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SECTION **EM**

ENGINE MECHANICAL

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PRECAUTIONS

PRECAUTIONS

PF0:00001

Precautions for Supplemental Restraint System (SRS) “AIR BAG” and “SEAT BELT PRE-TENSIONER”

EBS00RBV

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

WARNING:

- To avoid rendering the SRS inoperative, which could increase the risk of personal injury or death in the event of a collision which would result in air bag inflation, all maintenance must be performed by an authorized NISSAN/INFINITI dealer.
- Improper maintenance, including incorrect removal and installation of the SRS, can lead to personal injury caused by unintentional activation of the system. For removal of Spiral Cable and Air Bag Module, see the SRS section.
- Do not use electrical test equipment on any circuit related to the SRS unless instructed to in this Service Manual. SRS wiring harnesses can be identified by yellow and/or orange harnesses or harness connectors.

Precautions for Drain Coolant

EBS00RBW

- Drain coolant when engine is cooled.

Precautions for Disconnecting Fuel Piping

EBS00RBX

- 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.

Precautions for Removal and Disassembly

EBS00RBY

- 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.

Precautions for Inspection, Repair and Replacement

EBS00RBZ

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

Precautions for Assembly and Installation

EBS00RC0

- 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.

PRECAUTIONS

- After repairing, start engine and increase engine speed to check coolant, fuel, oil, and exhaust systems for leakage.

Parts Requiring Angular Tightening

EBS00RC1

- 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.

Precautions for Liquid Gasket

EBS00RC2

REMOVAL OF LIQUID GASKET SEALING

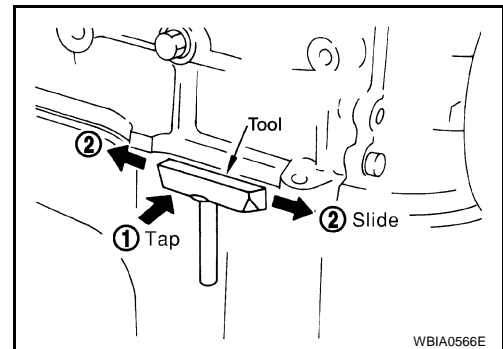
- After removing the bolts and nuts, separate the mating surface and remove the sealant using Tool.

Tool number : KV10111100 (J-37228)

CAUTION:

Be careful not to damage the mating surfaces.

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

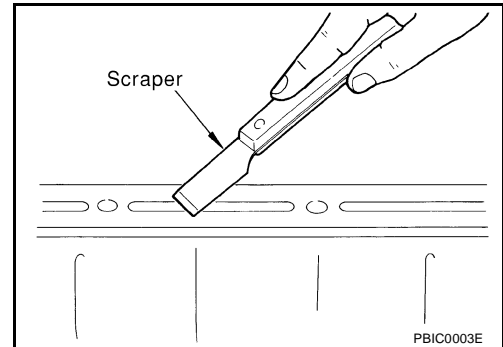


CAUTION:

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

LIQUID GASKET APPLICATION PROCEDURE

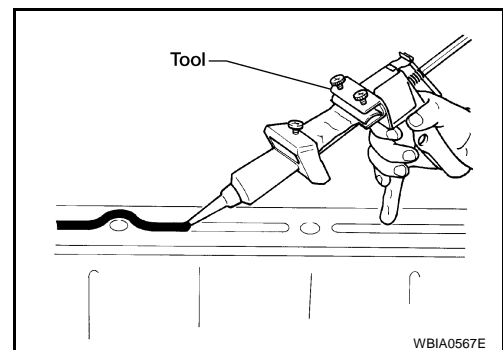
1. Using a scraper, remove the old Silicone RTV Sealant adhering to the gasket application surface and the mating surface.
 - Remove the sealant completely from the groove of the gasket application surface, bolts, and bolt holes.
2. Thoroughly clean the gasket application surface and the mating surface and remove adhering moisture, grease and foreign materials.
3. Attach the sealant tube to the tube presser.
Use Genuine Silicone RTV Sealant or equivalent. Refer to [GI-46, "Recommended Chemical Products and Sealants"](#) .



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

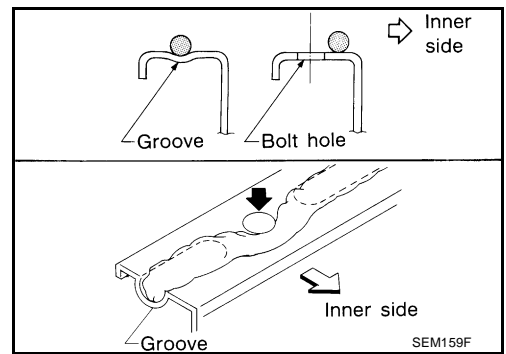
Tool number WS39930000 (-)

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



PRECAUTIONS

- After 30 minutes or more have passed from the installation, fill the engine with the specified oil and coolant. Refer to [MA-9, "Fluids and Lubricants"](#).



CAUTION:
Follow all specific instructions in this manual.

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PREPARATION

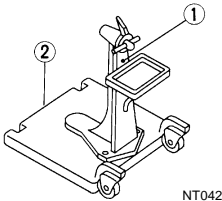
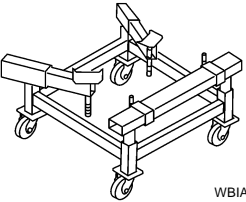
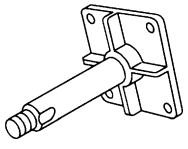
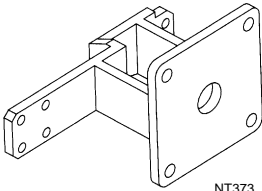
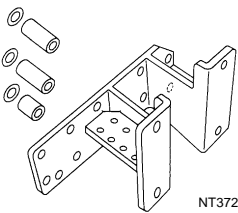
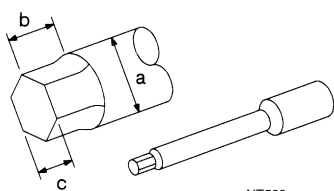
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PREPARATION

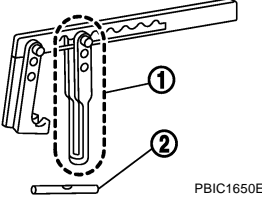
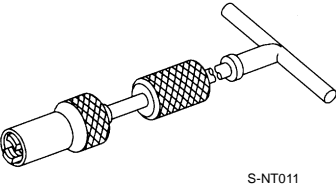
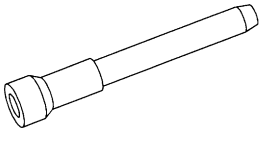
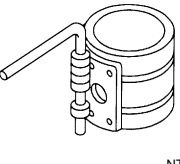
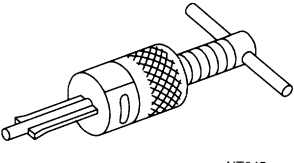
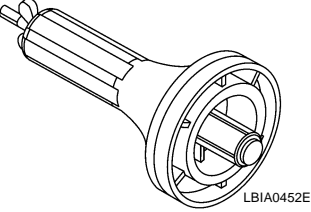
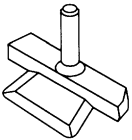
Special Service Tools

EBS00RC3

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

Tool number (Kent-Moore No.) Tool name	Description	
ST0501S000 (—) Engine stand assembly 1 ST05011000 (—) Engine stand 2 ST05012000 (—) Base	 <p style="text-align: right;">NT042</p>	
KV101J0010 (J-47242) Engine support table	 <p style="text-align: right;">WBIA0658E</p>	
KV10106500 (—) Engine stand shaft	 <p style="text-align: right;">NT028</p>	
KV10117000 (J-41262) Engine sub-attachment	 <p style="text-align: right;">NT373</p>	KV10117000 has been replaced with KV10117001 (KV10117000 is no longer in production, but it is usable).
KV10117001 (—) Engine sub-attachment	 <p style="text-align: right;">NT372</p>	Installing on the cylinder block
ST10120000 (J-24239-01) Cylinder head bolt wrench	 <p style="text-align: right;">NT583</p>	Loosening and tightening cylinder head bolt a: 13 (0.51) dia. b: 12 (0.47) c: 10 (0.39) Unit: mm (in)

PREPARATION

Tool number (Kent-Moore No.) Tool name	Description	
KV10116200 (J-26336-B) Valve spring compressor 1 KV10115900 (J-26336-20) Attachment 2 KV1019230 (—)	 Disassembling valve mechanism Part (1) is a component of KV10116200 (J-26336-B), but Part (2) is not.	A EM C
KV10107902 (J-38959) Valve oil seal puller	 Removing valve oil seal	D E
— (J-39386) Valve oil seal drift	 Installing valve oil seal	F G H
EM03470000 (J-8037) Piston ring compressor	 Installing piston assembly into cylinder bore	I J
ST16610001 (J-23907) Pilot bushing puller	 Removing crankshaft pilot bushing	K L
KV991J0120 (J-47128) Seal installer	 Installing rear main seal	M
KV10111100 (J-37228) Seal cutter	 Removing steel oil pan and rear timing chain case	

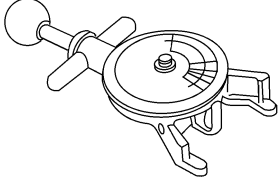
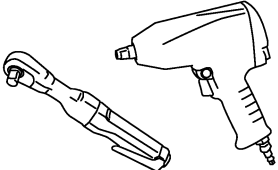
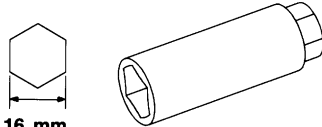
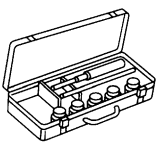
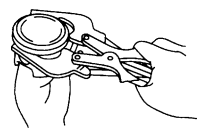
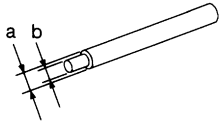
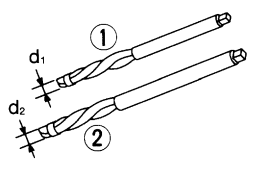
PREPARATION

Tool number (Kent-Moore No.) Tool name	Description
WS39930000 (—) Tube presser	Pressing the tube of liquid gasket
KV10112100 (BT-8653-A) Angle wrench	Tightening bolts for bearing cap, cylinder head, etc.
KV991J0050 (J-44626) Air fuel sensor Socket	Loosening or tightening air fuel ratio A/F sensor a: 22 mm (0.87 in)
KV10114400 (J-38365) Heated oxygen sensor wrench	Loosening or tightening rear heated oxygen sensor a: 22 mm (0.87 in)
KV10117700 (J-44716) Ring gear stopper	Removing and installing crankshaft pulley
KV10109300 (—) Pulley holder	Removing and installing crankshaft pulley a: 68 mm (2.68 in) b: 8 mm (0.31 in)
KV991J0100 (J-46531) T55 Torx® Bit	Removing and installing A/T drive plate and M/T flywheel bolts

PREPARATION

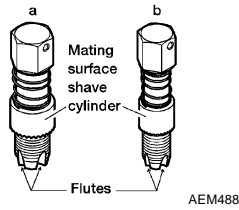
Commercial Service Tools

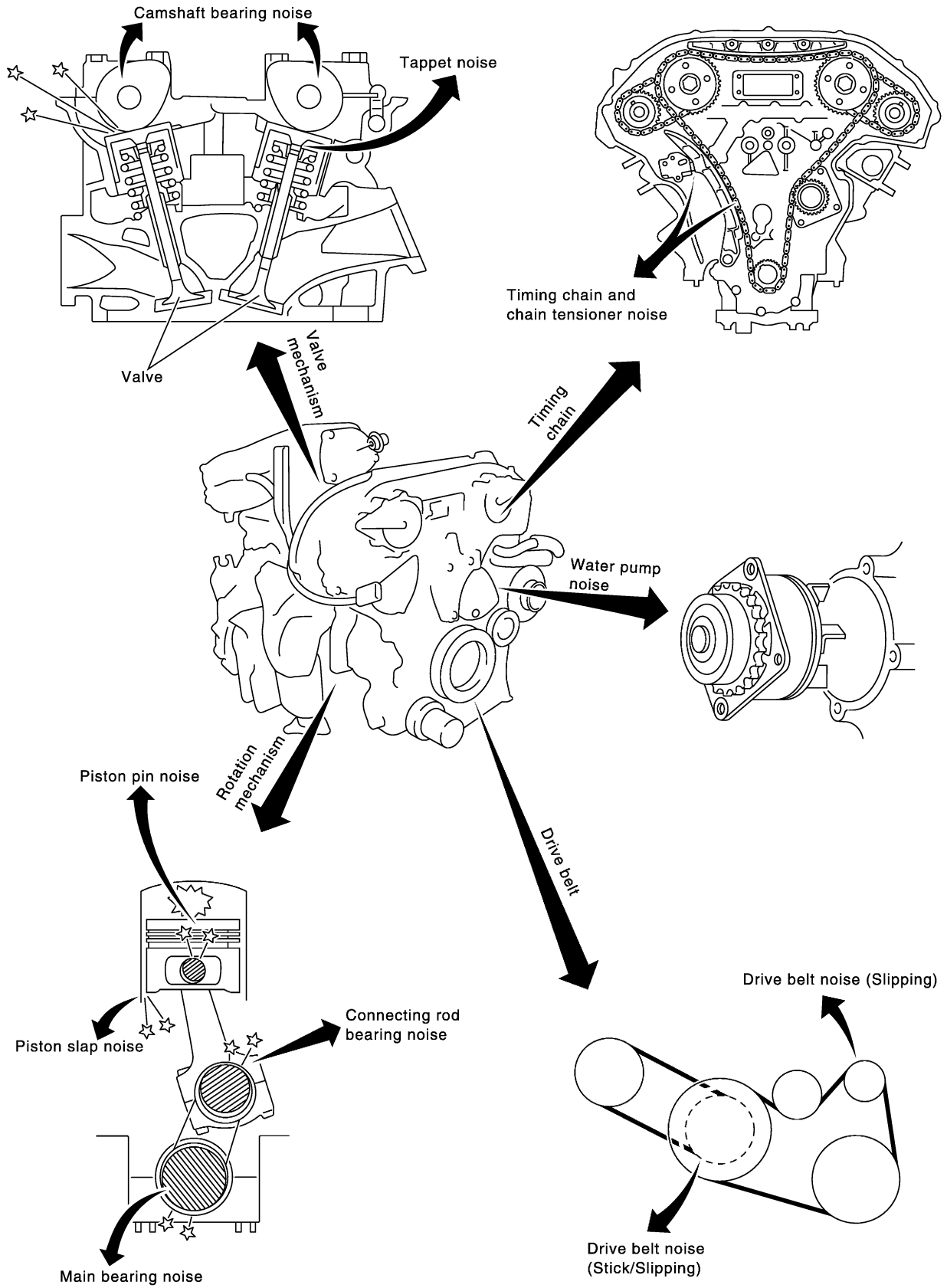
EBS00RC4

(Kent-Moore No.) Tool name	Description	A
(BT-3373-F) Belt tension gauge  <p style="text-align: right; margin-right: 20px;">AMA126</p>	Checking drive belt tension	EM
Power tool  <p style="text-align: right; margin-right: 20px;">PBIC0190E</p>	Loosening bolts and nuts	C
Spark plug wrench  <p style="text-align: center; margin-left: 50px;">16 mm (0.63 in)</p> <p style="text-align: right; margin-right: 20px;">NT047</p>	Removing and installing spark plug	D
Valve seat cutter set  <p style="text-align: right; margin-right: 20px;">NT048</p>	Finishing valve seat dimensions	E
Piston ring expander  <p style="text-align: right; margin-right: 20px;">NT030</p>	Removing and installing piston ring	F
KV10111800 Valve guide drift  <p style="text-align: right; margin-right: 20px;">NT015</p>	Removing and installing valve guide Intake & Exhaust: a: 9.5 mm (0.374 in) dia. b: 5.5 mm (0.217 in) dia.	G
Valve guide reamer  <p style="text-align: right; margin-right: 20px;">NT016</p>	(1): Reaming valve guide inner hole (2): Reaming hole for oversize valve guide Intake and Exhaust: d1 : 6.0 mm (0.236 in) dia. d2 : 10.175 mm (0.4006 in) dia.	H

PREPARATION

(Kent-Moore No.) Tool name	Description
(J-43897-18) (J-43897-12) Oxygen sensor thread cleaner	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)	Lubricating oxygen sensor thread cleaning tool when reconditioning exhaust system threads





NOISE, VIBRATION, AND HARSHNESS (NVH) TROUBLESHOOTING

EBS00RC6

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

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-82
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal clearance Camshaft runout	EM-73
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-90
	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-113
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing clearance (Small end) Connecting rod bearing clearance (Big end)	EM-113
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-113
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-54
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	EM-13
	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-16

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

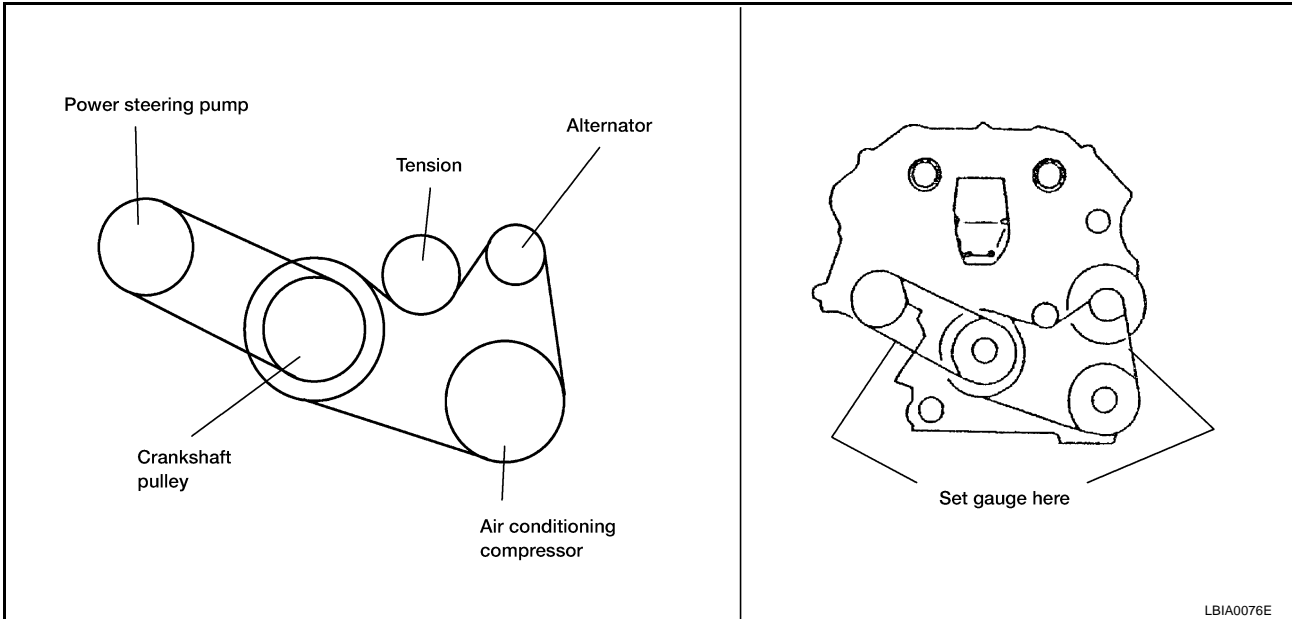
DRIVE BELTS

PFP:02117

DRIVE BELTS

Checking Drive Belts

EBS00RC7



WARNING:

Inspect and check the drive belts with the engine off.

1. Inspect belt for cracks, fraying, wear or oil adhesion. If necessary, replace with a new one.
2. Inspect drive belt deflections by pushing on the belt midway between pulleys as shown.
3. Rotate the crankshaft pulley two times then check the belt tension using Tool.

Tool number : — (BT-3373-F)

NOTE:

- Inspect drive belt deflection or tension when engine is cold.
- Adjust if belt deflections exceed the limit or if belt tension is not within specifications.

Belt Deflection and Tension

	Deflection adjustment		Unit: mm (in)	Tension adjustment*		Unit: N (kg, lb)
	Used belt		New belt	Used belt		New belt
	Limit	After adjustment		Limit	After adjustment	
Alternator and air conditioning compressor	7 (0.28)	4.2 - 4.6 (0.17 - 0.18)	3.7 - 4.1 (0.15 - 0.16)	294 (30, 66)	730 - 818 (74.5 - 83.5, 164 - 184)	838 - 926 (85.5 - 94.5, 188 - 208)
Power steering pump	11 (0.43)	7.3 - 8.0 (0.29 - 0.31)	6.5 - 7.2 (0.26 - 0.28)	196 (20, 44)	495 - 583 (50.5 - 59.5, 111 - 131)	603 - 691 (61.5 - 70.5, 135.6 - 155.4)
Applied pushing force	98 N (10 kg, 22 lb)			—		

*: If belt tension gauge cannot be installed at check points shown, check drive belt tension at different location on the belt.

Adjusting Drive Belts TENSION ADJUSTMENT

EBS00UHI

Portion	Belt tightening method for adjustment
Power steering oil pump belt	Adjusting bolt on power steering oil pump
Generator and air conditioner compressor belt	Adjusting bolt on idler pulley

CAUTION:

- When belt is replaced with a new one, adjust it to value for “New belt” to accommodate for insufficient adaptability with pulley grooves.

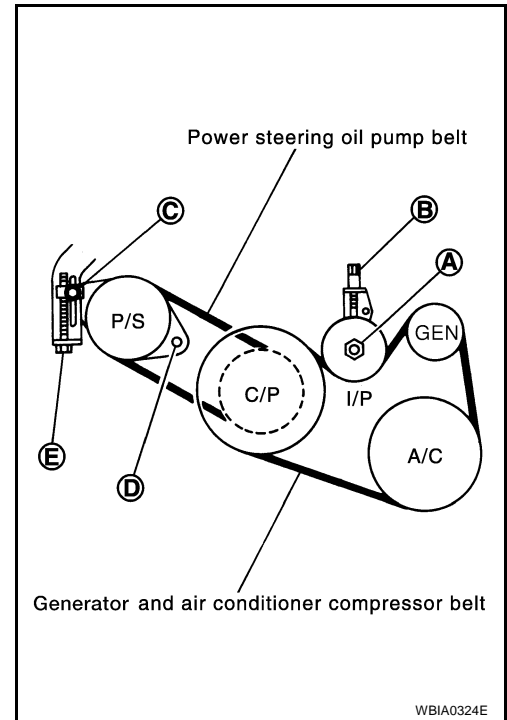
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DRIVE BELTS

- When deflection or tension of belt being used exceeds “Used belt limit” adjust it to value for “Used belt”.
- When checking belt deflection or tension immediately after installation, first adjust it to the specification value. Then, after turning the crankshaft two turns or more, readjust to the specified value to avoid variation in deflection between pulleys.
- When installing belt, make sure that it is correctly engaged with pulley groove.
- Keep oil and water away from belt.
- Do not twist or bend belt excessively.

Generator and Air Conditioner Compressor Belt

1. Remove engine undercover.
2. Loosen idler pulley lock nut (A) and adjust by turning adjusting bolt (B).
 - For specified belt tension, refer to [MA-11, "Drive Belts"](#) .
3. Tighten lock nut (A) to specification.
4. Tighten adjusting bolt (B) to specification.



Power Steering Oil Pump Belt

1. Remove engine undercover.

DRIVE BELTS

- Loosen adjusting bolt (C).
- Loosen power steering oil pump bolt (D).

NOTE:

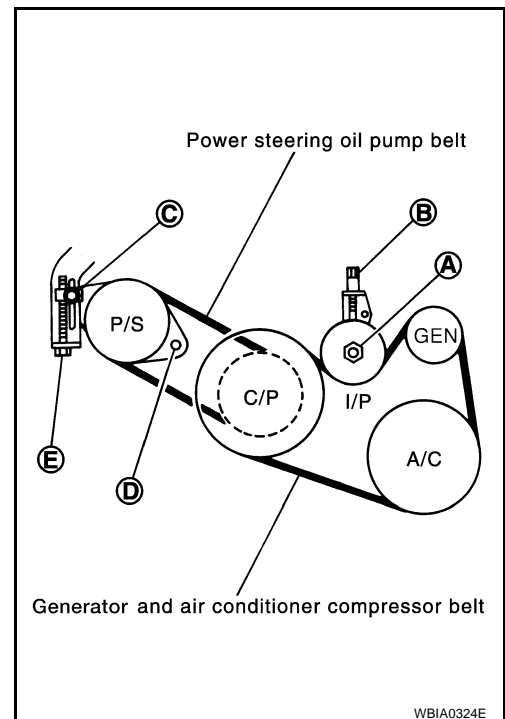
Bolt head (D) is at the engine rear side.

- Adjust by turning the adjusting bolt (E).
 - For specified belt tension, refer to [MA-11, "Drive Belts"](#).

NOTE:

Adjusting bolt (E) is loosened with counterclockwise rotation.

- Tighten adjusting bolt (C) to specification.
- Tighten power steering oil pump bolt (D) to specification.



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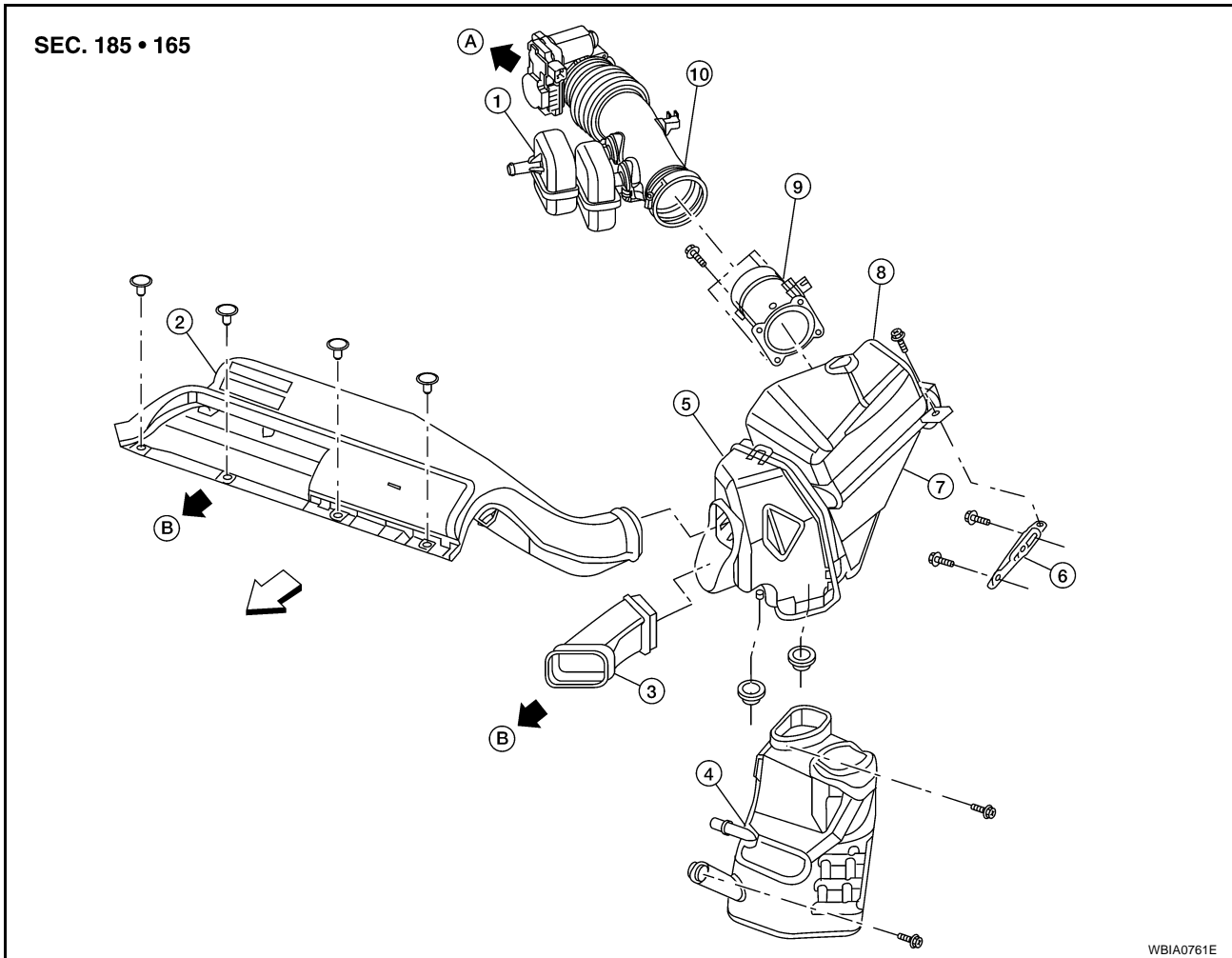
AIR CLEANER AND AIR DUCT

AIR CLEANER AND AIR DUCT

PF16500

Removal and Installation

EBS00RC8



- | | | |
|------------------------------------------------------------|----------------------------------|--------------------------------------|
| 1. Resonator | 2. Fresh air intake tube (upper) | 3. Fresh air intake tube (lower) |
| 4. Resonator in fender | 5. Air cleaner assembly | 6. Air cleaner case mounting bracket |
| 7. Air cleaner case (lower) | 8. Air cleaner case (upper) | 9. Mass air flow sensor |
| 10. Air cleaner to electric throttle control actuator tube | ← Front | A. To throttle body |
| B. Fresh air intake | | |

REMOVAL

1. Disconnect the harness connector from the mass air flow sensor.
2. Disconnect the tube clamp at the electric throttle control actuator and at the fresh air intake tube.
3. Remove air cleaner to electric throttle control actuator tube, air cleaner case (upper) with the mass air flow sensor attached.
4. 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.

5. Remove resonator in the fender, lifting left fender protector, as necessary.

INSTALLATION

Installation is in the reverse order of removal.

AIR CLEANER AND AIR DUCT

CHANGING AIR CLEANER ELEMENT

1. Unhook the air cleaner case side clips and lift up the air cleaner case (upper).
2. Remove the air cleaner element.
3. Install a new air cleaner element.
4. Installation of the remaining components is in the reverse order of removal.

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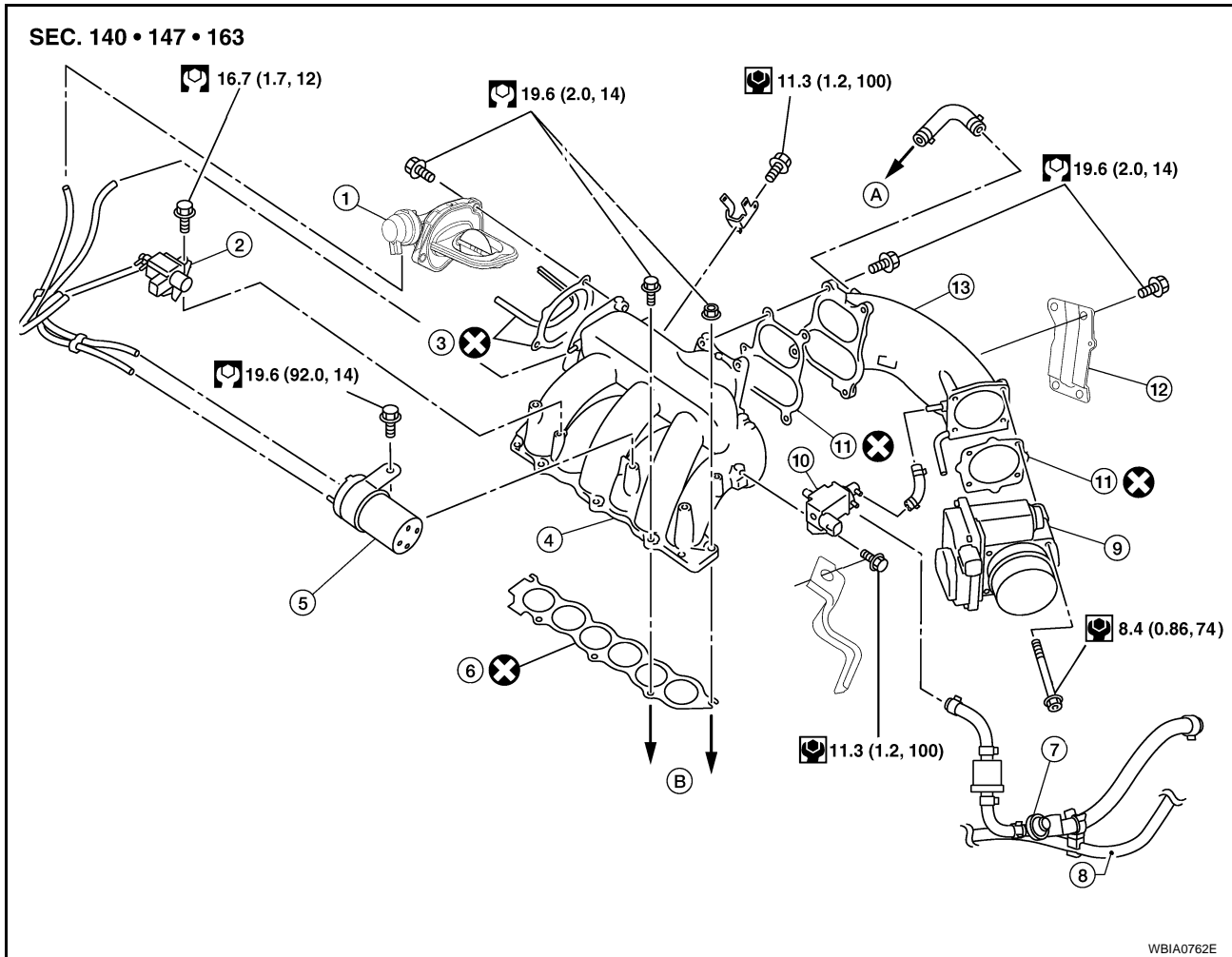
INTAKE MANIFOLD COLLECTOR

INTAKE MANIFOLD COLLECTOR

PFP:14010

Removal and Installation

EBS00RC9



- | | | |
|-------------------------------------------------------|--------------------------------|-------------------------------------------------------|
| 1. Power valve | 2. VIAS control solenoid valve | 3. Power valve gasket |
| 4. Intake manifold collector (lower) | 5. Vacuum tank | 6. Intake manifold collector (lower) gasket |
| 7. Service port | 8. Fuel Hose | 9. Electric throttle control actuator |
| 10. EVAP canister purge volume control solenoid valve | 11. Gasket | 12. Intake manifold collector (lower) support bracket |
| 13. Intake manifold collector (upper) | A. To rocker cover | B. To intake manifold |

REMOVAL

WARNING:

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

CAUTION:

The gasket for intake manifold collector (upper) is secured together with intake manifold collector (lower) bolt. Thus, when replacing only the upper gasket the lower gasket must also be replaced.

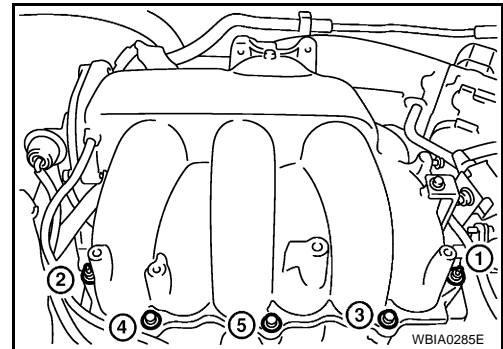
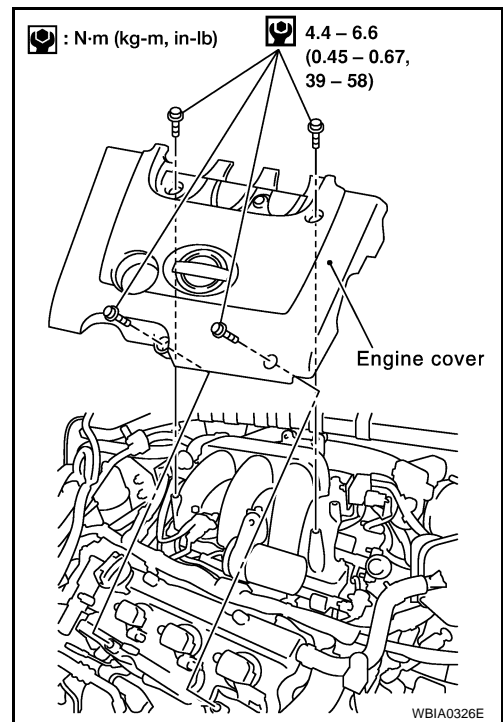
1. Remove the cowl top. Refer to [EI-19, "Removal and Installation"](#).
2. Remove the windshield wiper assembly. Refer to [WW-21, "REMOVAL AND INSTALLATION"](#).

INTAKE MANIFOLD COLLECTOR

3. Remove the engine cover using power tool.
4. Remove air cleaner case upper and mass air flow sensor, and air intake tube as an assembly.
Refer to [EM-16, "Removal and Installation"](#) .
5. Partially drain the coolant when the engine is cool. Refer to [CO-10, "DRAINING ENGINE COOLANT"](#) .
6. Disconnect the following:
 - Power brake booster vacuum hose
 - Coolant hoses from the intake manifold collector
 - Swirl control vacuum lines to power valve and intake manifold collector (upper)
 - Fuel injector electrical connectors
 - PCV hose
 - Electric throttle control actuator electrical connector
 - EVAP canister purge hose

CAUTION:

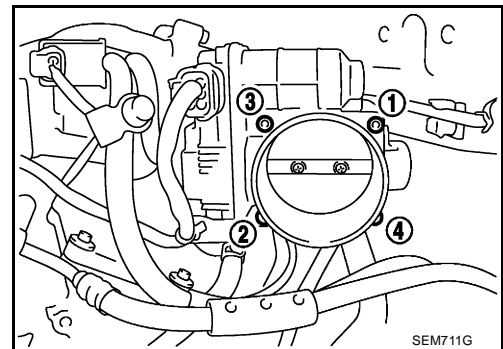
- **Cover any engine openings to avoid the entry of any foreign material.**
7. Disconnect the power steering hose bracket from the rear of the intake manifold collector.
 8. Remove the EVAP canister purge volume solenoid valve bracket bolt. Position the valve aside.
 9. Remove the VIAS control solenoid valve bracket bolt. Position the valve aside.
 10. Remove the vacuum tank.
 11. Remove the intake manifold collector (lower) support bracket from the back of the intake manifold collector (lower) using power tool.
 12. Loosen the intake manifold collector (lower) bolts in the order as shown using power tool, and remove the intake manifold collector (lower) and gasket.



13. If necessary, remove the electric throttle control actuator bolts in the order as shown and remove the electric throttle control actuator.

CAUTION:

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



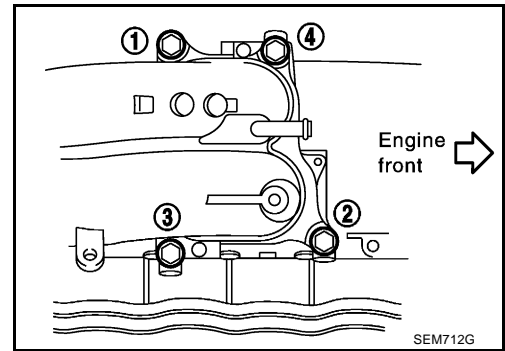
INTAKE MANIFOLD COLLECTOR

14. If necessary, remove the intake manifold collector (upper) bolts in the order as shown, using power tool and remove the intake manifold collector (upper).

- ⇒: Engine front

CAUTION:

Handle carefully to avoid any shock to the electric throttle control actuator, if installed.



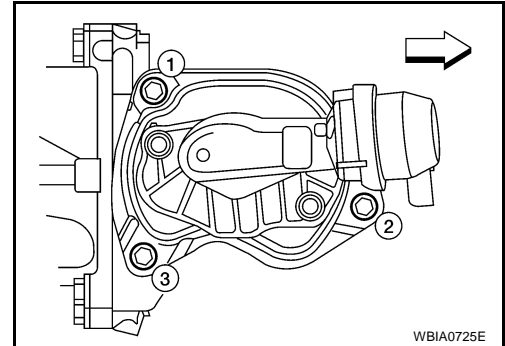
15. If necessary, remove power valve bolts in the order as shown and remove the power valve.

NOTE:

The power valve must be held in the closed position during installation.

16. If necessary remove the following components:

- Vacuum tank
- VIAS control solenoid valve
- EVAP canister purge volume control solenoid valve



INSTALLATION

Installation is in the reverse order of removal, paying attention to the following:

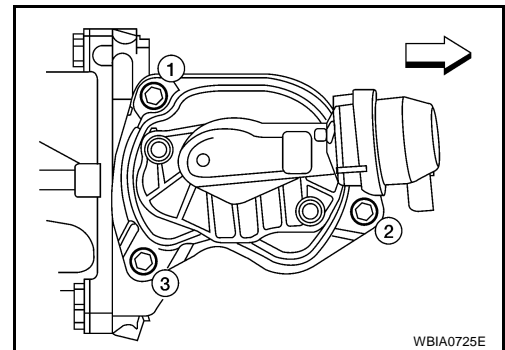
NOTE:

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-79, "Throttle Valve Closed Position Learning"](#).
 2. Perform the "Idle Air Volume Learning" when the electric throttle control actuator is replaced. Refer to [EC-79, "Idle Air Volume Learning"](#).
- If necessary, install power valve bolts in the order as shown.

CAUTION:

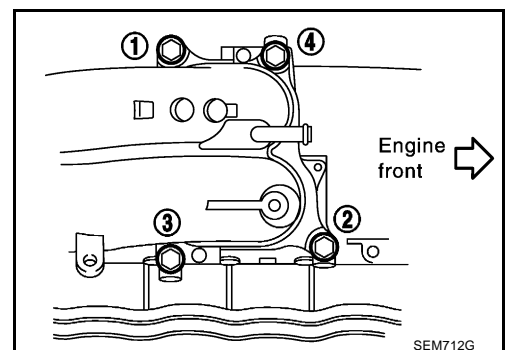
Do not reuse gasket.



- If necessary, tighten the intake manifold collector pipe bolts in the order as shown.

CAUTION:

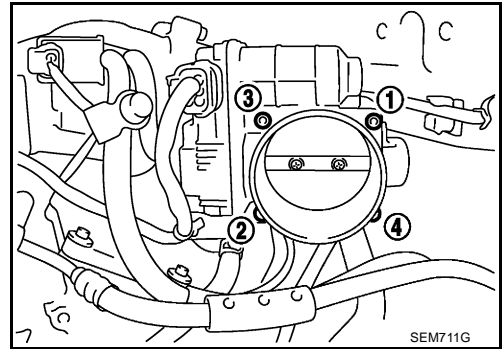
Do not reuse gasket.



INTAKE MANIFOLD COLLECTOR

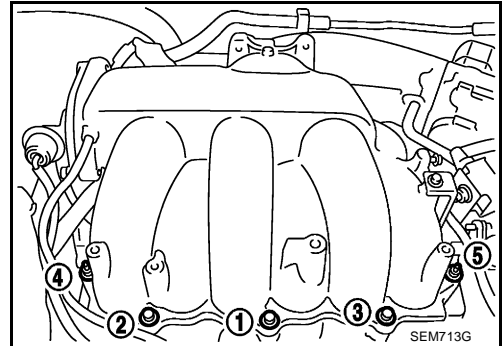
- If necessary, install the electric throttle control actuator bolts in the order as shown. Install gasket with three protrusions facing down.

CAUTION:
Do not reuse gasket.



- Install the intake manifold collector (lower) bolts in the order as shown.

CAUTION:
Do not reuse gasket.



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INTAKE MANIFOLD

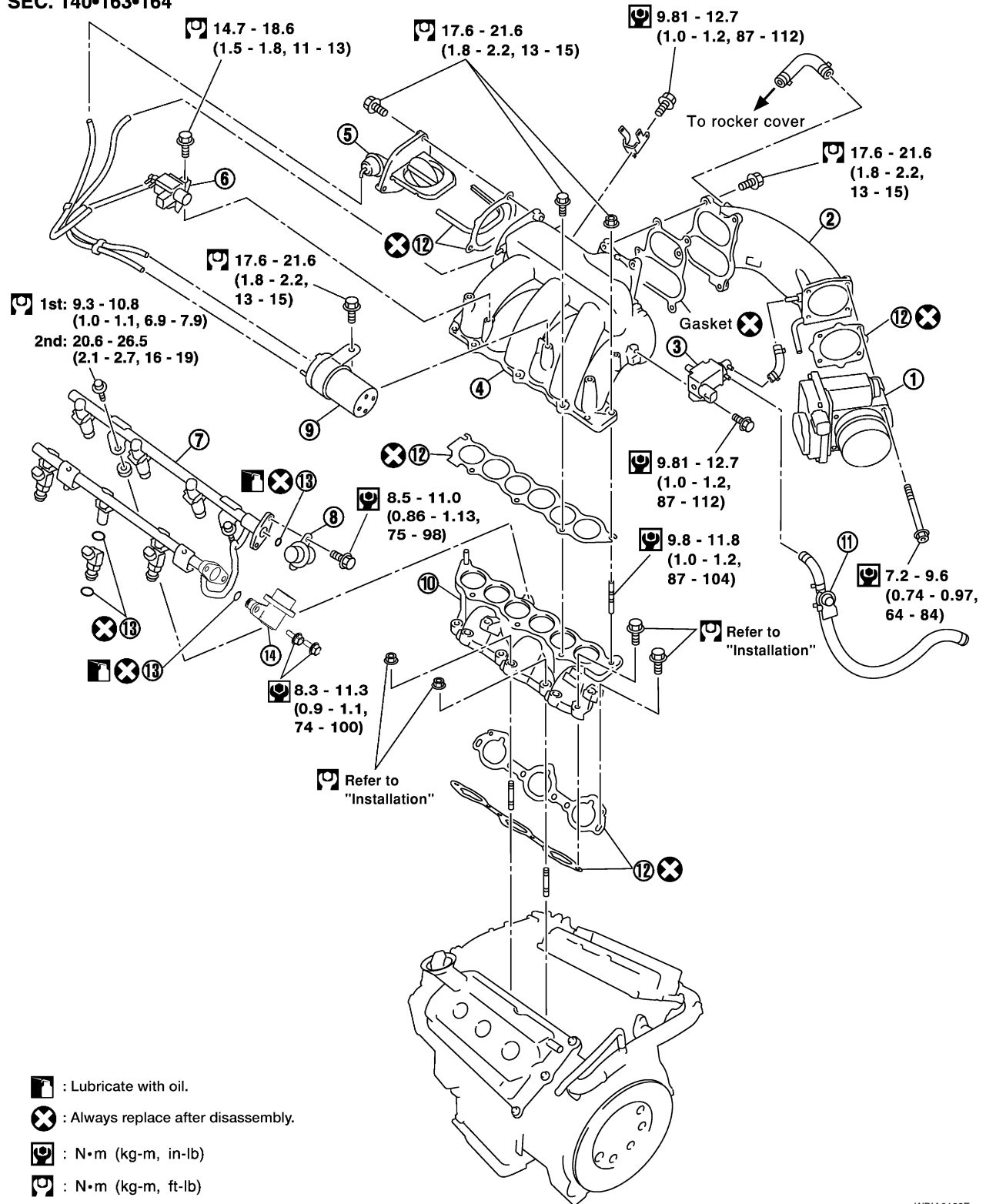
PF14003

EBS00RCB

INTAKE MANIFOLD

Removal and Installation

SEC. 140•163•164



WBIA0166E

- | | | |
|---------------------------------------|--------------------------------------|------------------------------------------------------|
| 1. Electric throttle control actuator | 2. Intake manifold collector (upper) | 3. EVAP canister purge volume control solenoid valve |
| 4. Intake manifold collector (lower) | 5. Power valve | 6. VIAS control solenoid valve |
| 7. Fuel tube | 8. Fuel damper | 9. Vacuum tank |

INTAKE MANIFOLD

10. Intake manifold
13. O-ring

11. Service port
14. Fuel damper

12. Gasket

REMOVAL

WARNING:

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

1. Remove the engine cover using power tool.
2. Release the fuel pressure. Refer to [EC-81, "Fuel Pressure Check"](#) .
3. Remove air cleaner case (upper) and mass air flow sensor, and air intake tube as an assembly. Refer to [EM-16, "Removal and Installation"](#) .
4. Partially drain the coolant when the engine is cool. Refer to [CO-10, "DRAINING ENGINE COOLANT"](#) .

5. Disconnect fuel tube quick connector at vehicle piping side.
6. To remove the quick connector cap, hold the sides of the connector, push in the tabs and pull out the tube.

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.

CAUTION:

- The tube can be removed when the tabs are completely depressed. Do not twist it more than necessary.
- 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.

7. Disconnect the power brake booster vacuum hose, the coolant hoses from the electric throttle control actuator, the swirl control vacuum lines, the fuel injectors electrical connectors, and the PCV hose.

CAUTION:

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

8. Disconnect the electric throttle control actuator electrical connectors.

9. Remove the windshield wiper assembly. Refer to [WW-21, "REMOVAL AND INSTALLATION"](#) .

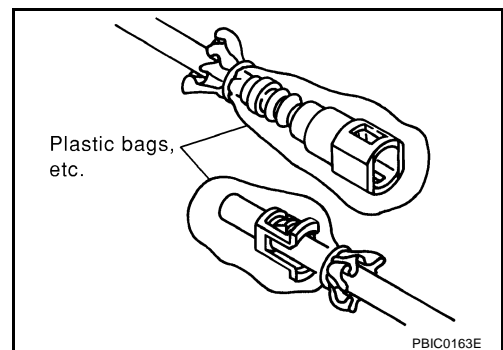
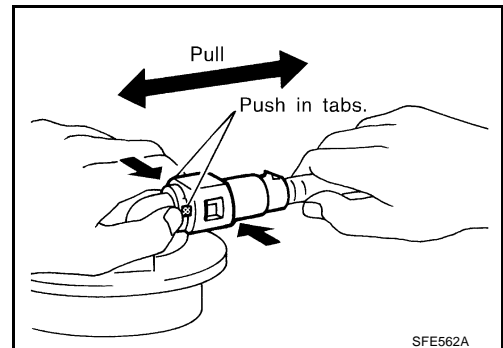
10. Disconnect the power steering hose bracket.

11. Remove the vacuum tank from the back of the intake manifold collector (lower).

12. Remove the intake manifold collector (upper) and electric throttle control actuator by loosening the four bolts in a diagonal pattern.

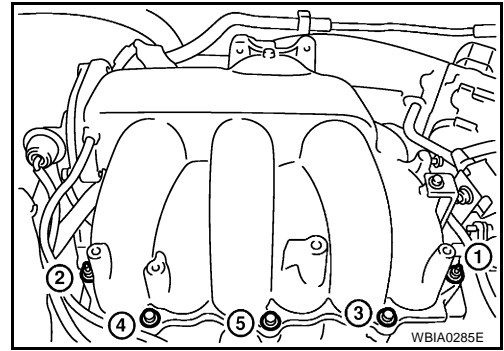
CAUTION:

Handle carefully to avoid any shock to the electric throttle control actuator.

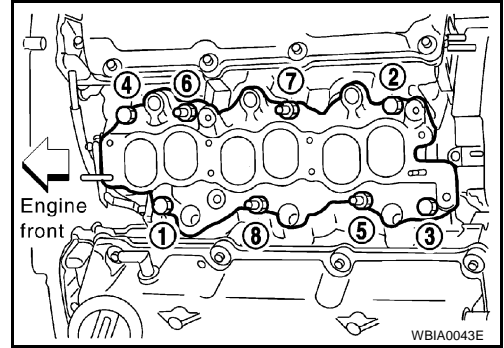


INTAKE MANIFOLD

13. Loosen the bolts in the order as shown, and remove the intake manifold collector (lower) using power tool.
14. 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.



