SECTION EM
ENGINE MECHANICAL

CONTENTS

PRECAUTIONS

PFP:00001

Precautions for Draining Coolant

EBS00OEB

- Drain coolant only after the engine has cooled down.

Precautions for Disconnecting Fuel Piping

EBS00OHR

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

Precautions for Removal and Disassembly

EBS00OED

- Use correct special service tool in the specified position. Always pay attention to safety.
- Be careful not to damage surface accuracy of mating or sliding surfaces.
- To prevent foreign material from entering the engine, close openings with appropriate tape as necessary.
- Arrange disassembled parts in their normal positions in order to simplify locating the cause of damage or excessive wear and to insure correct reassembly.
- The removal order of nuts and bolts should in principle move diagonally from the outside. Locations for which order is stipulated should follow that order.

Precautions for Inspections, Repairs, and Replacement

EBS00OEE

- Thoroughly inspect each part following inspection procedure, then correct or replace as necessary. Inspect new parts in the same way, and replace if necessary.

Precautions for Assembling and Installing

EBS00OEF

- Always use a torque wrench when tightening nuts and bolts.
- Unless otherwise specified, tighten nuts and bolts from inside to outside in crisscross pattern. Tighten them gradually and evenly in two to three steps.
- Always replace gasket, packing, oil seals, and O-rings with new ones.
- Thoroughly wash, clean, and blow dry each part. Be sure that engine oil and coolant passages are free of clogs.
- Remove any dirt and lint on sliding and mating surfaces. Before assembly, apply ample amount of engine oil to sliding surfaces.
- If coolant was drained, bleed air from the system.
- Follow the procedure below to make sure there are no fuel leaks.
  - Turn the ignition switch to ON (do not start engine), and with fuel pressure applied in the fuel line, check to make sure there are no fuel leaks from the connection.
  - Start the engine, and at in creased speed, check again to see if there are any fuel leaks from the connection.
- After assembly, start engine and increase the engine speed, then check coolant, fuel, oil, grease, and exhaust gas for leakage.

Parts Requiring Angle Tightening

EBS00OEG

- Use an angle wrench when attaching the following parts.
  - Cylinder head bolt
  - Main bearing cap bolt
  - Connecting rod cap nut
- The specified torque written for these parts is not the final tightening value, but is the torque used for tightening before angle tightening.
- When tightening, make sure there is no debris on the threads or mating surfaces, and lubricate the threads with engine oil.

Precautions for Liquid Gasket

EBS00OEH

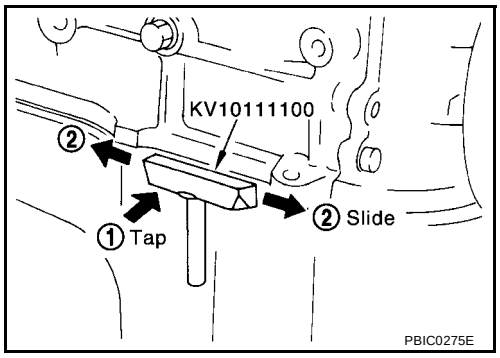
REMOVAL OF LIQUID GASKET SEALING

- Unscrew nuts and bolts. Use a seal cutter to cut the liquid gasket and remove the joined parts.

  CAUTION:
  Be careful not to damage the mating surfaces.

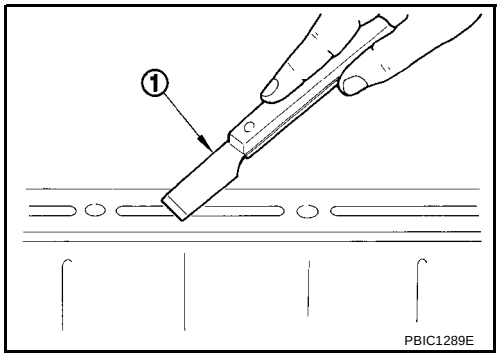
- In positions where a seal cutter is difficult to use, lightly tap with a plastic hammer and remove.

  CAUTION:
  When using a screwdriver, be careful not to scratch the mating surfaces.

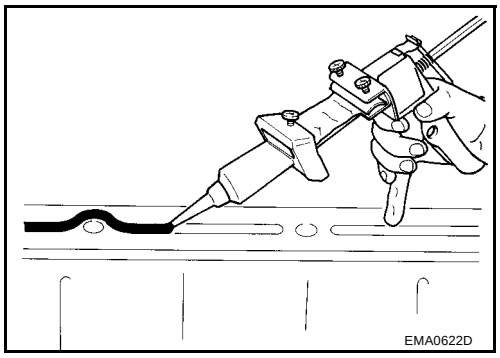


LIQUID GASKET APPLICATION PROCEDURE

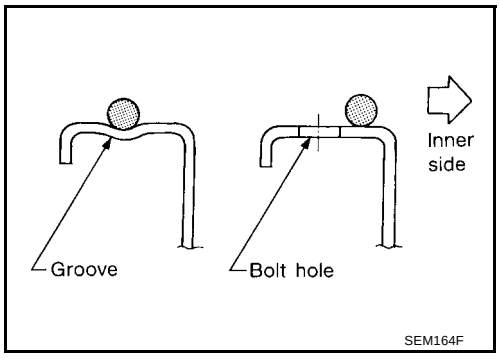
1. Using a scraper (1), remove any old liquid gasket remaining on the gasket application surface and its mating surface.
   - Remove any old liquid gasket remaining in the gasket application groove and on the threads of bolts and bolt holes.
2. Using white gasoline, wipe the gasket application surface and its mating surface to remove any moisture, oil, and foreign material.
3. Set the genuine liquid gasket in a tube presser.



4. Apply a continuous bead of liquid gasket to the specified position at the specified diameter.
   - Apply liquid gasket in the application groove.



   - Apply liquid gasket inside bolt holes. There may be times when application to the exterior is required, so follow those instructions if such are found in the text.
   - Attaching should be done within 5 minutes after gasket application.
   - Immediately wipe off any protruding liquid gasket.
   - Do nor retighten nuts and bolts after installation.
   - After finishing work, wait at least 30 minutes before refilling engine oil and coolant.



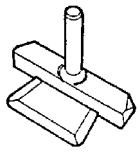
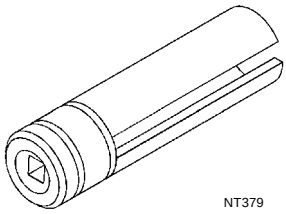
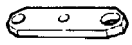
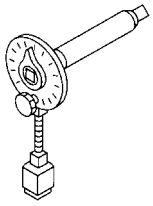
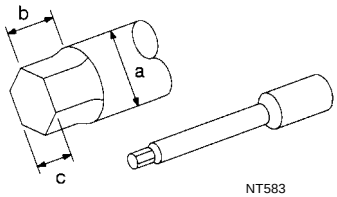
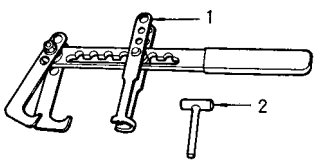
CAUTION:
Follow all specific instructions in this manual.

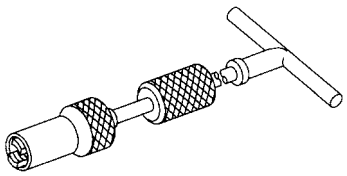
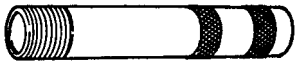
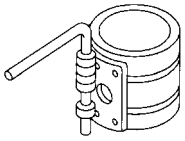
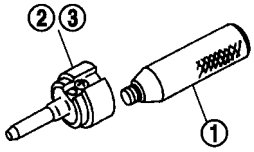
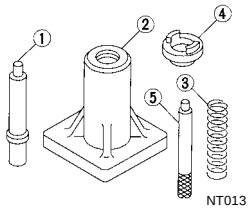
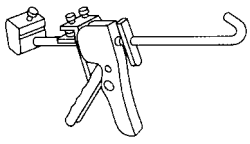
PREPARATION

PFP:00002

Special Service Tools

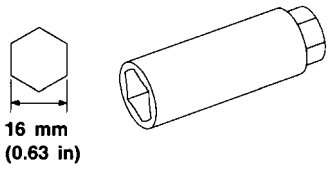
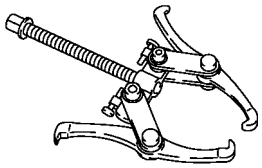
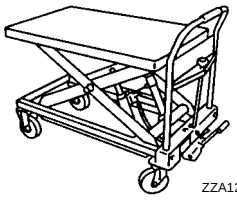
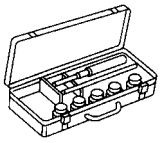
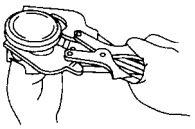
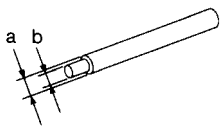
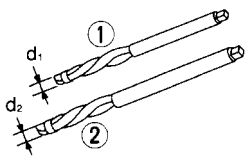
EBS00OEI

Tool number Tool name	Description
KV10111100 Seal cutter  ZZA0013D	Removing parts attached with liquid gasket
KV10117100 Heated oxygen sensor wrench  NT379	Removing and Installing heated oxygen sensor **For 22 mm (0.87 in) width hexagon nut**
KV10105630 Ring gear stopper  ZZA1005D	Removing and installing crankshaft pulley Removing and installing flywheel, drive plate
KV10105610 Stopper plate  ZZA0009D	Removing and installing crankshaft pulley
KV10112100 Angle wrench  NT014	Tightening bolts for bearing cap, cylinder head, etc.
ST10120000 Cylinder head bolt wrench  NT583	Loosening and tightening cylinder head bolt **a: 13 mm (0.51 in) dia.** **b: 12 mm (0.47 in)** **c: 10 mm (0.39 in)**
KV101092S0 Valve spring compressor set 1. KV10116200 Valve spring compressor set 2. KV10109220 Adapter  ZZA0993D	Removing and installing valve mechanism

Tool number Tool name	Description
KV10107902 Valve oil seal puller  NT011	Removing valve oil seal
KV10115600 Valve oil seal drift  ZZA0996D	Installing valve oil seal
EM03470000 Piston ring compressor  NT044	piston assembly into cylinder bore
1. ST15243000 Valve seat drift 2. KV11103710 Adapter 3. KV11103720 Adapter  PBIC1120E	Installing valve seat
KV10107400 Piston pin Press stand 1. KV10107310 Center shaft 2. ST03140030 Stand 3. ST13040030 Spring 4. KV10107320 Cap 5. ST13040050 Drift  NT013	Disassembling and assembling piston with connecting rod
WS39930000 Tube presser  NT052	Pressing the tube of liquid gasket

Commercial Service Tools

EBS00OHU

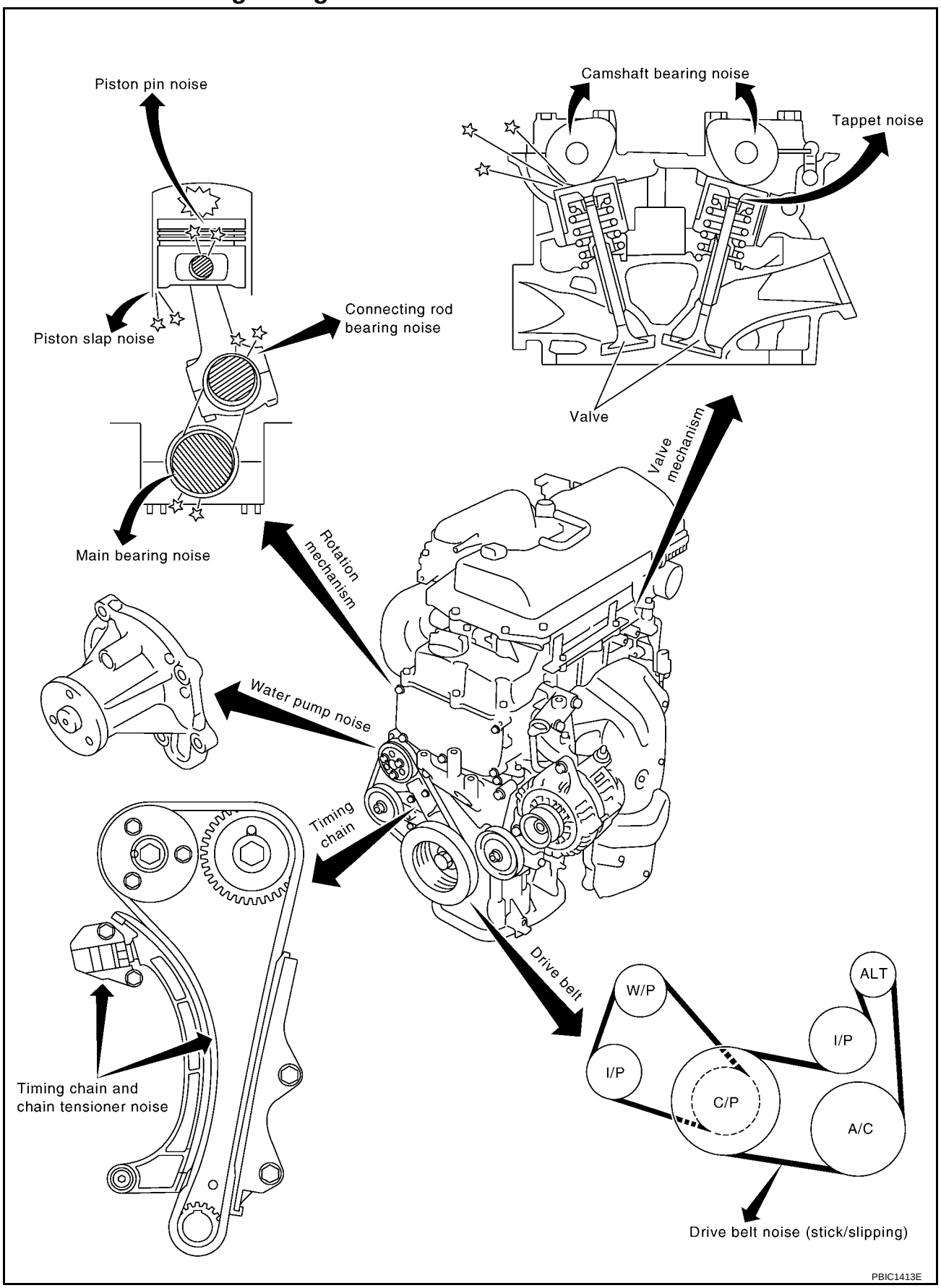
Tool name	Description
Spark plug wrench  NT047	Removing and installing spark plug
Crankshaft pulley puller  PBIC0887E	Removing crankshaft pulley
Manual lift table caddy  ZZA1210D	Removing and installing engine
Valve seat cutter set  NT048	Finishing valve seat dimensions
Piston ring expander  NT030	Removing and installing piston ring
Valve guide drift  NT015	Removing and installing valve guide **Intake & Exhaust:** **a: 9.5 mm (0.374 in) dia.** **b: 5.5 mm (0.217 in) dia.**
Valve guide reamer  NT016	Reaming valve guide **1** or hole for oversize valve guide **2** **Intake & Exhaust:** **d_1 : 5.0 mm (0.217 in) dia.** **d_2 : 9.675 mm (0.381 in) dia.**

NOISE, VIBRATION, AND HARSHNESS (NVH) TROUBLESHOOTING

PFP:00003

NVH Troubleshooting —Engine Noise

EBS00OGA



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

EBS00OGB

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

If necessary, repair or replace these parts.

Location of noise	Type of noise	Operating condition of engine						Source of noise	Check item	Reference page
		Before warm-up	After warm-up	When starting	When idling	When racing	While driving			
Top of engine Rocker cover Cylinder head	Ticking or clicking	C	A	—	A	B	—	Tappet noise	Valve clearance	EM-43
	Rattle	C	A	—	A	B	C	Camshaft bearing noise	Camshaft journal clearance Camshaft runout	EM-41 EM-41
Crankshaft pulley Cylinder block (Side of engine) Oil pan	Slap or knock	—	A	—	B	B	—	Piston pin noise	Piston and piston pin clearance Connecting rod bushing clearance	EM-81 EM-83
	Slap or rap	A	—	—	B	B	A	Piston slap noise	Piston-to-bore clearance Piston ring side clearance Piston ring end gap Connecting rod bend and torsion	EM-84 EM-81 EM-82 EM-82
	Knock	A	B	C	B	B	B	Connecting rod bearing noise	Connecting rod bushing clearance (Small end) Connecting rod bearing clearance (Big end)	EM-83 EM-83
	Knock	A	B	—	A	B	C	Main bearing noise	Main bearing oil clearance Crankshaft runout	EM-87 EM-86
Front of engine Timing chain cover	Tapping or ticking	A	A	—	B	B	B	Timing chain and chain tensioner noise	Timing chain cracks and wear Timing chain tensioner operation	EM-50 EM-47
Front of engine	Squeaking or fizzing	A	B	—	B	—	C	Drive belts (Sticking or slipping)	Drive belts deflection	EM-10
	Creaking	A	B	A	B	A	B	Drive belts (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	B	—	B	A	B	Water pump noise	Water pump operation	CO-20, "WATER PUMP"

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

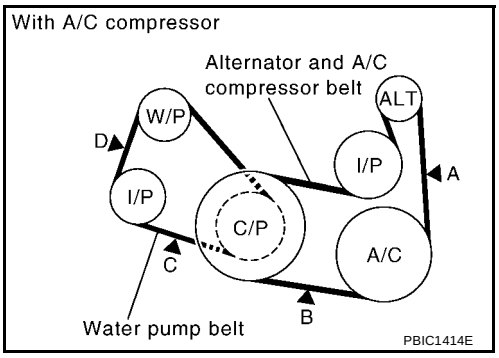
DRIVE BELTS

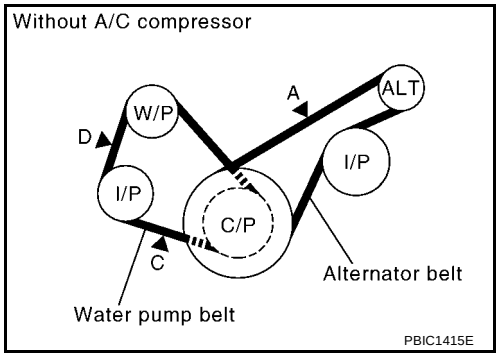
PFP:02117

Checking drive Belts

EBS00OGC

- Inspection should be done only when engine is cold or over 30 minutes after the engine is stopped.
- Turn the clamp pulleys two times clockwise, and make sure tension on all pulleys is equal before doing the test.
- Visually check the belts for wear, damage, and cracks on inside and edges.
- When measuring deflection, apply 98,1 N (10 kg, 22lb) at the ▼ marked point.





CAUTION:

When measuring belt tension immediately after the belt is installed, first set the tension to the standard, rotate the crankshaft for more than two turns in order to eliminate variance in the belt tension between pulleys, then measure and adjust tension to the standard again.

Location	Tension [N (kg, lb)]			Deflection [mm (in)] [When pressed by force of 98.1N (10 kg, 22lb)]			
	New	At adjustment	Limit	Measuring point	New belt	At adjustment	Limit
Alternator and A/C compressor belt	603 - 691 (61.5 - 70.5, 135.6 - 155.3)	495 - 583 (50.5 - 59.5, 111.3 - 131.1)	196 (20, 44.1)	A	6.6 - 7.8 (0.260 - 0.307)	7.3 - 8.5 (0.287 - 0.335)	13.8 (0.543)
				B	5.6 - 6.6 (0.220 - 0.260)	7.1 - 8.3 (0.280 - 0.327)	11.9 (0.469)
Alternator belt	603 - 691 (61.5 - 70.5, 135.6 - 155.3)	495 - 583 (50.5 - 59.5, 111.3 - 131.1)	196 (20, 44.1)	A	3.1 - 4.1 (0.122 - 0.161)	9.8 - 10.6 (0.386 - 0.417)	13.8 (0.543)
Water pump belt	446 - 534 (45.5 - 54.5, 100.3 - 120.0)	348 - 436 (35.5 - 44.5, 78.2 - 98.0)	137 (14, 30.9)	C	6.7 - 7.3 (0.264 - 0.287)	7.6 - 8.6 (0.299 - 0.339)	12.4 (0.448)
				D	4.7 - 5.6 (0.185 - 0.220)	7.0 - 7.7 (0.276 - 0.303)	8.6 (0.339)

Tension Adjustment

EBS00OGD

Location	Location of adjuster and tightening method
Alternator and A/C compressor drive belt	Adjusting bolt on idler pulley
Water pump belt	Adjusting bolt on idler pulley

CAUTION:

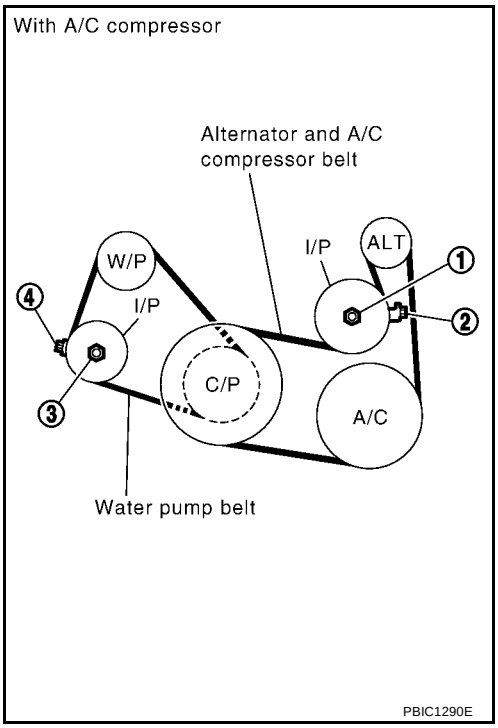
- **When the belt is replaced with new one, adjust the belt tension to the value for “New belt”, because new belt will not fully seat in the pulley groove.**
- **When tension of the belt being used exceeds “Limit”, adjust it to the value for “At adjustment”.**
- **When installing a belt, make sure that it is correctly engaged with the pulley groove.**
- **Do not allow oil or engine coolant to get on the belt.**
- **Do not twist or bend the belt strongly.**

ALTERNATOR AND A/C COMPRESSOR BELT (WITH A/C MODELS)

1. Remove RH front fender protector.
2. Loosen lock nut (1).
3. Tighten lock nut (1) with fingers.
4. Loosen lock nut (1) half a turn counter-clockwise.
5. Adjust the belt tension by turning the adjuster bolt (2).
   For the specified belt tension, refer to EM-10, "Checking drive Belts" .
6. Tighten lock nut (1).

   Nut (1) :

   : 24.5 - 31.4 N·m (2.5 - 3.2 kg-m, 18 - 23 ft-lb)
7. Turn the crankshaft pulley two times clockwise.
8. Check that the belt tension is within the standard. Refer to MA-14, "Checking drive Belts" .

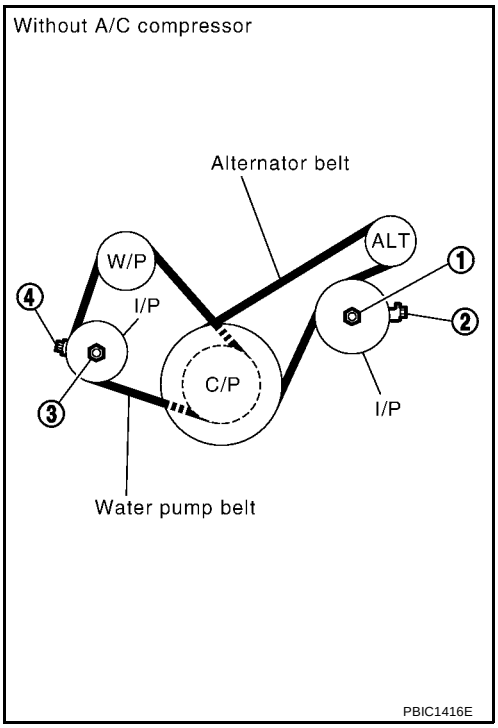


ALTERNATOR BELT (WITHOUT A/C MODELS)

1. Remove RH front fender protector.
2. Loosen lock nut (1).
3. Tighten lock nut (1) with fingers.
4. Loosen lock nut (1) half a turn counter-clockwise.
5. Adjust the belt tension by turning the adjuster bolt (2).
   For the specified belt tension, refer to EM-10, "Checking drive Belts" .
6. Tighten lock nut (1).

   Nut (1) :

   : 24.5 - 31.4 N·m (2.5 - 3.2 kg-m, 18 - 23 ft-lb)
7. Turn the crankshaft pulley two times clockwise.
8. Check that the belt tension is within the standard. Refer to MA-14, "Checking drive Belts" .



WATER PUMP BELT

1. Remove RH front fender protector.
2. Loosen lock nut (3).
3. Tighten lock nut (3) with fingers.
4. Adjust the belt tension by turning the adjuster bolt (4).
   For the specified belt tension, refer to EM-10, "Checking drive Belts" .
5. Tighten lock nut (3).

Nut (3) :

: 24.5 - 31.4 N·m (2.5 - 3.2 kg-m, 18 - 23 ft-lb)

6. Turn the crankshaft pulley two times clockwise.
7. Check that the belt tension is within the standard. Refer to MA-14, "Checking drive Belts" .

Removal and Installation

EBS00OGE

REMOVAL

- Fully loosen each belt while referring to EM-10, "Tension Adjustment" . Remove them one by one, starting with the one in the front.

INSTALLATION

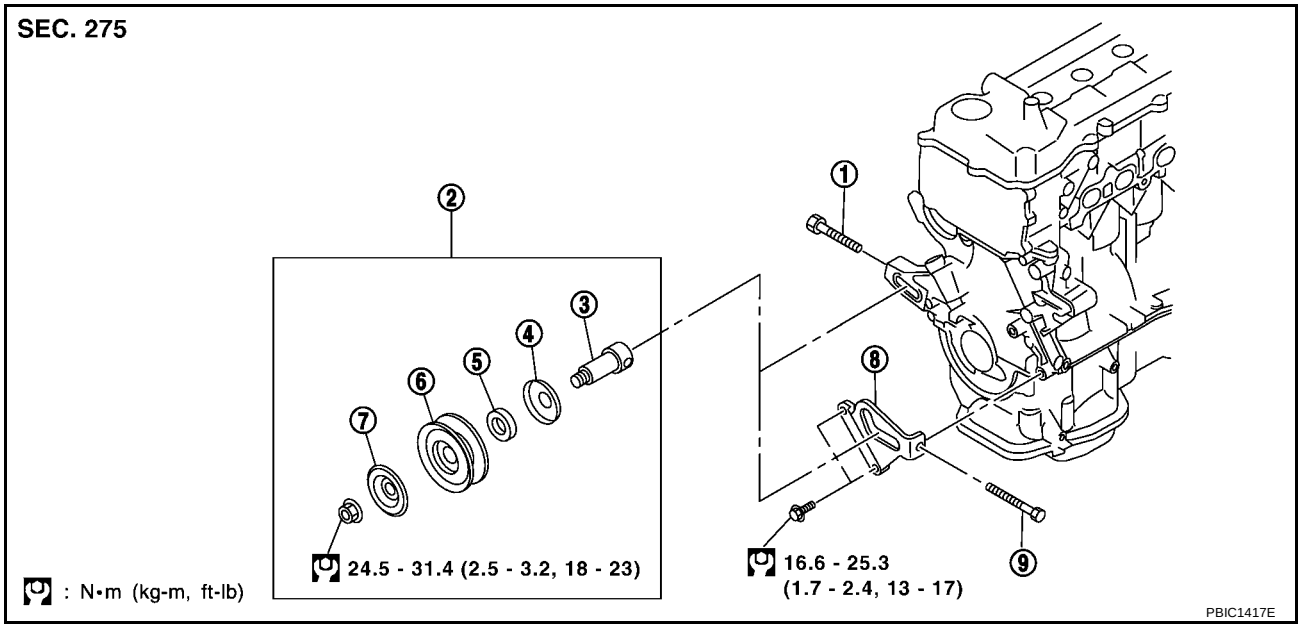
1. Install belts to the pulley in the reverse order of removal.

   CAUTION:
   - **Make sure the belt is securely inside the groove on each pulley.**
   - **Make sure there is no oil, grease, or coolant in pulley grooves.**
2. Adjust tension of each belt.

   CAUTION:
   - **When measuring belt tension immediately after the belt is installed, first set the tension to the standard, rotate the crankshaft for more than two turns in order to eliminate variance in the belt tension between pulleys, then measure and adjust tension to the standard.**
   - **When measuring belt tension, hand tighten idler pulley lock nut to eliminate any looseness.**
3. Tighten the lock nut of adjustment parts to the specified torque.
4. Make sure that tension of each belt is within the standard.

Removal and Installation of Drive Belt Idler Pulley

EBS00OGF



1. Adjuster bolt (for water pump belt)
2. Idler pulley assembly
3. Shaft

4. Cover
5. Spacer
6. Idler pulley
7. Cover
8. Bracket
9. Adjuster bolt (for alternator and A/C compressor belt)

REMOVAL

1. Remove drive belts. Refer to EM-12, "Removal and Installation" .
2. Pull the adjuster bolt out from the shaft.
3. Move the idler pulley assembly along the bracket slide groove and remove by turning the shaft end at the wider part of the groove. (For alternator and A/C compressor belt)
4. Remove the lock nut and remove the shaft by pulling towards the rear of the engine. (For water pump belt)

INSTALLATION

1. Install belts to pulley in reverse order of removal.

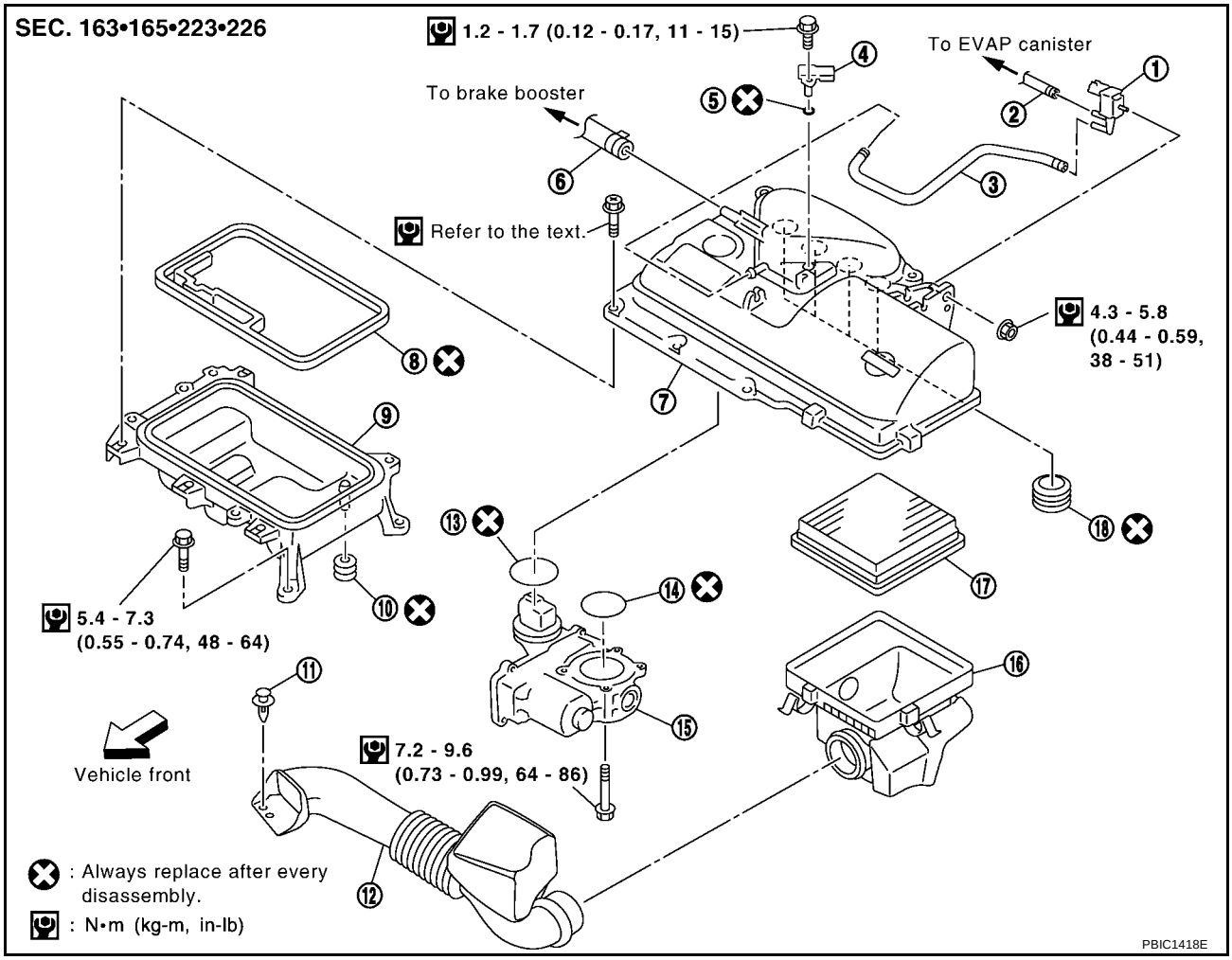
   CAUTION:
   - **Make sure belt is correctly engaged with the pulley groove.**
   - **Check for oil and coolant on belt and each pulley groove.**
2. Adjust belt tension. Refer to EM-10, "Tension Adjustment" .
3. Tighten each adjusting bolt and nut to the specified torque.
4. Make sure that tension of each belt is within the standard.

AIR CLEANER AND AIR DUCT

PFP:16500

Removal and Installation

EBS00OEO



1. EVAP canister purge volume control solenoid valve	2. Vacuum hose	3. Vacuum hose
4. Manifold absolute pressure sensor	5. O-ring	6. Vacuum hose
7. Air cleaner case (upper)	8. Gasket	9. Air cleaner case (lower)
10. Gasket	11. Clip	12. Air duct
13. Gasket	14. Gasket	15. Electric throttle control actuator
16. Air cleaner body	17. Air cleaner filter	18. Gasket

REMOVAL

NOTE:

The steps 1 to 2 can be skipped, moving straight to the step 3 (separation of harnesses and hoses, etc. cannot be skipped)

1. Remove the harness connector and then the manifold absolute pressure sensor.

   CAUTION:

   - **Handle manifold absolute pressure sensor with care. Avoid impacts.**
   - **Make sure no foreign matter is attached to the sensor (oils, chemicals, etc.)**

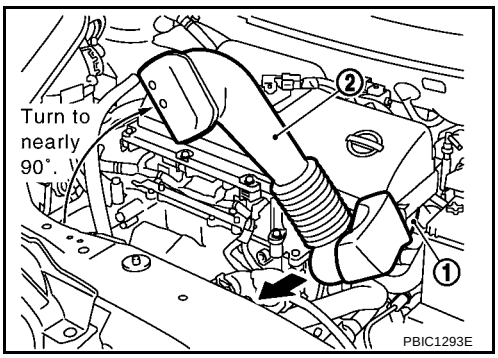
2. Remove the harness connector and vacuum hose and then the EVAP canister purge volume control solenoid valve.

   CAUTION:

   Handle EVAP canister purge volume control solenoid valve with care. Avoid impacts.

3. Remove air duct.

- Remove the clips, and with air duct (2) turned to nearly 90 degrees, pull off from the air cleaner body (1).

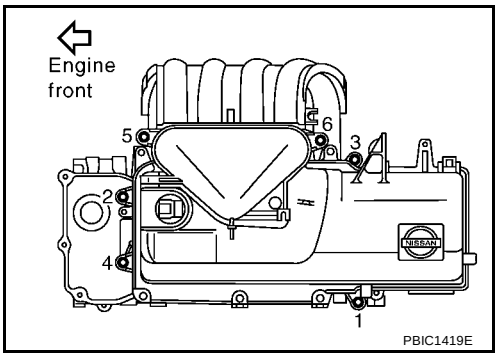


4. Remove the clips, pull the air cleaner body down then forward, and then remove the air cleaner body and the air cleaner filter.

NOTE:
Removal and disassembly of the air cleaner case (upper) and (lower) follows below.

5. Move the transaxle breather hose.
6. Remove the air cleaner case assembly in the following order.
   - The entire air cleaner case (upper and lower) is referred to as the air cleaner case assembly.

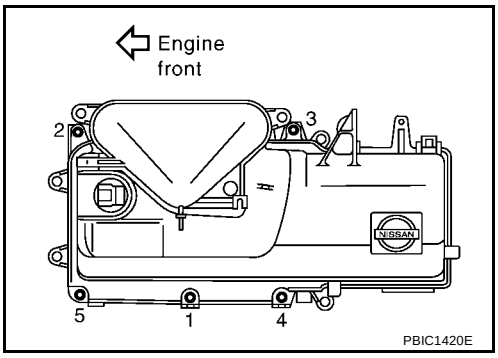
a. Separate the harness connector from the electronic throttle control actuator.
b. Separate the brake booster vacuum hose.
c. Loosen bolts in the reverse of the order shown in figure.



7. Remove the air cleaner case assembly by raising.
   - Slowly raise the force evenly on the intake manifold joint to lift it and remove the air cleaner case assembly.

CAUTION:
- **To avoid damaging parts, do not use sudden force.**
- **Block the intake manifold openings with tape to make sure no foreign particles get inside it while you are removing the air cleaner case assembly.**

8. Loosen the bolts in reverse of the order shown in the figure and separate the air cleaner case (upper) and (lower).



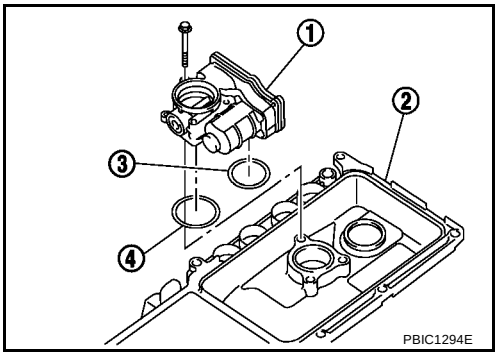
9. Remove the electronic throttle control actuator from the air cleaner case (upper).
   - Turn the air cleaner case (upper) over on the protective sheet to make sure the surface does not get scratched.
   - The electronic throttle control actuator should be handled with the following precautions in mind.

