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# SECTION **EM**

## ENGINE MECHANICAL

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## PRECAUTIONS

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

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The Supplemental Restraint System such as “AIR BAG” and “SEAT BELT PRE-TENSIONER”, used along with a front seat belt, helps to reduce the risk or severity of injury to the driver and front passenger for certain types of collision. This system includes seat belt switch inputs and dual stage front air bag modules. The SRS system uses the seat belt switches to determine the front air bag deployment, and may only deploy one front air bag, depending on the severity of a collision and whether the front occupants are belted or unbelted. Information necessary to service the system safely is included in the SRS and SB section of this Service Manual.

**WARNING:**

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

### Parts Requiring Angular Tightening

EBS00EY5

- Use an angle wrench for the final tightening of the following engine parts:
  - Cylinder head bolts
  - Connecting rod cap nuts
- 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 REMOVAL OF LIQUID GASKET SEALING

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- After removing the mounting bolts and nuts, separate the mating surface using a seal cutter and remove the liquid gasket sealing.

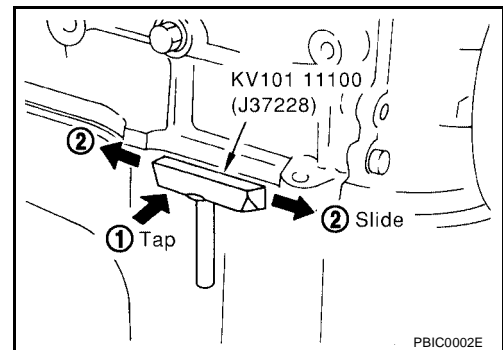
**CAUTION:**

**Be careful not to damage the mating surfaces.**

- Use a plastic hammer to lightly tap (1) the areas where the liquid gasket is applied. To advance the cutter, use a plastic hammer (2) to slide the cutter along the joint.

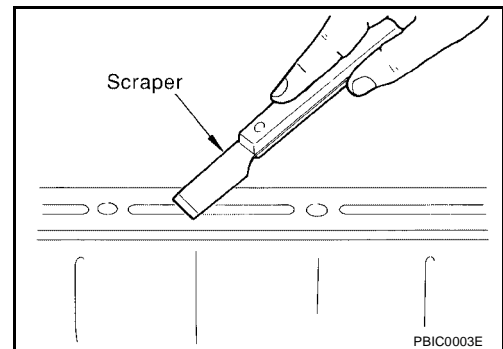
**CAUTION:**

**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

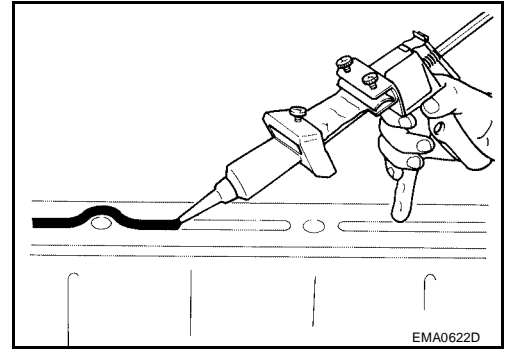
1. Using a scraper, remove the old liquid gasket adhering to the gasket application surface and the mating surface.
  - Remove the sealant completely from the groove of the gasket application surface, mounting bolts, and bolt holes.



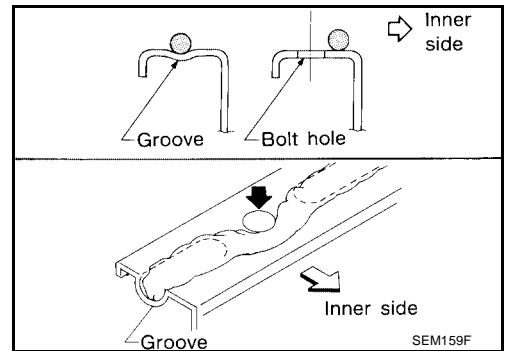
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2. Thoroughly clean the gasket application surface and the mating surface and remove adhering moisture, grease and foreign materials.
3. Attach the sealant tube to the tube presser.



4. Apply the sealant without breaks to the specified location with the specified dimensions.
  - 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.
  - After 30 minutes or more have passed from the installation, fill the engine with the specified oil and coolant. Refer to [MA-20, "Changing Engine Oil"](#) and [MA-16, "DRAINING ENGINE COOLANT"](#).



# PREPARATION

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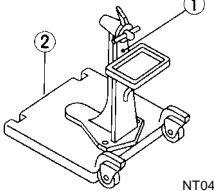
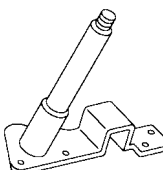
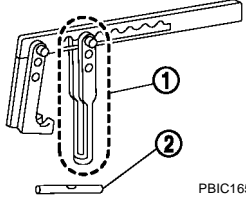
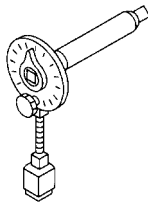
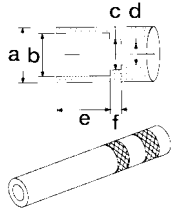
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## PREPARATION

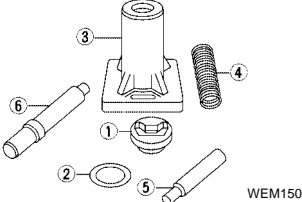
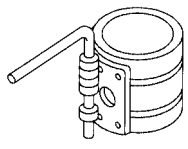
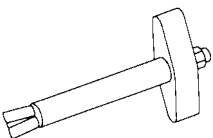
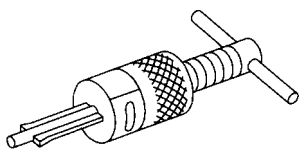
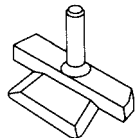
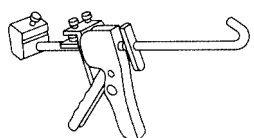
### Special Service Tools

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 <b>1</b> ST05011000 (    —    ) Engine stand <b>2</b> ST05012000 (    —    ) Base	 <p style="text-align: right; font-size: small;">NT042</p>	Disassembling and assembling
KV10105001 (    —    ) Engine attachment	 <p style="text-align: right; font-size: small;">NT031</p>	
KV101092S0 (J26336-B) Valve spring compressor <b>1</b> KV10109210 (    —    ) Compressor <b>2</b> KV100109220 (    —    ) Adapter	 <p style="text-align: right; font-size: small;">PBIC1650E</p>	Disassembling and assembling valve components
KV10112100 (BT8653-A) Angle wrench	 <p style="text-align: right; font-size: small;">NT014</p>	Tightening bearing cap, cylinder head bolts, etc.
KV10116300 (J-38955) Valve oil seal drift	 <p style="text-align: right; font-size: small;">WEM151</p>	Installing valve oil seal <b>a: 25 (0.98) dia.</b> <b>b: 14.4 (0.567) dia.</b> <b>c: 11.8 (0.465) dia.</b> <b>d: 10 (0.39) dia.</b> <b>e: 11 (0.43)</b> <b>f: 9 (0.35)</b>

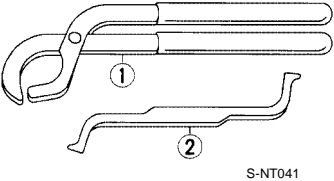
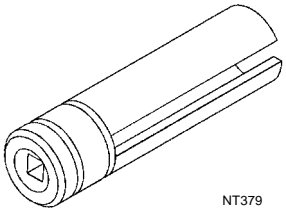
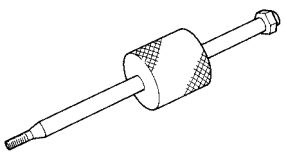
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[KA24DE]

Tool number (Kent-Moore No.) Tool name		Description	
KV10110300 ( — ) Piston pin press stand assembly <b>1</b> KV10110310 ( — ) Cap <b>2</b> KV10110330 ( — ) Spacer <b>3</b> ST13030020 ( — ) Press stand <b>4</b> ST13030030 ( — ) Spring <b>5</b> KV10110340 ( — ) Drift <b>6</b> KV10110320 ( — ) Center shaft		Disassembling and assembling piston with connecting rod	A <b>EM</b> C D E F G
EM03470000 (J8037) Piston ring compressor		Installing piston assembly into cylinder bore	H I
(J36467) Valve oil seal remover		Removing valve oil seal	J K
ST16610001 (J23907) Pilot bushing puller		Removing crankshaft pilot bushing	L M
KV10111100 (J37228) Seal cutter		Removing oil pan	
WS39930000 ( — ) Tube presser		Pressing the tube of liquid gasket	

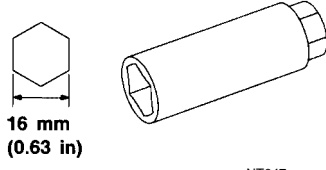
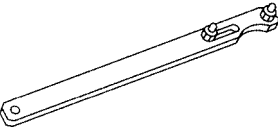
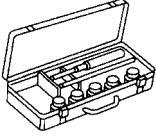
# PREPARATION

[KA24DE]

Tool number (Kent-Moore No.) Tool name		Description
KV101151S0 (J38972) Lifter stopper set <b>1</b> KV10115110 (J38972-1) Camshaft pliers <b>2</b> KV10115120 (J38972-2) Lifter stopper	 <p style="text-align: right; margin-right: 50px;">S-NT041</p>	Changing valve lifter shims
KV10117100 (J36471-A) Front heated oxygen sensor wrench	 <p style="text-align: right; margin-right: 50px;">NT379</p>	Loosen and tighten heated oxygen sensor <b>For 22 mm (0.87 in) hexagon nut</b>
KV10114700 (J38139) Main bearing cap remover	 <p style="text-align: right; margin-right: 50px;">ZZA0023D</p>	Removing crankshaft main bearing cap <b>For No. 3 and No. 5 bearing caps</b>

## Commercial Service Tools

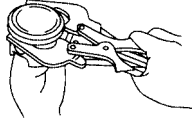
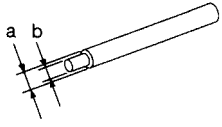
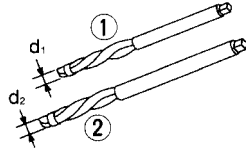
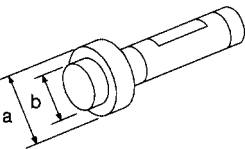
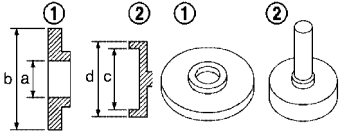
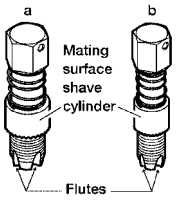
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Tool name (Kent Moore No.)		Description
Spark plug wrench	 <p style="text-align: center; margin-top: 5px;"><b>16 mm (0.63 in)</b></p> <p style="text-align: right; margin-right: 50px;">NT047</p>	Removing and installing spark plug
Pulley holder	 <p style="text-align: right; margin-right: 50px;">NT035</p>	Holding camshaft pulley while tightening or loosening camshaft bolt
Valve seat cutter set	 <p style="text-align: right; margin-right: 50px;">NT048</p>	Finishing valve seat dimensions




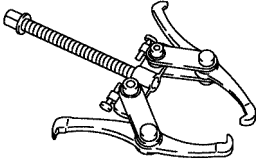
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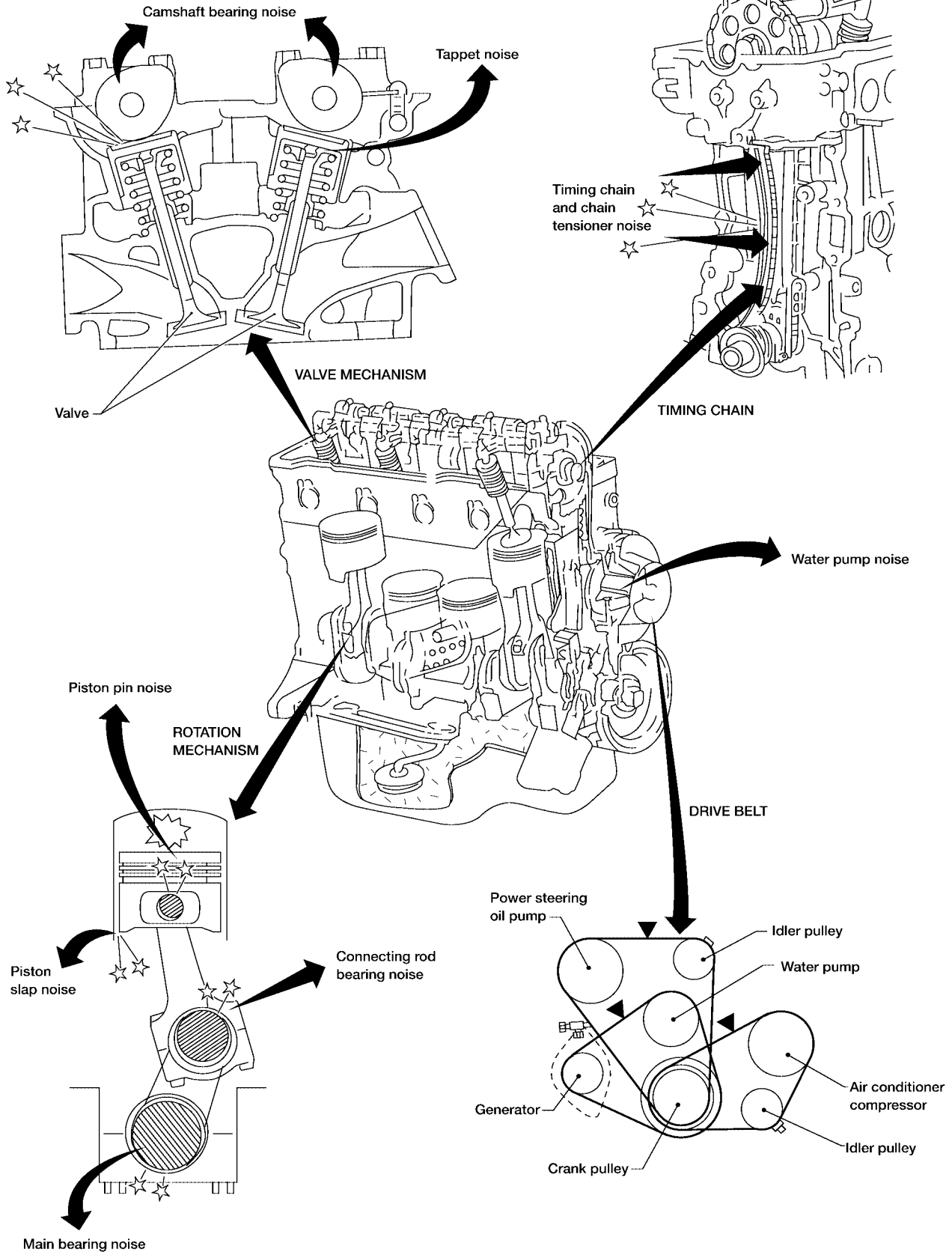
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Tool name (Kent Moore No.)		Description	
Piston ring expander	 <p style="text-align: center;">NT030</p>	Removing and installing piston ring	A EM C
Valve guide drift	 <p style="text-align: center;">NT015</p>	Removing and installing valve guide <b>Intake &amp; Exhaust:</b> <b>a = 10.5 mm (0.413 in) dia.</b> <b>b = 6.6 mm (0.260 in) dia.</b>	D E
Valve guide reamer	 <p style="text-align: center;">NT016</p>	Reaming valve guide 1 or hole for oversize valve guide 2 <b>Intake:</b> <b>d1 = 7.0 mm (0.276 in) dia.</b> <b>d2 = 11.2 mm (0.441 in) dia.</b> <b>Exhaust:</b> <b>d1 = 8.0 mm (0.315 in) dia.</b> <b>d2 = 12.2 mm (0.480 in) dia.</b>	F G
Front oil seal drift	 <p style="text-align: center;">NT049</p>	Installing front oil seal <b>a: 52 mm (2.05 in) dia.</b> <b>b: 44 mm (1.73 in) dia.</b>	H I
Rear oil seal drift	 <p style="text-align: center;">WEM152</p>	Installing rear oil seal <b>a: 46 mm (1.81 in)</b> <b>b: 110 mm (4.33 in)</b> <b>c: 84 mm (3.31 in)</b> <b>d: 96 mm (3.78 in)</b>	J K L
Thread repair tool for oxygen sensor a: (J-43897-18) b: (J-43897-12)	 <p style="text-align: center;">AEM488</p>	<b>a: 18 mm (0.71 in)</b> <b>b: 12 mm (0.47 in)</b>	M

# PREPARATION

[KA24DE]

Tool name (Kent Moore No.)		Description
Anti-seize thread compound	 <p>AEM489</p>	For preventing corrosion, seizing, and galling on high temperature applications.
Crankshaft pulley puller	 <p>PBIC0887E</p>	Removing crankshaft pulley



# NOISE, VIBRATION, AND HARSHNESS (NVH) TROUBLESHOOTING

[KA24DE]

## NVH TROUBLESHOOTING CHART — ENGINE NOISE

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 the engine.
4. Check the specified noise source.
5. As necessary, repair or replace the parts causing the noise.

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 revving	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Valve clearance	<a href="#">EM-41</a>
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal clearance Camshaft runout	<a href="#">EM-32</a>
Crankshaft pulley Cylinder block (upper side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston and piston pin clearance Connecting rod bushing clearance	<a href="#">EM-48</a>
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston ring side clearance Piston ring end gap Connecting rod bend and torsion Piston-to-bore clearance	<a href="#">EM-48</a>
	Knock	A	B	C	B	B	B	Connecting rod-bearing noise	Connecting rod bearing clearance (Big end) Connecting rod bushing clearance (Small end)	<a href="#">EM-48</a>
	Knock	A	B	—	A	B	C	Main bearing noise	Crankshaft runout Main bearing oil clearance	<a href="#">EM-48</a>
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	<a href="#">EM-24</a>
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belt deflection	<a href="#">MA-15, "Checking Drive Belts"</a>
	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	<a href="#">CO-11, "Inspection"</a>

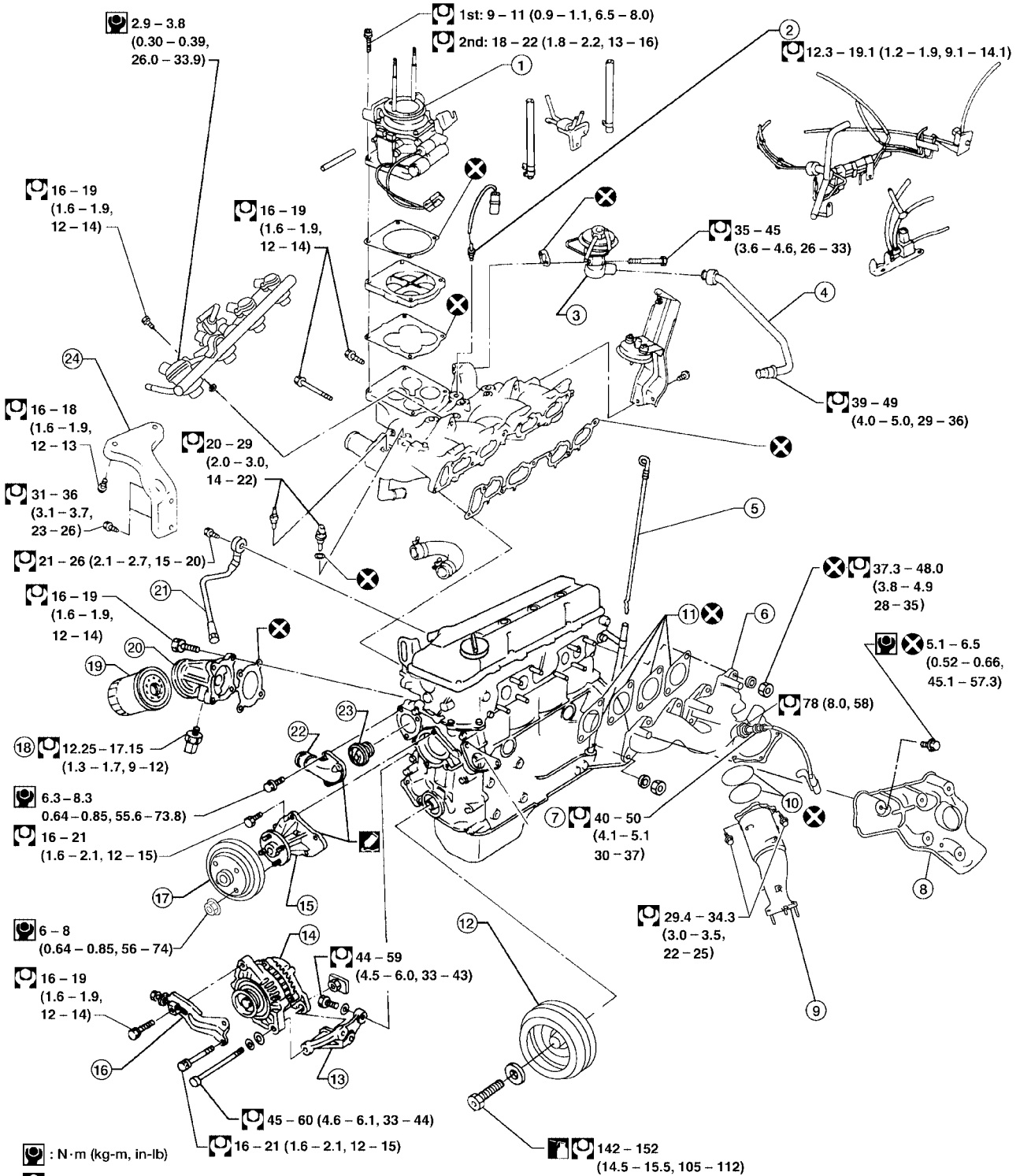
A: Closely related B: Related C: Sometimes related —: Not related

## OUTER COMPONENT PARTS

### Removal and Installation

#### Engine Outer Components

SEC. 120 • 140 • 147 • 150 • 163 • 164 • 210 • 220 • 221 • 230 • 231



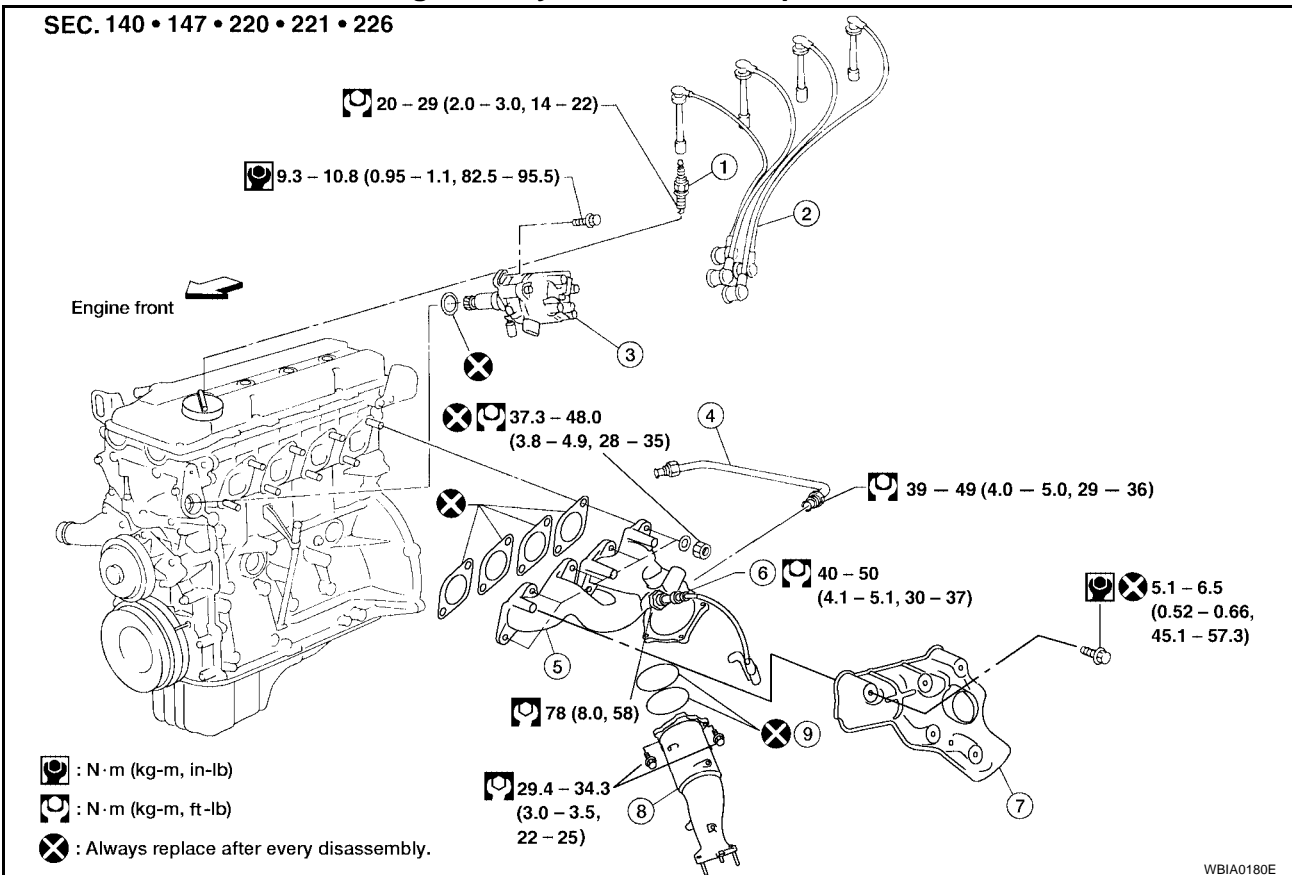
- : N·m (kg-m, in-lb)
- : N·m (kg-m, ft-lb)
- : Apply Genuine Silicone RTV or equivalent. Refer to GI Section.
- : Lubricate with new engine oil.
- : Always replace after every disassembly.

# OUTER COMPONENT PARTS

[KA24DE]

- |                            |                              |                             |
|----------------------------|------------------------------|-----------------------------|
| 1. Throttle body           | 2. EGR temperature sensor    | 3. EGR valve                |
| 4. EGR tube                | 5. Oil dipstick              | 6. Exhaust manifold         |
| 7. Heated oxygen sensor 1  | 8. Exhaust manifold cover    | 9. TWC (manifold)           |
| 10. TWC (manifold) gaskets | 11. Exhaust manifold gaskets | 12. Crankshaft pulley       |
| 13. Generator bracket      | 14. Generator                | 15. Water pump              |
| 16. Adjusting bar          | 17. Water pump pulley        | 18. Oil pressure switch     |
| 19. Oil filter             | 20. Oil filter bracket       | 21. Knock sensor            |
| 22. Water inlet            | 23. Thermostat               | 24. Intake manifold bracket |

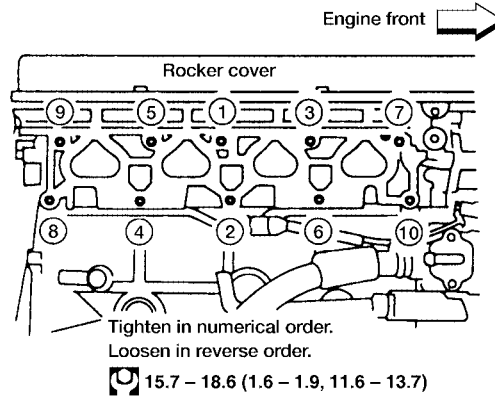
## Ignition System Outer Components



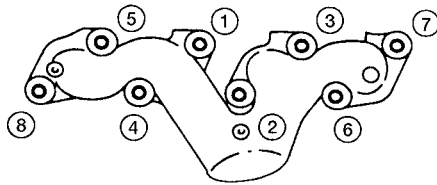
WBIA0180E

- |                           |                     |  |
|---------------------------|---------------------|--|
| 1. Spark plug             | 2. Ignition wires   | 3. Camshaft position sensor built into distributor |
| 4. EGR tube               | 5. Exhaust manifold | 6. Heated oxygen sensor 1                          |
| 7. Exhaust manifold cover | 8. TWC (manifold)   | 9. TWC (manifold) gaskets                          |

## Intake manifold



## Exhaust manifold

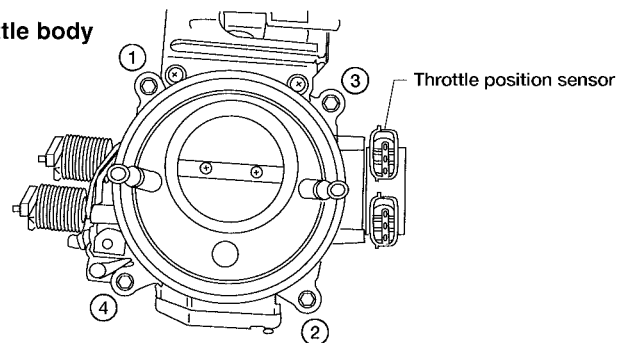


Tighten in numerical order.  
Loosen in reverse order.

37.3 - 48.0 (3.8 - 4.9, 27.5 - 35.4)

: N·m (kg-m, ft-lb)

## Throttle body



Tighten in numerical order.  
Loosen in reverse order.

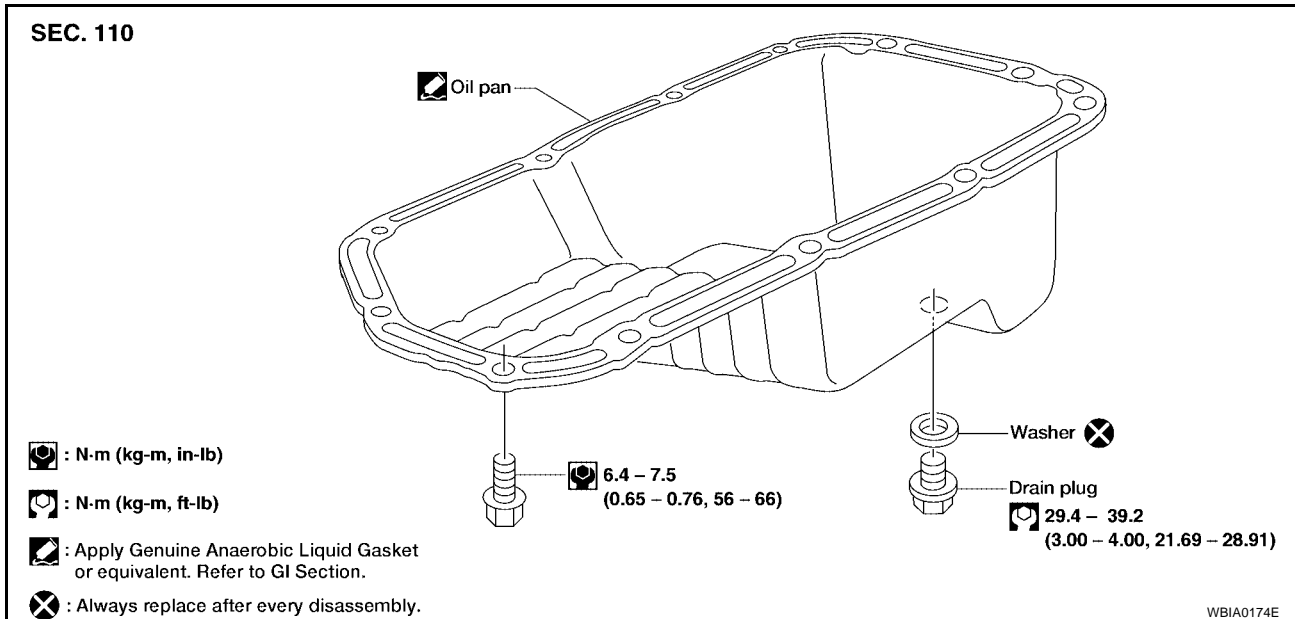
1st: 9 - 11 (0.9 - 1.1, 6.5 - 8.0)  
2nd: 18 - 22 (1.8 - 2.2, 13 - 16)

WBIA0099E

A  
EM  
C  
D  
E  
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H  
I  
J  
K  
L  
M

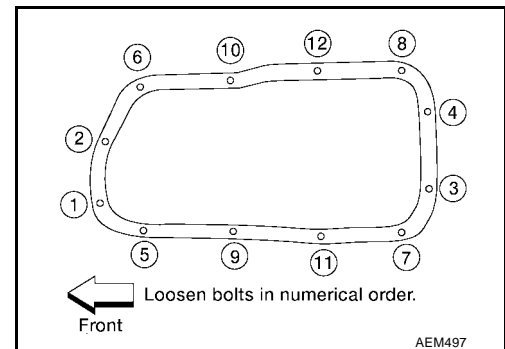
## OIL PAN

### Components

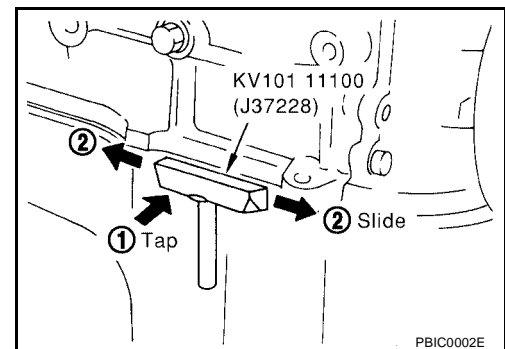


### Removal

1. Remove the engine under cover.
2. Drain the engine oil. Refer to [MA-20, "Changing Engine Oil"](#).
3. Remove the front suspension member. Refer to [FSU-5, "Components"](#).
4. Remove the oil pan bolts, loosen the oil pan bolts in the numerical order as shown.



5. Remove the oil pan.
  - a. Insert the Tool between the cylinder block and the oil pan and tap (1) with a plastic hammer as shown.
    - Be careful not to damage aluminum mating surface.
    - Do not insert a screwdriver, or the oil pan flange may be damaged.
  - b. Slide the Tool by tapping on the side (2) of the Tool with a plastic hammer as shown.

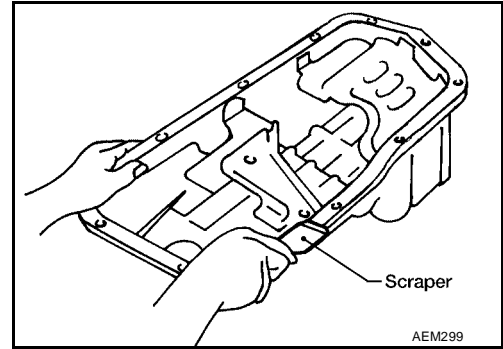


6. Pull the oil pan out from the front.

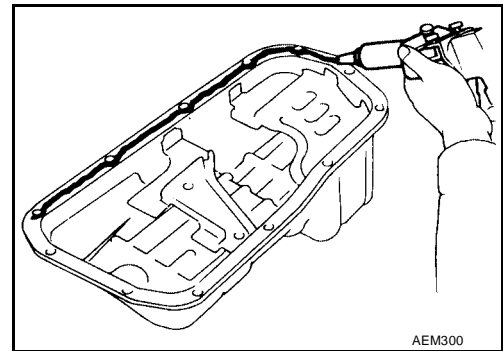


## Installation

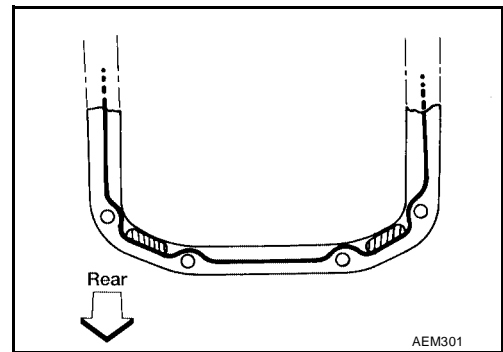
1. Use a scraper to remove the old liquid gasket from the mating surface of the oil pan.
  - Remove all traces of the liquid gasket from the mating surface of the cylinder block.



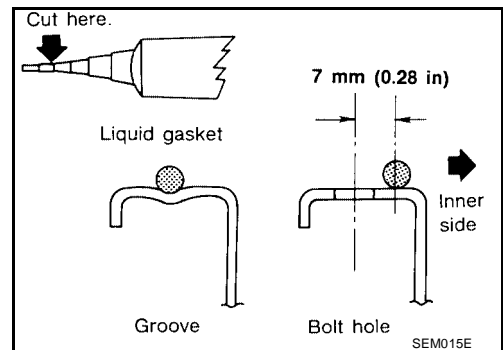
2. Apply a continuous bead of liquid gasket to the mating surface of the oil pan.
  - Use Genuine Anaerobic Liquid Gasket or equivalent. Refer to [EM-4, "Precautions for Liquid Gasket"](#).



- Apply the liquid gasket to the groove on the mating surface of the oil pan.



- Allow a 7mm (0.28 in) clearance around the oil pan bolt holes.
- The liquid gasket bead must have a diameter of 3.5 - 4.5 mm (0.138 - 0.177 in).



- Install the oil pan within 5 minutes after applying the liquid gasket.

A  
EM  
C  
D  
E  
F  
G  
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I  
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K  
L  
M

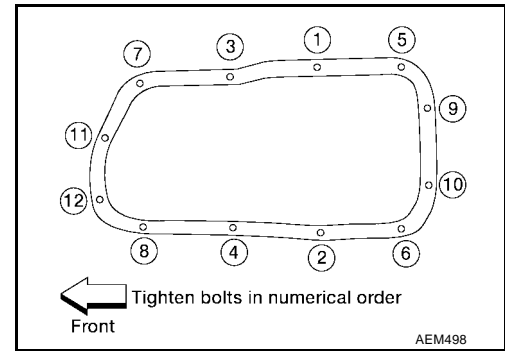
## OIL PAN

[KA24DE]

3. Install the oil pan.
  - Tighten the oil pan bolts to specification in the numerical order as shown.

**Oil pan bolts : 6.4 - 7.5 N·m (0.65 - 0.76 kg-m,  
56 - 66 in-lb)**

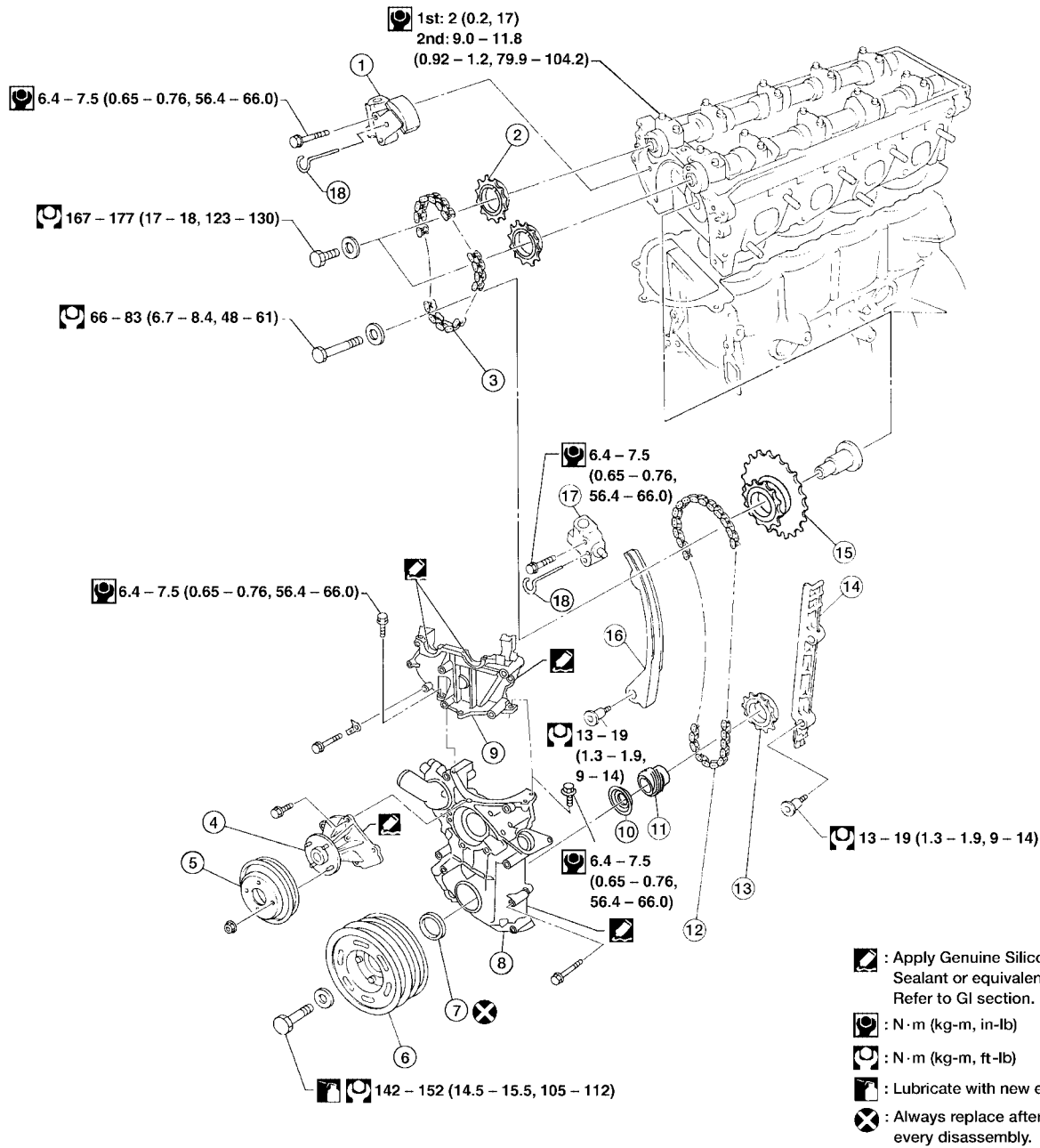
- Wait at least 30 minutes before refilling the engine with oil.



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

## TIMING CHAIN

### Components



- |                                   |                                    |                            |
|-----------------------------------|------------------------------------|----------------------------|
| 1. Timing chain tensioner (upper) | 2. Cam sprocket                    | 3. Timing chain (upper)    |
| 4. Water pump                     | 5. Water pump pulley               | 6. Crankshaft pulley       |
| 7. Front oil seal                 | 8. Front cover                     | 9. Camshaft sprocket cover |
| 10. Oil slinger                   | 11. Oil pump drive gear            | 12. Timing chain (lower)   |
| 13. Crankshaft sprocket           | 14. Chain guide                    | 15. Idler sprocket         |
| 16. Chain tension arm             | 17. Timing chain tensioner (lower) | 18. Suitable pin           |

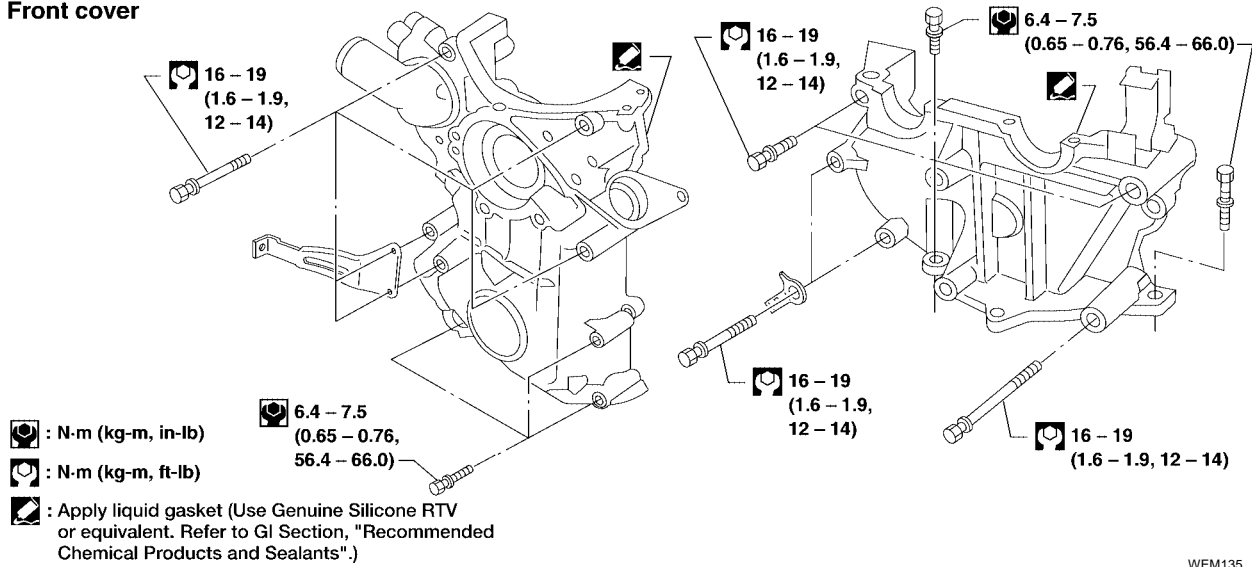
WBIA0214E

# TIMING CHAIN

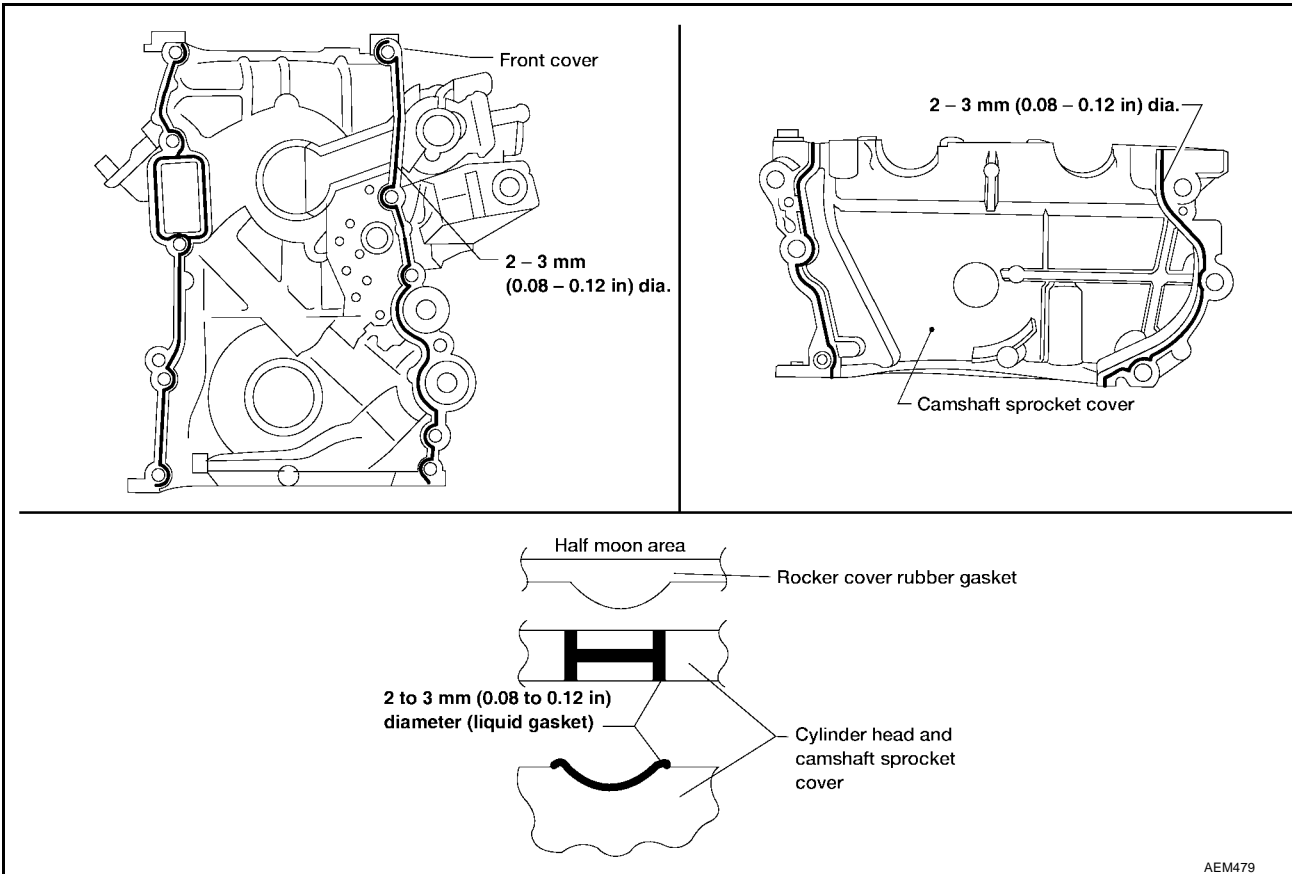
[KA24DE]

## SEC. 135 Front cover

### Camshaft sprocket cover



## LIQUID GASKET APPLICATION



## Removal

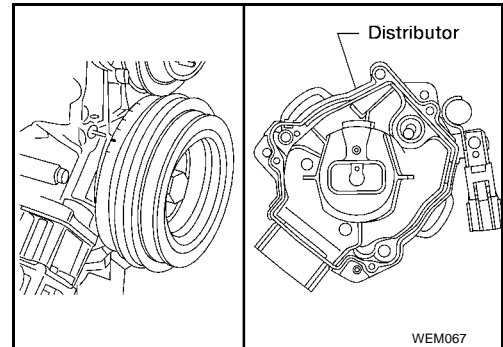
EBS00C9U

### CAUTION:

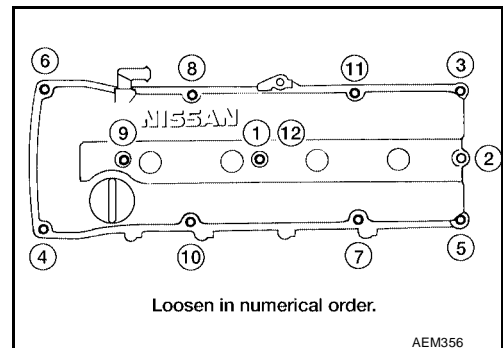
- After removing the timing chain, do not turn the crankshaft and camshaft separately, or the valves will strike piston heads, causing damage.
- When installing the chain tensioners or other sliding parts, lubricate their contact surfaces with new engine oil.
- Apply new engine oil to the bolt threads and seat surfaces when installing the camshaft sprockets and crankshaft pulley.
- Do not spill engine coolant on the drive belts.

## UPPER TIMING CHAIN

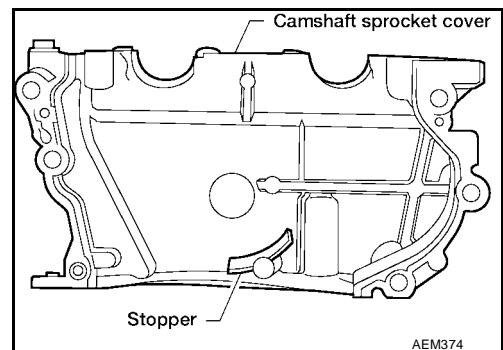
1. Remove the air cleaner assembly.
2. Remove the spark plug wires.
3. Set the No.1 piston at TDC on the compression stroke.



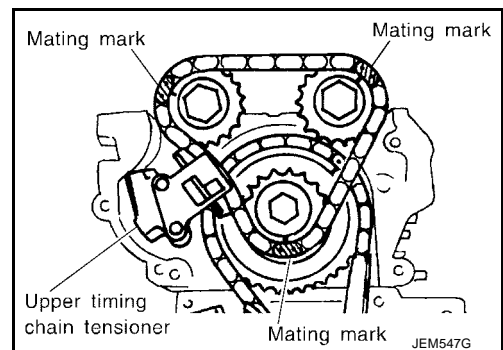
4. Remove the vacuum hoses, electrical harness connectors, and harness clamps.
5. Remove the power steering drive belt.
6. Remove the power steering pump and position it to one side. Remove the idler pulley and bracket.
7. Remove the rocker cover.
  - Loosen the rocker cover bolts in the numerical order as shown.



8. Remove the camshaft sprocket cover.



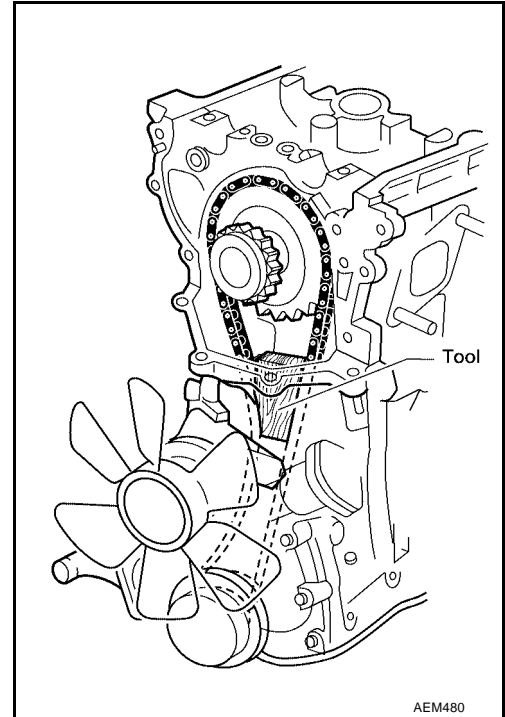
9. Clean the links of the timing chain that align to the mating marks on the sprockets. Put paint marks on the timing chain, matching them with the mating marks on the cam sprockets and idler sprocket.



10. Remove the cam sprocket bolts, cam sprockets and the upper timing chain.

## IDLER SPROCKET

1. Remove the upper timing chain.  
Refer to [EM-21, "UPPER TIMING CHAIN"](#).



2. Support the lower timing chain by using a suitable tool to prevent the chain tensioner spring from coming out.

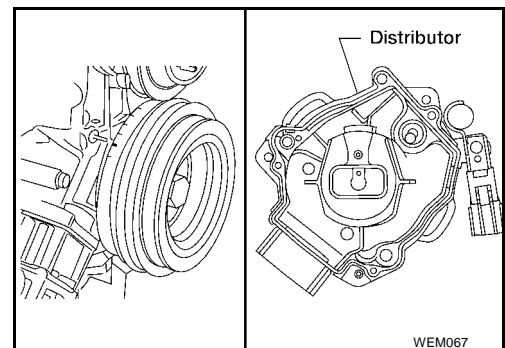
**NOTE:**

This step is only to be applied when the lower cover is not being removed.

3. Remove the idler sprocket.

## LOWER TIMING CHAIN

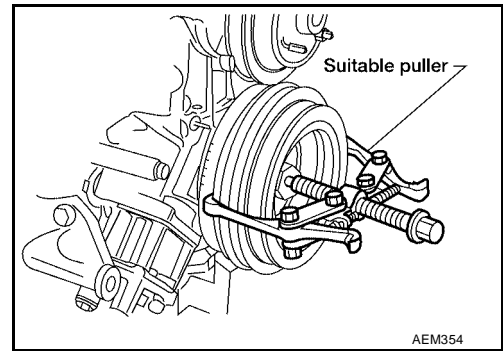
1. Drain the coolant by removing the cylinder block drain plug and opening the radiator drain cock. Refer to [MA-16, "DRAINING ENGINE COOLANT"](#).
2. Drain the engine oil. Refer to [MA-20, "Changing Engine Oil"](#).
3. Remove the intake air duct.
4. Remove the following parts:
  - Generator drive belt
  - A/C compressor drive belt
  - Cooling fan with coupling
  - Radiator shroud
5. Remove the A/C compressor from the mounting bracket without disconnecting the A/C hoses and position it to the side, secure it with wire.
6. Remove the idler pulley and bracket.
7. Set the No. 1 piston to TDC on the compression stroke.
8. Remove the distributor.



# TIMING CHAIN

[KA24DE]

9. Remove the crankshaft pulley with a suitable puller.

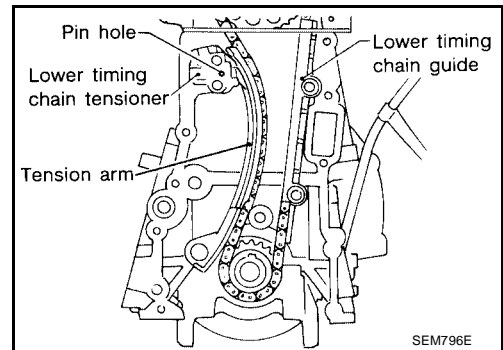


10. Remove the oil pan. Refer to [EM-16, "Removal"](#) .  
11. Remove the oil pump, distributor drive shaft, and the oil pickup strainer.  
12. Remove the engine front cover.

