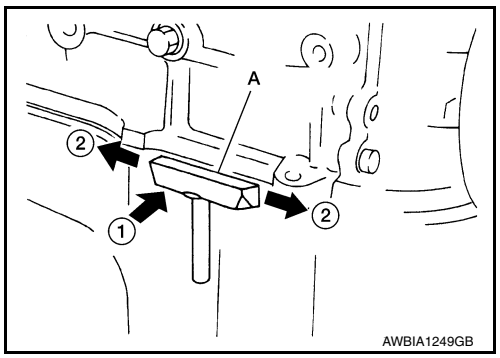
1. Drain the engine oil. Refer to LU-9, "Changing Engine Oil".
2. Loosen the lower oil pan bolts in the reverse order as shown using power tool.



3. Remove the lower oil pan.

a. Insert Tool between the lower oil pan and the upper oil pan.

Tool number : KV10111100 (J-37228)



CAUTION:
- **Be careful not to damage the mating surface.**
- **Do not insert a screwdriver, this will damage the mating surfaces.**

b. In areas where the cutter is difficult to use, use a plastic hammer to lightly tap (1) the cutter where the liquid gasket is applied. Use a plastic hammer to slide (2) the cutter by tapping on the side.

4. If re-installing the original lower oil pan, remove the old sealant from the mating surfaces using suitable tool.
   - Also remove the old sealant from mating surface of the upper oil pan.
   - Remove the old sealant from the bolt holes and threads.

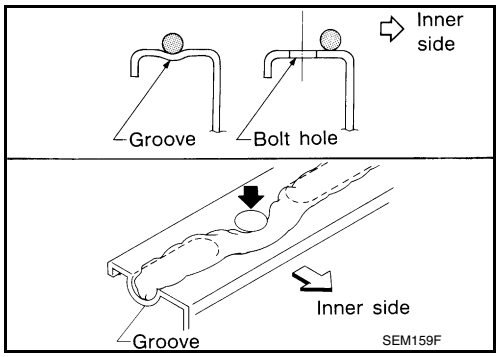
CAUTION:
Do not scratch or damage the mating surfaces when cleaning off the old sealant.

INSPECTION AFTER REMOVAL

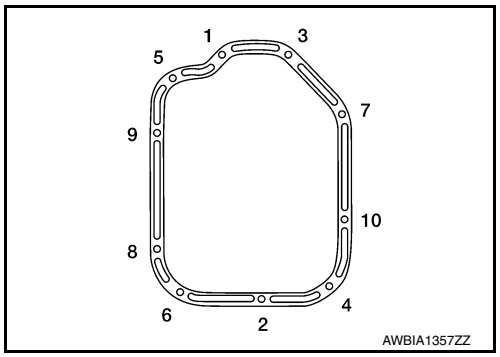
Clean debris from the oil strainer.

INSTALLATION

1. Apply a continuous bead of sealant to the lower oil pan.
   - Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".
   - Be sure the sealant is 4.5 - 5.5 mm (0.177 - 0.217 in) wide.
   - Installation must be done within 5 minutes after applying sealant.



2. Install the lower oil pan. Tighten the lower oil pan bolts in order as shown.
   - Wait at least 30 minutes before refilling the engine with oil.



INSPECTION AFTER INSTALLATION

- Start the engine and check for leaks. Refer to LU-8, "Inspection".
- Inspect the engine oil level. Adjust as necessary. Refer to LU-8, "Inspection".

Removal and Installation (Upper Oil Pan)

INFOID:0000000009466020

REMOVAL

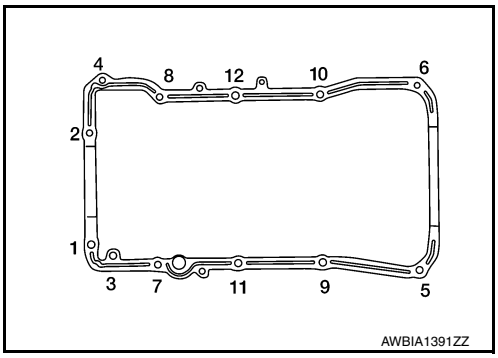
WARNING:
- **Do not remove the oil pan until the exhaust system and cooling system are completely cooled.**
- **When removing the front and rear engine through bolts and nuts, lift the engine up slightly for safety. For engine slingers, refer to EM-103, "Removal and Installation".**

CAUTION:
When removing the upper oil pan from the engine, first remove the crankshaft position sensor (POS). Be careful not to damage sensor edges or signal plate teeth.
NOTE:

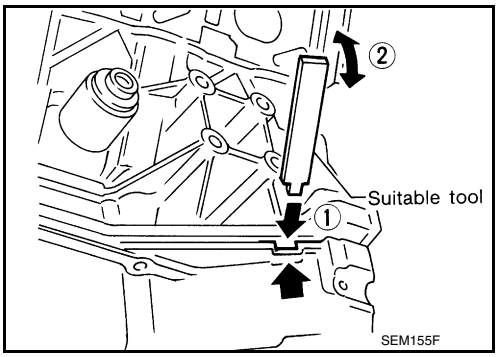
When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.

1. Remove the engine from the vehicle. Refer to EM-103, "Removal and Installation".
2. Drain the engine oil. Refer to LU-9, "Changing Engine Oil".
3. Remove the oil dipstick.
4. Remove the drive belt. Refer to EM-14, "Removal and Installation".
5. Disconnect the A/C compressor harness connector.
6. Remove the A/C compressor bolts and remove the A/C compressor. Refer to HA-37, "Removal and Installation for Compressor".
7. Remove coolant pipe bolts.
8. Disconnect the coolant lines from the engine oil cooler.
9. Remove the oil filter and engine oil cooler from the upper oil pan.
10. Remove the oil pressure switch, and the crankshaft position sensor (POS) from the upper oil pan.
11. Remove the lower oil pan. Refer to EM-36, "Removal and Installation (Lower Oil Pan)".
12. Remove the upper oil pan.

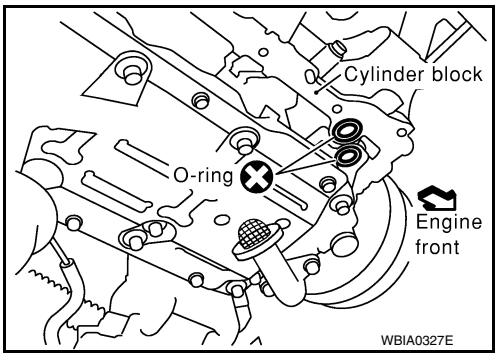
a. Loosen the bolts in the order as shown, using power tool.



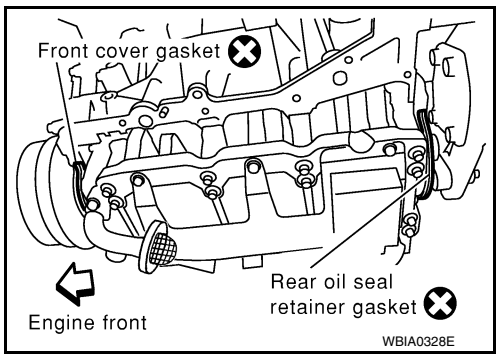
b. Insert suitable tool into the notch (1) of the upper oil pan as shown.
c. Pry off the upper oil pan by moving suitable tool up and down (2) as shown.



13. Remove the O-ring seals from the bottom of the cylinder block and oil pump housing. Use new O-rings for installation.
CAUTION:
Do not reuse O-rings.

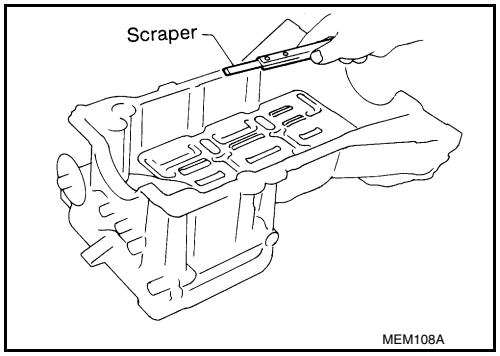


14. Remove front cover gasket and rear oil seal retainer gasket.
15. Remove the oil strainer.



16. If re-installing the original oil pan, remove the old sealant from the mating surfaces using suitable tool.
    - Also remove the old sealant from mating surface of the cylinder block.
    - Remove the old sealant from the bolt holes and threads.

    CAUTION:
    Do not scratch or damage the mating surfaces when cleaning off the old sealant.



INSPECTION AFTER REMOVAL

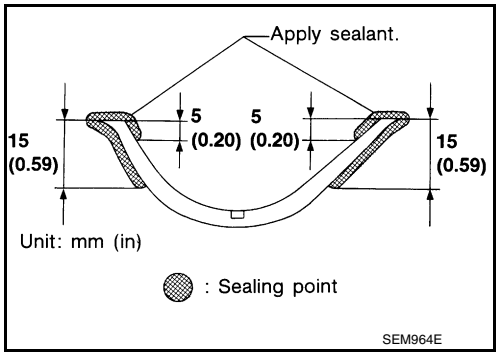
Clean debris from oil strainer.

INSTALLATION

1. Install oil strainer and tighten bolt to specified torque. Refer to EM-37, "Removal and Installation (Upper Oil Pan)".

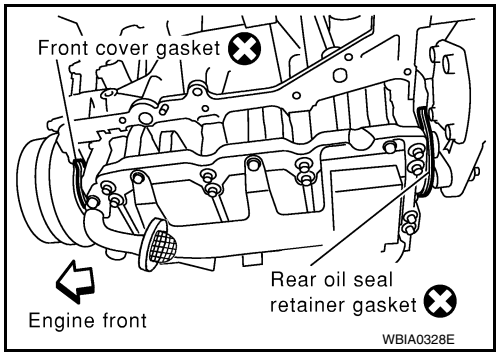
2. Apply Genuine Silicone RTV Sealant or equivalent, to the front cover gasket and the rear oil seal retainer gasket as shown. Refer to GI-21, "Recommended Chemical Products and Sealants".

    CAUTION:
    - **Installation should be done within 5 minutes after applying liquid gasket.**
    - **Do not fill the engine with oil for at least 30 minutes after the components are installed to allow the sealant to cure.**

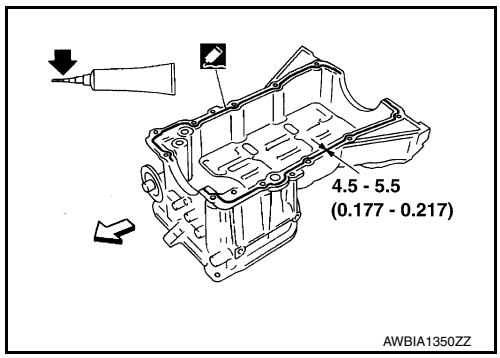


3. Install the front cover gasket and rear oil seal retainer gasket as shown.

    CAUTION:
    Do not reuse front cover gasket and rear oil seal retainer gasket.



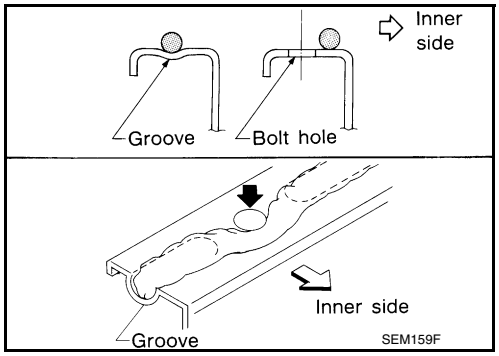
4. Apply a bead of sealant to the cylinder block mating surface of the upper oil pan as shown.
   - Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".
   - Be sure the sealant is applied 4.5 - 5.5 mm (0.177 - 0.217 in) as shown.



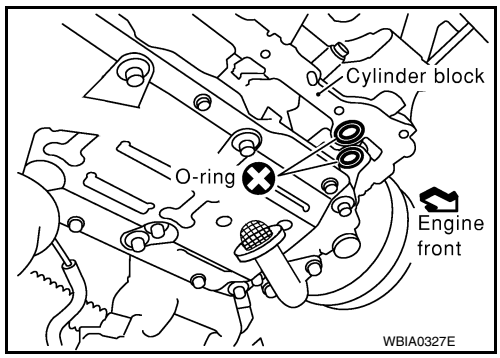
   ⇦ : **Engine front**

   ⬅ : **Cut here**

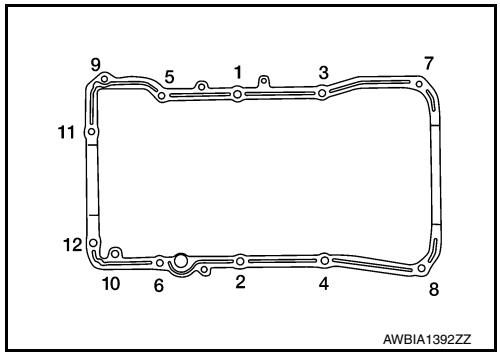
   CAUTION:
   - **Installation should be done within 5 minutes after applying liquid gasket.**
   - **Do not fill the engine with oil for at least 30 minutes after the components are installed to allow the sealant to cure.**



5. Install new O-rings on the cylinder block and oil pump body.
   CAUTION:
   Do not reuse O-rings.



6. Install the upper oil pan and tighten the upper oil pan bolts in the order shown.
   CAUTION:
   - **Installation should be done within 5 minutes after applying liquid gasket.**
   - **Do not fill the engine with oil for at least 30 minutes after the components are installed to allow the sealant to cure.**



7. Install the lower oil pan. Refer to EM-36, "Removal and Installation (Lower Oil Pan)".
8. Installation of the remaining components is in the reverse order of removal.

INSPECTION AFTER INSTALLATION

- 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-15, "FOR USA AND CANADA : Fluids and Lubricants" (United States and Canada) or MA-16, "FOR MEXICO : Fluids and Lubricants" (Mexico).
- 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 and 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, exhaust gas, or any oils/fluids including engine oil and engine coolant.
- Bleed air from passages in lines and hoses, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to specified level, if necessary.
- Summary of the inspection items:

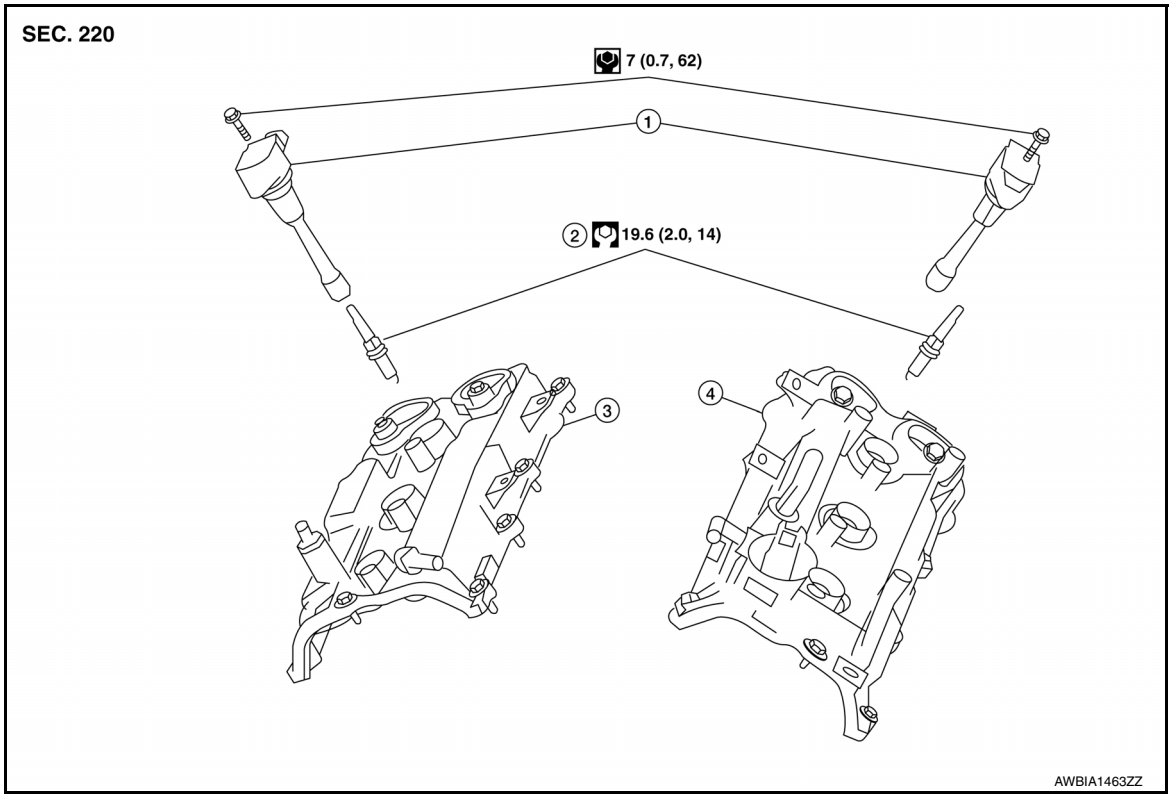
Item		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leakage	Level
Engine oil		Level	Leakage	Level
Transmission/ transaxle fluid	A/T and CVT Models	Leakage	Level/Leakage	Leakage
	M/T Models	Level/Leakage	Leakage	Level/Leakage
Other oils and fluids*		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gas		—	Leakage	—

*Power steering fluid, brake fluid, etc.

IGNITION COIL

Exploded View

INFOID:0000000009466021



1. Ignition coil
2. Spark plug
3. Rocker cover (RH)
4. Rocker cover (LH)

Removal and Installation (LH)

INFOID:0000000009466022

REMOVAL

1. Remove engine room cover. Refer to EM-23, "Removal and Installation".
2. Disconnect ignition coil harness connector.
3. Remove the ignition coil.
   CAUTION:
   Do not shock ignition coil.

INSTALLATION

Installation is in the reverse order of removal.

Removal and Installation (RH)

INFOID:0000000009466023

REMOVAL

1. Remove the intake manifold collector. Refer to EM-25, "Removal and Installation".
2. Disconnect ignition coil harness connector.
3. Remove the ignition coil.
   CAUTION:
   Do not shock ignition coil.

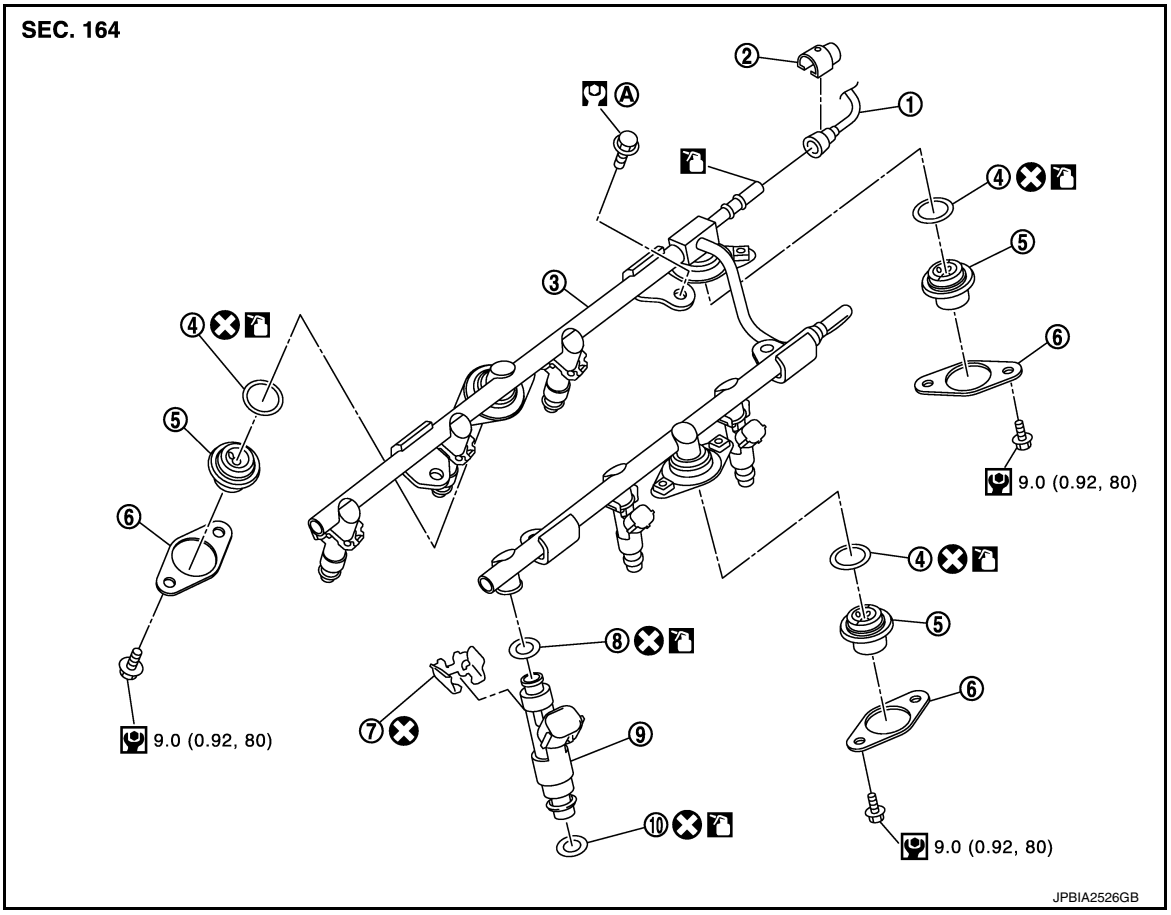
INSTALLATION

Installation is in the reverse order of removal.

FUEL INJECTOR AND FUEL TUBE

Exploded View

INFOID:0000000009466024



1. Fuel feed hose
2. Quick connector cap
3. Fuel tube
4. O-ring
5. Fuel damper
6. Fuel damper cap
7. Clip
8. O-ring (black)
9. Fuel injector
10. O-ring (green)
A. Refer to INSTALLATION

Removal and Installation

INFOID:0000000009466025

REMOVAL

WARNING:

- **Put a "CAUTION: FLAMMABLE" sign in the workshop.**
- **Be sure to work in a well ventilated area and furnish workshop with a CO_2 fire extinguisher.**
- **Do not smoke while servicing fuel system. Keep open flames and sparks away from the work area.**
- **To avoid the danger of being scalded, do not drain engine coolant when engine is hot.**

CAUTION:

- **Apply new engine oil when installing the parts as specified to do so.**
- **Do not remove or disassemble parts unless instructed.**

1. Release the fuel pressure. Refer to EC-592, "Inspection".
2. Disconnect the battery negative terminal. Refer to PG-67, "Removal and Installation (Battery)".
3. Remove intake manifold collector. Refer to EM-25, "Removal and Installation".
4. When separating fuel feed hose and fuel tube connection, disconnect quick connector using Tool as follows:

Tool number : 16441 6N210 (J-45488)

a. Remove quick connector cap from quick connector.

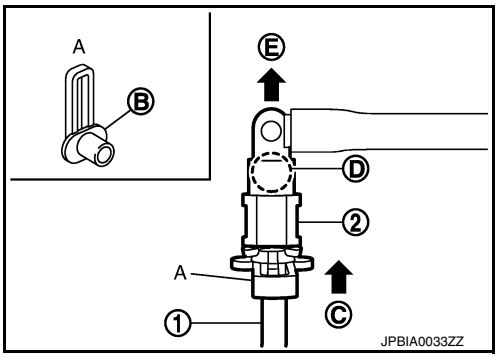
b. Disconnect quick connector from fuel tube as follows:

CAUTION:

Disconnect quick connector by using Tool. Not by prying out retainer tabs.

i. With the sleeve side of Tool facing to quick connector, install the Tool onto fuel tube.

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



(C) : Insert and retain

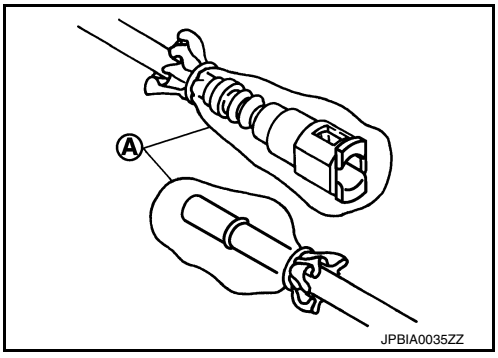
CAUTION:

Inserting Tool with excess force will not disconnect quick connector. Hold quick connector release where it contacts and goes no further.

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

CAUTION:

- **Pull quick connector (E) holding position (D) as shown.**
- **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 (with damper) during installation/removal.**
- **To keep clean the connecting portion and to avoid damage and foreign materials, cover them completely with plastic bags, etc. (A) or something similar.**



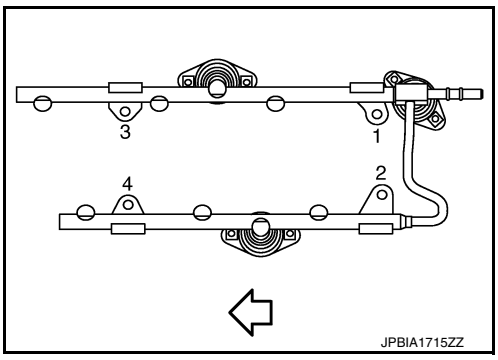
5. Disconnect harness connector from fuel injector.

6. Loosen bolts in reverse order as shown, and remove fuel tube and fuel injector assembly.

⇦ : Engine front

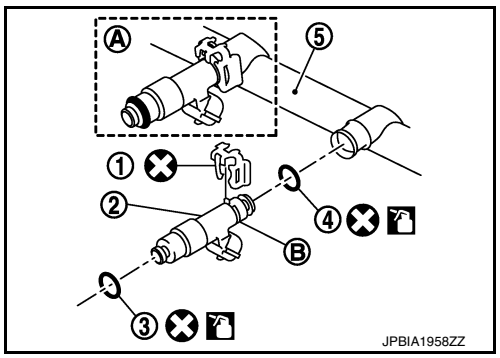
CAUTION:

Do not tilt fuel tube, or remaining fuel in pipes may flow out from pipes.



7. Remove fuel injector from fuel tube as follows:

a. Open and remove clip (1).



(3) : O-ring (green)
(4) : O-ring (black)
(A) : Installed condition
(B) : Clip groove

b. Remove fuel injector (2) from fuel tube (5) by pulling straight.

CAUTION:
- **Be careful, fuel may leak from the fuel tube.**
- **Be careful not to damage injector nozzle during removal.**
- **Do not bump or drop fuel injector.**
- **Do not disassemble fuel injector.**
- **Do not reuse O-rings.**

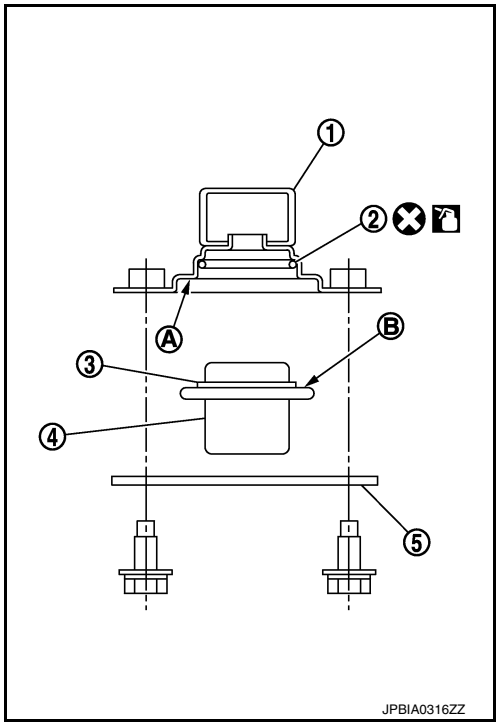
8. Remove fuel damper from fuel tube.

INSTALLATION

1. Install fuel damper as follows:

a. Install new O-ring (2) to fuel tube (1) as shown. When handling new O-ring, be careful of the following caution:

CAUTION:
- **Handle O-ring with bare hands. Do not wear gloves.**
- **Lubricate O-ring with new engine oil.**
- **Do not clean O-ring with solvent.**
- **Check that O-ring and its mating part are free of foreign material.**
- **When installing O-ring, be careful not to scratch, nick or damage it.**
- **Be careful not to twist or stretch O-ring.**
- **Insert new O-ring straight into fuel tube. Be sure O-ring is centered and not twisted.**



b. Install spacer (3) to fuel damper (4).

c. Insert fuel damper straight into fuel tube.

CAUTION:
- **Insert straight, checking that the axis is lined up.**
- **Do not pressure-fit with excessive force.**

Reference value : 130 N (13.3 kg, 29.2 lb)

- **Insert fuel damper until (B) is touching (A) of fuel tube.**

d. Tighten bolts evenly in turn.
- After tightening bolts, check that there is no gap between fuel damper cap (5) and fuel tube.

2. Install new O-rings to fuel injector paying attention to the following.

CAUTION:
- **Upper and lower O-ring are different. Be careful to install them in the correct location.**

Fuel tube side : Black
Nozzle side : Green

- **Handle O-ring with bare hands. Do not wear gloves.**
- **Do not reuse O-rings.**
- **Lubricate O-ring with new engine oil.**
- **Do not clean O-ring with solvent.**
- **Check that O-ring and its mating part are free of foreign material.**
- **When installing O-ring, be careful not to scratch, nick or damage it.**
- **Also be careful not to twist or stretch O-ring.**
- **If O-ring was stretched while it was being attached, wait for it to return to the original shape before inserting it into the fuel tube.**

- **Insert O-ring straight into fuel injector. Do not decenter or twist it.**

3. Install fuel injector to fuel tube as follows:

a. Insert clip (3) into clip groove (F) on fuel injector (5).

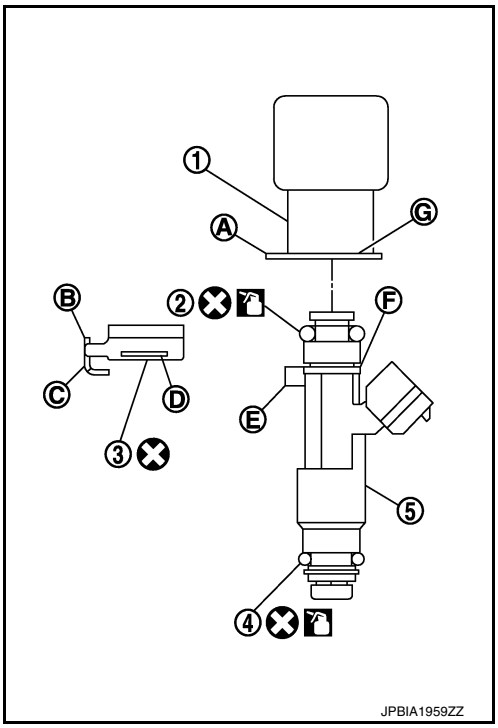
(2) : O-ring (black)
(4) : O-ring (green)

- Insert clip so that protrusion (E) of fuel injector matches cutout (C) of clip.

CAUTION:
- **Do not reuse clip. Replace it with new one.**
- **Be careful to keep clip from interfering with O-ring. If interference occurs, replace O-ring.**
- **Do not reuse O-rings.**

b. Insert fuel injector into fuel tube (1) with clip attached.
- Insert it while matching it to the axial center.
- Insert fuel injector so that protrusion (A) of fuel tube matches cutout (B) of clip.
- Check that fuel tube flange (G) is securely fixed in flange fixing groove (D) on clip.

c. Check that installation is complete by checking that fuel injector does not rotate or come off.
- Check that protrusions of fuel injectors and fuel tubes are aligned with cutouts of clips after installation.

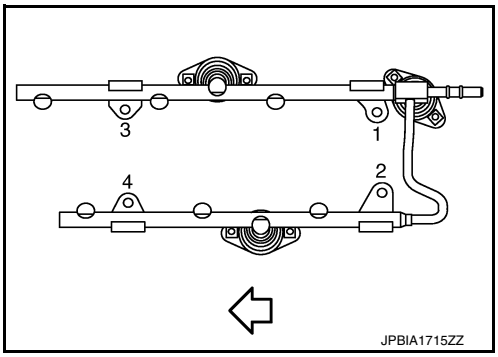


4. Install fuel tube and fuel injector assembly to intake manifold.

CAUTION:
Be careful not to let tip of injector nozzle come in contact with other parts.
- Tighten bolts in two steps in numerical order as shown.

⇦ **: Engine front**

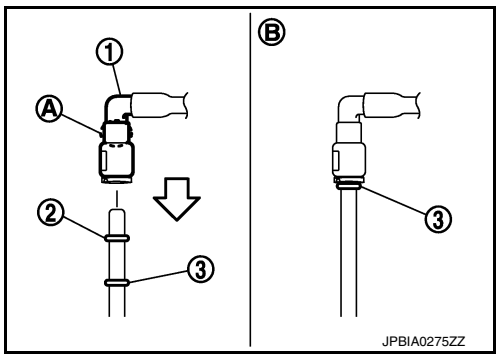
1st step : 10.1 N·m (1.0 kg-m, 7 ft-lb)
2nd step : 22.0 N·m (2.2 kg-m, 16 ft-lb)



5. Connect fuel injector harness.
6. Install intake manifold collector. Refer to EM-25, "Removal and Installation".
7. Connect quick connector between fuel feed hose and fuel tube connection with the following procedure:

a. Check no foreign substances are deposited in and around fuel tube and quick connector, and no damage on them.
b. Thinly apply new engine oil around fuel tube from tip end to spool end.
c. Align center to insert quick connector straightly into fuel tube.

- Insert quick connector (1) to fuel tube until top spool (2) is completely inside quick connector, and 2nd level spool (3) exposes right below quick connector.



(B) : Fitted condition

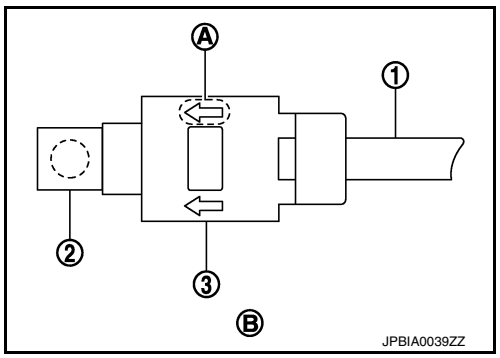
⇦ **: Upright insertion**

CAUTION:

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

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

e. Install quick connector cap (3) to quick connector.



(1) : Fuel feed hose

(2) : Fuel tube

(B) : Upper view

- Install quick connector cap with arrow (A) on surface facing in direction of quick connector (fuel feed hose side).

CAUTION:

If quick connector cap cannot be installed smoothly, quick connector may have not been installed correctly. Check connection again.

f. Secure fuel feed hose to clamp of quick connector cap.

8. Installation is in the reverse order of removal.

Inspection

INFOID:0000000009466026

INSPECTION AFTER INSTALLATION

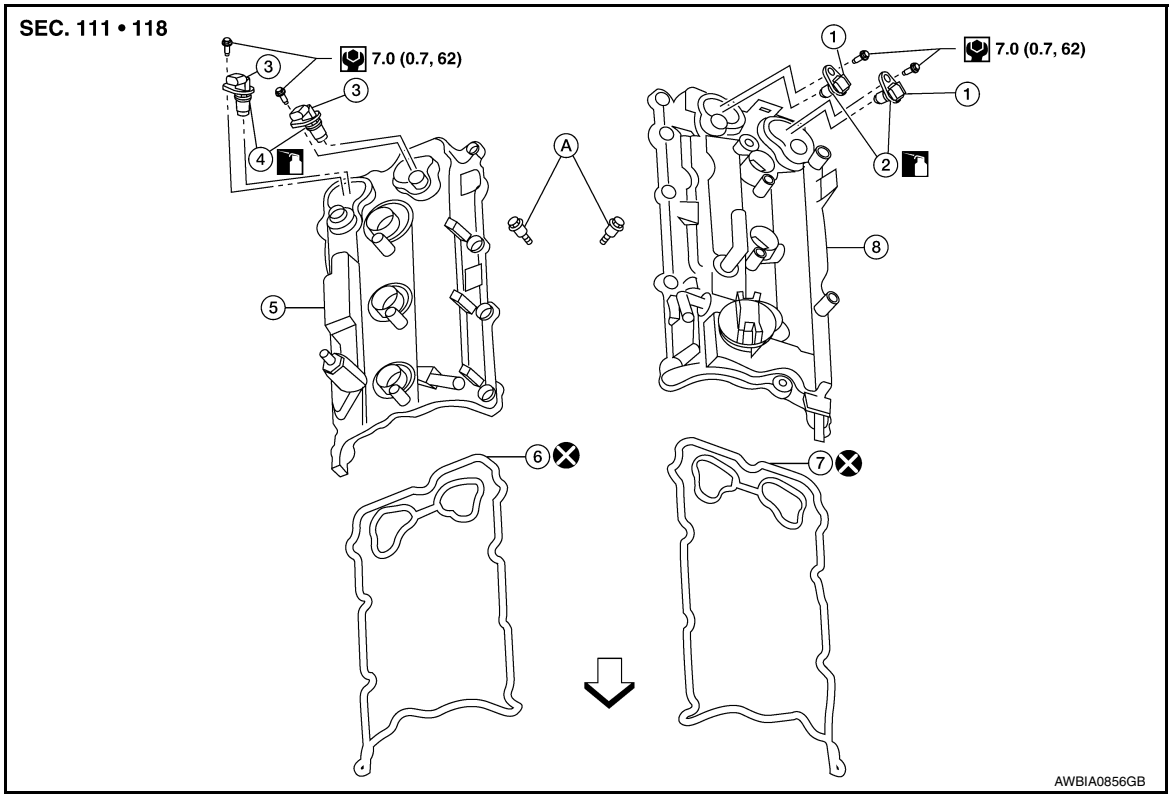
Check For Fuel Leaks

1. Turn ignition switch "ON" with the engine stopped. With fuel pressure applied to fuel piping, check for fuel leaks at connection points. Repair as necessary.
   NOTE:
   Use mirrors for checking at points out of clear sight.
2. Start the engine. With engine speed increased, check again for fuel leaks at connection points. Repair as necessary.
   CAUTION:
   Do not touch the engine immediately after stopped, as the engine becomes extremely hot.

ROCKER COVER

Exploded View

INFOID:0000000009466027



1. Camshaft position sensors (LH)
2. O-rings
3. Camshaft position sensors (RH)
4. O-rings
5. Rocker cover (RH)
6. Rocker cover gasket (RH)
7. Rocker cover gasket (LH)
8. Rocker cover (LH)
A. Refer to INSTALLATION

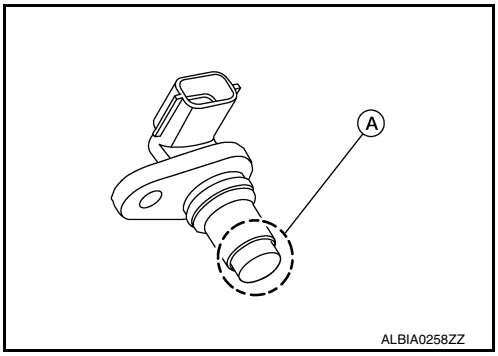
⇦ Front

Removal and Installation (LH)

INFOID:0000000009466028

REMOVAL

1. Remove the engine room cover. Refer to EM-23, "Removal and Installation".
2. Remove front air duct. Refer to EM-24, "Removal and Installation".
3. Remove blow by hose from rocker cover.
4. Remove camshaft position sensors.
   CAUTION:
   - **Handle carefully to avoid dropping and shocks.**
   - **Do not disassemble.**
   - **Do not allow metal powder to adhere to magnetic part at sensor tip (A).**
   - **Do not place sensors in a location where they are exposed to magnetism.**

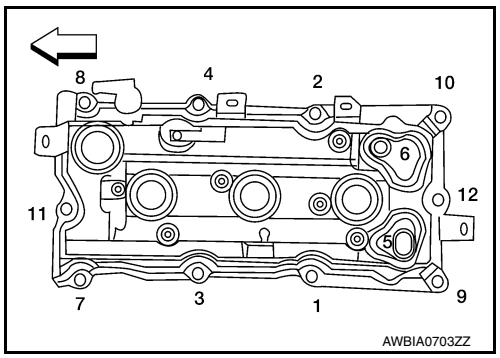


5. Remove the ignition coils. Refer to EM-42, "Removal and Installation (LH)".
   CAUTION:
   Do not shock ignition coils.

6. Remove (LH) rocker cover bolts from cylinder head in the reverse order as shown.

⇦ : Engine front

7. Remove the rocker cover and gasket.



INSTALLATION

Installation is in the reverse order of removal.