CAUTION:
- **Handle electronic throttle control actuator with care. Avoid impacts.**
- **Do not disassemble or adjust.**

INSTALLATION

1. Install the electronic throttle control actuator (1) to the air cleaner case (upper) (2) in the following procedure:

a. Install the gasket (3) to the connector base.
b. Attach the gasket (4) to the outer groove on the throttle bore on the side of the air cleaner case (upper) (2).
c. Install electronic throttle control actuator.
   - There is no pre-determined order in which the mounting bolts should be tightened.
   - Perform the “Throttle Valve Closed Position Learning” when harness connector of the electric throttle control actuator is



disconnected. Refer to EC-34, "Throttle Valve Closed Position Learning" (WITH EURO-OBD), EC-435, "Throttle Valve Closed Position Learning" (WITHOUT EURO-OBD).

- Perform the “Idle Air Volume Learning” and “Throttle Valve Closed Position Learning” when the electric throttle control actuator is replaced. Refer to EC-34, "Idle Air Volume Learning" and EC-34, "Throttle Valve Closed Position Learning" (WITH EURO-OBD), EC-435, "Idle Air Volume Learning" and EC-435, "Throttle Valve Closed Position Learning" (WITHOUT EURO-OBD).

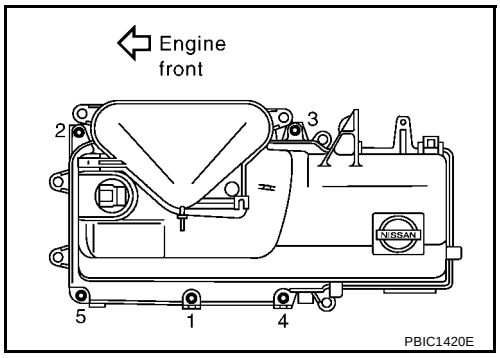
2. Assemble the air cleaner case (upper) and (lower).
   - Tighten bolts evenly in two steps in the order shown in figure.

   1st step

   : 1.9 - 2.2 N·m (0.20 - 0.22 kg-m, 17 - 19 in-lb)

   2nd step

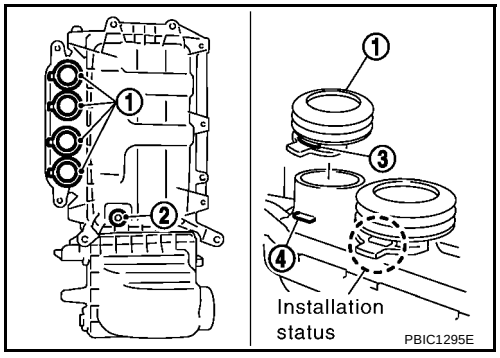
   : 3.8 - 4.4 N·m (0.40 - 0.44 kg-m, 35 - 38 in-lb)



3. Attach the air cleaner case assembly in the following order.

a. Attach the gasket (for the intake manifold (1) and the PCV path (2))
   - Attach for the intake manifold so that the case protrusion (4) fit into the cutout hole (3) on the side of the gasket.
   - Make sure foreign particles do not attach to the gasket or the sealing area.

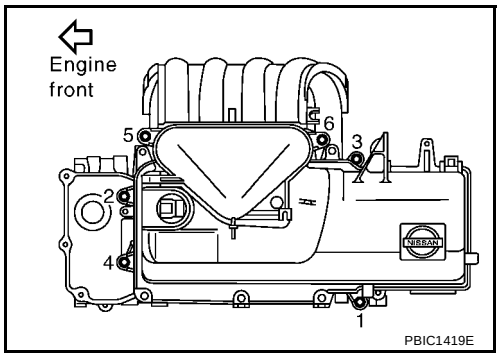
b. Insert the air cleaner case assembly into the intake manifold.
   - At the same time, insert the bottom path protrusions into the PCV path holes on the rocker cover.



   CAUTION:
   Insert straight, making sure the axis is lined up, to prevent the gaskets from being crooked or twisted.

c. Tighten bolts in the numerical order shown in figure.
   - Tighten bolts evenly in several steps.

   CAUTION:
   Tighten after making sure the positioning of bolts 5 and 6 is true.



4. Install air cleaner body and air cleaner filter. Refer to EM-17, "Changing Air Cleaner Filter" .
5. Attach air duct.
6. Attach EVAP canister purge volume control solenoid valve.
7. Attach the manifold absolute pressure sensor.
   - Make sure no foreign particles attach to the flange, O-ring, or attachment hole.
   - Tighten the mounting bolt after making sure it is fully inserted into the mounting hole.

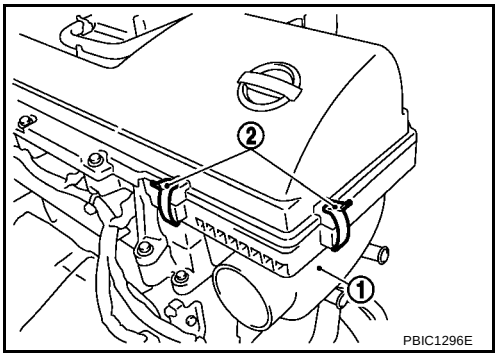
Changing Air Cleaner Filter

EBS00OEP

REMOVAL

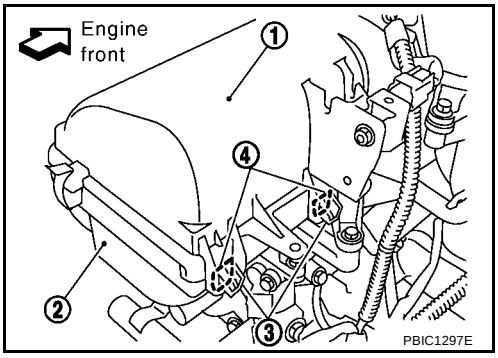
1. Remove air duct. Refer to EM-14, "REMOVAL" .
2. Remove clips (2) of air cleaner body (1).
3. After moving the air cleaner body downward, remove it by pulling it forward.
   - While pressing down the radiator upper hose, remove air cleaner body (1).
4. Remove air cleaner filter from the air cleaner body.

   NOTE:
   In some cases the air cleaner filter might remain in the air cleaner case (upper).



INSTALLATION

1. Set the air cleaner filter on the air cleaner case (upper) (1).
2. Insert the two projections (3) on the air cleaner body (2) into the two notch holes (4) on the rear of the air cleaner case (upper) (1), then lift up and fasten with the clip.
3. Attach air duct.

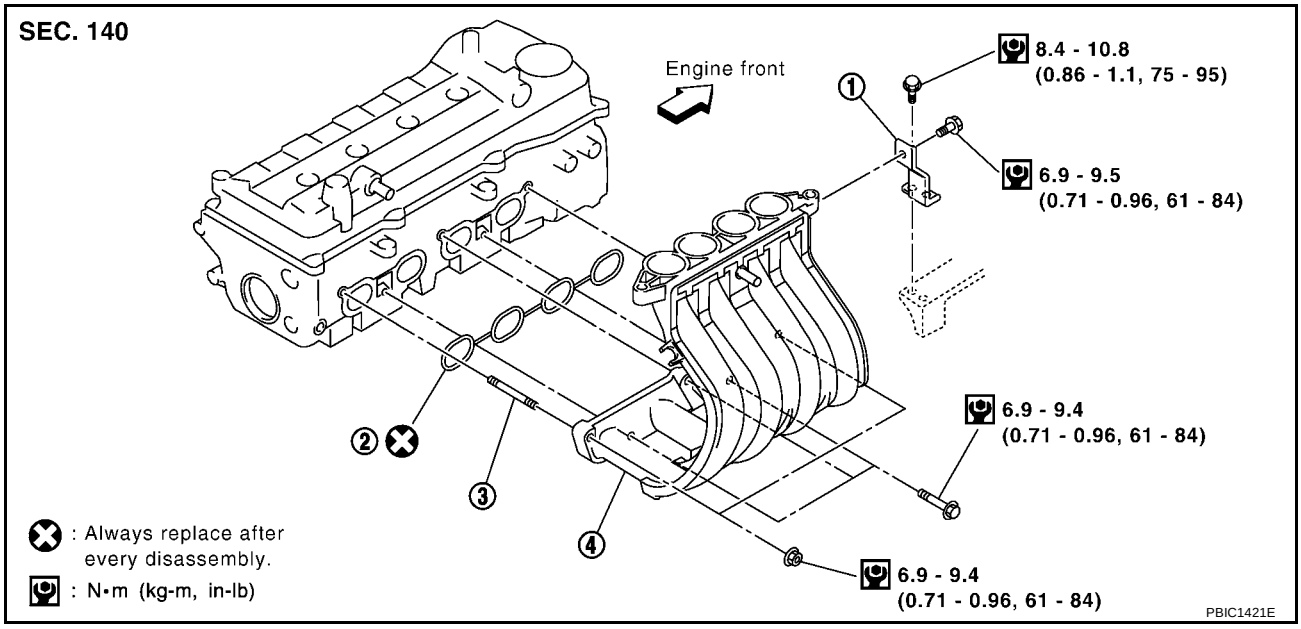


INTAKE MANIFOLD

PFP:14003

Removal and Installation

EBS00OEQ

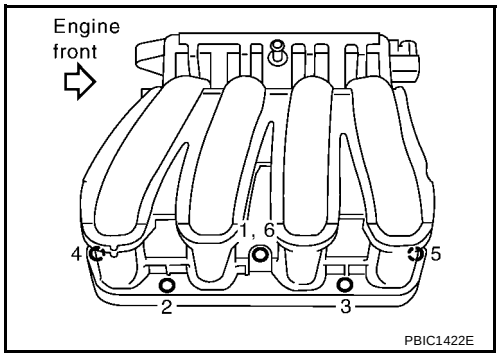


1. Support bracket
2. Gasket
3. Stud bolt
4. Intake manifold

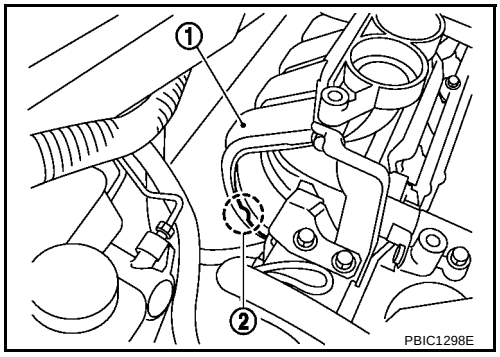
REMOVAL

1. Remove air duct and air cleaner case assembly. Refer to EM-14, "AIR CLEANER AND AIR DUCT" .
2. Remove the PCV hose (between the intake manifold and the rocker cover) from the intake manifold side.
3. Remove the support bracket mounting bolt (No. 1 port upper engine front side)
4. Loosen nuts and bolts in the reverse of the order shown in the figure to remove the intake manifold.

CAUTION:
Disregard No. 6 shown in figure in the loosening order.



NOTE:
Removal and installation of No. 5 nut is made easier by inserting the tool into the recommended cutout part (2) on the No. 1 port (1). (The same applies to No. 4 nut)



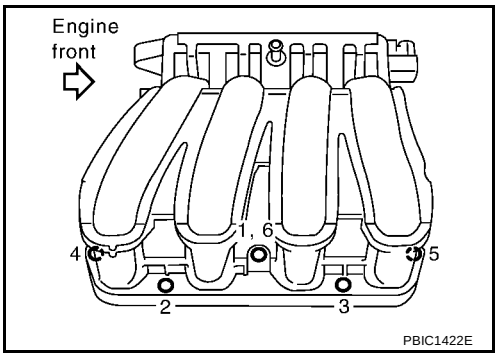
INSTALLATION

- Install in the reverse order of removal paying attention to the following.

Attachment of the Intake Manifold

- Check for damage or foreign material on the mounting surfaces.
- Tighten nuts and bolts in numerical order shown in figure.

  NOTE:
  No. 6 in the figure shows the 2nd tightening of No. 1 bolt.
- When installing support bracket, refer to EM-29, "INSTALLATION" .

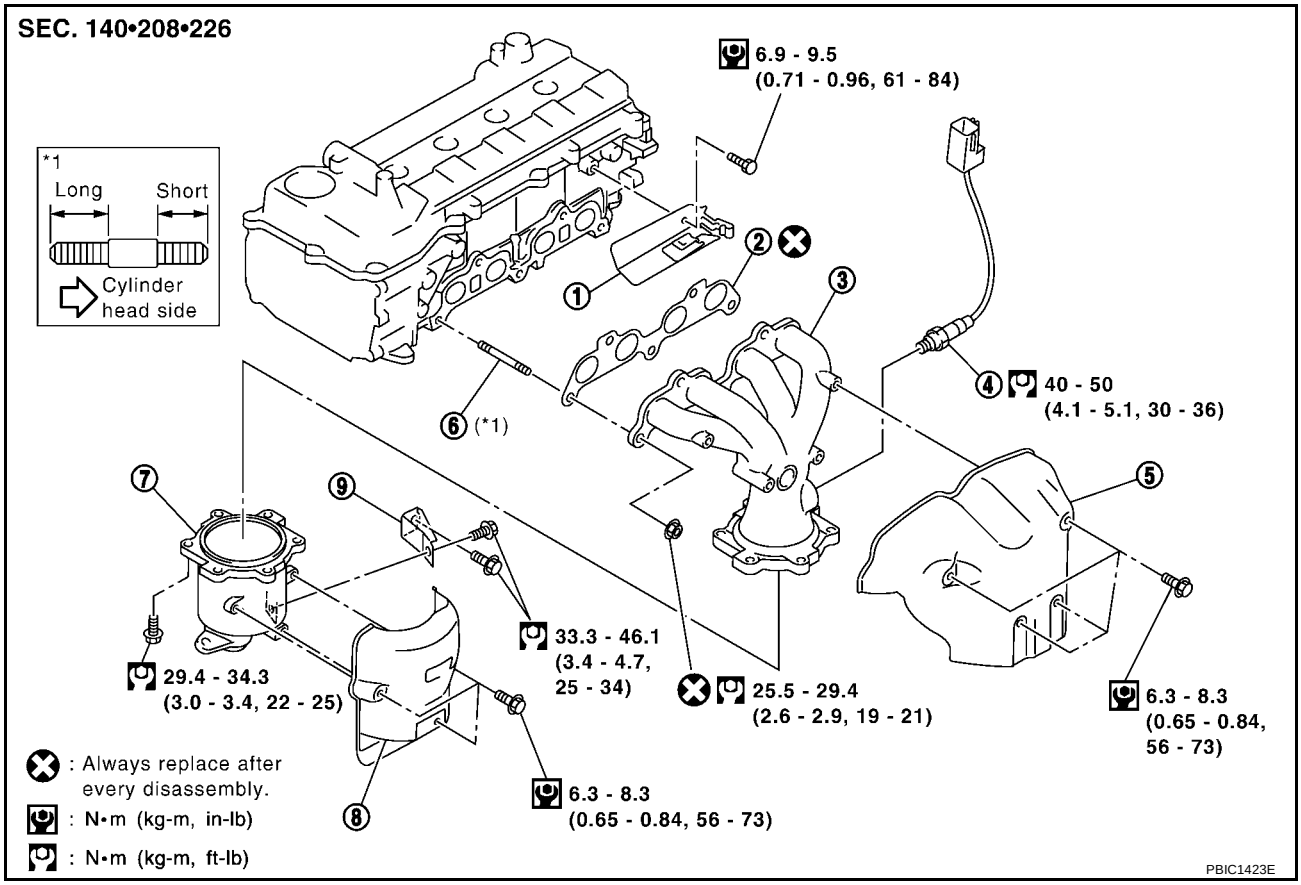


EXHAUST MANIFOLD AND THREE WAY CATALYST

PFP:14004

Removal and Installation

EBS00OI8



1. Bracket
2. Gasket
3. Exhaust manifold
4. Heated oxygen sensor 1
5. Exhaust manifold cover
6. Stud bolt
7. Three way catalyst (manifold)
8. Three way catalyst cover
9. Support

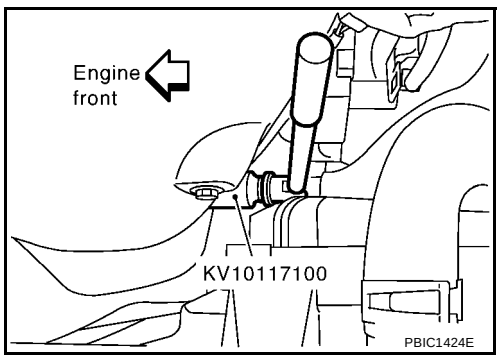
REMOVAL

1. Remove air duct. Refer to EM-14, "AIR CLEANER AND AIR DUCT" .
2. Remove RH front fender protector.
3. Remove alternator and A/C compressor belt. Refer to EM-10, "DRIVE BELTS" .
4. Remove A/C compressor with piping connected, move A/C compressor to body side and secure it onto body with a rope.
5. Remove exhaust front tube connection at front. Refer to EX-3, "EXHAUST SYSTEM" .
6. Remove RH engine mount stay and alternator bracket.
7. Loosen the lower bolt and move the alternator to the front of the vehicle.
8. As needed, remove the heated oxygen sensor 1 in the following order.

   NOTE:
   Steps 2 to 7 above are not needed for heated oxygen sensor 1 removal.

a. Separate the harness connector and remove it from bracket.

b. Using heated oxygen sensor wrench (special service tool), remove heated oxygen sensor 1.



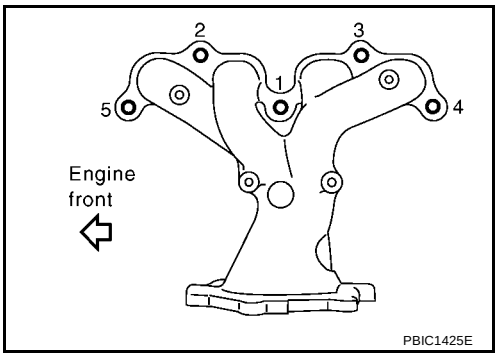
CAUTION:

- **Handle it carefully, avoid any chance of impact caused by dropping.**

- **Do not over torque the heated oxygen sensor. Doing so may cause damage to the heated oxygen sensor, resulting in the MI coming on.**

9. Remove exhaust manifold cover.
10. Remove the three way catalyst cover.
11. Loosen nuts and bolts in the reverse of the order shown in figure to remove the exhaust manifold and three way catalyst.

CAUTION:
Be careful not to damage the A/C piping.



12. Separate the exhaust manifold and three way catalyst.

CAUTION:
Avoid impacts to three way catalyst.

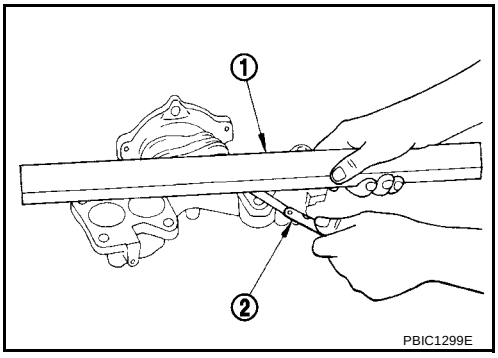
INSPECTION AFTER REMOVAL

Surface Distortion

- Using a reliable straightedge (1) and feeler gauge (2), check distortion of mounting surface on exhaust manifold.

Limit : 0.3 mm (0.012 in)

- If it exceeds the limit, replace the exhaust manifold.

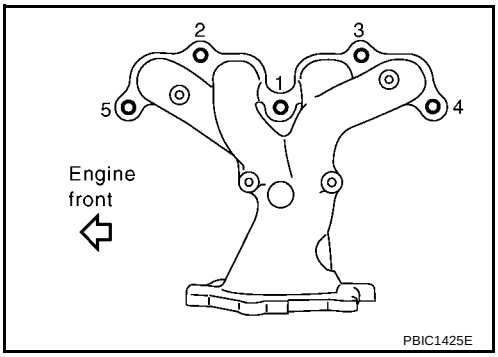


INSTALLATION

- Install in the reverse order of removal paying attention to the following.

Installation of Exhaust Manifold and Three Way Catalyst

- Check for damage or foreign material on the mounting surfaces.
- Tighten nuts in numerical order shown in figure.



Installation of Heated Oxygen Sensor 1

CAUTION:

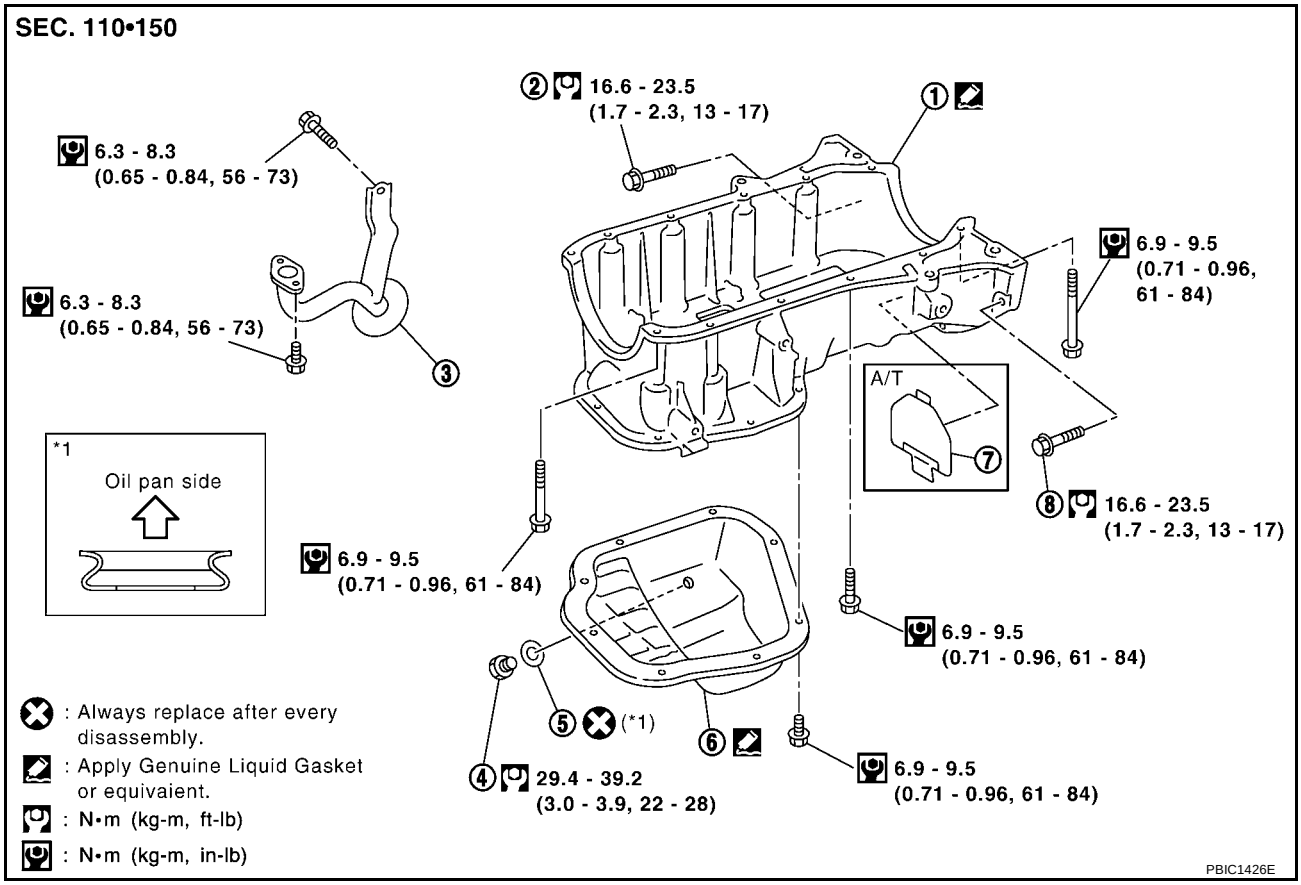
- **Do not over torque the heated oxygen sensor. Doing so may cause damage to the heated oxygen sensor, resulting in the MI coming on.**

OIL PAN AND OIL STRAINER

PFP:11110

Removal and Installation

EBS00OES



1. Oil pan (upper)
2. Transaxle connecting bolt
3. Oil strainer
4. Drain plug
5. Washer
6. Oil pan (lower)
7. Rear plate cover
8. Transaxle connecting bolt

REMOVAL

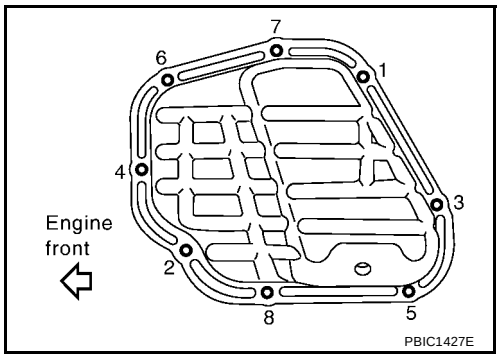
NOTE:

Installation and removal of manual transmission vehicle oil pan (upper) require removal of the transaxle.

1. Remove RH front fender protector.
2. Drain the engine oil.
3. Remove the oil pan (lower) in the following order.

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

b. Insert seal cutter (special service tool) between oil pan (upper) and oil pan (lower). Slide seal cutter by tapping on the side of the tool with a hammer. Remove oil pan (lower).



CAUTION:

Exercise care not to damage mating surface.

NOTE:

The following is the order for removing the oil pan (upper).

4. Remove the oil level gauge.
5. Remove drive belts. Refer to EM-10, "DRIVE BELTS" .
6. Remove the A/C compressor with piping connected and move the A/C compressor aside.

CAUTION:

Hang it with rope and temporarily tighten to body to avoid putting stress on air conditioner piping.

7. Remove the exhaust front tube. Refer to EX-3, "EXHAUST SYSTEM" .

8. Remove three way catalyst support. Refer to EM-20, "EXHAUST MANIFOLD AND THREE WAY CATALYST" .
9. Remove the transaxle in the following order. (M/T models)

a. Mount engine slingers on cylinder head. Refer to EM-58, "Removal and Installation" .

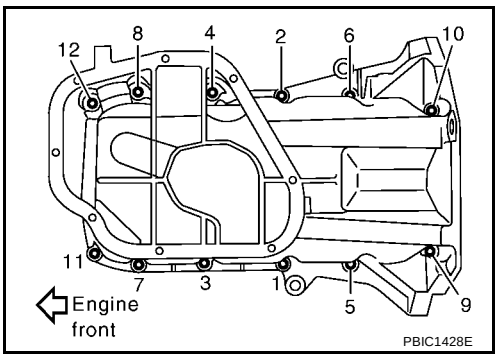
b. Lift with a hoist and position engine.

c. Remove transaxle. Refer to EM-65, "Removal and Installation" .

10. Remove oil pan (upper) with the following procedure.

a. Remove oil pan (upper) to transaxle connecting bolts (A/T models). Refer to AT-423, "REMOVAL AND INSTALLATION" .

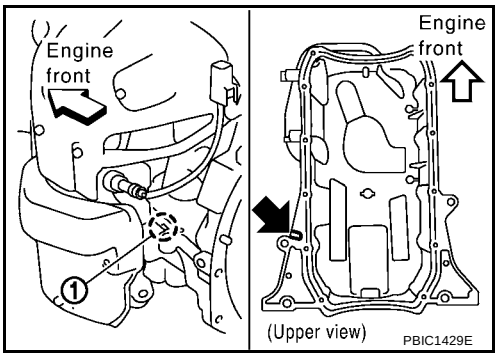
b. Loosen oil pan (upper) mounting bolts in the reverse of the order shown in figure.



c. Insert a flathead offset screwdriver into the cutout (1) shown in figure and create a crack between the oil pan and cylinder block.

d. Insert seal cutter (special service tool) between oil pan (upper) and cylinder block. Slide seal cutter by tapping on the side of the tool with a hammer. Remove oil pan (upper).

CAUTION:
Exercise care not to damage mating surface.



11. Remove oil strainer.

INSTALLATION

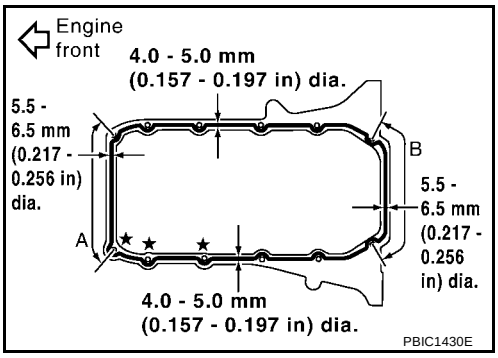
1. Install oil strainer.

NOTE:
Do not use O-ring, gasket, or other seal parts.

2. Attach the oil pan (upper) in the following order.

a. Apply the liquid gasket to the position shown in figure.
Use Genuine Liquid Gasket or equivalent.

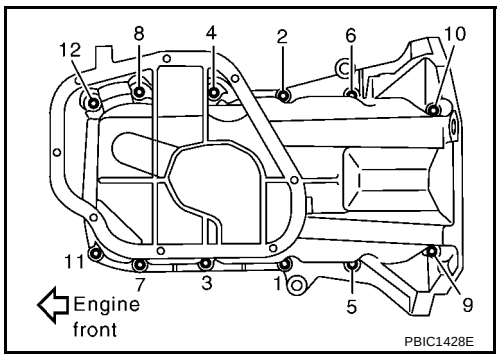
CAUTION:
- **For bolt holes with ★ marks (3 locations), apply liquid gasket outside the holes.**
- **Apply a bead of 5.5 to 6.5 mm (0.127 - 0.256 in) in diameter to area “A” and “B”.**



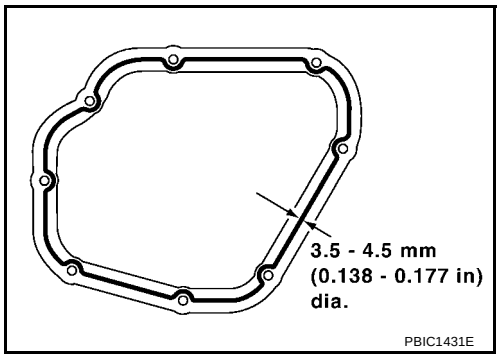
b. Tighten bolts in the numerical order shown in figure.

NOTE:
See below for mounting positions of bolts

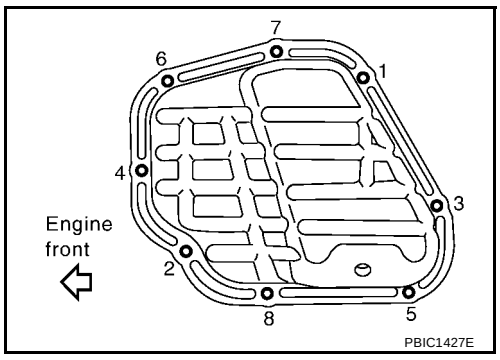
Under head 70 mm (2.76 in) : 4, 8, 12
Under head 90 mm (3.54 in) : 9,10
Under head 25 mm (0.98 in) : Other than the above



c. Tighten transaxle connecting bolts. (A/T models)
3. Install transaxle assembly. (M/T models)
4. Install oil pan (lower) in the following procedure:
a. Apply the liquid gasket to the position shown in figure.
Use Genuine Liquid Gasket or equivalent.



b. Tighten bolts in the numerical order shown in figure.



5. Install oil pan drain plug.
   - For washer installation direction, refer to components figure on EM-22, "Removal and Installation" .
6. Reinstall removed parts in reverse order of removal.

CAUTION:
Engine oil should be filled at least 30 minutes after the oil pan is installed.

INSPECTION AFTER INSTALLATION

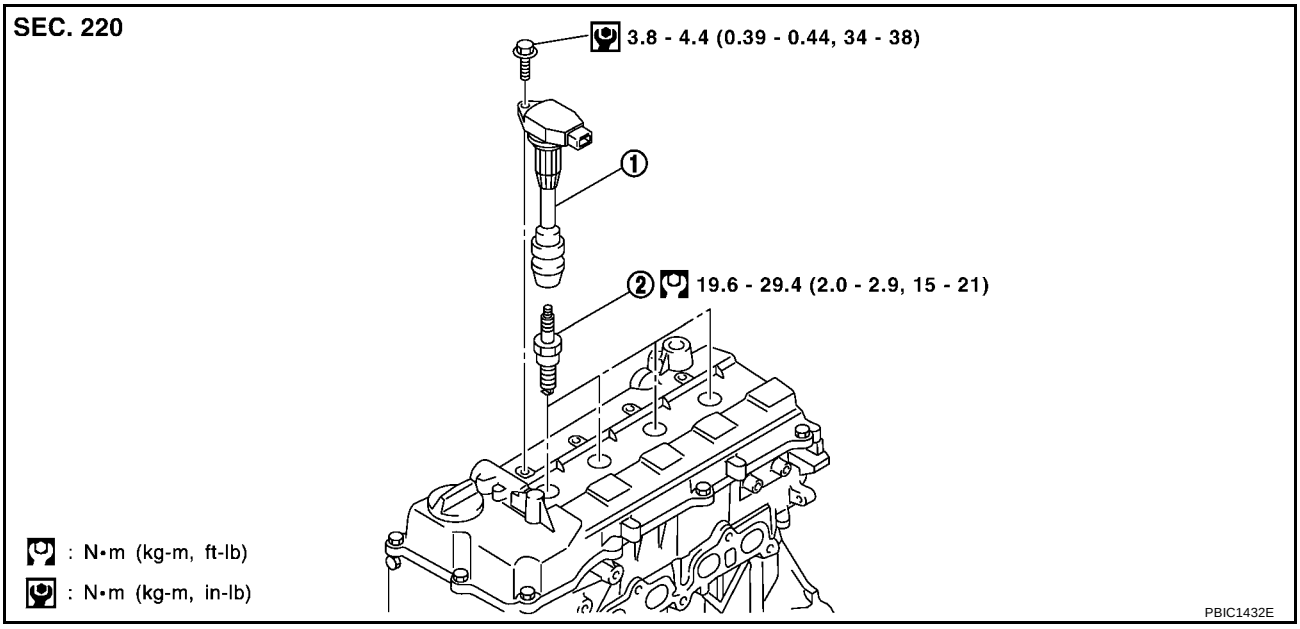
- Check engine oil level. Refer to LU-4, "ENGINE OIL" .
- Warm up engine and check the oil amount and no leakage of oil. Refer to LU-4, "ENGINE OIL" .

IGNITION COIL

PFP:22448

Removal and Installation

EBS00OET



1. Ignition coil
2. Spark plug

REMOVAL

1. Remove air duct and air cleaner case assembly. Refer to EM-14, "AIR CLEANER AND AIR DUCT" .
2. Disconnect harness connector from the ignition coil.
3. Remove ignition coil.

CAUTION:

- **Handle ignition coil with care. Avoid impacts.**
- **Do not disassemble.**

INSTALLATION

Install in the reverse order of removal.

SPARK PLUG (PLATINUM-TIPPED TYPE)

PFP:22401

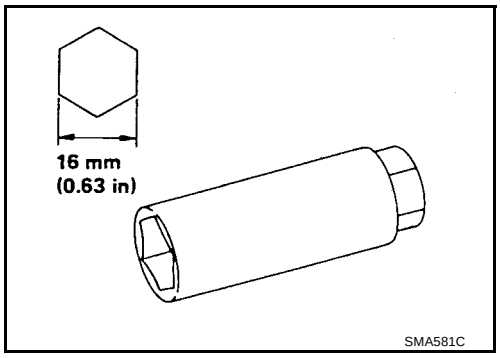
Removal and Installation

EBS00OEU

REMOVAL

1. Remove ignition coil. Refer to EM-25, "IGNITION COIL" .
2. Remove spark plugs with a spark plug wrench.

CAUTION:
Handle spark plug with care. Avoid impacts.



INSPECTION AFTER REMOVAL

- Use standard type spark plug for normal condition.

The hot type spark plug is suitable when fouling occurs with the standard type spark plug under conditions such as:

- Frequent engine starts
- Low ambient temperatures

The cold type spark plug is suitable when spark plug knock occurs with the standard type spark plug under conditions such as:

- Extended highway driving
- Frequent high engine revolution

Make	NGK	Champion
Standard type	LFR5AP-11	REC10PYC4
Hot type	LFR4AP-11	—
Cold type	LFR6AP-11	—

Gap (Nominal) : 1.1 mm (0.043 in)

CAUTION:

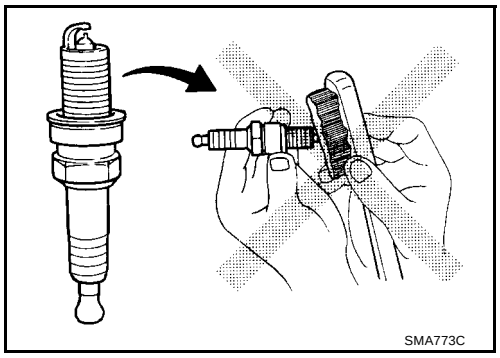
- **Do not use a wire brush for cleaning.**
- **If plug tip is covered with carbon, spark plug cleaner may be used.**

Cleaner air pressure:

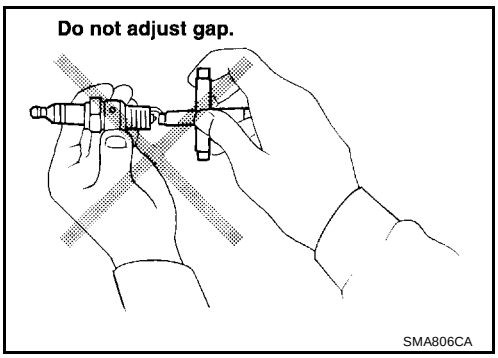
Less than 588 kPa (6 kg/cm^2 , 85 psi)

Cleaning time:

Less than 20 seconds



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



INSTALLATION

Install in the reverse order of removal.