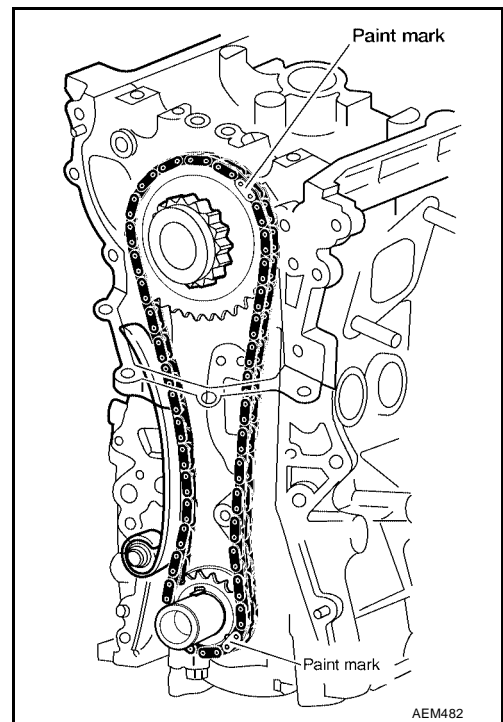
**CAUTION:**

**Be careful not to tear or damage the cylinder head gasket.**

13. Disengage the timing chain tensioner by pushing the piston in and inserting a suitable pin into the tensioner pin hole. Remove the following parts.
- Tension arm
  - Lower timing chain guide



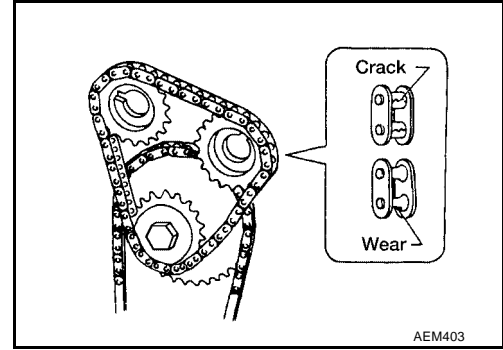
14. Remove the upper timing chain.  
Refer to [EM-21, "UPPER TIMING CHAIN"](#) .  
15. Clean the links of the timing chain that align to the mating marks on the sprockets. Align the paint marks applied on the timing chain to the mating marks on the crankshaft sprocket and idler sprocket.



16. Remove the lower timing chain and crankshaft sprocket and idler sprocket.

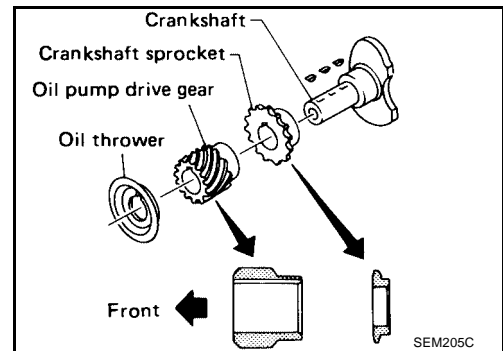
## Inspection

Check for cracks and excessive wear on the roller links. Replace the timing chain as necessary.



## Installation LOWER TIMING CHAIN

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

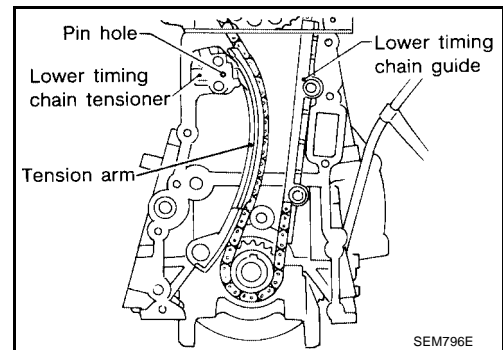


2. Install the idler sprocket and the lower timing chain by aligning the mating marks and the paint marks made during removal.

**CAUTION:**

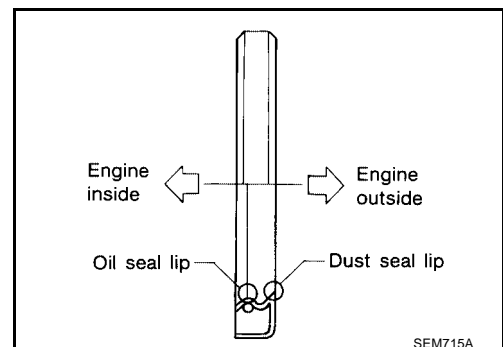
**Be careful not to tear or damage the cylinder head gasket.**

3. Install the chain guide and the chain tension arm.



4. Install the lower chain tensioner and remove the pin securing the piston into the tensioner body.
5. Install the front cover and oil seal.

- Using a scraper or other suitable tool, remove all traces of liquid gasket from the cylinder block and front cover mating surfaces.
- Install a new crankshaft seal in the front cover.
- Apply a continuous bead of liquid gasket to the front cover. Use Genuine RTV Silicone Sealant or equivalent. Refer to [EM-4, "Precautions for Liquid Gasket"](#) .

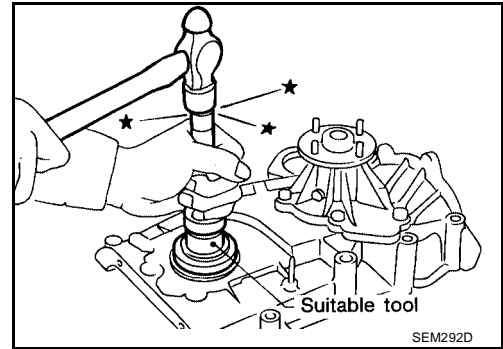




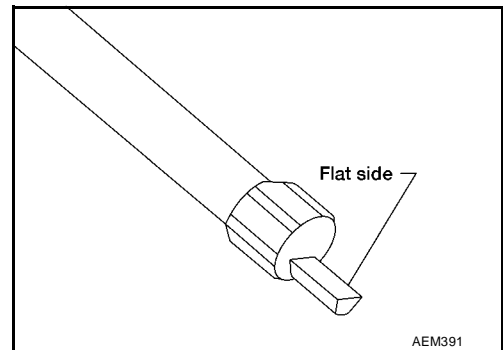
# TIMING CHAIN

[KA24DE]

- Install a new front oil seal using a suitable tool. Refer to [EM-27, "FRONT OIL SEAL"](#) .



- Apply Genuine Silicone RTV Sealant or equivalent, on the head gasket surface. Refer to [EM-4, "Precautions for Liquid Gasket"](#) .
  - Install the front engine cover.
6. Install the oil strainer and oil pan. Refer to [EM-17, "Installation"](#) .
  7. Install the oil pump and distributor drive shaft.
    - Make sure the flat side of the distributor drive shaft is facing the engine. so the distributor will be in correct timing.
  8. Install the crankshaft pulley. Refer to [EM-13, "OUTER COMPONENT PARTS"](#) .
  9. Install the A/C compressor and idler pulley bracket. Refer to [MTC-66, "Removal and Installation for Compressor"](#) .
  10. Install the radiator shroud and cooling fan with coupling. Refer to [CO-16, "Removal and Installation"](#) .
  11. Install the A/C compressor, alternator and power steering pump drive belts. Refer to [MA-15, "Checking Drive Belts"](#) .
  12. Install the intake air duct.

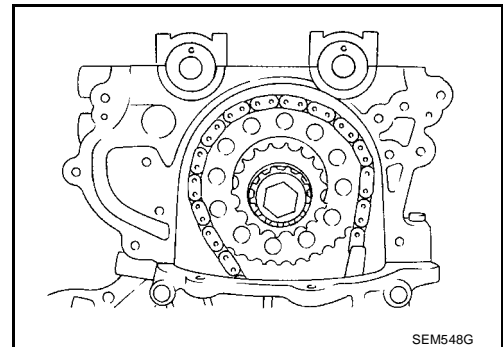


## IDLER SPROCKET

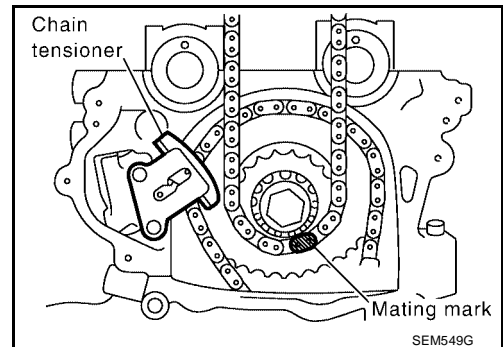
Install the lower timing chain. Refer to [EM-24, "LOWER TIMING CHAIN"](#) .

## UPPER TIMING CHAIN

1. Install the lower timing chain and idler sprocket. Refer to [EM-24, "LOWER TIMING CHAIN"](#) and [EM-25, "IDLER SPROCKET"](#) .



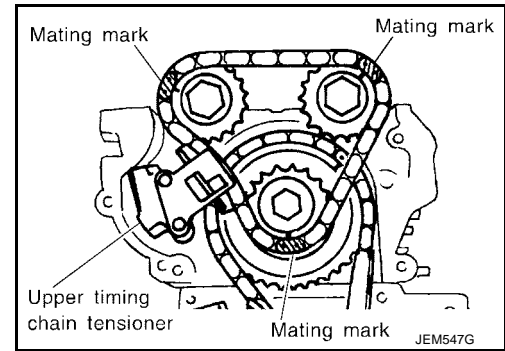
2. Install the upper timing chain and sprockets, aligning the chain on the sprockets with the painted marks made during removal.



# TIMING CHAIN

[KA24DE]

3. Install the chain tensioner and remove the pin holding the tensioner piston in the bore of the tensioner.
  - Check that the timing chain mating marks are aligned so that the timing chain is correctly installed.



4. Install the camshaft sprocket cover.

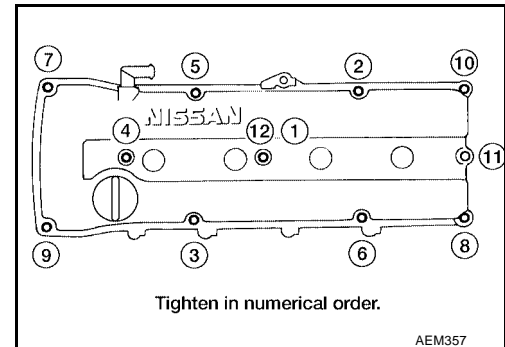
**CAUTION:**

**Do not tear or damage the cylinder head gasket.**

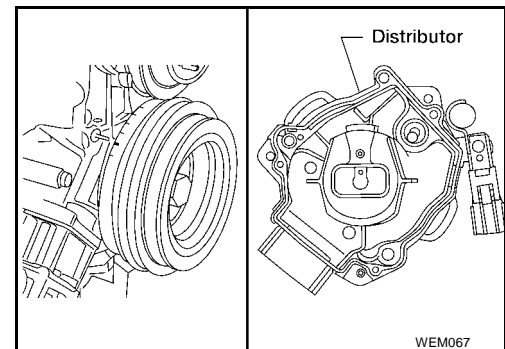
**Do not let the upper timing chain slip or jump on the sprockets when installing the camshaft sprocket cover.**

- Use a scraper to remove all traces of liquid gasket from the mating surfaces of the engine block and camshaft sprocket cover.
  - Apply liquid gasket on the head gasket surface.
  - Apply a continuous bead of liquid gasket to the cover. Use Genuine Silicone RTV Sealant or equivalent. Refer to [EM-4, "Precautions for Liquid Gasket"](#).
5. Install the rocker cover gasket on the rocker cover.
    - Apply a continuous bead of liquid gasket to the cylinder head camshaft sprocket cover. Use Genuine Silicone RTV Sealant or equivalent. Refer to [EM-4, "Precautions for Liquid Gasket"](#).
  6. Install the rocker cover. Tighten the bolts in the numerical order as shown.

**Rocker cover bolts : 8 - 11 N·m (0.8 - 1.1 kg·m, 69 - 95 in·lb)**



7. Install the distributor, align the distributor to the mark as shown.
8. Install the vacuum hoses, electrical harnesses, connectors, and harness clamps.



## OIL SEAL

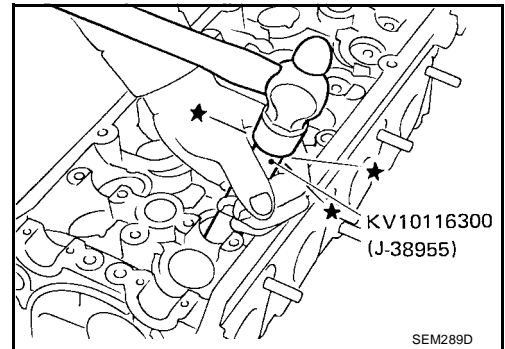
Replacement  
VALVE OIL SEAL

1. Remove the rocker cover.
2. Remove the camshaft. Refer to [EM-31, "Components"](#).
3. Remove the valve spring and valve oil seal using a suitable tool.

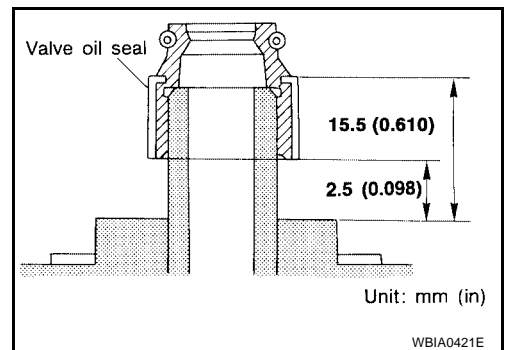
**NOTE:**

The piston must be at TDC on the compression stroke to prevent the valve from falling into the combustion chamber.

4. Apply clean engine oil to the new valve oil seal and install it using Tool.

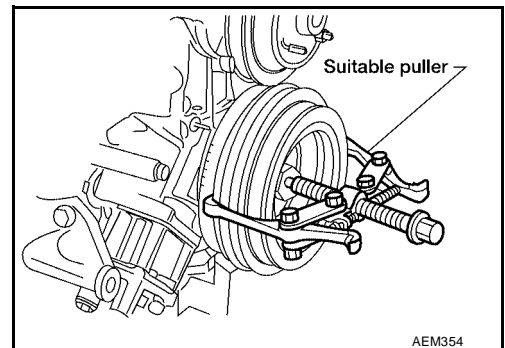


- The valve oil seal must be installed to specification over the valve stem opening as shown



## FRONT OIL SEAL

1. Remove the radiator shroud. Refer to [CO-14, "Components"](#).
2. Remove the crankshaft pulley with a suitable puller.



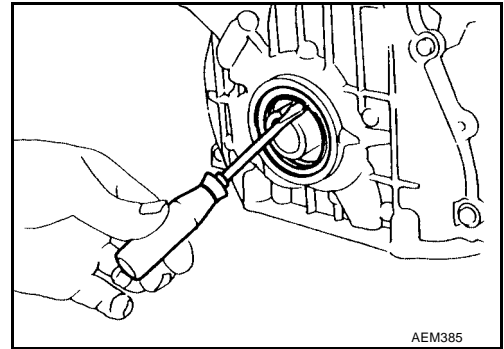
# OIL SEAL

[KA24DE]

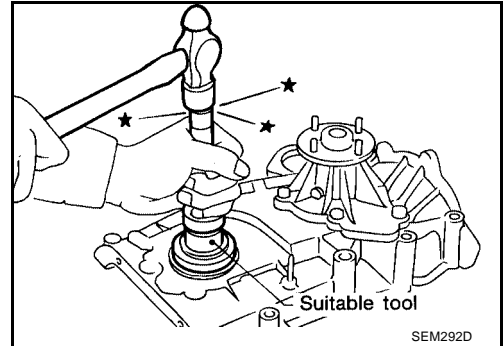
3. Remove the front oil seal using suitable tool.

**CAUTION:**

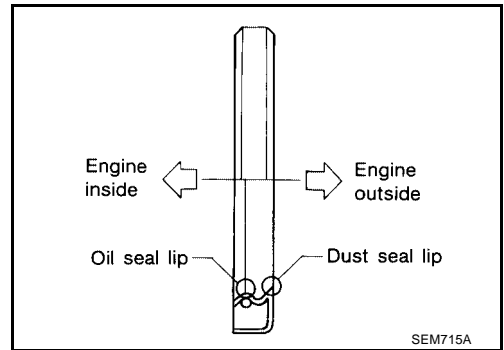
**Be careful not to scratch the front cover.**



4. Apply clean engine oil to the new oil seal and install it using a suitable tool.



- Install the new oil seal in the direction as shown.



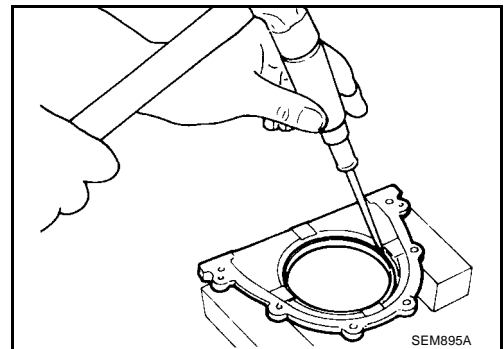
5. Install the crankshaft pulley. Refer to [EM-13, "OUTER COMPONENT PARTS"](#) .
6. Install the radiator shroud. Refer to [CO-14, "Components"](#) .

## REAR OIL SEAL

1. Remove the flywheel. Refer to [CL-12, "CLUTCH DISC, CLUTCH COVER AND FLYWHEEL"](#) .
2. Remove the rear oil seal retainer.
3. Remove the rear oil seal from the retainer.

**CAUTION:**

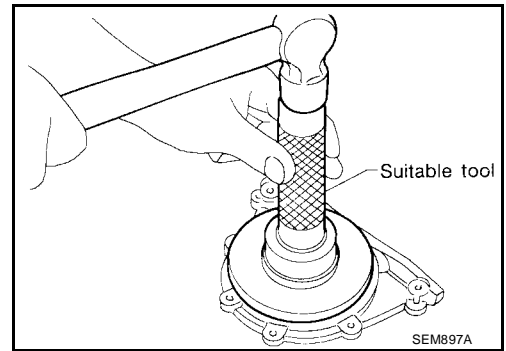
**Be careful not to scratch the rear oil seal retainer.**



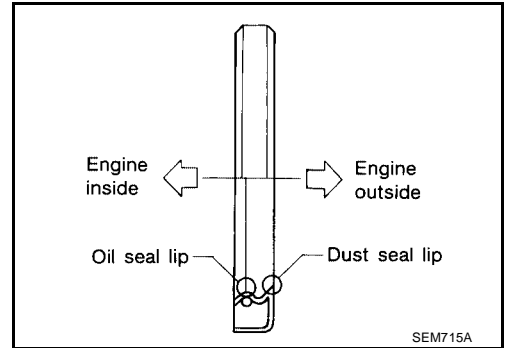
# OIL SEAL

[KA24DE]

4. Apply clean engine oil to the new oil seal and install it using a suitable tool.



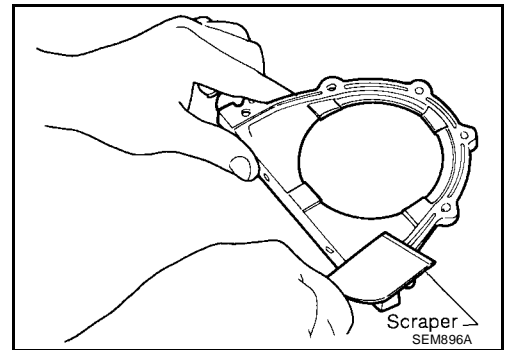
- Install the new oil seal in the direction as shown.



5. Install the rear oil seal retainer.

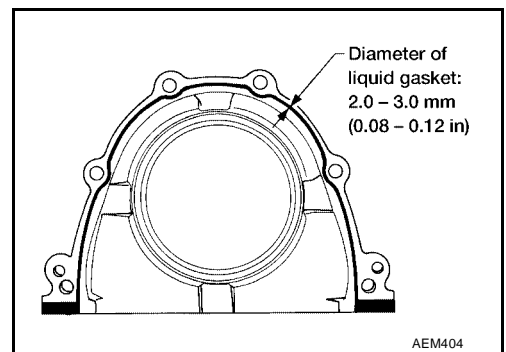
**Rear oil seal retainer bolts : 6.4 - 7.5 N·m (0.65 - 0.76 kg·m, 56 - 66 in·lb)**

- a. Before installing the rear oil seal retainer, remove all traces of the old liquid gasket from the mating surface using a scraper, as shown. Also remove all traces of the old liquid gasket from the mating surface of the cylinder block.



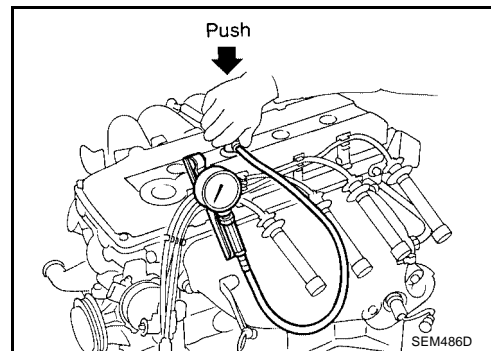
- b. Apply a continuous bead of liquid gasket to mating surface of rear oil seal retainer as shown. Use Genuine Silicone RTV Sealant or equivalent. Refer to [EM-4, "Precautions for Liquid Gasket"](#)

- Apply the liquid gasket around the inner side of the bolt holes as shown.



**CYLINDER HEAD****On-Vehicle Service****CHECKING COMPRESSION PRESSURE**

1. Warm up the engine.
2. Turn the ignition switch OFF.
3. Release the fuel pressure.  
Refer to [EC-45, "FUEL PRESSURE RELEASE"](#) .
4. Remove all of the spark plugs.
  - Clean the area around the spark plug with compressed air before removing the spark plug.
5. Disconnect the camshaft position sensor harness connector at the distributor.
6. Remove the fuel injector fuse **3** on FUSE BLOCK (J/B) behind the instrument lower panel driver's side.
7. Attach a compression tester to No. 1 cylinder.
8. Depress the accelerator pedal fully to keep the throttle valve wide open.
9. Crank the engine and record the highest gauge reading.



10. Repeat the measurement on each cylinder as described above.
  - Always use a fully-charged battery to obtain specified engine speed.

<b>Compression Measurement</b>	<b>: kPa (kg/cm<sup>2</sup> , psi) / 300 rpm</b>
<b>Standard</b>	<b>: 1,226 (12.5, 178)</b>
<b>Minimum</b>	<b>: 1,030 (10.5, 149)</b>
<b>Difference limit between cylinders</b>	<b>: 98 (1.0, 14)</b>

11. If the compression in one or more cylinders is low:
  - a. Pour a small amount of engine oil into cylinders through spark plug holes.
  - b. Retest the compression.
    - If adding oil improves cylinder compression, piston rings may be worn or damaged. If so, replace piston rings after checking piston.
    - If pressure stays low, a valve may be sticking or seating improperly. Inspect and repair valve and valve seat. Refer to [EM-61, "VALVE"](#) and [EM-64, "VALVE SEAT"](#) . If valve or valve seat is damaged excessively, replace it.
    - If compression in any two cylinders adjacent cylinders is low, and if adding oil does not improve compression, there is leakage past the gasket surface. If so, replace cylinder head gasket.
12. Reinstall the spark plugs, fuel injector fuse, fuel pump fuse, and reconnect the camshaft position sensor harness connector at the distributor.
13. Erase the DTC stored in the ECM.  
Refer to [EC-60, "HOW TO ERASE EMISSION-RELATED DIAGNOSTIC INFORMATION"](#) (KA24DE), [EC-626, "HOW TO ERASE EMISSION-RELATED DIAGNOSTIC INFORMATION"](#) (VG33E), [EC-1228, "HOW TO ERASE EMISSION-RELATED DIAGNOSTIC INFORMATION"](#) (VG33ER).

**CAUTION:**

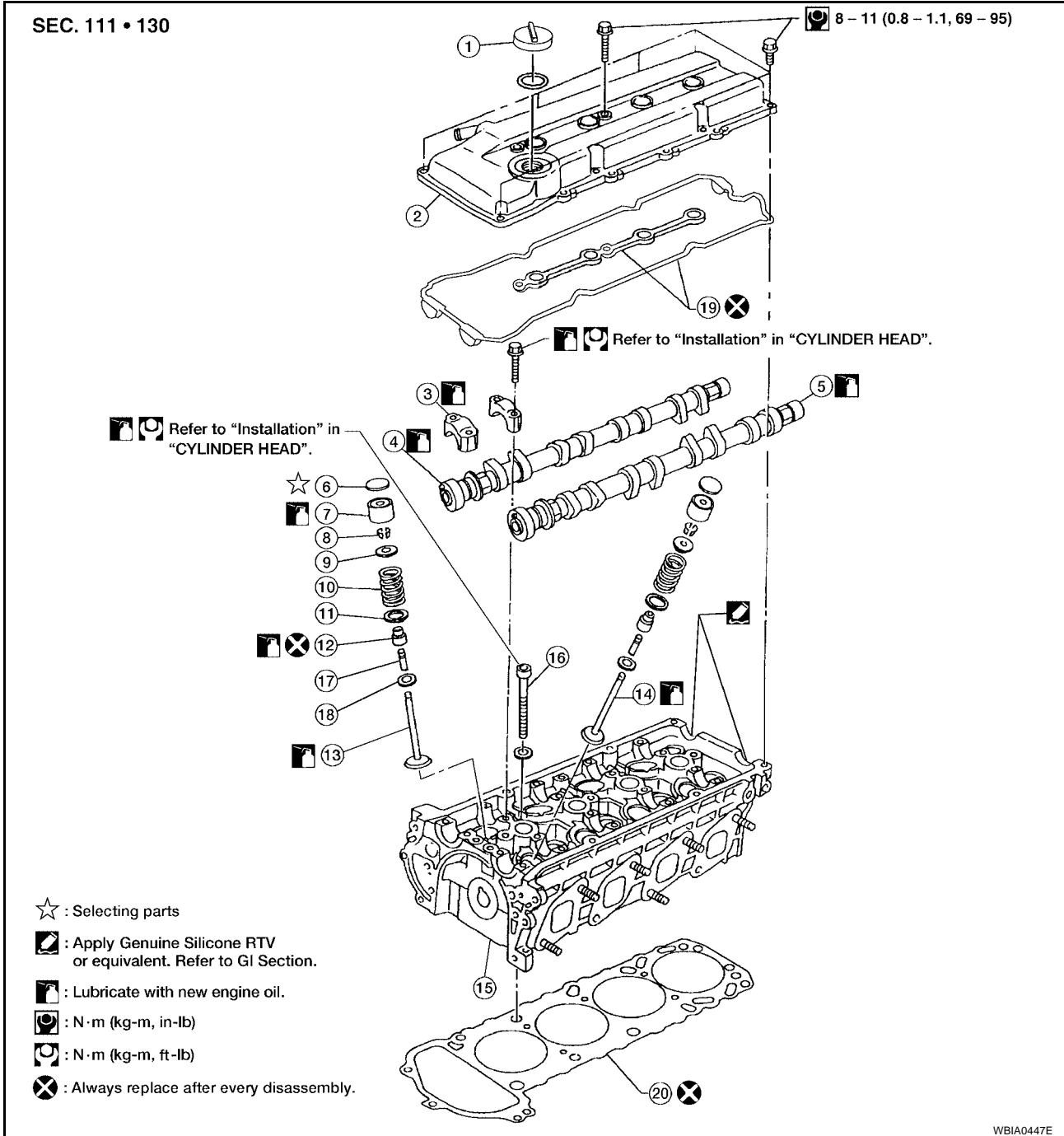
**Always erase the DTC after checking compression.**

# CYLINDER HEAD

[KA24DE]

EBS00C9Y

## Components



A  
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- |                         |                          |                     |
|-------------------------|--------------------------|---------------------|
| 1. Oil filler cap       | 2. Rocker cover          | 3. Camshaft bracket |
| 4. Intake camshaft      | 5. Exhaust camshaft      | 6. Adjusting shim   |
| 7. Valve lifter         | 8. Valve cotter          | 9. Spring retainer  |
| 10. Valve spring        | 11. Spring seat          | 12. Valve oil seal  |
| 13. Intake valve        | 14. Exhaust valve        | 15. Cylinder head   |
| 16. Cylinder head bolt  | 17. Valve guide          | 18. Valve seat      |
| 19. Rocker cover gasket | 20. Cylinder head gasket |                     |

## Removal

EBS00C9Z

### CAUTION:

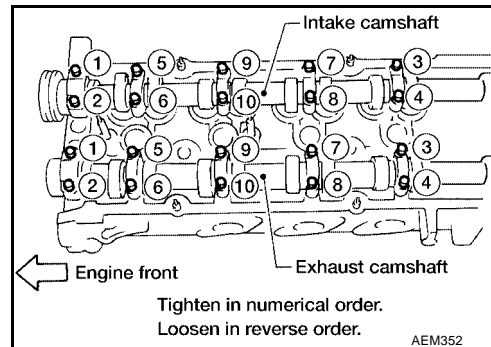
- When installing the camshafts, chain tensioners, oil seals, or other moving parts, lubricate the contact surfaces with new engine oil.

# CYLINDER HEAD

[KA24DE]

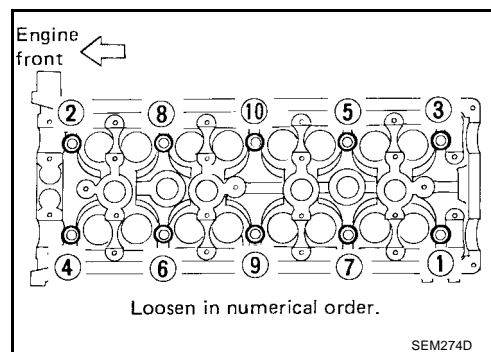
- Apply new engine oil to the threads and seat surfaces when installing the cylinder head, camshaft sprocket, crankshaft pulley, and camshaft bracket.
- Label the valve lifters when they are removed so they are installed in their original positions.
- Before removing the camshaft and idler sprockets, apply paint marks to the chain to align to the mating marks for correct timing after installation.

1. Remove the upper timing chain and idler sprocket.
  - Refer to [EM-21, "UPPER TIMING CHAIN"](#) and [EM-22, "IDLER SPROCKET"](#) .
2. Remove the camshaft brackets and camshafts.
  - Label the parts when they are removed so they are installed in their original position.



3. Remove the cylinder head bolts in numerical order as shown.
  - Loosen the cylinder head bolts in two or three steps.

**CAUTION:**  
Remove the bolts in the correct numerical order to avoid warping or cracking the cylinder head.



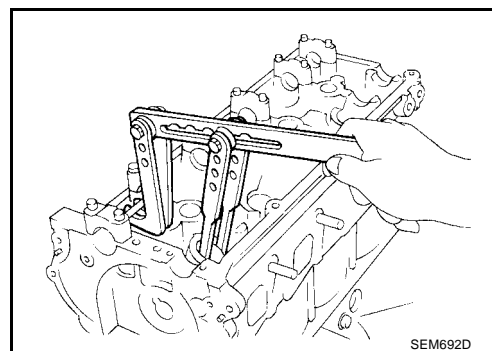
4. Remove the cylinder head and cylinder head gasket.

## Disassembly

EBS00CA1

1. Remove the intake manifold and exhaust manifold. Refer to [EM-13, "Removal and Installation"](#) .
2. Remove the valve components using Tool as shown.

**Valve spring compressor : KV101092S0 (J26336-B)**



3. Remove the valve oil seal using suitable tool.

## Inspection

EBS00CA2

### CYLINDER HEAD DISTORTION

1. Clean surface of cylinder head.



# CYLINDER HEAD

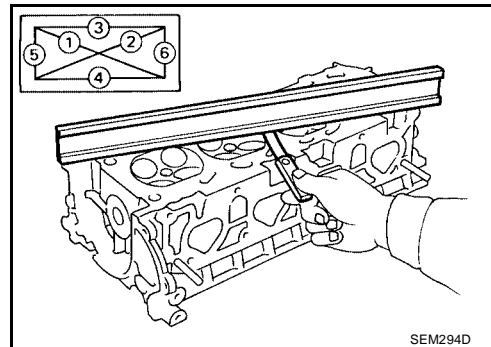
[KA24DE]

2. Use a reliable straightedge and feeler gauge to check the flatness of cylinder head surface. Check along six positions as shown.

## Head surface flatness

**Limit : 0.1 mm (0.004 in)**

If it exceeds the limit, replace or resurface the cylinder head.



3. Resurface the cylinder head as necessary to specification.  
**The limit of cylinder head resurfacing is determined by the cylinder block resurfacing:**  
**Amount of cylinder head resurfacing is "A".**  
**Amount of cylinder block resurfacing is "B".**

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

4. After resurfacing, the cylinder head must meet or exceed the nominal height specification.
  - Check that the camshaft rotates freely by hand. If resistance is felt, the cylinder head must be replaced.

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

## CAMSHAFT VISUAL CHECK

Check camshaft for scratches, seizure and wear.

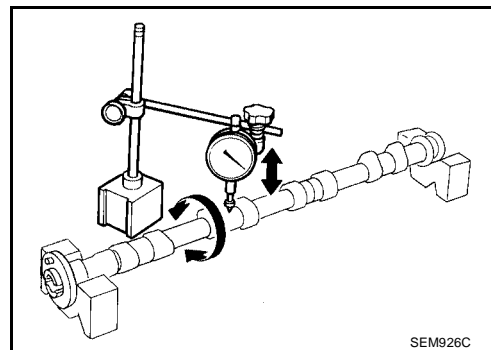
## CAMSHAFT RUNOUT

1. Measure the camshaft runout at the center of the journal.

**Runout (Total indicator reading)**

**Standard : less than 0.02 mm (0.0008 in)**

**Limit : 0.04 mm (0.0016 in)**



2. If the camshaft runout exceeds the limit, replace the camshaft.

## CAMSHAFT CAM HEIGHT

1. Measure the camshaft cam height as shown.

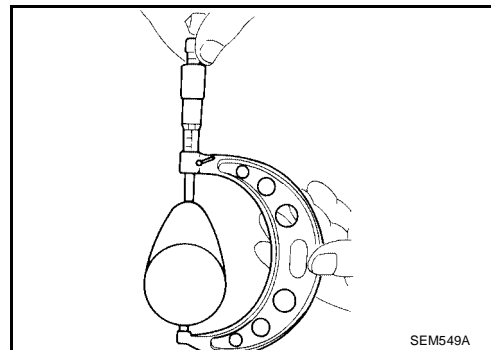
**Standard cam height**

**Intake : 41.755 - 41.945 mm (1.644 - 1.651 in)**

**Exhaust : 41.815 - 42.005 mm (1.646 - 1.654 in)**

**Cam height wear limit**

**Intake & Exhaust : 0.2 mm (0.008 in)**



2. If the cam wear exceeds the limit, replace the camshaft.

## CAMSHAFT JOURNAL CLEARANCE

1. Install the camshaft brackets, tighten the bolts to specification.

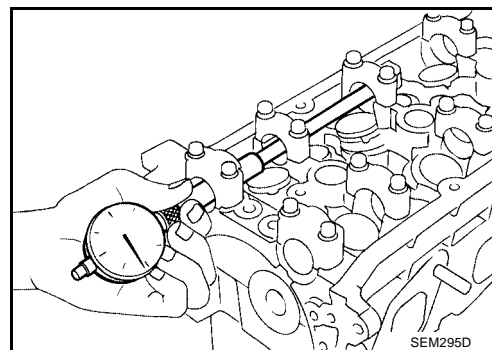
# CYLINDER HEAD

[KA24DE]

2. Measure the inner diameter of the camshaft bearing.

**Standard inner diameter**

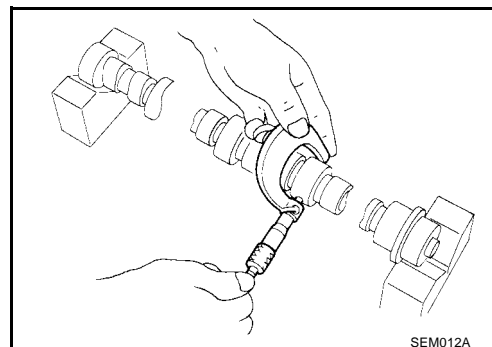
**No. 1 - No. 5 journals : 28.000 - 28.025 mm  
(1.1024 - 1.1033 in)**



3. Measure the outer diameter of the camshaft journal.

**Standard outer diameter**

**No. 1 to No. 5 journals : 27.935 - 27.955 mm  
(1.0998 - 1.1006 in)**



4. If the camshaft journal clearance exceeds the limit, replace the camshaft and/or cylinder head.

**Camshaft journal clearance**

**Standard : 0.045 - 0.090 mm (0.0018 - 0.0035 in)**

**Limit : 0.12 mm (0.0047 in)**

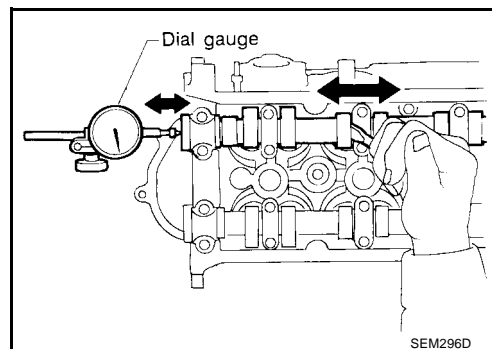
## CAMSHAFT END PLAY

1. Install the camshaft in the cylinder head.
2. Measure the camshaft end play.

**Camshaft end play**

**Standard : 0.070 - 0.148 mm (0.0028 - 0.0058 in)**

**Limit : 0.2 mm (0.008 in)**



3. If the end play exceeds the limit, replace the camshaft and remeasure the camshaft end play.
4. If the end play still exceeds the limit after replacing the camshaft, then replace the cylinder head.

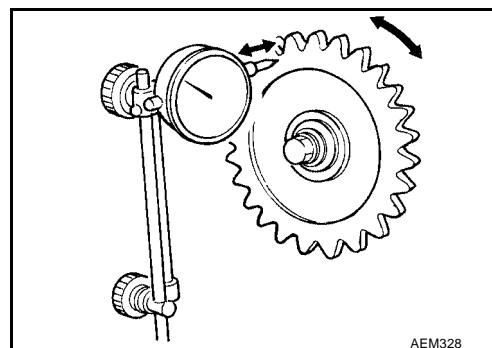
## CAMSHAFT SPROCKET RUNOUT

1. Install the sprocket on the camshaft.
2. Measure the camshaft sprocket runout.

**Runout (total indicator reading)**

**Limit : 0.15 mm (0.0059 in)**

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



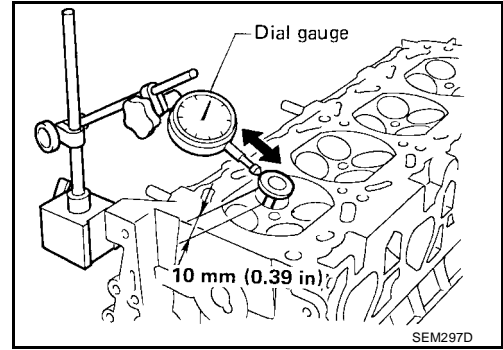
## VALVE GUIDE CLEARANCE

1. Measure the valve deflection as shown.

**NOTE:**

The valve and valve guide receive the most wear in the direction as shown.

**Valve deflection limit (maximum dial gauge reading)**  
**Intake & Exhaust : 0.2 mm (0.008 in)**



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

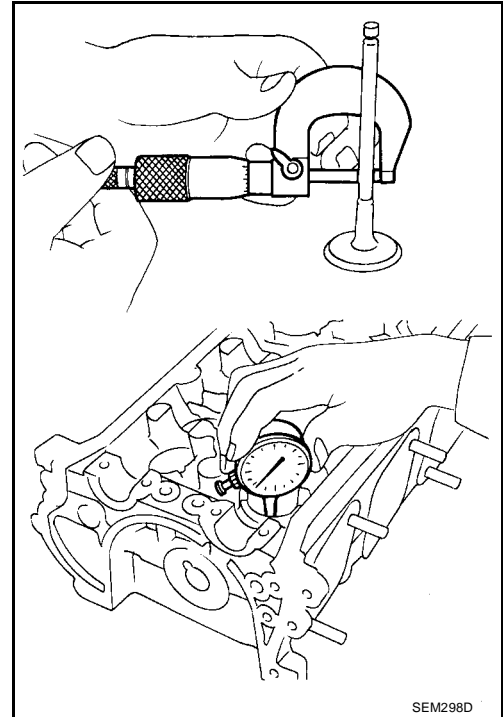
- a. Measure the valve stem diameter and the valve guide inner diameter.
- b. Check that the valve to valve guide clearance is within specification.

**Valve to valve guide clearance = valve guide inner diameter - valve stem diameter.**

Unit: mm (in)

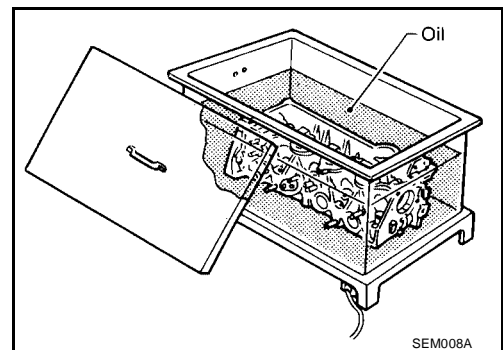
Valve	Standard	Limit
Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.08 (0.0031)
Exhaust	0.040 - 0.073 (0.0016 - 0.0029)	0.1 (0.004)

- c. If the clearance exceeds the limit, replace the valve and remeasure the clearance.
- d. If the clearance still exceeds the limit after replacing the valve, replace the valve guide.



## VALVE GUIDE REPLACEMENT

1. Heat the valve guide by heating the cylinder head to 120° - 140°C (248° - 284°F) by soaking it in heated oil.

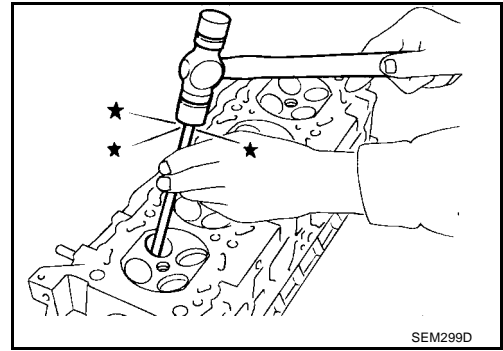


A  
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# CYLINDER HEAD

[KA24DE]

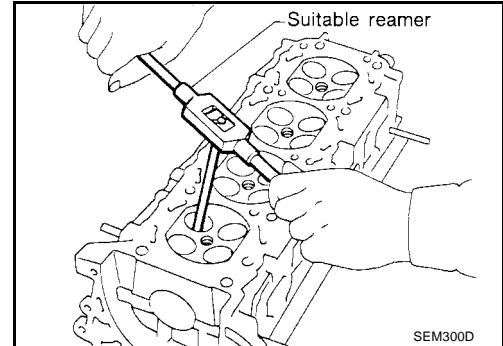
2. To remove the valve guide, use a press [less than 20 kN (2 metric ton, 2.2 U.S. ton, 2.0 Imp. ton) pressure] or hammer and suitable tool, to slide the valve guide out of the cylinder head.



3. Ream the cylinder head valve guide hole.

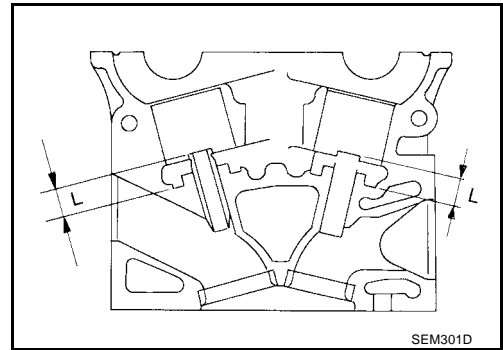
**Valve guide hole diameter (for replacement parts)**

**Intake & Exhaust : 11.175 - 11.196 mm  
(0.4400 - 0.4408 in)**



4. Heat the cylinder head to 120° to 140°C (248° to 284°F) in heated oil and press the replacement valve guide into the valve guide hole in the cylinder head. Press the valve guide in to the specified height "L" as shown.

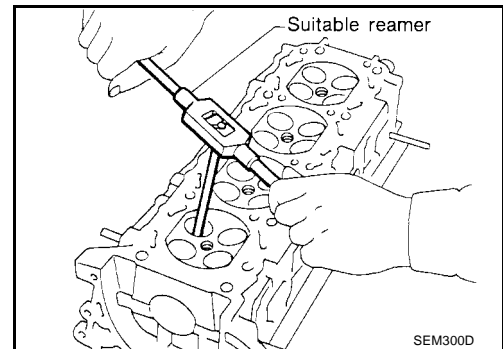
**Projection "L" : 13.3 - 13.9 mm (0.524 - 0.547 in)**



5. Ream the new replacement valve guide.

**Finished size**

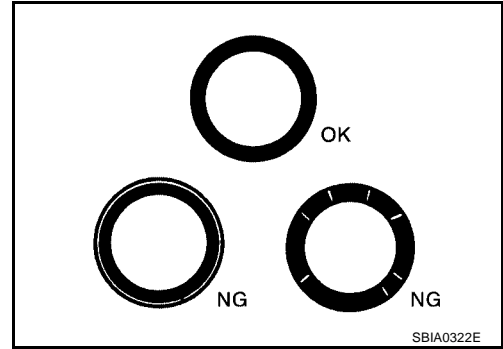
**Intake & Exhaust : 7.000 - 7.018 mm (0.2756 - 0.2763 in)**



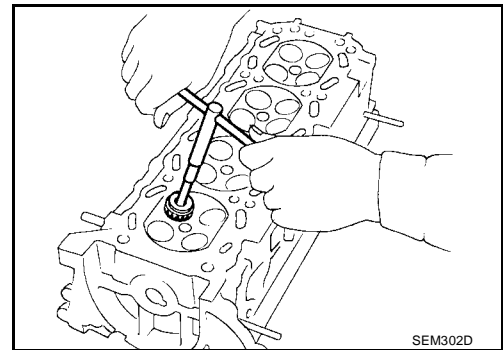
## VALVE SEAT INSPECTION

Check the valve seats for pitting at the contact surface. Resurface or replace as necessary.

- Before repairing the valve seats, check the valves and valve guides for wear as shown. If they are worn, replace them. Then resurface the valve seat as necessary.

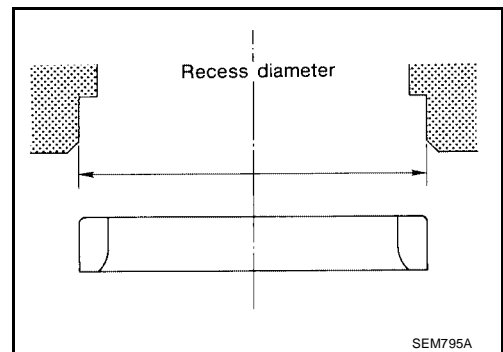


- Use both hands to resurface the valve seat uniformly using a suitable tool.



## REPLACING VALVE SEAT

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



2. Ream the cylinder head valve seat recess diameter.

**Reaming bore for replacement valve seat recess diameter**

**Oversize : 0.5 mm (0.020 in)**

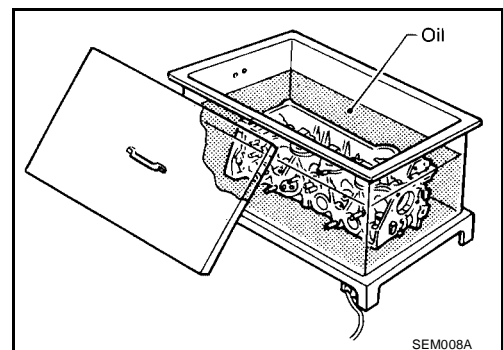
**Intake : 38.000 - 38.016 mm (1.4961 - 1.4967 in)**

**Exhaust : 32.700 - 32.716 mm (1.2874 - 1.2880 in)**

**CAUTION:**

**Use the valve guide center as a reference point for reaming so the valve and valve seat will have the correct fit.**

3. Heat the cylinder head to 120° to 140°C (248° to 284°F) in heated oil.



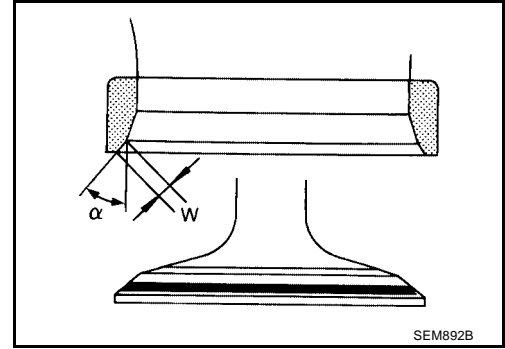
- Press fit the valve seat until it seats on the bottom of the recess.
- Cut or grind the valve seat using a suitable tool to the specified dimensions.

**Seat face angle " $\alpha$ "** : 45°15' - 45°45' degrees.

**Contacting width "W"**

**Intake** : 1.48 - 1.63 mm (0.0583 - 0.0642 in)

**Exhaust** : 1.8 - 2.0 mm (0.071 - 0.079 in)



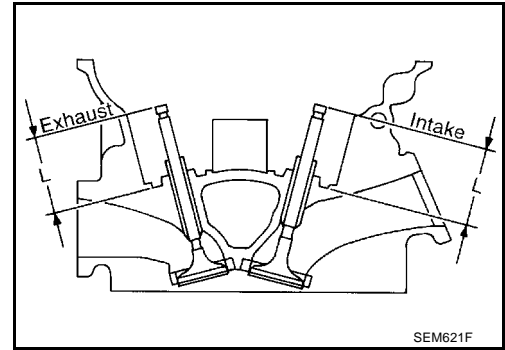
SEM892B

- After cutting, lap valve seat with abrasive compound.
- Check the valve seat specifications. Refer to [EM-61, "Valve"](#).
- 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 through 7 above, to adjust it. If it is longer, replace the valve seat with a new one.

**Valve seat resurface limit - height "L"**

**Intake** : 42.02 - 42.52 mm (1.6543 - 1.6740 in)

**Exhaust** : 42.03 - 42.53 mm (1.6547 - 1.6744 in)



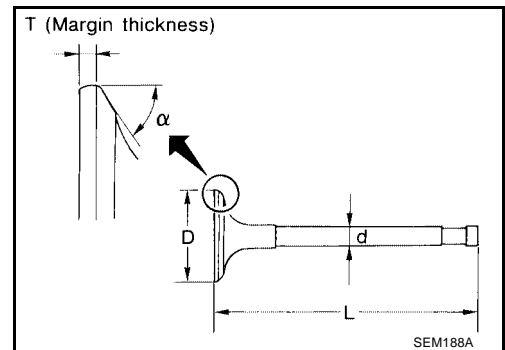
SEM621F

## VALVE DIMENSIONS

Check the dimensions of each valve. Refer to [EM-61, "Valve"](#). When valve head has been worn down to less than the specified margin thickness, replace the valve. The valve stem may be ground down to specification within the specified allowance.

**Margin thickness "T"** : 0.5 mm (0.020 in)

**Valve stem grinding allowance** : 0.2 mm (0.008 in) or less

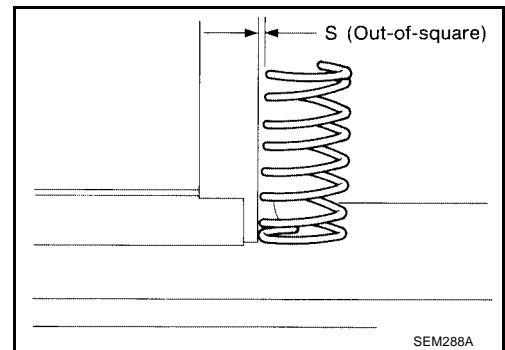


SEM188A

## VALVE SPRING

### Squareness

- Measure the valve spring dimension "S".
- Out-of-square "S"** : less than 2.2 mm (0.087 in)
- If the "S" measurement exceeds the limit, replace the valve spring.



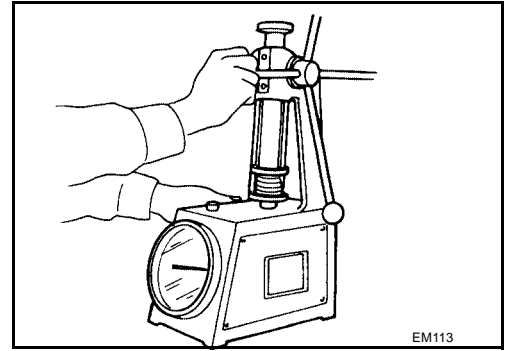
SEM288A

## Pressure

Check the valve spring pressure at the specified spring height.

- Pressure** : N (kg, lb) at height mm (in)
- Standard** : 418.0 (42.6, 93.9) at 29.17 (1.1484)
- Limit** : 393.0 (40.1, 88.4) at 29.17 (1.1484)

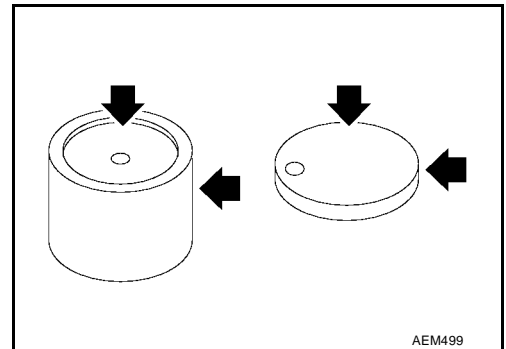
If not within specification, replace the spring.



EM113

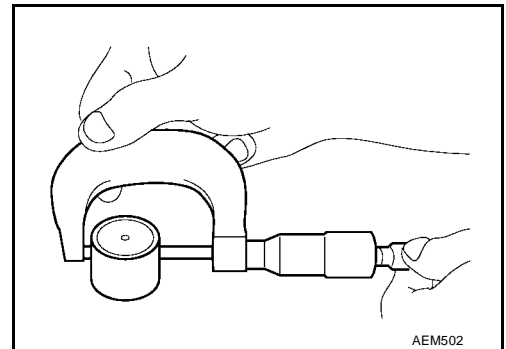
## VALVE LIFTER AND ADJUSTING SHIM

1. Visually check the contact and sliding surfaces of the valve lifter and adjusting shim for any wear or scratches.



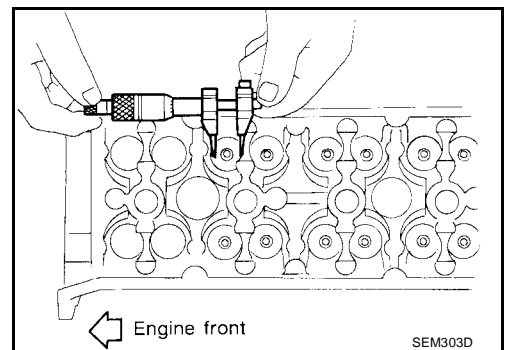
AEM499

2. Check the diameter of the valve lifter and valve lifter guide bore.



AEM502

3. Check the diameter of the valve guide bore as shown.



SEM303D

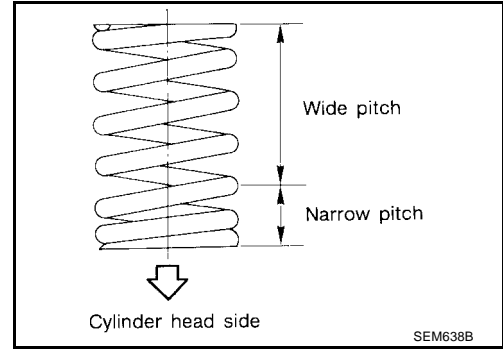
4. If the components exceed the standard diameter or clearance, replace the valve lifter or cylinder head as necessary.

- Valve lifter outer diameter** : 33.960 - 33.975 mm (1.3370 - 1.3376 in)
- Lifter guide bore diameter** : 34.000 - 34.021 mm (1.3386 - 1.3394 in)
- Valve lifter to valve lifter guide clearance** : 0.025 - 0.061 mm (0.0010 - 0.0024 in)

EBS00CA3

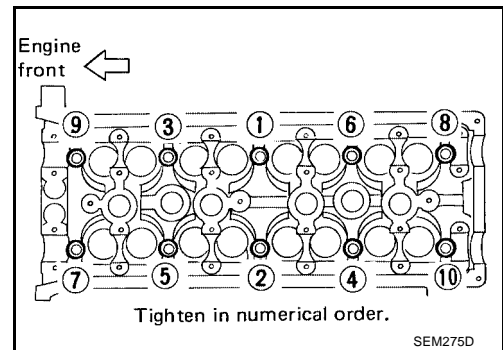
## Assembly

- Install the valve component parts.
  - Always use a new valve oil seal for assembly. Refer to [EM-27, "VALVE OIL SEAL"](#).
  - Before installing the valve oil seal, install the valve spring seat.
  - Install the valve spring (uneven pitch type) with its narrow pitch side toward the cylinder head side.
- After installing the valve component parts, tap valve stem tip with a plastic hammer to check that the components are properly assembled.