15. Loosen the bolts in the order as shown, and remove the intake manifold using power tool.

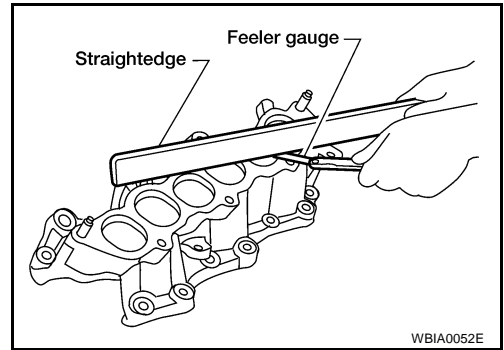


INSPECTION AFTER REMOVAL

Surface Distortion

- Using straightedge and feeler gauge, inspect the surface distortion of both the intake manifold and the intake manifold collector (lower).

Standard : 0.1 mm (0.004 in)



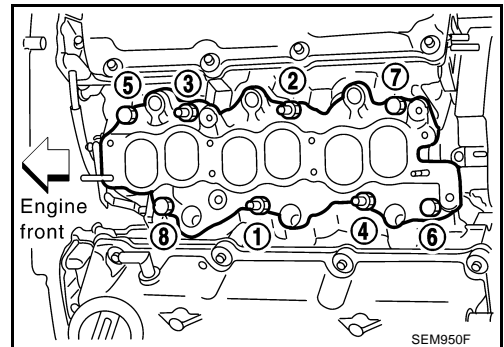
INSTALLATION

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

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

Stage 1 : 7.5 N·m (0.77 kg·m, 66 in-lb)

Stage 2 : 28.5 N·m (2.9 kg·m, 21 ft-lb)

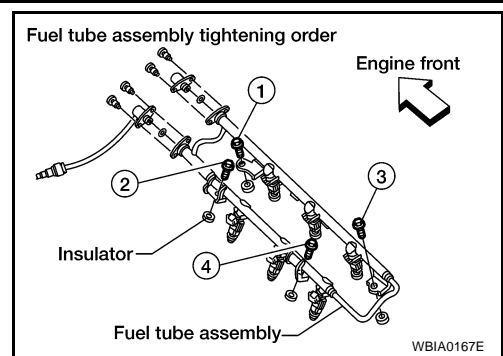


INTAKE MANIFOLD

- Seat the fuel injectors into the intake manifold with new O-rings. Tighten the fuel rail bolts as shown, in two stages:

CAUTION:

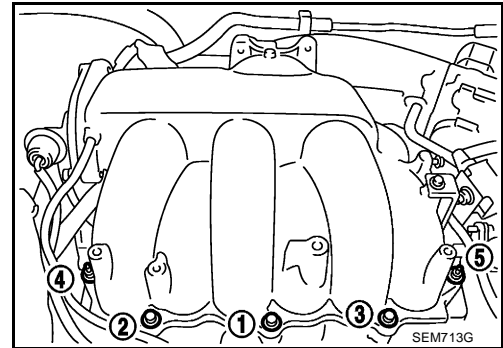
Do not reuse O-rings.



- Install the intake manifold collector (lower) bolts in the numerical order as shown.

CAUTION:

Do not reuse gaskets.



- Tighten the bolts of the intake manifold collector (upper) and electric throttle control actuator assembly equally and diagonally to specification.

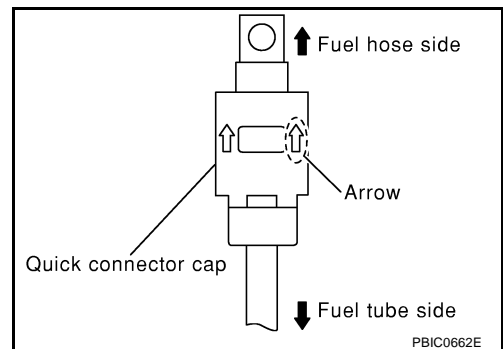
NOTE:

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-79, "Throttle Valve Closed Position Learning"](#).
2. Perform the "Idle Air Volume Learning" when the electric throttle control actuator is replaced. Refer to [EC-79, "Idle Air Volume Learning"](#).

- 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 is no fuel leakage 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.

NOTE:

Use mirrors for checking on connections out of the direct line of sight.

INTAKE MANIFOLD

WARNING:

Do not touch engine immediately after stopping as engine is extremely hot.

- Perform procedures for “Throttle Valve Closed Position Learning” after finishing repairs. Refer to [EC-79, "Accelerator Pedal Released Position Learning"](#) .
- If electric throttle control actuator is replaced, perform procedures for “Idle Air Volume Learning” after finishing repairs. Refer to [EC-79, "Idle Air Volume Learning"](#) .

EXHAUST MANIFOLD AND THREE WAY CATALYST

EXHAUST MANIFOLD AND THREE WAY CATALYST

Removal and Installation

PF1:14004

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Engine front

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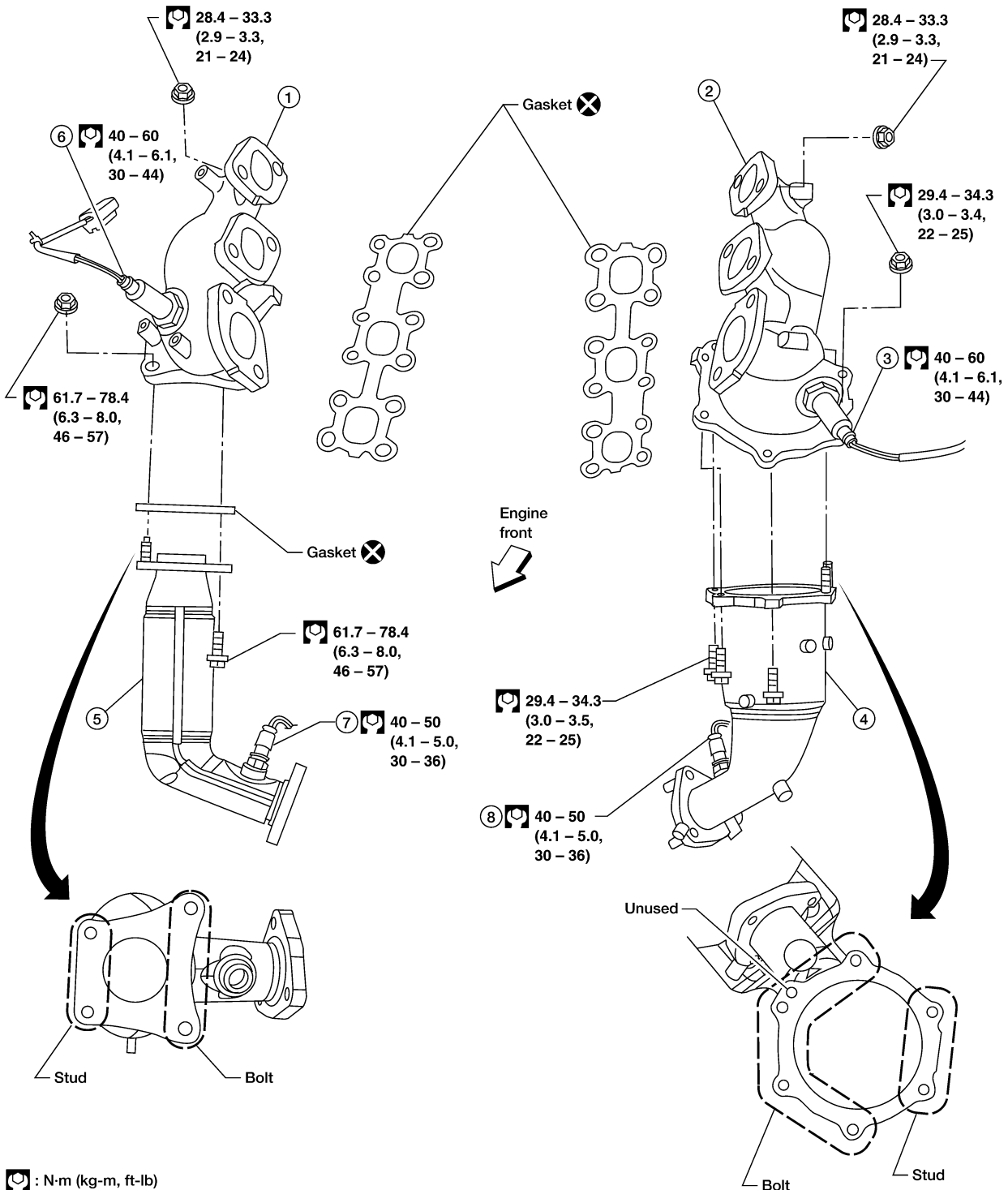
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WBIA0267E

- | | | |
|-------------------------------------------|-------------------------------------------|-------------------------------------------|
| 1. Exhaust manifold (RH bank) | 2. Exhaust manifold (LH bank) | 3. Air fuel ratio (A/F) sensor 1 (bank 2) |
| 4. Three way catalyst (manifold) (bank 2) | 5. Three way catalyst (manifold) (bank 1) | 6. Air fuel ratio (A/F) sensor 1 (bank 1) |
| 7. Heated oxygen sensor 2 (bank 1) | 8. Heated oxygen sensor 2 (bank 2) | |

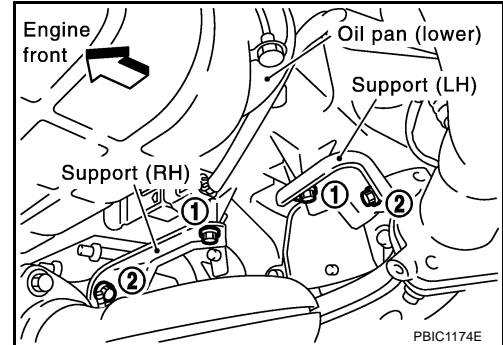
EXHAUST MANIFOLD AND THREE WAY CATALYST

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-109, "REMOVAL"](#).

1. Remove the front wheel and tires using power tool.
2. Remove the engine undercover.
3. Remove the inner wheel well splash shields.
4. Remove the radiator and cooling fan assembly. Refer to [CO-13, "Removal and Installation"](#).
5. Remove the front exhaust tube. Refer to [EX-3, "Removal and Installation"](#).
6. Remove the front suspension member. Refer to [FSU-16, "Removal and Installation"](#).
7. Remove the RH and LH three way catalyst support bolts in the order as shown.

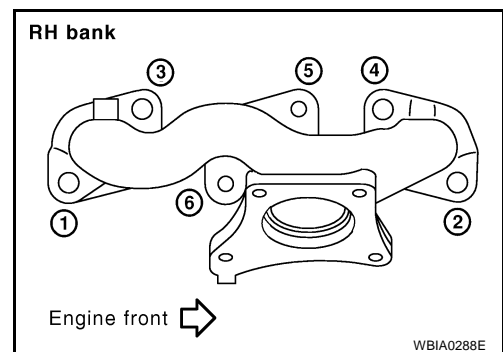


8. Remove heated oxygen sensor 2 (bank 1), heated oxygen sensor 2 (bank 2), air fuel ratio (A/F) sensor 1 (bank 1) and air fuel ratio (A/F) sensor 1 (bank 2).
 - a. Remove harness connector of each sensor, and disconnect the harness from the bracket and middle clamp.
 - b. Remove both heated oxygen sensors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

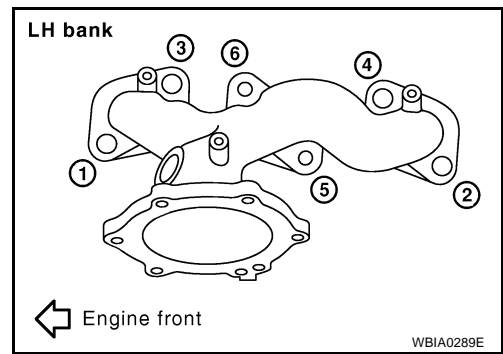
Tool numbers : KV10114400 (J-38365)
: KV991J0050 (J-44626)

CAUTION:

- Be careful not to damage heated oxygen sensors or air fuel ratio (A/F) sensors.
 - Discard any heated oxygen sensor which has been dropped from a height of more than 0.5 m (19.7 in) onto a hard surface such as a concrete floor; replace with a new sensor.
9. Remove exhaust manifold and three way catalyst heat shields using power tool.
 10. Remove the three way catalyst (manifold) (bank 1) and three way catalyst (manifold) (bank 2) by loosening the bolts first and then removing the nuts and through bolts.
 11. Remove the exhaust manifolds. Loosen the exhaust manifold nuts in the order as shown.



EXHAUST MANIFOLD AND THREE WAY CATALYST

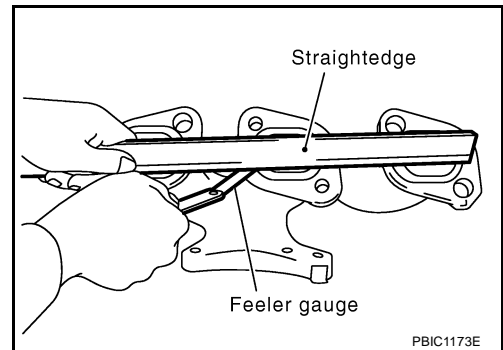


INSPECTION AFTER REMOVAL

Surface Distortion

- Use a reliable straightedge and feeler gauge to check the flatness of the exhaust manifold mating surfaces.

Limit : 0.3mm (0.012 in)



INSTALLATION

Installation is in the reverse order of removal.

- Install the exhaust manifold nuts in the order as shown.

CAUTION:

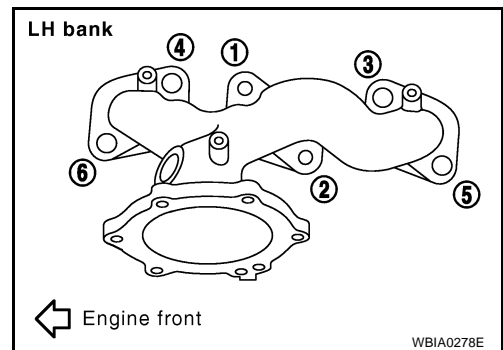
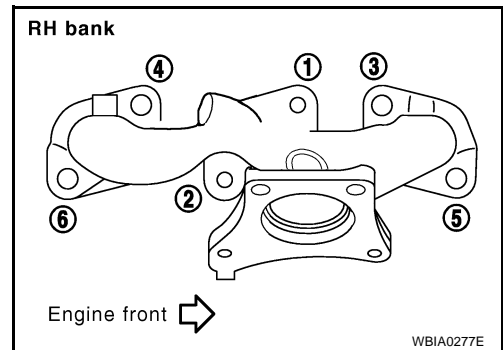
- When using the heated oxygen sensor wrench, tighten to the middle of specified torque range, because the length of the Tool may increase the actual tightness. Do not tighten to the maximum specified torque range.

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

- Before installing a heated oxygen sensor or air fuel ratio (A/F) sensor, 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

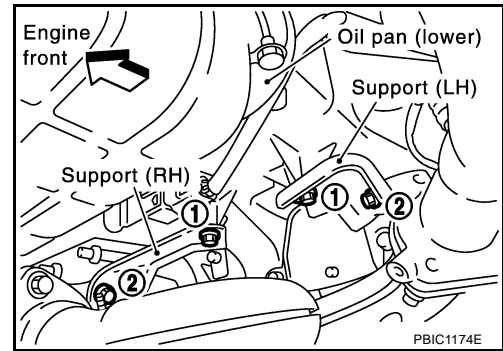
- Do not over-tighten the air fuel ratio (A/F) sensor or heated oxygen sensors. Doing so may cause damage.



EXHAUST MANIFOLD AND THREE WAY CATALYST

- Install the RH and LH three way catalyst support bolts in the order as shown.

Three way catalyst support bolts : 22 N·m (2.2 kg-m, 16 ft-lb)

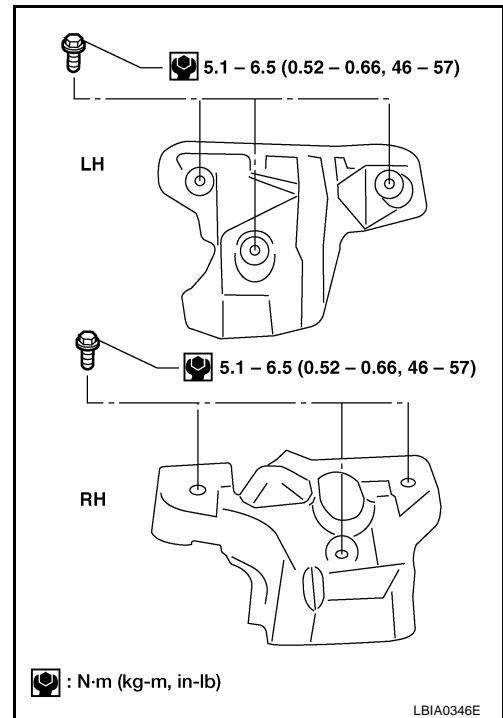


- Install the exhaust manifold heat shield bolts.

Exhaust manifold heat shield bolts : 5.8 N·m (0.59 kg-m, 51 in-lb)

- Install the three way catalyst heat shield bolts.

Three way catalyst heat shield bolts : 8.25 N·m (0.84 kg-m, 73 in-lb)



OIL PAN AND OIL STRAINER

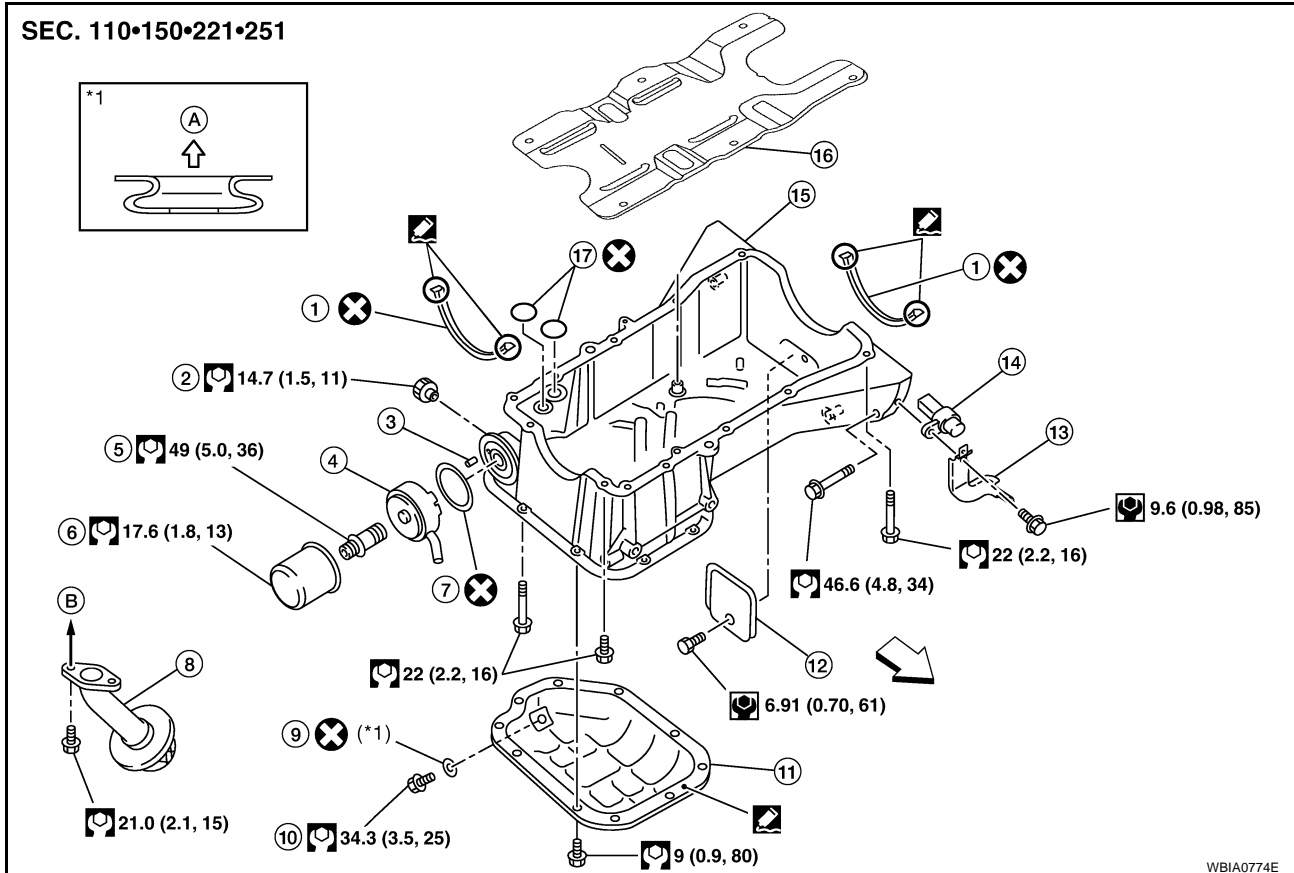
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EBS00RCD

OIL PAN AND OIL STRAINER

Removal and Installation

SEC. 110•150•221•251



- | | | |
|-------------------------------------------------|--------------------------------|----------------------|
| 1. Upper oil pan gasket | 2. Oil pressure switch | 3. Relief valve |
| 4. Oil cooler | 5. Oil cooler connection | 6. Oil filter |
| 7. Oil cooler gasket | 8. Oil strainer | 9. Drain plug gasket |
| 10. Drain plug | 11. Lower oil pan | 12. Rear plate cover |
| 13. Heated oxygen sensor (bank 2) harness clamp | 14. Crankshaft position sensor | 15. Upper oil pan |
| 16. Oil pan baffle | 17. O-ring | A. Oil pan side |
| B. To oil pump body | | |

REMOVAL

WARNING:

- You should not remove the oil pan until the exhaust system and cooling system have completely cooled off.
- When removing the front and rear engine through bolts and nuts, lift the engine up slightly for safety. For engine slingers, refer to [EM-109, "REMOVAL"](#).

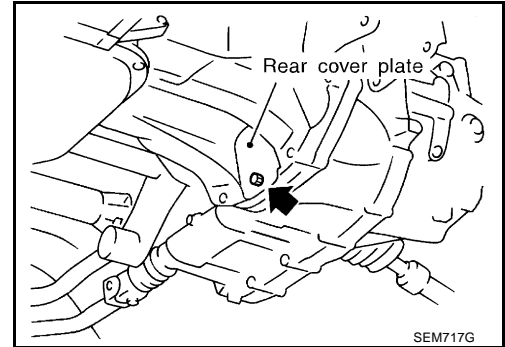
CAUTION:

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.

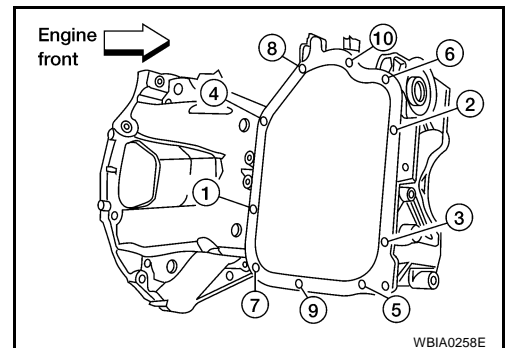
1. Remove the front RH wheel and tire using power tool. Refer to [WT-6, "WHEEL AND TIRE ASSEMBLY"](#).
2. Disconnect the battery negative terminal.
3. Remove the oil dipstick.
4. Drain the engine coolant. Refer to [CO-10, "DRAINING ENGINE COOLANT"](#).
5. Remove the engine undercover.
6. Remove the RH inner fender splash shield.
7. Remove the A/C drive belt. Refer to [EM-13, "DRIVE BELTS"](#).
8. Remove the front exhaust tube. Refer to [EX-3, "Removal and Installation"](#).

OIL PAN AND OIL STRAINER

9. Remove coolant pipe bolts.
10. Remove the A/C compressor with piping attached, and position it out of the way securely with wire.
CAUTION:
Do not pull on or crimp the A/C lines and hoses.
11. Disconnect the coolant lines from the engine oil cooler and plug them to prevent coolant loss.
12. Remove the oil filter and engine oil cooler from the upper oil pan.
13. Remove the oil pressure switch/sensor, and the crankshaft position sensor (POS) from the upper oil pan.
14. Remove the front drive shafts. Refer to [FAX-11, "Removal and Installation"](#) .
15. Remove the front suspension member. Refer to [FSU-16, "Removal and Installation"](#) .
16. Disconnect the heated oxygen sensors and air flow ratio (A/F) sensors and remove the two catalytic converters from the exhaust manifolds using power tool. Refer to [EM-27, "Removal and Installation"](#) .
17. Remove the rear plate cover from the upper oil pan.



18. Loosen the lower oil pan bolts using power tool in order as shown.

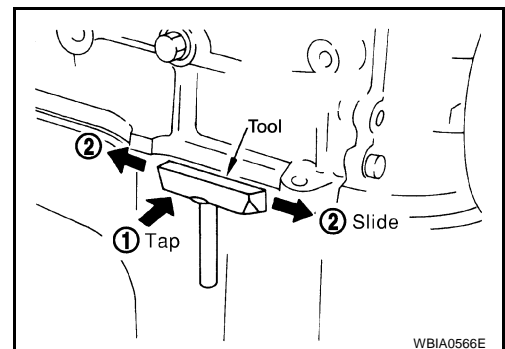


19. Remove the lower oil pan.
 - a. Insert Tool between the lower oil pan and the upper oil pan.

Tool number : KV10111100 (J-37228)

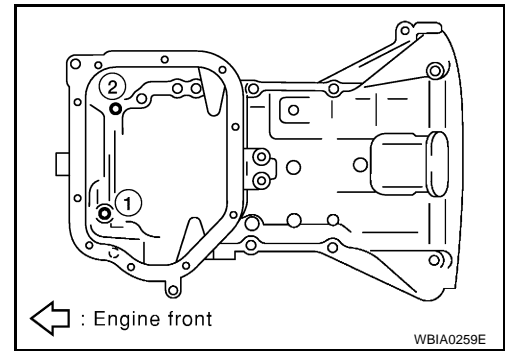
CAUTION:

- Be careful not to damage the mating surface.
 - Do not insert a screwdriver, this will damage the mating surfaces.
- b. Slide the Tool by tapping its side (2) with a hammer to remove the lower oil pan from the upper oil pan.

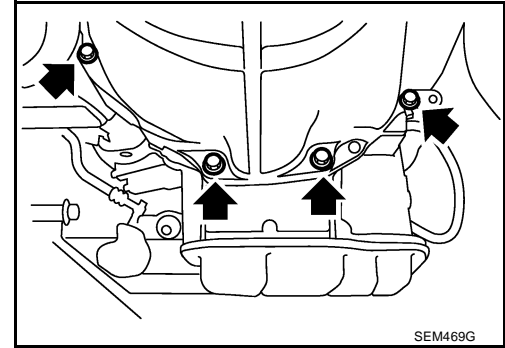


OIL PAN AND OIL STRAINER

20. Loosen upper oil pan front bolts in the order shown.

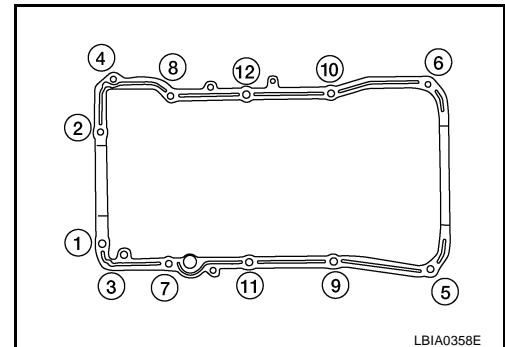


21. Remove the four upper oil pan to transaxle bolts.

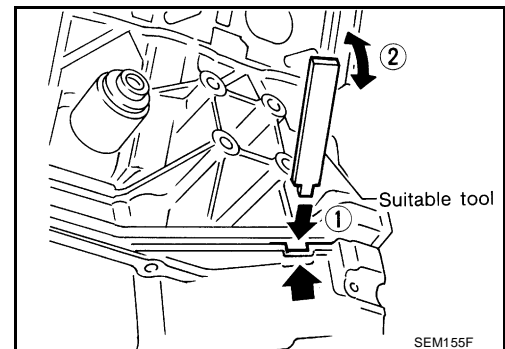


22. Remove the upper oil pan.

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



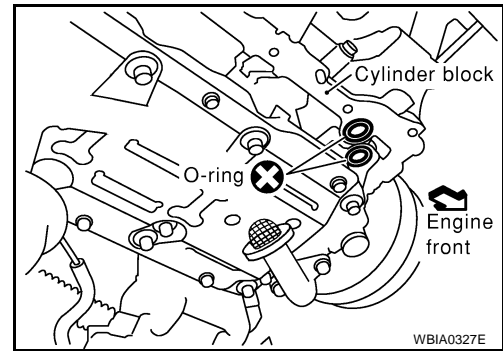
- b. Insert an appropriate size tool into the notch (1) of the upper oil pan as shown.
- c. Pry off the upper oil pan by moving the tool up and down (2) as shown.



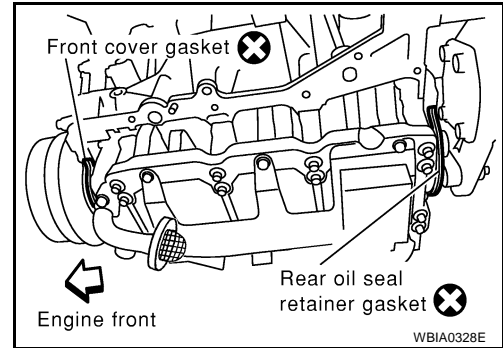
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OIL PAN AND OIL STRAINER

23. Remove the O-ring seals from the bottom of the cylinder block and oil pump housing, use new O-rings for installation.



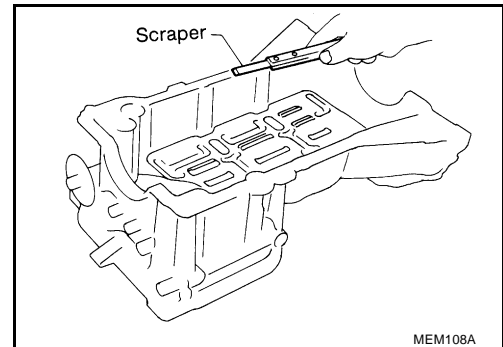
24. Remove front cover gasket and rear oil seal retainer gasket.
25. Remove the oil strainer.



26. If re-installing the original oil pan, remove the old sealant from the mating surfaces using a scraper.
- 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

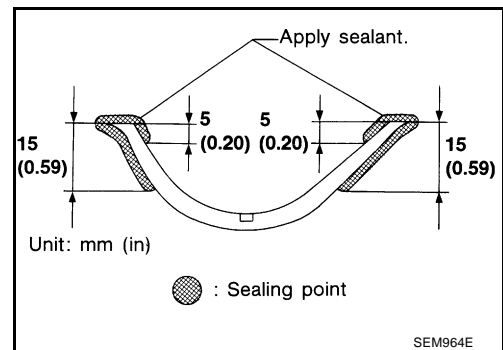
Inspect oil strainer for any foreign material replace as necessary.

INSTALLATION

CAUTION:

Wait at least 30 minutes before refilling the engine with oil.

1. Install oil strainer and tighten bolt to specified torque. Refer to [EM-31, "Removal and Installation"](#) .
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-46, "Recommended Chemical Products and Sealants"](#) .

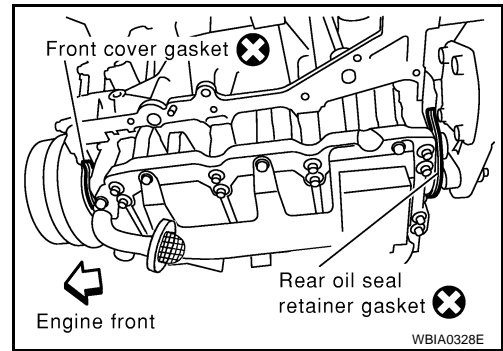


OIL PAN AND OIL STRAINER

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

CAUTION:

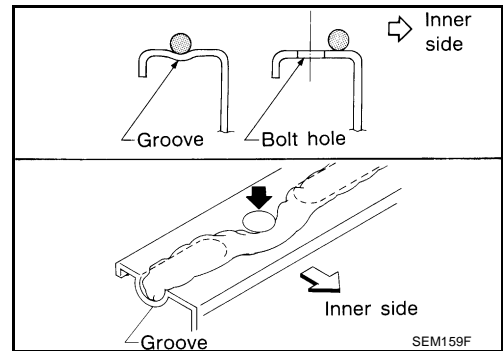
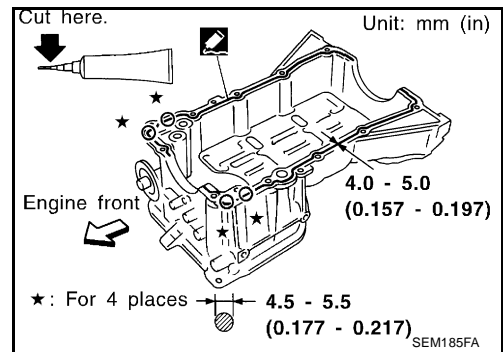
Do not reuse gaskets.



4. Apply a bead of sealant to the cylinder block mating surface of the upper oil pan to a limited portion using Tool as shown.

- Use Genuine Silicone RTV Sealant, or equivalent. Refer to [GI-46. "Recommended Chemical Products and Sealants"](#).
- Be sure the sealant is applied to a limited portion as shown, and the sealant is 4.0 - 5.0 mm (0.157 - 0.197 in) or 4.5 - 5.5 mm (0.177 - 0.217 in) wide.
- Installation should be done within 5 minutes after coating.

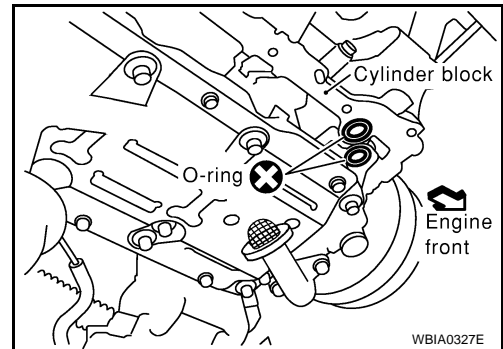
Tool number : WS39930000 (—)



5. Install new O-rings on the cylinder block and oil pump body.

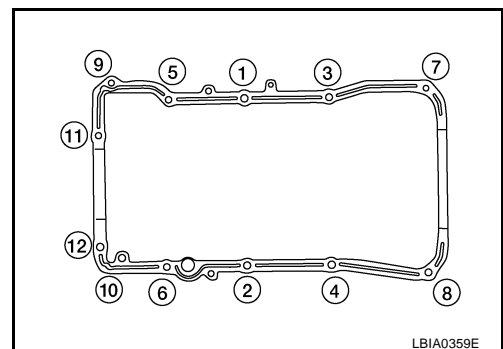
CAUTION:

Do not reuse O-rings.



6. Install the upper oil pan.

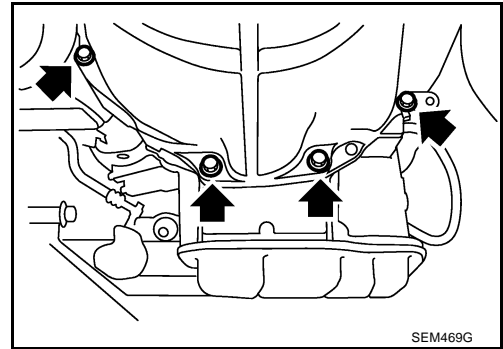
- Tighten upper oil pan bolts in the order as shown.
- Wait at least 30 minutes before refilling the engine with oil.



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OIL PAN AND OIL STRAINER

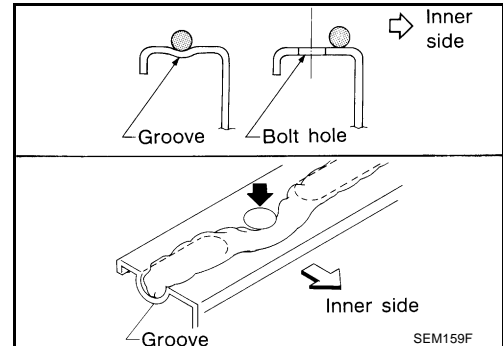
7. Install the four upper oil pan to transaxle bolts. Refer to [CVT-199, "Removal and Installation"](#) .



8. Apply a continuous bead of sealant to the lower oil pan using Tool as shown.

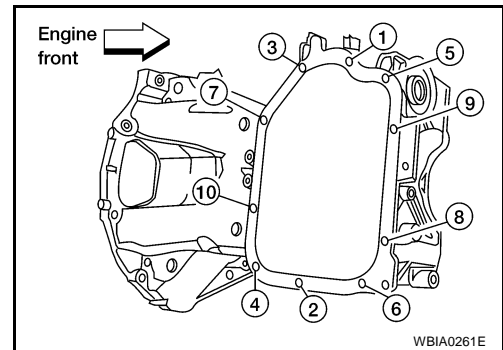
- Use Genuine Silicone RTV Sealant, or equivalent. Refer to [GI-46, "Recommended Chemical Products and Sealants"](#) .
- Be sure the sealant is 4.5 - 5.5 mm (0.177 - 0.217 in) wide.
- Installation must be done within 5 minutes after applying sealant.

Tool number : WS39930000 (—)



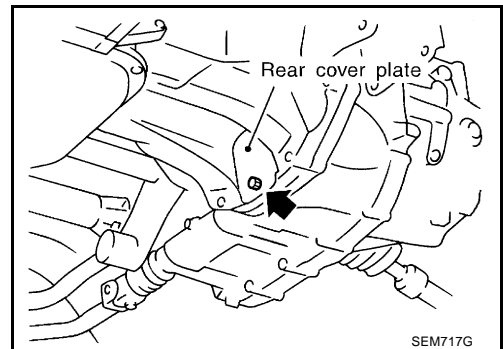
9. Install the lower oil pan. Tighten the lower oil pan bolts in order as shown.

- Wait at least 30 minutes before refilling the engine with oil.



10. Install rear plate cover.

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



INSPECTION AFTER INSTALLATION

- Start the engine and check for leaks. Refer to [LU-8, "Changing Engine Oil"](#) .
- Inspect the engine oil level. Refer to [LU-8, "Changing Engine Oil"](#) .

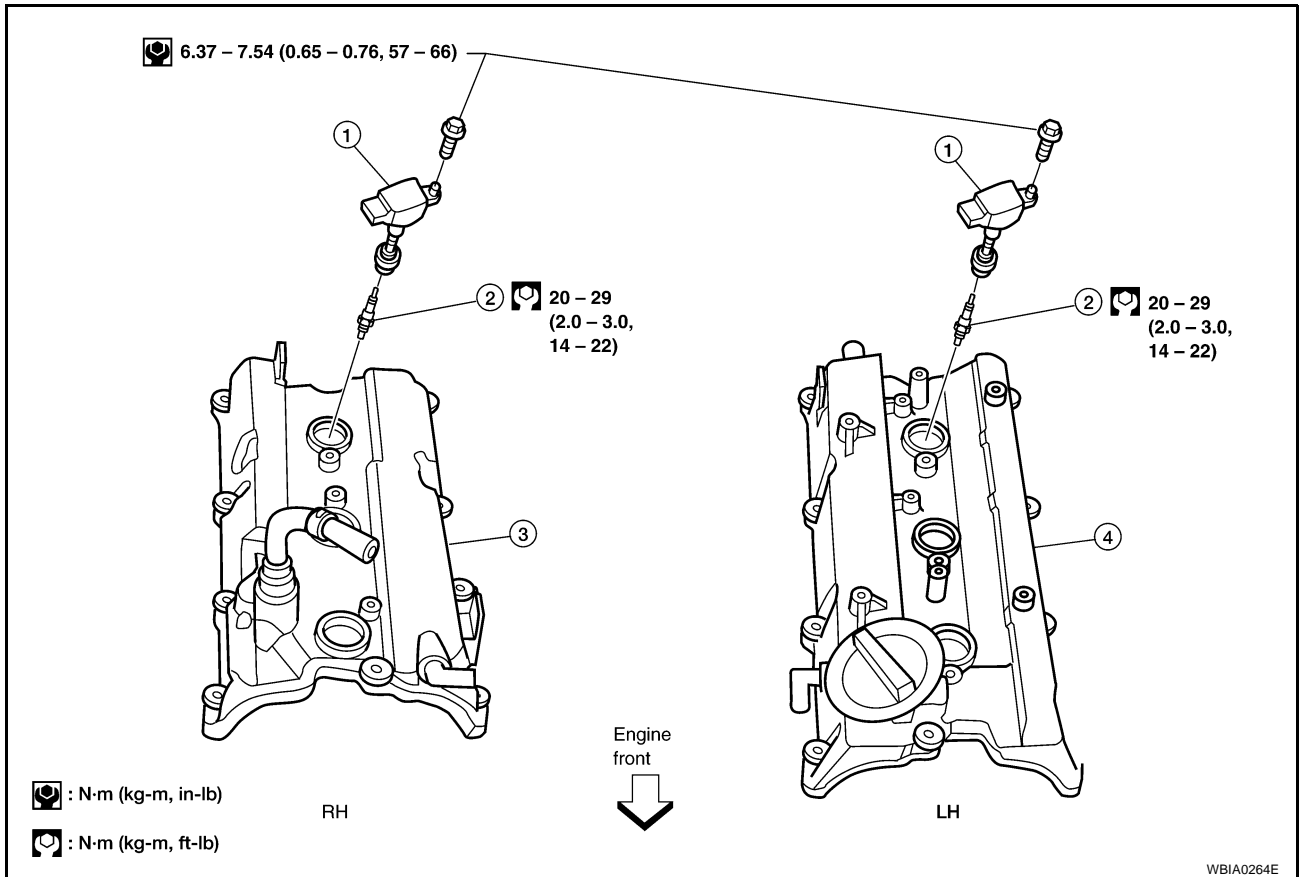
IGNITION COIL

PF2:22448

IGNITION COIL

Removal and Installation

EBS00RCE



1. Ignition coil
2. Spark plug
3. Rocker cover (right bank)
4. Rocker cover (left bank)

REMOVAL

1. Remove the intake manifold collector (upper), gasket, and throttle body. Refer to [EM-22, "Removal and Installation"](#).
2. Remove the six ignition coils.

CAUTION:
Do not shock it.

INSTALLATION

Installation is in the reverse order of removal.

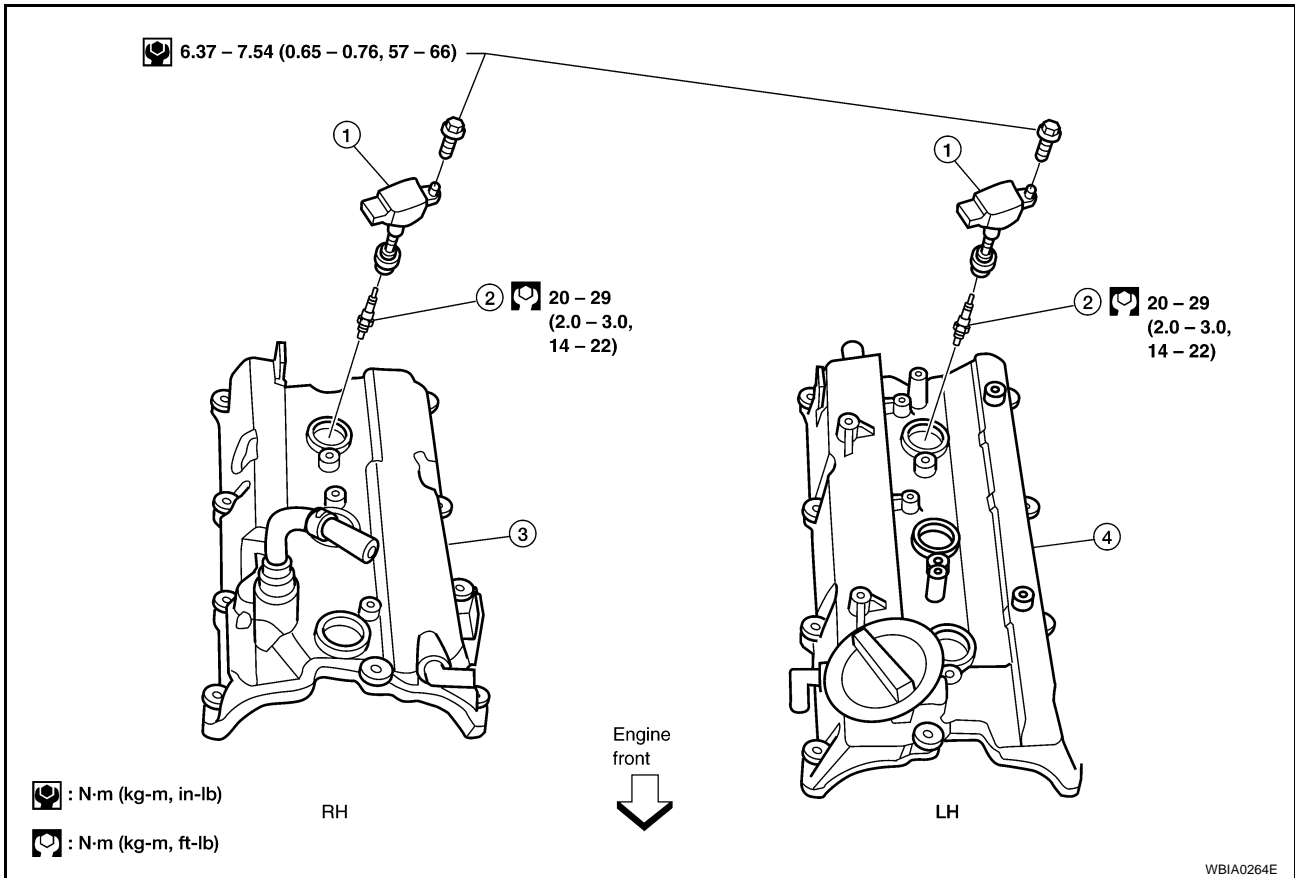
SPARK PLUG (PLATINUM-TIPPED TYPE)

SPARK PLUG (PLATINUM-TIPPED TYPE)

PF2:22401

Removal and Installation

EBS00RCF



1. Ignition coil
2. Spark plug
3. Rocker cover (right bank)
4. Rocker cover (left bank)

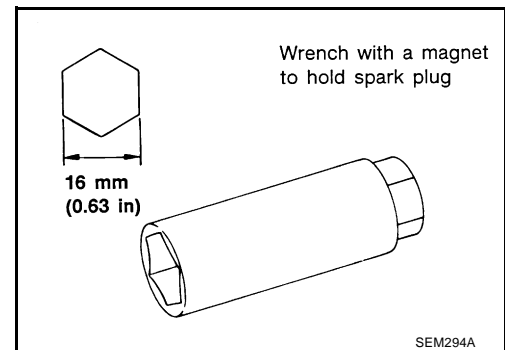
REMOVAL

1. Remove the intake manifold collector (upper), gasket, and throttle body. Refer to [EM-22, "Removal and Installation"](#).
2. Remove the six ignition coils.

CAUTION:

Do not shock it.

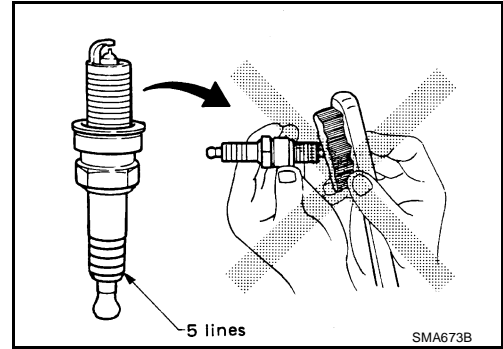
3. Remove the six spark plugs using suitable tool.
 - If replacing the spark plugs use the correct spark plug for maximum performance. Refer to [EM-39, "INSTALLATION"](#).



SPARK PLUG (PLATINUM-TIPPED TYPE)

INSPECTION AFTER REMOVAL

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



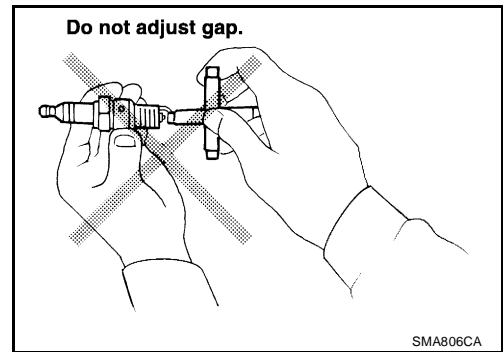
- If the spark plug tip is covered with carbon, a spark plug cleaner may be used.

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

Cleaning time : Less than 20 seconds

- Checking and adjusting the spark plug gap is not required between change intervals. If the gap is out of specification, replace the spark plug.

Gap (nominal) : 1.1 mm (0.043 in)



INSTALLATION

Installation is in the reverse order of removal.

Spark Plug Types

Make	NGK
Part number	DILFR5A11
Gap (nominal)	1.1 mm (0.043 in)

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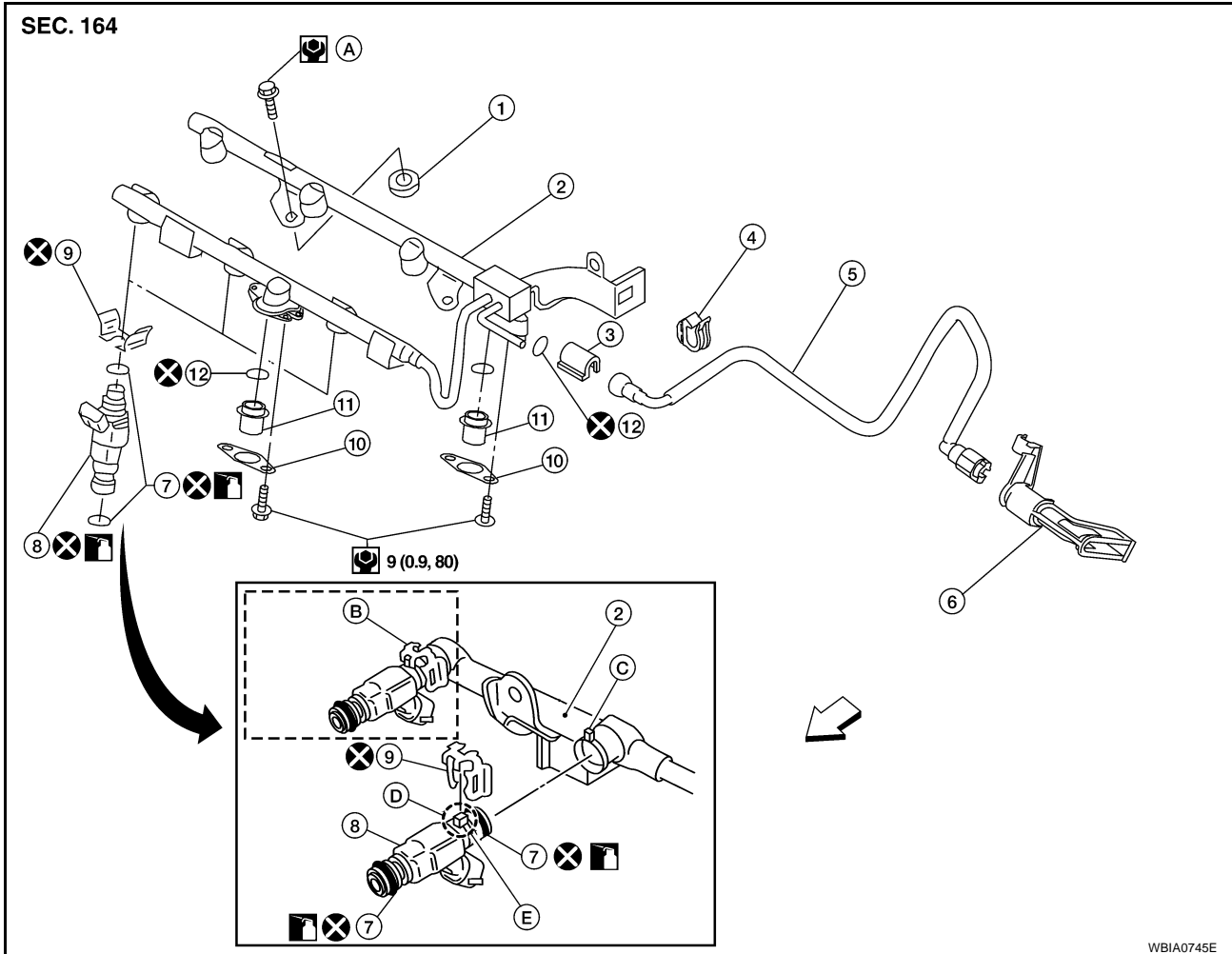
FUEL INJECTOR AND FUEL TUBE

PF16600

FUEL INJECTOR AND FUEL TUBE

Removal and Installation

EBS00RCG



- | | | |
|--------------------------|--------------------------|-------------------------|
| 1. Insulator | 2. Fuel tube assembly | 3. Quick connector cap |
| 4. Clip | 5. Fuel hose | 6. Quick connector cap |
| 7. O-ring | 8. Fuel injector | 9. Clip |
| 10. Fuel damper retainer | 11. Fuel damper | 12. O-ring |
| ← Front | A. Refer to installation | B. Installed condition |
| C. Protrusion | D. Align protrusion | E. Clip mounting groove |

CAUTION:

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

REMOVAL

1. Remove the engine cover using power tool.
2. Release the fuel pressure.
Refer to [EC-81, "FUEL PRESSURE RELEASE"](#).
3. Remove air cleaner case lid and mass air flow sensor, and air intake tube as an assembly.
Refer to [EM-16, "Removal and Installation"](#).
4. Partially drain the coolant when the engine is cool. Refer to [CO-10, "DRAINING ENGINE COOLANT"](#).