Spark plug

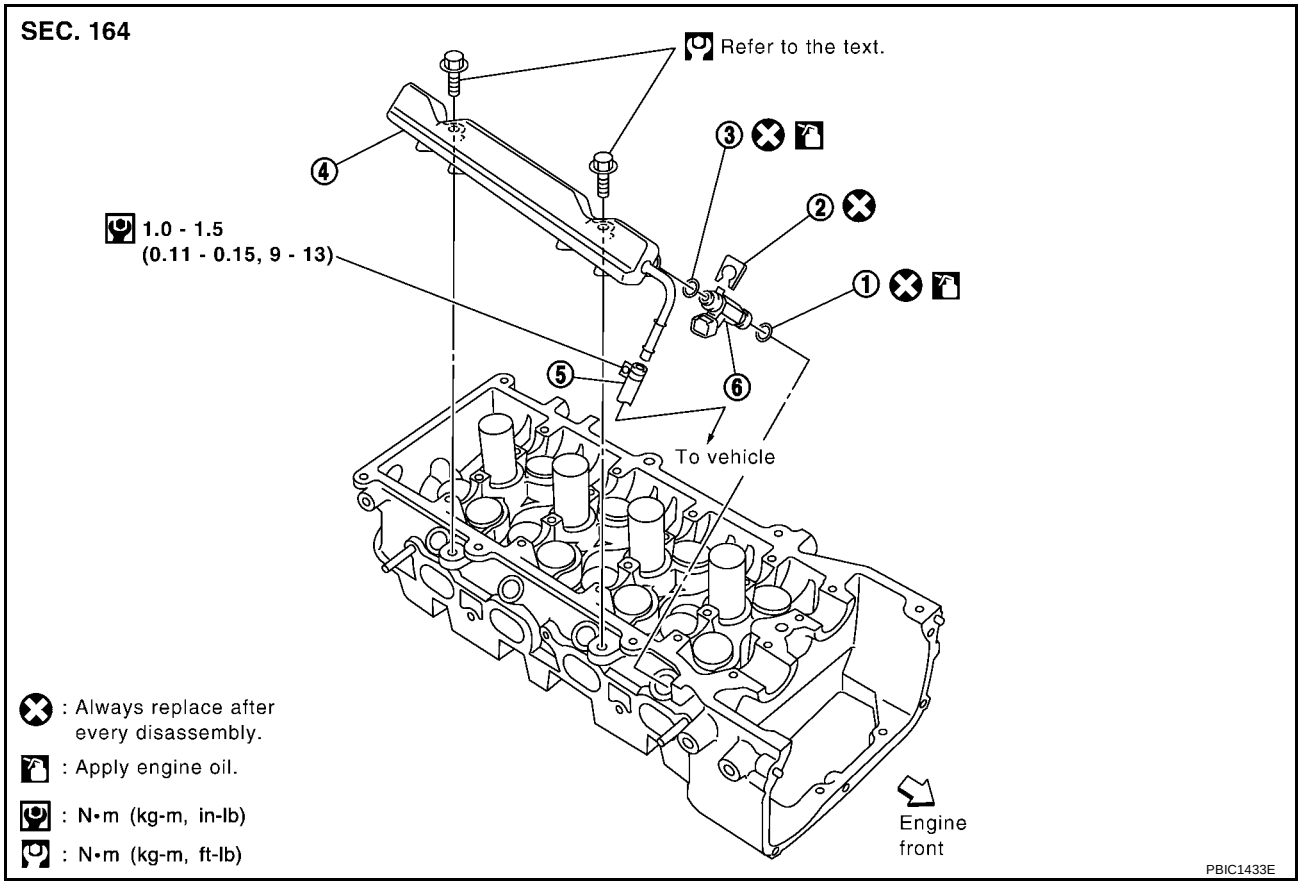
: 19.6 - 29.4 N·m (2.0 - 3.0 kg-m, 15 - 21 ft-lb)

FUEL INJECTOR AND FUEL TUBE

PFP:16600

Removal and Installation

EBS00OGG



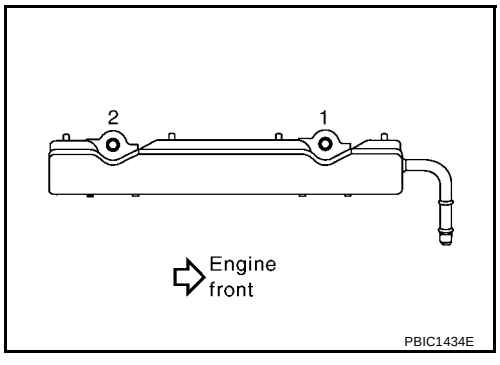
1. O-ring (brown)
2. Clip
3. O-ring (black)
4. Fuel tube
5. Fuel feed hose
6. Fuel injector

REMOVAL

1. Release fuel pressure. Refer to EC-36, "FUEL PRESSURE RELEASE" (WITH EURO-OBD), EC-437, "FUEL PRESSURE RELEASE" (WITHOUT EURO-OBD).
2. Remove air duct and air cleaner case assembly. Refer to EM-14, "AIR CLEANER AND AIR DUCT" .
3. Remove intake manifold support bracket.
4. Remove the fuel hose on the side of the fuel tube.

   CAUTION:
   Attach a plug to the removed hose to prevent fuel leaks.
5. Separate the fuel injector harness and move to a position where it will not get in the way of work.
   - If it is stuck or otherwise difficult to remove, remove the fuel injector and fuel tube assembly from the cylinder head and separate fuel injector harness in a better position.
6. Loosen bolts in the reverse of the order shown in the figure and then remove the fuel injector and fuel tube assembly.

   CAUTION:
   - **Make sure the fuel injector nozzle does not touch the other parts.**
   - **Take out without tipping, as this will cause fuel to leak.**



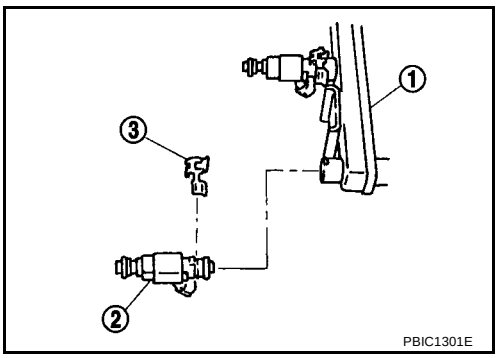
7. Remove the fuel injector (2) from the fuel tube (1) in the following order.

a. Open and pull out the clip (3).

b. Remove fuel injector from the fuel tube by pulling straight.

CAUTION:

- **Be careful not to damage the nozzle.**
- **Do not drop or impact the fuel injector.**
- **Do not disassemble or adjust fuel injector.**



INSTALLATION

1. Keep in mind the following points when attaching the O-ring to the fuel injector.

CAUTION:

- **The upper and lower O-rings are different, so use caution when attaching them.**

Fuel tube side	**: Black**
Nozzle side	**: Brown**

- **Handle O-ring with bare hands. Never wear gloves.**
- **Lubricate O-ring with engine oil.**
- **Do not clean O-ring with solvent.**
- **Make sure the O-ring and its mating part are free of foreign material.**
- **When installing the O-ring, be careful not to scratch it with tools or your fingernails. Also be careful not to twist or stretch O-ring. If O-ring is stretched while it is being attached, do not insert it into fuel tube immediately.**

2. Install the fuel injector onto the fuel tube in the following procedure:

a. Insert the clip (3) into the clip mounting groove (2) on the fuel injector (1).

- Insert clip cutout (5) into fuel injector protrusion (4).

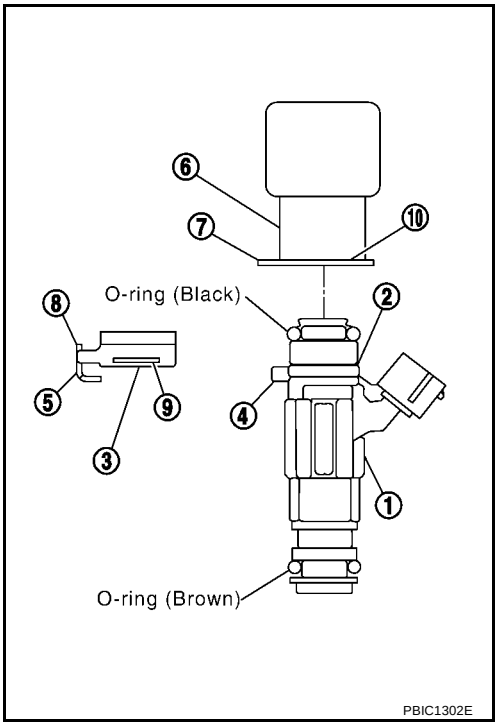
CAUTION:

- **Always replace clip with new one.**
- **Make sure the clip does not interfere with the O-ring. If it does, replace the O-ring.**

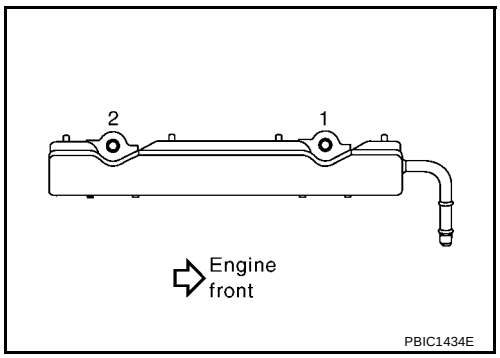
b. With the clip assembly as is, insert the fuel injector (1) into the fuel tube (6).

- Make sure the axis is lined up when inserting.
- Insert clip cutout (8) into fuel tube protrusion (7).
- Make sure the flange (10) on the fuel tube fits securely in the clip flange groove (9).

c. Make sure the fuel injector does not spin or come off.



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



CAUTION:

Make sure the injector nozzle does not touch the other parts.

- Tighten bolts evenly in two steps in the order shown in figure.

1st step

: 11.8 - 13.8 N·m (1.2 - 1.4 kg-m, 9 - 10 ft-lb)

2ne step

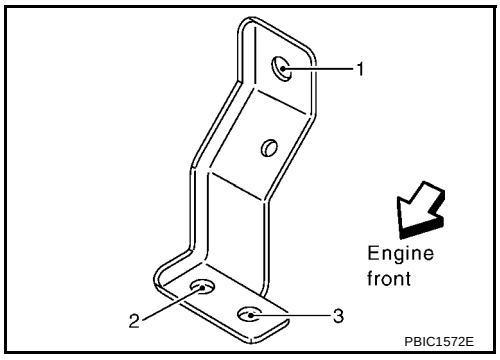
: 20.8 - 28.2 N·m (2.1 - 2.9 kg-m, 16 - 20 ft-lb)

4. Connect fuel feed hose.·

CAUTION:

Securely tighten the hose clamp at a position where it does not get in the way of the bulge.

5. Install intake manifold support bracket.



- Tighten mounting bolts in the following order.
  - Tighten bolts temporarily in numerical order shown in the figure.
  - Tighten bolts to the specification in numerical order shown in the figure.

Bolt 1

: 6.9 - 9.5 N·m (0.7 - 0.96 kg-m, 61 - 84 in-lb)

Bolts 2 and 3

: 8.4 - 10.8 N·m (0.86 - 1.1 kg-m, 75 - 95 in-lb)

6. Reinstall removed parts in reverse order of removal.

INSPECTION AFTER INSTALLATION

- Follow the procedure below to make sure there are no fuel leaks.

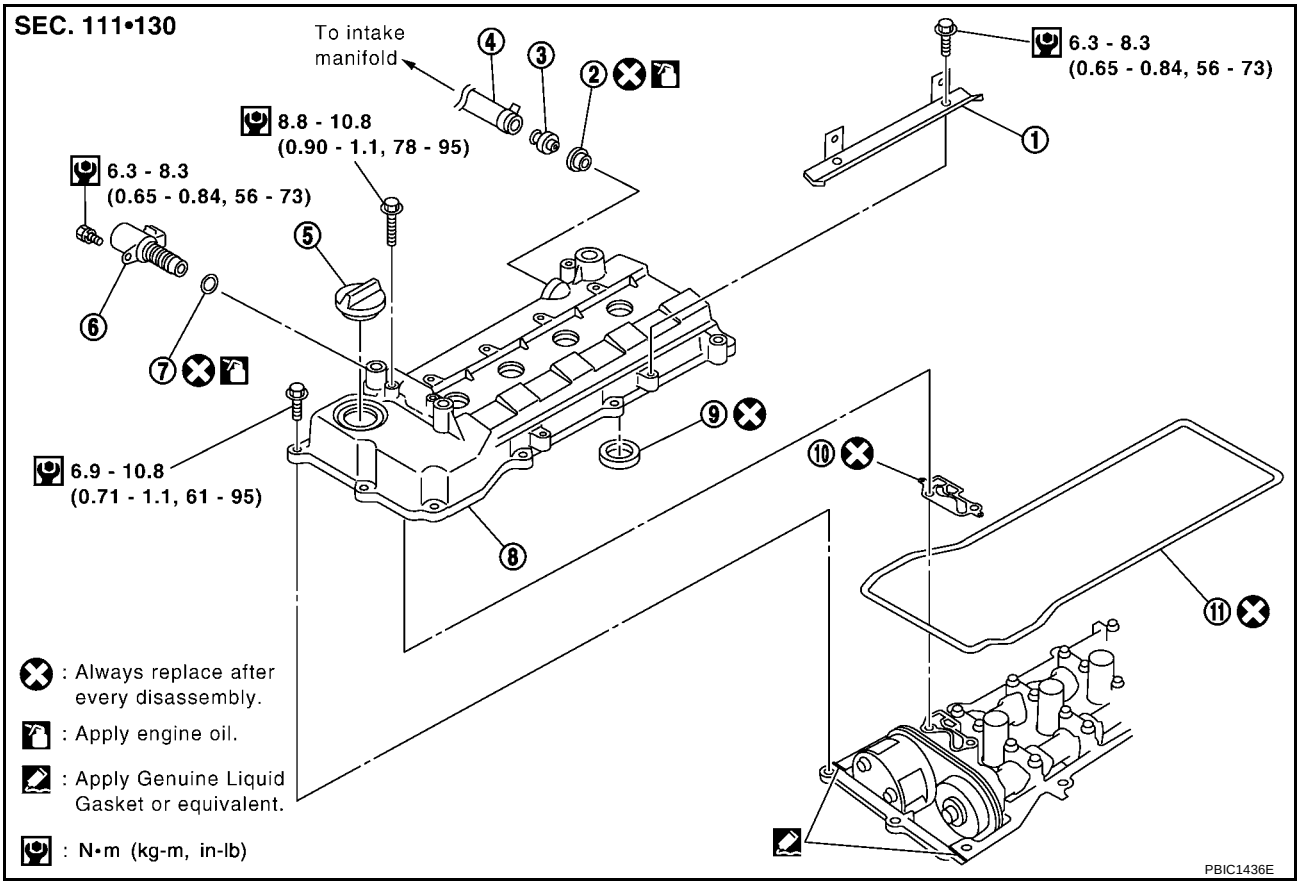
1. Turn the ignition switch to ON (do not start engine), and with fuel pressure applied in the fuel line, check to make sure there no fuel leaks from the connection.
2. Start the engine, and with the increased speed, check again to see if there are any fuel leaks from the connection.

ROCKER COVER

PFP:13264

Removal and Installation

EBS00OEX



1. Harness bracket	2. Grommet	3. PCV control valve
4. PCV hose	5. Oil filler cap	6. Intake valve timing control solenoid valve
7. O-ring	8. Rocker cover	9. Rocker cover oil seal
10. Gasket	11. Gasket	

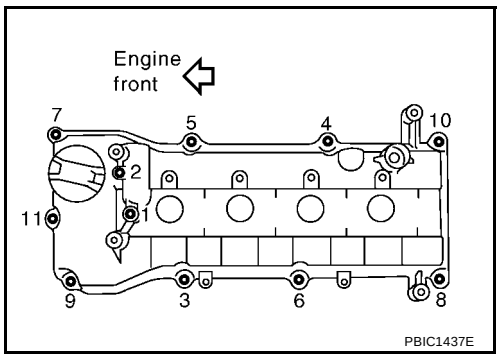
REMOVAL

1. Remove air duct and air cleaner case assembly. Refer to EM-14, "AIR CLEANER AND AIR DUCT" .
2. Remove RH engine mount stay. Refer to EM-65, "Removal and Installation" .

   NOTE:
   It is not necessary to support the engine using a jack.
3. Remove ignition coil. Refer to EM-25, "IGNITION COIL" .
4. Remove ignition coil harness bracket.
5. Disconnect PCV hose and intake valve timing control sorenoid valve harness connector.
6. Remove the PCV control valve if necessary.
7. Remove the intake valve timing control solenoid valve if necessary.

   CAUTION:
   - **Handle intake valve timing control solenoid valve with care. Avoid impacts.**
   - **Do not disassemble.**

8. Loosen bolts in the reverse of the order shown in the figure to remove rocker cover.

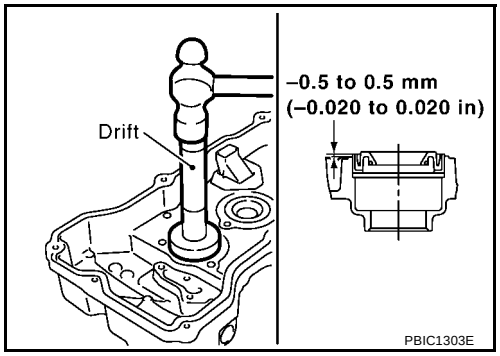


9. Remove the rocker cover oil seal using a screwdriver.

CAUTION:
Be careful not to damage the rocker cover.

INSTALLATION

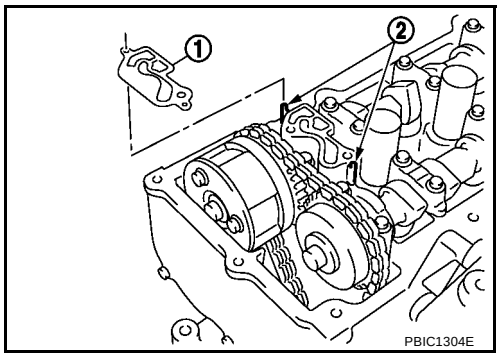
1. Install rocker cover oil seal.
   - Using drift with outer diameter 97 mm (3.82 in) and inner diameter 83 mm (3.27 in) to 88 mm (3.46 in), press oil seal in.
   - Press-fit the oil seal evenly to the mounting surface.



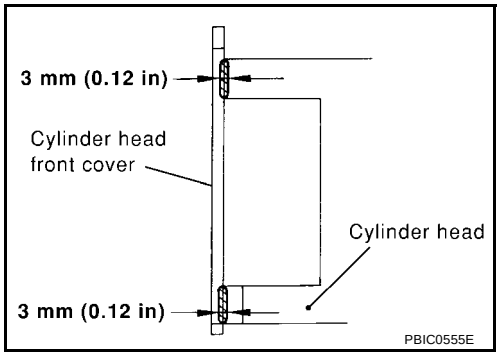
2. Install the rocker cover in the following procedure:

a. Install the gasket (1) to the No. 1 camshaft bracket upper surface.
   - Match up the positioning pins (2) and gasket holes in the direction of the shape of the camshaft bracket when attaching.

b. Install the gasket to the rocker cover mounting groove.



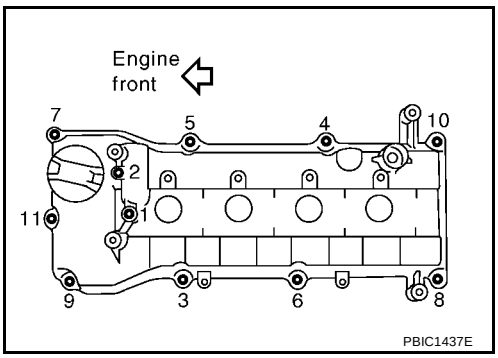
c. Apply the liquid gasket to the position shown in figure.
Use Genuine Liquid Gasket or equivalent.



d. Tighten bolts evenly in two steps in the order shown in the figure, to the specified torque.
   - See below for mounting positions of bolts

   Under head 45 mm (1.77 in) : 1, 2 (inside bolts)

   Under head 20 mm (0.79 in) : Other than above (outside bolts)



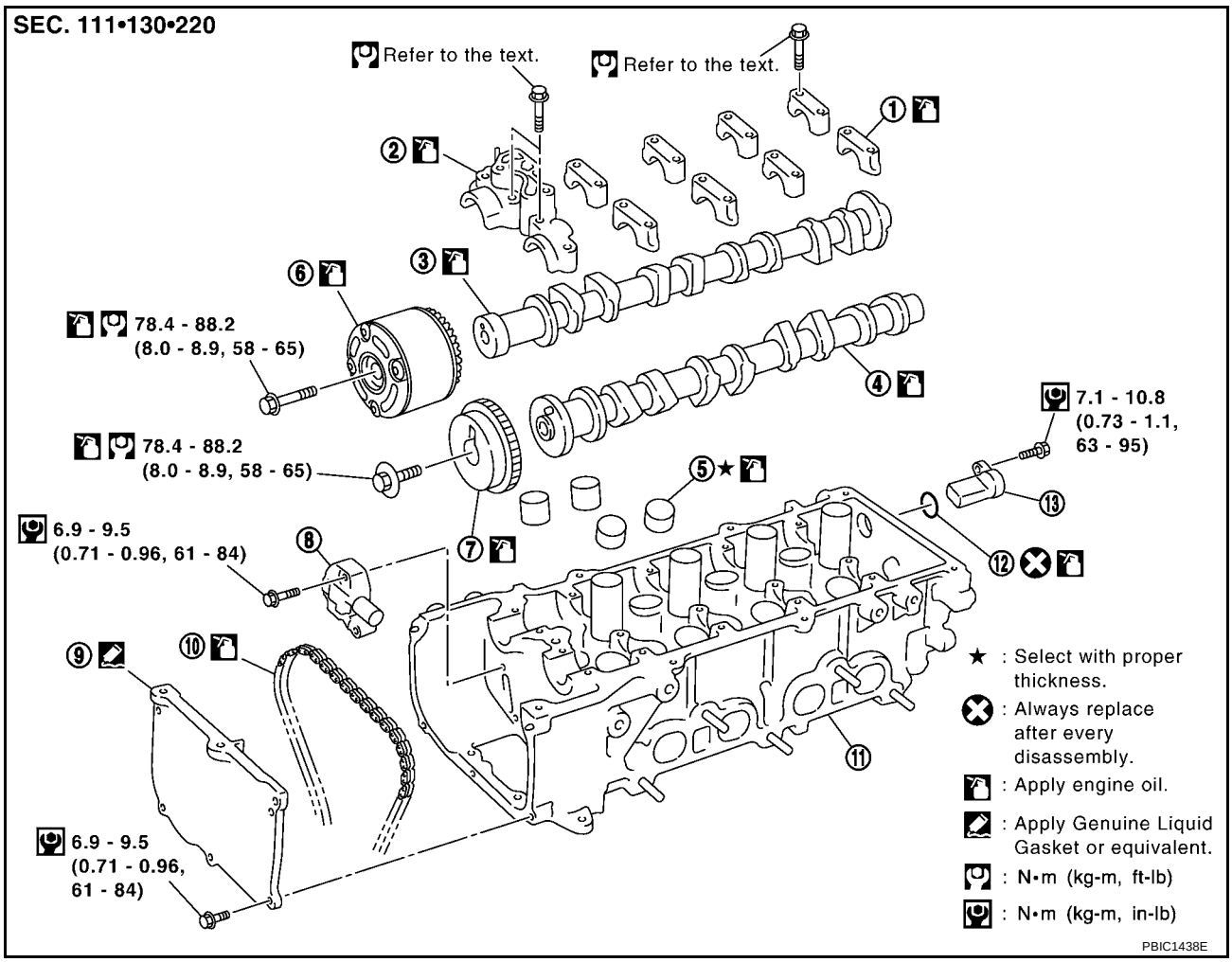
3. Install intake valve timing control solenoid valve.
   - Make sure no foreign particles attach to the flange, O-ring, or attachment hole.
   - Tighten the mounting bolt after making sure it is fully inserted into the mounting hole.
4. Install PCV control valve.
   - Insert until the flange is flush with the grommet.
5. Reinstall removed parts in reverse order of removal.

CAMSHAFT

PFP:13001

Removal and Installation

EBS00OEY



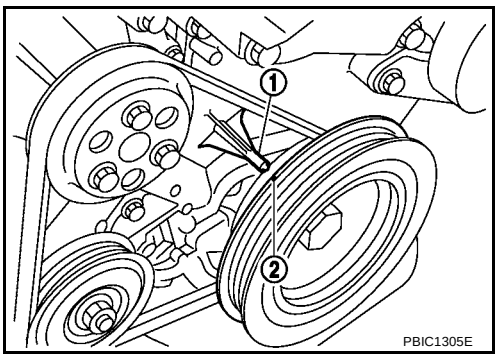
1. Camshaft bracket (No. 2 - 5)
2. Camshaft bracket (No. 1)
3. Camshaft (intake)
4. Camshaft (exhaust)
5. Valve lifter
6. Camshaft sprocket (intake)
7. Camshaft sprocket (exhaust)
8. Chain tensioner
9. Cylinder head front cover
10. Timing chain
11. Cylinder head
12. O-ring
13. Camshaft position sensor (PHASE)

REMOVAL

1. Remove RH front fender protector.
2. Secure the engine position using one of the following methods. Remove RH engine mount stay and engine mount bracket (upper). Refer to EM-65, "Removal and Installation" .
   - Mount engine slingers and hook with hoist. Refer to EM-65, "Removal and Installation" .
   - Support the oil pan bottom with a jack stand, etc.
3. Remove rocker cover. Refer to EM-31, "ROCKER COVER" .
4. Remove the camshaft position sensor (PHASE) from the back of the cylinder head if necessary.

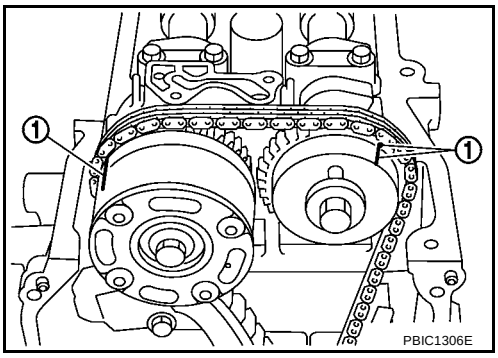
   CAUTION:
   - **Handle camshaft position sensor (PHASE) with care. Avoid impacts.**
   - **The tip of the sensor is magnetic, so do not let metal dust get on it or place it next to objects which can be affected by magnets.**
5. Remove RH headlamp. Refer to LT-5, "HEADLAMP -CONVENTIONAL TYPE-" .
6. Remove the cylinder head front cover.
7. Following the procedure below, place cylinder No. 1 at TDC of its compression stroke

a. Turn the crankshaft pulley clockwise as seen from the engine front, and match up the crankshaft pulley TDC mating mark (no color) (2) with the timing indicator (1) on the front cover.



b. Confirm mating marks (1) stamped on intake and exhaust sprockets are located as shown.
   - If there is no position mark at the position in the figure, turn the crankshaft pulley once more to position them as in the figure.

c. Make sure mating marks on intake and exhaust camshaft sprockets are located as shown in the figure, then paint mating marks on the timing chain links.

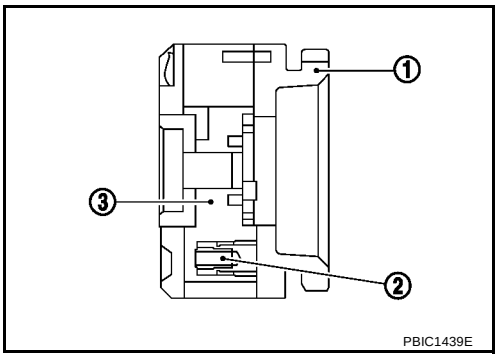


8. Make sure the intake camshaft sprocket is in the most advanced position.

CAUTION:

Installation and removal of the intake camshaft sprocket must be done in the most advanced position for the following reasons, so make sure you follow the procedure exactly.

- **The sprocket (1) and vane (camshaft coupling) (3) are designed to spin and move within the range of a certain angle.**
- **With the engine stopped the vane (3) is in the most retarded position. It will not spin because it is locked to the sprocket side by the internal lock pin (2).**
- **If the camshaft sprocket mounting bolts are turned in the situation described above (the most retarded position), the lock pin (2) will become damaged and cause malfunctions because of the increased horizontal load (cutting force) on the lock pin (2).**



- Put the intake camshaft sprocket in the most advance position in the following steps.

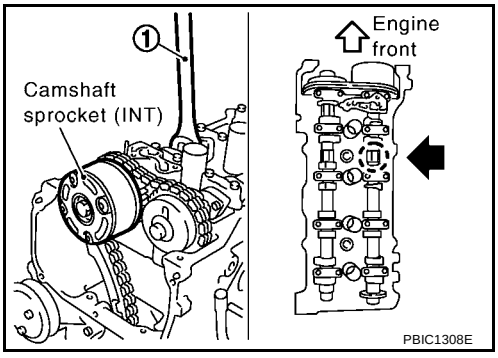
CAUTION:

The chain tensioner must not be removed before doing this step.

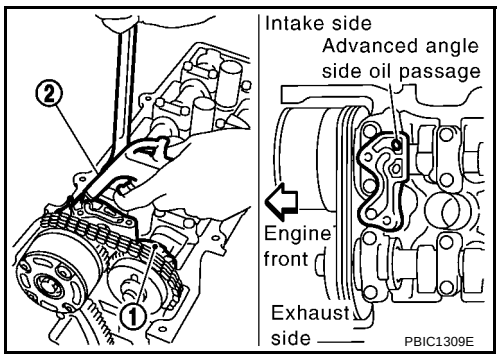
NOTE:

The spinning direction in the following description is as seen from the engine front.

a. Immobilize the hexagonal part of the camshaft with a wrench (1) to prevent the intake camshaft from moving.



b. Apply air pressure with an air gun (2) to the advanced angle side oil passage of the intake valve timing control on the top surface of the No. 1 camshaft bracket (1).



Compression pressure

: 300 kPa (3.00 bar, 3 kg/cm^2 , 43.5 psi) or more

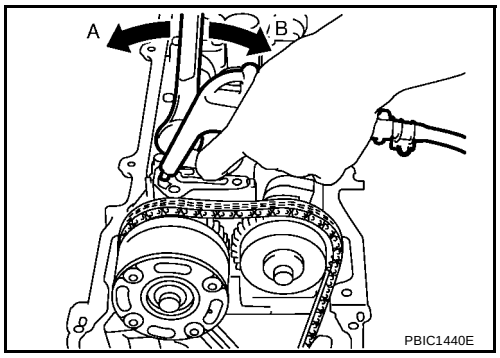
NOTE:
The air pressure is used to move the lock pin into the disengage position.

- Keep applying air pressure until step “e” is completed.

CAUTION:

- **Be sure not to damage the oil passage with the tip of the air gun.**
- **Wipe all the oil off on the top surface of the No. 1 camshaft bracket to prevent oil from being blown with the air, and the area around the air gun should be covered with a rag when applying air pressure. Eye protection should be worn as needed.**

c. Turn the intake camshaft slowly counter-clockwise in direction A (towards the intake manifold).



- Keep the air pressure on.

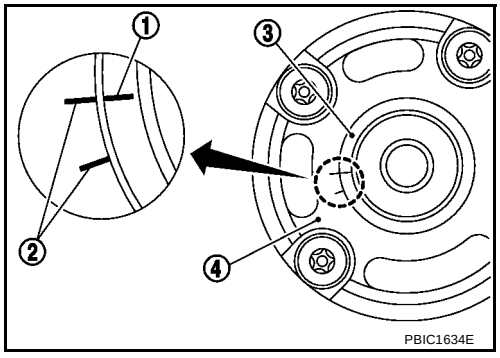
CAUTION:
Also be sure the wrench immobilizing the camshaft does not come loose.

d. While doing the above, once you hear a click (the sound of the internal lock pin disengaging) from inside the intake camshaft sprocket, start turning the intake camshaft in the opposite direction, direction B (clockwise: towards the exhaust manifold) and to the most advanced angle position.

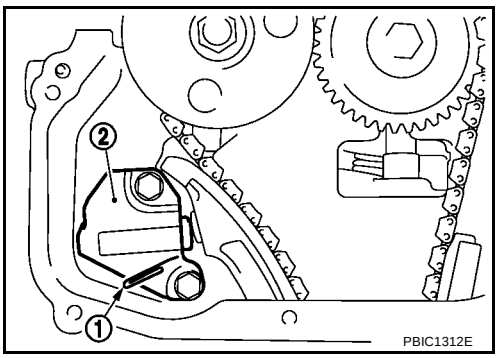
- Keep the air pressure on.
- If there is no click, as soon as the vane (camshaft coupling) starts moving independently of the camshaft sprocket, the lock pin has become disengaged.
- If the lock pin does not become disengaged, shake the wrench immobilizing the camshaft slightly.
- If this still does not help in disengaging the lock pin, tap the intake camshaft front very lightly with a plastic hammer.

e. Once the vane starts to spin and then the camshaft sprocket starts to spin with the camshaft, it has reached the most advanced position, so stop.

- Make sure the most advanced position locating intake valve timing control advance mark (1) of vane (3) and alignment mark (2) of sprocket (4) as shown in the figure.



9. Attach the stopper pin (1) such as a paper clip to secure the plunger in the full compressed position and remove the chain tensioner (2).

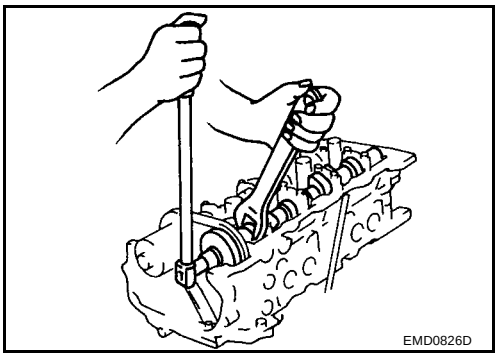


10. Keeping the wrench on the camshaft hexagonal part, loosen the mounting bolts and remove the intake and exhaust camshaft sprockets.

CAUTION:

- **Make sure the tools do not come in contact with the A/C piping.**
- **Do not loosen mounting bolts with securing anything other than the camshaft hexagonal part or with tensioning the timing chain.**

NOTE:
With the front cover attached, the timing chain and crankshaft sprocket will not come off, so there is no need to take steps to maintain the timing chain tension.



- The intake camshaft sprocket should be handled with the following precautions in mind.

CAUTION:

- **When removing intake camshaft sprocket, using adhesive tape or equivalent, prevent vane from rotating so that lock pin will not rejoin in the most retarded position.**
- **Handle it carefully, and avoid any chance of impact caused by dropping.**
- **Do not disassemble. (Do not loosen the four front bolts.)**

NOTE:
While removing the intake camshaft sprocket, if the lock pin has been rejoined in the most retarded position, do the following to restore it.

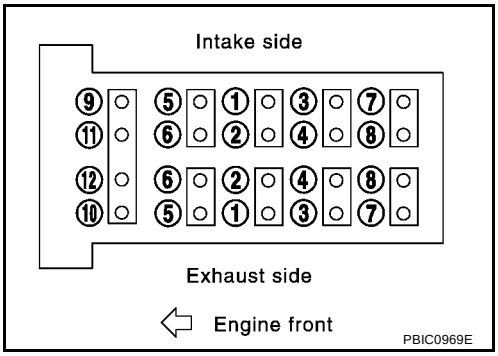
a. Reinstall the intake camshaft sprocket to the intake camshaft and tighten the mounting bolts enough to prevent air leaking out when the air pressure is applied later.

CAUTION:
To prevent internal lock pin from damaging, keep the torque on the mounting bolts to the minimum required to prevent air from escaping.

b. Apply the air pressure, disengage the lock pin following step 8, and turn the vane to the most advanced position. (The timing chain need not be attached for this step.)

c. Remove the intake camshaft sprocket from camshaft.

11. Remove camshaft brackets.
    - Loosen bolts in several steps in reverse order shown in the figure.



12. Remove camshaft.

CAUTION:
Do not deform or damage intake camshaft rear end signal plate.

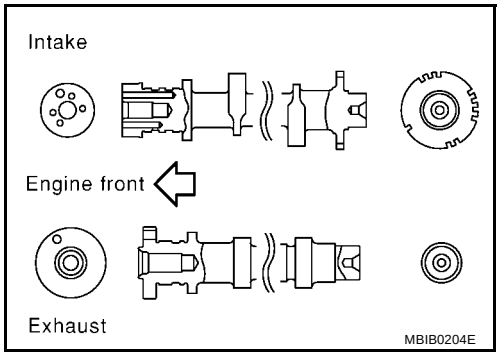
13. Remove valve lifter.
    - Identify installation position of each valve. Arrange removed valve lifters so they cannot be mixed up.

INSTALLATION

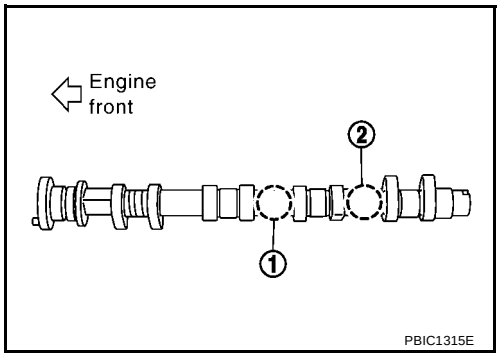
1. Install valve lifter.

- Install it in its original positions.

2. Install camshaft.
   - You can distinguish between the intake and the exhaust by looking at the different shapes of the front and rear ends of the camshaft.