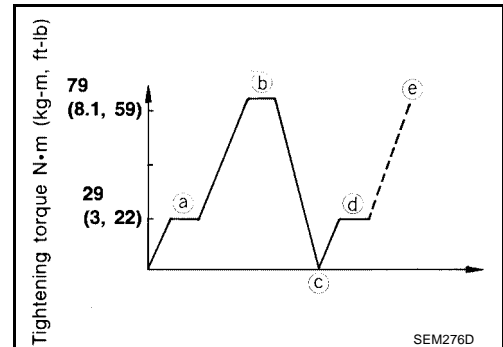
## Installation

- Tighten the cylinder head bolts in numerical order using five steps as shown.



### Cylinder head bolts tightening sequence

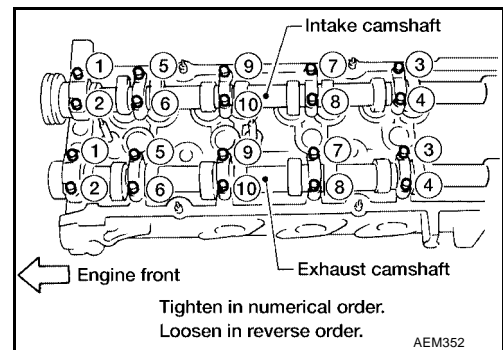
- Step "a"** : 29 N·m (3.0 kg·m, 22 ft·lb).
- Step "b"** : 79 N·m (8.1 kg·m, 59 ft·lb).
- Step "c"** : loosen all bolts completely
- Step "d"** : 25 - 34 N·m (2.5 - 3.5 kg·m, 18 - 25 ft·lb).
- Step "e"** : 86° - 91° degrees clockwise (if angle wrench is not available, mark all cylinder head bolts on the side facing engine front, then turn each cylinder head bolt 86° - 91° degrees clockwise)



- Set the camshafts and camshaft brackets.
  - Set the dowel pins of both the intake and exhaust camshafts at the 12 o'clock position when installing the camshafts.
- Tighten the camshaft bracket bolts in the order shown using two steps.
  - Apply new engine oil to the bolt threads and seat surfaces.

### Camshaft bracket bolts tightening sequence

- Step 1** : 2 N·m (0.2 kg·m, 17 in·lb).
- Step 2** : 9.0 - 11.8 N·m (0.92 - 1.2 kg·m, 79.9 - 104.2 in·lb).



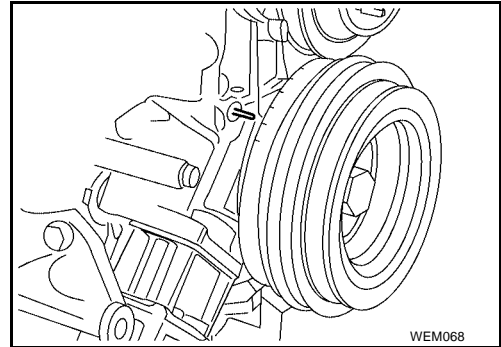
- Install upper timing chain and idler sprocket. Refer to [EM-25, "UPPER TIMING CHAIN"](#), and [EM-25, "IDLER SPROCKET"](#).



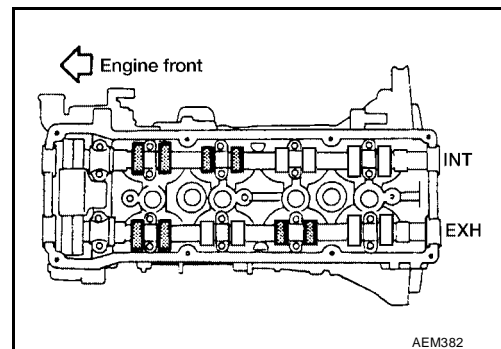
## Valve Clearance CHECKING

Check the valve clearance while the engine is warm but not running.

1. Remove the rocker cover and all of the spark plugs.
2. Set the No. 1 cylinder at TDC on the compression stroke.
  - Align the pointer with the TDC mark on the crankshaft pulley.
  - Check that the valve lifters on the No. 1 cylinder are loose and the valve lifters on No. 4 cylinder are tight. If not, turn the crankshaft one revolution (360° degrees) and align as above.



3. Check only those valves as shown.

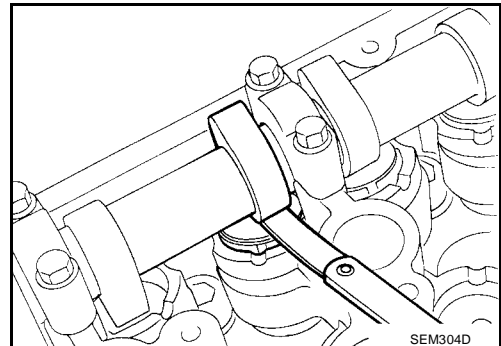


4. Use a feeler gauge to measure the clearance between the valve lifter and camshaft.
  - Record any valve clearance measurements which are out of specification. They will be used later to determine the required replacement adjusting shim.

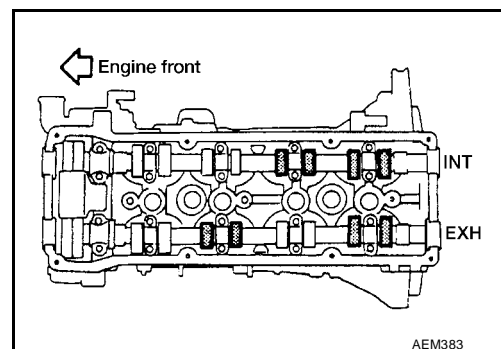
### Valve clearance (hot)

**Intake : 0.31 - 0.39 mm (0.012 - 0.015 in)**

**Exhaust : 0.39 - 0.47 mm (0.015 - 0.019 in)**



5. Turn the crankshaft one revolution (360°) and align the mark on the crankshaft pulley with the pointer.
6. Check those valves as shown.
  - Use the same procedure as described in step 4.



7. If all of the valve clearances are within specification, install the following parts:
  - Rocker cover
  - All spark plugs

## ADJUSTING

**CAUTION:**

Adjust the valve clearance when the engine is cold.

1. Turn the crankshaft to position the cam lobe upward on the camshaft of the valve that must be adjusted.
2. Place Tool (A) around the camshaft as shown.

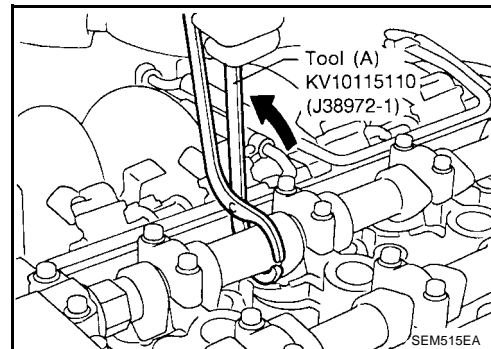
**CAUTION:**

Before placing Tool (A), rotate the notch toward the center of the cylinder head as shown, to remove the shim.

3. Rotate Tool (A) so that the lifter is pushed down.

**CAUTION:**

Be careful not to damage cam surface with Tool (A).



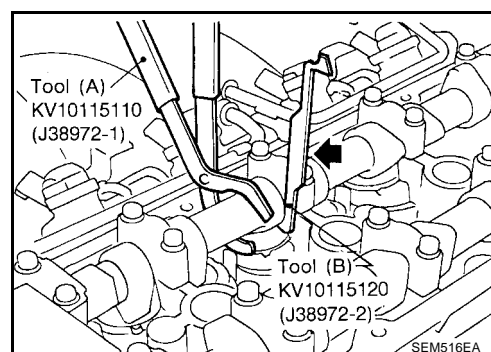
4. Place Tool (B) between the camshaft and the edge of the valve lifter to retain the valve lifter.

**CAUTION:**

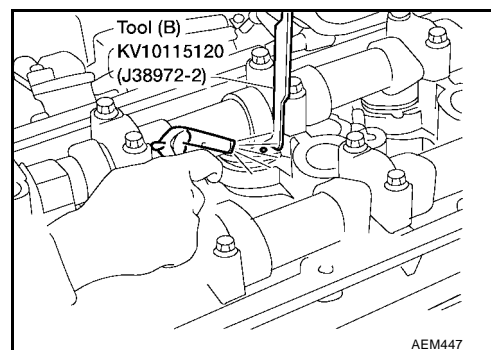
- Tool (B) must be placed as close to the camshaft bracket as possible.

- Be careful not to damage the cam surface with Tool (B).

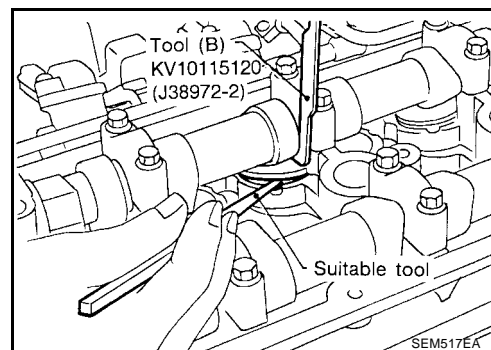
5. Remove Tool (A).



6. Rotate the adjusting shim until a hole is visible. Blow air into the hole to separate the adjusting shim from the valve lifter.



7. Remove the adjusting shim using a small screwdriver and a magnetic finger or suitable tool.

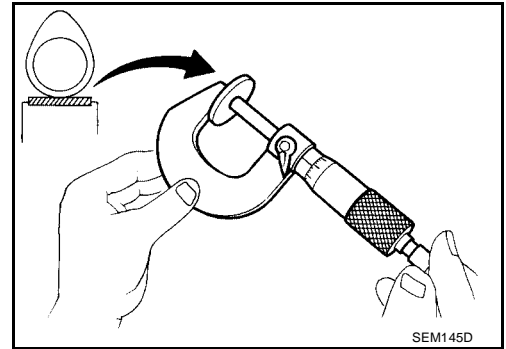


8. Calculate the replacement adjusting shim size.

# CYLINDER HEAD

[KA24DE]

- a. Use a micrometer to determine the thickness of the removed shim.



- b. Calculate the thickness of the new adjusting shim so that the valve clearance comes within the specified values.

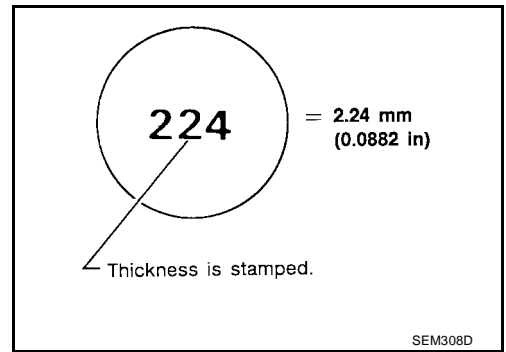
N = Thickness of new shim  
 R = Thickness of removed shim  
 M = Measured valve clearance

**Intake and exhaust shim calculation** :  $N = R + [M - 0.37 \text{ mm (0.0146 in)}]$

- c. Select a new shim with the thickness as close as possible to the calculated value. Refer to [EM-63, "AVAILABLE SHIMS"](#).

**NOTE:**

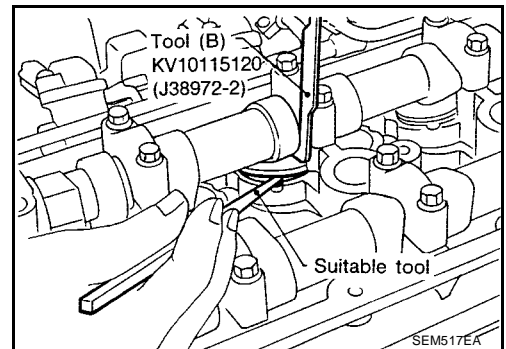
Shims are available in thicknesses from 1.96 mm (0.0772 in) to 2.68 mm (0.1055 in). The sizes increase in steps of 0.02 mm (0.0008 in) The size is stamped on the bottom of the adjusting shim as shown.



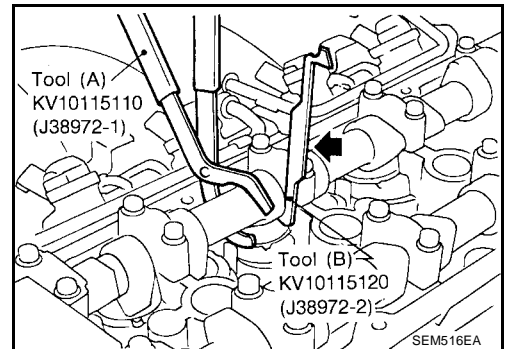
9. Install a new shim using a suitable tool.

**CAUTION:**

**Install the shim so the surface with the size stamped on it is facing down.**



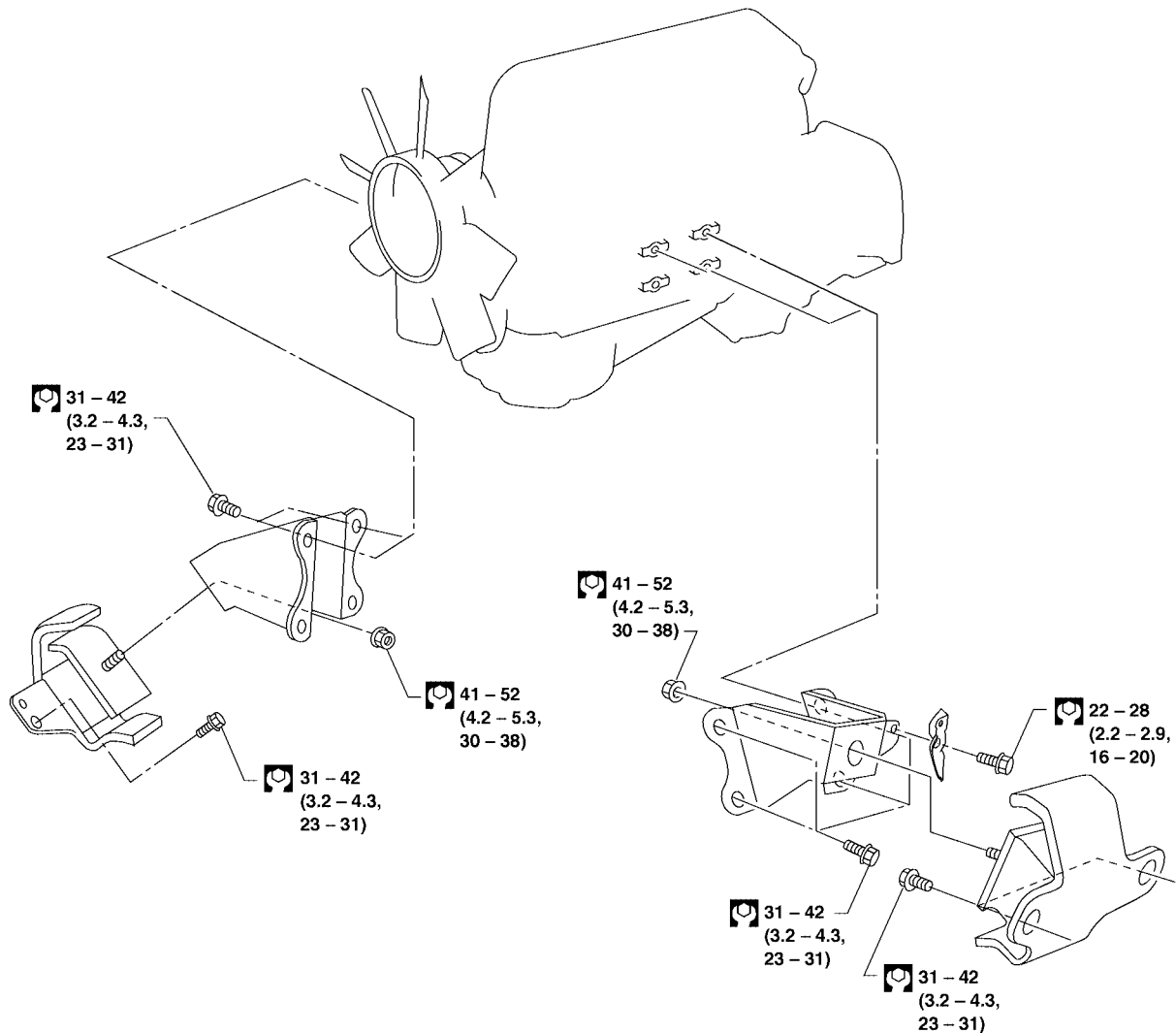
10. Install Tool (A) as described in steps 2 through 4.  
 11. Remove Tool (B).  
 12. Remove Tool (A).  
 13. Recheck the valve clearance. Refer to [EM-41, "Valve Clearance"](#).




## ENGINE ASSEMBLY

## Removal and Installation

SEC. 112



 : N·m (kg·m, ft·lb)

WEM055

**WARNING:**

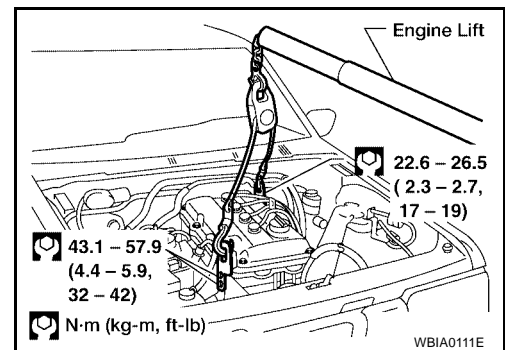
- Position the vehicle on a flat and solid surface.
- Place chocks at the front and back of the rear wheels.
- Do not remove the engine until the exhaust system has completely cooled off. Otherwise, you may burn yourself and/or a fire may break out in a fuel line.
- Before disconnecting the fuel hoses, you must release the fuel system pressure. Refer to [EC-45, "FUEL PRESSURE RELEASE"](#).
- Be sure to hoist the engine and transmission in a safe manner.
- For engines not equipped with engine slingers, attach the proper slingers and bolts described in the NISSAN Parts Catalog.

**CAUTION:**

- When lifting the engine, be sure to clear the surrounding components in the engine compartment. Take special care near the accelerator wire casing, brake lines and the brake master cylinder.
- When lifting the engine, always use the engine slingers in a safe manner.
- Before separating the engine and transmission, remove the crankshaft position sensor (OBD).
- Always take extra care not to damage the edge of crankshaft position sensor (OBD) or the ring gear teeth.

**REMOVAL**

1. Drain the coolant from the engine and radiator. Refer to [MA-16, "DRAINING ENGINE COOLANT"](#) .
2. Release the fuel pressure. Refer to [EC-45, "FUEL PRESSURE RELEASE"](#) .
3. Remove the negative battery cable.
4. Remove the hood. Refer to [EI-12, "BODY FRONT END"](#) .
5. Remove the air cleaner.
6. Remove the power steering drive belt, generator drive belt and A/C compressor drive belt.
7. Remove the radiator. Refer to [CO-14, "Removal and Installation"](#) .
8. Remove the exhaust manifold heat shield.
9. Disconnect the exhaust system at the rear of the TWC (manifold).
10. Remove the A/C compressor from the bracket. Refer to [MTC-66, "Removal and Installation for Compressor"](#) .
11. Disconnect the accelerator wire, vacuum hoses, electrical connectors, heater hoses and vacuum booster hose.
12. Remove the four power steering pump bolts.
13. Remove the transmission. Refer to [MT-10, "Removal and Installation"](#) (FS5W71C), [MT-48, "Removal and Installation"](#) (FS5R30A).
14. Install the engine slingers and connect the engine lift.
15. Remove the LH and RH engine mounts.
16. Remove the engine.



**INSTALLATION**

Installation is in the reverse order of removal.

# CYLINDER BLOCK

[KA24DE]

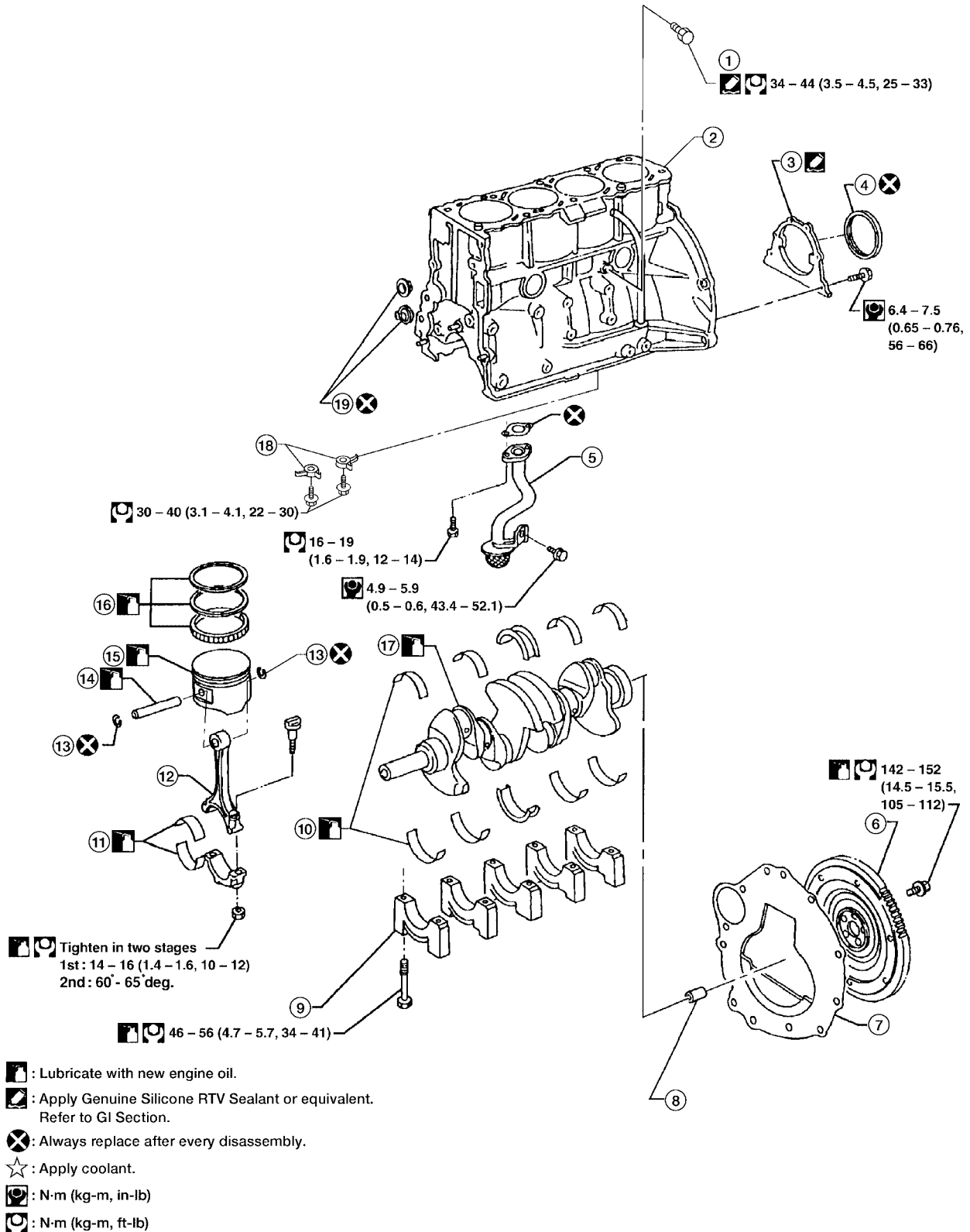
## CYLINDER BLOCK

PF1:11010

### Components

EBS00CA6

SEC. 110 • 120 • 135 • 150 • 210



WBIA0234E

- |                  |                                |                           |
|------------------|--------------------------------|---------------------------|
| 1. Drain plug    | 2. Cylinder block              | 3. Rear oil seal retainer |
| 4. Rear oil seal | 5. Oil strainer                | 6. Flywheel               |
| 7. Rear plate    | 8. Pilot bushing               | 9. Main bearing cap       |
| 10. Main bearing | 11. Connecting rod and bearing | 12. Connecting rod        |
| 13. Snap ring    | 14. Piston pin                 | 15. Piston                |
| 16. Piston rings | 17. Crankshaft                 | 18. Oil jets              |
| 19. Oil seal     |                                |                           |

A  
EM

## Removal and Installation

EBS00CA7

- To remove the cylinder block for disassembly, remove the engine. Refer to [EM-44, "Removal and Installation"](#).

**CAUTION:**

- When installing any sliding parts (bearings, pistons, etc.), lubricate the contacting surfaces with new engine oil.
- Label removed parts such as bearings and bearing caps in their proper order and direction for installation.
- When installing connecting rod nuts and main bearing cap bolts, apply new engine oil to threads and seating surfaces.
- Do not allow any magnetic material to contact the ring gear teeth of the flywheel.

- Installation is in the reverse order of removal.

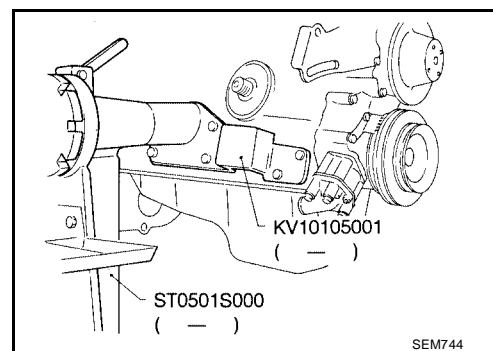
## Disassembly PISTON AND CRANKSHAFT

EBS00CA8

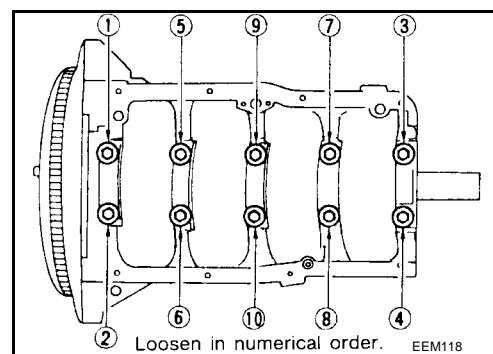
- Place the engine on a work stand.
- Remove the oil pan. Refer to [EM-16, "Removal"](#).
- Remove the timing chain. Refer to [EM-20, "Removal"](#).
- Remove the water pump. Refer to [CO-10, "Removal"](#).
- Remove the cylinder head. Refer to [EM-31, "Removal"](#).
- Remove the pistons with connecting rods.

**CAUTION:**

Use care not to scratch the engine block cylinder bore when removing the piston and connecting rod assemblies.



- Remove the main bearing caps and crankshaft.
  - Loosen the main bearing cap bolts in two or three steps and in the numerical order as shown.
    - Before removing the main bearing caps, mark them with their location and direction for correct placement during installation.
    - Before removing the bearing caps, measure the crankshaft end play. Refer to [EM-51, "CRANKSHAFT"](#).

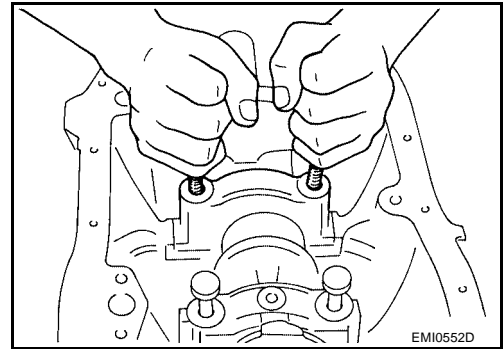


C  
D  
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H  
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J  
K  
L  
M

# CYLINDER BLOCK

[KA24DE]

- b. Using the main bearing cap bolts, remove the main bearing caps while shaking it to the right and left.
- Remove the No. 3 and No. 5 main bearing caps using Tool.
  - A sliding hammer type Main Bearing Cap Remover (special service tool No. KV101 14700) can be used.



8. Remove the crankshaft.  
9. Remove the main bearings from the cylinder block and main bearing caps.

**CAUTION:**

Mark the main bearing caps with their location and direction and set them aside in order to install them in their original position.

10. Remove the oil jets.

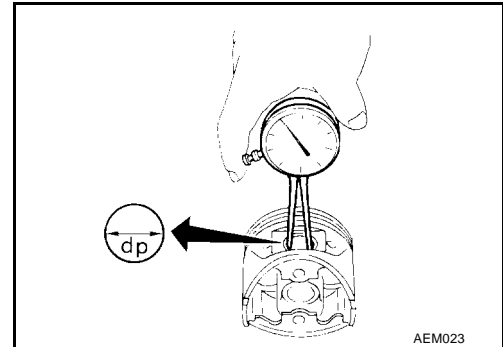
## Inspection

### PISTON AND PISTON PIN CLEARANCE

EBS00CA9

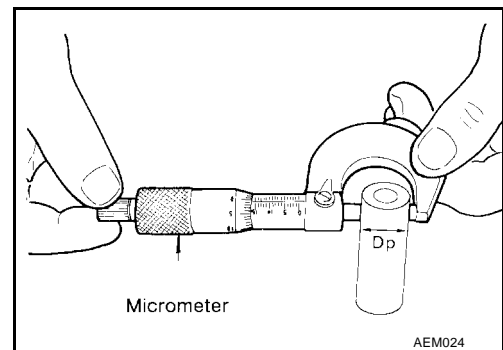
1. Measure the inner diameter of the piston pin hole "dp".

**Standard diameter "dp" : 20.993 - 21.005 mm  
(0.8265 - 0.8270 in)**



2. Measure the outer diameter of the piston pin "Dp".

**Standard diameter "Dp" : 20.989 - 21.001 mm  
(0.8263 - 0.8268 in)**



3. Calculate the piston pin clearance.  
If the calculated clearance exceeds specification, replace the piston and pin assembly.

**Piston pin clearance :  $dp - Dp = (-0.002) - 0.01 \text{ mm } [(-0.0001) - 0.0004 \text{ in}]$**

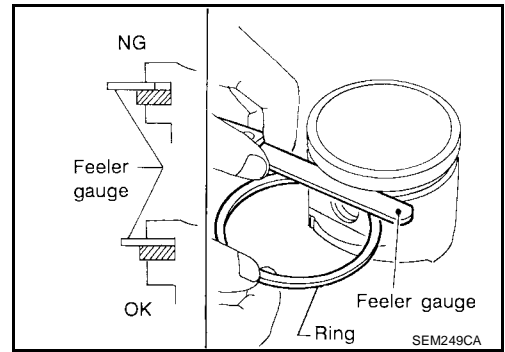


## PISTON RING SIDE CLEARANCE

Measure the piston ring side clearance as shown. If the clearance exceeds the specification, replace the piston ring.  
If the clearance exceeds the maximum side clearance limit with the new piston ring, replace the piston.

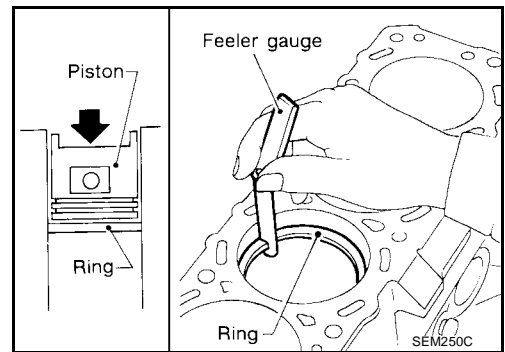
### Side clearance

<b>Top ring</b>	<b>: 0.04 - 0.08 mm (0.0016 - 0.0031 in)</b>
<b>2nd ring</b>	<b>: 0.03 - 0.07 mm (0.0012 - 0.0028 in)</b>
<b>Oil ring</b>	<b>: 0.065 - 0.135 mm (0.0026 - 0.0053 in)</b>
<b>Limit (Top, 2nd)</b>	<b>: 0.1 mm (0.004 in)</b>



## PISTON RING END GAP

- Measure the piston ring end gap as shown. If the end gap is out of specification, replace the piston ring.  
If the gap exceeds the maximum limit with the new ring, then rebore the cylinder and use an oversized piston and piston rings. Refer to [EM-67, "Piston, Piston Ring and Piston Pin"](#).



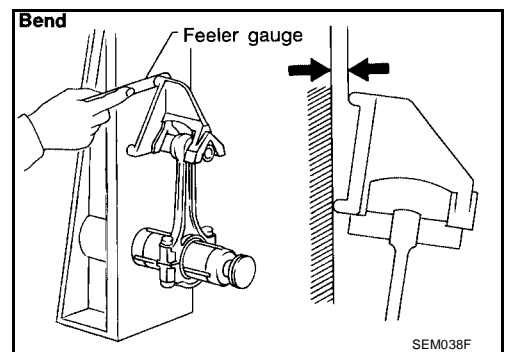
- When replacing the piston, check the cylinder block surface for any scratches or damage. If scratches or damage are found, hone or replace the cylinder block as necessary.

### Piston ring end gap

<b>Top ring</b>	<b>: 0.28 - 0.52 mm (0.0110 - 0.0205 in)</b>
<b>2nd ring</b>	<b>: 0.45 - 0.69 mm (0.0177 - 0.0272 in)</b>
<b>Oil ring (rail ring)</b>	<b>: 0.20 - 0.69 mm (0.0079 - 0.0272 in)</b>
<b>Limit</b>	<b>: 1.0 mm (0.039 in)</b>

## CONNECTING ROD BEND AND TORSION

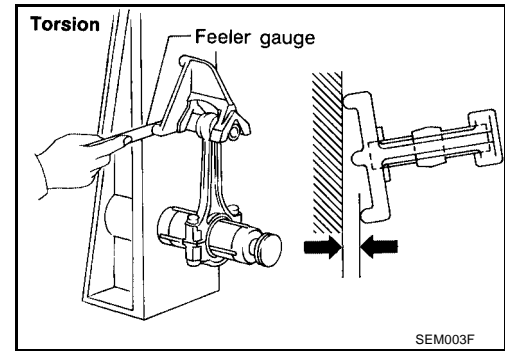
Measure the connecting rod bend and torsion as shown.  
If either of the measurements exceed the limits, replace the connecting rod assembly.



# CYLINDER BLOCK

[KA24DE]

- 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



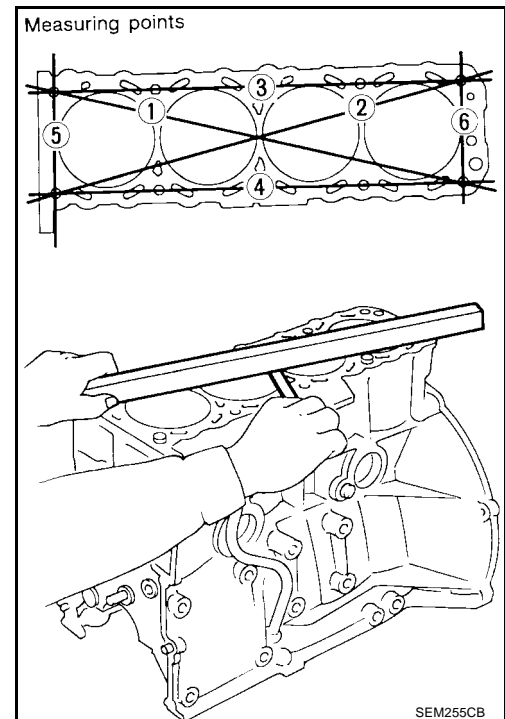
## CYLINDER BLOCK DISTORTION AND WEAR

1. Clean the upper face of the cylinder block.
2. Use a reliable straightedge and feeler gauge to check the flatness of the cylinder block upper face surface. Check along the six positions as shown.

### Cylinder block distortion

**Standard** : —

**Limit** : 0.1 mm (0.004 in)



3. If the block distortion exceeds specification, resurface the block. Replace the block if necessary.

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

**Amount of cylinder head resurfacing is "A"**

**Amount of cylinder block resurfacing is "B"**

**Nominal block height at crankshaft center** : 246.95 - 247.05 mm (9.7224 - 9.7264 in)

**Max. block distortion limit = A + B** : 0.2 mm (0.008 in)

## PISTON-TO-CYLINDER BORE CLEARANCE

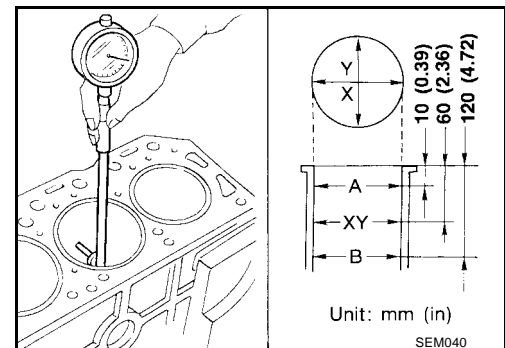
1. Using a bore gauge to measure the cylinder bore for wear, out-of-round, and taper. If the clearance exceeds the limit, rebore all of the cylinders. Replace the cylinder block if necessary.

**Standard inner bore diameter** : Refer to [EM-65, "Cylinder Block"](#).

**Out-of-round (X – Y) standard** : 0.015 mm (0.0006 in)

**Taper (A – B) standard** : 0.010 mm (0.0004 in)

**Wear limit** : 0.2 mm (0.008 in)



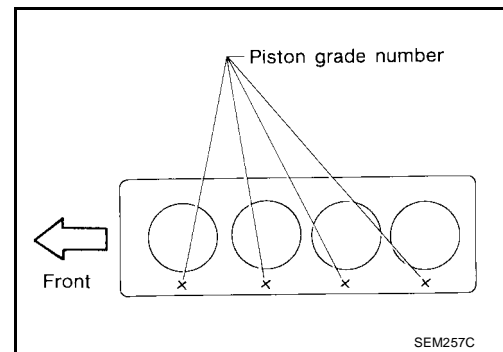
# CYLINDER BLOCK

[KA24DE]

2. Check for scratches and damage. If damage is found, hone the cylinder bore.

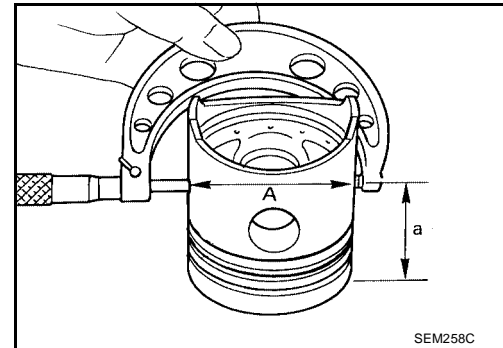
**CAUTION:**

If the cylinder block and pistons are replaced, match the piston grade with the grade number on the cylinder block upper surface as shown. Refer to [EM-67, "PISTON"](#).



3. Measure the piston skirt diameter "A" as shown, for the calculation in step 6.

**Piston diameter "A"** : refer to [EM-67, "PISTON"](#)  
**Measure point "A" at height "a" from the top** : approximately 48 mm (1.89 in)



4. Check that the piston-to-cylinder bore clearance "B" is within specification, record the measurement for the calculation in step 6.

**Piston-to-cylinder bore clearance "B"** : 0.020 - 0.040 mm (0.0008 - 0.0016 in)

5. Determine the piston oversize according to the amount of cylinder bore wear for the specified piston-to-bore clearance.

**NOTE:**

Oversize pistons are available for service. Refer to [EM-67, "PISTON"](#).

6. Cylinder rebore diameter "D" is determined by adding piston-to-cylinder bore clearance "B" to piston diameter "A" and subtracting the honing allowance "C".

**Rebored diameter calculation:  $D = A + B - C$**

where,

- D** : rebored diameter
- A** : piston diameter as measured
- B** : piston-to-cylinder bore clearance
- C** : honing allowance of 0.02 mm (0.0008 in)

7. Install the main bearing caps and tighten the cap bolts to specification. This will prevent distortion of the cylinder bores during the honing process.

**Main bearing cap bolts** : 46 - 56 N-m (4.7 - 5.7 kg-m, 34 - 41 ft-lb)

8. Hone the cylinder bores to obtain the specified piston-to-cylinder bore clearance.

**Piston-to-cylinder bore clearance** : 0.020 - 0.040 mm (0.0008 - 0.0016 in)

**CAUTION:**

- When any cylinder bore needs honing, all the other cylinder bores must also be honed.
- Do not cut too much out of cylinder bore at a time. Cut only 0.05 mm (0.0020 in) at a time.

9. Measure the finished cylinder bore for out-of-round and taper, refer to step 1.

**CAUTION:**

Measurements are done after the cylinder bore cools down.

## CRANKSHAFT

1. Check the crankshaft main and pin journals for scratches, wear, or cracks.

# CYLINDER BLOCK

[KA24DE]

2. With a micrometer, measure the journals for taper and out-of-round.

**Out-of-round (X – Y)**

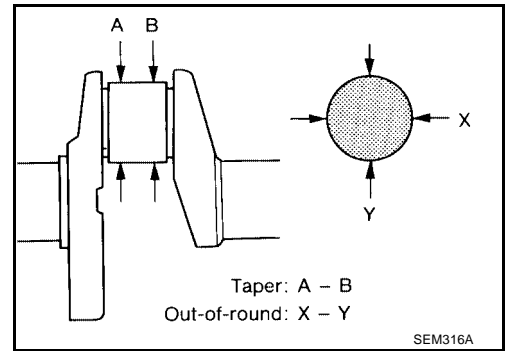
**Main journal : less than 0.01 mm (0.0004 in)**

**Crankshaft pin : less than 0.005 mm (0.0002 in)**

**Taper (A – B)**

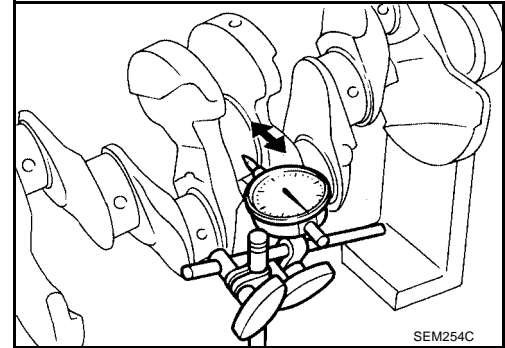
**Main journal : less than 0.01 mm (0.0004 in)**

**Crankshaft pin : less than 0.005 mm (0.0002 in)**



3. Measure the crankshaft runout.

**Runout (total indicator reading) : less than 0.10 mm (0.0039 in)**



4. If the crankshaft is out of specification, replace the crankshaft.

## BEARING CLEARANCE

### Method A (using bore gauge and micrometer)

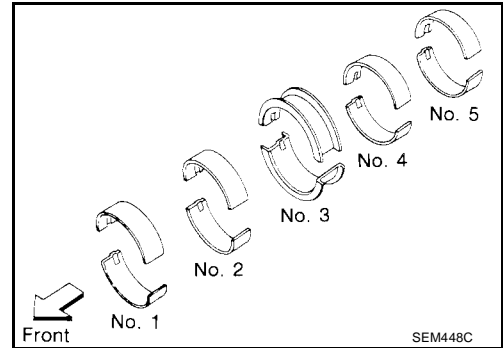
Use either Method A (bore gauge and micrometer) or Method B (plastigage) to measure for bearing clearance. The use of Method A is preferred because it is more accurate.

**NOTE:**

Use the following procedures to inspect the bearing clearance using Method A (bore gauge and micrometer).

### Main bearing

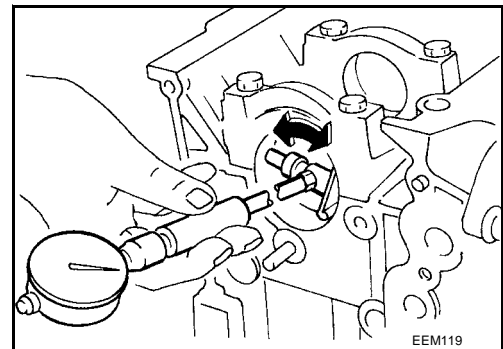
1. Set the main bearings in their proper positions on the cylinder block and main bearing caps. Follow the position numbering as shown.



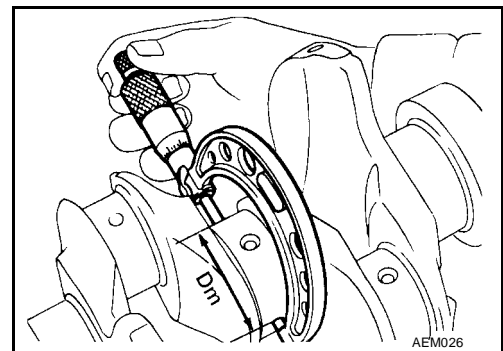
2. Install the main bearing caps on the cylinder block.
  - Tighten all bolts in two or three steps to specification.

**Main bearing cap bolts : 46 - 56 N·m (4.7 - 5.7 kg·m, 34 - 41 ft·lb)**

3. Measure the inner diameter "A" of each of the main bearing caps.



4. Measure the outer diameter "Dm" of each of the crankshaft main journals.



5. Calculate the main bearing clearance.

Main bearing clearance = A – Dm

**Standard : 0.020 - 0.047 mm (0.0008 - 0.0019 in)**

**Limit : 0.1 mm (0.004 in)**

If the clearance exceeds the limit, replace the bearings.

6. If the clearance cannot be adjusted within the standard of any bearing, grind the crankshaft journals and use an undersized replacement bearing as follows.

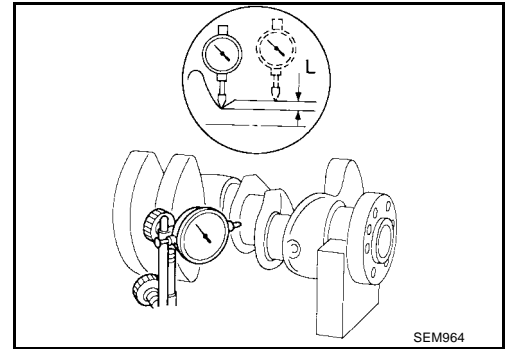
# CYLINDER BLOCK

[KA24DE]

- a. When grinding the crankshaft journals, confirm that the “L” dimension in the fillet roll is more than the specified limit.

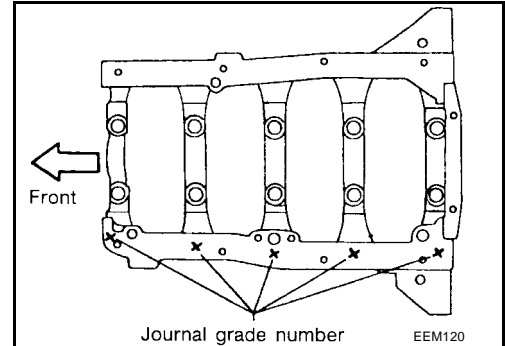
“L” : 0.1 mm (0.004 in)

- b. Grind the crankshaft to use it with replacement parts. Refer to [EM-68, "Crankshaft"](#) and [EM-69, "Available Main Bearing"](#).

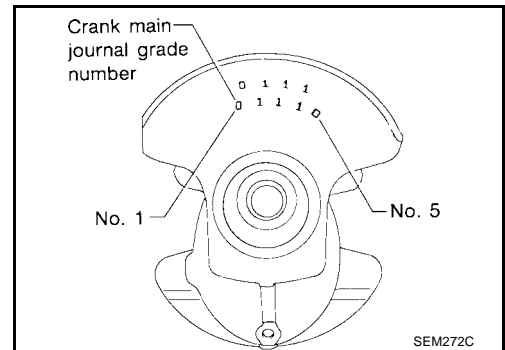


7. If the crankshaft is reused, measure the main bearing clearances and select the thickness of the main bearing. If the crankshaft or cylinder block is replaced, select the thickness of the main bearings as follows.

- a. The grade number of each cylinder block main journal is punched on the respective cylinder block journal. These numbers are in either Arabic or Roman numerals.



- b. The grade number of each crankshaft main journal is punched on the crankshaft. These numbers are in either Arabic or Roman numerals.



- c. Select the main bearing with a suitable thickness according to the following example and table.

Example:

Main journal grade number is 1 or I

Crankshaft journal grade number is 2 or II

Main bearing grade number = 1 + 2 = 3 (Yellow)

		Main journal grade number		
		0	1 or I	2 or II
Crankshaft journal grade number	0	0 (Black)	1 (Brown)	2 (Green)
	1 or I	1 (Brown)	2 (Green)	3 (Yellow)
	2 or II	2 (Green)	3 (Yellow)	4 (Blue)

## Connecting Rod Bearing (Big End)

1. Install the connecting rod bearing on the connecting rod and connecting rod cap.
2. Install connecting rod cap to connecting rod.

- Tighten the connecting rod cap bolts in two stages to specification.

### Connecting rod cap bolts

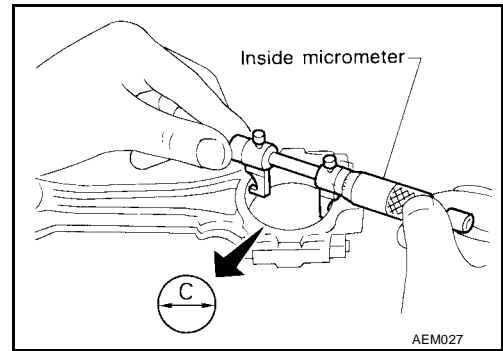
Stage 1 : 14 - 16 N·m (1.4 - 1.6 kg·m, 10 - 12 ft·lb)

Stage 2 : 60° - 65° degrees

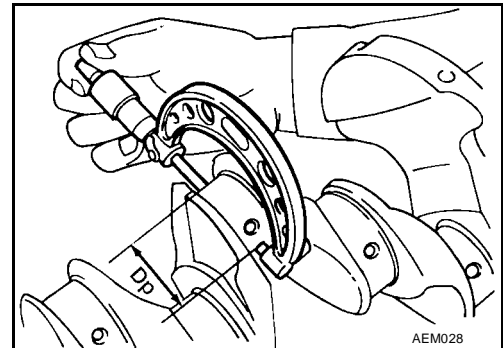
# CYLINDER BLOCK

[KA24DE]

3. Measure the inner diameter "C" of each bearing.



4. Measure the outer diameter "Dp" of each of the crankshaft pin journals.



5. Calculate the connecting rod bearing clearance.

**Connecting rod bearing clearance = C – Dp**  
**Standard : 0.010 - 0.035 mm (0.0004 - 0.0014 in)**  
**Limit : 0.09 mm (0.0035 in)**

If the clearance exceeds the limit, replace the bearing.

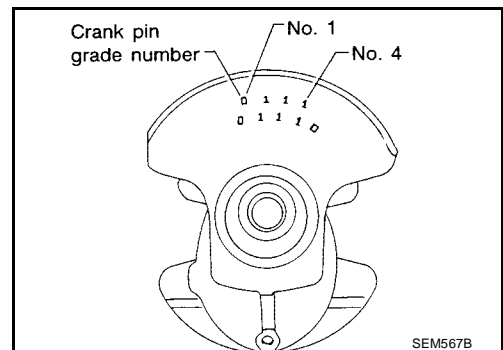
6. If the connecting rod bearing clearance cannot be adjusted within the standard of any bearing, grind crankshaft journal and use an undersized replacement bearing. Refer to [EM-69, "UNDERSIZE \(SERVICE\)"](#).

7. If the crankshaft is replaced, select the connecting rod bearing according to the following table.

**NOTE:**

The grade number of each crankshaft pin are punched on the crankshaft as shown. These grade numbers are in either Arabic or Roman numerals.

Crankshaft pin grade number	Connecting rod bearing grade number
0	0
1 or I	1
2 or II	2

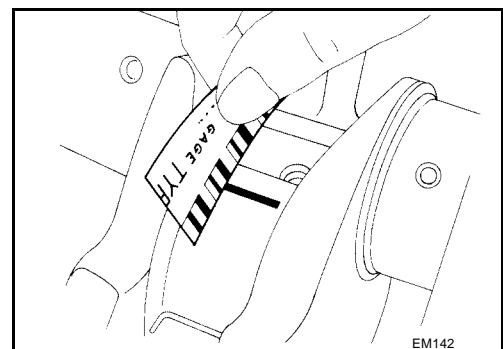


**Method B (using Plastigage)**

Measure the bearing clearances using the plastigage.

**CAUTION:**

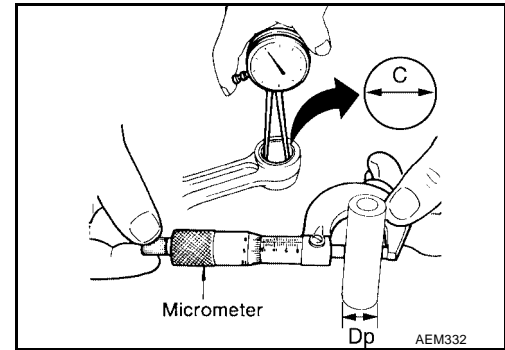
- Do not turn crankshaft or connecting rod while plastigage is being inserted.
- When bearing clearance exceeds the specified limit, ensure that the proper bearing has been installed. Then if excessive bearing clearance exists, use a thicker main bearing or undersized bearing so that the specified bearing clearance is obtained.



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## CONNECTING ROD BUSHING CLEARANCE (SMALL END)

1. Measure the inner diameter "C" of the bushing.
2. Measure the outer diameter "Dp" of the piston pin.



3. Calculate the connecting rod bushing clearance.

**Connecting rod bushing clearance = C – Dp**

**Standard : 0.005 - 0.017 mm (0.0002 - 0.0007 in)**

**Limit : 0.023 mm (0.0009 in)**

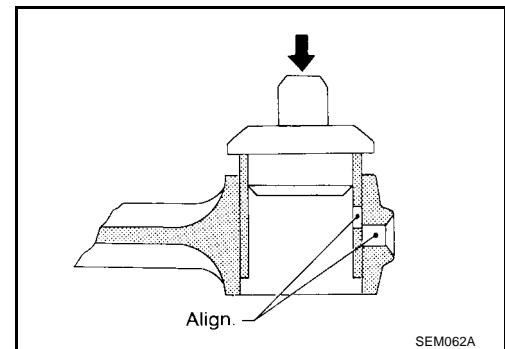
If the calculated clearance is out of specification, replace the connecting rod assembly or the piston set with pin assembly, or both, as necessary.

## REPLACEMENT OF CONNECTING ROD BUSHING (SMALL END)

1. Drive in the small end bushing until it is flush with the rod end surface.

**CAUTION:**

**Be sure to align the oil holes.**



2. Ream the bushing until the clearance with the piston pin is within specification.

**Connecting rod bushing clearance : 0.005 - 0.017 mm (0.0002 - 0.0007 in)**

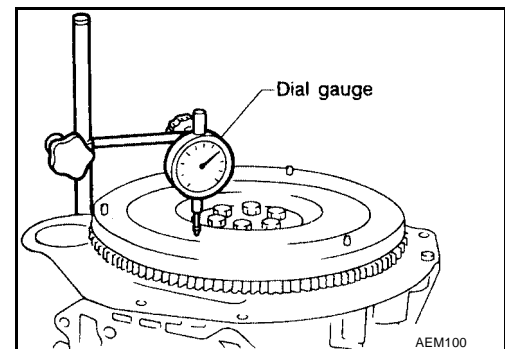
## FLYWHEEL RUNOUT

Using a dial gauge, rotate the flywheel and measure the flywheel runout by the total dial gauge indicator reading as shown.

**Flywheel runout (total indicator reading) : less than 0.15 mm (0.006 in)**

**CAUTION:**

- Be careful not to damage the ring gear teeth.
- Do not allow any magnetic materials to contact the ring gear teeth.
- Do not resurface the flywheel. Replace the flywheel as necessary.



## Assembly PISTON

1. Completely remove any foreign material from the cylinder block, inside the crankshaft case, and cylinder bores by blowing compressed air in the passages and oil passages.

EBS00CAA

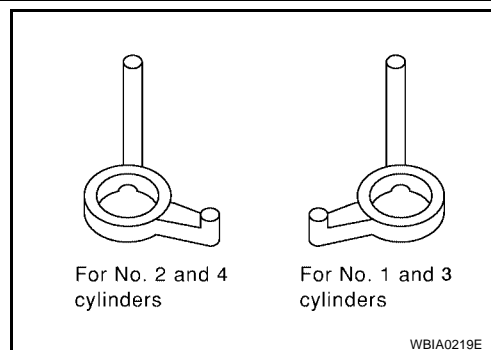


# CYLINDER BLOCK

[KA24DE]

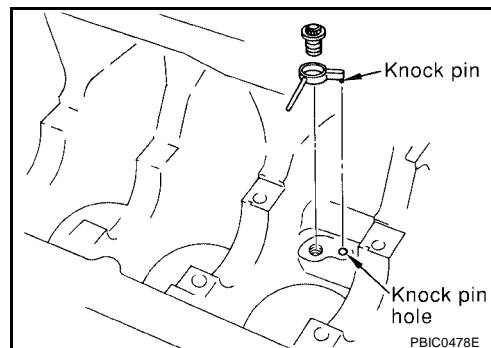
## 2. Install the oil jets.

- Oil jets for the No. 1 and No. 3 cylinders are different from those for cylinders No. 2 and No. 4 in shape as shown.