CAUTION:

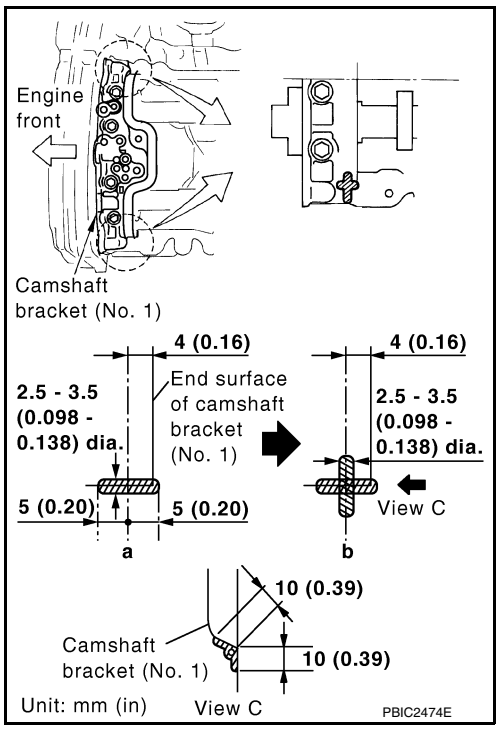
Do not reuse rocker cover gasket.

- Apply sealant to the areas on the front corners using Tool.
- Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".

Tool number : WS39930000 (—)

CAUTION:

- **Installation should be done within 5 minutes after applying liquid gasket.**
- **Do not fill the engine with oil for at least 30 minutes after the components are installed to allow the sealant to cure.**



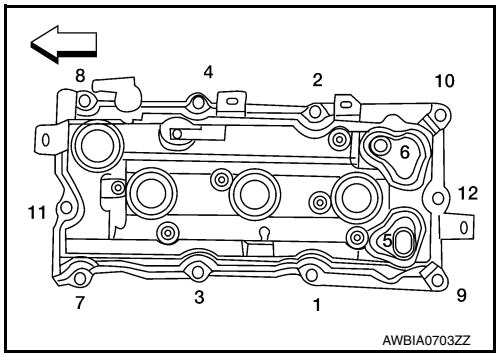
- **Tighten the rocker cover bolts in two steps in the order shown.**

⇦ : Engine front

Rocker cover bolts

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

Step 2 : 8.33 N·m (0.85 kg-m, 74 in-lb)



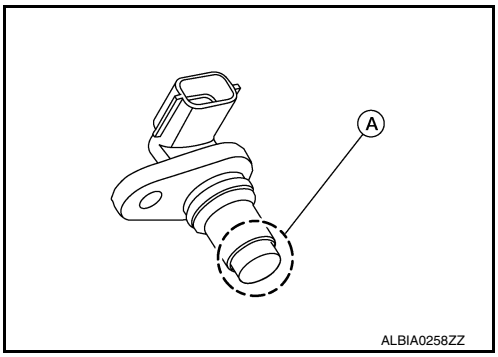
Removal and Installation (RH)

INFOID:0000000009466029

REMOVAL

1. Remove the engine room cover. Refer to EM-23, "Removal and Installation".
2. Remove the front air duct and air duct hose and resonator assembly. Refer to EM-24, "Removal and Installation".

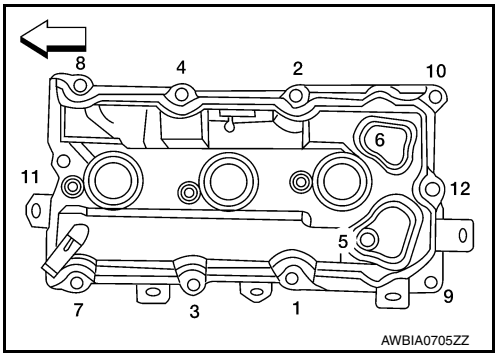
3. Remove the intake manifold collector. Refer to EM-28, "Removal and Installation".
4. Remove ignition coils. Refer to EM-42, "Removal and Installation (RH)".
   CAUTION:
   Do not shock ignition coils.
5. Remove camshaft position sensors.
   CAUTION:
   - **Handle carefully to avoid dropping and shocks.**
   - **Do not disassemble.**
   - **Do not allow metal powder to adhere to magnetic part at sensor tip (A).**
   - **Do not place sensors in a location where they are exposed to magnetism.**



6. Remove RH rocker cover bolts from cylinder head in the reverse order as shown.

   ⇦ **: Engine front**

7. Remove the rocker cover and gasket.



INSTALLATION

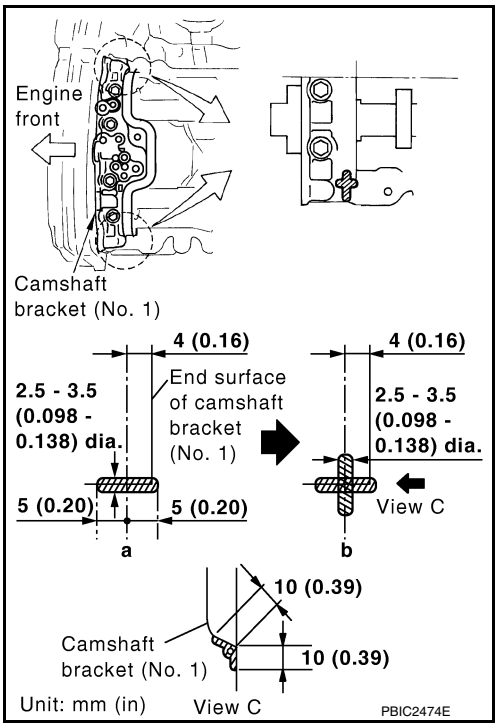
Installation is in the reverse order of removal.

CAUTION:
Do not reuse gaskets.

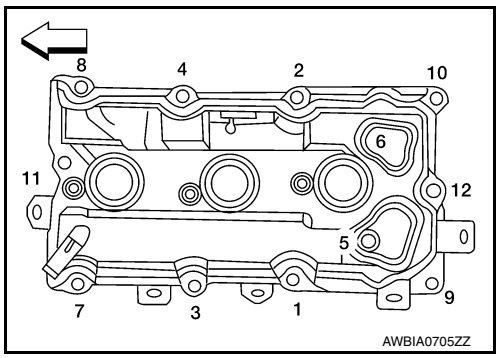
- Apply sealant to the areas on the front corners using Tool.
- Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".

Tool number : WS39930000 (—)

CAUTION:
- **Installation should be done within 5 minutes after applying liquid gasket.**
- **Do not fill the engine with oil for at least 30 minutes after the components are installed to allow the sealant to cure.**



- **Tighten the rocker cover bolts in two steps in the order shown.**



⇦ **: Engine front**

Rocker cover bolts

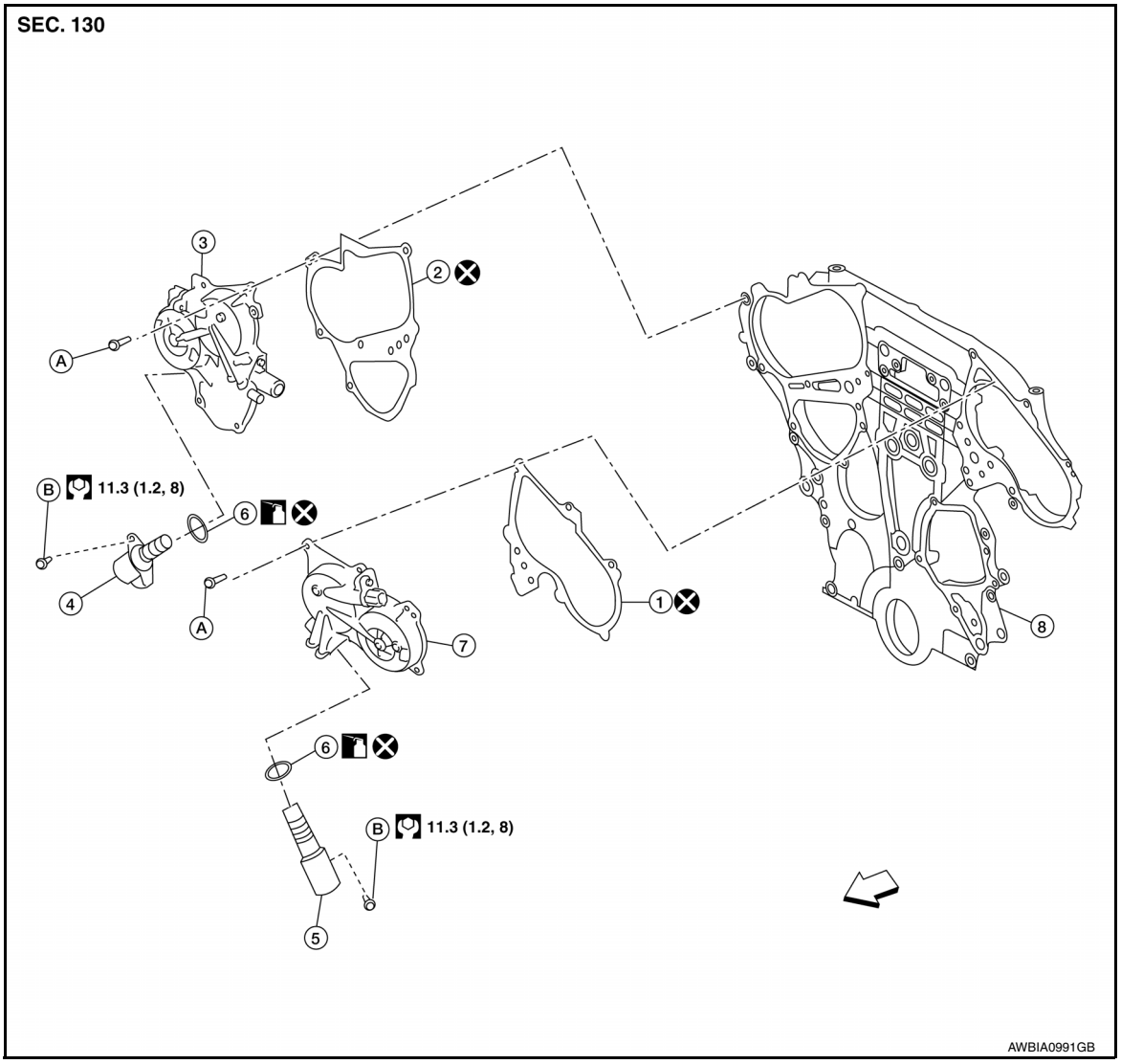
Step 1 : 1.96 N·m (0.20 kg-m, 17 in-lb)

Step 2 : 8.33 N·m (0.85 kg-m, 74 in-lb)

INTAKE VALVE TIMING CONTROL

Exploded View

INFOID:0000000009466030



1.	Intake valve timing control solenoid valve cover gasket (LH)	2.	Intake valve timing control solenoid valve cover gasket (RH)	3.	Intake valve timing control solenoid valve cover (RH) (bank 1)
4.	Intake valve timing control solenoid valve (RH)	5.	Intake valve timing control solenoid valve (LH)	6.	O-ring
7.	Intake valve timing control solenoid valve cover (LH) (bank 2)	8.	Front timing chain case	A.	Refer to INSTALLATION
B.	Refer to EM-54, "Removal and Installation".	⇦	Engine front		

Intake Valve Timing Control Solenoid Valve (LH) (bank 2)

INFOID:0000000009466031

REMOVAL

1. Remove hood ledge cover.
2. Remove coolant reservoir and set aside.
3. Disconnect intake valve timing control solenoid valve harness connector.
4. Remove intake valve timing control solenoid valve cover (LH) (bank 2). Refer to EM-54, "Removal and Installation".

5. Remove intake valve timing control solenoid valve and O-ring from intake valve timing control solenoid valve cover.
   CAUTION:
   Do not reuse O-ring.

INSTALLATION

Installation is in the reverse order of removal.

CAUTION:

- **Replace the O-ring for the intake valve timing control solenoid valve with a new one, then lubricate O-ring with engine oil before installing.**
- **Do not reuse O-ring.**

Intake valve timing control solenoid valve bolt	**: 11.3 N·m (1.2 kg-m, 8 ft-lb)**

Intake Valve Timing Control Solenoid Valve (RH) (bank 1)

INFOID:0000000009466032

REMOVAL

1. Remove front fender protector side cover (RH). Refer to EXT-23, "Exploded View".
2. Remove hood ledge cover.
3. Remove coolant reservoir and set aside.
4. Remove power steering reservoir and set aside.
5. Support engine using suitable tool.
6. Remove upper engine mount and bracket. Refer to EM-103, "Removal and Installation".
7. Remove intake valve timing control solenoid valve cover bolt behind intake valve timing control solenoid valve. Refer to EM-54, "Removal and Installation".
8. Disconnect intake valve timing control solenoid valve harness connector.
9. Remove intake valve timing control solenoid valve and O-ring from intake valve timing control solenoid valve cover.
   CAUTION:
   Do not reuse O-ring.

INSTALLATION

Installation is in the reverse order of removal.

CAUTION:

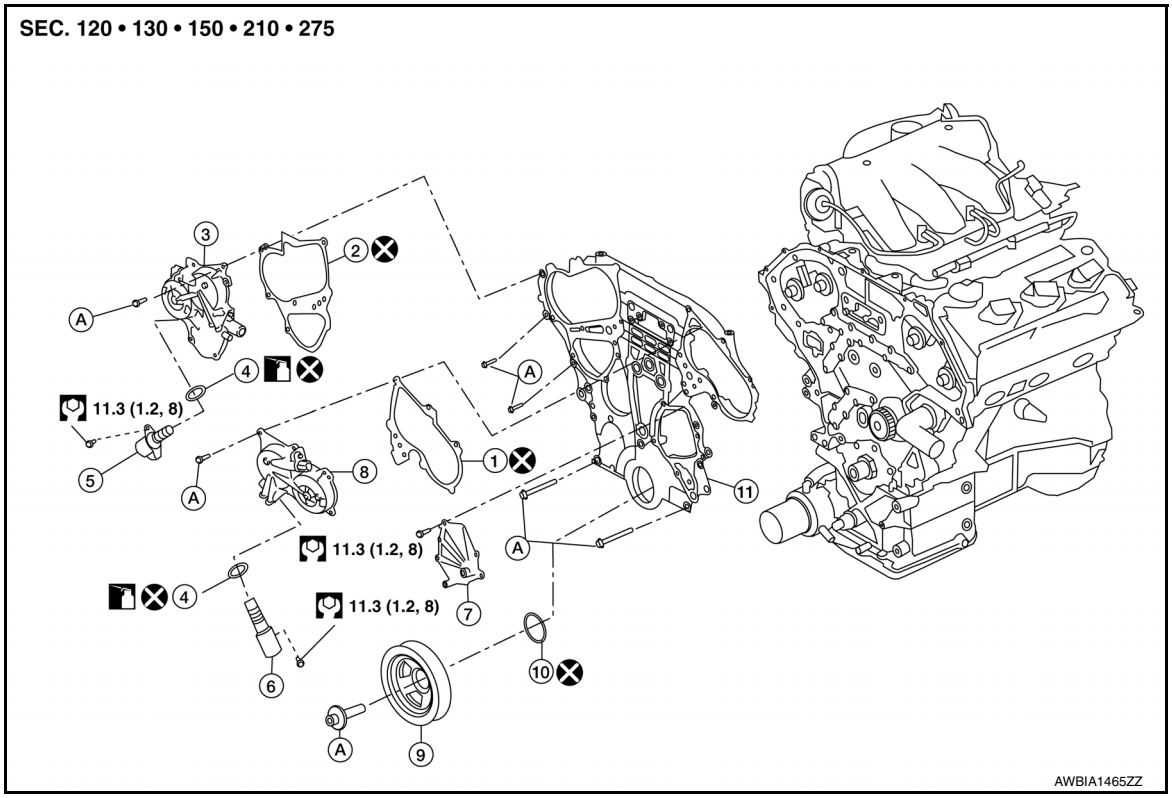
- **Replace the O-ring for the intake valve timing control solenoid valve with a new one, then lubricate O-ring with engine oil before installing.**
- **Do not reuse O-rings.**

Intake valve timing control solenoid valve bolt	**: 11.3 N·m (1.2 kg-m, 8 ft-lb)**

FRONT TIMING CHAIN CASE

Exploded View

INFOID:0000000009466033



1. Intake valve timing control solenoid valve cover gasket (LH)	2. Intake valve timing control solenoid valve cover gasket (RH)	3. Intake valve timing control solenoid valve cover (RH) (bank 1)
4. O-ring	5. Intake valve timing control solenoid valve (RH) with O-ring	6. Intake valve timing control solenoid valve (LH) with O-ring
7. Water pump cover	8. Intake valve timing control solenoid valve cover (LH) (bank 2)	9. Crankshaft pulley
10. Front oil seal	11. Front timing chain case	A. Refer to INSTALLATION

Removal and Installation

INFOID:0000000009466034

NOTE:

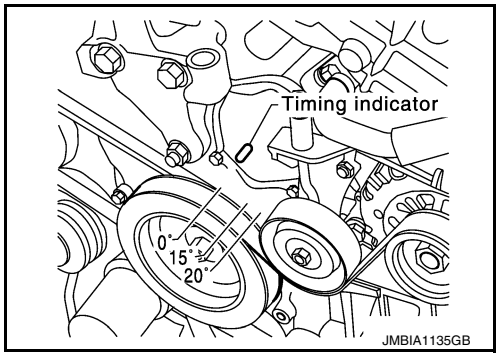
- This section describes the procedure for removal/installation of the front timing chain case without removing the oil pan (upper) from the vehicle.
- When rear timing chain case must be removed, remove the engine from the vehicle. Then remove front timing chain case, timing chain related parts, and rear timing chain case in this order, and install in reverse order of removal. Refer to EM-103, "Removal and Installation".
- Refer to EM-64, "Exploded View" for component parts location.
- When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.

REMOVAL

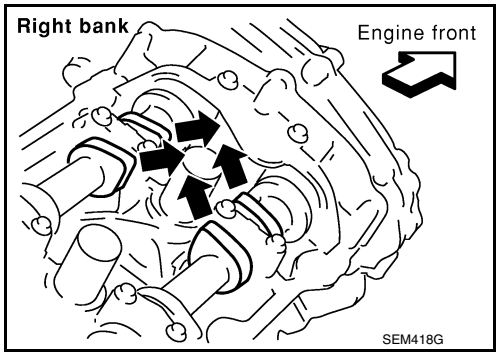
1. Disconnect the battery negative terminal. Refer to PG-67, "Removal and Installation (Battery)".
2. Remove engine under cover. Refer to EXT-15, "Exploded View".
3. Drain the engine coolant from the radiator. Refer to CO-11, "Changing Engine Coolant".
4. Drain the engine oil. Refer to LU-9, "Changing Engine Oil".
5. Drain the power steering fluid. Refer to ST-12, "Draining".
6. Remove engine room cover. Refer to EM-23, "Removal and Installation".
7. Remove front air duct. Refer to EM-24, "Removal and Installation".

8. Remove battery tray. Refer to PG-68, "Removal and Installation (Battery Tray)".
9. Remove the hood ledge covers (RH and LH).
10. Remove cowl top, cowl top extension and cowl top extension brace. Refer to EXT-21, "Removal and Installation".
11. Remove upper radiator hose.
12. Disconnect engine coolant reservoir hose from the radiator and remove engine coolant reservoir.
13. Remove cooling fan assembly. Refer to CO-16, "Removal and Installation".
14. Disconnect lower radiator hose from engine.
15. Disconnect the power steering fluid reservoir tank hose from the power steering pump and fluid cooler and remove the power steering fluid reservoir tank. Refer to ST-29, "Exploded View".
16. Remove the front (RH) wheel and tire using power tool. Refer to WT-60, "Adjustment".
17. Remove front fender protector side cover (RH). Refer to EXT-24, "Removal and Installation".
18. Remove the drive belt. Refer to EM-14, "Removal and Installation".
19. Remove the rocker covers, if necessary. Refer to EM-48, "Removal and Installation (LH)" and EM-49, "Removal and Installation (RH)".
    NOTE:
    Necessary only when removing timing chains.
20. If removing the timing chains, obtain compression TDC of No. 1 cylinder as follows:

a. Rotate crankshaft pulley clockwise to align timing mark (grooved line without color) with timing indicator.



b. Check that intake and exhaust camshaft lobes on No. 1 cylinder (right bank of engine) are located as shown.
   • If not, turn the crankshaft one revolution (360°) and align as shown.



21. Lock the drive plate using Tool.

Tool number : — (J-50288)

CAUTION:
Do not damage the ring gear teeth, or the signal plate teeth behind the ring gear, when setting the Tool.

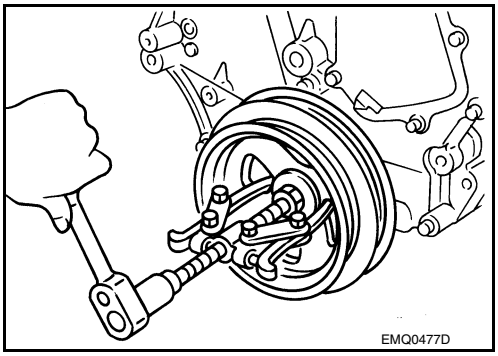
22. Remove the crankshaft pulley as follows:

a. Loosen crankshaft pulley and locate bolt seating surface at 10 mm (0.39 in) from its original position.

b. Position a pulley puller at recess hole of crankshaft pulley to remove crankshaft pulley.

CAUTION:

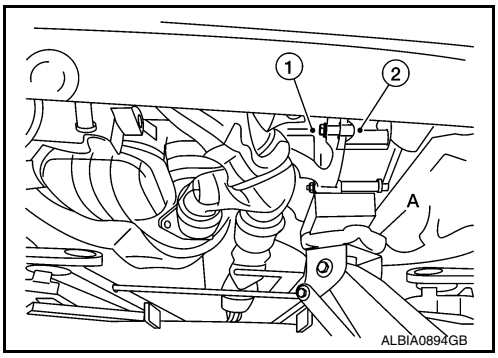
Do not use a puller claw on the outer diameter of the crankshaft pulley.



23. Remove the power steering pump. Refer to ST-28, "Removal and Installation".
24. Remove the generator. Refer to CHG-28, "Removal and Installation".
25. Remove the A/C compressor bolts, remove the A/C compressor and position aside. Refer to HA-37, "Removal and Installation for Compressor".
26. Remove the generator bracket. Refer to CHG-28, "Exploded View".
27. Support the engine (1) and transaxle (2) using a suitable jack (A) as shown.

CAUTION:

- **Position a suitable jack under the engine and transaxle assembly as shown.**
- **Do not damage the front exhaust tube or transaxle oil pan with the jack.**



28. Remove engine oil cooler tube bolts and bracket.
29. Disconnect the oil pressure switch harness connector.
30. Disconnect intake valve timing control solenoid valve harness connector.
31. Remove the intake valve timing control solenoid valve cover (RH) (bank 1) and intake valve timing control solenoid valve cover (LH) (bank 2).

a. Loosen intake valve timing control solenoid valve cover bolts in the reverse order as shown.

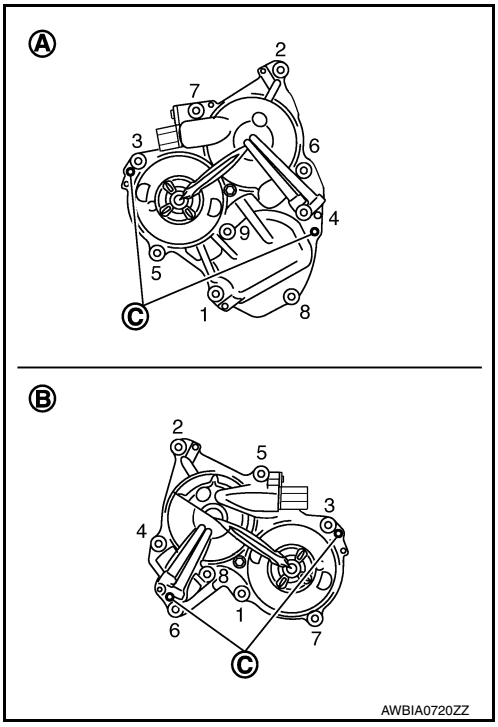
CAUTION:

The shaft in the intake valve timing control solenoid valve cover is inserted into the center hole of the intake camshaft sprocket. Remove the intake valve timing control solenoid valve cover by pulling straight out until the intake valve timing control solenoid valve cover disengages from the camshaft sprocket.

(A) : Intake valve timing control solenoid valve cover (RH) (bank 1)

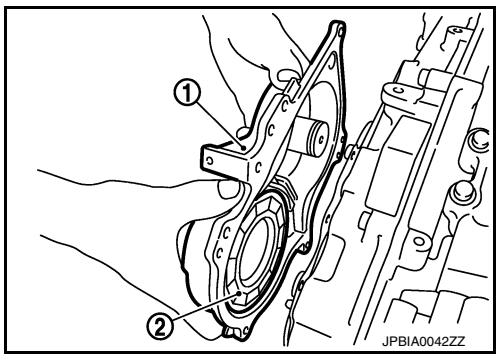
(B) : Intake valve timing control solenoid valve cover (LH) (bank 2)

(C) : Dowel pin hole



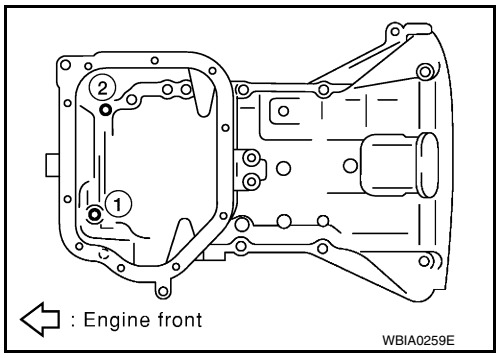
b. Shaft is engaged in intake camshaft sprocket center hole on inside. Pull straight out so as not to tilt until the shaft is disengaged.

- The mating surface of magnet retarder (2) may be fitted with the exhaust camshaft sprocket via engine oil. Open intake valve timing control solenoid valve cover (1) carefully.
- If the mating surface of the magnet retarder is fitted with the camshaft sprocket, open the intake valve timing control solenoid valve cover within the range that the load is not applied to the harness. Remove it so as to prevent magnet retarder from dropping.



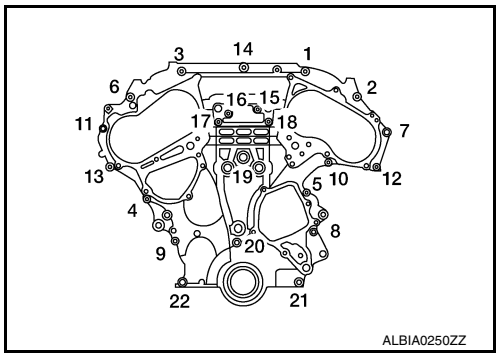
CAUTION:
- **Be careful not to damage magnet retarder.**
- **When carrying intake valve timing control solenoid valve cover, face the magnet retarder side up to prevent the intake valve timing control solenoid valve cover from falling from magnet retarder.**
- **Do not remove magnet retarder from intake valve timing control solenoid valve cover. (Disassembly prohibited)**

32. Remove the A/C idler pulley and bracket and the drive belt auto-tensioner.
33. If necessary, remove the idler pulley and water pump cover.
34. Remove lower oil pan. Refer to EM-36, "Removal and Installation (Lower Oil Pan)".
35. Remove upper oil pan bolts (1) and (2) as shown. Refer to EM-37, "Removal and Installation (Upper Oil Pan)".



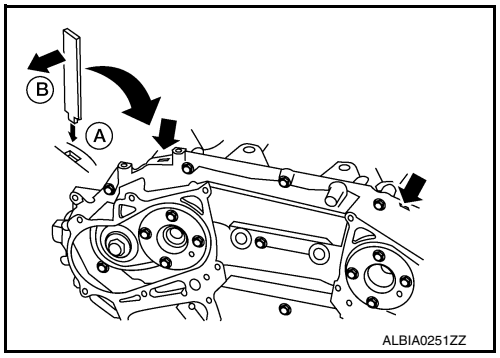
36. Remove the front timing chain case.

a. Loosen the front timing chain case bolts in the order as shown.



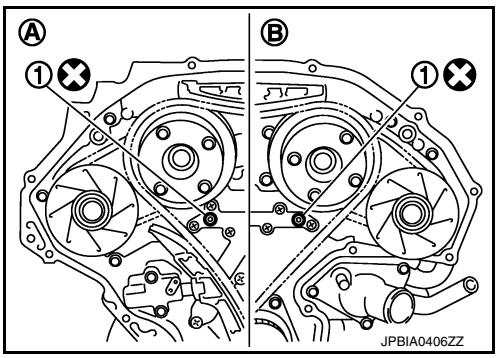
b. Insert suitable tool into the notch (A) at the top of the front timing chain case as shown.

c. Pry off the case by moving suitable tool (B) as shown.
- Cut liquid gasket for removal using Tool.



CAUTION:
- **Do not use a screwdriver or similar tool.**
- **After removal, handle carefully so it does not bend, or warp under a load.**

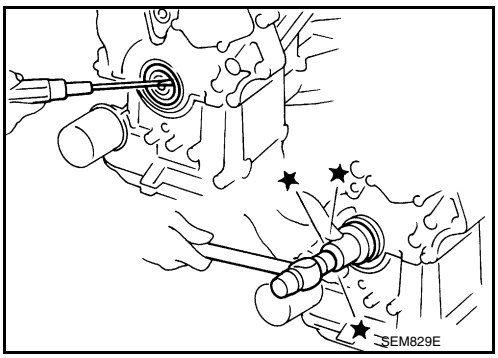
37. Remove O-rings (1) from rear timing chain case.



(A) : Bank 1 (RH)
(B) : Bank 2 (LH)

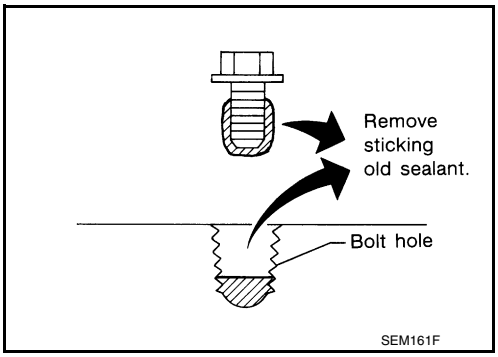
CAUTION:
- **Use new O-rings for installation.**
- **Do not reuse O-rings.**

38. Remove the front oil seal from the front timing chain case using a suitable tool.



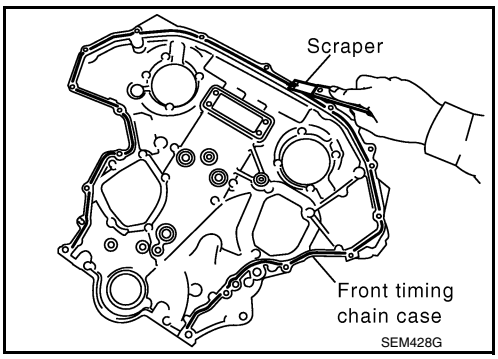
CAUTION:
Do not damage the front cover.

39. Remove all old Silicone RTV Sealant from all the bolt holes and bolts.



CAUTION:
Do not damage the threads or mating surfaces.

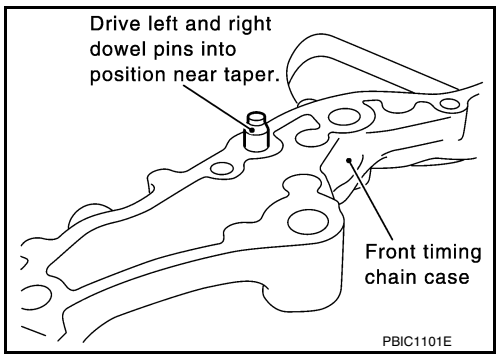
40. Use a scraper to remove all of the old Silicone RTV Sealant from the front timing chain case and opposite mating surfaces.



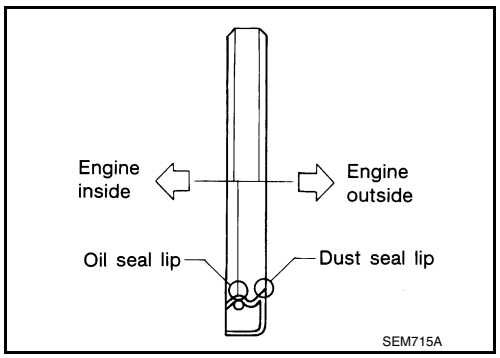
CAUTION:
Do not damage the mating surfaces.

INSTALLATION

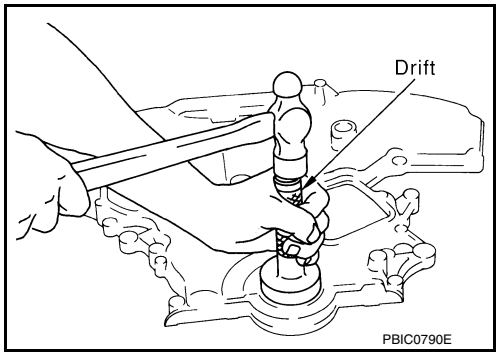
1. Install dowel pins (right and left) into front timing chain case up to a point close to taper in order to shorten protrusion length.
NOTE:
Be sure to place the dowel pins in original hole locations in the front timing chain case.



2. Install the new front oil seal on the front timing chain case. Apply new engine oil to the oil seal edges.
NOTE:
Install it so that each seal lip is oriented as shown.



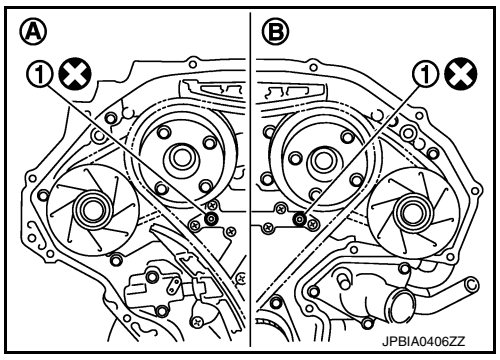
a. Install the new front oil seal so that it becomes flush with the face with front timing chain case using suitable tool.
CAUTION:
Press fit straight and avoid causing burrs or tilting the oil seal.
NOTE:
Make sure the garter spring is in position and seal lip is not inverted.



3. Install new O-rings (1) on rear timing chain case.

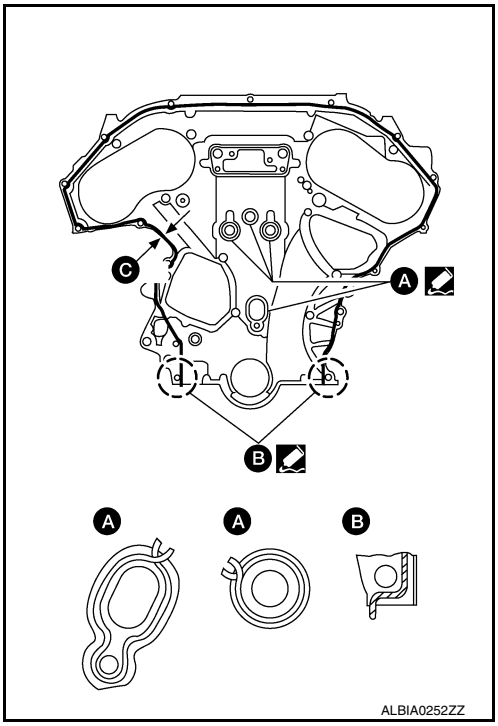
(A) : Bank 1 (RH)
(B) : Bank 2 (LH)

CAUTION:
- **Use new O-rings for installation.**
- **Do not reuse O-rings.**



4. Apply Silicone RTV Sealant to front timing chain case as shown.
   - Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".
   - Before installation, wipe off the protruding sealant.
   - C: 2.6 - 3.6 mm (0.102 - 0.142 in) dia.

   CAUTION:
   - **Installation should be done within 5 minutes after applying liquid gasket.**
   - **Do not fill the engine with oil for at least 30 minutes after the components are installed to allow the sealant to cure.**

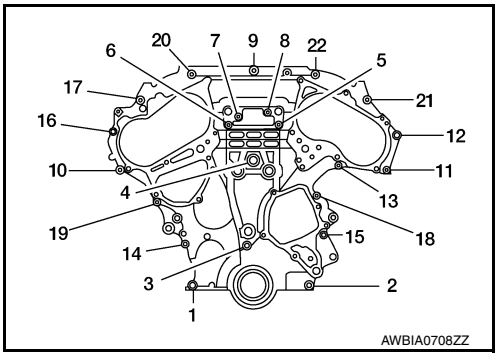


5. Install dowel pin on the front timing chain case into dowel pin hole in rear timing chain case.
6. Loosely install the front timing chain case bolts.

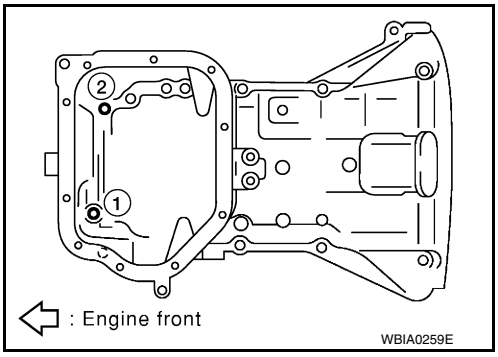
Bolt position	Bolt diameter
1, 2	: 8 mm (0.31 in)
3 – 22	: 6 mm (0.24 in)

7. Tighten the front timing chain case bolts in the order as shown.
   - Retighten the front timing chain case bolts in the order as shown.

Bolt position	Tightening specification
1, 2	: 28.5 N·m (2.9 kg-m, 21 ft-lb)
3 – 22	: 12.8 N·m (1.3 kg-m, 9 ft-lb)

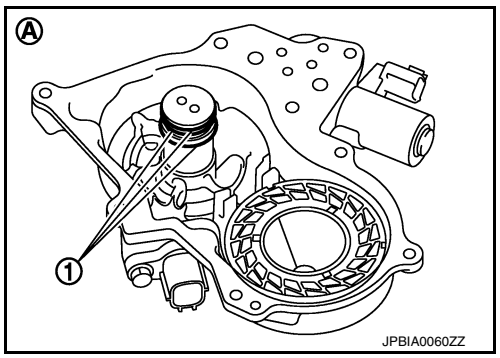


8. Install upper oil pan bolts (1) and (2) as shown. Refer to EM-37, "Removal and Installation (Upper Oil Pan)".



9. Install lower oil pan. Refer to EM-36, "Removal and Installation (Lower Oil Pan)".
10. Install intake valve timing control solenoid valve covers.

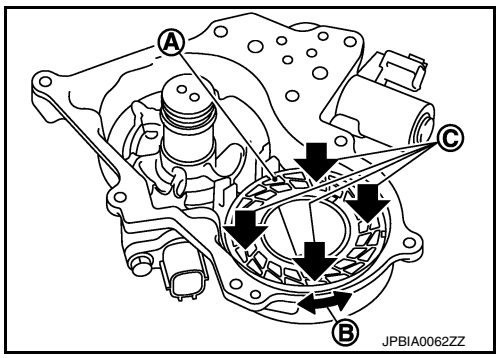
a. Install new seal rings (1) in shaft grooves.



(A) : Intake valve timing control solenoid valve cover (LH) (bank 2)

CAUTION:
- **When replacing seal rings, replace all rings with new ones on both intake valve timing control solenoid valve covers.**
- **Do not reuse O-rings.**

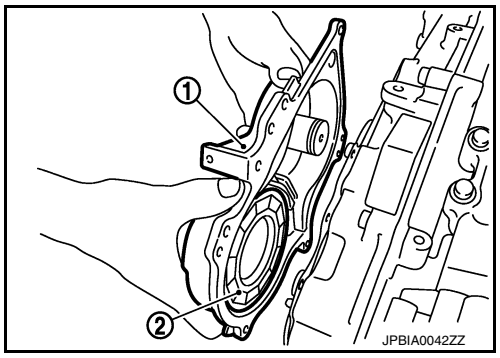
b. Check the joint between dowel pins and dowel pin holes for excessive free play.
- (A): Mating surface of magnet retarder
- (B): Moves slightly
- (C): Not shaken



CAUTION:
Always perform this procedure when removing to ensure the dowel pin holes are not worn or elongated.

c. Being careful not to move seal ring from the installation groove, align the dowel pins on the front timing chain case with the holes to install valve timing control covers.

d. Install intake valve timing control solenoid valve cover with a new gasket to front timing chain case.