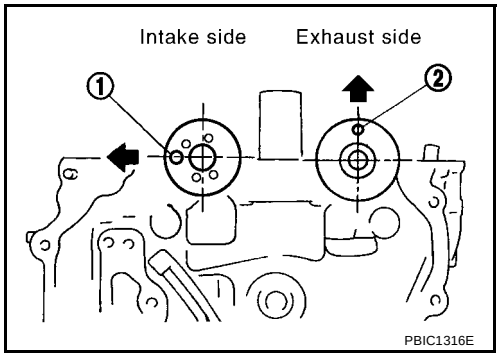


NOTE:
- Paint distinguishing the applicable engine (1) can be found between the cams for cylinders No. 2 to 3.
- Paint distinguishing the applicable engine (2) can be found between the cams for cylinders No. 3 to 4.(CR12DE, CR14DE)

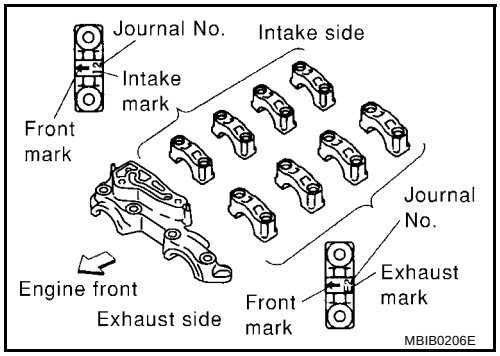


Paint distinguishing the applicable engine		(1)	(2)
CR10DE	INT	Green	—
	EXH	White	—
CR12DE, CR14DE	INT	Green	Green
	EXH	Red	Red

- Install the camshaft front ends dowel pin hole (1) and dowel pin (2) so that they are positioned as shown in the figure.



3. Install camshaft brackets.
   - Completely remove any foreign material on bottom surfaces of camshaft brackets and top surface of cylinder head.
   - Referring to the marks on top of the camshaft bracket, install so that it is in the same position and facing the same direction as when removed.



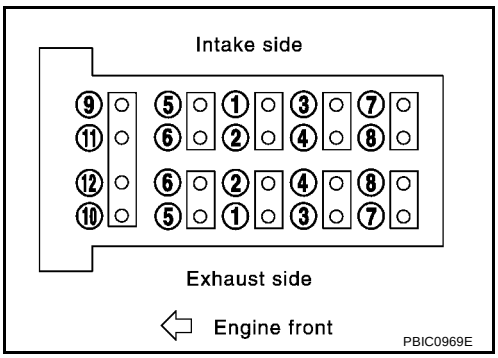
4. Tighten camshaft bracket bolts in the following order.

a. Bolt sizes vary with installation position. Refer to the following when installing bolts.

Bolt color

1 - 10 : Black

11, 12 : Gold



b. First tighten bolts 9 through 12, then tighten bolts 1 through 8 in numerical order.

: 2.0 N·m (0.2 kg-m, 18 in-lb)

c. Tighten all bolts in numerical order shown in the figure.

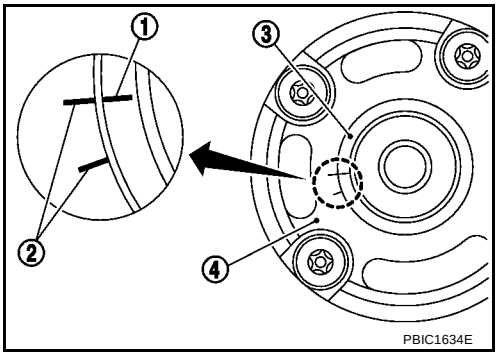
: 5.9 N·m (0.6 kg-m, 52 in-lb)

d. Retighten all bolts in numerical order shown in the figure.

: 9.0 - 11.8 N·m (0.92 - 1.2 kg-m, 80 - 104 in-lb)

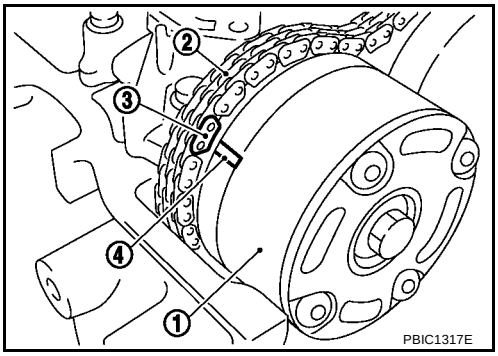
5. Install the intake camshaft sprocket in the following procedure:

- Make sure the most advanced position checking intake valve timing control advance mark (1) of vane (3) and alignment mark (2) of sprocket (4) are located as shown in the figure.

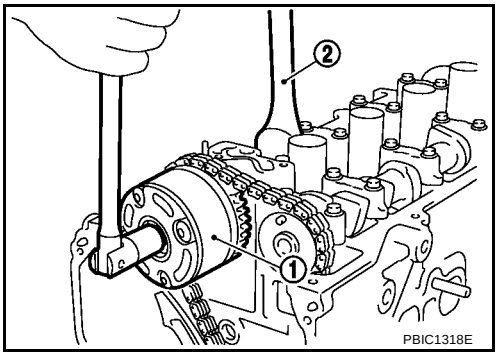


a. Install timing chain (2) by aligning its mating mark (3) (marked when timing chain is removed) with mark (4) on camshaft sprocket (1).

- Install by aligning the dowel pin on the back of the camshaft sprocket with dowel pin hole on the camshaft.



b. Keeping the camshaft hexagonal part still with the wrench (2), tighten the mounting bolt for the intake camshaft sprocket (1).



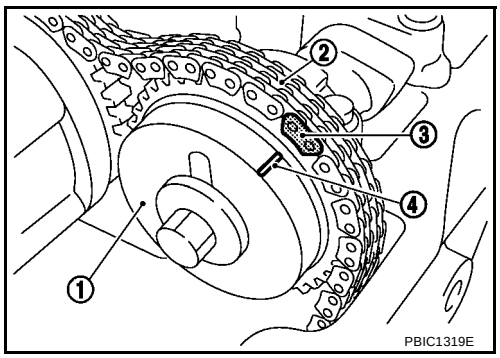
c. Remove adhesive tape or equivalent from camshaft sprocket.

6. Install the exhaust camshaft sprocket (1) in the following procedure:

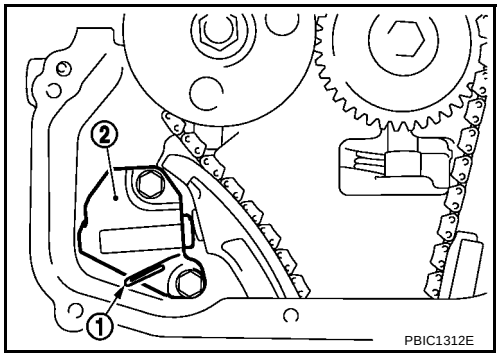
a. Install timing chain (2) by aligning its mating mark (3) (marked when timing chain is removed) with mark (4) on camshaft sprocket (1).
   - Install by aligning the dowel pin groove of the sprocket with dowel pin on the camshaft.

b. Keeping the camshaft hexagonal part still with the wrench, tighten the mounting bolt for the exhaust camshaft sprocket.

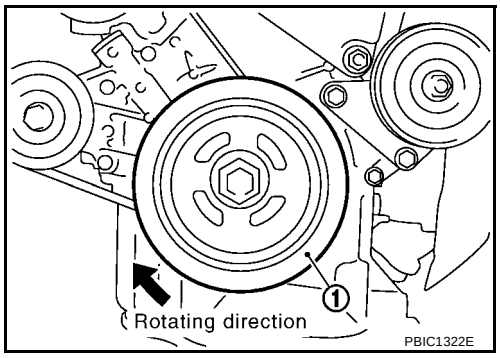
c. Make sure the markings for the intake and the exhaust camshaft sprockets and the timing chain are all lined up.



7. Install chain tensioner (2).
   - Install the stopper pin (1) with plunger secured.
   - After installation, remove the stopper pin (1) and release the plunger.
   - Make sure again that mating marks on the intake and exhaust camshaft sprockets and mating marks on timing chain are aligned.



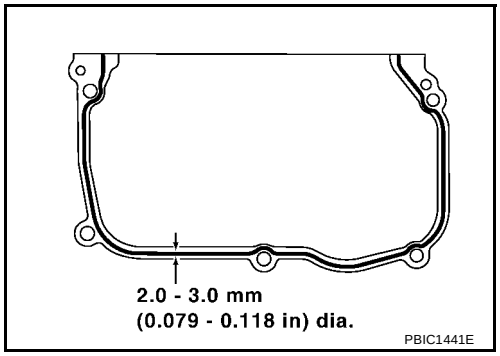
8. Turn the crankshaft pulley (1) slowly clockwise to return the intake camshaft sprocket to the most retarded position.



   - When first turning the crankshaft the intake camshaft sprocket will turn. Once it is turned more, and the vane (camshaft) also turns, then it has reached the most retarded position.
   - After spinning the crankshaft slightly in a counterclockwise direction, you can make sure the lock pin has joined by seeing if the vane and the sprocket move together.

9. Install the cylinder head front cover.
   - Evenly apply the liquid gasket to the position shown in figure. Use Genuine Liquid Gasket or equivalent.
   - Install so that the cylinder head front cover matches up with the dowel pin on the cylinder head side.

10. Install camshaft position sensor (PHASE).
   - Make sure no foreign particles attach to the flange, O-ring, or attachment hole.
   - Tighten the mounting bolt after making sure it is fully inserted into the mounting hole.



11. Inspect and adjust valve clearance. Refer to EM-43, "Valve Clearance" .

12. Reinstall removed parts in reverse order of removal.

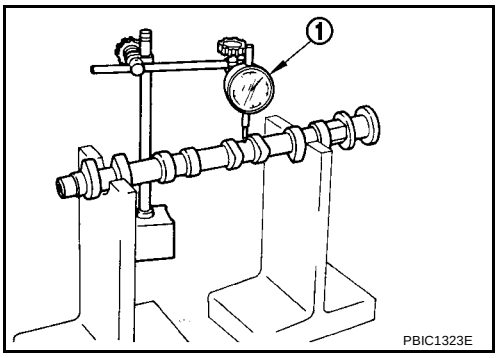
INSPECTION AFTER REMOVAL

Camshaft Runout

- Put V block on precise flat bed, and support No. 2 and No. 5 journal of camshaft.

  CAUTION:
  Do not support journal No. 1 (on the side of the camshaft sprocket) because it has a different diameter from the other four locations.
- Set a dial gauge (1) vertically onto journal No. 3.
- Rotate the camshaft in one direction by hand and read indication on the gauge. (Total indication reading)

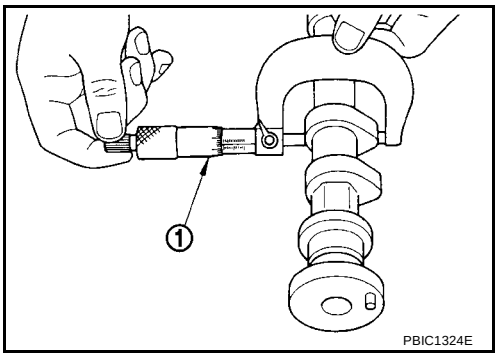
  Limit : 0.04 mm (0.0016 in) or less
- If exceeds the limit, replace the camshaft.



Camshaft Cam Height

- Measure with a micrometer (1).

  Standard
  CR10DE
  Intake : 39.155 - 39.345 mm (1.5415 - 1.5490 in)
  Exhaust : 39.155 - 39.345 mm (1.5415 - 1.5490 in)
  CR12DE, CR14DE
  Intake : 40.359 - 40.549 mm (1.5889 - 1.5964 in)
  Exhaust : 39.743 - 39.933 mm (1.5647 - 1.5722 in)
- If it exceeds the standard, replace the camshaft.

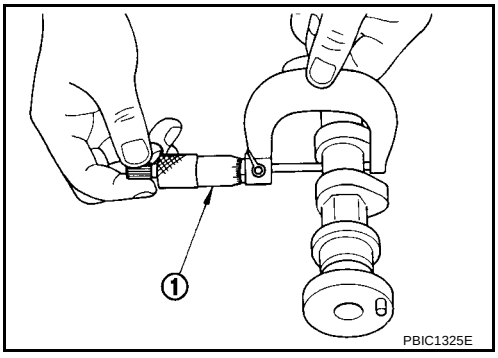


Camshaft Journal Clearance

Outer Diameter of Camshaft Journal

- Measure with a micrometer (1).

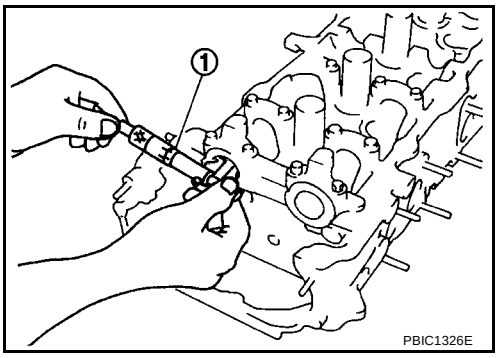
  Standard
  No. 1
  : 27.935 - 27.955 mm (1.0998 - 1.1006 in)
  No. 2 to No. 5
  : 23.450 - 23.470 mm (0.9232 - 0.9240 in)



Inner Diameter of Camshaft Journal

- Tighten camshaft bracket bolts to the specified torque.
- Using an inside micrometer (1), measure inner diameter of the camshaft bracket.

  Standard
  No. 1
  : 28.000 - 28.021 mm (1.1024 - 1.1032 in)
  No. 2 to No. 5
  : 23.500 - 23.525 mm (0.9252 - 0.9262 in)



Calculation of Camshaft Journal Clearance
(Journal clearance) = (inner diameter of camshaft bracket) - (outer diameter of camshaft journal).

Standard

No. 1

: 0.045 - 0.086 mm (0.0018 - 0.0034 in)

No. 2 to No. 5

: 0.030 - 0.071 mm (0.0012 - 0.0028 in)

- If clearance exceeded the standard, replace the camshaft and/or the cylinder head. Refer to the standard values for each individual part.

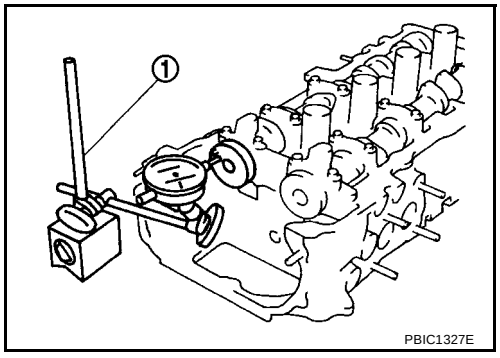
NOTE:
Since the camshaft brackets and the cylinder head are machined together, replacement must be done using the cylinder head assembly.

Camshaft End Play

- Set a dial gauge (1) to the camshaft front end in thrust direction. Move the camshaft back and forth (axially) and read indication on the gauge.

Standard : 0.070 - 0.143 mm (0.0028 - 0.0056 in)

- When out of the standard, replace with new camshaft and measure again.
- When out of the standard again, replace with new cylinder head.



Camshaft Sprocket Runout

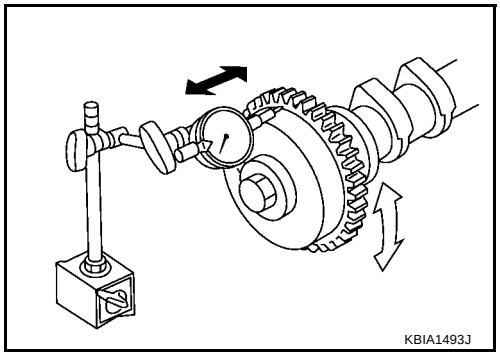
- Put V block on precise flat bed, and support No. 2 and No. 5 journal of camshaft.
- Using a dial gauge, measure camshaft sprocket runout.

Limit

Intake : 0.20 mm (0.0079 in)

Exhaust : 0.15 mm (0.0059 in)

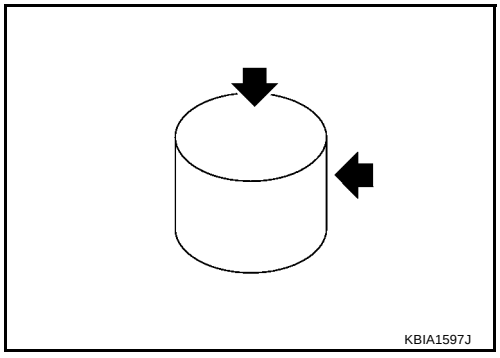
- If it exceeds the limit, replace camshaft sprocket.



Valve Lifter

Check for cracks and wear on valve lifter surface.

- If anything above is found, replace valve lifter.

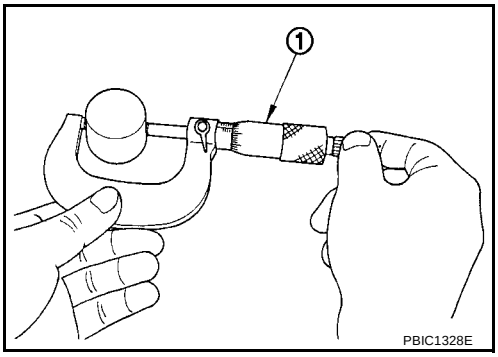


Valve Lifter Clearance

Outer Diameter of Valve Lifter

- Measure with a micrometer (1).

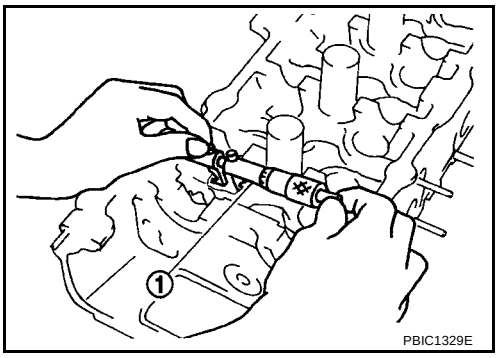
Standard : 29.960 - 29.975 mm(1.1795 - 1.1801 in) dia.



Valve Lifter Hole Diameter

- Using an inside micrometer (1), measure the valve lifter hole diameter in cylinder head.

Standard : 30.000 - 30.021 mm (1.1811 - 1.1819 in) dia.



Calculation of valve lifter clearance
(Valve lifter clearance) = (valve lifter hole diameter) - (outer diameter of valve lifter)

Standard : 0.025 - 0.061 mm (0.0010 - 0.0024 in)

- If clearance exceeded the standard, replace either one or both of valve lifter and cylinder head. Refer to the standard values for valve lifter outer diameter and hole diameter.

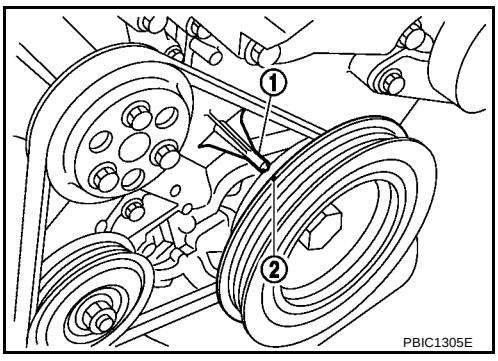
Valve Clearance

EBS00OEZ

INSPECTION

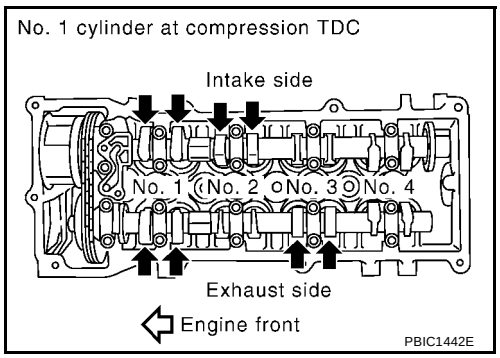
- Whenever the camshaft and valve related parts are removed and installed or replaced, or symptoms due to changes in valve clearance as a result of aging (poor starting, rough idle, unusual noise) are obvious, check valve clearance with the following procedure:

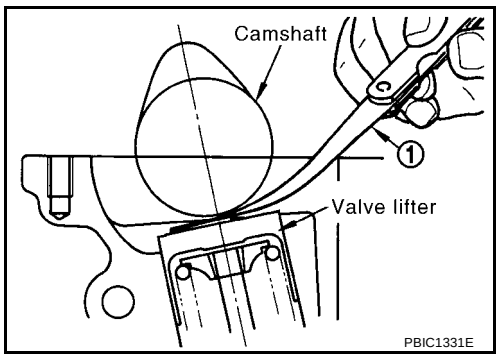
1. Warm up engine and stop it.
2. Remove the following parts.
   - RH front fender protector
   - Rocker cover; Refer to EM-31, "ROCKER COVER" .
3. Turn the crankshaft pulley clockwise as seen from the engine front, and match up the crankshaft pulley TDC mating mark (no color) (2) with the timing indicator (1) on the front cover.
4. When doing this, make sure both the intake and exhaust cam noses on cylinder No. 1 are facing outwards. (No. 1 cylinder at TDC of its compression stroke)
   - If they are not facing out, turn the crankshaft pulley further. It is OK to do step 6 first (checking when No. 4 cylinder at TDC of its compression stroke).



5. Referring to the figure, measure valve clearances of valves with × in table below using a feeler gauge (1).

Cylinder		No. 1	No. 2	No. 3	No. 4
No. 1 cylinder at TDC of its compression stroke.	INT	×	×		
	EXH	×		×	





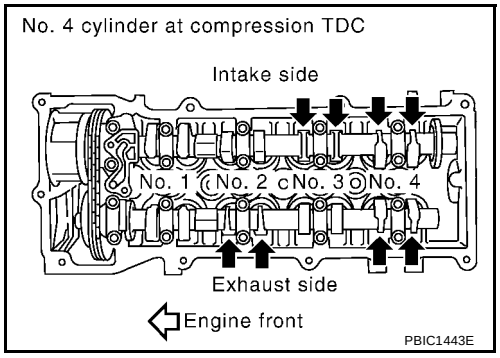
Valve clearance standard:

Hot	**Intake**	**: 0.314 - 0.426 mm (0.012 - 0.017 in)**
	Exhaust	**: 0.338 - 0.462 mm (0.013 - 0.018 in)**
Cold*	**Intake**	**: 0.29 - 0.37 mm (0.011 - 0.015 in)**
	Exhaust	**: 0.32 - 0.40 mm (0.013 - 0.016 in)**

***: Approximately 20°C (68°F) (Reference data)**
When adjusted for cold engine, the standard values for warm engine must be checked to see if they are correct, too.

6. Rotate crankshaft by 360° clockwise (when viewed from font) to align No. 4 cylinder at TDC of its compression stroke.
7. Referring to the figure, measure valve clearances of valves with × in table below.

Cylinder		No. 1	No. 2	No. 3	No. 4
No. 4 cylinder at TDC of its compression stroke.	INT			×	×
	EXH		×		×



8. Adjustment of places outside range of standard values is done as follows.

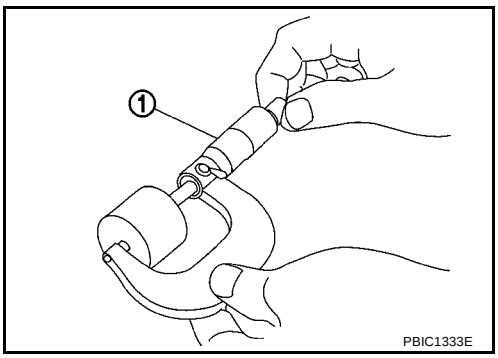
ADJUSTMENT

NOTE:

- The adjustment is made by selecting the thickness of the head of the valve lifter. (An adjuster shim is not used)
- The set thickness for the valve filter is measured at normal temperature, but any changes in dimension because of temperature differences maybe ignored. Accordingly, adjustment should use values for a warmed up engine (ready for inspection).

1. Remove camshaft. Refer to EM-34, "Removal and Installation" .
2. Remove the valve lifters for parts which are outside the range of standard values.

3. Using a micrometer (1), measure thickness of the removed valve lifter center part.



4. Measure the thickness of the valve lifter to be replaced using the following formula.

How to determine valve lifer thickness : $t = t_1 + (C_1 - C_2)$

t = Valve lifter thickness to be replaced

t_1 = Removed valve lifter thickness

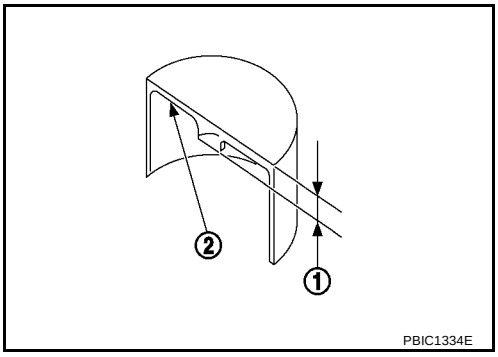
C_1 = Valve clearance measurement

C_2 = Standard valve clearance

Intake : 0.37 mm (0.015 in)

Exhaust : 0.40 mm (0.016 in)

- New valve lifter thickness (1) can be identified by stamp marks (2) on the reverse side (inside of cylindrical part).



Stamp mark	Valve lifter thickness
00	3.00 mm (0.1181 in)
02	3.02 mm (0.1189 in)
.	.
.	.
68	3.68 mm (0.1449 in)

- Valve lifter thickness settings: Thickness 3.00 - 3.68 mm (0.1181 - 0.1449 in) in 0.02 mm (0.0008 in) intervals and 35 types.

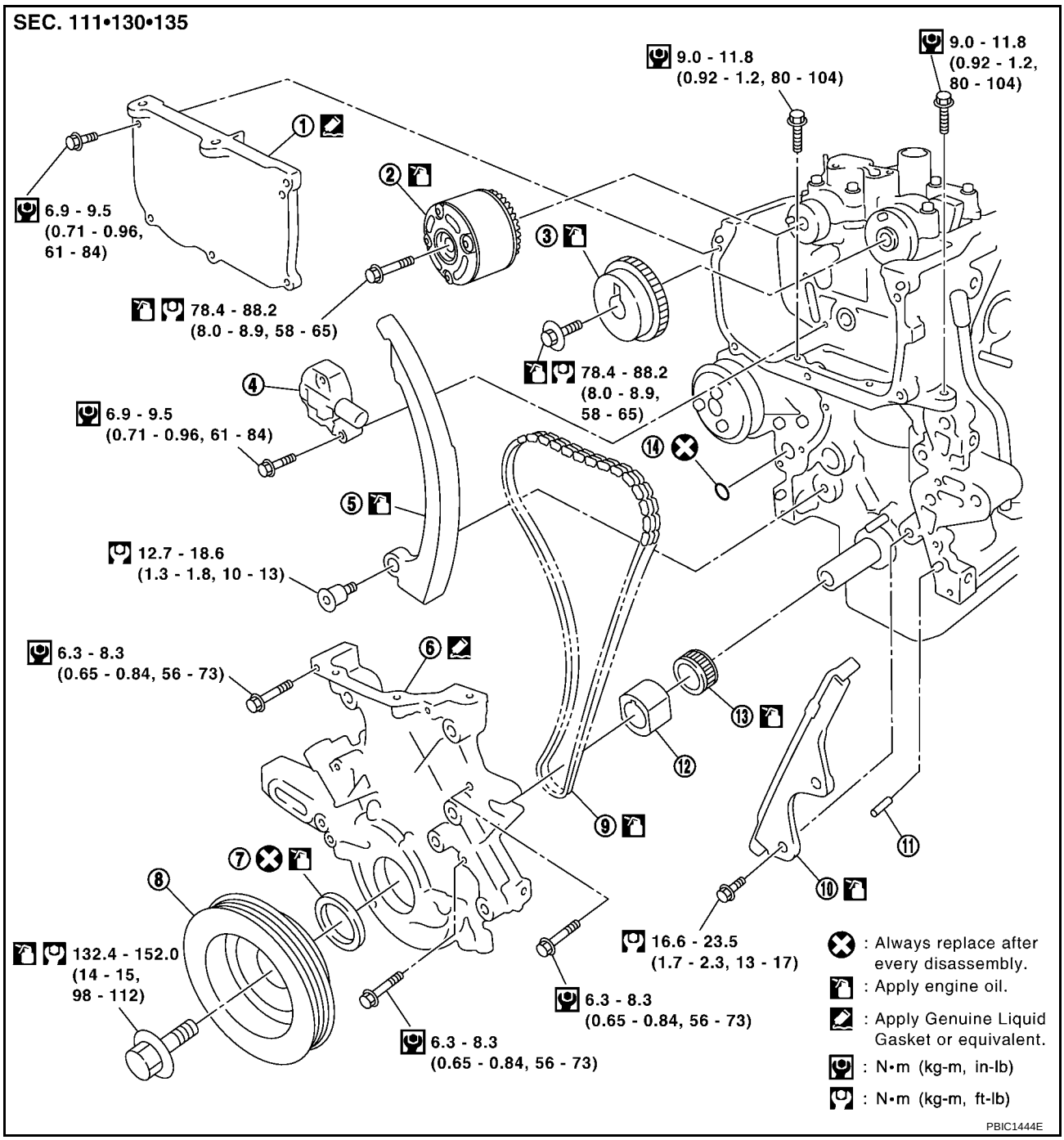
5. Install selected valve lifter.
6. Install camshaft. Refer to EM-34, "Removal and Installation" .
7. Manually turn crankshaft a few turns.
8. Make sure that the valve clearance is within the standard using the reference value when engine is cold.
9. After restoring, make sure the valve clearance is within the range of standard values with the engine warmed up.

TIMING CHAIN

PFP:13028

Removal and Installation

EBS00OF0



1. Cylinder head front cover
2. Camshaft sprocket (intake)
3. Camshaft sprocket (exhaust)
4. Chain tensioner
5. Slack guide
6. Front cover
7. Front oil seal
8. Crankshaft pulley
9. Timing chain
10. Tension guide
11. Dowel pin
12. Oil pump drive spacer
13. Crankshaft sprocket
14. O-ring

REMOVAL

Operation Description

M/T models

1.Remove engine and transaxle assembly from the vehicle. Refer to EM-65, "Removal and Installation" .

2.Separate engine from transaxle. Refer to EM-65, "Removal and Installation" .

3.Remove parts remaining in step 3 and proceed to step 5.

A/T models

: Start from step 1 with the engine mounted in the vehicle.

NOTE:

The reason for doing work with the engine by itself for M/T models is stated below.

- It is necessary to remove the transaxle when removing and installing the oil pan (upper).
- For this reason, the entirety of the supporting engine mount disappears when removing and installing the front cover.

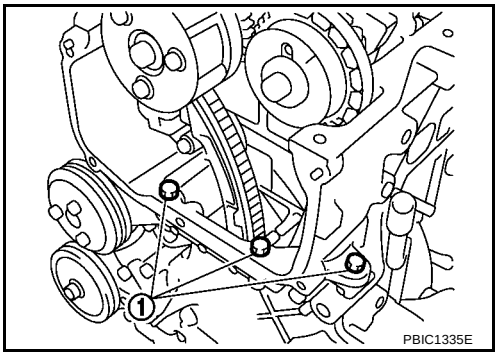
1. Remove RH front wheel and RH front fender protector.
2. Drain the engine oil.
3. Remove the following parts.
   - Drive belts and drive belt idler pulleys; Refer to EM-10, "DRIVE BELTS" .
   - Rocker cover; Refer to EM-31, "ROCKER COVER" .
   - Exhaust front tube; Refer to EX-3, "EXHAUST SYSTEM" .
   - Starter motor; Refer to SC-27, "STARTING SYSTEM" .
   - Oil pan (lower and upper) and oil strainer; Refer to EM-22, "OIL PAN AND OIL STRAINER" .
   - RH headlamp; Refer to LT-5, "HEADLAMP -CONVENTIONAL TYPE-" .
4. Using the following procedure, remove the RH engine mount stay and the RH engine mount brackets (upper and lower).

a. The engine should be immobilized using any one of the following methods.
   - Mount engine slingers and hook with hoist. Refer to EM-65, "Removal and Installation" .
   - Support the transaxle bottom with a jack stand, etc.

   CAUTION:
   Make sure the transaxle is not scratched while the bottom is being supported.

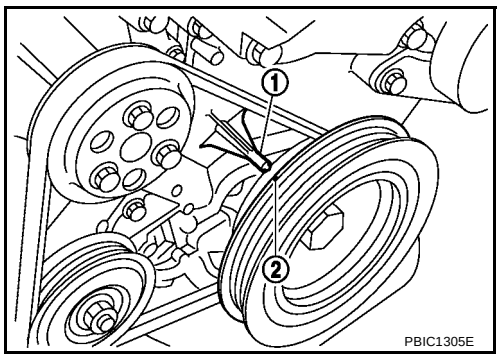
b. Remove RH engine mount stay and RH engine mount bracket (upper and lower). Refer to EM-65, "Removal and Installation" .

5. Remove alternator. Refer to SC-14, "CHARGING SYSTEM" .
6. Remove cylinder head front cover. Refer to EM-34, "CAMSHAFT" .
7. Remove the cylinder head auxiliary bolts (1).



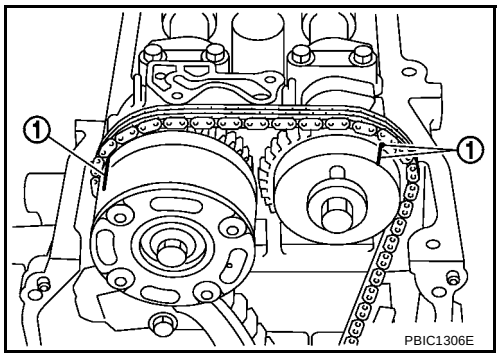
8. Set No. 1 cylinder at TDC on its compression stroke.

a. Turn the crankshaft pulley clockwise as seen from the engine front, and match up the crankshaft pulley TDC mating mark (no color) (2) with the timing indicator (1) on the front cover.



b. Confirm mating marks (1) stamped on intake and exhaust sprockets are rotated as shown.

- If there is no position mark in the figure, turn the crankshaft pulley once more to position them as in the figure.



9. Remove the crankshaft pulley in the following order.

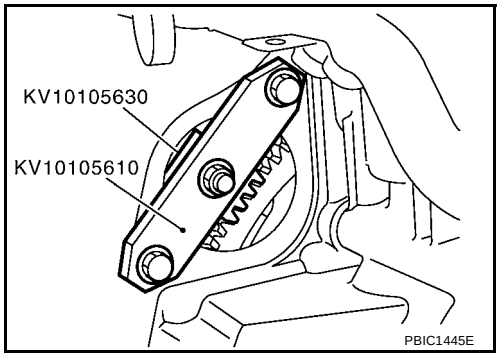
a. Using the starter motor mounting hole, attach a ring gear stopper (special service tool) and secure the crankshaft.

- You can also secure the crankshaft counterweight using hammer handle, etc., after removing the oil pan (upper). Make sure no foreign matter gets inside the engine.

b. Loosen crankshaft bolt and pull it out.

CAUTION:

Do not remove the mounting bolts as they will be used as a supporting point for the pulley puller.

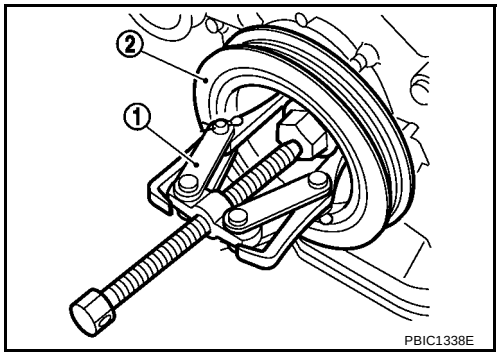


c. Place the crankshaft pulley puller (1) tab on the crank pulley hole, and pull the crankshaft pulley (2) through.

CAUTION:

Do not put the pulley tab on the crank pulley wide-diameter pulley, as this will damage the internal dampers.

10. Remove the idler pulley bracket assembly for drive belts from the front cover. Refer to EM-10, "DRIVE BELTS" .

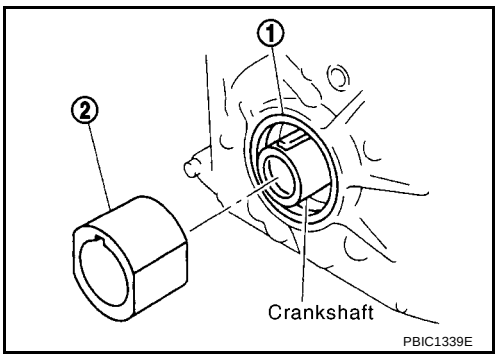


11. Remove the front cover in the following order.

a. To give more freedom to the front cover position during installation and removal, pull out the oil pump drive spacer (2) over the front oil seal (1).

- Pull out straight, using long nosed pliers or two screwdrivers, etc.

CAUTION:
Be careful not to damage oil pump drive spacer surface.

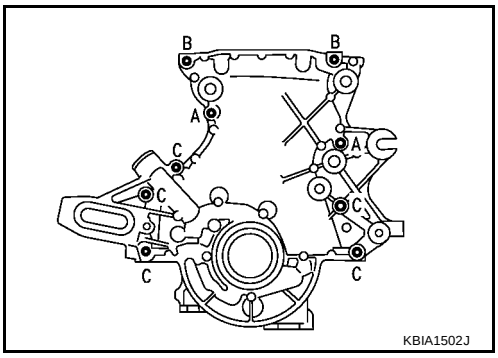


b. Remove front cover carefully.

- Remove bolts A to C shown in the figure.

CAUTION:

- **To prevent the front of the cylinder head gasket from getting bent or damaged, remove so that it comes apart cleanly from the front cover top and the gasket bottom.**
- **Replace the cylinder head gasket with a new one if it is damaged.**

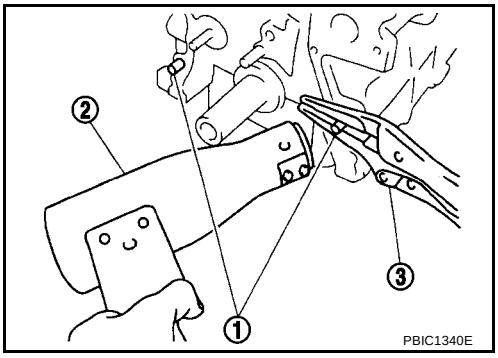


c. Remove O-ring from the cylinder block.

12. Remove the front cover dowel pins (1) from the cylinder block.

- After warming with an industrial drier (2), use locking pliers (3) to pull out the dowel pins.

NOTE:
This step is in preparation for installing the front cover. If the timing chain is to be removed, it can be done later.



13. Remove the front oil seal from the front cover.

- Insert a screwdriver behind the oil seal and pull up to remove.

14. Secure the intake camshaft sprocket in the most advanced position. Refer to EM-34, "CAMSHAFT" .

NOTE:
The following steps are for removing the timing chain and other related parts.