WARNING:

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

5. Disconnect fuel tube quick connector at vehicle piping side.
Refer to step 5 of [EM-23, "REMOVAL"](#).

FUEL INJECTOR AND FUEL TUBE

- Disconnect the power brake booster vacuum hose, the coolant hoses from the electric throttle control actuator, the swirl control vacuum lines, the fuel injectors electrical connectors, and the PCV hose.

CAUTION:

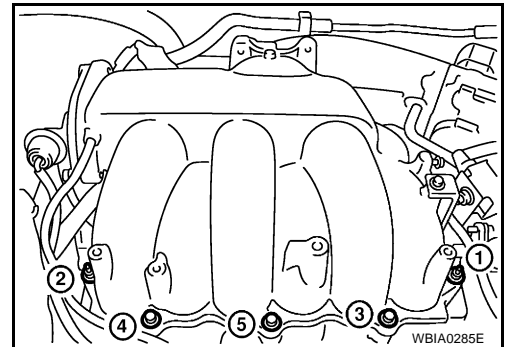
- Cover any engine openings to avoid the entry of any foreign material.

- Disconnect the electric throttle control actuator electrical connector and coolant hoses.
- Remove the windshield wiper assembly. Refer to [WW-21, "Removal"](#).
- Disconnect the power steering hose bracket.
- Remove the vacuum tank from the back of the intake manifold collector.
- Remove the intake manifold collector (upper) and electric throttle control actuator, by loosening the four bolts in a diagonal pattern.

CAUTION:

- Handle carefully to avoid any shock to the electric throttle control actuator.**

- Loosen the bolts in the order as shown, and remove the intake manifold collector (lower) using power tool.
- 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.

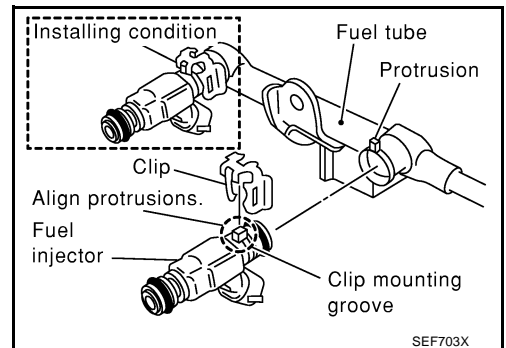


INSTALLATION

- Install the fuel rails with fuel injectors attached.

NOTE:

- Carefully install new O-rings, including the one used with the fuel damper.
- Lubricate O-rings by lightly coating with new engine oil.
- Be careful not to damage the O-rings and surfaces for O-ring sealing surfaces. Do not expand or twist O-rings.
- Discard old clips; replace with new ones.
- Make sure that protrusions of fuel injectors are aligned with cutouts of clips after installation.
- Position clips in grooves on the fuel injectors.
- Align the protrusions of the fuel tube assembly with those of the fuel injectors.
- After properly inserting the fuel injectors onto the fuel tube assembly, check that the fuel tube protrusions are engaged with those of fuel injectors, and the flanges of the fuel tube assembly are fully engaged with the clips.



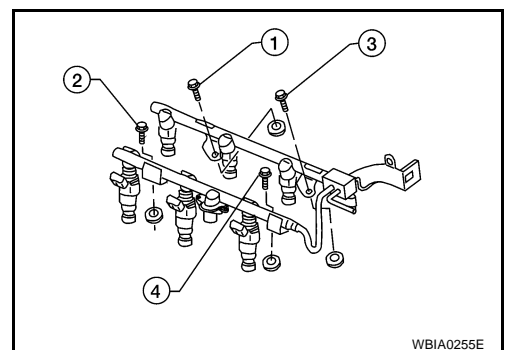
- Tighten fuel tube assembly bolts as shown, in two steps:

1st step : 10 N-m (1.0 kg-m, 7 ft-lb)

2nd step : 23.5 N-m (2.4 kg-m, 17 ft-lb)

CAUTION:

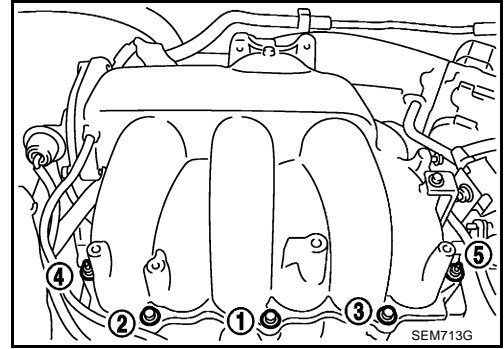
- After properly connecting fuel tube assembly to injector and fuel hose, check connection for fuel leakage.



FUEL INJECTOR AND FUEL TUBE

3. Install the intake manifold collector (lower) bolts in the numerical order as shown.

Intake manifold collector bolts : 19.5 N·m (2.0 kg-m, 14 ft-lb)



4. Tighten the bolts of the intake manifold collector (upper) and electric throttle control actuator assembly diagonally to specification.

Intake manifold collector pipe bolts : 19.5 N·m (2.0 kg-m, 14 ft-lb)

5. After installation, it is necessary to re-calibrate the electric throttle control actuator.
 - Perform "Throttle Control Closed Position Learning" when the harness connector of the electric throttle control actuator is disconnected. Refer to [EC-79, "Throttle Valve Closed Position Learning"](#) .
 - Perform "Idle Air Volume Learning" when the electric throttle control actuator is replaced. Refer to [EC-79, "Idle Air Volume Learning"](#) .
6. Attach the quick connector. Refer to [EM-24, "INSTALLATION"](#) .
7. Installation of remaining components is in the reverse order of removal.

INSPECTION AFTER INSTALLATION

Make sure there is no fuel leakage 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.

NOTE:

Use mirrors for checking on connections out of the direct line of sight.

CAUTION:

Do not touch engine immediately after stopping as engine is extremely hot.

- Perform procedures for "Throttle Valve Closed Position Learning" after finishing repairs. Refer to [EC-79, "Throttle Valve Closed Position Learning"](#) .
- If electric throttle control actuator is replaced, perform procedures for "Idle Air Volume Learning" after finishing repairs. Refer to [EC-79, "Idle Air Volume Learning"](#) .

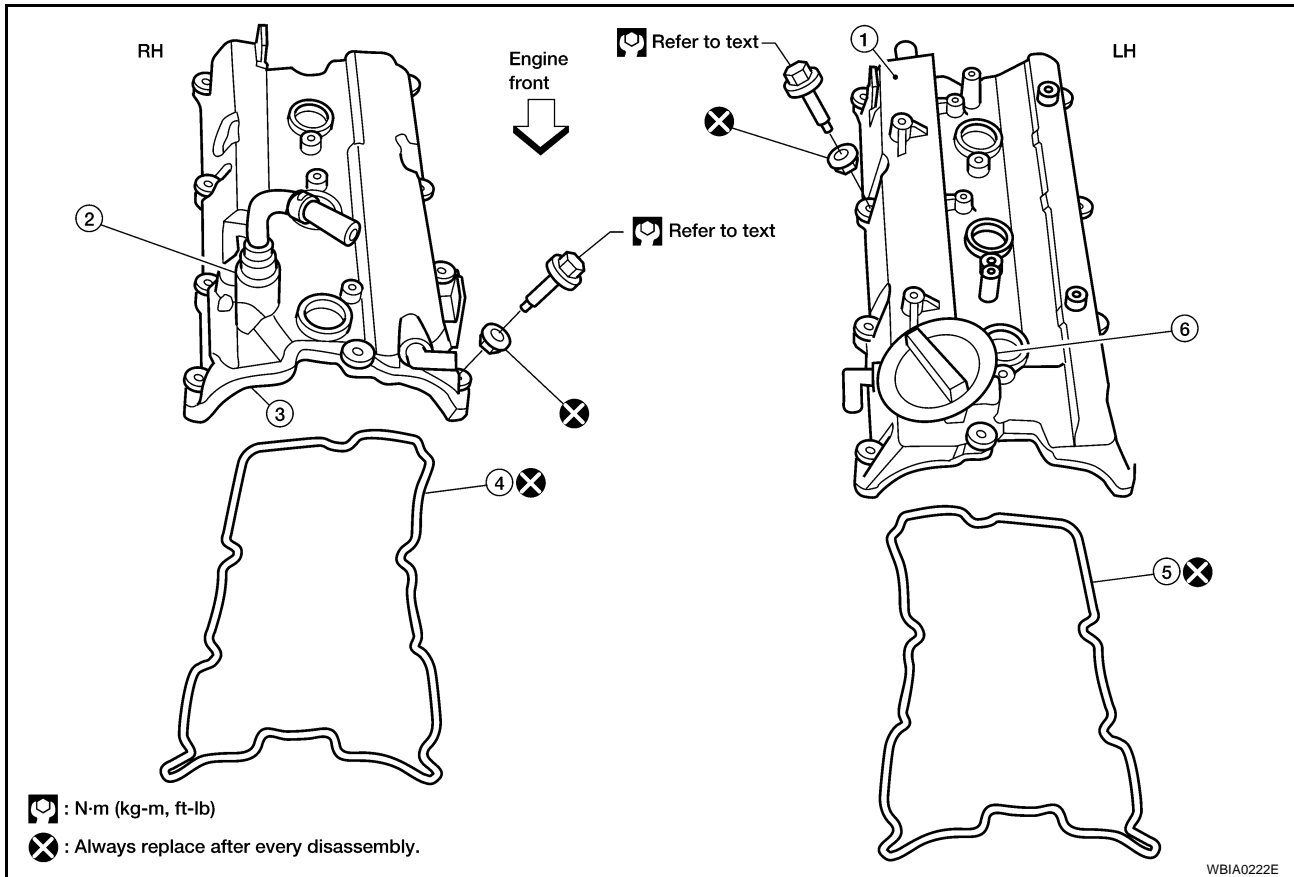
ROCKER COVER

PFP:13264

ROCKER COVER

Removal and Installation

EBS00RCH



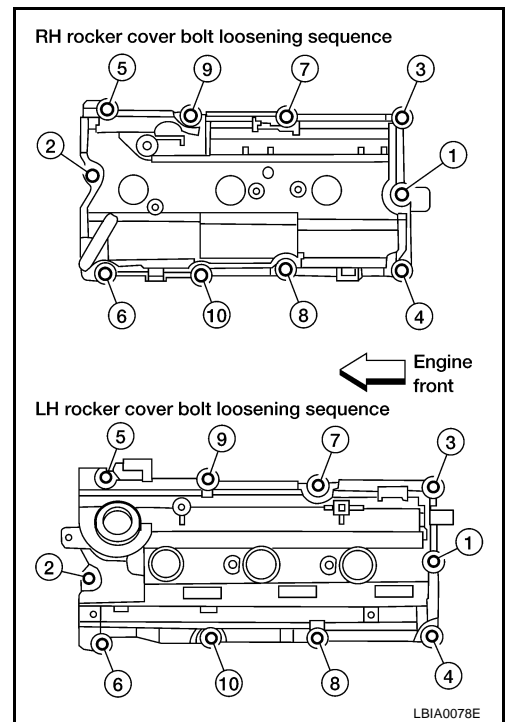
- | | | |
|-----------------------------|----------------------|----------------------|
| 1. Rocker cover (LH) | 2. PCV valve | 3. Rocker cover (RH) |
| 4. Rocker cover gasket (RH) | 5. Rocker cover (LH) | 6. Oil filler cap |

REMOVAL

1. Remove the intake manifold collector (upper) using power tool. Remove gasket and the electric throttle control actuator. Refer to [EM-22, "Removal and Installation"](#).
2. Remove the six ignition coils. Refer to [EM-37, "Removal and Installation"](#).
3. Remove the two intake valve timing control solenoid valves and gaskets. Refer to [EC-187, "Removal and Installation"](#).

ROCKER COVER

- Remove RH and LH rocker covers from cylinder head.
 - Follow the loosening sequence for each side rocker cover bolts as shown.



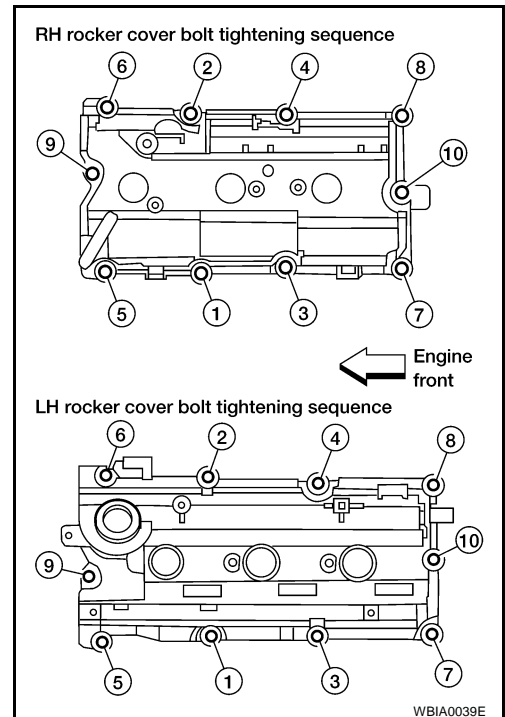
INSTALLATION

- Installation is in the reverse order of removal.
 - Apply sealant to the areas on the front corners. Refer to [EM-56, "POSITION FOR APPLYING LIQUID GASKET"](#).
 - Use Genuine Silicone RTV Sealant or equivalent. Refer to [GI-46, "Recommended Chemical Products and Sealants"](#).
 - Tighten the rocker cover bolts in two stages and in the numerical order as shown.

Rocker cover bolts

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

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



FRONT TIMING CHAIN CASE

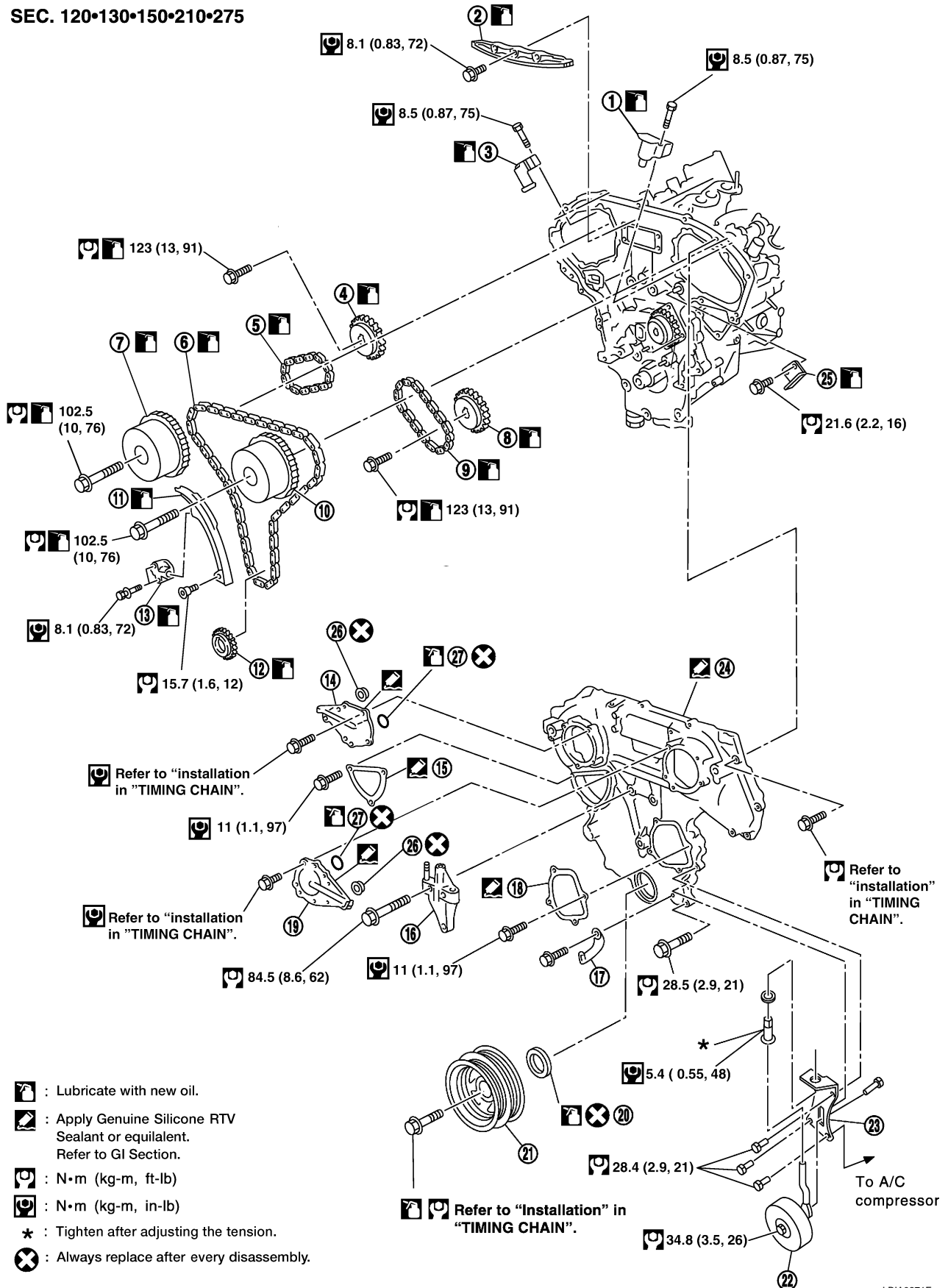
FPF:13599

EBS00RCI

FRONT TIMING CHAIN CASE

Removal and Installation

SEC. 120•130•150•210•275



- : Lubricate with new oil.
- : Apply Genuine Silicone RTV Sealant or equivalent. Refer to GI Section.
- : N·m (kg-m, ft-lb)
- : N·m (kg-m, in-lb)
- * : Tighten after adjusting the tension.
- : Always replace after every disassembly.

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FRONT TIMING CHAIN CASE

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| 1. Timing chain tensioner | 2. Internal chain guide | 3. Timing chain tensioner |
| 4. Camshaft sprocket (EXH) | 5. Timing chain (secondary) | 6. Timing chain (primary) |
| 7. Camshaft sprocket (INT) | 8. Camshaft sprocket (EXH) | 9. Timing chain (secondary) |
| 10. Camshaft sprocket (INT) | 11. Slack guide | 12. Crankshaft sprocket |
| 13. Timing chain tensioner | 14. IVT control valve cover - right | 15. Chain tensioner cover |
| 16. RH engine mounting bracket | 17. Water hose clamp | 18. Water pump cover |
| 19. IVT control valve cover - left | 20. Front oil seal | 21. Crankshaft pulley |
| 22. Idler pulley | 23. Idler pulley bracket | 24. Front timing chain case |
| 25. Timing tension guide | 26. Collared O-ring | 27. Seal ring |

NOTE:

Refer to [EM-54, "TIMING CHAIN"](#) for component parts location.

REMOVAL

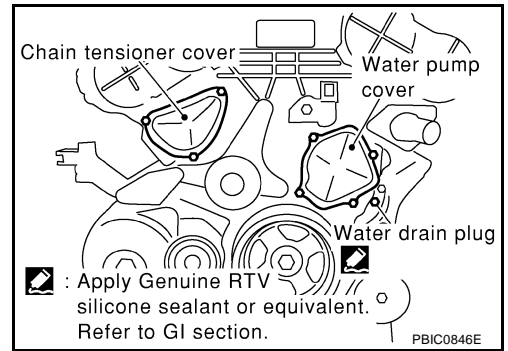
NOTE:

- This section describes procedures for removal/installation procedure of the front timing chain case and timing chain related parts without removing the oil pan (upper) from the vehicle.
 - When oil pan (upper) needs to be removed or installed, or when rear timing chain case is removed or installed, remove oil pans (upper and lower) first. 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-54, "TIMING CHAIN"](#).
1. Release fuel pressure. Refer to [EC-81, "FUEL PRESSURE RELEASE"](#).
 2. Remove lower and upper oil pans. Refer to [EM-31, "Removal and Installation"](#).
 3. Remove engine cover using power tool.
 4. Remove the upper air cleaner case, mass air flow sensor and air cleaner to electric throttle control actuator tube. Refer to [EM-16, "REMOVAL"](#).
 5. Remove the engine coolant reservoir. Refer to [CO-13, "Removal and Installation"](#).
 6. Remove the cowl top and cowl top extension. Refer to [WW-21, "Removal"](#).
 7. Remove the IPDM E/R and position aside. Remove the bracket. Refer to [PG-31, "Removal and Installation of IPDM E/R"](#).
 8. Remove the front RH wheel and tire using power tool. Refer to [WT-6, "WHEEL AND TIRE ASSEMBLY"](#).
 9. Remove the engine undercover.
 10. Remove the RH inner fender splash shield.
 11. Remove the drive belts and idler pulley. Refer to [EM-13, "DRIVE BELTS"](#).
 12. Recover the A/C system R134a and remove the A/C compressor. Refer to [ATC-130, "Evacuating System and Charging Refrigerant"](#).
 13. Remove engine oil cooler pipe bolts.
 14. Remove the power steering oil pump and reservoir tank with lines attached and position them aside. Refer to [PS-25, "Removal and Installation"](#).
 15. Remove the generator. Refer to [SC-26, "Removal and Installation"](#).
 16. Disconnect the engine harness and position aside.
 17. Remove the A/C low-pressure flexible hose. Refer to [ATC-136, "Removal and Installation for Low-pressure Flexible Hose"](#).
 18. Support the engine and remove the RH engine mounting insulator, mount and bracket. Refer to [EM-109, "Removal and Installation"](#).

FRONT TIMING CHAIN CASE

19. Remove the chain tensioner cover and water pump cover, using Tool.

Tool number : KV1011100 (J-37228)

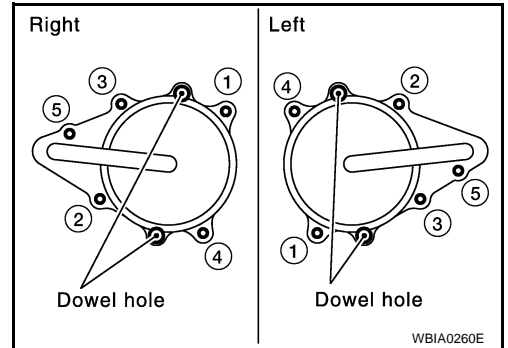


20. Remove the IVT control valve covers, right and left. Loosen the IVT control cover bolts in the order as shown.

NOTE:

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

21. Remove the starter motor. Refer to [SC-16, "Removal and Installation"](#).
22. Remove the intake manifold collector (upper) and (lower). Refer to [EM-18, "Removal and Installation"](#).

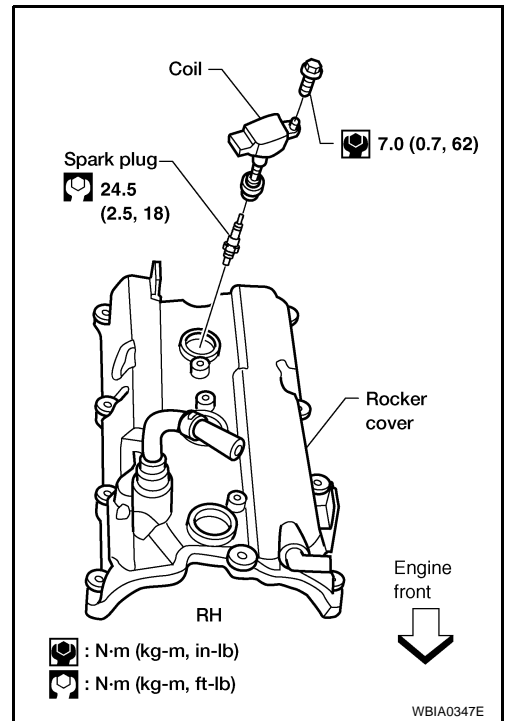


23. Remove the six ignition coils.

NOTE:

Identify the installed position to ensure proper installation

24. Remove the six spark plugs.

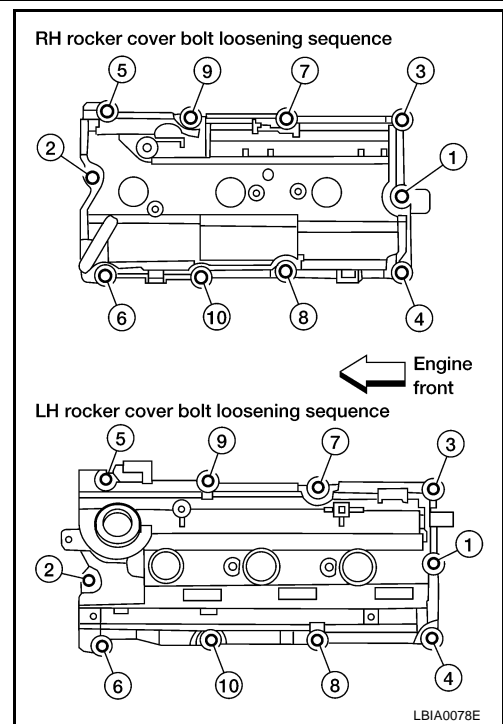


FRONT TIMING CHAIN CASE

25. If necessary, remove the rocker covers. Loosen the rocker covers bolts in the order as shown.

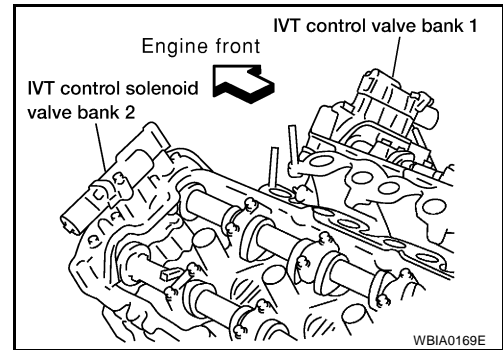
NOTE:

Necessary only when removing secondary timing chains.



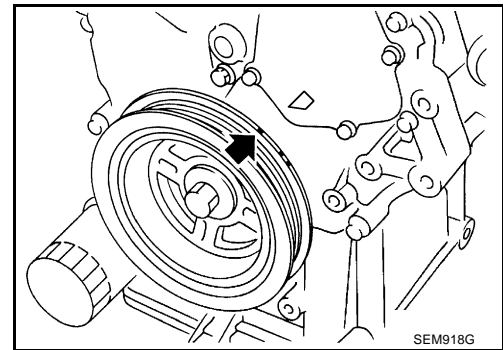
26. Remove the IVT control solenoid valves.

- Discard the gaskets and use new gaskets for installation.



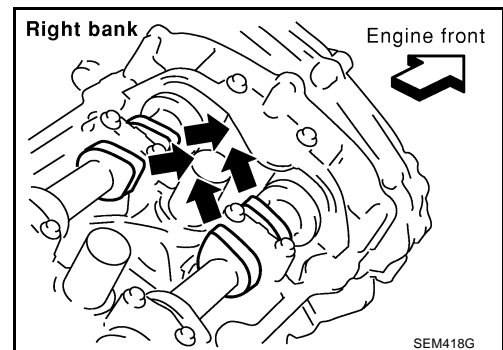
27. Obtain compression TDC of No. 1 cylinder as follows:

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



- 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.



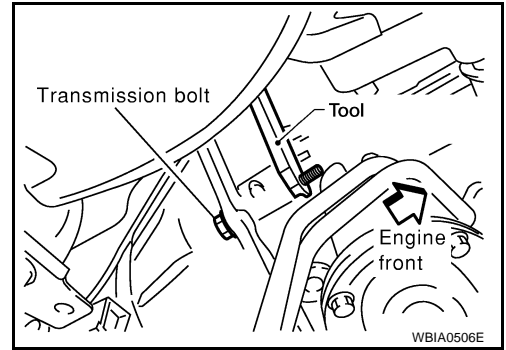
FRONT TIMING CHAIN CASE

28. Lock the drive plate (CVT) using Tool attached to the starter bolt hole in the transaxle.

Tool number : KV10117700 (J-44716)

CAUTION:

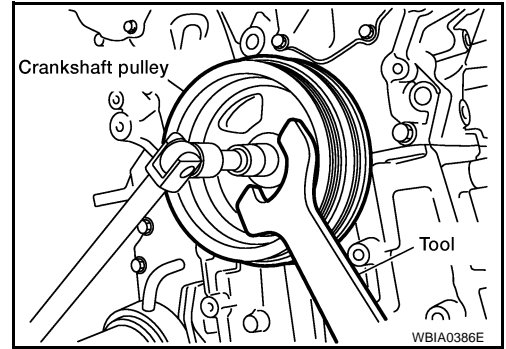
Do not damage the ring gear teeth, or the signal plate teeth behind the ring gear, when setting the Tool.



29. Remove the crankshaft pulley as follows:

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

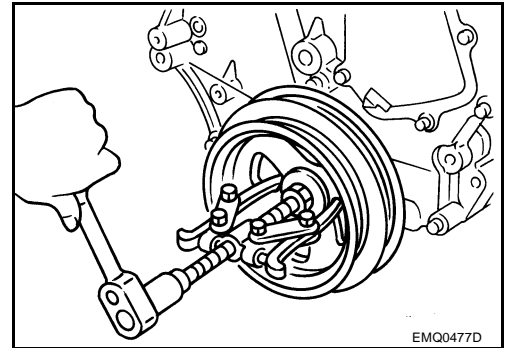
Tool number : KV10109300 (—)



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

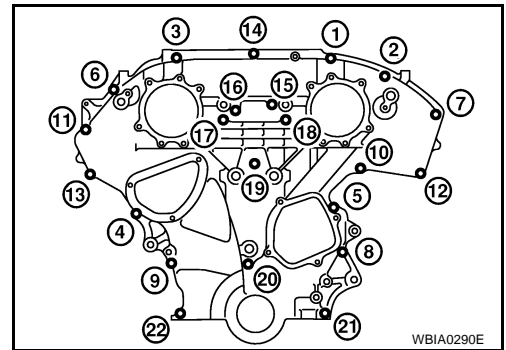
CAUTION:

Do not use a puller claw on crankshaft pulley periphery.



30. Remove the front timing chain case.

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



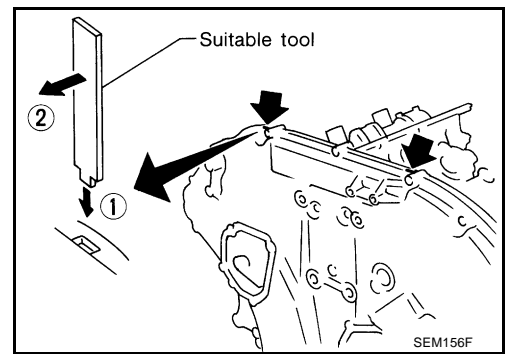
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FRONT TIMING CHAIN CASE

- b. Insert the suitable tool into the notch (1) at the top of the front timing chain case as shown.
- c. Pry off the case by moving the suitable tool (2) 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.



31. Remove the water pump cover and chain tensioner cover from the front timing chain case using Tool.

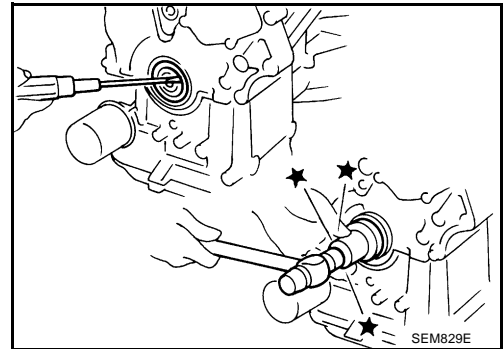
Tool number : KV1011100 (J-37228)

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

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

CAUTION:

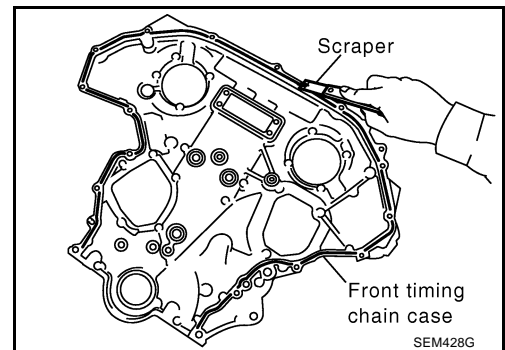
Do not damage the front cover.



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

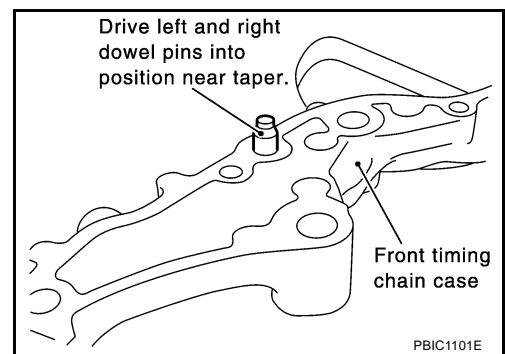
CAUTION:

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.



FRONT TIMING CHAIN CASE

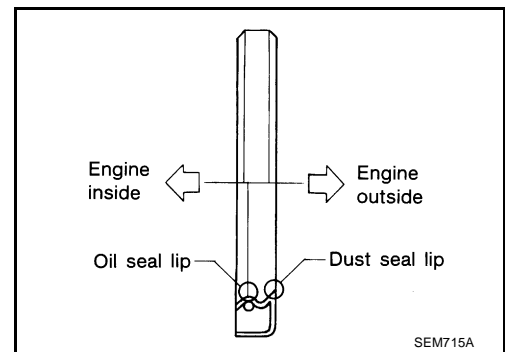
2. Install the new front oil seal on the front timing chain case. Apply new engine oil to the oil seal edges.

CAUTION:

Do not reuse oil seal.

NOTE:

Install it so that each seal lip is oriented as shown.



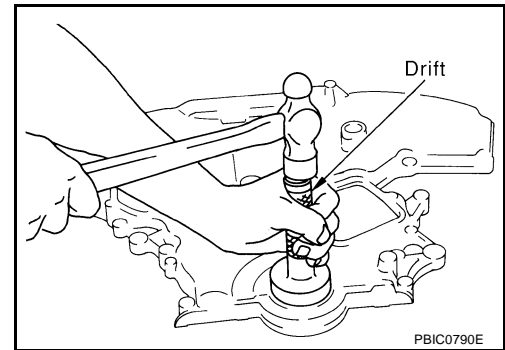
- a. Install the new front oil seal so that it becomes flush with the face with front timing chain case using suitable drift.

CAUTION:

Press fit straight and avoid causing burrs or tilting the oil seal.

NOTE:

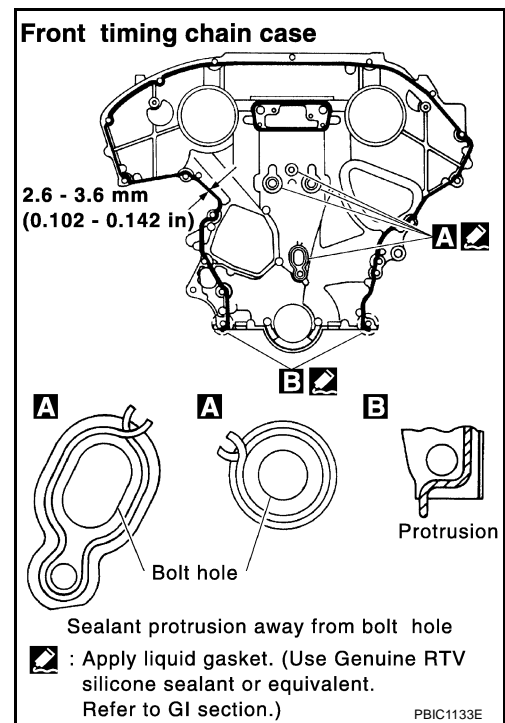
Make sure the garter spring is in position and seal lip is not inverted.



3. Apply Silicone RTV Sealant to front timing chain case using Tool as shown.

- Use Genuine Silicone RTV Sealant, or equivalent. Refer to [MA-9, "Fluids and Lubricants"](#) .
- Before installation, wipe off the protruding sealant.

Tool number : WS39930000 (—)



4. Install dowel pin on the rear timing chain case into dowel pin hole in front timing chain case.

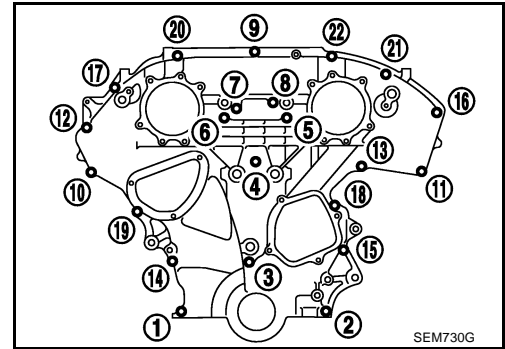
5. Loosely install the front timing chain case bolts.

FRONT TIMING CHAIN CASE

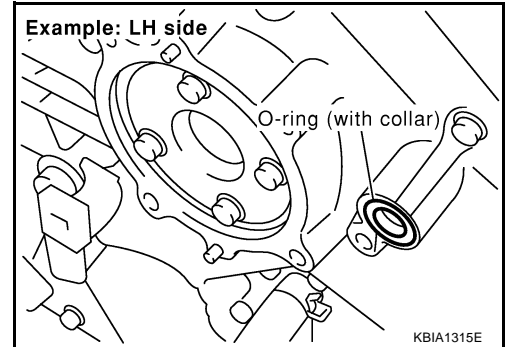
Bolt position	Bolt diameter
1, 2	: 8 mm (0.31 in)
3 – 22	: 6 mm (0.24 in)

6. 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)

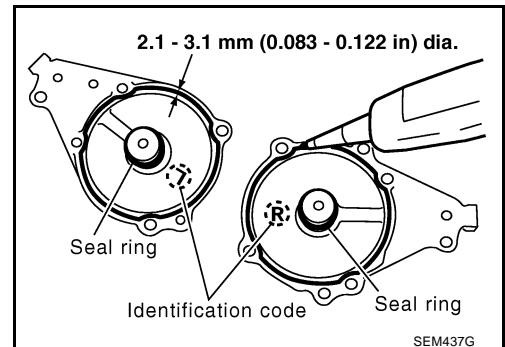


7. Install IVT control valve covers as follows:
- a. Install new collared O-rings in front cover oil hole (LH and RH sides).



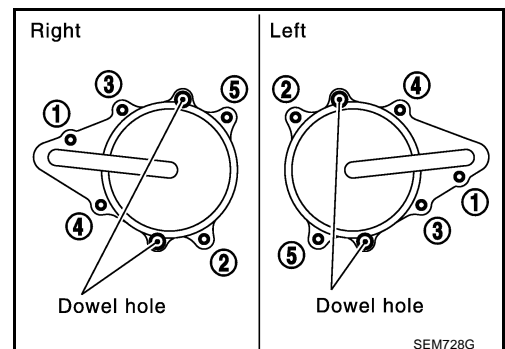
- b. Install new seal rings on the IVT control valve covers.
- c. Apply Silicone RTV Sealant to the IVT control valve covers using Tool as shown.
- Use Genuine Silicone RTV Sealant, or equivalent. Refer to [GI-46, "Recommended Chemical Products and Sealants"](#).

Tool number : WS39930000 (—)



- Being careful not to move the seal ring from the installation groove, align the dowel pins on the chain case with the holes to install the IVT control valve covers.
- Tighten the IVT control valve cover bolts in the order as shown.

IVT control valve cover bolts : 11.3 N·m (1.2 kg·m, 100 in·lb)



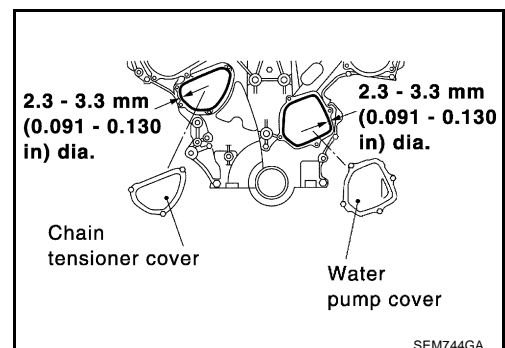
8. Apply liquid gasket and install the water pump cover and the chain tensioner cover.

Water pump cover bolts : 11 N·m (1.1 kg·m, 97 in·lb)

Chain tensioner cover bolts : 11 N·m (1.1 kg·m, 97 in·lb)

- Use Genuine Silicone RTV Sealant or equivalent. Refer to [GI-46, "Recommended Chemical Products and Sealants"](#).

Tool number : WS39930000 (—)



FRONT TIMING CHAIN CASE

9. 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 of angle tightening. Using Tool.

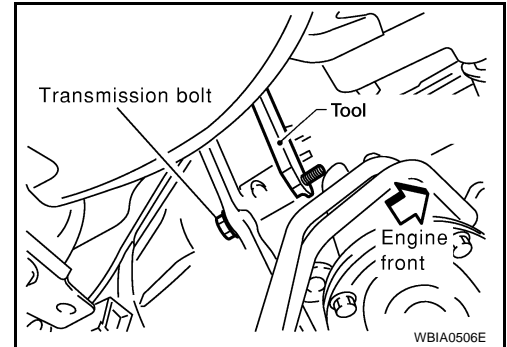
Step 1 : 44 N·m (4.5 kg-m, 32 ft-lb)

Step 2 : 90° degrees clockwise

Tool number : KV10112100 (BT-8653-A)

10. Remove Tool.

Tool number : KV10117700 (J-44716)



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

TIMING CHAIN

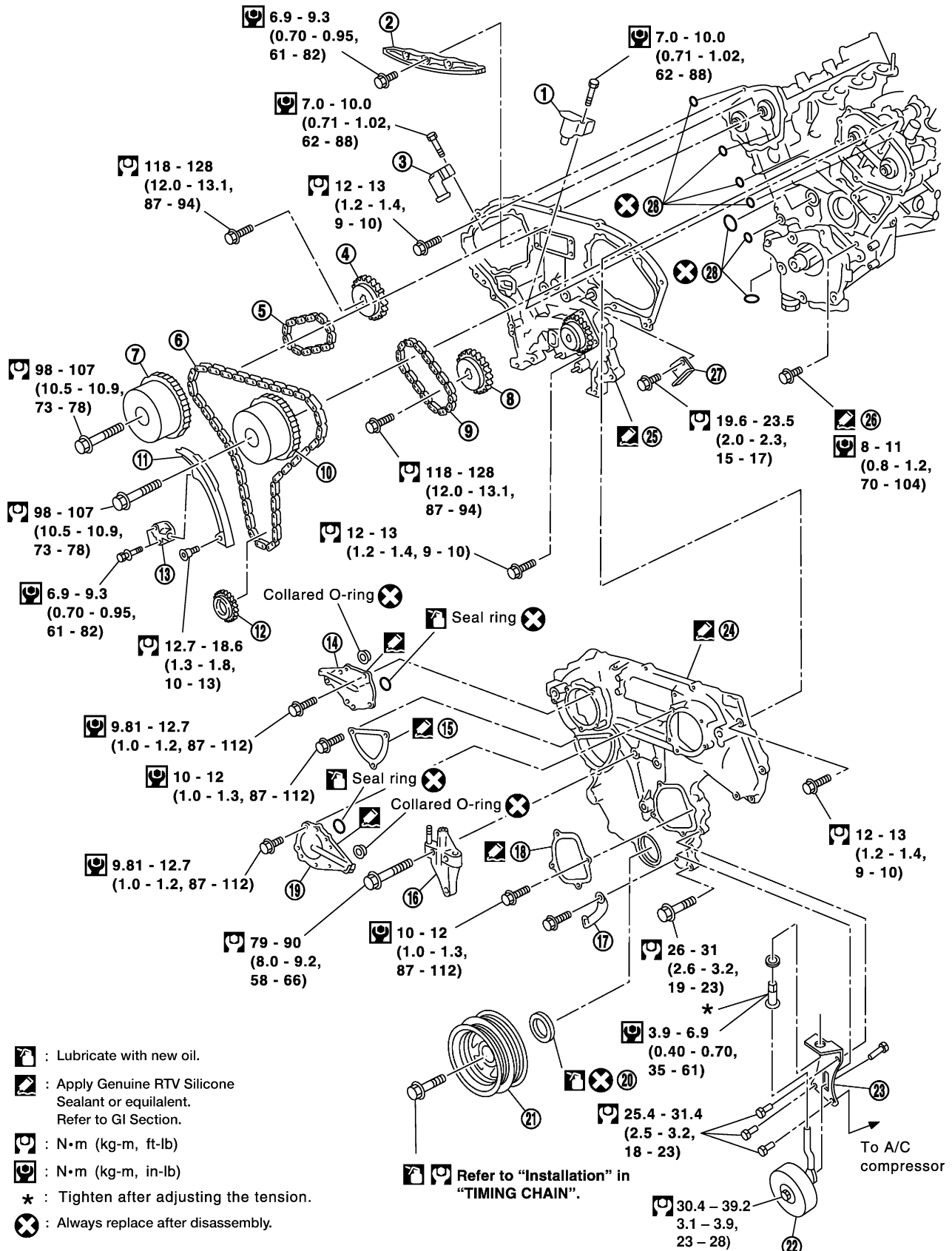
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TIMING CHAIN

Components

SEC. 120•130•150•210•275



WBIA0170E

TIMING CHAIN

-
- | | | |
|------------------------------------|-------------------------------------|-----------------------------|
| 1. Timing chain tensioner | 2. Internal chain guide | 3. Timing chain tensioner |
| 4. Camshaft sprocket (EXH) | 5. Timing chain (secondary) | 6. Timing chain (primary) |
| 7. Camshaft sprocket (INT) | 8. Camshaft sprocket (EXH) | 9. Timing chain (secondary) |
| 10. Camshaft sprocket (INT) | 11. Slack guide | 12. Crankshaft sprocket |
| 13. Timing chain tensioner | 14. IVT control valve cover - right | 15. Chain tensioner cover |
| 16. RH engine mounting bracket | 17. Water hose clamp | 18. Water pump cover |
| 19. IVT control valve cover - left | 20. Front oil seal | 21. Crankshaft pulley |
| 22. Idler pulley | 23. Idler pulley bracket | 24. Front timing chain case |
| 25. Rear timing chain case | 26. Water drain plug | 27. Tension guide |
| 28. O-ring | | |

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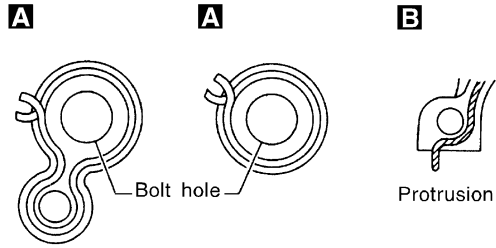
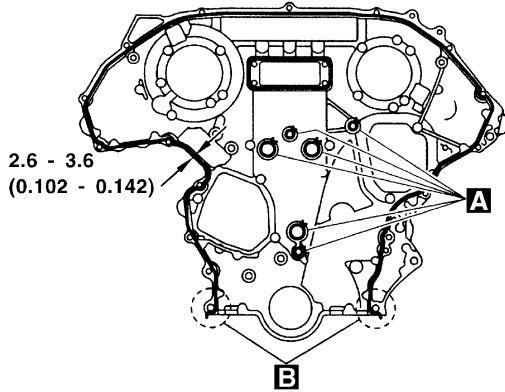
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TIMING CHAIN

POSITION FOR APPLYING LIQUID GASKET

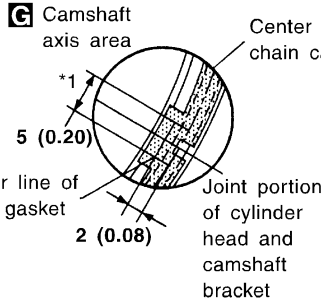
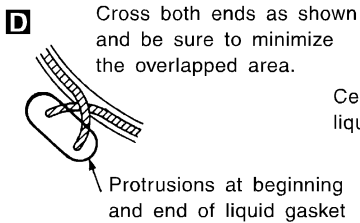
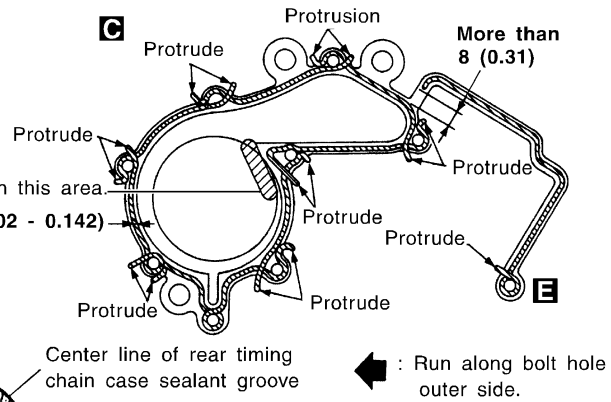
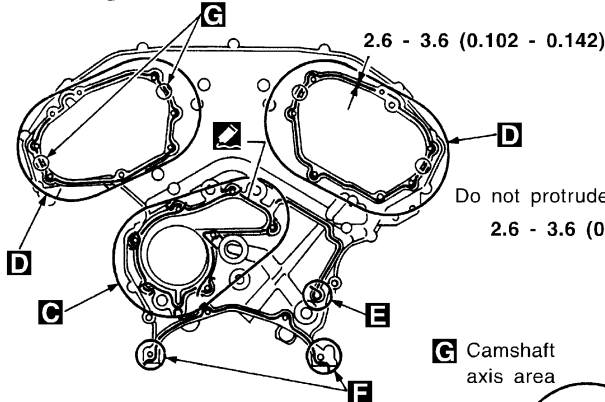
- Refer to [EM-4, "LIQUID GASKET APPLICATION PROCEDURE"](#) .
- Before installation, wipe off any protruding sealant.