(1) : Intake valve timing control solenoid valve cover

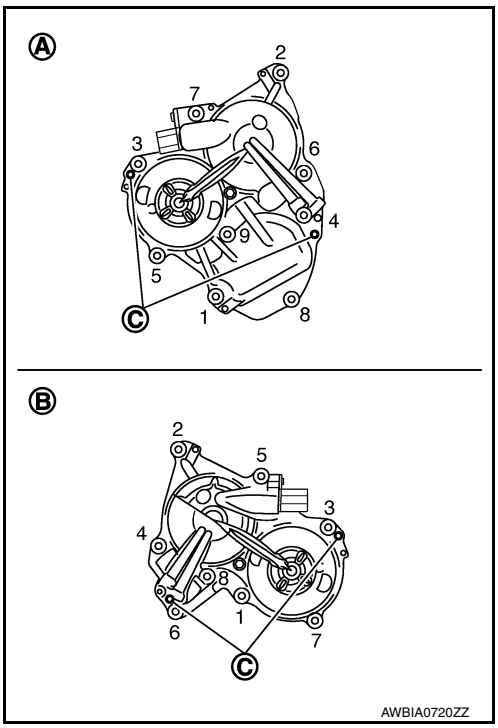
(2) : Magnet retarder

CAUTION:
- **Do not face magnet retarder side down to prevent magnet retarder from dropping.**
- **Check the mating surface of the magnet retarder and the drum of the exhaust camshaft sprocket for foreign materials.**
- **Align center of both shaft holes of the shaft and the intake camshaft sprocket, and then insert them.**
- **Be careful not to drop the seal ring from the shaft groove.**
- **When setting the intake valve timing control solenoid valve cover in position by hand, if intake valve timing control solenoid valve cover is not centered with the front timing chain case, the dowel pin of the magnet retarder may not be aligned with the dowel pin holes of the intake valve timing control solenoid valve cover. In this case, return to step "b".**

e. Tighten intake valve timing control solenoid valve cover bolts in the numerical order as shown.

Intake valve timing control solenoid valve cover bolts **11.3 N·m (1.2 kg-m, 8 ft-lb)**

(A) : Intake valve timing control solenoid valve cover (bank 1) (RH)
(B) : Intake valve timing control solenoid valve cover (bank 2) (LH)
(C) : Dowel pin hole



11. Apply liquid gasket and install the water pump cover, if removed.
    - Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".

CAUTION:
- **Installation should be done within 5 minutes after applying liquid gasket.**
- **Do not fill the engine with oil for at least 30 minutes after the components are installed to allow the sealant to cure.**

12. Install crankshaft pulley and tighten the bolt in two steps.
    - Lubricate thread and seat surface of the bolt with new engine oil.
    - For the second step angle tighten using Tool.

Step 1 : 44.1 N·m (4.5 kg-m, 33 ft-lb)
Step 2 : 84° - 90° degrees clockwise

Tool number : KV10112100 (BT-8653-A)

13. Remove the Tool to unlock the driveplate.

Tool number : — (J-50288)

CAUTION:
Do not damage the ring gear teeth, or the signal plate teeth behind the ring gear, when removing the Tool.

14. Rotate crankshaft pulley in normal direction (clockwise when viewed from front) to confirm it turns smoothly.
15. Installation of the remaining components is in reverse order of removal.

INSPECTION AFTER INSTALLATION

- 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-15, "FOR USA AND CANADA : Fluids and Lubricants" (United States and Canada) or MA-16, "FOR MEXICO : Fluids and Lubricants" (Mexico).
- 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 and 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, exhaust gas, or any oils/fluids including engine oil and engine coolant.
- Bleed air from passages in lines and hoses, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to specified level, if necessary.
- Summary of the inspection items:

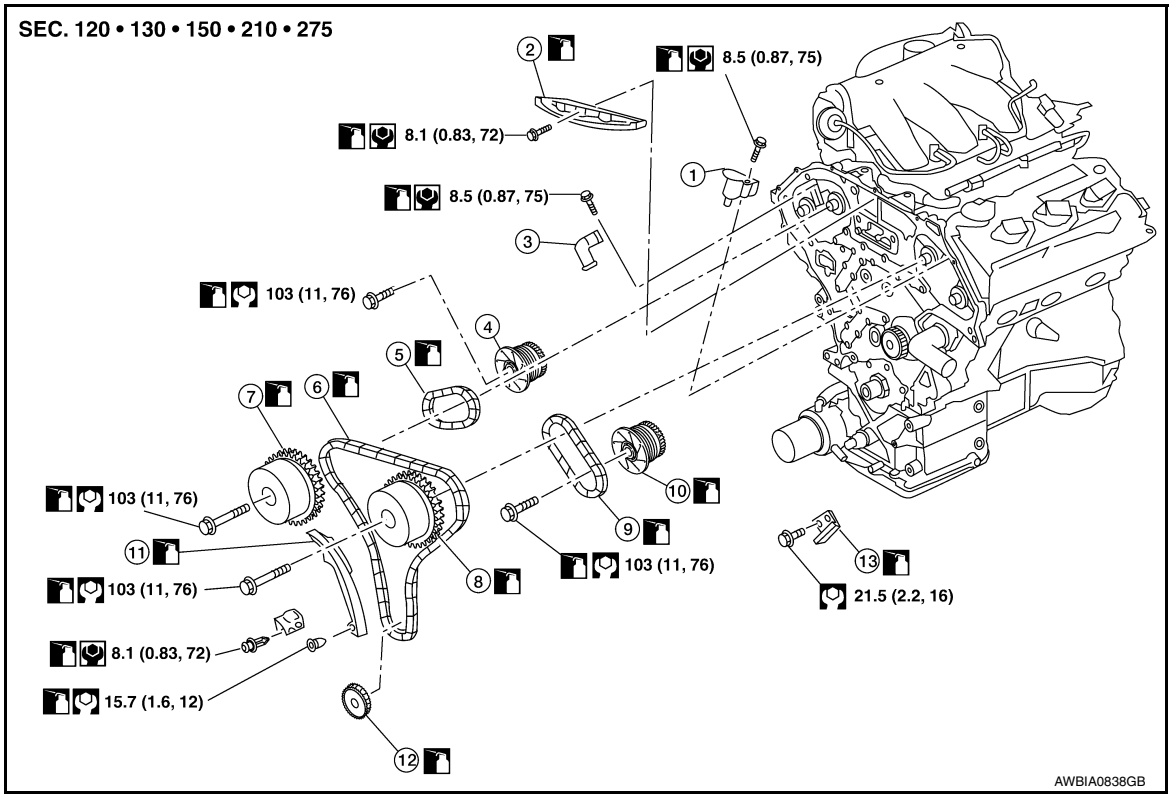
Item		Before starting engine	Engine running	After engine stopped
Engine coolant		Level	Leakage	Level
Engine oil		Level	Leakage	Level
Transmission/ transaxle fluid	A/T and CVT Models	Leakage	Level/Leakage	Leakage
	M/T Models	Level/Leakage	Leakage	Level/Leakage
Other oils and fluids*		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gas		—	Leakage	—

*Power steering fluid, brake fluid, etc.

TIMING CHAIN

Exploded View

INFOID:0000000009466035



1. Timing chain tensioner (secondary)
2. Internal chain guide
3. Timing chain tensioner (secondary)
4. Camshaft sprocket (EXH)
5. Timing chain (secondary)
6. Timing chain (primary)
7. Camshaft sprocket (INT)
8. Camshaft sprocket (INT)
9. Timing chain (secondary)
10. Camshaft sprocket (EXH)
11. Slack guide
12. Crankshaft sprocket
13. Tension guide

Removal and Installation

INFOID:0000000009466036

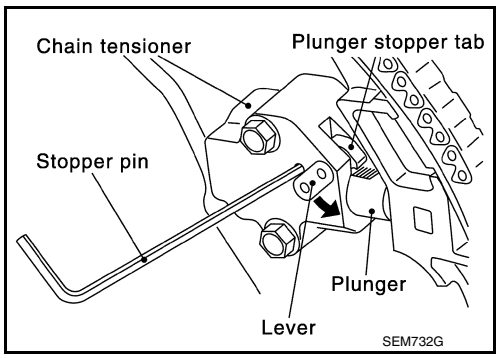
CAUTION:

- **After removing timing chains, do not turn the crankshaft and camshaft separately, or the valves will strike the pistons.**
- **When installing camshafts, chain tensioners, oil seals, or other sliding parts, lubricate contacting surfaces with new engine oil.**
- **Apply new engine oil to bolt threads and seat surfaces when installing camshaft sprockets, camshaft brackets, and crankshaft pulley.**

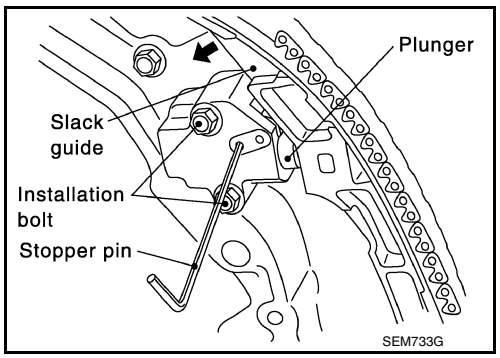
REMOVAL

1. Remove front timing chain case. Refer to EM-54, "Removal and Installation".
2. Remove the intake manifold collector. Refer to EM-25, "Removal and Installation".
3. Remove the engine oil dipstick.
4. Place paint marks on the timing chain and sprockets to indicate the correct position of the components for installation.
5. Remove the timing chain tensioner (primary).

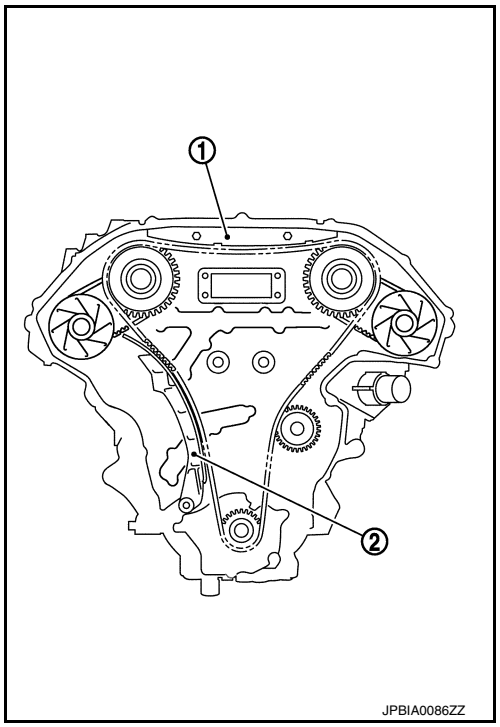
a. Pull lever down and release plunger stopper tab. Plunger stopper tab can be pushed up to release (coaxial structure with lever).



b. Insert stopper pin into timing chain tensioner (primary) body hole to hold lever, and keep the tab released. An Allen wrench [1.2 mm (0.047 in)] is used for a stopper pin as an example.
c. Insert plunger into tensioner body by pressing the slack guide.
d. Keep the slack guide pressed and hold it by pushing the stopper pin through the lever hole and body hole.
e. Remove the bolts and remove the timing chain tensioner (primary).

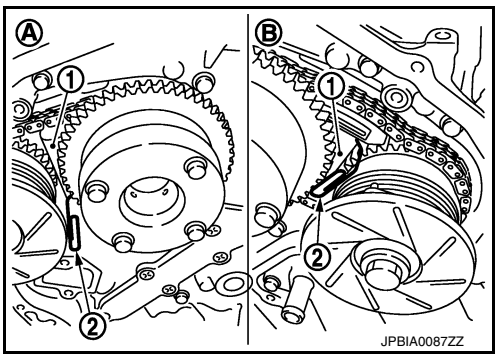


6. Remove the internal chain guide (1), and slack guide (2).



7. Remove timing chain (primary) and crankshaft sprocket.
CAUTION:
After removing timing chains, do not turn the crankshaft and camshaft separately, or the valves will strike the pistons.

8. Attach a suitable stopper pin (2) to the right and left timing chain tensioners (secondary) (1).



(A) : Bank 1
(B) : Bank 2

9. Remove the timing chains (secondary) with camshaft sprockets (INT) and (EXH).

a. Insert metal or resin plate [0.5 mm (0.020 in)] into guide between timing chain (secondary) and timing chain tensioner (secondary) plunger. Remove camshaft sprocket and timing chain (secondary) with timing chain removed from guide groove.

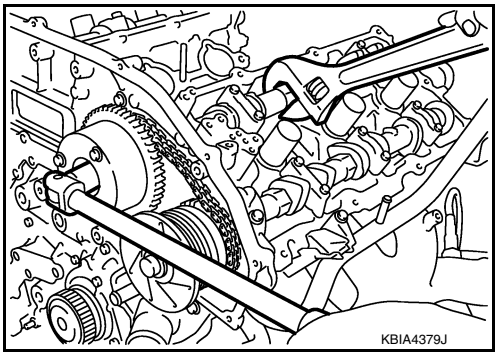
CAUTION:

Timing chain tensioner plunger can move while stopper pin is inserted in timing chain tensioner. Plunger can come out of tensioner when timing chain is removed. Use caution during removal.

- Apply paint marks to the timing chain and camshaft sprockets for alignment during installation.

b. Remove the camshaft sprocket (INT) and (EXH) bolts.

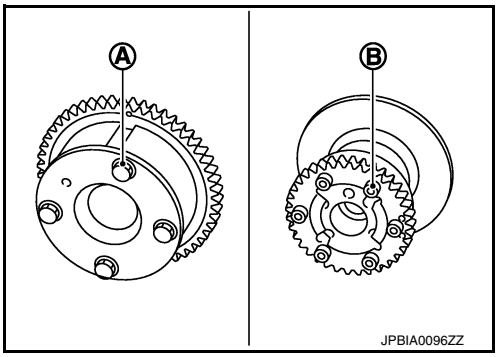
- Secure the hexagonal portion of the camshaft using a wrench to loosen the bolts.
- Handle the sprockets as an assembly.



c. Remove timing chains (secondary).

CAUTION:

- **Avoid impact or dropping the camshaft sprockets.**
- **Do not disassemble the camshaft sprockets (do not loosen bolts (A) and (B) as shown).**



10. Remove the tension guide.

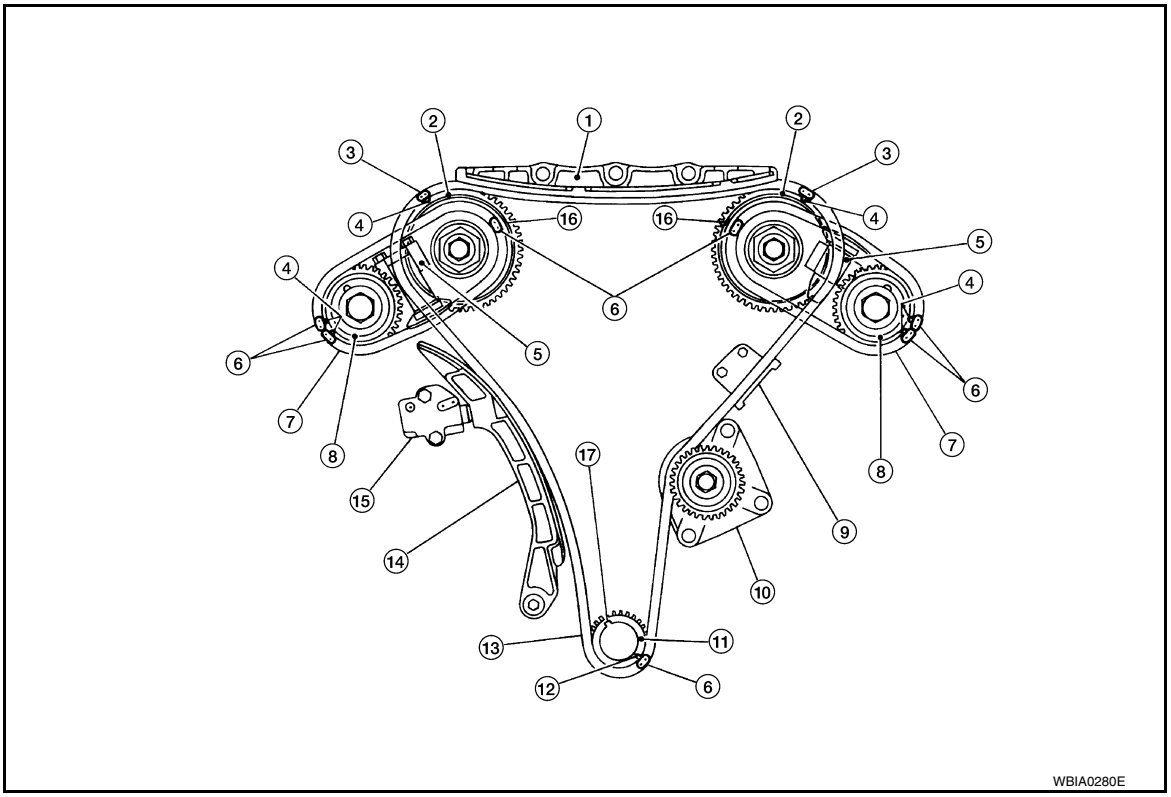
INSPECTION

Check for cracks and any excessive wear of the timing chain. Replace the timing chain as necessary.

INSTALLATION

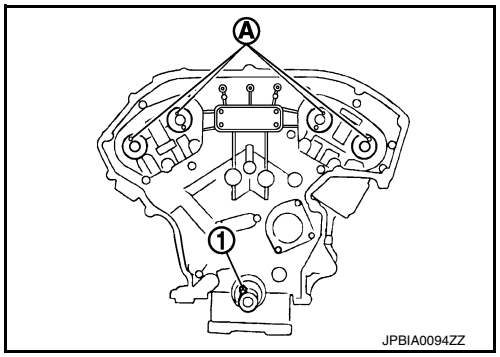
NOTE:

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

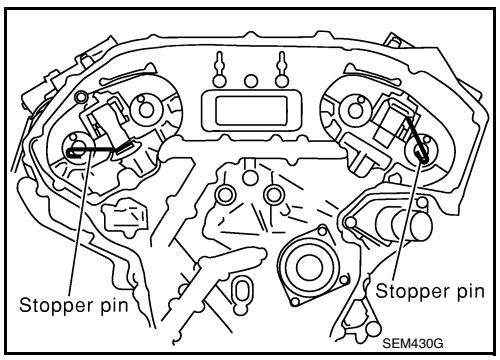


1. Internal chain guide	2. Camshaft sprocket (INT)	3. Mating mark (pink link)
4. Mating mark (punched)	5. Timing chain tensioner (secondary)	6. Mating mark (orange link)
7. Timing chain (secondary)	8. Camshaft sprocket (EXH)	9. Tension guide
10. Water pump	11. Crankshaft sprocket	12. Mating mark (notched)
13. Timing chain (primary)	14. Slack guide	15. Timing chain tensioner (primary)
16. Mating mark (back side)	17. Crankshaft key	

1. Install the tension guide.
2. Position the crankshaft so No. 1 piston is set at TDC on the compression stroke.
   NOTE:
   - Make sure that the dowel pins (A) and crankshaft key (1) are located as shown.
   - Camshaft dowel pin (INT): at cylinder head upper face side in each bank.
   - Camshaft dowel pin (EXH): at cylinder head upper face side in each bank.
   - Crankshaft key: at cylinder head side of RH bank.

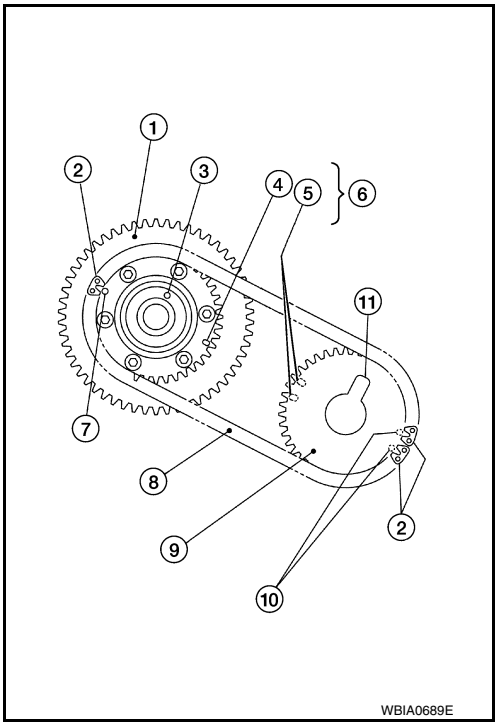


3. Install the timing chains (secondary) and camshaft sprockets.
   CAUTION:
   Matching marks between the timing chain and sprockets slip easily. Confirm all matching mark positions repeatedly during the installation process.
   - Push the sleeve of the chain tensioner (secondary) and keep it pressed in with a stopper pin.



a. Align the matching marks (4), (5), (7) and (10) on the timing chain (secondary) (8) (orange link) (2) with the ones on the camshaft sprockets (INT) and (EXH) (punched), and install them.
   - Matching marks for the camshaft sprocket (INT) are on the back side of the secondary sprocket.
   - There are two types of matching marks:
   - RH bank use round type (7) and (10).
   - LH bank (6): use oval type (4) and (5).

b. Align the dowel pin with the pin hole (3) on the camshaft sprocket (INT) side (1), and dowel pin groove (11) with the dowel pin on the camshaft sprocket (EXH) side (9), and install them.
   - Camshaft sprocket bolts must be tightened in the next step. Tightening them by hand is enough to prevent the dislocation of the dowel pins (3) and dowel pin grooves (11).

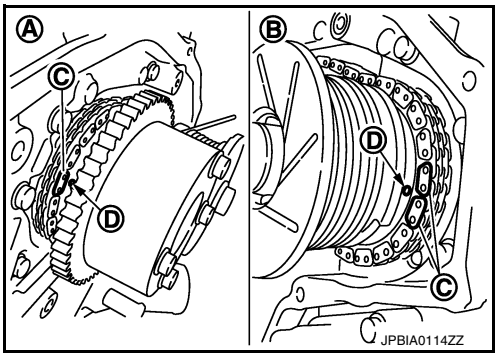


- Check mating mark (punched) (D) on each camshaft sprocket is positioned on the mating marks (orange link) (C) on timing chain (secondary).

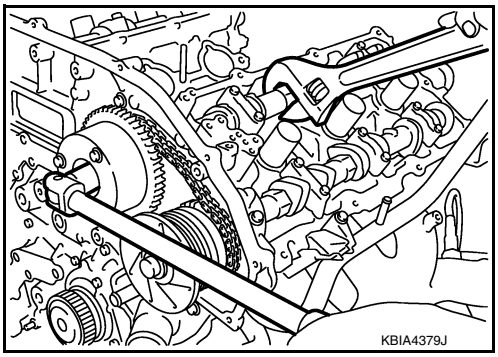
  (A) : Intake side

  (B) : Exhaust side

NOTE:
Ensure the mating mark (punched) (D) on the camshaft sprocket is aligned with the mating marks (orange link) (C) on the timing chain (secondary).

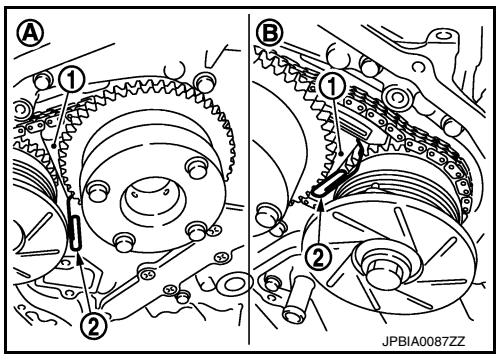


4. After confirming the mating marks are aligned, tighten the camshaft sprocket bolts.
   - Secure the camshaft using a wrench at the hexagonal portion to tighten the bolts.

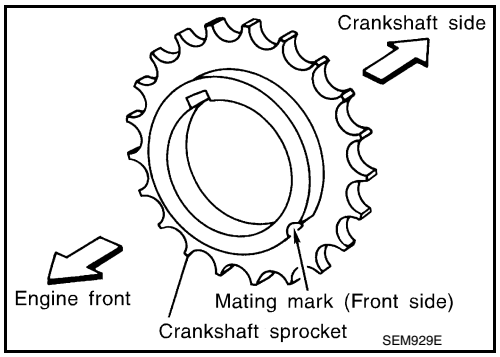


5. Pull the stopper pins (2) out from the timing chain tensioners (secondary) (1).

(A) : Bank 1
(B) : Bank 2

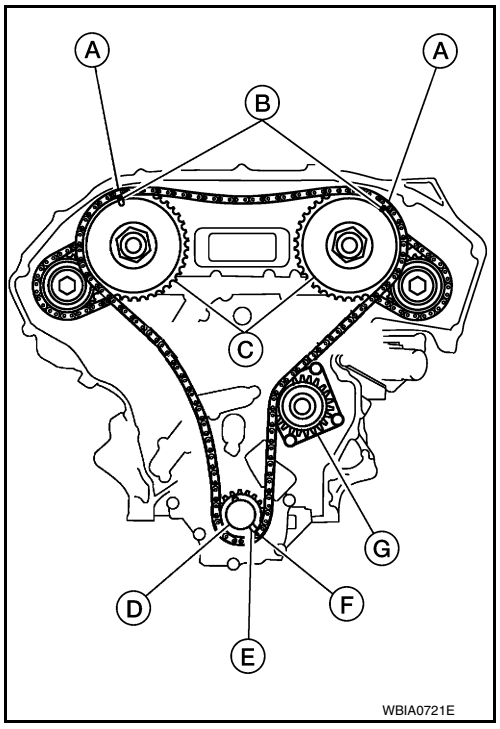


6. Install the crankshaft sprocket on the crankshaft.
   - Make sure the mating marks on the crankshaft sprocket face the front of the engine.

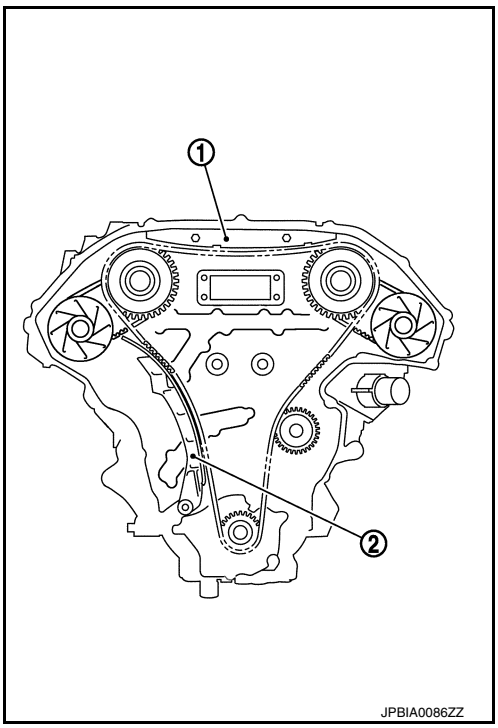


7. Install the timing chain (primary).
   - Install timing chain (primary) so the mating mark punched (B) on camshaft sprocket (C) is aligned with the pink link (A) on the timing chain, while the mating mark (notched) (E) on the crankshaft sprocket (D) is aligned with the orange one (F) on the timing chain, as shown.
   - When it is difficult to align mating marks of the timing chain (primary) with each sprocket, gradually turn the camshaft using a wrench on the hexagonal portion to align it with the mating marks.
   - During alignment, be careful to prevent dislocation of mating mark alignments of the secondary timing chains.

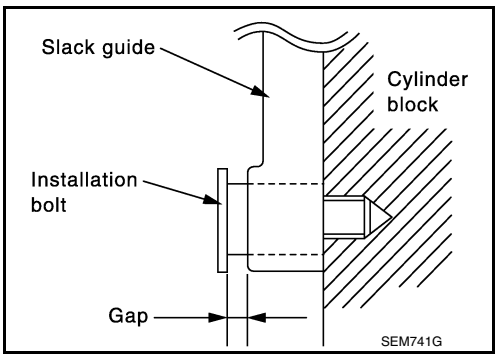
   (G): Water pump



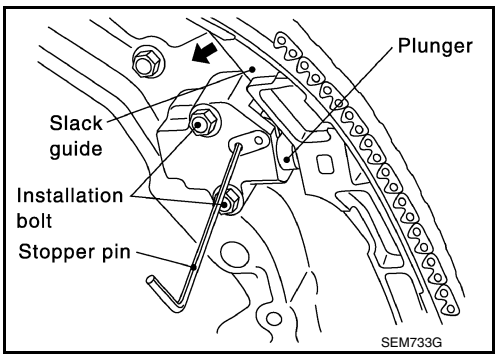
8. Install the internal chain guide (1), slack guide (2) and timing chain (primary).



CAUTION:
Do not overtighten the slack guide bolts. It is normal for a gap to exist under the bolt seats when the bolts are tightened to specification.



9. Install the timing chain tensioner (primary) for the slack guide.
   - When installing the timing chain tensioner (primary), push in the sleeve and keep it pressed in with the stopper pin.
   - Remove any dirt and foreign materials completely from the back and the mounting surfaces of the timing chain tensioner (primary).
   - After installation, pull out the stopper pin while pressing the slack guide.
10. Reconfirm that the matching marks on the sprockets and the timing chain have not slipped out of alignment.

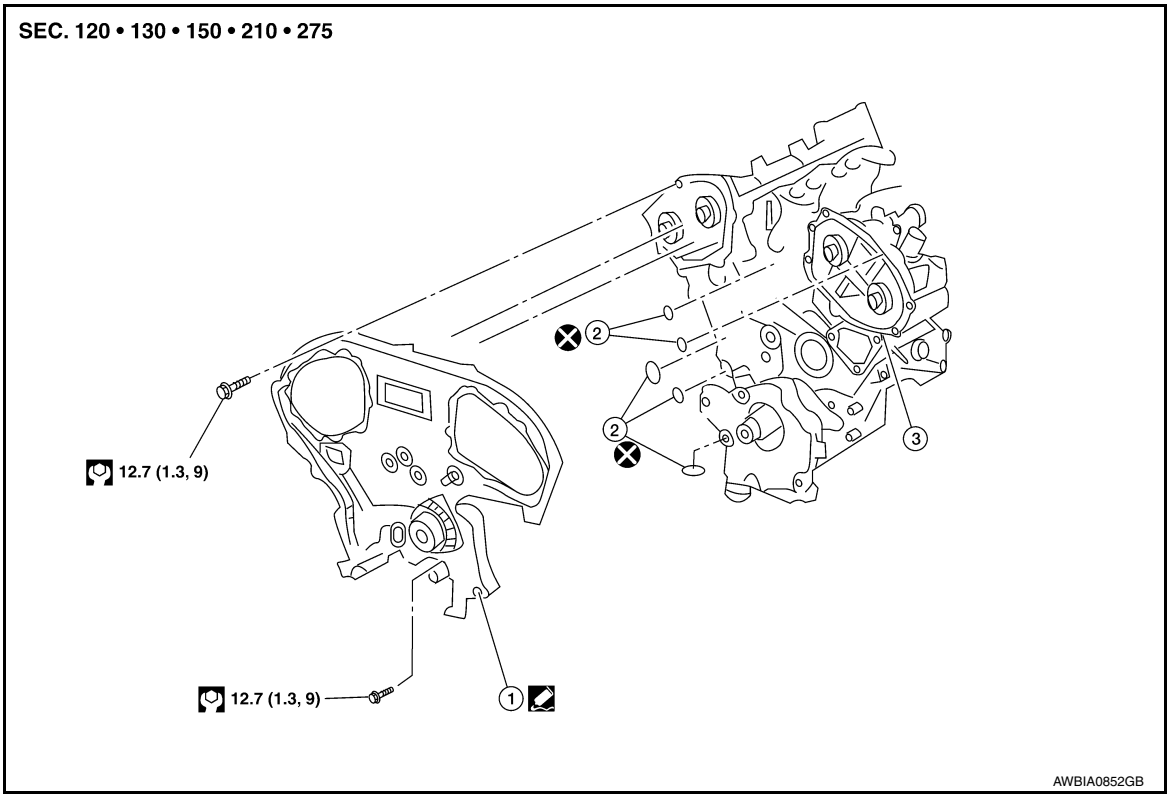


11. Install the front timing chain case. Refer to EM-54, "Removal and Installation".

REAR TIMING CHAIN CASE

Exploded View

INFOID:0000000009466037



1. Rear timing chain case
2. O-ring
3. Cylinder block

Removal and Installation

INFOID:0000000009466038

CAUTION:

- **After removing timing chain, do not turn the crankshaft and camshaft separately, or the valves will strike the pistons.**
- **Before removing the upper oil pan, remove the crankshaft position sensor (POS).**
- **Be careful not to damage sensor edges.**
- **Do not reuse O-ring.**

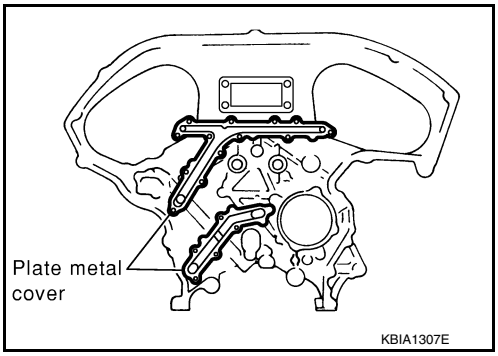
REMOVAL

1. Remove the engine assembly. Refer to EM-103, "Removal and Installation".
2. Remove the oil pan lower and upper. Refer to EM-37, "Removal and Installation (Upper Oil Pan)".
3. Remove the front timing chain case. Refer to EM-54, "Exploded View".
4. Remove the timing chains (primary) and (secondary). Refer to EM-64, "Removal and Installation".
5. Remove No. 1 camshaft bracket (RH) and No. 1 camshaft bracket (LH). Refer to EM-76, "Removal and Installation".

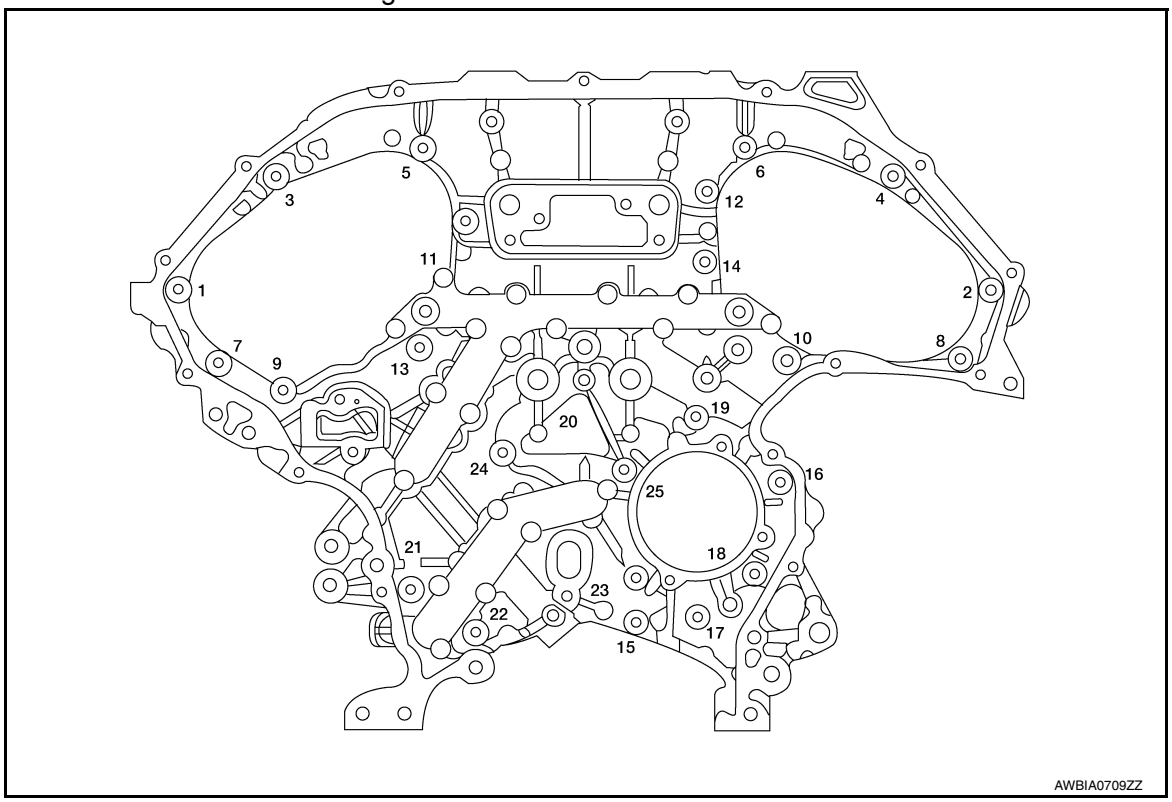
6. Remove the rear timing chain case.

CAUTION:

- **Do not remove the plate metal cover for the oil passage.**
- **After removing the chain case, do not apply any load to the case that might bend it.**



a. Loosen and remove the rear timing chain case bolts in the order as shown.

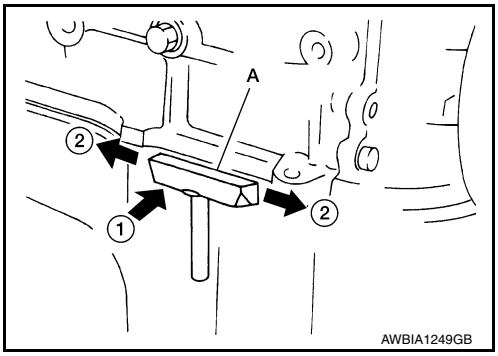


b. Cut the sealant using Tool and remove the rear timing chain case.

Tool number : KV10111100 (J-37228)

CAUTION:

- **Be careful not to damage the mating surface.**
- **Do not insert a screwdriver, this will 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 liquid gasket is applied. Use a plastic hammer to slide (2) the cutter by tapping on the side.

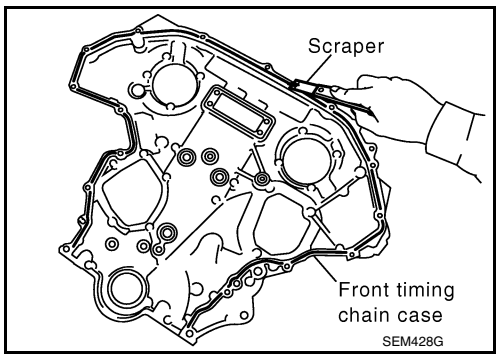


7. Remove O-rings to timing chain case and cylinder block.

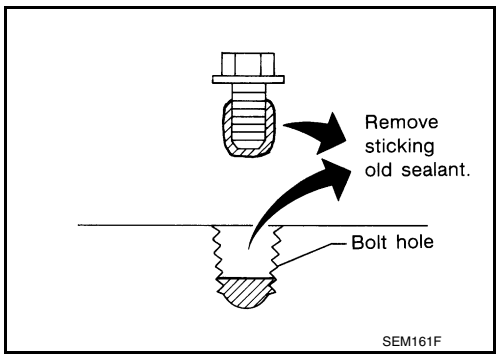
CAUTION:

Do not reuse O-rings.

8. Use a scraper to remove all of the old Silicone RTV Sealant from the front and rear timing chain case and opposite mating surfaces.
CAUTION:
Do not damage the mating surfaces.

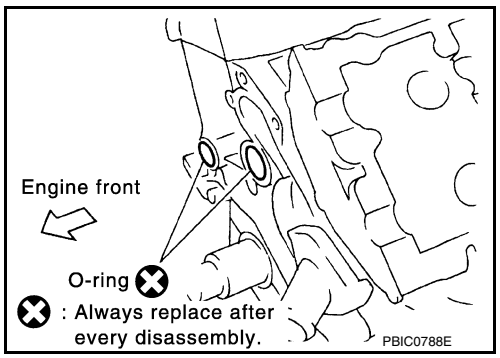


9. Remove all old Silicone RTV Sealant from all the bolt holes and bolts.
CAUTION:
Do not damage the threads or mating surfaces.