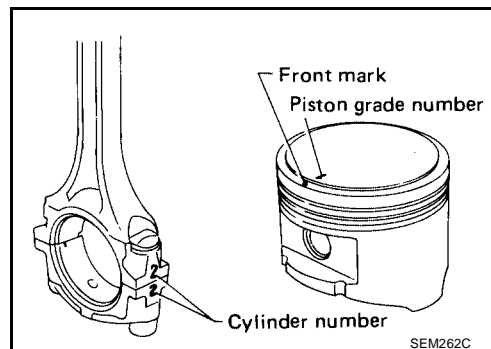
- Insert the oil jet knock pin into the knock pin hole in the cylinder block and tighten the oil jet bolt to specification.

**Oil jet bolt : 30 - 40 N·m (3.1 - 4.1 kg·m, 22 - 30 ft·lb)**

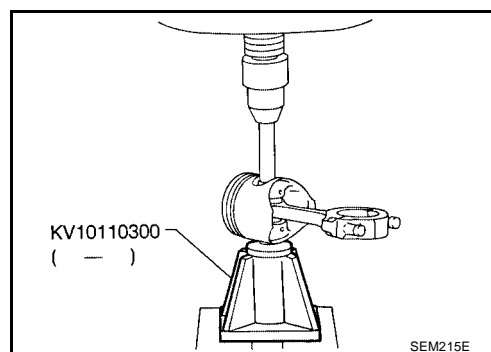


## 3. Heat the piston to 60° to 70°C (140° to 158°F) and assemble the piston, piston pin and connecting rod.

- Numbers stamped on the connecting rod and cap correspond to each cylinder number.
- Align the direction of the piston and connecting rod.



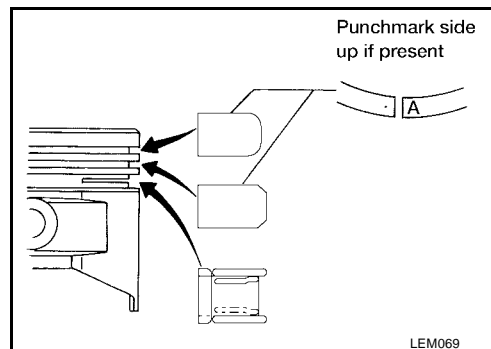
- Press the piston pin in with Tool as shown.
- After assembly, check that the connecting rod swings smoothly on the piston.



## 4. Set the piston rings with the punch mark side up as shown.

### CAUTION:

- When the piston rings are not replaced, make sure that the piston rings are mounted in their original positions.
- When the piston rings are being replaced and no punch mark is present, piston rings can be mounted with either side up.

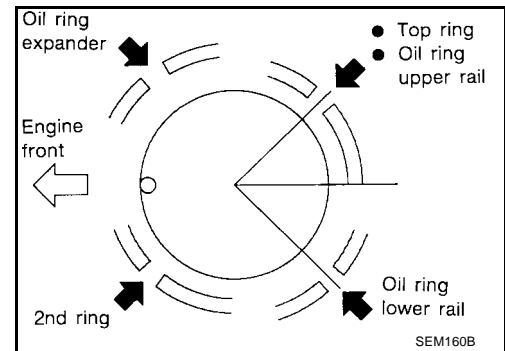


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# CYLINDER BLOCK

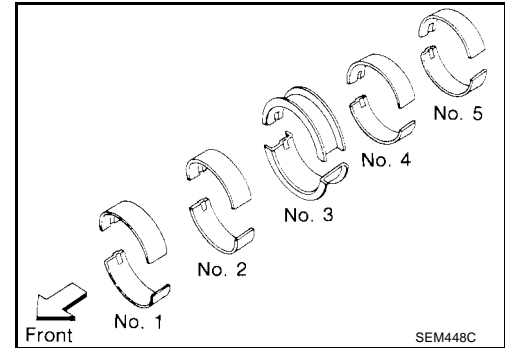
[KA24DE]

- Align the piston rings so that the end gaps are positioned at 90° degree angles as shown.



## CRANKSHAFT

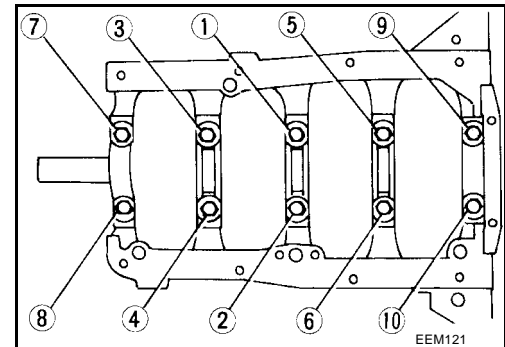
- Set the main bearings in their proper positions on the cylinder block and main bearing caps as shown.
  - Confirm that the correct main bearings are installed. Refer to [EM-53, "BEARING CLEARANCE"](#).
  - Apply new engine oil to the bearing surfaces.



- Install the crankshaft and main bearing caps and tighten the bolts to specification.
  - Apply new engine oil to the main bearing cap bolt threads and seat surfaces.
  - Prior to tightening the bearing cap bolts, place the bearing cap in the proper position by shifting the crankshaft in the axial direction.
  - Tighten the bearing cap bolts gradually in two or three steps. Start with the center bearing and tighten the main bearing cap bolts in the numerical order as shown.

**Main bearing cap bolts : 46 - 56 N·m (4.7 - 5.7 kg-m, 34 - 41 ft-lb)**

- After securing the bearing cap bolts, check that the crankshaft turns smoothly by hand.



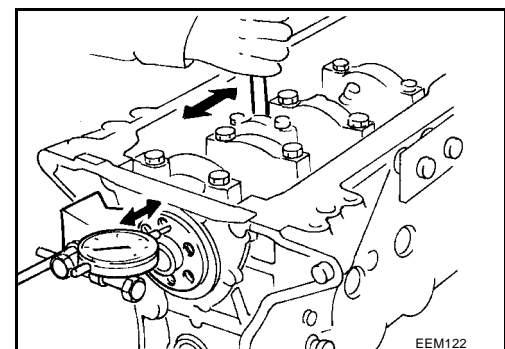
- Measure the crankshaft end play as shown.

### Crankshaft end play

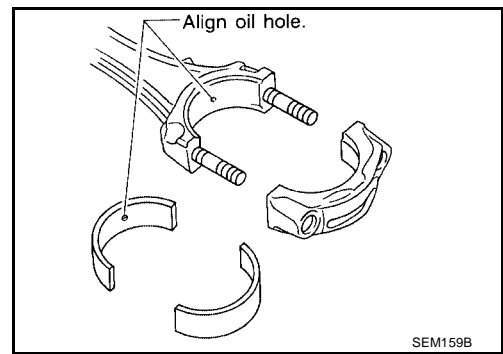
**Standard : 0.05 - 0.18 mm (0.0020 - 0.0071 in)**

**Limit : 0.3 mm (0.012 in)**

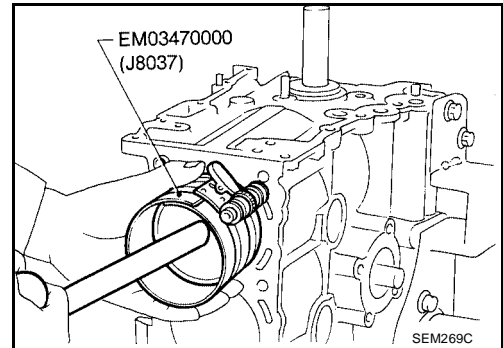
If beyond the limit, replace the No. 3 main bearing with a new one.



4. Install the connecting rod bearings in the connecting rods and connecting rod caps.
  - Confirm that the correct bearings are used. Refer to [EM-54, "Connecting Rod Bearing \(Big End\)"](#) .
  - Install the connecting rod bearings so the oil holes are aligned in the rod and bearing as shown.
  - Apply new engine oil to the bearing surfaces, bolt threads and seating surfaces.



5. Install the piston assemblies into the corresponding cylinder bores using Tool as shown.
  - Position the piston assembly so that the front mark on the piston head faces toward the front of the engine.
  - Make sure the connecting rod does not scratch the cylinder bore wall.
  - Make sure the connecting rod bolts do not scratch the crankshaft journals.



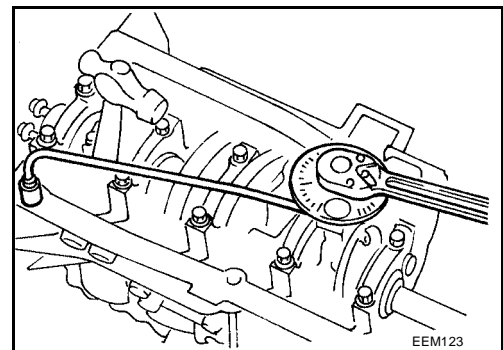
- Apply new engine oil to the piston rings and sliding surface of the piston.

6. Install the connecting rod bearing caps. If reusing the connecting rod bearing caps, they must be installed in their original position and direction.
  - Tighten the connecting rod bearing cap nuts in two steps. If an angle wrench is not available, then tighten the connecting rod bearing nuts to specification.

**Connecting rod bearing nuts**

**Step 1 : 14 - 16 N·m (1.4 - 1.6 kg·m, 10 - 12 ft·lb)**

**Step 2 : 60° - 65° degrees clockwise; or 38 - 44 N·m (3.9 - 4.5 kg·m, 28 - 33 ft·lb)**



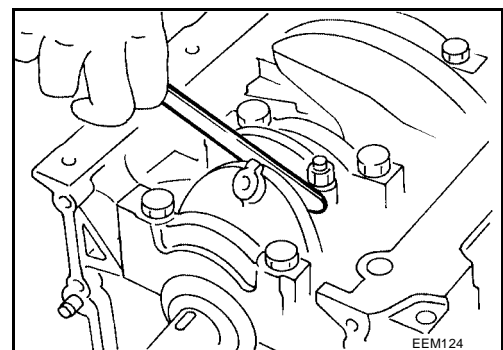
7. Measure the connecting rod side clearance.

**Connecting rod side clearance**

**Standard : 0.2 - 0.4 mm (0.008 - 0.016 in)**

**Limit : 0.6 mm (0.024 in)**

If the clearance is beyond the limit, replace either the connecting rod or crankshaft, or both, as necessary.



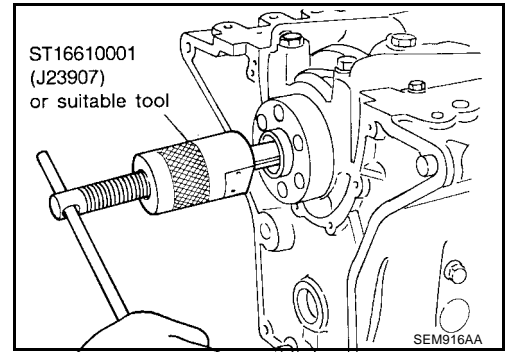
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# CYLINDER BLOCK

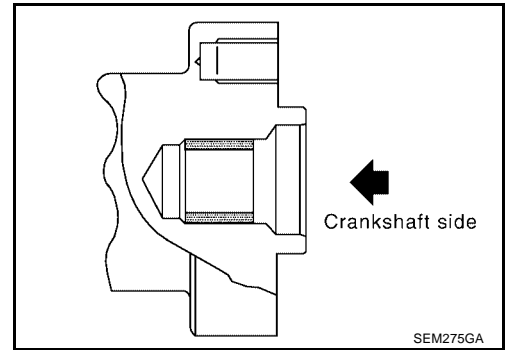
[KA24DE]

## REPLACING PILOT BUSHING

1. Remove the pilot bushing with Tool as shown.



2. Install the pilot bushing as shown.



# SERVICE DATA AND SPECIFICATIONS (SDS)

[KA24DE]

## SERVICE DATA AND SPECIFICATIONS (SDS)

PF0:00030

### General Specifications

EBS00CAB

Cylinder arrangement	In-line 4	
Displacement	2,389 cm <sup>3</sup> (145.78 cu in)	
Bore and stroke	89 x 96 mm (3.50 x 3.78 in)	
Valve arrangement	DOHC	
Firing order	1-3-4-2	
Number of piston rings	Compression	2
	Oil	1
Number of main bearings	5	
Compression ratio	9.2	

### COMPRESSION PRESSURE

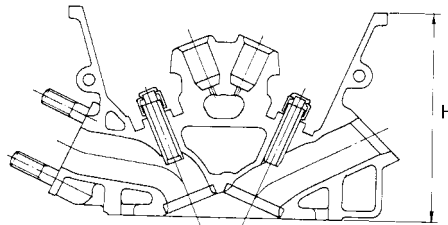
Unit: kPa (kg/cm<sup>2</sup>, psi)/300 rpm

Standard	1,226 (12.5, 178)
Minimum	1,030 (10.5, 149)
Differential limit between cylinders	98 (1.0, 14)

### Cylinder Head

EBS00CAC

Unit: mm (in)



Nominal cylinder head height:  
H = 126.3 - 126.5 (4.972 - 4.980)

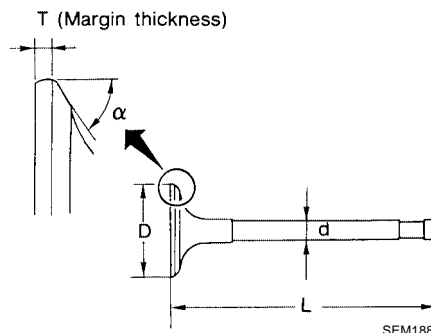
SEM519E

Cylinder head surface distortion	Limit 0.1 (0.004)
----------------------------------	----------------------

### Valve VALVE

EBS00CAD

Unit: mm (in)



SEM188

Valve head diameter "D"	Intake	36.5 - 36.7 (1.437 - 1.445)
	Exhaust	31.2 - 31.4 (1.228 - 1.236)
Valve length "L"	Intake	101.17 - 101.47 (3.9831 - 3.9949)
	Exhaust	98.67 - 98.97 (3.8846 - 3.8964)

# SERVICE DATA AND SPECIFICATIONS (SDS)

[KA24DE]

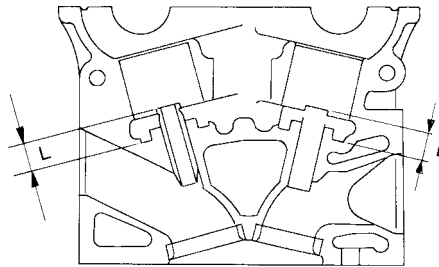
Valve stem diameter "d"	Intake	6.965 - 6.980 (0.2742 - 0.2748)
	Exhaust	6.945 - 6.960 (0.2734 - 0.2740)
Valve seat angle "α"	Intake & Exhaust	45°15' - 45°45'
Valve margin "T"	Intake	0.95 - 1.25 (0.0374 - 0.0492)
	Exhaust	1.15 - 1.45 (0.0453 - 0.0571)
Valve margin "T" limit		More than 0.5 (0.020)
Valve stem end surface grinding limit		Less than 0.2 (0.008)

## VALVE SPRING

Free height mm (in)		50.3 (1.9831)
Pressure N (kg, lb) at height mm (in)	Standard	418.0 (42.6, 93.9) at 29.17 (1.1484)
	Limit	393.0 (40.1, 88.4) at 29.17 (1.1484)
Out-of-square mm (in)		Less than 2.2 (0.087)

## VALVE GUIDE

Unit: mm (in)



SEM301D

		Standard	Service
Valve guide Outer diameter	Intake	11.023 - 11.034 (0.4340 - 0.4344)	11.223 - 11.234 (0.4418 - 0.4423)
	Exhaust	11.023 - 11.034 (0.4340 - 0.4344)	11.223 - 11.234 (0.4418 - 0.4423)
Valve guide Inner diameter (Finished size)	Intake	7.000 - 7.018 (0.2756 - 0.2763)	
	Exhaust	7.000 - 7.018 (0.2756 - 0.2763)	
Cylinder head valve guide hole diameter	Intake	10.975 - 10.996 (0.4321 - 0.4329)	11.175 - 11.196 (0.4400 - 0.4408)
	Exhaust	10.975 - 10.996 (0.4321 - 0.4329)	11.175 - 11.196 (0.4400 - 0.4408)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
		Standard	Limit
Stem to 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 limit		0.2 (0.008)	
Projection length "L"		13.3 - 13.9 (0.524 - 0.547)	

## VALVE LIFTER

Unit: mm (in)

Valve lifter outer diameter	33.960 - 33.975 (1.3370 - 1.3376)
Lifter guide inner diameter	34.000 - 34.021 (1.3386 - 1.3394)
Clearance between lifter and filter guide	0.025 - 0.061 (0.0010 - 0.0024)

# SERVICE DATA AND SPECIFICATIONS (SDS)

[KA24DE]

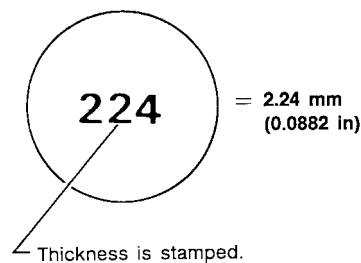
## VALVE CLEARANCE ADJUSTMENT

Unit: mm (in)

Valve clearance (Hot)	Intake	0.31 - 0.39 (0.012 - 0.015)
	Exhaust	0.39 - 0.47 (0.015 - 0.019)

## AVAILABLE SHIMS

Thickness mm (in)	Identification mark	Thickness mm (in)	Identification mark
—	—	1.90 (0.0748)	190
1.92 (0.0756)	192	1.94 (0.0764)	194
1.96 (0.0772)	196	1.98 (0.0780)	198
2.00 (0.0787)	200	2.02 (0.0795)	202
2.04 (0.0803)	204	2.06 (0.0811)	206
2.08 (0.819)	208	2.10 (0.0827)	210
2.12 (0.0835)	212	2.14 (0.0843)	214
2.16 (0.0850)	216	2.18 (0.0858)	218
2.20 (0.0866)	220	2.22 (0.0874)	222
2.24 (0.0882)	224	2.26 (0.0890)	226
2.28 (0.0898)	228	2.30 (0.0906)	230
2.32 (0.0913)	232	2.34 (0.0921)	234
2.36 (0.0929)	236	2.38 (0.0937)	238
2.40 (0.0945)	240	2.42 (0.0953)	242
2.44 (0.0961)	244	2.46 (0.0969)	246
2.48 (0.0976)	248	2.50 (0.0984)	250
2.52 (0.0992)	252	2.54 (0.1000)	254
2.56 (0.1008)	256	2.58 (0.1016)	258
2.60 (0.1024)	260	2.62 (0.1031)	262
2.64 (0.1039)	264	2.66 (0.1047)	266
2.68 (0.1055)	268	—	—



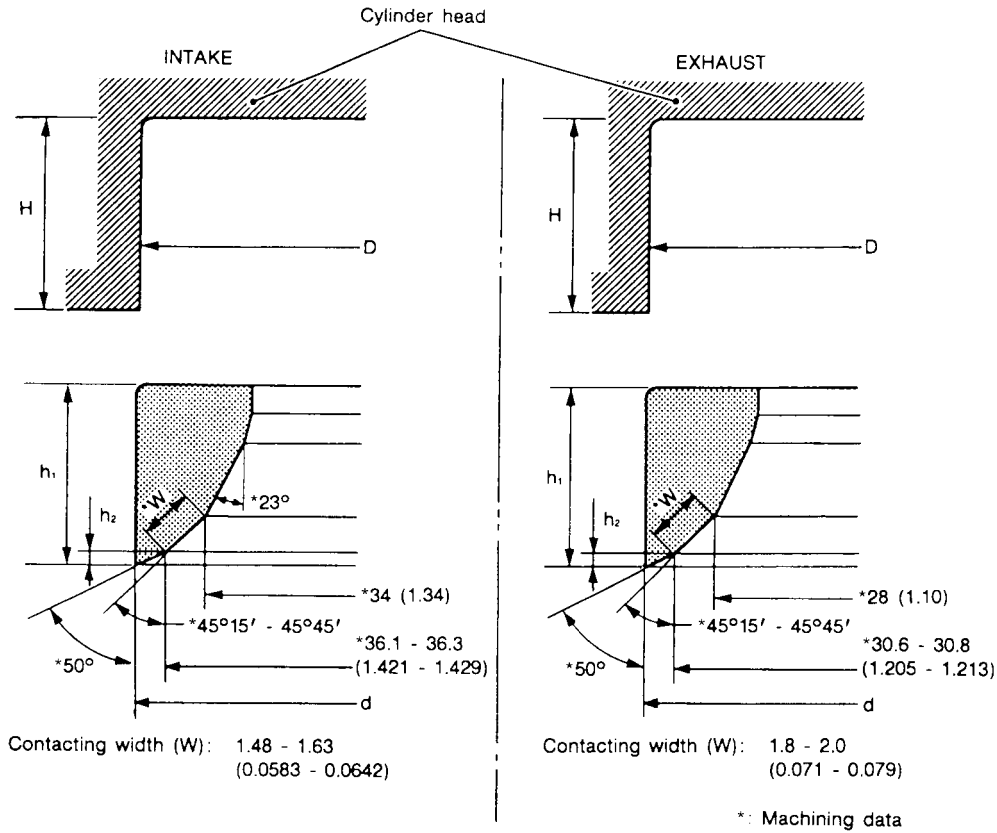
SEM308D

# SERVICE DATA AND SPECIFICATIONS (SDS)

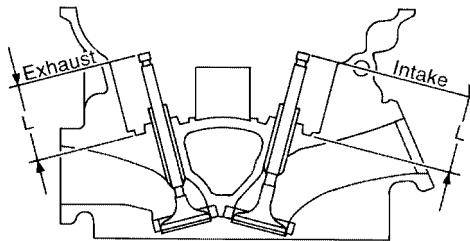
[KA24DE]

## VALVE SEAT

Unit: mm (in)



AEM456



SEM621F

		Standard	Service
Cylinder head seat recess dia. (D)	Intake	37.500 - 37.516 (1.4764 - 1.4770)	38.000 - 38.016 (1.4961 - 1.4967)
	Exhaust	32.200 - 32.216 (1.2677 - 1.2683)	32.700 - 32.716 (1.2874 - 1.2880)
Valve seat interference fit	Intake	0.064 - 0.096 (0.0025 - 0.0038)	
	Exhaust	0.064 - 0.096 (0.0025 - 0.0038)	
Valve seat outer dia. (d)	Intake	37.580 - 37.596 (1.4795 - 1.4802)	38.080 - 38.096 (1.4992 - 1.4998)
	Exhaust	32.280 - 32.296 (1.2709 - 1.2715)	32.780 - 32.796 (1.2905 - 1.2912)
Depth (H)	Intake	6.1 - 6.3 (0.240 - 0.248)	
	Exhaust	6.1 - 6.3 (0.240 - 0.248)	
Height ( $h_1$ )	Intake	5.8 - 6.0 (0.228 - 0.236)	5.3 - 5.5 (0.209 - 0.217)
		5.9 - 6.0 (0.232 - 0.236)	
	Exhaust	5.9 - 6.0 (0.232 - 0.236)	5.32 - 5.42 (0.209 - 0.213)



# SERVICE DATA AND SPECIFICATIONS (SDS)

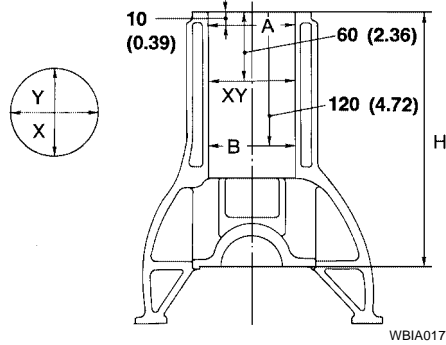
[KA24DE]

Height (h <sub>2</sub> )	Intake	0.24 - 0.64 (0.0094 - 0.0252) 0.34 - 0.64 (0.0134 - 0.0252)
	Exhaust	0.43 - 0.73 (0.0169 - 0.0287)
Valve seat resurface limit (L)	Intake	42.02 - 42.52 (1.6543 - 1.6740)
	Exhaust	42.03 - 42.53 (1.6547 - 1.6744)

## Cylinder Block

EBS00CAE

Unit: mm (in)



		Standard	Limit
Distortion		—	0.1 (0.004)
Cylinder bore	Inner diameter	Grade 1	89.000 - 89.010 (3.5039 - 3.5043)
		Grade 2	89.010 - 89.020 (3.5043 - 3.5047)
		Grade 3	89.020 - 89.030 (3.5047 - 3.5051)
	Out-of-round (X - Y)		Less than 0.015 (0.0006)
Taper (A - B)		Less than 0.010 (0.0004)	—
Difference in inner diameter between cylinders		Less than 0.03 (0.0012)	0.2 (0.008)
Piston-to-cylinder bore clearance		0.020 - 0.040 (0.0008 - 0.0016)	—
Cylinder block height (From crankshaft center)		246.95 - 247.05 (9.7224 - 9.7264)	0.2 (0.008)**

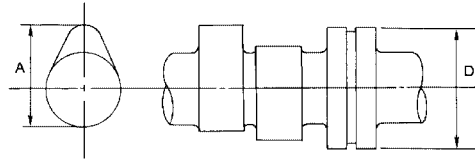
\* Wear limit

\*\* Total amount of cylinder head resurfacing and cylinder block resurfacing

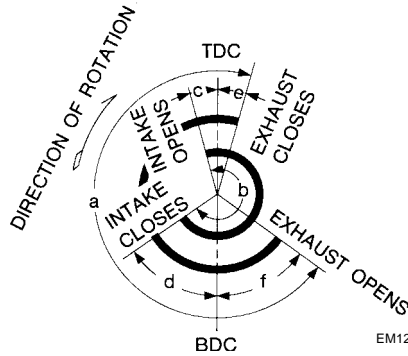
Camshaft and Camshaft Bearing

EBS00CAF

Unit: mm (in)



WBIA0176E



		Standard	Limit
Cam height (A)	Intake	41.755 - 41.945 (1.644 - 1.651)	—
	Exhaust	41.815 - 42.005 (1.646 - 1.654)	—
Wear limit of cam height		—	0.2 (0.008)
Camshaft journal to bearing clearance		0.045 - 0.090 (0.0018 - 0.0035)	0.12 (0.0047)
Inner diameter of camshaft bearing	#1 to #5 journals	28.000 - 28.025 (1.1024 - 1.1033)	—
Outer diameter of camshaft journal (D)	#1 to #5 journals	27.935 - 27.955 (1.0998 - 1.1006)	—
Camshaft runout*		Less than 0.02 (0.0008)	0.04 (0.0016)
Camshaft end play		0.070 - 0.148 (0.0028 - 0.0058)	0.2 (0.008)
Valve timing (Degree on crankshaft)	a	224	—
	b	224	—
	c	-1	—
	d	45	—
	e	7	—
	f	37	—

\* Total indicator reading

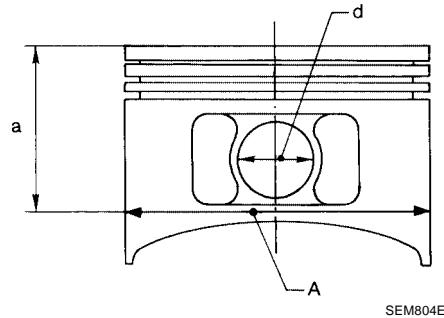
# SERVICE DATA AND SPECIFICATIONS (SDS)

[KA24DE]

## Piston, Piston Ring and Piston Pin PISTON

EBS00CAG

Unit: mm (in)



Piston skirt diameter "A"	Standard	Grade No. 1	88.970 - 88.980 (3.5027 - 3.5031)
		Grade No. 2	88.980 - 88.990 (3.5031 - 3.5035)
		Grade No. 3	88.990 - 89.000 (3.5035 - 3.5039)
	Service (Oversize)	0.5 (0.020)	89.470 - 89.500 (3.5224 - 3.5236)
		1.0 (0.039)	89.970 - 90.000 (3.5421 - 3.5433)
Height "a"	Approximately 48 (1.89)		
Piston pin hole diameter "d"	20.993 - 21.005 (0.8265 - 0.8270)		
Piston-to-cylinder bore clearance	0.020 - 0.040 (0.0008 - 0.0016)		

## PISTON PIN

Unit: mm (in)

	Standard	Limit
Piston pin outer diameter	20.989 - 21.001 (0.8263 - 0.8268)	—
Interference fit of piston pin to piston pin hole	-0.002 to 0.01 (-0.0001 to 0.0004)	—
Connecting rod bushing clearance	0.005 - 0.017 (0.0002 - 0.0007)	0.023 (0.0009)

## PISTON RING

Unit: mm (in)

		Standard	Limit
Side clearance	Top	0.040 - 0.080 (0.0016 - 0.0031)	0.1 (0.004)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.1 (0.004)
	Oil	0.065 - 0.135 (0.0026 - 0.0053)	—
Ring gap	Top	0.28 - 0.52 (0.0110 - 0.0205)	1.0 (0.039)
	2nd	0.45 - 0.69 (0.0177 - 0.0272)	1.0 (0.039)
	Oil (rail ring)	0.20 - 0.69 (0.0079 - 0.0272)	1.0 (0.039)

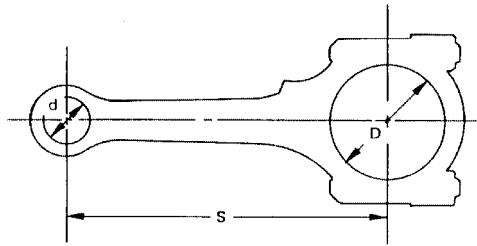
# SERVICE DATA AND SPECIFICATIONS (SDS)

[KA24DE]

## Connecting Rod

EBS00CAH

Unit: mm (in)



WBIA0178E

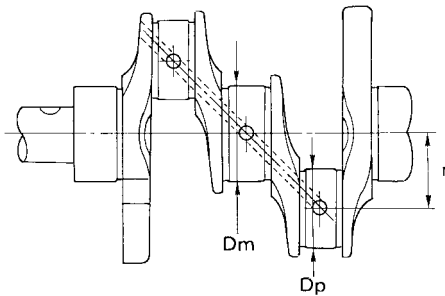
	Standard	Limit
Center distance (S)	164.95 - 165.05 (6.4941 - 6.4980)	—
Bend [per 100 mm (3.94 in)]	—	0.15 (0.0059)
Torsion [per 100 mm (3.94 in)]	—	0.30 (0.0118)
Connecting rod small end inner diameter (d)*	23.970 - 24.000 (0.9437 - 0.9449)	—
Piston pin bushing inner diameter	21.000 - 21.012 (0.8268 - 0.8272)	—
Connecting rod big end inner diameter (D)*	53.000 - 53.013 (2.0866 - 2.0871)	—
Side clearance	0.2 - 0.4 (0.008 - 0.016)	0.6 (0.024)

\* Without bearing

## Crankshaft

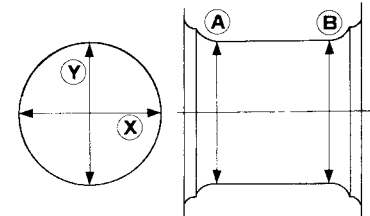
EBS00CAI

Unit: mm (in)



SEM394

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



EM715

Main journal diameter (Dm)	Grade No. 0	59.967 - 59.975 (2.3609 - 2.3612)	
	Grade No. 1	59.959 - 59.967 (2.3606 - 2.3609)	
	Grade No. 2	59.951 - 59.959 (2.3603 - 2.3606)	
Pin journal diameter (Dp)	Grade No. 0	49.968 - 49.974 (1.9672 - 1.9675)	
	Grade No. 1	49.962 - 49.968 (1.9670 - 1.9672)	
	Grade No. 2	49.956 - 49.962 (1.9668 - 1.9670)	
Center distance (r)		47.95 - 48.05 (1.8878 - 1.8917)	
Taper of journal and pin [A - B]	Journal	Standard —	Limit 0.01 (0.0004)
	Pin	—	0.005 (0.0002)
Out-of-round of journal and pin [X - Y]	Journal	—	0.01 (0.0004)
	Pin	—	0.005 (0.0002)
Runout [TIR]*		—	0.10 (0.0039)

# SERVICE DATA AND SPECIFICATIONS (SDS)

[KA24DE]

Free end play	0.05 - 0.18 (0.0020 - 0.0071)	0.3 (0.012)
Fillet roil	More than 0.1 (0.004)	

\* Total indicator reading

## Bearing Clearance

EBS00CAJ

Unit: mm (in)

	Standard	Limit
Main bearing clearance	0.020 - 0.047 (0.0008 - 0.0019)	0.1 (0.004)
Connecting rod bearing clearance	0.010 - 0.035 (0.0004 - 0.0014)	0.09 (0.0035)

## Available Main Bearing STANDARD

EBS00CAK

Unit: mm (in)

Grade number	Thickness	Identification color
0	1.821 - 1.825 (0.0717 - 0.0719)	Black
1	1.825 - 1.829 (0.0719 - 0.0720)	Brown
2	1.829 - 1.833 (0.0720 - 0.0722)	Green
3	1.833 - 1.837 (0.0722 - 0.0723)	Yellow
4	1.837 - 1.841 (0.0723 - 0.0725)	Blue

## UNDERSIZE (SERVICE)

Unit: mm (in)

	Thickness	Main journal diameter "Dm"
0.25 (0.0098)	1.952 - 1.960 (0.0769 - 0.0772)	Grind so that bearing clearance is the specified value.

## Available Connecting Rod Bearing STANDARD

EBS00CAL

Unit: mm (in)

Grade number	Thickness	Identification color
0	1.505 - 1.508 (0.0593 - 0.0594)	—
1	1.508 - 1.511 (0.0594 - 0.0595)	Brown
2	1.511 - 1.514 (0.0595 - 0.0596)	Green

## UNDERSIZE (SERVICE)

Unit: mm (in)

	Thickness	Crank pin journal diameter "Dp"
0.08 (0.0031)	1.540 - 1.548 (0.0606 - 0.0609)	Grind so that bearing clearance is the specified value.
0.12 (0.0047)	1.560 - 1.568 (0.0614 - 0.0617)	
0.25 (0.0098)	1.625 - 1.633 (0.0640 - 0.0643)	

## Miscellaneous Components

EBS00CAM

Unit: mm (in)

Camshaft sprocket runout (TIR)*	Less than 0.15 (0.0059)
Flywheel runout (TIR)*	Less than 0.15 (0.006)

\* Total indicator reading

## PRECAUTIONS

PFP:00001

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

*EBS00EXO*

The Supplemental Restraint System such as “AIR BAG” and “SEAT BELT PRE-TENSIONER”, used along with a front seat belt, helps to reduce the risk or severity of injury to the driver and front passenger for certain types of collision. This system includes seat belt switch inputs and dual stage front air bag modules. The SRS system uses the seat belt switches to determine the front air bag deployment, and may only deploy one front air bag, depending on the severity of a collision and whether the front occupants are belted or unbelted. Information necessary to service the system safely is included in the SRS and SB section of this Service Manual.

**WARNING:**

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

### Parts Requiring Angular Tightening

*EBS00CAO*

- Use an angle wrench for the final tightening of the following engine parts:
  - Cylinder head bolts
  - Connecting rod cap nuts
- 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 REMOVAL OF LIQUID GASKET SEALING

*EBS00EXP*

- After removing the mounting bolts and nuts, separate the mating surface using a seal cutter and remove the liquid gasket sealing.

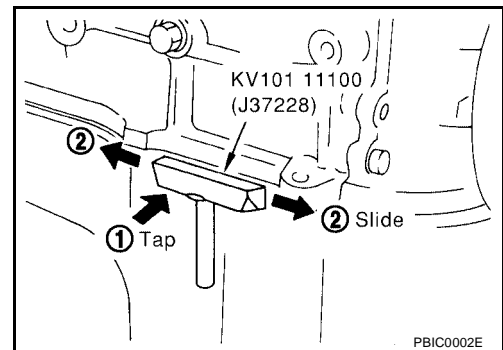
**CAUTION:**

**Be careful not to damage the mating surfaces.**

- Use a plastic hammer to lightly tap (1) the areas where the liquid gasket is applied. To advance the cutter, use a plastic hammer (2) to slide the cutter along the joint.

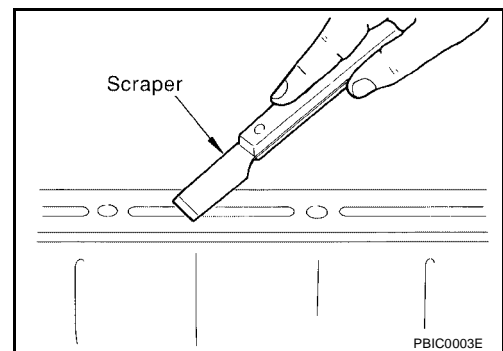
**CAUTION:**

**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

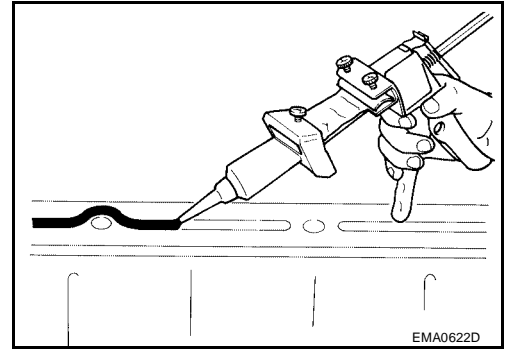
1. Using a scraper, remove the old liquid gasket adhering to the gasket application surface and the mating surface.
  - Remove the sealant completely from the groove of the gasket application surface, mounting bolts, and bolt holes.



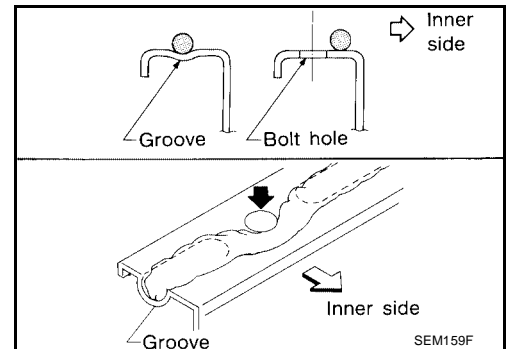
## PRECAUTIONS

[VG33E and VG33ER]

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.



4. Apply the sealant without breaks to the specified location with the specified dimensions.
  - 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.
  - After 30 minutes or more have passed from the installation, fill the engine with the specified oil and coolant. Refer to [GI-42, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



# PREPARATION

[VG33E and VG33ER]

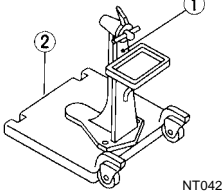
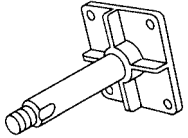
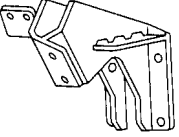
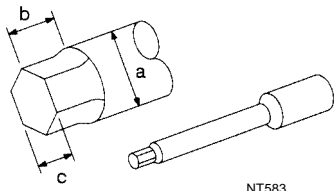
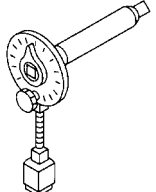
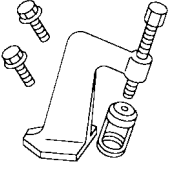
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## PREPARATION

### Special Service Tools

EBS00CAQ

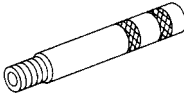
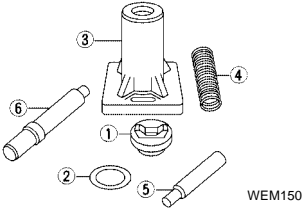
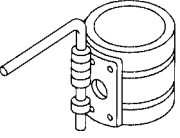
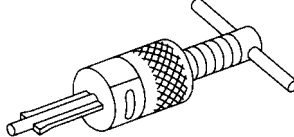
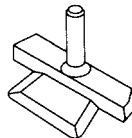
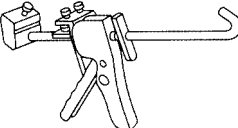
The actual shapes of Kent-Moore tools may differ from those of special service tools illustrated here.

Tool number (Kent-Moore No.) Tool name	Description
ST0501S000 (      —      ) Engine stand assembly <b>1</b> ST05011000 (      —      ) Engine stand <b>2</b> ST05012000 (      —      ) Base	 Disassembling and assembling the engine
KV10106500 (      —      ) Engine stand shaft	 Used with engine stand assembly
KV10110001 (      —      ) Engine sub-attachment	 Used with engine stand assembly
ST10120000 (J24239-01) Cylinder head bolt wrench	 Loosening and tightening cylinder head bolt <b>a: 13 mm (0.51 in) dia.</b> <b>b: 12 mm (0.47 in)</b> <b>c: 10 mm (0.39 in)</b>
KV10112100 (BT8653-A) Angle wrench	 Tightening bearing cap, cylinder head bolts, etc.
KV10110600 (J33986) Valve spring compressor	 Disassembling and assembling valve compo- nents



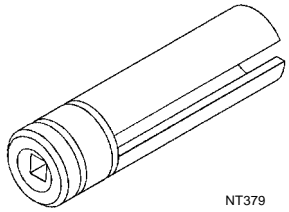
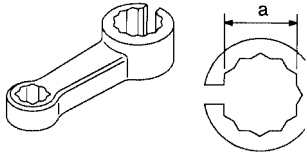
# PREPARATION

[VG33E and VG33ER]

Tool number (Kent-Moore No.) Tool name	Description	A
KV10107501 ( — ) Valve oil seal drift	  NT025	EM
KV10110300 ( — ) Piston pin press stand assembly <b>1</b> KV10110310 ( — ) Cap <b>2</b> KV10110330 ( — ) Spacer <b>3</b> ST13030020 ( — ) Press stand <b>4</b> ST13030030 ( — ) Spring <b>5</b> KV10110340 ( — ) Drift <b>6</b> KV10110320 ( — ) Center shaft	  WEM150	D E F G H I
EM03470000 (J8037) Piston ring compressor	  NT044	J K
ST16610001 (J23907) Pilot bushing puller	  NT045	L M
KV10111100 (J37228) Seal cutter	  NT046	
WS39930000 ( — ) Tube presser	  NT052	

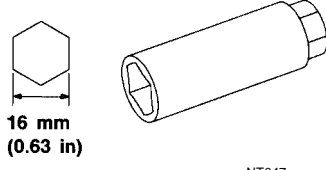
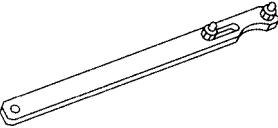
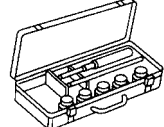
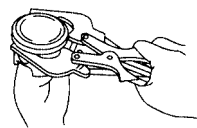
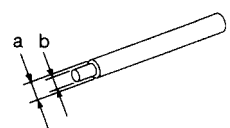
# PREPARATION

[VG33E and VG33ER]

Tool number (Kent-Moore No.) Tool name	Description
KV10117100 (J36471-A) Front heated oxygen sensor wrench  	Loosening or tightening heated oxygen sensor <b>For 22 mm (0.87 in) hexagon nut</b>
KV10114400 (J38365) Heated oxygen sensor wrench  	Loosening or tightening rear heated oxygen sensor (For right bank) <b>a: 22 mm (0.87 in)</b>

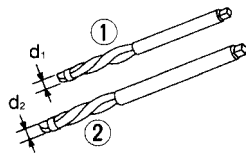
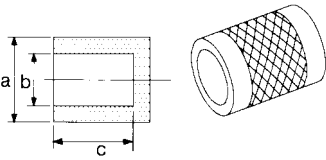
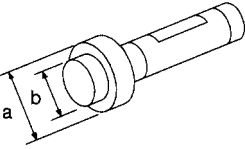
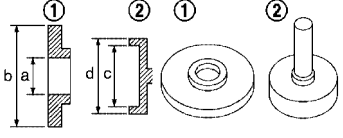
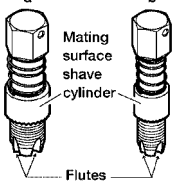

## Commercial Service Tools

EBS00CAR

Tool name (Kent-Moore No.)	Description
Spark plug wrench  	Removing and installing spark plug
Pulley holder  	Holding camshaft pulley while tightening or loosening camshaft bolt
Valve seat cutter set  	Finishing valve seat dimensions
Piston ring expander  	Removing and installing piston ring
Valve guide drift  	Removing and installing valve guide <b>Intake &amp; Exhaust:</b> <b>a = 10.5 mm (0.413 in) dia.</b> <b>b = 6.6 mm (0.260 in) dia.</b>

# PREPARATION

[VG33E and VG33ER]

Tool name (Kent-Moore No.)	Description
Valve guide reamer  NT016	Reaming valve guide 1 or hole for oversize valve guide 2 <b>Intake:</b> <b>d1 = 7.0 mm (0.276 in) dia.</b> <b>d2 = 11.2 mm (0.441 in) dia.</b> <b>Exhaust:</b> <b>d1 = 8.0 mm (0.315 in) dia.</b> <b>d2 = 12.2 mm (0.480 in) dia.</b>
Camshaft oil seal drift  NT613	Installing camshaft oil seal <b>a: 60 mm (2.36 in) dia.</b> <b>b: 44.5 mm (1.752 in) dia.</b> <b>c: 75 mm (2.95 in)</b>
Front oil seal drift  NT049	Installing front oil seal <b>a: 52 mm (2.05 in) dia.</b> <b>b: 44 mm (1.73 in) dia.</b>
Rear oil seal drift  WEM152	Installing rear oil seal <b>a: 46 mm (1.81 in)</b> <b>b: 110 mm (4.33 in)</b> <b>c: 84 mm (3.31 in)</b> <b>d: 96 mm (3.78 in)</b>
Thread repair tool for oxygen sensor a: (J-43897-18) b: (J-43897-12)  AEM488	<b>a: 18 mm (0.71 in)</b> <b>b: 12 mm (0.47 in)</b>
Anti-seize thread compound  AEM489	For preventing corrosion, seizing, and galling on high temperature applications.

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

# NOISE, VIBRATION, AND HARSHNESS (NVH) TROUBLESHOOTING

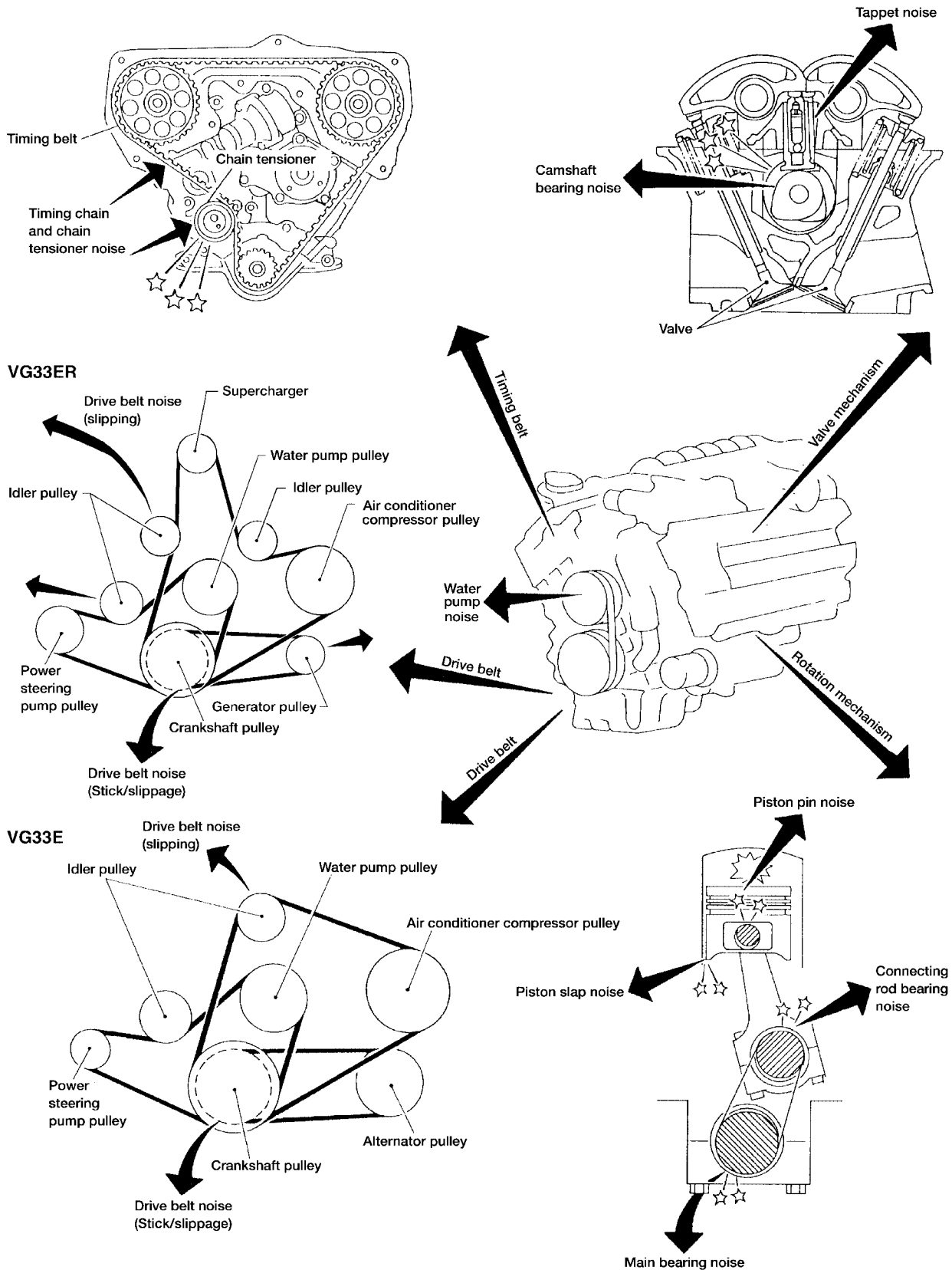
[VG33E and VG33ER]

## NOISE, VIBRATION, AND HARSHNESS (NVH) TROUBLESHOOTING

PFP:00003

### Noise, Vibration and Harshness (NVH)

EBS00CAS



WBIA0100E

# NOISE, VIBRATION, AND HARSHNESS (NVH) TROUBLESHOOTING

## [VG33E and VG33ER]

### NVH TROUBLESHOOTING CHART — ENGINE NOISE

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.
5. If necessary, repair or replace these parts.

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Hydraulic valve lifter	<a href="#">EM-106</a>
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal clearance Camshaft runout	<a href="#">EM-106</a>
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	<a href="#">EM-129</a>
	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	<a href="#">EM-129</a>
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing clearance (Small end) Connecting rod bearing clearance (Big end)	<a href="#">EM-129</a>
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	<a href="#">EM-129</a>
Timing belt cover	Whine or hissing	C	A	—	A	A	—	Timing belt noise (too tight)	Loose timing belt Belt contacting case	<a href="#">EM-90</a>
	Clatter	A	B	—	C	A	—	Timing belt noise (too loose)		
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	<a href="#">MA-24. "Checking Drive Belts"</a>
	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	<a href="#">CO-26. "Inspection"</a>

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



# OUTER COMPONENT PARTS

[VG33E and VG33ER]

- 
- |                             |                                      |                             |    |
|-----------------------------|--------------------------------------|-----------------------------|----|
| 1. PCV valve                | 2. Intake manifold collector         | 3. Gasket                   | A  |
| 4. Copper washer            | 5. Water outlet                      | 6. Thermal transmitter      |    |
| 7. Fresh air inlet          | 8. Engine coolant temperature sensor | 9. Intake manifold          |    |
| 10. Distributor             | 11. O-ring                           | 12. Water pump              |    |
| 13. Fuel injector cap       | 14. Insulator                        | 15. Fuel injector           | EM |
| 16. Engine cooling fan      | 17. Fuel tube                        | 18. Fuel pressure regulator |    |
| 19. Fuel feed hose          | 20. Fuel return hose                 | 21. Throttle body           | C  |
| 22. Air relief plug         | 23. EGR guide tube                   | 24. EGR temperature sensor  |    |
| 25. EGRC solenoid valve     | 26. EGR tube                         | 27. EGR control valve       |    |
| 28. EGRC-BPT valve          | 29. Throttle opener                  | 30. Ground                  | D  |
| 31. IACV-AAC valve assembly |                                      |                             |    |

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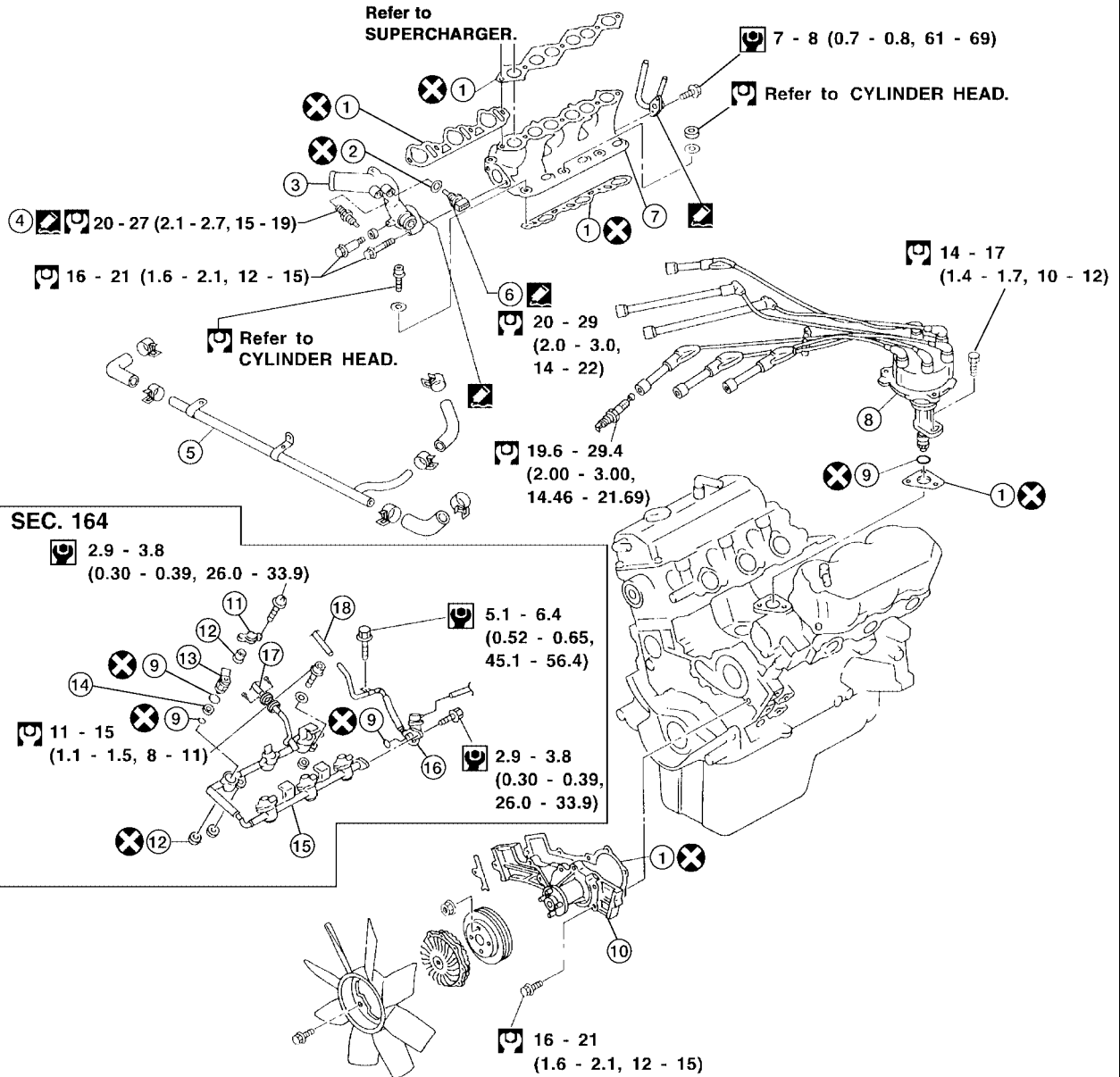
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# OUTER COMPONENT PARTS

[VG33E and VG33ER]

## VG33ER

SEC. 140•147•148•163•164•173•210•221



WBIA0422E

- |                        |                    |                                      |
|------------------------|--------------------|--------------------------------------|
| 1. Gasket              | 2. Copper washer   | 3. Water outlet                      |
| 4. Thermal transmitter | 5. Fresh air inlet | 6. Engine coolant temperature sensor |



# OUTER COMPONENT PARTS

[VG33E and VG33ER]

- 
- |                             |                        |                      |
|-----------------------------|------------------------|----------------------|
| 7. Intake manifold          | 8. Distributor         | 9. O-ring            |
| 10. Water pump              | 11. Fuel injector cap  | 12. Insulator        |
| 13. Fuel injector           | 14. Engine cooling fan | 15. Fuel tube        |
| 16. Fuel pressure regulator | 17. Fuel feed hose     | 18. Fuel return hose |

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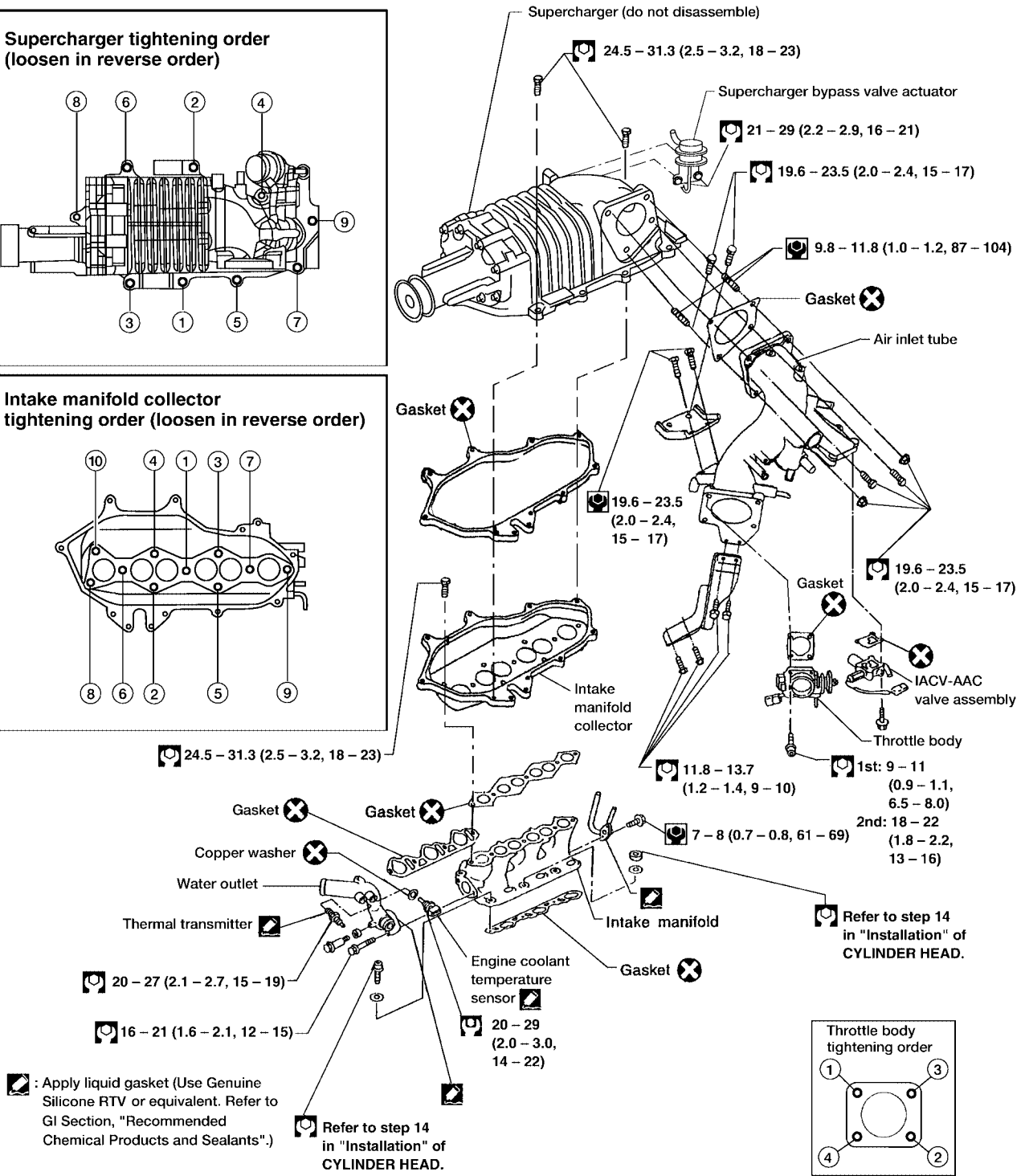
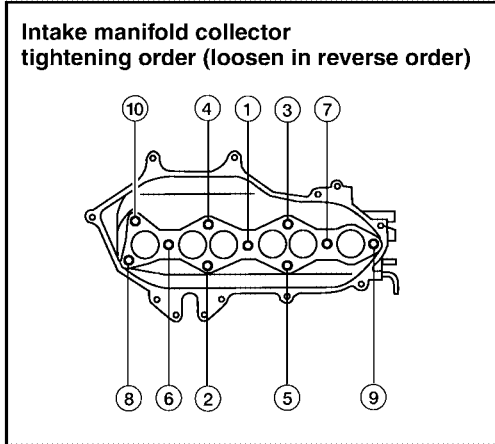
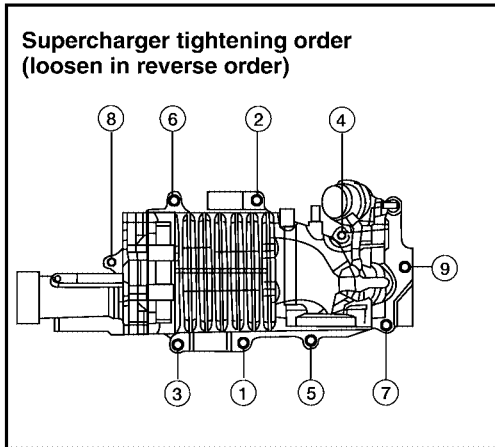
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# OUTER COMPONENT PARTS

[VG33E and VG33ER]

## VG33ER

SEC. 140 • 147 • 148 • 163 • 164 • 173 • 210 • 221



: Apply liquid gasket (Use Genuine Silicone RTV or equivalent. Refer to GI Section, "Recommended Chemical Products and Sealants".)