Front timing chain case



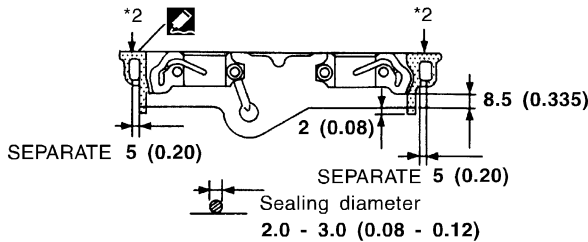
Sealant protrusion away from bolt hole

Rear timing chain case



*1: Apply liquid gasket to the chamfered surface between camshaft bracket and cylinder head.

Camshaft bracket

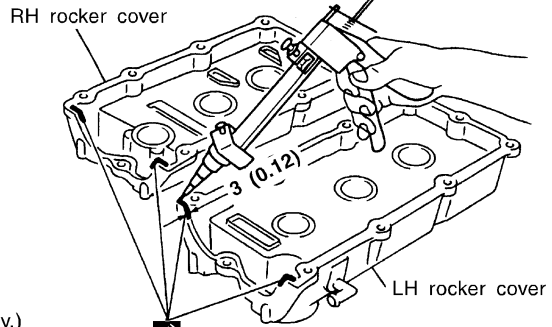


*2: Remove the protruding sealant from front face. (Remove the hardened sealant from surface only.)

Unit: mm (in)

: Apply Genuine Anaerobic Liquid Gasket or equivalent. Refer to GI Section.

Rocker cover



WBIA0171E

CAUTION:

- After removing timing chain, do not turn the crankshaft and camshaft separately, or the valves will strike the pistons.

TIMING CHAIN

- 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.
- Before disconnecting fuel hose, release fuel pressure. Refer to [EC-81, "FUEL PRESSURE RELEASE"](#).
- Before removing the upper oil pan, remove the crankshaft position sensor (POS).
- Be careful not to damage sensor edges.
- Do not spill engine oil or coolant on drive belts.

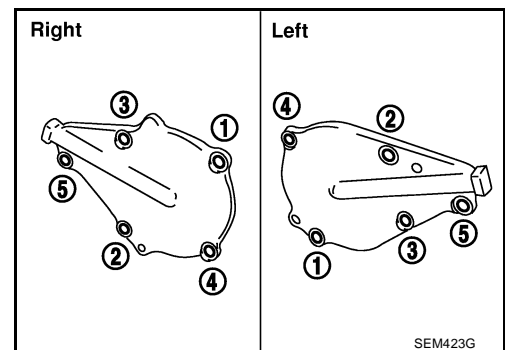
Removal

1. Release the fuel pressure. Refer to [EC-81, "FUEL PRESSURE RELEASE"](#).
2. Remove the battery.
3. Drain the engine cooling system. Refer to [CO-10, "DRAINING ENGINE COOLANT"](#).
4. Drain engine oil. Refer to [LU-8, "Changing Engine Oil"](#).
5. Remove engine cover using power tool.
6. Remove the intake air duct with the air cleaner case lid and mass air flow sensor.
7. Remove the engine coolant reservoir.
8. Disconnect the fuel rail quick connector at the vehicle piping side. Refer to [EM-40, "Removal and Installation"](#).
9. Remove the windshield wiper assembly. Refer to [WW-21, "REMOVAL AND INSTALLATION"](#).
10. Remove the front RH wheel and tire using power tool.
11. Remove the engine undercover using power tool.
12. Remove the inner fender splash shield using power tool.
13. Remove the drive belts and idler pulley.
14. Recover the A/C system R134a and remove the A/C compressor. Refer to [ATC-130, "HFC-134a \(R-134a\) Service Procedure"](#).
15. Dismount the power steering oil pump and reservoir tank. Tie them down with wire to reposition them out of the way.
16. Remove the lower and upper oil pans. Refer to [EM-31, "Removal and Installation"](#).
17. Remove the A/C high pressure line. Refer to [ATC-137, "Removal and Installation for High-pressure Pipe"](#).
18. Remove the alternator. Refer to [SC-26, "Removal and Installation"](#).
19. Disconnect the engine harness and set aside.
20. Support the engine and remove the RH engine mount and bracket.
21. Remove the IVT control valve covers, right and left. Loosen the bolts in the numerical order as shown.

NOTE:

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

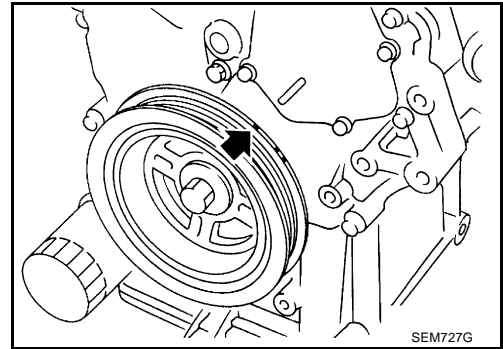
22. Remove the starter motor. Refer to [SC-16, "Removal and Installation"](#).



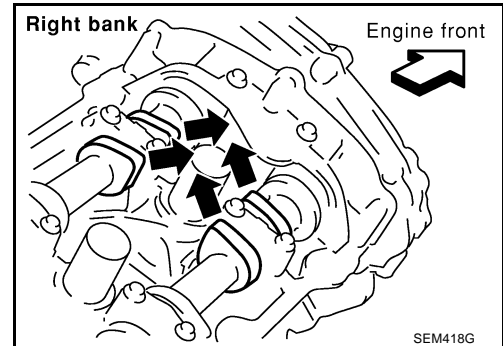
23. Obtain compression TDC of No. 1 cylinder as follows:

TIMING CHAIN

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



- b. Check that intake and exhaust cam nose on No. 1 cylinder (engine front side of right) are located as shown.
- If not, turn the crankshaft one revolution (360°) and align as shown.

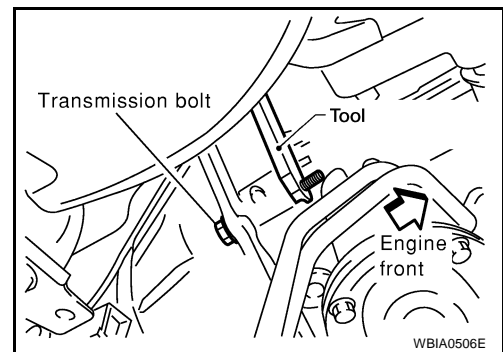


24. Remove the crankshaft pulley as follows:

- a. Set the ring gear stopper using the bolt hole.

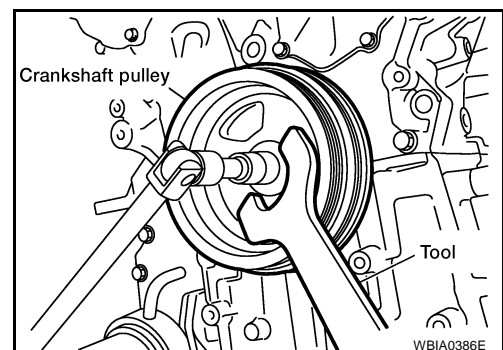
CAUTION:

Do not damage the ring gear teeth, or the signal plate teeth behind the ring gear when setting the stopper.



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

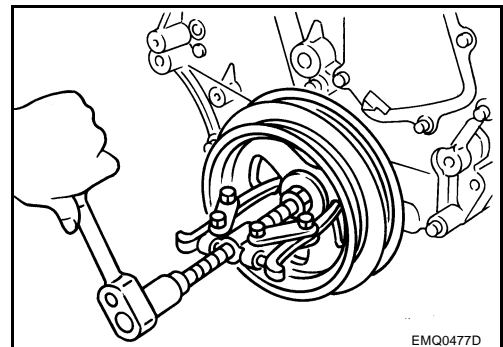
Tool number : KV10109300 (—)



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

CAUTION:

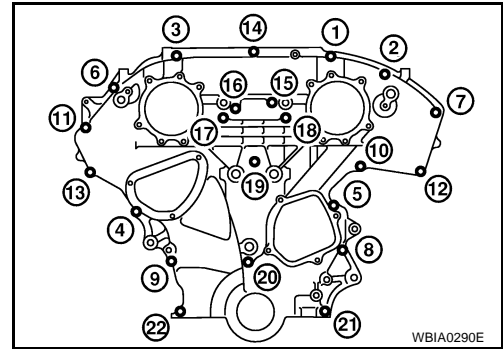
Do not use a puller claw on crankshaft pulley periphery.



TIMING CHAIN

25. Remove the front timing chain case.

a. Loosen the bolts in the numerical order as shown.



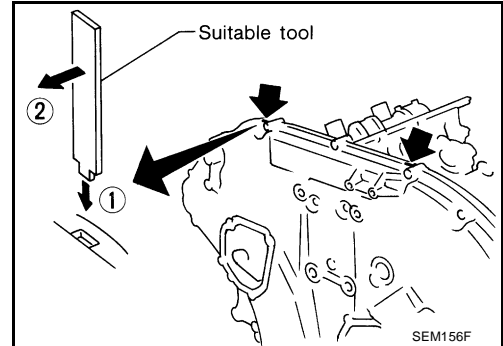
b. Insert the suitable tool (2) into the notch (1) at the top of the front timing chain case as shown.

c. Pry off the case by moving the suitable tool (2) as shown.

- Use seal cutter or an equivalent tool to cut liquid gasket for removal.

CAUTION:

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



26. Disconnect the power brake booster vacuum hose.

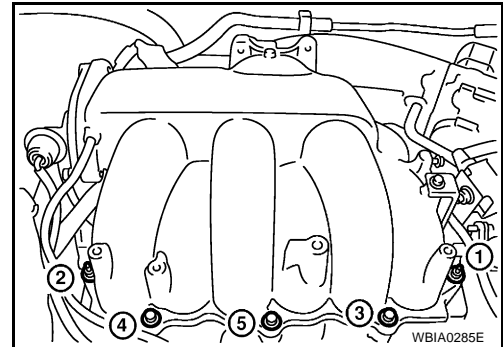
27. Disconnect the electric throttle control actuator.

28. Disconnect the coolant hoses at the electric throttle control actuator.

29. Disconnect the PCV hose.

30. Disconnect the EVAP canister purge volume control solenoid vacuum hose.

31. Remove the intake manifold collector (lower). Loosen the bolts and nuts in the numerical order as shown.

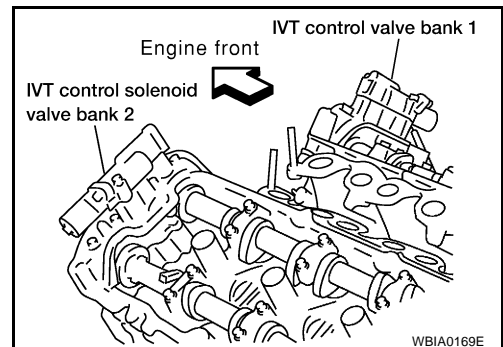


32. Remove the six spark plugs. Refer to [EM-38, "SPARK PLUG \(PLATINUM-TIPPED TYPE\)"](#).

33. Remove the engine oil dipstick.

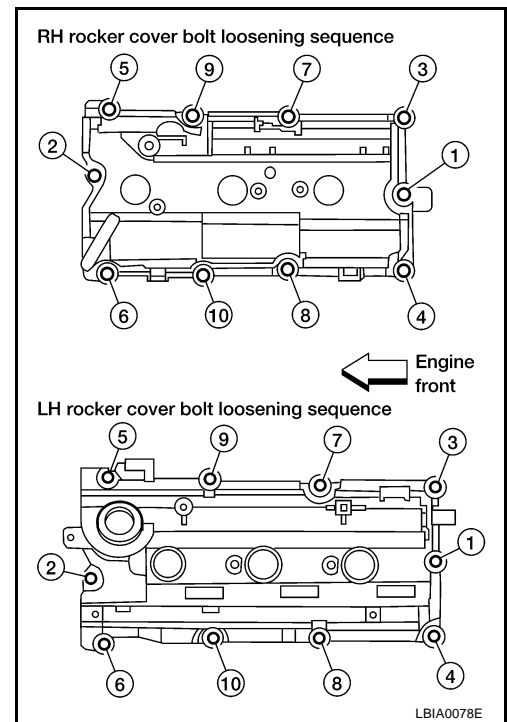
34. Remove the IVT control solenoid valves.

- Discard the gaskets and use new gaskets for installation.

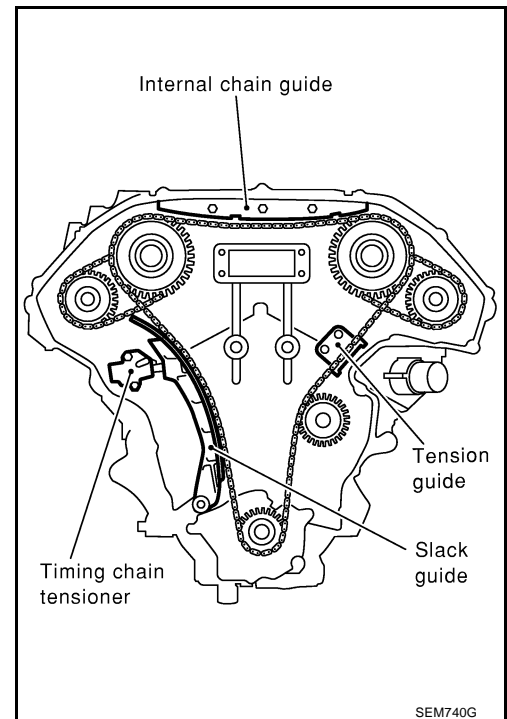


TIMING CHAIN

35. Remove the rocker covers. Loosen the bolts in the numerical order as shown.



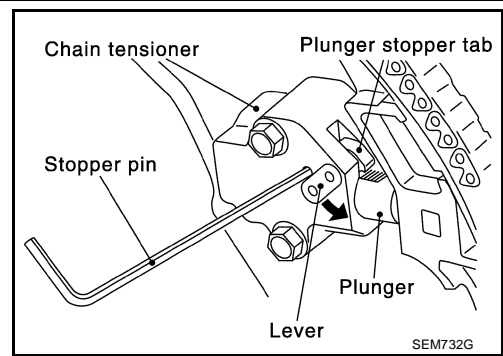
36. Place paint marks on the timing chain and sprockets to indicate the correct position of the components for installation.
37. Remove the internal chain guide.



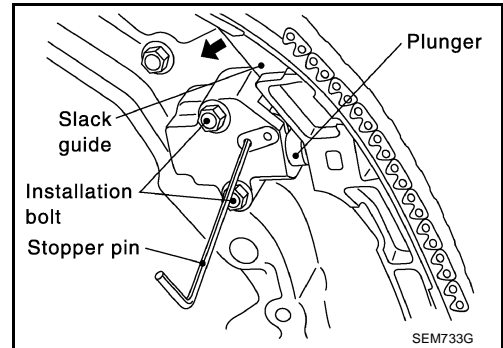
38. Remove the timing chain tensioner and slack side chain guide.

TIMING CHAIN

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



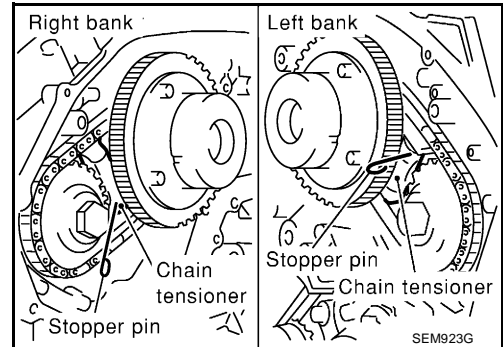
- b. Insert stopper pin into tensioner body hole to hold lever, and keep the tab released. An Allen wrench [2.5 mm (0.098 in)] is used for a stopper pin as an example.
- c. Insert plunger into tensioner body by pressing the slack side chain guide.
- d. Keep the slack side chain guide pressed and hold it by pushing the stopper pin through the lever hole and body hole.
- e. Remove the bolts and remove the timing chain tensioner.
39. Remove primary timing chain and crankshaft sprocket.



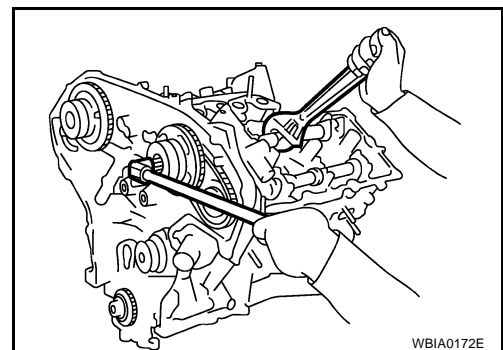
CAUTION:

After removing timing chain, do not turn the crankshaft and camshaft separately, or the valves will strike the pistons.

40. Attach a suitable stopper pin to the right and left camshaft chain tensioners (for secondary timing chains).



41. Remove the intake and exhaust camshaft sprocket bolts.
- Apply paint to the timing chain and camshaft sprockets for alignment during installation.
 - Secure the hexagonal portion of the camshaft using a wrench to loosen the bolts.



TIMING CHAIN

42. Remove the secondary timing chains with camshaft sprockets.

- Rotate camshaft slightly, and slacken timing chain of timing chain tensioner -side.
- Insert metal or resin plate [0.5 mm (0.020 in)] into guide between timing chain and chain tensioner plunger. Remove cam sprocket and secondary timing chain with timing chain removed from guide groove.

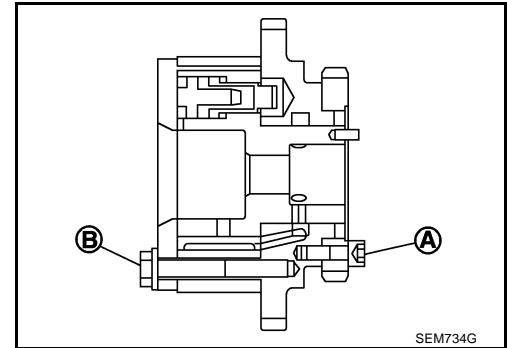
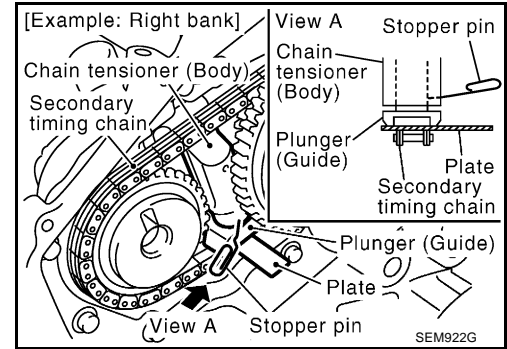
CAUTION:

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

- Intake camshaft sprocket is two-for-one structure of primary and secondary sprockets.
- Handle the intake sprockets as an assembly.

CAUTION:

- Avoid impact or dropping the intake sprockets.
- Do not disassemble the intake sprockets (never loosen bolts A and B as shown).

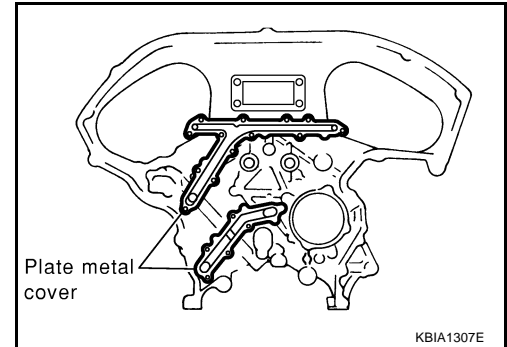


43. Remove the chain tension guide.

44. Remove the rear timing chain case.

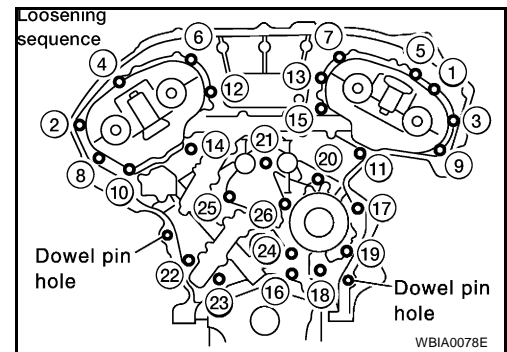
CAUTION:

- 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 suitable tool and remove the rear timing chain case.



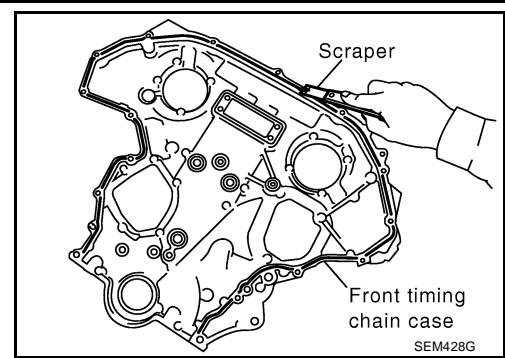
45. Remove O-rings to cylinder head and cylinder block.

TIMING CHAIN

46. 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:

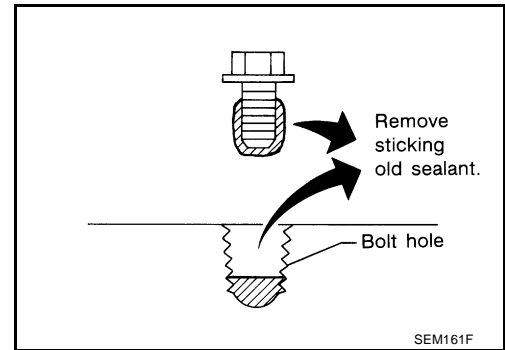
Do not damage the mating surfaces.



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

CAUTION:

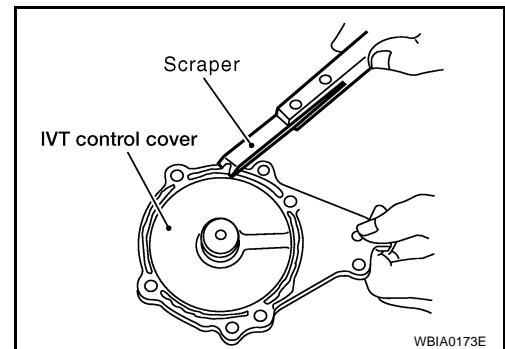
Do not damage the threads or mating surfaces.



48. Use a scraper to remove all the old Silicone RTV Sealant from the water pump cover, chain tensioner cover and IVT control valve covers.

CAUTION:

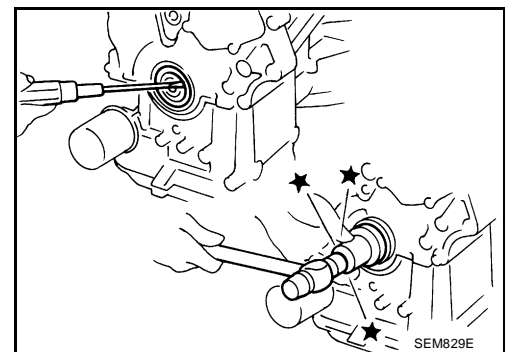
Do not damage the mating surfaces.



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

CAUTION:

Do not damage the front cover.



Inspection

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

EBS00RCL

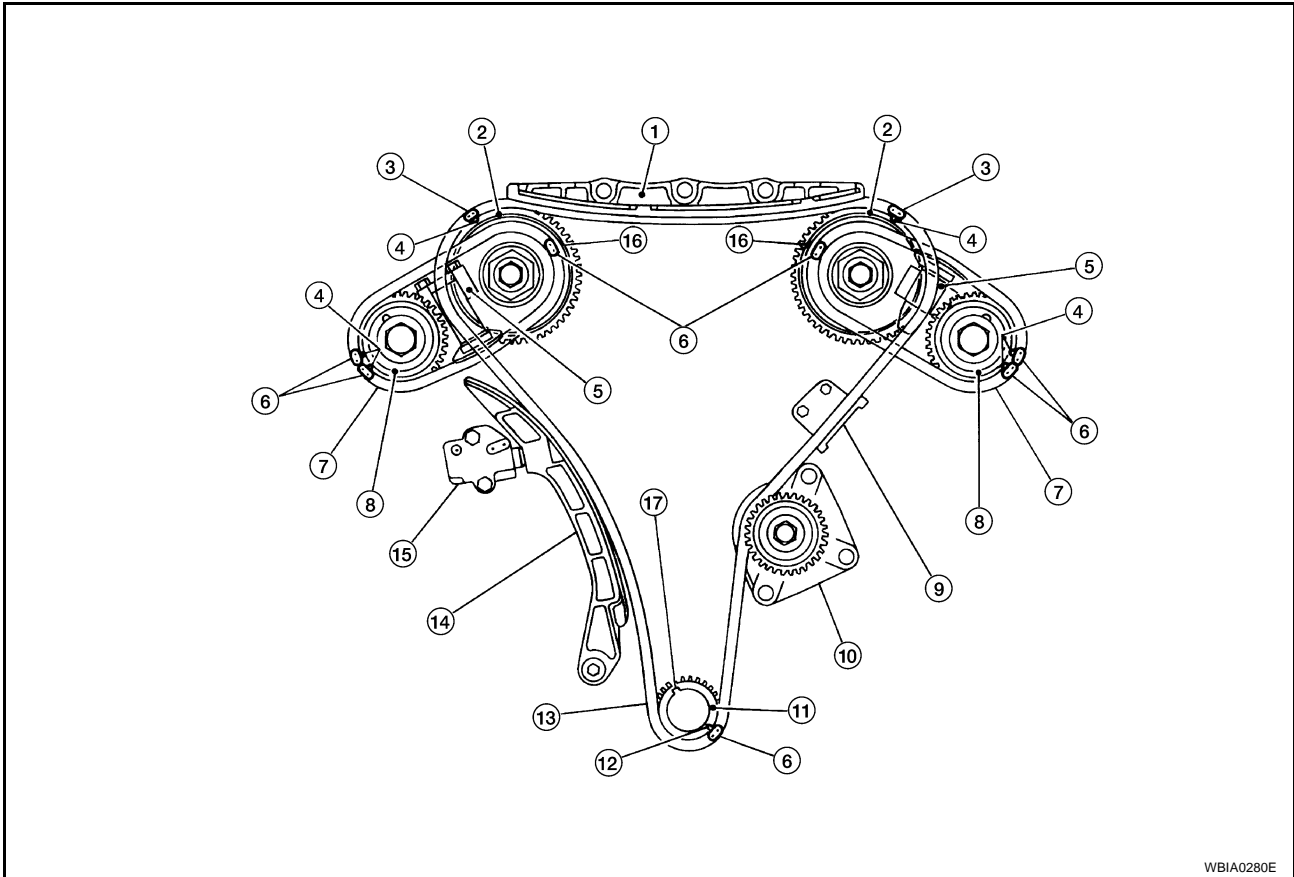
TIMING CHAIN

EBS00RCM

Installation

NOTE:

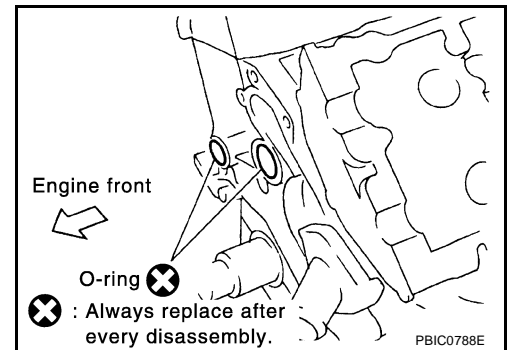
The figure shows the relationship between the mating mark on each timing chain and that on the corresponding sprocket, the components installed.



- | | | |
|-----------------------------|-------------------------------------|------------------------------------|
| 1. Internal chain guide | 2. Camshaft sprocket (intake) | 3. Mating mark (copper link) |
| 4. Mating mark (punched) | 5. Secondary timing chain tensioner | 6. Mating mark (yellow link) |
| 7. Secondary timing chain | 8. Camshaft sprocket (exhaust) | 9. Tensioner guide |
| 10. Water pump | 11. Crankshaft sprocket | 12. Mating mark (notched) |
| 13. Primary timing chain | 14. Slack guide | 15. Primary timing chain tensioner |
| 16. Mating mark (back side) | 17. Crankshaft key | |

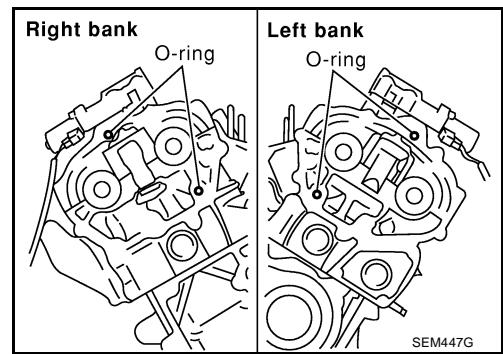
1. Install rear timing chain case as follows:

- a. Install O-rings on cylinder block.



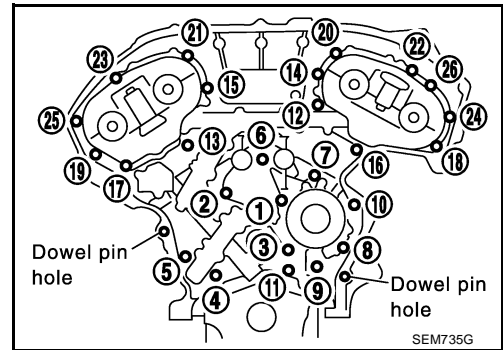
- b. Install O-rings on cylinder head.

TIMING CHAIN



2. Apply Genuine Silicone RTV Sealant or equivalent, to the rear timing chain case. Refer to [GI-46, "Recommended Chemical Products and Sealants"](#).
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.
- 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 position	Bolt length
1, 2, 3, 6, 7, 8, 9, 10	20 mm (0.79 in)
4, 5, 11 - 26	16 mm (0.63 in)



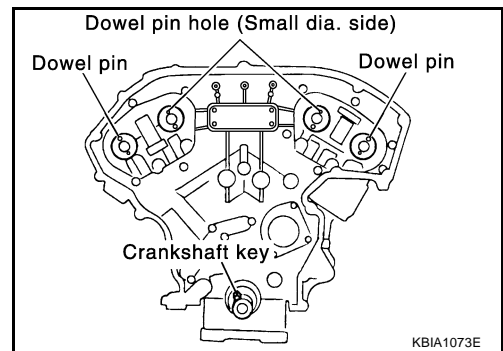
- b. After all bolts are initially tightened, retighten them to the specification in the numerical order as shown.

Rear timing chain case bolts : 12.5 N-m (1.3 kg-m, 9 ft-lb)

4. Install the timing chain tension guide.
5. Position the crankshaft so No. 1 piston is set at TDC on the compression stroke.
 - Make sure that the dowel pin hole, dowel pin and crankshaft key are located as shown.
 - Camshaft dowel pin hole (intake side): at cylinder head upper face side in each bank.
 - Camshaft dowel pin (exhaust side): at cylinder head upper face side in each bank.
 - Crankshaft key: at cylinder head side of RH bank.

CAUTION:

Hole on small diameter side must be used for intake camshaft sprocket dowel pin. Do not misidentify (ignore big diameter side).

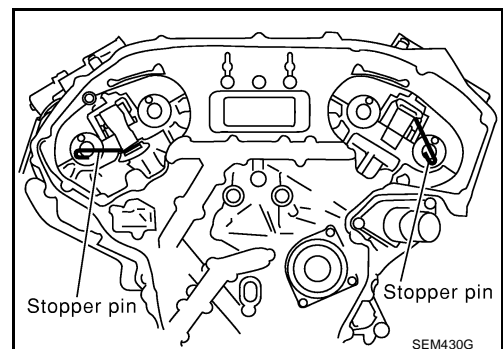


6. Install the secondary timing chains and camshaft sprockets.

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 secondary chain tensioner and keep it pressed in with a stopper pin.



TIMING CHAIN

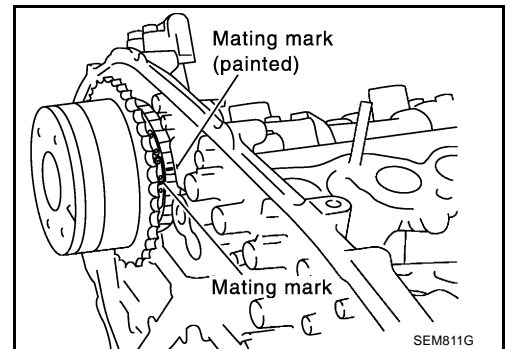
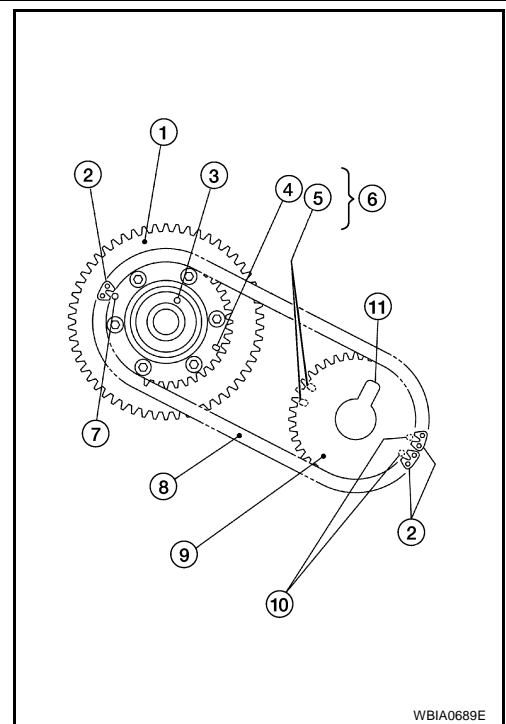
- a. Align the matching marks (4), (5), (7) and (10) on the secondary timing chain (8) [yellow link (2)] with the ones on the intake and exhaust sprockets (stamped), and install them.

- Illustration shows RH (rear view)
- Matching marks for the intake sprocket are on the back side of the secondary sprocket.
- There are two types of matching marks, round (7) and (10) and oval (4) and (5) types. They should be used for the RH and LH banks, respectively.
RH bank: use round type (7) and (10).
LH (6) bank: use oval type (4) and (5).

- b. Align the dowel pin (3) with the pin hole on the camshaft sprocket INT side (1), and the dowel pin groove (11) with the dowel pin on the camshaft EXH side, and install them.

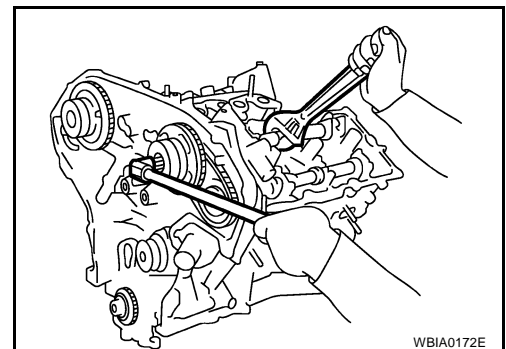
- On the intake side, align the pin hole on the small diameter side of the camshaft front end with the dowel pin (3) on the back side of the camshaft sprocket (1), and install them.
- On the exhaust side, align the dowel pin on the camshaft front end with the dowel pin groove (11) on the camshaft sprocket (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 pin (3) and dowel pin groove (11).

- It may be difficult to visually check the dislocation of mating marks during and after installation. To make the matching easier, make a mating mark on the sprocket teeth in advance with paint.



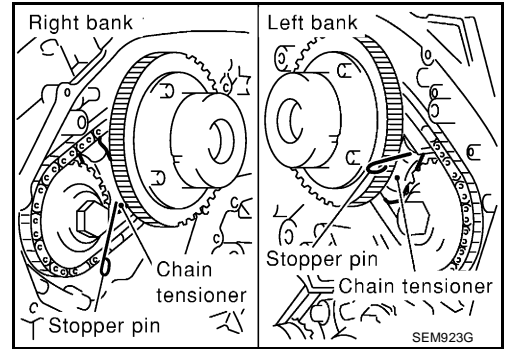
7. After confirming the mating marks are aligned, tighten the camshaft sprocket bolts.

- Secure the camshaft using a wrench at the hexagonal portion to tighten the bolts.



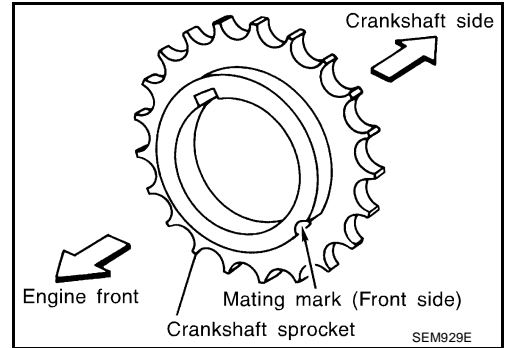
TIMING CHAIN

8. Pull the stopper pins out from the secondary timing chain tensioners.



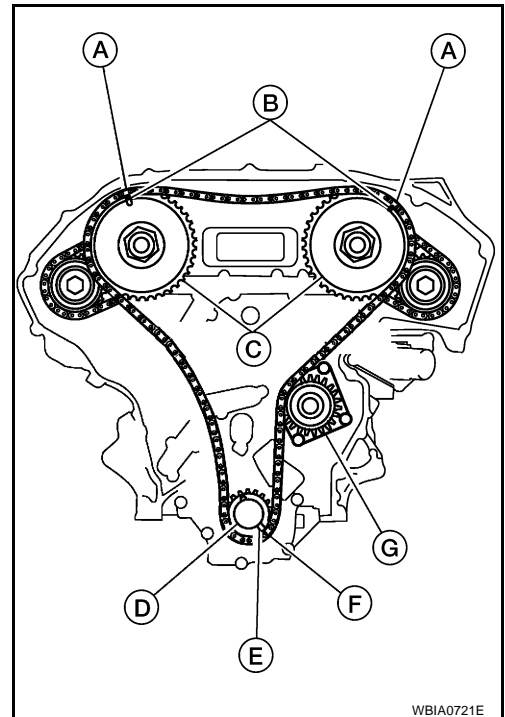
9. Install the crankshaft sprocket on the crankshaft.

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



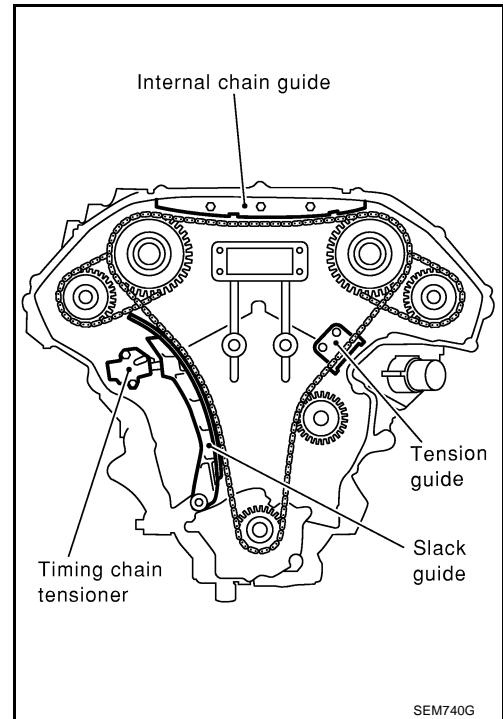
10. Install the primary timing chain.

- Water pump (G).
- Install primary timing chain so the mating mark punched (B) on camshaft sprocket is aligned with the copper link (A) on the timing chain, while the mating mark notched (E) on the crankshaft sprocket (D) is aligned with the yellow link (F) on the timing chain, as shown.
- When it is difficult to align mating marks (A) with (B) and (E) with (F) of the primary timing chain 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.



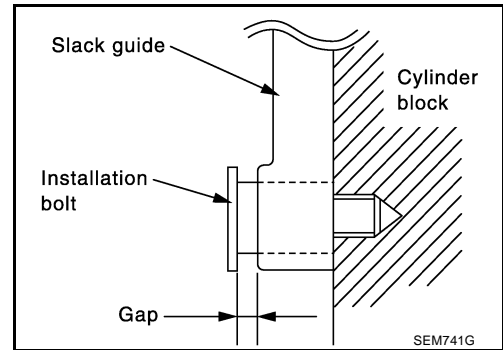
TIMING CHAIN

11. Install the internal chain guide.



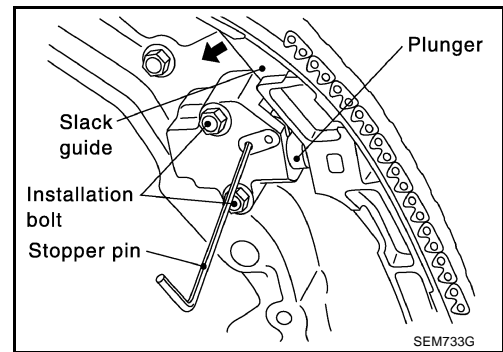
12. Install the slack guide.

- 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.



13. Install the timing chain tensioner for the slack guide.

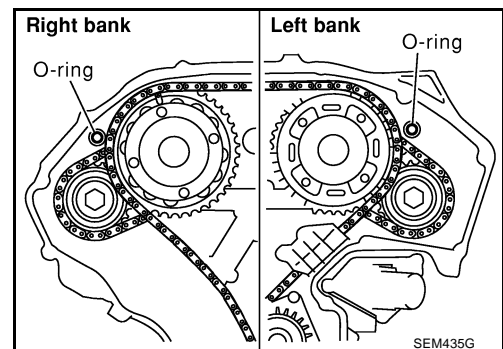
- When installing the chain tensioner, push in the sleeve and keep it pressed in with the stopper pin.
- Remove any dirt and foreign materials completely from the back and the mounting surfaces of the chain tensioner.
- After installation, pull out the stopper pin while pressing the slack guide.



14. Reconfirm that the matching marks on the sprockets and the timing chain have not slipped out of alignment.

15. Install new O-rings on the rear timing chain case.

CAUTION:
Do not reuse O-rings.



TIMING CHAIN

16. Install the new front oil seal on the front timing chain case using a suitable tool. Apply clean engine oil to the oil seal edges.

- Install it so that each seal lip is oriented as shown.

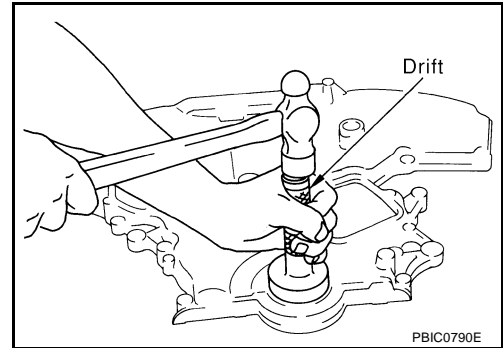
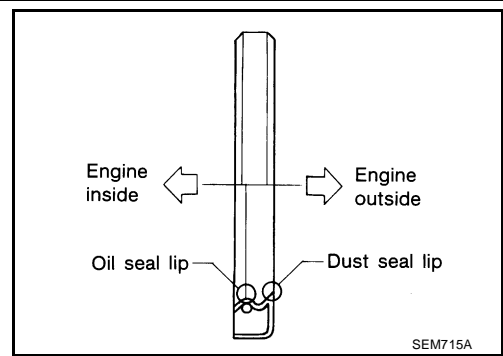
Suitable drift

Outer diameter : 59 mm (2.32 in)

Inner diameter : 49 mm (1.93 in)

CAUTION:

- Press fit straight and avoid causing burrs or tilting the oil seal.
- Do not reuse oil seal.
- Using a suitable drift, press-fit new oil seal until it becomes flush with timing chain case end face.
- Make sure the garter spring in the new oil seal is in position and seal lip is not inverted.



17. Apply Silicone RTV Sealant to front timing chain case. Refer to [EM-56, "POSITION FOR APPLYING LIQUID GASKET"](#).

- Use Genuine Silicone RTV Sealant, or equivalent. Refer to [GI-46, "Recommended Chemical Products and Sealants"](#).
- Before installation, wipe off the protruding sealant.

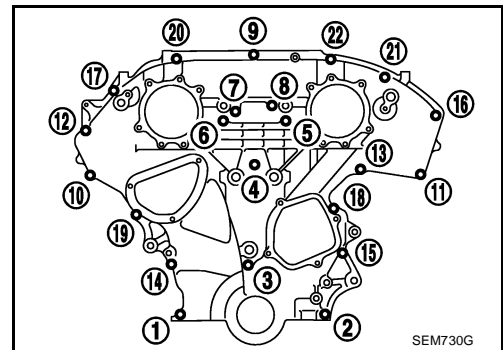
18. Install the rear case pin into dowel pin hole on front timing chain case.

19. Tighten bolts to the specified torque in order as shown.

Bolt position

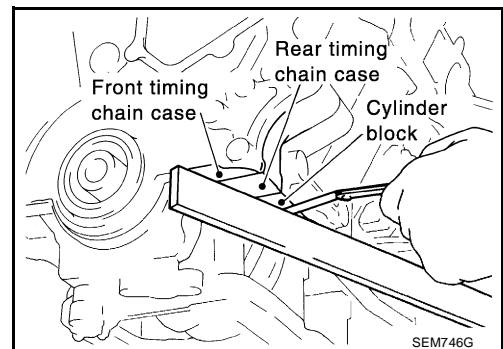
1, 2 : 28.5 N·m (2.9 kg-m, 21 ft-lb)

3 - 22 : 12.8 N·m (1.3 kg-m, 9 ft-lb)



20. After installing the front timing chain case, check the surface height difference between the following parts on the oil pan mating surface.

- If not within specification, repeat the installation procedure.



TIMING CHAIN

Front timing chain case to rear timing chain case

: (-0.14) - 0.14 mm [(-0.0055) - 0.0055 in]

Oil pump to cylinder block

: (-0.36) - (-0.10) mm [(-0.0142) - (-0.0039) in]

Rear timing chain case to cylinder block

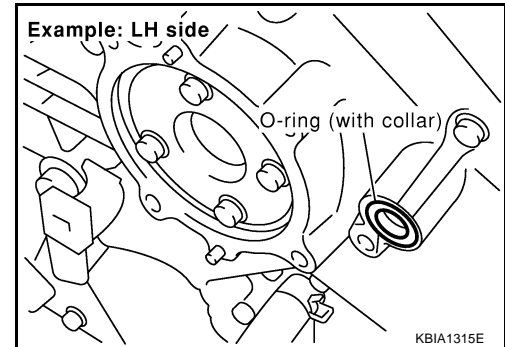
: (-0.24) - 0.14 mm [(-0.0094) - 0.0055 in]

21. Install IVT control valve covers as follows:

- a. Install new collared O-rings in front cover oil hole (LH and RH sides).

NOTE:

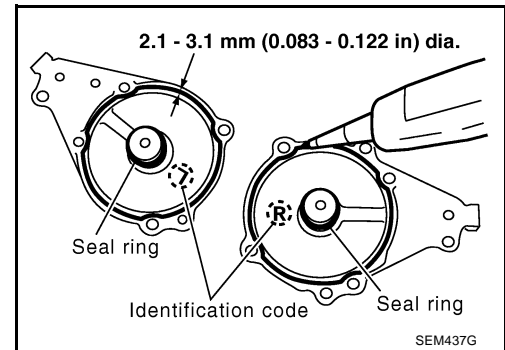
Do not reuse O-rings.



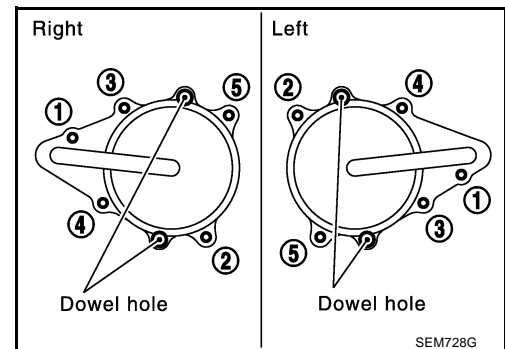
- b. Install new seal rings on the IVT control valve covers.
c. Apply Silicone RTV Sealant to the IVT control valve covers using Tool as shown.

Tool number : WS39930000 (—)

Use Silicone RTV Sealant, or equivalent. Refer to [GI-46, "Recommended Chemical Products and Sealants"](#).



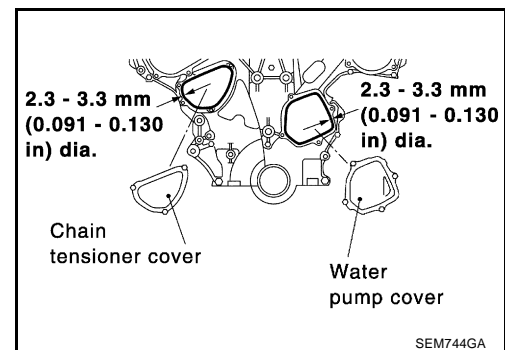
- Being careful not to move the seal ring from the installation groove, align the dowel pins on the chain case with the holes to install the IVT control valve covers.
- Tighten in the numerical order as shown.



22.

Install the water pump cover and the chain tensioner cover. Apply Silicone RTV Sealant or equivalent using Tool. Refer to [GI-46, "Recommended Chemical Products and Sealants"](#).

Tool number : WS39930000 (—)



TIMING CHAIN

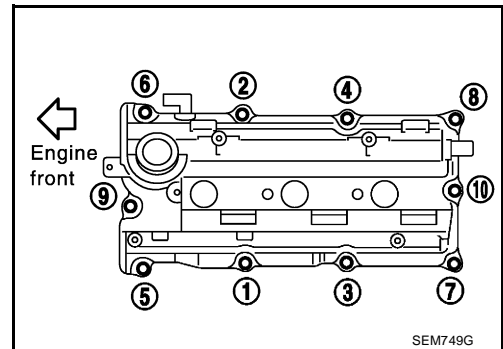
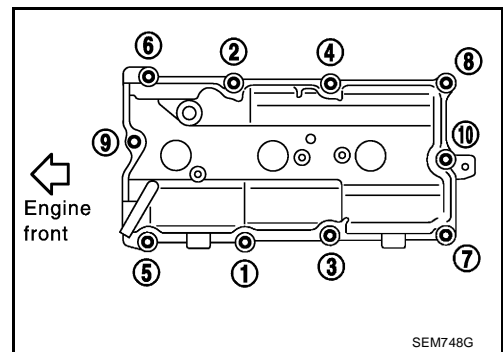
23. Install the RH and LH rocker covers.

Rocker cover tightening procedure:

- Tighten the rocker cover bolts in two stages in the numerical order as shown.

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

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



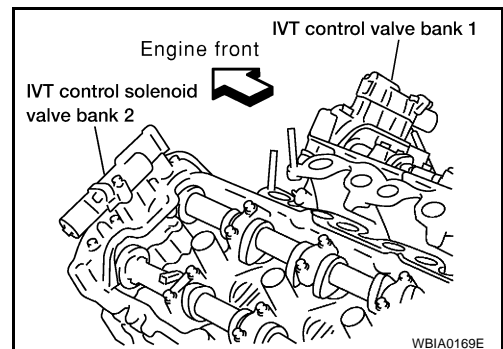
24. Install the IVT control solenoid valve bank 1 and bank 2.