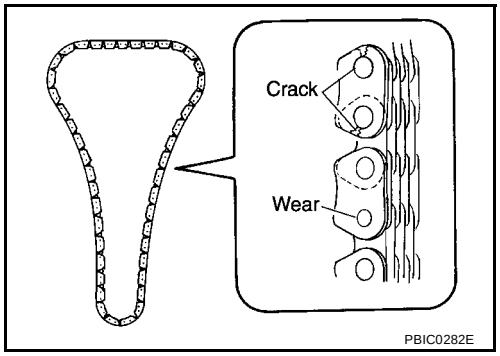
15. Remove chain tensioner. Refer to EM-34, "CAMSHAFT" .
16. Remove camshaft sprocket. Refer to EM-34, "CAMSHAFT" .

NOTE:
No markings are needed between the camshaft sprocket and timing chain.

17. Remove timing chain, the timing chain slack guide, and the tension guide.
18. Remove the crankshaft sprocket.

INSPECTION AFTER REMOVAL

Make sure there are no noticeable cracks or wear on the timing chain, and replace if there are.



INSTALLATION

CAUTION:

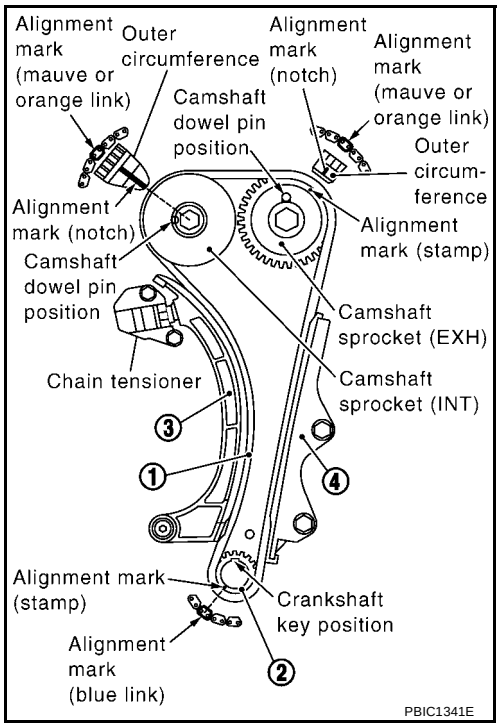
- **Completely remove liquid gasket attached to mounting surfaces using a scraper, and clean off with white gasoline.**
- **After installation, wipe off any extra liquid gasket.**

1. Install the timing chain and related parts in the following steps.
   - See the figure for positions sprockets, timing chain (1), and installation of other parts.
   - Attach each sprocket with its mating mark towards the engine front.

a. Install timing chain and crankshaft sprocket (2).
   - You can make sure the No. 1 cylinder is at the TDC of its compression stroke by checking if the crankshaft key is straight up.
   - Place the timing chain on the front of the camshaft to make sure it does not fall.

b. Install timing chain slack guide (3) and the tension guide (4).

c. Install camshaft sprockets. Refer to EM-34, "CAMSHAFT" .
   - Align the mating marks on camshaft sprocket and timing chain here.



d. Install chain tensioner. Refer to EM-34, "CAMSHAFT" .

e. Check again to make sure all the mating marks are in place.

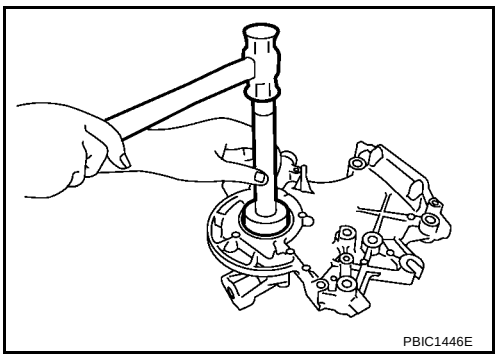
f. Temporarily install the oil pump drive spacer, the crankshaft pulley, and the crankshaft pulley bolt, and make it so that the crankshaft can be turned.

g. Turn the crankshaft clockwise viewing from engine front. Place intake side camshaft in the most retarded position. Refer to EM-34, "CAMSHAFT" .

h. Turn the crankshaft a few more times clockwise and make sure nothing is wrong with it.

i. Remove the parts installed in step f.

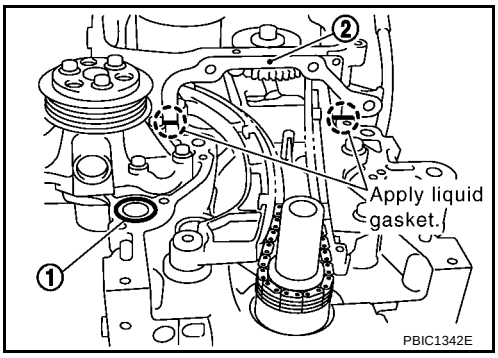
2. Install front oil seal to front cover.
   - Make sure the oil seal lettering is towards the engine front.
   - Using suitable drift, press oil seal in until it is flush with end surface of mounting position.
   - Do this without damaging the outer diameter of the oil seal.



3. Install the front cover with the following procedure:

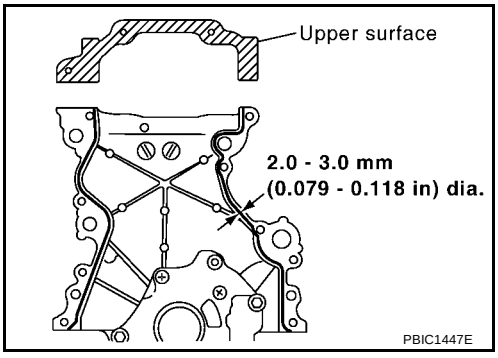
a. Install O-ring (1) to the cylinder block.

b. Apply liquid gasket to the contact area between the bottom of the cylinder head gasket (2) and the cylinder block (two places in the figure) using a screwdriver.
Use Genuine Liquid Gasket or equivalent.



c. Evenly apply the liquid gasket to the back of the front cover as per the position in the figure.

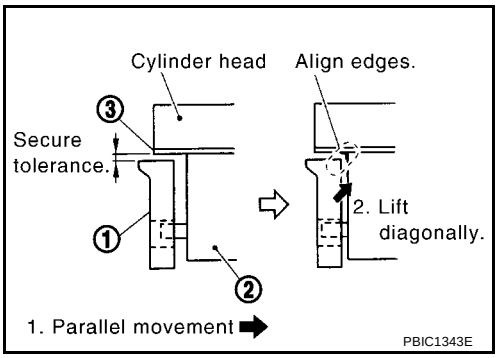
d. Apply a thin, even layer of liquid gasket to the entire upper surface of the front cover.
Use Genuine Liquid Gasket or equivalent.



e. With the inner rotor internal diameter part of the oil pump resting on the top of the crankshaft [with a space between the top of the front cover and the bottom of the cylinder head gasket (3)], bring the front cover (1) as close as possible to the cylinder block. (To the left in the figure)

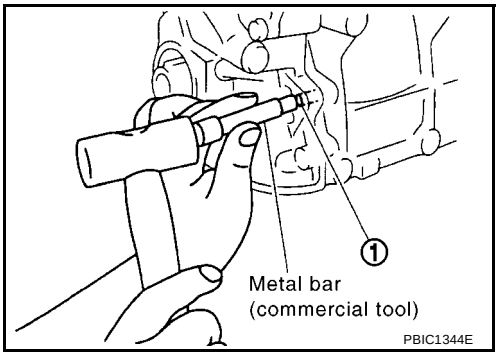
f. To make sure the front cover comes into contact with the cylinder head gasket (3) bottom and the cylinder block (2) front at the same time, lift it diagonally and set it in the mounting position. (To the right in the figure)

CAUTION:
- **Be careful not to damage the cylinder head gasket (3).**
- **Attach using caution not to let the liquid gasket get cut off by getting attached to unnecessary parts.**



g. Temporarily secure the front cover so it does not move using several bolts.

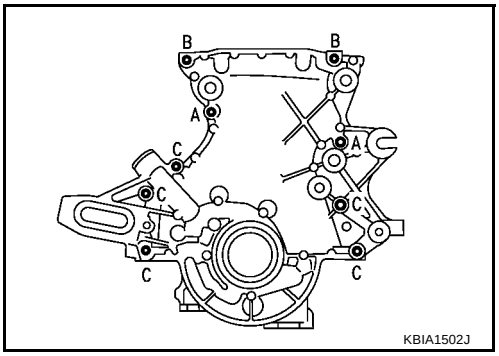
h. Press fit dowel pins (1) to the cylinder block through the front cover.



i. Temporarily tighten the front cover bolts.
- A [Under head length: 25 mm (0.98 in)], B [Under head length: 40 mm (1.57 in)], C [Under head length: 50 mm (1.97 in)]

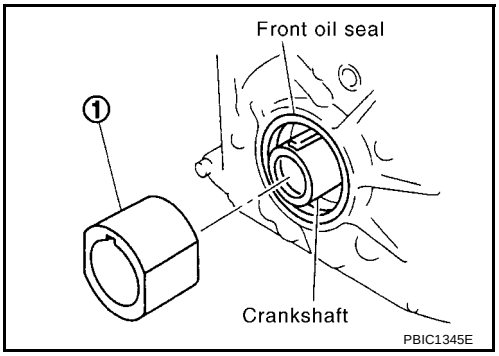
j. Temporarily tighten the cylinder head auxiliary bolts.

k. Tighten front cover bolts and the cylinder head auxiliary bolts to the specified torque.



4. Install oil pump drive spacer (1).
- When installing, align with flat face of oil pump inner rotor.
- If they are not aligned properly, turn the inner rotor with a screwdriver until they do.

CAUTION:
Be careful not to damage the oil seal lip.

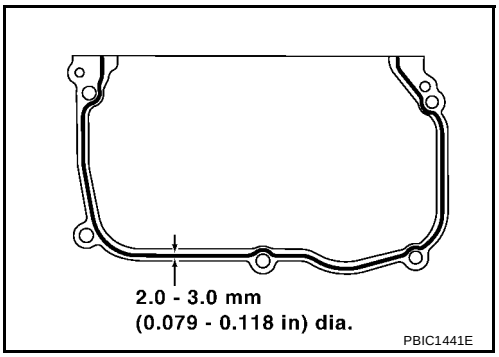


5. Install the drive belt idler pulley bracket assembly. Refer to EM-10, "DRIVE BELTS" .
6. Install crankshaft pulley.
- When installing, make sure the front oil seal lip does not fold back and the garter spring of oil seal lip does not fall.
- Secure the crankshaft as in “REMOVAL” and tighten the bolts.

CAUTION:
The bolt seats have a special lubricant applied in order to stabilize torque, so do not wipe off or apply oil.

7. Install the cylinder head front cover.
- Evenly apply the liquid gasket to the position shown in figure. Use Genuine Liquid Gasket or equivalent

8. Install RH engine mount bracket and RH engine mount stay. Refer toEM-65, "Removal and Installation" .
9. Reinstall removed parts in reverse order of removal.



INSPECTION AFTER INSTALLATION

- In order to allow liquid gasket to be cured, perform inspection at least 30 minutes after the last step in which parts sealed with liquid gasket are installed.
- With engine warmed up, check each part for engine oil leakage.

OIL SEAL

PFP:12279

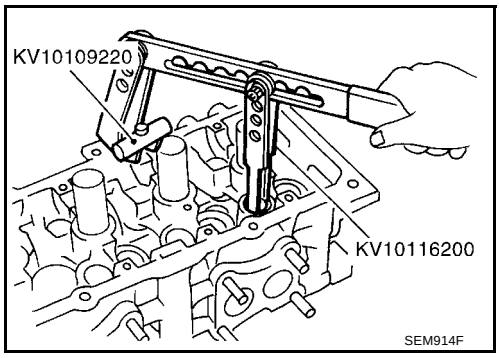
Removal and Installation of Valve Oil Seal

EBS00OF1

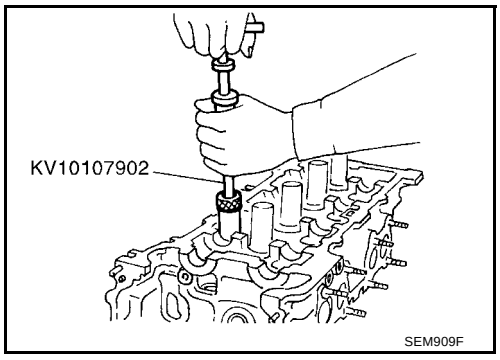
REMOVAL

1. Remove camshaft. Refer to EM-34, "CAMSHAFT" .
2. Remove valve lifter. Refer to EM-34, "CAMSHAFT" .
3. Turn the crankshaft, put the cylinder to have the oil seal removed in the TDC position to prevent the valve from falling into the cylinder.

   CAUTION:
   When rotating the crankshaft, make sure the timing chain does not get caught in the front cover.
4. Using a valve spring compressor (special service tool), remove the valve collet, valve spring retainer, and valve spring.

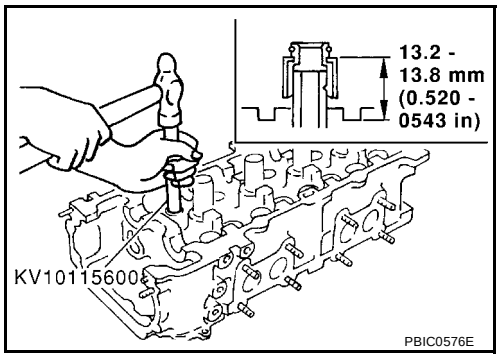


5. Using a valve oil seal puller (special service tool), remove the valve oil seal.



INSTALLATION

1. Apply engine oil to the new valve oil seal joint and seal lip.
2. Using a valve oil seal drift (special service tool), press fit the valve oil seal to the height shown in the figure.
3. Reinstall removed parts in reverse order of removal.



Removal and Installation of Front Oil Seal

EBS00OF2

REMOVAL

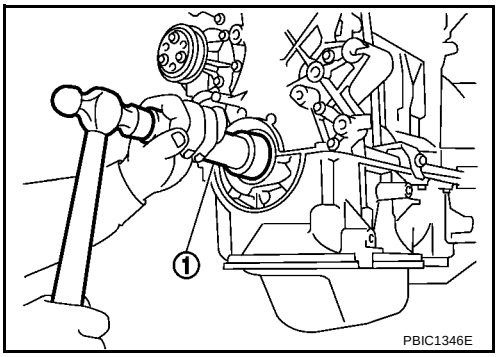
1. Remove the following parts.
   - RH front fender protector
   - Drive belt; Refer to EM-10, "DRIVE BELTS" .
   - Crankshaft pulley; Refer to EM-46, "TIMING CHAIN" .
2. Using a screwdriver, remove the front oil seal.

   CAUTION:
   Be careful not to damage the front cover or the crankshaft.

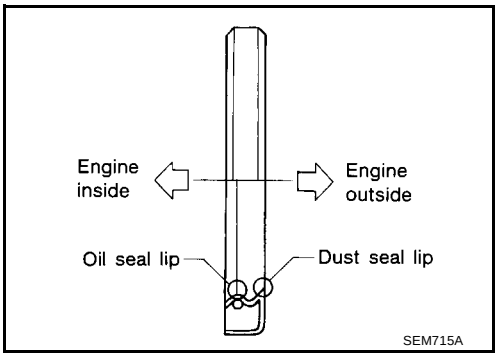
INSTALLATION

1. Apply engine oil to the new front oil seal joint and seal lip.
2. Using a suitable drift (1), press fit until the front end of front oil seal is level with the mounting surface.
   - Suitable drift (1) : outer diameter 50 mm (1.97 in), inner diameter 44 mm (1.73 in).

   CAUTION:
   - **Be careful not to damage the front cover or the crankshaft.**
   - **Press in straight, making sure the oil seal does not curl or tilt.**



   - See the figure for the direction the front oil seal should be fitted.



3. Reinstall removed parts in reverse order of removal.

Removal and Installation of Rear Oil Seal

EBS00OF3

REMOVAL

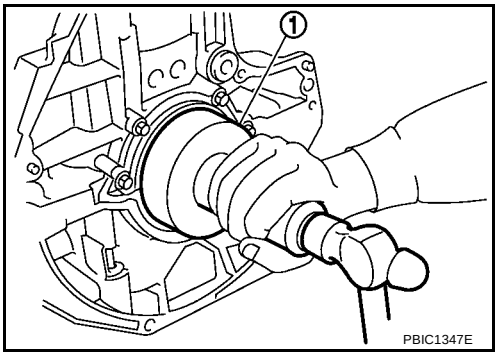
1. Remove transaxle assembly.
   - M/T: Refer to MT-12, "Removal and Installation From Vehicle" .
   - A/T: Refer to AT-423, "REMOVAL AND INSTALLATION" .
2. Remove clutch cover and clutch disc. (M/T models) Refer to CL-10, "CLUTCH DISC, CLUTCH COVER AND FLYWHEEL" .
3. Remove flywheel (M/T models), drive plate and adopter (A/T models). Refer toEM-69, "CYLINDER BLOCK" .
4. Using a screwdriver, remove the rear oil seal.

   CAUTION:
   Be careful not to damage the mounting surface.

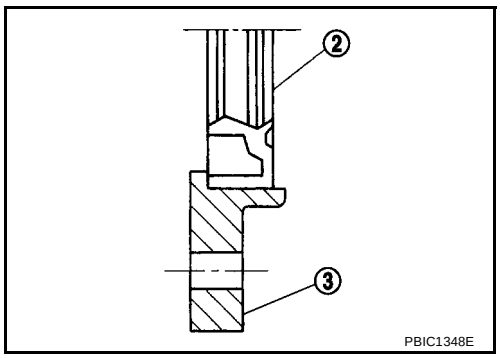
INSTALLATION

1. Using a suitable drift (1), press fit until the rear end of front oil seal is level with the mounting surface.
   - Suitable drift (1): outer diameter 102 mm (4.02 in), inner diameter 90 mm (3.54 in).

   CAUTION:
   - **Do not touch the grease applied to the oil seal lip.**
   - **Be careful not to damage the rear oil seal retainer or the crankshaft.**
   - **Press in straight, making sure the oil seal does not curl or tilt.**



- **Press rear oil seal (2) into rear oil seal retainer (3) so that it does not project from the end.**



2. Reinstall removed parts in reverse order of removal.

CYLINDER HEAD

PFP:11041

On Vehicle Inspection

EBS00OF4

COMPRESSION PRESSURE INSPECTION

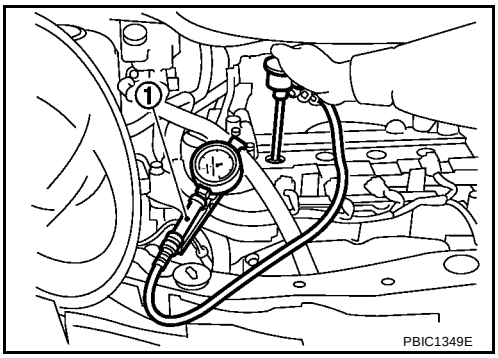
1. Warm up engine thoroughly. Then, stop it.
2. Release fuel pressure with the following procedure.

a. Remove rear seat assembly.
b. Open the inspection hole cover.
c. Disconnect fuel level sensor unit, fuel filter, and fuel pump assembly connector, and start engine. Refer to FL-4, "FUEL LEVEL SENSOR UNIT, FUEL FILTER AND FUEL PUMP ASSEMBLY" .
d. After you stop the engine, crank it two or three times to consume the fuel in the pipes.

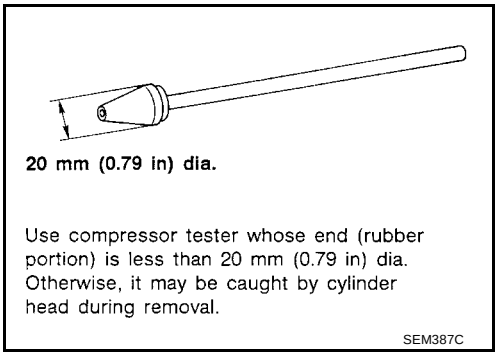
CAUTION:

After release the fuel pressure and until the compression pressure inspection, leave the harness connector off.

3. Remove ignition coil and spark plug from all the cylinders. Refer to EM-25, "IGNITION COIL" and EM-26, "SPARK PLUG (PLATINUM-TIPPED TYPE)" .
4. Attach a engine tachometer (not required in use of CONSULT-II).
5. Install compression tester (1) with adapter onto spark plug hole.



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



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

[kPa (bar, kg/cm^2 , psi)/350rpm]

Engine type	CR10DE	CR12DE, CR14DE
Standard	1,432 (14.32, 14.6, 208)	1,383 (13.83, 14.1, 201)
Minimum	1,236 (12.36, 12.6, 179)	1,187 (11.87, 12.1, 172)
Difference limit among cylinders	98 (0.98, 1.0, 14)	98 (0.98, 1.0, 14)

CAUTION:

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

- If the engine speed is out of specified range, check battery liquid for proper gravity. Check engine speed again with normal battery gravity.
- If compression pressure is below minimum value, check valve clearances and parts associated with combustion chamber (Valve, valve seat, piston, piston ring, cylinder bore, cylinder head, cylinder head gasket). After the checking, measure compression pressure again.
- If some cylinders have low compression pressure, pour small amount of engine oil into the spark plug hole of the cylinder to re-check it for compression.
  - If the added engine oil improves the compression, the piston rings may be worn out or damaged. Check the piston rings and replace if necessary.

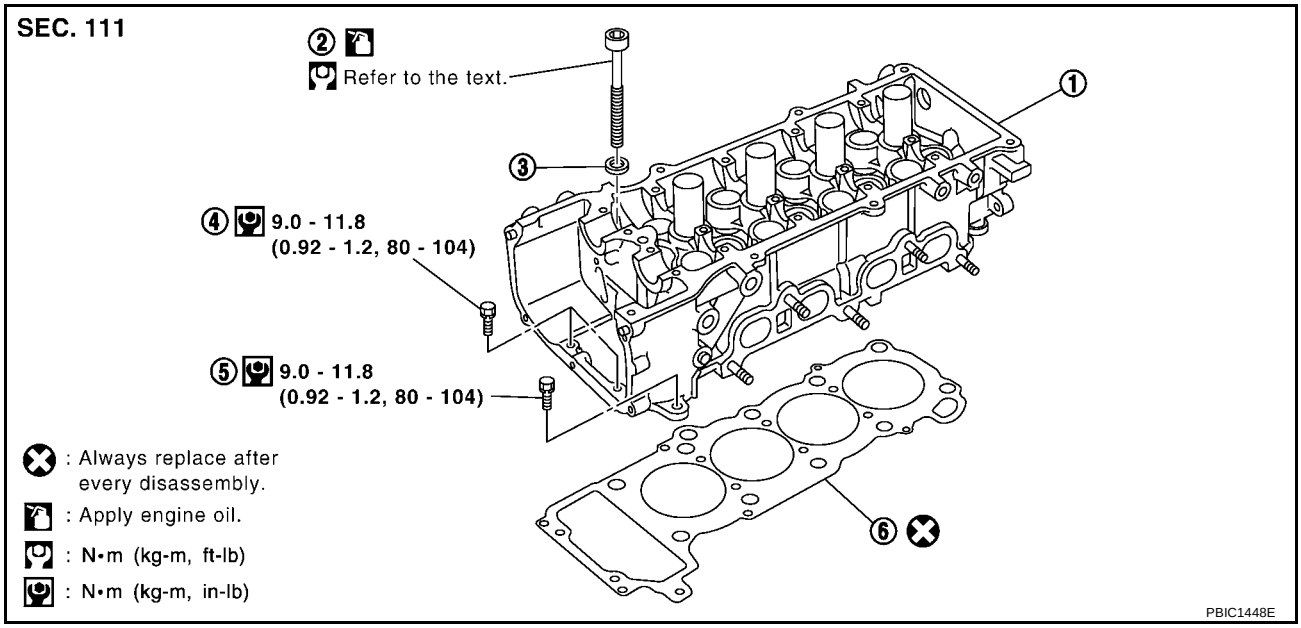
- If the compression pressure remains at low level despite the addition of engine oil, the valves may be malfunctioning. Check the valves for damage. Replace the valve or valve seat accordingly.

- If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, the gasket is leaking. In such a case, replace the cylinder head gasket.

7. After inspection, install removed parts in reverse order of removal.

Removal and Installation

EBS00OF5



1. Cylinder head assembly
2. Cylinder head bolt
3. Washer
4. Cylinder head auxiliary bolt
5. Cylinder head auxiliary bolt
6. Gasket

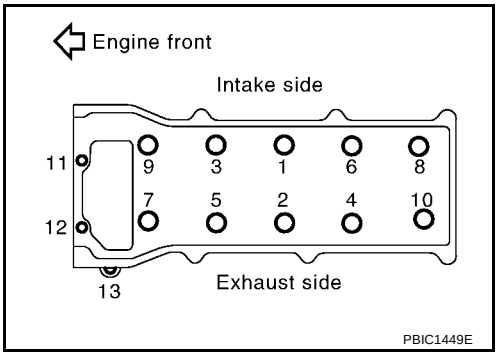
REMOVAL

1. Release the fuel pressure. Refer to EC-36, "FUEL PRESSURE RELEASE" (WITH EURO-OBD), EC-437, "FUEL PRESSURE RELEASE" (WITHOUT EURO-OBD).
2. Drain engine coolant. Refer to CO-7, "ENGINE COOLANT" .
3. Remove the following components and related parts.
   - RH front fender protector
   - Alternator and A/C compressor drive belt; Refer to EM-10, "DRIVE BELTS" .
   - Air duct and air cleaner case assembly; Refer to EM-14, "AIR CLEANER AND AIR DUCT" .
   - Intake manifold; Refer to EM-18, "INTAKE MANIFOLD" .
   - Fuel injector and fuel tube assembly; Refer to EM-28, "FUEL INJECTOR AND FUEL TUBE" .
   - Radiator upper hose and lower hose; Refer to CO-10, "RADIATOR" .
   - Alternator and alternator bracket; Refer to SC-14, "CHARGING SYSTEM" .
   - Exhaust manifold and three way catalyst assembly; Refer to EM-20, "EXHAUST MANIFOLD AND THREE WAY CATALYST" .
   - Ignition coil; Refer to EM-25, "IGNITION COIL" .
   - Rocker cover; Refer to EM-31, "ROCKER COVER" .
   - Camshaft; Refer to EM-34, "CAMSHAFT" .

     CAUTION:
     For the method for maintaining engine position, select the method which supports the bottom of the oil pan.
   - Heated oxygen sensor harness bracket; Refer to EM-20, "EXHAUST MANIFOLD AND THREE WAY CATALYST" .
   - Water outlet, thermostat, engine coolant temperature sensor and heater pipe; Refer to CO-22, "THERMOSTAT" .

- Water suction pipe mounting bolt; Refer to CO-20, "WATER PUMP" .

4. Loosen bolts in the reverse order shown in the figure and then remove the cylinder head assembly.
5. Remove cylinder head gasket.



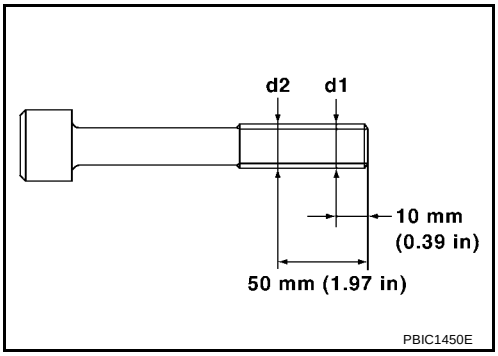
INSPECTION AFTER REMOVAL

Cylinder Head Bolt Outer Diameter

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

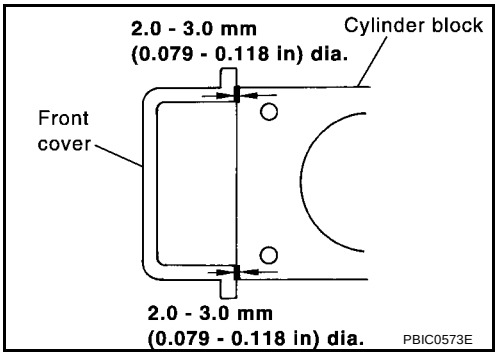
  Limit (d1 - d2) : 0.12 mm (0.0047 in)

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



INSTALLATION

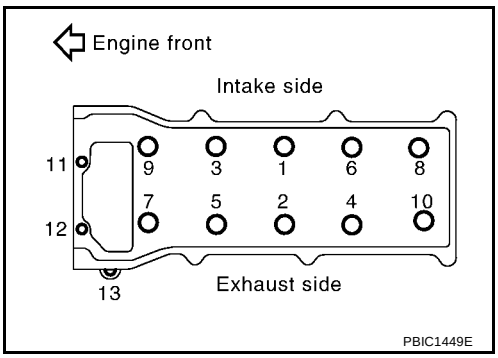
1. Evenly apply the liquid gasket to the position in the figure and then install the cylinder head gasket.
   Use Genuine Liquid Gasket or equivalent.



2. Attach the cylinder head assembly and then tighten bolts 1 to 10 in the order shown in the figure.

   CAUTION:
   For step c, loosen them in reverse of the order in the figure.

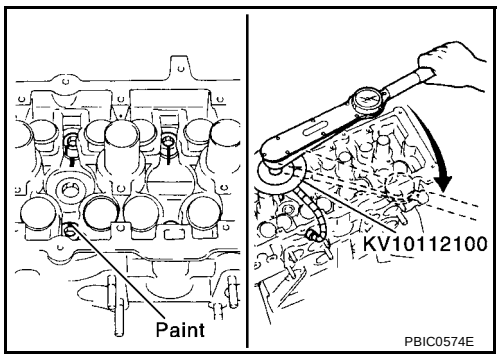
   NOTE:
   Bolts 11 to 13 should be tightened in step 3 after tightening bolts 1 to 10.



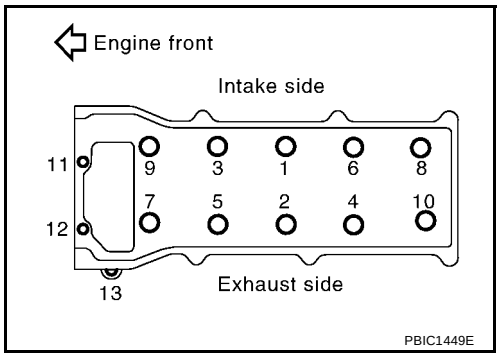
a. Apply new engine oil to threads and seat surfaces of bolts.
b. Tighten at 61.7 - 71.7 N·m (6.3 - 7.3 kg-m, 46 - 52 ft-lb).
c. Loosen completely to 0 N·m (0 kg-m).
d. Tighten at 22.5 - 32.5 N·m (2.3 - 3.3 kg-m, 17 - 23 ft-lb).
e. Tighten with 90 - 95 degrees clockwise [Target: 90 degrees]. (Angle tightening)

   CAUTION:
   Check and confirm the tightening angle by using angle wrench (special service tool). Avoid judgment by visual inspection without the tool.

- Check tightening angle indicated on the angle wrench indicator plate.



3. Tighten auxiliary bolts (11 to 13) in the numerical order shown in the figure.

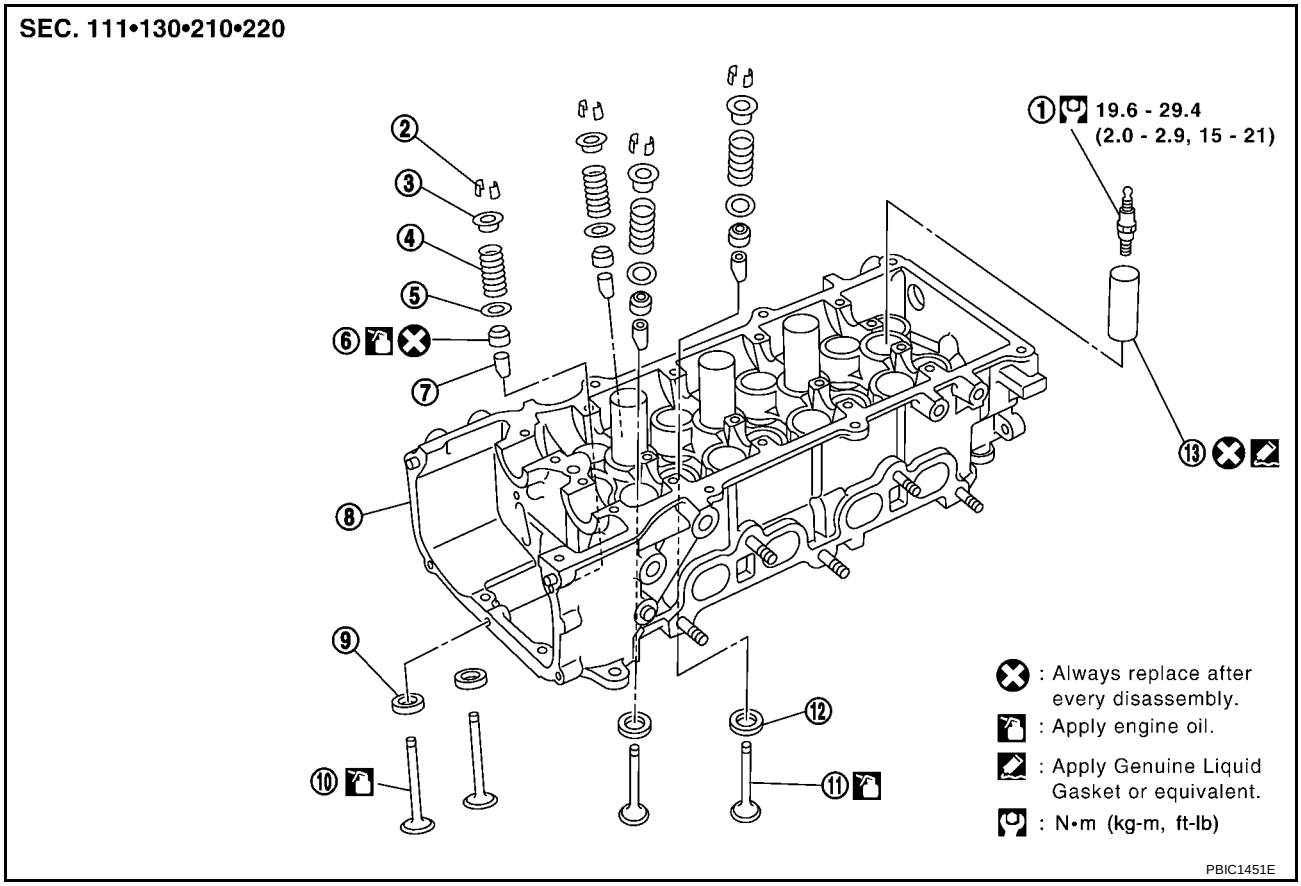


4. Reinstall removed parts in reverse order of removal.

Disassembly and Assembly

EBS00OF6

SEC. 111•130•210•220



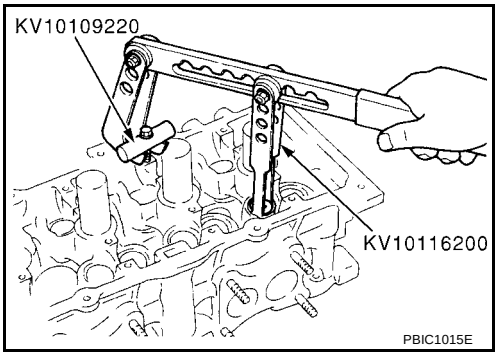
1. Spark plug
2. Valve collet
3. Valve spring retainer
4. Valve spring
5. Valve spring seat
6. Valve oil seal
7. Valve guide
8. Cylinder head
9. Valve seat (INT)

10. Valve (INT)
11. Valve (EXH)
12. Valve seat (EXH)
13. Spark plug tube

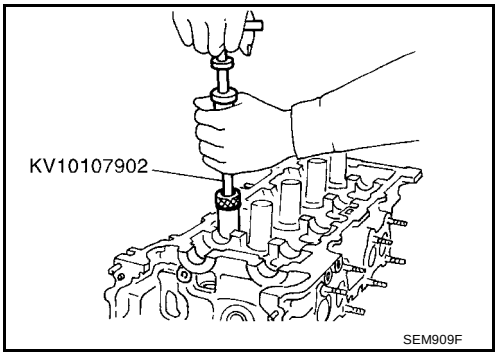
DISASSEMBLY

1. Remove spark plugs with a spark plug wrench.
2. Remove valve lifter.
   - Mark position on valve lifter for assembly.
3. Remove valve collet.
   - Compress the valve spring with a valve spring compressor (special service tool). Remove valve collet with a magnetic driver.

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



4. Remove valve spring retainer and valve spring.
5. Push the valve stem toward the combustion chamber side and remove the valve.
   - Before removal, check valve guide clearance. Refer to EM-63, "Valve Guide Clearance" .
   - Mark position on valve for assembly.
6. Remove valve oil seal.
   - Use valve oil seal puller (special service tool).
7. Remove valve spring seat.
8. When valve seat replacement is necessary, refer to EM-63, "Replacement of Valve Seat" .
9. When valve guide replacement is necessary, refer to EM-63, "Valve Guide Replacement" .
10. Remove spark plug tube, as necessary.
    - Using a pair of pliers, pull spark plug tube out of cylinder head.

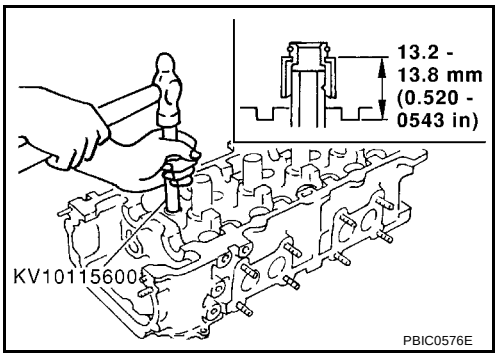


CAUTION:

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

ASSEMBLY

1. Install valve guide. Refer to EM-63, "Valve Guide Replacement" .
2. Install valve seat. Refer to EM-63, "Replacement of Valve Seat" .
3. Install valve oil seal.
   - Using a valve oil seal drift (special service tool), install to the dimensions specified in the figure.
4. Install valve spring seat.
5. Install valve.
   - Valves of larger diameter are for intake side.