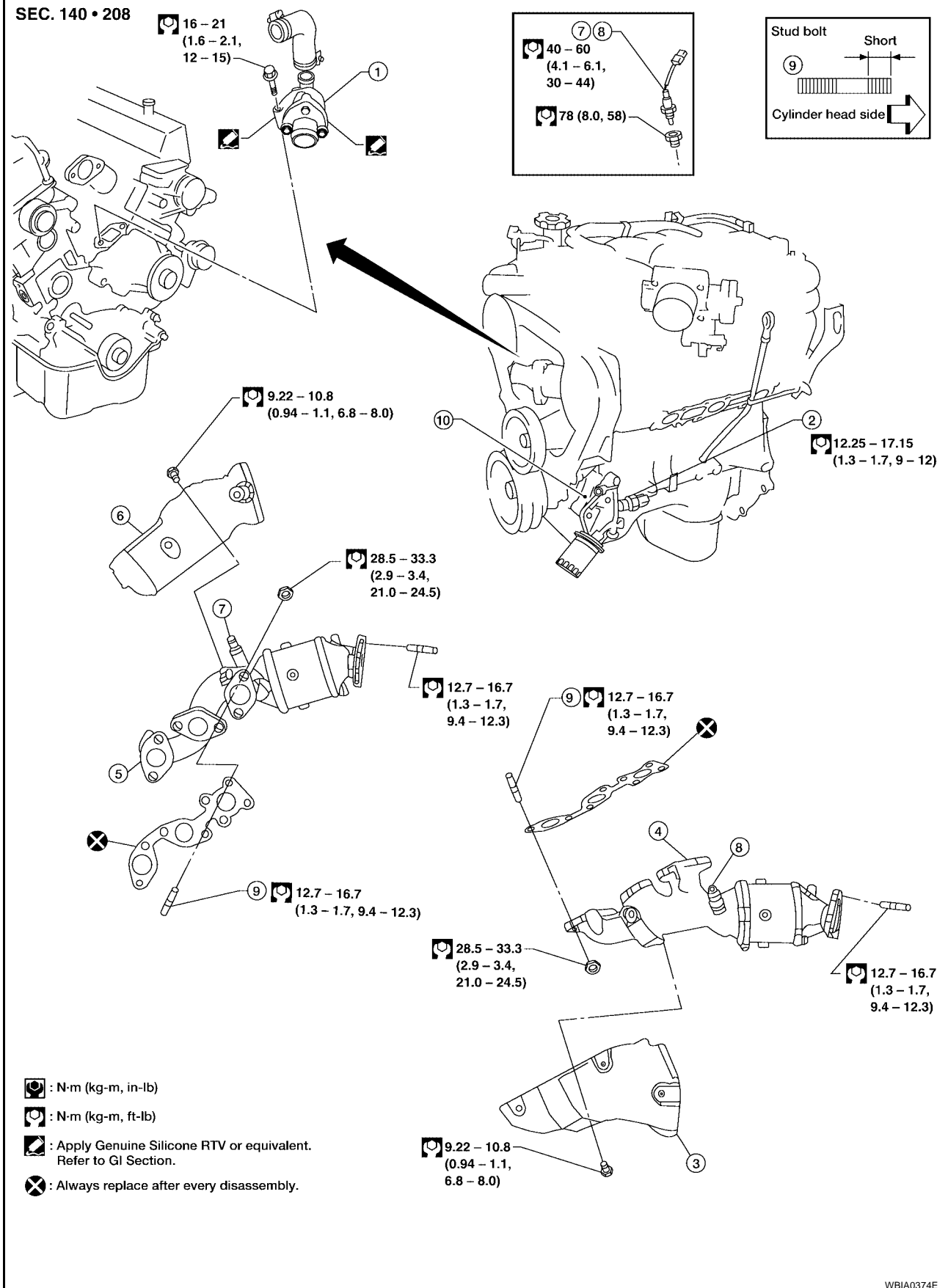
: Refer to step 14 in "Installation" of CYLINDER HEAD.

: N·m (kg·m, in·lb)

: N·m (kg·m, ft·lb)

# OUTER COMPONENT PARTS

[VG33E and VG33ER]



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- |                                     |                                     |                              |
|-------------------------------------|-------------------------------------|------------------------------|
| 1. Thermostat housing               | 2. Oil pressure switch              | 3. LH exhaust manifold cover |
| 4. LH exhaust manifold and catalyst | 5. RH exhaust manifold and catalyst | 6. RH exhaust manifold cover |

## OUTER COMPONENT PARTS

[VG33E and VG33ER]

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- 7. Heated oxygen sensor 1 (bank 1)
- 8. Heated oxygen sensor 1 (bank 2)
- 9. Exhaust manifold stud bolt
- 10. Oil filter bracket

## OIL PAN

## Removal

**WARNING:**

- Place the vehicle on a flat and solid surface.
- Place chocks at the front and rear of the rear tires.
- Do not remove the oil pan until the exhaust system and cooling system have completely cooled off. You may burn yourself. There is the possibility that fire may break out in the fuel line.
- When removing the front and rear engine mounting bolts or nuts, lift the engine slightly for safe removal.

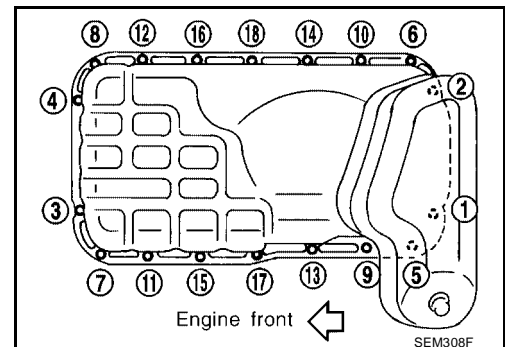
**CAUTION:**

- When lifting the engine, do not crush or damage any adjacent parts, with special attention to the accelerator wire casing end, brake tube, and brake master cylinder.
1. Remove the engine undercover.
  2. Drain the engine oil.
  3. Remove the RH and LH stabilizer bracket bolts. Refer to [FSU-17, "Removal"](#) .
  4. Remove the front propeller shaft from the front differential carrier. Refer to [PR-8, "Removal and Installation"](#) .
  5. Remove the RH and LH front drive shaft fixing bolts. Refer to [FAX-20, "Removal"](#) .
  6. Remove the front differential carrier bleeder hose.
  7. Remove the front suspension cross member. Refer to [FSU-5, "Components"](#) .
  8. Remove the RH and LH differential front mounting bolts and the rear mounting bolts. Refer to [FFD-9, "Removal and Installation"](#) .
  9. Remove the front differential carrier. Refer to [FFD-9, "Removal and Installation"](#) .
  10. Remove the front differential carrier mounting bracket. Refer to [FFD-9, "Removal and Installation"](#) .
  11. Remove the starter motor. Refer to [SC-23, "Removal"](#) .
  12. Remove the RH and LH transmission to rear engine mounting bracket nuts. Refer to [EM-124, "Removal and Installation"](#) .
  13. Remove the RH and LH engine mounting bolts or nuts. Refer to [EM-124, "Removal and Installation"](#) .
  14. Remove the power steering gear mounting brackets. Refer to [PS-15, "Removal and Installation"](#) .
  15. Lift up the engine. If necessary, disconnect the exhaust tube. Refer to [EX-3, "Removal and Installation"](#) .
  16. Remove the relay rod. Refer to [FSU-5, "Components"](#) .

**NOTE:**

It is not necessary to disconnect the pitman arm.

17. Remove the oil pan bolts, loosen the oil pan bolts in the numerical order as shown.



# OIL PAN

[VG33E and VG33ER]

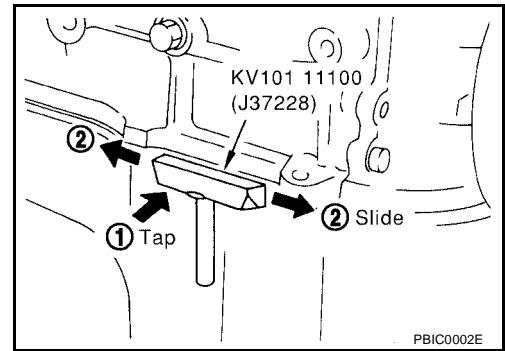
18. Remove the oil pan.

- a. Insert Tool between the cylinder block and oil pan by tapping (1) with a plastic hammer.

**CAUTION:**

- Do not drive the seal cutter into the oil pump or the rear oil seal retainer portion, or the aluminum mating face may be damaged.
- Do not insert a screwdriver or the oil pan flange may be damaged.

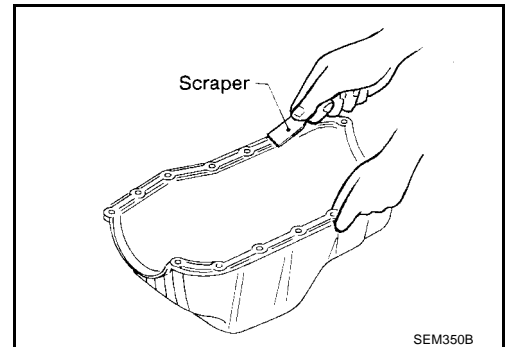
- b. Slide Tool along the joint by tapping the side of the Tool (2) with a plastic hammer, and remove the oil pan.



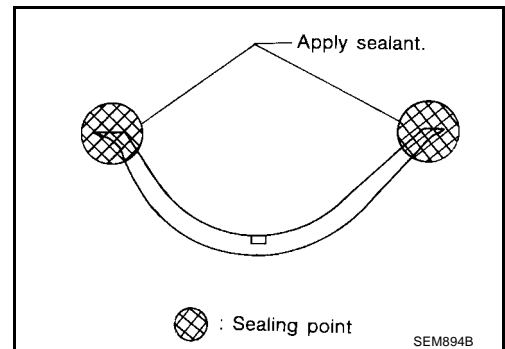
## Installation

1. Before installing the oil pan, remove all traces of liquid gasket from the mating surface using a scraper.

- Also remove all traces of liquid gasket from the mating surface of the cylinder block.

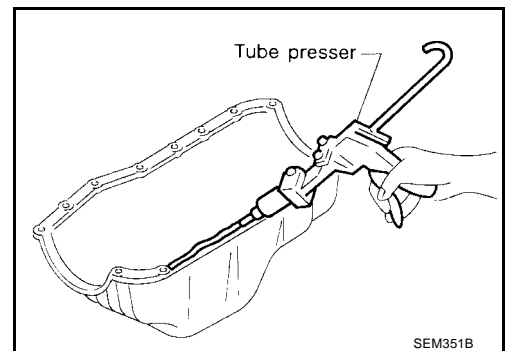


2. Apply sealant to the oil pump gasket and the rear oil seal retainer gasket.



3. Apply a continuous bead of liquid gasket to mating surface of oil pan.

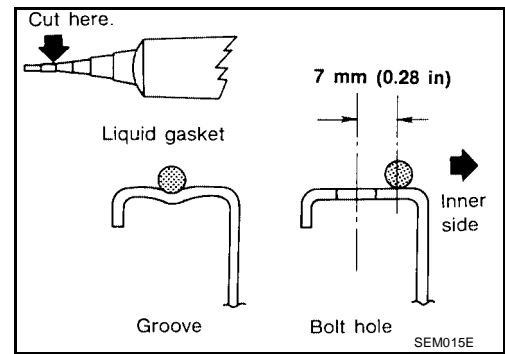
- Use Genuine Silicone RTV Sealant or equivalent. Refer to [EM-70, "Precautions for Liquid Gasket"](#).



# OIL PAN

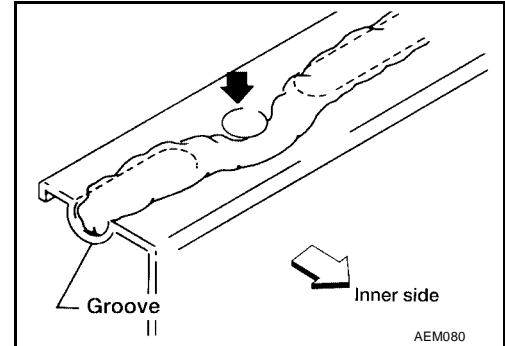
[VG33E and VG33ER]

- The bead of the liquid gasket applied is 3.5 - 4.5 mm (0.138 - 0.177 in) wide.



4. Apply liquid gasket to the inside of the bolt holes on the oil pan sealing surface as shown.

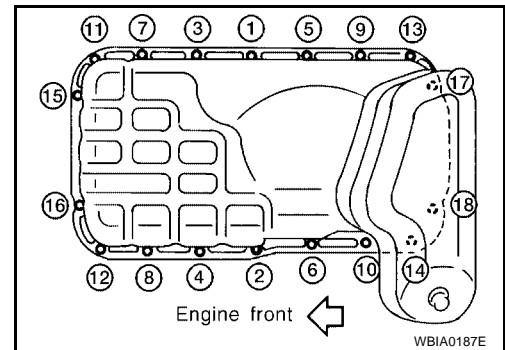
- Install the oil pan within 5 minutes after applying the liquid gasket



5. Install the oil pan.

- Tighten the oil pan bolts to specification, and in the numerical order as shown.
- Wait at least 30 minutes after installation before refilling the engine with oil.

**Oil pan bolts : 6.3 - 8.3 N·m (0.64 - 0.85 kg·m, 55.6 - 73.8 in-lb)**

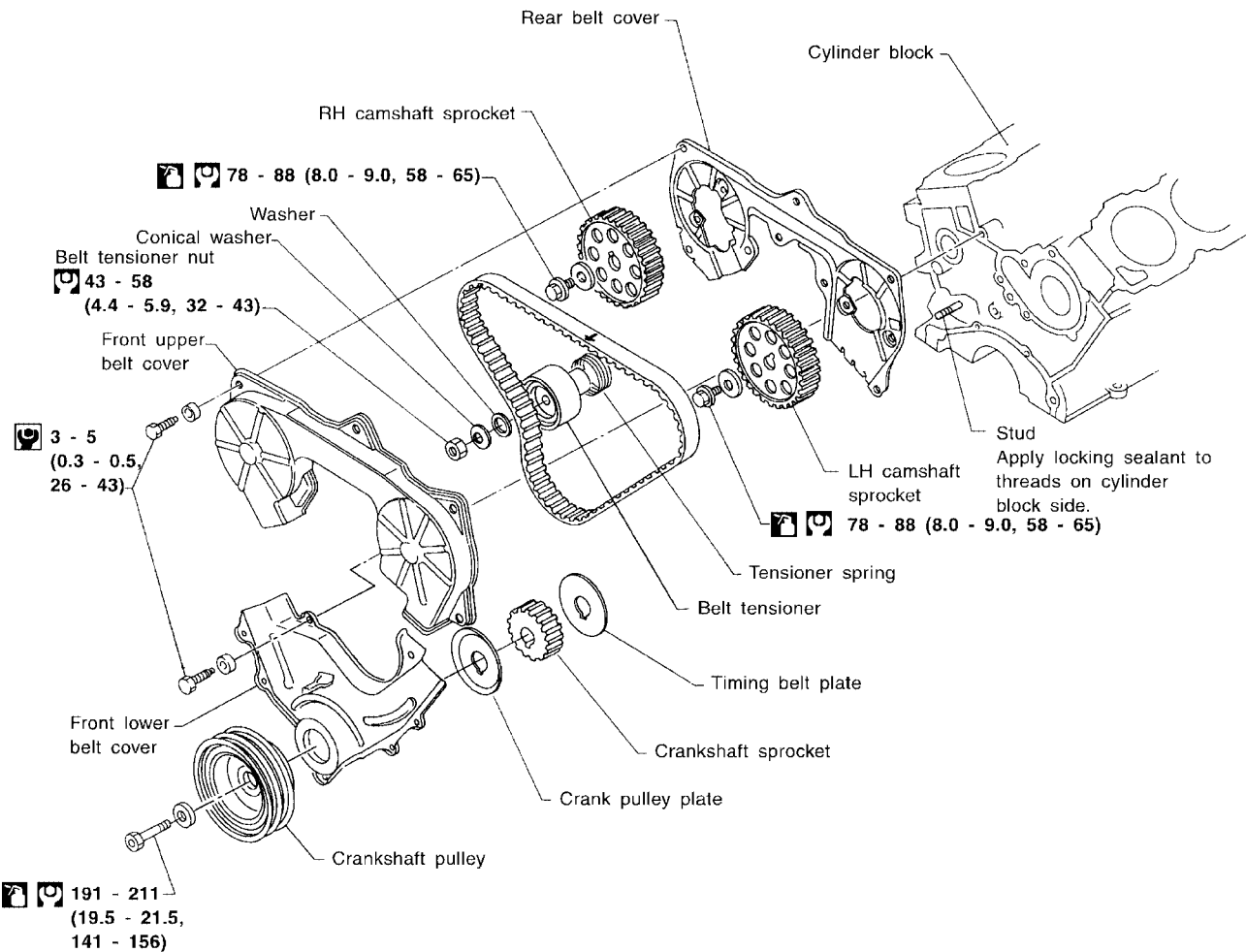


6. Install the remaining components in the reverse order of removal

### TIMING BELT

### Components

SEC. 120•130•135



: N•m (kg-m, in-lb)

: N•m (kg-m, ft-lb)

: Lubricate with new engine oil

WBIA0101E

### CAUTION:

- Do not bend or twist the timing belt.
- After removing the timing belt, do not turn the crankshaft and camshaft separately because the valves will strike the piston heads.
- Make sure that the timing belt, camshaft sprocket, crankshaft sprocket, and belt tensioner are clean and free of oil and water.
- Installation should be carried out when the engine is cold.

### Removal

1. Remove the engine under cover.
2. Drain the engine coolant from the radiator. Refer to [MA-26. "DRAINING ENGINE COOLANT"](#).

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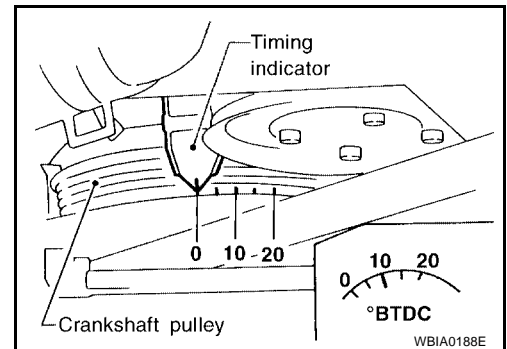
# TIMING BELT

[VG33E and VG33ER]

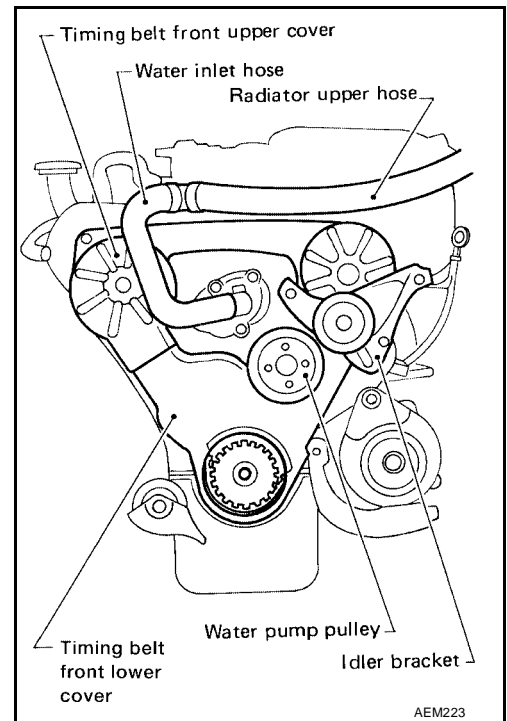
**CAUTION:**

**Do not spill coolant on the drive belts.**

3. Remove the radiator. Refer to [CO-29, "Removal and Installation"](#) .
4. Remove the engine cooling fan and water pump pulley. Refer to [CO-31, "Removal and Installation"](#) .
5. Remove the following drive belts.
  - Power steering pump drive belt
  - Compressor drive belt
  - Alternator drive belt
  - Supercharger drive belt (if equipped).
6. Remove all of the spark plugs. Refer to [EM-78, "Removal and Installation"](#) .
7. Remove the distributor protector.
8. Remove the A/C compressor drive belt idler bracket.
9. Remove the fresh-air intake tube from the rocker cover.
10. Remove the water hose from the thermostat housing.
11. Set the No. 1 piston at TDC on the compression stroke by rotating the crankshaft.
12. Remove the crankshaft pulley bolt.
13. Remove the crankshaft pulley using a suitable puller.



14. Remove the front upper and lower timing belt covers.

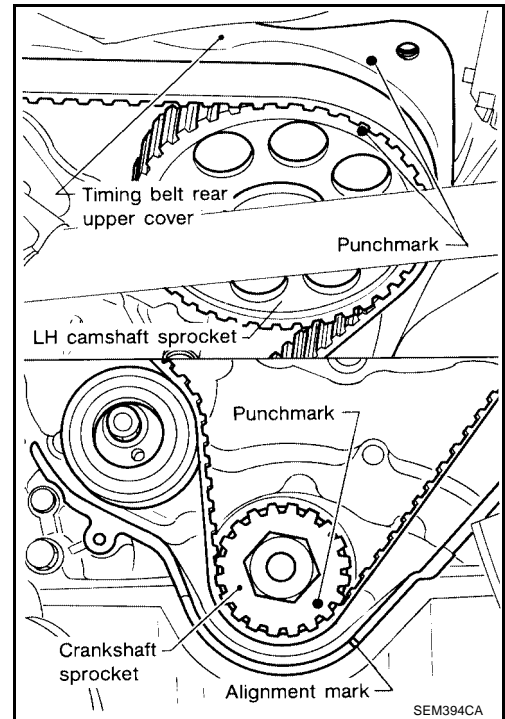


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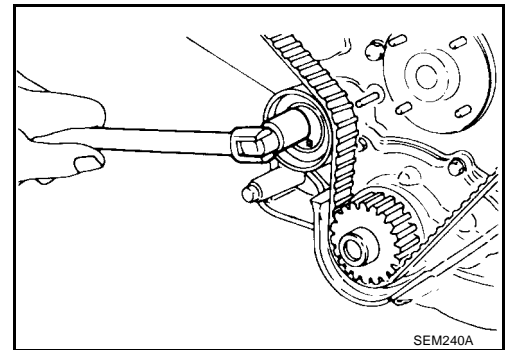
# TIMING BELT

[VG33E and VG33ER]

15. Align the timing belt sprockets to the timing marks on the engine.
- Align the punchmark on LH camshaft sprocket with the punchmark on the timing belt rear cover.
  - Align the punchmark on crankshaft sprocket with the alignment mark on the oil pump housing.
  - Temporarily install the crankshaft pulley bolt on the crankshaft so the crankshaft can be rotated.



16. Loosen the timing belt tensioner nut, rotate the tensioner, then remove the timing belt.



## Inspection

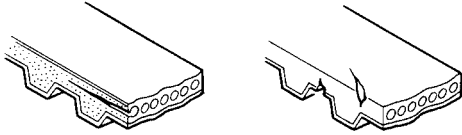
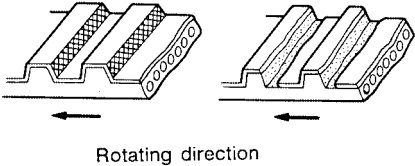
EBS00CAZ

Visually check the condition of timing belt. Replace if any abnormality is found.

Item to check	Visual inspection	Cause
<p>Tooth is broken/tooth root is cracked.</p> <p>SEM394A</p>	<ul style="list-style-type: none"> <li>● Camshaft jamming</li> <li>● Distributor jamming</li> <li>● Damaged camshaft/crankshaft oil seal</li> </ul>	
<p>Back surface is cracked/worn.</p> <p>SEM395A</p>	<ul style="list-style-type: none"> <li>● Tensioner jamming</li> <li>● Overheated engine</li> <li>● Interference with belt cover</li> </ul>	

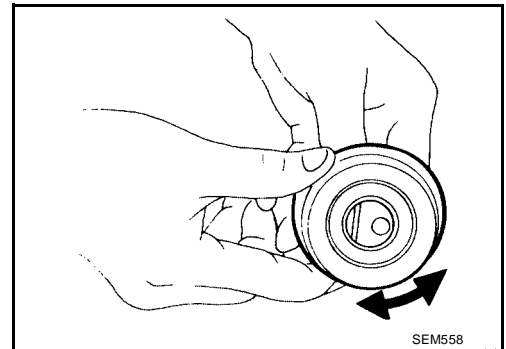
# TIMING BELT

[VG33E and VG33ER]

Item to check	Visual inspection	Cause
<ul style="list-style-type: none"> <li>● Side surface is worn.</li> <li>● Belt corners are worn and round.</li> <li>● Wicks are frayed and coming out.</li> </ul>	 <p style="text-align: right;">SEM396A</p>	<ul style="list-style-type: none"> <li>● Improper installation of belt</li> <li>● Malfunctioning crankshaft pulley plate/timing belt plate</li> </ul>
<ul style="list-style-type: none"> <li>● Teeth are worn.</li> <li>● Canvas on tooth face is worn down.</li> <li>● Canvas on tooth is fluffy, rubber layer is worn down and faded white, or weft is worn down and invisible.</li> </ul>	 <p style="text-align: center;">Rotating direction</p> <p style="text-align: right;">SEM397A</p>	<ul style="list-style-type: none"> <li>● Poor belt cover sealing</li> <li>● Coolant leakage at water pump</li> <li>● Camshaft not functioning properly</li> <li>● Distributor not functioning properly</li> <li>● Excessive belt tension</li> </ul>
<p>Oil, coolant or water has contaminated the belt.</p>	<p style="text-align: center;">—</p>	<ul style="list-style-type: none"> <li>● Poor oil sealing of each oil seal</li> <li>● Coolant leakage at water pump</li> <li>● Poor belt cover sealing</li> </ul>

## BELT TENSIONER AND TENSIONER SPRING

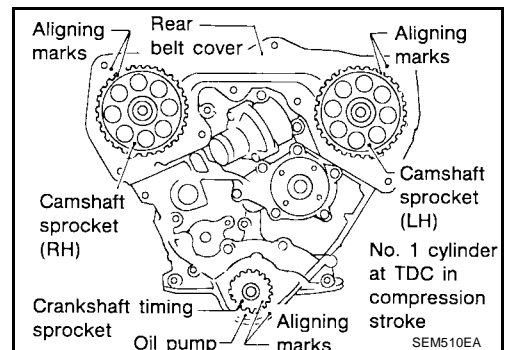
1. Check the belt tensioner for smooth turning.
2. Check the condition of the tensioner spring.
3. Replace the belt tensioner as necessary.



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## Installation

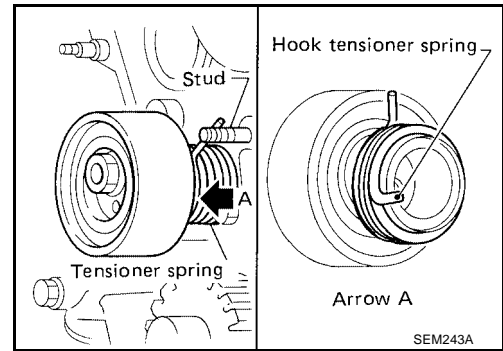
1. Confirm that the No. 1 piston is set at TDC on the compression stroke.



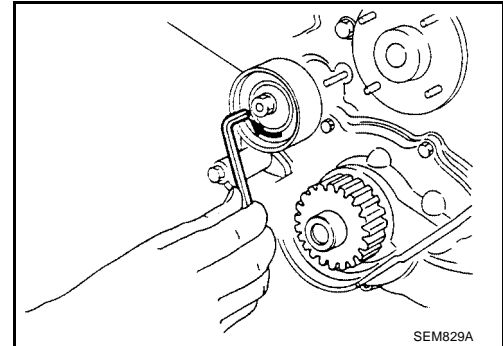
# TIMING BELT

[VG33E and VG33ER]

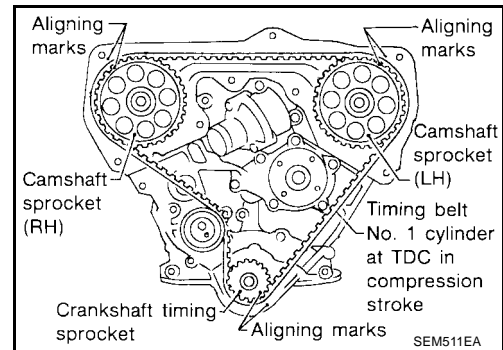
2. Install the tensioner and tensioner spring.
  - Once the stud is removed, apply locking sealant to the threads of the stud on the cylinder block side before installation.



3. Turn the tensioner fully outward with a hexagon wrench, and temporarily tighten the lock nut.



4. Install and align the timing belt when the engine is cold.
  1. Align the white lines on the timing belt with the punchmarks on the camshaft sprockets and crankshaft sprocket.
  2. Point the arrow on the timing belt toward the front belt cover.



## Number of timing belt teeth for installation (reference):

Number of timing belt teeth		133
Number of teeth between timing marks	Between LH and RH camshaft sprockets	40
	Between LH camshaft sprocket and crankshaft timing sprocket	43

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

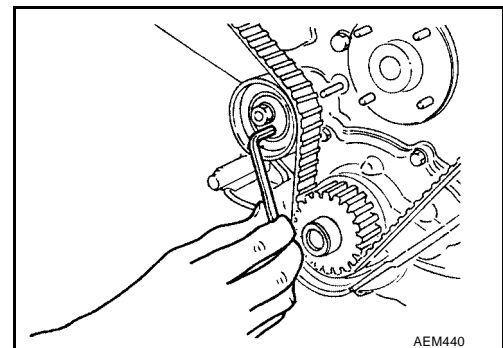
## Tension Adjustment AFTER BELT REPLACEMENT

EBS00CB1

### NOTE:

If the timing belt is replaced, or to adjust the tension on a used belt, follow the steps below.

1. Loosen tensioner lock nut, then turn tensioner clockwise and counterclockwise with hexagon wrench at least 2 times.
2. Tighten the tensioner lock nut.
3. Turn the crankshaft clockwise at least two times, then slowly set the No. 1 piston at TDC on the compression stroke.



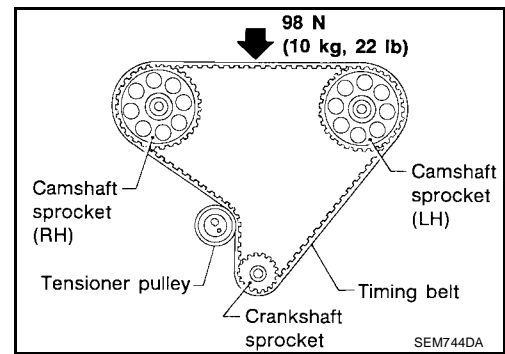
# TIMING BELT

[VG33E and VG33ER]

4. Measure the deflection of the timing belt midway between the camshaft pulleys while pushing with a specified force.

**Belt deflection when engine is cold at specified force (reference value) : 13 - 15 mm (0.51 - 0.59 in) with 98 N (10 kg, 22 lb) of force**

5. If the belt deflection is not within specification, return to step 1 and repeat the procedure.

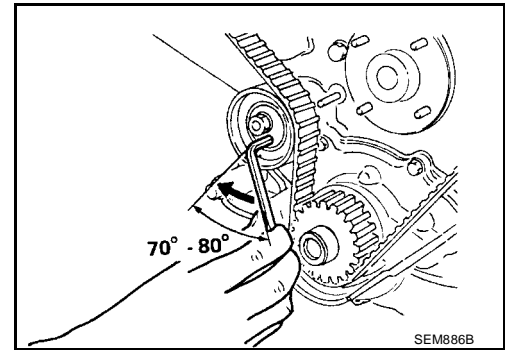


## AFTER ENGINE OVERHAUL OR ENGINE REASSEMBLY (WITH ROCKER COVERS REMOVED)

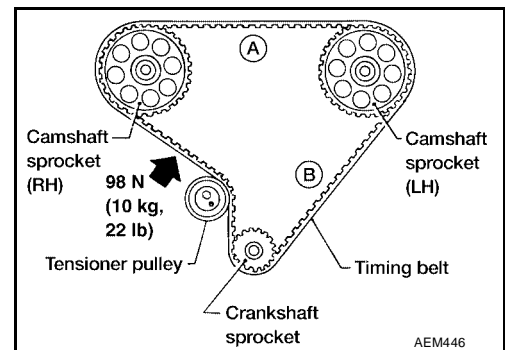
### NOTE:

If the engine was overhauled or previously disassembled (i.e. intake manifold or cylinder head were removed), follow the steps below.

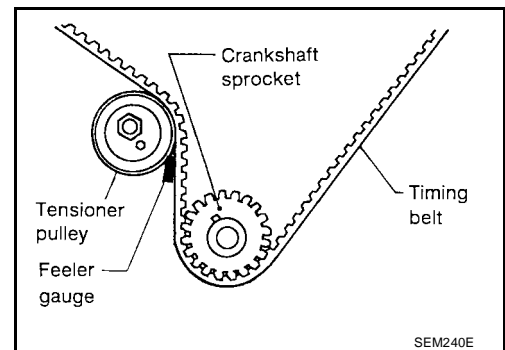
1. Loosen the rocker shaft bolts to relieve the timing belt tension caused by the camshafts.
2. Loosen the tensioner lock nut, keeping the tensioner steady with a hexagon wrench.
3. Turn the tensioner  $70^{\circ}$  to  $80^{\circ}$  degrees clockwise with a hexagon wrench to release the timing belt tension, and temporarily tighten the lock nut.
4. Turn the crankshaft clockwise at least two times, then slowly set the No. 1 piston at TDC on the compression stroke.



5. Push the timing belt between the RH camshaft sprocket and tensioner pulley with 98 N (10 kg, 22 lb) force to apply tension on part "A" and part "B" of the timing belt as shown.
6. Loosen the tensioner lock nut, keeping the tensioner steady with a hexagon wrench.



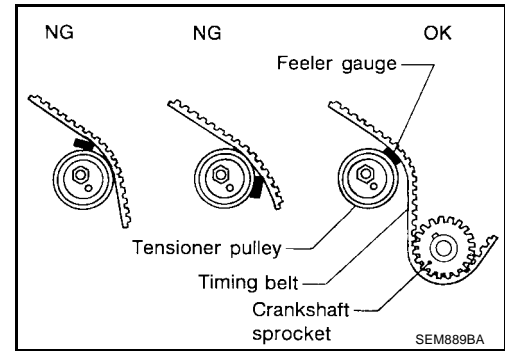
7. Position a feeler gauge size 0.5 mm (0.0206 in) thick and 12.7 mm (0.500 in) wide under the tensioner pulley as shown.



# TIMING BELT

[VG33E and VG33ER]

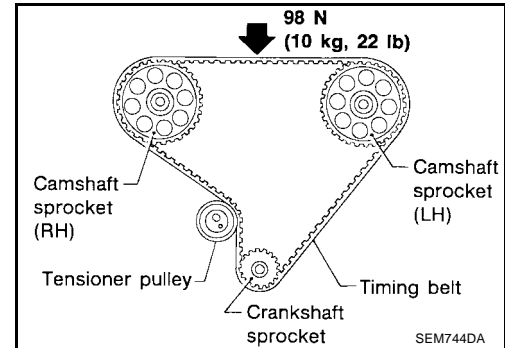
8. Turn the crankshaft clockwise until the feeler gauge is positioned between the timing belt and the tensioner pulley as shown.
  - The timing belt will move about 2.5 teeth.
9. Tighten the tensioner lock nut, keeping the tensioner steady with a hexagon wrench.
10. Turn the crankshaft clockwise or counterclockwise to remove the feeler gauge.
11. Turn the crankshaft clockwise at least two times, then slowly set the No. 1 piston at TDC on the compression stroke.



12. Measure the deflection of the timing belt halfway between the camshaft pulleys while pushing with a specified force.

**Belt deflection when engine is cold at specified force (reference value) : 13 - 15 mm (0.51 - 0.59 in) with 98 N (10 kg, 22 lb) of force**

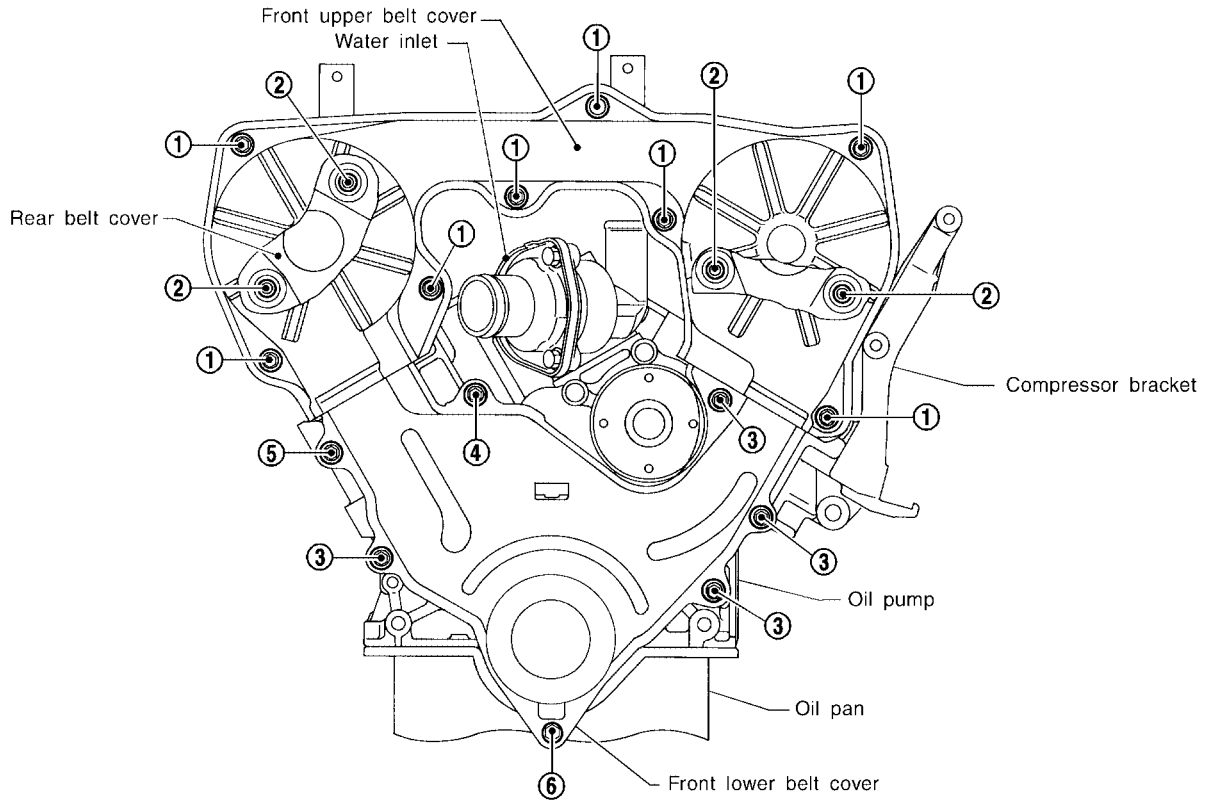
13. If the timing belt deflection is not within specification, return to step 1 and repeat this procedure.

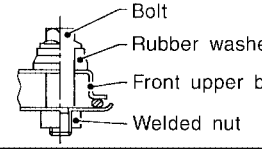
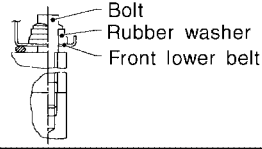
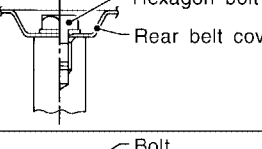
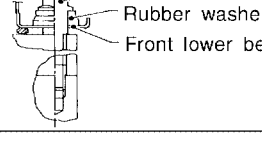
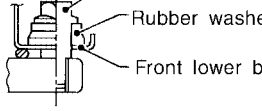
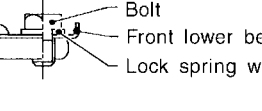


# TIMING BELT

[VG33E and VG33ER]

14. Install the lower and upper timing belt covers.



No.	Tightened parts	No.	Tightened parts		
①	 <p>Bolt Rubber washer Front upper belt cover Welded nut</p>	8 pcs.	④	 <p>Bolt Rubber washer Front lower belt cover</p>	1 pc.
②	 <p>Hexagon bolt with washer Rear belt cover</p>	4 pcs.	⑤	 <p>Bolt Rubber washer Front lower belt cover</p>	1 pc.
③	 <p>Bolt Rubber washer Front lower belt cover</p>	4 pcs.	⑥	 <p>Bolt Front lower belt cover Lock spring washer</p>	1 pc.

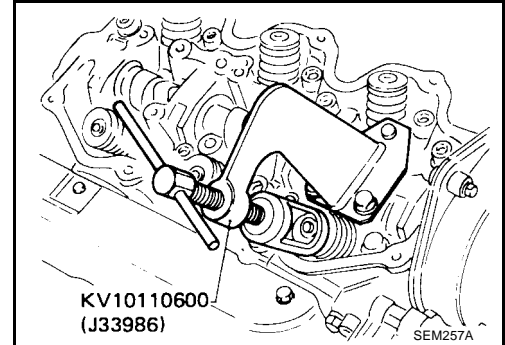
SEM313F

15. Install the remaining components in the reverse order of removal.

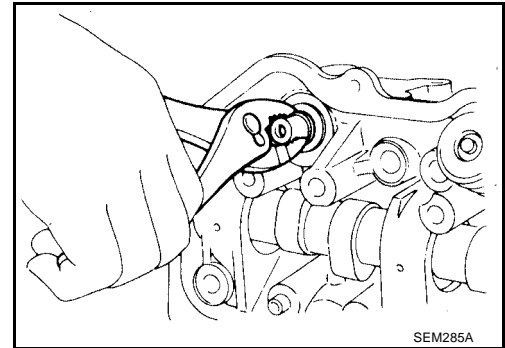
## OIL SEAL

Replacement  
VALVE OIL SEAL

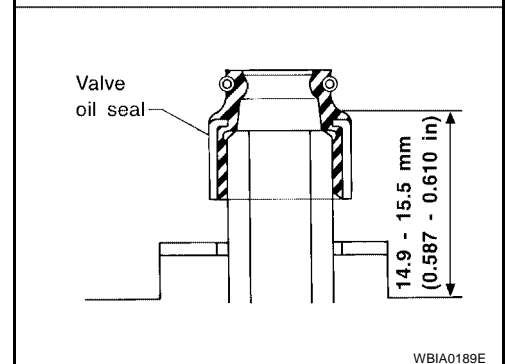
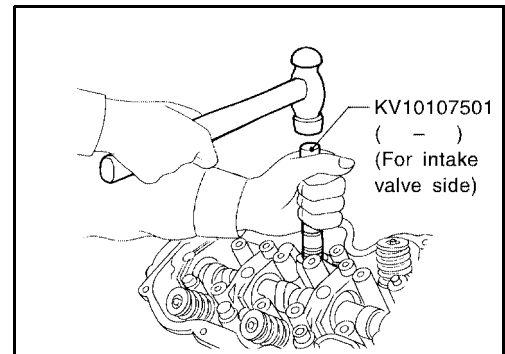
1. Remove the rocker cover.
2. Remove the camshaft and valve lifters with the valve lifter guide. Refer to [EM-105, "Disassembly"](#).
3. Remove the valve spring using Tool, as shown.
  - The piston must be set at TDC to prevent the valve from falling into the piston bore.



4. Remove the valve oil seals.
  - When removing the intake side valve oil seal, use Tool or a suitable tool.
  - When removing the exhaust side valve oil seal, pull it out with a suitable tool.



5. Apply engine oil to the new valve oil seal and install it to the specified height as shown.
  - Install the intake side valve oil seal using Tool, as shown.
  - Install the exhaust side valve oil seal by setting it by hand.



## CAMSHAFT OIL SEAL

1. Remove the timing belt. Refer to [EM-88, "Removal"](#).
2. Remove the camshaft sprocket. Refer to [EM-101, "Components"](#).
3. Remove the camshaft. Refer to [EM-105, "Disassembly"](#).
4. Remove the camshaft oil seal.



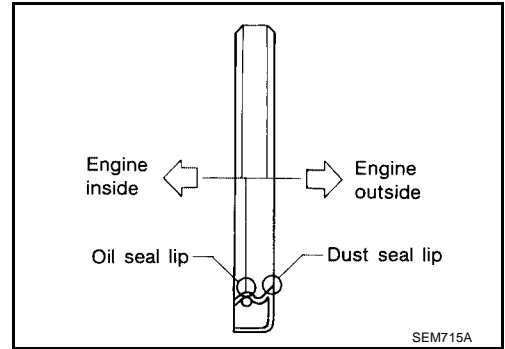
# OIL SEAL

[VG33E and VG33ER]

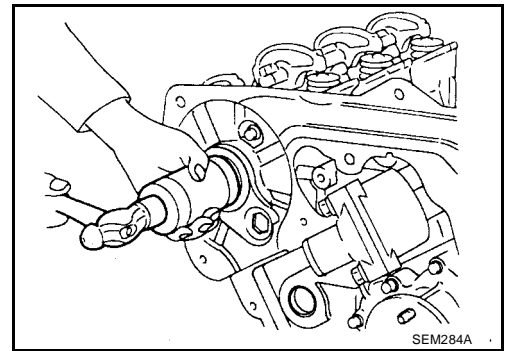
**CAUTION:**

**Be careful not to scratch or damage the camshaft.**

5. Apply new engine oil to the new camshaft oil seal.
6. Position the oil seal in the specified direction as shown.



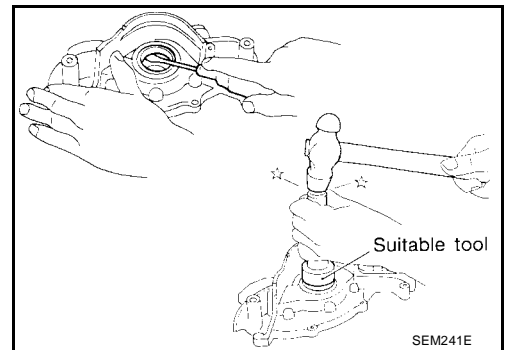
7. Install the oil seal using a suitable tool as shown.



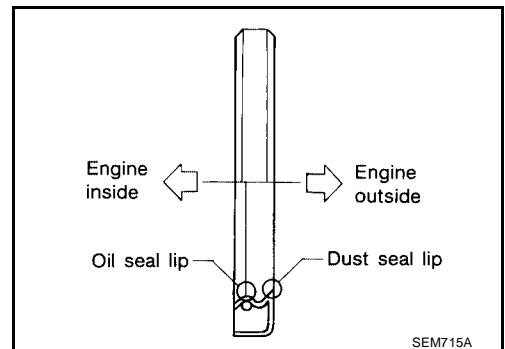
8. Install the remaining components in the reverse order of removal.

## FRONT OIL SEAL

1. Remove the timing belt and the crankshaft sprocket. Refer to [EM-88, "Removal"](#).
2. Remove the oil pump assembly. Refer to [LU-16, "Removal and Installation"](#).
3. Remove the front oil seal from the oil pump body as shown.



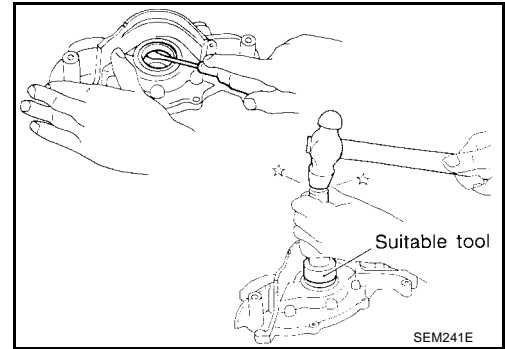
4. Apply new engine oil to the new oil seal.
5. Position the oil seal in the specified direction as shown.



## OIL SEAL

[VG33E and VG33ER]

6. Install the new oil seal using a suitable tool as shown.



7. Install the remaining components in the reverse order of removal.

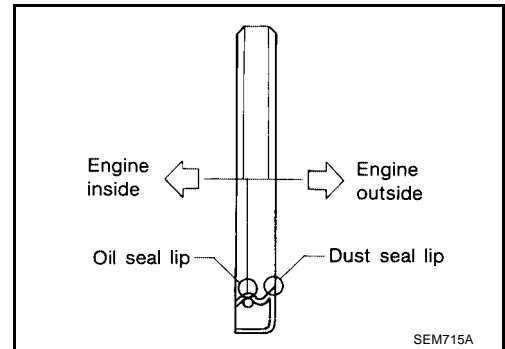
### REAR OIL SEAL

1. Remove the drive plate or flywheel. Refer to [MT-10, "Removal and Installation"](#) (FS5W71C), [MT-48, "Removal and Installation"](#) (FS5R30A), [AT-258, "REMOVAL AND INSTALLATION"](#) (A/T).
2. Remove the rear oil seal retainer.
3. Remove the rear oil seal from the retainer.

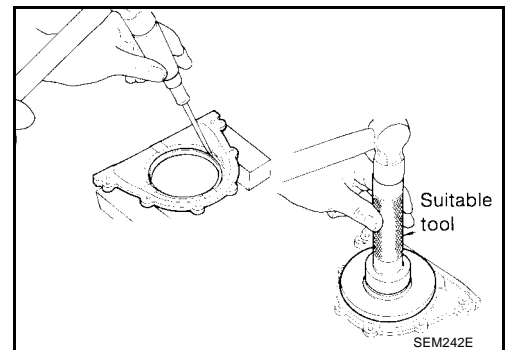
#### **CAUTION:**

**Be careful not to scratch the rear oil seal retainer.**

4. Apply new engine oil to new oil seal.
5. Position the oil seal in the specified direction as shown.



6. Install the new oil seal using a suitable tool as shown.



7. Install the rear oil seal retainer with a new gasket on the cylinder block.

#### **CAUTION:**

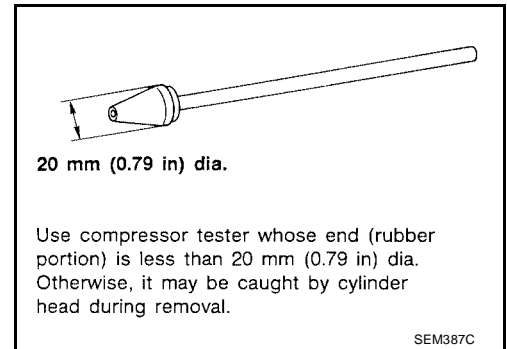
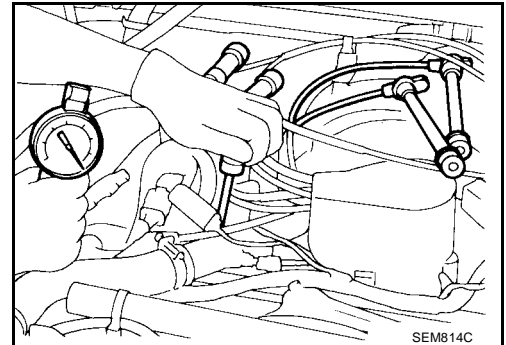
**Always use a new oil seal retainer to cylinder block gasket.**

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

### CYLINDER HEAD

#### Measurement of Compression

1. Warm up the engine.
2. Turn the ignition switch OFF.
3. Release the fuel pressure. Refer to [EC-611, "FUEL PRESSURE RELEASE"](#) (VG33E), [EC-1214, "FUEL PRESSURE RELEASE"](#) (VG33ER).
4. Remove all of the spark plugs.
  - Clean the area around the spark plug with compressed air before removing the spark plugs.
5. Disconnect the camshaft position sensor harness connector at the distributor.
6. Remove the fuel injector fuse **3** on FUSE BLOCK (J/B) behind the instrument panel lower panel. Refer to [PG-64, "FUSE BLOCK — JUNCTION BOX \(J/B\)"](#).
7. Attach the compression tester to the spark plug hole for the No. 1 cylinder.