IVT control solenoid valve bolts : 11 N·m (1.1 kg·m, 8 ft·lb)

25. Install the engine oil dipstick.

26. Install the six ignition coils to their original positions. Refer to [EM-37, "IGNITION COIL"](#).

Ignition coils (6) : 7.0 N·m (0.71 kg·m, 62 in·lb)



27. Install the intake manifold collector (lower). Tighten the bolts and nuts in numerical order as shown.

Intake manifold collector bolts : 19.5 N·m (2.0 kg·lb, 14 ft·lb)

28. Connect the EVAP purge volume control solenoid hose.

29. Connect the PCV hose.

30. Connect the coolant hoses to the electric throttle control actuator.

31. Connect the power brake booster vacuum hose.

32. Connect the electric throttle control actuator harness electrical connector.

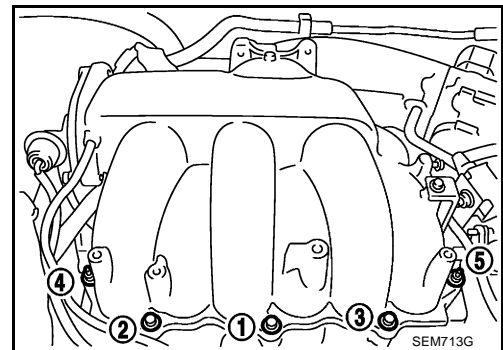
33. Install crankshaft pulley and tighten the bolt in two steps.

- Lubricate thread and seat surface of the bolt with new engine oil.
- For the second step of angle tightening. Use Tool.

Step 1 : 44 N·m (4.5 kg·m, 32 ft·lb)

Step 2 : 90° degrees clockwise

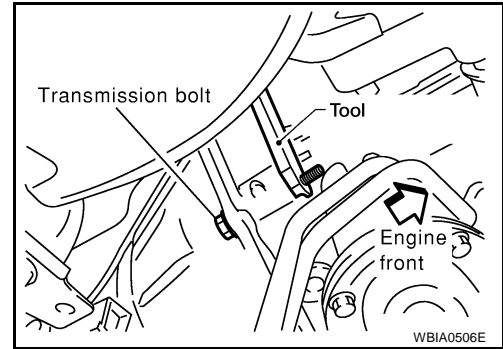
Tool number : KV10112100 (BT-8653-A)



TIMING CHAIN

34. Remove Tool.

Tool number : KV10117700 (J-44716)



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

36. Refill the engine with oil and coolant. Refer to [MA-9, "Fluids and Lubricants"](#) .

CAUTION:

- **Wait at least 30 minutes for the Silicone RTV Sealant to set before filling the engine with fluids to avoid leaks.**
- **Activate the fuel system. Check for any leaks when the system is repressurized and correct as necessary.**
- **Start the engine and check all systems for leaks or improper operation. Correct as necessary.**
- **After starting engine, keep idling for three minutes. Then rev engine up to 3,000 rpm under no load to purge air from the high-pressure oil chamber of the chain tensioners. The engine may produce a rattling noise. This indicates that air still remains in the chamber and is not a matter of concern.**

INSPECTION AFTER INSTALLATION

Inspection for Leaks

The following are procedures for checking fluid leaks, lubricant leaks and exhaust gases leaks.

- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to [MA-9, "RECOMMENDED FLUIDS AND LUBRICANTS"](#) .
- Use procedure below to check for fuel leakage.
- Turn ignition switch "ON" (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.

NOTE:

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

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

Summary of the inspection items:

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Other oils and fluid*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage

* Transmission/transaxle/CVT fluid, power steering fluid, brake fluid, etc.

CAMSHAFT

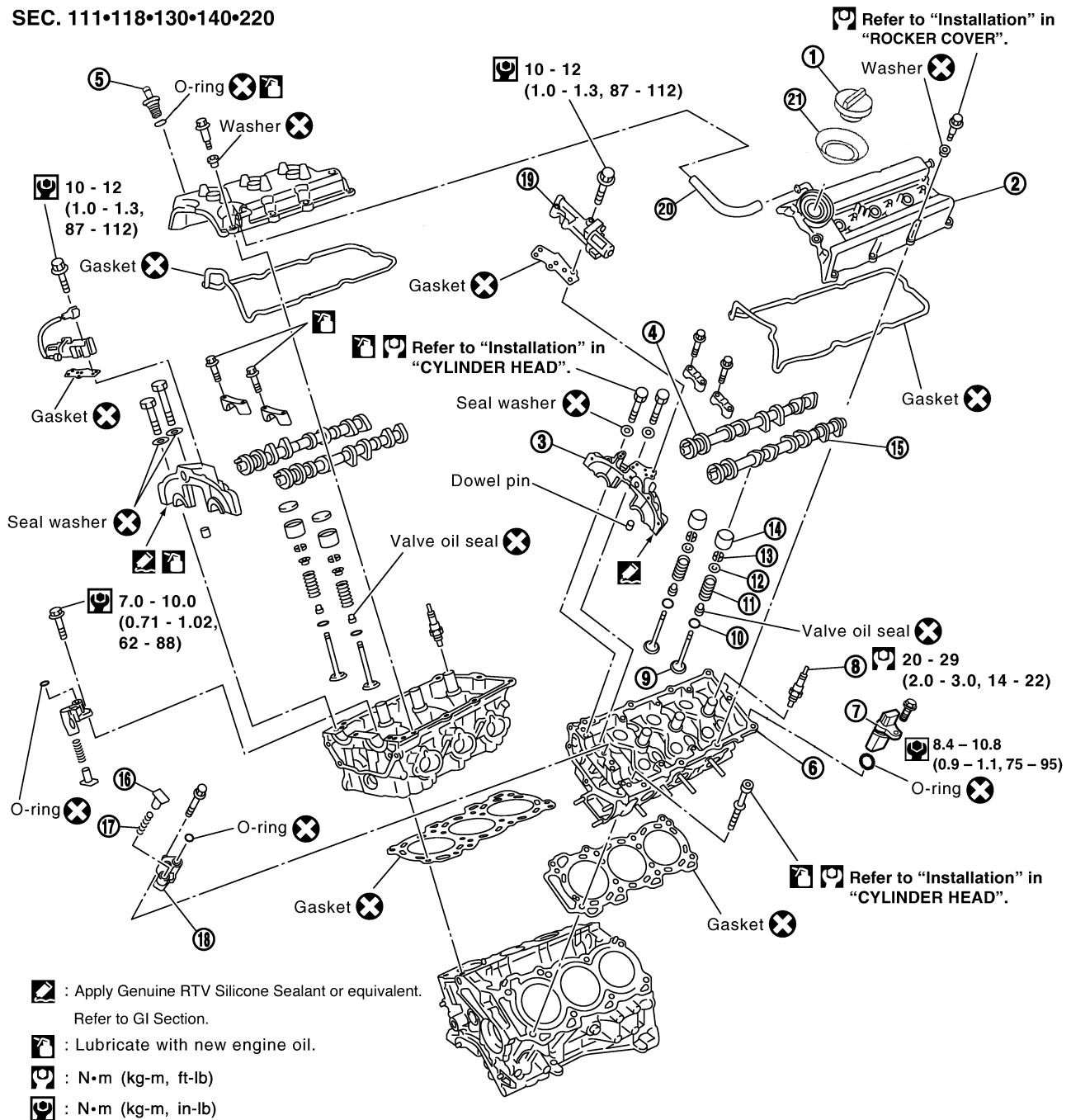
PFP:13001

EBS00RCN

CAMSHAFT

Removal and Installation

SEC. 111•118•130•140•220



- | | | |
|-------------------------------------|----------------------|---------------------------|
| 1. Oil filler cap | 2. Rocker cover (LH) | 3. Camshaft bracket (LH) |
| 4. Camshaft (INT) | 5. PCV valve | 6. Cylinder head |
| 7. Camshaft position sensor (PHASE) | 8. Spark plug | 9. Valve |
| 10. Valve spring seat | 11. Valve spring | 12. Valve spring retainer |
| 13. Valve collet | 14. Valve lifter | 15. Camshaft (EXH) |
| 16. Tensioner sleeve | 17. Tensioner spring | 18. Chain tensioner |
| 19. IVT control solenoid valve | 20. PCV hose | 21. Oil catcher |

REMOVAL

- Remove the timing chains. Refer to [EM-57, "Removal"](#).
- Remove the fuel rail and injectors. Refer to [EM-40, "Removal and Installation"](#).

CAMSHAFT

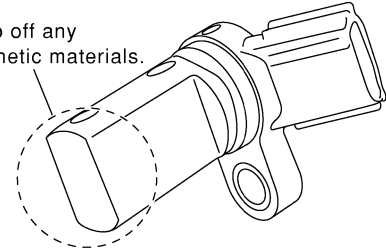
3. If necessary, remove camshaft position sensor (PHASE) (RH and LH bank) from cylinder head back side.

CAUTION:

- Handle carefully to avoid dropping an shocks.
- Do not disassemble.
- Do not allow metal powder to adhere to magnetic part at sensor tip.
- Do not place sensors in a location where they are exposed to magnetism.

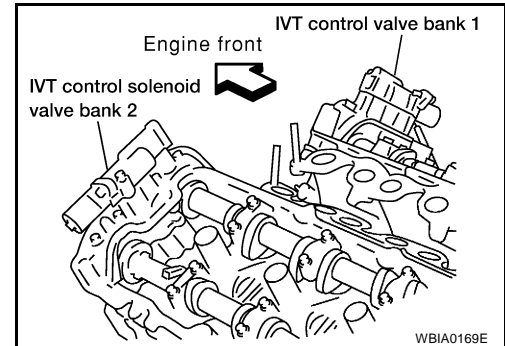
Example: Left bank

Keep off any magnetic materials.



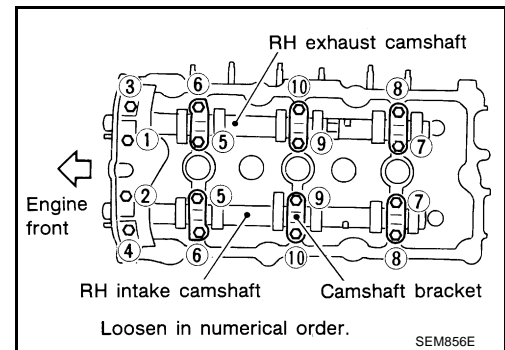
KBIA1046E

4. Remove the IVT control solenoid valves.
- Discard the IVT control solenoid valve gaskets and use new gaskets for installation.

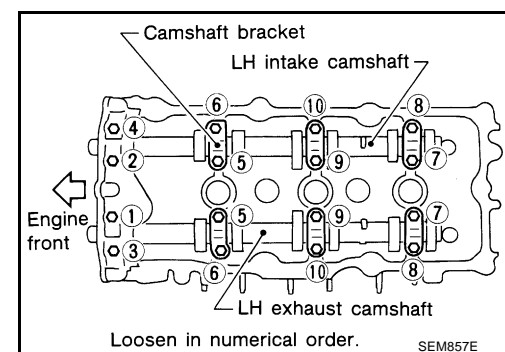


WBIA0169E

5. Remove the intake and exhaust 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 numerical order as shown.



SEM856E



SEM857E

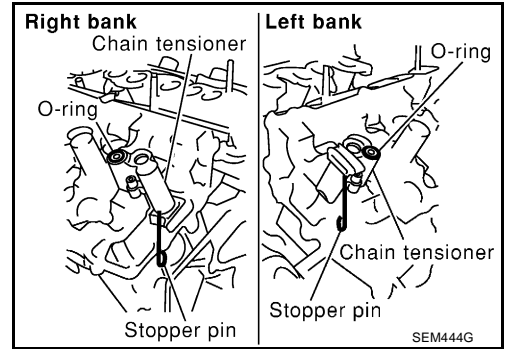
6. Remove valve lifters.
- NOTE:**
Identify installation positions to ensure proper installation.

CAMSHAFT

- 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

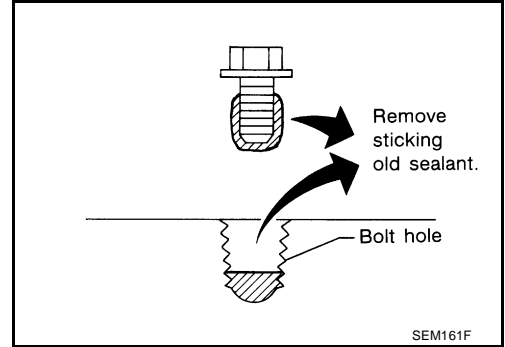
- Before installation, remove any old Silicone RTV Sealant from component mating surfaces using a scraper.

CAUTION:

Do not scratch or damage the mating surfaces.

NOTE:

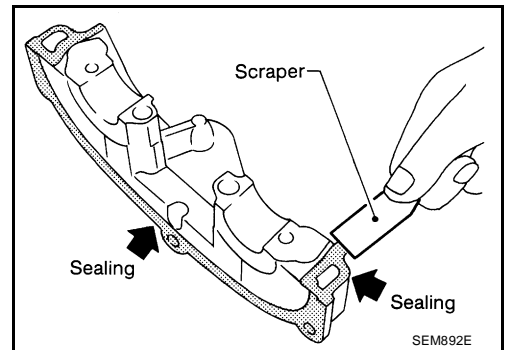
Remove the old Silicone RTV Sealant from the bolt holes and threads.



- Before installing the front cam bracket, remove the old Silicone RTV Sealant from the mating surface using a scraper.

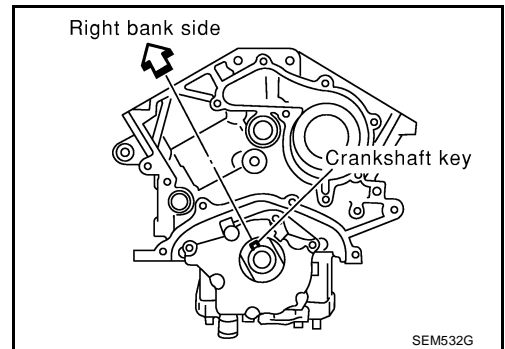
CAUTION:

Do not scratch or damage the mating surfaces.



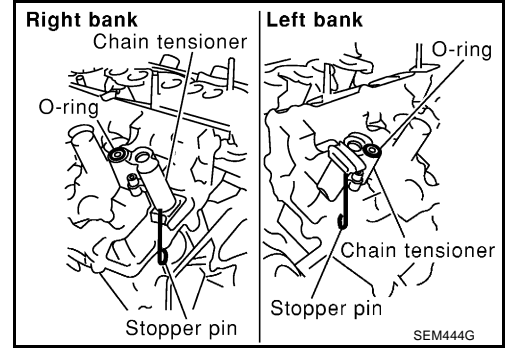
- Turn the crankshaft until No. 1 piston is set at TDC on the compression stroke.

- The crankshaft key should line up with the right bank cylinder center line as shown.



CAMSHAFT

4. Install camshaft chain tensioners on both sides of cylinder head.



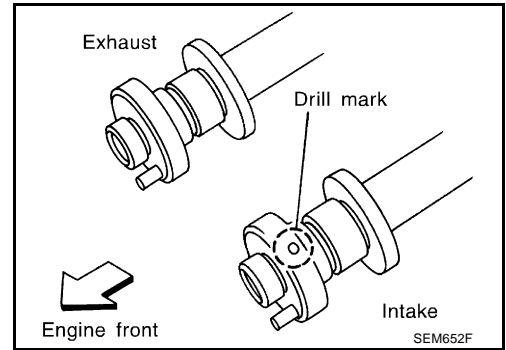
5. Install valve lifters.

NOTE:

Install them in original positions.

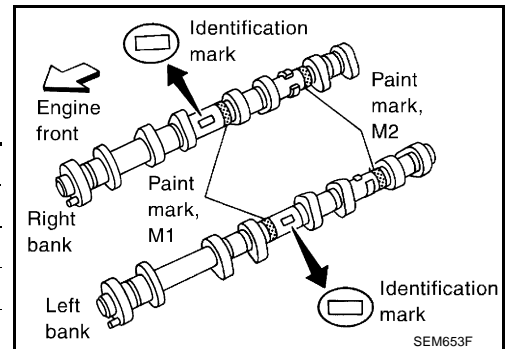
6. Install exhaust and intake camshafts and camshaft brackets.

- 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 camshafts components for proper placement and direction of the components.

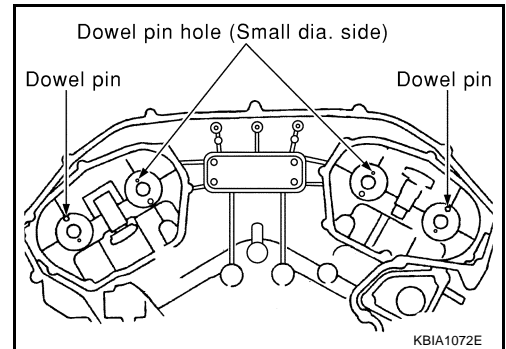
Bank	INT/EXH	ID mark	Drill mark	Paint marks	
				M1	M2
RH	INT	RE	Yes	Yes	No
	EXH	RE	No	No	Yes
LH	INT	LH	Yes	Yes	No
	EXH	LH	No	No	Yes



- Position the camshafts:

RH exhaust camshaft dowel pin at about 10 o'clock.

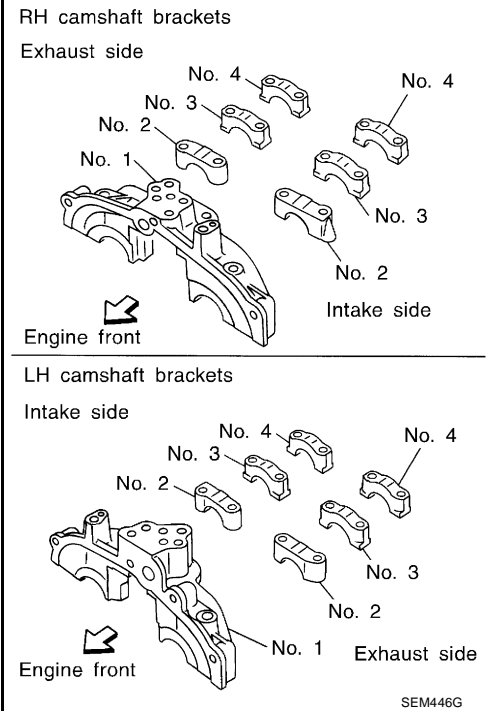
LH exhaust camshaft dowel pin at about 2 o'clock.



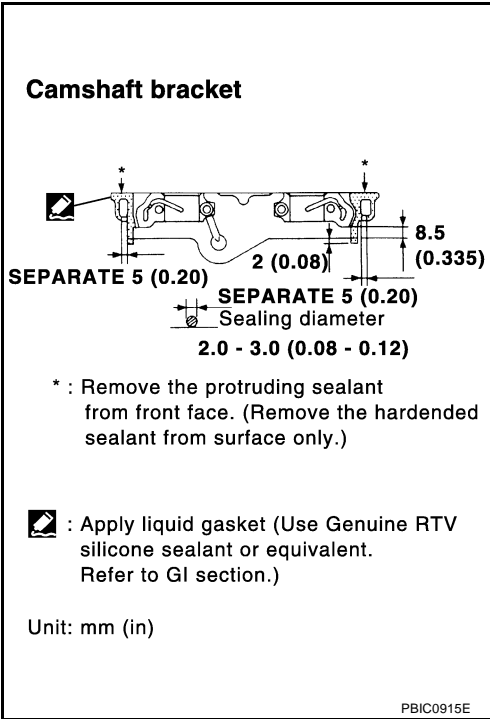
CAMSHAFT

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-46. "Recommended Chemical Products and Sealants"](#).



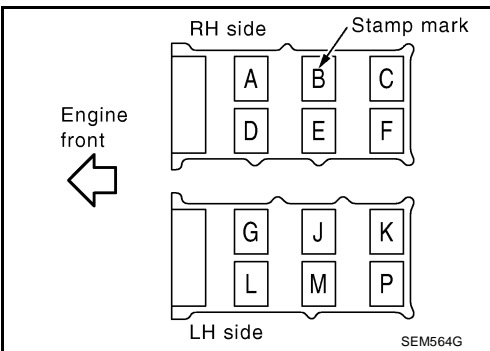
- Before installation, wipe off any protruding sealant.
- Refer to [EM-4. "LIQUID GASKET APPLICATION PROCEDURE"](#).



- 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-82. "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)



CAMSHAFT

8. Tighten the camshaft brackets in the four steps, in the order as shown.

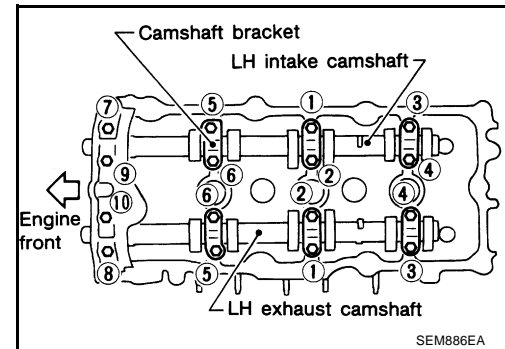
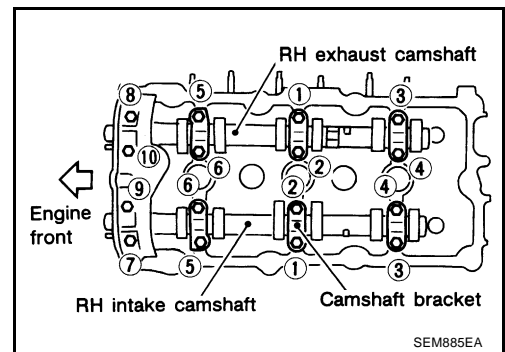
Camshaft bracket bolts

Step 1 (bolts 7 - 10) : 1.96 N·m (0.2 kg-m, 17 in-lb)

Step 2 (bolts 1 - 6) : 1.96 N·m (0.2 kg-m, 17 in-lb)

Step 3 : 5.88 N·m (0.6 kg-m, 52 in-lb)

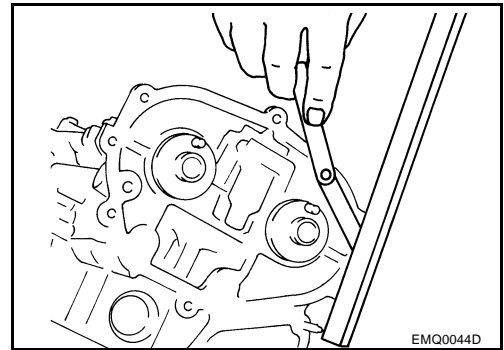
Step 4 : 10.4 N·m (1.1 kg-m, 92 in-lb)



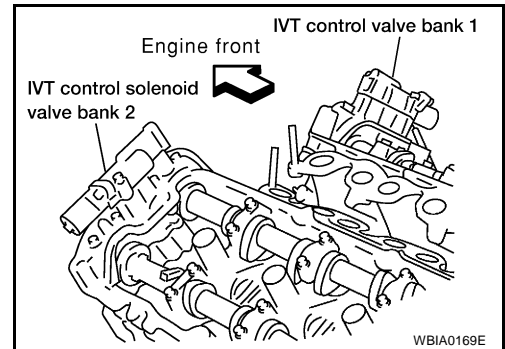
9. Measure difference in levels between front end faces of No. 1 camshaft bracket and cylinder head.

Standard : - 0.14 (- 0.0055 in)

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



10. Install the IVT control solenoid valves with new gaskets.



11. If necessary, install camshaft position sensor (PHASE) (RH and LH bank.)
12. Install the fuel rail and injectors. Refer to [EM-40, "Removal and Installation"](#) .
13. Install the timing chains. Refer to [EM-64, "Installation"](#) .

INSPECTION AFTER REMOVAL

Camshaft Visual Check

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

CAMSHAFT

Camshaft Runout

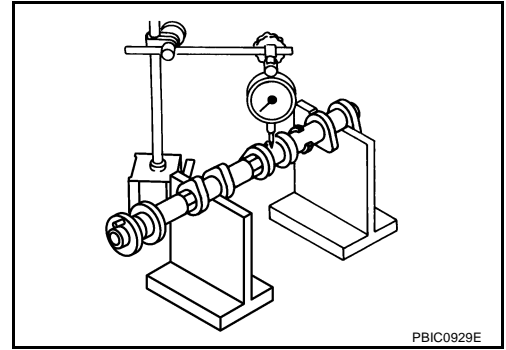
1. Put V-block on precise flat bed and support No. 2 and No. 4 journal of camshaft as shown.
2. Set dial gauges vertically to No. 3 journal as shown.
3. Turn camshaft in one direction slowly by hand, measure the camshaft runout on the dial gauges.
 - Runout is the largest indicator reading after one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

Camshaft Runout

Standard : Less than 0.02 mm (0.0008 in)

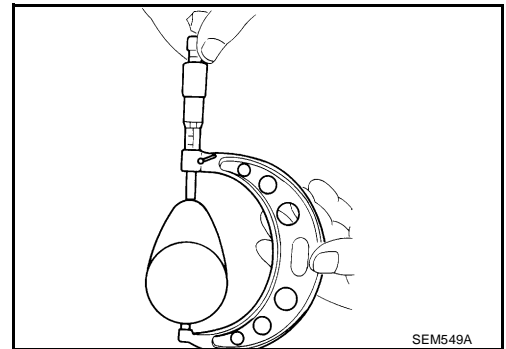
Limit : 0.05 mm (0.0020 in)

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



Camshaft Cam Lobe Height

1. Measure camshaft cam lobe height as shown. Refer to [EM-140, "CAMSHAFT AND CAMSHAFT BEARING"](#).
2. If wear has reduced the lobe height below specifications, replace the camshaft.



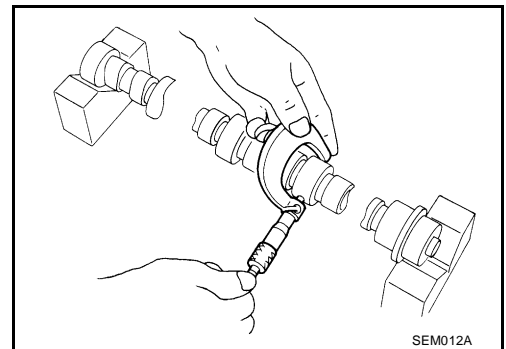
Camshaft Journal Clearance

Outer Diameter of Camshaft Journal

- Measure outer diameter of camshaft journal 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)

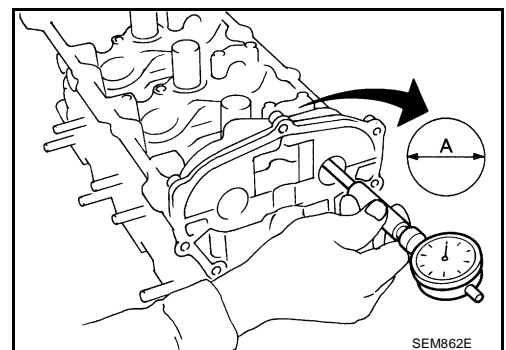


Inner Diameter of Camshaft Bracket

1. Tighten camshaft bracket bolt with specified torque.
2. Using inside micrometer, measure inner diameter "A" of camshaft bearing.

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)

CAMSHAFT

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:

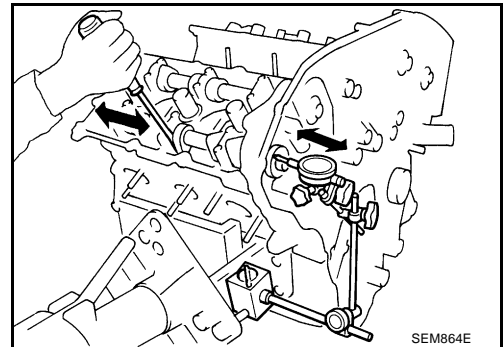
Inner diameter of camshaft bracket is manufactured together with cylinder head. Replace the whole cylinder head assembly.

Camshaft End Play

1. Install the camshaft in the cylinder head.
2. Install dial gauge 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.

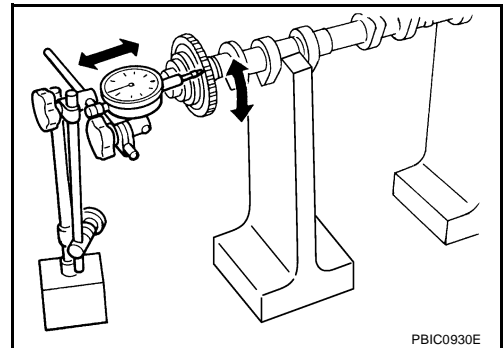


Camshaft Sprocket Runout

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.

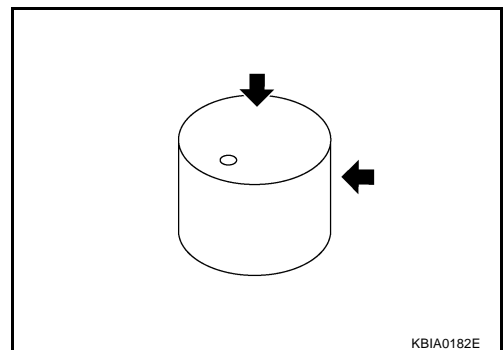
Runout	: Less than 0.15 mm (0.0059 in)
---------------	----------------------------------------

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.

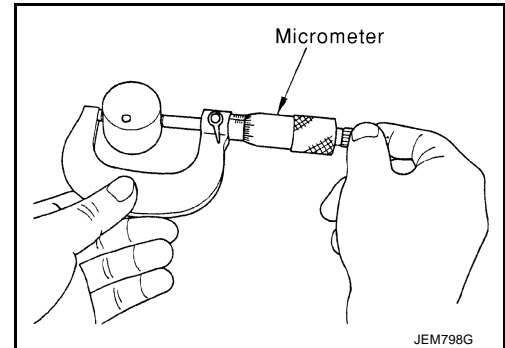


CAMSHAFT

Valve Lifter Clearance

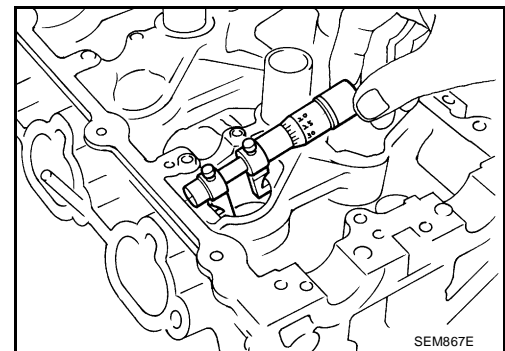
Outer Diameter of Valve Lifter

- Measure the outer diameter of the valve lifter. Refer to [EM-137, "Valve Lifter"](#).
- If out of the specified range, replace the valve lifter.



Valve Lifter Bore Diameter

- Using inside micrometer, measure diameter of valve lifter bore of cylinder head. Refer to [EM-137, "Valve Lifter"](#).
- 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-137, "Valve Lifter"](#).
- If out of specified range, replace either or both valve lifter and cylinder head assembly.

Inspection after Installation

INSPECTION OF CAMSHAFT SPROCKET (INT) OIL GROOVE

EBS00RCO

CAUTION:

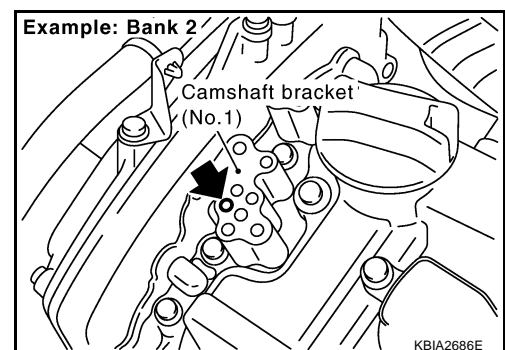
- Perform this inspection only when DTC P0011 is detected in self-diagnostic results of CONSULT II and it is directed according to inspection procedure of EC section. Refer to.
 - Check when engine is cold so as to prevent burns from any splashing engine oil.
1. Check engine oil level. Refer to [LU-7, "OIL LEVEL"](#).
 2. Perform the following procedure so as to prevent the engine from being unintentionally started while checking.
 - a. Release fuel pressure. Refer to [EC-81, "FUEL PRESSURE RELEASE"](#).
 - b. Disconnect ignition coil and injector harness connectors if practical.
 3. Remove IVT control solenoid valve.
 4. Crank engine, and then make sure that engine oil comes out from IVT control 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 IVT control solenoid valve installation hole during cranking. Use a shop cloth to prevent engine oil from splashing on worker, engine components and vehicle.



CAMSHAFT

- 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 IVT control solenoid valve if engine oil does not come out from IVT control valve cover oil hole.
 6. Remove components between IVT 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.

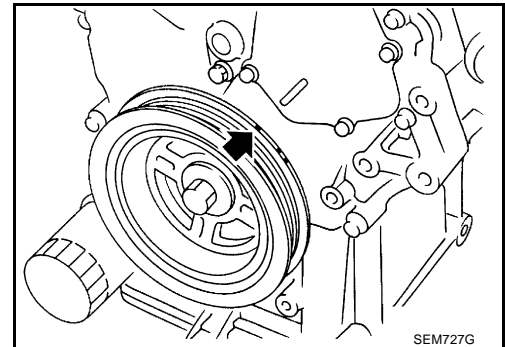
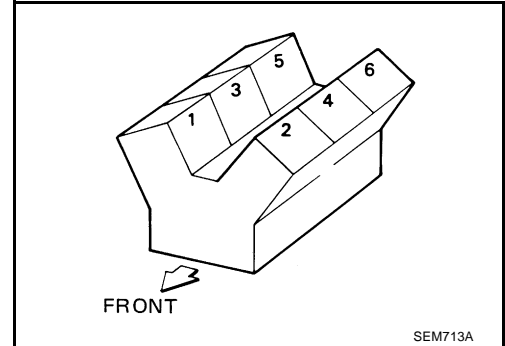
Valve Clearance CHECKING

EBS00RCP

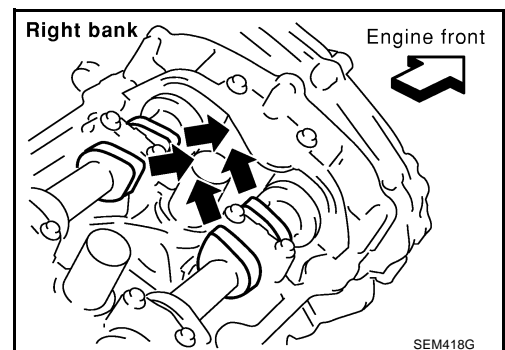
- Perform inspection as follows after removal, installation or replacement of camshaft or valve related parts, or if there is unusual engine conditions regarding valve clearance.

Check valve clearance while engine is cold and not running.

1. Remove the air duct with air cleaner case, collectors, hoses, wires, harnesses, and connectors.
 2. Remove the intake manifold collectors.
 3. Remove the ignition coils and spark plugs.
 4. Remove the rocker covers.
-
5. Set No.1 cylinder at TDC on its compression stroke.
 - Align pointer with TDC mark 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.



CAMSHAFT

6. Check only the valves as shown.

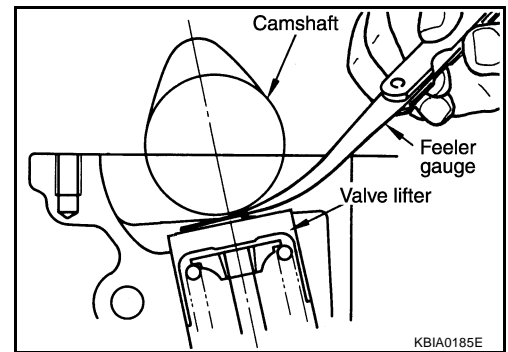
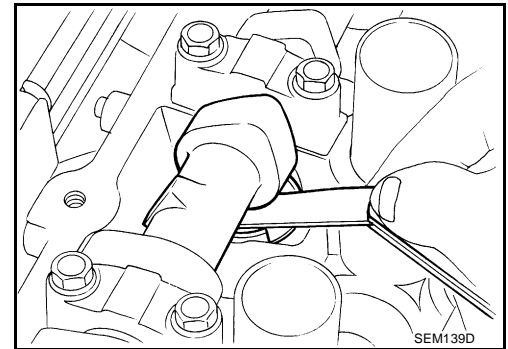
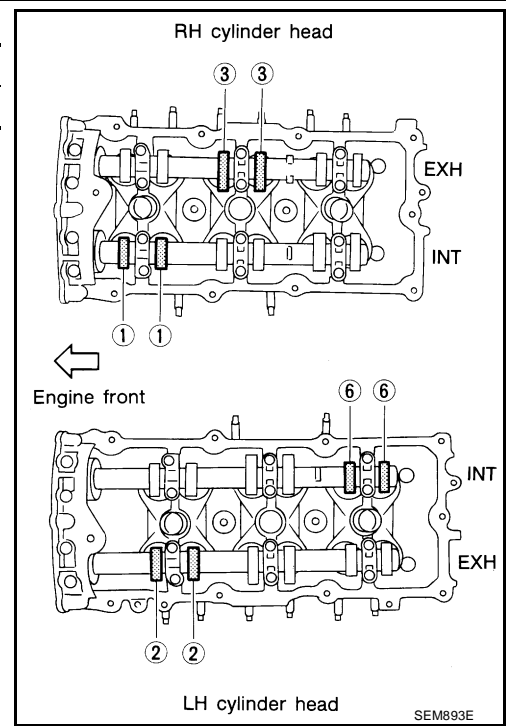
Crank Position	Valve No. 1	Valve No. 2	Valve No. 3	Valve No. 6
No. 1 TDC	Intake	Exhaust	Exhaust	Intake

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



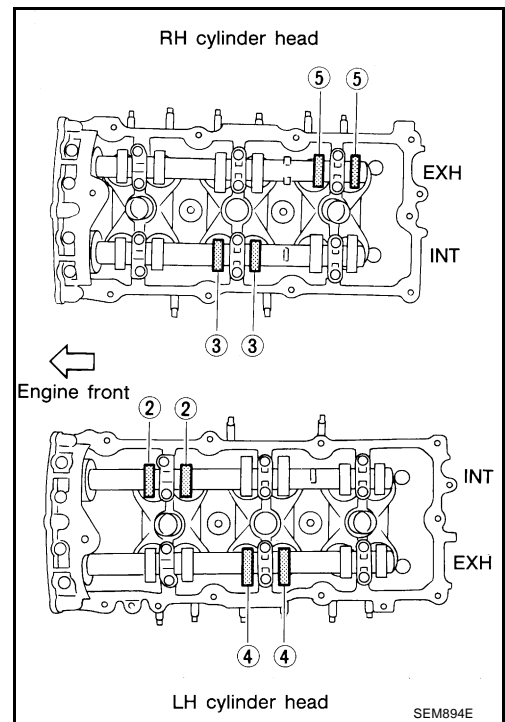
7. Turn crankshaft 240°.
8. Set No.3 cylinder at TDC on its compression stroke.

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

CAMSHAFT

9. Check only those valves as shown.

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

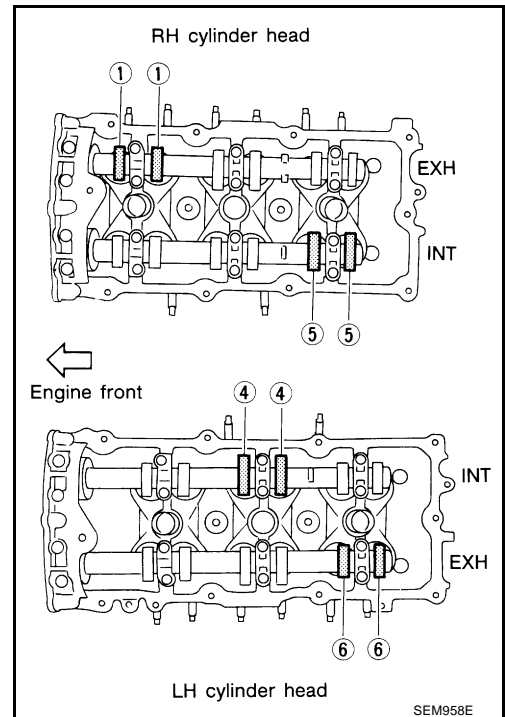


10. Turn the crankshaft 240° and align as above.

11. Set No.5 cylinder at TDC on its compression stroke.

12. Check only those valves 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 clearances are within specification, install the following components. If the valve clearances are out of specification, adjust the valve clearances.

- Intake manifold collectors
- Rocker covers
- All spark plugs
- All ignition coils

CAMSHAFT

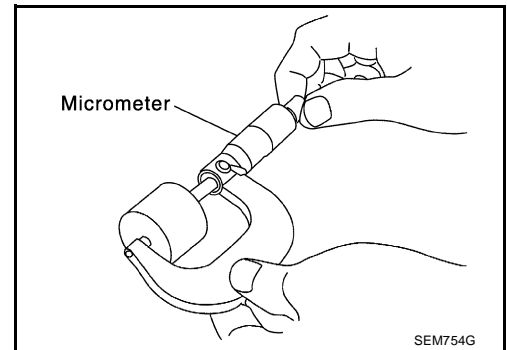
VALVE ADJUSTING

CAUTION:

Adjust valve 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 clearances.
1. Remove the camshaft.
 2. Remove the valve lifter that was measured as being outside the standard specifications.
 3. Measure the center thickness of the removed lifter with a micrometer, 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 lifter

t1 = thickness of the removed lifter

C1 = measured valve clearance

C2 = standard valve clearance

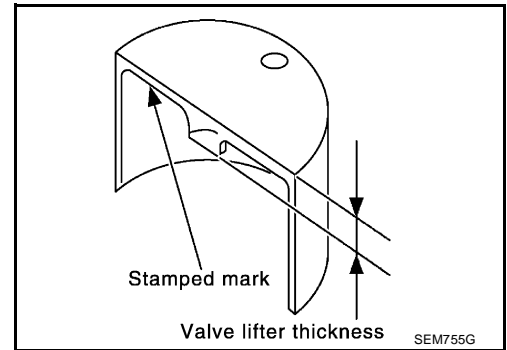
- The thickness of the new valve lifter can be identified by the stamp mark on the reverse side (inside the lifter).
- Available thickness of the valve lifter (factory setting): 7.88 - 8.36 mm (0.3102 - 0.3291 in), in 0.02 mm (0.0008 in) increments, in 25 sizes (intake / exhaust). Refer to [EM-137, "Valve Lifter"](#).

Value lifter thickness:

Intake: 0.30 mm (0.012 in)

Exhaust: 0.33 mm (0.013 in)

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



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)

OIL SEAL

Removal and Installation of Valve Oil Seal REMOVAL

EBS00RCQ

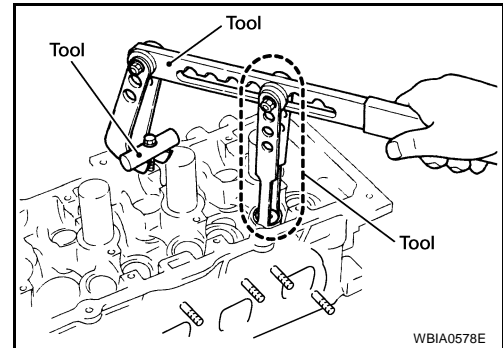
1. Remove camshaft relating to valve oil seal to be removed. Refer to [EM-73, "REMOVAL"](#) .
2. Remove valve lifters. Refer to [EM-73, "REMOVAL"](#) .
3. Remove valve collet, valve spring retainer and valve spring using Tool.

CAUTION:

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

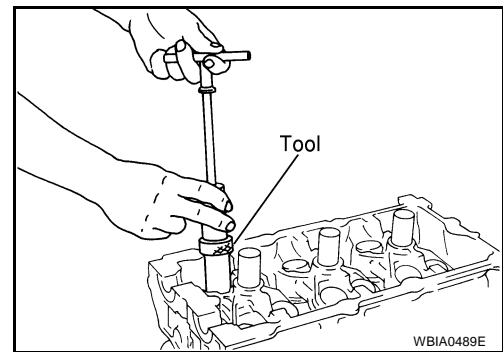
Tool numbers : KV10116200 (J-26336-B)
 : KV10115900 (J-26336-20)
 : KV10109230 (—)

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



4. Remove valve oil seal using Tool.

Tool number : KV10107902 (J-38959)



5. 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.

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.

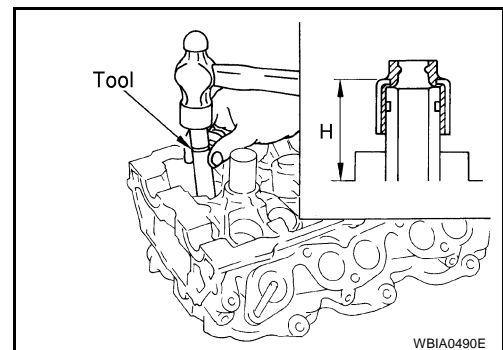
Tool number : — (J-39386)

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 REMOVAL

EBS00RCR

1. Remove the following parts:
 - Engine under cover
 - Drive belts. Refer to [EM-13, "DRIVE BELTS"](#) .
 - Radiator fan. Refer to [CO-13, "Removal and Installation"](#) .
2. Remove the crankshaft pulley as follows:
 - a. Remove the starter motor. Refer to [SC-16, "Removal and Installation"](#) .

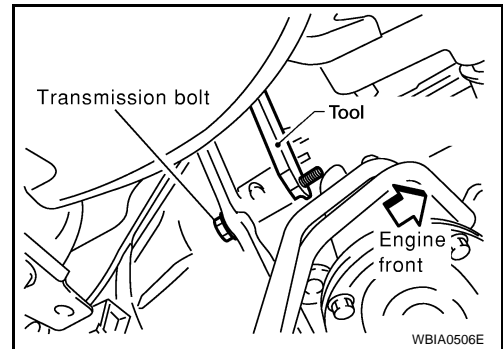
OIL SEAL

- b. Set the ring gear stopper using the bolt hole.

Tool number : KV10117700 (J-44716)

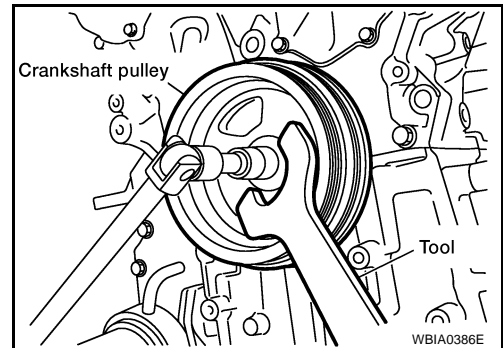
CAUTION:

Do not damage the ring gear teeth, or the signal plate teeth behind the ring gear when setting the stopper.



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

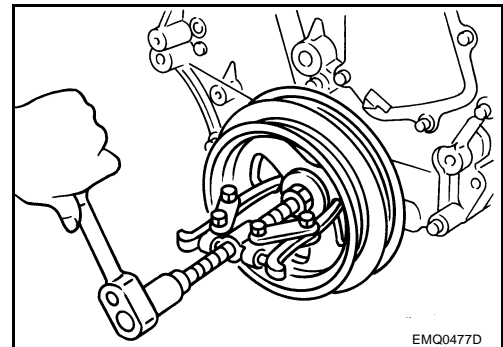
Tool number : KV10109300 (—)



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

CAUTION:

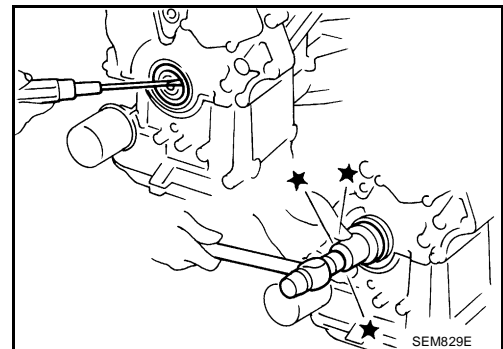
Do not use a puller claw on crankshaft pulley periphery.



3. Remove front oil seal from front cover.

CAUTION:

Be careful not to damage front cover or crankshaft.



OIL SEAL

INSTALLATION

1. Apply new engine oil to new oil seal and install it flush with front of mounting surface using a suitable tool.
 - Install new oil seal in the direction as shown.

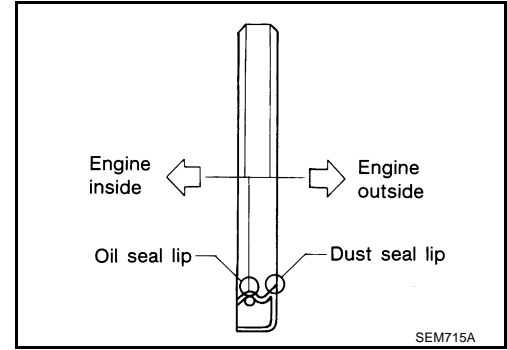
Suitable drift

Outer diameter : 59 mm (2.32 in)

Inner diameter : 49 mm (1.93 in)

CAUTION:

- Press fit straight and avoid causing burrs or tilting the oil seal.
- Do not reuse oil seal.



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 of angle tightening. Use Tool.

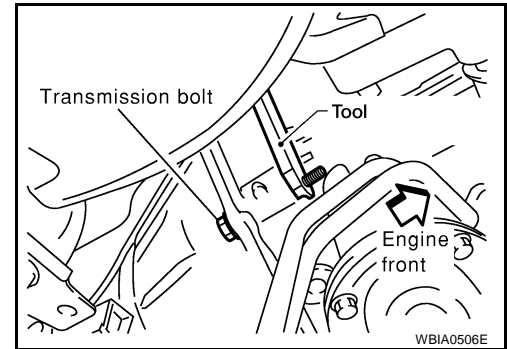
Step 1 : 44 N·m (4.5 kg-m, 32 ft-lb)

Step 2 : 90° degrees clockwise

Tool number : KV10112100 (BT-8653-A)

3. Remove Tool.

Tool number : KV10117700 (J-44716)



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

Removal and Installation of Rear Oil Seal

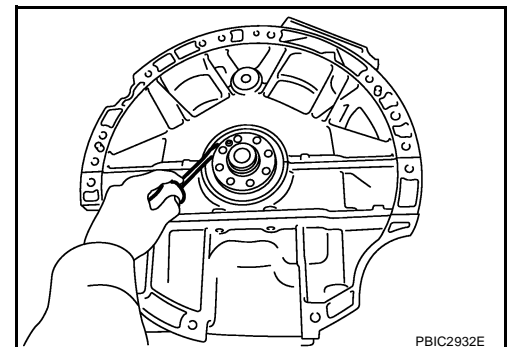
REMOVAL

EBS00RCS

1. Remove the transaxle. Refer to [CVT-199, "TRANSAXLE ASSEMBLY"](#).
2. Remove drive plate (CVT).
3. Remove rear oil seal using a suitable tool.

CAUTION:

Be careful not to damage crankshaft and cylinder block.

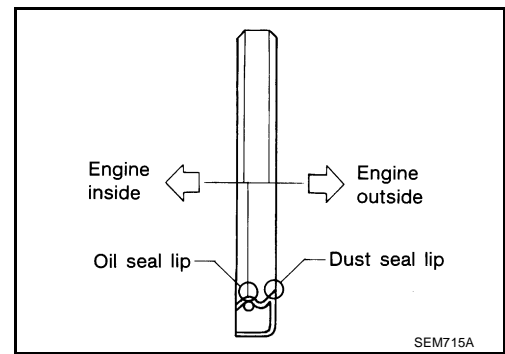


INSTALLATION

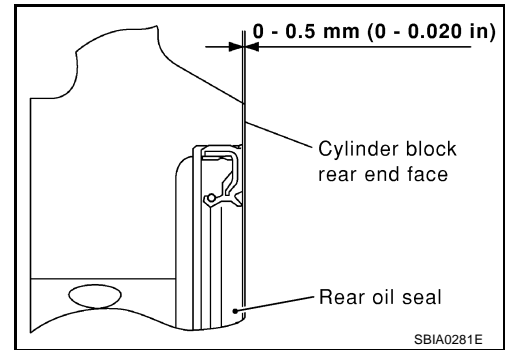
1. Apply new engine oil to new rear oil seal joint surface and seal lip.