6. Install valve spring.
7. Install valve spring retainer.
8. Install valve collet.
   - Use a valve spring compressor (special service tool) to compress the valve spring, then install collet with a magnetic finger.

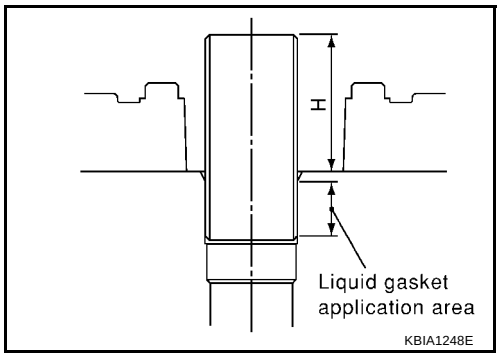
- After installing valve component parts, tap valve stem tip with a plastic hammer to assure a proper fit.

9. Install valve lifter.
   - Install it in its original positions.
10. Install spark plug tube.
   - Press-fit into cylinder head in the following order.

a. Remove the old liquid gasket which has become attached to the cylinder head mounting hole.

b. Apply the liquid gasket to the area around the spark plug tube press-fit.
   - Use Genuine Liquid Gasket or equivalent.

c. Using a drift, press-fit spark plug tube so that its height “H” is as specified in the figure.



Standard press-fit height “H”

: 41.0 - 42.0 mm (1.614 - 1.654 in)

CAUTION:
- **Press-fit, making sure not to deform the spark plug tube.**
- **After press-fitting, wipe off liquid gasket protruding onto cylinder head upper face.**

11. Install spark plug.
   - Use a spark plug wrench.

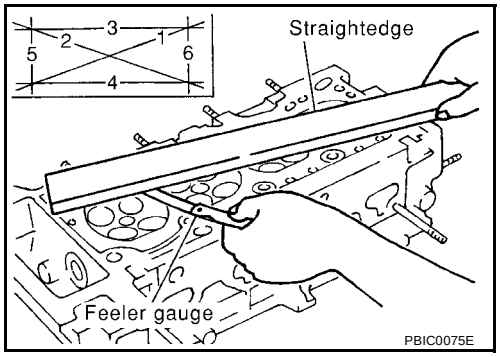
INSPECTION AFTER DISASSEMBLY

Cylinder Head Distortion

1. Using a scraper, wipe off oil, scale, gasket, sealant, and carbon deposits from surface of cylinder head.

   CAUTION:
   Do not allow gasket fragments to enter oil or engine coolant passages.

2. Check flatness of the cylinder head lower surface. Measure distortion in six directions shown in figure, at several points in each direction.

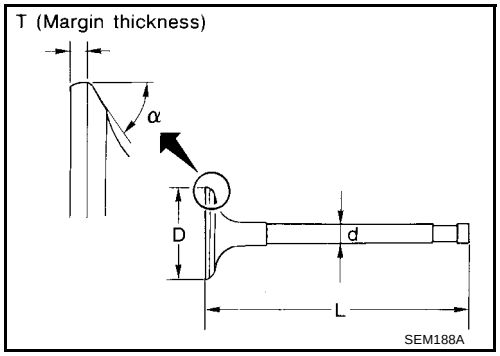


Limit : 0.1 mm (0.004 in)

- if it exceeds the limit, replace the cylinder head.

Valve Dimensions

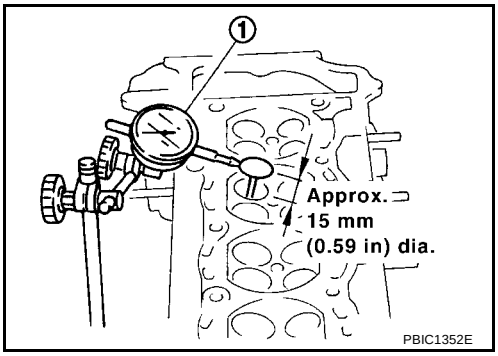
- Check dimensions of each valve. For dimensions, refer to EM-91, "VALVE" .
- If dimensions are out of the standard, replace valve.



Valve Guide Clearance

Check valve guide clearance before removing the valve guide.

1. Make sure valve stem diameter is within the standard.
2. Push the valve out toward combustion chamber for approximately 15 mm (0.59 in). Measure runout while pushing the valve toward the dial gauge (1).
3. The half of the dial gauge reading is the valve guide clearance.



Standard

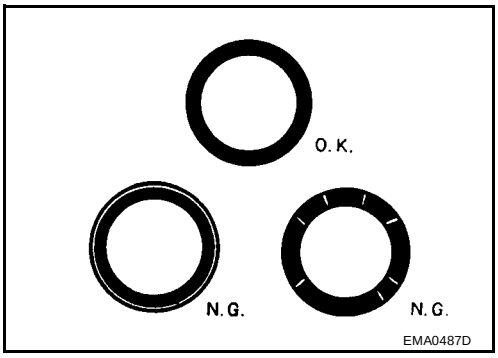
Intake	**: 0.020 - 0.053 mm (0.0008 - 0.0021 in)**
Exhaust	**: 0.040 - 0.073 mm (0.0016 - 0.0029 in)**

Valve Guide Replacement

To be informed

Valve Seat Contact

- After confirming that the dimensions of valve guides and valves are within specifications, perform this procedure.
- Apply prussian blue (or white lead) onto contacting surface of valve seat to check the condition of the valve contact on the surface.
- Check if the contact area band is continuous all around the circumference.
- If not, grind to adjust valve fitting and check again. If the contacting surface still has N.G conditions even after the re-check, replace valve seat.



Replacement of Valve Seat

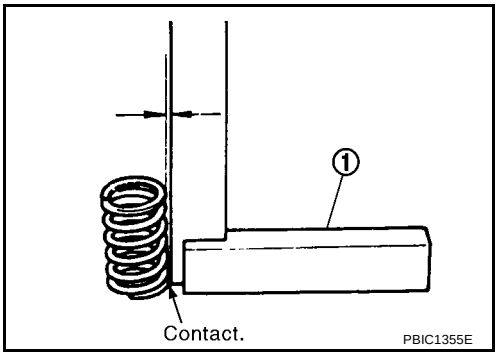
To be informed

Valve Spring Squareness

Set try square (1) along the side of valve spring and rotate the spring. Measure the maximum clearance between the top face of spring and try square (1).

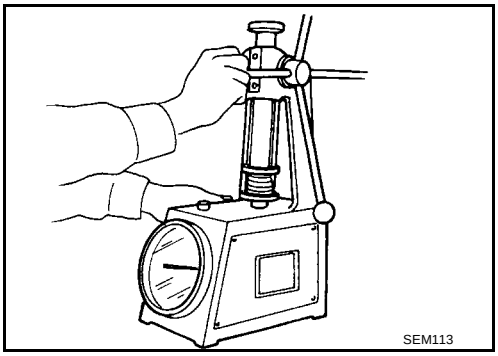
Limit : 1.6 mm (0.063 in)

- if exceeds the limit, replace the valve spring.



Valve Spring Dimensions and Valve Spring Pressure Load

- Check valve spring pressure load at specified spring height.



Standard

Free height	**:**	**53.3 mm (2.098 in)**
Installation height	**:**	**32.82 mm (1.2921 in)**
Installation load	**:**	**149 - 165 N (15.2 - 16.8 kg, 33.5 - 37 lb)**
Height during valve open	**:**	**24.73 mm (0.9736 in)**
Load with valve open	**:**	**228 - 250 N (23.3 - 25.5 kg, 51.3 - 56.2 lb)**

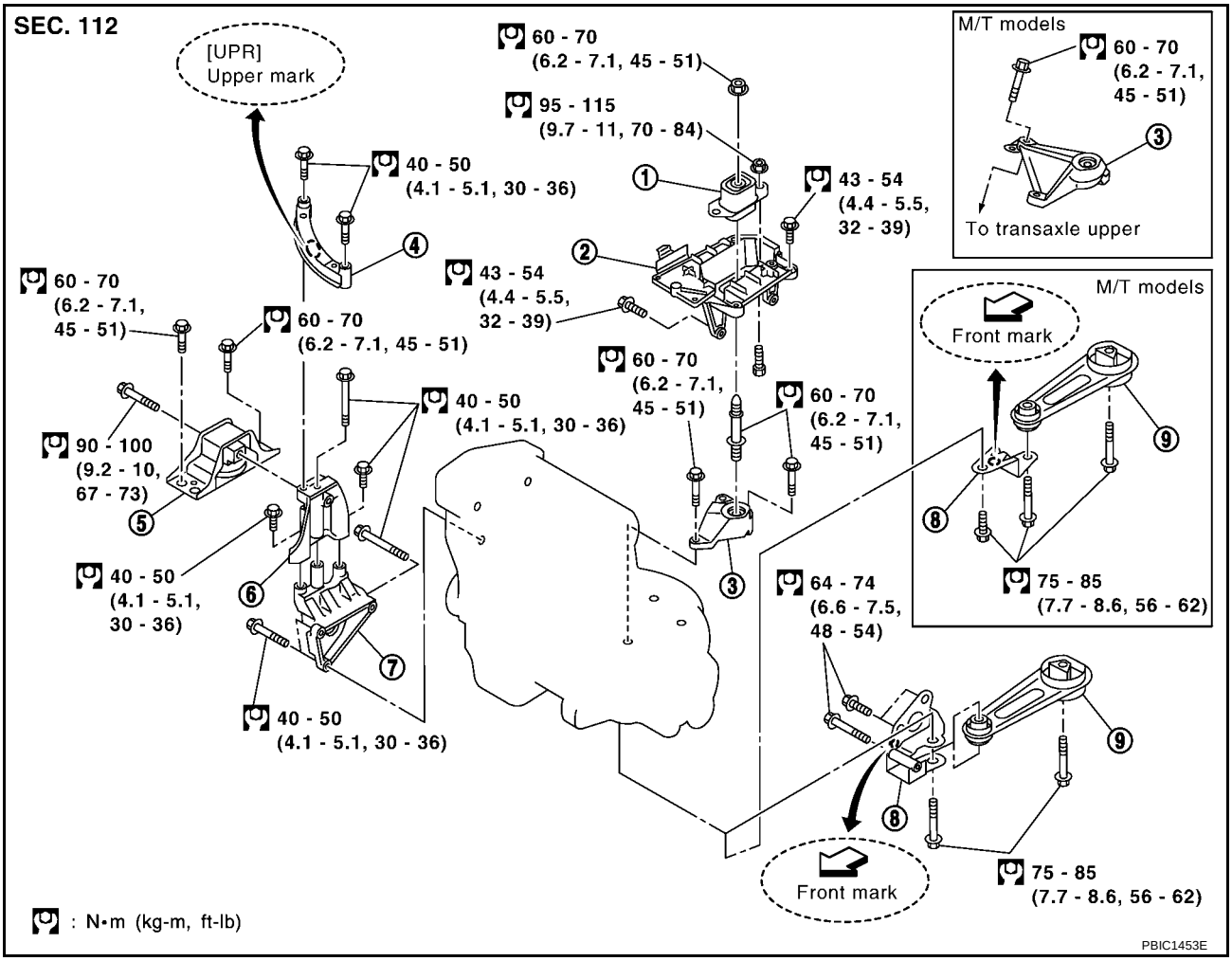
- If the dimensions exceed the standard, replace the valve spring.

ENGINE ASSEMBLY

PFP:10001

Removal and Installation

EBS00OF7



1. LH engine mount insulator	2. LH engine mount bracket (vehicle side)	3. LH engine mount bracket (transaxle side)
4. RH engine mount stay (The shape may not be the same as figure)	5. RH engine mount insulator	6. RH engine mount bracket (upper)
7. RH engine mount bracket (lower)	8. Rear engine mount bracket	9. Rear torque rod

WARNING:

- **Situate vehicle on a flat and solid surface.**
- **Place chocks at front and back of rear wheels.**
- **For engines not equipped with engine slingers, attach proper slingers and bolts described in PARTS CATALOG.**

CAUTION:

- **Always be careful to work safely, avoid forceful or uninstructed operations.**
- **Do not start working until exhaust system and engine coolant are cool enough.**
- **If items or work required are not covered by the engine main body section, refer to the applicable sections.**
- **Always use the support point specified for lifting.**
- **Use either 2-pole lift type or separate type lift as best you can. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.**
- **For supporting points for lifting and jacking point at rear axle, refer to GI-37, "Garage Jack and Safety Stand" .**

REMOVAL

Description of work

Remove engine and transaxle assembly from vehicle, and separate engine and transaxle.

Preparation

1. When engine can be hoisted, remove engine hood.
2. Release fuel pressure. Refer to EC-36, "FUEL PRESSURE RELEASE" (WITH EURO-OBD), EC-437, "FUEL PRESSURE RELEASE" (WITHOUT EURO-OBD).
3. Drain engine coolant. Refer to CO-7, "ENGINE COOLANT" .
4. Remove the following parts.
   - RH and LH front wheel
   - RH and LH front fender protector
   - Exhaust front tube; Refer to EX-3, "EXHAUST SYSTEM" .
   - Drive belt; Refer toEM-10, "DRIVE BELTS" .
   - Air duct; Refer to EM-14, "AIR CLEANER AND AIR DUCT" .
   - Battery
   - Radiator; Refer to CO-10, "RADIATOR" .

Engine room LH

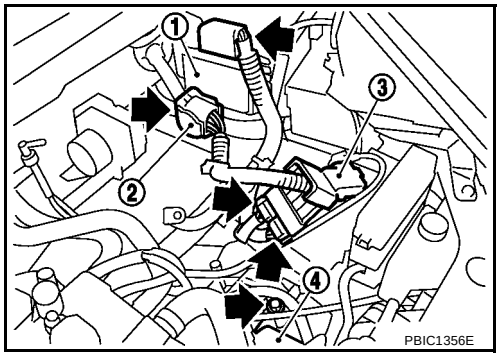
5. Disconnect the harness connectors and terminals from the following parts.

   NOTE:
   Figure shows A/T models. The position of the ground wire on the transaxle side is different for M/T models.

   - Remove the ECM (1) from the bracket and disconnect the two harness connectors.

   CAUTION:
   Avoid impacts to ECM.

   - Disconnect the intermediate connector (2) for the main harness between the vehicle and the engine room below the ECM.
   - Disconnect the harness connectors on the battery positive terminal (3).
   - Disconnect the ground wire on the transaxle (4) side.



6. Disconnect heater hose. Plug the hose immediately to prevent engine coolant from draining.
7. Disconnect the shift cable and the control cable (M/T models) or control cable (A/T models) from the transaxle.
   - M/T: Refer to MT-9, "CONTROL LINKAGE" .
   - A/T: Refer to AT-411, "A/T SHIFT LOCK SYSTEM" .
8. Disconnect the clutch tube from the transaxle side and temporarily fasten to vehicle. (M/T models)
   - Install the plug to prevent the clutch fluid from leaking.
9. Remove the crankshaft position sensor (POS) from the transaxle.

   CAUTION:
   Handle it carefully, avoid any chance of impact caused by dropping.

Engine room front and RH

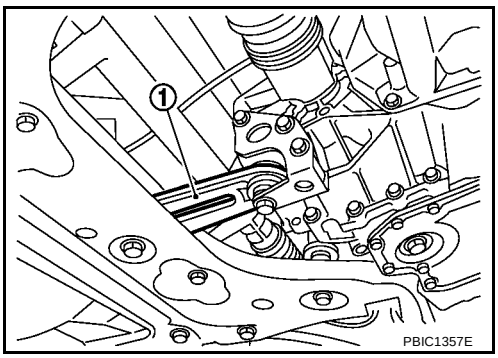
10. Remove the ground wire between the alternator bracket and the vehicle.
11. Remove RH engine mount stay, alternator bracket, and alternator.
12. Remove A/C compressor from engine with piping connected, and temporarily install it to vehicle with rope to avoid putting stress on air conditioner pipes.
13. Remove fuel tube protector. Refer to EM-28, "FUEL INJECTOR AND FUEL TUBE" .
14. Disconnect fuel hose. Plug the hose immediately to prevent fuel from draining.

Vehicle underbody

15. Remove the ABS wheel sensor from the steering knuckle.

16. Remove brake caliper from steering knuckle. Temporarily fix on vehicle side with rope or so to avoid putting stress on brake hose. Refer to BR-20, "FRONT DISC BRAKE" .
17. Remove RH and LH drive shafts. Refer to FAX-10, "FRONT DRIVE SHAFT" .
18. Remove rear torque rod (1).

    NOTE:
    Figure shows A/T models. The shape of the bracket on the transaxle side is different for M/T models.



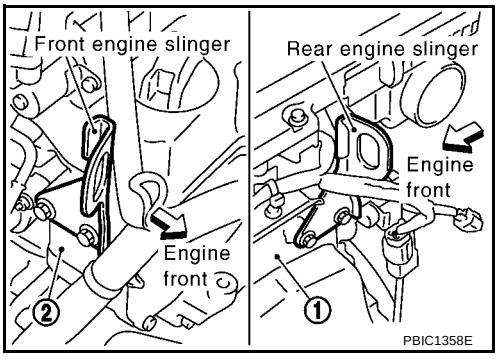
Removal

19. Install engine slinger to cylinder head front left side (1) and rear right side (2) and support the engine position with a hoist.

    NOTE:
    Front side and rear side engine slinger are common parts.

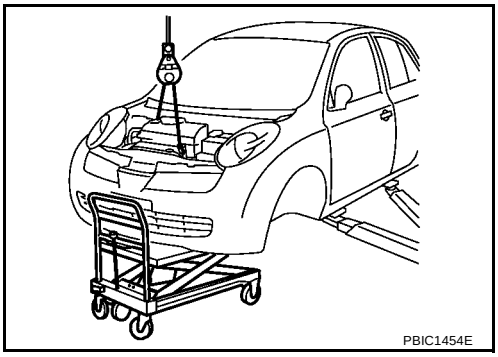
    : 16.6 - 23.5 N·m (1.7 - 2.3 kg-m, 13 - 17 in)

    - For front side, remove harness bracket under fuel tube protector and mount by using harness bracket mounting hole. Refer to EM-28, "FUEL INJECTOR AND FUEL TUBE" .

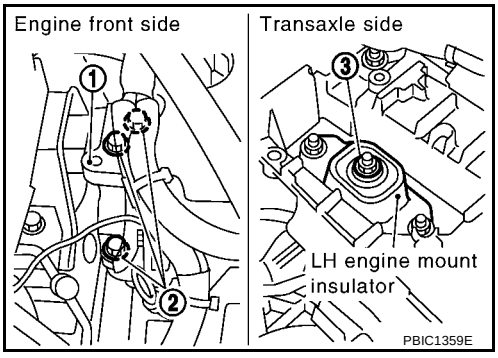


20. Lift to a height sufficient to allow easy work, support the bottom of the engine with either a manual lift table caddy (commercial service tool) or two suitable jacks, and adjust the tension of the hoist.

    CAUTION:
    - **Put a piece of wood or something similar as the supporting surface, secure a completely stable condition.**
    - **Make sure the hanging chain or hanging hook does not come into contact with the A/C piping or the vehicle (cowl top). Also make sure they do not get in the way by moving while the work is being done.**



21. Remove the RH engine mount bracket (upper) (1) mounting bolts (2).
22. Remove the LH engine mount bolt-securing nut (3).



23. Carefully lower the manual lift table caddy or suitable jack, (or carefully raise the lift), and remove the engine and transaxle assembly from the vehicle.
    - If you are going to lower the engine side, do this in tandem with the hoist.

    CAUTION:
    - **This should be done making sure it does not come in contact with the vehicle.**
    - **Check that all connection points have been disconnected.**

- **Make sure the hanging chain or hanging hook does not come into contact with the A/C piping or the vehicle (cowl top).**
- **During engine and transaxle assembly removal, always be careful to prevent the vehicle from falling off the lift due to changes in the center of gravity.**
- **If necessary, support the rear side of the vehicle with jack to prevent it from falling off.**

Separation Work

- On level ground, separate engine and transaxle with the following procedure:

CAUTION:

During the operation, securely support the engine by placing a piece of wood under the engine oil pan, transaxle oil pan, and suspension member, and suspend the engine slingers by hoist.

24. Remove the starter motor. Refer to SC-27, "STARTING SYSTEM" .
25. Separate the engine and the transaxle.
    - M/T: Refer to MT-12, "Removal and Installation From Vehicle" .
    - A/T: Refer to AT-423, "REMOVAL AND INSTALLATION" .

INSTALLATION

Install in the reverse order of removal while being careful of the following.

- Do not allow the engine mount insulator to be damaged and be careful no oil gets on it.
- For a part with a specified installation orientation, refer to component figure in EM-65, "Removal and Installation" .
- Make sure all mount insulators are seated properly, then tighten nuts and bolts.

INSPECTION AFTER INSTALLATION

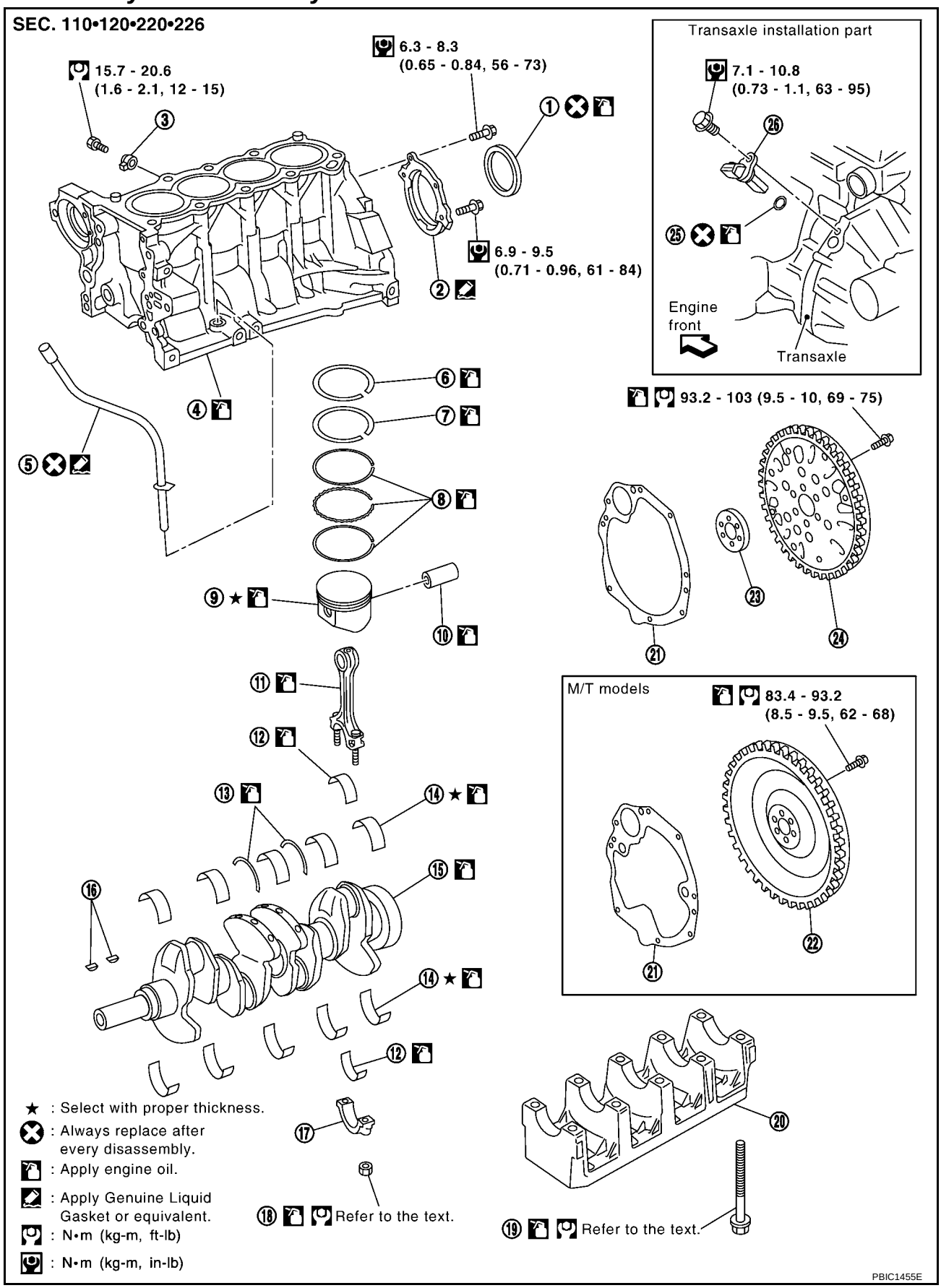
- Before starting engine, check the levels of engine coolant, lubrications and working oils. If less than required quantity, fill to the specified level.
- Use procedure below to check for fuel leakage.
  - Turn ignition switch ON (with engine stopped). With fuel pressure applied to fuel piping, check for fuel leakage at connection points.
  - Start engine. With engine speed increased, check again for fuel leakage at connection points.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of engine coolant, lubricants, working oil, fuel and exhaust gas.
- Bleed air from passages in pipes and tubes of applicable lines, such as in cooling system.
- After cooling down engine, again check amounts of engine coolant, lubricants, oil, and fluid. Refill to specified level, if necessary.

CYLINDER BLOCK

PFP:11010

Disassembly and Assembly

EBS00OGH



1. Rear oil seal
2. Rear oil seal retainer
3. Knock sensor
4. Cylinder block
5. Oil level gauge guide
6. Top ring
7. Second ring
8. Oil ring
9. Piston
10. Piston pin
11. Connecting rod
12. Connecting rod bearing
13. Thrust bearing
14. Main bearing
15. Crankshaft
16. Key
17. Connecting rod cap
18. Connecting rod nut
19. Main bearing cap bolt
20. Main bearing cap
21. Rear plate
22. Flywheel (M/T models)
23. Adapter (A/T models)
24. Drive plate (A/T models)
25. O-ring
26. Crankshaft position sensor (POS)

DISASSEMBLY

1. Remove engine and transaxle assembly from the vehicle and separate transaxle from the vehicle. Refer to EM-65, "Removal and Installation" .
2. Install engine to engine stand in the following procedure.

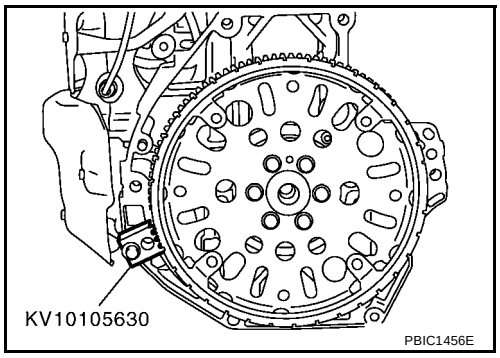
   NOTE:
   We will use as an example the engine stand (commercial service tool) specified to support the cylinder block rear (transaxle mounting surface).

a. Remove clutch cover and clutch disc. (M/T models) Refer to CL-10, "CLUTCH DISC, CLUTCH COVER AND FLYWHEEL" .

b. Remove the flywheel (M/T models), the drive plate and the adapter (A/T models).

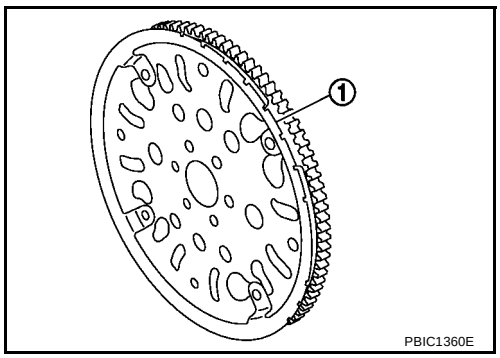
- Using a ring gear stopper (special service tool), secure the crankshaft, loosen the bolts diagonally and remove.

  NOTE:
  Figure shows the drive plate.



CAUTION:
Make sure signal plate (1) are not damaged or deformed.

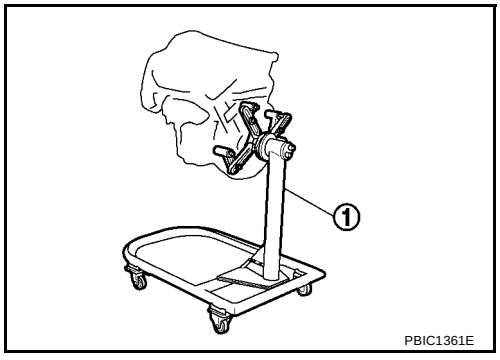
NOTE:
Figure shows the drive plate.



c. Remove rear plate.

d. Lift engine using a hoist and mount it on an engine stand (1).

- For installation of engine slingers, refer to EM-65, "Removal and Installation" .

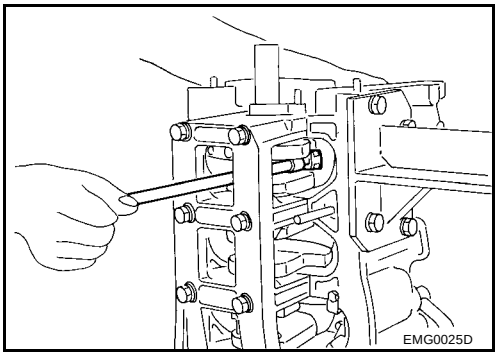


3. Drain engine oil and engine coolant from engine.
4. Remove following components and related parts.
   - Air cleaner case assembly; Refer to EM-14, "AIR CLEANER AND AIR DUCT" .
   - Intake manifold; Refer to EM-18, "INTAKE MANIFOLD" .
   - Fuel injector and fuel tube assembly; Refer to EM-28, "FUEL INJECTOR AND FUEL TUBE" .
   - Ignition coil; Refer to EM-25, "IGNITION COIL" .
   - Rocker cover; Refer to EM-31, "ROCKER COVER" .
   - Oil pan and oil strainer; Refer to EM-22, "OIL PAN AND OIL STRAINER" .
   - Front cover and timing chain; Refer to EM-46, "TIMING CHAIN" .
   - Camshaft; Refer to EM-34, "CAMSHAFT" .
   - Cylinder head assembly; Refer to EM-57, "CYLINDER HEAD" .
   - Oil filter; Refer to LU-6, "OIL FILTER" .
   - Oil pressure switch; Refer to LU-4, "OIL PRESSURE CHECK" .
5. Remove knock sensor.

   CAUTION:
   Avoid impact such as a dropping.
6. Remove oil level gauge guide, if necessary.

   CAUTION:
   Once removed, it cannot be reused. Do not remove it unless absolutely necessary.
7. Remove rear oil seal retainer.
   - Remove by inserting a screwdriver between main bearing cap and rear oil seal retainer.
8. Remove rear oil seal from rear oil seal retainer.
   - Remove by driving it out using a screwdriver.

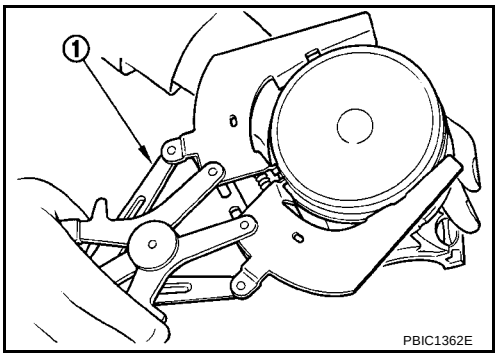
   CAUTION:
   Make sure the rear oil seal retainer is not damaged.
9. Remove piston and connecting rod assembly.
   - Before removing connecting rod, check connecting rod side clearance. Refer to EM-81, "CONNECTING ROD SIDE CLEARANCE" .



a. Position the crankshaft pin corresponding to the connecting rod to be removal onto the bottom dead center.
b. Remove connecting rod cap.
c. Push the piston and connecting rod assembly out toward cylinder head side with handle of a hammer.
10. Remove connecting rod bearings from connecting rod and connecting rod cap.

    CAUTION:
    When removing, check each part, and arrange them in a way that prevents mixing them up.
11. Remove piston rings from piston.
    - Use piston ring expander (1).

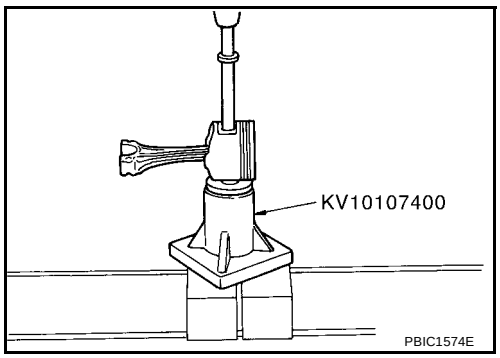
    CAUTION:
    - **Be careful not to damage piston.**
    - **Do not expand piston rings excessively. It can damage piston rings.**
    - Before removal of piston ring, check piston ring side clearance. Refer to EM-81, "PISTON RING SIDE CLEARANCE" .



12. Remove piston from connecting rod.
    - Use a piston pin press stand and a press to remove the piston pin.

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

    CAUTION:
    Be careful not to damage the piston and connecting rod.



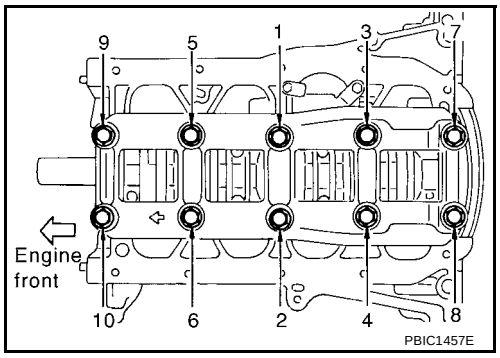
13. Remove the main bearing cap in the following order.

a. Loosen and remove bolts in several steps in reverse of the numerical order shown in figure.
    - Before loosening main bearing cap bolts, measure the crankshaft side clearance. Refer to EM-80, "CRANKSHAFT SIDE CLEARANCE" .

b. Tapping lightly with a plastic hammer, remove the main bearing cap.

14. Remove crankshaft.

15. Remove main bearing and thrust bearing from cylinder block and main bearing cap.

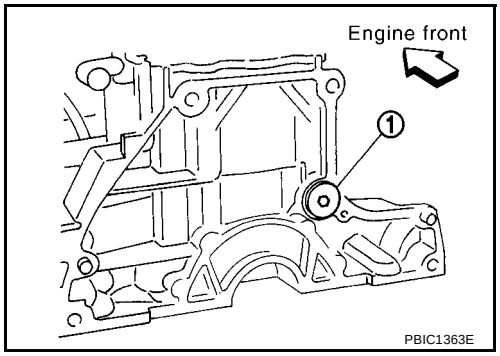


CAUTION:
Identify installation position of each part. Arrange removed parts so as not to mix them up.

ASSEMBLY

1. Thoroughly clean engine coolant and oil passages in cylinder block, as well as inside of crank case and cylinder bores, with compressed air.
2. If the plug (1) in figure is removed, apply liquid gasket to the plug screw.
   Use Genuine Liquid Gasket or equivalent.
   - Do not reuse washer. Replace it with a new washer.
   - Tighten to the specified torque.

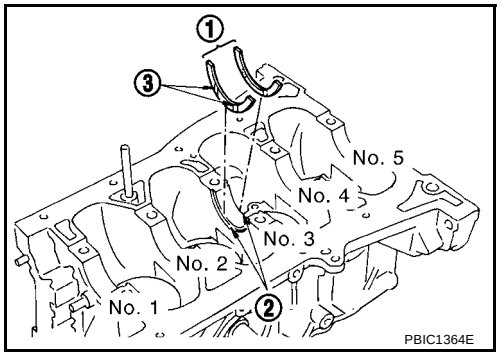
     : 58.8 - 68.6 N·m (6.0 - 6.9 kg-m, 44 - 50 ft-lb)



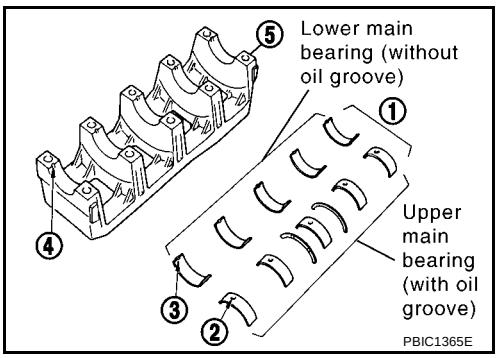
3. Install main bearings and thrust bearings.

a. Clean bearing mounting surfaces on cylinder block and main bearing cap to remove any foreign material, dust, and oil on them.

b. Install thrust bearings (1) on both sides of cylinder block No. 3 housing (2).
   - Install thrust bearing with its oil groove (3) facing crankshaft arm side (outer side).



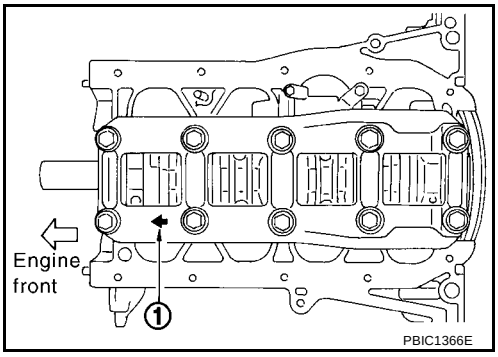
c. Install main bearing (1) in paying attention to the direction.
- Install main bearing with oil groove and oil hole (2) to cylinder block, and the one without oil groove and oil hole to main bearing cap (5).
- Before installing the main bearing, lubricate bearing surface (inside) with new engine oil. Do not apply engine oil to back surface, but thoroughly clean it.
- When installing, align the bearing stopper (3) to the notch (4).
- Make sure that oil holes in cylinder block and main bearing are aligned.



4. Install crankshaft to cylinder block.
- Rotate crankshaft by hand and make sure it turns smoothly.

5. Install main bearing cap.
- Install main bearing cap with its front mark (1) facing front of engine.

NOTE:
Since it is machined together with the cylinder block, it cannot be replaced on its own.