INSTALLATION

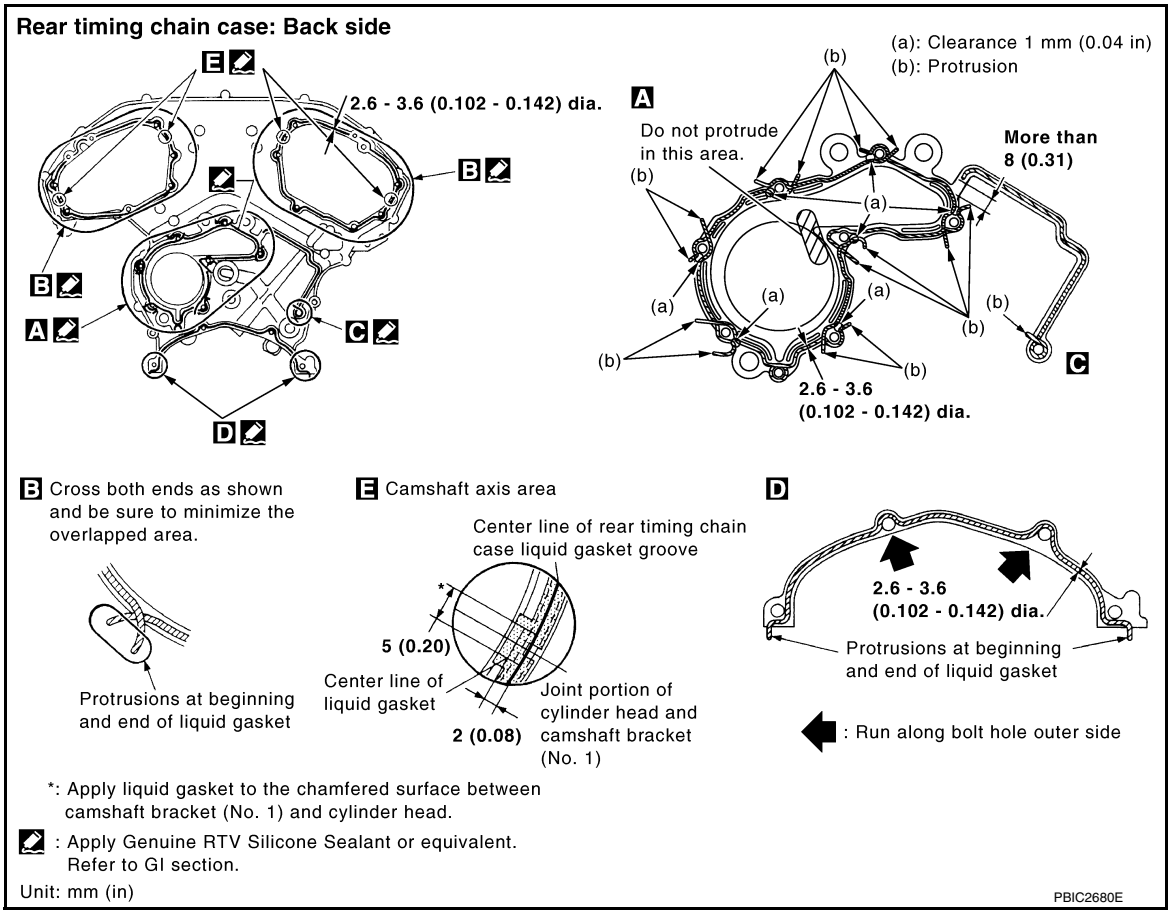
1. Install O-rings on cylinder block.
CAUTION:
Do not reuse O-rings.



2. Apply Genuine Silicone RTV Sealant or equivalent, to the rear timing chain case using Tool as shown. Refer to GI-21, "Recommended Chemical Products and Sealants".

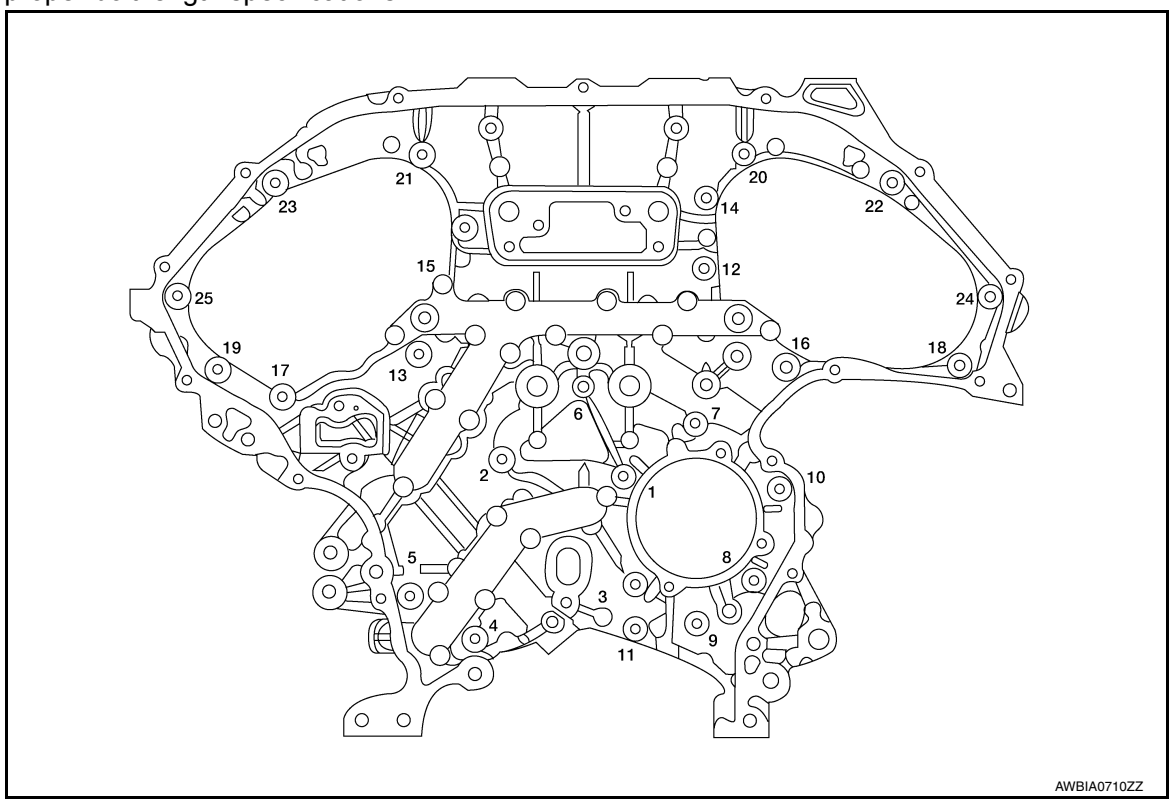
Tool number : WS39930000 (—)

CAUTION:
- **For "a", completely wipe out liquid gasket extended on a portion touching at engine coolant.**
- **Apply liquid gasket on installation position of water pump and cylinder completely.**
- **Installation should be done within 5 minutes after applying liquid gasket.**
- **Do not fill the engine with oil for at least 30 minutes after the components are installed to allow the sealant to cure.**



3. Align the rear timing chain case and water pump assembly with the dowel pins (RH and LH) on the cylinder block and install the case. Make sure the O-rings stay in place during installation.
   CAUTION:
   Do not reuse O-rings.

a. Tighten the bolts in the numerical order as shown. There are two bolt lengths used. Follow the chart below for proper bolt length specifications.



Bolt length	Bolt position	Torque specification
20 mm (0.79 in)	1, 2, 3, 6, 7, 8, 9, 10	12.7 N·m (1.3 kg-m, 9 ft-lb)
16 mm (0.63 in)	4, 5, 11	12.7 N·m (1.3 kg-m, 9 ft-lb)
16 mm (0.63 in)	12 - 25	12.7 N·m (1.3 kg-m, 9 ft-lb)

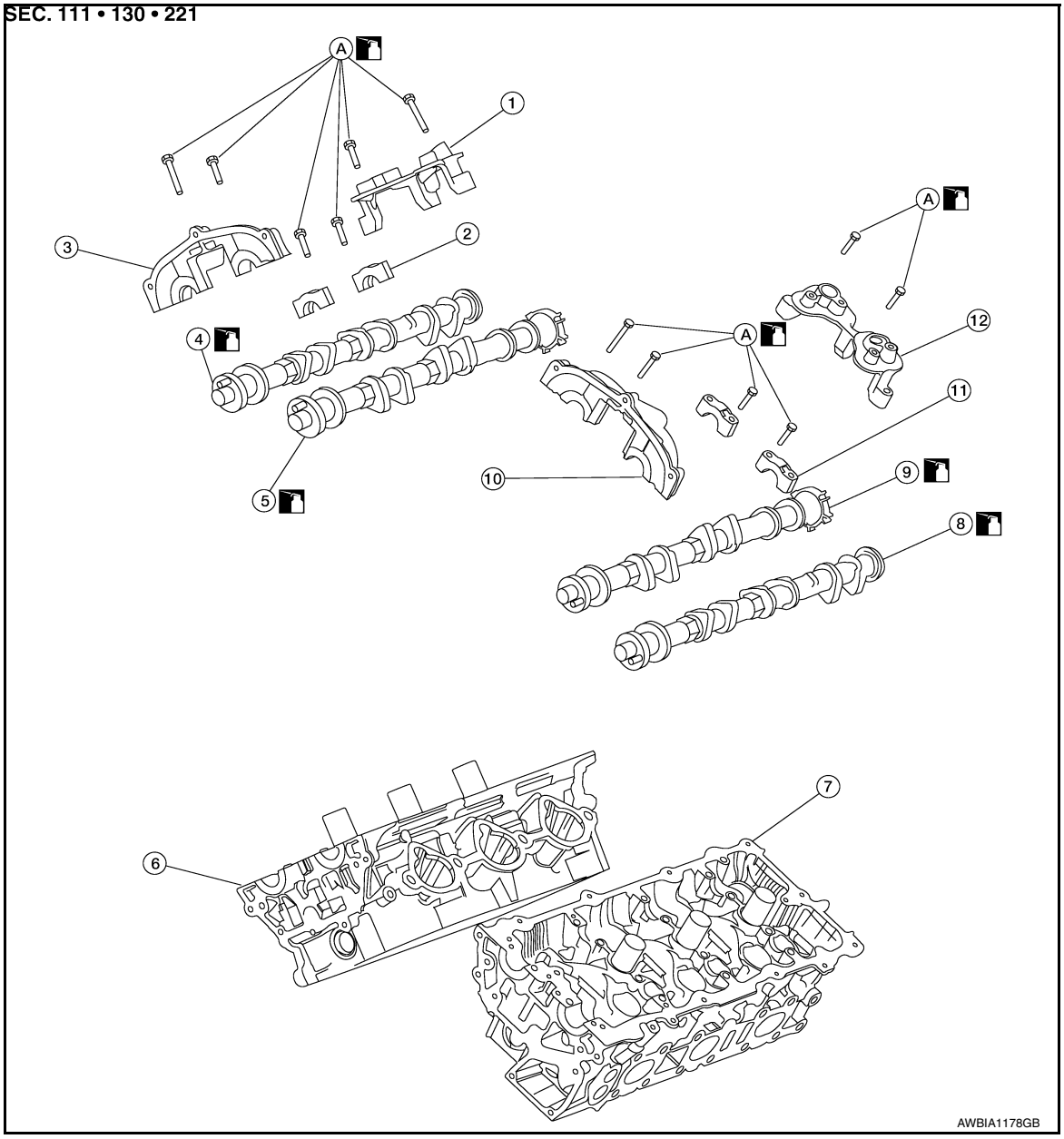
b. After all bolts are initially tightened, retighten them to the specification in the numerical order shown.

4. Install the primary and secondary timing chains. Refer to EM-64, "Removal and Installation".
5. Install the front timing chain case. Refer to EM-54, "Removal and Installation".
6. Install No. 1 camshaft bracket (RH) and No. 1 camshaft bracket (LH). Refer to EM-76, "Removal and Installation".
7. Install the oil pan upper and lower. Refer to EM-37, "Removal and Installation (Upper Oil Pan)".
8. Install the engine assembly. Refer to EM-103, "Removal and Installation".

CAMSHAFT

Exploded View

INFOID:0000000009466039



1.	Camshaft position sensor bracket (RH)	2.	Camshaft brackets	3.	No. 1 camshaft bracket (RH)
4.	Camshaft (EXH) (RH)	5.	Camshaft (INT) (RH)	6.	Cylinder head (RH)
7.	Cylinder head (LH)	8.	Camshaft (EXH) (LH)	9.	Camshaft (INT) (LH)
10.	No. 1 camshaft bracket (LH)	11.	Camshaft brackets	12.	Camshaft position sensor bracket (LH)
A.	Refer to INSTALLATION				

CAUTION:

Apply new engine oil to parts marked in illustration before installation.

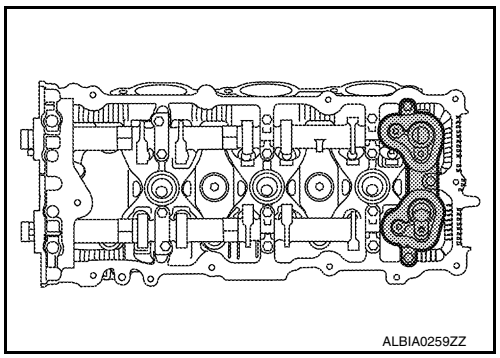
Removal and Installation

INFOID:0000000009466040

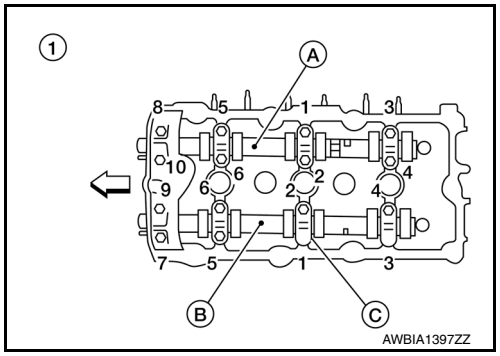
REMOVAL

1. Remove the timing chains. Refer to EM-64, "Removal and Installation".

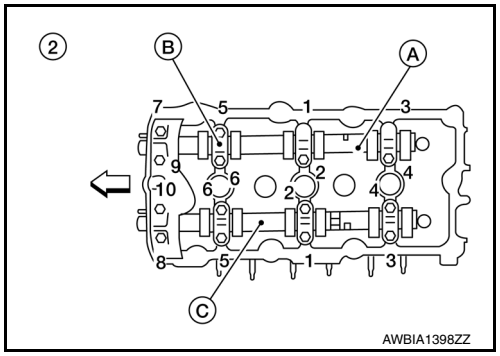
2. Remove camshaft position brackets (RH shown, LH similar).



3. Remove the camshaft brackets and the camshafts.
   - Mark the camshafts, camshaft brackets, and bolts so they are placed in the same position and direction for installation.
   - Equally loosen the camshaft bracket bolts in several steps in the reverse order as shown.



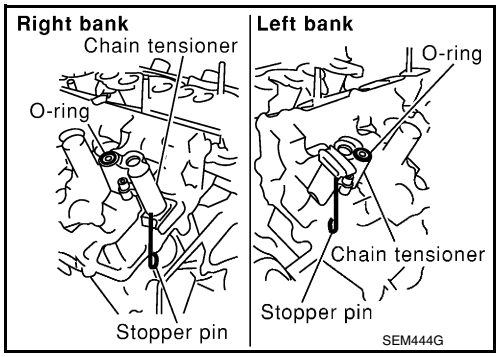
(1) : Cylinder head (RH)
(A) : Camshaft (EXH) (RH)
(B) : Camshaft (INT) (RH)
(C) : Camshaft bracket
⇦ : Engine front



(2) : Cylinder head (LH)
(A) : Camshaft (INT) (LH)
(B) : Camshaft bracket
(C) : Camshaft (EXH) (LH)
⇦ : Engine front

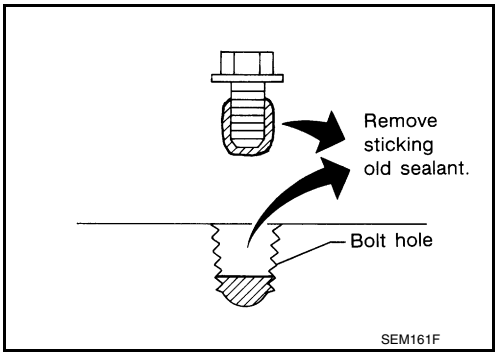
4. Remove valve lifters, if necessary.
   NOTE:
   Identify installation positions to ensure proper installation.
5. Remove secondary timing chain tensioner from cylinder head.
   - Remove secondary tensioner with its stopper pin attached.

   NOTE:
   Stopper pin was attached when secondary timing chain was removed.

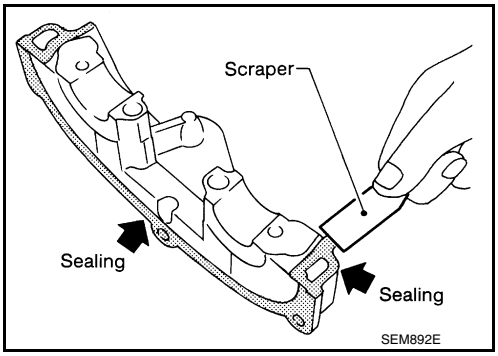


INSTALLATION

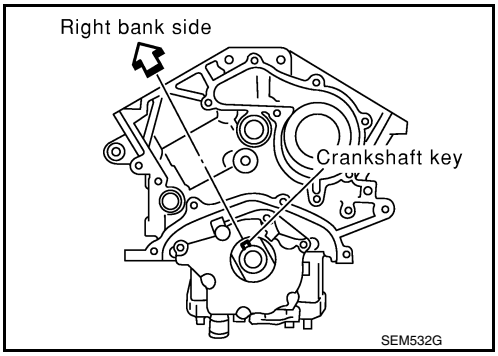
1. Before installation, remove any old Silicone RTV Sealant from component mating surfaces using a scraper.
   - Remove the old Silicone RTV Sealant from the bolt holes and threads.
   - Do not scratch or damage the mating surfaces.



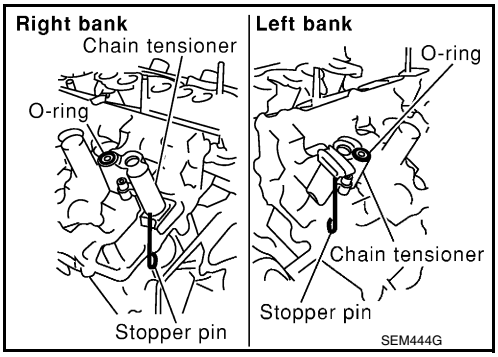
2. Before installing the front cam bracket, remove the old Silicone RTV Sealant from the mating surface using a scraper.
   - Do not scratch or damage the mating surface.



3. Turn the crankshaft until No. 1 piston is set at TDC on the compression stroke.
   - The crankshaft key should line up with the right bank cylinder center line as shown.

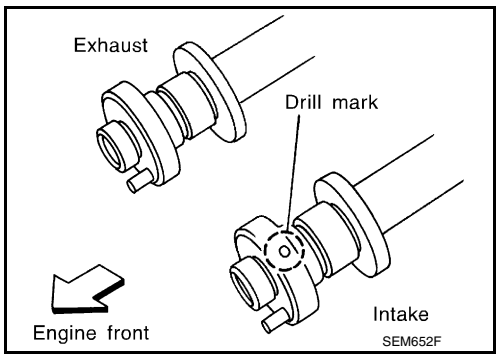


4. Install camshaft chain tensioners on both sides of cylinder head. Refer to EM-54, "Removal and Installation".



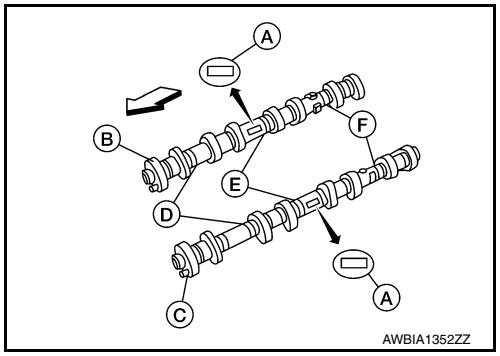
5. Install valve lifters, if removed.
   NOTE:
   Install them in original positions.

6. Install exhaust and intake camshafts and camshaft brackets.
   - Intake camshaft has a drill mark on camshaft sprocket mounting flange.



   - Follow your identification marks made during removal, or follow the identification marks that are present on the new camshaft components for proper placement and direction of the components.

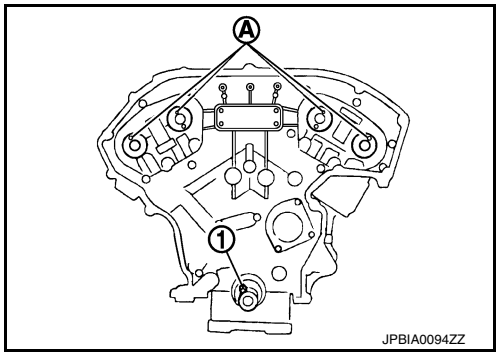
⇦ :Engine front



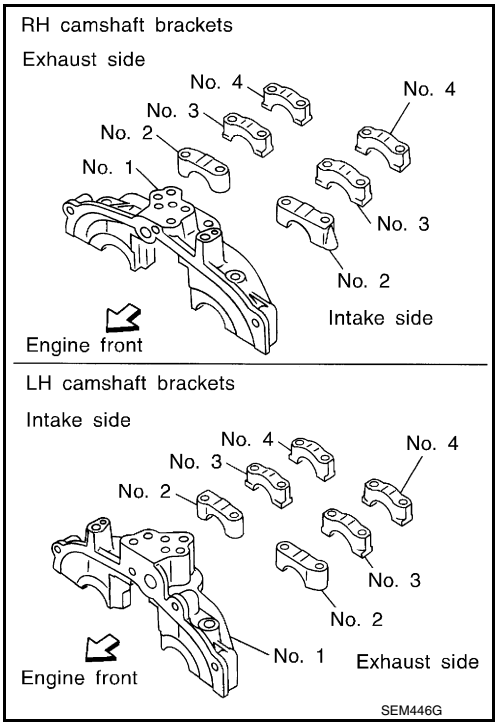
Bank	INT/EXH	ID mark (A)	Drill mark	Paint marks		
				M1 (E)	M2 (F)	M3 (D)
RH (B)	INT	1A	Yes	Purple	No	Light blue
	EXH	1C	No	No	Orange	Light blue
LH (C)	INT	1B	Yes	Purple	No	Light blue
	EXH	1D	No	No	Orange	Light blue

   - Position the camshaft dowel pins (A) as shown.

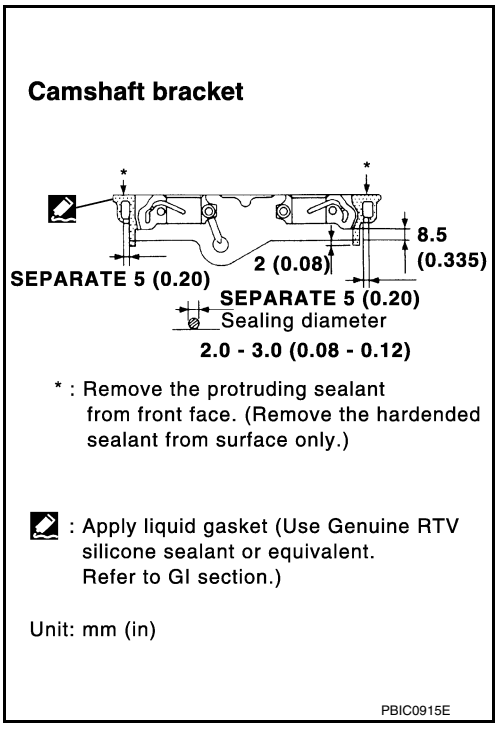
(1) :Crankshaft key



7. Before installing camshaft brackets, apply sealant to mating surface of No. 1 camshaft bracket.
   - **Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".**
   CAUTION:
   - **Installation should be done within 5 minutes after applying liquid gasket.**
   - **Do not fill the engine with oil for at least 30 minutes after the components are installed to allow the sealant to cure.**

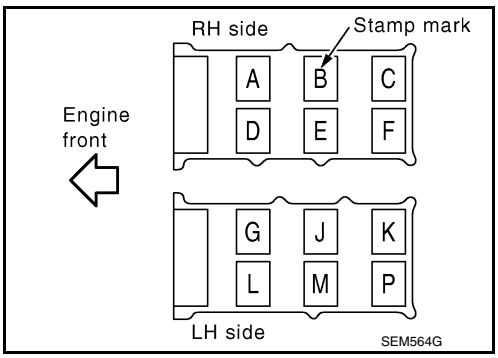


   - Before installation, wipe off any protruding sealant.
   - Refer to EM-4, "Precaution for Liquid Gasket".



   - Install camshaft brackets in their original positions and direction. Align the stamp marks as shown.
   - **If checking and adjusting any part of valve assembly or camshaft, check valve clearance according to the reference data. Refer to EM-18, "Valve Clearance".**

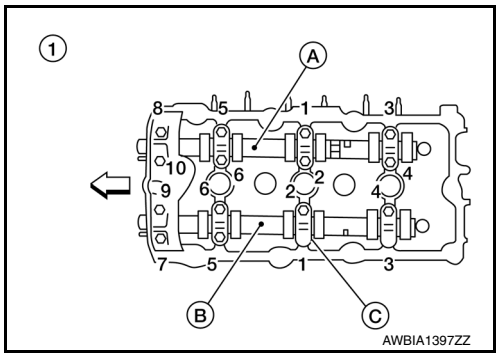
Valve clearance (cold) Intake	**: 0.26 - 0.34 mm (0.010 - 0.013 in)**
Valve clearance (cold) Exhaust	**: 0.29 - 0.37 mm (0.011 - 0.015 in)**



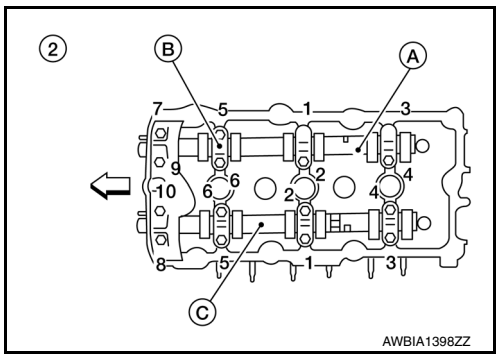
- Tighten the camshaft brackets in the three steps, in numerical order as shown.

1	1.96 N·m (0.2 kg-m, 17 in-lb)	Tighten No. 7 - 10, then tighten 1 - 6 in numerical order as shown.
2	5.88 N·m (0.6 kg-m, 52 in-lb)	Tighten in numerical order shown.
3	10.41 N·m (1.10 kg-m, 8 ft-lb)	Tighten No. 1 - 6 in the numerical order shown.

(1) : Cylinder head (RH)
(A) : Camshaft (EXH) (RH)
(B) : Camshaft (INT) (RH)
(C) : Camshaft bracket
⇦ : Engine front



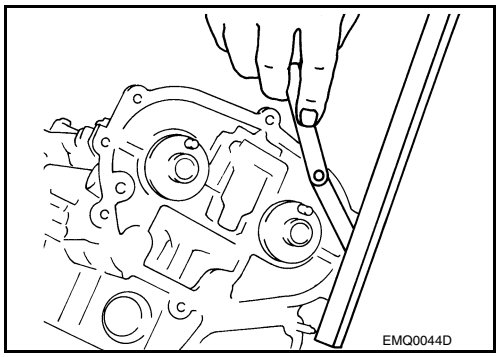
(2) : Cylinder head (LH)
(A) : Camshaft (INT) (LH)
(B) : Camshaft bracket
(C) : Camshaft (EXH) (LH)
⇦ : Engine front



8. Measure difference in levels between front end faces of No. 1 camshaft bracket and cylinder head.

Standard : – 0.14 mm (– 0.0055 in)

- If measurement is outside the specified range, re-install camshaft and camshaft bracket.



9. Install camshaft position sensors (PHASE) (RH/LH).
10. Install the fuel rail and injectors. Refer to EM-43, "Removal and Installation".
11. Install the timing chains. Refer to EM-64, "Removal and Installation".

Inspection After Removal

INFOID:0000000009466041

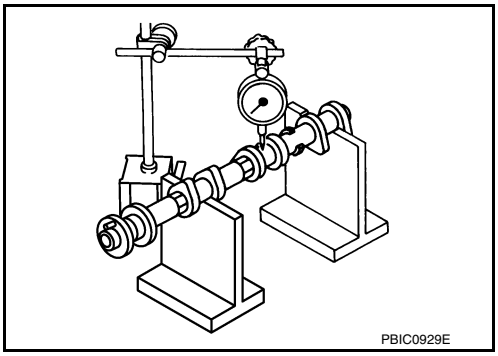
INSPECTION

Camshaft Visual Check

Check camshaft for scratches, seizure and wear. Replace if necessary.

Camshaft Runout

1. Put V-block on precise flat bed and support No. 2 and No. 4 journal of camshaft as shown.
2. Set dial gauges vertically to No. 3 journal as shown.
3. Turn camshaft in one direction slowly by hand, measure the camshaft runout using suitable tool as shown.
   • Runout is the largest indicator reading after one full revolution.



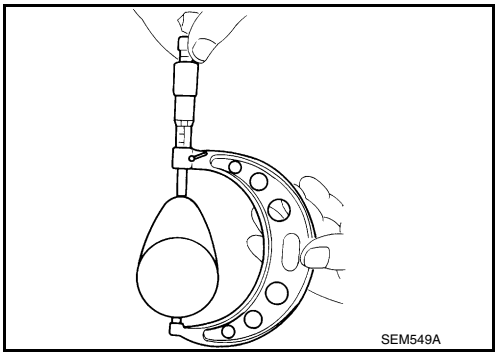
Camshaft Runout

Standard	**: Less than 0.02 mm (0.0008 in)**
Limit	**: 0.05 mm (0.0020 in)**

4. If actual runout exceeds the limit, replace the camshaft.

Camshaft Cam Lobe Height

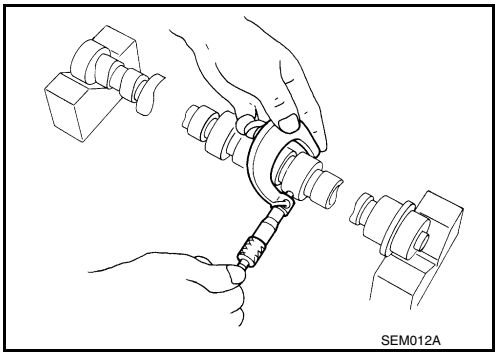
1. Measure camshaft cam lobe height using suitable tool as shown. Refer to EM-130, "Camshaft".
2. If wear has reduced the lobe height below specifications, replace the camshaft.



Camshaft Journal Clearance

Outer Diameter of Camshaft Journal

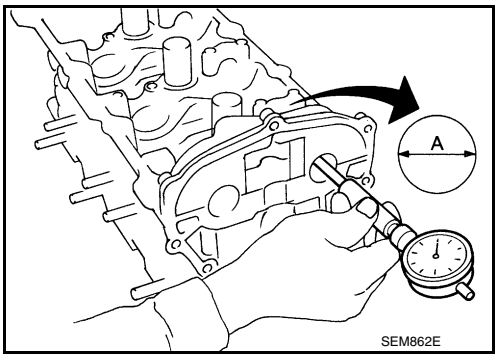
• Measure outer diameter of camshaft journal using suitable tool as shown.



Standard outer diameter No.1	**: 25.935 - 25.955 mm (1.0211 - 1.0218 in)**
Standard outer diameter No.2, 3, 4	**: 23.445 - 23.465 mm (0.9230 - 0.9238 in)**

Inner Diameter of Camshaft Bracket

1. Tighten camshaft bracket bolt with specified torque.
2. Measure inner diameter (A) of camshaft bearing using suitable tool as shown.



Standard inner diameter No.1	**: 26.000 - 26.021 mm (1.0236 - 1.0244 in)**
Standard inner diameter No.2, 3, 4	**: 23.500 - 23.521 mm (0.9252 - 0.9260 in)**

Calculation of Camshaft Journal Clearance

(Journal clearance) = (inner diameter of camshaft bracket) – (outer diameter of camshaft journal)

Standard No.1 : 0.045 - 0.086 mm (0.0018 - 0.0034 in)

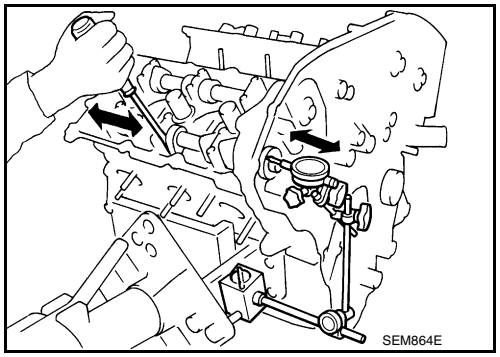
Standard No.2, 3, 4 : 0.035 - 0.076 mm (0.0014 - 0.0030 in)

Limit : 0.15 mm (0.0059 in)

- When out of the specified range, replace either or both camshaft and cylinder head.
  NOTICE:
  Inner diameter of camshaft bracket is manufactured together with cylinder head. Replace the whole cylinder head assembly.

Camshaft End Play

1. Install the camshaft in the cylinder head.
2. Install suitable tool in thrust direction on front end of camshaft. Measure end play when camshaft is moved forward/backward (in direction to axis) as shown.



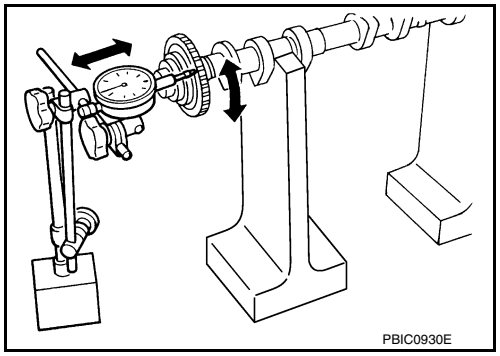
Standard : 0.115 - 0.188 mm (0.0045 - 0.0074 in)

Limit : 0.24 mm (0.0094 in)

- If out of the specified range, replace with new camshaft and measure again.
- If out of the specified range again, replace with new cylinder head.

Camshaft Sprocket Runout

1. Put V-block on precise flat bed and support No. 2 and No. 4 journal of camshaft as shown.
2. Install camshaft sprocket on camshaft.
3. Measure camshaft sprocket runout using suitable tool as shown.

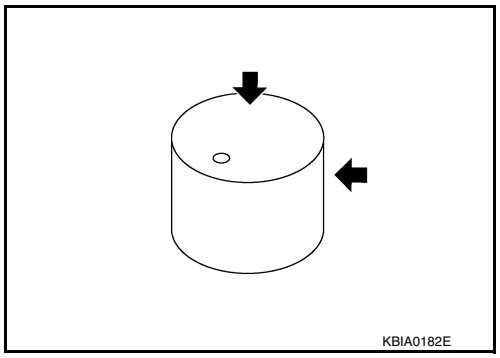


Runout : Less than 0.15 mm (0.0059 in)

4. If sprocket runout exceeds the limit, replace camshaft sprocket.

Valve Lifter

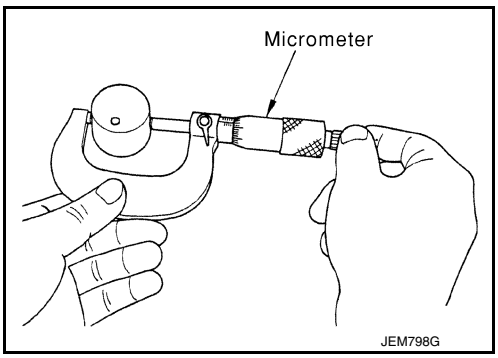
- Check if the surface of the valve lifter has any excessive wear or cracks, replace as necessary.



Valve Lifter Clearance

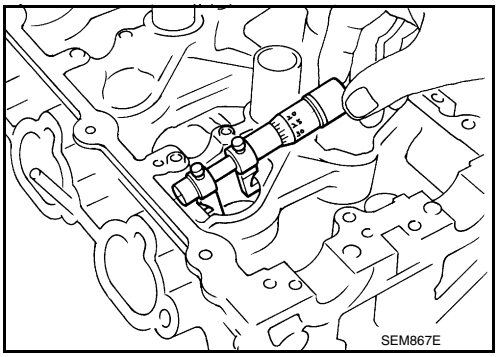
Outer Diameter of Valve Lifter

- Measure the outer diameter of the valve lifter using suitable tool as shown. Refer to EM-130, "Camshaft".
- If out of the specified range, replace the valve lifter.



Valve Lifter Bore Diameter

- Measure diameter of valve lifter bore of cylinder head using suitable tool as shown. Refer to EM-130, "Camshaft".
- If out of the specified range, replace the cylinder head assembly.



Calculation of Valve Lifter Clearance

- (Valve lifter clearance) = (hole diameter for valve lifter) – (outer diameter of valve lifter) Refer to EM-130, "Camshaft".
- If out of specified range, replace either or both valve lifter and cylinder head assembly.

Inspection after Installation

INFOID:0000000009466042

INSPECTION OF CAMSHAFT SPROCKET (INT) OIL GROOVE

CAUTION:

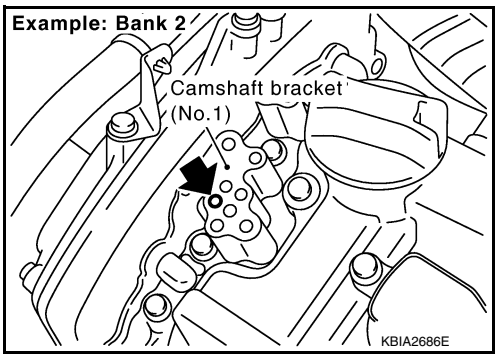
- **Perform this inspection only when DTC P0011 is detected in self-diagnostic results of CONSULT III and it is directed according to inspection procedure of EC section. Refer to EC-177, "Diagnosis Procedure".**
- **Check when engine is cold so as to prevent burns from any splashing engine oil.**

1. Check engine oil level. Refer to LU-8, "Inspection".
2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.

a. Release fuel pressure. Refer to EC-592, "Inspection".

b. Disconnect ignition coil and injector harness connectors if practical.

3. Remove intake valve timing control solenoid valve.
4. Crank engine, and then make sure that engine oil comes out from intake valve timing control solenoid valve cover oil hole. End cranking after checking.



WARNING:

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

CAUTION:

- **Engine oil may squirt from intake valve timing control solenoid valve installation hole during cranking. Use a shop cloth to prevent engine oil from splashing on worker, engine components and vehicle.**
- **Do not allow engine oil to get on rubber components such as drive belts or engine mount insulators. Immediately wipe off any splashed engine oil.**

5. Clean oil groove between oil strainer and intake valve timing control solenoid valve if engine oil does not come out from intake valve timing control solenoid valve cover oil hole.
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.
7. After inspection, installation of the remaining components is in the reverse order of removal.

OIL SEAL

Removal and Installation of Valve Oil Seal

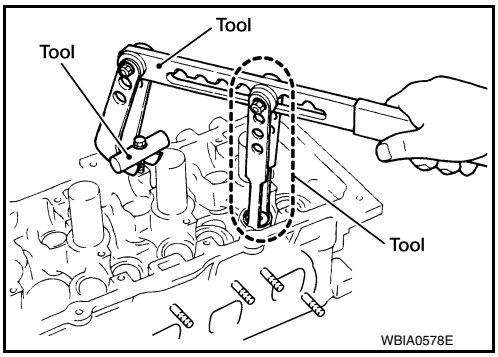
INFOID:0000000009466043

REMOVAL

1. Turn crankshaft until the cylinder requiring new oil seals is at TDC. This will prevent valve from dropping into cylinder.
   CAUTION:
   When rotating crankshaft, be careful to avoid scarring the front cover with the timing chain.
2. Remove camshaft relating to valve oil seal to be removed. Refer to EM-76, "Removal and Installation".
3. Remove valve lifters. Refer to EM-76, "Removal and Installation".
4. Remove valve collet, valve spring retainer and valve spring using Tool.
   CAUTION:
   When working, take care not to damage valve lifter holes.

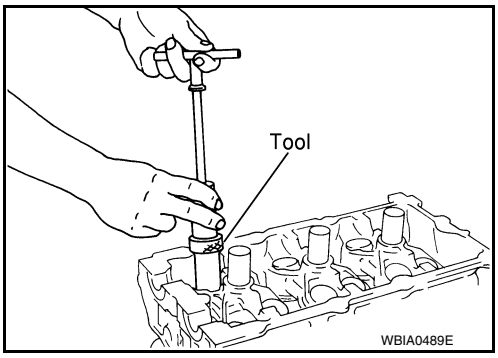
   Tool numbers : KV10116200 (J-26336-A)
   : KV10115900 (J-26336-20)
   : KV10109220 (—)

   - Compress valve spring using Tool attachment, adapter. Remove valve collet with magnet hand.



5. Remove valve oil seal using Tool.

   Tool number : KV10107902 (J-38959)



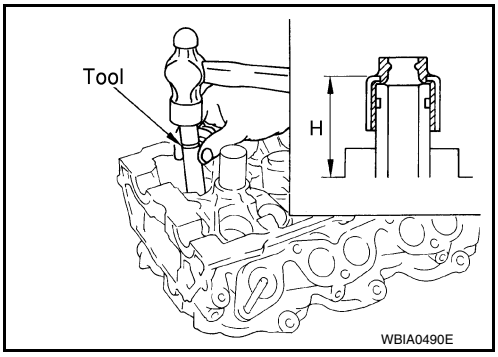
INSTALLATION

1. Apply new engine oil to new valve oil seal joint surface and seal lip.
2. Press in valve oil seal to height (H) using Tool to specified height.