OIL SEAL

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



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

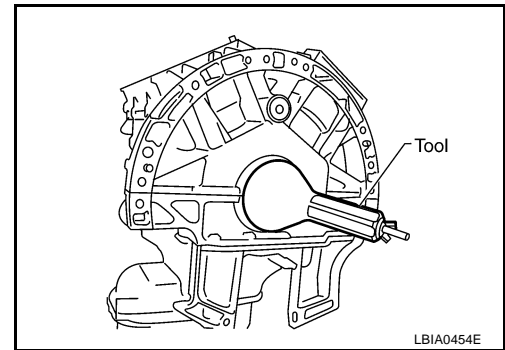


- Install new rear oil seal using Tool.

Tool number : KV991J0120 (J-47128)

CAUTION:

- Be careful not to damage crankshaft and cylinder block.
- Press-fit oil seal straight to avoid causing burrs or tilting.
- Do not touch grease applied onto oil seal lip.



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

CAUTION:

- When replacing an engine/CVT/transaxle you must make sure the dowels are installed correctly during re-assembly.
- Improper alignment caused by missing dowels may cause vibration, oil leaks or breakage of drivetrain components.

CYLINDER HEAD

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CYLINDER HEAD

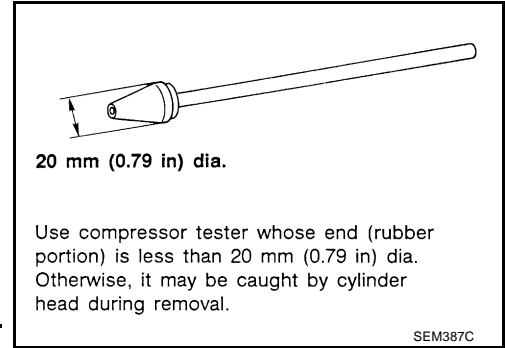
On-Vehicle Service

CHECKING COMPRESSION PRESSURE

1. Run the engine until it reaches normal operating temperature.
2. Turn the ignition switch to OFF.
3. Release fuel pressure and leave the fuel pump electrically disconnected. Refer to [EC-81, "FUEL PRESSURE RELEASE"](#).
4. Remove all six spark plugs. Refer to [EM-38, "REMOVAL"](#).
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).
 - **Always use a fully-charged battery to obtain specified engine speed.**

Unit: kPa (kg/cm², psi)/rpm

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



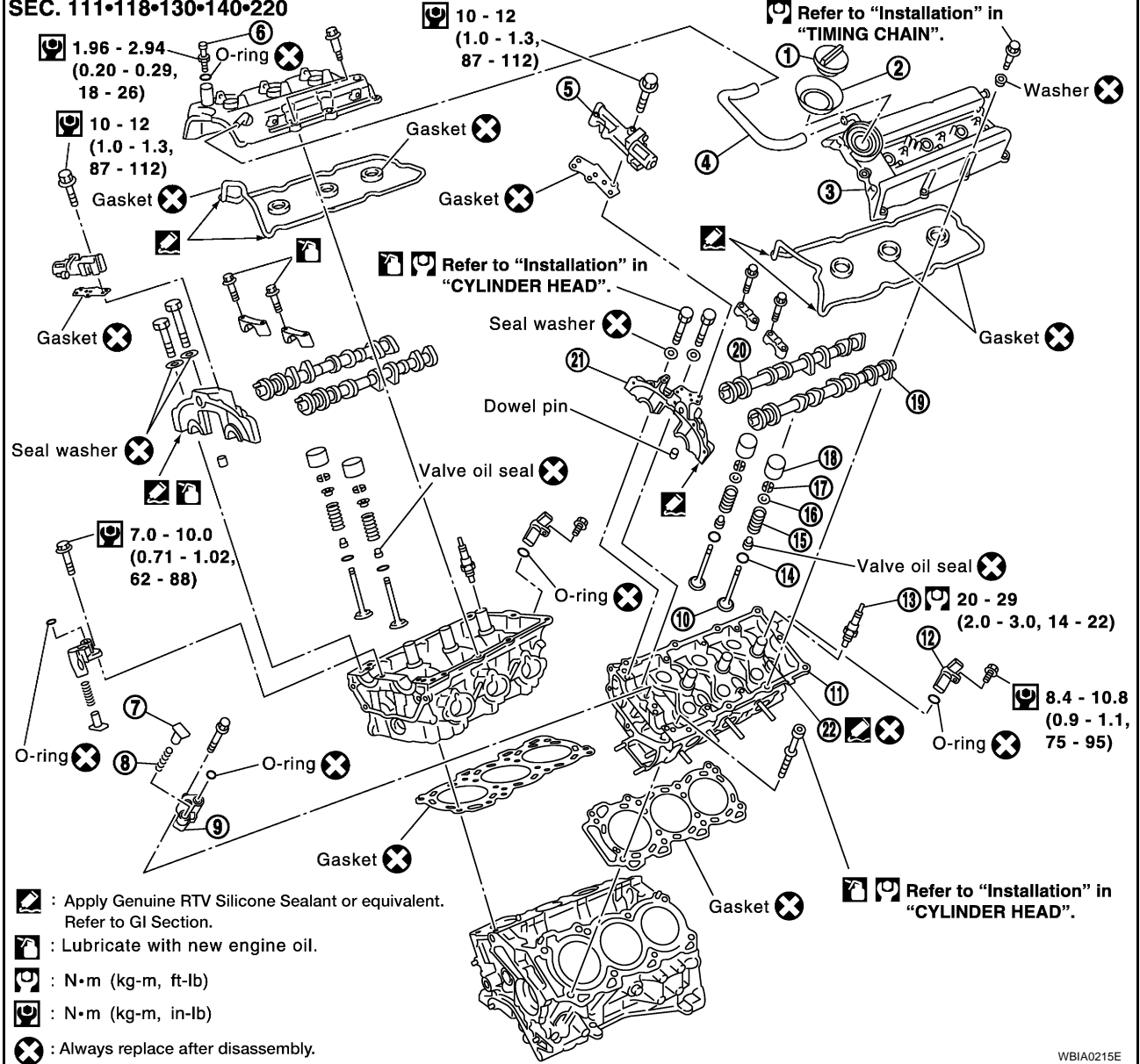
9. If compression in one or more cylinders is low:
 - a. Pour a small amount of engine oil into cylinders through the spark plug holes.
 - b. Retest compression (steps 5 - 8).
 - **If adding oil helps raise compression pressure, then the piston rings may be worn or damaged. If so, replace piston rings after checking piston.**
 - **If the pressure stays low, a valve may be sticking or is seating improperly. Inspect and repair the valve and/or valve seat. Refer to [EM-136, "VALVE"](#). If the valve and/or valve seat is damaged excessively, replace as necessary.**
 - **If compression stays low in two or more cylinders that are next to each other:**
 - The cylinder head gasket may be leaking.
 - Both cylinders may have valve component damage. Inspect and repair as necessary.

CYLINDER HEAD

EBS00RCU

Removal and Installation

SEC. 111•118•130•140•220



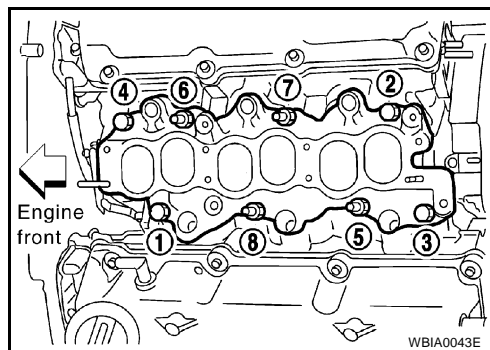
- | | | |
|---------------------------|-------------------------------|--------------------------------------|
| 1. Oil filler cap | 2. Oil catcher | 3. Rocker cover |
| 4. PCV hose | 5. IVT control solenoid valve | 6. PCV valve |
| 7. Tensioner sleeve | 8. Spring | 9. Chain tensioner |
| 10. Valve | 11. Cylinder head | 12. Camshaft position sensor (PHASE) |
| 13. Spark plug | 14. Valve spring seat | 15. Valve spring |
| 16. Valve spring retainer | 17. Valve collet | 18. Valve lifter |
| 19. Camshaft (EXH) | 20. Camshaft (INT) | 21. Camshaft bracket |
| 22. Spark plug tube | | |

REMOVAL

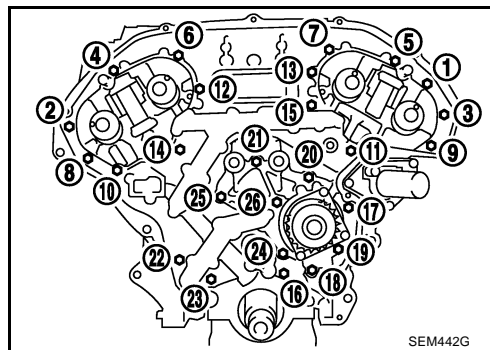
1. Remove the timing chains. Refer to [EM-57, "Removal"](#).
2. Remove the fuel rail and injectors. Refer to [EM-40, "Removal and Installation"](#).

CYLINDER HEAD

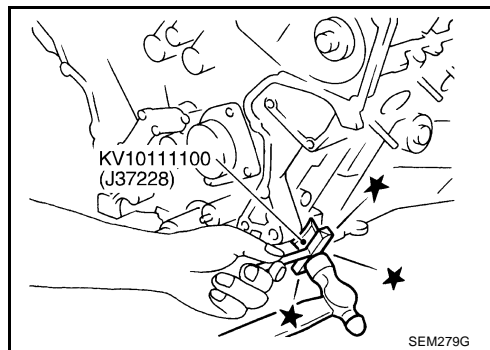
3. Remove the intake manifold using power tool.
 - Loosen the bolts in the numerical order as shown.
4. Remove the coolant outlet housing.



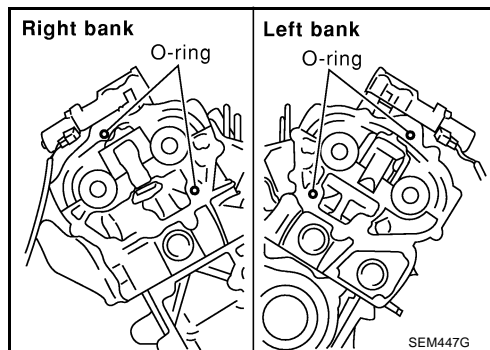
5. Remove rear timing chain case bolts using power tool.
 - Loosen the bolts in the numerical order as shown.



6. Remove rear timing chain case using Tool.
Tool number : KV10111100 (J-37228)

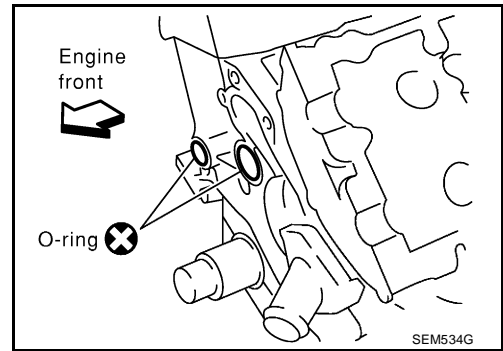


7. Remove the O-rings from the front of the cylinder heads.
 - Discard the O-rings and use new O-rings for installation.

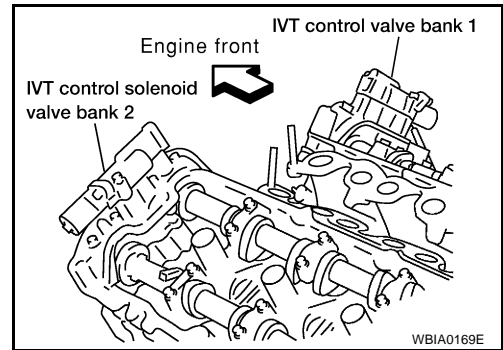


CYLINDER HEAD

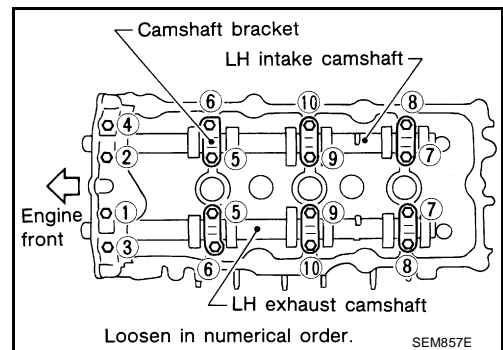
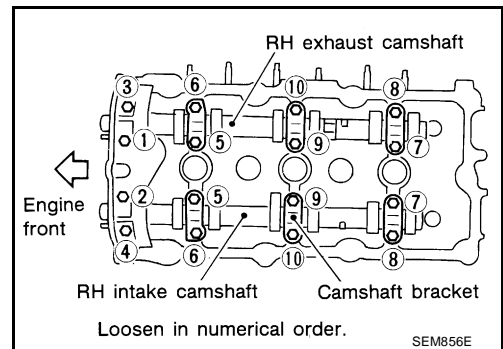
8. Remove the O-rings from the cylinder block.
- Discard the O-rings and use new O-rings for installation.



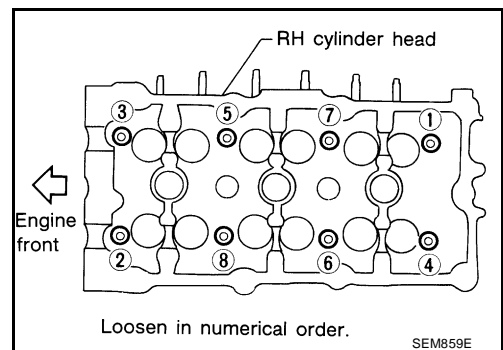
9. Remove the IVT control solenoid valves.
- Discard the IVT control solenoid valve gaskets and use new gaskets for installation.



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

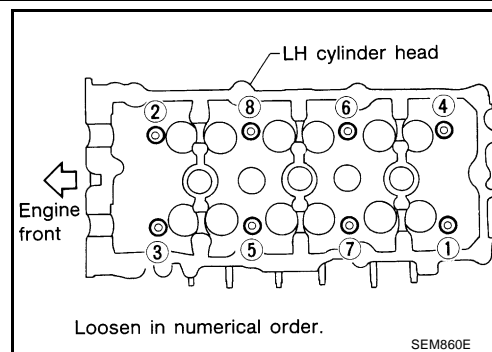


11. Remove the RH and LH cylinder head bolts, using power tool.
- The bolts should be loosened gradually in three stages.
 - Loosen the bolts in the numerical order as shown.



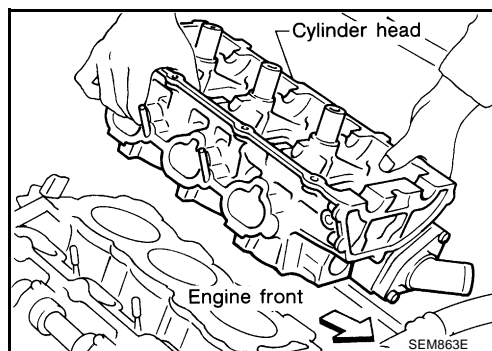
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CYLINDER HEAD



12. Remove cylinder heads and gaskets.

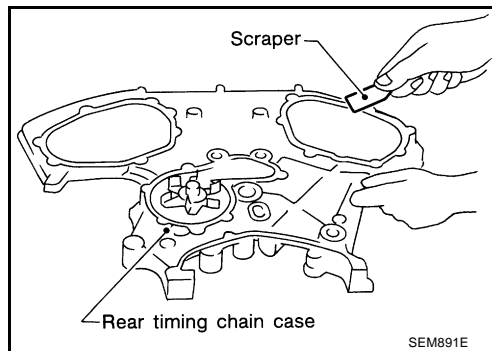
- Discard the cylinder head gaskets and use new gaskets for installation.



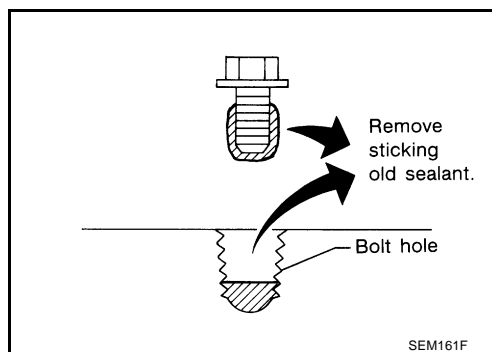
INSTALLATION

1. Before installing the rear timing chain case, remove the old Silicone RTV Sealant from mating surface using a scraper.

- Also remove old sealant from mating surface of cylinder block.



- Remove the old Silicone RTV Sealant from the bolt hole and thread.

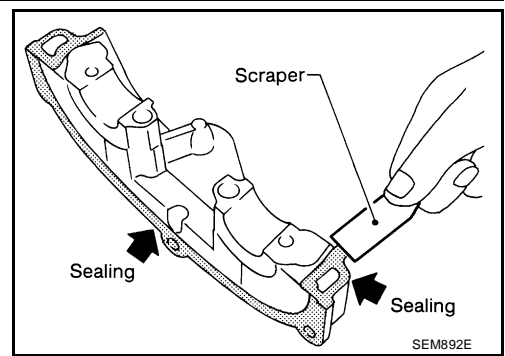


CYLINDER HEAD

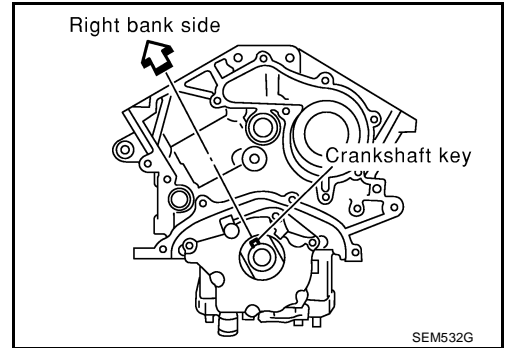
- Before installing the front cam bracket, remove the old RTV Silicone Sealant from the mating surface using a scraper.

CAUTION:

Do not scratch the mating surface.



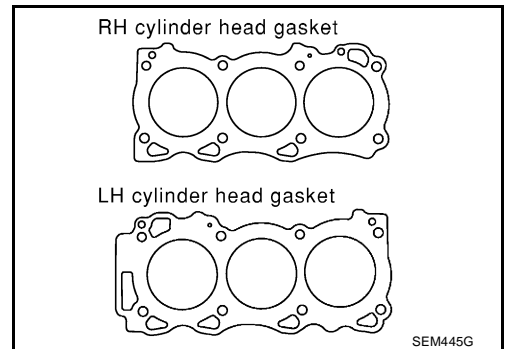
- Turn the crankshaft until No. 1 piston is set at TDC on the compression stroke.
 - The crankshaft key should line up with the right bank cylinder center line as shown.



- Install new gaskets on the cylinder heads.

CAUTION:

- Do not rotate crankshaft and camshaft separately or valves will strike piston heads.**
- Do not reuse gaskets.**



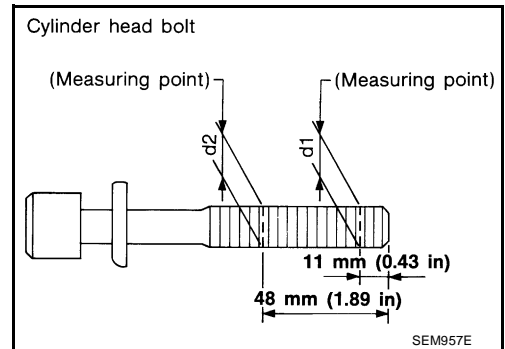
- Inspect the cylinder head bolts before installing the cylinder heads.

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.

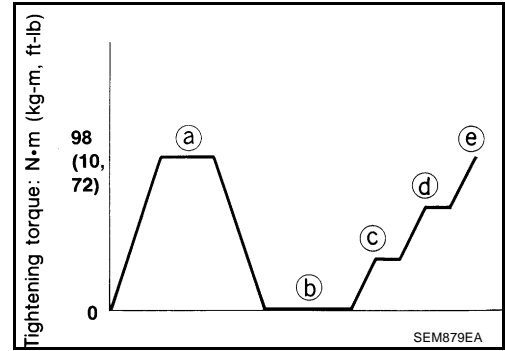
Limit (d1 - d2) : 0.11 mm (0.0043 in)

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



CYLINDER HEAD

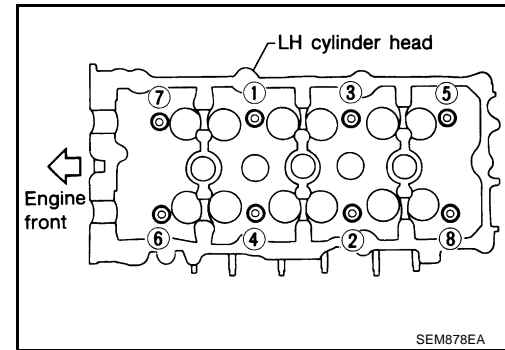
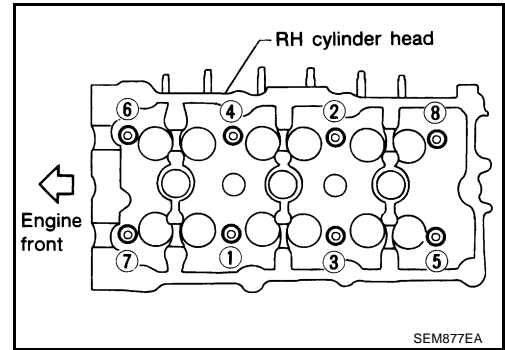
6. Install the cylinder heads on the cylinder block. Tighten the cylinder head bolts in the five stages in the numerical order as shown.



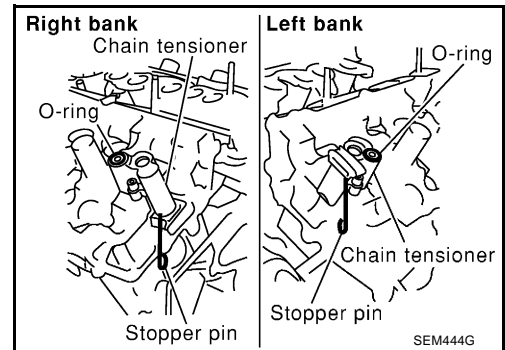
● **Tightening procedure:**

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** : 32.9 N·m (4.0 kg-m, 29 ft-lb)
- Step d** : 90° degrees rotation clockwise
- Step e** : 90° degrees rotation clockwise



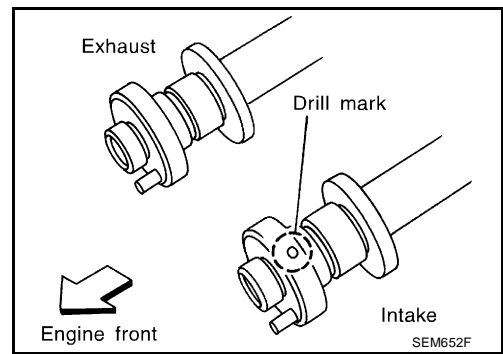
7. Install camshaft chain tensioners on both sides of cylinder head.



CYLINDER HEAD

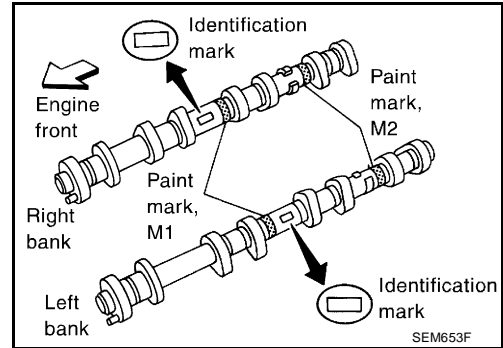
8. Install exhaust and intake camshafts and camshaft brackets.

- Intake camshaft has a drill mark on camshaft sprocket mounting flange.

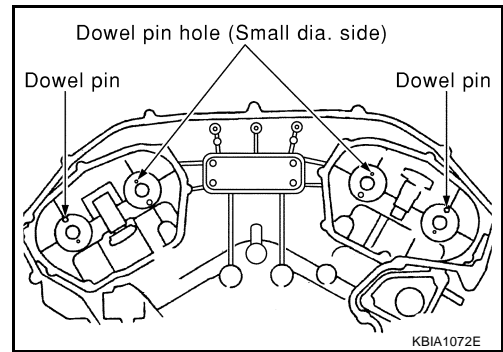


- Follow your identification marks made during removal, or follow the identification marks that are present on the new camshaft components for proper placement.

Bank	INT/EXH	ID mark	Drill mark	Paint marks	
				M1	M2
RH	INT	RE	Yes	Yes	No
	EXH	RE	No	No	Yes
LH	INT	LH	Yes	Yes	No
	EXH	LH	No	No	Yes

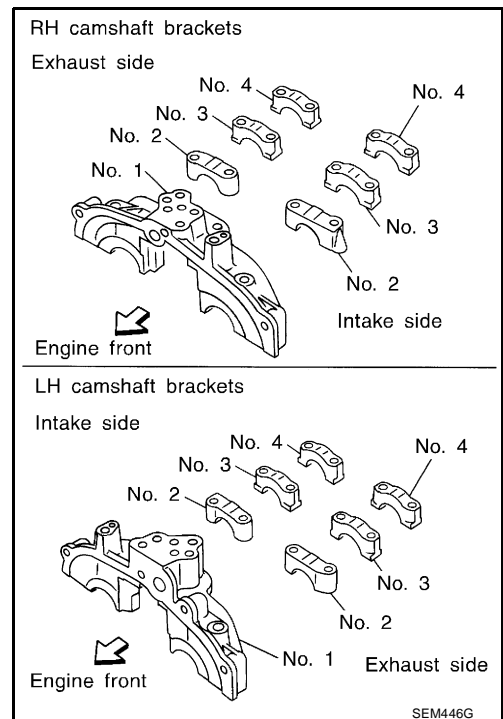


- Position the camshafts:
RH exhaust camshaft dowel pin at about 10 o'clock
LH exhaust camshaft dowel pin at about 2 o'clock.



9. Before installing camshaft brackets, apply sealant to mating surface of No. 1 journal head.

- Use Genuine RTV Silicone Sealant, or equivalent. Refer to [GI-46, "Recommended Chemical Products and Sealants"](#).
- Refer to [EM-56, "POSITION FOR APPLYING LIQUID GASKET"](#).

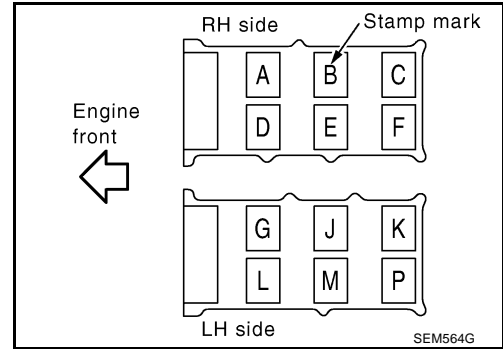


CYLINDER HEAD

- Install camshaft brackets in their original positions and direction. Align the stamp marks as shown.
- If any part of valve assembly or camshaft is replaced, check and adjust the valve clearance. Refer to [EM-82, "Valve Clearance"](#).

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

- Lubricate the threads and seat surfaces of the camshaft bracket bolts with new engine oil before installation.



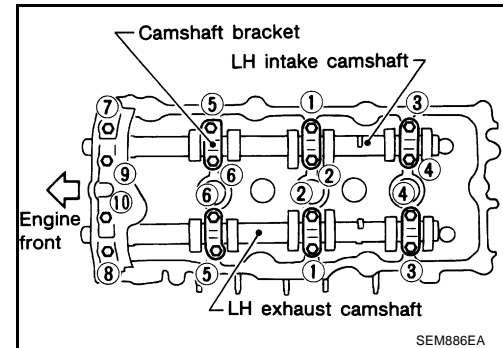
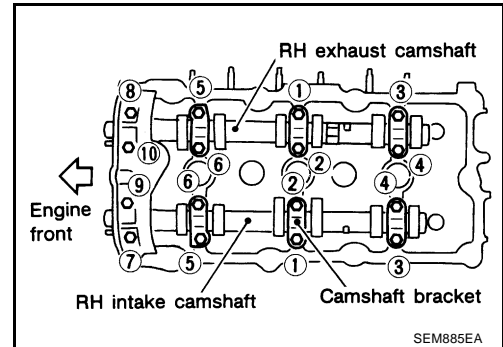
10. Tighten the camshaft brackets in four steps in the order as shown.

NOTE:

Lubricate the threads and seat surfaces of the camshaft bracket bolts with new engine oil before installation.

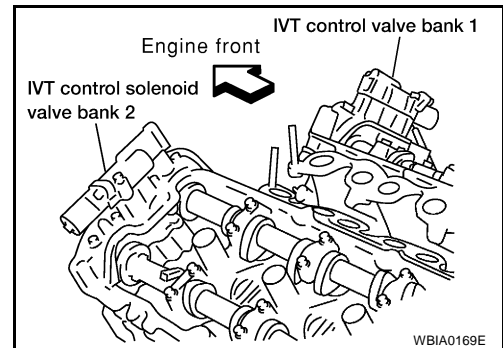
Camshaft bracket bolts

Step 1 (bolts 7 - 10) : 1.96 N·m (0.2 kg-m, 17 in-lb)
Step 2 (bolts 1 - 6) : 1.96 N·m (0.2 kg-m, 17 in-lb)
Step 3 : 5.88 N·m (0.6 kg-m, 52 in-lb)
Step 4 : 10.4 N·m (1.1 kg-m, 92 in-lb)



11. Install the IVT control solenoid valves with new gaskets.

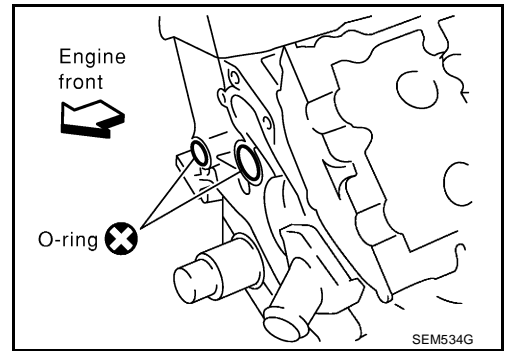
CAUTION:
Do not reuse gaskets.



CYLINDER HEAD

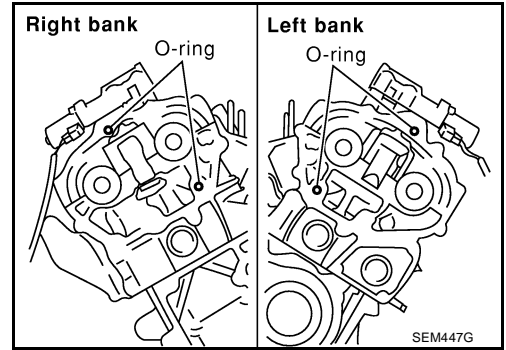
12. Install the new O-rings on the cylinder block.

CAUTION:
Do not reuse O-rings.



13. Install the new O-rings on the cylinder head.

CAUTION:
Do not reuse O-rings.



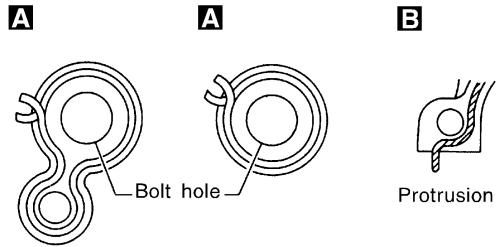
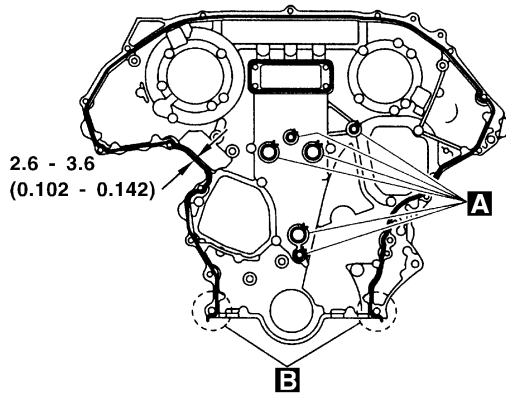
14. Apply sealant to the specified portion of the rear timing chain case. Refer to [EM-4, "LIQUID GASKET APPLICATION PROCEDURE"](#).

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CYLINDER HEAD

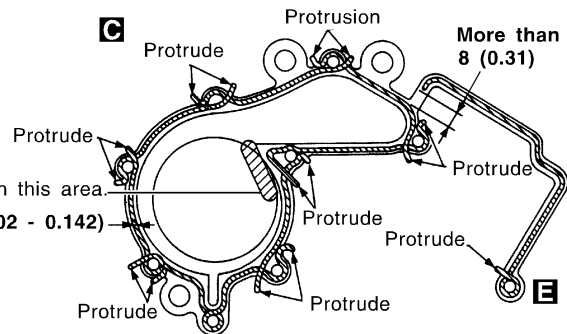
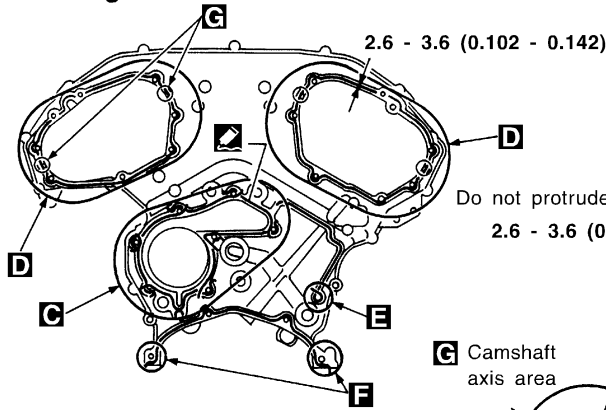
- Use Genuine Silicone RTV Sealant, or equivalent. Refer to [MA-9. "Fluids and Lubricants"](#).

Front timing chain case

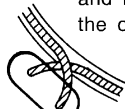


Sealant protrusion away from bolt hole

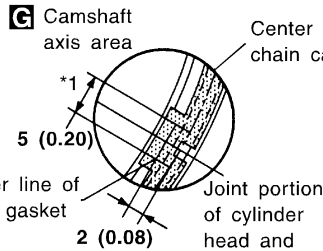
Rear timing chain case



D Cross both ends as shown and be sure to minimize the overlapped area.

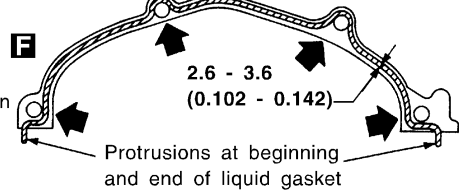


Protrusions at beginning and end of liquid gasket



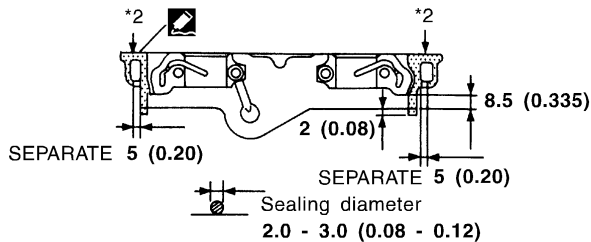
Center line of liquid gasket

Center line of rear timing chain case sealant groove
 ← : Run along bolt hole outer side.



*1: Apply liquid gasket to the chamfered surface between camshaft bracket and cylinder head.

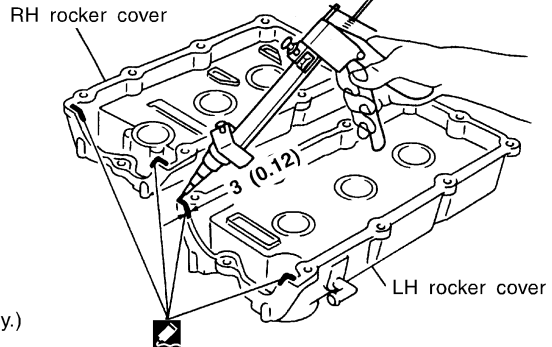
Camshaft bracket



*2: Remove the protruding sealant from front face. (Remove the hardened sealant from surface only.)

Unit: mm (in)

Rocker cover

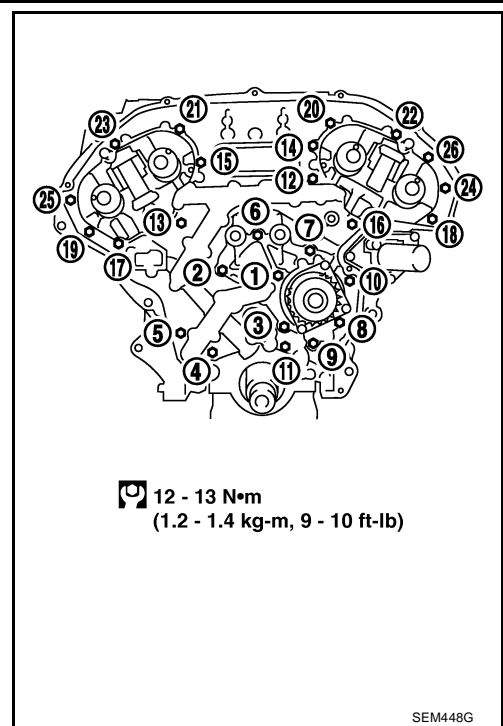


- Before installation, wipe off the protruding sealant.

SEM411G

CYLINDER HEAD

15. Align rear timing chain case with dowel pins, then install on cylinder head and block.
16. Tighten rear chain case bolts in two stages.
 - a. Tighten bolts in numerical order as shown.
 - b. Retighten bolts in numerical order as shown.
17. Install the coolant outlet housing.

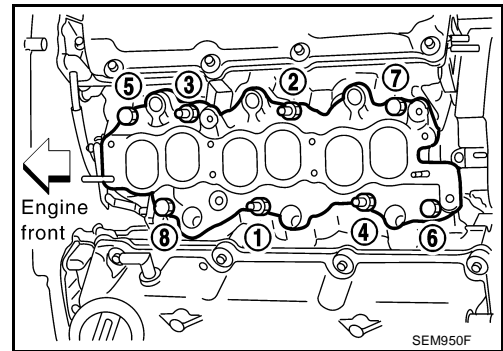


18. Install the intake manifold with a new gasket.
 - Tighten the bolts in the numerical order as shown.

Step 1 : 7.5 N·m (0.77 kg-m, 66 in-lb)

Step 2 : 28.5 N·m (2.9 kg-m, 21 ft-lb)

CAUTION:
Do not reuse gaskets.

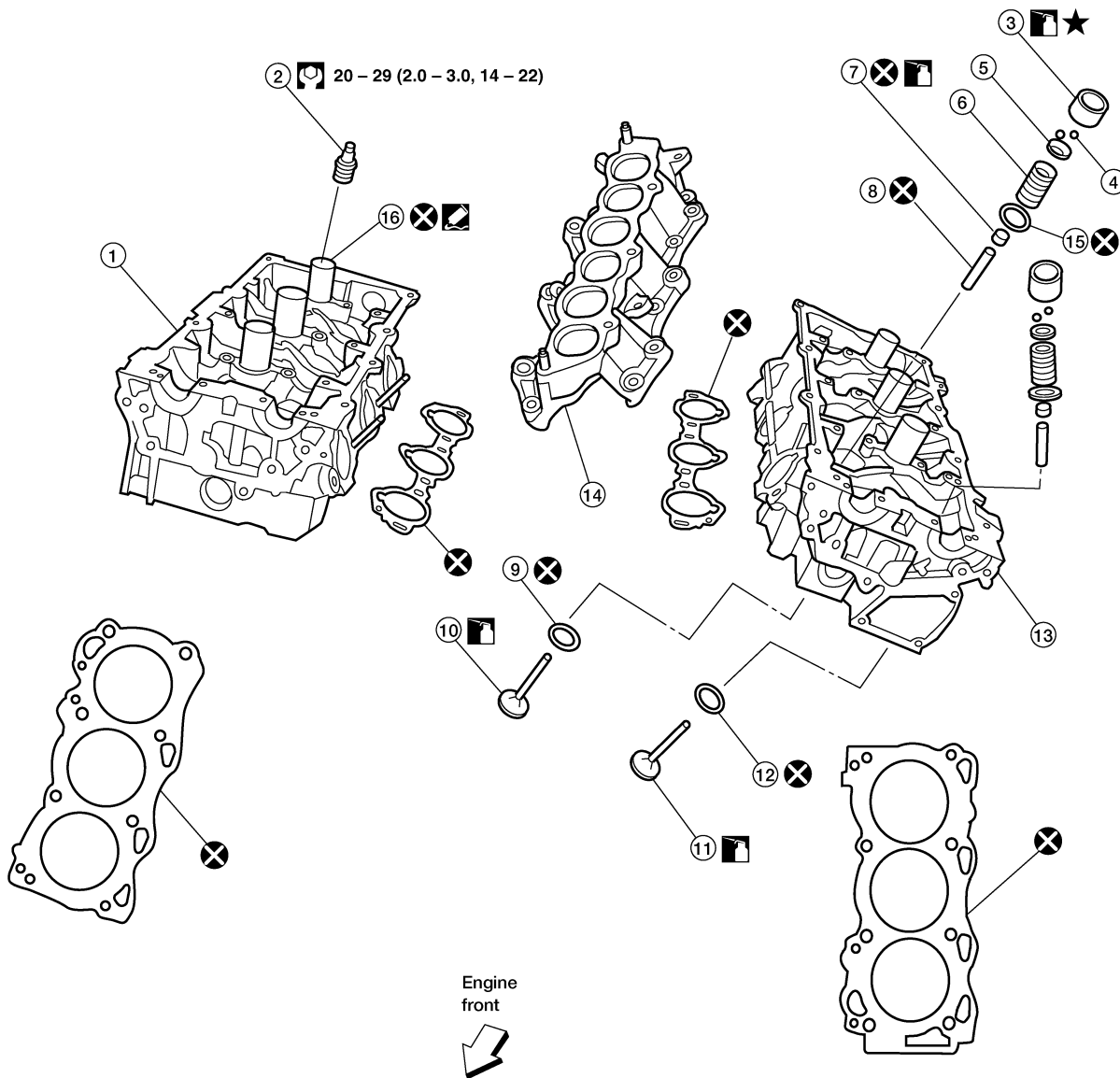


19. Install the fuel rail and injectors. Refer to [EM-40, "Removal and Installation"](#).
20. Install the timing chains. Refer to [EM-64, "Installation"](#).

CYLINDER HEAD

Disassembly and Assembly

EBS00RCV



: Apply Genuine Silicone RTV sealant or equivalent. Refer to GI section.

: Selectable parts

: Engine oil

: N·m (kg-m, ft-lb)

: Always replace after every disassembly.

WBIA0216E

- 1. Cylinder head (right bank)
- 4. Valve collet
- 7. Valve oil seal
- 10. Valve (INT)
- 13. Cylinder head (left bank)
- 16. Spark plug tube

- 2. Spark plug
- 5. Valve spring retainer
- 8. Valve guide
- 9. Valve seat (INT)
- 11. Valve (EXH)
- 12. Valve seat (EXH)
- 14. Intake manifold
- 15. Valve spring seat

- 3. Valve lifter
- 6. Valve spring

CYLINDER HEAD

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.

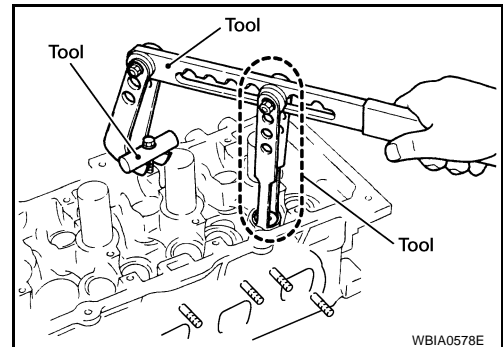
DISASSEMBLY

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:

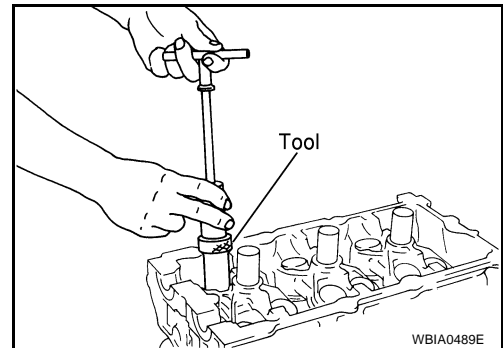
When working, take care not to damage valve lifter holes.

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-107, "VALVE SEAT REPLACEMENT"](#).
8. If valve guide must be replaced, refer to [EM-106, "VALVE GUIDE REPLACEMENT"](#).
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-106, "VALVE GUIDE REPLACEMENT"](#).
2. When valve seat is removed, install it. Refer to [EM-107, "VALVE SEAT REPLACEMENT"](#).

CYLINDER HEAD

3. Install new valve oil seals using Tool.

CAUTION:

Do not reuse oil seals.

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 new valve spring seat.

CAUTION:

Do not reuse valve spring seats.

5. Install valves.

- Install them in their original position.

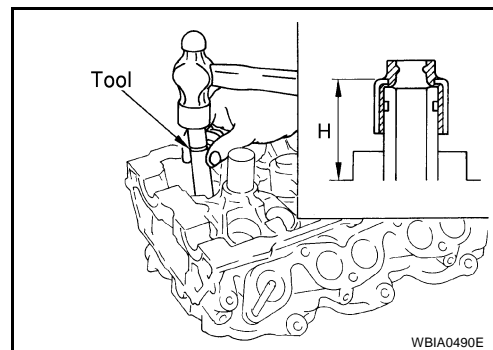
NOTE:

Larger diameter valves are for intake side.

6. Install valve spring (uneven pitch type).

- Install narrow pitch end (paint mark) to cylinder head side (valve spring seat side).
- Intake side and exhaust side valve springs are different. Install them referring to the following paint mark collar.

Paint mark collar **Blue or Violet**



7. Install valve spring retainer.

8. Install valve collet.

CAUTION:

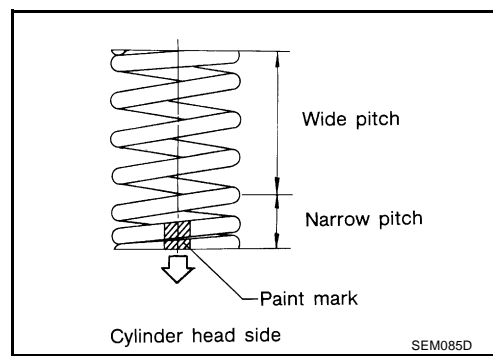
When working, take care not to damage valve lifter holes.

- Compress valve spring and remove valve collet with magnet hand using Tool.
- 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 it in the original position.

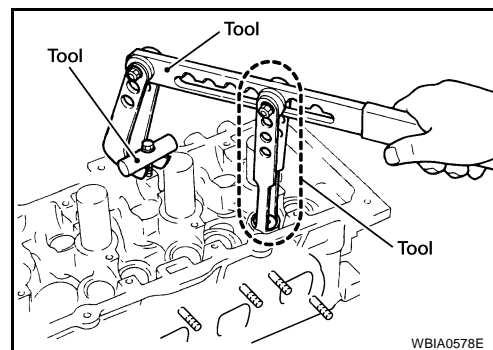
10. Install spark plug tube.

- 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-46. "Recommended Chemical Products and Sealants"](#) .



CYLINDER HEAD

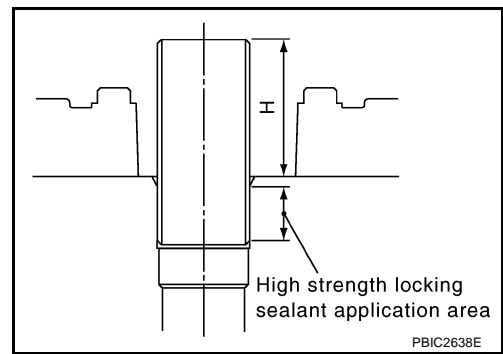
- c. Press-fit spark plug tube so that its height "H" is as specified in the figure using suitable drift.

Standard press-fit height "H"
: 38.1 - 39.1 mm (1.500 - 1.539 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.



EBS00RCW

Inspection After Disassembly 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)

If beyond the specified limit, resurface or replace it.

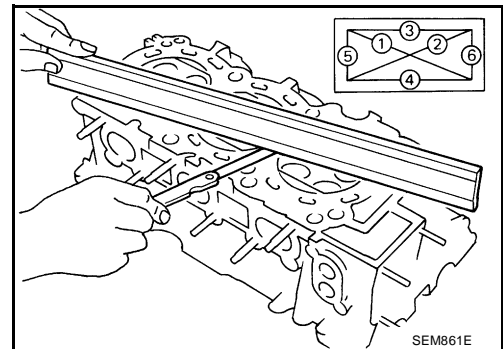
The limit for cylinder head resurfacing is determined by the cylinder block resurfacing.

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)

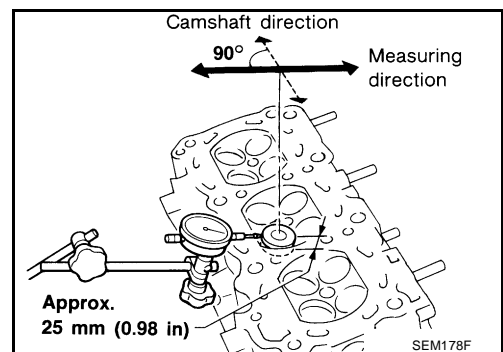
VALVE GUIDE CLEARANCE

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)



CYLINDER HEAD

2. If it exceeds the limit, check valve to valve guide clearance.
 - a. Measure valve stem diameter and valve guide inner diameter.
 - b. Check that clearance is within specification.

Valve to valve guide clearance standard

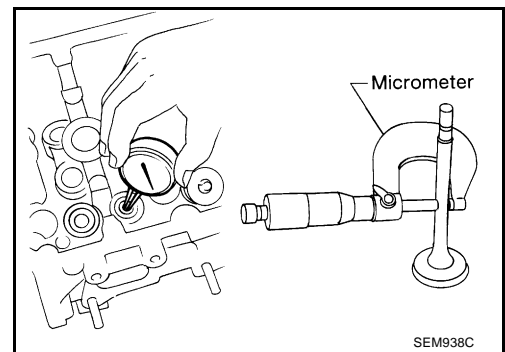
Intake : 0.020 - 0.053 mm (0.0008 - 0.0021 in)

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)

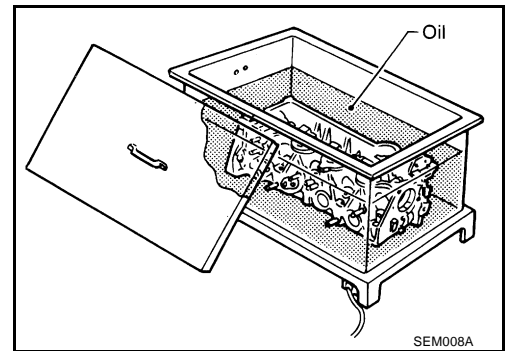


- c. If it exceeds the limit, replace valve or valve guide.

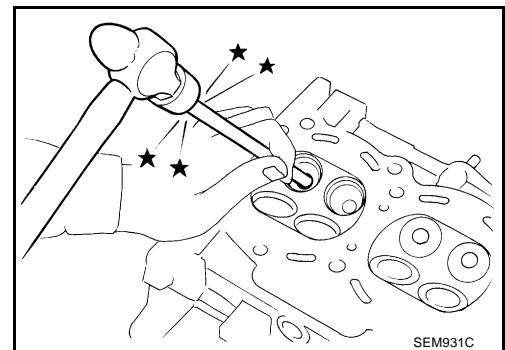
VALVE GUIDE REPLACEMENT

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.