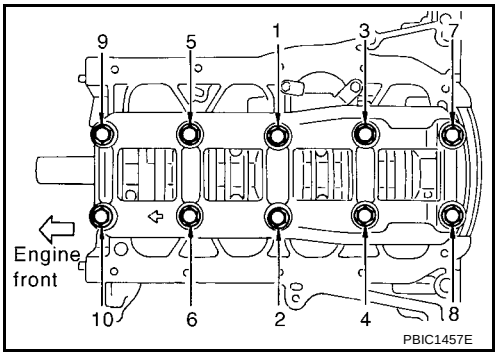


6. Tighten main bearing cap bolts in numerical order shown in figure with the following steps.

a. Lubricate threads and seat surface of each bolt with new engine oil.

b. Tighten it to 24.5 - 30.3 N·m (2.5 - 3.0 kg-m, 18 - 22 ft-lb).

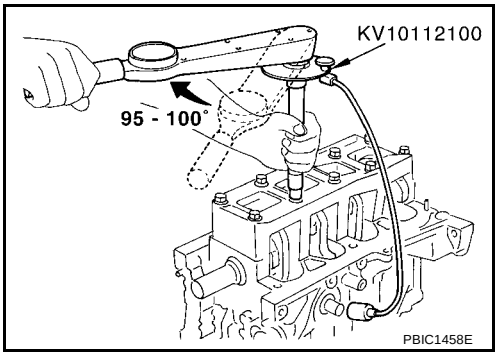
c. Tighten with 95 - 100 degrees clockwise [Target: 95 degrees].(Angle tightening)



- Use an angle wrench (special service tool) to check tightening angle.

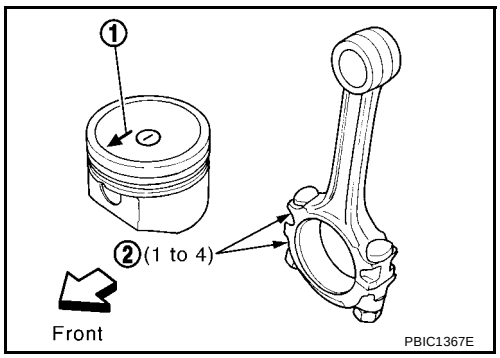
CAUTION:
Check tightening angle with an angle wrench. Do not visually check the tightening angle.

- After tightening main bearing cap bolts, rotate crankshaft by hand and make sure that it turns smoothly.
- Check crankshaft side clearance. Refer to EM-80, "CRANKSHAFT SIDE CLEARANCE" .



7. Install the piston onto the connecting rod in the following procedure:

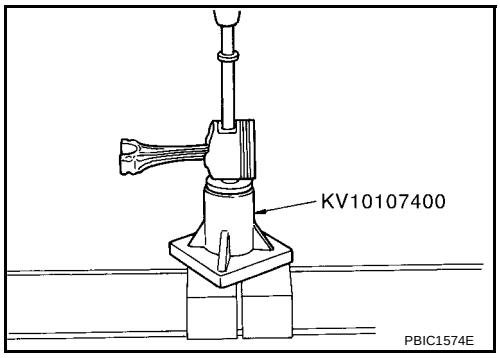
a. Set so that the piston front mark (1) on the piston head and the connecting rod cylinder number (2) engraving are in the position shown in figure.



b. Press fit the piston pin using the piston pin press stand (special service tool).

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

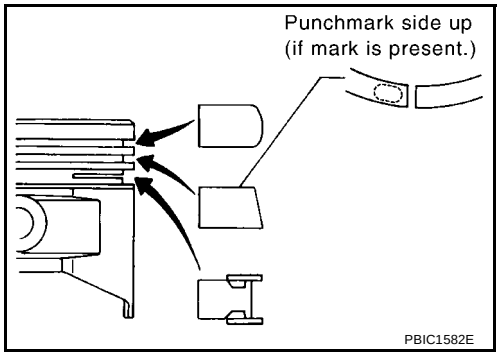
- After finishing work, make sure the piston moves freely.



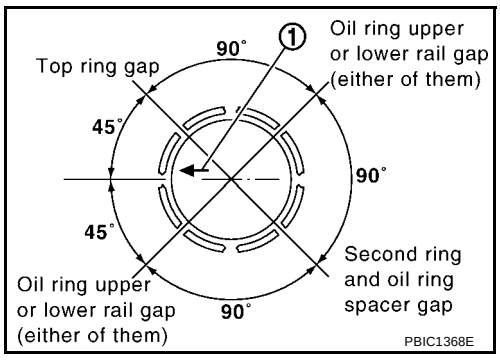
8. Install piston rings with piston ring expander as shown in the figure.

CAUTION:

- **Be careful not to damage piston.**
- **Make sure the piston ring does not spread out too much and break.**

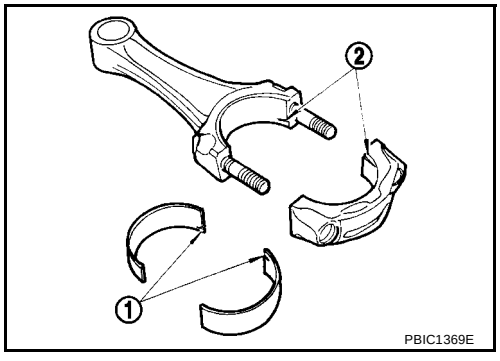


- Against the piston front mark (1), position end gaps of each piston ring as shown in figure.
- Install top ring and second ring with stamp mark side facing up.

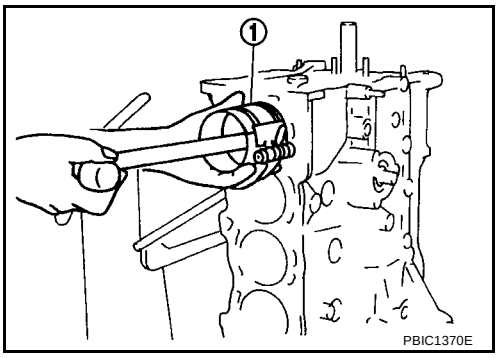


9. Install connecting rod bearing to connecting rod and connecting rod cap.

- When installing connecting rod bearing, lubricate bearing surface (inside) with new engine oil. Do not apply engine oil to back surface, but thoroughly clean it.
- Install connecting rod bearing by aligning the stopper protrusion (1) with notch (2) on connecting rod.

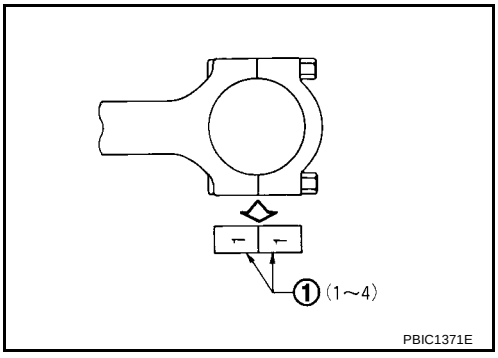


10. Install piston and connecting rod assembly to crankshaft.
    - Position the crankshaft pin corresponding to the connecting rod to be removal onto the bottom dead center.
    - Apply enough engine oil to cylinder bore, piston and crankshaft pin.
    - Install connecting rod to cylinder position corresponding to cylinder No. stamped on it.
    - Using a piston ring compressor (special service tool) (1), install piston so that piston grade number on piston head faces toward engine front.



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

11. Install connecting rod cap.
    - Be sure that cylinder No. (1) on connecting rod and connecting rod cap match.

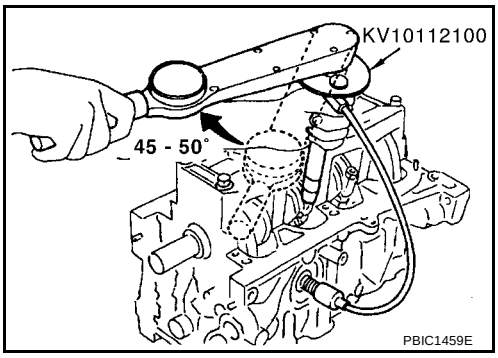


12. Tighten connecting rod nuts in following steps.

a. Lubricate threads and seat surface of connecting rod nuts and bolts with new engine oil.

b. Tighten at 13.7 - 15.7 N·m (1.4 - 1.6 kg-m, 10.1 - 11.5 ft-lb).

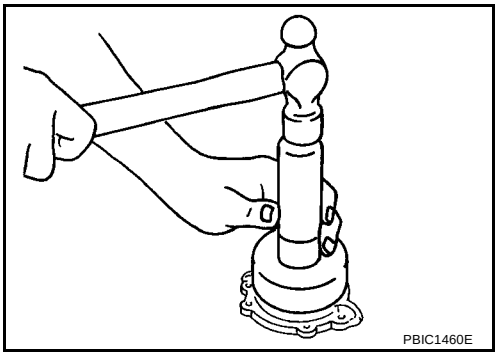
c. Tighten with 45 - 50 degrees clockwise [Target: 45 degrees]. (Angle tightening)



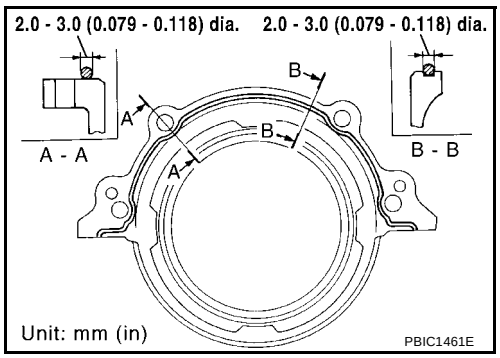
CAUTION:
Check tightening angle with an angle wrench (special service tool). Do not visually check the tightening angle.

- After the nuts were tightened, rotate crankshaft by hand and make sure that it turns smoothly.
- Check connecting rod side clearance. Refer to EM-81, "CONNECTING ROD SIDE CLEARANCE" .

13. Install rear oil seal.
    - Make sure the area surrounding the oil seal is not damaged, and use an oil seal drift to press fit.
    - Press fit until the end of rear oil seal is level with the edges of the retainer.

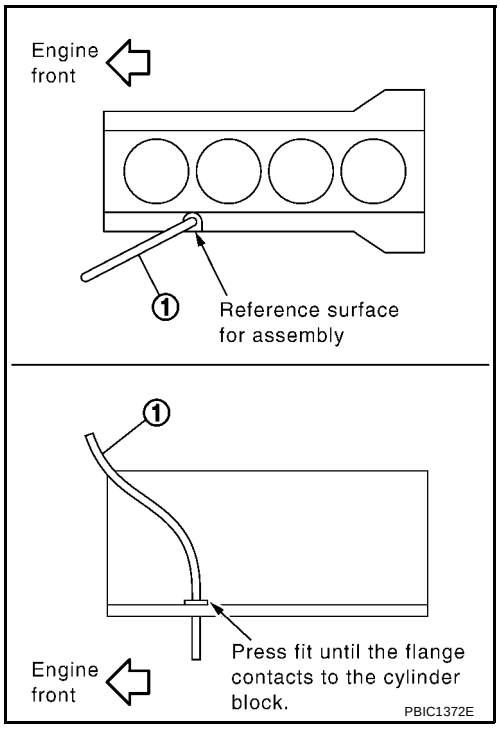


14. Install rear oil seal retainer.
    - Evenly apply the liquid gasket to the position shown in figure. Use Genuine Liquid Gasket or equivalent.
    - Install so that it matches up with the dowel pin on the cylinder block side.



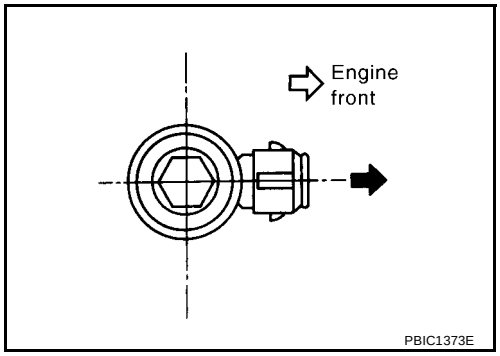
15. Install oil level gauge guide (1).
    - Press fit the oil level gauge guide (1) into the cylinder block with the assembly reference surface on the plate set as shown in the figure.
    - Apply sealant to the press fit areas.

    CAUTION:
    Replace used oil level gauges with new ones.



16. Install knock sensor.
    - Install connector so that it is positioned towards the engine front.

    CAUTION:
    - **Handle it carefully to avoid impact. If any impact is applied, replace it with new one.**
    - **Confirm no foreign material adhere to cylinder block and knock sensor mounting surfaces.**
    - **Be sure to use specified bolts.**
    - **Do not hold connector when tightening bolts.**
    - **Make sure installed sensor connector is away from contact with other parts.**

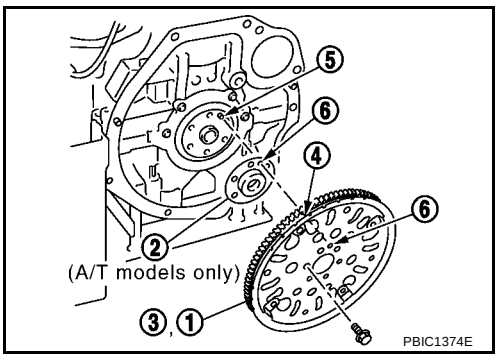


17. For the following, install the parts disassembled in step 4 in the reverse order.
18. Secure the position of the engine with the hoist, remove the bolts, and lower from the engine stand.
19. Install rear plate.

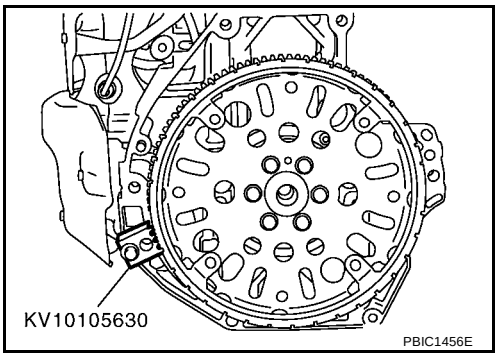
20. Install the flywheel (M/T models) (1), the adapter (A/T models) (2), and the drive plate (A/T models) (3).
    - Install so that signal plate (4) is towards the back of the engine.
    - Install by aligning the dowel pin hole (6) with the dowel pin (5) on the back of the crankshaft.

    NOTE:
    Figure shows A/T models.

    CAUTION:
    Make sure signal plate (4) are not damaged or deformed.



    - Using a ring gear stopper (special service tool), secure the crankshaft, and tighten the bolts diagonally.



21. Reinstall removed parts remained in reverse order of removal.

How to Select Piston and Bearing

EBS00OGI

DESCRIPTION

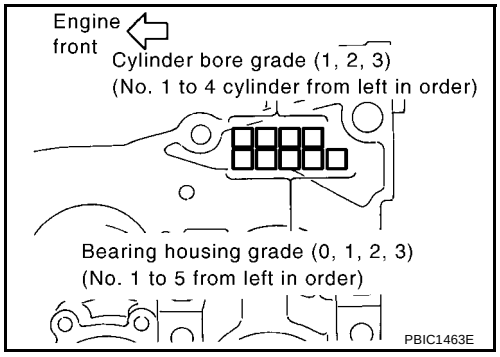
Selection points	Selection parts	Selection items	Selection methods
Between cylinder block and crankshaft	Main bearing	Main bearing grade (Bearing thickness)	Determined by cylinder block bearing housing grade (inner diameter of housing) and crankshaft journal grade (outer diameter of journal).
Between cylinder block and piston	Piston and piston pin assembly Note: Piston and piston pin are a set. They make up one part as an assembly.	Piston grade (Piston outer diameter)	Piston grade = cylinder bore grade (inner diameter of bore)

- The identification grade stamped on each part is the grade for the dimension measured in new condition. This grade cannot apply to reused parts.
- For reused or repaired parts, measure the dimension accurately. Determine the grade by comparing the measurement with the values of each selection table.
- For details of the measurement method of each part, the reuse standards and the selection method of the selective fitting parts, refer to the text.

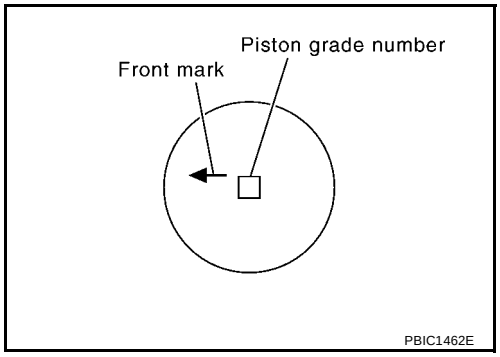
HOW TO SELECT PISTON

When New Cylinder Block is Used

- Check cylinder bore grade (1, 2, or 3) on cylinder block bottom rear surface and select piston of the same grade.



NOTE:
The piston head shape varies from engine to engine, as do their positions shown in figure.



When Cylinder Block is Reused

1. Measure cylinder bore inner diameter.
2. Determine the bore grade by comparing the measurement with the values under the cylinder bore inner diameter of the “Piston Selection Table”.
3. Select the piston of the same grade.

Piston selection Table

CR10DE,CR12DE

Unit: mm (in)

Grade	1	2	3
Inner diameter of cylinder bore	71.000 - 71.010 (2.7953 - 2.7957)	71.010 - 71.020 (2.7957 - 2.7961)	71.020 - 71.030 (2.7961 - 2.7965)
Outer diameter of piston	70.980 - 70.990 (2.7945 - 2.7949)	70.990 - 71.000 (2.7949 - 2.7953)	71.000 - 71.010 (2.7953 - 2.7957)

CR14DE

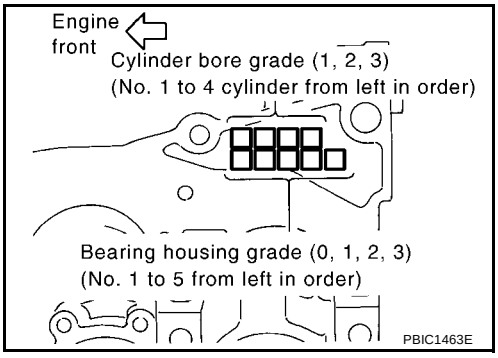
Unit: mm (in)

Grade	1	2	3
Inner diameter of cylinder bore	73.000 - 73.010 (2.8740 - 2.8744)	73.010 - 73.020 (2.8744 - 2.8748)	73.020 - 73.030 (2.8748 - 2.8752)
Outer diameter of piston	72.980 - 72.990 (2.8732 - 2.8736)	72.990 - 73.000 (2.8736 - 2.8740)	73.000 - 73.010 (2.8740 - 2.8744)

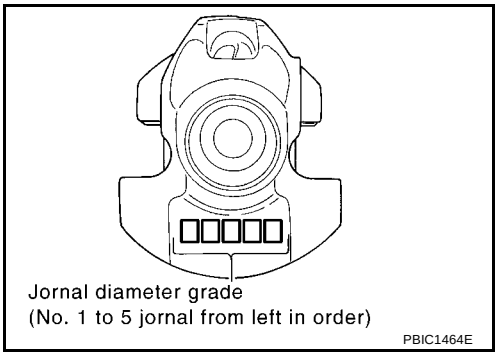
HOW TO SELECT MAIN BEARING

When New Cylinder Block and Crankshaft are Used

1. “Main Bearing Selection Table” rows correspond to bearing housing grade (0, 1, 2, or 3) on cylinder block bottom rear surface.



2. Apply journal diameter grade (0, 1, 2, or 3) stamped on crankshaft front side to column in “Main Bearing Selection Table”.
3. Select main bearing (STD 1 to 7) at the point where selected row and column meet in the following selection table.



When Cylinder Block and Crankshaft are Reused

1. Measure inner diameter of cylinder block main bearing housing and outer diameter of crankshaft journal.
2. Find measured dimension in “Cylinder block bearing housing inner diameter” row of “Main Bearing Selection Table”.
3. Find the measured dimension in “Crankshaft main journal diameter” column in the following selection table.
4. Select main bearing (STD 1 to 7) at the point where selected row and column meet in the following selection table.

Main bearing Selection Table

Units: mm (in)

Cylinder block main bearing housing inner diameter		-	49.004/49.000 (1.9293/1.9291)	49.008/49.004 (1.9294/1.9293)	49.012/49.008 (1.9296/1.9294)	49.016/49.012 (1.9298/1.9296)
Crankshaft journal diameter	Grade (stamped)	-	0	1	2	3
44.970/44.966 (1.7705/1.7703)	0	● Bearing grade No. ● Bearing thickness ● Identification color	STD1 2.002/2.006 (0.0788/0.0790) Red	STD 2 2.004/2.008 (0.0789/0.0791) Green	STD 3 2.006/2.010 (0.0790/0.0791) Yellow	STD 4 2.008/2.012 (0.0791/0.0792) Blue
44.966/44.962 (1.7703/1.7702)	1	● Bearing grade No. ● Bearing thickness ● Identification color	STD 2 2.004/2.008 (0.0789/0.0791) Green	STD 3 2.006/2.010 (0.0790/0.0791) Yellow	STD 4 2.008/2.012 (0.0791/0.0792) Blue	STD 5 2.010/2.014 (0.0791/0.0793) Pink
44.962/44.958 (1.7702/1.7700)	2	● Bearing grade No. ● Bearing thickness ● Identification color	STD 3 2.006/2.010 (0.0790/0.0791) Yellow	STD 4 2.008/2.012 (0.0791/0.0792) Blue	STD 5 2.010/2.014 (0.0791/0.0793) Pink	STD 6 2.012/2.016 (0.0792/0.0794) White
44.958/44.954 (1.7700/1.7698)	3	● Bearing grade No. ● Bearing thickness ● Identification color	STD 4 2.008/2.012 (0.0791/0.0792) Blue	STD 5 2.010/2.014 (0.0791/0.0793) Pink	STD 6 2.012/2.016 (0.0792/0.0794) White	STD 7 2.014/2.018 (0.0793/0.0794) Blue/yellow

Undersize Bearing Usage Guide

- If specified oil clearance cannot be obtained by standard size main bearing, use undersize (US) bearing.
- When using undersize bearing, install it, measure bearing inner diameter, and grind journal to obtain specified oil clearance.

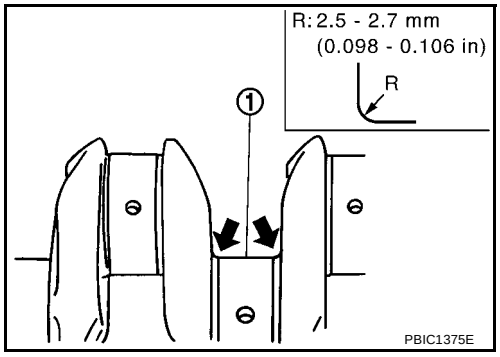
Bearing undersize table

Unit: mm (in)

Size	Thickness
US 0.25 (0.0098)	2.123 - 2.131 (0.836 - 0.839)

CAUTION:

Keep fillet R when grinding crankshaft journal (1) in order to use undersize bearing (All journals).



Inspection After Disassembly

EBS00OGJ

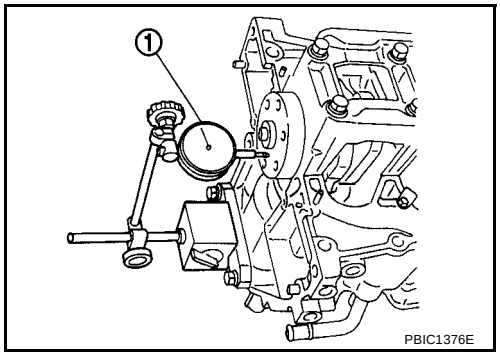
CRANKSHAFT SIDE CLEARANCE

- Using a dial gauge (1), measure the clearance between the thrust bearings and the crankshaft arm when the crankshaft is moved fully forward or backward.

  Standard : 0.060 - 0.260 mm (0.0024 - 0.0102 in)

  Limit : 0.3 mm (0.012 in)

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

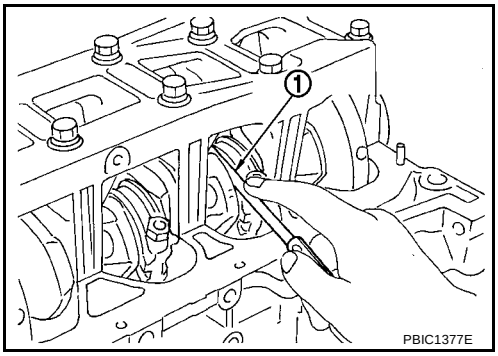


CONNECTING ROD SIDE CLEARANCE

- Measure side clearance between connecting rod and crankshaft arm with feeler gauge (1).

Standard : 0.050 - 0.420 mm (0.0020 - 0.0165 in)
Repair limit : 0.5 mm (0.0197 in)

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

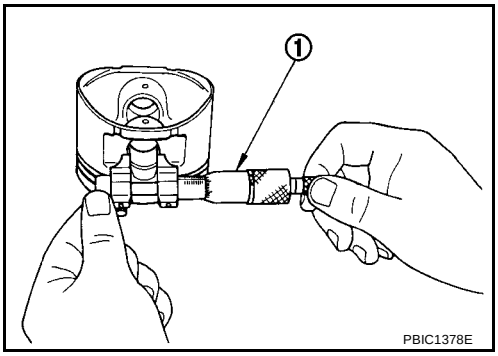


PISTON AND PISTON PIN CLEARANCE

Inner Diameter of Piston Pin

- Measure the inner diameter of piston pin bore with an inside micrometer (1).

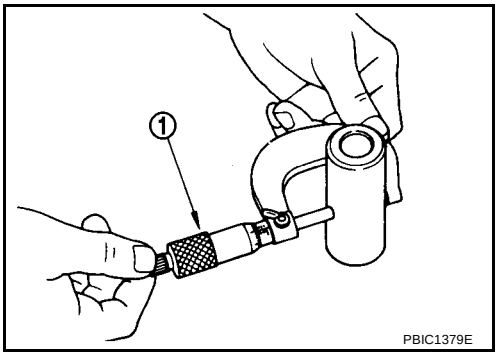
Standard : 18.008 - 18.012 mm (0.7090 - 0.7091 in)



Outer Diameter of Piston Pin

- Using a micrometer (1), measure piston pin outer diameter.

Standard : 17.996 - 18.000 mm (0.7085 - 0.7087 in)



Piston and Piston pin Clearance

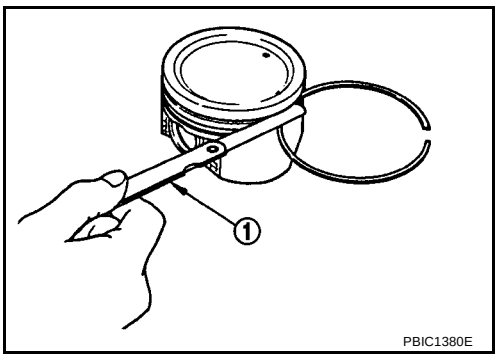
(Piston pin clearance) = (Piston pin bore diameter) – (Outer diameter of piston pin)

Standard : 0.008 - 0.016 mm (0.0003 - 0.0006 in)

- If clearance exceeds the standard, replace piston and piston pin assembly.
- When replacing piston and piston pin assembly, refer to EM-78, "HOW TO SELECT PISTON"

PISTON RING SIDE CLEARANCE

- Measure side clearance of piston ring and piston ring groove with feeler gauge (1).



Standard:

Top ring	**: 0.040 - 0.080 mm (0.0016 - 0.0031 in)**
2nd ring	**: 0.025 - 0.070 mm (0.0010 - 0.0028 in)**
Oil ring	**: 0.030 - 0.140 mm (0.0021 - 0.0055 in)**

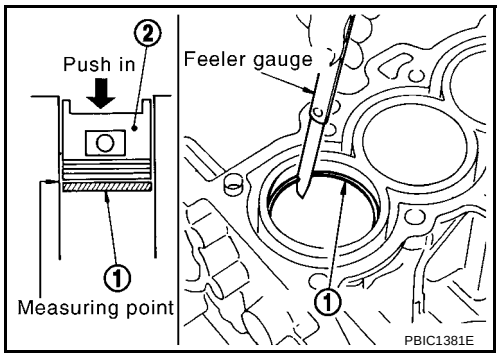
Limit:

Top ring	**: 0.11 mm (0.0043 in)**
2nd ring	**: 0.1 mm (0.0039 in)**

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

PISTON RING END GAP

- Check if inner diameter of cylinder bore is within specification. Refer to EM-84, "PISTON TO CYLINDER BORE CLEARANCE" .
- Insert piston ring (1) until middle of cylinder with piston (2), and measure gap.



Standard:

Top ring	**: 0.18 - 0.33 mm (0.0071 - 0.0130 in)**
2nd ring	**: 0.50 - 0.65 mm (0.0197 - 0.0256 in)**
Oil ring	**: 0.20 - 0.70 mm (0.0079 - 0.0276 in)**

Limit:

Top ring	**: 0.57 mm (0.0224 in)**
2nd ring	**: 0.85 mm (0.0335 in)**
Oil ring	**: 0.96 mm (0.0378 in)**

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

CONNECTING ROD BEND AND TORSION

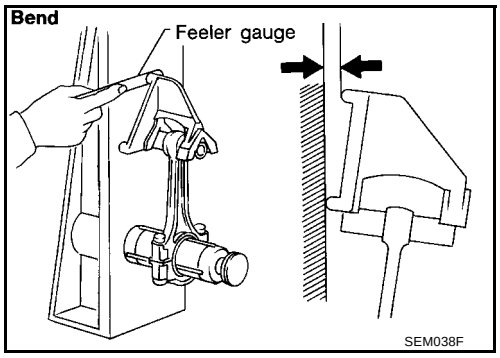
- Check connecting rod bend and torsion with a connecting rod aligner.

Bend:

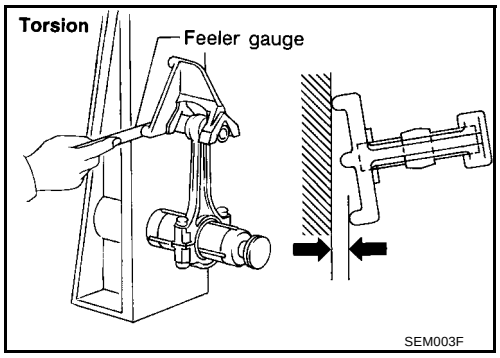
Limit : 0.15 mm (0.0059 in) per 100 mm (3.94 in) length

Torsion:

Limit : 0.30 mm (0.0118 in) per 100 mm (3.94 in) length



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

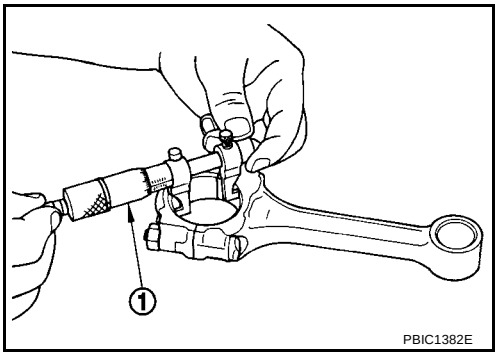


CONNECTING ROD BEARING HOUSING DIAMETER (BIG END)

- Install the connecting rod cap without the connecting rod bearing installed. After tightening the connecting rod bolt to the specified torque, measure the connecting rod big end inner diameter using an inside micrometer (1). Refer to EM-72, "ASSEMBLY" for the tightening procedure.

Standard : 43.000 - 43.013 mm (1.6929 - 1.6934 in) dia.

- If it exceeds the standard, replace the connecting rod.

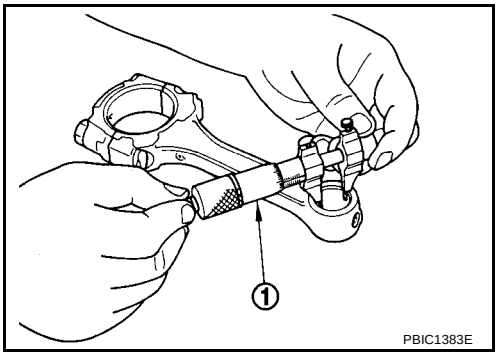


CONNECTING ROD BUSHING OIL CLEARANCE DIAMETER (SMALL END)

Inner Diameter of Connecting Rod Bushing (Small End)

- Using an inside micrometer (1), measure inner diameter of bushing.

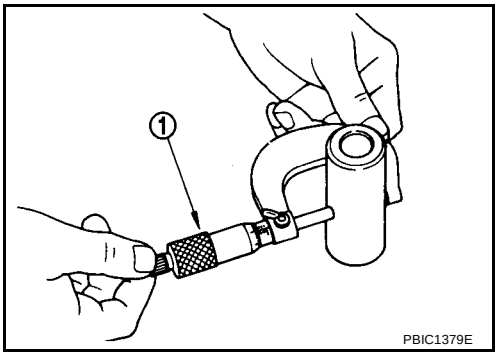
Standard : 17.962 - 17.978 mm (0.7072 - 0.7078 in) dia.



Outer Diameter of Piston Pin

- Using a micrometer (1), measure piston pin outer diameter.

Standard : 17.996 - 18.000 mm (0.7996 - 0.7087 in) dia.



Connecting Rod Bushing Oil Clearance (Small End)

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

Standard : –0.018 - –0.038 mm (–0.0007 - –0.0015 in)

- If the measured value exceeds the standard, replace the connecting rod assembly and/or piston and piston pin assembly.
- If replacing the piston and piston pin assembly, refer to EM-78, "HOW TO SELECT PISTON" .

CYLINDER BLOCK DISTORTION

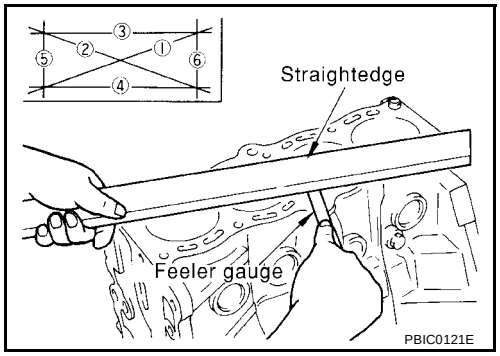
- Using a scraper, remove gasket on the cylinder block surface, and also remove oil, scale, carbon, or other contamination.

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

- Measure the distortion on the block upper face at some different points in 6 directions.

  Limit : 0.1 mm (0.004 in)

- If out of the distortion limit, replace the cylinder block.



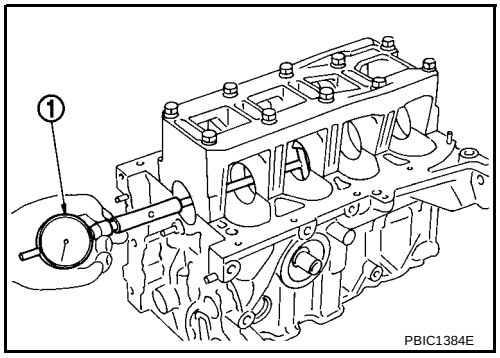
INNER DIAMETER OF MAIN BEARING HOUSING

- Install the main bearing cap with the main bearings removed, and tighten the mounting bolts to the specified torque. Refer to EM-72, "ASSEMBLY" for the tightening procedure.
- Using a bore gauge (1), measure the inner diameter of the main bearing housing.

  Standard : 49.000 - 49.016 mm (1.9291 - 1.9298 in) dia.

- If out of specification, replace cylinder block and main bearing cap as an assembly.

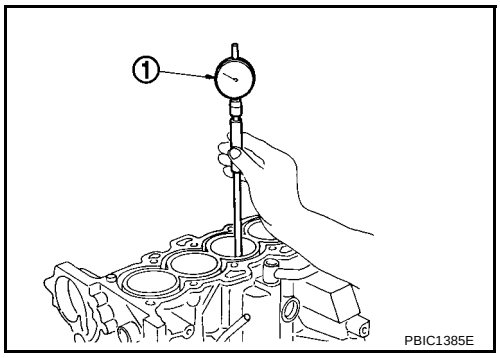
  NOTE:
  Cylinder block cannot be replaced as a single part because it is machined together with main bearing cap.



PISTON TO CYLINDER BORE CLEARANCE

Inner Diameter of Cylinder Bore

- Using a bore gauge (1), measure cylinder bore for wear, out-of-round and taper at 6 different points on each cylinder. (X and Y directions at A, B and C) (Y is in longitudinal direction of engine)



Standard inner diameter:

CR10DE, CR12DE : 71.000 - 71.030 mm (2.7953 - 2.7965 in) dia.

CR14DE : 73.000 - 73.030 mm (2.8740 - 2.8744 in) dia.

Wear limit:

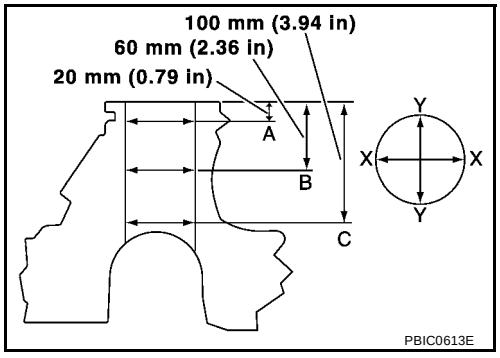
0.2 mm (0.008 in)

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

0.015 mm (0.0006 in)

Taper limit (Difference between A and C):

0.01 mm (0.0004 in)



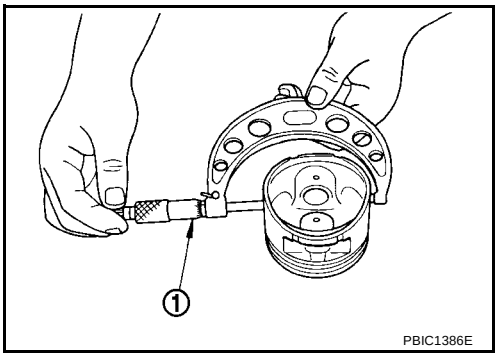
- If the measured value exceeds the limit, or if there are scratches and/or seizure on the cylinder inner wall, hone or rebore the inner wall.

- An oversize piston is provided. When using an oversize piston, rebore the cylinder so that the clearance of the piston-to-cylinder bore satisfies the standard.
- When using an oversize piston, use it for all cylinders with oversize piston rings.

Oversize (OS) : 0.2 mm (0.008 in)

Outer Diameter of piston

- Measure piston skirt outer diameter using micrometer (1).