   Tool number : — (J-39386)

   NOTE:
   Dimension (H): height measured before valve spring seat installation.

   Intake and exhaust : 14.3 - 14.9 mm (0.563 - 0.587 in)



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

Removal and Installation of Front Oil Seal

INFOID:0000000009466044

REMOVAL

1. Remove engine under cover. Refer to EXT-15, "Exploded View".
2. Remove drive belt. Refer to EM-14, "Removal and Installation".
3. Remove radiator fan. Refer to CO-16, "Removal and Installation".

4. Remove rear cover plate.
5. Remove the crankshaft pulley as follows:

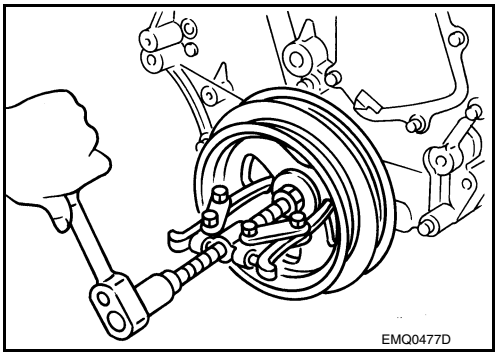
a. Lock the drive plate using Tool.

Tool number : — (J-50288)

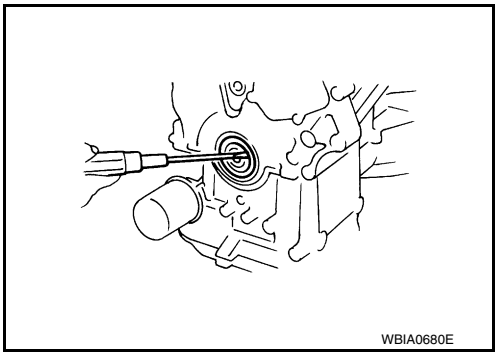
CAUTION:
Do not damage the ring gear teeth, or the signal plate teeth behind the ring gear, when setting the Tool.

b. Loosen crankshaft pulley and locate bolt seating surface at 10 mm (0.39 in) from its original position.

c. Position a pulley puller at recess hole of crankshaft pulley to remove crankshaft pulley.
CAUTION:
Do not use a puller claw on the outer diameter of the crankshaft pulley.

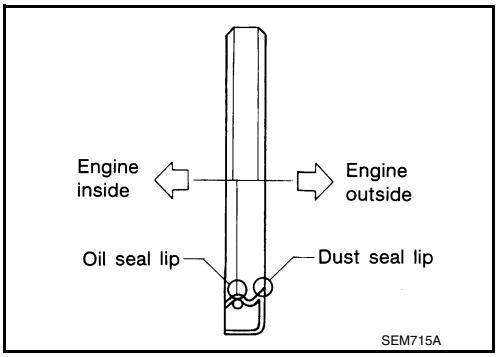


6. Remove front oil seal from front cover using a suitable tool.
CAUTION:
Be careful not to damage front cover or crankshaft.

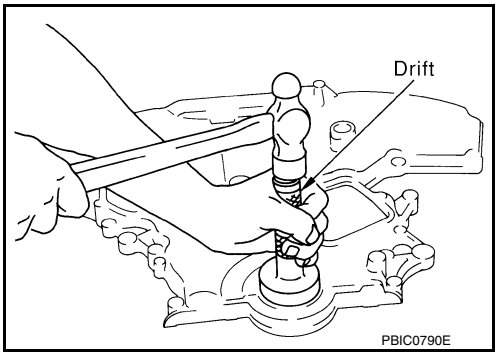


INSTALLATION

1. Apply new engine oil to new oil seal and install.
   • Install new oil seal in the direction as shown.
CAUTION:
Press fit straight and avoid causing burrs or tilting the oil seal.



- Press-fit oil seal until it becomes flush with the timing chain case end face, using suitable tool.
- Make sure the garter spring in the oil seal is in position and seal lip is not inverted.



2. Install crankshaft pulley and tighten the bolt in two steps.
   - Lubricate thread and seat surface of the bolt with new engine oil.
   - For the second step angle tighten using Tool.

Step 1 : 44.1 N·m (4.5 kg-m, 33 ft-lb)
Step 2 : 84° - 90° degrees clockwise

Tool number : KV10112100 (BT-8653-A)

3. Remove the Tool to unlock the drive plate.

Tool number : — (J-50288)

CAUTION:
Do not damage the ring gear teeth, or the signal plate teeth behind the ring gear, when removing the Tool.

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

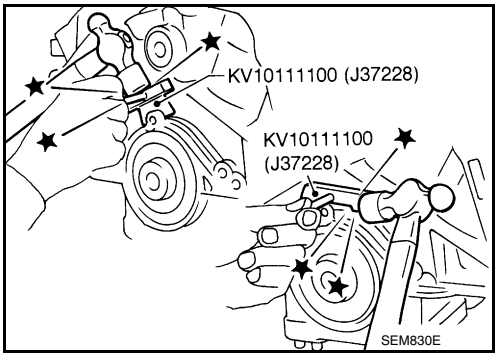
Removal and Installation of Rear Oil Seal

INFOID:0000000009466045

REMOVAL

1. Remove the upper oil pan. Refer to EM-37, "Removal and Installation (Upper Oil Pan)".
2. Remove drive plate. Refer to EM-127, "Dowel Pin Alignment".
3. Remove rear oil seal retainer using Tool.

Tool Number : KV10111100 (J-37228)



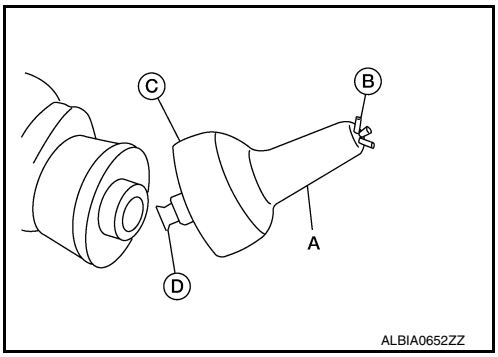
CAUTION:
- **Be careful not to damage mating surface.**
- **If rear oil retainer is removed, replace it with a new one**

NOTE:
Rear oil seal and retainer form a single part and are replaced as an assembly.

INSTALLATION

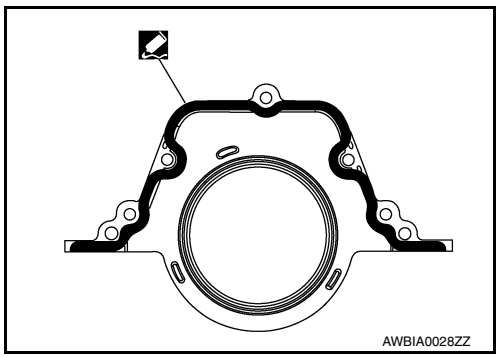
1. Remove old liquid gasket material from mating surface of cylinder block and oil pan using a suitable scraper.
2. Install the rear oil seal retainer using Tool (A).

Tool number : — (J-47128)

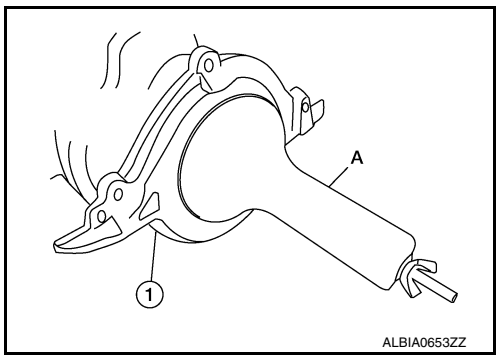


a. Loosen the wing nut (B) on the end of the Tool (A).
b. Insert the arbor (D) into the crankshaft pilot hole until the outer lip (C) of the Tool (A) covers the edge of the crankshaft sealing surface.
c. Tighten the wing nut (B) to secure the Tool (A) to the crankshaft.

d. Apply sealant to rear oil seal retainer as shown.
Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".
CAUTION:
- **Installation should be done within 5 minutes after applying liquid gasket.**
- **Do not fill the engine with oil for at least 30 minutes after the components are installed to allow the sealant to cure.**



e. Lubricate the sealing surface of the new rear main seal with new engine oil.
f. Slide the new rear main seal (1) over the Tool (A) and onto the crankshaft.
g. Loosen the wing nut and push the threaded rod into the handle to remove the Tool (A).
h. Tighten the rear oil seal retainer bolts to specification.

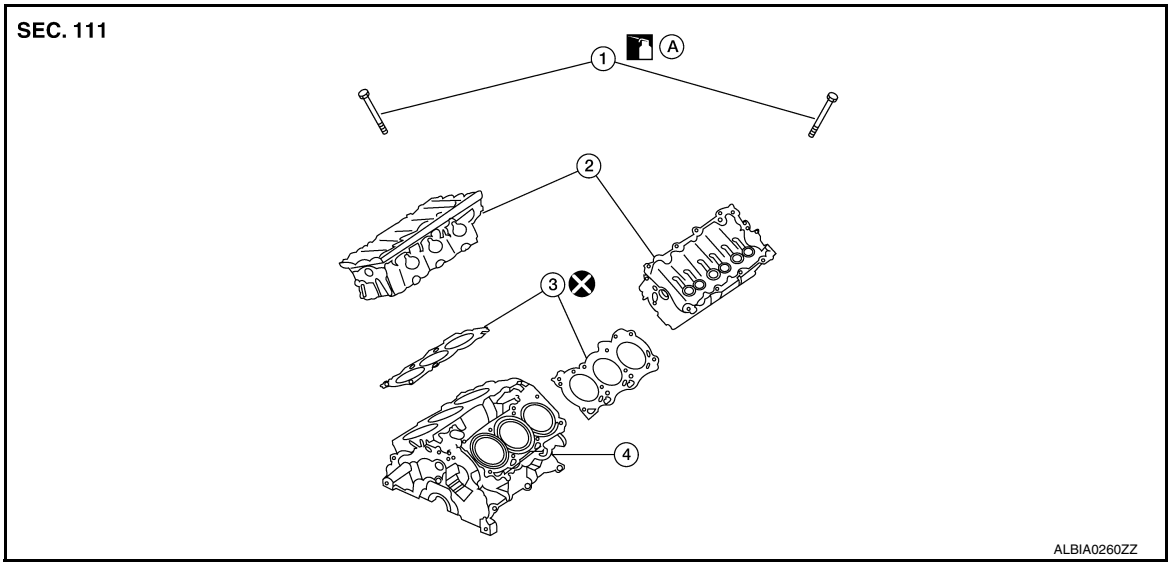


3. Installation of the remaining components is in the reverse order of removal.
CAUTION:
- **When replacing an engine or transmission you must make sure the dowels are installed correctly during re-assembly.**
- **Improper alignment caused by missing dowels may cause vibration, oil leaks or drivetrain component damage.**

CYLINDER HEAD

Removal and Installation

INFOID:0000000009466046



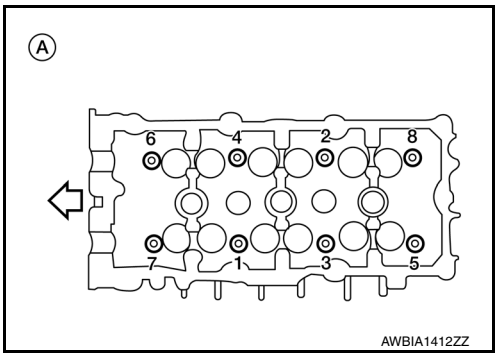
1. Cylinder head bolt
2. Cylinder head
3. Cylinder head gasket
4. Engine block
A. Refer to INSTALLATION

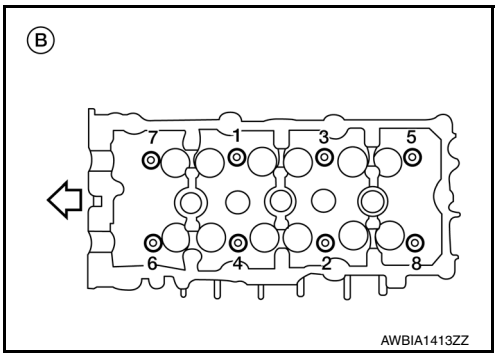
REMOVAL

CAUTION:

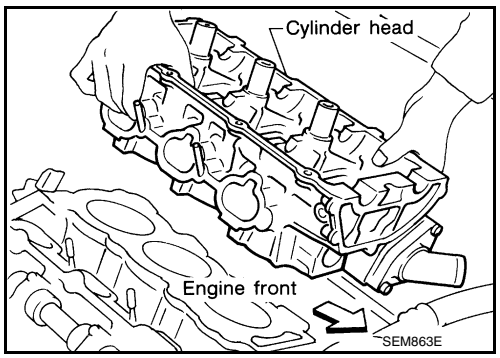
Do not rotate crankshaft and camshaft separately or valves will strike piston heads.

1. Remove the engine and transaxle assembly. Refer to EM-103, "Removal and Installation".
2. Remove the rear timing chain case. Refer to EM-71, "Removal and Installation".
3. Remove the intake manifold. Refer to EM-28, "Removal and Installation".
4. Remove the intake and exhaust camshafts. Refer to EM-76, "Removal and Installation".
5. Remove the coolant outlet housing. Refer to CO-24, "Removal and Installation".
6. Remove the RH (A) and LH (B) cylinder head bolts, with power tool.
   - The bolts should be loosened gradually in three stages.
   - Loosen the bolts in the numerical order as shown.



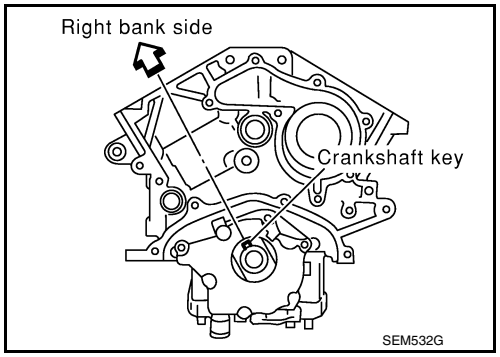


7. Remove cylinder heads and gaskets.
   • Discard the cylinder head gaskets and use new gaskets for installation.

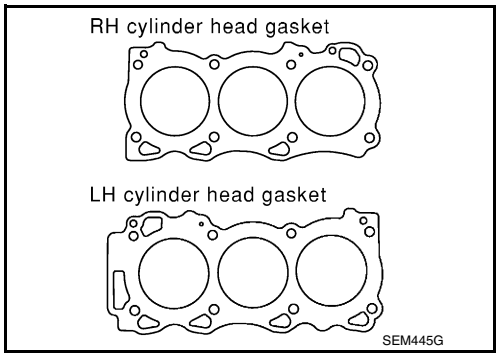


INSTALLATION

1. Turn the crankshaft until No. 1 piston is set at TDC on the compression stroke.
   • The crankshaft key should line up with the right bank cylinder center line as shown.



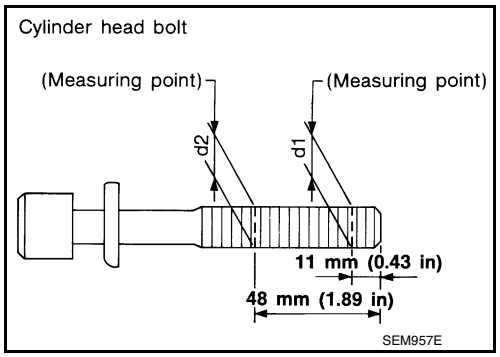
2. Install new gaskets on the cylinder heads.
   CAUTION:
   Do not reuse cylinder head gasket.



3. Inspect the cylinder head bolts before installing the cylinder heads.
   CAUTION:
   Cylinder head bolts are tightened by degree rotation tightening method. Whenever the size difference between d1 and d2 exceeds the limit, replace the bolts with new ones.

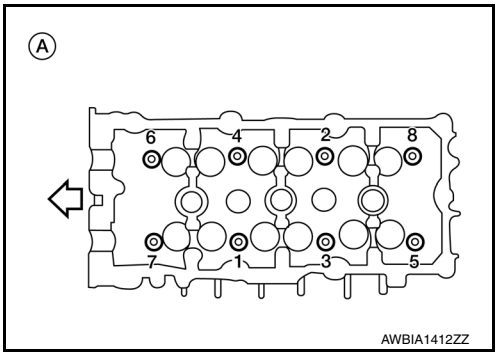
   Limit (d1 - d2) : 0.11 mm (0.0043 in)

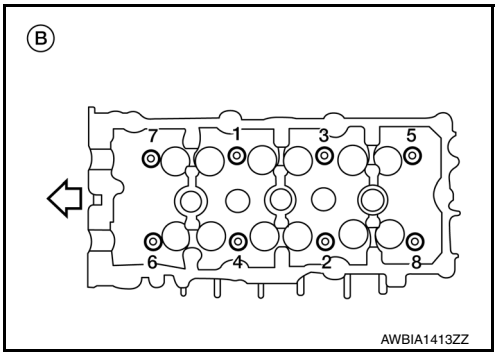
   • **Lubricate threads and seat surfaces of the bolts with new engine oil.**



4. Install the cylinder heads RH (A) and LH (B) on the cylinder block. Tighten the cylinder head bolts in the five steps in the numerical order as shown using Tool.

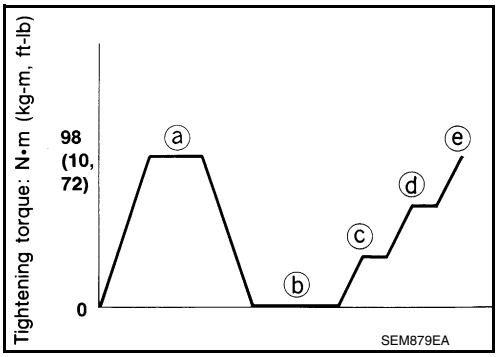
Tool Number : KV10112100 (BT-8653-A)





- **Tightening procedure:**

Cylinder head bolts
Step a : 98.1 N·m (10 kg-m, 72 ft-lb)
Step b : Loosen in the reverse order of tightening
Step c : 39.2 N·m (4.0 kg-m, 29 ft-lb)
Step d : 103° degrees rotation clockwise
Step e : 103° degrees rotation clockwise

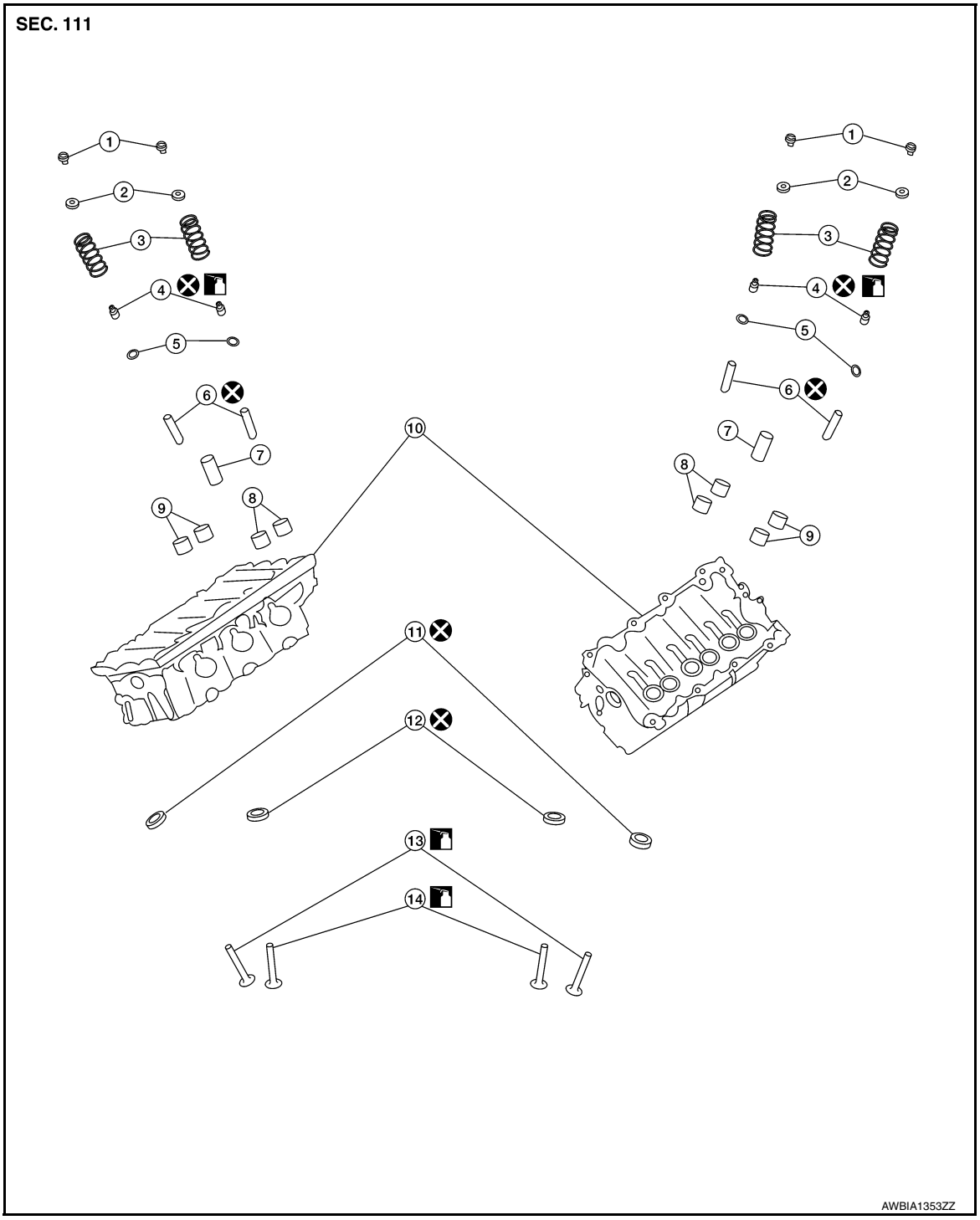


5. Installation of the remaining components is in the reverse order of removal.

Disassembly and Assembly

INFOID:0000000009466047

SEC. 111



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

CAUTION:

- **When installing camshafts, chain tensioners, oil seals, or other sliding parts, lubricate contacting surfaces with new engine oil.**
- **Apply new engine oil to threads and seat surface when installing cylinder head, camshaft sprocket, crankshaft pulley, and camshaft bracket.**

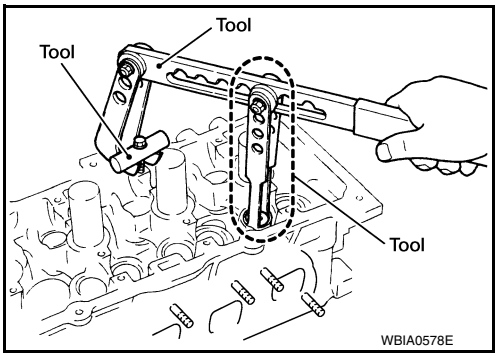
- **Attach tags to valve lifters so as not to mix them up.**

DISASSEMBLY

1. Remove spark plug.
2. Remove valve lifter.
   - Identify installation positions, and store them without mixing them up.
3. Remove valve collet.
   - Compress valve spring and remove valve collet with magnet hand using Tool.

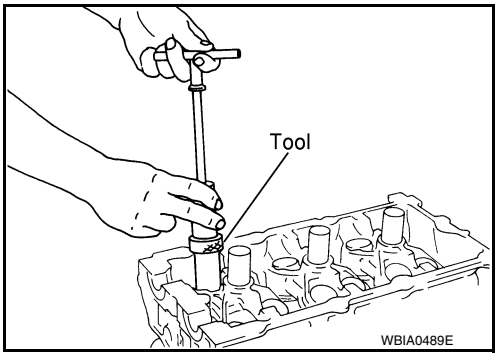
   CAUTION:
   When working, take care not to damage valve lifter holes.

   Tool numbers : KV10109220 (—)
   : KV10116200 (J-26336-A)
   : KV10115900 (J-26336-20)



4. Remove valve spring retainer, valve spring and valve spring seat.
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 seals using Tool.

   Tool number : KV10107902 (J-38959)



7. If valve seat must be replaced, refer to EM-95, "Inspection After Disassembly".
8. If valve guide must be replaced, refer to EM-95, "Inspection After Disassembly".
9. Remove spark plug tube, as necessary.
   - Using pair of pliers, pull spark plug tube out of cylinder head.

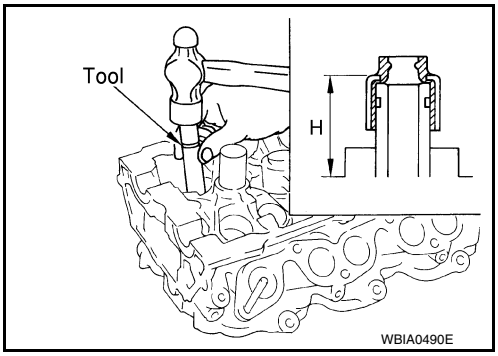
   CAUTION:
   - **Take care not to damage cylinder head.**
   - **Once removed, spark plug tube will be deformed and cannot be reused. Do not remove it unless absolutely necessary.**

ASSEMBLY

1. When valve guide is removed, install it. Refer to EM-95, "Inspection After Disassembly".
2. When valve seat is removed, install it. Refer to EM-95, "Inspection After Disassembly".
3. Install valve oil seals using Tool.

   Tool number : — (J-39386)

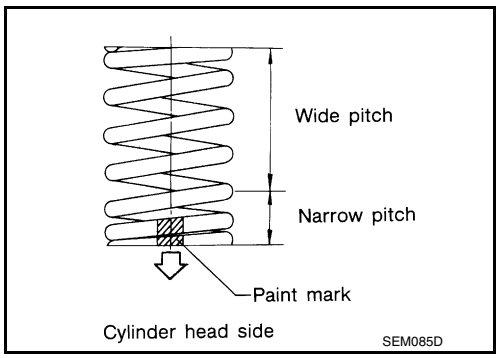
   Height "H" (Without valve spring seat installed)
   Intake and exhaust : 14.3 - 14.9 mm (0.563 - 0.587 in)



4. Install valve spring seat.
5. Install valves.
   - Install it in the original position.

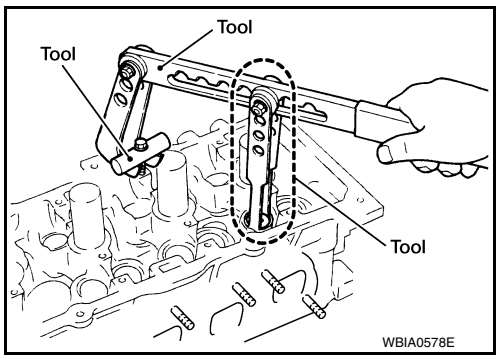
   NOTE:
   Larger diameter valves are for intake side.

6. Install valve spring (uneven pitch type) with narrow pitch end (paint mark) to cylinder head side (valve spring seat side).



7. Install valve spring retainer.
8. Install valve collet.
   - Compress valve spring with valve spring compressor, attachment and adapter using Tool. Install valve collet with magnet hand.

   CAUTION:
   When working, take care not to damage valve lifter holes.
   - Tap valve stem edge lightly with plastic hammer after installation to check its installed condition.

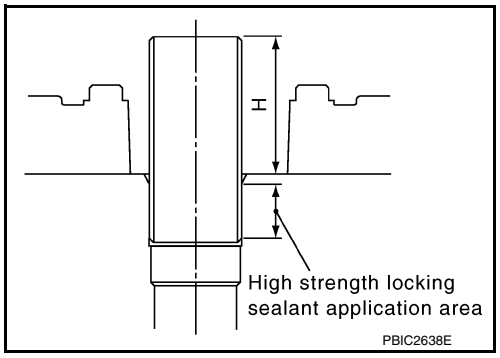


Tool numbers : KV10109220 (—)
: KV10116200 (J-26336-A)
: KV10115900 (J-26336-20)

9. Install valve lifter.
   - Install valve lifter in the original position.
10. Install spark plug tube.
    - Press-fit spark plug tube as follows:

a. Remove old liquid gasket adhering to cylinder head mounting hole.
b. Apply sealant to area within approximately 12 mm (0.47 in) from edge of spark plug tube press-fit side.
Use Genuine High Strength Locking Sealant or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".
c. Press-fit spark plug tube so that its height “H” is as specified in using suitable tool.

Press-fit height “H” : 37.7 - 38.7 mm (1.484 - 1.529 in)



CAUTION:
- **When press-fitting, take care not to deform spark plug tube.**
- **After press-fitting, wipe off liquid gasket protruding onto cylinder-head upper face.**

11. Install spark plug. Refer to EM-12, "Removal and Installation".

Inspection After Disassembly

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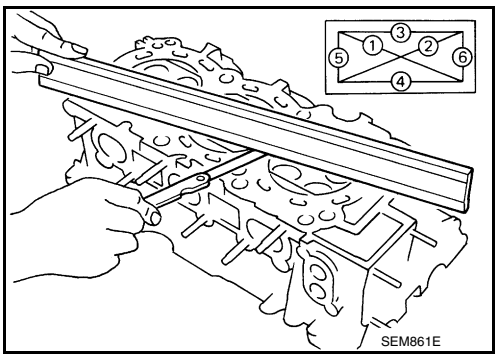
CYLINDER HEAD DISTORTION

Clean the surface of the cylinder head. Use a reliable straightedge and feeler gauge to check the flatness of cylinder head surface.

Check along six positions as shown.



Head surface distortion

Limit	**: 0.1 mm (0.004 in)**
Standard	**: Less than 0.03 mm (0.0012 in)**

CAUTION:
If it exceeds the limit, replace the cylinder head.
- **The limit for cylinder head resurfacing is determined by the cylinder block resurfacing.**

Resurfacing Limit

Amount of cylinder head resurfacing is "A".

Amount of cylinder block resurfacing is "B".

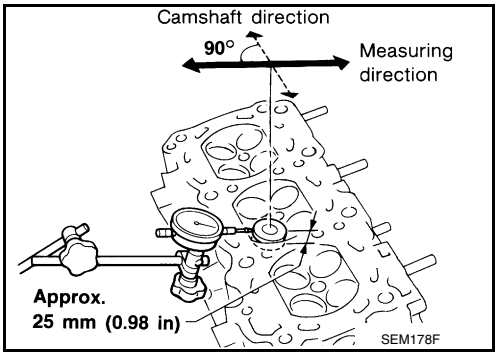
The maximum limit	**: A + B = 0.2 mm (0.008 in)**

- After resurfacing cylinder head, check that camshaft rotates freely by hand. If resistance is felt, cylinder head must be replaced.

Nominal cylinder head height : 126.3 - 126.5 mm (4.972 - 4.980 in)

VALVE GUIDE CLEARANCE

1. Measure valve deflection as shown. (Valve and valve guide mostly wear in this direction.)



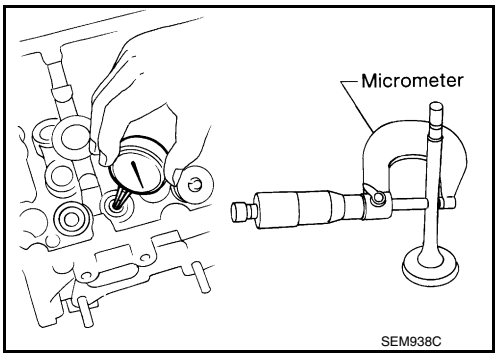
Valve deflection limit (dial gauge reading)

Intake	**: 0.24 mm (0.0094 in)**
Exhaust	**: 0.28 mm (0.0110 in)**

2. If it exceeds the limit, check valve to valve guide clearance.

a. Measure valve stem diameter and valve guide inner diameter. Refer to EM-132, "Cylinder Head".

b. Check that clearance is within specification.
(Valve guide clearance) = (Valve guide inner diameter) - (Valve stem diameter)



Valve to valve guide clearance standard

Intake	**: 0.020 - 0.053 mm (0.0008 - 0.0021 in)**
Exhaust	**: 0.040 - 0.073 mm (0.0016 - 0.0029 in)**

Valve to valve guide clearance limit

Intake	**: 0.08 mm (0.0031 in)**
Exhaust	**: 0.1 mm (0.004 in)**

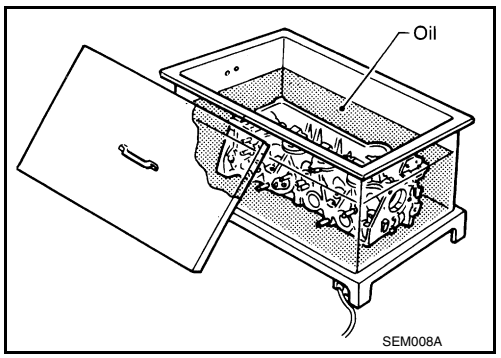
c. If it exceeds the limit, replace valve or valve guide.

VALVE GUIDE REPLACEMENT

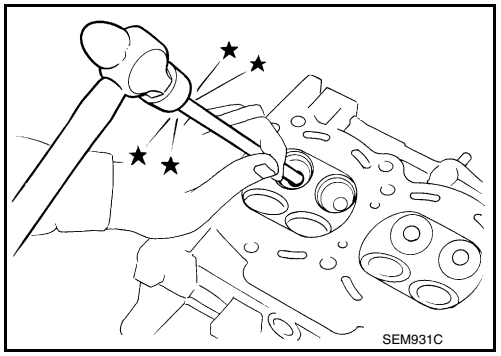
When valve guide is removed, replace with oversized [0.2 mm (0.008 in)] valve guide.

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

WARNING:
Cylinder head contains heat. When working, wear protective equipment to avoid getting burned.

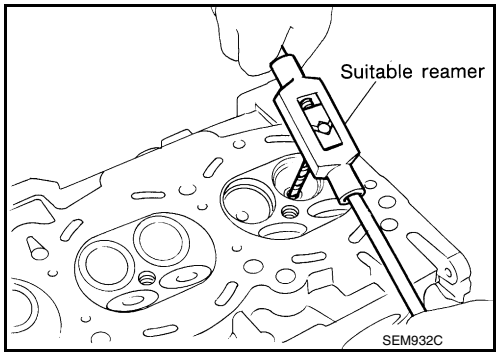


2. Drive out the valve guide with a press [under a 20 kN (2.2 US ton) pressure] or hammer and suitable tool.



3. Ream cylinder head valve guide hole.

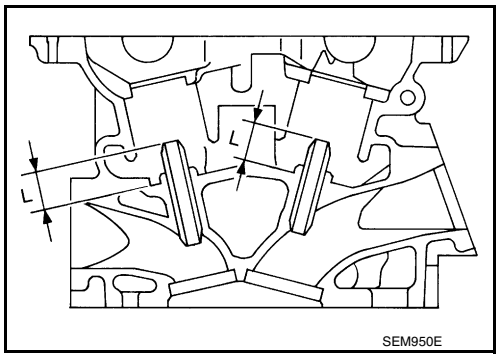
Valve guide hole diameter (for service parts), intake and exhaust : 10.175 - 10.196 mm (0.4006 - 0.4014 in)



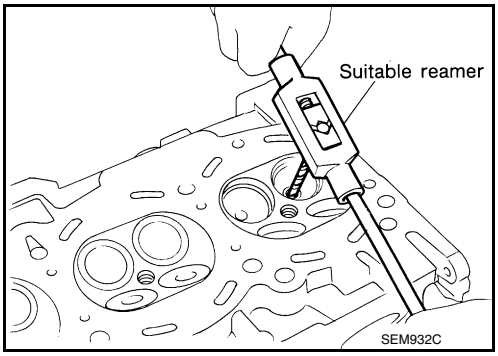
4. Heat cylinder head to 110° to 130°C (230° to 266°F) by soaking in heated oil and press new valve guide from camshaft side into the cylinder head to the dimensions as shown.

WARNING:
Cylinder head contains heat. When working, wear protective equipment to avoid getting burned.

Projection "L" : 12.6 - 12.8 mm (0.496 - 0.504 in)



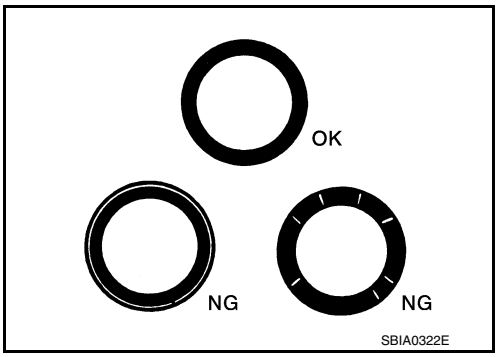
5. Using a valve guide reamer, apply a reamer finish to the valve guide.



Intake and exhaust finished size	**: 6.000 - 6.018 mm (0.2362 - 0.2369 in)**

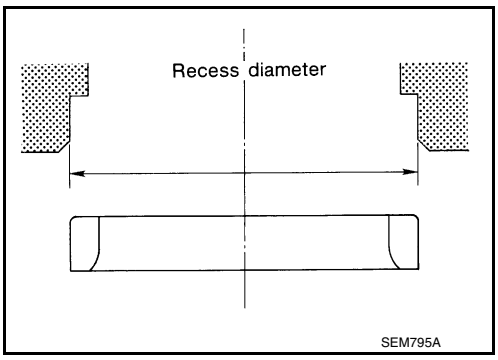
VALVE SEAT CONTACT

- After confirming that the dimensions of valve guides and valves are within specifications, perform this procedure.
- Apply prussian blue 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 N.G conditions even after the re-check, replace valve seat.



VALVE SEAT REPLACEMENT

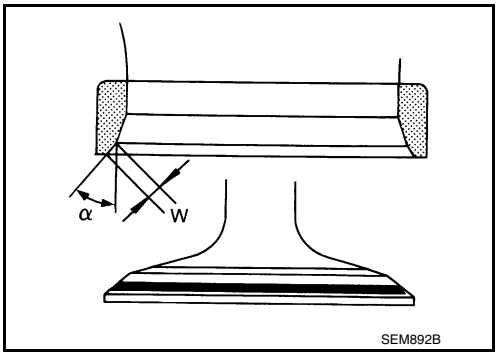
1. Bore out old valve seat until it collapses. Boring should not continue beyond the bottom face of the valve seat recess in cylinder head. Set the machine depth stop to ensure this.
2. Ream cylinder head recess for service valve seat.



Oversize	**: 0.5 mm (0.020 in)**
Intake	**: 38.500 - 38.516 mm (1.5157 - 1.5164 in)**
Exhaust	**: 32.100 - 32.116 mm (1.2638 - 1.2644 in)**

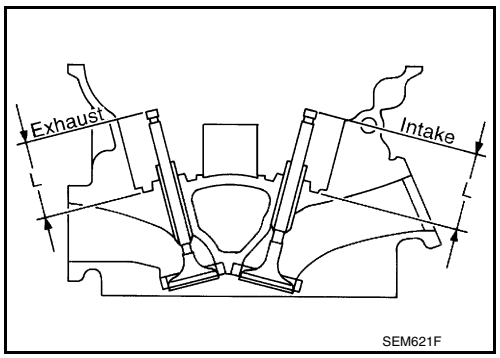
Be sure to ream in circles concentric to the valve guide center.
This will enable valve seat to fit correctly.

3. Heat cylinder head to 110° to 130°C (230° to 266°F) by soaking in heated oil.
4. Press fit valve seat until it seats on the bottom.
5. Cut or grind valve seat using suitable tool to the specified dimensions. Refer to EM-132, "Cylinder Head".
6. After cutting, lap valve seat with abrasive compound.
7. Check valve seating condition.



Seat face angle "α"	**: 45° 15' - 45° 45' degrees/minutes**
Contacting width "W" for intake	**: 1.18 - 1.22 mm (0.0465 - 0.0480 in)**
Contacting width "W" for exhaust	**: 1.38 - 1.42 mm (0.0543 - 0.0559 in)**

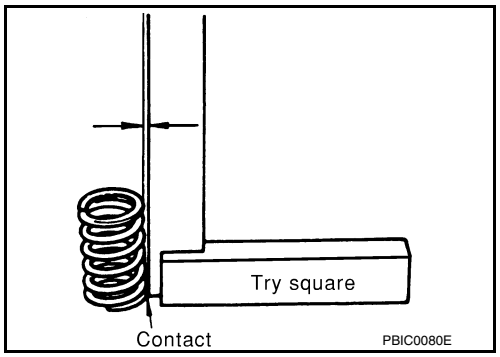
8. Use a depth gauge to measure the distance between the mounting surface of the cylinder head spring seat and the valve stem end. If the distance is shorter than specified, repeat step 5 to adjust it. If it is longer, replace the valve seat with a new one.