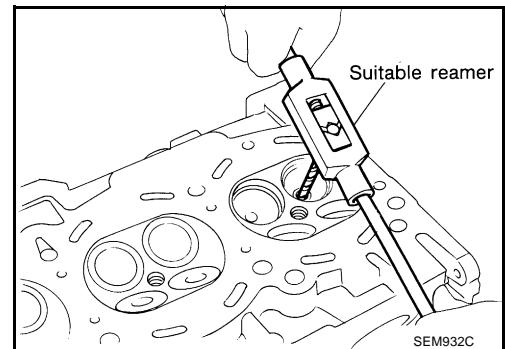


2. Drive out the valve guide with a press [under a 20 kN (2.2 US ton) pressure] or hammer and suitable tool.



3. Ream cylinder head valve guide hole.

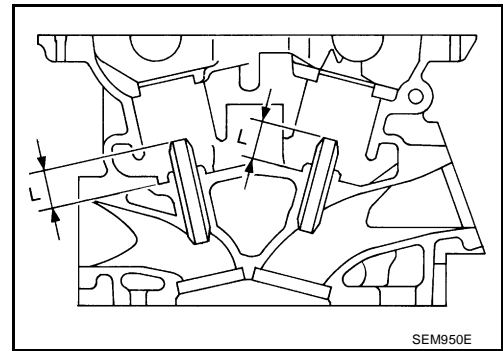
Valve guide hole diameter (for service parts), intake and exhaust : 10.175 - 10.196 mm (0.4006 - 0.4014 in)



CYLINDER HEAD

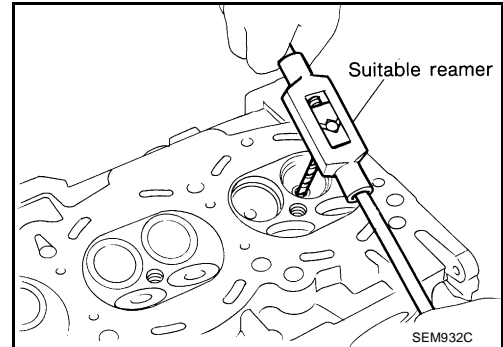
4. Heat cylinder head to 110° to 130°C (230° to 266°F) by soaking in heated oil and press new valve guide from camshaft side into the cylinder head to the dimensions as shown.

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



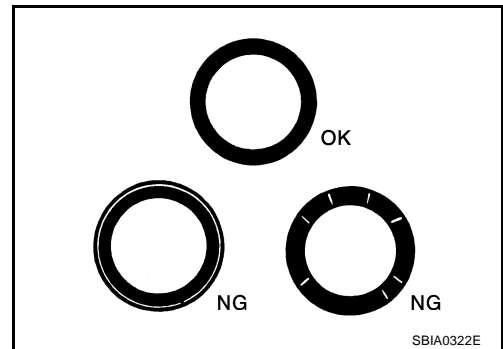
5. Using a valve guide reamer, apply a reamer finish to the valve guide.

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 NG conditions even after the re-check, replace valve seat.



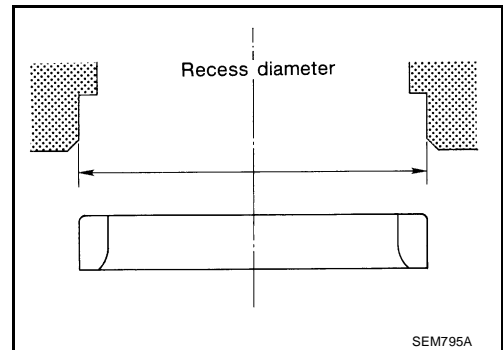
VALVE SEAT REPLACEMENT

1. Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this.
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 : 32.700 - 32.716 mm (1.2874 - 1.2880 in)



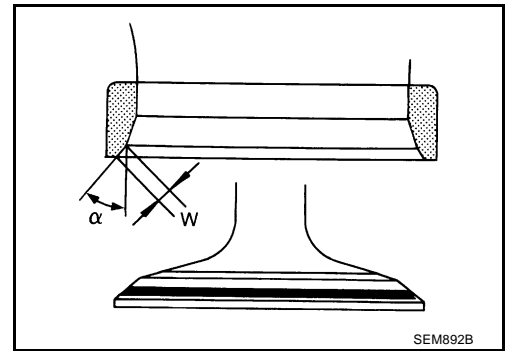
Be sure to ream in circles concentric to the valve guide center.

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-136, "VALVE"](#).
6. After cutting, lap valve seat with abrasive compound.
7. Check valve seating condition.

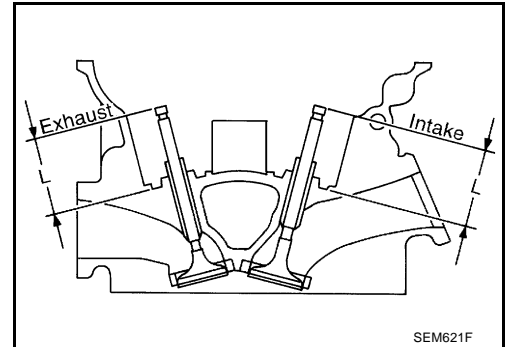
CYLINDER HEAD

Seat face angle “ α ”	: 45° degrees
Contacting width “W” for intake	: 1.09 - 1.31 mm (0.0429 - 0.0516 in)
Contacting width “W” for exhaust	: 1.29 - 1.51 mm (0.0508 - 0.0594 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.

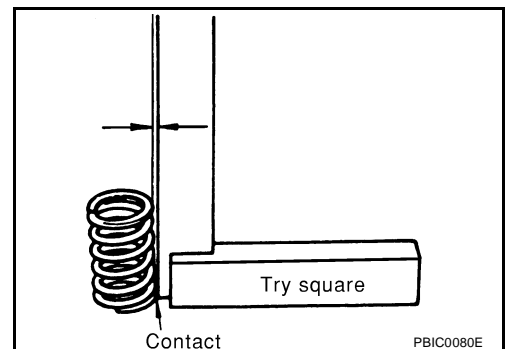
Valve seat resurface limit “L” intake	: 41.07 - 41.67 mm (1.6169 - 1.6405 in)
Valve seat resurface limit “L” exhaust	: 41.00 - 41.60 mm (1.6142 - 1.6378 in)



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)
---------------------	-------------------------------

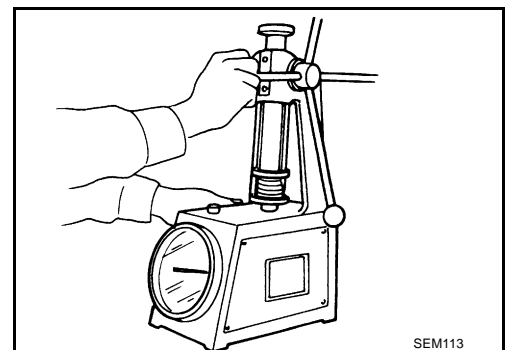


VALVE SPRING DIMENSIONS AND VALVE SPRING PRESSURE LOAD

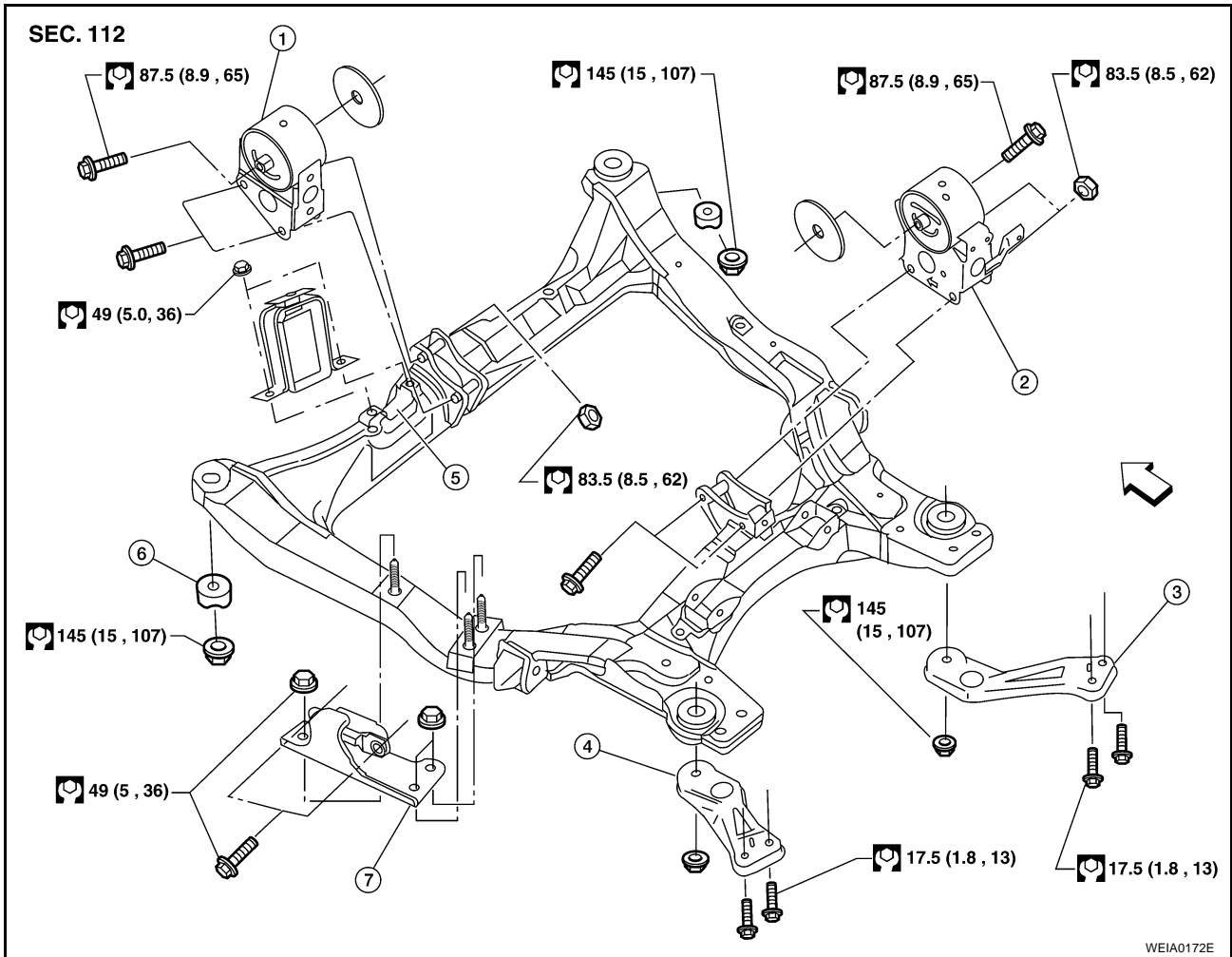
Check valve spring pressure at specified spring height.

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, 83.9 - 95.0 lb) at height 27.2 mm (1.071 in)

If it is not within specifications, replace the spring.



ENGINE ASSEMBLY Removal and Installation



- | | | |
|------------------------------------|-----------------------------------|------------------------|
| 1. Front engine mounting insulator | 2. Rear engine mounting insulator | 3. Member pin stay, RH |
| 4. Member pin stay, LH | 5. Front suspension member | 6. Cup |
| 7. LH transaxle mounting insulator | ←: Front | |

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, refer to the applicable sections.
- Use the correct supporting points for lifting and jacking. Refer to [GI-41, "LIFTING POINT"](#).
- 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).
- Do not damage the edge of the crankshaft position sensor (POS) or the ring gear teeth.

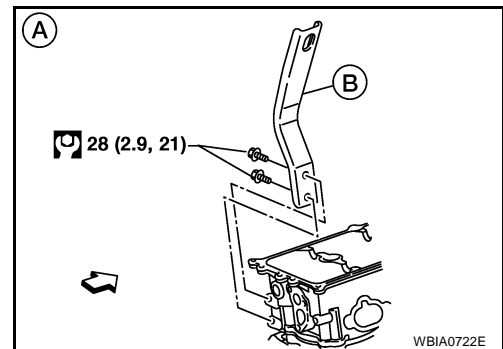
REMOVAL

1. Release fuel pressure. Refer to [EC-81, "FUEL PRESSURE RELEASE"](#).
2. Remove the engine cover, and the engine under cover using power tool.
3. Drain engine oil. [LU-8, "Changing Engine Oil"](#)
4. Drain coolant. Refer to [CO-10, "DRAINING ENGINE COOLANT"](#).

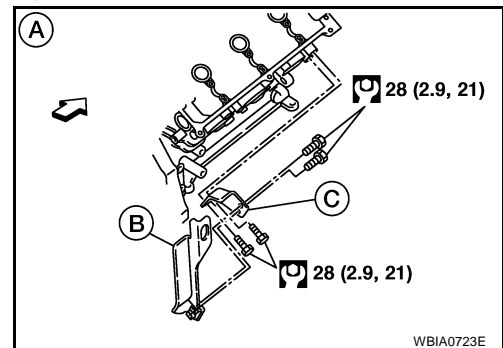
ENGINE ASSEMBLY

5. Remove hood assembly. Refer to [BL-13, "Removal and Installation of Hood Assembly"](#) .
6. Remove front tower bar using power tools.
7. Remove battery and tray using power tools.
8. Remove air inlet duct.
9. Remove air intake duct and air cleaner case assembly with mass air flow sensor.
10. Remove power brake booster vacuum hose.
11. Remove drive belts.
12. Remove radiator assembly, coolant reservoir, and system hoses. Refer to [CO-13, "Removal and Installation"](#) .
13. Remove windshield wiper assembly. Refer to [WW-21, "REMOVAL AND INSTALLATION"](#) .
14. Disconnect engine room harness from the engine side and set it aside. Disconnect engine harness ground connections.
15. Disconnect heater hoses.
16. Remove the front wheel and tires.
17. Remove the front drive shafts. Refer to [FAX-11, "Removal and Installation"](#) .
18. Discharge and recover the R134a refrigerant. Refer to [ATC-130, "HFC-134a \(R-134a\) Service Procedure"](#) .
19. Remove the A/C compressor using power tools.
20. Disconnect fuel hose quick connection at vehicle piping side. Refer to [EM-40, "Removal and Installation"](#) .
21. Disconnect the transaxle shift controls.
22. Remove the starter motor. Refer to [SC-16, "Removal and Installation"](#) .
23. Remove the front exhaust tube using power tools. Refer to [EX-3, "Removal and Installation"](#) .
24. Disconnect reservoir tank for the power steering from engine compartment bracket and position it aside.
25. Remove the front suspension member. Refer to [FSU-16, "Removal and Installation"](#) .
26. Disconnect the power steering pump, from the engine and move it aside without disconnecting the piping, and secure with wire.
27. Position a suitable transmission jack under the engine and transaxle assembly.
28. Install engine slingers into front of LH cylinder head and rear of RH cylinder head.

- a. Install the engine slinger rear (B).
A: Vehicle front
⇒: Front



- b. Install the engine front upper slinger (B) and engine front lower slinger (C).
A: Vehicle rear
⇒: Engine front



29. For additional safety, secure the engine in position with a hoist.

ENGINE ASSEMBLY

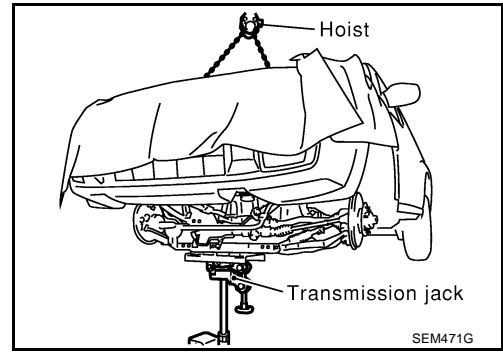
30. Disconnect the LH transaxle mount and the RH engine mount.
31. Carefully lower the engine and transaxle assembly using Tool, avoiding interference with the vehicle body.

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 mounting insulators.

Tool number : KV101J0010 (J-47242)

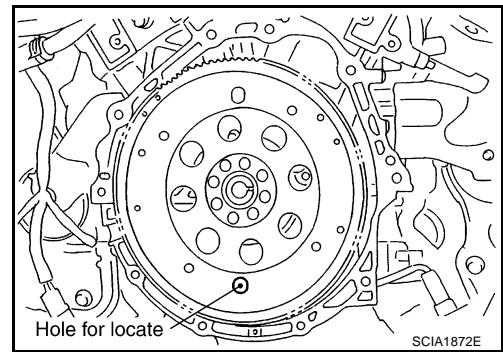
32. Remove the crankshaft position sensor (POS).
33. Separate the engine and transaxle and mount the engine on a suitable engine stand.



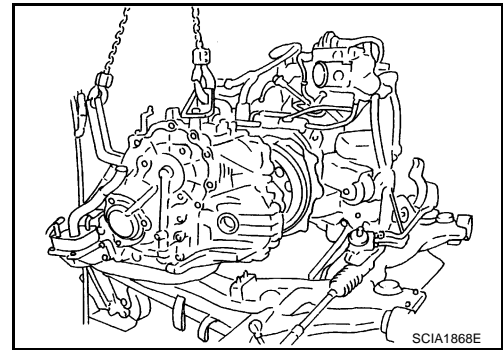
INSTALLATION

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

- Rotate the drive plate for the hole of the drive plate to go down.

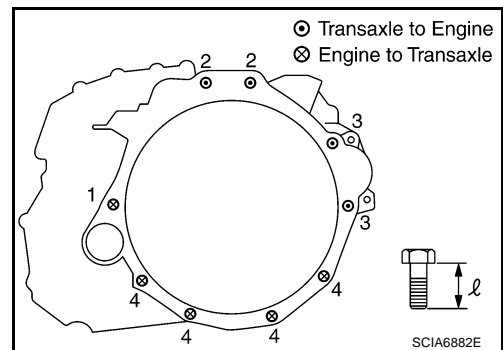


- Install transaxle assembly to engine assembly with a hoist.



- When installing transaxle to the engine, attach the bolts in accordance with the following standard.

Bolt No.	1	2	3	4
Number of bolts	1	2	2	4
Bolt length "ℓ"mm (in)	52 (2.05)	36 (1.42)	105 (4.13)	35 (1.38)
Tightening torque N·m (kg·m, ft·lb)	75 (7.7, 55)			47 (4.8, 35)



CAUTION:

- When replacing an engine or transaxle you must make sure the dowels are installed correctly during re-assembly.
- Improper alignment caused by missing dowels may cause vibration, oil leaks or breakage of drivetrain components.
- When turning crankshaft, turn it clockwise as viewed from the front of the engine.

A
EM
C
D
E
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M

ENGINE ASSEMBLY

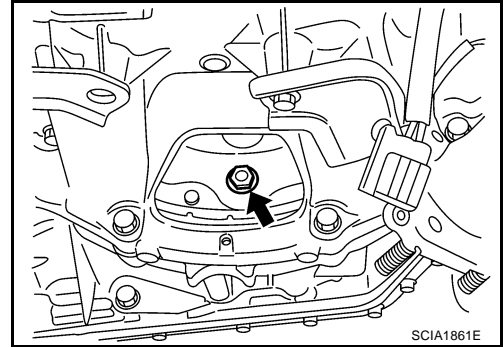
- After converter is installed to drive plate, rotate crankshaft several turns and check to be sure that transaxle rotates freely without binding.

- Align the positions of tightening nuts for drive plate with those of the torque converter, and temporarily tighten the nuts. Then, tighten the nuts with the specified torque.

Drive plate nuts : 51 N·m (5.2 kg·m, 38 ft-lb)

CAUTION:

- Do not reuse O-ring and copper washers.
- When turning crankshaft, turn it clockwise as viewed from the front of the engine.
- After converter is installed to drive plate, rotate crankshaft several turns and check to be sure that transaxle rotates freely without binding.
- Install crankshaft position sensor (POS) sensor. Refer to [EM-109, "REMOVAL"](#).
- After completing installation, check for fluid leakage, fluid level, and the positions of CVT. Refer to [CVT-15, "Checking CVT Fluid"](#), [CVT-188, "Adjustment of CVT Position"](#), [CVT-190, "Checking of CVT Position"](#).
- When replacing the CVT assembly, erase EEPROM in TCM. Refer to [CVT-8, "Precautions for TCM and CVT Assembly Replacement"](#).



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 [GI-46, "Recommended Chemical Products and Sealants"](#).
- Use procedure below to check for fuel leakage.
- Turn ignition switch ON (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
- Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of Fuel, exhaust 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
Other oils and fluids*	Level	Leakage	Level
Fuel	Leakage	Leakage	Leakage
Exhaust gas	—	Leakage	—

*Transmission/transaxle/CVT fluid, power steering fluid, brake fluid, etc.

CYLINDER BLOCK

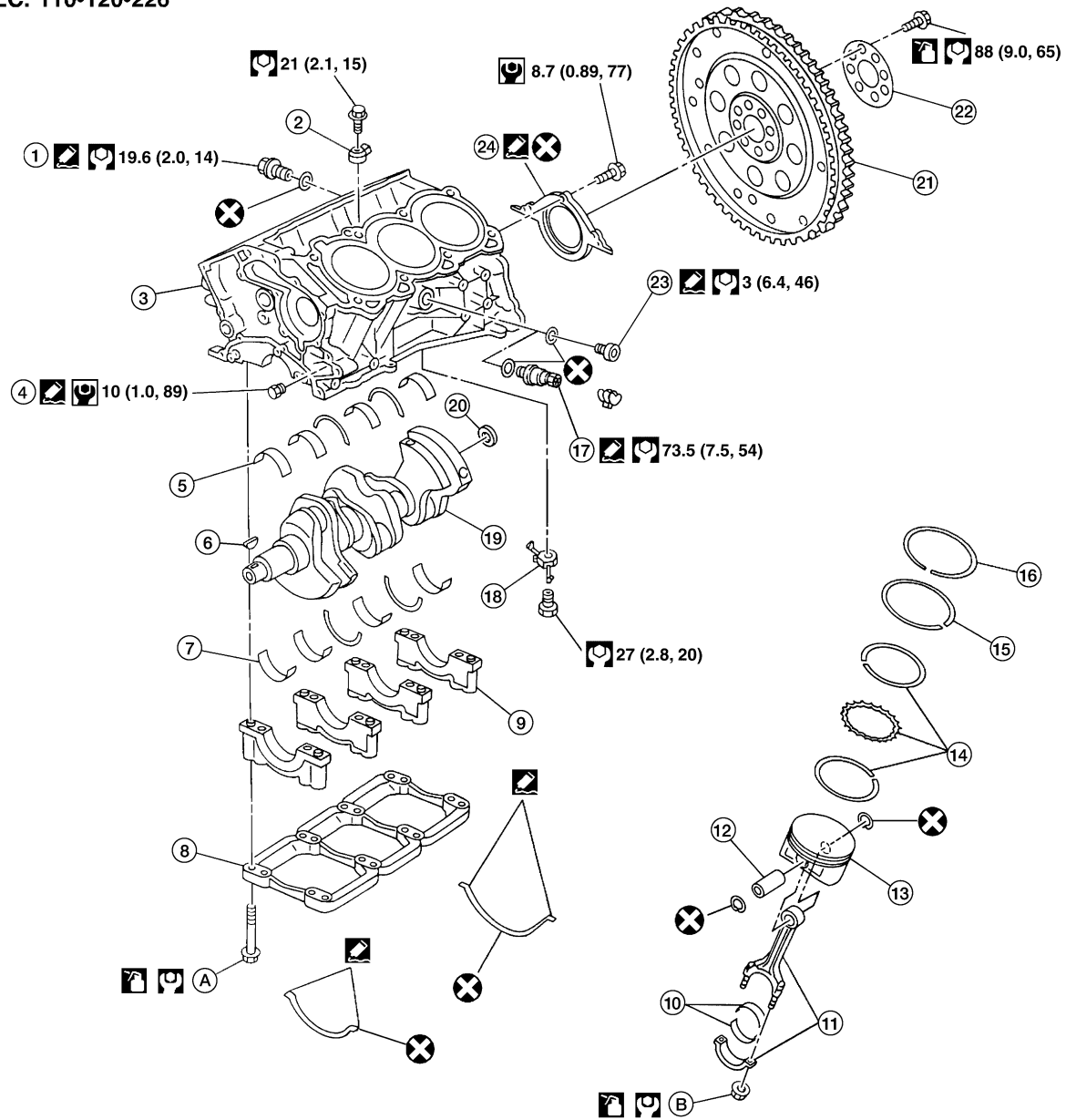
PF11010

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CYLINDER BLOCK

Disassembly and Assembly

SEC. 110•120•226



- | | | |
|---------------------------------------|-----------------------------------------|-----------------------------------|
| 1. Water drain plug (RH side) | 2. Knock sensor | 3. Cylinder block |
| 4. Water drain plug (water pump side) | 5. Upper main bearing | 6. Key |
| 7. Lower main bearing | 8. Main bearing beam | 9. Main bearing cap |
| 10. Connecting rod bearing | 11. Connecting rod | 12. Piston pin |
| 13. Piston | 14. Oil ring set | 15. Second ring |
| 16. Top ring | 17. Cylinder block heater (Canada only) | 18. Oil jet |
| 19. Crankshaft | 20. Pilot converter | 21. Drive plate with signal plate |
| 22. Drive plate reinforcement | 23. Water drain plug (LH side) | 24. Rear oil seal retainer |
| A. Refer to "Assembly" | B. Refer to "Assembly" | |

WBIA0775E

CYLINDER BLOCK

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-109, "ENGINE ASSEMBLY"](#) .
2. Install the engine on the engine stand.
3. Remove the knock sensor.

CAUTION:

Carefully handle sensor avoiding shocking it.

4. Drain the engine of all coolant and oil.
5. Remove the oil pan. Refer to [EM-31, "Removal and Installation"](#) .
6. Remove the timing chain. Refer to [EM-57, "Removal"](#) .
7. Remove the cylinder head. Refer to [EM-91, "Removal and Installation"](#) .
8. Remove the driveplate (CVT).
- a. Secure driveplate (CVT) using Tool, and remove bolts.

Tool number : KV10117700 (J-44716)

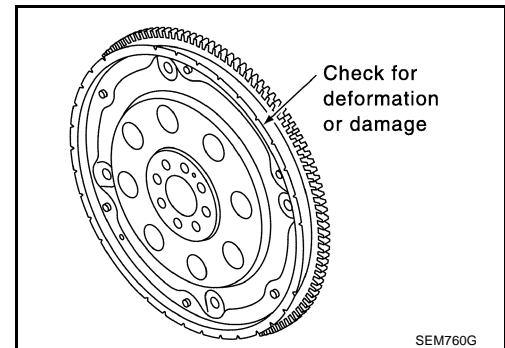
NOTE:

Match mark the driveplate (CVT) position to the crankshaft dowel pin prior to removal to assist in installation.

- Loosen bolts in diagonal order.

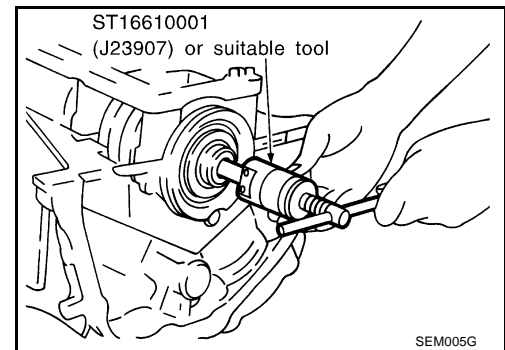
CAUTION:

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



9. Remove converter (CVT) using Tool.

Tool number : ST16610001 (J-23907)



CYLINDER BLOCK

10. Cut away liquid gasket and remove rear oil seal retainer using Tool. Refer to [EM-4, "REMOVAL OF LIQUID GASKET SEALING"](#).

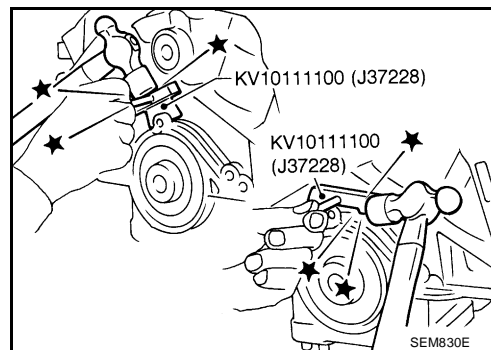
Tool number : KV10111100 (J-37228)

CAUTION:

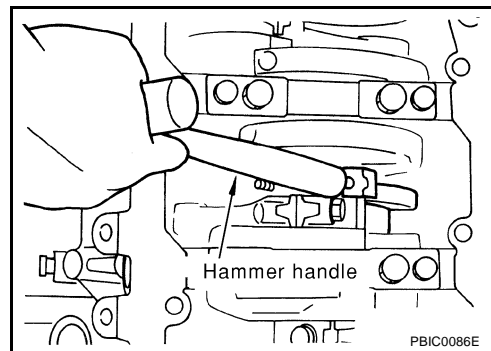
- Be careful not to damage mating surface.
- If rear oil seal retainer is removed, replace it with a new one.

NOTE:

Rear oil seal and retainer form a single part and are handled as an assembly.



11. 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-142, "CONNECTING ROD"](#).



12. Remove the connecting rod bearings.

CAUTION:

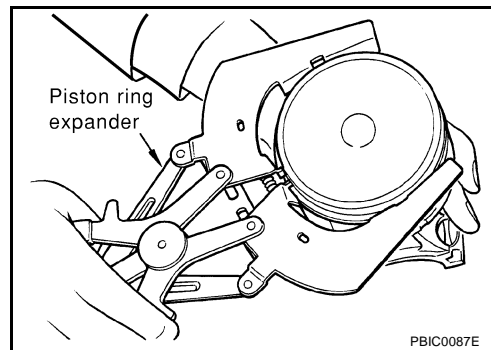
- When removing the connecting rod side bearings, note the installation position. Keep them in the correct order.

13. Remove the piston rings from the piston.

- Use a piston ring expander.

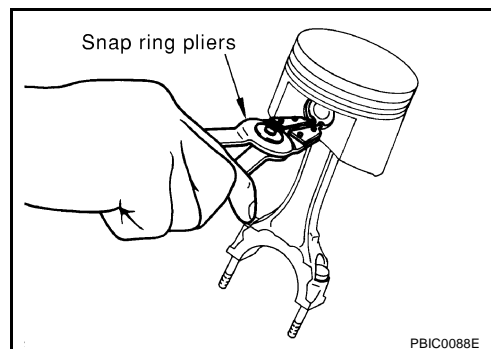
CAUTION:

- 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-124, "PISTON RING SIDE CLEARANCE"](#).



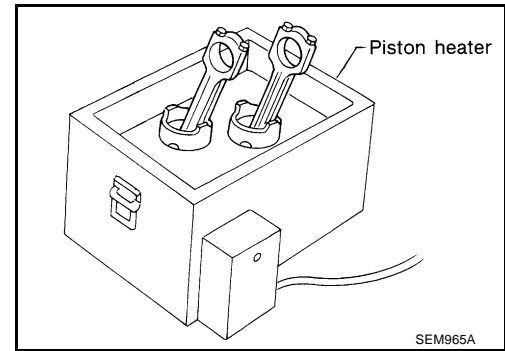
14. Remove the piston from the connecting rod as follows.

- a. Remove the snap ring, using snap ring pliers.

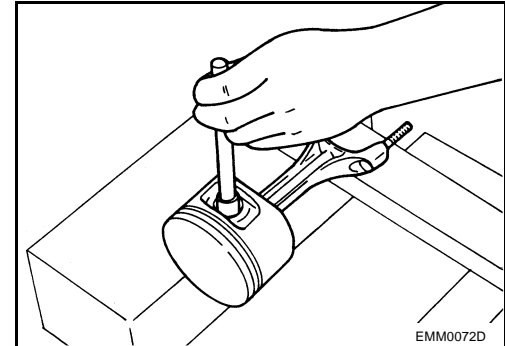


CYLINDER BLOCK

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



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



15. Remove the rear oil seal retainer from the cylinder block.
- Insert a screwdriver or similar tool between the rear end of the crankshaft counter weight and rear oil seal retainer, and separate the liquid gasket to remove.

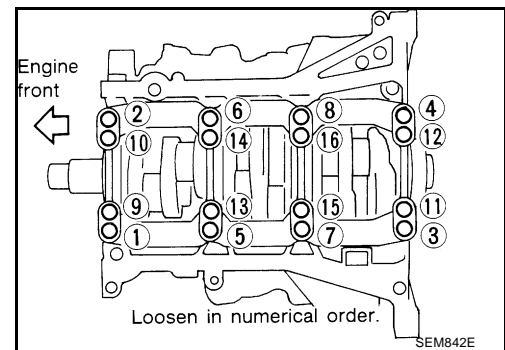
CAUTION:

Be careful not to damage the mating surface.

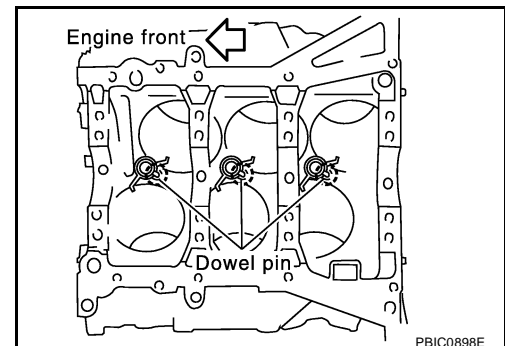
NOTE:

When replacing the rear oil seal during on-vehicle service, it is necessary to remove the oil pan. Refer to [EM-31, "Removal and Installation"](#).

16. Loosen the bolts in the numerical 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-129, "CRANKSHAFT"](#).



17. Remove the oil jets.
18. 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

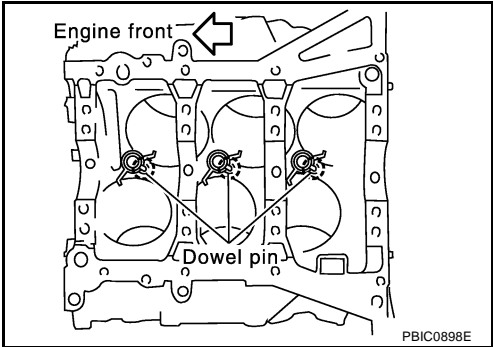
1. Blow out the coolant and oil passages and cylinder bore to remove any foreign materials.

CYLINDER BLOCK

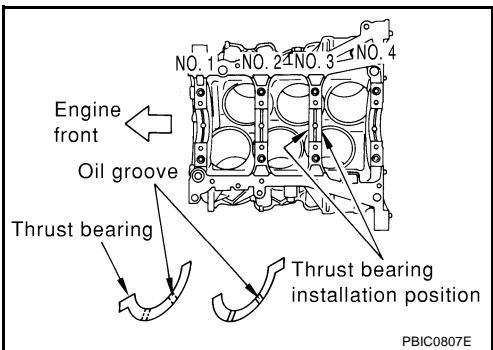
CAUTION:

Use goggles to protect your eyes.

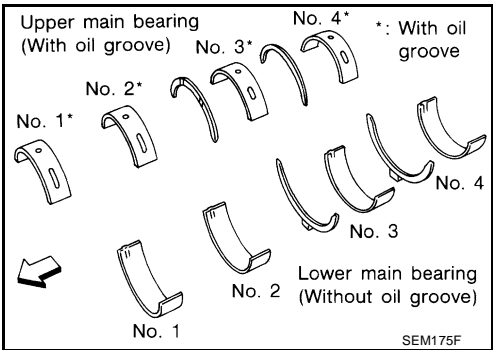
2. Apply liquid gasket and install each plug into the cylinder block.
 - Use Genuine Silicone RTV Sealant or equivalent. Refer to [MA-9, "Fluids and Lubricants"](#).
3. Install the oil jets.
 - Insert the oil jet dowel pin into the cylinder block dowel pin hole, and tighten the bolts.



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.

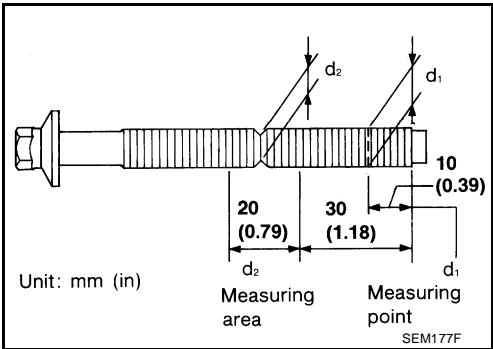


5. Set the upper main bearings in their proper positions on the cylinder block.
 - Confirm the correct main bearings are used. Refer to [EM-127, "PISTON-TO-CYLINDER BORE CLEARANCE"](#).



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.

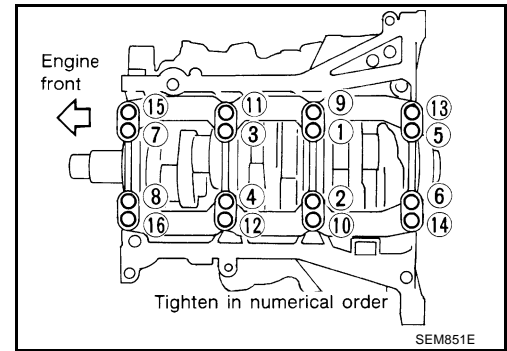
Limit (d1 - d2) : 0.11 mm (0.0043 in)



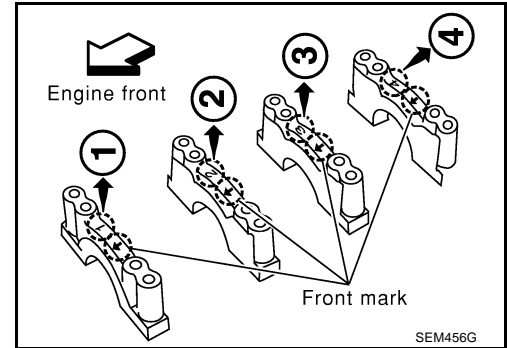
A
EM
C
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M

CYLINDER BLOCK

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.



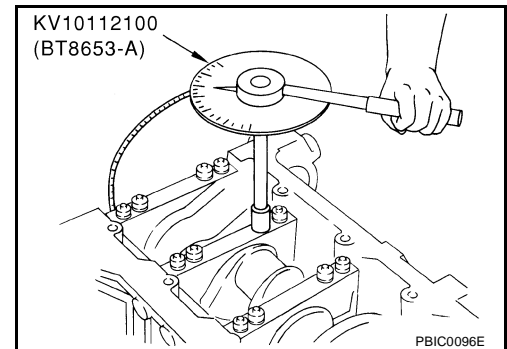
- Make sure that the front marks on the main bearing beam faces the front of the engine.
- Prior to tightening all the bearing cap bolts, place the bearing beam in its proper position by shifting the crankshaft in the axial position.
- After tightening the bearing cap bolts, make sure the crankshaft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



CAUTION:

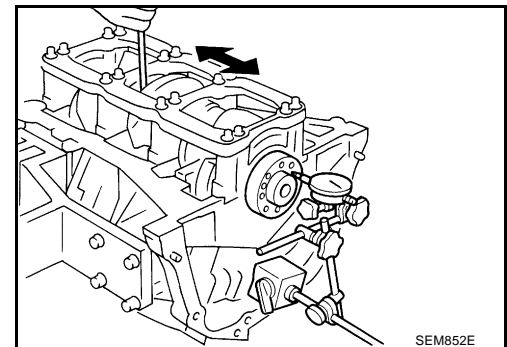
Measure the tighten angle in stage 2 with an angle wrench. Do not measure visually.

- Stage 1** : 35 N·m (3.6 kg·m, 26 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)

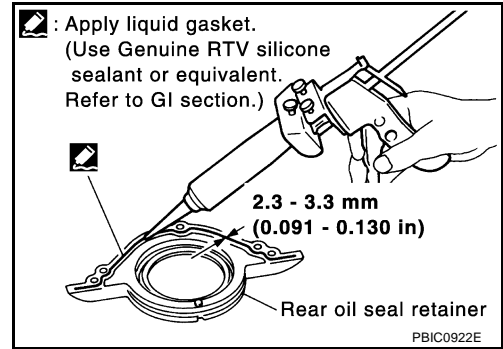


CYLINDER BLOCK

9. Install the rear oil seal retainer.

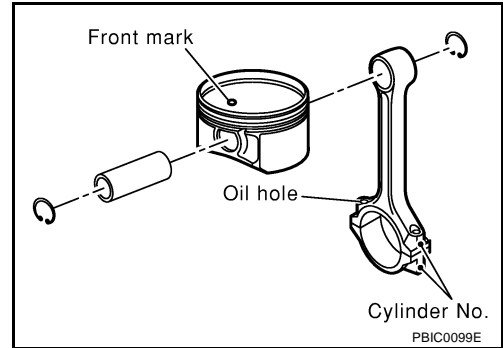
Tool number : WS3993000 (—)

- Apply sealant to rear oil seal retainer as shown, using Tool. **Use Genuine Silicone RTV Sealant, or equivalent. Refer to GI-46, "Recommended Chemical Products and Sealants"** .



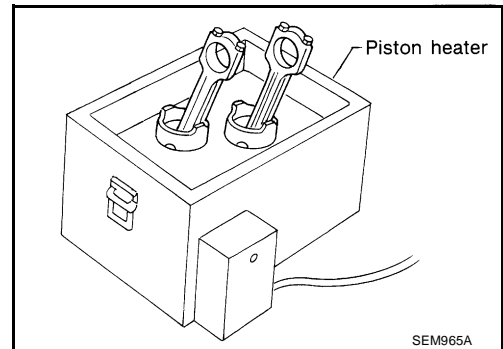
10. Install the piston to the connecting rod.

- a. Install the snap ring into the pin-groove of the piston rear side, using suitable tool.
- Insert it fully into groove to install.

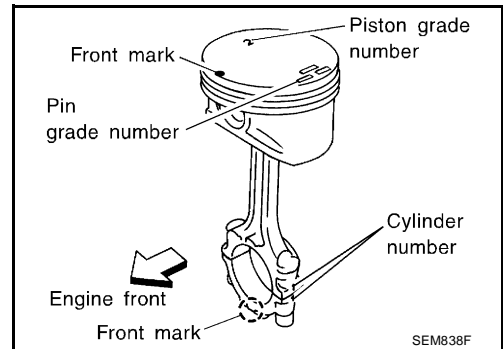


b. Install the piston to the connecting rod.

- 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.

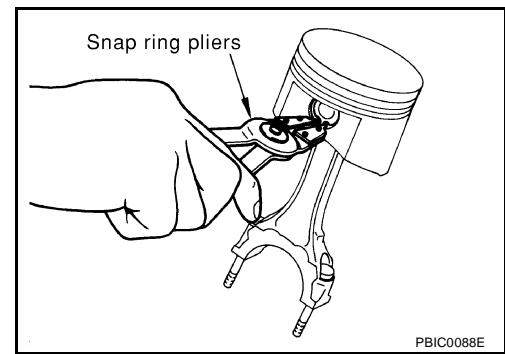


- Assemble so that the front mark on the piston crown and the oil holes and the cylinder No. on the connecting rod are positioned as shown.



CYLINDER BLOCK

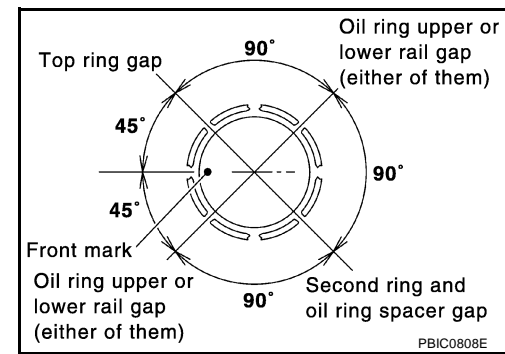
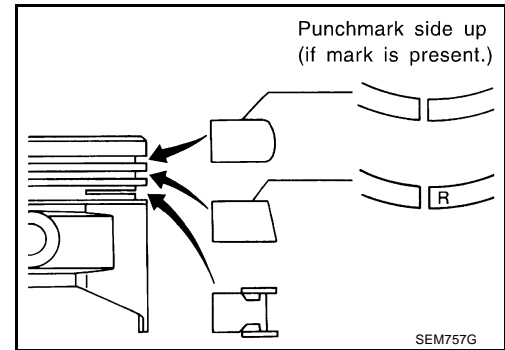
- c. Install the snap ring into the front of the piston pin-groove.
- After installing, check that the connecting rod pivots smoothly on the pin.



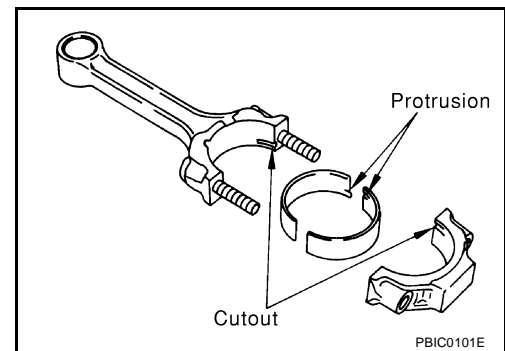
11. Using a piston ring expander, install the piston rings.

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 punchmarks can be mounted either side up.
- Position each ring with the gap as shown, referring to the piston front mark.
- Install the top ring and the second ring with the stamped surface facing upward. If the ring is not stamped it can face in either direction.



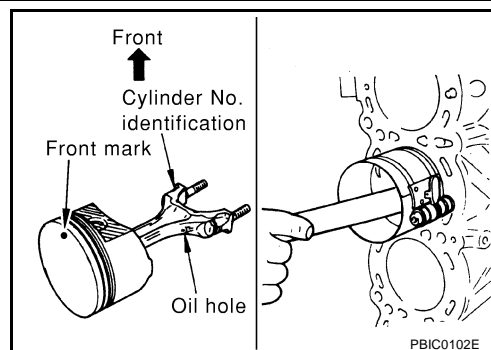
12. Install the connecting rod bearings to the connecting rod and the connecting rod cap.
- When installing the connecting rod bearings, apply engine oil to the bearing surface (crankshaft side). Do not apply oil to the back surface (connecting rod and cap side), but thoroughly clean it.
 - When installing, 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.



CYLINDER BLOCK

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. on the connecting rod to install.
- Install the piston with the front mark on the piston crown facing the front of the engine, using a suitable tool.

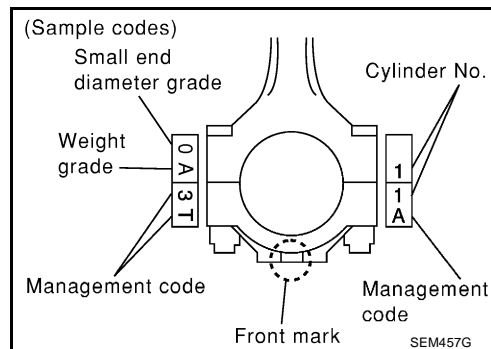


CAUTION:

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

14. Install the connecting rod cap.

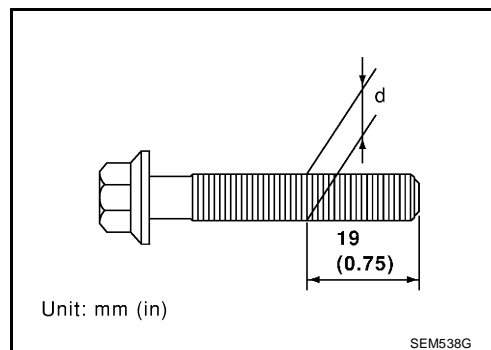
- Match the stamped cylinder number marks on the connecting rod with those on the cylinder cap for installation.
- Install the piston connecting rod assembly and cap so that the front mark on the cap and piston are facing the front of the engine.
- **Lubricate the threads and seat surfaces with new engine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

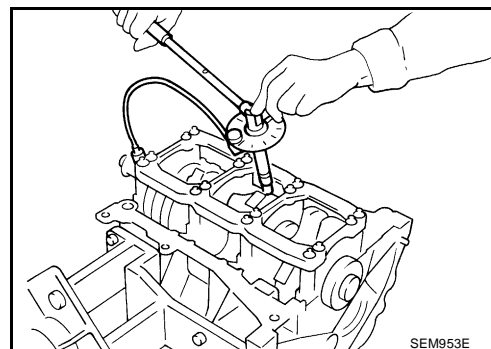
Stage 1 : 20 N·m (2.0 kg·m, 15 ft·lb)
Stage 2 : 90° - 95° degrees clockwise

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)

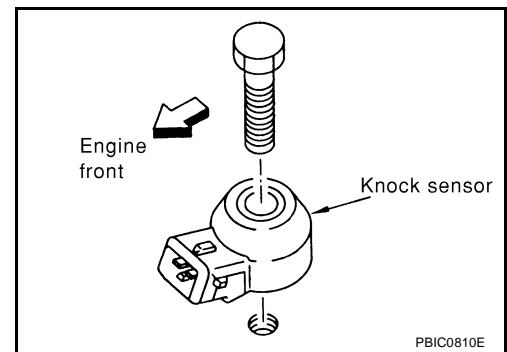
CYLINDER BLOCK

17. Install the knock sensor.

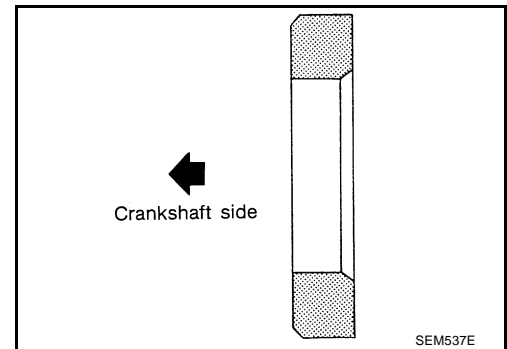
- Make sure that there is no foreign material on the cylinder block mating surface and the back surface of the knock sensor.
- Install the knock sensor with the connector facing the rear of the engine.
- Do not tighten the bolts while holding the connector.
- Make sure that the knock sensor does not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

CAUTION:

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



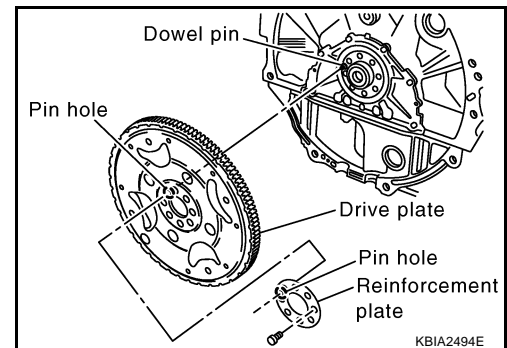
18. Press-fit pilot converter with its chamfer facing crankshaft as shown.



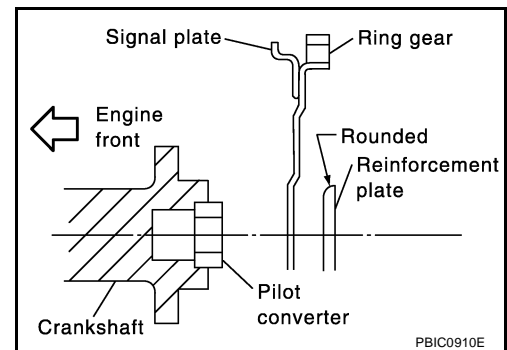
19. Install the drive plate (CVT), if equipped, aligning the match mark.

CAUTION:

When installing drive plate to crankshaft, be sure to correctly align crankshaft side dowel pin to the drive plate side dowel pin hole.