Measurement point (Distance from the top)

CR10DE : 37.3 mm (1.469 in)

CR12DE : 34.3 mm (1.350 in)

CR14DE : 32.3 mm (1.272 in)

Standard

CR10DE : 70.980 - 71.010 mm (2.7945 - 2.7949 in) dia.

CR12DE : 70.980 - 71.010 mm (2.7949 - 2.7953 in) dia.

CR14DE : 72.980 - 73.010 mm (2.7953 - 2.7957 in) dia.

Piston to Cylinder Bore Clearance

- Calculate by outer diameter of piston skirt and inner diameter of cylinder (direction X, position B).
(Clearance) = (Inner diameter of cylinder) – (Outer diameter of piston skirt).

Standard : 0.010 - 0.030 mm (0.0004 - 0.0012 in)

- If clearance exceeds the standard, replace piston and piston pin assembly. Refer to EM-78, "HOW TO SELECT PISTON" .

Reboring Cylinder Bore

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

Rebored size calculation: D = A + B - C

where,

D: Bored diameter

A: Piston diameter as measured

B: Piston - to - cylinder bore clearance (standard value)

C: Honing allowance 0.02 mm (0.0008 in)

2. Install main bearing caps, and tighten to the specified torque. Otherwise, cylinder bores may be distorted in final assembly.
3. Cut cylinder bores.

- When any cylinder needs boring, all other cylinders must also be bored.
- Do not cut too much out of cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so in diameter at a time.

4. Hone cylinders to obtain specified piston-to-cylinder bore clearance.
5. Measure finished cylinder bore for out-of-round and taper.

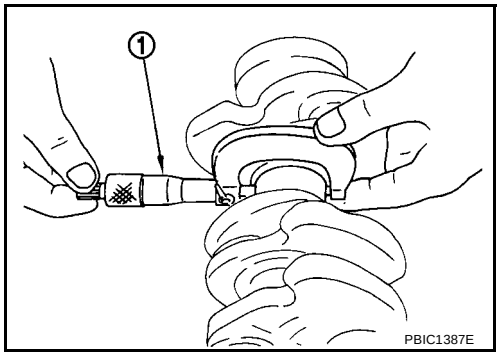
- Measurement should be done after cylinder bore cools down.

OUTER DIAMETER OF CRANKSHAFT JOURNAL

- Using a micrometer (1), measure outer diameter of crankshaft journals.

  Standard : 44.954 - 44.970 mm (1.7698 - 1.7705 in) dia.

- If it is out of the standard, measure the main bearing oil clearance. Then use the undersize bearing. Refer to EM-87, "OIL CLEARANCE OF MAIN BEARING" .



OUTER DIAMETER OF CRANKSHAFT PIN

- Using a micrometer, measure outer diameter of crankshaft pin.

  Standard : 39.961 - 39.974 mm (1.5733 - 1.5738 in) dia.

- If it is out of the standard, measure the connecting rod bearing oil clearance. Then use the undersize bearing. Refer to EM-87, "OIL CLEARANCE OF CONNECTING ROD BEARING" .

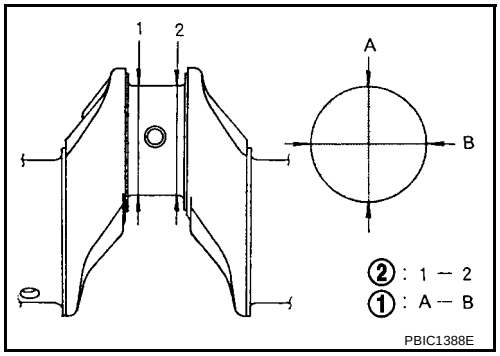
OUT-OF-ROUND AND TEPER OF CRANKSHAFT

- Using a micrometer, measure the dimensions at 4 different points shown in the figure on each journal and pin.
- Out-of-round (1) is indicated by the difference in dimensions between 1 and 2 at A and B.
- Taper (2) is indicated by the difference in dimension between A and B at 1 and 2.

  Limit:

  Out-of-round (X – Y) : 0.005 mm (0.0002 in)

  Taper (1 – 2) : 0.005 mm (0.0002 in)



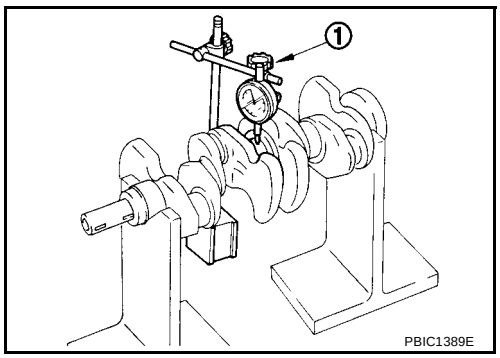
- If the measured value exceeds the limit, correct or replace the crankshaft.
- If corrected, measure the bearing oil clearance of the corrected journal or pin. Then select the main bearing or connecting rod bearing. Refer to EM-87, "OIL CLEARANCE OF MAIN BEARING" or EM-87, "OIL CLEARANCE OF CONNECTING ROD BEARING" .

CRANKSHAFT RUNOUT

- Place a V-block on a precise flat table to support the journals on the both end of the crankshaft.
- Place a dial gauge (1) straight up on the No. 3 journal.
- Rotate crankshaft and read indication on the gauge. (Total indicator reading)

  Limit : 0.05 mm (0.002 in)

- If it exceeds the limit, replace the crankshaft.

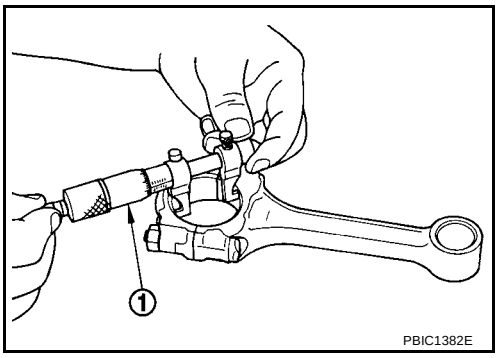


OIL CLEARANCE OF CONNECTING ROD BEARING

Method of Measurement

- Install the connecting rod bearings to the connecting rod and the cap, and tighten the connecting rod nuts to the specified torque. Using a inside micrometer (1) measure the inner diameter of connecting rod bearing. Refer to EM-72, "ASSEMBLY" for the tightening procedure.
  (Oil clearance) = (Inner diameter of connecting rod bearing) – (Outer diameter of crankshaft pin)

  Standard : 0.010 - 0.044 mm (0.0004 - 0.0017 in)
  Limit : 0.064 mm (0.0025 in)

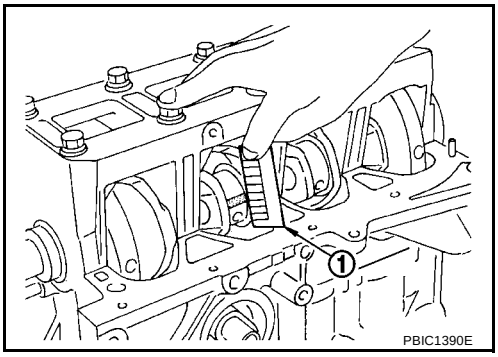


- When exceeding limit, use undersize bearing so that oil clearance remains within the standard value. Refer to EM-87, "Undersize Bearing Usage Guide" .

Method of Using Plastigage

- Remove oil and dust on the crankshaft pin and the surfaces of each bearing completely.
- Cut a plastigage (1) slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install the connecting rod bearings to the connecting rod cap, and tighten the connecting rod nuts to the specified torque. Refer to EM-72, "ASSEMBLY" for the tightening procedure.

  CAUTION:
  Never rotate crankshaft while Plastigage is in place.
- Remove the connecting rod cap and bearings, and using the scale on the plastigage bag, measure the plastigage width.



NOTE:
The procedure when the measured value exceeds the limit is same as that described in the “Method of Measurement”.

Undersize Bearing Usage Guide

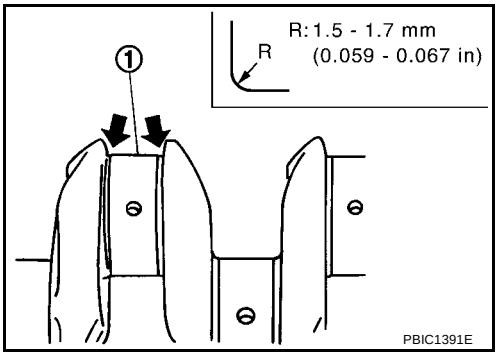
- If specified oil clearance cannot be obtained by standard size connecting rod bearing, use undersize (US) bearing.
- When using undersize bearing, install it, measure bearing inner diameter, and grind crankshaft pin to obtain specified oil clearance.

Bearing undersize table

Unit: mm (in)

Size	Thickness
STD (Reference)	1.504 - 1.508 (0.0529 - 0.0594)
US 0.25 (0.0098)	1.627 - 1.635 (0.0641 - 0.0644)

CAUTION:
Keep fillet R when grinding crankshaft pin (1) in order to use undersize bearing (All crankshaft pin).



OIL CLEARANCE OF MAIN BEARING

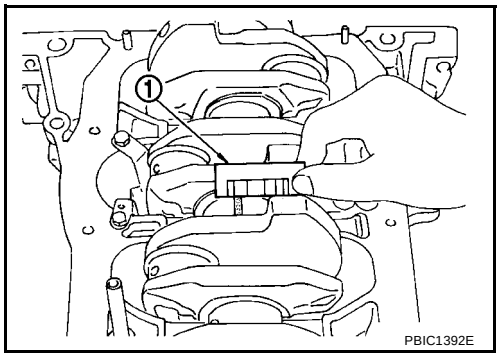
Method of Measurement

- Install the main bearings to the cylinder block and bearing cap. Measure the main bearing inner diameter with the bearing cap bolt tightened with main bearing cap to the specified torque. Refer to EM-72, "ASSEMBLY" for the tightening procedure.
  (Oil clearance) = (Inner diameter of main bearing) – (Outer diameter of crankshaft journal)

  Standard : 0.018 - 0.034 mm (0.0007 - 0.0013 in)
  Limit : 0.05 mm (0.002 in)

- If the measured value exceeds the limit, select main bearings (including the undersize) referring to the main bearing inner diameter and crankshaft journal outer diameter, so that the oil clearance satisfies the standard. Refer to EM-79, "HOW TO SELECT MAIN BEARING" .

Method of Using Plastigage

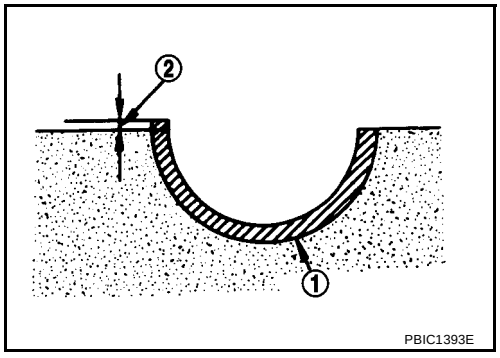


- Remove oil and dust on the crankshaft journal and the surfaces of each bearing completely.
- Cut a plastigage (1) slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Tighten the main bearing bolts with main bearing cap to the specified torque. Refer to EM-72, "ASSEMBLY" for the tightening procedure.

  CAUTION:
  Never rotate crankshaft while Plastigage is in place.
- Remove the bearing cap and bearings, and using the scale on the plastigage bag, measure the plastigage width.

NOTE:
The procedure when the measured value exceeds the limit is same as that described in the “Method of Measurement”.

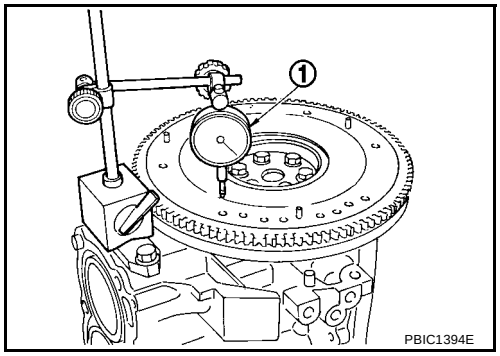
CRUSH HEIGHT OF MAIN BEARING OR CONNECTING ROD BEARING



- When the bearing cap is removed after being tightened to the specified torque with main bearings or connecting rod bearings (1) installed, the tip end of bearing must protrude. Refer to EM-72, "ASSEMBLY" for the tightening procedure.

  Standard : There must be crush height (2).
- If the standard is not met, replace main bearings or connecting bearings.

FLYWHEEL RUNOUT



- The runout of the clutch contact surface of the flywheel should be measured using a dial gauge (1). (Total indicator reading)

  Flywheel (M/T models)
  Limit : 0.15 mm (0.0059 in)

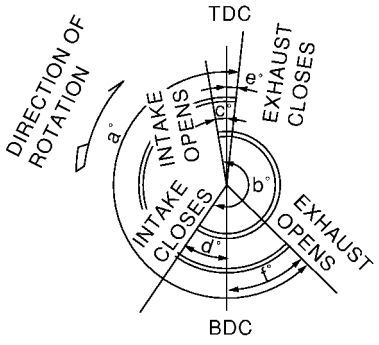
SERVICE DATA AND SPECIFICATIONS (SDS)

PFP:00030

Standard and Limit

EBS00OGK

GENERAL SPECIFICATIONS

Engine		CR10DE	CR12DE	CR14DE
Cylinder arrangement		4, in-line		
Displacement cm^3 (cu in)		977 (59.62)	1,240 (75.66)	1,386 (84.57)
Bore and stroke mm (in)		71.0 x 63.0 (2.795 x 2.480)	71.0 x 78.3 (2.795 x 3.083)	73.0 x 82.8 (2.874 x 3.260)
Valve arrangement		DOHC		
Firing order		1-3-4-2		
Number of piston rings	Compression	2		
	Oil	1		
Number of main bearings		5		
Compression ratio		10.2	9.9	
Compression pressure kPa (bar, kg/cm^2 , psi) / 350 rpm	Standard	1,432 (14.32, 14.6, 208)	1,383 (13.83, 14.1, 201)	
	Minimum	1,236 (12.36, 12.6, 179)	1,187 (11.87, 12.1, 172)	
	Differential limit between cylinders	98 (0.98, 1.0, 14)		
Valve timing (Intake valve timing control - OFF)				

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Unit: degree

	a	b	c	d	e	f
CR10DE	208	208	– 17	45	4	24
CR12DE, CR14DE	216	224	– 11	55	4	32

INTAKE MANIFOLD AND EXHAUST MANIFOLD

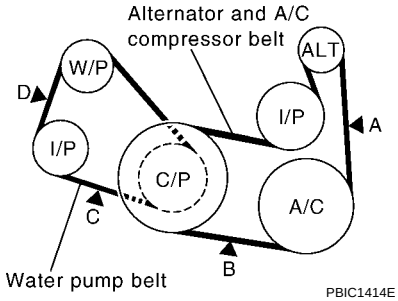
Unit: mm (in)

	Limit
Surface distortion	0.3 (0.012)

DRIVE BELTS

Location	Tension [N (kg, lb)]			Deflection [mm (in)] [When pressed by force of 98.1N (10 kg, 22lb)]			
	New	At adjustment	Limit	Measuring point	New belt	At adjustment	Limit
Alternator and A/C compressor belt	603 - 691 (61.5 - 70.5, 135.6 - 155.3)	495 - 583 (50.5 - 59.5, 111.3 - 131.1)	196 (20, 44.1)	A	6.6 - 7.8 (0.260 - 0.307)	7.3 - 8.5 (0.287 - 0.335)	13.8 (0.543)
				B	5.6 - 6.6 (0.220 - 0.260)	7.1 - 8.3 (0.280 - 0.327)	11.9 (0.469)
Alternator belt	603 - 691 (61.5 - 70.5, 135.6 - 155.3)	495 - 583 (50.5 - 59.5, 111.3 - 131.1)	196 (20, 44.1)	A	3.1 - 4.1 (0.122 - 0.161)	9.8 - 10.6 (0.386 - 0.417)	13.8 (0.543)
Water pump belt	446 - 534 (45.5 - 54.5, 100.3 - 120.0)	348 - 436 (35.5 - 44.5, 78.2 - 98.0)	137 (14, 30.9)	C	6.7 - 7.3 (0.264 - 0.287)	7.6 - 8.6 (0.299 - 0.339)	12.4 (0.448)
				D	4.7 - 5.6 (0.185 - 0.220)	7.0 - 7.7 (0.276 - 0.303)	8.6 (0.339)

With A/C compressor



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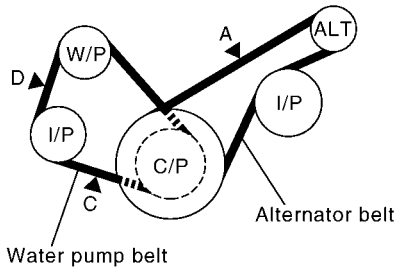
Without A/C compressor



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SPARK PLUG

Make	NGK	Champion
Standard type	LFR5AP-11	REC10PYC4
Hot type	LFR4AP-11	—
Cold type	LFR6AP-11	—
Gap (nominal)	1.1 mm (0.043 in)	

CYLINDER HEAD

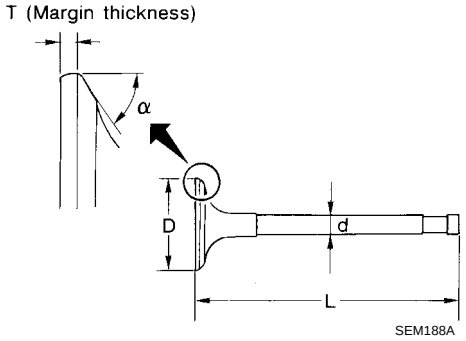
Unit: mm (in)

	Limit
Cylinder head distortion	0.1 (0.004)
Height	121.2 (4.77)

VALVE

Valve Dimensions

Unit: mm (in)



		Standard
Valve head diameter “D”	Intake	27.4 - 27.6 (1.079 - 1.087)
	Exhaust	22.4 - 22.6 (0.882 - 0.890)
Valve length “L”	Intake	97.85 (3.8524)
	Exhaust	97.92 (3.8551)
Valve stem diameter “d”	Intake	5.465 - 5.480 (0.2152 - 0.2157)
	Exhaust	5.445 - 5.460 (0.2144 - 0.2150)
Valve seat angle “α”		45°15′ - 45°45′
Valve margin “T”		1.05 - 1.35 (0.0413 - 0.0531)

Valve Clearance

Unit: mm (in)

	Hot	Cold* (reference data)
Intake	0.314 - 0.426 (0.012 - 0.017)	0.29 - 0.37 (0.011 - 0.015)
Exhaust	0.338 - 0.462 (0.013 - 0.018)	0.32 - 0.40 (0.013 - 0.016)

*: At a temperature of approximately 20°C (68°F)

Valve Spring

Free height		mm (in)	53.3 (2.098)
Pressure load N (kg, lb) at height mm (in)	Standard	Installation	149 - 165 N (15.2 - 16.8, 33.5 - 37.1) at 32.82 (1.2921)
		Valve open	228 - 250 N (23.3 - 25.5, 51.3 - 56.2) at 24.73 (0.9736)
Out-of-square mm (in)	Limit		Less than 1.6 (0.063)

Valve Lifter

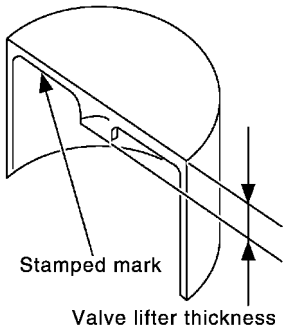
Unit: mm (in)

	Standard
Valve lifter outer diameter	29.960 - 29.975 (1.1795 - 1.1801)
Valve lifter hole inner diameter	30.000 - 30.021 (1.1811 - 1.1819)
Clearance between valve lifter and valve lifter hole	0.025 - 0.061 (0.0010 - 0.0024)

Available Valve Lifter

Thickness mm (in)	Identification Mark
3.000 (0.1181)	00
3.020 (0.1189)	02
3.040 (0.1197)	04
3.060 (0.1205)	06
3.080 (0.1213)	08
3.100 (0.1220)	10
3.120 (0.1228)	12
3.140 (0.1236)	14
3.160 (0.1244)	16
3.180 (0.1252)	18
3.200 (0.1260)	20
3.220 (0.1268)	22
3.240 (0.1276)	24
3.260 (0.1283)	26
3.280 (0.1291)	28
3.300 (0.1299)	30
3.320 (0.1307)	32
3.340 (0.1315)	34
3.360 (0.1323)	36
3.380 (0.1323)	38
3.400 (0.1339)	40
3.420 (0.1346)	42
3.440 (0.1354)	44
3.460 (0.1362)	46
3.480 (0.1370)	48
3.500 (0.1378)	50
3.520 (0.1386)	52
3.540 (0.1394)	54
3.560 (0.1402)	56
3.580 (0.1409)	58
3.600 (0.1417)	60
3.620 (0.1425)	62
3.640 (0.1433)	64
3.660 (0.1441)	66
3.680 (0.1449)	68

Thickness mm (in)	Identification Mark

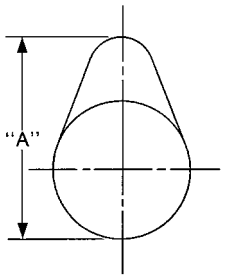


PBIC1077E

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

	Standard
Camshaft runout [TIR*]	0.04 (0.0016)



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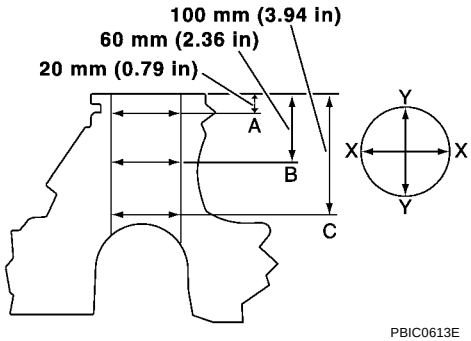
		CR10DE	CR12DE, CR14DE
		Standard	
Cam height "A"	Intake	39.155 - 39.345 (1.5415 - 1.5490)	40.359 - 40.549 (1.5889 - 1.5964)
	Exhaust	39.155 - 39.345 (1.5415 - 1.5490)	39.743 - 39.933 (1.5647 - 1.5722)
Outer diameter of camshaft journal	No. 1 journal	27.935 - 27.955 (1.0998 - 1.1006)	
	No. 2 to No. 5 journals	23.450 - 23.470 (0.9232 - 0.9240)	
Inner diameter of camshaft bracket	No. 1 journal	28.000 - 28.021 (1.1024 - 1.1032)	
	No. 2 to No. 5 journals	23.500 - 23.525 (0.9252 - 0.9262)	
Camshaft journal clearance	No. 1 journal	0.045 - 0.086 (0.0018 - 0.0034)	
	No. 2 to No. 5 journals	0.030 - 0.071 (0.0012 - 0.0028)	
Camshaft end play		0.070 - 0.143 (0.0028 - 0.0056)	

*: Total indicator reading

CYLINDER BLOCK

Unit: mm (in)



PBIC0613E

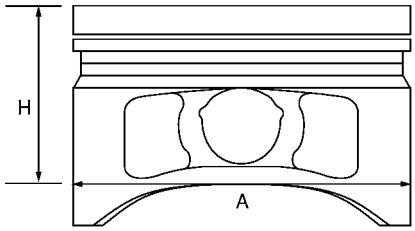
		CR10DE, CR12DE	CR14DE	Limit
		Standard		
Surface flatness		—		0.1 (0.004)
Height “H” (nominal)		189 (8.4232 - 8.4271)		—
Cylinder bore inner diameter	Grade No. 1	71.000 - 71.010 (2.7953 - 2.7957)	73.000 - 73.010 (2.8740 - 2.8744)	0.2 (0.008)*
	Grade No. 2	71.010 - 71.020 (2.7957 - 2.7961)	73.010 - 73.020 (2.8744 - 2.8748)	
	Grade No. 3	71.020 - 71.030 (2.7961 - 2.7965)	73.020 - 73.030 (2.8748 - 2.8752)	
Out-of-round (Difference between X and Y)		—		0.015 (0.0006)
Taper (Difference between A and C)		—		0.01 (0.0004)
Difference in inner diameter between cylinders		0.05 (0.0020)		0.2 (0.008)
Main bearing housing inner diameter	Grade 0	49.000 - 49.004 (1.9291 - 1.9293)		—
	Grade 1	49.004 - 49.008 (1.9293 - 1.9294)		—
	Grade 2	49.008 - 49.012 (1.9294 - 1.9296)		—
	Grade 3	49.012 - 49.016 (1.9296 - 1.9298)		—

*: Cylinder bore wear

PISTON, PISTON RING AND PISTON PIN

Available Piston

Unit: mm (in)



PBIC0188E

		CR10DE	CR12DE	CR14DE
		Standard		
Piston skirt diameter “A”	Grade No. 1	70.980 - 70.990 (2.7945 - 2.7949)	70.980 - 70.990 (2.7945 - 2.7949)	72.980 - 72.990 (2.8732 - 2.8736)
	Grade No. 2	70.990 - 71.000 (2.7949 - 2.7953)	70.990 - 71.000 (2.7949 - 2.7953)	72.990 - 73.000 (2.8736 - 2.8740)
	Grade No. 3	71.000 - 71.010 (2.7953 - 2.7957)	71.000 - 71.010 (2.7953 - 2.7957)	73.000 - 73.010 (2.8740 - 2.8744)
0.2 (0.002) oversize (service)		71.180 - 71.210 (2.8024 - 2.8035)	71.180 - 71.210 (2.8024 - 2.8035)	73.180 - 73.210 (2.8811 - 2.8823)
“H” dimension		37.3 (1.469)	34.3 (1.350)	32.3 (1.272)
Piston pin hole inner diameter		18.008 - 18.012 (0.7090 - 0.7091)		
Piston to cylinder bore clearance		0.010 - 0.030 (0.0004 - 0.0012)		

Piston Ring

Unit: mm (in)

		Standard	Limit
Side clearance	Top	0.040 - 0.080 (0.0016 - 0.0031)	0.110 (0.0043)
	2nd	0.025 - 0.070 (0.0010 - 0.0028)	0.1 (0.0039)
	Oil ring	0.030 - 0.140 (0.0021 - 0.0055)	—
End gap	Top	0.18 - 0.33 (0.0071 - 0.0130)	0.57 (0.0224)
	2nd	0.50 - 0.65 (0.0197 - 0.0256)	0.85 (0.0335)
	Oil (rail ring)	0.20 - 0.70 (0.0079 - 0.0276)	0.96 (0.0378)

Piston Pin

Unit: mm (in)

Piston pin outer diameter	Standard	17.996 - 18.000 (0.7085 - 0.7087)
Piston pin to piston clearance	Standard	0.008 - 0.016 (0.0003 - 0.0006)
Piston pin to connecting rod bushing clearance	Standard	–0.018 - –0.038 (–0.0007 - –0.0015)

CONNECTING ROD

Unit: mm (in)

		CR10DE	CR12DE, CR14DE
Center distance		120.70 - 120.80 (4.752 - 4.756)	129.45 - 129.55 (5.096 - 5.100)
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)	
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)	

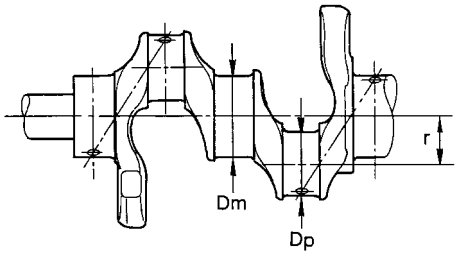
Connecting rod bushing inner diameter* (small end)	Standard	17.962 -17.978 (0.7072 - 0.7078)
Connecting rod big end inner diameter	Standard	43.000 - 43.013 (1.6929 - 1.6934)
Side clearance	Standard	0.050 - 0.420 (0.0020 - 0.0165)
	Limit	0.5 (0.0197)

*: After installing in connecting rod

CRANKSHAFT

Unit: mm (in)

Main journal dia. “Dm”	Grade No. 0	44.966 - 44.970 (1.7703 - 1.7705)
	Grade No. 1	44.962 - 44.966 (1.7702 - 1.7703)
	Grade No. 2	44.958 - 44.962 (1.7700 - 1.7702)
	Grade No. 3	44.954 - 44.958 (1.7698 - 1.7700)
Pin dia. “Dp”	Standard	39.961 - 39.974 (1.5733 - 1.5738)
Out-of-round (X – Y)	Limit	0.005 (0.0002)
Taper (A – B)	Limit	0.005 (0.0002)
Runout [TIR*]	Limit	0.05 (0.0020)
Side clearance	Standard	0.060 - 0.260 (0.0024 - 0.0102)
	Limit	0.3 (0.012)



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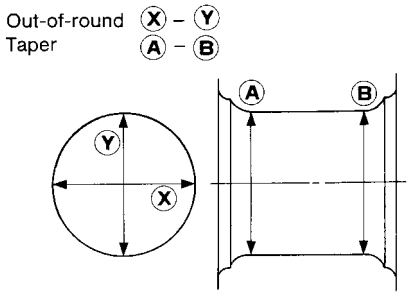

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*: Total indicator reading

MAIN BEARING

Standard size

Unit: mm (in)

Grade No.	Thickness	Identification color
STD1	2.002 - 2.006 (0.0788 - 0.0790)	Red
STD2	2.004 - 2.008 (0.0789 - 0.0791)	Green
STD3	2.006 - 2.010 (0.0790 - 0.0791)	Yellow
STD4	2.008 - 2.012 (0.0791 - 0.0792)	Blue
STD5	2.010 - 2.014 (0.0791 - 0.0793)	Pink
STD6	2.012 - 2.016 (0.0792 - 0.0794)	White
STD7	2.014 - 2.018 (0.0793 - 0.0794)	Blue/yellow

Undersize

Unit: mm (in)

Grade	Thickness
US 0.25 (0.0098)	2.123 - 2.131 (0.836 - 0.839)

Bearing Clearance

Unit: mm (in)

Main bearing clearance	Standard	0.018 - 0.034 (0.0007 - 0.0013)
	Limit	0.05 (0.002)

CONNECTING ROD BEARING

Standard Size

Unit: mm (in)

Grade	Thickness
Standard	1.504 - 1.508 (0.0529 - 0.0594)

Undersize

Unit: mm (in)

Grade	Thickness
US 0.25 (0.0098)	1.627 - 1.635 (0.0641 - 0.0644)

Bearing Clearance

Unit: mm (in)

Connecting rod bearing clearance	Standard	0.010 - 0.044 (0.0004 - 0.0017)
	Limit	0.064 (0.0025)

MISCELLANEOUS COMPONENTS

Unit: mm (in)

Flywheel runout [TIR*]	Limit		0.15 (0.0059)
Camshaft sprocket runout [TIR*]	Limit	Intake	0.20 (0.0079)
		Exhaust	0.15 (0.0059)

*: Total indicator reading

Tightening Torque

EBS00OHQ

*1: Parts to be tightened in particular orders
1)-: Order of tightening when tightening two or more steps separately.

Unit: N·m (kg-m, ft-lb)
Unit: N·m (kg-m, in-lb)*2

	Idler pulley locknut (for water pump belt)			24.5 - 31.4 (2.5 - 3.2, 18 - 23)
	Idler pulley locknut (for alternator and A/C compressor belt)			24.5 - 31.4 (2.5 - 3.2, 18 - 23)
	Idler pulley bracket (for alternator and A/C compressor belt)			16.6 - 23.5 (1.7 - 2.4, 13 - 17)
	Manifold absolute pressure sensor			1.2 - 1.7 (0.12 - 0.17, 11 - 15)*2
*1	Air cleaner case (upper) to (lower)		1) 2)	1.9 - 2.2 (0.20 - 0.22, 17 - 19)*2 3.8 - 4.4 (0.40 - 0.44, 35 - 38)*2
*1	Air cleaner case assembly			5.4 - 7.3 (0.55 - 0.74, 48 - 64)*2
	Electronic throttle control actuator			7.2 - 9.6 (0.73 - 0.99, 64 - 86)*2
	EVAP canister purge volume control solenoid valve			4.3 - 5.8 (0.44 - 0.59, 38 - 51)*2
*1	Intake manifold			6.9 - 9.4 (0.71 - 0.96, 61 - 84)*2
	Support bracket	M6 × 15 mm (0.59 in)		6.9 - 9.5 (0.71 - 0.96, 61 - 84)*2
		M6 × 12 mm (0.47 in)		8.4 - 10.8 (0.86 - 1.1, 75 - 95)*2
*1	Fuel injector and fuel tube assembly		1) 2)	11.8 - 13.8 (1.2 - 1.4, 9 - 10) 20.8 - 28.2 (2.1 - 2.9, 16 - 20)
	Clamp for fuel feed hose			1.0 - 1.5 (0.10 - 0.15, 9- 13)*2
*1	Exhaust manifold			25.5 - 29.4 (2.6 - 2.9, 19 - 21)
	Exhaust manifold cover			6.3 - 8.3 (0.65 - 0.84, 56 - 73)*2
	Heated oxygen sensor 1			40 - 50 (4.1 - 5.1, 30 - 36)
	Heated oxygen sensor harness bracket			6.9 - 9.5 (0.71 - 0.96, 61 - 84)*2
	Three way catalyst (under exhaust manifold)			29.4 - 34.3 (3.0 - 3.4, 22 - 25)
	Three way catalyst support			33.3 - 46.1 (3.4 - 4.7, 25 - 34)
	Three way catalyst cover			6.3 - 8.3 (0.65 - 0.84, 56 - 73)*2
	Ignition coil			3.8 - 4.4 (0.39 - 0.44, 34 - 38)*2
	Spark plug			19.6 - 29.4 (2.0 - 2.9, 15 - 21)
*1	Rocker cover	M6 × 45 mm (1.77 in)		8.8 - 10.8 (0.90 - 1.1, 78 - 95)*2
		M6 × 20 mm (0.79 in)		6.9 - 10.8 (0.71 - 1.1, 61 - 95)*2
	Intake valve timing control solenoid valve			6.3 - 8.3 (0.65 - 0.84, 56 - 73)*2
	Harness bracket			6.3 - 8.3 (0.65 - 0.84, 56 - 73)*2
*1	Oil pan (upper)			6.9 - 9.5 (0.71 - 0.96, 61 - 84)*2
*1	Oil pan (lower)			6.9 - 9.5 (0.71 - 0.96, 61 - 84)*2
	Oil pan drain plug			29.4 - 39.2 (3.0 - 3.9, 22 - 28)
	Connecting bolt between oil pan (upper) and transaxle			16.6 - 23.5 (1.7 - 2.3, 13 - 17)
	Oil strainer			6.3 - 8.3 (0.65 - 0.84, 56 - 73)*2
	Cylinder head front cover			6.9 - 9.5 (0.71 - 0.96, 61 - 84)*2
	Chain tensioner			6.9 - 9.5 (0.71 - 0.96, 61 - 84)*2
	Camshaft position sensor (PHASE)			7.1 - 10.8 (0.73 - 1.1, 63 - 95)*2
	Camshaft sprocket	Intake		78.4 - 88.2 (8.0 - 8.9, 58 - 65)
		Exhaust		78.4 - 88.2 (8.0 - 8.9, 58 - 65)

*1	Camshaft bracket	1)	2.0 (0.2, 18)*2
		2)	5.9 (0.6, 52)*2
		3)	9.0 - 11.8 (0.92 - 1.2, 80 - 104)*2
	Chain tension guide		16.6 - 23.5 (1.7 - 2.3, 13 - 17)
	Chain slack guide		12.7 - 18.6 (1.3 - 1.8, 10 - 13)
	Crankshaft pulley		132.4 - 152.0 (14 - 15, 98 - 112)
	Front cover		6.3 - 8.3 (0.65 - 0.84, 56 - 73)*2
*1	Cylinder head bolt	1)	61.7 - 71.7 (6.3 - 7.3, 46 - 52)
		2)	0 (0.0, 0)
		3)	22.5 - 32.5 (2.3 - 3.3, 17 - 23)
		4)	90° - 95° (Angle tightening)
*1	Cylinder head auxiliary bolt		9.0 - 11.8 (0.92 - 1.2, 80 - 104)*2
	Engine slinger		16.6 - 23.5 (1.7 - 2.3, 13 - 17)
	LH engine mount insulator		95 - 115 (9.7 - 11, 70 - 84)
	LH engine mount bracket (vehicle side)		43 - 54 (4.4 - 5.5, 32 - 39)
	LH engine mount bracket (transaxle side)		60 - 70 (6.2 - 7.1, 45 - 51)
	RH engine mount stay		40 - 50 (4.1 - 5.1, 30 - 36)
	RH engine mount insulator RH		60 - 70 (6.2 - 7.1, 45 - 51)
	RH engine mount bracket (upper)		40 - 50 (4.1 - 5.1, 30 - 36)
	RH engine mount bracket (lower)		40 - 50 (4.1 - 5.1, 30 - 36)
	Rear engine mount bracket	A/T models M/T models	64 - 74 (6.6 - 7.5, 48 - 54) 75 - 85 (7.7 - 8.7, 56 - 62)
	Rear torque rod		75 - 85 (7.7 - 8.7, 56 - 62)
	Connecting nut between LH engine mount insulator and LH engine mount bracket (transaxle side)		60 - 70 (6.2 - 7.1, 45 - 51)
	Connecting bolt between RH engine mount insulator and RH engine mount bracket (upper)		90 - 100 (9.2 - 10, 67 - 73)
*1	Main bearing cap	1)	24.5 - 30.3 (2.5 - 3.0, 18 - 22)
		2)	95° - 100° (Angle tightening)
	Connecting rod cap	1)	13.7 - 15.7 (1.4 - 1.6, 10.1 - 11.5)
		2)	45° - 50° (Angle tightening)
	Rear oil seal retainer		6.9 - 9.5 (0.71 - 0.96, 61 - 84)*2
	Flywheel (M/T)		83.4 - 93.2 (8.5 - 9.5, 62 - 68)
	Drive plate (A/T)		93.2 - 103 (9.5 - 10, 69 - 75)
	Knock sensor		15.7 - 20.6 (1.6 - 2.1, 12 - 15)
	Crankshaft position sensor (POS) [Note: transaxle side mounting parts]		7.1 - 10.8 (0.73 - 1.1, 63 - 95)*2