Valve seat resurface limit “L” intake	**: 41.16 - 41.76 mm (1.6205 - 1.6441 in)**
Valve seat resurface limit “L” exhaust	**: 41.09 - 41.69 mm (1.6177 - 1.6413 in)**

VALVE SPRING SQUARENESS

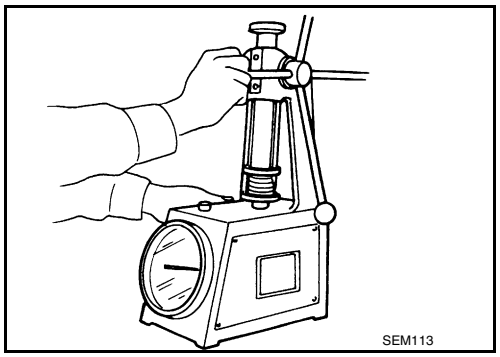
Set try square along the side of valve spring and rotate the spring. Measure the maximum clearance between the top face of spring and try square.



Out-of-square limit : Less than 2.0 mm (0.079 in)

VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

Check valve spring pressure at specified spring height.



Standard	**: 166 - 188 N (16.9 - 19.2 kg, 37.3 - 42.3 lb) at height 37.0 mm (1.457 in)**
Limit	**: 373 - 421 N (38.0 - 42.9 kg, 84 - 95 lb) at height 27.2 mm (1.071 in)**

If it is not within specifications, replace the spring.

ENGINE MOUNT
ENGINE MOUNT (FRONT)
ENGINE MOUNT (FRONT) : Removal and Installation

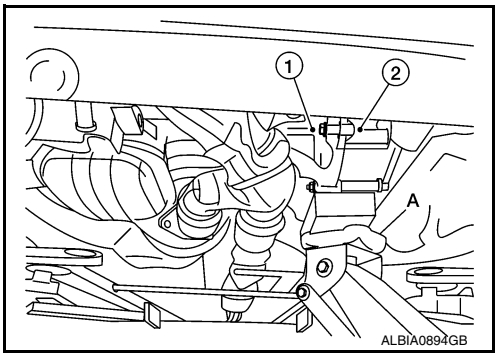
INFOID:0000000009466049

WARNING:
- **Situate the vehicle on a flat and solid surface.**
- **Place chocks at front and back of rear wheels.**
- **Always work safely.**
- **Do not start work until the engine and exhaust system are cooled completely.**

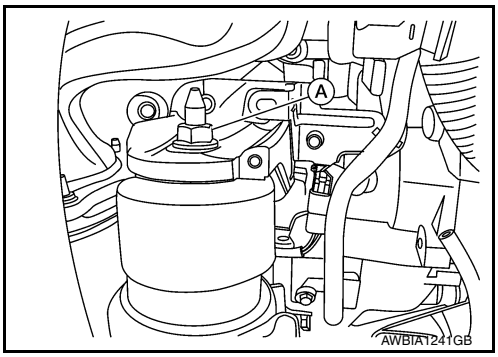
CAUTION:
Do not damage or spill oil on the engine mount insulator (front).
NOTE:
When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.

REMOVAL

1. Remove the air cleaner assembly, front air duct, and air duct hose and resonator tube assembly. Refer to EM-24, "Removal and Installation".
2. Remove the battery and battery tray assembly. Refer to PG-68, "Removal and Installation (Battery Tray)".
3. Remove the engine under cover. Refer to EXT-15, "Exploded View".
4. Remove the fender protector side covers (RH/LH). Refer to EXT-24, "Removal and Installation".
5. Remove the radiator. Refer to CO-14, "Removal and Installation".
6. Remove the fan shroud and motor assembly. Refer to CO-16, "Removal and Installation".
7. Remove the exhaust manifold heat shield (LH). Refer to EM-31, "Removal and Installation (LH)".
8. Support the engine (1) and transaxle (2) using a suitable jack (A) as shown.
   CAUTION:
   - **Position a suitable jack under the engine and transaxle assembly as shown.**
   - **Do not damage the front exhaust tube or transaxle oil pan with the jack.**

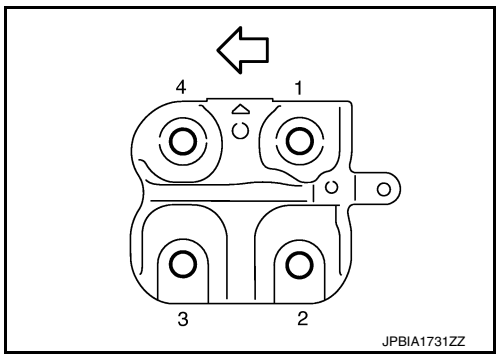


9. Disconnect the engine mount insulator (front) vacuum hose.
10. Remove the engine mount insulator (front) nut (A).



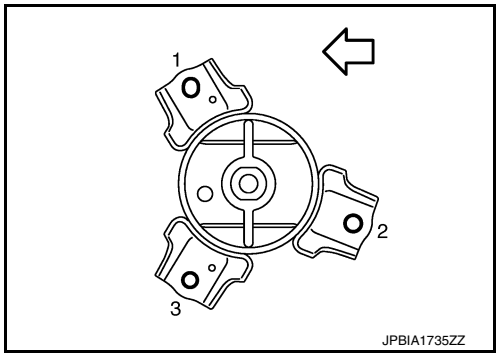
11. Loosen the engine mount bracket (front) bolts in the reverse order shown.

⇦ : Engine front

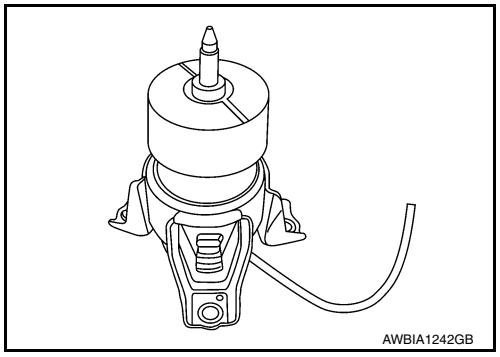


12. Remove the engine mount bracket (front).
13. Remove the engine mount insulator (front) bolts in the reverse order as shown.

⇦ : Vehicle front

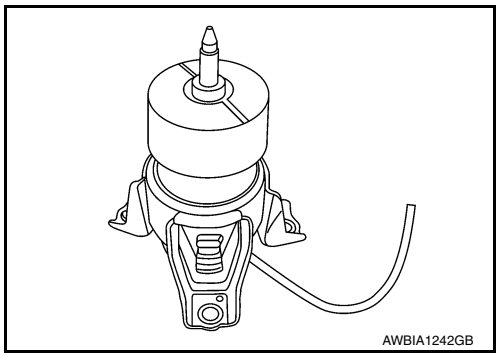


14. Remove the engine mount insulator (front).

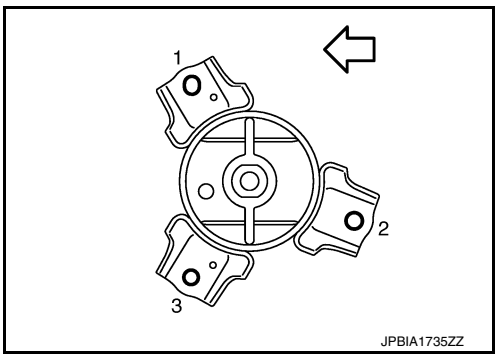


INSTALLATION

1. Install the engine mount insulator (front).



2. Install the engine mount insulator (front) bolts and tighten to specification in the order shown.

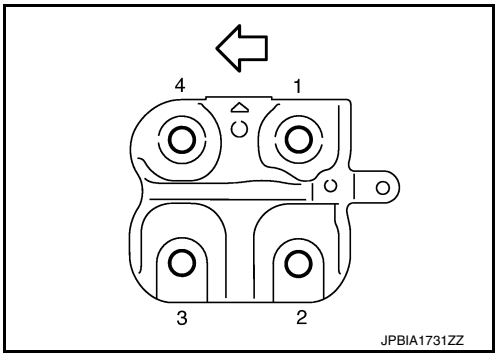


⇦ : Front

Engine mount insulator (front) bolts	**: 43 N·m (4.4 kg-m, 32 ft-lb)**

CAUTION:
Check engine mount insulator (front) is seated properly before tightening.

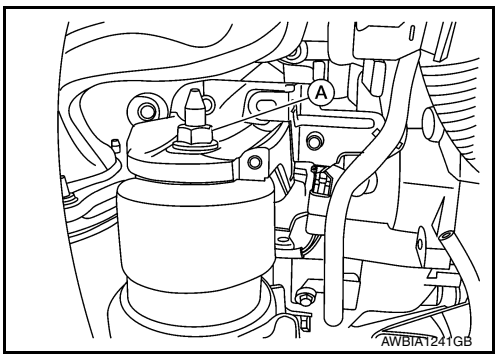
3. Install the engine mount bracket (front) to the engine block.
4. Tighten the engine mount bracket (front) bolts to specification in the order shown.



⇦ : Engine front

Engine mount bracket (front) bolts	**: 40 N·m (4.1 kg-m, 30 ft-lb)**

5. Install the engine mount insulator (front) nut (A) and tighten to specification.



Engine mount insulator (front) nut	**: 103 N·m (11 kg-m, 76 ft-lb)**

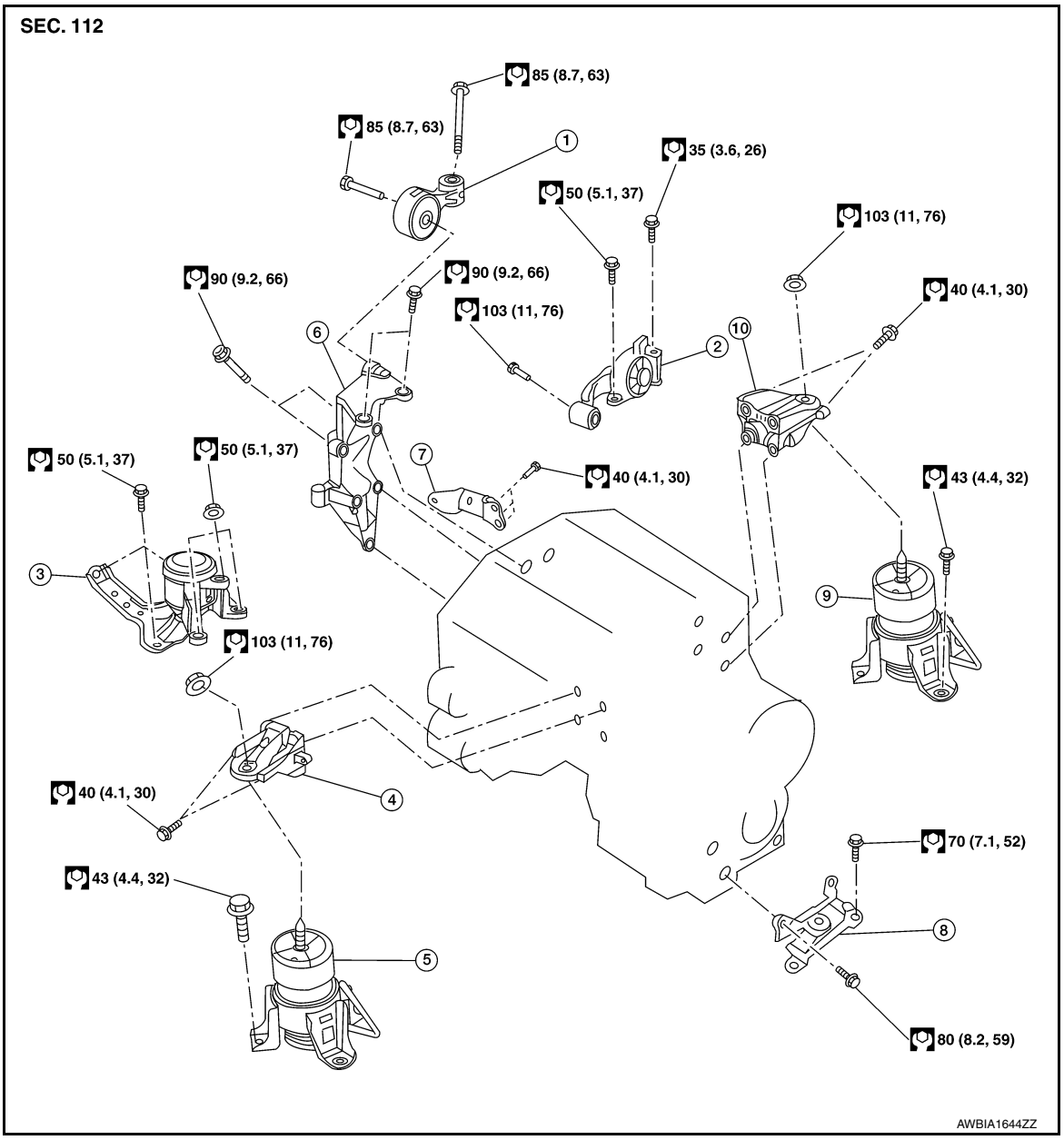
6. Installation of the remaining components is in the reverse order of removal.

UNIT REMOVAL AND INSTALLATION

ENGINE ASSEMBLY

Removal and Installation

INFOID:0000000009466050



1. Upper torque rod	2. Rear torque rod	3. Engine mounting insulator (RH)
4. Engine mounting bracket (front)	5. Engine mounting insulator (front)	6. Engine mounting bracket (RH)
7. Rear torque rod bracket	8. Engine mounting insulator (LH)	9. Engine mounting insulator (rear)
10. Engine mounting bracket (rear)		

WARNING:

- **Place chocks at front and back of rear wheels.**
- **For engines not equipped with engine slingers, attach proper slingers and bolts as described in the NISSAN Parts Catalog.**

CAUTION:

- **Do not start working until exhaust system and coolant are cool.**

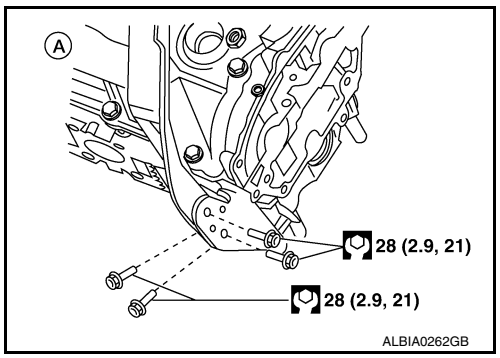
- **If items or work required are not covered by the engine main body section, follow the applicable procedures.**
- **Use the correct supporting points for lifting and jacking. Refer to GI-32, "Garage Jack and Safety Stand".**
- **In removing the drive shafts, be careful not to damage any transaxle grease seals.**
- **Before separating the engine and transaxle, remove the crankshaft position sensor (POS). Refer to EM-36, "Exploded View".**
- **Do not damage the edge of the crankshaft position sensor (POS) or the ring gear teeth.**

NOTE:
When removing components such as hoses, tubes/lines, etc., cap or plug openings to prevent fluid from spilling.

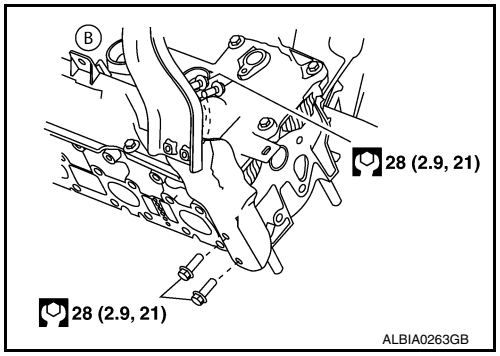
REMOVAL

1. Release fuel pressure. Refer to EC-592, "Inspection".
2. Drain coolant. Refer to CO-11, "Changing Engine Coolant".
3. Drain power steering fluid. Refer to ST-12, "Draining".
4. Remove the engine under cover. Refer to EXT-15, "Exploded View".
5. Remove the engine room cover. Refer to EM-23, "Removal and Installation".
6. Remove front air duct, air duct hose and resonator assembly and air cleaner case assembly. Refer to EM-24, "Removal and Installation".
7. Remove battery. Refer to PG-67, "Removal and Installation (Battery)".
8. Remove TCM. Refer to TM-168, "Removal and Installation".
9. Remove battery ground cable with current sensor.
10. Remove battery tray and bracket. Refer to PG-68, "Removal and Installation (Battery Tray)".
11. Remove cowl top extension, lower cowl top extension and lower cowl top extension brace. Refer to EXT-21, "Removal and Installation".
12. Remove IPDM E/R. Refer to PCS-35, "Removal and Installation".
13. Remove upper radiator hose.
14. Disconnect CVT cooler hoses.
15. Disconnect fuel hose quick connection at vehicle piping side. Refer to EM-43, "Removal and Installation".
16. Disconnect EVAP vacuum hose.
17. Disconnect heater hoses (engine side).
18. Remove coolant reservoir tank.
19. Disconnect transaxle shift control cables at transaxle side.
20. Remove lower radiator hose.
21. Disconnect brake booster vacuum hose.
22. Remove power steering reservoir.
23. Remove upper torque rod.
24. Remove engine mounting insulator (RH).
25. Remove the cooling fan. Refer to CO-16, "Removal and Installation".
26. Discharge and recover the R134a refrigerant. Refer to HA-28, "Recycle Refrigerant".
27. Remove the front drive shafts. Refer to FAX-9, "Removal and Installation (LH)" (LH) and FAX-10, "Removal and Installation (RH)" (RH).
28. Remove the engine mounting insulator (rear) nut and rear torque rod.
29. Remove the front exhaust tube. Refer to EX-5, "Removal and Installation".
30. Disconnect the A/C high side and low side hoses from the A/C compressor. Refer to HA-43, "HIGH-PRESSURE FLEXIBLE HOSE : Removal and Installation", HA-42, "LOW-PRESSURE FLEXIBLE HOSE : Removal and Installation".

31. Install engine slingers into front of LH cylinder head and rear of RH cylinder head.
    - (A): RH cylinder head



    - (B): LH cylinder head



32. Remove rear cover plate.
33. Remove the torque converter bolts.
34. Disconnect engine mount vacuum hoses.
35. Position a suitable support table under suspension member and engine assembly.
36. For additional safety, secure the engine in position with suitable tool.
37. Remove engine mounting insulator (front) nut and engine mounting insulator (RH) bolts
38. Remove suspension member bolts. Refer to FSU-8, "Removal and Installation".
39. Carefully lower the engine, transaxle assembly and suspension member using Tool, avoiding interference with the vehicle body.

Tool number : KV101J0010 (J-47242)

CAUTION:
- **Before and during this procedure, always check if any harnesses are left connected.**
- **Avoid any damage to, or any oil/grease smearing or spills onto the engine mount insulators.**

40. Remove the starter motor. Refer to STR-19, "Removal and Installation".
41. Remove the crankshaft position sensor (POS). Refer to EM-36, "Exploded View".
42. Disconnect CVT speed sensor and CVT unit harness connector. Refer to TM-184, "Exploded View".
43. Separate the engine from the transaxle assembly.
44. Lift the engine from the suspension member.

INSTALLATION

Installation is in the reverse order of removal.
- Tighten transmission bolts to specification. Refer to TM-188, "Removal and Installation".

INSPECTION AFTER INSTALLATION

- 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-15, "FOR USA AND CANADA : Fluids and Lubricants" (United States and Canada) or MA-16, "FOR MEXICO : Fluids and Lubricants" (Mexico).
- 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 and 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, exhaust gas, or any oils/fluids including engine oil and engine coolant.
- Bleed air from passages in lines and hoses, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to 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
Transmission/ transaxle fluid	A/T and CVT Models	Leakage	Level/Leakage	Leakage
	M/T Models	Level/Leakage	Leakage	Level/Leakage
Other oils and fluids*		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gas		—	Leakage	—

*Power steering fluid, brake fluid, etc.

UNIT DISASSEMBLY AND ASSEMBLY

CYLINDER BLOCK

Disassembly and Assembly

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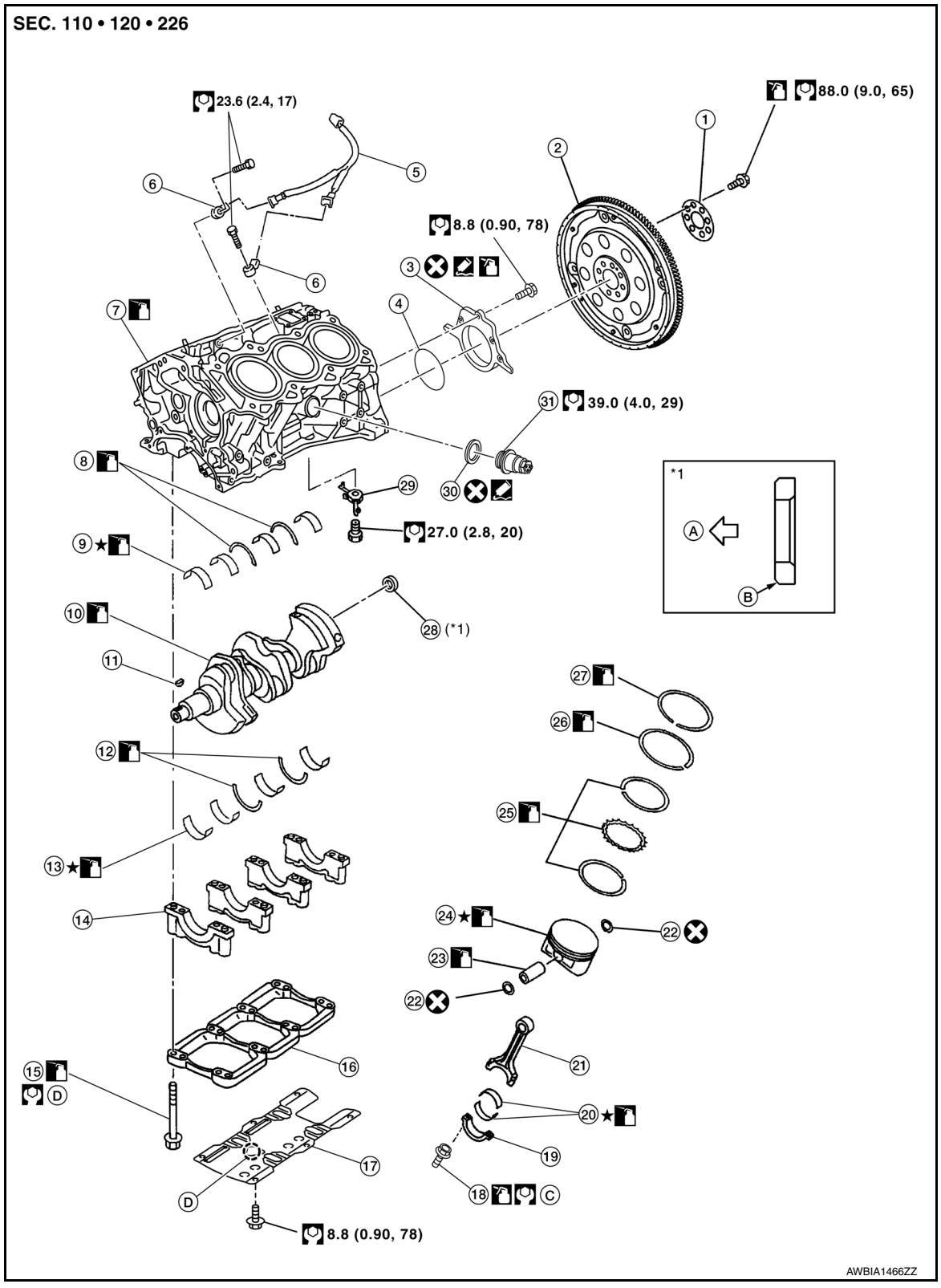


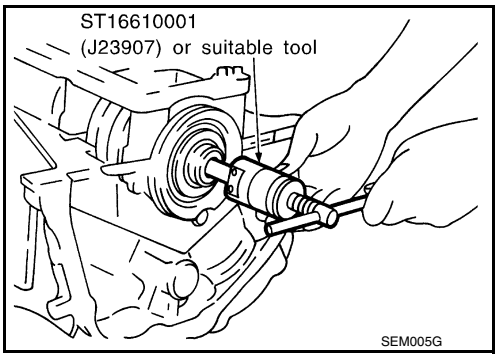
1. Reinforcement plate
2. Drive plate
3. Rear oil seal retainer
4. Rear oil seal
5. Sub harness
6. Knock sensor
7. Cylinder block
8. Thrust bearing (upper)
9. Main bearing (upper)
10. Crankshaft
11. Crankshaft key
12. Thrust bearing (lower)
13. Main bearing (lower)
14. Main bearing cap
15. Main bearing cap bolt
16. Main bearing beam
17. Baffle plate
18. Connecting rod bolt
19. Connecting rod bearing cap
20. Connecting rod bearing
21. Connecting rod
22. Snap ring
23. Piston pin
24. Piston
25. Oil ring
26. Second ring
27. Top ring
28. Pilot converter
29. Oil jet
30. Gasket (for Canada)
31. Cylinder block heater (for Canada)
A. Crankshaft side
B. Chamfered
C. Refer to INSTALLATION
D. Front mark

CAUTION:
- **Apply new engine oil to parts as marked in illustrations before installation.**
- **Place removed parts such as bearings and bearing caps in their proper order and direction.**
- **When installing the connecting rod nuts, and main bearing cap bolts, apply new engine oil to the threads and mating surfaces**
- **Do not allow any magnetic materials to contact the signal plate teeth on the drive plate.**

DISASSEMBLY

1. Remove the engine assembly. Refer to EM-103, "Removal and Installation".
2. Remove the crankshaft pulley.
   - Use a suitable tool to prevent the crankshaft from turning.
3. Remove pilot converter using Tool.

Tool number : ST16610001 (J-23907)



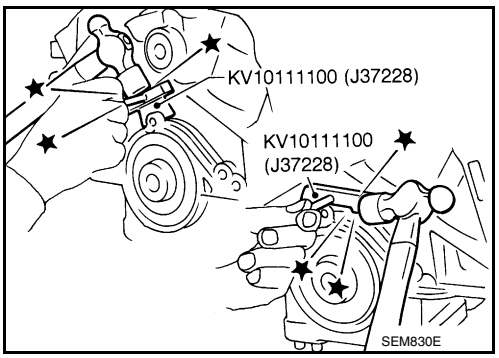
4. Remove the drive plate. Refer to EM-127, "Dowel Pin Alignment".
5. Install the engine on engine stand.
   CAUTION:
   Use an engine stand that has a load capacity [approximately 240kg (529) or more] large enough for supporting the engine weight.
   Before removing the hanging chains, make sure the engine stand is stable and there is no risk of overturning.
6. Remove the knock sensor.
   CAUTION:
   Carefully handle sensor to avoid shocking it.
7. Drain the engine of all coolant and oil.
8. Remove the upper oil pan. Refer to EM-37, "Removal and Installation (Upper Oil Pan)".
9. Remove the timing chain. Refer to EM-64, "Removal and Installation".
10. Remove the cylinder head. Refer to EM-90, "Removal and Installation".

11. Cut away liquid gasket and remove rear oil seal retainer using Tool. Refer to EM-4, "Precaution for Liquid Gasket".

Tool number : KV10111100 (J-37228)

CAUTION:
- **Be careful not to damage mounting surface.**
- **If rear oil seal retainer is removed, replace it with a new one.**

NOTE:
Rear oil seal and retainer form a single part and are replaced as an assembly.

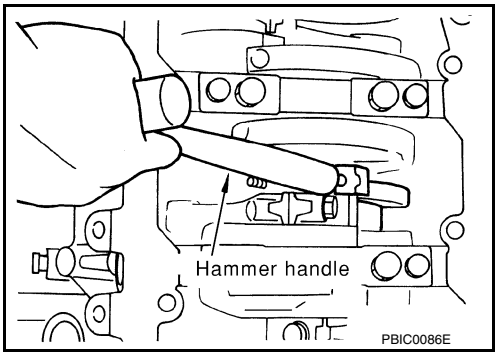


12. Remove the piston and connecting rod assemblies.

a. Position the crankshaft pin corresponding to the connecting rod to be removed onto the bottom dead center.

b. Remove the connecting rod cap.

c. Using a hammer handle or similar tool, push the piston and connecting rod assembly out to the cylinder head side.
- Before removing the piston and connecting rod assembly, check the connecting rod side clearance. Refer to EM-139, "Connecting Rod Bearing".



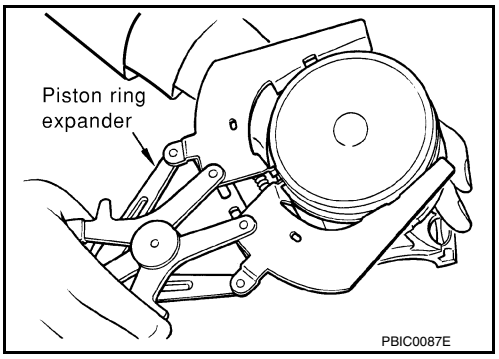
13. Remove the connecting rod bearings.

CAUTION:
- **When removing the connecting rod side bearings, note the installation position. Keep them in the correct order.**

14. Remove the piston rings from the piston.
- Use a piston ring expander.

CAUTION:
- **When removing the piston rings, be careful not to damage the piston. Do not expand the rings excessively.**
- **Be careful to mark the rings if they are to be reused so they are installed in their original position.**

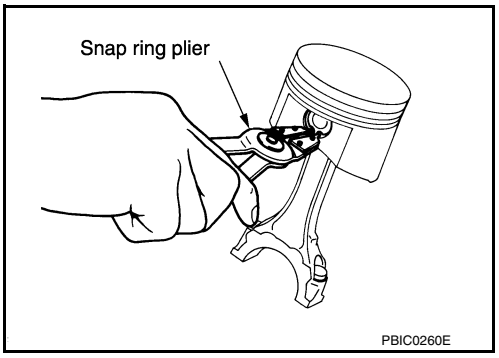
- Before removing the piston rings, check the piston ring side clearance. Refer to EM-117, "Inspection".



15. Remove the piston from the connecting rod as follows.

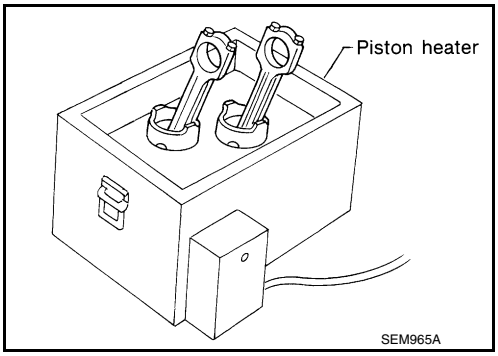
a. Using a snap ring pliers, remove the snap ring.

CAUTION:
Do not reuse snap rings, always replace with new ones.

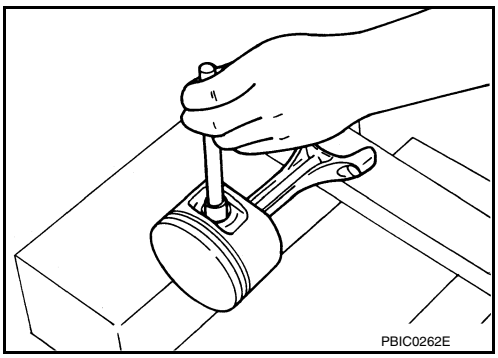


b. Heat the pistons to 60° - 70°C (140° - 158°F).

WARNING:
Pistons contain heat. When working, wear protective equipment to avoid getting burned.

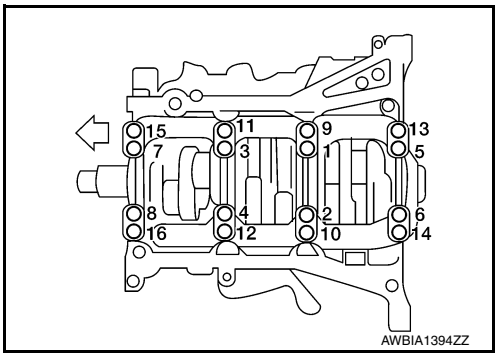


c. Push out the piston pin with a suitable tool, with an outer diameter approximately 20 mm (0.8 in).

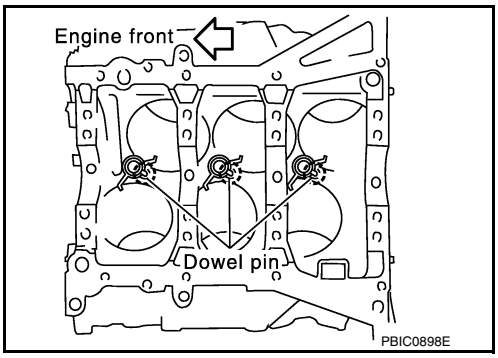


16. Remove the baffle plate from the main bearing beam.
17. Loosen the bolts in the reverse order as shown and remove the main bearing beam, bearing caps and crankshaft.
    - Before loosening the main bearing cap bolts, measure the crankshaft side clearance.
      Refer to EM-117, "Inspection".

⇦ : Engine front



18. Remove the oil jets and dowel pins.
19. Remove the main bearings and thrust bearings from the cylinder block and main bearing caps.
    - When removing them, note the direction and position. Keep them in the correct order for installation.



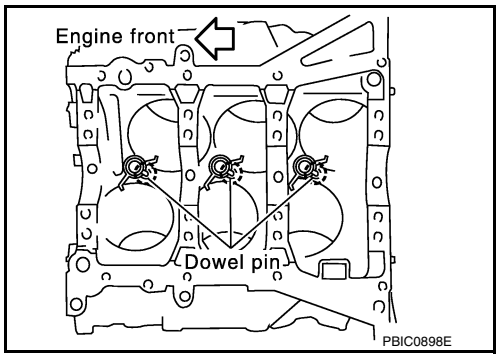
ASSEMBLY

1. Blow out the coolant and oil passages and cylinder bore to remove any foreign materials.
   CAUTION:
   Use goggles to protect your eyes.
2. Apply liquid gasket and install each plug into the cylinder block.
   - Use Genuine Silicone RTV Sealant or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".

   CAUTION:
   - **Installation should be done within 5 minutes after applying liquid gasket.**

- **Do not fill the engine with oil for at least 30 minutes after the components are installed to allow the sealant to cure.**

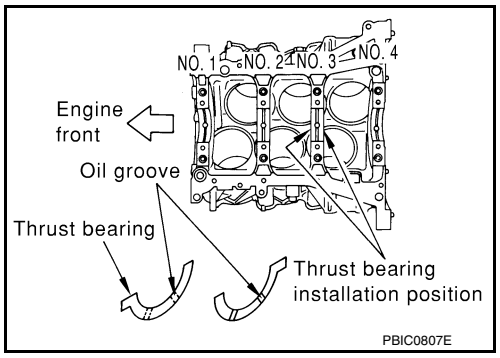
3. Install the oil jets.
   - Insert the oil jet dowel pin into the cylinder block dowel pin hole, and tighten the bolts.



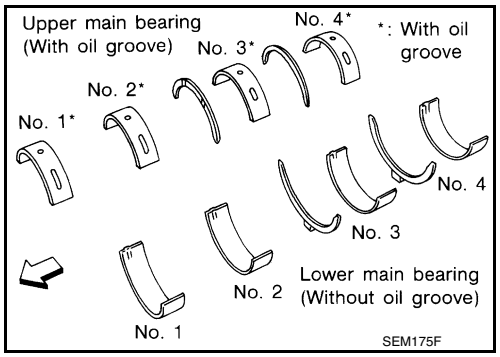
4. Install the main bearings and the thrust bearings.

a. Remove dust, dirt, and oil on the bearing mating surfaces of the cylinder block and the main bearing cap.

b. Install the thrust bearings to both sides of the No. 3 journal housing on the cylinder block and the main bearing cap.
   - Install the thrust bearings with the oil groove facing the crankshaft arm (outside).
   - Install bearing with a projection on one end on cylinder block and bearing with a projection at center on cap. Align each projection with mating notch.

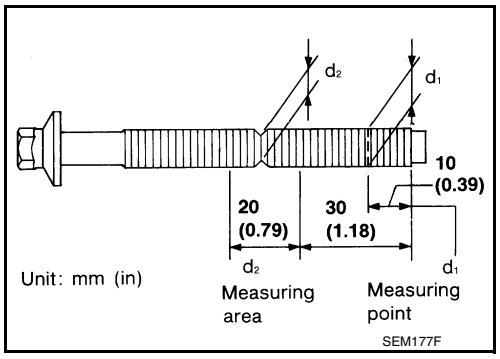


5. Set the upper main bearings in their proper positions on the cylinder block.
   - Confirm the correct main bearings are used. Refer to EM-117, "Inspection".



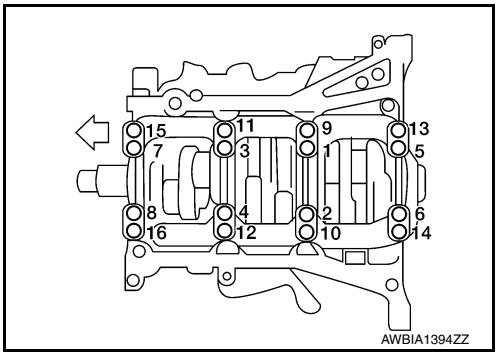
6. Instructions for the re-use of the main bearing cap bolts.
   - A plastic zone tightening method is used for tightening the main bearing cap bolts. Measure d1 and d2 as shown.
   - For d2, select the minimum diameter in the measuring area.
   - If the difference between d1 and d2 exceeds the limit, replace the bolts for assembly.

Limit (d1 - d2) : 0.11 mm (0.0043 in)

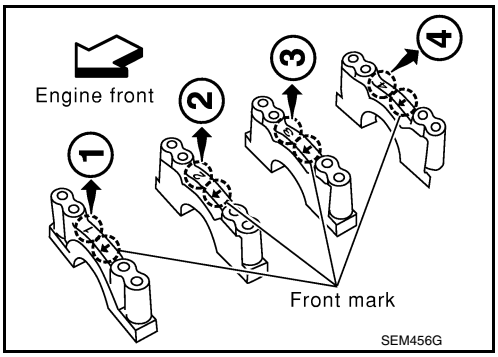


7. After installing the crankshaft, lower main bearings, main bearing caps, main bearing beam, and bearing cap bolts. Tighten the bearing cap bolts in the numerical order as shown.

⇦ : Engine front



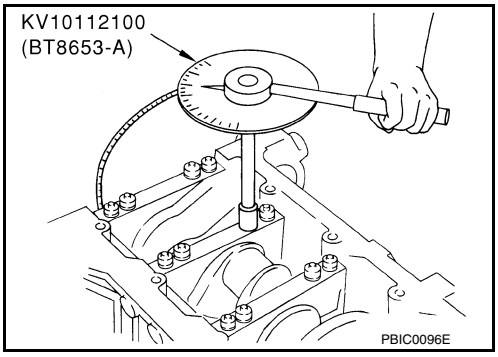
a. Make sure that the front marks on the main bearing beam faces the front of the engine.
b. Prior to tightening all the bearing cap bolts, place the bearing beam in its proper position by shifting the crankshaft in the axial position.
c. After tightening the bearing cap bolts, make sure the crankshaft turns smoothly.
d. Lubricate the threads and seat surfaces of the bolts with new engine oil.
e. Tighten the bolts in two stages:



CAUTION:
Measure the tightening angle in two stages using Tool. Do not measure with eyes only, be sure to use Tool.

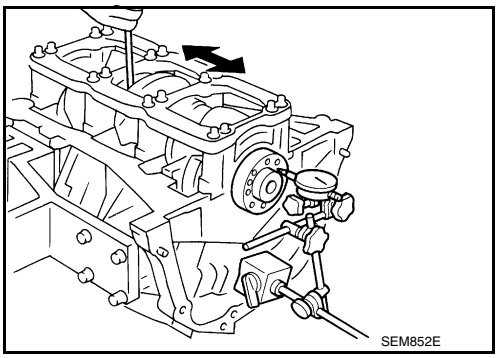
Stage 1 : 32.3 - 38.3 N·m (3.3 - 3.9 kg-m, 24 - 28 ft-lb)
Stage 2 : 90° - 95° degrees clockwise

Tool number : KV10112100 (BT-8653-A)



8. Measure crankshaft end play.
   • If beyond the limit, replace the bearing with a new one.

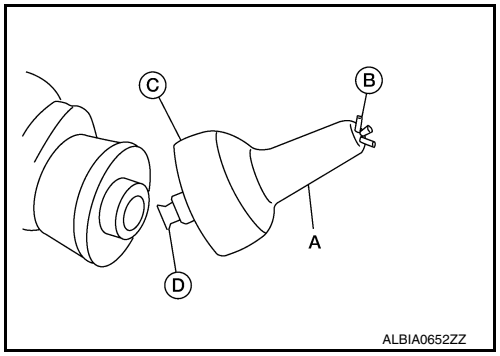
Standard : 0.10 - 0.25 mm (0.0039 - 0.0098 in)
Limit : 0.30 mm (0.0118 in)



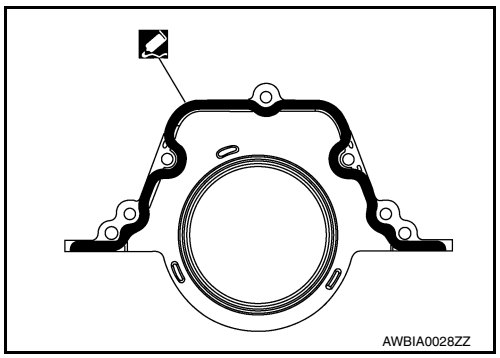
9. Install the rear oil seal retainer using Tool (A).