8. Depress the accelerator pedal fully to keep the throttle valve wide open.
9. Crank the engine and record the highest compression tester gauge reading.
10. Repeat the measurement on each cylinder.
  - Always use a fully-charged battery to obtain the specified engine speed.

<b>Compression</b>	<b>: kPa (kg/cm<sup>2</sup> , psi)/300 rpm</b>
<b>Standard</b>	<b>: 1,196 (12.2, 173)</b>
<b>Minimum</b>	<b>: 883 (9.0, 128)</b>
<b>Difference limit between cylinders</b>	<b>: 98 (1.0, 14)</b>

11. If the cylinder compression in one or more cylinders is low, pour a small amount of engine oil into the cylinders through the spark plug holes and retest the compression.
  - If adding oil improves the cylinder compression, the piston rings may be worn or damaged. If so, replace the piston rings after checking the piston.
  - If the pressure stays low, a valve may be sticking or seating improperly. Inspect and repair the valve and valve seat. Refer to [EM-106, "Inspection"](#). If the valve or valve seat is damaged, replace them as necessary.
  - If the compression in any two adjacent cylinders is low and if adding oil does not improve the compression, there is possible leakage past the head gasket. If so, replace the cylinder head gasket.

## CYLINDER HEAD

[VG33E and VG33ER]

12. Reinstall all the spark plugs, fuel injector fuse, fuel pump fuse, and reconnect the camshaft position sensor harness connector at the distributor.
13. Erase the DTC stored in the ECM.

**CAUTION:**

Always erase the DTC after checking compression.

Refer to [EC-626, "HOW TO ERASE EMISSION-RELATED DIAGNOSTIC INFORMATION"](#) (VG33E), [EC-1228, "HOW TO ERASE EMISSION-RELATED DIAGNOSTIC INFORMATION"](#) (VG33ER).

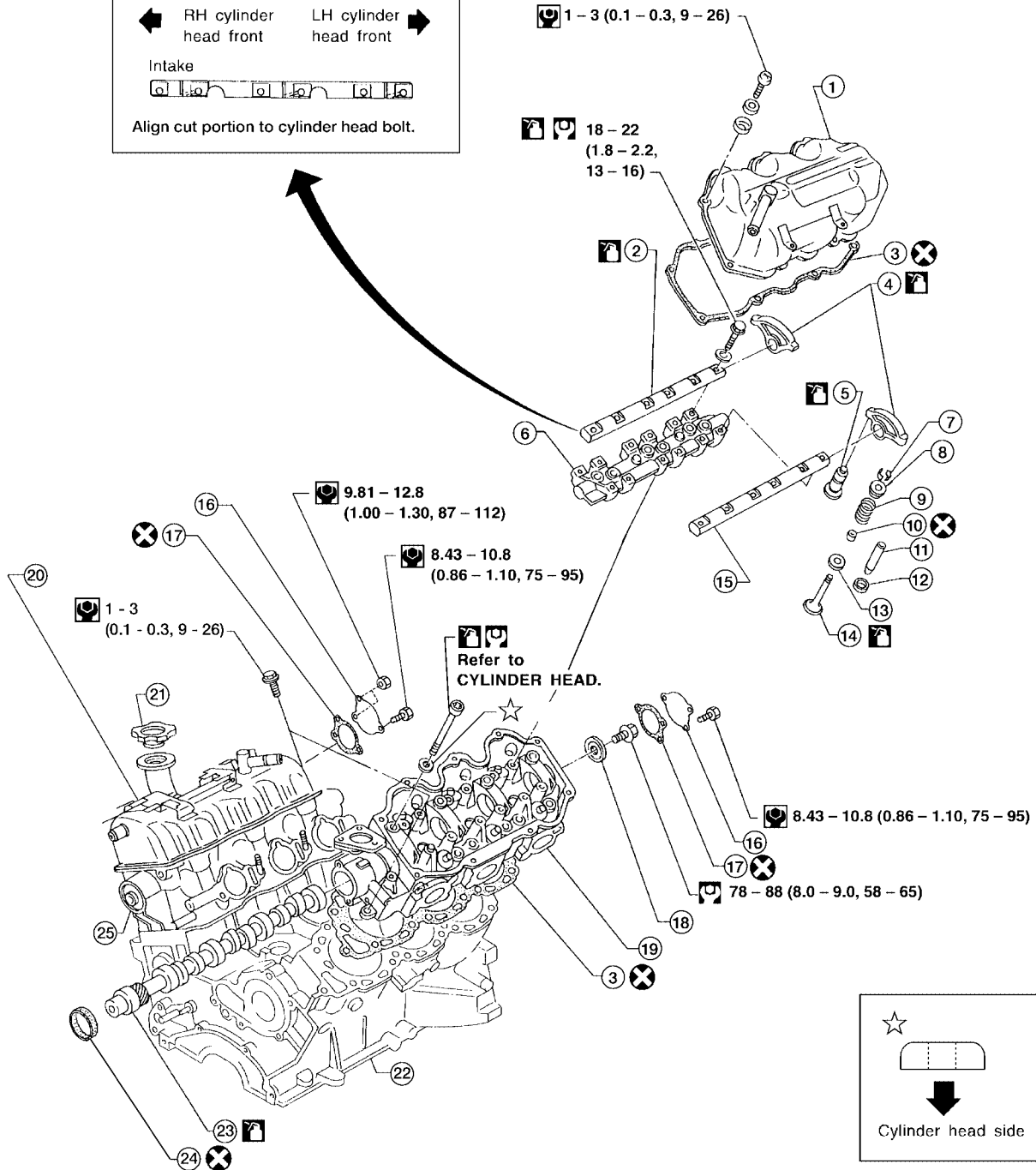
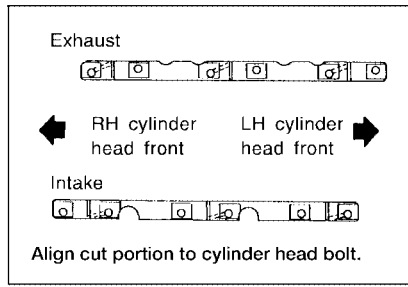
# CYLINDER HEAD

[VG33E and VG33ER]

EBS00CB3

## Components

SEC. 102•111•130



- : N·m (kg-m, in-lb)
- : N·m (kg-m, ft-lb)
- : Lubricate with new engine oil
- : Always replace after every disassembly.

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# CYLINDER HEAD

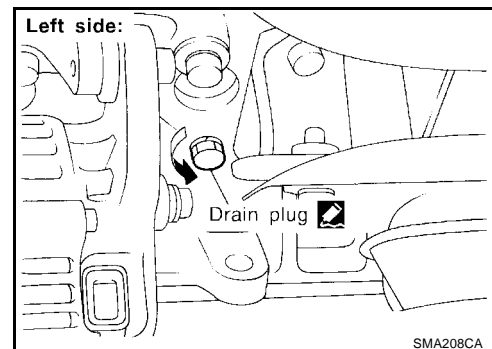
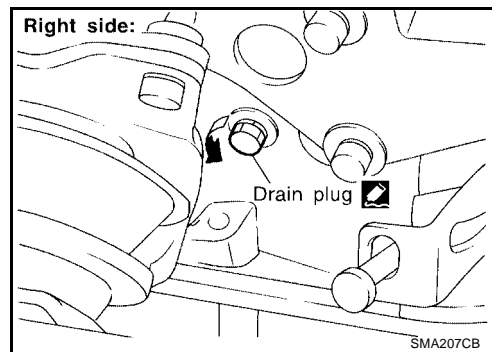
[VG33E and VG33ER]

- |                              |                           |                             |
|------------------------------|---------------------------|-----------------------------|
| 1. LH rocker cover           | 2. Intake rocker shaft    | 3. Gasket                   |
| 4. Rocker arm                | 5. Hydraulic valve lifter | 6. Valve lifter guide       |
| 7. Valve collet              | 8. Valve spring           | 9. Valve spring             |
| 10. Valve oil seal           | 11. Valve guide           | 12. Valve seat              |
| 13. Valve spring seat        | 14. Exhaust valve         | 15. Exhaust rocker shaft    |
| 16. Cylinder head rear cover | 17. Rear cover gasket     | 18. Camshaft locate plate   |
| 19. LH cylinder head         | 20. RH rocker cover       | 21. Oil filler cap          |
| 22. Cylinder block           | 23. LH camshaft           | 24. Camshaft front oil seal |
| 25. RH cylinder head         |                           |                             |

## Removal

EBS00CB4

1. Release the fuel pressure. Refer to [EC-611, "FUEL PRESSURE RELEASE"](#) (VG33E), [EC-1214, "FUEL PRESSURE RELEASE"](#) (VG33ER).
2. Remove the timing belt. Refer to [EM-88, "Removal"](#).
3. Drain the engine coolant by removing the drain plugs from both sides of the cylinder block as shown.

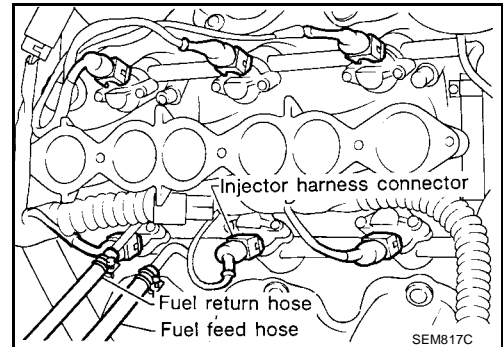
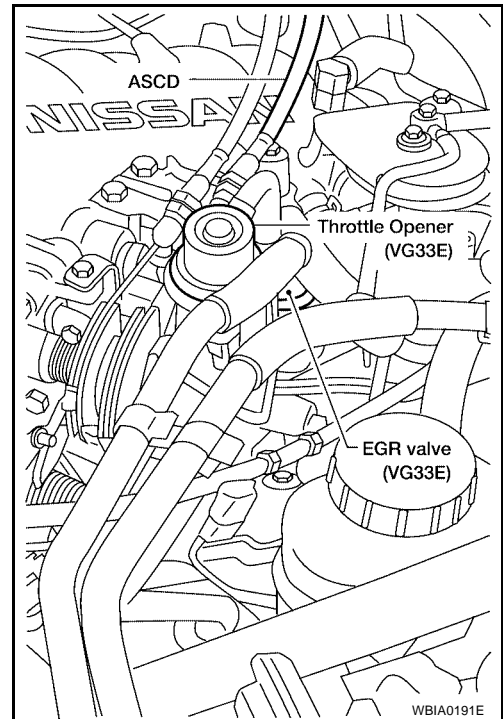


4. Separate the ASCD and the accelerator control wires from the intake manifold collector (VG33E only).
5. Remove the intake manifold collector from the engine (VG33E only).

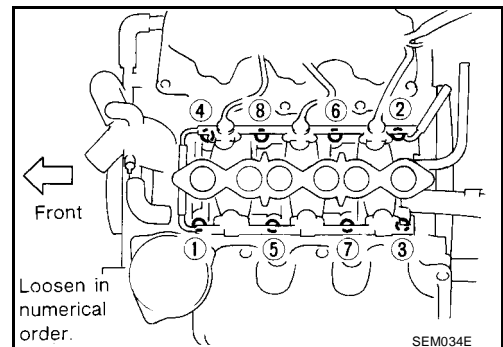
# CYLINDER HEAD

[VG33E and VG33ER]

6. Disconnect the following parts:
  - a. Harness connectors for:
    - IACV-AAC valve
    - Throttle position sensor
    - Throttle position switch
    - Distributor (ignition coil)
    - Distributor
    - EGRC solenoid valve (VG33E only)
    - EGR temperature sensor (VG33E only)
  - b. Water hoses from the intake manifold collector (VG33ER only)
  - c. Heater hoses
  - d. PCV hose from the rocker cover
  - e. Vacuum hoses for:
    - EVAP canister
    - Brake master cylinder
    - Pressure regulator
  - f. Purge hose from the purge control valve
  - g. Spark plug wires
  - h. Three left or right bank fuel injector connectors
  - i. Ground harness
  - j. EGR tube (VG33E only)
7. Remove the fuel feed and fuel return hoses from the fuel injector tube assembly.



8. Remove the fuel injector tube assembly.
9. Remove the intake manifold from the engine. The following parts should be disconnected to remove the intake manifold:
  - Engine coolant temperature switch harness connector
  - Thermal transmitter harness connector
  - Water hose from thermostat housing

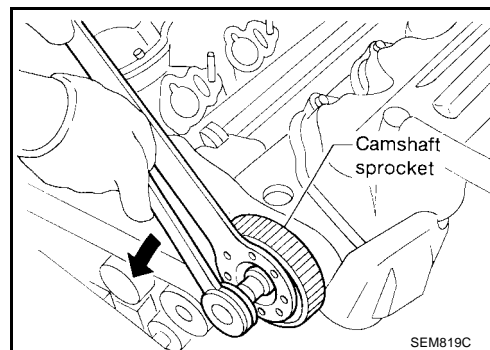


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# CYLINDER HEAD

[VG33E and VG33ER]

10. Remove both of the camshaft sprockets.

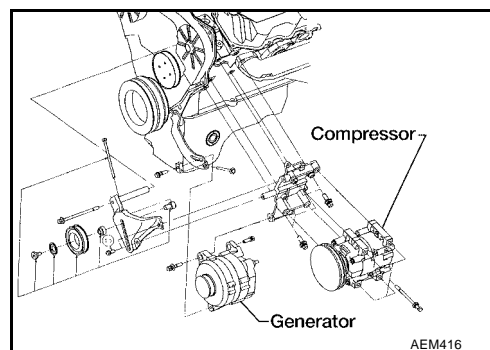


11. Remove the rear timing belt cover.  
 12. Remove the distributor and ignition wires.

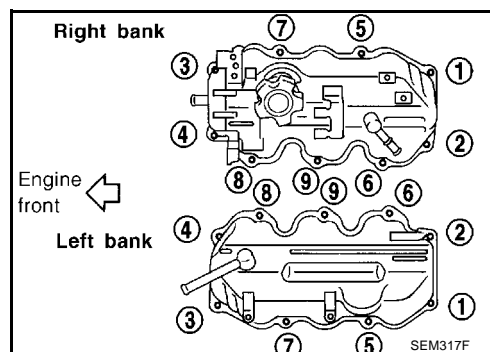
**CAUTION:**

**After pulling out the distributor from the cylinder head, do not rotate the distributor rotor.**

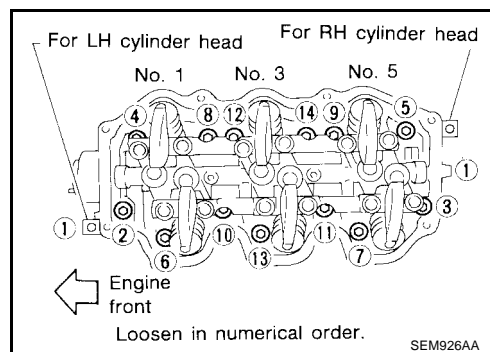
13. Remove harness clamp from RH rocker cover.  
 14. Remove exhaust tube from exhaust manifold.  
 15. Remove the A/C compressor. Refer to [MTC-66, "Removal and Installation for Compressor"](#) .  
 16. Remove the generator. Refer to [SC-35, "Removal"](#) .  
 17. Remove the power steering pump. Refer to [PS-17, "Components"](#) .  
 18. Remove the A/C compressor, generator, and power steering pump brackets.



19. Loosen and remove the bolts from both rocker covers in the numerical order as shown. Remove both of the rocker covers.



20. Remove the cylinder head with the exhaust manifold attached.
- Remove the cylinder head bolts in the specified numerical order or a warped or cracked cylinder head could result from removing the bolts in the incorrect numerical order.
  - Cylinder head bolts should be loosened in two or three steps in the numerical order as shown.

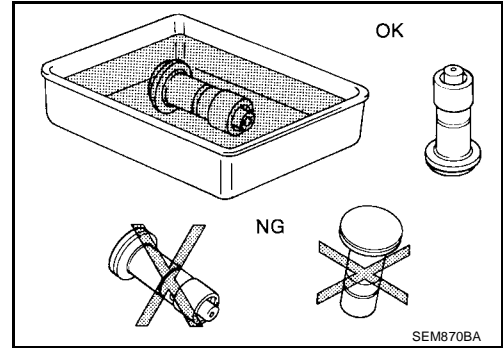




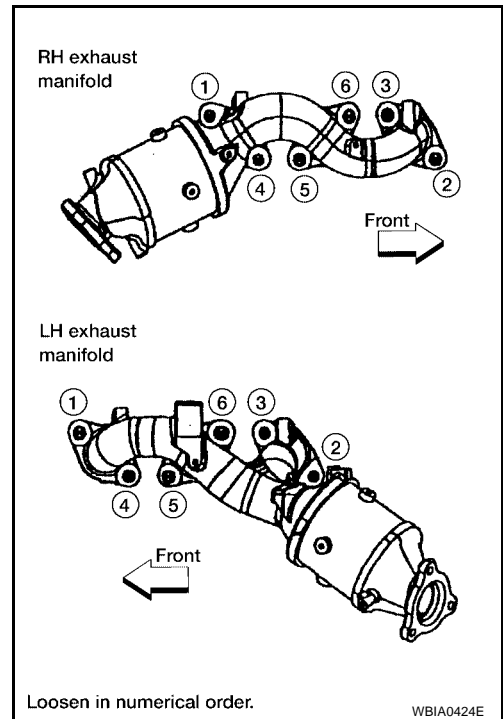
### Disassembly

**CAUTION:**

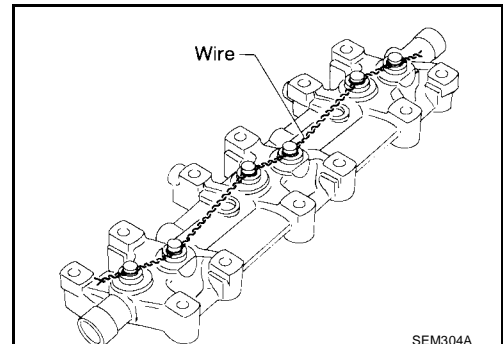
- When installing sliding parts such as rocker arms, camshaft and oil seal, be sure to apply new engine oil on their sliding surfaces.
- When tightening cylinder head bolts and rocker shaft bolts, apply new engine oil to thread portions and seat surfaces of bolts.
- If hydraulic valve lifter is kept on its side, there is a risk of air entering it. After removal, always set hydraulic valve lifter straight up, or when laying it on its side, have it soak in new engine oil.
- Do not disassemble hydraulic valve lifter.
- Attach tags to valve lifters so as not to mix them up.



1. Remove the exhaust manifold from the cylinder head. Loosen the manifold bolts in the numerical order as shown.



2. Remove the rocker shafts with the rocker arms attached.
  - The rocker shaft bolts must be loosened in two or three steps.
3. Remove the hydraulic valve lifters and lifter guide.
  - Hold the hydraulic valve lifters with a wire so that they will not drop out of the lifter guide.

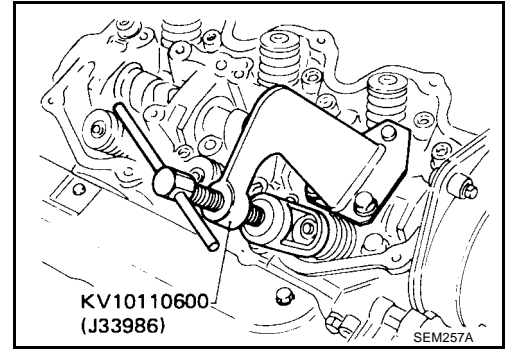


4. Remove the oil seal and camshaft.

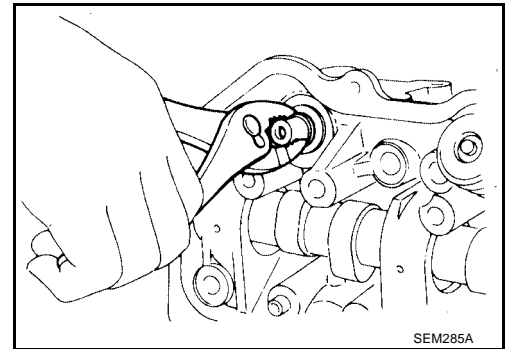
# CYLINDER HEAD

[VG33E and VG33ER]

- Before removing the camshaft, measure the camshaft end play. Refer to [EM-108, "CAMSHAFT END PLAY"](#).
5. Remove the valve spring components using Tool as shown.



6. Remove the valve oil seals using Tool, or suitable tool.

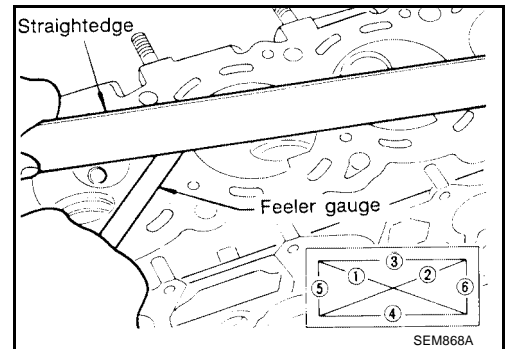


EBS00CB6

## Inspection CYLINDER HEAD DISTORTION

1. Using a straight edge and a feeler gauge, measure the flatness variation of the sealing surface of the cylinder head.

**Head surface flatness : less than 0.1 mm (0.004 in)**



2. If beyond the specified limit, resurface the cylinder head or replace it as necessary.

### Resurfacing limit:

**The resurfacing limit of cylinder head is determined by the cylinder block resurfacing.**

**Amount of cylinder head resurfacing is "A".**

**Amount of cylinder block resurfacing is "B".**

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

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

**Nominal cylinder head height : 106.8 - 107.2 mm (4.205 - 4.220 in)**

## CAMSHAFT VISUAL CHECK

Check camshaft for scratches, seizure and wear.

# CYLINDER HEAD

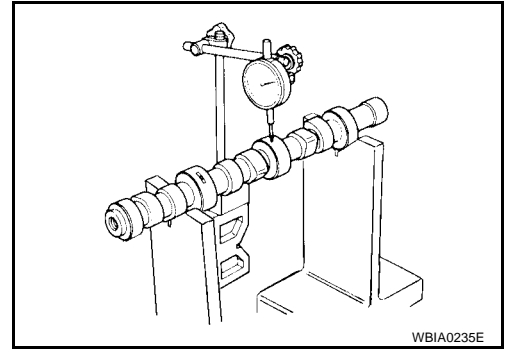
[VG33E and VG33ER]

## CAMSHAFT RUNOUT

1. Support the camshaft at the No. 2 and No. 4 journals.
2. Measure the camshaft runout at the No. 3 journal.

**Runout limit (total indicator reading)** : 0.1 mm (0.004 in)

3. If the runout exceeds the limit, replace the camshaft.



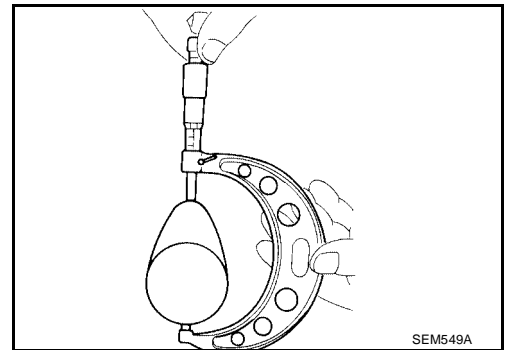
## CAMSHAFT CAM HEIGHT

1. Measure the camshaft cam height.

**Standard cam height**  
**Intake and exhaust** : 38.943 - 39.133 mm  
(1.5332 - 1.5407 in)

**Cam wear limit** : 0.15 mm (0.0059 in)

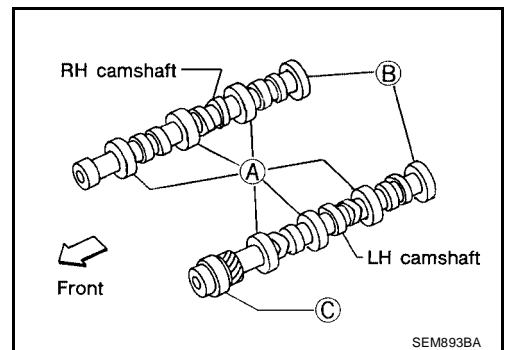
2. If the cam wear is beyond the limit, replace the camshaft.



## CAMSHAFT JOURNAL CLEARANCE

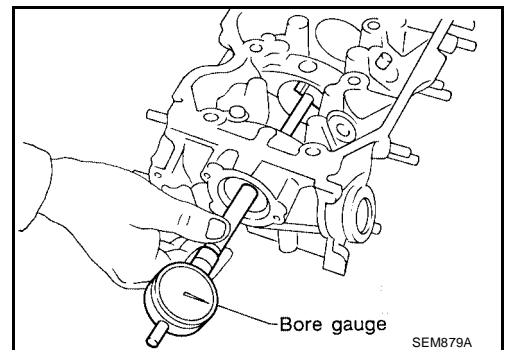
1. Measure the outer diameter of the camshaft journal as shown.

**Standard outer diameter**  
**A** : 46.920 - 46.940 mm (1.8472 - 1.8480 in)  
**B** : 42.420 - 42.440 mm (1.6701 - 1.6709 in)  
**C** : 47.920 - 47.940 mm (1.8866 - 1.8874 in)



2. Measure the inner diameter of camshaft bearing to the corresponding positions of the camshaft in step 1.

**Standard inner diameter**  
**A** : 47.000 - 47.025 mm (1.8504 - 1.8514 in)  
**B** : 42.500 - 42.525 mm (1.6732 - 1.6742 in)  
**C** : 48.000 - 48.025 mm (1.8898 - 1.8907 in)



3. If the camshaft journal or bearing clearances exceed the limit, replace either the camshaft or the cylinder head, or both, as necessary.

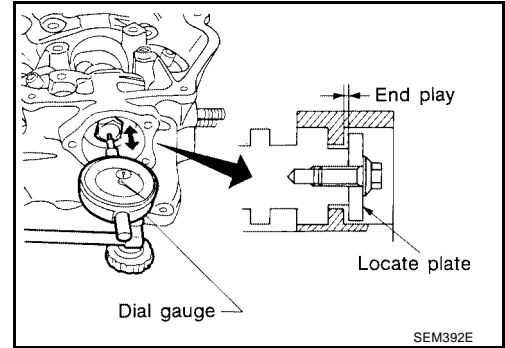
**Camshaft journal and bearing clearance limit** : 0.15 mm (0.0059 in)

### CAMSHAFT END PLAY

1. Install the camshaft and the locate plate in the cylinder head.
2. Measure the camshaft end play.

#### Camshaft end play

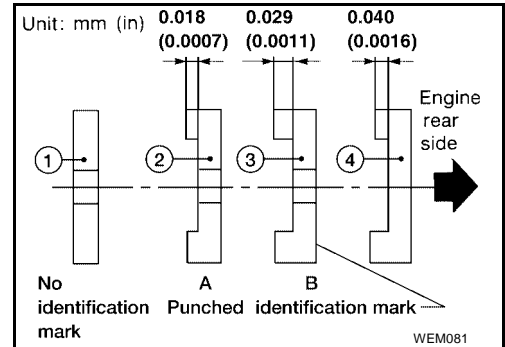
**Standard**      **0.03 - 0.06 mm (0.0012 - 0.0024 in)**



3. If the camshaft end play is out of the specified range, select the thickness of the camshaft locate plate to obtain the standard specified end play as shown.

Example:

When the camshaft end play is 0.08 mm (0.0031 in) with the camshaft locate plate No.1, replace the camshaft locate plate No.1 with the camshaft locate plate No.4 to set the camshaft end play at the specified 0.04 mm (0.0016 in).

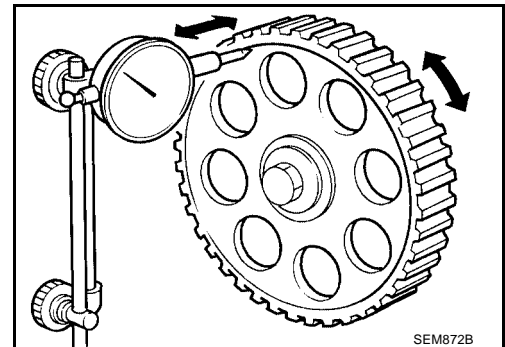


### CAMSHAFT SPROCKET RUNOUT

1. Install the sprocket on the camshaft.
2. Support the camshaft at the No. 2 and No. 4 journals.
3. Measure the camshaft sprocket runout.

**Runout limit (total indicator reading)**      **: 0.1 mm (0.004 in)**

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



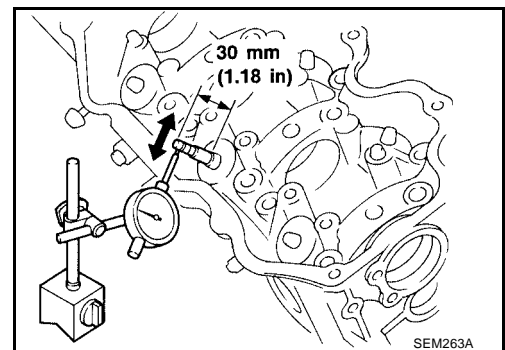
### VALVE GUIDE CLEARANCE

1. Measure the valve deflection in a right-angle direction with the camshaft as shown.

#### NOTE:

The valve and valve guide mostly wear in this direction.

**Valve deflection limit (dial gauge reading)**      **: 0.20 mm (0.0079 in)**



# CYLINDER HEAD

[VG33E and VG33ER]

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

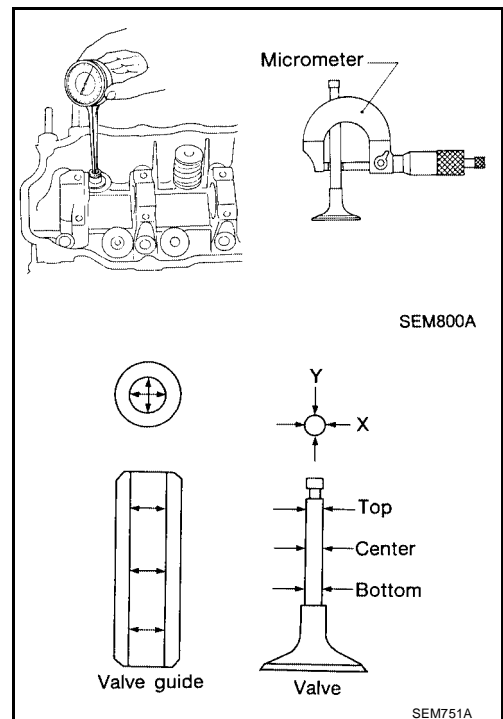
### Valve to valve guide clearance

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

**Exhaust : 0.030 - 0.049 mm (0.0012 - 0.0019 in)**

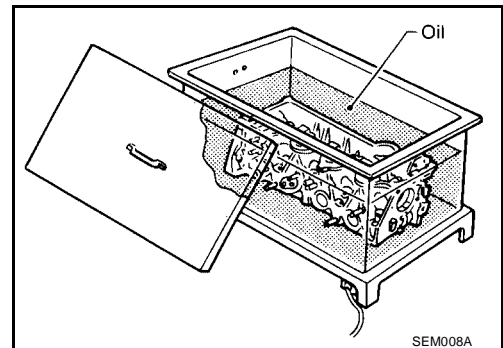
**Limit : 0.10 mm (0.0039 in)**

- c. If the valve to valve guide clearance exceeds the limit, replace the valve or valve guide as necessary.

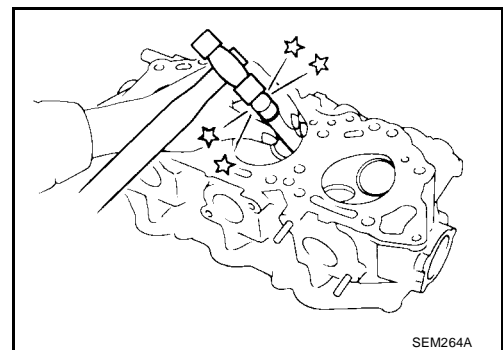


## VALVE GUIDE REPLACEMENT

1. To remove the valve guide, heat the cylinder head to 150° - 160°C (302° - 320°F) by soaking the cylinder head in heated oil as shown.



2. Drive out the valve guide with a press using a force under a 20 kN (2 ton, 2.2 US ton, 2.0 Imp. ton) of pressure, or use a hammer and a suitable tool as shown.

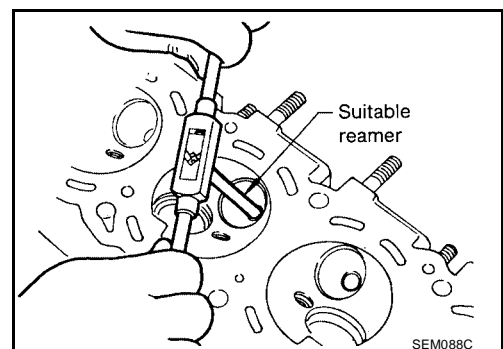


3. Ream the cylinder head valve guide hole as shown.

### Valve guide hole diameter (for service parts)

**Intake : 11.175 - 11.196 mm (0.4400 - 0.4408 in)**

**Exhaust : 12.175 - 12.196 mm (0.4793 - 0.4802 in)**



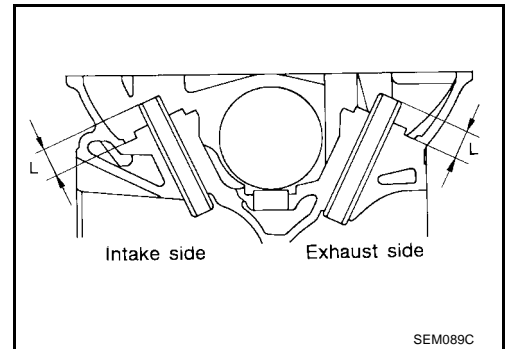
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# CYLINDER HEAD

[VG33E and VG33ER]

- Heat the cylinder head to 150° - 160°C (302° - 320°F) in heated oil and press the service valve guide into the cylinder head to the specified height as shown.

**Height "L" : 13.2 - 13.4 mm (0.520 - 0.528 in)**

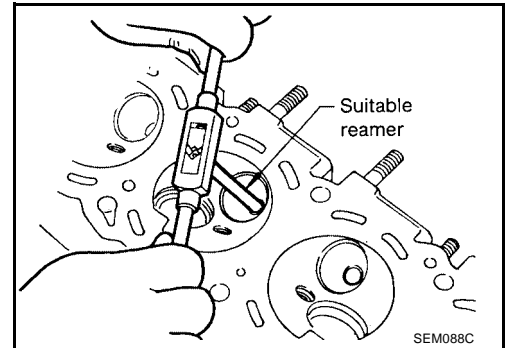


- Ream the new valve guides to specification.

**Finished size**

**Intake : 7.000 - 7.018 mm (0.2756 - 0.2763 in)**

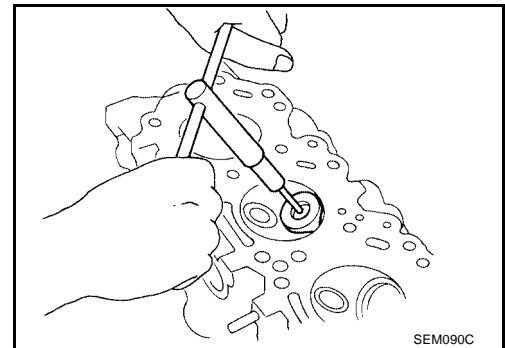
**Exhaust : 8.000 - 8.011 mm (0.3150 - 0.3154 in)**



## VALVE SEATS

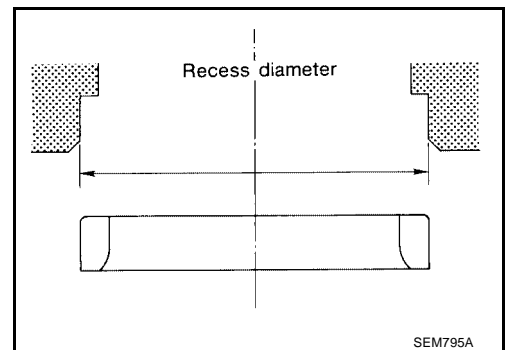
Check the valve seats for any pitting at the valve contact surface, and re-seat or replace the valve seat if it has worn out.

- Before repairing the valve seats, check the valve and valve guide for wear. Refer to [EM-142, "Valve"](#).
- Use both hands to cut the valve seat uniformly as shown.



## REPLACING VALVE SEAT FOR SERVICE PARTS

- Bore out the old valve seat until it collapses. The machine depth stop should be set so that boring cannot continue beyond the bottom face of the seat recess in cylinder head.



# CYLINDER HEAD

[VG33E and VG33ER]

2. Ream the cylinder head valve seat recess.

**CAUTION:**

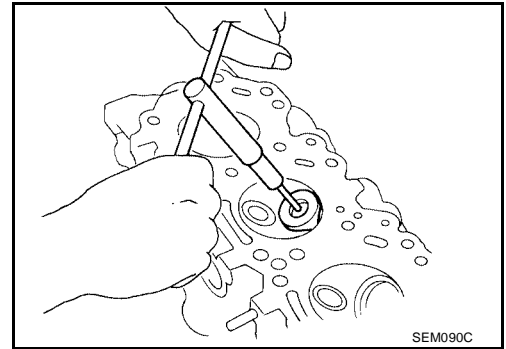
Reaming should be done in circles concentric to the valve guide center so that valve seat will have the correct fit.

Reaming bore for service valve seat

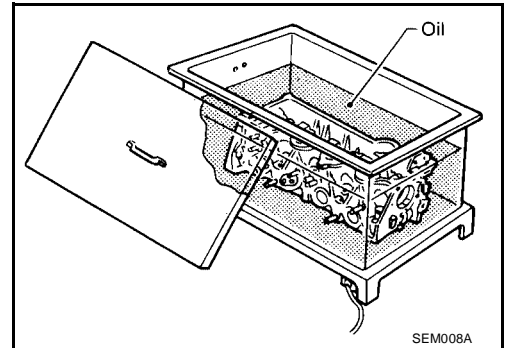
Oversize : 0.5 mm (0.020 in)]

Intake : 44.500 - 44.516 mm (1.7520 - 1.7526 in)

Exhaust : 37.500 - 37.516 mm (1.4764 - 1.4770 in)

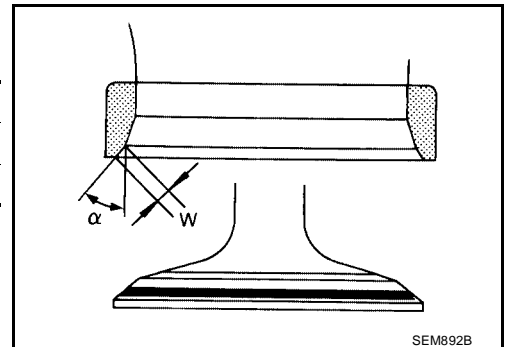


3. Heat the cylinder head to 150° - 160°C (302° - 320°F) by soaking it in heated oil as shown.



4. Press fit the valve seat until it seats on the bottom of the recess.  
5. Cut or grind the valve seat using a suitable tool to the specified dimensions as shown.

Valve	Intake	Exhaust
Seat face angle "α" degree	45°	45°
Contacting width "W" mm (in)	1.75 (0.0689)	1.7 (0.067)



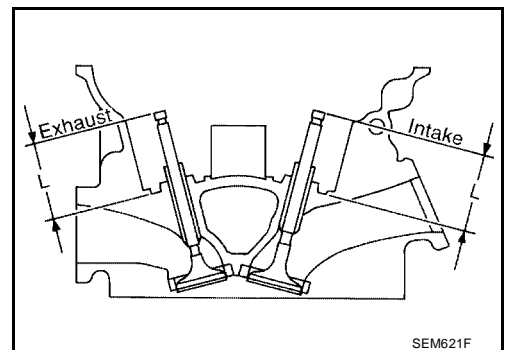
6. After cutting the valve seat, lap the valve seat with an abrasive compound.  
7. Inspect the valve seating for proper fit.

8. Use a depth gauge to measure the distance "L" between the mounting surface of the cylinder head spring seat and the valve stem end as shown.

Intake "L" : 44.7 - 44.9 mm (1.760 - 1.768 in)

Exhaust "L" : 45.4 - 45.6 mm (1.787 - 1.795 in)

- If the distance "L", as shown, is shorter than specified, repeat step 5 above to adjust it.
- If the distance "L", as shown, is longer and the valve stem tip cannot be ground down within the specified limit to obtain the specified distance "L", then replace the valve seat with a new one.

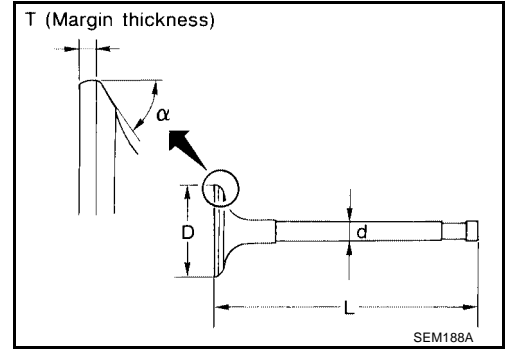


Valve stem tip grinding allowance : 0.2 mm (0.008 in)  
or less

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### VALVE DIMENSIONS

Check the dimensions of each valve. Refer to [EM-142, "VALVE"](#). If the valve head has been worn to less than 0.5 mm (0.020 in) in margin thickness "T", replace the valve.

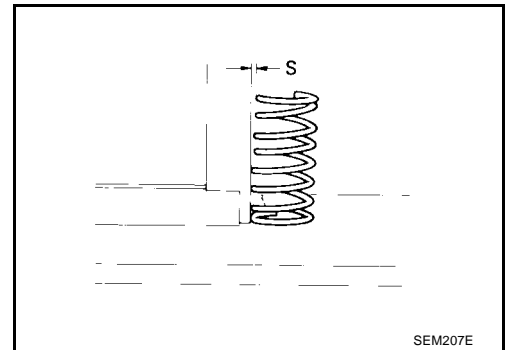


### VALVE SPRING

#### Squareness

1. Measure the distance "S" of the valve spring against a right angle as shown.

**Out-of-square : less than 2.0 mm (0.079 in)**



2. If the valve spring out-of-square exceeds the limit, replace the valve spring.

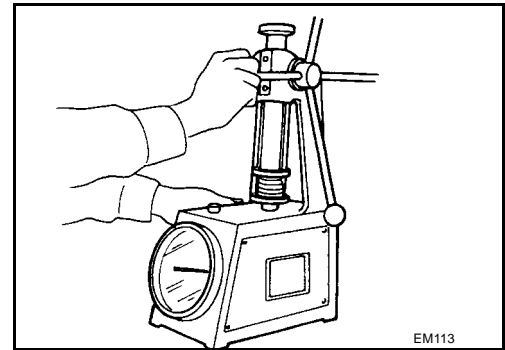
#### Pressure

1. Check the valve spring pressure at the specified compressed height (valve open height).

**Standard pressure : 770 - 837 N (78.5 - 85.4 kg, 173.1 - 188.2 lb) at 30.0 mm (1.181 in) height**

**Limit pressure : 733 N (74.7 kg, 164.7 lb) at 30.0 mm (1.181 in) height**

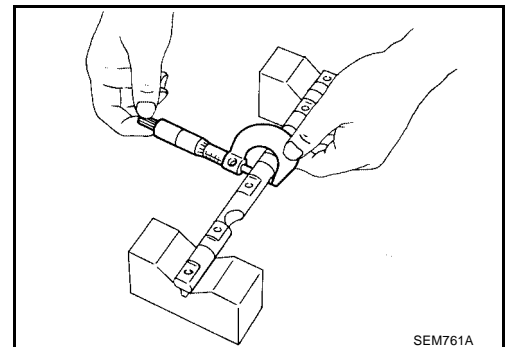
2. If not within specification, replace the spring.



### ROCKER SHAFT AND ROCKER ARM

1. Check the rocker shafts for scratches, seizure, and wear.
2. Check the outer diameter of the rocker shafts.

**Rocker shaft outer diameter : 17.979 - 18.000 mm (0.7078 - 0.7087 in)**





# CYLINDER HEAD

[VG33E and VG33ER]

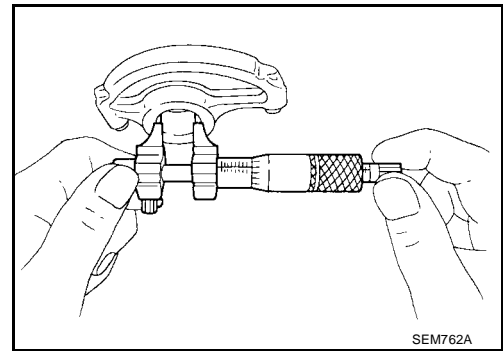
3. Check the inner diameter of the rocker arms.

**Rocker arm inner diameter** : 18.007 - 18.028 mm  
(0.7089 - 0.7098 in)

**Rocker arm to shaft clearance** : 0.007 - 0.049 mm  
(0.0003 - 0.0019 in)

**CAUTION:**

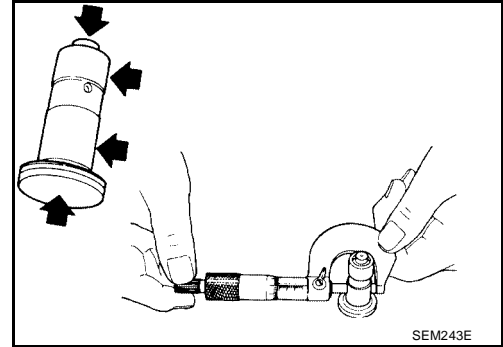
Keep rocker arm with hydraulic valve lifter standing to prevent air from entering hydraulic valve lifter when checking.



## HYDRAULIC VALVE LIFTER

1. Check the outer diameter of the valve lifter. Check the contact and sliding surfaces for wear or scratches.

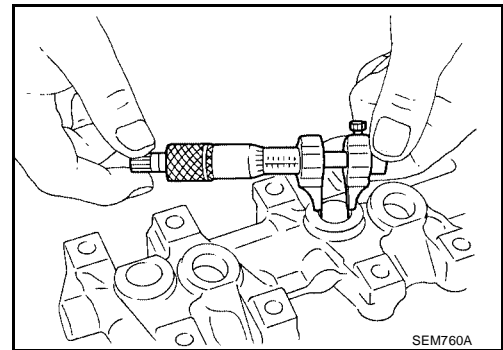
**Valve lifter outer diameter** : 15.947 - 15.957 mm  
(0.6278 - 0.6282 in)



2. Check valve lifter guide inner diameter.

**Inner diameter** : 16.000 - 16.013 mm  
(0.6299 - 0.6304 in)

**Standard clearance between valve lifter and lifter guide** : 0.043 - 0.066 mm  
(0.0017 - 0.0026 in)

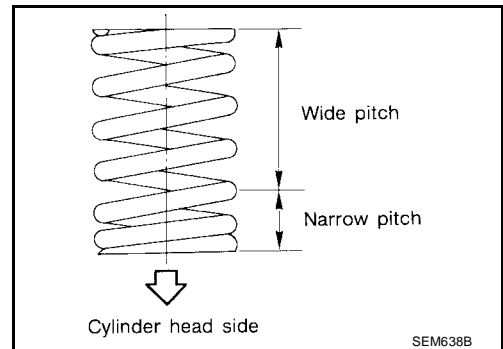


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## Assembly

1. Install the valve component parts.

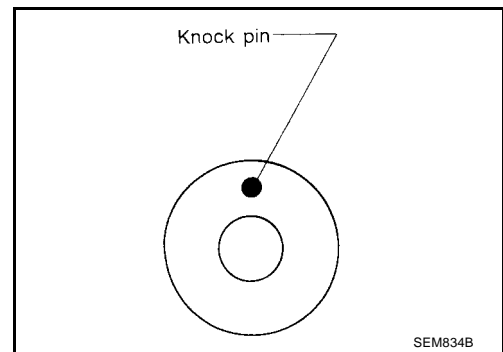
- Always use a new valve oil seal. Refer to [EM-96, "VALVE OIL SEAL"](#).
- Install the valve spring (uneven pitch type) with the narrow pitch side toward the cylinder head side as shown.
- After installing the valve component parts, use a plastic hammer to lightly tap the valve stem tip to check for a proper fit.



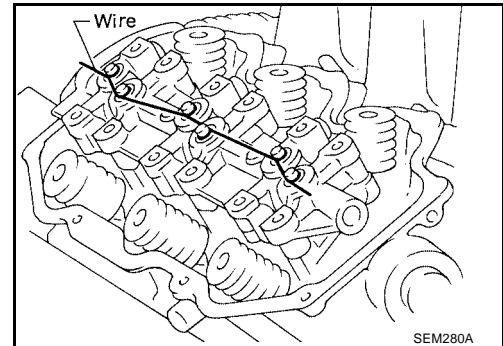
# CYLINDER HEAD

[VG33E and VG33ER]

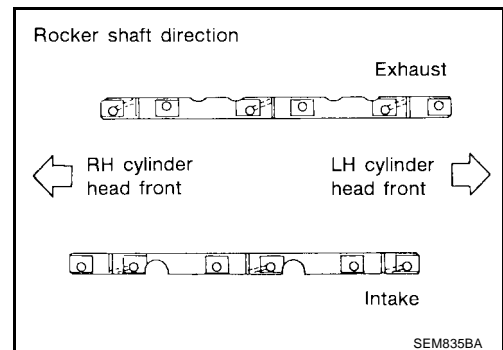
2. Install the camshafts, locate plates, and cylinder head rear covers.
  - Set the knock pin of the camshafts at the top as shown.



3. Install the valve lifters into the valve lifter guide.
  - Assemble the valve lifters into their original positions and hold all of the valve lifters with a wire to prevent the lifters from falling out of the guide.
  - After installation, remove the wire.



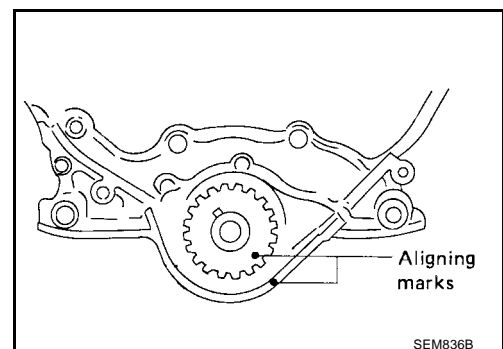
4. Install the rocker shafts with the rocker arms.
  - Tighten the rocker shaft bolts gradually in two or three stages.
  - Before tightening the bolts, set the camshaft with the lobe at the position where lobe is not contacting a lifter.
- a. Set the No. 1 piston at TDC on the compression stroke and tighten the rocker shaft bolts for No. 2, No. 4, and No. 6 cylinders.
- b. Set the No. 4 piston at TDC on the compression stroke and tighten the rocker shaft bolts for No. 1, No. 3, and No. 5 cylinders.



5. Install the remaining components in the reverse order of removal

## Installation

1. Set the No. 1 piston at TDC on the compression stroke as follows:
  - a. Align the crankshaft sprocket alignment mark with the mark on the oil pump housing as shown.
  - b. Confirm that the knock pin on the camshaft is still set at the top.



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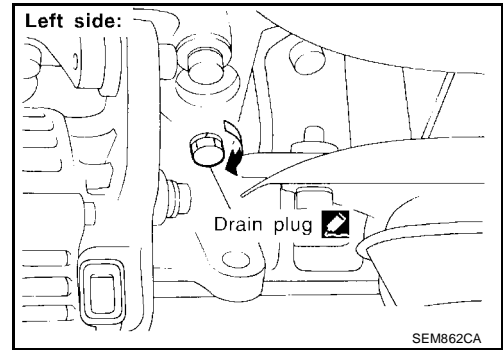
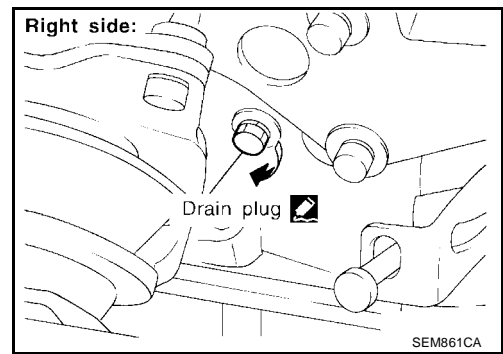
# CYLINDER HEAD

[VG33E and VG33ER]

2. Install both of the engine block drain plugs and tighten to specification.

**Engine block drain plugs : 34 - 44 N·m (3.5 - 4.5 kg·m, 25 - 33 ft·lb)**

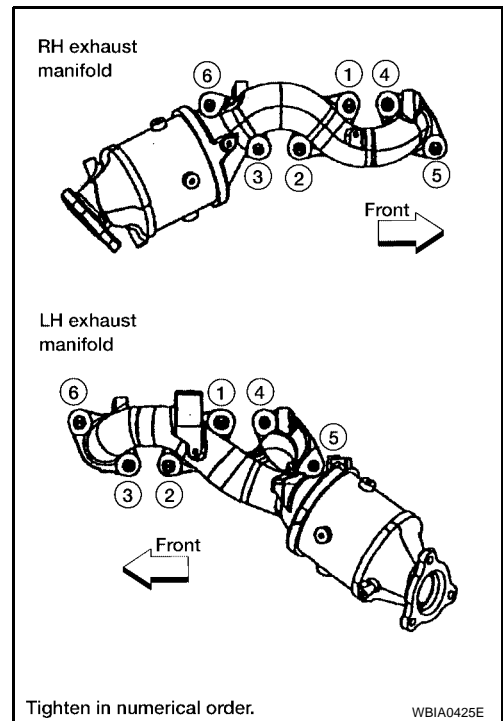
- Use Genuine High Performance Thread Sealant or equivalent. Refer to [GI-42, "RECOMMENDED CHEMICAL PRODUCTS AND SEALANTS"](#).



3. Install the exhaust manifold on to the cylinder head.

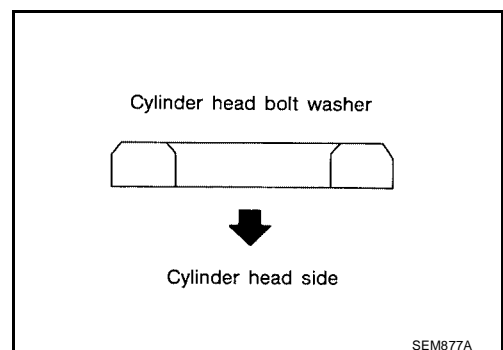
**CAUTION:**

**Tighten the exhaust manifold bolts to specification in the numerical order as shown. Refer to [EM-78, "Removal and Installation"](#).**



4. Install cylinder head with new gasket.

- Install the washers between the bolts and cylinder head with the washer beveled side up as shown.
- Do not rotate the crankshaft and camshaft separately, or the valves will hit the pistons.



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# CYLINDER HEAD

[VG33E and VG33ER]

5. Tighten the cylinder head bolts and the intake manifold bolts in 14 steps, and in the numerical order as shown. Use the specified angle wrench as necessary.