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

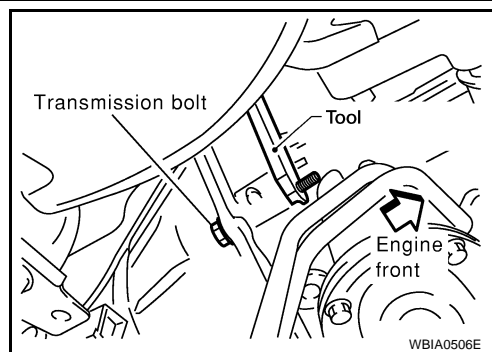


CYLINDER BLOCK

20. Secure the drive plate (CVT) using Tool.

Tool number : KV10117700 (J-44716)

- Tighten the drive plate (CVT) crosswise several times using suitable tool.



21. Install the cylinder head. Refer to [EM-91, "Removal and Installation"](#) .

22. Install the timing chain. Refer to [EM-64, "Installation"](#) .

23. Install the oil pan. Refer to [EM-31, "Removal and Installation"](#) .

24. Remove the engine from the stand and install the engine assembly into the vehicle. Refer to [EM-109, "Removal and Installation"](#) .

25. Assembly of the remaining parts is in the reverse order of disassembly.

26. Fill the engine with the specified oil and coolant. Refer to [MA-9, "Fluids and Lubricants"](#) .

CAUTION:

Wait at least 30 minutes for the sealant to set-up before filling the engine with fluids and running it.

Inspection

PISTON AND PISTON PIN CLEARANCE

EBS00RCZ

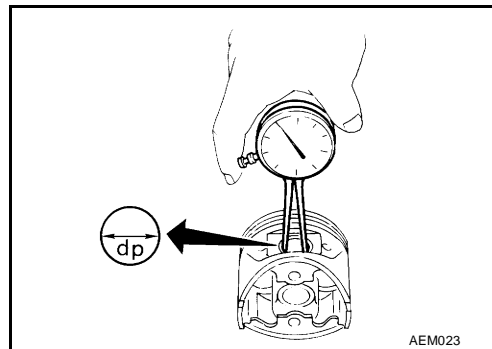
Inner Diameter of Piston Pin Hole

- Measure the inner diameter of piston pin hole "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)



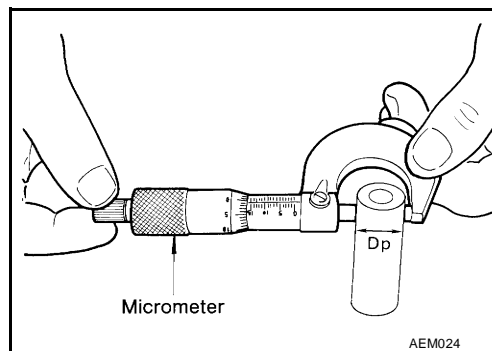
Outer Diameter of Piston Pin

- 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)



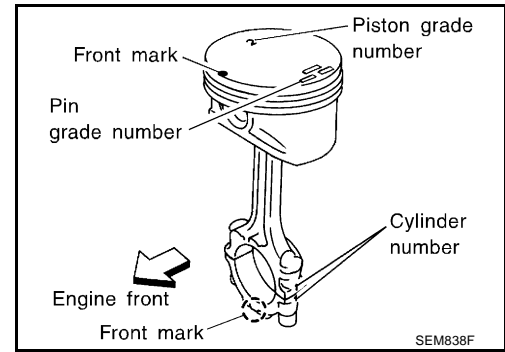
CYLINDER BLOCK

Piston and Piston Pin Interference Fit

Standard Interference Fit = "Dp" – "dp"

Standard : 0.002 mm (0.0001 in) - 0.006 mm (0.0002 in) = - 0.0004 mm (-0.0001 in)

- If clearance exceeds specification, replace either or both of 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 : 0.065 - 0.135 mm (0.0026 - 0.0053 in)

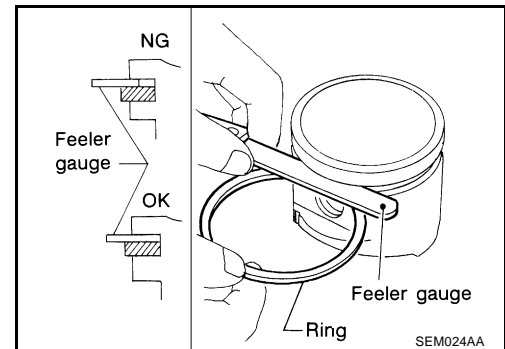
Maximum Limit

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 - 0.33 mm (0.0091 - 0.0130 in)

2nd ring : 0.33 - 0.48 mm (0.0130 - 0.0189 in)

Oil ring : 0.20 - 0.50 mm (0.0079 - 0.0197 in)

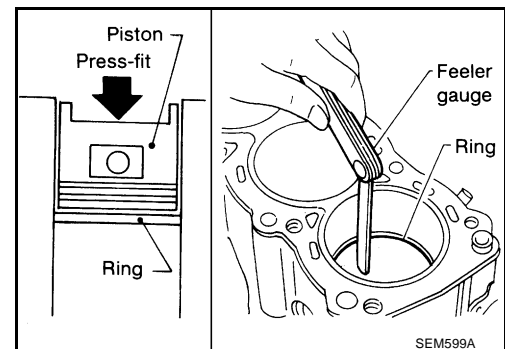
Limit:

Top ring : 0.54 mm (0.0213 in)

2nd ring : 0.80 mm (0.0315 in)

Oil ring : 0.95 mm (0.0374 in)

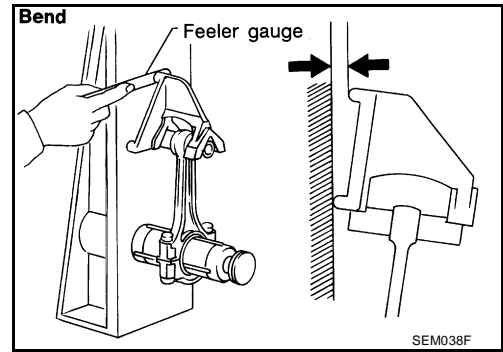
- If out of specification, replace piston ring. If gap still exceeds the limit even with a new ring, re-bore cylinder and use oversized piston and piston ring.



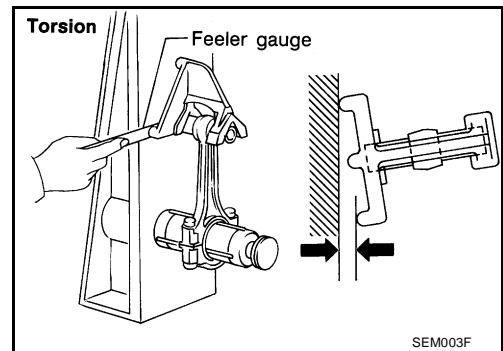
CYLINDER BLOCK

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



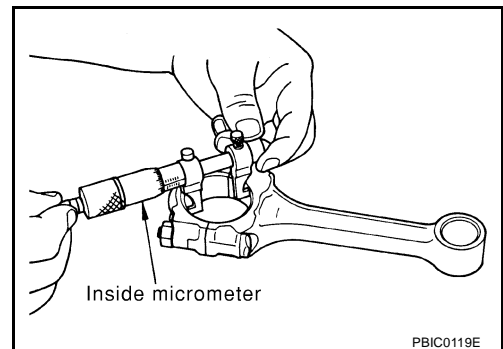
- If it exceeds the limit, replace connecting rod assembly.



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)



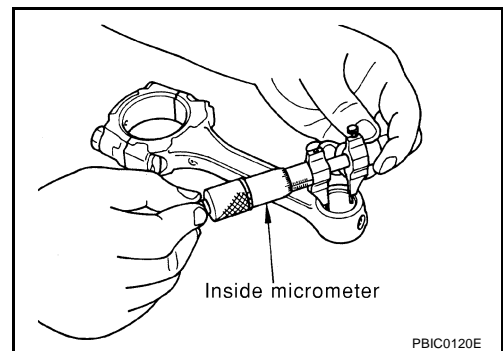
CONNECTING ROD BUSHING OIL CLEARANCE (SMALL END)

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)



CYLINDER BLOCK

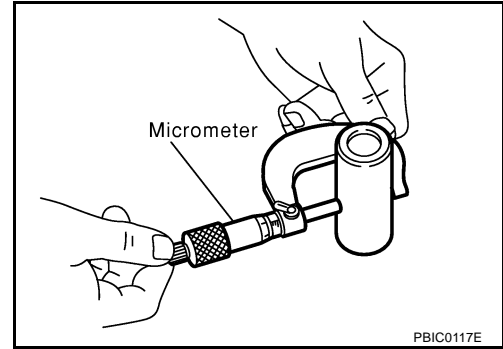
Outer Diameter of Piston Pin

- Measure outer diameter of piston pin.

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)



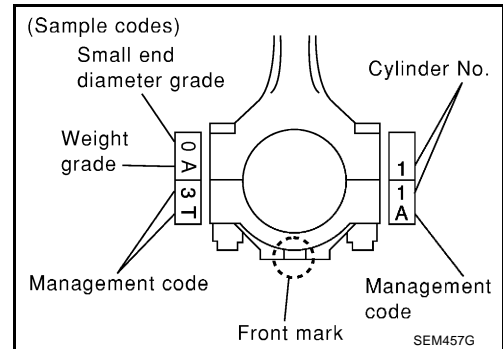
Connecting Rod Bushing Oil Clearance (Small End)

(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 - 0.007 in)

Limit : 0.030 - mm (0.0012 in)

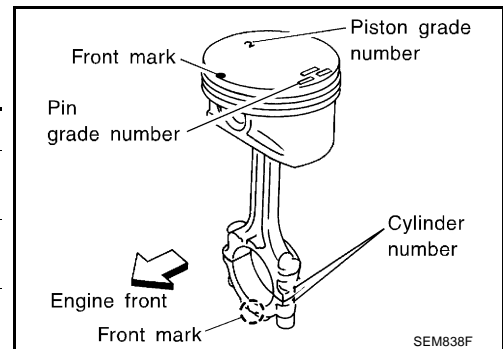
- If the measured value exceeds the standard, replace the connecting rod assembly and/or piston and piston pin assembly.
- If replacing the piston and piston pin assembly, refer to the Table for Selective Fitting for Piston to select the piston corresponding to the applicable bore grade of the cylinder block to be used. Refer to [EM-127, "PISTON-TO-CYLINDER BORE CLEARANCE"](#).



Factory installed parts grading:

- Service parts apply only to grade 0.

Grade	Unit: mm (in)	
	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	21.989 - 21.995 (0.8657 - 0.8659)	21.995 - 22.001 (0.8659 - 0.8662)



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:

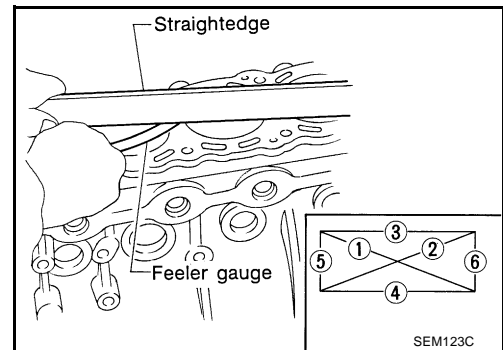
Be careful not to allow gasket flakes to enter the oil or coolant passages.

- 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)



CYLINDER BLOCK

INNER DIAMETER OF MAIN BEARING HOUSING

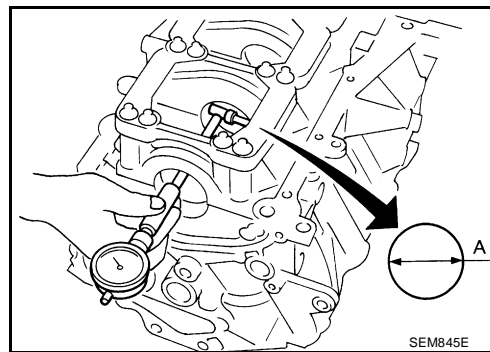
- Install the main bearing caps with the main bearings removed, and tighten the bolts to the specified torque.
- Using a bore gauge, measure the inner diameter of the main bearing housing.

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.

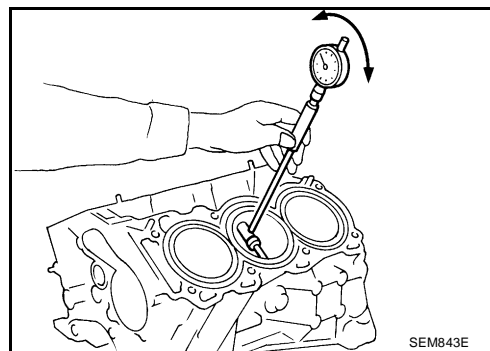


PISTON-TO-CYLINDER BORE CLEARANCE

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

Cylinder bore inner diameter

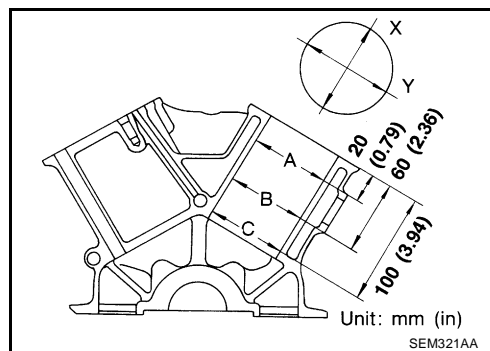
Grade No.	Standard inner diameter	Wear limit
No. 1	95.500 - 95.510 mm (3.7598 - 3.7602 in)	0.20 mm (0.0079 in)
No. 2	95.510 - 95.520 mm (3.7602 - 3.7606 in)	
No. 3	95.520 - 95.530 mm (3.7606 - 3.7610 in)	



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

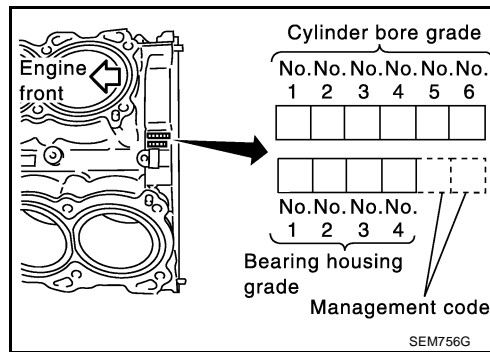
Out-of-round (Difference between X and Y) : limit 0.015 mm (0.0006 in)

Taper (Difference between A and C) : limit 0.015 mm (0.0006 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.

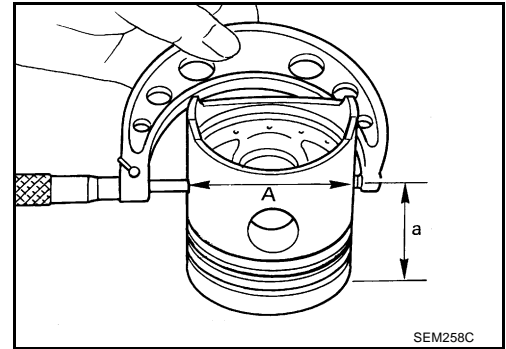


CYLINDER BLOCK

3. Measure piston skirt diameter.

Piston diameter "A" : Refer to [EM-141, "PISTON, PISTON RING AND PISTON PIN"](#) .

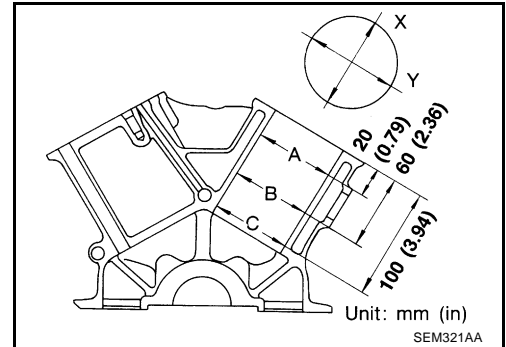
Measuring point "a" : 41.0 mm (1.614 in)
(Distance from the top)



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. Determine piston oversize according to amount of cylinder wear.

Oversize pistons are available for service.

Refer to [EM-141, "PISTON, PISTON RING AND PISTON PIN"](#) .

6. 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)

7. Install main bearing caps, and tighten to the specified torque. Otherwise, cylinder bores may be distorted after boring.
8. 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.**
9. Hone cylinders to obtain specified piston-to-bore clearance.
10. Measure finished cylinder bore for out-of-round and taper.
- **Measurement should be done after cylinder bore cools down.**

CYLINDER BLOCK

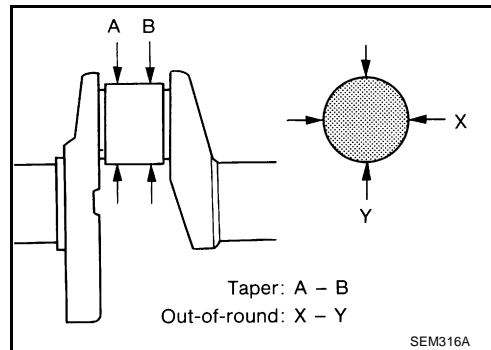
CRANKSHAFT

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)

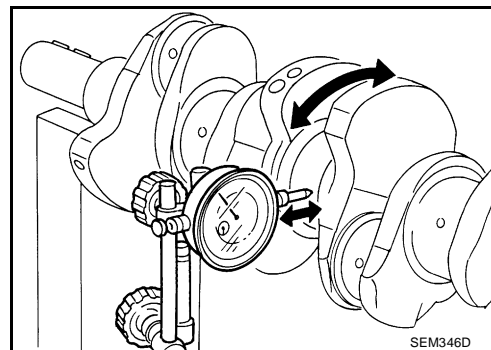
Taper (A - B) : 0.002 mm (0.0001 in)



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)



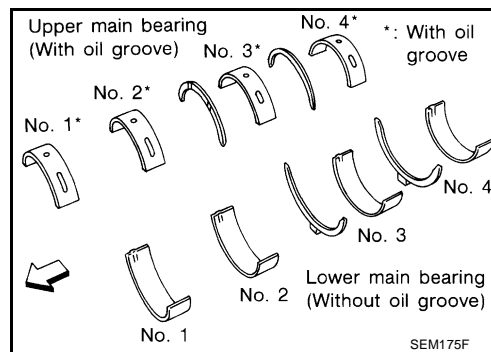
BEARING CLEARANCE

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

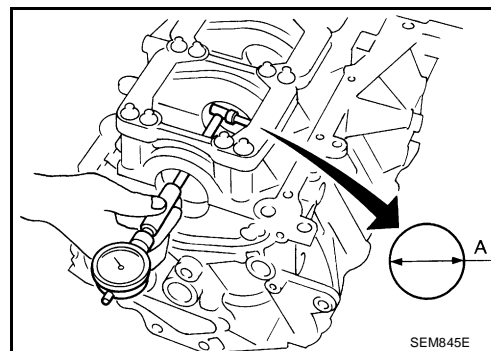
Method A (Using Bore Gauge and Micrometer)

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-113, "Disassembly and Assembly"](#).



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



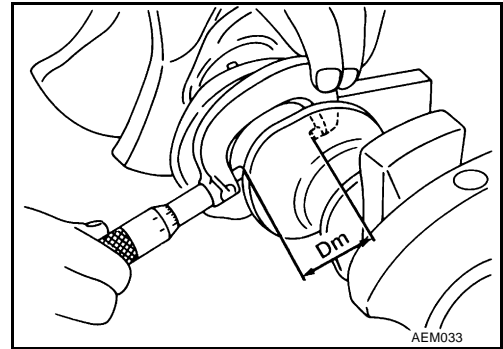
CYLINDER BLOCK

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 : 0.035 - 0.045 mm (0.0014 - 0.0018 in)

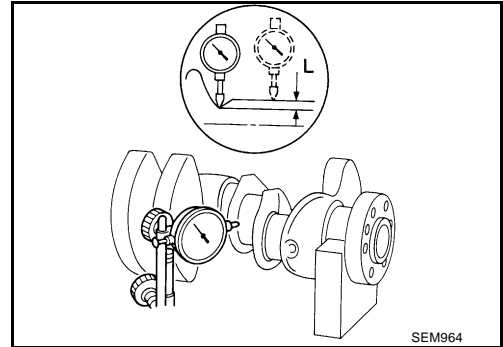
Limit : 0.065 mm (0.0026 in)

- 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.



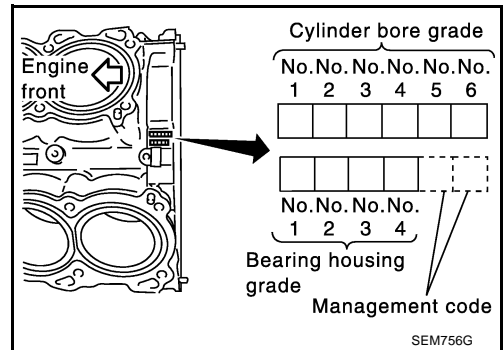
- When grinding the crankshaft journal, confirm that the "L" dimension in the fillet role is more than the specified limit.

"L" : 0.1 mm (0.004 in)

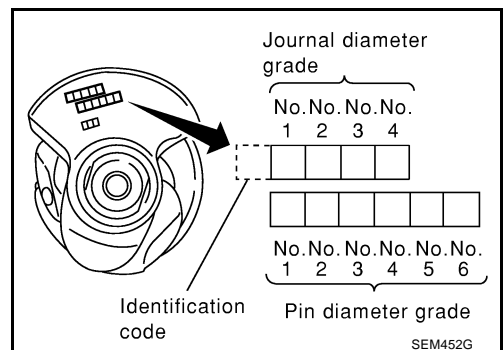


6. If the crankshaft or the cylinder block is replaced with a new one, select thickness of the main bearings as follows:

- 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.



CYLINDER BLOCK

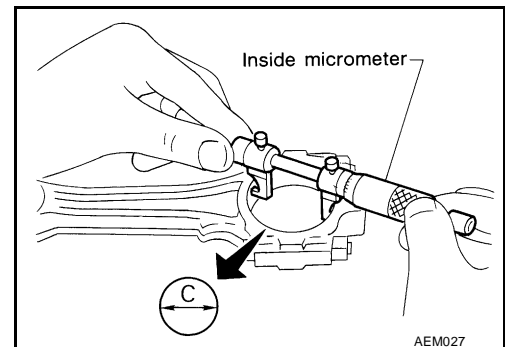
c. Select the main bearing suitable thickness according to the following table:

Cylinder block bearing housing inner diameter Unit: mm (in) Crankshaft main journal diameter Unit: mm (in)		Hole diameter		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	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	12	12	12	12	2	2	2	23	23	23	3	3	3	3	34	34	34
B	59.974 - 59.973 (2.3612 - 2.3611)	0	0	01	01	01	01	1	1	1	12	12	12	12	12	12	12	2	2	2	23	23	23	3	3	3	3	34	34	34
C	59.973 - 59.972 (2.3611 - 2.3611)	0	01	01	01	01	1	1	1	1	12	12	12	12	12	12	12	2	2	2	23	23	23	3	3	3	3	34	34	34
D	59.972 - 59.971 (2.3611 - 2.3611)	01	01	01	1	1	1	1	1	12	12	12	12	12	12	12	12	2	2	2	23	23	23	3	3	3	3	34	34	34
E	59.971 - 59.970 (2.3611 - 2.3610)	01	01	1	1	1	1	12	12	12	12	12	12	12	12	12	12	2	2	2	23	23	23	3	3	3	3	34	34	34
F	59.970 - 59.969 (2.3610 - 2.3610)	01	1	1	1	12	12	12	12	12	12	12	12	12	12	12	12	2	2	2	23	23	23	3	3	3	3	34	34	34
G	59.969 - 59.968 (2.3610 - 2.3609)	1	1	1	12	12	12	12	12	12	12	12	12	12	12	12	12	2	2	2	23	23	23	3	3	3	3	34	34	34
H	59.968 - 59.967 (2.3609 - 2.3609)	1	1	12	12	12	12	12	12	12	12	12	12	12	12	12	12	2	2	2	23	23	23	3	3	3	3	34	34	34
J	59.967 - 59.966 (2.3609 - 2.3609)	1	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	2	2	2	23	23	23	3	3	3	3	34	34	34
K	59.966 - 59.965 (2.3909 - 2.3608)	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	2	2	2	23	23	23	3	3	3	3	34	34	34
L	59.965 - 59.964 (2.3608 - 2.3608)	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	2	2	2	23	23	23	3	3	3	3	34	34	34
M	59.964 - 59.963 (2.3608 - 2.3607)	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	2	2	2	23	23	23	3	3	3	3	34	34	34
N	59.963 - 59.962 (2.3607 - 2.3607)	2	2	2	23	23	23	23	23	23	23	23	23	23	23	23	23	2	2	2	23	23	23	3	3	3	3	34	34	34
P	59.962 - 59.961 (2.3607 - 2.3607)	2	2	23	23	23	23	23	23	23	23	23	23	23	23	23	23	2	2	2	23	23	23	3	3	3	3	34	34	34
R	59.961 - 59.960 (2.3607 - 2.3606)	2	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	2	2	2	23	23	23	3	3	3	3	34	34	34
S	59.960 - 59.959 (2.3606 - 2.3606)	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	2	2	2	23	23	23	3	3	3	3	34	34	34
T	59.959 - 59.958 (2.3606 - 2.3605)	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	2	2	2	23	23	23	3	3	3	3	34	34	34
U	59.958 - 59.957 (2.3605 - 2.3605)	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	2	2	2	23	23	23	3	3	3	3	34	34	34
V	59.957 - 59.956 (2.3605 - 2.3605)	3	3	3	34	34	34	34	34	34	34	34	34	34	34	34	34	2	2	2	23	23	23	3	3	3	3	34	34	34
W	59.956 - 59.955 (2.3605 - 2.3604)	3	3	34	34	34	34	34	34	34	34	34	34	34	34	34	34	2	2	2	23	23	23	3	3	3	3	34	34	34
X	59.955 - 59.954 (2.3604 - 2.3604)	3	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	2	2	2	23	23	23	3	3	3	3	34	34	34
Y	59.954 - 59.953 (2.3604 - 2.3603)	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	2	2	2	23	23	23	3	3	3	3	34	34	34
4	59.953 - 59.952 (2.3603 - 2.3603)	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	2	2	2	23	23	23	3	3	3	3	34	34	34
7	59.952 - 59.951 (2.3603 - 2.3603)	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	2	2	2	23	23	23	3	3	3	3	34	34	34

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-113, "Disassembly and Assembly"](#).
3. Measure the inner diameter "C" of each connecting rod (big end) as shown.



AEM027

CYLINDER BLOCK

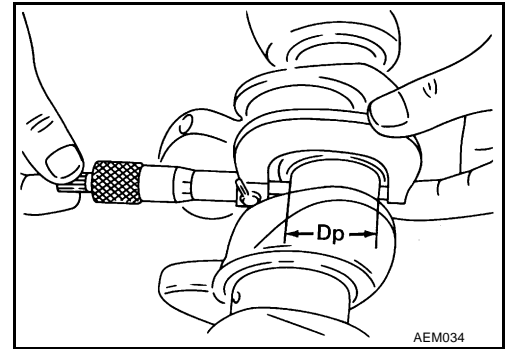
4. Measure the outer diameter "Dp" of each crankshaft pin journal.
5. Calculate the connecting rod bearing clearance.

Connecting rod bearing clearance = C - Dp

Standard : 0.034 - 0.059 mm (0.0013 - 0.0023 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.

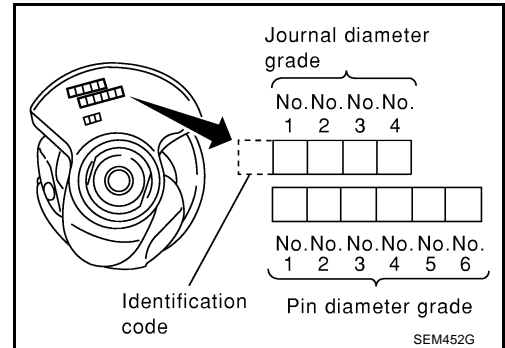


8. If the crankshaft is replaced with a new one, select the connecting rod bearings according to the following table:

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.

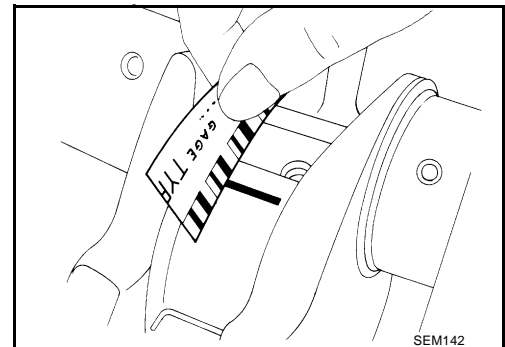
CAUTION:

Never 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)".



CYLINDER BLOCK

DRIVE PLATE RUNOUT (CVT)

Runout (Total Indicator Reading):

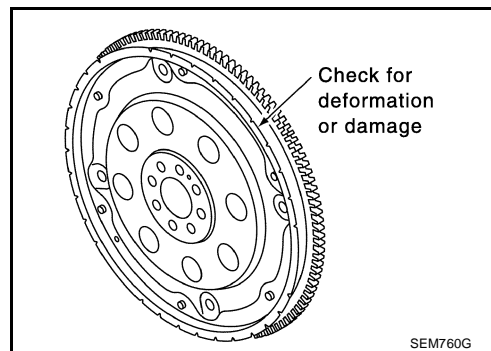
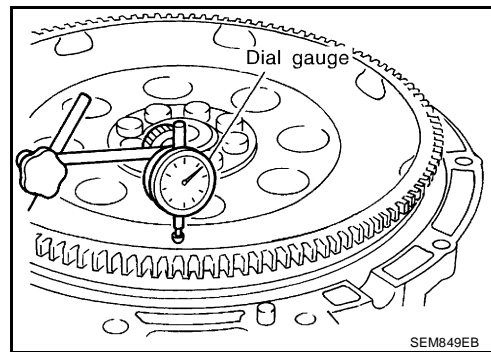
Drive plate (CVT)

torque converter surface : less than 0.35mm (.0138 in)

Ring gear : less than 0.5mm (.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 any magnetized objects away from the signal plate, particularly the teeth.

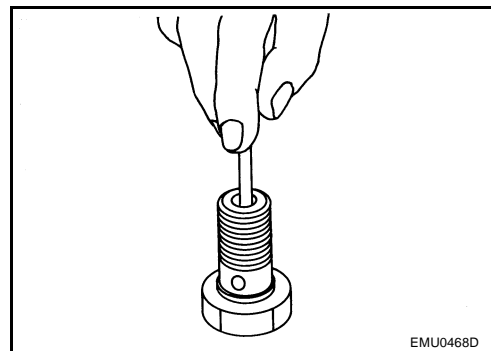


OIL JET

- Check nozzle for deformation and damage.
- Blow compressed air from nozzle, and check for clogs.
- If it is not satisfied, 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 satisfied, replace oil jet relief valve.



SERVICE DATA AND SPECIFICATIONS (SDS)

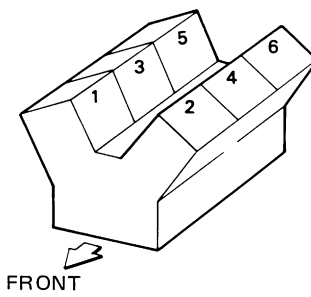
SERVICE DATA AND SPECIFICATIONS (SDS)

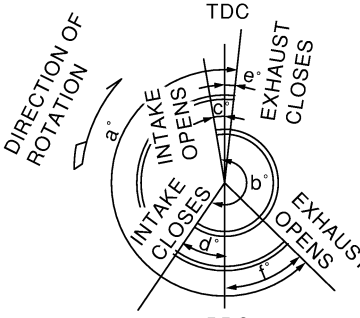
PF00:00100

Standard and Limit GENERAL SPECIFICATIONS

EBS00RD00

Cylinder arrangement		V-6
Displacement cm ³ (in ³)		3,498 (213.45)
Bore and stroke mm (in)		95.5 x 81.4 (3.76 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		10.3:1
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)

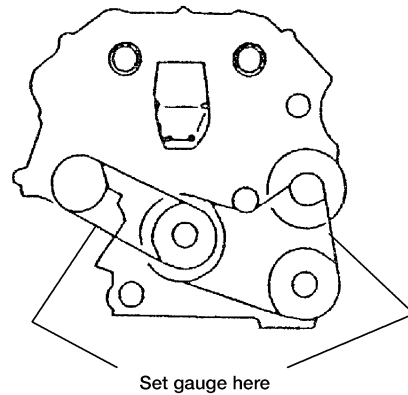
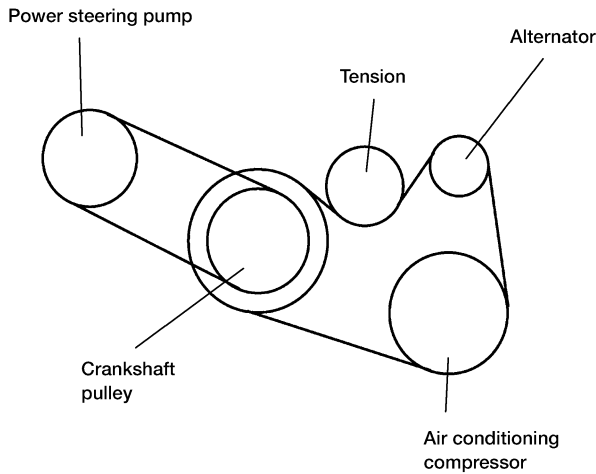
Cylinder number	 <p style="text-align: right; margin-top: 10px;">SEM713A</p>
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Valve timing (IVTC - OFF)	 <p style="text-align: right; margin-top: 10px;">PBIC0187E</p>
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Unit: degree					
a	b	c	d	e	f
240°	238°	- 6°	64°	8°	52°

SERVICE DATA AND SPECIFICATIONS (SDS)

DRIVE BELT



LBIA0076E

	Deflection adjustment		Unit: mm (in)	Tension adjustment*		Unit: N (kg, lb)
	Used belt		New belt	Used belt		New belt
	Limit	After adjustment		Limit	After adjustment	
Alternator and air conditioning compressor	7 (0.28)	4.2 - 4.6 (0.17 - 0.18)	3.7 - 4.1 (0.15 - 0.16)	294 (30, 66)	730 - 818 (74.5 - 83.5, 164 - 184)	838 - 926 (85.5 - 94.5, 188 - 208)
Power steering pump	11 (0.43)	7.3 - 8 (0.29 - 0.30)	6.5 - 7.2 (0.26 - 0.28)	196 (20, 44)	495 - 583 (50.5 - 59.5, 111 - 131)	603 - 691 (61.5 - 70.5, 135.6 - 155.4)
Applied pushing force	98 (10, 22)			—		

*: If belt tension gauge cannot be installed at check points shown, check drive belt tension at different location on the belt.

INTAKE MANIFOLD AND EXHAUST MANIFOLD

Unit: mm (in)

Item	Limit
Intake manifold collector	0.1 (0.004)
Intake manifold	0.1 (0.004)
Exhaust manifold	0.3 (0.012)

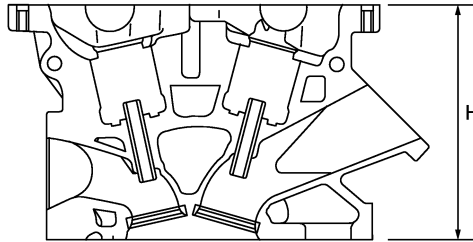
SPARK PLUG

Make	NGK
Part number	DILFR5A11
Gap (nominal)	1.1 mm (0.043 in)

SERVICE DATA AND SPECIFICATIONS (SDS)

CYLINDER HEAD

Unit: mm (in)



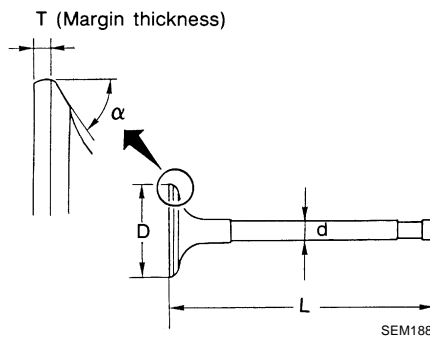
PBIC0924E

	Standard	Limit
Head surface distortion	Less than 0.03 (0.0012)	0.1 (0.004)
Normal cylinder head height "H"	—	126.3 - 126.5 (4.972 - 4.980)

VALVE

Valve Dimensions

Unit: mm (in)



Valve head diameter "D"	Intake	37.0 - 37.3 (1.4567 - 1.4685)
	Exhaust	31.2 - 31.5 (1.228 - 1.240)
Valve length "L"	Intake	96.46 (3.7976)
	Exhaust	96.81 (3.8114)
Valve stem diameter "d"	Intake	5.965 - 5.980 (0.2348 - 0.2354)
	Exhaust	5.945 - 5.960 (0.2341 - 0.2346)
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 Clearance

Unit: mm (in)

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

*: Approximately 80°C (176°F)

SERVICE DATA AND SPECIFICATIONS (SDS)

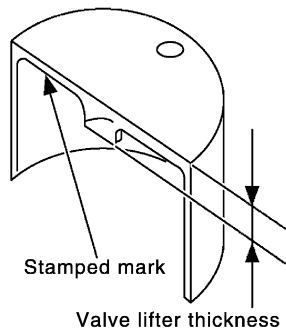
Valve Spring

Free height	mm (in)		46.52 (1.8315)
Pressure	N (kg, lb) at height mm (in)	Standard	166-188 (16.9 - 19.2, 37.3 - 42.3) at 37.0 (1.457)
		Limit	373 - 421 (38.0 - 42.9, 83.9 - 95.0) at 27.2 (1.071)
Out-of-square	mm (in)		Less than 2.0 (0.079)

Valve Lifter

Unit: mm (in)

Valve lifter outer diameter	33.977 - 33.987 (1.3377 - 1.3381)
Lifter lifter bore diameter	34.000 - 34.016 (1.3386 - 1.3392)
Clearance between lifter and lifter guide	0.013 - 0.039 (0.0005 - 0.0015)



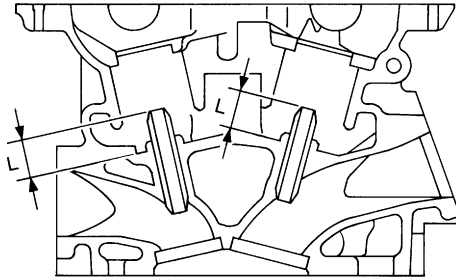
SEM758G

Identification Mark	Thickness mm (in)
788C	7.88 (0.3102)
790C	7.90 (0.3110)
792C	7.92 (0.3118)
794C	7.94 (0.3126)
796C	7.96 (0.3134)
798C	7.98 (0.3142)
800C	8.00 (0.3150)
802C	8.02 (0.3157)
804C	8.04 (0.3165)
806C	8.06 (0.3173)
808C	8.08 (0.3181)
810C	8.10 (0.3189)
812C	8.12 (0.3197)
814C	8.14 (0.3205)
816C	8.16 (0.3213)
818C	8.18 (0.3220)
820C	8.20 (0.3228)
822C	8.22 (0.3236)
824C	8.24 (0.3244)
826C	8.26 (0.3252)
828C	8.28 (0.3260)
830C	8.30 (0.3268)
832C	8.32 (0.3276)
834C	8.34 (0.3283)
836C	8.36 (0.3291)

SERVICE DATA AND SPECIFICATIONS (SDS)

Valve Guide

Unit: mm (in)



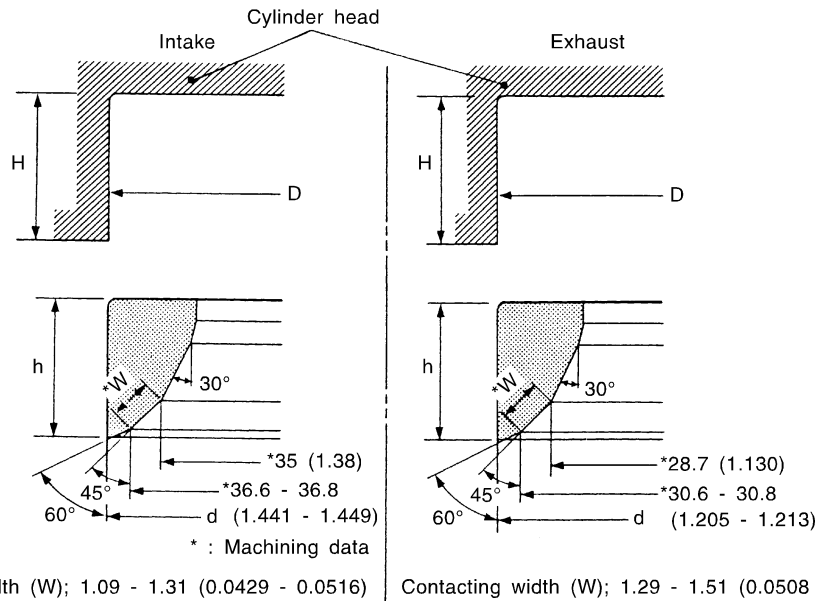
SEM950E

		Standard	Service
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
Valve guide	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)	
		Standard	Limit
Valve to 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)	0.1 (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)	

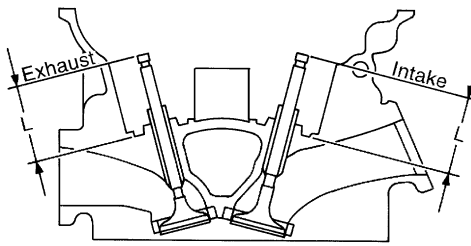
SERVICE DATA AND SPECIFICATIONS (SDS)

Valve Seat

Unit: mm (in)



SEM021EB



SEM621F

		Standard	Service
Cylinder head seat recess diameter (D)	Intake	38.000 - 38.016 (1.4961 - 1.4967)	38.500 - 38.516 (1.5157 - 1.5164)
	Exhaust	32.200 - 32.216 (1.2677 - 1.2683)	32.700 - 32.716 (1.2874 - 1.2880)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.064 - 0.096 (0.0025 - 0.0038)	
Valve seat outer diameter (d)	Intake	38.097 - 38.113 (1.4999 - 1.5005)	38.597 - 38.613 (1.5196 - 1.5202)
	Exhaust	32.280 - 32.296 (1.2709 - 1.2715)	32.780 - 32.796 (1.2905 - 1.2912)
Height (h)	Intake	5.9 - 6.0 (0.232 - 0.236)	5.05 - 5.15 (0.1988 - 0.2028)
	Exhaust	5.9 - 6.0 (0.232 - 0.236)	4.95 - 5.05 (0.1949 - 0.1988)
Depth (H)		5.9 - 6.1 (0.232 - 0.240)	
Depth (L)	Intake	41.07 - 41.67 (1.6169 - 1.6405)	
	Exhaust	41.00 - 41.60 (1.6142 - 1.6378)	

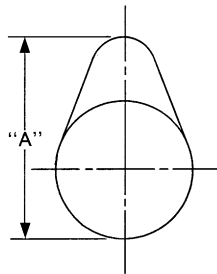
SERVICE DATA AND SPECIFICATIONS (SDS)

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

	Standard	Limit
Camshaft journal to bearing clearance	No. 1 0.045 - 0.086 (0.0018 - 0.0034) No. 2, 3, 4 0.035 - 0.076 (0.0014 - 0.0030)	0.15 (0.0059)
Inner diameter of camshaft bearing	No. 1 26.000 - 26.021 (1.0236 - 1.0244) No. 2, 3, 4 23.500 - 23.521 (0.9252 - 0.9260)	—
Outer diameter of camshaft journal	No. 1 25.935 - 25.955 (1.0211 - 1.0218) No. 2, 3, 4 23.445 - 23.465 (0.9230 - 0.9238)	—
Camshaft runout [TIR*]	Less than 0.02 (0.0008)	0.05 (0.0020)
Camshaft sprocket runout [TIR*]	Less than 0.15 (0.0059)	—
Camshaft end play	0.115 - 0.188 (0.0045 - 0.0074)	0.24 (0.0094)

*: Total indicator reading

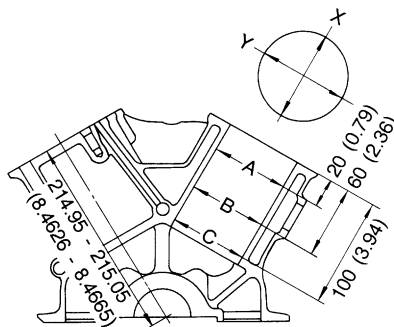


SEM671

Cam lobe height "A"	Intake and exhaust	44.465 - 44.655 (1.7506 - 1.7581)
Wear limit of cam lobe height		0.2 (0.008)

CYLINDER BLOCK

Unit: mm (in)



SEM022EA

Surface distortion	Standard			Less than 0.03 (0.0012)
	Limit			0.10 (0.0039)
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 (Difference between X and Y)				Less than 0.015 (0.0006)

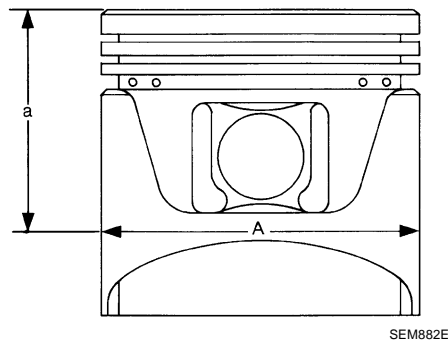
SERVICE DATA AND SPECIFICATIONS (SDS)

Taper (Difference between A and C)		Less than 0.015 (0.0006)
Main journal 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)

PISTON, PISTON RING AND PISTON PIN

Available Piston

Unit: mm (in)



Piston skirt diameter "A"	Standard	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)
		0.20 (0.0079) oversize (Service)	95.680 - 95.710 (3.7669 - 3.7681)
"a" dimension			41.0 (1.614)
Piston pin hole 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-bore clearance to cylinder block			0.010 - 0.030 (0.0004 - 0.0012)

SERVICE DATA AND SPECIFICATIONS (SDS)

Piston Ring

Unit: mm (in)

		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 - 0.135 (0.0026 - 0.0053)	—
End gap	Top	0.23 - 0.33 (0.0091 - 0.0130)	0.54 (0.0213)
	2nd	0.33 - 0.48 (0.0130 - 0.0189)	0.80 (0.0315)
	Oil (rail ring)	0.20 - 0.50 (0.0079 - 0.0197)	0.95 (0.0374)

Piston Pin

Unit: mm (in)

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)
Interference fit of piston pin to piston		0.002 - 0.006 (0.0001 - 0.0002)
Piston pin to connecting rod bushing oil clearance	Standard	0.005 - 0.017 (0.0002 - 0.0007)
	Limit	0.030 (0.0012)

*: Values measured at ambient temperature of 20°C (68°F)

CONNECTING ROD

Unit: mm (in)

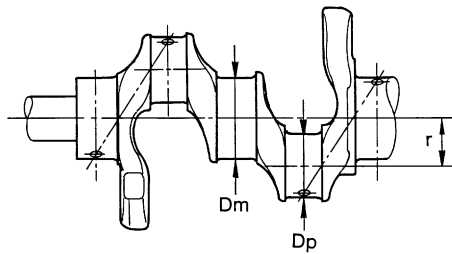
Center distance		144.15 - 144.25 (5.6752 - 5.6791)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)
Connecting rod small end inner diameter		23.980 - 24.000 (0.9441 - 0.9449)
Piston pin bushing inner diameter*	Grade No. 0	22.000 - 22.006 (0.8661 - 0.8664)
	Grade No. 1	22.006 - 22.012 (0.8664 - 0.8666)
Connecting rod big end inner diameter		55.000 - 55.013 (2.1654 - 2.1659)
Side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)
	Limit	0.40 (0.0157)

*: After installing in connecting rod

SERVICE DATA AND SPECIFICATIONS (SDS)

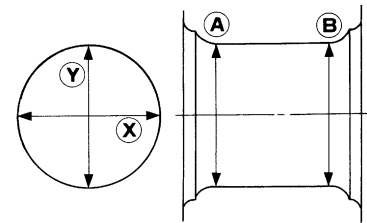
CRANKSHAFT

Unit: mm (in)



SEM645

Out-of-round (X) - (Y)
Taper (A) - (B)



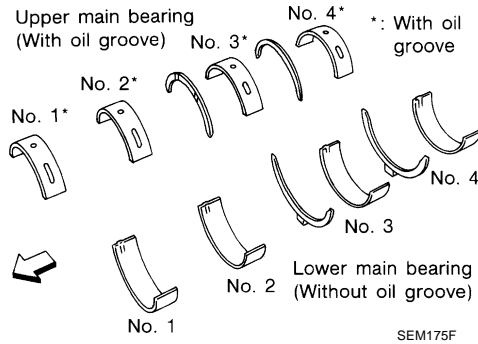
SEM715

Main journal dia. "Dm" grade	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 dia. "Dp"	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"		40.36 - 40.44 (1.5890 - 1.5921)
Out-of-round (Difference between X and Y)	Standard	Less than 0.002 (0.0001)
Taper (Difference between A and B)	Standard	Less than 0.002 (0.0001)
Runout [TIR*]	Limit	Less than 0.10 (0.0039)
End play	Standard	0.10 - 0.25 (0.0039 - 0.0098)
	Limit	0.30 (0.0118)

*: Total indicator reading

SERVICE DATA AND SPECIFICATIONS (SDS)

AVAILABLE MAIN BEARING



Grade number	Thickness "T" mm (in)	Width "W" mm (in)	Identification color (UPR/LWR)	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	Grade is different for upper and lower bearings.	
01	UPP		2.003 - 2.006 (0.0789 - 0.0790)		Brown/Black
	LWR		2.000 - 2.003 (0.0787 - 0.0789)		
12	UPR		2.006 - 2.009 (0.0790 - 0.0791)		Green/Brown
	LWR		2.003 - 2.006 (0.0789 - 0.0790)		
23	UPR		2.009 - 2.012 (0.0791 - 0.0792)		Yellow/Green
	LWR		2.006 - 2.009 (0.0790 - 0.0791)		
34	UPR	2.012 - 2.015 (0.0792 - 0.0793)	Blue/Yellow		
	LWR	2.009 - 2.012 (0.0791 - 0.0792)			
45	UPR	2.015 - 2.018 (0.0793 - 0.0794)	Pink/Blue		
	LWR	2.012 - 2.015 (0.0792 - 0.0793)			
56	UPR	2.018 - 2.021 (0.0794 - 0.0796)	Purple/Pink		
	LWR	2.015 - 2.018 (0.0793 - 0.0794)			
67	UPR	2.021 - 2.024 (0.0796 - 0.0797)	White/Purple		
	LWR	2.018 - 2.021 (0.0794 - 0.0796)			

Undersize

Unit: mm (in)

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

CONNECTING ROD BEARING

Grade number	Thickness "T" mm (in)	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

SERVICE DATA AND SPECIFICATIONS (SDS)

Undersize

Unit: mm (in)

	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.

A

EM

MISCELLANEOUS COMPONENTS

Unit: mm (in)

Drive plate deflection [TIR]* - on torque converter mount surface	Less than 0.35 (0.0138)
Drive plate deflection [TIR]* - on ring gear	0.5 (0.0197)
Flywheel runout [TIR]* limit	Less than 0.45 (0.0177)
Flywheel axial displacement limit measured at 250mm (9.84 in)	Less than 1.3 (0.051) or less under 100N (22.48 lb) force.

C

D

*: Total indicator reading

E

BEARING CLEARANCE

Unit: mm (in)

Main bearing clearance	Standard	0.035 - 0.045 (0.0014 - 0.0018)*
	Limit	0.065 (0.0026)
Connecting rod bearing clearance	Standard	0.034 - 0.059 (0.0013 - 0.0023)*
	Limit	0.070 (0.0028)

F

G

*: Actual clearance

H

I

J

K

L

M

SERVICE DATA AND SPECIFICATIONS (SDS)