Tool number : — (J-47128)

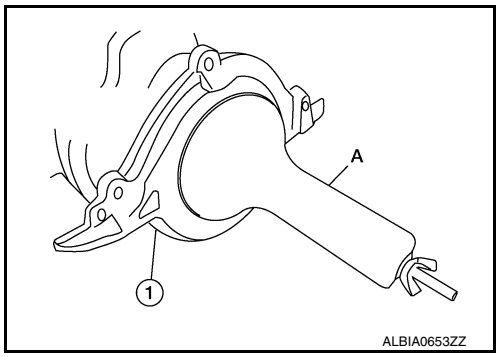
a. Loosen the wing nut (B) on the end of the Tool (A).
b. Insert the arbor (D) into the crankshaft pilot hole until the outer lip (C) of the Tool (A) covers the edge of the crankshaft sealing surface.
c. Tighten the wing nut (B) to secure the Tool (A) to the crankshaft.



d. Apply sealant to rear oil seal retainer as shown.
Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-21, "Recommended Chemical Products and Sealants".
CAUTION:
- **Installation should be done within 5 minutes after applying liquid gasket.**
- **Do not fill the engine with oil for at least 30 minutes after the components are installed to allow the sealant to cure.**

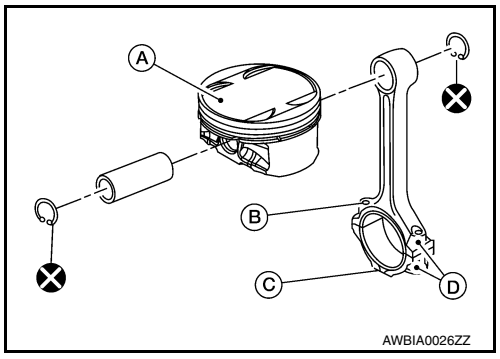


e. Lubricate the sealing surface of the new rear main seal with new engine oil.
f. Slide the new rear main seal (1) over the Tool (A) and onto the crankshaft.
g. Loosen the wing nut and push the threaded rod into the handle to remove the Tool (A).
h. Tighten the rear oil seal retainer bolts to specification.



10. Install the piston to the connecting rod.
a. Using suitable snap ring pliers, install the snap ring fully into the pin-groove of the piston rear side.

(A) : Piston front mark
(B) : Oil hole
(C) : Connecting rod front mark
(D) : Cylinder No.

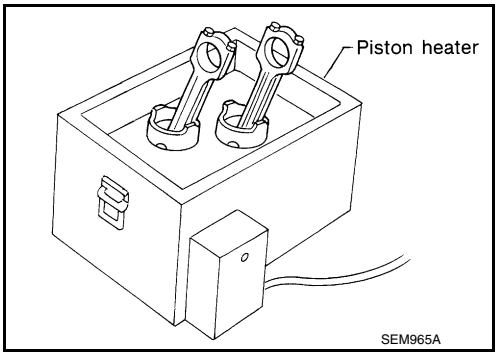


b. Install the piston to the connecting rod.

- Heat the piston until the piston pin can be pushed in by hand without excess force [approx. 60° - 70°C (140° to 158°F)]. From the front to the rear, insert the piston pin into the piston and through the connecting rod.

  WARNING:

  Pistons contain heat. When working, wear protective equipment to avoid getting burned.

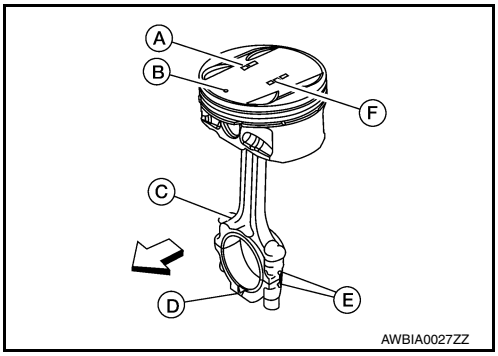


- Assemble so that the piston front mark (B) on the crown and the oil hole (C), connecting rod front mark (D) and Cylinder No. (E) on the are positioned as shown.

  ⇦ : Engine front

  (A) : Piston grade number

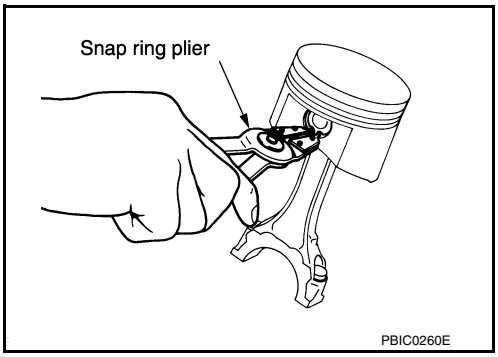
  (F) : Pin grade number



c. Install the snap ring into the front of the piston pin-groove.
- After installing, check that the connecting rod pivots smoothly on the pin.

  CAUTION:

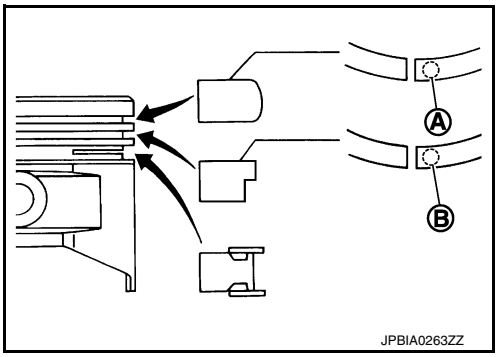
  Do not reuse snap rings, always replace with new ones.



11. Using a piston ring expander, install the piston rings.

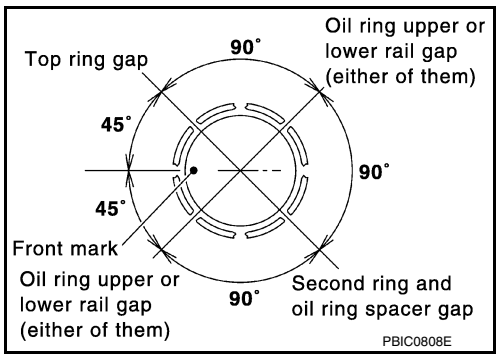
  CAUTION:

- **Be careful not to damage the piston.**
- **When the piston rings are not replaced, remount the rings in their original positions.**
- **When replacing the piston rings, those without stamped surface (A) can be mounted either side up.**
- **Install the second ring with the stamped surface (B) facing upward. If the ring is not stamped it can face in either direction.**

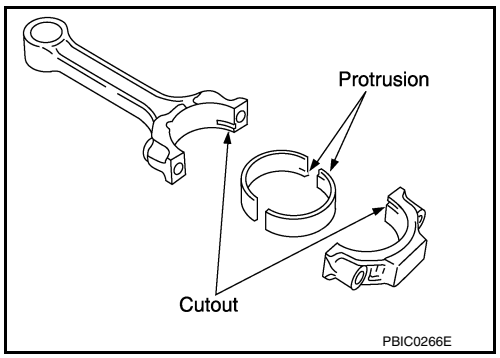


Top ring (A)	**: —**
Second ring (B)	**: 2A**

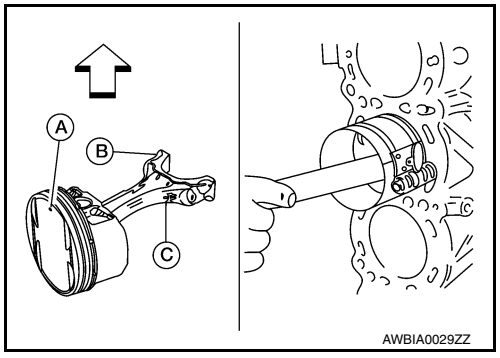
- Position each ring with the gap as shown, referring to the piston front mark.



12. Install the connecting rod bearings to the connecting rod and the connecting rod cap.
    - When installing the connecting rod bearings, apply engine oil to the bearing surface (crankshaft side). Do not apply oil to the back surface (connecting rod and connecting rod cap side), but thoroughly clean it.
    - When installing, align the connecting rod bearing protrusion with the notch of the connecting rod to install.
    - Check that the oil holes on the connecting rod and on the corresponding bearing are aligned.



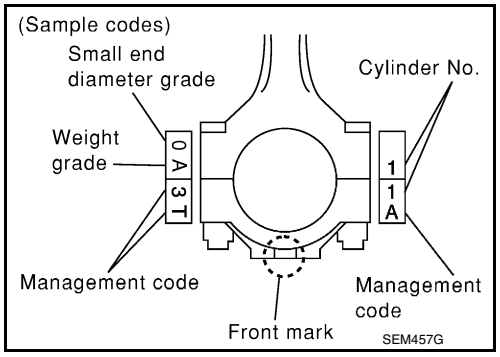
13. Install the piston and connecting rod assembly into the corresponding cylinder.
    - Position the crankshaft pin corresponding to the connecting rod to be installed onto the bottom dead center.
    - Apply engine oil sufficiently to the cylinder bore, piston, and crankshaft pin.
    - Match the cylinder position with the cylinder No. (B) on the connecting rod to install.
    - Install the piston with the piston front mark (A) on the crown facing the front of the engine (⇦) using a suitable tool.
    - Oil hole (C)



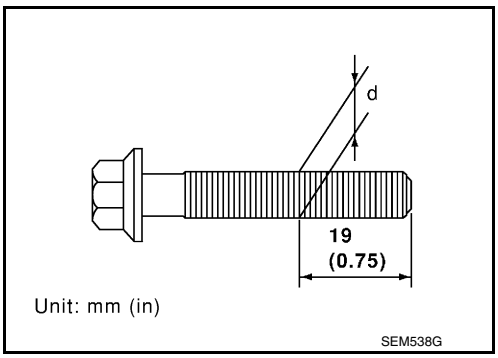
CAUTION:

Be careful not to damage the crankshaft pin and cylinder wall, resulting from interference of the connecting rod big end.

14. Install the connecting rod cap.
    - Match the stamped cylinder number marks on the connecting rod with those on the cylinder cap for installation.
    - Install the piston connecting rod assembly and cap so that the front mark on the cap and piston are facing the front of the engine.
    - **Lubricate the threads and seat surfaces with new engine oil.**

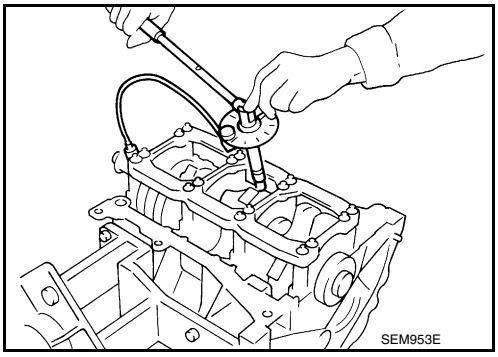


15. Check the connecting rod cap bolts before reusing, then install in their original position in the connecting rod. The bolts should screw in smoothly by hand.
    - Measure the outer diameter of the connecting rod cap bolt as shown.



Outer diameter "d" of the connecting rod bolt
Standard : 7.90 - 8.00 mm (0.3110 - 0.3150 in)
Limit : 7.75 mm (0.3051 in)

16. Tighten the connecting rod nuts in two stages using Tool:



Stage 1 : 19 - 21 N·m (1.9 - 2.1 kg-m, 14 - 15 ft-lb)
Stage 2 : 90° - 95° degrees clockwise

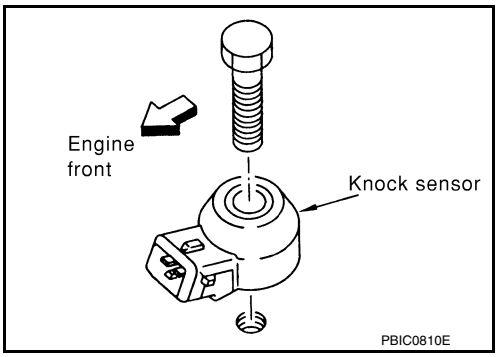
CAUTION:
Always use either an angle wrench or protractor. Avoid tightening based on visual check alone.

Tool number : KV10112100 (BT-8653-A)

- Apply engine oil to the threads and seats of the connecting rod bolts and nuts.
- After tightening the nuts, make sure that the crankshaft rotates smoothly.
- Check the connecting rod side clearance. If beyond the limit, replace the connecting rod and/or crankshaft.

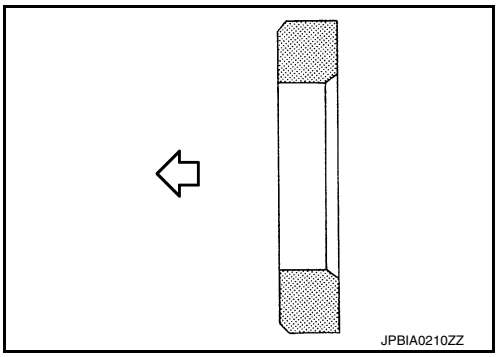
Connecting rod side clearance:
Standard : 0.20 - 0.35 mm (0.0079 - 0.0138 in)
Limit : 0.40 mm (0.0157 in)

17. Install the baffle plate to the main bearing beam.
18. Install the knock sensor.
    - Make sure that there is no foreign material on the cylinder block mating surface and the back surface of the knock sensor.
    - Install the knock sensor with the connector facing the rear of the engine.
    - Do not tighten the bolts while holding the connector.
    - Make sure that the knock sensor does not interfere with other parts.



CAUTION:
If any impact by dropping occurs to the knock sensor, replace it with new one.

19. Install the pilot converter with it's chamfer facing crankshaft as shown.
    - ⇦: Crankshaft side



20. Install the drive plate. Refer to EM-127, "Dowel Pin Alignment".
21. Install the cylinder head. Refer to EM-90, "Removal and Installation".
22. Install the timing chain. Refer to EM-64, "Removal and Installation".
23. Install the oil pan. Refer to EM-37, "Removal and Installation (Upper Oil Pan)".
24. Remove the engine from the stand and install the engine assembly into the vehicle. Refer to EM-103, "Removal and Installation".
25. Assembly of the remaining parts is in the reverse order of disassembly.
    CAUTION:
    Do not fill the engine with oil for at least 30 minutes after the components are installed to allow the sealant to cure.

INSPECTION AFTER INSTALLATION

- 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-15, "FOR USA AND CANADA : Fluids and Lubricants" (United States and Canada) or MA-16, "FOR MEXICO : Fluids and Lubricants" (Mexico).
- 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 and 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, exhaust gas, or any oils/fluids including engine oil and engine coolant.
- Bleed air from passages in lines and hoses, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to 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
Transmission/ transaxle fluid	A/T and CVT Models	Leakage	Level/Leakage	Leakage
	M/T Models	Level/Leakage	Leakage	Level/Leakage
Other oils and fluids*		Level	Leakage	Level
Fuel		Leakage	Leakage	Leakage
Exhaust gas		—	Leakage	—

*Power steering fluid, brake fluid, etc.

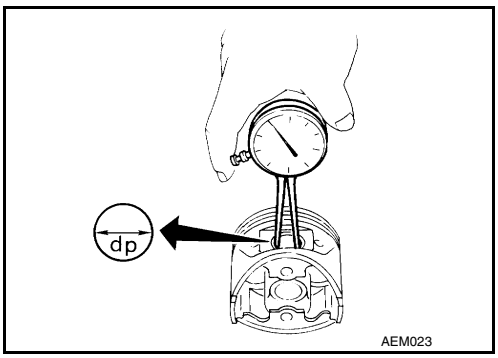
Inspection

INFOID:0000000009466052

PISTON AND PISTON PIN CLEARANCE

Inner Diameter of Piston Pin Hole

- Measure the inner diameter of piston pin hole "dp".



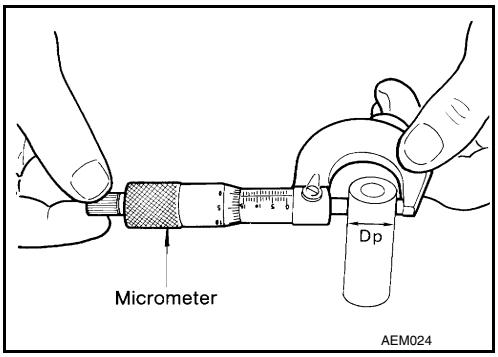
Standard diameter "dp"

Grade No. 0 : 21.993 – 21.999 mm (0.8659 – 0.8661 in)

Grade No. 1 : 21.999 – 22.005 mm (0.8661 – 0.8663 in)

Outer Diameter of Piston Pin

- Measure outer diameter of piston pin "Dp".

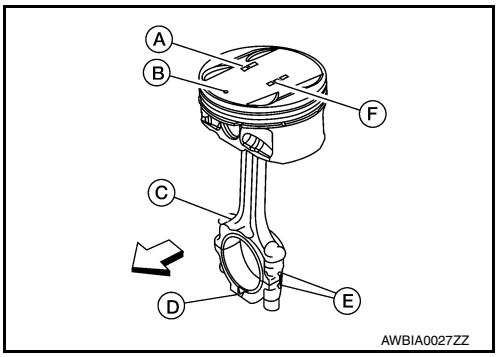


Standard diameter "Dp"

Grade No. 0 : 21.989 – 21.995 mm (0.8657 – 0.8659 in)

Grade No. 1 : 21.995 – 22.001 mm (0.8659 – 0.8662 in)

- ⇦: Engine front
- Piston Grade No. (A)
- Piston front mark (B)
- Oil hole (C)
- Connecting rod front mark (D)
- Cylinder No. (E)
- Pin Grade No. (F)



Piston and Piston Pin Interference Fit

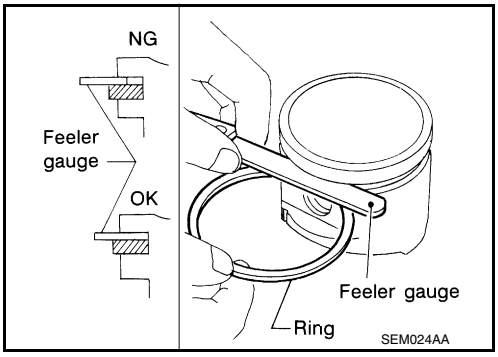
Standard Interference Fit = "Dp" – "dp"

Standard : 0.002 – 0.010 mm (0.0001 – 0.0004 in)

- If clearance exceeds specification, replace either or both the piston/piston pin assembly and connecting rod assembly with reference to specification of each part.

PISTON RING SIDE CLEARANCE

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



Standard Side Clearance

Top ring : 0.045 - 0.080 mm (0.0018 - 0.0031 in)

2nd ring : 0.030 - 0.070 mm (0.0012 - 0.0028 in)

Oil ring : 0.045 - 0.125 mm (0.0018 - 0.0049 in)

Maximum Limit

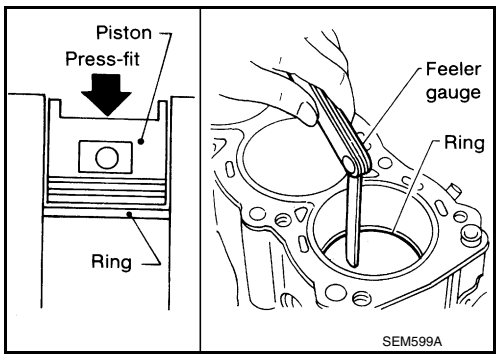
Top ring : 0.11 mm (0.0043 in)

2nd ring : 0.1 mm (0.004 in)
Oil ring : —

- If out of specification, replace piston ring assembly. If clearance exceeds maximum limit with new rings, replace piston

PISTON RING END GAP

- Insert piston ring until it is in the middle of the cylinder bore and measure the end gap.



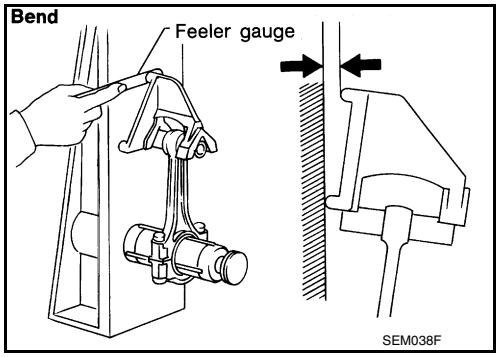
Standard
Top ring : 0.23 - 0.28 mm (0.0091 - 0.0110 in)
2nd ring : 0.33 - 0.43 mm (0.0130 - 0.0169 in)
Oil ring : 0.20 - 0.45 mm (0.0079 - 0.0177 in)

Limit:
Top ring : 0.50 mm (0.0197 in)
2nd ring : 0.62 mm (0.0244 in)
Oil ring : 0.80 mm (0.0315 in)

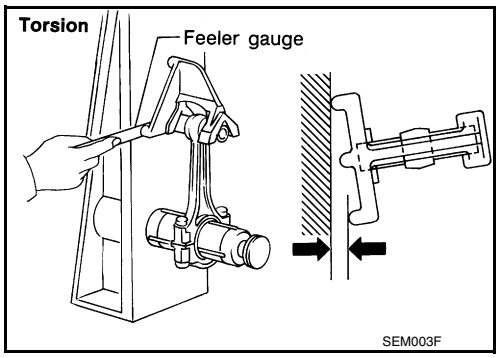
- If out of specification, replace piston ring.

CONNECTING ROD BEND AND TORSION

Bend : Limit 0.15 mm (0.0059 in) per 100 mm (3.94 in) length
Torsion : Limit 0.30 mm (0.0118 in) per 100 mm (3.94 in) length



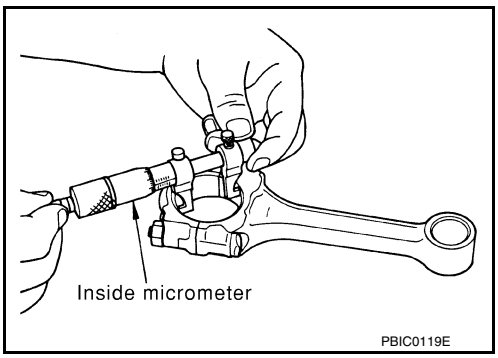
- If it exceeds the limit, replace connecting rod assembly.



CONNECTING ROD BEARING HOUSING DIAMETER (BIG END)

- Install the connecting rod cap without the connecting rod bearing installed. After tightening the connecting rod nut to the specified torque, measure the connecting rod bearing housing big end inner diameter using an inside micrometer.

Standard : 55.000 - 55.013 mm (2.1654 - 2.1659 in)

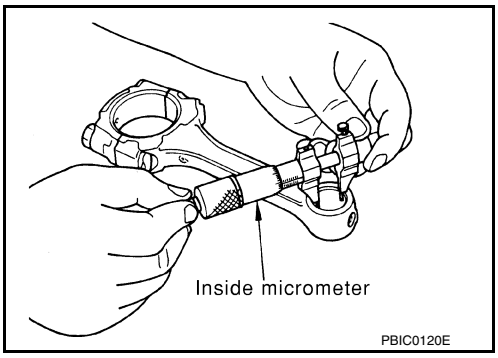


CONNECTING ROD BUSHING OIL CLEARANCE (SMALL END)

Inner Diameter of Connecting Rod (Small End)

- Measure inner diameter of piston pin bushing.

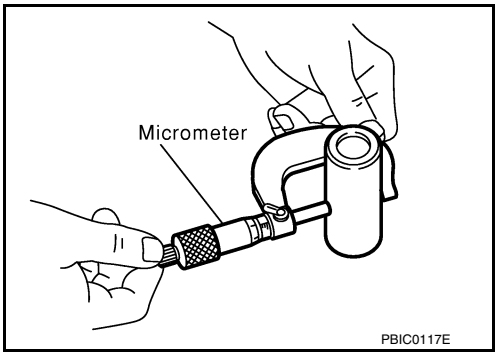
Standard Grade No. 0
: 22.000 - 22.006 mm (0.8661 - 0.8664 in)
Grade No. 1
: 22.006 - 22.012 mm (0.8664 - 0.8666 in)



Outer Diameter of Piston Pin

- Measure outer diameter of piston pin.

Standard Grade No. 0
: 21.989 - 21.995 mm (0.8657 - 0.8659 in)
Grade No. 1
: 21.995 - 22.001 mm (0.8659 -0.8662 in)

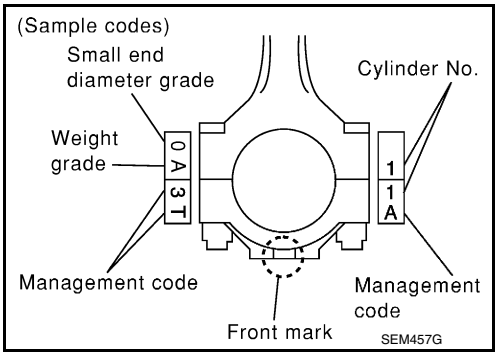


Connecting Rod Bushing Oil Clearance (Small End)

(Connecting rod small end oil clearance) = (Inner diameter of connecting rod small end) – (Outer diameter of piston pin)

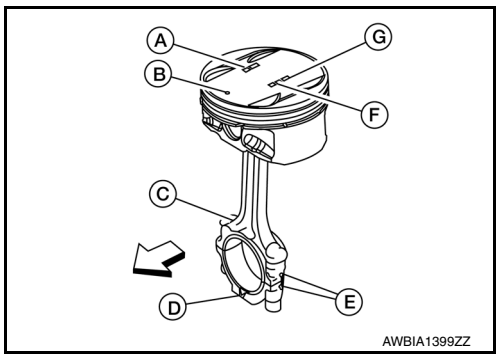
Standard : 0.005 - 0.017 mm (0.0002 - 0.0007 in)
Limit : 0.030 mm (0.0012 in)

- If the measured value exceeds the standard, replace the connecting rod assembly and/or piston and piston pin assembly.
- If replacing the piston and piston pin assembly, use the Table for Selective Fitting for Piston to select the piston corresponding to the applicable bore grade of the cylinder block to be used. Follow the "PISTON-TO-CYLINDER BORE CLEARANCE" procedure.



Factory installed parts grading:

- ⇦: Engine front
- Piston Grade No. (A)
- Piston front mark (B)
- Oil hole (C)
- Connecting rod front mark (D)
- Cylinder No. (E)
- Pin Grade No. (F)
- Crown I.D. code (G)



Service parts apply only to grade 0.

Unit: mm (in)

Grade	0	1
Connecting rod small end inner diameter	22.000 - 22.006 (0.8661 - 0.8664)	22.006 - 22.012 (0.8664 - 0.8666)
Piston pin outer diameter	21.989 - 21.995 (0.8657 - 0.8659)	21.995 - 22. 001 (0.8659 - 0.8662)
Piston pin hole diameter	21.993 - 21.999 (0.8659 - 0.8661)	21.999 - 22.005 (0.8661 - 0.8663)

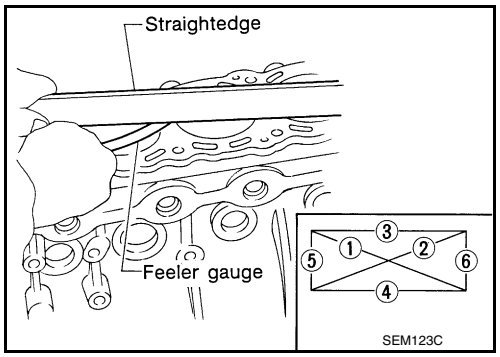
CYLINDER BLOCK DISTORTION

- Using a scraper, remove any old gasket material on the cylinder block surface, and remove any oil, scale, carbon, or other contamination.

CAUTION:

Be careful not to allow gasket flakes to enter the oil or coolant passages.

- Measure the distortion on the block upper face at different points in six directions.



Distortion limit : 0.10 mm (0.0039 in)

- If out of specification, resurface the cylinder block. The allowable amount of resurfacing is dependent on the amount of any cylinder head resurfacing. The resurfacing limit is [amount of cylinder head resurfacing] + [amount of cylinder head resurfacing] = 0.2 mm (0.008 in).

Cylinder block height : 214.95 - 215.05 mm (8.4626 - 8.4665 in)

INNER DIAMETER OF MAIN BEARING HOUSING

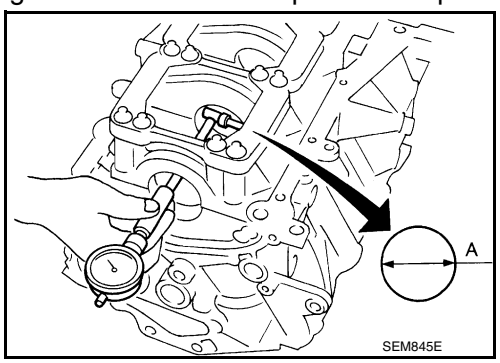
- Install the main bearing caps with the main bearings removed, and tighten the bolts to the specified torque.
- Using a bore gauge, measure the inner diameter of the main bearing housing "A".

Standard : 63.993 - 64.017 mm (2.5194 - 2.5203 in)

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

NOTE:

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

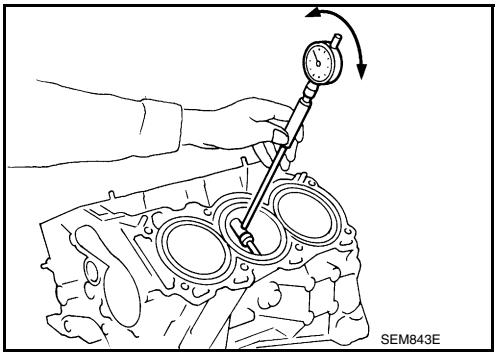


PISTON-TO-CYLINDER BORE CLEARANCE

1. Using a bore gauge, measure cylinder bore for wear, out-of-round and taper at (A), (B) and (C). The X axis is in the longitudinal direction of the engine.

Cylinder bore inner diameter

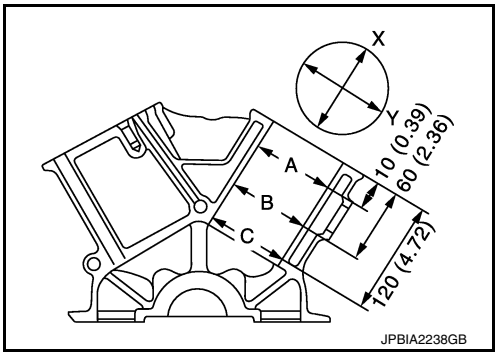
Grade No.	Standard inner diameter	Wear limit
No. 1	95.500 - 95.510 mm (3.7598 - 3.7602 in)	0.20 mm (0.0079 in)
No. 2	95.510 - 95.520 mm (3.7602 - 3.7606 in)	
No. 3	95.520 - 95.530 mm (3.7606 - 3.7610 in)	



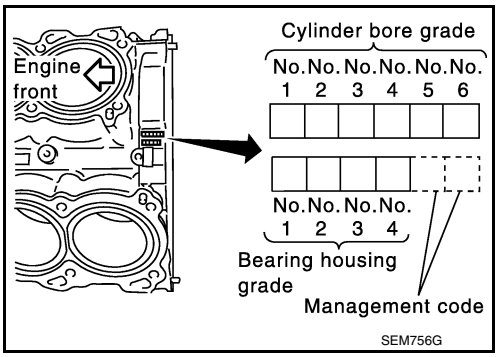
If it exceeds the limit, rebore all cylinders. Replace cylinder block if necessary.

Out-of-round (Difference between X and Y) : limit 0.015 mm (0.0006 in)

Taper (Difference between A and C) : limit 0.010 mm (0.0004 in)



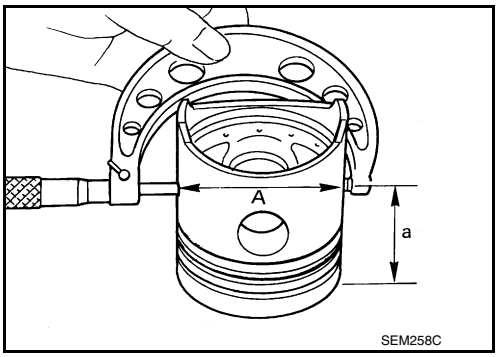
2. Check for scratches and seizure. If seizure is found, hone it.
   - **If both cylinder block and piston are replaced with new ones, select piston of the same grade number punched on cylinder block rear position. These numbers are punched in either Arabic or Roman numerals.**



3. Measure piston skirt diameter.

Piston diameter "A" : Refer to EM-135, "Cylinder Block".

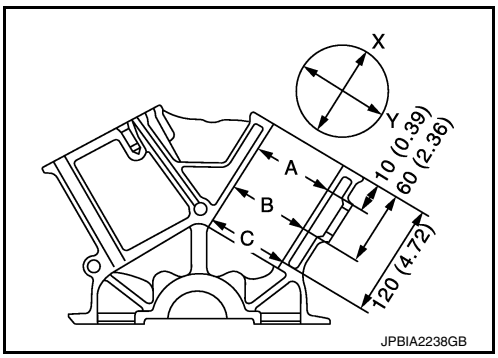
Measuring point "a" (Distance from the top) : 38.0 mm (1.496 in)



4. Check that piston-to-bore clearance is within specification.

Piston-to-bore clearance at "B" : 0.010 - 0.030 mm (0.0004 - 0.0012 in)

- The piston-to-bore clearance is measured at the "B" level in the cylinder as shown.



5. Cylinder bore size is determined by adding piston-to-bore clearance to piston diameter “A”.

Rebored size calculation : D = A + B – C

where,

D : Bored diameter

A : Piston diameter as measured

B : Piston-to-bore clearance

C : Honing allowance 0.02 mm (0.0008 in)

6. Install main bearing caps, and tighten to the specified torque. Otherwise, cylinder bores may be distorted after boring.
7. Cut cylinder bores.
   - **When any cylinder needs boring, all other cylinders must also be bored.**
   - **Do not cut too much out of cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so in diameter at a time.**
8. Hone cylinders to obtain specified piston-to-bore clearance.
9. Measure finished cylinder bore for out-of-round and taper.
   - **Measurement should be done after cylinder bore cools down.**

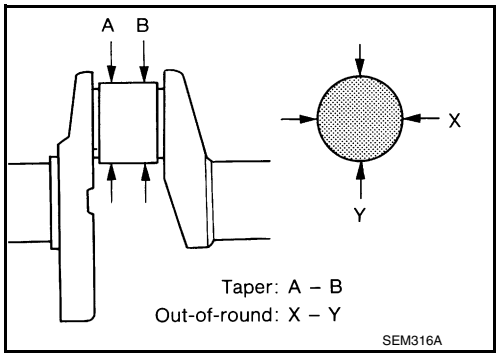
CRANKSHAFT

1. Check the crankshaft main and pin journals for scoring, wear, or cracks.
2. Measure the journals for taper and out-of-round.

Standard

Out-of-round (X - Y) : 0.002 mm (0.0001 in)

Taper (A - B) : 0.002 mm (0.0001 in)



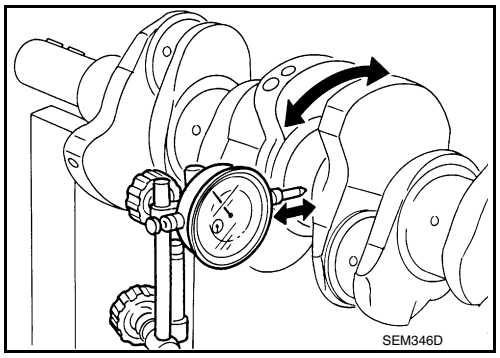
3. Measure crankshaft runout.

a. Place a V-block on a precise flat table to support the journals on the both ends of the crankshaft.

b. Place a dial gauge straight up on the No. 3 journal.

c. While rotating the crankshaft, read the movement of the pointer on the dial gauge.

Runout limit (total indicator reading) : 0.10 mm (0.0039 in)



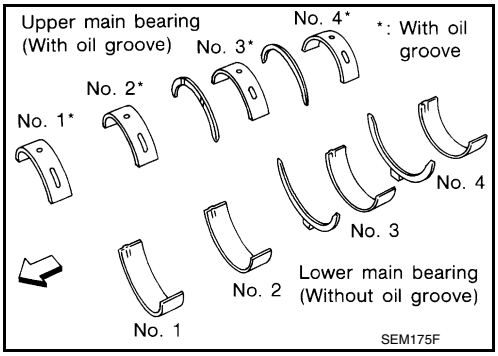
BEARING CLEARANCE

- Use either of the following two methods, however method "A" gives more reliable results and so is the preferred method.

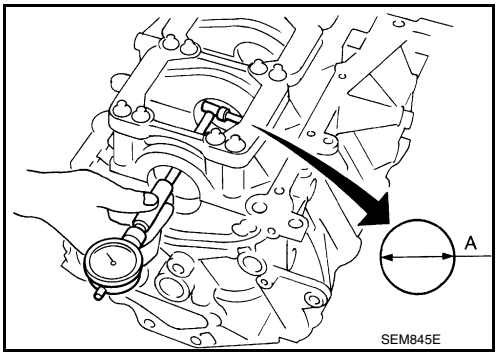
Method A (Using Bore Gauge and Micrometer)

Main Bearing

1. Set the main bearings in their proper positions on the cylinder block and the main bearing cap.
2. Install the main bearing caps and bearing beam to the cylinder block. Tighten all bolts in the numerical order as specified. Refer to EM-107, "Disassembly and Assembly".



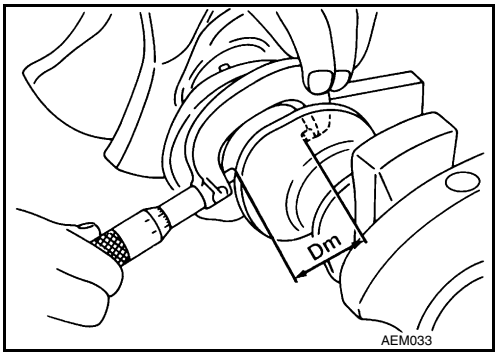
3. Measure the inner diameters "A" of each main bearing as shown.



4. Measure the outer diameters "Dm" of each crankshaft main journal as shown.
5. Calculate the main bearing clearance.
Main bearing clearance = "A" - "Dm"

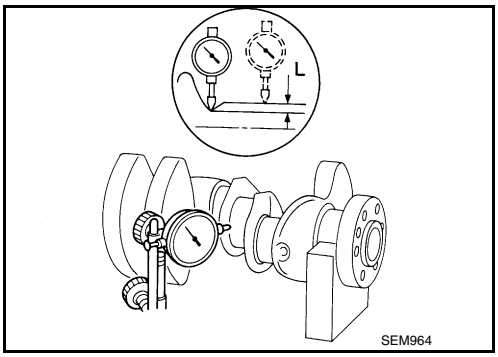
Standard : 0.012 - 0.022 mm (0.0005 - 0.0009 in)
Limit : 0.065 mm (0.0026 in)

- If it exceeds the limit, replace the bearing.
- If clearance cannot be adjusted using any standard bearing grade, grind crankshaft journal and use an undersized bearing.



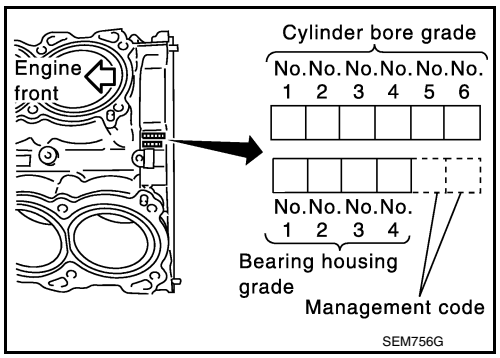
- When grinding the crankshaft journal, confirm that the "L" dimension in the fillet role is more than the specified limit.

"L" : 0.10 mm (0.0039 in)

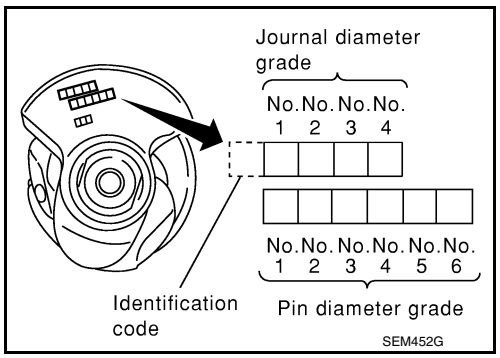


6. If the crankshaft or the cylinder block is replaced with a new one, select thickness of the main bearings as follows:

a. The grade number of each cylinder block main journal is punched on the respective cylinder block. These numbers are punched in either Arabic or Roman numerals. If measured diameter is out of the grade punched, decide suitable grade from available main bearings.



b. The grade number of each crankshaft main journal is punched on the crankshaft end. These numbers are punched in either Arabic or Roman numerals. If measured diameter is out of grade punched, decide the suitable grade from available main bearings.