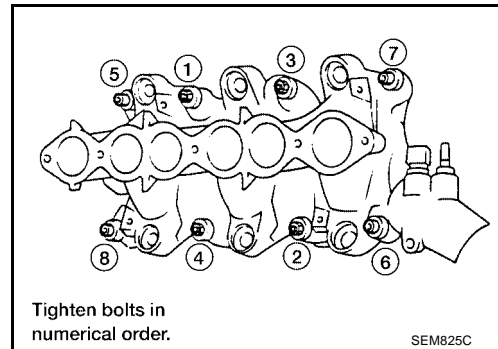
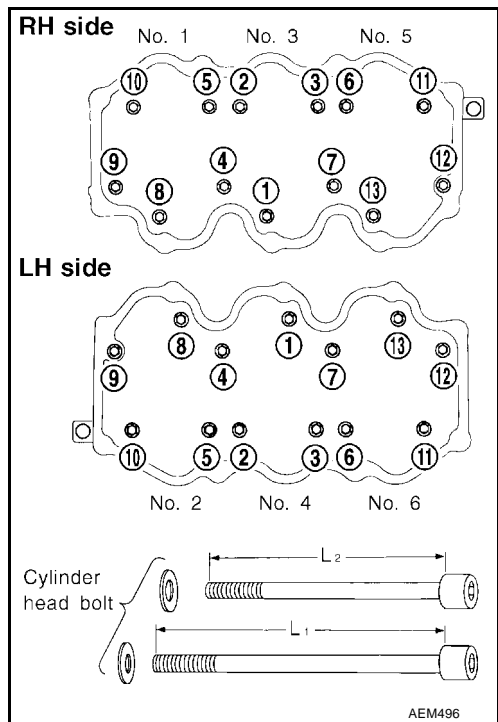
**Angle wrench : ST10120000 (J24239-01)**

- Apply engine oil to the threads and seating surfaces of the cylinder head bolts before installation.
- Cylinder head bolts No. 4, 7, 9, and 12 (L1) are longer than the others (L2).

**Cylinder head bolts "L1" : 127 mm (5.00 in)**

**Cylinder head bolts "L2" : 106 mm (4.17 in)**

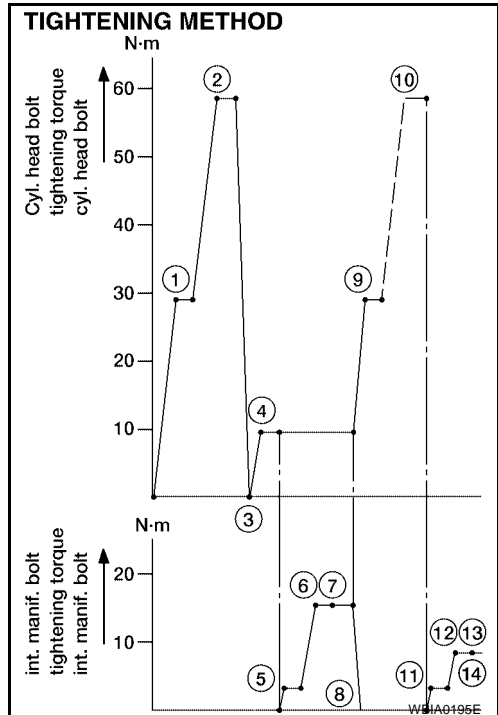
- Install the intake manifold and the cylinder head at the same time using the 14 steps.



Tighten bolts in numerical order.

## Cylinder head and intake manifold nuts and bolts tightening:

- Step 1 : tighten cylinder head bolts 29 N-m (3.0 kg-m, 22 ft-lb)**
- Step 2 : tighten cylinder head bolts 59 N-m (6.0 kg-m, 43 ft-lb)**
- Step 3 : loosen all cylinder head bolts completely**
- Step 4 : tighten cylinder head bolts 10 N-m (1.0 kg-m, 7 ft-lb)**
- Step 5 : tighten intake manifold bolts and nuts 4 N-m (0.4 kg-m, 2.9 ft-lb)**
- Step 6 : tighten intake manifold bolts and nuts 18 N-m (1.8 kg-m, 13 ft-lb)**
- Step 7 : tighten intake manifold bolts and nuts 16 - 20 N-m (1.6 - 2.0 kg-m, 12 - 14 ft-lb)**
- Step 8 : loosen all intake manifold bolts and nuts completely**
- Step 9 : tighten cylinder head bolts to 29 N-m (3.0 kg-m, 22 ft-lb)**



# CYLINDER HEAD

[VG33E and VG33ER]

- Step 10 : tighten cylinder head bolts 60° - 65° degrees (clockwise), if an angle wrench is not available, tighten cylinder head bolts 54 - 64 N·m (5.5 - 6.5 kg-m, 40 - 47 ft-lb)
- Step 11 : tighten cylinder head sub-bolts to 9.0 - 11.8 N·m (0.92 - 1.20 kg-m, 6.7 - 8.7 ft-lb)
- Step 12 : tighten intake manifold bolts and nuts to 4 N·m (0.4 kg-m, 2.9 ft-lb)
- Step 13 : tighten intake manifold bolts and nuts to 9 N·m (0.9 kg-m, 6.5 ft-lb)
- Step 14 : tighten intake manifold bolts and nuts to 8 - 10 N·m (0.8 - 1.0 kg-m, 5.8 - 7 ft-lb)

- If only the intake manifold is removed, install the manifold using three steps and tightening the manifold nuts and bolts to specification:

### Intake manifold nuts and bolts tightening steps:

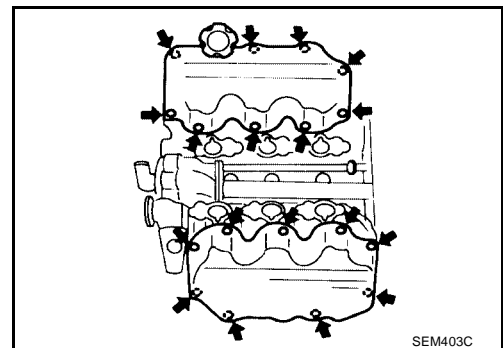
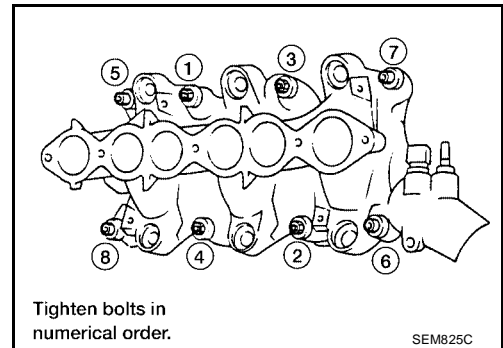
- Step 1 : 4 N·m (0.4 kg-m, 2.9 ft-lb)
- Step 2 : 9 N·m (0.9 kg-m, 6.5 ft-lb)
- Step 3 : 8 - 10 N·m (0.8 - 1.0 kg-m, 5.8 - 7 ft-lb)

### CAUTION:

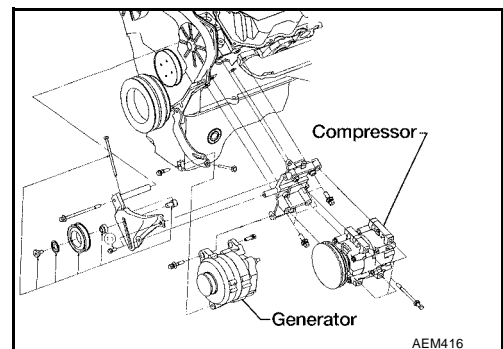
If replacing the intake manifold with a new one, the cylinder head gasket must also be replaced with a new one.

- 6. Install the rocker covers and tighten the bolts to specification.

Rocker cover bolts : 1 - 3 N·m (0.1 - 0.3 kg-m, 9 - 26 in-lb)



- 7. Install the A/C compressor, generator, and power steering pump brackets.



- 8. Install the power steering pump. Refer to [PS-17, "Components"](#) .
- 9. Install the A/C compressor. Refer to [MTC-66, "Removal and Installation for Compressor"](#) .
- 10. Install the generator. Refer to [SC-35, "VG33E AND VG33ER MODELS"](#) .
- 11. Install the exhaust front tube to the exhaust manifold. Refer to [EX-3, "Removal and Installation"](#) .

# CYLINDER HEAD

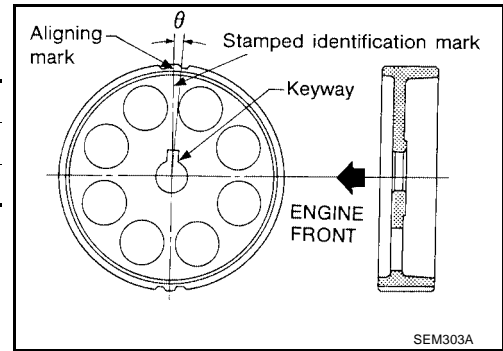
[VG33E and VG33ER]

12. Install the rear timing belt cover and camshaft sprocket as shown.

	Identification mark	$\theta$
RH camshaft sprocket	R3	$0^{\circ}53'$
LH camshaft sprocket	L3	$-3^{\circ}27'$

**CAUTION:**

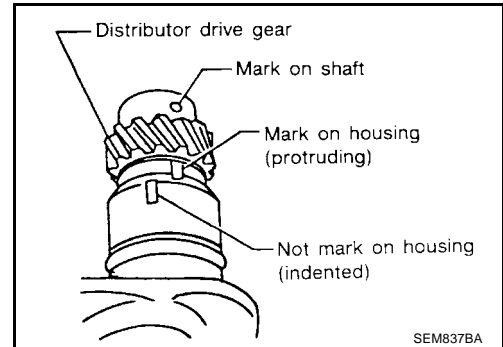
**RH camshaft sprocket and LH camshaft sprocket are different parts. Be sure to install them in the correct location.**



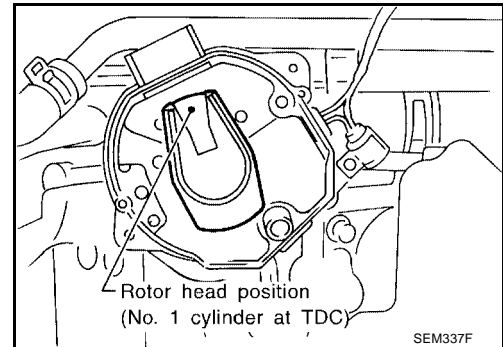
13. Install the timing belt and adjust the timing belt tension. Refer to [EM-93, "AFTER ENGINE OVERHAUL OR ENGINE REASSEMBLY \(WITH ROCKER COVERS REMOVED\)"](#).

14. Install the distributor.

a. Align the mark on the distributor shaft with the protruding mark on the distributor housing as shown.

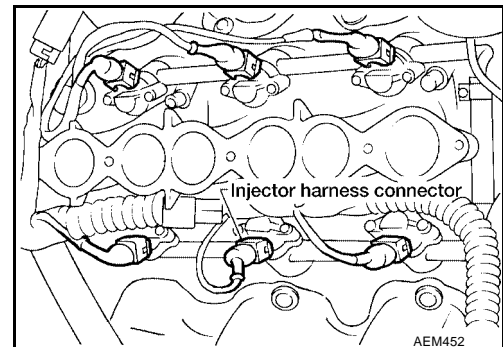


b. After installing, confirm that distributor rotor head is set as shown in figure.



15. Install the fuel injector tube assembly.

16. Connect the fuel injector harness connectors.



17. Install the fuel feed and fuel return hoses to the fuel injector tube assembly.

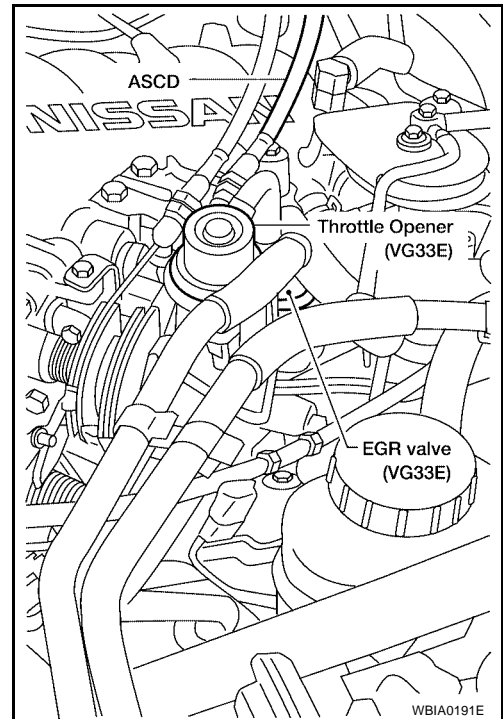
18. Install the intake manifold collector (VG33E only). Refer to [EM-78, "Removal and Installation"](#).

# CYLINDER HEAD

[VG33E and VG33ER]

19. Connect the following parts:

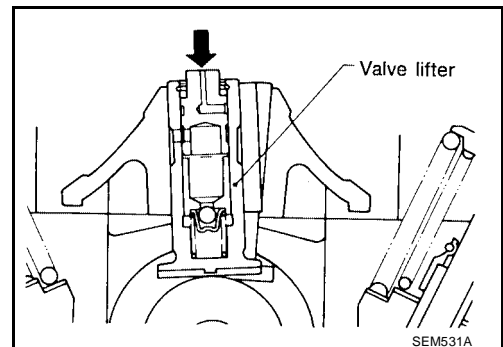
- a. Harness connectors for:
  - IACV-AAC valve
  - Throttle position sensor
  - Throttle position switch
  - Distributor (ignition coil)
  - Distributor
  - EGRC solenoid valve (VG33E only)
  - EGR temperature sensor (VG33E only)
- b. Water hoses from the intake manifold collector (VG33ER only)
- c. Heater hoses
- d. PCV hose from the rocker cover
- e. Vacuum hoses for:
  - EVAP canister
  - Brake master cylinder
  - Pressure regulator
- f. Purge hose from the purge control valve
- g. Spark plug wires.
- h. Three left/right bank fuel injector connectors
- i. Ground harness
- j. EGR tube (VG33E only)



20. Install the ASCD and accelerator control wires on to the intake manifold collector (VG33E only).

21. Check the hydraulic valve lifter.

- a. Push the plunger forcefully with your finger.
  - Be sure to check the lifter with the rocker arm is in the free position (not on the camshaft lobe).
- b. If the valve lifter moves more than 1 mm (0.04 in), air may be trapped inside.
- c. Bleed off the air by running the engine at 1,000 rpm under no load for about 10 minutes.
- d. If the hydraulic lifters are still noisy, replace the lifters.
- e. Bleed off the air by running the engine at 1,000 rpm under no load for about 10 minutes. Repeat as necessary to bleed the air out of the new lifters.



22. Install the remaining components in the reverse order of removal.

# SUPERCHARGER

[VG33E and VG33ER]

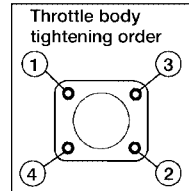
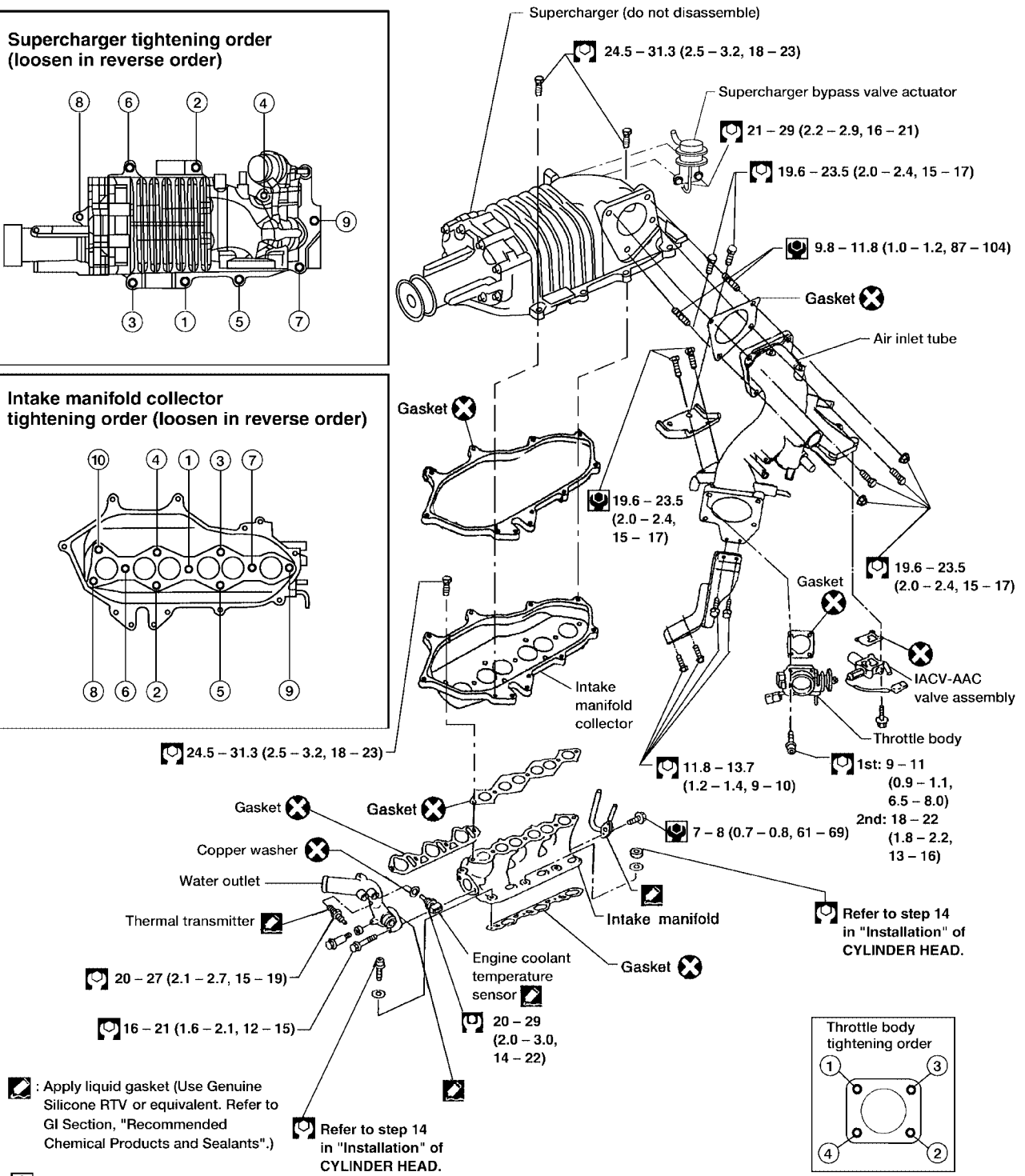
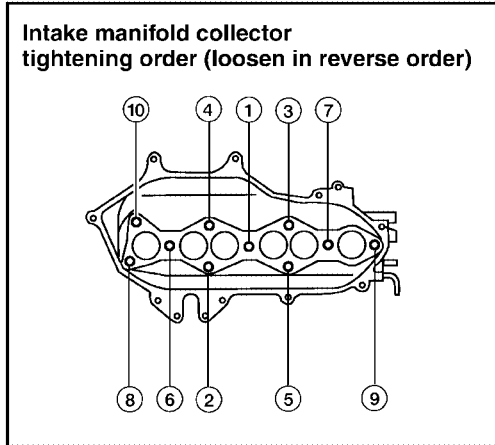
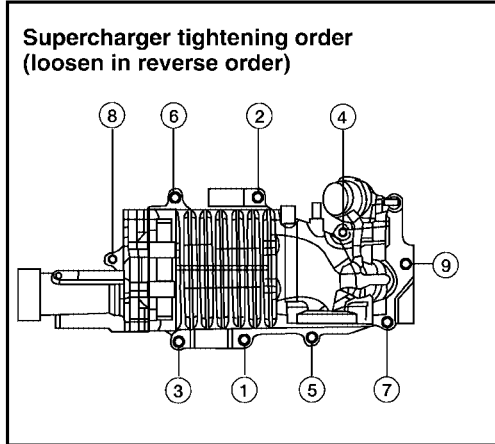
## SUPERCHARGER

PF14110

### Components

EBS00CB9

SEC. 140 • 147 • 148 • 163 • 164 • 173 • 210 • 221



- : Apply liquid gasket (Use Genuine Silicone RTV or equivalent. Refer to GI Section, "Recommended Chemical Products and Sealants".)
- : Refer to step 14 in "Installation" of CYLINDER HEAD.
- : N-m (kg-m, in-lb)
- : N-m (kg-m, ft-lb)

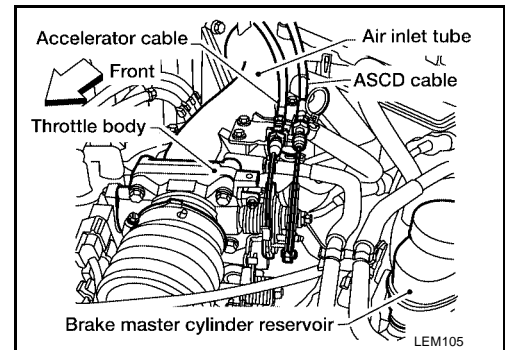


### Removal

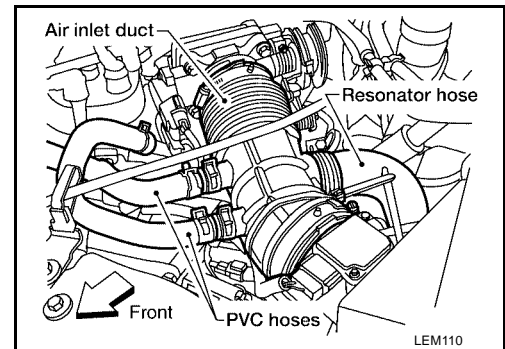
**CAUTION:**

**Do not disassemble or adjust the supercharger.**

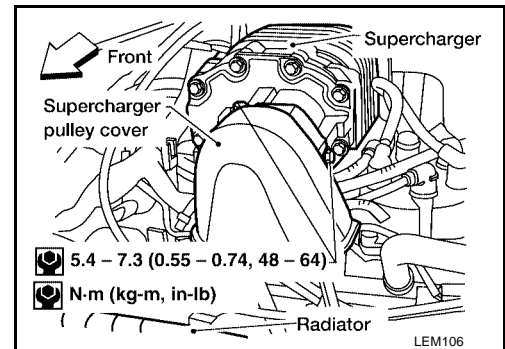
1. Disconnect the negative battery cable.
2. Disconnect the accelerator cable from the throttle body and the air inlet tube bracket.



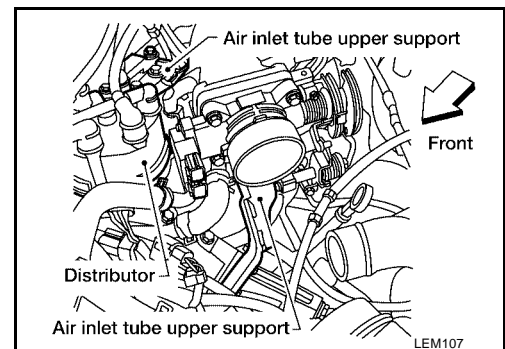
3. Disconnect the ASCD cable from the throttle body and the air inlet tube bracket, if equipped.
4. Remove the air inlet duct
  - Disconnect the PCV hoses.
  - Disconnect the resonator hose.



5. Partially drain the cooling system. Refer to [MA-26, "DRAINING ENGINE COOLANT"](#).
6. Remove the supercharger pulley cover and the supercharger/air conditioning compressor drive belt. Refer to [MA-24, "Checking Drive Belts"](#).



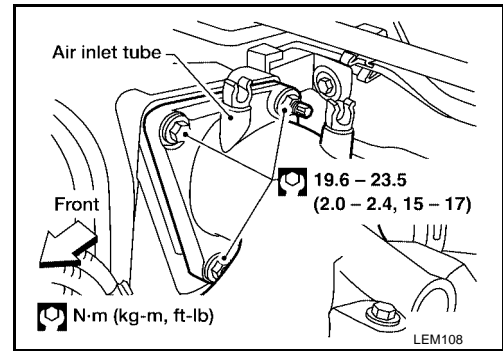
7. Remove the air inlet tube upper and lower supports.



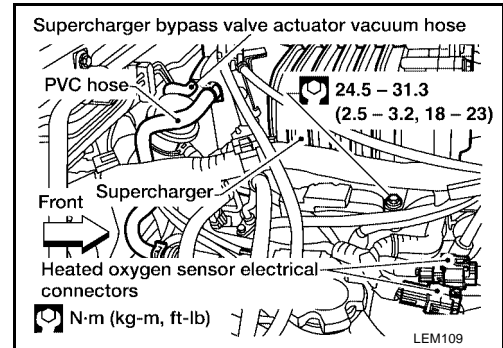
# SUPERCHARGER

[VG33E and VG33ER]

- Remove the air inlet tube bolts, nuts, and studs. Position the air inlet tube aside.
  - Disconnect the evaporative emission vacuum hose.
  - Disconnect the brake booster vacuum hose.
  - Disconnect the TPS sensor electrical connector.
  - Disconnect the TPS switch electrical connector.



- Remove the supercharger bolts and the supercharger assembly.
  - Disconnect the boost control valve vacuum hose.
  - Disconnect the PCV hose.

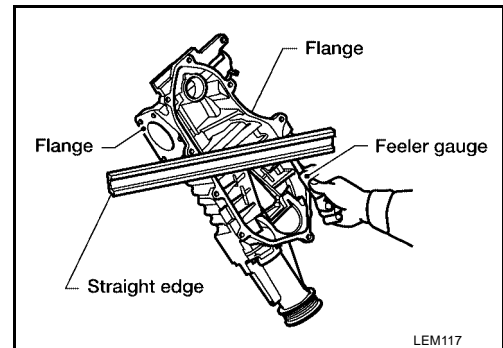


## Inspection SUPERCHARGER FLANGE

EBS00CBB

- Clean the mating surface of the supercharger flange.
- Check the flange surface for any deformation and flatness. Use a straightedge and feeler gauge, or attach the supercharger flange to the intake collector mating flange, and check that the flatness is within specification.

**Flange flatness limit : 0.12 mm (0.005 in)**



## ROTOR SYSTEM

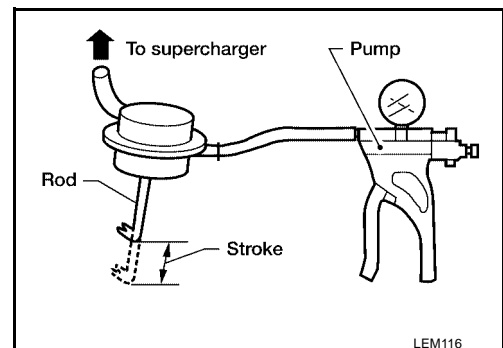
- Check that the supercharger pulley rotates smoothly when turning it by hand in a clockwise direction. Rotating force/torque must not exceed specification.

**Rotating force/torque : 0.5 N.m (0.05 kg-m, 4 in-lb)**

- Check that both the left and right rotors are free from any cracks or contamination.

## SUPERCHARGER BYPASS VALVE ACTUATOR

- Apply air pressure of less than 12 kPa (90 mmHg, 3.54 inHg) to the supercharger bypass valve actuator's lower side hose port and check for any leakage.



# SUPERCHARGER

[VG33E and VG33ER]

2. Check the supercharger bypass valve actuator rod for smooth movement while maintaining the pressure at the specified levels below:

**Rod starts to extend at approximate pressure : 12 Kpa (90 mmHg, 3.54 inHg)**  
**Rod is fully extended at approximate pressure : 33.3 kPa (250 mmHg, 9.84 inHg)**  
**Rod length when fully extended : 20.83 - 22.71 mm (0.82 - 0.89 in)**

## Installation

EBS00CBC

Installation is in the reverse order of removal.

- Replace all gaskets; all gasket surfaces must be clean, flat, and undamaged.
- Follow all torque sequences and specifications for tightening fasteners.
- Refill the cooling system. Refer to [MA-26, "REFILLING ENGINE COOLANT"](#) .

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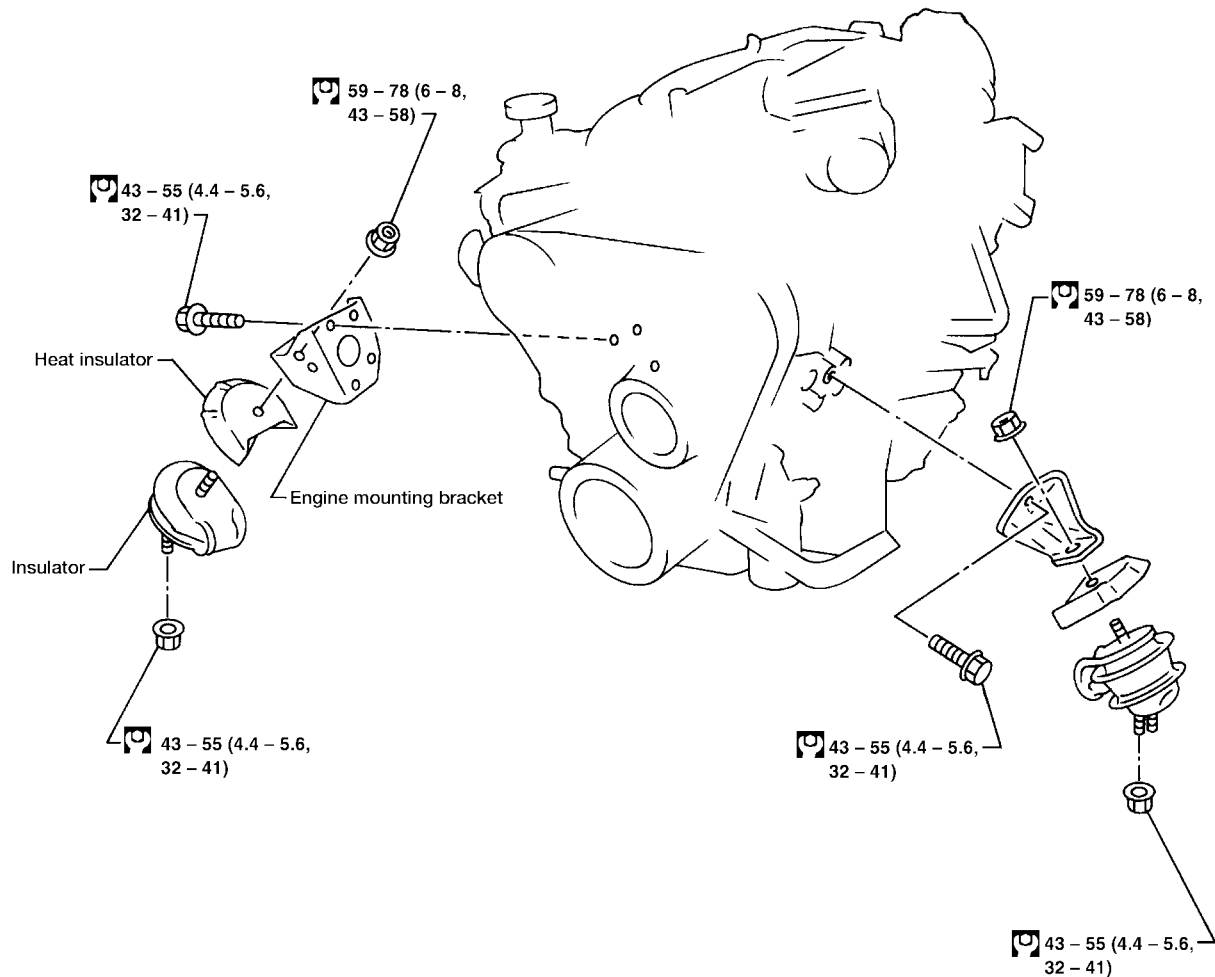
### ENGINE ASSEMBLY

PFP:10001

### Removal and Installation

EBS00CBD

SEC. 112



AEM471

#### **WARNING:**

- Position the vehicle on a flat and solid surface.
- Place wheel chocks at the front and back of the rear wheels.
- Do not remove the engine until the exhaust system has completely cooled off. Otherwise, you may burn yourself and/or fire may break out in a fuel line.

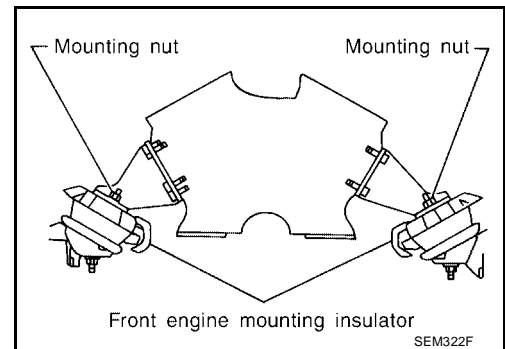
# ENGINE ASSEMBLY

[VG33E and VG33ER]

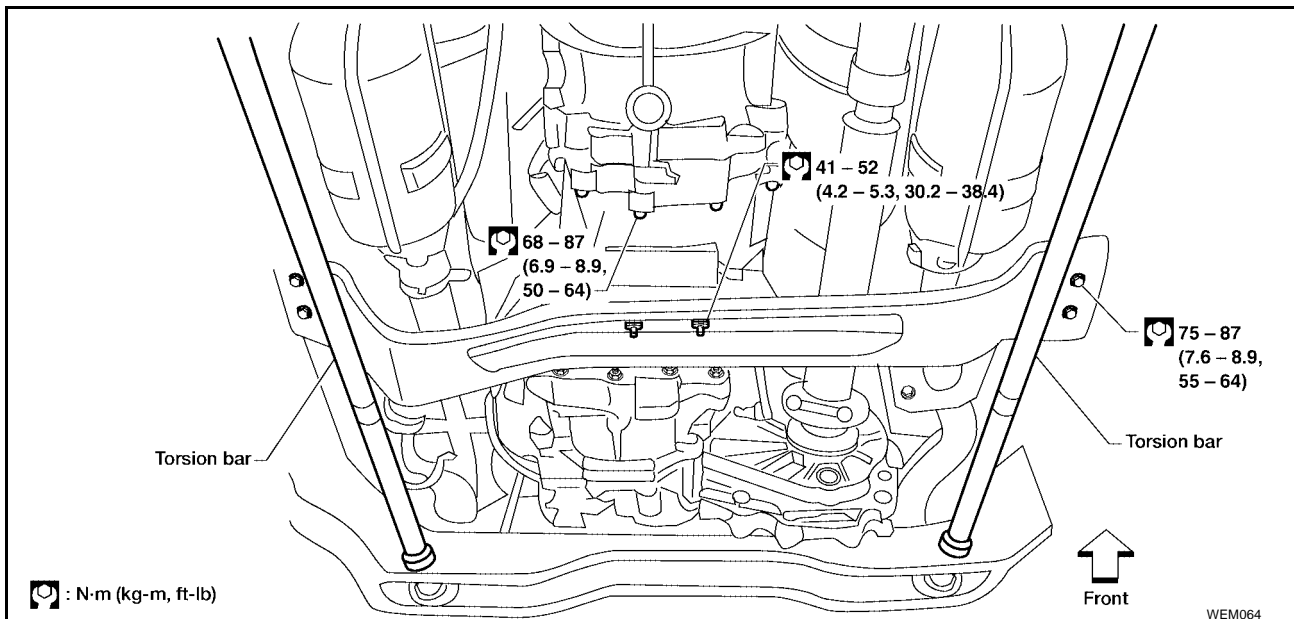
- For safety during subsequent steps, the tension of wires should be loosened against the engine.
- Before disconnecting the fuel hose, release the fuel pressure from the fuel system. Refer to [EC-611, "FUEL PRESSURE RELEASE"](#) (VG33E), [EC-1214, "FUEL PRESSURE RELEASE"](#) (VG33ER).
- Before removing the front axle from the transmission, place safety stands under the designated front supporting points. Refer to [GI-38, "2-POLE LIFT"](#).
- Lift the engine and transmission in a safe manner.
- For engines not equipped with engine slingers, attach the proper slingers and bolts described in the PARTS CATALOG.

## CAUTION:

- When lifting the engine, be careful not to strike any adjacent parts, especially the accelerator wire casing, brake lines, and brake master cylinder.
- In hoisting the engine, always use the engine slingers in a safe manner.
- Before separating the engine and transmission, remove the crankshaft position sensor (OBD).
- Do not damage the edge of the crankshaft position sensor (OBD), or the ring gear teeth.
- Do not loosen the front engine mounting insulator cover bolts.
- When the front engine cover is removed, the damper oil flows out and the mounting insulator will not function.
- Tighten all transmission mounting fasteners to specification. Refer to [AT-258, "Removal"](#) (automatic); or [MT-10, "REMOVAL"](#) (FS5W71C manual), [MT-48, "REMOVAL"](#) (FS5R30A manual).



## REMOVAL



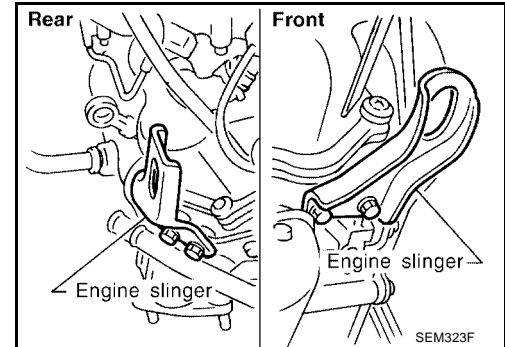
1. Remove the engine undercover and the hood. Refer to [EI-12, "BODY FRONT END"](#).
2. Drain the coolant from the cylinder block and radiator. Refer to [MA-26, "DRAINING ENGINE COOLANT"](#).
3. Release the fuel pressure from the fuel system. Refer to [EC-611, "FUEL PRESSURE RELEASE"](#) (VG33E), [EC-1214, "FUEL PRESSURE RELEASE"](#) (VG33ER).
4. Remove the vacuum hoses, fuel tubes, wires, harnesses and connectors.
5. Remove the radiator with the shroud and cooling fan. Refer to [CO-29, "Removal and Installation"](#).
6. Remove the drive belts. Refer to [MA-24, "Checking Drive Belts"](#).
7. Discharge the A/C refrigerant. Refer to [MTC-63, "HFC-134a \(R-134a\) Service Procedure"](#).

## ENGINE ASSEMBLY

[VG33E and VG33ER]

8. Remove the A/C compressor manifold. Refer to [MTC-65, "Components"](#) .
9. Remove the power steering oil pump from the engine, secure the pump with wire to the engine compartment. Refer to [PS-17, "Components"](#) .
10. Remove the front exhaust tubes. Refer to [EX-3, "Removal and Installation"](#) .
11. Remove the transmission. Refer to [AT-258, "Removal"](#) (automatic); or [MT-10, "REMOVAL"](#) (FS5W71C manual), [MT-48, "REMOVAL"](#) (FS5R30A manual).
12. Install the engine slingers.

**Slinger bolts** : 20 – 26 N·m (2.1 – 2.7 kg–m,  
15 – 20 ft–lb)



13. Hoist the engine with the engine slingers to take the tension off of the engine mounts and remove the engine mounting nuts from both sides.
14. Lift and remove the engine from the engine compartment.

### INSTALLATION

Installation is in the reverse order of removal.

# CYLINDER BLOCK

[VG33E and VG33ER]

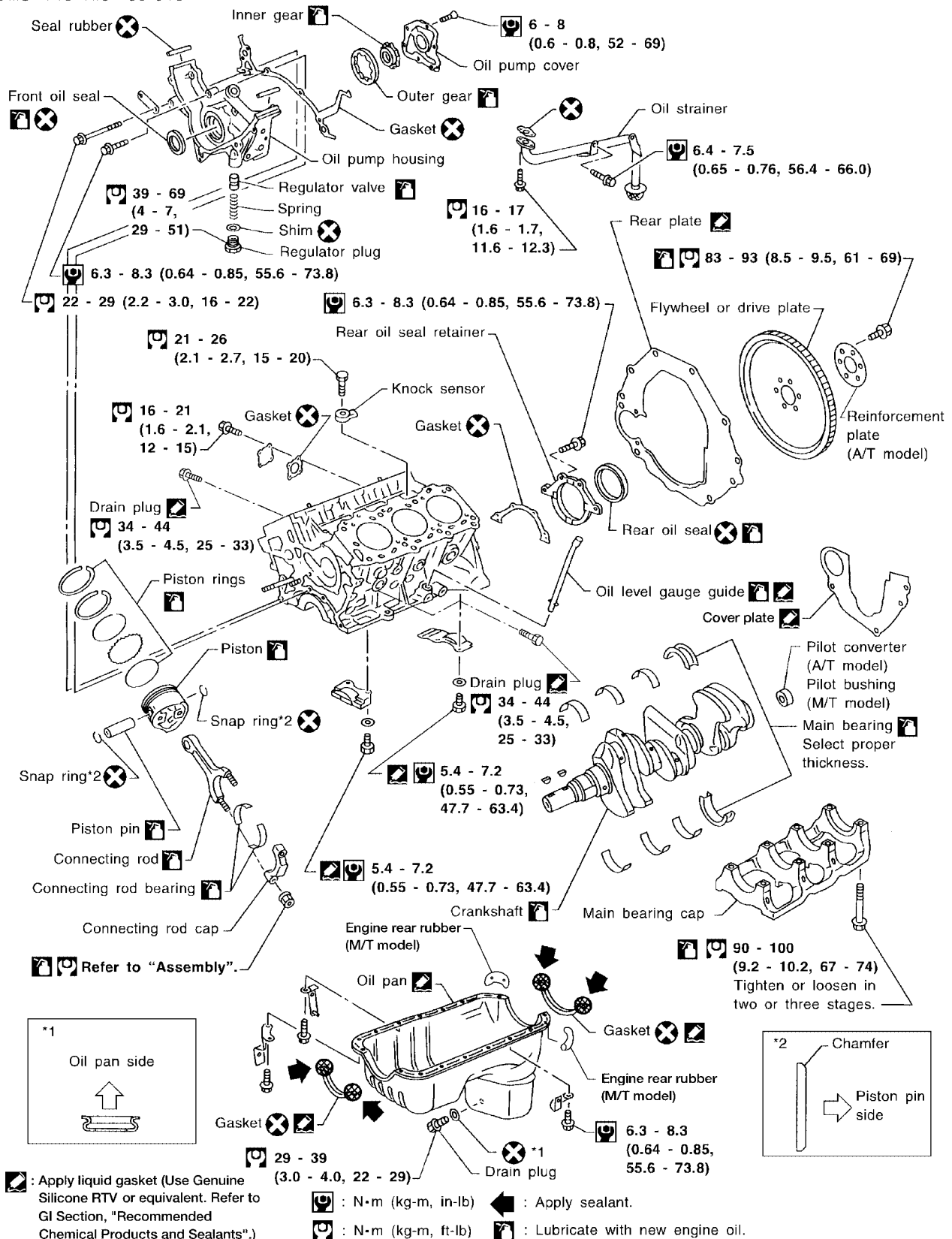
## CYLINDER BLOCK

### Components

SEC. 110•120•150•313

PF1:11010

EBS00CBE

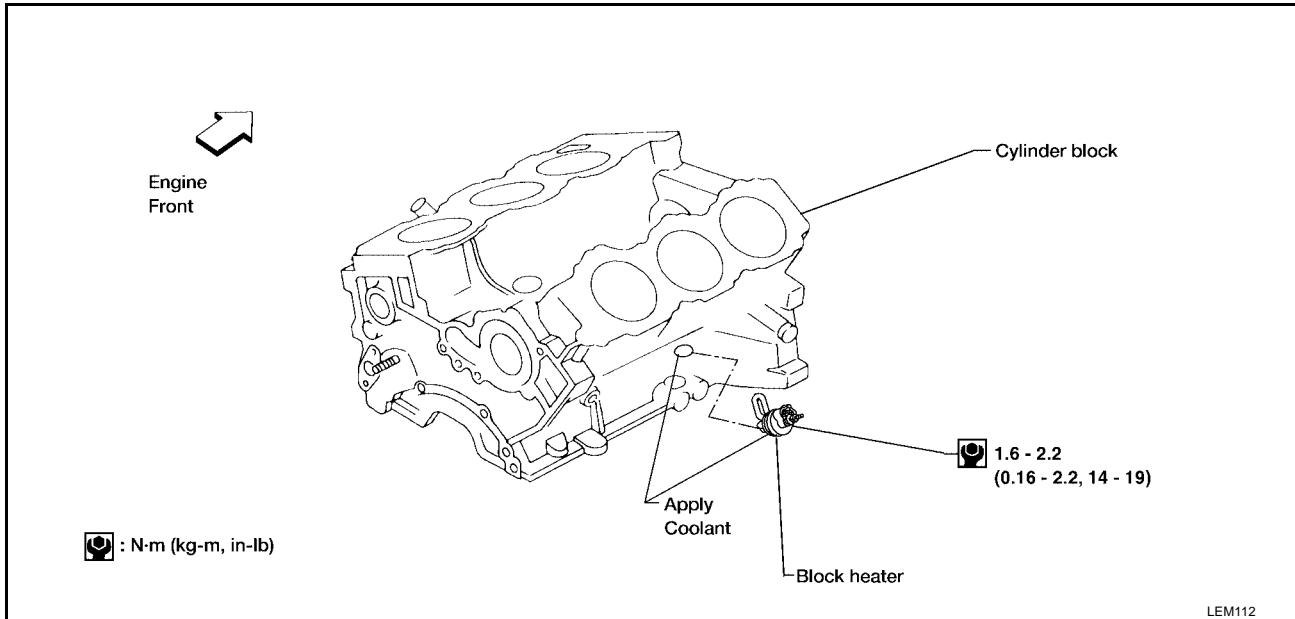


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# CYLINDER BLOCK

[VG33E and VG33ER]

## Canada Models — Block Heater



## Removal and Installation

EBS00CBF

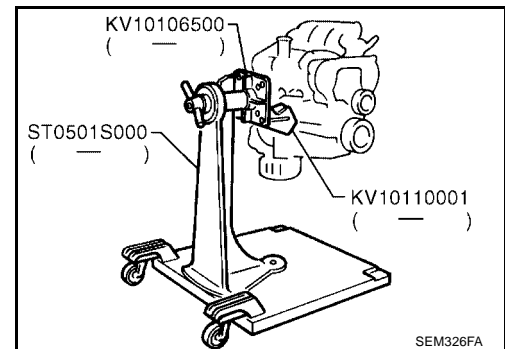
### CAUTION:

- When installing the sliding parts such as bearings and pistons, be sure to apply engine oil on the sliding surfaces.
- Label the removed parts, such as bearings and bearing caps, in their proper order and direction for installation back in their original positions.
- When installing the connecting rod bolts and main bearing cap bolts, apply new engine oil to the threads and seating surfaces.
- Do not allow any magnetic materials to contact the ring gear teeth on the drive plate and rear plate.

## Disassembly PISTON AND CRANKSHAFT

EBS00CBG

1. Place the engine assembly on a engine stand as shown.



2. Drain the engine of coolant. Refer to [MA-26, "DRAINING ENGINE COOLANT"](#) .
3. Drain the engine oil. Refer to [MA-30, "Changing Engine Oil"](#) .
4. Remove the timing belt. Refer to [EM-88, "Removal"](#) .
5. Remove the oil pan and oil pump. Refer to [EM-85, "Removal"](#) .
6. Remove the water pump. Refer to [CO-25, "Removal"](#) .
7. Remove the cylinder head. Refer to [EM-102, "Removal"](#) .



# CYLINDER BLOCK

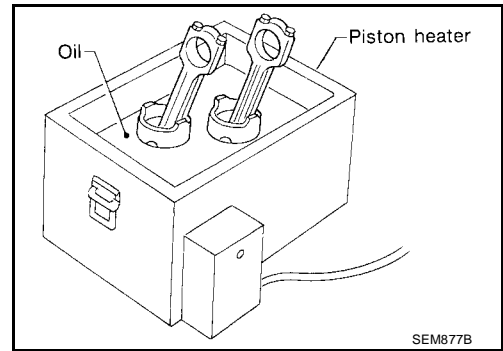
[VG33E and VG33ER]

8. Remove the pistons with connecting rod.

- When disassembling the piston and connecting rod, remove the snap ring first, then the heat piston to 60° - 70°C (140° - 158°F) in heated oil as shown; or use a piston pin press stand at room temperature.

**CAUTION:**

- When the piston rings are not replaced, make sure that piston rings are mounted in their original positions.
- When replacing the piston rings the punchmark should be pointed away from the connecting rod end. If there is no punchmark, install the piston rings with either side up.

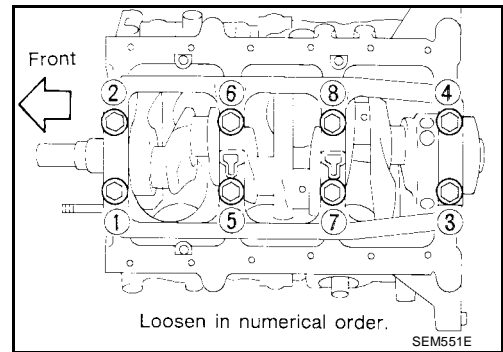


9. Remove the bearing caps and crankshaft.

- Before removing the bearing cap, measure the crankshaft end play.

**CAUTION:**

The bearing cap bolts must be loosened in two or three steps in the numerical order as shown.

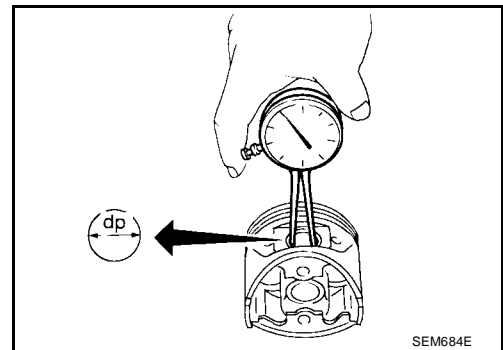


## Inspection

### PISTON AND PISTON PIN CLEARANCE

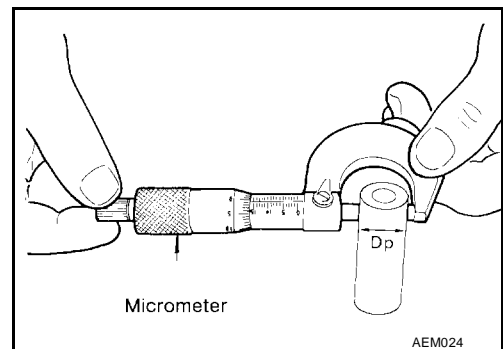
1. Measure inner diameter of piston pin hole "dp".

**Standard diameter "dp" : 20.969 - 20.981 mm (0.8255 - 0.8260 in)**



2. Measure outer diameter of piston pin "Dp".

**Standard diameter "Dp" : 20.971 - 20.983 mm (0.8256 - 0.8261 in)**



3. Calculate the piston to pin clearance.

**Piston to pin clearance :  $dp - Dp = 0 - (-0.004)$  mm [0 - (-0.0002) in]**

If the piston to pin clearance exceeds the specified value, replace the piston with pin assembly.

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# CYLINDER BLOCK

[VG33E and VG33ER]

## PISTON RING SIDE CLEARANCE

Measure the piston ring side clearance using a feeler gauge as shown.

### Side clearance

Top ring : 0.040 - 0.080 mm (0.0016 - 0.0031 in)

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

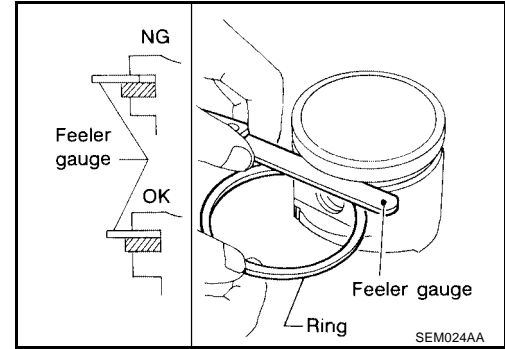
Oil ring : 0.015 - 0.185 mm (0.0006 - 0.0073 in)

### Side clearance limit (maximum)

Top ring : 0.11 mm (0.0043 in)

2nd ring : 0.1 mm (0.004 in)

Oil ring : —



If out of specification, replace piston and/or piston ring assembly.

## PISTON RING END GAP

Measure the piston ring end gap using a feeler gauge as shown.

### End gap

Top ring : 0.21 - 0.31 mm (0.0083 - 0.0122 in)

2nd ring : 0.50 - 0.60 mm (0.0197 - 0.0236 in)

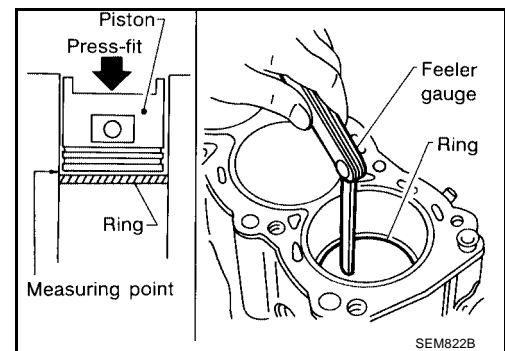
Oil ring : 0.20 - 0.60 mm (0.0079 - 0.0236 in)

### End gap limit (maximum)

Top ring : 0.43 mm (0.0169 in)

2nd ring : 0.69 mm (0.0272 in)

Oil ring : 0.84 mm (0.0331 in)



If the piston ring end gap is out of specification, replace the piston ring. If the end gap still exceeds the limit with a new ring, rebore the cylinder and use an oversized piston and piston rings. Refer to [EM-147, "Piston, Piston Ring and Piston Pin"](#).

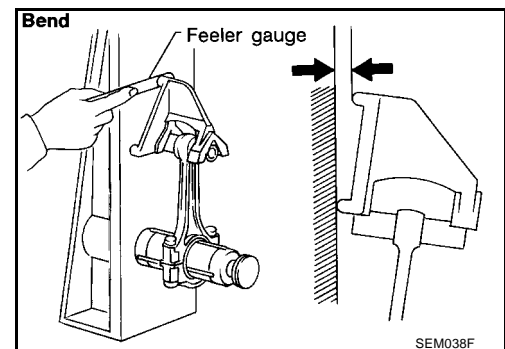
### CAUTION:

When replacing the piston, check the cylinder block surface for scratches or seizure. If scratches or seizure are found, hone or replace the cylinder block.

## CONNECTING ROD BEND AND TORSION

Bend limit : 0.15 mm (0.0059 in) per 100 mm (3.94 in) length

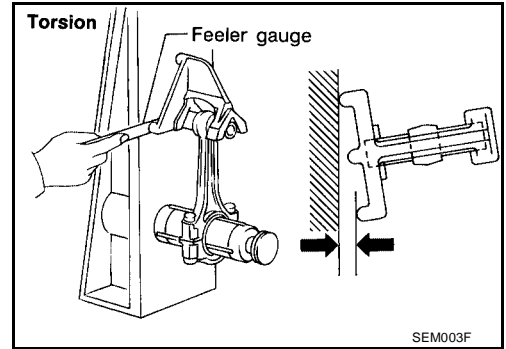
Torsion limit : 0.30 mm (0.0118 in) per 100 mm (3.94 in) length



# CYLINDER BLOCK

[VG33E and VG33ER]

If it exceeds the limit, replace connecting rod assembly.



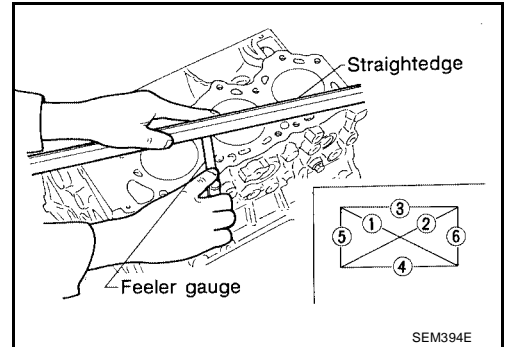
## CYLINDER BLOCK DISTORTION AND WEAR

1. Clean upper face of cylinder block and measure the upper face distortion using a feeler gauge and a straight edge as shown.

### Cylinder block distortion

**Standard : less than 0.03 mm (0.0012in)**

**Limit : 0.1 mm (0.004 in)**



2. If the cylinder block upper face distortion is out of specification, resurface the cylinder block upper face. The resurfacing limit is determined by cylinder head resurfacing.

**Amount of cylinder head resurfacing is "A".**

**Amount of cylinder block resurfacing is "B".**

**Maximum resurfacing limit (A + B) : 0.2 mm (0.008 in)**

**Nominal cylinder block height at crankshaft center : 227.60 - 227.70 mm (8.9606 - 8.9645 in)**

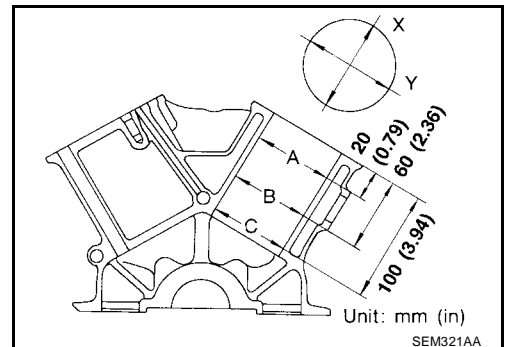
3. If necessary, replace the cylinder block.

## PISTON-TO-CYLINDER BORE CLEARANCE

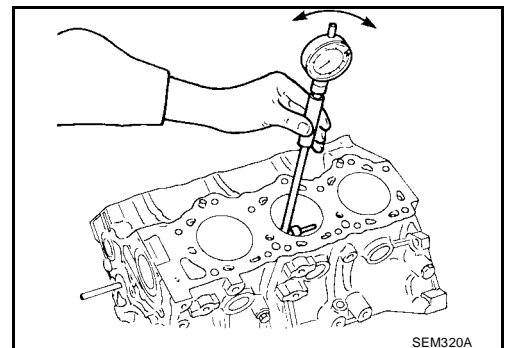
1. Using a bore gauge, measure the cylinder bore for out-of-round, taper, standard inner diameter, and wear.

**Out-of-round (difference between X and Y) standard : 0.015 mm (0.0006 in)**

**Taper (difference between A and C) standard : 0.015 mm (0.0006 in)**



If the measurements exceed specifications, rebore all of the cylinder bores. Replace the cylinder block if necessary. Refer to [EM-146, "Cylinder Block"](#).

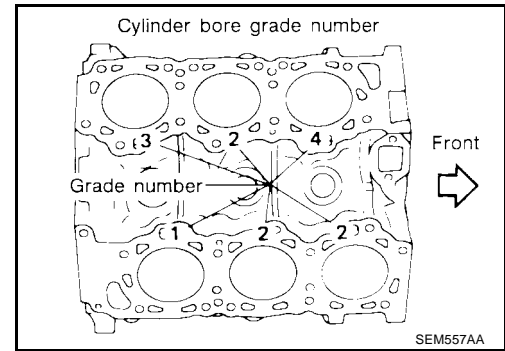


# CYLINDER BLOCK

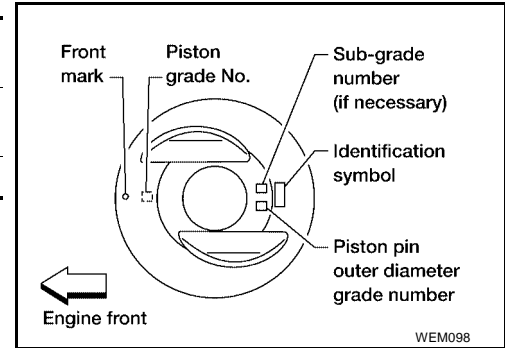
[VG33E and VG33ER]

- Check the cylinder bores for scratches and damage. If any are found, hone the cylinder bores. If necessary replace the cylinder block and use the chart below to select the proper grade pistons.

- If both the cylinder block and pistons are replaced with new ones, select a piston of the correct grade number according to the following table. These numbers are punched on the cylinder block and piston in either Arabic or Roman numerals.



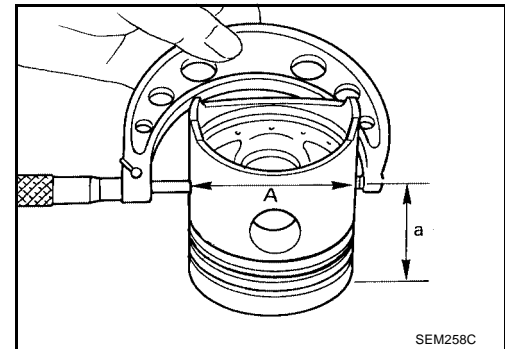
	For No. 3, 4 and 5 cylinders						For No. 1, 2 and 6 cylinders		
Cylinder bore grade No.	1	2	3	4	5	6	1	2	3
Piston grade No.	2-1	3-2	3-3	4-4	4-5	5-6	1	2	3



- Measure piston skirt diameter as shown.

**Piston diameter "A"** : refer to [EM-147, "AVAILABLE PISTON"](#)

**Measuring point "a"** : 49.0 mm (1.929 in)  
(distance from the top)



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

**Piston-to-cylinder bore clearance "B"**

**No. 1, 2, and 6 (No. 5 VG33ER only) cylinders** : 0.025 - 0.045 mm (0.0010 - 0.0018 in)

**No. 3 and 4 cylinders** : 0.015 - 0.025 mm (0.0006 - 0.0010 in)

**No. 5 cylinder (VG33E only)** : 0.030 - 0.040 mm (0.0012 - 0.0016 in)

- Determine the piston oversize according to the amount of cylinder bore wear.

**NOTE:**

Oversize pistons are available for service. Refer to [EM-147, "AVAILABLE PISTON"](#).

- The cylinder bore rebore size is calculated by adding the piston diameter "A" to the piston-to-cylinder bore clearance "B" then subtracting the honing allowance.

**Cylinder bore rebore size calculation ( $D = A + B - C$ )**

where,

**D** : cylinder bore rebore diameter

**A** : piston diameter as measured

**B** : piston-to-bore clearance

**C** : honing allowance of 0.02 mm (0.0008 in)

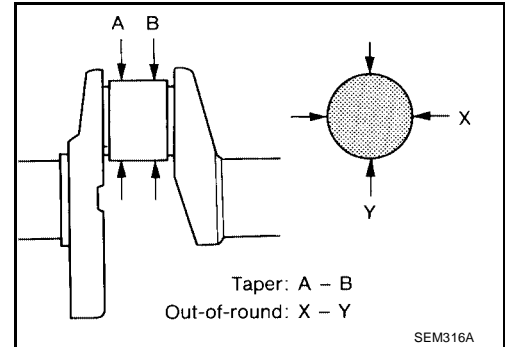
# CYLINDER BLOCK

[VG33E and VG33ER]

7. Install the main bearing caps, and tighten the main bearing cap bolts to specification to prevent distortion of the cylinder bores when honing.
- 8.hone the cylinder bores.  
**CAUTION:**
  - When any cylinder bore needs honing, all of the other cylinders must also be honed.
  - Do not hone too much out of a cylinder bore at one time. Hone no more than 0.05 mm (0.0020 in) increase in diameter at a time.
9. Hone the cylinders to obtain the specified piston-to-bore clearance.
10. Measure the finished cylinder bore for out-of-round and taper.
  - Measurements should be done after the cylinder bore cools down.

## CRANKSHAFT

1. Check crankshaft main and pin journals for score, wear or cracks.



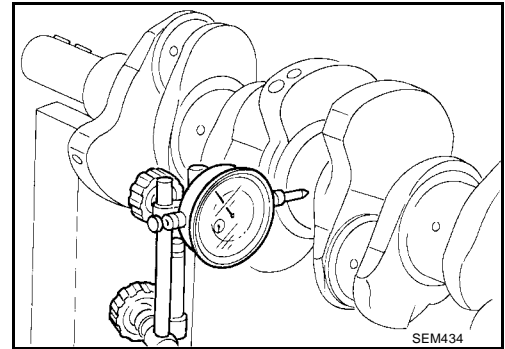
2. With a micrometer, measure the journals for taper and out-of-round.

**Out-of-round (X - Y) : less than 0.005 mm (0.0002 in)**

**Taper (A - B) : less than 0.005 mm (0.0002 in)**

3. Measure the crankshaft runout using a dial gauge as shown.

**Runout (total indicator reading) : less than 0.10 mm (0.0039 in)**



## BEARING CLEARANCE

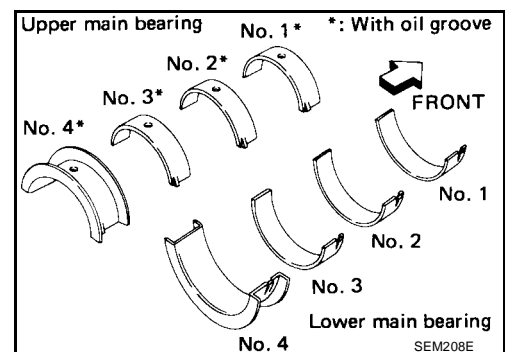
### Method A (using a bore gauge and micrometer)

#### NOTE:

Either of the following two methods (A and B) may be used, however, method A gives more reliable results and is preferable over method B for measuring bearing clearance.

### Main Bearing

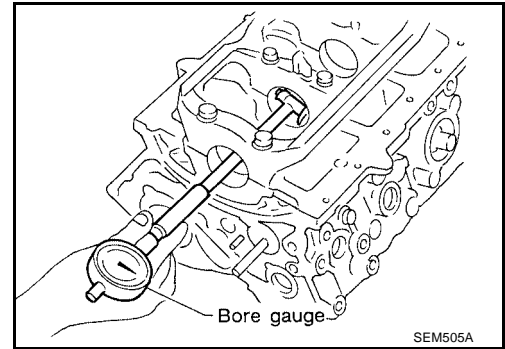
1. Set main bearings in their proper positions on cylinder block and main bearing cap.
2. Install the main bearing caps on to the cylinder block, tighten the main bearing cap bolts to specification. Refer to [EM-127, "Components"](#).



# CYLINDER BLOCK

[VG33E and VG33ER]

3. Measure inner diameter "A" of each main bearing.



4. Measure outer diameter "Dm" of each crankshaft main journal.
5. Calculate main bearing clearance.

**No. 1 main bearing clearance (A – Dm)**

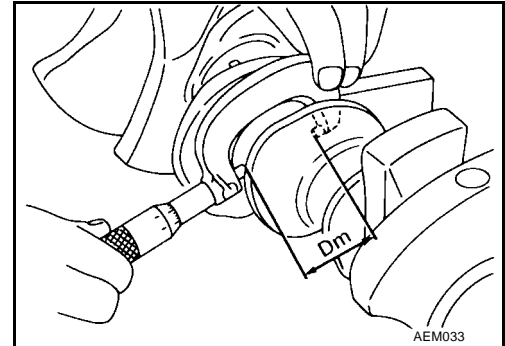
**Standard : 0.030 - 0.048 mm (0.0012 - 0.0019 in)**

**Limit : 0.060 mm (0.0024 in)**

**No. 2, 3, 4 main bearing clearance (A – Dm)**

**Standard : 0.038 - 0.065 mm (0.0015 - 0.0026 in)**

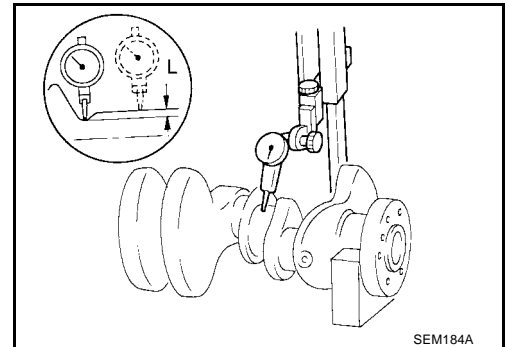
**Limit : 0.080 mm (0.0031 in)**



6. If it exceeds the limit, replace bearing.
7. If clearance cannot be adjusted within the standard of any bearing, grind crankshaft journal and use undersized bearing.
  - a. When grinding crankshaft journal, confirm that "L" dimension in fillet roll is more than the specified limit.

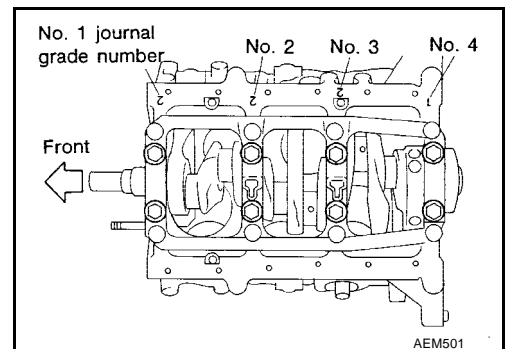
**"L" : 0.1 mm (0.004 in)**

- b. Grind the crankshaft to specification, and use available service parts. Refer to [EM-148, "Crankshaft"](#).



8. If the crankshaft is reused, measure the main bearing clearances and then select the thickness of the main bearings. If the crankshaft is replaced with a new one, it is necessary to select the thickness of the main bearings as follows:

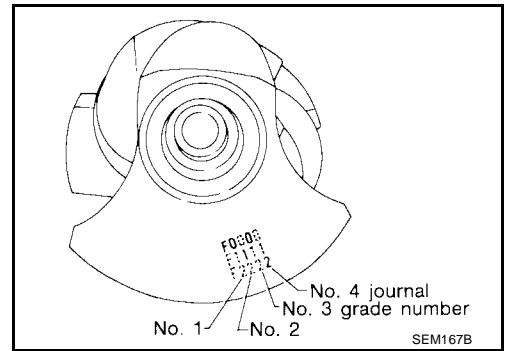
1. The grade number of each cylinder block main journal is punched on the respective cylinder block main journal as shown. These grade numbers are punched in either Arabic or Roman numerals.



# CYLINDER BLOCK

[VG33E and VG33ER]

- The grade number of each crankshaft main journal is punched on the crankshaft as shown. These grade numbers are punched in either Arabic or Roman numerals.



- Select the main bearing with a suitable thickness according to the following tables.

## No.1 Main Bearing Grade Number (Identification Color)

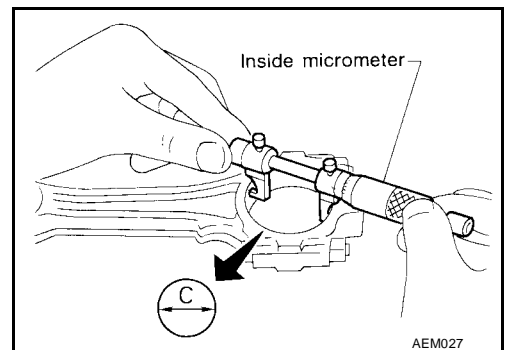
Crankshaft journal grade number	Main journal grade number			
	3 or III	4 or IV	5 or V	6 or VI
3 or III	0 (Black)	1 (Brown)	2 (Green)	3 (Yellow)
4 or IV	1 (Brown)	2 (Green)	3 (Yellow)	4 (Blue)
5 or V	2 (Green)	3 (Yellow)	4 (Blue)	5 (Pink)
6 or VI	3 (Yellow)	4 (Blue)	5 (Pink)	6 (Purple)

## Except No.1 Main Bearing Grade Number (Identification Color)

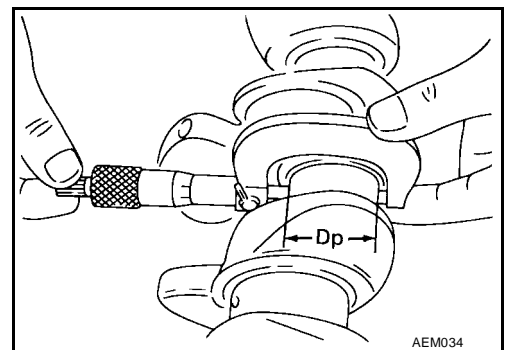
Crankshaft journal grade number	Main journal grade number		
	0	1 or I	2 or II
0	0 (Black)	1 (Brown)	2 (Green)
1 or I	1 (Brown)	2 (Green)	3 (Yellow)
2 or II	2 (Green)	3 (Yellow)	4 (Blue)

## Connecting Rod Bearing (Big end)

- Install the connecting rod bearings on to the connecting rod and cap.
- Install the connecting rod cap to the connecting rod. Tighten the bolts to the specified torque. Refer to [EM-127, "Components"](#).
- Measure the inner diameter "C" of each connecting rod bearing as shown.



- Measure the outer diameter "Dp" of each crankshaft pin journal as shown.



- Calculate the connecting rod bearing clearance.

**Connecting rod bearing clearance (C – Dp)**

**Standard : 0.024 - 0.064 mm (0.0009 - 0.0025 in)**

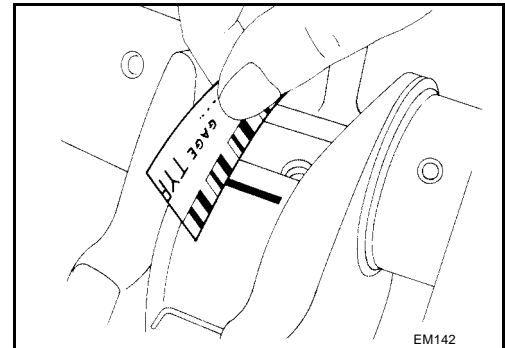
**Limit : 0.090 mm (0.0035 in)**

- If the connecting rod bearing clearance exceeds the limit, replace the bearing.
- If the clearance cannot be adjusted to within the standard for any bearing, then grind the crankshaft journals and use undersized bearings. Refer to [EM-149, "Available Connecting Rod Bearing"](#).

### Method B (using plastigage)

#### CAUTION:

- Do not turn the crankshaft or the connecting rod while the plastigage is being inserted.
- When the bearing clearance exceeds the specified limit, check that the correct size bearing has been installed. Then if any excessive bearing clearance exists, use a thicker main bearing or an undersized bearing so that the specified bearing clearance is obtained.



### CONNECTING ROD BUSHING CLEARANCE (SMALL END)

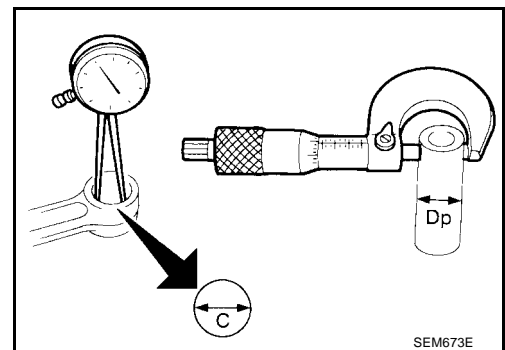
- Measure inner diameter "C" of bushing.
- Measure outer diameter "Dp" of piston pin.
- Calculate connecting rod bushing clearance.

**Connecting rod bushing clearance (C – Dp)**

**Standard : 0.005 - 0.017 mm (0.0002 - 0.0007 in)**

**Limit : 0.023 mm (0.0009 in)**

If it exceeds the specified limit, replace the connecting rod assembly or connecting rod bushing and/or piston set with pin.

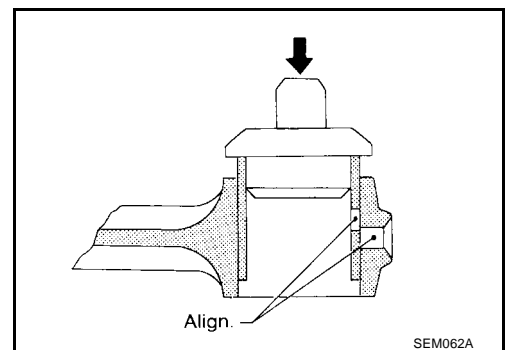


### REPLACEMENT OF CONNECTING ROD BUSHING (SMALL END)

- Drive in small end bushing until it is flush with end surface of rod.

#### CAUTION:

Align the oil holes as shown for proper lubrication.



- After driving in small end bushing, ream the bushing so that clearance between connecting rod bushing and piston pin is the specified value.

**Clearance between connecting rod bushing and piston pin : 0.005 - 0.017 mm (0.0002 - 0.0007 in)**



# CYLINDER BLOCK

[VG33E and VG33ER]

## FLYWHEEL/DRIVE PLATE RUNOUT

Measure the runout using a dial gauge as shown. The runout is measured with a dial gauge reading from a full rotation of the flywheel (M/T only) or driveplate (A/T only).

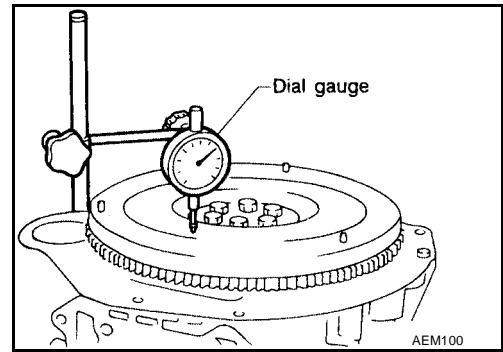
**Runout (total indicator reading)**

**Flywheel (M/T only) : less than 0.15 mm (0.0059 in)**

**Drive plate (A/T only) : less than 0.15 mm (0.0059 in)**

### CAUTION:

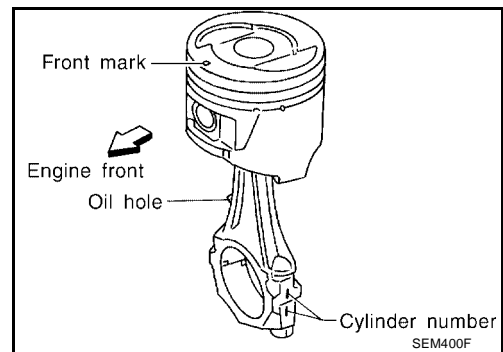
- Be careful not to damage the ring gear teeth.
- Check the drive plate for deformation or cracks.
- Do not allow any magnetic materials to contact the ring gear teeth.
- Do not surface flywheel or drive plate. Replace as necessary.



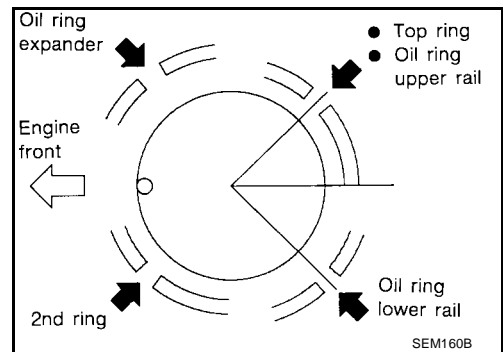
## Assembly PISTON

EBS00CBI

1. Install new snap ring on one side of piston pin hole.
2. Heat the piston to 60° - 70°C (140° - 158°F) and assemble the piston, piston pin, connecting rod and new snap ring.
  - Align the direction of the piston and connecting rod.
  - Numbers stamped on the connecting rod and cap correspond to each cylinder.
  - After assembly, make sure the connecting rod swings smoothly.

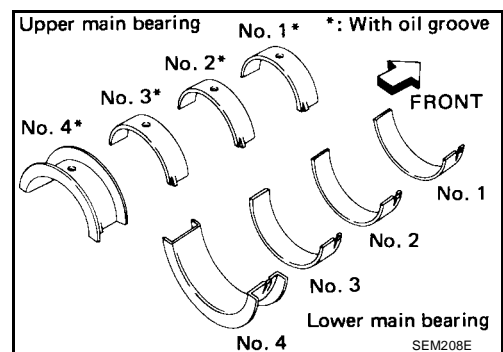


3. Set piston rings positioning the gaps at 90° degree angles as shown.



## CRANKSHAFT

1. Set the main bearings in their proper positions on the cylinder block journals and main bearing caps.
  - Confirm that the correct main bearings are installed. Refer to [EM-133, "BEARING CLEARANCE"](#).
  - Apply new engine oil to the bearing surfaces.



# CYLINDER BLOCK

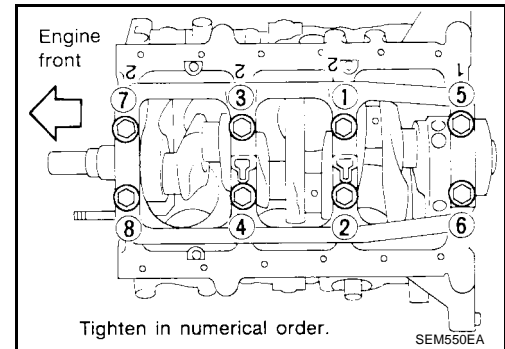
[VG33E and VG33ER]

2. Install the crankshaft and main bearing caps and tighten the bolts in numerical order as shown, gradually in two or three steps, to specification.

- Prior to tightening the main bearing cap bolts, place the main bearing cap in the proper position by shifting the crankshaft in the axial direction.
- Tighten the main bearing cap bolts gradually in two or three steps to specification in numerical order as shown.

**Main bearing cap bolts : 90 - 100 N·m (9.2 - 10.2 kg·lb, 57 - 74 ft·lb)**

- After tightening the main bearing cap bolts, check that the crankshaft turns smoothly by hand.
- Lubricate the threads and seat surfaces of the main bearing cap bolts with new engine oil.



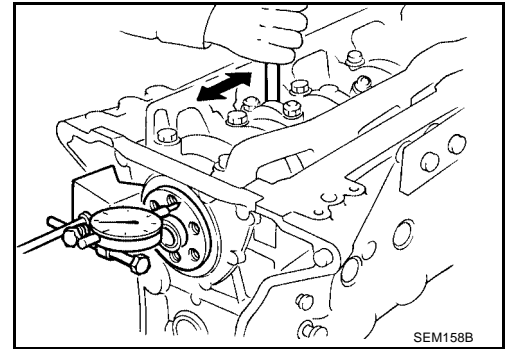
3. Measure the crankshaft end play using a dial gauge as shown.

**Crankshaft end play**

**Standard : 0.050 - 0.170 mm (0.0020 - 0.0067 in)**

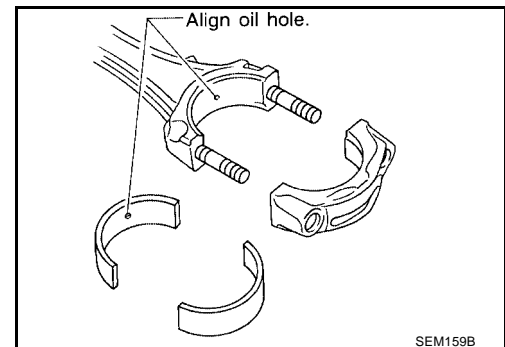
**Limit : 0.30 mm (0.0118 in)**

If beyond the limit, replace bearing with a new one.



4. Install the connecting rod bearings in the connecting rods and connecting rod caps.

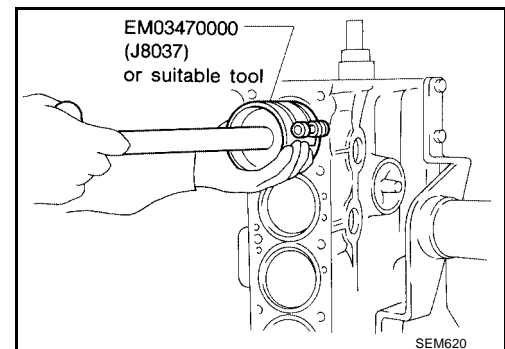
- Check that the correct connecting rod bearings are being installed. Refer to [EM-135, "Connecting Rod Bearing \(Big end\)"](#).
- Install the connecting rod bearings so the oil hole in the connecting rod aligns with the oil hole in the bearing.



5. Install the pistons with connecting rods.

- a. Install the piston assemblies into their corresponding cylinders using Tool.

- Do not scratch the cylinder wall with the connecting rod.
- Position the piston so the front mark on the piston head faces toward the front of the engine.



# CYLINDER BLOCK

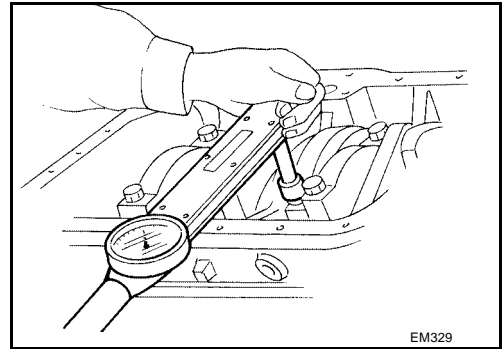
[VG33E and VG33ER]

- b. Install the connecting rod bearing caps.
- Lubricate the connecting rod bearing cap stud threads and nut seats with new engine oil.
  - Tighten the connecting rod bearing cap nuts in two steps to the specification. Only if an angle wrench is not available, tighten the connecting rod bearing cap nuts to specification in step 2.

### Connecting rod bearing cap nut

**Step 1 : 14 to 16 N·m (1.4 to 1.6 kg·m, 10 to 12 ft·lb).**

**Step 2 : 60° - 65° degrees clockwise, or 38 - 44 N·m (3.9 - 4.5 kg·m, 28 - 33 ft·lb).**



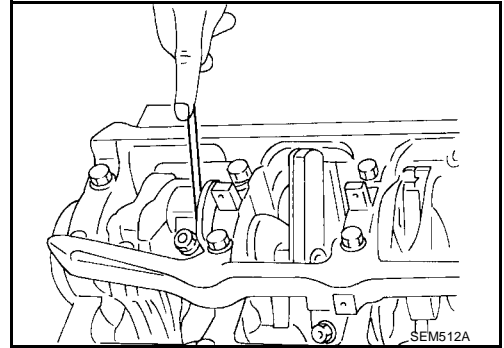
6. Measure the connecting rod side clearance.

### Connecting rod side clearance

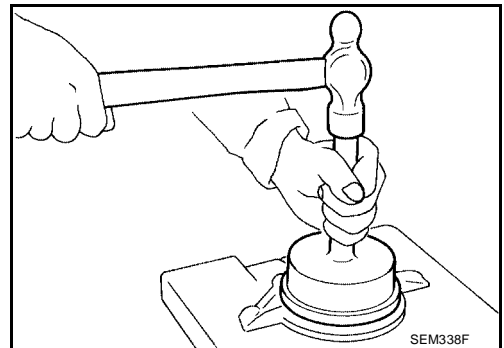
**Standard : 0.20 - 0.35 mm (0.0079 - 0.0138 in)**

**Limit : 0.40 mm (0.0157 in)**

If beyond the limit, replace connecting rod and/or crankshaft.

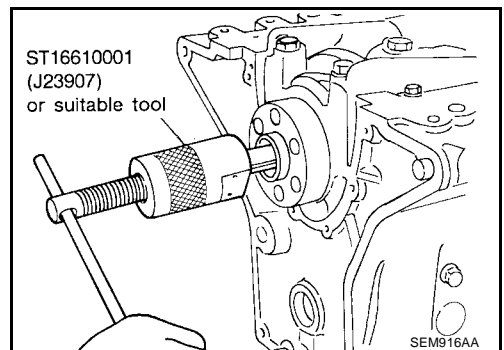


7. Install the rear oil seal and retainer.



## REPLACING PILOT BUSHING (M/T) OR PILOT CONVERTER (A/T)

1. Remove the pilot bushing (M/T) or pilot converter (A/T) using Tool as shown.

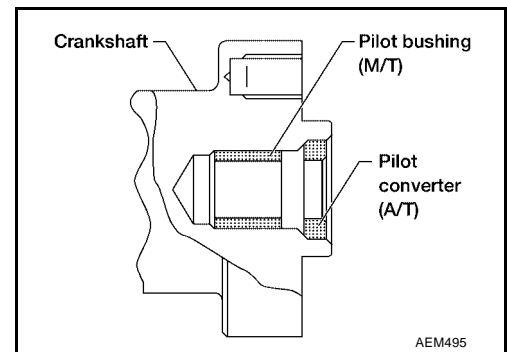


A  
EM  
C  
D  
E  
F  
G  
H  
I  
J  
K  
L  
M

## CYLINDER BLOCK

[VG33E and VG33ER]

2. Install the pilot bushing (M/T) or pilot converter (A/T) using Tool as shown.



# SERVICE DATA AND SPECIFICATIONS (SDS)

[VG33E and VG33ER]

## SERVICE DATA AND SPECIFICATIONS (SDS)

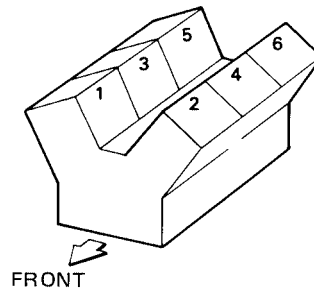
PF0:00030

### General Specifications

EBS00CBJ

Cylinder arrangement		V-6
Displacement		3,275 cm <sup>3</sup> (199.84 cu in)
Bore and stroke		91.5 x 83 mm (3.602 x 3.27 in)
Valve arrangement		OHC
Firing order		1-2-3-4-5-6
Number of piston rings	Compression	2
	Oil	1
Number of main bearings		4
Compression ratio	VG33E	8.9:1
	VG33ER	8.3:1

Cylinder numbers



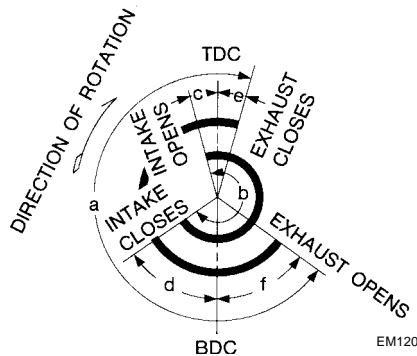
SEM713A

Unit: kPa (kg/cm<sup>2</sup>, psi)/300 rpm

Compression pressure	Standard	1,196 (12.2, 173)
	Minimum	883 (9.0, 128)
	Differential limit between cylinders	98 (1.0, 14)

Unit: degree

Valve timing



EM120

a	b	c	d	e	f
240	244	4	60	7	53

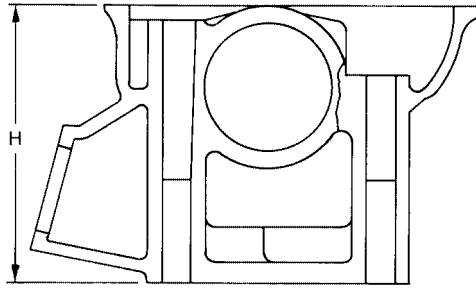
# SERVICE DATA AND SPECIFICATIONS (SDS)

[VG33E and VG33ER]

## Cylinder Head

EBS00CBK

Unit: mm (in)



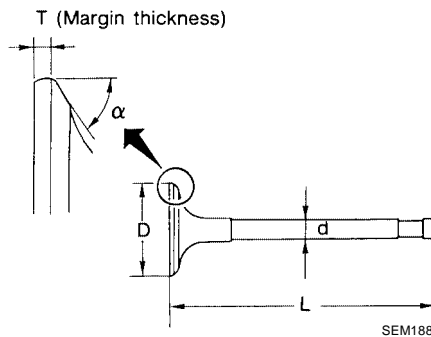
WBIA0236E

	Standard	Limit
Nominal cylinder head height "H"	106.8 - 107.2 (4.205 - 4.220)	—
Head surface distortion	Less than 0.03 (0.0012)	0.1 (0.004)

## Valve VALVE

EBS00CBL

Unit: mm (in)



SEM188

Valve head diameter "D"	Intake	42.0 - 42.2 (1.654 - 1.661)
	Exhaust	34.95 - 35.25 (1.376 - 1.388)
Valve length "L"	Intake	125.3 - 125.9 (4.933 - 4.957)
	Exhaust	124.2 - 124.8 (4.890 - 4.913)
Valve stem diameter "d"	Intake	6.965 - 6.980 (0.2742 - 0.2748)
	Exhaust	7.962 - 7.970 (0.3135 - 0.3138)
Valve seat angle "α"	Intake	45°15' - 45°45' degrees
	Exhaust	
Valve margin "T"	Intake	1.15 - 1.45 (0.0453 - 0.0571)
	Exhaust	1.35 - 1.65 (0.0531 - 0.0650)
Valve margin "T" limit		More than 0.5 (0.020)
Valve stem end surface grinding limit		Less than 0.2 (0.008)
Valve clearance	Intake	0 (0)
	Exhaust	0 (0)

## VALVE SPRING

Free height	50.47 mm (1.987 in)
Valve closed (installation) height	40.0 mm (1.575 in)
Valve open height	30.0 mm (1.181 in)

# SERVICE DATA AND SPECIFICATIONS (SDS)

[VG33E and VG33ER]

Pressure at valve open height	Standard	770 - 837 N (78.5 - 85.4 kg, 173.1 - 188.2 lb) at 30.0 mm (1.181 in)
	Limit	733 N (74.8 kg, 164.8 lb) at 30.0 mm (1.181 in)
Out-of-square		2.0 mm (0.079 in)

## HYDRAULIC VALVE LIFTER

Unit: mm (in)

Lifter outside diameter	15.963 - 15.973 (0.6285 - 0.6289)
Lifter guide inside diameter	16.000 - 16.013 (0.6299 - 0.6304)
Clearance between lifter and lifter guide	0.027 - 0.050 (0.0011 - 0.0020)

## VALVE GUIDE

Unit: mm (in)

			Standard	Service
Valve guide	Outer diameter	Intake	11.023 - 11.034 (0.4340 - 0.4344)	11.223 - 11.234 (0.4418 - 0.4423)
		Exhaust	12.023 - 12.034 (0.4733 - 0.4738)	12.223 - 12.234 (0.4812 - 0.4817)
	Inner diameter (Finished size)	Intake	7.000 - 7.018 (0.2756 - 0.2763)	
		Exhaust	8.000 - 8.011 (0.3150 - 0.3154)	
Cylinder head valve guide hole diameter		Intake	10.975 - 10.996 (0.4321 - 0.4329)	11.175 - 11.196 (0.4400 - 0.4408)
		Exhaust	11.975 - 11.996 (0.4715 - 0.4723)	12.175 - 12.196 (0.4793 - 0.4802)
Interference fit of valve guide		Intake	0.027 - 0.059 (0.0011 - 0.0023)	
		Exhaust		
			Standard	Max. tolerance
Valve to valve guide clearance		Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.10 (0.0039)
		Exhaust	0.030 - 0.049 (0.0012 - 0.0019)	
Valve deflection limit			—	0.20 (0.0079)

## ROCKER SHAFT AND ROCKER ARM

Unit: mm (in)

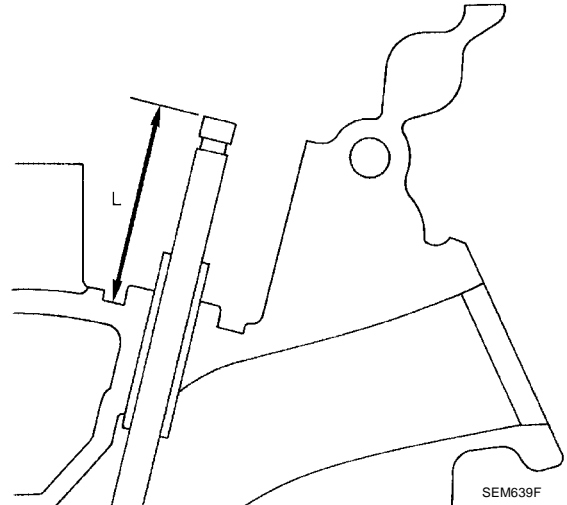
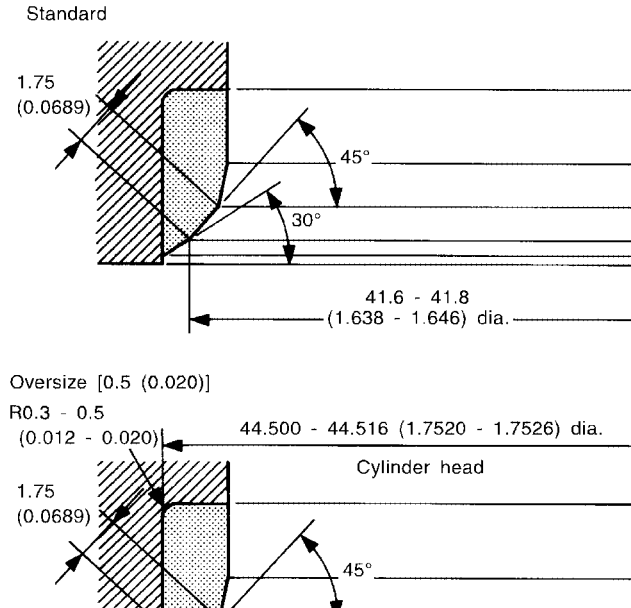
Rocker shaft	Outer diameter	17.979 - 18.000 (0.7078 - 0.7087)
Rocker arm	Inner diameter	18.007 - 18.028 (0.7089 - 0.7098)
Clearance between rocker arm and rocker shaft		0.007 - 0.049 (0.0003 - 0.0019)

# SERVICE DATA AND SPECIFICATIONS (SDS)

[VG33E and VG33ER]

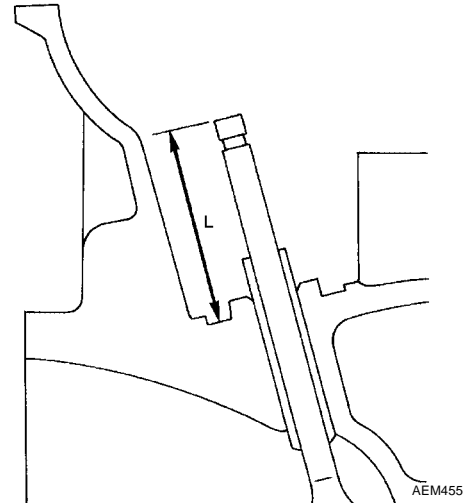
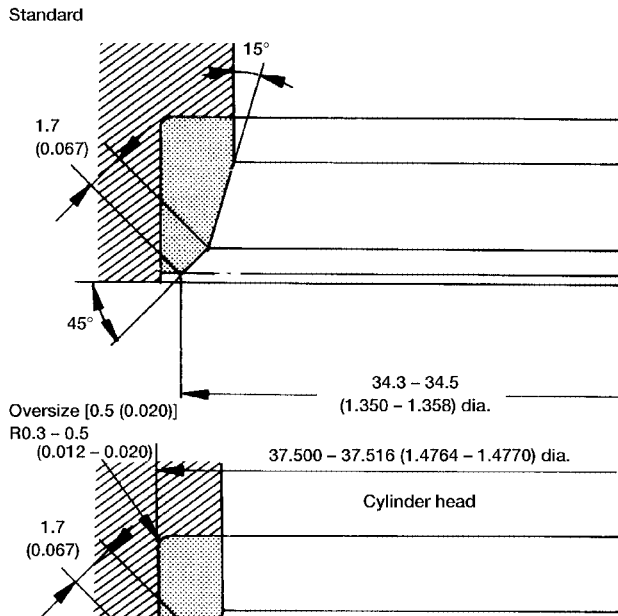
EBS00CBM

## Valve Seat INTAKE VALVE SEAT



Intake valve stem "L" closed height: 44.7 - 44.9 mm (1.760 - 1.768 in)

## EXHAUST VALVE SEAT



Exhaust valve stem "L" closed height: 45.4 - 45.6 mm (1.787 - 1.795 in)



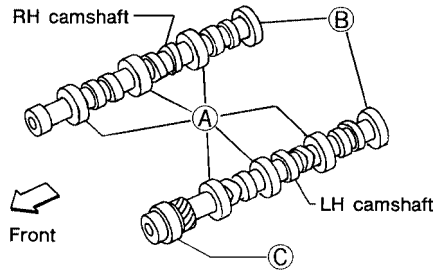
# SERVICE DATA AND SPECIFICATIONS (SDS)

[VG33E and VG33ER]

## Camshaft and Camshaft Bearing

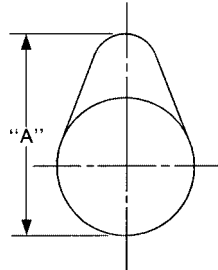
EBS00CBN

Unit: mm (in)



SEM893BA

	Standard	Max. tolerance
Camshaft journal to bearing clearance	0.060 - 0.105 (0.0024 - 0.0041)	0.15 (0.0059)
Inner diameter of camshaft bearing	A: 47.000 - 47.025 (1.8504 - 1.8514)	—
	B: 42.500 - 42.525 (1.6732 - 1.6742)	—
	C: 48.000 - 48.025 (1.8898 - 1.8907)	—
Outer diameter of camshaft journal	A: 46.920 - 46.940 (1.8472 - 1.8480)	—
	B: 42.420 - 42.440 (1.6701 - 1.6709)	—
	C: 47.920 - 47.940 (1.8866 - 1.8874)	—
Camshaft runout [TIR*]	Less than 0.04 (0.0016)	0.1 (0.004)
Camshaft end play	0.03 - 0.06 (0.0012 - 0.0024)	—



EM671

Cam height "A"	Intake	38.943 - 39.133 (1.5332 - 1.5407)
	Exhaust	38.943 - 39.133 (1.5332 - 1.5407)
Wear limit of cam height		0.15 (0.0059)

\*Total indicator reading

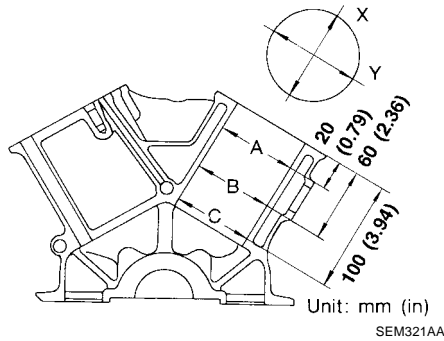
# SERVICE DATA AND SPECIFICATIONS (SDS)

[VG33E and VG33ER]

## Cylinder Block

EBS00CBO

Unit: mm (in)



Distortion		Standard		Less than 0.03 (0.0012)
		Limit		0.10 (0.004)
Cylinder bore	Inner diameter	Standard (for No. 3 and 4 cylinders)	Grade No. 1	91.500 - 91.505 (3.6024 - 3.6026)
			Grade No. 2	91.505 - 91.510 (3.6026 - 3.6027)
			Grade No. 3	91.510 - 91.515 (3.6027 - 3.6029)
			Grade No. 4	91.515 - 91.520 (3.6029 - 3.6031)
			Grade No. 5	91.520 - 91.525 (3.6031 - 3.6033)
			Grade No. 6	91.525 - 91.530 (3.6033 - 3.6035)
		Standard (for No. 1, 2 and 6 cylinders)	Grade No. 1	91.500 - 91.510 (3.6024 - 3.6027)
			Grade No. 2	91.510 - 91.520 (3.6027 - 3.6031)
			Grade No. 3	91.520 - 91.530 (3.6031 - 3.6035)
		Standard (for No. 5 cylinder)	Grade No. 1	91.515 - 91.520 (3.6029 - 3.6031)
			Grade No. 2	91.520 - 91.525 (3.6031 - 3.6033)
			Grade No. 3	91.525 - 91.530 (3.6033 - 3.6035)
			Grade No. 4	91.530 - 91.535 (3.6035 - 3.6037)
			Grade No. 5	91.535 - 91.540 (3.6037 - 3.6039)
Grade No. 6	91.540 - 91.545 (3.6039 - 3.6041)			
Wear limit		0.20 (0.0079)		
Out-of-round (difference between X and Y)				Less than 0.015 (0.0006)
Taper (difference between A and C)				Less than 0.015 (0.0006)
Main journal inner diameter	No. 1 main journal	Grade No.3	66.645 - 66.651 (2.6238 - 2.6240)	
		Grade No. 4	66.651 - 66.657 (2.6240 - 2.6243)	
		Grade No. 5	66.657 - 62.663 (2.6243 - 2.6245)	
		Grade No. 6	66.663 - 66.669 (2.6245 - 2.6248)	
	Except No. 1 main journal	Grade No. 0	66.645 - 66.654 (2.6238 - 2.6242)	
		Grade No. 1	66.654 - 66.663 (2.6242 - 2.6245)	
Grade No. 2		66.663 - 66.672 (2.6245 - 2.6249)		
Difference in inner diameter between cylinders		Standard	Less than 0.05 (0.0020)	

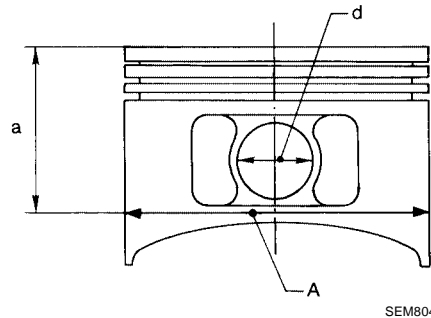
# SERVICE DATA AND SPECIFICATIONS (SDS)

[VG33E and VG33ER]

## Piston, Piston Ring and Piston Pin AVAILABLE PISTON

EBS00CBP

Unit: mm (in)



Piston skirt diameter "A"	Standard (for No. 3, 4 and 5 cylinders)	Grade No. 2-1	91.480 - 91.485 (3.6016 - 3.6018)
		Grade No. 3-2	91.485 - 91.490 (3.6018 - 3.6020)
		Grade No. 3-3	91.490 - 91.495 (3.6020 - 3.6022)
		Grade No. 4-4	91.495 - 91.500 (3.6022 - 3.6024)
		Grade No. 4-5	91.500 - 91.505 (3.6024 - 3.6026)
		Grade No. 5-6	91.505 - 91.510 (3.6026 - 3.6027)
	Standard (for No. 1, 2 and 6 cylinders)	Grade No. 1	91.465 - 91.475 (3.6010 - 3.6014)
		Grade No. 2	91.475 - 91.485 (3.6014 - 3.6018)
		Grade No. 3	91.485 - 91.495 (3.6018 - 3.6022)
	0.25 (0.0098) oversize (Service)		91.715 - 91.745 (3.6108 - 3.6120)
0.50 (0.0197) oversize (Service)		91.965 - 91.995 (3.6207 - 3.6218)	
Height "a"		49.0 (1.929)	
Piston pin hole diameter "d"	Grade No. 0	20.969 - 20.975 (0.8255 - 0.8258)	
	Grade No. 1	20.975 - 20.981 (0.8258 - 0.8260)	
Piston clearance to cylinder block	Standard	For No. 3 and 4 cylinders	0.015 - 0.025 (0.0006 - 0.0010)
		For No. 1, 2 and 6 cylinders (No. 5 cylinder VG33ER only)	0.025 - 0.045 (0.0010 - 0.0018)
		For No. 5 cylinder (VG33E only)	0.030 - 0.040 (0.0012 - 0.0016)

## PISTON RING

Unit: mm (in)

		Standard	Limit
Side clearance	Top	0.040 - 0.080 (0.0016 - 0.0031)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.10 (0.0039)
	Oil	0.015 - 0.185 (0.0006 - 0.0073)	—
Ring gap	Top	0.21 - 0.31 (0.0083 - 0.0122)	0.43 (0.0169)
	2nd	0.50 - 0.60 (0.0197 - 0.0236)	0.69 (0.0272)
	Oil (rail ring)	0.20 - 0.60 (0.0079 - 0.0236)	0.84 (0.0331)

## PISTON PIN

Unit: mm (in)

Piston pin outer diameter	20.971 - 20.983 (0.8256 - 0.8261)
Interference fit of piston pin to piston	0 to -0.004 (0 to -0.0002)
Piston pin to connecting rod bushing clearance	0.005 - 0.017 (0.0002 - 0.0007)

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

# SERVICE DATA AND SPECIFICATIONS (SDS)

[VG33E and VG33ER]

## Connecting Rod

EBS00CBQ

Unit: mm (in)

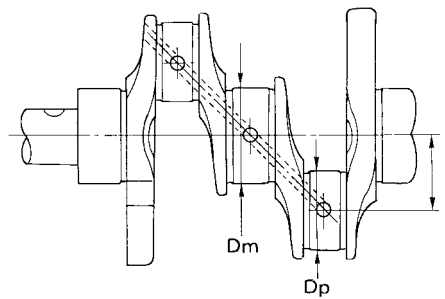
Center distance		154.1 - 154.2 (6.067 - 6.071)
Bend, torsion [per 100 (3.94)]	Limit	Bend: 0.15 (0.0059) Torsion: 0.30 (0.0118)
Piston pin bushing inner diameter*		20.982 - 20.994 (0.8261 - 0.8265)
Connecting rod big end inner diameter		53.000 - 53.013 (2.0866 - 2.0871)
Side clearance	Standard	0.20 - 0.35 (0.0079 - 0.0138)
	Limit	0.40 (0.0157)

\*After installing in connecting rod

## Crankshaft

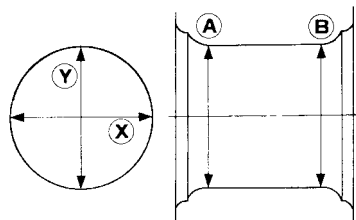
EBS00CBR

Unit: mm (in)



SEM394

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



EM715

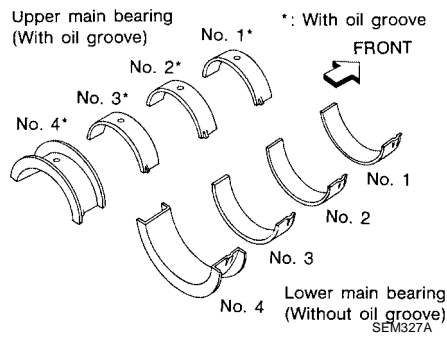
Main journal dia. "Dm"	No. 1 main journal	Grade No. 3	62.696 - 62.975 (2.4683 - 2.4793)
		Grade No. 4	62.963 - 62.969 (2.4789 - 2.4791)
		Grade No. 5	62.957 - 62.963 (2.4786 - 2.4789)
		Grade No. 6	62.951 - 62.957 (2.4784 - 2.4786)
	Except No. 1 main journal	Grade No. 0	62.967 - 62.975 (2.4790 - 2.4793)
		Grade No. 1	62.959 - 62.967 (2.4787 - 2.4790)
Pin journal dia. "Dp"		Grade No. 2	62.951 - 62.959 (2.4784 - 2.4787)
Center distance "r"		41.5 (1.634)	
Out-of-round (X - Y)		Standard	Less than 0.005 (0.0002)
Taper (A - B)		Standard	Less than 0.005 (0.0002)
Runout (total indicator reading)		Standard	Less than 0.025 (0.0010)
		Limit	Less than 0.10 (0.0039)
End free play		Standard	0.050 - 0.170 (0.0020 - 0.0067)
		Limit	0.30 (0.0118)

# SERVICE DATA AND SPECIFICATIONS (SDS)

[VG33E and VG33ER]

## Available Main Bearing

EBS00CBS



### NO. 1 MAIN BEARING

Grade number	Thickness "T" mm (in)	Width "W" mm (in)	Identification color (mark)
0	1.822 - 1.825 (0.0717 - 0.0719)	22.4 - 22.6 (0.882 - 0.890)	Black (A)
1	1.825 - 1.828 (0.0719 - 0.0720)		Brown (B)
2	1.828 - 1.831 (0.0720 - 0.0721)		Green (C)
3	1.831 - 1.834 (0.0721 - 0.0722)		Yellow (D)
4	1.834 - 1.837 (0.0722 - 0.0723)		Blue (E)
5	1.837 - 1.840 (0.0723 - 0.0724)		Pink (F)
6	1.840 - 1.843 (0.0724 - 0.0726)		Purple (G)

### NO. 2 AND 3 MAIN BEARING

Grade number	Thickness "T" mm (in)	Width "W" mm (in)	Identification color
0	1.817 - 1.821 (0.0715 - 0.0717)	18.9 - 19.1 (0.744 - 0.752)	Black
1	1.821 - 1.825 (0.0717 - 0.0719)		Brown
2	1.825 - 1.829 (0.0719 - 0.0720)		Green
3	1.829 - 1.833 (0.0720 - 0.0722)		Yellow
4	1.833 - 1.837 (0.0722 - 0.0723)		Blue

### NO. 4 MAIN BEARING

Grade number	Thickness "T" mm (in)	Identification color
0	1.817 - 1.821 (0.0715 - 0.0717)	Black
1	1.821 - 1.825 (0.0717 - 0.0719)	Brown
2	1.825 - 1.829 (0.0719 - 0.0720)	Green
3	1.829 - 1.833 (0.0720 - 0.0722)	Yellow
4	1.833 - 1.837 (0.0722 - 0.0723)	Blue

### UNDER SIZE

Unit: mm (in)

		Thickness "T" mm (in)	Main journal diameter "Dm"
0.25 (0.0098)	No.1 main bearing	1.956 - 1.962 (0.0770 - 0.0772)	Grind so that bearing clearance is the specified value.
	No.2,3 and No.4 main bearing	1.948 - 1956 (0.0767 - 0.0770)	

### Available Connecting Rod Bearing CONNECTING ROD BEARING UNDERSIZE

EBS00CBT

Unit: mm (in)

	Thickness	Crank pin journal diameter "Dp"
Standard	1.502 - 1.506 (0.0591 - 0.0593)	49.955 - 49.974 (1.9667 - 1.9675)

# SERVICE DATA AND SPECIFICATIONS (SDS)

[VG33E and VG33ER]

Undersize	0.08 (0.0031)	1.542 - 1.546 (0.0607 - 0.0609)	Grind so that bearing clearance is the specified value.
	0.12 (0.0047)	1.562 - 1.566 (0.0615 - 0.0617)	
	0.25 (0.0098)	1.627 - 1.631 (0.0641 - 0.0642)	

## Miscellaneous Components

EBS00CBU

Unit: mm (in)

Flywheel / drive plate runout (total indicator reading)	Less than 0.15 (0.0059)
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## BEARING CLEARANCE

Unit: mm (in)

No. 1 Main bearing clearance	Standard	0.030 - 0.048 (0.0012 - 0.0019)
	Limit	0.060 (0.0024)
No. 2, 3, 4 Main bearing clearance	Standard	0.038 - 0.065 (0.0015 - 0.0026)
	Limit	0.080 (0.0031)
Connecting rod bearing clearance	Standard	0.024 - 0.064 (0.0009 - 0.0025)
	Limit	0.090 (0.0035)