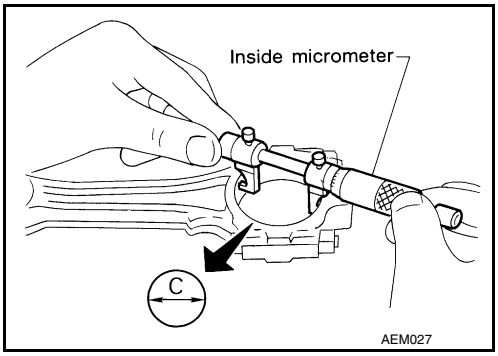
c. Select the main bearing suitable thickness according to the following table:

Cylinder block bearing housing inner diameter Unit: mm (in) / Crankshaft main journal diameter Unit: mm (in)		Mark	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	4	7
Mark	Axle diameter	Hole diameter	63.993 - 63.994 (2.5194 - 2.5194)	63.994 - 63.995 (2.5194 - 2.5195)	63.995 - 63.996 (2.5195 - 2.5195)	63.996 - 63.997 (2.5195 - 2.5196)	63.997 - 63.998 (2.5196 - 2.5196)	63.998 - 63.999 (2.5196 - 2.5196)	63.999 - 64.000 (2.5196 - 2.5197)	64.000 - 64.001 (2.5197 - 2.5197)	64.001 - 64.002 (2.5197 - 2.5198)	64.002 - 64.003 (2.5198 - 2.5198)	64.003 - 64.004 (2.5198 - 2.5198)	64.004 - 64.005 (2.5198 - 2.5199)	64.005 - 64.006 (2.5199 - 2.5199)	64.006 - 64.007 (2.5199 - 2.5200)	64.007 - 64.008 (2.5200 - 2.5200)	64.008 - 64.009 (2.5200 - 2.5200)	64.009 - 64.010 (2.5200 - 2.5201)	64.010 - 64.011 (2.5201 - 2.5201)	64.011 - 64.012 (2.5201 - 2.5202)	64.012 - 64.013 (2.5202 - 2.5202)	64.013 - 64.014 (2.5202 - 2.5202)	64.014 - 64.015 (2.5202 - 2.5203)	64.015 - 64.016 (2.5203 - 2.5203)	64.016 - 64.017 (2.5203 - 2.5203)
A	59.975 - 59.974 (2.3612 - 2.3612)		0	0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34
B	59.974 - 59.973 (2.3612 - 2.3611)		0	0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4
C	59.973 - 59.972 (2.3611 - 2.3611)		0	01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4
D	59.972 - 59.971 (2.3611 - 2.3611)		01	01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4
E	59.971 - 59.970 (2.3611 - 2.3610)		01	01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45
F	59.970 - 59.969 (2.3610 - 2.3610)		01	1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45
G	59.969 - 59.968 (2.3610 - 2.3609)		1	1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45
H	59.968 - 59.967 (2.3609 - 2.3609)		1	1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5
J	59.967 - 59.966 (2.3609 - 2.3609)		1	12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5
K	59.966 - 59.965 (2.3909 - 2.3608)		12	12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5
L	59.965 - 59.964 (2.3608 - 2.3608)		12	12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56
M	59.964 - 59.963 (2.3608 - 2.3607)		12	2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56
N	59.963 - 59.962 (2.3607 - 2.3607)		2	2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56
P	59.962 - 59.961 (2.3607 - 2.3607)		2	2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6
R	59.961 - 59.960 (2.3607 - 2.3606)		2	23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6
S	59.960 - 59.959 (2.3606 - 2.3606)		23	23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6
T	59.959 - 59.958 (2.3606 - 2.3605)		23	23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67
U	59.958 - 59.957 (2.3605 - 2.3605)		23	3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67
V	59.957 - 59.956 (2.3605 - 2.3605)		3	3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67
W	59.956 - 59.955 (2.3605 - 2.3604)		3	3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7
X	59.955 - 59.954 (2.3604 - 2.3604)		3	34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7
Y	59.954 - 59.953 (2.3604 - 2.3603)		34	34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7
4	59.953 - 59.952 (2.3603 - 2.3603)		34	34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	7
7	59.952 - 59.951 (2.3603 - 2.3603)		34	4	4	4	45	45	45	5	5	5	56	56	56	6	6	6	67	67	67	7	7	7	7	7

PBIC0814E

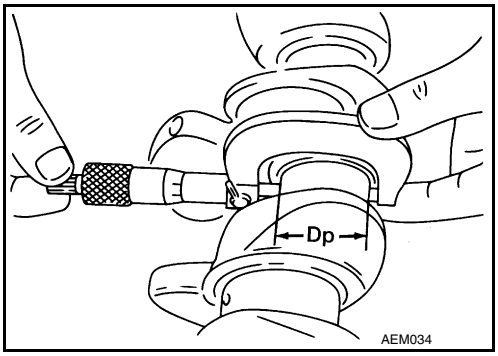
Connecting Rod Bearing (Big End)

1. Install the connecting rod bearing to the connecting rod and cap.
2. Install the connecting rod cap to the connecting rod. Tighten to specification. Refer to EM-107, "Disassembly and Assembly".
3. Measure the inner diameter "C" of each connecting rod (big end) as shown.



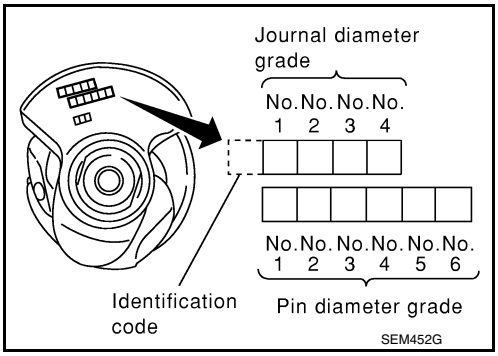
4. Measure the outer diameter "Dp" of each crankshaft pin journal.
5. Calculate the connecting rod bearing clearance.
   Connecting rod bearing clearance = C - Dp

   Standard : 0.020 - 0.045 mm (0.0008 - 0.0018 in)
   Limit : 0.070 mm (0.0028 in)



6. If the calculated clearance exceeds the specified limit, replace the bearings.
7. If the clearance cannot be adjusted within the standard of any bearing, grind the crankshaft journal and use undersized bearings.
8. If the crankshaft is replaced with a new one, select the connecting rod bearings according to the following table:
   Connecting Rod Bearing Grade Number (Identification Color)

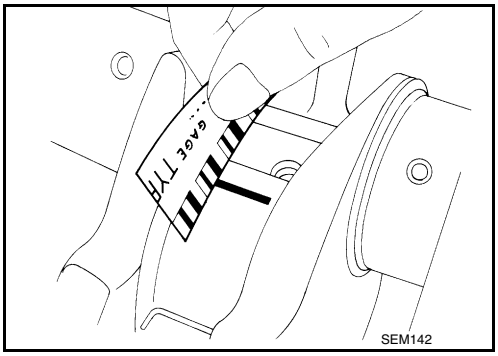
Crankshaft pin journal grade number	Connecting rod bearing grade number
0	0 (black)
1	1 (brown)
2	2 (green)



These numbers are punched in either Arabic or Roman numerals.

Method B (Using Plastigage)

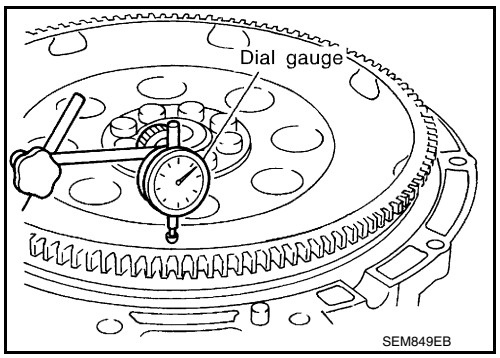
- Remove oil and dust on the crankshaft pin and the surfaces of each bearing completely.
- Cut a Plastigage slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install the connecting rod bearings to the connecting rod cap, and tighten the connecting rod nuts to the specified torque.
  CAUTION:
  Do not rotate the crankshaft.
- Remove the connecting rod cap and bearings, and using the scale on the Plastigage bag, measure the Plastigage width.
  NOTE:
  The procedure when the measured value exceeds the repair limit is same as that described in "Method A (Using Bore Gauge and Micrometer)".



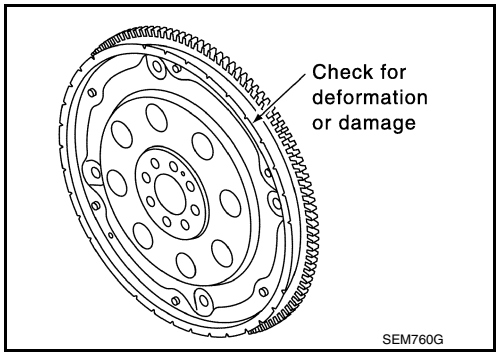
DRIVE PLATE RUNOUT

Use a suitable tool to measure the runout (Total Indicator Reading) as shown.

Drive plate torque converter surface	**: less than 0.35 mm (.0138 in)**
Ring gear	**: less than 0.5 mm (.0197 in)**

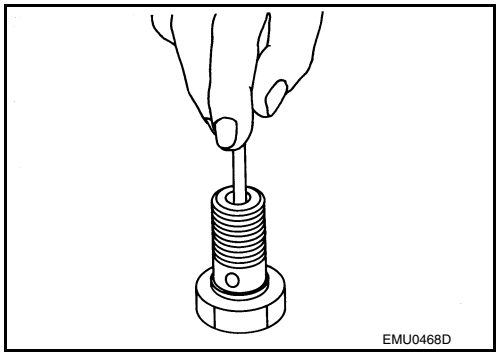


CAUTION:
- **The signal plate is built into the drive assembly. Be careful not to damage the signal plate, particularly the teeth.**
- **Check the drive plate and signal plate for deformation or cracks.**
- **Keep all magnetized objects away from the signal plate, particularly the teeth.**



OIL JET
- Check nozzle for deformation and damage.
- Blow compressed air from nozzle, and check for clogs.
- If it is not operating properly, replace oil jet.

OIL JET RELIEF VALVE
- Using a clean plastic stick, press check valve in oil jet relief valve. Make sure that valve moves smoothly with proper reaction force.
- If it is not operating properly, replace oil jet relief valve.

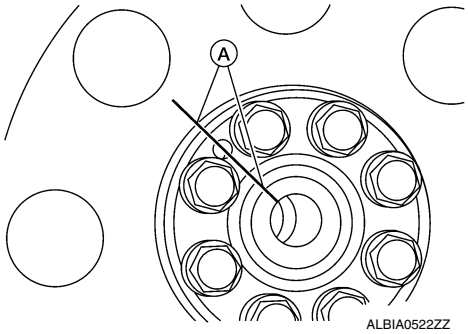


Dowel Pin Alignment

INFOID:0000000009466053

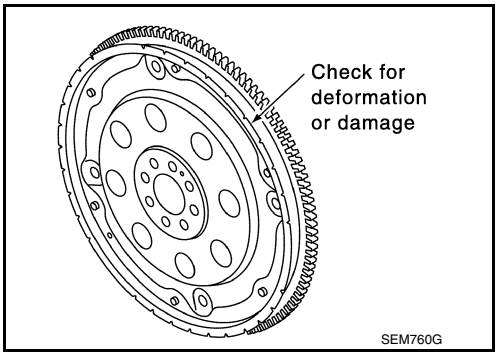
REMOVAL

1. Use suitable tool to lock the drive plate and match mark (A) the drive plate before removing the bolts.
   CAUTION:
   Do not damage the ring gear teeth, or the signal plate teeth behind the ring gear.



2. Remove drive plate.
   • Loosen the drive plate in a diagonal order.

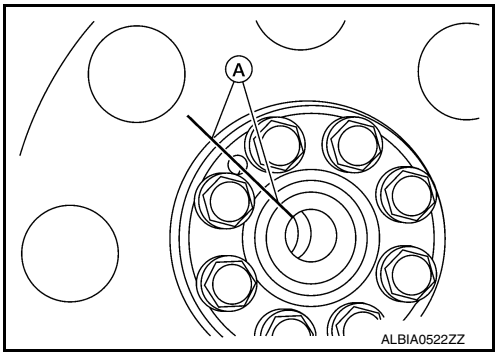
CAUTION:
- **Do not place drive plate with signal plate facing down.**
- **When handling the signal plate, take care not to damage or scratch it.**
- **Handle the signal plate in a manner that prevents it from becoming magnetized.**



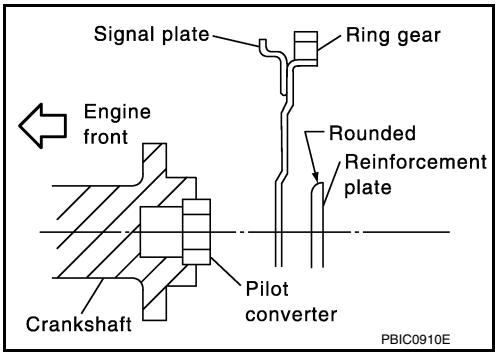
INSTALLATION

Installation is in the reverse order of removal.

- When installing the drive plate to the crankshaft, use the match mark (A) as shown to correctly align the crankshaft side dowel pin to the drive plate side dowel pin hole.



- Install the drive plate and the reinforcement plate in the direction as shown.



- Tighten the drive plate bolts in a diagonal pattern in two steps. Refer to EM-107, "Disassembly and Assembly".

- Use a suitable tool to lock the drive plate.

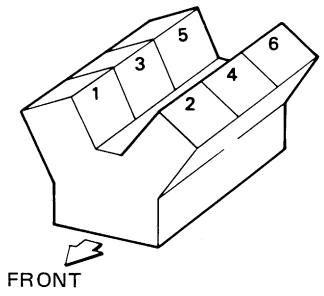
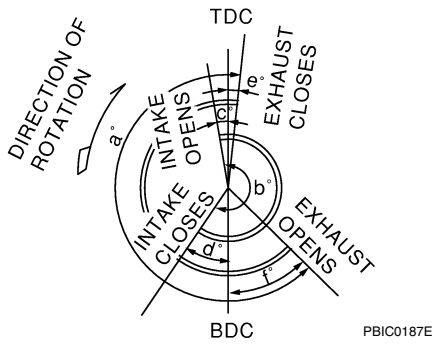
SERVICE DATA AND SPECIFICATIONS (SDS)

SERVICE DATA AND SPECIFICATIONS (SDS)

General Specification

INFOID:0000000009466054

GENERAL SPECIFICATIONS

Cylinder arrangement		V-6
Displacement cm^3 (cu in)		3,498 (213.45)
Bore and stroke mm (in)		95.5 x 81.4 (3.760 x 3.205)
Valve arrangement		DOHC
Firing order		1-2-3-4-5-6
Number of piston rings	Compression	2
	Oil	1
Number of main bearings		4
Compression ratio		10.6:1
Compression pressure kPa (kg/cm^2, psi)/300 rpm	Standard	1,275 (13.0, 185)
	Minimum	981 (10.0, 142)
	Differential limit between cylinders	98 (1.0, 14)
Cylinder number	 SEM713A	
Valve timing (Valve timing control - “OFF”)	 PBIC0187E	

Unit: degree

a	b	c	d	e	f
240	240	−10	70	10	50

Drive Belt

INFOID:0000000009466055

DRIVE BELT

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

Spark Plug

INFOID:0000000009466056

SPARK PLUG

Unit: mm (in)

Make		DENSO
Standard type*		FXE22HR11
Gap	Standard	1.1 (0.043)
	Limit	1.4 (0.055)

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

Intake Manifold

INFOID:0000000009466057

INTAKE MANIFOLD

Unit: mm (in)

Items		Limit
Surface distortion	Intake manifold	0.1 (0.004)

Exhaust Manifold

INFOID:0000000009466058

EXHAUST MANIFOLD

Unit: mm (in)

Items		Limit
Surface distortion	Exhaust manifold	0.3 (0.012)

Camshaft

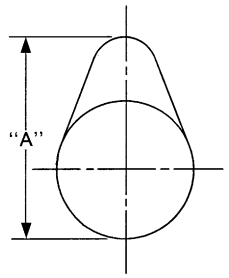
INFOID:0000000009466059

CAMSHAFT

Unit: mm (in)

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	0.035 - 0.076 (0.0014 - 0.0030)	
Camshaft bracket inner diameter	No. 1	26.000 - 26.021 (1.0236 - 1.0244)	—
	No. 2, 3, 4	23.500 - 23.521 (0.9252 - 0.9260)	—
Camshaft journal diameter	No. 1	25.935 - 25.955 (1.0211 - 1.0218)	—
	No. 2, 3, 4	23.445 - 23.465 (0.9230 - 0.9238)	—
Camshaft end play		0.115 - 0.188 (0.0045 - 0.0074)	0.24 (0.0094)
Camshaft cam height “A”	Intake	45.475 - 45.665 (1.7904 - 1.7978)	0.2 (0.008)*1
	Exhaust	45.485 - 45.675 (1.7907 - 1.7982)	0.2 (0.008)*1
Camshaft runout [TIR*2]		Less than 0.02 (0.0008)	0.05 (0.0020)
Camshaft sprocket runout [TIR*2]		Less than 0.15 (0.0059)	—

Difference in level between front end faces of No. 1 camshaft bracket and cylinder head	-0.14 (-0.0055)	—



SEM671

*1: Cam wear limit

*2: Total indicator reading

VALVE LIFTER

Unit: mm (in)

Items	Standard
Valve lifter outer diameter	33.977 - 33.987 (1.3377 - 1.3381)
Valve lifter hole diameter	34.000 - 34.016 (1.3386 - 1.3392)
Valve lifter clearance	0.013 - 0.039 (0.0005 - 0.0015)

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)

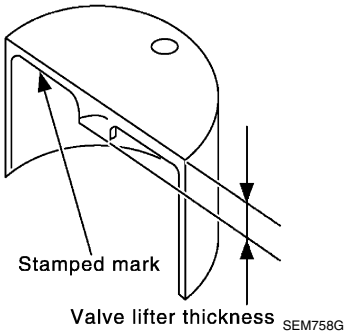
*: Approximately 80°C (176°F)

AVAILABLE VALVE LIFTER

Unit: mm (in)

Identification (stamped) mark*	Thickness
788U	7.88 (0.3102)
790U	7.90 (0.3110)
792U	7.92 (0.3118)
794U	7.94 (0.3126)
796U	7.96 (0.3134)
798U	7.98 (0.3142)
800U	8.00 (0.3150)
802U	8.02 (0.3157)
804U	8.04 (0.3165)
806U	8.06 (0.3173)
808U	8.08 (0.3181)
810U	8.10 (0.3189)
812U	8.12 (0.3197)
814U	8.14 (0.3205)
816U	8.16 (0.3213)
818U	8.18 (0.3220)

Identification (stamped) mark*	Thickness
820U	8.20 (0.3228)
822U	8.22 (0.3236)
824U	8.24 (0.3244)
826U	8.26 (0.3252)
828U	8.28 (0.3260)
830U	8.30 (0.3268)
832U	8.32 (0.3276)
834U	8.34 (0.3283)
836U	8.36 (0.3291)
838U	8.38 (0.3299)
840U	8.40 (0.3307)



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

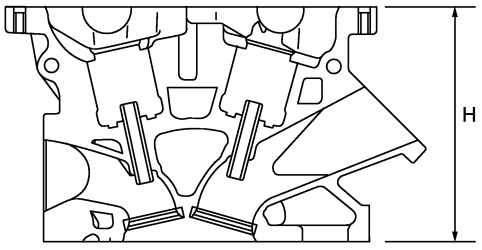
Cylinder Head

INFOID:0000000009466060

CYLINDER HEAD

Unit: mm (in)

Items	Standard	Limit
Head surface distortion	Less than 0.03 (0.0012)	0.1 (0.004)
Normal cylinder head height “H”	126.3 - 126.5 (4.97 - 4.98)	—
Spark plug tube installation height	37.7 - 39.1 (1.484 - 1.539)	—



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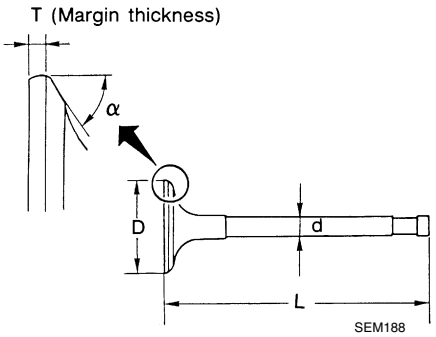
VALVE DIMENSIONS

Unit: mm (in)



Valve head diameter “D”	Intake	36.6 - 36.9 (1.441 - 1.453)
	Exhaust	30.2 - 30.5 (1.189 - 1.201)
Valve length “L”	Intake	97.13 (3.8240)
	Exhaust	94.67 (3.7272)
Valve stem diameter “d”	Intake	5.970 - 5.980 (0.2350 - 0.2354)
	Exhaust	5.955 - 5.970 (0.2344 - 0.2350)
Valve seat angle “α”	Intake	45°15′ - 45°45′
	Exhaust	
Valve margin “T”	Intake	1.15 - 1.45 (0.0453 - 0.0571)
	Exhaust	1.45 - 1.75 (0.0571 - 0.0689)
Valve margin “T” limit		More than 0.5 (0.020)
Valve stem end surface grinding limit		Less than 0.2 (0.008)

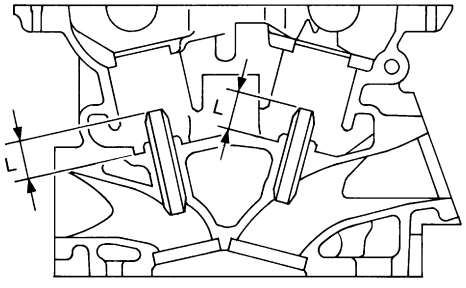
VALVE OIL SEAL

Unit: mm (in)

Description	Standard
Valve oil seal installation height	14.3 - 14.9 (0.563 - 0.587)

VALVE GUIDE

Unit: mm (in)



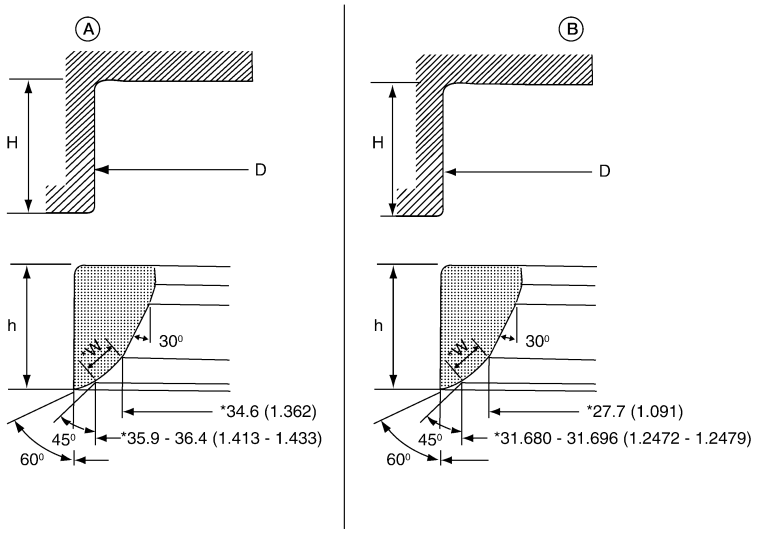
Items		Standard	Oversize (Service) [0.2 (0.008)]
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)	
Cylinder head valve guide hole diameter		9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
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)	0.08 (0.0031)
	Exhaust	0.040 - 0.073 (0.0016 - 0.0029)	0.01 (0.004)
Valve deflection	Intake	—	0.24 (0.0094)
	Exhaust	—	0.28 (0.0110)
Projection length “L”		12.6 - 12.8 (0.496 - 0.504)	

VALVE SEAT

Unit: mm (in)

Items	Standard	Oversize (Service) [0.5 (0.02)]



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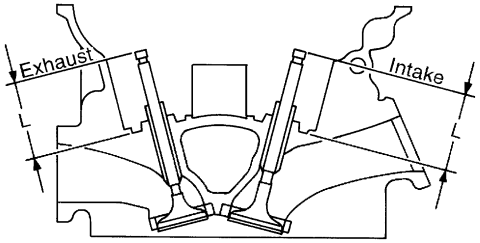

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Cylinder head seat recess diameter “D”	Intake (A)	38.000 - 38.016 (1.4961 - 1.4967)	38.500 - 38.516 (1.5157 - 1.5164)
	Exhaust (B)	31.600 - 31.616 (1.2441 - 1.2447)	32.100 - 32.116 (1.2638 - 1.2644)
Valve seat outer diameter	Intake	38.097 - 38.113 (1.4999 - 1.5005)	38.597 - 38.613 (1.5196 - 1.5202)
	Exhaust	31.680 - 31.696 (1.2472 - 1.2479)	32.180 - 32.196 (1.2669 - 1.2676)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.064 - 0.096 (0.0025 - 0.0038)	
Height “h”	Intake (A)	5.9 - 6.0 (0.232 - 0.236)	5.0 - 5.1 (0.197 - 0.201)
	Exhaust (B)	5.9 - 6.0 (0.232 - 0.236)	4.9 - 5.0 (0.193 - 0.197)
Contacting width “W”*	Intake (A)	1.18 - 1.22 (0.0465 - 0.0480)	
	Exhaust (B)	1.38 - 1.42 (0.0543 - 0.0559)	
Cylinder head seat recess depth (H)		6.0 (0.236)	
Depth “L”	Intake (A)	41.16 - 41.76 (1.6205 - 1.6441)	
	Exhaust (B)	41.09 - 41.69 (1.6177 - 1.6413)	

*:Machining data

VALVE SPRING

Items	Standard
Free height	47.07 mm (1.8531 in)
Installation height	37.00 mm (1.4567 in)
Installation load	166 - 188 N (16.9 - 19.2 kg, 37 - 42 lb)
Height during valve open	27.20 mm (1.0709 in)
Load with valve open	373 - 421 N (38.0 - 42.9 kg, 84 - 95 lb)

Unit: mm (in)

Items	Limit
Squareness	2.0 (0.079)

Cylinder Block

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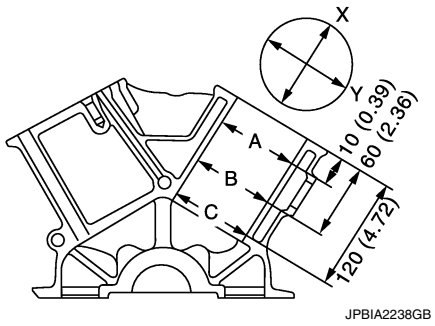
CYLINDER BLOCK

Unit: mm (in)



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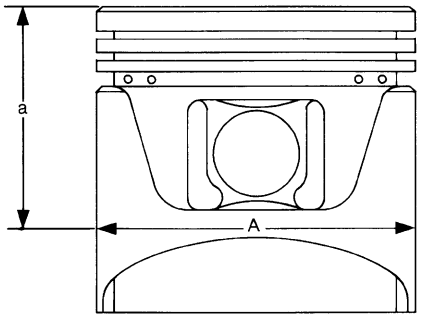
Surface distortion		Standard		Less than 0.03 (0.0012)
		Limit		0.10 (0.0039)
Main bearing housing inner diameter		Standard		63.993 - 64.017 (2.5194 - 2.5203)
Cylinder bore	Inner diameter	Standard*	Grade No. 1	95.500 - 95.510 (3.7598 - 3.7602)
			Grade No. 2	95.510 - 95.520 (3.7602 - 3.7606)
			Grade No. 3	95.520 - 95.530 (3.7606 - 3.7610)
		Wear limit		0.20 (0.0079)
Out-of-round		Limit		0.015 (0.0006)
Taper (Difference between A and C)				0.015 (0.0006)

Main bearing housing inner diameter grade (Without bearing)*		Grade No. A	63.993 - 63.994 (2.5194 - 2.5194)
		Grade No. B	63.994 - 63.995 (2.5194 - 2.5195)
		Grade No. C	63.995 - 63.996 (2.5195 - 2.5195)
		Grade No. D	63.996 - 63.997 (2.5195 - 2.5196)
		Grade No. E	63.997 - 63.998 (2.5196 - 2.5196)
		Grade No. F	63.998 - 63.999 (2.5196 - 2.5196)
		Grade No. G	63.999 - 64.000 (2.5196 - 2.5197)
		Grade No. H	64.000 - 64.001 (2.5197 - 2.5197)
		Grade No. J	64.001 - 64.002 (2.5197 - 2.5198)
		Grade No. K	64.002 - 64.003 (2.5198 - 2.5198)
		Grade No. L	64.003 - 64.004 (2.5198 - 2.5198)
		Grade No. M	64.004 - 64.005 (2.5198 - 2.5199)
		Grade No. N	64.005 - 64.006 (2.5199 - 2.5199)
		Grade No. P	64.006 - 64.007 (2.5199 - 2.5200)
		Grade No. R	64.007 - 64.008 (2.5200 - 2.5200)
		Grade No. S	64.008 - 64.009 (2.5200 - 2.5200)
		Grade No. T	64.009 - 64.010 (2.5200 - 2.5201)
		Grade No. U	64.010 - 64.011 (2.5201 - 2.5201)
		Grade No. V	64.011 - 64.012 (2.5201 - 2.5202)
		Grade No. W	64.012 - 64.013 (2.5202 - 2.5202)
		Grade No. X	64.013 - 64.014 (2.5202 - 2.5202)
		Grade No. Y	64.014 - 64.015 (2.5202 - 2.5203)
		Grade No. 4	64.015 - 64.016 (2.5203 - 2.5203)
		Grade No. 7	64.016 - 64.017 (2.5203 - 2.5203)
Difference in inner diameter between cylinders	Standard		Less than 0.03 (0.0012)

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

AVAILABLE PISTON

Unit: mm (in)



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Items	Grade*	Standard
Piston skirt diameter “A”	Grade No. 1	95.480 - 95.490 (3.7590 - 3.7594)
	Grade No. 2	95.490 - 95.500 (3.7594 - 3.7598)
	Grade No. 3	95.500 - 95.510 (3.7598 - 3.7602)
“a” dimension		38.0 (1.496)
Piston pin hole diameter	Grade No. 0	21.993 - 21.999 (0.8659 - 0.8661)
	Grade No. 1	21.999 - 22.005 (0.8661 - 0.8663)
Piston to cylinder bore clearance		0.010 - 0.030 (0.0004 - 0.0012)

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

PISTON RING

Unit: mm (in)

Items		Standard	Limit
Side clearance	Top	0.045 - 0.080 (0.0018 - 0.0031)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.1 (0.004)
	Oil ring	0.065 - 0.125 (0.0018 - 0.0049)	—

End gap	Top	0.23 - 028 (0.0091 - 0.0110)	0.50 (0.0197)
	2nd	0.33 - 0.43 (0.0130 - 0.0169)	0.62 (0.0244)
	Oil (rail ring)	0.20 - 0.45 (0.0079 - 0.0177)	0.80 (0.0315)

PISTON PIN

Unit: mm (in)

Items	Grade*	Standard	Limit
Piston pin outer diameter	Grade No. 0	21.989 - 21.995 (0.8657 - 0.8659)	—
	Grade No. 1	21.995 - 22.001 (0.8659 - 0.8662)	—
Piston to piston pin oil clearance		0.002 - 0.010 (0.0001 - 0.0004)	—
Connecting rod bushing oil clearance		0.005 - 0.017 (0.0002 - 0.0007)	0.030 (0.0012)

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

CONNECTING ROD

Unit: mm (in)

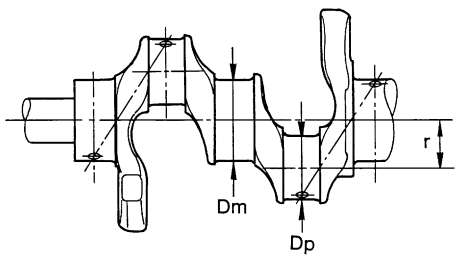
Items	Grade[1]	Standard	Limit
Center distance		144.15 - 144.25 (5.68 - 5.68)	—
Bend [per 100 (3.94)]		—	0.15 (0.0059)
Torsion [per 100 (3.94)]		—	0.30 (0.0118)
Connecting rod small end inner diameter		23.980 - 24.000 (0.9441 - (0.9449)	
Connecting rod bushing inner diameter[2]	Grade No. 0	22.000 - 22.006 (0.8661 - 0.8664)	—
	Grade No. 1	22.006 - 22.012 (0.8664 - 0.8666)	—
Connecting rod big end diameter (Without bearing)		55.000 - 55.013 (2.1654 - 2.1659)	—
Side clearance		0.20 - 0.35 (0.0079 - 0.0138)	0.40 (0.0157)

[1]: Always check with the Parts Department for the latest parts information.

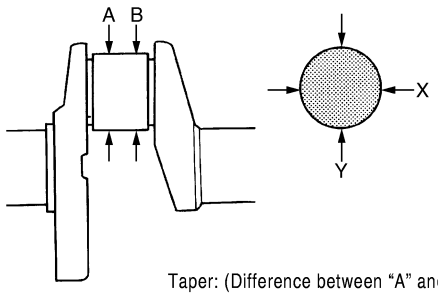
[2]: After installing in connecting rod

CRANKSHAFT

Unit: mm (in)



SEM645



Taper: (Difference between “A” and “B”)
Out-of-round: (Difference between “X” and “Y”)

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		Grade[1]	Dimension
Main journal diameter. “Dm” grade	Standard	Grade No. A	59.975 - 59.974 (2.3612 - 2.3612)
		Grade No. B	59.974 - 59.973 (2.3612 - 2.3611)
		Grade No. C	59.973 - 59.972 (2.3611 - 2.3611)
		Grade No. D	59.972 - 59.971 (2.3611 - 2.3611)
		Grade No. E	59.971 - 59.970 (2.3611 - 2.3610)
		Grade No. F	59.970 - 59.969 (2.3610 - 2.3610)
		Grade No. G	59.969 - 59.968 (2.3610 - 2.3609)
		Grade No. H	59.968 - 59.967 (2.3609 - 2.3609)
		Grade No. J	59.967 - 59.966 (2.3609 - 2.3609)
		Grade No. K	59.966 - 59.965 (2.3609 - 2.3608)
		Grade No. L	59.965 - 59.964 (2.3608 - 2.3608)
		Grade No. M	59.964 - 59.963 (2.3608 - 2.3607)
		Grade No. N	59.963 - 59.962 (2.3607 - 2.3607)
		Grade No. P	59.962 - 59.961 (2.3607 - 2.3607)
		Grade No. R	59.961 - 59.960 (2.3607 - 2.3606)
		Grade No. S	59.960 - 59.959 (2.3606 - 2.3606)
		Grade No. T	59.959 - 59.958 (2.3606 - 2.3605)
		Grade No. U	59.958 - 59.957 (2.3605 - 2.3605)
		Grade No. V	59.957 - 59.956 (2.3605 - 2.3605)
		Grade No. W	59.956 - 59.955 (2.3605 - 2.3604)
		Grade No. X	59.955 - 59.954 (2.3604 - 2.3604)
		Grade No. Y	59.954 - 59.953 (2.3604 - 2.3603)
		Grade No. 4	59.953 - 59.952 (2.3603 - 2.3603)
		Grade No. 7	59.952 - 59.951 (2.3603 - 2.3603)
Pin journal diameter. “Dp” grade	Standard	Grade No. 0	51.968 - 51.974 (2.0460 - 2.0462)
		Grade No. 1	51.962 - 51.968 (2.0457 - 2.0460)
		Grade No. 2	51.956 - 51.962 (2.0445 - 2.0457)
Center distance “r”			40.66 - 40.74 (1.6008 - 1.6039)
Taper (Difference between “A” and “B”)	Limit		Less than 0.002 (0.0001)
Out-of-round (Difference between “X” and “Y”)			Less than 0.002 (0.0001)
Crankshaft runout [TIR[2]]	Standard		Less than 0.05 (0.0020)
	Limit		0.10 (0.0039)
Crankshaft end play	Standard		0.10 - 0.25 (0.0039 - 0.0098)
	Limit		0.30 (0.0118)
Fillet role of crankshaft journal	Standard		More than 0.10 (0.0039)

[1]: Always check with the Parts Department for the latest parts information.

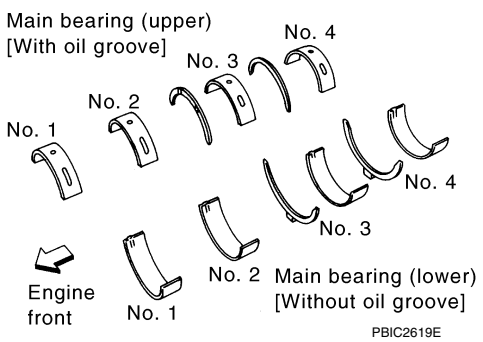
[2]: Total indicator reading

Main Bearing

INFOID:0000000009466062

MAIN BEARING

Unit: mm (in)



PBIC2619E

Grade number*	Thickness	Width	Identification color	Remarks

0		2.000 - 2.003 (0.0787 - 0.0789)	19.9 - 20.1 (0.783 - 0.791)	Black	Grade is the same for upper and lower bearings.
1		2.003 - 2.006 (0.0789 - 0.0790)		Brown	
2		2.006 - 2.009 (0.0790 - 0.0791)		Green	
3		2.009 - 2.012 (0.0791 - 0.0792)		Yellow	
4		2.012 - 2.015 (0.0792 - 0.0793)		Blue	
5		2.015 - 2.018 (0.0793 - 0.0794)		Pink	
6		2.018 - 2.021 (0.0794 - 0.0796)		Purple	
7		2.021 - 2.024 (0.0796 - 0.0797)		White	
01	UPR	2.003 - 2.006 (0.0789 - 0.0790)		Brown	Grade and color are different for upper and lower bearings.
	LWR	2.000 - 2.003 (0.0787 - 0.0789)		Black	
12	UPR	2.006 - 2.009 (0.0790 - 0.0791)		Green	
	LWR	2.003 - 2.006 (0.0789 - 0.0790)		Brown	
23	UPR	2.009 - 2.012 (0.0791 - 0.0792)		Yellow	
	LWR	2.006 - 2.009 (0.0790 - 0.0791)		Green	
34	UPR	2.012 - 2.015 (0.0792 - 0.0793)		Blue	
	LWR	2.009 - 2.012 (0.0791 - 0.0792)		Yellow	
45	UPR	2.015 - 2.018 (0.0793 - 0.0794)		Pink	
	LWR	2.012 - 2.015 (0.0792 - 0.0793)		Blue	
56	UPR	2.018 - 2.021 (0.0794 - 0.0796)		Purple	
	LWR	2.015 - 2.018 (0.0793 - 0.0794)		Pink	
67	UPR	2.021 - 2.024 (0.0796 - 0.0797)		White	
	LWR	2.018 - 2.021 (0.0794 - 0.0796)		Purple	

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

UNDERSIZE

Unit: mm (in)

Items	Thickness	Main journal diameter
0.25 (0.0098)	2.132 - 2.140 (0.0839 - 0.0843)	Grind so that bearing clearance is the specified value.

MAIN BEARING OIL CLEARANCE

Unit: mm (in)

Items	Standard	Limit
Main bearing oil clearance	0.012 - 0.022 (0.0005 - 0.0009)*	0.065 (0.0026)

*: Actual clearance

Connecting Rod Bearing

INFOID:0000000009466063

CONNECTING ROD BEARING

Unit: mm (in)

Grade number*	Thickness	Identification color (mark)
0	1.500 - 1.503 (0.0591 - 0.0592)	Black
1	1.503 - 1.506 (0.0592 - 0.0593)	Brown
2	1.506 - 1.509 (0.0593 - 0.0594)	Green

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

UNDERSIZE

Unit: mm (in)

Items	Thickness	Crank pin journal diameter "Dp"
0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)	Grind so that bearing clearance is the specified value.

CONNECTING ROD BEARING OIL CLEARANCE

Unit: mm (in)

Items	Standard	Limit
Connecting rod bearing oil clearance	0.020 - 0.045 (0.0008 - 0.0018)*	0.070 (0.0028)

*: Actual clearance

Drive Plate

INFOID:0000000009466064

Unit: mm (in)

Drive plate runout [TIR]* - on torque converter mounting surface	Less than 0.35 (0.0138)
Drive plate runout [TIR]* - on ring gear	0.5 (0.0197)

*: Total indicator reading